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TETHERED SATELLITE SYSTEM
A COOPERATIVE PROJECT—USA & ITALY
NASA-CNR

FIRST ELECTRODYNAMIC MISSION

EXPERIMENT INTERFACE DOCUMENT

EXPERIMENT "ROPE"

RESEARCH ON ORBITAL PLASMA ELECTRODYNAMICS

psn
PIANO SPAZIALE NAZIONALE

I

TETHERED SATELLITE FIRST ELECTRODYNAMIC MISSION

EXPERIMENT INTERFACE DOCUMENT

EXPERIMENT "ROPE"

Research On Orbital Plasma Electrodynamics

ES53

APPROVED	ACCEPTED
For Experimenter : .... Dr. N. H. Stone Principal Investigator NASA/MSFC, Huntsville, AL 35812	For NASA : .... Bill J. Duncan Experiments Manager FA31 NASA/MSFC, Huntsville AL 35812
For CNR/PSN : .... Dr. J. Sabbagh TSS-S Payload Manager	For TSS-S Contractor : .... Dr. O. Tornani TSS-S Program Manager AERITALIA, Torino

DOCUMENT CHANGE RECORD

ISSUE N.	DATE	ECP N. and / or DCN N.	PAGES AFFECTED	REMARKS
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2	Sept. 20, 1985		All	
3	~~[illegible]~~		All	

LIST OF VALID PAGES

PAGE	ISSUE N°	PAGE	ISSUE N°	PAGE	ISSUE N°	PAGE	ISSUE N°	PAGE	ISSUE N°
All	3								

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1.0 SCOPE

This document defines the interfaces between the Experiment ROPE and the TSS Satellite, including the other Experiments, to be flown for the first electrodynamic mission.

After approval and acceptance of this document by all the parties involved (see first page) its detailed requirements and specifications become binding on both the Experimenter and Satellite Contractor.

2.0 DOCUMENTATION

2.1 Applicable Documents

The latest issue of the following documents are applicable to the Satellite mounted Experiment units except if clearly specified in this document.

TS-SY-AI-001	TSS-S Specification.
TS-SR-AI-001	Environmental Specification.
TS-SR-AI-002	EMC Specification.
TS-SR-AI-003	Safety Specification.
TS-SR-AI-004	Parts, Material and Processes Specification.
TS-SR-AI-005	General Design and Interface Requirement.
TS-SR-AI-006	Test Requirements Specification.

2.2 Reference Documents

TS-PL-AI-002	TSS-S Product Assurance Plan.
TS-PL-AI-005	Assembly, Integration and Verification Plan.
TS-PL-AI-027	TSS-S EMC Control Plan.
TS-IC-AI-001	Vol. 3, Electrical Interfaces.
TS-PR-AI-003	Reliability Analisis Procedure.
TS-PR-AI-008	Subsystem Interface Data Sheets (IDS)-Preparation Procedure.
TS-RQ-AI-026	Design Guidelines for TSS-S Magnetic Cleanliness.
TS-LI-AI-023	TSS-S Spares List.

NOTE:

Parts/materials doc., TS-SR-AI-004, is under review by MSFC to determine for clarification of requirements. Compliance is uncertain because the document is unclear and appears contradictory.

3.0 DELIVERABLE RESPONSIBILITIES AND KEY PERSONNEL

3.1 Hardware and Software Responsibilities

Does not address all aspects/Responsibilities but not appropriate here

NASA, Marshall Space Flight Center (MSFC) will be responsible for:

- the development of the Differential Ion Flux Probe, sensor (DIFP-S) and electronics (DIFP-E), ✓
- the complete Experiment during the Experiment level qualification and acceptance testing, and ✓
- the integration of the different ~~Experiment items onto~~ instrument subsystems into the ROPE Experiment. ✓

Southwest Research Institute (SwRI) will be responsible, for the development of all the other Experiment units, [illegible] five (5) SPES analyzer units, Two (2) High voltage units (HVU's), one (1) Central electronics package (CEP), and one (1) floating high voltage system (FS).

3.2 Integration and Test Responsibilities

NASA, Marshall Space Flight Center will be responsible for:

- ✓ the complete Experiment during the Experiment level qualification testing,
- ✓ the integration of the different subsystems composing the Experiment at Experiment level,
- ✓ all test activities up to Experiment delivery,
- ✓ providing integration and test procedures and prefered sequences for Experiment integration and test onto TSS-S to be used by the Integrator during such activities, and
- ✓ indicating an Experiment deputy representative to be present during the Intergrator managed activities.

Note: After Experiment delivery all integration and test activities will be performed by an Integrator team, under its management, according to Experimenter supplied procedures and in presence of Experimenter representatives.

3.3 Key Personnel

Principal Investigator: Dr. N.H. Stone / ES53
Space Science Laboratory
NASA/MSFC
Huntsville , AL 35812
Phone : (205)544-7642
(Home): (205)536-9339
Telex : 594416
TWX : (205)544-5848

Contact at SwRI : Dr. J.D. Winningham
Southwest Research Institute
San Antonio, TX 78284
6270 CULEBRA
Phone : (512~~)684-5111 / ext. 3075~~ 522-3075
(Home): (512) 695-3736
TWX : (512)684-7523
TELEFAX: (512) 647-4325
TELEX: 767357

Other Co-Investigators:

- NASA/MSFC, Huntsville, AL : C.R. Baugher, II ✓
- NASA/GSFC, Greenbelt, MD : L.H. Brace ✓
- CNR/IFSI, Frascati, Italy : M. Dobrowolny ✓
- Camel Research Center, Santa monica, CA : D.S. Intriligator ✓
- U. of Alabama, Huntsville, AL : S.T.WU, N. Singh ✓
- SwRI, San Antonio, TX : J.L. Burch, C. Lin, ✓ N. Saflekos ✓
- U. of Michigan, Ann Arbor, MI : G.R. Carignan, U. Samir ✓
- Utah State U., Lcgan, UT : R.W. Schunk, ~~N. Singh~~ ✓

4.0 BRIEF EXPERIMENT DESCRIPTION

4.1 Scientific Objectives

The scientific objective of the ROPE Experiment is to study the interaction that occurs when a large conducting body moves through a collisionless space plasma at supersonic sub-Alfvénic speeds. The effects of this interaction are many and complex and its nature may vary greatly, depending on the characteristics of the body and the plasma.

From the practical point of view, this Experiment deals primarily with the environmental plasma dynamics of the TSS and its ability to collect an electrical current from the ionosphere. In particular, these effects include:

a) The characteri~~c~~stics of the high voltage plasma sheath.
b) The possible anomalous ionization of ambient nutrals within the sheath for high Satellite potentials.
c) Plasma waves and instabilities generated in the plasma sheath and wake by the motion of the Satellite.

In addition, preliminary data can show the formation of double layers at large Tether currents and the nature of the Satellite near wake.

Extrapolations of our understanding of the planetary magnetospheres to astrophysical phenomena, such as pulsars, are made under the assumption that the basic physical processes relevant to the phenomena in the solar system are the same, in certain cases, as those involved in astrophysics. Similarily, the plasma dynamics of bodies in collisionless laboratory plasmas has been successfully applied for some conditions to the interaction of artificial satellites with the Earth's ionosphere. Therefore, it is submitted that the same principles of qualitative simulation can be invoked to extrapolate the resultes from this Experiment, conducted in the Earth's ionosphere, to plasma phenomena that occur elsewhere in the solar system.

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4.2 Experiment Functional Description

The ROPE Experiment consists of ~~14~~ 11 ~~separate~~ units. A functional block diagram is shown in Figure 4.2.1.

Three of these, the DIFP-S and SPES-1 and 2 are combined into a single boom-mounted sensor package (LBMSP).

The Soft Particle Energy Spectrometer (SPES) package consists of ~~8~~ 5 electrostatic analysers: two mounted on the Satellite fixed boom, and ~~six~~ three on the Satellite surface as seen in Figure 4.2.2. Each SPES analyser measures the electron and ion energy distribution functions and the local space potential.

three

The Differential Ion Flux Probe with the sensor (DIFP-S) mounted on the Satellite fixed boom and measuring ion flux direction, energy, temperature and current density, and its electronics (DIFP-E) mounted inside the Satellite.

s

The two High Voltage Units (HVU1 & HVU2) supply high voltage to the ~~4~~ 5 SPES analysers.

The Central Electronics Package (CEP) controls the overall Experiment.

The Floating Supply (FS) supplies a bias voltage (0 to 500 V) ~~low voltage~~ to SPES1 & 2 and to DIFP-E, and isolates them and the HVU2 from the CEP.

Physically, the DIFP-E unit has replaced the following baselined three units:
- the Power Conditioning Unit (PCU),
- the Optical Isolator (OI), and
- the HILP.

The change in the baseline is still under evaluation before possible acceptance.

??

This is not a history book !!!

Delete

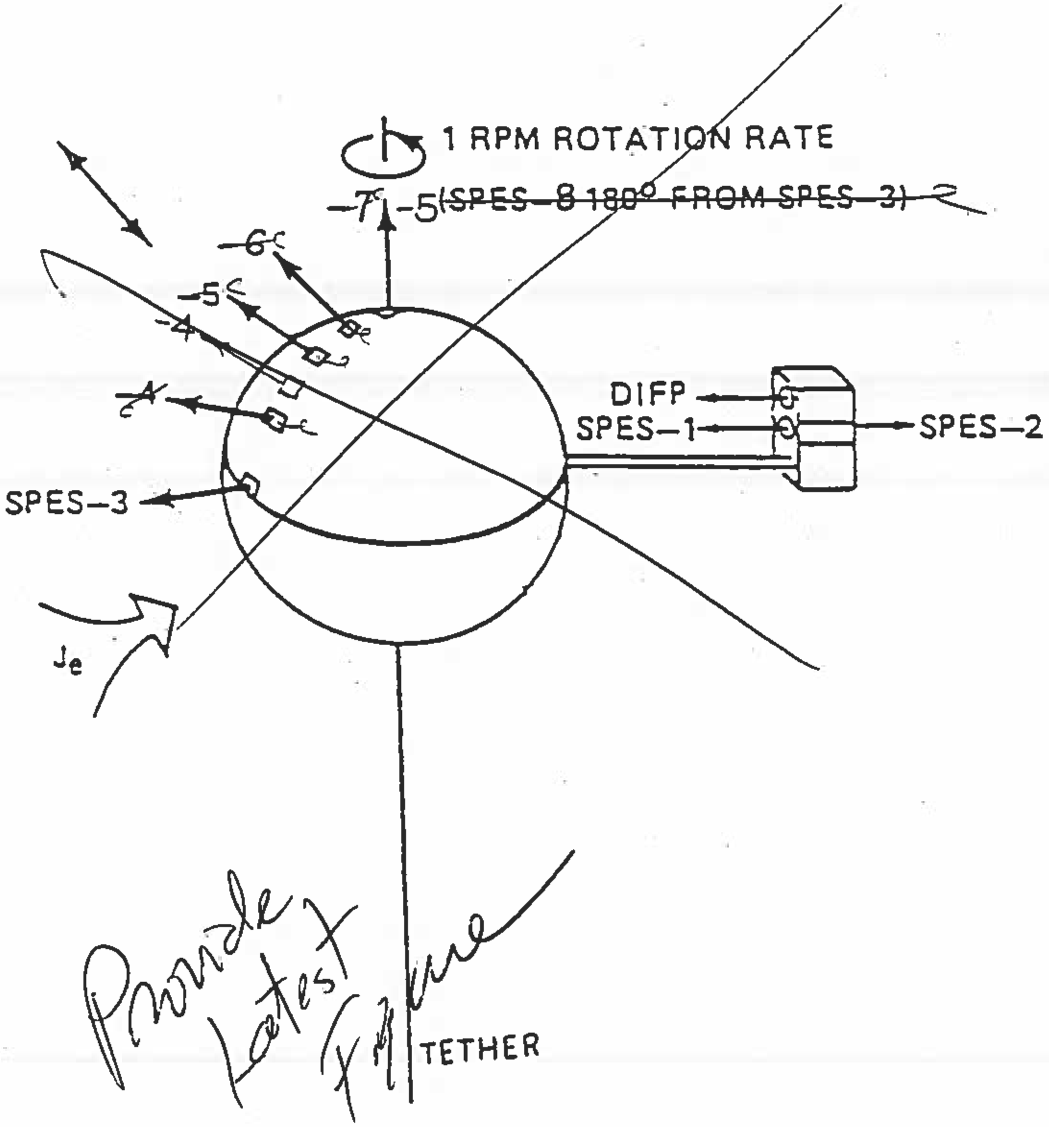
Figure 4.2.1: Functional Block Diagram

TO BE PROVIDED BY THE EXPERIMENTER

Provide latest Fig.

16

Figure 4.2.2: Sketch of the Sensors Arrangement



Provide latest Figure

12

4.3 Instrumentation

The ROPE Experiment consists of nine (9) ~~twelve (12)~~ separate deliverable units:

Each of the Soft Particle Energy Spectrometers SPES-1 to SPES-~~8~~ 5 is an electrostatic analyzer that measures the energy distributions of both ions and electrons independently and simultaneously from 1 eV to 10 KeV. This is accomplished by means of a pair of parabolic deflection plates. Measurements of the electron and ion energy distributions simultaneously allows the local space potential to be determined. A SPES analyzer module schematic is seen in Figure 4.3.1.

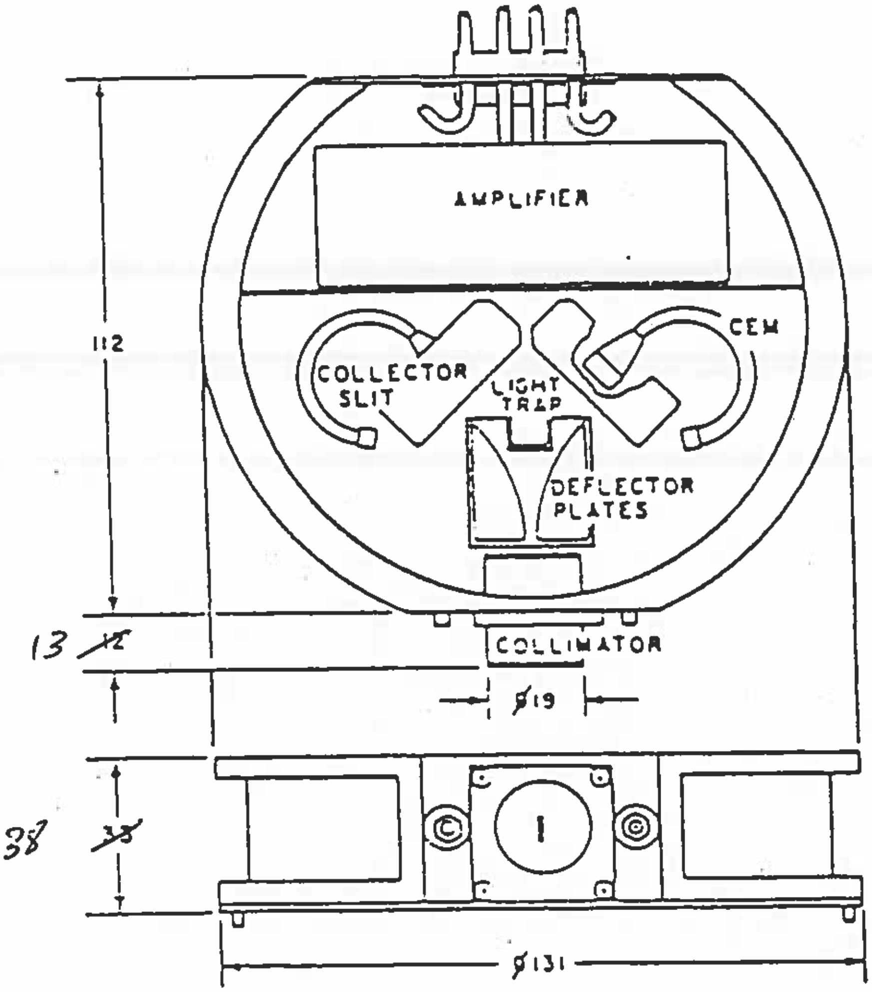
The Differential Ion Flux Probe sensor (DIFP-S) makes differential measurements of the ion flux vector; i.e. the angle of incidence and drift energy corresponding to the mean velocity of an ion stream, and the distribution of thermal motion superimposed on the drift. It is designed specifically to measure disturbed ion flow fields in the plasma wakes of supersonic bodies, where multiple ion streams are known to exist and can converge simultaneously to a point of the wake. The DIFP-S measures the ion flux direction, energy, temperature, and current density. It is formed with an electrostatic deflection system mounted in front of a standard planar ~~plasma~~ retarding potential analyzer (see Figure 4.3.2).

- SPES-1, SPES-2 and DIFP-S sensors form one deliverable unit, the fixed Boom Mounted Sensor Package (BMSP).
- SPES-3 to SPES-~~8~~ 5 sensors are mounted on the Satellite skin, five equidistant on a meridian line of the Payload Module from the pole to the equatorial plane, and one at 180° from the equatorial plane mounted SPES.
- The two High Voltage Units (HVU1 & HVU2) supply high voltage to the ~~8~~ 5 SPES analysers.
- The Central Electronic Package (CEP) controls ~~the~~ the entire Experiment and provides the power, ~~and~~ data ~~and~~ and command interface to the satellite.
- The Floating Supply (FS) contains a 35-watt, ~~-5 kV~~ -500V programmable power supply, an isolated low voltage power supply, isolated remote interface electronics for SPES-1, -2 and DIFP-E, and electro-optic couplers for interface with CEP.
- The DIFP-Electronics (DIFP-E) contains the electronics of the DIFP-S (i.e., low voltage ~~power~~ supplies, sweep potential generator, logic and data handling system).

No — should be offset approximately 45° from the S-Band Antenna.

-14-

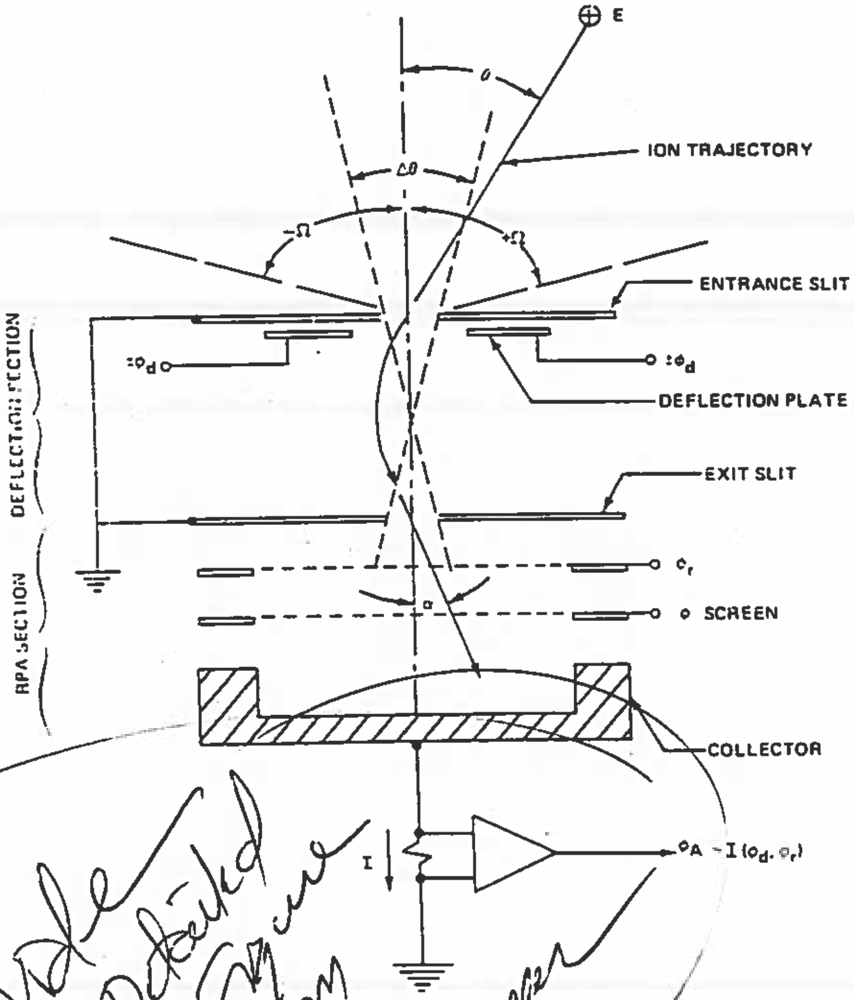
Figure 4.3.1: SPES Analyser Module Schematic



Dimensions in millimeter.

SwRI
Provide
Drawing

Figure 4.3.2: DIFP-S Functional Schematic



Provide Detailed figure from RSI paper

4.4 Modes of Operation

TO BE PROVIDED BY THE EXPERIMENTER

TBD ~ later in development phase

4.5 Measurement Accuracy

Sensor	Measurement		Accuracy
SPES	Electron Density	(Ne)	5 %
SPES	Electron Energy	(Ee)	~~32~~ % 16
SPES	Ion Current Density	(Ji)	5%
SPES	Space Potential	(Qs)	16%
DIFP-S	Ion Current Density	(Ji)	
DIFP-S	Ion Energy	(Ei)	5 %
DIFP-S	Ion Temperature	(Ti)	
DIFP-S	Ion Angle of Attack	(Oi)	10 %

ck values &
provide missing data

5.0 LAY-OUT DRAWINGS

5.1 Lay-out drawings: Satellite

5.1.1 Satellite Reference Axes

5.1.2 Payload Module Exploded View (Boom not shown)

5.1.3 Satellite Configuration

5.1.4 Earth and Sun Sensors Lay-out

5.1.5 Sun Sensor Field of View

5.1.6 Earth Sensor Field of View

5.1.7 Satellite Position in the Orbiter Cargo Bay

5.1.8 Satellite External Configuration

5.2 Lay-out Drawings: Experiment

5.2.1a Experiment ROPE Equipement Lay-out (side view)

5.2.1.b " " " " - (Top view)

Figure 5.1.1 : Satellite Reference Axes

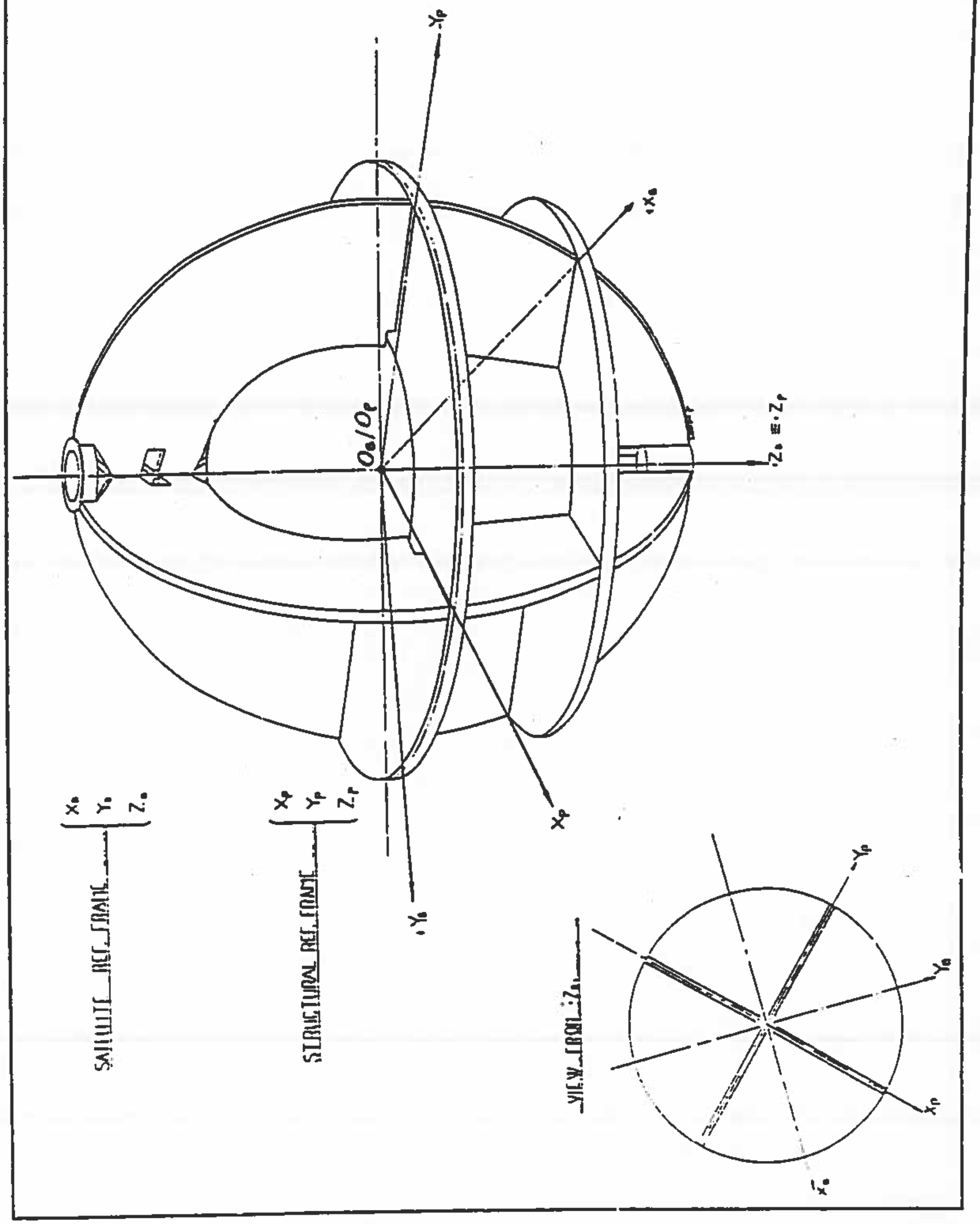


Figure 5.1.2: Payload Module Exploded View
(Booms not shown)

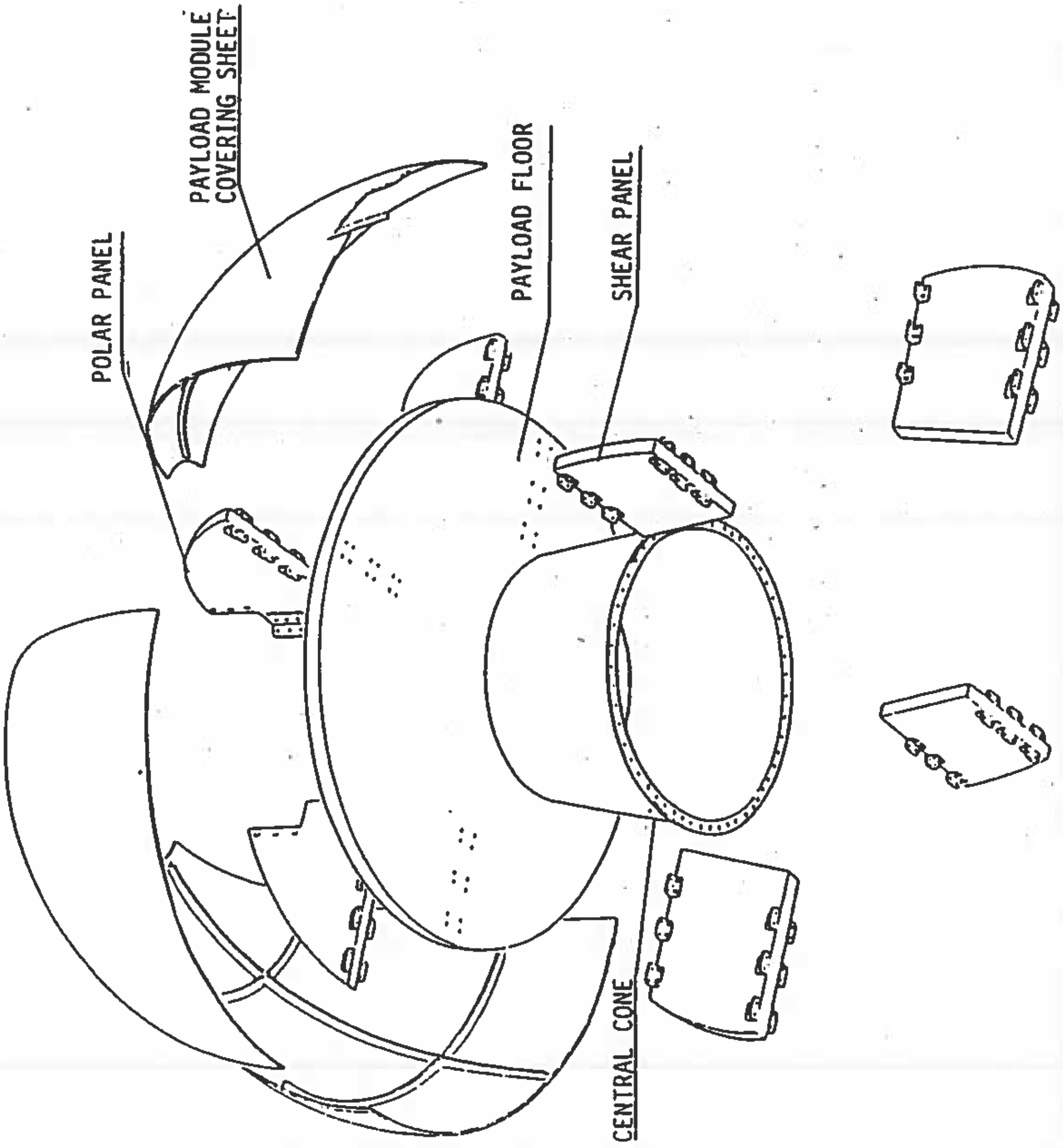
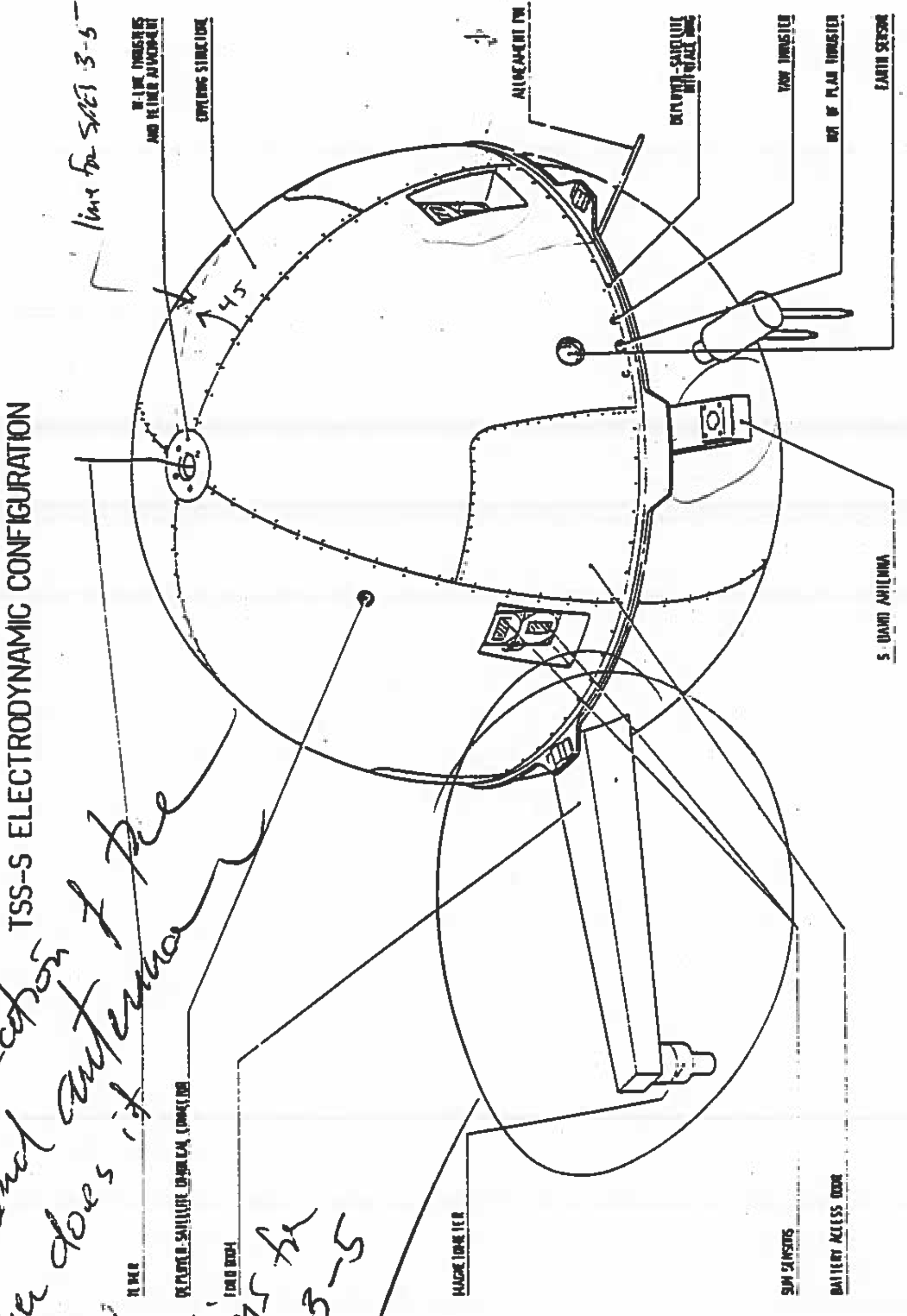


