

INTERFACE SPECIFICATION
for
DMSP BLOCK 5D-2 SPACECRAFT (S11-S14) to OPERATIONAL LINESCAN SYSTEM
to MISSION SENSORS

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1.0 SCOPE

1.1 General

This Interface Specification (IS) establishes the requirements for the interfaces between:

- (1) the DMSP Block 5D-2 Spacecraft (S11-S14) and the Operational Linescan System (OLS)
- (2) the DMSP Block 5D-2 Spacecraft (S11-S14) and DMSP Mission Sensors
- (3) the OLS and DMSP Mission Sensors

1.2 Interface Documentation

This IS establishes requirements for the interfaces described in Section 1.1, and is supplemented by a set of Interface Control Documents (ICDs). The interface documentation relationship is described in GE Astro Space document 2617401.

1.2.1 Interface Specification

The IS may be changed in response to changes in system requirements in either the Spacecraft or the Sensors. Changes to the IS shall be proposed by SCN and issued by SCN, and shall be controlled by the USAF CCB.

1.2.2 Interface Control Documents Each Mission Sensor will have an ICD which will contain sensor specific requirements for interface with the spacecraft and with the OLS. A separate ICD will contain Spacecraft/OLS requirements. The ICDs will be changed as necessary to incorporate changing or new interface definitions as they evolve from agreements between the affected contractors and/or government agencies. Proposed ICD changes shall be submitted to the DMSP Space Segment Integrator. A Space Segment ICWG TIM will be convened to review proposed changes and to summarize all anticipated impacts. Consensus TIM approval of any change, without cost impact, shall result in change approval. Consensus TIM disapproval of any change shall result in change disapproval. All nonconsensus ICD changes and all changes with cost impacts shall be submitted to, and resolved by, the AF DMSP SPO. Once approved, the Space Segment Integrator shall produce and distribute formal change notices to all ICD holders.

1.3 Items Description

1.3.1 General. The sensors consist of the Operational Linescan System (OLS AVE) and a set of mission sensors (SSPs). Each of the sensors are delivered as GFE to the spacecraft contractor. A summary of the functional interface elements is shown in Figure 1.

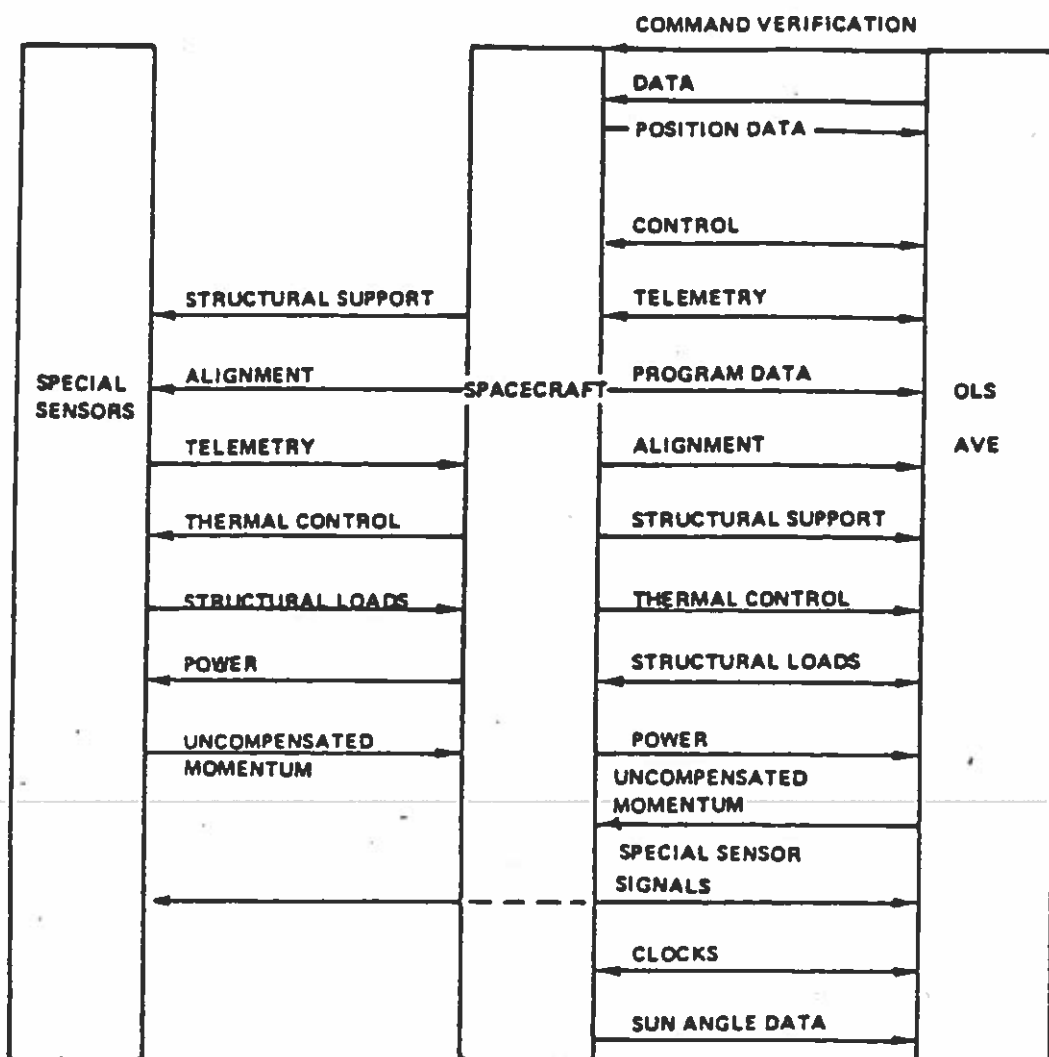


FIGURE 1.
SPACECRAFT/SENSORS FUNCTIONAL INTERFACES

1.3.2 Operational Linescan System. The OLS AVE consists of a number of individually packaged units. These units perform all functions necessary for gathering and processing OLS data and for formatting, storing, encrypting, and controlling both OLS and mission sensor data.

1.3.3 Mission Sensors. The mission sensors are independent sensors providing data about either in situ or remote geophysical phenomenon or device technology. Their identity, scientific description, characteristics and the like are described in the individual ICDs.

1.3.4 Spacecraft The spacecraft serves as a stable platform for structural support and alignment of sensor units and provides the necessary communications, control, power, and thermal control.

2.0 APPLICABLE DOCUMENTS

2.1 Government Documents

The following documents form a part of this interface specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

NONE

2.2 Non-Government Documents

The following documents form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

Standards

ASTM-E595-84 Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment

Spacecraft - Sensor - OLS Interface Control Documents

ICD-2617401	Interface Control Document, Space Segment Documentation Relationship
ICD-2617402	Interface Control Document, DMSP Block 5D-2 (S11-S14)/OLS
ICD-2617403	Interface Control Document, DMSP Block 5D-2 (S11-S14)/Mission Sensor SSBX-2
ICD-2617404	Interface Control Document, DMSP Block 5D-2 (S11-S14)/Mission Sensor SSIES-2
ICD-2617405	Interface Control Document, DMSP Block 5D-2 (S11-S14)/Mission Sensor SSJ4
ICD-2617406	Interface Control Document, DMSP Block 5D-2 (S11-S14)/Mission Sensor SSM
ICD-2617407	Interface Control Document, DMSP Block 5D-2 (S11-S14)/Mission Sensor SSMI
ICD-2617408	Interface Control Document, DMSP Block 5D-2 (S11-S14)/Mission Sensor SSMT-1

3.0 INTERFACE REQUIREMENTS

3.1 Physical

The physical interfaces, and requirements for the interfaces, between the spacecraft, mission sensors, and OLS are as described herein. In general, the spacecraft contractor shall provide for the mounting of sensor units such that the Field of View requirements and alignment requirements of each sensor are satisfied. The spacecraft shall provide, as a minimum, the volume and mounting areas required for each sensor unit and shall provide additional clearance, as necessary, for installation, connector access, thermal blanketing, dynamic excursions, and any other required clearances.

3.1.1 Mass Properties

The specific mass characteristics for each sensor are defined in the individual spacecraft/sensor ICD.

3.1.1.1 Payload Weight Allocations The Satellite payload weight allocations are as follows:

- a. 310 lbs allocated to the OLS.
- b. 250 lbs allocated to,
 1. Mission sensor complement and command and telemetry encryption and decryption units
 2. Spacecraft growth required as a result of either the addition of new mission sensors or contracted spacecraft design enhancements
 3. The Glare Obstructor (GLOB)
 4. All balance weights required by the Satellite.

3.1.1.2 Harness Weight Accounting Harness weights shall be accounted for as follows:

- a. All harnesses that connect components of a mission sensor system shall be provided by the mission sensor contractor and shall be included in that sensor's weight budget.
- b. All harnesses that connect components of the OLS shall be provided by the OLS contractor and shall be included in the OLS weight budget.
- c. Harness between the primary sensor or mission sensors and the spacecraft shall be provided by the spacecraft contractor and shall be included in the spacecraft weight budget.

- d. Harness between the primary sensor and each mission sensor shall be provided by the spacecraft contractor and shall be included in the spacecraft weight budget.
- e. The OLS test harness shall be provided by the Spacecraft contractor and shall be included in the spacecraft weight budget

3.1.2 Mechanical Interface

The spacecraft shall provide the volumetric envelope and mounting area, and shall accommodate the Field of View requirements specified in the mission sensor and OLS ICDs.

3.1.2.1 Structural and Thermal Loads The Spacecraft structure subsystem shall provide mounting of OLS and Mission Sensors in a manner that meets the structural and thermal requirements of the Mission.

These mounting requirements are detailed in the individual ICD's, and form the basis for the design of the particular Sensor interfaces.

3.1.2.2 Fields of View (FOV) The spacecraft contractor shall provide arrangement of components and sensors such that the fields of view required by the OLS and by the mission sensors are not obstructed, and glare/glint is controlled. Detailed field of view requirements are documented in the appropriate ICD.

3.1.2.3 Uncompensated Momentum As a design goal, each sensor shall minimize uncompensated momentum. The total uncompensated momentum from all sensor sources shall be less than 4.0 inch-pound-seconds about any axis. Details of individual sensor uncompensated momentum are described in the appropriate ICD.

3.1.3 Alignment

The alignment of any operating Sensor shall be maintained with other Sensors operating, non-operating, failed, or absent, in part or entirely.

3.1.3.1 Alignment Axes

3.1.3.1.1 OLS Primary Coordinate Axes. The coordinate axes X_p , Y_p , Z_p , of the SSS subsystem of the Operational Linescan System (OLS) are the primary alignment reference axes for the Satellite.

The orientation of the primary axes are defined by a set of secondary reference axes, X_r , Y_r , Z_r , and a set of rotation angles δ_{xy} , δ_{xz} , δ_{yz} from the secondary axes. The relationship of these axes and angles is shown in Figure 2

p = Primary coordinate axes
r = Reference or secondary coordinate axes
 δ = Rotation angles

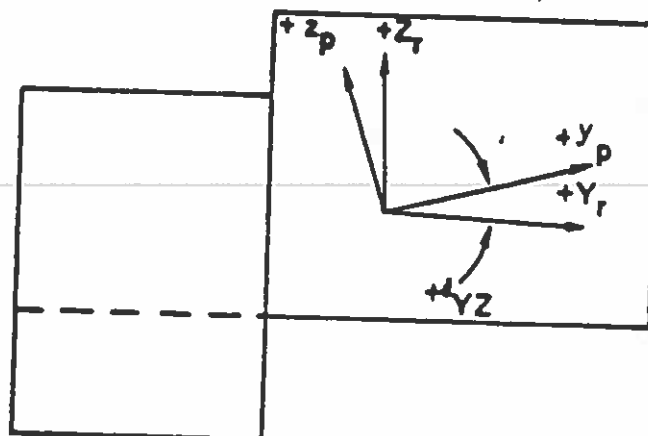
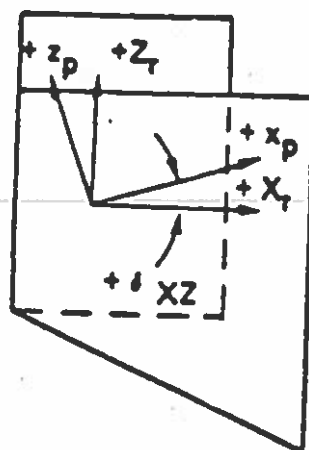
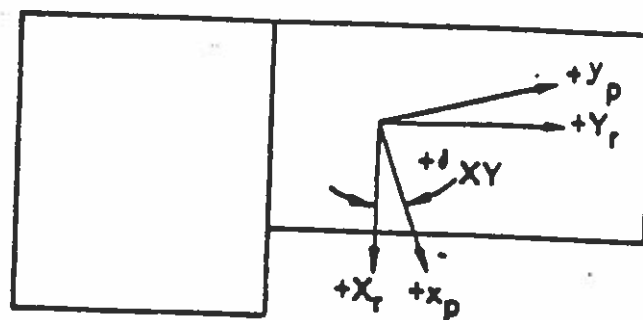


Figure 2
Alignment Coordinates

3.1.3.1.2 OLS Secondary Axes. The secondary reference axes, X_R , Y_R , Z_R comprise the normals to the X, Y, and Z surfaces, respectively, of the secondary reference optical cube of the SSS.

The optical cube, the values of δ_{xy} , δ_{xz} , δ_{yz} , and the order of rotation shall be furnished for each OLS by the OLS Contractor.

3.1.3.1.3 Mission Sensor Coordinate Axes The X, Y, Z coordinate axes of each Mission Sensor are defined by a set of secondary reference axes X_R , Y_R , Z_R and a set of rotation angles δ_{xy} , δ_{xz} , δ_{yz} from the secondary axes.

The relationships of these axes and angles is exactly analogous to that shown in Figure 2 where the X, Y, Z axes of a Mission Sensor are analogous to the X_p , Y_p , Z_p axes of Figure 2. The sense and nominal direction of the X, Y, Z axes of each Mission Sensor are shown in the individual ICDs.

3.1.3.1.4 Mission Sensor Secondary Axes. The secondary reference axes X_R , Y_R , Z_R , for each Mission Sensor shall be defined by the normals to the X, Y, Z surfaces, respectively, of the secondary reference optical cube (or secondary reference surfaces) of each Mission Sensor. A secondary reference surface shall be defined for each mission sensor, in the mission sensor ICD, along with the values of δ_{xy} , δ_{xz} , and δ_{yz} and the order of rotation. For mission sensors whose secondary axes are defined by normals to an optical cube, an optical cube shall be supplied by the mission sensor contractor with each sensor unit.

3.1.3.2 Alignment Requirements

3.1.3.2.1. Primary Axes The Spacecraft shall maintain the attitude of the Satellite such that the primary axes x_p , y_p , z_p , of the SSS remain aligned with the X, Y, Z reference axes of the geodetic local vertical within 0.01 degrees. This attitude shall be maintained during all orbital conditions for the life of the Satellite except during start-up and shut-down of the Mission Sensor SSMI. Details of the effects of SSMI start-up and shut-down, on alignment, are described in the SSMI ICD. The tolerance is three-sigma per axis, and includes all errors due to mounting, structural alignment, attitude determination and control, thermal distortions, and all other error sources affecting SSS orientation.

3.1.3.2.2. Mission Sensor Axes The Spacecraft shall maintain, under all orbital conditions, the X, Y, Z axes of each Mission Sensor aligned with the X_p , Y_p , Z_p reference axes of the SSS to the tolerance requirements specified in the sensor ICD.

3.1.3.3 Alignment Knowledge The Spacecraft contractor shall provide Sensor and component mounting arrangement such that measurement of actual alignment of the Sensors is possible when the sensors are integrated with the spacecraft. Details of the tolerance for component mounting and the alignment knowledge for each sensor are described in the ICDs.

3.1.4 Materials

3.1.4.1 Outgassing In accordance with ASTM-E595-84, materials used in the fabrication of the Spacecraft or the Sensors shall not have have outgassing characteristics greater than the following:

- 0.1% volatile condensable material (VCM) loss in vacuum
- 1% total mass loss (TML) in vacuum

unless they are suitably encased to prevent contamination of adjacent equipment.

3.1.4.2 Dissimilar Metals Use of dissimilar metals in direct contact shall be avoided in all interfaces. Metals used shall be of the corrosion resistant type or shall be suitably treated and controlled to resist corrosion, except where untreated surfaces are needed to meet electrical grounding requirements. Interface details are contained in the individual sensor ICDs.

3.1.4.3 Magnetic Materials In no case shall the total magnetic moment of any individual Sensor exceed 0.1 ampere-turn-meter² along any axis. Detailed Sensor magnetic characteristics are defined in the individual Sensor ICD.

The total magnetic moment from all Sensors shall not exceed 1.0 ampere-turn-meter² along any axis. The maximum magnetic moment difference between any modes of operation for the OLS and each Mission Sensor shall be 0.01 ampere-turn-meter².

3.1.5 Deployment Characteristics

The spacecraft deployment characteristics, to the extent that they may affect the sensors, are shown in Figures 3 thru 11. Sensor and sensor cover deployment characteristics are described in the individual sensor ICDs.

3.1.6 Structural and Thermal Models

Requirements for sensor structural and/or thermal models, when necessary, shall be as defined in each sensor ICD.

3.1.7 Actuator Location

The location of actuators shall permit access for installation and arming, if required, while the Sensor is mounted on the Spacecraft.

