SPIRE INSTRUMENT

DRCU / DPU

INTERFACE CONTROL DOCUMENT

SPIRE-SAP-PRJ-001364

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List of Acronyms

ADC	Analog to Digital Converter
AMUX	Analog Multiplexer
BSM	Beam Steering Mirror
DAC	Digital to Analog Converter
DCE	Detector Control Electronics
DCU	Detector Control Unit
DMUX	Digital Multiplexer
DPU	Data Processing Unit
DRCU	Detector Readout & Control Unit
FPU	Focal Plane Unit
FTS	Fourier Transform Spectrometer
JFET	Junction Field Effect Transistor
LIA	Lock-in amplifier
LPF	Low Pass Filter
MCE	Mechanisms Control Electronics
MCU	Mechanisms Control Unit
NA	Not Applicable
NC	Not connected
OEP	Optical Encoder Preamplifier
PDU	Power Distribution Unit
PSU	Power Supply Unit
S/S	Sub-System
S/W	Software
SCE	Sub-system Control Electronics
SCU	Sub-system Control Unit
SMEC	Spectrometer Mechanism Control
SMPS	Switching Mode Power Supply
SNR	Signal over Noise Ratio
TBC	To Be Confirmed
TBD	To Be Defined
TBW	To Be Written
WIH	Warm Interconnect Harnesses

Table of Contents

1. Introduction

1.1. Purpose

The purpose of this document is to provide a description of all the DRCU units' electrical interfaces to the DPU. Along with the "DRCU ICD" and the "MCU/DPU Command List ICD" this document shall allows a complete overview of the DRCU units in terms of interfaces.

1.2. Scope

The scope of this document includes all the DRCU units external interfaces low-level description including electrical and low level protocol and connector pin-out.

1.3. Reference Documents

RD1	Note IFSI : *DPU/DRCU Interfaces*	SP-RCI-18.5.00
RD2	Efficient Shift Registers, and Long Pseudo-Random Sequence Generators	XILINX XAPP 052
RD4	A Generic DPU Interface for SPIRE DRCU Subsystems	CEA internal note
RD5	DPU Interface Control Document	SPIRE-IFS-PRJ-00650 - Issue: 1.3 13/02/2003

1.4. Applicable Documents

AD1	Herschel/Planck IID part A	SCI-PT-IIDA-04624
AD2	MCU/DPU Command List ICD and User Manual	LAM/ELE/SPI/011011 issue 3.0

2. Electrical interfaces with the DPU

The DRCU has two kinds of interface with the DPU: one is devoted to low level command transmission (to the DRCU) for H/W configuration and housekeeping/status parameters reporting while the second is in turn devoted to data transfer from the DRCU to the DPU for further packing activities.
While the low-level command interface is slow (312 kps) bi-directional with word-based protocol the data transfer interface is fast (up to 2.5 Mbps) unidirectional with frame-based protocol.

2.1. Command interface

2.1.1. General Information

The command interface goal is manifold:

• Passing of commands from the DPU to the DRCU subsystems.
• Setting of DRCU Subsystems parameters.
• DRCU Subsystems synchronisation.

Physically it consists in 3 sets of bi-directional point-to-point links between the DPU and the DRCU (one link per DRCU subsystem except PSU: DCU MCU & SCU). The protocol is master-slave based, the DPU being the master.
It allows operating independently the 3 DRCU sub-units.

All commands being sent simultaneously to the 3 DRCU subsystems each subsystem recognising its own commands by means of a address inserted into the command word. In addition a broadcast address allows sending the same (broadcast) command simultaneously to the 3 DRCU sub-units.

The command format is fixed and consists in a 32-bit word with 3 fields:

• a DRCU sub-unit address field,
• a command identifier field,
• a parameter field.

DRCU subsystems, if addressed individually (with SYN0=0 see table 2.1-a) reply with a response word with the following format:

• a field for reporting interface error (in place of the sub-unit address),
• a field echoing the command identifier,
• a data field which contains, either the echo of the command parameter, or a data requested by the command (housekeeping parameter).

In the case of broadcast command, no acknowledgement is sent back by the DRCU subsystems. If the DPU requires acknowledgement it has to be carried out by sending successive acknowledgement request (specific command) to the DRCU sub-units.

2.1.2. Interface Overall Diagrams

The Command Interface diagram is given in figure 2.1-a.: main and redundant interfaces are shown.

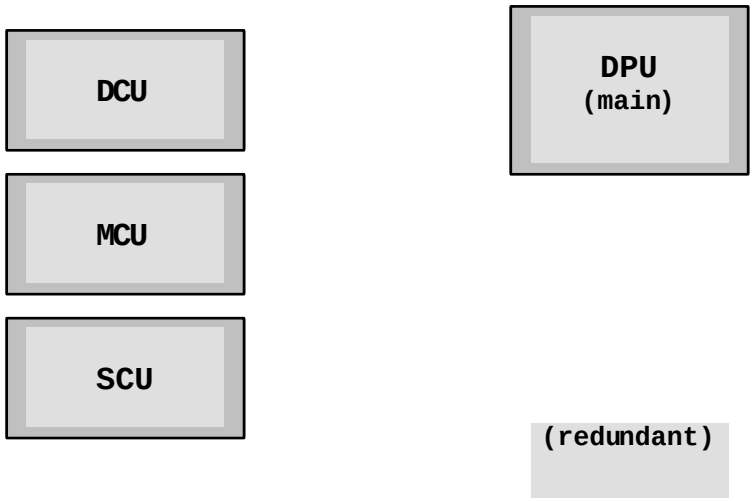


Figure 2.1-a

2.1.3. Interface Circuit

Each interface is defined by the following signals:

- a command (CMD) line - from DPU to DCU, MCU, SCU sub-units
- a response (RES) line - from each sub-unit to DPU
- a clock (CLK) line for bit synchronisation and S/S format time clock- from the DPU to DCU, MCU, SCU sub-units.

Each sub-unit implements a complete set of the above interface signals: that is the DPU implements 3 electrically independent “Command Interfaces” each having 2 transmitters + 1 receiver. However all those signals are interconnected type by type inside the DPU. In particularly the 3 RES signals are mixed according to the sub-unit address previously sent.

The interface uses the balanced lines RS422 electrical standard based on 26C31 and 26C32 transmitter and receiver types.

Complete interface functional and electrical diagrams are given figures 2.1-b and 2.1-c.

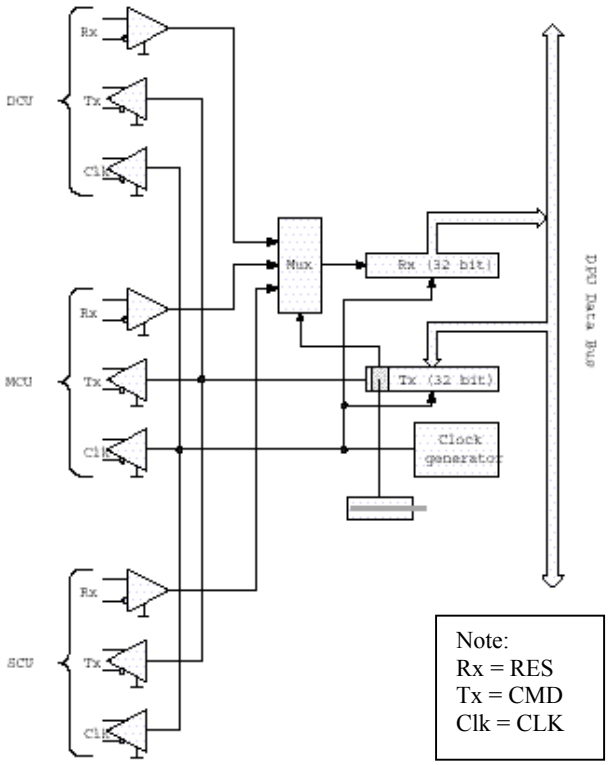


Figure 2.1-b - DPU Low Speed Interface Functional Diagram

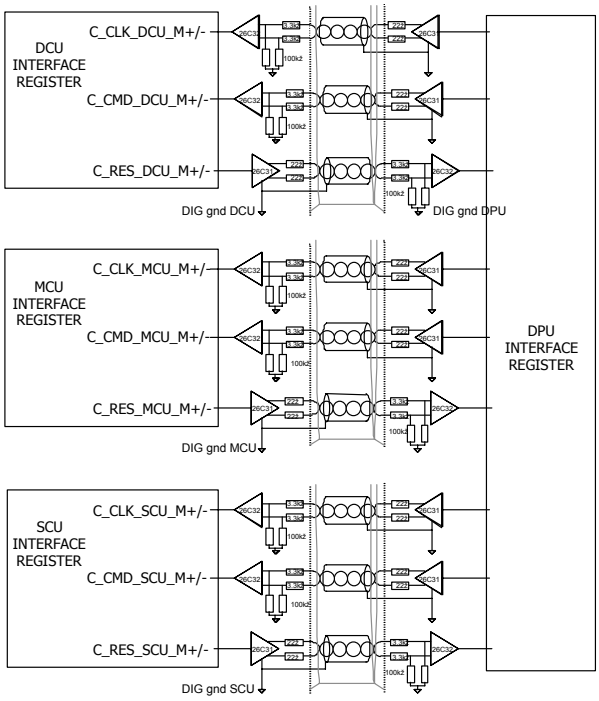


Figure 2.1-c - Electrical configuration

2.1.4. Protocol definition

2.1.4.1. Command Word

At any time after completion of a previous command/response exchange the DPU can send command words to the DRCU subsystems on the CMD line.
The 32-bit command word is divided into 5 fields as defined bellow:

- a 2-bit sync pattern: see table 2.1-a for details,
- a 2-bit sub-unit address: see table 2.1-b for details,
- a 12-bit command identifier: see table 2.1-c for details,
- a 16-bit parameter when applicable*.

*: Filled with zero if the command does not require any parameter.

These 4 fields are concatenated as follow to form the 32-bits word:

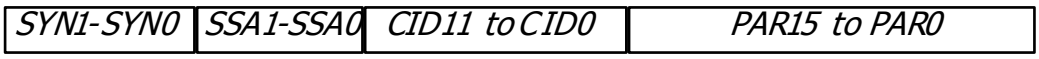


Figure 2.1-d - Command Word Field Structure

SYN1 - SYN0 : sync. pattern
SSA1 - SSA0 : subsystem address
CID11 to CID0 : command identifier
PAR15 to PAR0 : command parameter*
*: filled with zero if no used

Note : • MSB is transmitted first
• SYN1 = MSB
• PAR0 = LSB

SYN1	SYN0	Response
1	0	Yes
1	1	No

Table 2.1-a - Sync Pattern definition

SSA1	SSA0	Subsystem Name
0	0	DCU
0	1	MCU
1	0	SCU
1	1	Broadcast Command

Table 2.1-b - Subsystem address allocation

Bit 11 of the Command IDentifier determines the type of the command between Read (or Get) and Write (or Set). The following table explicits the R/W bit definition:

CID11	CID10--CID0	Command Type
1	X	Read
0	X	Write

Table 2.1-c - Command Identifier Structure

Note: the subsystems do not include any command buffering. If a subsystem is unable for any reason to execute a command it will reply with a negative acknowledge and the last command is definitively lost.

2.1.4.2. Response Word

The response line (RES) enables command verification and DRCU sub-system housekeeping parameters reading by the DPU.

When a "*SetParameter*" command (with SYN0=0) is received the subsystem responds to the DPU by transferring a command acknowledge word (positive or negative) on the response line. The positive acknowledgement is normally required for further command transfer after specific critical commands.
When a "*GetParameter*" command is received (with SYN0=0) the subsystem responds to the DPU by transferring the requested housekeeping parameter. (SPIRE housekeeping parameter polling is running typically at 1Hz).

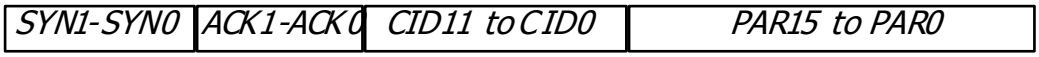
The sub-system shall respond (leading bit of the response word) within a maximum delay of N clock periods as shown table 2.1-e. The DPU S/W shall include a time-out in order to recover from a lack of response and then report such anomaly.

The 32-bit command response is divided into 4 fields, which are:

- a 2-bit sync pattern (SYN0 & SYN1),
- a 2-bit acknowledge code word (ACK0 & ACK1),
- a 12-bit command or parameter address echo (CID11 to CID0),
- a 16-bit parameter (PAR15 to PAR0) echo or requested housekeeping.

Note : • MSB is transmitted first
• SYN1 = MSB
• PAR0 = LSB

These 4 fields are concatenated as follow to form the 32-bits word:



If the subsystem address corresponds to the broadcast address the subsystems do not generate any response word to avoid collision at the DPU end.

Along with the "synchro. Pattern", Command Id field and the Parameter field an acknowledge word is in place of the sub-system address field of the received command. While normally the ACK field will content a null character (00 binary) provision for "negative" acknowledge has been introduced to enable sub-system reporting in case of anomaly.
A "negative" acknowledge may result from the following reasons:

• a transmission error occurred: receiver does not recognise command identifier,
• a command is not allowed in a specific subsystem status (e.g. modification of FTS scan length when mechanism is scanning): return ACK code = CID forbidden,
• the S/S H/W does not respond to the I/F H/W within a given delay: return ACK code = S/S time-out.

ACK	Command Status
00	OK
01	CID unknown
10	CID forbidden
11	S/S Time-out

Table 2.1-d

2.1.5. Interface Timing

2.1.5.1. Low-level Timing

The CMD signal transmitted by the DPU is modified on the falling edge of the CLK signal. Since CLK to CMD delay can be negative (see table 2.1-e) this signal shall be sampled by the DRCU subsystem on a rising edge of the CLK signal. To validate the command the subsystem shall identify the word sync pattern ("10" or "11") and then check the subsystem address. If one of these conditions is not fulfilled the subsystem input logic shall stay in the "wait for command" status.
When responding to a command a subsystem shall transmit the RES synchronously with the DPU CLK signal. The RES signal shall be modified on the falling edge of the CLK signal and being sampled by the DPU on the rising edge of the CLK signal. Similarly to a DRCU subsystem the DPU shall identify the sync pattern ("10" or "11") to properly synchronize the input register to the RES signal.

2.1.5.2. Command timing

The figure 2.1-d specifies the command interface timing. Delays are given for both mode of the protocol:

- command without response
- command with response

The maximum "command to response" delay depends on the considered subsystem. A time-out is implemented in the DPU interface in order to avoid logic lock in the case a subsystem is not able to respond within a given maximum time. The DPU interface time-out value being identical for the 3 subsystems it is fixed by the slowest one.
The following value are given from sub-system designs:

S/S	t_5 (nominal)	t_5 (S/S time-out *)
DCU	≤ 150 µs	NA
MCU	≤ 20 µs	≤ 812.8 µs
SCU	≤ tbd	≤ 812.8 µs

* an internal time-out is implementation in both MCU and SCU between the DRCU/DPU interface logic and the S/S specific logic.

Then the maximum delay the DPU S/W has to take into account is given by:

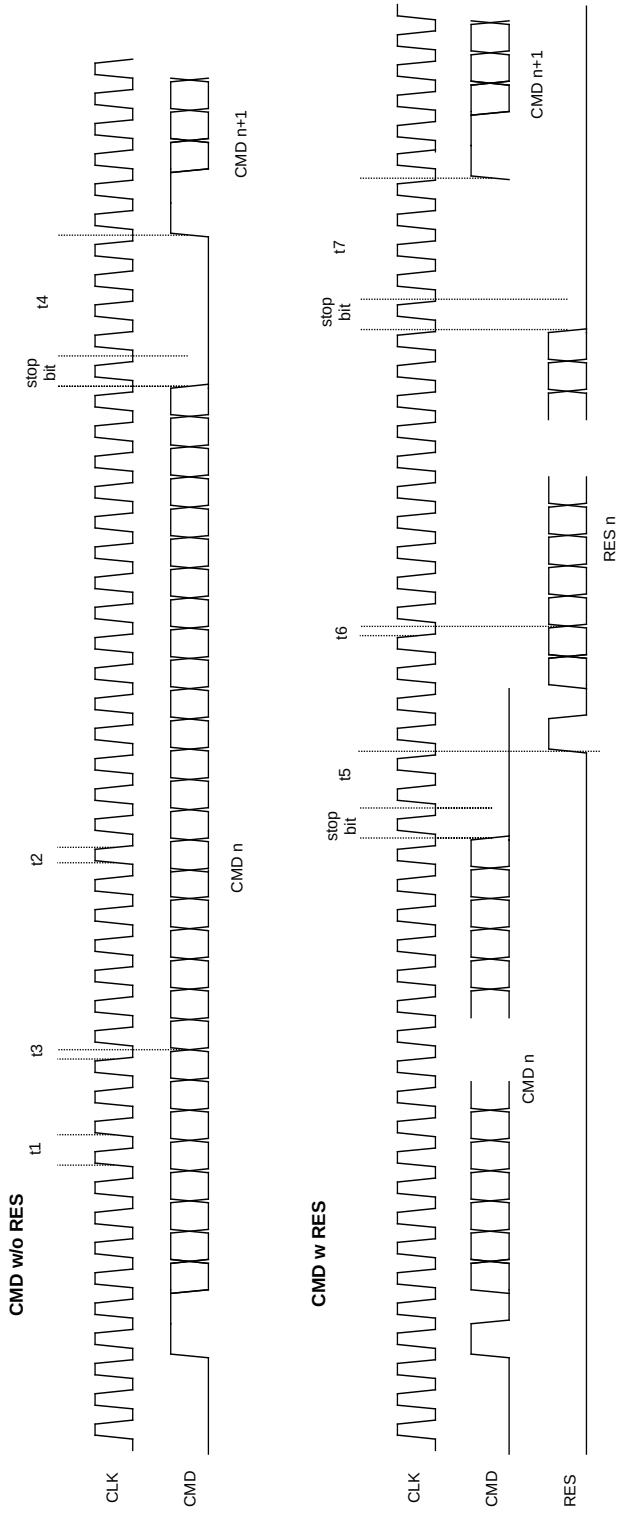
$$TO\ (DPU\ S/W\ time\text{-}out) \geq t_{5max} + t_7 + t_{CMD} + t_{RES} = 1034\ \mu s$$

2.1.5.3. Command Rate

The NRZ data rate being fixed at 312,500 bit per second the absolute maximum command rate can be computed. The command rate including both command word transmission and command response word transmission is (when no S/S time-out occurs):

$$\text{Max. Command rate} = \frac{1}{(3.2\mu s \cdot 33) \cdot 2 + t5max + t7} \leq 2630 \text{ commands per second.}$$

This value gives the maximum rate supported by the protocol. Real rates will have to take into account the DPU software performance.



