ALCATEL SPACE

HERSCHEL PLANCK

REF. : HP-ASPI-MN-41

DATE 18/19/04/01 | PAGE : 1/12

COMPTE RENDU DE REUNION / *MINUTES OF MEETING*

LIEU / PLACE :

OBJET / PURPOSE : K.O. Instrument I/Face meeting (PACS + SPIRE) / Electrical splinter meeting.

CLASSIFICATION :

PARTICIPANTS ATTENDEES	SOCIETE FIRM	SIGNATURE SIGNATURE	PARTICIPANTS ATTENDEES	SOCIETE FIRM	SIGNATURE SIGNATURE
Bob Hibberd	Alcatel		Ken Kung	RAL	
Glenn Lund	Alcatel.				
Otto Bauer	MPE				
Albrecht Poglitsch	MPE				
Marco SIAS	ALENIA				
P. COUZIN	ALCATEL				
S. Thürey	ESA				
REDACTEUR / WRITTEN BY :	G. Lund				

CONCLUSION :

DISTRIBUTION : PARTICIPANTS / ATTENDEES

POUR ACTION : FOR FURTHER ACTION

POUR INFORMATION : FOR INFORMATION ASPI - SS Suillet, B Collaudin

APPROUVE PAR / APPROVED BY				
NOM / NAME				
SIGNATURE / SIGNATURE				

ALCATEL SPACE	HERSCHEL PLANCK	REF. :	
		DATE :	PAGE : 4/12
COMPTE RENDU DE REUNION / *MINUTES OF MEETING*		LIEU / PLACE :	

SUITE / CONTINUED : ALCATEL Presentation on attachment 1 ACTION

Pb related to ON failure of LCL : might be a problem for some units.
Solution can be to double the FET in LCL Cannot be done for all LCL's.
Experiment to define critical input lines w.r.t. LCL ON failure.

Distribution of clock + sync lines will be 1 NOM + 1 Red. Coming will be on S/C side.

ALCATEL strongly recommend to avoid the implementation of any concurrent protection at instrument level.

ALCATEL pointed out that the power budget does not seem consolidated (eg. large range of power figures provided for DPU/ICU). This impacts the LCL sizing as well as thermal analysis validity.

Power distribution electronics on spacecraft side will offer, for each line :
- status line monitoring
- current monitoring.

DC/DC converter synchronization

ALCATEL express their position :
- synchronization is not desirable from a spacecraft point of view.

ALCATEL SPACE

HERSCHEL PLANCK

REF. :

DATE : PAGE : 5/12

COMPTE RENDU DE REUNION / *MINUTES OF MEETING*

LIEU / PLACE :

SUITE / CONTINUED : ACTION

• should it be proved to be necessary, it is intended to distribute it through 1 nominal and 1 redundant

The last statement is considered as not acceptable by the instruments which baseline is not to distribute any such synchronization internally.
PACS state that, as far as they are concerned, synchronization of converters is not required.
ALCATEL position is to use RS422 (SpaceWire) type interface for synchronization signal distribution (if proved necessary). Transformers are considered both

- useless
- very constraining in terms of mass, power, volume on spacecraft side.

Temperature monitoring

PACS state that the requirement expressed in PID B for Temp. monitoring is not representing any instruments requirements. These are part of the spacecraft normal temperature monitoring or of the cryostat normal temperature monitoring (ASTRIUM task).

ALCATEL SPACE

HERSCHEL PLANCK

REF. :

DATE :

COMPTE RENDU DE REUNION / *MINUTES OF MEETING*

LIEU / PLACE :

SUITE / CONTINUED :

ACTION

Discrete telemetry :

PACS confirm that no discrete telemetry monitoring is required.

PACS presentation : (see Abbildung 2)

PACS have 4 x 2 (redundancy) power lines.

FPDEC 1, FPDEC 2 and FMEC share the same supply line.

Current average maximum consumption is 136 W. The figures are not considered to be fully mature. PACS have action to clarify this issue.

EMC: PACS strong assumption is that the whole spacecraft comprises one single "good" ground. PACS current implementation would be strongly impacted/compromised if it is not the case.

SPIRE (19/4/2001)

SPIRE confirm they need 4 power lines (2 Nom + 2 Red.). No latch down is needed.

Temperature monitoring:

Substitution is similar to PACS. SPIRE ~~[illegible]~~ request box temperature to be monitored. This will be performed by the spacecraft which will ask, via the IIDA the instrument to receive

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		DATE :	PAGE : 2/12
COMPTE RENDU DE REUNION / *MINUTES OF MEETING*		LIEU / PLACE :	

SUITE / CONTINUED :

ACTION

locations for the installation of a nominal and redundant thermistors.
The cryo temperature indicated in IID B to be monitored by the spacecraft will be acquired by the cryostat control Unit, and inserted in the spacecraft telemetry.

Timing measurement:

Generally both PACS and SPIRE do not require any timing synchronization beyond the 1553 capability.
PACS requests to receive the indication of the "on Target" together with the date/time. Accuracy in the delivery of this information could be in the order of seconds.

~~Connections:~~ Both PACS and SPIRE do not require to receive a high-accuracy 131 kHz signal for driving a local on-board time function.
SPIRE confirm DC/DC converters synchronization has been requested by them. They shall however provide some more information on the source of the requirement.

ALCATEL SPACE

LISTE D'ACTIONS / *ACTION ITEM LIST*

OBJET / *PURPOSE* :

REF. :

DATE :