Figure 5.1.3: Satellite Configuration



line for SPES 3-5

This figure does not reflect the current Fixed boom instrumentation or the location of the S Band antenna

← Neither does it show the locations for SPES 3-5

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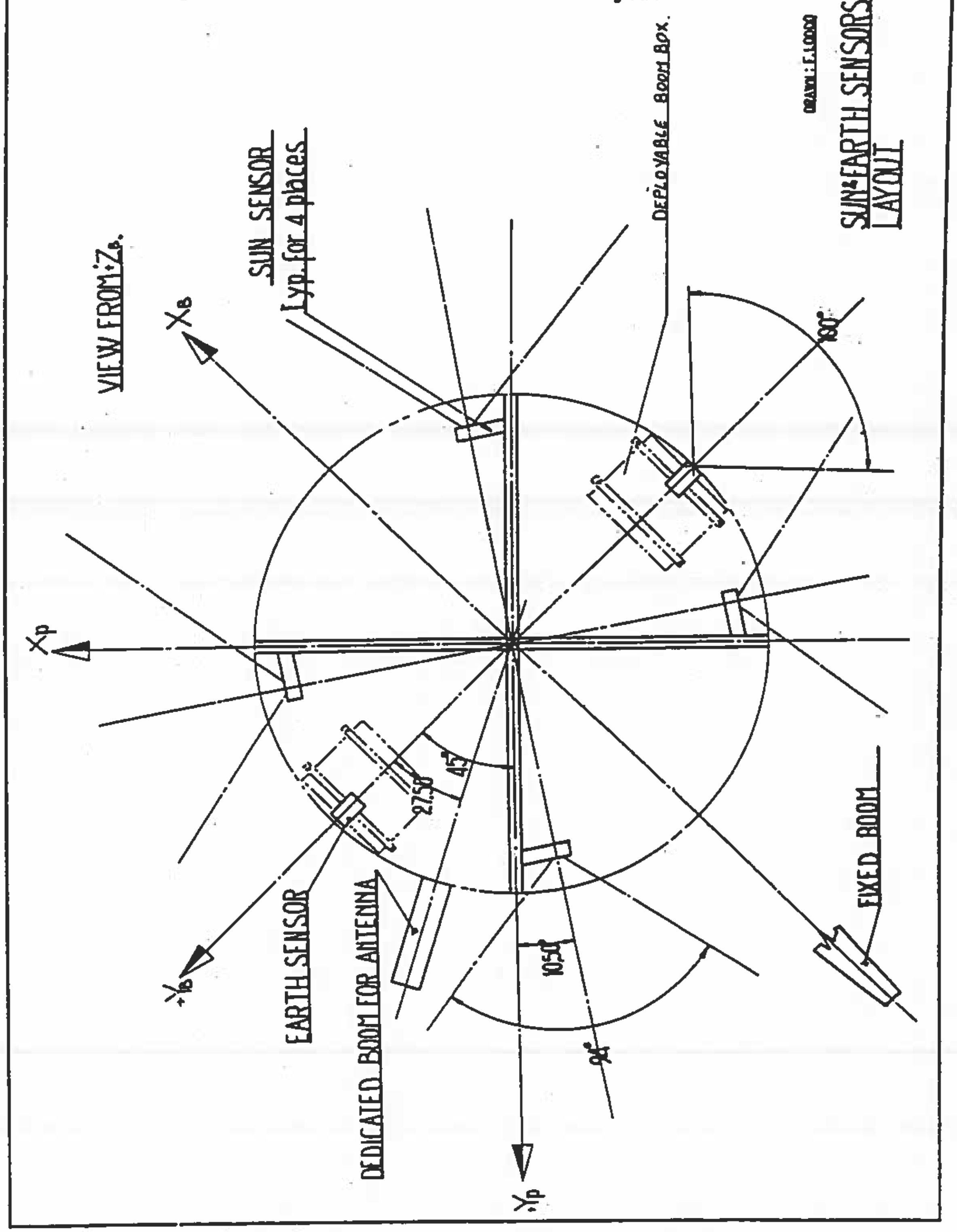
Figure 5.1.4: Earth and Sun Sensors Layout



S-Band Antenna
not properly located.

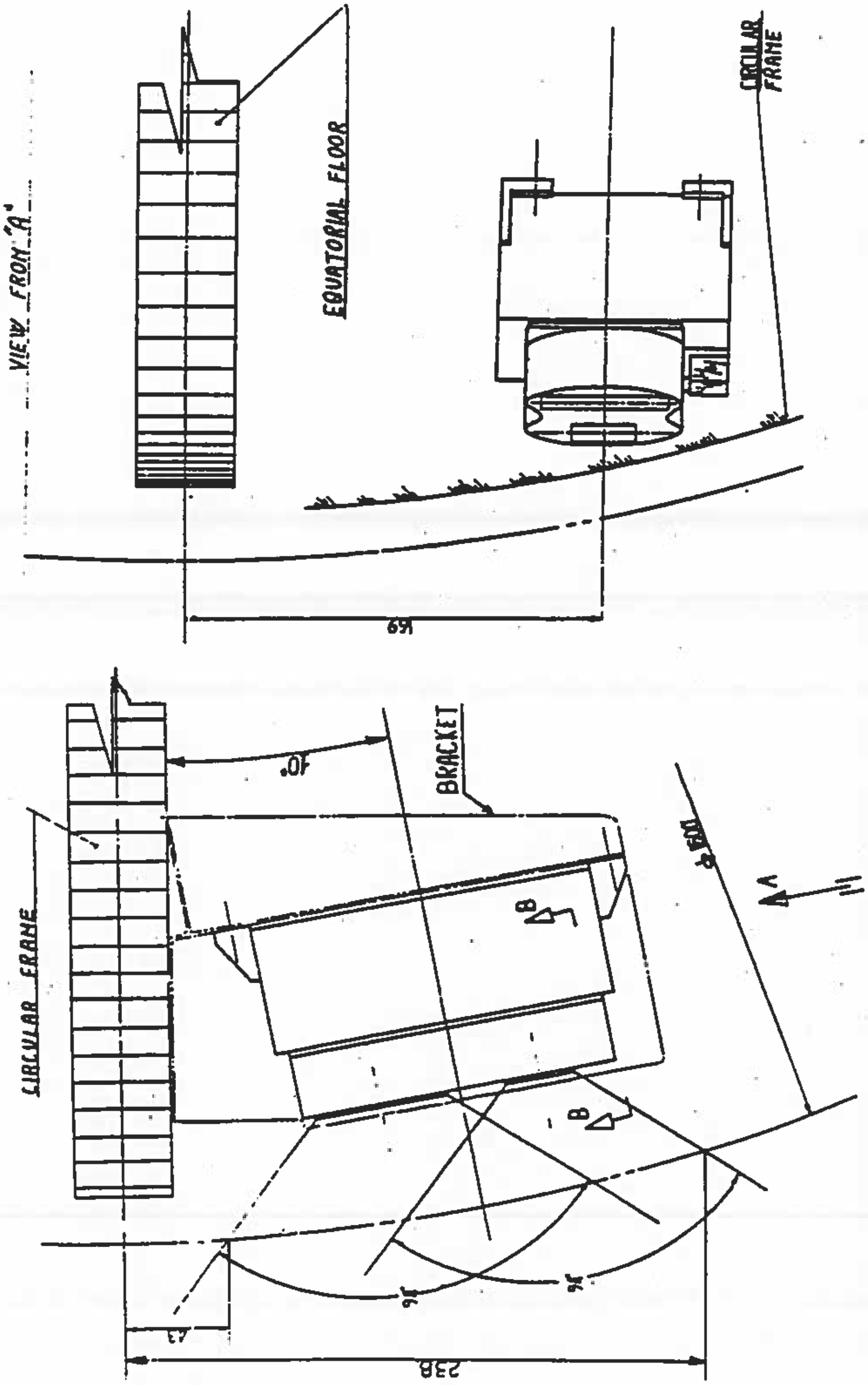


Figure 5.1.5: Sun Sensor Field of View

Figure 5.1.6: Earth Sensor Field of View

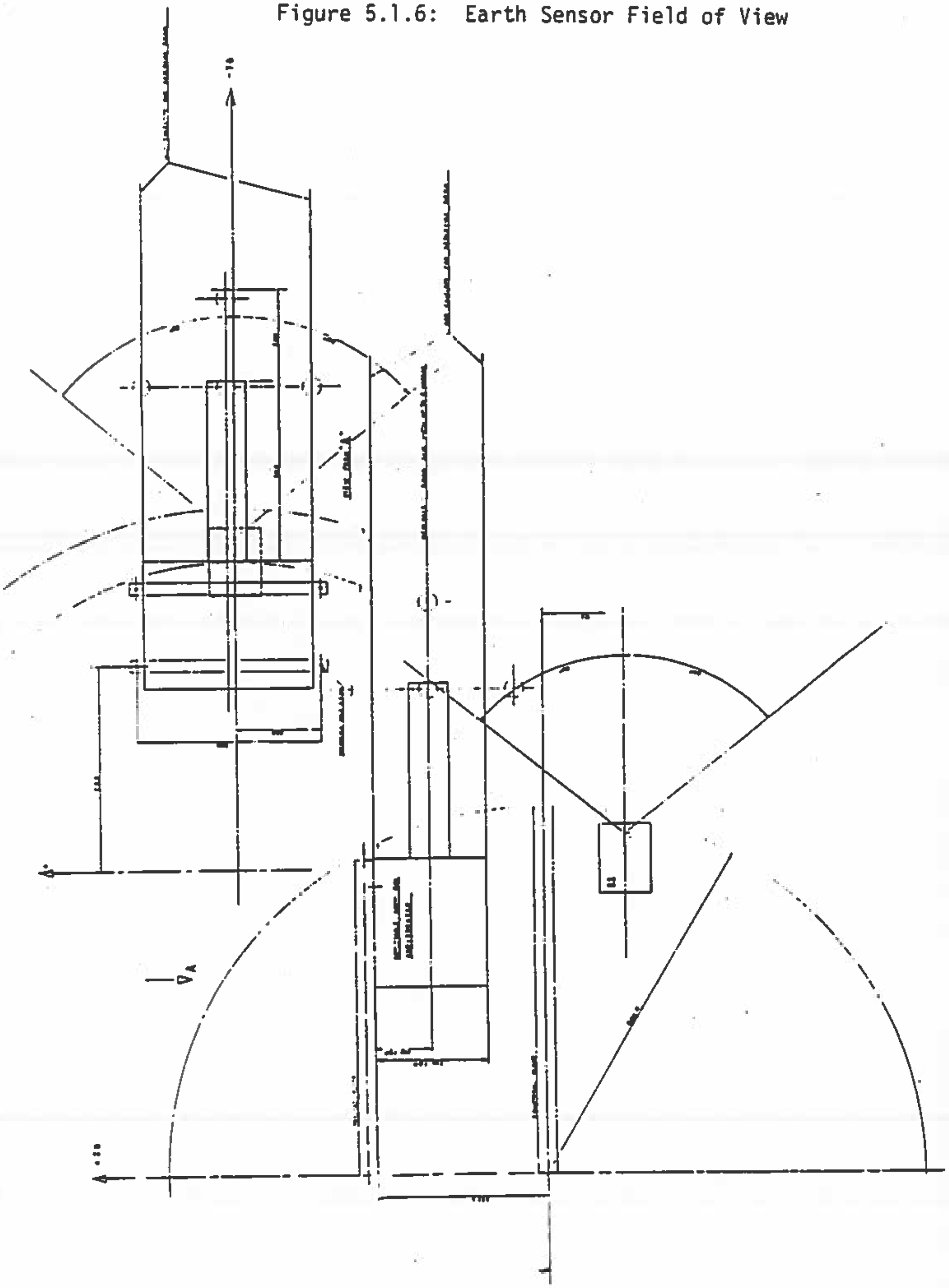


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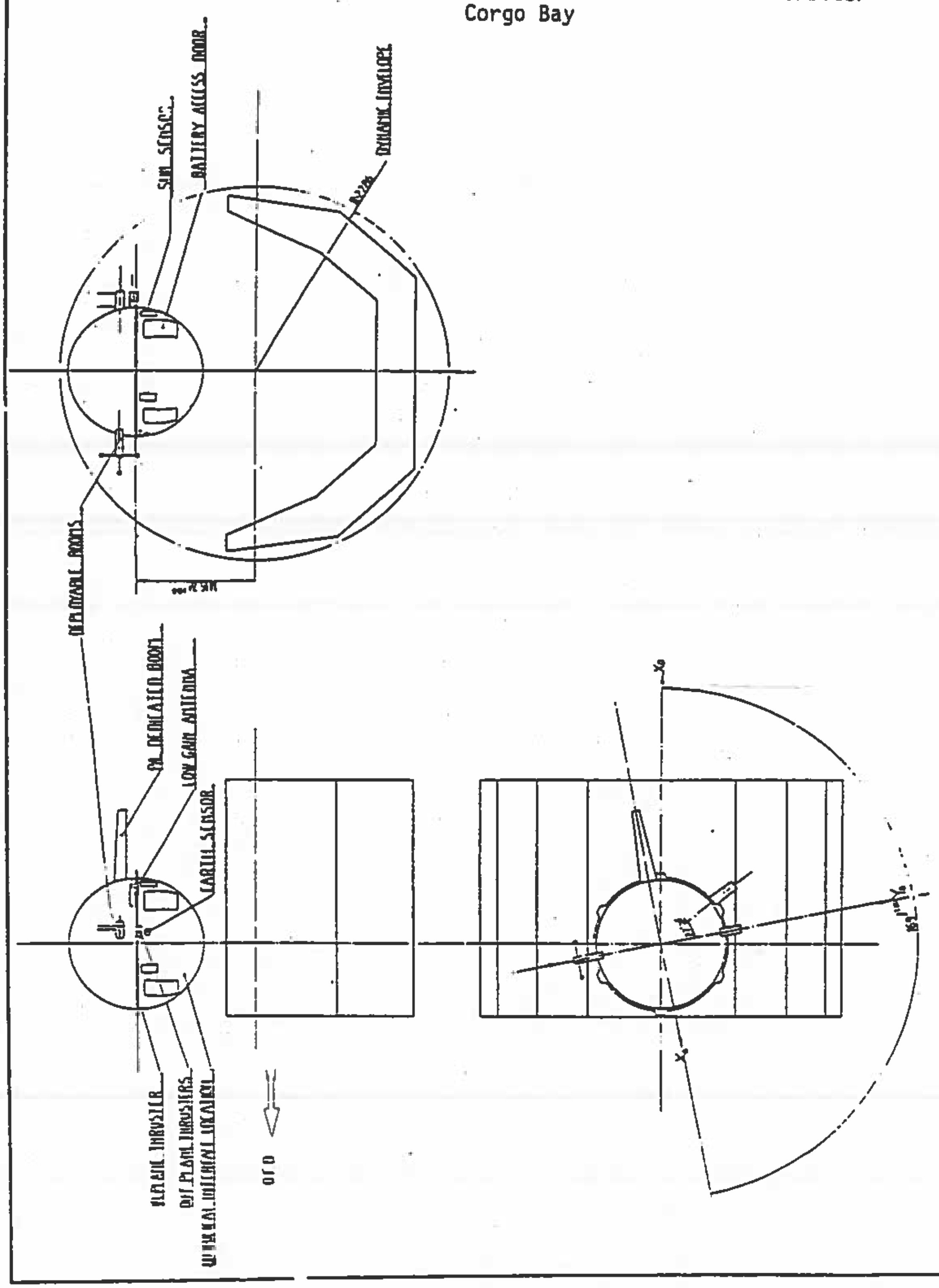
Figure 5.1.7: Satellite Position in the Orbiter Corgo Bay



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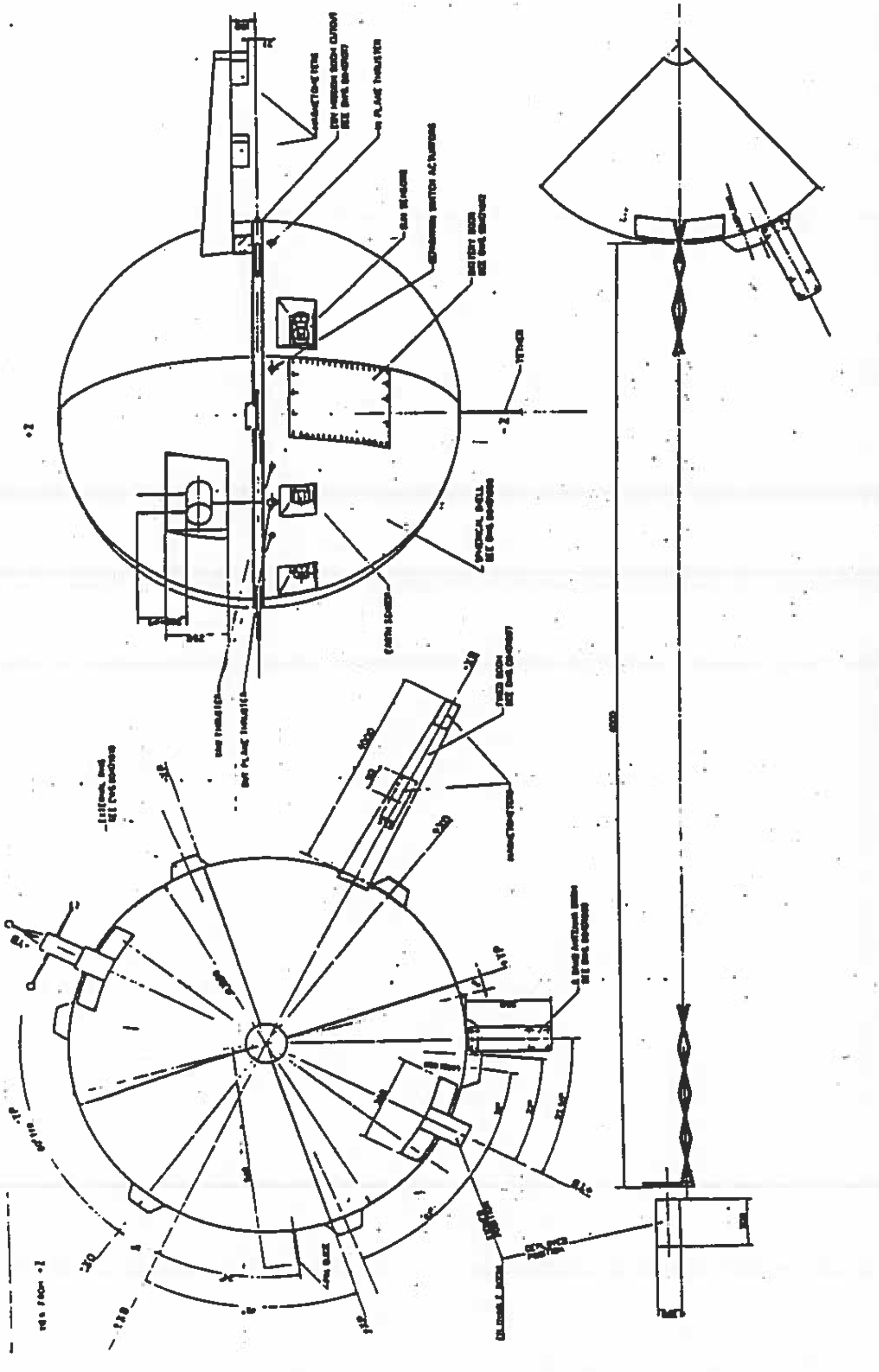

Figure 5.1.8: Satellite External Configuration

S-Band Antenna improperly located Again – The whole Fixed Boom arrangement is incorrect. No SPES-3 to 5

Figure 5.2.1a Experiment ROPE Equipment Lay-out

Does not give correct location of magnetometer sensors — they can not be in FOV of SPES-2 or DIFF-S

Extent of attachment BMSP are unclear

BOOM ASSEMBLY SKETCH

THIS ASSEMBLY GEOMETRY WILL BE TAKEN INTO ACCOUNT IN THE STATIC AND DYNAMIC ANALYSES

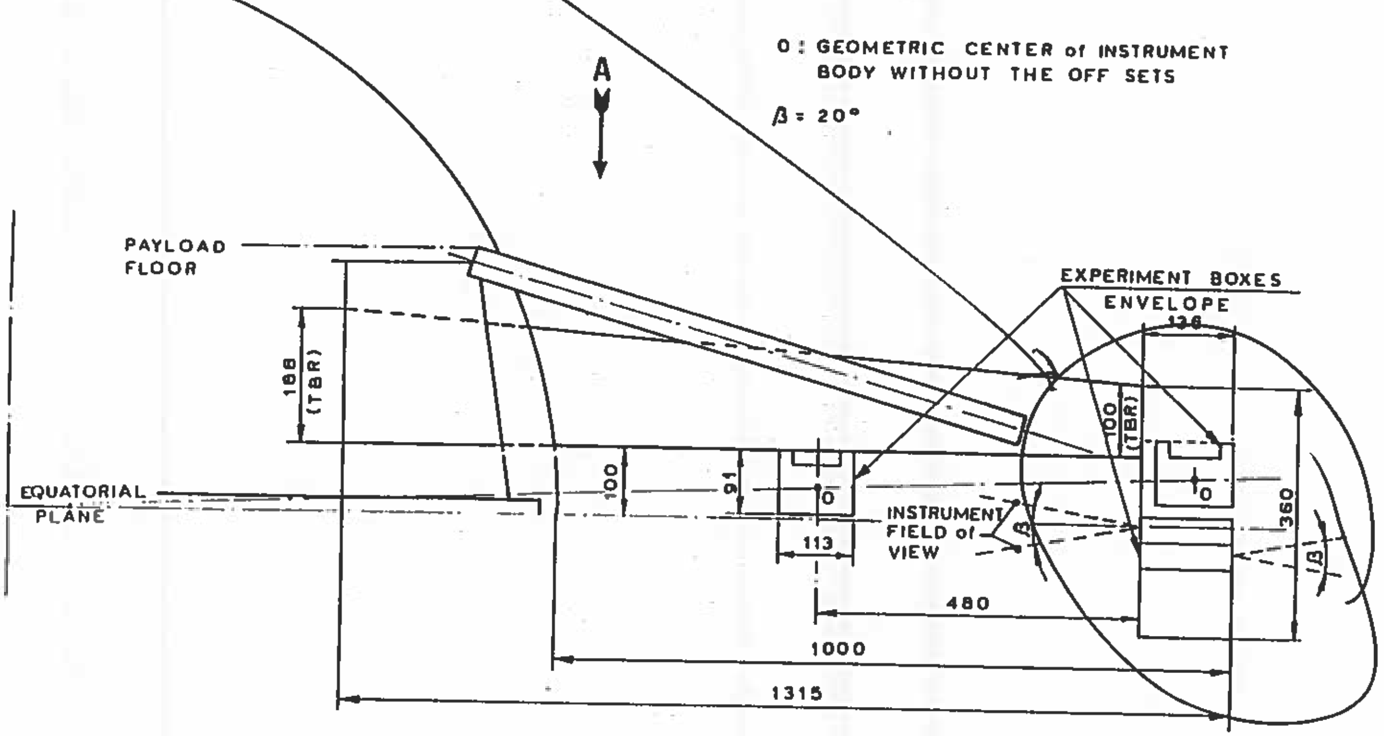

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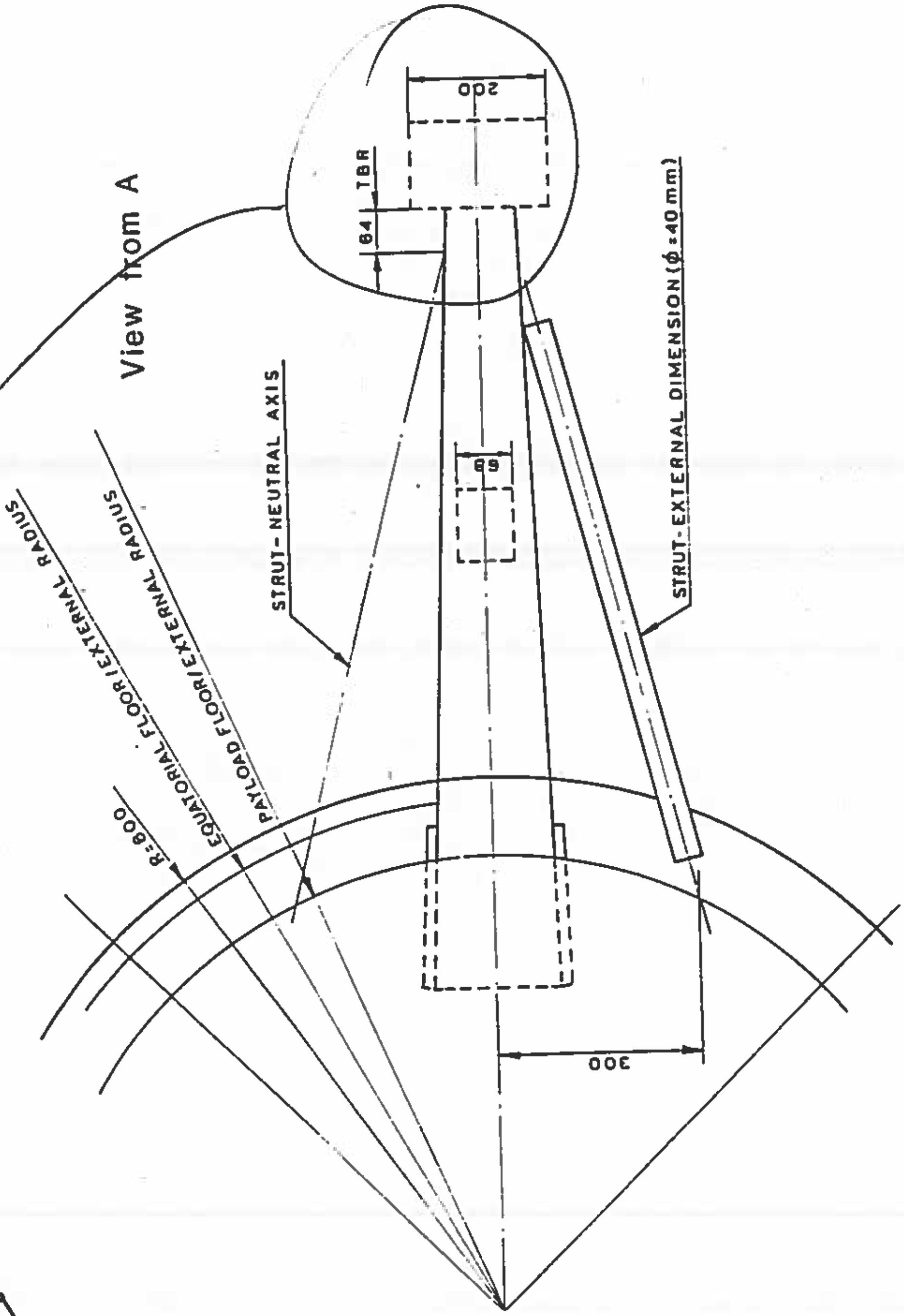
Figure 5.2.1b Experiment ROPE Equipment Lay-out



Attachment details unclear — is the dashed portion boom? or instruments?