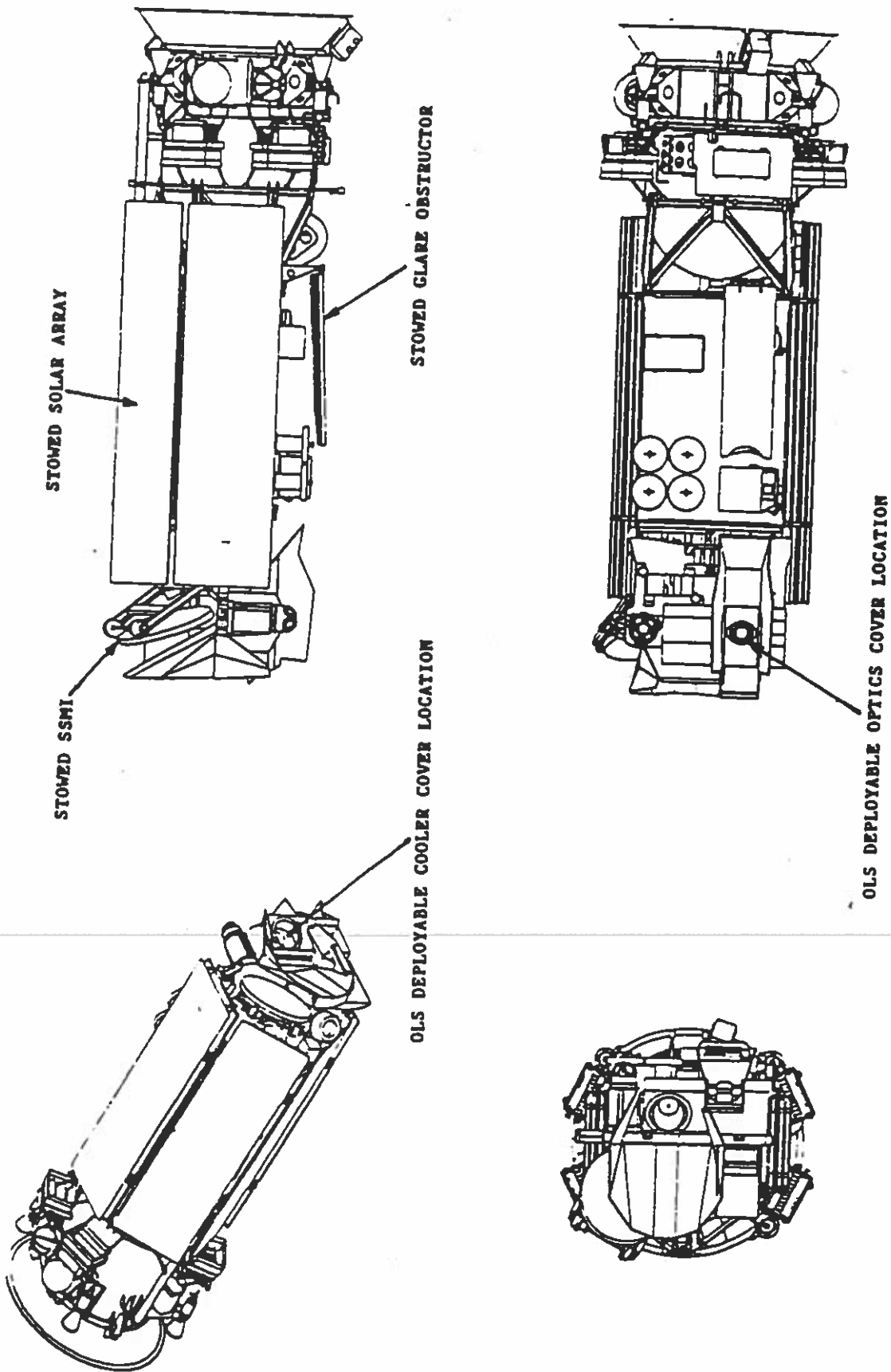


FIGURE 3
DMSP BLOCK 5D-2 S11-14
STOWED CONFIGURATION

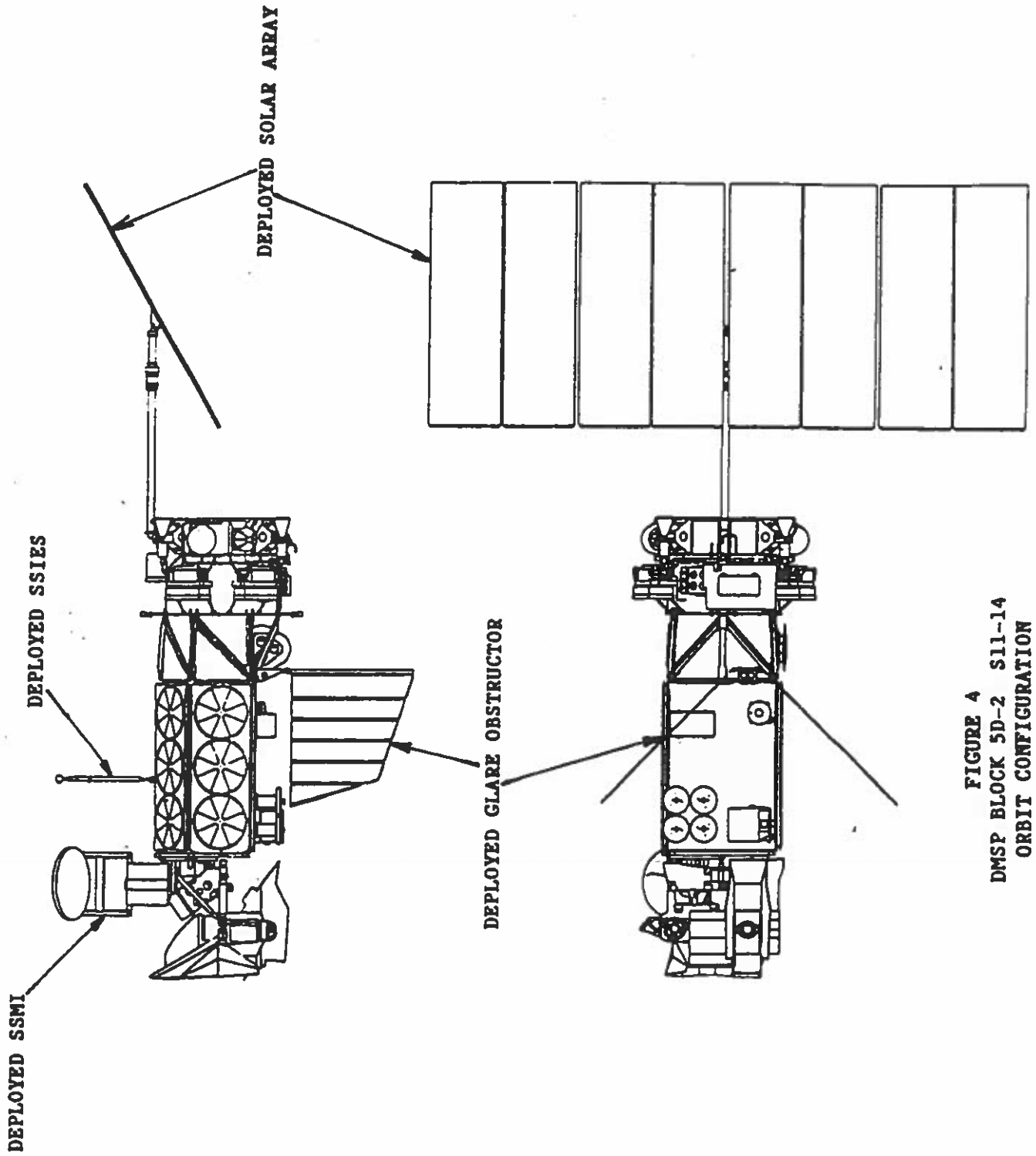


FIGURE 4
DMSP BLOCK 5D-2 S11-14
ORBIT CONFIGURATION

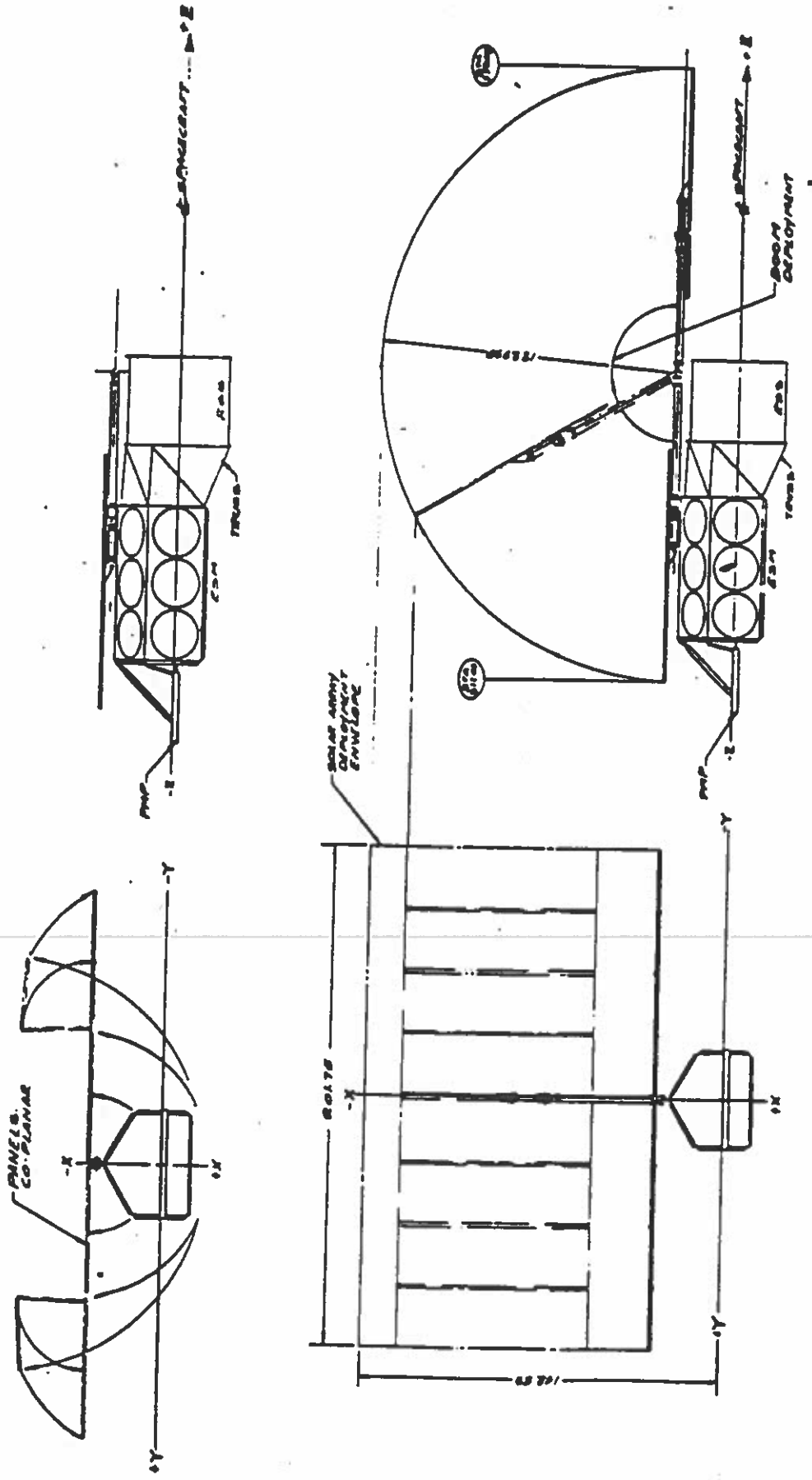


Figure 6
Solar Array Panel Final Deployment and Deployment Envelope

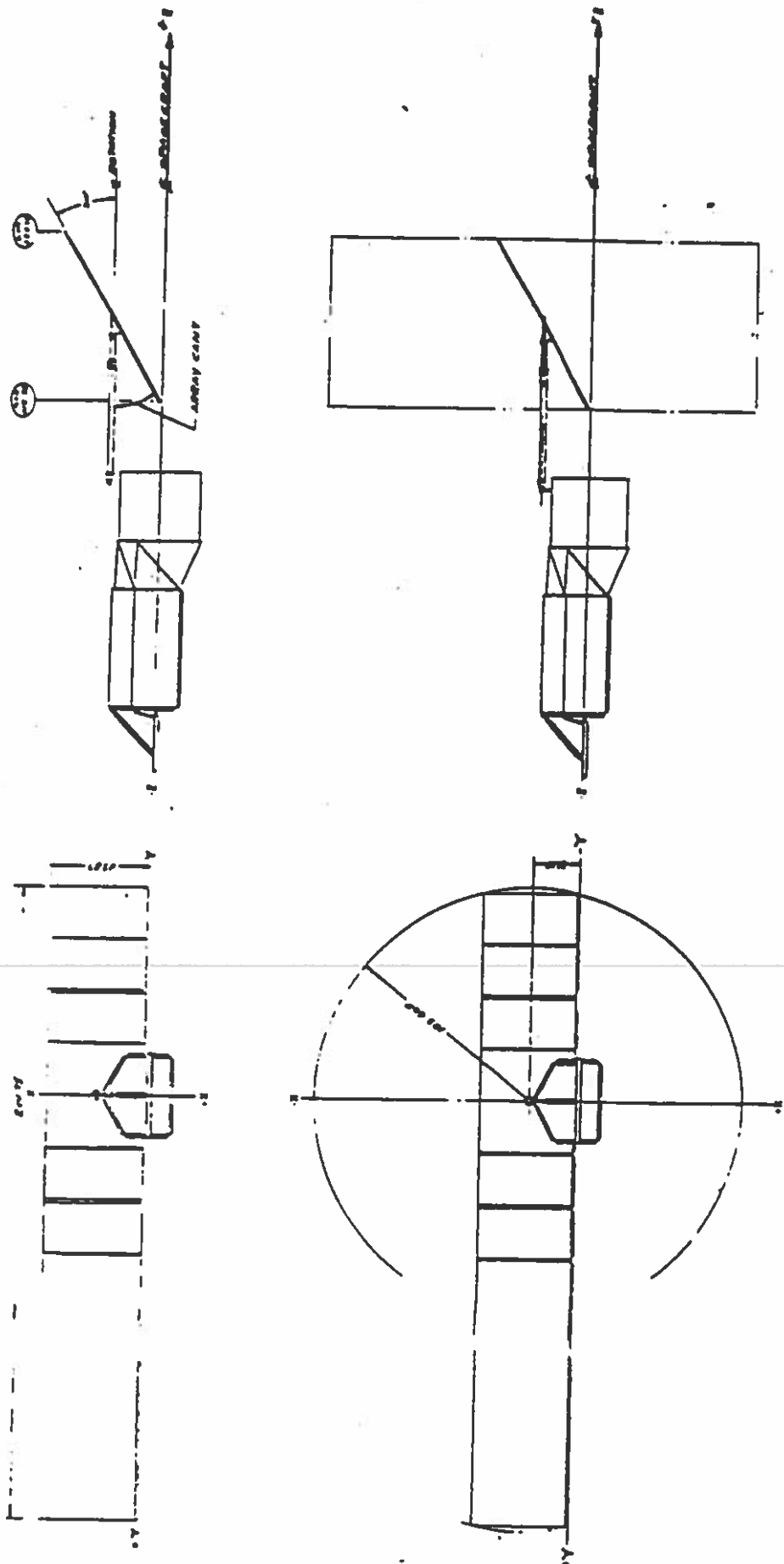
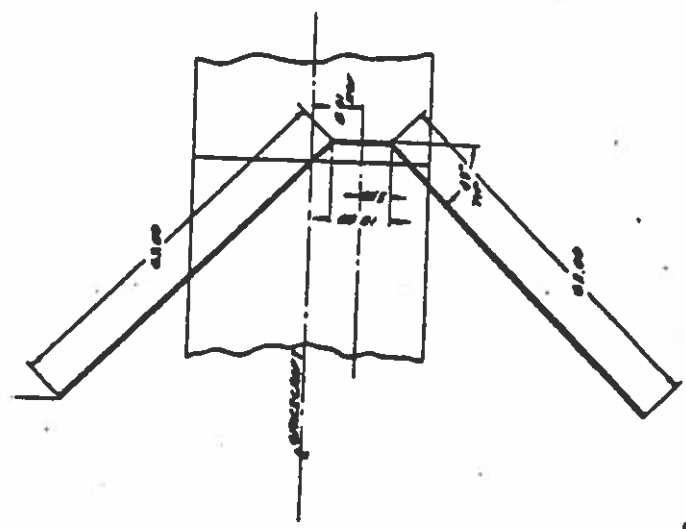
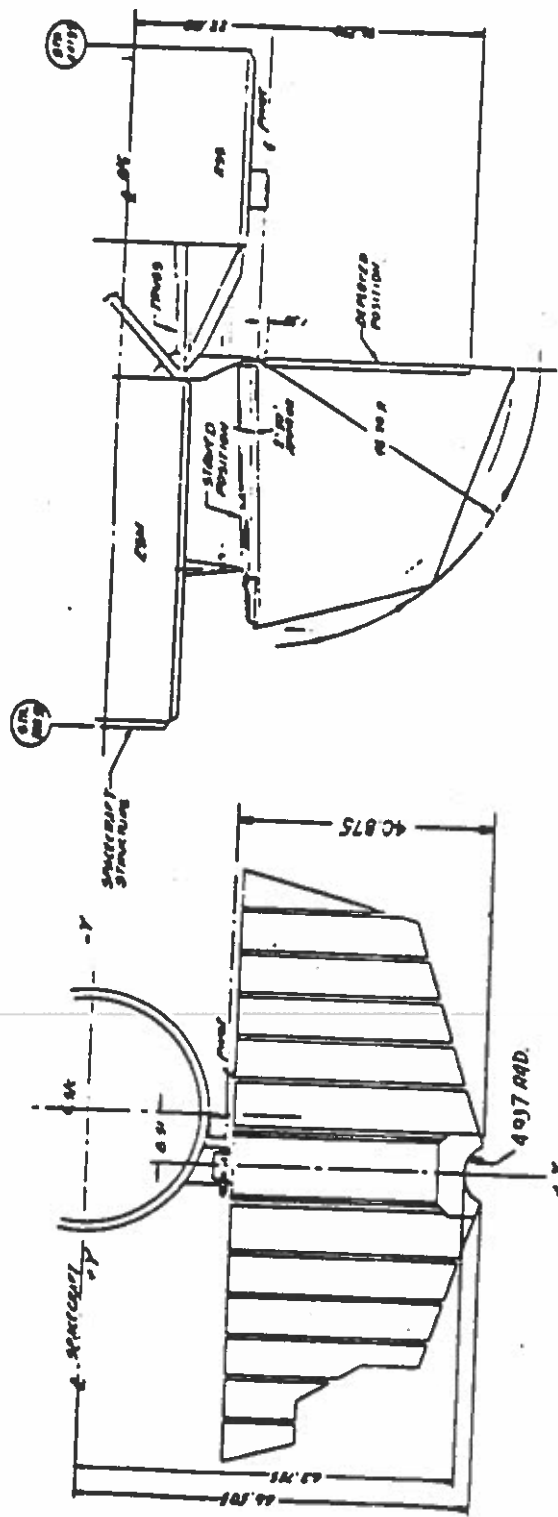
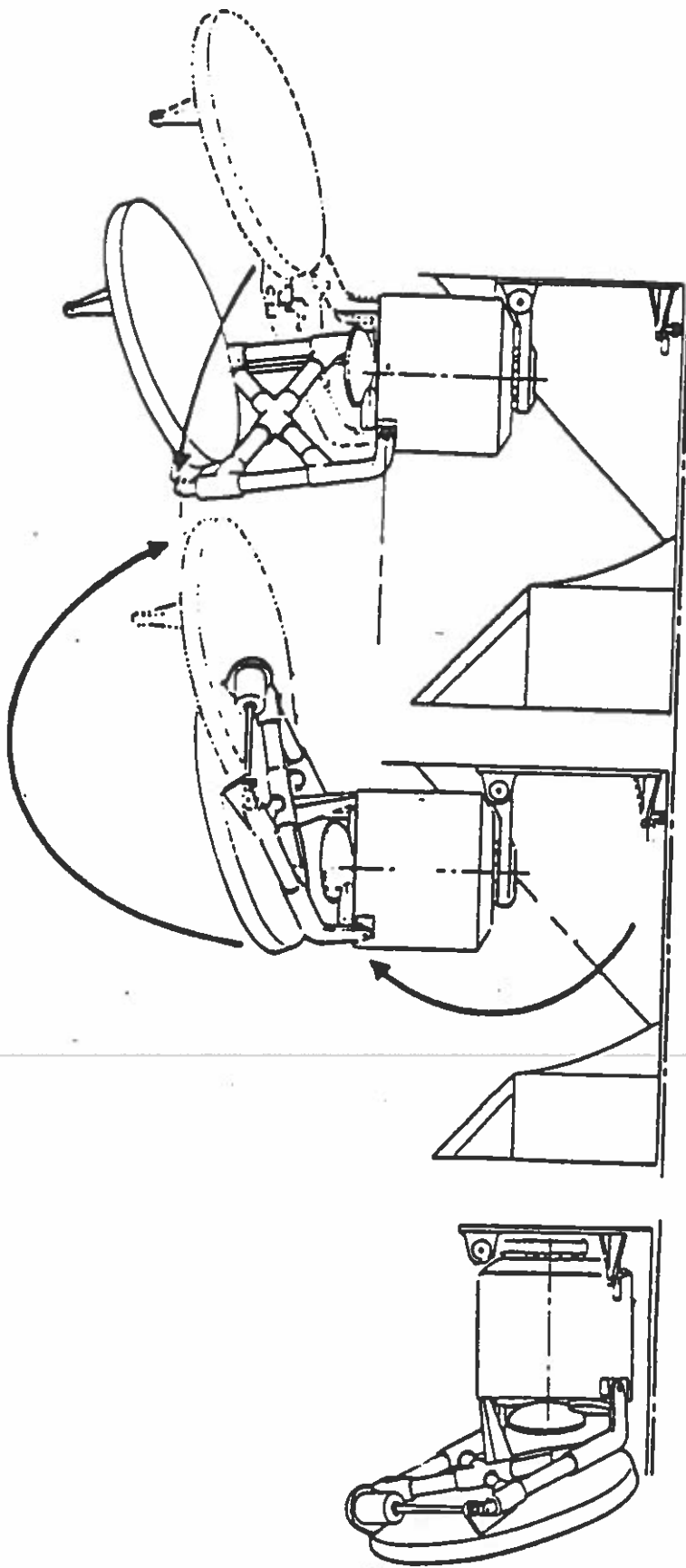


Figure 7
Solar Array Rotational Envelope and Final Orbit Configuration



NOTE: Static envelope is at 57.000
 DIA about s/c center line

Figure 8
 GLOB Configuration and Deployment



- a) STOWED
- b) SENSOR DEPLOYMENT AND ANTENNA ROTATION
- c) ANTENNA TRANSLATION TO FINAL POSITION

Figure 9
SSMI Deployment Sequence

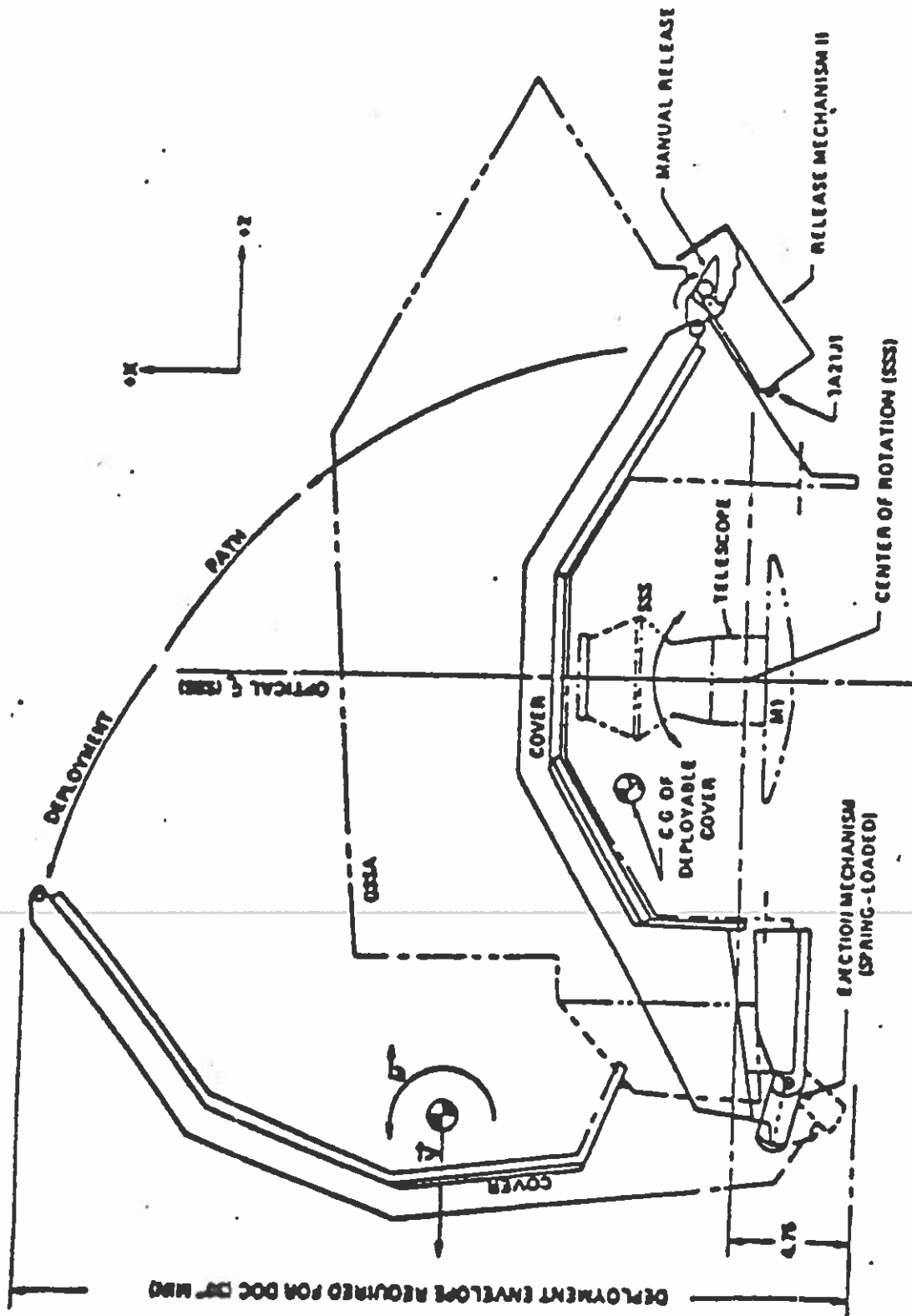
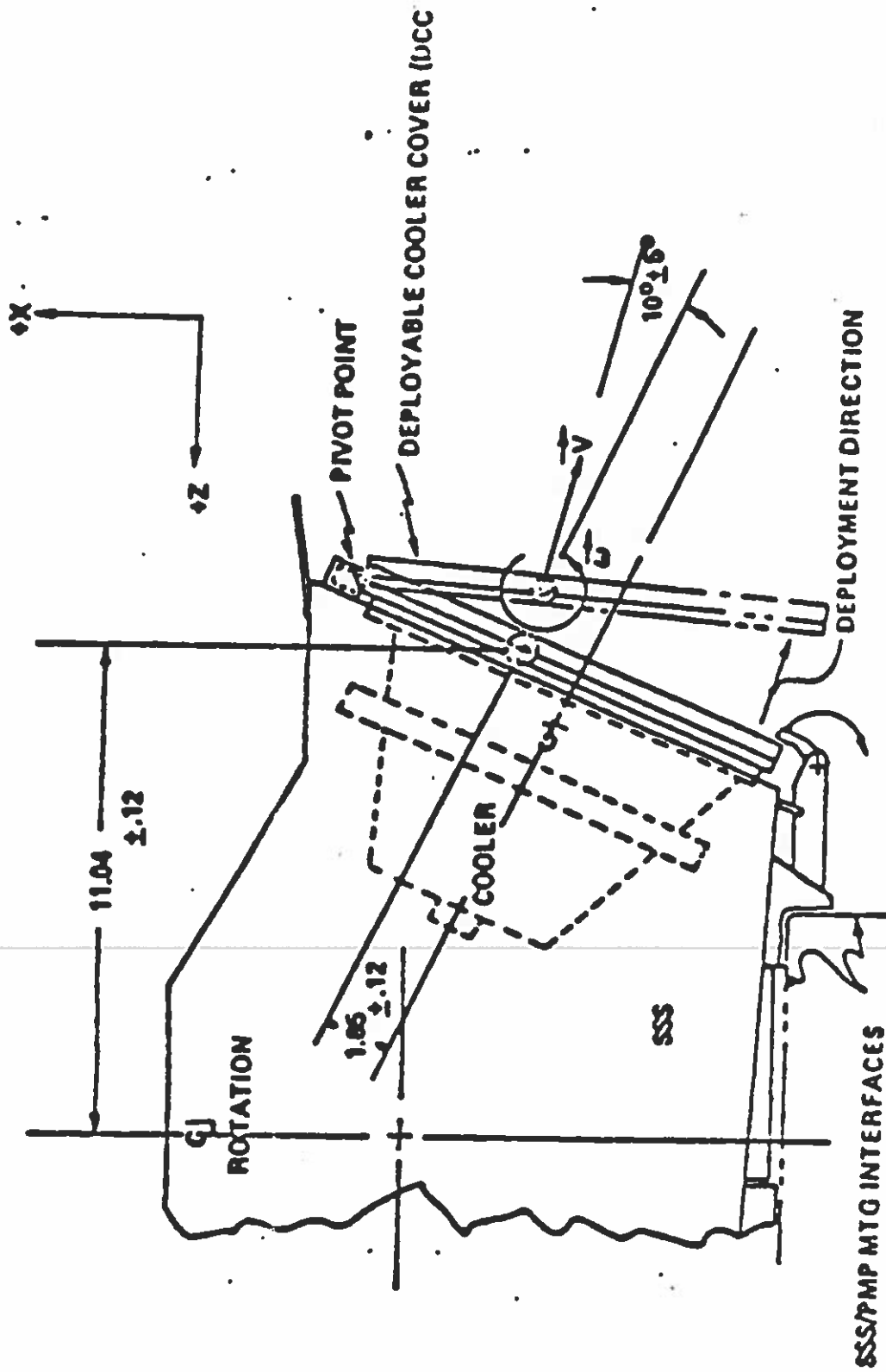


Figure 10
DOC Configuration and Deployment



AT THE INSTANT THE DCC DISENGAGES FROM THE SSS AT ITS PIVOT POINT, ITS C.G. WILL HAVE A LINEAR VELOCITY (V) IN THE DIRECTION SHOWN AND IT WILL HAVE AN ANGULAR VELOCITY (ω) ABOUT ITS C.G. CAUSING IT TO TUMBLE AWAY FROM THE SSB.

Figure 11
DCC Configuration and Deployment

3.2 SPACECRAFT/OLS and SPACECRAFT/MISSION SENSOR ELECTRICAL INTERFACE

3.2.1 General. The spacecraft shall be functionally compatible with the OLS units and the mission sensor units and shall have the capability of supporting all sensors as described in this interface specification. The spacecraft shall provide power for the sensors, and shall provide, collect, store, and transmit the sensor interface signals. Detailed description of the applicable sensor/spacecraft interfaces are contained in each sensor/spacecraft ICD.

3.2.2 Interface Signal Characteristics. The interface signal characteristics shall be as defined in each sensor/spacecraft ICD.

3.2.3 Actuator Signals. The purpose of the actuator signals are to initiate any caging devices included in the sensors. The specific requirements for actuator signals from the spacecraft to a sensor will be included in the sensor/spacecraft ICD. When an actuator signal is provided by the spacecraft, it shall consist of firing pulses from 4.4 to 7.75 amperes for a minimum of 25 milliseconds. The sensor shall provide an input impedance of 1.3 ± 0.2 ohms resistive for each caging device that requires an actuator signal. The actuators shall have a maximum no-fire current of 1 ampere and a minimum all-fire current of 4.4 amperes.

3.2.4 Equipment Status Telemetry (EST). The spacecraft shall accept and process a maximum of 300 EST signals from the sensors allocated as follows.

<u>Source</u>	<u>Analog Data</u>	<u>Discrete Data</u>
OLS AVE	88	60
<u>Special Sensors</u>	<u>112</u>	<u>40</u>
Total-All Sensors	200	100

The number of EST signals used, their characteristics, and functions shall be defined in the individual sensor interface control documents.

3.2.4.1 Analog Data Channel Input. All analog data channels shall have nominal input signal levels of 0 volts to +5.10 volts with the EST subsystem surviving overrange limits of -15 volts to +15 volts. The source impedance shall be a minimum of 2k ohms and a maximum of 15k ohms. The 15k ohm maximum can be exceeded if the defined PIP accuracy of ± 2 least significant bits is not required.

3.2.4.2 Discrete Data Channel Input. The discrete data channels shall be used for on/off, true/false, or yes/no type data. A logic "1" (low or true or on) shall be -0.1 volt to +1.5 volt. A logic "0" (high or false or off) shall be +3.5 volts to +5.7 volts. The source overrange limits shall be -15 volts to +15 volts. The source impedance shall be a minimum of 2k ohms and a maximum of 15k ohms.

3.2.4.3 EST Subsystem Characteristics. The spacecraft EST subsystem shall impose the following conditions:

- a. LOAD - 2 megohms minimum for signals within the data voltage range.
- b. DATA RANGE - 0.0V to +5.1V referenced to spacecraft single point ground.
- c. PIP GATE FAILURE CONDITION - ± 5 milliamperes maximum fed back to source.
- d. BANDWIDTH - The sampling rate shall vary from 1 sample per 10 seconds to 4 samples per second in the normal 2 and 10 kbit/sec TCTR modes. Dwell modes are available which provide sampling rates from 32 samples per second to 3600 samples per second. Analog data is DC coupled and is not subject to any filtering other than that provided by the sampling process. The standard sampling rates for each PIP mode are as follows:

PIP Mode (kbit/sec)	Standard Sampling Rates (Samples/Seconds)	
	Analog	Discrete
2	1/10, 1/5, 1/1.25	1/10
10	1/2, 1/1, 4/1	1/2
60	1/2, 1/1, 4/1	3/1

- e. QUANTIZATION - 8 bits per sample.
- f. ACCURACY - ± 2 least significant bits (with source impedance 2k to 15k ohms).

3.2.5 Power. The spacecraft shall supply a peak output current of 14.0 amperes at +28.0 volts DC and up to 2.0 amperes of current at +5.0 volts DC to the mission sensors with the characteristics described in the subsequent paragraphs.

3.2.5.1 +28 Volt

3.2.5.1.1 Regulated Power Bus. The spacecraft shall provide a regulated power bus at a level of +28.0 ± 0.56 volts exclusive of ripple voltage and transients. The voltage on the +28 volt bus shall not exceed +38 volts, including all ripple and transients. Bus voltage during load current changes up to 6.0 amperes applied at any rate not exceeding 50 milliamperes/millisecond shall not deviate from nominal by more than 200 millivolts for 100 milliseconds maximum.

3.2.5.1.2 Output Impedance. The +28 volt regulated bus output impedance shall be as follows:

<u>Frequency Range</u>	<u>Ohmic Value (Less Than)</u>
DC - 100 Hz	0.03
100 Hz - 1 kHz	0.1
1 kHz - 100 kHz	0.2
100 kHz - 1 MHz	2.0
1 MHz - 10 MHz	20.0

3.2.5.1.3 Voltage Ripple. The voltage ripple on the +28 volt bus from the PSE shall not exceed 0.25 volt peak-to-peak maximum in the frequency range 10 Hz to 10 MHz.

3.2.5.1.4 Voltage Transients. Maximum voltage in the presence of transients on the +28 volt bus shall not exceed the following limits:

<u>Peak Voltage (Volts)</u>	<u>Maximum Transient Width (milliseconds)</u>
34.0	1
33.5	1.1
29.3	150
26.7	1800
0.0	2000

At 0.0 volts the sensors are in a non-operating state.

3.2.5.1.5 Current Ripple. The steady state current ripple generated by each mission sensor on the 28 volt regulated bus, exclusive of stepping transients, shall not exceed 30 milliamperes peak-to-peak for a bus source impedance of 1 ohm or less. The OLS AVE shall be designed to minimize the current ripple imposed on the spacecraft +28 volt power bus. Peak rate of change of load current shall not exceed 50 milliamperes per microsecond with the exception of BBx and OLS power enable turn-on transients. Total OLS current ripple, when measured in a 0-2000 Hz passband shall not exceed 50 milliamperes in RMS value and 700 milliamperes in peak value in air (500 milliamperes in vacuum). Additionally, the peak narrow band (10Hz) current ripple shall not exceed 100 milliamperes anywhere within the 0-2000 Hz passband.

* 3.2.5.1.6 Current Transients. The rise rate of load current transients initiated by each mission sensor on the +28 volt regulated bus shall be 20 milliamperes or less per microsecond. During spacecraft power initialization, the spacecraft shall supply peak currents of 2.5 amperes for less than 1 millisecond on the 28 volt regulated bus. The OLS AVE (excluding BB1, BB2, and BB3) shall require a peak transient current of less than 2.5 amperes from the +28 volt bus for a period of 10 seconds or less for mode changes. The BBxs may each require peak transient currents of up to 8 amperes each on initial application of power to the +28 volt bus. Transient current required by the BBxs in nominal operation shall not exceed 0.25 amperes.

3.2.5.2 +5 Volt

3.2.5.2.1 Regulated Power Bus. The spacecraft shall normally provide a continuous and uninterrupted regulated power bus at a level of +5.0 ±0.25 volts. The voltage on the +5 volt bus shall not exceed +7.5 volts, including all ripple and transients. If conditions should necessitate this bus having to be interrupted, then the OLS must be OFF prior to this interruption for normal operation of the OLS to occur. During +5 volt power converter switching (primary mode to back-up mode or vice-versa) the +5 volt bus can reduce to 0 volts for up to 0.1 second.

3.2.5.2.2 Output Impedance. The +5.0 volt regulated bus output impedance shall be as follows:

<u>Frequency Range</u>	<u>Ohmic Value (Less Than)</u>
DC - 100 kHz	0.2
100 kHz - 1 MHz	2.0
1 MHz - 10 MHz	20.0

3.2.5.2.3 Voltage Ripple. Voltage ripple on the +5 volt bus shall not exceed 0.25 volt peak-to-peak for frequencies up to 10 MHz.

3.2.5.2.4 Voltage Transients. Maximum voltage in the presence of transients on the +5 volt bus shall not exceed the following limits:

<u>Peak Voltage above Nominal (Volts)</u>	<u>Maximum Transient Width (Microseconds)</u>
0.05	200 to 500
0.10	150 to 200
0.50	100 to 150
1.00	50 to 100
1.50	0 to 50

3.2.5.2.5 Current Ripple. Current ripple generated by each mission sensor on the +5.0 volt regulated bus shall be less than 0.5 milliamperes peak-to-peak. The current ripple generated by the OLS AVE on the +5 volt bus, exclusive of mode changing transients, shall not exceed 50 milliamperes peak-to-peak for ripple frequencies up to 100 Hz, and 100 milliamperes peak-to-peak for ripple frequencies from 100 Hz to 10 MHz.

