PCN LANL ACE 003B

INSTRUMENT FUNCTIONAL REQUIREMENTS DOCUMENT

for the

Solar Wind Electron, Proton, and Alpha Monitor (SWEPAM)

for the

Advanced Composition Explorer (ACE) Mission

Prepared by

Los Alamos National Laboratory
Los Alamos, NM
and
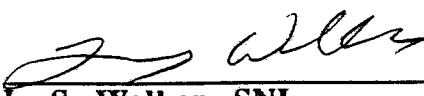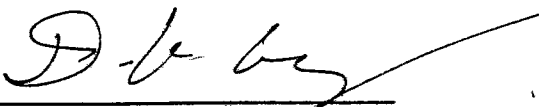Sandia National Laboratories
Albuquerque, NM

October 19, 1995

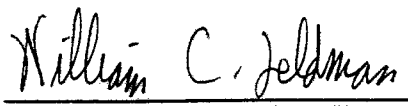# Los Alamos
NATIONAL LABORATORY

Photograph by Chris J. Lindberg
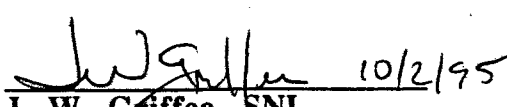
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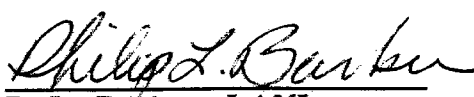SWEPAM Project Engineer
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1. Background

The purpose of the Solar Wind Electron, Proton, and Alpha Monitor (SWEPAM) is to provide detailed knowledge of solar wind conditions. This knowledge will meet requirements both for providing and interpreting contextual information for elemental and isotopic composition data measured by the ion experiments aboard the Advanced Composition Explorer (ACE).

We will achieve this purpose by modifying the Ulysses BAM-E and BAM-I instruments to provide high-quality measurements of electron and ion fluxes in the low-energy solar wind range (electrons: 1 to 1450 eV; ions: 0.26 to 35 kV). The instruments' digital processing electronics will be retrofit to adapt to the ACE Observatory interfaces and to meet the ACE science requirements.

The SWEPAM, as was the Ulysses BAM instruments (and many previous space plasma instruments, starting in the early 1960s) will be a result of a collaborative effort between the Los Alamos National Laboratory (LANL) Space and Atmospheric Science Group and the Civilian Space Science and Applications Department at Sandia National Laboratories (SNL). This group of people working together have developed, qualified, and operated dozens of space flight plasma instruments over the last 30 years.

The instrument science requirements were defined in Phase A and the instrument modifications were planned in Phase B to meet these requirements. In Phase B it was also decided to retrofit the two stand-alone electronics boxes contained in each instrument chassis rather than develop a separate data processing unit, as was first planned.

The modifications to the spare Ulysses instruments, as stated in the EIP, consist of 1) removal of the aperture motor and wheel from the ion instrument and installing a spring loaded, pyro pin-cut activated pivoting door, 2) adding a smaller permanent entrance aperture to the ion instrument, 3) adding a mask to the 12 inner exit apertures to reduce the count rate expected on orbit (the four outer exit apertures, on one side, will be left unmasked to count supera-thermal ions, 4) modifying the look angle of the ion instrument relative to the spacecraft (s/c) spin axis, and 5) installing new memory (80C51 microprocessor), software and S/C interfaces to modify the command, data handling, and data processing functions of both instruments.

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2. Purpose and Scope

The purpose of this document is to describe which of the ACE mission science objectives are relevant to the SWEPAM instrument development, translate those science objectives into specific SWEPAM performance objectives, and then describe the basic instrument architecture, partitioning the assembly and sub-assembly requirements in a way that the overall performance objectives can be met. This includes describing relevant instrument functions, s/c interfaces, and resource requirements such as data processing, thermal, command, mass, power size, etc. Environmental constraints on the design are also identified.

The IFRD is not meant to give detailed specifications for all the modifications, designs, and retro-fits for SWEPAM. This will be delineated as part of the detailed design process during phase C/D and documented in the Instrument Design and Data Package. The IFRD identifies instrument components and assemblies at the block diagram level. Each instrument modification is based on the design architecture selected in Phase B. Those specifications which are driven by external requirements such as spacecraft interfaces, environmental test specifications, etc. are noted. Signature of the IFRD by the Co-Investigator responsible for the instrument constitutes recognition of performance goals consistent with the mission requirements, and defines the scope of modification and retro-fit for the instrument. The IFRD is the metric by which instrument modification designs and performance will be measured throughout phase C/D. As described in the Caltech Configuration Management Plan, the SWEPAM IFRD, will be under configuration management of the Caltech PMO.

3. Applicable Documents

1) The ISPM Solar-Wind Plasma Experiment, Los Alamos National Laboratory and Sandia National Laboratories.

2) ACE Mission Science Requirements Document (GSFC-410-ACE--004).

3) Spacecraft Environmental Specification (JHU/APL 7345-9007).

4) Environmental Design and Test Requirements for the ACE Payload (ACE-CT-100-22).

5) ACE Payload Verification Matrix (ace-CT-100-24).

6) Performance Assurance Requirements for the Science Payload of the Advanced Composition Explorer (ACE) Mission (GSFC-410-ACE-008).

7) Instrument Assurance Implementation Plan (ACE-CT-013-25).

8) General Instrument Interface Specification (ACE-APL-7345-9005).

9) Specific Instrument Interface Specification for SWEPAM (ACE-APL-7345-0015). There are two SIIS documents, one for I and one for E. 7345-9018 is the document number for the E and 7345-9020 for the I.

10) Instrument Assurance Implementation Plan for the ACE SWEPAM (IAIP/SNL-ACE004(A).

11) Phase A Study of an Advanced Composition Explorer, Calif. Institute of Technology.

12) SWEPAM: Experiment Implementation Plan for the Advanced Composition Explorer Mission (ACE-CT-018-41).

13) Payload Configuration Management Plan (ACE-CT-100-031).

14) ACE Payload Interface Requirements Document (PIRD), Calif. Institute of Technology.

4. FUNCTIONAL/PERFORMANCE REQUIREMENTS AND CONSTRAINTS

The ACE primary mission requirements are defined in the ACE Science Requirements Document and drive the basic performance requirements for the SWEPAM instrument.

4.1 Instrument Performance Requirements

The primary science requirement of SWEPAM is to provide the solar wind context for the elemental and isotopic abundance measurements to be made by other experiments aboard the ACE.

Secondary requirements include: 1) Providing high quality He/H abundance ratios to allow normalization of all other measured abundances to hydrogen, and 2) the determination of suprathermal proton and alpha-particle velocity distributions to explore injection mechanisms responsible for the acceleration of energetic storm particles (ESP) and perhaps Solar energetic particles (SEP). Several modifications will be installed in the backup Ulysses plasma analyzer, including modifications to the operating modes, in order to optimize its use aboard ACE to achieve these goals. These modifications, although mentioned in the background section, are listed below in light of the science goals.

1) Choose a different subset of the SWEPAM Electron instrument electrostatic analyzer plate voltage levels to extend measurements of suprathermal electrons up to 1,500 eV.

2) Increase electron count accumulation times to 64 ms in order to improve the definition of bi-streaming electron distributions that are used to define coronal mass ejections (CMEs).

3) Replace the ion sensor aperture wheel with a permanent aperture suitable for the ACE heliocentric orbit

4) Install masks on the exit apertures of the 12 CEMS devoted to the solar wind thermal ion population (the 4 CEMS devoted to suprathermal ions will remain fully open). These modifications are necessary in order to optimize operation of the fixed heliocentric distance of 1 AU, and to understand injection mechanisms for interplanetary ion acceleration.

