

SPIRE

SUBJECT: Test Facility Control System
TM Packet ICD

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Glossary

APID	Application ID
EGSE	Electronic Ground Support Equipment
SID	Structure ID
SPIRE	Spectral and Photometric Imaging REceiver
TFCS	Test Facility Control System

1. INTRODUCTION

The Test Facility Control System (TFCS) controls the equipment in the SPIRE Test Facility that is used to simulate the environment in which the instrument will operate and to stimulate the instrument. Although able to operate in a stand-alone manner during testing of the Test Facility itself, it is also used as part of the SPIRE EGSE during instrument-level tests, and in this role it has to conform to the data communication interfaces of the EGSE.

All telemetry data produced by the EGSE systems will follow the same standards as is used in the Herschel Spacecraft and Ground Segment systems (this allows easier transition from the testing to the operational environments). The data is generated in the form of TM Source Packets conforming to the ESA Packet Utilisation Standard (RD1), but the set of supported packet types within the Herschel project is restricted. This restricted set is defined in the Herschel Packet Structure ICD (AD1).

The TFCS utilises a reduced set of telemetry packet types and this document details the contents of each of these.

1.1 Scope

Telemetry packets are passed between the components of the EGSE by sending them as messages, through the Packet Router. The Packet Router ICD (AD2) defines the format of these messages, whereas this document defines the content of the data component of them.

2. DOCUMENTS

2.1 Applicable Documents

AD1	Herschel Packet Structure ICD
AD2	Herschel Packet Router ICD
AD3	SPIRE EGSE Configuration Plan

2.2 Reference Documents

RD1	ESA Packet Utilisation Standard
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3. PACKET STRUCTURES

3.1 Telecommand Packets

The following table gives the general structure of a TFCS TC Packet (after AD1)

Packet Header	Packet ID	00011	APID
	Sequence Control	11 Src	Count
	Length	Length	
Data Field	Data Field Header	0000 Ack	Type
		Sub-Type	00000000
	Source Data	DATA	
	Error Control	Checksum	

- Src, Count, Length and Checksum are defined in AD1
- Ack is defined in AD1. 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 AD1.

3.2 Telemetry Packets

The following table gives the general structure of a TFCS TM Packet (after AD1)

Packet Header	Packet ID	00001	APID
	Sequence Control	11	Count
	Length	Length	
Data Field	Data Field Header	00000000	Type
		Sub-Type	00000000
	Source Data	TIME	
	Error Control	Checksum	

Count, Length, TIME and Checksum are defined in AD1
 Type and Sub-Type define the packet type and are also defined in AD1

3.3 APIDs

The Application ID is used to identify the source or destination of a telemetry packet. Herschel uses different APIDs for different types of packet (see AD1). The TFCS will follow this convention. The APIDS to be used by the TFCS are defined in the EGSE Configuration Plan (AD3) and are given in the following table:

Telemetry types	APID (hex)
Command Verification and Events	7F4

4. TELECOMMAND PACKETS

This section defines all the telecommand packets accepted by the TFCS.

It is the default that all telecommands received by the TFCS will be acknowledged with a TC Acceptance Report (Service1,1 or 1,2 depending on outcome).

There are currently no telecommands that generate command execution reports (Services 1,3; 1,5 or 1,7).

4.1 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 SPIRE TFCS

Description	Service Type	Service Sub-Type	Comments
Function Management Perform Activity of Function	8	4	
Time Management Enable Time Verification	9	7	
Test Service Perform Connection Test	17	1	

Table 4-1 Telecommand Packet Types

4.2 Telecommand Packet Definition

4.2.1.1 Perform Activity of Function (Service 8,4)

All commands 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

4.2.1.1.1 Function 0xC1 Observations, Activity 0x01: Set Observation ID

This command sets the value for the Observation ID, which is included in all telemetry packets to allow them to be ingested into the HCSS database. The current BBID value is unaffected.