3.2.5.2.6 Current Transients. The rise rate of load current transients initiated by each mission sensor on the 5.0 volt regulated bus shall be 1 milliamperes or less per microsecond. During spacecraft power initialization, the spacecraft shall supply a peak current of 1 ampere for less than 2 milliseconds on the 5.0 volt regulated bus. The OLS shall require a peak transient current of less than 0.5 amperes from the +5.0 volt bus for a period of 1 second or less for mode changes.

3.2.5.3 +10 Volts

3.2.5.3.1 Regulated Power Bus. The spacecraft shall provide a regulated power bus at a level of $+10.0 \pm 0.5$ volts to the OLS only. The maximum +10V current supplied to the OLS shall be 12 milliamperes. The OLS shall current limit this +10 volt line to 100 milliamperes. The voltage on the +10 volt bus shall not exceed 12 volts, including all ripple and transients. The +10 volt bus shall be used only for powering control signal interface circuits.

3.2.5.3.2 Output Impedance. The source impedance of the +10 volt bus shall be as follows:

<u>Frequency Range</u>	<u>Ohmic Value (Less Than)</u>
DC - 200 kHz	0.4
200 kHz - 1MHz	2.0
1 MHz - 10 MHz	20.0

3.2.5.3.3 Voltage Ripple. Voltage ripple on the +10 volt bus shall not exceed 250 millivolts peak-to-peak for frequencies up to 10 MHz.

3.2.5.3.4 Voltage Transients. Voltage transients on the +10 volt bus shall not exceed ± 1.0 volt nominal-to-peak with a maximum pulse width of 50 microseconds.

3.2.5.3.5 Current Ripple. The peak-to-peak amplitude of steady-state load current ripple generated by the OLS shall not exceed 5 percent of the maximum average steady-state current drawn by the OLS. The fundamental frequency of load current ripple shall not exceed 2.5 MHz.

3.2.5.3.6 Current Transients. Transient load currents drawn by the OLS shall not exceed 125 percent of the maximum average steady-state current drawn by the OLS and steady-state operation shall be attained within 50 milliseconds from the start of the transient. The rate of change of current during transients shall in no case exceed 20 milliamperes per microsecond.

3.2.5.4 Power Application. The sensors shall be designed to withstand the following initialization sequence of spacecraft power:

- a. The +28 volt bus will be increased from 0 to +28 volts (in an approximately linear manner) within 2 seconds. During the initialization sequence the rate of change on the 28 volt bus shall not exceed 100 volts per second.
- b. The +5 volt bus will increase from 0 to +5 volts during the +28 volt bus buildup.

3.2.5.4 (cont.)

- c. The +10 volt CPC bus will increase from 0 to +10 volts during the +28 volt bus buildup.
- d. The nominal +5 volt and +10 volt control signal outputs will be at indeterminate levels (although within the normal 0 to 5 volt and 0 to 10 volt ranges respectively) during the +28 volt bus buildup.

No operational spacecraft mode shall remove +28 volts, +10 volts, or +5 volts from the sensors, except as described in para. 3.2.5.2.1.

3.2.6 Grounding Requirements. The spacecraft and sensors shall implement a common grounding philosophy. The spacecraft grounding shall accommodate the grounding requirements for the sensors as defined here in and in each sensor/spacecraft ICD.

3.2.6.1 Spacecraft Signal Grounds. The spacecraft provided signal grounds shall be electrically isolated by at least 100K ohm DC from the chassis ground of the spacecraft boxes which interface with the sensors and from power ground. The AC impedance shall be maximized when these same spacecraft boxes are not connected to the single point ground. As a design goal, the AC isolation shall be no more than 50 picofarads. Detailed requirements for signal grounds are specified in each sensor/spacecraft ICD.

3.2.6.2 Spacecraft Power Grounds. The spacecraft shall provide power grounds (or returns) for the Squib Signals and the Power Interfaces. Details for the power grounds are described in each sensor/spacecraft ICD.

3.2.6.3 Chassis (Case) Ground. Except for the sensor scanning subsystem (SSS) of the OLS which has the case isolated from the mounting structure, each sensor chassis (case) shall be electrically connected to the spacecraft by an insulation-free metal-to-metal bond of 0.1 ohm or less. All mission sensors shall be designed to provide a chassis ground output pin for use in testing.

3.2.7 Sensor Harnessing. Harness responsibility shall be as follows:

- a. All harnesses that connect components of a mission sensor system shall be provided by the mission sensor contractor
- b. All harnesses that connect components of the OLS shall be provided by the OLS contractor
- c. Harness between the OLS or mission sensors and the spacecraft shall be provided by the spacecraft contractor
- d. Harness between the OLS and each mission sensor shall be provided by the spacecraft contractor
- e. The OLS test harness shall be provided by the spacecraft contractor.

3.2.7 (cont.)

A description of the harness characteristics, connectors, and pin assignments for each sensor/spacecraft functional interface is included in the individual sensor/spacecraft ICD. Each OLS/mission sensor interface signal and its respective return shall be a twisted pair and the cable shall be bundle shielded with the shield terminated at the OLS end. The OLS/mission sensor cable shall have a maximum capacitance of 900 picofarads from any signal line to all other lines and shield.

3.2.8 Electromagnetic Compatibility. The spacecraft and sensors shall be designed to minimize emanation of and susceptibility to spurious electromagnetic signals, both radiated and conducted. The spacecraft will have transmitters operating at 2207.5 MHz, 2237.5 MHz, 2252.5 MHz, 2267.5 MHz and a receiver operating at 1791.748 MHz with a 300 MHz 60 dB bandwidth.

3.2.9 Fusing. The spacecraft Sensor Interface Unit (SIU) fuses power to all mission sensors. Generally, the +28 volt supply to each mission sensor is fused with a 3 ampere fuse, and the +5 volt supply to each mission sensor is fused with a 1 ampere fuse. Exceptions to this standard fusing scheme, as dictated by individual sensor needs, are detailed in the appropriate mission sensor ICD.

3.3 OLS/MISSION SENSOR ELECTRICAL INTERFACE

Section 3.3 establishes the requirements for the interfaces between the OLS and each of the mission sensors (abbreviated SSPs or SSxs) and for the interfaces between the OLS field test equipment (FTE) and each SSP AGE. The OLS provides control and data handling for up to 12 (inclusive) SSPs, provided the total requirement for SSP data does not exceed the OLS data handling capacity. The OLS shall be capable of supporting any combination of the SSPs, including the possibility of any or all of them being absent entirely or requiring less support than specified herein. Stated requirements which dictate either the OLS or SSP to provide interface signals shall require that the receiving segment be compatible with the interface signal provided.

3.3.1 SSP Generated Signals

3.3.1.1 SSP Data. Each mission sensor shall provide digital data to the OLS AVE for inclusion with the SDS or RTD primary data streams. The OLS shall accept a single data signal, designated as (SSxDAT), from each SSP. All SSP output interface signals to the OLS must remain at the zero volt level when the OLS is turned OFF.

3.3.1.1.1 Data Content. The mission sensor data signal shall consist of digital NRZ-L data as defined in Figure 12. Data shall be transferred in phase with the OLS supplied bit clock in bursts of X contiguous bits, at a bit rate of 9990.244 ± 1 Hz. The 90 percent level (defined in Figure 13.) of all NRZ-L SSP data (SSx DAT) transitions shall occur within 20 microseconds after receipt of the 90 percent level (defined in Figure 14) of the positive going edge of the bit clock (SSx BCK) when the loading on the SSXDAT signal is as defined in Figure 23. Each SSP shall upon command from the OLS provide one data block per second. One data block consists of a burst of X contiguous bits. All SSP data words shall be output from the SSP least significant bit (LSB) first of the first word.

3.3.1.1.2 Bit Structure. Each SSP shall structure their word length to be 6, 9, 12, 18, or 36 bits in length. In addition each SSP shall incorporate an output buffer or register of sufficient length to allow the OLS to interrogate that buffer or register for an integral number of 36 bit words. For example, a SSP having an output of 6 bits/second will place those 6 bits in a 36 bit (or larger) register. The OLS will output those six bits of data followed by 30 bits which reflect the state of the remainder of the SSP data register.

3.3.1.1.3 Data Routing. The spacecraft will route mission sensor data from each of the mission sensor packages to the SPU of the OLS AVE.

3.3.1.1.4 Signal Ground. The OLS AVE shall provide signal grounds for the mission sensor data interface. These signal grounds shall be electrically connected within the OLS AVE at the OLS AVE signal point ground.

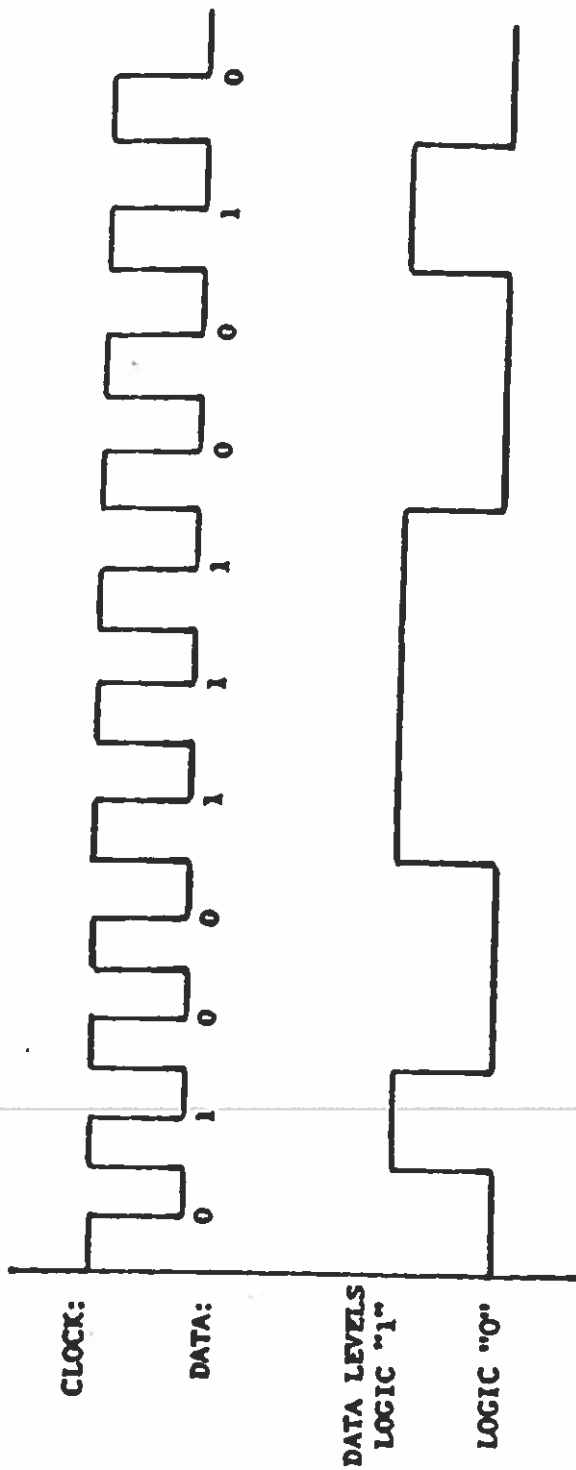
These signal grounds shall be isolated by each mission sensor from the mission sensor's chassis and power return by a resistance of at least 20K ohms shunted by a capacitance of no more than 0.01 microfarads. This isolation shall be maintained by each mission sensor whether powered ON or OFF except the SSM/I which shall be powered ON to meet this isolation specification.

The sum of the currents generated by any mission sensor on these signal ground lines shall not exceed 30 milliamperes dc. The peak to peak ac component of this current shall not exceed 15 milliamperes for a total current not to exceed 37.5 milliamperes.

The voltage difference between any two signal ground lines on a single connector that a mission sensor can expect to see shall not be greater than 50 millivolts peak to peak as measured at the OLS SPU connector.

The resistance in the OLS between any of these signal grounds on any one mission sensor connector shall not exceed 0.5 ohms as measured at the OLS SPU connector. The resistance between any of these signal ground lines at the OLS SPU connector and the OLS AVE single point ground shall not exceed 1.0 ohms.

The maximum common mode voltage present on the OLS generated signals and these signal grounds with respect to the OLS single point ground shall not be greater than ± 1.0 volts.



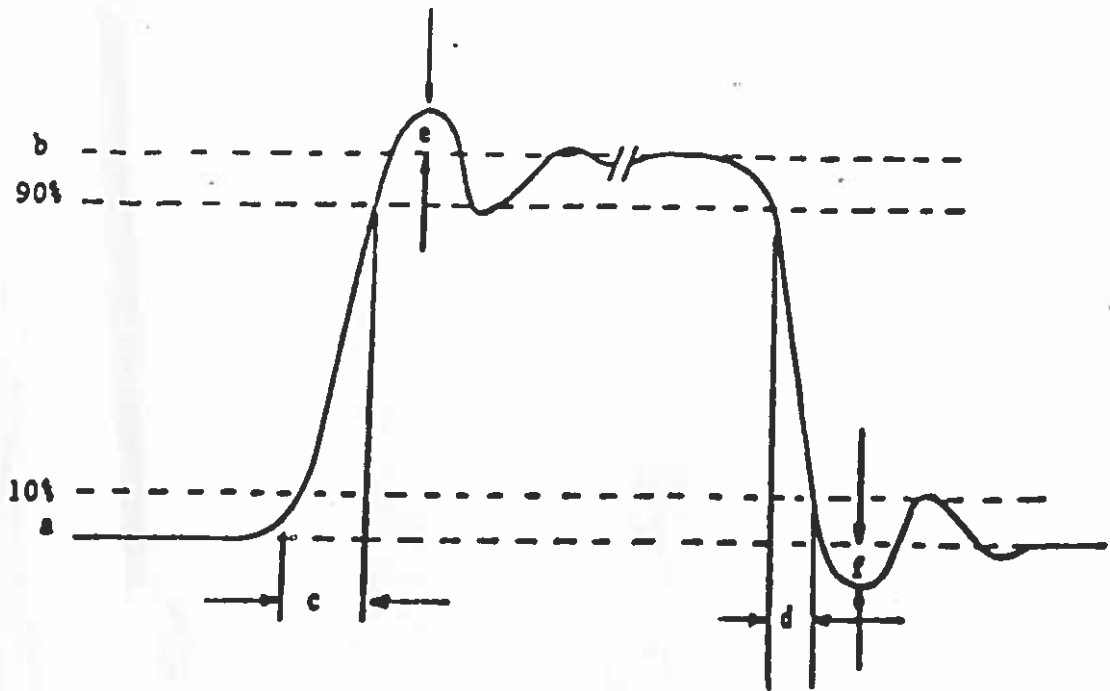
NRZ-L - Non return to zero level (level changes with clock only when data state changes)

"ONE" - "1" is represented by high level

"ZERO" - "0" is represented by low level

LSB first shifted out of SSP

Figure 12
Digital NRZ-L Data Definition



a. Low Level Nominal - Logic '0'	0.0 ^{+0.5} -0.0 Volts
b. High Level Nominal - Logic '1'	5.0 ^{+0.5} -1.0 Volts
c. Rise Time (10% to 90%)	$t_r \leq 10\mu\text{SEC}$
d. Fall Time (90% to 10%)	$t_f \leq 8\mu\text{SEC}$
e. Overshoot Leading Edge	≤ 0.5 Volts
f. Overshoot Trailing Edge	< 0.6 Volts

Figure 13
 SSP Data (SSxDAT) Waveform Characteristics

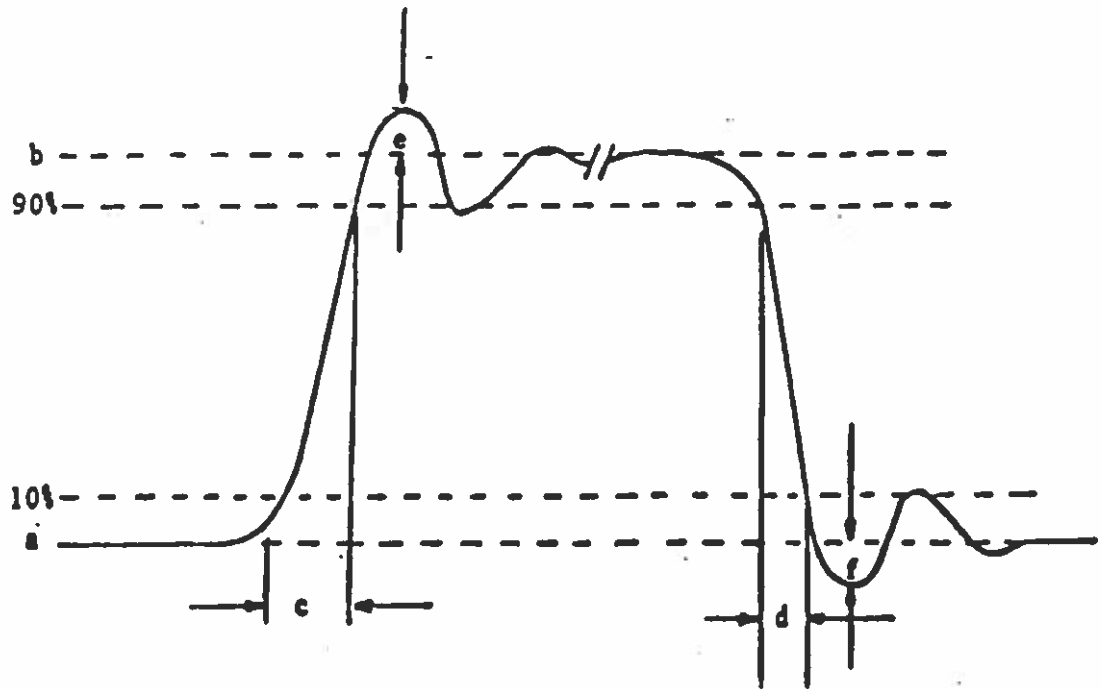
3.3.1.1.5 Signal Characteristics. The mission sensor data signal level is defined as the voltage differential between the signal line and the associated signal ground of paragraph 3.3.1.1.4. Additional data signal characteristics are shown in Figure 13. Unless otherwise specified, each SSP data signal shall comply with the characteristics of Figure 13 when operating into the test circuit shown in Figure 23. When the data signal is at the low voltage level, a SSP shall be capable of accepting at least 1.0 milliampere of current from a positive voltage source in the OLS.

3.3.1.2 SSP ON-OFF Indicator. Each mission sensor shall generate a mission sensor On/Off Signal designated as (SSxOFF) to indicate the readiness of data coming from the mission sensor. When power is applied to the sensor, the signal shall be "OFF" (+5 Volt level) if the data is not valid. If a SSP desires to use (SSxOFF) to indicate invalid data, the OLS will inhibit the read gate SSxRED and gated bit clock SSxBCK during the SSxOFF is at the high (+5 volt) level. The signal shall be "ON" (0V level) if valid data is present from the mission sensor. If there is no mission sensor present or the mission sensor is turned off and not actively controlling the SSxOFF signal, the OLS has a pull-up resistor to +5 volts to indicate an OFF state (see Figure 22). The voltage, as measured at the interface under these conditions, will be a minimum of +3.0 volts for an OLS single side powered configuration to a maximum of +5.5 volts for an OLS both sides powered configurations.

3.3.1.2.1 Data Routing. The spacecraft contractor provides the cable harness for each mission sensor. An ON/OFF signal from each mission sensor will be routed to the SPU of the OLS AVE through this harness.

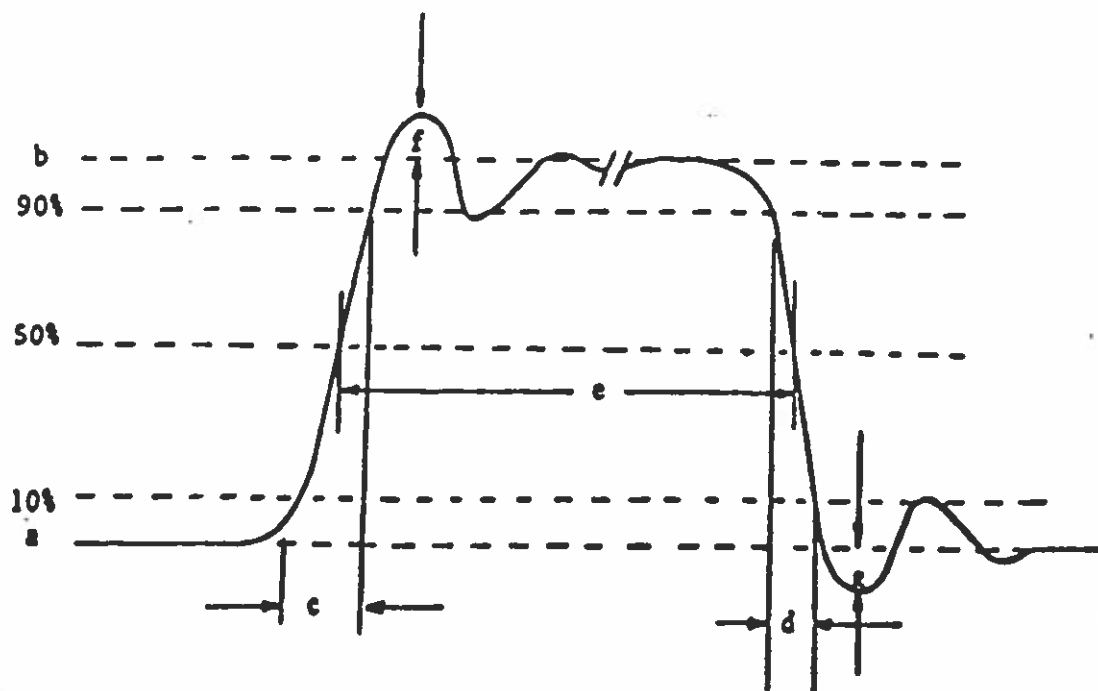
3.3.1.2.2 Signal Ground. The OLS AVE shall provide a signal ground for the mission sensor ON/OFF Signal. For a description of this signal ground refer to paragraph 3.3.1.1.4.

3.3.1.2.3 Signal Characteristics. The SSxOFF signal level is defined as the voltage differential between the signal line and the associated signal ground of paragraph 3.3.1.2.2. Additional data signal characteristics are shown in Figure 15. Unless otherwise specified, each SSxOFF signal shall comply with the characteristics of Figure 15 when shunted to signal ground by an external capacitor of 6800 picofarads at the SSP output. When the data signal is at the low voltage level, a SSP shall be capable of accepting at least 1.0 milliampere of current from a positive source in the OLS.



a. Low Level Nominal	0.0 ^{+0.5} -0.0 Volts
b. High Level Nominal	5.0 ^{+0.5} -1.0 Volts
c. Rise Time (10% to 90%)	$t_r \leq 10\mu\text{SEC}$ ≈ 5
d. Fall Time (90% to 10%)	$t_f \leq 8\mu\text{SEC}$ 4
e. Overshoot Leading Edge	≤ 0.5 Volts
f. Overshoot Trailing Edge	≤ 0.5 Volts

Figure 14
 Waveform Characteristics
 (SSxREF, SSxBCK, SSxRED, SSxSER, SSxENB)



a. Low Level Nominal	0.0 $\begin{matrix} +0.5 \\ -0.0 \end{matrix}$ Volts
b. High Level Nominal	5.0 $\begin{matrix} +0.5 \\ -1.0 \end{matrix}$ Volts
c. Rise Time (10% to 90%)	$t_r \leq 110\mu\text{SEC}$
d. Fall Time (90% to 10%)	$t_f \leq 80\mu\text{SEC}$
e. Pulse Width (50% to 50%)	$1.25 \pm 0.25\text{mSEC}$ (SSxMD1 and SSxMD2)
f. Overshoot Leading Edge	≤ 0.5 Volts
g. Overshoot Trailing Edge	≤ 0.5 Volts

Figure 15
 Waveform Characteristics
 (SSxPEN, SSxOFF, SSxMD1, SSxMD2)

3.3.2 OLS Generated Control Signals

3.3.2.1 Power Enable. The OLS shall provide a power enable signal designed at SSxPEN to each mission sensor. A high state (+5 volt) shall command the mission sensor to an "ON" condition and a low state (0 volt) shall command the mission sensor to an "OFF" state. These states were chosen so that when the OLS is OFF the mission sensors will, also, be in an OFF state. The control signal characteristics are listed in Table I. The waveform characteristics are shown in Figure 15 when shunted to ground by an external capacitor of 7600 picofarads. The relative timing of the SSxPEN is shown in Figure 16. The SSxPEN is routed to each sensor through the spacecraft harness along with its signal return line SSxPEN RET. This signal return line shall be isolated from all other grounds inside the mission sensor other than OLS signal return lines by 20 KOhms and by no more than 0.10 microfarads. This isolation shall be maintained by each mission sensor whether powered ON or OFF except the SSM/I which shall be powered ON to meet this isolation specification.

*all mission sensors
SSxPEN
ground*

Table I.
CONTROL SIGNAL CHARACTERISTICS
(SSxPEN, SSxENB, SSxSER)

	<u>LOW LEVEL</u>	<u>HIGH LEVEL</u>
Voltage Level	0.0 +0.5 -0.0V	5.0 +0.5 -1.0V
Logic Sense	FALSE OFF or "0"	TRUE ON or "1"
Output Impedance	≤2.5K Ohm	2.5-4.0K Ohm
Signal Current	The source shall be capable of accepting at least 160µA from the load	The source shall be capable of supplying at least 100µA to the load

3.3.2.2 Read Gate. The OLS shall provide a Read Gate to each mission sensor designated as SSxRED whenever the mission sensor's SSxOFF signal indicates that the mission sensor is ON and ready to send data. This signal shall normally be OFF and shall be pulse ON during the interval in which the mission sensor data is to be read into the OLS. Each read gate shall be negative going pulse with a normal duty cycle of X divided by 9990.24 Hz (X being the number of bits assigned to the sensor). The control signal characteristics are listed in Table II. The waveform characteristics are shown in Figure 14 when shunted by an external capacitor of 470 picofarads to signal return. The relative timing of SSxRED is shown in Figure 16 and Figure 17.

3.3.2.2 (cont.) Each read gate shall have a repetition period of 1 second plus or minus 2 milliseconds of jitter and shall change level at the positive going edge of the bit clock. The positive-going and negative-going edges of this pulse shall be coincident with a positive-going edge of the mission sensor reference clock and bit clock to within 10 microseconds as shown in Figure 17. ⁵

The SSxRED is routed to each sensor through the spacecraft harness along with its signal return line SSxRED RET. This signal return line shall be isolated from all other mission sensor ground inside the mission sensor other than the OLS signal return lines by at least 20K ohms and by no more than 0.10 microfarads. This isolation shall be maintained by the SSM/I which shall be powered ON to meet this isolation specification.

Table II.
CONTROL SIGNAL CHARACTERISTICS
(SSxRED, SSxBCK, SSxRED, SSxMD1, SSxMD2)

	<u>LOW LEVEL</u>	<u>HIGH LEVEL</u>
Voltage Level	0.0 +0.5 -0.0V	5.0 +0.5 -1.0V
Logic Sense	TRUE -ON or "1"	FALSE -OFF or "0"
Output Impedance	≤2.5K Ohm	2.5-4.0K Ohm
Signal Current	The source shall be capable of accepting at least 160μA from the load	The source shall be capable of supplying at least 100μA to the load

3.3.2.3 Bit Clock. The OLS shall provide a gated clock designated as SSxBCK for transferring data from each of the mission sensors. The clock shall be used to provide a transfer of mission sensor data to the OLS when the read gates SSxRED is in its ON state. The bit clock shall be a nominal square wave with a fundamental frequency of 9990.24 Hz. The duty cycle of the clock shall be 0.50 ± 0.05 . The signal characteristics are given in Table II. The waveform characteristics are shown in Figure 14 when shunted by an external capacitor of 470 picofarads. The relative timing of SSxBCK is shown in Figure 16 and 17. The SSxBCK is routed to each sensor through the spacecraft harness along with its signal return line SSxBCK RET. The signal return line shall be isolated from all other mission sensor grounds inside the mission sensor other than OLS signal return lines by at least 20 KOhms and no more than 0.10 microfarads. This isolation shall be maintained by each mission sensor whether powered ON or OFF except the SSM/I which shall be powered ON to meet this isolation specification.