There needs to be some detailed discussions w/ Bill Chisholm, ESG3.

Again: This is not a history document!! We Have No "current" baseline until this doc is agreed to. This is "BS"!

6.0 MECHANICAL INTERFACES

6.1 Units Identification and Drawings

6.1.1 Units Identification and Location

See Figure 6.1.1.1. This Experiment configuration, being a change to the baseline, is under evaluation befor possible acceptance.

6.1.2 Bondstrap Attachment

The bonding strap attachment point of each unit shall comply with the requirements contained in TS-SR-AI-005, 4.12, and with the following requirements:

- It shall be placed on the same side of the unit as the connectors to allow easy integration.
- The bonding stud shall be placed within a band centered at 15 ± 5 mm from the unit's base.
- The bonding stud must be threaded starting 1 mm from its root and shall be provided by the Experimenter with its washer and nut.
- The bonding stud shall be 10 mm long.
- The nut shall be self-locking and 4 mm high (standard self-locking m4 nut, e.g. LN9161-0 4 m).

See Figure 6.1.2.1 for other details.

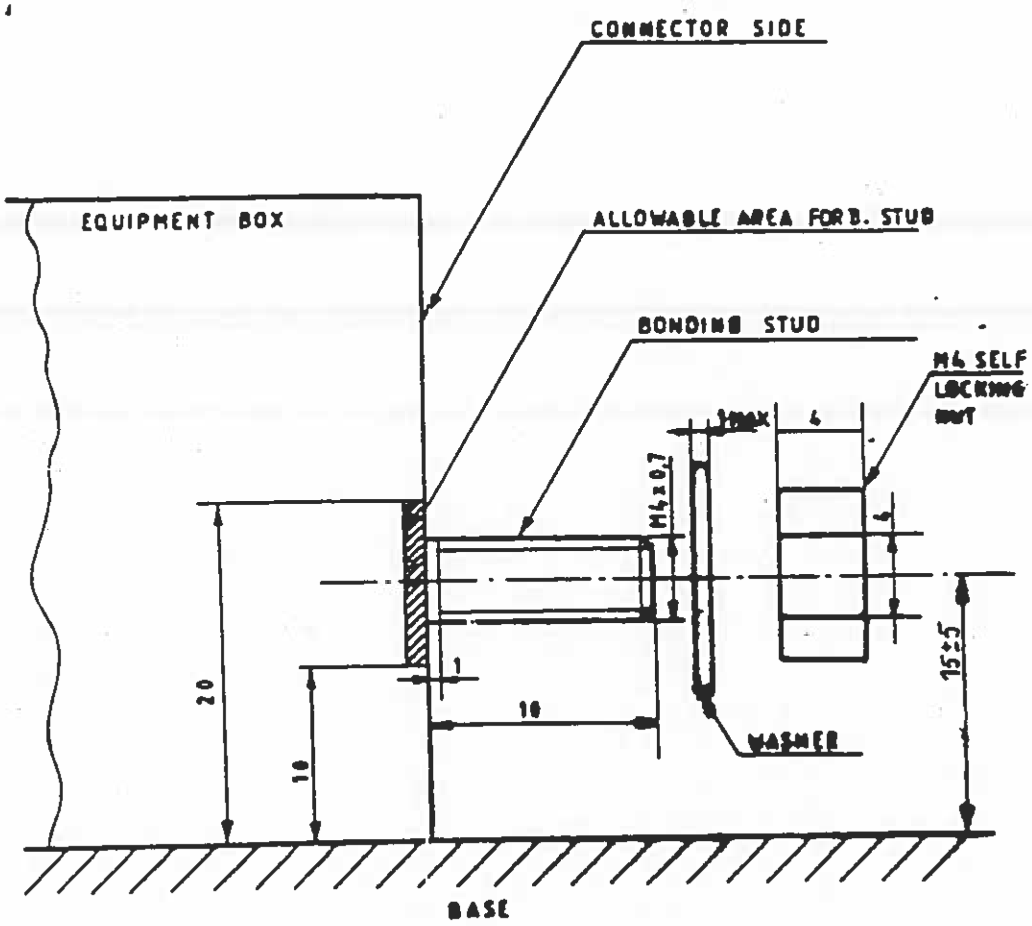
Figure 6.1.1.1: Units Identification and Location (*)

Unit Code	Acronym	Function	Location
1801 1802	SPES-1 SPES-2	Soft Particle Energy Spectrometers	On Fixed Boom Tip
1803 ~~to~~ 180~~8~~5	SPES-3 to SPES-5	Soft Particle Energy Spectrometer	On S/C Skin Viewing Space
1809	DIFP-S	Differential Ion Flux Probe - Sensor	On Fixed Boom Tip
1810	HVU1	High Voltage Unit	Inside S/C
1811	HVU2	High Voltage Unit	Indide S/C
1812	CEP	Central Electronics Package	Inside S/C
1813	FS	Floating Supply	Inside S/C
1814	DIFP-E	Differential Ion Flux Probe - Electronics	Inside S/C

(*) SPES-1, SPES-2 and DIFP-S sensors form one deliverable unit, the TSS-S fixed Boom Mounted Sensor package (BMSP)

Figure 6.1.2.1 Bonding Strap Attachment

NOTE: SPESS connector panel will not support a stud. AER can bond strap under one installation screws.



BONDING STRAP ATTACHEMENT STUD

Again: This is not appropriate. This doc. is to Establish a baseline!

6.1.3 Units Mechanical Drawings

See Figures 6.1.3.1 to 6.1.3.8 . The new mechanical envelopes (different from the baseline) are under evaluation before possible acceptance.

The following mechanical interface (assembly) drawings will be provided by the Experimenter.

- 42A31340 for 1810 (HVU1) unit.
- 42A31341 for 1811 (HVU2) unit.
- 42A31342 for 1813 (FS) unit.
- 42A31343 for 1812 (CEP) unit.
- 42A31344 for 1814 (DIFP-E) unit.
- 42A31345 for 1803 to 180~~8~~5(SPES-3 to SPES-~~8~~5) units. ✓
- 42A31346 for BMPS (SPES-1, SPES-2 & DIFP-S) deliverable unit.

New Figure is available

Figure 6.1.3.9 shows ~~the crude but fairly well-sealed~~ sketches of the fixed Boom Mounted Sensor Package (BMSP). The Sketches show cables, but do not show any thermal cover, which may or may not be necessary. SPES-1 attaches to the fixed boom, SPES-2 attaches to SPES-1, and DIFP-S attaches to SPES-2. The cables must be routed to keep them out of the field of view (FOV) of the sensors. Exposed cable should be wrapped with metal braid or foil~~m~~, and bonded to the sensor structure. ✓

Figure 6.1.3.10 shown the minimum clearance and bend radius requirements for a Reynolds high voltage cable using the 167-2896 coaxial cable terminated with a 167-3770A connector. Reynolds 178-7215 high voltage wire is 1.27 mm diameter and weighs 4 grams per meter, Reynolds 167-2896 high voltage coaxial cable is 2.41 mm diameter and weighs 16 grams per meter.

Notes on figure 6.1.3.4:

1- HVU1 height is 2.50 ~~minimum and 3.50 maximum.~~

2- Quantity of Reynolds 167-3771 connectors on panel are 4 minimum and 24 maximum. Minimum clearance behind panel for harness connectors and cable bend radius is 1.55 inch.

3- Primary thermal interface is thru the 0.45 x 9.00 flanges. Remainder of base is recessed 0.005 nominal. Thermal filler probably required.

4- Flange width and mounting hole diameter set for M4 bolts with 8 mm washer as per TS-SR-AI-005, 4.9. Bight attachments are preferred for thermal contact purposes.

5- Normal length of HVU housing is 7.88 inches plus external power interconnection cable making total length 9.20 inches. The Experimenter prefers to interconnect power's inside housing for ROPE to eliminate potential high voltage problem with external cable on HVU2. It is felt that total length can be 9.00 inches but length could be increased to 9.20 inch if necessary.

6- All 25 contacts in assembly connector are used. if additional wires are added, the Experimenter will change connector to 311P407-2P-B-12 or 311P407-3P-B-12. Connector 311P409-4P-B-12 will not fit.

HVU2 size and mass will be the same as HVU1, but installation size and mass will be grater due to external high voltage isolation size and grounded cage.

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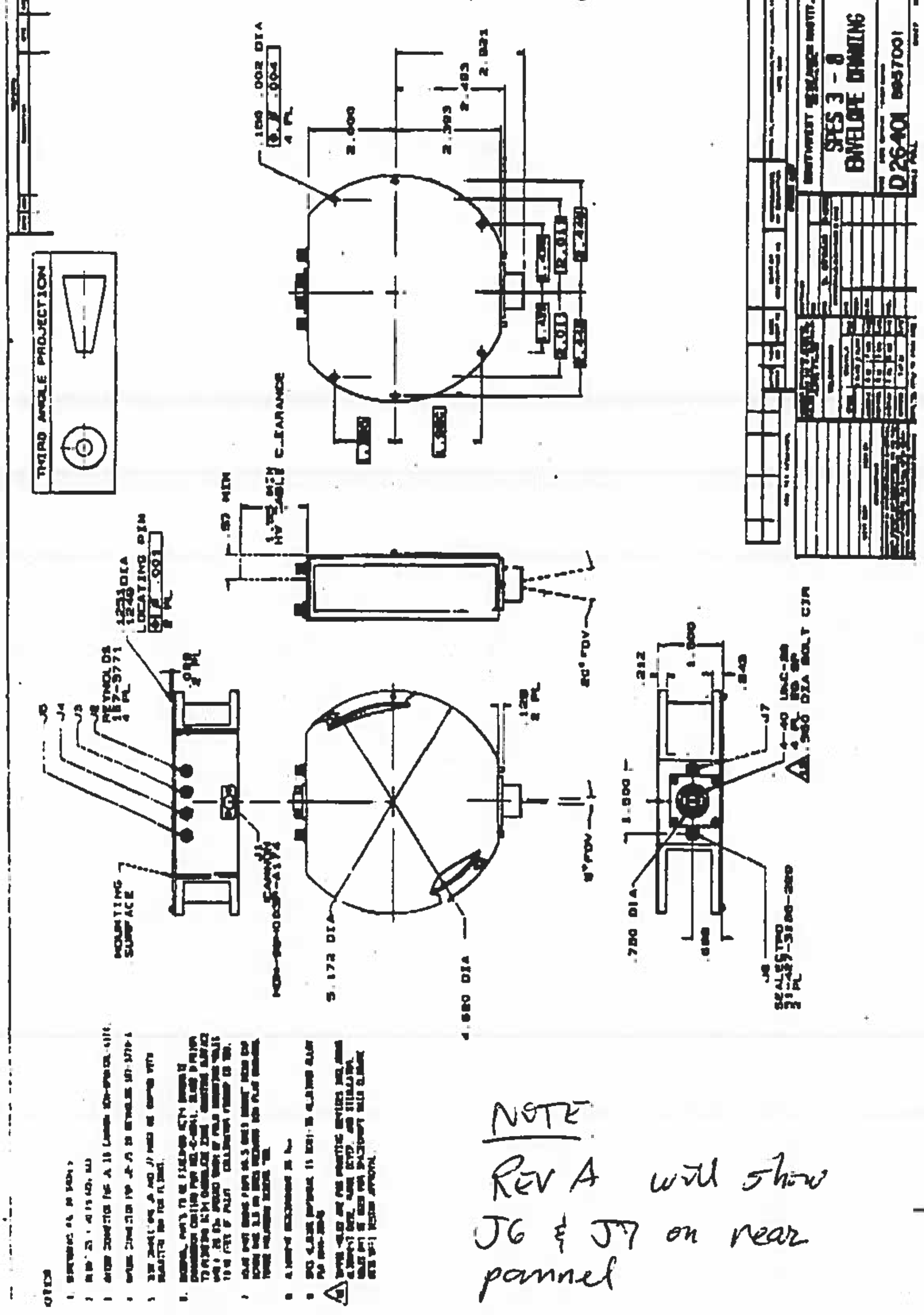
Figure 6.1.3.1: 1803 to 0~~8~~6 (SPES3 to ~~8~~5) Envelope Drawing



NOTE

Rev A will show J6 & J7 on rear pannel

Figure 6.1.3.2: 1803 to 08 (SPES3 to 8) Mounting Bracket

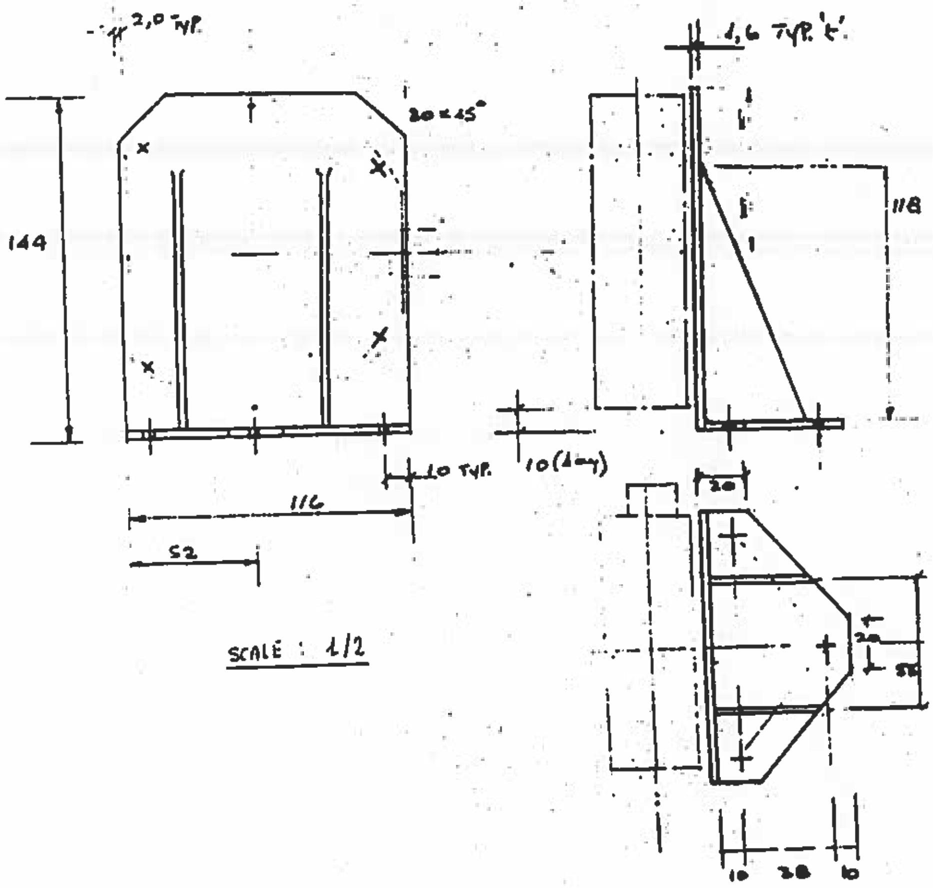


Figure 6.1.3.3: 1809 (DIFP-S) Box

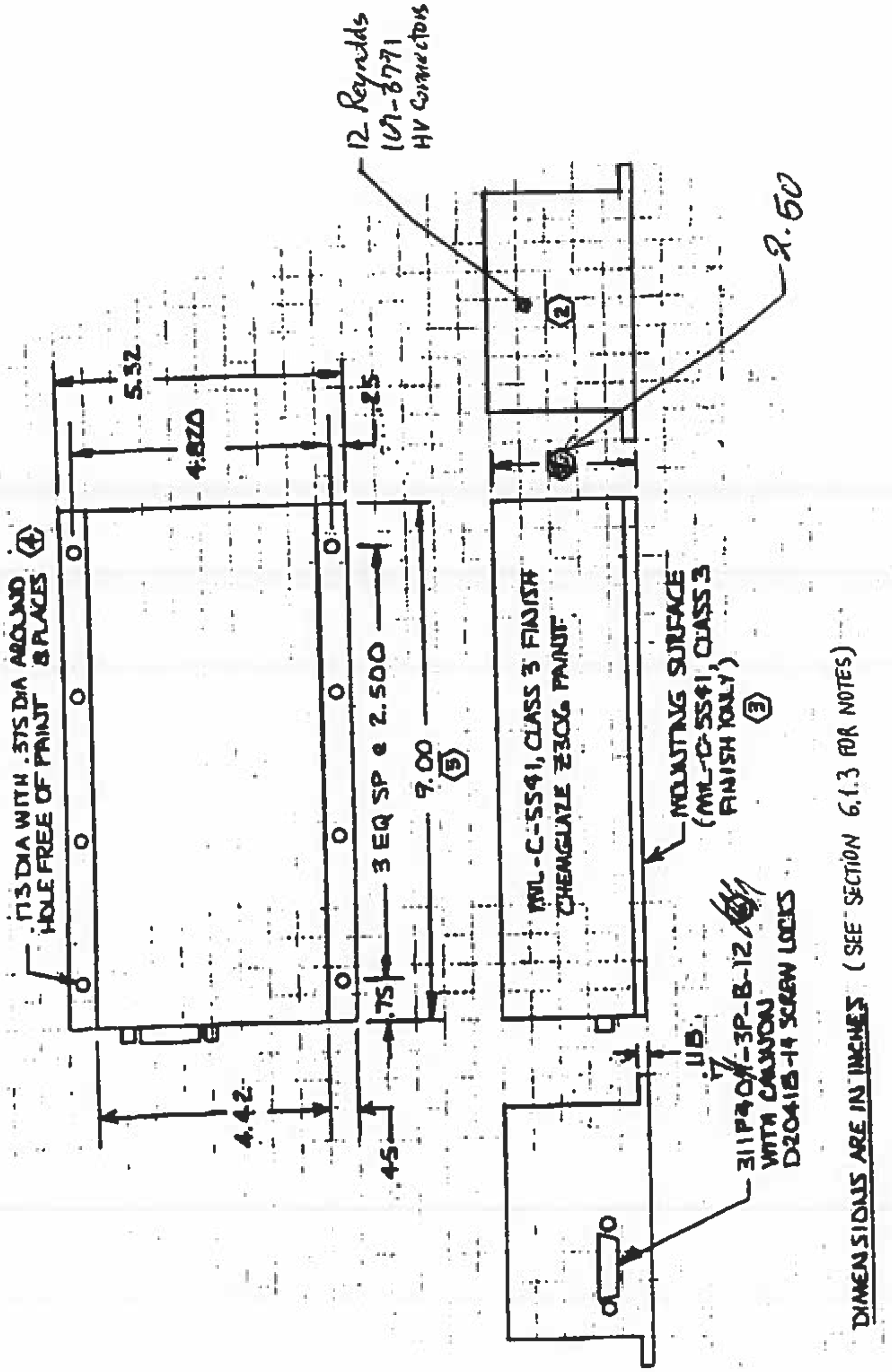
<u>TO BE PROVIDED BY THE EXPERIMENTER</u>

~~Provide Drawings.~~

NOT REQUIRED

i.e. DIFP-S exists only in BMSP

Figure 6.1.3.4: 1810 (HVU1) Box



NOTE: Envelope drawings should be available by 1 Nov 86

Figure 6.1.3.5: 1811 (HVU2) Box

TO BE PROVIDED BY THE EXPERIMENTER

Same as Hvu-1

CURRENT ESTIMATE OF CEP SIZE AND SHAPE IS SHOWN BELOW. CURRENT ESTIMATE OF WEIGHT IS ~~5.9~~ 6.4 POUNDS.

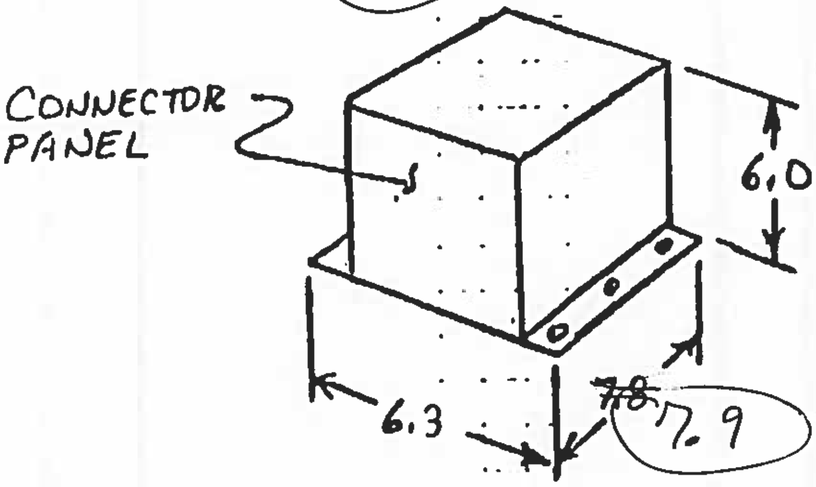


Figure 6.1.3.6: 1812 (CEP) Box

DIMENSIONS ARE IN INCHES

~~PLEASE NOTE THAT THESE ARE ESTIMATES BASED ON BEST GUESS AT OBDH INTERFACE. GROWTH, IF ANY, WILL BE IN LENGTH (7.3 INCH DIMENSION)~~

Note: Envelope drawing should be available by 1 Nov. 86.

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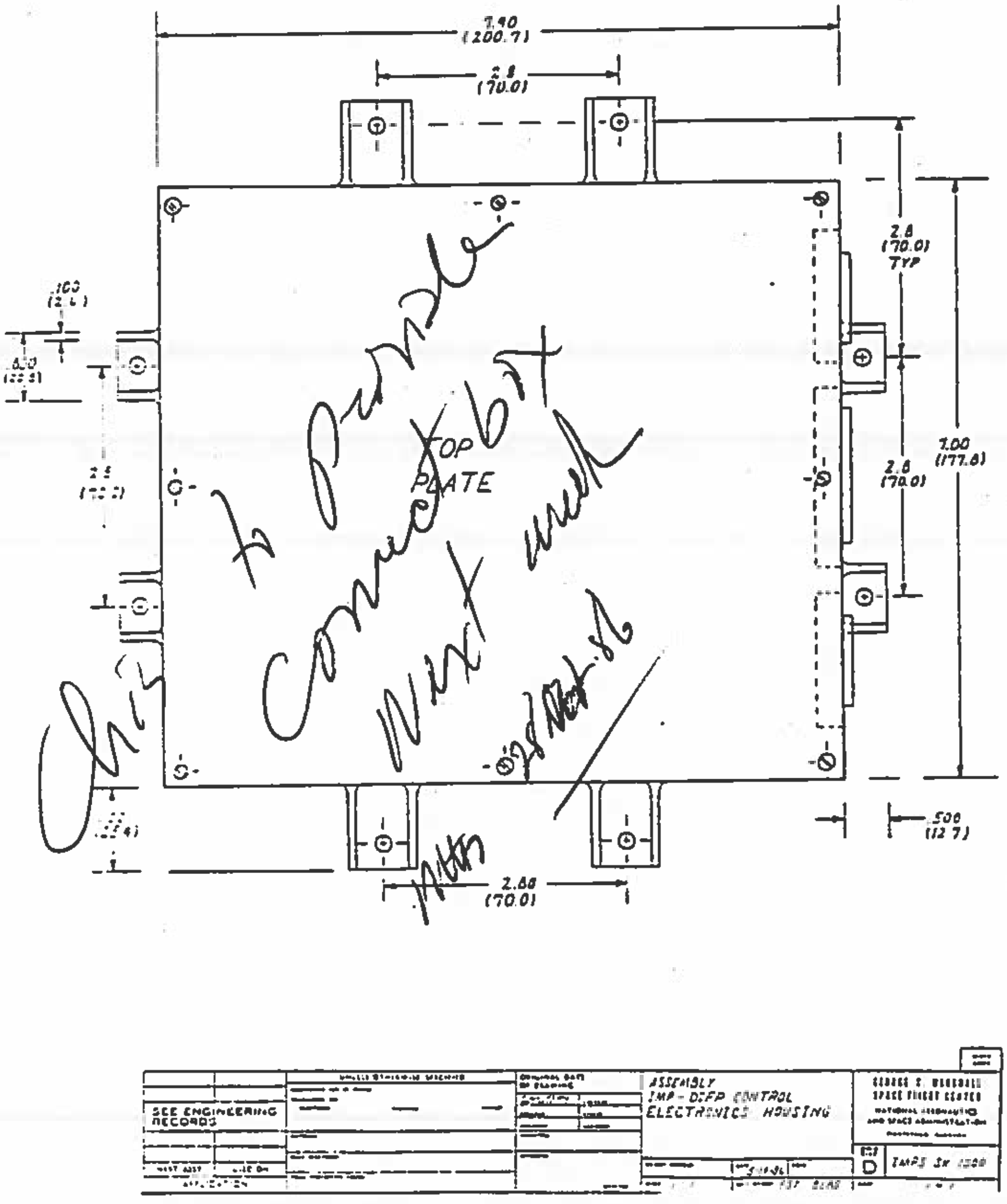
Figure 6.1.3.7: 1813 (FS) Box

TO BE PROVIDED BY THE EXPERIMENTER

TBD

Figure 6.1.3.8a: 1814 (DIFP-E) Box



Chris to provide correct bit next week
28 Oct 86

Note: ~~[illegible]~~ Correct drawing will be provided by Chisholm: before this is forwarded back.

