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DESIGN CONTROL SPECIFICATION

FOR

DOUBLE IMPROVED STELLAR-INDEX
CAMERA (DISIC) SUBSYSTEM

APPROVED:

____________________ DATE__________
CONTRACTOR REPRESENTATIVE

____________________ DATE__________
CONTRACTOR REPRESENTATIVE

____________________ DATE__________
CUSTOMER REPRESENTATIVE

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Revision E Summary

Page	Paragraph	Description
1	2.[illegible]	Changed [redacted] to new number T3-6-002
5	3.2.1.2	Changed "Field of view shall be 23 1/2°" to "Full field of view angle shall be 23 1/2°."
6	3.2.1.3	Removed "exposed".
8	3.2.1.6	Changed 1/400 to 1/500
11	3.2.1.[illegible].1	Last sentence changed "binary bit" to "binary array" and "end of operation" to "beginning of operation".
12	3.2.1.9	Last paragraph changed "12 to 24 volts DC" to "12 ± 3 volts DC".
18	3.3.4.2	Changed 100 pounds to 104 pounds.

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1. SCOPE

1.1 DOCUMENT SCOPE

This document covers the general requirements for the design of a frame camera which will provide terrain reference and celestial orientation information. Another requirement will be to furnish information for mapping purposes.

2.0 APPLICABLE DOCUMENTS

The following documents shall form a part of this specification to the extent specified herein in subsequent paragraphs:

Specifications

MIL-E-5400	Electronic Equipment, Aircraft, General Specification for
LMSC-6117D	General Environmental Specification
LMSC-1412815-B	X-Ray Inspection of Semi-Conductors
LMSC-447969E	Electro Magnetic Interference Control Requirements
LMSC-0419A Amendment No. 1	Plastics for Application to Electrical and Electronic Components and Assemblies
MIL-F-9329	Filters, Light, Photographic Lens for Aerial and Ground Cameras, General Specification for
MIL-V-173	Varnish, Moisture and Fungus-Resistant
T3-6-002	General Environmental Specification

T3-4-505	General A/P Storage and Handling Specification dated 12 March 1965
T3-4-508A	DCS for Triple Parallel Output Clock Generator dated 19 May 1964
MIL-STD-150A	Photographic Lenses
JAN-F-675	Films, Reflection Reduction for Glass Optical Elements
MIL-C-4150	Case, Carrying and Storage, Shock and Waterproof
MIL-S-19500	Semi-Conductor Devices, General Specification for
MIL-R-5757	Relay, Electromagnetic, Hermetically Sealed, General Specification for
T3-5-021	J2-J3-DISIC Interface Specification

3.0 REQUIREMENTS

3.1 GENERAL DESIGN REQUIREMENTS

The DISIC Sub-System is a precision mapping camera consisting of 3 precisely oriented frame cameras. The optics of each frame camera and their relative orientation to each other are calibrated and fixed. One optical axis is oriented for terrain photography and two axes are oriented for stellar photography. Terrain and stellar photographs will be recorded on two separate film webs. The terrain exposure and one exposure of every pair of simultaneous stellar exposures shall have a time word recorded on the film.

3.1.1 Components of the DISIC Sub-System

In order to satisfy the system constraints on space available for the camera components, the Camera Sub-System will be composed of components according to Items 1 through 6 shown below:

Item No.	Description	Quantity	See Detail Rqmt.
1	Camera Body	1	3.2.1
2	Supply Cassette (incl. film)	1	3.2.2
3	Film Exit Housing	1	3.2.3
4	Film Chutes	2	3.2.4
5	Takeup Cassettes	2	3.2.5
6	Stellar Baffles	2	3.2.6

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3.1.2 Vehicle Interfaces

The camera contractor shall conduct technical liaison with Lockheed Missiles & Space Company in establishing the mechanical, optical and electrical compatibility of their respective systems. The camera arrangement and mounting shall be established by N.Y. and LMSC. The takeup cassette design shall be properly coordinated by the two contractors for compatibility with the recovery sub-system. Electrical power and signal requirements shall be established by mutual agreement and consultation, with the maximum limit for power requirements (excluding TM Power) set at 1600 watt hours for consumption of 2000 feet of terrain film and 2000 feet of stellar film. LMSC drawing T26-100 shall be used to establish the camera arrangement and mounting.

3.2 DETAILED CAMERA DESIGN REQUIREMENTS

3.2.1 Camera Body

The camera body shall contain the terrain and stellar frame cameras positioned so that the terrain camera is oriented vertically downward in the vehicle's orbital plane and each stellar camera is at an elevation angle of 100°. The body shall house the camera drive motor, lens shutters, film rollers and film handling mechanisms. The body housing shall be a non-structural sheet metal box and will be light-tight except

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for the lens and film exit ports. The body shall mount to the vehicle contractor's structural support which will properly orient it with respect to the vehicle and to the other camera subsystem components.

3.2.1.1 Terrain Lens

The terrain camera lens shall consist of a 3-inch focal length f/4.5 lens and focal plane corrector plate designed as an integral part of the optical system. The plane surface of the corrector plate shall contain the best plane of focus of this lens. This plane shall be used for film registration. The equivalent focal length shall be 76.2mm ± 1.5mm. The lens shall provide coverage over a 4-1/2 inch square format. Field of view shall be 74°.

3.2.1.1.1 Terrain Cone Distortion and Resolution

The radial lens distortion measured as installed in the lens cone assembly shall not exceed .030mm. The maximum tangential distortion within the format shall not exceed 0.005mm.

The contractor shall endeavor to optimize the design of the photographic system to maximize resolution for objects having a 2:1 target contrast. The design requirement is that the terrain camera shall have a minimum acceptable static resolution on Type 4400 film of 60 lines per millimeter AWAR when tested with resolution test targets of contrast 2:1. Testing shall be in accord with the provisions of MIL-STD-150A except that targets will be proportioned to decrease in size by increments of the twelfth root of two. 2:1 target contrast at the target is defined to be the range from 1.78:1 to 2.24:1.

3.2.1.1.2 Filter

The terrain lens shall be provided with a filter which shall have equivalent transmission to a Wratten 12. This filter shall be plane parallel to within 5 seconds of arc and shall conform to the material requirements of Class III of Specification MIL-F-9329. As an option, the filter may be incorporated as an integral part of the lens in order to save weight and space.

3.2.1.2 Stellar Lens

Each Stellar lens shall consist of a 3-inch focal length f/2.8 lens and a focal plane plate. The focal plane shall be defined by the glass plate and shall be used for film registration. Equivalent focal length shall be 76.2mm ± 1.5mm. Full field of view angle shall be 23 1/2°.

3.2.1.2.1 Lens Performance

The radial and tangential lens distortion as installed in the cone assembly shall not exceed .015mm and .005mm respectively.

The lens shall have a minimum acceptable static resolution of 80 lines/mm AWAR when tested with standard high contrast USAF test targets as specified in MIL-STD-150A, on film type 4400; only three targets shall be used to establish the AWAR.

Transmission of the lens will be such as to record 5.5 magnitude stars throughout the format in flight, using a 1½ second exposure on Type 4400 film with processing being equivalent to full level processing used for flight film.

3.2.1.3 Reseau

Both terrain and stellar glass focal plane plates shall contain a reseau in the format areas. The reseau shall consist of series of grid lines spaced 2.5mm apart and a line thickness of .005mm to 0.010mm. The reseau pattern will create a series of lines on the terrain format by virtue of natural illumination, and on the stellar format by artificial illumination introduced into the stellar cone. The reseau arrangement relative to the format shall be defined by figure 2A in the camera contractor specification. Stellar reseau background fogging exposure shall provide a delta density of 0.3 ± 0.1 with a full processing to a gamma of 2.

3.2.1.3.1 Format Frame

The focal plane plates will contain the frame mask for defining the format of the stellar and terrain cameras respectively. Indication of flight direction and center of frame shall be included.

3.2.1.3.2 Special Terrain Reseau Illumination

A means for artificially illuminating the terrain reseau will be provided. This capability will be used when natural light is not available for exposing the reseau, such as during calibration tests. Any special electrical components required for producing this illumination will be provided as part of the AGE checkout equipment.

3.2.1.4 Optical Calibration

Optical calibration measurements shall be accomplished by the camera contractor.

3.2.1.5 Camera Controls and Cycling Rates

The camera shall be designed to operate as an auto-cycle device. The unit shall be turned on and off by an external command to be supplied by the vehicle. Vehicle commands shall also select the camera mode. In the event of direct sun rays on either of the stellar lens, a light sensing device shall cap the shutter of the lens. A parallel capping command control will be furnished by the vehicle [illegible] an Off command is given, the camera shall automatically complete the metering cycle to preclude double exposure of the last format exposure.

3.2.1.5.1 Cycling Period

The system shall be designed for a nominal cycling period of 1 cycle every 9.375 seconds ± 2% for the terrain camera. This period is consistent with 65% overlap at an orbital altitude of 80 nautical miles. The stellar cameras shall have a cycling period of 1 cycle every 3.125 seconds ± 2%. Consideration of other periods shall be included in the design as stated in paragraph 3.2.1.5.3.

3.2.1.5.2 Stellar Cycling Period Change

The stellar cycle period shall be capable of changing in flight from a cycling period of 1 cycle every 3.125 seconds to the same cycling period of the terrain camera. (9.375 sec. or 12.5 sec.). This change shall be initiated from a vehicle command.

3.2.1.5.3 Terrain Cycle Period Change

The terrain camera shall be capable of operating at one preset cycling period during flight. This period will be determined prior to flight and shall be 9.375 or 12.5 seconds per cycle. One of these two available periods shall be selected prior to flight.

Other altitudes above 110 nm may be proposed for future missions. Therefore as a design objective, terrain cycle periods of 15.6 sec/cycle and above shall be considered in order to obtain these cycle periods with gear changes and no camera redesign.

3.2.1.6 Shutters

Each lens cone shall contain a between-the-lens rotary shutter. The effective exposures of the terrain shutter shall be 1/250 and 1/500 second and the stellar shutters shall be 1.5 seconds. Stellar exposures shall be fixed and shall be held to ± 10%. Terrain exposure shall be selectable by tape command or pre-flight manual adjustment and shall be held to ± 10%. Shutter efficiency shall be greater than 50%. In the event of exposure control failure, the shutter shall assume the 1/500 position.

3.2.1.6.1 Synchronization

The mid-point of exposure of the terrain and either of the stellar shutters shall be within 0.005 second of each other. The N[illegible] test equipment shall be capable of checking synchronization.

3.2.1.6.2 Manual Operation

The shutter mechanism shall allow for the operation of the camera with all shutters in a fully open position for purposes of calibration and resolution tests.

3.2.1.6.3 Shutter Capping

Means shall be provided to adequately cap the shutters or prevent the camera from stopping with the shutters in an open position to prevent film fogging. This provision or design feature shall preclude the shutter from assuming any open position by virtue of normal camera shut down or due to an operating power interruption or failure. For automatic or command capping controls, see paragraph 3.2.1.5.

3.2.1.6.4 Stellar Calibration Operation

The design of the shutter mechanism shall allow for their use in stellar calibration of the camera. Auxiliary means shall be employed in obtaining the long stellar and terrain exposures required for these tests. This shall, however, not require mechanical disassembly of the camera mechanism.

3.2.1.6.5 Dynamic Shutter Operation (Terrain Lens)

The design objective for the operation of the shutter or any other dynamic components of the camera shall be that the dynamic test resolution be no less than 93.3% of static test resolution. The design requirement is that dynamic test resolution under the conditions as stated in paragraph 3.2.1.1.1 shall not be less than 56 l/mm AWAR (at 2:1 contrast.)

Test Method:

The dynamic test will be performed with a bank of 5 collimators distributed in the terrain format. Initial static tests will be performed to establish the base line for the dynamic resolution test on a lens accepted in accordance with paragraph 3.2.1.1.1. The dynamic tests will be performed using the same 5 collimators and a figure of merit will be established in order to determine an allowable degradation of 6.7% of the static base line. All dynamic testing shall be at high contrast including the static base line for determining the 6.7% degradation due to camera dynamics.

3.2.1.6.6 Dynamic Shutter Operation (Stellar Lens)

The dynamic stellar camera performance shall be tested in a similar manner to that described in 3.2.1.6.5 and an allowable loss of resolution of 11% from static to dynamic operation shall be allowed.

3.2.1.7 Film

The camera system shall be designed to utilize 2.5 mil Estar base film of type 4400 (3400) emulsion. Alternate film for the terrain is 4404 (3404) and for the stellar 4401 (3401). The terrain camera will use 5-inch wide film and the stellar cameras will use 35mm wide film. The stellar cameras shall utilize the same web of film for simultaneous exposures on both stellar cameras. A design objective shall be to use 1.5 mil base polyester film (2.0 mil with emulsion).

3.2.1.7.1 Film Handling, Tracking and Markings

The camera system shall be designed to prevent detrimental scratches of film base or emulsion, crushing of film edges and harmful electrostatic discharge marks. Tracking or side to side wander shall be held to a maximum of 1/32 inch measured between the format and the film edge.

In any acceptance test 90% of the formats from any camera may have marks whose density is less than 0.1 above the base plus processing fog level, and no format shall have marks whose density exceeds 0.4 above base plus processing fog density; processing of test film shall be consistent with the practices used in processing flight film.

3.2.1.7.2 Film Flattening

Film will be held flat in the focal plane by providing means to hold the film in intimate contact with the glass focal plane plates. The pressure required for this film flattening means will be held to a minimum consistent with good design practice in order to minimize focal plane plate distortion.

3.2.1.8 Data Recording

The camera serial number shall be recorded near each terrain photograph and near each stellar photo. Each pair of simultaneous stellar/terrain frames shall record the time interval at the center of exposure, accurate to ± 0.001 second. The time interval shall also be recorded for each stellar pair which is taken independently. Each stellar frame shall indicate which stellar unit exposed the frame.

3.2.1.8.1 Binary Time Recording

The camera shall use solid state silicon light pulser arrays for time recording. The time recording array format shall be suitable for automated readout of time data, and shall be an array of 6 rows of 32 bits each at a spacing of 55 devices per inch. One row of 32 elements covering an area of 0.576" by 0.009" shall be used for the 29 bits of time information. The light pulser device shall operate compatibly with the Time Interval Recording System, and may be used for recording other information if required. Density shall be compatible with the data readout equipment. A binary array shall be used to indicate the beginning of operation.

3.2.1.8.2 Time Interval Recording System

The time generator to be used will be the Fairchild Triple Parallel Output Clock Generator as described in [redacted] The resolution of time recording shall be 0.001 second. The camera contractor shall be responsible for proper interfacing with this device. The scope of this specification does not cover the design requirements of this unit.

3.2.1.9 Telemetry

Proper operation of the camera system shall be indicated by the following instrumented functions ~~to be included~~ by the camera contractor.

1. Presence of film by film idler roller motion
2. Film transport
3. Camera cycling

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4. Film takeup footage (cassette only)

5. Temperature sensors

6. Drive motor voltage

7. Operate command

8. Mode selection command

9. Shutter operation (at least terrain shutter)

10. Stellar platen position (2)

11. Terrain platen position

12. Metering clutch command (2)

13. Capping shutter solenoid command (3 req.)

14. T.U. Cassette rotation (2 req.) (Test)

15. Terrain Shutter Speed Monitor (1/250 or 1/500 second)

When possible, output signals shall be combined so that a minimum number of telemetry points are required from the camera body. A minimum of 2 temperature sensors located in the camera body will be supplied.

Signal scaling will be done external to the camera, except that the shutter monitor shall be conditioned within the camera to provide a signal duration greater than 150 milliseconds, and an amplitude of 12 ± 3 volts DC. Design shall be coordinated with A/P for vehicle compatibility.

3.2.1.10 Cycle Counter

A counter indicating the number of camera cycles shall be incorporated and located externally on the camera body. This device will be readily removable by the use of simple tools just prior to flight. Operation of the counter shall not effect TM signals or camera operation.

3.2.2 Supply Cassette

The supply cassette shall contain the film supply required for the camera system. Size and weight shall be held to a minimum. The supply cassette shall mount on the structural support provided by the vehicle contractor which will properly orient it with respect to the other camera system components. A brake shall be provided to lock the spools during ascent and pre-launch testing. Initial operate command shall unlock the brake for the entire mission. Provision will be made to reset the mechanism for ground checkout and testing.

3.2.2.1 Film Capacity

The cassette shall provide means for mounting two film spools, of the camera contractor's design, containing 2,000 feet of 5-inch and 2,000 feet of 35mm 2.5 mil base film.

3.2.2.2 Film Loading

The supply cassette design will allow for ease of film spool loading and threading. The cassette will be darkroom loaded outside of its vehicle installation.

3.2.2.3 Construction

The supply cassette will be of light-weight construction. It will contain the film spool supports, film rollers and guides. The cassette housing will consist of a non-structural sheet metal box and will be light-tight except for the film exit port.

3.2.2.4 Operation

The supply cassette will provide means for keeping the film spools in a locked position during normal pre-launch handling and during the ascent phase of the system operation. This will prevent the film from unspooling and causing a film handling failure. During system operation the cassette design will allow for independent film motion of either the 5-inch or 35mm spools consistent with the camera cycling rates and shall provide film tension compatible with acceptable subsystem performance. The vehicle shall furnish a signal to [illegible] the brake prior to launch. Any camera operate signal shall deactivate the brake for the entire orbital mission.

3.2.3 Film Exit Housing

The Film Exit Housing will be designed to accept the film supplied by the camera body and redirect it towards the takeup cassettes. It will contain 5-inch and 35mm film rollers and adjustments will be designed and incorporated in order to facilitate proper film tracking.

The housing will be of a light-weight, non-structural sheet metal design and will be light-tight except for the film entrance and exit ports. Location of the exit port, vehicle chute mounting, and housing mounting will be coordinated with the integration contractor.

3.2.4 Film Chutes

The chutes form a light-tight path between the supply cassette, camera body and film exit housing. The 2 chutes shall be designed so that they can be installed after the 3 camera components have been mounted and threaded with film. They will be light-weight, readily removable and non-structural in design.

3.2.5 Takeup Cassettes

Each camera system shall contain 2 takeup cassettes. Each cassette shall be housed inside a vehicle recovery sub-system. The camera and integration contractors shall coordinate the design of this unit for compatibility with the recovery system constraints.

3.2.5.1 Construction

The takeup cassette will be of light-weight, open type construction. It shall consist of side plates suitably joined that will serve as a mounting structure for the takeup spools, film rollers, spool drives, etc. A light-tight construction will not be required. Mounting points to the recovery sub-system will be coordinated with the integration contractor.

3.2.5.2 Film Capacity

Each cassette shall contain a 5-inch film spool of 1,000 foot capacity and a 35mm spool of 1000 foot capacity.

3.2.5.3 Operation and Film Handling

The cassette will be capable of taking up both the 5-inch and 35mm films as supplied during the camera cycling periods. Film will be handled without formation of loops, excessive slack, film scratches, marking and/or wrinkling, and a continuous turn potentiometer shall be used to provide constant tension as spool diameter changes.

3.2.5.4 Anti-Backup Device

A spool anti-backup device will be incorporated on each cassette spool and will prevent the takeup spools from unwinding during normal operation. When energized by a 21 to 29 VDC power, the spool will have freedom of rotation for unspooling in order to retrieve the film. With application of reverse voltage to the takeup drive, the maximum tension required to retrieve the film shall be 2 pounds.

3.2.5.5 Rotation Monitor

The T.U. rotation monitor shall be a continuous turn linear potentiometer. Maximum resistance shall be 2000 ohms on the wiper and shall not be open more than 12 degrees when transferring from minimum to maximum resistance.

3.2.5.6 Film Footage Indicator

Each spool will contain a film indication transducer to indicate its accumulated film. The transducer shall have a variable resistance representing a zero to full film spool condition, and shall be compatible with the A/P TM system, and TM power supply. Resistance change shall be a continuous function and shall vary from 1850 to zero ohms. Zero ohms shall indicate a 10 percent (100 feet) overfull condition. Sensitivity from 75% full to 110% full shall be a minimum of 100 ohms change for each 100 feet of film.

3.2.6 Stellar Baffles

Baffles shall be provided to extend from the front lens mountings of both stellar cameras to the outer skin of the flight vehicle. These baffles shall preclude the entrance of extraneous light (reflected from any portion of the vehicle, camera, baffle, etc.) into the cameras, but shall not vignette any portion of the fields of these cameras. Mounting provisions will be coordinated with the integration contractor. The baffles shall be readily removable when the camera body is installed in the vehicle. The baffles shall be non-structural in design.

3.3 Mechanical, Electrical and Environmental Requirements

3.3.1 Workmanship

Each component, including all parts and accessories, shall be constructed and finished in a thorough and workmanlike manner. Particular attention will be given to neatness, cleanliness, toughness of soldering, wiring, impregnation of cores, marking of parts and assembling, welding, brazing, painting, riveting, machine screw assemblies, and the freedom of parts from burrs and sharp edges.

