AGILE	DWG

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TITLE: **TELEMETRY AND TELECOMMAND PACKETS DEFINITION**

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1. INTRODUCTION

1.1 SCOPE OF THE DOCUMENT

The aim of this document is to provide the specifications of the Telemetry and Telecommand Packets of the AGILE Payload.

1.2 ACRONYMS

ABT	AGILE Burst Trigger
AC	Anti-Coincidence
AC-LAT	AC lateral panel
AC-TOP	AC Top panel
ACS	Attitude Control System
APID	Application Process ID
BBFP	Burst Background Filtering Procedure
BKG	Background
BS	Burst Search
BSR	Burst Search Ratemeter
CRC	Cyclic Redundancy Code
DR	Detector Ratemeter
EEPROM	Electrically Erasable Programmable Read Only Memory
FEB	Front-End Block
FEE	Front-End Electronics
FTB	Front-end and Trigger Board
FVC	Fired Views Check
GRB	Gamma-Ray Burst
GRID	Gamma-Ray Imaging Detector
GPS	Global Positioning System
HK	Housekeeping
HV	High Voltage
MCAL	Mini-Calorimeter
MFV	Multiplicity Fired Views
MGO	Multi-hit trigger Output
MID	Memory ID
OBT	On-Board Time
PD	Photodiode
PDHU	Payload Data Handling Unit
P/L	Payload
PSU	Power Supply Unit

RAM	Random Access Memory
SA	Super-AGILE
SAA	South-Atlantic Anomaly
SAIE	Super-AGILE Interface Electronics
S/C	Spacecraft
ST	Silicon Tracker
SS	Star Sensor
S/S	Sub-System
TC	Telecommand
TID	Task ID
TM	Telemetry
TPT	Telemetry Partition Table

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

AD [1] *AGILE-DWG-SS-002 Issue 7*
AD [2] *AGILE-DWG-SP-001 Issue 5*
AD [3] *ACO-DC-IC-001 Issue 1*

2.2 REFERENCE DOCUMENTS

RD [1] *AGILE Phase A Report*
RD [2] *AGILE Phase C/D Technical Proposal – Executive Summary TL16397 – Issue 2 (LABEN)*

2.3 DOCUMENT PRIORITY

A priority in the applicability of documents is established as follows:

1. P/L System Requirements
2. Current Document
3. Applicable Documents
4. Minutes of Meeting

In case of conflict among technical material contained in these documents, the highest rank document shall have the precedence.

3. TELEMETRY PACKETS

3.1 GENERAL

URS-3.1.1 The PDHU shall be capable to generate telemetry source packets for an OBDH bus bandwidth up to 80 kbits/sec.

URS-3.1.2 The PDHU shall be able to generate the source telemetry packet types and sub-types shown in **Table 3.1** and in Appendix B.

Packet Type	Type Function	Packet Sub-type	Sub-type Function
32	*Periodic TM Reports*	1	Housekeeping Report
33	*Telecommand Verification TM Reports*	1	Successful Command Acceptance Report
		2	Unsuccessful Command Acceptance Report
		3	Successful Command Execution Report
		4	Unsuccessful Command Execution Report
34	*Event TM Reports*	1	Boot Report
		2	Automatic Transition Report
35	*Exception TM Reports*	1	Buffer Saturation Report
		2	Buffer Desaturation Report
		3	Latch-up Report
		4	P/L Sub-Systems Link Anomaly Report
		5	Software Error Report
		6	Monitoring Report
36	*P/L Configuration TM Reports*	1	General P/L Configuration Report
37	*Memory Maintenance TM Reports*	1	Memory Dump Report
		2	Memory Checksum Report
38	*Telemetry Management TM Reports*	1	TM Packet Generation Status Report

Packet Type	Type Function	Packet Sub-type	Sub-type Function
39	*Science Data TM Reports*	1	GRID Event Report
		2	GRID Calibration Report
		3	ST Pedestal Report
		4	ST Electrical Calibration Report
		5	SA Event Report
		6	SA Imaging Report
		7	SA Burst Imaging Report
		8	MCAL Burst Event Report
		9	MCAL Burst Calibration Report
		10	MCAL Electrical Calibration Report
		11	Burst Fast Ratemeters Report
		12	Burst Alert
		13	Scientific Ratemeters Report
		14	Star Sensor Data Report
		15	Star Sensor for S/C ACS Report
		16	GPS Data Report
40	*GPS and SS Management TM Reports*	TBD	TBD

Table 3.1 - Applicable PDHU Telemetry Packets Types and Subtypes

URS-3.1.3 The maximum length for any source packet (Source Packet Header and Trailer included) shall be 2048 octets.

URS-3.1.4 The APID used for the P/L telemetry packets shall be 0x2FF.

URS-3.1.5 The Source Packet Header shall be implemented as detailed in AD[3].

URS-3.1.6 The Data Field Header shall be implemented as detailed in AD[3].

URS-3.1.7 All TM packets shall have as last information of the packet a 16 bits CRC checksum, that shall be computed by the PDHU.

URS-3.1.8 All the TM packets shall include the information about the PDHU mode of operation at the TM packet generation.

3.2 PERIODIC TM REPORTS (TYPE=32)

3.2.1 HOUSEKEEPING REPORT (32,1)

URS-3.2.2 This TM Report shall be used to transport, once every 16 seconds, the HK data sampled from all the P/L Sub-Systems.

TM Name	Type	Sub-type	S/S	Generated in Mode
Housekeeping Report	32	1	PDHU	Idle Obs. & Proc. In-Flight Op. Runtime Maint. Shutdown

The TM Report shall contain:

- the reference time tag sampled at the start of the HK data collection;

- Information about the temporal coherence of the collected HK data;

- The HKs data listed in Appendix A.

3.3 TELECOMMAND VERIFICATION TM REPORTS (TYPE=33)

3.3.1 SUCCESSFUL COMMAND ACCEPTANCE REPORT: TM (33,1)

URS-3.3.1.1 This TM Report shall be generated in case of a successful command acceptance for a received PDHU telecommand.

The TC acceptance procedure shall require, for each received P/L TC, the following syntactic checks:

1. verify that header fields (packet type, subtype and packet length) are correct;
2. verify the correctness of the telecommand checksum and of the vertical parity.
3. verify goodness with respect to the current operating mode.

TM Name	Type	Sub-type	S/S	Generated in Mode
Successful Command Acceptance Report	33	1	PDHU	Idle Obs. & Proc. In-Flight Op. Boot Maint. Runtime Maint. Shutdown

The TM Report shall contain:

- the Type of the received TC;
- the Sub-Type of the received TC;
- The Packet Sequence Count of the received TC.

3.3.2 UNSUCCESSFUL COMMAND ACCEPTANCE REPORT: TM(33,2)

URS-3.3.2.1 This TM Report shall be generated in case of an unsuccessful command acceptance for a received PDHU telecommand.

The TC acceptance procedure shall require, for each received P/L TC, the following syntactic checks:

1. verify that header fields (packet type, subtype and packet length) are correct;
2. verify the correctness of the telecommand checksum and of the vertical parity.
3. verify goodness with respect to the current operating mode.

TM Name	Type	Sub-type	S/S	Generated in Mode
Unsuccessful Command Acceptance Report	33	2	PDHU	Idle Obs. & Proc. In-Flight Op. Boot Maint. Runtime Maint. Shutdown

The TM Report shall contain:

- the Type of the received TC;
- the Sub-Type of the received TC;
- the Packet Sequence Count of the received TC;
- the error code.

3.3.3 SUCCESSFUL COMMAND EXECUTION REPORT: TM(33,3)

URS-3.3.3.1 This TM Report shall be generated in the following cases:

- a successful command **execution** for all the TCs addressed to the PDHU;

- a successful command **start execution** for all the TCs addressed to the MCAL, ST; SA, PSU, GPS and SS. This rule shall be applied with the exception of the TC(33,1), the TC(33,9), the TC(33,12) and TBD for which a complete execution report shall be generated.

TM Name	Type	Sub-type	S/S	Generated in Mode
Successful Command Execution Report	33	3	PDHU	Idle Obs. & Proc. In-Flight Op. Boot Maint. Runtime Maint. Shutdown

The TM Report shall contain:

- the Type of the received TC;

- the Sub-Type of the received TC;

- The Packet Sequence Count of the received TC.

3.3.4 UNSUCCESSFUL COMMAND EXECUTION REPORT: TM(33,4)

URS-3.3.4.1 This TM Report shall be generated in the following cases:

- an unsuccessful command **execution** for all the TCs addressed to the PDHU;

- an unsuccessful command **start execution** for all the TCs addressed to the MCAL, ST; SA, PSU, GPS and SS. This rule shall be applied with the exception of the TC(33,1), the TC(33,9), the TC(33,12) and TBD for which a complete execution report shall be generated.

TM Name	Type	Sub-type	S/S	Generated in Mode
Successful Command Execution Report	33	4	PDHU	Idle Obs. & Proc. In-Flight Op. Boot Maint. Runtime Maint. Shutdown

The TM Report shall contain:

- the Type of the received TC;

- the Sub-Type of the received TC;

- The Packet Sequence Count of the received TC.

- The error code.

3.4 EVENT TM REPORTS (TYPE=34)

3.4.1 BOOT REPORT: TM(34,1)

URS-3.4.1.1 This TM report shall be completed in INIT-2 at the end of the system verification and the SW verification. On anomaly the reports shall be completed in BOOT MAINT..

TM Name	Type	Sub-type	S/S	Generated in Mode
Boot Report	34	1	PDHU	Init-2 Boot Maint.

The TM Report shall contain:

- the results of the PDHU initialization checks (see AD[2] section 6.2)

3.4.2 AUTOMATIC TRANSITION REPORT: TM(34,2)

URS-3.4.2.1 This TM report shall be generated whenever an automatic mode transition has been performed.

TM Name	Type	Sub-type	S/S	Generated in Mode
Automatic Transition Report	34	2	PDHU	Init-2 Idle Boot Maint. Runtime Maint.

The TM Report shall contain:

- all the information related to the occurrence of the mode transition.

3.5 EXCEPTION TM REPORTS (TYPE=35)

3.5.1 BUFFER SATURATION REPORT: TM(35,1)

URS-3.5.1.1 This TM report shall be generated whenever one of the following data buffers (see AD[1] section 6.2.5) saturates:

- The pre-processing pipeline for the ST events;
- the MCAL/GRID events buffer;
- the MCAL/Zombie events buffer;
- the GRID events buffer;
- the SA events buffer;
- the TM packets queues.

TM Name	Type	Sub-type	S/S	Generated in Mode
Buffer Saturation Report	35	1	PDHU	Obs. & Proc. In-Flight Test

The TM Report shall contain:

- the buffer ID;

- the time-tag of the saturation event.

- the saturation ID (code related to the saturation type).

3.5.2 BUFFER DESATURATION REPORT: TM(35,2)

URS-3.5.2.1 This TM report shall be generated when, after a saturation event, one of the following data buffers (see AD[1] section 6.2.5) desaturates:

- The pre-processing pipeline for the ST events;
- the MCAL/GRID events buffer;
- the MCAL/Zombie events buffer;
- the GRID events buffer;

- the SA events buffer;
- the TM packets queues.

TM Name	Type	Sub-type	S/S	Generated in Mode
Buffer Desaturation Report	35	2	PDHU	Obs. & Proc. In-Flight Test

The TM Report shall contain:

- the involved buffer ID;

- the time-tag of the desaturation event.

3.5.3 LATCH-UP REPORT: TM(35,3)

URS-3.5.3.1 This TM report shall be generated whenever a latch-up occurs on a SA Daisy Chain or on a ST FEB.

TM Name	Type	Sub-type	S/S	Generated in Mode
Latch-up Report	35	3	PDHU	Idle Obs. & Proc. In-Flight Op. Runtime Maint. Shutdown

The TM Report shall contain:

- the involved Sub-System ID (SA or ST);

- the ID code of the involved Sub-System part (SA Daisy Chains or ST FEBs)

- the time-tag of the Latch-up event.