4

Figure 6.1.3.8b: 1814 (DIFP-E) Box

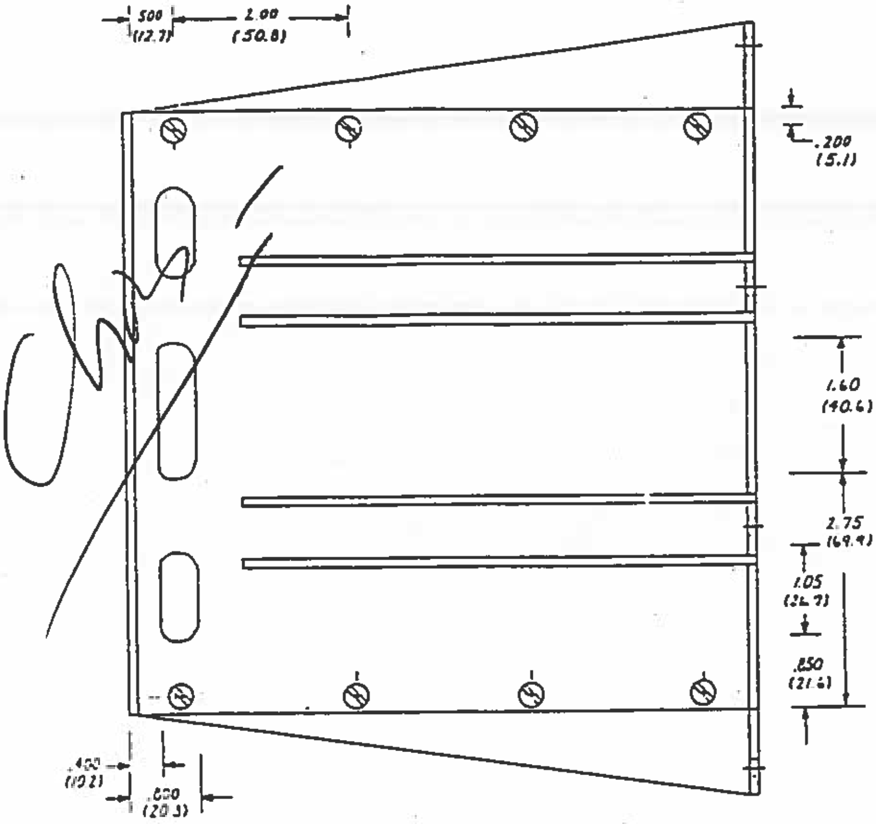


Figure 6.1.3.8c: 1814 (DIFP-E) Box

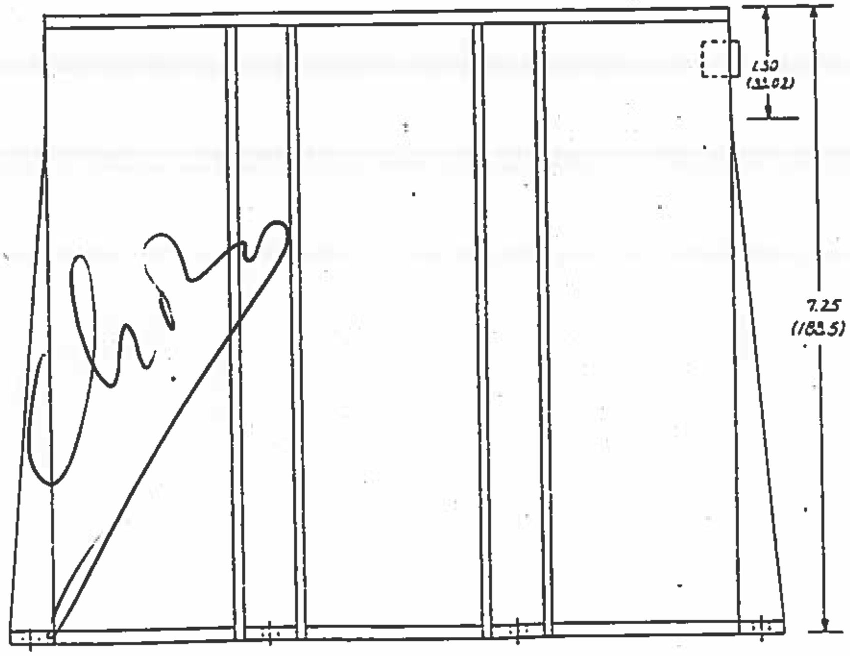


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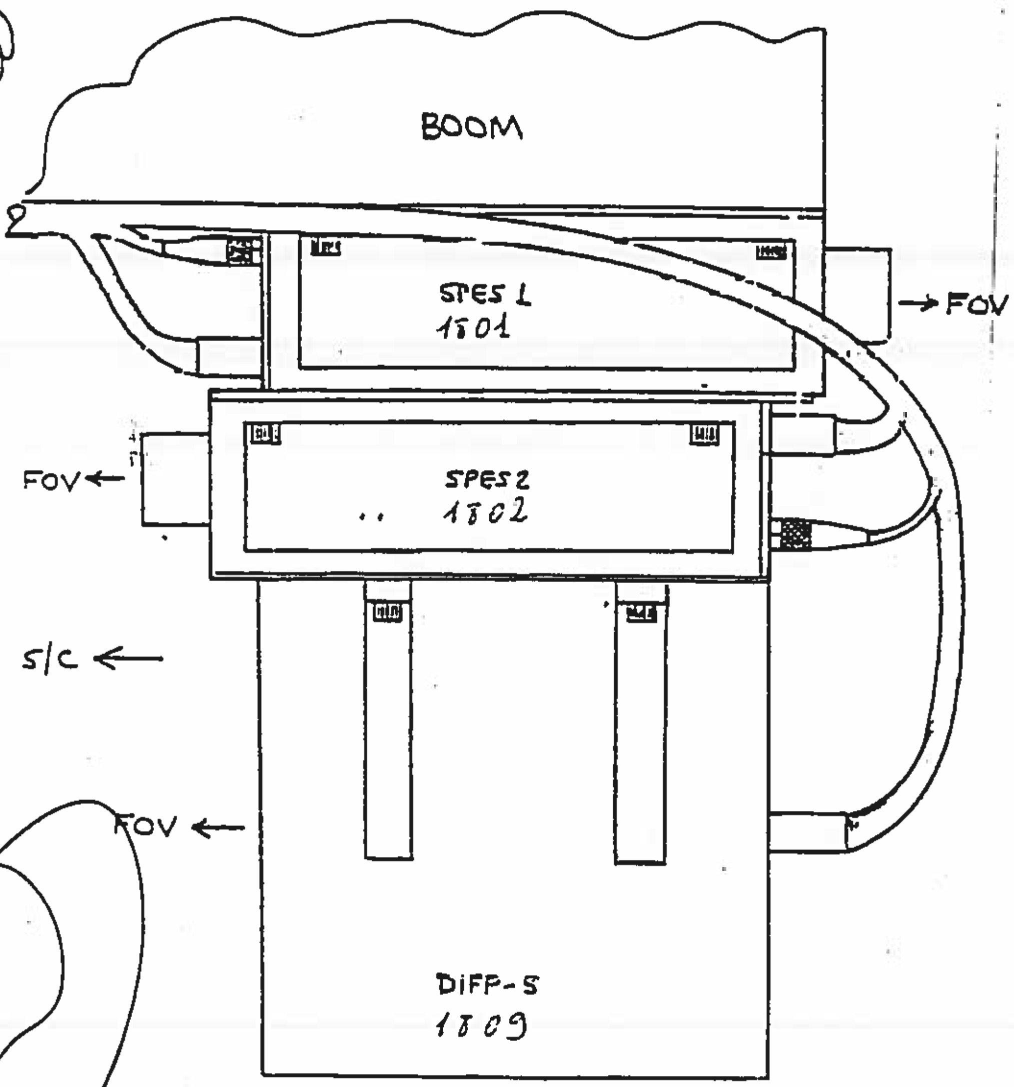
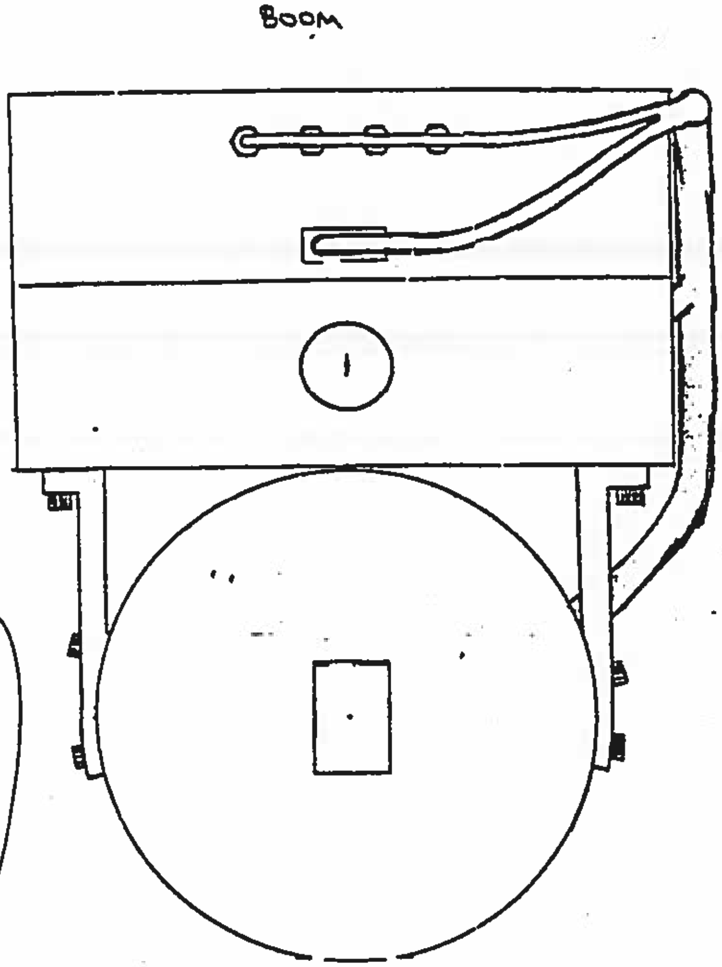
Figure 6.1.3.9a: Fixed Boom Mounted Sensor Package (BMSP)



Design Drawing

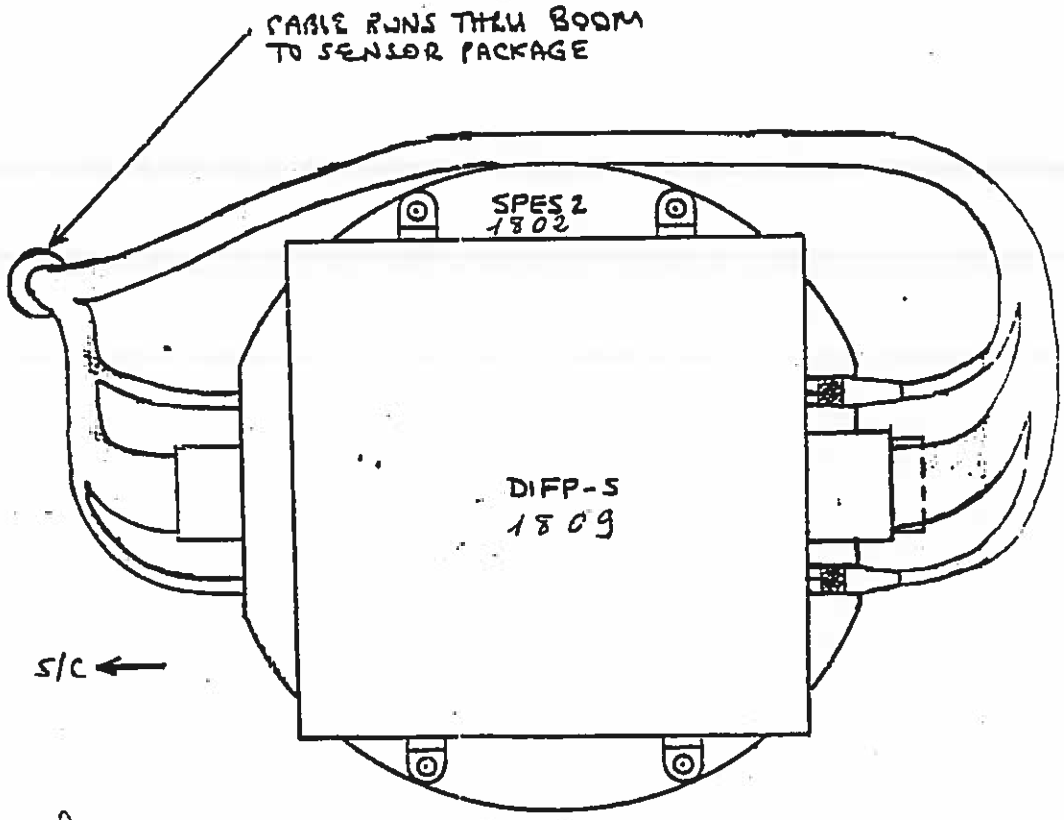
Portable Here

Figure 6.1.3.9b: Fixed Boom Mounted Sensor Package (BMSP) View. Looking from Satellite toward Sensors



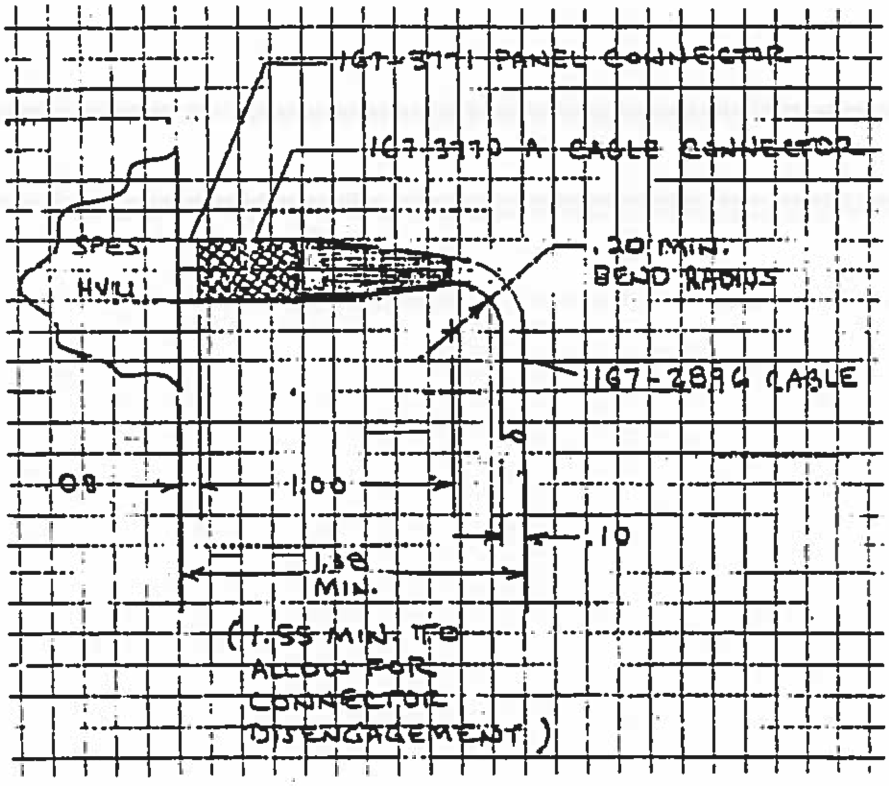
Provide New Drawing

Figure 6.1.3.9c: Fixed Boom Mounted Sensor Package (BMSP)
View Looking toward Fixed Boom



Possible New Drawing

Figure 6.1.3.10: Minimum Clearance and Bend Radius Requirement for Reynolds High Voltage Cables



Inappropriate for this doc. This is not a ~~policy~~ doc. We put in NB's and either agree or change them!

6.2 Mass Properties Data

6.2.1 Flight Items Mass Data

The ~~masses in the~~ mass properties sheet, Figure 6.2.1.1, are provided by the Experimenter as estimated with no declared contingency. They are, therefore, condidered current masses (no contingency to be added). The requirement to reduce the overall Experiment mass and to reduce drastically the mass of the fixed Boom Mounted Sensor Package (BMSP) must be met by the Experimenter before acceptance of any unit mass. The mass of the BMSP by itself exceeds the total 2 kg allocated to the experiments (ROPE & TEMAG).

The mass breakdown does include thermal control related mass (MLI, electric heaters, etc...) supplied by the Experimenter as part of the unit to which the device belongs. Each of the 1803 to 180~~8~~5 sensors will be mounted on an Integrator provided bracket (see fig. 6.1.3.2) for positioning and alignment of the sensor. The basic mass of each bracket is 0.150 kg (Al alloy about 2.8 x 10E-6 kg/mm3). ✓

The unit size is the overall envelope including the mounting feet but not other irregular shapes like connectors and bonding strap except for units 1801 to 180~~8~~5 which length includes connector protrusion. ✓

All tolerances on the centres of gravity (C.O.G.) are ± 10 mm along the Z axis and ± 20 mm along the X and Y axes. The origin O of the C.O.G. is the lower left angle of the overall unit envelope. The C.O.G. of unit 1801 to 180~~8~~5 is its geometric center.

The moments of inertia (M.O.I.) of units 1031 to 1035 are calculated assuming uniform mass distribution. All tolerances are ± 20 % .

What are these?

The products of inertia (P.O.I.) are calculated assuming uniform mass distribution.

The underlined dimentions in figure 6.2.1.1 identify the connector side. The double underlining means that the connectors are on both opposite sides.

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for all 4

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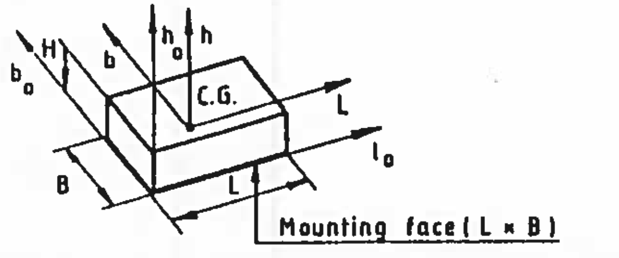
MASS PROPERTIES		PREPARED BY				APPROVAL			SHEET Nr.			Nr. of SHEETS					
Nr.	UNIT	Nr. of UNITS PER SAT.	DESIGN MATURITY CODE	UNIT MASS % CONTINGENCY	BASIC MASS PER UNIT (Kg)	CURRENT MASS ~~PER UNIT (Kg)~~	TOTAL CURRENT MASS PER SAT. (Kg)	UNIT SIZE (1) (mm) L	B/φ	H	UNIT C.G.W.R.T.O (2) (mm) l$_o$	b$_o$	h$_o$	UNIT INERTIA THROUGH UNIT C.G. (3) (Kg mm^2)10^3 I$_l$	I$_b$	I$_h$	UNIT PRODUCT OF INERTIA THROUGH UNIT C.G. (3) (Kg mm^2) I$_{lb}$	I$_{lh}$	I$_{bh}$
1	1801-1808, SPES	5 ~~8~~	PR	8	.482	0.441 0.408	2.205 9.264	132.6	131.4	38.1			19.0						
2	1809, DiFP-S	1			.900	1.062 1.200	1.062 ~~1.200~~	[illegible] ~~N/A~~	101.56	101.56		0.0	16.93						
3	1810, HVU1	1	CL	13	1.179	1.332 ~~1.179~~	~~1.179~~	237.2	135.1	88.9	l/2	B/2	H/3						
4	1811, HVU2	1	CL	13	1.179	1.332 1.179	1.332 1.179	237.2	135.1	63.5	L/2	B/2	H/3						
5	1812, CEP	1	CL	13	2.903	3.281 ~~2.903~~	3.281 ~~2.903~~	200.1	160.0	152.4	L/2	B/2	H/3		BOTH TO BE				
6	1813, FS	1	E	18	3.629	4.282 ~~3.629~~	4.282 ~~3.629~~	254.0	178.0	178.0	l/2	B/2	H/3		228.6		135.1		63.5
7	1814, DiFP-E	1			3.360	3.965 4.200	3.965 ~~4.200~~	228.6	226.1	188.5	L/2	B/2	H/3						
8	HARNESS	/		33	2.500	3.325	3.325												
9	BRACKETS FOR 1803 TO 1808	3 ~~6~~		18	0.150	0.177	1.532 ~~0.462~~												
10	BRACKET AND THERMAL PROVISION FOR BHSP	/		18	0.850 ~~0.713~~	1.662 0.841	1.662 0.841		Gards -										
11									254	160	152.4								
12																			



(1) Overall envelope including mounting face and connectors. Irregular shapes have to be specified on separate sheets

(2) Position of C.G. and O have to be specified on unit drawings

(3) Moments and products of inertia are defined as fellows

$I_l = \int_m (b^2 + h^2)dm \,;\; I_b = \int_m (l^2 + h^2)dm \,;\; I_h = \int_m (l^2 + b^2)dm \,;$

$I_{lb} = \int_m lb\, dm \,;\; I_{bh} = \int_m bh\, dm \,;\; I_{hl} = \int_m hl\, dm \,;$

6.2.2 Non-flight Items Mass Data

TBD by the Experimenter.

✓

6.3 Dynamics Characteristics

The resonant frequency shall be compliant with the applicable document TS-SR-AI-005, 4.1.2 and table 4.1.2-1 (>150 Hz for hard mounted units; >80 Hz for bracket mounted units).

Unit Code	Acronym	F (Hz) (1)	M (kg) (2)
1801 to 180~~8~~5	SPES-1 to SPES-~~8~~5	> 80 Hz	
1809	DIFP-S	> 80 Hz	
1810	HVU1	> 150 Hz	
1811	HVU2	> 150 Hz	
1812	CEP	> 150 Hz	
1813	FS	> 150 Hz	
1814	DIFP-E	> 150 Hz	

(1) F = Resonant frequency of unit.
(2) M = Model mass of unit.

6.4 Venting

In order to withstand the pressurization/depressurization profiles shown in TS-SR-AI-001, 3.2.1, during ascent/reentry phases, the Experiment units have to be properly designed. Depending on the chosen design solution, the units are classified as follows:

A- Open vented units: units with hole such that (Avh/V) > 1 where Avh is the venting hole area in square inches and V the box volume in cubic feet.

B- Sealed units: units whose structure can withstand 1 atm. pressure difference between outside and inside pressures, both inward and outward.

C- Closed units: units that belong to neither class above.

The venting analysis is required for class C Experiment units only. It aims at assessing:

- air venting time during launch-ascent, and
- box structural integrity when the box is subjected to the quoted press/depress profile.

Figure 6.4.1: Venting Classes of Experiment Units.

Unit Code	Acronysm	Venting Class	Comments
1801 to 1808	SPES - 1 to SPES - ~~8~~5	A	1803-1805 · Venting TBD Pending determination of S/C internal pressure
1809	DIFP - S	A	
1810	HVU 1	A	
1811	HVU 2	A	
1812	CEP	A	
1813	FS	A	
1814	DIFP - E	A	

6.5 Viewings, Location and Alignment

6.5.1 Sensors Viewing Angles

Sensors viewing axis and viewing angles are defined as:

SVA/P = Angle of projection of the sensor viewing axis on the plane formed by the spin axis and the Satellite fixed boom, where 0° is the positive spin vector.
SVA = Sensor View Axis angle with respect to the plane formed by the spin axis and the Satellite fixed boom.
SOE = Sensor Opening angle about SVA in Elevation.
SOA = Sensor Opening angle about SVA in Azimuth.

Figure 6.5.1.1 details the requirements for this Experiment.

6.5.2 Sensors Location

See Figure 5.2.1a and b.

These figures do not show the correct sensor location; ie neither the EPSP, SPES-3 + 5, or the TMAG sensors.

6.5.3 Sensors Alignment

See Figure 6.5.3.1 .

Sensors alignment knowledge is ± ~~0.05°~~ ±0.5°. at integration only and provided mirrors are present on sensors according to the applicable document TS-SR-AI-005, 4.8.

6.5.4 Sensors Position Accuracy

See Figure 6.5.3.1 .

The sensors position accuracy is required to be within 5.0 mm for all three axes.

6.5.5 Alignment Devices

To be specified by the Experimenter.

Figure 6.5.1.1: Sensors Viewing Angles

Sensor	Acronym	SVA/P (°)	SVA (°)	SOE (°)	SOA (°)
1801	SPES-1	~~270~~ 90	0		
1802	SPES-2	~~90~~ 270	0		
1803	SPES-3	270	(1)		
1804	SPES-4	~~292.5~~ 315	(1)		
1805	SPES-5	~~315~~ 360	(1)		
~~1806~~	~~SPES-6~~	~~337.5~~			
~~1807~~	~~SPES-7~~	~~360~~	~~0~~		
~~1808~~	~~SPES-8~~	~~90~~			
1809	DIFP-S	270	0	±45°	± 50° [illegible]

(1) Should be rotated 45° wrt S-Band antenna; ie, if S-Band Antenna SVA = 0° then this angle should be 315°.

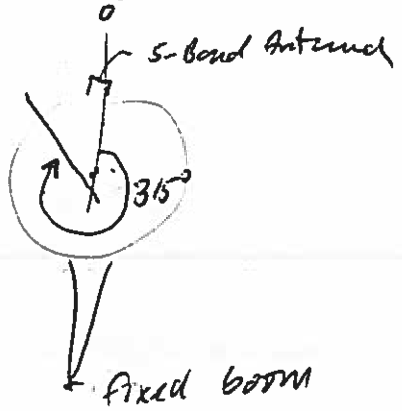


Figure 6.5.3.1: Sensors Alignment and Position Accuracy w.r.t. Satellite Reference Frame

Sensor	(1) Azimuth (°)	(1) Elevation (°)	X (mm)	Y (mm)	Z (mm)
1801	± 0.5	± 0.5	± 5.0	± 5.0	± 5.0
1802	± 0.5	± 0.5	± 5.0	± 5.0	± 5.0
1803	± 0.5	± 0.5	± 5.0	± 5.0	± 5.0
1804	± 0.5	± 0.5	± 5.0	± 5.0	± 5.0
1805	± 0.5	± 0.5	± 5.0	± 5.0	± 5.0
~~1806~~	~~± 0.5~~	~~± 0.5~~	~~± 5.0~~	~~± 5.0~~	~~± 5.0~~
~~1807~~	~~± 0.5~~	~~± 0.5~~	~~± 5.0~~	~~± 5.0~~	~~± 5.0~~
~~1808~~	~~± 0.5~~	~~± 0.5~~	~~± 5.0~~	~~± 5.0~~	~~± 5.0~~
1809	± 0.5	± 0.5	± 5.0	± 5.0	± 5.0

(1) Knowledge of Azimuth and Elevation angles must be within ±0.5° ~~0.05° at integration only and provided mirrors are present on sensors according to TS-SR-AI-005, 4.8~~.

Note: According to the applicable document TS-SR-AI-005, units requiring very accurate ~~alignment must~~ have ~~three mounting feet only.~~

6.6 Baseplate flatness

Foot flatness shall be within 0.1 mm.
Surface finish for each foot shall be 3.2 micrometers.

The detailed requirements are in the applicable document TS-SR-AI-005.

7.0 ELECTRICAL INTERFACES

7.1 Overall Requirements Summary

PARAMETER	SIGNAL TYPE	REQUIRED	UNIT
POWER	Experiment bus from PPDA 1.5A 5.0A	1 1	1812 1812
	Exp. Heater bus from PPDA	1	1812
	Exp. Heater bus from PCDA	1	1812
TELEMETRY	Serial Digital 16-bit (SD16) (1)	2	1812
	Bi-Level Digital (BLMN)		
	Relay Sensing (RSMN)		
	Analog Single Ended (ASMN)		
TELE-COMMAND	Relay Drive (RDCM)		
	Memory Load Data (MLDT) (2)	2	1812
TIMING	Frame Pulse (FRPL)	2	1812
	Format Pulse (FTPL)	2	1812
	Event Datation Channel (EDCH)		
SPECIAL	Tether Current Monitor Analog (TCMA)		
	Synchronization Clock 128 KHz (SYCK)	1	1812

(1) One Serial Digital Sampling (SDSP) and one Serial Digital Clock (SDCK) with each SD16 signal.

(2) One Memory Load Sampling (MLSP) and one Memory load Clock (MLCK) with each MLDT signal.

7.2 Power Interface

7.2.1 Specified Maximum Total Energy

The specified maximum total energy drain from the Satellite batteries at the Experiment power bus from PPDA, integrated over the operational profile of the Experiment, is 27 x T (WH), where T is the total switch-on hours time for the Experiment. 3 x Th (WH) are to be added, where Th is the time sensor heaters are ON after U1 umbilical connector disconnection. Also to be added is 50 xTp (WH), where Tp is the time the floating power supply of the unit 1813 (FS) is on.

7.2.2 Power Data

The power requested and dissipated is detailed in Figure 7.2.2.1 .

Power consuption: 27 W + TBD (for the floating power supply of unit 1813) continuous (30 V dc at PPDA output) + 3 W peaks for heaters (32 V dc at U1). Occational peaks of 50 W occur for the floating power supply of unit 1813 (FS). The given values include converter losses.

The Experiment will be operative during the on-station phase, including the intermediate stops. The Experiment will be switched off at the latest possible moment prior to the Satellite power off.

The power profile during the whole TSS-S mission from the Satellite deployment till the end of retrieval is shown in Figure 7.2.2.2. The figure is valid for a voltage range of 22.5 to 36 V dc. Acceptance of the power data depends on compatibility with the other Experiments.

7.2.3 Current Limiters

Current limiters to be adopted by the Experimenter shall be compliant with the requirements in TS-SR-AI-005, 6.2.2.

SOUTHWEST
RESEARCH
INSTITUTE

TELEFAX

(512) 647-4325

REF. NO.:

DATE: 25 MARCH 86

PAGE 1 OF 1

TO: RAY HOLDER/MSFC
FROM: AL BLEVINS/SWRI
SUBJECT: ROPE/TSS-S POWER INTERFACE

FOLLOWING IS POWER INTERFACE INFORMATION TO TRANSMIT TO SABBAGH. HAVE NOBIE VERIFY BOTH THE FLOATING POWER SUPPLY AND HEATER POWER NUMBERS BEFORE TRANSMITTAL. CHANGE IF NECESSARY, BUT PLEASE INFORM ME OF ANY CHANGES.

1. SWRI WILL PROVIDE A 311P409-1P-B-12 CONNECTOR ON THE CEP FOR INTERFACE WITH THE SPACECRAFT POWER SYSTEM. INSTRUMENT POWER AND BOOM SENSOR HEATER POWER (FROM BOTH THE SPACECRAFT AND FROM THE STS) WILL BE PROVIDED THROUGH THIS CONNECTOR.

2. CURRENT POWER ESTIMATES:

4/1/86
telecon
Stone

DIPP-E/DIPP-S	5.00 WATTS MAXIMUM
SPES 1-8 (8 @ .26 WATTS EACH)	2.08 WATTS MAXIMUM
CEP	4.29 WATTS MAXIMUM
HVU1	5.60 WATTS MAXIMUM
HVU2	3.90 WATTS MAXIMUM
FS (EXCEPT FLOATING POWER SUPPLY)	6.13 WATTS MAXIMUM
FLOATING POWER SUPPLY	50.00 ~~35.00~~ WATTS PEAK (ASSIGNED DESIGN PARAMETER)
BOOM SENSOR PACKAGE HEATER POWER	3.00 WATTS (ASSUMED)

about 1.00W
nominal

3. AER WILL FURNISH ONE 1.5A AND ONE 5A CIRCUIT. CURRENT PLANS ARE TO POWER THE CEP, HVU1, AND SPES 3-8 FROM THE 1.5A CIRCUIT, AND TO POWER THE FS (INCLUDING FLOATING POWER SUPPLY), HVU2, SPES 1-2, DIPP-E, AND DIPP-S FROM THE 5A CIRCUIT.

4. METHOD OF ISOLATING AND SWITCHING BOOM SENSOR PACKAGE HEATER POWER IS TBD.

5. SWRI WILL USE AER'S PIN ASSIGNMENT FOR THE POWER INTERFACE CONNECTOR. ASSIGNMENT WILL INCLUDE TWO PINS FOR THE 1.5A CIRCUIT, TWO PINS FOR THE 5A CIRCUIT, TWO PINS FOR HEATER POWER FROM PCDA, TWO PINS FOR HEATER POWER FROM PPDA, AND ONE SPARE PIN.

CC: N. STONE/MSFC
J. ALEXANDER/SWRI

Figure 7.2.2.1 : Power Data Sheet

EXPERIMENT : ROPE

INPUT VOLTAGE (V)		POWER REQUESTED			POWER DISSIPATION			RF POWER (W)
Unit	Supplied by:	STAND BY (W)	ACTIVE (W)	PEAK (W)	STAND BY (W)	ACTIVE (W)	PEAK (W)	
1801 02	181~~1~~3 and 1811	0.26 ea	0.26 ea	0.26 ea	0.26 ea	0.26 ea	0.26 ea	N/A
1803 to ~~08~~5	181~~0~~2 & 1810	0.26 ea	0.26 ea	0.26 ea	0.26 ea	0.26 ea	0.26 ea	N/A
1809	1814	0.50	0.50	0.50	0.50	0.50	0.50	N/A
1810	1812	5.60	5.60	5.60	~~4.04~~ 5.60	~~4.04~~ 5.60	~~4.04~~ 5.60	N/A
1811	1813	3.90	3.90	3.90	~~3.38~~ 3.90	~~3.38~~ 3.90	~~3.38~~ 3.90	N/A
1812	PPDA	27.00+TBD*	27.00+TBD*	77.00	4.29+TBD	4.29+TBD*	54.29	N/A
1813	{PPDA via 1812	15.03+TBD*	15.03+TBD*	65.03	6.13+TBD*	6.13+TBD*	56.13	N/A
1814	1813	5.00	5.00	5.00	4.50	4.50	4.50	N/A
1812 PWR for : 1801+2+9 Heaters from PCDA at 32 V		3.00	3.00	3.00	3.00	3.00	3.00	N/A

*For the flowting power supply of unit 1813 (FS) which needs 50W peak momentanary and occationally.