Symbol	Parameter	Min	Typ	Max	Unit
t1	clock period	3.17	3.2	3.23	µs
t2	level "1" period	1.53	1.6	1.66	µs
t3	clk to cmd delay	-30		700	ns
t4	cmd to cmd delay	10			µs
t5	cmd to res delay	6.4		see text	µs
t6	clk to res delay	0		1.2	µs
t7	res to cmd delay	10			µs

Figure 2.1-d Command interface - Detailed timing

2.2. Command lists

2.2.1. DRCU generic command list summary

2.2.1.1. Command and parameter mapping

The following table shows respectively the bit mapping for CID and PAR field of a low-level command for the DRCU.

CID11	CID10 to CID0	PAR15 to PAR0
R/$\overline{W}$	Command Code	Parameter(s)

Note: These list refer to commands common to the 3 DRCU S/S. The execution of those commands is supported by the DRCU to DPU (CmdIF) interface H/W only.

2.2.1.2. Write only commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
SetTStampRst	NA	NA	Ack. code	

2.2.1.3. Read only commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
GetCmdIfStat	CmdIfStat	NA	NA	
GetSubSDelay	SubSDelay	0 to 511	NA	

2.2.1.4. Read/Write Commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
Set/GetCmdIfCtrl	CmdIfCtrl	NA	Get… cmd	

2.2.2. DRCU command description

2.2.2.1. CmdIfStat

Command	Unit	Code	Description
GetCmdIfStat	DCU	800	Get the S/S interface status
Returned Parameter(s)	Location	Length	
CmdIfStat	0	6	Bit 5-4: LastCmdStatus Bit 3: SubSystemTimeout Bit 2: ForbiddenRead Bit 1: ForbiddenBroadcast Bit 0: CommandOverlapped

2.2.2.2. CmdIfCtrl

Command	Unit	Code	Description
SetCmdIfCtrl	DCU	001	Set the S/S command IF control word.
Parameters	Location	Length	
CmdIfCtrl	0	3	Bit 2: StatusRst Bit 1 : SubSystemRst Bit 0: DataIfReset

Command	Unit	Code	Description
GetCmdIfCtrl	DCU	801	Get the S/S command IF control word.
Returned Parameter(s)	Location	Length	
CmdIfCtrl	0	3	Bit 2: StatusRst Bit 1 : SubSystemRst Bit 0: DataIfReset

2.2.2.3. SubSDelay

Command	Unit	Code	Description
GetSubSDelay	DCU	802	Get the S/S maximum predefined response time expressed in low-level command interface clock periods
Returned Parameter(s)	Location	Length	
SubSDelay	0	9	Bit 8 to 0: Register preset -

2.2.2.4. TstampRst

Command	Unit	Code	Description
SetTstampRst	DRCU	003	Reset the 32-bit counter inserted in the S/S output data format.
Parameters	Location	Length	
NA	NA	NA	PAR15 to PAR00 = 00 hexa

2.2.3. DRCU parameter description

Name	Type	Size	Conversion	Limits	Description
LastCmdStatus	Discrete	2	See ACK definition table 2.1-d		
SubSystemTimeout	Discrete	1	1=last command time out error		
ForbiddenRead	Discrete	1	1=last read command forbidden		
ForbiddenBroacast	Discrete	1	1=last broadcast command forbidden		
CommandOverlapped	Discrete	1	1=successive command overlap		
StatusRst	Discrete	1	0=reset the CmdIfStat register		
SubSystemRst	Discrete	1	0=reset S/S		
DataIfReset	Discrete	1	0=reset S/S IF logic		
SubSDelay	Digital	9	Delay between command reception & response transmission = SubSDelay/319 488		

2.2.4. DRCU typical commanding scenarios

2.2.5. DCU specific command list summary

2.2.5.1. Command and parameter mapping

The following table shows respectively the bit mapping for CID and PAR field of a low-level command for the DCU.

CID11	CID10 to CID0	PAR15 to PAR9	PAR8 to PAR0
R/$\overline{W}$	Command Code	-	Parameter(s)

Note: for the SetLIAPxOffset and SetLIASxOffset commands the *parameter* field is in turn divided into two sub-fields has described bellow.

PAR8 to PAR4	PAR3 to PAR0
Channel Number	Offset Value

2.2.5.2. Photometer write/read commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
Set/GetPhotoSampFreq	Channel id Bias freq divider	NA 002 to 255	Get... cmd	
Set/GetPhotoBiasFreq	Channel id. Frequency divider	NA 064 to 511	Get... cmd	
Set/GetPhotoDemod	Ref. Channel id PSD Phase	0 to 3 000 to 255	Get... cmd	
Set/GetPhotoBiasMode	Channel id Bias gene mode	NA 000 to 255	Get... cmd	
Set/GetPhotoBiasAmpl	Bias Channel id. Sine amplitude	00 to 03 000 to 255	Get... cmd	
Set/GetPhSWJfetVss	Channel id. Vss voltage	0 to 5 000 to 255	Get... cmd	
Set/GetPhMLWJfetVss	Channel id. Vss voltage	0 to 3 000 to 255	Get... cmd	
Set/GetPhTCJfetVss	Channel id. Vss voltage	0 to 1 000 to 255	Get... cmd	
Set/GetPhotoHeaterBias	Channel id. Bias current	NA 000 to 255	Get... cmd	
Set/GetPhotoJfetPwr	Channel id On/Off word	00 to 01 NA - discrete	Get... cmd	
Set/GetLIAPxOffset	Channel id.	00 to 08	Get... cmd	

	Channel number Offset value	00 to 31 00 to 15		

2.2.5.3. Spectrometer write/read commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
Set/GetSpectroSampFreq	Channel id Bias freq divider	NA 000 to 255	Get_... cmd	
Set/GetSpectroBiasFreq	Channel id. Frequency divider	NA 064 to 511	Get_... cmd	
Set/GetSpectroDemod	Channel id PSD Phase	0 to 1 000 to 255	Get_... cmd	
Set/GetSpectroBiasMode	Channel id Bias gene mode	NA 000 to 255	Get_... cmd	
Set/GetSpectroBiasAmpl	Channel id. Sine amplitude	0 to 1 000 to 255	Get_... cmd	
Set/GetSpectroHeaterBias	Channel id. Bias current	NA 000 to 255	Get_... cmd	
Set/GetSpSWJfetVss	Channel id. Vss voltage	0 to 01 000 to 255	Get_... cmd	
Set/GetSpLWJfetVss	Channel id. Vss voltage	NA 000 to 255	Get_... cmd	
Set/GetSpSLWJfetPwr	Channel id On/Off word	00 to 01 NA - discrete	Get_... cmd	
Set/GetLIASxOffset	Channel id. Channel number Offset value	00 to 02 00 to 23 00 to 15	Get_... cmd	

2.2.5.4. Photometer / spectrometer common write/read commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
Set/GetDataMode	Channel id. Mode id.	NA NA - discrete	Get... cmd TBC	
Set/GetFrameNber	Channel id Nber of frames	NA 0 to 255	Get... cmd TBC	
Set/GetStartFrame	Channel id Run/Stop code	NA 000 / 255	Get... cmd TBC	

2.2.5.5. Read only commands

Command Name	Argument(s)	Execution Delay
GetHKChannel	HK Channel id.	See §2.2.7.4

2.2.6. DCU command description

2.2.6.1. Photometer

2.2.6.1.1. PhotoSampFreq

Command	Unit	Code	Description
SetPhotoSampFreq	DCU	418	Set the photometer & T/C bolometer sampling frequency division from the photometer bias clock
Parameters	Location	Length	
PhotoBiasDiv	0	8	Sampling rate divider setting parameter (Min 2)

Command	Unit	Code	Description
GetPhotoSampFreq	DCU	C18	Get the photometer & T/C bolometer sampling frequency division from the photometer bias clock
Returned Parameters	Location	Length	
PhotoBiasDiv	0	8	

2.2.6.1.2. PhotoBiasFreq

Command	Unit	Code	Description
SetPhotoBiasFreq	DCU	419	Set the photometer & T/C bolometer sine bias frequency division from the master clock
Parameters	Location	Length	
PhotoMClkDiv	0	9	Master clock divider setting parameter (Min 64; Max 511)

Command	Unit	Code	Description
GetPhotoBiasFreq	DCU	C19	Get the photometer & T/C bolometer sine bias frequency division from the master clock
Returned Parameters	Location	Length	
PhotoMClkDiv	0	9	

2.2.6.1.3. PhotoBiasMode

Command	Unit	Code	Description
SetPhotoBiasMode	DCU	400	Set the photometer & T/C bolometer sine bias mode
Parameters	Location	Length	
PhotoBiasMode	0	8	FF=run ; 00=stop ; 01 to FE = discrete values

Command	Unit	Code	Description
GetPhotoBiasMode	DCU	C00	Get the photometer & T/C bolometer sine bias mode
Parameters	Location	Length	
PhotoBiasMode	0	8	FF=run ; 00=stop ; 01 to FE= test values

2.2.6.1.4. PhotoDemodxx

Command full name	Unit	Code	Description
SetPhotoDemodSW SetPhotoDemodMW SetPhotoDemodLW SetPhotoDemodTC	DCU	41A + x	Set the bolometer group demodulation phase shift x = 0 for SW group x = 1 for MW group x = 2 for LW group x = 3 for TC group
Parameters	Location	Length	
PhotoPhaseShiftxx	0	8	Phase shift register setting parameter
PhotoBiasChannel	-	-	Encoded with the command code (see x definition above)

Command full name	Unit	Code	Description
GetPhotoDemodSW GetPhotoDemodMW GetPhotoDemodLW GetPhotoDemodTC	DCU	C1A + x	Set bolometer group demodulation phase shift x = 0 for SW group x = 1 for MW group x = 2 for LW group x = 3 for TC group
Parameters	Location	Length	
PhotoBiasChannel	-	-	Encoded with the command code (see x definition above)
Returned Parameters			
PhotoPhaseShiftxx	0	8	

2.2.6.1.5. PhotoBiasAmplxx

Command full name	Unit	Code	Description
SetPhotoBiasAmplSW SetPhotoBiasAmplMW SetPhotoBiasAmplLW SetPhotoBiasAmplTC	DCU	401 + x	Set bolometer group sine bias amplitude x = 0 for SW group x = 1 for MW group x = 2 for LW group x = 3 for TC group
Parameters	Location	Length	
PhotoBiasAmplxx	0	8	Bias amplitude DAC setting parameter
PhotoBiasChannel	-	-	Encoded with the command code (see x definition above)

Command full name	Unit	Code	Description
GetPhotoBiasAmplSW GetPhotoBiasAmplMW GetPhotoBiasAmplLW GetPhotoBiasAmplTC	DCU	C01 + x	Set bolometer group sine bias amplitude x = 0 for SW group x = 1 for MW group x = 2 for LW group x = 3 for TC group
Parameters	Location	Length	
PhotoBiasChannel	-	-	Encoded with the command code (see x definition above)

Returned Parameters	Location	Length	
PhotoBiasAmplxx	0	8	

2.2.6.1.6. PhotoHeaterBias

Command full name	Unit	Code	Description
SetPhotoHeaterBias	DCU	411	Set the photometer heater bias voltage
Parameters	Location	Length	
PhotoHeaterBias	0	8	JFET Heater DAC setting parameter

Command full name	Unit	Code	Description
GetPhotoHeaterBias	DCU	C11	Get the photometer heater bias voltage
Parameters	Location	Length	
PhotoHeaterBias	0	8	

2.2.6.1.7. PhSWJfetVSSx

Command full name	Unit	Code	Description
SetPhSWJfetVSS1 SetPhSWJfetVSS2 SetPhSWJfetVSS3 SetPhSWJfetVSS4 SetPhSWJfetVSS5 SetPhSWJfetVSS6	DCU	405 + x	Set PSW channels JFET source voltage x = 0 for VSS1 x = 1 for VSS2 x = 2 for VSS3 x = 3 for VSS4 x = 4 for VSS5 x = 5 for VSS6
Parameters	Location	Length	
PSW_VSSx	0	8	VSS DAC setting parameter
VSSChannelID	-	-	Encoded with the command code (see x definition above)

Command full name	Unit	Code	Description
GetPhSWJfetVSS GetPhSWJfetVSS2 GetPhSWJfetVSS3 GetPhSWJfetVSS4 GetPhSWJfetVSS5 GetPhSWJfetVSS6	DCU	C05	Get PSW channels JFET source voltage x = 0 for VSS1 x = 1 for VSS2 x = 2 for VSS3 x = 3 for VSS4 x = 4 for VSS5 x = 5 for VSS6
Parameters	Location	Length	
VSSChannelID	-	-	Encoded with the command code (see x definition above)
Returned Parameters			
PSW_VSSx	0	8	

2.2.6.1.8. PhMWJfetVSSx

Command full name	Unit	Code	Description

SetPhMWJfetVSS1 SetPhMWJfetVSS2 SetPhMWJfetVSS3 SetPhMWJfetVSS4	DCU	40B + x	Set PMW channel JFET source voltage x = 0 for VSS1 x = 1 for VSS2 x = 2 for VSS3 x = 3 for VSS4
Parameters	Location	Length	
PMW_VSSx	0	8	VSS DAC setting parameter
VSSChannelID	-	-	Encoded with the command code (see x definition above)

Command full name	Unit	Code	Description
GetPhMWJfetVSS1 GetPhMWJfetVSS2 GetPhMWJfetVSS3 GetPhMWJfetVSS4	DCU	C0B + x	Get PMW channels JFET source voltage x = 0 for VSS1 x = 1 for VSS2 x = 2 for VSS3 x = 3 for VSS4
Parameters	Location	Length	
VSSChannelID	-	-	Encoded with the command code (see x definition above)
Returned Parameters			
PMW_VSSx	0	8	

*2.2.6.1.9. PhLWJfetVSS*x

Command full name	Unit	Code	Description
SetPhLWJfetVSS1 SetPhLWJfetVSS2	DCU	40F + x	Set LW channels JFET source voltage x = 0 for VSS1 x = 1 for VSS2
Parameters	Location	Length	
PLW_VSSx	0	8	VSS DAC setting parameter
VSSChannelID	-	-	Encoded with the command code (see x definition above)

Command full name	Unit	Code	Description
GetPLWJfetVSS1 GetPLWJfetVSS2	DCU	C16	Get LW channels JFET source voltage x = 0 for VSS1 x = 1 for VSS2
Parameters	Location	Length	
VSSChannelID	-	-	Encoded with the command code (see x definition above)
Returned Parameters			
PLW_VSSx	0	8	

2.2.6.1.10. PhTCJfetVSS

Command full name	Unit	Code	Description
SetTCJfetVSS1	DCU	414	Set TC channels JFET source voltage
Parameters	Location	Length	
TC_VSS	0	8	VSS DAC setting parameter

Command full name	Unit	Code	Description
GetTCJfetVSS1	DCU	C14	Get TC channels JFET source voltage
Returned Parameters			
TC_VSS	0	8	

2.2.6.1.11. PhSWJfetPwr

Command	Unit	Code	Description
SetPhSWJFfetPwr	DCU	412	Switch the PSW JFETs drain voltage on/off
Parameters	Location	Length	
PSW_JFET_1	0	1	JFET drain bias On/Off switch command
PSW_JFET_2	1	1	"
PSW_JFET_3	2	1	"
PSW_JFET_4	3	1	"
PSW_JFET_5	4	1	"
PSW_JFET_6	5	1	"

Command	Unit	Code	Description
GetPhSWJFfetPwr	DCU	C12	Get the PSW JFETs drain voltage status
Parameters	Location	Length	
PSW_JFET_1	0	1	
PSW_JFET_2	1	1	
PSW_JFET_3	2	1	
PSW_JFET_4	3	1	
PSW_JFET_5	4	1	
PSW_JFET_6	5	1	

2.2.6.1.12. PhMLWJfetPwr

Command	Unit	Code	Description
SetPhMLWJfetPwr	DCU	413	Switch the PMW & PLW channels JFETs drain voltage on/off
Parameters	Location	Length	
PMW_JFET_1	0	1	JFET drain bias On/Off switch command
PMW_JFET_2	1	1	"
PMW_JFET_3	2	1	"
PMW_JFET_4	3	1	"
PLW_JFET_1	4	1	"
PLW_JFET_2	5	1	"
TC_JFET	6	1	"