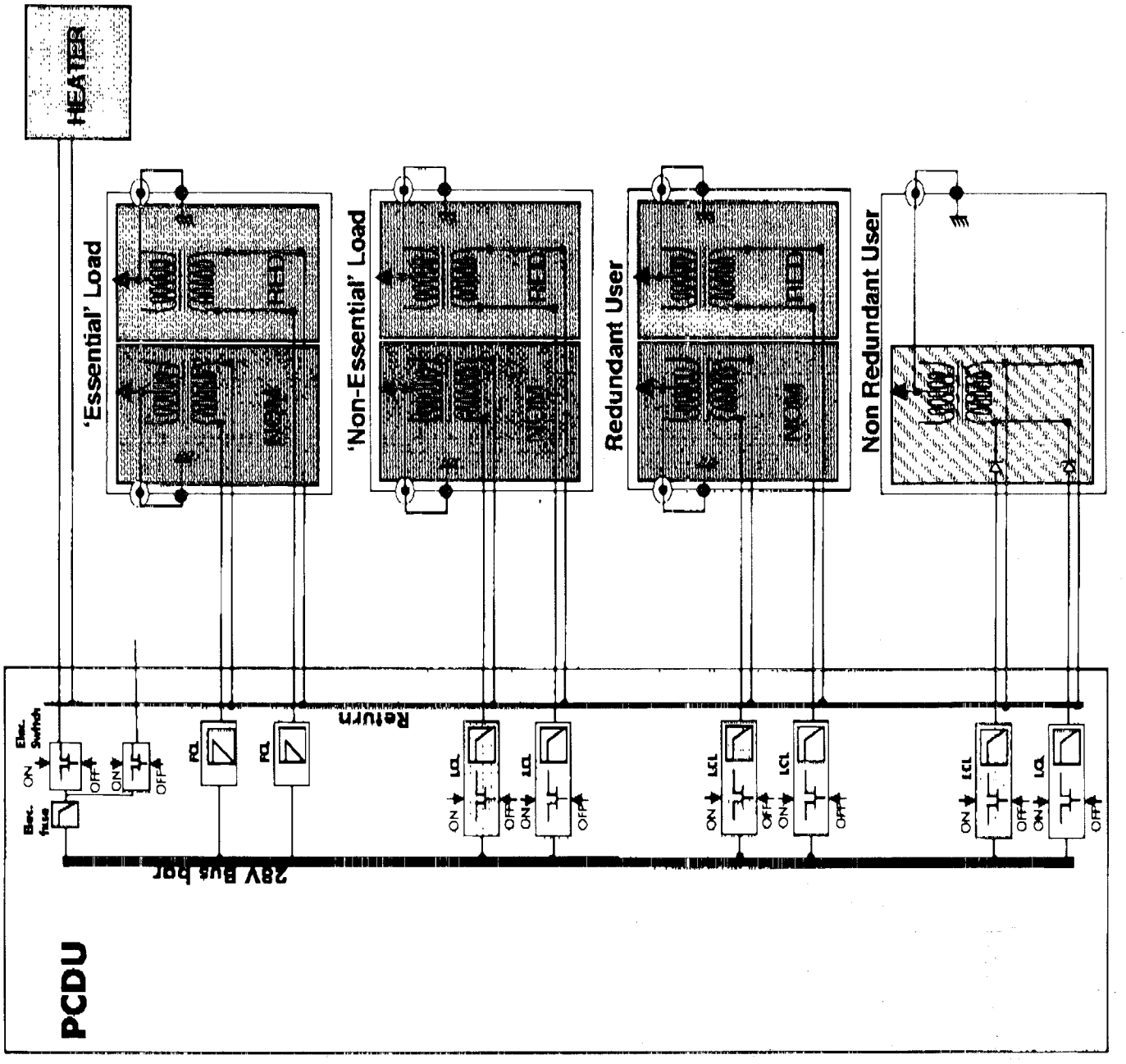
PAGE : 12/12

Origine	ACTION		DATE
	N°	Description	Responsable / *Responsible*	Echéance / *Due*

