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# SPACELAB

# PAYLOAD ACCOMMODATION HANDBOOK

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## APPENDIX A

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UNCONTROLLED DOCUMENT

SLP/2104-1
ISSUE No.: 1
DATE: JULY 1978

EUROPEAN SPACE AGENCY

# SPACELAB

# PAYLOAD ACCOMMODATION HANDBOOK

## APPENDIX A – AVIONICS INTERFACE DEFINITION

ISSUE No.: 1

DATE : 31 JULY 1978

This document is under configuration control within the Spacelab Project (ESA/NASA level II) and it is maintained to ensure proper reflection of the Spacelab side of standard Spacelab/Experiment interfaces.
However, no liability is assumed for any consequences resulting from incorrect or incomplete data in this document or from misinterpretation of these data. The same applies to future changes which will be incorporated in this document.

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# ERRATA TO SPAH APPENDIX A, ISSUE 1, REVISION 0

During printing the following errors and shortcomings have been identified. They are listed below and should be considered as advanced information which is contingent upon formal approval.

(1) p. A3-1, sect. 3.1

Experimenter may only interface directly with free EPDB outputs if it is ensured that the power on/cooling off monitoring in experiment racks is not invalidated (see also sect. 3.2).

(2) p. A3-30, table 3.6-1

P 01 : Exp. RAU supply is no experimenter interface
max. current is 10 A

P 02 : Exp. RAU supply is no experiment interface,
max. current is 10 A

All connectors contacts not identified in this table are spare contacts.

(3) p. A3-33 to A3-38, sect. 3.7

CB 18, CB 26, CB 28 are under re-evaluation because of potential interference of the standard experiment power interface with subsystem power busses which are on the same connectors.

(4) p. 4.1-3, table 4.1-3

Due to pin/socket alignment problems it is under investigation to replace the GWSW plugs (last column of table) by Hughes HAC PAC plugs, MIL-C-28804/4.

(5) p. 4.1-13, table 4.1-6

Should read : Overall accuracy : 0.6 % of full scale (assuming ± 6 V common mode voltage)

(6) p. 4.1-17,table 4.1.-7

| Should read | RAU : | Experiment : |
|---|---|---|
| | Fault current: 50 mA max | Fault current protection: 50 mA min |

(7) p. 4.1-31, table 4.1-12

Should read :

| RAU : | Experiment: |
|---|---|
| Fault voltage and current emission ± 15V, ± 15 mA | Output protection ± 15V, ± 15 mA |
| Input overvoltage protection : ± 10 V (not ±10mA) | Fault voltage emission ± 10V |

(8) p. 4.2-6, table 4.2-3

Should read :

Experiment line driver :

Output overvoltage protection

line to ground ± 10V

line to line ± 10V

Differential output voltage

line to line $\geq$ 0.8 V, $\leq$ 2V

(9) p. 4.2-7

Experiment clock requirement for duty cycles error should read

| HRM input | Experiment output |
|---|---|
| Clock duty cycle (incl. asymmetry and gitter): Direct access channels* 50%±6% Experiment channels 50%±15% | Clock duty cycle (incl. asymmetry and gitter): Direct access channels 50%±5% Experiment channels 50%±10% |

* Direct access channels have no clock regeneration. Input specification is driven by KUSP interface requirement.

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# APPENDIX A

## AVIONICS INTERFACE DEFINITION

### 1. SCOPE

The Avionics Interface Definition presents the Spacelab side of the electrical interface between Spacelab subsystem equipment and experiments.

This document

- defines the electrical hardware which interfaces with the experiments.
- states the signal/load characteristics.

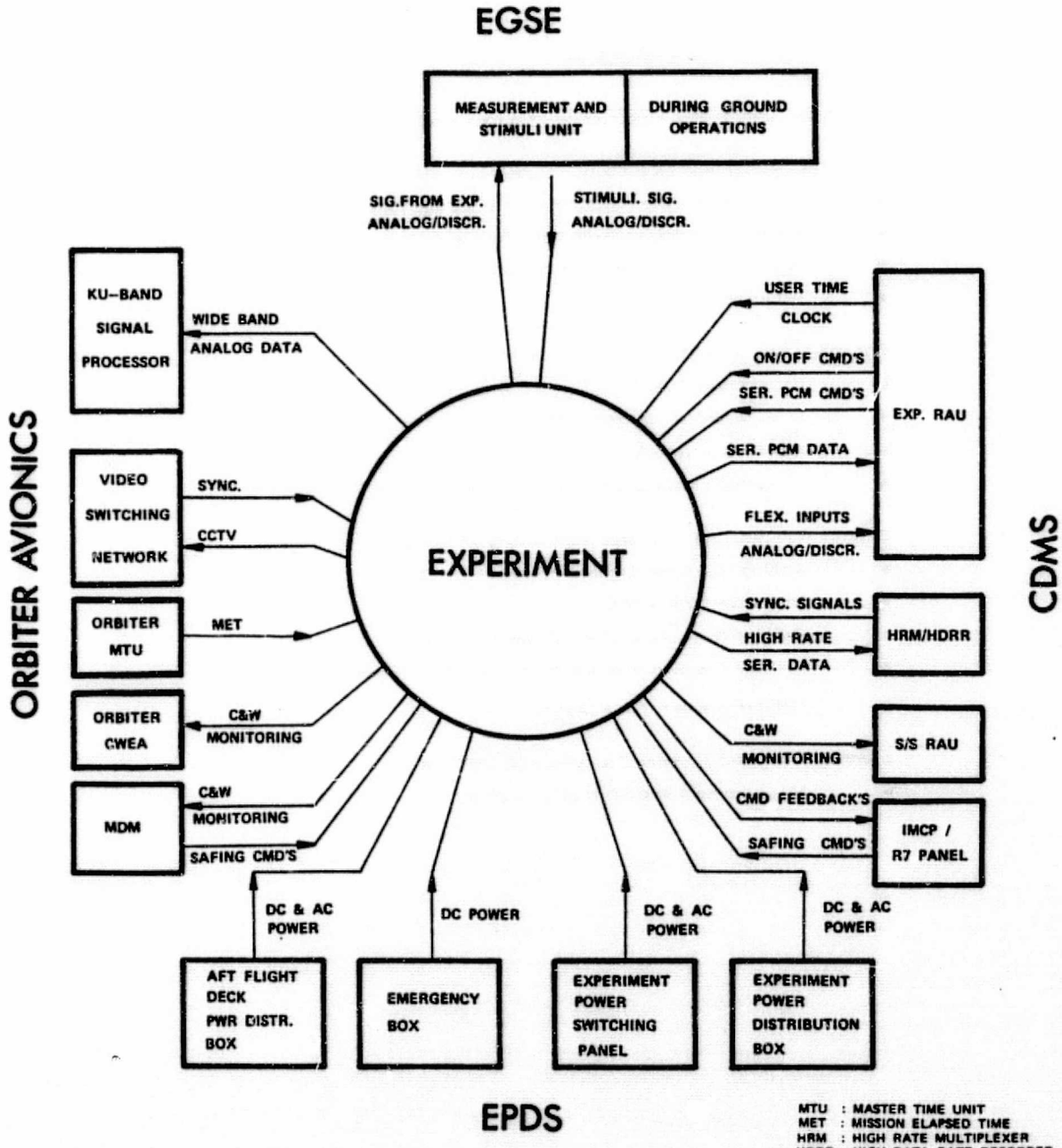
The Avionics Interface Definition is a controlled document. Changes will be communicated by the issue of revision pages.

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2. CONTENTS OF THE DOCUMENT

The experiment may directly interface electrically with four major subsystems (as depicted in Figure 2 - 1).

- Electrical Power and Distribution Subsystem (EPDS) via
  - Experiment Power Distribution Boxes (EPDB's)
  - Experiment Power Switching Panels (EPSP's)
  - Aft Flight Deck Power Distribution Box (AFD PDB)
  - Emergency Box (EB)
- Command and Data Management Subsystem (CDMS) via
  - Experiment RAU's
  - High Rate Multiplexer (HRM)
  - Subsystem RAU's
  - Integrated Monitoring and Control Panel (IMCP - R7 Panel)
- Orbiter Avionics via dedicated connectors of Spacelab
  - Analog KU-Band Signal Processor (KUSP)
  - Video Switching Network
  - Orbiter Multiplexer/Demultiplexer (MDM)
  - Orbiter Caution and Warning Electronic Assembly
  - Orbiter Master Time Unit (MTU)
- Electrical Ground Support Equipment (EGSE) via
  - Measurement and Stimuli Unit (MSU)




LEGEND : ( 1 ) DURING GROUND OPERATION ONLY

MTU : MASTER TIME UNIT
MET : MISSION ELAPSED TIME
HRM : HIGH RATE MULTIPLEXER
HDRR : HIGH DATA RATE RECORDER
S/S : SUBSYSTEM
C&W : CAUTION AND WARNING
CCTV : CLOSED CIRCUIT TELEVISION
CWEA : CAUTION AND WARNING ELECTRONIC ASSEMBLY

Figure 2 - 1 : Experiment Avionics Interface Block Diagram

3. ELECTRICAL POWER DISTRIBUTION SUBSYSTEM

3.1 Experiment Power Distribution Box (EPDB)

At the pallet the experiments interface directly with the EPDB. In the module the EPDB's primarily supply the EPSP's in the racks and the center aisle. However, experiments may interface directly with free EPDB outputs. In the case all racks are connected to the electrical power distribution subsystem, these free outputs are EPDB 2 and EPDB 3, DC 24 and DC 34.

3.1.1 Connector Location

Figure 3.1 – 1 depicts the power connector locations of the Experiment Power Distribution Box. The user will have access only to the connectors J 01, J 02, J 03, J 04 (DC power) and J 05, J 06, J 07, J 08 (AC power).

The character N in the power outlet notation denotes the number of the particular EPDB.

The EPDB numbering system starts with N = 1 for the most forward EPDB and than goes up to N = 5 (depending on Spacelab configuration) for the farthest aft EPDB.

As an example the EPDB numbering is given for the Long Module plus 1 Pallet Configuration in para. 4.3.3 of the main volume.

The exact locations of the EPDB's are given in Appendix B, Structure Interface Definition, Section 3.3.

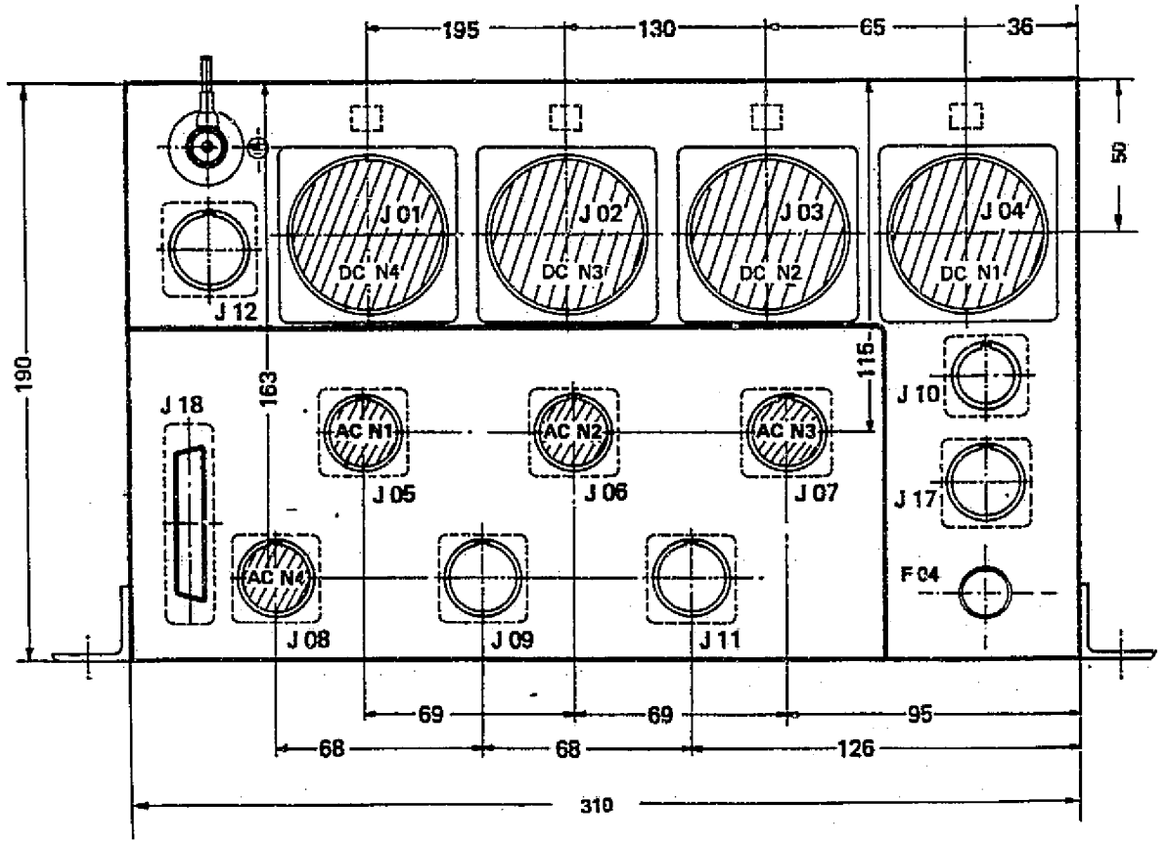



Figure 3.1 – 1: Connector Location of the EPDB

3.1.2 Pin Allocation of EPDB Power Connectors for Experiments

DC power is provided to the user via two contacts and two wires for each power and power return line. The use of both twinlines is necessary to accommodate the maximum current defined by the EPDB circuit breakers.

The AC power connectors provide three phase AC. The nominal dependence on time of AC Phase A, B, C is given by :

$$\text{AC A: } \sim \exp i(\omega t)$$
$$\text{AC B: } \sim \exp i(\omega t - 2\pi/3)$$
$$\text{AC C: } \sim \exp i(\omega t + 2\pi/3)$$

$$\omega = 2\pi\nu, \quad \nu = 400\ \text{Hz}$$

Table 3.1 - 1 : Pin Allocation List of EPDB Power Connectors for Payloads

| Connector Notation | Power Outlet Notation | Pin Not. | Pin Function | Nominal Voltage | Nominal Rating Current | Spacelab Connector Type ( Spec.) | Experiment Connector Type ( Spec.) |
|---|---|---|---|---|---|---|---|
| J 01 | DC N4 | A<br>B<br>D<br>C | PWR<br>PWR Rtn<br>PWR(twin line)<br>PWR Rtn | 28 VDC<br>28 VDC | 60 A | M83723-21R3217N (Spec MIL-C-83723) | MS 3459 U-32-17 PN |
| J 02 | DC N3 | A<br>B<br>D<br>C | PWR<br>PWR Rtn<br>PWR(twin line)<br>PWR Rtn | 28 VDC<br>28 VDC | | M83723-21R3217W (Spec MIL-C-83723) | MS 3459 U-32-17 PW |
| J 03 | DC N2 | C<br>A<br>D<br>B | PWR<br>PWR Rtn<br>PWR(twin line)<br>PWR Rtn | 28 VDC<br>28 VDC | 60 A | M83723-21R3217X (Spec MIL-C-83723) | MS 3459 U-32-17 PX |
| J 04 | DC N1 | A<br>C<br>B<br>D | PWR<br>PWR Rtn<br>PWR(twin line)<br>PWR Rtn | 28 VDC<br>28 VDC | 60 A | M83723-21R3217Y (Spec MIL-C-83723) | MS 3459 U-32-17 PY |
| J 05 | AC N1 | A<br>B<br>C<br>D | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 Vrms | equivalent to 2.7 kVA in total, max. 10 $A_{rms}$ per phase due to inverter characteristics, see Fig. 3.1 - 4 | NB0E14 - 5 SWC (Spec 40M 39569) | NB 6 E-14-5 PW |
| J 06 | AC N2 | A<br>B<br>C<br>D | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 Vrms | | NB0E14 - 5 SXC (Spec 40M 39569) | NB 6 E-14-5 PX |
| J 07 | AC N3 | A<br>B<br>C<br>D | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 Vrms | | NB0E14 - 5 SYC (Spec 40M 39569) | NB 6 E-14-5 PY |
| J 08 | AC N4 | A<br>B<br>C<br>D | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 Vrms | | NB0E 14-5 SZC (Spec 40M 39569) | NB 6 E-14-5 PZ |

The figures for the AC voltage amplitudes are given in $V_{rms}$ line-to-ground/line-to-line.

3.1.3 Electrical Power Output Characteristics

3.1.3.1 DC Power

| | |
|---|---|
| Voltage range: | 24 V to 32 V |
| Voltage range at last two pallets of 5 – pallet configuration : | 23.5 V to 32 V |
| Source impedance : | see para 3.9 |

3.1.3.2 AC Power

| | |
|---|---|
| Output: | 3 phases plus neutral line |
| Voltage range: | 115/200 $V_{rms}$ $\pm$ 5 % line to ground/line to line |
| Max. continuous power: | 4 outputs, 2.7 kVA in total<br>EPDB provides remote control capability but no circuit protection |
| Peak power: | 3.5 kVA for 120 s max |
| Source impedance: | see para 3.9 |
| Wave form: | Sinusoidal |
| Frequency: | 400 Hz $\pm$ 1 Hz |
| Frequency modulation: | $\pm$ 1 Hz about the mean frequency during any one minute |
| Voltage modulation: | 3 V amplitude modulation over a period of at least 1 s (Modulation voltage under condition of steady state loading and frequency modulation) |
| Harmonic distortion: | < 5 % |
| Phase displacement between two adjacent phases: | $120 \pm 1^{\circ}$ for power factors 0.85 lag to 0.85 lead<br>$120 \pm 3^{\circ}$ for power factors 0.50 to 0.85 lag and 0.80 to 0.85 lead |
| Maximum load unbalance: | 100 VA between any of the three phase lines (Otherwise, the DC/AC inverter will not meet the EMC requirements) |
| Fault operation: | In the event of fault operation only two-phases or one phase may operate continuously until manually switched-off by keyboard or IMCP-R7 panel. |
| Inverter efficiency: | see Figure 3.1 – 2 |
| Power factor range: | 0.85 lead to 0.85 lag |

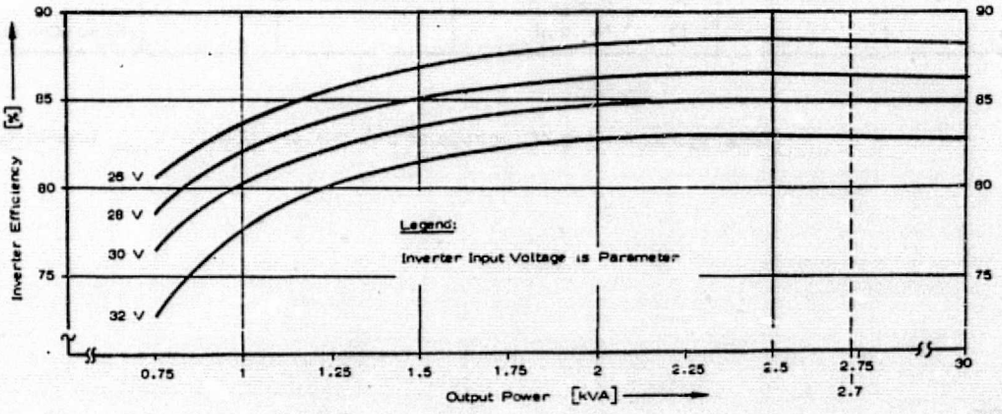



Figure 3.1 – 2 : Inverter Efficiency Curves

3.1.4 Fusing in the EPDB

3.1.4.1 DC Fusing

| | |
|---|---|
| J 04 (DC N1 ) : | circuit breaker, 60 A |
| J 03 (DC N2 ) : | circuit breaker, 60 A |
| J 02, J 01 ( DC N3 and DC N4 ) | circuit breaker, 60 A in total |

The EPDB circuit breakers act as thermal switches. Therefore the tripping characteristics depend on the thermal environment. Figure 3.1 - 3 shows two curves. One curve is valid on ground ( 1g, 1atm air ), the other curve represents the projected values for on orbit conditions ( 0g, 1atm air in the module as well as 0g, vacuum on pallets ).

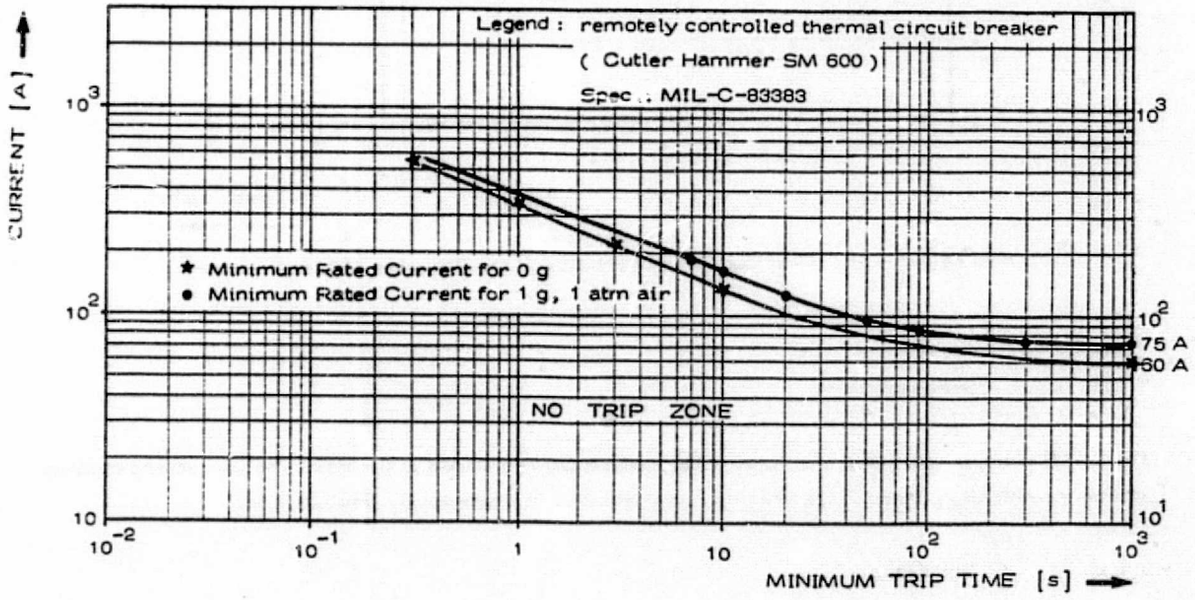



Figure 3.1 - 3: EPDB DC Trip Curve

3.1.4.2 AC Fusing

| | |
|---|---|
| J 05 (AC N1 ) : | not fused in the EPDB |
| J 06 (AC N2 ) : | not fused in the EPDB |
| J 07, J 08 (AC N3 and AC N4 ) : | not fused in the EPDB |

The 400 Hz inverter is protected against overload, i.e. for each phase the voltage will be regulated down in case of overcurrent. The regulation will start at a current of 10 $A_{rms}$ min. and will limit the current to 12 $A_{rms}$ line - to - neutral (14 $A_{rms}$ line-to-line) under short circuit conditions. In addition to this current limitation a thermal protection device will trip after 120s at 10$A_{rms}$ (see Figure 3.1-4). The thermal device will shut off all three phases even if only one is overloaded.

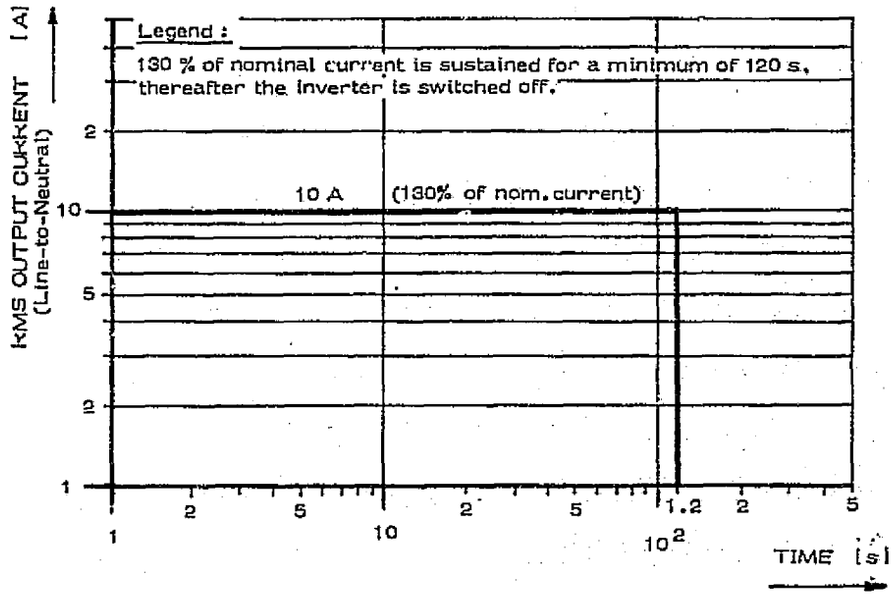



Figure 3.1 – 4: Overload Characteristics of the Spacelab 400 Hz Inverter

3.1.5 Bonding

The EPDB chassis is bonded to S/L structure with a DC resistance $\leq$ 10 m$\Omega$. The connector housings will be electrically bonded to the chassis, as described in Appendix B, Section 3.3.1.

3.1.6 Grounding

The EPDB provides for each power output line a dedicated power return line. The DC and AC power return lines are each isolated from chassis ground by at least 1 M$\Omega$ impedance (DC to 25 Hz).

3.1.7 Conducted Emission on EPDB Power and Power Return Lines

3.1.7.1 DC Power Lines

With a Spacelab dedicated fuel cell, which is the normal mode on – orbit, the power bus characteristics will be determined principally by Spacelab emission levels.

During operational phases without Spacelab dedicated fuel cell (i.e. ascent, power switch over, back-up power operation, descent) the power bus characteristics will be determined principally by Orbiter emission levels. For those noise levels, see Section 3.3.7.1.

Ripple/Spikes

- 1.5 $V_{rms}$ at any discrete frequency between 30 Hz and 3 kHz.
- 0.6 $V_{rms}$ when measured in a frequency band extending from 3 kHz to 100 kHz.

Transients

Primary bus transients measured on the DC power line will not exceed ± 56 V superimposed on the nominal voltage and up to 10 µs in duration with rise and fall times > 1 µs.

For transient surge DC voltages during normal and abnormal electrical system operation see Figures 3.1 - 5 and 3.1 - 6 , respectively .

- Normal electrical system operation describes a status free of an EPDS self occuring or load induced faults.
- Abnormal electrical system operation describes a single event, when an EPDS or load induced fault occurs which will be cleared subsequently by fault protection devices.

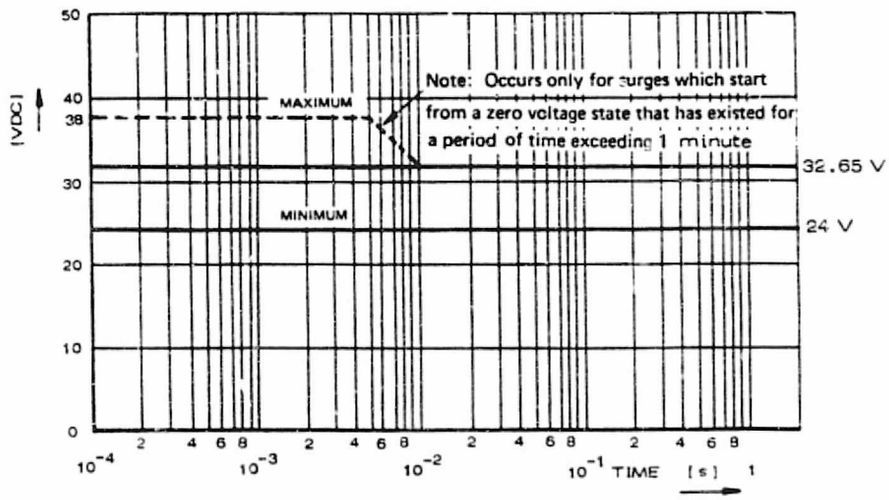



Figure 3.1 - 5 : Transient Surge DC Voltages During Normal Electrical Operation

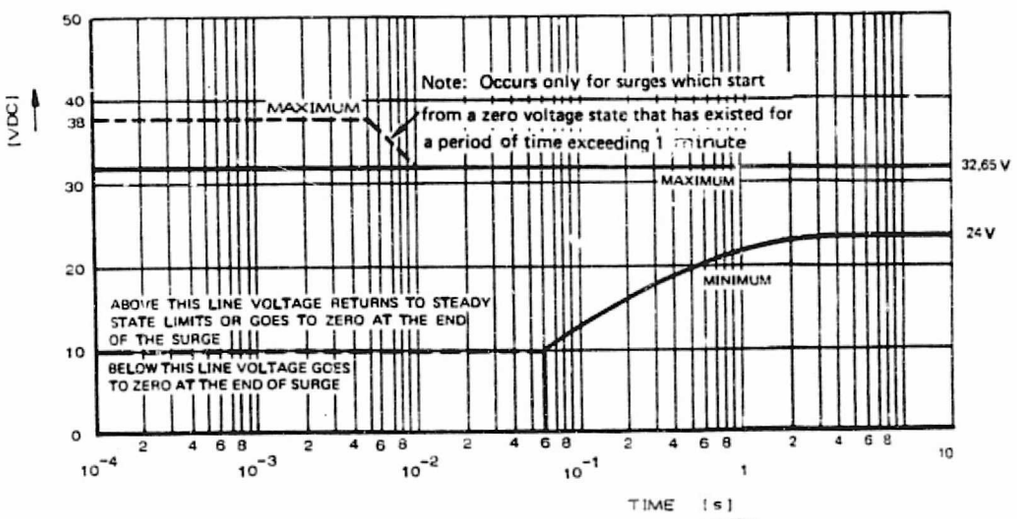



Figure 3.1 - 6 : Transient Surge DC Voltages During Abnormal Electrical Operation

3.1.7.2 AC Power Lines

Transient Spikes

Transients will occur on each of the three phases simultaneously with amplitudes <60 Vpp and a duration <400 µs.

Transient Surge Voltages

Transient surge voltages will be in the limits of Figure 3.1 - 7.

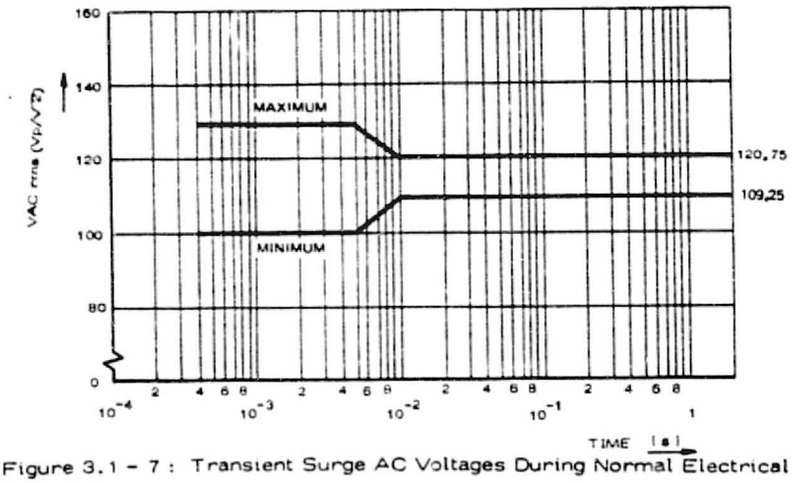



Figure 3.1 - 7 : Transient Surge AC Voltages During Normal Electrical Operation

For transient surge AC voltages during abnormal electric AC-system operation and fault operation of the electrical AC-system, see Figure 3.1 - 8

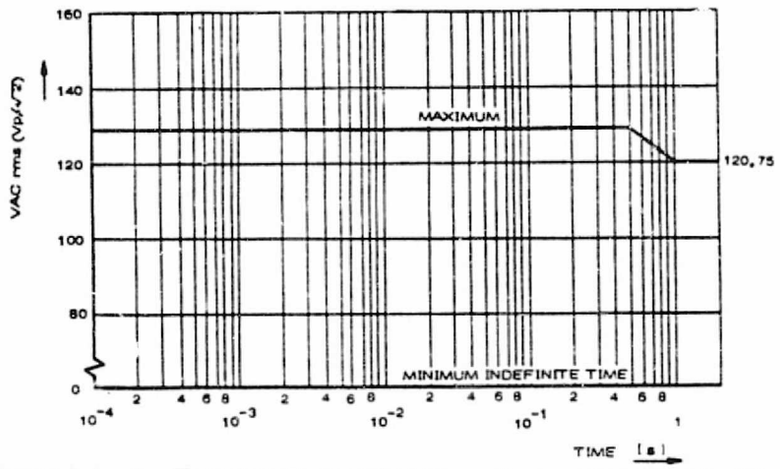



Figure 3.1 - 8 : Transient Surge AC Voltages During Abnormal Electrical Operation

3.2 Experiment Power Switching Panel (EPSP)

The EPSP is the standard power interface for experiments in Spacelab racks. The EPSP also provides means for the power on/cooling off monitoring. Therefore an EPSP has to be installed in each rack where electrical power is consumed. The location of the EPSP's in the racks are given in Appendix B, Section 3.2.4.

3.2.1 Connector Location

Figure 3.2 -1 shows the power connector locations of the experiment power switching panel. There will be one front outlet and nine outlets at the rear side. The notation of these connectors is :

- J 02 (DC1), J 03 (DC2), J 04 (DC3), J 06 (DC4), each controlled by a front panel switch
- J 05 (DC utility power, front outlet), J 12 (DC airlock power), both controlled by one common front panel switch
- J 07 (DC5), directly routed from the EPDB
- J 09 (AC1), J 10 (AC2), each controlled by a front panel switch
- J 13 (RAU DC supply) for the supply of an experiment RAU only

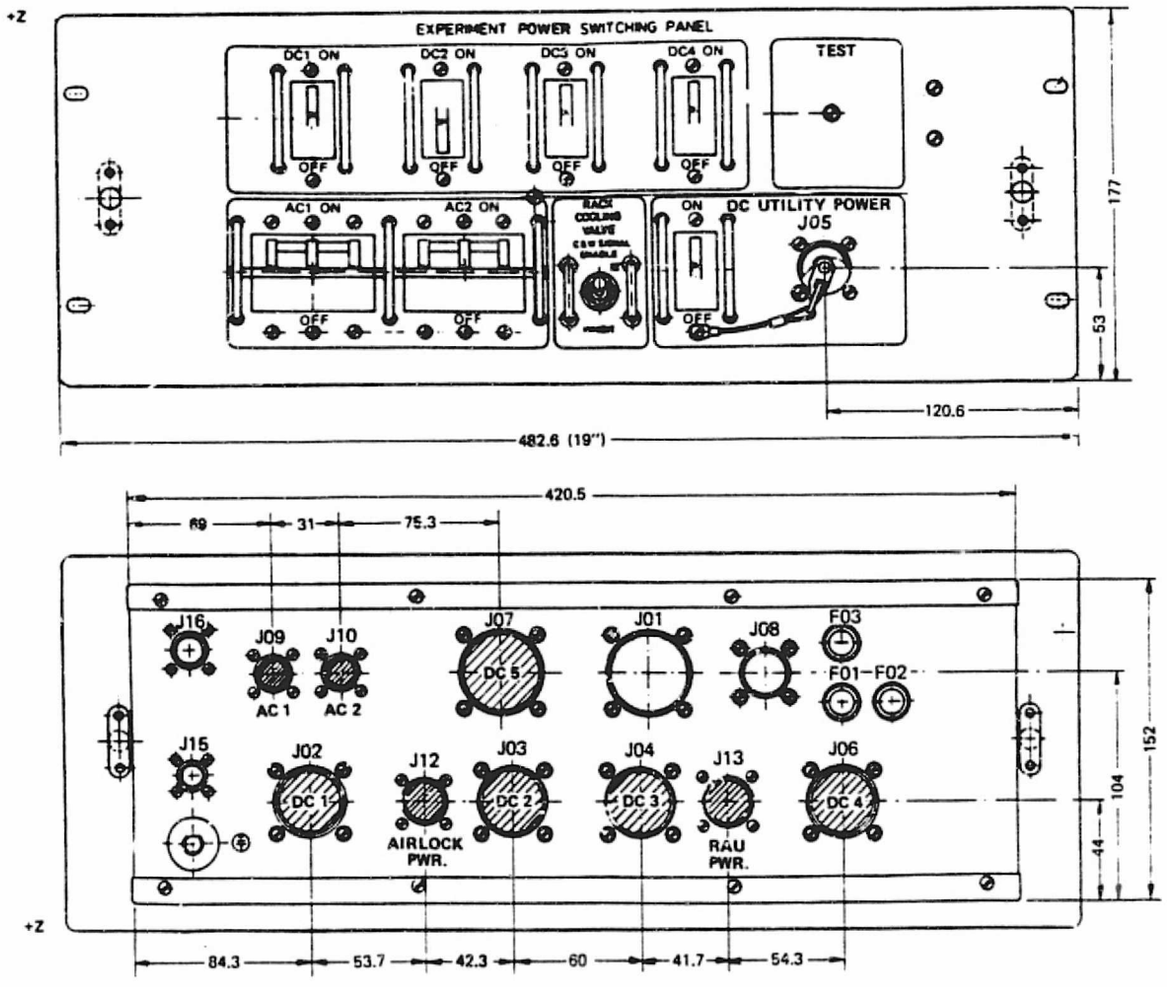



Figure 3.2 – 1: Location of EPSP Power Connectors

3.2.2 Pin Allocation of EPSP Power Connectors for Experiments

The connector and pin allocation for EPSP experiment power is given in Table 3.2 – 1.

DC power at the rear outlets for rack internal access is provided via twin contacts. The use of both twin lines is necessary to accommodate the maximum current defined by the EPSP circuit breakers. The front outlet is a bayonet type connector providing one socket for power and one socket for power return.

Table 3.2 – 1 : Pin Allocation List of EPSP Power Connectors for Payloads

| Connector Notation | Power Outlet Notation | Pin Not. | Pin Function | Nominal Voltage | Nominal Rating Current | Spacelab Connector Type (Spec.) | Experiment Connector Type (Spec.) |
|---|---|---|---|---|---|---|---|
| J o2 | DC 1 | A<br>B<br>C<br>D | PWR<br>PWR Rtn<br>PWR (twin line)<br>PWR Rtn | 28 VDC<br>28 VDC | 35 A | M83723-21R2015N (Spec MIL-C-83723) | MS 3459 U-20-15 PN |
| J 03 | DC 2 | A<br>B<br>C<br>D | PWR<br>PWR Rtn<br>PWR (twin line)<br>PWR Rtn | 28 VDC<br>28 VDC | 35 A | M83723-21R2015W (Spec MIL-C-83723) | MS 3459 U-20-15 PW |
| J 04 | DC 3 | A<br>B<br>C<br>D | PWR<br>PWR Rtn<br>PWR (twin line)<br>PWR Rtn | 28 VDC<br>28 VDC | 35 A | M83723-21R2015N (Spec MIL-C-83723) | MS 3459 U-20-15 PN |
| J 06 | DC 4 | A<br>B<br>C<br>D | PWR<br>PWR Rtn<br>PWR (twin line)<br>PWR Rtn | 28 VDC<br>28 VDC | 35 A | M83723-21R2015Z (Spec MIL-C-83723) | MS 3459 U-20-15 PZ |
| J 09 | AC 1 | A<br>B<br>C<br>D | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 $V_{rms}$ | 3 x 3 $A_{rms}$ | NBOE 10-6 SNC (Spec 40M 39569) | NB 6 E-10-6 PN |
| J 10 | AC 2 | A<br>B<br>C<br>D | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 $V_{rms}$ | 3 x 3 $A_{rms}$ | NBOE 10-6 SWC (Spec. 40M 39569) | NB 6 E-10-6 PW |
| J 07 | DC 5 | A<br>B<br>C<br>D | PWR<br>PWR Rtn<br>PWR (twin line)<br>PWR Rtn | 28 VDC<br>28 VDC | 60 A | M83723-21R2422N (Spec. MIL-C-83723) | MS 3459 U-24-22 PN |
| J 05 | DC utility power | J<br>K<br>L | PWR<br>PWR Rtn<br>Chassis Ground | 28 VDC | 7 A | NBOE 14-12 SNC (Spec. 40M 39569) | NB 6 E 14-12 PN |
| J 12 | DC Airlock | A<br>D<br>B<br>C | PWR<br>PWR Rtn<br>PWR (twin line)<br>PWR Rtn | 28 VDC<br>28 VDC | | NBOE 14-4 SNC (Spec. 40M 39569) | NB 6 E 14-4 PN |
| J 13 | RAU DC Supply | G<br>A<br>F<br>H<br>B<br>C<br>D<br>E | PWR A1<br>PWR A1 Rtn<br>PWR A2<br>PWR A2 Rtn<br>PWR B1<br>PWR B1 Rtn<br>PWR B2<br>PWR B2 Rtn | 28 VDC<br>28 VDC<br>28 VDC<br>28 VDC | 7,5 A<br>7,5 A | NBOE 12-8 SNC (Spec. 40M 39569) | NB 6 E 12-8 PN |

3.2.3 Electrical Power Output Characteristics

3.2.3.1 DC Power

| | |
|---|---|
| Voltage range: | 28 $\pm$ 4 V |
| Max. current: | see 3.2.4.1 – DC Fusing |
| Source impedance: | see para 3.9 |

3.2.3.2 AC Power

| | |
|---|---|
| Output: | 3 phases plus neutral line |
| Voltage range: | 115/200 $V_{rms}$ $\pm$ 5% line to ground/line to line |
| Max. power: | 2 outputs, 1 kVA each, see also 3.2.4.2 – AC Fusing |
| Source impedance: | see para 3.9 |

For additional characteristics see 3.1.3.2.

3.2.4 Fusing in the EPSP

3.2.4.1 DC Fusing

| | |
|---|---|
| J02 (DC 1 ): | circuit breaker, 35 A (see Figure 3.2 – 2) |
| J03 (DC 2 ): | circuit breaker, 35 A (see Figure 3.2 – 2) |
| J04 (DC 3 ): | circuit breaker, 35 A (see Figure 3.2 – 2) |
| J05 (DC utility power) : | circuit breaker, 7 A (see Figure 3.2 – 3) |
| J06 (DC 4 ): | circuit breaker, 35 A (see Figure 3.2 – 2) |
| J07 (DC 5 ): | not fused in the EPSP (60 A remote controlled EPDB circuit breaker see Figure 3.1 – 3) |
| J 12 (airlock power) : | shares the same circuit breaker with J 05 |
| J13 (exp RAU power) : | melting fuse 7,5 A |

Figures 3.2 - 2 and 3.2 - 3 depict the trip curves of the EPSP DC circuit breakers.

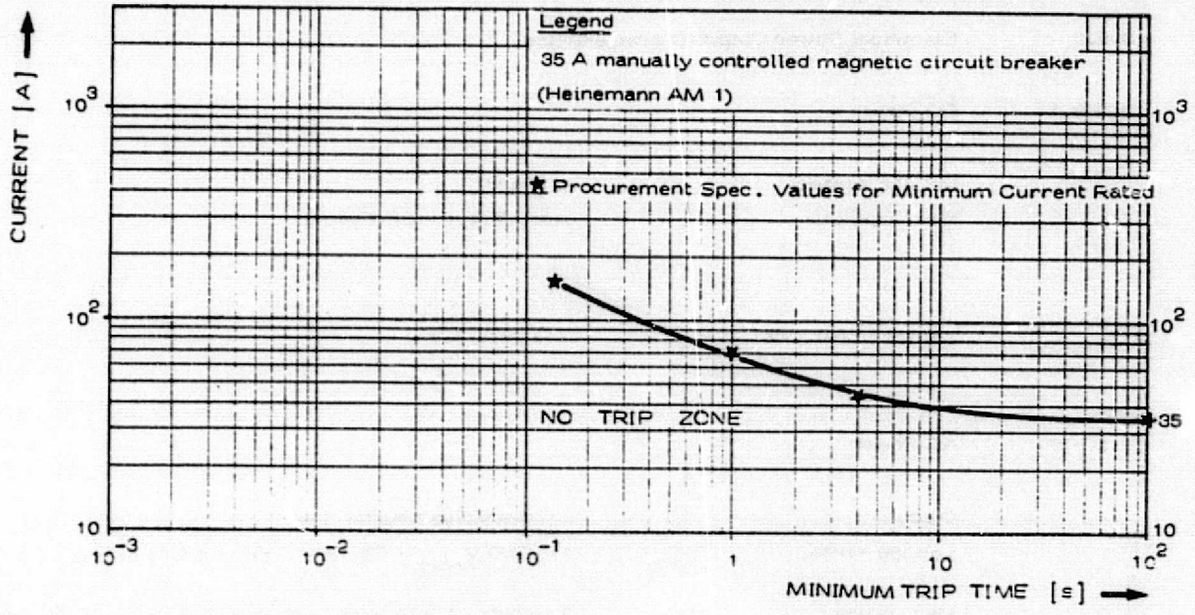



Figure 3.2 - 2: Trip Curve of 35 A EPSP DC Circuit Breaker

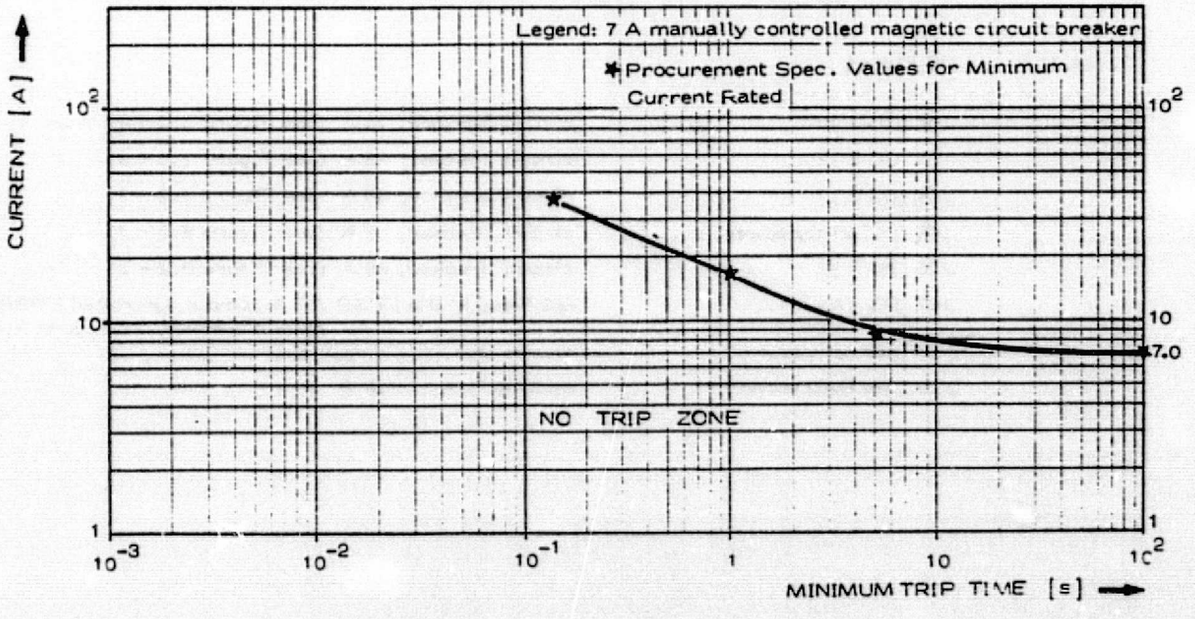



Figure 3.2 - 3: Trip Curve of 7 A EPSP DC Circuit Breaker

3.2.4.2 AC Fusing

J09 (AC output 1): circuit breaker, 3 $A_{rms}$ per phase

J10 (AC output 2): circuit breaker, 3 $A_{rms}$ per phase

Figure 3.2 – 4 depicts the trip curve of the EPSP AC circuit breakers.

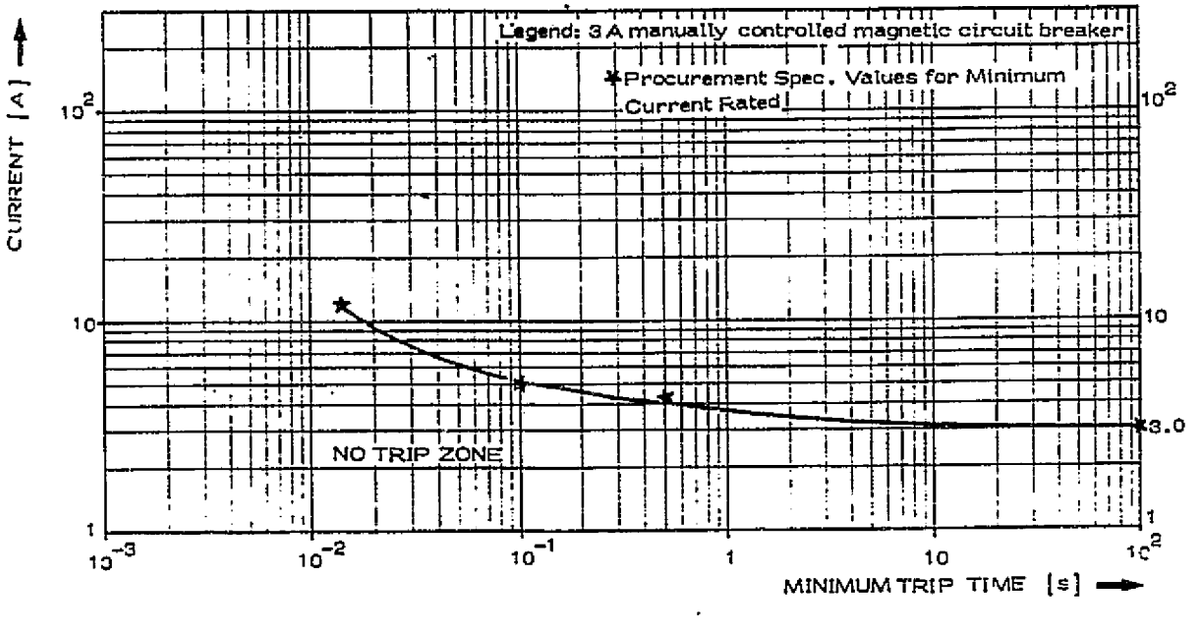



Figure 3.2 – 4: Trip Curve of 3 A EPSP AC Circuit Breaker

3.2.5 Bonding

Same as 3.1.5

3.2.6 Grounding

Same as 3.1.6

3.2.7 Conducted Emission on Power and Power Return Lines

3.2.7.1 DC Power Lines

Same as 3.1.7.1

3.2.7.2 AC Power Lines

Same as 3.1.7.2

3.3 AFD Power Distribution Box

The AFD power distribution box is the standard power interface for experiments in the aft flight deck. The location of the AFD power distribution box is shown in Appendix B, Section 5.

3.3.1 Connector Location

The AFD Power Distribution Box provides one output for Experiment DC power (J 03) and one output for Experiment AC power (J 04). Figure 3.3 - 1 depicts the power connector location on the AFD Power Distribution Box.

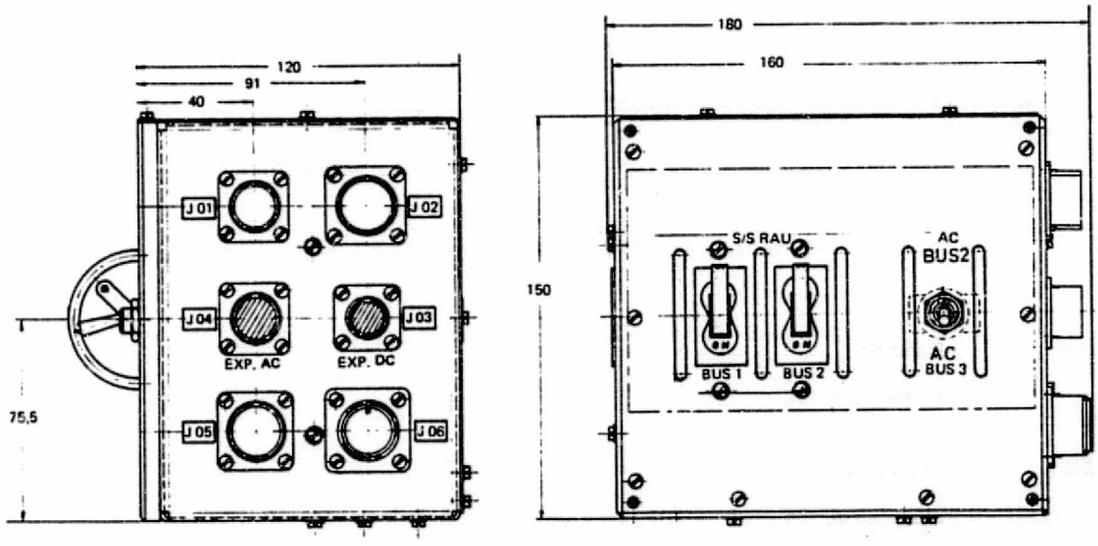



Figure 3.3 - 1: Connector Location of AFD PDB

3.3.2 Pin Allocation of AFD PDB Power Connectors

The pin allocation of AFD PDB power connectors for payloads is given in Table 3.3 – 1 .

Table 3.3 – 1 : Pin Allocation List of AFD PDB Power Connectors for Payloads

| Connector Notation | Power Outlet Notation | Pin Not. | Pin Function | Nominal Voltage | Nominal Rating Current | Spacelab Connector Type ( Spec.) | Experiment Connector Type ( Spec.) |
|---|---|---|---|---|---|---|---|
| J 03 | Exp. DC Bus 3 | A<br>B | PWR<br>PWR Rtn | 28 VDC | 15 A | NBGE 14-4 SWT (Spec. 40M 39569) | NB 6 E 14-4 PW |
| | Exp. DC Bus 1 | C<br>D | PWR<br>PWR Rtn | 28 VDC | 15 A* | | |
| J 04 | Exp. AC | A<br>B<br>C<br>D | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 $V_{rms}$ | 3 x 3 $A_{rms}$ | NBOE 10-6 SNC (Spec. 40M 39569) | NB 6 E 10-6 PN |

* The current for one S/S RAU has to be subtracted from this value.

