SUBJECT: **Test Facility FTS Data ICD**

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Glossary

APID	Application ID
EGSE	Electrical Ground Support Equipment
SID	Structure ID
SPIRE	Spectral and Photometric Imaging Receiver
TBD	To Be Determined
TBW	To Be Written
TFTS	Test Fourier Transform Spectrometer
TC	Telecommand Packet
TM	Telemetry Packet
U500	Unidex 500
ULONG	Unsigned long (32 bit)
USHORT	Unsigned short integer (16 bit)
UINT	Unsigned integer (generic term)
UU	Unidex units (10 nm units)

1 INTRODUCTION

The Test Facility FTS (TFTS) is a Fourier Transform Spectrometer, which will be used for instrument level testing of the SPIRE instrument. The Unidex 500 (U500), a motion controller card that plugs into the TFTS PC's PCI bus, controls the Aerotech linear translation stage on which the spectrometer's scanning mirror is placed. The TFTS PC hosts the TFTS control software, which runs under Windows 2000. The control software listens for instructions from the SPIRE EGSE to initialise the TFTS and take interferogram scans. The resulting data sets are packetized and sent back to the SPIRE EGSE. Commands are formatted and sent as telecommand packets, and data as telemetry packets, both of which are received/transmitted over an Ethernet-based local area network.

All telemetry data produced by the SPIRE EGSE systems will follow the same standards used in the Herschel Spacecraft and Ground Segment systems. This will ease transition from testing to the operational environments. TM and TC packets conform to the ESA Packet Utilisation Standards (RD01, RD02, and RD03), and the Herschel Packet Structure ICD (AD01) subset. The TFTS reduced set of telemetry packet types are detailed herein.

1.1 Scope

This document defines the packet types and contents that will be accepted and generated by the Test Facility FTS (TFTS). These packets conform to the formats given in the Packet Structure ICD (AD01) and the Ground Segment to Instruments ICD (AD02).

1.2 Structure of the Document

Section 2 describes the packet interface used between the SPIRE instrument and the SPIRE EGSE, including the Test Facility Control System and test equipment. This includes the general format of the packets used by the SPIRE instrument for telecommanding and telemetry (from AD01), the allocation of Application IDs used by the instrument, and the functionality of the packet transfer protocol of the instrument/spacecraft interface (from AD01, appendix 9) that is used by the instrument.

Section 3 defines the format and content of each of the telecommand packets accepted by the TFTS. Section 4 defines the corresponding information for the telemetry packets generated by the TFTS. A description of how these packets are handled by the TFTS is given in RD04. Section 5 defines in detail the parameters used within the telecommand and telemetry packets.

1.3 Documents

1.3.1 Applicable Documents

AD01 Herschel/Planck Packet Structure Interface Control Document
(SPIRE-ESA-DOC-000433), Issue 2.0 (draft2)

AD02 Herschel/Planck Operations Interface Requirements Document
(SPIRE-ESA-DOC-000188), Issue 2.0 (draft3)

AD03 Herschel Science Ground Segment to Instruments Interface Control Document
(FIRST-FSC-DOC-0200), Issue 1.0

AD04 Packet Router ICD
(SRON-G/HIFI/ICD/2001-001), Issue 1.1

AD05 FIRST/Planck CDMS Simulator Requirements
(SRON-U/HIFI/SP/2000-004), Issue 1.1

1.3.2 Reference Documents

RD01 Packet Telemetry Standard
(ESA PSS-04-106), Issue 1, 1998

RD02 Packet Telecommand Standard
(ESA PSS-04-107), Issue 2, 1992

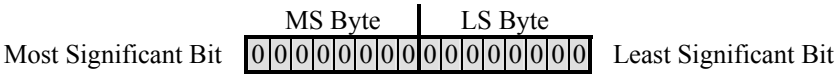
RD03 Telemetry and Telecommand Packet Utilisation Standard
(ECSS-E-70/41), Draft 04, April 1999

RD04 Test Facility FTS User's Manual
TBW

2 THE PACKET INTERFACE

2.1 Packet Structures

The following packet structures are shown as a set of 16 bit words, contained in two consecutive bytes in the packet structure (all packets are composed of an even number of bytes). The most significant byte of each word comes before the least significant in the packet. The least significant bit of each word is on right of each field:



2.1.1 Fields

Within a field (of any length) the most significant bit is designated bit (0); the least significant bit is bit (length-1).