3.3.2.4 Reference Clock. The OLS shall provide a reference clock designated as SSxREF to each of the mission sensors. This clock may serve as the basic timing reference for operation of the mission sensors. This clock shall be gated with the SSxPEN signal. The reference clock shall be a nominal square wave with a fundamental frequency of 9990.24 Hz plus or minus 1 Hz. The duty cycle of the clock shall be 0.50 plus or minus 0.05. The control signal characteristics are listed in Table II. The waveform characteristics are shown in Figure 14 when shunted by an external capacitor of 470 picofarads. The relative timing of SSxREF is shown in Figures 16 and 17.

The SSxREF signal is routed to each sensor through the spacecraft harness along with its signal return line SSxREF RET. This signal return line shall be isolated from all other mission sensor grounds inside the mission sensor other than OLS signal return lines by at least 20 KOhms and no more than 0.10 microfarads. This isolation shall be maintained by each mission sensor whether powered ON or OFF except the SSM/I which shall be powered ON to meet this isolation specification.

3.3.2.5 Mode 1 Select. The OLS shall provide a mode select signal designated SSxMD1 to each of the mission sensors. The mode select signal can be either a level or a pulse depending on mission sensor requirements. The level type Mode 1 select line has two states. The control signal characteristics are listed in Table II. The waveform characteristics are shown in Figure 15 when shunted by an external capacitor of 7600 picofarads. The relative timing is shown in Figure 16.

The pulse type Mode 1 select line has control signal characteristics identical to the level type Mode 1 select. The waveform of the pulse has the same characteristics as shown in Figure 16. However, instead of being a level change the SSxMD1 line shall be a negative going pulse of 1.25 plus or minus 0.25 milliseconds as measured at the 50 percent points. When the SSxMD1 is in its quiescent state (+5 volt) the mission sensor will remain in its current operating mode. When SSxMD1 is pulsed negative (0 volt), the mission sensor will respond to the command to advance to its next operating mode.

3.3.2.5 (cont.)

The turn on state of both the level and the pulse type signals is plus 5 volts. Relative timing of the SSxMD1 is shown in Figure 16. The SSxMD1 signal is routed to each mission sensor through the spacecraft harness along with its return line SSxMD2 RET. This signal return line shall be isolated from other sensor grounds inside the mission sensor other than the OLS signal return lines by at least 20 K Ohms and no more than 0.10 microfarads. This isolation shall be maintained by each mission sensor whether powered ON or OFF except the SSM/I which shall be powered ON to meet this isolation specification.

3.3.2.6 Mode 2 Select. The OLS shall provide a mode select signal designated SSxMD2 to each of the mission sensors. The SSxMD2 signal is identical in operation to, but independent of, the SSxMD1 signal. See paragraph 3.3.2.5 for a description of the SSxMD1 signal characteristics.

3.3.2.7 Serial Command Enable. The OLS shall provide a serial command enable line designated SSxENB to be used in conjunction with the SSxREF signal (paragraph 3.3.2.4) and the SSxSER signal (paragraph 3.3.2.8) to transfer an eight bit serial command to a mission sensor.

The control signal characteristics of SSxENB are listed in Table I. The waveform characteristics are shown in Figure 14 when shunted by an external capacitor of 470 picofarads. The relative timing of SSxENB is shown in Figure 18. The SSxENB is routed to each mission sensor through the spacecraft harness along with its return signal SSxENB RET. The SSxENB RET shall be isolated from all other mission sensor grounds inside the mission sensor other than OLS signal returns by at least 20 K Ohms and not more than 0.10 microfarads. This isolation shall be maintained by each mission sensor whether powered ON or OFF except the SSM/I which shall be powered ON to meet this isolation specification.

3.3.2.8 Serial Command Word. The OLS shall provide a serial command word designated as SSxSER is used in conjunction with the SSxREF signal (paragraph 3.3.2.4) and the SSxENB signal (paragraph 3.3.2.7) to transfer its contents in the form of a serial command to each mission sensor.

The contents of the eight bit command can be any combination of ones and zeros specified. The control signal characteristics are specified in Table I. The waveform characteristics specified in Figure 14 when shunted by an external capacitor of 470 picofarads. The relative timing of SSxSER and its logic ONE and ZERO states are shown in Figure 18. The SSxSER is an NRZ-L signal that should be transferred by the mission sensor utilizing the SSxREF signal and the SSxENB signal for the transfer. The SSxSER is routed to each mission sensor along with its signal return SSxSER RET. The SSxSER RET shall be isolated from all other mission sensor grounds inside the mission sensor other than OLS signal returns by at least 20 K ohms and not more than 0.10 microfarads. This isolation shall be maintained by each mission sensor whether powered ON or OFF except the SSM/I which shall be powered ON to meet this isolation specification.

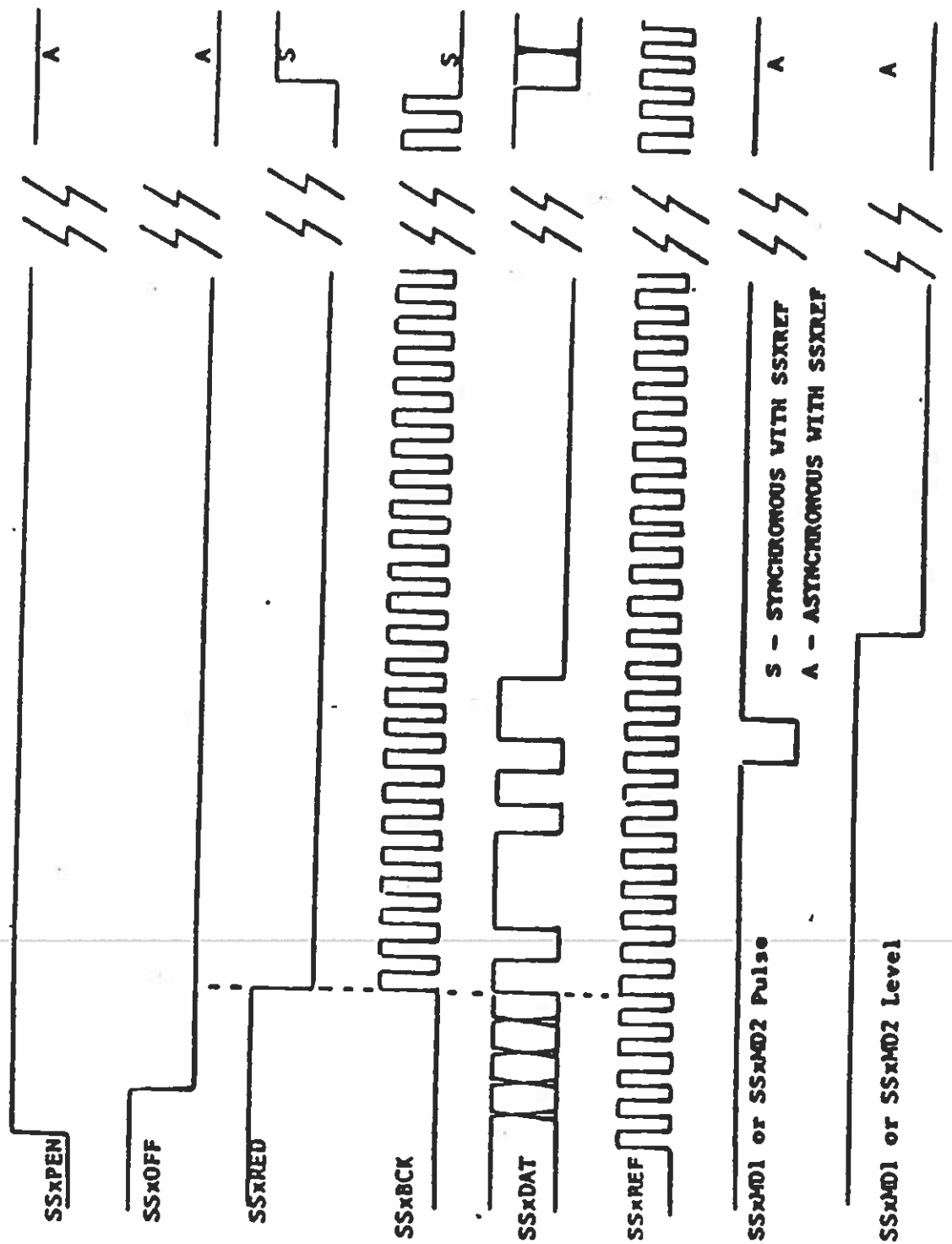


Figure 16
Timing Diagram

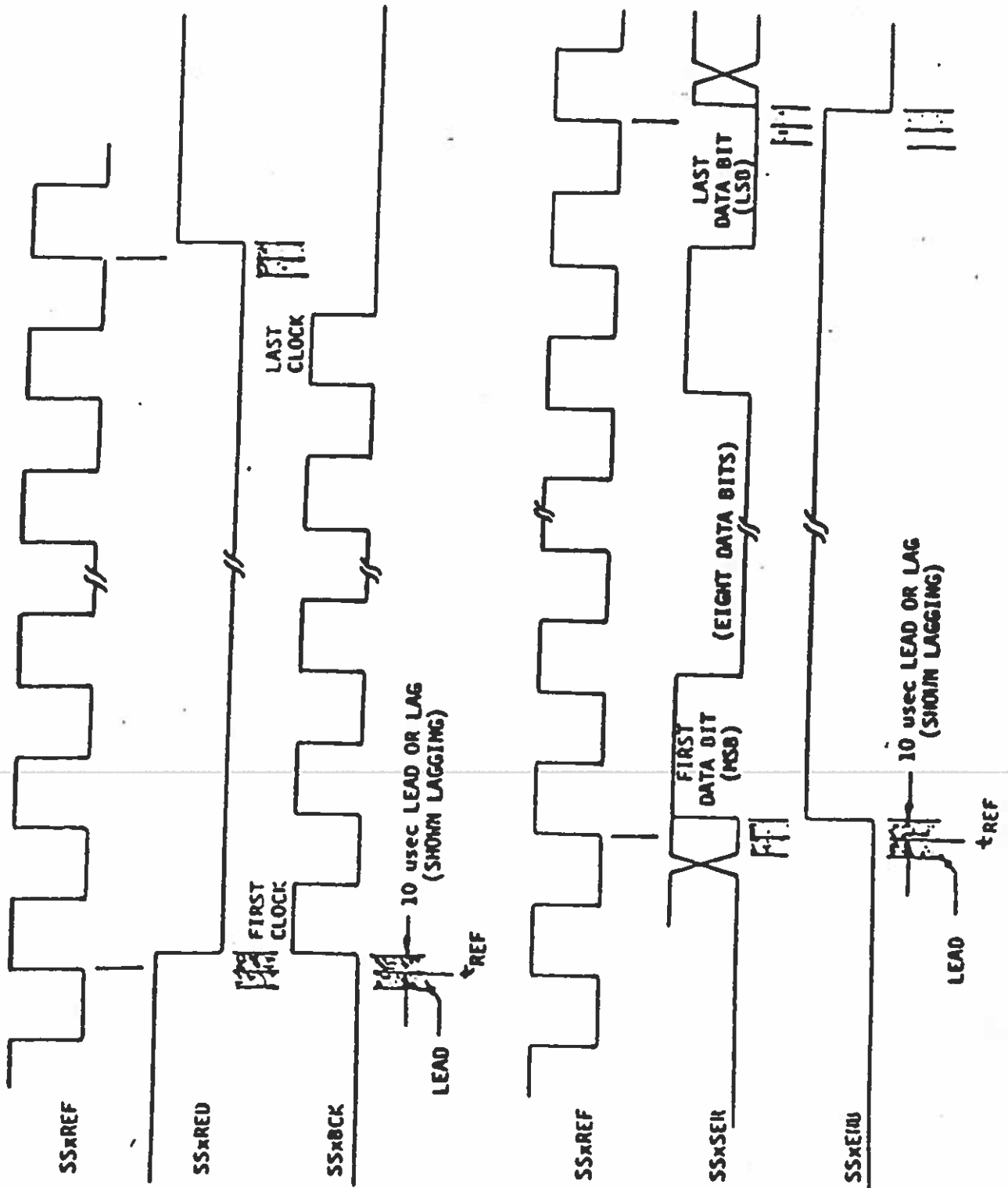


Figure 17
 OLS Signal Phase Relations

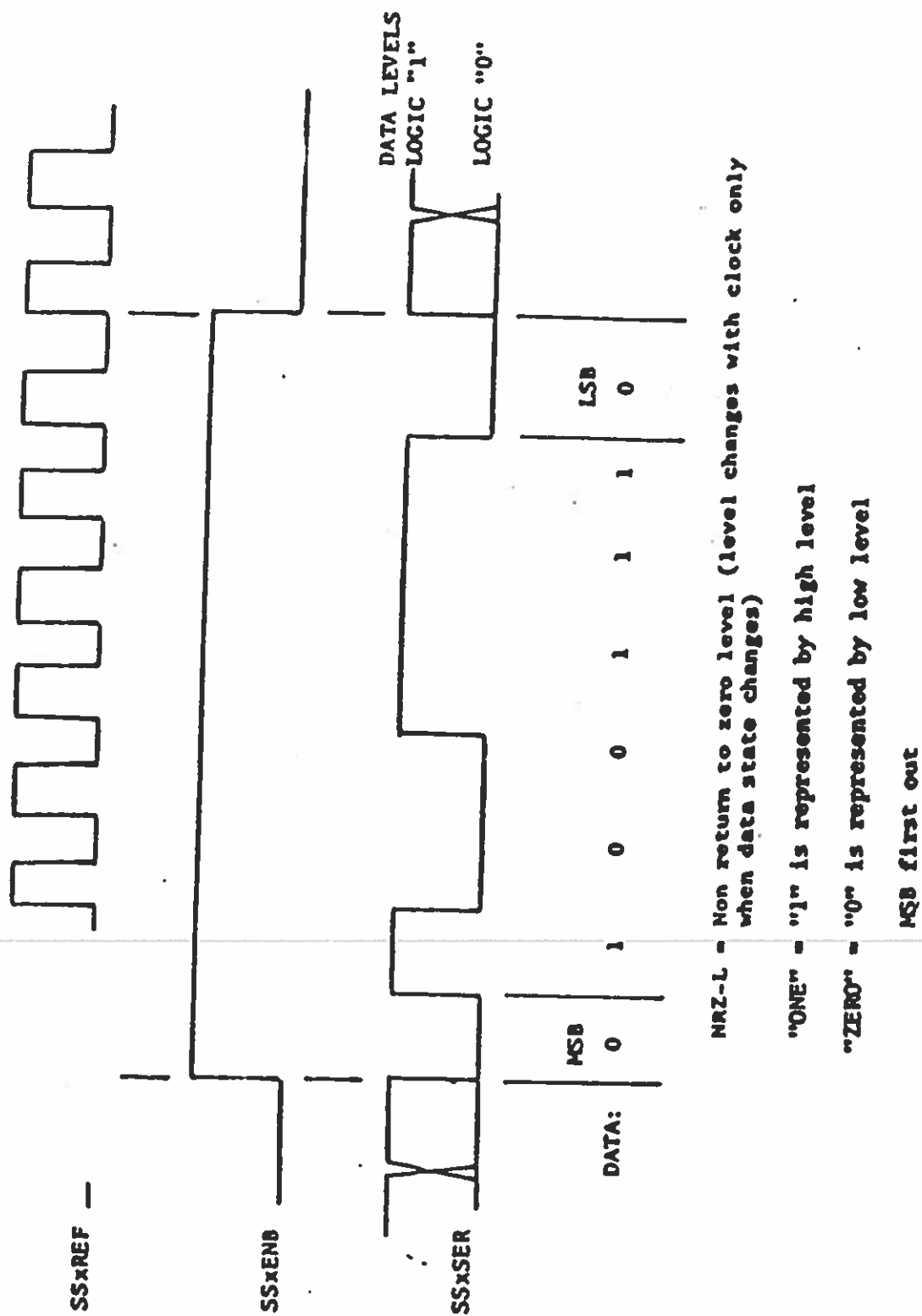


Figure 18
 Serial Command Timing

3.3.3 Block Transfer. Each OLS, with operational software capability, can provide block transfers of 16 bit words to a mission sensor. The block transfer is via the SSxENB and SSxSER 8 bit serial command interface. The 16 bits are transferred in two 8 bit bytes. The number of 16 bit words transferred as a block can be specified as any number between one and 32,767 inclusive.

3.3.3.1 Block Format. For a block transfer of 16 bit words, a fixed format must be used to standardize the process for the OLS and ground system. The format to satisfy the OLS requirements is shown in Figure 19. The format consists of a Control Header, Data and a Block Checksum all of which is transferred to the specified mission sensor.

3.3.3.1.1 Control Header. The Control Header consists of three control words and a checksum for those three words. The Configuration Number is for use by the mission sensor and will be defined in the mission sensor's ICD. The Starting Address defines a memory word address for the first Data Word of the Block where Data Word 1 is destined to memory "START ADDRESS" and Data Word 1 is destined to memory "START ADDRESS + i-1." The Data Word Count must specify the number of Data Words in the Block. The checksum algorithm for the Control Header is "Add and Rotate 1 Bit Right".

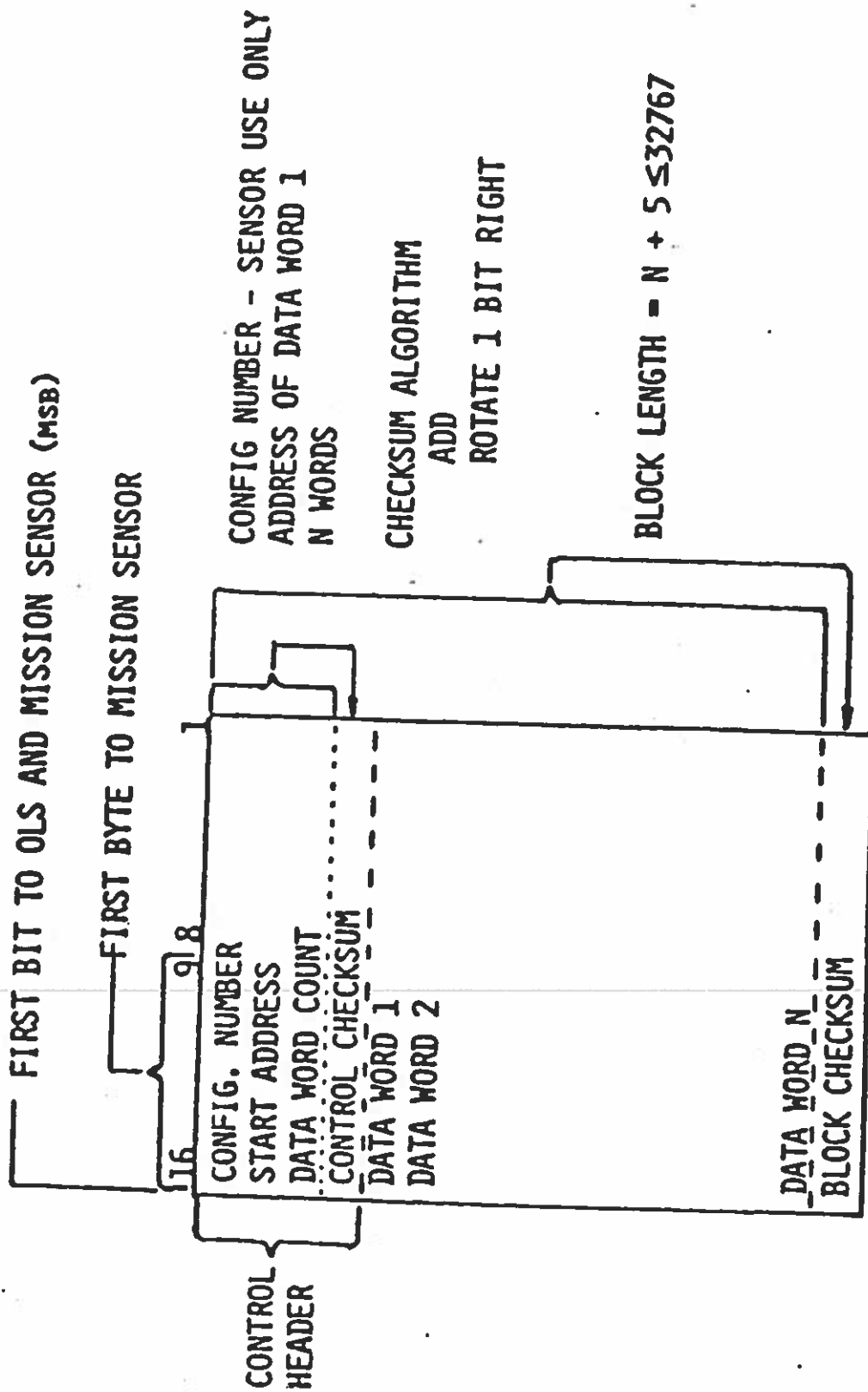
3.3.3.1.2 Data Block. The Data Block consists of 16 bit words. The maximum number of 16 bit words is 32,762 (32,767 less 5 overhead words). The five accounts for the three control words and the two checksums in the Block. The Data Words, if they need further definition, are defined in the mission sensor's ICD.

3.3.3.1.3 Block Checksum. The Block Checksum is for the entire Block consisting of the Control Header and Data words. The Block Checksum's algorithm, like the Control Checksum is "Add and Rotate 1 Bit Right".

3.3.3.2 Load Timing. The timing for the transfer of the block of data to the mission sensor is shown in Figure 20. The COMDAT reference is determined by internal OLS timing. COMDAT is not externally accessible. The two 8 bit bytes are transferred across the 8 bit serial command interface during the windows shown in the figure.

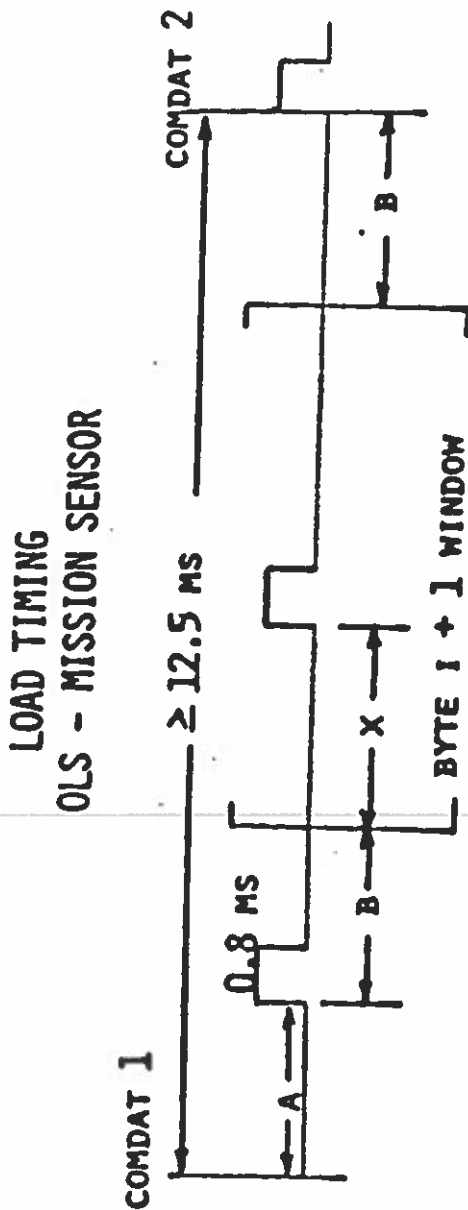
3.3.3.3 Protocol. The protocol, between the OLS and the mission sensor receiving the block transfer, may be tailored for that particular sensor provided that the hardware interface does not change from that specified in this interface specification. The mission sensor may make use of the SSxMD1, SSxMD2 and SSxSER interfaces to ready it for a block transfer, terminate a block transfer, or initialize it after the transfer has taken place. These particulars will appear in the mission sensor's ICD.

LOAD BLOCK FORMAT



ENTIRE BLOCK TRANSMITTED TO MISSION SENSOR.
 OLS RECEIVES BLOCK AS A DATA LOAD (NON-AUTHENTICATE).

Figure 19
 Load Block Format



- $B + X \geq B$
- $B + X \leq 12.5 - A - B$
- $0 \leq X \leq 12.5 - A - 2B$
- $A \leq 4.3$ MS FROM OLSP SIMULATION
- $B \geq 1.0$ MS OLS REQUIREMENT
- $0 \leq X \leq 6.2$ MS

TOLERANCE ON $B = \pm 0.488$ MICROSECONDS
 OLSP WILL GUARANTEE LEADING EDGE OF WINDOW AND FLAG TRAILING EDGE VIOLATION

Figure 20
 Load Timing

3.3.3.4 Load Verification

3.3.3.4.1 OLS Originated. The OLS will output unique error codes in its telemetry for each of the following conditions that would prevent a successful block transfer to a mission sensor:

1. Transfer timing occurring outside of the envelope shown in Figure 20.
2. OLS computer checksum not equal to the Block Checksum.
3. A TAKE XMIT B bit serial command control word that was command from OLS memory while the block transfer was taking place. These commands would not be executed under these circumstances and would not corrupt the block transfer.

If any of the above errors are detected, the OLS will continue to transfer the block load to the mission sensor and place the error code in the OLS System Error Table.

3.3.3.4.2 Mission Sensor Originated. The mission sensor may make use of SSxDAT or SSxOFF to indicate a successful block transfer. Or, it may use its interface with the spacecraft telemetry processing system for the same purpose. The mission sensor's verification mechanism will be specified in its ICD.

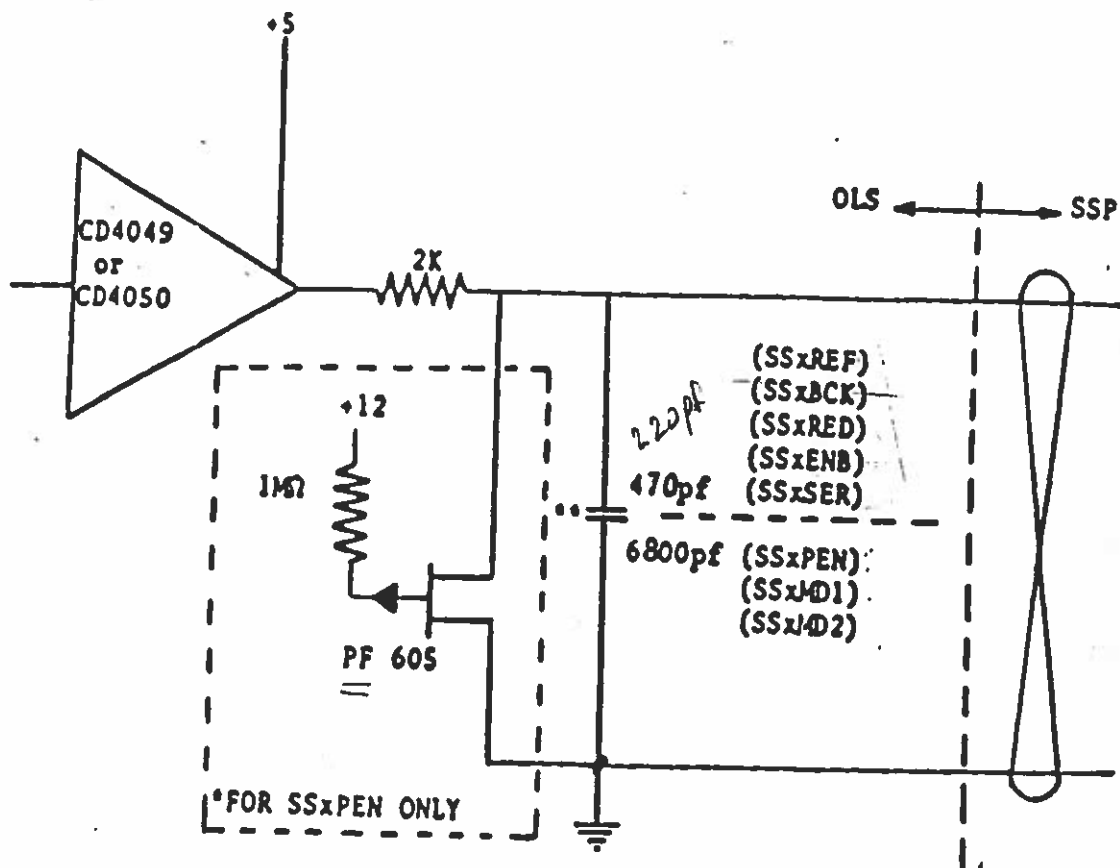
3.3.3.5 Load File Transmittal. The load file transmittal between contractor's ground facilities shall be an ASCII file consisting of a 512 byte header followed by one or more blocks as described in Section 3.3.3.1. The load blocks shall consist of ASCII hex. The load file header shall include:

Program name
Revision letter
Flight number
Sensor name
Sensor ID
Sensor serial number
Number of load block in file
File record size
Comments

3.3.4 OLS Electrical Interface Circuits. The OLS driver interface circuit shall be as shown in Figure 21. The OLS receiver interface circuit shall be as shown in Figure 22.

