**SPIRE INSTRUMENT**

# DETECTOR READOUT & CONTROL UNIT

## INTERFACE CONTROL DOCUMENT

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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 |
| 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. Along with the DRCU Mechanical ICD this document shall allows a complete overview of the DRCU units in terms of interfaces. This document will be useful when performing unit test, integration or qualification by containing all the DRCU electrical interfaces (this avoids he need for multiple documents).

## 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. However in the case of the analog interfaces with FPU the description is limited to pin-out since these interfaces are already described in respective sub-system ICDs.

## 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 |
| RD3 | MCU interconnections list | LAM/ELE/FTS/NTT/010314 - issue 2.0 |

## 1.4. Applicable Documents

| | | |
|---|---|---|
| AD1 | Herschel/Planck IID part A | SCI-PT-IIDA-04624 |
| | | |

## 1.5. Interfaces cross-matrix

This table lists the interface types against the SPIRE sub-assembly for the HSDCU and HSFCU units.

| Unit | Interface Types | Interfaces with: |
|---|---|---|
| HSDCU | Electrical – Digital | DPU |
| | Electrical – Analog | FPU |
| | Mechanical | S/C |
| | Thermal | S/C |
| HSFCU | Electrical – Digital | DPU |
| | Electrical – Analog | FPU |
| | Electrical - Power | S/C |
| | Mechanical | S/C |
| | Thermal | S/C |

# 2. Thermo-mechanical Interfaces

## *2.1. Mechanical interfaces*

### 2.1.1. HSDCU unit

The mechanical interface can be summarized by assuming the HSDCU unit occupies a rectangular volume defined by its surface, its height and its mass:

- 494 (xxx) mm x 289 mm
- 305 (352.5) mm
- 15.41 kg

Those values (dimensions) take into account connectors back shields (worst case GLENAIR type-values into brackets).
Mounting on the S/C is done by means of 10 feet and fastening by means of 10 M6 screws.

For a fully detailed mechanical interface description refers to the figure 2.1-a.

### 2.1.2. HSFCU unit

The mechanical interface can be summarized by assuming the HSFCU unit occupies a rectangular volume defined by its surface, its height and its mass:

- 334 (xxx) mm x 329 mm
- 330.5 (377.9) mm
- 14.28 kg

Those values (dimensions) take into account connectors back shields (worst case GLENAIR type-values into brackets).
Mounting on the S/C is done by means of 10 feet and fastening by means of 10 M6 screws.

For a fully detailed mechanical interface description refers to the figure 2.1-b.

## *2.2. Thermal interfaces*

### 2.2.1. HSDCU unit

The thermal is defined by the dissipated power by the unit and the parameters, which define the heat exchange (by radiation and conduction) with its environment.
The parameters for heat exchange dimensioning are:

| Dissipated Power (W) | Radiation Surfaces | Surfaces Emissivity | Feet Surfaces |
|---|---|---|---|
| 40.57 - see §2.3.1<br>18.49 | See §2.1.1 | 0.8 | 10 x 4 $cm^2$ |

### 2.2.2. HSFCU unit

The thermal is defined by the dissipated power by the unit and the parameters, which define the heat exchange (by radiation and conduction) with its environment.
The parameters for heat exchange dimensioning are:

| Dissipated Power (W) | Radiation Surfaces | Surfaces Emissivity | Feet Surfaces |
|---|---|---|---|
| 51.27 - see §2.3.1<br>40.75 | See §2.1.2 | 0.8 | 10 x 4 $cm^2$ |

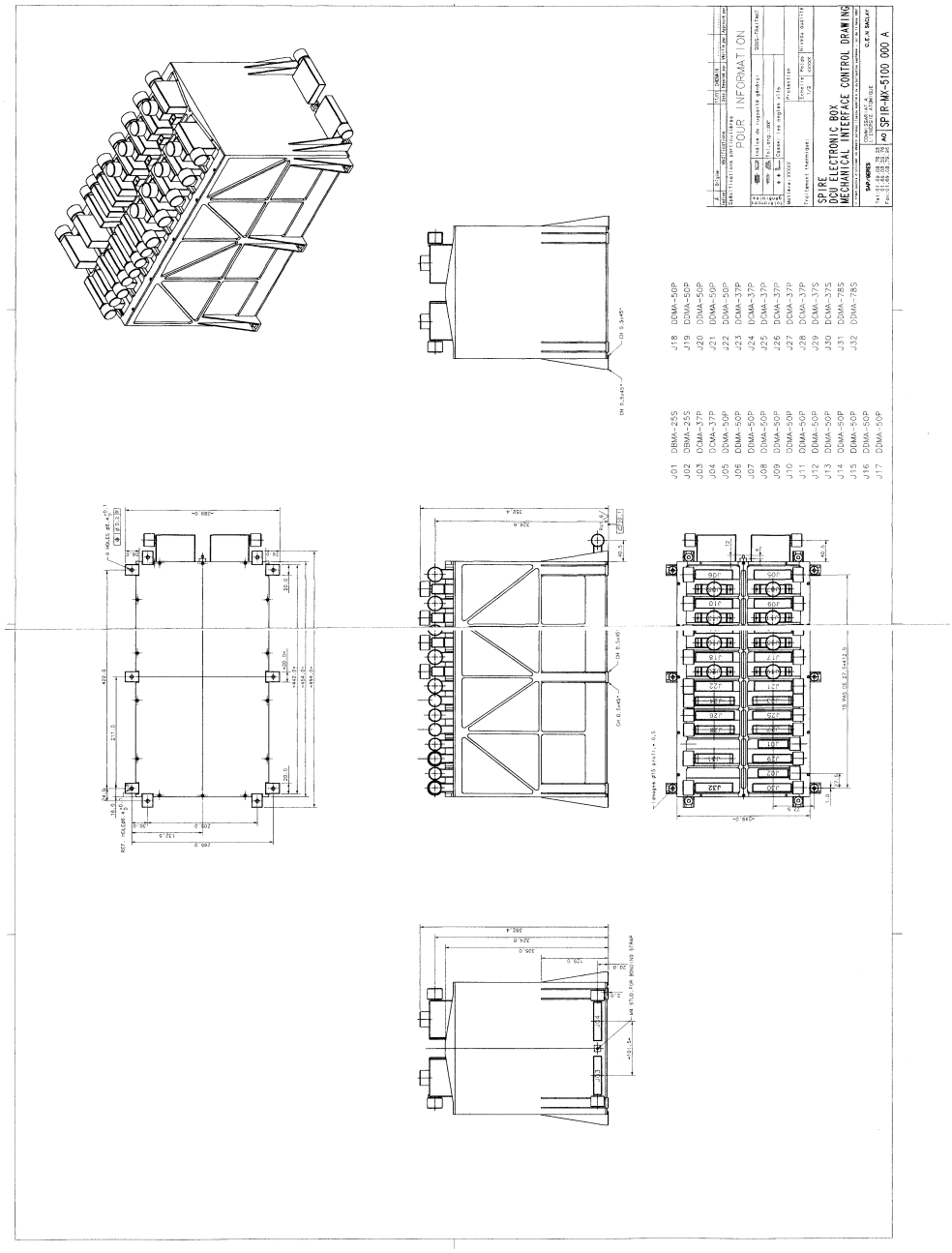



Figure 2.1-a DCU mechanical ICD

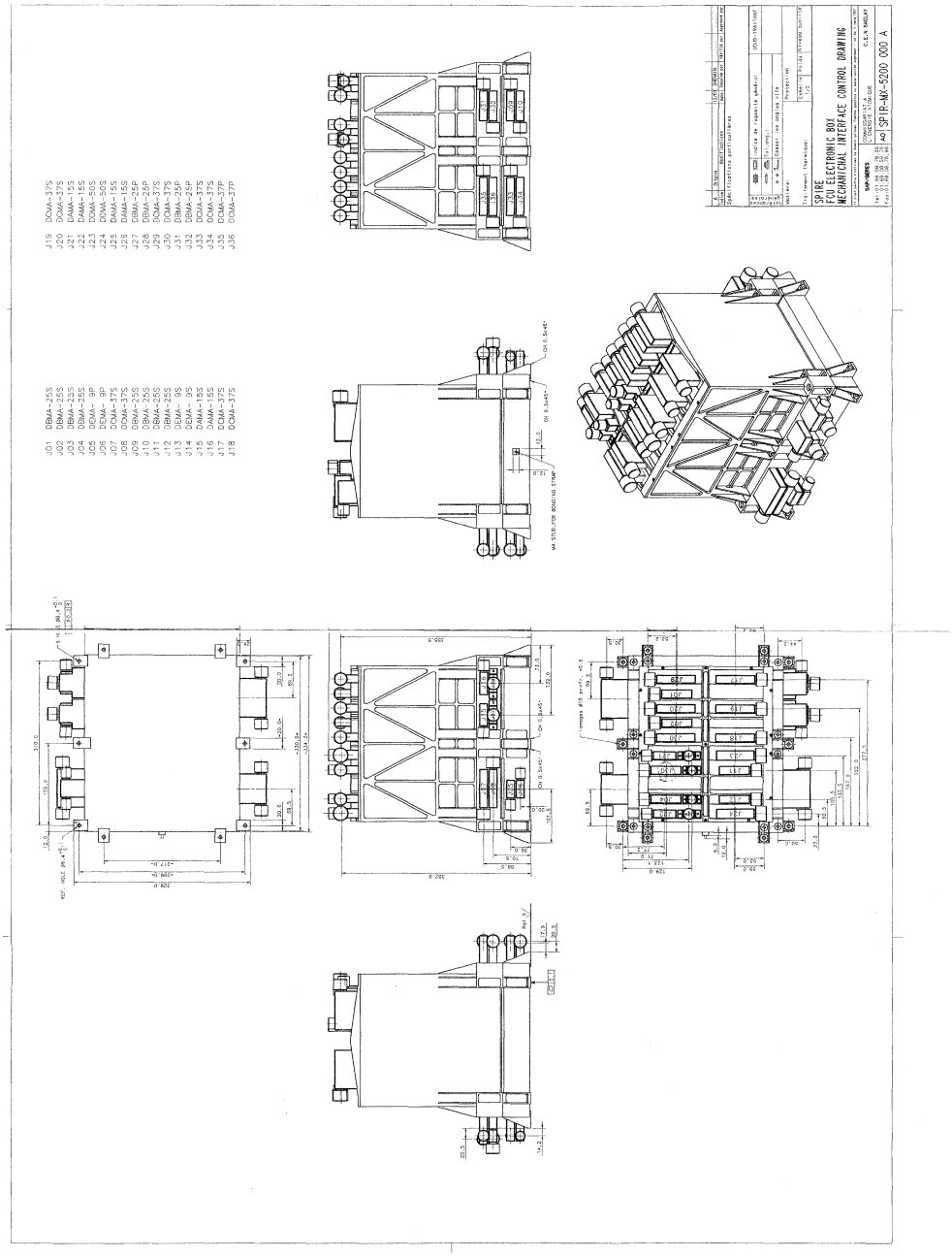



Figure 2.1-b FCU mechanical ICD

# 3. 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 command interface is slow (312kps) bi-directional with word-based protocol the data interface is fast (up to 2.5 Mbps) unidirectional with frame-based protocol.

## *3.1. Command interface*

### 3.1.1. 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 consist 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 code allows sending the same (broadcast) command simultaneously to the 3 DRCU sub-units.

The command format is fix 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 reply with a response word with the following format:

• a field echoing the sub-unit address and the command identifier field.
• a data field which contains, either the echo of the command parameter field, 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.

### 3.1.2. Interface Overall Diagrams

The Command Interface diagram is given in figure 1.2-a. Main and Redundant interfaces are shown.

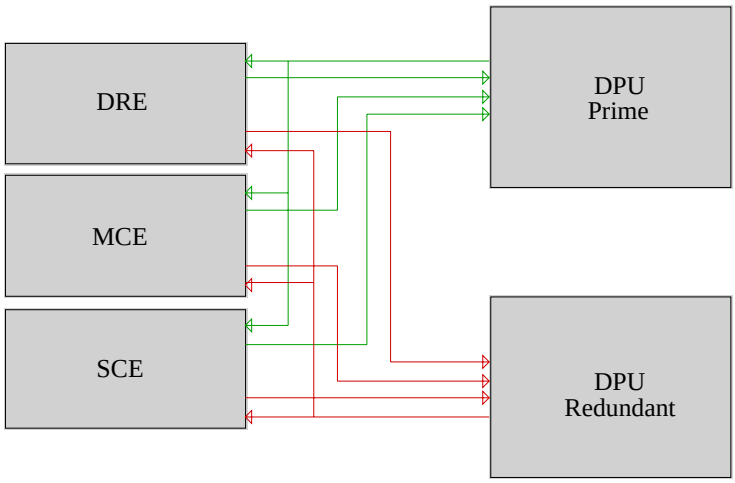



Figure 1.2-a

### 3.1.3. Interface Circuit

Each interface is defined by the following signals:

- a command (CMD) line - from DPU to DRU, MCU, SCU sub-units
- a response (RES) line - from each sub-unit to DPU
- a clock (CLK) line for bit synchronisation - from the DPU to DRU, 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 these 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 type.

Complete interface functional diagram is given figures 2.3-a and 2.3-b.

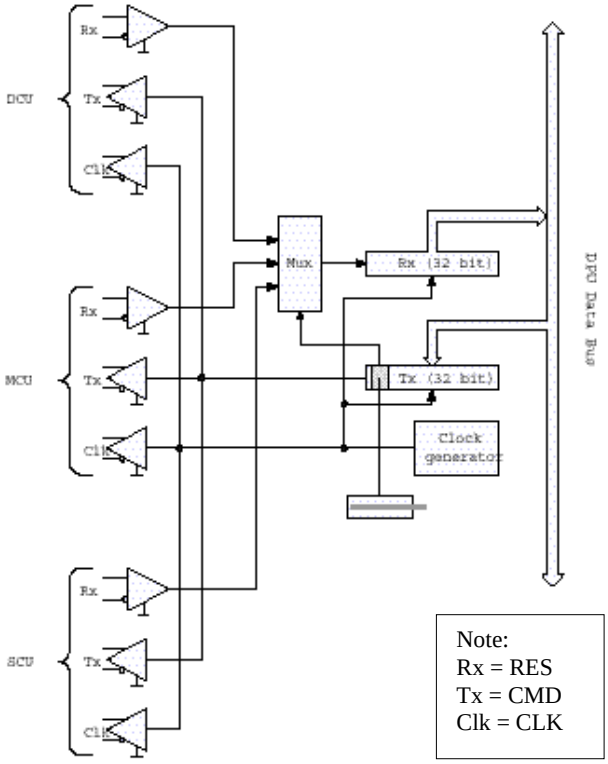



Figure 2.3-a - DPU Low Speed Interface Functional Diagram

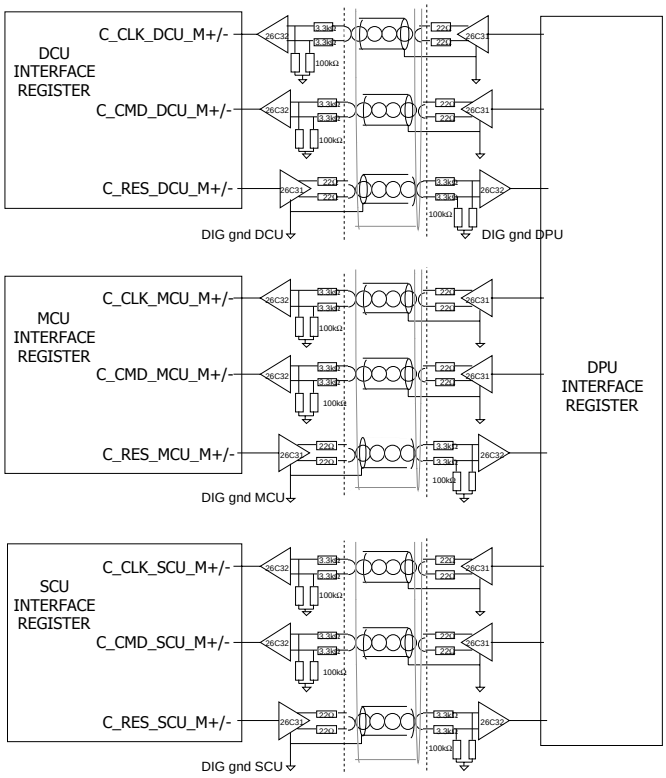



Figure 2.3-b - Electrical configuration

### 3.1.4. Protocol definition

#### 3.1.4.1. 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 2.4.1-a for details
- a 2-bit sub-unit address : see table 2.4.1-b for details
- a 12-bit command or command + parameter address : see table 2.4.1-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 2.4.1-a - 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 [1] |

Table 2.4.1-a - Sync Pattern definition

[1] Not used by DRCU S/S (equivalent to: SYN0 has no signification)

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

Table 2.4.1-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 definition:

| CID11 | Command Type |
|---|---|
| 1 | Read |
| 0 | Write |

Table 2.4.1-c - Command Identifier Structure

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

#### 3.1.4.2. Response Word

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

When a "Set_*parameter*" command 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 required for further command transfer after specific critical commands.
When a "get_parameter" command is received the subsystem responds to the DPU by transferring the requested housekeeping parameter. (Housekeeping parameter polling is running typically at 1Hz).

The sub-system shall respond (leading bit of the response word) within a maximum delay of tbd clock periods ($\partial$T1 – see §1.6). The DPU S/W shall include a time-out in order to recover from a lack of response and then report the anomaly.

The 32-bit command response is divided into 3 fields, which are:

- a 2-bit sync pattern (SYN0 & SYN1),
- a 2-bit acknowledge 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.

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

| SYN1-SYN0 | ACK | CID11 to CID0 | PAR15 to PAR0 |
|---|---|---|---|

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

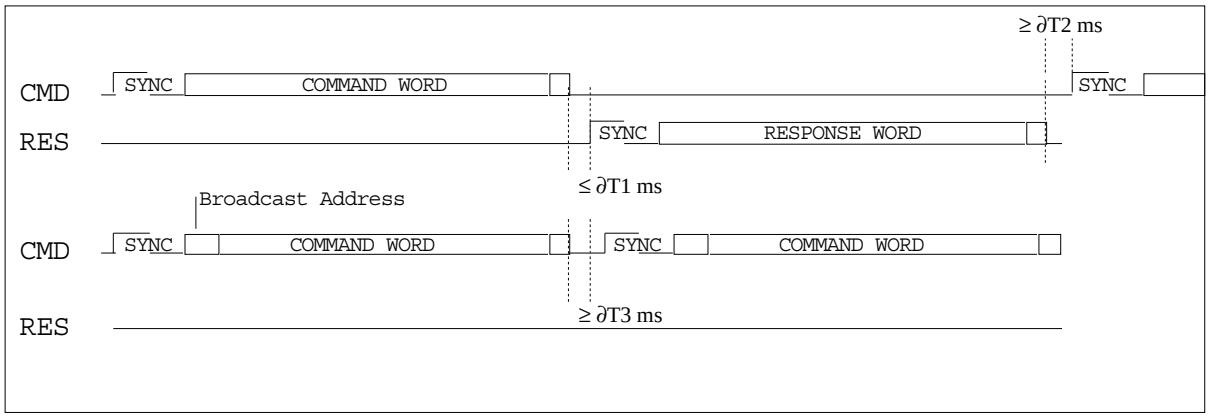
Along with the "synchro. Pattern", Command Id field and the Parameter field an acknowledge word is in place of the sub-system address field of the received command. While normally the ACK field will content a null character (00 binary) provision for "negative" acknowledge has been introduced to enable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

- DRCU subsystem is off
- 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 |

### 3.1.4.3. Word exchange

The following figure illustrates the command interface protocol for the possible modes of operation (a "set_parameter" / "get_parameter" command and a "broadcast command").



### 3.1.5. Interface Timing

#### 3.1.5.1. Low level Timing

The CMD signal is switched on the falling edge of the CLK signal. This signal shall be sampled by the DRCU subsystem on the next 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. In order to achieve cyclic re-synchronisation of the interface the subsystem shall implement a time-out counter, which will reset the input 32-bit register if no command is received (all input register bits contain zero) within 33 CLK periods. The RES signal shall by modified on the rising edge of the CLK signal and being sampled by the DPU on the next falling edge of the CLK signal.

For detailed interface timing see AD01.

#### 3.1.5.2. Command timing

The following table gives interval timing value for the delay shown in §2.6.

| Parameters | Symbols | Limits | | Units |
|---|---|---|---|---|
| | | Min | Max | |
| Command to Response Delay | ∂T1 | 6.4 | 102.4 | µs |
| Response to next Command Delay | ∂T2 | 3.2 | 500 | µs |

#### 3.1.5.3. Performance

The NRZ data rate is fixed at 312.5 kbit per second.
The command rate including both command word transmission and command response word transmission is:

$$\text{Max. Command rate} = 1 / ((3.2\ \mu s \times 32) \times 2 + \partial T2) \leq 4883 \text{ commands per second.}$$

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

## 3.2. Command list

#### 3.2.1.1. Command and parameter mapping

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

| CID11 | CID10 to CID0 | PAR15 to PAR0 |
|---|---|---|
| R/W | Command Code | Parameter(s) |

### 3.2.2. DRCU generic command list summary

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.

#### 3.2.2.1. Write only commands

| Command Name | Argument(s) | Ranges List | Command verification | Execution Delay |
|---|---|---|---|---|
| SetTStampRst | NA | NA | Cmd Echo | |

#### 3.2.2.2. Read only commands

| Command Name | Argument(s) | Ranges List | Command verification | Execution Delay |
|---|---|---|---|---|
| GetCmdIfStat | TBD | | NA | |

#### 3.2.2.3. Read/Write Commands

| Command Name | Argument(s) | Ranges List | Command verification | Execution Delay |
|---|---|---|---|---|
| Set/GetCmdIfCtrl | TBD | | Get… cmd | |

## 3.2.3. DRCU command description

### 3.2.3.1. TstampRst

| Command | Unit | Code | Description |
|---|---|---|---|
| SetTstampRst | DRCU | | Reset the 32-bit counter inserted in the S/S output data format. |
| Parameters | Location | Length | |
| No parameter | NA | NA | PAR15 to PAR00 = 00 hexa |

### 3.2.3.2. CmdIfStat

| Command | Unit | Code | Description |
|---|---|---|---|
| GetCmdIfStat | DCU | | Get the S/S interface status |
| Returned Parameter(s) | Location | Length | |
| CmdIfStat | 0 | 8 | |

### 3.2.3.3. CmdIfCtrl

| Command | Unit | Code | Description |
|---|---|---|---|
| SetCmdIfCtrl | DCU | | Set the S/S command IF control word. |
| Parameters | Location | Length | |
| CmdIfCtrl | 0 | 8 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetCmdIfCtrl | DCU | | Get the S/S command IF control word. |
| Returned Parameter(s) | Location | Length | |
| CmdIfCtrl | 0 | 8 | |

## 3.2.4. DRCU parameter description

| Name | Type | Size | Conversion | Limits | Description |
|---|---|---|---|---|---|
| CmdIfStat | Digital | | | | |
| CmdIfCtrl | Digital | | | | |

### 3.2.5. DCU specific command list summary

#### 3.2.5.1. 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/W | Command Code | Channel id. | Parameter(s) |

Note: for the SetPhotoOffset and SetSpetroOffset 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 |

#### 3.2.5.2. Photometer write/read commands

| Command Name | Argument(s) | Ranges List | Command verification | Execution Delay |
|---|---|---|---|---|
| SetPhotoSampFreq | Channel id<br>Bias freq divider | NA<br>000 to 255 | Get_... cmd | |
| SetPhotoBiasFreq | Channel id.<br>Frequency divider | NA<br>064 to 511 | Get_... cmd | |
| SetPhotoDemodPh | Ref. Channel id<br>PSD Phase | 00 to 03<br>000 to 255 | Get_... cmd | |
| SetPhotoBiasMode | Channel id<br>Bias gene mode | NA<br>000 to 255 | Get_... cmd | |
| SetPhotoBiasAmpl | Bias Channel id.<br>Sine amplitude | 00 to 03<br>000 to 255 | Get_... cmd | |
| SetPhotoJfetVss | Channel id.<br>Vss voltage | 00 to 11<br>000 to 255 | Get_... cmd | |
| SetPhotoHeaterVolt | Channel id.<br>Bias current | NA<br>000 to 255 | Get_... cmd | |
| SetPhotoJfetBias | Channel id<br>On/Off word | 00 to 01<br>See note x | Get_... cmd | |
| SetPhotoOffset | Channel id.<br>Channel number<br>Offset value | 00 to 08<br>00 to 32<br>00 to 15 | Get_... cmd | |

### 3.2.5.3. Spectrometer write/read commands

| Command Name | Argument(s) | Ranges List | Command verification | Execution Delay |
|---|---|---|---|---|
| SetSpectroSampFreq | Channel id<br>Bias freq divider | NA<br>000 to 255 | Get_... cmd | |
| SetSpectroBiasFreq | Channel id.<br>Frequency divider | NA<br>064 to 511 | Get_... cmd | |
| SetSpectroDemodPh | Channel id<br>PSD Phase | 00 to 01<br>000 to 255 | Get_... cmd | |
| SetSpectroBiasMode | Channel id<br>Bias gene mode | NA<br>000 to 255 | Get_... cmd | |
| SetSpectroBiasAmpl | Channel id.<br>Sine amplitude | 00 to 01<br>000 to 255 | Get_... cmd | |
| SetSpectroHeaterPwr | Channel id.<br>Bias current | NA<br>000 to 255 | Get_... cmd | |
| SetSpectroJfetVss | Channel id.<br>Vss voltage | 00 to 02<br>000 to 255 | Get_... cmd | |
| SetSpectroJfetPwr | Channel id<br>On/Off word | 00 to 01<br>See note x | Get_... cmd | |
| SetSpectroOffset | Channel id.<br>Channel number<br>Offset value | 00 to 02<br>00 to 32<br>00 to 15 | Get_... cmd | |

### 3.2.5.4. Photometer / spectrometer common write/read commands

| Command Name | Argument(s) | Ranges List | Command verification | Execution Delay |
|---|---|---|---|---|
| SetDataMode | Channel id.<br>Mode id. | NA<br>See xx | Get_... cmd<br>TBC | |
| SetFrameNber | Channel id<br>Nber of frames | NA<br>000 to 255 | Get_... cmd<br>TBC | |
| StartFrame | Channel id<br>Run/Stop code | NA<br>000 / 255 | Get_... cmd<br>TBC | |

### 3.2.5.5. Read only commands

| Command Name | Argument(s) |
|---|---|
| GetHKChannel | HK Channel id. |

### 3.2.5.6. DCU housekeeping identifier list

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

| Parameter Name | Word size (bits) | Comments | HK Channel id (hex) | Delay To Transmit |
|---|---|---|---|---|
| T/C_1 | 20-TBC | 16-bit ADC + 4-bit offset | 00 | |
| T/C_2 | 20-TBC | 16-bit ADC + 4-bit offset | 01 | |
| T/C_3 | 20-TBC | 16-bit ADC + 4-bit offset | 02 | |
| LIA_B1_TEMP | 8 | LIA board 1 temperature | 03 | |
| LIA_B2_TEMP | 8 | LIA board 2 temperature | 04 | |
| LIA_B3_TEMP | 8 | LIA board 3 temperature | 05 | |
| LIA_B4_TEMP | 8 | LIA board 4 temperature | 06 | |
| LIA_B5_TEMP | 8 | LIA board 5 temperature | 07 | |
| LIA_B6_TEMP | 8 | LIA board 6 temperature | 08 | |
| LIA_B7_TEMP | 8 | LIA board 7 temperature | 09 | |
| LIA_B8_TEMP | 8 | LIA board 8 temperature | 0A | |
| LIA_B9_TEMP | 8 | LIA board 9 temperature | 0B | |
| LIA_B10_TEMP | 8 | LIA board 10 temperature | 0C | |
| LIA_B11_TEMP | 8 | LIA board 11 temperature | 0D | |
| LIA_B12_TEMP | 8 | LIA board 12 temperature | 0E | |
| BIAS_TEMP | 8 | BIAS board temperature | 0F | |
| DAQ_I/F_TEMP | 8 | DAQ_I/F board temperature | 10 | |

## 3.2.6. DCU command description

### 3.2.6.1. Photometer

#### *3.2.6.1.1. PhotoSampFreq*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetPhotoSampFreq | DCU | 00 | Set the photometer & T/C bolometer sampling frequency division from the photometer bias clock |
| Parameters | Location | Length | |
| PhotoBiasDiv | 0 | 8 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetPhotoSampFreq | DCU | 40 | Get the photometer & T/C bolometer sampling frequency division from the photometer bias clock |
| Returned Parameters | Location | Length | |
| PhotoBiasDiv | 0 | 8 | |