~~NOTE : The data in this table are unconsistent because derived from unclear and uncompleted Expt. provided data.~~

CEP 4.29 W FS 7.13W nominal, 56.13 W peak

7.2.4 Inrush Current

The nrush current is defined in Figure 7.2.4.1 and is compliant with TS-SR-AI-005, 6.2.2.6.

7.2.5 Converter Frequency and Synchronization

The Experiment power converter is synchronized to a frequency of 64 KHz by a 128 KHz synchronization clock (SYCK) signal from the Satellite OBDH. The free running frequency shall be at 64 KHz ± TBD KHz.
The DC/DC converter data sheet is in Figure 7.2.5.1 .

The detailed requirements on converter frequency and synchronization are in TS-SR-AI-005, 6.2.3.1.3.4 .

7.2.6 Input Voltage

The Experiment power bus voltage from PPDA at the input to the 1812 (CEP) unit ranges between 22.5 and 36 V dc.

7.2.7 External Sensors Heater Power

The routing of the requested 3.0 W power to the Experiment Boom Mounted Sensor Package (BMSP) is as follows:

1- The Experimenter shall implement the electrical scheme shown in Figure 7.2.7.1 inside the 1812 (CEP) unit. The Experimenter shall therefore:

   - adopt one fuse on each heater line to avoid impacts on other Experiment sensors in case of failure. Protection of different type could be acceptable provided the equivalent load at the user interface remains purely resistive,

   - adopt thermostatically controlled heaters to optimize power use, guaranteing their EMI compliance with the requirements in the applicable documents,

- adopt heaters capable of operating over the voltage range of 19 to 36 V dc (TS-SR-AI-005, 6.2.2.2 and tables 6.2.2.2.2a and b),

- adopt non-latching relays with rest position as shown in Figure 7.2.7.1, and with consumption not more than 0.3 W each,

- guarantee that no noise is injected on heater power lines (TS-SR-AI-002), and

- guarantee appropriate heater system isolation against high voltages (particularly with respect to Satellite structure).

2- No power will be delivered to any equipment during the post-retrieval quiescent phase.

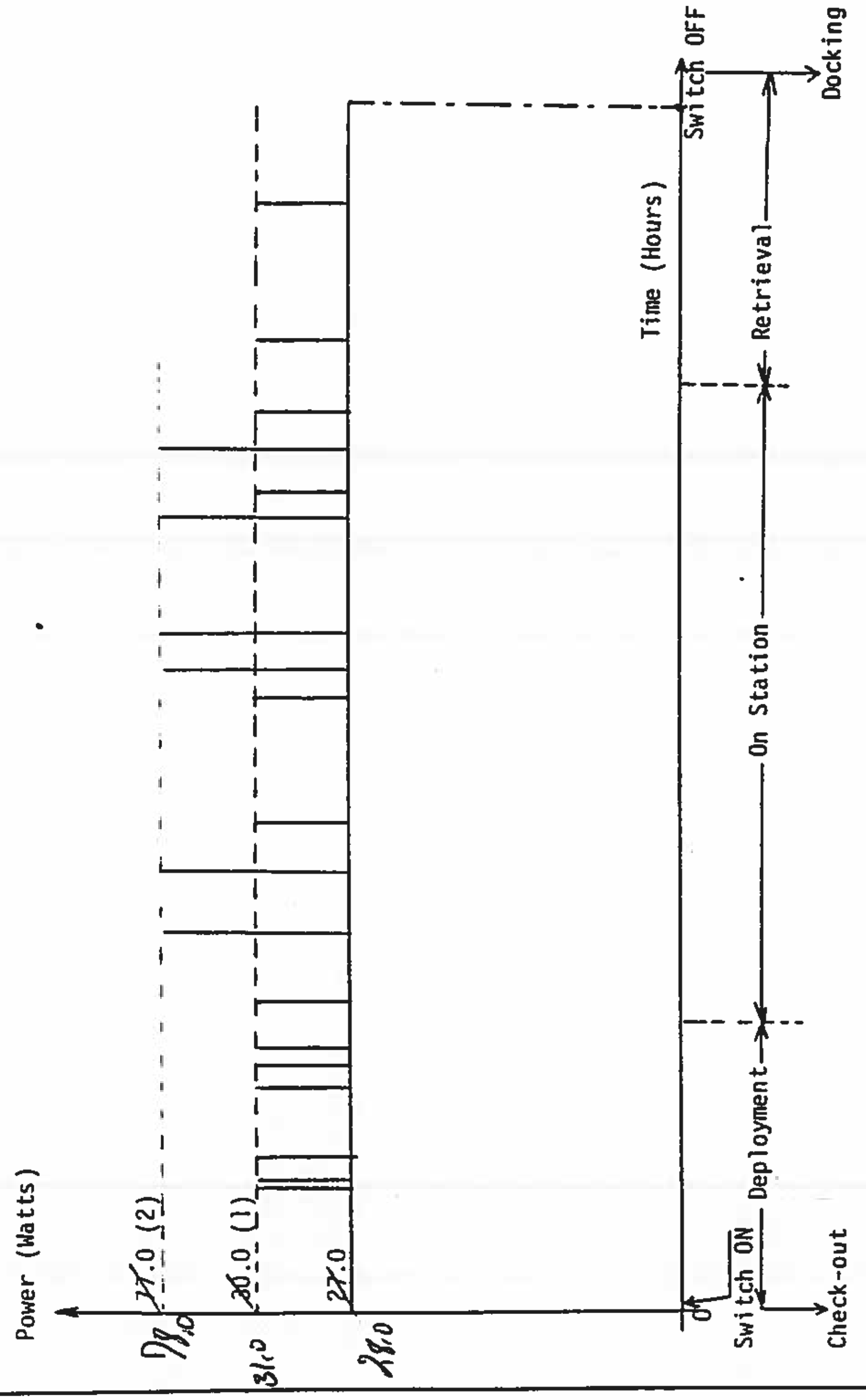
3- No umbilical line will be dedicated to Experiment sensors heating during pre-deployment quiescent phase: heater power will be delivered to the Satellite on the same line used for Satellite heaters.

4- The requested 3.0 W power is the absolute maximum at U1 umbilical interface (i.e. calculated at 32 V dc). Furthermore, the corresponding mean power at the U1 umbilical interface must be calculated as the minimum guaranteed power at 21 V dc. Both 3.0 W peak and TBD (<3.0) W mean include losses due to distribution from the U1 umbilical connector to the Experiment interface.

The Experimenter shall provide the value of the peak power at maximum voltage at Experiment interface, and power breakdown in its circuit including losses.

Figure 7.2.7.2 shows the Experiment heaters electrical scheme.

Figure 7.2.2.2 Power Profile at 30 Vdc mean voltage



(1) Peaks occur when sensor heaters are ON.
(2) Peaks occur when floating power supply of unit 1813 (FS) is at max. operation.

Figure 7.2.4.1: Inrush Current

TO BE PROVIDED BY THE EXPERIMENTER

TBD after protoflight power supply test.

EXPERIMENT : ROPE UNIT : ______

Figure 7.2.5.1: Converter Data Sheet

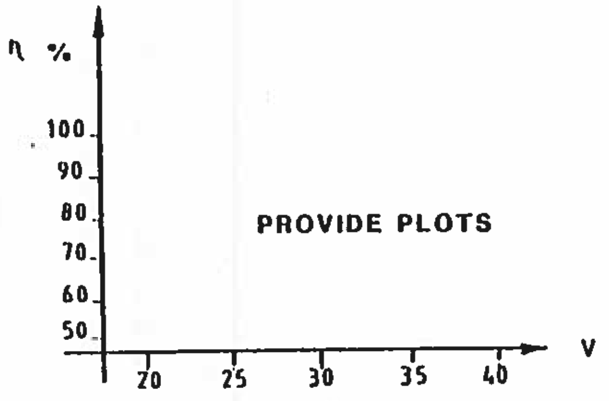


FIG. a: CONVERTER EFFICIENCY

PROVIDE SCHEMATIC

FIG. b: CONVERTER SCHEMATIC

V	(%)
22.75	
24	
28	
30	
38.5	

AT NOMINAL LOAD

TABLE a: CONVERTER EFFICIENCY

FREQUENCY (Khz) : ______

INRUSH CURRENT (A) : ______ I MAX ______ T ______ τ ______ dI/dt

NOMINAL VOLTAGE (V) : ______

OVERLOAD CAPABILITY (A) : ______

INPUT VOLTAGE RANGE (A) : ______

OUTPUT VOLTAGE (V) : ______ ______

INPUT IMPEDANCE : ______ ______

TABLE b: CONVERTER CHARACTERISTICS

CONVERTER DATA

Figure 7.2.7.1: Electrical Scheme for Heater Power Distribution

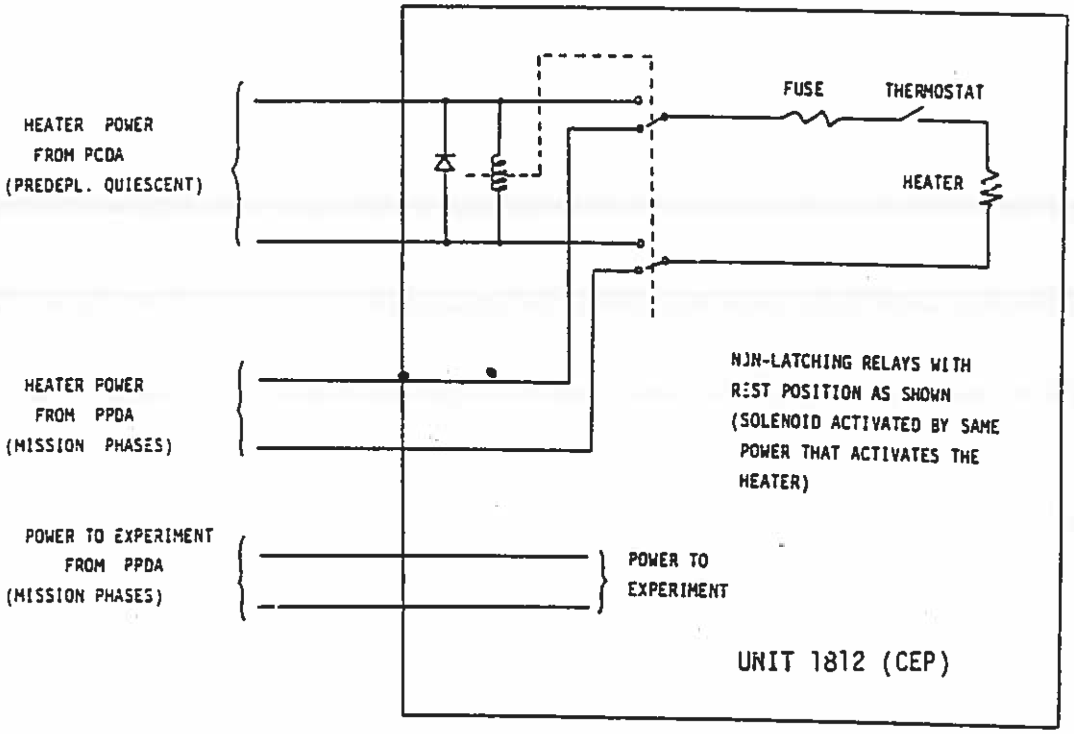


Figure 7.2.7.2: Experiment Heaters Electrical Scheme

TO BE PROVIDED BY THE EXPERIMENTER

TBD

7.3 Command Interface

Command interface is in accordance with TS-SR-AI-005 General Design and Interface Requirement.

Figure 7.3.1 shows the TLC bit rate requirement profile.

Figure 7.3.2 is the command sheet identification to be compiled by the Experimenter following the procedures in the TS-PR-AI-008.

7.3.1 Relay Drive (RDCM)

No RDCM is requested by this Experiment.

7.3.2 Memory Load Data (MLDT)

The detailed description is in Figure 7.3.2.1.
Details of commands are shown in Figure 7.3.2.2 .

7.3.3 Command Timetag Requirements

No command time-tagging capability is provided by the Satellite On Board Data Handling Subsystem (OBDH).

Figure 7.3.1: TLC Bit Rate Requirement Profile

<u>TO BE PROVIDED BY THE EXPERIMENTER</u>

TBP

Figure 7.3.2a Command Sheet Identification

COMMAND SHEET IDENTIFICATION ☐☐C☐☐☐

ELECTRICAL ICD REFERENCE ☐☐☐☐☐☐☐☐☐

SUBSYSTEM | UNIT

COMMAND DESCRIPTION

OPERATIVE PHASE INTERESTED Q☐ D☐ R☐ ON/S☐ B/U☐

COMMAND TYPE :

CYCLIC COMMAND ☐ | FREQUENCY ☐ ACCURACY ☐

COMMAND RESULTING FROM A PROCESS ▨ | PROCESS SHEET ▨P▨

COMMAND FROM DEPLOYER ☐ | RTUS ☐ RTUP ☒ DEC ☐ CTU ☐

OBDH COMMAND TYPE:

CMD CHARACTERISTICS

TO BE PROCESSED ▨ | PROCESS SHEET ▨P▨

DIRECT TO USER ☒

OUTPUT CHANNEL IDENTIFICATION COMMAND ☐☐☐ SAMPLING ☐☐☐ SYNC. ☐☐☐

COMMAND STRUCTURE B0 ☐☐☐☐☐☐☐☐☐☐☐☐☐☐ B15
MSB LSB

VALIDATION (Y N) ☐

RESPONSE TIME ☐ min ACQUISITION SHEET ☐☐D☐☐☐

☐ max (if any)

Figure 7.3.2b Command Sheet Identification

COMMAND SHEET IDENTIFICATION ☐ ☐ C ☐ ☐ ☐

ELECTRICAL ICD REFERENCE ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

SUBSYSTEM

UNIT

COMMAND DESCRIPTION

DETAILED DESCRIPTION

Figure 7.3.2.1: Memory Load Data Commands

Unit Code	Acronym	Command			
		Code		Description	(*) Source
		Exp.	S/C		
1812		01			RTUP
1812		02			RTUP

(*) RTUP = Remote Terminal Unit for Payload (Satellite OBDH Subsystem unit)

Figure 7.3.2.2: Memory Load Data Command Description

Command Code		MSB															LSB
Exp.	S/C	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
01																	
02																	

Note: MSB = Must Significant Bit, the first bit to be shifted out to the Experiment.
LSB = Least Significant Bit.

7.4 Telemetry Data Interface

Telemetry data interface is compliant with TS-SR-AI-005, General Design and Interface Requirement.

The telemetry bit rate requirements are summarized in Figure 7.4.1. The Experiment requires 4500 bps from Experiment switch-on to Experiment switch-off to be obtained with 18 16-bit words/frame at frame end and close to each other (see 7.4.4). Acceptance of these requirements depends on compatibility with the other Experiments. Figure 7.4.2 is the data sheet identification compiled following the procedures in the TS-PR-AI-008.

7.4.1 Telemetry Requirements Summary

The TLM requirements summary is shown in Figure 7.4.1.1.

7.4.2 Telemetry Format Lay-out

The NASA type 3 TLM format lay-out is shown in Fig. 7.4.2.1 and the data format lay-out is shown in Figure 7.4.2.2. The 3 format arrangements 1, 2 and 3 are with 16 kbps (256 frames x 128 8-bit words) each which is distributed as follows: (a) 2250 bps for TLM Synch., (b) 3500 bps for Satellite Housekeeping Data, (c) 10250 bps for P/L Data. The number of interrogation 8-bit words and related recycle frequency dedicated to TSS-S Housekeeping and P/L Data is:

- P/L Data: 300 words with recycle at 4 Hz and 112 at 1 Hz.
- TSS-S Housekeeping Data: 416 words with recycle at 1 Hz, 4 words with recycle at 4 Hz and 256 words at 1/16 Hz.

Columns 4,8 (Satellite) and, as a goal, columns 1,5 (P/L) depending on the (P/L checkout position in TSS checkout timeline and on P/L operation timeline) are down linked via UM2.

The synchronization words are words 1, 2 & 3 in the first frame, and words 1 & 2 in the other frames.

The 8-bit transition words are words 8k (k = 1 to 15) in all the frames.
The trasmission of one format takes place in 16.384 seconds.

This still seem unnecessary & a great waste

7.4.3 Analog Data Description

Details on analog data, both Science (SC) and Experiment Housekeeping (EHK), are given in Figure 7.4.3.1.

7.4.4 Data Location in Telemetry Format

Figure 7.4.4.1 shows the location of the SD16 data in the telemetry format. Figure 7.4.4.2 shows the Experiment suggestions on his 8-bit words assignment. The list assumes 18 16-bit words per frame in 7 word groups separated by transition words (see 7.4.2 above). The Experimenter prefered location is at the end of the frame.

Figure 7.4.1: TLM Bit Rate Requirements Profile

<u>TO BE PROVIDED BY THE EXPERIMENTER</u>

Has this not already been provided?

Figure 7.4.2a Data Sheet Identification

DATA SHEET IDENTIFICATION ☐ ☐ D ☐ ☐ ☐

ELECTRICAL ICD REFERENCE ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

SUBSYSTEM

UNIT

DATA DESCRIPTION

OPERATIVE PHASE INTERESTED P ☐ D ☐ R ☐ ON/S ☐ B/U ☐

SOURCE

CYCLIC ☐ CONTINUOUS ☐

SAMPLING FREQ. ▨ ACQUIS. FREQ. ☐ ALLOWED JITTER ☐

OBDH CHANNEL TYPE

INPUT CHANNEL IDENTIF. DATA ▨ SAMPLING ▨ SYNC. ▨

DISCRETE
DATA POSITION/
SERIAL DATA

▨ B0 … B7 ▨ B8 … B15 ▨
MSB LSB

ENG UNIT ☐ ACC. ☐ LO ☐ HI ☐

SCALING COEFF. A_0 ☐ A_1 ☐ A_2 ☐ A_3 ☐

DESTINATION

TO BE PROCESSED ▨

▨ R ▨

TELEMETRY DATA DIRECT ☐

TM FREQUENCY ☐

FORMAT ALLOCATION ▨ ▨

Figure 7.4.2b Data Sheet Identification

DATA SHEET IDENTIFICATION							D			
ELECTRICAL ICD REFERENCE										

SUBSYSTEM

UNIT

DATA DESCRIPTION

DETAILED DESCRIPTION

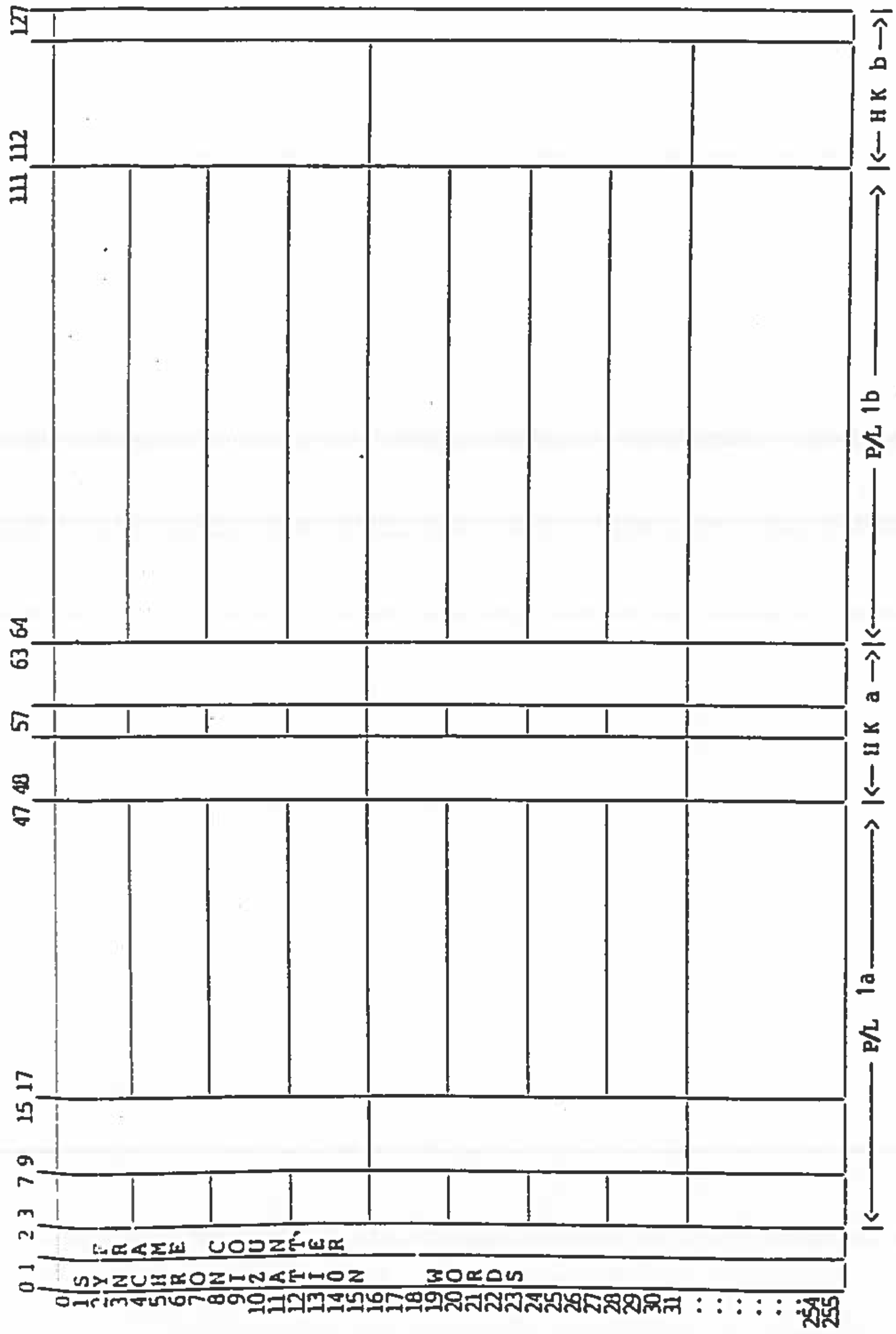
Figure 7.4.1.1: Telemetry Data Requirements Summary

Unit Code	Channel Type (*)	Channel Code		Sampling Rate per Format (**)	Description (*)
		Exp. (*)	S/C		
1812	SD16	SC1			16-bit words
1812	SD16	SC1			16-bit words

(*) SD16 = Serial Digital 16-bit
SC = Science

(**) With 16 seconds format duration.

Figure 7.4.2.1 a Telemetry Format Lay-out . . Format 1



What is the difference between a, b & c ?

? Tables ~~it~~ are not clear ?

Figure 7.4.2.1c Telemetry Format Lay-out . . Format 3.

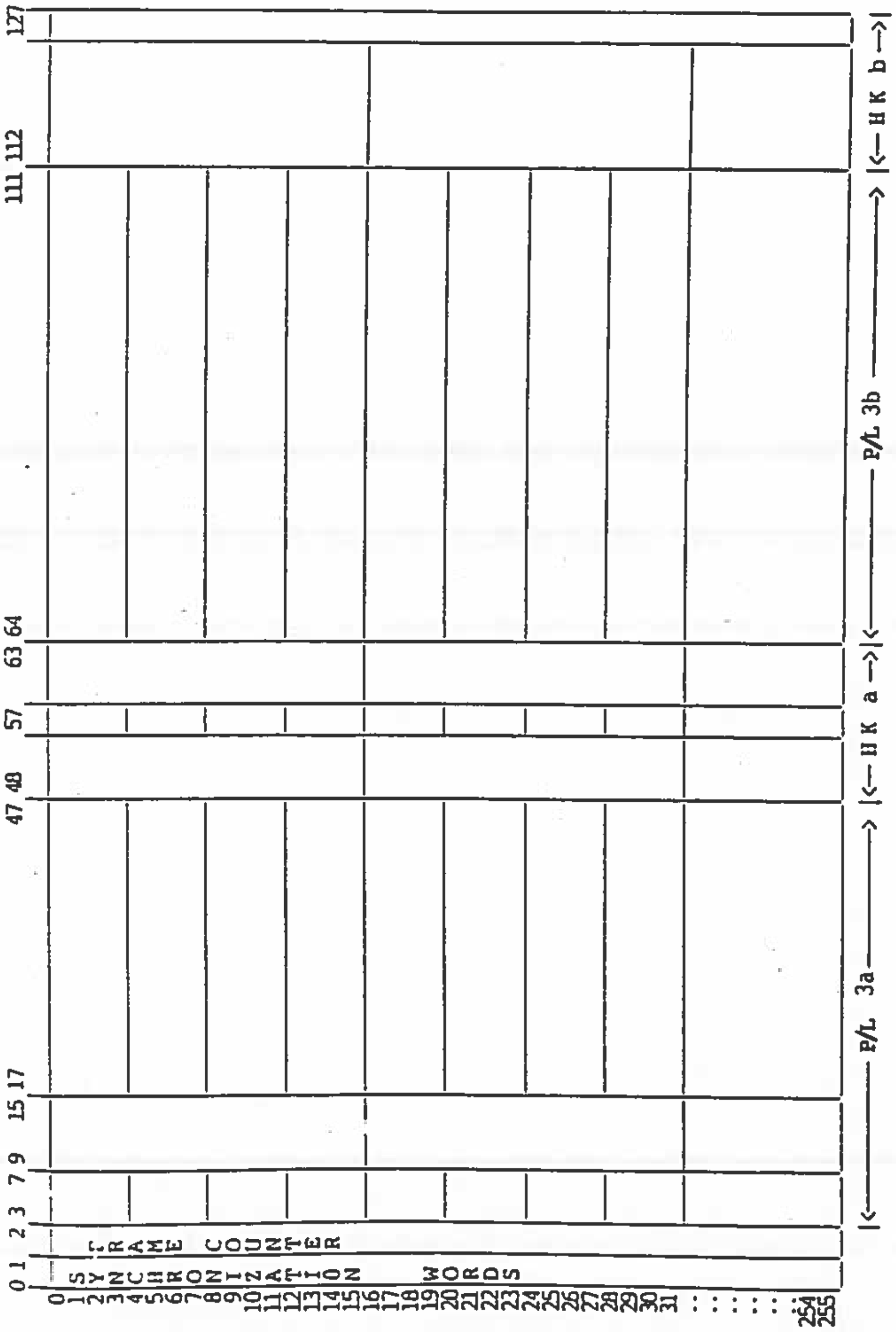


Figure 7.4.2.1 b Telemetry Format Lay-out .. Format 2

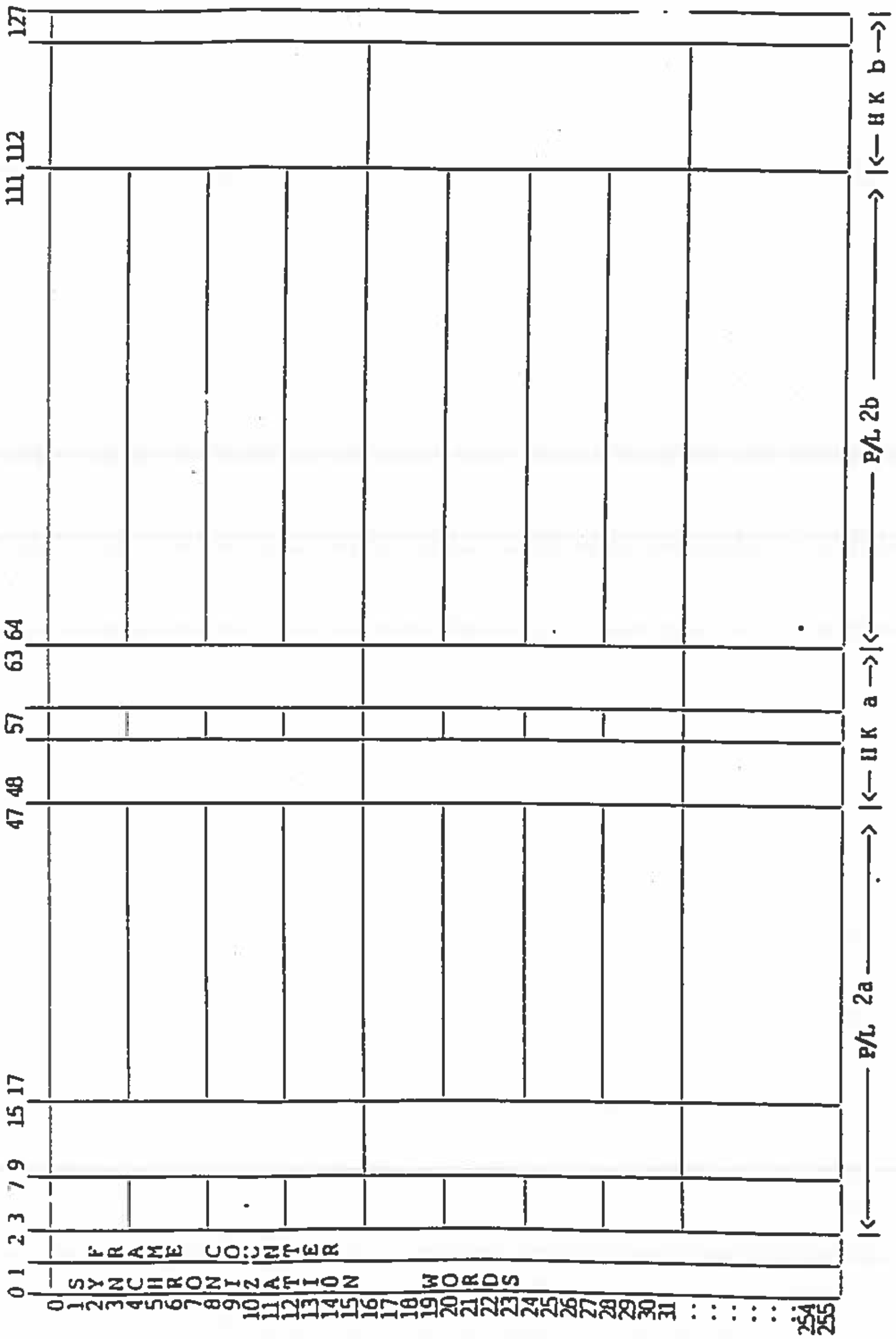


Figure 7.4.2.2: Data Format Lay-out

Channel Code		Channel Description	Sampling Rate	Location in TLM Format		
Exp.	S/C			Frame	Word	Bit

Figure 7.4.3.1: Analog Data Description

Channel Code (Exp.)	Limits			Unit Code	Calibration	Comments
	High	Low	Delta			

Figure 7.4.4.1: Signal Digital 16-bit (SD16) Data Location

Channel Code		Source Unit	Channel Description	Location in TLM Format		
Exp.	S/C			Format	Word	Bit
SC1		1812	Science Data			
SC1		1812	Science Data			

?