APID1										
Count										
Length = 11										
0	0	0	0	0	1	0	0	0	0	0
FUNCTIONID					ACTIVITYID					
OBSID										
Checksum										

Parameter	Value	Description
FUNCTIONID	0xC1	
ACTIVITYID	0x01	Set Observation ID (32bits)
OBSID		Observation ID

4.2.1.1.2 Function 0xC1 Observations, Activity 0x02: Set Building Block ID

This command sets the value for the Building Block ID which is included in all telemetry packets to allow them to be ingested into the HCSS database

APID1										
Count										
Length = 11										
0	0	0	0	0	1	0	0	0	0	0
FUNCTIONID					ACTIVITYID					
BBID										
Checksum										

Parameter	Value	Description
FUNCTIONID	0xC1	
ACTIVITYID	0x02	Set BBID (32bits)
BBID		Building Block ID (32bits)

4.2.1.1.3 Function 0xCC TFCS, Various Activities.

These commands control the activation and deactivation of the logging subsystems of the Temperature, Cryogen Level, and Pressure monitoring systems.

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

Parameter	Value	Description
FUNCTIONID	0xCC	
ACTIVITYID	0x01	Activate Temp. Logging
	0x02	Deactivate Temp. Logging
	0x03	Activate Cryogen Logging
	0x04	Deactivate Cryogen Logging
	0x05	Activate Pressure Logging
	0x06	Deactivate Pressure Logging

4.2.1.1.4 Function 0xCC TFCS, Activity 0x07: Set Interface Temperature

This command sets the temperature of an interface.

						APID1						
						Count						
Length = 13												
0	0	0	0	0	1	0	0	0	0	0	0	0
FUNCTIONID						ACTIVITYID						
						INTERF						
TEMP												
Checksum												

Parameter	Value	Description
FUNCTIONID	0xCC	
ACTIVITYID	0x07	Set Interface Temperature.
INTERF		Interface Number.
TEMP		Target Temperature. (32 bits)

4.2.1.1.5 Function 0xCC TFCS, Various Activities.

These commands set various attributes of the Cold Black Body.

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

Parameter	Value	Description
FUNCTIONID	0xCC	
ACTIVITYID	0x08	Activate Logging
	0x09	Deactivate Logging
	0x0A	Open Flip Mirror
	0x0B	Close Flip Mirror
	0x0C	Open Heat Shunt
	0x0D	Close Heat Shunt

4.2.1.1.6 Function 0xCC TFCS, Activity 0x0E. Set Cold Black Body Power

This command sets the Cold Black Body to a specific power level.

						APID1						
						Count						
Length = 11												
0	0	0	0	0	1	0	0	0	0	0	0	0
FUNCTIONID						ACTIVITYID						
POWER												
Checksum												

Parameter	Value	Description
FUNCTIONID	0xCC	
ACTIVITYID	0x0E	Set CBB Power.
POWER		Power Setting. (32 bit)

4.2.1.1.10 Function 0xCC TFCS, Activity 0x14. Scan from Detector X1,Y1 to X2,Y2

This command scans the Telescope beam across the detector from position X1, Y1 to X2,Y2.

APID1															
Count															
Length = 31															
0 0 0 0 0 1 0 0 0															
FUNCTIONID								ACTIVITYID							
POSITIONX1															
POSITIONY1															
POSITIONZ1															
POSITIONX2															
POSITIONY2															
POSITIONZ2															
Checksum															

Parameter	Value	Description
FUNCTIONID	0xCC	
ACTIVITYID	0x14	Scan from X1,Y1 to X2,Y2.
POSITIONX1		Detector X1 Coordinate.
POSITIONY1		Detector Y1 Coordinate.
POSITIONZ1		Detector Z1 Coordinate.
POSITIONX2		Detector X2 Coordinate.
POSITIONY2		Detector Y2 Coordinate.
POSITIONZ2		Detector Z2 Coordinate.

4.2.2 Time Management

4.2.2.1 Enable Time Verification (Service 9,7)

On receipt of this TC, The TFCS responds with a Time Verification Report (Service 9,9)

APID1															
Count															
Length = 5															
0 0 0 0 1 1 1															
Checksum															

4.2.3 Test Service

4.2.3.1 Perform Connection Test (Service 17,1)

On successful receipt of this command the TFCS shall respond with a nominal Successful Command Acceptance Report (Service 1,1) followed by a Link Connection Report (Service 17,2).