#### *3.2.6.1.2. PhotoBiasFreq*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetPhotoBiasFreq | DCU | 01 | Set the photometer & T/C bolometer sine bias frequency division from the master clock |
| Parameters | Location | Length | |
| PhotoMClkDiv | 0 | 9 | Min 64; Max 511 |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetPhotoBiasFreq | DCU | 41 | Get the photometer & T/C bolometer sine bias frequency division from the master clock |
| Returned Parameters | Location | Length | |
| PhotoMClkDiv | 0 | 9 | Min 64; Max 511 |

#### *3.2.6.1.3. PhotoBiasMode*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetPhotoBiasMode | DCU | 06 | 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 | 46 | Get the photometer & T/C bolometer sine bias mode |
| Parameters | Location | Length | |

| | | | |
|---|---|---|---|
| PhotoBiasMode | 0 | 8 | FF=run ; 00=stop ; 01 to FE= test values |

#### *3.2.6.1.4. DemodPh*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetDemodPh | DCU | 02 | Set the P250 bolometer demodulation phase shift |
| Parameters | Location | Length | |
| PhotoPhaseShift | 0 | 8 | |
| PhotoBiasChannel | 9 | 2 | 0=P250, 1=P350, 2=P500, 3=TC |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetDemodPh | DCU | 42 | Set bolometer group demodulation phase shift |
| Parameters | Location | Length | |
| PhotoBiasChannel | 9 | 2 | 0=P250, 1=P350, 2=P500, 3=TC |
| Returned Parameters | | | |
| PhaseShift | 0 | 8 | |

#### *3.2.6.1.5. PhotoBiasAmpl*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetPhotoBiasAmpl | DCU | 07 | Set bolometer group sine bias amplitude |
| Parameters | Location | Length | |
| PhotoBiasAmpl | 0 | 8 | |
| PhotoBiasChannel | 9 | 2 | 0=P250, 1=P350, 2=P500, 3=TC |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetPhotoBiasAmpl | DCU | 47 | Set bolometer group sine bias amplitude |
| Parameters | Location | Length | |
| PhotoBiasChannel | 9 | 2 | 0=P250, 1=P350, 2=P500, 3=TC |
| Returned Parameters | Location | Length | |
| PhotoBiasAmpl | 0 | 8 | |

#### *3.2.6.1.6. PhotoHeater*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetPhotoHeaterVolt | DCU | 0B | Set the photometer heater bias voltage |
| Parameters | Location | Length | |
| PhotoHeaterVolt | 0 | 8 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetPhotoHeater Volt | DCU | 4B | Get the photometer heater bias voltage |
| Parameters | Location | Length | |
| PhotoHeaterVolt | 0 | 8 | |

#### *3.2.6.1.7. PhSWJfetVSS*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetPhSWJfetVSS | DCU | 0C | Set P250 JFET source voltage |
| Parameters | Location | Length | |
| PSW_VSS (Ampl) | 0 | 8 | Analogue value $=VSS_{max}\frac{Ampl}{255}$ with $0 \le Ampl \le 255$ |
| VSSChannelID | 9 | 3 | 000=VSS1, 001=VSS2, 010=VSS3, 011=VSS4, 100=VSS5, 101=VSS6 |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetPhSWJfetVSS | DCU | 4C | Get P250 JFET source voltage |
| Parameters | Location | Length | |
| VSSChannelID | 9 | 3 | 000=VSS1, 001=VSS2, 010=VSS3, 011=VSS4, 100=VSS5, 101=VSS6 |
| Returned Parameters | | | |
| PSW_VSS | 0 | 8 | |

#### *3.2.6.1.8. PhMWJfetVSS*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetPhSWJfetVSS | DCU | 12 | Set P350 JFET source voltage |
| Parameters | Location | Length | |
| PMW_VSS (Ampl) | 0 | 8 | |
| VSSChannelID | 9 | 2 | 00=VSS1, 01=VSS2, 10=VSS3, 11=VSS4, |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetPhMWJfetVSS | DCU | 52 | Get P350 JFET source voltage |
| Parameters | Location | Length | |
| VSSChannelID | 9 | 2 | 00=VSS1, 01=VSS2, 10=VSS3, 11=VSS4 |
| Returned Parameters | | | |
| PMW_VSS | 0 | 8 | |

#### *3.2.6.1.9. PhLWJfetVSS*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetPhLWJfetVSS | DCU | 16 | Set JFET source voltage |
| Parameters | Location | Length | |
| PLW_VSS (Ampl) | 0 | 8 | |
| VSSChannelID | 9 | 1 | 0=VSS1, 1=VSS2 |

| Command | Unit | Code | Description |
|---|---|---|---|
| Get_P500_JFET_VSS1 | DCU | 56 | Get JFET source voltage |
| Parameters | Location | Length | |
| VSSChannelID | 9 | 1 | 0=VSS1, 1=VSS2 |

| Returned Parameters | | | |
|---|---|---|---|
| PSW_VSS | 0 | 8 | |

### 3.2.6.2. SetPhSWJfetBias

| Command | Unit | Code | Description |
|---|---|---|---|
| SetPhSWJFfetBias | DCU | 18 | Switch the P250 JFETs drain voltage on/off |
| Parameters | Location | Length | |
| P250_JFET_1 | 0 | 1 | |
| P250_JFET_2 | 1 | 1 | |
| P250_JFET_3 | 2 | 1 | |
| P250_JFET_4 | 3 | 1 | |
| P250_JFET_5 | 5 | 1 | |
| P250_JFET_6 | 6 | 1 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetPhSWJFfetBias | DCU | 58 | Get the P250 JFETs drain voltage status |
| Parameters | Location | Length | |
| P250_JFET_1 | 0 | 1 | |
| P250_JFET_2 | 1 | 1 | |
| P250_JFET_3 | 2 | 1 | |
| P250_JFET_4 | 3 | 1 | |
| P250_JFET_5 | 5 | 1 | |
| P250_JFET_6 | 6 | 1 | |

### 3.2.6.3. SetPhMLWJfetBias

| Command | Unit | Code | Description |
|---|---|---|---|
| SetPhMLWJfetBias | DCU | 19 | Switch the P350 & P500 JFETs drain voltage on/off |
| Parameters | Location | Length | |
| P350_JFET_1 | 0 | 1 | |
| P350_JFET_2 | 1 | 1 | |
| P350_JFET_3 | 2 | 1 | |
| P350_JFET_4 | 3 | 1 | |
| P500_JFET_1 | 5 | 1 | |
| P500_JFET_2 | 6 | 1 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetPhMLWJfetBias | DCU | 59 | Get the P350 & P500 JFETs drain voltage status |
| Parameters | Location | Length | |
| P350_JFET_1 | 0 | 1 | |
| P350_JFET_2 | 1 | 1 | |
| P350_JFET_3 | 2 | 1 | |
| P350_JFET_4 | 3 | 1 | |
| P500_JFET_1 | 5 | 1 | |
| P500_JFET_2 | 6 | 1 | |

### *3.2.6.3.1. SetLIAP1Offset to Set LIAP9Offset*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAP1Offset | DCU | 20 | Set one LIA_P1 channel offset value |
| Parameters | Location | Length | |
| Offset_ P1 | 0 | 4 | |
| Channel_P1 | 4 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAP2Offset | DCU | 21 | Set one LIA_P2 channel offset value |
| Parameters | Location | Length | |
| Offset_ P2 | 0 | 4 | |
| Channel_P2 | 4 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAP3Offset | DCU | 22 | Set one LIA_P3 channel offset value |
| Parameters | Location | Length | |
| Offset_ P3 | 0 | 4 | |
| Channel_P3 | 4 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAP4Offset | DCU | 23 | Set one LIA_P4 channel offset value |
| Parameters | Location | Length | |
| Offset_ P4 | 0 | 4 | |
| Channel_P4 | 4 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAP5Offset | DCU | 24 | Set one LIA_P5 channel offset value |
| Parameters | Location | Length | |
| Offset_ P5 | 0 | 4 | |
| Channel_P5 | 4 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAP6Offset | DCU | 25 | Set one LIA_P6 channel offset value |
| Parameters | Location | Length | |
| Offset _P6 | 0 | 4 | |
| Channel_P6 | 4 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAP7Offset | DCU | 26 | Set one LIA_P7 channel offset value |
| Parameters | Location | Length | |
| Offset _P7 | 0 | 4 | |
| Channel_P7 | 4 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAP8Offset | DCU | 27 | Set one LIA_P8 channel offset value |
| Parameters | Location | Length | |
| Offset _P8 | 0 | 4 | |
| Channel_P8 | 4 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAP9Offset | DCU | 28 | Set one LIA_P9 channel offset value |
| Parameters | Location | Length | |
| Offset_P9 | 0 | 4 | |
| Channel_P9 | 4 | 5 | |

#### 3.2.6.4. Spectrometer

##### *3.2.6.4.1. SpectroSampFreq*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSpectroSamplfreq | DCU | 30 | Set the spectrometer bolometer sampling frequency division from the spectrometer bias clock |
| Parameters | Location | Length | |
| SpectroBiasDiv | 0 | 8 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSpectroSamplFreq | DCU | 70 | Get the photometer & T/C bolometer sampling frequency division from the photometer bias clock |
| Parameters | Location | Length | |
| SpectroBiasDiv | 0 | 8 | |

##### *3.2.6.4.2. SpectroBiasFreq*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSpectroBiasFreq | DCU | 31 | Set the spectrometer bolometer sine bias frequency division from the master clock |
| Parameters | Location | Length | |
| SpectroMClkDiv | 0 | 9 | Min 64; Max 511 |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSpectroBiasFreq | DCU | 71 | Get the spectrometer bolometer sine bias frequency division from the master clock |
| Parameters | Location | Length | |
| SpectroMClkDiv | 0 | 9 | Min 64; Max 511 |

##### *3.2.6.4.3. SpectroBiasMode*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSpectroBiasMode | DCU | 34 | Set the spectrometer bolometer sine bias mode |
| Parameters | Location | Length | |
| SpectroBiasMode | 0 | 9 | FF=run ; 00=stop ; 01 to FE = test values |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSpectroBiasMode | DCU | 74 | Get the spectrometer bolometer sine bias mode |
| Parameters | Location | Length | |
| SpectroBiasMode | 0 | 9 | FF=run ; 00=stop ; 01 to FE = test values |

#### *3.2.6.4.4. SpectroDemodPh*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSpectroDemodPh | DCU | 72 | Set the S-SW bolometer demodulation phase shift |
| Parameters | Location | Length | |
| SpectroPhaseShift | 0 | 8 | |
| SpectroBiasChannel | 9 | 1 | 0=SW, 1=LW |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSpectroDemodPh | DCU | 32 | Get the S-SW bolometer demodulation phase shift |
| Parameters | Location | Length | |
| SpectroBiasChannel | 9 | 1 | |
| Returned Parameters | | | |
| SpectroPhaseShift | 0 | 8 | |

#### *3.2.6.4.5. SpectroBiasAmpl*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSpectroBiasAmpl | DCU | 35 | Set bolometer group sine bias amplitude |
| Parameters | Location | Length | |
| PhotoBiasAmpl | 0 | 8 | |
| PhotoBiasChannel | 9 | 2 | 0=P250, 1=P350, 2=P500, 3=TC |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSpectroBiasAmpl | DCU | 75 | Set bolometer group sine bias amplitude |
| Parameters | Location | Length | |
| PhotoBiasChannel | 9 | 2 | 0=SW, 1=LW |
| Returned Parameters | Location | Length | |
| PhotoBiasAmpl | 0 | 8 | |

#### *3.2.6.4.6. SpectroHeater*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSpectroHeaterVolt | DCU | 38 | Set the spectrometer heater bias voltage |
| Parameters | Location | Length | |
| SpectroHeaterVolt | 0 | 8 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSpectroHeaterVolt | DCU | 78 | Set the spectrometer heater bias voltage |
| Parameters | Location | Length | |
| SpectroHeaterVolt | 0 | 8 | |

### *3.2.6.4.7. SpSWJfetVSS*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSpSWJfetVSS | DCU | 39 | Set S-SW JFET source voltage |
| Parameters | Location | Length | |
| SSW_VSS (Ampl) | 0 | 8 | |
| VSSChannelID | 9 | 1 | 0=VSS1, 1=VSS2 |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSpSWJfetVSS | DCU | 12 | Get S-SW JFET source voltage |
| Parameters | Location | Length | |
| VSSChannelID | 9 | 1 | 0=VSS1, 1=VSS2 |
| Returned Parameters | | | |
| SSW_VSS | 0 | 8 | |

### *3.2.6.4.8. SpLWJfetVSS*

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSpLWJfetVSS | DCU | 39 | Get L-SW JFET source voltage |
| Parameters | Location | Length | |
| SLW_VSS | 0 | 8 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSpLWJfetVSS | DCU | 7A | Set L-SW JFET source voltage |
| Returned Parameters | Location | Length | |
| SLW_VSS | 0 | 8 | |

### *3.2.6.4.9. SetSpSLWJfetBias*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSpSLWJfetBias | DCU | 3B | Switch the spectrometer JFETs drain voltage on/off |
| Parameters | Location | Length | |
| S-LW_JFET_1 | 0 | 1 | |
| S-SW_JFET_1 | 1 | 1 | |
| S-SW_JFET_2 | 2 | 1 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSpSLWJfetBias | DCU | 7B | Get the spectrometer JFETs drain voltage status |
| Parameters | Location | Length | |
| S-LW_JFET_1 | 0 | 1 | |
| S-SW_JFET_1 | 1 | 1 | |
| S-SW_JFET_2 | 2 | 1 | |

### *3.2.6.4.10. SetLIAS1Offset to Set LIAS3Offset*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAS1Offset | DCU | 3C | Set one LIA_S1 channel offset value |
| Parameters | Location | Length | |
| Offset _S1 | 0 | 4 | |
| Channel_S1 | 4 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAS2Offset | DCU | 3D | Set one LIA_S2 channel offset value |
| Parameters | Location | Length | |
| Offset _S2 | 0 | 4 | |
| Channel_S2 | 4 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLIAS3Offset | DCU | 3E | Set one LIA_S3 channel offset value |
| Parameters | Location | Length | |
| Offset _S3 | 0 | 4 | |
| Channel_S3 | 4 | 5 | |

### *3.2.6.4.11. SetDataMode*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetDataMode | DCU | 49 | Set modes |
| Parameters | Location | Length | |
| DataMode | 0 | 5 | Bit 4 : 0=acquisition ; 1=offset<br>Bit 3 : 0=normal ; 1=test<br>Bit 2 to 0 :<br>0=photometer ; 1=P250 ; 2=P350&T/C ; 3=P500<br>4=specrometer ; 5=S-LW ; 6=S-SW |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetDataMode | DCU | 69 | Get mode |
| Parameters | Location | Length | |
| DataMode | 0 | 5 | |

### *3.2.6.4.12. SetFrameNber*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetFrameNber | DCU | 2A | Set photometer frames acquisition mode |
| Parameters | Location | Length | |
| frame | 0 | 8 | 0=continues; 1 to 255 =number of frames |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFrameNber | DCU | 6A | Get photometer frames acquisition mode |
| Parameters | Location | Length | |
| frame | 0 | 8 | 0=continues; 1 to 255 =number of frames |

#### *3.2.6.4.13. StartFrame*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetstartFrame | DCU | 2B | |
| Parameters | Location | Length | |
| StartFrame | 0 | 1 | 1=run ; 0=stop |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetStartFrame | DCU | 6B | |
| Parameters | Location | Length | |
| Startframe | 0 | 1 | 1=run ; 0=stop |

## 3.2.7. DCU parameters description

### 3.2.7.1. Photometer

| Name | Type | Size | Conversion | Limits | Description |
|---|---|---|---|---|---|
| Div_photo_sampl | Analogue | 8 | $F_{sampl}=\frac{F_{bias}}{2.(Div\_photo\_sampl)}$ | 0 to 255 | |
| Div_photo_bias | Analogue | 9 | $F_{BIAS}=\frac{xxMHz}{2.256.(Div\_photo\_bias)}$ | 64 to 511 | |
| Mode_photo_bias | Discrete | 8 | FF=run sine<br>00 to FE= DC level | 0 to 254 | |
| Phase_shift_P250 | Analogue | 8 | $Ph_{xx}=\frac{360°(Phase\_shift\_xx)}{255}$ | 0 to 255 | |
| Phase_shift_P350 | Analogue | 8 | $Ph_{xx}=\frac{360°(Phase\_shift\_xx)}{255}$ | 0 to 255 | |
| Phase_shift_P500 | Analogue | 8 | $Ph_{xx}=\frac{360°(Phase\_shift\_xx)}{255}$ | 0 to 255 | |
| Phase_shift_T/C | Analogue | 8 | $Ph_{xx}=\frac{360°(Phase\_shift\_xx)}{255}$ | 0 to 255 | |
| Ampl_P250 | Analogue | 8 | $Vb_{xx}=\frac{Vb\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P350 | Analogue | 8 | $Vb_{xx}=\frac{Vb\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P500 | Analogue | 8 | $Vb_{xx}=\frac{Vb\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_T/C | Analogue | 8 | $Vb_{xx}=\frac{Vb\max.(Ampl\_xx)}{255}$ | 0 to 255 | |

| Name | Type | Size | Conversion | Limits | Description |
|---|---|---|---|---|---|
| Amp_photo_heater | Analogue | 8 | $Vh_{xx}=\frac{Vh\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P250_VSS1 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P250_VSS2 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P250_VSS3 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P250_VSS4 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P250_VSS5 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P250_VSS6 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P350_VSS1 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P350_VSS2 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P350_VSS3 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P350_VSS4 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P500_VSS1 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_P500_VSS2 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| P250_JFET_1 | Discrete | 1 | 0=off ; 1=on | | |
| P250_JFET_2 | Discrete | 1 | 0=off ; 1=on | | |
| P250_JFET_3 | Discrete | 1 | 0=off ; 1=on | | |
| P250_JFET_4 | Discrete | 1 | 0=off ; 1=on | | |
| P250_JFET_5 | Discrete | 1 | 0=off ; 1=on | | |
| P250_JFET_6 | Discrete | 1 | 0=off ; 1=on | | |
| P350_JFET_1 | Discrete | 1 | 0=off ; 1=on | | |
| P350_JFET_2 | Discrete | 1 | 0=off ; 1=on | | |
| P350_JFET_3 | Discrete | 1 | 0=off ; 1=on | | |
| P350_JFET_4 | Discrete | 1 | 0=off ; 1=on | | |
| P500_JFET_1 | Discrete | 1 | 0=off ; 1=on | | |
| P500_JFET_2 | Discrete | 1 | 0=off ; 1=on | | |

| Name | Type | Size | Conversion | Limits | Description |
|---|---|---|---|---|---|
| Channel_P1 | Discrete | 5 | Channel 1 to 32 of LIA_P1 | | |
| Channel_P2 | Discrete | 5 | Channel 1 to 32 of LIA_P2 | | |
| Channel_P3 | Discrete | 5 | Channel 1 to 32 of LIA_P3 | | |
| Channel_P4 | Discrete | 5 | Channel 1 to 32 of LIA_P4 | | |
| Channel_P5 | Discrete | 5 | Channel 1 to 32 of LIA_P5 | | |
| Channel_P6 | Discrete | 5 | Channel 1 to 32 of LIA_P6 | | |
| Channel_P7 | Discrete | 5 | Channel 1 to 32 of LIA_P7 | | |
| Channel_P8 | Discrete | 5 | Channel 1 to 32 of LIA_P8 | | |
| Channel_P9 | Discrete | 5 | Channel 1 to 32 of LIA_P9 | | |
| Offset_P1 | Analogue | 4 | | | |
| Offset_P2 | Analogue | 4 | | | |
| Offset_P3 | Analogue | 4 | | | |
| Offset_P4 | Analogue | 4 | | | |
| Offset_P5 | Analogue | 4 | | | |
| Offset_P6 | Analogue | 4 | | | |
| Offset_P7 | Analogue | 4 | | | |
| Offset_P8 | Analogue | 4 | | | |
| Offset_P9 | Analogue | 4 | | | |

### 3.2.7.2. Spectrometer

| Name | Type | Size | Conversion | Limits | Description |
|---|---|---|---|---|---|
| Div_spectro_sampl | Analogue | 8 | $F_{sampl}=\frac{F_{bias}}{2.(Div\_photo\_sampl)}$ | 0 to 255 | |
| Div_spectro_bias | Analogue | 9 | $F_{BIAS}=\frac{xxMHz}{2.256.(Div\_photo\_bias)}$ | 64 to 511 | |
| Mode_spectro_bias | Discrete | 8 | FF=run sine<br>00 to FE= DC level | 0 to 254 | |
| Phase_shift_S-SW | Analogue | 8 | $Ph_{xx}=\frac{360°(Phase\_shift\_xx)}{255}$ | 0 to 255 | |
| Phase_shift_S-LW | Analogue | 8 | $Ph_{xx}=\frac{360°(Phase\_shift\_xx)}{255}$ | 0 to 255 | |
| Ampl_S-SW | Analogue | 8 | $Vb_{xx}=\frac{Vb\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_S-LW | Analogue | 8 | $Vb_{xx}=\frac{Vb\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Amp_spectro_heater | Analogue | 8 | $Vh_{xx}=\frac{Vh\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_S-LW_VSS1 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_S-SW_VSS1 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| Ampl_S-SW_VSS2 | Analogue | 8 | $VSS_{xx}=\frac{VSS\max.(Ampl\_xx)}{255}$ | 0 to 255 | |
| S-LW_JFET_1 | Discrete | 1 | 0=off ; 1=on | | |
| S-SW_JFET_1 | Discrete | 1 | 0=off ; 1=on | | |
| S-SW_JFET_2 | Discrete | 1 | 0=off ; 1=on | | |
| Channel_S1 | Discrete | 5 | Channel 1 to 24 of LIA_S1 | | |
| Channel_S2 | Discrete | 5 | Channel 1 to 24 of LIA_S2 | | |
| Channel_S3 | Discrete | 5 | Channel 1 to 24 of LIA_S3 | | |
| Offset_S1 | Analogue | 4 | Offset_S1 | | |
| Offset_S2 | Analogue | 4 | Offset_S2 | | |
| Offset_S3 | Analogue | 4 | Offset_S3 | | |

| Name | Type | Size | Conversion | Limits | Description |
|---|---|---|---|---|---|
| mode | Discrete | 5 | 00= acquisition photometer<br>01= acquisition P250<br>02= acquisition P350<br>03= acquisition P500<br>04= acquisition Spectrometer<br>05= acquisition S-SW<br>06= acquisition S-LW<br>08= Test Pattern photometer<br>0C= Test Pattern Spectrometer<br>10= Automatic offset photometer set<br>14= Automatic offset spectrometer set<br>18= Get offset photometer<br>1C= Get offset spectrometer<br>Other = do nothing | | |
| frame | Discrete | 8 | 0=continues;<br>1 to 255 = number of frames | | |
| start | Discrete | 1 | 1=run ; 0=stop | | |

## 3.2.8. DCU typical commanding scenarios

### 3.2.8.1. DCU Configuration

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 1 | Set_photo_bias_freq | Div_photo_bias | With a 10 MHz master clock for a photometer bias frequency of 199,3Hz; Div_photo_sampl = 98 |
| 2 | Set_photo_Samp_freq | Div_photo_sampl | For a photometer sampling frequency of 15,3Hz;<br>Div_photo_sampl=13 |
| 3 | Set_P250_demod_sht | Phase_shift_P250 | The optimised phases shift for each possible bias frequency must be set in a table during the ground calibration<br>(447cases of each type of BDA) |
| 4 | Set_P350_demod_sht | Phase_shift_P350 | |
| 5 | Set_P500_demod_sht | Phase_shift_P500 | |
| 6 | Set_T/C_demod_sht | Phase_shift_T/C | |
| 7 | Set_P250_bias_ampl | Ampl_P250 | Optimised amplitude could be determine during the ground calibration |
| 8 | Set_P350_bias_ampl | Ampl_P350 | |
| 9 | Set_P500_bias_ampl | Ampl_P500 | |
| 10 | Set_T/C_bias_ampl | Ampl_T/C | |
| 11 | Set_P250_JFET_VSS1 | Ampl_P250_VSS1 | Optimised amplitude could be determine during the ground calibration |
| 12 | Set_P250_JFET_VSS2 | Ampl_P250_VSS2 | |
| 13 | Set_P250_JFET_VSS3 | Ampl_P250_VSS3 | |
| 14 | Set_P250_JFET_VSS4 | Ampl_P250_VSS4 | |
| 15 | Set_P250_JFET_VSS5 | Ampl_P250_VSS5 | |
| 16 | Set_P250_JFET_VSS6 | Ampl_P250_VSS6 | |
| 17 | Set_P350_JFET_VSS1 | Ampl_P350_VSS1 | |
| 18 | Set_P350_JFET_VSS2 | Ampl_P350_VSS2 | |
| 19 | Set_P350_JFET_VSS3 | Ampl_P350_VSS3 | |
| 20 | Set_P350_JFET_VSS4 | Ampl_P350_VSS4 | |
| 21 | Set_P500_JFET_VSS1 | Ampl_P500_VSS1 | |
| 22 | Set_P500_JFET_VSS2 | Ampl_P500_VSS2 | |
| 23 | Set_P250_JFET_PWR | P250_JFET | All JFET on (P250_JFET=111111) |
| 24 | Set_P350&500_JFET_PWR | P350&500_JFET | All JFET on (P350&500_JFET=111111) |
| 25 | Set_photo_bias_mode | Mode_photo_bias | Mode = EF |
| 26 | Set_photo_heater_ampl | Ampl_photo_heater | Start heat the photometer JFET modules<br>Set Ampl_photo_heater with xx |
| | **Wait XX ms** | | |
| 27 | Set_photo_heater_ampl | Ampl_photo_heater | Stop heat the photometer JFET modules<br>Set Ampl_photo_heater with 00 |

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 28 | Set_spectro_bias_freq | Div_spectro_bias | With a 10 MHz master clock for a photometer bias frequency of 160,1Hz; Div_photo_sampl=122 |
| 29 | Set_spectro_Sampl_freq | Div_spectro_sampl | For a photometer sampling frequency of 80 Hz; Div_photo_sampl=2 |
| 30 | Set_S-SW_demod_sht | Phase_shift_S-SW | The optimised phases shift for each possible bias frequency must be set in a table during the ground calibration (447cases of each type of BDA) |
| 31 | Set_S-LW_demod_sht | Phase_shift_S-LW | |
| 32 | Set_S-SW_bias_ampl | Ampl_S-SW | Optimised amplitude could be determine during the ground calibration |
| 33 | Set_S-LW_bias_ampl | Ampl_S-LW | |
| 34 | Set_S-LW_JFET_VSS1 | Ampl_S-LW_VSS1 | Optimised amplitude could be determine during the ground calibration |
| 35 | Set_S-SW_JFET_VSS1 | Ampl_S-SW_VSS1 | |
| 36 | Set_S-SW_JFET_VSS2 | Ampl_S-SW_VSS2 | |
| 37 | Set_spectro_JFET_PWR | S-LW&S-SW_JFET | All JFET on (S-LW&S-SW_JFET =111111) |
| 38 | Set_spectro_bias_mode | Mode_spectro_bias | Mode = EF |
| 39 | Set_spectro_heater_ampl | Ampl_spectro_heater | Start heat the spectrometer JFET modules Set Ampl_spectro_heater with xx |
| | **Wait XX ms** | | |
| 40 | Set_spectro_heater_ampl | Ampl_spectro_heater | Stop heat the spectrometer JFET modules Set Ampl_spectro_heater with 00 |

So after all this steps the spectrometer and the photometer JFETs are running.
All the sine bias parameters and acquisition parameters are loaded.
And the bolometers are bias receive a differential 0V.
So we could choose to run the spectrometer or the photometer.