2.1.2 Telecommand Packets

The following figure gives the general structure of a TC Packet (after AD01)

Packet Header	Packet ID	0 0 0 1 1 APID
	Sequence Control	1 1 Src Count
	Length	Length
Data Field	Data Field Header	0 0 0 0 Ack Type
		Sub-Type 0 0 0 0 0 0 0 0
	Source Data	D A T A
	Error Control	Checksum

- Src, Count, Length, and Checksum are defined in AD01
- Ack is defined in AD01. Only bit 3 of the Ack field (TC Acceptance Verification) is used, other bits are assumed to be zero
- Type and Sub-Type define the packet type and are also defined in AD01

2.1.3 Telemetry Packets

The following figure gives the general structure of a TM Packet (after AD01)

Packet Header	Packet ID	0 0 0 0 1 APID
	Sequence Control	1 1 Count
	Length	Length
Data Field	Data Field Header	0 0 0 0 0 0 0 0 Type
		Sub-Type 0 0 0 0 0 0 0 0
		TIME
	Source Data	D A T A
	Error Control	Checksum

- Count, Length, TIME and Checksum are defined in AD01
- Type and Sub-Type define the packet type and are also defined in AD01

2.1.4 Telecommands and Telemetry Responses

Below is the mapping between telecommands and telemetry packets. FID=FUNCTIONID, AID=ACTIONID.

Telecommand	Service	FID	AID	Telemetry	Service	FID	AID
Reset TFTS	(8, 4)	0xF1	0x01				
Home TFTS	(8, 4)	0xF1	0x02				
Reset Limit	(8, 4)	0xF1	0x04				
Move Table	(8, 4)	0xF2	0x01				
Read U500 Parameter	(8, 4)	0xF4	0x01	U500 Parameter Report	(8, 4)	N/A	N/A
Write U500 Parameter	(8, 4)	0xF4	0x02				
Read U500 Status	(8, 4)	0xF4	0x04	Diagnostic Science Report	(8, 4)	N/A	N/A
Perform Scan	(8, 4)	0xF8	0x01	Nominal Science Report	(8, 4)	N/A	N/A
Run U500 Program	(8,4)	0xF8	0x02				
Abort Scan	(8, 4)	0xF8	0x04				
Truncate Scan	(8, 4)	0xF8	0x08				
Get TFTS Time	(8, 4)	0xF4	0x08	TFTS Time Report	(8, 4)	N/A	N/A
Perform Connect Test	(17, 1)	N/A	N/A	Link Connection Report	(17, 1)	N/A	N/A
	Every Telecommand is acknowledged with either of these two telecommands.			TC Accept. Rept: success	(1, 1)		
				TC Accept. Rept: failure	(1, 2)		
Housekeeping Report	(8, 4)	These telecommands sent only during scans.		*NOTE: Telecommands that have no corresponding telemetry packet invoke actions, as carried out by the TFTS.*			
Exception Report	(5, 2)						

Table 1: Telecommands and Their Respective Telemetry Responses

2.2 APIDs

The Application ID is used to identify the source or destination of a telemetry packet. SPIRE has been allocated APIDs for different types of packets (see AD1) as well as for EGSE equipment. The APID to be used by the TFTS is given in the following table:

ID	Telemetry types	APID (hex)
APID	Telecommands, Telecommand Verification and Events	7F5

Table 2: Table of APIDs

2.3 Packet Transfer Protocol

The packets are transferred between the TFTS and the EGSE following the Packet Router ICD (AD04).

3 TELECOMMAND PACKETS

This section defines all the telecommand packets accepted by the TFTS Simulator.

3.1 Telecommand Packet Types

The Packet Structure ICD (AD1) defines many types of service that can be provided by an Application. The following table shows the telecommand packet types that will be accepted by the TFTS.

Description	Service Type	Service Sub-Type	Comments
Telecommand Verification Service	1		N/A
Device Command Distribution	2		Not Used
Housekeeping and Diagnostic Data Reporting	3		Not Used
Event Reporting	5		N/A
Memory Management	6		Not Used
Function Management			
Start Function	8	1	Not Used
Stop Function	8	2	Not Used
Perform Activity of Function	8	4	
Report Function Status	8	5	Not Used
Time Management	9		Not Used
On-Board Scheduling	11		Not Used
On-Board Monitoring	12		Not Used
Packet Transmission Control	14		Not Used
On-Board Storage and Retrieval	15		Not Used
On-Board Traffic Management	16		Not Used
Test Service			
Perform Connection Test	17	1	
On-Board Control procedures	18		Not Used
Action/Event Service	19		Not Used
Information Distribution Service	20		Not Used
Science Data	21		N/A
Context Saving Service	22		Not Used

Table 3: Telecommand Packet Types

3.2 Telecommand Packet Definition

3.2.1 Telecommand Verification Service

Not Applicable

3.2.2 Device Command Distribution

Not Used.