APID1									
Count									
Length = 5									
0	0	0	0	0	1	0	0	0	1
0	0	0	0	0	0	1			
Checksum									

4.3 TFCS Telemetry Packets

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

4.3.1 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 TFCS:

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 - Failure	1	8	
Housekeeping and Diagnostic Data Reporting			
Housekeeping Parameter Report	3	25	
Event Reporting			
Event Report	5	1	
Error/Alarm Report	5	4	
Time Management			
Time Verification Report	9	9	
Science Data			
Nominal Science Data Report	21	1	

4.4 TC Verification Packets

4.4.1 Telecommand Acceptance Report - Success

0	0	0	0	1	1	1	1	1	1	1	0	1	0	0
1	1	Count												
0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
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
TIME														
0	0	0	0	1	1	1	1	1	1	1	1	1	0	0
1	1	TC Packet Count												
Checksum														

4.4.2 Telecommand Acceptance Report - Failure

The structure of this packet depends on the type of error found.

0	0	0	0	1	1	1	1	1	1	1	0	1	0	0
1	1	Count												
0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
TIME														
0	0	0	0	1	1	1	1	1	1	1	1	1	0	0
1	1	TC Packet Count												
Parameter							Code							
Checksum														

Error	Code	Parameter
Illegal Packet Type	3	Type
Illegal Packet Sub-Type	4	Sub-Type

0	0	0	0	1	1	1	1	1	1	1	0	1	0	0
1	1	Count												
0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
TIME														
0	0	0	0	1	1	1	1	1	1	1	1	1	0	0
1	1	TC Packet Count												
Code							Parameter							
Checksum														

Error	Code	Parameter
Illegal APID	0	APID
Incomplete Packet or invalid Length	1	Length
Incorrect Checksum	2	Checksum

00001111111110100
11 Count
Length
000000000000000001
000000010000000000
TIME
00001111111111000
11 TC Packet Count
00000000 Code
Parameters
Checksum

Error	Code	Parameters
Illegal or inconsistent Application Data	16	See Note
Illegal TFCS Subsystem	17	See Note
Other TBD TFCS errors	18-255	See Note

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

4.4.3 Telecommand Execution Report - Failure

The structure of this packet depends on the type of error found and are currently TBD, but the Telemetry packet will take the following form.

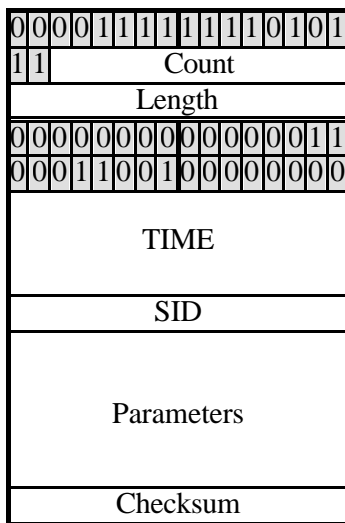
00001111111110100
11 Count
Length
000000000000000001
000000010000000000
TIME
00001111111111000
11 TC Packet Count
00000000 Code
Parameters
Checksum

4.5 Housekeeping Packets

4.5.1 Housekeeping Parameter Report

Each TFCS packet type is allocated a single Structure ID (SID) which is used to identify the source and contents of the housekeeping packet. The number of parameters, and hence the length of the packet depends on the SID.

4.5.1.1 TFCS Telemetry Packets

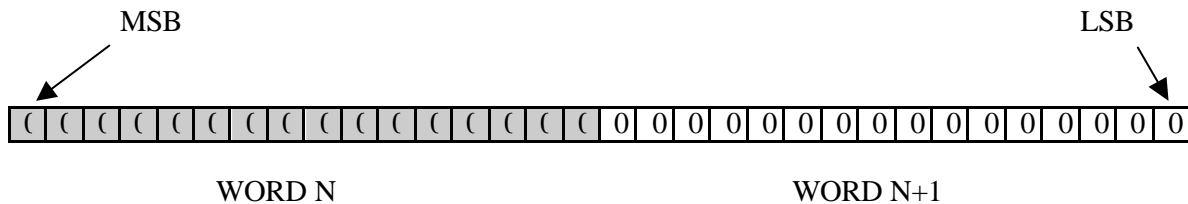


Subsystem	SID
TFCS	0x100
TFCS Long	0x101

The data field in the cryostat telemetry packet is broken down in the following way. Each parameter is converted from REAL format to a 32 bit binary (Packet Type Code 5, Packet Format Code 1) in accordance with AD1 Section A6.3.5.