3.3.5 SSP Cabling and Pin Assignments. All electrical connections between the OLS and each SSP shall be made by a connector mounted on each SSP. The spacecraft will supply all harnesses required between the OLS and each SSP for SSP data routing, OLS generated control signals, and SSP ON-OFF indicators. Each OLS cable connector shall be a DBM-25S (Male on the SSP). Pin assignments shall be as shown in Table III.

Each Mission Sensor signal to/from the OLS will be twisted with its return. The cable bundle will have one outer shield which will be tied at the OLS end to the SPU chassis.



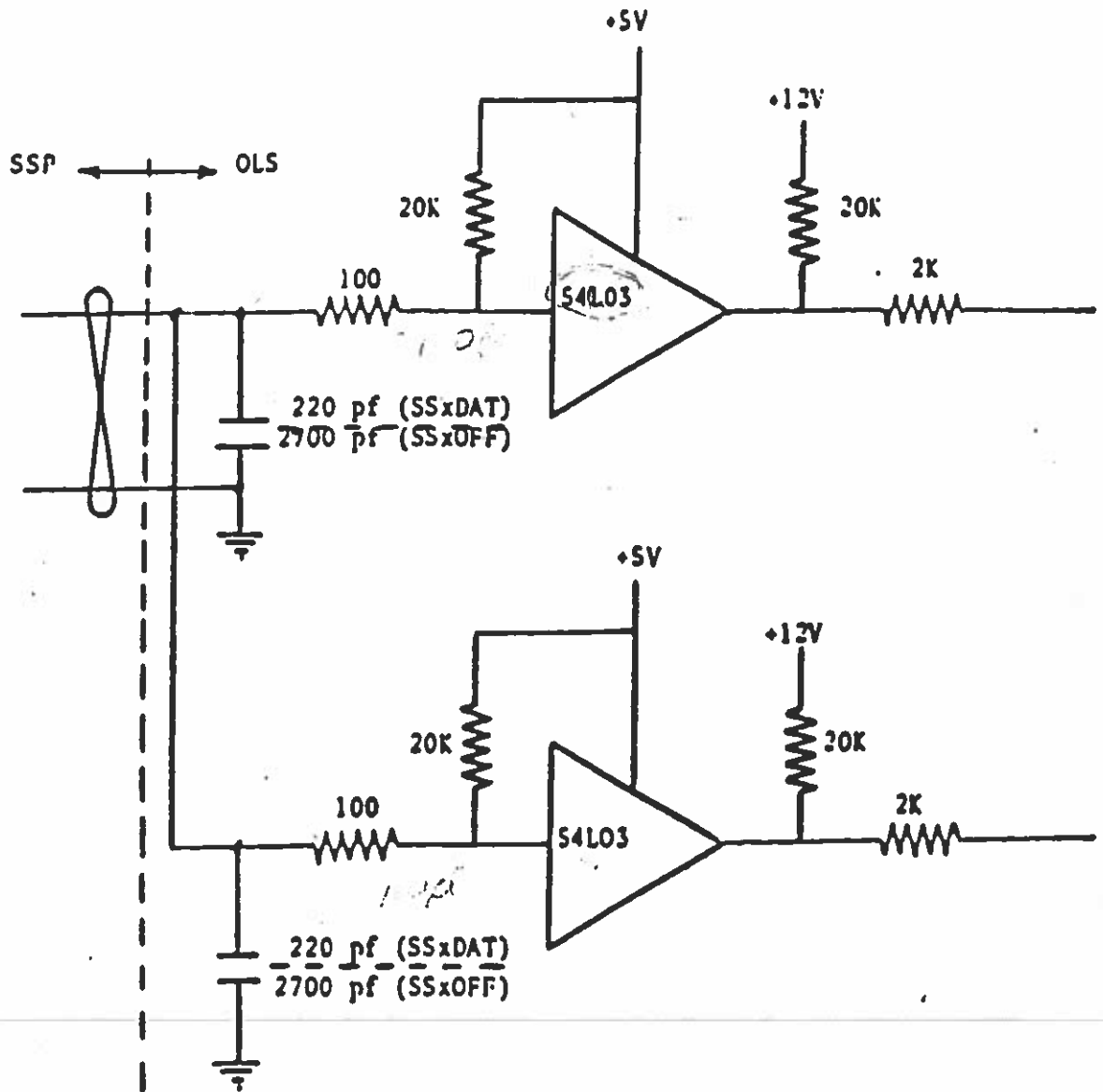
*OLS OFF = 100 ΩMS

OLS ON = OPEN

Purpose: So SSxPEN does not look back into open circuit when OLS is OFF.

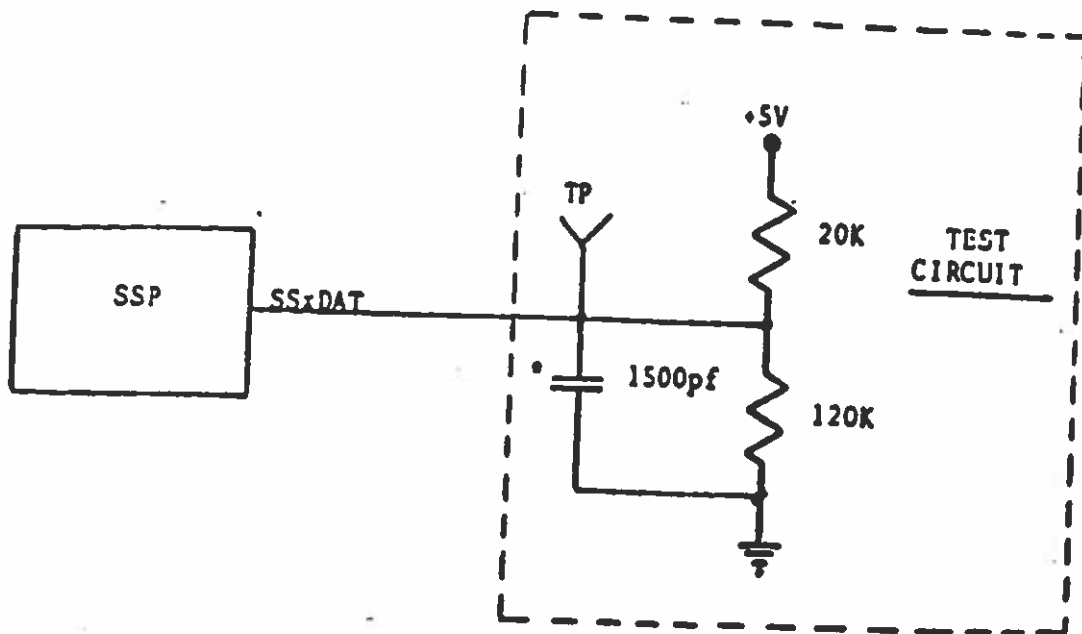
**These capacitance values do not include cable capacitance

Figure 21
OLS Driver Interface Circuit



- Notes:
1. Capacitance values DO NOT include cable capacitance.
 2. Either one or both of the 54L03(s) may or may not have +5V of bias depending upon the OLS configuration

Figure 22
 OLS Receiver Interface Circuit



NOTES:

- (1) • 1500 picofarads represents the maximum expected capacitance on the SSxDAT signal line. It includes cable capacitance and OLS interface circuit capacitance.
- (2) When both sides of the OLS (Normal and Redundant) are powered, the SSP must be able to sink at least 1 milliamperes and still meet the logic "0" level of 0volts $\pm 0.5V$ $\pm 0.0V$

Figure 23 D
SSxDAT Test Circuit

Table III.
SSP PIN ASSIGNMENTS - STANDARD INTERFACE

<u>PIN</u>	<u>FUNCTION</u>	<u>PIN</u>	<u>FUNCTION</u>
1	Spare	14	Spare
2	Data	15	On-Off Indicator
3	Data Ret	16	On-Off Indicator Ret
4	Bit Clock	17	Power Enable
5	Bit Clock Return	18	Power Enable Ret
6	Read Gate	19	Mode 1 Select
7	Read Gate Ret	20	Mode 1 Select Ret
8	Reference Clock	21	Mode 2 Select
9	Reference Clock Ret	22	Mode 2 Select Ret
10	Serial Command Enable	23	Spare
11	Serial Command Enable Ret	24	Spare
12	Serial Command	25	Spare
13	Serial Command Ret		

3.3.6 OLS/Mission Sensor Information Annex

This section provides basic information on the SSP-OLS data interface.

3.3.6.1 Total SSP Data Rate and Distribution. The OLS has the capability of formatting SSP data within the light smooth (LS) line format or within the thermal smooth (TS) line format. The OLS does not have the capability of formatting the data from one SSP in both LS and TS simultaneously. The OLS has the capability of formatting X data bits of a SSP in LS and Y bits from the same SSP in TS where Y data bits contiguously follow X data bits and the SSP is addressed twice. The latter capability allows a high data rate SSP to output its data part in LS and the rest in TS. The SSP must be addressed twice resulting in two read gates separated by not more than 30 microseconds in order to use this capability. Thus the SSP would "appear" to be two sensors to the OLS.

3.3.6.2 SSP Control Signals. Each SSP receives one set of control signals as outlined in this document.

3.3.6.3 SSP Data Off/Invalid Signal. The OLS will respond to data off (SSxOFF) by substituting for the SSP data a transition code equal to the bits per second of the original data. The transition code for each 36 bit SSP word is 35 "0" fill bits with a "1" in the LSB position to meet transition density requirements. The OLS will ignore any data on the SSxDAT interface line under these conditions.

3.3.6.4 Time Code. The SSP message is formatted once per second by the OLS and contains a 27 bit time code which is the 27 bits of the ETC clock time coincident with the change of state (off to on) of the first read gate to the first SSP (the first SSP whose data is to be included on the LS primary line). The LSB of the time code is 2^{-10} seconds. This ETC clock is the same ETC clock used in the primary data for time coincidence of the OLS scan crossing at nadir. Since the SSP receives a read gate every $1 \text{ sec} \pm 2$ milliseconds, and each SSP read gate has a known time delay from the first read gate to the first SSP interrogated for data, the time of receipt of each SSP read gate can be computed and should be constant within approximately 5 milliseconds. Therefore, a SSP can time reference the read gate and establish a relationship between its data samples and the ETC clock (which references orbit position).

3.4 SPACECRAFT/OLS and SPACECRAFT/MISSION SENSORS ENVIRONMENTAL INTERFACE

3.4.1 Thermal

3.4.1.1 General. The spacecraft contractor shall provide thermal control, as required, for each sensor unit for the life of the spacecraft for all sun angles between 0 and 95 degrees (sun angle is defined as the angle between the sun vector and the normal to the spacecraft orbital plane) and for all sensor power dissipations from sensor off-state to sensor on-state. Detailed requirements for sensor power dissipation are defined in each spacecraft/sensor ICD. Provisions may be made to terminate thermal control of a sensor which has been declared by the AF to have failed, if such termination results in enhanced system performance. Specific temperature control requirements for each sensor are defined in the sensor/spacecraft ICD.

Subject to the field-of-view requirements of this specification, and provided all other requirements of this specification are met, the spacecraft contractor may attach thermal blankets, fins, heaters, or other passive thermal control devices to the sensors. Such attachments shall be defined in the sensor/spacecraft ICD.

3.4.1.2 Nodal Models. Detailed nodal models may be required for thermal analysis. The need for nodal models, and their description when needed, shall be as defined in each sensor/spacecraft ICD.

3.4.2 Contamination. The spacecraft contractor shall provide a design and equipment arrangement which minimizes contamination of the sensor units. Spacecraft and sensors shall be designed to minimize contamination of each other. Outgassing of the propulsion subsystem onto sensors and other sensitive equipment shall be minimized by shielding, protective covers, orientation and arrangement of components, or other means as necessary to meet mission requirements.

3.4.3 Spacecraft Test Environments. The satellite undergoes testing as described in Section 6 (Notes). Critical interfaces during these testings are defined in each spacecraft/sensor ICD.

3.4.4 Facilities Environment. The satellite is subjected to the facilities environments as described in Section 6 (Notes).

3.4.5 Flight Environments. The satellite is subjected to the flight environments as described in Section 6 (Notes). Critical interfaces during this environment will be defined in the individual spacecraft/sensor ICD.

4.0 Quality Assurance Provisions

4.1 General

A Verification Matrix is included in this Section to serve two functions:

- a. to provide a basis for establishing that all requirements pertinent to this interface have been addressed
- b. to provide a responsibility matrix to define which of the several organizations participating in the particular interface has responsibility for the performance of the analysis, test, and/or inspection necessary to complete verification of compliance to the requirement.

Methods of verification are defined below:

INSPECTION (I)	verification is based on visual inspection of such areas as form, fit, and configuration of hardware or of computer programs.
ANALYSIS (A)	verification is based on studies, calculations, and/or analytical modelling.
TEST (T)	verification is based on instrumented functional operation and evaluation techniques.

4.2 Test Responsibilities

Table IV details the responsibilities for verification of specification compliance. General responsibilities are given below.

4.2.1 Spacecraft Contractor

The Spacecraft contractor is responsible for:

- a. Preparing test plans and procedures for testing of the integrated Spacecraft.
- b. Performing the testing of the integrated Satellite in accordance with documented test procedures.
- c. Providing support, as required, for Sensor testing performed by the primary Sensor contractor, and the mission sensor contractor.

4.2.2 Sensor Contractor

As applicable to the Sensor provided, each Sensor contractor is responsible for:

- a. Providing detailed test procedures and evaluation criteria for testing the Sensor to the prime item specification.
- b. Performing Sensor testing.
- c. Providing support for the acceptance and launch test activities.
- d. Providing all unique Sensor AGE.

Table IV
IS-2617400 VERIFICATION RESPONSIBILITIES

Paragraph/Parameter	N/A	Spacecraft Contractor			OLS Contractor			Miss. Sens. Contractor		
		I	A	T	I	A	T	I	A	T
1.0 SCOPE	X									
1.1 GENERAL	X									
1.2 INTERFACE DOCUMENTATION	X									
1.2.1 INTERFACE SPECIFICATION	X									
1.2.2 INTERFACE CONTROL DOCUMENTS	X									
1.3 ITEM DESCRIPTION	X									
1.3.1 GENERAL	X									
1.3.2 PRIMARY SENSOR	X									
1.3.3 MISSION SENSORS	X									
2.0 APPLICABLE DOCUMENTS	X									
2.1 GOVERNMENT DOCUMENTS	X									
2.2 NON-GOVERNMENT DOCUMENTS	X									
3.0 INTERFACE REQUIREMENTS	X									
3.1 PHYSICAL	X									
3.1.1 MASS PROPERTIES	X									
3.1.1.1 PAYLOAD WEIGHT ALLOCATIONS			X			X				
3.1.1.2 HARNESS WEIGHT ACCOUNTING	X									

Table IV
IS-2617400 VERIFICATION RESPONSIBILITIES

Paragraph/Parameter	R/A	Spacecraft Contractor			OLS Contractor			Miss. Sens. Contractor		
		I	A	T	I	A	T	I	A	T
3.1.2 MECHANICAL INTERFACE	X									
3.1.2.1 STRUCTURAL AND THERMAL LOADS	X									
3.1.2.2 FIELD OF VIEW (FOV)	X									
3.1.2.3 UNCOMPENSATED MOMENTUM			X							
3.1.3 ALIGNMENT	X									
3.1.3.1 ALIGNMENT AXES	X									
3.1.3.1.1 OLS PRIMARY COORDINATE AXES	X									
3.1.3.1.2 OLS SECONDARY AXES						X				
3.1.3.1.3 MISSION SENSOR COORDINATE AXES	X									
3.1.3.1.4 MISSION SENSOR SECONDARY AXES	X									
3.1.3.2 ALIGNMENT REQUIREMENTS	X									
3.1.3.2.1 PRIMARY AXES			X							
3.1.3.2.2 MISSION SENSOR AXES	X									
3.1.3.3 ALIGNMENT KNOWLEDGE	X									
3.1.4 MATERIALS	X									
3.1.4.1 OUTGASSING			X			X			X	
3.1.4.2 DISSIMILAR METALS			X			X			X	

Table IV
IS-2617400 VERIFICATION RESPONSIBILITIES

Paragraph/Parameter	N/A	Spacecraft Contractor			OLS Contractor			Miss. Sens. Contractor		
		I	A	T	I	A	T	I	A	T
3.1.4.3 MAGNETIC MATERIALS			X			X			X	
3.1.5 DEPLOYMENT CHARACTERISTIC	X									
3.1.6 STRUCTURAL AND THERMAL MODELS	X									
3.1.7 ACTUATOR LOCATION		X	X							
3.2 SPACECRAFT/OLS AND SPACECRAFT/MISSION SENSOR ELECTRICAL INTERFACE	X									
3.2.1 GENERAL	X									
3.2.2 INTERFACE SIGNAL CHARACTERISTICS	X									
3.2.3 ACTUATOR SIGNALS				X					X	
3.2.4 EQUIPMENT STATUS TELEMETRY (EST)	X									
3.2.4.1 ANALOG DATA CHANNEL INPUT			X			X			X	
3.2.4.2 DISCRETE DATA CHANNEL INPUT			X			X			X	
3.2.4.3 EST SUBSYSTEM CHARACTERISTICS			X							
3.2.5 POWER			X							
3.2.5.1 +28 VOLT	X									
3.2.5.1.1 REGULATED POWER BUS				X						
3.2.5.1.2 OUTPUT IMPEDANCE			X							
3.2.5.1.3 VOLTAGE RIPPLE				X						

Table IV
IS-2617400 VERIFICATION RESPONSIBILITIES

Paragraph/Parameter	N/A	Spacecraft Contractor			OLS Contractor			Miss. Sens. Contractor		
		I	A	T	I	A	T	I	A	T
3.2.5.1.4 VOLTAGE TRANSIENTS				X						
3.2.5.1.5 CURRENT RIPPLE				X						
3.2.5.1.6 CURRENT TRANSIENTS				X						
3.2.5.2 +5 VOLTS	X									
3.2.5.2.1 REGULATED POWER BUS				X						
3.2.5.2.2 OUTPUT IMPEDANCE			X							
3.2.5.2.3 VOLTAGE RIPPLE				X						
3.2.5.2.4 VOLTAGE TRANSIENTS				X						
3.2.5.2.5 CURRENT RIPPLE				X						
3.2.5.2.6 CURRENT TRANSIENTS				X						
3.2.5.3 +10 VOLTS	X									
3.2.5.3.1 REGULATED POWER BUS				X						
3.2.5.3.2 OUTPUT IMPEDANCE			X							
3.2.5.3.3 VOLTAGE RIPPLE				X						
3.2.5.3.4 VOLTAGE TRANSIENTS				X						
3.2.5.3.5 CURRENT RIPPLE				X						
3.2.5.3.6 CURRENT TRANSIENTS				X						
3.2.5.4 POWER APPLICATION				X		X			X	
3.2.6 GROUNDING REQUIREMENTS	X									
3.2.6.1 SPACECRAFT SIGNAL GROUNDS				X						

Table IV
IS-2617400 VERIFICATION RESPONSIBILITIES

Paragraph/Parameter	N/A	Spacecraft Contractor			OLS Contractor			Miss. Sens. Contractor		
		I	A	T	I	A	T	I	A	T
3.2.6.2 SPACECRAFT POWER GROUNDS	X									
3.2.6.3 CHASSIS (CASE) GROUND				X					X	
3.2.7 SENSOR HARNESSING			X			X			X	
3.2.8 ELECTROMAGNETIC COMPATIBILITY	X									
3.2.9 FUSING			X							
3.3 OLS/MISSION SENSOR ELECTRICAL INTERFACE	X									
3.3.1 SSP GENERATED SIGNALS	X									
3.3.1.1 SSP DATA						X	X			X
3.3.1.1.1 DATA CONTENT						X	X			X
3.3.1.1.2 BIT STRUCTURE						X				X
3.3.1.1.3 DATA ROUTING				X		X				X
3.3.1.1.4 SIGNAL GROUND						X	X			X
3.3.1.1.5 SIGNAL CHARACTERISTIC						X	X			X
3.3.1.2 SSP ON-OFF INDICATOR							X			X
3.3.1.2.1 DATA ROUTING				X						
3.3.1.2.2 SIGNAL GROUND						X	X			X
3.3.1.2.3 SIGNAL CHARACTERISTIC						X	X			X
3.3.2 OLS GENERATED CONTROL SIGNALS	X									

Table IV
IS-2617400 VERIFICATION RESPONSIBILITIES

Paragraph/Parameter	N/A	Spacecraft Contractor			OLS Contractor			Miss. Sens. Contractor		
		I	A	T	I	A	T	I	A	T
3.3.2.1 POWER ENABLE							X			
3.3.2.2 READ GATE							X			
3.3.2.3 BIT CLOCK							X			
3.3.2.4 REFERENCE CLOCK							X			
3.3.2.5 MODE 1 SELECT							X			
3.3.2.6 MODE 2 SELECT							X			
3.3.2.7 SERIAL COMMAND ENABLE							X			
3.3.2.8 SERIAL COMMAND WORD							X			
3.3.3 BLOCK TRANSFER							X			
3.3.3.1 BLOCK FORMAT							X			
3.3.3.1.1 CONTROL HEADER							X			
3.3.3.1.2 DATA BLOCK							X			
3.3.3.1.3 BLOCK CHECKSUM							X			
3.3.3.2 LOAD TIMING							X			
3.3.3.3 PROTOCOL							X			X
3.3.3.4 LOAD VERIFICATION	X									
3.3.3.4.1 OLS ORIGINATED							X			
3.3.3.4.2 MISSION SENSOR ORIGINATED							X			

Table IV
IS-2617400 VERIFICATION RESPONSIBILITIES

Paragraph/Parameter	N/A	Spacecraft Contractor			OLS Contractor			Miss. Sens. Contractor		
		I	A	T	I	A	T	I	A	T
3.3.3.5 LOAD FILE TRANSMITTAL	X									
3.3.4 OLS ELECTRICAL INTERFACE CIRCUITS					X					
3.3.5 SSP CABLING AND PIN ASSIGNMENTS				X	X					
3.3.6 OLS/MISSION SENSOR INFORMATION ANNEX	X									
3.3.6.1 TOTAL SSP DATA RATE AND DISTRIBUTION	X									
3.3.6.2 SSP CONTROL SIGNALS	X									
3.3.6.3 SSP DATA OFF/INVALID SIGNAL	X									
3.3.6.4 TIME CODE	X									
3.4 SPACECRAFT/OLS AND SPACECRAFT/MISSION SENSORS ENVIRONMENTAL INTERFACE	X									
3.4.1 THERMAL	X									
3.4.1.1 GENERAL	X									
3.4.1.2 NODAL MODELS	X									
3.4.2 CONTAMINATION	X									
3.4.3 SPACECRAFT TEST ENVIRONMENTS	X									
3.4.4 FACILITIES ENVIRONMENT	X									
3.4.5 FLIGHT ENVIRONMENTS	X									

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5.0 PREPARATION FOR DELIVERY

This section is not applicable to this specification.

6.0 NOTES

6.1 Organizations

Under the coordination of the identified Space Segment Integrator, who has prime responsibility for the interfaces detailed in Section 1.1, each contractor listed below has collateral responsibility for compliance with the interface requirements, which are applicable to the particular contractor, contained in this specification. The specific responsibilities of each organization, for fulfilling the requirements of this IS, are detailed in Section 4 of this IS and in the applicable ICDs.

Space Segment Integrator	GE Aerospace Astro-Space Division P.O. Box 800 Princeton, NJ 08543-0800
Spacecraft Contractor	GE Aerospace Astro-Space Division P.O. Box 800 Princeton, NJ 08543-0800
Primary Sensor Contractor	Westinghouse Electric Corporation Space Division BWI Airport P.O. Box 8703 Baltimore, MD 21240
Mission Sensor Contractors	
SSM/I	Hughes Aircraft Corporation Space and Communications Group P.O. Box 92919 Los Angeles, CA 90009
SSJ/4	Air Force Geophysics Laboratory Hanscom Air Force Base, MA 01731
SSIES-2	Air Force Geophysics Laboratory Hanscom Air Force Base, MA 01731
SSM	Air Force Geophysics Laboratory Hanscom Air Force Base, MA 01731
SSB/X-2	Sandia National Laboratories P.O. Box 5800 Albuquerque, New Mexico 87185

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SSM/T-1

Aerojet Electro-Systems
1100 W. Hollyvale Street
P.O. Box 296
Azusa, CA 91702

SSM/T-2

Aerojet Electro-Systems
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Azusa, CA 91702

SSZ

Aerospace Corporation
P.O. Box 92957
Los Angeles, CA 90009

6.2 Definitions and Abbreviations

For the purpose of the spacecraft to sensors interface documentation, the following definitions and/or abbreviations shall apply. Other abbreviations are defined within the documents.

5D2	-	Block 5D2 DMSP Satellite
AGE	-	Aerospace Ground Equipment
ASM	-	AVE Simulator Model (OLS)
AVE	-	Aerospace Vehicle Equipment
BBX	-	GFE Encryption Device (BB1, BB2, BB3)
CCB	-	Configuration Control Board
CIU	-	Controls Interface Unit (S/C)
CPC	-	Controls Power Converter (S/C)
DCC	-	Deployable Cooler Cover (OLS)
DDT	-	Direct Data Transmitter (S/C)
DMSP	-	Defense Meteorological Satellite Program
DOC	-	Deployable Optics Cover (OLS)
EDTX	-	EST Data Transmitter (S/C)
EPH CLK	-	Ephemeris Clock
ESM	-	Equipment Support Module
EST	-	Equipment Status Telemetry
ETC	-	Elapsed Time Clock
FOV	-	Field-of-View
FTE	-	Field Test Equipment
GFE	-	Government Furnished Equipment
GLOB	-	Glare Obstructor
GSSA	-	Glare Suppression System Assembly (OLS)
ICD	-	Interface Control Document
ICWG	-	Interface Control Working Group
ISS	-	Integrated Spacecraft System
IS	-	Interface Specification
LS	-	Light Smooth
LSB	-	Least Significant Bit
MSB	-	Most Significant Bit
NRZ-L	-	Non-Return-to-Zero-Level
OLS	-	Operational Linescan System (OLS AVE also describes the system)
OSU	-	Output Switching Unit (OLS)
PC	-	Power Converter (S/C)
PDTX	-	Primary Data Transmitter (PDT1, PDT2) (S/C)
PIP	-	Programmable Information Processor (S/C)
PMO	-	Program Management Office (CWD)
PMP	-	Precision Mounting Platform
PRX	-	Primary Tape Recorder (PR1, PR2, PR3, PR4) (OLS)
PSE	-	Power Supply Electronics (S/C)
PSU	-	Power Supply Unit (OLS)

RSS - Reaction Support Structure
RTD - Real-Time Data Mode - the direct data mode
S/C - Spacecraft
SCN - Spec Change Notice
SCU - Signal Conditioning Unit (S/C)
SDF - Stored Data Fine Mode - one of the OLS record modes
SDS - Stored Data Smooth Mode - one of the OLS record modes
SPO - System Program Office
SPS - Signal Processing Subsystem (OLS)
SPU - Special Sensor Processing Unit (OLS)
SSP - Special Sensor Unit (P is a general form) - also known as
Mission Sensor Unit
SSS - Sensor Scanning Subsystem (OLS)
STE - Special Test Equipment (OLS)
TBD - To be determined
TIM - Technical Interchange Meeting
TS - Thermal Smooth
USAF - United States Air Force

X,Y,Z - Reference axes of geodetic local vertical

x_p, y_p, z_p - Primary alignment reference axes - also alignment
coordinate axes of SSS

x_r, y_r, z_r - Secondary references axes - also special sensor
alignment coordinate axes

x_m, y_m, z_m - Mounting or mechanical axes

6.3. Test Environments

The spacecraft test environments are described herein for informational purposes only. Sensor contractors shall review these environments and document with the Air Force/SPO any conditions at variance with or considered potentially in excess of environments stated in the applicable sensor segment specification. Where applicable sensor segment specifications conflict with these environments, the sensor segment specifications shall take precedence. It shall be the responsibility of the Air Force/SPO to resolve any such conflicts.