3.5.4 P/L SUB-SYSTEMS LINK ANOMALY REPORT: TM(35,4)

URS-3.5.4.1 This TM Report shall be generated whenever a fault condition occurs in the internal communication link between the PDHU and the other P/L Sub-Systems. This function shall obviously be executed only if the occurred fault condition allows the performing of this function.

TM Name	Type	Sub-type	S/S	Generated in Mode
P/L Subsystems Link Anomaly Report	35	4	PDHU	Idle Obs. & Proc. In-Flight Op. Boot Maint. Runtime Maint. Shutdown

The TM Report shall contain:

- the involved Sub-System ID (SA, ST, MCAL, PSU, GPS, SS)

- the error code;

- the time-tag of the anomaly occurrence.

3.5.5 SOFTWARE ERROR REPORT: TM(35,5)

URS-3.5.5.1 This TM Report shall be generated whenever a fault condition occurs in the on-board software. This function shall obviously be executed only if the occurred fault condition allows the performing of this function.

TM Name	Type	Sub-type	S/S	Generated in Mode
Software Error Report	35	5	PDHU	Idle Obs. & Proc. In-Flight Op. Runtime Maint. Shutdown

The TM Report shall contain:

- the error code;

- the time-tag of the error occurrence.

3.5.6 MONITORING REPORT: TM(35,6)

URS-3.5.6.1 This TM Report shall be generated whenever the S/C mass memory filling level exceeds the fixed threshold or some selected temperature, voltage or current HKs exceeds the relevant limits. This function shall obviously be executed only if the occurred fault condition allows the performing of this function.

TM Name	Type	Sub-type	S/S	Generated in Mode
Monitoring Report	35	6	PDHU	Idle Obs. & Proc. In-Flight Op. Boot Maint. Runtime Maint. Shutdown

The TM Report shall contain:

- the anomaly ID (S/C mass memory overflow or overthreshold HK);

In case of S/C mass memory overflow, the TC shall contain:

- the S/C mass memory filling level;

In case of an overthreshold HK, the TC shall contain:

- the overthreshold HK ID;

- the overthreshold HK value;

- the time-tag of the alert occurrence.

Other kinds of fatal or non-fatal anomalies, tightly related to the unit architecture, can be defined by the manufacturer. However the number of these anomalies shall be kept as small as possible.

3.6 P/L CONFIGURATION TM REPORTS (TYPE=36)

3.6.1 GENERAL P/L CONFIGURATION REPORT: TM(36,1)

URS-3.6.2 This TM Report shall be generated as a response to the telecommand Report Task Parameters TC(34,1).

TM Name	Type	Sub-type	S/S	Generated in Mode
General P/L Configuration Report	36	1	PDHU	Idle Obs. & Proc. In-Flight Op.

The TM Report shall contain all the most recently updated parameters related to the following Load TCs (type=33): TC(33,1), TC(33,21), TC(33,24), TC(33,25), TC(33,26), TC(33,27), TC(33,28), TC(33,29), TC(33,30).

3.7 MEMORY MAINTENANCE TM REPORTS (TYPE=37)

3.7.1 MEMORY DUMP REPORT: TM(37,1)

URS-3.7.1.1 This TM Report shall be generated as consequence of a memory dump command TC(36,3). The report may contain either PDHU's memory area dump data or subsystem's memory area dump data.

TM Name	Type	Sub-type	S/S	Generated in Mode
Memory Dump Report	37	1	PDHU	Boot Maint. Idle. Runtime Maint. In-Flight Test.

The TM Report shall contain:

- the start address from which the memory dump starts;

- the length of the memory dump;

- the dump data.

3.7.2 MEMORY CHECKSUM REPORT: TM(37,2)

URS-3.7.2.1 This TM Report shall be generated as a consequence of a calculate memory checksum command TC(36,4).

TM Name	Type	Sub-type	S/S	Generated in Mode
Memory Checksum Report	37	2	PDHU	Boot Maint. Idle. Runtime Maint. In-Flight Test

The TM Report shall contain:

- the start address from which the checksum has been calculated;
- the number of words from which the checksum has been calculated;
- the calculated checksum for the specified memory area.

3.8 TELEMETRY MANAGEMENT TM REPORTS (TYPE=38)

3.8.1 TM PACKET GENERATION STATUS REPORT: TM(38,1)

URS-3.8.1.1 This TM Report shall be generated as a consequence of a TC(37,1).

TM Name	Type	Sub-type	S/S	Generated in Mode
TM Packets Generation Status Report	38	1	PDHU	Boot Maint. Idle. Runtime Maint. In-Flight Test

The TM Report shall give the status of all the TM packets.

3.9 SCIENTIFIC DATA TM REPORTS (TYPE=39)

3.9.1 GRID EVENT REPORT: TM(39,1)

URS-3.9.1.1 The GRID data packet shall contain a variable number of single GRID events (min 1, max 15 TBC) as a function of their length. Each packet shall contain the last samples of the SS Attitude and the GPS Ephemeris acquired before the packet generation. Data words belonging to the same GRID event, or header or trailer cannot be split into two different packets.

TM Name	Type	Sub-type	S/S	Generated in Mode
GRID Event Report	39	1	PDHU	Obs. & Proc. In-Flight Test

Each event block contained in the GRID packet shall contain:

- The time tag of the event;
- The OBT correction;
- The configuration of the triggered AC top acquisition chains;
- The configuration of the triggered AC lateral acquisition chains;
- The SA MGO and upper thresholds signals;
- The GRID Observation configuration ID;
- The AC Lateral Flag F_{AC} (see AD [2] section 4.1.2);
- The MCAL Flag F_{MCAL} (see AD [2] section 4.1.2);
- The Background Flag F_{BKG} (see AD [2] section 4.1.2);
- The High Threshold Flag F_{HT} (see AD [2] section 4.1.2);
- The Burst Flag F_{BURST} (see AD [2] section 4.1.2);
- The Silicon Tracker Flag F_{ST} (see AD [2] section 4.1.2);
- The FVC $\underline{X}$ vector (see AD [2] section 4.1.6.2.1);
- The FVC $\underline{Z}$ vector (see AD [2] section 4.1.6.2.1).

- A variable block containing the data related to each Silicon Tracker cluster (max 96 clusters TBC) at Complete Cluster-ID level (see AD [2] section 4.1.7): Center Cluster, Total Charge, Total Width, 5-strips Charge.

- A variable block containing the zero-suppressed MCAL/GRID bars (max: 30 bars TBC);

- A variable block containing the address of the triggered TAA1s exceeding the maximum number of TAA1s that can be read per couple of views (max: 116 TAA1s TBC).

- If enabled by TC, a variable block containing the zombie events (max: 16 event blocks including 1time-tag+2bars+2addresses each).

3.9.2 GRID CALIBRATION REPORT: TM(39,2)

URS-3.9.2.1 The GRID Calibration packet shall contain a variable number of single GRID Calibration events detected during the GRID Physical Calibration as a function of their length. Each packet shall contain the last samples of the SS Attitude and the GPS Ephemeris acquired before the packet generation. Data words belonging to the same GRID event, or header or trailer cannot be split into two different packets.

TM Name	Type	Sub-type	S/S	Generated in Mode
GRID Calibration Report	39	2	PDHU	Obs. & Proc. In-Flight Test

Each event block contained in the GRID Calibration packet shall contain:

- The complete time tag of the event;
- The OBT correction;
- The configuration of the triggered AC top acquisition chains;
- The SA MGO and upper thresholds signals;

- A variable block containing the data related to each Silicon Tracker cluster (max 96 clusters TBC) at Complete Cluster-ID level (see AD [2] section 4.1.7): Center Cluster, Total Charge, Total Width, 5-strips Charge.

- A variable block containing the zero-suppressed MCAL/GRID bars (max: 30 bars TBC);

3.9.3 ST PEDESTAL REPORT: TM(39,3)

URS-3.9.3.1 The mean value and the rms value of the noise evaluated during the ST Pedestal Procedure for each Silicon Tracker channel (total number of ST channel: 36864) shall be sent to ground by means of a stream of ST Pedestal packets (96 packets). Each Pedestal Packet shall contain the information related to a single ST ladder. Each packet belonging to the stream shall be tagged by a counter in order to allow an on ground correct merging of data.

TM Name	Type	Sub-type	S/S	Generated in Mode
ST Pedestal Report	39	3	PDHU	Obs. & Proc. In-Flight Test

Each ST Pedestal packet shall contain:

- The Time-tag sampled at the beginning of the ST Pedestal Procedure;
- The ST Ladder address;

- The mean value of the noise for each ladder channel;
- The rms value of the noise for each ladder channel.

3.9.4 ST ELECTRICAL CALIBRATION REPORT: TM(39,4)

URS-3.9.4.1 The count values evaluated during the ST Electrical Calibration Procedure for Silicon Tracker channel (total number of ST channel: 36864) and for each threshold value shall be sent to ground by means of a stream of ST Electrical Calibration packets. Each packet belonging to the stream shall be tagged by a counter in order to allow an on-ground correct merging of data.

TM Name	Type	Sub-type	S/S	Generated in Mode
ST Electrical Calibration Report	39	4	PDHU	Obs. & Proc. In-Flight Test

3.9.5 SA EVENT REPORT: TM(39,5)

The single SA event blocklet is fixed in 32 bits length and shall contain the information in alternative of:

- Good event (Photon event)
- Dummy event
- Calibration event
- Absolute time (split in two 32 bit sequential blocklets)

URS-3.9.5.1 The sequence of the packet shall maintain the real time flow (separately for each SAIE) of the events (GE, Dummy events, ABS, Calibration events).

TM Name	Type	Sub-type	S/S	Generated in Mode
SA Event Data Report	39	5	PDHU	Obs. & Proc. In-Flight Test

Each SA Event Data packet shall contain:

- the offset value between the Absolute Time contained in the packet;
- the OBT;
- the OBT correction sampled at the packet generation;
- the SA Observation configuration ID;
- the SA event blocklets.

3.9.6 SA IMAGING REPORT: TM(39,6)

URS-3.9.6.1 The packet (39,6) generation must be considered as a back-up solution respect to the packet (39,5) generation as defined in section. The packet (39,6) shall contain the data of one complete SA image (4 SA Detector images not deconvolved) which corresponds to 49152 bit of data (6144 integer of 8 bit each). Each SA image shall be divided in four packets. Each packet belonging to a stream of SA Imaging packets shall be tagged by a counter in order to allow an on-ground correct merging of data.

TM Name	Type	Sub-type	S/S	Generated in Mode
SA Imaging Report	39	6	PDHU	Obs. & Proc. In-Flight Test

Each packet shall contain:

-The time tag at the starting of image acquisition.

- The OBT correction sampled at the packet generation.

-The image integration time.

- The SA Imaging configuration ID;

- The data of one SA Detector Image.

3.9.7 SA BURST IMAGING REPORT: TM(39,7)

URS-3.9.7.1 The packet (39,7) shall contain the data of one complete SA subtracted image (4 SA Detector subtracted images not deconvolved) processed after a Burst detection as specified in AD [2] URS-4.3.1.4.3.2. Each SA subtracted image corresponds to 49152 bit of data (6144 integer of 8 bit each). Each SA subtracted image shall be divided in four packets. Each packet belonging to a stream of SA Imaging packets shall be tagged by a counter in order to allow an on-ground correct merging of data.

TM Name	Type	Sub-type	S/S	Generated in Mode
SA Burst Imaging Report	39	7	PDHU	Obs. & Proc. In-Flight Test

Each packet shall contain:

- General information about the burst detection: $T_{SA/B\text{-}START}$, T_{stop}, the identifiers of the n $R_{j,k}$ that caused the trigger activation and the relevant values, the GRB coordinates in the reference system of SA, the RA and Dec GRB coordinates, the X and Z peak values evaluated in AD [2] URS-4.3.1.4.3.7.