MOS2-1

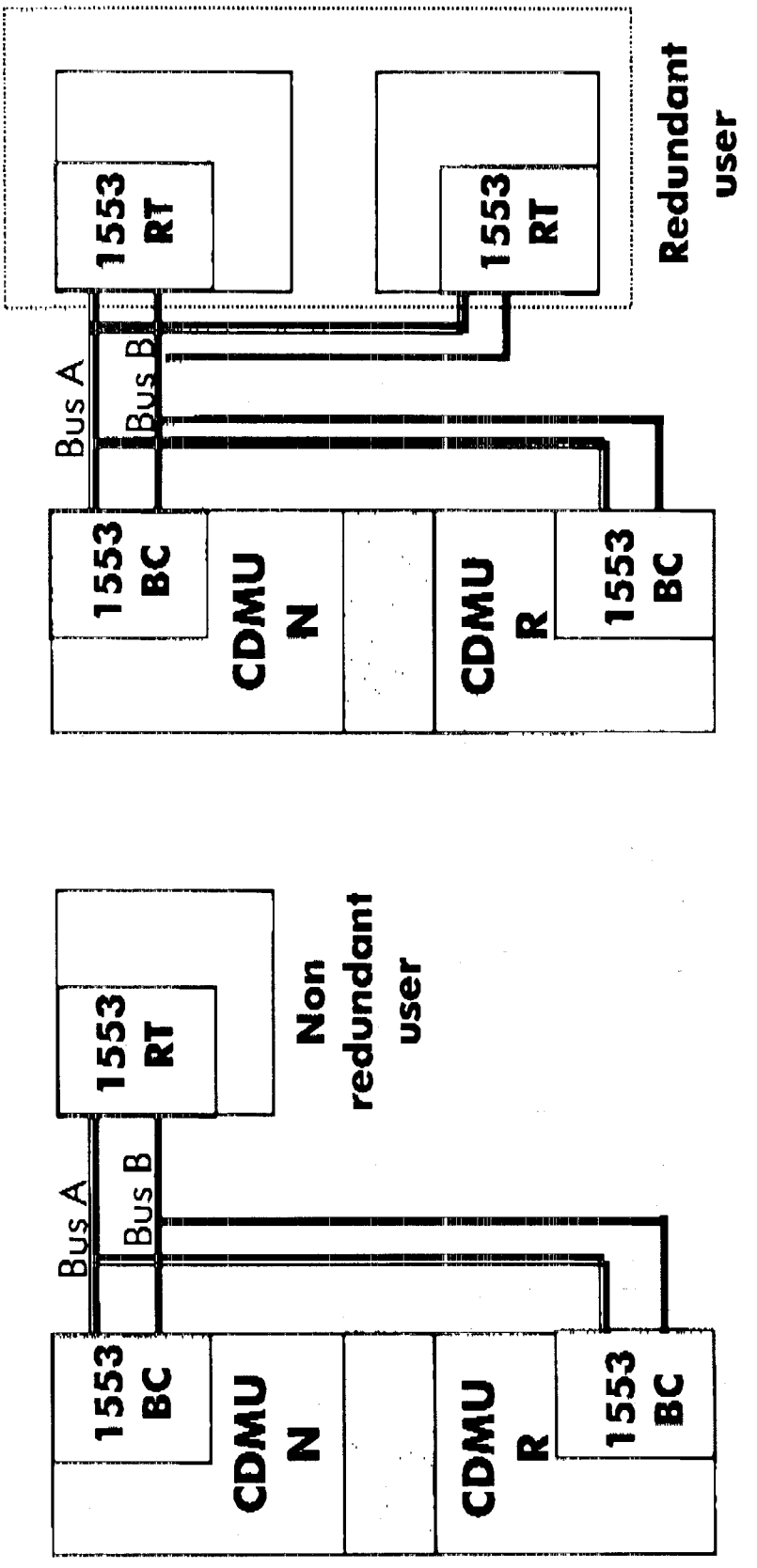
ATTACHMENT 1

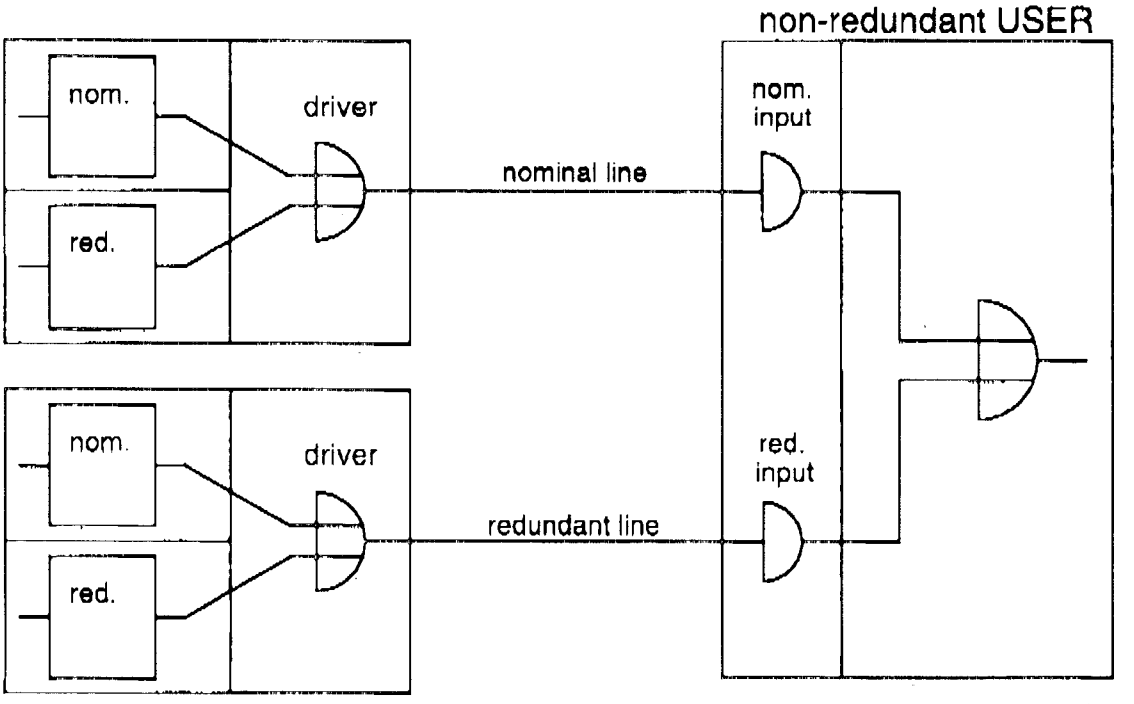
Herschel Planck Electrical Interfaces To the Instruments and within Instruments


HEATER
'Essential' Load
'Non-Essential' Load
Redundant User
Non Redundant User
Return
28V Bus bar
PCDU

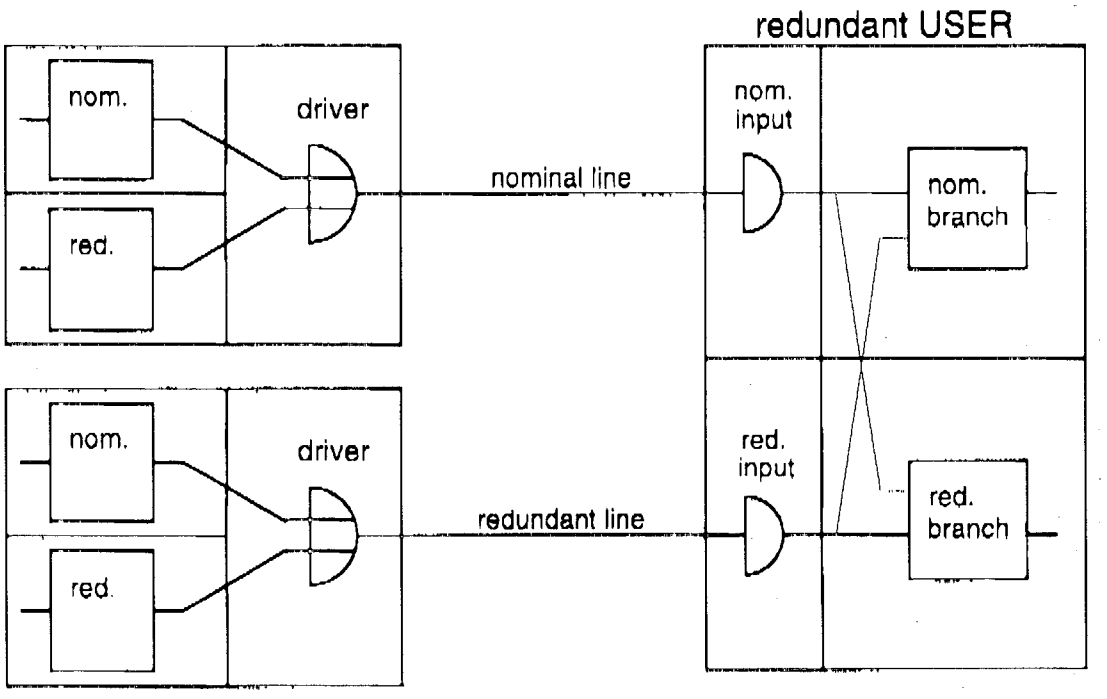
ALCATEL SPACE

1553 Bus connection principles





Commanding Schematic of Non-redundant User



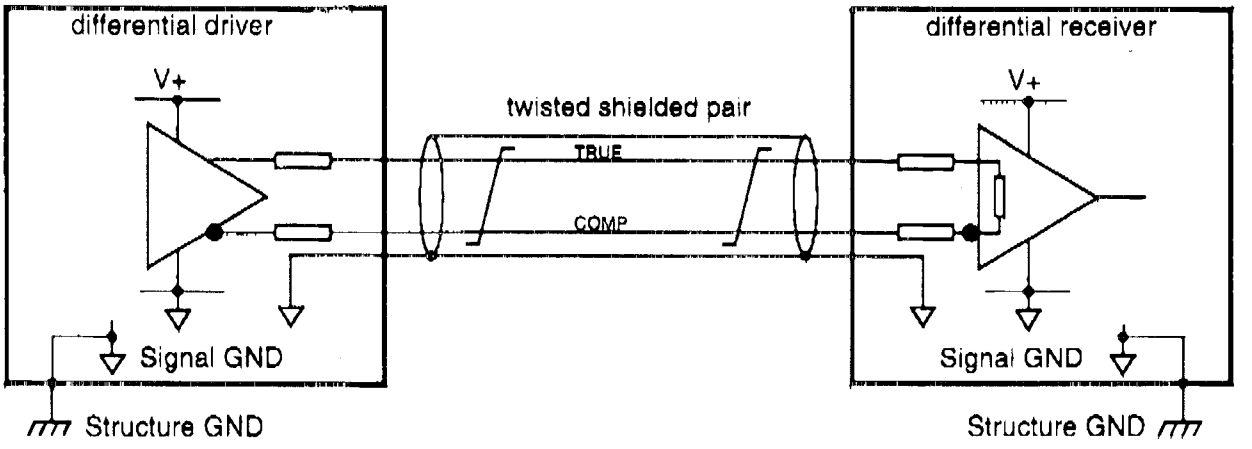
Commanding Schematic of Redundant User

Standard Balanced Digital Link (SBDL)

For all digital interfaces, the signals shall be sent on differential lines. The principle scheme is shown in the following figure.