#### 3.2.8.2. Photometer Configuration

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 1 | Set_photo_bias_mode | Mode_photo_bias | Mode = FF |
| | **Wait XX ms** | | After this time the system must be stable |

#### 3.2.8.3. Photometer offset setting

##### *3.2.8.3.1. Automatic*

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 1 | Set_start_mode | start | Start=0 |
| 2 | Set_photo_mode | Mode | Mode = 10 |
| 3 | Set_start_mode | start | Start=1 |
| | **Wait XX ms** | | All the offset are set |
| 4 | Set_start_mode | start | Start=0 |
| 5 | Set_photo_mode | Mode | Mode = 18 |
| 6 | Set_start_mode | start | Start=1 |
| | **Wait XX ms** | | All the offset are send to DPU |

##### *3.2.8.3.2. Manual*

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 1 | Set_LIA_P1_Offset | Channel_P1<br>Offset_P1 | Channel_P1=0<br>Offset_P1=X |
| - | - | - | - |
| 32 | Set_LIA_P1_Offset | Channel_P1<br>Offset_P1 | Channel_P1=31<br>Offset_P1=X |
| 17 | Set_LIA_P2_Offset | Channel_P2<br>Offset_P2 | Channel_P2=0<br>Offset_P2=X |
| - | - | - | - |
| 32 | Set_LIA_P2_Offset | Channel_P2<br>Offset_P2 | Channel_P2=31<br>Offset_P2=X |
| - | - | - | - |
| - | - | - | - |
| 288 | Set_LIA_P9_Offset | Channel_P9<br>Offset_P9 | Channel_P9=31<br>Offset_P9=X |

#### 3.2.8.4. Photometer acquisition

##### *3.2.8.4.1. Continue*

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 1 | Set_start_mode | start | Start=0 |
| 2 | Set _mode | Mode | Mode = 00 |
| 3 | Set_frames_photo | frame | Frame=0 |
| 4 | Set_start_mode | start | Start=1 |

##### *3.2.8.4.2. Discrete*

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 1 | Set_start_mode | start | Start=0 |
| 2 | Set _mode | Mode | Mode = 00 |
| 3 | Set_frames_photo | frame | Frame=x (1 to 255 = number of frames) |
| 4 | Set_start_mode | start | Start=1 |

#### 3.2.8.5. Spectrometer Configuration

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 1 | Set_Spectro_bias_mode | Mode_Spectro_bias | Mode = FF |
| | **Wait XX ms** | | After this time the system must be stable |

#### 3.2.8.6. Spectrometer offset setting

##### *3.2.8.6.1. Automatic*

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 1 | Set_start_mode | start | Start=0 |
| 2 | Set_Spectro_mode | Mode | Mode = 14 |
| 3 | Set_start_mode | start | Start=1 |
| | **Wait XX ms** | | All the offset are set |
| 4 | Set_start_mode | start | Start=0 |
| 5 | Set_Spectro_mode | Mode | Mode = 1C |
| 6 | Set_start_mode | start | Start=1 |
| | **Wait XX ms** | | All the offset are send to DPU |

##### *3.2.8.6.2. Manual*

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 1 | Set_LIA_S1_Offset | Channel_S1<br>Offset_S1 | Channel_S1=0<br>Offset_S1=X |

| | | | |
|---|---|---|---|
| - | - | - | - |
| 32 | Set_LIA_S1_Offset | Channel_S1<br>Offset_S1 | Channel_S1=23<br>Offset_S1=X |
| 17 | Set_LIA_S2_Offset | Channel_S2<br>Offset_S2 | Channel_S2=0<br>Offset_S2=X |
| - | - | - | - |
| 32 | Set_LIA_S2_Offset | Channel_S2<br>Offset_S2 | Channel_S2=23<br>Offset_S2=X |
| - | - | - | - |
| - | - | - | - |
| 288 | Set_LIA_S3_Offset | Channel_S3<br>Offset_S3 | Channel_S3=23<br>Offset_S3=X |

#### 3.2.8.7. Spectrometer acquisition

##### *3.2.8.7.1. Continue*

| Steps | Command | Parameters | Comment |
|---|---|---|---|
| 1 | Set_start_mode | start | Start=0 |
| 2 | Set _mode | Mode | Mode = 04 |
| 4 | Set_start_mode | start | Start=1 |

### 3.2.9. MCU specific command list summary

#### 3.2.9.1. 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 CID9 | CID9 to CID0 | PAR15 to PAR0 |
|---|---|---|---|
| R/W | Axis Id | Command Code | Parameter(s) |

| Axis | Axis Id |
|---|---|
| All | 00 |
| SMEC | 01 |
| Chopper | 10 |
| Jiggle | 11 |

Axis identifier definition

#### 3.2.9.2. SMEC Commands

##### *3.2.9.2.1. Initialisation set commands*

| Com. Mnemonic | Com. Name | Action |
|---|---|---|
| 000h | SetEncoderPwr | Power on the encoder led. The led has 8 levels encoded on 3 bits from 0 to max. |
| 001h | SetLVDTPwr | Power on/off the LVDT oscillator (Boolean) |
| 002h | SetLoopMode | Open or close loop mode selection<br>Parameter definition:<br>00 = Loop opened (0020000h)<br>01 = Loop closed on Back EMF(0020001h)<br>10 = Loop closed on LVDT(0020002h)<br>11 = Loop closed on optical encoder(0020003h) |
| 003h | SetLaunchLatch1 | Engage/disengage Launch Latch 1 (0 or 1) |
| 004h | SetLaunchLatch2 | Engage/disengage Launch Latch 2 (0 or 1) |
| 005h | SetInitMotion | Starts the motion initialisation procedure<br>(0 or 1) |

##### *3.2.9.2.2. General configuration commands*

| | | |
|---|---|---|
| 080h | SetScanStart | specifies the scan starting position |
| 880h | GetScanStart | Reads the start position |

| | | |
|---|---|---|
| 081h | SetScanSpeed | specifies the velocity to reach the position target (scan speed) |
| 881h | GetScanSpeed | |
| 082h | SetScanEnd | |
| 882h | GetStartScan | 0: Scan commanded to stop<br>1: Scan commanded to run |
| ~~083h~~ | ~~Update~~ | ~~Cancelled: the update shall be taken into account on each SetStartScan Command~~ |
| 084h | SetScanMode | 0: motion stopped<br>1:position step<br>2: sawtooth motion<br>3:triangular motion |
| 085h | SetScanNumber | Specifies the number of scans to be performed |

Starts/Stops the scan. (start of trajectory generation and the closed loop control scan according to Scan parameters)

#### *3.2.9.2.3. Control loop and trajectory tuning specific commands*

| Command Mnemonic | Command Name | Action |
|---|---|---|
| 100h | SetKpHigh | Proportional gain of the digital PID controller |
| 101h | SetKpLow | |
| 102h | SetKdHigh | Derivative Gain of the digital PID controller |
| 103h | SetKdLow | |
| 104h | SetDerivFilterHigh | Sets the filtering time constant to calculate the derivative term. |
| 105h | SetDerivFilterLow | |
| 106h | SetKiHigh | Integral gain of the digital PID controller |
| 107h | SetKiLow | |
| 108h | SetIntegrationLimit | Loads/Reads the integration saturation for the integral compensation of the servo |
| 109h | Set PositionErrorLimit | determine/reads the position error value that causes an error on the servo |
| 10Ah | SetNotchParamHigh | Parameters for notch filtering of mechanical modes. Here is the pole compensation of the first parasitic mechanical mode |
| 10Bh | SetNotchParamLow | |

#### *3.2.9.2.4. HK specific get commands*

| | | |
|---|---|---|
| 980h | GetSmecStatus | reads the Activity Status Register. This Status Register can only be read and no bit can be cleared since the word is refreshed by the chipset. |
| 981h | GetActualPosition | returns the last absolute position |
| 982h | GetActualVelocity | Get the instantaneous (20 Hz filtered) velocity |
| 983h | GetMeanSpeed | Actual scan mean measured speed<br>Allows to verify the velocity scan error |
| 984h | GetMeanPositionError | Returns the mean position error over a scan |

### 3.2.9.3. CHOP COMMANDS

To be Completed

#### *3.2.9.3.1. Initialisation set commands*

| Com. Mnemonic | Com. Name | Parameter / Action |
|---|---|---|
| 200h | SetSensorPwr | On/Off (0 /1) : Power on magnetoresistive sensor. |
| 201h | Reserve | |
| 202h | SetChopLoopMode | Open or close loop mode selection<br>Parameter definition:<br>00 = Loop opened (2020000h)<br>01 = Loop closed on Back EMF(2020001h)<br>10 = Loop closed on magnetoresistive(2020002h) |
| 203h | SetChopLaunchLatch | Engage/disengage Launch Latch (0 or 1) |

#### *3.2.9.3.2. General configuration commands*

| | | |
|---|---|---|
| 280h | SetPosition0 | specifies the y0 position step |
| A80h | GetPosition0 | |
| 281h | SetPosition1 | specifies the y1 position step |
| A81h | GetPosition1 | |
| 282h | SetChopPeriod | Specifies the chopping cycle |
| A82h | GetChopPeriod | |
| 284h | SetChopMode<br>(alias MoveChop) | 0: Chopper commanded to stop<br>1: Chopper commanded to run in step mode<br>2: Chopper commanded to run in toggle mode |
| 285h | SetScanNumber | Specifies the number of scans to be performed |

#### *3.2.9.3.3. Control loop and trajectory tuning specific commands*

| Command Mnemonic | Command Name | **Action** |
|---|---|---|
| 300h | SetKpHigh | Proportional gain of the digital PID controller |
| 301h | SetKpLow | |
| 302h | SetKdHigh | Derivative Gain of the digital PID controller |
| 303h | SetKdLow | |
| 304h | SetDerivFilterHigh | Sets the filtering time constant to calculate the derivative term. |
| 305h | SetDerivFilterLow | |
| 306h | SetKiHigh | Integral gain of the digital PID controller |
| 307h | SetKiLow | |
| 308h | SetIntegrationLimit | Loads/Reads the integration saturation for the integral compensation of the servo |

| | | |
|---|---|---|
| 309h | Set PositionErrorLimit | determine/reads the position error value that causes an error on the servo |

#### *3.2.9.3.4. HK specific get commands*

| | | |
|---|---|---|
| **B80h** | **GetChopStatus** | reads the Activity Status Register. This Status Register can only be read and no bit can be cleared since the word is refreshed by the chipset. |
| **B81h** | **GetActualPosition** | returns the last absolute position |
| **B82h** | **GetMeanPositionError** | Returns the mean position error over a scan |

TO BE COMPLETED

### 3.2.9.4. JIGGLE COMMANDS

Idem than Chopper commands with command mnemonics + 200h

### 3.2.9.5. Telemetry & Trace configuration commands

| # | Parameter | Action |
|---|---|---|
| 600h | SetTelemetry | Activate or inhibits the possible predefined packets to be sent |
| 601h | SetTelemetrySampling | Set the sampling rate of the telemetry packets |
| 602h | Set TraceSampling | Sets the time period, expressed in ms, between successive trace points |
| 603h | SetTraceBuffer | Sets the length of the trace data buffer. |
| 604h | SetTraceParam#1 | parameter identifier to be put in the trace frame up to 6 values<br>In the trace frame, the 2 first data are the data name and the data sampling. |
| 605h | SetTraceParam#2 | |
| 606h | SetTraceParam#3 | |
| 607h | SetTraceParam#4 | |
| 608h | SetTraceParam#5 | |
| 609h | SetTraceParam#6 | |

### 3.2.9.6. HK and miscellaneous commands

| | | |
|---|---|---|
| 680h | SetDPUPollingTime | Set a maximum time between 2 commands before a IO Error code is generated, meaning a communication problem |
| E81h | ReadMemory | Returns the value of whatever DSP memory mapping |

## 3.2.10. MCU typical commanding scenarios

### 3.2.10.1. SMEC Commanding scenarios

#### *3.2.10.1.1. SMEC initialisation procedure*

Previous State: The Main Power supply switch on

| | Command to be sent | Action | Remarks - Error switch to degraded mode procedure |
|---|---|---|---|
| 1 | SetEncoderPwr(on) | Power on the optical encoder led | |
| 2 | GetEncoderSignalsStatus() | Verify if the optical encoder works properly | Goto procedure #2 'Initialisation in degraded mode' |
| 3 | SetLoopMode (on optical encoder) | Close the loop on optical encoder | It is recommanded to move the SMEC while latched thanks to the latch clearance of few 10 microns |
| 4 | GetSMEC Status() | Verify if the loop is closed properly | |
| 5 | SetLVDTPwr(on) | Power on the LVDT Oscillator | |
| 6 | GetLVDTStatus | Verify the oscillator works properly | |
| 7 | SetLaunchLatch1(off) | Disengage Launch Latch 1 | |
| 8 | GetLaunchLatch1Status | Verify the first launch latch disengagement | |
| 9 | SetLaunchLatch2(off) | Engage/disengage Launch Latch 2 | |
| 10 | GetLaunchLatch2Status | Verify the launch latch #2 disengagement | |
| 11 | SetInitMotion(on) | Starts the motion initialisation procedure (0 or 1) | Consists in applying the mechanism on mechanical stop for absolute position reference capture |
| 12 | GetSMECStatus | Verify if the motion is properly initialised | |

AT THIS STAGE, THE SMECm IS INITIALISED, WAITING IN CLOSED LOOP CONTROL AT HOME POSITION. Next possible State: operating the SMEC in nominal mode.

### 3.2.10.2. Commanding the SMEC

| # | Command to be sent | Parameter | Remark |
|---|---|---|---|
| 1 | **SetScanMode** | 0 | SMEC stopped |
| 2 | **SetScanSpeed** | Scan Speed | |
| 3 | **SetScanNumber** | Number of scan | |
| 4 | **SetScanStart** | number of counts from home at which to start scientific part of scan | |
| 5 | **SetScanEnd** | number of counts from home position of end of scientific part of scan | |
| 6 | **SetTelemetrySampling** | Bit related to SMEC telemetry packet and encoder count sample value | |
| 7 | **SetTelemetry** | Bit related to SMEC telemetry packet = 1 | generate a SMEC data sample at every i counts |
| 8 | **SetScanMode** | on: can be sawtooth,triangular,step | The motion is started with set up parameters |

• If the scan is running while configuration is set up, parameters shall not be taken into account and the command reply shall indicate an error to DPU

• This operation should be followed by a flush_fifo command to the DPU

• Scan quality information should be put in memory for reading as housekeeping data (it will need to be associated with a scan number)

#### 3.2.10.3. Commanding the Chopper

Chopping can be commanded in the MCU in the following ways:
*CHOP(y0,y1)*

##### *3.2.10.3.1. Automatic*

| # | Command to be sent | Parameter | Remark |
|---|---|---|---|
| 1 | SetChopPosition0 | (y0) | |
| 2 | SetChopPosition1 | (y1) | |
| 3 | SetChopPeriod | Period | |
| 4 | SetTelemetrySample | Sample interval | |
| 5 | SetChopSamples | number of samples per chop position | |
| 6 | SetChopCycles | Number of steps<br>0 = indefinite chopping | |
| 7 | SetChopMode | 1 : Automatic Step mode | Update parameters and starts chopping |

##### *3.2.10.3.2. Command Driven*

| # | Command to be sent | Parameter | Remark |
|---|---|---|---|
| 1 | SetChopPosition0 | y0 | |
| 2 | SetChopPosition1 | y1 | |
| 3 | SetChopPeriod | Period | |
| 4 | SetTelemetrySample | Sample interval | |
| 5 | SetChopSamples | number of samples per chop position | |
| 6 | SetChopMode | 2 :Toggle Mode | Update parameters and starts chopping |
| 7 | SetChopMode | 2 :Toggle Mode | Move the chopper |
| 8 | SetChopMode | 2 : Toggle Mode | Move the chopper |
| 9 | SetChopMode | Toggle Mode | Move the chopper |
| | etc ..... | | |

### 3.2.10.4. Commanding the Jiggle and Chopper

**Jiggle is commanded in the following way:**
Input: z, y0,y1 for each jiggle position
***JIGGLEANDCHOP(z,y0,y1,……)***

| # | Command to be sent | Parameter | Remark |
|---|---|---|---|
| 1 | SetJigPosition | z | |
| 2 | SetChopPosition0 | y0 | |
| 3 | SetChopPosition1 | y1 | |
| 4 | SetJigMode | 1 :Step Mode | This updates parameters and Move jiggle |
| 5 | SetChopMode | 1 :Step Mode | Move the chopper |
| 6 | SetJigPosition | z’ | |
| 7 | SetChopPosition0 | y0’ | |
| 8 | SetChopPosition1 | y1’ | |
| 9 | SetJigMode | 1 :Step Mode | This updates parameters and Move jiggle |
| 10 | SetChopMode | 1 :Step Mode | Move the chopper |
| | Etc.... | | |

## 3.2.11. SCU specific command list summary

### 3.2.11.1. 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 PAR0 |
|---|---|---|
| R/W | Command Code | Parameter(s) |

### 3.2.11.2. Write/read commands

| Command Name | Argument(s) | Ranges List | Command verification | Execution Delay |
|---|---|---|---|---|
| | | | | |

### 3.2.11.3. Read only commands

| Command Name | Argument(s) | Ranges List | Command verification | Execution Delay |
|---|---|---|---|---|
| | | | | |

## 3.2.12. SCU command description

### 3.2.12.1. Write only commands

#### *3.2.12.1.1. FrRequest*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetFrRequest | SCU | tbd | Initiate frame sequence transfer |
| Parameters | Location | Length | |
| NA | | | |

### 3.2.12.2. Read/Write commands

#### *3.2.12.2.1. FrameRate*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetFramRate | SCU | tbd | Set frame rate |
| Parameters | Location | Length | |
| FramRate | 0 | 8 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFramRate | SCU | tbd | Return frame rate |
| Returned Parameters | Location | Length | |
| FramRate | 0 | 8 | |

#### *3.2.12.2.2. SeqLength*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSeqLength | SCU | tbd | Set number of frame per sequence ( 0 meaning infinit ) |
| Parameters | Location | Length | |
| SeqLength | 0 | 8 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFramRate | SCU | tbd | Return number of frame per sequence ( 0 meaning infinit ) |
| Returned Parameters | Location | Length | |
| SeqLength | 0 | 8 | |

#### 3.2.12.2.3. TempOnOff

| Command | Unit | Code | Description |
|---|---|---|---|
| SetTempOnOff | SCU | tbd | Set sub K and FPU temperature probes on/off |
| Parameters | Location | Length | |
| TempOnOff | 0 | 8 | 12bits on/off word |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetTempOnOff | SCU | tbd | Return sub K and FPU temperature probes on/off |
| Returned Parameters | Location | Length | |
| TempOnOff | 0 | 8 | 12bits on/off word |

#### 3.2.12.2.4. SubKpFreq

| Command | Unit | Code | Description |
|---|---|---|---|
| SetSubKpFreq | SCU | tbd | Set sub K temperature probe bias frequency |
| Parameters | Location | Length | |
| SubKpFreq | 0 | 8 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSubKpFreq | SCU | tbd | Return sub K temperature probe bias frequency |
| Returned Parameters | Location | Length | |
| SubKpFreq | 0 | 8 | |

#### 3.2.12.2.5. DCDCOnOff

| Command | Unit | Code | Description |
|---|---|---|---|
| SetDCDCOnOff | SCU | tbd | Set DCDC on/off command word |
| Parameters | Location | Length | |
| DCDCOnOff | 0 | 5 | |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSubKpFreq | SCU | tbd | Return DCDC on/off command word |
| Returned Parameters | Location | Length | |
| DCDCOnOff | 0 | 5 | |

#### 3.2.12.2.6. LPHBias1

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLPHBias1 | SCU | tbd | Set value of current applied to Low Power Heater 1 |

| Parameters | Location | Length | |
|---|---|---|---|
| LPHBias1 | 0 | 12 | Current value |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetLPHBias1 | SCU | tbd | Get voltage across Low Power Heater 1 |
| Returned Parameters | Location | Length | |
| LPHBias1 | 0 | 12 | Heater voltage analog value |

#### 3.2.12.2.7. LPHBias2

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLPHBias2 | SCU | tbd | Set value of current applied to Low Power Heater 2 |
| Parameters | Location | Length | |
| LPHBias2 | 0 | 12 | Current value |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetLPHBias2 | SCU | tbd | Get voltage across Low Power Heater 2 |
| Returned Parameters | Location | Length | |
| LPHBias2 | 0 | 12 | Heater voltage analog value |

#### 3.2.12.2.8. LPHBias3

| Command | Unit | Code | Description |
|---|---|---|---|
| SetLPHBias3 | SCU | tbd | Set value of current applied to Low Power Heater 3 |
| Parameters | Location | Length | |
| LPHBias3 | 0 | 12 | Current value |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetLPHBias3 | SCU | tbd | Get voltage across Low Power Heater 3 |
| Returned Parameters | Location | Length | |
| LPHBias3 | 0 | 12 | Heater voltage analog value |

#### 3.2.12.2.9. HPHBias4

| Command | Unit | Code | Description |
|---|---|---|---|
| SetHPHBias4 | SCU | tbd | Set value of current applied to High Power Heater 4 (Sorption Pump) |
| Parameters | Location | Length | |
| HPHBias4 | 0 | 12 | Current value |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetHPHBias4 | SCU | tbd | Get voltage across High Power Heater 4 (Sorption Pump) |
| Returned Parameters | Location | Length | |
| HPHBias4 | 0 | 12 | Heater voltage analog value |

#### 3.2.12.2.10. StimBias1

| Command | Unit | Code | Description |
|---|---|---|---|
| SetStimBias1 | SCU | tbd | Set value of current applied to Stimulus Source 1 (xxxxx) |
| Parameters | Location | Length | |
| StimBias1 | 0 | 12 | Current value |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetStimBias1 | SCU | tbd | Get current in Stimulus Source 1 (xxxxx) |
| Returned Parameters | Location | Length | |
| StimBias1 | 0 | 12 | Stimulus source current analog value |

#### 3.2.12.2.11. StimBias2

| Command | Unit | Code | Description |
|---|---|---|---|
| SetStimBias2 | SCU | tbd | Set value of current applied to Stimulus Source 2 (xxxxx) |
| Parameters | Location | Length | |
| StimBias2 | 0 | 12 | Current value |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetStimBias2 | SCU | tbd | Get current in Stimulus Source 2 (xxxxx) |
| Returned Parameters | Location | Length | |
| StimBias2 | 0 | 12 | Stimulus source current analog value |

#### *3.2.12.2.12. StimBias3*

| Command | Unit | Code | Description |
|---|---|---|---|
| SetStimBias3 | SCU | tbd | Set value of current applied to Stimulus Source 3 (xxxxx) |
| Parameters | Location | Length | |
| StimBias3 | 0 | 12 | Current value |

| Command | Unit | Code | Description |
|---|---|---|---|
| GetStimBias3 | SCU | tbd | Get current in Stimulus Source 3 (xxxxx) |
| Returned Parameters | Location | Length | |
| StimBias3 | 0 | 12 | Stimulus source current analog value |

#### 3.2.12.3. Read only commands

##### 3.2.12.3.1. StimVolt1

| Command | Unit | Code | Description |
|---|---|---|---|
| GetStimVolt1 | SCU | tbd | Get voltage across Stimulus Source 1 |
| Parameters | Location | Length | |
| StimVolt1 | 0 | 12 | Voltage analog value |

##### 3.2.12.3.2. StimVolt2

| Command | Unit | Code | Description |
|---|---|---|---|
| GetStimVolt2 | SCU | tbd | Get voltage across Stimulus Source 2 |
| Parameters | Location | Length | |
| StimVolt2 | 0 | 12 | Voltage analog value |

##### 3.2.12.3.3. StimVolt3

| Command | Unit | Code | Description |
|---|---|---|---|
| GetStimVolt3 | SCU | tbd | Get voltage across Stimulus Source 3 |
| Parameters | Location | Length | |
| StimVolt3 | 0 | 12 | Voltage analog value |

##### 3.2.12.3.4. ScuCHTp05

| Command | Unit | Code | Description |
|---|---|---|---|
| GetScuCHTp05 | SCU | tbd | Return value of +05V of SCU/CCHK&TEMP |
| Returned Parameter(s) | Location | Length | |
| ScuCHTp05 | 0 | 12 | Voltage analog value |

##### 3.2.12.3.5. ScuCHTp09

| Command | Unit | Code | Description |
|---|---|---|---|
| GetScuCHTp09 | SCU | tbd | Return value of +09V of SCU/CCHK&TEMP |
| Returned Parameter(s) | Location | Length | |
| ScuCHTp09 | 0 | 12 | Voltage analog value |

##### 3.2.12.3.6. ScuCHTn09

| Command | Unit | Code | Description |
|---|---|---|---|
| GetScuCHTn09 | SCU | tbd | Return value of -09V of SCU/CCHK&TEMP |
| Returned Parameter(s) | Location | Length | |
| ScuCHTn09 | 0 | 12 | Voltage analog value |

#### 3.2.12.3.7. FpuTemp01

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp01 | SCU | tbd | Return FPU temperature probe 01 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.8. FpuTemp02

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp02 | SCU | tbd | Return FPU temperature probe 02 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp02 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.9. FpuTemp03

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp03 | SCU | tbd | Return FPU temperature probe 03 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp03 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.10. FpuTemp04

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp04 | SCU | tbd | Return FPU temperature probe 04 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp04 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.11. FpuTemp05

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp05 | SCU | tbd | Return FPU temperature probe 05 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp05 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.12. FpuTemp06

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp06 | SCU | tbd | Return FPU temperature probe 06 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp06 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.13. FpuTemp07

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp07 | SCU | tbd | Return FPU temperature probe 07 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp07 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.14. FpuTemp08

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp01 | SCU | tbd | Return FPU temperature probe 01 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp01 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.15. FpuTemp09

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp01 | SCU | tbd | Return FPU temperature probe 01 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp01 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.16. FpuTemp10

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp01 | SCU | tbd | Return FPU temperature probe 01 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp01 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.17. FpuTemp11

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp01 | SCU | tbd | Return FPU temperature probe 01 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp01 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.18. FpuTemp12

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp01 | SCU | tbd | Return FPU temperature probe 01 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp01 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.19. FpuTemp13

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp01 | SCU | tbd | Return FPU temperature probe 01 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp01 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.20. FpuTemp14

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp01 | SCU | tbd | Return FPU temperature probe 01 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp01 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.21. FpuTemp15

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp01 | SCU | tbd | Return FPU temperature probe 01 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp01 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.22. FpuTemp16

| Command | Unit | Code | Description |
|---|---|---|---|
| GetFpuTemp01 | SCU | tbd | Return FPU temperature probe 01 current value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| FpuTemp01 | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.23. SubKTempP

| Command | Unit | Code | Description |
|---|---|---|---|
| GetSubKTempP | SCU | tbd | Return subK temperature probe voltage value (pr_name) |
| Returned Parameter(s) | Location | Length | |
| SubKTempP | 0 | 12 | Probe voltage analog value (function of the temperature) |

#### 3.2.12.3.24. CcuTempRd

| Command | Unit | Code | Description |
|---|---|---|---|
| GetCcuTempRd | SCU | tbd | Return CCHK board temperature sensor value |
| Returned Parameter(s) | Location | Length | |
| CcuTempRd | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.25. TcuTempRd

| Command | Unit | Code | Description |
|---|---|---|---|
| GetTcuTempRd | SCU | tbd | Return TEMP board temperature sensor value |
| Returned Parameter(s) | Location | Length | |
| TcuTempRd | 0 | 12 | Probe current analog value (function of the temperature) |

#### 3.2.12.3.26. PsuTempRd

| Command | Unit | Code | Description |
|---|---|---|---|
| Get PsuTempRd | SCU | tbd | Return PSU board temperature sensor value |
| Returned Parameter(s) | Location | Length | |
| PsuTempRd | 0 | 12 | Probe current analog value (function of the temperature) |

### 3.2.13. SCU parameters description

| Name | Type | Size | Conversion | Limits | Description |
|---|---|---|---|---|---|
| FramRate | Analogue | 8 | | 0 to 255 | |
| SeqLength | | | | | |
| TempOnOff | Discrete | | | | |
| SubKpFreq | | | | | |
| DCDCOnOff | | | | | |
| LPHBias1 | | | | | |
| LPHBias2 | | | | | |
| LPHBias3 | | | | | |
| HPHBias4 | | | | | |
| StimBias1 | | | | | |
| StimBias2 | | | | | |
| StimBias3 | | | | | |
| StimVolt1 | | | | | |
| StimVolt2 | | | | | |
| StimVolt3 | | | | | |
| ScuCHTp05 | | | | | |
| ScuCHTp09 | | | | | |
| ScuCHTn09 | | | | | |
| FpuTemp01 | | | | | |
| FpuTemp02 | | | | | |
| FpuTemp03 | | | | | |
| FpuTemp04 | | | | | |
| FpuTemp05 | | | | | |
| FpuTemp06 | | | | | |
| FpuTemp07 | | | | | |
| FpuTemp08 | | | | | |
| FpuTemp09 | | | | | |
| FpuTemp10 | | | | | |
| FpuTemp11 | | | | | |
| FpuTemp12 | | | | | |
| FpuTemp13 | | | | | |
| FpuTemp14 | | | | | |
| FpuTemp15 | | | | | |
| FpuTemp16 | | | | | |
| SubKTempP | | | | | |
| CcuTempRd | | | | | |
| TcuTempRd | | | | | |
| PsuTempRd | | | | | |

### 3.2.14. SCU typical commanding scenarios

## 3.3. Data Interface

### 3.3.1. 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.

### 3.3.2. Overall Interface Diagram

The Command Interface diagram is given in figure 2.2. Prime and Redundant interfaces are shown.