Command	Unit	Code	Description
GetPhMLWJfetPwr	DCU	C13	Get the PMW & PLW channels JFETs drain voltage status
Parameters	Location	Length	
PMW_JFET_1	0	1	
PMW_JFET_2	1	1	
PMW_JFET_3	2	1	
PMW_JFET_4	3	1	
PLW_JFET_1	4	1	
PLW_JFET_2	5	1	
TC_JFET	6	1	

2.2.6.1.13. SetLIAPxOffset

Command	Unit	Code	Description
SetLIAP1Offset	DCU	420	Set one LIA_P1 channel offset value
Parameters	Location	Length	
Offset_P1	0	4	Offset value
Channel_P1	4	5	

Command	Unit	Code	Description
SetLIAP2Offset	DCU	421	Set one LIA_P2 channel offset value
Parameters	Location	Length	
Offset_P2	0	4	Offset value
Channel_P2	4	5	

Command	Unit	Code	Description
SetLIAP3Offset	DCU	422	Set one LIA_P3 channel offset value
Parameters	Location	Length	
Offset_P3	0	4	Offset value
Channel_P3	4	5	

Command	Unit	Code	Description
SetLIAP4Offset	DCU	423	Set one LIA_P4 channel offset value
Parameters	Location	Length	
Offset_P4	0	4	Offset value
Channel_P4	4	5	

Command	Unit	Code	Description
SetLIAP5Offset	DCU	424	Set one LIA_P5 channel offset value
Parameters	Location	Length	
Offset_P5	0	4	Offset value
Channel_P5	4	5	

Command	Unit	Code	Description
SetLIAP6Offset	DCU	425	Set one LIA_P6 channel offset value
Parameters	Location	Length	
Offset_P6	0	4	Offset value
Channel_P6	4	5	

Command	Unit	Code	Description
SetLIAP7Offset	DCU	426	Set one LIA_P7 channel offset value
Parameters	Location	Length	
Offset_P7	0	4	Offset value
Channel_P7	4	5	

Command	Unit	Code	Description

SetLIAP8Offset	DCU	427	Set one LIA_P8 channel offset value
Parameters	Location	Length	
Offset_P8	0	4	Offset value
Channel_P8	4	5	

Command		Code	Description
SetLIAP9Offset	DCU	428	Set one LIA_P9 channel offset value
Parameters	Location	Length	
Offset_P9	0	4	Offset value
Channel_P9	4	5	

2.2.6.2. LIA_P channel/Bolometer number cross table (to be completed)

	LIAP1	LIAP2	LIAP3	LIAP4	LIAP5	LIAP6	LIAP7	LIAP8	LIAP9
Channel Number	Bolometer Number	Bolometer Number	Bolometer Number	Bolometer Number	Bolometer Number	Bolometer Number	Bolometer Number	Bolometer Number	Bolometer Number
1	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
2	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
3	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
4	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
5	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
6	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
7	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
8	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
9	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
10	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
11	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
12	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
13	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
14	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
15	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
16	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
17	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
18	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
19	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
20	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
21	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
22	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
23	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
24	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
25	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
26	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
27	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
28	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
29	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
30	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx
31	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx

32	PSW_xxx	PSW_xxx	PSW_xxx	PSW_xxx	PLW_xxx	PLW_xxx	PMW_xxx	PMW_xxx	PMW_xxx

2.2.6.3. Spectrometer

2.2.6.3.1. SpectroSampFreq

Command	Unit	Code	Description
SetSpectroSamplFsreq	DCU	438	Set the spectrometer bolometer sampling frequency division from the spectrometer bias clock
Parameters	Location	Length	
SpectroBiasDiv	0	8	Sampling rate divider setting parameter

Command	Unit	Code	Description
GetSpectroSamplFreq	DCU	C38	Get the photometer & T/C bolometer sampling frequency division from the photometer bias clock
Parameters	Location	Length	
SpectroBiasDiv	0	8	

2.2.6.3.2. SpectroBiasFreq

Command	Unit	Code	Description
SetSpectroBiasFreq	DCU	439	Set the spectrometer bolometer sine bias frequency division from the master clock
Parameters	Location	Length	
SpectroMClkDiv	0	9	Master clock divider setting parameter (Min 64; Max 511)

Command	Unit	Code	Description
GetSpectroBiasFreq	DCU	C39	Get the spectrometer bolometer sine bias frequency division from the master clock
Parameters	Location	Length	
SpectroMClkDiv	0	9	

2.2.6.3.3. SpectroBiasMode

Command	Unit	Code	Description
SetSpectroBiasMode	DCU	430	Set the spectrometer bolometer sine bias mode
Parameters	Location	Length	
SpectroBiasMode	0	8	FF=run ; 00=stop ; 01 to FE = test values

Command	Unit	Code	Description
GetSpectroBiasMode	DCU	C30	Get the spectrometer bolometer sine bias mode
Parameters	Location	Length	
SpectroBiasMode	0	8	FF=run ; 00=stop ; 01 to FE = test values

2.2.6.3.4. *SpectroDemod*xx

Command	Unit	Code	Description
SetSpectroDemodSW SetSpectroDemodLW	DCU	43A + x	Set the S-SW bolometer demodulation phase shift x = 0 for SW group x = 1 for LW group
Parameters	Location	Length	
SpectroPhaseShiftxx	0	8	Phase shift register setting parameter
SpectroBiasChannel	-	-	Encoded with the command code (see x definition above)

Command	Unit	Code	Description
GetSpectroDemodSW GetSpectroDemodLW	DCU	C3A + x	Get the S-SW bolometer demodulation phase shift x = 0 for SW group x = 1 for LW group
Parameters	Location	Length	
SpectroBiasChannel	-	-	Encoded with the command code (see x definition above)
Returned Parameters			
SpectroPhaseShift	0	8	

2.2.6.3.5. *SpectroBiasAmpl*xx

Command	Unit	Code	Description
SetSpectroBiasAmplSW SetSpectroBiasAmplLW	DCU	431 + x	Set bolometer group sine bias amplitude x = 0 for SW group x = 1 for LW group
Parameters	Location	Length	
SpectroBiasAmplxx	0	8	Bias amplitude DAC setting parameter
SpectroBiasChannel	-	-	Encoded with the command code (see x definition above)

Command	Unit	Code	Description
GetSpectroBiasAmplSW GetSpectroBiasAmplLW	DCU	C31 + x	Get bolometer group sine bias amplitude x = 0 for SW group x = 1 for LW group
Parameters	Location	Length	
SpectroBiasChannel	-	-	Encoded with the command code (see x definition above)
Returned Parameters	Location	Length	
SpectroBiasAmplxx	0	8	

2.2.6.3.6. *SpectroHeaterBias*

Command	Unit	Code	Description
SetSpectroHeaterBias	DCU	433	Set the spectrometer heater bias voltage
Parameters	Location	Length	
SpectroHeaterBias	0	8	JFET Heater DAC setting parameter

Command	Unit	Code	Description
GetSpectroHeaterBias	DCU	C33	Get the spectrometer heater bias voltage

Parameters	Location	Length	
SpectroHeaterBias	0	8	

2.2.6.3.7. SpSWJfetVSSx

Command full name	Unit	Code	Description
SetSpSWJfetVSS1 SetSpSWJfetVSS2	DCU	435 + x	Set SSW JFET source voltage x = 0 for VSS1 x = 1 for VSS2
Parameters	Location	Length	
SSW_VSSx	0	8	VSS DAC setting parameter
VSSChannelID	-	-	Encoded with the command code (see x definition above)

Command full name	Unit	Code	Description
GetSpSWJfetVSS1 GetSpSWJfetVSS2	DCU	C35 + x	Get SSW JFET source voltage x = 0 for VSS1 x = 1 for VSS2
Parameters	Location	Length	
VSSChannelID	-	-	Encoded with the command code (see x definition above)
Returned Parameters			
SSW_VSSx	0	8	

2.2.6.3.8. SpLWJfetVSS

Command	Unit	Code	Description
SetSpLWJfetVSS	DCU	434	Set SLW JFET source voltage
Parameters	Location	Length	
SLW_VSS	0	8	

Command	Unit	Code	Description
GetSpLWJfetVSS	DCU	C34	Get SLW JFET source voltage
Returned Parameters	Location	Length	
SLW_VSS	0	8	

2.2.6.3.9. SpSLWJfetPwr

Command	Unit	Code	Description
SetSpSLWJfetPwr	DCU	437	Switch the spectrometer JFETs drain voltage on/off
Parameters	Location	Length	
SLW_JFET1	0	1	JFET drain bias On/Off switch command
SSW_JFET1	1	1	“
SSW_JFET2	2	1	“

Command	Unit	Code	Description
GetSpSLWJfetPwr	DCU	C37	Get the spectrometer JFETs drain voltage status
Parameters	Location	Length	
SLW_JFET1	0	1	
SSW_JFET1	1	1	

SSW_JFET2	2	1	

2.2.6.3.10. SetLIASxOffset

Command	Unit	Code	Description
SetLIAS1Offset	DCU	42C	Set one LIA_S1 channel offset value
Parameters	Location	Length	
Offset_S1	0	4	Offset value
Channel_S1	4	5	

Command	Unit	Code	Description
SetLIAS2Offset	DCU	42D	Set one LIA_S2 channel offset value
Parameters	Location	Length	
Offset_S2	0	4	Offset value
Channel_S2	4	5	

Command	Unit	Code	Description
SetLIAS3Offset	DCU	42E	Set one LIA_S3 channel offset value
Parameters	Location	Length	
Offset_S3	0	4	Offset value
Channel_S3	4	5	

2.2.6.4. LIA_S channel/Bolometer number cross table (to be completed)

	LIAS1	LIAS2	LIAS3		LIAS1	LIAS2	LIAS3
Channel Number	Bolometer Number	Bolometer Number	Bolometer Number	Channel Number	Bolometer Number	Bolometer Number	Bolometer Number
1	SSW_xxx	SSW_xxx	SLW_xxx	1	SSW_xxx	SSW_xxx	SLW_xxx
2	SSW_xxx	SSW_xxx	SLW_xxx	2	SSW_xxx	SSW_xxx	SLW_xxx
3	SSW_xxx	SSW_xxx	SLW_xxx	3	SSW_xxx	SSW_xxx	SLW_xxx
4	SSW_xxx	SSW_xxx	SLW_xxx	4	SSW_xxx	SSW_xxx	SLW_xxx
5	SSW_xxx	SSW_xxx	SLW_xxx	5	SSW_xxx	SSW_xxx	SLW_xxx
6	SSW_xxx	SSW_xxx	SLW_xxx	6	SSW_xxx	SSW_xxx	SLW_xxx
7	SSW_xxx	SSW_xxx	SLW_xxx	7	SSW_xxx	SSW_xxx	SLW_xxx
8	SSW_xxx	SSW_xxx	SLW_xxx	8	SSW_xxx	SSW_xxx	SLW_xxx
9	SSW_xxx	SSW_xxx	SLW_xxx	9	SSW_xxx	SSW_xxx	SLW_xxx
10	SSW_xxx	SSW_xxx	SLW_xxx	10	SSW_xxx	SSW_xxx	SLW_xxx
11	SSW_xxx	SSW_xxx	SLW_xxx	11	SSW_xxx	SSW_xxx	SLW_xxx
12	SSW_xxx	SSW_xxx	SLW_xxx	12	SSW_xxx	SSW_xxx	SLW_xxx

2.2.6.5. Photometer & Spectrometer common commands

2.2.6.5.1. SetDataMode

Command	Unit	Code	Description
SetDataMode	DCU	43C	Set the DCU output data format between bolometer or 4-bit offset transmission and test patten.
Parameters	Location	Length	
DataMode	0	5	Bit 4: 0 = bolometer 1 = offset Bit 3: 0 = normal (bolometer or offset - see bit 4) 1 = test pattern Bit 2 to 0: 000 = Full photometer 001 = PSW 010 = PMW&T/C 011 = PLW 100 = Full spectrometer 101 = SLW 110 = SSW

Command	Unit	Code	Description
GetDataMode	DCU	C3C	Get DCU data mode
Parameters	Location	Length	
DataMode	0	5	

2.2.6.5.2. FrameNber

Command	Unit	Code	Description
SetFrameCount	DCU	43D	Set photometer frames acquisition mode
Parameters	Location	Length	
FrameCount	0	8	0 = continuous 1 to 255 =number of frames

Command	Unit	Code	Description
GetFrameCount	DCU	C3D	Get photometer frames acquisition mode
Parameters	Location	Length	
FrameCount	0	8	0 = continuous 1 to 255 =number of frames

2.2.6.5.3. StartFrame

Command	Unit	Code	Description
SetStartFrame	DCU	43E	
Parameters	Location	Length	
StartFrame	0	1	1 = run 0 = stop

Command	Unit	Code	Description

GetStartFrame	DCU	C3E	
Parameters	Location	Length	
Startframe	0	1	1 = run 0 = stop

2.2.6.5.4. GetHKChannel

Command	Unit	Code	Description
GetHKChannel	DCU	C3F	Get additional parameter
Parameters	Location	Length	
HKChannel	0	-	

2.2.7. DCU parameters description

2.2.7.1. Photometer

Name	Type	Size	Conversion	Limits	Description
PhotoDivBias	Analogue	8	$F_{sampl}(Hz)=\frac{F_{bias}}{1+PhotoDivBias}$	2 to 255	0.15 Hz ≤ Fsampl ≤ 305 Hz
PhotoMClkDiv	Analogue	9	$F_{BIAS}(Hz)=\frac{10^7}{512.PhotoMClkDiv}$	64 to 511	38 Hz ≤ Fbias ≤ 305 Hz
PhotoBiasMode	Discrete	8	FF=run sine 00 to FE= DC level	0 to 255	
PhotoDemodSW PhotoDemodMW PhotoDemodLW PhotoDemodTC	Analogue	8	$Ph_{xx}(\deg)=360\frac{PhotoDemodtxx}{255}$	0 to 255	
PhotoBiasAmplSW PhotoBiasAmplMW PhotoBiasAmplLW PhotoBiasAmplTC	Analogue	8	$V_{bxx}=V_{b\max}.\frac{PhotoBiasAmplxx}{255}$	0 to 255	Vbmax = 200 mV pp
PhotoHeaterBias	Analogue	8	$Vh=Vh\max.\frac{PhotoHeaterBias}{255}$	0 to 255	Vhmax = -5 V
PSW_VSS1 PSW_VSS2 PSW_VSS3 PSW_VSS4 PSW_VSS5 PSW_VSS6	Analogue	8	$VSS_x=VSS\max\frac{PSW\_VSSx}{255}$	0 to 255	Vssmax = -5 V
PMW_VSS1 PMW_VSS2 PMW_VSS3 PMW_VSS4	Analogue	8	$VSS_{xx}=VSS\max\frac{PMW\_VSSxx}{255}$	0 to 255	Vssmax = -5 V
PLW_VSS1 PLW_VSS2	Analogue	8	$VSS_{xx}=VSS\max\frac{PLW\_VSSx}{255}$	0 to 255	Vssmax = -5 V
PSW_JFET_1	Discrete	1	0=off ; 1=on	0/1	
PSW_JFET_2	Discrete	1	0=off ; 1=on	0/1	
PSW_JFET_3	Discrete	1	0=off ; 1=on	0/1	
PSW_JFET_4	Discrete	1	0=off ; 1=on	0/1	
PSW_JFET_5	Discrete	1	0=off ; 1=on	0/1	
PSW_JFET_6	Discrete	1	0=off ; 1=on	0/1	
PMW_JFET_1	Discrete	1	0=off ; 1=on	0/1	
PMW_JFET_2	Discrete	1	0=off ; 1=on	0/1	
PMW_JFET_3	Discrete	1	0=off ; 1=on	0/1	
PMW_JFET_4	Discrete	1	0=off ; 1=on	0/1	
PLW_JFET_1	Discrete	1	0=off ; 1=on	0/1	
PLW_JFET_2	Discrete	1	0=off ; 1=on	0/1	
Channel_P1	Discrete	5	Channel 1 to 32 of LIA_P1	0 to 31	
Channel_P2	Discrete	5	Channel 1 to 32 of LIA_P2	0 to 31	
Channel_P3	Discrete	5	Channel 1 to 32 of LIA_P3	0 to 31	
Channel_P4	Discrete	5	Channel 1 to 32 of LIA_P4	0 to 31	
Channel_P5	Discrete	5	Channel 1 to 32 of LIA_P5	0 to 31	

Channel_P6	Discrete	5	Channel 1 to 32 of LIA_P6	0 to 31	
Channel_P7	Discrete	5	Channel 1 to 32 of LIA_P7	0 to 31	
Channel_P8	Discrete	5	Channel 1 to 32 of LIA_P8	0 to 31	
Channel_P9	Discrete	5	Channel 1 to 32 of LIA_P9	0 to 31	
Offset_P1	Analogue	4	$V_{Offset\_Px}=V_{Offset\max}\frac{Offset\_Px}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V
Offset_P2	Analogue	4	$V_{Offset\_Px}=V_{Offset\max}\frac{Offset\_Px}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V
Offset_P3	Analogue	4	$V_{Offset\_Px}=V_{Offset\max}\frac{Offset\_Px}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V
Offset_P4	Analogue	4	$V_{Offset\_Px}=V_{Offset\max}\frac{Offset\_Px}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V
Offset_P5	Analogue	4	$V_{Offset\_Px}=V_{Offset\max}\frac{Offset\_Px}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V
Offset_P6	Analogue	4	$V_{Offset\_Px}=V_{Offset\max}\frac{Offset\_Px}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V
Offset_P7	Analogue	4	$V_{Offset\_Px}=V_{Offset\max}\frac{Offset\_Px}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V
Offset_P8	Analogue	4	$V_{Offset\_Px}=V_{Offset\max}\frac{Offset\_Px}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V
Offset_P9	Analogue	4	$V_{Offset\_Px}=V_{Offset\max}\frac{Offset\_Px}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V