- The OBT correction sampled at the packet generation.

- The SA Burst Imaging configuration ID.

- The subtracted image data of one SA Detector.

3.9.8 MCAL BURST EVENT REPORT: TM(39,8)

URS-3.9.8.1 The MCAL Burst data acquired by the Burst logic shall be sent to ground by means of a stream of (39,8) packets. Each packet belonging to a stream of MCAL Burst packets shall be tagged by a counter in order to allow an on-ground correct merging of data.

TM Name	Type	Sub-type	S/S	Generated in Mode
MCAL Burst Event Report	39	8	PDHU	Obs. & Proc. In-Flight Test

Each packet shall contain:

- General information about the burst detection: $T_{B\text{-}START}$, $T_{B\text{-}STOP}$, the identifiers of the $R_{j,k}$ or the $R_{m,n}$ that caused the trigger activation and the relevant values.

- The OBT correction sampled at the packet generation and the MCAL Burst configuration ID.

- The MCAL Burst Event data.

3.9.9 MCAL BURST CALIBRATION REPORT: TM(39,9)

URS-3.9.9.1 The MCAL Burst Calibration data acquired during the calibration procedure shall be sent to ground by means of a stream of (39,9) packets. Each packet belonging to a stream of MCAL Burst Calibration packets shall be tagged by a counter in order to allow an on-ground correct merging of data.

TM Name	Type	Sub-type	S/S	Generated in Mode
MCAL Burst Calibration Report	39	9	PDHU	Obs. & Proc. In-Flight Test

Each packet shall contain:

- The OBT correction sampled at the packet generation.

- The MCAL Burst Calibration data.

3.9.10 MCAL ELECTRICAL CALIBRATION REPORT: TM(39,10)

URS-3.9.10.1 The MCAL Electrical Calibration data acquired during the calibration procedure shall be sent to ground by means of a stream of (39,10) packets. Each packet belonging to a stream of MCAL Burst Calibration packets shall be tagged by a counter in order to allow an on-ground correct merging of data.

TM Name	Type	Sub-type	S/S	Generated in Mode
MCAL Electrical Calibration Report	39	10	PDHU	Obs. & Proc. In-Flight Test

Each packet shall contain:

- The OBT correction sampled at the packet generation.

- The MCAL Electrical Calibration data.

3.9.11 BURST FAST RATEMETERS REPORT: TM(39,11)

URS-3.9.11.1 The Burst Fast Ratemeters acquired by the Burst logic shall be sent to ground by means of a stream of (39,11) packets. Each packet belonging to a stream of Burst Fast Ratemeters packets shall be tagged by a counter in order to allow an on-ground correct merging of data.

TM Name	Type	Sub-type	S/S	Generated in Mode
Burst Fast Ratemeters Report	39	11	PDHU	Obs. & Proc. In-Flight Test

Each packet shall contain:

- General information about the burst detection: $T_{B\text{-}START}$, $T_{B\text{-}STOP}$, the identifiers of the $R_{j,k}$ or the $R_{m,n}$ that caused the trigger activation and the relevant values.

- The OBT correction sampled at the packet generation.

- The Burst Fast Ratemeters data.

3.9.12 BURST ALERT: TM(39,12)

URS-3.9.12.1 The Burst Alert shall be generated only in case of a SA/B-START and immediately after the GRB coordinates determination.

TM Name	Type	Sub-type	S/S	Generated in Mode
Burst Alert	39	12	PDHU	Obs. & Proc. In-Flight Test

The Burst Alert shall contain:

- the SA B-START onboard time ($T_{SA/B\text{-}START}$),
- the final T_{stop},
- the identifiers of the n $R_{j,k}$ that caused the trigger activation and the relevant values.
- the GRB coordinates in the reference system of SA;
- the RA and Dec GRB coordinates;
- the X and Z peak values evaluated in AD [2] URS-4.3.1.4.3.7.

- The OBT correction sampled at the packet generation.

3.9.13 SCIENTIFIC RATEMETERS REPORT: TM(39,13)

URS-3.9.13.1 The packet 38.13 shall be generated, if enabled, every 8 seconds.

TM Name	Type	Sub-type	S/S	Generated in Mode
Scientific Ratemeters Report	39	13	PDHU	Obs. & Proc. In-Flight Test

Each packet (39,13) shall contain:

- The reference time of the generation of the first ratemeter contained in the packet

- The OBT correction sampled at the packet generation.

- 8 seconds of the ST scientific ratemeters (1 sec integration time)

- 8 seconds of the MCAL scientific ratemeters (1 sec integration time)

- 8 seconds of the AC scientific ratemeters (1 sec integration time)

- 8 seconds of the SA scientific ratemeters (1/2 sec integration time)

- 8 seconds of the GRID/Single-Tracks scientific ratemeters (1 sec integration time)

3.9.14 STAR SENSOR DATA REPORT: TM(39,14)

URS-3.9.14.1 This packet shall contain the measurement of the star sensor, sampled every 0.1s, and the time tag of the measurement filling as much as possible the frame of TM source packet (2048 bytes).

TM Name	Type	Sub-type	S/S	Generated in Mode
Star Sensor Data Report	39	14	PDHU	Boot Maint. Runtime Maint. Idle Obs. & Proc. In-Flight Test

3.9.15 STAR SENSOR FOR S/C ACS REPORT: TM(39,15)

URS-3.9.15.1 The PDHU shall provide to the S/C the measurement of the star sensors and GPS not later than one second from the data generation.

TM Name	Type	Sub-type	S/S	Generated in Mode
Star Sensor for ACS Report	39	15	PDHU	Boot Maint. Runtime Maint. Idle Obs. & Proc. In-Flight Test

The packet (39,15) shall contain the Star Sensor measurement with the time tag of the measure itself.

3.9.16 GPS DATA REPORT: TM(39,16)

URS-3.9.16.1 This packet shall contain the measurement of the GPS, sampled every 16s, and the time tag of the measurement filling as much as possible the frame of TM source packet (2048 bytes).

TM Name	Type	Sub-type	S/S	Generated in Mode
GPS Data Report	39	16	PDHU	Boot Maint. Runtime Maint. Idle Obs. & Proc. In-Flight Test

3.10 GPS AND SS MANAGEMENT TM REPORTS (TYPE=40)

TBD

3.11 TELEMETRY PACKET TEMPORARY STORAGE

URS-3.11.1 The PDHU shall provide temporary storage capabilities for all the TM source packets in three different queues of source packets:

Normal priority queue packet: TM(39,1), TM(39,2), TM(39,3), TM(39,4), TM(39,5), TM(39,6), TM(39,8), TM(39,9), TM(39,10), TM(39,11), TM(39,14), TM(39,16).

High priority queue packet: TM(32,1), TM(33,1), TM(33,2), TM(33,3), TM(33,4), TM(34,1), TM(34,2), TM(35,1), TM(35,2), TM(35,3), TM(35,4), TM(35,5), TM(35,6), TM(36,1), TM(37,1), TM(37,2), TM(38,1), TM(39,7), TM(39,12), TM(39,13).

Star Sensor packet for ACS: TM(39,15).

3.12 GENERATION OF SCIENTIFIC SOURCE PACKET TELEMETRY

URS-3.12.1 A TM source packet shall be assembled only if there are enough data on the Work Memory page to fill a source TM frame at 80 % average level TBC of its capacity.

URS-3.12.2 The partition of the P/L –S/C data link among the TM sources of the P/L is managed by 2 TPTs (Telemetry Partition Tables), programmable by TC, where are fixed the transmission channel partition for a set of type 39 packets.

The type 39 TM Packets managed by the TPTs are: TM(39,1), TM(39,2), TM(39,3), TM(39,4), TM(39,5), TM(39,6), TM(39,8), TM(39,9), TM(39,10), TM(39,11).

The periodic TM Packets TM(39,14) and TM(39,16) shall be introduced in the Normal priority queue independently of the TPT current value.

The switch between the two TPTs shall be based on the F_{BURST} value. The switch condition shall be checked every 16s. The TPT related to the "No Burst configuration" shall be called TPT_1 and the TPT related to the "Burst configuration" shall be called TPT_2.

4. TELECOMMAND PACKETS

4.1 GENERAL

URS-4.1.1 The PDHU shall receive, decode, re-route or execute commands according to the operational mode as indicated in AD[2].

URS-4.1.2 All telecommands shall be appropriately verified by telemetry at acceptance and execution level.

URS-4.1.3 The PDHU shall accept telecommand packet only from the OBDH.

URS-4.1.4 The PDHU shall be able to handle the source telecommand packet types and sub-types shown in Table 4.1 and in Appendix B.

Packet Type	Type Function	Packet Sub-type	Sub-type Function
32	*Task Management TCs*	1	Start Task Telecommand
		2	Stop Task Telecommand
33	*Load Configuration Parameters TCs*	1	Scientific Configuration Set-up Telecommand
		2	GRID Observation HW Set-up Telecommand
		3	GRID Observation SW Set-up Telecommand (Step-1)
		4	GRID Observation SW Set-up Telecommand (Step-2)
		5	AC Digital FEE Observation Set-up Telecommand
		6	AC FEE Calibration Set-up Telecommand
		7	ST General Observation Set-up Telecommand
		8	ST Ladder Observation Set-up Telecommand
		9	ST Calibration Set-up Telecommand
		10	SA General Observation Set-up Telecommand
		11	SA daisy Chain Observation Set-up Telecommand
		12	SA Calibration Set-up Telecommand
		13	MCAL Observation Set-up Telecommand
		14	MCAL Calibration Set-up Telecommand
		15	Burst Search General Set-up Telecommand

Packet Type	Type Function	Packet Sub-type	Sub-type Function
33	*Load Configuration Parameters TCs (continued)*	16	Burst Search HW Set-up Telecommand
		17	SA Burst Search SW Set-up Telecommand
		18	SA Imaging Set-up Telecommand
		19	MCAL Burst Search SW Set-up Telecommand
		20	Telemetry Partition Tables Load Telecommand
		21	Dynamic Configuration Table Load Telecommand
		22	Dynamic Configuration Table Enable Telecommand
		23	Special Orbital Phases Management Telecommand
		24	Star Sensors Switch Telecommand
		25	Monitoring Set-up Telecommand
		26	AC Power Supply Set-up Telecommand
		27	ST Power Supply Set-up Telecommand
		28	SA Power Supply Set-up Telecommand
		29	MCAL Power Supply Set-up Telecommand
		30	SS Power Supply Set-up Telecommand
		31	GPS Power Supply Set-up Telecommand
34	*Report P/L Configuration TCs*	1	Report P/L Configuration Telecommand

Packet Type	Type Function	Packet Sub-type	Sub-type Function
35	*Mode Transition TCs*	1	Enter INIT-1 Mode Telecommand
		2	Enter INIT-2 Mode Telecommand
		3	Enter IDLE Mode Telecommand
		4	Enter OBS. & PROC. Mode Telecommand
		5	Enter BOOT MAINT. Mode Telecommand
		6	Enter RUNTIME MAINT. Mode Telecommand
		7	Enter SHUTDOWN Mode Telecommand
		8	Enter IN-FLIGHT TEST Mode Telecommand
36	*Memory Maintenance TCs*	1	Load Memory Telecommand
		2	Load Data EEPROM Telecommand
		3	Dump Memory Telecommand
		4	Calculate Memory Checksum Telecommand
		5	Copy Memory Telecommand
		6	Sub-System FEE Reset Telecommand
37	*Telemetry Management TCs*	1	Report TM Packet Generation Status
		2	Enable Generation of TM Packets
		3	Disable Generation of TM Packets

Packet Type	Type Function	Packet Sub-type	Sub-type Function
38	*Test Commands*	1	Test Command
39	*GPS and SS Management TCs*	TBD	TBD

Table 4.1 - Applicable PDHU Telecommand Subtypes

URS-4.1.5 The APID used for the P/L telecommand packets shall be 0x2FF.