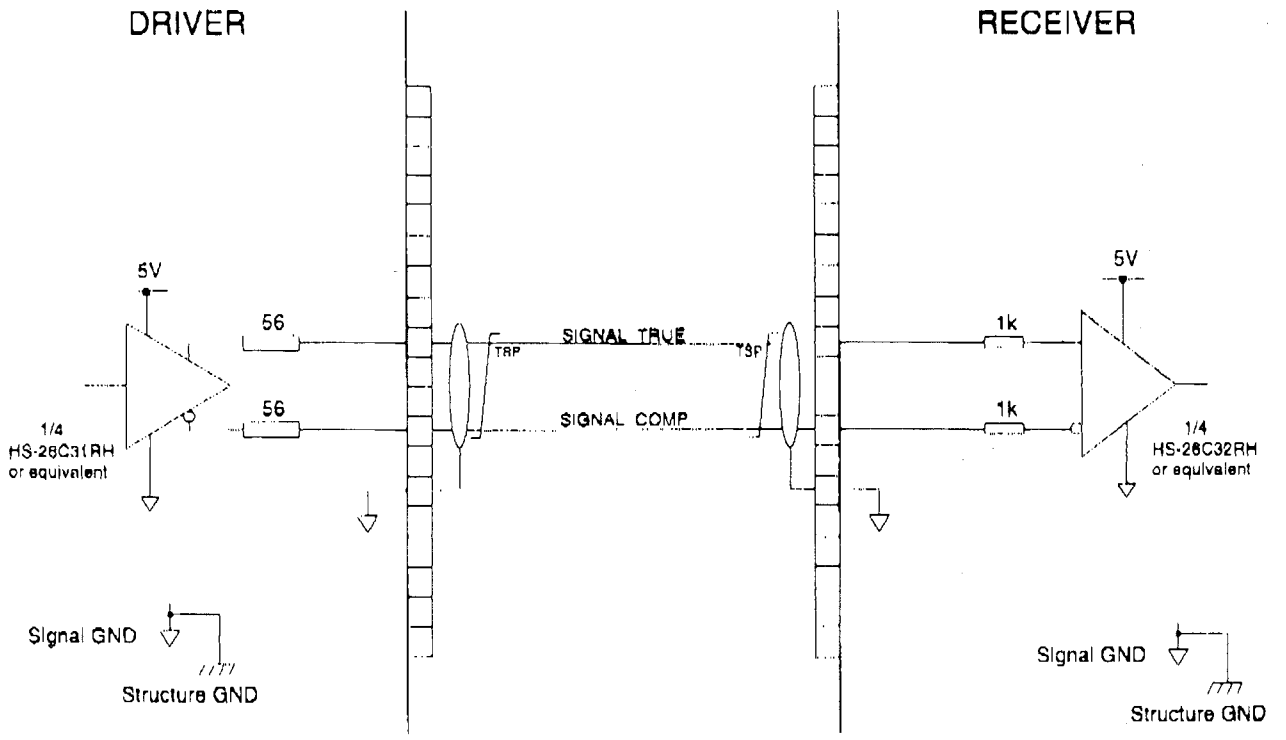
The link is symmetrical, the two lines shall be identified as 'true' and 'complementary' lines.

The 'quiescent' level on the 'true' line is high (5 V), the 'active' level is low (0 V), with the complementary levels on the inverting output.



SBDL Interface Circuits (principle drawing)

NOTES
1. The 'true' line is the non-inverting output of the driver ('TRUE')
2. The 'complementary' line is the inverting output of the driver ('COMP')



SBDL Interface Circuits

Sync. Signals Interface Characteristics:

INTERFACE DATA SHEET		
	Timing & Sync Signals	

This Interface Data Sheet covers the following lines:

- DC/DC Sync Clock
- Reference Star Pulse
- Broadcast Pulse

SOURCE CIRCUIT SPECIFICATION		
Circuit Type	balanced CMOS driver	
Transfer	DC coupled	
Zero Reference	signal ground	
Low Level Output Voltage	$0\ V \leq V_{OL} \leq 0.5\ V$	(1)
High Level Output Voltage	$2.5\ V \leq V_{OH} \leq 5.5\ V$	(1)
Differential Output Voltage	$2.0\ V \leq \lvert V_{OD} \rvert \leq 5.5\ V$	
Rise and Fall Times	$0.1\ \mu s \leq (tr, tf) \leq 1.0\ \mu s$	(2)
Current Drive and Sink Capability	sufficient to comply with specified tr & tf	(2)
Short Circuit	short circuit proof; current limited to <150 mA	
Max. Fault Voltage	Tolerance: -3 V to +TBD V Emission: -1 V to +TBD V	(3)

RECEIVER CIRCUIT SPECIFICATION		
Circuit Type	differential receiver, CMOS compatible	
Transfer	DC coupled	
Differential Input Voltage	Low : $V_{ID} \leq -1V$ High $V_{ID} \geq +1V$	
Common Mode Voltage	$-7.0\ V \leq V_{CM} \leq +7.0\ V$	
Diff. Input Impedance	DC: $\geq$ 5 kOhm	
Max. Fault Voltage	Tolerance: -3 V to +TBD V Emission: -2 V to +TBD V	(3)

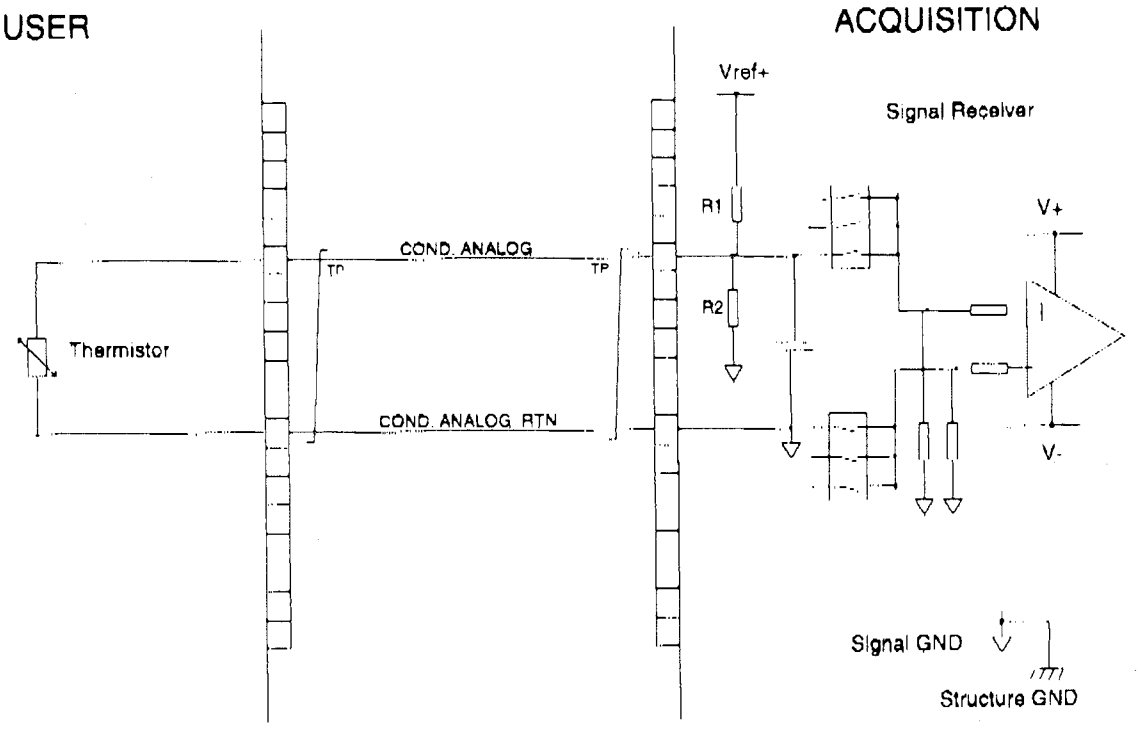
NOTES:
1. non-inverting (true) & inverting (comp) output with ref. to signal ground;
2. when loaded with differential 1.2 nF (harness & user input capacitance)
3. with an overvoltage source impedance of 1.5 kOhm

TIMING CHARACTERISTICS		
DC/DC Sync	Frequency:	125kHz < F < 150 kHz (4)
	Frequency Stability	± 1%
	Duty Cycle:	1:1 ± 5%
Reference Star Pulse	pulse width	TBD μsec
	jitter	< TBD μsec
Broadcast Pulse	Frequency	8Hz
	Frequency Stability	TBD
	pulse width	TBD μsec
	jitter	< TBD μsec
NOTES: 4. The nominal frequency will be established depending upon the clock generator selected within the data handling subsystem.		