5) Replace the Ulysses ion sensor-head mounting bracket with one optimized for the more confined range of spin-pointing directions to be used by ACE.

6) Change the Ulysses C&DH interface with one that is compatible with the ACE S/C.

4.2 Ground Support Functional Requirements

4.2.1 Test Phases

The SWEPAM GSE shall support the following four distinct SWEPAM test phases with the necessary software development, test control and monitoring, test data collection and archiving, and test data analysis.

a) New processor, spacecraft interface electronics and software checkout and, qualifications tests,

b) Instrument acceptance and calibration tests,

c) Observatory testing as relates to the SWEPAM instruments, and

d) Post launch turn-on and functional tests.

Figures 4.2.1 and 4.2.2 depict the GSE configurations for these four different test phases.
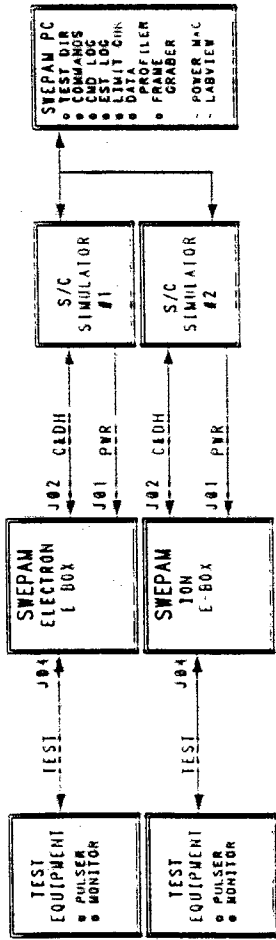
NEW LOGIC CHECKOUT AND QUALIFICATION

INSTRUMENT ACCEPTANCE TESTING

SWEPAM PC
- TEST DIR
- COMMANDS
- CMD LOG
- TEST LOG
- LIMIT Chk
- DATA
- PROFILER
- FRAME
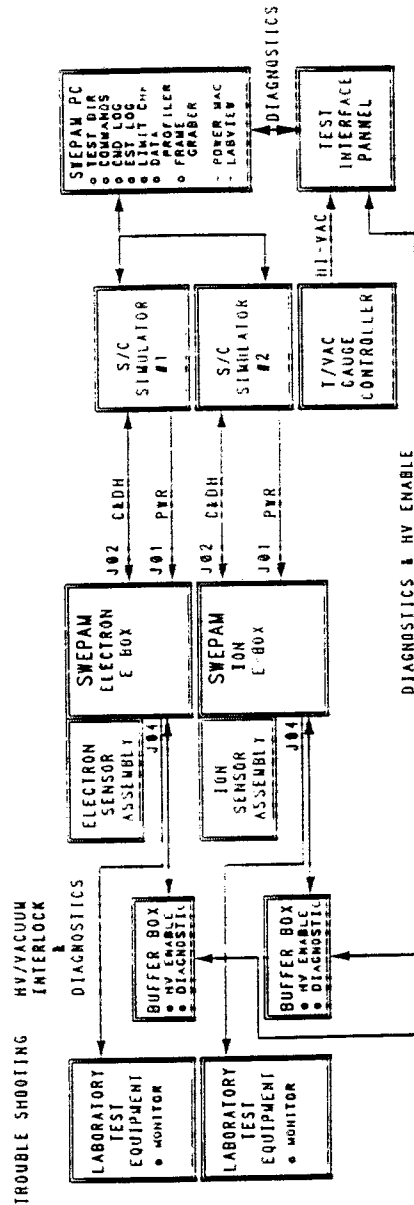 GRABER
- POWER MAC
- LABVIEW

S/C SIMULATOR #1

S/C SIMULATOR #2

J02 C&DH
J01 PWR
J02 C&DH
J01 PWR

SWEPAM ELECTRON E BOX

SWEPAM ION E-BOX

J04 TEST
J04 TEST

TEST EQUIPMENT
- PULSER
- MONITOR

TEST EQUIPMENT
- PULSER
- MONITOR

SWEPAM PC
- TEST DIR
- COMMANDS
- CMD LOG
- TEST LOG
- LIMIT Chk
- DATA
- PROFILER
- FRAME
  GRABER
- POWER MAC
- LABVIEW

DIAGNOSTICS

TEST INTERFACE PANNEL

S/C SIMULATOR #1

S/C SIMULATOR #2

T/VAC GAUGE CONTROLLER

HI-VAC

J02 C&DH
J01 PWR
J02 C&DH
J01 PWR

DIAGNOSTICS & HV ENABLE

SWEPAM ELECTRON E BOX

SWEPAM ION E-BOX

ELECTRON SENSOR ASSEMBLY

ION SENSOR ASSEMBLY

J04
J04

TROUBLE SHOOTING   HV/VACUUM INTERLOCK & DIAGNOSTICS

BUFFER BOX
- HV ENABLE
- DIAGNOSTIC

BUFFER BOX
- HV ENABLE
- DIAGNOSTIC

LABORATORY TEST EQUIPMENT
- MONITOR

LABORATORY TEST EQUIPMENT
- MONITOR

Fig. 4.2.1   INSTRUMENT TEST CONFIGURATIONS

OETTST DWG

Fig. 4.2.2 FULL SYSTEM TEST CONFIGURATION

4.2.2 Physical Requirements

a) In order to facilitate the testing of the two SWEPAM instruments it shall be possible to test each instrument independent of the other. There will be times when one instrument is at SNL while the other is at LANL.

b) To facilitate execution of requirement 4.2.1 and 4.2.2a, the GSE shall be easy to transport.

c) To make the most efficient use of resources such as thermal vacuum chambers, the GSE design shall support simultaneous testing of both instruments. This implies, for example, a need for two sets of thermal vacuum bulkhead cables and a capability for both sets to be installed through the chamber wall at the same time.

4.2.3 The SWEPAM GSE shall use the APL designed and manufactured spacecraft simulator to verify compatibility with the spacecraft interface including compliance with the functional and performance specifications of the GIIS and SIIS documents. The following are the top level requirements for the spacecraft simulator.

a) High fidelity simulation of C&DH driver/receiver circuits, relative signal timing, and redundancy.

b) Transmit science and housekeeping data from the instrument to the host and transmit commands, and memory loads from the host to the instrument.

c) Provide uninterrupted timing signals to the instrument even if the SWEPAM PC host is off-line (the spacecraft simulator is operating "stand-alone"). There is no need for the simulator to save the data during these times.

d) Digitize the instrument's analog monitors with a resolution equal to that of the ACE spacecraft. Monitors to be digitized include the internal AD590s, 0-5v monitors and the external Primary Power voltage and current at least once per second. The GSE must also identify which major frame relative to the 8xmajor frame pulse these readings were taken from (required since each SWEPAM instrument has two commutated 0.5v monitors with a new channel presented every major frame pulse and synchronized with the 8xmajor frame pulse).

e) Provide relay switched 28 volt power to the instrument. No pyro fire circuit simulation is required.

f) Capable of limit checking the 28v current monitor and removing power if the limit is exceeded...even in the stand-alone case. The circuit breakers should remain tripped until manually cleared (a keyboard command from the PC is acceptable).

g) Capable of providing the host with simulator status information including critical states (power on/off, circuit breakers normal/trip), operating voltage, instrument currents, data interface activity, and command interface activity.

h) Capable of the following interface "stress testing".
   1) Primary Power low and high voltage operations (24v to 32v).
   2) Adjustable data acquisiton and command transmision time base (nominal +/- 10% and a resolution of about 2%).
   3) Interface voltage adjustable (4.5 to 5.5 v).

i) SWEPAM PC Host interface can be any of the following in the order of preference: Ethernet, IEEE-488 or RS232.