URS-4.1.6 The maximum length for any TC packet (Source Packet Header included) shall be 240 octets.

URS-4.1.7 The Source Packet Header shall be equal for all packet types and shall be implemented as detailed in A[3].

URS-4.1.8 The Data Field Header for all packets types shall be implemented as detailed in AD[3].

URS-4.1.9 All TC packets shall have as last information of the packet a 16 bit CRC checksum, that shall be computed by the PDHU.

4.2 TASK MANAGEMENT TELECOMMANDS (TYPE=32)

4.2.1 START TASK TELECOMMAND: TC(32,1)

URS-4.2.1.1 When the request is received, the on-board application shall start the task identified by the TID code with the current configuration. The task status shall become "running".

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Start task	32	1	PDHU	Runt. Anomaly Idle In-Flight Test

The TC shall contain the identifier of the task to be started.

4.2.2 STOP TASK TELECOMMAND: TC(32,2)

URS-4.2.2.1 When the request is received, the on-board application shall stop the task identified by the TID code. The task status shall become "stopped".

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Stop task	32	2	PDHU	Runt. Anomaly Idle In-Flight Test.

The TC shall contain the identifier of the task to be stopped.

4.3 LOAD CONFIGURATION PARAMETERS TELECOMMANDS (TYPE=33)

URS-4.3.1 The parameters loaded in IDLE mode by means of the TCs from TC(33,2) to TC(33,20) and related to the scientific configuration identified by the last received TC(33,1) must not be used until a TC(35,4) or a TC(35,8) has been received (see Figure 4.2).

The receipt of a TC(33,1) in IDLE mode shall determine, after the receipt of a TC(35,4) or a TC(35,8), the loading of the entire P/L scientific configuration to be used during the OBS & PROC. mode or during the IN-FLIGHT TEST mode (see Figure 4.1).

The parameters loaded in IN-FLIGHT TEST mode by means of the TCs from TC(33,2) to TC(33,20) and related to the scientific configuration identified by the last received TC(33,1) must be used immediately.

The receipt of a TC(33,1) in IN-FLIGHT TEST mode shall determine immediately the updating of the entire P/L scientific configuration used during the current mode.

A Dynamic Configuration Table loaded by the TC(33,22) must not be used until the relevant TC(33,23) has been received.

The switch of the P/L Scientific Configuration during the different orbital phases shall be managed by the Dynamic Configuration Tables or by the time-tagged telecommend TC(33,24) and TC(33,25).

The parameters loaded by the TCs from TC(33,24) to TC(33,30) shall be used immediately.

The Figure 4.1 and Figure 4.2 shows the general strategy for: the upload from ground of the on-board processing parameters, the on-board data storage and the on-board configuration selection.

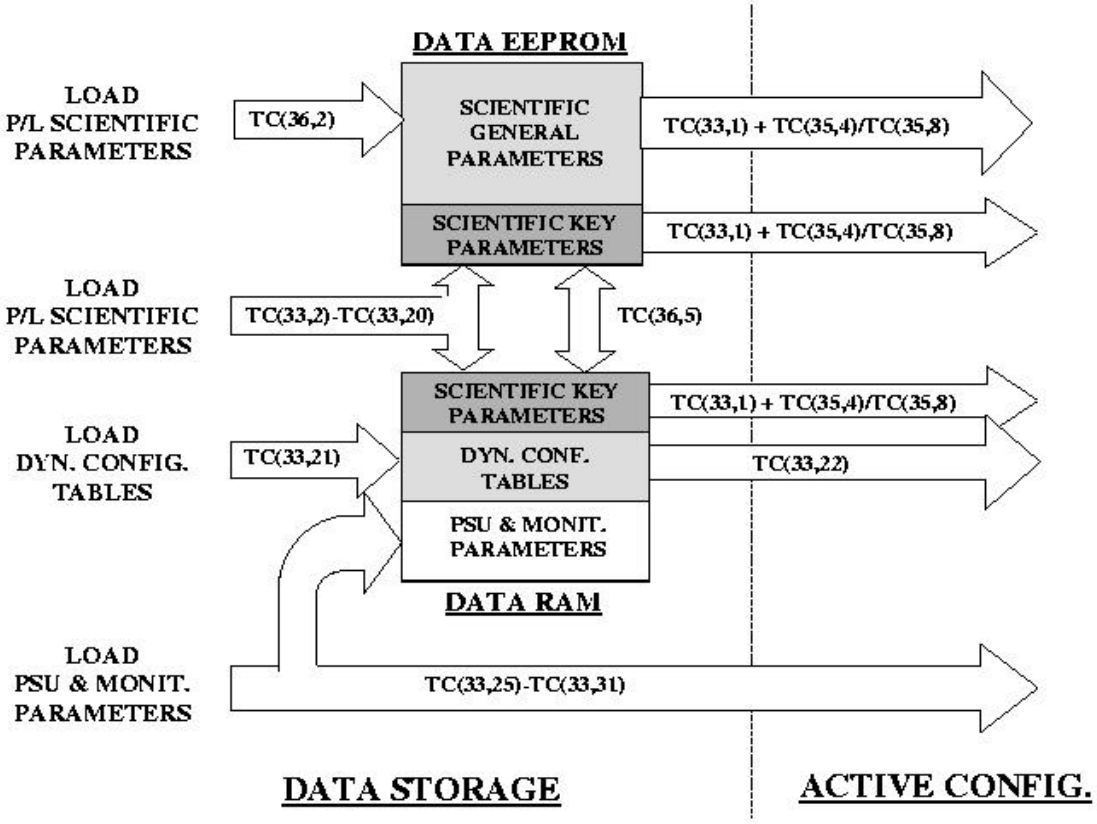

Figure 4.1 – P/L Configuration procedure from IDLE mode with complete Scientific Configuration updating.

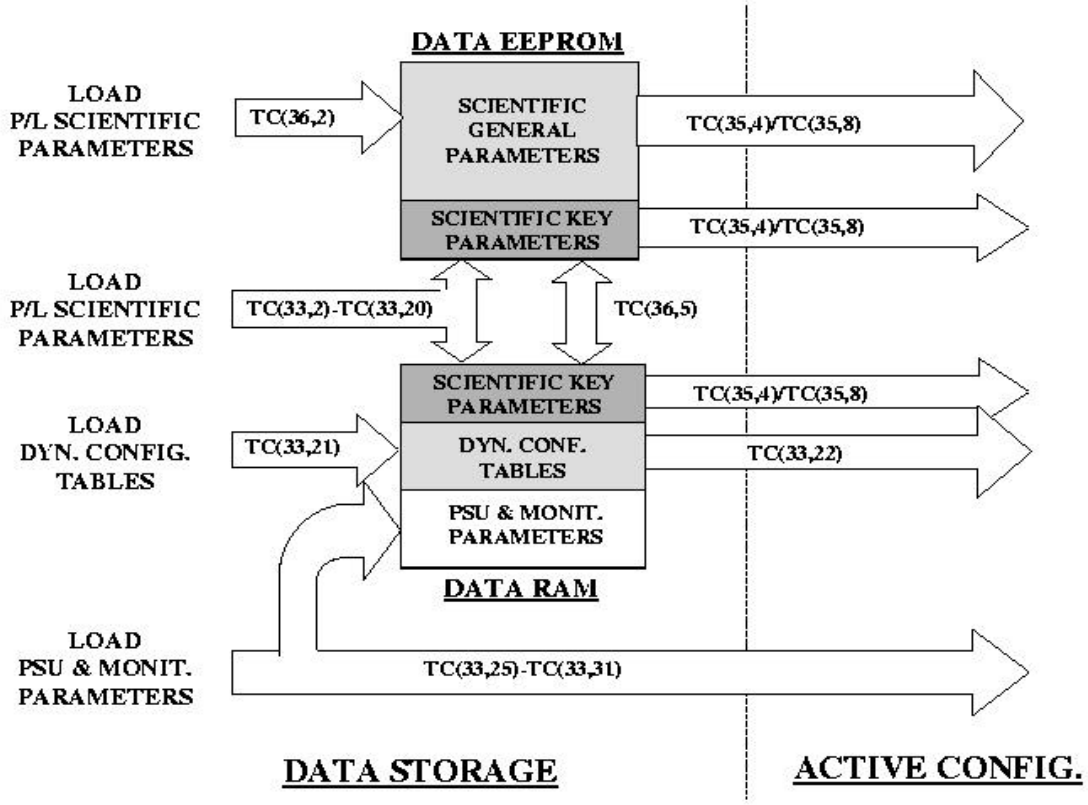

Figure 4.2 - P/L Configuration procedure from IDLE mode with updating of the changed scientific parameters.

4.3.1 SCIENTIFIC CONFIGURATION SET-UP TELECOMMAND: TC(33,1)

URS-4.3.1.1 This TC shall be used to select the set of parameters (stored in the Data EEPROM and in the Data RAM) to be loaded to configure the P/L in the following four orbital phases: the Nominal phase, the SAA phase, the Earth Occultation phase and the Ground Station contact phase.

The TC shall be divided in five data blocks: four defining the P/L Scientific Configuration to be loaded during the four orbital phases; one defining, in case of S/C mass memory overflow, the recovery P/L Scientific Configuration to be loaded during the marked orbital phases (to be selected among the three special orbital phases).

The Data EEPROM and Data RAM shall be divided into five segments, one for each AGILE data acquisition type: AC FEE, GRID, SA, SA/Burst, MCAL/Burst.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Scientific Configuration Set-up	33	1	PDHU	Idle In-Flight Test

The TC shall contain for the Nominal orbital phase the following information:

1st Data Block (Nominal phase P/L Scientific Configuration):

- The identifier of the GRID Scientific set-up selected among the following possible configurations:

  - Observation (TBD possible options);

  - ST Pedestal Mode;

  - ST Electrical Calibration;

  - Physical Calibration;

  - Stand-by at the FEE level;

- Stand-by at the PDHU level (data storage disabled; scientific ratemeters enabled).

- The identifier of the AC FEE Scientific set-up selected among the following possible configurations:

  - Observation (TBD possible options);

  - Electrical Calibration;

  - Stand-by (all the discriminator outputs disabled).

- The identifier of the SA Scientific set-up selected among the following possible configurations:

  - Separate SAIEs Scientific set-up:

    - SAIE-X set-up:

      - Observation photon-by-photon mode (TBD possible options);

      - Electrical Calibration (Threshold calibration);

      - Electrical Calibration (Gain calibration);

      - Stand-by at the FEE level;

    - SAIE-Z set-up:

      - Observation photon-by-photon mode (TBD possible options);

      - Electrical Calibration (Threshold calibration);

      - Electrical Calibration (Gain calibration);

      - Stand-by at the FEE level;

  - Observation imaging mode (TBD possible options);

  - Physical Calibration;

  - Stand-by at the PDHU level (data storage disabled; scientific ratemeters enabled).

- The identifier of the SA/Burst Scientific set-up selected among the following possible configurations:

  - Observation (TBD possible options);

  - Stand-by (SA Burst Search disabled: SA/Burst LUT reset and SA B-STOP disabled).

- The identifier of the MCAL/Burst Scientific set-up selected among the following possible configurations:

  - Observation (TBD possible options);

  - Electrical Calibration;

  - MCAL Physical Calibration;

  - Stand-by at the FEE level;

  - Stand-by at the PDHU level (data storage disabled; MCAL Burst Search disabled; Scientific Ratemeters enabled).

- The identifier of the selected set of TPTs (TBD possible options).

2nd – 4th Data Blocks (Special phases P/L Scientific Configuration):

- The flag forcing, in case of S/C mass memory overflow, the loading of the Recovery P/L Configuration defined in the 5th data block.