3.3.2 Materials

3.3.2.1 Metals

Metals shall be of the corrosion-resistant type or treated to resist corrosion caused by atmospheric conditions likely to be met in storage, testing or normal service. Wherever possible, dissimilar metals shall not be used in intimate contact with each other unless protected against electrolytic corrosion.

3.3.2.2 Fungus-Proof Materials

Materials that are not nutrients for fungus shall be used to the greatest extent practicable. Over-all spraying or brushing of the equipment with fungicide shall not be permitted. Fungistatic coating material, if used, shall be type I varnish in accordance with MIL-V-173.

3.3.3 Finishes

Unless otherwise specified, all interior surfaces of the camera system shall be finished to provide a durable surface. Finish shall be omitted on the wiring. All interior surfaces of the camera system which relate to optical performance, or housing of sensitized materials, shall be finished to provide a durable black matte, low reflecting surface, sufficiently dull to hold light reflection to a minimum. Special finishing requirements of exterior surfaces shall be determined during the design phase of the program and coordinated with the Contracting Officer.

3.3.4 Configuration and Weight

3.3.4.1 Size and Location

Size and location shall be coordinated with the Contracting Officer and the Integration Contractor. The takeup cassette shall be of minimum configuration consistent with the recovery system requirements.

3.3.4.2 Weight

The camera system weight, including the following items, shall not exceed 106 pounds:

Camera Body and Film Chutes

Supply Cassette (including film)

Film Exit Housing

Takeup Cassettes (2)

Baffles (2)

3.3.5 Electrical Components

Electrical and electronic components used shall meet the requirements of Specification MIL-E-5400, except as specified below. All electrical and electronic components shall be miniaturized to reduce system weight. The following Specifications for capacitors and resistors shall be adhered to when possible: MIL-R-55182, MIL-C-39003, MIL-C-39004, MIL-C-23269, MIL-C-39001.

3.3.5.1 Non-Standard Components

Where non-standard parts are used, every consideration shall be made to have them conform to the requirements of Specification MIL-E-5400.

3.3.5.2 Component Derating

Adequate component derating practices shall be adhered to per good engineering practice.

3.3.6 Circuit Closure

Circuits of prime importance which are imperative to the proper functioning of the camera, shall be activated by closing to the positive or "hot" sides of the circuit.

3.3.8.3 Bonding [redacted]

The camera subsystem shall conform to the bonding requirements of paragraphs 3.2.12.1 through 3.2.12.2.2 and paragraphs 3.2.12.2.4 through 3.2.12.5 of [redacted] to every extent possible.

3.3.9 Decoupling

All critical and sensitive circuits in the camera subsystem shall be R-C or L-C decoupled. High frequency capacitors shall be shunted across the large low frequency response decoupling capacitors.

3.3.10 Flow Coating Insulation

Uninsulated electrical wiring and terminals shall be insulated via flow coating per [redacted] Amendment 1.

3.3.11 X-Ray Inspection of Semiconductors

Silicon semiconductor devices shall be used wherever possible and shall be X-ray inspected per [redacted]

3.3.12 Temperature Environment

The camera subsystem must be capable of operating through a range of 40°F to 120°F for external ambient temperatures with a minimum of photographic degradation. Takeup cassettes shall be capable of operation down to 20°F. The camera subsystem shall operate from 50 to 90°F with no photographic [illegible]

3.3.13 Radiation Environment

No provision for radiation shielding is incorporated in the design requirements in the preceding paragraphs.

3.4 Aerospace Ground and Handling Equipment

Special ground checkout and handling equipment will be fabricated for the camera system in order to verify performance of the components during all phases of the program.

3.4.1 Checkout Console

A camera system checkout console will be designed and fabricated. This unit will be designed to exercise the camera system by providing simulated vehicle standby and operate commands. Provisions for connecting an elapsed time generator (not provided as part of the console) to the camera system shall be included. Monitoring points of camera functions shall be incorporated in addition to provisions for checking telemetry outputs. The console shall accept 110-120 volt, 60 cycle power, and include such conversion circuitry as is necessary to perform its anticipated functions. The camera contractor shall design, fabricate, and furnish the console to LMSC. Regulated and unregulated power shall be derived from separate power supplies. The checkout console design shall be coordinated with A/P to assure compatibility with test objectives.

3.4.2 Optical Stand

Three banks of collimators mounted in a stable fixture will be used for photographically checking the camera system resolution. The three banks of collimators shall be in line with the stellar terrain lenses respectively. The collimators will contain special reticles and light sources in order to record resolution targets on test film. Collimators shall be of at least twelve inch focal length and shall comply with MIL-STD-150A. The optical stand shall be capable of testing the camera system in subsystem tests at the camera contractor's facility, and shall be capable of testing both stellar lenses when the camera is installed in the recovery barrel.

3.4.3 Camera Test Stand

The camera test stand shall be designed to mount all components of the camera system in their proper relationship to each other. The takeup cassettes will be contained in a light-tight enclosure so that live film can be run through the camera system for photographic tests. Means will be provided for mounting a film cut and splice mechanism (G.F.E.). The stand will mount on swivel casters for ease of transport. The camera contractor shall design, fabricate, and furnish the stand to LMSC. Design shall be coordinated with A/P to assure compatibility with test objectives and vehicle hardware.

3.4.4 Optical Test Stand (Deliverable)

An optical test stand for resolution testing of the camera will be designed, fabricated, and shipped for installation at the integration facility. This unit will consist of a weldment containing 11 collimators. They will be located so that 5 collimators will be presented to the terrain field and 3 collimators will be presented to each stellar field. Angular location of these collimators will be similar to those of the optical stand of paragraph 3.4.2. The collimators will be of the same focal length as those of paragraph 3.4.2. The reticle targets will be similar to those used in paragraph 3.4.2 and the test stand will include its own light sources and lamp power supplies.

The optical test stand will be used for both sub-system and vehicle system tests. The design of the stand will be coordinated with the integration contractor for compatibility with vehicle system test procedures.

3.5 Space Mockup

A camera space mockup will be designed and fabricated to the final system configuration. The mockup will contain final camera mounting points, electrical connectors, access doors and covers. Such parts that require removal and/or access when the system is installed in the vehicle will be animated to check installation accessibility and clearance.

3.6 Shipping Containers

The camera system components shall be delivered in carrying cases which will conform wherever feasible to MIL-C-4150, each case to contain an impactograph shock measuring device.

3.7 Storage and Handling

Specification [redacted] shall apply to the camera system after shipment to the integration contractor's facility. The application of this Specification shall be modified by the following:

1. The camera contractor will determine the additional wrapping requirements of camera system components when shipped in containers described in paragraph 3.6
2. Integration Contractor Quality Assurance Inspection will not apply until after FSDS inspection and verification test have been performed.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract or purchase order, the camera contractor will be responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the camera contractor may utilize his own facilities or any commercial laboratory. The customer reserves the right to perform any of the inspections set forth in this Specification where such inspections are deemed necessary to assure hardware and services conform to prescribed requirements.

4.1.1 Results of Inspection and Test

The results of all inspections and tests required shall be recorded by the contractor. The orignal records shall be retained by the contractor and made available to the customer upon request. Certified copies of the records shall be distributed as directed by the Contracting Officer.

4.2 Visual Inspection Test

The components of the system shall be visually inspected to determine compliance with the requirements of the specification for which physical measurements or operational testing is not appropriate, such as: finish, workmanship, markings, etc.

4.3 Optical Performance and Calibration Tests

4.3.1 Camera Resolving Power Test

The terrain and stellar cameras shall be tested in order to determine the resolving performance requirements of paragraphs 3.2.1.1.1 and 3.2.1.2.1 and their dynamic performance as indicated in paragraph 3.2.1.6.5. Processing shall be for 8 minutes in D-19 at 68°F, resulting in a gamma of approximately 2.0

4.3.2 Cone Calibration Test

The terrain and stellar lens cones shall be calibrated in accordance with paragraph 3.2.1.4. The equivalent focal lengths shall be determined to 0.010 mm. The calibrated focal lengths shall be computed to 0.001 mm. The radial and tangential distortion of both lenses shall be determined by laboratory calibrating in accordance with methods described in MIL-STD-150A; the method to be used will be determined by the camera contractor. The principal point of auto-collimation of each lens shall be located relative to their respective reseau grids. The reseaux shall be measured and recorded.

4.3.3 Terrain-Stellar Coordinate Calibration Test

The angular relationship between the stellar and terrain lenses shall be measured and recorded. This angular relationship has been defined by [redacted] The three angles used to define this relationship are tilt, swing and azimuth. Simultaneous exposures of the three lenses shall be made using the optical stand, paragraph 3.4.2, as a reference. Ten consecutive frames shall be used for the calculated angular relationships of the three lenses. Considering the plane of the stellar cameras as fixed and using it as a reference, the plane of the terrain camera shall fall within the following limits for the three axes:

Tilt:	100° and 260° ± 5 minutes
Swing:	90° ± 20 minutes
Azimuth	90° ± 30 minutes

The measurements shall be conducted at room temperature and pressure.

4.3.3.1 Alternate Calibration Test Method

The camera contractor may during the course of the program investigate more precise techniques of coordinate calibration testing than described in this paragraph. The purpose of this investigation will be to improve the accuracy to which the camera calibration tests can be made. Any improvements will reduce the limits indicated in paragraph 4.3.3.2. The camera contractor will provide the necessary fixtures, their design fabrication, and test procedures, required by any new calibration techniques. This will also include modification or changes to any fixtures previously described.

4.3.3.2 Terrain-Stellar Coordinate Stability

The repeatability of terrain-stellar calibration tests shall be considered satisfied when the previously described angular relationships fall within the following limits:

Tilt ± 37 seconds of arc (3 sigma value)

Swing ± 85 seconds of arc (3 sigma value)

Azimuth ± 30 seconds of arc (3 sigma value)

These limits will be used in comparing coordinate calibration tests made on a camera system undergoing acceptance or qualification tests. The camera system will be considered stable and not affected by environments if the repeatability criterion is satisfied.

The intent of this test is to assure that the camera is stable and the optical axes are held to within ± 5 seconds of arc.

4.4 Camera Operation Tests

A camera system will be tested to determine compliance with the following design requirements.

4.4.1 Camera cycling periods as described in paragraph 3.2.1.5.

4.4.2 Camera shutter operation as described in paragraph 3.2.1.6.

4.4.3 Film handling and metering as described in paragraph 3.2.1.7.

4.4.4 Data recording as described in paragraph 3.2.1.8.

4.4.5 Telemetry outputs as described in paragraph 3.2.1.9.

4.5 <u>Acceptance Tests</u>

Each camera system shall be required to satisfy the tests and calibration of paragraphs 4.2 through 4.4. In addition, the following tests shall also be performed.

4.5.1 <u>Vibration</u>

The camera system shall be subjected to an acceptance level vibration in accordance with [redacted]

The components of the system may undergo this test individually or as a system.

4.5.2 <u>Altitude</u>

The camera system shall be subjected to an altitude environment of 820 mm of Hg to 2 x 10^{-5} mm of Hg for a period of not less than 24 hours. The system shall be operated until 1,000 feet of terrain film and 1,000 feet of stellar film has been expended. Corona discharge is to be tested in accordance with paragraph 3.2.1.7.1.

4.5.3 <u>Verification Tests</u>

The following tests shall be repeated before and after the vibration and altitude tests:

4.2 Visual Inspection Test
4.3.3.1 Terrain-Stellar Coordinate Stability
4.4 Camera Operation Tests

4.6 Qualification Test

One camera system shall be used to demonstrate design compatibility with a Qualification Test Program. The following environmental test shall be performed on the camera system.

4.6.1 Vibration Test

A vibration test in accordance with [redacted] shall be performed. Tests may be performed on each component of the system individually.

4.6.2 Acceleration Test

An acceleration test in accordance with [redacted] shall be performed. Tests may be performed on each component of the system individually. The recoverable components are not required to be operational after re-entry acceleration except that payload shall be retrievable without damage or structural refurbishment.

4.6.3 Altitude

An altitude test shall be performed on the camera system in accordance with paragraph 4.5.2 of this specification except that the duration time of the test shall be fourteen (14) days and termal ambient conditions shall be 40°F to

120°F. The time at 40° and 120°F shall be a minimum of 24 hours for each temperature. Take-up cassette operation shall be demonstrated (separately or in the system) at 20°F.

4.6.4 Shock Test

A shock test shall be in accordance with [redacted]. Tests may be performed on each component of the system individually. The recoverable components are not required to be operational after re-entry shock except that the payload shall be retrievable without damage or structural refurbishment.

4.6.5 Electro Magnetic Interference

The camera subcontractor shall perform an audiosusceptibility test on a qualification basis in order to determine the degree of susceptibility to sinusoidal power modulation in the audio frequency range. As a minimum standard the camera system shall meet the audiosusceptibility requirements of paragraph 4.3.4.1.2 of [redacted] except that the voltage amplitude shall be limited to 1.2 volts rms.

4.6.6 Verification Tests

The verification tests described in paragraph 4.5.3 of this specification shall be made in order to assess performance of the camera system after environmental tests have been performed. Terrain-Stellar coordinate stability will be tested by the stellar calibration method prior to and after tests described in paragraph 4.6.1 through 4.6.4. The results of the pre and post-environment angular relation determinations shall compare to within five seconds of arc (3 sigma) for the axes.

4.7 Rejection and Retest

When one or more components fails any of the specified tests, acceptance of the camera will be withheld until the extent and cause of failure is determined. If the corrective measures involve parts, assemblies or performance parameters already successfully tested, the applicable tests will be re-run.

4.8 Conditions of Environmental Tests

4.8.1 Non-Operating Tests

The following tests previously described will be non-operating type tests and require operation of the equipment only after the environmental conditions have been imposed.

4.5.1 Vibration

4.6.1 Vibration Test

4.6.2 Acceleration Test

4.6.4 Shock Test

4.8.2 Vibration Test Conditions

The vibration tests of paragraph 4.5.1 and 4.6.1 shall be performed by mounting the components to a vibration fixture simulating the final mounting points of each component.

5.0 DELIVERY

Delivery shall be in accordance with A/P and N.Y. schedules as coordinated with the Contracting Officer.

5.1 Acceptance

The camera will be accepted by the customer after satisfactory completion of a pre-integration test at the integration contractor's facility. Normal warranty and service shall apply at its destination after shipment.

REQUIREMENT SPEC
J3 P/L SYSTEM

TOP SECRET

TOP SECRET

TOP SECRET [redacted]

NO. [redacted]

19 April 1966

REQUIREMENT SPECIFICATION, "J3" PAYLOAD SYSTEM, CORONA J PROGRAM

Approved: [redacted] Date: 12-8-65

Approved: [redacted] Advanced Projects Date: 3-18-66

Approved: [redacted] Date:

Approved: [redacted] Electric Date: 3/

Approved; [redacted] Date: 3/
New York

Approved: [redacted] Date: 3/
Contracting Officer Representative

TOP SECRET [redacted]

NO.

TABLE OF CONTENTS

1.0 SCOPE

This specification defines the requirements for the "J3" Satellite Reconnaissance System, serial CR1-12.

1.1 General

The term "J3" System includes the Panoramic Camera, DISIC, Recovery, and Space Structure subsystems. The requirements for design, fabrication, test, preparation for delivery, design maintenance, and operations support of the J3 System are included in this document.

1.2 Comparison

The major changes included in the "J3" Program as compared to the J1 Program (Systems J21-J39) are as follows:

1. New Constant Rotating Panoramic Camera Assembly with three point mount, Panoramic Geometry, and Supply Cassette Assembly.
2. Two Stellar/Index Cameras replaced by one DISIC Subsystem.
3. Mark 5A Recovery subsystems modified to accommodate redesigned Panoramic take-up cassettes and DISIC take-up cassettes.
4. Increase in Instrument Barrel diameter from 50 to 60 inches and the associated structure changes.
5. Low Orbit Capability
6. Use of Automatic Checkout Equipment
7. Removal of the Requirement for Regulated DC Power Supply from the LMSC 39205 Vehicle.
8. Forward Flying System (SRV Forward)

9. Increased Operational Capability Resulting from Command and Control System Improvements.

2.0 APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form a part of this specification to the extent specified herein.

Specification	
T3-6-012	Acceptance Test Specification, Light Leakage
T3-5-043	Acceptance Test Specification, J3 System
T3-5-021	J-3 DISIC Interface Specification
T3-4-508	DCS, Triple Parallel Output Clock Generator F Type
T3-5-019	Electrical Interface Specification, "J3"
T3-6-002	General Environmental Specification
LMSC 6117	General Environmental Specification for Agena Satellite Program
T3-5-009	Design Control Specification, DISIC Subsystem
T3-5-007	Design Control Specification, Oribtal Sine Function Generator
	System Design Specification - SRV
LMSC 447969	EMI Control Agena System Electrical Interface
LMSC 1412815	Radiographic Inspection of Semiconductors
LMSC 1415131	Programmer, Type VIII
Itek DCS-397-1	DCS Panoramic Camera Subsystem
[redacted]	Process Specification; Film 4404

[redacted]	Process Specification Film 3404
	Process Specification Film 4400
LMSC 1417161	Model 39205 Vehicle, [redacted]
LMSC T3-4-505	Storage and Handling
Itek 65-020-03-D3	Itek Lens Design Specification
T25-701	Recovery Vehicle - Aft (J/ISIC) Reference
T25-702	Recovery Vehicle - Fwd (J/ISIC) Reference
T25-101	Clearance Area & Component Relocation J System Cassettes
T33-600	Payload to Agena Final Assembly
T33-103	System Inboard Profile
T33-600	Payload Assembly Complete
T33-100	"J3" Interface, Payload Complete
T33-101	"J3" Interface, Nose Cone, Sta. 0.0 to 86.0
T33-102	"J3" Interface, Nose Cone, Sta. 86.0, Aft
T3-5-023	Tracking, T/M, Commands, Power and Pyro Interface Spec.
198P358G (later)	Vehicle Assembly - Satellite Recovery
6761?G (Later)	Vehicle Assembly - Satellite Recovery
Itek 78550	Main Supply Spool
Itek 78549	Take-up B
Itek 78548	Take-up A
Itek 78900	Interface Take-up
Itek 78969	Constant Rotator Profile

Itek 78600	Format
Itek 78555G1	Main Instrument No. 1 (Aft looking)
Itek 78554G1	Main Instrument No. 2 (Fwd. looking)
Itek 78547	Intermediate Roller Assembly
N.Y. ( )	DISIC Subsystem
Itek 78552	Aux. Structure
QTS-397-1	Qualification Test Specification, J-3 Pan Cam Module
QTS-397-2	Qualification Test Specification, Take-up B.
QTS-397-3	Qualification Test Specification, Main Supply
QTS-397-4	Qualification Test Specification, Intermediate Roller
QTS-397-5	Qualification Test Specification, Petzval Lens
QTS-397-6.	Qualification Test Specification, Supply Spool
ATS-397-1	Acceptance Test Specification, J-3 Pan Cam Module
ATS-397-2	Acceptance Test Specification, Take-up A
ATS-397-3	Acceptance Test Specification, Take-up B
ATS-397-4	Acceptance Test Specification, Main Supply
ATS-397-5	Acceptance Test Specification, Petzval Lens
65-020-03-D3	Itek Lens Design (New Lens)
65-003-03-A1-M1	Itek Lens Design (Old Lens)

Military Documents

MIL-E-1D	Electron Tubes and Crystal Rectifiers .
MIL-STD-150A	Photographic Lenses
TO-0025-203	Standard Functional Criteria for the Design and Operation of Clean Rooms
MIL-S-19500	Semi-Conductor Devices, General Specification for
MIL-R-5757	Relay, Electromagnetic, Hermetically Sealed General Specification for
MIL-R-55182	Resistors, Fixed Film, Established Reliability General Specification for
MIL-C-39003	Capacitors, Fixed Solid Electrolyte Tantalum, Established Reliability, General Specification for
MIL-C-39004	Capacitors, Fixed Ceramic, General Purpose, Established Reliability, General Specification for
MIL-C-23269	Capacitors, Fixed Glass Dielectric, Established Reliability, General Specification for
MIL-C-39001	Capacitor, Fixed Mica Dielectric, Established Reliability, General Specification for

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3.0 REQUIREMENTS

The requirements of this specification shall apply to the system configuration noted in paragraph 1.1.

3.1 Functions

Following a launch and injection into orbit by the THORAD-A booster and LMSC 39205 Vehicle, the Payload System shall be capable of providing a minimum of fourteen(14) days of photo reconnaissance (7 days nominal for each recovery) within the first fourteen (14) days of planned orbital life. After a prescribed number of orbits, the two recoverable portions of the reconnaissance system shall be ejected at separate times and within a predetermined area.

3.2 System Design

The design of the system is predicated upon the design provisions of drawing T-33-600 and shall be compatible with the operational requirements. Maximum launch weight shall be 1750 pounds.