3.3.3 Electrical Power Output Characteristics

3.3.3.1 DC Power

| | |
|---|---|
| Voltage range: | 25.7 to 32.0 V |
| Max. current: | Fused upstream of the AFD PDB; 15 A max. continuous However, the output of the Experiment DC Bus 1 provides also power for a S/S RAU, i.e. this power has to be subtracted from the 15 A max. |
| Source impedance : | TBD |

3.3.3.2 AC Power

| | |
|---|---|
| Output: | 3 phases plus neutral line |
| Voltage range: | $115 \pm 5\ V_{rms}$ line to ground |
| Max. current: | Fused upstream of the AFD PDB; 3 A max. continuous for each phase |
| Source impedance : | see para 3.9 |
| Frequency: | $400 \pm 1$ Hz synchronized to MTU<br>$400 \pm 7$ Hz free running (fault operation) |
| Wave form: | sinusoidal |
| Frequency modulation: | $\pm$ 1 Hz about the mean frequency during any one minute period |
| Voltage modulation: | $\leq$ 1.5 Vpp modulation amplitude over a period of at least 1 s<br>(Modulation voltage under conditions of steady state loading and frequency modulation) |
| Harmonic distortion: | $\leq$ 5 % |
| Phase displacement between two adjacent phases: | $120 \pm 2^{o}$ |
| Maximum load unbalance: | $\leq$ 100 VA between each of the three phase lines |
| Fault operation: | In the event of inverter failure, only two phases or one phase may operate continuously until manually switched off |
| Inverter efficiency: | 76.5 % average |
| Power factor: | 0.75 lagging to 1.0 to 0.85 leading |

3.3.4 Fusing in the AFD PDB

3.3.4.1 DC Fusing

The experiment DC power output is not fused in the AFD PDB. However, the Orbiter AFD main bus power feeders are protected by 15 A Remote Power Controller s with tripping characteristics shown in Fig. 3.3 - 2.

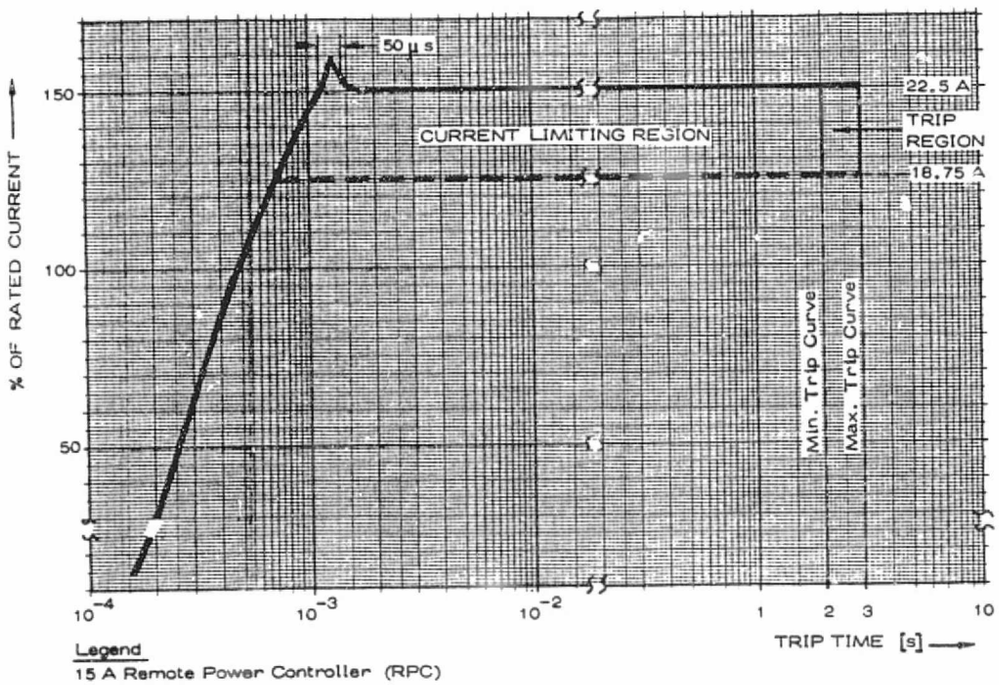
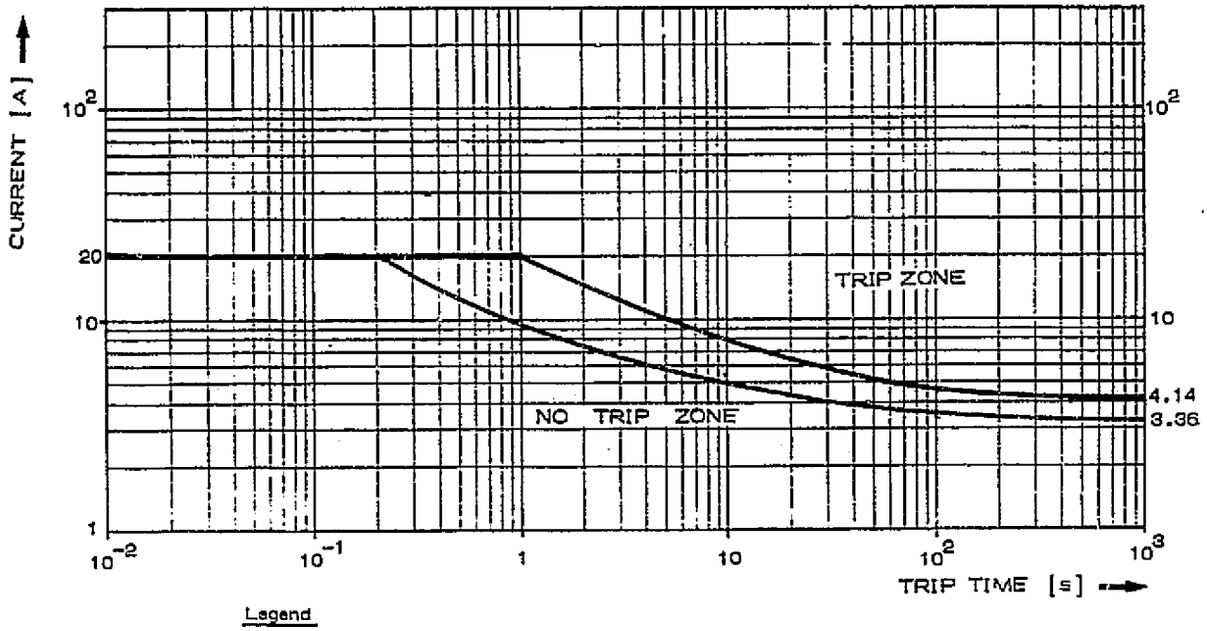



Figure 3.3 - 2: AFD PDB DC Overload Protection Characteristics
(Derived from ICD-2-05301)

3.3.4.2 AC Fusing

There is no fusing for experiment AC power outputs provided in the AFD PDB.

The Orbiter AC bus current is limited to 20 A by the inverter system until circuit breakers (3 A for each phase) are activated. The tripping characteristics are depicted in Figure 3.3 – 3.




Legend

AC 3 A Thermal Circuit Breaker

Figure 3.3 – 3 AFD PDB AC Power Protection Characteristics (Derived from ICD-2-05301)

3.3.5 Bonding

The AFD PDB chassis is bonded to Orbiter structure with a DC resistance $< 2.5\ m\Omega$. The connector housings will be electrically bonded to the chassis.

3.3.6 Grounding

The AFD PDB provides for each power output line a dedicated power return line. The power return line is isolated from chassis ground by at least 1 MΩ impedance (DC to 25 Hz).

3.3.7 Conducted Emission on AFD PDB Power and Power Return Lines

3.3.7.1 DC Power Lines

a) If connected to any of the Orbiter primary DC power sources (referenced to Orbiter structure):

Ripple

The ripple will not exceed:

(1) 0.9 $V_{pp}$ narrowband (30 Hz to 7 kHz) falling 10 dB per decade to 0.28 $V_{pp}$ at 70 kHz, thereafter remaining constant to 400 MHz.

(2) $\pm$ 0.8 V peak broadband in the frequency band from 30 Hz to 7 kHz and $\pm$ 0.3 V peak in the frequency band from 7 kHz to 400 MHz.

Transients

Transients will not exceed the impulse equivalent of $3 \times 10^{-4}$ Vs above or below normal line voltage.

The amplitude of the transient is limited to:

- $\pm$ 50 V positive line – to – return line and positive line – to – structure
- $\pm$ 30 V return line – to – structure

Rise and fall time of each transient is $\geq 1$ µs .

b) If supplied by Ground Support Equipment Power:

Ripple

The ripple will not exceed:

(1) 1.2 $V_{pp}$ (30 Hz to 7 kHz) falling to 0.28 Vpp at 70 kHz, thereafter remaining constant to 400 MHz.

(2) $\pm$ 1.0 V peak broadband in the frequency band from 30 Hz to 7 kHz and $\pm$ 0.3 V peak in the frequency band from 7 kHz to 400 MHz.

Transients

Same as above

Note: The ripple voltages include a confidence margin of 6 dB.

3.3.7.2 AC Power Lines

Transient Spikes

Transient spikes will not exceed the limits defined by Figure 3.3 – 4.

Transient Surge

Transient Surge AC voltages during normal operating conditions will not exceed the limits defined by Figure 3.3 – 5. For transient surge AC voltages during short circuit and emergency switching conditions, see ICD-2-05301.

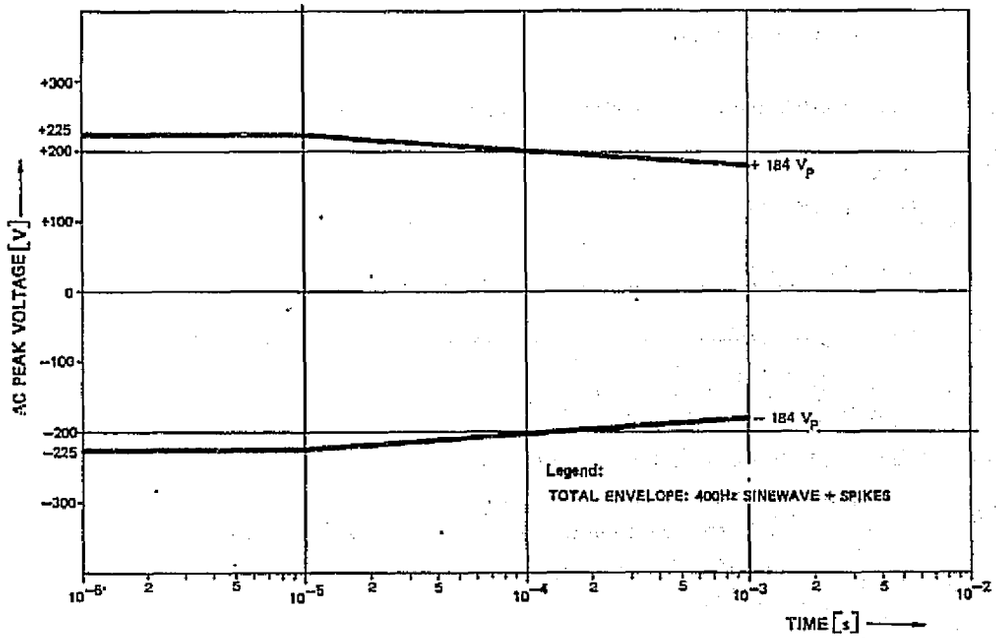



Figure 3.3 - 4 : Envelope of Shuttle Produced Spikes on the AC Power Bus.

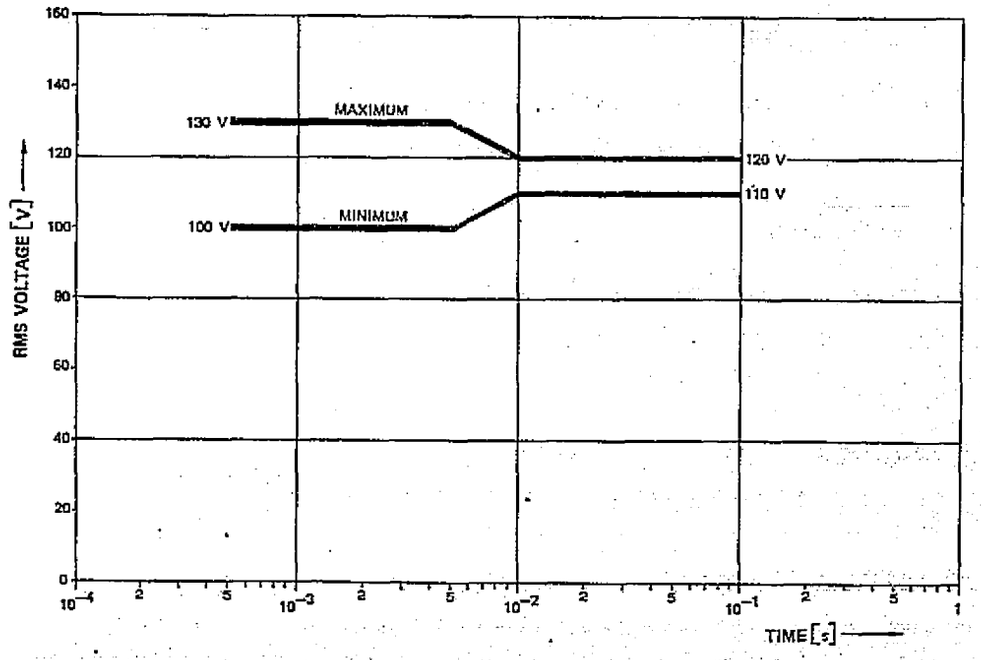



Figure 3.3 - 5 : Transient Surge AC Voltage Step Function Limits During Normal Switching Conditions for Orbiter AC Power Lines

3.4 Experiment Essential Power

The experiment essential power bus provides the power for experiment caution and warning devices as well as for experiment holding functions in case of main power loss. All experiment loads connected to this bus must, therefore, provide a protection concept in order to prevent failure propagation into the experiment essential power bus.

In the module, the experiment essential power is routed through the connector brackets CB 6, CB 16 and CB 28. At the pallets the essential power is provided through the connector bracket CB 51. The location of the connector brackets is described in the Appendix B, Structure Interface Definition, Section 3.2.2.

3.4.1 Connector Location

The connector location on the CB's for experiment essential power is depicted in Figures 3.4 - 1 thru 4.

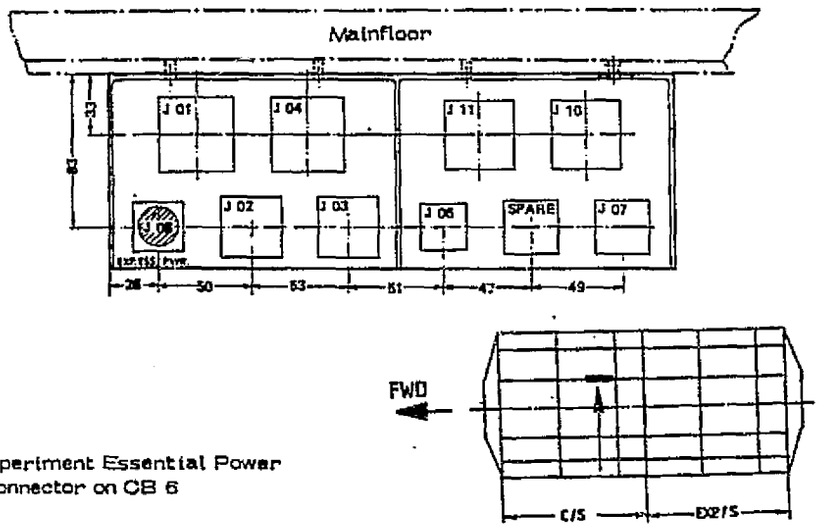



Figure 3.4 - 1: Experiment Essential Power Connector on CB 6

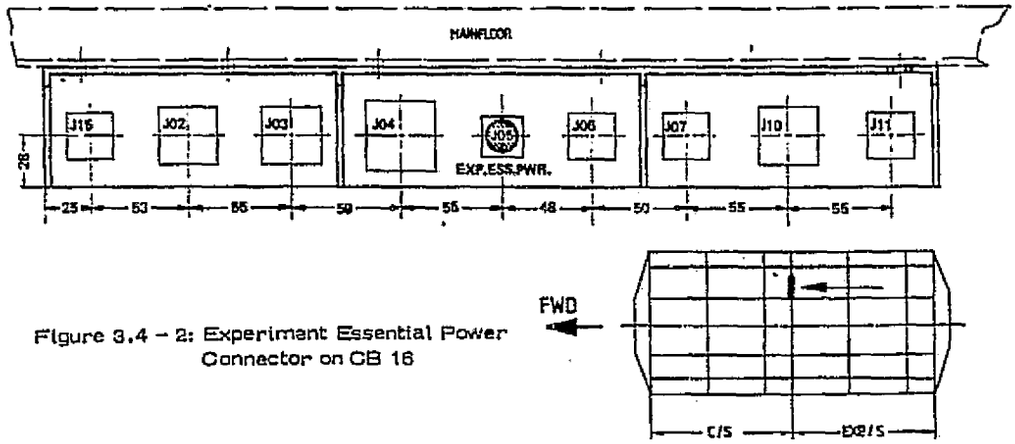



Figure 3.4 - 2: Experiment Essential Power Connector on CB 16

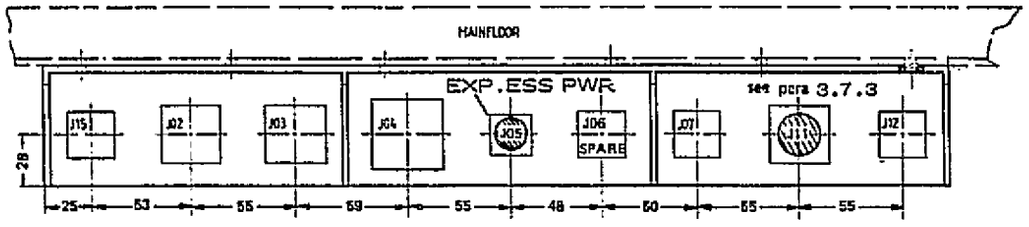
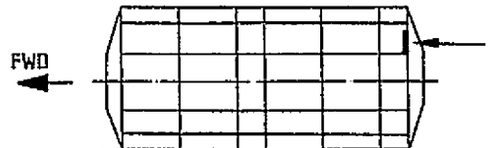
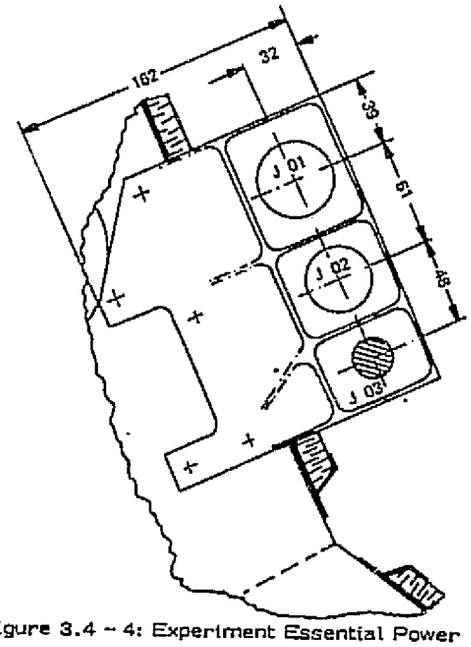



Figure 3.4 - 3: Experiment Essential Power Connector on CB 28



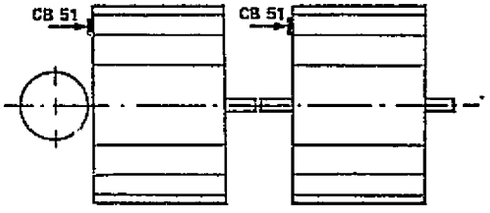




Figure 3.4 - 4: Experiment Essential Power Connector on CB 51

3.4.2 Pin Allocation of Experiment Essential Power Connectors

Connector type and pin allocation for experiment essential power, as given in Table 3.4 - 1, are identical at all connector brackets.

Table 3.4 - 1 : Pin Allocation List of Experiment Essential Power Connectors

| Connector Notation | Power Outlet Notation | Pin Notation | Pin Function | Nominal Voltage | Nominal Rating Current | Spacelab Connector Type (Spec.) | Experiment Connector Type (Spec.) |
|---|---|---|---|---|---|---|---|
| J 0F at CB 6<br>CB 16<br>CB 28<br>J 03 at CB 51 | Exp.Ess.DC | A<br>B<br>C | PWR<br>PWR Rtn<br>Spare | 28 V DC | 7.5 A | NBOE 12-3 SNS (Spec. 40 M 39569) | NB 6 E 12-3 PN |

3.4.3 Electrical Power Output Characteristic

DC voltage range: 22.0 to 32.0 V in the module
21.5 to 32.0 V on the pallet

Source impedance: see para 3.9

3.4.4 Fusing

The experiment essential power bus is protected against overload by a melting fuse (7.5A) in the emergency box. The trip curve is shown in Figure 3.4 - 5 .

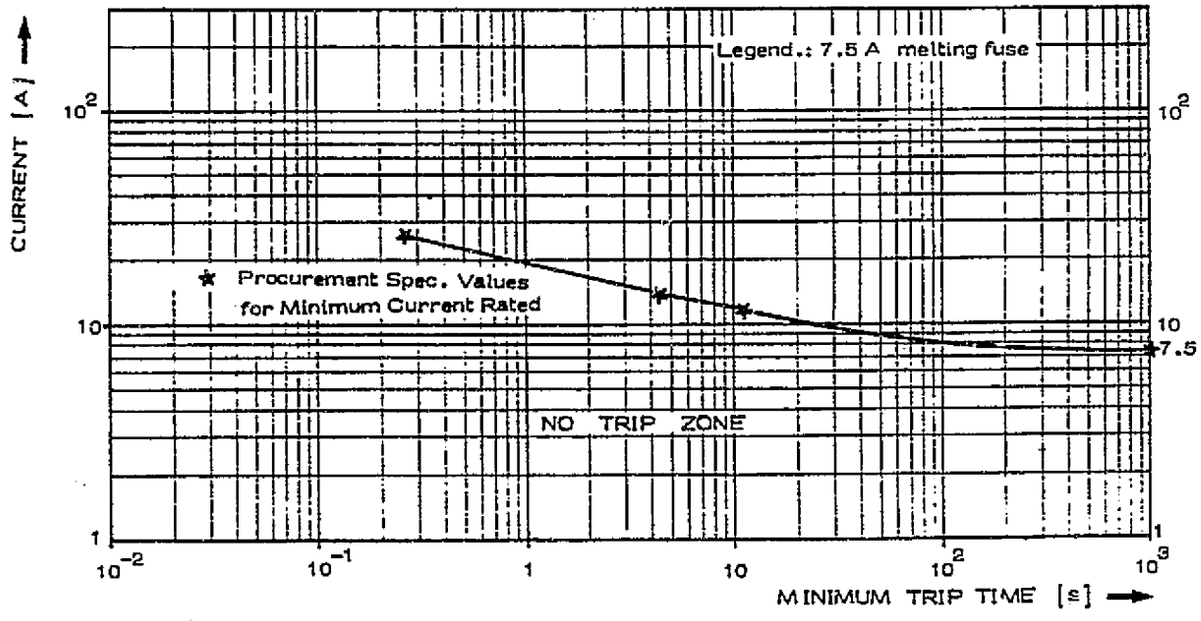



Figure 3.4 - 5: Trip Curve of 7.5A Melting Fuse

3.4.5 Bonding

Same as 3.1.5

3.4.6 Grounding

Same as 3.1.6

3.4.7 Conducted Emission on Power and Power Return Lines

Same as 3.3.7

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3.5 Experiment Power Supply in the Module Center Aisle

Through connector bracket CB 31 in the core segment and connector bracket CB 32 in the experiment segment power is provided to experiment equipment in the module center aisle. The location of these connector brackets is given in Appendix B, Structure Interface Definition, Section B 3.3.1.

3.5.1 Connector Location

The connector location at the center aisle connector brackets CB 31 and CB 32 are given in Figure 3.5 - 1. Two connectors provide DC and AC power for experiments; five connectors represent the interface for an experiment RAU.

For CB 31, experiment DC and AC is routed from EPDB 1, connector J 04 ( DC 11 ) and connector J 05 ( AC 11 ) via a branching unit. Note that the EPSP in rack 3 is supplied by the same branching unit as CB 31.

For CB 32, experiment DC and AC power is routed from EPDB 3, connector J 01 ( DC 34 ) and connector J 08 ( AC 34 ).

The harness for this standard configuration is Spacelab provided. For any other harness configuration, the experimenter/payload integrator has to provide the harness.

The other connectors have no direct experiment interface; they are exclusively to support an experiment RAU. The harness from CB 31 and 32 to an experiment RAU is not delivered by Spacelab and has to be provided by the experimenter/payload integrator. The harness data are described in Appendix A, Section 8.1.2.

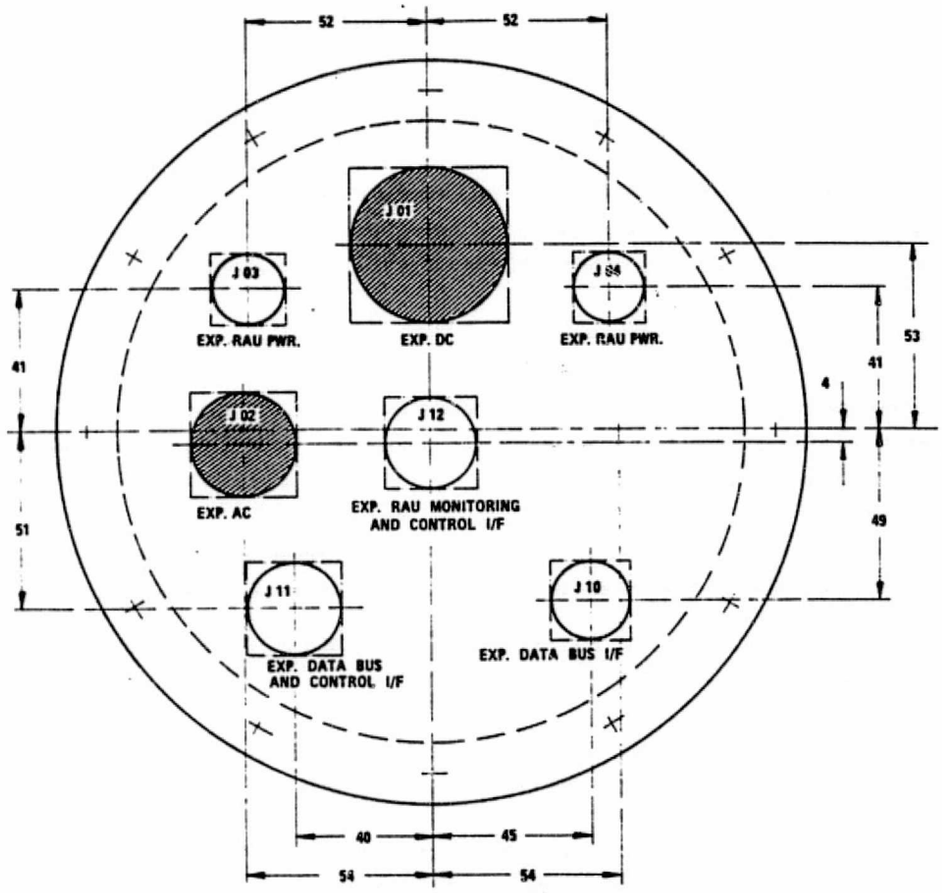



Figure 3.5 - 1: Connector Location in Center Aisle
Connector Bracket CB 31 and CB 32

3.5.2 Pin Allocation of Power Connectors for Experiments

The connector and pin allocation for center aisle experiment power is given in Table 3.5 – 1.

DC power is provided via twin contacts. The use of both twinlines is necessary to accommodate the maximum current defined by the EPDB circuit breaker located upstream.

Table 3.5 – 1: Pin Allocation List of Center Aisle Power Connectors for Payloads

| Connector Notation | Power Outlet Notation | Pin Notation | Pin Function | Nominal Voltage | Nominal Rating Current | Spacelab Connector Type ( Spec.) | Experiment Connector Type ( Spec.) |
|---|---|---|---|---|---|---|---|
| J 01 | Exp. DC | A<br>B<br>C<br>D | Pwr<br>Pwr Rtn<br>Pwr (twin)<br>Pwr Rtn (line) | 28 VDC | 60 A | MS 3450-U 24-22 SN (Spec. MIL-C-0085015) | MS 3459 U-24-22 PN |
| J 02 | Exp. AC | A<br>B<br>C<br>D | Phase A<br>Phase B<br>Phase C<br>Neutral | 115 $V_{rms}$ | 3 x 7.8 $A_{rms}$ | NBOE 14-5 SNS (Spec.40 M 39569) | NB 6 E 14-5 PN |

3.5.3 Electrical Power Output Characteristics

3.5.3.1 DC Power

Voltage range: 28 ± 4 V

Output current: 1 output max. 60 A, if connected to an EPDB

Source impedance: see para 3.9

For additional characteristics, see para 3.1.3.1.

3.5.3.2 AC Power

| | |
|---|---|
| Output: | 3 phases plus neutral line |
| Voltage range: | 115/200 $V_{rms}$ $\pm$ 5% line to ground/line to line |
| Max. continuous power: | 1 output<br>2.7 kVA in total,<br>remote control capability but no circuit protection in the EPDS |
| Source impedance: | see para 3.9 |

For additional characteristics, see para 3.1.3.2.

3.5.4 Fusing

3.5.4.1 DC Power Output

Same as 3.1.4.1, if connected to an EPDB or 3.2.4.1, if connected to an EPSP.

3.5.4.2 AC Power Output

Same as 3.1.4.2, if connected to an EPDB or 3.2.4.2, if connected to an EPSP.

3.5.5 Bonding

Same as 3.1.5

3.5.6 Grounding

Same as 3.1.6

3.5.7 Conducted Emission on Power and Power Return Lines

3.5.7.1 DC Power Lines

Same as 3.1.7.1

3.5.7.2 AC Power Lines

Same as 3.1.7.2

3.6 Experiment Power Supply in the Airlock

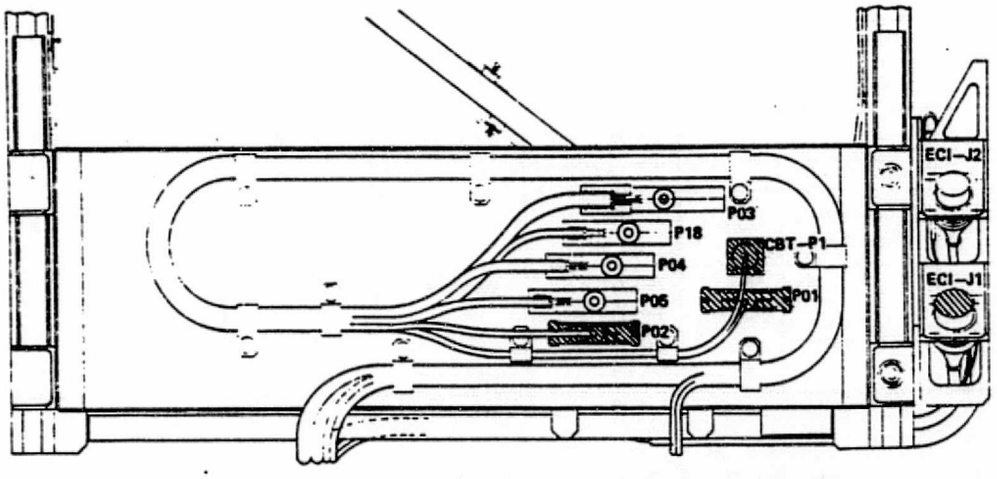
3.6.1 Connector Location

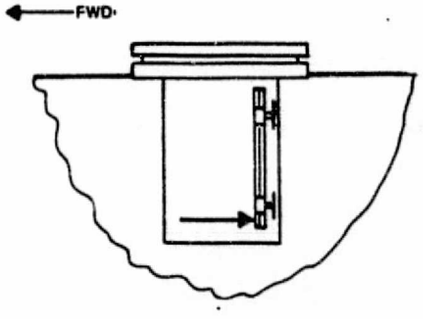
At the airlock experiment table there is a single power connector (ECI – J1) for both experiment DC and AC power. The experiment DC and AC power is supplied from the EPSP in rack No. 4 through J 12 (DC) and J 09 (AC).

The connector CBT – P1 on the experiment table provides the power exclusively for Exp.RAU Heaters. The power is routed from the Subsystem Power Distribution Box via the Airlock Control Panel to CBT – P1.

The redundant power supply for the Exp.RAU is provided by the connectors P01 and P02 which are supplied from the Subsystem Power Distribution Box.

Figure 3.6 – 1 depicts the power connector locations on the experiment table in the airlock. The signal connectors P03, P04, P05 and P 18 at the airlock experiment table are described in section 5.2.




Note: 1) One hand operation is possible for connecting/disconnecting cables with release fasteners

2) Length of pigtail is approximately 750 mm after release

Figure 3.6 – 1: Power Connector Location on the Experiment Table in the Airlock

3.6.2 Pin Allocation of the Power Connector for Experiments

The connector and pin allocation for airlock experiment power is given in Table 3.6 - 1. DC power is provided via twin contacts. The use of both twin lines is necessary to accommodate the maximum current defined by the circuit breakers of the EPSP located upstream.

Table 3.6 - 1: Pin Allocation List of Power Connectors for Experiments in the Airlock

| Connector Notation | Power Outlet Notation | Pin Notation | Pin Function | Nominal Voltage | Maximum Current | Spacelab Connector Type ( Spec.) | Experiment Connector Type ( Spec.) |
|---|---|---|---|---|---|---|---|
| EC1 - J 1 | Exp.DC | J<br>K<br>M<br>L | PWR<br>PWR Rtn<br>PWR [twin]<br>PWR [line]<br>Rtn | 28 V DC<br>28 V DC | 7 A | NB 0E 14-12 SNT (Spec. 40 M 39569) | NB 6 E 14-12 PN |
| | Exp. AC | B<br>A<br>H<br>G | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 $V_{rms}$ | 3 x 3 $A_{rms}$ | | |
| | DC Airlock Control Panel | C<br>D | Status<br>Status Rtn | 28 V DC | 0.03 A | | |
| P01 | DC Exp.RAU Power Supply | 1<br>16 | PWR<br>PWR Rtn | 28 V DC | 1.25 A | 311 P 405 - 3S - B12 | 311 P 405 - 3P - B12 |
| P02 | DC Exp.RAU Power Supply | 1<br>16 | PWR<br>PWR Rtn | 28 V DC | 1.25 A | 311 P 405 - 3S - B12 | 311 P 405 - 3P - B12 |
| CBT - P1 | DC RAU Heaters | 1<br>2 | PWR<br>PWR Rtn | 28 V DC | 2 A | TBD | TBD |
| | | 4<br>5 | PWR Rtn<br>PWR | 28 V DC | 2 A | | |

3.6.3 Electrical Power Output Characteristics

3.6.3.1 DC Power

Voltage range: 21.7 V to 32 V

Output current: max 7 A (protected in the EPSP)

Source impedance: see para 3.9

For additional characteristics, see para 3.2.3.1.

3.6.3.2 AC Power

Output: 3 phases plus neutral line

Voltage range: 104/180 $V_{rms}$ to 121/210 $V_{rms}$

Source impedance: see para 3.9

For additional characteristics, see para 3.2.3.2

3.6.4 Fusing

3.6.4.1 DC Power Output

Same as 3.2.4.1 ( J 12 )

3.6.4.2 AC Power Output

Same as 3.2.4.2 ( J 09 )

3.6.5 Bonding

Bonding resistance to structure <50 m Ω .

3.6.6 Grounding

Same as 3.1.6

3.6.7 Conducted Emission on Power and Power Return Lines

3.6.7.1 DC Power Lines

Same as 3.1.7.1

3.6.7.2 AC Power Lines

Same as 3.1.7.2

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3.7 CPSE Connector Brackets

In addition to the experiment power interfaces described above there are three connector brackets in the module which provide for experiment DC and AC power. These connector brackets have been designed in the context with Common Payload Support Equipment (CPSE) to be accommodated in the module. The power routing is shown in Figure 3.7 - 1.

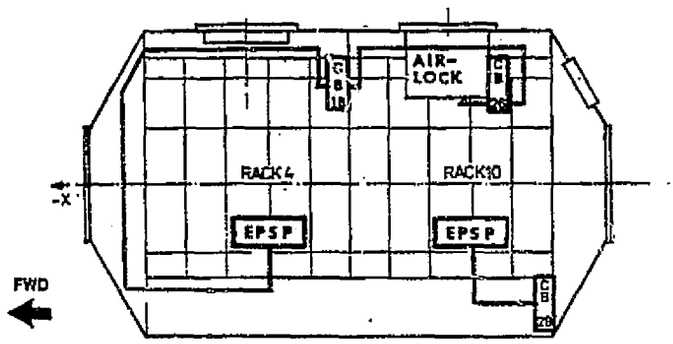



Figure 3.7 - 1: CPSE Connector Brackets

The three CPSE connector brackets providing experiment power in the module are

- CB 18 This connector bracket provides the break between core segment and experiment segment for the airlock power harness. In short module configurations this connector bracket is accessible for experiments (e.g. experiment equipment attached to the High Quality Window/Viewport Assembly).

- CB 26 This connector bracket provides the power interface between Airlock and Spacelab subsystem. If the airlock is not flown this connector bracket is accessible for experiments.

- CB 28 This connector bracket originally was foreseen for the power supply of the aft airlock which has been deleted. This connector bracket is always available in long module configurations (e.g. for experiments attached to the aft end viewport).

3.7.1 Connector Bracket CB 18

3.7.1.1 Connector Location on CB 18

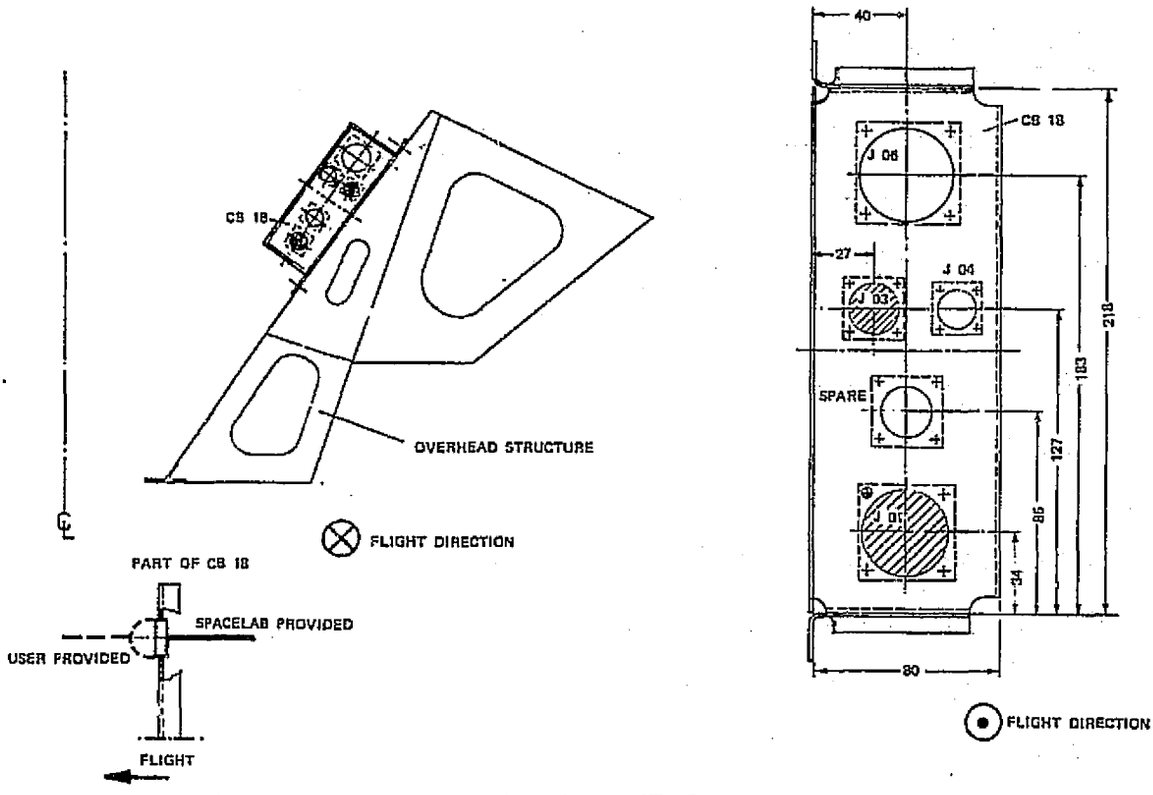



Figure 3.7 - 2: Connector Location on CB 18

3.7.1.2 Pin Allocation of Experiment Power Connectors

Table 3.7.-1 Pin Allocation List of CB 18 Power Connectors for Payloads

| Connector Notation | Power Outlet Notation | Pin Notation | Pin Function | Nominal Voltage | Maximum Current | Spacelab Connector Type ( Spec.) | Experiment Connector Type ( Spec.) |
|---|---|---|---|---|---|---|---|
| J 01 | Exp. DC | H<br>I<br>F<br>G | PWR<br>PWR Rtn<br>PWR ( twin<br>PWR line)<br>Rtn | 28 V DC<br>28 V DC | 7 A | NBOE 22-12 SNS<br>(Spec. 40 M 39569) | NB 6 E 22-12 PN |
| J 03 | Exp. AC | B<br>C<br>D<br>J | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 V rms | 3 x 3 $A_{rms}$ | NBOE 12-10 SNS<br>(Spec. 40 M 39569) | NB 6 E 12-10 PN |

For DC power the use of both twinlines is necessary to accommodate the maximum current.

3.7.1.3 Electrical Power Output Characteristics

3.7.1.3.1 DC Power

| | |
|---|---|
| Voltage range : | 22.4 – 32 V |
| Source impedance : | see para 3.9 |
| All other characteristics : | same as given in para 3.2.3.1 |

3.7.1.3.2 AC Power

| | |
|---|---|
| Voltage range : | 106 – 120.5 $V_{rms}$ line-to-neutral |
| | 183 – 210 $V_{rms}$ line-to-line |
| Source impedance : | see para 3.9 |
| All other characteristics : | same as given in para 3.2.3.2 |

3.7.1.4 Fusing

3.7.1.4.1 DC Power Output
Same as 3.2.4.1 ( J 12 )

3.7.1.4.2 AC Power Output
Same as 3.2.4.2 ( J 09 )

3.7.1.5 Bonding
Same as 3.1.5

3.7.1.6 Grounding
Same as 3.1.6

3.7.1.7 Conducted Emission on Power and Power Return Lines

3.7.1.7.1 DC Power Lines
Same as 3.1.7.1

3.7.1.7.2 AC Power Lines
Same as 3.1.7.2

3.7.2 Connector Bracket CB 26

3.7.2.1. Connector Location on CB 26

Figure 3.7. - 3 depicts the power connector location of the CB 26.

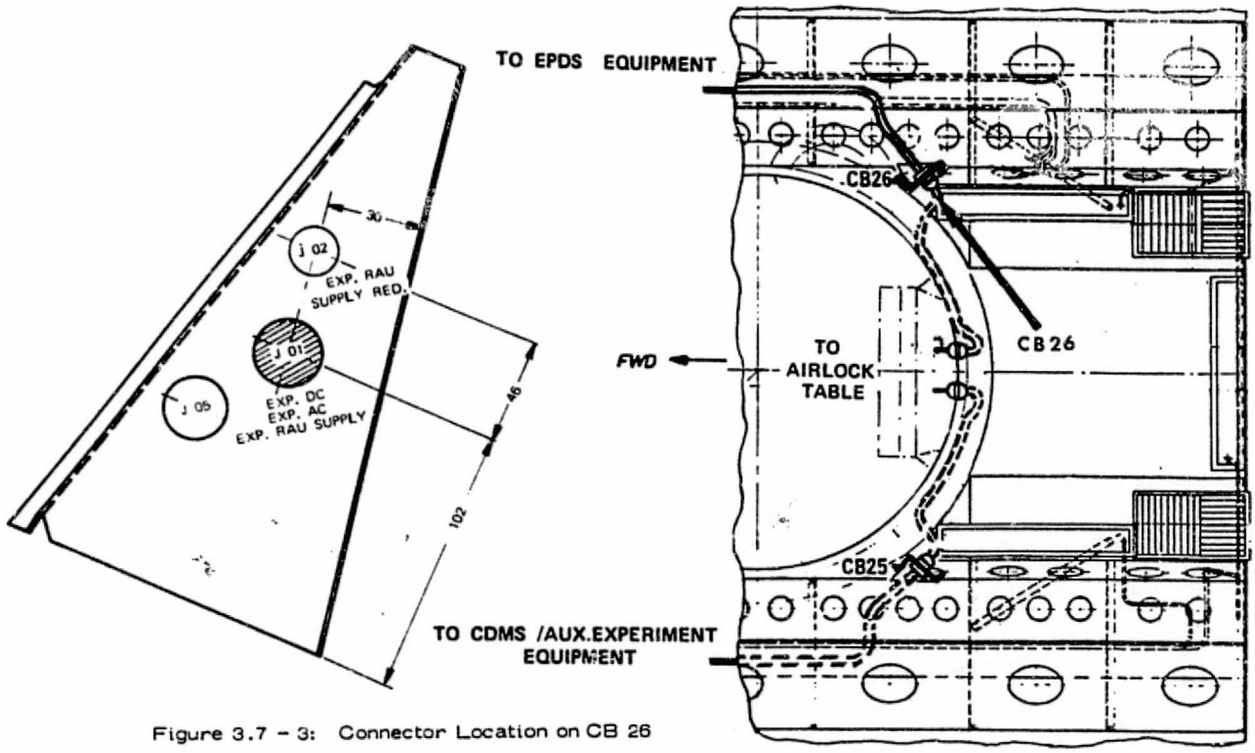



Figure 3.7 - 3: Connector Location on CB 26

3.7.2.2 Pin Allocation of Experiment Power Connector

Table 3.7 - 2: Pin Allocation List of CB 26 Power Connector for Payloads

| Connector Notation | Power Outlet Notation | Pin Notation | Pin Function | Nominal Voltage | Maximum Current | Spacelab Connector Type ( Spec.) | Experiment Connector Type ( Spec.) |
|---|---|---|---|---|---|---|---|
| J 01 | Exp.DC | J<br>K<br>M<br>L | PWR<br>PWR Rtn<br>PWR [twin line]<br>PWR Rtn | 28 V DC<br>28 V DC | 7 A | NBOE 14-12 SNS | NB 6 E 14-12 PN |
| | Exp. AC | B<br>A<br>H<br>G | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 $V_{rms}$ | 3 x 3 $A_{rms}$ | (Spec. 40 M 39569) | (Spec. 40M39569) |
| | Exp. RAU Supply 3 ( no exp. interface) | C<br>D | PWR<br>PWR Rtn | 28 V DC | 10 A | | |

For DC power the use of both twinlines is necessary to accommodate the maximum current.

3.7.2.3 Electrical Power Output Characteristics

same as 3.7.1.3

3.7.3 Connector Bracket CB 28

3.7.3.1 Connector Location on CB 28

Figure 3.7 – 4 depicts the connector location on CB 28

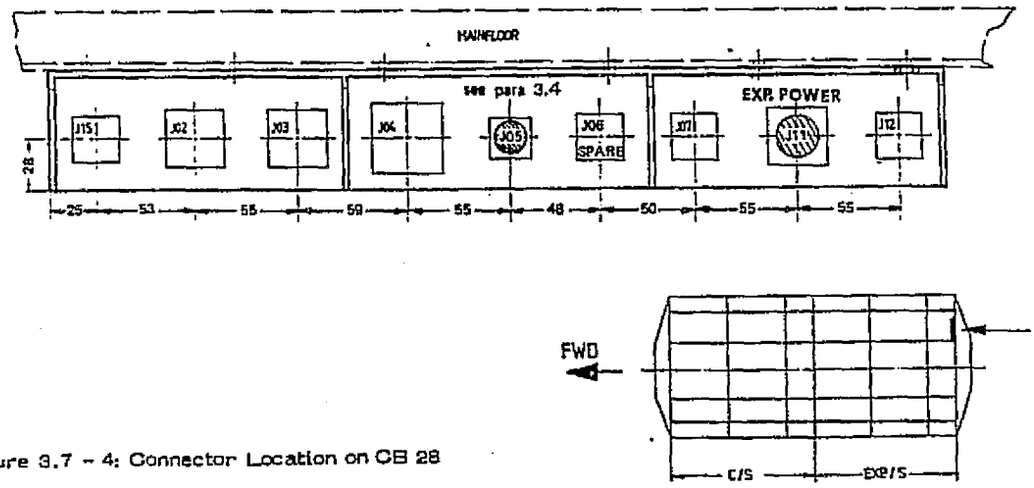



Figure 3.7 – 4: Connector Location on CB 28

3.7.3.2 Pin Allocation of Experiment Power Connector

Table 3.7 – 3: Pin Allocation List of CB 28 Power Connector for Payloads

| Connector Notation | Power Outlet Notation | Pin Notation | Pin Function | Nominal Voltage | Maximum Current | Spacelab Connector Type ( Spec.) | Experiment Connector Type ( Spec.) |
|---|---|---|---|---|---|---|---|
| J 11 | Exp. DC | J<br>K<br>M<br>L | PWR<br>PWR Rtn<br>PWR (twinline)<br>PWR Rtn (twinline) | 28 V DC<br>28 V DC | 7 A | NBOE 14-12 SNS (Spec. 40 M 39569 ) | NB 6 E 14-12 PN (Spec. 40 M 39569 ) |
| | Exp. AC | B<br>A<br>H<br>G | Phase A<br>Phase B<br>Phase C<br>Neutral | 115/200 $V_{rms}$ | 3 x 3 $A_{rms}$ | | |
| | Exp. RAU Supply 1 ( no exp. interface) | C<br>D | PWR<br>PWR Rtn | 28 V DC | 10 A | | |

For DC power the use of both twinlines is necessary to accomodate the maximum current.

3.7.3.3 Electrical Power Output Characteristics

3.7.3.3.1 DC Power
Same as 3.2.3.1

3.7.3.3.2 AC Power
Same as 3.2.3.2

3.7.3.4 Fusing

3.7.3.4.1 DC Power Output
Same as 3.2.4.1 ( J 12 )

3.7.3.4.2 AC Power Output
Same as 3.2.4.2 ( J 09 )

3.7.3.5 Bonding
Same as 3.1.5

3.7.3.6 Grounding
Same as 3.1.6

3.7.3.7 Conducted Emission on Power and Power Return Lines

3.7.3.7.1 DC Power Lines
Same as 3.1.7.1

3.7.3.7.2 AC Power Lines
Same as 3.1.7.2

3.8 Experiment Power Supply on the IPS

TBD

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3.9 Steady State Impedances of the EPDS

The intention of this para is to provide the user with impedances to calculate voltage drops and voltage levels up to and at the experiment power interface. The impedance figures shown in the following sections are composed of harness impedance for supply and return line, connector, switch and internal box impedances. The values given below are best estimates, except for the harness impedances which are well known. The behaviour of the distribution system has not been reflected with respect to transients and spikes, i.e. all figures are only valid for steady state conditions.

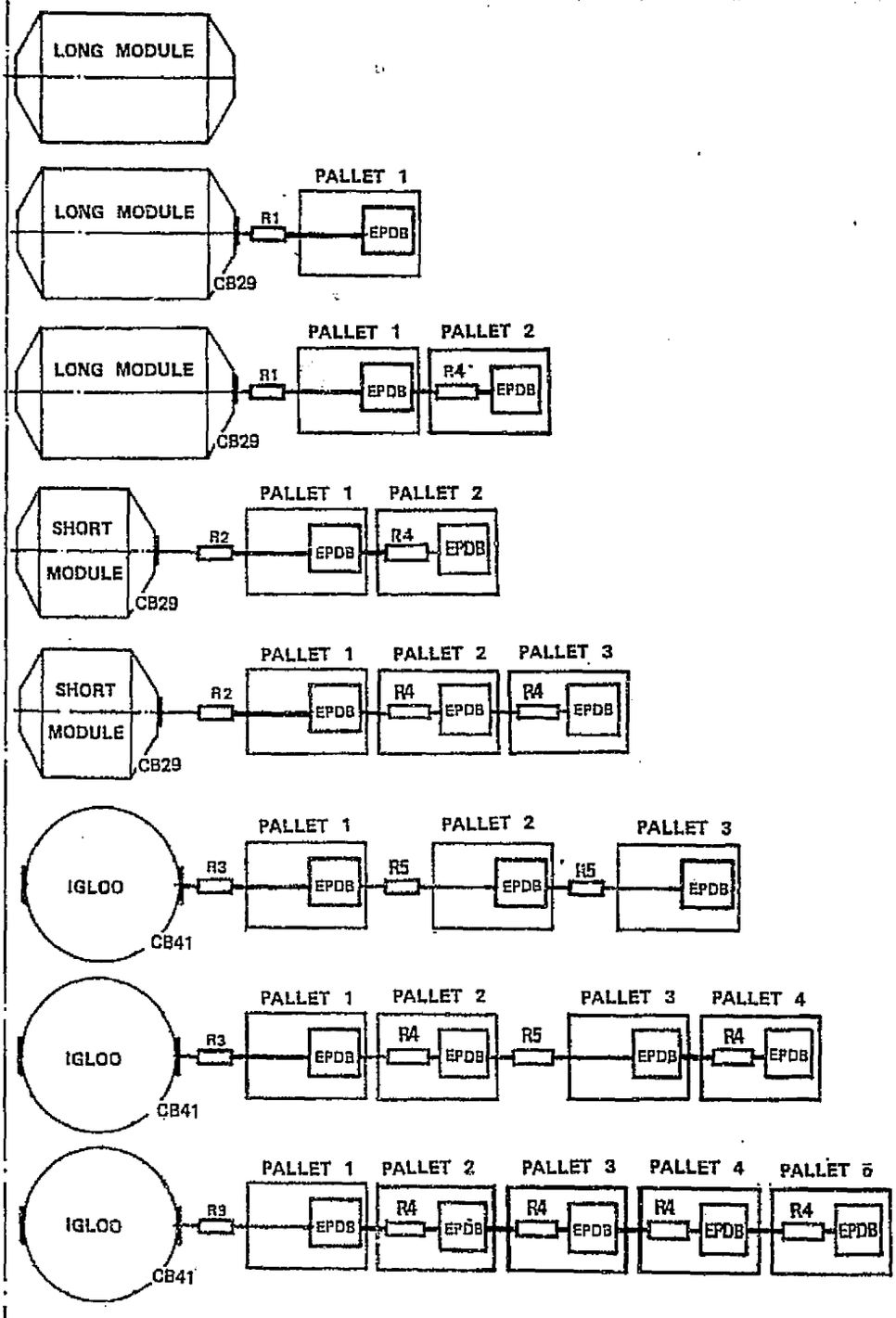
3.9.1 Impedances of the Experiment Main DC Power Supply

The ICD - 2 - 05301 defines the on-orbit voltage level at the Orbiter/Spacelab interface (CB 1 or CB 41 respectively) for primary DC. The voltage level is specified to be within a range of 26.6 V - 32 V for loads varying between 12 KW and 2 KW. However, the minimum value of 26.6 V is only preliminary.