- The identifier of the GRID Scientific set-up selected among the following possible configurations:

  - The configuration already loaded for the Nominal phase;

  - ST Pedestal Mode;

  - ST Electrical Calibration;

  - Physical Calibration;

  - Stand-by at the FEE level;

  - Stand-by at the PDHU level (data storage disabled; scientific ratemeters enabled).

- The identifier of the AC FEE Scientific set-up selected among the following possible configurations:

  - The configuration already loaded for the Nominal phase;

  - Electrical Calibration;

  - Stand-by (all the discriminator outputs disabled).

- The identifier of the SA Scientific set-up selected among the following possible configurations:

  - The configuration already loaded for the Nominal phase;

  - Separate SAIEs Scientific set-up:

    - SAIE-X set-up:

      - Observation photon-by-photon mode (TBD possible options);

      - Electrical Calibration (Threshold calibration);

      - Electrical Calibration (Gain calibration);

      - Stand-by at the FEE level;

    - SAIE-Z set-up:

      - Observation photon-by-photon mode (TBD possible options);

      - Electrical Calibration (Threshold calibration);

      - Electrical Calibration (Gain calibration);

      - Stand-by at the FEE level;

  - Stand-by at the PDHU level (data storage disabled; scientific ratemeters enabled).

- The identifier of the SA/Burst Scientific set-up selected among the following possible configurations:

  - The configuration already loaded for the Nominal phase;

- Stand-by (SA Burst Search disabled: SA/Burst LUT reset and SA B-STOP disabled).

- The identifier of the MCAL/Burst Scientific set-up selected among the following possible configurations:

  - The configuration already loaded for the Nominal phase;

  - Electrical Calibration;

  - MCAL Physical Calibration;

  - Stand-by at the FEE level;

  - Stand-by at the PDHU level (data storage disabled; MCAL Burst Search disabled; Scientific Ratemeters enabled).

- The identifier of the selected set of TPTs (TBD possible options).

5th Data Block (Recovery P/L Scientific Configuration):

- The identifier of the GRID Scientific set-up selected among the following possible configurations:

  - The configuration already loaded for the current orbital phase;

  - Stand-by at the FEE level;

  - Stand-by at the PDHU level (data storage disabled; scientific ratemeters enabled).

- The identifier of the AC FEE Scientific set-up selected among the following possible configurations:

  - The configuration already loaded for the current orbital phase;

  - Stand-by (all the discriminator outputs disabled).

- The identifier of the SA Scientific set-up selected among the following possible configurations:

  - The configuration already loaded for the current orbital phase;

  - Observation imaging mode (TBD possible options);

- Stand-by at the FEE level;

- Stand-by at the PDHU level (data storage disabled; scientific ratemeters enabled).

- The identifier of the SA/Burst Scientific set-up selected among the following possible configurations:

- The configuration already loaded for the current orbital phase;

- Stand-by (SA Burst Search disabled: SA/Burst LUT reset and SA B-STOP disabled).

- The identifier of the MCAL/Burst Scientific set-up selected among the following possible configurations:

- The configuration already loaded for the current orbital phase;

- Stand-by at the FEE level;

- Stand-by at the PDHU level (data storage disabled; MCAL Burst Search disabled; Scientific Ratemeters enabled).

- The Type 39 TM generation mask.

- The identifier of the selected set of TPTs (TBD possible options).

4.3.2 GRID OBSERVATION HW SET-UP TELECOMMAND: TC(33,2)

URS-4.3.2.1 This TC shall be used to load the parameters related to the Observation configuration of the GRID HW Logic.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
GRID Observation HW Set-up	33	2	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);

- The identifier of the set of the GRID HW Logic parameters to be programmed by the current TC;

- The GRID AC Veto Set-up:

    - The AC veto condition selection (5 options: Normal condition, Particle-1, Particle-2, Photon-1, Photon-2);

    - The AC signals stretcher;

- The GRID Level-1 Trigger Set-up:

    - The MCAL High Th. enable;

    - The MCAL High Th. R-Trigger enable;

    - The delay of the ST Hold;

    - The R-Trigger output logic selection (AND/OR).

- The GRID Level-1.5 Trigger Set-up:

    - The MCAL High Th. Enable;

    - The anomaly cases action (FEF activation or event rejection);

    - The NEAR X algorithm enable;

    - The NEAR Z algorithm enable;

    - The NEAR n_X Threshold;

    - The NEAR n_Z Threshold;

    - The COEF algorithm enable;

    - The DIS algorithm enable;

    - The Trigger-1.5 output LUT.

- The ST Zero-suppression Threshold.

4.3.3 GRID OBSERVATION SW SET-UP TELECOMMAND (STEP-1): TC(33,3)

URS-4.3.3.1 This TC shall be used to load the parameters related to the Observation configuration of the GRID SW Logic until the Level-2/Step-1 processing.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
GRID Observation SW Set-up (Step-1)	33	3	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- The identifier of the set of the Step-1 GRID Observation SW parameters to be programmed by the current TC;
- The GRID Status Flag Set-up:
  - The F_{AC} mode selection (determined by AC or fixed);
  - The F_{AC} fixed value;
  - The F_{MCAL} mode selection (determined by MCAL or fixed);
  - The F_{MCAL} fixed value;
  - The F_{BKG} mode selection (determined by AC or fixed);
  - The AC Threshold for the F_{BKG} generation;
  - The F_{BKG} fixed value;
  - The F_{HT} mode selection (determined by MCAL High Th. or fixed);
  - The F_{HT} GRID SW Processing configuration (14bits);

- The F_{HT} fixed value;
- The F_{BURST} mode selection (determined by BS or fixed);
- The F_{BURST} fixed value;
- The F_{BURST} generation Logic (AND/OR);
- The F_{ST} mode selection (determined by ST or fixed);
- The number of the ST planes from the bottom considered in the F_{ST} generation;

- The GRID Simplified Cluster-ID High Threshold;
- The GRID MCAL Zero-suppression enable;
- The GRID Level-2/Step-1 set-up:
  - The 3PLAND enable;
  - The CDIS enable;
  - The CDIS X difference threshold;
  - The CDIS Z difference threshlod;
  - The CDIS X distance threshold;
  - The CDIS Z distance threshold;
  - The FCN3MIP enable;
  - The 8 FCN3MIP Energy thresholds;
  - The 8 FCN3MIP Ratio threshold;
  - The M15 enable;
  - The M15 Single-Track enable;
  - The M15 Multi-Track enable;
  - The 8 M15 M_X thresholds;
  - The 8 M15 M_Z thresholds;

- The M15 output logic selection (AND/OR).

4.3.4 GRID OBSERVATION SW SET-UP TELECOMMAND (STEP-2): TC(33,4)

URS-4.3.4.1 This TC shall be used to load the parameters related to the Observation configuration of the GRID Level-2/Step-2 processing.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
GRID Observation SW Set-up (Step-2)	33	4	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- The identifier of the set of the Step-2 GRID Observation SW parameters to be programmed by the current TC;
- The Pre-Kalmaex set-up:
    - The MCAL energy estimation enable;
    - The Cluster Filtering enable;
    - The Cluster Filtering low energy threshold;
    - The Cluster Filtering high energy threshold;
- The Kalmaex set-up:
    - The Kalmaex enable;
    - The FVC/MFV first view X TCC number threshold;
    - The FVC/MFV first view Z TCC number threshold;
    - The FVC/MFV Multiplicity X M' threshold;

- The FVC/MFV Multiplicity Z M' threshold;
- The FVC/MFV output LUT;
- The FVC X hits combination threshold;
- The FVC Z hits combination threshold;
- The FVC hits combination output logic selection (AND/OR);
- The K.F. sigma of the space resolution;
- The $\div^2$ Filetring enable;
- The 24 $\div^2$ thresholds;
- The Incoming direction det. enable;
- The Incoming direction det. k factor;
- The Albedo Filtering enable;
- The 24 Albedo Filtering T thresholds;
- The K-DIS enable;
- The K-DIS first procedure flag.
- The K-DIS AC-LAT factor for the transverse direction;
- The K-DIS AC-LAT factor for the longitudinal direction.

- GRID Event Building: enable for the MCAL Zombie events.

4.3.5 AC DIGITAL FEE OBSERVATION SET-UP TELECOMMAND: TC(33,5)

URS-4.3.5.1 This TC shall be used to load the parameters related to the Observation configuration of the AC Digital FEE.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
AC Digital FEE Observation Set-up	33	5	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- The identifier of the set of the AC Digital FEE parameters to be programmed by the current TC;
- The 3 AC-TOP discrimnators enables;
- The 12 AC-LAT discriminators enables;
- The 3 AC-TOP discriminators thresholds;
- The 12 AC-LAT discriminators thresholds.

4.3.6 AC FEE CALIBRATION SET-UP TELECOMMAND: TC(33,6)

URS-4.3.6.1 This TC shall be used to load the parameters related to the Electrical Calibration configuration of the AC FEE.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
AC FEE Calibration Set-up	33	6	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- The number of repetitions of the AC FEE Electrical Calibration procedure.

  For each repetition, the TC shall contain the following information:

  - The single test duration;
  - The 30 test pulse amplitudes;
  - The 3 AC-TOP discriminators thresholds;
  - The 12 AC-LAT discriminators thresholds.

4.3.7 ST GENERAL OBSERVATION SET-UP TELECOMMAND: TC(33,7)

URS-4.3.7.1 This TC shall be used to load the parameters related to the Observation configuration of the ST FEE.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
ST General Observation Set-up	33	7	ST	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);

- The identifier of the set of the ST Observation parameters to be programmed by the current TC;

- The ST FEBs Set-up.
  The TC shall contain, for each ST FEB, the following information:

  - The +/- 2V post regulation On/Off;

  - The silicon bias regulation;

  - The TAA1 shaper feedback resistor;

  - The TAA1 pre-amplifier feedback resistor;

  - The TAA1 pre-bias;

  - The TAA1 Trigger impulse width;

  - The TAA1 reference bias;

  - The TAA1 Threshold;

- The ¾Trigger ouput logic selection (AND/OR).

4.3.8 ST LADDER OBSERVATION SET-UP TELECOMMAND: TC(33,8)

URS-4.3.8.1 This TC shall be used to load the parameters related to the Observation configuration of a single ST ladder.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
ST Ladder Observation Set-up	33	8	ST	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);

- The identifier of the set of the ST Ladder Observation parameters to be programmed by the current TC;

- The address of the ST ladder;

- The ST ladder Set-up.
  The TC shall contain, for each ST ladder channel, the following information:

  - The trigger enable;

  - The threshold fine regulation.

4.3.9 ST CALIBRATION SET-UP TELECOMMAND: TC(33,9)

URS-4.3.9.1 This TC shall be used to load the parameters related to the Electrical Calibration configuration of the ST.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
ST Calibration Set-up	33	9	ST	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);

- The Threshold start value;

- The Threshold final value;

- The increment value for the Threshold scanning;

- The 4 pulse amplitudes;

- The number of pulses per channel to be generated for each amplitude and for each threshold.

4.3.10 SA GENERAL OBSERVATION SET-UP TELECOMMAND: TC(33,10)

URS-4.3.10.1 This TC shall be used to load the parameters related to the Observation configuration of the SA.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
SA General Observation Set-up	33	10	SA	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- The identifier of the set of the SA General Observation parameters to be programmed by the current TC;
- TBD.

4.3.11 SA DAISY CHAIN OBSERVATION SET-UP TELECOMMAND: TC(33,11)

URS-4.3.11.1 This TC shall be used to load the parameters related to the Observation configuration of a single SA Daisy Chain.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
SA Daisy Chain Observation Set-up	33	11	SA	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- The identifier of the set of the SA Daisy Chain Observation parameters to be programmed by the current TC;
- TBD.