3.3 System Operation

3.3.1 Operating Environment

The Payload System shall operate in orbital vacuum conditions existing in altitudes ranging from 80 to 200 nautical miles under direct solar radiation. A pressure make-up unit for corona discharge suppression shall be utilized and shall be capable of maintaining pressures of 20 microns or higher in the instrument barrels during instrument operation. Photographic operation shall normally occur at altitudes of 80 to 120 nautical miles. Requirements may dictate missions as high as 200 nm, however design tradeoffs should be aligned to the 80 nm to 120 nm range of altitudes.

3.3.2 Payload Orbit Operations

During active orbit life, the system shall be capable of being programmed for any portion of the ground track on any orbit except during the recovery maneuver or A to B switchover. Duty cycle limits specified in paragraph 3.4.1.1 and 3.4.3.1 shall apply. Such predetermined operation shall be independent of increasing or decreasing orbit altitude. Capability for early A to B transfer shall be provided for the panoramic cameras and the DISIC subsystem and each subsystem transfer shall be independently controlled by a secure command.

3.3.2.1 Orbital Parameters

Period: 88 to 91.5 minutes

Perigee Height: 80-110 nm

Injection Height: 80-140 nm

Perigee Latitude: 20-60 degrees north descending

3.3.2.2 Launch Parameters

Inclination Angle: 60 to 110 degrees

Weight: Maximum 1750 pounds

3.3.2.3 Cross Track Corrections

LMSC shall provide the Orbital Sine Function Generator. The generator shall provide a voltage to the Agena guidance system to compensate for image smear resulting from the cross-track component of the earth rotation vector.

3.3.3 System On-Orbit Power

The system shall receive the following electrical energy from the LMSC 39205 Agena vehicle power source. Camera contractors shall furnish a power summary for the full operating range of the camera subsystems to indicate the power consumption of components and subsystems. Power requirements shall be based on a 14 day active mission with the following power supplied to the "J3" subsystems interfaces:

1. Unregulated DC Power:

   No Load: +22 to +29.5 VDC

2. No Regulated DC shall be supplied
3. AC Power: 400 ± 0.008 cycles, Single Phase

   No Load: 113.7 to 117.3 volts RMS

   Average Load: 111.7 to 115.3 volts RMS

4. Electrical Interface:

   T3-5-019. "Electrical Interface Specification for the "J3 Constant

Rotator System" shall apply and shall be used for additional descriptions or clarification as required for subsystem design and analysis.

3.4 System Description

The system shall consist of the following major items:

1. 70 mm Panoramic Camera Subsystem
2. DISIC Subsystem
3. Space Structure Subsystem
4. Two Modified Mark 5A Recovery Subsystems

3.4.1 Panoramic Camera Subsystems

The Panoramic Camera subsystem shall consist of two Panoramic Cameras mounted in nominal 30° converging stereoscopic configuration, horizon cameras, film supply cassette, film take-up cassettes, intermediate roller assembly, as per the System Inboard Profile Drawing No. T33-103. The IR Assembly shall incorporate monitors on the rollers and the signals shall be conditioned and telemetered by LMSC. The main Panoramic camera assembly including aux. structure and associate electronics shall weigh less than [illegible] pounds. The main supply (including support structure and two empty spools) shall weigh less than 75 pounds. Each J3 take-up cassette assembly shall weigh less than 23 pounds. Radiation shielding shall not be supplied. The Panoramic camera subsystem shall be furnished GFE to LMSC and shall have a minimum operational life of 50,000 cycles for test and flight. The required camera sub-system handling dollies and camera check out consoles shall also be furnished as GFE to LMSC.

The Panoramic Camera Subsystems shall operate from 21 to 29.5 VDC Unregulated Power measured at the subsystem interface.

3.4.1.1 Panoramic Camera

The two Panoramic Cameras shall be capable of operating simultaneously to generate stereoscopic photography or separately to generate monoscopic photography. The camera subsystem shall have a sustained operational capability of 20 minutes operation for each orbit. The cameras shall be in phase at beginning of each stereo operation and shall be counter-rotating to reduce vehicle perturbations and to meet the requirements for momentum unbalance stated in paragraph 3.4.1.8. The cameras shall follow the V/H signal to ± 1% RMS.

3.4.1.2 Resolution.

Each Panoramic Camera shall demonstrate a minimum dynamic resolution of 110 lines per millimeter utilizing a low contrast (density difference 0.30 + .05 -.00) test target with the standard USAF 1951 target pattern and 100% FMC match. Other requirements for this test are as follows:

a. Collimator: Focal length 60" (Minimum), Aperture 10" (min.)

b. Film: Kodak Emulsion Type, 3404

c. Filter: Wratten 21.

d. Film Processing: Per S.0004

e. Exposure Time: 1/400 - 1/600 sec. (Test Only)

f. Temperature: Test specimen, test equipment and ambient temperature shall be 70° ± 10°F during the testing to establish resolution. R/H shall be less than 50%.

g. Lens: The lens shall be a Petzval type with the following characteristics: Aperture, f/3.5, focal length - 24"

Field of View 6°, Spectral Range .5461 - .6900, back vacuum focus 0.256. The lens shall provide a minimum resolution of 240 l/mm Hi Cont. (1000:1) and 140 l/mm lo cont. (2:1) when measured on a Mann Bench with EK 3404 film.

3.4.1.3 Calibration

3.4.1.3.1 Lens Rotation

The calibration of the lens by Itek Corporation shall be performed such that the axis of cell rotation is positioned with respect to the rear nodal point of the lens system so as to minimize degradation due to image smear under orbital vacuum conditions as specified in paragraph 3.3.1. See paragraph 3.4.1.6 for Panoramic Geometry Calibration.

3.4.1.3.2 Lens Distortion

The radial distortion of the lens shall be measured to an accuracy of one micron in accordance with MIL-STD-150A.

3.4.1.3.3 Lens Alignment

The angular location of the principal ray of each panoramic camera at format center shall be calibrated to the respective horizon cameras principal rays. The camera systems shall be capable maintaining the alignment to within ± 60 arc seconds. The calibration shall be performed with equipment accurate to within ± 6 arc seconds.

3.4.1.3.4 Pan Convergence Angle

The stereo convergence angle of the two panoramic cameras shall be determined at a defined scan position and shall maintain this angle to within ± 60 arc seconds. The calibration shall be performed with equipment accurate to within ± 6 arc seconds.

3.4.1.3.5 Horizon Camera Calibration

The principal point of each horizon camera shall be calibrated with respect to the intersection of the horizon fiducials to within 25 microns.

3.4.1.3.6 The focal length of each horizon camera lens shall be determined to 100 microns.

3.4.1.4 Lens Focus

(1) The lens system shall be focused for orbital vacuum condition by Itek Corp.

(2) The image plane/film plane separation shall not exceed ± 0.001 inches (1.5° max. gradient across the longitudinal axis of the lens cell) over a temperature range of 40°F to 100°F when the camera subsystem is in flight configuration.

3.4.1.5 FMC Calibration

The camera contractor shall provide for a system of object space FMC by nodding the camera about an axis perpendicular to the axis of scan.

The orthogonality of the nod and scan rotations shall be within 120 arc seconds.

3.4.1.6 Panoramic Geometry

The Panoramic cameras shall provide a means to obtain a relationship between points on the format and corresponding ground points. The objective of the calibration is to provide equipment and procedures which make it possible to recover, for any image point, two coordinates, the scan angle α and the cross angle ϕ to within ± 4 seconds of arc (1 sigma level). The design goal shall be to obtain these angles to within ± 1.5 seconds of arc (1 sigma level).

The scan angle α is defined as the dihedral angle between the plane through the scan axis and the central principal point, and the plane through the scan axis and the image point in question. The cross angle ϕ is defined as the complement of the angle between the scan axis and a line connecting the image point with momentary center of projection, i.e., the ray of projection.

3.4.1.6.1 Calibration holes in the film rails shall be located so that holes on both rails are illuminated simultaneously and shall be spaced approximately 1 cm apart.

3.4.1.6.2 The holes shall be 40 ± 20 microns in diameter and as circular as possible.

3.4.1.6.3 Scan traces shall be provided and shall be 50 to 60 microns in width.

3.4.1.6.4 The minimum density of the images shall be 0.3 above base fog at the primary processing level and fastest camera operating speed.

3.4.1.7 Panoramic Film

The cameras shall utilize 3404, 2.5 mil base polyester film but a design goal shall be to provide operation using 1.5 mil base (UTB) polyester film. Nominal thickness with emulsion for the above film is 3.0 mil and 2.0 mil respectively. Each camera shall be capable of utilizing split loads of 3404 and SO 121 film (i.e., 3404 film for some portion of the mission followed by SO 121 for the remainder of the mission - the sequence may be reversed). A design goal shall include the capability to utilize split loads of any combination of two of the following film types: 3404, SO 121, SO 362 and 8443.

3.4.1.8 Camera Operational Error Limits (Image Blur in Microns)

	100 N.M.		80 N.M.		
	Along Track	Cross Track	Along Track	Cross Track	Accuracy
Random Error Sources (3 Sigma)					
Camera Vibration	1.2	1.0	2.0	2.0	
Servo Error	1.8 cos		2.2 cos		3%
Image Motion Compensation	1.8 cos	0.1	2.2 cos	0.2	3%
Nodal Point Location		0.2		0.2	±0.001"
Focal Length Error	0.012 cos		0.016 cos		
Systematic Error Sources					
Motion Due to Film lift (70° F.)		0.9		1.1	0.005"
Across Track Image Motion		7.9 sin 2		9.8 sin 2	
Uncompensated Forward Motion	1.5*		1.8*		
Lens Distortion	0.01 cos*	0.6+	0.01 cos*	0.8+	
Momentum Unbalance		± 0.2		± 0.25	

Above based on the following:

2.44 Milliseconds exposure
0.175 inch slit at 100 nautical miles
0.220 inch slit at 80 nautical miles

* At edge of format

+ Accuracy 5 Micron

3.4.1.9 Camera Data Readout

3.4.1.9.1 A Silicon light pulser data head shall be used for each 70 mm Panoramic camera and has the following nominal capabilities and characteristics:

1. Dot Size: 8 mils @ the 50% density point
2. Dot Spacing: 18 mils on centers
3. Density: 0.3 minimum delta (base fog & dot)
4. Drive: 50 milliamp constant current
5. Data Recorded: an index column, 29 bit time word plus a parity bit, and a complement time word plus a parity bit.

3.4.1.9.2 The numerical Camera Serial Number shall be recorded on each Panoramic format (under the rail area) by a lamp.

3.4.1.9.3 The Start of Pass Mark shall be recorded (under the rail area) on the initial Panoramic frame at an operate sequence.

3.4.1.9.4 A 200 PPS timing track shall be recorded on each Panoramic format (under the rail area).

3.4.1.10 Horizon Cameras

Two 55 millimeter focal length, f/6.3 horizon cameras shall be integrated with each Panoramic camera. The horizon cameras shall be capable of recording the earth horizons to the port and starboard side of the vehicle from orbital altitudes. In addition, the following requirements shall be met:

1. Paired horizon cameras shall operate simultaneously on alternate panoramic cycles and expose horizon formats adjacent to Panoramic formats per Itek Drawing No. 78600.

2. Artificially illuminated fiducials shall be generated adjacent to each horizon format and shall be used as a reference to assist in the determination of the angular roll and pitch of the vehicle.

3. The format dimensions and fiducial locations shall be per Itek Drawing No. 78600.

4. The lens shall have characteristics as follows:

   a. Focal length 55 millimeters.

   b. Field Angle: Not less than 48° in the vehicle x-x axis
   Not less than 23° in the vehicle z-z axis

   c. f/6.3 aperture with iris diaphragm control from f/6.3 to f/22

5. The focus shall be for vacuum conditions at 70°F.

6. Shutters - Alphax II heavy duty, 1/100 sec.

7. LMSC shall provide structure doors compatible with the above parameters and at angles of ± 75 degrees from the vehicle +z axis.

3.4.2 Panoramic Camera Control

The camera controls shall include the following:

1. V/H Programmer
2. Camera Servo
3. FMC (Forward Motion Compensation) device (NODDER)
4. Homing Control
5. Variable Slit Width Control
6. Filter Control.

Camera controls shall be an integral part of the camera subsystem except for the V/H Programmer. The V/H Programmer shall be supplied by LMSC.

3.4.2.1 V/H Programmer

The V/H Programmer shall provide sinusoidal voltage over a period range of 2400 to 4800 seconds. The voltage shall be proportional to the V/H ratio and shall be compatible with the camera servo system and orbital altitudes of 80 to 200 nautical miles.

3.4.2.1.1 Design Criteria

The following items shall be included in the V/H Programmer Design:

1. Output Impedance - less than 10 ohms
2. V/H Programmer output shall see a minimum input impedance of 10 K ohms resistive. (Camera Servo System Requirements - see paragraph 3.4.2.2).
3. The Programmer shall be capable of generating both positive and negative cosine functions.
4. Output voltage shall be 1.4 volt DC minimum and 4.2 volts DC maximum with the start voltage adjustable in 20 equal steps and the half cycle voltage adjustable in 20 equal steps.

A predetermined voltage (start voltage) shall be programmed between each V/H Programmer cycle (once every orbit) and no open circuit shall occur.

6. The programmer shall be resettable to the start position during any part of the cycle by tape command and shall allow the start command to re-initiate the time delay for cycle start when the cameras are not operating.

7. The programmer design shall preclude inputs to the camera that would exceed 5 volts.

8. The V/H Programmer output voltage shall be proportional to the forward motion compensation in radians per second. The relationship is: 1 volt output from the V/H Program is equal to 1 rad/sec. The signal shall include the effects of V/H ratio, stereo half angle, and pitch rate of the vehicle.

3.4.2.1.2 Adjustments (V/H)

Period and start time interval shall be adjustable in the field to permit mission selection and subsequent V/H Programmer adjustment six (6) days prior to launch. The following requirements shall be used and shall be compatible with pre-flight and in-flight adjustment.

1. Nominal start time intervals shall be 25, 50 or 200 seconds.

2. Twenty start time intervals shall be available.

3. Start and half cycle voltages shall increase in magnitude with increasing step positions to minimize the number of on-orbit adjustments.

3.4.2.1.3 Accuracy

The V/H Programmer shall provide the following accuracies:

1. Ramp to function match within 1.0% RMS.

2. Ramp repeatability 1.0% RMS.

3.4.2.2 Camera Servo System

The servo system shall regulate the camera cycle periods within 1% RMS of the corresponding V/H Programmer voltage over a camera temperature range of 40 to 100°F. The servo-drive system shall provide a range of cycle periods from 1.5 to 4.5 seconds per cycle. The cycle periods of both cameras shall be within ± 1% RMS of the period as defined by the corresponding V/H Programmer voltage. The velocity of the lens-scan arm during the photographic scan shall be controlled so as to produce no visible banding or photographic degradation in ground scenes. The input impedance shall be compatible with the V/H Programmer and shall be greater than 10 K ohms (resistive).

3.4.2.3 FMC Device

The FMC device shall provide angular motion of the appropriate camera components to eliminate image smear resulting from vehicle forward motion in flight. The design shall produce the appropriate image velocity to match the ground angular velocity and yield a minimum of 3% overlap at the center of format. The device shall be capable of providing displacement for any operational cycle period from 1.5 to 4.5 seconds.

3.4.2.4 Homing Device and Transfer Operation

The camera shall include the necessary circuitry and components to operate the cameras during the A to B transfer as described in paragraph 3.4.1.2 of T3-5-019. The circuitry shall also include lens position control to preclude film fogging during non-operational periods.

3.4.2.5 Exposure Control (Design Goal)

A means shall be provided to vary the slit width as a function of solar altitude. A fail safe device shall be provided which can be RTC commanded to return the slit to a nominal position.

A means shall be provided to switch filter types (Detector and RTC controlled), thereby providing a means to control exposure of split film loads (Para 3.4.1.7).

3.4.3 DISIC Subsystem

The DISIC subsystem shall be supplied per A/P Design Control Specification T3-5-009. The subsystem shall consist of one DISIC camera with two take-up cassettes, one supply cassette, exit housing, film chutes and baffles, designed so that the total weight is less than 105 pounds, including 2000 ft. of terrain film and 2000 feet of stellar film. (2.5 mil base). DISIC photography shall be generated concurrently with 70mm Panoramic photography. The DISIC subsystem shall also have the capability of independent programmed operation. Exposed film shall be transported to the cassettes within the recovery systems via independent film paths. The A and B film paths shall contain back-up film cutters. Fusing shall be provided in power circuits to protect the Panoramic subsystem power. The DISIC shall operate with 21 to 29.5 volts unregulated DC with power consumption less than 1600 watt-hours for 2000 feet of terrain film.

3.4.3.1 Cycle Period

The DISIC camera shall expose film to obtain 60 to 70 percent overlapping terrain photography at 80nm altitude and 9.375 sec/cycle. The DISIC subsystem shall have a maximum sustained operational capability of 45 minutes per single orbit. A change of gears shall provide a terrain cycling period of 12.500 seconds for higher orbital altitudes.

3.4.3.2 Angular Relationship

The Angular Relationship between the stellar and terrain optical axes shall be 100 degrees. Calibration test of the angular relationship to an accuracy of five (5) seconds of arc shall be conducted prior to delivery to LMSC. (Data shall have been obtained but not necessarily reduced at time of delivery).

3.4.3.3 Distortion

The stellar and terrain lenses shall be calibrated to an accuracy of three (3) microns for radial and tangential distortion prior to delivery to LMSC. Data shall be supplied to LMSC for inclusion in the flight data book, and to any other agencies as directed by the Customer.

3.4.3.4 Terrain Unit

The terrain unit shall provide photography to be used for indexing and correlations of Panoramic photography by the Government. The terrain unit shall be equipped with calibrated reseau plate. Grid line width shall be 10 microns or less and line spacing shall be 5 mm. The terrain unit supply spool shall accommodate 2000 feet of 5 inch 2.5 mil. base polyester film. The time relationship between the opening of the terrain unit shutter and one of the stellar unit shutters shall be capable of being determined to within 1 milli-seconds. A terrain unit photograph shall be exposed every 9.375 seconds. The stellar unit photograph shall be exposed every 3.125 seconds for the slave mode and 9.375 seconds for the independent mode.

3.4.3.5 Stellar Unit

The 35mm stellar camera shall provide photography to be used to determine vehicle attitude. Six stellar photographs shall be generated for each terrain format in the slave mode (9.375 sec/terrain frame). Two simultaneous stellar photographs shall be generated for each terrain format in the independent mode. The necessary lens baffling shall be provided by the camera contractor to minimize obscuration of stellar imagery due to earth haze layer illumination. An automatic sensor and an in-flight select shall be available to cap either one of the stellar units if required.

3.4.3.6 Transfer Sequence - DISIC Subsystem

During the transfer sequence from the A to B take-up cassette, the following requirements shall apply: (LMSC Responsibility)

1. Stowing of the payload splice on the B take-up cassette after the cut and splice operation is not required prior to the beginning of the B mission.

2. Up to 80 inches of the A mission payload can be stored on the B take-up cassette.

3. The loss of some payload at the end of the B mission shall be tolerated to simplify the subsystem and/or improve the reliability of the flight article.

4. Slack between the DISIC metering roller and the cut and splice mechanism shall not be acceptable.

5. The cut and splice operation shall occur prior to the beginning of the B Panoramic mission.

6. Back-up cutter functions shall be provided for the A and B missions.

7. The transfer sequence shall be initiated by a secure RTC. independent of the normal recovery sequence. Initiation of the recovery sequence shall be used as a back-up for the transfer sequence.

8. Early A to B transfer of the prime photographic system shall be independent of the DISIC subsystem.

9. Subsequent to the cut and splice, and prior to the A recovery, the DISIC A payload (from the cut and splice mechanism to the A take-up cassette) shall be taken up.

3.4.3.7 DISIC Exposure Control

The exposure control shall consist of an electro-mechanical device to provide effective terrain exposures of 1/250 or 1/500 seconds. The camera interface shall include the necessary electrical pins for exposure control commands. LMSC shall furnish the necessary command and control to activate the exposure control in flight and adjust the timing of the command during Pad checkout. Items to be considered in the LMSC design shall include the following:

1. A tape command (H-timer) shall be used to start the timing circuits for on-orbit switchover from 1/500 to 1/250. In the event of failure, the DISIC shall provide exposure control at 1/500 sec. throughout the balance of the mission.

2. H-timer brush location shall be shifted for each orbit operation to allow for solar changes resulting from precession of the orbital plane.

3. Brush locations can be determined when the mission inclination angle is specified.

4. The time delay for switchover from 1/500 sec. to 1/250 sec. shall be selectable in orbit by the orbital programmer. The time delay range shall be 1500-3000 seconds, with initiation adjustable in equal intervals (pre-launch) through the umbilical connector.

5. The time delay for switchover from 1/250 sec. back to 1/500 sec. shall be initiated by an orbital timer command. The time delay range shall be 1000-3000 seconds selectable in orbit.