4.2.4 SWEPAM PC

The SWEPAM PC shall be a collection of commercial equipment (computer, monitor, keyboard, pointing device, mass storage, printer) selected with the following atttributes in mind:

a) Usable for all four phases of testing in order to maximize the software reusability and facilitate configuration management.

4.2.5 GSE Interfaces

The following identify the primary GSE interfaces and their function.

a) Spacecraft simulator/SWEPAM PC: A single cable interface permitting bi-directional communications between the PC and the Simulator.

b) Spacecraft simulator/SWEPAM Instrument: A two cable interface with primary power on one and all C&DH functions on the second. Science housekeeping and memory dump data are routed through the spacecraft simulator to the PC. Commands and memory loads are routed from the PC through the spacecraft simulator. These interface specifications are as defined in GIIS and SIIS documents.

c) SWEPAM PC/Instrument Test Connector: A single cable interface permitting bi-directional diagnostics communication exchanges with the Instrument's test connector. In order to provide ground isolation between the PC and the test connector and to provide the line drive capability a piece of custom GSE will be needed in this interface. In

Figures 4.2.1 and 4.2.2 this is identified as the Test Interface Panel. The buffer box is an extension of the Test Interface Panel at the instrument end of the interface cable.

d) Instrument Test Connector/Thermal Vacuum (TVAC) Pressure: A 110v power source provided by the TVAC gauge controller as long as the vacuum is suitable for high voltage operation. The Test Interface Panel is used to translate this into a logic level at the Test Connector in order to inhibit the instrument's high voltage when the chamber vacuum is not suitable. It is required during instrument level thermal vacuum testing since the test is not continuously monitored by an operator and loss of vacuum would damage the instrument. Additional review of the Observatory thermal vacuum test environment needs to be conducted in order to determine if this function is required after instrument delivery.

e) SWEPAM PC/Spacecraft Test Computer: A multi-cable interface with the following functional requirements:

   1) Complete spacecraft telemetry data stream to be used by the PC for data monitoring, display and recording during observatory testing. The Spacecraft Test Computer shall perform the Reed Solomon Decoding before transferring the data stream to the SWEPAM PC.

   2) Bi-directional file sharing between the SWEPAM PC and the Spacecraft Test Computer. Primary used to facilitate information sharing before and after a test procedure. Command files could be sent from the PC to the Spacecraft Test Computer before a test and the Spacecraft Test Computer could send the command log back after a test.

   3) Test time (or test sequence number) from the Spacecraft Test Computer to all instrument workstations to permit correlation of the distributed test control, monitoring and analysis task.

f) SWEPAM PC/Mission Operations Computer: Similar interface as for the Spacecraft Test Computer.

4.3   Resource Constraints

Based on heritage information and conceptual analysis, a careful study of the SWEPAM instrument resources has been completed. Likewise, development of the spacecraft bus design has matured to the level that overall allocations have been made to each instrument. Allocations and estimates as of the start of Phase C/D are shown in the following table.

TABLE 4.3.1. Resource Constraints

Constraint	Estimated Usage		Total
	Electron Inst.	Ion Inst	Estimated
Mass	2.6 Kg	4.1 Kg	6.7 Kg
Power	3.0 W	3.4 W	6.4 W
Average Data Date	456 bps	544 bps	1000bps

4.4 Operational Constraints

As Discussed in the introduction, certain externally imposed requirements dictate the conditions under which the instrument must perform. The table below lists the known operational constraints, references the source of the requirement, and notes which of the instrument subsystems or assemblies are impacted by these constraints.

TABLE 4.4.1. Operational Constraints

Constraint	Limits	Impact
angle betweeen s/c spin axis	±20° while operating	sw may enter unmasked
and the vehicle-sun direction		apertures resulting in CEM
		saturation
Temperature	Survival (power off) -30/+60°C	Damage
	Operate in spec -20/+50°C	Out of calibration
	Test -25/+50°C	Malfunction
Contamination	Hydrocarbons, humidity > 50%	Gain/reliability damage to CEMs
HV operation	ultra-clean 5x10⁻⁴ Torr	HV breakdown, CEM damage
Post launch outgassing	2 Weeks	Same as contamination
		and HV operation impacts
Pyro devices	Operate in door and TV tests only	Contamination, damage to door
Bus voltage	29.4 to 27.5 v	Out of calibration

5. Interface Functional Requirements

5.0 Interface Functional Requirements

Figure 5.0-1 provides an overview of the functional interfaces which exist between the SWEPAM Instruments, the spacecraft and the Ground Support Equipment.
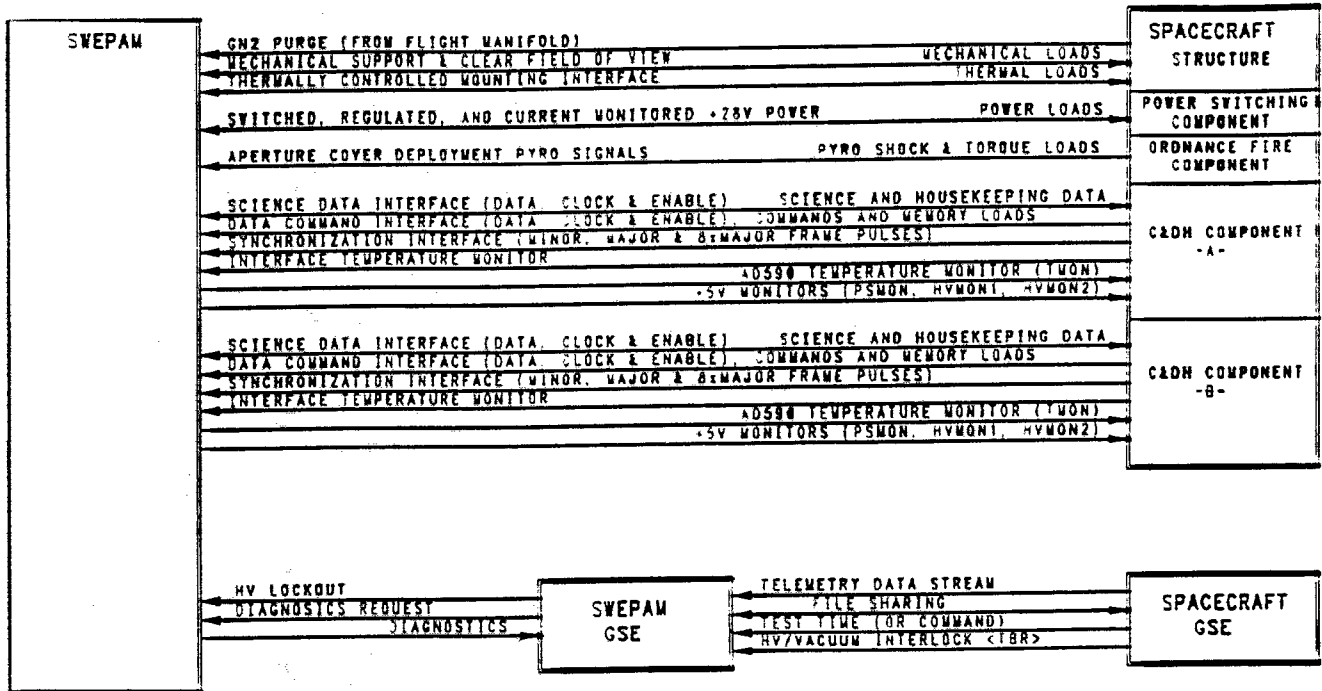

Fig. 5.0-1. Functional Interface Block Diagram

5.1 Spacecraft Interfaces

The following paragraphs identify the functional interfaces between the spacecraft and the SWEPAM instruments. The SWEPAM-I and SWEPAM-E interfaces shall be independent from each other so that the failure of one instrument does not compromise the other. Detailed definitions and performance requirements for these interfaces are provided in the General Instrument Interface Specification (GIIS) and the Specific Instrument Interface Specification (SIIS) for the SWEPAM.