2.2.7.2. Spectrometer

Name	Type	Size	Conversion	Limits	Description
SpectroBiasDiv	Analogue	8	$F_{sampl}=\frac{F_{bias}}{1+SpectroBiasDiv}$	0 to 255	0.15 Hz ≤ Fsampl ≤ 305 Hz
SpectroMClkDiv	Analogue	9	$F_{BIAS}=\frac{10^7}{512.SpectroMClkDiv}$	64 to 511	38 Hz ≤ Fbias ≤ 305 Hz
SpectroBiasMode	Discrete	8	FF=run sine 00 to FE= DC level	- 0 to 254	
SpectroDemod	Analogue	8	$Ph_{xx}=360\cdot\frac{SpectroPhaseShiftxx}{255}$	0 to 255	
SpectroBiasAmplSW SpectroBiasAmplLW	Analogue	8	$Vb_{xx}=Vb\max\cdot\frac{SpectroBiasAmplxx}{255}$	0 to 255	Vbmax =
SpectroHeaterBias	Analogue	8	$Vh_{xx}=Vh\max\cdot\frac{SpectroHeaterBias}{255}$	0 to 255	Vhmax =
SLW_VSS1 SLW_VSS2	Analogue	8	$VSS_x=VSS\max\frac{SLW\_VSSx}{255}$	0 to 255	Vssmax =
SSW_VSS	Analogue	8	$VSS=VSS\max\cdot\frac{SLW\_VSS}{255}$	0 to 255	Vssmax =
SLW_JFET1	Discrete	1	0=off ; 1=on	0/1	
SSW_JFET1	Discrete	1	0=off ; 1=on	0/1	
SSW_JFET2	Discrete	1	0=off ; 1=on	0/1	
Channel_S1	Discrete	5	Channel 1 to 24 of LIA_S1	0 to 23	
Channel_S2	Discrete	5	Channel 1 to 24 of LIA_S2	0 to 23	
Channel_S3	Discrete	5	Channel 1 to 24 of LIA_S3	0 to 23	
Offset_S1	Analogue	4	$V_{Offset\_Sx}=V_{Offset\max}\frac{Offset\_Sx}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V
Offset_S2	Analogue	4	$V_{Offset\_Sx}=V_{Offset\max}\frac{Offset\_Sx}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V
Offset_S3	Analogue	4	$V_{Offset\_Sx}=V_{Offset\max}\frac{Offset\_Sx}{15}$	0 to 15	$V_{Offsetmax}$ = 5 V

2.2.7.3. Photometer & Spectrometer

Name	Type	Size	Conversion	Limits	Description
DataMode	Discrete	5	00= acquisition photometer 01= acquisition PSW 02= acquisition PMW 03= acquisition PLW 04= acquisition Spectrometer 05= acquisition SLW 06= acquisition SSW 08= Test Pattern photometer 0C= Test Pattern Spectrometer 10= Automatic offset photometer set 14= Automatic offset spectrometer set 18= Get offset photometer 1C= Get offset spectrometer Other = do nothing	0 to 1C	
FrameCount	Discrete	8	0=continuous; 1 to 255 = number of frames	0 to 255	
StartFrame	Discrete	1	1=run 0=stop	0/1	
HKChannel	Discrete		See table §2.2.7.4	0 to 26	

2.2.7.4. DCU housekeeping identifier list

The following table explicits the *HKChannel* id to be transmitted as an argument of the *GetHKChannel* command.

Parameter Name	Size (bits)	Comments	Channel ID (hex)	Delay To Transmit
BIAS_TEMP	16	BIAS board temperature	00	≤ 150 µs
LIA_B10_TEMP	16	LIA board 10 temperature	01	≤ 150 µs
LIA_B11_TEMP	16	LIA board 11 temperature	02	≤ 150 µs
LIA_B12_TEMP	16	LIA board 12 temperature	03	≤ 150 µs
LIA_B1_TEMP	16	LIA board 1 temperature	04	≤ 150 µs
LIA_B2_TEMP	16	LIA board 2 temperature	05	≤ 150 µs
LIA_B3_TEMP	16	LIA board 3 temperature	06	≤ 150 µs
LIA_B4_TEMP	16	LIA board 4 temperature	07	≤ 150 µs
LIA_B5_TEMP	16	LIA board 5 temperature	08	≤ 150 µs
LIA_B6_TEMP	16	LIA board 6 temperature	09	≤ 150 µs
LIA_B7_TEMP	16	LIA board 7 temperature	0A	≤ 150 µs
LIA_B8_TEMP	16	LIA board 8 temperature	0B	≤ 150 µs
LIA_B9_TEMP	16	LIA board 9 temperature	0C	≤ 150 µs
DAQ_IF_TEMP	16	DAQ_IF board temperature	0D	≤ 150 µs
BDAQ_P5	16	BIAS/DAQ_IF +5V voltage (before post regulator)	0E	≤ 150 µs
BQAD_P9	16	BIAS/DAQ_IF +9V voltage (before post regulator)	0F	≤ 150 µs
BDAQ_N9	16	BIAS/DAQ_IF -9V voltage (before post regulator)	10	≤ 150 µs
LIAP_P5	16	LIAP +5V voltage (before post regulator)	11	≤ 150 µs
LIAP_P9	16	LIAP +9V voltage (before post regulator)	12	≤ 150 µs
LIAP_N9	16	LIAP -9V voltage (before post regulator)	13	≤ 150 µs
LIAS_P5	16	LIAS +5V voltage (before post regulator)	14	≤ 150 µs
LIAS_P9	16	LIAS +9V voltage (before post regulator)	15	≤ 150 µs
LIAS_N9	16	LIAS -9V voltage (before post regulator)	16	≤ 150 µs
PWR_STATUS	12	LIA 1 to LIA 12 +5V/+9V/-9V status	17	≤ 150 µs
T/C_1	16	16-bit ADC (Offset=0)	18	≤ 150 µs
T/C_2	16	16-bit ADC (Offset=0)	1A	≤ 150 µs
T/C_3	16	16-bit ADC (Offset=0)	1C	≤ 150 µs

2.2.8. DCU typical commanding scenarios

2.2.8.1. DCU Configuration

2.2.8.1.1. Photometer

Steps	Command	Parameters	Comment
1	SetPhotoBiasFreq	PhotoMClkDiv	With a 10 MHz master clock for a photometer bias frequency of 199.3Hz; PhotoMClkDiv = 98
2	SetPhotoSampFreq	PhotoBiasDiv	Set a sampling frequency of 15,3Hz; PhotoBiasDiv = 13
3	SetPhotoDemod	PSW PhotoPhaseShiftSW	The optimised phases shift for each possible bias frequency must be set in a table during the ground calibration (448 cases of each type of BDA)
4	SetPhotoDemod	PMW PhotoPhaseShiftMW	
5	SetPhotoDemod	PLW PhotoPhaseShiftLW	
6	SetPhotoDemod	T/C PhotoPhaseShiftTC	
7	SetPhotoBiasAmpl	PSW PhotoBiasAmplPSW	Optimised amplitude could be determined during the ground calibration
8	SetPhotoBiasAmpl	PMW PhotoBiasAmplPMW	
9	SetPhotoBiasAmpl	PLW PhotoBiasAmplPLW	
10	SetPhotoBiasAmpl	T/C PhotoBiasAmplTC	
11	SetPhSWJfetVSS	VSS1 PSW_VSS1	Optimised amplitude could be determined during the ground calibration
12	SetPhSWJfetVSS	VSS2 PSW_VSS2	
13	SetPhSWJfetVSS	VSS3 PSW_VSS3	
14	SetPhSWJfetVSS	VSS4 PSW_VSS4	
15	SetPhSWJfetVSS	VSS5 PSW_VSS5	
16	SetPhSWJfetVSS	VSS6 PSW_VSS6	
17	SetPhMWJfetVSS	VSS1 PMW_VSS1	
18	SetPhMWJfetVSS	VSS2 PMW_VSS2	
19	SetPhMWJfetVSS	VSS3 PMW_VSS3	

20	SetPhMWJfetVSS	VSS4 PMW_VSS4	
21	SetPhLWJfetVSS	VSS1 PLW_VSS1	
22	SetPhLWJfetVSS	VSS2 PLW_VSS2	
23	SetSWJfetPwr	PSW_JFET	All JFET on (PSW_JFET=111111)
24	SetMLWJfetPwr	PMLW_JFET	All JFET on (PMLW_JFET=111111)
25	SetPhotoBiasMode	PhotoBiasMode	Mode = EF (DAC mid-scale)
26	SetPhotoHeaterBias	PhotoHeaterBias	Start heating the photometer JFET modules Set PhotoHeaterBias with xx
	Wait xx ms		
27	SetPhotoHeaterBias	PhotoHeaterBias	Stop heating the photometer JFET modules Set PhotoHeaterBias with 00

2.2.8.1.2. Spectrometer

Steps	Command	Parameters	Comment
28	SetSpectroBiasFreq	SpectroMClkDiv	With a 10 MHz master clock for a photometer bias frequency of 160,1 Hz; SpectroMClkDiv = 122
29	SetSpectroSamplFreq	SpectroBiasDiv	Set a sampling frequency of 80 Hz; SpectroBiasDiv = 2
30	SetSpectroDemod	SW SpectroPhaseShiftSW	The optimised phases shift for each possible bias frequency must be set in a table during the ground calibration (448 cases of each type of BDA)
31	SetSpectroDemod	LW SpectroPhaseShiftLW	
32	SetSpectroBiasAmpl	SW SpectroBiasAmplSW	Optimised amplitude could be determine during the ground calibration
33	SetSpectroBiasAmpl	LW SpectroBiasAmplLW	
34	SetSpLWJfetVSS	VSS SLW_VSS	Optimised amplitude could be determine during the ground calibration
35	SetSpSWJfetVSS	VSS1 SSW_VSS2	
36	SetSpSWJfetVSS	VSS2 SSW_VSS2	
37	SetSpectroJfetPwr	SSLW_JFET	All JFET on (SSLW_JFET =111111)
38	SetSpectroBiasMode	SpectroBiasMode	Mode = EF (DAC mid scale)
39	SetSpectroHeaterBias	SpectroHeaterBias	Start heating the spectrometer JFET modules Set SpectroHeaterBias with xx
	Wait xx ms		
40	SetSpectroHeaterBias	SpectroHeaterBias	Stop heating the spectrometer JFET modules Set SpectroHeaterBias with 00

So after all those steps the spectrometer and the photometer JFETs are running. All the sine bias parameters and acquisition parameters are loaded and the bolometers biases receive a differential 0V.
Next step: start running the spectrometer or the photometer.

2.2.8.2. Photometer Configuration

Steps	Command	Parameters	Comment
1	SetPhotoBiasMode	PhotoBiasMode	Mode = FF
	Wait xx ms		After this time the system must be stable

2.2.8.3. Photometer offset setting

2.2.8.3.1. Automatic

Steps	Command	Parameters	Comment
1	SetStartFrame	start	Start=0
2	SetPhotoMode	Mode	Mode = 10
3	SetStartFrame	start	Start=1
	Wait xx ms		All the offset are set
4	SetStartframe	start	Start=0
5	SetPhotoMode	Mode	Mode = 18
6	SetStartFrame	start	Start=1
	Wait xx ms		All the offset are send to DPU

2.2.8.3.2. Manual

Steps	Command	Parameters	Comment
1	SetLIAP1Offset	Channel_P1 Offset_P1	Channel_P1=0 Offset_P1=X
-	-	-	-
32	SetLIAP1Offset	Channel_P1 Offset_P1	Channel_P1=31 Offset_P1=X
17	SetLIAP2Offset	Channel_P2 Offset_P2	Channel_P2=0 Offset_P2=X
-	-	-	-
32	SetLIAP2Offset	Channel_P2 Offset_P2	Channel_P2=31 Offset_P2=X
-	-	-	-
-	-	-	-
288	SetLIAP9Offset	Channel_P9 Offset_P9	Channel_P9=31 Offset_P9=X

2.2.8.4. Photometer acquisition

2.2.8.4.1. Continuous

Steps	Command	Parameters	Comment
1	SetStartFrame	start	Start=0
2	SetDataMode	Mode	Mode = 00
3	SetFrameNber	frame	Frame=0
4	SetStartMode	start	Start=1

2.2.8.4.2. Frame burst

Steps	Command	Parameters	Comment
1	SetStartFrame	start	Start=0
2	SetDataMode	Mode	Mode = 00
3	SetFrameNber	frame	Frame=x (1 to 255 = number of frames)
4	SetStartFrame	start	Start=1

2.2.8.5. Spectrometer Configuration

Steps	Command	Parameters	Comment
1	SetSpectroBiasMode	SpectroBiasMode	Mode = FF
	Wait xx ms		After this time the system must be stable

2.2.8.6. Spectrometer offset setting

2.2.8.6.1. Automatic

Steps	Command	Parameters	Comment
1	SetStartFrame	start	Start=0
2	SetSpectroMode	Mode	Mode = 14
3	SetStartFrame	start	Start=1
	Wait xx ms		All the offset are set
4	SetStartFrame	start	Start=0
5	SetSpectroMode	Mode	Mode = 1C
6	SetStartFrame	start	Start=1
	Wait xx ms		All the offset are send to DPU

2.2.8.6.2. Manual

Steps	Command	Parameters	Comment
1	SetLIAS1Offset	Channel_S1 Offset_S1	Channel_S1=0 Offset_S1=X
-	-	-	-
32	SetLIAS1Offset	Channel_S1 Offset_S1	Channel_S1=23 Offset_S1=X
17	SetLIAS2Offset	Channel_S2 Offset_S2	Channel_S2=0 Offset_S2=X
-	-	-	-
32	SetLIAS2Offset	Channel_S2 Offset_S2	Channel_S2=23 Offset_S2=X
-	-	-	-
-	-	-	-
288	SetLIAS3Offset	Channel_S3 Offset_S3	Channel_S3=23 Offset_S3=X

2.2.8.7. Spectrometer acquisition

2.2.8.7.1. Continuous

Steps	Command	Parameters	Comment
1	SetStartFrame	start	Start=0
2	SetDataMode	Mode	Mode = 04
4	SetStartFrame	start	Start=1

2.2.9. MCU specific command list summary

2.2.9.1. Forewords

The information given in the present document is limited to an overview of the MCU commands and parameters. Complete commands documentation will be found in AD2.

2.2.9.2. Command and parameter mapping

The following table shows respectively the bit mapping for CID and PAR field of a low-level command for the MCU.

CID11		CID8 to CID0	PAR15 to PAR0
R/$\overline{W}$	- *	Command Code	Parameter(s)

*: not used - set to zero

2.2.9.3. General commands

Important notice:

Those commands are only available in MCU initialisation phase before switching by means of the “SetBootRam” command from PROM to RAM program execution. Before executing this command it is mandatory to check the RAM integrity reported by the “BootStatusRegister” parameter. During this phase (INIT) other commands are not available.