6. TM monitors shall be provided for exposure and delay time.

3.4.3.8 Control Sequence Box

LMSC shall furnish a Control Sequence box to provide control of the DISIC subsystem. The box shall include provisions for the transfer sequence events in paragraphs 3.4.3.6 and exposure control in paragraph 3.4.3.7.

3.4.3.9 Cut and Splice Mechanism

LMSC shall provide a Cut and Splice mechanism to accomplish the transfer of the take-up operation from the A to the B DISIC take-up cassettes. The mechanism shall be compatible with the transfer sequence of paragraph 3.4.3.6 and shall mechanically interface with the film exit housing.

3.4.3.10 DISIC Film

The following film shall be used for the DISIC subsystem:

Terrain - 3400 (4400)

Alternate 3404 (4404)
(To be evaluated in the event of incorporation of forward motion compensation of DISIC.)

Stellar 3400 (4400)

Alternate 3401 (4401)

Film 2.5 mil base, 3.0 mil thick

Alternate 1.5 mil base, 2.0 mil thick

3.4.3.11 Data Recording

The DISIC shall utilize the same type data head and have the same characteristics as described in items 1 thru 4 of paragraph 3.4.1.9.1.

3.4.4 System Structures

System structures shall include the payload frame as shown in LMSC Drawing No. T33-600 and the mechanical and electrical interfaces between subsystems. In addition to carrying distributed loads, the system structures shall provide a light tight housing for the camera subsystems. Light leakage acceptability is as defined in T3-6-012. The structures shall include mounting provisions for the following major components:

1. Command Box
2. TM & Power J Box
3. Pyro Junction Box
4. Transfer Box
5. DISIC Control Box
6. Pressure Make-up subsystem
7. V/H Programmer
8. Orbital Sine Function Generator

9. Panoramic Supply Cassette
10. Digital Clock
11. DISIC Components
12. SRV's
13. Panoramic Camera Module
14. DISIC
15. SLP Data Block Conditioner for Pan Instruments

3.4.4.1 Instrument Barrel Assembly

The barrel structure shall provide the mechanical and electrical interface for the LMSC 39205 vehicle and the conic adapter. Three mounting brackets shall be provided for the panoramic camera assembly and the main supply. Mounting brackets shall also be provided for other components as required. The barrel shall be fabricated in one section. The assembly shall be 60 inches in diameter and shall not require additional structure for mating to the LMSC 39205 vehicle. A pressure diaphragm shall be provided between the LMSC 39205 vehicle and the barrel assembly. The diaphragm shall be structurally compatible with the differential pressure encountered during test, pad checkout, launch and orbit operations.

3.4.4.2 Conic Adapter

The conic adapter shall provide the mechanical and electrical interface for the Instrument Barrel Assembly and the B SRV. Structural mounts shall be provided for the required components.

3.4.4.3 SRV Mount

The system structures shall provide structural mounting compatible with the SRV's described in paragraph 3.4.5.

3.4.4.4 Fairing

The fairing shall provide the mechanical and electrical interfaces for the Conic Adapter and the "A" SRV and shall include a thermal curtain.

3.4.4.5 Film Chutes

Film chutes shall be provided by LMSC as required to psotect the payload from light or mechanical damage.

3.4.4.6 Doors and Boots

The system structure shall provide detachable doors which shall be ejected on command during orbit injection. The structures shall also provide boots or other similar devices to seal the camera subsystems from external light. Boot design shall provide for pressure variations encounter ed during test, pad, ascent, and orbit operations.

3.4.4.7 Access Panels

Access panels shall be provided as required and shall include access doors for tracking, adjustment, and observations of all camera subsystem major film paths.

3.4.5 Basic Recovery Subsystem

The minimum requirements for the Recovery Subsystem will consist of two (2) Mark 5A Satellite Recovery Vehicles described in GE-RSD Drawing No. 198R358G (later). "Vehicle Assemblies - Satellite Recovery Vehicle will consist of those elements necessary to the sequencing and execution of events by which the SRV is ejected from orbit, the Thrust Cone is separated from the re-entry vehicle, the Capsule is separated from the heat shield, and then decelerated by parachute to the required descent rate. Recovery aids and their sequencing are also required.

3.4.5.1 Powered Flight Requirements

3.4.5.1.1 Thermal Requirements

The forward SRV will form the nose of the Space Vehicle and, as such, it must withstand aerodynamic heating during ascent. Any thermal control coatings used on the exterior surface of this forward re-entry vehicle must resist this heating environment and be able to perform their thermal control function in orbit thereafter.

3.4.5.1.2 STRUCTURAL REQUIREMENTS

The SRV shall be capable of sustaining the aerodynamic and inertial loading during the powered flight ascent trajectory. The ascent loads shall be based upon criteria presented in T3-6-002 Environmental Specification.

3.4.5.2 ON ORBIT REQUIREMENTS

The system shall be designed for orbital and launch parameters as stated in Section 3.3.2.1 and 3.3.2.2 of this document. The normal attitude of vehicle system in flight shall be "forward flying" - (SRV Forward). The "A" SRV shall be capable of a minimum time in orbit of 10 days.

3.4.5.2.1 THERMAL CONTROL

When the SRV is directly exposed to the space environment during the on-orbit phase of the mission, thermal control of the film in the take-up spools shall be maintained at 70° F. ± 30° F. by Passive means. Film temperatures shall be maintained within this range for all (two coating matrices will be required) orbital parameters identified in 3.3.2.1 and for all B angles between ± 65 degrees, where B is the angle between the orbit plane and the sun vector. Minimum temperature of TB battery at activation shall be 60° F. Active heating is required prior to activation of the battery to insure maintaining this minimum temperature.

3.4.5.3 RECOVERY REQUIREMENTS

The LMSC 39205 Agena vehicle will orient the space vehicle in the proper attitude for SRV separation. Upon receipt of the proper signal from the Agena, the SRV shall be capable of initiating and undergoing a recovery sequence with specified film loads from empty to full. Following ejection from orbit and atmospheric re-entry, the SRV shall deploy a parachute deceleration system. The 3 σ dispersion limits for design operation shall be $\pm$ 10 nautical miles cross track and $\pm$ 70 nautical miles along track at a nominal impact point of 10,000 ft. altitude. Bias for wind drift should be capable of being calculated and its contribution to dispersion is not included.

3.4.5.3.1 SEPARATION AND EJECTION

The Space Vehicle shall contain mechanisms for separating the SRV vehicle from its structural mounting on the Space Vehicle at a velocity between 1.5 and 2 feet per second. Total rate (pitch and yaw components) due to structural separation shall not exceed 1^{o}/sec. Following separation the SRV ~~shall be~~ spun about its axis of symmetry at the rate sufficient to average out thrust misalignments. Retro velocity of not less than 800'/ sec with a full load of film will be initiated by firing of a retro-rocket, nominally 12 sec. after transfer signal. This retro velocity in conjunction with the specified deboost envelope and R/V loading conditions will permit re-entry of the R/V within the dispersion envelope. Despin shall reduce roll rate to a level compatible with aerodynamic alignment of the vehicle in the re-entry region. Prior to re-entry the remaining retro-rocket assembly will be jettisoned.

3.4.5.3.2 Atmospheric Re-entry

The re-entry vehicle shall be capable of withstanding the aerodynamic heating and loads associated with a re-entry under all film loading conditions. The RV contractor shall prepare an operational matrix of re-entry conditions describing margins and dispersions provided under varying conditions of film loading. True anomaly values for deboost shall be derived for impact in the Hawaiian recovery area, with deboost velocities corresponding to all load configurations. The vehicle shall have sufficient aerodynamic stability in all specified load configurations so that the angle of attack envelope approaches a value near zero at the time of peak axial deceleration.

3.4.5.3.3 Parachute Descent

A subsonic deceleration system shall be incorporated in the re-entry vehicle and shall be deployed immediately after the vehicle achieves subsonic velocity. This subsystem shall be designed to provide a descent rate of not greater than 29 ft per second at an altitude of 10,000 ft in a fully loaded configuration. When the main or primary parachute is deployed, the heat shield shall have separated from the recovery vehicle. The parachute system shall be designed for air pickup by the aircraft.

3.4.5.3.4 Recovery Aids

Recovery aids shall include a beacon and a flashing light. The beacon will be activated at the time of the transfer signal. The flashing light will be activated at the time of parachute deployment.

3.4.5.3.5 Water Impact Flotation

In the event air snatch is not successful and the recovery capsule assembly descends at nominal decent rate to the ocean surface, it is required that the capsule maintain a water-tight environment for the film both before and after water impact and that it float in an upright position for a minimum of 48 hours in a condition of sea state 3. At the end of this period, it shall be self-scuttling.

3.4.5.4 Weight and Ballistic Coefficient Requirements

A fully loaded SRV shall have a Separation Weight of 400 lb. (max.), a Re-entry Vehicle Weight of 300 lb (max.) and a suspended weight of 230 lb. These weights shall include 80 lbs for main camera film, 23 lb for main camera takeup equipment, 12.5 lb for DISIC film, and 7.4 lb for DISIC camera takeup equipment. The hypersonic ballistic coefficient of the configuration which exists during the atmospheric re-entry shall not exceed a value of 95 lb per square foot at zero angle of attack.

3.4.5.5 SRV Capabilities

Up to 16,000 feet of 3.0 mil 70mm film and up to 1000 feet of DISIC stellar and 1000 feet of DISIC terrain film shall be stored in the number one Recovery subsystem during the first operational phase. At some time after completion of the first operational phase, the number one Recovery subsystem shall be ejected. After ejection of Recovery system number one, the LMSC 39205 Agena vehicle shall be programmed for the second operational phase. Power and attitude of the system shall be maintained throughout the transition from the A to B mission. The LMSC 39205 Agena vehicle shall maintain attitudes between all reconnaissance operations. During the second operational phase approximately 15,500 feet of 70mm film and 1000 feet of stellar and 1000 feet of terrain film shall be programmed, during a one (1) to seven (7) day interval. Recovery system number two shall be recovered sometime between completion of first photo reconnaissance phase and the 14th day in orbit. The re-entry and recovery sequence of operations shall be initiated and recovery of number two Recovery subsystem shall be effected, thus completing the system operations.

3.4.6 System Supply Cassettes

The supply cassettes for the Panoramic and DISIC subsystems shall consist of film spools, mounting brackets, enclosures, drive unit braking device, the necessary controls to assure proper tension throughout the test, ascent, and orbital phases of operation. The cassettes shall be compatible with the system structure supplied by LMSC, and shall operate from 21 to 29.5 VDC Unregulated

Power measured at the cassette subsystem interface. All spools on each subsystem shall be capable of individual independent operation. The main supply shall operate at a low tension during ascent by an initial Pad command which shall be released by the receipt of the Orbit Mode Signal Command. Design shall allow for control during test.

3.4.6.1 Panoramic Supply Cassette

Each Panoramic supply cassette shall consist of two spools, Each spool shall have a nominal capacity of 16,000 feet of 2.5 mil base, 3.0 mil thick 70mm film.

Spool core diameter shall be a minimum of six (6) inches.

Main supply mounts shall be provided by LMSC and shall be located in the instrument barrel.

3.4.6.2 DISIC Supply Cassette

The DISIC supply cassette shall have a nominal capacity of 2000 feet of 2.5 mil base, 3.0 mil thick 5 inch terrain film and 2000 feet of 2.5 base, 3.0 mil thick 35mm stellar film.

3.4.7 System Take-up Cassette

The Take-up Cassettes for the Panoramic and DISIC subsystems shall include the same basic type of components shown for the Supply Cassettes.

The Design shall conform to the basic configuration and space limitations of the Recovery Subsystem as described in paragraph 3.4.3. The cassettes shall utilize a flange design and provide sufficient clearances to assure satisfactory operation at a minimum temperature of 20°F. The center to center distance of the two (2) panoramic films shall be a nominal 3.12 inches.

Each A take-up spool shall have a nominal capacity of 8000 feet of 3.0 mil thick, 2.5 mil base 70mm film.

Each B take-up spool shall have a nominal capacity of 7750 feet of 3.0 mil thick, 2.5 mil base 70mm film.

The cassettes shall operate from 21.0 to 29.5 (+) VDC unregulated power at the take-up interface. All spools shall be operated at a programmed current and include film radius telemetry monitors.

The panoramic camera subsystem shall utilize a cut and wrap sequence for transfer from the A to the B take-up cassettes. The DISIC subsystem shall utilize a cut and splice sequence for A to B transfer.

3.4.7.1 Panoramic Take-up Cassette - A

Each spool shall utilize an anti-back up device that does not interfere with the Panoramic Camera operation. During the ascent mode, the anti back-up devices shall be released and a reduced voltage applied to the spool drive systems to insure adequate film tension compensation. The anti back-up device shall be capable of being released for test and checkout purposes by applying 21 to 29.5 VDC to the appropriate take-up interface connector pins. This device shall be in effect without application of power.

3.4.7.2 Panoramic Take-up Cassette - B

Each spool shall utilize a brake device that will prevent spool rotation during ascent, "A" mode operation and "B" mode non-operate periods. The device shall be in effect without application of power.

The spools will be indexed to allow optimum film tracking through the "B" cassette to the "A" cassette. The gap between the hub rollers shall not interfere with the passage of a maximum splice thickness of .0075 inches.

3.4.7.3 DISIC Take-up Cassette

The DISIC take-up cassettes shall have a nominal capacity of 1000 feet of 2.5 mil base, 3.0 mil thick 5 inch terrain film and 1000 feet of 2.5 mil base, 3.0 mil thick 35 mm stellar film.

3.4.7.4 Temperature Limits

All take-up cassettes shall provide satisfactory operation over a temperature range of 20-100° F. LMSC shall provide a passive method for indicating temperatures above 140°F. Heaters shall be provided by LMSC and installed in the panoramic cassette area to assure cassette operational temperature above 40°F.

3.4.7.5 Start Stop Capability

All take-up cassettes shall be capable of being started and stopped a minimum of three hundred (300) times in flight.

3.4.7.6 Film Off-spooling, Panoramic Subsystem - Test Conditions

Spool RPM during film off-spooling shall not exceed 60 RPM.

3.4.8 DRCG

LMSC shall provide and checkout the Digital clock. The clock shall be capable of storing time unambiguously for a period of five days. Upon receipt of an interrogate command, the clock shall provide the signals required for auxiliary recording of binary time on the Panoramic Camera and DISIC subsystem film. The clock error shall not exceed 2.5 milliseconds in any twelve hour period after accounting for clock offset. The Clock shall operate from the LMSC Agena Vehicle 24 Volt DC Unregulated power source. The clock and its ancillary equipment shall be capable of driving the data heads to provide the proper exposure for the film as described in paragraph 3.4.1.7 and 3.4.3.10.

3.4.9 Commands and Programming

The LMSC 39205 Vehicle orbital timer shall contain punched mylar tapes which control both the vehicle orbital functions (such as telemetry and Beacon operations) and system program options. The electrical interfaces shall be compatible with TS-5-019, Electrical Interface Specification - J3.

3.4.9.1 Program Options

The program options shall include the following items: each item controlled by a tape - brush command:

1. Reset V/H Programmer start control, Yaw Programmer start, exposure control reset and V/H oblateness function start.
2. Panoramic Geometry Control
3. Continuous TM on
4. V/H Programmer start control
5 Redundant Camera "Off" *
6. Intermix Stepper Switch
7. Camera Program 1 thru 9 (18 brushes)
8. DISIC "On"
9. DISIC "Off"
10. DISIC Exposure Control
11. Pan Exposure Control

3.4.9.2 Real Time Commands

Eighteen (18) Real Time Commands shall be utilized for Program selection and control. Real Time Command descriptions are shown below:

1. RTC 6, 8, 10 - V/H Programmer Control:

2. RTC 9- Camera Program Select
3. RTC 11 - Camera Operations Mode Select
4. RTC 12 - Intermix No. 1
5. RTC 14 - DISIC Mode Select
6. RTC 15 - Intermix No. 2
7. KIK/Zorro 38 (Secure) - Transfer A to B (Panoramic)
8. KIK/Zorro 39 (Secure) - Transfer A to B (DISIC)
9. RTC (not assigned) - Variable slit over-ride - two required.
10. RTC (not assigned) - Back-up filter selection - two required.
11. RTC (not assigned) - Exposure control delay.
12. RTC (not assigned) - Yaw enable/disable.
13. RTC (not assigned) - DISIC East/West/both/off.
14. RTC (not assigned) - Emergency Ops select/mode select bypass.

3.4.10 Telemetry Transducers

LMSC shall coordinate instrumentation schedules and functions to be telemetered. The instrumentation functions shall provide information for "On" orbit analysis of system operation. TM functions shall be provided for as described in T3-5-019 paragraph 3.5.

3.4.11 Telemetry Signal Conditioner

A signal conditioner capable of accepting instrumentation signals from the system and conditioning them into suitable form for transmission by the LMSC 39205 Agena Vehicle. The signal conditioner shall be compatible with the telemeter channels. One channel which is time shared with Research Payloads and a tape recorder shall be provided. The tape recorder shall record data from a .4 RPS Commutator, TM monitoring of all stepper switches shall be standardized and shall utilize a 5 x 5 code as shown below.

VOLTS - PIN 2 \ VOLTS - PIN 1	1	2	3	4	5
1	1	6	11	16	21
2	2	7	12	17	22
3	3	8	13	18	23
4	4	9	14	19	24
5	5	10	15	20	25

POSITION

3.4.12 Attitude Determination

Vehicle attitude determination shall be derived from stellar photography provided by the DISIC subsystem. The stellar photography shall be compatible with the following accuracy requirements for attitude: when multi star solutions are utilized:

Roll: ± 5.0 seconds

Yaw: ± 5.0 seconds

Pitch: ± 35.0 seconds

The panoramic horizon cameras shall provide back-up attitude information with accuracies of $\pm$ 10.0 minutes of roll and pitch.

3.4.12.1 Attitude Determination System

LMSC shall investigate systems for improving attitude determination and the feasibility of incorporating such a system (ADS) into the "J3" configuration.

3.5 Storage and Handling

Storage and Handling shall be in accordance with LMSC T3-4-505, and/or GE SVS 3702 and SVS 3703. New Storage and Handling procedures shall be incorporated as the Factory to Pad concept is continued. The camera contractors shall furnish ground handling equipment (dollies) as required for handling their equipment at the S/P Facility (GFE).

Under conditions of controlled environment, a minimum shelf life of 24 months is required for all pyros used on payload systems and GFE equipment.

3.6 Thermal Design

Passive thermal control means shall be employed in the "J" System. Structural surface optical properties and associate Mosaic geometry shall be adjusted to provide a computed time averaged temperature for the camera structural components of $70^\circ \pm 30^\circ F$ (at nominal space environmental conditions). The design goal of the temperature control shall be to maintain the camera optical train at a temperature of $70^\circ \pm 10^\circ$. All temperature transducers shall be Micro Systems Type TE3-D or equivalent with a low voltage excitation system. A System Thermal Math Model shall be used to predict inflight temperatures. Symmetrical and/or assymmetrical paint skin patterns will be developed, based on the analytical model predictions. Aluminum thermal shielding shall be used as required for components mounted to the space structure. Associate Contractors shall identify temperature sensitive components in their respective subsystems and establish temperature limits. The maximum-minimum and time averaged temperature will be predicted for all system components in a space environment range as follows:

Beta: -65° to $+65^\circ$

Period: 88 to 91.5 minutes

Minimum Height: 80 nautical miles

Inclination Angle: 60 thru 110°

Nominal Perigee Latitude: 20° North to North Tangent Point Descending

Solar Constant shall include diurnal variations

Average Albedo coefficient shall range from .25 to .55. The internal power duty cycle shall be calculated on a range from 0 minutes to 20 minutes per orbit. The attitude during active phase shall be as specified for the LMSC 39205 Agena vehicle.

3.7 Light Leaks

Light Leak Tests in accordance with the appropriate LMSC Specification shall be performed on the system. All leaks located shall be corrected prior to final pre-launch assembly. Maximum density of 0.02 above base fog shall be used as the limit for light leaks.

A light leak detection system shall be developed and installed for leak checks during the test phases. The system shall consist of self contained (includes power supply) photometer system and shall be installed within the system structure. The photometer systems may remain on the system for flight but shall not be operational during flight.

3.8 System Altitude Test and Corona Marking

3.8.1 System Altitude Test

The system, in flight configuration, shall be tested in an altitude chamber to test system environmental performance and suscepti-bility to corona marking. Operate times will follow the flight profile and the static system internal pressure shall be 3 to 10 microns during a minimum of 5% of the A mode and 1 to 3 microns or less during a minimum of 20% of the B mode. The DISIC and Main Instruments shall be programmed for simultaneous operation. The DISIC subsystem shall also be programmed for independent operation to confirm independent mode operation. DISIC in-flight shutter capping capability shall be confirmed for both automatic and command control.

3.8.2 Main Instruments

Corona marking shall be limited to a density of less than 0.4 above the base plus fog level during the first five consecutive frames from the start of pass mark at each instrument start-up. Tests shall be in accordance with paragraph 3.8.1.