For the harness impedance between fuel cell and the Orbiter/Spacelab interface only tentative data is available. Assuming 4.1 mΩ for this impedance the total impedance between the fuel cell and the branching point of the subsystem and the experiment bus is 5.2 mΩ.

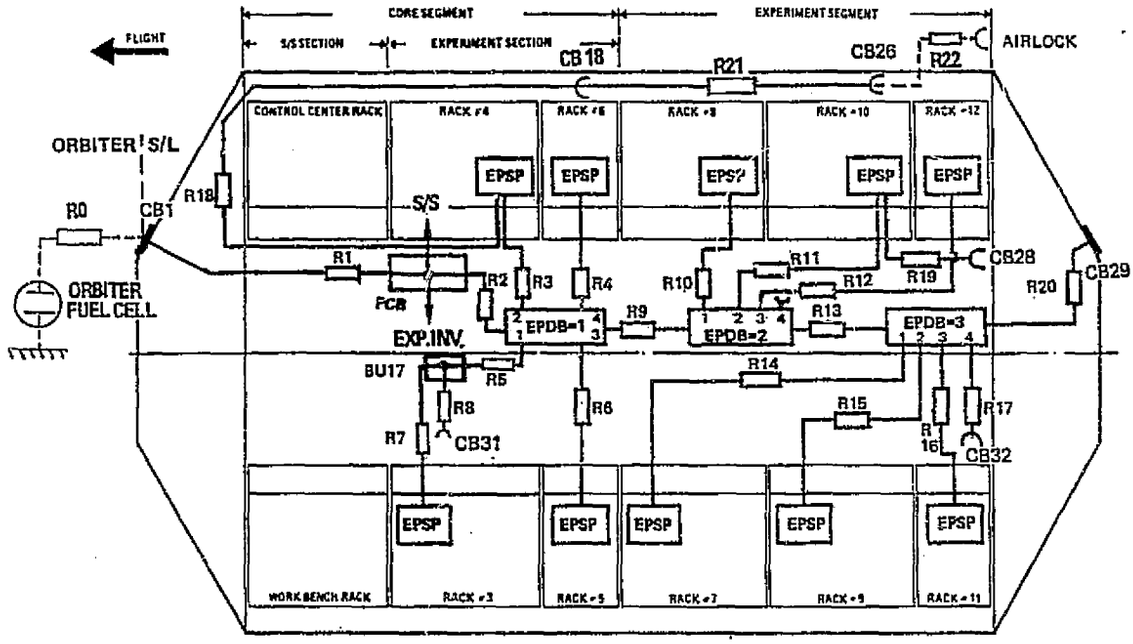
Voltage drops and harness losses up to this branching point can be calculated by taking into account the total subsystem loads defined in Table 3 - 11 of the SPAH main volume plus the actual experiment loads.

Figures 3.9 -1 thru 3.9 -5 depict distribution impedances for Experiment Main DC power.




| ITEM | | R1 | R2 | R3 | R4 | R5 |
|---|---|---|---|---|---|---|
| (m Ω) | | 1.3 | 1.3 | 0.7 | 0.6 | 1.5 |

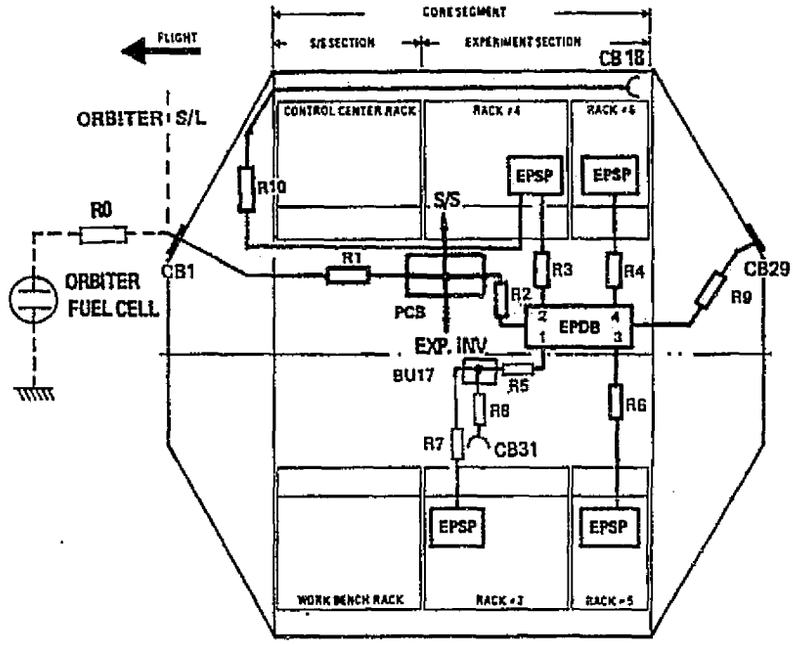
Figure 3.9 - 1 : Impedances of the Experiment DC Power Supply




| ITEM | R0 | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 | R11 | R12 | R13 | R14 | R15 | R16 | R17 | R18 | R19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (m Ω ) | 4,1 | 1,1 | 1,0 | 12,9 | 14,2 | 4,9 | 11,9 | 9,1 | 2,8 | 0,3 | 8,9 | 10,2 | 12,9 | 0,9 | 15,5 | 12,9 | 11,6 | 8,9 | 159 | 60,4 |

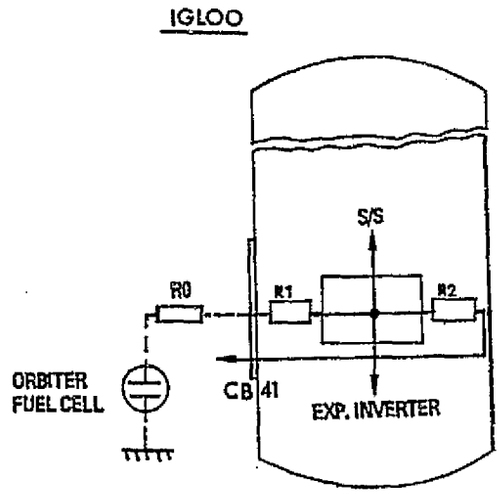
| R20 | R21 | R22 |
|---|---|---|
| 0,3 | 45,0 | 76,0 |

Figure 3.9 - 2 : Impedances of the Experiment DC Power Supply - Long Module




| ITEM | R0 | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (m Ω) | 4.1 | 1.1 | 1.0 | 12.9 | 14.2 | 4.9 | 11.9 | 9.1 | 2.8 | 0.3 | |

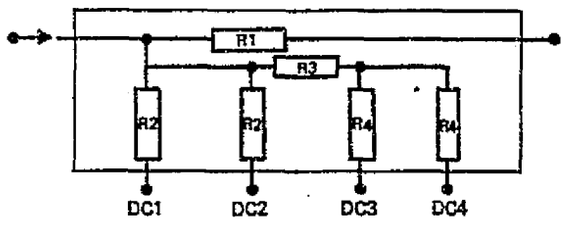
Figure 3.9 - 3 : Impedances of the Experiment DC Power Supply - Short Module




| ITEM | R0 | R1 | R2 |
|---|---|---|---|
| (m Ω) | 4.1 | 1.1 | 0.6 |

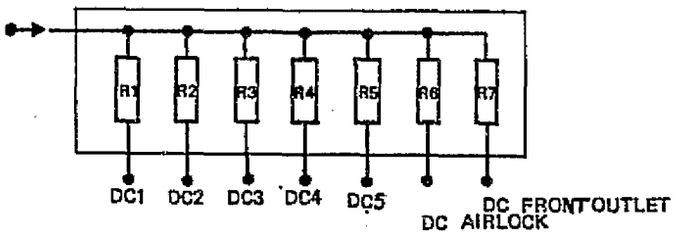
Figure 3.9 - 4: Impedances of the Experiment DC Power Supply - Igloo

EPDB




| ITEM | R1 | R2 | R3 | R4 |
|---|---|---|---|---|
| (m Ω ) | 0.1 | 3.1 | 2.9 | 0.15 |

EPSP



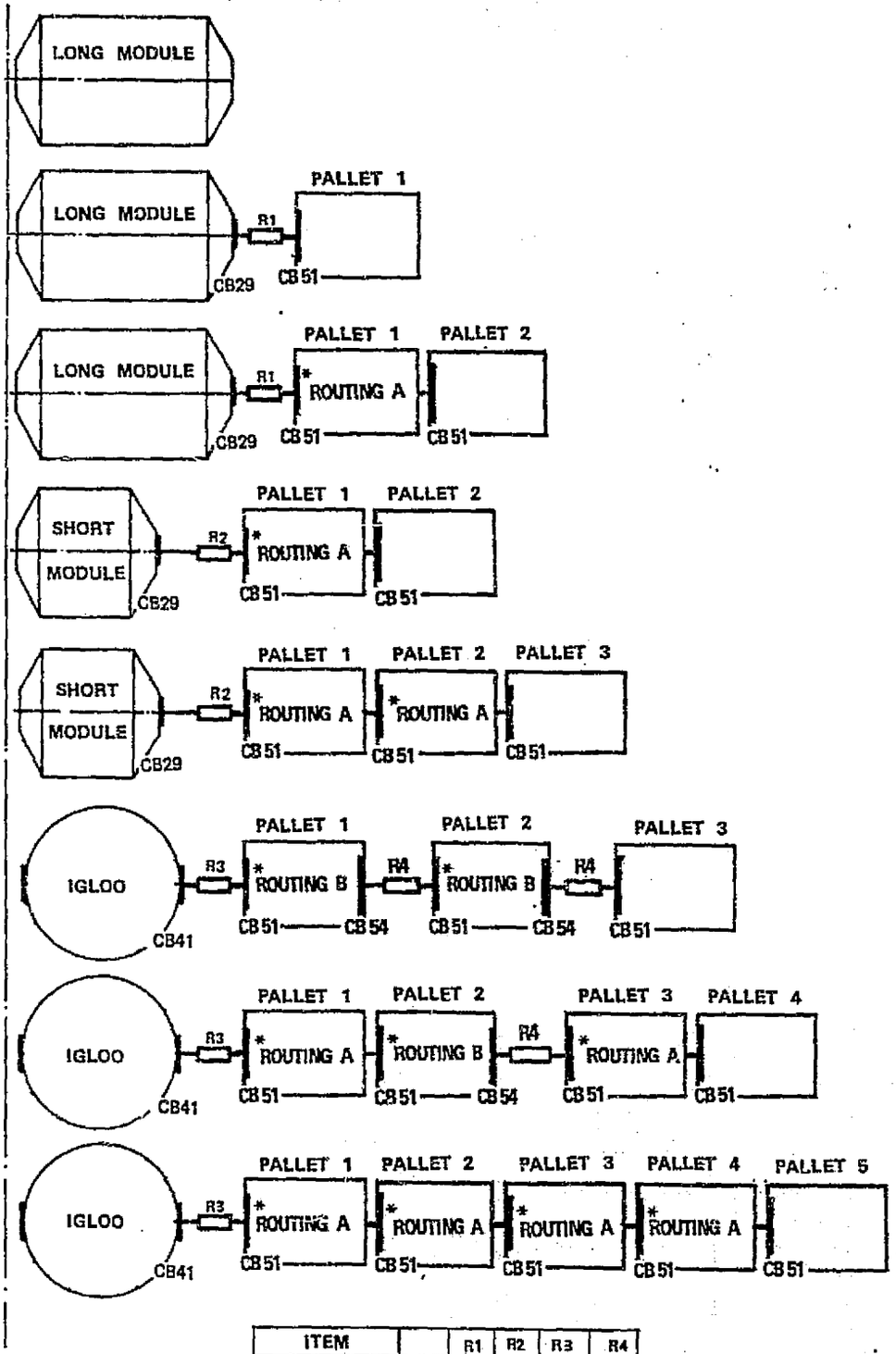

| ITEM | R1 | R2 | R3 | R4 | R5 | R6 | R7 |
|---|---|---|---|---|---|---|---|
| (m Ω ) | 7.9 | 9.2 | 9.5 | 11.0 | 2.8 | 40.0 | 31.6 |

Figure 3.9 - 5 : Impedances of the Experiment DC Power Supply - Elements

3.9.2 Impedances of the Experiment Essential Power Supply

The on-orbit voltage range at the Orbiter/Spacelab interface (CB 1 or CB 41) is 25.7 V to 32 V (see ICD-2-05301). The path between CB 1 or CB 41, respectively, and the emergency box (see Figure 3.9 -7 thru 3.9 -9) is common for subsystem emergency, subsystem essential and experiment essential power. Thus subsystem loads have also to be considered to calculate the voltage level at the emergency box output for experiment essential power.

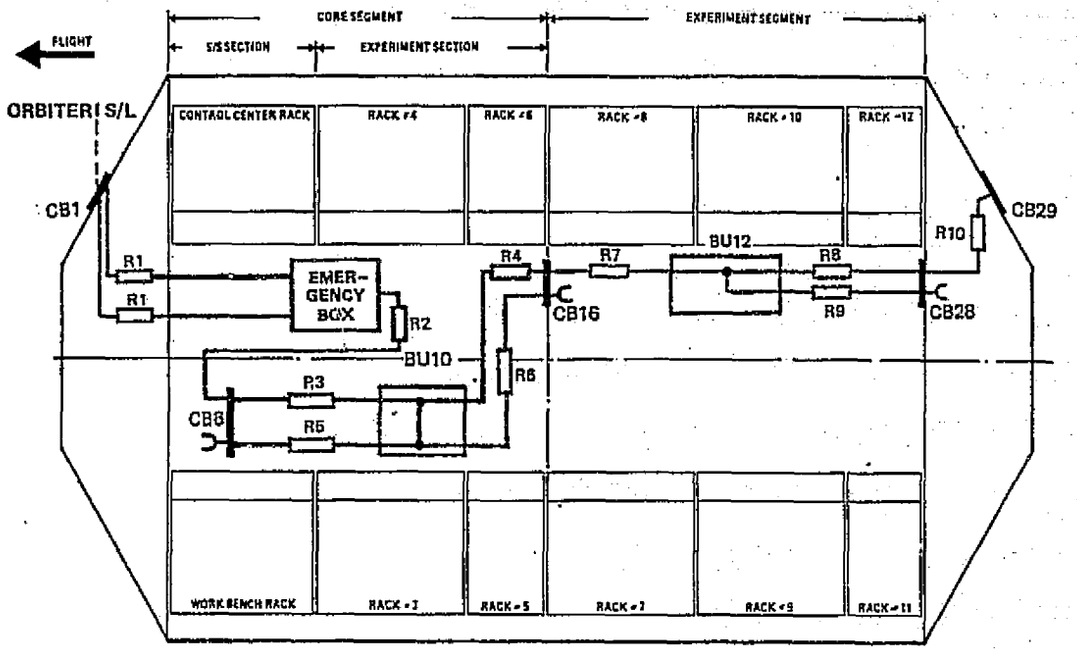
Figures 3.9 -6 thru 3.9 -10 depict the distribution impedances of the experiment essential power supply.




| ITEM | | R1 | R2 | R3 | R4 |
|---|---|---|---|---|---|
| (m Ω) | | 1.3 | 1.3 | 0.7 | 144 |

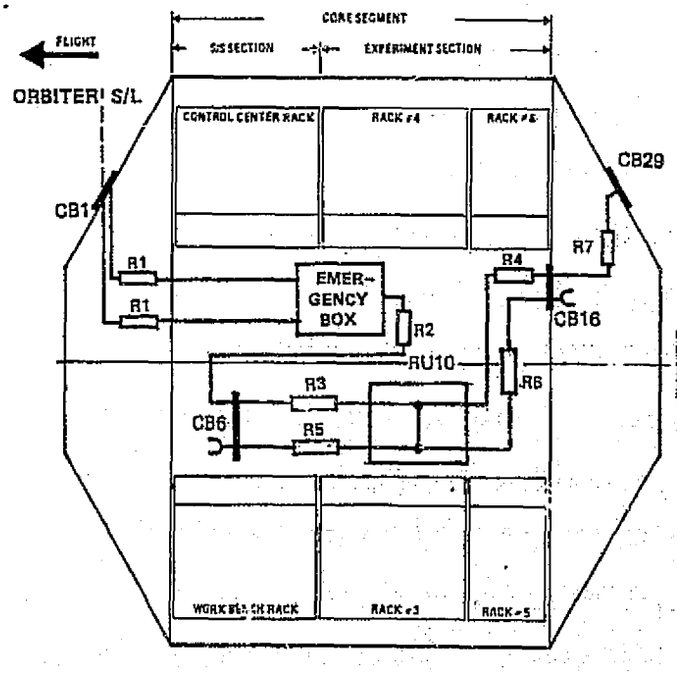
* FOR PALLET EXP. ESSENTIAL POWER IMPEDANCES SEE FIGURE 3.9-10

Figure 3.9 - 6: Impedances of the Experiment Essential Power Supply



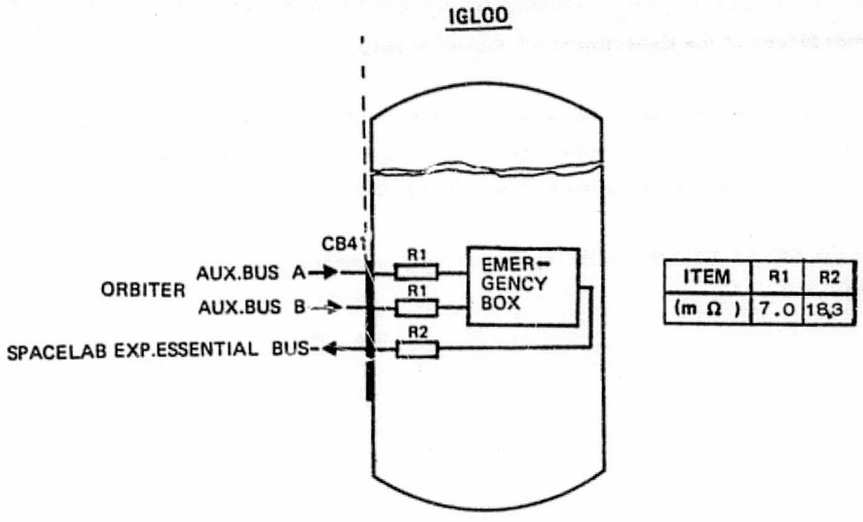

| ITEM | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 |
|---|---|---|---|---|---|---|---|---|---|---|
| (m Ω ) | 14,9 | 47.5 | 2 .9 | 39,4 | 22.9 | 39,4 | 72,9 | 37.9 | 37.9 | 55.0 |

Figure 3.9 – 7: Impedances of the Experiment Essential Power Supply – Long Module



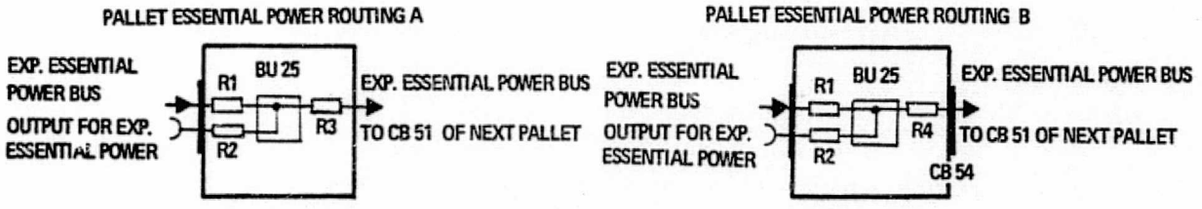

| ITEM | R1 | R2 | R3 | R4 | R5 | R6 | R7 |
|---|---|---|---|---|---|---|---|
| (m Ω ) | 14,9 | 47,5 | 2 .9 | 39,4 | 22 .9 | 39,4 | 55,0 |

Figure 3.9 – 8: Impedances of the Experiment Essential Power Supply – Short Module

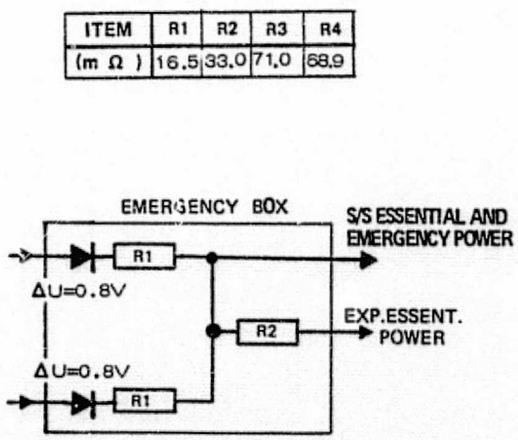



| ITEM | R1 | R2 |
|---|---|---|
| (m Ω ) | 7.0 | 18,3 |

Figure 3.9 - 9: Impedances of the Experiment Essential Power Supply-Igloo




| ITEM | R1 | R2 | R3 | R4 |
|---|---|---|---|---|
| (m Ω ) | 16,5 | 33,0 | 71,0 | 68,9 |



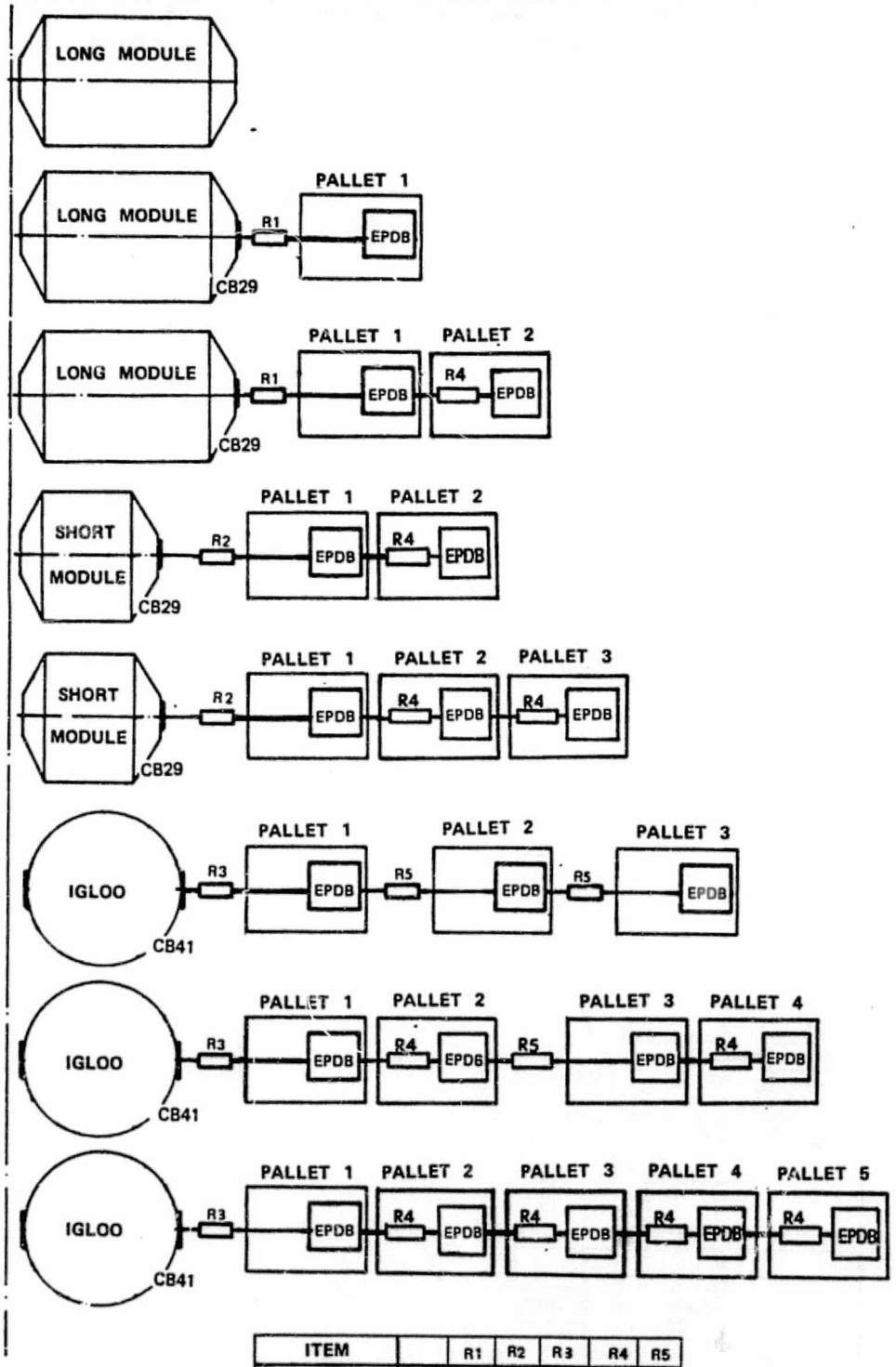

| ITEM | R1 | R2 |
|---|---|---|
| (mΩ) | 8.25 | 24.75 |

Figure 3.9 -10; .Impedances of the Experiment Essential Power Supply - Elements

3.9.3 Impedances of the Experiment AC Power Supply

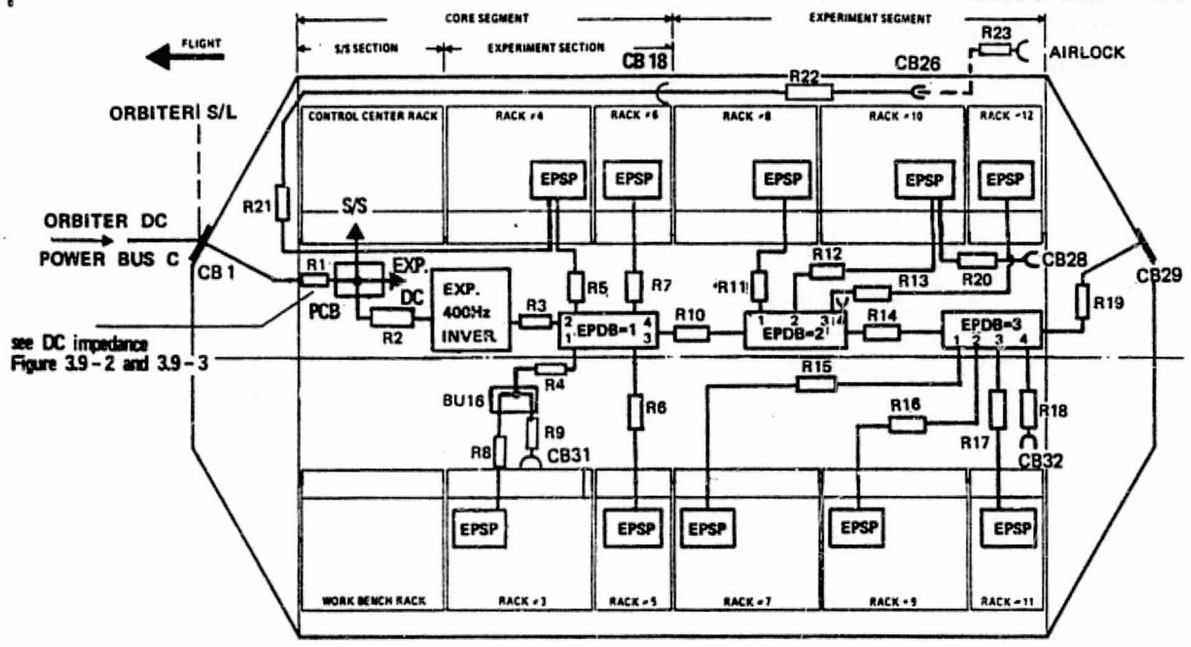
The power source for Experiment 400 Hz AC power is for normal loads the Experiment 400 Hz inverter. However, in the case of minor experiment AC loads the experiment inverter may be switched off and experiments will be supplied by the identical S/S inverter.

The impedances of the 400 Hz AC distribution system for experiments are shown in figures 3.9 -11 thru. 3.9 - 15.



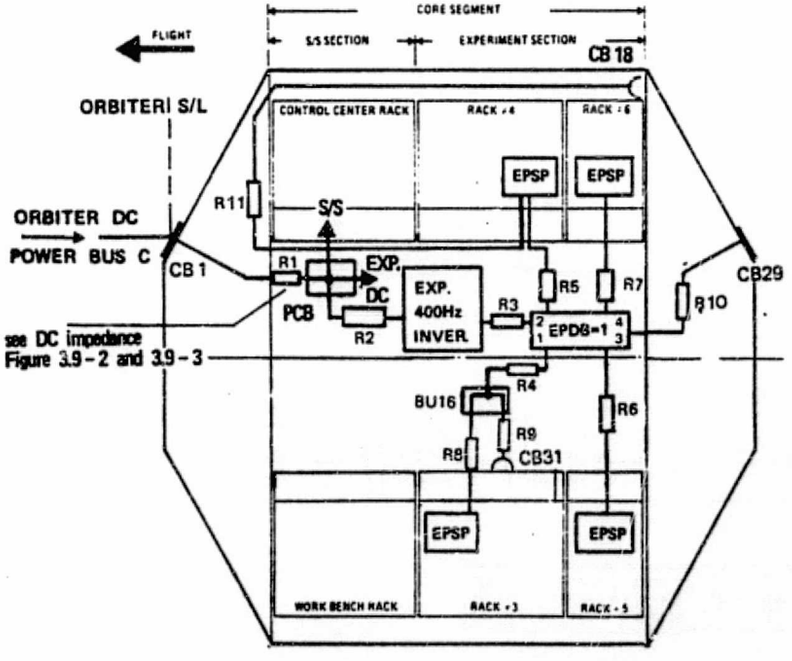

| ITEM | | R1 | R2 | R3 | R4 | R5 |
|---|---|---|---|---|---|---|
| (m Ω ) | | 89,0 | 89,0 | 58,0 | 83,0 | 209 |

Figure 3.9 - 11: Impedances of the Experiment AC Power Supply



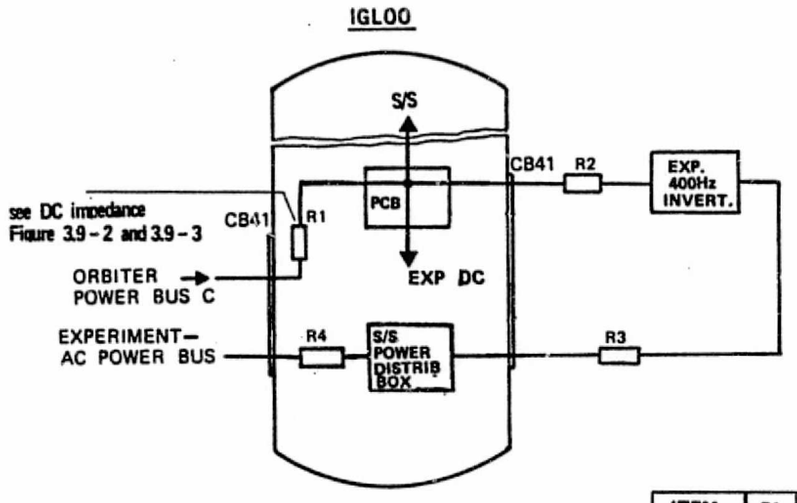

| ITEM | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 | R11 | R12 | R13 | R14 | R15 | R16 | R17 | R18 | R19 | R20 | R21 | R22 | R23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (m Ω ) | 1.1 | 6.0 | 53.5 | 24.5 | 70.0 | 66.5 | 66.5 | 45.5 | 17.4 | 22.5 | 70.0 | 70.0 | 79.0 | 44.5 | 79.0 | 70.0 | 66.5 | 44.0 | 22.5 | 58.8 | 689 | 82.0 | 17.4 |

Figure 3.9 - 12: Impedances of the Experiment AC Power Supply - Long Module



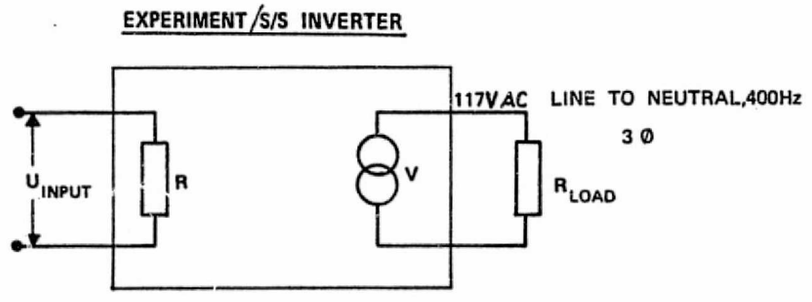

| ITEM | R1 | R2 | R3 | R4 | R5 | R6 |
|---|---|---|---|---|---|---|
| (m Ω ) | 1.1 | 6.0 | 53.5 | 24.5 | 70.0 | 66.5 |
| | R7 | R8 | R9 | R10 | R11 | |
| | 66.5 | 45.5 | 17.4 | 22.5 | 689 | |

Figure 3.9 - 13: Impedances of the Experiment AC Power Supply - Short Module

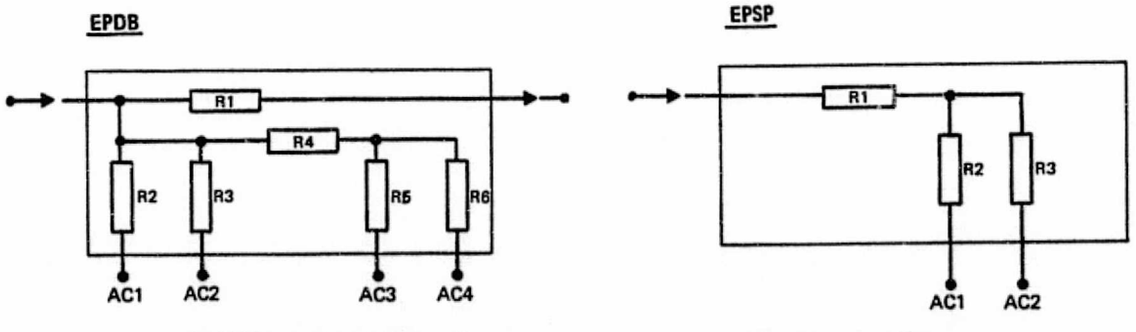



| ITEM | R1 | R2 | R3 | R4 |
|---|---|---|---|---|
| (m Ω) | 1.1 | 7.8 | 119 | 54.0 |

Figure 3.9 - 14: Impedances of the Experiment AC Power Supply-Igloo




$R = R(U_{Input}, R_{Load})$ see also App. A Figure 3.1 - 2




| ITEM | R1 | R2 | R3 | R4 | R5 | R6 |
|---|---|---|---|---|---|---|
| (m Ω) | 7.0 | 21.5 | 21.5 | 11.0 | 22.0 | 23.5 |

| ITEM | R1 | R2 | R3 |
|---|---|---|---|
| (m Ω) | 5.1 | 510 | 508 |

Figure 3.9 - 15: Impedances of the Experiment AC Power Supply - Elements

3.9.4 Impedances of the IPS Experiment Power Supply

TBD

3.10 Dynamic Experiment Power Bus Impedances

3.10.1 Experiment DC Main Bus

The dynamic source impedance of the Orbiter DC bus at the Spacelab interface plane is shown in Figures 3.10 - 1 and 3.10 - 2. The Spacelab dynamic bus impedance as seen from the EPDS outlets is shown in Figure 3.10 - 3, which will be supplied at a later date.

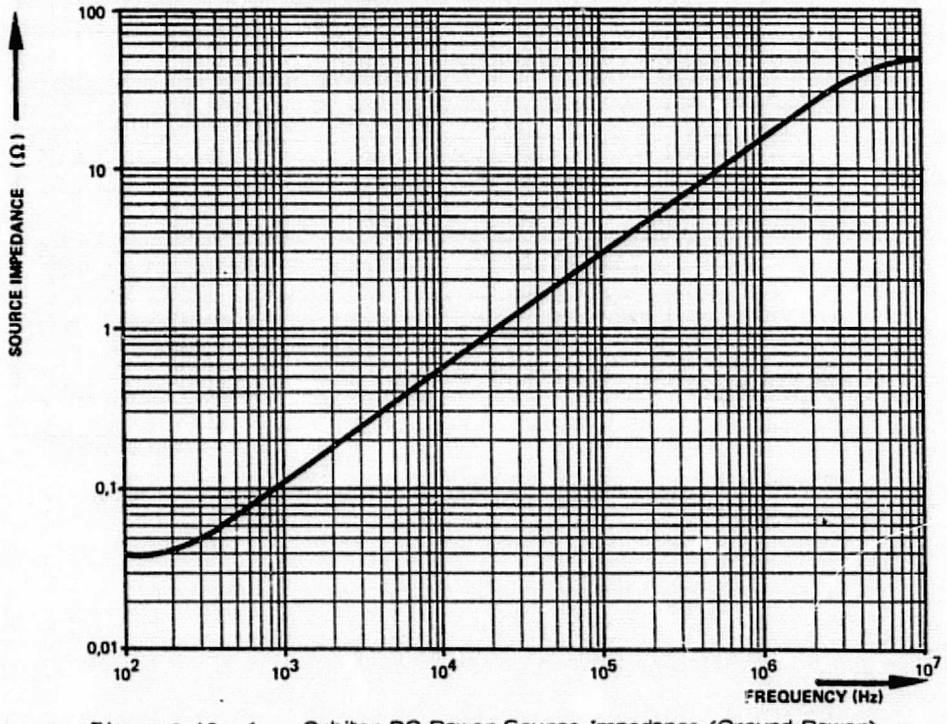



Figure 3.10 - 1 Orbiter DC Power Source Impedance (Ground Power)

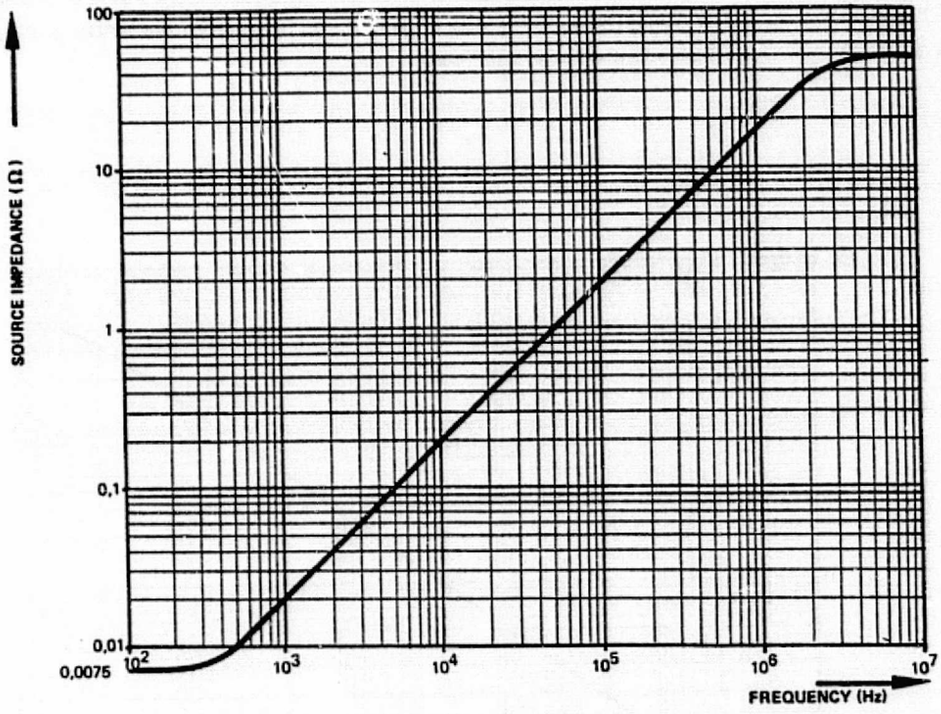



Figure 3.10 - 2 Orbiter DC Power Source Impedance (In-Flight)

TBS

Figure 3.10 - 3: Spacelab Dynamic Power Bus Impedance

3.10.2 Experiment Essential Power Bus

The dynamic source impedance of the Orbiter auxiliary busses at the Orbiter/Spacelab interface is the same one as shown in Figure 3.10 - 2. Dynamic source impedances at the Spacelab experiment essential power outlets are TBD.

3.10.3 Experiment AC Power Bus

The dynamic AC power bus impedance as seen from the experiment dedicated AC power outlets is shown in Figure 3.10 - 4 . This diagram depicts mainly the inverter source impedance above 1 kHz under minimum and maximum load conditions.

The impedances below 1 KHz should be evaluated using the impedances given in para 3.9 .

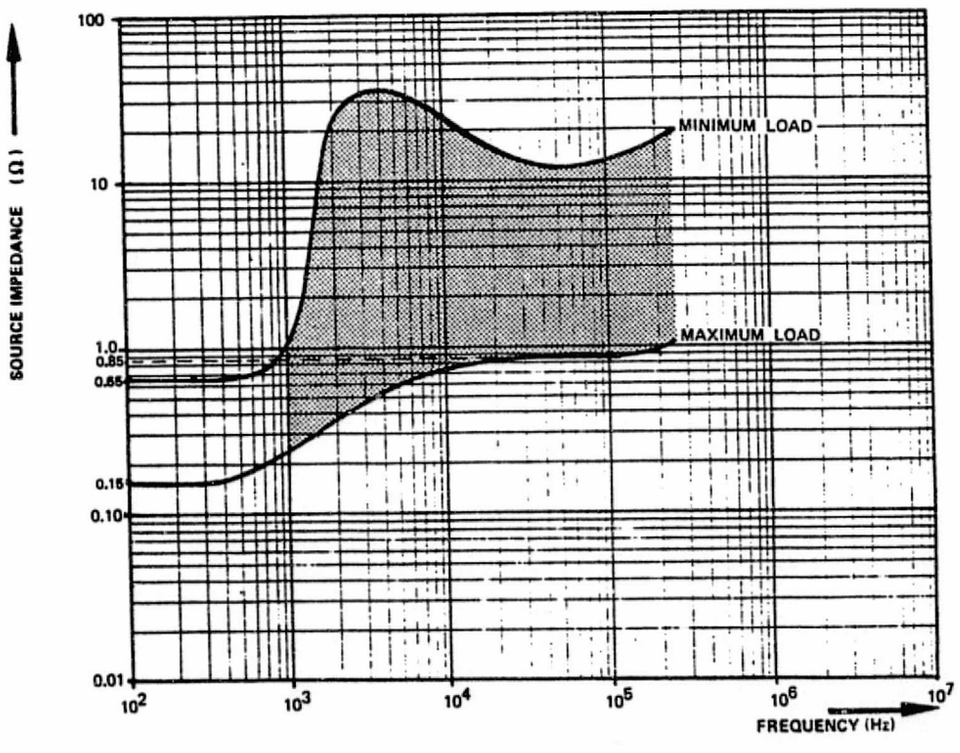



Figure 3.10 - 4: Spacelab AC Source Impedance Characteristics (Phases to Neutral)

3.10.4 Experiment AFD Power

The dynamic Orbiter DC source impedance at the AFD power distribution box interface plane is shown in Figure 3.10 – 2 . It is expected that the AFD power distribution box itself will provide only a negligible contribution to the dynamic source impedance, as seen by the experiment.

The dynamic Orbiter AC source impedance as seen from the AFD is still TBD.

# 4. COMMAND AND DATA MANAGEMENT SUBSYSTEM

## 4.1 Experiment Remote Acquisition Unit (Experiment RAU)

### 4.1.1 Connector Location

Figure 4.1. - 1 depicts the connector location of the experiment RAU. Three types of connectors are used, a 25-pole, a 38-pole and an 88-pole type.

25-pole connector (receptacle equipped with pins)

| | |
|---|---|
| G 311 P 405 - 3P - B - 12 | J 01, J 02 , J 19 |

38-pole connector (receptacle equipped with pins)

| | |
|---|---|
| GWSW 038 BN RPFB | J 04, J 09 , J 13 , J 16 |
| GWSW 038 BV RPFB | J 05 , J 14 , J 17 |
| GWSW 038 BW RPFB | J 07, J 11, J 15, J 18 |

88-pole connector (receptacle equipped with pins)

| | |
|---|---|
| GWSW 088 BN RPFB | J 06, J 10 |
| GWSW 088 BV RPFB | J 03, J 08, J 12 |

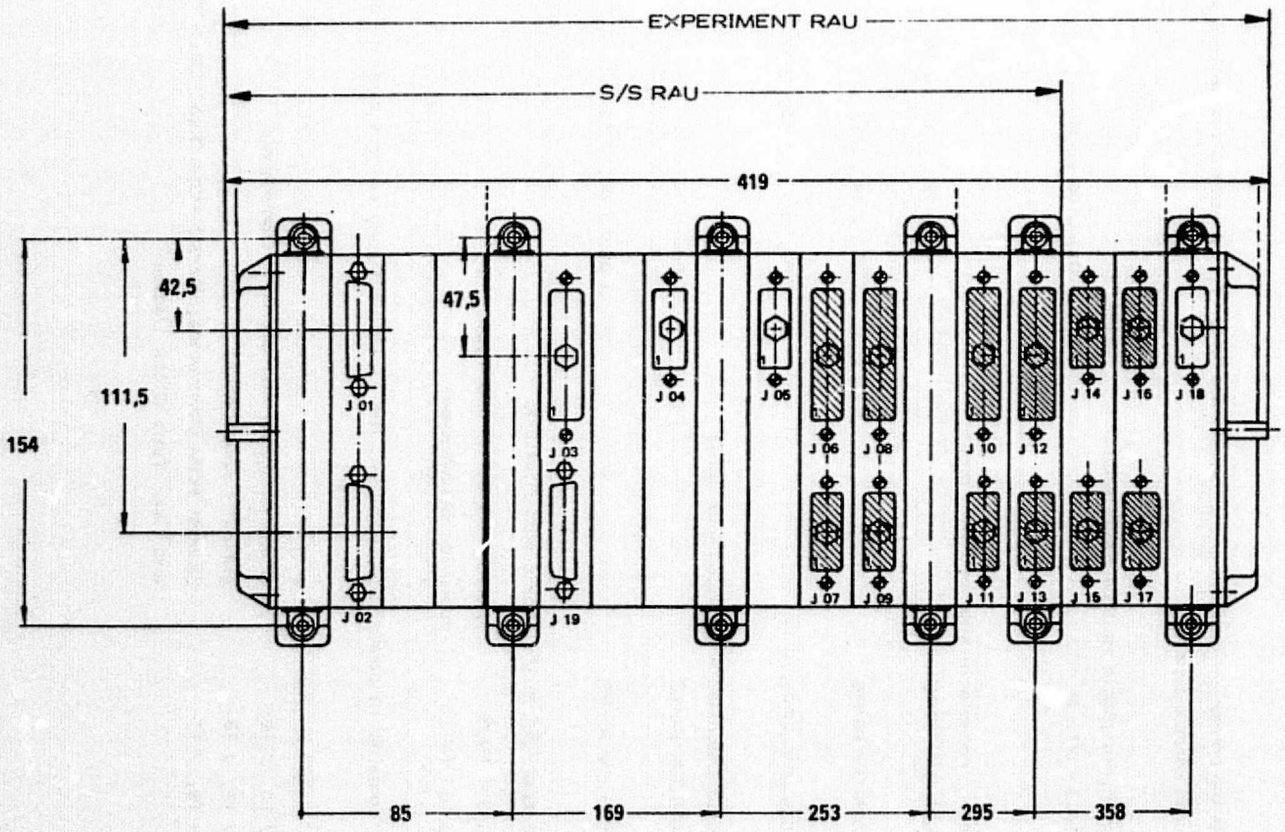
These connectors are specified in the GSFC specifications:

| | |
|---|---|
| GSFC-S-311-P4/5 | (appl. for G 311 P 405-Type) |
| GSFC-S-311-P4/1 | (appl. for GWSW-type) |

The experiment RAU contains 19 connectors, however, the experiment may connect directly only to the following connectors:

| | |
|---|---|
| J 06, J 08, J 10, J 12 | (Flexible inputs and ON/OFF Commands) |
| J 07, J 09, J 11, J 13 | (ON/OFF Commands) |
| J 14, J 15, J 16, J 17 | (Serial PCM Commands, Serial PCM Data, User Time Clock, and User Time Clock Update) |

Note: Unused connectors should be protected against EMI by metal :c covers provided by Spacelab.




Note: J06 through J17 have a direct interface to the user.

Figure 4.1 - 1: Experiment RAU Connector Location

The function of each user connector is depicted in Table 4.1 - 1.

Table 4.1 - 1: Experiment RAU User Connector Functions

| Spacelab Experiment RAU | | | Experiment |
|---|---|---|---|
| Not. | Function | Receptacle | Plug |
| J 06 | 32 Flexible Inputs 4 ON/OFF Commands | GWSW 088 BN RPFB | GWSW 088 BN PSHB |
| J 08 | | " BV " | " BV " |
| J 10 | | " BN " | " BN " |
| J 12 | | " BV " | " BV " |
| J 07 | 12 ON/OFF Commands | GWSW 038 BW RPFB | GWSW 088 BW PSHB |
| J 09 | | " BN " | " BN " |
| J 11 | | " BW " | " BW " |
| J 13 | | " BN " | " BN " |
| J 14 | Serial PCM Command Channel (one) | GWSW 038 BV RPFB | GWSW 038 BV PSHB |
| J 15 | Serial PCM Data Channel (one) | " BW " | " BW " |
| J 16 | | " BN " | " BN " |
| J 17 | User Time Clock Channel (one) | " BV " | " BV " |

In case that the experimenter is responsible for the Experiment RAU accomodation, he has to provide additionally the harness between the Experiment RAU and dedicated Spacelab CDMS and EPDS connectors. This applies to the RAU connectors

| | |
|---|---|
| J 01, J 02 | (Power Interface) |
| J 03 | (Monitoring and Control) |
| J 04, J 05 | (CDMS Data/Command Bus) |
| J18 | (CDMS UTC Bus) |
| J19 | (RAU Adress Connector) |

More details are given in Section 8.1

As shown in Table 4.1 – 1 the RAU Experiment connectors have pin allocations that provide for :

- Flexible Inputs

  Twisted pair for each flex. input, 4 twisted pairs belonging to the same block address will have a common shield.

- ON/OFF Commands

  Twisted shielded pair for each ON/OFF command output

- Serial PCM Commands

  Twisted shielded pair for each serial PCM command and clock output.

- Serial PCM Data

  Twisted shielded pair for each data input, request input, and clock output.

- User Time Clock

  Twisted shielded pair for each user time clock and user time clock update output.

For flexible input addresses, reference is made to para 4.4.2.1.4.2, Data Transfer, in the main volume of SPAH. Table 4.1 – 2 depicts the cross references of connector notations, block addresses and channel addresses.

ON/OFF command channels, serial PCM command channels and serial PCM data channels have a channel address only. The Tables 4.1 – 2, 4.1 – 3 and 4.1 – 4 depict the cross references of connector notation and addresses.

4.1.2 Pin Allocation of Experiment RAU Connectors for Signals to/from Experiment

The pin allocation is given in Table 4.1 - 2 through 4.1 - 4.