3.6.5 Temperature Housekeeping Channels

General Concept

a) For acquisition of temperature HK values, the SVM shall be able to directly interface with the thermistors. These thermistors shall be powered by the SVM and the resulting voltage shall be utilised to feed a dedicated analogue channel.



Conditioned Analogue Interface and Schematic Circuitry

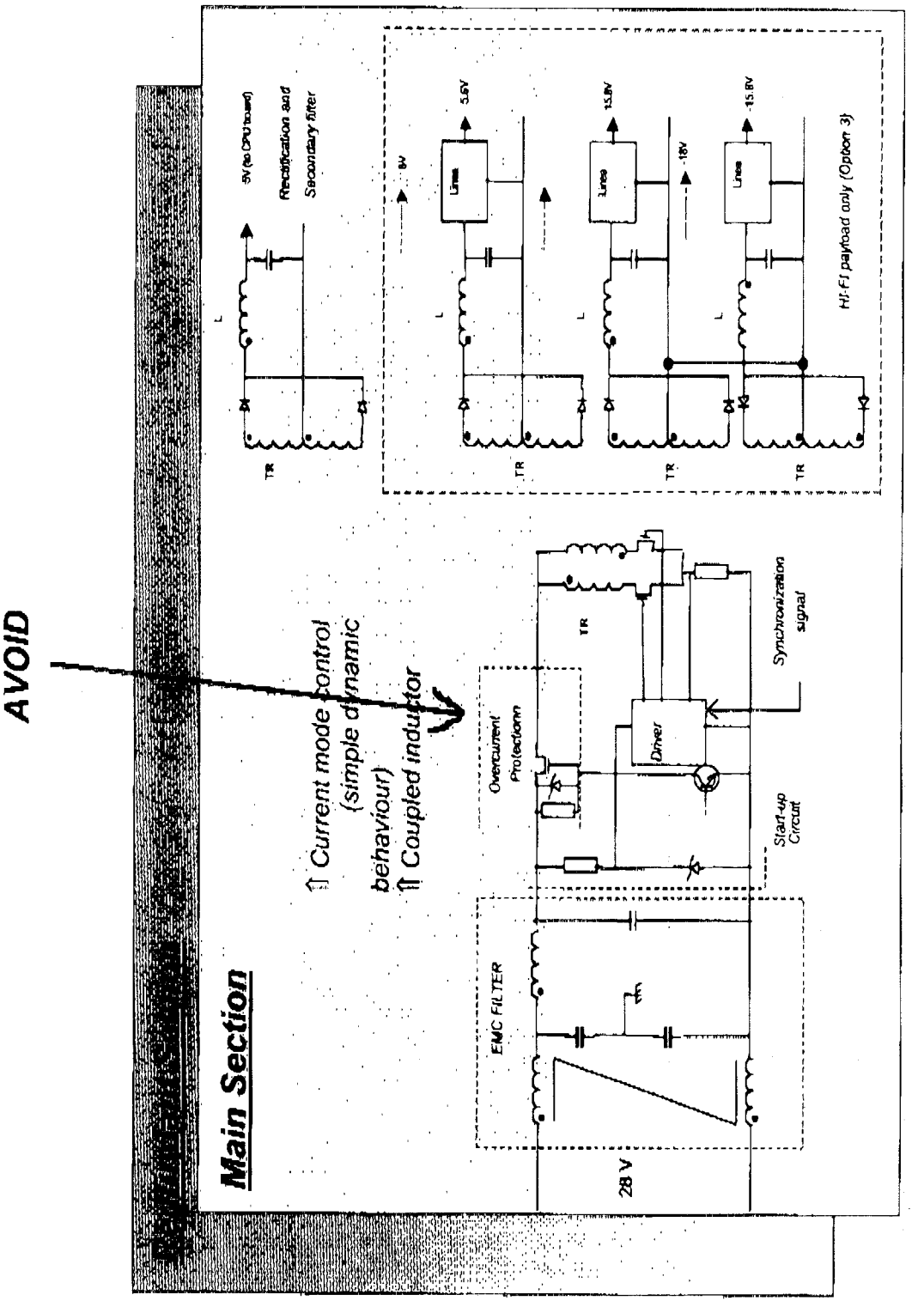
Thermistor Conditioning Interface Characteristics:

INTERFACE DATA SHEET		
	Conditioned Analog T/M	
SOURCE CIRCUIT SPECIFICATION		
Circuit Type Transfer	Thermistor DC coupled	
Thermistor Type	Type A: TBD Type B: TBD	
Operating Temperature Range	Type A: from TBD to TBD deg C Type B: from TBD to TBD deg C	
Max. Fault Voltage	Tolerance: -16.5 V to +16.5 V Emission: not applicable	(1)
RECEIVER CIRCUIT SPECIFICATION		
Circuit Type Transfer	conditioning circuitry DC coupled	
Calibration Resist.	Type A: R1 = TBD kOhm; R2 = TBD kOhm Type B: R1 = TBD kOhm; R2 = TBD kOhm	
Conditioning Module Supply Voltage	TBD V	
Overall Accuracy	< ± TBD %	
Max. Fault Voltage	Tolerance: -3 V to +14 V Emission: -15.8 V to +15.8 V	(1)
NOTES: 1. With an overvoltage source impedance of 1.5 kOhm		

POWER

GENERAL

GDIR-00xx:	The main bus switching protection and distribution is based on the fact that the power S/S provides a protected (current limited) main: o In case of redundant user, a non-redundant protection is provided for each redundant item. o In case of non-redundant user (e.g. experiment), a redundant protection is provided for the user.
GDIR-00xx:	Three types of current limitation shall be used: o ON/OFF switchable current limiters (LCL's) for 'non-essential' loads; i.e. items not always to be powered. o Permanent ON current limiters (FCL's) for 'essential' loads (receiver, decoder ...). o Sets of Electronic fuse + electronic switches (EF/ES) for resistive loads (heaters)
GDIR-00xx:	The responsibility of the secondary power is with the user. Power converter frequencies shall be selected outside the operating bandwidths of the experiments. A minimum set of stability requirements is applicable.
GDIR-00xx:	On user side overvoltage protection has to be performed.
GDIR-00xx:	The use of current protection circuits on the primary side of the user DC/DC converters shall be avoided. The PCDU LCL will provide all the required protection. If the protection circuits cannot be avoided then the protection threshold must be set lower than the PCDU LCL and tests must be performed with a representative PCDU as early as possible..


AVOID
Main Section
⇑ Current mode control (simple dynamic behaviour)
⇑ Coupled inductor
28 V
EMC FILTER
Overcurrent Protection
Driver
Start-up Circuit
Synchronization signal
TR
Rectification and Secondary filter
5V (to CPU board)
Lines
5.6V
15.8V
-15.8V
-18V
8V
Hi-Fi payload only (Option 3)

POWER

HERSCHEL

GENERAL

The ICU is used for all 3 Herschel instruments, yet the power budget allocated for this unit varies between 25W to 71W !