3.8.3 DISIC Subsystem

Corona marking shall be limited to 10% of the programmed formats and any such marking shall be at a density less than 0.4 above the base fog level. Tests shall be in accordance with 3.8.1.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Selection of Parts and Components

Parts and Components shall be selected from any of the following sources preferably in the order listed:

A. LMSC Space Systems Preferred Parts Handbook

B. Military Standards/Military Specification

C. Missiles and Space Industry Standards

D. LMSC and ITEK Specification Controlled Drawings

E. Items Proven Satisfactory by Prior Flight Useage

F. Parts and Components which have been qualified prior to flight to Level Requirements by the Design Application.

4.2 Semi-Conductors

Requirements and characteristics of MIL-S-19500 are minimum. No semi-conductors shall be used that are not vendor certified. All semi-conductor devices except for non-cavity devices (micro-diodes) shall be inspected by the X-ray method in accordance with LMSC 1412815C.

4.3 Electro Magnetic Interference (EMI) Control

The provisions of specification LMSC 447969 and T3-6-002 are to be used as a guide for controlling EMI in electrical and electronic assemblies and conic components. No EMI testing of the system or subsystem shall be required.

4.4 Inspection and Certification

Prior to testing a "J3" system, all components of the system shall be inspected by a Quality Assurance Representative and certified as complying with the applicable drawing. The system shall meet flight quality standards in regard to workmanship and cleanliness.

4.4.1 Failure During Test

In the event of failure during test, the testing shall be discontinued. Such failure shall be completely documented and reported for analysis and dispositioned. Disposition shall be in accordance with LMSC and/or Associate Contractors Standard Operating Procedures and Specifications.

4.4.2 Test Certification

A Quality Assurance Representative shall witness and verify the accuracy of all testing.

4.5 Testing

4.5.1 Operational Systems

The testing of the system shall consist of acceptance and pre-launch tests and shall be compatible with the A/P Factory to launch Program. The system shall be tested to demonstrate the photographic integrity and provide H.O. calibration data. Pan Geometry data shall be provided to LMSC by Itek at time of delivery of cameras to A/P. (Reference paragraphs 3.4.1.2; 3.4.1.3.3; 3.4.1.6). Testing shall be in accordance with the basic provisions of the applicable LMSC Acceptance Test Specification. A minimum of five (5) days duration shall be required for the thermal altitude environmental chamber test.

4.5.2 Qualification

One system shall be qualified for flight in accordance with the applicable LMSC Qualification Test Specification. A minimum of fourteen (14) days duration shall be required for the thermal altitude environmental chamber test. Environmental levels shall be 70% of full qualification levels.

5.0 PREPARATION FOR DELIVERY

Precautions shall be taken to protect the accepted System from damage and contamination during storage and shipment. Storage of Panoramic Instruments, DISIC Camera, Cassettes, and etc., shall be under modified Class #2 Clean Room Conditions as per TO-0025-203. Transit cases for the camera subsystems components shall be furnished by the camera contractors and shall incorporate a shock recorder, humidity recorder and air pressure regulation valve.

6.0 NOTES

6.1 Field Support

Associate Contractors shall provide field support at the A/P facility.

6.2 Spare Parts

Spare parts requirements shall be submitted to the Customer by all contractors.

Long lead items shall be noted and spare parts shall be furnished as GFE after approval by the Customer. A/P shall maintain stockrooms and inventories of all spare parts provisioned to support the program.

6.3 Film Requirements

The film required to support test and flight operations shall be furnished to all contractors and on a schedule to adequately support all phases of the program. Film requirements and schedules will be coordinated with the Customer by each contractor for the film requirements at their respective facilities.

6.4 Test Equipment

A/P shall furnish test equipment required for all phases of the A/P to Pad Test Program. Test equipment for the DISIC Subsystem shall be GFE per DCS T3-5-009C for verification testing. Test equipment for Itek subsystem shall be provided GFE and maintained by Itek Field Engineering.

T3-6-002A - GENERAL SPEC FOR P/L QUALIFICATION & ACCEPT.

~~TOP SECRET~~

TOP SECRET

T3-6-002A
9 June 1966

GENERAL SPECIFICATION
FOR
PAYLOAD QUALIFICATION
AND ACCEPTANCE

Prepared By: [redacted]
Systems Integration

Approved By: [redacted]anager
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Approved By: [redacted]
Resident Officer

Approved By: ____________________
Associate 1

____
Associate 2

____
Associate 3

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LIST OF ILLUSTRATIONS

1.0 SCOPE

This specification defines the environments which the [redacted] Payload will encounter during ascent, orbital, and recovery operations; further, it establishes qualification and acceptance test requirements based on these criteria. Boost phase environments are based on the use of the Thorad. This document may be used as an intrinsic part of detail equipment specifications.

1.1 Purpose

a. To consolidate all pertinent environmental and test criteria.

b. To establish qualification and acceptance test levels.

c. To provide design reference to be used in optimizing reliability.

d. To standardize requirements and tolerances such that repeatability may be achieved.

1.2 Use

This document may be used in conjunction with detail specification to specify requirements against which the payload shall be designed, qualified, and accepted.

1.3 Application

Detail specifications may be combined with this document to specify design or test requirements. In these instances the following additional specific requirement[redacted]ll be specified:

a. Sequence of testing or a statement that such a sequence is unnecessary.

b. Acceptable performance limits before and after the test.

c. Standards of acceptance for qualification.

d. Arrangement and mode of operation.

e. A statement as to whom should receive records and data.

f. Specific locations of test instrumentation.

g. Special tests and unusual test conditions.

h. Location and orientation of components which are not to be qualified for the general payload usage.

i. Design operating and shelf life

j. Location of points of comparison to determine resonances.

k. Deviations to the general specification.

l. Which of the tests herein shall be performed.

1.4 Deviations

a. Requirements may be modified if it is shown that installations protect equipments from existing environments.

b. Requirements may be modified if it can be shown that equipment performance is not sensitive to certain phases of operation.

c. Requirements may be modified if an increase in severity of requirement will not result in increased weight and power.

1.5 Severity of Qualification Tests

The qualification tests specified herein are for qualifying equipment designed for use in the payload (Agena interface forward) only. They are not intended as acceptance tests suitable for verifying manufacturing integrity. The test levels are therefore set sufficiently high to compensate for absence of combined environments during testing, normal variations in manufacture, and to verify design safety factors.

1.6 Definitions

1.6.1 Component or Minor Subassembly

The lowest level of assembly of parts, arranged within one package that will permit performance of some prescribed function and which is easily removable as a self-contained functional unit. In general, items here defined as components are not disassemblable to a lower level by payload personnel.

1.6.2 System

An assembly which integrates the outputs of various components into a final prescribed function or group of functions. For the purposes of this specification, systems are divided into three groups by weight:

a. 75 lbs. or less

b. 76 lbs. to 250 lbs.

c. Above 250 lbs.

1.6.3 Structure

An assembly whose major function is the support of components and systems.

1.6.4 "Non-recoverable" is defined as any component, system, or structure which does not re-enter.

1.6.5 "Payload System Complete" is defined as the spaceframe structures and all internal parts, with the exception of simulated batteries, parachutes, retro rockets, and those live pyros not being tested.

2.0 APPLICABLE DOCUMENTS

2.1 The intent of the following documents shall form the basis of this specification.

2.1.1 [redacted] General Environmental Specification

[redacted] Satellite Encountered Radiation Doses from Trapped Particles

2.2 Precedence of Specifications

In the event of conflict between this specification and the detail specifications, the detail specifications shall take precedence.

2.3 Conflict

This document is not intended to conflict in any way with mandatory Federal Specifications.

3.0 ENVIRONMENTAL CRITERIA

Payload components, systems, and structures shall be designed to fulfill operation objectives in all of the following phases, under maximum stresses predicted for these phases:

a. Thorad Booster Phase

b. Agena Burn Phase

c. Orbital Flight

d. Re-entry

The following stresses to be here defined are actual loads either measured or predicted.

a. Shock

b. Vibration

c. Acceleration

d. Temperature

e. Pressure

f. Radiation

g. Humidity

Handling equipment shall be designed such that stresses encountered in storage and test shall in no case exceed those defined in operational phases.

3.1 Thorad Booster Phase

3.1.1 Sinusoidal Vibration

a. Complete Payload

Longitudinal

Freq. (cps)	Level (g's)
15 - 20	3.0

Lateral

Freq. (cps)	Level (g's)
15 - 20	0.25

Disturbance occurs at Thorad Burnout (T-200 seconds).

b. Systems

Systems receive inputs as shown in para. 3.1.1 a.

Resonances in the 15-20 cps range shall be avoided.

c. Components - See 3.1.1 b. - Components may have any orientation.

3.1.2 Random Vibration

a. Complete payload - 6 g's rms overall - all axes at Thorad Ignition and in transonic region.

b. System resonances at all frequencies are excited sinusoidally.

c. Components (see. 3.1.2 b.)

3.1.3 Steady-State Acceleration

a. Complete Payload

6 g's axial

1 g lateral

At Thorad Burnout

Components may have any orientation. See 3.1.1 a.

3.1.4 Shock at the Agena/Payload Interface

a. Complete Payload

1. Thorad Ignition Phase 16g's longitudinal

2 g's lateral

2. Separation pyro event

(Under investigation) ______ g's - all axes

3.1.5 Temperature

a. Complete Payload

The following correlation curves based upon predicted skin temperatures for ten design trajectories shall be used as a basis for ascent thermal design. These data are based on the assumption that the payload skin outer surface has the emissivity of gold. Higher ascent temperatures are found in the +Z side of the payload during ascent.

b. Internal Systems

$70^{\circ}F \pm 30^{\circ}F$

c. Components

See 3.1.5 b.

3.1.6 Pressure Static

a. Complete Payload

1. 0.4 - 0.8 psi differential at the payload Agena interface at launch.

2. The absolute pressure during ascent is reduced from sea level to 25 mm Hg. in 90 seconds. A maximum pressure reduction rate of 15 mm Hg.

per second occurs in the transonic region for a maximum duration of 30 seconds.

b. Internal Systems

See 3.1.6 a.

c. Components

See 3.1.6 a.

3.1.7 Dynamic Pressure

a. Complete Payload

Maximum dynamic pressure is 800 p.s.f.

b. Internal Systems

Not applicable

c. Components

Not applicable

3.1.8 Radiation (Negligible)

3.1.9 Humidity

a. Payload Complete

External surface

exposure to relative humidity up to 100%.

b. Internal Systems

50% humidity maximum

c. Components

(See 3.1.9 b)

3.2 Agena Burn Phase

3.2.1 Sinusoidal Vibration

Negligible

3.2.2 Random Vibration

Negligible

3.2.3 Acceleration

a. Complete Payload

5 g's axial
1 g lateral
at Agena Shut Off

3.2.4 Shock at Agena/Payload Interface

a. Payload Separation

Pyrotechnic Event

(Under investigation)____ all axes

3.2.5 Pressure

10^{-2} - 10^{-13} mm Hg

3.2.6 Temperature

Note: All temperatures are decreasing after the Thorad Phase and are not critical.

3.2.7 Radiation

Negligible

3.3 Orbital Flight

All environmental stresses except temperature pressure and radiation are negligible.

3.3.1 Temperature

a. Complete Payload

Maximum orbital skin temperatures are uniform longitudinally, varying overall between 140°F and 220°F. Differentials on opposite ends of lateral axes are 150°F maximum. The temperatures are cyclic and a function of the orbit.

b. Internal Systems

The heat sink for internal systems shall be maintained at 65 ± 30°F, thus providing an effective environment of 70 ± 30°F.

c. Components

See 3.3.1 b.

3.3.2 Pressure

a. Complete Payload

10^{-13} mm Hg external

b. Systems

20 - 100 microns internally

c. Components

See 3.3.2 b.

3.3.3 Radiation

a. Complete Payload System

Electron dose of 1.6×10^{-3} rads per day.

Trapped particle dose of 2×10^{-1} rads per day.

3.4 Re-entry (Recovery System only)

3.4.1 Vibration

Negligible

* 3.4.2 Acceleration (Reference Figure 2)

12.5 g's axial

5 g's lateral (concurrently for 35 seconds duration)

* 3.4.3 Shock

a. Air Recovery

18 g's longitudinal (individually)

5 g's lateral

b. Separation pyrotechnic events (at the SRV interface)

All axes

3.4.4 Temperature (Reference Figure 1)

125°F max. inside recovery capsule skin (at parachute deployment).

3.4.5 Pressure (Reference Figure 2)

a. De-orbit & Separation - 10^{-13} mm Hg - 5×10^{-7} mm Hg

b. Re-entry - 5×10^{-7} - 5.6 in Hg

c. Recovery - 5.6 in Hg - 30.5 in Hg

* Based on a fully loaded recovery system.

4.0 TEST REQUIREMENTS

Recoverable units must endure non-recoverable stresses. If the non-recoverable stress is more severe than that specified for recoverable units, the non-recoverable stress shall apply. If a non-recoverable stress is omitted in the recoverable schedule of tests, the omitted stress shall automatically apply to the recoverable unit.

4.1 Vibration Testing

a. The equipment shall be loaded and operated in accordance with the equipment qualification test specification prior and subsequent to testing. The specimen shall be inspected for damage and defects resulting from vibration at the conclusion of test periods, as specified in the equipment qualification specification.

b. Resonances at frequencies other than those in the range from 15 - 20 cps shall be monitored and used to limit the input of the shaker to accelerations such that individual components shall not receive greater than their specified levels.

Resonances in the 15 - 20 cps range shall subject the equipment to further design review.

c. The test fixture shall be vibrated alone and the resonant frequencies noted. The fixture shall be modified until all resonant frequencies are above 400 cps for small systems and components and 200 cps for assemblies over 75 lbs. The equipment shall be secured at its mounting points to the fixture and 1/4 - 1/2 g resonance searches of the fixture-equipment combination shall be conducted in all 3 axes.

d. All accelerometers specified shall be monitored to determine resonance of the units on which they are mounted.

Induced vibration along axes other than those being excited principally shall be measured.

e. Sinusoidal vibration shall be applied separately along each of three mutually perpendicular axes at the amplitude values specified. The test along each axis shall consist of a single sinusoidal sweep, starting at the lowest frequency limit and proceeding at a sweep rate of 3 minutes per octave to the highest frequency limit in not less than 25 minutes. All resonant frequencies shall be noted and recorded.

Resonant frequencies shall be determined by observation of increased acceleration amplitudes or displacements of equipment being tested. Specific dwell at resonance is not required.

f. Input cross talk in normal axes shall not exceed 100% of the specified input.

g. Input shall be applied as near as possible to the CG of the equipment being tested. Attachment points shall be monitored.

h. Axes refer to vehicle axes.

4.1.1 Sinusoidal Testing

4.1.1.1 System Vibration

a. Recoverable systems weighing 75 lbs or less

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.5 inches peak to peak
15 - 20	7.0 g's, 0 - peak
20 - 400	5.0 g's, 0 - peak
400 - 2000	7.5 g's, 0 - peak

Lateral Axes

Frequency (cps)	Level
11 - 2000	3.0 g's, 0-peak

If specimen axis is not defined, longitudinal axis levels shall be used.

b. Non-recoverable systems weighing 75 lbs or less

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.5 inches, peak-to-peak
15 - 20	7.0 g's, 0 - peak
20 - 400	5.0 g's, 0 - peak
400 - 2000	7.5 g's, 0 - peak

4.1.1.1 (Continued)

Lateral Axes

Frequency (cps)	Level
11 - 2000	3.0

c. Recoverable Systems weighing from 76 lbs. through 250 lbs.

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.38 inches peak-to-peak.
15 - 20	4.0 g's, 0 - peak
20 - 400	3.0 g's, 0 - peak
400 - 2000	3.5 g's, 0 - peak

Lateral Axes

Frequency (cps)	Level (g's)
11 - 2000	2.0

d. Non-recoverable systems weighing from 76 lbs. through 250 lbs.

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.38 inches peak to peak
15 - 20	4.0 g's, 0 - peak
20 - 400	3.0 g's, 0 - peak
400 - 2000	3.5 g's, 0 - peak

Lateral Axes

Frequency (cps)	Level (g's)
11 - 2000	2.0

e. Recoverable systems weighing more than 250 lbs.

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.38 inches peak to peak
15 - 20	4.0 g's, 0 - peak
20 - 400	3.0 g's, 0 - peak
400 - 2000	3.5 g's, 0 - peak

Lateral Axes

Frequency (cps)	Level (g's)
11 - 2000	2.0

f. Non-recoverable systems weighing more than 250 lbs.

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.18 inches peak to peak
15 - 20	3.0 g's, 0 - peak
20 - 400	1.5 g's, 0 - peak
400 - 2000	3.0 g's, 0 - peak

Lateral Axes

Frequency (cps)	Level (g's 0 - peak)
11 - 2000	1.0

4.1.1.2 Structures Vibration

a. Recoverable Structures

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.4 inches peak-to-peak
15 - 400	5 g's 0 - peak
400 - 2000	10 g's 0 - peak

Lateral Axes

Frequency (cps)	Level
15 - 2000	3.0

b. Non-recoverable Structures

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.4 inches peak to peak
15 - 400	5 g's 0 - peak
400 - 2000	10 g's 0 - peak

Lateral Axes

Frequency (cps)	Level
15 - 2000	3.0

4.1.1.3 Components and Minor Subassembly Vibration

The component shall be hard-mounted on the vibration exciter.

a. Recoverable Components - All axes

Frequency (cps)	Level
5 - 20	0.5 inches peak to peak
15 - 20	7.0 g's 0 - peak
20 - 400	5.0 g's 0 - peak
400 - 2000	10.0 g's 0 - peak

b. Non-Recoverable and Minor Subassembly Components - All Axes

Frequency (cps)	Level
5 - 20	0.5 inches peak to peak
15 - 20	7.0 g's 0 - peak
20 - 400	5.0 g's 0 - peak
400 - 2000	10.0 g's 0 - peak

4.1.2 Random Vibration

The random vibration shall be conducted in the frequency range of 20 - 2000 cps. The method may be either broad or narrow band. The equipment shall be vibrated for 180 seconds in each of the three mutually perpendicular axes at maximum level specified. Paragraphs 4.1 a, c, d, f, g and h shall apply.

4.1.2.1 System Vibration

a. Recoverable systems weighing 75 lbs. or less

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.05	
400 - 2000	0.12	14.5

b. Non-recoverable systems weighing 75 lbs. or less

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS.)
20 - 400	0.05	
400 - 2000	0.12	14.5

c. Recoverable systems weighing from 76 lbs. to 250 lbs.

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.05	
400 - 2000	0.12	14.5

d. Non-recoverable systems weighing from 76 lbs. to 250 lbs.

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.05	
400 - 2000	0.12	14.5

e. Recoverable systems weighing more than 250 lbs.

No requirement.

f. Non-recoverable systems weighing more than 250 lbs.

No requirement

4.1.2.2 Structures Vibration

a. Recoverable Structures

No requirement

b. Non-recoverable structures

No requirement

4.1.2.3 Components and Minor Subassembly Vibration

a. Recoverable Components

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.05	
400 - 2000	0.18	17.5

b. Non-recoverable Components

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.05	
400 - 2000	0.18	17.5

4.2 Acceleration Testing

a. The equipment shall be secured to the test fixture by its mounting points. The equipment shall then be subjected to specified values of acceleration, in each direction along each of the indicated axes for a period of 10 minutes unless otherwise specified.

b. The equipment shall be loaded and operated in accordance with the applicable qualification specification.

c. The acceleration forces shall be applied at the CG of the specimen.

d. No combination of radial and tangential forces shall exceed specified levels.

e. Equivalent static load testing may be substituted for dynamic acceleration if the combined effect of acceleration and dynamic loading is taken into account.

4.2.1 System Acceleration*

a. Recoverable Systems weighing 250 lbs. or less

Longitudinal Axis (+ indicates ascent)

Level (g's)	Direction
15.0	±

Lateral Axes (Not to be performed concurrently)

Level (g's)	Direction
6.0	±

* Systems weighing over 250 lbs. may be tested by static load [illegible] with limit loads shown in Para. 4.2.1.

b. Non-Recoverable system weighing 250 lbs. or less

Longitudinal Axis

Level (g's)	Direction
11.0	±

Lateral Axes

Level (g's)	Direction
2.0	±

4.2.2 Structures Acceleration

a. Recoverable Structures

Longitudinal Axis

Level (g's)	Direction
22.0	±

Lateral Axes

Level (g's)	Direction
8.0	±

b. Non-Recoverable Structures

Longitudinal Axis

Level (g's)	Direction
15.0	Plus only

Lateral Axes

Level (g's)	Direction
2.5	±

4.2.3 Component Acceleration

a. Recoverable Components

All Axes

Level (g's)	Direction
22	±

Lateral Axes

Level (g's)	Direction
6.0	± (If component orientation is established)

b. Non-Recoverable Components

All Axes

Level (g's)	Direction
15	±

Lateral Axes

Level (g's)	Direction
2.5	± (If component orientation is established)

4.3 Load Application as a Substitute for Dynamic Acceleration Testing

4.3.1 Recoverable and Non-recoverable Structure Load Testing

Tests shall be conducted to limit and ultimate loads. The load level at both limit and ultimate load shall be held from 5 to 10 seconds. The test may be conducted in either of two methods:

a. Incremental Loading: Up to limit load, the test loading shall be applied in increments of not more than 10% of limit load. After application of 100% limit load, all loads shall be reduced to zero. The specimen and data shall be carefully examined and any evidence of yielding documented and evaluated prior to continuing tests. The test load increments from limit to ultimate load shall not exceed 5% of limit load. The load shall be applied for a maximum of 10 seconds at each load increment.

b. Continuous Loading: Up to limit load, the test loading shall be applied at a constant rate of 2% of limit load per second. After application of 100% limit load, all loads shall be reduced to zero. The specimen and data shall be carefully examined and any evidence of yielding documented and evaluated prior to continuing tests. The test load to ultimate load shall be applied at a constant rate of 2% of limit load per second.