3.2.3 Housekeeping and Diagnostic Data Reporting

Not Used.

3.2.4 TBD

Not Available.

3.2.5 Event Reporting

Not Applicable.

3.2.6 Memory Management

Not Used.

3.2.7 TBD

Not Available.

3.2.8 Function Management

3.2.8.1 Start Function (Service 8,1)

Not Used.

3.2.8.2 Stop Function (Service 8,2)

Not Used.

3.2.8.3 (Service 8,3)

Not Available.

3.2.8.4 Perform an Activity of a Function (Service 8,4)

All command packets of this type and subtype may give rise to the following Errors:

Error	TM Service	Error Code	Description
Illegal_Activity_ID	(1,2)	0x0802	Activity_ID not known

3.2.8.4.1 Function: Reset TFTS

This command resets the U500 motion control card.

0	0	0	1	1	APID											
1	1	Src			Count											
Length = 7																
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
FUNCTIONID								ACTIVITYID								
CRC																

Parameter	Value and Comments
FUNCTIONID	0xF1
ACTIVITYID	0x01

3.2.8.4.2 Function: Home TFTS Stage

This command instructs the TFTS to send the stage on a "homing cycle" (where the stage finds the centre calibration marker), then moves the stage to the starting position.

0	0	0	1	1	APID											
1	1	Src			Count											
Length = 7																
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
FUNCTIONID								ACTIVITYID								
CRC																

Parameters	Value and Comments
FUNCTIONID	0xF1
ACTIVITYID	0x02

3.2.8.4.3 Function: Reset Table After Limit Fault

If stage has moved beyond the acceptable CW and CCW limits of the table (which is triggered by optical switches in the table), the U500 signals this error and halts the table, disallowing any further motion commands until the stage is moved back into the safe region of the table (between the optical limit switches). This command calls the U500 command to move the stage into the safe region, reset the U500 card, and perform a homing cycle, which moves the stage back into starting position.

0	0	0	1	1	APID											
1	1	0	0	0	Count											
Length = 7																
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
FUNCTIONID								ACTIVITYID								
CRC																

Parameter	Value and Comments
FUNCTIONID	0xF1
ACTIVITYID	0x04

3.2.8.4.4 Function: Move Table

Move the Aerotech stage a defined distance, direction, velocity and acceleration.

0	0	0	1	1	APID										
1	1	0	0	0	Count										
Length = 21															
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
FUNCTIONID								ACTIVITYID							
DISTANCE															
DIRECTION															
VELOCITY															
ACCELERATION															
CRC															

Parameter	Value and Comments
FUNCTIONID	0xF2
ACTIVITYID	0x01
DISTANCE	Distance Table Travels (uu) (ULONG)
DIRECTION	Move stage in the direction towards TOP or BOTTOM (USHORT) TOP: 0x0000 BOTTOM: 0x0001
VELOCITY	Velocity of Table (uu s^{-1}) (ULONG)
ACCELERATION	Acceleration of Table (uu s^{-2}) (ULONG)

3.2.8.4.5 Function: Read Unidex 500 Parameter

Return the value of a specified Unidex 500 parameter. The response to this telecommand is the Unidex 500 Parameter Report, described in section 4.2.8.2.

0	0	0	1	1	APID										
1	1	0	0	0	Count										
Length = 11															
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
FUNCTIONID								ACTIVITYID							
PARAM_NUM															
INDEX															
CRC															

Parameter	Value and Comments
FUNCTIONID	0xF4
ACTIVITYID	0x01
PARAM_NUM	Parameter number (USHORT)
INDEX	Parameter index (USHORT)

3.2.8.4.6 Function: Write Parameter to Unidex 500

Write a value to a specified Undex 500 Parameter. Consult the Unidex 500 manual to specify the correct datatype of the parameter.