4.3.12 SA CALIBRATION SET-UP TELECOMMAND: TC(33,12)

URS-4.3.12.1 This TC shall be used to load the parameters related to the Calibration (Gain Calibration, Threshold Calibration and SA Physical Calibration) configuration of the SA FEE.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
SA Calibration Set-up	33	12	SA	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- TBD.

4.3.13 MCAL OBSERVATION SET-UP TELECOMMAND: TC(33,13)

URS-4.3.13.1 This TC shall be used to load the parameters related to the Observation configuration of the MCAL FEE, GRID chain and BURST chain.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
MCAL Observation Set-up	33	13	MCAL	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- The identifier of the set of the MCAL Observation parameters to be programmed by the curent TC;
- The MCAL FEE GRID Set-up:
    - The Delay on the T1_yes signal;
    - The Gain of the step amplifier;
    - The Fast Trigger threshold.
- The MCAL FEE BURST Set-up:
    - The multiple events coincidence time;
    - The 30 MCAL bars enables;
    - The DACs reference level;
    - The 30 Ch A Trigger thresholds;
    - The 30 Ch sum Trigger thresholds;
    - The 30 Ch B Trigger thresholds;
- The MCAL FEE Digital HKs Set-up:
    - The address of the fixed Digital ratemeter on the board X;
    - The address of the fixed Digital ratemeter on the board Z;
    - The Digital HKs integration time;

4.3.14 MCAL CALIBRATION SET-UP TELECOMMAND: TC(33,14)

URS-4.3.14.1 This TC shall be used to load the parameters related to the Calibration (MCAL/Burst Electrical Calibration, MCAL/Burst Physical Calibration and MCAL/GRID Physical Calibration) configuration of the MCAL.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
MCAL Calibration Set-up	33	14	MCAL	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);

- TBD;

4.3.15 BURST SEARCH GENERAL SET-UP TELECOMMAND: TC(33,15)

URS-4.3.15.1 This TC shall be used to load the parameters related to the general Observation configuration of the Burst Search.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Burst Search General Set-up	33	15	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);

- The identifier of the set of the Burst Search General parameters to be programmed by the current TC;

- The MCAL Burst Search enable;

- The SA Burst Search enable;

- The B-STOP Short-Burst./Long-Burst Threshold;

- The MCAL enable for the Short-Burst B-STOP;

- The SA enable for the Short-Burst B-STOP;

- The MCAL enable for the Long-Burst B-STOP;

- The SA enable for the Long-Burst B-STOP;

- The energy threshold E_c defining the MCAL BSRs;

- The energy threshold E_t defining the SA BSRs;

- The delay for the restart of the MCAL Burst Search after the SAA phase transition;

- The MCAL:Background History set-up.
  The TC shall contain, for each MCAL DR channel (j=1,..,12), the following information:

  - The number of the Background samples;

  - The integration time of the Background samples;

  - The sampling time of the Background samples;

- The Long-Burst Procedure set-up.
  The TC shall contain the following information:

  - The Long-Burst B-STOP mode selection (comparison with the background or T_{limit});

  - The Background limits: B_{min} and B_{max};

  - The T_{limit} parameter;

- The B-STOP sampling time;

- The Burst Background Filtering Procedure set-up.
  The TC shall contain the following information:

  - The address reference bit for the 1ms logic;

- The address reference bit for the 16ms logic;

- The 1ms BBFP output LUT;

- The 16ms BBFP output LUT;

- The BBFP output logic selection (AND/OR);

- The Pre-Burst/Post-Burst values for $\Delta T_{BURST} \leq 1s$;

- The Pre-Burst/Post-Burst values for $1s < \Delta T_{BURST} \leq 10s$;

- The Pre-Burst/Post-Burst values for $\Delta T_{BURST} > 10s$;

4.3.16 BURST SEARCH HW SET-UP TELECOMMAND: TC(33,16)

URS-4.3.16.1 This TC shall be used to load the parameters related to the Observation configuration of the HW Burst Search.

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Burst Search HW Set-up	33	16	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);

- The identifier of the set of the Burst Search HW parameters to be programmed by the current TC;

- The SA Normal Burst Search set-up;
  The TC shall contain, for each $R_{1,n}$ (n=1,2), the following information:

  - The Burst Search enable;

  - The BS strategy selection (Adaptative Trigger or Static Trigger);

- The number of the Background sigma used by the BS Logic;

- The average Background enable for the Static Trigger Logic;

- The Background fixed component used by the Static Trigger Logic;

- The Background Estimation Time;

- The sampling time of the Background Estimation;

- The Background Estimation Delay;

- The Short-Burst B-STOP Background mode: strategy selection (Adaptative or Static);

- The Long-Burst B-STOP Background mode: strategy selection (Adaptative or Static);

- The B-STOP Background mode: the number of the Background sigma used by the Static Logic;

- The B-STOP Background mode: the Background fixed component used by the Static Logic;

- The B-STOP determination time window.

- The MCAL Normal Burst Search set-up;
  The TC shall contain, for each $R_{2,n}$ (n=1,2), the following information:

  - The Burst Search enable;

  - The BS strategy selection (Adaptative Trigger or Static Trigger);

  - The number of the Background sigma used by the BS Logic;

  - The average Background enable for the Static Trigger Logic;

  - The Background fixed component used by the Static Trigger Logic;

  - The Background Estimation Time;

  - The sampling time of the Background Estimation;

- The Background Estimation Delay;

- The Short-Burst B-STOP Background mode: strategy selection (Adaptative or Static);

- The Long-Burst B-STOP Background mode: strategy selection (Adaptative or Static);

- The B-STOP Background mode: the number of the Background sigma used by the Static Logic;

- The B-STOP Background mode: the Background fixed component used by the Static Logic;

- The B-STOP determination time window.

- The Sub-Millisecond Burst Search set-up;
The TC shall contain the following information:

- The SA Burst Search enable;

- The MCAL Burst Search enable;

- The 5 MCAL couples of thresholds n, $\Delta t^{th}(n)$;

- The 2 SA couples of thresholds n, $\Delta t^{th}(n)$;

- The Pre-Burst/Post-Burst $\Delta t'$;

- The enable of the Sub-Millisecond Trigger inhibition during an ABT.

4.3.17 SA BURST SEARCH SW SET-UP TELECOMMAND: TC(33,17)

URS-4.3.17.1 This TC shall be used to load the parameters related to the Observation configuration of the SA Burst Search related to a single integration time managed by the SW (S64ms).

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
SA SW Burst Search Set-up	33	17	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);

- The identifier of the set of the SA Burst Search SW parameters to be programmed by the current TC;

- The BSRs integration time identifier.
  The TC shall contain, for each Rj,k (k fixed, j=13,..,20), the following information:

  - The BS strategy selection (Adaptative Trigger or Static Trigger);

  - The number of the Background sigma used by the BS Logic;

  - The average Background enable for the Static Trigger Logic;

  - The Background fixed component used by the Static Trigger Logic;

  - The Background Estimation Time;

  - The sampling time of the Background Estimation;

  - The Background Estimation Delay;

  - The Short-Burst B-STOP Background mode: strategy selection (Adaptative or Static);

  - The Long-Burst B-STOP Background mode: strategy selection (Adaptative or Static);

  - The B-STOP Background mode: the number of the Background sigma used by the Static Logic;

  - The B-STOP Background mode: the Background fixed component used by the Static Logic;

- The B-STOP determination time window.

4.3.18 SA IMAGING SET-UP TELECOMMAND: TC(33,18)

URS-4.3.18.1 This TC shall be used to load the parameters related to the Observation configuration of the SA Imaging (Imaging mode and Burst Imaging).

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
SA Imaging Set-up	33	18	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- The identifier of the set of the SA Imaging parameters to be programmed by the current TC;
- The attitude correction set-up.
  The TC shall contain the following information:
  - The systematic off-sets;
  - The coefficient C used by the step-3 logic;
- The SA Imaging mode set-up;
  The TC shall contain the following information:
  - The 4 SA Detectors enables;
  - The images integration time;
- The SA Burst Imaging set-up;
  The TC shall contain the following information:
  - The 4 SA Detectors enables;
  - The T_{stop} computation enable;

- The T_{stop} sampling time;
- The $N_{\sigma\text{-image}}$ parameter;
- The $T_{stop\text{-}max}$ parameter;
- The T_{stop} fixed value;
- The T_{EN} parameter;
- The images co-adding procedure: shift parameters;
- The peak finding algorithm: the number of pixel used to implement the weighted mean;
- The peak finding algorithm: the peak threshold;
- The systematics off-sets at GRB coordinates level.

4.3.19 MCAL BURST SEARCH SW SET-UP TELECOMMAND: TC(33,19)

URS-4.3.19.1 This TC shall be used to load the parameters related to the Observation configuration of the MCAL Burst Search related to a single integration time managed by the SW (S64ms).

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
MCAL SW Burst Search Set-up	33	19	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- The identifier of the set of the MCAL Burst Search SW parameters to be programmed by the current TC;

- The BSRs integration time identifier.

The TC shall contain, for each Rj,k (k fixed, j=1,..,12), the following information:

- The BS strategy selection (Adaptative Trigger or Static Trigger);
- The number of the Background sigma used by the BS Logic;
- The average Background enable for the Static Trigger Logic;
- The Background fixed component used by the Static Trigger Logic;
- The Background Estimation Time;
- The sampling time of the Background Estimation;
- The Background Estimation Delay;
- The Short-Burst B-STOP Background mode: strategy selection (Adaptative or Static);
- The Long-Burst B-STOP Background mode: strategy selection (Adaptative or Static);
- The B-STOP Background mode: the number of the Background sigma used by the Static Logic;
- The B-STOP Background mode: the Background fixed component used by the Static Logic;
- The B-STOP determination time window.

4.3.20 TELEMETRY PARTITION TABLES LOAD TELECOMMAND: TC(33,20)

URS-4.3.20.1 This TC shall be used to load the TPT_1 (Low Bkg) and the TPT_2 (Burst).

The uplinked parameters shall be loaded in the Data EEPROM or in the Data RAM as required by the TC.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Telemetry Partition Tables Set-up	33	20	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Memory ID (Data EEPROM or Data RAM);
- The identifier of the set of the TPTs to be programmed by the current TC;
- The TPT_1 (Nominal);
- The TPT_2 (Burst);

4.3.21 DYNAMIC CONFIGURATION TABLE LOAD TELECOMMAND: TC(33,21)

URS-4.3.21.1 This TC shall be used to load the 5 Tables (SAA, SS switch, Earth occultation, Satellite-Earth position, Ground Station contacts) used by the Dynamic Configuration logic.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Dynamic Configuration Tables Set-up	33	21	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Table ID;
- The Table Segment ID;
- The Table Segment data;

4.3.22 DYNAMIC CONFIGURATION TABLE ENABLE TELECOMMAND: TC(33,22)

URS-4.3.22.1 This TC shall be used to active the last uploaded Dynamic Configuration Table (SAA, SS switch, Earth occultation, Satellite-Earth position, Ground Station contacts).

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Dynamic Configuration Table Enable	33	22	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Table ID;

4.3.23 SPECIAL ORBITAL PHASES MANAGEMENT TELECOMMAND: TC(33,23)

URS-4.3.23.1 This TC shall be used to inform to the PDHU of the entry and the exit from the special orbital phases (SAA, Earth occultation, Ground Station contacts). This TC shall be managed by the BUS as a time-tagged TC and shall be used as a back-up solution of the Dynamic Configuration Tables related to the special orbital phases.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Special Orbital Phases Management	33	23	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Special Orbital Phase ID (SAA, Earth occultation, Ground Station contacts);

- The Phase-in/Phase-out identifier.