So where's the beef?

Figure 7.4.4.2: Telemetry Word Assignment List

Word	Parameter
~~72~~	~~SPES 3 (Channel 4)~~
~~73~~	~~Transition Word~~
~~74~~	~~SPES 3 (Channel 5)~~
~~75~~	~~SPES 4 (Channel 6)~~
~~76~~	~~SPES 4 (Channel 7)~~
~~77~~	~~SPES 5 (Channel 8)~~
~~78~~	~~SPES 5 (Channel 9)~~
79	SPES ~~6~~3 (Channel ~~10~~) 4
80	SPES ~~6~~3 (Channel ~~11~~) 5
81	Transition Word
82	SPES ~~7~~4 (Channel ~~12~~) 6
83	SPES ~~7~~4 (Channel ~~13~~) 7
84	SPES ~~8~~5 (Channel ~~14~~) 8
85	SPES ~~8~~5 (Channel ~~15~~) 9
86	HVU1 (PPS1 Step)
87	Engineering
88	SPES 1 (Channel 0)
89	Transition Word
90	SPES 1 (Channel 1)
91	SPES 2 (Channel 2)
92	SPES 2 (Channel 3)
93	HVU2 (PPS2 Step)
94	DIFP-1
95	DIFP-2
96	DIF~~F~~-3 P
97	Transition Word
98	DIFP-4
99	DIFP-5
100	DIFP-6
101	DIFP-7
102	DIFP-8
103	DIFP-9
104	DIFP-10
105	Transition word
106	DIFP-11
107	DIFP-12
108	DIFP-13
109	DIFP-14
110	DIFP-15
111	DIFP-16
112	DIFP-17

Rearrange in ascending order

ch. 1 ↓ 5   0 ↓ 9

1 SPES should be in one 16 Bit Slot by AEK Convention; i.e.,
0 and 1 → 16 bits
2 and 3 → 16 bits
etc.

7.5 Electrical Interface Circuits

7.5.1 General Requirements

General requirements for interface circuit design within the Experiment units are detailed in TS-SR-AI-005, General Design and Interface Requirement.

The Satellite side is as per TS-SR-AI-005 and TS-IC-AI-001/3

7.5.2 Interface Circuits

The actual electrical interface circuits for each electrical function facing the Satellite subsystems including all component values are shown as follows:

Fig. 7.5.2.1 : Power

Fig. 7.5.2.2 : Synchronization Clock

Fig. 7.5.2.3 : Memory Load Data

Fig. 7.5.2.4 : Serial Digital 16-bit

Fig. 7.5.2.5 : Frame Pulse

Fig. 7.5.2.6 : Format Pulse

Fig. 7.5.2.7 : Heaters

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Figure 7.5.2.1: Electrical Interface Circuit: Power

<u>TO BE PROVIDED BY THE EXPERIMENTER</u>

TBD

Figure 7.5.2.2: Electrical Interface Circuit: Synchronization

<u>TO BE PROVIDED BY THE EXPERIMENTER</u>

TBD

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Figure 7.5.2.3: Electrical Interface Circuit: Memory Load data

<u>TO BE PROVIDED BY THE EXPERIMENTER</u>

TBD

Figure 7.5.2.4: Electrical Interface Circuit:
Serial Digital 16-Bit

TO BE PROVIDED BY THE EXPERIMENTER

TBD

Figure 7.5.2.5: Electrical Interface Circuit: Frame Pulse

<u>TO BE PROVIDED BY THE EXPERIMENTER</u>

TBD

Figure 7.5.2.6: Electrical Interface Circuit:
Format Pulse

TO BE PROVIDED BY THE EXPERIMENTER

TBD

9.

Figure 7.5.2.7: Electrical Interface Circuit: Heaters

<u>TO BE PROVIDED BY THE EXPERIMENTER</u>

TBD

9)

7.6 Twisting, Shielding and Grounding Concept

The twisting, shielding and grounding for harness between Experiment to Experiment units and Experiment to Satellite units shall be compliant with the TS-SR-AI-002, EMC Specification, and the TS-SR-AI-005, General Design and Interface Requirement except otherwise precised in this document. It is d~~a~~etailed in the contact functions of the connectors, section 7.7 . ✓

7.6.1 Grounding Scheme

Figure 7.6.1.1 shows the Experiment 0 V grounding schematic, and Figure 7.6.1.2 shows the Experiment sensor heaters 0 V grounding schematic.

Figure 7.6.1.1 : O V Grounding Schematic

TO BE PROVIDED BY THE EXPERIMENTER

TBD

101

Figure 7.6.1.2: Experiment Sensor Heaters 0 V Grounding Schematic

TO BE PROVIDED BY THE EXPERIMENTER

TBP

7.7 Harness Interface

we need to submit request waivers for SDES & DIFR subsystems

A schematic of the Experiment harness is reported in Figure 7.7.1 and the cable functions are listed in figure 7.7.2. From this list, mixing of signals belonging to different EMC classes in the same connector appears which is not in compliance with the requirement in TS-SR-AI-002. The Experimenter shall provide a compliant list or ask for waiver.

The Experimenter shall provide "MUA" for the following parts:

SwRI will submit MUA's

- connectors:	CANNON	MDM-.....-H003P-A174
	REYNOLDS	167-3771 and 167-3770-A
	SEALECTRO	51-427-3188
- cables :	REYNOLDS	167-2896; 167-9346; 178-7215; 178-7633

H.V. isolation of above cables, 1500 V AC RMS, is inadequate to the Experiment planned voltages (>5000 V DC). The Experimenter shall provide adequate cable list.

7.7.1 Experiment to Satellite Harness

The connector matrix of the Experiment to Satellite harness is shown in Figures 7.7.1.1, and the connector functions with the wiring diagrams are identified in Figures 7.7.1.2, 3 and 4. This is a change to the baseline and it is being evaluated before acceptance. No contacts are be connected to the Satellite EGSE skin connector.

to

?

No Baseline yet!

7.7.2 Experiment Internal Harness

The connector matrix of the Experiment internal harness is shown in Figures 7.7.2.1 to 14. The contact functions with the wiring diagramas shall be provided by the Experimenter. Figure 7.7.2.15 shows the monitor list.

ROSE has requested SPES test connectors

Cables 6 and 7 only.

"Flying leads" or "pig tails"

The Experimenter request to use "~~blind leads~~" instead of connectors on 1811 (HVU2) and 1814 (DIFP-E) boxes is being evaluated. The use of "~~blind leads~~" would eliminate ~~11~~ 2 connectors containing high voltage pins and would simplify the high voltage interface ~~at the boxes~~ between 1813 (FS), 1811 (HVU-2), and 1814 (DIFP-E).

7.7.3 Harness to Other Experiments

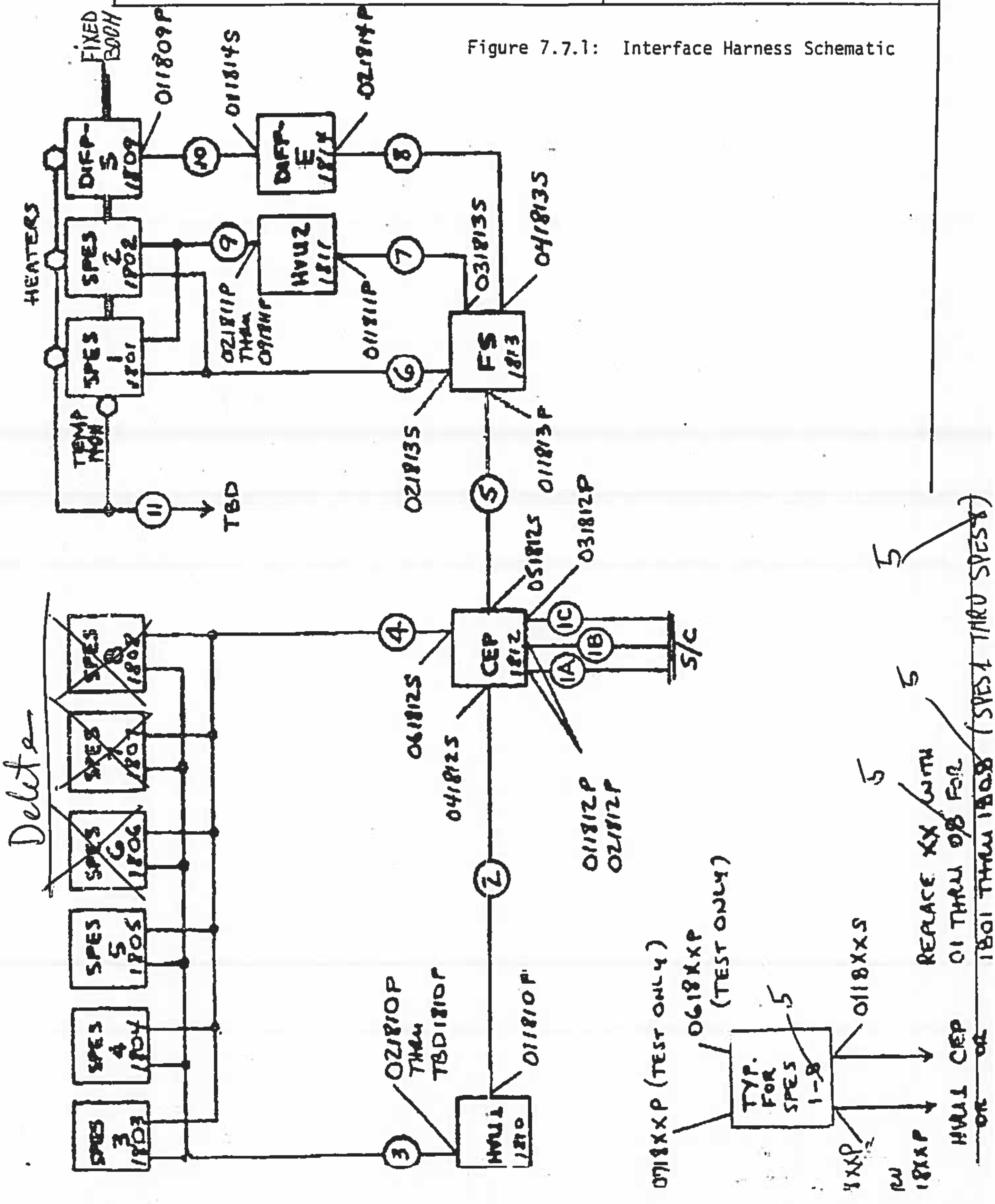
No interface between this Experiment and other Experiments is foreseen.

7.7.4 Electrical ed EMC Characteristics of Wires and Signals

The EICD Program sheets shall be provided by the Experimenter following the procedures in TS-PR-AI-008.

ROPE may not wish to use "flying leads" on HVU-2 and DIFP-E now that FS is only -500v, assuming AER will accept 500V on D connectors. See EID-11 paragraph A.8.

Figure 7.7.1: Interface Harness Schematic



CABLE NO.	FUNCTION	DESCRIPTION/ EMC CLASS	CABLE WIRE
1A	ROPE MLDT 1 & RTN	RF	24 AWG TWS
	ROPE MLSP 1 & RTN	RF	24 AWG TWS
	ROPE MLCK 1 & RTN	RF	24 AWG TWS
	ROPE MLDT 2 & RTN	RF	24 AWG TWS
	ROPE MLSP 2 & RTN	RF	24 AWG TWS
	ROPE MSCK 2 & RTN	RF	24 AWG TWS
	ROPE SYCK & RTN	RF	24 AWG TWS
1B	ROPE SD16 1 & RTN	RF	24 AWF TWS
	ROPE SDSP 1 & RTN	RF	24 AWF TWS
	ROPE SDCK 1 & RTN	RF	24 AWG TWS
	ROPE FTPL 1 & RTN	RF	24 AWG TWS
	ROPE FMLP 1 & RTN	RF	24 AWG TWS
	ROPE SD16 2 & RTN	RF	24 AWG TWS
	ROPE SDSP 2 & RTN	RF	24 AWG TWS
	ROPE SDCK 2 & RTN	RF	24 AWG TWS
	ROPE FTPL 2 & RTN	RF	24 AWG TWS
	ROPE FMPL 2 & RTN	RF	24 AWG TWS
1C	ROPE 1.5A PWR & RTN	~ ~~@~~410 mA	20 AWG TWS
	ROPE 5.0A PWR & RTN	~ ~~@~~2.4A PEAK	20 AWG TWS
	ROPE PPDA HTR PWR & RTN	~ ~~@~~100 mA	20 AWG TWS
	ROPE PCDA HTR PWT & RTN	~ ~~@~~100 mA	20 AWG TWS
2	HVU1 CMDS (9)	5V DIGITAL	24 AWG
	HVU1 MONITORS (12)	0-5V ANALOG	24 AWG
	COMMON (2)		24 AWG
	SYCK & RTN	RF	24 AWG TWS
	+28V & RTN	~ ~~@~~200 mA	24 AWG TWS
3	+PPS (~~6~~)3	0 TO +2200V STEPPING	REYNOLDS 167-2896
	-PPS (~~6~~)3	0 TO -2200V STEPPING	REYNOLDS 167-2896
	+HVPS (~~6~~)3	+2650V OR +2950V	REYNOLDS 167-2896
	-HVPS (~~6~~)3	-2650V OR -2950V	REYNOLDS 167-2896

NOTE: CABLE SHIELD IS USED FOR RETURN

④	SPES OUTPUT (~~12~~)6	5V DIGITAL	26 AWG
	+5V (~~12~~)6	-12mA EACH	26 AWG
	+5V RTN (~~12~~)6		26 AWG
	+BIAS (~~6~~)3	+1V/+5V	26 AWG
	-BIAS (~~6~~)3	-1V/-5V	26 AWG

NOTE : 26 AWG WIRE IS FACTORY INSTALLED IN MDM-9 CONNECTORS ON SPES END OF CABLE. AER TO CUT TO LENGHT AND TERMINATE AT CEP END OF CABLE. +5V AND +5V RTN WIRES MAY BE TWISTED. ANY WIRES, OR THE ENTIRE CABLE, MAY BE OVER-SHIELDED.

⑤	SEND & RTN	RF	24 AWG TWS
	RECEIVE & RTN	RF	24 AWG TWS
	ROPE FTPL 2 & RTN	RF	24 AWG TWS
	ROPE FMPL 2 & RTN	RF	24 AWG TWS
	SYCK & RTN	RF	24 AWG TWS
	PPS HIGH & RTN	0-10V ANALOG (HO)	24 AWG TWS
	PPS LOW & RTN	0-10V ANALOG (HO)	24 AWG TWS
	PPS HIGH/LOW & RTN	5V DIGITAL (ML)	24 AWG TWS
	INPUT VOLT. MON & RTN	0-5V ANALOG	24 AWG TWS
	INPUT CUR. MON & RTN	0-5V ANALOG	34 AWG TWS
	FPS OUTPUT MON & RTN	0-5V ANALOG	24 AWG TWS
	FPS TEMP MON & RTN	0-5V ANALOG	24 AWG TWS
	IPS TEMP MON & RTN	0-5V ANALOG	24 AWG TWS
	ROPE 5.0A PWR & RTN	~ ~~@~~2.4A PEAK	20 AWG TWS
	ROPE PPDA HEATER PWR &RTN	~ ~~@~~100 mA	20 AWG TWS
	ROPE PCDA HEATER PWR &RTN	~ ~~@~~100 mA	24 AWG TWS

NOTE: PPS HIGH/LOW MAY BE DELETED.

⑥	SPES OUTPUT (4)	5 DIGITAL	REYNOLDS 178-7215
	+5V (4)	~ ~~@~~12 mA EACH	REYNOLDS 178-7215
	+5V RTN (4)		REYNOLDS 178-7215
	+BIAS (2)	+1V/+5V	REYNOLDS 178-7215
	-BIAS (2)	-1V/-5V	REYNOLDS 178-7215

NOTE: REYNOLDS 178-7215 WIRE IS INSTALLED IN MDM-9 CONNECTCRS ON SPES END OF CABLE. AER TO CUT TO LENGTH AND TERMINATE AT FS END OF CABLE. +5V AND +5V RTN WIRES MAY BE TWISTED. ANY WIRES, OR THE ENTIRE CABLE MAY BE OVER-SHIELDED, BUT AER IS CAUTIONED THAT THE CONDUCTORS ARE REFERENCED TO THE PPS OUTPUT (O TO ~~5000V~~ -500V FLOATING).

⑦

HVU2 CMDS (9)	5V DIGITAL	REYNOLDS 178-7215
HVU2 MONITORS (12)	0-5V ANALOG	REYNOLDS 178-7215
ISOLATED COMMON (2)		REYNOLDS 178-7215
ISOLATED SYCK	RF	REYNOLDS 167-2896
ISOLATED SYCK RTN		REYNOLDS 167-2896
ISOLATED +28V	~140 mA	REYNOLDS 167-9346
ISOLATED +28V RTN		REYNOLDS 167-9346

CAUTION: ALL WIRES AND SHIELDS ARE REFERENCED TO FPS OUTPUT (0 TO -500V, FLOATING). ~~SEE CAUTION NOTE 3 FOR CABLE 9 CONCERNING SHIELD INSULATION REQUIREMENTS.~~

⑧

DATA IN (8)	5V DIGITAL	REYNOLDS 178-7215
DATA OUT (8)	5V DIGITAL	REYNOLDS 178-7215
ENABLE	5V DIGITAL	REYNOLDS 178-7215
TIME TAG	DIGITAL PULSE	REYNOLDS 178-7215
RESET	DIGITAL PULSE	REYNOLDS 178-7215
ISOLATED COMMON		REYNOLDS 178-7215
ISOLATED SYCK & RTN	RF	REYNOLDS 178-7215
ISOLATED +28V & RTN	~180 mA	REYNOLDS 178-7633

NOTE: ISOLATED SYCK AND RETURN MAY BE TWISTED. ISOLATED +28V AND RETURN MAY BE TWISTED.

CAUTION: ALL WIRES ARE REFERENCED TO FPS OUTPUT (0 TO -500V ~~5000V,~~ FLOATING).

⑨

+PPS (2)	0V/+2200V	REYNOLDS 167-2896
-PPS (2)	0V/-2200V	REYNOLDS 167-2896
+HVPS (2)	+2650V/+2950V	REYNOLDS 167-2896
-HVPS (2)	-2650V/-2950V	REYNOLDS 167-2896

CAUTION:

1. CABLE SHIELD IS USED FOR HV RETURN.
2. CABLE CENTER CONDUCTORS AND SHIELDS (HENCE CONNECTOR SHELLS) ARE REFERENCED TO PPS OUTPUT (0 TO -500V ~~5000V~~, FLOATING).
3. ~~CABLE OUTER JACKET TO SHIELD INSULATION SPECIFICATION IS 1500 V AC RMS, AND SHIELDS MUST HAVE >5000V TOTAL ISOLATION FROM SATELLITE STRUCTURE. INSULATING STANDOFFS AND/OR SLEEVING ARE REQUIRED AS PART OF CABLE DISIGN, CONSTRUCTION, AND INSTALLATION.~~

⑩	DIFP OUTPUT	0-5V ANALOG	REYNOLDS 167-2896
	+DEFLECTOR	+100V TO -100V SWEEP	REYNOLDS 178-7215
	-DEFLECTOR	-100V TO +100V SWEEP	REYNOLDS 178-7215
	GRID BIAS	-100V	REYNOLDS 178-7215
	RETARD	0 TO +100V	REYNOLDS 178-7215
	BIT 0 GAIN	5V DIGITAL	REYNOLDS 178-7215
	BIT 1 GAIN	5V DIGITAL	REYNOLDS 178-7215
	+7.5V	-10 mA	REYNOLDS 178-7215
	-7.5V	-10 mA	REYNOLDS 178-7215
	COMMON		REYNOLDS 178-7215

CAUTION: ALL WIRES, AND SHIELD OF DIFP OUTPUT CABLE, ARE REFERENCED TO FPS OUTPUT (0 TO -500V ~~-5000V~~, FLOATING. ~~SEE CAUTION NOTE 3 FOR CABLE 9 CONCERNING SHIELD INSULATION REQUIREMENT.~~

⑪ BOOM MOUNTED SENSOR PACKAGE (BMSP) HEATER AND TEMPERATURE SENSOR REQUIREMENTS ARE TBD.

NOTE: There is no provision for power and control leads for the BMSP heater. This is TBD at this time.

Fig. 7.7.1.1 : Experiment - to - Satellite Connector Matrix of Unit 1812 (CEP)

EXPERIMENT : ROPE

UNIT : 1812 (CEP)

TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011812 P		ROPE SERIAL CMD	311P407-2P-B-12	26	14
021812 P		ROPE SERIAL CMD/MNT	311P407-2P-B-12	26	20
031812 P		ROPE EXPT & HTR POWER	311P409 -1P-B-12	9	8

Figure 7.7.1.2: Contact Functions of Connector 011812P

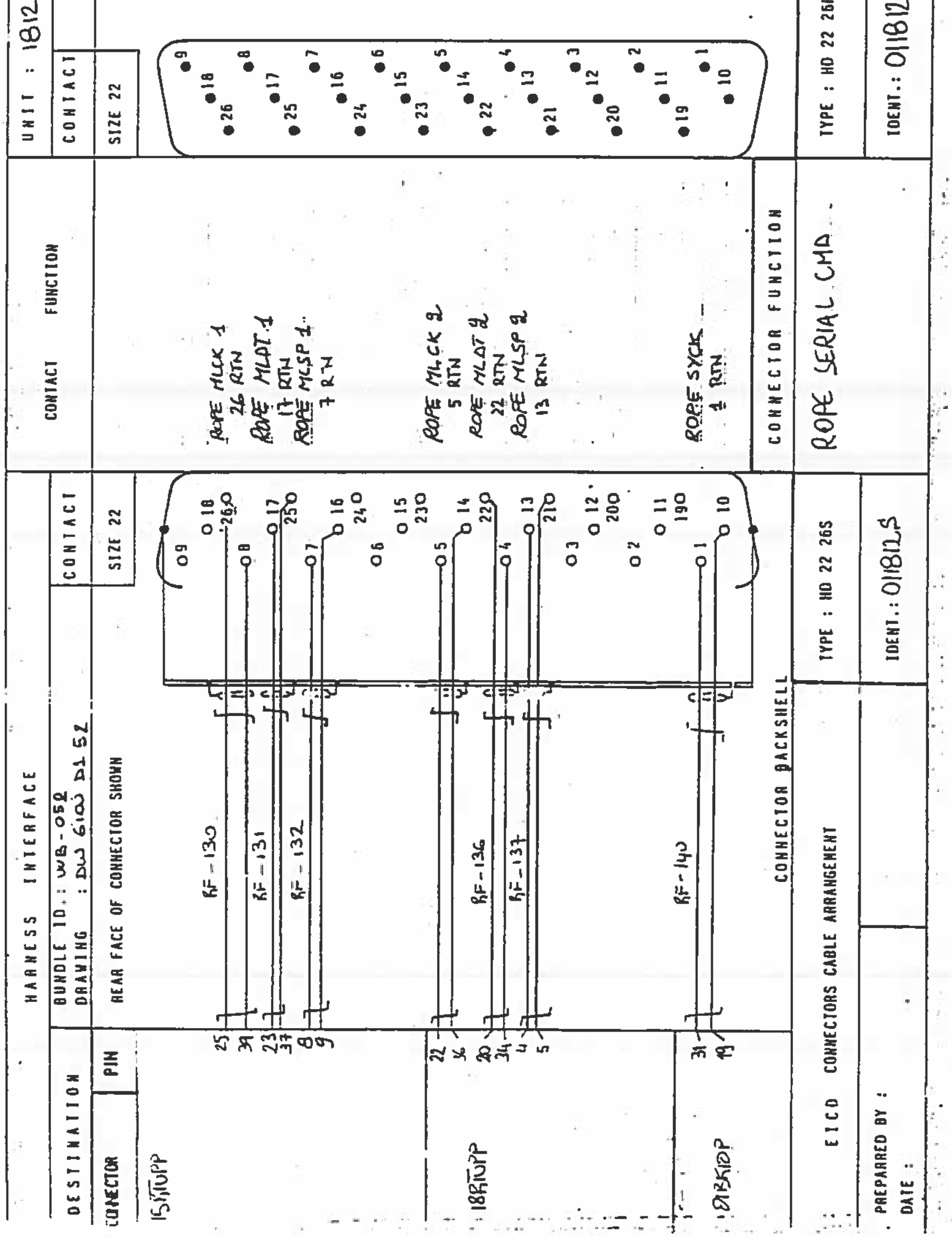
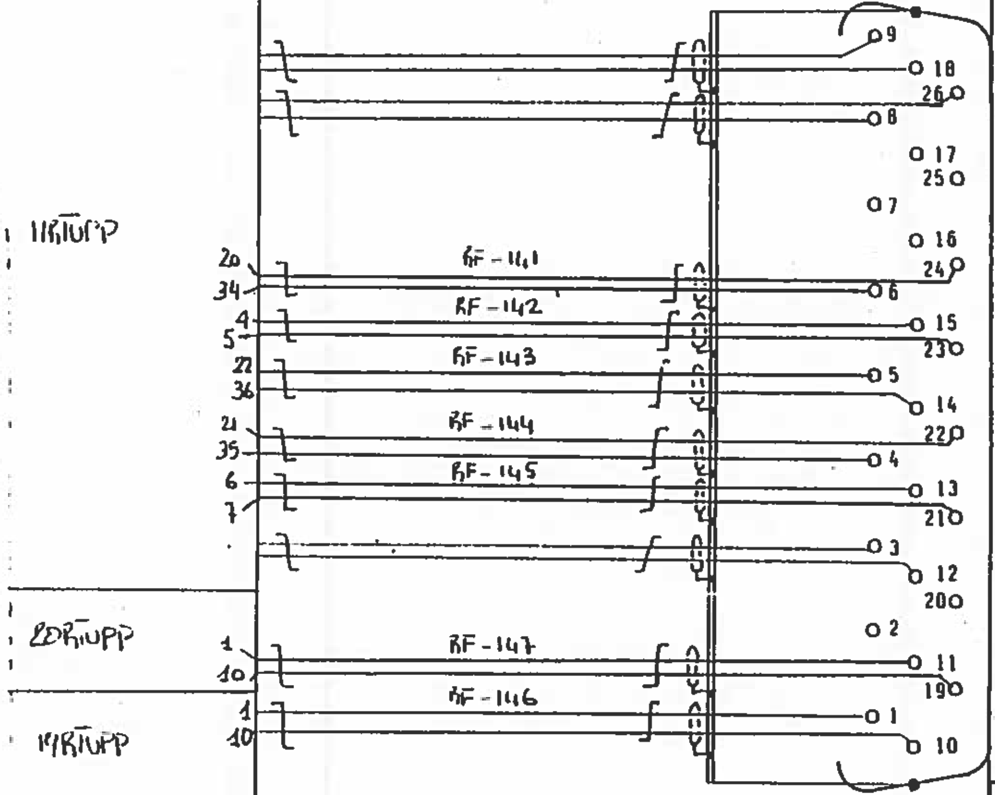


Figure 7.7.1.3: Contact Functions of Connector 021812P

HARNESS INTERFACE
BUNDLE ID.: WB-052
DRAWING : DW 6100 D1 52
REAR FACE OF CONNECTOR SHOWN

DESTINATION
CONNECTOR | PIN

CONTACT SIZE 22



CONNECTOR BACKSHELL

CONTACT FUNCTION

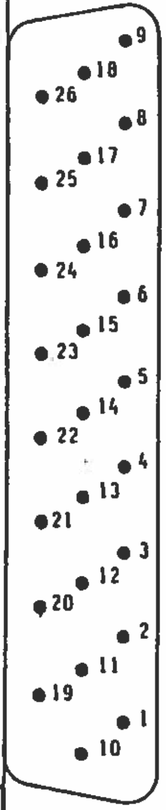
ROPE FTPL 1
9 RTN
ROPE FRPL 1
26 RTN

ROPE SD16 1
24 RTN
ROPE SDSP 1
15 RTN
ROPE SDCK
5 RTN
ROPE SD16 2
22 RTN
ROPE SDSP2
13 RTN
ROPE SDCK 2
3 RTN

ROPE FTPL 2
11 RTN
ROPE FRPL 2
1 RTN

CONNECTOR FUNCTION
ROPE SERIAL CMD/MNT

UNIT : 1812
CONTACT SIZE 22



EICO CONNECTORS CABLE ARRANGEMENT
TYPE : HD 22 26S
IDENT.: 021812S
TYPE : HD 22 26P
IDENT.: 021812P
PREPARED BY
DATE :

TSS SATELLITE

TETHERED SATELLITE SYSTEM

EXPERIMENT INTERFACE DOCUMENT

Doc. N°

Issue Date

Page

Figure 7.7.1.4: Contact Functions of Connector 031812P

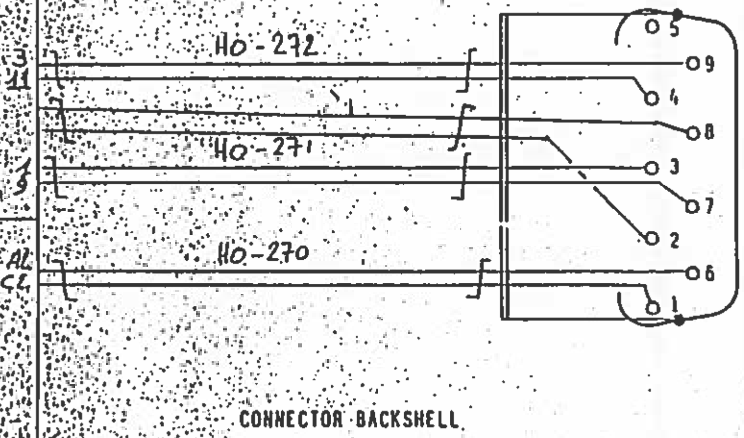
HARNESS INTERFACE

DESTINATION

UNIT	CONNECTOR
PPDA	02PPDAP
JM18	

BUNDLE ID.: WB-033
DRAWING : DW 6100 01 33
REAR FACE OF CONNECTOR SHOWN.