4.4 Thermal Altitude Testing

The equipment shall be loaded, instrumented, and operated as specified in the applicable detail qualification test specification during all phases of testing.

4.4.1 System Orbital Simulation

The complete payload system shall be subjected to an orbital simulation in which dynamic thermal programming shall reproduce the effects of various orbit solar incidence angles (Beta) at vacuums equivalent to those found in typical orbits. Temperature and pressure at all critical areas, both internal and external, shall be measured. Payload external surface patterns shall be correct for the orbits being simulated. If contingencies make this impossible, the thermal programming shall be adjusted to compensate for such lack of patterns.

All payload thermal masses such as parachutes and retro rockets shall be installed or simulated.

The payload shall be in orbital configuration.

a. After installation of the payload in the thermal altitude chamber, an interval vacuum of at least 10^{-4} mm Hg shall be achieved. During pump-down, all equipment normally operated during ascent and injection shall be energized.

b. The duration of the test shall equal the maximum planned mission of the payload.

c. During the course of the test, orbital solar incidence angles of 0°, $\pm 40^\circ$, $\pm 70^\circ$, shall be programmed.

d. The system shall be operated in all modes as specified in the applicable detail qualification specification.

e. At the conclusion of the programmed thermal test, the entire payload temperature shall be stabilized at 50°F and the system operated continuously for its maximum design continuous duty cycle period.

f. The test specified in paragraph e. shall be repeated with the payload temperature stabilized at 90°F.

g. The chamber shall be returned to room ambient conditions (Para. 5.1) and tests made as specified in the detail specification.

4.4.2 Non-Recoverable System Thermal Altitude Testing

These tests shall apply to systems subsidiary to the complete payload.

a. After the system is installed in the chamber, a vacuum of at least 10^{-5} mm Hg shall be achieved. The temperature of the system shall be stabilized at 105°F.

b. The system shall be operated continuously for its maximum design duty cycle period. (See Note 1, para. 4.4.4 d.)

c. The temperature shall be elevated to 110° and the system soaked non-operating for 8 hours.

d. The equipment shall be returned to ambient conditions (See Para. 5.0) and tests performed as specified in the detail qualification specification (See Para. 1.3).

e. The test shall be repeated using a temperature of 35°F for the operational test of Para. 4.4.2 b. and 20°F for the non-operational test of Para. 4.4.2 c.

4.4.3 Recoverable System Thermal Altitude Testing

The tests specified in Para. 4.4.2 shall be performed with the following exceptions.

a. The high-temperature operational test shall be performed at 105°F (Para. 4.4.2 a and b)

b. The high-temperature non-operational test shall be performed at 110°F (Para. 4.4.2 c)

c. The low-temperature operational test shall be performed at 30°F. (Para. 4.4.2 e)

d. The low-temperature non-operational test shall be performed at 0°F. (Para. 4.4.2 e)

4.4.4 Non-recoverable Components Thermal Altitude testing

a. After installation of the component in the thermal altitude chamber, a vacuum of at least 10^{-3} mm Hg shall be achieved in 180 seconds. During this period, the maximum pressure reduction rate shall be 15 mm Hg per second for a maximum period of 30 seconds. Pressure reduction shall continue until a pressure of 10^{-5} mm Hg or less is achieved.

b. Temperature change shall be started at approximately the same time as evacuation.

c. The temperature of the component stabilized at 125°F.

d. The component shall be operating normally during evacuation and temperature change. Ascent equipment shall be de-energized when 10^{-3} mm Hg pressure level has been reached. Orbital equipment shall be soaked inoperative for 4 hours and operated for 1.25 times the orbital mission duty cycle. (See Note 1)

Note 1: For duty cycles longer than 1 hr., operation periods for each test shall be 50% of the time specified.

e. The chamber shall be returned to room conditions and the equipment shall be tested according to applicable component specifications.

f. The tests specified in Para. 4.4.4 a - 4.4.4 e shall be re-performed, with the exception that the temperature shall be 0°F.

4.4.5 SRV Component Thermal Altitude Testing

4.4.5.1 The component shall be placed in the test chamber and the pressure reduced to 10^{-5} mm Hg or lower. While maintaining the reduced pressure, the temperature shall be cycled as follows:

Cycle	Temperature	Time
1	125°F	10 days
2	0°	4 days

At the end of the first cycle, while at 125°F and 10^{-5} mm Hg or lower, the component shall be subjected to a performance test in accordance with the requirements of the applicable component specification.

At the end of the second cycle, while at 0°F and 10^{-5} mm Hg or lower, the component shall be subjected to a performance test in accordance with the requirements of the applicable, component specification.

4.4.6 Recoverable and Non-Recoverable System and Component Leakage Testing

The container shall be purged with helium and then charged to the required pressure before being sealed. The sealed container shall then be placed in a suitable high-vacuum test chamber and elevated to its maximum operating temperature. The chamber shall then be evacuated to 10^{-3} mm Hg as quickly as possible. A suitable helium leakage detector shall be used for measurements. For containers with equipment that must be operational for more than a one-day period in orbit, the test chamber shall be maintained below 10^{-3} mm Hg for a minimum of 4 hours. The test item shall be maintained at its maximum specified operating temperature during this 4-hour period. The maximum allowable leakage rate shall be predicated on the maximum stand time of the unit being tested.

4.5 Shock Testing

a. The equipment shall be operated prior and subsequent to the following shock tests, and a performance record shall be made in accordance with the applicable qualification specification. Equipment shall be operative in test if it is operative during the launch or recovery phases of the mission. Shocks shall be applied thru the normal mounting points of the equipment in each direction along 3 mutually perpendicular axes. The shock wave form for ascent shall approximate a half sine wave with a duration of 6 ms. The magnitude of the shock shall be measured at the interface of the equipment and the test fixture. Induced secondary accelerations shall be measured along the two transverse axes.

As a test goal, the deceleration rate shall be no greater than one-half the initial input acceleration when the velocity is maximum at the end of the input shock.

b. Tests shall be performed on equipment susceptible to pyrotechnic shock environments. The test shall be capable of providing a pyrotechnic environment that simulates payload pyrotechnic events. The environment shall originate from the detonation of pyrotechnic devices equivalent in a manner to that found in the payload.

4.5.1 Systems Shock Testing

4.5.1.1 Recoverable System Weighing 75 lbs. or less

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
20	6	3

Lateral Axes

Level (g's)	Duration (ms)	Number (each)
6	6	3

4.5.1.2 Non-Recoverable Systems weighing 75 lbs. or less

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
20	6	3

Lateral Axes

Level (g's)	Duration (ms)	Number (each)
5	6	3

4.5.1.3 Recoverable Systems Weighing 76 lbs. to 250 lbs.

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
20	6	3

Lateral Axes

Level (g's)	Duration (ms)	Number (each)
5	6	3

4.5.1.4 Non-Recoverable Systems Weighing 76 lbs. to 250 lbs.

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
14	6	3

Lateral Axes

Level (g's)	Duration (ms)	Number (each)
5	6	3

4.5.1.5 Recoverable Systems Weighing over 250 lbs.

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
15	6	3

Lateral Axes

Level (g's)	Duration (ms)	Number (each)
5	6	3

4.5.1.6 Non-recoverable System Weighing over 250 lbs.

No requirement

4.5.1.7 SRV System Launch Configuration

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
20	6	3

Lateral Axes

Level (g's)	Duration (ms)	Number (each)
4	6	3

4.5.2 Structures Shock Testing

4.5.2.1 Recoverable Structure

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
25	8	3

Lateral Axes

Level (g's)	Duration (ms)	Number (each)
6	8	3

4.5.2.2 Non-recoverable Structure

No requirement

4.5.3 Component Shock Testing

4.5.3.1 Recoverable Components

All Axes

Level (g's)	Duration (ms)	Number (each)
35	8	3

4.5.3.2 Non-recoverable Components

Level (g's)	Duration (ms)	Number (each)
20	8	3

4.5.4 Pyrotechnic Shock Testing

Due to the difficulty of specifying pyrotechnic loads, pyrotechnic shock tests shall consist of the firing of actual pyrotechnic devices with the equipment in design configuration. Special pyrotechnic devices producing an average of 1.25 times normal load shall be used.

4.5.4.1 <u>Payload System Complete Pyrotechnic Shock Testing</u>

a. Pyrotechnic devices as specified in Para. 4.6.2 shall be fired in payload system complete configuration for a total of three shocks.

4.5.4.2 <u>Structures Pyrotechnic Shock Testing</u>

No requirement

4.5.4.3 <u>Component Pyrotechnic Shock Testing</u>

No requirement

4.6 Payload System Complete Acceptance Testing

4.6.1 Vibration

A low-level vibration environment shall be imposed during the acceptance testing of all systems. The specified vibration may be utilized for the purpose of detecting possible manufacturing and assembly defects, such as loose fasteners and cold solder joints. This test will not reflect the qualification environment. The equipment should be operating during testing if operative during launch*, and as many functional checks may be performed as required in the detail acceptance specification. Either random or sinusoidal vibration should be imposed along the longitudinal axis as follows:

a. Random Vibration: The system shall be subjected to random vibration for a period of 2 minutes at the following levels:

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.025	
400 - 2000	0.09	13.0

* Pyrotechnics and other one-shot devices excluded.

b. Sinusoidal Vibration: The system shall be subjected to a single sweep of sinusoidal vibration. A sweep rate equivalent to 30 seconds per octave shall be employed. The time for a single sweep from 15 to 2000 cps will be approximately 3.5 minutes.

15 - 400 cps	1 g zero-to-peak acceleration
400 - 2000 cps	2.5 g zero-to-peak acceleration

System resonant responses shall be limited to two times the input acceleration.

4.6.2 Thermal Altitude

An acceptance thermal altitude test to be performed on the system shall simulate the thermal vacuum conditions to which the system is expected to operate.

Note: Flight thermal shields shall not be used in altitude testing.

The chamber walls shall be programmed between minus 120°F and plus 230°F in a thermal simulation of a 75° orbit. The chamber pressure shall be maintained at 10^{-5} mm Hg.

Thermal gradients shall not be programmed.

5.0 TOLERANCES AND CONDITIONS (Unless otherwise specified)

5.1 Atmospheric Conditions (Ambient)

a.	Temperature:	60°F - 95°F
b.	Pressure:	710 - 810 mm Hg
c.	Relative Humidity:	Not more than 50%

5.2 Tolerances

a.	Temperature (°F):	± 5°F or 3%, whichever is greater
b.	Barometric Pressure	± 5%
c.	Relative Humidity:	5% of R_H
d.	Vibration Amplitude (g or inches), sinusoidal and random:	± 10%
e.	Vibration Frequency (cycles):	± 2% or 1 cycle, whichever is greater
f.	Shock (g or sec) Ascent and Recovery :	± 10%

g. Acceleration (g): ± 5% (at ref. point)

h. Regulated 28 VDC (positive): +27.85 VDC to +28.9 VDC

i. Unregulated 28 VDC: +21.5 VDC to +29.5 VDC

k. 115V, 400-cycle VAC: (1-Phase or 3-Phase) 113.7 - 117.3 VAC

l. 115V, 400-cycle frequency may vary between 399.996 and 400.004 cps

6.0 RECORDING AND REPORTING REQUIREMENTS

6.1 Performance Records

The equipment shall be operated under the conditions of 5.1 and a record made of all data necessary to determine compliance with qualification requirements in detail equipment specifications prior to conducting any of the tests specified herein. A comparison shall be made between data obtained under 5.1 and those obtained during and after testing. This comparison shall determine compliance with criteria for qualification. Variations from performance requirements shall be within limits acceptable to the Contractor, but shall not be in conflict with the contractual agreements between the Procuring Agency and the Contractor.

6.1.1 Detailed log books, test data, failure data, calibrations, and supporting analyses shall be provided in documented form accompanying the deliverable hardware. After acceptance, the payload equipment and SRV's shall be provided as government-furnished equipment (GFE) to the payload contractor for integration into the payload section of the satellite vehicle. Assembly of the integrated payload shall be in accordance with the requirements of the payload specification, including all applicable interface requirements. The payload section of the satellite vehicle shall then be acceptance tested as a complete unit, and offered for delivery to the procuring agency. Specifications, test plans, and procedures shall be subject to review and approval by the procuring agency. A/P will agree to having all test data, calibrations, etc., accompany the delivered hardware to the procuring agency. The payload test philosophy shall be documented in a test matrix by the payload contractor. The test matrix shall minimize unnecessary redundant testing, disassembly and handling of the payload section components at the factory areas and at the launch base. The test matrix shall provide the basis for approval modifications to implement changes to optimize the payload test plan.

6.2 Failure During Test

The test shall be stopped if a part or component fails during testing. No replacement, adjustment, maintenance, or repairs are authorized during tests. This requirement does not prevent the replacement or adjustment of equipment that has exceeded its design operating life during tests; provided that after such replacement the equipment is then given as many tests as are necessary to assure its proper operation. A complete record of any exception taken to this requirement shall be included in the test report.

6.3 Test Reports

Preparation of test reports shall be the responsibility of the testing agency. Each report shall document the test arrangement and test conditions in detail. The description shall include sufficient detail so that the test can be repeated independently of other information sources. Photographs of the test arrangement shall be included. The report shall contain a record of all measurements and observations, including laboratory ambient conditions. The sequence of testing shall be recorded. Degradation of equipment performance during testing shall be recorded even though still within tolerance limits at the conclusion of testing. Any failures experienced during testing shall be reported together with action taken to correct the efficiency.

6.4 Test Facilities

The test facilities and apparatus used in conducting the environmental tests shall be capable of producing and maintaining the test conditions required.

6.4.1 Volume

The volume of the test facilities shall be such that the bulk of the equipment under test shall not interfere with the generation and maintenance of test conditions.

6.4.2 Heat Source

The heat source of the test facilities shall be so located that intense radiant heat shall not fall directly on the equipment under test, except where application of radiant heat is a test requirement.

6.5 Measurement

All measurements shall be made with laboratory instruments whose accuracy has been certified. The accuracy of these instruments should be such that their tolerances are better than 0.1 times those tolerances specified in 5.2.

6.6 Equipment Operation

Equipment shall be operated during testing if this equipment will also be operated under similar environmental conditions in its actual application.

6.7 Controlled Environmental Equipment

Controlled-environment equipment shall be subjected to the environmental tests while installed in its associated container, when applicable.

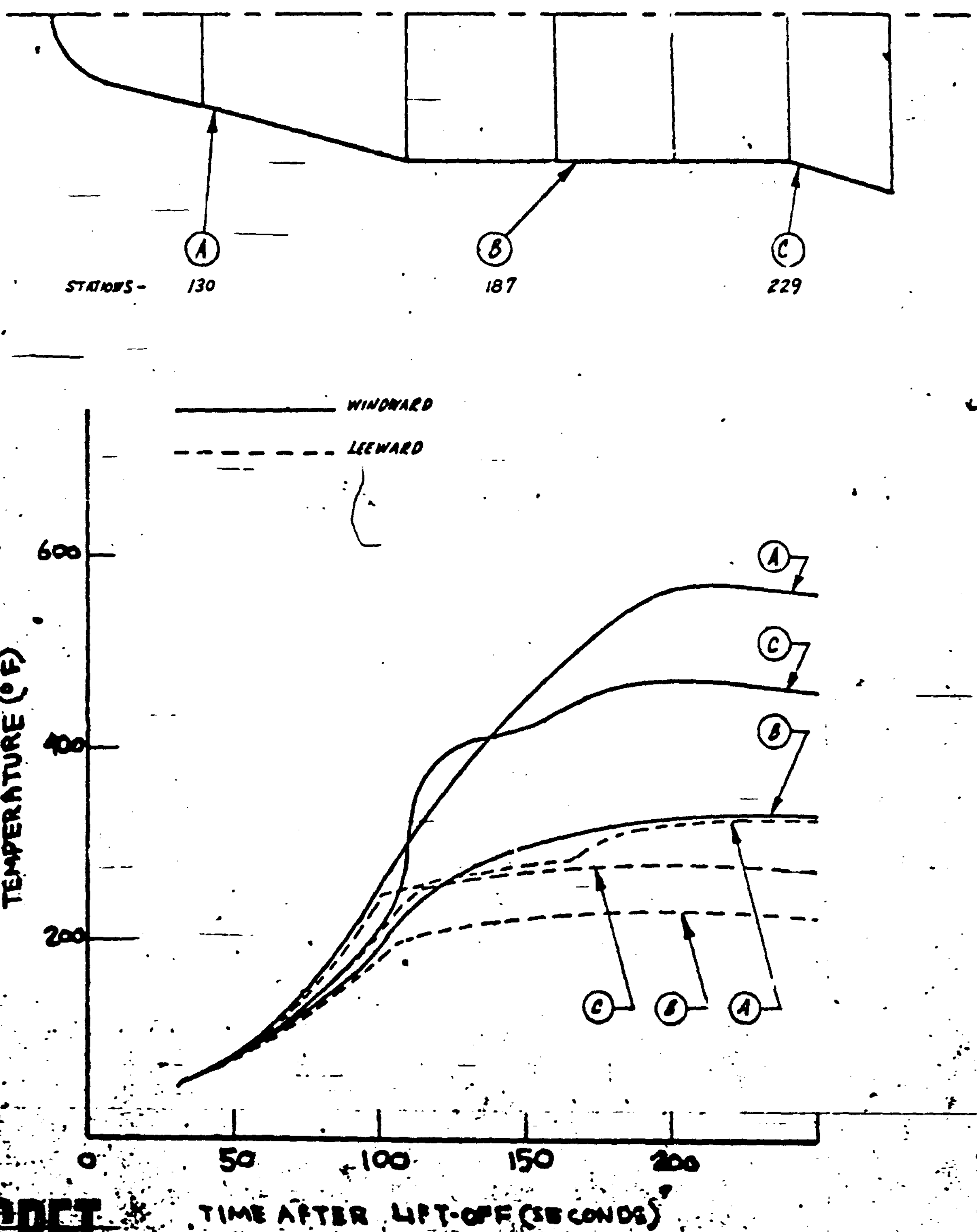
6.8 Sequence of Tests

The environmental tests shall be conducted in the order specified in the applicable detail equipment specification.