0	0	0	1	1	APID										
1	1	0	0	0	Count										
Length = 59															
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
FUNCTIONID								ACTIVITYID							
PARAM_NUM															
DATATYPE															
VALUE															
CRC															

Parameter	Value and Comments
FUNCTIONID	0xF4
ACTIVITYID	0x02
PARAM_NUM	Parameter number (USHORT)
DATATYPE	Datatype of value to write to U500 (USHORT) 0x0001 Char string 0x0002 32 bit integer 0x0004 Floating point
VALUE	Value to populate U500 parameter CHAR[48] (null terminated string)

3.2.8.4.7 Function: Read TFTS Status

Returns values from Unidex 500, time counter, network communication stats, scan details, etc. which describes status of the entire TFTS system. The response to this telecommand is the Diagnostic Science Report, as found in section 4.2.21.2.

0	0	0	1	1	APID										
1	1	0	0	0	Count										
Length = 7															
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
FUNCTIONID								ACTIVITYID							
CRC															

Parameter	Value and Comments
FUNCTIONID	0xF4
ACTIVITYID	0x04

3.2.8.4.8 Function: Acquire Single-Sided Interferogram "Scan"

The response to this telecommand (besides the associated Telecommand Verification Service telemetry) is the Nominal Science Report, as found in section 4.2.21.1.

0 0 0 1 1	APID
1 1 0 0 0	Count
Length = 27	
0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0	
0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0	
FUNCTIONID	ACTIVITYID
DISTANCE	
ITERATIONS	
SAMPLING_INTERVAL	
VELOCITY	
ACCELERATION	
CRC	

Parameter	Value and Comments
FUNCTIONID	0xF8
ACTIVITYID	0x01
DISTANCE	Distance stage to travel (uu)
ITERATIONS	Number of single-sided interferograms to acquire in a scan sequence (ULONG)
SAMPLING INTERVAL	Interval (in uu) in which to perform a data sample (position, time) (ULONG)
VELOCITY	Stage velocity (uu s^{-1}) (ULONG)
ACCELERATION	Stage acceleration (uu s^{-2}) (ULONG)

3.2.8.4.9 Function: Run Unidex 500 Script

Load and execute a specified .prg script under the Unidex 500's interpreter.

0 0 0 1 1	APID
1 1 0 0 0	Count
Length = 9	
0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0	
0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0	
FUNCTIONID	ACTIVITYID
SCRIPT_ID	
CRC	

Parameter	Value and Comments
FUNCTIONID	0xF8
ACTIVITYID	0x02
SCRIPT_ID	Script ID codes TBD (USHORT)

3.2.8.4.10 Function: Abort Scan

Halt the Aerotech stage and close any open data files.

0 0 0 1 1	APID
1 1 0 0 0	Count
Length = 7	
0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0	
0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0	
FUNCTIONID	ACTIVITYID
CRC	

Parameter	Value and Comments
FUNCTIONID	0xF8
ACTIVITYID	0x04

3.2.8.4.11 Function: Truncate Scan

While performing a batch of multiple scans, do not perform any further scans after the currently running one. In other words, truncate the current multiple-scan session.

0	0	0	1	1	APID											
1	1	0	0	0	Count											
Length = 7																
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
FUNCTIONID								ACTIVITYID								
CRC																

Parameter	Value and Comments
FUNCTIONID	0xF8
ACTIVITYID	0x08

3.2.8.4.12 Get TFTS Time

Return the Test FTS's system time and DPS counter time. The telemetry packet TFTS Time Report, as described in section 4.2.8.2, is the response.

0	0	0	1	1	APID1											
1	1	0	0	0	Count											
Length = 7																
0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
FUNCTIONID								ACTIVITYID								
CRC																

Parameter	Value and Comments
FUNCTIONID	0xF4
ACTIVITYID	0x08

3.2.9 Time Management

3.2.10 TBD

Not Available.

3.2.11 On-Board Scheduling

Not Used.

3.2.12 On-Board Monitoring

Not Used.

3.2.13 TBD

Not Available.

3.2.14 Packet Transmission Control

Not Used.

3.2.15 On-Board Storage and Retrieval

Not Used.

3.2.16 On-Board Traffic Management

Not Used

3.2.17 Test Service

3.2.17.1 Perform Connection Test (Service 17,1)

This telecommand requests the TFTS to echo back the Link Connection Report packet (section 4.2.17.1). This test is used to determine if the EGSE network connection is up.

0	0	0	1	1	APID											
1	1	0	0	0	Count											
Length = 5																
0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
CRC																

3.2.18 On-Board Control Procedures

Not Used.

3.2.19 Action/Event Service

Not Used.

3.2.20 Information Distribution Service

Not Used.