4.3.24 STAR SENSORS SWITCH TELECOMMAND: TC(33,24)

URS-4.3.24.1 This TC shall be used to drive the on-board switch between the two Star Sensors. This TC shall be managed by the BUS as a time-tagged TC and shall be used as a back-up solution of the Dynamic Configuration Table related to the Star Sensors switch.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Star Sensors Switch	33	24	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The ID code of the Star Sensor to be activated;

4.3.25 MONITORING SET-UP TELECOMMAND: TC(33,25)

URS-4.3.25.1 This TC shall be used to load the set of parameters used by the on-board monitoring.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Monitoring Set-up	33	25	PDHU	Idle In-Flight Test

The TC shall contain the following information:

- The Monitoring parameters TBD

4.3.26 AC POWER SUPPLY SET-UP TELECOMMAND: TC(33,26)

URS-4.3.26.1 This TC shall be used to configure the AC HV DC-DC converter.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
AC PSU Set-up	33	26	PSU	Idle In-Flight Test

The TC shall contain the following information:

- The HV On/Off;

- The HV regulation (0-1100V).

4.3.27 ST POWER SUPPLY SET-UP TELECOMMAND: TC(33,27)

URS-4.3.27.1 This TC shall be used to configure the ST DC-DC converters.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
ST PSU Set-up	33	27	PSU	Idle In-Flight Test

The TC shall contain the following information:

- The 130V On/Off;

- The +/- 5V On/Off;

- The FTB-X +/- 2.3V On/Off;

- The FTB-Z +/- 2.3V On/Off.

4.3.28 SA POWER SUPPLY SET-UP TELECOMMAND: TC(33,28)

URS-4.3.28.1 This TC shall be used to configure the SA DC-DC converters.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
SA PSU Set-up	33	28	PSU	Idle In-Flight Test

The TC shall contain the following information:

- The 130V On/Off;
- The +/- 5V On/Off;
- The SAIE-X +/- 5V analog On/Off;
- The SAIE-Z +/- 5V analog On/Off.
- The SAIE-X +/- 2.3V On/Off;
- The SAIE-Z +/- 2.3V On/Off.

4.3.29 MCAL POWER SUPPLY SET-UP TELECOMMAND: TC(33,29)

URS-4.3.29.1 This TC shall be used to configure the MCAL DC-DC converters.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
MCAL PSU Set-up	33	29	PSU	Idle In-Flight Test

The TC shall contain the following information:

- The Power Supply On/Off;

4.3.30 SS POWER SUPPLY SET-UP TELECOMMAND: TC(33,30)

URS-4.3.30.1 This TC shall be used to configure the SS Power Supply.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
SS PSU Set-up	33	30	PSU	Idle In-Flight Test

The TC shall contain the following information:

- The first SS Power Supply On/Off;
- The second SS Power Supply On/Off;

4.3.31 GPS POWER SUPPLY SET-UP TELECOMMAND: TC(33,31)

URS-4.3.31.1 This TC shall be used to configure the GPS Power Supply.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
GPS PSU Set-up	33	31	PSU	Idle In-Flight Test

The TC shall contain the following information:

- The Nominal GPS Power Supply On/Off;
- The Redundant GPS Power Supply On/Off;

4.4 REPORT P/L CONFIGURATION TELECOMMANDS (TYPE=34)

4.4.1 REPORT P/L CONFIGURATION TELECOMMAND: TC(34,1)

URS-4.4.1.1 This telecommand shall cause the on-board application to generate a Task Parameter Report TM (35,4) containing the most recently uploaded P/L Configuration.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Task Parameter Report Request	34	1	PDHU	Idle Obs. & Proc. In-Flight Test

4.5 MODE TRANSITION TELECOMMANDS (TYPE=35)

4.5.1 ENTER INIT-1 MODE TELECOMMAND: TC(35,1)

URS-4.5.1.1 On reception of this TC, the PDHU shall enter in the INIT-1 Operative Mode.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Enter INIT-1 Mode	35	1	PDHU	Boot Maint. Shutdown

4.5.2 ENTER INIT-2 MODE TELECOMMAND: TC(35,2)

URS-4.5.2.1 On reception of this TC, the PDHU shall enter in the INIT-2 Operative Mode.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Enter INIT-2 Mode	35	2	PDHU	Boot Maint. Runtime Maint.

4.5.3 ENTER IDLE MODE TELECOMMAND: TC(35,3)

URS-4.5.3.1 On reception of this TC, the PDHU shall enter in the IDLE Operative Mode according to the parameters included in TC itself.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Enter IDLE Mode	35	3	PDHU	Obs. & Proc. Runtime Maint. In-Flight Test

The TC shall contain the following information:

- The flag (process/ignore) defining, in case of transition from OBS. & PROC. or from IN-FLIGHT TEST to IDLE, the processing on the data stored in the buffers to be performed before the mode transition;

4.5.4 ENTER OBS & PROC. MODE TELECOMMAND: TC(35,4)

URS-4.5.4.1 On reception of this TC, the PDHU shall enter in the OBS. & PROC. Operative Mode according to the flag included in TC itself. On reception of this TC, the P/L Configuration shall be managed as described in URS-4.3.1.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Enter OBS. & PROC. Mode	35	4	PDHU	Idle

The TC shall contain the following information:

- The flag (EEPROM/EEPROM+RAM) selecting the set of P/L configuration parameters, identified by the memory area where they are stored, to be loaded for the OBS. & PROC. mode;

4.5.5 ENTER BOOT MAINT. MODE TELECOMMAND: TC(35,5)

URS-4.5.5.1 On reception of this TC, the PDHU shall enter in the BOOT MAINTENANCE Operative Mode.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Enter BOOT MAINT. Mode	35	5	PDHU	Init-2

4.5.6 ENTER RUNTIME MAINT. MODE TELECOMMAND: TC(35,6)

URS-4.5.6.1 On reception of this TC, the PDHU shall enter in the RUNTIME MAINTENANCE Operative Mode.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Enter RUNTIME MAINT. Mode	35	6	PDHU	Idle In-Flight Test

4.5.7 ENTER SHUTDOWN MODE TELECOMMAND: TC(35,7)

URS-4.5.7.1 On reception of this TC, the PDHU shall enter in the SHUTDOWN Operative Mode.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Enter SHUTDOWN Mode	35	7	PDHU	Runtime Maint. Idle Obs. & Proc. In-Flight Test

4.5.8 ENTER IN-FLIGHT TEST MODE TELECOMMAND: TC(35,8)

URS-4.5.8.1 On reception of this TC, the PDHU shall enter in the IN-FLIGHT TEST Operative Mode.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Enter IN-FLIGHT TEST Mode	35	8	PDHU	Idle

The TC shall contain the following information:

- The flag (EEPROM/EEPROM+RAM) selecting the set of the P/L configuration parameters, identified by the memory area where they are stored, to be loaded for the IN-FLIGHT TEST mode;

4.6 MEMORY MAINTENANCE TELECOMMANDS (TYPE=36)

4.6.1 LOAD MEMORY TELECOMMAND: TC(36,1)

URS-4.6.1.1 This telecommand shall be used to load part of the PDHU EEPROM/RAM memory area. The command shall be executed only in SAFE Context.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Load Memory	36	1	PDHU	Boot Maint. Runtime Maint.

The TC shall contain the following information:

- The Start Address of the patch;

- The length of the patch;

- The patch data.

4.6.2 LOAD DATA EEPROM TELECOMMAND: TC(36,2)

URS-4.6.2.1 This telecommand shall be used to load part of the PDHU Data EEPROM area. A special TC verification procedure shall control that the data patch on EEPROM not have impact on the SW stored in the same EEPROM bank.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Load Data EEPROM	36	2	PDHU	Idle. In-Flight Test

The TC shall contain the following information:

- The Start Address of the patch;

- The length of the patch;

- The patch content.

4.6.3 DUMP MEMORY TELECOMMAND: TC(36,3)

URS-4.6.3.1 This telecommand is used to dump some PDHU memory area.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Dump Memory	36	3	PDHU	Boot Maint. Idle. Runtime Maint. In-Flight Test

The TC shall contain the following information:

- The Start Address of the dump;

- The length of the dump;

- The dump content.

4.6.4 CALCULATE MEMORY CHECKSUM TELECOMMAND: TC(36,4)

URS-4.6.4.1 This telecommand is used to calculate checksum of the specified part of PDHU memory area.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Memory Checksum Request	36	4	PDHU	Boot Maint. Idle. Runtime Maint. In-Flight Test

The TC shall contain the following information:

- The Start Address of the memory area to be checked;

- The length of the memory area to be checked;

4.6.5 COPY MEMORY TELECOMMAND: TC(36,5)

URS-4.6.5.1 This telecommand is used to copy a memory area from the DATA EEPROM to the DATA RAM or viceversa.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Copy Memory Request	36	5	PDHU	Boot Maint. Idle. Runtime Maint. In-Flight Test

The TC shall contain the following information:

- The Source memory start address;

- The Destination start address;

- The memory length.

4.6.6 SUB-SYSTEM FEE RESET TELECOMMAND: TC(36,6)

URS-4.6.6.1 This telecommand is used to reset the Sub-System FEEs.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Sub-System FEE Reset	36	6	PDHU	Boot Maint. Idle. Runtime Maint. In-Flight Test

The TC shall contain the following information:

- The ID code of the Sub-System FEE to be reset.

4.7 TELEMETRY MANAGEMENT TELECOMMANDS (TYPE=37)

4.7.1 REPORT TM PACKET GENERATION STATUS: TC(37,1)

URS-4.7.1.1 On reception of this TC, a report showing the generation status of all the P/L TM packets shall be generated and downlinked to the ground.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Report TM Pkt Generation Status	37	1	PDHU	Boot Maint. Runtime Maint. Idle In-Flight Test

4.7.2 ENABLE GENERATION OF TM PACKETS: TC(37,2)

URS-4.7.2.1 On reception of this TC, generation of the specified P/L TM packets shall be enabled.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Enable Generation of specific TM Packets	37	2	PDHU	Boot Maint. Runtime Maint. Idle In-Flight Test

The TC shall contain the following information:

- The addresses of the P/L TM Packets to be enabled.

4.7.3 DISABLE GENERATION OF TM PACKETS: TC(37,3)

URS-4.7.3.1 On reception of this TC, generation of the specified P/L TM packets shall be enabled.

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Disable Generation of specific TM Packets	37	3	PDHU	Boot Maint. Runtime Maint. Idle In-Flight Test

The TC shall contain the following information:

- The addresses of the P/L TM Packets to be enabled.

4.8 TEST COMMANDS (TYPE=38)

4.8.1 TEST COMMAND: TC(38,1)

URS-4.8.1.1 This telecommand is required to have a confirmation that the link to the application is operational. PDHU will response to the telecommand issuing a Successful Command Acceptance Report (TM 33.2)

TC Name	Type	Sub-type	Subsystem	Accepted in Mode
Test Command	38	1	PDHU	All

4.9 GPS AND SS MANAGEMENT TELECOMMANDS (TYPE=39)

TBD

APPENDIX A

Housekeepings List

HK No. ID	S/S	Pourpose	Measure	HK type	Position	No.	Sample rate [sec]	Range of measure	Bit/HK [bit]
1	AC	temperature	temperature	analogic	1 HVDB/ AC analog FEE 1 AC TOP 4 AC LAT	6	16	-50C° +60°C	8
2	AC	HV	voltage	analogic	PSU	2	16	0-1300 Volts	8
3	AC	ratemeters of TOP and AC-LAT discriminators	ratemeter	digital	PDHU	15	16	-	24
4	ST	temperature	temperature	analogic	two each FTB	4	16	-50C° +60°C	8
5	ST	temperature	temperature	analogic	Si layer	4	16	-50C° +60°C	8
6	ST	Silicon bias	voltage	analogic	After regulation on FEB	12	16	0-200 Volts	8
7	ST	Silicon bias current	current	analogic	After regulation on FEB	12	16	0-300 µA	8
8	ST	FEB current to TAA1 supply on line +/- 2 V	current	analogic	Between TAA1 and latch_up controll	24	16	0-1 A, TBC	8
9	ST	12 AC-vetoed ratemeters of 6 X views and 6 Z views for 6 alternating planes 1 ratemeter of not AC-vetoed first X view*.	ratemeter	digital	PDHU	13	16	-	16
10	SA	temperature	temperature	analogic	SA	36	16	-50C° +60°C	8
11	SA	temperature	temperature	analogic	SA	16	16	-50C° +60°C	8
12	SA	2.3V voltage	voltage	analogic	SA	32	16	0-3V	8
13	SA	Silicon bias voltage; +/- 5V analog; 5V digital	voltage	analogic	SA	10	16	According to each Secondary SA supply	8
14	SA	Silicon bias current	current	analogic	SA detectors	4	16	TBD	8
15	SA	MGOs single-hit	ratemeter	digital	SA	16	16	-	16

*The not AC-voeted ratemeter shall be coded with 10bits on the integration time of 16ms.