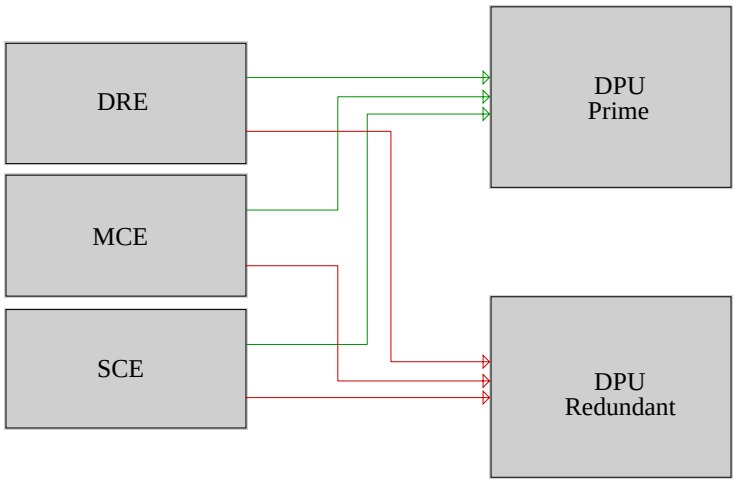



Figure 3.2-a

### 3.3.3. 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 3.3-a).
The interface uses the balanced line RS422 electrical standard based on 26C31 and 26C32 transmitter and receiver type respectively.

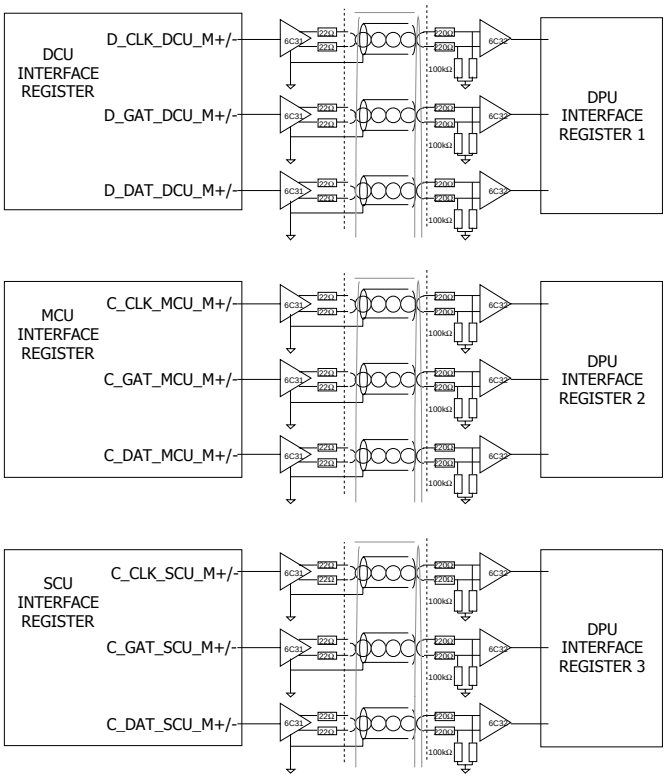



Figure 3.3-a - Electrical configuration

### 3.3.4. 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

### 3.3.5. 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:

- a length word
- a frame ID
- a data structure
- a frame time
- a check word

#### 3.3.5.1. 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.

#### 3.3.5.2. 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:

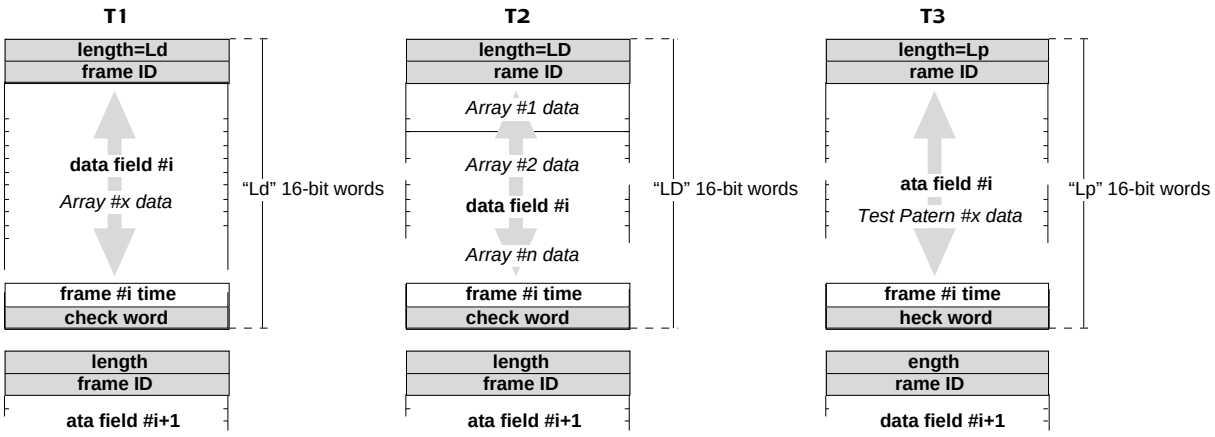
| UNIT | Frame Type | Frame ID (hex) |
|---|---|---|
| DCU | Ph Full Array | 00 |
| DCU | Sp Full array | 01 |
| DCU | P-SW | 02 |
| DCU | P-MW | 03 |
| DCU | P-LW | 04 |
| DCU | S-SW | 05 |
| DCU | S-LW | 06 |
| DCU | Test Pattern | 07 |
| DCU | Ph Offset | 08 |
| DCU | Sp Offset | 09 |
| DCU | Not Allocated | 0A-0F |
| MCU | SMEC scan | 10 |
| MCU | SMEC Step | 11 |
| MCU | Chop | 12 |

| UNIT | Frame Type | Frame ID (hex) |
|---|---|---|
| MCU | Jiggle | 13 |
| MCU | Trace | 14 |
| MCU | Test Pattern | 15 |
| MCU | Not Allocated | 16-1F |
| SCU | HSK | 20 |
| SCU | Test Pattern | 21 |
| SCU | Not Allocated | 22-2F |

### 3.3.5.3. Data structure

#### *3.3.5.3.1. 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 | Length |
|---|---|---|---|
| Photo. Full Array | 00 | T2 | 301 |
| Spectro. Full Array | 01 | T2 | 69 |
| P-SW | 02 | T1 | |
| P-MW | 03 | T1 | |
| P-LW | 04 | T1 | 301 |
| S-SW | 05 | T1 | |
| S-LW | 06 | T1 | |
| Test Pattern | 07 | T3 | 301 |
| Ph Offset | 08 | T2 | 301 |
| Sp Offset | 09 | T2 | 69 |

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

For the T2 frame length it assumed:

- the photometer is composed of 288 bolometers
- the spectrometer is composed of 56 bolometers
- along with the imaging bolometers we transfer 3 thermometry bolometers

#### *3.3.5.3.2. Photometer Full Array pixel arrangement*

| ADC1 | ADC2 | ADC3 | ADC4 | ADC5 | ADC6 |
|---|---|---|---|---|---|
| | | | | | |
| CH1/LIA_P1 | CH16/LIA_P2 | CH1/LIA_P4 | CH16/LIA_P5 | CH1/LIA_P7 | CH16/LIA_P8 |
| CH16/LIA_P1 | CH1/LIA_P3 | CH16/LIA_P4 | CH1/LIA_P6 | CH16/LIA_P7 | CH1/LIA_P9 |
| CH1/LIA_P2 | CH16/LIA_P3 | CH1/LIA_P5 | CH16/LIA_P6 | CH1/LIA_P8 | CH16/LIA_P9 |
| CH2/LIA_P1 | CH17/LIA_P2 | CH2/LIA_P4 | CH17/LIA_P5 | CH2/LIA_P7 | CH17/LIA_P8 |
| CH17/LIA_P1 | CH2/LIA_P3 | CH17/LIA_P4 | CH2/LIA_P6 | CH17/LIA_P7 | CH2/LIA_P9 |
| CH2/LIA_P2 | CH17/LIA_P3 | CH2/LIA_P5 | CH17/LIA_P6 | CH2/LIA_P8 | CH17/LIA_P9 |
| CH3/LIA_P1 | CH18/LIA_P2 | CH3/LIA_P4 | CH18/LIA_P5 | CH3/LIA_P7 | CH18/LIA_P8 |
| CH18/LIA_P1 | CH3/LIA_P3 | CH18/LIA_P4 | CH3/LIA_P6 | CH18/LIA_P7 | CH3/LIA_P9 |
| CH3/LIA_P2 | CH18/LIA_P3 | CH3/LIA_P5 | CH18/LIA_P6 | CH3/LIA_P8 | CH18/LIA_P9 |
| CH4/LIA_P1 | CH19/LIA_P2 | CH4/LIA_P4 | CH19/LIA_P5 | CH4/LIA_P7 | CH19/LIA_P8 |
| CH19/LIA_P1 | CH4/LIA_P3 | CH19/LIA_P4 | CH4/LIA_P6 | CH19/LIA_P7 | CH4/LIA_P9 |
| CH4/LIA_P2 | CH19/LIA_P3 | CH4/LIA_P5 | CH19/LIA_P6 | CH4/LIA_P8 | CH19/LIA_P9 |
| CH5/LIA_P1 | CH20/LIA_P2 | CH5/LIA_P4 | CH20/LIA_P5 | CH5/LIA_P7 | CH20/LIA_P8 |
| CH20/LIA_P1 | CH5/LIA_P3 | CH20/LIA_P4 | CH5/LIA_P6 | CH20/LIA_P7 | CH5/LIA_P9 |
| CH5/LIA_P2 | CH20/LIA_P3 | CH5/LIA_P5 | CH20/LIA_P6 | CH5/LIA_P8 | CH20/LIA_P9 |
| CH6/LIA_P1 | CH21/LIA_P2 | CH6/LIA_P4 | CH21/LIA_P5 | CH6/LIA_P7 | CH21/LIA_P8 |
| CH21/LIA_P1 | CH6/LIA_P3 | CH21/LIA_P4 | CH6/LIA_P6 | CH21/LIA_P7 | CH6/LIA_P9 |
| CH6/LIA_P2 | CH21/LIA_P3 | CH6/LIA_P5 | CH21/LIA_P6 | CH6/LIA_P8 | CH21/LIA_P9 |
| CH7/LIA_P1 | CH22/LIA_P2 | CH7/LIA_P4 | CH22/LIA_P5 | CH7/LIA_P7 | CH22/LIA_P8 |
| CH22/LIA_P1 | CH7/LIA_P3 | CH22/LIA_P4 | CH7/LIA_P6 | CH22/LIA_P7 | CH7/LIA_P9 |
| CH7/LIA_P2 | CH22/LIA_P3 | CH7/LIA_P5 | CH22/LIA_P6 | CH7/LIA_P8 | CH22/LIA_P9 |
| CH8/LIA_P1 | CH23/LIA_P2 | CH8/LIA_P4 | CH23/LIA_P5 | CH8/LIA_P7 | CH23/LIA_P8 |
| CH23/LIA_P1 | CH8/LIA_P3 | CH23/LIA_P4 | CH8/LIA_P6 | CH23/LIA_P7 | CH8/LIA_P9 |
| CH8/LIA_P2 | CH23/LIA_P3 | CH8/LIA_P5 | CH23/LIA_P6 | CH8/LIA_P8 | CH23/LIA_P9 |
| CH9/LIA_P1 | CH24/LIA_P2 | CH9/LIA_P4 | CH24/LIA_P5 | CH9/LIA_P7 | CH24/LIA_P8 |
| CH24/LIA_P1 | CH9/LIA_P3 | CH24/LIA_P4 | CH9/LIA_P6 | CH24/LIA_P7 | CH9/LIA_P9 |
| CH9/LIA_P2 | CH24/LIA_P3 | CH9/LIA_P5 | CH24/LIA_P6 | CH9/LIA_P8 | CH24/LIA_P9 |
| CH10/LIA_P1 | CH25/LIA_P2 | CH10/LIA_P4 | CH25/LIA_P5 | CH10/LIA_P7 | CH25/LIA_P8 |
| CH25/LIA_P1 | CH10/LIA_P3 | CH25/LIA_P4 | CH10/LIA_P6 | CH25/LIA_P7 | CH10/LIA_P9 |
| CH10/LIA_P2 | CH25/LIA_P3 | CH10/LIA_P5 | CH25/LIA_P6 | CH10/LIA_P8 | CH25/LIA_P9 |
| CH11/LIA_P1 | CH26/LIA_P2 | CH11/LIA_P4 | CH26/LIA_P5 | CH11/LIA_P7 | CH26/LIA_P8 |
| CH26/LIA_P1 | CH11/LIA_P3 | CH26/LIA_P4 | CH11/LIA_P6 | CH26/LIA_P7 | CH11/LIA_P9 |
| CH11/LIA_P2 | CH26/LIA_P3 | CH11/LIA_P5 | CH26/LIA_P6 | CH11/LIA_P8 | CH26/LIA_P9 |
| CH12/LIA_P1 | CH27/LIA_P2 | CH12/LIA_P4 | CH27/LIA_P5 | CH12/LIA_P7 | CH27/LIA_P8 |

| | | | | | |
|---|---|---|---|---|---|
| CH27/LIA_P1 | CH12/LIA_P3 | CH27/LIA_P4 | CH12/LIA_P6 | CH27/LIA_P7 | CH12/LIA_P9 |
| CH12/LIA_P2 | CH27/LIA_P3 | CH12/LIA_P5 | CH27/LIA_P6 | CH12/LIA_P8 | CH27/LIA_P9 |
| CH13/LIA_P1 | CH28/LIA_P2 | CH13/LIA_P4 | CH28/LIA_P5 | CH13/LIA_P7 | CH28/LIA_P8 |
| CH28/LIA_P1 | CH13/LIA_P3 | CH28/LIA_P4 | CH13/LIA_P6 | CH28/LIA_P7 | CH13/LIA_P9 |
| CH13/LIA_P2 | CH28/LIA_P3 | CH13/LIA_P5 | CH28/LIA_P6 | CH13/LIA_P8 | CH28/LIA_P9 |
| CH14/LIA_P1 | CH29/LIA_P2 | CH14/LIA_P4 | CH29/LIA_P5 | CH14/LIA_P7 | CH29/LIA_P8 |
| CH29/LIA_P1 | CH14/LIA_P3 | CH29/LIA_P4 | CH14/LIA_P6 | CH29/LIA_P7 | CH14/LIA_P9 |
| CH14/LIA_P2 | CH29/LIA_P3 | CH14/LIA_P5 | CH29/LIA_P6 | CH14/LIA_P8 | CH29/LIA_P9 |
| CH15/LIA_P1 | CH30/LIA_P2 | CH15/LIA_P4 | CH30/LIA_P5 | CH15/LIA_P7 | CH30/LIA_P8 |
| CH30/LIA_P1 | CH15/LIA_P3 | CH30/LIA_P4 | CH15/LIA_P6 | CH30/LIA_P7 | CH15/LIA_P9 |
| CH15/LIA_P2 | CH30/LIA_P3 | CH15/LIA_P5 | CH30/LIA_P6 | CH15/LIA_P8 | CH30/LIA_P9 |
| CH16/LIA_P1 | CH31/LIA_P2 | CH16/LIA_P4 | CH31/LIA_P5 | CH16/LIA_P7 | CH31/LIA_P8 |
| CH31/LIA_P1 | CH16/LIA_P3 | CH31/LIA_P4 | CH16/LIA_P6 | CH31/LIA_P7 | CH16/LIA_P9 |
| CH16/LIA_P2 | CH31/LIA_P3 | CH16/LIA_P5 | CH31/LIA_P6 | CH16/LIA_P8 | CH31/LIA_P9 |

#### *3.3.5.3.3. Spectrometer Full Array pixel arrangement*

| ADC1 | ADC2 | ADC3 | ADC4 | ADC5 | ADC6 |
|---|---|---|---|---|---|
| | | | | | |
| CH1/LIA_S1 | CH13/LIA_S1 | CH1/LIA_S2 | CH13/LIA_S2 | CH1/LIA_S3 | CH13/LIA_S3 |
| CH2/LIA_S1 | CH14/LIA_S1 | CH2/LIA_S2 | CH14/LIA_S2 | CH2/LIA_S3 | CH14/LIA_S3 |
| CH3/LIA_S1 | CH15/LIA_S1 | CH3/LIA_S2 | CH15/LIA_S2 | CH3/LIA_S3 | CH15/LIA_S3 |
| CH4/LIA_S1 | CH16/LIA_S1 | CH4/LIA_S2 | CH16/LIA_S2 | CH4/LIA_S3 | CH16/LIA_S3 |
| CH5/LIA_S1 | CH17/LIA_S1 | CH5/LIA_S2 | CH17/LIA_S2 | CH5/LIA_S3 | CH17/LIA_S3 |
| CH6/LIA_S1 | CH18/LIA_S1 | CH6/LIA_S2 | CH18/LIA_S2 | CH6/LIA_S3 | CH18/LIA_S3 |
| CH7/LIA_S1 | CH19/LIA_S1 | CH7/LIA_S2 | CH19/LIA_S2 | CH7/LIA_S3 | CH19/LIA_S3 |
| CH8/LIA_S1 | CH20/LIA_S1 | CH8/LIA_S2 | CH20/LIA_S2 | CH8/LIA_S3 | CH20/LIA_S3 |
| CH9/LIA_S1 | CH21/LIA_S1 | CH9/LIA_S2 | CH21/LIA_S2 | CH9/LIA_S3 | CH21/LIA_S3 |
| CH10/LIA_S1 | CH22/LIA_S1 | CH10/LIA_S2 | CH22/LIA_S2 | CH10/LIA_S3 | CH22/LIA_S3 |
| CH11/LIA_S1 | CH23/LIA_S1 | CH11/LIA_S2 | CH23/LIA_S2 | CH11/LIA_S3 | CH23/LIA_S3 |
| CH12/LIA_S1 | CH24/LIA_S1 | CH12/LIA_S2 | CH24/LIA_S2 | CH12/LIA_S3 | CH24/LIA_S3 |

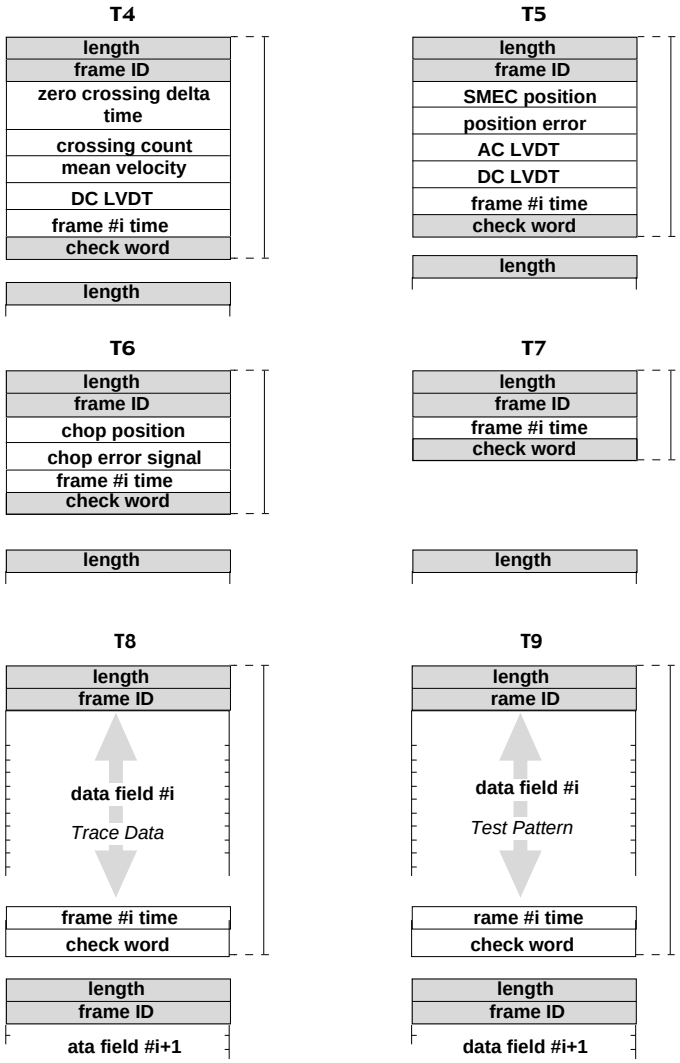
The last word of the data field has a specific meaning: it informs the DPU of occurrence of analog to digital converter latch-up or S/S to DPU interface fault and then of the risk to pack corrupted data. When a flag or more is set the related data of the current frame have to be discarded during on-ground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

| DCU Configuration | Frame Format | # of flags |
|---|---|---|
| Photo. Array Subset | T1 | 1 |
| Spectro. Array Subset | T1 | 1 |
| Photo. Full Array | T2 | 6 |

| | | |
|---|---|---|
| Spectro. Full Array | T2 | 2 |
| Test Pattern | T3 | 0 |
| Photo. Offset table | T2 | 0 |
| Spectro Offset table | T2 | 0 |

#### *3.3.5.3.4. MCU Frame Definition*

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



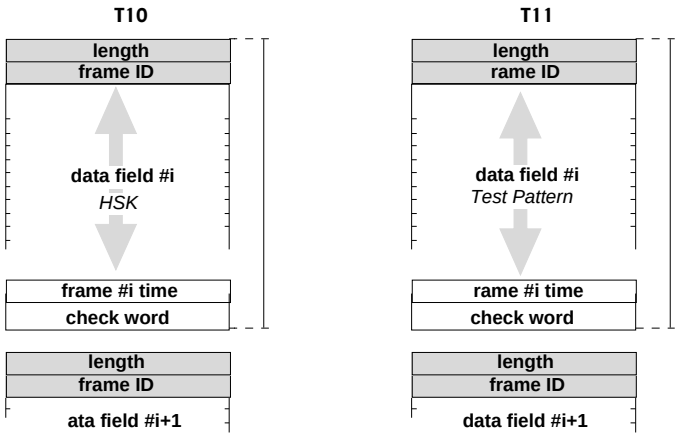

The following cross table shows the corresponding Frame ID for each MCU configuration status:

| Configuration Status | Frame ID | Frame Format | Length |
|---|---|---|---|
| SMEC Scan | 10 | T4 | 8 |
| SMEC step | 11 | T5 | 7 |
| Chop | 12 | T6 | 7 |
| Jiggle | 13 | T7 | 5 |
| Trace | 14 | T8 | TBD |

| | | | |
|---|---|---|---|
| Test Pattern | 15 | T9 | TBD |

#### *3.3.5.3.5. 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 | Length |
|---|---|---|---|
| HSK | T10 | 20 | |
| Test Pattern | T11 | 21 | |

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 table above for details

| SCU Configuration | FST | # of flags |
|---|---|---|
| HSK | T8 | 1 |
| Test Pattern | T9 | 1 |

### 3.3.5.4. 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.

#### 3.3.5.5. 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.

### 3.3.6. 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.
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:

### 3.3.7. Interface Timing

For detailed interface timing see AD01.

### 3.3.8. Timing Performance

The NRZ data rate is fixed at 1 Mbits per second (max is 2.5 Mbps).

Max data rate = 1 / ( 1 µs x (16+1) ) = 58,823 data per second

### 3.3.9. Data Rate Estimations

# 4. Electrical interfaces with S/C

Electrical interfaces with the S/C are of two kinds. One is connected to a PCDU port for DRCU power supply while the second is connected to RTU for shutter sub-system monitoring.

## *4.1. PCDU interface*

### 4.1.1. Electrical characteristics

The following table gives a summary of this interface:

| | |
|---|---|
| Connector Id(s) | HS_FCU_J05<br>HS_FCU_J06 |
| Pin number(s) | 2, 7 |
| Interface type | Input |
| Signal type | DC voltage |
| Voltage range (nominal) | 26 to 29 V |
| Voltage range (operating) | 0 to 35 V |
| Maximum Power (average) | 91.84 W |
| Current range | See Power Profile §4.1.2 |
| Reference pin(s) (return line) | 4, 8 |
| Corresponding command(s) | NA |
| Source impedance [2] | < 200 mΩ for f < 1kHz<br>≤ 50 Ω for f > 1MHz |

For further dynamic performance refer to AD1 §5.9.5

### 4.1.2. Power profile

`

| Mode | Power Consumption (W) | Comment |
|---|---|---|
| Observing Photometer(average) | 91.84 | Nominal operation |
| Observing Spectrometer (average | 56.77 | |
| Recycling | 34.51 | Nominal operation |
| Stand-by | 33.88 | Nominal operation |
| MCU boot | 38.34 | DRCU power on |

[2] See LISN characteristics (§9.5.6.9) for detailed description

# 5. Interface with FPU

The DRCU units interface with the FPU by means of a large number of analog interfaces. Those interfaces are related to the detector, mechanism, cooler, calibrators and thermometer sub-systems respectively.

## *5.1. DCU interface*

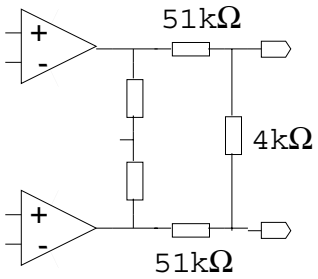
### 5.1.1. Seeing Bolometer Bias Interface

The bolometer bias interface consists of 6 individual balanced ports has described here after.

#### 5.1.1.1. Electrical characteristics

| | |
|---|---|
| Connector Id(s) | HSDCU_J29 to HSDCU_J32 |
| Pin number(s) | |
| Interface type | Output |
| Signal type | AC voltage |
| Voltage Range | 0 to 100 mV |
| Current range | tbd |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | See |
| Source impedance | < 4 kΩ |
| Load impedance (range) | |
| AC characteristics | |
| Waveform | Sine |
| Frequency | 50 – 300 Hz |
| Transition Time | NA |
| Corresponding command(s) *Photometer:* | SetPhotoBiasFreq SetPhotoBiasAmpl |
| Corresponding command(s) *Spectrometer:* | SetSpectroBiasFreq SetSpectroBiasAmpl |

#### 5.1.1.2. Interface circuitry

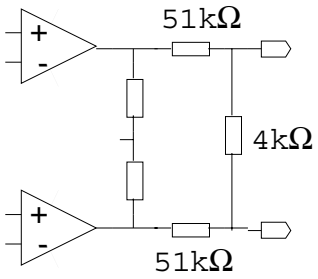


## 5.1.2. T/C Bolometer Bias Interface

### 5.1.2.1. Electrical characteristics

| | |
|---|---|
| Connector Id(s) | HSDCU_Jxx<br>HSDCU_Jxx |
| Pin number(s) | |
| Interface type | Output |
| Signal type | AC voltage |
| Voltage Range | 0 to 500 mV |
| Current range | tbd |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | |
| Source impedance | < 4 kΩ |
| Load impedance (range) | |
| AC characteristics | |
| Waveform | Sine |
| Frequency | 50 – 300 Hz |
| Transition Time | NA |
| Corresponding command(s) | Set…..BiasFreq<br>Set….BiasAmpl |

### 5.1.2.2. Interface circuitry

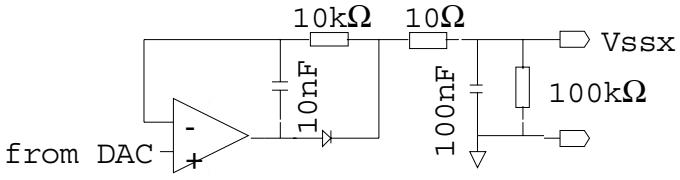


### 5.1.3. JFET Vss bias interface

#### 5.1.3.1. Electrical characteristics

| | |
|---|---|
| Connector Id(s) | HSDCU_J29 to HSDCU_J32 |
| Pin number(s) | |
| Interface type | Output |
| Signal type | DC voltage |
| Voltage Range | 0 to –5 V |
| Current range | 0 to 5 mA |
| Transmission mode | Single |
| Reference pin(s) (return line) | |
| Source impedance | 10 Ω |
| Load impedance (range) | NA |
| Corresponding command(s) *Photometer:* | SetPhotoJfetVss SetPhotoJfetPwr |
| Corresponding command(s) *Spectrometer:* | SetSpectroJfetVss SetSpectroJfetPwr |

#### 5.1.3.2. Interface circuitry

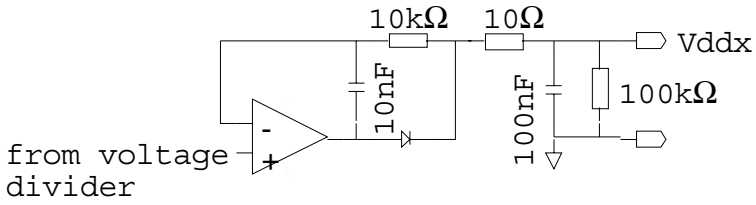


### 5.1.4. JFET Vdd bias interface

#### 5.1.4.1. Electrical characteristics

| | |
|---|---|
| Connector Id(s) | HSDCU_J29 to HSDCU_J32 |
| Allocated pin(s) | |
| Interface type | Output |
| Signal type | DC voltage |
| Voltage Range | 1.5 to 4 V |
| Current range | 0 to 5 mA |
| Transmission mode | Single |
| Reference pin(s) (return line) | |
| Source impedance | 10 Ω |
| Load impedance (range) | |
| Corresponding command(s) | NA |
| Corresponding command(s) *Photometer:* | SetPhotoJfetPwr |
| Corresponding command(s) *Spectrometer:* | SetSpectroJfetPwr |