CONTACT SIZE 20



CONTACT FUNCTION

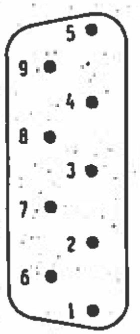
ROPE HTR PWR FROM PPDA
9 RTN
ROPE PWR (5.0 A)
ROPE PWR (1.5 A)
3 RTN
8 RTN
ROPE HTR PWR FROM PCDA
6 RTN

CONNECTOR FUNCTION

ROPE EXPT & HTR PWR

UNIT: 18/2

CONTACT SIZE 20



E.I.C.D. CONNECTORS CABLE ARRANGEMENT

TYPE : DEMA 9S

IDENT.: 031812S

TYPE : DEMA 9P

IDENT.: 031812P

PREPARRED BY

DATE

SHEET OF

Figure 7.7.2.1 : Experiment - to - Experiment Connector Matrix of Unit 1801 (SPES 1)

EXPERIMENT : ROPE

UNIT : 1801 (SPES 1)

TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011801 S	(1)	FROM/TO FS 021813S H.V.	S MDM-9SH003P-A174 CANNON	9	8
021801 P		+PPS FROM 021811P H.V.	167-3771 REYNOLDS	1	1
031801 P		+HVPS FROM 061811P H.V.	167-3771 REYNOLDS	1	1
041801 P		-HVPS FROM 081811P H.V.	167-3771 REYNOLDS	1	1
051801 P		-PPS FROM 041811P H.V.	167-3771 REYNOLDS	1	1
061801 P		PROTON CHANNEL TEST H.V.	51-427-3188 SEALECTRO	1	1
071801 P		ELECTRON CHANNEL TEST H.V.	51-427-3188 SEALECTRO	1	1

(1) Experimenter will furnish cable half of connector.
~~Own H.V. isolation is inadequate to foreseen voltage levels w.r.t. structure.~~
Mixing of signals belonging to different EMC classes occurs in connector.

(2) CONNECTORS 06 & 07 ARE FOR TEST ONLY.

Figure 7.7.2.2 : Experiment - to - Experiment Connector Matrix of Unit 1802 (SPES2)

EXPERIMENT : ROPE

UNIT : 1802 (SPES2)

TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011802S	(1)	FROM/TO FS 021813S H.V.	S MDM-9~~B~~H003P-A174 CANNON	9	8
021802P		+PPS FROM 031811P H.V.	167-3771 REYNOLDS	1	1
031802P		+HVPS FROM 071811P H.V.	167-3771 REYNOLDS	1	1
041802P		-HVPS FROM 091811P H.V.	167-3771 REYNOLDS	1	1
051802P		-PPS FROM 051811P H.V.	167-3771 REYNOLDS	1	1
061802P		PROTON CHANNEL TEST H.V.	51-427-3188 SEALECTRO	1	1
071802P		ELECTRON CHANNEL TEST H.V.	51-427-3188 SEALECTRO	1	1

(1) Experimenter will furnish cable half of connector.
~~Own H.V. isolation is inadequate to foreseen voltage levels w.r.t. structure~~ S2
Mixing of signals belonging to different EMC classes occurs in connector.

(2) CONNECTORS 06 & 07 ARE FOR TEST ONLY.

Figure 7.7.2.3 : Experiment -to - Experiment Connector Matrix of Unit 1803 (SPES3)

EXPERIMENT : ROPE

UNIT : 1803 (SPES3)

TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011803S	(1)	FROM/TO CEP 061812S ~~H.V.~~	MDM-9SH003P-A174 CANNON	9	8
021803 P		+PPS FROM ~~HVU1~~ 021810P H.V.	167-3771 REYNOLDS	1	1
031803P		+HVPS FROM ~~HVU1~~ 081810P H.V.	167-3771 REYNOLDS	1	1
041803P		-HVPS FROM HVU1 111810P H.V.	167-3771 REYNOLDS	1	1
051803P		-PPS FROM ~~HVU1~~ 051810P H.V.	167-3771 REYNOLDS	1	1
061803P		PROTON CHANNEL TEST	51-427-3188 SEALECTRO	1	1
071803P		ELECTRON CHANNEL TEST	51-427-3188 SEALECTRO	1	1

(1) Experimenter will furnish cable half of connector.
~~Own H.V. isolation is inadequate to foreseen voltage levels w.r.t. structure.~~
Mixing of signals belonging to different EMC classes occurs in connector.

(2) CONNECTORS 06 & 07 ARE FOR TEST ONLY.

Figure 7.7.2.4 : Experiment - to - Experiment Connector Matrix of Unit 1804 (SPES4)

EXPERIMENT : ROPE			UNIT : 1804 (SPES4)		
TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011804S	(1)	FROM/TO CEP 061812S ~~H.V.~~ S	S MDM-9~~S~~H003P-A174	9	8
021804P		031810P +PPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
031804P		091810P +HVPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
041804P		121810P -HVPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
051804P		061810P -PPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
061804P		PROTON CHANNEL TEST	51-427-3188 SEALECTRO	1	1
071804P		ELECTRON CHANNEL TEST	51-427-3188 SEALECTRO	1	1

(1) Experimenter will furnish cable half of connector.
~~Own H.V. isolation is inadequate to foreseen voltage levels w.r.t. structure.~~ S
Mixing of signals belonging to different EMC classes occurs in connector.

(2) CONNECTORS 06 & 07 ARE FOR TEST ONLY.

Figure 7.7.2.5 : Experiment - to - Experiment Connector Matrix of Unit 1805 (SPES5)

EXPERIMENT : ROPE			UNIT : 1805 (SPES5)		
TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011805S	(1)	FROM/TO CEP 061812S ~~H.V.~~ 9	MDM-9BH003P-A174 CANNON	9	8
021805P		041810P +PPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
031805P		101810P +HVPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
041805P		131810P -HVPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
051805P		071810P -PPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
061805P		PROTON CHANNEL TEST	51-427-3188 SEALECTRO	1	1
071805P		ELECTRON CHANNEL TEST	51-427-3188 SEALECTRO	1	1

(1) Experimenter will furnish cable half of connector.
~~Own H.V. isolation is inadequate to foreseen voltage levels w.r.t.~~
Mixing of signals belonging to different EMC classes occurs in connector.

(2) CONNECTORS 06 & 07 ARE FOR TEST ONLY.

Delete

Figure 7.7.2.6 : Experiment - to - Experiment Connector Matrix of Unit 1806 (SPES6)

EXPERIMENT : ROPE			UNIT : 1806 (SPES6)		
TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011806S	(1)	FROM/TO CEP 061812S H.V.	MDM-95H003P-A174 CANNON	9	8
021806P		+PPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
031806P		+HVPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
041806P		-HVPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
051806P		-PPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
061806P		PROTON CHANNEL TEST	51-427-3188 SEALECTRO	1	1
071806P		ELECTRON CHANNEL TEST	51-427-3188 SEALECTRO	1	1

(1) Experimenter will furnish cable half of connector.
Own H.V. isolation is inadeguate to foreseen voltage levels w.r.t. structure.
Mixing of signal belonging to different EMC classes occurs in connector.

(2) CONNECTORS 06 & 07 ARE FOR TEST ONLY.

Delete

Figure 7.7.2.7 : Experiment - to - Experiment Connector Matrix fo Unit 1807 (SPES7)

EXPERIMENT : ROPE

UNIT : 1807 (SPES7)

TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011807S	(1)	FROM/TO CEP 061812S H.V.	MDM-95H003P-A174 CANNON	9	8
021807P		+PPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
031807P		+HVPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
041807P		-HVPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
051807P		-PPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
061807P		PROTON CHANNEL TEST	51-427-3188 SEALECTRO	1	1
071807P		ELECTRON CHANNEL TEST	51-427-3188 SEALECTRO	1	1

(1) Experimenter will furnish cable half of connector.
Own H.V. isolation is inadequate to foreseen voltage levels w.r.t. structure.
Mixing of signals belonging to different EMC classes occurs in connector.

(2) CONNECTORS 06 & 07 ARE FOR TEST ONLY.

DIFP-S

Figure 7.7.2.9 : Experiment - to - Experiment Connector Matrix of Unit 1809 ~~(SPES9)~~

EXPERIMENT : ROPE

UNIT : 1809 (DIFP-S)

	TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
	011809P	(1)	TO/FROM 011814S ~~H.V.~~	311P405-2P-D~~B~~12 ITT CANNON	15	10

(1) ~~Own H.V. isolation is inadequate to foreseen voltage levels w.r.t. structure.~~
Mixing of signals belonging to different EMC classes occurs in connector.

Delete

Figure 7.7.2.8 : Experiment - to - Experiment Connector Matrix of Unit 1808 (SPES8)

EXPERIMENT : ROPE

UNIT : 1808 (SPES8)

TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011808S	(1)	FROM/TO CEP 061812S H.V.	MDM-95H003P-A174 CANNON	9	8
021808P		+PPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
031808P		+HVPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
041808P		-HVPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
051808P		-PPS FROM HVU1 H.V.	167-3771 REYNOLDS	1	1
061808P		PROTON CHANNEL TEST	51-427-3188 SEALECTRO	1	1
071808P		ELECTRON CHANNEL TEST	51-427-3188 SEALECTRO	1	1

(1) Experimente will furnish cable half of connector.
Own H.V. isolation is inadeguate to foreseen voltage levels w.r.t. structure.
Mixing of signals belonging to different EMC classes occurs in connector.

(2) CONNECTROS 06 & 07 ARE FOR TEST ONLY.

Figure 7.7.2.10 : Experiment - to - Experiment Connector of Unit 1810 (HVU1)

EXPERIMENT : ROPE

UNIT : 1810 (HVU1)

TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011810P	(1)(2)	TO/FROM 041812S ~~H.V.~~	311-P407-3P-B12 AMP	44	27
021810P		+PPS TO 021803P H.V.	167-3771 REYNOLDS	1	1
031810P		~~+HVPS~~ +PPS TO ~~031803P~~ 021804P H.V.	167-3771 REYNOLDS	1	1
041810P		~~-HVPS~~ +PPS TO ~~041803P~~ 021805P H.V.	167-3771 REYNOLDS	1	1
051810P		-PPS TO ~~041803P~~ 051803P H.V.	167-3771 REYNOLDS	1	1
061810P 071810P		-PPS to 051804P H.V. -PPS to 051805P H.V.		1 1	1 1
081810P 091810P		+ ~~1804-1808~~ HVPS to 031803P H.V. + HVPS to 031804P H.V.		1 1	1 1
101810P 111810P		+ HVPS to 031805P H.V. - HVPS to 041803P H.V.		1 1	1 1
121810P ~~251810P~~ 131810P		- HVPS to 041804P H.V. - HVPS to 041805P H.V.	167-3771 REYNOLDS	1 1	1 1

(1) Mixing of signal belonging to different EMC classes occurs in connector.

(2) 011810P may need to be 311PH09-4P-B-12

Figure 7.7.2.11 : Experiment - to - Experiment Connector Matrix of Unit 1811 (HVU2)

EXPERIMENT : ROPE			UNIT : 1811 (HVU2)		
TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011811P	(1) (2)	TO/FROM 0341813S H.V.	311-P407-3P-B12 AMP	44	27
021811P		+PPS TO 021801P H.V.	167-3771 REYNOLDS	1	1
031811P		+PPS TO 021802P H.V.	167-3771 REYNOLDS	1	1
041811P		-PPS TO 051801P H.V.	167-3771 REYNOLDS	1	1
051811P		-PPS TO 051802P H.V.	167-3771 REYNOLDS	1	1
061811P		+HVPS TO 031801P H.V.	167-3771 REYNOLDS	1	1
071811P		+HVPS TO 031802P H.V.	167-3771 REYNOLDS	1	1
081811P		-HVPS TO 041801P H.V.	167-3771 REYNOLDS	1	1
091811P		-HVPS TO 041802P H.V.	167-3771 REYNOLDS	1	1

(1) ~~Own H.V. isolation is inadequate to foreseen voltage levels w.r.t. to structure~~
Mixing of signals belonging to different EMC classes occurs in connector.

(2) 011811P may need to be 311P409 - 4P-B-12

Figure 7.7.2.12 : Experiment - to - Experiment Connector Matrix of Unit 1812 (CEP)

EXPERIMENT : ROPE			UNIT : 1812 (CEP)		
TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
041812S	(1)	TO/FROM CONN. 011810P	311P407-3S-B-12 AMP	44	27
051812S	(1)	TO/FROM CONN. 011813P	311P409-4S-B-12 ~~ITT CANNON~~ AMP	37	32
061812S	(1) ~~(2)~~	TO/FROM 011803S THRU 01180~~8~~5S	311P407-~~4~~3S-B-12 AMP	~~62~~ 44	~~48~~ 24

(1) Mixing of signals belonging to different EMC classes occurs in connector.

~~(2) Own H.V. isolation is inadequate to foreseen voltage levels w.r.t. structure.~~

Figure 7.7.2.13 : Experiment - to - Experiment Connector Matrix of Unit 1813 (FS)

EXPERIMENT : ROPE

UNIT : 1813 (FS)

TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011813P	(1)	5 TO/FROM CEP 061812S ~~H.V.~~	311P409-4P-B12 ~~ITT CANNON~~ AMP	37	32
021813S	(1) (2)	TO/FROM 011801S & 02S H.V.	311P407-2S-B12 AMP	26	16
031813S	(1) (3)	TO/FROM 011811P H.V.	311P407-3S-B12 AMP	44	27
041813S	(1)(*)~~(2)~~	TO/FROM 021814P H.V.	311P409-3S-B12 ~~ITT CANNON~~ AMP	25	24
				No. of Pins' will change (drop) w/ update?	

BOOM SENSOR HEATER POWER AND TEPERATURE SENSOR INTERFACE: TBD

(1) Mixing of signal belonging to different EMC classes occurs in connector.
~~(2) Own H.V. isolation is inadequate to foreseen voltage levels w.r.t. structure.~~
(*) Connector size may not allow cable configuration compliant with TS-SR-AI-005 and/or TS-SR-AI-002.

(2) 021813S may need to be 311P409-3S-B-12
(3) 031813S " " " " 311P409-4S-B-12

igure 7.7.2.14 : Experiment - to - Experiment Connector Matrix of Unit 1814 (DIFP-E)

EXPERIMENT : ROPE

UNIT : 1814 (DIFP-E)

TSS CONNECTOR ID.	SUB-CONNECTOR ID.	CONNECTOR FUNCTION	CONNECTOR PART NUMBER	PIN Q.TY	PIN USED
011814S	(1)	TO/FROM 011809P H.V.	311P409-2S-B12 ~~ITT CANNON~~ Amp	15	10
021814P	(1) (*)	TO/FROM 041813S H.V.	311P409-3P-B12 ~~ITT CANNON~~ Amp	25	24

No. Pins may drop w/ Update

(1) Mixing of signals belonging to different EMC classes occurs in same connector.
~~Own H.V. isolation is inadequate to foreseen voltage levels w.r.t. structure.~~

(*) Connector size may not allow cable configuration compliant with TS-SR-AI-005 and/or TS-SR-AI-002.

Figure 7.7.2.15 : List of Monitors

	ROPE MONITORS
SPES3-~~B~~5	NONE
HVU1,2	+30V
	+30V CURRENT
	HVPS +V
	HVPS -V
	HVPS CURRENT
	HVPS TEMPERATURE
	PPS +V
	PPS -V
	PPS CURRENT
	PPS TEMPERATURE
CEP	INPUT VOLTAGE
	INPUT CURRENT
	+5V
	+15V
	-15V
	+BIAS (6)
	-BIAS (6)
	CEP TEMPERATURE
FS	INPUT VOLTAGE
	INPUT CURRENT
	PPS OUTPUT
	PPS TEMPERATURE
	IPS TEMPERATURE
	+5V
	+15V
	-15V
	+28V
	+BIAS (2)
	-BIAS (2)
	FSE TEMPERATURE
DIFP-E	~~TBD~~ None *

BMSP (DIFP-S, SPES1-2, Heaters, Temp. Sensor) TBD

* all DIFP monitors are in telemetry.

7.8 Timing Requirements

7.8.1 Frame and Format Pulse Channels (FRPL, FTPL)

The characteristics of the frame and format pulse channels are in TS-SR-AI-005, 6.3.2.1.3.1. In particular, the relative phase of the format and frame pulses is shown in TS-SR-AI-005, Figure 6.3.2.1.3.1.1.

The relative phase of the frame pulse and the falling edge of the sampling signal issued by the RTUP to the Experiment is trp = [500(n-1)-128.9-267.6] microsec for the n-th word in the telemetry frame. Clarification is given in Figure 7.8.1.1.

Figure 7.8.1.1: Relative Phase of Frame Pulse and Falling Edge of Sampling Signal Issued by RTUP.

8.0 THERMAL INTRFACES

8.1 Thermal Interface Control Drawing

To be provided by the Experimenter.

8.2 Experiment Unit Thermal Location

Unit Code	Function	Thermal Location		
		Inside Thermal Env.	Outside Thermal Env.	View to Space
1801	Soft Particle Energy Spectometer		X	X
1802	Soft Particle Energy Spectrometer		X	
1803 to 0~~8~~5	Soft Particle Energy Spectrometer	X		X
1809	Differential Ion Flux Probe - Sensor		X	
1810	High Voltage Unit	X		
1811	High Voltage Unit	X		
1812	Central Electronics Unit	X		
1813	Floating Supply	X		
1814	DIFP Electronics	X		

8.3 Temperature Sensors

Unit Code	Sensor Location	Sensor Type	Range °C		TLM Ch.
			Min.	Max.	
1801 & 1802	~~One inside each unit~~ NONE	~~Thermistor~~	~~TBD~~	~~TBD~~	
1803 to ~~08~~ 5	~~One Indide each unit~~ NONE	~~Thermistor~~	~~TBD~~	~~TBD~~	
1809	Inside unit	Thermistor	TBD	TBD	
1810	Inside unit (X2)	Themistor	~~-30~~	~~+70~~	
1811	Inside unit (X2)	Thermistor	~~-30~~	~~+70~~	
1812	Inside unit	Thermistor	~~-30~~	~~+70~~	
1813	Inside unit (X3)	Thermistor	~~-30~~	~~+70~~	
1814	Inside unit	Thermistor	~~-30~~	~~+70~~	

all TBD

8.4 Thermal Data

The thermal date (emissivity, unit contact area, thermal capacity, number of working units, heat dissipation per unit, operating and non-operating temperature ranges, start-up minimum temperature) are displayed in the Thermal Data Sheet of Figure 8.4.1 where design temperatures are shown.

why?

For the fixed boom mounted sensor package (BMSP), the emissivity and the absorbivity shall be ~~0.82 and 0.29~~ respectively, the same as the white painted ~~Satellite skin.~~ TBD

8.5 Qualification/Acceptance Temperature Limits

The qualification/acceptance temperature limits are shown in TS-SR-AI-001, tables 4.3.1-15 and 4.3.1-16.

8.6 Special Thermal Control Devices

To be provided by the Experimenter.

8.7 Thermal Isolation Requirements (Conductance, Radiation)

TBD by the Experimenter. Compliance will be assured with the applicable documents, and in particular with TS-SR-AI-005.

TSS SATELLITE

TETHERED SATELLITE SYSTEM

EXPERIMENT INTERFACE DOCUMENT
Doc. N°
Issue
Date
Page

Figure 8.4.1a: Thermal Data Sheet

THERMAL DATA			EXPERIMENT : ROPE							SHEET Nr 1									Nr OF SHEETS : 2	
Nr	UNIT	EMISSIVITY, ε	UNIT CONTACT AREA (m² 10⁻³)	(2) THERMAL CAPACITY (J/°C) Min. Max.	NUMBER OF WORKING UNITS						HEAT DISSIPATION PER UNIT (WATTS)						OPERATING TEMPERAT. RANGE (°C) ①		START-UP MIN. T. °C	NONOPERAT TEMPERAT. RANGE (°C) ①	
					PRE OPERATIONAL	CHECK-OUT	DEPLOYMENT	STATION - KEEPING	RETRIEVAL	POST - OPERATIONAL	PRE - OPERATIONAL	CHECK-OUT	DEPLOYMENT	STATION KEEPING	RETRIEVAL	POST - OPERATIONAL	MIN	MAX		MIN	MAX
1	1801 SPES 1 (*)	~~[illegible]~~		349 385	X	1	1	1	1	-	0.1	0.1	0.1	0.1	0.1	-	-10	+50	-10	-20	+60
2	1802 SPES 2 (*)	~~[illegible]~~		349 385	X	1	1	1	1	-	0.1	0.1	0.1	0.1	0.1	-	-10	+50	-10	-20	+60
3	1803 SPES 3 (**)	0.85 to 0.90	(†)	349 385	-	1	1	1	1	-	0.1	0.1	0.1	0.1	0.1	-	-10	+50	-10	-20	+60
4	1804 SPES 4 (**)	0.85 to 0.90	(†)	349 385	-	1	1	1	1	-	0.1	0.1	0.1	0.1	0.1	-	-10	+50	-10	-20	+60
5	1805 SPES 5 (**)	0.85 to 0.90	(†)	349 385	-	1	1	1	1	-	0.1	0.1	0.1	0.1	0.1	-	-10	+50	-10	-20	+60
~~6~~	~~1806 SPES 6 (**)~~	~~0.85 to 0.90~~	~~(†)~~	~~349 385~~	~~-~~	~~1~~	~~1~~	~~1~~	~~1~~	~~-~~	~~0.1~~	~~0.1~~	~~0.1~~	~~0.1~~	~~0.1~~	~~-~~	~~-10~~	~~150~~	~~-10~~	~~-20~~	~~+60~~
~~7~~	~~1807 SPES 7 (**)~~	~~0.85 to 0.90~~	~~(†)~~	~~349 385~~	~~-~~	~~1~~	~~1~~	~~1~~	~~1~~	~~-~~	~~0.1~~	~~0.1~~	~~0.1~~	~~0.1~~	~~0.1~~	~~-~~	~~-10~~	~~150~~	~~-10~~	~~-20~~	~~+60~~
~~8~~	~~1808 SPES 8 (**)~~	~~0.85 to 0.90~~	~~(†)~~	~~349 385~~	~~-~~	~~1~~	~~1~~	~~1~~	~~1~~	~~-~~	~~0.1~~	~~0.1~~	~~0.1~~	~~0.1~~	~~0.1~~	~~-~~	~~-10~~	~~150~~	~~-10~~	~~-20~~	~~+60~~
9	1809 DIFP-S (*)	~~[illegible]~~		1026 1134	X	1	1	1	1	-	0.5	0.5	0.5	0.5	0.5	-	-10	150	-10	TBD	TBD
-	BMSP (1)	TBD	TBD	TBD	X	1	1	1	1	—	0.7	0.7	0.7	0.7	0.7	—	~~TBD~~	TBD	-10		

① FOR THE DEFINITION OF OPERATING AND NON-OPERATING QUALIFICATION TEMPERATURE RANGE REFER TO TS-SR-AI-005

BMSI? (rows 1–2)

BMSP (row 9)

-10 +60

Both -20 +60 \#

COMMENTS : (*) Outside Thermal Controlled Volume. Dissipation during preoperational is heater dissipation.
(**) Facing space (~ 1140 mm²)
(†) Depends on mounting brackets
(2) Assumption: Thermal Capacity = (Mass (g) x [illegible] ± 5 %) J/°C
(1) Does not include heater in heat dissipation no's.

Figure 8.4.1b: Thermal Data Sheet

THERMAL DATA | EXPERIMENT : ROPE | SHEET Nr 2 | Nr OF SHEETS : 2

Nr	UNIT	EMISSIVITY, ε	UNIT CONTACT AREA (m²)10⁻³ (a)	(b) THERMAL CAPACITY (J/°C) Min. Max	NUMBER OF WORKING UNITS						HEAT DISSIPATION PER UNIT (WATTS) (c)						OPERATING TEMPERAT. RANGE (°C) ①		START-UP MIN. T. °C	NONOPERAT. TEMPERAT. RANGE (°C) ①	
					PRE OPERATIONAL	CHECK-OUT	DEPLOYMENT	STATION - KEEPING	RETRIEVAL	POST-OPERATIONAL	PRE - OPERATIONAL	CHECK-OUT	DEPLOYMENT	STATION KEEPING	RETRIEVAL	POST-OPERATIONAL	MIN	MAX		MIN	MAX
10	1910 HVU1	0.85 to 0.90	32.05	1008 1114	–	1	1	1	1	–	--	4.04	4.04	4.04	4.04	–	-10	+50	-10	-20	+60
11	1911 HVU 2	0.85 to 0.90	32,05	1008 1114	–	1	1	1	1	–	--	3,39	3,38	3.38	3.38	–	-10	+50	-10	-20	+60
12	1912 CEP	0.85 to 0.90	32.11	2492 2742	–	1	1	1	1	–	–	4.29 +TBD	4.29 +TBD	4.29 +TBD	4.29 +TBD	–	-10	+50	-10	-20	+60
13	1913 FS	0,85 to 0.90	45.21	3103 3429	–	1	1	1	1	–	–	6.13 +TBD	6.13 +TBD	6.13 +TBD	6,13 +TBD	–	-10	+50	-10	-20	+60
14	1914 DIFP-E	0.85 to 0.90	51.69	3591 3969	–	1	1	1	1	–	–	4.50	4,50	4,50	4,50	–	-10	+50	-10	-20	+60

① FOR THE DEFINITION OF OPERATING AND NON-OPERATING QUALIFICATION TEMPERATURE RANGE REFER TO TS-SR-AT-005

COMMENTS : (a) Full mountplate area
(b) Assumption : Thermal Capacity = (Mass (g) x 0.9 ± 5 %)
(c) Data are inconsistent. See Power Data 7.2.2 and Figure 7.2.2.1

8.8 Emission Properties for Units Inside Satellite

Unit Code	Radiation Area (cm**2)	Absorptivity	Emissivity
1810		~~0.1-0.15~~	~~0.85-0.90~~
1811		~~0.1-0.15~~	~~0.85-0.90~~
1812		~~0.1-0.15~~	~~0.85-0.90~~
1813		~~0.1-0.15~~	~~0.85-0.90~~
1814		0.1- .15	0.85-0.90

The emission properties reported in the above table are achieved using an appropriate paint like Electrodag +501 or Chemglaze Z306.

$\alpha_s = .94 - .97$

$\epsilon = .85 - .89$

.1 - .115 wrong.

.85 - .90 OK.

8.9 Emission Properties for Units Outside Satellite

Unit Code	Radiation Area (cm**2)	Absorptivity	Emissivity
1801 & 1802		0.29	0.82
1809		~~0.29~~ TBD	~~0.82~~ TBD

9.0 ENVIRONMENTAL INTERFACES

The environmental interfaces shall be compliant with the applicable document TS-SR-AI-001, Environmental Specification.

9.1 Electromagnetic Cleanliness

The electromagnetic cleanliness shall be compliant with TS-SR-AI-002, TS-SR-AI-005, TS-RQ-AI-026, and TS-PL-AI-027. Interfering signal lines will be concentrated around 64 KHz, 128 KHz and 100.4 KHz, the latter is the Gyro electronics DC/DC converter wich is anticipated not to be synchronizable.

9.2 Chemical Cleanliness

9.2.1. Emission

Unit Code	Potential Non-Clean Materials	Material Characteristics
1801 to 180~~8~~5	None	
1809	None	
1810	None	
1811	None	
1812	None	
1813	None	
1814	None	

✓

Add Sutti contamination memo

9.2.2 Sensitivity

To be provided by the Experimenter.

9.3 Ground Environment

The general environmental conditions and requirements are in the applicable document TS-SR-AI-001.