The switching, status and current telemetry of the power lines is performed within the PCDU. It is not necessary nor desirable to repeat these functions within each instrument.

It is possible that the PCDU LCL has a failure mode whereby it is permanently ON. Each instrument should evaluate this failure case and state if this is acceptable for the instrument considering functional, power, thermal aspects.

POWER

HERSCHEL SPIRE

Confirm that SPIRE needs a total of 4 +28V power lines:

- HPDU Nominal
- HPDU Redundant
- HCDMU Nominal
- HCDMU Redundant

POWER

HERSCHEL PACS

Confirm that PACS requests a total of 8 +28V power lines:

- FPDMC Nominal
- FPDMC Redundant
- FPDPU Nominal
- FPDPU Redundant
- FPSPU Nominal
- FPSPU Redundant
- FPBOLC Nominal
- FPBOLC Redundant

POWER

HERSCHEL HIFI

Confirm that HIFI needs a total of 10 +28V power lines:

- FHLCU Nominal
- FHLCU Redundant
- FHSCU Nominal
- FHSCU Redundant
- FHICU Nominal
- FHICU Redundant
- FHHRH
- FHHRV
- FHWBE-H
- FHWBE-V

TIMING & SYNCRONISATION SIGNALS

GENERAL

DC/DC Synchronization

ALCATEL baseline is to not synchronize any DC/DC converter.

If DC/DC synchronization is proved to be necessary :

- The 131kHz clock should be used only for DC/DC synchronization and not for synchronization of On Board time to Local On Board Time. The accuracy, jitter, for this DC/DC synchronization clock is not the same as for a time sync signal, in addition there may be failure cases for the 131kHz DC/DC clock such as multiple frequencies or uneven duty cycles.
- One Nominal + One Redundant 131kHz clock for DC/DC sync purposes will be provided for each instrument if required.
- Normally only 1 of these sync lines will be active.
- The instrument shall perform the routing and distribution of these sync lines to the various instrument units as required.
- The DC/DC sync line interface shall be a true differential signal, i.e. the signal return shall not use the ground line or chassis as a return. The user may use transformer or opto-couplers on their input interface.

OBT to LOBT Synchronization

The spacecraft time will be distributed via the 1553 Bus according to Packet Structure Interface Control Document SCI-PT-ICD-7527.

If a "hard" signal is required, then a 1Hz (TBC) Broadcast pulse which is synchronized to the On Board Time Master clock may be made available.

TIMING & SYNCRONISATION SIGNALS

GENERAL HERSCHEL

ALCATEL preferred solution is the distribution of the "Start of Scan" signal via 1553 messages.
If highly accurate "Start of Scan" timing is proved to be necessary:

- A "Start of Scan" signal (Nominal + Redundant) will be available to Herschel users.
- The "Start of Scan" signal will be distributed as a true differential signal, the ground line or chassis shall not be used as a return signal.

HERSCHEL SPIRE

131kHz DC/DC sync signal not required, yet the DPU is the same for the other two Herschel instruments which need this sync.

HERSCHEL PACS

8 DC/DC Sync signals are requested :

- DPU Nom
- DPU Red
- MEC1
- MEC2
- BOLC Nom
- BOLC Red
- SPU1
- SPU2

HERSCHEL HIFI

Seems that 10 DC/DC synces are required :

- LCU Nom
- LCU Red
- LSU Nom
- LSU Red
- ICU Nom
- ICU Red
- HRH
- HRV
- WBE-H
- WBV

DISCRETE TELEMETRY SIGNALS

GENERAL

The only discrete TM that has to be acquired directly by the SVM that have been identified are thermistor lines.

The type and number of thermistors have to be defined.

The acquisition range and accuracy have to be consolidated.

The redundancy concept for these thermistor lines has to be established.

DISCRETE TELEMETRY SIGNALS

HERSCHEL SPIRE

Number of thermistors identified as:

FPU range 1.5K to 90°C

Level 0 Strap to Cooler	2 Thermistors (1 Nom + 1Red) ?
Level 0 Strap to FSFPU enclosure	2 Thermistors (1 Nom + 1Red) ?
Level 1 Strap to FSFPU	2 Thermistors (1 Nom + 1Red) ?
Level 2 Strap to FSFTB	2 Thermistors (1 Nom + 1Red) ?
Optical bench at FSFPU Mech IF	2 Thermistors (1 Nom + 1Red) ?

DRC range -80 to 90°C

SVM at FSDRC Mechanical IF	2 Thermistors (1 Nom + 1Red) ?

DPU range -80 to 90°C

SVM at FSDPU Mechanical IF	2 Thermistors (1 Nom + 1Red) ?

IID-B Paragraph 5.11.2 States:

"The S/C should be capable of monitoring the following instrument parameters every TBD minutes and provide a data packet with the results.

Voltages to instruments
Currents to instruments
Power status – i.e. which SPIRE units are on i.e. FSDPU and FSDRC
Requested temperatures in Section 5.7.5.2 "

This implies that these TM are acquired via the 1553 bus. How can the status of the DPU be monitored via the bus if it is OFF (and so the 1553 interface will be OFF)?

DISCRETE TELEMETRY SIGNALS

HERSCHEL PACS

Number of thermistors identified as:

- FPFPU Quantity & Type & Range TBD
- FPDMC1 Quantity & Type & Range TBD
- FPDMC2 Quantity & Type & Range TBD

HERSCHEL HIFI

Number of thermistors identified as:

- FHLOU Quantity & Type TBD Range -210° to +100°C

1553 Busses

GENERAL

Each Instrument redundancy will be provided with a nominal 1553 bus and a redundant 1553 Bus.