#### 5.1.4.2. Interface circuitry

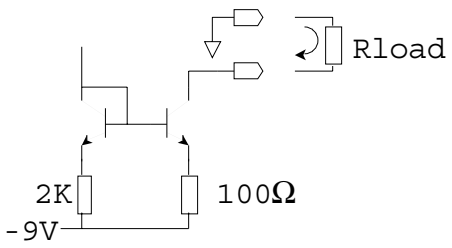


### 5.1.5. Heater bias interface

#### 5.1.5.1. Electrical characteristics

| | |
|---|---|
| Connector Id(s) | HS_DCU_J29<br>HS_DCU_J32 |
| Allocated pin(s) | |
| Interface type | Output |
| Signal type | DC voltage |
| Voltage Range<br>*Photometer* | 0 to 5 V |
| Voltage Range<br>*Spectrometer* | 0 to 3 V |
| Current range<br>*Photometer* | 0 to 10 mA |
| Current Range<br>*Spectrometer* | 0 to 25 mA |
| Transmission mode | Single |
| Reference pin(s) (return line) | |
| Source impedance | NA |
| Load impedance (range) | TBD |
| Corresponding command(s)<br>*Photometer* | SetSpectroHeaterPwr |
| Corresponding command(s)<br>Spectrometer | SetPhotoHeaterPwr |

#### 5.1.5.2. Interface circuitry

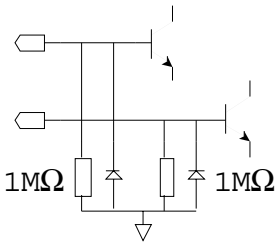


## 5.1.6. Photometer JFET signal interface

### 5.1.6.1. Electrical characteristics

| | |
|---|---|
| Connector Id(s) | HSDCU_J05 to HSDCU_J22 |
| Allocated pin(s) | See §6.3.3 |
| Interface type | Input |
| Signal type | AC voltage |
| Voltage range | 0 to 11 mVrms |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | See §6.3.3 |
| Source impedance | 7 kΩ |
| Load impedance | 1 MΩ |
| AC characteristics | |
| Waveform | Sine |
| Frequency | 50 – 300 Hz |
| Transition Time | NA |
| Corresponding command(s) | NA |

### 5.1.6.2. Interface circuitry

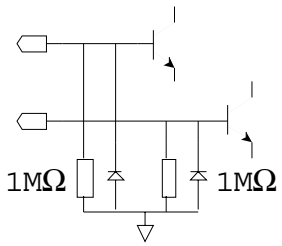


## 5.1.7. Spectrometer JFET signal interface

### 5.1.7.1. Electrical characteristics

| | |
|---|---|
| Connector Id(s) | HSDCU_J23<br>HSDCU_J28 |
| Allocated pin(s) | See §6.3.3 |
| Interface type | Input |
| Signal type | AC voltage |
| Voltage range | 0 to 17 mVrms |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | See §6.3.3 |
| Source impedance | 7 kΩ |
| Load impedance | 1 MΩ |
| AC characteristics | |
| Waveform | Sine |
| Frequency | 50 – 300 Hz |
| Transition Time | NA |
| Corresponding command(s) | NA |

### 5.1.7.2. Interface circuitry



## 5.2. MCU interface

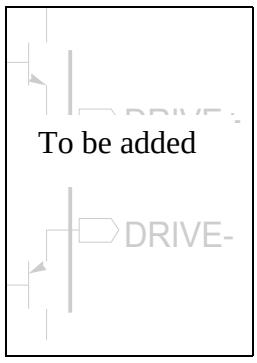
### 5.2.1. SMEC Drive coil

#### 5.2.1.1. Excitation

##### *5.2.1.1.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

##### *5.2.1.1.2. Interface circuitry*

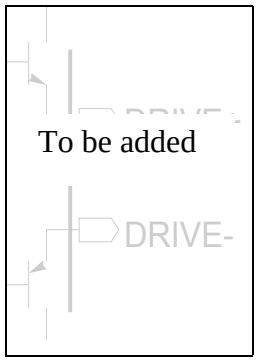


#### 5.2.1.2. Supply Sense

##### *5.2.1.2.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

##### *5.2.1.2.2. Interface circuitry*

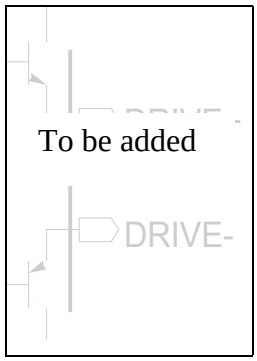


## 5.2.2. SMEC position sensor LED

### 5.2.2.1. Electrical characteristics

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

#### *5.2.2.1.1. Interface circuitry*

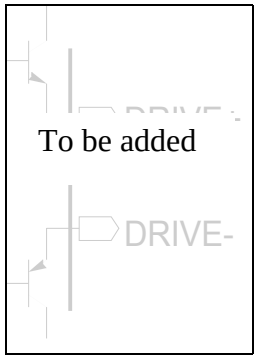


### 5.2.3. SMEC position sensor photodiode

#### 5.2.3.1. Electrical characteristics

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

#### 5.2.3.2. Interface circuitry

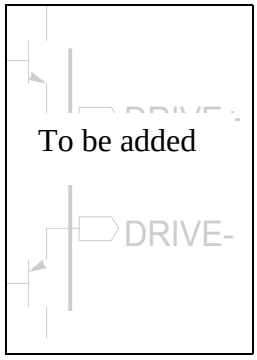


## 5.2.4. SMEC position sensor supply

### 5.2.4.1. Electrical characteristics

| | |
|---|---|
| Connector Id(s) | HSFCU_J<br>HSFCU_J |
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

### 5.2.4.2. Interface circuitry

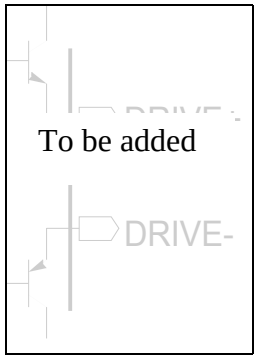


## 5.2.5. SMEC position sensor photodiode

### 5.2.5.1. Electrical characteristics

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

### 5.2.5.2. Interface circuitry

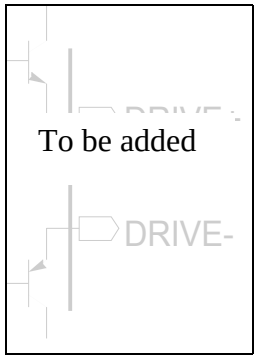


## 5.2.6. SMEC launch latch supply

### 5.2.6.1. Electrical characteristics

| | |
|---|---|
| Connector Id(s) | HSFCU_J<br>HSFCU_J |
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

### 5.2.6.2. Interface circuitry

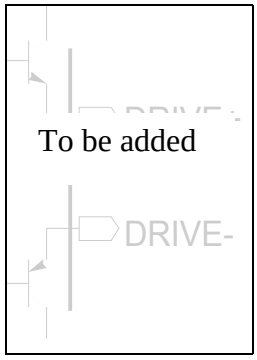


## 5.2.7. SMEC launch confirmation

### 5.2.7.1. Electrical characteristics

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

### 5.2.7.2. Interface circuitry

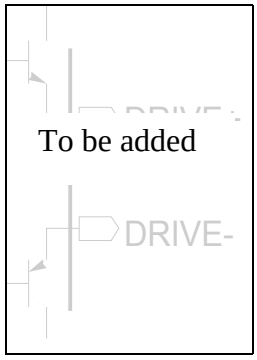


## 5.2.8. SMEC LVDT coil supply

### 5.2.8.1. Electrical characteristics

| | |
|---|---|
| Connector Id(s) | HSFCU_J<br>HSFCU_J |
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

### 5.2.8.2. Interface circuitry



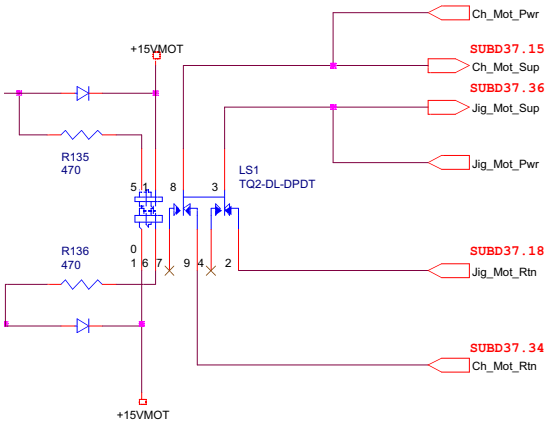
## 5.2.9. Chop sensor

### 5.2.9.1. Supply

#### *5.2.9.1.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

#### *5.2.9.1.2. Interface circuitry*

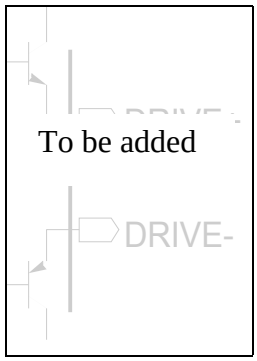


#### 5.2.9.2. Sense

##### *5.2.9.2.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

##### *5.2.9.2.2. Interface circuitry*

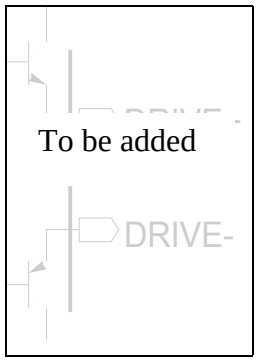


## 5.2.10. Chop sensor output

#### *5.2.10.1.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

### 5.2.10.2. Interface circuitry



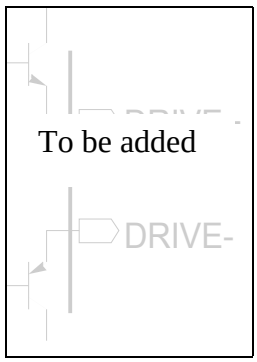
## 5.2.11. Jiggle sensor

### 5.2.11.1. Supply

#### *5.2.11.1.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

#### *5.2.11.1.2. Interface circuitry*

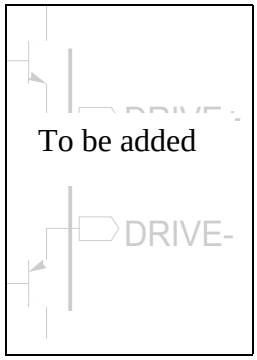


#### 5.2.11.2. Sense

##### *5.2.11.2.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

#### 5.2.11.3. Interface circuitry

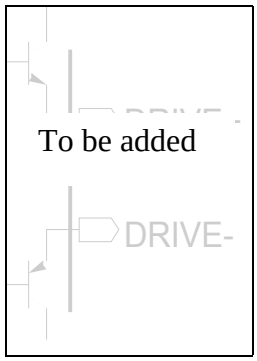


## 5.2.12. Launch latch sensor

#### *5.2.12.1.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

### 5.2.12.2. Interface circuitry

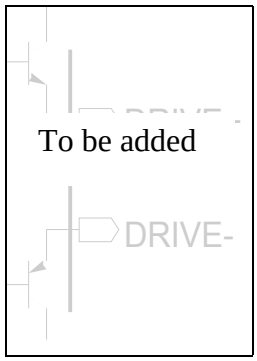


## 5.2.13. Launch latch coil supply

#### *5.2.13.1.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

### 5.2.13.2. Interface circuitry



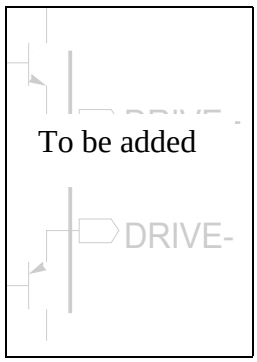
## 5.2.14. Chop motor

### 5.2.14.1. Supply

#### *5.2.14.1.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

#### *5.2.14.1.2. Interface circuitry*

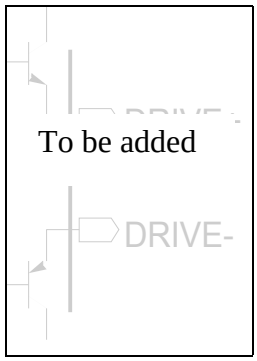


#### 5.2.14.2. Sense

##### *5.2.14.2.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

##### *5.2.14.2.2. Interface circuitry*



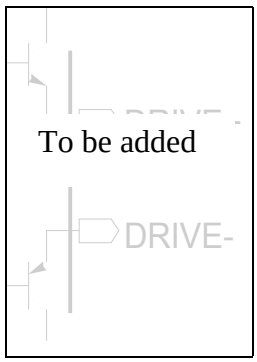
## 5.2.15. Jiggle motor

### 5.2.15.1. Supply

#### *5.2.15.1.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

#### *5.2.15.1.2. Interface circuitry*

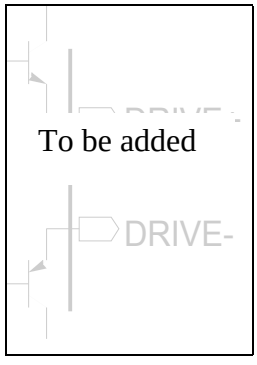


#### 5.2.15.2. Sense

##### *5.2.15.2.1. Electrical characteristics*

| Connector Id(s) | HSFCU_J<br>HSFCU_J |
|---|---|
| Allocated pin(s) | |
| Interface type | |
| Signal type | |
| Voltage range | |
| Transmission mode | |
| Reference pin(s) (return line) | |
| Source impedance | |
| Load impedance | |
| AC characteristics | |
| Waveform | |
| Frequency | |
| Transition Time | |
| Corresponding command(s) | |

##### *5.2.15.2.2. Interface circuitry*



## 5.3. SCU interfaces

### 5.3.1. Temperature Probes – "300 mK"

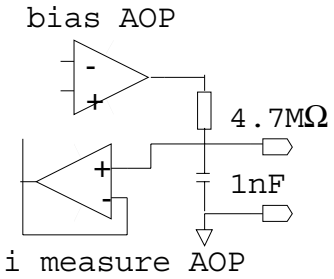
This interface is a 4-wire input/output type as described bellow:

#### 5.3.1.1. Probe bias

##### *5.3.1.1.1. Electrical characteristics*

| | |
|---|---|
| Connector Id(s) | HS_FCU_J23<br>HS_FCU_J24 |
| Allocated pin(s) | 1 |
| Interface type | Output |
| Signal type | AC current |
| Current range | 0 / 40nA |
| Transmission mode | Balanced |
| Reference pin(s) (return lines) | 2 |
| Source impedance | 4.7 MΩ |
| AC characteristics | |
| Waveform | Square |
| Frequency | 10 to 30 Hz |
| Transition Time | < 1 ms |
| Corresponding command(s) | TPBiasOnOff<br>SubKpRate |

##### *5.3.1.1.2. Interface circuitry*

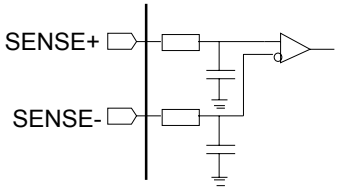


#### 5.3.1.2. Probe sense

##### *5.3.1.2.1. Electrical characteristics*

| | |
|---|---|
| Connector Id(s) | HS_FCU_J23<br>HS_FCU_J24 |
| Pin number(s) | 18 |
| Interface type | Input |
| Signal type | AC voltage |
| Voltage range | 0 to 6 mVpp |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | 35 |
| Load impedance | > 1 MΩ |
| Corresponding command(s) | NA |

##### *5.3.1.2.2. Interface circuitry*



### 5.3.2. Standard Temperature Probes

This interface is a 4-wire input/output type as described bellow:

#### 5.3.2.1. Probe bias

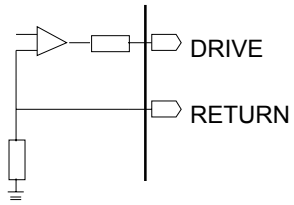
##### *5.3.2.1.1. Electrical characteristics*

| | |
|---|---|
| Connector Id(s) | HS_SCU_J21<br>HS_SCU_J22 |
| Pin number(s) | 1, 4, 6 |
| Interface type | Output |
| Signal type | DC voltage |
| Voltage | 0 / 20 mV |
| Current range | 0-200µA |
| Transmission mode | Single |
| Reference pin (return line) | 2, 5, 7 |
| Source impedance | |
| Load impedance | 100Ω - 100kΩ |
| Corresponding command(s) | TPBiasOnOff |

| | |
|---|---|
| Connector Id(s) | HS_SCU_J23<br>HS_SCU_J24 |
| Pin number(s) | 1, 3, 4, 6, 7, 9, 10, 12, 13 |
| Interface type | Output |
| Signal type | DC voltage |
| Voltage | 0 / 20 mV |
| Current range | 0-200µA |
| Transmission mode | Single |
| Reference pin (return line) | 19, 5, 22, 8, 24, 25, 11, 28, 14 |
| Source impedance | |
| Load impedance | 100Ω - 100kΩ |
| Corresponding command(s) | TPBiasOnOff |

| | |
|---|---|
| Connector Id(s) | HS_SCU_J25<br>HS_SCU_J26 |
| Pin number(s) | 1, 4, 6 |
| Interface type | Output |
| Signal type | DC voltage |
| Voltage | 0 / 20 mV |
| Current range | 0-200µA |
| Transmission mode | Single |
| Reference pin (return line) | 9, 11, 14 |
| Source impedance | |
| Load impedance | 100Ω - 100kΩ |
| Corresponding command(s) | TPBiasOnOff |

#### *5.3.2.1.2. Interface circuitry*



#### 5.3.2.2. Probe sense

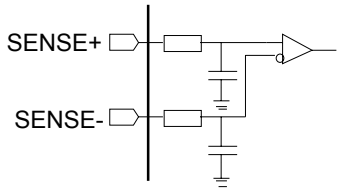
##### *5.3.2.2.1. Electrical characteristics*

| | |
|---|---|
| Connector Id(s) | HS_FCU_J21<br>HS_FCU_J22 |
| Pin number(s) | 9, 11, 14 |
| Interface type | Input |
| Signal type | DC current |
| Current range | 0 to 200 µA |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | 10, 12, 17 |
| Load impedance | |

| | |
|---|---|
| Connector Id(s) | HS_FCU_J23<br>HS_FCU_J24 |
| Pin number(s) | 20, 21, 23, 24, 26, 27, 29, 30 |
| Interface type | Input |
| Signal type | DC current |
| Current range | 0 to 200 µA |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | 36, 37, 39, 40, 42, 44, 45, 47 |
| Load impedance | |

| | |
|---|---|
| Connector Id(s) | HS_FCU_J25<br>HS_FCU_J26 |
| Pin number(s) | 2, 5, 7 |
| Interface type | Input |
| Signal type | DC Current |
| Current range | 0 to 200 µA |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | 10, 12, 15 |
| Load impedance | |

#### *5.3.2.2.2. Interface circuitry*



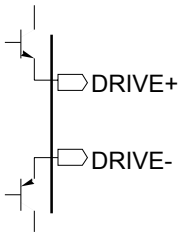
## 5.3.3. Heaters

### 5.3.3.1. Sorption pump

#### *5.3.3.1.1. Electrical characteristics*

| | |
|---|---|
| Connector Id(s) | HSFCU_J11<br>HSFCU_J12 |
| Pin number(s) | 1, 2 |
| Interface type | Output |
| Signal type | DC current |
| Current range | 0 to 40 mA |
| Short current | 100 mA |
| Voltage range | - 15 V to +15 V |
| Transmission mode | Balanced |
| Reference pin(s) (return lines) | 14, 15 |
| Source impedance | |
| Corresponding command(s) | HHeaterI |

#### *5.3.3.1.2. Interface circuitry*

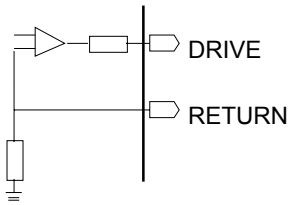


#### 5.3.3.2. Heat switches

##### *5.3.3.2.1. Electrical characteristics*

| | |
|---|---|
| Connector Id(s) | HSFCU_J11<br>HSFCU_J12 |
| Pin number(s) | |
| Interface type | Output |
| Signal type | DC current |
| Current range | 0 to 2 mA |
| Voltage range | 0 to 9 V |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | |
| Load impedance | |
| Corresponding command(s) | LHeaterI1<br>LHeaterI2 |

##### *5.3.3.2.2. Interface circuitry*

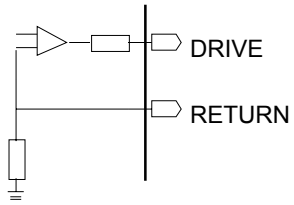


#### 5.3.3.3. Thermal strap

##### *5.3.3.3.1. Electrical characteristics*

| | |
|---|---|
| Connector Id(s) | HSFCU_J11<br>HSFCU_J12 |
| Pin number(s) | |
| Interface type | Output |
| Signal type | DC current |
| Current range | 0 to x mA |
| Voltage range | 0 to 9 V |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | |
| Load impedance | |
| Corresponding command(s) | LHeaterI3 |

##### *5.3.3.3.2. Interface circuitry*



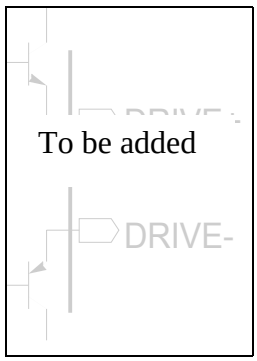
## 5.3.4. Calibrator

### 5.3.4.1. Flood type

#### *5.3.4.1.1. Electrical characteristics*

| | |
|---|---|
| Connector Id(s) | HSFCU_J11<br>HSFCU_J12 |
| Pin number(s) | |
| Interface type | Output |
| Signal type | DC current |
| Current range | 0 to x mA |
| Voltage range | 0 to 9 V |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | |
| Load impedance | |
| Corresponding command(s) | |

#### *5.3.4.1.2. Interface circuitry*

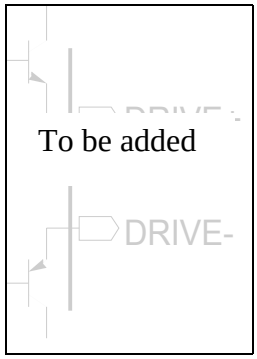


#### 5.3.4.2. Point source type

##### *5.3.4.2.1. Electrical characteristics*

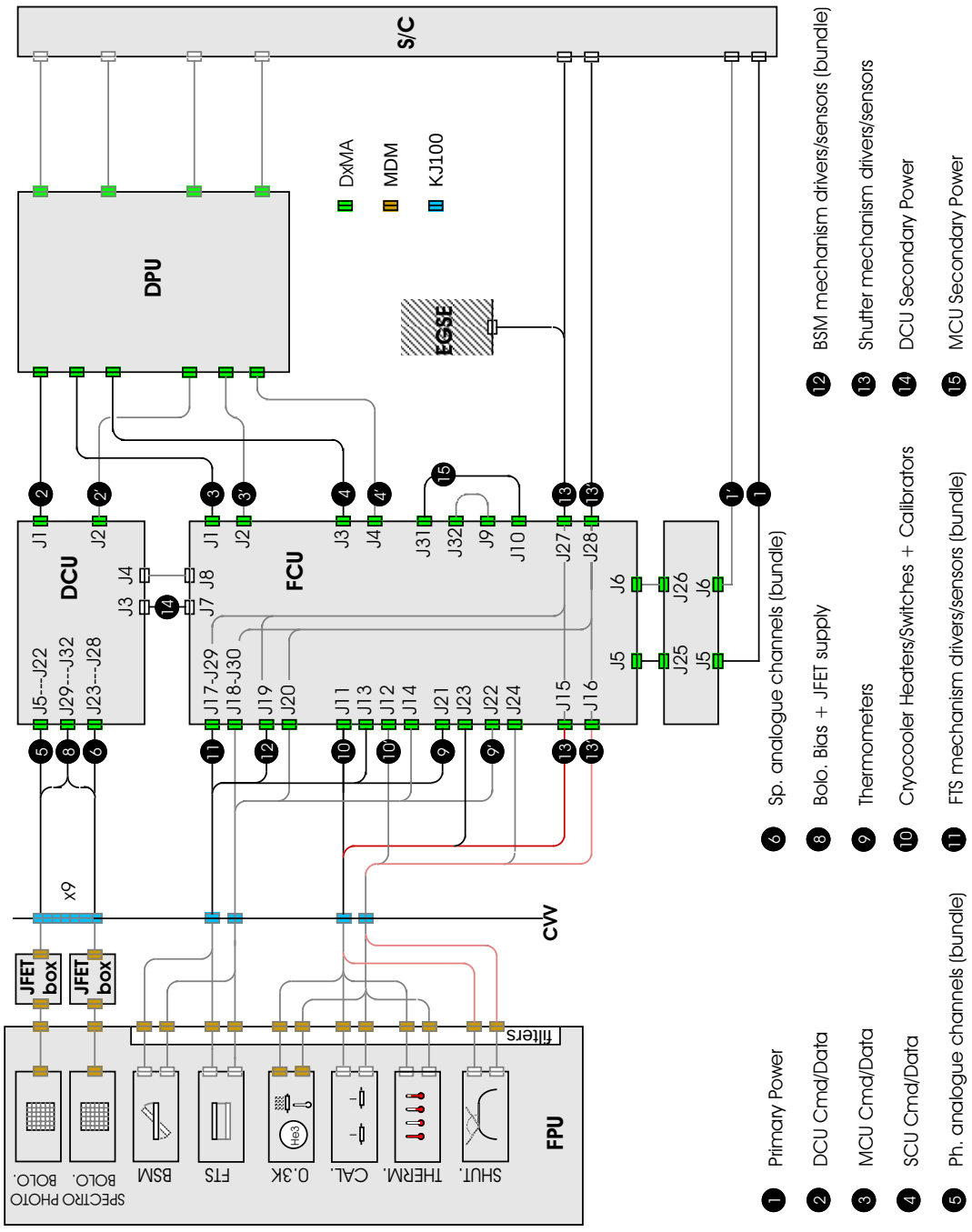
| | |
|---|---|
| Connector Id(s) | HSFCU_J11<br>HSFCU_J12 |
| Pin number(s) | |
| Interface type | Output |
| Signal type | DC current |
| Current range | 0 to x mA |
| Voltage range | 0 to 9 V |
| Transmission mode | Balanced |
| Reference pin(s) (return line) | |
| Load impedance | |
| Corresponding command(s) | |