6.3.1 Thermal Test. The satellite thermal test environment conditions at ambient pressure are shown in Figure 24. Functional verification of the spacecraft/sensor interface is performed at each temperature plateau during one or more cycles. The rate of temperature change will be 10°C/hour maximum. Tolerance on the temperature extremes is $\pm 2^\circ\text{C}$.

The thermal chamber relative humidity will be 60% maximum. Temperature transitions shall be accomplished in a manner that prohibits condensation on any equipment under test.

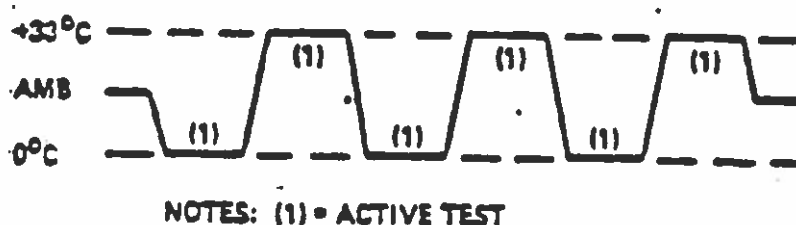


Figure 24. Thermal Test Profile

6.3.2 Orbit Confidence Test. The Satellite will be subjected to a vacuum of less than 10^{-5} Torr and programmed for a daily 14 orbit mission profile. System Performance Tests will be conducted in a vacuum before and after the orbit tests. The complete orbit confidence test, including the System Performance Tests, will consist of 21 days in vacuum. During the test, the Satellite will be operated at nominal orbit temperature by controlling vacuum chamber walls to -70°C minimum. The Satellite will be operated using simulated solar array power. Power load levels will be varied as in orbit by commanding Satellite equipment on and off. The Satellite subsystems, including sensor packages, will be monitored during the test.

6.3.3 Acoustic Vibration Test. The integrated spacecraft, configured for launch, will be subjected to an acoustic vibration test in accordance with the levels and exposure times as shown in Table V. Equipment operating during launch mode is operating and monitored during this test.

Table V. ACOUSTIC TEST SOUND PRESSURE LEVELS

<u>1/3 Octave Band Center Frequency (Hz)</u>	<u>1/3 Octave Band Sound Pressure Level (dB)</u>		<u>Test Tolerance*</u>
	<u>First Article</u>	<u>Acceptance</u>	
40	120.5	117.5	±3 dB
50	123	120	±3 dB
63	125	122	±3 dB
80	126.5	123.5	±3 dB
100	128.2	125.2	±3 dB
125	130	127	±3 dB
160	131.5	128.5	±3 dB
200	133	130	±3 dB
250	133.8	130.8	±3 dB
315	134.5	131.5	±3 dB
400	134.75	131.75	±3 dB
500	134	131	±3 dB
630	133	130	±3 dB
800	130.5	127.5	±15 dB
1000	128	125	±15 dB
1250	125.5	122.5	±15 dB
1600	122.5	119.5	±15 dB
2000	119	116	±15 dB
2500	116	113	±15 dB
3150	113	110	±15 dB
4000	109	106	±15 dB
5000	106	103	±15 dB
6300	102	99	±15 dB
8000	98	95	±15 dB
10000	95	92	±15 dB
OVERALL SPL	143.3	140.3	±3 dB
Test Duration	2.0 Minutes	1.0 Minute	

SPL Reference - 0.0002 dyne/cm²

*Tolerance - difference between specification value and room average sound pressure level for each 1/3 octave band and for the overall level.

6.3.4 Pyro Shock Test. The satellite will be subjected to pyro shocks generated by all integrated spacecraft ordnance devices (less GE and sensors). Live separation ordnance will be used. Sensor input and spacecraft equipment responses will be measured. A system performance test will be conducted to verify that no functional degradation of the system results from these shocks.

6.3.5 EMI Test. The EMI test is designed to test pertinent spacecraft parameters in the presence of a self-induced worst case environment. The exposure consists of spacecraft induced radiations in the S-band region produced by the spacecraft transmitters through their normal network and antennae and any other interferers on the spacecraft.

6.3.6 Degaussing. The PMP, ESM, and RSS will be degaussed in each axis with a 50 Gauss maximum field. The field will be cycled positively and negatively 25 times decrementing from 50 Gauss to 0.25 Gauss.

6.4 Facilities Environment. The spacecraft integration and test area at GE will conform to the requirements of a Class 10,000 clean room. Temperatures is controlled to 75 \pm 10°F and humidity to 45 \pm 10%. During those periods requiring spacecraft location outside this integration and test area, the spacecraft will be draped with a polyethylene cover and local purge applied as required.

6.5 Transport Environments

6.5.1 Factory to Prelaunch Processing Facility. The 5D-2 spacecraft is shipped in two sections, each having a separate container. The Equipment Support Module container is equipped with shock mounting and is provided with a continuous nitrogen purge. Temperature, humidity, and load information are recorded. The Reaction Support Structure container is pressurized with nitrogen and sealed, and is also provided with shock mounting and environment recording.

6.5.2 Prelaunch Processing Facility to Pad. The integrated 5D-2 spacecraft is transported to the launch site in the payload fairing. Air conditioning is provided, and temperature, humidity, and load information are recorded continuously.

6.6 Flight Environment. The anticipated flight-induced environments for the spacecraft are described in the following subparagraphs for informational purposes only. Sensor contractors shall review these environments and document with the Air Force/SPO any conditions at variance with or considered potentially in excess of environments stated in the applicable sensor segment specification. Where applicable sensor segment specifications conflict with these environments, the sensor segment specifications shall take precedence. It shall be the responsibility of the Air Force/SPO to resolve any such conflicts.

6.6.1 Launch and Ascent Environment

6.6.1.1 Acceleration. The expected flight accelerations are shown in Table VI.

Table VI. FLIGHT ACCELERATIONS

	Loads, g		
	Longitudinal	Pitch	Lateral Yaw
Liftoff			
PMP (Sta 303)	+3.0 max	±1.4	±2.9
ESM (Sta 329)	-0.5 min	±0.9	±2.1
PRE-BECO TRANSIENT			
PMP		±0.6	±1.2
ESM	+7.0	±0.4	±0.9
BPJ			
PMP	+2.0 max	±3.3	±1.0
ESM	0 min	±2.3	±0.9
Flight Winds			
PMP	+3.0 max	±4.0	±2.9
ESM	±1.6 min	±2.2	±2.2
SECO			
PMP		±0.5	±0.4
ESM	+8.2	±0.3	±0.2

6.6.1.2 Fairing Temperature. The inside wall surfaces of the fairing visible to the sensors will not exceed 150°C. The temperature as a function of time from start of flight is shown in Figure 25. The emittance of the inside surface (normal to the fairing wall) is temperature dependent as follows:

Temperature (°C)	Emittance
27	0.057
127	0.077
227	0.106

Nominal fairing separation occurs at a flight time of 142.5 seconds at a minimum altitude of 370,000 feet. Minimum fairing jettison altitude is such that the instantaneous free molecular heat flux is less than 322 BTU per ft² per hour.

6.6.1.3 Vibration. The expected vibration exposure at launch is shown in Figure 26.

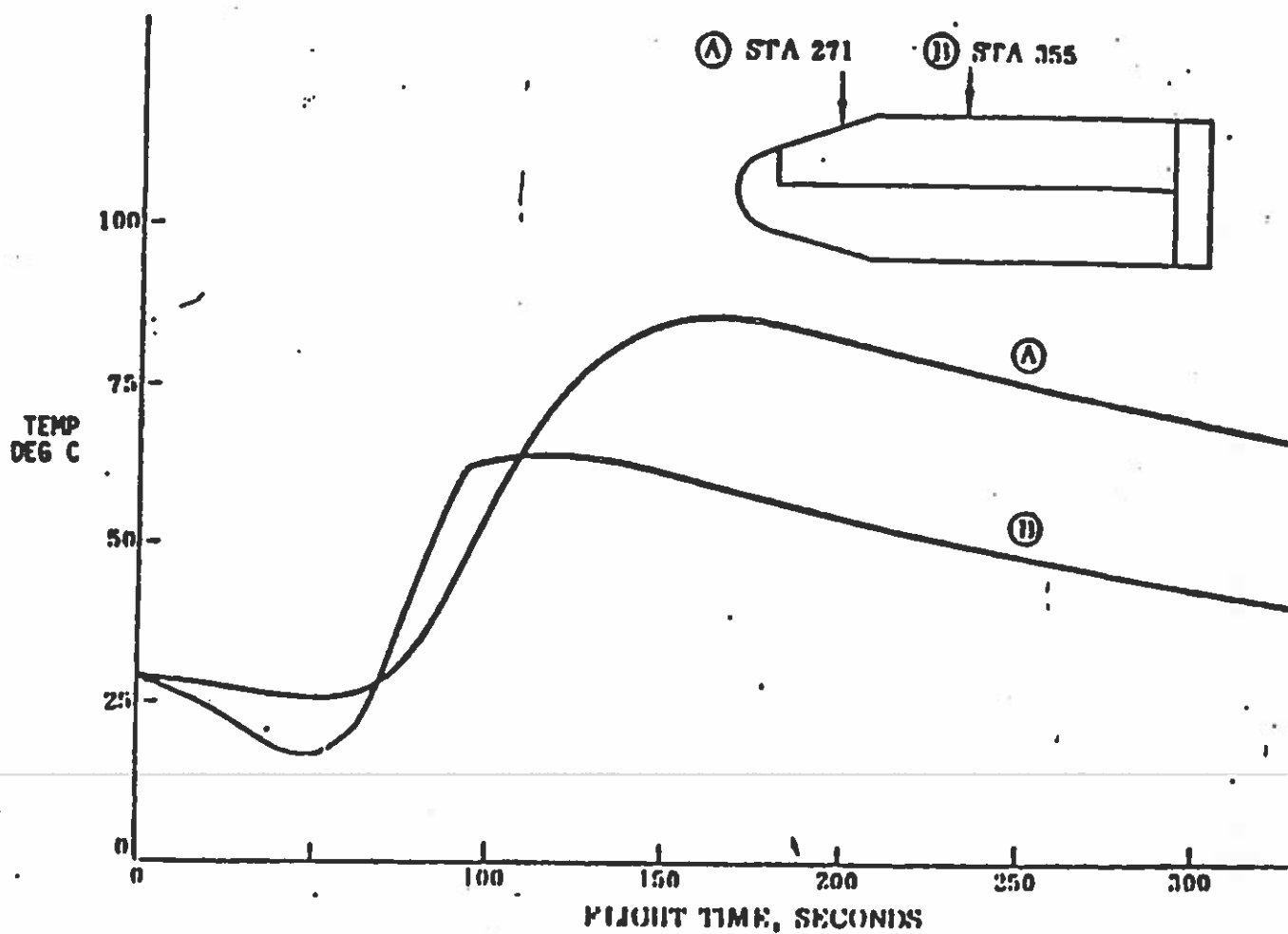


Figure 25
Fairing Inner Surface Maximum Temperatures
(3S Depressed Case)

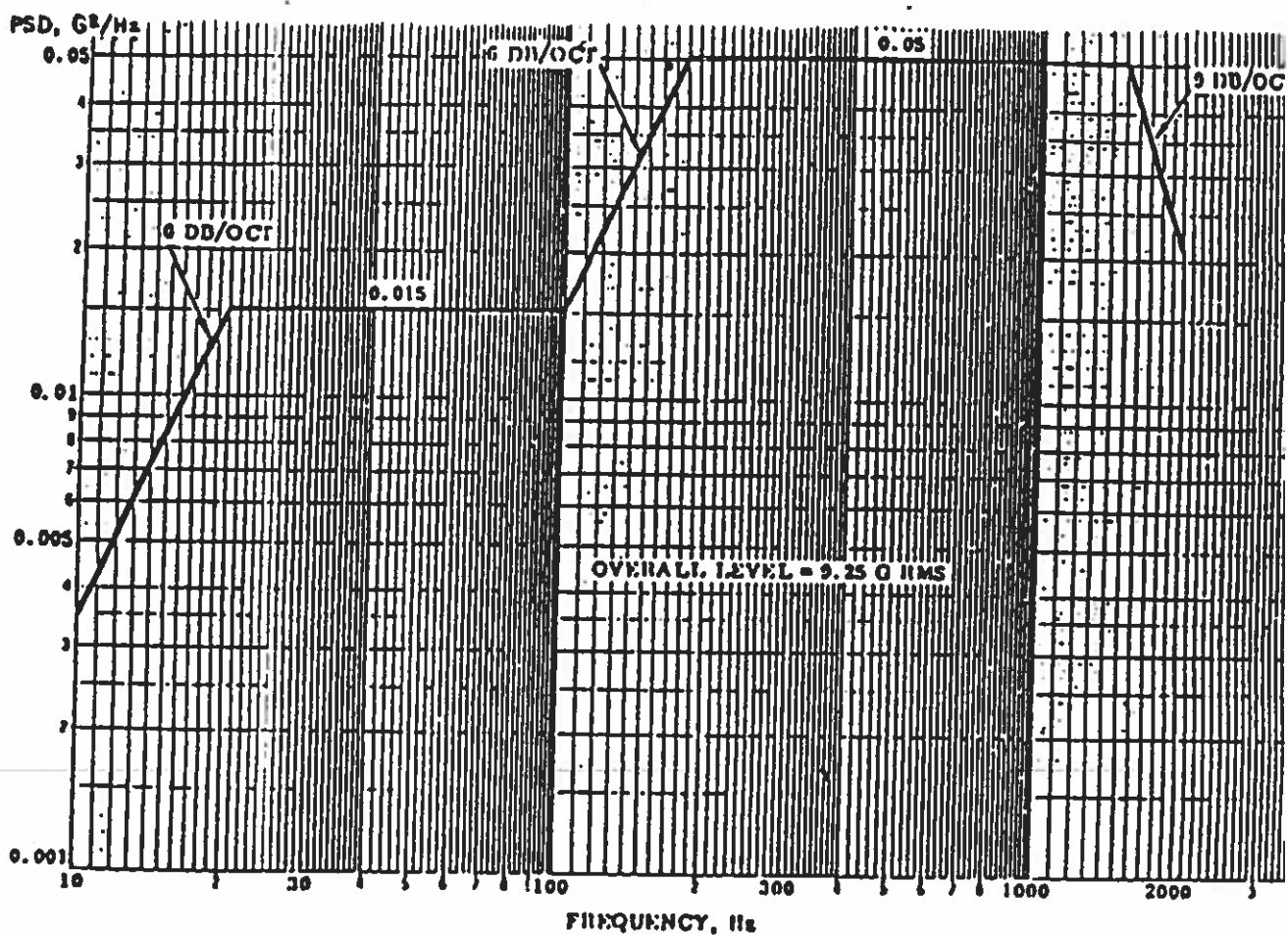


Figure 26
Expected Launch and Flight Vibration

6.6.1.4 Contamination. The Fairing forward adapter internal surfaces, the forward surfaces of the conical adapter, and all of the Launch Vehicle equipment within this volume will be cleaned to MIL-STD-1246A Level 500G at VAFB. All other surfaces will be visually clean. The Fairing will be cleaned of both absorbed and surface molecular contamination which would outgas below the maximum expected internal temperature. Materials used inside the Fairing will not produce greater than 0.2 percent VCM (by weight) nor total mass loss (TML) of 2 percent or more from satellite installation on the launch vehicle until satellite separation.

6.6.1.5 Pressure. Typical ambient pressure internal to the fairing as a function of time from launch is as shown in Table VII.

Table VII. ATMOSPHERIC PRESSURE AS A FUNCTION OF TIME

Time (sec)	Pressure (psi)
0	14.50
10	14.09
20	12.84
30	10.73
40	8.07
50	5.27
60	2.84
70	1.27
80	0.44
90	0.13

The maximum sound pressure fluctuations in any frequency band at any time during flight are the levels shown in Table V in the column headed Acceptance.

6.6.2 On Orbit Environment

6.6.2.1 Orbit Characteristics. The normal Block 5D-2 orbit is a nominally circular, sun-synchronous, 450 nautical mile altitude orbit.

6.6.2.2 Radiation. The radiation environment is the combined effects of the environments shown in Table VIII, Omnidirectional Proton Flux, and Table IX, Omnidirectional Electron Flux, and Table X, Solar Flare Proton Environment for any Three Year or Greater Time Period Between 1977 and 1983. These environments are to be taken as isotropic and omnidirectional and represent the incident spectra on the external surfaces of the spacecraft.

Table XI, Peak Fluxes - Electron, and Table XII, Peak Fluxes - Protons show the peak electron and proton flux levels versus particle energy expected in the nominal orbit. These peak fluxes occur over a longitude range from 60°E to 111°W and a latitude range from 15°N to 55°S.

Table VIII. OMNIDIRECTIONAL PROTON FLUX
(PROTONS/cm² - day)

ENERGY RANGES (MeV) <u>E1 - E2</u>	AVG. FLUX ABOVE E1 (PER DAY)	AVG. INTEGRAL FLUX IN BAND <u>E1 - E2 (PER DAY)</u>
1.00 - 2.00	1.60E 08	6.19E 07
2.00 - 3.00	9.78E 07	2.01E 07
3.00 - 4.00	7.77E 07	1.26E 07
4.00 - 5.00	6.51E 07	8.29E 06
5.00 - 6.00	5.68E 07	5.70E 06
6.00 - 7.00	5.11E 07	3.34E 06
7.00 - 8.00	4.78E 07	2.80E 06
8.00 - 9.00	4.50E 07	2.37E 06
9.00 - 10.00	4.26E 07	2.04E 06
10.00 - 11.00	4.06E 07	1.17E 06
11.00 - 12.00	3.94E 07	1.10E 06
12.00 - 13.00	3.83E 07	1.03E 06
13.00 - 14.00	3.73E 07	9.71E 05
14.00 - 15.00	3.63E 07	9.16E 05
15.00 - 20.00	3.54E 07	3.93E 06
20.00 - 25.00	3.14E 07	1.99E 06
25.00 - 30.00	2.94E 07	1.79E 06
30.00 - 35.00	2.77E 07	1.40E 06
35.00 - 40.00	2.63E 07	1.31E 06
40.00 - 45.00	2.49E 07	1.23E 06
45.00 - 50.00	2.37E 07	1.16E 06
50.00 - 60.00	2.25E 07	2.28E 06
60.00 - 70.00	2.03E 07	2.02E 06
70.00 - 80.00	1.82E 07	1.80E 06
80.00 - 90.00	1.64E 07	1.60E 06
90.00 - 100.00	1.48E 07	1.43E 06
100.00 - 110.00	1.34E 07	1.35E 06
110.00 - 120.00	1.21E 07	1.21E 06
120.00 - 130.00	1.09E 07	1.08E 06
130.00 - 140.00	9.78E 06	9.66E 05
140.00 - 150.00	8.81E 06	8.67E 05
150.00 - 200.00	7.95E 06	3.17E 06
200.00 - 250.00	4.77E 06	1.86E 06
250.00 - 300.00	2.92E 06	1.12E 06
300.00 - Infinity	1.79E 06	1.79E 06

Table IX. OMNIDIRECTIONAL ELECTRON FLUX
(ELECTRONS/cm² - day)

ENERGY RANGES (MeV) <u>E1 - E2</u>	AVG. FLUX ABOVE E1 (PER DAY)	AVG. INTEGRAL FLUX IN BAND <u>E1 - E2 (PER DAY)</u>
0.05 - 0.25	6.04E 10	5.02E 10
0.25 - 0.50	1.02E 10	7.25E 09
0.50 - 0.75	2.96E 09	1.31E 09
0.75 - 1.00	1.65E 09	5.95E 08
1.00 - 1.25	1.06E 09	3.13E 08
1.25 - 1.50	7.42E 08	2.14E 08
1.50 - 1.75	5.28E 08	1.44E 08
1.75 - 2.00	3.84E 08	1.03E 08
2.00 - 2.25	2.81E 08	6.74E 07
2.25 - 2.50	2.13E 08	5.07E 07
2.50 - 2.75	1.63E 08	4.22E 07
2.75 - 3.00	1.21E 08	2.94E 07
3.00 - 3.25	9.12E 07	1.86E 07
3.25 - 3.50	7.26E 07	1.41E 07
3.50 - 3.75	5.85E 07	1.11E 07
3.75 - 4.00	4.74E 07	8.90E 06
4.00 - 4.25	3.84E 07	1.12E 07
4.25 - 4.50	2.72E 07	7.94E 06
4.50 - 4.75	1.93E 07	5.61E 06
4.75 - 5.00	1.37E 07	3.97E 06
5.00 - 5.25	9.68E 06	4.43E 06
5.25 - 5.50	5.25E 06	2.40E 06
5.50 - 5.75	2.85E 06	1.30E 06
5.75 - 6.00	1.55E 06	7.07E 05
6.00 - 6.25	8.40E 05	5.88E 05
6.25 - 6.50	2.53E 05	1.77E 05
6.50 - 6.75	7.52E 04	5.39E 04
6.75 - 7.00	2.13E 04	2.13E 04
7.00 - 7.25	0.0	0.0
7.25	0.0	

Table X. SOLAR FLARE PROTON ENVIRONMENT (PROTONS/cm²) FOR ANY THREE YEAR OR GREATER TIME PERIOD BETWEEN 1977 - 1983

<u>FLARE PROTON ENERGY (E) (MeV)</u>	<u>FLUX ABOVE ENERGY (E)</u>
0.10	2.0 x 10 ¹¹
0.50	1.3 x 10 ¹¹
1.00	1.0 x 10 ¹¹
5.00	4.0 x 10 ¹⁰
10.00	2.0 x 10 ¹⁰
20.00	9.0 x 10 ⁹
50.00	2.0 x 10 ⁹
100.00	4.0 x 10 ⁸
200.00	3.5 x 10 ⁷

Table XI. PEAK FLUXES - ELECTRONS

<u>PARTICLE ENERGY (E) (MeV)</u>	<u>PEAK FLUX (E) PER CM²/SEC</u>
0.05	1.1 x 10 ⁷
0.50	3.7 x 10 ⁵
1.00	1.8 x 10 ⁵
2.00	5.7 x 10 ⁴
3.00	2.3 x 10 ⁴
4.00	1.0 x 10 ⁴
5.00	3.0 x 10 ³

ICD-2617409

Code I.D. No. 49671

16 June 1988

FINAL DRAFT

Interface Control Document

for

DMSF Block 5D-2 (S11-S14)

MISSION SENSOR SSM/T-2

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1.0 SCOPE

1.1 Introduction. The Spacecraft serves as a stable platform and provides the necessary power and thermal control for each of the Sensors, except as otherwise noted.

The SSM/T-2 is a passive microwave sensor used to obtain spectrally selective radiometric measurements at frequencies of 91.65 ± 1.25 , 150.0 ± 1.25 , 183.3 ± 1 , 183.3 ± 3 and 183.3 ± 7 GHz. Data obtained at these frequencies subsequently will be used to obtain water vapor profiles and other environmental parameters.

1.2 Interface Documentation. The general requirements for all the Spacecraft - Primary Sensor - Mission Sensor interfaces are defined in the Interface Specification IS-2617400. This Interface Control Document (ICD) defines the implementation of these general requirements, and identifies those areas peculiar to this Mission Sensor. A separate ICD exists for each of the DMSP Mission Sensors. These ICD's are identified in the Space Segment Documentation Relationship ICD-2617401.

1.3 Item Description. The SSM/T-2 is a multi-channel instrument that consists of a mechanically scanned reflector antenna, a stepper motor/gear antenna drive, a ~~seven~~^{five} channel super heterodyne receiver, and signal processing/timing circuitry. The system is calibrated inflight by viewing known radiometric temperatures through the antenna system. An accurately known ambient hot load (300K) and the cosmic background (2.7K) are used for this purpose. X

The mechanically scanned reflector antenna system consists of a ~~lens cor~~^{rected} corrugated feed horn, a shrouded reflector and ~~an orthogonal mode~~^{a radio frequency transducer} transducer. It provides a planar scan by a rotation of the reflector surface, allowing the antenna feed system to remain fixed.

The antenna beam scans in a cross-track fashion, with an ~~1800~~^{1800 km} swath width perpendicular to the satellite subtrack. The instrument steps through 28 discrete earth-looking positions at a fixed, programmed rate, then is rapidly rotated, first to the hot load and then to the cold load, before the scanning sequence is repeated.

The SSM/T-2 is GFE to the Spacecraft Contractor. A simplified block diagram of the SSM/T-2 is shown in Figure 1.

2.0 APPLICABLE DOCUMENTS

2.1 Government Documents

IS 2617400 DMSF Spacecraft-OLS-Mission Sensor Interface Specification
(3-way) (TBD)

ICD-2617401 Space Segment Documentation Relationship (TBD)

DMSP-300 General System Performance Specification for the Defense
Meteorological Satellite Program (6 Sep 83)

DMSS-OLS-300 Prime Item Development Specification for the Operational
Linescan System (OLS) of the Block 5D-3 Defense Meteorological
Satellite System (DMSS) (28 Sep 82)

SS-YD-860 Space Segment Specification for the Defense Meteorological
Satellite Program (DMSP) (28 Oct 87)

PS-2298490 Prime Item Development Specification for DMSP Block 5D-2
Spacecraft (S11-14) (19 May 87)

SS-YD-824 Specification for DMSP SSM/T (30 Aug 82)

2.2 Non-Government Documents

Aerojet Sensor Handling Procedure for the SSM/T Program

3.0 INTERFACE REQUIREMENTS

3.1 Physical. The requirements for the physical interfaces between the Spacecraft and the SSM/T-2 are described herein.

The spacecraft provides mounting for the SSM/T-2 such that the field of view and alignment requirements of the SSM/T-2 are satisfied, however, unavoidable intrusions by the GLOB will cause a percentage of the FOV to be obstructed at the +Z end of scan. The FOV requirements are described in Figure 2.

The spacecraft provides, as a minimum, the volume and mounting areas as required for each sensor. The dimensions and mounting configuration of the SSM/T-2 are defined in Figure 2.

3.1.1 Mass Properties. The total mass of the sensor, including mounting hardware, shall be less than or equal to 30 pounds. The spacecraft shall be capable of structurally supporting a mass of 36 pounds for the sensor.

3.1.1.1 Center of Mass (CM). The CM location and coordinates are shown in Figure 2. Tolerance on the CM coordinates shall be ± 0.5 inch.

3.1.1.2 Moments of Inertia. The moments of inertia are shown in Figure 2 as I_x , I_y , I_z . The moments are about axes parallel to the X,Y,Z axes but passing through the CM. The moments of inertia are expressed in units of in-lb-sec² with a tolerance of $\pm 30\%$.

3.1.2 Mechanical Interfaces. The Spacecraft structure shall provide volume and mounting areas for the SSM/T-2. Installation of the SSM/T-2 on the spacecraft is shown in Figure 3.

3.1.2.1 Fields-of-View, Glare/Glint. The two separate fields of view (FOV) required by the SSM/T-2 are shown in Figure 2. One FOV emanates from a 3 inch diameter aperture and is a 3.0° cone at the half power points ($\pm 1.5^\circ$ from the centerline) and at 183.3 GHz, which is scanned $\pm 40.5^\circ$ from the nadir (+X axis) in the X, Z plane. The clear FOV required by the SSM/T-2 is 18° in the X, Y plane and 100° in the X, Z plane. The second FOV (used for calibration) is bounded by 15° and 105° from -Z to +Y, and by 35° and 125° from -X to +Y. The spacecraft shall provide mounting of the SSM/T-2 to assure that the required field of view is not obstructed except as described herein.

With a GLOB mounted on the spacecraft, the SSM/T-2 scanning FOV is partially obstructed. The cold calibration FOV is unobstructed at the +Z end of the scan.