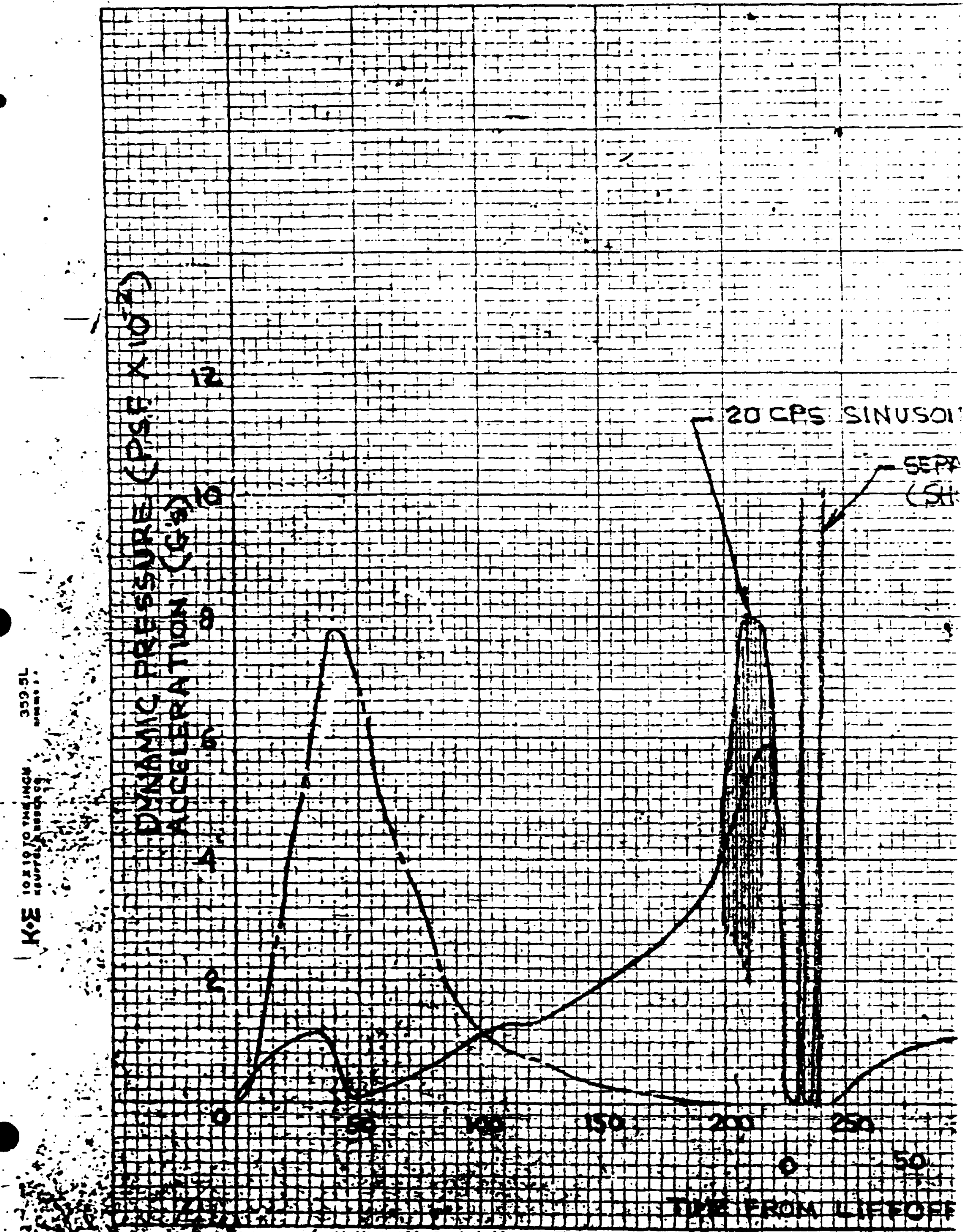
FIGURE 1

TYPICAL SKIN TEMPERATURE HISTORIES FOR THE HOTTEST MISSION (PALC)

(90 NM / 65° INCL)



TOP SECRET



TOP SECRET

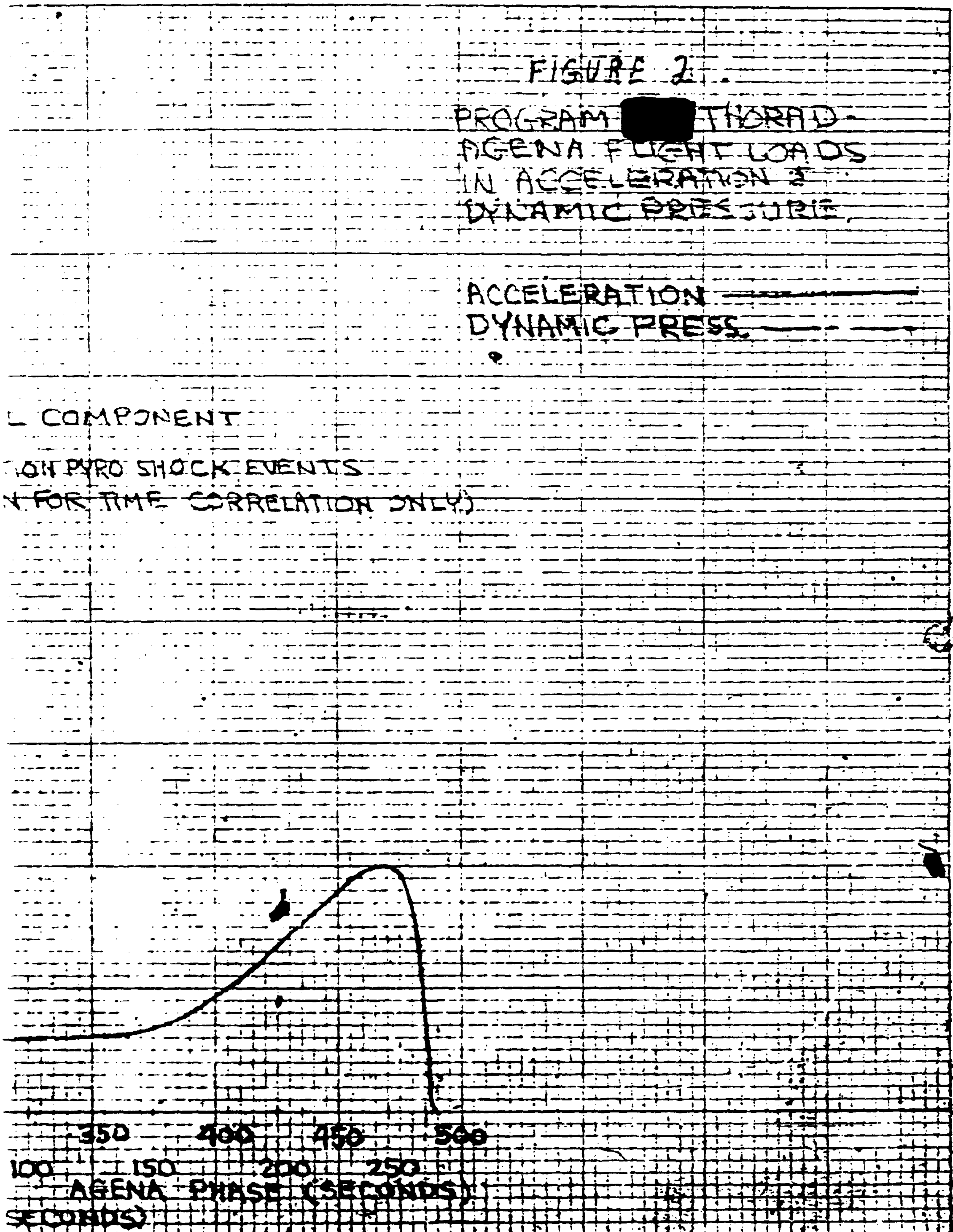


FIGURE 2
PROGRAM [redacted] THORAD-AGENA FLIGHT LOADS IN ACCELERATION & DYNAMIC PRESSURE.

TOP SECRET

T3-5-01)E - ELECTRICAL INTERFACE
SPEC -J3 CONSTANT ROTATOR

TOP SECRET

T3-5-019B

~~TOP SECRET~~ [redacted]

ELECTRICAL INTERFACE SPECIFICATION

FOR THE

"J-3"/CONSTANT ROTATOR SYSTEM

[redacted]

Contractor

[redacted]

Contractor

[redacted]

Customer

~~TOP SECRET~~ [redacted]

1.0 SCOPE

2.0 APPLICABLE DOCUMENTS

3.0 REQUIREMENTS

4.0 QUALITY ASSURANCE PROVISION

5.0 PREPARATION FOR DELIVERY

1.0 SCOPE

This document shall define the electrical interface between the "J-3" system as described in T3-5-016 Requirement Specification - J3 Configuration, and the Constant Rotator system as described in Camera Design Control Specification DCS-397-1, latest revision.

2.0 APPLICABLE DOCUMENTS

The following documents shall form a part of this specification to the extent specified herein. In the event of conflict, this specification shall prevail.

2.1 LMSC Documents:

LMSC 447969B - Specification for Electromagnetic Interference Control Requirement and Electrical Interface for Agena systems.

3.0 REQUIREMENTS

3.1 Electrical Interface Connectors

The "J-3" system will interface electrically with the Constant Rotator (C.R.) system through thirteen (13) connectors. The LMSC half of each connector is defined below. The C.R. shall provide a compatible mating connector in each instance, which shall be physically located per T33-100, -101, -102 interface drawing. Connectors with aluminum shells and gold iridite finish will be used wherever possible.

3.2 Connector Description and Pin Assignments

3.2.1 Command Connector
P1001 (PT06SE-16-26S-011)

A. Exposure Control No. 1
B Exposure Control No. 2
C. Exposure Control No. 3
D Exposure Control No. 4

E V/H Control Voltage
F V/H Control Return
G V/H Control Voltage
H V/H Control Return
J No. 1 Filter Control Back-up
K Orbit Mode Signal
L Orbit Mode Signal
M Relay Reset
N Relay Reset
P No. 1 Operate Command
R No. 1 Operate Command
S A to B Transfer Command
T A to B Transfer Command
U No. 2 Operate Command
V No. 2 Operate Command
W V/H Shield Tie
X V/H Shield Tie
Y Fail-Safe No. 1
Z Fail-Safe No. 2
a No. 2 Filter Control Back-up
b No. 1 Slit Width Fail Safe
c No. 2 Slit Width Fail Safe

Note: E and F are a twisted shielded pair with W as the shield tie

G and H are a twisted shielded pair with X as the shield tie

3.2.2 Power Connector
P1002 (PT06SE-20-16S-011)

A Unregulated Return #1
B AC Shield Tie
C Unregulated Return #1
D Spare
E Unregulated Return #2
F Spare
G Unregulated Return #2
H AC Return
J AC Shield Tie
K AC Return
L 115 VAC 400 CPS
M +24VDC Unregulated #1

N	+24 VDC Unregulated #1
P	+24 VDC Unregulated #2
R	+24 VDC Unregulated #2
S	115 VAC 400 CPS

Note: A and M are twisted unshielded pair
C and N are twisted unshielded pair
E and P are twisted unshielded pair
G and R are twisted unshielded pair
H and S are twisted shielded pair with J as shield tie
K and L are twisted shielded pair with B as shield tie

3.2.3 T/M Connector (No. 1)
P1004 (PT06SE-22-55P-011)

A	Spare
B	Temp Sensor #1
C	Temp Sensor #2
D	Temp Sensor #3
E	Temp Sensor #4
F	Temp Sensor #5
G	Temp Sensor #6
H	Temp Sensor #7
J	Temp Sensor #8
K	+5 VDC Temp Sensor Excitation
L	Temp Sensor Return
M	Temp Sensor Shield Tie
N	Launch Mode Monitor
P	Spare
R	Tachometer Feedback Voltage
*S	Servo Amp Output Voltage
*T	Operate Voltage
*U	Drive Motor Voltage
*V	Supply Spool Motor Voltage
*W	99/100 Clutch Command
*X	H.O. Platen Command
*Y	H.O. Shutter Command
Z	Units Cycle Count
a	Tens Cycle Count
b	Hundreds Cycle Count
c	Thousands Cycle Count
d	Cycle Counter Excitation (+ 5 VDC)
e	Cycle Counter Return
*f	Center of Format Command Monitor

g	Slit Width Position
h	Input H.O. Platen Position
i	Output H.O. Platen Position
j	Position Monitor Common for N, h, i, DD,
** k	Input Film Tension Monitor
** m	Input Film Tension Monitor Excitation
n	Input Metering Roller Pot Excitation
p	Input Metering Roller Pot Wiper
q	Input Film Idler Pot Excitation
r	Input Film Idler Pot Wiper
** s	Output Film Tension Monitor
** t	Output Film Tension Monitor Excitation
u	Output Framing Roller Pot Excitation
v	Output Framing Roller Pot Wiper
w	Output Film Idler Roller Pot Excitation
x	Output Film Idler Roller Pot Wiper
y	Lens Assembly Rotation Pot Excitation
z	Lens Assembly Rotation Pot Wiper
** AA	Shuttle Position Monitor
** BB	Shuttle Position Monitor Excitation
CC	Pot Common for k through BB, & GG,
DD	Filter Position Mon.
EE	Spare
FF	T/M Ret. for EE
GG	Spare
HH	Spare

* These functions require isolation from monitoring circuits external to the C.R.

** These pins reserved for functions listed

3.2.4 T/M Connector (No. 2)
P1005 (PT06SE-22-55PW-011)

A	Spare
B	Temp Sensor #1
C	Temp Sensor #2
D	Temp Sensor #3
E	Temp Sensor #4
F	Temp Sensor #5
G	Temp Sensor #6
H	Temp Sensor #7
J	Temp Sensor #8

K	+5 VDC Temp Sensor Excitation
L	Temp Sensor Return
M	Temp Sensor Shield Tie
N	Launch Mode Monitor
P	Spare
R	Tachometer Feedback Voltage
*S	Servo Amp Output Voltage
*T	Operate Voltage
*U	Drive Motor Voltage
*V	Supply Spool Motor Voltage
*W	99/100 Clutch Command
*X	H.O. Platen Command
*Y	H.O. Shutter Command
Z	Units Cycle Count
a	Tens Cycle Count
b	Hundreds Cycle Count
c	Thousands Cycle Count
d	Cycle Counter Excitation (+5 VDC)
e	Cycle Counter Return
*f	Center of Format Command Monitor
g	Slit Width Position
h	Input H.O. Platen Position
i	Output H.O. Platen Position
j	Position Monitor Common for N, h, i, DD,
**k	Input Film Tension Monitor
**m	Input Film Tension Monitor Excitation
n	Input Metering Roller Pot Excitation
p	Input Metering Roller Pot Wiper
q	Input Film Idler Pot Excitation
r	Input Film Idler Pot Wiper
**s	Output Film Tension Monitor
**t	Output Film Tension Monitor Excitation
u	Output Framing Roller Pot Excitation
v	Output Framing Roller Pot Wiper
w	Output Film Idler Roller Pot Excitation
x	Output Film Idler Roller Pot Wiper
y	Lens Assembly Rotation Pot Excitation
z	Lens Assembly Rotation Pot Wiper
**AA	Shuttle Position Monitor
**BB	Shuttle Position Monitor Excitation
CC	Pot Common for k through BB & GG, g,
DD	[illegible] Position Mon.

EE Pad Temperature Sensor
FF Pad Temperature Sensor
GG Spare
HH Spare

* These functions require isolation from monitoring circuits external to the C. R.
** Pins reserved for functions listed

3.2.5 Take-Up (T/U) Control Connector
P1003 (PT06SE-16-26P-011)

A	#2 T/U Control Voltage, Ascent Mode	
B	#1 T/U Control Voltage, Ascent Mode	A SRV
C	#1 T/U Control Voltage Return (A)	
D	#1 T/U Control Voltage Return (A)	
E	#1 T/U Control Voltage Return (B)	
F	#2 T/U Control Voltage, C/W Mode	B SRV
G	#2 T/U Control Voltage Return (A)	
H	#2 T/U Control Voltage Return (A)	
J	#1 T/U Control Voltage, C/W Mode	
K	Spare	
L	#2 T/U Control Voltage Return (B)	
M	#2 T/U Control Voltage (B)	
N	#2 T/U Control Voltage (B)	
P	#2 T/U Control Voltage Return (B)	
R	#1 T/U Control Voltage Return (B)	
S	#1 T/U Control Voltage (B)	
T	#1 T/U Control Voltage (A)	
U	#1 T/U Control Voltage (A)	
V	#1 T/U Control Voltage (B)	
W	#2 T/U Control Voltage (A)	
X	#2 T/U Control Voltage (A)	
Y	Brake Release Command #1	
Z	Brake Release Command #2	
a	Anti-back up Command #1	
b	Anti-back up Command #2	
c	Spare	

3.2.6 Data Connector (No. 1)
P1006 (PT06SE-22-55S-011)

A Spare
B Spare
C Spare

D Spare
E Spare
F Spare
G Spare
H Spare
J Spare
K Spare
L Spare
M Spare
N Spare
P Spare
R Spare
S Data 3 Column Select
T Data 4 Column Select
U Data 5 Column Select
V Data 2 Column Select
W Data 1 Column Select
X Index Column Select
Y 200 PPS Signal Input
Z No. 1 Interrogate Pulse
a Bit #1
b Bit #2
c Bit #3
d Bit #4
e Bit #5
f Bit #6
g Bit #7
h Bit #8
i Bit #9
j Bit #10
k Bit #11
m Bit #12
n Bit #13
p Bit #14
q Bit #15
r Bit #16
s Bit #17
t Bit #18
u Bit #19
v Bit #20
w Bit #21
x Bit #22
y Bit #23
z Bit #24

AA	Bit #25
BB	Bit #26
CC	Bit #27
DD	Bit #28
EE	Bit #29
FF	Bit #30
GG	Bit #31
HH	Bit #32

3.2.7 Data Connector (No. 2)
P1007 (PT06SE-22-55S-011)

A	Spare
B	Spare
C	Spare
D	Spare
E	Spare
F	Spare
G	Spare
H	Spare
J	Spare
K	Spare
L	Spare
M	Spare
N	Spare
P	Spare
R	Spare
S	Spare
T	Spare
U	Spare
V	Data 2 Column Select
W	Data 1 Column Select
X	Index Column Select
Y	200 PPS Signal Input
Z	No. 2 Interrogate Pulse
a	Bit #1
b	Bit #2
c	Bit #3
d	Bit #4
e	Bit #5
f	Bit #6
g	Bit #7
h	Bit #8
i	Bit #9
j	Bit #10

k	Bit #11
m	Bit #12
n	Bit #13
p	Bit #14
q	Bit #15
r	Bit #16
s	Bit #17
t	Bit #18
u	Bit #19
v	Bit #20
w	Bit #21
x	Bit #22
y	Bit #23
z	Bit #24
AA	Bit #25
BB	Bit #26
CC	Bit #27
DD	Bit #28
EE	Bit #29
FF	Bit #30
GG	Bit #31
HH	Bit #32

3.2.8 Take-up Connector ("A" SRV)
W2P8 (PT06SE-16-26S-011)

A	Temp Sensor Monitor
*B	No. 2 T/U Rotation Monitor Excitation
*C	No. 1 T/U Rotation Monitor
D	No. 2 T/U Film Footage Monitor
E	No. 1 T/U Control Voltage
F	Heater Power
G	No. 2 T/U Motor Voltage Monitor
*H	No. 2 T/U Rotation Monitor
J	No. 2 T/U Anti-Backup Control Voltage
*K	No. 1 T/U Rotation Monitor Excitation
L	No. 1 Film Footage Monitor
*M	No. 1 and No. 2 Rotation Monitors Common
N	No. 1 and No. 2 Control Voltage Return
P	No. 1 T/U Motor Voltage Monitor
R	Shield Tie
S	No. 1 and No. 2 Film Footage Pot Excitation (+5 VDC)
T	Heater Power Return

U No. 1 Anti-Backup Control Voltage
V No. 2 T/U Control Voltage
W No. 2 T/U Control Voltage
X No. 1 T/U Control Voltage
Y Temp Sensor Return
Z #1 T/U Control Voltage, Ascent Mode
a No. 1 and No. 2 Film Footage Pot Return
b No. 1 and No. 2 T/U Control Voltage Return
c #2 T/U Control Voltage, Ascent Mode
* Pins Reserved for functions listed

3.2.9 Take-up Connector ("B" SRV)
W2P8 (PT06SE-16-26S-011)

A Temp Sensor Monitor
*B No. 2 T/U Rotation Monitor Excitation
*C No. 1 T/U Rotation Monitor
D No. 2 T/U Film Footage Monitor
E No. 1 T/U Control Voltage
F Heater Power
G No. 2 T/U Motor Voltage Monitor
*H No. 2 T/U Rotation Monitor
J No. 2 T/U Brake Control Voltage
*K No. 1 T/U Rotation Monitor Excitation
L No. 1 Film Footage Monitor
*M No. 1 and No. 2 Rotation Monitors Common
N No. 1 and No. 2 Control Voltage Return
P No. 1 T/U Motor Voltage Monitor
R Shield Tie
S No. 1 and No. 2 Film Footage Pot Excitation (+5 VDC)
T Heater Power Return
*U No. 1 T/U Brake Control Voltage
V No. 2 T/U Control Voltage
W No. 2 T/U Control Voltage
X No. 1 T/U Control Voltage
Y Temp Sensor Return
Z #1 T/U Control Voltage, C/W Mode
a No. 1 and No. 2 Film Footage Pot Return
b No. 1 and No. 2 T/U Control Voltage Return
c #2 T/U Control Voltage, C/W Mode

* Pins Reserved for functions listed

3.2.10 C.R. to Supply Cassette Harness

LMSC shall supply an electrical harness to interconnect the C.R. No. 3 J-Box connector J-1008 to the supply spool cassette connector J1009. The harness shall be wired to the listing below:

C.R. No. 3 J-Box P1008 PT06SE-16-26P-011		Supply Spool P1009 PT06SE-16-26S-011
From	**Wire Description**	**To**
A	20 AWG Single Unshielded	A
B	20 AWG Single Unshielded	B
C	20 AWG Single Unshielded	C
D	20 AWG Single Unshielded	D
E	No connection	E
F	No connection	F
G	No connection	G
H	No connection	H
J	No connection	J
K	No connection	K
L	20 AWG Single Unshielded	L
M	20 AWG Single Unshielded	M
N	20 AWG Single Unshielded	N
P	20 AWG Single Unshielded	P
R	20 AWG Single Unshielded	R
S	20 AWG Single Unshielded	S
T	20 AWG Single Unshielded	T
U	20 AWG Single Unshielded	U
V	22 AWG Single Shielded	V
W	22 AWG Single Shielded	W
X	22 AWG Single Shielded	X
Y	22 AWG Single Shielded	Y
Z	22 AWG Single Shielded	Z
a	20 AWG Single Unshielded	a
b	20 AWG Single Unshielded	b
c	20 AWG Single Unshielded	c

The shields of conductors on pins V, thru Z, shall be commoned and returned to Pin T.