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
GetBootStatusRegister	BootStatusRegister	Discrete	NA	
Set/GetDownloadConfig	DownloadParam	Discrete	Get... cmd	
Set/GetDownloadWord*	DownloadWord	0 to FFFF hexa	Get... cmd	
GetDownLoadCounter*	DownloadCounter	0 to FFFF hexa	NA	
SetBootRam	NA			

* for development phase only - not for flight

2.2.9.4. SMEC commands

2.2.9.4.1. Write/Read Commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
Set/GetSEncoderPwr	SEncoderPwr	0…7	Get... cmd	
Set/GetSLVDTPwr	SLVDTPwr	0/1	Get... cmd	
Set/GetSLaunchLatch	SLaunchLatch	1/2	Get... cmd	
Set/GetSLoopMode	SLoopMode	0…6	Get... cmd	
Set/GetSTrajEndPosition	STrajEndPos	0 to 65535	Get... cmd	
Set/GetSTrajStartPosition	STrajStartPos	0 to 65535	Get... cmd	
Set/GetSScanFwdSpeed	SScanFwdSpeed	0 to 65535	Get... cmd	
Set/GetSScanNumber	SScanN	0/1 to 65535	Get... cmd	
Set/GetSTrajMode	STrajMode	0…5	Get... cmd	
Set/GetSKp	SKp	0 to FFFF hexa	Get... cmd	
Set/GetSKd	SKd	0 to FFFF hexa	Get... cmd	
Set/GetSDerivFilter	SDerivFilt	0 to FFFF hexa	Get... cmd	
Set/GetSKi	SKi	0 to FFFF hexa	Get... cmd	
Set/GetSIntegrationLimit	SIntegratorLimit	0 to FFFF hexa	Get... cmd	
Set/GetSIntegrationThreshold	SIntegrationThreshold	0 to FFFF hexa	Get... cmd	
Set/GetSRateLimit	SRateLimit	0 to FFFF hexa	Get... cmd	
Set/GetSDerivFilter2	SDerivFilter2	0 to FFFF hexa	Get... cmd	
Set/GetSFeedFwdDiffGain	SFeedFwdDiffGain	0 to FFFF hexa	Get... cmd	
Set/GetSFeedFwdGain	SFeedFwdGain	0 to FFFF hexa	Get... cmd	
Set/GetSFeedFwdOffset	SFeedFwdOffset	0 to FFFF hexa	Get... cmd	
Set/GetSScanRevSpeed	ScanRevSpeed	0 to FFFF hexa	Get... cmd	
Set/GetLVDTLUT	LVDTLUTAdd LVDTLUTVal	0…15 0…4095	Get... cmd	
Set/GetLVDTOffset	LVDTOffset	0 to FFFF hexa	Get... cmd	
Set/GetLVDTScale	LVDTScale	0 to FFFF hexa	Get... cmd	
Set/GetSMotorBEMFGain	SMotorBEMFGain	0 to FFFF hexa	Get... cmd	
Set/GetSMotorResistance	SMotorResistance	0 to FFFF hexa	Get... cmd	
Set/GetSMotorInductance	SMotorInductance	0 to FFFF hexa	Get... cmd	
Set/GetSRateScaleFactor	SRateScaleFactor	0 to FFFF hexa	Get... cmd	
Set/GetSPositionScaleFactor	SPositionScaleFactor	0 to FFFF hexa	Get... cmd	
Set/GetSBEMFRateFilter1	SBEMFRateFilter1	0 to FFFF hexa	Get... cmd	
Set/GetSBEMFRateFilter2	SBEMFRateFilter2	0 to FFFF hexa	Get... cmd	

2.2.9.4.2. Read only commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
GetSMECStatus	SMECStatus	Discrete	NA	
GetSEncoderIncrPosition	SEncodIncrPos	0 to FFFF hexa	NA	
GetSEncoderSignal1	SEncoderfS1	0 to FFFF hexa	NA	
GetSEncoderSignal2	SEncoderS2	0 to FFFF hexa	NA	
GetSEncoderSignal3	SEncoderS3	0 to FFFF hexa	NA	
GetLVDTPosition	LVDTPosition	0 to FFFF hexa	NA	
GetLVDTAC	LVDTAC	0 to FFFF hexa	NA	
GetLVDTDC	LVDTDC	0 to FFFF hexa	NA	
GetTrajectoryPosition	TrajectoryPosition	0 to FFFF hexa	NA	
GetSmecDACValue	SmecDACValue	0 to FFFF hexa	NA	
GetEncLVDTPosDelta	EncLVDTPosDelta	0 to FFFF hexa	NA	
GetEncoderFinePosition	EncoderFinePosition	0 to FFFF hexa	NA	
GetMeanSpeed	MeanSpeed	0 to FFFF hexa	NA	
GetMeanPositionError	MeanPosError	0 to FFFF hexa	NA	
GetSMotorCurrent	SMotorCurrent	0 to FFFF hexa	NA	
GetSBEMF	SBEMF	0 to FFFF hexa	NA	

2.2.9.4.3. Write only commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
SetEncoderSignal1Amp	EncoderSignal1Amp	0 to FFFF hexa	NA	
SetEncoderSignal1Offset	EncoderSignal1Offset	0 to FFFF hexa	NA	
SetEncoderSignal2Amp	EncoderSignal2Amp	0 to FFFF hexa	NA	
SetEncoderSignal2Offset	EncoderSignal2Offset	0 to FFFF hexa	NA	
SetEncoderSignal3Amp	EncoderSignal3Amp	0 to FFFF hexa	NA	
SetEncoderSignal3Offset	EncoderSignal3Offset	0 to FFFF hexa	NA	

2.2.9.5. Chop commands

2.2.9.5.1. Write/Read commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
Set/GetCSensorPwr	CSensorPwr	0/1	Get... cmd	
Set/GetBSMLaunchLatch	BSMLaunchLatch	0/1	Get... cmd	
SetChopLoopMode	ChopLoopMode	0…3	NA	
Set/GetChopTargetPos	ChopTargetPos	0 to FFFF hexa	Get... cmd	
Set/GetBSMMove	BSMMove	0…2	Get... cmd	
Set/GetCKp	CKp	0 to FFFF hexa	Get... cmd	
Set/GetCKd	CKd	0 to FFFF hexa	Get... cmd	
Set/GetCKi	Cki	0 to FFFF hexa	Get... cmd	
Set/GetCIntegThreshold	CIntegThreshold	0 to FFFF hexa	Get... cmd	
Set/GetCIntegLimit	CIntegLimit	0 to FFFF hexa	Get... cmd	
Set/GetCFeedFwdGain	CFeedFwdGain	0 to FFFF hexa	Get... cmd	
Set/GetCFeedFwdDiffG	CFeedFwdDiffG	0 to FFFF hexa	Get... cmd	
Set/GetDiffFilterTC1	DiffFilterTC1	0 to FFFF hexa	Get... cmd	
Set/GetDiffFilterTC2	DiffFilterTC2	0 to FFFF hexa	Get... cmd	
SetCRateLimit	CRateLimit	0 to FFFF hexa	Get... cmd	
Set/GetCMotorBEMFGain	CMotorBEMFGain	0 to FFFF hexa	Get... cmd	
Set/GetCMotorResistance	CMotorResistance	0 to FFFF hexa	Get... cmd	
Set/GetCMotorInductance	CMotorInductance	0 to FFFF hexa	Get... cmd	
Set/GetCRateScaleFactor	CRateScaleFactor	0 to FFFF hexa	Get... cmd	
Set/GetCPosScaleFactor	CPosScaleFactor	0 to FFFF hexa	Get... cmd	
Set/GetCBEMFRateFilter1	CBEMFRateFilter1	0 to FFFF hexa	Get... cmd	
Set/GetCBEMFRateFilter2	CBEMFRateFilter2	0 to FFFF hexa	Get... cmd	

2.2.9.5.2. Read only commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
GetCMeanPosError	CMeanPosError	0 to FFFF hexa	NA	
GetCMagResSignal	CMagResSignal	0 to FFFF hexa	NA	
GetCDACValue	CDACValue	0 to FFFF hexa	NA	
GetCMotorCurrent	CMotorCurrent	0 to FFFF hexa	NA	
GetCBEMF	CBEMF	0 to FFFF hexa	NA	

2.2.9.6. Jiggle commands

2.2.9.6.1. Write/Read commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
Set/GetJSensorPwr	JSensorPwr	0/1	Get... cmd	
SetJigLoopMode	JigLoopMode	0…3	NA	
Set/GetJigTargetPos	JigTargetPos	0 to FFFF hexa	Get... cmd	
Set/GetJKp	JKp	0 to FFFF hexa	Get... cmd	
Set/GetJKd	JKd	0 to FFFF hexa	Get... cmd	
Set/GetJKi	Jki	0 to FFFF hexa	Get... cmd	
Set/GetJIntegThres	JIntegThres	0 to FFFF hexa	Get... cmd	
Set/GetJIntegLimit	JIntegLimit	0 to FFFF hexa	Get... cmd	
Set/GetJFeedFwdGain	JFeedFwdGain	0 to FFFF hexa	Get... cmd	
Set/GetJFeedFwdDiffG	JFeedFwdDiffG	0 to FFFF hexa	Get... cmd	
Set/GetJDiffFilterTC1	JDiffFilterTC1	0 to FFFF hexa	Get... cmd	
Set/GetJDiffFilterTC2	JDiffFilterTC2	0 to FFFF hexa	Get... cmd	
Set/GetJRateLimit	JRateLimit	0 to FFFF hexa	Get... cmd	
Set/GetJMotorBEMFGain	JMotorBEMFGain	0 to FFFF hexa	Get... cmd	
Set/GetJMotorResistance	JMotorResistance	0 to FFFF hexa	Get... cmd	
Set/GetJMotorInductance	JMotorInductance	0 to FFFF hexa	Get... cmd	
Set/GetJRateScaleFactor	JRateScaleFactor	0 to FFFF hexa	Get... cmd	
Set/GetJPosScaleFactor	JPosScaleFactor	0 to FFFF hexa	Get... cmd	
Set/GetJBEMFRateFilter1	JBEMFRateFilter1	0 to FFFF hexa	Get... cmd	
Set/GetJBEMFRateFilter2	JBEMFRateFilter2	0 to FFFF hexa	Get... cmd	

2.2.9.6.2. Read only

NA

2.2.9.7. Telemetry and trace configuration commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
Set/GetTP10SampFreq	TP10SampFreq	0 to xxxx hexa	Get... cmd	
Set/GetTP12SampFreq	TP12SampFreq	0 to xxxx hexa	Get... cmd	
Set/GetTP14SampFreq	TP14SampFreq	0 to xxxx hexa	Get... cmd	
Set/GetTP15SampFreq	TP15SampFreq	0 to xxxx hexa	Get... cmd	
Set/GetPack10Param1 … Set/Get Pack10Param6	Pack10Param1 to Pack10Param6	0 to FFFF hexa	Get... cmd	
Set/GetPack14Param1 … Set/Get Pack14Param14	Pack14Param1 to Pack14Param14	0 to FFFF hexa	Get... cmd	
Set/GetTelemetryStatus	TelemetryStatus	0…3	Get… cmd	

2.2.9.8. HK and miscellaneous commands

Command Name	Argument(s)	Ranges	Command verification	Execution Delay
GetMACTemp	MACTemp	0 to FFFF hexa	NA	
GetSMECTemp	SMECTemp	0 to FFFF hexa	NA	
GetBSMTemp	BSMTemp	0 to FFFF hexa	NA	
GetP15V	P15V	0 to FFFF hexa	NA	
GetM15V	M15V	0 to FFFF hexa	NA	
GetP13V	P13V	0 to FFFF hexa	NA	
GetM13V	M13V	0 to FFFF hexa	NA	
GetP5V	P5V	0 to FFFF hexa	NA	
SetDPUPollingTime	DPUPollingT	0 to FFFF hexa	NA	
GetErrorCode	ErrorCode	Discrete	NA	
GetSchedCntLSW	SchedCntLSW	0 to FFFF hexa	NA	
GetSchedCntMSW	SchedCntMSW	0 to FFFF hexa	NA	
SetWarmReset	WarmReset	NA	NA	

2.2.10. MCU command description

For MCU full command description please refer to AD2.

2.2.11. MCU parameter description

For MCU full parameter description please refer to AD2.

2.2.12. MCU typical commanding scenarios

For typical commanding scenarios please refer to AD2 chapter 4.

2.2.13. SCU specific command list summary

2.2.13.1. Command and parameter mapping

The following table shows respectively the bit mapping for CID and PAR field of a low-level command for the SCU.

CID11	CID10 to CID0	PAR15 to PAR0
R/$\overline{W}$	Command Code	Parameter(s)

2.2.13.2. Write/read commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
Set/GetFrameConf	Frame type Frame Rate	0/1 0 to 255	Get... cmd	
Set/GetSeqLength	Frame Number	0 to 15	Get... cmd	
Set/GetTempOnOff	On/Off Word	NA	Get... cmd	
Set/GetSubKOnOff	On/Off bit	0/1	Get... cmd	
Set/GetDRelOnOff	On/Off Word	NA	Get... cmd	
Set/GetSPHSHeatB	Heater Current (Set) Heater Voltage (Get)	0 to 4095 0 to 65355	Get... cmd	
Set/GetEVHSHeatB	Heater Current (Set) Heater Voltage (Get)	0 to 4095 0 to 65355	Get... cmd	
Set/GetTCHeaterB	Heater Current (Set) Heater Voltage (Get)	0 to 4095 0 to 65355	Get... cmd	
Set/GetSPHeaterB	Heater Current (Set) Heater Voltage (Get)	0 to 4095 0 to 65355	Get... cmd	
Set/GetPhCalBias	Heater Current (Set) Heater Voltage (Get)	0 to 4095 0 to 65355	Get... cmd	
Set/GetSCal4Bias	Heater Current (Set) Heater Voltage (Get)	0 to 4095 0 to 65355	Get... cmd	
Set/GetSCal2Bias	Heater Current (Set) Heater Voltage (Get)	0 to 4095 0 to 65355	Get... cmd	
Set/GetScuContrl	ScuStatus reset ctrl bit	0/1	Get... cmd	
Set/GetFramCtrl	Frame transfer start/stop	0/1	Get... cmd	

2.2.13.3. Read only commands

Command Name	Argument(s)	Ranges List	Command verification	Execution Delay
GetScuStatus	ScuStatus	0 to FFFF hexa	NA	
GetCsuTempRd	CsuTemp	0 to FFFF hexa	NA	
GetTsuTempRd	TsuTemp	0 to FFFF hexa	NA	
GetPsuTemp1Rd	PsuTemp1	0 to FFFF hexa	NA	
GetPsuTemp2Rd	PsuTemp2	0 to FFFF hexa	NA	
GetScuCHTp05	ScuCHTp05	0 to FFFF hexa	NA	
GetScuCHTp09	ScuCHTp09	0 to FFFF hexa	NA	
GetScuCHTn09	ScuCHTn09	0 to FFFF hexa	NA	
GetCPHPtemp	CPHPtemp	0 to FFFF hexa	NA	
GetCPHStemp	CPHStemp	0 to FFFF hexa	NA	
GetCEHStemp	CEHStemp	0 to FFFF hexa	NA	
GetCSHTtemp	CSHTtemp	0 to FFFF hexa	NA	
GetSOBtemp	SOBPtemp	0 to FFFF hexa	NA	
GetSL0temp	SL0Ptemp	0 to FFFF hexa	NA	
GetPL0temp	PL0temp	0 to FFFF hexa	NA	
GetSUBtemp	SUBtemp	0 to FFFF hexa	NA	
GetBAFtemp	BAFPtemp	0 to FFFF hexa	NA	
GetBSMStemp	BSMStemp	0 to FFFF hexa	NA	
GetSCL2temp	SCL2temp	0 to FFFF hexa	NA	
GetSCL4temp	SCL4temp	0 to FFFF hexa	NA	
GetSCSTtemp	SCSTtemp	0 to FFFF hexa	NA	
GetFTSStemp	FTSStemp	0 to FFFF hexa	NA	
GetFTSMtemp	FTSMtemp	0 to FFFF hexa	NA	
GetBSMMtemp	BSMMtemp	0 to FFFF hexa	NA	
GetCEVTemp	CEVTemp	0 to FFFF hexa	NA	
GetPhCalVolt	PhCalVolt	0 to FFFF hexa	NA	
GetSCal4Volt	SCal4Volt	0 to FFFF hexa	NA	
GetSCal2Volt	SCal2Volt	0 to FFFF hexa	NA	
GetScuCHT25	ScuCHT25	0 to FFFF hexa	NA	
GetScuCHTref	ScuCHTref	0 to FFFF hexa	NA	
GetScuCHTgnd	ScuCHTgnd	0 to FFFF hexa	NA	
GetScuTHTref	ScuTHTref	0 to FFFF hexa	NA	
GetScuTHTgnd	ScuTHTgnd	0 to FFFF hexa	NA	

2.2.14. SCU command description

2.2.14.1. Read/Write commands

2.2.14.1.1. FrameConf

Command	Unit	Code	Description
SetFrameConf	SCU	083	Set frame rate and type (normal/test pattern)
Parameters	Location	Length	
FrameConf	0	16	Bit 15: FrameType Bit 14 to 08: don't care Bit 07 to 00: FrameRate

Command	Unit	Code	Description
GetFrameConf	SCU	883	Return frame rate and type (normal/test pattern)
Returned Parameter(s)	Location	Length	
FrameConf	0	16	Bit 15: FrameType Bit 14 to 08: null Bit 07 to 00: FrameRate

2.2.14.1.2. SeqLength

Command	Unit	Code	Description
SetSeqLength	SCU	084	Set number of frame per sequence
Parameters	Location	Length	
SeqLength	0	5	Bit 4 to 0: frame number 0 hexa = infinite 1 to 1F hexa = number of frame to be successively transmitted

Command	Unit	Code	Description
GetFramRate	SCU	884	Return number of frame per sequence
Returned Parameters	Location	Length	
SeqLength	0	5	

2.2.14.1.3. TempOnOff

Command	Unit	Code	Description
SetTempOnOff	SCU	085	Set standard FPU temperature probes bias on/off
Parameters	Location	Length	
TempOnOff	0	16	Bit 15 to 0: 16 bits on/off word

Command	Unit	Code	Description
GetTempOnOff	SCU	885	Return standard FPU temperature probes bias on/off
Returned Parameters	Location	Length	
TempOnOff	0	16	Bit 15 to 0: 16 bits on/off word

2.2.14.1.4. SubKOnOff

Command	Unit	Code	Description
SetSubKOnOff	SCU	086	Set sub K temperature probe bias on/off
Parameters	Location		
SubKOnOff	0	1	Bit 0: on/off flag

Command	Unit	Code	Description
GetSubKpOnOff	SCU	886	Return sub K temperature probe bias on/off
Returned Parameters	Location		
SubKpOnOff	0	1	Bit 0: on/off flag

2.2.14.1.5. DRelOnOff

Command	Unit	Code	Description
SetDRelOnOff	SCU	087	Set DCDC on/off command word
Parameters	Location	Length	
DRelOnOff	0	3	Bit 2 to 0: on/off flags

Command	Unit	Code	Description
GetDRelOnOff	SCU	887	Return DCDC on/off command word
Returned Parameters	Location	Length	
DRelOnOff	0	3	Bit 2 to 0: on/off flags