3.1.2.2 Uncompensated Momentum. The uncompensated momentum of the SSM/T-2 for all modes of operation shall not exceed 0.02 in-lb-sec. The nominal uncompensated momentum for the SSM/T-2 is 0.006 in-lb-sec.

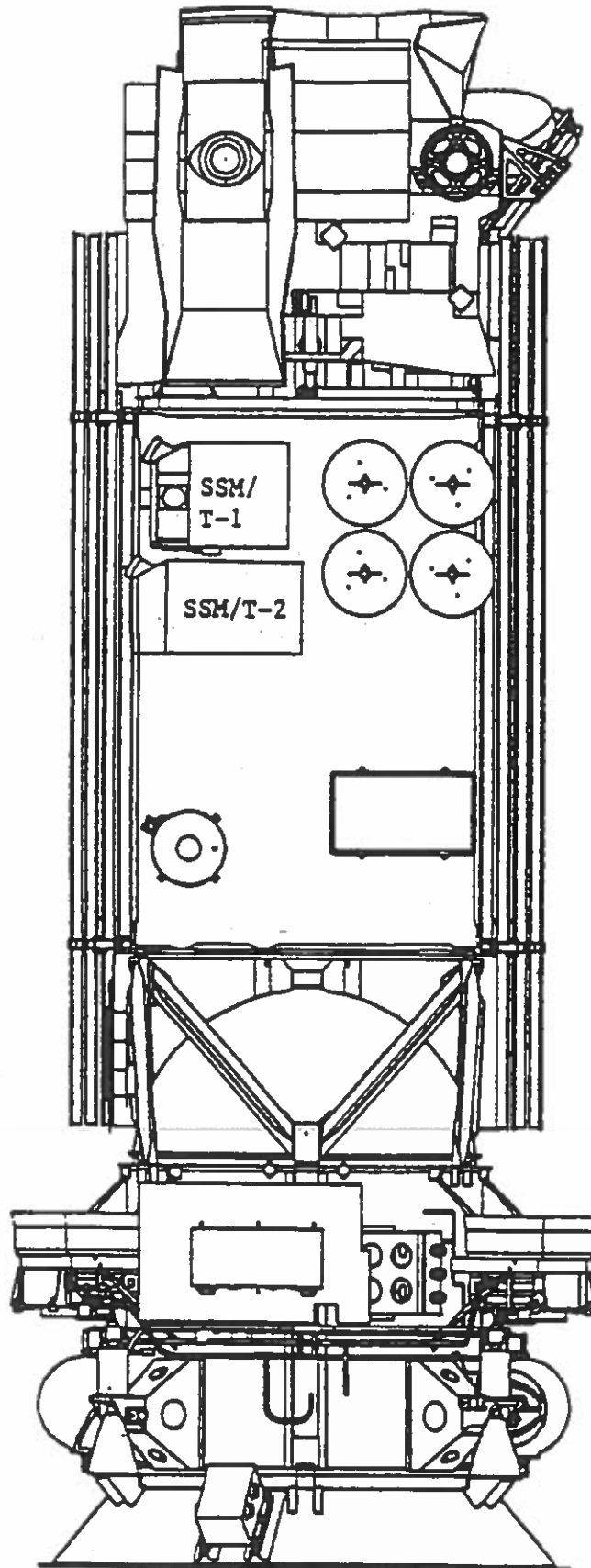


Figure 3. S/C Installation of SSM/T-2

3.1.3. Alignment. The primary alignment axes for the satellite, the secondary reference axes for the sensor, and their relationships are defined in IS-2617400. The sense and nominal direction of the axes of the SSM/T-2 are shown in Figure 2.

The spacecraft shall maintain the axes of the sensor aligned with the primary alignment axes within a 3 sigma tolerance of 1440 arc seconds per axis. Measurement of actual sensor alignment shall enable knowledge of sensor alignment within a 3 sigma tolerance of 360 arc seconds per axis.

3.1.4 Materials. There are no materials of potential contamination either to or from the spacecraft.

3.1.4.1 Magnetic Characteristics. The SSM/T-2 shall be designed to minimize the use of magnetic materials. The difference in magnetic dipole of the sensor about any axis between any two modes is less than 0.01 ampere-turn-meter².

3.1.5 Deployment Characteristics. There are no deployables on the SSM/T-2.

3.1.6 Structural or Thermal Modelling. The models required in the analysis of the SSM/T-2 are briefly described below, (TBS), with a listing of reference documents which describe the models in detail (TBS).

3.1.7 Actuator Location. There are no actuators on the SSM/T-2.

3.2 Electrical Interfaces.

3.2.1 Power

3.2.1.1 SSM/T-2 to Spacecraft Interface Signals. The spacecraft shall supply 28 volt and 5 volt power to the SSM/T-2 with the characteristics as defined in IS-2617400. The power used by the SSM/T-2 shall be 30 watts maximum (equivalent 28V power).

A synchronization signal is provided by the SSM/T-2 for synchronization with the SSM/T-1. The signal will be sent to the SSM/T-1 via the SIU. The signal characteristics are described below.

pulse polarity	:	negative going from +5V baseline
high level	:	4.70 to 5.25 volts
low level	:	0.00 to 0.10 volts
pulse width	:	1.0 ± 0.1 msec (50% point)
rise/fall time	:	4.0 ± 0.4 usec (10 to 90%)
rep rate	:	one pulse every 32 seconds (once every four scan cycles)

when data

3.2.1.1.1 Current Ripple. The current ripple generated by the sensor on the +28 Volt bus shall not exceed 30 milliamperes peak-to-peak. The ripple generated by the sensor on the +5 volt bus shall not exceed 0.5 milliamperes peak-to-peak.

3.2.1.1.2 Current Transients. The rise rate of load current transients initiated by the sensor on the +28 volt bus shall be 20 milliamperes or less per microsecond. The rise rate of load current transients initiated by the sensor on the +5 volt bus shall be 1 milliampere or less per microsecond. The spacecraft shall supply peak currents of not greater than 2.5 amperes for less than 1 millisecond on the +28 volt bus for a period of 1 second or less during sensor turn on and/or mode change. The peak transient current demanded by the sensor shall not exceed 1.0 amperes.

3.2.1.1.3 Load Requirements. The regulated bus output impedance is defined in IS-2617400. The SSM/T-2 load requirements for power are defined as follows:

	<u>+28 VDC Bus</u>	<u>+5 VDC Bus</u>
Sensor OFF	0 ma	0.10 ma
Sensor ON	1.0 ma	0.10 ma

3.2.1.2 SSM/T-2 to OLS Interface Signals. The SSM/T-2 output circuit drives two identical OLS circuits that are wired in parallel for redundancy. Either one or both of the circuits may be powered. Normally only one of the circuits is powered and there is a low impedance to ground. When both are powered there is a +5 Vdc bias.

The SSM/T-2 shall send its User data to the OLS. Details of the data format are given in Appendix A for information only.

3.2.1.2.1 ON/OFF Indicator. The SSM/T-2 provides an ON/OFF signal to the OLS via the (SSxOFF) interface line to indicate that the sensor is on and ready to send data across the SSxDAT interface.

3.2.1.3 OLS to SSM/T-2 Interface Signals. The SSM/T-2 uses the following control signals supplied by the OLS.

<u>NAME</u>	<u>FUNCTION</u>	<u>REMARKS</u>
PEN	POWER ENABLE	
BCK	GATED BIT CLOCK	GATED 9990.24 Hz
RED	READ GATE	
REF	REFERENCE CLOCK	9990.24 Hz (used for
ENB	SERIAL COMMAND ENABLE	all sensor sync/nonsync
SER	SERIAL COMMAND	internal timing)

Signal characteristics are as contained in IS-2617400. Relative timing and phase relations for control signals are illustrated in Figures 4 and 5. Control signal interface circuits are identical to each other except for the power enable circuit which is modified to prevent any current flow from the sensor when the OLS is OFF.

Signals available to but not used by the SSM/T-2 are:

<u>NAME</u>	<u>FUNCTION</u>
MD1	MODE SELECT
MD2	SPARE MODE SELECT

3.2.1.4 Grounding Requirements. Each SSM/T-2 chassis (case) shall be electrically connected to the spacecraft by an insulation-free metal-to metal bond of 0.1 ohm or less. A chassis ground output pin shall be made available to the spacecraft for test purposes only.

3.2.1.4.1 Signal Ground - OLS to SSM/T-2. The OLS provides a signal ground for each of the timing, control and data signals. The grounds will be electrically connected to a ground in the SPU with a single line running to the OLS single point ground within the OLS. The SSM/T-2 signal ground line is isolated from the chassis and power grounds by 100K ohms or more DC resistance.

3.2.1.4.2 +28 Volt Power Return. The +28 Volt bus current supplied by the spacecraft shall be returned through a dedicated power ground wire which shall be electrically isolated from chassis ground.

3.2.1.4.3 +5 Volt Power Return. The +5 volt bus current supplied by the spacecraft shall be returned through a dedicated power ground wire which shall be electrically isolated from chassis ground.

3.2.1.4.4 Signal Grounds. The spacecraft shall provide signal grounds of those spacecraft connector pins designated signal ground in Tables I-III.

3.2.1.4.5 Shield Grounds. Not required. See Tables I-III for pin designations.

3.2.1.5 Harnessing

3.2.1.5.1 Sensor to Sensor Harness. The SSM/T-2 will be coupled to a SSM/T-1. ~~The design for their interface is TBD.~~ *via the SIU.* X

3.2.1.5.2 Sensor to OLS Harness. The SSM/T-2/OLS interface signal and their respective returns shall be a twisted pair provided by the Spacecraft Contractor. The cable shall be bundle shielded with the shield terminated at the OLS end. The SSM/T-2/OLS harness connector types and pin assignments shall be as shown in Table II. Connector locations are shown in Figure 2.

3.2.1.5.3 AVE Harness. All harness between the SSM/T-2 and the spacecraft shall be provided by the Spacecraft Contractor. Pin assignments for the spacecraft/SSM/T-2 harness shall be as shown in Table I. The +28V and +5V power and return lines should be twisted shielded pairs.

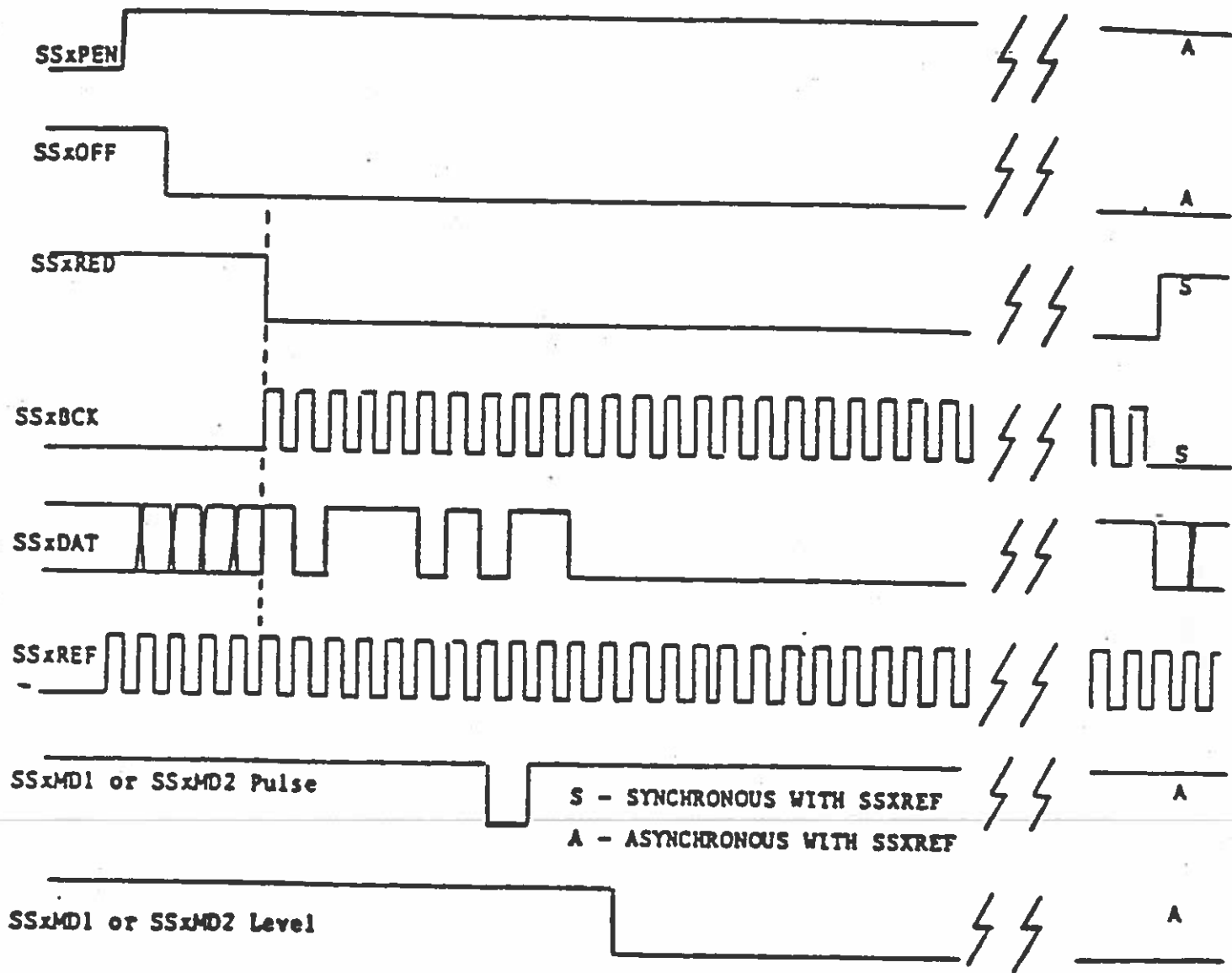


Figure 4. OLS Signal Timing Diagram

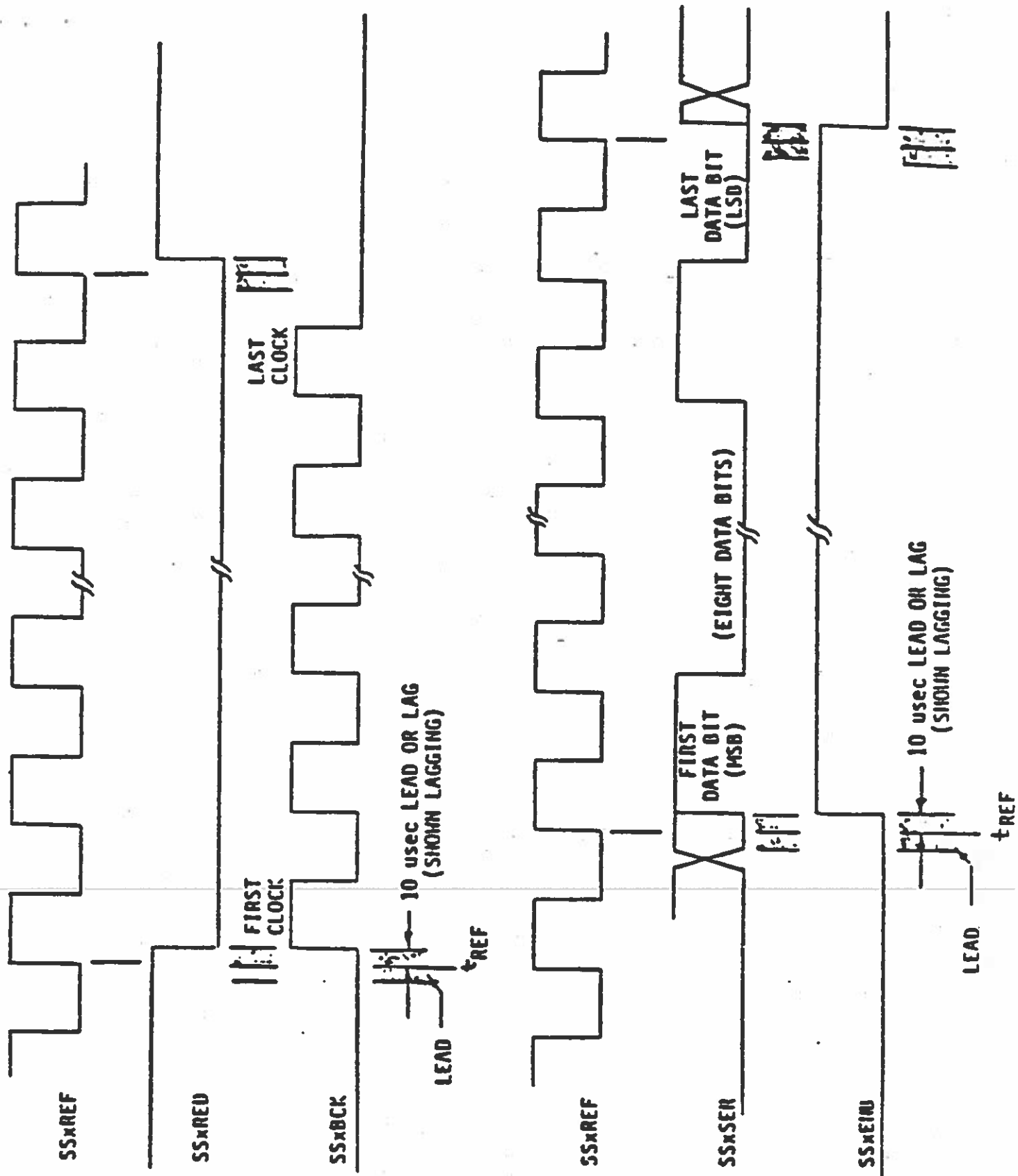


Figure 5. OLS Signal Phase Relations

3.2.1.5.4 Test Harness. A test connector (~~P-3~~^{J-3}) is provided for testing at the sensor vendor. When the sensor is shipped to the spacecraft contractor a flight connector cover shall be installed on ~~P-3~~^{J-3}. X

3.2.2 Actuator Signals. There are no actuators on the SSM/T-2.

3.2.3 Equipment Status Telemetry (EST). The spacecraft shall provide for and process 9 analog EST signals and 1 discrete EST signal from the SSM/T-2 as listed in Table IV. The allocation of EST signals to the SSM/T-2, and the functions of these signals are also given in Table III. These signals shall have the characteristics described in IS-2617400.

TABLE I
PIN ASSIGNMENTS
SSM/T-2 TO SPACECRAFT INTERFACE CONNECTOR P1

Sensor/Spacecraft Connector
SSM/T-2 J1 Type: DBJ-25P-NM Equivalent
Spacecraft P1 Type: DBM-25S-NMB-K56

<u>Pin</u>	<u>Sensor Function</u>	<u>Spacecraft Function</u>
1	SSM/T-1 SYNC	SSM/T-1 SYNC
2	SPARE	SPARE
3	EST 7 DISCRETE - REFLECTOR SYNC	D115 - EST 7 DISC - REF SYNC
4	EST 8 ANALOG - MOTOR CURRENT	A004 - EST 8 ANALOG - MOTOR CURRENT
5	EST 9 RF TEMP	A271 - EST 9 - RF TEMP
6	EST 10 BASEPLATE TEMP	A272 - EST 10 - BASEPLATE TEMP
7	EST 1 ANALOG - +15V	A243 - EST 1 ANALOG - +15V
8	EST 2 ANALOG - -15V	A244 - EST 2 ANALOG - -15V
9	EST 3 ANALOG - +8V	A245 - EST 3 ANALOG - +8V
10	SPARE	SPARE
11	+28V PRIMARY POWER	+28V PRIMARY POWER
12	+28V PRIMARY RETURN	+28V PRIMARY RETURN
13	+28V PRIMARY SHIELD (Not Connected)	SPARE
14	CASE GROUND	SPARE
15	SPARE	SPARE
16	EST 4 ANALOG - +L.O. #1	A246 - EST 4 ANALOG - L.O. #1
17	EST 11 ANALOG (SPARE)	SPARE
18	EST 5 ANALOG - +5V	A249 - EST 5 ANALOG - +5V TELEMETRY
19	SPARE	SPARE
20	EST 6 ANALOG - +L.O. #2	A247 - EST 6 ANALOG - L.O. #2
21	SPARE	SPARE
22	SPARE	SPARE
23	SPARE	SPARE
24	+5V SECONDARY POWER	+5V SECONDARY POWER
25	+5V SECONDARY RETURN	+5V SECONDARY RETURN

TABLE II
PIN ASSIGNMENTS
SSM/T-2 TO OLS INTERFACE CONNECTOR P2

Pin	<u>Sensor/OLS Connector</u>		<u>OLS Function</u>
	SSM/T-2 Spacecraft	J2 P2	
		Type: DBJ-25P-NM Equivalent	
		Type: DBM-25S-NMB-K56	
<u>Pin</u>	<u>Sensor Function</u>		<u>OLS Function</u>
1	SPARE		SPARE
2	SERIAL DATA		SERIAL DATA
3	SERIAL DATA RETURN		SERIAL DATA RETURN
4	BIT CLOCK		BIT CLOCK
5	BIT CLOCK RETURN		BIT CLOCK RETURN
6	READ GATE		READ GATE
7	READ GATE RETURN		READ GATE RETURN
8	REFERENCE CLOCK		REFERENCE CLOCK
9	REFERENCE CLOCK RETURN		REFERENCE CLOCK RETURN
10	SERIAL COMMAND ENABLE		SERIAL COMMAND ENABLE
11	SERIAL COMMAND ENABLE RTN		SERIAL COMMAND ENABLE RTN
12	SERIAL COMMAND		SERIAL COMMAND
13	SERIAL COMMAND RETURN		SERIAL COMMAND RETURN
14	SPARE		SPARE
15	ON-OFF INDICATOR		ON-OFF INDICATOR
16	ON-OFF INDICATOR RETURN		ON-OFF INDICATOR RETURN
17	POWER ENABLE		POWER ENABLE
18	POWER ENABLE RETURN		POWER ENABLE RETURN
19	MODE 1 SELECT (Not Connected)		MODE 1 SELECT
20	MODE 1 SELECT RETURN (Not Connected)		MODE 1 SELECT RETURN
21	MODE 2 SELECT (Not Connected)		MODE 2 SELECT
22	MODE 2 SELECT RETURN (Not Connected)		MODE 2 SELECT RETURN
23	SPARE		SPARE
24	SPARE		SPARE
25	SPARE		SPARE

TABLE III
SSM/T-2 EQUIPMENT STATUS TELEMETRY (EST)

<u>EST #</u>	<u>EST FUNCTION</u>	<u>LEVEL (NOMINAL)</u>	<u>CONNECTOR P1 PIN #</u>
1	+15 Volt supply (analog)	+3.0 VDC \pm 5%	7
2	-15 Volt supply (analog)	+3.0 VDC \pm 5%	8
3	+8 Volt Supply (analog)	+3.0 VDC \pm 5%	9
4	Local Oscillator #1 (analog)	+3.0 VDC Nominal(1)	16
5	+5 Volt supply (analog)	+3.0 VDC \pm 5%	18
6	Local Oscillator #2 (analog)	+3.0 VDC Nominal(1)	20
7	Reflector Sync (discrete)	0/5 VDC \pm 10%	3
8	Motor Current (analog)	TBD (3)	4
9	RF Temp. (analog)	+3.0 VDC Nominal(2)	5
10	Baseplate Temp. (analog)	+3.0 VDC Nominal(2)	6

Notes: (1) Adjustable: range to be determined at test
 (2) Varies with temperature: range to be determined at test
 (3) Duty cycle related: range to be determined at test

3.2.4 Fusing. The SSM/T-2 uses the spacecraft supplied +28 Vdc bus for primary power. All +28 Vdc power derived from the spacecraft has been fused to the extent that a short circuit anywhere within the SSM/T-2 will not cause catastrophic failure of the spacecraft power systems.

The +28 Vdc line is protected by two 3.0 amp fuses wired in parallel. The +28 Vdc line has one fuse in the spacecraft Sensor Interface Unit (SIU) rated at 3.0 amps that is supplied by the spacecraft contractor.

The +5 Vdc line is protected by two 0.25 amp fuses wired in parallel. The +5 Vdc line has one fuse in the SIU rated at 1.0 amp that is supplied by the spacecraft contractor.

3.2.5 Interface Signals. The electrical interface diagram is shown in Figure 6.

3.2.6 Electromagnetic Compatibility. Electromagnetic characteristics of the SSM/T-2 are defined in Table IV for all modes of operation. TBS

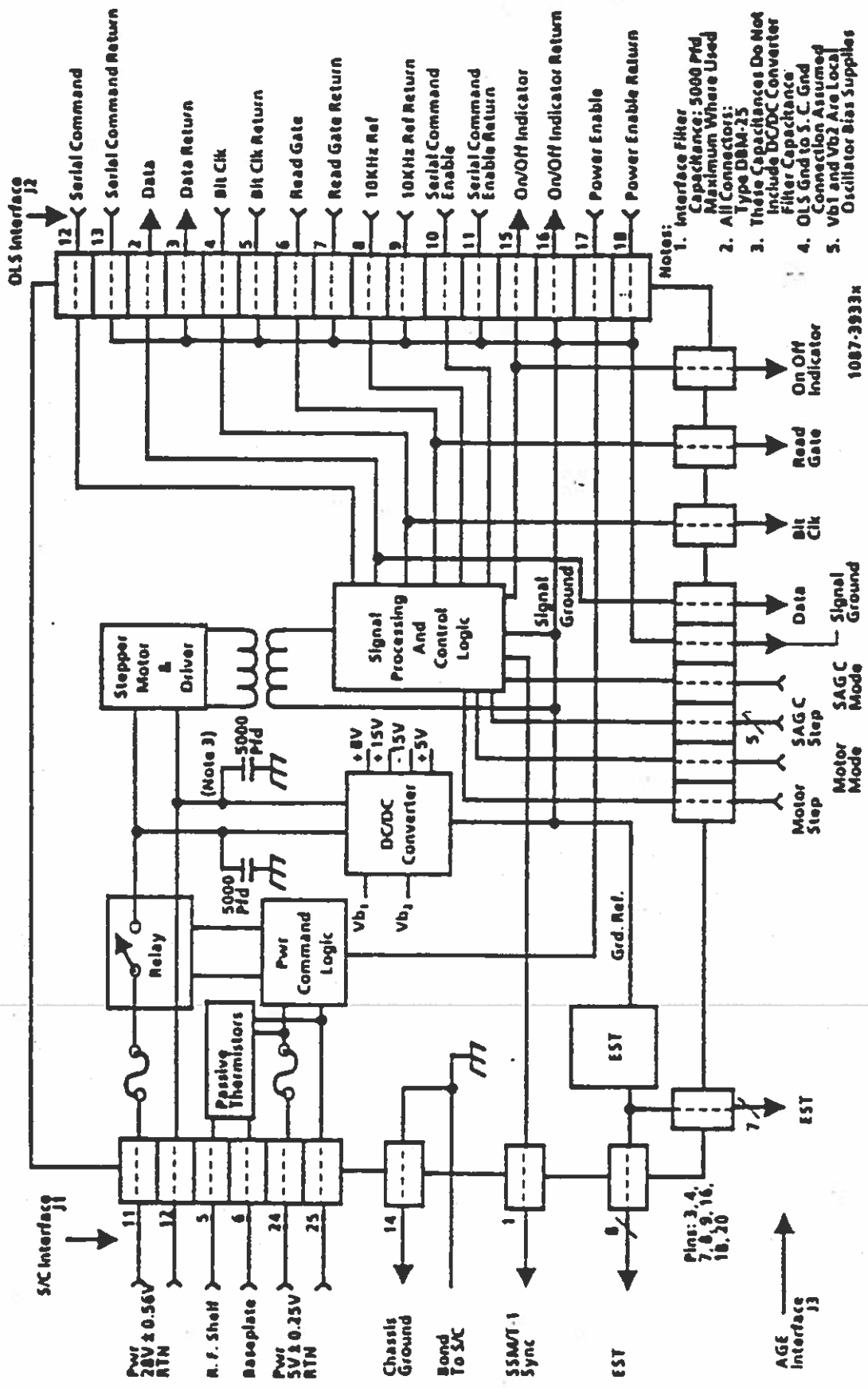


Figure 6. SSM/T-2 Interfaces and Power Distribution

3.3 Environmental

3.3.1 General. The SSM/T-2 operational environment is as defined in SS-YD-824 Specification for the DMSP Block 5D-2 Microwave Temperature Sounder (SSM/T) 3.2.6.