Table 4.1 - 2: Pin Allocation of RAU Connectors J 06, J 08, J 10, and J 12

| Pin Not | Signal Code | Function | J06 | | J08 | | J10 | | J12 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Block Addr. | Ch'nl Addr. | Block Addr. | Ch'nl Addr. | Block Addr. | Ch'nl Addr. | Block Addr. | Ch'nl Addr. |
| 1 | ON/OFF CMD | Line | N/A | 12 | N/A | 28 | N/A | 44 | N/A | 60 |
| 2 | | Return | | | | | | | | |
| 3 | | Shield | | | | | | | | |
| 4 | Flex. Input | Line | 0 | 0 * | 0 | 1 | 4 | 64* | 4 | 65 |
| 5 | | Return | | | | | | | | |
| 6 | Flex. Input | Line | | 2 | | 3 | | 66 | | 67 |
| 7 | | Return | | | | | | | | |
| 8 | Flex. Input | Line | | 4 | | 5 | | 68 | | 69 |
| 9 | | Return | | | | | | | | |
| 10 | Flex. Input | Line | | 6 | | 7 | | 70 | | 71 |
| 11 | | Return | | | | | | | | |
| 12 | Flex. Input | Line | | 8 | | 9 | | 72 | | 73 |
| 13 | | Return | | | | | | | | |
| 14 | Flex. Input | Line | | 10 | | 11 | | 74 | | 75 |
| 15 | | Return | | | | | | | | |
| 16 | Flex. Input | Line | | 12 | | 13 | | 76 | | 77 |
| 17 | | Return | 0 | | 0 | | 4 | | 4 | |
| 18 | Block Shield | Shield | | N/A | | N/A | | N/A | | N/A |
| 19 | ON/OFF CMD | Line | N/A | 13 | N/A | 29 | N/A | 45 | N/A | 61 |
| 20 | | Return | | | | | | | | |
| 21 | | Shield | | | | | | | | |
| 22 | Spare | | | | | | | | | |
| 23 | Block Shield | Shield | | N/A | | N/A | | N/A | | N/A |
| 24 | Flex. Input | Line | 0 | 14 | 0 | 15 | 4 | 78 | 4 | 79 |
| 25 | | Return | | | | | | | | |
| 26 | Flex. Input | Line | 1 | 16 * | 1 | 17 | 5 | 80 * | 5 | 81 |
| 27 | | Return | | | | | | | | |
| 28 | Flex. Input | Line | | 18 | | 19 | | 82 | | 83 |
| 29 | | Return | | | | | | | | |
| 30 | Flex. Input | Line | | 20 | | 21 | | 84 | | 85 |
| 31 | | Return | | | | | | | | |
| 32 | Flex. Input | Line | | 22 | | 23 | | 86 | | 87 |
| 33 | | Return | | | | | | | | |
| 34 | Flex. Input | Line | | 24 | | 25 | | 88 | | 89 |
| 35 | | Return | 1 | | 1 | | 5 | | 5 | |
| 36 | Block Shield | Shield | | N/A | | N/A | | N/A | | N/A |
| 37 | Connect Cover | Shield | | | | | | | | |
| 38 | Connect Cover | Shield | | | | | | | | |
| 39 | Block Shield | Shield | | N/A | | N/A | | N/A | | N/A |
| 40 | Block Shield | Shield | | N/A | | N/A | | N/A | | N/A |
| 41 | Flex. Input | Line | 1 | 26 | 1 | 27 | 5 | 90 | 5 | 91 |
| 42 | | Return | | | | | | | | |
| 43 | Flex. Input | Line | | 28 | | 29 | | 92 | | 93 |
| 44 | | Return | | | | | | | | |
| 45 | Flex. Input | Line | | 30 | | 31 | | 94 | | 95 |
| 46 | | Return | 1 | | 1 | | 5 | | 5 | |

* This bit will be transfered as MSB for discrete block scan.

Table 4.1 - 2 : Pin Allocation List of RAU Connectors J 06, J 08, J 10 and J 12 (Cont'd)

| Pin Not. | Signal Code | Function | J 06 | | J 08 | | J 10 | | J 12 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Block Addr. | Ch'nl Addr. | Block Addr. | Ch'nl Addr. | Block Addr. | Ch'nl Addr. | Block Addr. | Ch'nl Addr. |
| 47 | Flex. Input | Line | 2 | 32 * | 2 | 33 | 6 | 96 * | 6 | 97 |
| 48 | | Return | | | | | | | | |
| 49 | Flex. Input | Line | | 34 | | 35 | | 98 | | 99 |
| 50 | | Return | | | | | | | | |
| 51 | Flex. Input | Line | | 36 | | 37 | | 100 | | 101 |
| 52 | | Return | 2 | | 2 | | 6 | | 6 | |
| 53 | ON/OFF CMD | Line | N/A | 14 | N/A | 30 | N/A | 46 | N/A | 62 |
| 54 | | Return | | | | | | | | |
| 55 | | Shield | | | | | | | | |
| 56 | Spare | | | | | | | | | |
| 57 | Block Shield | Shield | | N/A | | N/A | | N/A | | N/A |
| 58 | Flex. Input | Line | 2 | 38 | 2 | 39 | 6 | 102 | 6 | 103 |
| 59 | | Return | | | | | | | | |
| 60 | Flex. Input | Line | | 40 | | 41 | | 104 | | 105 |
| 61 | | Return | | | | | | | | |
| 62 | Flex. Input | Line | | 42 | | 43 | | 106 | | 107 |
| 63 | | Return | | | | | | | | |
| 64 | Flex. Input | Line | | 44 | | 45 | | 108 | | 109 |
| 65 | | Return | | | | | | | | |
| 66 | Flex. Input | Line | | 46 | | 47 | | 110 | | 111 |
| 67 | | Return | 2 | | 2 | | 6 | | 6 | |
| 68 | Flex. Input | Line | 3 | 48 * | 3 | 49 | 7 | 112 * | 7 | 113 |
| 69 | | Return | | | | | | | | |
| 70 | Block shield | Shield | | N/A | | N/A | | N/A | | N/A |
| 71 | ON/OFF CMD | Line | N/A | 15 | N/A | 31 | N/A | 47 | N/A | 63 |
| 72 | | Return | | | | | | | | |
| 73 | | Shield | | | | | | | | |
| 74 | Flex. Input | Line | 3 | 50 | 3 | 51 | 7 | 114 | 7 | 115 |
| 75 | | Return | | | | | | | | |
| 76 | Flex. Input | Line | | 52 | | 53 | | 116 | | 117 |
| 77 | | Return | | | | | | | | |
| 78 | Flex. Input | Line | | 54 | | 55 | | 118 | | 119 |
| 79 | | Return | | | | | | | | |
| 80 | Flex. Input | Line | | 56 | | 57 | | 120 | | 121 |
| 81 | | Return | | | | | | | | |
| 82 | Flex. Input | Line | | 58 | | 59 | | 122 | | 123 |
| 83 | | Return | | | | | | | | |
| 84 | Flex. Input | Line | | 60 | | 61 | | 124 | | 125 |
| 85 | | Return | | | | | | | | |
| 86 | Flex. Input | Line | | 62 | | 63 | | 126 | | 127 |
| 87 | | Return | 3 | | 3 | | 7 | | 7 | |
| 88 | Block Shield | Shield | | N/A | | N/A | | N/A | | N/A |

* This bit will be transfered as MSB for discrete block scan.

Table 4.1 - 3 : Pin Allocation List of RAU Connector J 07, J 09, J 11 and J 13

| Pin Not. | Signal Code | Function | Channel Address | | | |
|---|---|---|---|---|---|---|
| | | | J 07 | J 09 | J 11 | J 13 |
| 1 | ON/OFF CMD | Line | 0 | 16 | 32 | 48 |
| 2 | | Return | | | | |
| 9 | | Shield | | | | |
| 3 | | Line | 1 | 17 | 33 | 49 |
| 4 | | Return | | | | |
| 12 | | Shield | | | | |
| 5 | | Line | 2 | 18 | 34 | 50 |
| 6 | | Return | | | | |
| 13 | | Shield | | | | |
| 7 | | Line | 3 | 19 | 35 | 51 |
| 8 | | Return | | | | |
| 16 | | Shield | | | | |
| 10 | | Line | 4 | 20 | 36 | 52 |
| 24 | | Return | | | | |
| 17 | | Shield | | | | |
| 11 | | Line | 5 | 21 | 37 | 53 |
| 25 | | Return | | | | |
| 19 | | Shield | | | | |
| 14 | | Line | 6 | 22 | 38 | 54 |
| 28 | | Return | | | | |
| 20 | | Shield | | | | |
| 31 | | Line | 7 | 23 | 39 | 55 |
| 32 | | Return | | | | |
| 23 | | Shield | | | | |
| 33 | | Line | 8 | 24 | 40 | 56 |
| 34 | | Return | | | | |
| 26 | | Shield | | | | |
| 35 | | Line | 9 | 25 | 41 | 57 |
| 36 | | Return | | | | |
| 27 | | Shield | | | | |
| 37 | | Line | 10 | 26 | 42 | 58 |
| 38 | | Return | | | | |
| 30 | | Shield | | | | |
| 15 | | Line | 11 | 27 | 43 | 59 |
| 29 | | Return | | | | |
| 22 | | Shield | | | | |
| 21 | Connnector Cover Shield | Shield | N/A | N/A | N/A | N/A |
| 18 | Spare | N/A | N/A | N/A | N/A | N/A |

Table 4.1 - 4 : Pin Allocation List of RAU Connectors J 14, J 15, J 16 and J 17

| Pin Not. | Signal Code | Function | Input / Output | Channel Address J 14 | J 15 | J 16 | J 17 | Electrical Characterist. Section |
|---|---|---|---|---|---|---|---|---|
| 3<br>4<br>12 | Serial PCM Command | Line<br>Return<br>Shield | O | 0 | 1 | 2 | 3 | 4.1.3.3.1 |
| 5<br>6<br>13 | Serial PCM CMD Clock | Line<br>Return<br>Shield | O | 0 | 1 | 2 | 3 | 4.1.3.3.2 |
| 33<br>34<br>26 | Serial PCM Data | Line<br>Return<br>Shield | I | 0 | 1 | 2 | 3 | 4.1.3.4.1 |
| 35<br>36<br>27 | Serial PCM Data Clock | Line<br>Return<br>Shield | O | 0 | 1 | 2 | 3 | 4.1.3.4.2 |
| 11<br>25<br>19 | Serial PCM Data Request | Line<br>Return<br>Shield | I | 0 | 1 | 2 | 3 | 4.1.3.4.3 |
| 14<br>28<br>20 | User Time Clock | Line<br>Return<br>Shield | O | UTC 0 | UTC 1 | UTC 2 | UTC 3 | 4.1.3.5.1 |
| 15<br>29<br>22 | User Time Clock Update | Line<br>Return<br>Shield | O | UTCU 0 | UTCU 1 | UTCU 2 | UTCU 3 | 4.1.3.5.2 |
| 21 | Connector Cover Shield | Shield | N/A | N/A | N/A | N/A | N/A | N/A |

Note : The remaining 16 pins are spare pins

4.1.3 Input / Output Characteristics

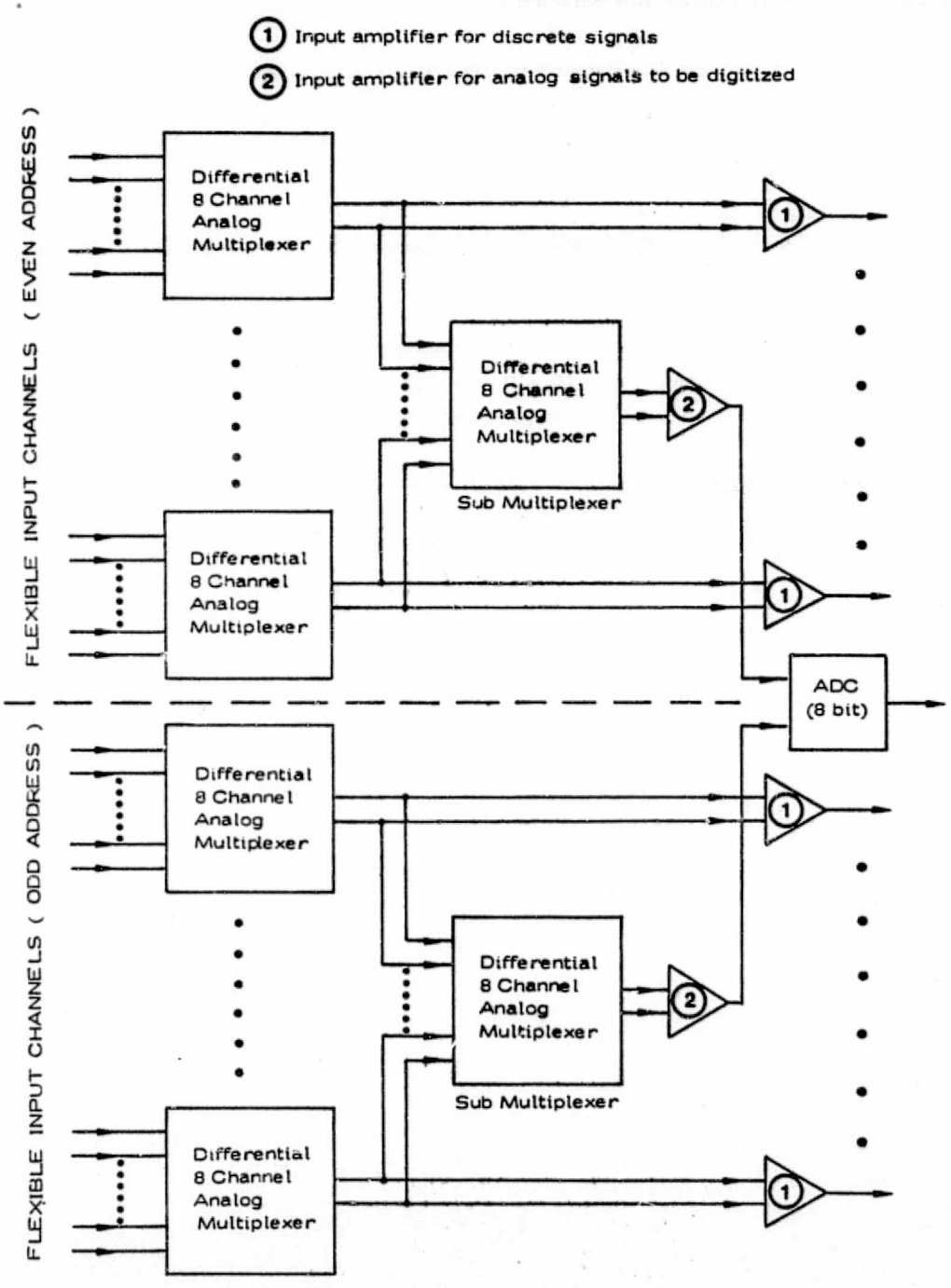
Section 4.1.3 describes the experiment RAU input/output circuits to provide the user with sufficient information to adapt the experiment signal driver/receiver characteristics (including cabling) to the RAU signal receiver/driver characteristics.

4.1.3.1 Flexible Inputs

As depicted in Figure 4.1 – 2 all flexible inputs are connected to a differential analog multiplexer system with $R_{ON} \leq 2.0\ k\Omega$ for each line.

If the user signal is handled as a discrete, it will be discriminated by a comparator, as shown in Figure 4.1–3. If handled as an analog signal, the signal will pass a second differential multiplexer (see Figure 4.1 – 2) and will be fed to the input of an instrumentation amplifier depicted in Figure 4.1 – 4.

The RAU electrical input characteristics (specification values) as well as the user output characteristics (recommended values) are given in Table 4.1 – 5 .




Legend:

This diagram does not reflect the multiplexer addressing scheme
Multiplexer : HI 1-507A-5; $R_{ON} \leq 2.4\ k\Omega$ for each line

Figure 4.1 - 2: Circuit Diagram for Flexible Inputs

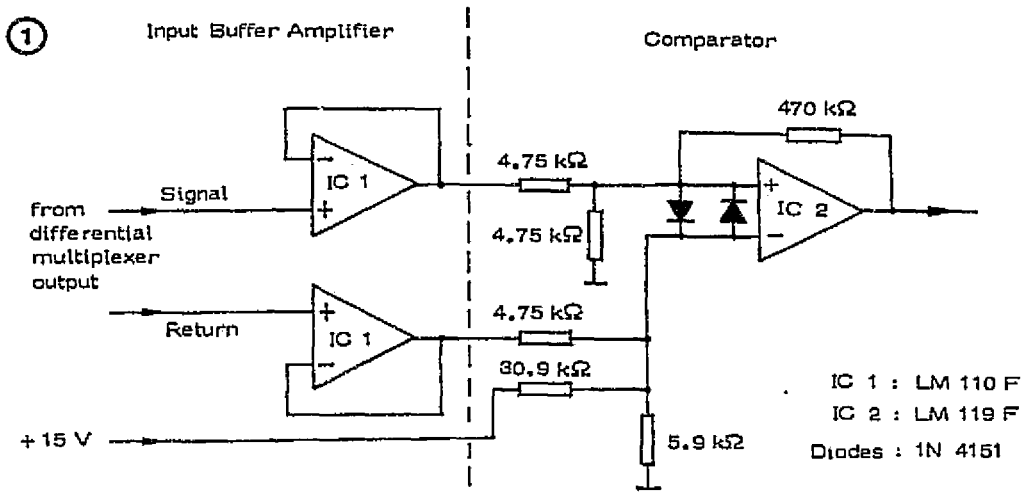



Figure 4.1 - 3: Input Amplifier for Discrete Signals

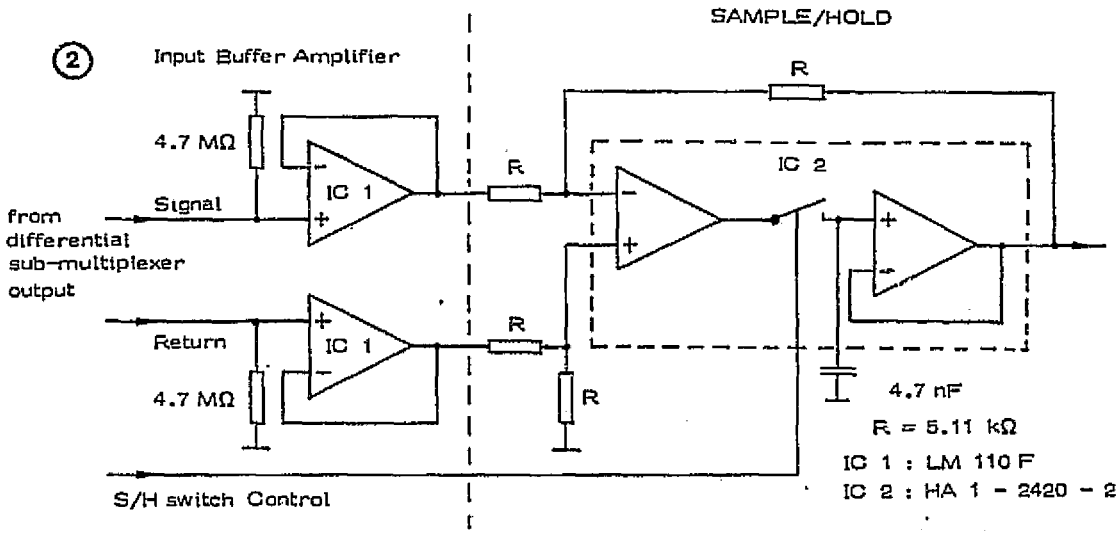



Figure 4.1 - 4: Input Amplifier for Analog Signals to be Digitized

Table 4.1 - 5: Input/Output Characteristics of Experiment RAU Flexible Input

| RAU Flexible Input Characteristics (Specification Values) | | Experiment Driver Characteristics that will ensure proper function | |
|---|---|---|---|
| Input protection: | the RAU input will withstand the application of max ± 15 V and ± 15 mA line-to-line and line-to-ground | Fault voltage and current emission: | ± 15 V max , ± 15 m A |
| Fault voltage and current emission: | ± 15 V max , ± 15m A as a result of any single point failure | Output protection: | the experiment output shall withstand the application of ± 15 V and ± 15 m A |
| Input isolation, power on : 1 MΩ minimum line-to-ground shunted with 1.6 nF maximum<br>power off: same as power on | | Output grounding: | connected to experiment signal ground |
| Wire shield reference: | RAU chassis ground | Wire shield reference: | TBD |
| | | Cable type: | TSP , ≤10 m |
| Input impedance<br>Power on : | $R_i$ = 500 KΩ minimum line-to-line shunted with 200 pF maximum | Output impedance: | $R_o$ = 1 KΩ max. at DC to 500 Hz, greater impedance degrades accuracy according to voltage drop $U \cdot R_o / (R_o + R_i)$ |
| | | Driving capability: | 50 kΩ in parallel with 2.5 nF |
| Power off : | 2 kΩ minimum line-to-line, (measured line-to-line with a differential signal of 5 V and a common mode signal of 5 V) | | |
| Used as analog input: | | | |
| Input type: | differential, isolated | Output type: | balanced (unbalanced and single-ended signals are also acceptable but will degrade RAU performance) |
| Full scale analog voltage range: | - 5.12 V to + 5.08 | Full scale voltage range: | - 5.12 V to + 5.08 V |
| Conversion resolution: | 7 bit + sign (see Table 4.1 - 6) | | |
| Common mode voltage: | ± 6 V max | Common mode voltage: | ± 1 V max (± 6 V causes degraded performance) |
| Common mode rejection ratio: | ≥40 dB between DC and 500 Hz, decreasing with 6 dB/octave above 500 Hz | | |
| Sampling window: | 5 µs | Bandwidth : | to be selected according to the sampling rate |
| - 3 dB frequency: | TBD | | |
| Roll-off rate: | TBD | | |
| Used as discrete input: | | | |
| Input Type: | differential, isolated | Output type: | single ended or balanced |
| Digitial 'zero' level: | - 0.5 V to + 2.0 V | Digital 'zero' level: | - 0.5 V to + 0.5 V |
| Digital 'one' level: | + 2.5 V to + 6.0 V | Digital 'one' level: | + 4.0 V to + 6.0 V |
| Common mode voltage: | TBD | Common mode voltage: | TBD |
| Common mode rejection ratio: | no output change for $V_{CM}$ TBD | | |

Table 4.1 - 6: Characteristics of the RAU Analog - to - Digital Converter

Accuracy

| | |
|---|---|
| Quantization error: | ± 20 m V max. |
| Non-linearity: | ± 10 m V max. |
| Temperature coefficient: | 50 ppm/ °C max. (10 ppm/ °C typ.) |
| Overall accuracy: | 0.6 % of full scale (assuming ± 1 V common mode voltage) |

Coding

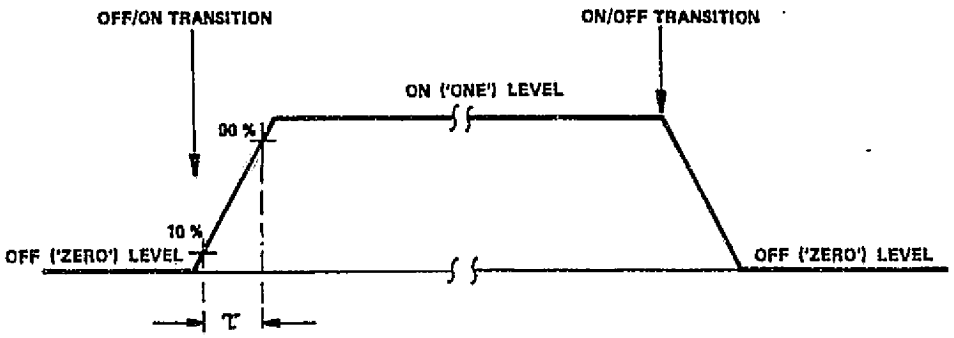
| Input Voltage Range (V) | ADC Output Bit Pattern | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sign | B 7 | B 6 | B 5 | B 4 | B 3 | B 2 | B 1 = LSB |
| + 5.06 < U | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| + 5.02 < U ≤ + 5.06 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| + 4.98 < U ≤ + 5.02 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| ⋮ | | | | | | | | |
| + 0.06 < U ≤ + 0.10 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| + 0.02 < U ≤ + 0.06 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| - 0.02 < U ≤ + 0.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - 0.06 < U ≤ - 0.02 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| - 0.10 < U ≤ - 0.06 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| - 0.14 < U ≤ - 0.10 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| ⋮ | | | | | | | | |
| - 5.06 < U ≤ - 5.02 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| - 5.10 < U ≤ - 5.06 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| U ≤ - 5.10 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

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4.1.3.2 ON/OFF Command Channel

Each RAU offers 64 ON/OFF command channels to the user with signal characteristics listed in Table 4.1-7.

The time function of a RAU ON/OFF command output channel is depicted in Figure 4.1 - 5.




RISE/FALL TIME : 0.1 μs<τ<100 μs

Note: Transition occurs only after the RAU has received an instruction from the computer.

Figure 4.1 - 5: Shape of an RAU ON/OFF Command

The voltage level of a specific ON/OFF command output channel is determined by the type of the last ON/OFF command related instruction word sent from the experiment I/O-unit to the experiment RAU addressed. Therefore, a software initiated request is necessary in order to change the command output status. The RAU itself does not limit the duration of the ON status. However, the ECOS software provides two types of ON/OFF commands:

- pulse commands
  The ON/OFF command is reset to zero automatically after 100 ms, thus providing a pulse of 100 ms length
- level commands
  The ON/OFF command is set to a certain level ('1' or '0') and will stay there until user application software initiates a change

The total number of 'ON' commands is limited by the RAU design, which allows 0.8 A for all ON/OFF command drivers, but does not provide any protection for loads above 0.8 A. As a consequence, the user is restricted to the following actual limits :

- 32 commands at 25 mA load current at the same time.

It should be noted that the following Table 4.1-7 states specified values of the driving capability, showing a certain margin of safety .

The RAU output circuit for ON/OFF commands is shown in Figure 4.1 - 6 with a measured driving characteristics as shown in Figure 4.1 - 7.

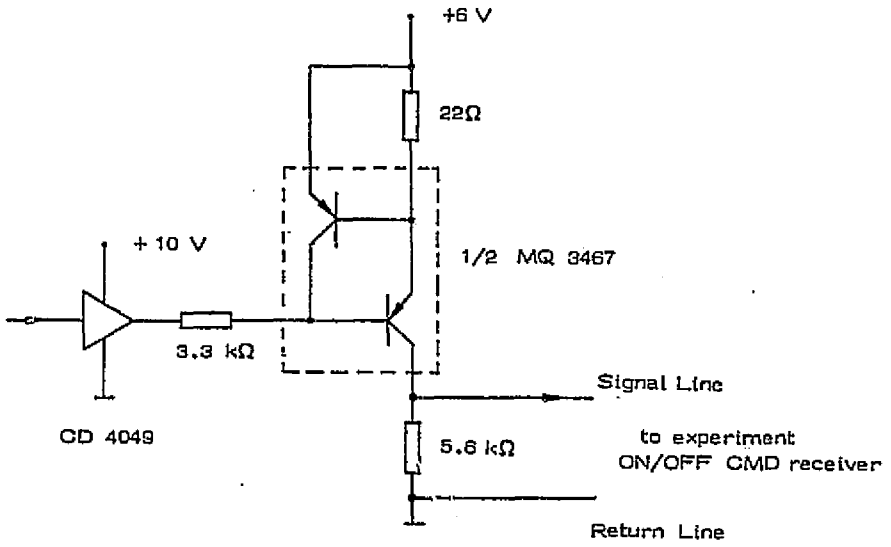
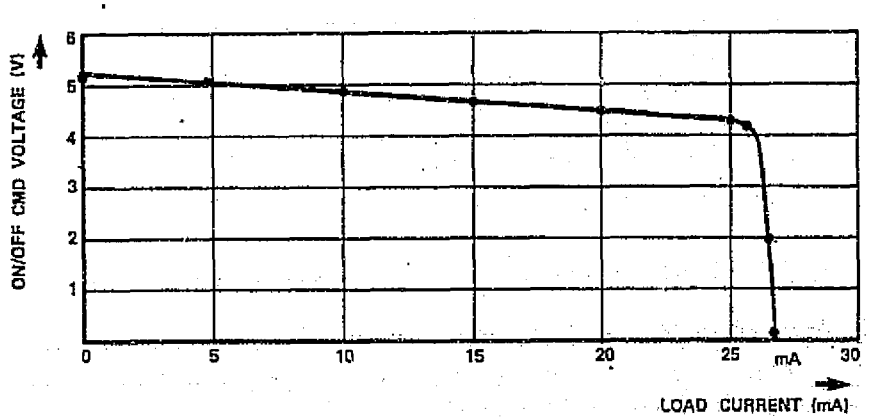



Figure 4.1 - 6: ON/OFF Command Driver




ON/OFF COMMAND VOLTAGE VERSUS LOAD CURRENT (MEASURED)

Figure 4.1 - 7: ON/OFF Command Driver Characteristics

Table 4.1 – 7 : Input / Output Characteristics of RAU ON/OFF Commands

| RAU ON / OFF command output characteristics ( Specification values ) | | Experiment receiver characteristics that will ensure proper function | |
|---|---|---|---|
| Output protection: | The output will withstand the application of ± 15 V max and ± 15 mA max | Fault voltage and current emission : | ± 15 V max and ± 15 mA max |
| Fault voltage emission : | ± 9 V max, line-to-ground as a result of any single point failure | Fault voltage protection : | ± 15 V line-to-ground |
| Fault current : | 50 mA max, in case of either output transistor short-circuited or external short circuit to RAU | Fault current protection : | ± 15 mA |
| | | Cable type : | TSP or twisted shielded multiconductor cable ≤ 10 m |
| Wire shield reference: RAU chassis ground | | Wire shield reference: | TBD |
| Output grounding : | Connected to RAU signal ground | Input isolation : | 1 MΩ min line-to-ground shunted with 1 nF max |
| Output type : | Single ended | Input type : | e.g. diff. amplifier, opto coupler, relais |
| Digital 'zero' level : | 0 ± 0.5 V | Digital 'zero' level : | ≤ + 2.0 V |
| Digital 'one' level : | +5 ± 1.0 V | Digital 'one' level : | ≥ + 2.5 V |
| | | Common mode rejection : | ± 10 V DC to 400 Hz line-to-ground shall not activate receiver circuits |
| Signal shape : | constant level or 100 ms pulses | | |
| Rise / fall time : | 0.1 to 100 µs between 10% and 90% at a load of 10 kΩ in parallel with 1 nF | | |
| Driving capability : | 25 mA per output (see Fig. 4.1 – 7) and ≤ 800 mA in total for all 64 outputs | Input current alternatively used pairs of cmd channels : 20 mA<br>independently used cmd channels: 10 mA | |

4.1.3.3 Serial PCM Command Channel

The RAU Serial PCM Command Channel comprises a serial command output with associated clock output. Figure 4.1 - 8 depicts a time diagram of command and clock signals.

As shown in Figure 4.1-8 the main characteristics are:

- Each serial command word consists of 16 data bits and an odd parity bit (NRZ-L code) i.e. the 17th bit has to be generated such that the total number of 'ones' is odd.
- Command words are separated by a 8 µs gap
- The clock is delivered in bursts of 17 clock pulses
- The trailing edge of each clock pulse will be in the middle ± 10 % of each command bit.
- For power saving reasons clock and data are delivered as tristate level signals.
- The MSB is the first bit delivered to the user.

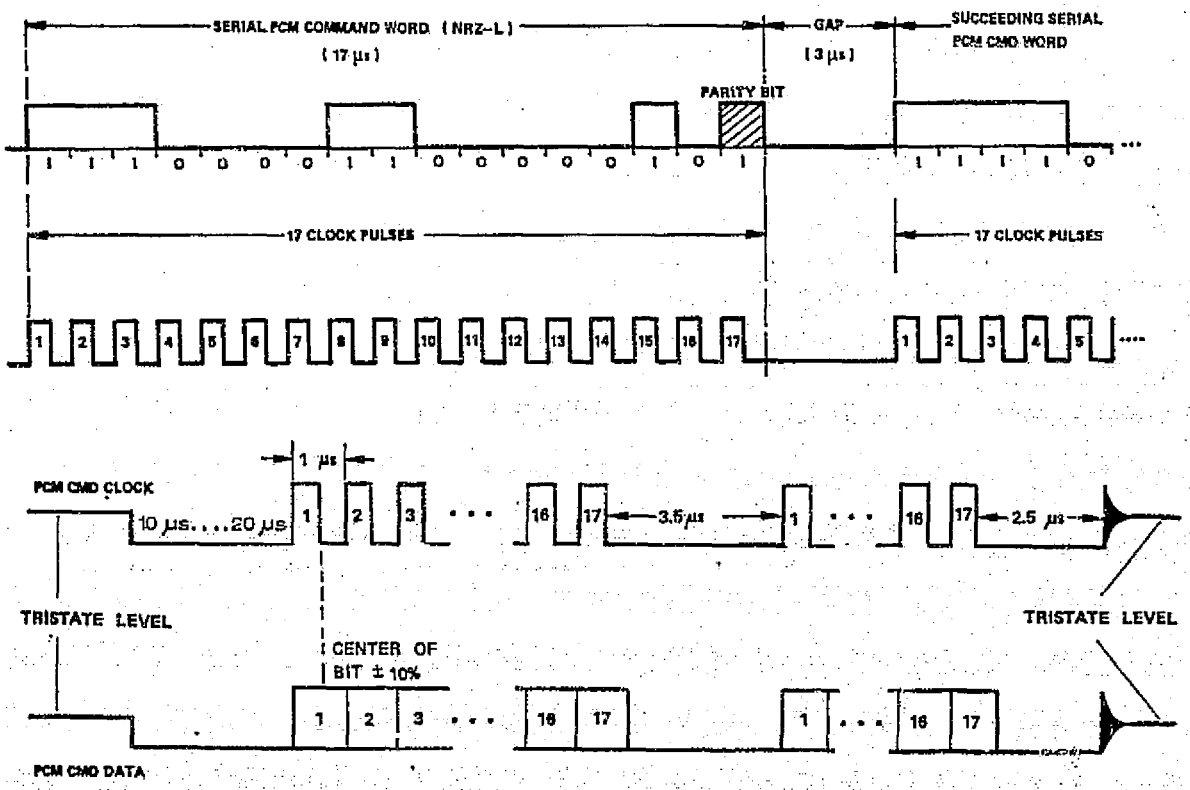



Figure 4.1 - 8: Time Diagram of Serial PCM Command Channel Signals

4.1.3.3.1 Serial PCM Command Output

Figure 4.1 - 9 depicts the RAU serial PCM command driver

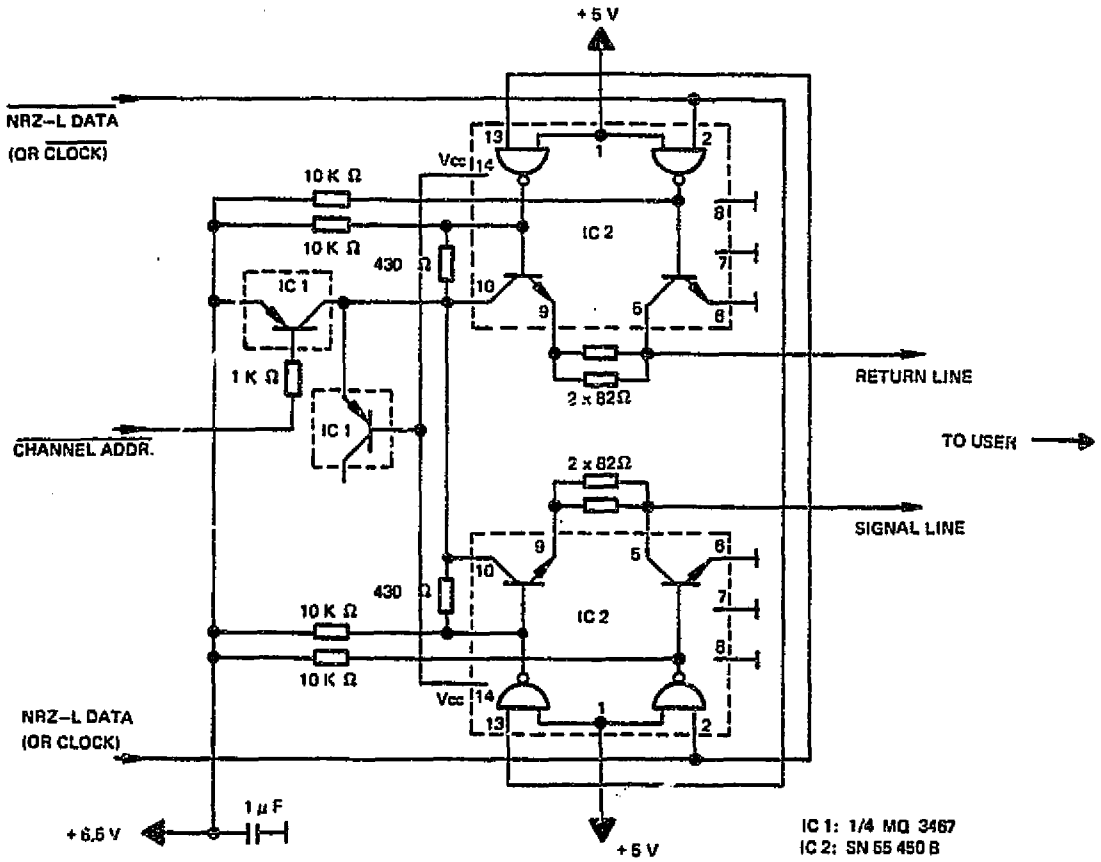



Figure 4.1 - 9: Serial PCM Command Driver

The characteristics of this driver as well as the recommended receiver on the user's site is given in Table 4.1 - 8.

Table 4.1 - 8: Input/Output Characteristics of the Experiment RAU Serial PCM Command Output

| RAU serial PCM command output (specification values) | | Experiment differential line receiver characteristics that will ensure proper functions | |
|---|---|---|---|
| Output protection: | TBD | Fault voltage and current emission | TBD |
| Fault voltage and current emission: | ± 15 V max., +150mA/-15mA max. as a result of any single-point failure | Input protection: | the input will withstand the application of ±15 V and +150mA/-15mA |
| | | Cable type: | TSP, 75 Ω , ≤ 10 m |
| Wire shield reference: | RAU chassis ground | Wire shield reference: | TBD |
| Output grounding: | Connected to RAU signal ground | Input isolation: | 1 MΩ minimum line-to-ground shunted with 1 nF maximum |
| Output type: | complementary | Input type : | differential |
| Digital 'one' level line-to-ground: | + 2.5 to + 4.5 V | Digital 'one' level: | + 2.0 V to + 6.0 V line-to-line |
| return line-to-ground: | - 0.5 to + 0.5 V | | |
| Digital 'zero' level line-to-ground: | - 0.5 to + 0.5 V | Digital 'zero' level: | - 2.0 V to - 6.0 V line-to-line |
| return line-to-ground: | + 2.5 to + 4.5 V | | |
| Tristate level: | when the PCM output is not addressed (see Figure 4.1-9), signal and return line have high resistance against signal ground | | |
| | | Threshold : | 0 ± 0.5 V line-to-line |
| | | Common mode rejection : | 10 V peak, DC to 2 MHz line-to-ground on signal and return line shall not activate receiver circuit |
| Phase relation between signal line and return line: | see Figure 4.1 - 10 | | |
| Rise/fall time: | < 150 n s line-to-line (see Figure 4.1-10)(measured between 10 and 90 % of the peak signal values on a load of 75Ω + 10 % in parallel with 0.5 nF ± 10 % | Rise/fall time : | <200 n s (measured between 10 and 90 % of the peak signal values on a load impedance of 75Ω ± 10 %) |
| Distortion (overshoot, ringing): | 0.25 Vp line-to-ground positive 0.15 Vp line-to-ground negative | | |
| Output impedance: | 75Ω ± 10 % | Input impedance : | 75Ω ± 10 % in parallel with 0.2 nF |

4.1.3.3.2 Serial PCM Command Clock Output

Same characteristics as given in Section 4.1.3.3.1 besides:

| | |
|---|---|
| Wave form: | square wave |
| Duty cycle: | 0.5 ± 0.05 |
| Frequency: | 1 MHz ± 0.1 % over each period |

Figure 4.1 - 10 depicts the skew between signal and return line of the RAU complementory output driver.

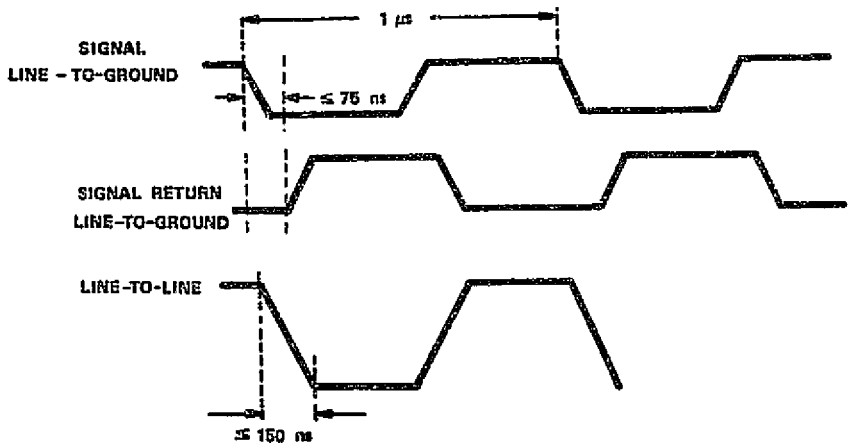
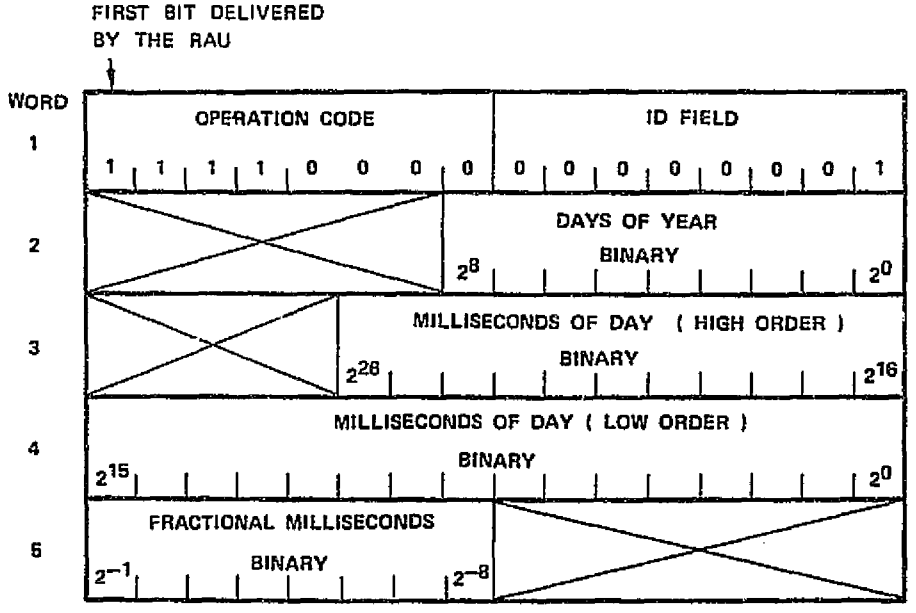



Figure 4.1 - 10: Phase Relation Diagram

4.1.3.3.8 Serial PCM Command Standard Messages

The design requirements for the Experiment Computer Operating System ( ECOS ), developped by NASA, contain basic software which allows the user to initiate Standard Synchronous Serial RAU Output Messages. These messages are called by statements included in the users Flight Application Software. The formats of GMT, Navigation and Attitude messages are depicted in Tables 4.1 -9, 4.1 - 10 and 4.1 - 11.

Table 4.1 - 9 : GMT TO EXPERIMENT BY PCM COMMANDS




- All 5 words are sent to the user
- Time in this message is the GMT of the next subsequent occurence of a 4 pps UTC update signal
- ECOS schedules the arrival of GMT message not later than 10 ms prior to a 4 pps signal occurence
- GMT message can be transmitted once per second

Table 4.1 — 10: ECOS STANDARD SYNCHRONOUS SERIAL NAVIGATION MESSAGE FORMAT

| WORD NUMBER | DATA | BIT DESCRIPTION 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 |
|---|---|---|
| 1 | | OPERATION CODE: 1 1 1 1 0 0 0 0 — ID FIELD: 0 0 0 0 1 0 0 0 |
| 2 | GMT [s] | S $C_1$ $C_2$ $C_3$ $C_4$ $C_5$ $C_6$ $C_7$ $M_1$ $M_2$ $M_3$ $M_4$ $M_5$ $M_6$ $M_7$ $M_8$ |
| 3 | | $M_9$ — $M_{24}$ |
| 4 | | $M_{25}$ — $M_{40}$ |
| 5 | | $M_{41}$ — $M_{56}$ |
| 6 | x [m] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 7 | | $M_9$ — $M_{24}$ |
| 8 | | $M_{25}$ — $M_{40}$ |
| 9 | | $M_{41}$ — $M_{56}$ |
| 10 | y [m] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 11 | | $M_9$ — $M_{24}$ |
| 12 | | $M_{25}$ — $M_{40}$ |
| 13 | | $M_{41}$ — $M_{56}$ |
| 14 | z [m] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 15 | | $M_9$ — $M_{24}$ |
| 16 | | $M_{25}$ — $M_{40}$ |
| 17 | | $M_9$ — $M_{56}$ |
| 18 | $\dot{x}$ [m/s] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 19 | | $M_9$ — $M_{24}$ |
| 20 | $\dot{y}$ [m/s] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 21 | | $M_9$ — $M_{24}$ |
| 22 | $\dot{z}$ [m/s] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 23 | | $M_{41}$ — $M_{24}$ |

The representation of a real number x in the above format is as follows:

$$X = (-1)^S \cdot M \cdot 16^{C-64} \text{ with}$$

S = sign (1 = negative, 0 = positive)

$$M = \text{mantissa } (M = M_1 \cdot 2^{n-1} + M_2 \cdot 2^{n-2} + \ldots + M_n \cdot 2^0)$$

$$C = \text{characteristic } (C = C_1 \cdot 2^{m-1} + C_2 \cdot 2^{m-2} + \ldots + C_m \cdot 2^0)$$

$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$ = Orbiter position vector at GMT expressed in meters. The coordinates are given in a Greenwich Tru of Data (Greenwich TOD) geocentric inertial coordinate system

$\begin{bmatrix} \dot{X} \\ \dot{Y} \\ \dot{Z} \end{bmatrix}$ = Orbiter velocity vector at GMT. The dimensions are m/s and the coordinate system is the same as above.

Table 4.1 – 11: ECOS STANDARD SYNCHRONOUS SERIAL ATTITUDE MESSAGE FORMAT

| WORD NUMBER | DATA | BIT DESCRIPTION 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 |
|---|---|---|
| 1 | | OPERATION CODE: 1 1 1 1 0 0 0 0 — ID FIELD: 0 0 0 0 1 0 0 1 |
| 2 | GMT [s] | S $C_1$ $C_2$ $C_3$ $C_4$ $C_5$ $C_6$ $C_7$ $M_1$ $M_2$ $M_3$ $M_4$ $M_5$ $M_6$ $M_7$ $M_8$ |
| 3 | | $M_9$ — $M_{24}$ |
| 4 | | $M_{25}$ — $M_{40}$ |
| 5 | | $M_{41}$ — $M_{56}$ |
| 6 | ATT $_\Phi$ [rad] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 7 | | $M_9$ — $M_{24}$ |
| 8 | ATT $_\Psi$ [rad] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 9 | | $M_9$ — $M_{24}$ |
| 10 | ATT $_\Theta$ [rad] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 11 | | $M_9$ — $M_{24}$ |
| 12 | $\omega_X$ [rad/s] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 13 | | $M_9$ — $M_{24}$ |
| 14 | $\omega_Y$ [rad/s] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 15 | | $M_9$ — $M_{24}$ |
| 16 | $\omega_Z$ [rad/s] | S $C_1$ — $C_7$ $M_1$ — $M_8$ |
| 17 | | $M_9$ — $M_{24}$ |

The representation of a real number x in the above format is as follows:

$$X = (-1)^S \cdot M \cdot 16^{C-64} \text{ with}$$

S = sign (1 = negative, 0 = positive)

$M = \text{mantissa } (M = M_1 \cdot 2^{n-1} + M_2 \cdot 2^{n-2} + \ldots + M_n \cdot 2^0)$

$C = \text{characteristic } (C = C_1 \cdot 2^{m-1} + C_2 \cdot 2^{m-2} + \ldots + C_m \cdot 2^0)$

GMT = Greenwich Mean Time expressed in seconds.

$\begin{bmatrix} ATT_\Phi \\ ATT_\Psi \\ ATT_\Theta \end{bmatrix}$ = Orbiter attitude vector at GMT in a Greenwich TOD coordinate system.

$\begin{bmatrix} \omega_x \\ \omega_y \\ \omega_z \end{bmatrix}$ = Orbiter angular velocity vector given with respect to the Orbiter coordinate system.

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4.1.3.4 Serial PCM Data Channel

Each experiment RAU serial PCM data channel comprises

- one RAU input for experiment data request line
- one RAU input for serial experiment data line
- one RAU output for data clock line

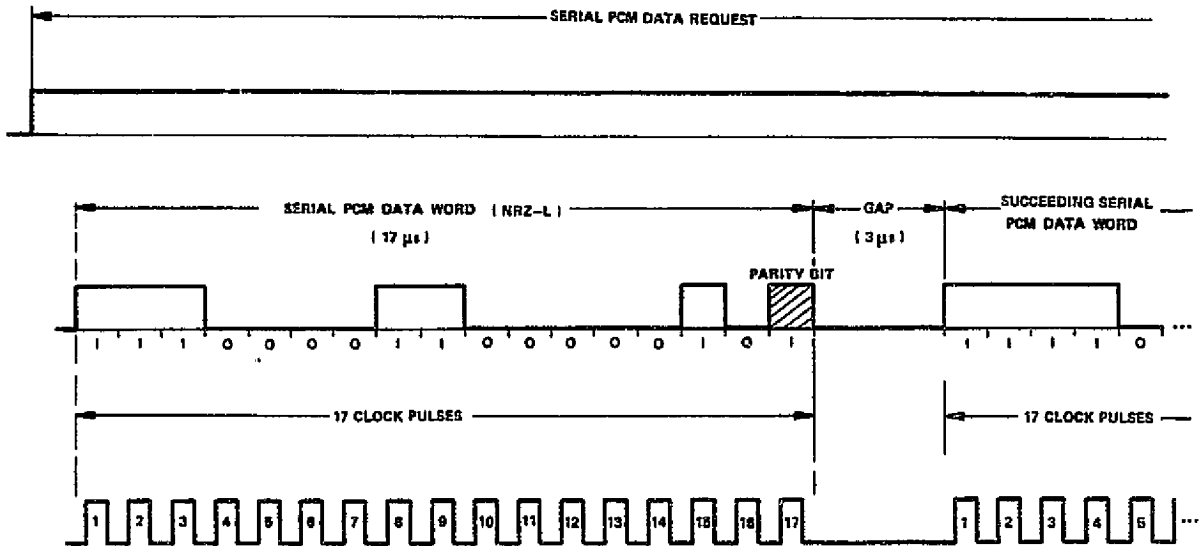
As shown in Figure 4.1-11 the Serial PCM Data Channel has the following main characteristics:

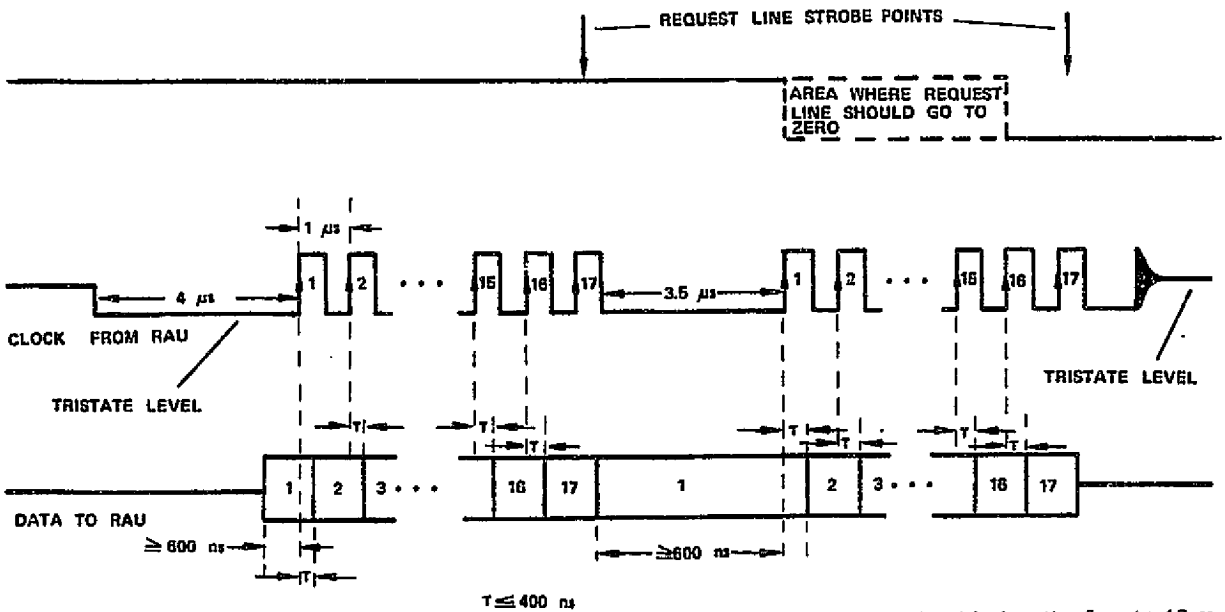
- Serial data transfer from the user to the experiment RAU, is only possible if the user provided Serial PCM Data Request shows a 'one' level. The RAU will handle this experiment provided signal as a discrete. Figure 4.1-11 shows that the strobe points are selected to check the status of the request line during the 17$^{th}$ clock pulse, i.e. every time the request line has a high level during the 17$^{th}$ clock pulse the following full data word will be read by the RAU. The RAU characteristics for this signal are specified in para. 4.1.3.4.3.

- Each serial data word (NRZ-L code) consists of 16 data bits and an odd parity bit. (The 17th bit has to be generated such that the total number of 'ones' is odd.) The first bit of a data word delivered by the user to the RAU will be stored as MSB in the Experiment computer. Succeeding data words are separated by a gap of 3 $\mu$s duration. The RAU input characteristics are specified in Section 4.1.3.4.1.

- The data transfer from the user to the RAU is controlled by the RAU provided serial PCM data clock. The serial PCM clock is delivered by the RAU as a tristate level signal. The RAU clock output characteristics are specified in para 4.1.3.4.2 .

- Figure 4.1-11 shows the required phase relationship between RAU delivered clock and experiment provided data signals assuming a cable of up to 10 m. The first data bit has to be present at the experiment output at least 600 ns before the first clock pulse arrives at the experiment input.




Required phase relationship at experiment input/output assuming a RAU experiment cable length of up to 10 m.

Figure 4.1 - 11: Time Diagram of Serial PCM Data Channel Signals

4.1.3.4.1 Serial PCM Data Input

Figure 4.1 - 12 depicts the RAU receiver for the experiment provided serial PCM data signals and data request signals. The Input/Output characteristics are shown in Table 4.1-12.