3.2.21 Science Data

Not Applicable.

3.2.22 Context Saving Service

Not Used.

4 TELEMETRY PACKETS

This section defines all the TM packets that will be produced by the TFTS.

4.1 Telemetry Packet Types

The Packet Structure ICD (AD1) defines many types of service that can be provided by an Application. The following table shows the telemetry packet types that will be produced by the TFTS.

Description	Service Type	Service Sub-Type	Comments
Telecommand Verification Service			
Telecommand Acceptance Report - Success	1	1	
Telecommand Acceptance Report - Failure	1	2	
Telecommand Execution Report - Started	1	3	
Telecommand Execution Report - Progress	1	5	Not Used
Telecommand Execution Report - Completed	1	7	
Telecommand Execution Report - Failure	1	8	Not Used
Telecommand Contents Report	1	9	Not Used
Device Command Distribution	2		N/A
Housekeeping and Diagnostic Data Reporting			
HK Parameter Report Definitions Report	3	10	Not Used
Diagnostic Parameter Definitions Report	3	12	Not Used
Housekeeping Parameter Report	3	25	
Diagnostic Parameter Report	3	26	Not Used
Event Reporting			
Event Report	5	1	TBD
Exception Report	5	2	
Error/Alarm Report	5	4	Not Used
Memory Management	6		Not Used
Function Management	8	4	
Time Management			
Central Time Reference	9	8	Not Used
Time Verification Report	9	9	Not Used
On-Board Scheduling	11		Not Used
On-Board Monitoring	12		Not Used
Packet Transmission Control	14		Not Used
On-Board Storage and Retrieval	15		Not Used
Test Service			
Link Connection Report	17	2	Not Used
On-Board Control procedures	18		Not Used
Action/Event Service	19		Not Used
Information Distribution Service	20		Not Used
Science Data			
Nominal Science Data Report	21	1	
Science Type B Data Report	21	2	Not Used
Diagnostic Science Data Report	21	3	
Auxiliary Science Data Report	21	4	Not Used
Context Saving Service	22		Not Used

Table 4: Telemetry Packet Types

4.2 Telemetry Packet Definitions

4.2.1 TC Verification Service

4.2.1.1 Telecommand Acceptance Report - Success (1,1)

Upon receipt of a telecommand, the TFTS will send to the EGSE (the TC sender) a "Telecommand Acceptance Report – Success" packet if there are no errors detected. The errors are listed in the packet control error table shown in section 4.2.1.2.1 below.

0	0	0	0	1	APID											
1	1	Count														
Length = 15																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
TIME																
TC_Packet_ID																
TC_Packet_Sequence_Control																
CRC																

4.2.1.2 Telecommand Acceptance Report - Failure (1,2)

If errors are detected in the telecommand (sent by the EGSE to the TFTS), the TFTS will respond with a (1,2) Telecommand Acceptance report. Two additional data fields, the Failure Code and Parameter fields, describe the type of error experienced. The structure of this packet depends on the type of error found in the telecommand.

4.2.1.2.1 Packet Control Errors

0	0	0	0	1	APID											
1	1	Count														
Length = 19																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
TIME																
TC_Packet_ID																
TC_Packet_Sequence_Control																
Failure Code																
Parameter																
CRC																

Error	***Failure Code***	***Parameter***
Illegal APID	0	TC_Packet_APID
Incomplete Packet or invalid Length	1	TC_Packet_Length
Incorrect Checksum	2	TC_Packet_Checksum
Illegal Packet Type	3	TC_Packet_Type
Illegal Packet Sub-Type	4	TC_Packet_Sub-Type

Note: The parameter is placed in the least significant bits of the16 bit 'parameter' field and the most significant bits are padded with zeros

Packet Content Error

0	0	0	0	1	APID											
1	1	Count														
Length = 57																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1		0	0	0	0	0	0	0	0
TIME																
TC_Packet_ID																
TC_Packet_Sequence_Control																
Failure Code																
Parameters																
CRC																

Error	*Failure Code*	*Parameters*
Illegal or inconsistent Application Data	5	See Note
Other TBD errors	16-255	See Note
Illegal_Function_ID	0x0801	See Note
Illegal_Activity_ID	0x0802	See Note

Note: The parameters for each error are TBD, but as a suggestion this field should contain the first 20 words (40 bytes) from the 'source data' field of the received telecommand packet, unless this field is less than 20 words (40 bytes) in length, in which case all words from the 'source data' field will be included.