HERSCHEL PACS
Electrical & Avionics Session

Matthias Rumitz

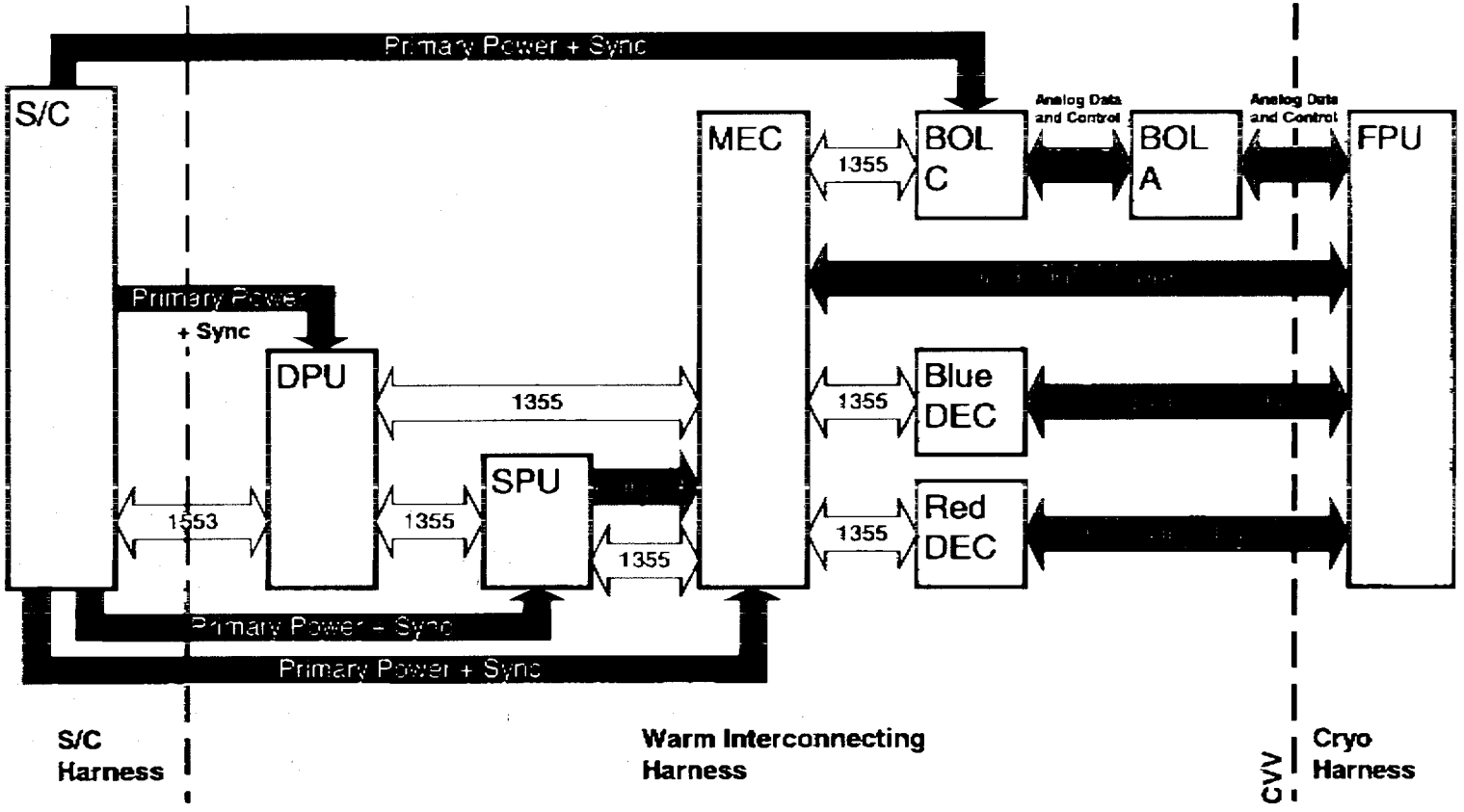
MPE, Garching

ATTACHMENT 2: PACS

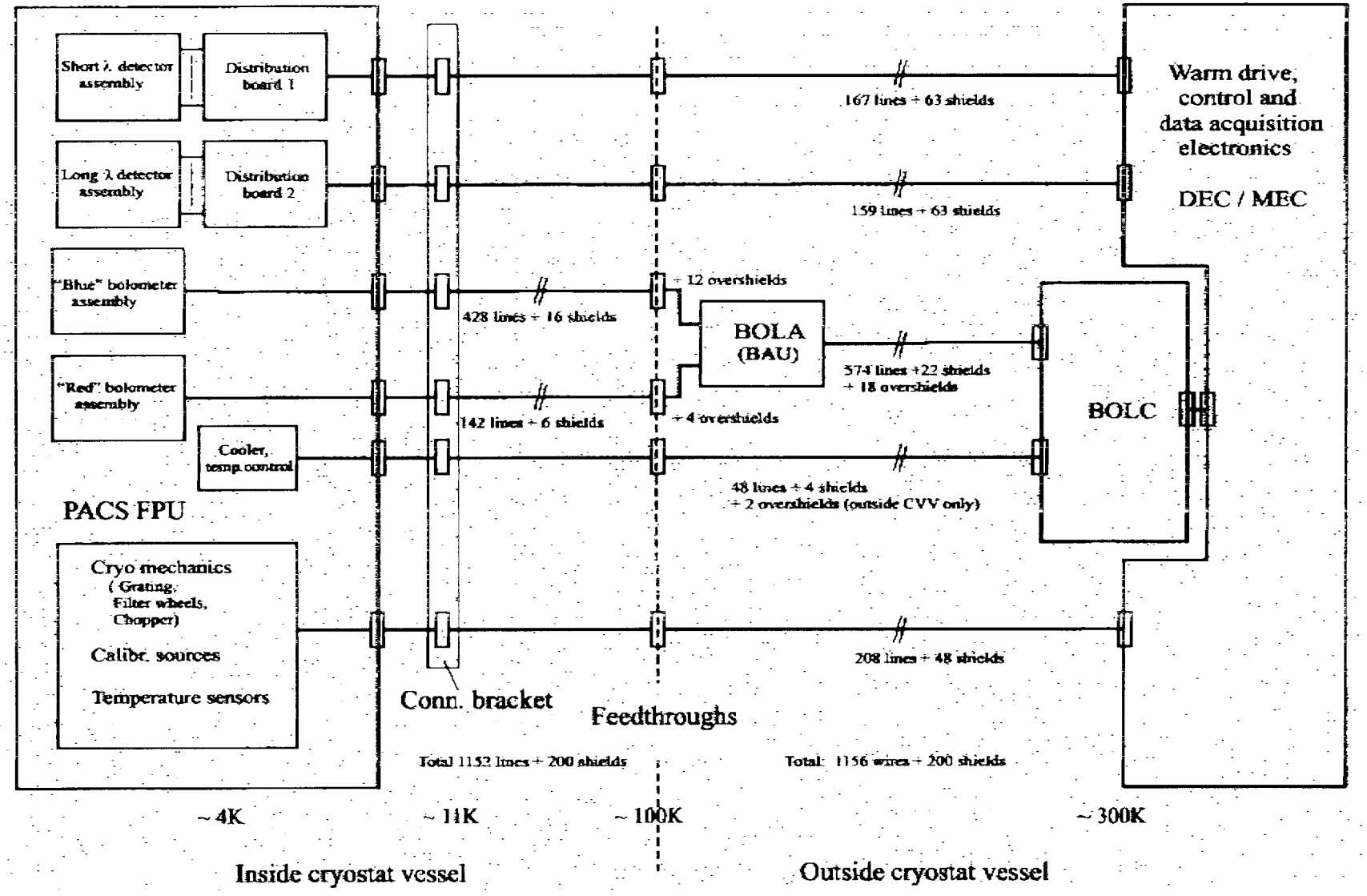
Topics of Electrical & Avionics Session

- Cryoharness
- Connectors
- 1553 Bus / Instrument Packets Definition
- Operability / Autonomy
- Power Interfaces
- TM / TC List
- T Sensors
- EMC
- EGSE
- ACMS / Pointing Calibration with PACS

Harness Overview



Cryoharness Overview



Cryoharness

- PACS Cryo Harness Specification
  PACS-MA-SP-001, Version 12/03/2001
- 95% complete
- Cables:
  - 5 ISO types
  - 7 ISO similar
  - 7 new types: brass, triaxial, twisted pairs
- Possible problems:
  - Parts selection / procurement
  - CRE wire reduction
  - Length / routing
  - BOLA status

Connectors

- PACS Cryo Harness Specification
  PACS-MA-SP-001, Version 12/03/2001
- FPU Connector and Harness Specification
  PACS-KT-SP-009
- Subsystem Specifications & ICDs
  S/C: DPU, Cryo-harness: BOLC/BOLA & DEC/MEC
- 99% complete (incl. pin allocations)
- Possible problems:
  - Infrared light-tight connectors at FPU
  - Grounding / shielding at CVV / FPU
  - Parts selection / procurement
  - BOLA status

1553 Bus / Instrument Packets Definition

- According applicable ESA documents

Operability / Autonomy

- Current work
- Overall autonomy function concept missing
- Points of interest:
  - PS-ICD / OIRD: "how to" communicate events / telecommands
    But "who" implements response logic in case of anomaly?
  - How far can the instruments rely on CDMS ?
    Sub-system/instrument switch-off vs. complex decision trees?