4.1.3.4.2 Serial PCM Data Clock Output

Same input/output characteristics as given in para. 4.1.3.3.2.

4.1.3.4.3 Serial PCM Data Request Input

Same input/output characteristics as given in para. 4.1.3.1 for discretes

The RAU receiver for the experiment serial data request signal is depicted in Figure 4.1 - 12.

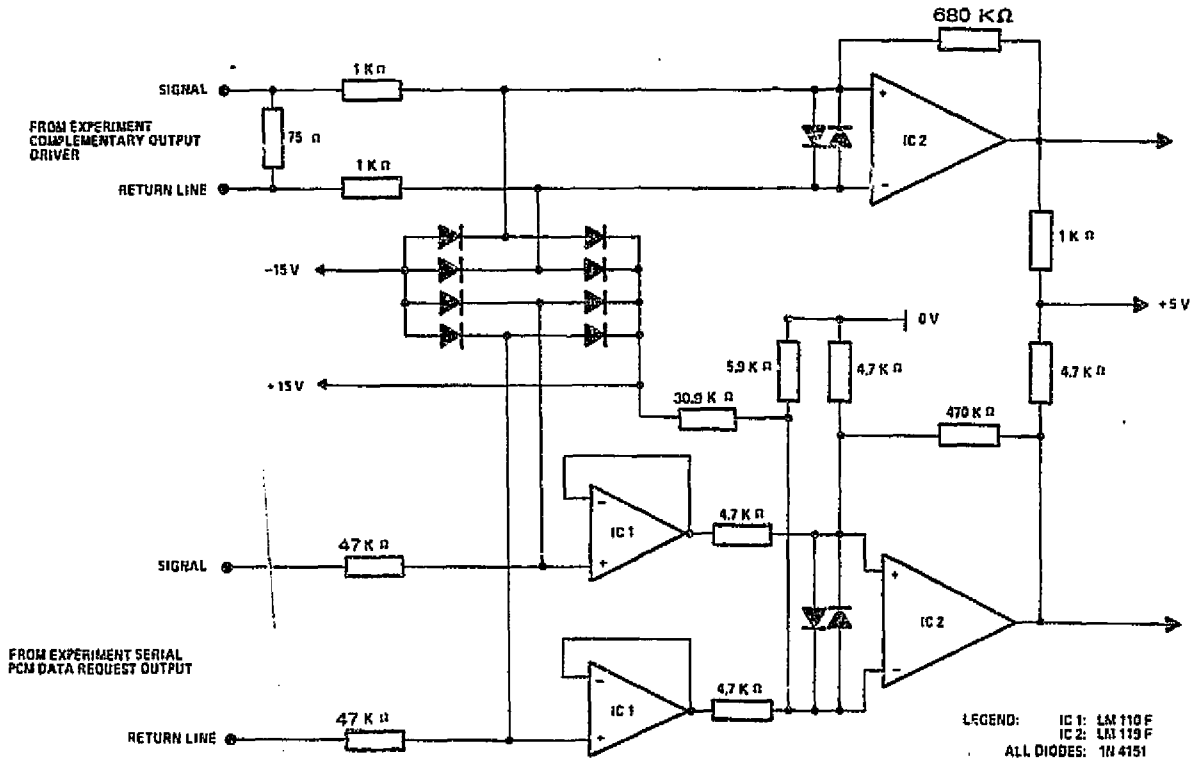



Figure 4.1 - 12: Receiver for Experiment Serial PCM Data and Data Request

The specified RAU serial data receiver characteristics as well as the recommended experiment line driver characteristics are given in Table 4.1 - 12.

Table 4.1 - 12 : Input / Output Characteristics of the Experiment RAU Serial PCM Data Input

| RAU differential line receiver characteristics (specification values) | | Experiment complementary output driver characteristics that will ensure proper function | |
|---|---|---|---|
| Fault voltage and current emission: | ± 15 V | Output protection: | ± 15 V |
| Input protection: | The input will withstand the application of ± 10 V and ± 10 mA max. | Fault voltage and current emission: | ± 15 V max., ± 15 mA max. as a result of any single point failure |
| | | Cable : | TSP, 75 Ω, ≤ 10 m |
| Wire shield reference: | RAU chassis ground | Wire shield reference: | TBD |
| Input isolation: | 1 MΩ minimum line - to - ground shunted with 1.6 nF maximum | Output grounding: | connected to experiment signal ground |
| Input type: | differential | Output type: | complementary |
| Digital 'one': | + 2.0 V to + 6.0 V line-to-line | Digital 'one' level<br>line-to-ground:<br>return line-to-ground: | <br>+ 2.5 to + 4.5 V<br>- 0.5 to + 0.5 V |
| Digital 'zero': | - 2.0 V to - 6.0 V line-to-line | Digital 'zero' level<br>line-to-ground:<br>return line-to-ground: | <br>- 0.5 to + 0.5 V<br>+ 2.5 to + 4.5 V |
| Threshold: | 0 ± 0.5 V line-to-line | | |
| Common mode rejection: | ±6 V peak, DC to TBD Hz line-to-ground on signal and return line will not activate receiver circuit | | |
| Rise/fall time: | < 200 ns (measured between 10 and 90 % of the peak signal values on a load impedance of 75 Ω ± 10 %) | Rise/fall time: | < 150 ns line-to-line (measured between 10 and 90 % of the peak signal values on a load of 75 Ω ± 10 % in parallel with 0.5 nF ± 10 %) |
| | | Distortion (overshoot, ringing): | 0.25 V peak line-to-ground positive<br>0.15 V peak line-to-ground negative |
| Input impedance: | 75 Ω ± 10 % in parallel with 0.2 nF | Output impedance: | 0 to 83 Ω |
| | | Driving capability: | the PCM output shall be able to drive a load of 75 Ω ± 10 % in parallel with 1 nF |

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4.1.3.5 User Time Clock Channel

The experiment RAU User Time Clock Channel comprises the RAU User Time Clock (UTC) and User Time Clock Update output (see Figure 4.1 - 13).

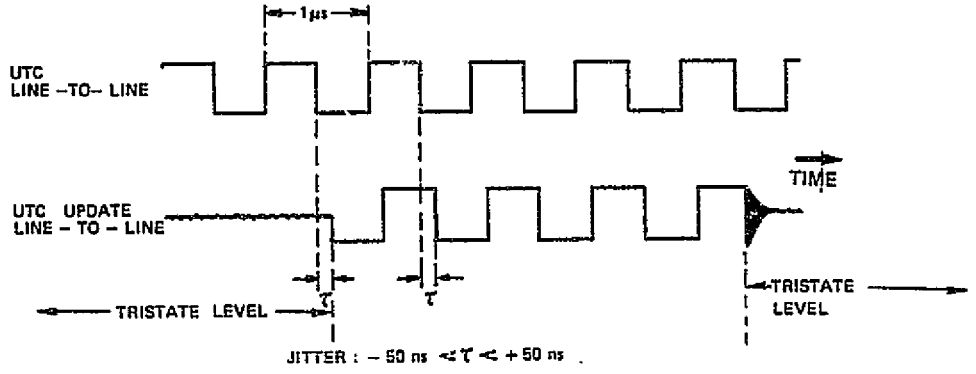



Figure 4.1 - 13: RAU User Time Clock Channel Signals

The UTC output delivers a continuous 1024 kHz square wave signal with characteristics specified in para 4.1.3.5.1. The UTC update delivers a burst of four UTC clock pulses every 250 ms. The signal characteristics are specified in para 4.1.3.5.2.

Each PCM command and data channel with the same address is associated with an UTC channel. Address and channel notation are the same ,e.g. one PCM command , data and UTC channel have the same notation and are routed to the same RAU connector.

4.1.3.5.1 User Time Clock Output

The Experiment RAU User Time Clock output driver is depicted in Figure 4.1 - 14.

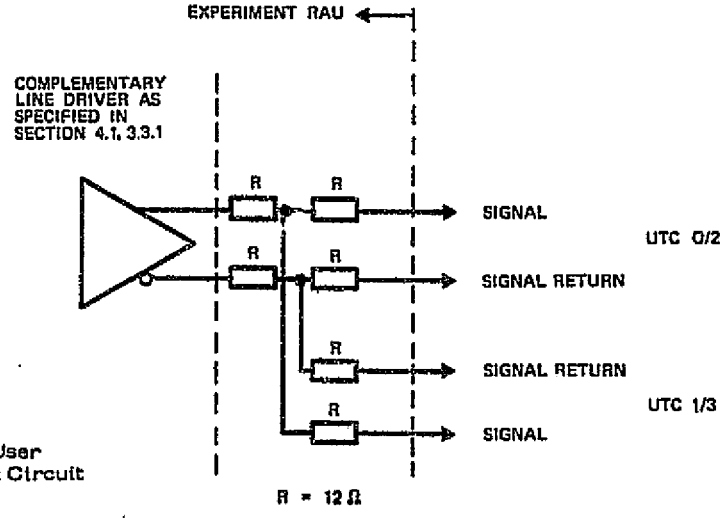



Figure 4.1 - 14:
Experiment RAU User Time Clock Output Circuit

As depicted in Figure 4.1 - 14,one complementory line driver supplies two outputs in parallel, e.g. UTC Channel No 0 and 1, respectively, No 2 and 3 have a common line driver. Therefore, the RAU output characteristics given in para 4.1.3.3.1 have to be modified in respect to the following characteristics:

Output Voltage Characteristics

- Both outputs connected to a load of 75Ω ± 10 %

  Digital "High"

  | | |
  |---|---|
  | signal line-to-ground | +2.5 V to +4.5 V |
  | return line-to-ground | -0.5 V to +1.5 V |

  Digital "Low"

  | | |
  |---|---|
  | signal line-to-ground | -0.5 V to +1.5 V |
  | return line-to-ground | +2.5 V to +4.5 V |

- One output connected to a load of 75Ω ± 10 % the second one not loaded

  same characteristics

- One output connected to a load of 75Ω ± 10 %, the second one has a short circuit (abnormal operation)

  | | |
  |---|---|
  | line-to-line | not specified |
  | | ≥ 1.0 V actual value |

Additional Characteristics

| | |
|---|---|
| Frequency: | 1024 kHz ± 0.1 % |
| Wave form: | square wave |
| Duty cycle: | 0.5 ± 0.05 |
| Short term stability: | one part in $10^{10}$ |
| Long term stability: | one part in $10^{10}$ |

The experiment input characteristics of para 4.1.3.3.1 can be applied

4.1.3.5.2 User Time Clock Update Output

Same input/output characteristics as specified in para 4.1.3.5.1 besides:

Each RAU UTC update output delivers to the experimenter a burst of four UTC clock pulses every 250 m s. The leading edges of clock and associated update clock pulses will have a maximum phase shift corrsponding to ≤ 50 n s .

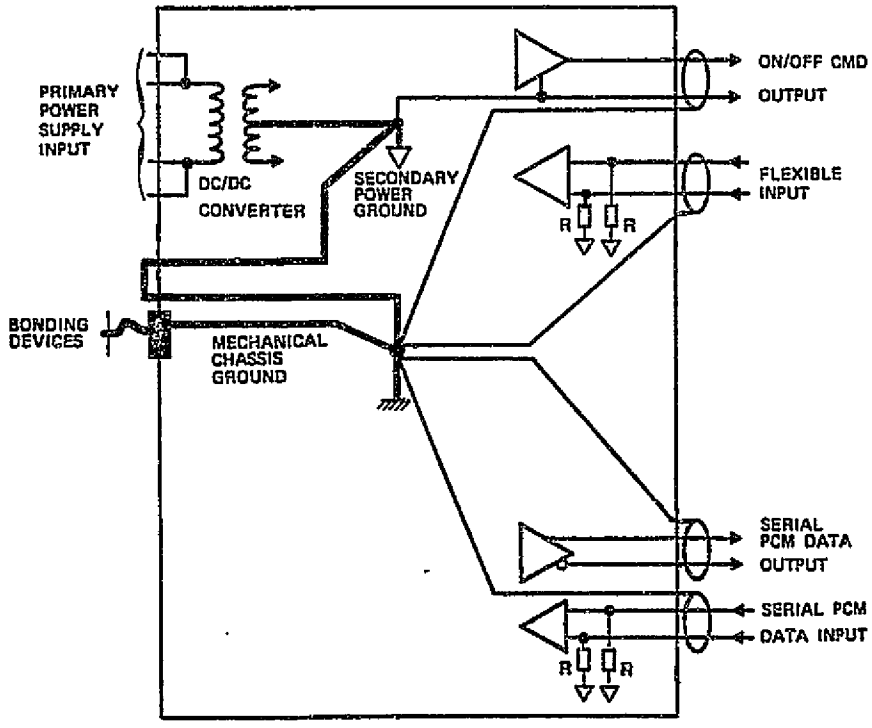
4.1.4 Bonding

The experiment RAU is bonded to Spacelab structure by a bonding strap ($\leq$ 10 m$\Omega$ impedance).

4.1.5 Grounding

The RAU has, if disconnected from the primary DC power supply, a galvanic isolation impedance of at least 1 M$\Omega$ (DC to 25 Hz) between primary power ground and chassis as well as secondary power ground and signal ground.

Secondary power ground, signal ground and wire shields are referenced to Spacelab structure. ON/OFF command outputs are referenced to RAU signal ground (see Figure 4.1 - 15).




Note: R $\geq$1M$\Omega$ shunted with $\leq$1,6nF

Figure 4.1 - 15: Experiment RAU Grounding Schematics

4.1.6 Conducted Emission on Signal and Signal Return Lines

- Flexible Input Data Lines, ON/OFF Command Lines

The maximum internally generated noise level at the RAU inputs/outputs will not exceed 20 m Vpp when measured within a bandwidth of 30 Hz to 1 MHz (Specification).

- Serial PCM Data,Command,and Clock Lines

The maximum internally generated noise level at the RAU inputs/outputs will not exceed 100 m Vpp when measured within a bandwidth of 30 Hz to at least 25 MHz (Specification).

4. . High Data Rate Assembly

The high data rate assembly parts interfacing with the experiments are the HRM, to which experiment flight equipment is connected, and the HRDM, to which the respective experiment GSE is connected on the ground.

4.2.1 High Rate Multiplexer (HRM)

Experiment serial data channels may be connected to the following HRM inputs

- 2 direct access channels
- 16 experiment channels

Three HRM outputs provide the experiment with HRM sync signals

- 1 HRM frame sync pulse
- 1 HRM format sync pulse
- 1 HRM format change signal

4.2.1.1 Interface for Module Configurations

4.2.1.1.1 Connector Location

In the Spacelab module configurations, the interface is at connector bracket CB 50 (see Appendix B, para 3.8.1). The specific connector location at CB 50 is given in Figure 4.2 - 1.

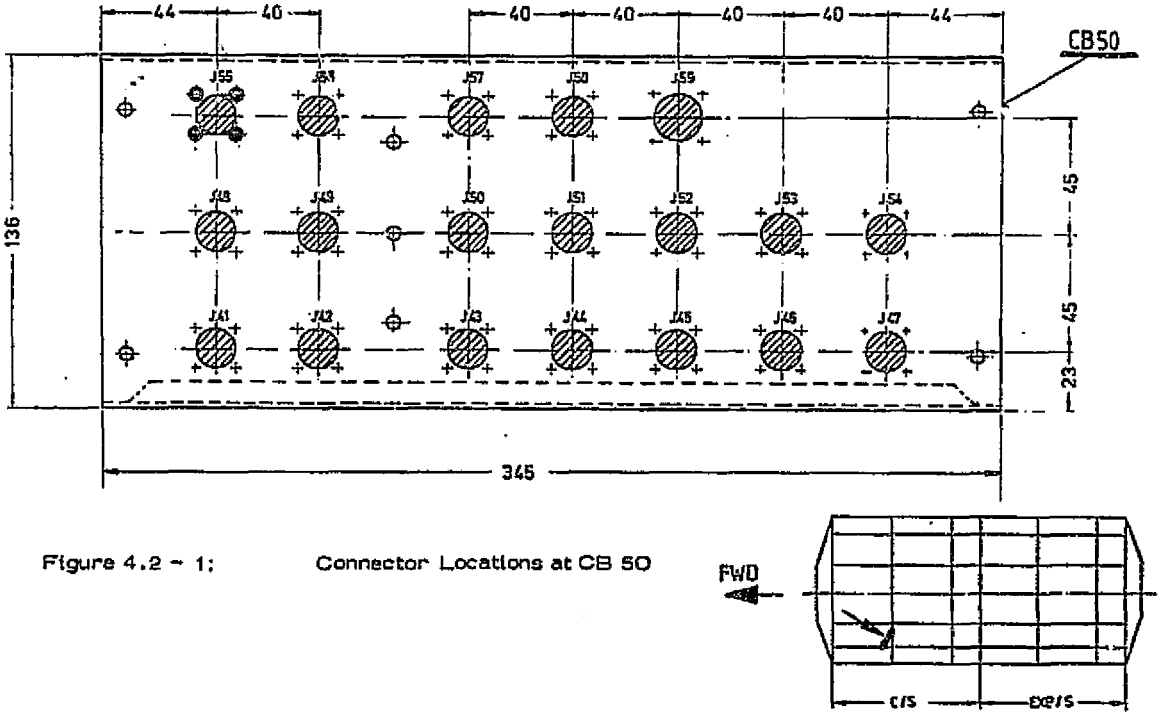



Figure 4.2 - 1: Connector Locations at CB 50

4.2.1.1.2 Pin Allocation

For the CB 50 interface the connector types and functions are specified in Table 4.2 - 1. The pin allocation is the same for all the serial data input connectors J 41 thru J 58.

Table 4.2 - 1: Connector Functions on CB 50

| Connector Notation | Function | S/L Connector Type | Exp. Connector Type |
|---|---|---|---|
| J 41 | Exp. 1 Data + Clock | NLS OT 8-35 SN | NLS 6GT 8-35 PN |
| J 42 | " 2 " " | NLS OT 8-35 SA | NLS 6GT 8-35 PA |
| J 43 | " 3 " " | NLS OT 8-35 SD | NLS 6GT 8-35 PD |
| J 44 | " 4 " " | NLS OT 8-35 SN | NLS 6GT 8-35 PN |
| J 45 | " 5 " " | NLS OT 8-35 SA | NLS 6GT 8-35 PA |
| J 46 | " 6 " " | NLS OT 8-35 SD | NLS 6GT 8-35 PD |
| J 47 | " 7 " " | NLS OT 8-35 SN | NLS 6GT 8-35 PN |
| J 48 | " 8 " " | NLS OT 8-35 SA | NLS 6GT 8-35 PA |
| J 49 | " 9 " " | NLS OT 8-35 SD | NLS 6GT 8-35 PD |
| J 50 | " 10 " " | NLS OT 8-35 SN | NLS 6GT 8-35 PN |
| J 51 | " 11 " " | NLS OT 8-35 SA | NLS 6GT 8-35 PA |
| J 52 | " 12 " " | NLS OT 8-35 SD | NLS 6GT 8-35 PD |
| J 53 | " 13 " " | NLS OT 8-35 SN | NLS 6GT 8-35 PN |
| J 54 | " 14 " " | NLS OT 8-35 SA | NLS 6GT 8-35 PA |
| J 55 | " 15 " " | NLS OT 8-35 SD | NLS 6GT 8-35 PD |
| J 56 | " 16 " " | NLS OT 8-35 SN | NLS 6GT 8-35 PN |
| J 57 | DACH 1" " | NLS OT 8-35 SA | NLS 6GT 8-35 PA |
| J 58 | DACH 2" " | NLS OT 8-35 SD | NLS 6GT 8-35 PD |
| J 59 | Sync Pulses | NLS OT 12-35 SN | NLS 6GT 12-35 PN |

Table 4.2 - 2: Pin Allocation List of J 41 and J 59 on CB 50

| Connect. Notation | Pin Notation | Signal Code | Function | Wire | EMC Class | Routed |
|---|---|---|---|---|---|---|
| J 41 thru J 58 | 5 | Exp Data | Signal | 2 TSP 24 AWG | IV | to HRM |
| | 1 | | Return | | | |
| | 6 | | Shield | | | |
| | 2 | Exp Clock | Signal | 125 Ω | | |
| | 4 | | Return | | | |
| | 3 | | Shield | | | |
| J 59 | 7 | Frame Sync Pulse | Signal | 3 TSP 24 AWG | IV | from HRM |
| | 18 | | Return | | | |
| | 9 | | Shield | | | |
| | 2 | Format Sync Pulse | Signal | 75Ω | | |
| | 15 | | Return | | | |
| | 1 | | Shield | | | |
| | 14 | Format Change Signal | Signal | | | |
| | 21 | | Return | | | |
| | 13 | | Shield | | | |

4.2.1.2 Interface for Pallet - Only Configurations

4.2.1.2.1 Connector Location

In the Spacelab pallet only configurations, the interface is at the Igloo feedthrough CB 42 (see Appendix B, para 4.4.3)

The connector location is TBD

4.2.1.2.2 Pin Allocation

The pin allocation is TBD

4.2.1.3 Input / Output Characteristics

4.2.1.3.1 Direct Access and Experiment Channels

The direct access channel and experiment channel inputs are electrically identical. The serial input data have to be delivered in the code NRZ-L plus clock. The electrical characteristics are described in Tables 4.2-3 and 4.2-4 while Figure 4.2-2 gives a definition of the characteristics used in these tables.

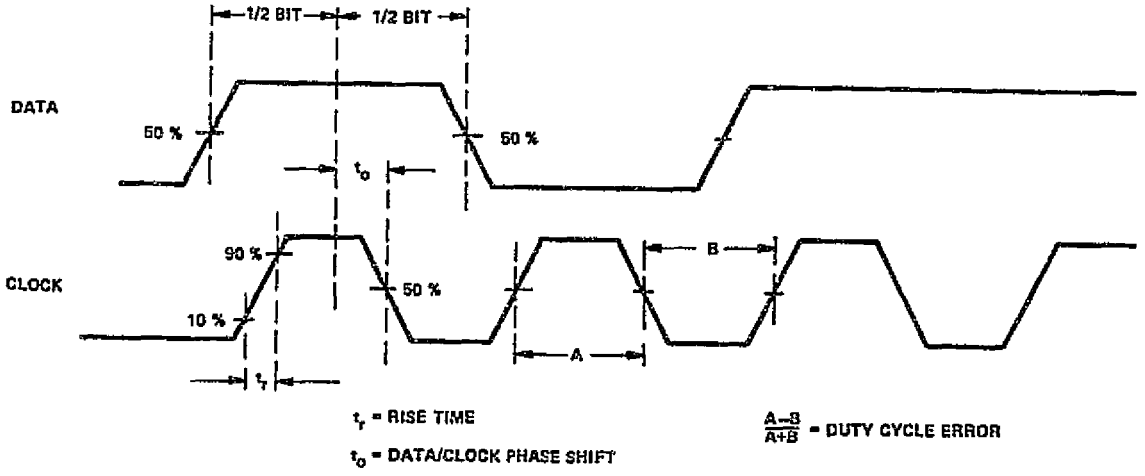



Figure 4.2 - 2: Data / Clock Phase Relationship

The input circuit, which is the same for data and for clock, is given in Figure 4.2 - 3 . The design of the experiment / HRM links, which may be as long as 50 m , is based on a 125Ω TSP cable, Type Gore GSC 1620.

The input/output characteristics of the experiment / HRM links are listed in Table 4.2 - 3 .

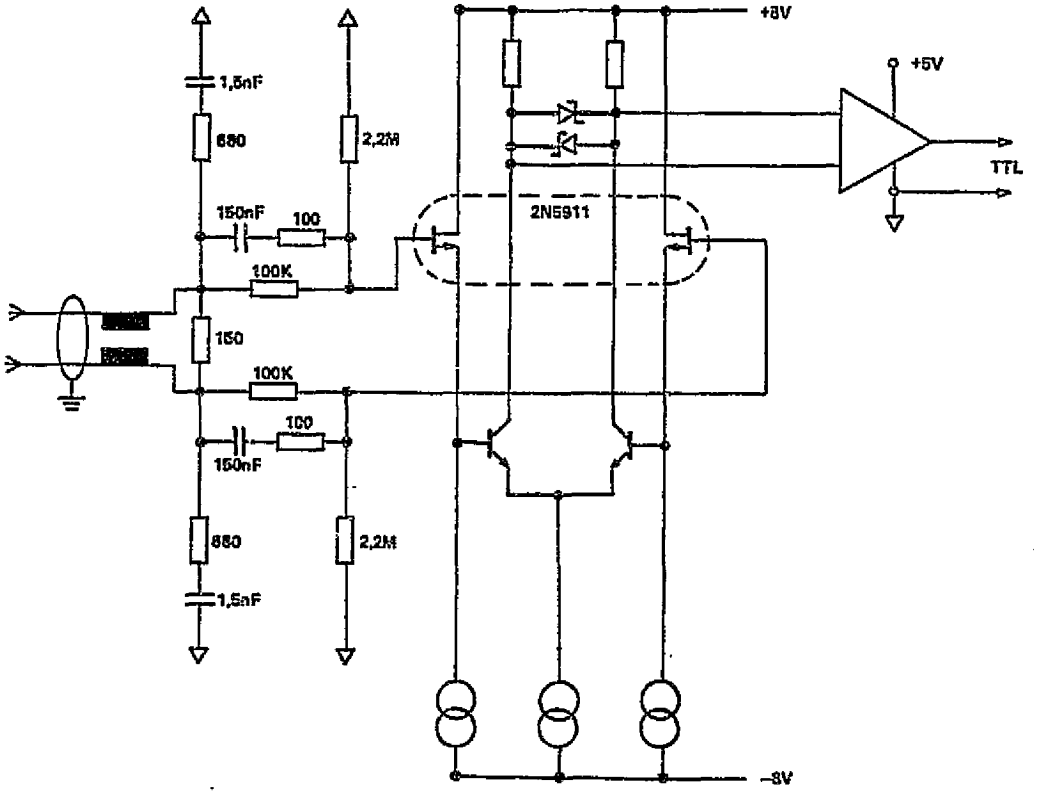



Figure 4.2 - 3 : HRM Input Circuit

Table 4.2 - 3: Input / Output Characteristics of HRM Experiment Dedicated Input Channels

| HRM input characteristics for experiment and Direct Access Channels | | Experiment line driver output characteristics that will ensure proper function | |
|---|---|---|---|
| Input overvoltage protection<br>line-to-ground :<br>line-to-line : | <br>-15V to +32V<br>± 5 V | Fault voltage and current emission: | ± 10 V -30 mA to + 100 mA |
| Max. fault voltage and current emission : | ± 10 V, ± 10 mA | Input protection<br>line-to-ground :<br>line-to-line : | <br>± 10V<br>TBD V |
| Wire shield reference : | HRM chassis ground | Wire shield reference : | Experiment chassis |
| Input isolation : | 1 MΩ min line-to-ground shunted with 3 nF | Output grounding : | connected to experiment signal ground |
| Input type :<br><br>Differential input voltage:<br><br>Differential input voltage offset : | differential, DC coupled<br><br>0,5 V to 1,5 V<br><br>≤ 100 mV | Output type :<br><br>Differential output voltage | complementary<br><br>≥0.8 V, ≤ TBD V |
| Common mode voltage range ( $U_{in}$ = 0,8 V ) : | ± 3 V | Common mode output voltage : | ± 0,5 V |
| Input impedance line-to-line : | 125Ω ± 10% | Output impedance : | equivalent to 8 mA current source |
| Max. Phase Shift between clock and data (see Figure 4.2-2 ) at receiver input including transmitter and cable offset<br>Direct access channels :<br>Experiment channels : | <br><br><br>± 3,5 ns<br>± 24 % of bit period | Max. Phase Shift between clock and data at driver output<br>Direct access channels :<br>Experiment channels : | <br><br>± 2 ns<br>± 8 % of bit period |
| Rise and fall time at receiver input between 10% and 90%<br>Direct access channels :<br>Experiment channels : | <br>≤ 3,5 ns<br>≤ 17,5% of bit period and ≤ 100 ns | Rise and fall time at driver output between 10% and 90%<br>Direct access channels :<br>Experiment channels : | <br>≤ 3,5 ns<br>≤ 17,5% of bit period and ≤ 100 ns |

Experiment clock requirements

- Clock duty cycle error including jitter at receiver input : (see Figure 4.2-2) ± 10%
- Clock stability

  Direct access channel : $10^{-4}$

  Experiment channel

  Word pattern transparency mode : random

  Normal mode HRDM output frequencies jumping between $f_{out}$ and $f_{out}$ ± 2.5% : ± 0.3%

  Normal mode HRDM output frequencies jumping between $f_{out}$-2.5%, $f_{out}$, $f_{out}$+2.5% : ± 1%

4.2.1.3.2 HRM Frame Pulse

The frame pulse leading edge is synchronized with the beginning of each frame. The pulse duration t is

$$t = 2 \text{ words} = \frac{2 \times 16 \quad [\text{bits}]}{\text{HRM output rate} \quad [\text{bits/s}]}$$

The electrical output characteristics are given in Table 4.2 - 4 .

Table 4.2 - 4: Input/Output Characteristics of HRM Frame Pulse

| HRM Frame Pulse Output Characteristics | | Experiment Receiver Input Characteristics that will ensure proper function | |
|---|---|---|---|
| Output protection: | ± 15 V | Fault voltage and current emission: | ± 15 V, ± 15 mA |
| Fault voltage and current emission: | ± 10 V, ± 10 mA | Input protection: | ± 15 V, ± 15 mA |
| Output grounding: | connected to HRM signal ground | Input isolation: | 1 MΩ minimum line-to-ground shunted with 1 nF |
| Wire shield reference: | HRM chassis ground | Wire shield reference: | Chassis Ground |
| Output type: | single ended | Input type: | differential |
| Output impedance: | 200 Ω maximum at DC in either logic state | Input impedance: line-to-line | ≥50 KΩ in parallel with 2.5 nF |
| Digital 'zero' level: | - 0.5 V to + 0.5 V | Digital 'zero' level: | - 0.5 V to + 2.0 V |
| Digital 'one' level: | + 4.0 V to + 6.0 V | Digital 'one' level: | + 2.5 V to + 6.0 V |
| | | Common mode voltage: | ± 10 V |
| Rise/fall time: | ≤ 100 ns | | |

4.2.1.3.3 HRM Format Pulse

The format pulse leading edge is synchronized with the beginning of each new format. The pulse duration t is

$$t = 1 \text{ frame} = \frac{96 \times 16 \quad [\text{bits}]}{\text{HRM output rate} \quad [\text{bits/s}]}$$

The electrical output characteristics are the same as in Table 4.2 - 4 .

4.2.1.3.4 HRM Format Change Signal

The mode change signal trailing edge is synchronized with the beginning of a new format. The pulse duration is

$$t = 4 \text{ formats} = \frac{4 \times 8 \times 96 \times 16 \quad [\text{bits}]}{\text{HRM output rate} \quad [\text{bits/s}]}$$

The electrical output characteristics are the same as in Table 4.2 - 4 .

4.2.2 High Rate Demultiplexer (HRDM)

The experiment GSE interfaces with the on-ground part of the High Data Rate Assembly are

- 1 direct access channel (DACH) Output
  (serial data stream routed through the HRDM without demultiplexing)
- 16 HRDM experiment channel outputs
- 1 HRDM GMT output
- 3 HRDM analog voice outputs

4.2.2.1 Connector Location

The connector are located at a TBD patch panel.

4.2.2.2 Pin Allocation

For the DACH connector type and pin allocation are TBD.

For the experiment channel outputs, the GMT output (each data and clock), and the analog voice output the connector type is BNC B J79-29 (twin axial). The pin allocation is TBD.

4.2.2.3 Input/Output Characteristics

4.2.2.3.1 Direct Access Channel Output: TBD

4.2.2.3.2 HRDM Experiment Channel Output

The data from the HRDM experiment channel outputs are available to the user in a variety of forms. In summary the variety of characteristics are:

- burst or continuous
- data or $\overline{\text{data}}$
- NRZ-L all channels, or biphase-L below 4 Mb/s
- TTL or ECL compatible signal levels

The choice of burst or continuous is part of the format program.
Also the output clock rate of each experiment channel is determined by the format program.
The clock rate is given by:

$$f = 15\ \text{MHz} \cdot \frac{M}{2^{l} \cdot (N+n)}$$

The parameters can be selected in the following range:

M = 1.....65
N = 40 .....65
l = 0 ..... 16
n = −1, 0, + 1

In the burst mode the output clock rate is constant, i.e. n = 0

In the continuous mode the output clock rate can have three different discrete values determined by n = −1, n = 0, and n = + 1. The actual value of n is determined by the status of the particular experiment channel output buffer.
The other characteristics are selected by manuel switches inside the HRDM according to actual experiment GSE needs.

For the NRZ-L output mode the phase relationship between data and clock is given in Figure 4.2 - 4. It should be noted that in all cases a clock is not present in the absence of data.

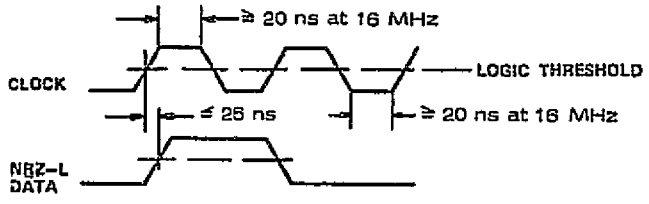



Figure 4.2 - 4: Experiment Channel Output Phase Relationship between Data and Clock

The output circuit of HRDM experiment channel output, which is the same for data and clock, is given in Figure 4.2 - 5

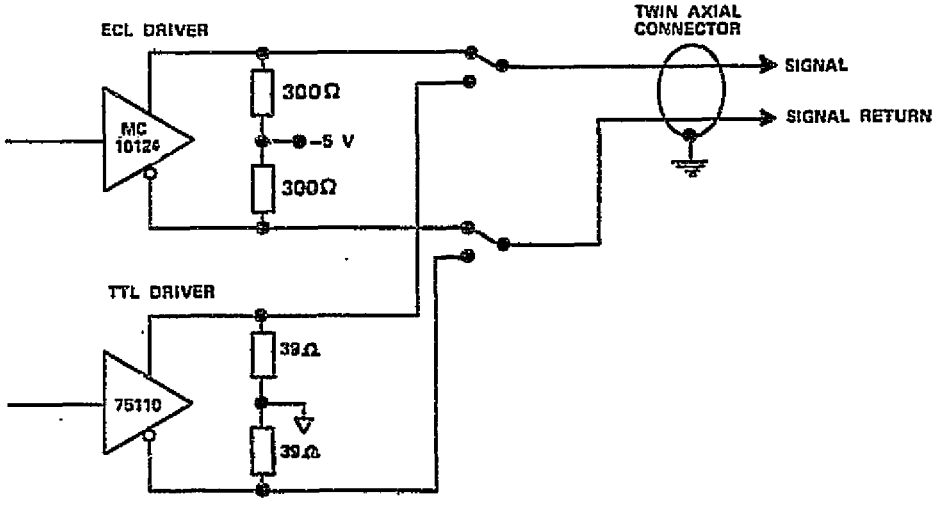



Figure 4.2 - 5: Experiment Channel ECL/TTL Output Circuit

The input/output characteristics for the ECL driver are given in Table 4.2 - 5. The characteristics for the TTL output are given in Table 4.2 - 6.

The HRDM and all related ground support equipment is based on standard 78Ω cables. The onboard system i.e. the HRM and related experiment flight equipment, however, is based on 125 Ω cables for power saving reasons.
Therefore experiment provided ground support equipment which shall be alternatively used for direct connection to the experiment flight equipment (125Ω) or to the HRDM (78 Ω ) should have a selectable input impedance of 125Ω and 78 Ω .

Table 4.2 - 5: ECL Driver Input/Output Characteristics

| HRDM Experiment Channel Output ECL Driver (Specification Values) | | Experiment GSE Input Characteristics that will ensure proper function | |
|---|---|---|---|
| Output protection: | TBD | Fault voltage and current emission: | TBD |
| Fault voltage and current emission: | -5V ; 30 mA | Input protection: | -5 V |
| Wire shield reference: | HRDM chassis ground | Wire shield reference: | experiment GSE chassis ground |
| Output grounding: | connected to HRDM signal to ground | Input isolation: | ≥ 1.5 kΩ line-to-ground |
| Output type: | complementary | Input type: | differential |
| Differential output voltage at connector no external load: | ≥780 m V | Differential input voltage: | ≥ 500 m V |
| 78 Ω load at end of 30 m cable: | ≥540 m V | | |
| Common mode output voltage: | - 1.25 V | Common mode input voltage range: | + 2.5 V -3.0 V |
| Ouput impedance line-to-line: | 78 Ω | Input impedance line-to-line: | 78 Ω |
| Max. Phase Shift between clock and data (see Figure 4.2-2): | - 20 to +8 ns ( 1 Sigma ) | Max. Phase Shift between clock and data at receiver input: | -28 to +14 ns |

Table 4.2 - 6: TTL Driver Input/Output Characteristics

| HRDM Experiment Channel Output TTL Driver (Specification Values) | | Experiment GSE Input Characteristics that will ensure proper function | |
|---|---|---|---|
| Output protection: | TBD | Fault voltage and current emission: | TBD |
| Fault voltage and current emission: | ± 5 V ; 600 mA | Input protection: | ± 5 V |
| Wire shield reference: | HRDM chassis ground | Wire shield reference: | Experiment GSE chassis ground |
| Output grounding: | connected to HRDM signal ground | Input isolation: | ≥ 1.5 kΩ line-to-line |
| Output type: | complementary | Input type: | differential |
| Differential output voltage at connector no external load: | ≥ 500 m V | Differential input voltage: | ≥ 200 m V |
| 78 Ω load at end of 30 m cable: | ≥ 250 m V | | |
| Common mode output voltage: | 0 V | Common mode input voltage range: | ± 5 V |
| Output impedance line-to-line: | 78 Ω | Input impedance line-to-line: | 78 Ω |
| Max. Phase Shift between clock and data: (see Figure 4.2-2) | -20 to +8 ns ( 1 Sigma ) | Max. Phase Shift between clock and data at receiver input: | + 26 to + 12 ns |

4.2.2.3.3 GMT Output

The GMT information is delivered in bursts of 56 bits each. The bit rate is the HRDM input bit rate divided by 512. The data content and the time relationship to the format of the incoming composite data stream is given in Figure 4.2 - 6.

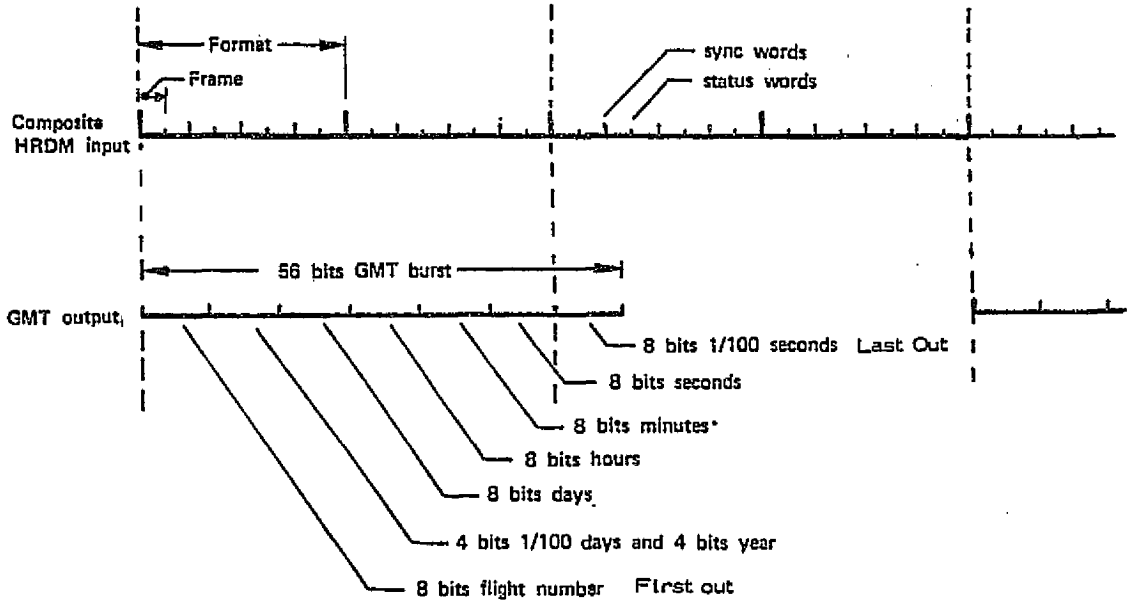



Figure 4.2 - 6: GMT Output Burst

The GMT output data and clock are always provided in NRZ-L form at TTL levels. The input/output characteristics are the same as given in Table 4.2 - 6. The data are BCD coded with the MSB delivered first.

4.2.2.3.4 Analog Voice Output

The HRDM analog voice output provides an analog signal with the bandwidth

flat between 300 Hz and 2300 Hz

28 dB/octave roll-off below 300 and above 2300 Hz

The signal to noise ratio is better than 30 dB.

The output circuit is shown in Figure 4.2 - 7. The input/output characteristics are given in Table 4.2 - 7.

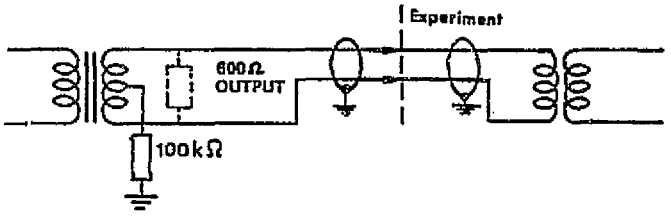



Figure 4.2 - 7: Analog Voice Output Circuit

Table 4.2 - 7: Analog Voice Input/Output Characteristics

| HRDM Voice Analog Output (Specification Values) | | Experiment GSE Input Characteristics that will ensure proper function | |
|---|---|---|---|
| Output protection: | ± 32 V line-to-ground max. 30 mA line-to-line | Fault voltage and current emission: | ± 32 V line-to-ground max. 30 mA line-to-line |
| Fault voltage and current emission: | TBD | Input protection: | TBD |
| Wire shield reference: | HRDM chassis ground | Wire shield reference: | Experiment GSE chassis ground |
| Output isolation: | Galvanic isolation | Input grounding: | connected to exp. GSE signal ground |
| Output type: | transformer coupled | Input type: | transformer coupled |
| Output impedance: | 600Ω ± 10 % | Input impedance: | 600Ω ± 10 % |
| Output power at 1 kHz: | 0 dbm ± 3 dB | | |

4.2.2.3.5 Format and Mode Change Signals:

TBD

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4.3 Analog Data Acquisition

4.3.1 Closed Circuit TV (CCTV)

As an extension of the Orbiter CCTV system Spacelab is going to introduce new interface connectors, which are accessible by the user.

Spacelab provides in module configurations (see Figure 4.3-1)

- 3 inputs for experimenter provided composite video signals
- 1 output for an Orbiter provided sync signal
- 1 output for an Orbiter provided video signal to be displayed on a TV monitor
- signal/power inputs for operating a TV monitor in the control center rack

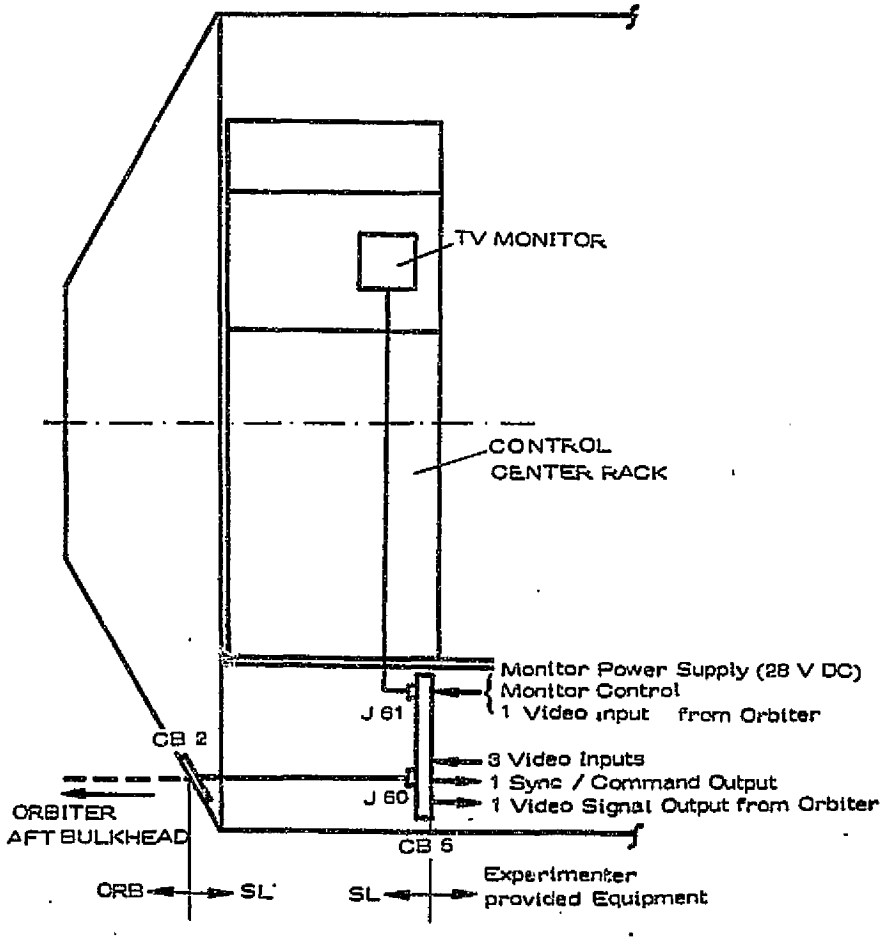



Figure 4.3 - 1; Spacelab CCTV Harness Provisions (Module Configuration)

Spacelab provides in pallet-only configurations (see figure 4.3-2 ):

- 3 inputs for experimenter provided composite video signals
- 1 output for an Orbiter provided sync signal
- 1 input to an Orbiter supplied video recorder

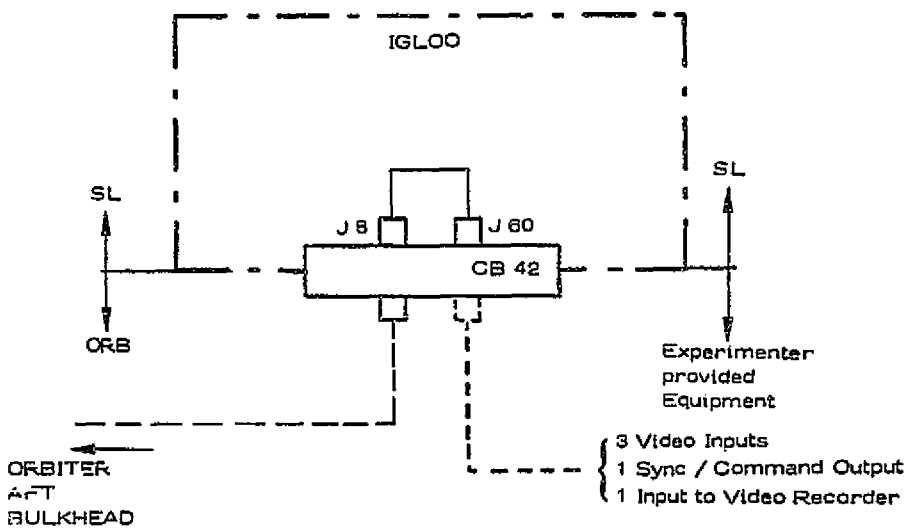



Figure 4.3 - 2 Spacelab CCTV Harness Provisions (Pallet-Only Configuration)

4.3.1.1 Interface for Module Configurations

4.3.1.1.1 Connector Location

In module configurations, the interface location is the Spacelab connector bracket CB 5.

The interface connectors are J 60 respectively J 61 (see Figure 4.3 - 3)

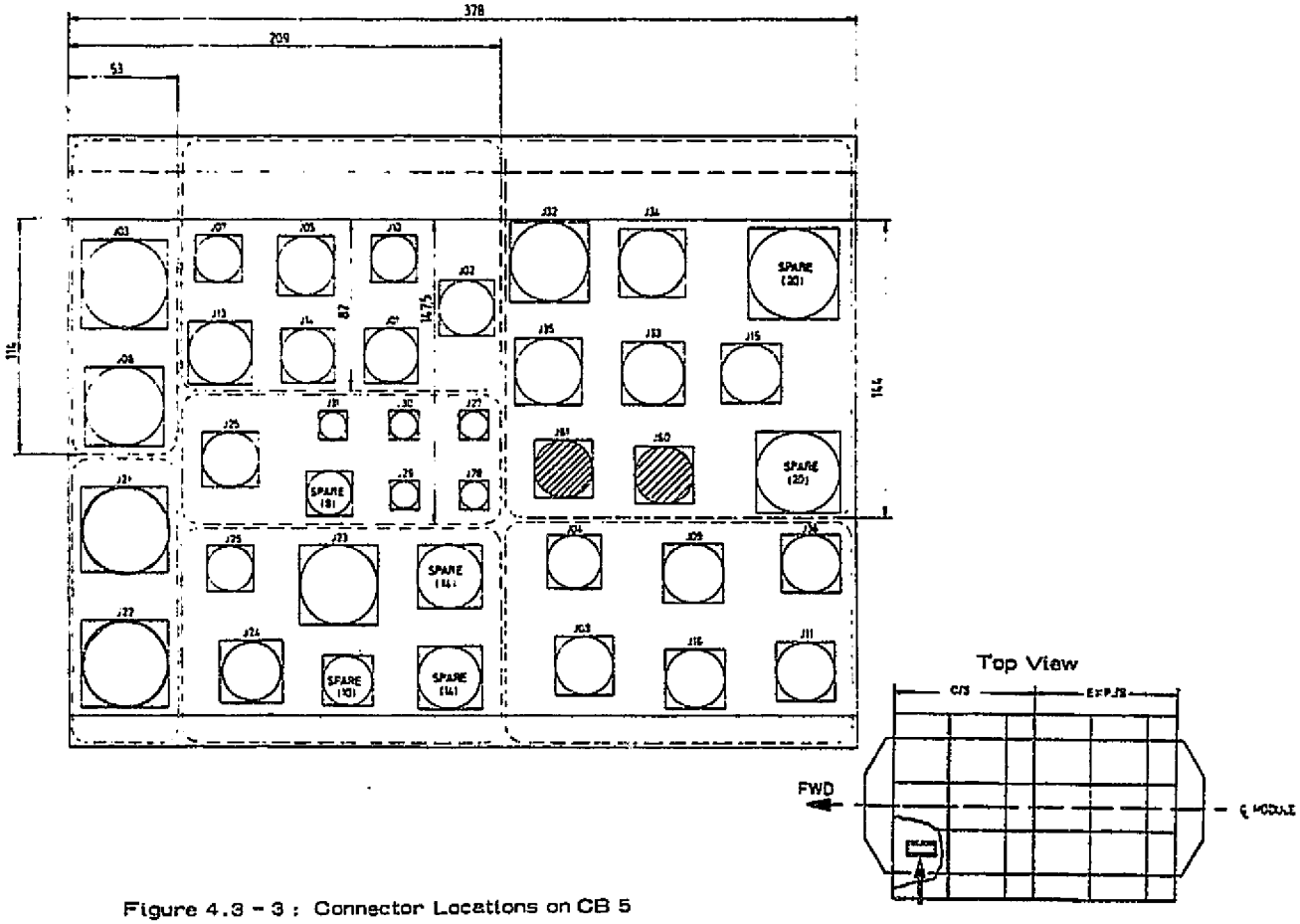



Figure 4.3 - 3 : Connector Locations on CB 5

4.3.1.1.2 Pin Allocation

Pin Allocation of J60 and J61 is given in Table 4.3 - 1.

Table 4.3 - 1: Connector Pin Correlation of J60 and J61 on CB 5

To be supplied later.

4.3.1.2 Interface for Pallet - Only Configurations

4.3.1.2.1 Connector Location

In pallet-only configurations, the interface location is the Igloo signal feedthrough CB 42. The particular interface connector is J 60 see Figure 4.3 - 4).

To be supplied later.

Figure 4.3 - 4: Connector Location on CB 42

4.3.1.2.2 Pin Allocation

Pin Allocation of J60 is given in Table 4.3 - 2.

Table 4.3 - 2: Connector Pin Correlation of J60 on CB 42

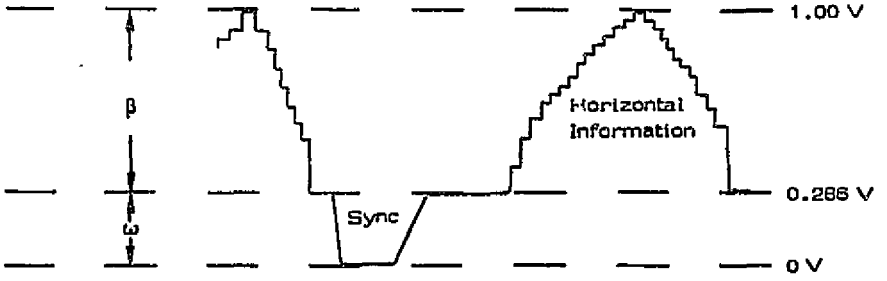
To be supplied later.

4.3.1.3 Input/Output Characteristics for Experiment Provided Composite Video Signals ( Specification Values )

The Spacelab CCTV signals at the interface shall be compatible with U.S. commercial black and white video format defined in EIA specifications RS 170 and RS 330 with the following modifications:

| | |
|---|---|
| Frame Rate: | 29.97 frames/s |
| Lines per Frame: | 525 (interlaced 2 : 1) |
| Aspect Ratio: | 4/3 |
| Horizontal Scanning Frequency: | 15.734264 KHz |
| Vertical Scanning Frequency: | Hor. Freq./262.5 |
| Fields: | 60 interlaced Fields/s |
| Composite Video Bandwidth (3 db $\pm$ 1 db): | 4.5 MHz |
| Amplitude of Composite Video Signal (white signal level, see Figure 4.3-5): | 1 V $\pm$ 10% Peak-to-Peak |
| Tip of Sync Signal: | 0 $\pm$ 0.05 V Peak |

The Spacelab composite video signal shall be synchronous with the Orbiter sync signal.