4.2.1.3 Telecommand Acceptance Report – Function Started (1, 3)

This telemetry packet is sent to alert the EGSE that the TFTS function (such as a multiple scan job) has started.

0	0	0	0	1	APID											
1	1	Count														
Length = 15																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
TIME																
TC_Packet_ID																
TC_Packet_Sequence_Control																
CRC																

4.2.1.4 Telecommand Acceptance Report – Function Completed (1,7)

This telemetry packet is sent to alert the EGSE that the TFTS function (such as a multiple scan job) has completed.

0	0	0	0	1	APID											
1	1	Count														
Length = 15																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
TIME																
TC_Packet_ID																
TC_Packet_Sequence_Control																
CRC																

4.2.2 Device Command Distribution

Not Applicable.

4.2.3 Housekeeping and Diagnostic Data Reporting

4.2.3.1 Housekeeping Parameter Report (Service 3,25)

The general packet structure is shown below. The Structure ID identifies the housekeeping packet type.

0	0	0	0	1	APID											
1	1	Count														
Length = 29																
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	
TIME																
SID																
Parameters																
CRC																

SID (Structure ID)	Packet type	Default Frequency (msec)
0x0301	Nominal Housekeeping Report	1000

Parameter	Value and Comments
NUM_TC	Number of telecommands received by TFTS (ULONG)
NUM_TM	Number of telemetry packets sent by TFTS (ULONG)
DIRECTION	Stage movement direction (USHORT) TOP 0x0000 BOTTOM 0x0001
TASK_STATUS	TFTS software state (USHORT) IDLE 0x0000 SCANNING 0x0001
U500_STATUS	U500 status word (ULONG)

4.2.3.2 Nominal Housekeeping Report (SID=0x0301)

The following table lists the fields to be found in this report

Location (msb)		Length (bits)	Datatype	Parameter Name
byte	bit			
		32	ULONG	NUM_TC
		32	ULONG	NUM_TM
		16	USHORT	DIRECTION
		16	USHORT	TASK_STATUS
		32	ULONG	U500_STATUS

Table 5: Nominal Housekeeping Report Fields

4.2.4 TBD

Not Available.

4.2.5 Event Reporting

4.2.5.1 Event Report (5,1)

Not Used.

4.2.5.2 Exception Report (5,2)

4.2.5.2.1 Limit Error

This packet is generated in the event of a limit error. This occurs when the stage goes beyond the CW or CCW optical limits of the table. Bits set in the parameter fields indicate the type of error that occurred.

0	0	0	0	1	APID											
1	1	Count														
Length=25																
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
TIME																
EVENTID = 0x0001																
NUM_TC																
NUM_TM																
U500_STATUS																
CRC																

Parameter	Comment
EVENTID	Type of event (USHORT)
NUM_TC	Number of telecommands received (ULONG)
NUM_TM	Number of telemetry packets sent (ULONG)
U500_STATUS	U500 Status (ULONG)

4.2.5.2.2 DPU Counter Error

This packet is generated in the event of the TFTS control software receiving an error from the DPU counter hardware (some card plugged into the PC's PCI bus).

0	0	0	0	1	APID											
1	1	Count														
Length = 25																
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
TIME																
EVENTID = 0x0002																
NUM_TC																
NUM_TM																
U500_STATUS																
CRC																

Parameter	Comment
EVENTID	Type of event (USHORT)
NUM_TC	Number of telecommands received (ULONG)
NUM_TM	Number of telemetry packets sent (ULONG)
U500_STATUS	U500 Status (ULONG)

4.2.5.2.3 Unidex 500 Error

This packet is generated in the event of the TFTS control software receiving an error from the Unidex 500 motion control card.

0	0	0	0	1	APID											
1	1	Count														
Length = 25																
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
TIME																
EVENTID = 0x0003																
NUM_TC																
NUM_TM																
U500_STATUS																
CRC																

Parameter	Comment
EVENTID	Type of event (USHORT)
NUM_TC	Number of telecommands received (ULONG)
NUM_TM	Number of Telemetry packets sent (ULONG)
U500_STATUS	U500 Status (ULONG)

4.2.6 Memory Management

Not Used.

4.2.7 TBD

Not Available.

4.2.8 Function Management

4.2.8.1 TFTS Time Report (service 8, 4)

This packet contains the TFTS PC's system time and the count on the DPU counter, and is the response to the Get TFTS Time telecommand, as found in section 3.2.8.4.11.