Power Budget Update

Project code	Instrument Unit	Power Dissipation (W)
FPDEC1	Detector Control 1	18
FPDEC2	Detector Control 2	18
FPMEC1	Mechanism Control 1	12
FPMEC2	Mechanism Control 2	(12)
FPBOLC	Bolometer/Cooler Contr	35
FPDPU	DPU	25
FPSPU	SPU	28
TOTAL on SVM		136
on CVV outside	BOLA	2.5

Power Interfaces

- According ESA guidelines & recommendations
  e.g. HIFI-U/MEMO/AN/2000-002
- Defined in subsystem specifications
- Overview in CM12WE02.ppt

TM / TC List

- Nominal TM rate extremely tight
  Increase to 120 ... 150 kbit/s (sience data rate) would help
- TM budget should be average over ~ hour
- Problem with OIRD requirement TC-10:
  Readouts of loaded on-board data or software parameters shall be requested via a dedicated telecommand and not via a multi-purpose software dump telecommand.
  For certain loaded tables (detector selection table, subsystem parameters table), software dump is currently the only working transfer mechanism. No suitable TM packet type available.
- DMC sequences do not fit into one single TC packet
  Solution: generic memory load (even from the MTL)
  This is in conflict with OIRD requirement TC-9.

T Sensors

- PACS-ME-ID-003 Temperature Sensors ICD
- FPU subsystem specifications:

PACS-ME-RS-001	Chopper Specification
PACS-ME-RS-003	Black Body and Filter Wheel Requ. Spec.
PACS-ME-RS-009	PACS Grating Assembly Requ. Spec.
PACS-MA-ID-002	PACS Ge Detector Electrical ICD
SAp-PACS-CCa-25-00	BOLC/BOLA Subsystem Specifications

EMC

- According applicable ESA documents
- Exceptions:

5.14.2.6	Intermediate spare pins left unconnected
5.14.2.8	Not applicable
5.14.2.10	Grounding of outer and inner shields
9.5.6	W/E tests with outer shields connected

- Additional:

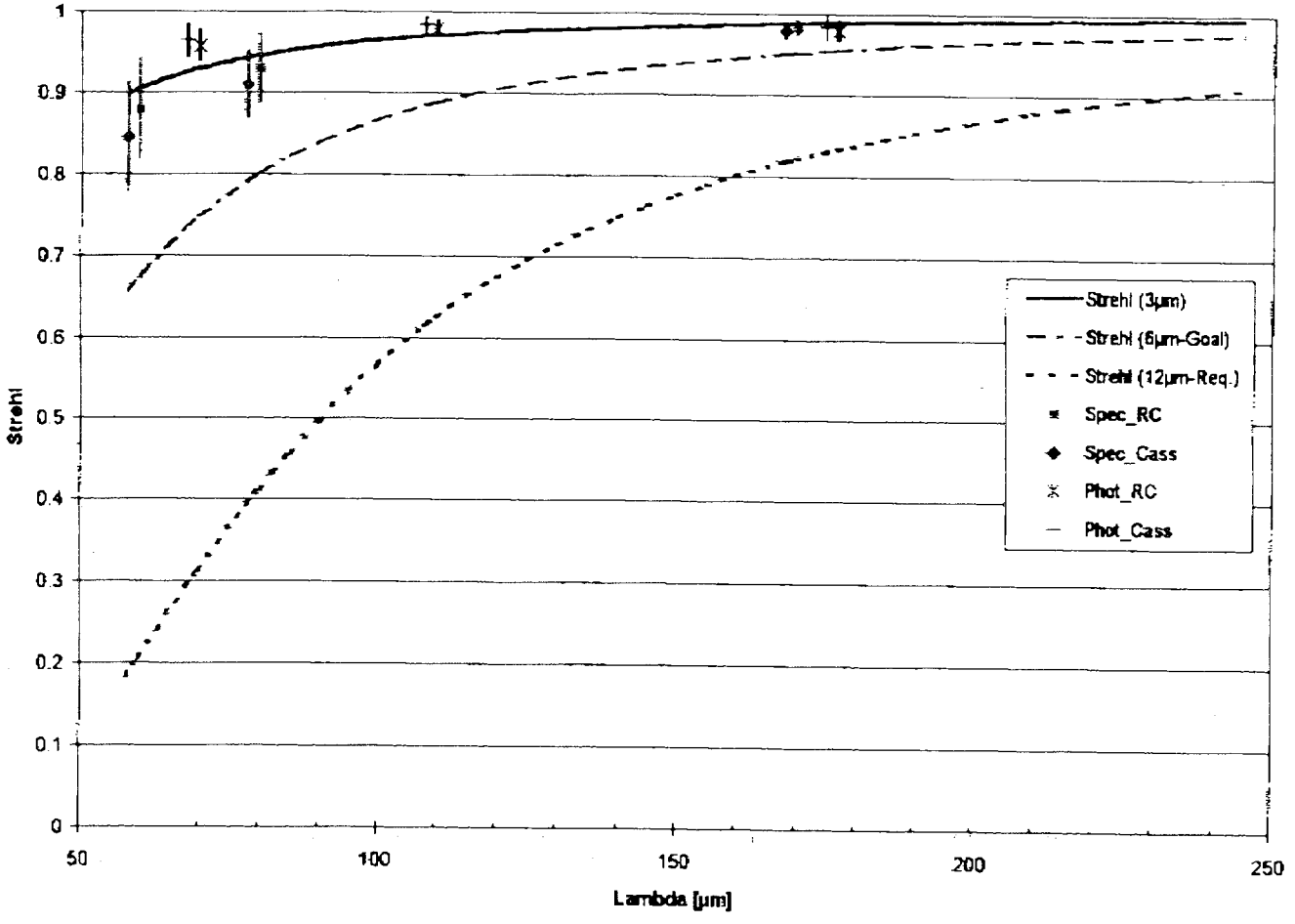
W/E harness between boxes < 1m
FPDEC & FPBOLC filters at DC/DC secondary side
Minimize coupling capacitance of DC/DC transformer
Grounded overall shields wherever possible
Detector housings & W/E boxes connected to S/C structure

EGSE

- See presentation by O.Bauer

ACMS / Pointing Calibration with PACS

- Integration time ~ (Strehl)$^{-2}$



Additional Information

- CM12\CM12WE02.ppt
- FMECA\PACS-GrndEMCRed.ppt
- FMECA\PACS-RelA.ppt
- Sub-system Specifications
- Sub-system ICDs
- IIDR