The Experiment requires a dry nitrogen (N2) purge clean room environment. SPES detectors are to be kept in their environmentally protected shipping containers whenever possible. When not in their containers, they must be purged with dry nitrogen containing less than 1 PPM total hydrocarbons whenever they might be subjected to a potentially harmful atmosphere.

10.0 SATELLITE ATTITUDE REQUIREMENTS

Real time on-board attitude knowledge is not available for the Experiments. Near real time knowledge on the ground depends on POCC.

10.1 Post-flight Satellite Attitude Reconstruction Requirements.

Parameter	Required	Accuracy
Pitch Angle	Yes	± 1°
Roll Angle	Yes	± 1°
Yaw Angle	Yes	± 1°
Spin Rate (± 1 RPM)	Yes	± 0.01 RPM
Sun Aspect Angle	Yes	± 1°
Earth Signal	No	

10.2 Satellite Attitude Control Requirements

Parameter	Required	Accuracy
Yaw Angle	Yes	± 1°
Spin Rate (± 1 RPM)	Yes	± 0.1 RPM

11

11.0 EXPERIMENT GSE REQUIRED AT SYSTEM LEVEL

11.1 General EGSE

ph

Whereas the role of the EGSE at Experiment test level is to act as a stand-alone test equipment, its role at Satellite level testing is to act as a periferal of the OCOE. In this configuration all Experiment monitoring should be done via telemetry data received on the science data link.

Communication between OCOE and EGSE is by means of a single broad band coax cable terminating at the EGSE in a "LAN Access Unit" (LAU). The LAU interfaces to the EGSE are by means of two Cannon DB25S connectors wich provide connections to the High Level Conversation link and Science Data link.

rate and format?

In addition to the EGSE equipment required at subsystem level, the EGSE should be provided with two interfaces which are compatible with the RS232C interface standard for connection to the High Level and Science Date links (see document EID-03).

Provision of cable between user equipment and associated LAU is the responsibility of the user.

The general concept of the EGSE interface is shown in the drawing of Figure 11.1.1.

There should be maximum carry-forward of EGSE hardware and software from subsystem to system level to achieve maximum commonality of procedures, economy and minimum schedule risk.

The EGSE shall be:

- built to withstand transportation,
- provided with all transportation containers,
- provided with documentation,
- provided with tools, spare parts, etc...

14

The built quality shall be to all commer~~t~~cially acceptable standards with simple interfacing between units of the EGSE.

All connectors shall be clearly marked with their signal name and connector number.

11.2 MGSE

The ROPE instrumentation will be hand carried to the integration site for integration into the Satellite. All hardware will be ~~sealed in plastic bags and~~ trasnsported in containers that will serve for storage (so long as -20°C < T < +70°C) until integration activities are begun. All sensor will be provided with dust covers and/or purge covers that should remain on during integration to prevent mechanical demage or contamination. These covers will not interfere with electrical checkout. They may be removed during thermal-vac testing.Size and other characteristics shall be provided by the Experimenter. These covers are "non-flight items" to be removed before launch.

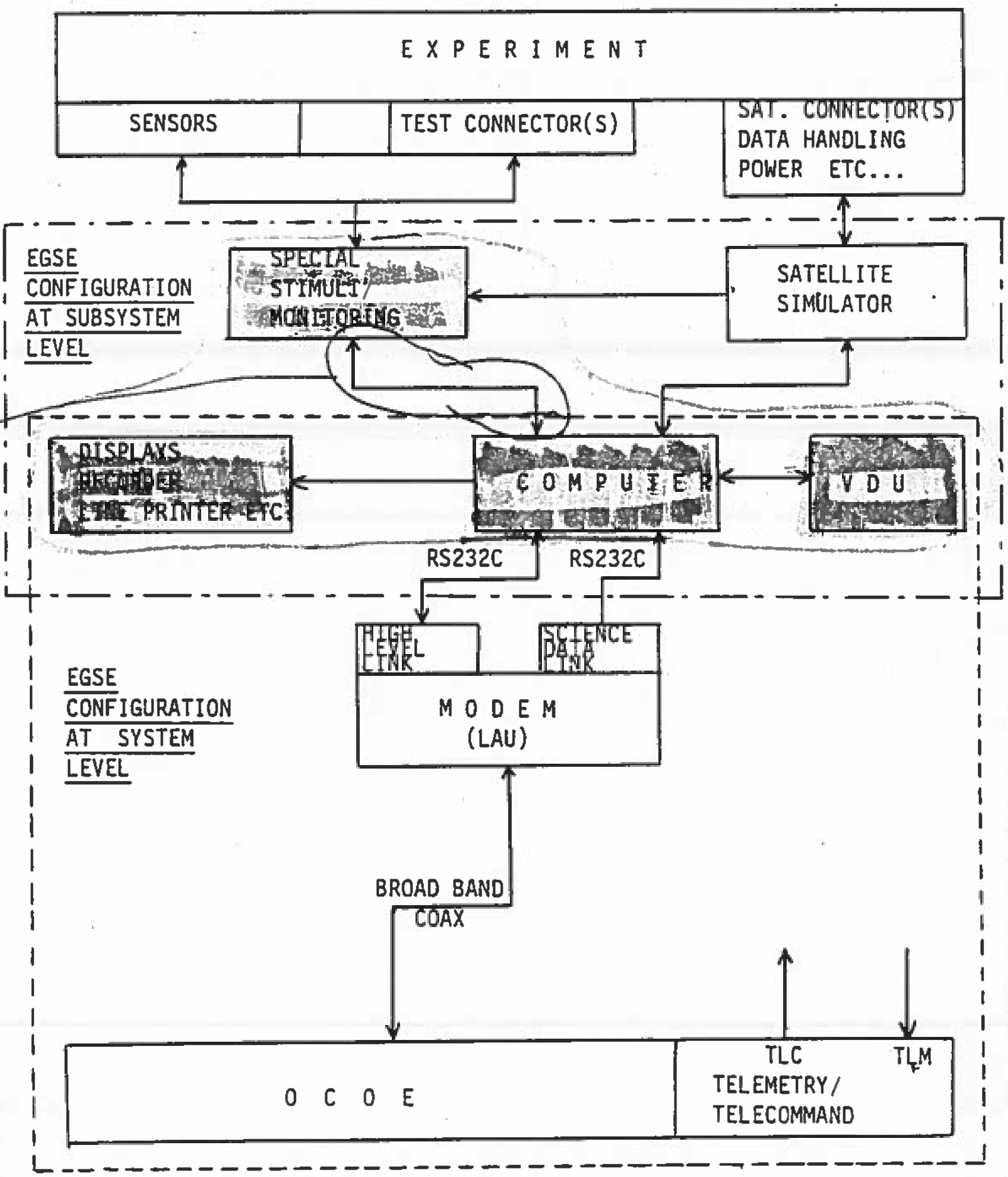
In view of the above consideration, the Experimenter does not anticipate the need for special storage containers or handling devices.

The Experimenter shall describe the following as a minimum:

1- Experiment peculiar MGSE and list of delivered Experiment MGSE items.
2- Expected laboratory standard tooling/equipment, (to be negotiated).
3- Laboratory, Experiment peculiar tooling/equipment, to be supplied by the Integrator (after negotiations).

Figure 11.2.1 shows the Experiment MGSE dr~~o~~awings

Figure 11.1.1: Experiment EGSE Interface Drawing General Concept



Control of Special Stimuli/monitoring should be controlled by experiment (RPE) EGSE

Not clear: the RPE understanding of EGSE functions & interfacing is on reverse side

14

Figure 11.2.1: Experiment MGSE Drawings.

TO BE PROVIDED BY THE EXPERIMENTER

TBD

11.3 EGSE

11.3.1 Hardware

To be provided by the Experimenter

11.3.2 Experiment Stimuli

To be provided by the Experimenter.

11.3.3 EGSE Main Functions

The Experiment EGSE must check the Experiment at bench level testing (i.e. when disconnected from the Satellite). To perform this function it provides the necessary power supply and the ability to command the Experiment and to get Experiment Housekeeping and Science data back.

Furthermore it must supply stimuli for calibration and function~~n~~al tests of the sensors.

The Experiment EGSE acts as a peri~~f~~pheral of the OCOE computer at Satellite level testing (i.e. as SCOE). Its main role is to stimulate Experiment sensors and verify scientific data transmitted by the OCOE.

The Experiment EGSE interfaces with the POCC as ground segment for real time data analysis and display are TBD.

11.3.4 EGSE Interfaces

Serial Channels

Experiment Test Level	Satellite Test Level

Parallel Channels

Experiment Test Level	Satellite Test Level

The EGSE interface drawing at Experiment test level is shown in Figure 11.3.4.1, and the EGSE interface drawing at Satellite test level is shown in Figure 11.4.2.

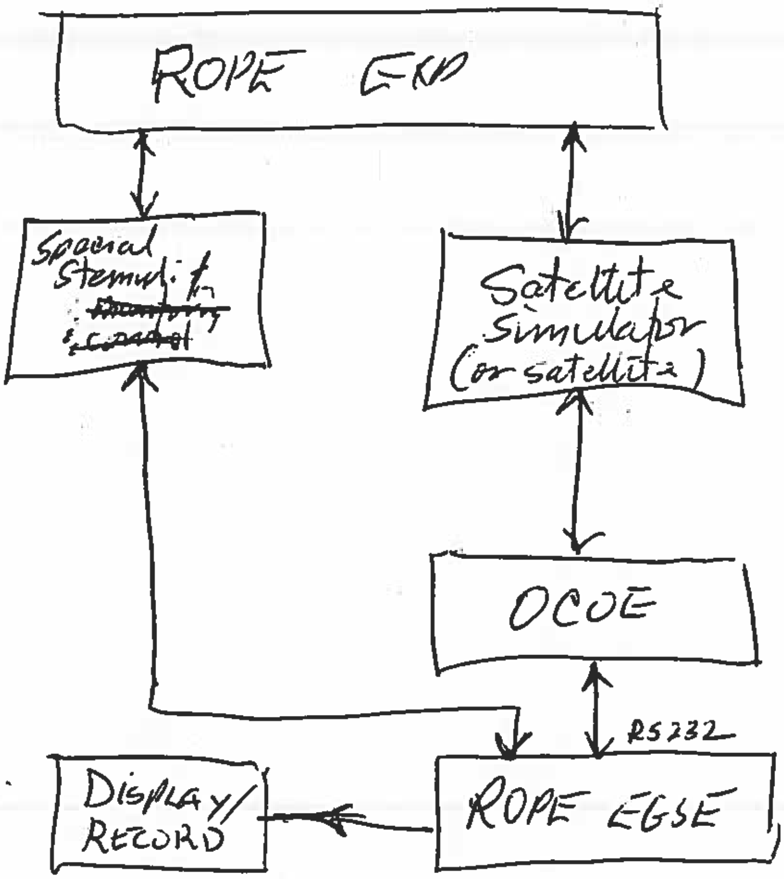
Figure 11.3.4.1: EGSE Interface Drawing: Experiment Test Level

<u>TO BE PROVIDED BY THE EXPERIMENTER</u>

TBD

Figure 11.3.4.2: EGSE Interface Drawing: Satellite Test Level

TO BE PROVIDED BY THE EXPERIMENTER



11.4 Experiment Integration and Test Reqirements

11.4.1 Integration Sequences of Experiment Units

To be provided by the Experimenter. It should also include classifications as: mandatory, recommended, etc....

11.4.2 Test Sequences

The Experimenters shall list the test sequences for:

- test during/after integration,
- IST (see TS-SR-AI-006 for definition): fully accessible Satellite, partial interactivity.
- ISC (see TS-SR-AI-006 for definition): non accessible Satellite, no interactivity.

11.4.3 Test duration

To be provided by the Experimenter.

14

12.0 EXPERIMENT OPERATION REQUIREMENTS

12.1 General Operation Requirements

The Experiment GSE inerface with the POCC is TBD.
No extraction of significant data sets from the instrument format data is foreseen as baseline service of the Satellite OBDH subsystem.

Quick look data requirements are TBD. Additional Satellite data necessary for off-line instrument data processing at ground are TBD.

The TLM bit rate requirements profile during the mission is in Figure 7.4.1.

The TLC (16 bit words or on/off commands) rate requirements profile during the mission is in Figure 7.3.1.

Operations to be performed by the Crew, in support of the Experiment, are TBD.

The Satellite OBDH gives no support to the Experiment.s with the possible exception of verification test via sensor stimulation during thermal vac testing ~~system level~~ satellite

12.2 Ground Operation and Calibration

The Experiment sensors (both DIFP-~~S~~2 and SPES) require a high vacuum plasma environment to operate. Therefore N ground checkout will be limited to a verification of voltage biases, sweep ranges and rates, operational modes, high voltage isolation, and the operational noise level.

During thermal-vac testing, it is possible to exercise the total hardware and software capability of the ROPE Experiment by stimulating the sensors and generating test data with filament emitted charged particles. This test appears to be the only means of verifying the complete Experiment hardware and software after delivery and before on-orbit operations. However, special filament holders must be designed for each instrument sensor and additional EGSE, cabling, and vacuum feed throughs would be required during thermal-vac testing.

15

The decision to initiate design of the additional required hardware will be made at a later date, pending a decision on the overall TSS Level 1 schedule and the rate of progress in the Experiment flight hardware design and fabrication. Command and data flow for the ROPE instrumentation during ground checkout will require the Satellite Overall Checkout Equipment (OCOE) to route all ROPE signals through an RS 232 Interface. SPES sensors must not be tested in diffusion and/or mechanical pumped vacuum chambers because pump oils will poison channel electron multipliers.

NOTE!

12.3 Experiment Operation Description

The following is considered indicative and is reproduced as provided be the Experimenter. The final Experiment operation description will be given after coordination with the other Experiments and with the TSS mission operations.

The Experiment will have a high voltage on/off command capability. In addition, it will be capable of being commanded to operate sensors in various sequences and in different measurement modes in order to maximize the scientific value of the data obtained within the allocated data rate. ?

The ROPE DIFP and SPES insturments should be checked out as soon as possible once the Orbiter payload bay ~~doors~~ 1x10^{-5} TO are open. (The high-voltage modes should ~~not be~~ initiated until the local gas pressure and ~~internal~~ Satellite gas pressure drop belw the 1.0E-04 Torr range). The instrument checkout should be conducted from the POCC where all instrument responses can be observed and data reduction and display software can be validated. In addition, the display of any data required at the Aft Flight Deck (AFD) should also be validated. In the event of anomalous operations, the experimental procedure should be replanned as required at this time.

0

OK

at [illegible]

The Experiment insturmentation should be operating at all times during the TSS deployment, on-station, and retrieval operations. The Satellite is required to spin at approximately 1 RPM at all stations to provide the necessary azimuthal coverage of Satellite induced plasma effects. Although the Satellite will not spin during deployment and retrieval operations, at least some of the Experiment sensors should collect valuable data during these periods that may be required to assess the overall system performance and its response to the Tether-generated emf.

Functional objectives will be developed that will provide a detailed outline of the required Satellite conditions, instrument operational modes, orbital constraints, Tether current, Satellite potential, and the timeline of the Experiment operations.

12.4 Experiment Modes of Operation

See section 4.4.

12.5 Operation before Deployment (Predeployment Quiescent and Check-out)

The mission phase referred to in this section is the one beginning with opening of Cargo Bay doors and ending ~~by~~ at the beginning of Tether deployment.

?
?,
1×10^{-5}

The ROPE DIFP and SPES instruments schould be checked out as soon as possible once the Orbiter payload bay doors are open to allow time to evaluate instrument performance and reprogram Experiment operational procedures, if necessary. (The high-voltage modes should not be initiated until the local gas pressure and internal Satellite gas pressure drop below the 1.0E-04 Torr range). The instrument checkout should be conducted from the POCC where all instrument responses can be observed and data reduction and display software can be validated. In addition, the display of any data required at the Orbiter Aft Flight Deck (AFD) should also be validated. In the event of anomalous opeations, the experimental procedure should be replanned as required at this time.

12.6 Operation during Deployment

This mission phase goes from beginning of Tether deployment till on station at 20 Km, excluding the intermediate stops.

Experiment ROPE will be operational as soon as possible after RF link is established and after check-out. Only some Experiment sensors will operate during this phase. — ?

Why ?

?

True – we *may* wish to select certain sensors — however, we may wish to use ∀ sensors at a lower operational rate. (data rate.)

12.7 On-Station Activity

This mission phase goes from ending Tether deployment till beginning of Tether retrieval and includes the intermendiate stops.

The Experiment will be fully operational during this phase.

12.8 Operation during Retrieval

This mission phase goes from beginning of Tether retrieval to Satellite power off.
Only some Experiment sensors will operate during this phase. Experiment ROPE will be switched off at the latest possible moment pior to Satellite power off.

Cgun —

(wh] ?

12.9 Processing of Data (On Ground)

TBD by the Experimenter.

13.0 PRODUCT ASSURANCE REQUIREMENTS

13.1 Safety Interface Requirements

? The policy and safety requirements applicable to all the Experiments are estabilished in the applicable document TS-SR-AI-003, Safety Specification. The following NASA documents form an essential part of this document:

- NHB 1700.7A : Safety Policy and Requirements for Payloads using the STS.
- KHB 1700.7A : STS Payload Ground Safety Handbook.
- JSC 13830 A : Implementation Procedure for STS Payloads System Safety Requirements.

The document NHB 1700.7A establishes both technical and system safety requirements applicable to all STS Payloads. The launch/landing site safety requirements are specified in the document KSC 1700.7A. These documents are applicable to all Payload hardware, including new design, exiting design (reflow hardware), GSE, and hardware designed primarily for commercial use.

The document JSC 13830 A defines the safety review process which implements the system safety requirements in chapter 3 of KSC 1700.7A.

The following NASA documents are useful as guidelines to understand how to perform the safety analysis and its implementation for the Safety Data packages:

- JSC 18798 : Interpretation of STS Payload Safety Requirements.
- JSC 11123 : STS Payloads Safety Guidelines Handbook.

Based on the above, the Experimenter shall provide Safety Data packages (flight and ground) including the Experiment Safety Analyses as an input to the Satellite Safety Data packages.

13.2 Reliability Requirements

A reliability analysis of the Experiment shall be provided by the Experimenter as an input to the Satellite Reliability Analysis. The Experimenter can be guided by the document TS-PR-AI-003, Reliability Analysis Procedure.

?

13.3 Parts and Materials List

List of used parts and materials with evidence of necessary MUA's approval (see 7.7), shall be provided by the Experimenter and compliant with TS-SR-AI-004.

13.3.1. Spare Parts List

Figure 13.3.1.1 is the Experiment Spare Parts list to be provided by the Experimenter. It will be considered as an input to the document TS-LI-AI-023, TSS-S Spares List.

13.3.2 Equipment Hardware Matrix

Figure 13.3.2.1 is the Experimenter Equipment Hardware Matrix to be provided by him. It will be considered as an input to the document TS-LI-AI-023, TSS-S Spares List.

13.4 Failure Effects Summary List

Figure 13.4.1 is the Experiment Failure Effects Summary List to be provided by the Experimenter.

13.5 Critical Items List

Figure 13.5.1 is the Experiment Critical Items List to be provided by the Experimenter and where it shall appear all items which, for their limited life, high probability of failure and/or requirement/specification losses, may generate criticalities to the Satellite Project.

?

Figure 13.3.1.1: Spare Parts List

SPARE PARTS LIST EXPERIMENT : ROPE

CONFIGURATION ITEM No.	ITEM NOMENCLATURE	QUANTITY FLIGHT CONFIG.	FAILURE RATE	OPERATING TIME	ZONE LOCATION	SPARE QUANTITY

Figure 13.3.2.1: Equipment Hardware Matrix

EQUIPMENT HARDWARE MATRIX EXPERIMENT : ROPE

ITEM	SUPPLIER	DESIGN STATUS			NO. OF UNITS	MODELS					REMARKS
		NEW	MOD	EXIS		QUAL	STM	EM	FU	SPARE	

MOD = MODIFIED DESIGN
EXIS = EXISTING DESIGN
STM = STRUCTURAL TEST MODEL

Figure 13.4.1: Failure Effect Summary List

EXPERIMENT : ROPE

UNIT :

OPERATIONAL PHASE:

MISSION PHASE:

FUNCTIONAL RELIABILITY DIAGRAM:

No.	Failure Effect	Contributed by	Failure Probability	Observable Symptoms	Prevention or Compensation Methods	Recommendations and Remarks

EXPERIMENT : ROPE			UNIT :	
Item Description	Nature of Degradation/ Vulnerability	Effect	Precaution Required / Corrective Action	Status

Figure 13.5.1: Critical Items List

14.0 EXPERIMENT DEVELOPMENT-DELIVERY SCHEDULE

14.1 Development-Delivery Shedule (Bar-Chart)

The development-delivery schedule of the Experiment compliant with the TSS system schedule requirements and milestones is on Figure 14.1.1.

The following delivery dates (TBR) shall be met:

?

- Experiment Engineering/functionnal Electrical Model (EM): End of june 1986.
- Experiment Flight Unit (FU): End of december 1986.

?

We will not provide an EM

Possible refurbishment of EM as Flight Spare, if requested by the Experimenter, will take place by him after termination of EM integrated test activities.

No EM

No EM

The EM and FU shall be delivered with their respective SCOE, acceptance procedures, tooling, handling, integration and system testing procedures and preferred sequences, to be agreed upon by CNR/PSN and the Integrator.

Handling, integration and system level testing procedures and preferred sequences delivery dates shall be displayed on the Experiment Development-Delivery Schedule (Bar-Chart).

14.2 List of Deliverable Items

No

In addition to the relevant Experiment EM unit and FU the following items shall also be delivered by the Experimenter:

No EM unit

a) For the EM unit:
  - one dust cap for each connector, and
  - one protection cover for each test connector, when deemed necessary to ensure Experiment unit correct performance.

b) For the FU:
  - one dust cap for each connector,
  - one protection cover for each connector, and
  - one connector saver for each connector.

Protection cover and connector saver quality shall be appropriate to the model they are related to.

14.3 List of Delivrable Documentation

The following documents shall be delivered by the Experimenter under his responsibilities:

PLANS :

?

Experiment Development-Delivery Schedule/Bar-Chart

BUDGETS & LISTS :

Limited life items list (if necessary) : by July 1986 (TBR).

PROCEDURES

1- Acceptance Test Procedures: 30 days before Experiment delivery.
2- Handling, Transportation & Storage Procedures: 30 days before the Experiment delivery.
3- Cleanliness Procedures: 6 months before the Experiment delivery.
4- Special Mechanical and Electrical Assembly and Integration Procedures: 6 months before the Experiment delivery.
5- Calibration Procedures (as necessary) : 6 months before the Experiment delivery.
6- Input to the Integrator Procedures Test Inspection : 30 days before the Experiment delivery.
7- Special Operation Requirements (as required by the Experimenter): 6 months before the Experiment delivery.
8- Experiment SCOE Test Procedures : 6 months before the Experiment delivery.

REPORTS :

1- Experiment input to Safety Analysis for Ground Operation: 30 days before safety reviews.
2- Experiment Input to TSS-S Reliability Analysis: 6 months before the Experiment delivery.
~~3-~~ Experiment Pyro Intended Use (if necessary): 6 months before the Experiment delivery.
4- Experiment Compliance Analysis & EMC requirements : 6 months before Experiment delivery.
? —5- Experiment Test and Analysis Reports : at the end of test/analysis.
6- Experiment Compliance to TSS-S Requirements : at Experiment delivery date.
7- Experiment Operation Description : 6 months before Experiment delivery.
8- Experiment Test Equipment Operation Description : 6 months before the SCOE delivery.
9- GSE Definition/Drawings (instruments, special test equipment, MGSE, tools to be used during integration on Satellite): 6 months before the Experiment delivery .

CONFIGURATION :

1- Installation Drawings with alignment constraints: 6 months before the Experiment delivery.
2- CIDL's for Experiment: 6 months before the Experiment delivery.
3- Experiment Log-Book: at the Experiment delivery date.
4- Experiment SCOE Log-Book: at the Experiment SCOE delivery date.
5- Acceptance Data Package with Flight Worthiness Cerificate: at the Experiment delivery date.
6- List of Used Materials and evidence of MUA's approval : 6 months before the Experiment delivery.
7- RFW's and RFW status list : at the Experiment delivery date.
8- RFD's and RFD status list : at the Experiment delivery date.
9- ECP's and ECP status list : at the Experiment delivery date.

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Figure 14.1.1 : Development-Delivery Schedule (Bar-Chart)

TO BE PROVIDED BY THE EXPERIMENTER

15.0 SPECIAL FEATURES AND REQUIREMENTS

15.1 Frequencies to be Avoided by Other Experiments

Frequencies in the range of 14 to 17 KHz and second harmonics should be avoided by other Experiments and Satellite units.

15.2 Surface Resistivity

The surface resistivity of the Satellite conductive skin shall be lower than 1000 Ohm/□.

15.3 Special Requiremnts Affecting Mission Profile

The following are the Experiment requirements affecting mission pofile. Actual timing and duration of these requirements will be defined by the Experiment functional objectives. (see 12.3).

1. Spinning Satellite (about 1 RPM) for the duration of all on-station operations (with the possible exception of the requirement of a spin direction reversal at the 20 Km on-station).
2. Near real-time (reduced and displayed at the POCC) spin phase determination to an accuracy of ± 3°
3. Experimental sequences (of about 15 to 30 minute duration) at selected latitudes and local times (sun angles and day/night conditions).
4. Experimental sequences carried out at approximately constant Satellite voltages (of about 15 to 30 minute duration).
5. Some experimental sequences must be carried out with data accessible from the POCC. Sequences must be planned so that an AOS/LOS transition does not occur at a critical point in the Experiment. (This may become a difficult requirement if a second TDRSS is not available).

Requirement 2 is a requirement on the POCC (see 10.0)

15.4 Special Requirements for Incoming Inspection

TBD by the Experimenter.

15.5 Special Requirements for Mechanical Integration

TBD by the Experimenter.

16.0 ACRONYMS

AC	Alternative Current	
AOS	Aquisition of signal	
ASMN	Analog Single ended Monitor	
Avh	Area of Venting Hole	
BLMN	Bilevel digital Monitor	
BMSP	Boom Mounted Sensor Package	
CEP	Central Electronic Package	
CIDL		?
CMD	Command	
CNR	Consiglio Nazionale Delle Ricerche	
C.O.G.	Center of Gravity	
DC	Direct Current	
DCN	Document Change Notice	
DIFP	Differential Ion Flux Probe	
DIFP-E	Differential Ion Flux Probe - Electronics	
DIFP-S	Differential Ion Flux Probe - Sensor	
ECP	Engineering Change Request	ECR ?
EDCH	Event Datation Channel	
EGSE	Electrical Ground Support Equipment	
EHK	Experiment HouseKeeping	
EICD	Eectrical Interface Control Data	
EID	Experiment Interface Document	
EM	Engineering/functionnal Electrical Model	
EMC	Electro Magnetic Compatibility	
ESA	European Spage Agency	
ESTEC	European Space Research and Technology Center	
EXPT	Experiment	
FR	FRame	
FRPL	FRame Pulse	
FS	Floating Supply	
FT	FormaT	
FTPL	FormaT PuLse	
FU	Flight Unit	

GSE	Ground Support Equipment
HTR	Heater
HVU	High Voltage Unit
IDS	Interface Data Sheet
IFSI	Istituto di Fisica dello Sazio Interplanetario
ISC	Integrated System Chech-out
IST	Integrated System Testing
LAN	Local Area Network
LAU	LAN Access Unit
LOS	Loss of Signal
MGSE	Mechanical Ground Support Equipment
MLCK	Memory Load Clock
MLDT	Memory Load DaTa
MLI	MultiLayer Isolator
MLSP	Memory Load SamPling
MNT	Monitor
M.O.I.	Moment of Inertia
MFSC	Marshall Space Flight Center
MUA	Materials Usage Agreement
N2	Molecular Nitrogen
N/A	Not Applicable
NASA	National Aeronautics and Space Admisistration
OBDH	On Board Data Handling
OCOE	Overall Check-Out Equipment
PCDA	Power Control and Distribution Assembly
P/L	PayLoad
POCC	PayLoad Operation Control Center
P.O.I.	Product Of Inertia
PPDA	Payload Power Distibution Assembly
PSN	Piano Spaziale Nazionale
PWR	Power
RDCM	Relay Drive ComMand
RF	Radio Freqency
RFD	Request for Deviation
RFW	Request for Waver
ROPE	Research on Orbital Plasma Electrodynamics
RPM	Rotation Per Minute
RSMN	Relay Sensing Monitor
RTN	Return
RTUP	Remote Terminal Unit for Payload
RTUS	Remote Terminal Unit for Service

SC	SCience
S/C	Spacecraft
SCOE	Special Check-Out Equipment
SCORE	Satellite CORE equipment
SD16	Serial Digital 16-bit data
SDCK	Serial Digital Clock
SDSP	Serial Digital SamPling
SOA	Sensor Opening angle about SVA in Azimuth
SOE	Sensor Opening angle about SVA in Elevation
SPES	Soft Particle Energy Spectrometer
STS	Space Transportation System (including the Orbiter)
SVA	Sensor View Axis angle w.r.t. spin axis and fixed S/C boom plane
SVA/P	SVA Projection on spin axis and fixed S/C boom plane where 0° is the positive spin vector
SWRI	Southwest Research Institute
SYCK	SYnchronization Clock
TBD	To Be Defined
TBR	To Be Reviewed
TLC	TeleCommand
TLM	Telemetry
TSS	Tethered Satellite System
TSS-D	TSS-Deployer
TSS-S	TSS-Satellite
UM1	U1 UMbilical connector
UM2	U2 UMbilical connector
VDU	Video Unit
WD	Word
WH	Watt-Hour.