$\beta$ = 0.714 V nominal
$\omega$ = 0.286 V nominal
Sync to Signal Ratio $\frac{\omega}{\beta+\omega} = 0.286 \pm 5\%$

Figure 4.3 - 5 : Composite Video Signal

| | |
|---|---|
| Signal to Noise Ratio: (Peak to Peak Sync Signal Level/Peak to Peak Noise Level) | $\geq$ 20 db within sync signal level range at the Spacelab feedthrough plate |
| Cross Talk: | $\leq$ 40 db (0 – 4.5 MHz) |
| Source Impedance: | 75Ω $\pm$ 5 % |
| Load Impedance: | 75Ω $\pm$ 5 % |
| Line Impedance: | 70 to 80Ω , TSP 24 AWG |

Signal/Load Characteristics for Orbiter Provided Sync Signal

| | |
|---|---|
| Signal to Noise Ratio: | same as 4.3.1.3 |
| Voltage Level: | 1 V $\pm$ 10 % Peak-to-Peak |
| Load Impedance: | 75Ω $\pm$ 5 % |
| Source Impedance: | 75Ω $\pm$ 5 % |
| Line Impedance: | 70 to 80Ω , TSP 24 AWG |

4.3.1.4 Input Characteristics of the TV Monitor

To be supplied later

4.3.1.5 Grounding

Video sync and signal returns shall be isolated on the Spacelab side from vehicle ground, Spacelab ground, and 28 VDC return by an equivalent impedance of at least 1 MΩ.

4.3.2 4.5 MHz Analog Channel

The 4.5 MHz analog channel provides a direct interface to the Orbiter Ku-band signal processor for experiments. This interface is accessible at

- o Connector Bracket CB 5 for Spacelab module configurations (see Appendix B, para 3.8.1)
- o Connector Bracket CB 57 for Spacelab pallet-only configurations (see Appendix B, para 4.4.1)

4.3.2.1 Connector Location

The connector location at CB5 is given in para 5.3 Figure 5 - 8. (see also Appendix B, para 3.8) Connector J26 is exclusively dedicated to the 4.5 MHz analog channel.

The connector location at CB 57 is given in Figure 4.3 - 6 (see also Appendix B,para. 4.4). Connector P18 is exclusively dedicated to the 4.5 MHz analog channel.

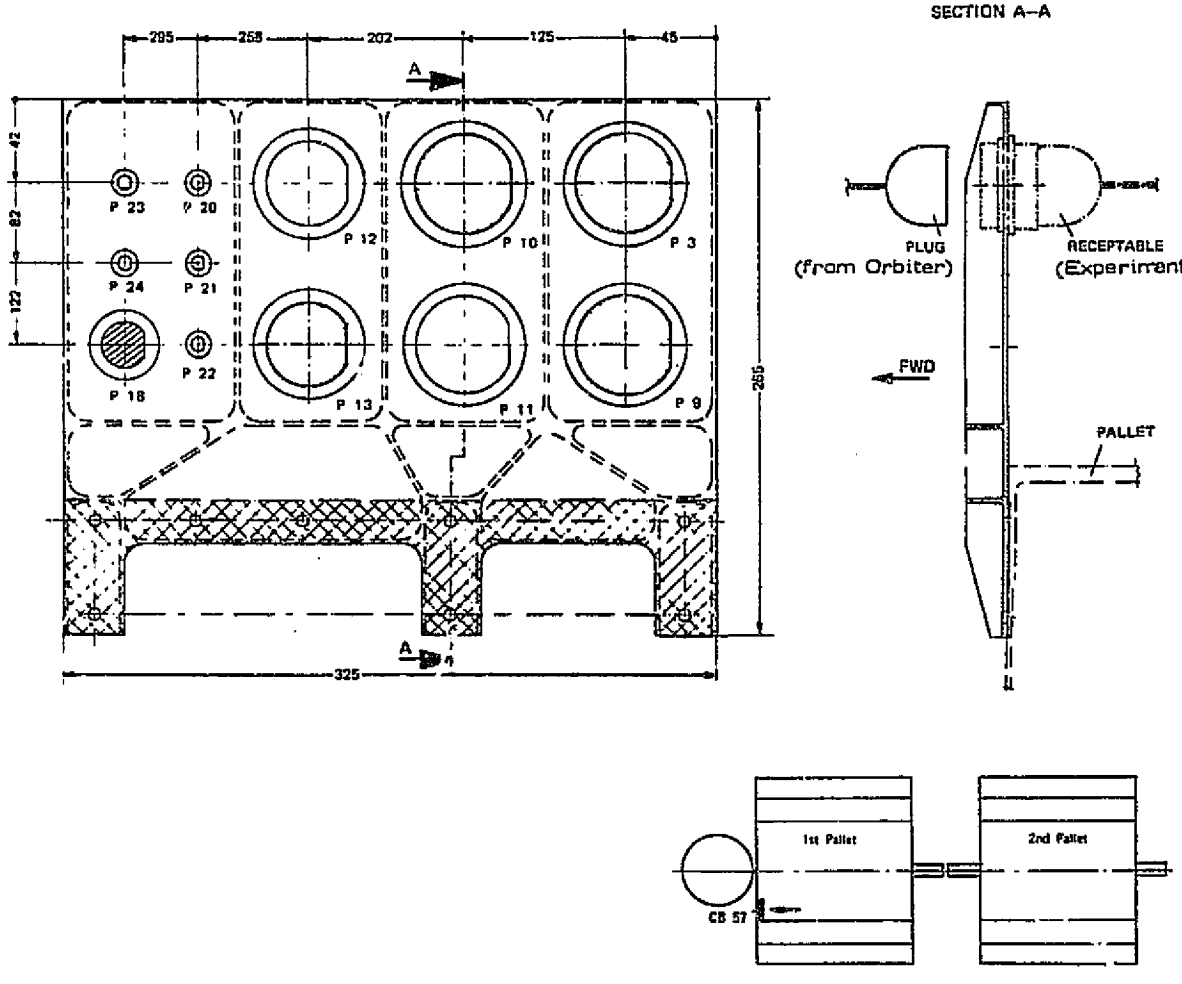



Figure 4.3 - 6 : Connector Location of P 18 at CB 57

4.3.2.2 Pin Allocation

For both the CB 5 interface and the CB 57 interface, at the SL side, the pin allocation is given in Table 4.3-3.

Table 4.3 - 3: 4.5 MHz Analog Channel Pin Allocation

| Configuration | Signal Code | Pin Not'n | Function | SL Connect. Type | Experiment Prov. |
|---|---|---|---|---|---|
| P 18 at CB 57 (pallet-only config'ns | 4.5 MHz | 1<br>2<br>3<br>4<br>5<br>6 | Signal<br>Return<br>Spare<br>Spare<br>Spare<br>Spare<br>* | NLS 6GT 8 - 35 PB ( Plug ) | NLS 0T 8 - 35 SB |
| J 26 at CB 5 (module config'ns ) | 4.5 MHz | 1<br>6<br>5<br>2<br>3<br>4 | Signal<br>Return<br>Shield<br>Spare<br>Spare<br>Spare | NLS 0T 8 - 35 SD | NLS 6GT 10 - 35 PD ( Plug ) |

* Shields are terminated to connector shells ( multi-point grounding)

4.3.2.3 Input / Output Characteristics

The 4.5 MHz input characteristics are listed in Table 4.3 - 4 .

Table 4.3 -4 : 4.5 MHz Input / Output Characteristics

| | |
|---|---|
| Input type: | TBD |
| Voltage range: | 0 - 1 V ± 10 % |
| Source Impedance: | 75Ω ± 10 % |
| Line Impedance: | 75Ω ± 5 % , TSP 24 AWG |
| Load Impedance: | 75Ω ± 10 % |
| Frequency Range: | DC - 4.5 MHz<br>Analog signals will be filtered to 4.5 MHz in the Orbiter KU-Band Signal Processor prior to transmission to the ground |
| Peak signal-to-RMS noise ratio:<br>Flatness :<br>Roll-off rate at 4.5 MHz: | TBD |
| Grounding : | The shield is referenced to structure at the KU- Band signal processor input, at the Spacelab feedthrough and at each individual connector bracket |

4.4 Mission Elapsed Time (MET)

The MET channel provides a direct interface to the Orbiter master time unit for experiments. This interface is accessible at

- connector bracket CB 5 for Spacelab module configurations (see Appendix B, para. 3.8.1),
- connector bracket CB 57 for Spacelab pallet-only configurations (see Appendix B, para.4.4.1).

4.4.1 Connector Location

The connector location at CB 5 is given in para 5.3 Figure 5 - 8.

The MET signal lines are at connector J 24 together with other experiment dedicated lines (see Table 5 - 6).

The connector location at CB 57 is shown in Figure 4.4 - 1. The MET signal lines are at connector P 12 together with other experiment dedicated lines (see Table 5 - 11).

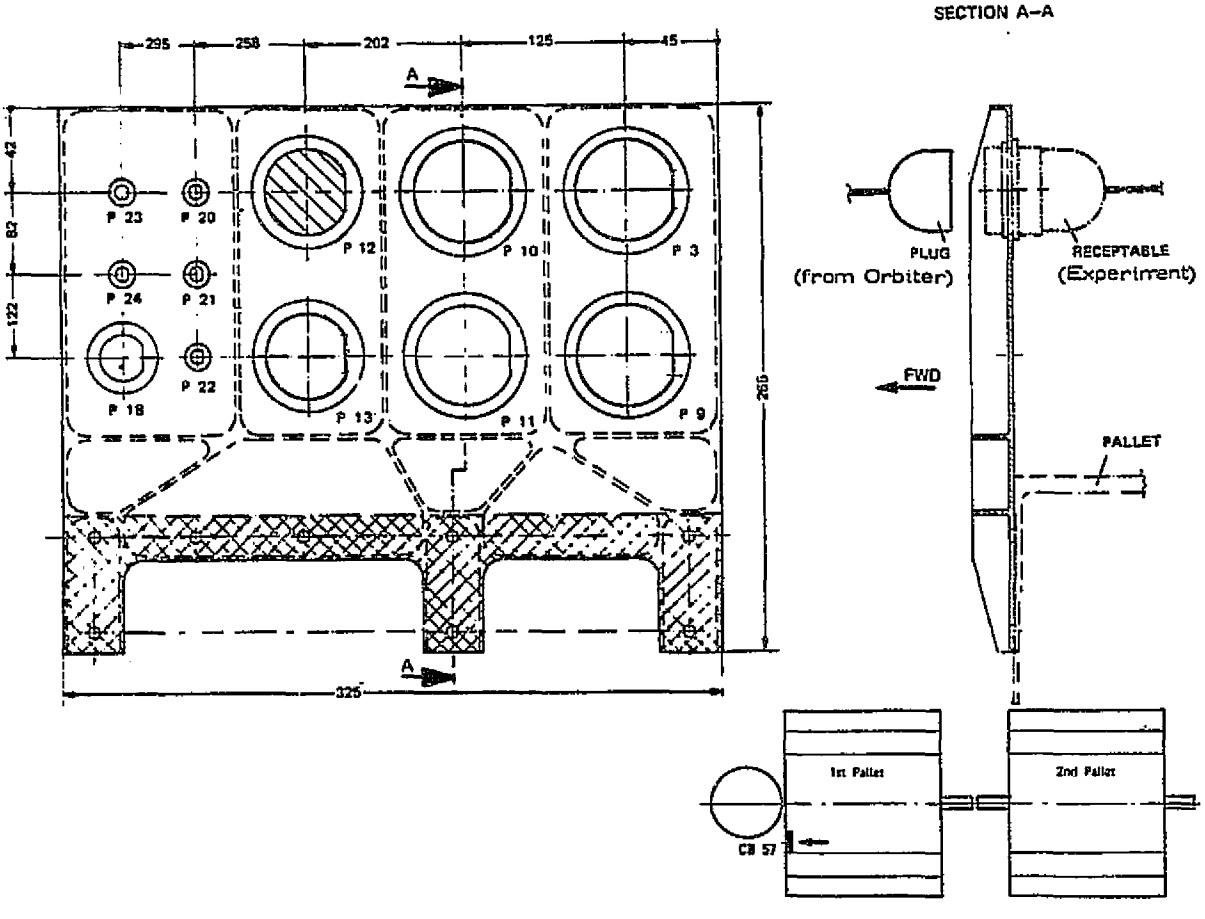



Figure 4.4 - 1: Connector Location of P 12 at CB 57

4.4.2 Pin Allocation

For the CB5 interface, the pin allocation of J 24 is given in Table: 5 - 6.

For the CB 57 interface, the pin allocation of P 12 is given in Table 5 - 11.

4.4.3 Input/Output Characteristics

A schematic of the Orbiter master time unit /experiment link is given in Figure 4.4-2.

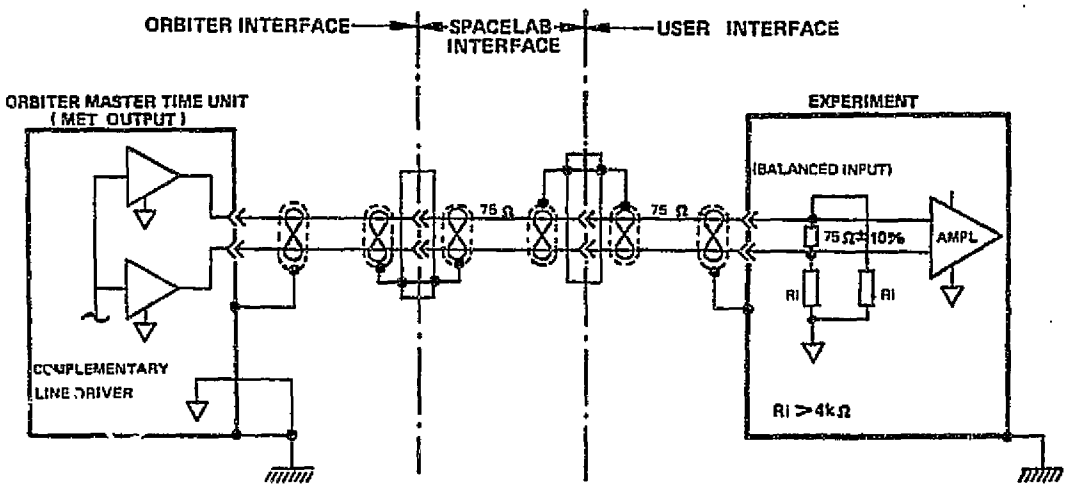



Figure 4.4 - 2: MTU/Experiment Link Schematic

The output characteristics of the MET channel are listed in Table 4.4 - 1 .

Table 4.4 - 1: Input/Output Characteristics of MET User Channel

| Output Characteristics of the MET User Channel at the S/L Feedthrough | | Input Circuit Requirements to Ensure Proper Functioning | |
|---|---|---|---|
| Output type/ | complementary DC coupled | Input type: | balanced DC coupled |
| Output code: | IRIGB modified (see SPAH Main Vol. para 4.4.2.1.5 | | |
| Discrete 'zero': | - 1.8 V to - 3.0 V peak line-to-line | Discrete 'zero': | - 1.3 V to - 3.0 V peak line-to-line |
| Discrete 'one': | + 1.8 V to + 3.0 V peak line-to-line | Discrete 'one': | + 1.3 V to + 3.0 V peak line-to-line |
| Driving capability: | ≤ 40 m A | Load current: | ≤40 m A |
| Signal to noise ratio (S/N): | 25 dB | | |
| Jitter pulse-to-pulse: | ≤ 1µs | Jitter pulse-to-pulse: | ≤ 1µs |
| Rise time: (measured between 10 % and 90 % of peak value) | ≤ 1.2 µ s | Rise time: | ≤ 1.5 µ s |
| Fall time: (measured between 10 % and 90 % of peak value) | ≤ 1.2 µs | Fall time: | ≤ 1.5 µ s |
| Distortion/overshoot: | ± 500 m V max. p-p | Distortion/overshoot: | ± 200 mV max. p - p |
| DC offset: | ≤ 0.5 V line-to-ground | | N/A |
| Skew at 50 % point: | 20 n s | | N/A |
| Power-off impedance: | ≤100Ω | Power-off impedance: | 75Ω ± 10 % |
| Output impedance: | ≤100Ω | Input impedance: | 75Ω ± 10 % |
| Overvoltage protection: | ± 5.5 V line-to-line and line-to-ground | Fault voltage emission: | ≤ 10 V line-to-line and line-to-ground |
| Fault voltage emission: | ≤ ± 10 V line-to-line and line-to-ground | Overvoltage protection: | ± 12 V line-to-line and line-to-ground |
| Fault current limitation: | 120 m A | | |
| | | Isolation against signal ground at 1 MHz : | ≥2 kΩ |
| Isolation against primary power ground | ≥2 MΩ | Isolation against primary power ground at op.freq.: | ≥1 MΩ |

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# 5. EXPERIMENT DEDICATED HARNESSES

## 5.1 Signal Harness Classification

This section describes S/L signal harnesses which are experiment dedicated. These harnesses are devided in four classes to minimize EMI problems. The different EMC classes are defined by the following criteria:

Class I:

- All primary power wiring
- Wiring carrying AC or switched DC currents in excess of 1 A (peak transient)

Class II:

- Relay or solenoid wiring switched DC currents less than 1 A
- Wiring carrying AC or switched DC currents ranging from 0.05 to 1 A (peak transient)

Class III:

- Low level voltage and current signal wiring
- Audio communication lines

Class IV:

- Video and RF communication lines
- Digital signal wiring where signal rise and/or fall times are below 2 µs

Where no metallic carrier exists between bundles of different EMC classes the following minimum separation distance will be used:

- 10 cm minimum distance between Class I and Class III or Class IV wire bundles
- 5 cm minimum distance between bundles of all other categories

5.2 Airlock Experiment Harness

Connection between experiment equipment in the airlock and experiment equipment in the module can be achieved by means of an experiment dedicated signal harness , which is part of the airlock. This signal harness is available in addition to the harness for experiment power described in para. 3.7. As shown in Figure 5 - 1 and Figure 5 - 2, the interface from the interior of the airlock to the harness is represented by a connector bracket and a pigtail on the experiment table. The interface from the module, outside the airlock, is given by the connector bracket CB 25, which is located at the overhead structure.

The experiment dedicated airlock harness can be exchanged on a mission-by-mission basis. Spacelab provides two signal harnesses that may be flown alternatively :

- Airlock Experiment Harness I
  Typical for this harness is the provision that a subset of the wires can be used as data and control lines for an experiment RAU accommodated in the airlock by the experimenter.
- Airlock Experiment Harness II
  This harness provides a subset of wires suitable as a high rate data link between the experiments inside the airlock and the HRM .

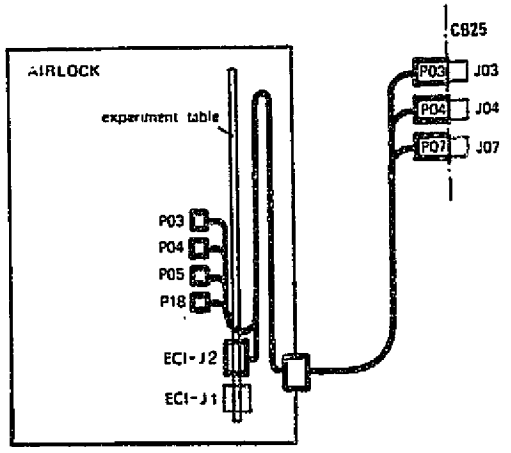



Figure 5 - 1: Airlock Experiment Harness I

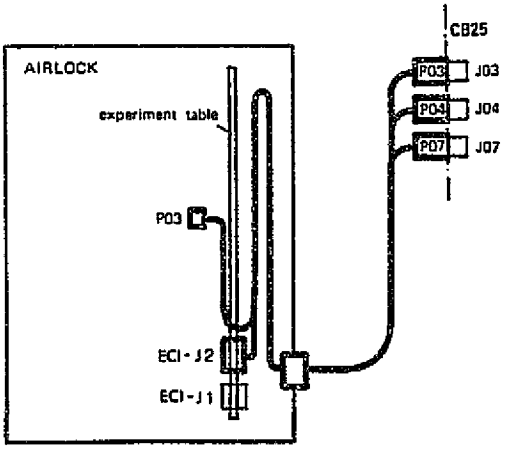



Figure 5 - 2 : Airlock Experiment Harness II

5.2.1 Connector Location

The connector location on Connector Bracket CB 25 is shown in Figure 5 - 3. P03, P04 and P07 are the connectors provided at experiment interfaces.

The connector location at the experiment table is given in Figure 5 - 4. Connector EC1-J2 is mounted on a connector bracket. The pigtail (P03,P04,P05,P18) is tied down on removable plate attached to the experiment table rails.

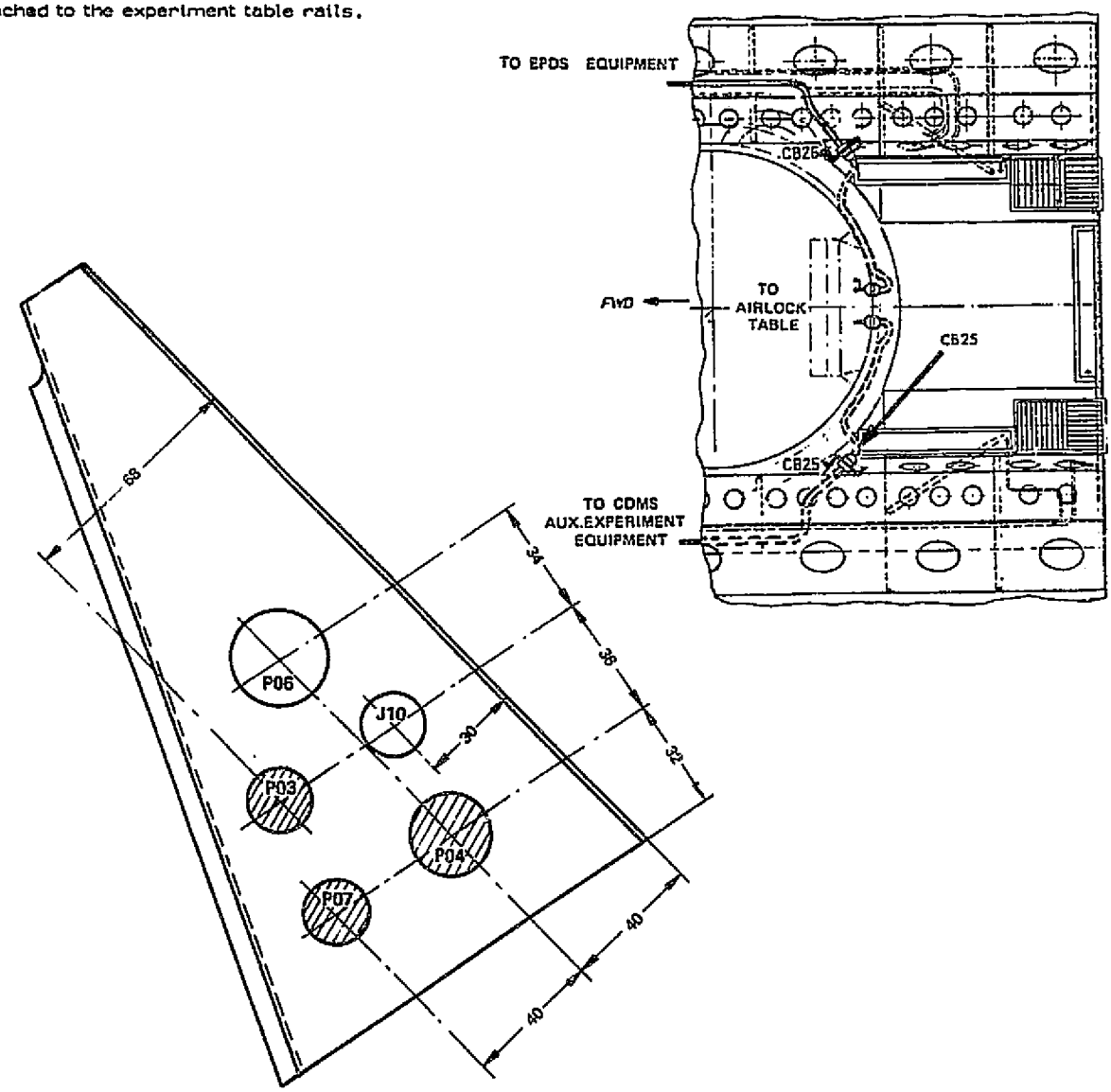
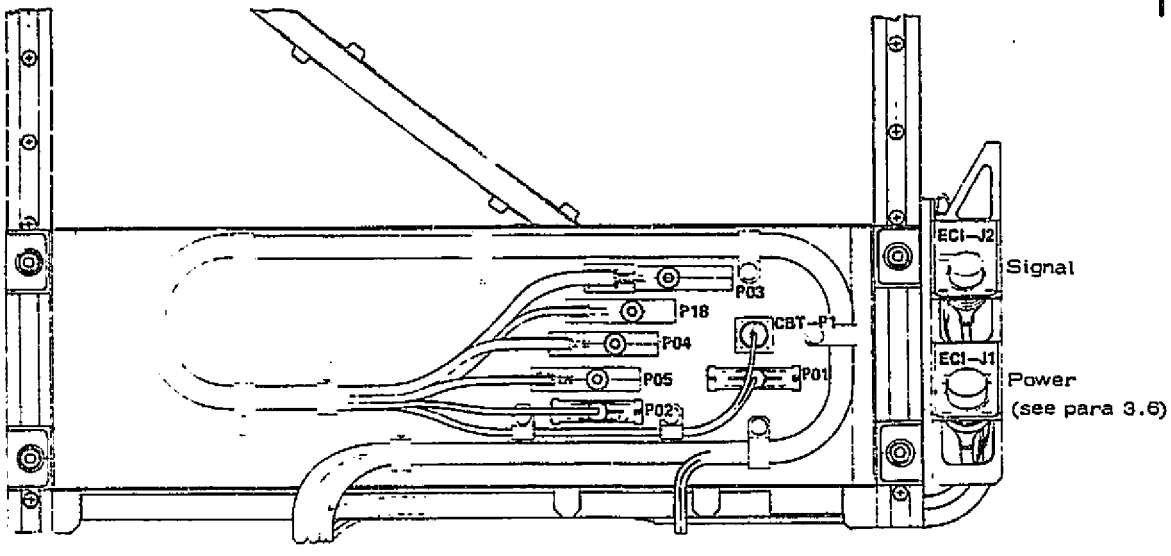
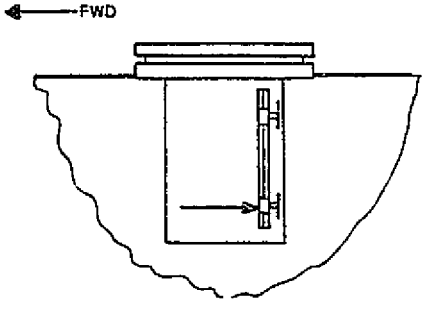



Figure 5-3: Connector Bracket CB 25




Note: 1) One hand operation is possible for connecting/disconnecting cables with release fasteners

2) Length of pigtail is approximately 750 mm after release

Figure 5 - 4: Signal Connector Location of the Experiment Table in the Airlock for Harness I

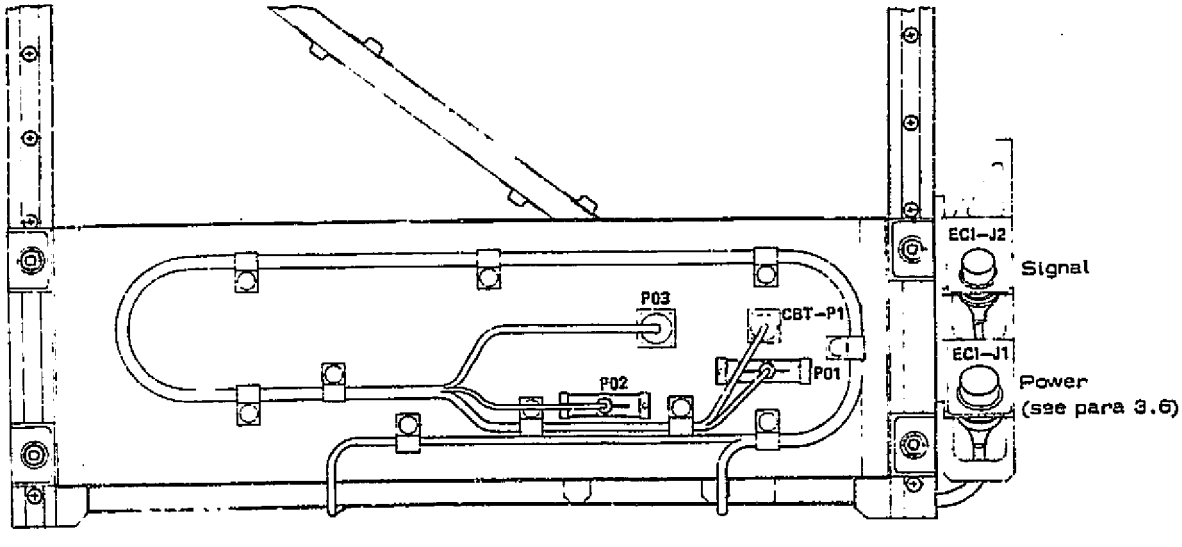



Figure 5 - 5: Signal Connector Location on the Experiment Table in the Airlock for Harness II

5.2.2 Connector/Pin Correlation for Harness I

This harness comprises:

- 1 TS 3 C impedance not specified
- 6 TSP Impedence not specified
- 7 TSP, 75Ω impedance

Table 5-1 : Harness I Connector Pin Correlation List.

| Routed | Connector Bracket CB 25 | | | Wiring | | | Airlock Experiment Table | | | Experiment | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| from | Conn' Not'n | Connector Type | Pin Not'n | Pin Funct. | Harness Type | EMC Class | Pin Not'n | Connector Type | Conn' Not'n | Conn' Not'n | Connector Type |
| S/L or USER | P07 | NLS-6GT-10-35PA 4) 2) | 11 | Line | 2 TSP 24 AWG (75 Ω) | IV 3) | 14 | GWSW 038 BV PSHB 4) 1) | P05 | J05 | GWSW 038 BV RPFB 1) |
| | | | 12 | Line | | | 28 | | | | |
| | | | 13 | Shield | | | 20 | | | | |
| | | | 4 | Line | | | 11 | | | | |
| | | | 5 | Line | | | 25 | | | | |
| | | | 6 | Shield | | | 19 | | | | |
| S/L or USER | P04 | NLS-6GT-14-35 P 4) 2) | 1 | Line | 1 TSP | III 3) | 10 | GWSW 038 BN PSHB 4) 1) | P04 | J04 | GWSW 038 BN RPFB 1) |
| | | | 2 | Line | | | 24 | | | | |
| | | | 3 | Shield | | | 17 | | | | |
| | | | 31 | Line | | IV 3) | 14 | | | | |
| | | | 32 | Line | | | 28 | | | | |
| | | | 33 | Shield | | | 20 | | | | |
| | | | 28 | Line | 2 TSP 24 AWG (75 Ω) | | 11 | | | | |
| | | | 29 | Line | | | 25 | | | | |
| | | | 30 | Shield | | | 19 | | | | |
| | | | 25 | Line | 2 TSP 24 AWG (75 Ω) | IV 3) | 10 | GWSW 038 BW PSHB 1) | P18 | J18 | GWSW 038 BW RPFB 1) |
| | | | 26 | Line | | | 24 | | | | |
| | | | 27 | Shield | | | 17 | | | | |
| | | | 34 | Line | 1 TS 3C 24 AWG | III 3) | 53 | GWSW 038 BV PSHB 4) 1) | P03 5) | J03 | GWSW 038 BV RPFB 1) |
| | | | 35 | Line | | | 71 | | | | |
| | | | 36 | Line | | | 54 | | | | |
| | | | 37 | Shield | | | 39 | | | | |
| | | | 22 | Line | 5 TSP 24 AWG | III 3) | 22 | | | | |
| | | | 23 | Line | | | 56 | | | | |
| | | | 24 | Shield | | | 40 | | | | |
| | | | 19 | Line | | | 1 | | | | |
| | | | 20 | Line | | | 2 | | | | |
| | | | 21 | Shield | | | 18 | | | | |
| | | | 16 | Line | | | 19 | | | | |
| | | | 17 | Line | | | 20 | | | | |
| | | | 18 | Shield | | | 38 | | | | |
| | | | 13 | Line | | | 51 | | | | |
| | | | 14 | Line | | | 52 | | | | |
| | | | 15 | Shield | | | 70 | | | | |
| | | | 4 | Line | | | 68 | | | | |
| | | | 5 | Line | | | 69 | | | | |
| | | | 6 | Shield | | | 88 | | | | |
| USER | P03 | NLS-6GT-10-35 P 4) 2) | 11 | Line | 2 TSP 24 AWG (75 Ω) | IV 3) | 17 | NLS-OT-12 -35-S 4) 2) | ECI J2 | Exp' ment Conn' | NLS 6GT 12-35 P 2) |
| | | | 12 | Line | | | 18 | | | | |
| | | | 13 | Shield | | | 19 | | | | |
| | | | 4 | Line | | | 20 | | | | |
| | | | 5 | Line | | | 21 | | | | |
| | | | 6 | Shield | | | 22 | | | | |

1) Connector Spec: GSFC-S-311-P4/1
2) Connector Spec: 40 M 38277
3) EMC Classification is described in Para 5.1
4) All pins not mentioned explicitely are spare pins.
5) Pin 8 and 23 respectively 57 and 78 are connected within P03 by a jumper

5.2.3 Connector/Pin Correlation for Harness II

The connector and pin correlation of Airlock Experiment Harness II is given in Table 5 - 2 .

This harness comprises:

- 2 TSP, 125Ω impedance
- 5 TSP, 75Ω impedance
- 1 TS4C, impedance not specified

Table 5 - 2 : Harness II/Connector Pin Correlation List.

| Routed from | Connector Bracket CB 25 | | | Wiring | | | Airlock Experiment Table | | | Experiment | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Conn.' Not'n | Connector Type | Pin Not'n | Pin Funct. | Harness Type | EMC Class | Pin Not'n | Connector Type | Conn.' Not'n | Conn.' Not'n | Connector Type |
| S/L or USER | P04 | NLS-6GT-14-35 P 4) 2) | 16 | Line | 1 TS 4C 24 AWG | III | 2 | NLS-6GE 10-35 P 4) 2) | P03 | J03 | NLS 0T 10-35 S 2) |
| | | | 17 | Line | | | 3 | | | | |
| | | | 18 | Shield | | | 1 | | | | |
| | | | 19 | Line | | | 11 | | | | |
| | | | 20 | Line | | | 12 | | | | |
| | | | 21 | Shield | | | 1) | | | | |
| | | | | | | 3) | | | | | |
| | | | 31 | Line | 5 TSP (75Ω) 24 AWG | IV | 10 | NLS-0T- 12-35 S 4) 2) | ECI- J2 | P02 | NLS 6GT 12-35 P 2) |
| | | | 32 | Line | | | 9 | | | | |
| | | | 33 | Shield | | | 19 | | | | |
| | | | 28 | Line | | | 8 | | | | |
| | | | 29 | Line | | | 7 | | | | |
| | | | 30 | Shield | | | 18 | | | | |
| | | | 25 | Line | | | 6 | | | | |
| | | | 26 | Line | | | 5 | | | | |
| | | | 27 | Shield | | | 17 | | | | |
| | P03 | NLS-6GT- 10-35 P 4) 2) | 11 | Line | | | 4 | | | | |
| | | | 12 | Line | | | 3 | | | | |
| | | | 13 | Shield | | | 16 | | | | |
| | | | 4 | Line | | | 2 | | | | |
| | | | 5 | Line | | | 1 | | | | |
| | | | 6 | Shield | | | 15 | | | | |
| | P07 | NLS-6GT- 10-35 PA 4) 2) | 7 | Line | 2 TSP (125Ω) 24 AWG | | 14 | | | | |
| | | | 8 | Line | | | 13 | | | | |
| | | | 9 | Shield | | | 21 | | | | |
| | | | 10 | Line | | | 12 | | | | |
| | | | 1 | Line | | | 11 | | | | |
| | | | 2 | Shield | | | 20 | | | | |
| | | | | | | 3) | | | | | |

1) Common Shield

2) Connector Spec: 40 M 38277

3) EMC Classification is described in Para 5.1

4) All pins not mentioned explicitely are spare pins.

5.3 Aft Flight Deck / Spacelab Experiment Harness

Experiment equipment in the Orbiter AFD and experiment equipment in the module (for module configurations) or on the pallet (for pallet-only configurations) can be connected by means of an experiment dedicated harness, which is part of basic Spacelab equipment.

As shown in Figures 5 - 6 and 5 - 7, this experiment dedicated harness is routed from the distribution panel in the Orbiter to Connector Bracket CB 5 in the module core segment and to Connector Bracket CB 57 on the first foreward pallet frame, respectively. The provided experiment harness to Connector Bracket CB 5 is terminated by receptacles, while the experiment harness to Connector Bracket CB 57 is terminated by plugs.

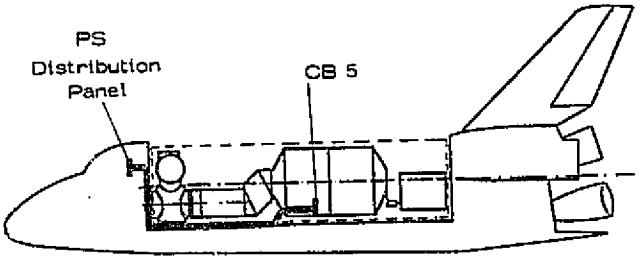



Figure 5-6: AFD / Spacelab Experiment Harness - Module Configuration

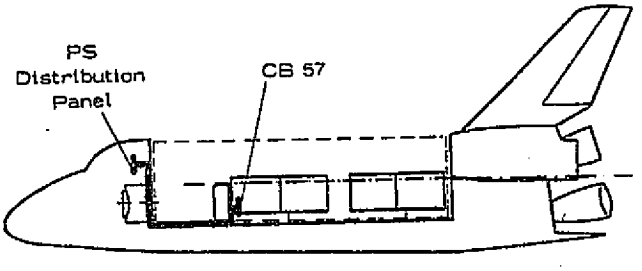



Figure 5-7: AFD/Spacelab Experiment Harness - Pallet-Only Configuration

5.3.1 Module Configuration

5.3.1.1 Connector Description of CB 5

CB5 is the central signal interface between the Spacelab subsystem section and the experiment train. It contains much more than only the interface for the AFD / Spacelab experiment harness. The other interfaces are described in other parts of this document. However for clarification all connector functions are listed below.

| | |
|---|---|
| J 8 | IPS S/S and exp RAU |
| J 9 | IPS S/S and exp RAU |
| J 13 | S/S RAU and DDS 3 monitoring |
| J 15 | DDS data bus |
| J 16 | DDS data bus |
| J 21 | Experiment signal provisions (27 TSPś, EMC Class III )<br>IMCP R7 panel, experiment safing command verification (5 TSPś , EMC Class III ) |
| J 22 | Experiment signal provisions (27 TSPś , EMC Class III )<br>CWEA experiment C & W monitoring (5 TSPś , EMC Class III ) |
| J 23 | Experiment signal provisions (27 TPś, EMC Class II ) |
| J 24 | Experiment signal provisions (7 TSPś ,EMC Class IV )<br>MET (1 TSP , EMC Class IV ) |
| J 25 | IMCP R7 panel, experiment safing commands (5 TPś , EMC Class II ) |
| J 26 | 4.5 MHz analog channel (1 TSP , 75Ω, EMC Class IV ) |
| J 27 | Experiment signal provisions ( 1 coax, 75Ω , EMC Class IV ) |
| J 28 | Experiment signal provisions ( 1 coax, 75Ω , EMC Class IV ) |
| J 29 | Experiment signal provisions ( 1 coax, 75Ω , EMC Class IV ) |
| J 30 | Experiment signal provisions ( 1 coax, 75Ω , EMC Class IV ) |
| J 31 | Experiment signal provisions ( 1 coax, 75Ω , EMC Class IV ) |
| J 32 | MDM experiment safing (12 channels, 3 TS5C, EMC Class II ) |
| J 33 | MDM experiment safing ( 12 channels, 3 TS5C, EMC Class II ) |
| J 34 | MDM experiment C & W monitoring ( 11 channels, 8 TSPś, 1 TS4C, EMC Class III ) |
| J 35 | MDM experiment C & W monitoring ( 8 channels, 7 TSPś, 1 TS5C, EMC Class III ) |
| J 60 | CCTV from Orbiter |
| J 61 | TV monitor in CCR |

5.3.1.2 Connector Location on CB 5

The connector location on CB 5 is given in Figure 5 - 8. The connectors J 21, J 22, J 23 and J 24 provide experiment interfaces for TSP and TP, while J 27, J 28, J 29, J 30 and J 31 are experiment interfaces for coax cables.

The connector location on the Orbiter distribution panel is still TBD.

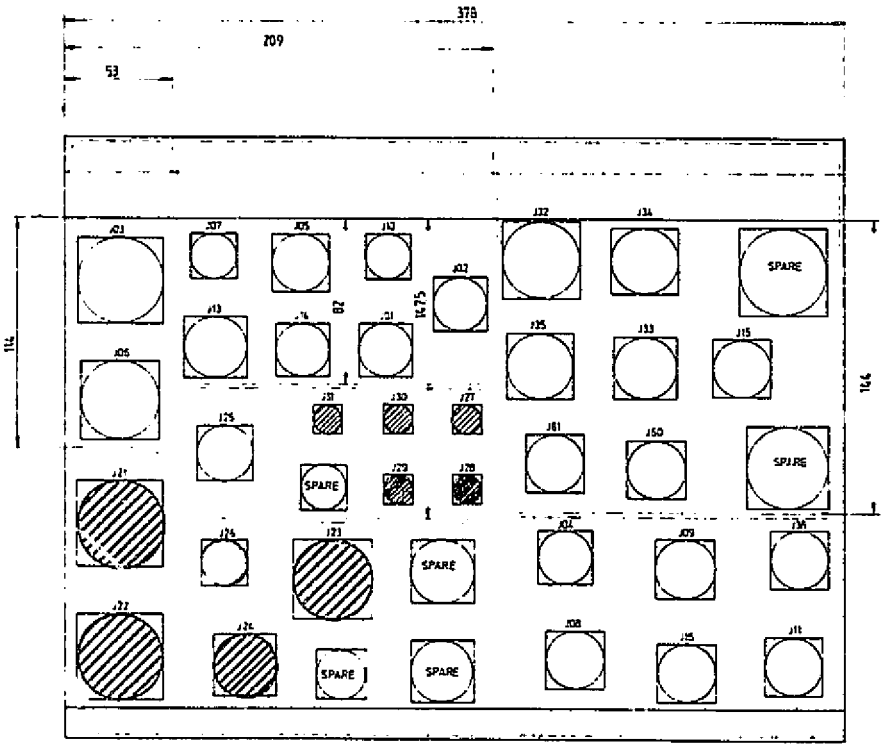
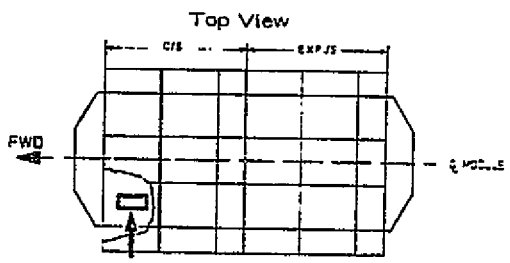



Figure 5 - 8 Connector Locations on CB5



5.3.1.3 Connector / Pin Correlation of AFD/Spacelab Harness - Module Configuration

The connector pin correlation of the AFD / Spacelab experiment harness is given in the subsequent Tables 5 - 3 thru 5 - 7

Table 5 - 3 : Connector Pin Correlation of J 21on CB 5

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 5 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type (Spec.) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Receptacle | Conn' Not'n | Plug |
| TBD | TBD | TBD | TBD | line | TSP | 1 | NLS OT 22-35 SA | J 21 | NLS 6GT 22-35 PA |
| | | | | line | 24 AWG | 2 | | | |
| | | | | shield | | 3 | | | |
| | | | | line | EMC | 7 | | | |
| | | | | line | Class III | 6 | | | |
| | | | | shield | | 5 | 2) | | 2) |
| | | | | line | | 8 | | | |
| | | | | line | | 9 | | | |
| | | | | shield | | 10 | | | |
| | | | | line | | 13 | | | |
| | | | | line | | 12 | | | |
| | | | | shield | | 11 | | | |
| | | | | line | | 16 | | | |
| | | | | line | | 17 | | | |
| | | | | shield | | 18 | | | |
| | | | | line | | 21 | | | |
| | | | | line | | 20 | | | |
| | | | | shield | | 19 | | | |
| | | | | line | | 22 | | | |
| | | | | line | | 32 | | | |
| | | | | shield | | 43 | | | |
| | | | | line | | 14 | | | |
| | | | | line | | 23 | | | |
| | | | | shield | | 33 | | | |
| | | | | line | | 15 | | | |
| | | | | line | | 24 | | | |
| | | | | shield | | 34 | | | |
| | | | | line | | 57 | | | |
| | | | | line | | 46 | | | |
| | | | | shield | | 35 | | | |
| | | | | line | | 47 | | | |
| | | | | line | | 36 | | | |
| | | | | shield | | 25 | | | |
| | | | | line | | 48 | | | |
| | | | | line | | 37 | | | |
| | | | | shield | | 26 | | | |
| | | | | line | | 49 | | | |
| | | | | line | | 38 | | | |
| | | | | shield | | 27 | | | |
| | | | | line | | 50 | | | |
| | | | | line | | 39 | | | |
| | | | | shield | | 28 | | | |
| | | | | line | | 51 | | | |
| | | | | line | | 40 | | | |
| | | | | shield | | 29 | | | |
| | | | | line | | 52 | | | |
| | | | | line | | 41 | | | |
| | | | | shield | 1) | 30 | | | |

1) EMC Classification is described in Para. 5.1

2) Spec: 40 M 38277

Table 5 - 3 (cont'd) : Connector Pin Correlation of J 21 on CB 5

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 5 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type (Spec.) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Receptacle | Conn' Not'n | Plug |
| TBD | TBD | TBD | TBD | line | TSP | 53 | NLS OT | J 21 | NLS 6GT |
| | | | | line | 24 AWG | 42 | 22-35 SA | | 22-35 PA |
| | | | | shield | | 31 | | | |
| | | | | line | EMC | 64 | 3) | | 3) |
| | | | | line | Class III | 54 | | | |
| | | | | shield | | 44 | | | |
| | | | | line | | 65 | | | |
| | | | | line | | 55 | | | |
| | | | | shield | | 45 | | | |
| | | | | line | | 56 | | | |
| | | | | line | | 67 | | | |
| | | | | shield | | 77 | | | |
| | | | | line | | 58 | | | |
| | | | | line | | 59 | | | |
| | | | | shield | | 60 | | | |
| | | | | line | | 63 | | | |
| | | | | line | | 62 | | | |
| | | | | shield | | 61 | | | |
| | | | | line | | 87 | | | |
| | | | | line | | 78 | | | |
| | | | | shield | | 68 | | | |
| | | | | line | | 88 | | | |
| | | | | line | | 79 | | | |
| | | | | shield | | 69 | | | |
| | | | | line | | 72 | | | |
| | | | | line | | 71 | | | |
| | | | | shield | | 70 | | | |
| | | | | line | | 73 | | | |
| | | | | line | | 74 | | | |
| | | | | shield | | 75 | | | |
| | | | | line | | 66 | | | |
| | | | | line | | 76 | | | |
| | | | | shield | | 85 | | | |
| IMCP R7 Panel see para. 6.3 | | Exp. Verification Indicator Channel 1 | | Signal | | 81 | | | |
| | | | | Return | | 80 | | | |
| | | | | Shield | | 89 | | | |
| | | Exp. Verification Indicator Channel 2 | | Signal | | 96 | | | |
| | | | | Return | | 98 | | | |
| | | | | Shield | | 97 | | | |
| | | Exp. Verification Indicator Channel 3 | | Signal | | 91 | | | |
| | | | | Return | | 82 | | | |
| | | | | Shield | | 90 | | | |
| | | Exp. Verification Indicator Channel 4 | | Signal | | 92 | | | |
| | | | | Return | | 83 | | | |
| | | | | Shield | | 84 | | | |
| | | Exp. Verification Indicator Channel 5 | | Signal | | 99 | | | |
| | | | | Return | | 100 | | | |
| | | | | Shield | 1) | 93 2) | | | |

1) EMC Classification is described in Para. 5.1

2) J21 has a total of 100 sockets. All J21 sockets not mentioned in this table are spare sockets

3) Spec: 40 M 38277

Table 5 - 4 : Connector Pin Correlation of J 22 on CB 5

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 5 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type (Spec.) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Receptacle | Conn' Not'n | Plug |
| TBD | TBD | TBD | TBD | line | TSP 24 AWG | 1 | NLS OT 22-35 SB 2) | J 22 | NLS 6GT 22-35 PB 2) |
| | | | | line | | 2 | | | |
| | | | | shield | | 3 | | | |
| | | | | line | EMC Class III | 7 | | | |
| | | | | line | | 6 | | | |
| | | | | shield | | 5 | | | |
| | | | | line | | 8 | | | |
| | | | | line | | 9 | | | |
| | | | | shield | | 10 | | | |
| | | | | line | | 13 | | | |
| | | | | line | | 12 | | | |
| | | | | shield | | 11 | | | |
| | | | | line | | 14 | | | |
| | | | | line | | 23 | | | |
| | | | | shield | | 33 | | | |
| | | | | line | | 16 | | | |
| | | | | line | | 17 | | | |
| | | | | shield | | 18 | | | |
| | | | | line | | 21 | | | |
| | | | | line | | 20 | | | |
| | | | | shield | | 19 | | | |
| | | | | line | | 22 | | | |
| | | | | line | | 32 | | | |
| | | | | shield | | 43 | | | |
| | | | | line | | 47 | | | |
| | | | | line | | 36 | | | |
| | | | | shield | | 25 | | | |
| | | | | line | | 48 | | | |
| | | | | line | | 37 | | | |
| | | | | shield | | 26 | | | |
| | | | | line | | 49 | | | |
| | | | | line | | 38 | | | |
| | | | | shield | | 27 | | | |
| | | | | line | | 39 | | | |
| | | | | line | | 50 | | | |
| | | | | shield | | 28 | | | |
| | | | | line | | 51 | | | |
| | | | | line | | 40 | | | |
| | | | | shield | | 29 | | | |
| | | | | line | | 52 | | | |
| | | | | line | | 41 | | | |
| | | | | shield | | 30 | | | |
| | | | | line | | 53 | | | |
| | | | | line | | 42 | | | |
| | | | | shield | | 31 | | | |
| | | | | line | | 57 | | | |
| | | | | line | | 46 | | | |
| | | | | shield | 1) | 35 | | | |

1) EMC Classification is described in Para. 5.1

2) Spec: 40 M 38277

Table 5 - 4 (cont'd) : Connector Pin Correlation of J 22 on CB 5

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 5 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type (Spec.) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Receptacle | Conn' Not'n | Plug |
| TBD | TBD | TBD | TBD | line | TSP 24 AWG | 58 | NLS OT 22-35 SB | J 22 | NLS 6GT 22-35 PB |
| | | | | line | | 59 | | | |
| | | | | shield | | 60 | | | |
| | | | | line | EMC Class III | 63 | 3) | | 3) |
| | | | | line | | 62 | | | |
| | | | | shield | | 61 | | | |
| | | | | line | | 64 | | | |
| | | | | line | | 54 | | | |
| | | | | shield | | 44 | | | |
| | | | | line | | 65 | | | |
| | | | | line | | 55 | | | |
| | | | | shield | | 45 | | | |
| | | | | line | | 15 | | | |
| | | | | line | | 24 | | | |
| | | | | shield | | 34 | | | |
| | | | | line | | 56 | | | |
| | | | | line | | 67 | | | |
| | | | | shield | | 77 | | | |
| | | | | line | | 87 | | | |
| | | | | line | | 78 | | | |
| | | | | shield | | 68 | | | |
| | | | | line | | 88 | | | |
| | | | | line | | 79 | | | |
| | | | | shield | | 69 | | | |
| | | | | line | | 72 | | | |
| | | | | line | | 71 | | | |
| | | | | shield | | 70 | | | |
| | | | | line | | 73 | | | |
| | | | | line | | 74 | | | |
| | | | | shield | | 75 | | | |
| | | | | line | | 66 | | | |
| | | | | line | | 76 | | | |
| | | | | shield | | 85 | | | |
| Orbiter CWEA (see para 6.4) | | Exp. CWEA C&W Signal No. 1 | | Signal | | 92 | | | |
| | | | | Return | | 83 | | | |
| | | | | Shield | | 84 | | | |
| | | Exp. CWEA C&W Signal No. 2 | | Signal | | 81 | | | |
| | | | | Return | | 80 | | | |
| | | | | Shield | | 89 | | | |
| | | Exp. CWEA C&W Signal No. 3 | | Signal | | 96 | | | |
| | | | | Return | | 98 | | | |
| | | | | Shield | | 97 | | | |
| | | Exp. CWEA C&W Signal No. 4 | | Signal | | 91 | | | |
| | | | | Return | | 82 | | | |
| | | | | Shield | | 90 | | | |
| | | Exp. CWEA C&W Signal No. 5 | | Signal | | 99 | | | |
| | | | | Return | | 100 | | | |
| | | | | Shield | 1) | 93 2) | | | |

1) EMC Classification is described in Para. 5.1

2) J22 has a total of 100 sockets. All J22 sockets not mentioned in this table are spare sockets.