2.2.14.1.6. EVHSHeatB

Command	Unit	Code	Description
SetEVHSHeatB	SCU	0C4	Set value of current applied to cryo-cooler evaporator heat switch
Parameters	Location	Length	
EVHSHeatCurSP	0	12	Current value (set DAC)

Command	Unit	Code	Description
GetEVHSHeatB	SCU	8C4	Get voltage across cryo-cooler evaporator heat switch
Returned Parameters	Location	Length	
EVHSHeatVolt	0	16	Heater voltage analog value

2.2.14.1.7. SPHSHeatB

Command	Unit	Code	Description
SetSPHSHeatB	SCU	0C5	Set value of current applied to cryo-cooler sorption pump heat

			switch
Parameters	Location	Length	
SPHSHeatCurSP	0	12	Current value (set DAC)

Command	Unit	Code	Description
GetSPHSHeatB	SCU	8C5	Get voltage across cryo-cooler sorption pump heat switch
Returned Parameters	Location	Length	
SPHSHeatVolt	0	16	Heater voltage analog value

2.2.14.1.8. TCHeaterB

Command	Unit	Code	Description
SetTCHeaterB	SCU	0C6	Set value of current applied to FPU thermal control heater
Parameters	Location	Length	
TCHeaterCurSP	0	12	Current value (set DAC)

Command	Unit	Code	Description
GetTCHeaterB	SCU	8C6	Get voltage across FPU thermal control heater
Returned Parameters	Location	Length	
TCHeaterVolt	0	16	Heater voltage analog value

2.2.14.1.9. SPHeaterB

Command	Unit	Code	Description
SetSPHeaterB	SCU	0C7	Set value of current applied to cryo-cooler sorption pump
Parameters	Location	Length	
SPHeaterCurSP	0	12	Current value (set DAC)

Command	Unit	Code	Description
GetSPHeaterB	SCU	8C7	Get voltage across cryo-cooler sorption pump
Returned Parameters	Location	Length	
SPHeaterVolt	0	16	Heater voltage analog value

2.2.14.1.10. PhCalBias

Command	Unit	Code	Description
SetPhCalBias	SCU	0C8	Set value of current applied to Stimulus Source PCal (set DAC)
Parameters	Location	Length	
PhCalCurSP	0	12	Current value

Command	Unit	Code	Description
GetPhCalBias	SCU	8C8	Get current in Stimulus Source 1 PCal
Returned Parameters	Location	Length	
PhCalCur	0	16	Stimulus source current analog value

2.2.14.1.11. SCal2Bias

Command	Unit	Code	Description
SetSCal2Bias	SCU	0CA	Set value of current applied to Stimulus Source SCal 2%
Parameters	Location	Length	
SCal2CurSP	0	12	Current value

Command	Unit	Code	Description
GetSCal2Bias	SCU	8CA	Get current in Stimulus Source SCal 2%
Returned Parameters	Location	Length	
SCal2Cur	0	16	Stimulus source current analog value

2.2.14.1.12. SCal4Bias

Command	Unit		Description
SetSCal4Bias	SCU	0CC	Set value of current applied to Stimulus Source SCal 4%
Parameters	Location	Length	
SCal4CurSP	0	12	Current value

Command	Unit	Code	Description
GetSCal4Bias	SCU	8CC	Get current in Stimulus Source SCal 4%
Returned Parameters	Location	Length	
SCal4Cur	0	16	Stimulus source current analog value

2.2.14.1.13. ScuContrl

Command	Unit	Code	Description
SetScuContrl	SCU	081	Initiate frame sequence transfer
Parameters	Location	Length	
ScuContrl	0	1	Reset ScuStatus register (active low)

Command	Unit	Code	Description
Get SetScuContrl	SCU	881	Get ScuContrl parameter status
Returned Parameter(s)	Location	Length	
SetScuContrl	0	1	

2.2.14.1.14. FrameCtrl

Command	Unit	Code	Description
SetFrameCrtl	SCU	082	Initiate frame sequence transfer
Parameters	Location	Length	
FrameCtrl	0	1	On/off frame transfer (auto cleared after sequence completion)

Command	Unit	Code	Description
GetSCal4Bias	SCU	882	Get FrameCtrl parameter status
Returned Parameter(s)	Location		
FrameCtrl	0	1	

2.2.14.2. Read only commands

2.2.14.2.1. ScuStatus

Command	Unit	Code	Description
GetScuStatus	SCU	880	Get SCU electronics status
Parameters	Location	Length	
ScuStatus	0	3	TEMP & CCHK ADC latch-up status register - Reset by the ScuContrl command

2.2.14.2.2. CsuTempRd

Command	Unit	Code	Description
GetCsuTempRd	SCU	8C0	Return CCHK board temperature sensor value
Returned Parameter(s)	Location	Length	
CsuTempRd	0	16	Probe current analog value (function of the temperature)

2.2.14.2.3. TsuTempRd

Command	Unit	Code	Description
GetTsuTempRd	SCU	8C1	Return TEMP board temperature sensor value
Returned Parameter(s)	Location	Length	
TsuTempRd	0	16	Probe current analog value (function of the temperature)

2.2.14.2.4. PsuTmp1Rd

Command	Unit	Code	Description
GetPsuTmp1Rd	SCU	8C2	Return PSU board temperature sensor 1 value
Returned Parameter(s)	Location	Length	
PsuTmp1Rd	0	16	Probe current analog value (function of the temperature)

2.2.14.2.5. PsuTmp2Rd

Command	Unit	Code	
GetPsuTmp2Rd	SCU	8C3	Return PSU board temperature sensor 2 value
Returned Parameter(s)	Location	Length	
PsuTmp2Rd	0	16	Probe current analog value (function of the temperature)

2.2.14.2.6. PhCalVolt

Command	Unit	Code	Description
GetPhCalVolt	SCU	8C9	Get voltage across Stimulus Source PCal
Parameters	Location	Length	
PhCalVolt	0	16	Voltage analog value

2.2.14.2.7. SCal2Volt

Command	Unit	Code	Description
GetSCal2Volt	SCU	8CB	Get voltage across Stimulus Source SCal2
Parameters	Location	Length	
SCal2Volt	0	16	Voltage analog value

2.2.14.2.8. SCal4Volt

Command	Unit	Code	Description
GetSCal4Volt	SCU	8CD	Get voltage across Stimulus Source SCal4
Parameters	Location	Length	
SCal4Volt	0	16	Voltage analog value

2.2.14.2.9. ScuCHTn09

Command	Unit	Code	Description
GetScuCHTn09	SCU	8CE	Return value of -09V of SCU/CCHK&TEMP
Returned Parameter(s)	Location		
ScuCHTn09	0	16	Voltage analog value

2.2.14.2.10. ScuCHTp09

Command	Unit	Code	Description
GetScuCHTp09	SCU	8CF	Return value of +09V of SCU/CCHK&TEMP
Returned Parameter(s)	Location		
ScuCHTp09	0	16	Voltage analog value

2.2.14.2.11. ScuCHTp05

Command	Unit	Code	Description
GetScuCHTp05	SCU	8D0	Return value of +05V of SCU/CCHK&TEMP
Returned Parameter(s)	Location	Length	
ScuCHTp05	0	16	Voltage analog value

2.2.14.2.12. ScuCHT25

Command	Unit	Code	Description
GetScuCHTref	SCU	8D1	Return CCHK internal 2.5 Vreference voltage - For internal calibration purpose
Returned Parameter(s)		Length	
ScuCHTref	0	16	CCHK internal reference voltage measure

2.2.14.2.13. ScuCHTref

Command	Unit	Code	Description
GetScuCHTref	SCU	8D2	Return CCHK internal reference voltage - For internal calibration purpose
Returned Parameter(s)	Location	Length	
ScuCHTref	0	16	CCHK internal reference voltage measure

2.2.14.2.14. ScuCHTgnd

Command	Unit	Code	
GetScuCHTgnd	SCU	8D3	Return CCHK internal ground reference voltage - For internal calibration purpose
Returned Parameter(s)	Location	Length	
ScuCHTgnd	0	16	CCHK internal ground reference voltage measure

2.2.14.2.15. CPHPtemp

Command	Unit	Code	Description
GetCPHPtemp	SCU	8E0	Return FPU temperature of cryo-cooler sorption pump heater
Returned Parameter(s)	Location	Length	
CPHPtemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.16. CPHStemp

Command	Unit	Code	Description
GetCPHStemp	SCU	8E1	Return FPU temperature of cryo-cooler sorption pump heat switch
Returned Parameter(s)		Length	
CPHStemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.17. CEHStemp

Command	Unit	Code	Description

GetCEHStemp	SCU	8E2	Return FPU temperature of cryo-cooler evaporator heat switch
Returned Parameter(s)	Location	Length	
CEHStemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.18. CSHTtemp

Command	Unit	Code	Description
GetCSHTtemp	SCU	8E3	Return FPU temperature of cryo-cooler thermal shunt
Returned Parameter(s)	Location	Length	
CSHTtemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.19. SOBtemp

Command	Unit	Code	Description
GetSOBtemp	SCU	8E4	Return FPU temperature SPIRE optical bench
Returned Parameter(s)	Location	Length	
SOBtemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.20. SL0temp

Command	Unit	Code	Description
GetSL0temp	SCU	8E5	Return FPU temperature of spectrometer L0
Returned Parameter(s)	Location	Length	
SL0temp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.21. PL0temp

Command	Unit	Code	Description
GetPL0temp	SCU	8E6	Return FPU temperature of photometer L0
Returned Parameter(s)	Location	Length	
PL0temp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.22. SUBtemp

Command	Unit		Description
Get SUBtemp	SCU	8E7	Return FPU temperature of optical sub-bench
Returned Parameter(s)	Location	Length	
SUBtemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.23. BAFtemp

Command	Unit		Description
GetBAFtemp	SCU	8E8	Return FPU temperature of input baffle
Returned Parameter(s)	Location	Length	
BAFtemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.24. BSMStemp

Command	Unit	Code	
GetBSMStemp	SCU	8E9	Return FPU temperature of BSM/SOB i/f
Returned Parameter(s)	Location	Length	
BSMStemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.25. SCL2temp

Command	Unit	Code	Description
Get SCL2temp	SCU	8EA	Return FPU temperature of spectrometer calibrator %2
Returned Parameter(s)	Location	Length	
SCL2temp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.26. SCL4temp

Command	Unit	Code	Description
GetSCL4temp	SCU	8EB	Return FPU temperature of spectrometer calibrator %4
Returned Parameter(s)	Location	Length	
SCL4temp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.27. SCSTtemp

Command	Unit	Code	Description
GetSCSTtemp	SCU	8EC	Return FPU temperature spectrometer calibration flange
Returned Parameter(s)	Location	Length	
SCSTtemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.28. FTSStemp

Command	Unit	Code	Description
GetFTSStemp	SCU	8ED	Return FPU temperature of SMEC/SOB i/f
	Location	Length	
FTSStemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.29. FTSMtemp

Command	Unit	Code	Description
GetFTSMtemp	SCU	8EE	Return FPU temperature of SMEC mechanism
Returned Parameter(s)	Location	Length	
FTSMtemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.30. BSMMtemp

Command	Unit	Code	Description
GetBSMMtemp	SCU	8EF	Return FPU temperature of BSM mechanism
Returned Parameter(s)	Location	Length	
BSMMtemp	0	16	Probe current analog value (function of the temperature)

2.2.14.2.31. CEVTemp

Command	Unit	Code	Description
GetCEVTemp	SCU	8F0	Return subK temperature of cryo-cooler evaporator
Returned Parameter(s)	Location	Length	
CEVTemp	0	16	Probe voltage analog value (function of the temperature)

2.2.14.2.32. ScuTHTref

Command	Unit		Description
GetScuTHTref	SCU	8F1	Return TEMP internal reference voltage - For internal calibration purpose
Returned Parameter(s)	Location	Length	
ScuTHTref	0	16	TEMP internal reference voltage measure

2.2.14.2.33. ScuTHTgnd

Command	Unit	Code	Description
GetScuTHTgnd	SCU	8F2	Return TEMP internal ground reference voltage - For internal calibration purpose
Returned Parameter(s)	Location	Length	
ScuTHTgnd	0	16	TEMP internal ground reference voltage measure

2.2.15. SCU parameters description (to be completed)

Name	Type	Size	Conversion	Limits	Description
FrameRate	Discrete	8		0 to 255	Set value
SeqLength	Discrete				Set value
TempOnOff	Discrete				Set word
DRelOnOff	Discrete				Set word
SPHSHeatCurSP	Analogue				Set point
EVHSHeatCurSP	Analogue				Set point
TCHeaterCurSP	Analogue				Set point
SPHeaterCurSP	Analogue				Set point
SPHSHeatVolt	Analogue				Measure
EVHSHeatVolt	Analogue				Measure
TCHeaterVolt	Analogue				Measure
SPHeaterVolt	Analogue				Measure
PhCalCurSP	Analogue				Set point
SCal4CurSP	Analogue				Set point
SCal2CurSP	Analogue				Set point
PhCalCur	Analogue				Measure
SCal4Cur	Analogue				Measure
SCal2Cur	Analogue				Measure
PhCalVolt	Analogue				Measure
SCal4Volt	Analogue				Measure
SCal2Volt	Analogue				Measure
ScuCHTp05	Analogue				Measure
ScuCHTp09	Analogue				Measure
ScuCHTn09	Analogue				Measure
CPHPtemp	Analogue				Measure
CPHStemp	Analogue				Measure
CEHStemp	Analogue				Measure
CSHTtemp	Analogue				Measure
SOBtemp	Analogue				Measure
SL0temp	Analogue				Measure
PL0temp	Analogue				Measure
SUBtemp	Analogue				Measure
BAFtemp	Analogue				Measure
BSMStemp	Analogue				Measure
SCL2temp	Analogue				Measure
SCL4temp	Analogue				Measure
SCSTtemp	Analogue				Measure
FTSStemp	Analogue				Measure
FTSMtemp	Analogue				Measure
BSMMtemp	Analogue				Measure
SubKTempP	Analogue				Measure
CsuTempRd	Analogue				Measure
TsuTempRd	Analogue				Measure
PsuTempRd1	Analogue				Measure
PsuTempRd2	Analogue				Measure

2.2.16. SCU typical commanding scenarios

TBW

2.3. Data Interface

2.3.1. General Information

The Data Interface is dedicated to data transfer from subsystem to DPU. Three independent "Data Interface" are required allowing simultaneous DRCU data transfer.
This interface is unidirectional: data are transferred from the DRCU sub-units to the DPU acquisition electronics. Fixed data packets are defined according to sub-unit operating mode.
This data packet contents both scientific data (i.e. bolometer signal) and/or housekeeping parameters.

2.3.2. Overall Interface Diagram

The Command Interface diagram is given in figure 2.3-a Prime and Redundant interfaces are shown.

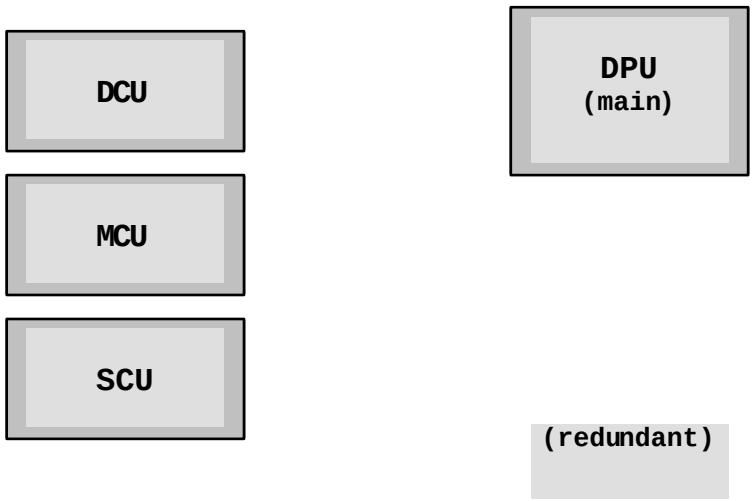


Figure 2.3-a

2.3.3. Interface Circuit

The interface is a synchronous serial link based on one data line (DTA) associated to a clock line (CLK) for bit synchronisation and a gate line (GAT) for word synchronisation. Each sub-unit implements a complete set of signals: that is the DPU implements 3 totally independent Data interfaces each having 3 receivers (as shown by figure 2.3-b).
The interface uses the balanced line RS422 electrical standard based on 26C31 and 26C32 transmitter and receiver type respectively.