0	0	0	0	1	APID										
1	1	Count													
Length = 21															
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
TIME															
FUNCTIONID								ACTIVITYID							
PC_SYSTEM_TIME															
DPU_COUNTER_TIME															
CRC															

Parameter	Comment
FUNCTIONID	0xF4
ACTIVITYID	0x08
PC_SYSTEM_TIME	PC System time on TFTS (ULONG)
DPU_COUNTER_TIME	Count on DPU counter (ULONG)

4.2.8.2 Unidex 500 Parameter Report (service 8,4)

This packet contains the value of the requested Unidex 500 parameter. It is the response to the Read Unidex 500 Parameter telecommand, described in section 3.2.8.4.5.

0	0	0	0	1	APID										
1	1	Count													
Length = 21															
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
TIME															
FUNCTIONID								ACTIVITYID							
U500_PARAMETER															
DATATYPE															
CRC															

Parameter	Comment
FUNCTIONID	0xF4
ACTIVITYID	0x01
U500_PARAMETER	The returned parameter (48 byte character array)
DATATYPE	The datatype of the returned Unidex 500 parameter (UINT). 0x0001 Char String 0x0002 32-bit Integer 0x0004 Double Float

4.2.9 Time Management

4.2.9.1 Central Time Reference (Service 9,8)

Not used.

4.2.10 TBD

Not Available.

4.2.11 On-Board Scheduling

Not Used.

4.2.12 On-Board Monitoring

Not Used.

4.2.13 TBD

Not Available.

4.2.14 Packet Transmission Control

Not Used.

4.2.15 On-Board Storage and Retrieval

Not Used.

4.2.16 TBD

Not Available.

4.2.17 Test Service

4.2.17.1 Link Connection Report (Service 17,2)

0	0	0	0	1	APID											
1	1	Count														
Length = 11																
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
TIME																
CRC																

This function is analogous to a “ping” command used to test TCP/IP connections. When the TFTS receives a “Perform Connection Test” telecommand, it responds by sending this telemetry packet.

4.2.18 On-Board Control Procedures

Not Used.

4.2.19 Action/Event Service

Not Used.

4.2.20 Information Distribution Service

Not Used.

4.2.21 Science Data

4.2.21.1 Nominal Science Report (Service 21, 1)

0	0	0	0	1	APID											
x	x	Count														
Length = variable																
0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
TIME																
OBSERV_ID																
TOT_PACKETS																
CURR_PACKET																
NUM_DATAPTS																
SAMPLE_TIME																
SAMPLE_POS																
CRC																

The data fields SAMPLE_TIME and SAMPLE_POS (in grey) represent a single sample tuple. It repeats the number of times defined in NUM_DATAPTS

Parameter	Comment
OBSERV_ID	ID number of observation (USHORT)
TOT_PACKETS	Number of packets in scan (USHORT)
CURR_PACKET	Current packet number (of total n pkts) (USHORT)
NUM_DATAPTS	Number of data points in this packet (USHORT)
SAMPLE_TIME	Time of Sample (taken from DPU Counter in 3.17 μs increments) (ULONG)
SAMPLE_POS	Table Position (in uu) (ULONG)

NOTE: This report returns segmented data packets (due to size of data set being returned) to the EGSE, and is the response to the Acquire Single-Sided Interferogram Scan function as found in section 3.2.8.4.8. Therefore, the segmentation flag (beside the count field) will reflect the process of sending back a segmented data packet. For the first packet in the data set, the segmentation flag = 01. Intermediate packets in the set will have the flag = 00. The last packet in the data set = 10. NUM_DATAPTS defines the number of times SAMPLE_TIME and SAMPLE_POS are repeated. This telemetry packet cannot be larger than 1024 bytes.

4.2.21.2 Diagnostic Science Report (Service 21, 3)

This type of telemetry packet returns the current status of the TFTS system and Unidex 500 motion control card. It is the response to the Read TFTS Status telecommand in section 3.2.8.4.7

0	0	0	0	1	APID											
1	1	Count														
Length=23																
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
TIME																
NUM_TC																
NUM_TM																
U500_STATUS																
CRC																

Parameter	Comment
NUM_TC	Number of telecommands received (ULONG)
NUM_TM	Number of Telemetry packets sent (ULONG)
U500_STATUS	Status of U500 card (ULONG)

4.2.22 Context Saving Service

Not Used.