5.1.1 Purge

Each SWEPAM instrument shall be connected to the spacecraft GN2 purge manifold and purged from the time the instrument's environmental seals are removed right up to launch.

5.1.2 Mechanical

Each instrument shall be mounted on the spacecraft to satisfy the following requirements:

a)   Location and mounting techniques shall be compatible with the loads the instrument will place on the spacecraft and the loads the spacecraft will couple into the heritage instruments.

b)   The instruments' fields of views shall be unobstructed (Refer to Fig. 6).

c)   The look direction shall be parallel to a spin radial and the angular offset of this radial from the spin reference radial must be defined.

d)   Location and mounting techniques shall provide the physical access to the test connector, pump-out port, purge port and HV make/break jumper block.

e)   To the extent possible, the surfaces in the electron instruments near the field of view shall be conductive to preclude static charging from influencing the scientific measurements. These surfaces shall be connected to s/c ground.

5.1.3 Thermal Interface

The instrument and spacecraft thermal design shall permit continuous operation of the instruments once the spacecraft is on station. If for any reason power must be removed from the instrument, the thermal design shall keep the temperature of the instruments from dropping below the lower survival temperature limit. Furthermore, the design must assure that the instruments can be returned to the lower operational limits before power is reapplied.

5.1.4 Power

Each SWEPAM instrument requires a dedicated switched, regulated and monitored 28v power circuit from the spacecraft power supply subsystem. The spacecraft shall include the 28v current monitor in its housekeeping data stream and will deactivate the instrument if an over current or under voltage condition develops. If interface fuses are used, the size of the fuse shall be selected to protect the cable harness, not the instrument.

5.1.5 Aperture Cover Deployment

Each instrument has a deployable aperture cover. These covers shall remain closed until the observatory is in transit to L1. The spacecraft shall provide the necessary pyro fire circuits to initiate cover deployment.

5.1.6 Data Interface

Each instrument shall provide science data, housekeeping data and memory dump data through a single serial data interface, one interface for each instrument. The spacecraft shall provide the necessary clock and gate signals.

5.1.7 Command Interface

Each instrument shall receive command and memory load data through a single serial command interface, one interface for each instrument. The spacecraft shall provide all necessary data, clock and gate signals.

5.1.8 Data Synchronization

The SWEPAM instruments require the following synchronization signals to control and "tag" data collection process:

a) Minor frame pulse once per second

b) Major frame pulse once every 16 minor frames

c) 8xMajor frame pulse once every 8 major frames

The timing relationship of all three signals shall be fixed and preferably, the major frame pulse would be coincident with the first minor frame pulse in a 16 minor frame sequence and the 8xmajor frame pulse coincident with the first major frame pulse in a 8 major frame sequence.

5.1.9 Spin Synchronization

In order to "despin" the SWEPAM science data during ground data analysis the SWEPAM IDT needs knowledge of the spacecraft attitude at each instant in time the SWEPAM instrument receives a minor frame pulse. To achieve this, the spacecraft needs to sample and transmit the observatory attitude at least once per spin and the sample time must be referenced to the data synchronization signals of requirement 5.1.8.

5.1.10 Analog Housekeeping Data

The SWEPAM heritage design does not have an A/D converter to digitize analog housekeeping signals. These signals are to be digitized by the spacecraft once per major frame. Two of the signals (HVMON1 and

HVMON2) are commutated with the commutator advanced by the major frame pulse and reset by the 8xmajor frame pulse.

5.2   Ground Support Equipment Interfaces (see paragraph 4.2.5)

6. SWEPAM INSTRUMENT DESCRIPTION AND REQUIREMENTS

6.1 Principles of Operation

Simultaneous electron and ion measurements will be made with two completely separate instruments. Both sensors make use of curved-plate, spherical section electrostatic analyzers (ESAs). Biased channel electron multipliers (CEMs) are spaced along the exit apertures of the ESAs for ion and electron detection. Different CEMs sample different portions of the fan shaped fields of view (FOV), allowing measurement of particle arrival directions in a spacecraft coordinate system of azimuthal angle and polar angle. Polar angle from the sun-pointing spin axis is given by the CEM number, while azimuthal angle is given by phase of spacecraft spin. The local coordinate system will be converted at the ACE Science Operations Center (ASOC) to a solar ecliptic frame of reference from spacecraft ephemeris data provided by the project.

The simultaneous ion and electron measurements will provide an important measure of redundancy since the solar wind bulk-flow parameters can be derived from measurements of either instrument. Each is separately powered with its own low-voltage converter, fixed-level analyzer plate voltage supply, and channel electron multiplier HV supply. Each is operated with an independent microprocessor-based electronics control system.