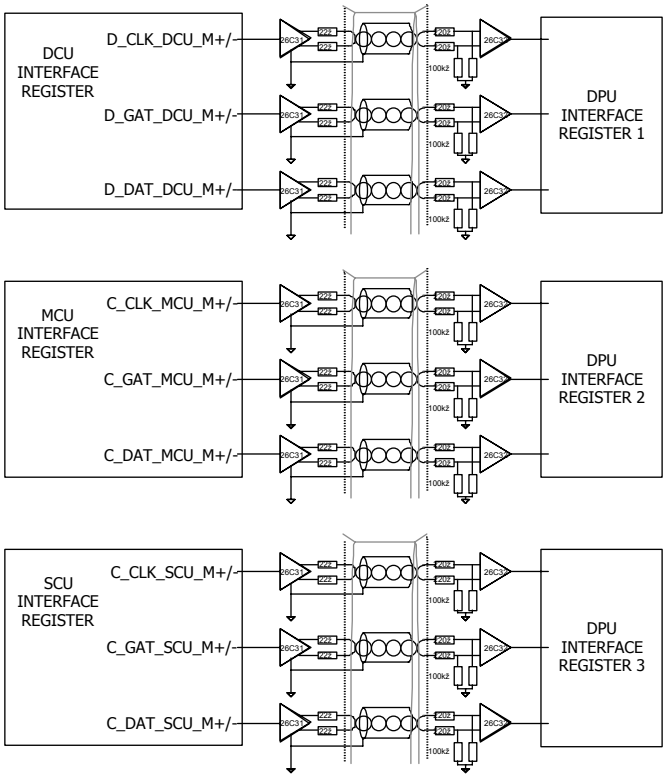


Figure 2.3-b - Electrical configuration

2.3.4. Word definition

Word definition is subsystem dependent. Data are currently 16-bit encoded and correspond to bolometer signal, mechanisms motion parameters, instrument temperature and all other housekeeping channels.
In order to deal with the latch-up effect of the analogue to digital converters (see RD01), which cause the generation of wrong data until the converter recovers full performances, a specific “invalid” data identifier is defined. This avoids the DRCU to transfer unpredictable packet length following a cosmic ray impact on the converter and later on-ground misanalysis.

These data words are defined as follow:

DAT15 to DAT0

Figure 3.4-a - Data Word Definition

DAT15 to DAT0: data

Note: • MSB (DAT15) is transmitted first

2.3.5. General Frame Definition

Data frame length and structure are defined regarding the DRCU sub-unit and its mode of operation. The sub-systems data structures are encapsulated into a common frame structure as described bellow (except two MCU modes).

The frame is composed of transmitted successively according to the order:

- a length word (1 word)
- a frame ID (1 word)
- a data structure (n words)
- a frame time (2 words)
- a check word (1 word)

2.3.5.1. Length

The "length" field (16 bits) is placed at the head of the frame. It indicates the number of 16-bit words of the frame (including all the fields). Along with the "frame ID" and "check word" fields this field allows frame consistency checking by the receiver unit.

2.3.5.2. Frame ID

The "frame ID" field is a 16-bit word following the "length" word. Along with the "length" field and the "check" word it allows data consistency checking. In case the check fails the DPU takes action to resynchronise with the data stream.
The purpose of the frame ID is to enable identifying to frame after packing by the DPU. A specific code is allocated for each frame type of each DRCU S/S. The following table shows the identifier allocation:

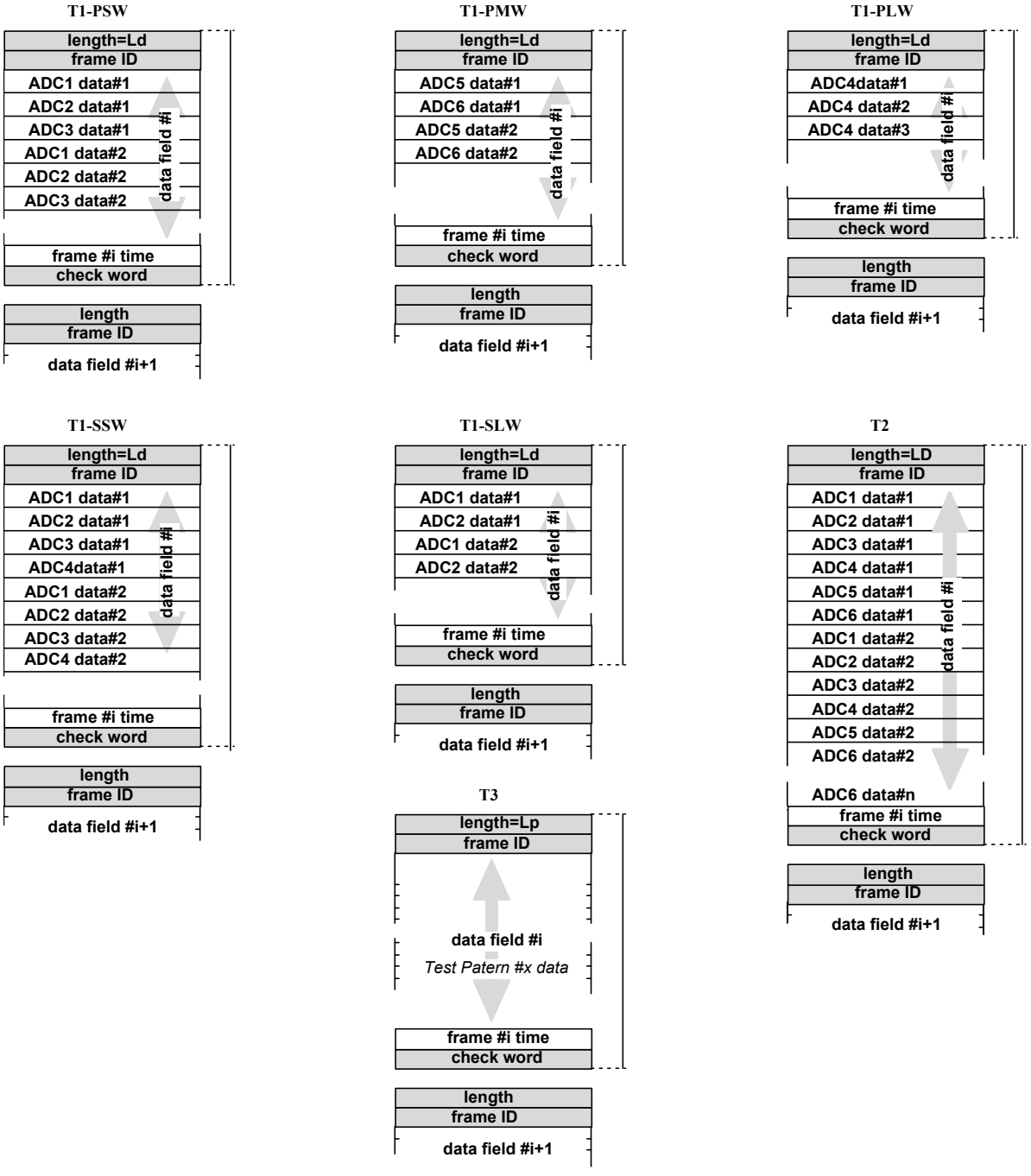
UNIT	Frame Type	Frame ID (hex)
DCU	Ph Full Array	00
DCU	Sp Full array	01
DCU	P-SW	02
DCU	P-MW	03
DCU	P-LW	04
DCU	S-SW	05
DCU	S-LW	06
DCU	Ph Offset	07
DCU	Sp Offset	08
DCU	Ph Full Test Pattern	09
DCU	P-SW Test Pattern	0A
DCU	P-MW Test Pattern	0B
DCU	P-LW Test Pattern	0C
DCU	Sp Test Pattern	0D

UNIT	Frame Type	Frame ID (hex)
DCU	S-SW Test Pattern	0E
DCU	S-LW Test Pattern	0F
MCU	SMEC ~~scan~~	10
~~MCU~~	~~SMEC Step~~	~~11~~
MCU	BSM~~Chop~~	12
~~MCU~~	~~Jiggle~~	~~13~~
MCU	Engineering	14
MCU	Test Pattern	15
MCU	Not Allocated	16-1F
SCU	HSK	20
SCU	Test Pattern	21
SCU	Not Allocated	22-2F

2.3.5.3. Data structure

2.3.5.3.1. DCU Frames Definition

The four frame structures of the DCU are defined as follow:



The following cross table shows the corresponding Frame ID for each DCU configuration status:

DCU Configuration	Frame ID	Frame Format	Frame Length
Photometer Full Array	00	T2	294
Spectrometer Full Array	01	T2	78
Photometer SW	02	T1-PSW	150
Photometer MW	03	T1-PMW	102
Photometer LW	04	T1-PLW	54
Spectrometer SW	05	T1-SSW	54
Spectrometer LW	06	T1-SLW	30
Photometer Offset	07	T2	294
Spectrometer Offset	08	T2	78
Photometer Test Pattern Full Array	09	T3	294
Photometer Test Pattern SW	0A	T3	150
Photometer Test Pattern MW	0B	T3	102
Photometer Test Pattern LW	0C	T3	54
Spectrometer Test Pattern Full Array	0D	T3	78
Spectrometer Test Pattern SW	0E	T3	54
Spectrometer Test Pattern LW	0F	T3	30

Remind: the DCU data interface configuration is configured by means of the “SetDataMode” command.

2.3.5.3.2. DCU Photometer Full Array pixel arrangement

Index	0	1	2	3	4	5	6	7
0	CH1/LIA_P1	CH2/LIA_P1	CH3/LIA_P1	CH4/LIA_P1	CH5/LIA_P1	CH6/LIA_P1	CH7/LIA_P1	CH8/LIA_P1
8	CH9/LIA_P1	CH10/LIA_P1	CH11/LIA_P1	CH12/LIA_P1	CH13/LIA_P1	CH14/LIA_P1	CH15/LIA_P1	CH16/LIA_P1
16	CH17/LIA_P1	CH18/LIA_P1	CH19/LIA_P1	CH20/LIA_P1	CH21/LIA_P1	CH22/LIA_P1	CH23/LIA_P1	CH24/LIA_P1
24	CH25/LIA_P1	CH26/LIA_P1	CH27/LIA_P1	CH28/LIA_P1	CH29/LIA_P1	CH30/LIA_P1	CH31/LIA_P1	CH32/LIA_P1
32	CH1/LIA_P2	CH2/LIA_P2	CH3/LIA_P2	CH4/LIA_P2	CH5/LIA_P2	CH6/LIA_P2	CH7/LIA_P2	CH8/LIA_P2
40	CH9/LIA_P2	CH10/LIA_P2	CH11/LIA_P2	CH12/LIA_P2	CH13/LIA_P2	CH14/LIA_P2	CH15/LIA_P2	CH16/LIA_P2
48	CH17/LIA_P2	CH18/LIA_P2	CH19/LIA_P2	CH20/LIA_P2	CH21/LIA_P2	CH22/LIA_P2	CH23/LIA_P2	CH24/LIA_P2
56	CH25/LIA_P2	CH26/LIA_P2	CH27/LIA_P2	CH28/LIA_P2	CH29/LIA_P2	CH30/LIA_P2	CH31/LIA_P2	CH32/LIA_P2
64	CH1/LIA_P3	CH2/LIA_P3	CH3/LIA_P3	CH4/LIA_P3	CH5/LIA_P3	CH6/LIA_P3	CH7/LIA_P3	CH8/LIA_P3
72	CH9/LIA_P3	CH10/LIA_P3	CH11/LIA_P3	CH12/LIA_P3	CH13/LIA_P3	CH14/LIA_P3	CH15/LIA_P3	CH16/LIA_P3
80	CH17/LIA_P3	CH18/LIA_P3	CH19/LIA_P3	CH20/LIA_P3	CH21/LIA_P3	CH22/LIA_P3	CH23/LIA_P3	CH24/LIA_P3
88	CH25/LIA_P3	CH26/LIA_P3	CH27/LIA_P3	CH28/LIA_P3	CH29/LIA_P3	CH30/LIA_P3	CH31/LIA_P3	CH32/LIA_P3
96	CH1/LIA_P4	CH2/LIA_P4	CH3/LIA_P4	CH4/LIA_P4	CH5/LIA_P4	CH6/LIA_P4	CH7/LIA_P4	CH8/LIA_P4
104	CH9/LIA_P4	CH10/LIA_P4	CH11/LIA_P4	CH12/LIA_P4	CH13/LIA_P4	CH14/LIA_P4	CH15/LIA_P4	CH16/LIA_P4
112	CH17/LIA_P4	CH18/LIA_P4	CH19/LIA_P4	CH20/LIA_P4	CH21/LIA_P4	CH22/LIA_P4	CH23/LIA_P4	CH24/LIA_P4
120	CH25/LIA_P4	CH26/LIA_P4	CH27/LIA_P4	CH28/LIA_P4	CH29/LIA_P4	CH30/LIA_P4	CH31/LIA_P4	CH32/LIA_P4
128	CH1/LIA_P5	CH2/LIA_P5	CH3/LIA_P5	CH4/LIA_P5	CH5/LIA_P5	CH6/LIA_P5	CH7/LIA_P5	CH8/LIA_P5
136	CH9/LIA_P5	CH10/LIA_P5	CH11/LIA_P5	CH12/LIA_P5	CH13/LIA_P5	CH14/LIA_P5	CH15/LIA_P5	CH16/LIA_P5
144	CH17/LIA_P5	CH18/LIA_P5	CH19/LIA_P5	CH20/LIA_P5	CH21/LIA_P5	CH22/LIA_P5	CH23/LIA_P5	CH24/LIA_P5
152	CH25/LIA_P5	CH26/LIA_P5	CH27/LIA_P5	CH28/LIA_P5	CH29/LIA_P5	CH30/LIA_P5	CH31/LIA_P5	CH32/LIA_P5
160	CH1/LIA_P6	CH2/LIA_P6	CH3/LIA_P6	CH4/LIA_P6	CH5/LIA_P6	CH6/LIA_P6	CH7/LIA_P6	CH8/LIA_P6
168	CH9/LIA_P6	CH10/LIA_P6	CH11/LIA_P6	CH12/LIA_P6	CH13/LIA_P6	CH14/LIA_P6	CH15/LIA_P6	CH16/LIA_P6
176	CH17/LIA_P6	CH18/LIA_P6	CH19/LIA_P6	CH20/LIA_P6	CH21/LIA_P6	CH22/LIA_P6	CH23/LIA_P6	CH24/LIA_P6
184	CH25/LIA_P6	CH26/LIA_P6	CH27/LIA_P6	CH28/LIA_P6	CH29/LIA_P6	CH30/LIA_P6	CH31/LIA_P6	CH32/LIA_P6
192	CH1/LIA_P7	CH2/LIA_P7	CH3/LIA_P7	CH4/LIA_P7	CH5/LIA_P7	CH6/LIA_P7	CH7/LIA_P7	CH8/LIA_P7
200	CH9/LIA_P7	CH10/LIA_P7	CH11/LIA_P7	CH12/LIA_P7	CH13/LIA_P7	CH14/LIA_P7	CH15/LIA_P7	CH16/LIA_P7

208	CH17/LIA_P7	CH18/LIA_P7	CH19/LIA_P7	CH20/LIA_P7	CH21/LIA_P7	CH22/LIA_P7	CH23/LIA_P7	CH24/LIA_P7
216	CH25/LIA_P7	CH26/LIA_P7	CH27/LIA_P7	CH28/LIA_P7	CH29/LIA_P7	CH30/LIA_P7	CH31/LIA_P7	CH32/LIA_P7
224	CH1/LIA_P8	CH2/LIA_P8	CH3/LIA_P8	CH4/LIA_P8	CH5/LIA_P8	CH6/LIA_P8	CH7/LIA_P8	CH8/LIA_P8
232	CH9/LIA_P8	CH10/LIA_P8	CH11/LIA_P8	CH12/LIA_P8	CH13/LIA_P8	CH14/LIA_P8	CH15/LIA_P8	CH16/LIA_P8
240	CH17/LIA_P8	CH18/LIA_P8	CH19/LIA_P8	CH20/LIA_P8	CH21/LIA_P8	CH22/LIA_P8	CH23/LIA_P8	CH24/LIA_P8
248	CH25/LIA_P8	CH26/LIA_P8	CH27/LIA_P8	CH28/LIA_P8	CH29/LIA_P8	CH30/LIA_P8	CH31/LIA_P8	CH32/LIA_P8
256	CH1/LIA_P9	CH2/LIA_P9	CH3/LIA_P9	CH4/LIA_P9	CH5/LIA_P9	CH6/LIA_P9	CH7/LIA_P9	CH8/LIA_P9
264	CH9/LIA_P9	CH10/LIA_P9	CH11/LIA_P9	CH12/LIA_P9	CH13/LIA_P9	CH14/LIA_P9	CH15/LIA_P9	CH16/LIA_P9
272	CH17/LIA_P9	CH18/LIA_P9	CH19/LIA_P9	CH20/LIA_P9	CH21/LIA_P9	CH22/LIA_P9	CH23/LIA_P9	CH24/LIA_P9
280	CH25/LIA_P9	CH26/LIA_P9	CH27/LIA_P9	CH28/LIA_P9	CH29/LIA_P9	CH30/LIA_P9	CH31/LIA_P9	CH32/LIA_P9

RED: PLW channels BLUE: PSW channels
GREEN: PMW channels BLACK: T/C channels

2.3.5.3.3. DCU Spectrometer Full Array pixel arrangement

Index	0	1	2	3	4	5	6	
0	CH1/LIA_S1	CH2/LIA_S1	CH3/LIA_S1	CH4/LIA_S1	CH5/LIA_S1	CH6/LIA_S1	CH7/LIA_S1	CH8/LIA_S1
8	CH9/LIA_S1	CH10/LIA_S1	CH11/LIA_S1	CH12/LIA_S1	CH13/LIA_S1	CH14/LIA_S1	CH15/LIA_S1	CH16/LIA_S1
16	CH17/LIA_S1	CH18/LIA_S1	CH19/LIA_S1	CH20/LIA_S1	CH21/LIA_S1	CH22/LIA_S1	CH23/LIA_S1	CH24/LIA_S1
24	CH1/LIA_S2	CH2/LIA_S2	CH3/LIA_S2	CH4/LIA_S2	CH5/LIA_S2	CH6/LIA_S2	CH7/LIA_S2	CH8/LIA_S2
32	CH9/LIA_S2	CH10/LIA_S2	CH11/LIA_S2	CH12/LIA_S2	CH13/LIA_S2	CH14/LIA_S2	CH15/LIA_S2	CH16/LIA_S2
40	CH17/LIA_S2	CH18/LIA_S2	CH19/LIA_S2	CH20/LIA_S2	CH21/LIA_S2	CH22/LIA_S2	CH23/LIA_S2	CH24/LIA_S2
48	CH1/LIA_S3	CH2/LIA_S3	CH3/LIA_S3	CH4/LIA_S3	CH5/LIA_S3	CH6/LIA_S3	CH7/LIA_S3	CH8/LIA_S3
56	CH9/LIA_S3	CH10/LIA_S3	CH11/LIA_S3	CH12/LIA_S3	CH13/LIA_S3	CH14/LIA_S3	CH15/LIA_S3	CH16/LIA_S3
64	CH17/LIA_S3	CH18/LIA_S3	CH19/LIA_S3	CH20/LIA_S3	CH21/LIA_S3	CH22/LIA_S3	CH23/LIA_S3	CH24/LIA_S3