5 PARAMETERS

5.1 TC Parameters

5.1.1 Parameter Definition

Parameter Name	Service Reference	Type	Size (bits)	Conversion Curve	Constraint Table	Comments
ACTIVITYID	(8,4)	UINT	8	None	None	Defines activity to perform.
APID	(20,1) (20,2)	UINT	11	None	None	Application ID.
CRC	ALL	UINT	16	None	None	Cyclic Redundancy Check.
FUNCTIONID	(8,1) (8,2) (8,4) (8,5)	UINT	8	None	None	Defines activity to perform.
Length	ALL	UINT	16	None	None	Number of bytes contained in packet data field. See section 2.1.2
DISTANCE	(8,4)	UINT	32	None	None	Distance the Aerotech stage travels.
DIRECTION	(8,4)	UINT	16	None	None	Direction that Aerotech stage travels.
VELOCITY	(8,4)	UINT	32	None	None	Velocity at which Aerotech stage travels.
ACCELERATION	(8,4)	UINT	32	None	None	Acceleration at which Aerotech stage performs movement.
ITERATIONS	(8,4)	UINT	16	None	None	Number of scans to perform in a scan sequence.
SAMPLING_INTERVAL	(8,4)	UINT	32	None	None	Distance interval in which to repeatedly take time/position samples.
PARAM_NUM	(8,4)	UINT	16	None	None	First argument used to select which Unidex 500 parameter to read/modify
INDEX	(8,4)	UINT	16	None	None	Second argument used to select which Unidex 500 parameter to read/modify
DATATYPE	(8,4)	UINT	16	None	None	The datatype that the Unidex 500 expects the parameter (to be written) to be. See Unidex 500 manual for details.
SCRIPT_ID	(8,4)	UINT	16	None	None	ID number of script to be executed under U500 interpreter.
Count	ALL	UINT	11	None	None	Telecommand packet sequence number.

Conversion Curves

Name	Type	Raw Value	Converted Value	Comments
TBD				

5.1.2 Constraints

TBD

5.2 TM Parameters

5.2.1 Parameter Definition

Name	Length (bits)	Conversion	Limits	Description
NUM_TC	32	TBD	TBD	Number of Telecommand packets received by the TFTS.
NUM_TM	32	TBD	TBD	Number of Telemetry packets sent by the TFTS.
DIRECTION	16	TBD	TBD	Direction of travel of the Aerotech table.
TASK_STATUS	16	TBD	TBD	State of TFTS software – running a scan / initialisation, or waiting for commands.
U500_STATUS	32	TBD	TBD	Status word of Unidex 500.
EVENTID	16	TBD	TBD	Type of exception raised by TFTS.
PC_SYSTEM_TIME	32	TBD	TBD	TFTS's PC clock time (time in 1980 epoch time)
DPU_COUNTER_TIME	32	TBD	TBD	DPU counter value – driven by 315 kHz DPU clock signal
U500_PARAMETER	384	TBD	TBD	Value of requested Unidex 500 parameter – returned as a NULL terminated ASCII string.
DATATYPE	16	TBD	TBD	Datatype of requested Unidex parameter – defines how the parameter should be interpreted.
APID	11	TBD	TBD	Application ID.
CRC	16	TBD	TBD	Cyclic Redundancy Check.
Length	16	TBD	TBD	Number of bytes in telemetry packet's data field.
Count	11	TBD	TBD	Telemetry packet sequence number.
TIME	48	TBD	TBD	Time TC was transmitted.
Failure Code	16	TBD	TBD	Reasons for failure of acceptance of a telecommand.

TC_PACKET_APID	16	TBD	TBD	A failure code: APID of TM's corresponding TC.
TC_PACKET_LENGTH	16	TBD	TBD	A failure code: Length data field of TM's corresponding TC.
TC_PACKET_CRC	16	TBD	TBD	A failure code: CRC value of TM's corresponding TC.
TC_PACKET_TYPE	16	TBD	TBD	A failure code: TC packet type of TM's corresponding TC.
TC_PACKET_SUBTYPE	16	TBD	TBD	A failure code: TC packet sub-type of TM's corresponding TC.
Packet_Sequence_Control	16			A copy of the TC packet header sequence control bytes (17^{th} thru 32^{nd} bit) to which this TM replies to.
SID	16			Structure ID
TC_PACKET_ID				Telecommand Packet ID: copy of the corresponding field from the packet header of the TC to which this TM replies to.

5.2.2 Conversion Curve

Name	Type	Raw Value	Converted Value	Units	Comments
TBD					

5.2.3 Constraints

TBD