The ion instrument, displayed in Figure 6.1.1, consists of a 105° bending angle ESA with an average radius of 100 mm and a plate spacing of 2.84 mm. This gives a k-factor of 35, an intrinsic energy resolution ($\Delta E/E$) of ~5% FWHM, and an intrinsic azimuthal angular resolution of 53 to 4.5° FWHM, depending on the polar look angle relative to the central view directed. The 16 CEMs, contiguously spaced along the exit gap of the ESA, give ~5° polar angle resolution over an ~85° acceptance fan. For ACE a new mounting bracket will be required to orient this fan so that the 12 CEMs composing the solar wind portion of the instrument are nearly centered on the sunward-pointing spin axis direction.
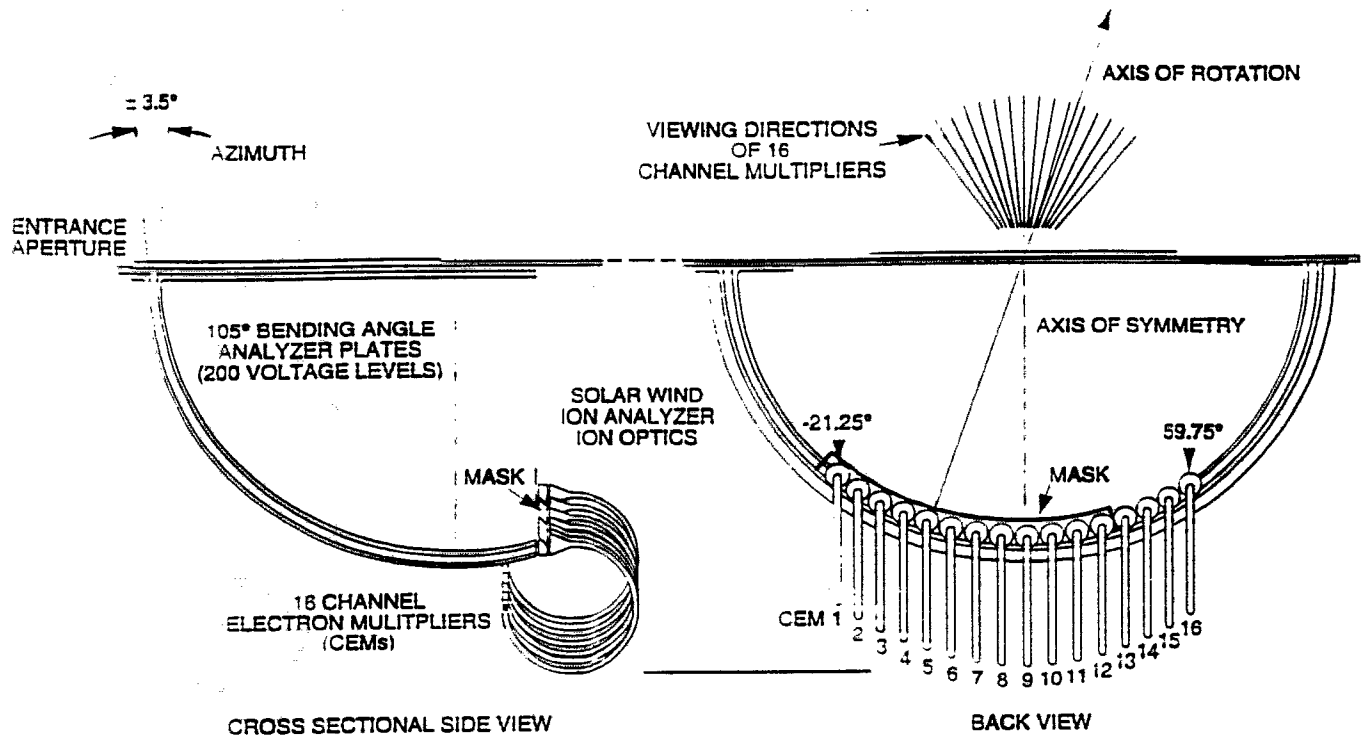
Fig. 6.1.1. Ion instrument curved plate electrostatic analyzer. A cross-sectional view is provided on the left and a back view on the right. The sphereical-section analyzer has a sector geometry with a bending angle of 105°, chosen to give good resolution and slioghtly overlapping responses from 16 CEMs arranged around the analyzer exit with 5° spacing. To avoid backgrounds causec by AV reflections through the plates to the CEMS, the plates are copper plated and blackened

The analyzer is mounted on the spacecraft so that the spin axis is 1.25° offset from the center of CEM#5. This gives a field of view of 23.75° on one half of the CEM array and 56.25 on the other. Upon rotating, this offset results in sample interleaving. The 4 CEMs at the end of the array (#13-16) will detect supra-thermal-ions, which exist at a lower angle than the solar wind beam.

Because the Ulysses (ULYS) instrument was designed to operate at varying solar wind intensities, an aperture wheel and stepping motor are used to regulate the size of the entrance aperture. The ACE SWEPAM instrument will be operating in a stable solar wind environment and the heavy, complicated ULYS aperture system has been traded for a simple dust cover and entrace aperture. The fixed aperture was sized to accomodate sampling of the supra-thermals; an exit aperture mask will be used to throttle down the ions entering CEMs 1-12. A block diagram of the ion-sensorhead electronics is shown on Figure 6.2.
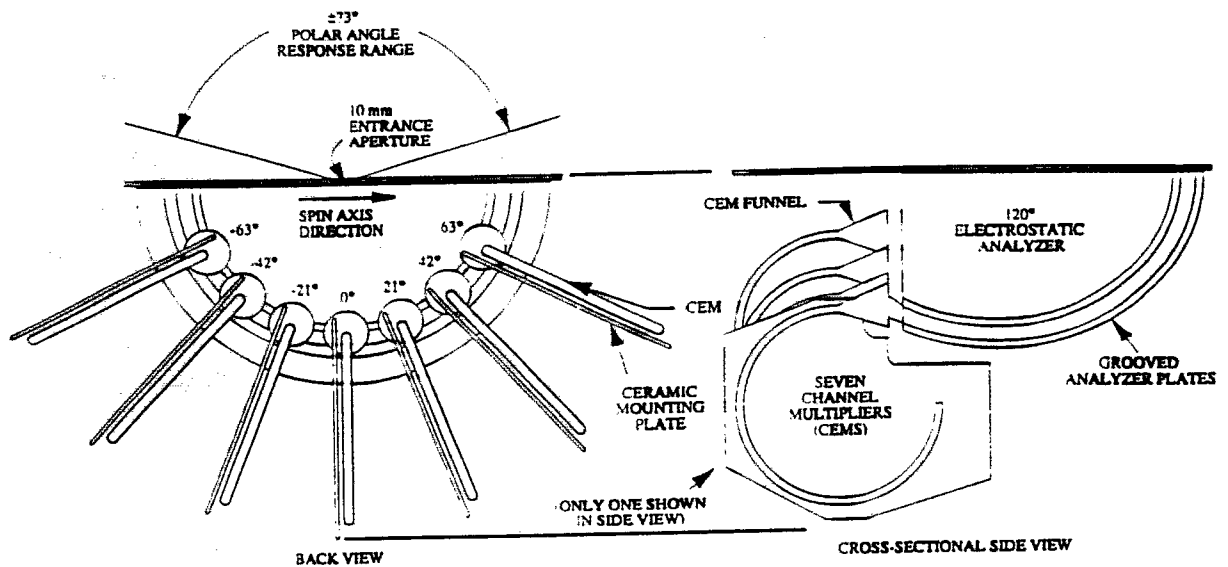
Fig. 6.1.2. The Electron Instrument. A cross-sectional view is provided on the right and a back view on the left. Electrons over a polar range of ~±73° are accepted by the 120° spherical section electrostatic analyzer with seven CEMs at the exit. The inner surfaces of the analyzer are grooved, copper plated, and blackened to reduce background responses due to photoelectron and secondary electron production within the gap itself.

As shown on the right, the azimuthal acceptance angle of the analyzer depends on polar angle; at 0° the acceptance angle is ~±9°, and at 73° it is ~±14°. The analyzer is mounted on the spacecraft with its fan-shaped acceptance solid angle oriented so that the plane of symmetry of the fan is parallel to the spin axis and the 0° CEM views along the spacecraft equatorial plane.

The electron instrument, displayed in Figure 6.1.2, consists of a 120° bending angle ESA with an average radius of 41.9 mm and a plate spacing of 3.5 mm. This gives a k-factor of 12, $\Delta E/E$ of ~12%, and intrinsic azimuthal angular resolution of 9° (at 0° polar angle) to 28° (at ~+/-73° polar angles). Seven large-funnel CEMs along the exit gap give ~20° polar angle resolution over a 160° fan. For ACE, this fan would be centered perpendicularly to the spacecraft spin axis (covering from ~10° to 170° spacecraft polar angles) in order to maximize the solid angle coverage for solar wind electrons. A block diagram of the electronics of the electron sensor head is shown in Figure 6.4.