3.3.2 Thermal

3.3.2.1 Temperature Requirements. The spacecraft shall provide the necessary thermal controls to assure that the temperature of the thermal reference point, as defined in Figure 2, remains within the range of +5° to +25°C during the sensor operating mode for all orbital conditions. After being in the non-operating mode, the sensor shall be capable of being turned-on at any temperature as low as -30°C minimum and, when the sensor temperature is restored to the operating mode temperature range, the sensor shall function within its operating performance requirements. *Power cycling is permissible to p the sensor in a correct operating mode.*

3.3.2.2 Thermal Control Devices. The SSM/T-2 shall be delivered to the spacecraft contractor with thermal blanket and radiator material installed.

3.3.2.3 Thermal Gradients. The spacecraft shall control thermal gradients on the mounting surface of the SSM/T-2 to TBD or less. Spacecraft thermal control shall not cause the temperature of the SSM/T-2 to change at a rate greater than 3°C per hour.

3.3.2.4 Nodal Models. None required.

3.3.2.5 Thermal Finishes. No special thermal finish is required at the mounting points.

3.3.3 Contamination. The SSM/T-2 design shall provide for minimization of contamination from external sources before, during, and after launch, and for access for removal of prelaunch contamination.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Storage and Handling Precautions. The SSM/T-2 shall satisfy its performance requirements following one year of storage in a protected environment without repair or maintenance. A protected environment is defined as (1) the unit in an acceptable storage container if not installed on a spacecraft; or if the unit is installed on a spacecraft, the spacecraft storage room; (2) a protected indoor environment normally at a temperature of 70°F \pm 10°F and humidity less than 70% but subject to possible exposure for periods of less than five days per year to temperatures as low as 32°F and/or as high as 95°F and humidity as high as 95% in the event of heating/air conditioning failure. There shall be no scheduled maintenance or repair actions required during the storage cycle.

4.2 Test Responsibilities. Table V details the responsibilities for verification of specification compliance.

- (I) Inspection - Verifies conformance of physical characteristics related requirements without the aid of special laboratory equipment procedures and services.
- (A) Analysis - Verifies conformance to requirements. The verification is based on studies, calculations, and modelling.
- (T) Test - Verifies conformance to required performance/physical characteristics and design/construction features by instrumented functional operation and evaluation techniques.

TABLE V - Responsibilities for Verification of ICD Compliance

Paragraph/Parameter	N/A	Spacecraft Contractor			OLS Contractor			MS Contractor		
		I	A	T	I	A	T	I	A	T
3.1 Physical								X	X	
3.1.1 Mass Properties				X						X
3.1.1.1 Center of Mass									X	X
3.1.1.2 Moments of Inertia									X	
3.1.2 Mechanical Interfaces		X						X		
3.1.2.1 Fields of View, Glare/Glint			X						X	
3.1.2.2 Uncompensated Momentum									X	
3.1.3 Alignment				X						X
3.1.4 Materials		X						X		
3.1.4.1 Magnetic Characteristics									X	X
3.1.5 Deployment Characteristics	X									
3.1.6 Structural or Thermal Modelling									X	
3.1.7 Actuator Location	X									
3.2.1.1 SSM/T-2 to S/C IF Signals			X	X						
3.2.1.1.1 Current Ripple									X	X
3.2.1.1.2 Current Transients									X	X
3.2.1.1.3 Load Requirements									X	X
3.2.1.2 SSM/T-2 to OLS IF Signals							X			
3.2.1.2.1 ON/OFF Indicator				X			X			X
3.2.1.3 OLS to SSM/T-2 IF Signals							X			
3.2.1.4 Grounding Requirements				X			X			X

TABLE V (cont'd) - Responsibilities for Verification of ICD Compliance

Paragraph/Parameter	N/A	Spacecraft Contractor			OLS Contractor			MS Contractor		
		I	A	T	I	A	T	I	A	T
3.2.1.4.1 Signal Ground-OLS to SSM/T-2				X			X			
3.2.1.4.2 +28 Volt Power Return				X						
3.2.1.4.3 +5 Volt Power Return				X						
3.2.1.4.4 Signal Grounds				X						
3.2.1.4.5 Shield Grounds										X
3.2.1.5.1 Sensor to Sensor Harness	X									
3.2.1.5.2 Sensor to OLS Harness	X									
3.2.1.5.3 AVE Harness		X								
3.2.1.5.4 Test Harness	X									
3.2.2 Actuator Signals	X									
3.2.3 Equipment Status Telemetry (EST)				X						X
3.2.4 Fusing		X						X		
3.2.5 Interface Signals								X		
3.2.6 Electromagnetic Compatibility				X						X
3.3.1 General Environmental			X							
3.3.2.1 Temperature Requirements			X	X						
3.3.2.2 Thermal Control Devices								X		
3.3.2.3 Thermal Gradients			X	X						

TABLE V (cont'd) - Responsibilities for Verification of ICD Compliance

Paragraph/Parameter	N/A	Spacecraft Contractor			OLS Contractor			MS Contractor		
		I	A	T	I	A	T	I	A	T
3.3.2.4 Nodal Models	X									
3.3.2.5 Thermal Finishes	X									
3.3.3 Contamination	X									

5.0 NOTES

5.1 Definitions and Abbreviations. For the purpose of the Spacecraft to Sensors interface documentation, the following definitions and/or abbreviations shall apply. Other abbreviations are defined within the documents.

AGE	- Aerospace Ground Equipment
AF	- Air Force
BP	- Beam Position
BPS	- Bits Per Second
CC	- Cold Calibration
CG	- Center of Gravity
CMOS	- Complimentary Metal Oxide Semiconductor
CRS	- Command Readout Station
DB	- Decibels
DC	- Direct Current
DMSF	- Defense Meteorological Satellite Program
EMC	- Electromagnetic Compatibility
EMI	- Electromagnetic Interference
EST	- Equipment Status Telemetry
FOV	- Field-of-View
GFE	- Government Furnished Equipment
HZ	- Hertz (cycles per second)
ICD	- Interface Control Document
IS	- Interface Specification
KB	- Kilobits
MHZ	- Megahertz

MS - Mission Sensor
 MV - Millivolt
 NRZ-L - Non-Return-to-Zero-Level
 OLS - Operational Linescan System
 PF - Picofarad
 PLBK - Playback
 PMO - Program Management Office (YD)
 RTD - Real-Time Data Mode - the direct data mode
 SAGC - Stepped Automatic Gain Control
 SPO - System Program Office
 SS - Space Segment
 SSI - Space Segment Integrator
 SSS - Sensor Scanning Subsystem (OLS)
 STE - Special Test Equipment (OLS)
 TBD - To be determined
 TBS - To be supplied
 TCTR - Time Commutated Telemetry Readout
 TTL - Transistor-Transistor Logic
 USAF - United States Air Force

WC - Warm Calibration
 5D - Block 5D DMSP Satellite
 X,Y,Z - Reference axes of geodetic local vertical
 X_p, Y_p, Z_p - Primary alignment reference axes - also alignment coordinate axes of SSS
 X_r, Y_r, Z_r - Secondary references axes - also Mission Sensor alignment coordinate axes
 X_m, Y_m, Z_m - Mounting or mechanical axes

APPENDIX A

SSM/T-2 DATA FRAME

The SSM/T-2 data frame is 32 seconds in length and consists of 864, 12 bit words. Four 8 second subframes (scans of data) are contained in the data frame. Data is output to the OLS one block at a time, with each block containing 27, 12 bit words (324 contiguous bits). The output block rate is one block per second. Contents of the data frame is presented in Table 1 and subsequent bit and structure definitions.

A "filler block" of all ones will occur once every 17.0765 minutes (1024.59 seconds), due to the 9.99024 KHz reference clock and one second data request enable.

TABLE A1 SSM/T-2 DATA FRAME

<u>Word No.</u>	<u>Parameter</u>	<u>Word No.</u>	<u>Parameter</u>
1	Data Ident 1 (Begin Scan 1)	37	BP 7 Ch 4
2	Time Start Scan 1	38	BP 7 Ch 5
3	BP 1 Ch 1	39	BP 8 Ch 1
4	BP 1 Ch 2	40	BP 8 Ch 2
5	BP 1 Ch 3	41	BP 8 Ch 3
6	BP 1 Ch 4	42	BP 8 Ch 4
7	BP 1 Ch 5	43	BP 8 Ch 5
8	BP 2 Ch 1	44	BP 9 Ch 1
9	BP 2 Ch 2	45	BP 9 Ch 2
10	BP 2 Ch 3	46	BP 9 Ch 3
11	BP 2 Ch 4	47	BP 9 Ch 4
12	BP 2 Ch 5	48	BP 9 Ch 5
13	BP 3 Ch 1	49	BP 10 Ch 1
14	BP 3 Ch 2	50	BP 10 Ch 2
15	BP 3 Ch 3	51	BP 10 Ch 3
16	BP 3 Ch 4	52	BP 10 Ch 4
17	BP 3 Ch 5	53	BP 10 Ch 5
18	BP 4 Ch 1	54	BP 11 Ch 1
19	BP 4 Ch 2	55	Data Ident 3
20	BP 4 Ch 3	56	BP 11 Ch 2
21	BP 4 Ch 4	57	BP 11 Ch 3
22	BP 4 Ch 5	58	BP 11 Ch 4
23	BP 5 Ch 1	59	BP 11 Ch 5
24	BP 5 Ch 2	60	BP 12 Ch 1
25	BP 5 Ch 3	61	BP 12 Ch 2
26	BP 5 Ch 4	62	BP 12 Ch 3
27	BP 5 Ch 5	63	BP 12 Ch 4
28	Data Ident 2	64	BP 12 Ch 5
29	BP 6 Ch 1	65	BP 13 Ch 1
30	BP 6 Ch 2	66	BP 13 Ch 2
31	BP 6 Ch 3	67	BP 13 Ch 3
32	BP 6 Ch 4	68	BP 13 Ch 4
33	BP 6 Ch 5	69	BP 13 Ch 5
34	BP 7 Ch 1	70	BP 14 Ch 1
35	BP 7 Ch 2	71	BP 14 Ch 2
36	BP 7 Ch 3	72	BP 14 Ch 3

TABLE A1 (CON'T) SSM/T-2 DATA FRAME

Word No.	Parameter	Word No.	Parameter
73	BP 14 Ch 4	109	Data Ident 5
74	BP 14 Ch 5	110	BP 21 Ch 4
75	BP 15 Ch 1	111	BP 21 Ch 5
76	BP 15 Ch 2	112	BP 22 Ch 1
77	BP 15 Ch 3	113	BP 22 Ch 2
78	BP 15 Ch 4	114	BP 22 Ch 3
79	BP 15 Ch 5	115	BP 22 Ch 4
80	BP 16 Ch 1	116	BP 22 Ch 5
81	BP 16 Ch 2	117	BP 23 Ch 1
82	Data Ident 4	118	BP 23 Ch 2
83	BP 16 Ch 3	119	BP 23 Ch 3
84	BP 16 Ch 4	120	BP 23 Ch 4
85	BP 16 Ch 5	121	BP 23 Ch 5
86	BP 17 Ch 1	122	BP 24 Ch 1
87	BP 17 Ch 2	123	BP 24 Ch 2
88	BP 17 Ch 3	124	BP 24 Ch 3
89	BP 17 Ch 4	125	BP 24 Ch 4
90	BP 17 Ch 5	126	BP 24 Ch 5
91	BP 18 Ch 1	127	BP 25 Ch 1
92	BP 18 Ch 2	128	BP 25 Ch 2
93	BP 18 Ch 3	129	BP 25 Ch 3
94	BP 18 Ch 4	130	BP 25 Ch 4
95	BP 18 Ch 5	131	BP 25 Ch 5
96	BP 19 Ch 1	132	BP 26 Ch 1
97	BP 19 Ch 2	133	BP 26 Ch 2
98	BP 19 Ch 3	134	BP 26 Ch 3
99	BP 19 Ch 4	135	BP 26 Ch 4
100	BP 19 Ch 5	136	Data Ident 6
101	BP 20 Ch 1	137	BP 26 Ch 5
102	BP 20 Ch 2	138	BP 27 Ch 1
103	BP 20 Ch 3	139	BP 27 Ch 2
104	BP 20 Ch 4	140	BP 27 Ch 3
105	BP 20 Ch 5	141	BP 27 Ch 4
106	BP 21 Ch 1	142	BP 27 Ch 5
107	BP 21 Ch 2	143	BP 28 Ch 1
108	BP 21 Ch 3	144	BP 28 Ch 2

TABLE A1 (CON'T) SSM/T-2 DATA FRAME

Word No.	Parameter	Word No.	Parameter
145	BP 28 Ch 3	181	WC 4 Ch 3
146	BP 28 Ch 4	182	WC 4 Ch 4
147	BP 28 Ch 5	183	WC 4 Ch 5
148	SAGC Ch 1	184	Temp 7
149	SAGC Ch 2	185	Temp 8
150	SAGC Ch 3	186	Temp 9
151	SAGC Ch 4	187	Temp 10
152	SAGC Ch 5	188	Temp 11
153	Spare	189	Temp 12
154	Spare	190	Data Ident 8
155	Spare	191	CC 1 Ch 1
156	Therm Ref	192	CC 1 Ch 2
157	Temp 1	193	CC 1 Ch 3
158	Temp 2	194	CC 1 Ch 4
159	Temp 3	195	CC 1 Ch 5
160	Temp 4	196	CC 2 Ch 1
161	Temp 5	197	CC 2 Ch 2
162	Temp 6	198	CC 2 Ch 3
163	Data Ident 7	199	CC 2 Ch 4
164	WC 1 Ch 1	200	CC 2 Ch 5
165	WC 1 Ch 2	201	CC 3 Ch 1
166	WC 1 Ch 3	202	CC 3 Ch 2
167	WC 1 Ch 4	203	CC 3 Ch 3
168	WC 1 Ch 5	204	CC 3 Ch 4
169	WC 2 Ch 1	205	CC 3 Ch 5
170	WC 2 Ch 2	206	CC 4 Ch 1
171	WC 2 Ch 3	207	CC 4 Ch 2
172	WC 2 Ch 4	208	CC 4 Ch 3
173	WC 2 Ch 5	209	CC 4 Ch 4
174	WC 3 Ch 1	210	CC 4 Ch 5
175	WC 3 Ch 2	211	Temp 13
176	WC 3 Ch 3	212	Temp 14
177	WC 3 Ch 4	213	Temp 15
178	WC 3 Ch 5	214	Temp 16
179	WC 4 Ch 1	215	Temp 17
180	WC 4 Ch 2	216	Temp 18

(End Scan 1, 8 Sec)

TABLE A1 (CON'T) SSM/T-2 DATA FRAME

<u>Word No.</u>	<u>Parameter</u>	<u>Word No.</u>	<u>Parameter</u>
217	Data Ident 9	<u>378</u>	Temp 6
218	Time Start Scan 2	379	Data Ident 15
219	BP 1 Ch 1	380	WC 1 - Ch 1
.	.	.	.
.	.	.	.
.	.	.	.
<u>243</u>	BP 5 Ch 5	<u>405</u>	Temp 12
244	Data Ident 10	406	Data Ident 16
245	BP 6 Ch 1	407	CC 1 Ch 1
.	.	.	.
.	.	.	.
.	.	432	Temp 18
<u>270</u>	BP 11 Ch 1	(End Scan 2,	16 Sec)
271	Data Ident 11	433	Data Ident 17
272	BP 11 Ch 2	434	Time Start Scan 3
.	.	435	BP 1 Ch 1
.	.	.	.
.	.	.	.
297	BP 16 Ch 2	.	.
298	Data Ident 12	459	BP 5 Ch 5
299	BP 16 Ch 3	460	Data Ident 18
.	.	461	BP 6 Ch 1
.	.	.	.
.	.	.	.
<u>324</u>	BP 21 Ch 3	.	.
325	Data Ident 13	<u>486</u>	BP 11 Ch 1
326	BP 21 Ch 4	487	Data Ident 19
.	.	488	BP 11 Ch 2
.	.	.	.
.	.	.	.
<u>351</u>	BP 26 Ch 4	.	.
352	Data Ident 14	.	.
353	BP 26 Ch 5	<u>513</u>	BP 16 Ch 2
		514	Data Ident 20
		515	BP 16 Ch 3

TABLE A1 (CON'T) SSM/T-2 DATA FRAME

Word No.	Parameter	Word No.	Parameter
540	BP 21 Ch 3	675	BP 5 Ch 5
541	Data Ident 21	676	Data Ident 26
542	BP 21 Ch 4	677	BP 6 Ch 1
.	.	.	.
.	.	.	.
567	BP 26 Ch 4	702	BP 11 Ch 1
568	Data Ident 22	703	Data Ident 27
569	BP 26 Ch 5	704	BP 11 Ch 2
.	.	.	.
.	.	.	.
594	Temp 6	729	BP 16 Ch 2
595	Data Ident 23	730	Data Ident 28
596	WC Ch 1	731	BP 16 Ch 3
.	.	.	.
.	.	.	.
621	Temp 12	756	BP 21 Ch 3
622	Data Ident 24	757	Data Ident 29
623	CC 1 Ch 1	758	BP 21 Ch 4
.	.	.	.
.	.	.	.
648	Temp 18 (End Scan 3, 24 Sec)	783	BP 26 Ch
649	Data Ident 25	784	Data Ident 30
650	Time Start Scan 4	785	BP 26 Ch 5
651	BP 1 Ch 1	.	.
		.	.
		810	Temp 6
		811	Data Ident 31
		812	WC 1 Ch 1

TABLE A1 (CON'T) SSM/T-2 DATA FRAME

<u>Word No.</u>	<u>Parameter</u>
837	Temp 12
838	Data Ident 32
839	CC 1 Ch 1
.	.
.	.
.	.
864	Temp 18
(Ends Scan 4 32 Sec)	

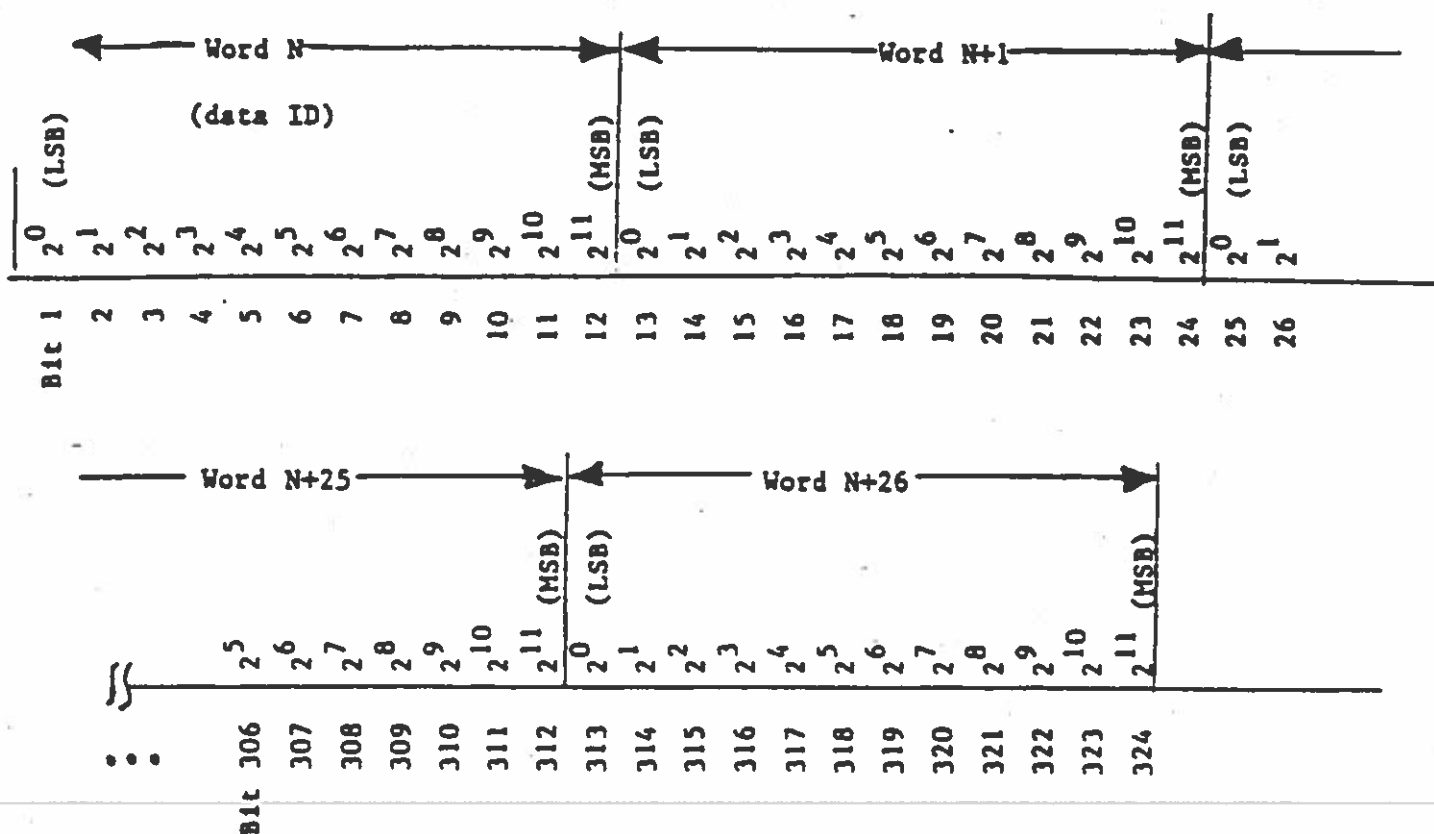
End Data Frame

Average Bit Rate = 324 bps

SSM/T-2 DATA FRAME

Word 1, data identification 1; all zeros. The only word in the data frame which is all zeros.

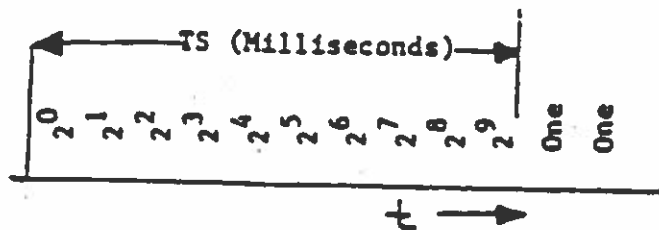
A data identification word heads each group of 27 words read out. One group of 27 words (324 bits) is read out each second in the following format:



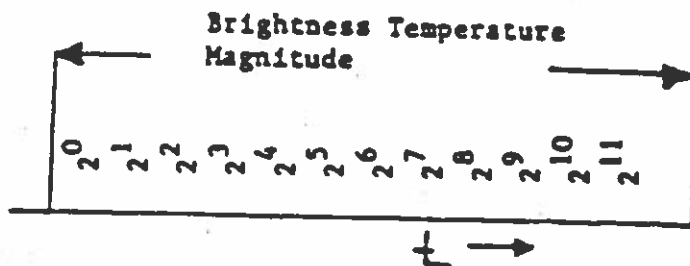
Output bit rate is 9990.244 ± 1 bits/second; at levels and in a format compatible with IS2617400.

Data (magnitude) of identification words 2 through 32 is, 1 through 31, respectively.

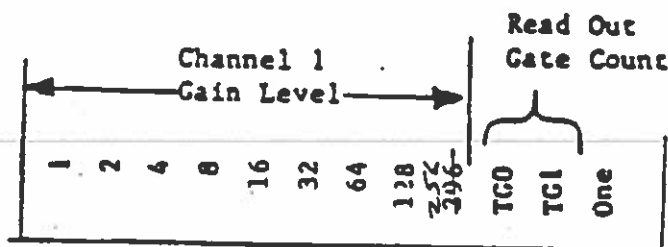
Word 2, time start scan 1; number of milliseconds between beginning of data integration 1 (beam position 1) and the following OLS read out enable (TS).



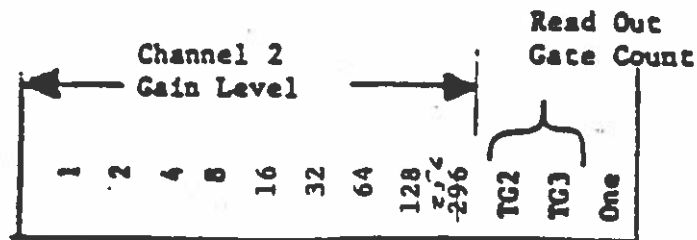
All "BP J, CH K" words are 12 bit A/D converter outputs, magnitude proportional to antenna brightness temperature of beam position "J", frequency channel "K".



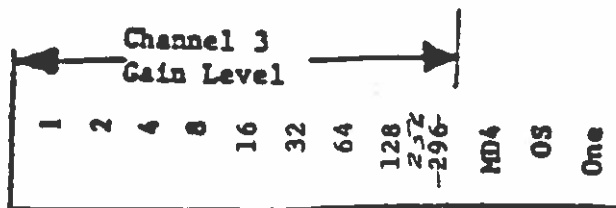
Word 148, SAGC CH 1; gain level of frequency channel 1 (~~0.1dB resolution~~) in addition to the two LSBs of the number of read out enables between data integration 1 (beam position 1) and the read out enable which contains this (time start scan) block of data (TG).



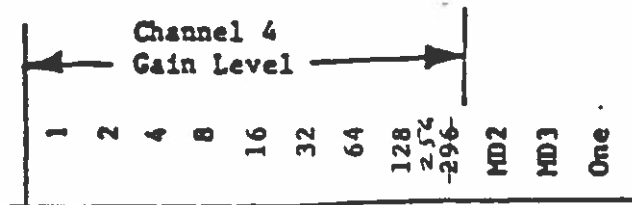
Word 149, SAGC CH 2, same as work 148 with channel 2 gain level and MSBs of read out gate count.



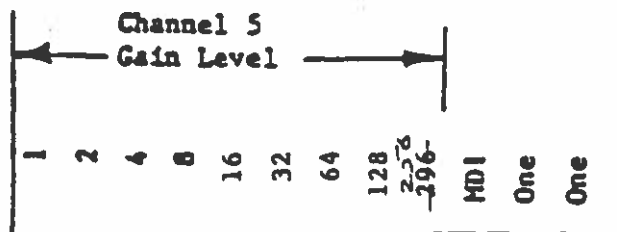
Word 150, SAGC CH 3, same as above with channel 3 gain level, and most significant mode bit (MD4), and "out of sync" flag bit (OS).



Word 151, SAGC CH 4, gain level of frequency channel 4 in addition to 2 mode bits.



Word 152, SAGC CH 5, same as above for channel 5 with one mode bit.



Word 153, 154, 155, spares; all ones.

Word 156, therm ref.; A/D converter output, magnitude proportional to thermistor conditioning bridge reference voltage.

All temp "N" are 12 bit A/D converter outputs, magnitude proportional to instrument temperature at location "N".

All WC "K", are 12 bit A/D converter outputs, magnitude proportional to radiometric temperature of warm calibration load of frequency channel "K".

All CC "K" are 12 bit A/D converter outputs, magnitude proportional to radiometric temperature of cold calibration observations of frequency channel "K".

The three remaining subframes (8 second scans) are identical in format to the first subframe.

BIT DEFINITIONS

OS "out of sync flag"; "1" (high level) indicates physically the reflector is not in synchronization with the reflector scan drive (timing).

TG0, TG1, TG2, TG3; number of OLS readout enables between data integration, beam position #1, and the OLS readout enable which contains this data (beam position #1).

	0	1	2	3	4	5	6	7	8	9	No. OLS Enables
TG3	0	0	0	0	0	0	0	0	1	1	Level
TG2	0	0	0	0	1	1	1	1	0	0	
TG1	0	0	1	1	0	0	1	1	0	0	
TG0	0	1	0	1	0	1	0	1	0	1	

MD1, MD2, MD3, MD4; Command mode bits.

MD1; Select program memory
"1", Program memory (A)
"0", Redundant program memory (B)
Bit 8 (LSB) of serial command word

MD2; Select data memory
"1", Data memory (A)
"0", Redundant data memory (B)
Bit 7 of serial command word

MD3; Select ^{91.5}~~91.5~~ GHz Gunn diode oscillator
"1", ^{91.5}~~91.5~~ GHz oscillator (A)
"0", Redundant 91.5 GHz oscillator (B)
Bit 6 of serial command word

MD4; Select scan index detector circuit
"1", Scan index detection circuit (A)
"0", Redundant scan index detection circuit (B)
Bit 5 of serial command word