##### *5.3.4.2.2. Interface circuitry*



# 6. Connectors and Harness Definition

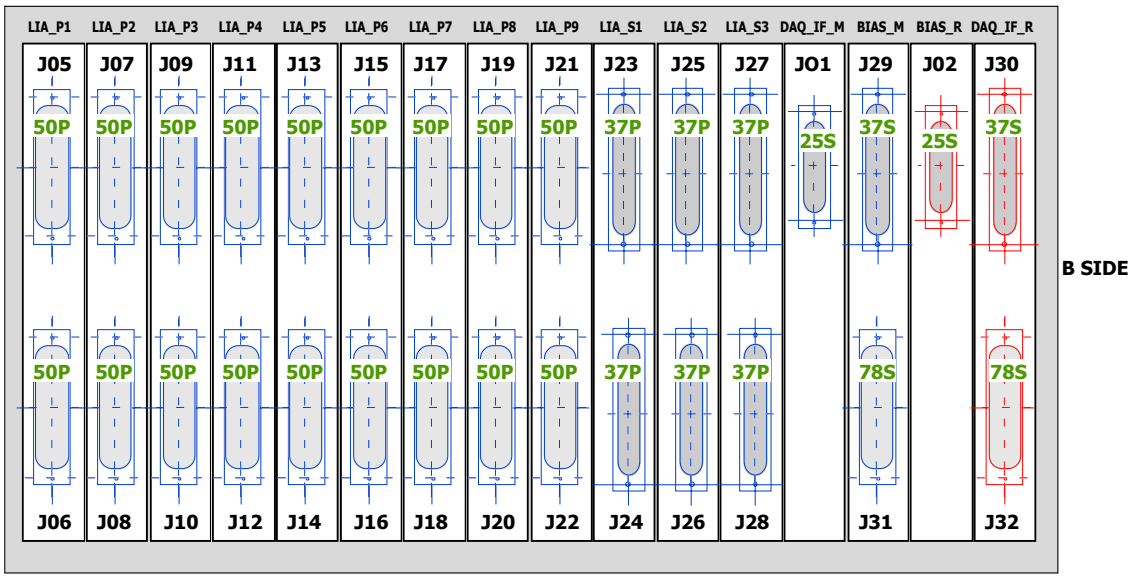
## *6.1. Overall harness configuration*



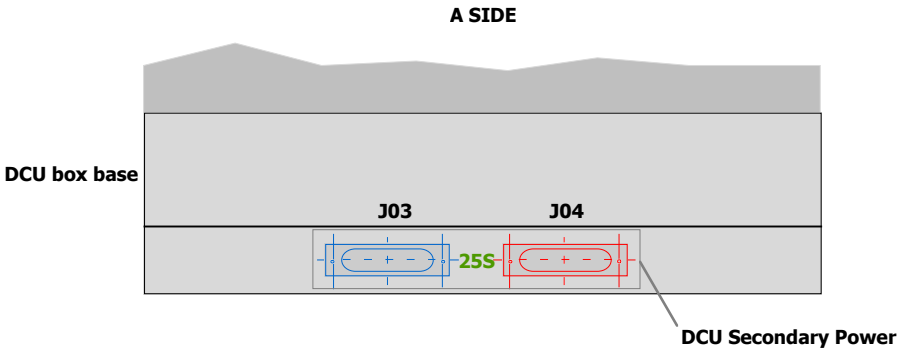
## 6.2. Connector layout on box

### 6.2.1. DCU box

#### 6.2.1.1. Top View

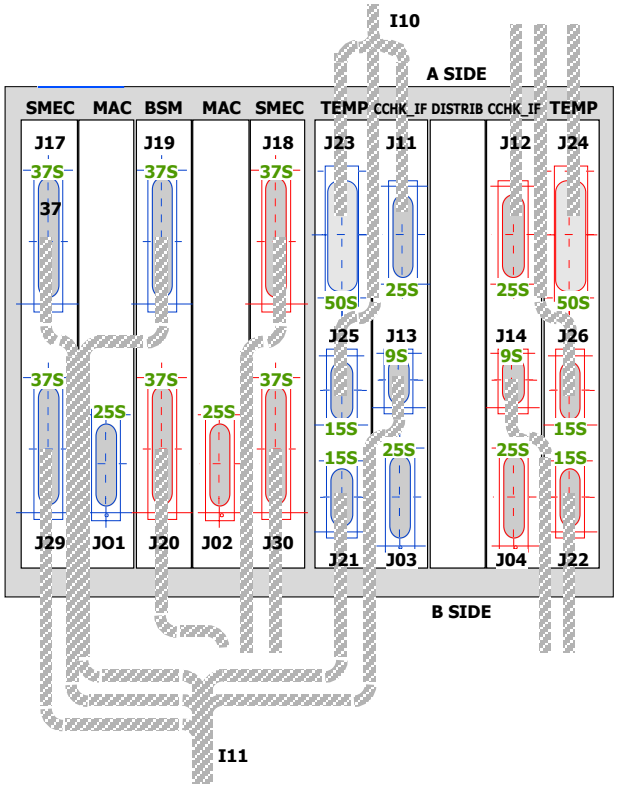



#### 6.2.1.2. Lateral View

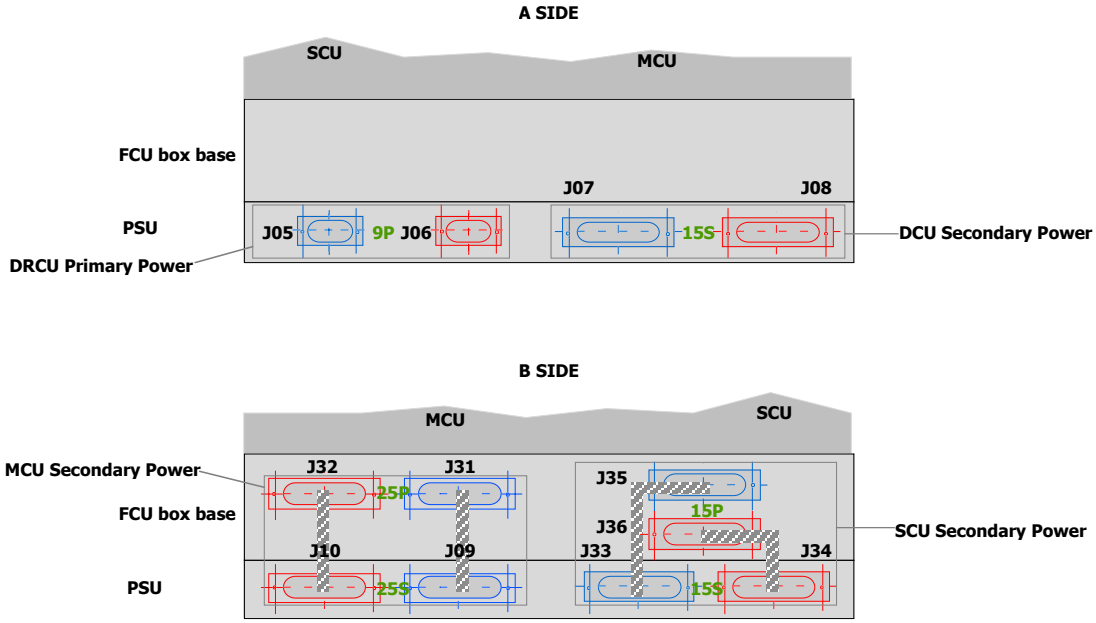


## 6.2.2. FCU box

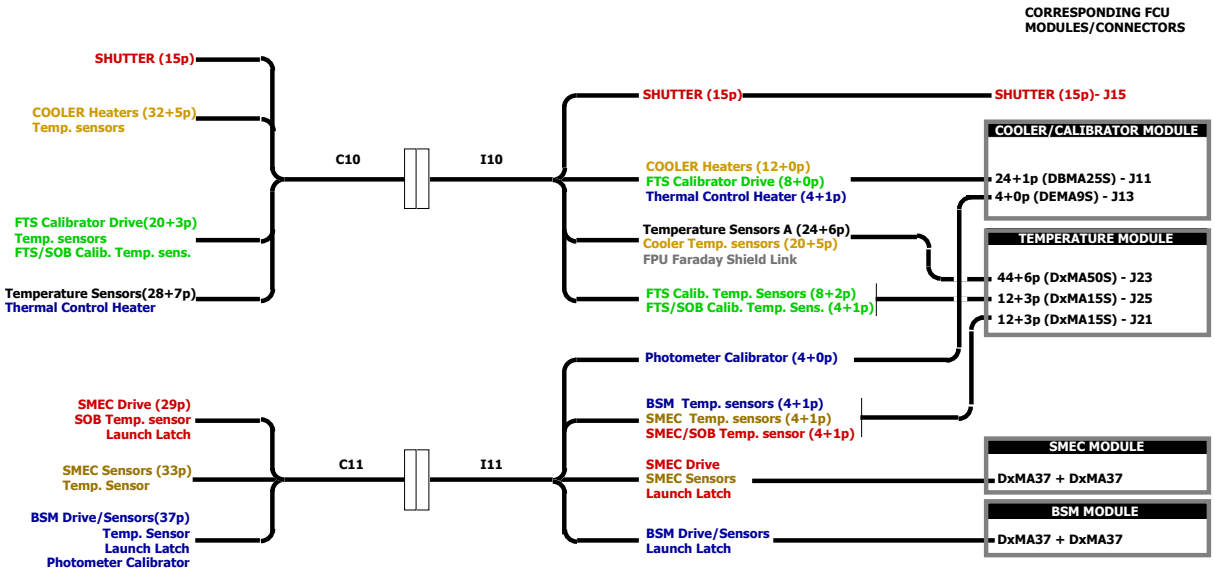
### 6.2.2.1. Top View




### 6.2.2.2. Lateral Views



### 6.2.3. DRCU to FPU harness tail configuration



## 6.3. Connector list

| S/S | Connector Id | Connector Type | Interface Name |
|---|---|---|---|
| DCU | J01 | DBMA25S | DAQ_IF_M / DPU_M |
| | J02 | DBMA25S | DAQ_IF_R / DPU R |
| | J03 | DCMA25P | DCU / PSU_M |
| | J04 | DCMA25P | DCU / PSU_R |
| | J05 | DDMA50P | LIA_P_1 / FPU |
| | J06 | DDMA50P | LIA_P_1 / FPU |
| | J07 | DDMA50P | LIA_P_2 / FPU |
| | J08 | DDMA50P | LIA_P_2 / FPU |
| | J09 | DDMA50P | LIA_P_3 / FPU |
| | J10 | DDMA50P | LIA_P_3 / FPU |
| | J11 | DDMA50P | LIA_P_4 / FPU |
| | J12 | DDMA50P | LIA_P_4 / FPU |
| | J13 | DDMA50P | LIA_P_5 / FPU |
| | J14 | DDMA50P | LIA_P_5 / FPU |
| | J15 | DDMA50P | LIA_P_6 / FPU |
| | J16 | DDMA50P | LIA_P_6 / FPU |
| | J17 | DDMA50P | LIA_P_7 / FPU |
| | J18 | DDMA50P | LIA_P_7 / FPU |
| | J19 | DDMA50P | LIA_P_8 / FPU |
| | J20 | DDMA50P | LIA_P_8 / FPU |
| | J21 | DDMA50P | LIA_P_9 / FPU |
| | J22 | DDMA50P | LIA_P_9 / FPU |
| | J23 | DDMA37P | LIA_S_1 / FPU |
| | J24 | DDMA37P | LIA_S_1 / FPU |
| | J25 | DDMA37P | LIA_S_2 / FPU |
| | J26 | DDMA37P | LIA_S_2 / FPU |
| | J27 | DDMA37P | LIA_S_3 / FPU |
| | J28 | DDMA37P | LIA_S_3 / FPU |
| | J29 | DDMA37S | BIAS_M / FPU |
| | J30 | DDMA37S | BIAS_R / FPU |
| | J31 | DBMA78S | BIAS_M / FPU |
| | J32 | DBMA78S | BIAS_R / FPU |
| MCU | J01 | DBMA25S | MAC_M / DPU_M |
| MCU | J02 | DBMA25S | MAC_R / DPU_R |
| SCU | J03 | DBMA25S | CCHK_IF_M / DPU_M |
| SCU | J04 | DBMA25S | CCHK_IF_R / DPU_R |
| PSU | J05 | DEMA9P | PSU_M / PCDU_M |
| PSU | J06 | DEMA9P | PSU_R / PCDU_R |
| PSU | J07 | DBMA15S | PSU_M / DCU |
| PSU | J08 | DBMA15S | PSU_R / DCU |
| PCU | J09 | DCMA25S | PSU_M / MCU_M |
| PCU | J10 | DCMA25S | PSU_R / MCU_R |
| SCU | J11 | DBMA25S | CCHK_IF_M / FPU_COOL_CAL_M |
| SCU | J12 | DBMA25S | CCHK_IF_R / FPU_COOL_CAL_R |
| SCU | J13 | DEMA9S | CCHK_IF_M / FPU_PH_STIM_M |
| SCU | J14 | DEMA9S | CCHK_IF_R / FPU_PH_STIM_R |
| FCU | J15 | NA | NA |

| S/S | Connector Id | Connector Type | Interface Name |
|---|---|---|---|
| FCU | J16 | NA | NA |
| MCU | J17 | DCMA37S | SMEC_M / FPU_SMECm_1_M |
| MCU | J18 | DCMA37S | SMEC_M / FPU_SMECm_2_M |
| MCU | J19 | DCMA37S | BSM_M / FPU_BSM_M |
| MCU | J20 | DCMA37S | BSM_R / FPU_BSM_R |
| SCU | J21 | DAMA15S | TEMP_M / FPU_TS_1_M |
| SCU | J22 | DAMA15S | TEMP_R / FPU_TS_1_R |
| SCU | J23 | DDMA50S | TEMP_M / FPU_TS_2_M |
| SCU | J24 | DDMA50S | TEMP_R / FPU_TS_2_R |
| SCU | J25 | DAMA15S | TEMP_M / FPU_MEC_TS_M |
| SCU | J26 | DAMA15S | TEMP_R / FPU_MEC_TS_R |
| FCU | J27 | NA | NA |
| FCU | J28 | NA | NA |
| MCU | J29 | DCMA37S | SMEC_M / FPU_SMECm_2_M |
| MCU | J30 | DCMA37S | SMEC_R / FPU_SMECm_2_R |
| MCU | J31 | DCMA25P | MCU_M / PSU_M |
| MCU | J32 | DCMA25P | MCU_R / PSU_R |
| PSU | J33 | DAMA15S | PSU_M / SCU_M |
| PSU | J34 | DAMA15S | PSU_R / SCU_R |
| SCU | J35 | DAMA15P | SCU_M / PSU_M |
| SCU | J36 | DAMA15P | SCU_R / PSU_R |

## 6.4. Connectors Description

### 6.4.1. Interfaces with DPU

Unit : DCU
Sub-unit/Module : DAQ_IF
Connector Identifier : J01
Connector Type : DBMA25S
Connector Name : HSDCU_J01

| Pin # | Signal Name | EMC Class | Comment |
|---|---|---|---|
| 1 | | | |
| 2 | C_CLK_DCU_P+ | 2 | Twisted with 15 |
| 3 | C_CMD_DCU_P+ | 2 | Twisted with 16 |
| 4 | C_RES_DCU_P+ | 2 | Twisted with 17 |
| 5 | C_RES_SHD | 2 | Connected DCU side only |
| 6 | | | |
| 7 | | | |
| 8 | D_CLK_DCU_P+ | 2 | Twisted with 21 |
| 9 | D_CLK_SHD | 2 | Connected DCU side only |
| 10 | D_DAT_DCU_P+ | 2 | Twisted with 22 |
| 11 | D_GAT_DCU_P+ | 2 | Twisted with 24 |
| 12 | D_GAT_SHD | 2 | Connected DCU side only |
| 13 | - | | |
| 14 | C_SHD | 2 | Connected DPU side only |
| 15 | C_CLK_DCU_P- | 2 | Twisted with 2 |
| 16 | C_CMD_DCU_P- | 2 | Twisted with 3 |
| 17 | C_RES_DCU_P- | 2 | Twisted with 4 |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | D_CLK_DCU_P- | 2 | Twisted with 15 |
| 22 | D_DAT_DCU_P- | 2 | Twisted with 10 |
| 23 | D_SHD | 2 | Connected DCU side only |
| 24 | D_GAT_DCU_P- | 2 | Twisted with 11 |
| 25 | - | | |

Unit : FCU
Sub-unit/Module : MCU/MAC
Connector Identifier : J01
Connector Type : DBMA25S
Connector Name : HSFCU_J01

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | |
| 2 | C_CLK_MCU_P+ | 2 | Twisted with 15 |
| 3 | C_CMD_MCU_P+ | 2 | Twisted with 16 |
| 4 | C_RES_MCU_P+ | 2 | Twisted with 17 |
| 5 | C_RES_SHD | 2 | Connected MCU side only |
| 6 | | | |
| 7 | | | |
| 8 | D_CLK_MCU_P+ | 2 | Twisted with 21 |
| 9 | D_CLK_SHD | 2 | Connected MCU side only |
| 10 | D_DAT_MCU_P+ | 2 | Twisted with 22 |
| 11 | D_GAT_MCU_P+ | 2 | Twisted with 24 |
| 12 | D_GAT_SHD | 2 | Connected MCU side only |
| 13 | - | | |
| 14 | C_SHD | 2 | Connected DPU side only |
| 15 | C_CLK_MCU_P- | 2 | Twisted with 2 |
| 16 | C_CMD_MCU_P- | 2 | Twisted with 3 |
| 17 | C_RES_MCU_P- | 2 | Twisted with 4 |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | D_CLK_MCU_P- | 2 | Twisted with 15 |
| 22 | D_DAT_MCU_P- | 2 | Twisted with 10 |
| 23 | D_SHD | 2 | Connected MCU side only |
| 24 | D_GAT_MCU_P- | 2 | Twisted with 11 |
| 25 | - | | |

Unit : FCU
Sub-unit/Module : SCU/CCHK_IF
Connector Identifier : J03
Connector Type : DBMA25S
Connector Name : HSFCU_J03

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | |
| 2 | C_CLK_SCU_P+ | 2 | Twisted with 15 |
| 3 | C_CMD_SCU_P+ | 2 | Twisted with 16 |
| 4 | C_RES_SCU_P+ | 2 | Twisted with 17 |
| 5 | C_RES_SHD | 2 | Connected SCU side only |
| 6 | | | |
| 7 | | | |
| 8 | D_CLK_SCU_P+ | 2 | Twisted with 21 |
| 9 | D_CLK_SHD | 2 | Connected SCU side only |
| 10 | D_DAT_SCU_P+ | 2 | Twisted with 22 |
| 11 | D_GAT_SCU_P+ | 2 | Twisted with 24 |
| 12 | D_GAT_SHD | 2 | Connected SCU side only |
| 13 | - | | |
| 14 | C_SHD | 2 | Connected DPU side only |
| 15 | C_CLK_SCU_P- | 2 | Twisted with 2 |
| 16 | C_CMD_SCU_P- | 2 | Twisted with 3 |
| 17 | C_RES_SCU_P- | 2 | Twisted with 4 |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | D_CLK_SCU_P- | 2 | Twisted with 15 |
| 22 | D_DAT_SCU_P- | 2 | Twisted with 10 |
| 23 | D_SHD | 2 | Connected SCU side only |
| 24 | D_GAT_SCU_P- | 2 | Twisted with 11 |
| 25 | - | | |

Unit : DCU
Sub-unit/Module : DAQ_IF
Connector Identifier : J02
Connector Type : DBMA25S
Connector Name : HSDCU_J02

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | |
| 2 | C_CLK_DCU_R+ | 2 | Twisted with 15 |
| 3 | C_CMD_DCU_R+ | 2 | Twisted with 16 |
| 4 | C_RES_DCU_R+ | 2 | Twisted with 17 |
| 5 | C_RES_SHD | 2 | Connected DCU side only |
| 6 | | | |
| 7 | | | |
| 8 | D_CLK_DCU_R+ | 2 | Twisted with 21 |
| 9 | D_CLK_SHD | 2 | Connected DCU side only |
| 10 | D_DAT_DCU_R+ | 2 | Twisted with 22 |
| 11 | D_GAT_DCU_R+ | 2 | Twisted with 24 |
| 12 | D_GAT_SHD | 2 | Connected DCU side only |
| 13 | - | | |
| 14 | C_SHD | 2 | Connected DPU side only |
| 15 | C_CLK_DCU_R- | 2 | Twisted with 2 |
| 16 | C_CMD_DCU_R- | 2 | Twisted with 3 |
| 17 | C_RES_DCU_R- | 2 | Twisted with 4 |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | D_CLK_DCU_R- | 2 | Twisted with 15 |
| 22 | D_DAT_DCU_R- | 2 | Twisted with 10 |
| 23 | D_SHD | 2 | Connected DCU side only |
| 24 | D_GAT_DCU_R- | 2 | Twisted with 11 |
| 25 | - | | |

Unit : FCU
Sub-unit/Module : MCU/MAC
Connector Identifier : J02
Connector Type : DBMA25S
Connector Name : HSFCU_J02

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | |
| 2 | C_CLK_MCU_R+ | 2 | Twisted with 15 |
| 3 | C_CMD_MCU_R+ | 2 | Twisted with 16 |
| 4 | C_RES_MCU_R+ | 2 | Twisted with 17 |
| 5 | C_RES_SHD | 2 | Connected MCU side only |
| 6 | | | |
| 7 | | | |
| 8 | D_CLK_MCU_R+ | 2 | Twisted with 21 |
| 9 | D_CLK_SHD | 2 | Connected MCU side only |
| 10 | D_DAT_MCU_R+ | 2 | Twisted with 22 |
| 11 | D_GAT_MCU_R+ | 2 | Twisted with 24 |
| 12 | D_GAT_SHD | 2 | Connected MCU side only |
| 13 | - | | |
| 14 | C_SHD | 2 | Connected DPU side only |
| 15 | C_CLK_MCU_R- | 2 | Twisted with 2 |
| 16 | C_CMD_MCU_R- | 2 | Twisted with 3 |
| 17 | C_RES_MCU_R- | 2 | Twisted with 4 |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | D_CLK_MCU_R- | 2 | Twisted with 15 |
| 22 | D_DAT_MCU_R- | 2 | Twisted with 10 |
| 23 | D_SHD | 2 | Connected MCU side only |
| 24 | D_GAT_MCU_R- | 2 | Twisted with 11 |
| 25 | - | | |

Unit : FCU
Sub-unit/Module : SCU/CCHK_IF
Connector Identifier : J04
Connector Type : DBMA25S
Connector Name : HSDCU_J04

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | |
| 2 | C_CLK_SCU_R+ | 2 | Twisted with 15 |
| 3 | C_CMD_SCU_R+ | 2 | Twisted with 16 |
| 4 | C_RES_SCU_R+ | 2 | Twisted with 17 |
| 5 | C_RES_SHD | 2 | Connected SCU side only |
| 6 | | | |
| 7 | | | |
| 8 | D_CLK_SCU_R+ | 2 | Twisted with 21 |
| 9 | D_CLK_SHD | 2 | Connected SCU side only |
| 10 | D_DAT_SCU_R+ | 2 | Twisted with 22 |
| 11 | D_GAT_SCU_R+ | 2 | Twisted with 24 |
| 12 | D_GAT_SHD | 2 | Connected SCU side only |
| 13 | - | | |
| 14 | C_SHD | 2 | Connected DPU side only |
| 15 | C_CLK_SCU_R- | 2 | Twisted with 2 |
| 16 | C_CMD_SCU_R- | 2 | Twisted with 3 |
| 17 | C_RES_SCU_R- | 2 | Twisted with 4 |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | D_CLK_SCU_R- | 2 | Twisted with 15 |
| 22 | D_DAT_SCU_R- | 2 | Twisted with 10 |
| 23 | D_SHD | 2 | Connected SCU side only |
| 24 | D_GAT_SCU_R- | 2 | Twisted with 11 |
| 25 | - | | |

### 6.4.2. Interfaces with S/C

Unit : FCU
Sub-unit : PSU
Connector Identifier : J05
Connector Type : DBMA9P
Connector Name : HSFCU_J05

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | |
| 2 | PWR_28V_P | 1 | |
| 3 | | | |
| 4 | RTN_PWR_P | 1 | |
| 5 | | | |
| 6 | | | |
| 7 | PWR_28V_P | 1 | |
| 8 | RTN_PWR_P | 1 | |
| 9 | | | |

Unit : FCU
Sub-unit : PSU
Connector Identifier : J06
Connector Type : DBMA9P
Connector Name : HSFCU_J06

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | |
| 2 | PWR_28V_P | 1 | |
| 3 | | | |
| 4 | RTN_PWR_P | 1 | |
| 5 | | | |
| 6 | | | |
| 7 | PWR_28V_P | 1 | |
| 8 | RTN_PWR_P | 1 | |
| 9 | | | |

Unit : FCU
Sub-unit/Module : Shutter (Main)
Connector Identifier : J27
Connector Type : DCMA25P
Connector Name : HSFCU_J27

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | Shutter Actuator Position Sensor + | | |
| 2 | Shutter Latch Sense + | | |
| 3 | Shutter Sense Shld | | |
| 4 | Shutter Shutter Vane Heater+ | | |
| 5 | Shutter Stepper Drive Phase B + | | |
| 6 | Shutter Temp Sensor Bias+ | | |
| 7 | Shutter Common Temp V | | |
| 8 | Shutter Temp Sensor Bias -/Shld | | |
| 9 | SMEC launch latch # 1 confirmation - | | |
| 10 | SMEC launch latch # 2 confirmation + | | |
| 11 | SMEC launch latch # 2 confirmation Shield | | |
| 12 | BSM Launch latch confirmation - | | |
| 14 | Shutter Actuator Position Sensor - | | |
| 15 | Shutter Latch Sense - | | |
| 16 | Shutter Latch Drive + | | |
| 17 | Shutter Stepper Drive Phase A + | | |
| 18 | Shutter Power Ground / Rtn. as shld | | |
| 19 | Shutter Vane Temp V+ | | |
| 20 | Shutter Actuator Temp V- | | |
| 21 | SMEC launch latch # 1 confirmation + | | |
| 22 | SMEC launch latch # 1 confirmation Shield | | |
| 23 | SMEC launch latch # 2 confirmation - | | |
| 24 | BSM Launch latch confirmation + | | |
| 25 | BSM Launch latch confirmation Shield | | |

Unit : FCU
Sub-unit/Module : Shutter (Redundant)
Connector Identifier : J28
Connector Type : DCMA9P
Connector Name : HSFCU_J05

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | Shutter Actuator Position Sensor + | | |
| 2 | Shutter Latch Sense + | | |
| 3 | Shutter Sense Shld | | |
| 4 | Shutter Shutter Vane Heater+ | | |
| 5 | Shutter Stepper Drive Phase B + | | |
| 6 | Shutter Temp Sensor Bias+ | | |
| 7 | Shutter Common Temp V | | |
| 8 | Shutter Temp Sensor Bias -/Shld | | |
| 9 | SMEC launch latch # 1 confirmation - | | |
| 10 | SMEC launch latch # 2 confirmation + | | |
| 11 | SMEC launch latch # 2 confirmation Shield | | |
| 12 | BSM Launch latch confirmation - | | |
| 14 | Shutter Actuator Position Sensor - | | |
| 15 | Shutter Latch Sense - | | |
| 16 | Shutter Latch Drive + | | |
| 17 | Shutter Stepper Drive Phase A + | | |
| 18 | Shutter Power Ground / Rtn. as shld | | |
| 19 | Shutter Vane Temp V+ | | |
| 20 | Shutter Actuator Temp V- | | |
| 21 | SMEC launch latch # 1 confirmation + | | |
| 22 | SMEC launch latch # 1 confirmation Shield | | |
| 23 | SMEC launch latch # 2 confirmation - | | |
| 24 | BSM Launch latch confirmation + | | |
| 25 | BSM Launch latch confirmation Shield | | |

### 6.4.3. Interfaces with FPU

#### 6.4.3.1. DCU Interfaces

##### *6.4.3.1.1. LIA_P Module*

Unit : DCU
Sub-unit/Module : LIA_P
Connector Identifier : J05, J07, J09, J11, J13, J15, J17, J19, J21
Connector Type : DDMA50P
Connector Name : HSDCU_J05 to HSDCU_J21

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | Channel 1 + | 3 | |
| 18 | Channel 1 – | 3 | |
| 34 | Channel 1gnd shld | 3 | |
| 2 | Channel 2 + | 3 | |
| 19 | Channel 2 - | 3 | |
| 35 | Channel 2gnd shld | 3 | |
| 3 | Channel 3 + | 3 | |
| 20 | Channel 3 - | 3 | |
| 36 | Channel 3gnd shld | 3 | |
| 4 | Channel 4 + | 3 | |
| 21 | Channel 4 - | 3 | |
| 37 | Channel 4gnd shld | 3 | |
| 5 | Channel 5 + | 3 | |
| 22 | Channel 5 - | 3 | |
| 38 | Channel 5gnd shld | 3 | |
| 6 | Channel 6 + | 3 | |
| 23 | Channel 6 - | 3 | |
| 39 | Channel 6gnd shld | 3 | |
| 7 | Channel 7 + | 3 | |
| 24 | Channel 7 - | 3 | |
| 40 | Channel 7gnd shld | 3 | |
| 8 | Channel 8 + | 3 | |
| 25 | Channel 8 – | 3 | |
| 41 | Channel 8gnd shld | 3 | |
| 9 | GND WIRE | 3 | |
| 42 | FPU Faraday Shield Link | 3 | |
| 26 | Channel 9 + | 3 | |
| 10 | Channel 9 - | 3 | |
| 43 | Channel 9gnd shld | 3 | |
| 27 | Channel 10 + | 3 | |
| 11 | Channel 10 - | 3 | |
| 44 | Channel 10gnd shld | 3 | |
| 28 | Channel 11 + | 3 | |

| | | | |
|---|---|---|---|
| 12 | Channel 11 - | 3 | |
| 45 | Channel 11gnd shld | 3 | |
| 29 | Channel 12 + | 3 | |
| 13 | Channel 12 - | 3 | |
| 46 | Channel 12gnd shld | 3 | |
| 30 | Channel 13 + | 3 | |
| 14 | Channel 13 - | 3 | |
| 47 | Channel 13gnd shld | 3 | |
| 31 | Channel 14 + | 3 | |
| 15 | Channel 14 – | 3 | |
| 48 | Channel 14gnd shld | 3 | |
| 32 | Channel 15 + | 3 | |
| 16 | Channel 15 - | 3 | |
| 49 | Channel 15gnd shld | 3 | |
| 33 | Channel 16 + | 3 | |
| 17 | Channel 16 - | 3 | |
| 50 | Channel 16gnd shld | 3 | |

Unit : DCU
Sub-unit/Module : LIA_P
Connector Identifier : J06, J08, J10,J12, J14, J16, J18, J20, J22
Connector Type : DDMA50P
Connector Name : HSDCU_J06 to HSDCU_J22