Figures 6.2 through 6.7 describe the instruments functional, electrical, and data flow systems as well as instument controlled parameters.
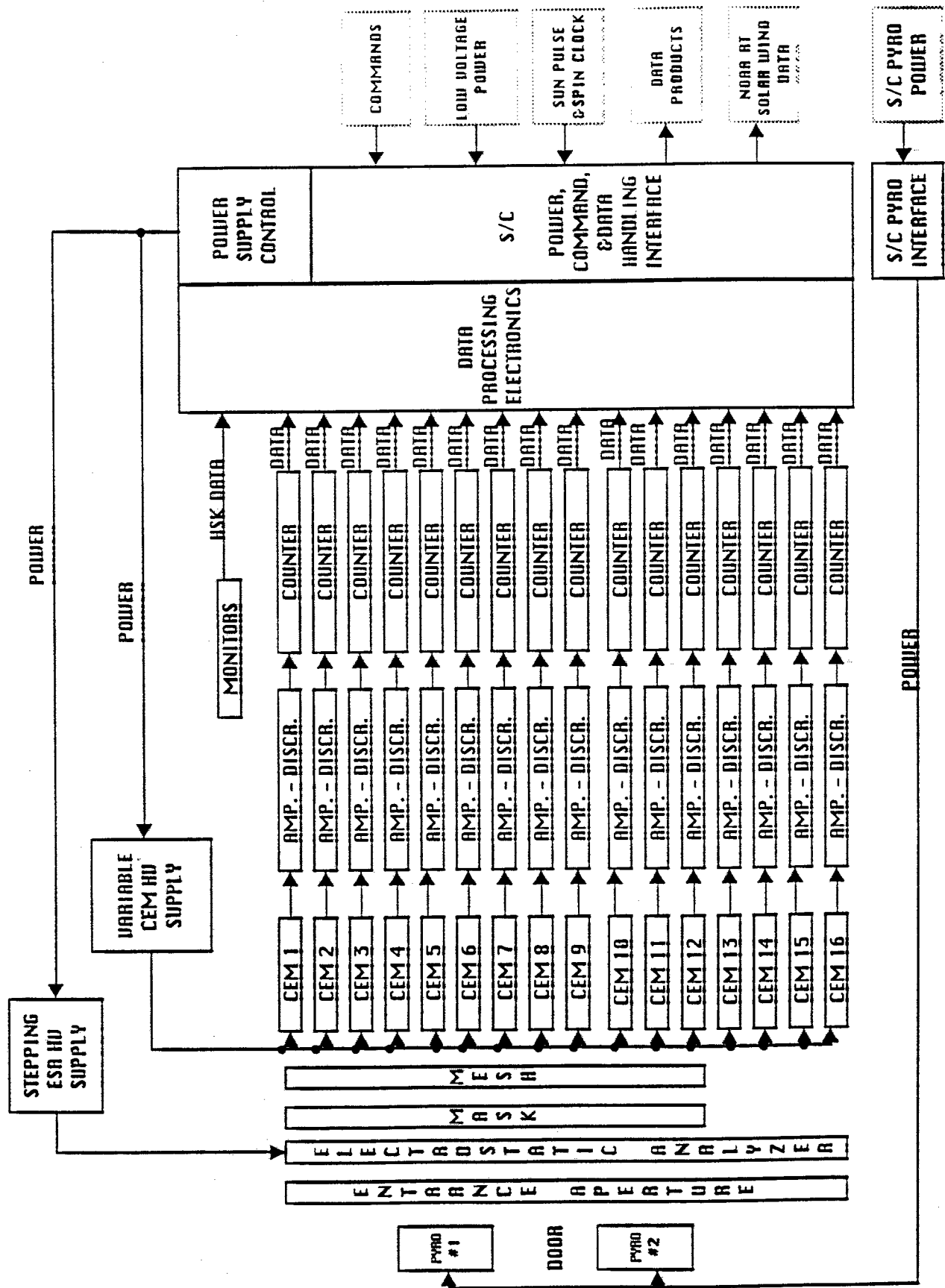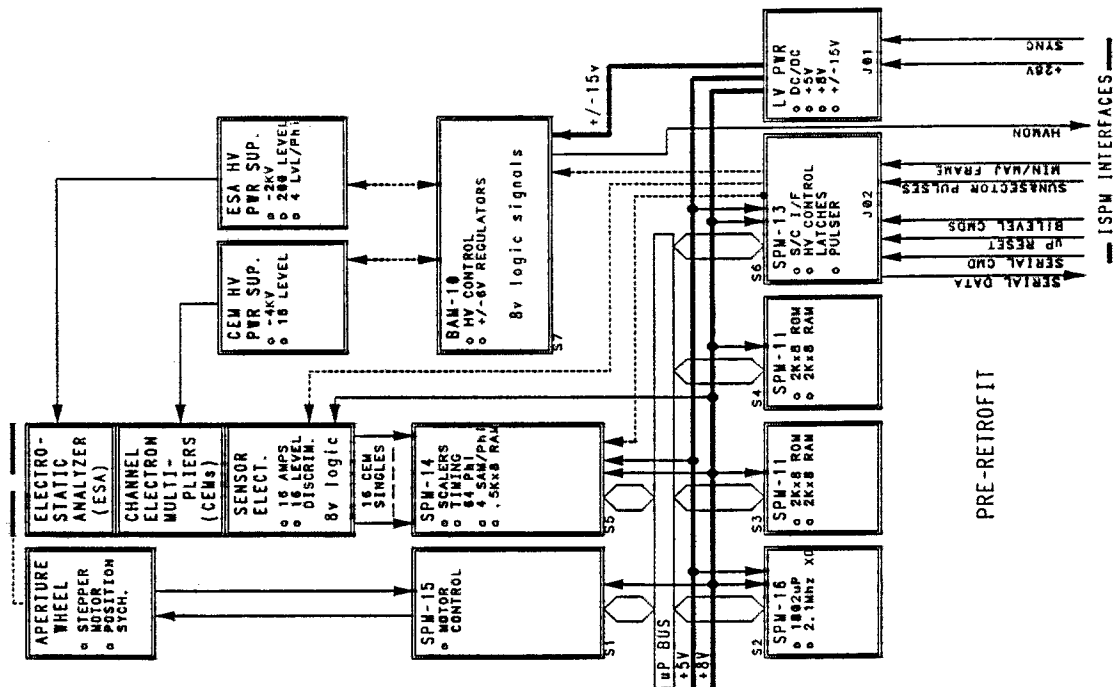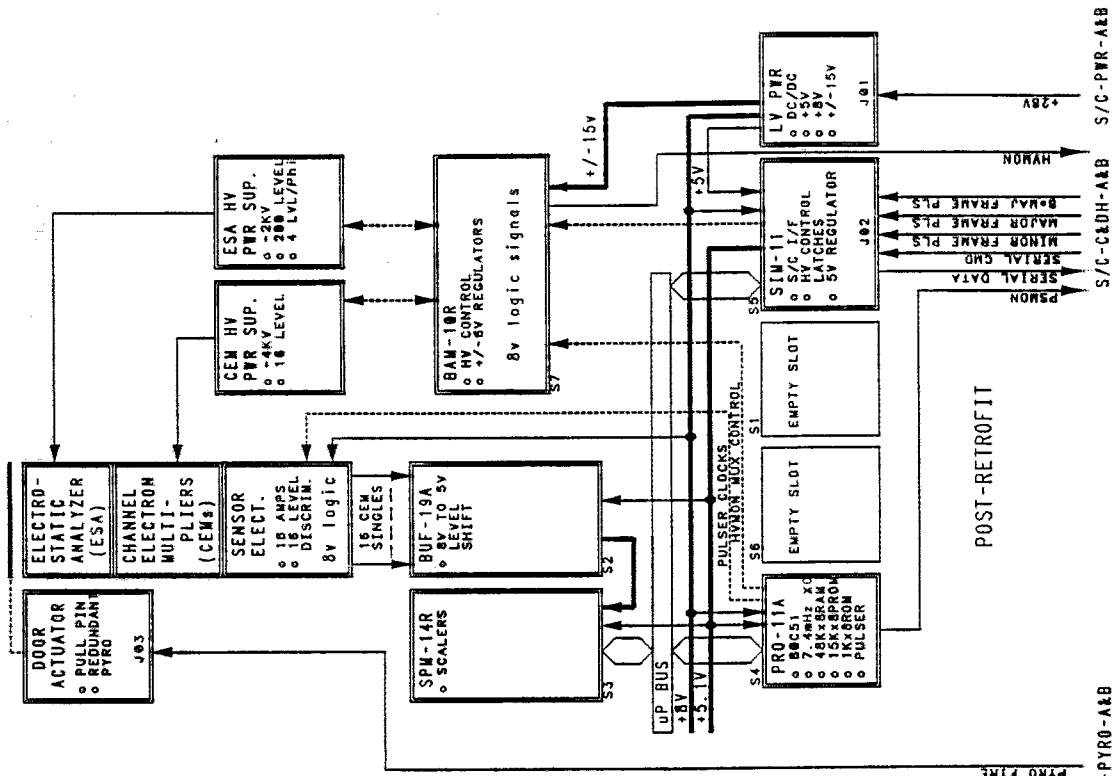
FIG. 6.2 SWEPAM-ION INSTRUMENT FUNCTIONAL BLOCK DIAGRAM