HK No. ID	S/S	Pourpose	Measure	HK type	Position	No.	Sample rate [sec]	Range of measure	Bit/HK [bit]
16	SA	MGOs multi-hit	ratemeter	digital	SA	16	16	-	16
17	SA	Events rejected by coincidence with AC top	ratemeter	digital	SA	4	16	-	16
18	SA	Events rejected by coincidence with AC LAT	ratemeter	digital	SA	4	16	-	16
19	SA	Events rejected by coincidence with ST	ratemeter	digital	SA	4	16	-	16
20	SA	Events rejected by coincidence with MCAL	ratemeter	digital	SA	4	16	-	16
21	SA	Energy rejection	ratemeter	digital	SA	4	16	-	16
22	SA	Good Events	ratemeter	digital	SA	16	16	-	16
23	MCAL	temperature	temperature	analogic	Bar side EL. Board	6	16	-50C° +60°C	8
24	MCAL	PD voltage	voltage	analogic	One for each MCAL side	2	16	0-28 Volts	8
25	MCAL	Electronic board voltage	voltage	analogic	MCAL	3	16	+5 digital, +5 analogic, -5 analogic for	8
26	MCAL	ratemeters of sum bar/side bar signals – Board X**	ratemeter	digital	MCAL	45	1440	-	16
27	MCAL	ratemeters of sum bar/side bar signals – Board Z*	ratemeter	digital	MCAL	45	1440	-	16
28	MCAL	ratemeters from HK. No. 13 and 14*	ratemeter	digital	MCAL	2	16	-	16
29	MCAL	ratemeter fast trigger	ratemeter	digital	MCAL	1	16	-	16

* The Housekeeping TM Report TM(32,1) shall contain the addresses of the ratemeters sampled in the current packet

HK No. ID	S/S	Pourpose	Measure	HK type	Position	No.	Sample rate [sec]	Range of measure	Bit/HK [bit]
30	PDHU	ppm correction for 1 sec windows time , are required 16 values contained in one HK packet	ratemeter	digital	PDHU	1	16	+1000 - 1000 (TBV)	16
31	PDHU	Bkg Flag value		digital	PDHU	1	16		1
32	PDHU	TPT address		digital	PDHU	1	16		1
33	PDHU	PDHU-OBDH Data Link: Data Exchange errors	ratemeter	digital	PDHU	1	16	-	16
34	PDHU	PDHU-OBDH Data Link: Response Frame transmission errors	ratemeter	digital	PDHU	1	16	-	16
35	PDHU	PDHU-OBDH Data Link: Data Frame transmission errors	ratemeter	digital	PDHU	1	16	-	16
36	PDHU	ratemeter of T1_YES signal	ratemeter	digital	PDHU	1	16	-	16
37	PDHU	ratemeter of R_trig_NO signal	ratemeter	digital	PDHU	1	16	-	16
38	PDHU	ratemeter of T 1.5_NO signal	ratemeter	digital	PDHU	1	16	-	16
39	PDHU	Software Scientific Monitoring Ratemeters	ratemeter	digital	PDHU	70 (TBC)	16	-	16
40	PDHU	GRID Memory buffer occupation in the TAB (events zero-suppressed)	digital	digital	PDHU	1	16	-	16

HK No. ID	S/S	Pourpose	Measure	HK type	Position	No.	Sample rate [sec]	Range of measure	Bit/HK [bit]
41	PDHU	Memory buffer SA occupation	digital	digital	PDHU	1	16	-	16
42	PDHU	Memory buffer MCAL occupation	digital	digital	PDHU	1	16	-	16
43	PDHU	Number of packet telemetry packet sent to the OBDH	ratemeter	digital	PDHU	1	16	-	16
44	PDHU	temperature	temperature	analogic	PDHU	3	16	-50C° +60°C	8
45	PSU	temperature	temperature	analogic	PSU	4	16	-50C° +60°C	8
46	PSU	secondary voltage supply	voltage	analogic	PSU	13	16	All Secondary Values	8
47	PSU	DC-DC primary currents	currents	analogic	PSU	13	16	All Primary values	8
48	PSU	secondary voltage supply	voltage	analogic	PSU	13	16	All Secondary Values	8
49	PSU	DC-DC primary currents	currents	analogic	PSU	13	16	All Primary values	8
50	PSU	DC_DC converters status on/off	digital	digital	PDHU	13	16	1-0	1
51	GPS	TBD	TBD	TBD	GPS	2	16	TBD	16
52	SS.	TBD	TBD	TBD	SS	4	16	TBD	16

APPENDIX B

Telemetry packets List

		SAFE			NOMINAL						TEST
	MODE	Boot Maint	Runtime Anomaly	Shutdown	Off	INIT-1	INIT-2	INIT-3	IDLE SET-UP	OBS & PROC	In-Flight Test
TM TYPE	**TM Subtype**										
Periodic TM Reports	Housekeeping Report	x	x	x					x	x	x
Telecommand Verification	Successful Command Acceptance Report	x	x	x					x	x	x
	Unsuccessful Command Acceptance Report	x	x	x					x	x	x
	Successful Command Execution Report	x	x	x					x	x	x
	Unsuccessful Command Execution Report	x	x	x					x	x	x
Event TM Reports	Boot Report	x					x				
	Automatic Transition Report	x	x				x		x		
Exception TM Reports	Buffer Saturation Report									x	x
	Buffer Desaturation Report									x	x
	Latch-up Report		x	x					x	x	x
	P/L Sub-Systems Link Anomaly Report	x	x	x					x	x	x
	Software Error Report		x	x					x	x	x
	Monitoring Report	x	x	x					x	x	x
P/L Configuration TM Reports	General P/L Configuration Report								x	x	x
Memory Maint. TM Reports	Memory Dump Report	x	x						x		x
	Memory Checksum Report	x	x						x		x
Telemetry Manag. TM Reports	TM Packet Generation Status Report	x	x						x		x

		SAFE			NOMINAL						TEST
	MODE	Boot Maint	Runtime Anomaly	Shutdown	Off	INIT-1	INIT-2	INIT-3	IDLE SET-UP	OBS & PROC	In-Flight Test
TM TYPE	TM Subtype										
Science Data	GRID Events Report									x	x
	GRID Calibration Report									x	x
	ST Pedestal Report									x	x
	ST Electrical Calibration Report									x	x
	SA Events Report									x	x
	SA Imaging Report									x	x
	SA Burst Imaging Report									x	x
	MCAL Burst Events Report									x	x
	MCAL Burst Calibration Report									x	x
	MCAL Burst Electrical Calibration Report									x	x
	Burst Fast Ratemeters Report									x	x
	Burst Alert									x	x
	Scientific ratemeters Report									x	x
	Star Sensor Data Report	x	x						x	x	x
	Star Sensor for S/C ACS Report	x	x						x	x	x
	GPS Data Report	x	x						x	x	x

Telecommand packets List

	MODE	SAFE			NOMINAL						TEST
		Boot Maint.	Runtime Anomaly	Shutdown	Off	INIT-1	INIT-2	INIT-3	IDLE SET-UP	OBS & PROC	In-Flight Test
TC TYPE	**TC Subtype**										
TASK MANAG. TC	Start Task		x						x		x
	Stop Task		x						x		x
LOAD CONFIG. PAR. TC	Scient. Config. Par. Telecommand								x		x
	GRID Obs. HW Set-up Telecommand								x		x
	GRID Obs. SW Set-up Telecommand (Step-1)								x		x
	GRID Obs. SW Set-up Telecommand (Step-2)								x		x
	AC Dig. FEE Obs. Set-up Telecommand								x		x
	AC FEE Cal. Set-up Telecommand								x		x
	ST General Obs. Set-up Telecommand								x		x
	ST Ladder Obs. Set-up Telecommand								x		x
	ST Cal. Set-up Telecommand								x		x
	SA General Obs. Set-up Telecommand								x		x
	SA Daisy Chain Obs. Set-up Telecommand								x		x
	SA Cal. Set-up Telecommand								x		x
	MCAL Obs. Set-up Telecommand								x		x
	MCAL Cal. Set-up Telecommand								x		x
	Burst Search General Set-up Telecommand								x		x
	Burst Search HW Set-up Telecommand								x		x
	SA Burst Search SW Set-up Telecommand								x		x
	SA Imaging Set-up Telecommand								x		x
	TM Partition Tables Load Telecommand								x		x

	MODE	SAFE			NOMINAL						TEST
		Boot Maint.	Runtime Anomaly	Shutdown	Off	INIT-1	INIT-2	INIT-3	IDLE SET-UP	OBS & PROC	In-Flight Test
TC TYPE	**TC Subtype**										
LOAD CONFIG. PAR. TC (continued)	Dynamic Config. Table Load Telecommand								x		x
	Dynamic Config. Table Enable Telecommand								x		x
	Special Orbital Phases Manag. Telecommand								x	x	x
	Star Sensors Switch Telecommand								x	x	x
	Monitoring Set-up Telecommand								x		x
	AC Power Supply Set-up Telecommand								x		x
	ST Power Supply Set-up Telecommand								x		x
	SA Power Supply Set-up Telecommand								x		x
	MCAL Power Supply Set-up Telecommand								x		x
	SS Power Supply Set-up Telecommand								x		x
	GPS Power Supply Set-up Telecommand								x		x
REP. P/L CONFIG. TC	Report P/L Config. Telecommand								x	x	x
MODE TRANSITION TC	Enter INIT-1 Mode Telecommand	x		x							
	Enter INIT-2 Mode Telecommand	x	x								
	Enter IDLE Mode Telecommand		x							x	x
	Enter OBS. & PROC. Mode Telecommand								x		
	Enter BOOT MAINT. Mode Telecommand						x				
	Enter RUNTIME MAINT. Mode Telecommand								x		x
	Enter SHUTDOWN Mode Telecommand		x						x	x	x
	Enter IN-FLIGHT TEST Mode Telecommand								x		

		SAFE			NOMINAL						TEST
	MODE	Boot Maint.	Runtime Anomaly	Shutdown	Off	INIT-1	INIT-2	INIT-3	IDLE SET-UP	OBS & PROC	In-Flight Test
TC TYPE	**TC Subtype**										
MEMORY MAINTENANCE TCs	Load Memory Telecommand	x	x								
	Load Data EEPROM Memory Telecommand								x		x
	Dump Memory Telecommand	x	x						x		x
	Calc. Memory Checksum Telecommand	x	x						x		x
	Copy Memory Telecommand	x	x						x		x
	S/S FEE Reset Telecommand	x	x						x		x
TM MANAGEMENT TCs	Report TM Packet Gen. Status	x	x						x		x
	Enable Gen. Of all TM Packets	x	x						x		x
	Disable Gen. Of all TM Packets	x	x						x		x
TEST COMMANDS	Test Command	x	x	x	x	x	x	x	x	x	x
SS AND GPS MANAG. TCs	TBD										