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | Channel 1 + | 3 | |
| 18 | Channel 1 – | 3 | |
| 34 | Channel 1gnd shld | 3 | |
| 2 | Channel 2 + | 3 | |
| 19 | Channel 2 - | 3 | |
| 35 | Channel 2gnd shld | 3 | |
| 3 | Channel 3 + | 3 | |
| 20 | Channel 3 - | 3 | |
| 36 | Channel 3gnd shld | 3 | |
| 4 | Channel 4 + | 3 | |
| 21 | Channel 4 - | 3 | |
| 37 | Channel 4gnd shld | 3 | |
| 5 | Channel 5 + | 3 | |
| 22 | Channel 5 - | 3 | |
| 38 | Channel 5gnd shld | 3 | |
| 6 | Channel 6 + | 3 | |
| 23 | Channel 6 - | 3 | |
| 39 | Channel 6gnd shld | 3 | |
| 7 | Channel 7 + | 3 | |
| 24 | Channel 7 - | 3 | |
| 40 | Channel 7gnd shld | 3 | |
| 8 | Channel 8 + | 3 | |
| 25 | Channel 8 – | 3 | |
| 41 | Channel 8gnd shld | 3 | |
| 9 | GND WIRE | 3 | |
| 42 | FPU Faraday Shield Link | 3 | |
| 26 | Channel 9 + | 3 | |
| 10 | Channel 9 - | 3 | |
| 43 | Channel 9gnd shld | 3 | |
| 27 | Channel 10 + | 3 | |
| 11 | Channel 10 - | 3 | |
| 44 | Channel 10gnd shld | 3 | |
| 28 | Channel 11 + | 3 | |
| 12 | Channel 11 - | 3 | |
| 45 | Channel 11gnd shld | 3 | |
| 29 | Channel 12 + | 3 | |
| 13 | Channel 12 - | 3 | |
| 46 | Channel 12gnd shld | 3 | |
| 30 | Channel 13 + | 3 | |
| 14 | Channel 13 - | 3 | |
| 47 | Channel 13gnd shld | 3 | |
| 31 | Channel 14 + | 3 | |

| | | | |
|---|---|---|---|
| 15 | Channel 14 – | 3 | |
| 48 | Channel 14gnd shld | 3 | |
| 32 | Channel 15 + | 3 | |
| 16 | Channel 15 - | 3 | |
| 49 | Channel 15gnd shld | 3 | |
| 33 | Channel 16 + | 3 | |
| 17 | Channel 16 - | 3 | |
| 50 | Channel 16gnd shld | 3 | |

#### *6.4.3.1.2. LIA_S Module*

Unit : DCU
Sub-unit/Module : LIA_S
Connector Identifier : J23, J25, J27
Connector Type : DDMA37P
Connector Name : HSDCU_J23, HSDCU_J25, HSDCU_J27

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | Channel 1gnd shld | 3 | |
| 2 | Channel 1 - | 3 | |
| 3 | Channel 2 + | 3 | |
| 4 | Channel 3gnd shld | 3 | |
| 5 | Channel 3 - | 3 | |
| 6 | Channel 4 + | 3 | |
| 7 | Channel 5gnd shld | 3 | |
| 8 | Channel 5 - | 3 | |
| 9 | Channel 6 + | 3 | |
| 10 | FPU Faraday Shield Link | 3 | |
| 11 | Channel 7 + | 3 | |
| 12 | Channel 8 – | 3 | |
| 13 | Channel 8gnd shld | 3 | |
| 14 | Channel 9 + | 3 | |
| 15 | Channel 10 - | 3 | |
| 16 | Channel 10gnd shld | 3 | |
| 17 | Channel 11 + | 3 | |
| 18 | Channel 12 - | 3 | |
| 19 | Channel 12gnd shld | 3 | |
| 20 | Channel 1 + | 3 | |
| 21 | Channel 2gnd shld | 3 | |
| 22 | Channel 2 – | 3 | |
| 23 | Channel 3 + | 3 | |
| 24 | Channel 4gnd shld | 3 | |
| 25 | Channel 4 - | 3 | |
| 26 | Channel 5 + | 3 | |
| 27 | Channel 6gnd shld | 3 | |
| 28 | Channel 6 - | 3 | |
| 29 | Channel 7 – | 3 | |
| 30 | Channel 7gnd shld | 3 | |
| 31 | Channel 8 + | 3 | |
| 32 | Channel 9 - | 3 | |
| 33 | Channel 9gnd shld | 3 | |
| 34 | Channel 10 + | 3 | |
| 35 | Channel 11 - | 3 | |
| 36 | Channel 11gnd shld | 3 | |
| 37 | Channel 12 + | 3 | |

Unit : DCU
Sub-unit/Module : LIA_S
Connector Identifier : J24, J26, J28
Connector Type : DDMA37P
Connector Name : HSDCU_ J24, HSDCU_J26, HSDCU_ J28

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | Channel 1gnd shld | 3 | |
| 2 | Channel 13 – | 3 | |
| 3 | Channel 14 + | 3 | |
| 4 | Channel 15gnd shld | 3 | |
| 5 | Channel 15 – | 3 | |
| 6 | Channel 16 + | 3 | |
| 7 | Channel 17gnd shld | 3 | |
| 8 | Channel 17 - | 3 | |
| 9 | Channel 18 + | 3 | |
| 10 | GND WIRE | 3 | |
| 11 | Channel 19 + | 3 | |
| 12 | Channel 20 - | 3 | |
| 13 | Channel 1gnd shld | 3 | |
| 14 | Channel 21 + | 3 | |
| 15 | Channel 22 - | 3 | |
| 16 | Channel 22gnd shld | 3 | |
| 17 | Channel 23 + | 3 | |
| 18 | Channel 24 – | 3 | |
| 19 | Channel 24gnd shld | 3 | |
| 20 | Channel 13 + | 3 | |
| 21 | Channel 1gnd shld | 3 | |
| 22 | Channel 14 - | 3 | |
| 23 | Channel 15 + | 3 | |
| 24 | Channel 16gnd shld | 3 | |
| 25 | Channel 16 - | 3 | |
| 26 | Channel 17 + | 3 | |
| 27 | Channel 18gnd shld | 3 | |
| 28 | Channel 18 - | 3 | |
| 29 | Channel 19 – | 3 | |
| 30 | Channel 19gnd shld | 3 | |
| 31 | Channel 20 + | 3 | |
| 32 | Channel 21 - | 3 | |
| 33 | Channel 21gnd shld | 3 | |
| 34 | Channel 22 + | 3 | |
| 35 | Channel 23 - | 3 | |
| 36 | Channel 23gnd shld | 3 | |
| 37 | Channel 24 + | 3 | |

#### *6.4.3.1.3. BIAS Module*

Unit : DCU
Sub-unit/Module : BIAS_P (Main)
Connector Identifier : J29
Connector Type : DDMA78S
Connector Name : HSDCU_J29

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | Vdd1_P | | |
| 2 | Vss1_P | | |
| 3 | Vdd2_P | | |
| 4 | Vdd3_P | | |
| 5 | Vss3_P | | |
| 6 | PBias_P250 | | |
| 7 | Gnd_Bias_Ph | | |
| 8 | Gnd_Bias_Ph | | |
| 9 | Nheater_PSW1 | | |
| 10 | Vdd7_P | | |
| 11 | Vss7_P | | |
| 12 | Vdd8_P | | |
| 13 | PBias_P350 | | |
| 14 | Nbias_P350 | | |
| 15 | Nheater_PMW1 | | |
| 16 | Gnd_Bias_Ph | | |
| 17 | Vss11_P | | |
| 18 | Vdd12_P | | |
| 19 | Vss12_P | | |
| 20 | Gnd_Bias_Ph | | |
| 21 | Gnd_Bias_Ph | | |
| 22 | Gnd_Bias_Ph | | |
| 23 | Vss2_P | | |
| 24 | Gnd_Bias_Ph | | |
| 25 | Gnd_Bias_Ph | | |
| 26 | Nbias_250 | | |
| 27 | Gnd_Bias_Ph | | |
| 28 | Gnd_Bias_Ph | | |
| 29 | Gnd_Bias_Ph | | |
| 30 | Gnd_Bias_Ph | | |
| 31 | Vss8_P | | |
| 32 | Gnd_Bias_Ph | | |
| 33 | Gnd_Bias_Ph | | |
| 34 | Gnd_Bias_Ph | | |
| 35 | Gnd_Bias_Ph | | |
| 36 | Vdd11_P | | |
| 37 | Gnd_Bias_Ph | | |
| 38 | Gnd_Bias_Ph | | |

| | | | |
|---|---|---|---|
| 39 | Nheater_PLW1 | | |
| 40 | Gnd_Bias_Ph | | |
| 41 | Vdd4_P | | |
| 42 | Gnd_Bias_Ph | | |
| 43 | Gnd_Bias_Ph | | |
| 44 | Vss6_P | | |
| 45 | Gnd_Bias_Ph | | |
| 46 | Gnd_Bias_Ph | | |
| 47 | Pbias_P250 | | |
| 48 | Gnd_Bias_Ph | | |
| 49 | Nheater_PSW2 | | |
| 50 | Gnd_Bias_Ph | | |
| 51 | Gnd_Bias_Ph | | |
| 52 | Vss10_P | | |
| 53 | Gnd_Bias_Ph | | |
| 54 | Gnd_Bias_Ph | | |
| 55 | Gnd_Bias_Ph | | |
| 56 | Gnd_Bias_Ph | | |
| 57 | Nbias_P500 | | |
| 58 | Gnd_Bias_Ph | | |
| 59 | Gnd_Bias_Ph | | |
| 60 | Vss4_P | | |
| 61 | Vdd5_P | | |
| 62 | Vss5_P | | |
| 63 | Vdd6_P | | |
| 64 | Nbias_P250 | | |
| 65 | Pbias_P250 | | |
| 66 | Nbias_P250 | | |
| 67 | Nheater_PSW3 | | |
| 68 | Gnd_Bias_Ph | | |
| 69 | Vdd9_P | | |
| 70 | Vss9_P | | |
| 71 | Vdd10_P | | |
| 72 | Nbias_P350 | | |
| 73 | Pbias_P350 | | |
| 74 | Nheater_PMW2 | | |
| 75 | Pbias_P500 | | |
| 76 | Nbias_P500 | | |
| 77 | Pbias_P500 | | |
| 78 | Gnd_Bias_Ph | | |

Unit : DCU
Sub-unit/Module : BIAS_S (Main)
Connector Identifier : J31
Connector Type : DCMA37S
Connector Name : HSDCU_J31

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | PBias_TC | | |
| 2 | Gnd_Bias_Ph | | |
| 3 | Vdd_TC | | |
| 4 | Gnd_Bias_Ph | | |
| 5 | NHeater_TC | | |
| 6 | NBias_SLW | | |
| 7 | Gnd_Bias_Sp | | |
| 8 | Vss1_P | | |
| 9 | Gnd_Bias_Sp | | |
| 10 | NBias_SSW | | |
| 11 | Gnd_Bias_Sp | | |
| 12 | PBias_SSW | | |
| 13 | Vss2_S | | |
| 14 | Vdd3_S | | |
| 15 | Gnd_Bias_Sp | | |
| 16 | NHeater_SLW | | |
| 17 | Gnd_Bias_Sp | | |
| 18 | NHeater_SSW | | |
| 19 | Gnd_Bias_Sp | | |
| 20 | NBias_TC | | |
| 21 | Vss_TC | | |
| 22 | Gnd_Bias_Ph | | |
| 23 | Gnd_Bias_Ph | | |
| 24 | PBias_SLW | | |
| 25 | Vdd1_S | | |
| 26 | Gnd_Bias_Sp | | |
| 27 | Gnd_Bias_Sp | | |
| 28 | PBias_SSW | | |
| 29 | NBias_SSW | | |
| 30 | Gnd_Bias_Sp | | |
| 31 | Vdd2_S | | |
| 32 | Gnd_Bias_Sp | | |
| 33 | Vss3_S | | |
| 34 | Gnd_Bias_Sp | | |
| 35 | Gnd_Bias_Sp | | |
| 36 | Gnd_Bias_Sp | | |
| 37 | Gnd_Bias_Sp | | |

Unit : DCU
Sub-unit/Module : BIAS_P (Redundant)
Connector Identifier : J30
Connector Type : DDMA78S
Connector Name : HSDCU_J30

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | Vdd1_P | | |
| 2 | Vss1_P | | |
| 3 | Vdd2_P | | |
| 4 | Vdd3_P | | |
| 5 | Vss3_P | | |
| 6 | PBias_P250 | | |
| 7 | Gnd_Bias_Ph | | |
| 8 | Gnd_Bias_Ph | | |
| 9 | Nheater_PSW1 | | |
| 10 | Vdd7_P | | |
| 11 | Vss7_P | | |
| 12 | Vdd8_P | | |
| 13 | PBias_P350 | | |
| 14 | Nbias_P350 | | |
| 15 | Nheater_PMW1 | | |
| 16 | Gnd_Bias_Ph | | |
| 17 | Vss11_P | | |
| 18 | Vdd12_P | | |
| 19 | Vss12_P | | |
| 20 | Gnd_Bias_Ph | | |
| 21 | Gnd_Bias_Ph | | |
| 22 | Gnd_Bias_Ph | | |
| 23 | Vss2_P | | |
| 24 | Gnd_Bias_Ph | | |
| 25 | Gnd_Bias_Ph | | |
| 26 | Nbias_250 | | |
| 27 | Gnd_Bias_Ph | | |
| 28 | Gnd_Bias_Ph | | |
| 29 | Gnd_Bias_Ph | | |
| 30 | Gnd_Bias_Ph | | |
| 31 | Vss8_P | | |
| 32 | Gnd_Bias_Ph | | |
| 33 | Gnd_Bias_Ph | | |
| 34 | Gnd_Bias_Ph | | |
| 35 | Gnd_Bias_Ph | | |
| 36 | Vdd11_P | | |
| 37 | Gnd_Bias_Ph | | |
| 38 | Gnd_Bias_Ph | | |
| 39 | Nheater_PLW1 | | |
| 40 | Gnd_Bias_Ph | | |
| 41 | Vdd4_P | | |
| 42 | Gnd_Bias_Ph | | |

| | | | |
|---|---|---|---|
| 43 | Gnd_Bias_Ph | | |
| 44 | Vss6_P | | |
| 45 | Gnd_Bias_Ph | | |
| 46 | Gnd_Bias_Ph | | |
| 47 | Pbias_P250 | | |
| 48 | Gnd_Bias_Ph | | |
| 49 | Nheater_PSW2 | | |
| 50 | Gnd_Bias_Ph | | |
| 51 | Gnd_Bias_Ph | | |
| 52 | Vss10_P | | |
| 53 | Gnd_Bias_Ph | | |
| 54 | Gnd_Bias_Ph | | |
| 55 | Gnd_Bias_Ph | | |
| 56 | Gnd_Bias_Ph | | |
| 57 | Nbias_P500 | | |
| 58 | Gnd_Bias_Ph | | |
| 59 | Gnd_Bias_Ph | | |
| 60 | Vss4_P | | |
| 61 | Vdd5_P | | |
| 62 | Vss5_P | | |
| 63 | Vdd6_P | | |
| 64 | Nbias_P250 | | |
| 65 | Pbias_P250 | | |
| 66 | Nbias_P250 | | |
| 67 | Nheater_PSW3 | | |
| 68 | Gnd_Bias_Ph | | |
| 69 | Vdd9_P | | |
| 70 | Vss9_P | | |
| 71 | Vdd10_P | | |
| 72 | Nbias_P350 | | |
| 73 | Pbias_P350 | | |
| 74 | Nheater_PMW2 | | |
| 75 | Pbias_P500 | | |
| 76 | Nbias_P500 | | |
| 77 | Pbias_P500 | | |
| 78 | Gnd_Bias_Ph | | |

Unit : DCU
Sub-unit/Module : BIAS_S (Redundant)
Connector Identifier : J32
Connector Type : DCMA37S
Connector Name : HSDCU_J32

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | PBias_TC | | |
| 2 | Gnd_Bias_Ph | | |
| 3 | Vdd_TC | | |
| 4 | Gnd_Bias_Ph | | |
| 5 | NHeater_TC | | |
| 6 | NBias_SLW | | |
| 7 | Gnd_Bias_Sp | | |
| 8 | Vss1_P | | |
| 9 | Gnd_Bias_Sp | | |
| 10 | NBias_SSW | | |
| 11 | Gnd_Bias_Sp | | |
| 12 | PBias_SSW | | |
| 13 | Vss2_S | | |
| 14 | Vdd3_S | | |
| 15 | Gnd_Bias_Sp | | |
| 16 | NHeater_SLW | | |
| 17 | Gnd_Bias_Sp | | |
| 18 | NHeater_SSW | | |
| 19 | Gnd_Bias_Sp | | |
| 20 | NBias_TC | | |
| 21 | Vss_TC | | |
| 22 | Gnd_Bias_Ph | | |
| 23 | Gnd_Bias_Ph | | |
| 24 | PBias_SLW | | |
| 25 | Vdd1_S | | |
| 26 | Gnd_Bias_Sp | | |
| 27 | Gnd_Bias_Sp | | |
| 28 | PBias_SSW | | |
| 29 | NBias_SSW | | |
| 30 | Gnd_Bias_Sp | | |
| 31 | Vdd2_S | | |
| 32 | Gnd_Bias_Sp | | |
| 33 | Vss3_S | | |
| 34 | Gnd_Bias_Sp | | |
| 35 | Gnd_Bias_Sp | | |
| 36 | Gnd_Bias_Sp | | |
| 37 | Gnd_Bias_Sp | | |

#### 6.4.3.2. FCU Interfaces

##### *6.4.3.2.1. SMEC Module*

Unit : FCU
Sub-unit : MCU/SMEC (Main)
Connector Identifier : J17
Connector Type : DCMA37P
Connector Name : HSFCU_J17

| Pin # | Signal name | Signal function | Max. current |
|---|---|---|---|
| 1 | S_Mot_Coil_P | SMEC drive coil I+ | 100 mA |
| 2 | S_Mot_Coil_N | SMEC drive coil I- | 100 mA |
| 20 | S_Mot_Coil_Shd | SMEC drive coil shld | N/A |
| 4 | S_Mot_Bemf_P | SMEC drive coil supply sense | 10 µA |
| 5 | S_Mot_Bemf_N | SMEC drive coil return sense | 10 µA |
| 23 | S_Mot_Bemf_Shd | SMEC drive coil supply sense shield | N/A |
| 6 | | NC | |
| 7 | LEDA | SMEC position sensor Led power supply | 1 mA |
| 8 | LEDC | SMEC position sensor Led power return | 1 mA |
| 26 | LED_Shd | Shield | N/A |
| 10 | IPD1A | SMEC position sensor photodiode #1 I+ | 20 µA |
| 11 | IPD1C | SMEC position sensor photodiode #1 I- | 20 µA |
| 29 | IPD1_SHD | Shield | N/A |
| 13 | IPD2A | SMEC position sensor photodiode #2 I+ | 20 µA |
| 14 | IPD2C | SMEC position sensor photodiode #2 I- | 20 µA |
| 32 | IPD2_Shd | Shield | N/A |
| 16 | IPD3A | SMEC position sensor photodiode #3 I+ | 20 µA |
| 17 | IPD3C | SMEC position sensor photodiode #3 I- | 20 µA |
| 35 | IPD3_Shd | Shield | N/A |
| 21 | S_Mot_Coil_P | SMEC drive coil I+ (rob) | 100 mA |
| 22 | S_Mot_Coil_N | SMEC drive coil I- (rob) | 100 mA |
| 3 | S_Mot_Coil_Shd | SMEC drive coil shld rob) | N/A |
| 24 | | NC | |
| 25 | | NC | |
| 27 | -3V | SMEC position sensor power supply | 1 mA |
| 28 | -3V | SMEC position sensor power return | 1 mA |
| 9 | POS_POWER_Shd | Shield | N/A |
| 30 | CRPD1A | SMEC pos. sensor photodiode #1 feedback + | 10 µA |
| 31 | CRPD1C | SMEC pos. sensor photodiode #1 feedback - | 10 µA |
| 12 | CRPD1_SHD | Shield | N/A |
| 33 | CRPD2A | SMEC pos. sensor photodiode #2 feedback + | 10 µA |
| 34 | CRPD2C | SMEC pos. sensor photodiode #2 feedback - | 10 µA |
| 15 | CRPD2_Shd | Shield | N/A |
| 36 | CRPD3A | SMEC pos. sensor photodiode #3 feedback + | 10 µA |

Unit : FCU
Sub-unit : MCU/SMEC (Redundant)
Connector Identifier : J18
Connector Type : DCMA37P
Connector Name : HSFCU_J18

| Pin # | Signal name | Signal function | Max. current |
|---|---|---|---|
| 1 | S_Mot_Coil_P | SMEC drive coil I+ | 100 mA |
| 2 | S_Mot_Coil_N | SMEC drive coil I- | 100 mA |
| 20 | S_Mot_Coil_Shd | SMEC drive coil shld | N/A |
| 4 | S_Mot_Bemf_P | SMEC drive coil supply sense | 10 µA |
| 5 | S_Mot_Bemf_N | SMEC drive coil return sense | 10 µA |
| 23 | S_Mot_Bemf_Shd | SMEC drive coil supply sense shield | N/A |
| 6 | | NC | |
| 7 | LEDA | SMEC position sensor Led power supply | 1 mA |
| 8 | LEDC | SMEC position sensor Led power return | 1 mA |
| 26 | LED_Shd | Shield | N/A |
| 10 | IPD1A | SMEC position sensor photodiode #1 I+ | 20 µA |
| 11 | IPD1C | SMEC position sensor photodiode #1 I- | 20 µA |
| 29 | IPD1_SHD | Shield | N/A |
| 13 | IPD2A | SMEC position sensor photodiode #2 I+ | 20 µA |
| 14 | IPD2C | SMEC position sensor photodiode #2 I- | 20 µA |
| 32 | IPD2_Shd | Shield | N/A |
| 16 | IPD3A | SMEC position sensor photodiode #3 I+ | 20 µA |
| 17 | IPD3C | SMEC position sensor photodiode #3 I- | 20 µA |
| 35 | IPD3_Shd | Shield | N/A |
| 21 | S_Mot_Coil_P | SMEC drive coil I+ (rob) | 100 mA |
| 22 | S_Mot_Coil_N | SMEC drive coil I- (rob) | 100 mA |
| 3 | S_Mot_Coil_Shd | SMEC drive coil shld rob) | N/A |
| 24 | | NC | |
| 25 | | NC | |
| 27 | -3V | SMEC position sensor power supply | 1 mA |
| 28 | -3V | SMEC position sensor power return | 1 mA |
| 9 | POS_POWER_Shd | Shield | N/A |
| 30 | CRPD1A | SMEC pos. sensor photodiode #1 feedback + | 10 µA |
| 31 | CRPD1C | SMEC pos. sensor photodiode #1 feedback - | 10 µA |
| 12 | CRPD1_SHD | Shield | N/A |
| 33 | CRPD2A | SMEC pos. sensor photodiode #2 feedback + | 10 µA |
| 34 | CRPD2C | SMEC pos. sensor photodiode #2 feedback - | 10 µA |
| 15 | CRPD2_Shd | Shield | N/A |
| 36 | CRPD3A | SMEC pos. sensor photodiode #3 feedback + | 10 µA |
| 37 | CRPD3C | SMEC pos. sensor photodiode #3 feedback - | 10 µA |
| 18 | CRPD3_Shd | Shield | N/A |

Unit : FCU
Sub-unit : MCU/SMEC (Main)
Connector Identifier : J29
Connector Type : DCMA37P
Connector Name : HSFCU_J29

| Pin # | Signal name | Signal function | Max. current |
|---|---|---|---|
| 1 | S_LL#1_Coil_P | SMEC lauch latch #1 power supply | 400 mA / 50 ms |
| 2 | S_LL#1_Coil_N | SMEC lauch latch #1 power return | 400 mA / 50 ms |
| 20 | S_LL#1_Coil_Shd | Shield | N/A |
| 3 | | Reserved | |
| 4 | | Reserved | |
| 5 | | Reserved | |
| 7 | | Reserved | |
| 8 | | Reserved | |
| 9 | | Reserved | |
| 10 | S_LL#2_Stat_P | SMEC launch latch # 2 confirmation + (TBC) | 1 mA |
| 11 | S_LL#2_Stat_N | SMEC launch latch # 2 confirmation – (TBC) | 1 mA |
| 29 | S_LL#2_Stat_Shd | Shield | N/A |
| 13 | LVDT_PRIM_P | SMEC LVDT primary coil power supply (P) | 5 mA |
| 14 | LVDT_PRIM_N | SMEC LVDT primary coil power supply (N) | 5 mA |
| 32 | LVDT_PRIM_Shd | Shield | N/A |
| 15 | LVDT_SECA_P | SMEC LVDT secondary coil # 1signal (P) | 50 µA |
| 16 | LVDT_SECA_N | SMEC LVDT secondary coil # 1 signal (N) | 50 µA |
| 34 | LVDT_SECA_Shd | Shield | N/A |
| 17 | LVDT_SECB_P | SMEC LVDT secondary coil # 2 signal (P) | 50 µA |
| 18 | LVDT_SECB_N | SMEC LVDT secondary coil # 2 signal (N) | 50 µA |
| 36 | LVDT_SECB_Shd | Shield | N/A |
| 19 | | | |
| 21 | | Reserved | |
| 22 | | Reserved | |
| 23 | | Reserved | |
| 24 | S_LL#2_Coil_P | SMEC launch latch #2 power supply (TBC) | 400 mA / 50 ms |
| 25 | S_LL#2_Coil_N | SMEC launch latch #2 power return (TBC) | 400 mA / 50 ms |
| 6 | S_LL#2_Coil_Shd | Shield | N/A |
| 26 | | Reserved | |
| 27 | | Reserved | |
| 28 | | Reserved | |
| 30 | S_LL#1_Stat_P | SMEC launch latch # 1 confirmation + | 1 mA |
| 31 | S_LL#1_Stat_N | SMEC launch latch # 1 confirmation - | 1 mA |
| 12 | S_LL#1_Stat_Shd | Shield | N/A |
| 33 | | | |
| 35 | | | |
| 37 | | | |

Unit : FCU
Sub-unit : MCU/SMEC (Redundant)
Connector Identifier : J30
Connector Type : DCMA37P
Connector Name : HSFCU_J30

| Pin # | Signal name | Signal function | Max. current |
|---|---|---|---|
| 1 | S_LL#1_Coil_P | SMEC lauch latch #1 power supply | 400 mA / 50 ms |
| 2 | S_LL#1_Coil_N | SMEC lauch latch #1 power return | 400 mA / 50 ms |
| 20 | S_LL#1_Coil_ Shd | Shield | N/A |
| 3 | | Reserved | |
| 4 | | Reserved | |
| 5 | | Reserved | |
| 7 | | Reserved | |
| 8 | | Reserved | |
| 9 | | Reserved | |
| 10 | S_LL#2_Stat_P | SMEC lauch latch # 2 confirmation + (TBC) | 1 mA |
| 11 | S_LL#2_Stat_N | SMEC lauch latch # 2 confirmation – (TBC) | 1 mA |
| 29 | S_LL#2_Stat_ Shd | Shield | N/A |
| 13 | LVDT_PRIM_P | SMEC LVDT primary coil power supply (P) | 5 mA |
| 14 | LVDT_PRIM_N | SMEC LVDT primary coil power supply (N) | 5 mA |
| 32 | LVDT_PRIM_ Shd | Shield | N/A |
| 15 | LVDT_SECA_P | SMEC LVDT secondary coil # 1signal (P) | 50 µA |
| 16 | LVDT_SECA_N | SMEC LVDT secondary coil # 1 signal (N) | 50 µA |
| 34 | LVDT_SECA_ Shd | Shield | N/A |
| 17 | LVDT_SECB_P | SMEC LVDT secondary coil # 2 signal (P) | 50 µA |
| 18 | LVDT_SECB_N | SMEC LVDT secondary coil # 2 signal (N) | 50 µA |
| 36 | LVDT_SECB_ Shd | Shield | N/A |
| 19 | | | |
| 21 | | Reserved | |
| 22 | | Reserved | |
| 23 | | Reserved | |
| 24 | S_LL#2_Coil_P | SMEC lauch latch #2 power supply (TBC) | 400 mA / 50 ms |
| 25 | S_LL#2_Coil_N | SMEC lauch latch #2 power return (TBC) | 400 mA / 50 ms |
| 6 | S_LL#2_Coil_ Shd | Shield | N/A |
| 26 | | Reserved | |
| 27 | | Reserved | |
| 28 | | Reserved | |
| 30 | S_LL#1_Stat_P | SMEC lauch latch # 1 confirmation + | 1 mA |
| 31 | S_LL#1_Stat_N | SMEC lauch latch # 1 confirmation - | 1 mA |
| 12 | S_LL#1_Stat_Shd | Shield | N/A |
| 33 | | | |
| 35 | | | |
| 37 | | | |