ACE SWEPAM-I TOP LEVEL BLOCK DIAGRAM
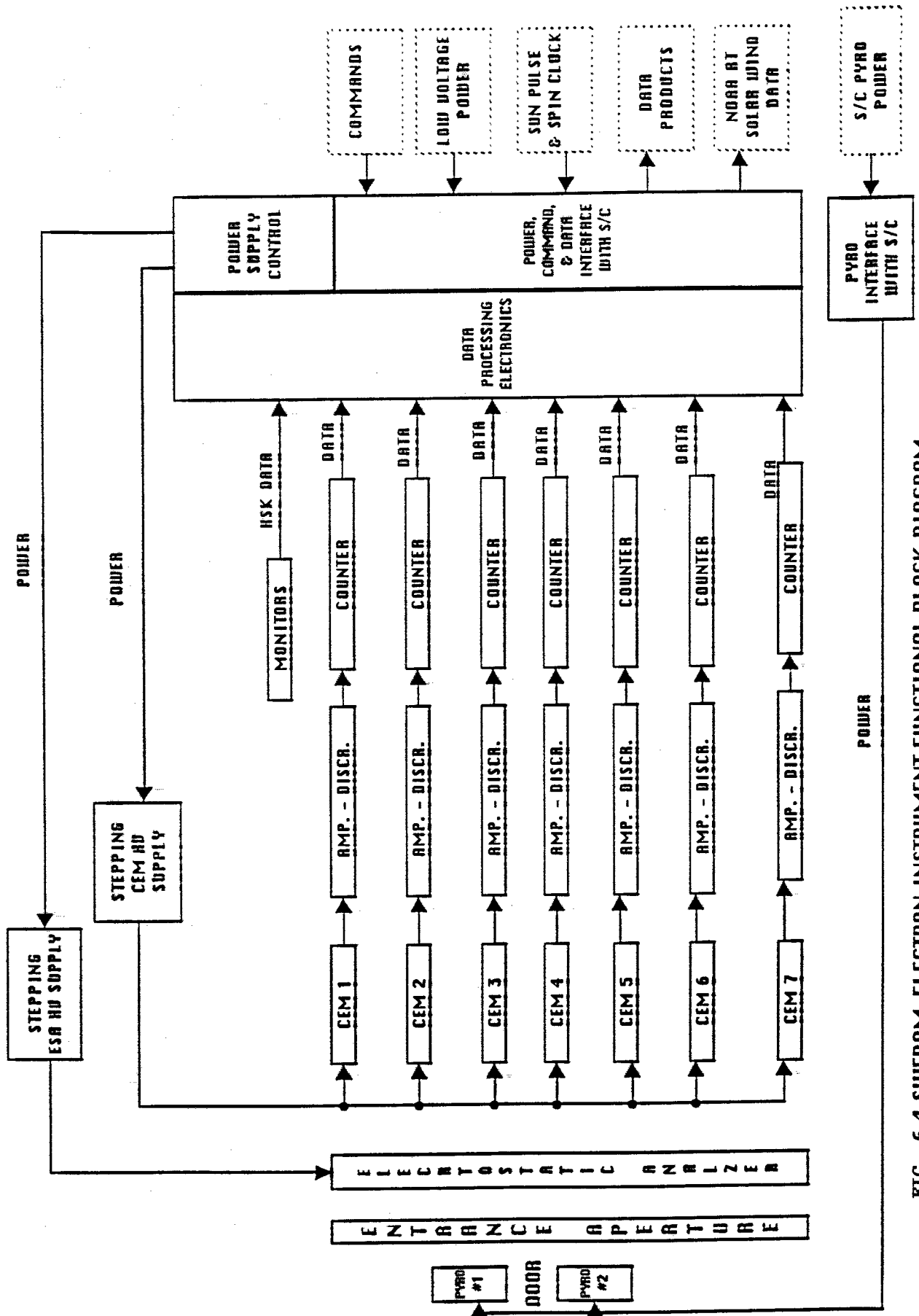
FIG. 6.4 SWEPAM-ELECTRON INSTRUMENT FUNCTIONAL BLOCK DIAGRAM

-19-
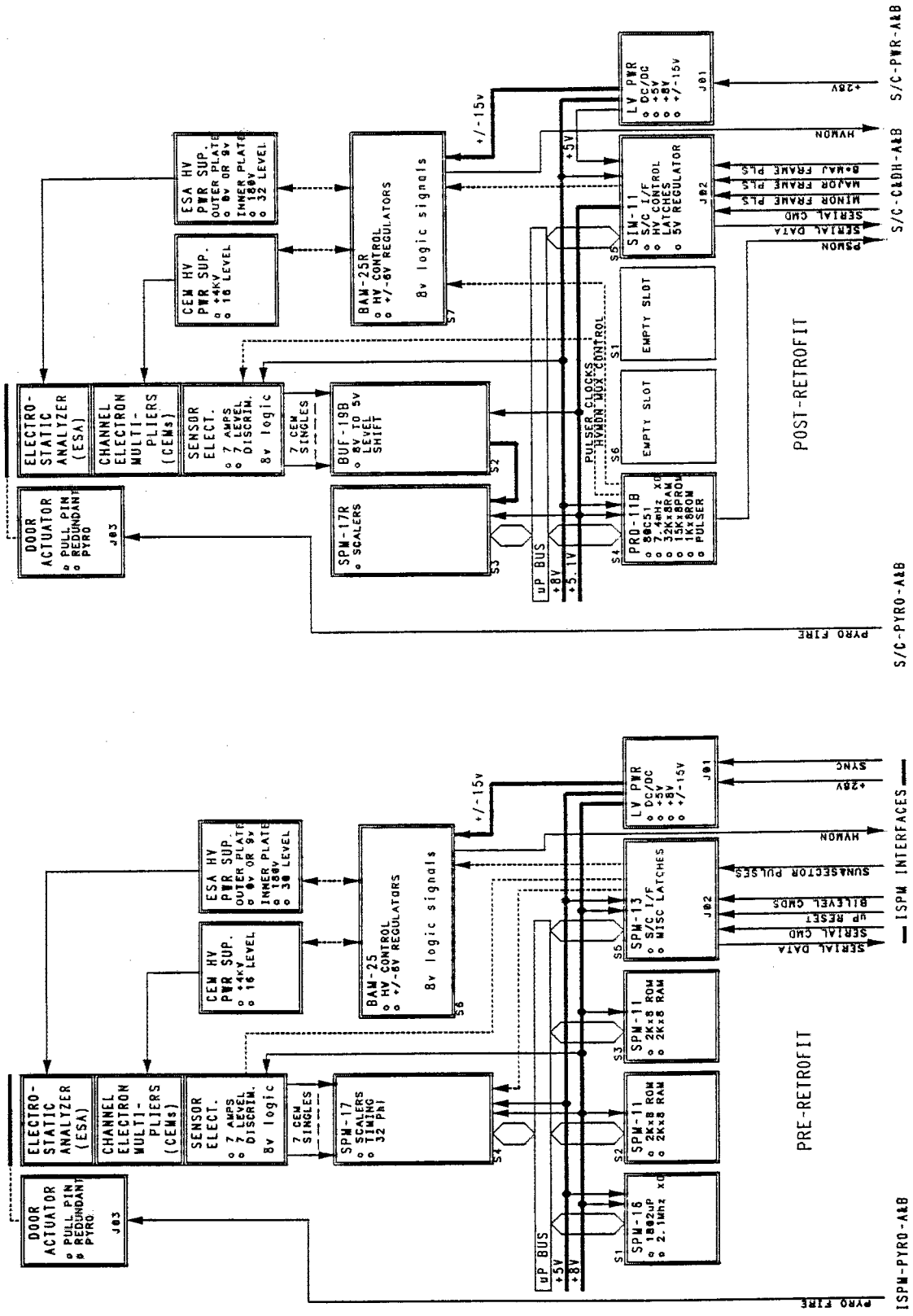
ACE SWEPAM-E TOP LEVEL BLOCK DIAGRAM