3) Spec: 40 M 38277

Table 5 - 5 : Connector Pin Correlation of J 23on CB 5

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 5 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type (Spec.) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Receptacle | Conn' Not'n | Plug |
| TBD | TBD | TBD | TBD | line<br>line | TP<br>24 AWG | 1<br>2 | NLS OT<br>18-35 S | J 23 | NLS 6GT<br>18-35 P |
| | | | | line<br>line | EMC<br>Class II | 7<br>3 | 2) | | 2) |
| | | | | line<br>line | | 10<br>4 | | | |
| | | | | line<br>line | | 5<br>6 | | | |
| | | | | line<br>line | | 9<br>8 | | | |
| | | | | line<br>line | | 11<br>12 | | | |
| | | | | line<br>line | | 14<br>13 | | | |
| | | | | line<br>line | | 16<br>15 | | | |
| | | | | line<br>line | | 18<br>19 | | | |
| | | | | line<br>line | | 21<br>20 | | | |
| | | | | line<br>line | | 23<br>22 | | | |
| | | | | line<br>line | | 26<br>27 | | | |
| | | | | line<br>line | | 32<br>31 | | | |
| | | | | line<br>line | | 35<br>36 | | | |
| | | | | line<br>line | | 29<br>38 | | | |
| | | | | line<br>line | 1) | 41<br>40 | | | |

1) EMC Classification is described in Para. 5.1

2) Spec: 40 M 38277

Table 5 - 5 (cont'd) : Connector Pin Correlation of J 23 on CB 5

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 5 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type (Spec.) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Receptacle | Conn' Not'n | Plug |
| TBD | TBD | TBD | TBD | line<br>line | TP<br>24 AWG | 44<br>45 | NLS OT<br>18-35 S | J 23 | NLS 6GT<br>18-35 P |
| | | | | line<br>line | EMC<br>Class II | 47<br>46 | 3) | | 3) |
| | | | | line<br>line | | 49<br>48 | | | |
| | | | | line<br>line | | 52<br>53 | | | |
| | | | | line<br>line | | 55<br>54 | | | |
| | | | | line<br>line | | 57<br>56 | | | |
| | | | | line<br>line | | 51<br>58 | | | |
| | | | | line<br>line | | 59<br>60 | | | |
| | | | | line<br>line | | 61<br>66 | | | |
| | | | | line<br>line | | 63<br>62 | | | |
| | | | | line<br>line | 1) | 64<br>65 2) | | | |

1) EMC Classification is described in Para. 5.1

2) J23 has a total of 66 sockets. All J23 sockets not mentioned in this table are spare sockets.

3) Spec: 40 M 38277

Table 5 - 6 : Connector Pin Correlation of J 24 on CB 5

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 5 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type (Spec.) | Pin Not'n | Pin Funct'n | Harness Ty. | Pin Not'n | Receptacle | Conn' Not'n | Plug |
| TBD | | | | Line<br>Line<br>Shield<br>Line<br>Line<br>Shield<br>Line<br>Line<br>Shield<br>Line<br>Line<br>Shield<br>Line<br>Line<br>Shield<br>Line<br>Line<br>Shield<br>Line<br>Line<br>Shield | TSP 24 AWG<br>EMC Class IV | 29<br>17<br>16<br>26<br>11<br>12<br>30<br>18<br>36<br>25<br>10<br>34<br>19<br>1<br>31<br>24<br>9<br>33<br>23<br>8<br>7 | NLS OT 14-35 SA 3) | J 24 | NLS 6GT 14-35 PA 3) |
| N/A | Orbiter Master Time Unit (see para 4.4) | | | Signal Return Shield | 1) | 20<br>2<br>3 | | | |

Note: Shields are terminated to connector shells (multi-point ground)

1) EMC Classification is described in Para 5.1

2) J 24 has a total of 37 pins. All pins not mentioned in this table are spare pins.

3) Spec: 40 M 38277

Table 5 - 7 : Correlation of Coax Cables on CB 5

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | Spacelab CB 5 | | | Experiment |
|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Coax 75 EMC Class IV | Pin Not'n | Receptacle | Conn' Not'n | Plug |
| TBD | TBD | TBD | TBD | Coax 1<br>Coax 2<br>Coax 3<br>Coax 4<br>Coax 5 | 1<br>1<br>1<br>1<br>1 | OSM 636-3A (Spec: MIL-C -390128 B) | J 27<br>J 28<br>J 29<br>J 30<br>J 31 | MC 414-0614-0011 3) |

1) EMC Classification is described in Para 5.1

2) Connector shell is connected to chassis

3) Spec: Rockwell 4140614

5.3.2 Pallet-Only Configuration

5.3.2.1 Connector Location on CB 57

The connector location on Connector Bracket CB 57 is given in Figure 5 - 9. P09, P10, P11 and P12 are connectors provided as experiment interfaces for TSP and TP cables, while P20, P21, P22, P23 and P24 are experiment interfaces for coax cables.

The connector location on the Orbiter distribution panel is still TBD.

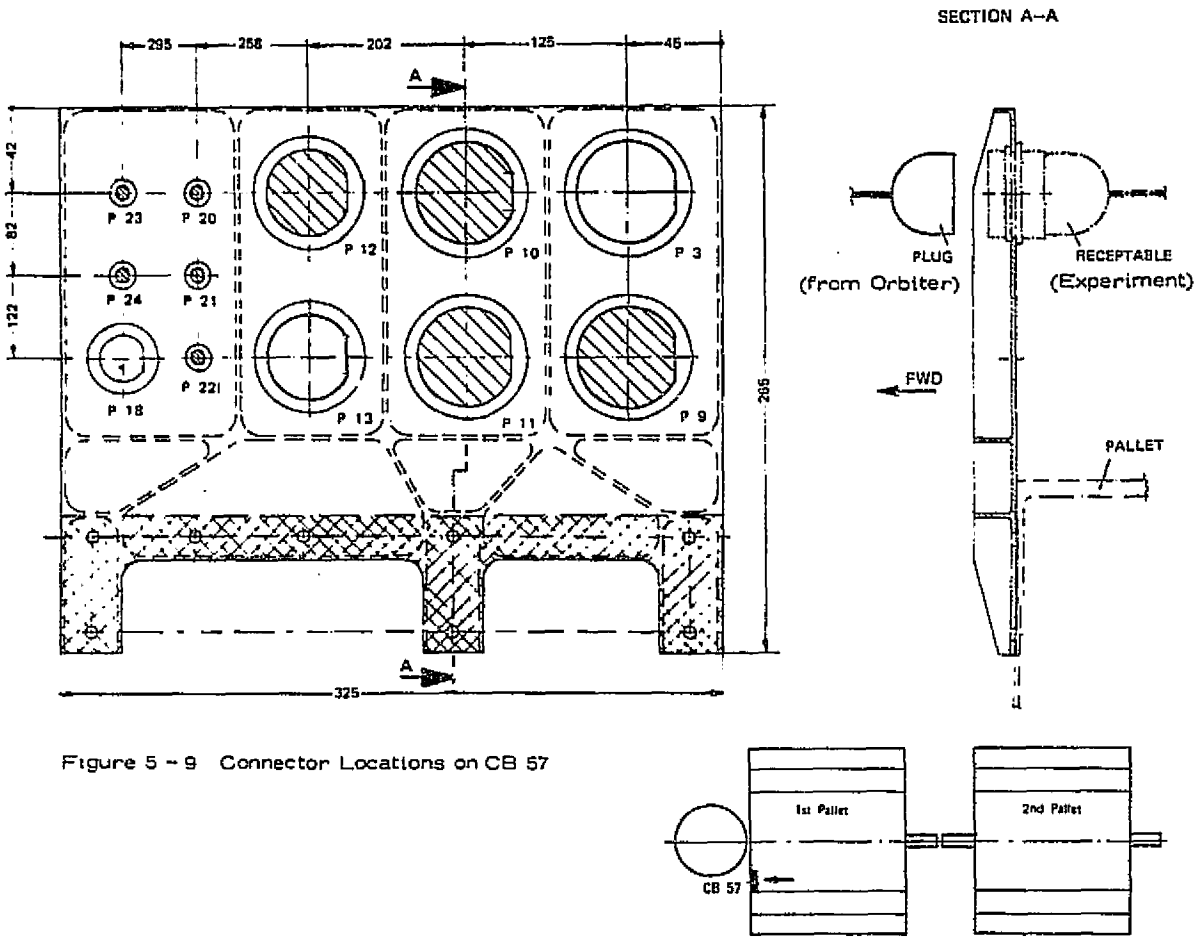



Figure 5 - 9 Connector Locations on CB 57

5.3.2.2 Connector / Pin Correlation of AFD/Spacelab Harness - Pallet-Only Configuration

The connector pin correlation of the AFD / Spacelab experiment harness is given in the subsequent Tables 5 - 8 thru 5 - 12.

Table 5 - 8 : Connector/Pin Correlation of P09 on CB 57

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab : CB 57 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Plug | Conn' Not'n | Receptacle |
| TBD | TBD | TBD | TBD | line | 54 TSP | 9 | NLS 6GT 24-35P | P09 | NLS 7E 24-35 S |
| | | | | line | 22 AWG | 10 | | | |
| | | | | shield | | 11 | | | |
| | | | | line | EMC | 13 | 2) | | 2) |
| | | | | line | Class III | 22 | | | |
| | | | | shield | | 12 | | | |
| | | | | line | | 17 | | | |
| | | | | line | | 27 | | | |
| | | | | shield | | 38 | | | |
| | | | | line | | 18 | | | |
| | | | | line | | 28 | | | |
| | | | | shield | | 39 | | | |
| | | | | line | | 21 | | | |
| | | | | line | | 20 | | | |
| | | | | shield | | 19 | | | |
| | | | | line | | 30 | | | |
| | | | | line | | 29 | | | |
| | | | | shield | | 40 | | | |
| | | | | line | | 31 | | | |
| | | | | line | | 43 | | | |
| | | | | shield | | 55 | | | |
| | | | | line | | 32 | | | |
| | | | | line | | 44 | | | |
| | | | | shield | | 56 | | | |
| | | | | line | | 33 | | | |
| | | | | line | | 45 | | | |
| | | | | shield | | 57 | | | |
| | | | | line | | 41 | | | |
| | | | | line | | 42 | | | |
| | | | | shield | | 54 | | | |
| | | | | line | | 48 | | | |
| | | | | line | | 59 | | | |
| | | | | shield | | 71 | | | |
| | | | | line | | 49 | | | |
| | | | | line | | 60 | | | |
| | | | | shield | | 72 | | | |
| | | | | line | | 50 | | | |
| | | | | line | | 61 | | | |
| | | | | shield | | 73 | | | |
| | | | | line | | 51 | | | |
| | | | | line | | 62 | | | |
| | | | | shield | | 74 | | | |
| | | | | line | | 52 | | | |
| | | | | line | | 63 | | | |
| | | | | shield | | 75 | | | |
| | | | | line | | 53 | | | |
| | | | | line | | 64 | | | |
| | | | | shield | 1) | 76 | | | |

1) EMC Classification is described in Para 5.1 2) Spec: 40 M 38277

Table 5 - 8 (cont'd): Connector/Pin Correlation of P09 on CB 57

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 57 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Plug | Conn' Not'n | Receptacle |
| TBD | TBD | TBD | TBD | line | TSP 22 AWG | 77 | NLS 6GT 24-35P | P09 | NLS 7E 24-35 S |
| | | | | line | | 88 | | | |
| | | | | shield | | 65 | | | |
| | | | | line | EMC Class III | 78 | 3) | | 3) |
| | | | | line | | 89 | | | |
| | | | | shield | | 66 | | | |
| | | | | line | | 79 | | | |
| | | | | line | | 90 | | | |
| | | | | shield | | 67 | | | |
| | | | | line | | 80 | | | |
| | | | | line | | 91 | | | |
| | | | | shield | | 68 | | | |
| | | | | line | | 84 | | | |
| | | | | line | | 96 | | | |
| | | | | shield | | 107 | | | |
| | | | | line | | 85 | | | |
| | | | | line | | 97 | | | |
| | | | | shield | | 108 | | | |
| | | | | line | | 86 | | | |
| | | | | line | | 98 | | | |
| | | | | shield | | 109 | | | |
| | | | | line | | 87 | | | |
| | | | | line | | 99 | | | |
| | | | | shield | | 110 | | | |
| | | | | line | | 101 | | | |
| | | | | line | | 100 | | | |
| | | | | shield | | 111 | | | |
| | | | | line | | 102 | | | |
| | | | | line | | 112 | | | |
| | | | | shield | | 120 | | | |
| | | | | line | | 116 | | | |
| | | | | line | | 117 | | | |
| | | | | shield | | 118 | | | |
| IMCP R7 Panel (see para 6.3) | | Exp. Verification Indicator Channel 1 | | Signal | | 16 | | | |
| | | | | Return | | 26 | | | |
| | | | | Shield | | 37 | | | |
| | | Exp. Verification Indicator Channel 2 | | Signal | | 23 | | | |
| | | | | Return | | 34 | | | |
| | | | | Shield | | 46 | | | |
| | | Exp. Verification Indicator Channel 3 | | Signal | | 58 | | | |
| | | | | Return | | 69 | | | |
| | | | | Shield | | 81 | | | |
| | | Exp. Verification Indicator Channel 4 | | Signal | | 83 | | | |
| | | | | Return | | 95 | | | |
| | | | | Shield | | 106 | | | |
| | | Exp. Verification Indicator Channel 5 | | Signal | | 92 | | | |
| | | | | Return | | 103 | | | |
| | | | | Shield | 1) | 2) 113 | | | |

1) EMC Classification is described in Para 5.1

2) P 09 has a total of 128 pins. All P 09 pins not mentioned in this table are spare pins

3) Spec: 40 M 38277

Table 5 - 9 : Connector/Pin Correlation of P10 on CB 57

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 57 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Plug | Conn' Not'n | Receptacle |
| TBD | TBD | TBD | TBD | line | TSP 22 AWG | 9 | NLS 6GT 24-35 PD | P 10 | NLS 7E 24-35 SD |
| | | | | line | | 10 | | | |
| | | | | shield | | 11 | | | |
| | | | | line | EMC | 13 | | | |
| | | | | line | Class III | 22 | | | |
| | | | | shield | | 12 | 2) | | 2) |
| | | | | line | | 16 | | | |
| | | | | line | | 26 | | | |
| | | | | shield | | 37 | | | |
| | | | | line | | 17 | | | |
| | | | | line | | 27 | | | |
| | | | | shield | | 38 | | | |
| | | | | line | | 18 | | | |
| | | | | line | | 28 | | | |
| | | | | shield | | 39 | | | |
| | | | | line | | 20 | | | |
| | | | | line | | 21 | | | |
| | | | | shield | | 19 | | | |
| | | | | line | | 29 | | | |
| | | | | line | | 30 | | | |
| | | | | shield | | 40 | | | |
| | | | | line | | 31 | | | |
| | | | | line | | 43 | | | |
| | | | | shield | | 55 | | | |
| | | | | line | | 32 | | | |
| | | | | line | | 44 | | | |
| | | | | shield | | 56 | | | |
| | | | | line | | 33 | | | |
| | | | | line | | 45 | | | |
| | | | | shield | | 57 | | | |
| | | | | line | | 41 | | | |
| | | | | line | | 42 | | | |
| | | | | shield | | 54 | | | |
| | | | | line | | 60 | | | |
| | | | | line | | 72 | | | |
| | | | | shield | | 49 | | | |
| | | | | line | | 61 | | | |
| | | | | line | | 73 | | | |
| | | | | shield | | 50 | | | |
| | | | | line | | 62 | | | |
| | | | | line | | 74 | | | |
| | | | | shield | | 51 | | | |
| | | | | line | | 63 | | | |
| | | | | line | | 75 | | | |
| | | | | shield | | 52 | | | |
| | | | | line | | 64 | | | |
| | | | | line | | 76 | | | |
| | | | | shield | 1) | 53 | | | |

1) EMC Classification is described in Para 5.1

2) Spec: 40 M 38277

Table 5 - 9 (cont'd): Connector / Pin Correlation of P 10 on CB 57

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 57 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Plug | Conn' Not'n | Receptacle |
| TBD | TBD | TBD | TBD | line | TSP 22 AWG | 77 | NLS 6GT 24-35 PD | P 10 | NLS 7E 24-35 SD |
| | | | | line | | 88 | | | |
| | | | | shield | | 65 | | | |
| | | | | line | EMC Class III | 78 | | | |
| | | | | line | | 89 | | | |
| | | | | shield | | 66 | 3) | | 3) |
| | | | | line | | 79 | | | |
| | | | | line | | 90 | | | |
| | | | | shield | | 67 | | | |
| | | | | line | | 80 | | | |
| | | | | line | | 91 | | | |
| | | | | shield | | 68 | | | |
| | | | | line | | 84 | | | |
| | | | | line | | 96 | | | |
| | | | | shield | | 107 | | | |
| | | | | line | | 85 | | | |
| | | | | line | | 97 | | | |
| | | | | shield | | 108 | | | |
| | | | | line | | 86 | | | |
| | | | | line | | 98 | | | |
| | | | | shield | | 109 | | | |
| | | | | line | | 87 | | | |
| | | | | line | | 99 | | | |
| | | | | shield | | 110 | | | |
| | | | | line | | 101 | | | |
| | | | | line | | 100 | | | |
| | | | | shield | | 111 | | | |
| | | | | line | | 102 | | | |
| | | | | line | | 112 | | | |
| | | | | shield | | 120 | | | |
| | | | | line | | 116 | | | |
| | | | | line | | 117 | | | |
| | | | | shield | | 118 | | | |
| Orbiter CWEA (see para 6.4) | | Exp. CWEA C&W Signal No. 1 | | Signal | | 14 | | | |
| | | | | Return | | 24 | | | |
| | | | | Shield | | 35 | | | |
| | | Exp. CWEA C&W Signal No. 2 | | Signal | | 23 | | | |
| | | | | Return | | 34 | | | |
| | | | | Shield | | 46 | | | |
| | | Exp. CWEA C&W Signal No. 3 | | Signal | | 58 | | | |
| | | | | Return | | 69 | | | |
| | | | | Shield | | 81 | | | |
| | | Exp. CWEA C&W Signal No. 4 | | Signal | | 92 | | | |
| | | | | Return | | 103 | | | |
| | | | | Shield | | 113 | | | |
| | | Exp. CWEA C&W Signal No. 5 | | Signal | | 104 | | | |
| | | | | Return | | 114 | | | |
| | | | | Shield | 1) | 2) 121 | | | |

1) EMC Classification is described in Para 5.1

2) P 10 has a total of 128 pins. All P 10 pins not mentioned in this table are spare pins

3) Spec: 40 M 38277

Table 5 -10: Connector/Pin Correlation of P 11 on CB 57

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 57 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Plug | Conn' Not'n | Receptacle |
| TBD | TBD | TBD | TBD | line<br>line | TP<br>22 AWG<br>EMC<br>Class II | 10<br>11<br>12<br>13<br>16<br>26<br>18<br>28<br>20<br>19<br>27<br>17<br>29<br>30<br>31<br>43<br>33<br>45<br>42<br>41<br>44<br>32<br>60<br>72<br>62<br>74<br>64<br>76<br>73<br>61<br>75<br>63<br>77<br>88<br>79<br>90<br>84<br>96<br>86<br>98<br>78<br>89<br>80<br>91<br>85<br>97<br>87<br>99<br>100<br>111<br>101<br>112<br>116<br>117 2) | NLS 6GT<br>24-35 PB<br>3) | P 11 | NLS 7E<br>24-35 SB<br>3) |

1) EMC Classification is described in Para 5.1

2) P 11 has a total of 128 pins. All P 11 pins not mentioned in this table are spare pins.

3) Spec: 40 M 38277

Table 5 - 11: Connector/Pin Correlation of P 12 on CB 57

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | | Spacelab CB 57 | | | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Funct'n | Harness Type | Pin Not'n | Plug | Conn' Not'n | Receptacle |
| TBD | TBD | TBD | TBD | line<br>line<br>line<br>line<br>line<br>line<br>line<br>line<br>line<br>line<br>line<br>line | TSP 24 AWG<br>EMC Class IV 1) | 44<br>45<br>46<br>47<br>48<br>49<br>62<br>63<br>64<br>65<br>66<br>76<br>75<br>74 | NLS 6GT 20-35 PA 3) | P 12 | NLS 7E 20-35 SA 3) |
| N/A | ORBITER MASTER TIME UNIT | | | signal return | | 60<br>61 2) | | | |

Note: Shields are terminated to connector shells (multi-point ground)

1) EMC Classification is described in Para 5.1

2) P 12 has a total of 79 pins. All P 12 pins not mentioned in this table are either dedicated to the experiment- MTU interface or spare pins.

3) Spec: 40 M 38277

Table 5 - 12: Correlation of Coax Cables on CB 57

| Experiment | AFD Payload Station Distribution Panel | | | Wiring | Spacelab CB 57 | | | Experiment |
|---|---|---|---|---|---|---|---|---|
| Conn' Not'n | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Coax 75 EMC Class IV | Pin Not'n | Plug | Conn' Not'n | Receptacle |
| Orbiter<br>TBD | TBD | TBD | TBD | Coax 1<br>Coax 2<br>Coax 3<br>Coax 4<br>Coax 5 1) | 1<br>1<br>1<br>1<br>1 | MC 414-0614-0011 3) 2) | P 20<br>P 21<br>P 22<br>P 23<br>P 24 | MC 414-0614-0061 3) |

1) EMC Classification is described in Para 5.1

2) Connector shell is connected to chassis

3) Rockwell Spec. 4140614

5.4 IPS Experiment Signal Harness

TBD

# 6. CAUTION AND WARNING

The experiment will interface with the Spacelab/Orbiter caution and warning system via:

- Orbiter MDM monitoring and safing command channels
- Subsystem RAU channels for back up monitoring of experiment C&W signals
- Orbiter Caution and Warning Electronic Assembly channels (Orbiter CWEA)
- Safing command channels from SL integrated monitoring and control panel (IMCP-R7 Panel)

The C&W channels described by the last two bullets are also available during flight phases when Spacelab is not activated.

Experiment C&W electronics will be powered by experiment essential power (see para 3.4 - Experiment Essential Power). The detailled design requirements for experiment C&W are described in para 7.12 of SPAH Main Volume.

## 6.1 Experiment Caution and Warning Interface to Subsystem RAU

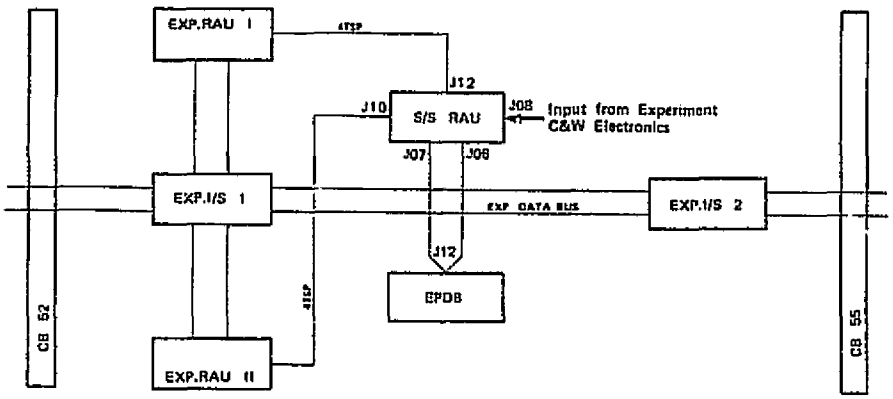
Dedicated subsystem RAU's will acquire signals from experiment C & W sensors. These sensors have to be powered by experiment essential power (see para 3.4). The user has to provide signals according to the specifications for flexible inputs (see para 4.1.3.1).

The experiment C & W signals will be interpreted by the Spacelab Subsystem Computer System .

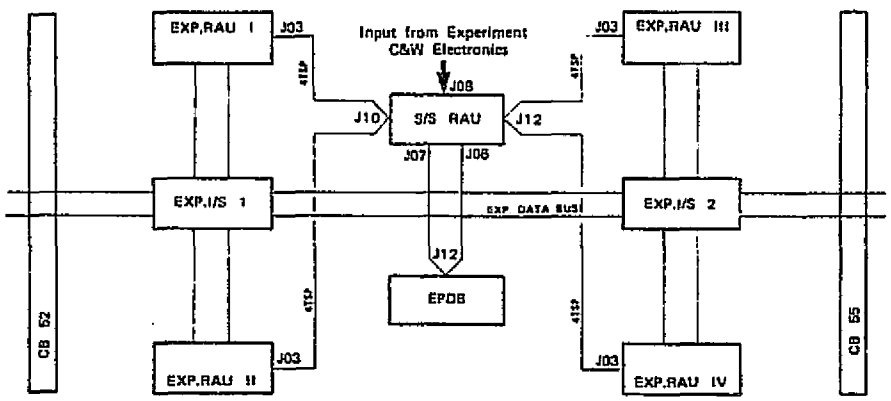
### 6.1.1 Connector Location

- Interface location in the module :
  J08 of the subsystem RAU-F is reserved for the acquisition of all experiment caution and warning signals generated in the module. The location of the subsystem RAU -F in the module is depicted Figure 3.9 - '2a, Appendix B - Structure Interface Definition. For the location of RAU Connector J08, see Figure 4.1 - 1 .

- Interface location on each pallet :
  J08 of the subsystem RAU on each pallet is reserved for the acquisition of experiment caution and warning signals, as can be seen in Figure 6 - 1 .




Configuration with Two Experiment RAU's on One Pallet




Configuration with Four Experiment RAU's on One Pallet

Figure 6 - 1 : Experiment Caution and Warning Interface to Subsystem RAU on a Pallet

6.1.2 Allocation of Subsystem RAU Caution and Warning Channels for Experiments

- J08 of S/S RAU-F in the Module

  At present SCOS provides acquisition at a sampling rate of one sample per second :

  | | |
  |---|---|
  | Channel 1, 3 thru 15 | as discrete data |
  | Channel 17, 19, thru 47 | as analog data |
  | Channel 49, 51, thru 63 | as either analog or discrete |

  For pin allocation of J 08, see Table 4.1 - 2

- J08 of the subsystem RAU on the pallet:

  All 32 flexible inputs of J08 may be used. Information about acquisition mode and sampling rates will be given at a later date.

6.1.3 Input/Output Characteristics

Same as described in para. 4.1.3.1.

6.1.4 Bonding

Same as described in para. 4.1.4.

6.1.5 Grounding

Same as described in para. 4.1.5.

6.1.6 Conducted Emission on Signal and Signal Return Lines

Same as described in para. 4.1.6 for flexible input data lines.

6.2 Experiment Caution and Warning Interface to Orbiter MDM

The Orbiter MDM's PF - 1 and PF - 2 (see para. 4.4.9 of SPAH main volume) provide experiment dedicated Caution and Warning monitoring and safing command channels, controlled by the Orbiter General Purpose Computer.

Table 6 - 1 depicts an overview of the Orbiter MDM-channels reserved for experiment Caution and Warning purposes.

Table 6 - 1: Number of Experiment Dedicated Orbiter MDM Channels

| Spacelab Configuration | MDM PF - 1 | | | MDM PF - 2 | | |
|---|---|---|---|---|---|---|
| | Analog Input (AID) | Digital Input (DIL) | Safing CMD (DOH) | Analog Input (AID) | Digital Input (DIL) | Safing CMD (DOH) |
| Module | 8 | 3 | 20 | 7 | 1 | 4 |
| Pallet-Only | - | - | - | 7 | 4 | 4 |

Note: AID - Analog Input Differential
DIL - Discrete Input Low Level
DOH - Discrete Output High Level

6.2.1 Connector Location

Module Configurations

The user interface is at CB 5 for all module configurations. The connector location on CB 5 is shown in Figure 6 - 2 .

The experiment caution and warning interface connectors on CB 5 are

- O J21; IMCP - R7 Panel experiment safing verification indicators channels.
- O J22; caution and warning signals to Orbiter CWEA
- O J25; safing commands from IMCP - R7 Panel
- O J32; safing commands from MDM PF - 1
- O J 33; safing commands from MDM PF-2
- O J 34; caution and warning signals to MDM PF-1
- O J 35; caution and warning signals to MDM PF-2

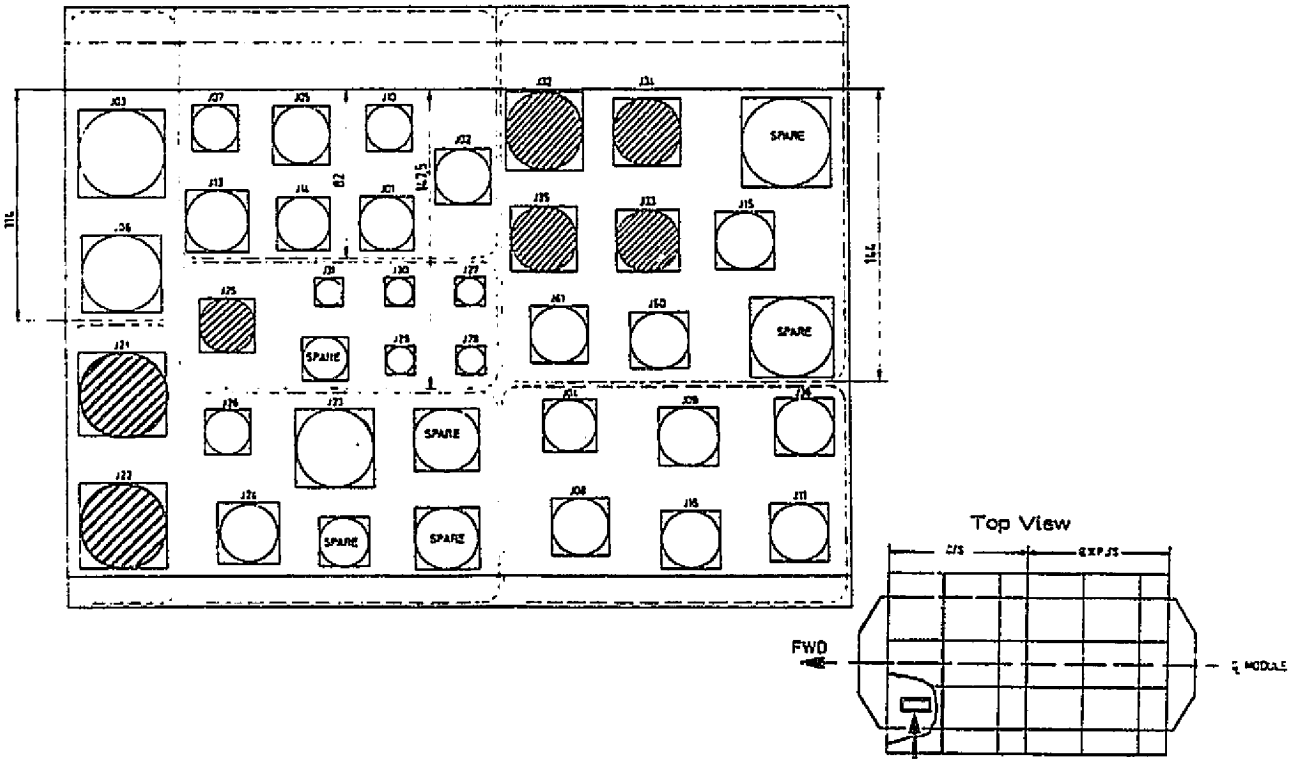



Figure 6 - 2 : Location of Experiment Dedicated Interface Connectors on CB 5 to the Spacelab/Orbiter Caution and Warning System ( Hatched Connectors )

Pallet-Only Configurations

The user interface is at CB 57 ( see Figure 6 - 3) for all pallet-only configurations. The location of CB 57 is shown in Figure 4.3 - 6 of this appendix .

The experiment caution and warning interface connectors on CB 57 are :

- o P 09 ; IMCP -R7 Panel experiment safing verification indicators channels.
- o P 10 ; caution and warning signals to Orbiter CWEA
- o P 13 ; safing commands from IMCP-R7 Panel and from MDM PF-2
- o P 3 ; caution and warning signals to MDM PF-2

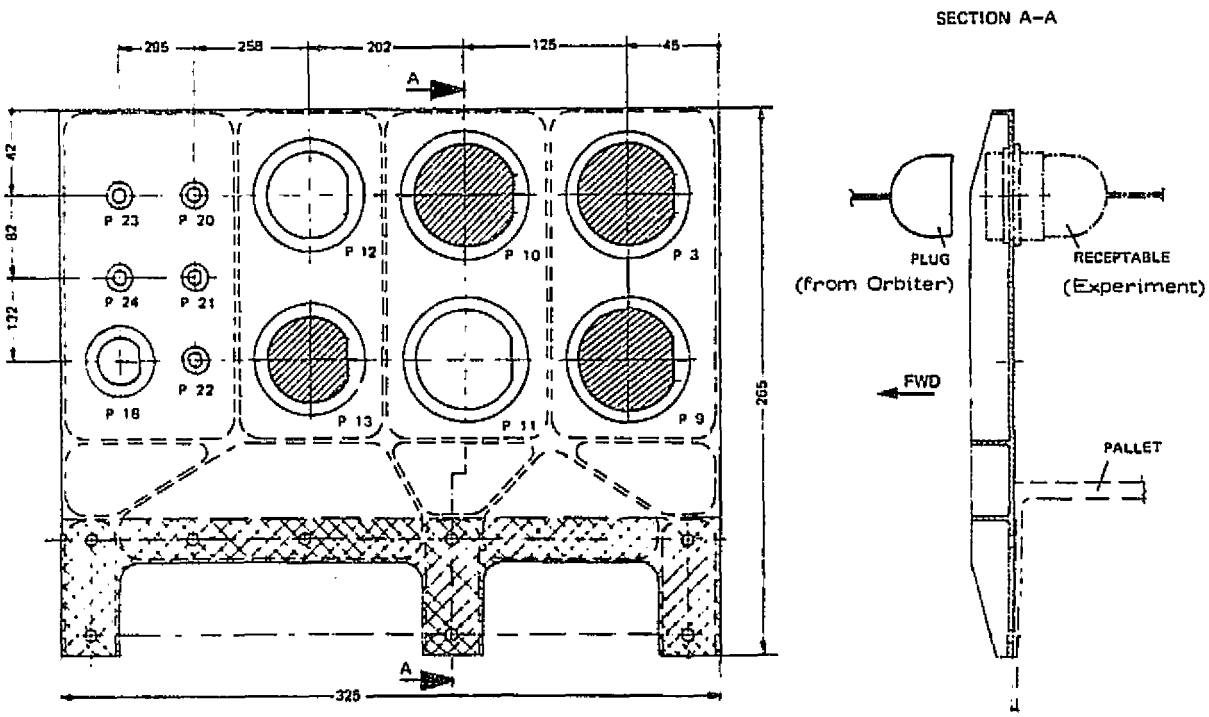



Figure 6 - 3: Location of Experiment Dedicated Interface Connectors on CB 57 to the Spacelab/Orbiter Caution and Warning System ( Hatched Connectors )

6.2.2 Pin Allocation List

6.2.2.1 Pin Allocation for MDM Safing Commands to the Experiment

- Module configuration
  The pin allocation for experiment safing commands from MDM PF-1 and MDM PF-2 is given in Table 6 - 2.
- Pallet-only configuration
  The pin allocation for experiment safing commands from MDM PF-2 is given in Table 6 - 3.

6.2.2.2 Pin Allocation for Experiment Caution and Warning Signals to MDM's

- Module configuration
  The pin allocation for experiment signals to be monitored by MDM PF-1 and MDM PF-2 is given in Table 6 - 2.
- Pallet-only configuration
  The pin allocation for experiment signals to be monitored by MDM PF-2 is given in Table 6 - 3.

Table 6 - 2 Pin Allocation List for Experiment Dedicated MDM C & W Channels on CB 5 (Module)

| Connect. Not'n | Pin Not'n | Signal Code | Function | SL Input/ Output | Wire Type | EMC Class | Routed from/to | Spacelab | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| J32 | 19 | Exp. Safing CMD 01(DOH) | Signal | O | TS 5 C 24 AWG | II | MDM PF-1 | NLS 0T 14-35 SB (Spec. 40M38277) | NLS 6GT 14-35 PB (Spec. 40M38277) |
| | 3 | Exp. Safing CMD 02(DOH) | Signal | O | | | | | |
| | 20 | Exp. Safing CMD 03(DOH) | Signal | O | | | | | |
| | 31 | Exp. Safing CMD 04(DOH) | Signal | O | | | | | |
| | 2 | Common Return | Return | | | | | | |
| | 1 | Common Shield | Shield | | | | | | |
| | 28 | Exp. Safing CMD 05(DOH) | Signal | O | | | | | |
| | 15 | Exp. Safing CMD 06(DOH) | Signal | O | | | | | |
| | 16 | Exp. Safing CMD 07(DOH) | Signal | O | | | | | |
| | 17 | Exp. Safing CMD 08(DOH) | Signal | O | | | | | |
| | 35 | Common Return | Return | | | | | | |
| | 29 | Common Shield | Shield | | | | | | |
| | 25 | Exp. Safing CMD 09(DOH) | Signal | O | | | | | |
| | 10 | Exp. Safing CMD 10(DOH) | Signal | O | | | | | |
| | 11 | Exp. Safing CMD 11(DOH) | Signal | O | | | | | |
| | 12 | Exp. Safing CMD 12(DOH) | Signal | O | | | | | |
| | 34 | Common Return | Return | | | | | | |
| | 26 | Common Shield | Shield | | | | | | |
| J 33 | 19 | Exp. Safing CMD 13(DOH) | Signal | O | TS 5 C 24 AWG | II | | NLS 0T 14-35 SC (Spec. 40M38277) | NLS 6GT 14-35 PC (Spec. 40M38277) |
| | 3 | Exp. Safing CMD 14(DOH) | Signal | O | | | | | |
| | 20 | Exp. Safing CMD 15(DOH) | Signal | O | | | | | |
| | 31 | Exp. Safing CMD 16(DOH) | Signal | O | | | | | |
| | 2 | Common Return | Return | | | | | | |
| | 1 | Common Shield | Shield | | | | | | |
| | 25 | Exp. Safing CMD 21(DOH) | Signal | O | | | | | |
| | 10 | Exp. Safing CMD 22(DOH) | Signal | O | | | | | |
| | 11 | Exp. Safing CMD 23(DOH) | Signal | O | | | | | |
| | 12 | Exp. Safing CMD 24(DOH) | Signal | O | | | | | |
| | 34 | Common Return | Return | | | | | | |
| | 26 | Common Shield | Shield | | | | | | |
| | 28 | Exp. Safing CMD 17(DOH) | Signal | O | | | MDM PF-2 | | |
| | 15 | Exp. Safing CMD 18(DOH) | Signal | O | | | | | |
| | 16 | Exp. Safing CMD 19(DOH) | Signal | O | | | | | |
| | 17 | Exp. Safing CMD 20(DOH) | Signal | O | | | | | |
| | 35 | Common Return | Return | | | | | | |
| | 29 | Common Shield | Shield | | | | | | |

Note: J 32 has a total number of 37 sockets. All J 32 sockets not mentioned in this table are spare sockets. J 33 has a total number of 37 sockets. All J 33 sockets not mentioned in this table are spare sockets.

Table 6 - 2 (cont'd) Pin Allocation List for Experiment Dedicated MDM C & W Channels on CB 5 (Module)

| Connect. No'n | Pin No'n | Signal Code | Function | L Input Output | Wire Type | EMC Class | Routed from/to | Spacelab | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| J 34 | 24 | Caution Signal No 5 (AID) | Signal | I | TSP 24 AWG | III | MDM PF-2 | NLS 0T 16-35 SN (Spec. 40M38277) | NLS 6GT 16-35 PN (Spec. 40M38277) |
| | 23 | | Return | | | | | | |
| | 16 | | Shield | | | | | | |
| | 46 | Caution Signal No 6 (AID) | Signal | I | | | | | |
| | 38 | | Return | | | | | | |
| | 39 | | Shield | | | | | | |
| | 55 | Caution Signal No 7 (AID) | Signal | I | | | | | |
| | 51 | | Return | | | | | | |
| | 52 | | Shield | | | | | | |
| | 48 | Caution Signal No 8 (AID) | Signal | I | | | | | |
| | 49 | | Return | | | | | | |
| | 53 | | Shield | | | | | | |
| | 40 | Warning Signal No 5 (AID) | Signal | I | | | | | |
| | 41 | | Return | | | | | | |
| | 47 | | Shield | | | | | | |
| | 25 | Warning Signal No 7 (AID) | Signal | I | | | | | |
| | 33 | | Return | | | | | | |
| | 32 | | Shield | | | | | | |
| | 4 | Warning Signal No 8 (AID) | Signal | I | | | | | |
| | 11 | | Return | | | | | | |
| | 10 | | Shield | | | | | | |
| | 27 | Warning Signal No 9 (AID) | Signal | I | | | | | |
| | 19 | | Return | | | | | | |
| | 20 | | Shield | | | | | | |
| | 7 | Caution Signal No 11 (DIL) | Signal | I | TS 5 C 24 AWG | III | | | |
| | 8 | Caution Signal No 12 (DIL) | Signal | I | | | | | |
| | 6 | Warning Signal No 14 (DIL) | Signal | I | | | | | |
| | 2 | Common Return | Return | | | | | | |
| | 1 | Common Shield | Shield | | | | | | |
| J 35 | 40 | Caution Signal No 9 (AID) | Signal | I | TSP 24 AWG | III | MDM PF-2 | NLS 0T 16-35 SA (Spec. 40M38277) | NLS 6GT 16-35 PA (Spec. 40M38277) |
| | 41 | | Return | | | | | | |
| | 47 | | Shield | | | | | | |
| | 25 | Caution Signal No 10 (AID) | Signal | I | | | | | |
| | 33 | | Return | | | | | | |
| | 32 | | Shield | | | | | | |
| | 24 | Warning Signal No 6 (AID) | Signal | I | | | | | |
| | 23 | | Return | | | | | | |
| | 16 | | Shield | | | | | | |
| | 46 | Warning Signal No 10 (AID) | Signal | I | | | | | |
| | 38 | | Return | | | | | | |
| | 39 | | Shield | | | | | | |
| | 55 | Warning Signal No 11 (AID) | Signal | I | | | | | |
| | 51 | | Return | | | | | | |
| | 52 | | Shield | | | | | | |
| | 48 | Warning Signal No 12 (AID) | Signal | I | | | | | |
| | 49 | | Return | | | | | | |
| | 53 | | Shield | | | | | | |
| | 27 | Warning Signal No 13 (AID) | Signal | I | | | | | |
| | 19 | | Return | | | | | | |
| | 20 | | Shield | | | | | | |
| | 4 | Caution Signal No 13 (DIL) | Signal | I | TS 5 C 24 AWG | III | | | |
| | 11 | | Return | | | | | | |
| | 10 | | Shield | | | | | | |

Note: J 34 has a total number of 55 sockets. All J 34 sockets not mentioned in this table are spare sockets.
J 35 has a total number of 55 sockets. All J 35 sockets not mentioned in this table are spare sockets.

Table 6 - 3: Pin Allocation List for Experiment Dedicated MDM C & W Channels on CB 57 (Pallet-Only)

| Connect. Not'n | Pin Not'n | Signal Code | Function | SL Input/ Output | Wire Type | EMC Class | Routed from/ to | Spacelab | Experiment |
|---|---|---|---|---|---|---|---|---|---|
| P 13 | 46 | Exp. Safing CMD 1 | Signal | O | TP 24 AWG | II | IMCP-R7 (see para 6.3) | NLS 6 GT 20-35PC (Spec.: 40M 38277) | NLS OT 20-35 SC (Spec: 40 M 38277) |
| | 47 | | Return | | | | | | |
| | 48 | Exp. Safing CMD 2 | Signal | O | | | | | |
| | 49 | | Return | | | | | | |
| | 62 | Exp. Safing CMD 3 | Signal | O | | | | | |
| | 63 | | Return | | | | | | |
| | 64 | Exp. Safing CMD 4 | Signal | O | | | | | |
| | 65 | | Return | | | | | | |
| | 74 | Exp. Safing CMD 5 | Signal | O | | | | | |
| | 75 | | Return | | | | | | |
| | 30 | Exp. Safing CMD (DOH) | Signal | O | TS5C 24AWG | | MDM PF-2 | | |
| | 31 | Exp. Safing CMD (DOH) | Signal | O | | | | | |
| | 51 | Exp. Safing CMD (DOH) | Signal | O | | | | | |
| | 52 | Exp. Safing CMD (DOH) | Signal | O | | | | | |
| | 29 | Common Return | Return | | | | | | |
| | 50 | Common Return | Shield | | | | | | |
| P 3 | 53 | Caution Signal No. 9 (AID) | Signal | I | TSP 24AWG | III | MDM PF-2 | NLS6GT 24-35 PB (Spec.: 40M38277) | NLS OT 24-35 SB (Spec: 40 M 38277) |
| | 65 | | Return | | | | | | |
| | 77 | | Shield | | | | | | |
| | 54 | Caution Signal No. 10 (AID) | Signal | I | | | | | |
| | 66 | | Return | | | | | | |
| | 78 | | Shield | | | | | | |
| | 37 | Warning Signal No. 13 (AID) | Signal | I | | | | | |
| | 38 | | Return | | | | | | |
| | 36 | | Shield | | | | | | |
| | 55 | Warning Signal No. 6 (AID) | Signal | I | | | | | |
| | 67 | | Return | | | | | | |
| | 79 | | Shield | | | | | | |
| | 56 | Warning Signal No. 10 (AID) | Signal | I | | | | | |
| | 68 | | Return | | | | | | |
| | 80 | | Shield | | | | | | |
| | 57 | Warning Signal No. 11 (AID) | Signal | I | | | | | |
| | 69 | | Return | | | | | | |
| | 81 | | Shield | | | | | | |
| | 87 | Warning Signal No. 12 (AID) | Signal | I | | | | | |
| | 99 | | Return | | | | | | |
| | 110 | | Shield | | | | | | |
| | 84 | C & W Spare (DIL) | Signal | I | TS5C 24AWG | | | | |
| | 85 | C & W Spare (DIL) | Signal | I | | | | | |
| | 86 | C & W Spare (DIL) | Signal | I | | | | | |
| | 83 | Caution Signal No. 13 (DIL) | Signal | I | | | | | |
| | 82 | Common Return | | | | | | | |
| | 71 | Common Shield | | | | | | | |

P 3 has a total number of 128 pins. All P 3 pins not mentioned in this table are spare pins.

P 13 has a total number of 79 pins. All P13 pins not mentioned in this table are spare pins.

6.2.3 Input/Output Characteristics

Figure 6 - 4 depicts those Orbiter MDM input/output circuits which interface with experiment safing command receivers and caution and warning sensors.

Figure 6 - 4 as well as the Tables 6 - 4, 6 - 5 and 6 - 6 give recommendations for the experiment side. It should be noted that the experiment side of the caution and warning system shall be powered by the experiment emergency power which is available during a main power failure.

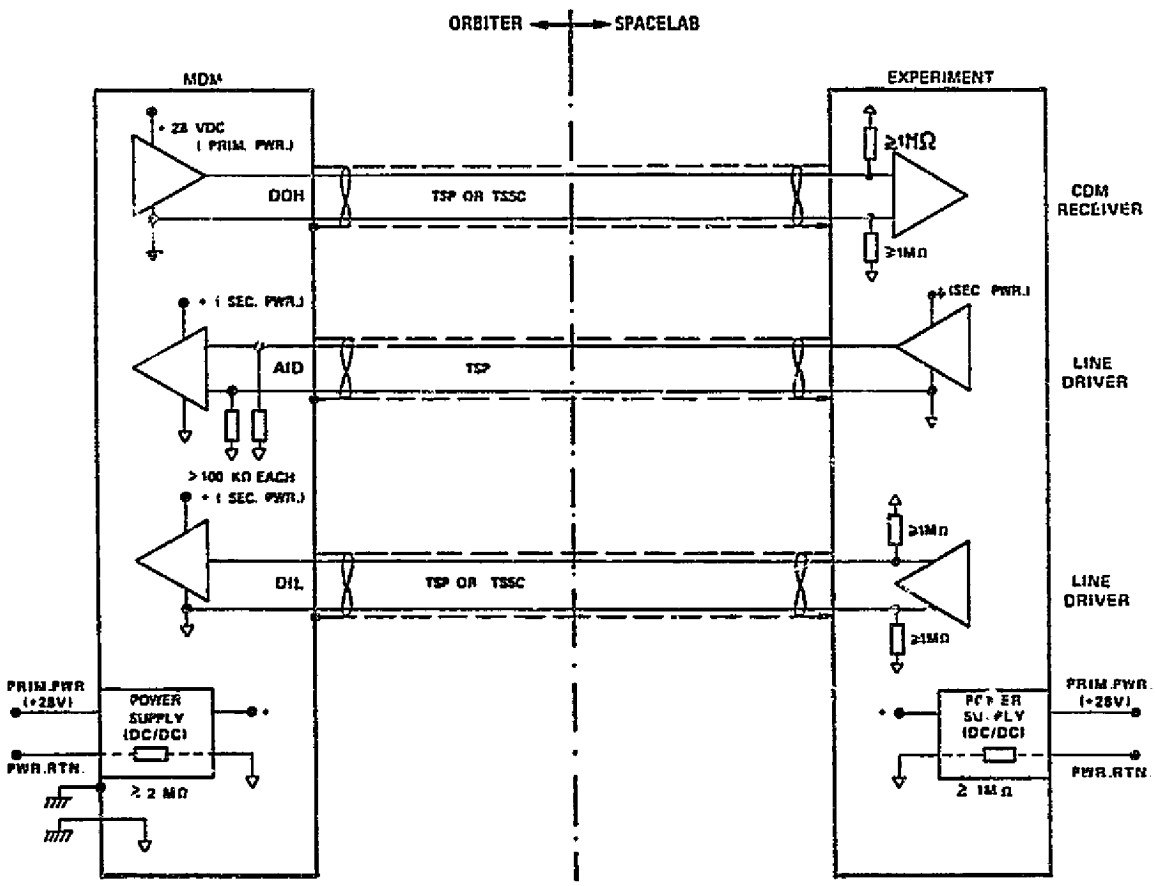



Figure 6 - 4 : MDM - Experiment Interface Diagram

Table 6 - 4: Input/Output Characteristics of MDM Safing Command Channels (DOH)

| Characterstics of MDM Safing Command Channels | | Characteristics of Experiment Input Circuits for MDM Safing Commands that will ensure proper function | |
|---|---|---|---|
| Overvoltage protection: | ± 32 V max. | Fault voltage emission: | ± 32 V max. |
| Fault voltage emission: | ± 32 V max. | Overvoltage protection: | ± 32 V max. |
| Fault current limitation: | ± 20 mA | | |
| | | Cable type: | TP |
| Wire shield reference: | MDM chassis ground | Wire shield reference: | Structure |
| Output grounding: | Connected to MDM primary power ground | Input isolation: | 1MΩ min line to ground shunted with 1nF max. |
| Output type: | single ended | Input type: | differential |
| Discrete 'zero': | 0 V to 3 V | Discrete 'zero': | 0 V to 5 V |
| Discrete 'one': | 19.5 V to 32 V | Discrete 'one': | 11 V to 32 V |
| Ripple & noise: | $\leq 0.9\ V_{pp}$ single frequency<br>$\leq 1.6\ V_{pp}$ broadband | | |
| Rise/fall time: | 10µs to 100µs (measured between 10 % and 90 % of the peak signal values) | | |
| Driving capability: | 10 m A for discrete "one" status | Max. load current: | ≤ 10 mA |
| Output impedance: | ≤ 450Ω | Input impedance: | ≥ 3.2 kΩ |
| Output capacitance: | ≤ 3500 pF | Input capacitance: | ≤ 1500 pF |
| Power-off output impedance: | ≥ 10 kΩ *) | Power-off input impedance: | ≥ 3.2 kΩ |

*) at external application of 8 VDC max .

Table 6 - 5: Input/Output Characteristics of MDM C & W Analog Input Channels (AID)

| MDM Analog Input Characteristics | | Experiment C & W Analog Driver Characteristics that will ensure proper function | |
|---|---|---|---|
| Fault voltage emission: | ± 15 V max | Overvoltage protection: | ± 15V max |
| Fault current limitation: | ± 1 m A | Fault current limitation: | 10 mA |
| Overvoltage protection: | ± 32 V max | Fault voltage emission: | ± 32 V max |
| | | Cable type: | TSP |
| Wire shield reference: | MDM signal ground | Wire shield reference: | Structure |
| Input isolation: | >100kΩ line to ground | Output grounding: | Connected to experiment signal ground. |
| | | Ripple & Noise : | ≤ 20 mV pk/pk |
| Input type: | differential | Output type: | single ended (return line grounded at source) |
| Full scale analog voltage range: | - 5.12 V to + 5.11V | Full scale voltage range: | 0 V to 5 V<br>Alarm is generated by software limit sensing |
| Common mode voltage: | ± 10 V max. | Common mode voltage: | N/A |
| Input filter bandwidth: | 0 - 40 Hz (± 10 %) | Max. input frequency: | 40 Hz (± 10 %) |
| Roll-off rate: | 6 dB/oct. min. | | |
| Common mode voltage rejection ratio: | 60 dB within filter bandwidth | | |
| Input impedance: | ≥ 500 kΩ | Output impedance: | ≤ 100 Ω |
| Input capacitance: | ≤ 2500 p F | Output capacitance: | ≤ 5000 p F |
| Power-off input impedance: | ≥ 100 kΩ | Power-off output impedance: | ≥ 1 MΩ |
| Load current: | 0.01 m A at 5V | Drive capability: | 1 m A |

Table 6 - 6: Input/Output Characteristics of MDM C & W Discrete Input Channels (DIL)

| Characteristics of MDM Input Circuits for Discrete C & W Signals | | Experiment C & W Discrete Driver Characteristics that will Ensure Proper Function | |
|---|---|---|---|
| Overvoltage protection: | ± 32 V max | Fault voltage emission: | ± 15 V max |
| Fault voltage emission: | ± 15 V max | Overvoltage protection: | ± 15 V max |
| Fault current limitation: | ± 2 m A | Fault current limitation: | ± 10 m A |
| | | Cable type: | TSP |
| | | Ripple & Noise : | ≤ 50 mV |
| Wire shield reference: | MDM chassis ground | Wire shield reference: | Structure |
| Input type: | single ended | Output type: | isolated 1) |
| Discrete 'zero' (alarm): | - 0.5 V to 2.0 V line-to-line (open input interpreted as 'zero') | Discrete 'zero' (alarm): | - 0.5 V to + 0.5 V line-to-line |
| Discrete 'one' (no alarm): | + 2.5 V to + 6.0 V line-to-line | Discrete 'one' (no alarm): | + 4.0 V to + 6.0 V line-to line |
| Noise suppression bandwidth: | 1 m s ± 12 % (filter line constant) | | |
| Roll-off rate: | 6 dB/oct. | | |
| Input impedance: | 14 kΩ ≤ $R_{in}$ ≤ 21 kΩ (6 kΩ above 6 V) | Output impedance: | ≤ 1 kΩ |
| Input capacitance: | ≤ 5000 p F | Output capacitance: | ≤ 2500 p F |
| Power-off input impedance: | ≥ 14 kΩ (6 kΩ above 6 V) | Power-off output impedance: | ≤ 1 MΩ |
| Load current: | 0.43 m A at 6 V | Drive capability: | 1 m A |

1) isolated from power return and from signal ground to which other sources of MDM-DIL signals are referenced.