The data field is a fixed length of 300 words. All parameters are always sent. If data is not available for a particular parameter, it will be set to FFFFFFFF to indicate invalid data.

The parameters are broken down into 2 consecutive 16 bit words:



Data field definition:

Location (Octet)	Parameter Description
0	SID

2	OBSID
6	BBID
10	Temperature Logging Enabled/Disabled
11	Pressure Logging Enabled/Disabled
12	Cryogen level logging Enabled/Disabled
14	Pirani Gauge Pressure
18	Full Range Gauge Pressure
22	N2 Level
26	He Level
30	77K Shield Endcap 1 Temperature
34	77K Shield Endcap 2 Temperature
38	77K Shield Filter Flange Temperature
42	10K Shield Inlet Pipe Temperature
46	10K Shield Outlet Pipe Temperature
50	10K Shield Endcap 1 Temperature
54	10K Shield Endcap 2 Temperature
58	10K Shield Cylinder End 1 Temperature
62	10K Shield Cylinder Centre Temperature
66	10K Shield Cylinder End 2 Temperature
70	10K Shield Filter Flange Temperature
74	Vacuum Vessel Standoff 1 Temperature
78	Vacuum Vessel Standoff 2 Temperature
82	Vacuum Vessel Standoff 3 Temperature
86	Vacuum Vessel Standoff 4 Temperature
90	HOB Sim Phot JFET Enclosure Temperature
94	HOB Sim Spec JFET Enclosure Temperature
98	HOB Sim FPU Foot 1 Interface Temperature
102	HOB Sim FPU Foot 2 Interface Temperature
106	HOB Sim FPU Foot 3 Interface Temperature
110	HOB Sim Harness Sink - RF Filters Temperature
114	HOB Sim Harness Sink - Phot JFET Temperature
120	HOB Sim Harness Sink - Spec JFET Temperature
122	4K Vessel Top Temperature
126	4K Vessel Bottom Temperature
130	4K FPU Level 1 Strap interface Temperature
134	1.7K Vessel - Bottom Temperature
138	1.7K FPU Box Strap interface Temperature
142	1.7K FPU Pump Strap interface Temperature
146	1.7K FPU Evap Strap interface Temperature
150	1.7K Vessel - Top Temperature
154	Level 0 Interface 1 Set Point Temperature
158	Level 0 Interface 1 Set Point Temperature
162	Level 0 Interface 1 Set Point Temperature
166	Level 1 Interface Set Point Temperature
170	10K Shield Set Point Temperature
174	HOB Simulator Heater Power
178	Level 0 Heater 1 Power
182	Level 0 Heater 2 Power
186	Level 0 Heater 3 Power
190	Level 1 Heater Power
194	10K Shield Heater Power

198	HOB Simulator Heater Power
202	Fold Mirror 2 Commanded Azimuth
206	Fold Mirror 2 Measured Azimuth
210	Fold Mirror 2 Commanded Elevation
214	Fold Mirror 2 Measured Elevation
218	Fold Mirror 3 Commanded Azimuth
222	Fold Mirror 3 Measured Azimuth
226	Fold Mirror 3 Commanded Elevation
230	Fold Mirror 3 Measured Elevation
234	Translation Stage Commanded Position
238	Translation Stage Measured Position
242	Flip Mirror Status
246	Heat Shunt Status
250	Cold Blackbody Temperature 1
254	Cold Blackbody Temperature 2
258	Cold Blackbody Temperature 3
262	Cold Blackbody Heater Power

4.5.2 Error/Alarm Report

Each subsystem within the TFCS is allocated a single Structure ID (SID) which is used to identify the source of the alarm. The number of parameters, and hence the length of the packet depends on the subsystem.

0000111111110100
11 Count
Length
0000000000000101
0000010000000000
TIME
SID
Parameters
Checksum

Subsystem	SID
TFCS	0
Telescope Simulator	1
FTS	2
Beam Monitor	3
FIR Laser	4
Cold BB	5
Cryostat	6

4.6 Time Management Packets

4.6.1 Time Verification Report

0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0
1	1	Count													
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	
0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
TIME															
Local Time															
Checksum															