POST-RETROFIT

PRE-RETROFIT

EBD.DWG

SWEPAM Instrument Controlled Parameters			
Item	Electron Inst.	Ion Inst.	Total
	Estimated	Estimated	Allocated
Box Size (LxWxH)	25 x 18 x1 9 cm	36 x 24 x 30 cm	
Mass	2.6 Kg	4.1 Kg	7.3 Kg
Power, average	3.0 W	3.4 W	7.3 W
Power, peak	3.0 W	3.4 W	10.0 W
Particle Species Measured	3-D electrons	3-D protons & alphas	
Energy Range	1 eV - 1,450 eV	206 eV - 35 keV	
Telemetry rate	454 bps	544 bps	1000 bps
Number of CEMs	7	16	
Energy Res. $\Delta E/E$ (FWHM)	12%	5%	
Polar Resolution (FWHM)	21°	5°	
Azimuthal Resolution(FWHM)	9°to 28°	3° to 4.5°	
Field of View (Polar x AZ)	160° - 30°	90° to 10°	
Field of View, Polar	10° - 170°	(-)25° to 65°	
Time resolution	64 sec.	64 sec.	
Acceptance Fan	160%	85%	
EMC interference			
DC magnetic	.04nT	0.1 nT	
AC magnetic	BDL	BDL	
AC Electrical	BDL	BDL	
Ordinance	2 pyro pin cutters	2 pyro pin cutters	
Red tags	4*	4*	
Density Dynamic Range	0.01 to 200 cm^{-3}	0.01 to 200 cm^{-3}	
BDL = Below Detectable Levels			
* 1) HV arm/safe. 2) pyro arm/safe. 3) test port cover. & 4) baffle cover.			

Fig. 6.6. SWEPAM Instrument Controlled Parameters
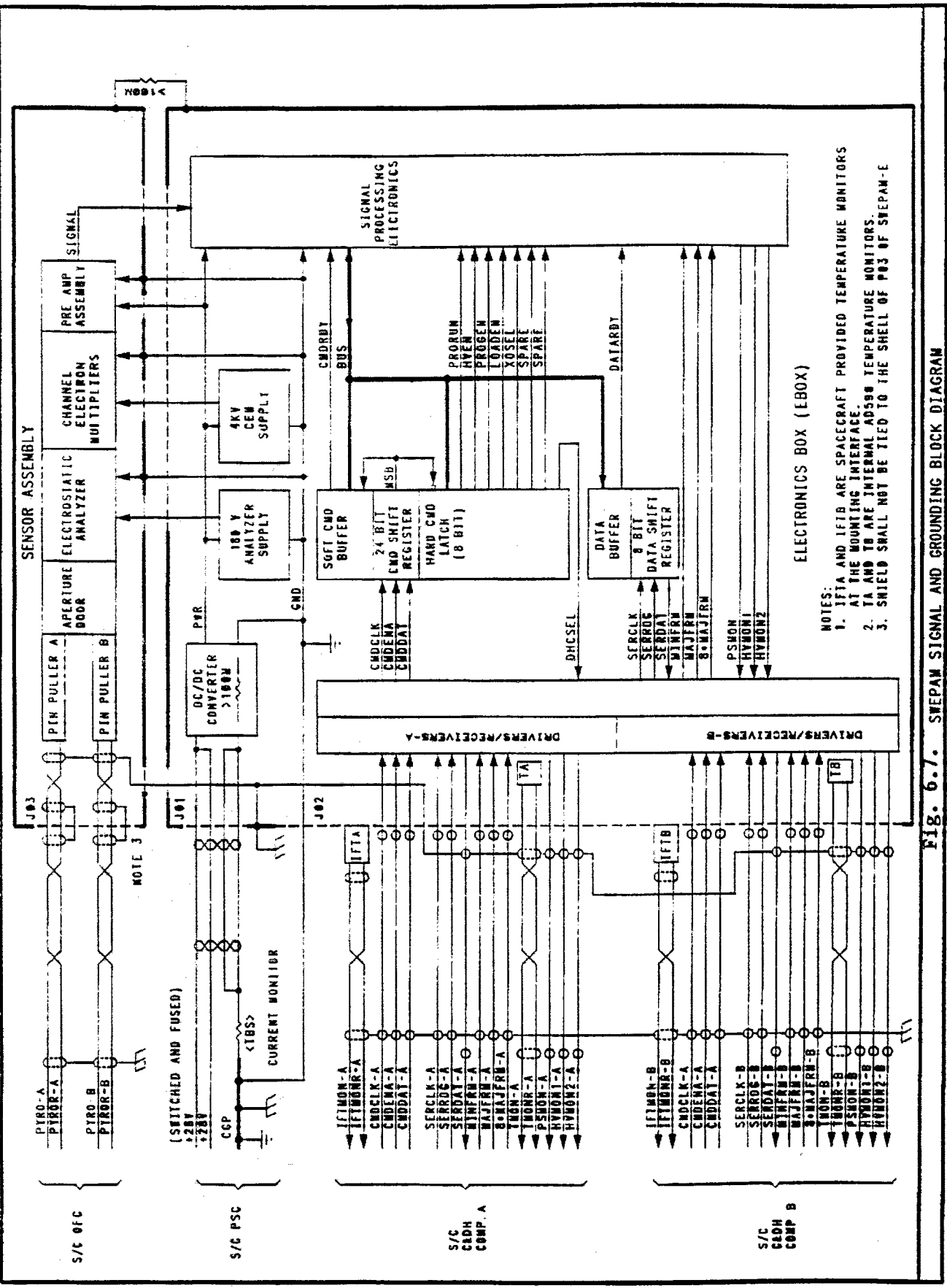
Fig. 6.7. SWEPAM SIGNAL AND GROUNDING BLOCK DIAGRAM

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