6.2.4 Bonding

The MDM chassis is bonded to Orbiter structure by a bonding strap of $\leq 2.5\ m\Omega$ resistance.

6.2.5 Grounding

The MDM has, if disconnected from the primary DC power supply a galvanic isolation impedance of at least 2 MΩ (DC to 25 Hz) between primary power ground and chassis as well as secondary power ground and signal ground.

Secondary power ground, signal ground and wire shields are referenced to Orbiter structure.

Safing command output signals ( DOH ) are referenced to MDM primary DC power return.

6.2.6 Conducted Emission on MDM Signal and Signal Return Lines

- MDM Safing Command Output (DOH)
  Same as specified in para. 3.3.7.1.

- MDM Monitoring Input (AID and DIL)
  $\leq 200\ mV_{pp}$ at the Orbiter/Spacelab interface.

6.3 Integrated Monitor and Control Panel ( IMCP - R7 Panel)

The IMCP-R7 panel provides five safing functions for experiments, each consisting of a safing actuator ( toggle switch) and a verification indicator ( LED). It should be noted that the IMCP-R7 panel does not provide for the monitoring of experiment unsafe conditions. Monitoring is performed by the Spacelab and Orbiter C&W system.

In the case of a safing command having been initiated at the IMCP-R7 panel and the experiment having reached a safe condition, a contact has to be closed by the experiment in order to switch on the respective LED on the IMCP - R7 panel, as can be seen in Figure 6 - 5. This LED shows the operator that the safing functions have been completed as planned.

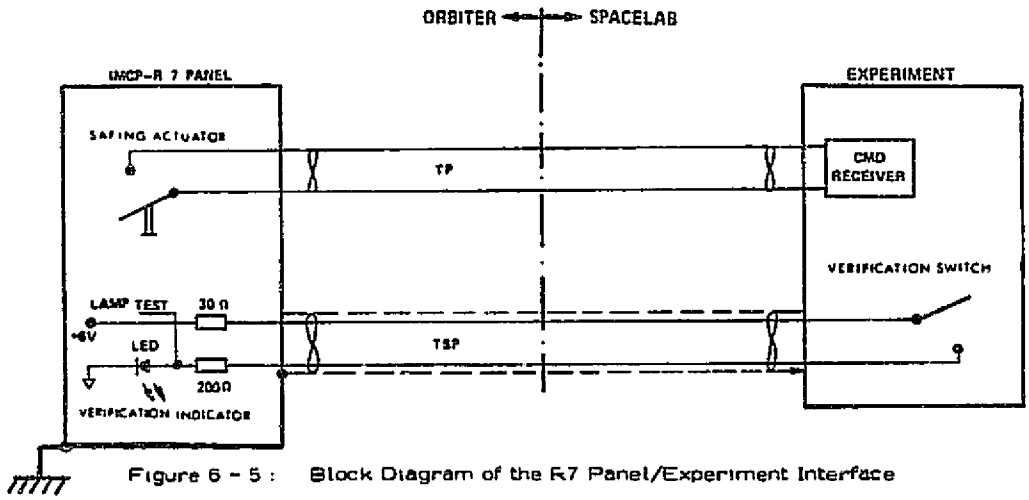



Figure 6 - 5 : Block Diagram of the R7 Panel/Experiment Interface

6.3.1 Connector Location

Spacelab provides the interface connectors

- at CB 5 for all module configurations
  The connector location is depicted in Figure 6 - 2 .
- at CB 57 for pallet-only configurations.
  The connector P 13 provides the safing command channels and the connector P 09 provides the verification indicator channels. The location of the interface connectors is depicted in Figure 6 - 3 .

6.3.2 Connector/Pin Allocation for R7-Panel Experiment Safing

6.3.2.1 Module Configuration

J 21 on CB 5 contains the 5 Experiment Verification Indicator channels together with the AFD/Spacelab Experiment Harness wiring. The pin allocation is given in Table 5 - 3.

J 25 on CB 5 contains the 5 Experiment Safing Command channels only. The pin allocation is given in Table 6 - 7 below.

Table 6 - 7: Pin Allocation List of IMCP - R7 Safing Commands of J 25 on CB 5 (Module)

| Connect. Not'n | Pin Not'n | Signal Code | Function | SL Input/ Output | Wire Type | EMC Class | Routed from/ to | Spacelab Connector Type ( Spec.) | Experiment Connector Type ( Spec.) |
|---|---|---|---|---|---|---|---|---|---|
| J 25 | 9<br>10 | Exp. Safing CMD 1 | Signal Return | O | TP 24 AWG | II | IMCP - R7 | NLS OT 10-35 SD (Spec.: 40 M 38277) | NLS 6GE 10-35 PD (Spec. 40 M 38277 ) |
| | 11<br>1 | Exp. Safing CMD 2 | Signal Return | O | | | | | |
| | 3<br>2 | Exp. Safing CMD 3 | Signal Return | O | | | | | |
| | 4<br>5 | Exp. Safing CMD 4 | Signal Return | O | | | | | |
| | 8<br>7 | Exp. Safing CMD 5 | Signal Return | O | | | | | |

J 25 has a total of 13 sockets. All J 25 sockets not mentioned in this table are spare sockets.

6.3.2.2 Pallet-Only Configuration

P 09 on CB 57 contains the 5 Experiment Verification Indicator channels together with AFD/Spacelab Harness wiring. The pin allocation is given in Table 5 - 8.

P 13 on CB 57 contains the 5 Experiment Safing Command channels together with MDM experiment safing command channels. The pin allocation is given in Table 6 - 3.

6.3.3 Input / Output Characteristics

Figure 6 - 5 depicts a block diagram of the experiment / IMCP-R7 panel interface. The input / output characteristics are given in the respective Table 6 - 8 .

Table 6 - 8 : Input / Output Characteristics of IMCP-R7 Panel Safing Command and Verification Indicator Channels

| Characteristics of IMCP-R7 C&W Input/Output Circuits | | | Characteristics of Experiment Input/Output Circuits that will ensure proper function | | |
|---|---|---|---|---|---|
| Safing command output : | | | Experiment command receiver input : | | |
| Max current for closed switch position | : | $10^3$ mA | Fault current emission | : | $10^3$ mA max |
| Output type | : | Floating switch contact (see Figure 6 - 5 ) | Input type | : | relay coil or other appropriate device (single ended) |
| Switch position : | | | Current level : | | |
| Normal | : | open switch ( ≥ 1 MΩ ) | Open switch current | : | ≤ TBD µA |
| Safe | : | closed switch ( ≤ 1Ω ) | Closed switch current | : | ≥ TBD mA ≤ 100 mA |
| Safing Indicator Input : | | | Experiment Safing Indicator Output : | | |
| Fault voltage emission | : | ± 10 V max | | | |
| Fault current emission | : | 250 mA max | | | |
| Input type | : | LED driving circuit (see Figure 6 - 5 ) | Driver type | : | relay contact (see Figure 6 - 5 ) |
| Current emission : | | | Circuit impedance within experiment : | | |
| • LED OFF | : | ≤ 20 nA | • LED OFF | : | ≥ 1 MΩ |
| • LED ON | : | ≤ 20 mA | • LED ON | : | ≤ 1Ω |

6.3.4 Bonding

Same as specified in para. 6.2.4

6.3.5 Grounding

The R7 panel is operated with secondary power only. Secondary power return is isolated from structure by at least 1 MΩ (DC to 25 Hz). Wire shields are referenced to the chassis (see Figure 6 - 5).

6.4 Orbiter Caution and Warning Electronic Assembly

The Orbiter Caution and Warning Electronic Assembly (CWEA) provides five experiment dedicated C & W input channels. The interface block diagramm is depicted in Figure 6 - 6 for one channel.

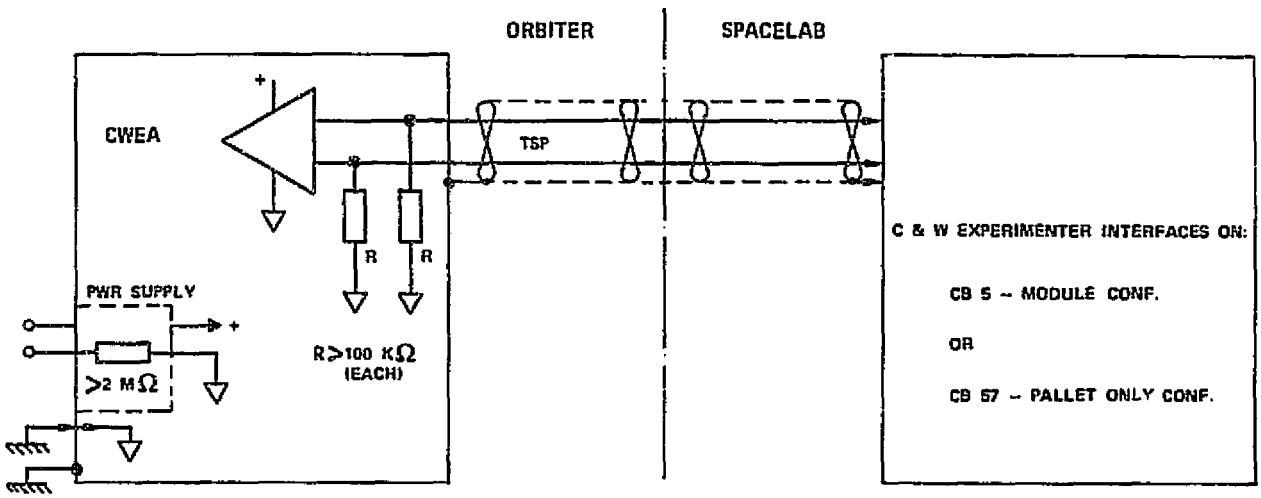



Figure 6 - 6: Orbiter CWEA-Experiment Interface Diagram

6.4.1 Connector Location

Spacelab provides the interface connectors

- J 22 at CB 5 for all module configurations
  (see Fig. 6 - 2).

- P 10 at CB 57 for pallet-only configurations
  (see Fig. 6 - 3).

6.4.2 Connector/Pin Correlation

6.4.2.1 Module Configuration

J22 on CB 5 contains 5 Orbiter CWEA inputs for experiments together with AFD/Spacelab Experiment Harness wiring.
The pin allocation is given in Table 5 - 4.

6.4.2.2 Pallet-Only Configuration

P 10 on CB 57 contains 5 Orbiter CWEA inputs for experiments together with AFD/Spacelab Experiment Harness wiring.
The pin allocation is given in Table 5 - 9.

6.4.3 Input/Output Characteristics

Table 6 - 9. depicts the input/output characteristics of the experiment C&W signals to be fed into the Orbiter CWEA.

Table 6 - 9 : Input/Output Characteristics of Analog C&W Input Channels to Orbiter CWEA

| CWEA Analog Input Characteristics | | Experiment C & W Analog Driver Characteristics that will ensure proper function | |
|---|---|---|---|
| Fault voltage emission:<br>Fault current limitation:<br>Overvoltage protection: | ± 15 V max<br>1.28 mA<br>± 32 V max | Overvoltage protection:<br>Fault voltage emission: | ± 15 V<br>± 15 V |
| Cable Type: | TSP 24 AWG | Cable type: | TSP |
| Wire shield reference: | CWEA signal ground | Wire shield reference: | Structure |
| Input isolation: | 100 kΩ line to ground | Output grounding: | Connected to experiment signal ground. |
| Input type: | differential, analog | Output type: | single ended (return line grounded at source) |
| Full scale analog voltage range: | 0V to 5 V | Full scale voltage range: | 0 V to 5 V |
| Limit detection: | 1) see next page | | |
| Common mode voltage:<br>Common mode voltage rejection ratio: | ± 5 V max.<br>≥ 33 dB | | |
| Input filter bandwidth:<br>Roll-off rate: | 0 - 10 Hz (± 25 %) Recognition-Filter<br>NA | | NA<br>NA |
| Input impedance<br>Input capacitance<br>Power-off input impedance: | 583 kΩ<br>25 pF<br>583 kΩ | Output impedance | ≤ 100 Ω |
| Load current: | 25 µA | Drive capability: | 1 mA |

1) Limit Detection

The CWE provides high, low and dual limit detection for each system status input as follows:

High Limit. An output signal shall be generated whenever the input voltage exceeds a predetermined limit. This limit may vary from 0.3 Volt DC to plus 5.0 Volts DC.

Low Limit. An output signal shall be generated whenever the input voltage falls below a predetermined limit. This limit may vary from plus 4.8 Volts DC to plus 0.1 Volt DC.

Dual Limit. An output signal shall be generated whenever the input voltage deviates above or below predetermined limits. The upper and lower limits may vary as given above for high and low limit. The voltage range between the upper und lower limits may vary from plus 0.2 Volt DC to plus 4.9 Volts DC.

6.4.4 Bonding

Same as given in para 6.2.4

6.4.5 Grounding

Same as given in para 6.2.5

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# 7 MEASUREMENT AND STIMULI UNIT (MSU)

## 7.1 Connector Location

The connector locations of the analog and digital concentrator distributor (C/D) drawers are depicted in Figures 7 - 1 and 7 - 2, respectively.

The connectors J1, J3 and J6 at the analog C/D drawers are used for analog stimuli outputs, while the connectors J2, J4 and J7 are used for analog measurements.

The connectors J1, J3 and J6 at the digital C/D drawers are used for discrete stimuli and digital 12 bit parallel outputs, where each connector contains one 12 bit parallel channel. The connectors J2, J4 and J7 at the digital C/D drawers are used for discrete and digital 12 bit parallel inputs, where each connector contains one 12 bit parallel channel.

The connector types will be supplied at a later date.

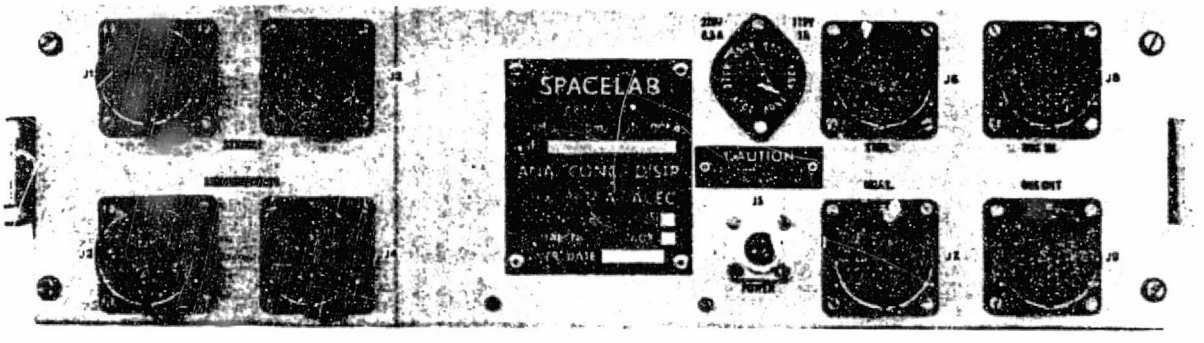



Figure 7 - 1 : Analog Concentrator Distributor Drawer

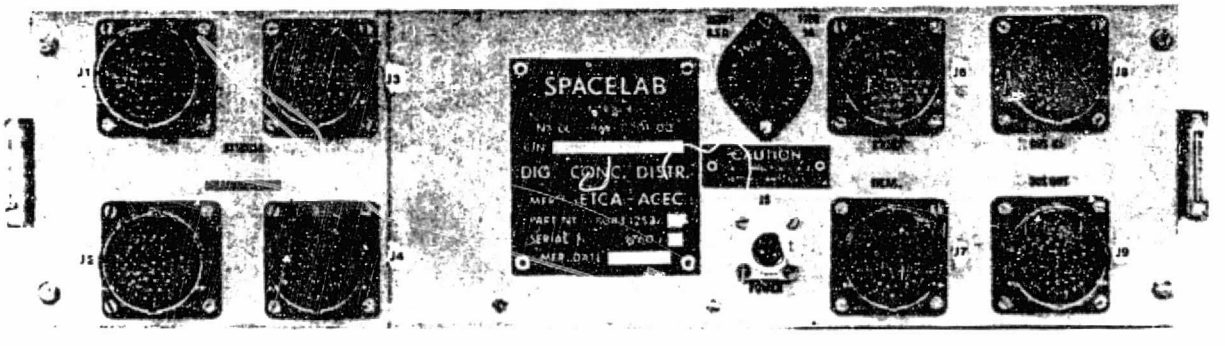



Figure 7 - 2 : Digit Concentrator Distributor Drawer

| | | |
|---|---|---|
| 7.2 | Pin-Allocation | – to be supplied at a later date – |
| 7.3 | Input / Output Characteristics | |
| 7.3.1 | Analog Concentrator/Distributor Module | |
| 7.3.1.1 | Analog Input Channels | |
| | Number of channels: | 56 |
| | Signal/load characteristics (specification values) | |
| | Input type: | differential |
| | Input impedance: | > 2 MΩ line-to-line |
| | Line isolation: | > 1 MΩ line-to-ground |
| | Power-off input impedance: | > 2 MΩ line-to-line |
| | Power off line isolation: | > 1 MΩ line-to-ground |
| | Voltage range: | – 5.12 to + 5.11 V line-to-line |
| | Conversion resolution: | 10 bits and sign |
| | Conversion accuracy: | 0.5 % full scale |
| | Conversion time: | ⩽ 40µs |
| | Common mode voltage: | ± 5 V max. |
| | Common mode rejction ratio: | 34 dB |
| | Input bandwidth: | compatible with 3200 samples/s |
| | Roll-off rate: | 6 dB/octave |
| | Overvoltage protection: | ± 32 V (ON)<br>± 10 V (OFF) |
| | Fault voltage emission: | ± 7 V max. |
| | Fault current limitation: | ± 12 µA |
| 7.3.1.2 | Analog Output Channels | |
| | Number of channels: | 28 |
| | Signal/load characteristics (Specification values) | |
| | Output type: | Single ended, ground return |
| | Output impedance: | ⩽ 1Ω |
| | Load impedance: | ⩾ 2 kΩ |
| | Voltage range: | – 5.12 to + 5.11 V |
| | Input for D/A converter: | 10 bits + sign |
| | Conversion accuracy: | 0.5 % full scale |
| | Fault emission voltage: | ± 15 V max. |

7.3.2 Digital Concentrator/Distributor Module

7.3.2.1 Discrete Input Channels

| | |
|---|---|
| Number of channels: | 40 |
| Signal/load characteristics (specification values) | |
| Input type: | differential |
| Input impedance: | $\geq$2 MΩ line-to-line |
| Line isolation: | $\geq$1 MΩ line-to-ground |
| Power-off input impedance: | $\geq$2 MΩ line-to-line |
| Power-off isolation: | $\geq$1 MΩ line-to-ground |
| Digital 'one' level: | + 4 V nominal<br>+ 2.5 V $\leq V_{in} \leq$ + 6 V |
| Digital 'zero' level: | 0 V nominal<br>− 0.5 V $\leq V_{in} \leq$ + 0.5 V |
| Common mode voltage: | $\pm$ 5 V max. |
| Common mode rejection ratio: | 34 dB |
| Fault voltage emission: | $\pm$ 7 V max. |
| Fault current limitation: | $\pm$ 15 µA |

7.3.2.2 Discrete Output Channels

| | |
|---|---|
| Number of channels: | 40 |
| Signal/load characteristics (specification values) | |
| Output type: | single ended, ground return |
| Digital 'zero' level: | 0 V nominal<br>− 0.55 V $\leq V_{out} \leq$ + 0.55 V at $\pm$ 0.2 mA |
| Digital 'one' level: | + 5 V nominal<br>4.3 V $\leq V_{out} \leq$ 6 V |
| Output current: | $\leq$ 20 mA |
| Rise and fall times: | $t_r \leq 1$ µs, $t_f \leq 1$ µs } 300 Ω‖200 pF load<br>$t_r \leq 1$ µs, $t_f \leq 5$ µs } 4 KΩ‖200 pF load |
| Overvoltage protection: | − 32 V to + 6 V |
| Fault voltage emission: | $\pm$ 15 V max. |
| Fault current limitation: | 40 mA |
| Ripple and noise: | < 100 mV |

7.3.2.3 Parallel Digital Input Channel

| | |
|---|---|
| Number of channels: | 3 |
| | 12 bits parallel per channel |
| Input type: | single ended parallel |
| | digital words |
| Input impedance: | $>12\ K\Omega$ |
| Digital 'zero' level: | 0 V nominal<br>$-0.5\ V \leqslant V_{in} \leqslant +0.5\ V$ |
| Digital 'one' level: | $+2.4\ V \leqslant V_{in} \leqslant +5.5\ V$ |

7.3.2.4 Parallel Digital Output Channel

| | |
|---|---|
| Number of channels: | 3 |
| | 12 bits parallel per channel |
| Output type: | single ended parallel digital words |
| Digital 'zero' level: | $0 \pm 0.5\ V$, 30 mA sink |
| Digital 'one' level: | $5 \pm 0.5\ V$, impedance<br>$10\ K\Omega \pm 10\ \%$ |

# 8 USER PROVIDED HARNESSES FOR SUBSYSTEMS

## 8.1 RAU Harness

### 8.1.1 Airlock RAU Harnesses

Spacelab provides two experiment dedicated signal harness to connect experiment equipment inside and outside the airlock.

Harness 1 allows the operation of an experiment RAU inside the airlock. The signal harness is described in Table 5 - 1 and the power harness is given in Table 3.6 - 1 .

### 8.1.2 Center Aisle Experiment RAU Harness Provisions

Each center aisle connector bracket, CB 31 (in the core segment) and CB 32 ( in the experiment segment), can be connected to one experiment RAU for center aisle mounted experiments. The connector locations at CB 31 and CB 32 are described in para 3.5.

The user provided RAU harness interfaces at the connector brackets CB 31 and with the subsequent connectors:

| | |
|---|---|
| J 03, J 04 | RAU power supply |
| J 10, J 11 | experiment data bus |
| J 12 | RAU monitor and control |

The overall routing of the RAU harness is sketched in Figure 8 - 1 . Connector / pin correlations of the RAU harness are given in Table 8 - 1 .

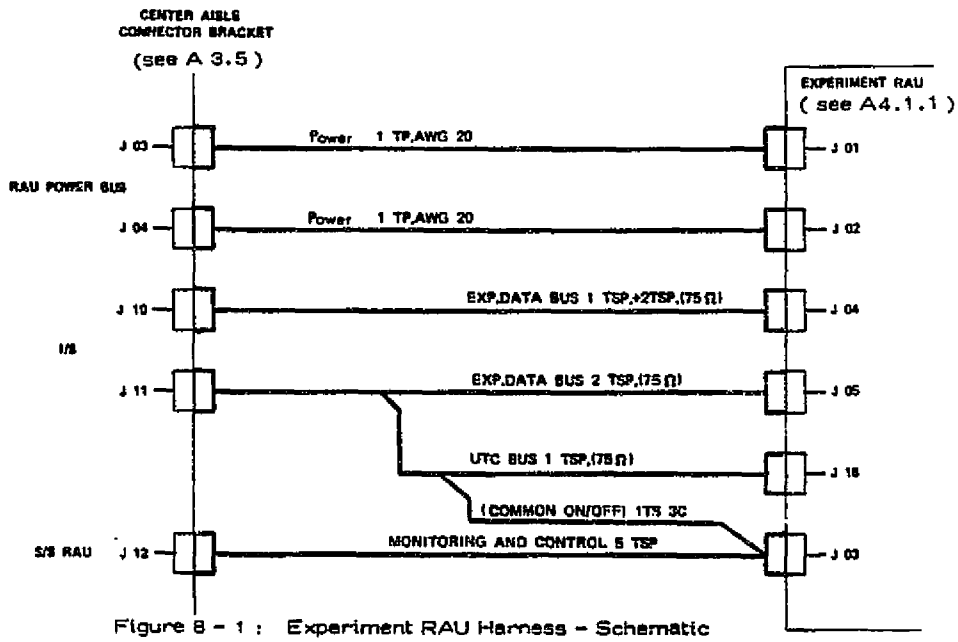



Figure 8 - 1 : Experiment RAU Harness - Schematic

Table 8 - 1 : Connector/Pin Correlation of the Center Aisle Experiment RAU Harness

| Routed from Center Aisle Conn' Brkt. CB31/32 | Experiment provided Harness | | | | | | | | | Routed to Exp. RAU |
|---|---|---|---|---|---|---|---|---|---|---|
| | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Funct'n | Harness Type | EMC Class | Pin Not'n | Connector Type ( Spec ) | Conn' Not'n | |
| J03 | P 03 | NB 6 GE 8-98 PNS 3) | A<br>B | line<br>line | 1 TP 20 AWG | I | 1<br>16 | 311P405-3S-B-12 1) | P 01 | J01 |
| J04 | P 04 | NB 6 GE 8-98 PNS 3) | A<br>B | line<br>line | 1 TP 20 AWG | I | 1<br>16 | 311P405-3S-B-12 1) | P 02 | J02 |
| J10 | P 10 | NLS 6 GT 10-35 P 4) | 1<br>11<br>2 | line<br>line<br>shield | 2 TSP 24 AWG 75Ω | IV | 14<br>28<br>20 | GWSW 038 BV PSHB 2) | P 05 | J05 |
| | | | 8<br>13<br>9 | line<br>line<br>shield | | | 11<br>25<br>19 | | | |
| | | | 12<br>7<br>6 | line<br>line<br>shield | 1 TSP 24 AWG | III | 10<br>24<br>17 | | | |
| J11 | P 11 | NLS 6 GT 12-35 P 4) | 10<br>19<br>9 | line<br>line<br>shield | 2 TSP 24 AWG 75 Ω | IV | 14<br>28<br>20 | GWSW 038 BN PSHB 2) | P 04 | J04 |
| | | | 20<br>11<br>12 | line<br>line<br>shield | | | 11<br>25<br>19 | | | |
| | | | 17<br>6<br>5 | line<br>line<br>shield | 1 TSP 24 AWG 75Ω | IV | 10<br>24<br>17 | GWSW 038 BW PSHB 2) | P 18 | J18 |
| | | | 2<br>3<br>15<br>1 | line<br>line<br>line<br>shield | 1 TS 3C 24 AWG | III | 53<br>71<br>54<br>39 | | | |
| J12 | P 12 | NLS 6 GT 12-35 PA 4) | 14<br>21<br>13 | line<br>line<br>shield | 5 TSP 24 AWG | III | 1<br>2<br>18 | GWSW 088 BV PSHB 5) 2) | P 03 | J03 |
| | | | 15<br>1<br>2 | line<br>line<br>shield | | | 19<br>20<br>38 | | | |
| | | | 18<br>7<br>8 | line<br>line<br>shield | | | 51<br>52<br>70 | | | |
| | | | 5<br>17<br>6 | line<br>line<br>shield | | | 68<br>69<br>88 | | | |

Connector Spec: 1) GSFC-S-311-P4/5 3) 40 M 39569
2) GSFC-S-311-P4/1 4) 40 M 38277
5) Pin 8 and 23 respectively 57 and 78 of Plug 03 have to be connected internally by a jumper.

8.1.3 Harness of RAU on Pallet

8.1.3.1 Power Harness

The power supply for experiment RAU's on pallets is provided by the Connector Bracket CB 51 (Connectors J 01 and J 02). The power will be distributed by means of Branching Unit 26.

The Spacelab baseline provides one experiment RAU per branching unit; however, Branching Unit 26 is capable of supplying up to four experiment RAU's, as shown in the schematic Figure 8 - 2 .

The optional connections to Branching Unit 26 are provided by four modules for power and power return plus redundant lines respectively.

These modules are of the type Deutsch MRTB 12 E 04-089 (spec. MIL-T-81714), which require a special tool for pin disconnection.

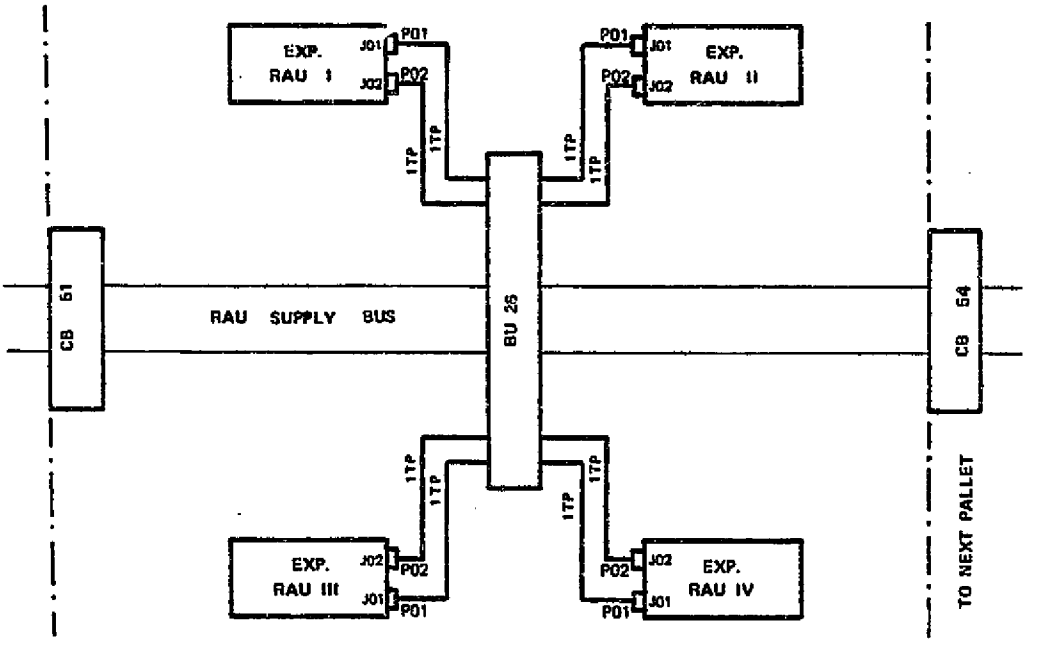



Figure 8 - 2 : Power Distribution from Branching Unit 26 to Experiment RAU's
- Schematic -

Table 8 - 2: Connector/Pin Correlation for RAU Power on the Pallet

TBD

8.1.3.2 Signal Harness

The signal and data lines are routed to Connector Bracket CB 52 via the connectors J 15 and J 16. From hereon, signal and data lines are routed to experiment interconnecting station 1 located on the pallet cold plate.

Spacelab provides as basline a harness set required to operate up to four experiment RAU's on a pallet. This harness fits to experiment RAU standard locations given in Section 4.4 - 2 of Appendix B, Structure Interface Definition.

The routing of the signal harness, required to operate an experiment RAU is given in Figure 8 - 3, 8 - 4, and 8 - 5.

Figure 8 - 3 depicts the routing of an RAU signal harness in case, that two experiment RAU's are located on one pallet. The user has to provide the signal harness only, if the experiment RAU does not have a standard location. Figure 8 - 3 depicts the Spacelab standard routing concept.

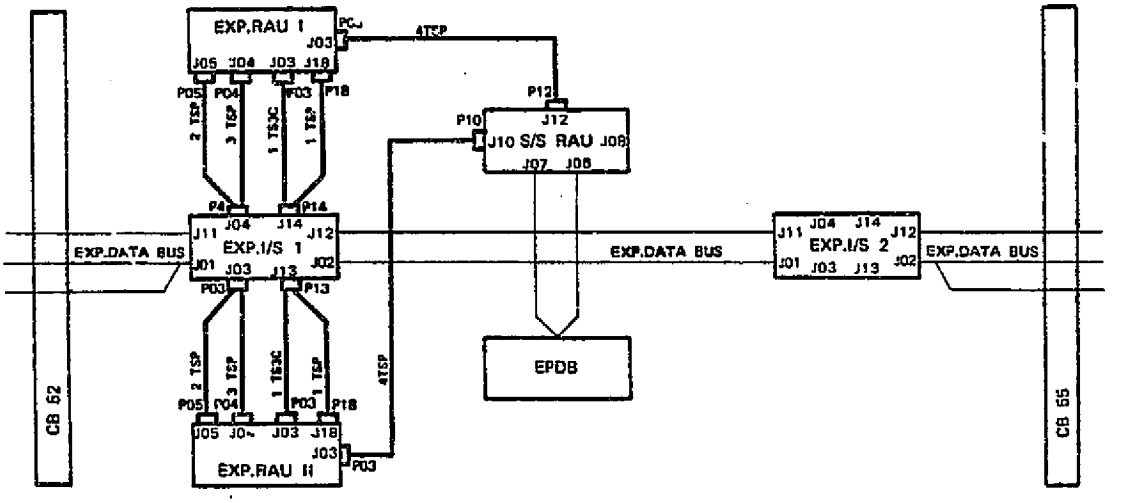



Figure 8 - 3: Schematic - Signal Harness to two Experiment RAU's (Spacelab Standard Routing Concept)

Figure 8 - 4 depicts the Spacelab standard RAU signal harness routing for four experiment RAUs on one pallet. It should be noted, that this routing concept may be used only, if no experiment caution and warning signals have to be acquired by the subsystem RAU shown in Figure 8 - 4, because the subsystem RAU connec- connector J 08 is reserved for acquisition of experiment caution and warning signals. In this case a modified RAU signal harness routing ( see Figure 8 - 5 ) has to be used.

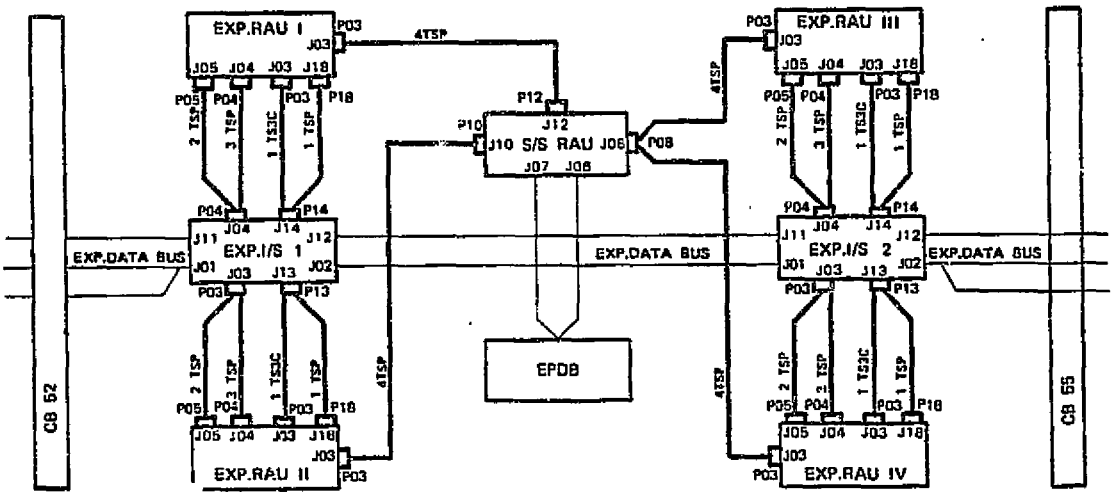



Figure 8 - 4: Schematic - Signal Harness to Four Experiment RAUs (Spacelab Standard Routing Concept)

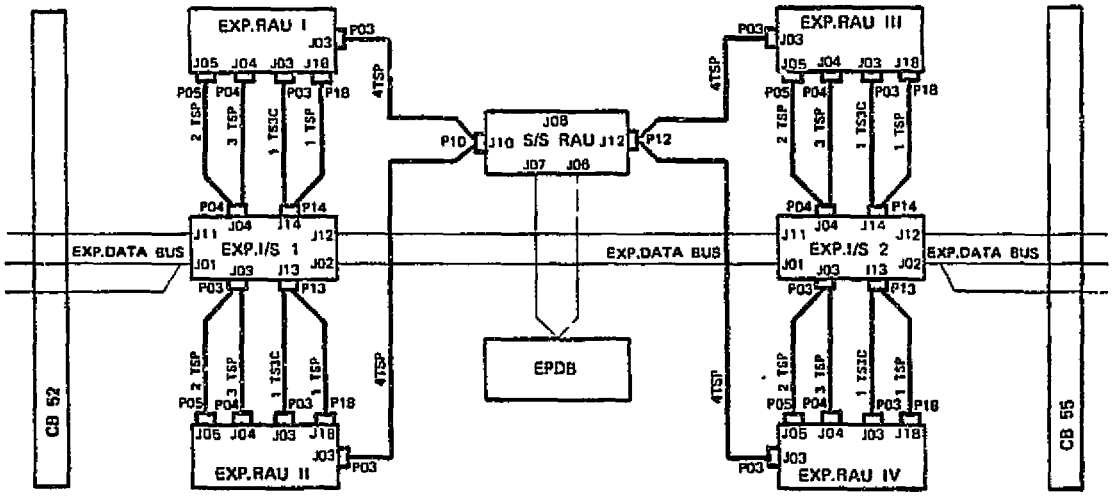



Figure 8 - 5: Schematic - Signal Harness to Four Experiment RAUs with J 08 Reserved for Experiment-S/S RAU C&W Interface.

The connector/pin correlation of the pallet experiment RAU harness between interconnecting station and experiment RAU is given in Table 8 - 3.

The connector/pin correlation of the experiment RAU monitoring and control harness is given in Table 8 - 4 and 8 - 5.

Table 8 - 3 : Pallet Experiment RAU / Interconnecting Station Harness

| Routed from Exp. I/S | Experiment provided Harness (See Figure 8-3,4 and 5) | | | | | | | | | Routed to Exp. RAU |
|---|---|---|---|---|---|---|---|---|---|---|
| | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Funct'n | Harness Type | EMC Class | Pin Not'n | Connector Type ( Spec ) | Conn' Not'n | |
| J03/04 | P03/04 | 311 P 405 -2P-8-12 1) | 13 | line | 2 TSP 24 AWG (75Ω) | IV | 14 | GWSW 038 BV PSHB 2) | P05 | J05 |
| | | | 14 | line | | | 28 | | | |
| | | | *12 | -shield- | | | 20 | | | |
| | | | 4 | line | | | 11 | | | |
| | | | 5 | line | | | 25 | | | |
| | | | 12 | shield | | | 19 | | | |
| | | | 7 | line | 1 TSP 24 AWG | III | 10 | GWSW 038 BN PSHB 2) | P04 | J04 |
| | | | 8 | line | | | 24 | | | |
| | | | 15 | shield | | | 17 | | | |
| | | | 10 | line | 2 TSP 24 AWG (75Ω) | IV | 14 | | | |
| | | | 11 | line | | | 28 | | | |
| | | | 3 | shield | | | 20 | | | |
| | | | 1 | line | | | 11 | | | |
| | | | 2 | line | | | 25 | | | |
| | | | 9 | shield | | | 19 | | | |
| J13/14 | P13/14 | 311 P 405 -2P-8-12 1) | 4 | line | 1 TSP 24 AWG (75Ω) | IV | 10 | GWSW 038 BW PSHB 2) | P 18 | J18 |
| | | | 11 | line | | | 24 | | | |
| | | | 3 | shield | | | 17 | | | |
| | | | 1 | line | 1 TS 3 C 24 AWG | III | 53 | GWSW 088 BV PSHB 3) 2) | P03 | J03 |
| | | | 2 | line | | | 71 | | | |
| | | | 10 | line | | | 54 | | | |
| | | | 9 | shield | | | 39 | | | |

Note: * Common shield pin for line 4,5,13, and 14

1) Connector Spec: GSFC-S-311-P4/5

2) Connector Spec: GSFC-S-311-P4/1

3) Pin 8 and 23 respectively 57 and 78 of Plug 03 have to be connected internally by a jumper.

Table 8-4: Pallet Experiment RAU Monitoring and Control Harness

| Routed from S/S RAU | Experiment provided Harness (See Figure 8-3,4) | | | | | | | | | Routed to Exp. RAU |
|---|---|---|---|---|---|---|---|---|---|---|
| | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Funct'n | Harness Type | EMC Class | Pin Not'n | Connector Type ( Spec ) | Conn' Not'n | |
| J 12 or J 10 | P 12 or P 10 | GWSW 088 BV PSHB or GWSW 088 BN PSHB 1) | 1<br>2<br>3<br>19<br>20<br>21<br>6<br>7<br>23<br>24<br>25<br>40 | line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield | 4 TSP 24 AWG | III | 1<br>2<br>18<br>19<br>20<br>38<br>51<br>52<br>70<br>68<br>69<br>88 | GWSW 088 BV PSHB 3) 1) | P03 | J03 RAU I or II |
| J 08 | P08 | GWSW 088 BV PSHB 1) | 1<br>2<br>3<br>19<br>20<br>21<br>6<br>7<br>23<br>24<br>25<br>40 | line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield | 4 TSP 24 AWG | III | 1<br>2<br>18<br>19<br>20<br>38<br>51<br>52<br>70<br>68<br>69<br>88 | GWSW088 BV PSHB 3) 1) | P 03 | J 03 RAU III |
| | | | 53<br>54<br>55<br>1<br>2<br>73<br>41<br>42<br>57<br>43<br>44<br>57 | line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield | 4 TSP 24 AWG | III | 1<br>2<br>18<br>19<br>20<br>38<br>51<br>52<br>70<br>68<br>69<br>88 | GWSW088 BV PSHB 3) 1) | P 03 | J 03 RAU IV |

1) Connector Spec: GSFC-S-311-P4/1

3) Pin 8 and 28 respectively 57 and 78 of Plug 03 have to be connected internally by a jumper.

Table 8-4 (cont'd): Pallet Experiment RAU Monitoring and Control Harness

| Routed from S/S RAU | Experiment provided Harness (See Figure 8-5) | | | | | | | | | Routed to Exp. RAU |
|---|---|---|---|---|---|---|---|---|---|---|
| | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Funct'n | Harness Type | EMC Class | Pin Not'n | Connector Type ( Spec ) | Conn' Not'n | |
| | | | 1 | line | 1 TSP 24 AWG | III | 1 | GWSW 088 BV PSHB | P 03 | J 03 RAU III or I |
| | | | 2 | line | | | 2 | | | |
| | | | 3 | shield | | | 18 | | | |
| | | | 19 | line | | | 19 | | | |
| | | | 20 | line | | | 20 | | | |
| | | | 21 | shield | | | 38 | | | |
| | | | 6 | line | | | 51 | | | |
| | | | 7 | line | | | 52 | | | |
| | | | 23 | shield | | | 70 | | | |
| J 12 or J 10 | P 12 or P 10 | GWSW 088BV PSHB or GWSW 088BN PSHB 1) | 24 | line | | | 68 | 3) 1) | | |
| | | | 25 | line | | | 69 | | | |
| | | | 40 | shield | | | 88 | | | |
| | | | 53 | line | 4 TSP 24 AWG | III | 1 | GWSW 088 BV PSHB | P 03 | J03 RAU IV or II |
| | | | 54 | line | | | 2 | | | |
| | | | 55 | shield | | | 18 | | | |
| | | | 71 | line | | | 19 | | | |
| | | | 72 | line | | | 20 | | | |
| | | | 73 | shield | | | 38 | | | |
| | | | 41 | line | | | 51 | | | |
| | | | 42 | line | | | 52 | | | |
| | | | 57 | shield | | | 70 | | | |
| | | | 43 | line | | | 68 | | | |
| | | | 44 | line | | | 69 | | | |
| | | | 57 | shield | | | 88 | 3) 1) | | |

1) Connector Spec: GSFC-S-311-P4/1

3) Pin 8 and 23 respectively 57 and 78 of Plug 03 have to be connected internally by a jumper.

8.2 Data Display System Harness

The mission dependent data display system will be accommodated in an experiment rack. The harnesses to connect the data display system to the CDMS (data display bus, monitor and control) and to the EPDS (AC power supply) have to be provided by the experimenter/payload integrator. The interface to the CDMS is at Connector Bracket CB 5. The connector location of CB 5 is given in para 5.3 Figure 5 - 8. The interface to the EPDS is the EPSP of the particular experiment rack. As shown in Figure 8 - 6, four different harnesses have to be provided:

- o the monitor and control harness
- o the data display bus harness (experiment and subsystem bus)

These harness have to be routed from CB 5 through the provision for experiment utilities in the main floor through the connector bracket at the bottom of the particular experiment rack, and to the data display system or the data display bus interconnecting stations, respectively.

- o the data display stub harness (experiment and subsystem bus)
- o the AC power supply harness

Both harnesses are routed completely inside the rack.

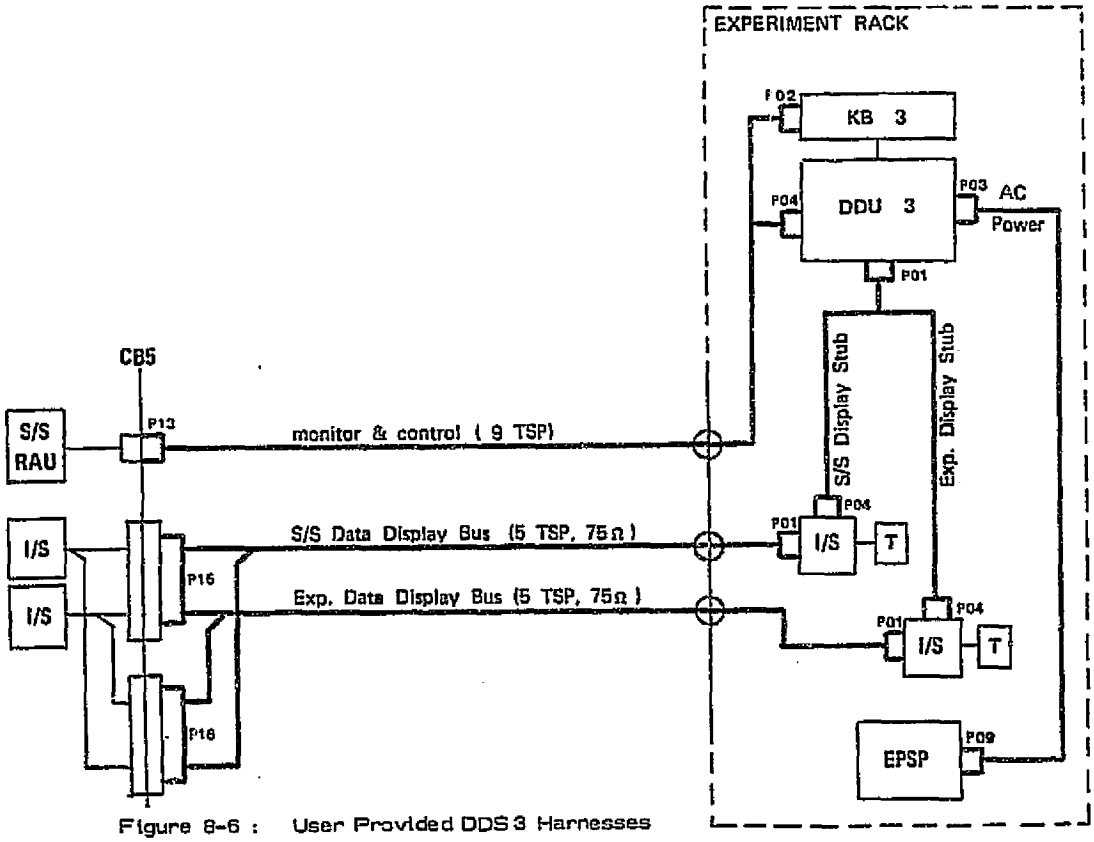



Figure 8-6 : User Provided DDS 3 Harnesses

The connector/pin correation of the harnesses is given in Table 8-5 thru 8-7.

Table 8-5 : Connector / Pin Correlation of the Monitor and Control Harness.

| Routed from Conn' Brkt. CB 5 | Experiment provided Harness | | | | | | | | | Routed to |
|---|---|---|---|---|---|---|---|---|---|---|
| | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Fnct'n | Harness Type | EMC Class | Pin Not'n | Connector Type ( Spec ) | Conn' Not'n | |
| J13 | P13 | MS 27484E 14F 35P (Spec MIL-C-38999) | TBD | line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield | 9 TSP 22 AWG | III | 29<br>30<br>31<br>35<br>36<br>37<br>4<br>5<br>6<br>20<br>21<br>22<br>45<br>46<br>47<br>1<br>2<br>3<br>7<br>8<br>9<br>10<br>11<br>12<br>4<br>5<br>6 | DSx2H21S15S-0001<br>(Spec. TBD)<br>311 P405-3S-B-12 (Spec GSFC -S-311-P-4) | P04<br>P02 | J04 (DDU3)<br>J02 (KB3) |
| J15 | P 15 | MS 27484E 12F 35PA (Spec MIL-C-38999) | TBD | line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield | 4 TSP 22 AWG 75 Ω<br>1 TSP 22 AWG | IV<br>III | 1<br>2<br>9<br>10<br>11<br>3<br>4<br>5<br>12 *<br>13<br>14<br>7<br>8<br>15 | 311P405-2P-B-12 (Spec GSFC -S-311-P-4) | P01 | J01 (S/S I/S) |
| J16 | P 16 | MS 27484E 12F 35PB (Spec MIL-C-38999) | TBD | line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield<br>line<br>line<br>shield | 4 TSP 22 AWG 75Ω<br>1 TSP 22 AWG | IV<br>III | 1<br>2<br>9<br>10<br>11<br>3<br>4<br>5<br>12 *<br>13<br>14<br>7<br>8<br>15 | 311 P405-2P-B-12 (Spec GSFC -S-311-P-4) | P01 | J01 (Exp. I/S) |

* Note: Common shield pin for line 4,5,13 and 14.

Table 8-6 : Connector / Pin Correlation of the Data Display Stub Harness

| Routed from | Experiment provided Harness | | | | | | | | | Routed to |
|---|---|---|---|---|---|---|---|---|---|---|
| | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Fnct'n | Harness Type | EMC Class | Pin Not'n | Connector Type ( Spec ) | Conn' Not'n | |
| J04 (S/S I/S) | P04 | 311 P 405-2P-B-12 (Spec GSFC -S-311-P-4) | 7 | line | 1 TSP 20 AWG | III | 1 | | | J01 (DDU3) |
| | | | 8 | line | | | 2 | | | |
| | | | 15 | shield | | | 8 | | | |
| | | | 13 | line | 4 TSP 24 AWG 75Ω | IV | 21 | | | |
| | | | 14 | line | | | 22 | | | |
| | | | 12 | shield | | | 13 | | | |
| | | | 1 | line | | | 15 | | | |
| | | | 2 | line | | | 16 | | | |
| | | | 9 | shield | | | 7 | | | |
| | | | 4 | line | | | 17 | | | |
| | | | 5 | line | | | 18 | | | |
| | | | 12 | shield | | | 9 | | | |
| | | | 10 | line | | | 19 | | | |
| | | | 11 | line | | | 20 | | | |
| | | | 3 | shield | | | 11 | DSx2H 17S 15S 0001 | P01 | |
| J04 (Exp. I/S) | P04 | 311P405-2P-B-12 (Spec GSFC -S-311-P-4) | 7 | line | 1 TSP 20 AWG | III | 3 | | | |
| | | | 8 | line | | | 4 | | | |
| | | | 15 | shield | | | 10 | | | |
| | | | 1 | line | 4 TSP 24 AWG 75 Ω | IV | 32 | | | |
| | | | 2 | line | | | 33 | | | |
| | | | 9 | shield | | | 24 | | | |
| | | | 4 | line | | | 34 | | | |
| | | | 5 | line | | | 35 | | | |
| | | | 12 | shield | | | 26 | | | |
| | | | 10 | line | | | 36 | | | |
| | | | 11 | line | | | 37 | | | |
| | | | 3 | shield | | | 28 | | | |
| | | | 13 | line | | | 38 | | | |
| | | | 14 | line | | | 39 | | | |
| | | | 12 | shield | | | 30 | | | |

Table 8-7 : Connector / Pin Correlation of the AC Power Supply Harness

| Routed from EPSP | Experiment provided Harness | | | | | | | | | Routed to DDU 3 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Conn' Not'n | Connector Type ( Spec ) | Pin Not'n | Pin Fnct'n | Harness Type | EMC Class | Pin Not'n | Connector Type ( Spec ) | Conn' Not'n | |
| J09 or J10 | P09 or P10 | NBOE10-6 SNC or WC (Spec. 40M 39569) | A | line | 16 AWG | I | 1 | DSx2H 21S 15S 0001 | P03 | J03 |
| | | | B | line | | | 2 | | | |
| | | | C | line | | | 3 | | | |
| | | | D | ground | | | 4 | | | |