RED: SLW channels BLUE: SSW channels

2.3.5.3.4. DCU Data Status Word

The last word of the data field has a specific meaning: it informs the DPU of occurrence of analog to digital converter latch-up or S/S to DPU interface fault and then of the risk to pack corrupted data. When a flag or more is set the related data of the current frame have to be discarded during on-ground data processing.
The meaning of this word depends on the data interface mode as shown below:

DCU Configuration	Frame Format	# of significant flags	Flags description
Photo. Array Subset	T1	1 to 3	bit 0 (LSB) = ADC1 latch-up flag bit 1 = ADC2 latch-up flag bit 2 = ADC2 latch-up flag bit 3 = ADC4 latch-up flag bit 4 = ADC5 latch-up flag bit 5 (MSB) = ADC6 latch-up flag
Spectro. Array Subset	T1	2 to 4	
Photo. Full Array	T2	6	
Spectro. Full Array	T2	6	
Test Pattern	T3	0	
Photo. Offset table	T2	0	
Spectro Offset table	T2	0	

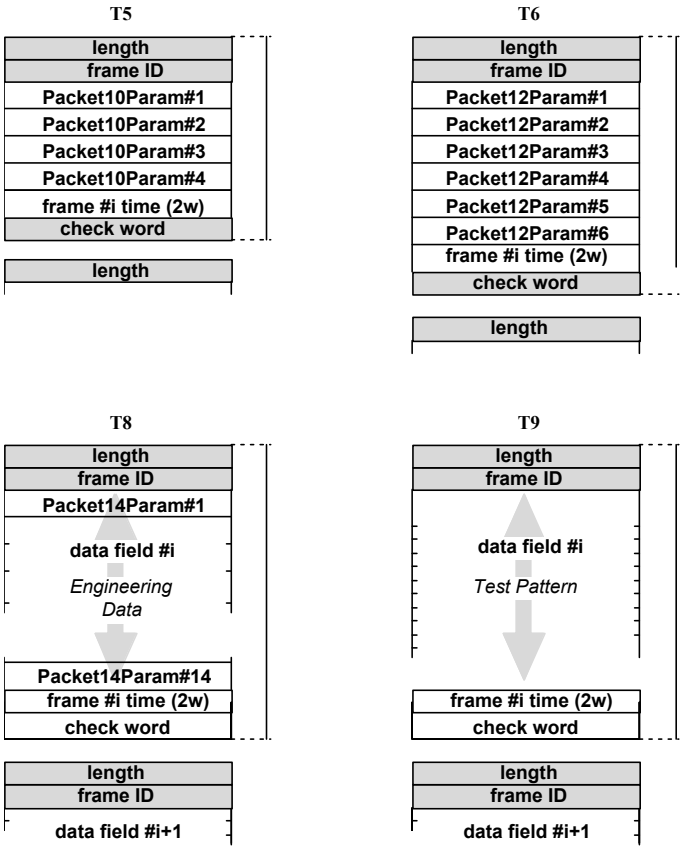
Additionally in order to be able to reject data from the data format in both photometer and

spectrometer mode ADC channel to LIA_P and LIA_S channel assignation has to be defined. The following table specify this assignation:

ADC channel	LIA_P channels	
ADC1	LIA_P1 channels 1 to 16 LIA_P1 channels 17 to 32 LIA_P2 channels 1 to 16	LIA_S1 channels 1 to 12 LIA_S1 channels 13 to 24 LIA_S2 channels 1 to 12
ADC2	LIA_P2 channels 17 to 32 LIA_P3 channels 1 to 16 LIA_P3 channels 17 to 32	LIA_S2 channels 13 to 24 LIA_S3 channels 1 to 12 LIA_S3 channels 13 to 24
ADC3	LIA_P4 channels 1 to 16 LIA_P4 channels 17 to 32 LIA_P5 channels 1 to 16	LIA_S4 channels 1 to 12 LIA_S4 channels 13 to 24 LIA_S5 channels 1 to 12
ADC4	LIA_P5 channels 17 to 32 LIA_P6 channels 1 to 16 LIA_P6 channels 17 to 32	LIA_S5 channels 13 to 24 LIA_S6 channels 1 to 12 LIA_S6 channels 13 to 24
ADC5	LIA_P7 channels 1 to 16 LIA_P7 channels 17 to 32 LIA_P8 channels 1 to 16	LIA_S7 channels 1 to 12 LIA_S7 channels 13 to 24 LIA_S8 channels 1 to 12
ADC6	LIA_P8 channels 17 to 32 LIA_P9 channels 1 to 16 LIA_P9 channels 17 to 32	LIA_S8 channels 13 to 24 LIA_S9 channels 1 to 13 LIA_S9 channels 13 to 24

2.3.5.3.5. MCU Frame Definition

The four frame structures of the MCU are defined as follow:



The following cross table shows the corresponding Frame ID for each MCU configuration status:

Configuration Status	Frame ID	Frame Format	Frame Length
SMEC ~~Scan~~	10	T4	10
~~SMEC step~~	~~11~~	~~T5~~	~~11~~
BSM~~Chop~~	12	T6	9
~~Jiggle~~	~~13~~	~~T7~~	~~5~~
Engineering	14	T8	24
Test Pattern	15	T9	24

2.3.5.3.6. MCU Data Field Description (frame ID 10)

The following table defines the data field for a "SMEC" frame:

Index	Parameter Name	Default
0	Pack10Param#1	Optical Encoder Coarse Position
1	Pack10Param#2	Optical Encoder Fine Position
2	Pack10Param#3	LVDT DC Signal
3	Pack10Param#4	Motor BEMF

2.3.5.3.7. MCU Data Field Description (frame ID 12)

The following table defines the data field for a "BSM" frame:

Index	Parameter Name	Default
0	Pack12Param#1	Chopper Position (from magneto resistor)
1	Pack12Param#2	Chopper Motor Setting Current
2	Pack12Param#3	Chopper Motor Measured Voltage
3	Pack12Param#4	Jiggle Motor Position (from magneto resistor)
4	Pack12Param#5	Jiggle Motor Setting Current
5	Pack12Param#6	Jiggle Motor Measured Voltage

2.3.5.3.8. MCU Data Field Description (frame ID 14)

The following table defines the data field for an "Engineering" frame:

Index	Parameter Name	Default
0	Pack14Param#1	SMEC Servo Error (reference - position)
1	Pack14Param#2	SMEC Encoder Signal 1 Measure
2	Pack14Param#3	SMEC Encoder Signal 2 Measure
3	Pack14Param#4	SMEC Encode Signal 3 Measure
4	Pack14Param#5	SMEC LVDT AC Signal Measure
5	Pack14Param#6	SMEC LVDT DC Signal Measure
6	Pack14Param#7	SMEC Motor Current Measure
7	Pack14Param#8	SMEC Motor Voltage Measure
8	Pack14Param#9	Chopper Magneto Resistor Signal Measure
9	Pack14Param#10	Chopper Motor Current Measure
10	Pack14Param#11	Chopper Servo Error (reference - position)
11	Pack14Param#12	Jiggle Magneto Resistor Signal Measure
12	Pack14Param#13	Jiggle Motor Current Measure
13	Pack14Param#14	Jiggle Servo Error (reference - position)

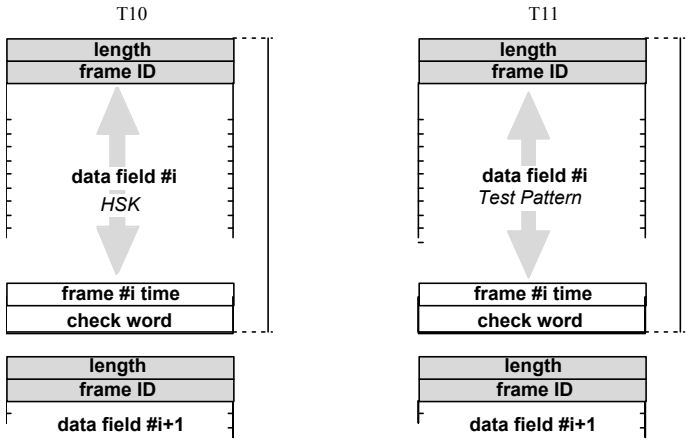
2.3.5.3.9. MCU Data Field Description (frame ID 15) - to be completed

The following table defines the data field for a “Test Pattern” frame:

Index	Data (hexa)
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	

2.3.5.3.10. SCU Frame Definition

The two frame structures of the SCU are defined as follow:



The following cross table shows the corresponding Frame Structure Type for each SCU configuration status:

Configuration Status	Frame Format	Frame ID	Frame Length
HSK	T10	20	30
Test Pattern	T11	21	30

2.3.5.3.11. SCU data field description (frame ID 20)

Index	Parameter Name	Description	ADC ID
0	T_CPHP	Cryo-cooler sorption Pump Heater temperature	TEMP
1	T_CPHS	Cryo- cooler sorption Pump Heat Switch temperature	TEMP
2	T_CEHS	Cryo-cooler Evaporator Heat Switch temperature	TEMP
3	T_CSHT	Cryo-cooler thermal SHunt temperature	TEMP
4	T_SOB	SPIRE Optical Bench temperature	TEMP
5	T_SL0	Spectrometer Level 0 (detector box) temperature	TEMP
6	T_PL0	Photometer Level 0 (detector box) temperature	TEMp
7	T_SUB	Optical SUb Bench temperature	TEMP
8	T_BAF	FPU input BAFfle temperature	TEMP
9	T_BSMS	BSM/Sob i/f temperature	TEMP
10	T_SCL2	Spectrometer CaLibrator 2% temperature	TEMP
11	T_SCL4	Spectrometer CaLibrator 4% temperature	TEMP
12	T_SCST	Spectrometer Calibrator flange (STructure) temperature	TEMP
13	T_FTSS	SMEC/Sob i/f temperature	TEMP
14	T_FTSM	SMEC Mechanism temperature	TEMP

15	T_BSMM	BSM Mechanism temperature	TEMP
16	T_CEV	Cryo-cooler EVaporator temperature	TEMP
17	PhCalCur	Bias current of Photometer Calibrator	TEMP
18	PhCalVolt	Voltage across Photometer Calibrator	CCHK
19	SCal2Cur	Bias current of Spectrometer Calibrator 2%	CCHK
20	SCal2Volt	Voltage across Spectrometer Calibrator 2%	CCHK
21	SCal4Cur	Bias current of Spectrometer Calibrator 4%	CCHK
22	SCal4Vol	Voltage across Spectrometer Calibrator 4%	CCHK
23	TCheater	Voltage across Thermal Control heater	CCHK

2.3.5.3.12. SCU data field description (frame ID 21) -to be completed

Index	Data (hexa)	Index	Data (hexa)
0		12	
1		13	
2		14	
3		15	
4		16	
5		17	
6		18	
7		19	
8		20	
9		21	
10		22	
11		23	

2.3.5.3.13. SCU Data Status Word

The last word of the data field has a specific meaning: it informs the DPU of occurrence of analog to digital converter latch-up or S/S to DPU interface fault and then of the risk to pack corrupted data. When a flag or more is set the related data of the current frame have to be discarded during on-ground data processing.
The meaning of this word depends on the data interface mode.
See following table for details

SCU Configuration	FST	# of significant flags	Flags description
HSK	T8	2	bit 0 = CCHK ADC latch-up flag
Test Pattern	T9	2	bit 1 = TEMP ADC latch-up flag

2.3.5.4. Frame time

The "frame time" field follows the data structure area. It is a 32-bit word filled with the contents of the subsystem "time tag" counters. In order to keep data frame synchronisation for the 3 subsystems this counter is driving by a single clock signal and reset by a broadcast command. The clock is derived from the CLK line of the Command interface and the resolution is then 3.2 µs. The full range of the counter is then above 13740 s (229 min); this means the DPU have to sent the reset command at least every 229 min in order to keep synchronisation between the 3 DRCU sub-systems.
The subsystem time counter shall be effectively reset within 10 (tbc) µs from the command reception and with a maximum skew between subsystems of 3 µs.

2.3.5.5. Check word

The "check" word ends the data frame. Along with the "header" and "length" field it allows frame consistency checking. It is calculated by exclusive or of all frame words.

2.3.6. Test pattern

The purpose of this mode is to generate variable and predictable digital data for test and verification activities. Instead of transmitting a fixed pattern it implements a pseudo random generator based on a LFSR (see RD1).

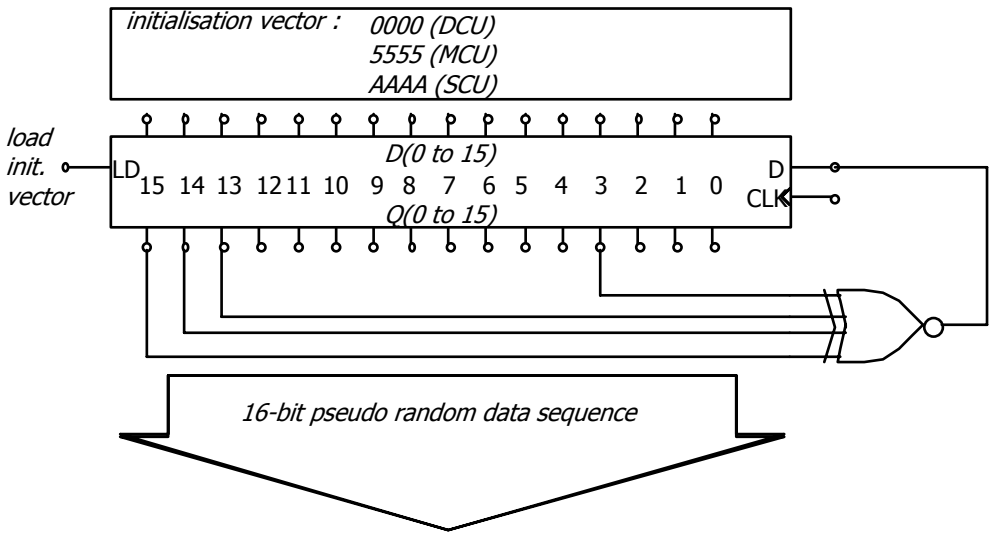


Figure 2.3-a LFSR functional description

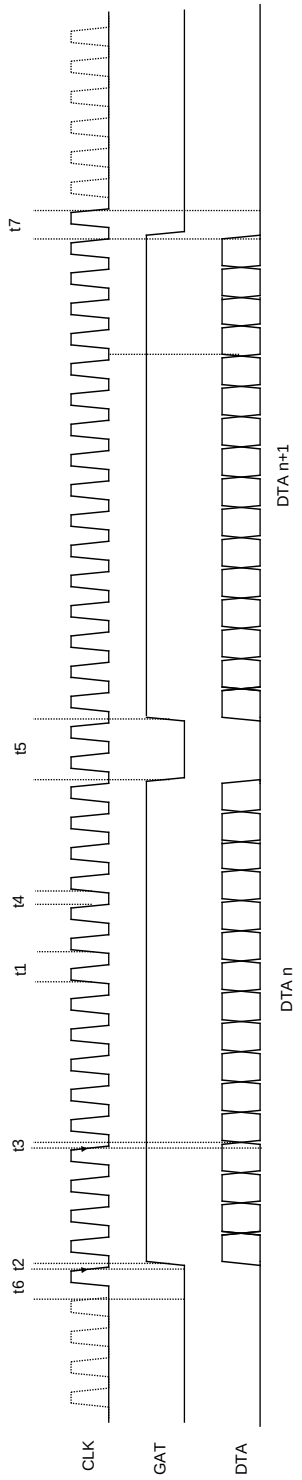
When in test pattern mode the DRCU interface control logic substitutes the data with a pseudo-random sequence generated by a 16-bit linear feedback shift register (see RD2). The

DRCU unit features 3 independent LFSR each corresponding to a data interface. Additionally each LFSR is initialised with a specific vector as show bellow:

V0	Subsystem Name
0000 hexa	DCU
5555 hexa	MCU
AAAA hexa	SCU

2.3.7. Interface Timing

The figure 2.3-b specifies the data interface timing.



Symbol	Parameter	Min	Typ	Max	Unit
t1	clock period	396	-	1010	ns
t2	clk to gat delay	-30		50	ns
t3	clk to dat delay	-30		50	ns
t4	level "1" period	-10%	0.5 t1	+10%	ns
t5	gat to gat delay	2 t1			period
t6	clk active before gat	1 t1			period
t7	clk active after gat	1 t1			period

Fig 2.3-b Data Interface detailed Timing