#### *6.4.3.2.2. BSM Module*

Unit : FCU
Sub-unit : MCU/BSM (Main)
Connector Identifier : J19
Connector Type : DCMA37S
Connector Name : HSFCU_J19

| Pin # | Name | Signal function | Electrical signal |
|---|---|---|---|
| 1 | Ch_Sens_Sup | Chop sensor supply | I = 1 mA |
| 20 | Ch_Sens_Rtn | Chop sensor return | I = 1 mA |
| 22 | Ch_Sens_Shd1 | Chop sensor supply screen | U = 0 V |
| 2 | Ch_Sens_Sup_Meas | Chop sensor supply sense | U = 0.4 V |
| 3 | Ch_Sens_Rtn_Meas | Chop sensor return sense | U = 0 V |
| 21 | Ch_Sens_O/P | Chop sensor o/p | U = 0,4V |
| 4 | Jig_Sens_Sup | Jiggle sensor supply | I = 1 mA |
| 23 | Jig_Sens_Ret | Jiggle sensor return | U = 0 V |
| 5 | Jig_Sens_Sup_Meas | Jiggle sensor supply sense | U = 0.4 V |
| 6 | Jig_Sens_Rtn_Meas | Jiggle sensor return sense | U = 0 V |
| 24 | Jig_Sens_O/P | Jiggle sensor o/p | U = 0,4V |
| 12 | B_LL_Sens_Sup | Launch latch sensor | U = 5 V |
| 30 | B_LL_Sens_Rtn | Launch latch sensor return | U = 0 V |
| 31 | LL_Sens_Shd | Launch latch sensor screen | U = 0 V |
| 13 | B_LL_Sup | Launch latch coil supply | I = 400 mA |
| 14 | B_LL_Rtn | Launch latch coil return | I = 400 mA |
| 33 | LL_Shd | Launch latch coil screen | I = 0 mA |
| 15 | Ch_Mot_Sup | Chop motor supply | I = 40 mA |
| 34 | Ch_Mot_Rtn | Chop motor return | I = 40 mA |
| 17 | Ch_Mot_Shd | Chop motor screen | U = 0 V |
| 16 | Ch_Bemf_Meas_P | Chop motor supply sense | U = 15 V |
| 35 | Ch_Bemf_Meas_N | Chop motor return sense | U = 0 V |
| 36 | Jig_Mot_Sup | Jiggle motor supply | I = 40 mA |
| 18 | Jig_Mot_Rtn | Jiggle motor return | I = 40 mA |
| 37 | Jig_Bemf_Meas_P | Jiggle motor supply sense | U = 15 V |
| 19 | Jig_Bemf_Meas_N | Jiggle motor return sense | U = 0 V |
| 7 | | Reserved | |
| 8 | | Reserved | |
| 9 | | not connected | |
| 10 | | Reserved | |
| 11 | | Reserved | |
| 25 | | Reserved | |
| 26 | | Reserved | |
| 27 | | Reserved | |
| 28 | | Reserved | |
| 29 | | Reserved | |
| 32 | | not connected | |

Unit : FCU
Sub-unit : MCU/BSM (Redundant)
Connector Identifier : J20
Connector Type : DCMA37S
Connector Name : HSFCU_J20

| Pin # | Name | Signal function | Electrical signal |
|---|---|---|---|
| 1 | Ch_Sens_Sup | Chop sensor supply | I = 1 mA |
| 20 | Ch_Sens_Rtn | Chop sensor return | I = 1 mA |
| 22 | Ch_Sens_Shd1 | Chop sensor supply screen | U = 0 V |
| 2 | Ch_Sens_Sup_Meas | Chop sensor supply sense | U = 0.4 V |
| 3 | Ch_Sens_Rtn_Meas | Chop sensor return sense | U = 0 V |
| 21 | Ch_Sens_O/P | Chop sensor o/p | U = 0,4V |
| 4 | Jig_Sens_Sup | Jiggle sensor supply | I = 1 mA |
| 23 | Jig_Sens_Ret | Jiggle sensor return | U = 0 V |
| 5 | Jig_Sens_Sup_Meas | Jiggle sensor supply sense | U = 0.4 V |
| 6 | Jig_Sens_Rtn_Meas | Jiggle sensor return sense | U = 0 V |
| 24 | Jig_Sens_O/P | Jiggle sensor o/p | U = 0,4V |
| 12 | B_LL_Sens_Sup | Launch latch sensor | U = 5 V |
| 30 | B_LL_Sens_Rtn | Launch latch sensor return | U = 0 V |
| 31 | LL_Sens_Shd | Launch latch sensor screen | U = 0 V |
| 13 | B_LL_Sup | Launch latch coil supply | I = 400 mA |
| 14 | B_LL_Rtn | Launch latch coil return | I = 400 mA |
| 33 | LL_Shd | Launch latch coil screen | I = 0 mA |
| 15 | Ch_Mot_Sup | Chop motor supply | I = 40 mA |
| 34 | Ch_Mot_Rtn | Chop motor return | I = 40 mA |
| 17 | Ch_Mot_Shd | Chop motor screen | U = 0 V |
| 16 | Ch_Bemf_Meas_P | Chop motor supply sense | U = 15 V |
| 35 | Ch_Bemf_Meas_N | Chop motor return sense | U = 0 V |
| 36 | Jig_Mot_Sup | Jiggle motor supply | I = 40 mA |
| 18 | Jig_Mot_Rtn | Jiggle motor return | I = 40 mA |
| 37 | Jig_Bemf_Meas_P | Jiggle motor supply sense | U = 15 V |
| 19 | Jig_Bemf_Meas_N | Jiggle motor return sense | U = 0 V |
| 7 | | Reserved | |
| 8 | | Reserved | |
| 9 | | not connected | |
| 10 | | Reserved | |
| 11 | | Reserved | |
| 25 | | Reserved | |
| 26 | | Reserved | |
| 27 | | Reserved | |
| 28 | | Reserved | |
| 29 | | Reserved | |
| 32 | | not connected | |

#### 6.4.3.3. SCU Interfaces

##### *6.4.3.3.1. TEMP Module*

Unit : FCU
Sub-unit/Module : SCU/TEMP (Main)
Connector Identifier : J21
Connector Type : DAMA15S
Connector Name : HSFCU_J21

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | BSM temperature drive+ |
| 9 | | | BSM temperature sense+ |
| 10 | | | BSM temperature sense- |
| 2 | | | BSM temperature drive- |
| 3 | | | BSM temperature shield |
| 4 | | | SMEC temperature drive+ |
| 11 | | | SMEC temperature sense+ |
| 12 | | | SMEC temperature sense- |
| 5 | | | SMEC temperature drive- |
| 13 | | | SMEC temperature shield |
| 6 | | | SMEC/SOB I/F temperature drive+ |
| 14 | | | SMEC/SOB I/F temperature sense+ |
| 15 | | | SMEC/SOB I/F temperature sense- |
| 7 | | | SMEC/SOB I/F temperature drive- |
| 8 | | | SMEC/SOB I/F temperature shield |

Unit : FCU
Sub-unit/Module : SCU/TEMP (Main)
Connector Identifier : J23
Connector Type : DDMA50S
Connector Name : HSFCU_J23

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | Evaporator temperature drive+ |
| 2 | | | Evaporator temperature drive- |
| 18 | | | Evaporator temperature sense+ |
| 35 | | | Evaporator temperature sense- |
| 34 | | | Evaporator temperature shield |
| 3 | | | Sorption Pump temperature drive+ |
| 19 | | | Sorption Pump temperature drive- |
| 20 | | | Sorption Pump temperature sense+ |
| 36 | | | Sorption Pump temperature sense- |
| 4 | | | Sorption Pump HS temperature drive+ |
| 5 | | | Sorption Pump HS temperature drive- |
| 21 | | | Sorption Pump HS temperature sense+ |
| 37 | | | Sorption Pump HS temperature sense- |
| 38 | | | Cooler temperature probe shields |
| 6 | | | Evaporator HS temperature drive+ |
| 22 | | | Evaporator HS temperature drive- |
| 23 | | | Evaporator HS temperature sense+ |
| 39 | | | Evaporator HS temperature sense- |
| 7 | | | Thermal Shunt temperature drive+ |
| 8 | | | Thermal Shunt temperature drive- |
| 24 | | | Thermal Shunt temperature sense+ |
| 40 | | | Thermal Shunt temperature sense- |
| 41 | | | FPU Faraday Shield Link |
| 9 | | | SOB temperature drive+ |
| 25 | | | SOB temperature drive- |
| 26 | | | SOB temperature sense+ |
| 42 | | | SOB temperature sense- |
| 43 | | | SOB & Spect. Det. Box probe shields |
| 10 | | | Spect. Det. Box temperature drive+ |
| 11 | | | Spect. Det. Box temperature drive- |
| 27 | | | Spect. Det. Box temperature sense+ |
| 44 | | | Spect. Det. Box temperature sense- |
| 12 | | | Phot. Det. Box temperature drive+ |
| 28 | | | Phot. Det. Box temperature drive- |
| 29 | | | Phot. Det. Box temperature sense+ |
| 45 | | | Phot. Det. Box temperature sense- |
| 46 | | | Phot. Det. Box & Opt. S/bench shields |
| 13 | | | Optical Sub-bench temperature drive+ |
| 14 | | | Optical Sub-bench temperature drive- |
| 30 | | | Optical Sub-bench temperature sense+ |
| 47 | | | Optical Sub-bench temperature sense- |
| 15 | | | FPU Input Baffle temperature drive+ |

| | | | |
|---|---|---|---|
| 31 | | | FPU Input Baffle temperature drive |
| 32 | | | FPU Input Baffle temperature sense+ |
| 48 | | | FPU Input Baffle temperature sense- |
| 49 | | | FPU i/p baffle & BSM/SOB I/F shields |
| 16 | | | BSM/SOB I/F temperature drive+ |
| 17 | | | BSM/SOB I/F temperature drive- |
| 33 | | | BSM/SOB I/F temperature sense+ |
| 50 | | | BSM/SOB I/F temperature sense- |

Unit : FCU
Sub-unit/Module : SCU/TEMP (Main)
Connector Identifier : J25
Connector Type : DAMA15S
Connector Name : HSFCU_J25

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | Spect. Stim. Flange temperature drive+ |
| 9 | | | Spect. Stim. Flange temperature drive- |
| 2 | | | Spect. Stim. Flange temperature sense+ |
| 10 | | | Spect. Stim. Flange temperature sense- |
| 3 | | | Spect. Stim. Flange shield |
| 4 | | | HS Spect. Stim. 4% temperature drive+ |
| 11 | | | HS Spect. Stim. 4% temperature drive- |
| 5 | | | HS Spect. Stim. 4% temperature sense+ |
| 12 | | | HS Spect. Stim. 4% temperature sense- |
| 13 | | | HS Spect. Stim. 4% shield |
| 6 | | | HS Spect. Stim. 2% temperature drive+ |
| 14 | | | HS Spect. Stim. 2% temperature drive- |
| 7 | | | HS Spect. Stim. 2% temperature sense+ |
| 15 | | | HS Spect. Stim. 2% temperature sense- |
| 13 | | | HS Spect. Stim. 2% shield |

Unit : FCU
Sub-unit/Module : SCU/TEMP (Redundant)
Connector Identifier : J22
Connector Type : DAMA15S
Connector Name : HSFCU_J22

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | BSM temperature drive+ |
| 9 | | | BSM temperature sense+ |
| 10 | | | BSM temperature sense- |
| 2 | | | BSM temperature drive- |
| 3 | | | BSM temperature shield |
| 4 | | | SMEC temperature drive+ |
| 11 | | | SMEC temperature sense+ |
| 12 | | | SMEC temperature sense- |
| 5 | | | SMEC temperature drive- |
| 13 | | | SMEC temperature shield |
| 6 | | | SMEC/SOB I/F temperature drive+ |
| 14 | | | SMEC/SOB I/F temperature sense+ |
| 15 | | | SMEC/SOB I/F temperature sense- |
| 7 | | | SMEC/SOB I/F temperature drive- |
| 8 | | | SMEC/SOB I/F temperature shield |

Unit : FCU
Sub-unit/Module : SCU/TEMP (Redundant)
Connector Identifier : J24
Connector Type : DDMA50S
Connector Name : HSFCU_J24

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | Evaporator temperature drive+ |
| 2 | | | Evaporator temperature drive- |
| 18 | | | Evaporator temperature sense+ |
| 35 | | | Evaporator temperature sense- |
| 34 | | | Evaporator temperature shield |
| 3 | | | Sorption Pump temperature drive+ |
| 19 | | | Sorption Pump temperature drive- |
| 20 | | | Sorption Pump temperature sense+ |
| 36 | | | Sorption Pump temperature sense- |
| 4 | | | Sorption Pump HS temperature drive+ |
| 5 | | | Sorption Pump HS temperature drive- |
| 21 | | | Sorption Pump HS temperature sense+ |
| 37 | | | Sorption Pump HS temperature sense- |
| 38 | | | Cooler temperature probe shields |
| 6 | | | Evaporator HS temperature drive+ |
| 22 | | | Evaporator HS temperature drive- |
| 23 | | | Evaporator HS temperature sense+ |
| 39 | | | Evaporator HS temperature sense- |
| 7 | | | Thermal Shunt temperature drive+ |
| 8 | | | Thermal Shunt temperature drive- |
| 24 | | | Thermal Shunt temperature sense+ |
| 40 | | | Thermal Shunt temperature sense- |
| 41 | | | FPU Faraday Shield Link |
| 9 | | | SOB temperature drive+ |
| 25 | | | SOB temperature drive- |
| 26 | | | SOB temperature sense+ |
| 42 | | | SOB temperature sense- |
| 43 | | | SOB & Spect. Det. Box probe shields |
| 10 | | | Spect. Det. Box temperature drive+ |
| 11 | | | Spect. Det. Box temperature drive- |
| 27 | | | Spect. Det. Box temperature sense+ |
| 44 | | | Spect. Det. Box temperature sense- |
| 12 | | | Phot. Det. Box temperature drive+ |
| 28 | | | Phot. Det. Box temperature drive- |
| 29 | | | Phot. Det. Box temperature sense+ |
| 45 | | | Phot. Det. Box temperature sense- |
| 46 | | | Phot. Det. Box & Opt. S/bench shields |
| 13 | | | Optical Sub-bench temperature drive+ |
| 14 | | | Optical Sub-bench temperature drive- |
| 30 | | | Optical Sub-bench temperature sense+ |
| 47 | | | Optical Sub-bench temperature sense- |
| 15 | | | FPU Input Baffle temperature drive+ |

| | | | |
|---|---|---|---|
| 31 | | | FPU Input Baffle temperature drive |
| 32 | | | FPU Input Baffle temperature sense+ |
| 48 | | | FPU Input Baffle temperature sense- |
| 49 | | | FPU i/p baffle & BSM/SOB I/F shields |
| 16 | | | BSM/SOB I/F temperature drive+ |
| 17 | | | BSM/SOB I/F temperature drive- |
| 33 | | | BSM/SOB I/F temperature sense+ |
| 50 | | | BSM/SOB I/F temperature sense- |

Unit : FCU
Sub-unit/Module : SCU/TEMP (Redundant)
Connector Identifier : J26
Connector Type : DAMA15S
Connector Name : HSFCU_J26

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | Spect. Stim. Flange temperature drive+ |
| 9 | | | Spect. Stim. Flange temperature drive- |
| 2 | | | Spect. Stim. Flange temperature sense+ |
| 10 | | | Spect. Stim. Flange temperature sense- |
| 3 | | | Spect. Stim. Flange shield |
| 4 | | | HS Spect. Stim. 4% temperature drive+ |
| 11 | | | HS Spect. Stim. 4% temperature drive- |
| 5 | | | HS Spect. Stim. 4% temperature sense+ |
| 12 | | | HS Spect. Stim. 4% temperature sense- |
| 13 | | | HS Spect. Stim. 4% shield |
| 6 | | | HS Spect. Stim. 2% temperature drive+ |
| 14 | | | HS Spect. Stim. 2% temperature drive- |
| 7 | | | HS Spect. Stim. 2% temperature sense+ |
| 15 | | | HS Spect. Stim. 2% temperature sense- |
| 13 | | | HS Spect. Stim. 2% shield |

#### *6.4.3.3.2. CCHK_IF Module*

Unit : FCU
Sub-unit/Module : SCU/CCHK (Main)
Connector Identifier : J11
Connector Type : DBMA25S
Connector Name : HSFCU_J11

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | Sorption Pump heater I+_A |
| 2 | | | Sorption Pump heater I+_B |
| 14 | | | Sorption Pump heater I-_A |
| 15 | | | Sorption Pump heater I-_B |
| 3 | | | Sorption Pump Heat Switch heater I+_A |
| 4 | | | Sorption Pump Heat Switch heater I+_B |
| 16 | | | Sorption Pump Heat Switch heater I-_A |
| 17 | | | Sorption Pump Heat Switch heater I-_B |
| 5 | | | Evaporator Heat Switch heater I+_A |
| 6 | | | Evaporator Heat Switch heater I+_B |
| 18 | | | Evaporator Heat Switch heater I-_A |
| 19 | | | Evaporator Heat Switch heater I-_B |
| 7 | | | HS Spect. 4% heater I+_A |
| 8 | | | HS Spect. 4% heater I+_B |
| 20 | | | HS Spect. 4% heater I-_A |
| 21 | | | HS Spect. 4% heater I-_B |
| 9 | | | HS Spect. 2% heater I+_A |
| 10 | | | HS Spect. 2% heater I+_B |
| 22 | | | HS Spect. 2% heater I-_A |
| 23 | | | HS Spect. 2% heater I-_B |
| 11 | | | 300-mK Thermal Control Heater I+_A |
| 12 | | | 300-mK Thermal Control Heater I+_B |
| 24 | | | 300-mK Thermal Control Heater I-_A |
| 25 | | | 300-mK Thermal Control Heater I-_B |
| 13 | | | 300-mK Thermal Control Heater shield. |

Unit : FCU
Sub-unit/Module : SCU/CCHK (Main)
Connector Identifier : J13
Connector Type : DEMA9S
Connector Name : HSFCU_J13

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | |
| 2 | | | Photometer Point Stim. heater I+_A |
| 3 | | | Photometer Point Stim. heater I+_B |
| 4 | | | Screen |
| 5 | | | |
| 6 | | | |
| 7 | | | Photometer Point Stim. heater I-_A |
| 8 | | | Photometer Point Stim. heater I-_B |
| 9 | | | |

Unit : FCU
Sub-unit/Module : SCU/CCHK (Redundant)
Connector Identifier : J12
Connector Type : DBMA25S
Connector Name : HSFCU_J12

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | Sorption Pump heater I+_A |
| 2 | | | Sorption Pump heater I+_B |
| 14 | | | Sorption Pump heater I-_A |
| 15 | | | Sorption Pump heater I-_B |
| 3 | | | Sorption Pump Heat Switch heater I+_A |
| 4 | | | Sorption Pump Heat Switch heater I+_B |
| 16 | | | Sorption Pump Heat Switch heater I-_A |
| 17 | | | Sorption Pump Heat Switch heater I-_B |
| 5 | | | Evaporator Heat Switch heater I+_A |
| 6 | | | Evaporator Heat Switch heater I+_B |
| 18 | | | Evaporator Heat Switch heater I-_A |
| 19 | | | Evaporator Heat Switch heater I-_B |
| 7 | | | HS Spect. 4% heater I+_A |
| 8 | | | HS Spect. 4% heater I+_B |
| 20 | | | HS Spect. 4% heater I-_A |
| 21 | | | HS Spect. 4% heater I-_B |
| 9 | | | HS Spect. 2% heater I+_A |
| 10 | | | HS Spect. 2% heater I+_B |
| 22 | | | HS Spect. 2% heater I-_A |
| 23 | | | HS Spect. 2% heater I-_B |
| 11 | | | 300-mK Thermal Control Heater I+_A |
| 12 | | | 300-mK Thermal Control Heater I+_B |
| 24 | | | 300-mK Thermal Control Heater I-_A |
| 25 | | | 300-mK Thermal Control Heater I-_B |
| 13 | | | 300-mK Thermal Control Heater shld. |

Unit : FCU
Sub-unit/Module : SCU/CCHK (Redundant)
Connector Identifier : J14
Connector Type : DEMA9S
Connector Name : HSFCU_J14

| Pin# | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | | | |
| 2 | | | Photometer Point Stim. heater I+_A |
| 3 | | | Photometer Point Stim.heater I+_B |
| 4 | | | Screen |
| 5 | | | |
| 6 | | | |
| 7 | | | Photometer Point Stim.heater I-_A |
| 8 | | | Photometer Point Stim.heater I-_B |
| 9 | | | |

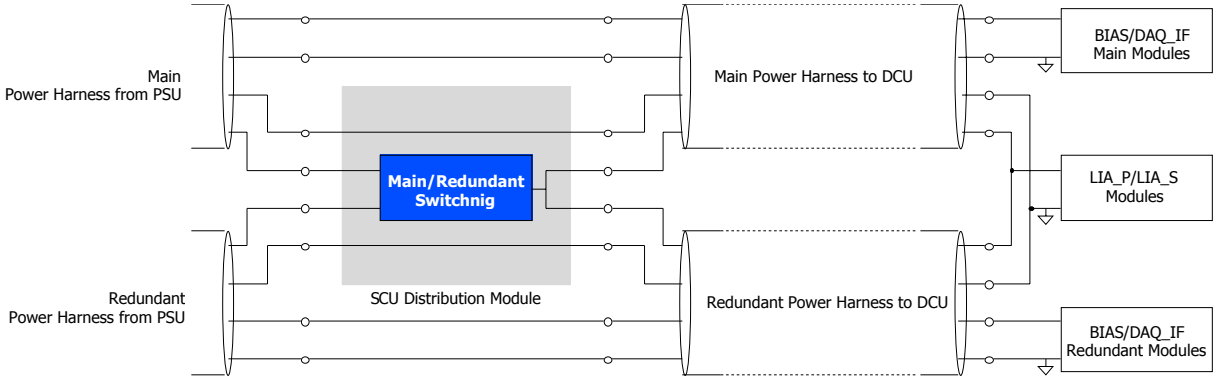
# 7. Grounding Scheme

# 8. Appendix – DRCU Sub-system interconnections

## *8.1. PSU to DCU interface*

This interface concerns exclusively secondary power lines distribution to the DCU electronics. This interface corresponds to the external routing of power lines from the distribution board to the DCU box. No other interface is identified between these to sub-systems.

### 8.1.1. Interface Description




### 8.1.2. Interface definition

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | LIA_P_P9V | 1 | |
| 2 | LIA_P_GND9V | 1 | |
| 3 | LIA_P_N9V | 1 | |
| 4 | LIA_S_P9V | 1 | |
| 5 | LIA_S_GND9V | 1 | |
| 6 | LIA_S_N9V | 1 | |
| 7 | PDAQ_P9V | 1 | |
| 8 | PDAQ_GND9V | 1 | |
| 9 | PDAQ_N9V | 1 | |
| 10 | PDAQ_P5V | 1 | |
| 11 | LIA_S_P5V | 1 | |
| 12 | LIA_P_P5V | 1 | |
| 13 | Chassis | 1 | |
| 14 | LIA_P_P9V | 1 | |
| 15 | LIA_P_GND9V | 1 | |
| 16 | LIA_P_N9V | 1 | |
| 17 | LIA_S_P9V | 1 | |
| 18 | LIA_S_GND9V | 1 | |
| 19 | LIA_S_N9V | 1 | |

| | | | |
|---|---|---|---|
| 20 | PDAQ_P9V | 1 | |
| 21 | PDAQ_GND9V | 1 | |
| 22 | PDAQ_N9V | 1 | |
| 23 | PDAQ_GND9V | 1 | |
| 24 | LIA_P_GND5V | 1 | |
| 25 | LIA_S_GND5V | 1 | |

## 8.2. PSU to MCU interface

This interface concerns exclusively secondary power lines distribution to the MCU electronics. This interface corresponds to the internal routing of power lines from the distribution board to the MCU back plane. No other interface is identified between these to sub-systems.

Unit : MCU (Main)
Sub-unit/Module :
Connector Identifier : J31
Connector Type : DBMA25P
Connector Name : HSFCU_J31

| Pin # | Function | Symbol | Remarks |
|---|---|---|---|
| 1 | +5 V prime | +5VdigP | |
| 2 | +5 V prime | +5VdigP | |
| 3 | +5 V prime | +5VdigP | |
| 4 | | | |
| 5 | + 13.5 V prime | +13VanalogP | |
| 6 | + 13.5 V prime | +13VanalogP | |
| 7 | - 13.5 V prime | -13VanalogP | |
| 8 | - 13.5 V prime | -13VanalogP | |
| 9 | | | |
| 10 | + 15 V prime | +15VmotP | |
| 11 | + 15 V prime | +15VmotP | |
| 12 | - 15 V prime | -15VmotP | |
| 13 | - 15 V prime | -15VmotP | |
| 14 | 0 V digital prime | 0VdigP | connected to 0VanalogP inside the MAC board |
| 15 | 0 V digital prime | 0VdigP | connected to 0VanalogP inside the MAC board |
| 16 | 0 V digital prime | 0VdigP | connected to 0VanalogP inside the MAC board |
| 17 | | | |
| 18 | 0 V analog prime | 0VanalogP | connected to 0VdigP inside the MAC board |
| 19 | 0 V analog prime | 0VanalogP | connected to 0VdigP inside the MAC board |
| 20 | 0 V analog prime | 0VanalogP | connected to 0VdigP inside the MAC board |
| 21 | 0 V analog prime | 0VanalogP | connected to 0VdigP inside the MAC board |
| 22 | | | |
| 23 | 0 V motor prime | 0VmotP | must be connected to 0VanalogP in the PSU |
| 24 | 0 V motor prime | 0VmotP | must be connected to 0VanalogP in the PSU |
| 25 | 0 V motor prime | 0VmotP | must be connected to 0VanalogP in the PSU |

Unit : MCU (redundant)
Sub-unit/Module :
Connector Identifier : J32
Connector Type : DBMA25P
Connector Name : HSFCU_J32

| Pin # | Function | Symbol | Remarks |
|---|---|---|---|
| 1 | +5 V prime | +5VdigP | |
| 2 | +5 V prime | +5VdigP | |
| 3 | +5 V prime | +5VdigP | |
| 4 | | | |
| 5 | + 13.5 V prime | +13VanalogP | |
| 6 | + 13.5 V prime | +13VanalogP | |
| 7 | - 13.5 V prime | -13VanalogP | |
| 8 | - 13.5 V prime | -13VanalogP | |
| 9 | | | |
| 10 | + 15 V prime | +15VmotP | |
| 11 | + 15 V prime | +15VmotP | |
| 12 | - 15 V prime | -15VmotP | |
| 13 | - 15 V prime | -15VmotP | |
| 14 | 0 V digital prime | 0VdigP | connected to 0VanalogP inside the MAC board |
| 15 | 0 V digital prime | 0VdigP | connected to 0VanalogP inside the MAC board |
| 16 | 0 V digital prime | 0VdigP | connected to 0VanalogP inside the MAC board |
| 17 | | | |
| 18 | 0 V analog prime | 0VanalogP | connected to 0VdigP inside the MAC board |
| 19 | 0 V analog prime | 0VanalogP | connected to 0VdigP inside the MAC board |
| 20 | 0 V analog prime | 0VanalogP | connected to 0VdigP inside the MAC board |
| 21 | 0 V analog prime | 0VanalogP | connected to 0VdigP inside the MAC board |
| 22 | | | |
| 23 | 0 V motor prime | 0VmotP | must be connected to 0VanalogP in the PSU |
| 24 | 0 V motor prime | 0VmotP | must be connected to 0VanalogP in the PSU |
| 25 | 0 V motor prime | 0VmotP | must be connected to 0VanalogP in the PSU |

## 8.3. PSU to SCU interface

This interface concerns exclusively secondary power lines distribution to the FCU electronics for distribution to all the relevant S/S. No other interface is identified between these to sub-systems.

Unit : SCU (main)
Sub-unit/Module :
Connector Identifier : J36
Connector Type : DAMA15P
Connector Name : HSFCU_J36

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | SCU_P5 | 1 | |
| 2 | SCU_P9 | 1 | |
| 3 | SCU_N9 | 1 | |
| 4 | | | |
| 5 | MCU_OnOff_Cmd | 2 | |
| 6 | | | |
| 7 | PSU_ThSens+ | 3 | |
| 8 | PSU_ThSens- | 3 | |
| 9 | SCU_P5_RTN | 1 | |
| 10 | SCU_9_RTN | 1 | |
| 11 | | | |
| 12 | LIAP_OnOff_Cmd | 2 | |
| 13 | LIAS_OnOff_Cmd | 2 | |
| 14 | | | |
| 15 | PSU_ThSens_Shield | 3 | |

Unit : SCU (redundant)
Sub-unit/Module :
Connector Identifier : J34
Connector Type : DAMA15P
Connector Name : HSFCU_J34

| Pin # | Signal Name | EMC Class | Signal Description |
|---|---|---|---|
| 1 | SCU_P5 | 1 | |
| 2 | SCU_P9 | 1 | |
| 3 | SCU_N9 | 1 | |
| 4 | | | |
| 5 | MCU_OnOff_Cmd | 2 | |
| 6 | | | |
| 7 | PSU_ThSens+ | 3 | |
| 8 | PSU_ThSens- | 3 | |

| | | | |
|---|---|---|---|
| 9 | SCU_P5_RTN | 1 | |
| 10 | SCU_9_RTN | 1 | |
| 11 | | | |
| 12 | LIAP_OnOff_Cmd | 2 | |
| 13 | LIAS_OnOff_Cmd | 2 | |
| 14 | | | |
| 15 | PSU_ThSens_Shield | 3 | |