3.2.11 Intermediate Roller Monitor #1 P1010 (PT06-SE-10-6S (SR)

A. Excitation
B. Wiper
C. Common

3.2.12 Intermediate Roller Monitor #2 P1011 (PT06-SE-10-6S (SR)

A. Excitation
B. Wiper
C. Common

3.3 Electrical Interface Design Requirements

3.3.1 Electrical Power

LMSC shall supply unregulated DC and 115 VAC, 400 CPS, 1Ø power to the C.R. system. Power shall be supplied continuously during a normal mission which includes pre-launch and launch modes. The C.R. system, including take-up and supply cassettes, shall be capable of operating without impairment of function when supplied from the main bus of a central system with power within the limits and characteristics specified in the following subsections and under the conditions of power utilization prescribed by Section 3.3.1.3.

3.3.1.2 Power Supply Characteristics

3.3.1.2.1 Steady-State Voltages.

The steady-state voltages of the central power supplies measured at distribution buses in the vehicle shall be within the limits specified below at zero load.

(a) Unregulated DC +22.0 to +29.5 volts

(b) 400 CPS, 1 Ø 113.7 to 117.3 V rms

The allowable line drops from the distribution buses to the C.R. system power input connector is 1.0 volt DC and 2.0 volts rms AC with an average load (see Para. 3.3.1.3.2)

3.3.1.2.2 Output Impedance

The output impedance of the DC power supply shall not exceed 0.25 ohms at +29.5 volts.

3.3.1.2.3 Wave Form Distortion

The total non-fundamental frequency content of the voltage wave form of the vehicle AC supply measured as distortion of the fundamental shall not exceed 5% for noise-free linear loads from zero to rated load for frequencies above the fundamental supply frequency.

[redacted]

NO [redacted]

3.3.1.2.4 Amplitude Modulation

The modulation shall not exceed 7 volts p-to-p over a period of not less than 1 second for noise-free linear loads for frequencies below the fundamental supply frequency. These limits shall not be exceeded for DC input voltages as specified in 3.3.1.2.1 while the audio frequency conducted test signal is applied as specified in paragraph 4.3.4.1.2 of LMSC 447969B.

3.3.1.2.5 Voltage Transients

The dynamic regulation of the vehicle AC supply shall be such that, under the worst combination of step function changes in all input voltages within prescribed limits and in load current from no load to rated load or vice-versa, the peak output voltage shall remain within +100 volts and -50 volts of 162.6 volts and shall recover with a time constant (63% response) of 25 milliseconds.

3.3.1.2.6 Frequency

The frequency of the vehicle AC supply shall be maintained between 399.992 and 400.008 cps. These limits shall apply for steady state conditions, under worst combination of step function changes in all input voltages within prescribed limits and in load current from no load to rated load or vice-versa.

3.3.1.3 Load Characteristics

3.3.1.3.1 Power Utilization

Subsystems utilizing power shall be designed to give required performance when supplied with the types of power having the values and tolerances of parameters at the power distribution buses as specified in 3.3.1.2.

3.3.1.3.2 Power Consumption

The current requirements of the C.R. system, including

[redacted]

the take-up and supply cassettes, shall not exceed the limits listed below

DC current: 20 amps average with peaks not to exceed 25 amps during operation with starting surges not to exceed an additional 20 amps for durations not to exceed 500 milliseconds.

AC current: 0.5 amps average during operation with starting surges not to exceed an additional 0.25 amps for durations not to exceed 500 milliseconds

The C.R. system power requirements shall be minimized when not operating. All continuous power requirements of the C.R. system shall be subject to review by LMSC.

3.3.1.3.3 Load Impedance

(a) The impedance presented by the C.R. system to the DC power supply shall be essentially resistive, and noise-free to the greatest extent possible.

(b) The load presented to the vehicle AC supply shall have a power factor as near unity as practicable for all modes of operation and shall not present loads with steady-state power factors less than 0.8 Lagging and 0.95 Leading.

3.3.1.4 Switched Capacitor Loads

Switched capacitor loads shall have surge current limiting resistors in series.

3.3.1.5 Inductive Spike Suppression

The use of diodes or other equally effective devices to suppress spikes that result from collapsing DC magnetic fields is mandatory in every case where a DC current that flows through an inductance is interrupted. The diode or other suppression device shall be mounted as close to the inductance as is possible.

3.3.1.6 Cable and Harnessing

Cables and harnesses for the C.R. system and those portions of LMSC cables and harnesses that interface, with the C.R. system shall be fabricated conforming to the applicable requirements of paragraph 3.2.11.1.1, 3.2.11.1.4 and paragraph 3.2.6.1.4 through 3.2.6.1.7 of LMSC 447969B, to every extent possible.

3.3.1.7 AF Signal Circuits

A.F. signal circuits (0-150 KC) which require shielding for proper operation shall be shielded with the shield grounded by LMSC at the vehicle ground point only. Shields shall not be connected in any way which creates a loop having nominally zero ohms impedance. The shields shall be routed through the pins provided on the various interface connectors. (See Section 3.2)

3.3.1.8 Grounding

The C.R. system shall not ground any power or signal returns to chassis or structure. All airborne ground return leads, shall be grounded to the vehicle frame through the vehicle ground point (VGP) only. (See LMSC 447969B, paragraph 3.2.8.1)

3.3.1.8 Bonding

The C.R. system shall conform to the applicable portions of bonding requirements of paragraph 3.2.12.1 through 3.2.12.2.2 and paragraph 3.2.12.3 through 3.2.12.5 of LMSC 447969B to every extent possible.

3.4 Electrical Interface Function Description

3.4.1 Command Descriptions

3.4.1.2 No. 1 Operate Command (P1001-P & R)

The No. 1 Operate Command shall be +24 VDC Unregulated referenced to unregulated return. It shall be continuous throughout each programmed operation. Only the No. 1 camera and its associated supply and take-up cassettes shall begin operation upon receipt of the command and shall cease operation at the end of the next complete cycle after the command is removed. The command length will be a minimum of 23 seconds long with a minimum of 30 seconds between commands The command source shall be capable of supplying 1.0 amps. continuously through isolating diodes which have a 1.0 volt forward drop at 0.5 amps forward current. The C.R. system shall be insensitive to normal relay contact bounce present at the leading and trailing edge of the command.

3.4.1.3 No. 2 Operate Command (P1001-U & V)

The No. 2 Operate Command shall be identical to but electrically isolated from the No. 1 Operate Command. The No. 2 Operate Command shall cause only the No. 2 camera and its associated supply and take-up cassettes to operate.

3.4.1.4 "A" to "B" Transfer Command (P1001-S & T)

The "A" to "B" Transfer Command shall be + 24 V unregulated signal referenced to unregulated return. The "A" to "B" Transfer Command shall be 30 seconds long with a current capacity of 2.0 amps. The No. 1 and No. 2 Operate Commands will be energized for 30 seconds coincident with "A" to "B" Transfer Command. A V/H control voltage shall be supplied by LMSC that will cause the No. 1 and No. 2 cameras to operate a minimum of 4 cycles in 25 seconds. Upon receipt of the "A" to "B" Transfer Command the C. R. system shall transfer from the "A" mode to the "B" mode. The C.R. system shall contain the necessary circuits and components to perform this transfer operation. (The "A" mode is that part of the mission when film is taken up by the cassettes in the "A" or forward SRV. The "B" mode is that part of the mission when film is taken up by the cassettes in the "B" or aft SRV.)

3.4.1.5 V/H Control Voltage (P1001-E & G)

LMSC shall supply a V/H control voltage to the C.R. system referenced to the V/H control voltage return (P1001-F & H). The V/H Control voltage shall vary between 5 volts maximum and 1 volts minimum with a maximum rate of change of $\frac{\pi(V_{max} - V_{min})}{2400}$ volts per second.

The voltage source shall have an output impedance (measured between P1001-E & G and P1001-F & H) of 10 ohms when the voltage source is operating. The C.R. system input impedance (measured between J1001-E & G and J1001-F & H) shall be 10-kilo-ohms resistive or greater. The C.R. system response to the V/H Control voltage shall be repeatable within ± 1% of the V/H Control voltage versus cycle rate. Pins F&H, v/h voltage return shall be isolated from the Unregulated Return."

3.4.1.6 Relay Reset Command (P1001-M & N)

The Relay Reset Command shall be a +24 VDC Unregulated ~~command~~ referenced to unregulated return. The Relay Reset Command shall be a non-flight, pre-launch command of 10 seconds or less duration and has a current capacity of 2 amps. Upon receipt of the command the C.R. system shall be placed in a launch ready mode.

3.4.1.7 Orbit Mode Signal

The Orbit Mode Signal shall be a +24 VDC unregulated signal referenced to unregulated return. The Orbit Mode signal shall be a 15 second long pulse which will indicate the end of powered flight. Upon the receipt of the signal the C.R. system shall be placed in a mission ready condition.

3.4.1.8 Fail Safe No. 1 (P1001-Y)

The No. 1 camera system shall provide switches on each shuttle mechanism which shall be operated (closed to unregulated ground) by either shuttle in extreme overtravel condition. The switches shall be wired in parallel and when operated shall cause the immediate removal ~~of GSE power~~ to the No. 1 camera system. The circuits shall be used for pre-flight operations only. The circuits shall be inoperative during a normal mission.

3.4.1.9 Fail Safe No. 2 (P1001-Z)

The No. 2 camera system shall provide switches and circuits identical to the No. 1 camera. (See paragraph 3.4.1.8).

3.5 Telemetry Signals Description

3.5.1 All rotating idlers and metering roller monitors, in the C. R. system, shall consist of continuously rotating potentiometers having an electrical angle of not less than 350°. The nominal resistance value shall be 5K Ω and the resistance tolerance shall be ± 10% or better. The potentiometer linearity shall be ± 1.0% and the resolution shall be .1% or less.

The functions to be monitored with transducers having these characteristics are as follows:

a) Input Metering Roller

b) Input Film Idler

c) Output Framing Roller

d) Output Film Idler

e) Lens Assembly Rotation

3.5.2 All linear and certain rotary action telemetry monitors shall generate analog outputs that are repeatable to ± 1%. It is preferred to have unconditioned linear resistive outputs from the monitors but if the nature of the transducer is incompatible with this requirement then the output shall be 0 to 5 volts DC.

The functions to be monitored with transducers having these characteristics are as follows:

a) Input Film Tension

b) Output Film Tension

c) Shuttle Position

d) T/U Rotation

3.5.3 Slit Width Monitor (P1004 & P1005 - g)

The C.R. system shall provide a 0 to 5 volt DC signal, referenced to unregulated return, which will indicate the slit width. The monitor output shall be wired to P1004 and P1005-g, and shall be a potentiometer with a resistance of 5,000 ohms ± 10%. Approximately four fifths (4/5) of the total potentiometer available excursion shall be utilized to cover the full range of available slits.

3.5.4 Input H.O. Platen Position (P1004 & P1005 - h)

The input H.O. platen position monitor shall be configured so as to indicate the position of the input H.O. platen. The monitor shall consist of a form A contact arrangement wired so that closed contacts indicate that the platen is clamped and open contacts indicate that the platen is released. The movable contact shall be wired to pin h (P1004 & P1005) and the stationary contact shall be wired to T/M position monitor common pin j (P1004 & P1005).

3.5.5 Output H.O. Platen Position (P1004 & P1005 - i)

The output H.O. Platen position monitor shall be configured so as to indicate the position of the output H.O. platen. The monitor shall consist of a form A contact arrangement wired so that closed contacts indicate that the platen is clamped and open contacts indicate that the platen is unclamped. The movable contact shall be wired to pin i (P1004 & P1005) and the stationary contact shall be wired to T/M position monitor common pin j (P1004 & P1005).

3.5.6 Temperature Sensor Characteristics

Each camera subsystem shall provide eight temperature sensors with the following characteristics:

Nominal Resistance	2000 Ω ± 2% at a nominal temperature between 70°F and 78°F.

Coefficient of Resistance	90% ± 2% change in resistance with a 200°F change in temperature from nominal.
Operating Range	-100°F to +400°F
Leakage Resistance	Room temperature leakage resistance with a 50 volt excitation shall be greater than 50 megohms
Power Dissipation	Nominal resistance value shall remain to ± 2% when power is applied (10 to 50 milliwatts) and through resistance stabilization."
Calibration	A four or five point vender calibration shall be furnished with each temperature sensor. The calibration shall cover the range from -50°F to +150°F if possible.

3.5.7 Temperature Monitoring Circuit

Each temperature monitoring circuit shall consist of the temperature sensor of paragraph 3.5.6 in series with a 1.5K ohm divider resistor. The divider resistor shall be rated for 1/4 watt dissipation and the resistance tolerance shall be ± 0.1% with a temperature coefficient of resistance of 100 PPM per degree centigrade or less.

3.5.8 Cycle Counter

The cycle counter shall be a mechanically actuated four place counter. Each decade shall furnish a single wire output signal to indicate the count accumulated in that decade. The signal shall start at 0.5 volts for count of zero and proceed in steps of 0.5 volts to a maximum of 5.0 volts for a count of nine. The four decades shall be provided with isolated excitation on pin d (P1004 & P1005) and common return on pin e (P1004 and P1005)

3.5.9 Launch Mode Monitor (P1004 & P1005 - N)

The launch mode monitor shall be configured so as to indicate the launch condition of the camera system. The monitor shall be a form A contact arrangement wired so that closed contacts indicate a launch ready condition and open contacts indicate receipt of the orbit mode signal. The movable contact shall be wired to pin N (P1004 & P1005) and the stationary contact shall be sired to T/M position monitor common pin j (P1004 & P1005).

3.5.10 Unconditioned Signal Monitoring

The following functions shall be monitored and the actual unconditioned command and operating voltages shall be provided as signals to the T/M interface:

a) Servo Amp. Output Voltage	Pin S
b) Operate Voltage	Pin T
c) Drive Motor Voltage	Pin U
d) Supply Spool Motor Voltage	Pin V
e) 99/101 Clutch Command	Pin W
f) H.O. Platen Command	Pin X
g) H.O. Shutter Command	Pin Y
h) Center of Format Command	Pin f

The signals shall be isolated from the source by means of emitter followers or any other high input impedance devices. The output impedance of the isolation amplifiers shall be less than 500 ohms and the signals shall be referenced to unregulated return.

3.5.11 Tachometer Feedback Voltage (P1004 & P1005-R)

The C.R. System shall provide a 0 to 5 volt DC signal proportional to the Tachometer Feed back voltage and referenced to unregulated return: The LMSC monitor circuit shall draw a maximum of one milliamp when the telemetry system is operating.

3.5.12 Pad Temperature Sensor (P1005 - EE, FF)

The C.R. System shall provide a single temperature sensor with the characteristics as described in paragraph 3.5.6, located on the C.R. structure so that the sensor will monitor a temperature representative of the C.R. system during all pre-launch activity. The temperature sensor shall have one lead wired directly to J1005-EE and the other wired directly to J1005-FF.

3.5.13 Film Footage Monitor (P1003)

The C.R. System shall provide separate Film Footage monitors on each take-up spool. The monitors shall be potentiometer with maximum resistance of 5000 ohms $\pm$ 10%. The output resistance of each potentiometer, measured between the wiper and return, shall vary from the minimum resistance to the maximum resistance as the quantity of film increases from zero to 70% of a full spool. The output resistance shall then decrease to the minimum value as the quantity of film increases from 70% to 115% of a full spool. A spool is defined as full when the film wrap diameter is coincident with the outer edge of the spool flange. The relationship of potentiometer output resistance to film quantity shall be linear within $\pm$2%.

3.6 Data Signal Description

3.6.1 200 PPS Signal (P1006-Y and P1007-Y)

The Digital Recording Clock Generator (DRCG) shall furnish the C.R. system a 200 pps signal suitable to trigger a pulsing circuit. The 200 pps signal supplied to the C.R. system shall be referenced to unregulated return and conform to the following parameters:

(a) Repetition rate	200 pulses per second
(b) Amplitude	-10 volts ± 1 volt (from ground to -10 volts)
(c) Pulse Width	70 micro seconds, ± 10 micro seconds (at half amplitude)
(d) Rise Time	2 microseconds maximum, 10% to 90%
(e) Allowable Loading	2000 ohms in parallel with 500 pico farads

3.6.2 Interrogate Pulse (P1006-Z and P1007-Z)

The C.R. system cameras shall each generate an interrogate pulse gated by each of their Center-of-Format pulses, and synchronized with a 200 pps pulse. The interrogate pulse shall be referenced to unregulated return and have the following parameters:

(a) Amplitude	+12 volts, +3, -1 volt
(b) Pulse Width	5 microseconds minimum
(c) Rise Time	2 microseconds maximum, 10% to 90%

3.6.3 DRCG Data Bits (P1006-a thru HH and P1007-a thru HH)

The C.R. system shall provide unshielded direct wiring between the Data Connectors, J1006 and J1007, and the Silicon Light Pulser (S.L.P.) data heads. LMSC shall supply conditioned data signals directly to the SLP unit. The columns and rows shall be defined by Fairchild Spec Control Dwg. C700036 Rev. A.

4.0 QUALITY ASSURANCE PROVISION

Not applicable

5.0 PREPARATION FOR DELIVERY

Not applicable

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SPECIFICATION CHANGE NOTICE NO. 1

Program: J-3	Supersedes: Rev. No. B Paragraph No. Page No.	Date: 5-3-66 File Opposite Spec Page No.
Spec. No. TS-5-019B		

Effectivity: J-3 Configuration

Initiated by: [redacted] Date 5-2-66

Reason for Change:

[redacted] 5-4-66 Date [redacted] 5-10-66 Date

[redacted] 5-13-66 Date [redacted] 5-13-66 Date

CHANGE:

Page 7 (Clarification & Reassignment Para 3.2.6)

Page 8 (Clarification & Reassignment Para 3.2.7)

Data Connector No. 1 and No. 2

Pages 7 & 8 are both changed as shown:

Was:	Is:
S Data 3 Column Select	S Column 6 Drive (Spare)
T Data 4 Column Select	T Column 5 Drive (Spare)
U Data 5 Column Select	U Column 4 Drive (DISIC Operate)
V Data 2 Column Select	V Column 3 Drive (Time Compliment)
W Data 1 Column Select	W Column 2 Drive (Time and Parity)
X Index Column Select	X Column 1 Drive (Index)

Page 15

Change Bonding 3.3.1.8 to 3.3.19 (typing error)

TOP SECRET

~~TOP SECRET~~ [redacted]

SPECIFICATION CHANGE NOTICE NO. 2

Program: J-3	Supersedes: Rev. No. B	Date:
Spec. No. T3-5-019B	Paragraph No.	File Opposite Spec
	Page No.	Page No.

Effectivity: Original Design

Initiated by: [redacted] Date 5-10-66

Reason for Change: System Requirements Increase

[redacted] 5-11-66 Date

5-11-66 Date

[redacted] ...-66 Date

Resident Office

Date

CHANGE:

PAGE	PARA.	CHANGE
1	3.2.1	Connector Type Change Is: PT06SE-20-41S-011 Was: PT06SE-16-26S-011 Add to Pin A "Minimum Width" Add to Pin D "Maximum Width"
2	3.2.1	Add the following pins: d Slit width fail safe No. 1 reset e Slit width fail safe No. 2 reset f Spare g Spare h Spare i Spare j No Connection k " " m " " n " " p " " q " " r " "

TOP SECRET [redacted]

TOP SECRET [redacted]

SPECIFICATION CHANGE NOTICE NO. 2

Program: J-1	Supersedes: Rev. No. B	Date:
Spec. No. T3-5-019B	Paragraph No. Page No.	File Opposite Spec Page No.

Effectivity: Original Design

Initiated by: [redacted] Date 5-10-66

Reason for Change: System Requirements Increase

[redacted] 5-11-66 Date [redacted] 5-13-66 Date

5-16-66 Date Resident Office Date

PAGE	PARA.	CHANGE
	3.2.1	Connector Type Change Is: PT06SE-20-41S-011 Was: PT06SE-16-26S-011 Add to Pin A "Minimum Width" Add to Pin D "Maximum Width"
	3.2.1	Add the following pins: d Slit width fail safe No. 1 reset e Slit width fail safe No. 2 reset f Spare g Spare h Spare i Spare j No Connection k " " m " " n " " p " " r " "

[redacted]

Program: J-3
Spec. No: T3-5-019B

[redacted]

CHANGE:

PAGE	PARA.	CHANGE
2	3.2.1	e. No Connection t. No Connection
2	3.2.1	Add the following notes: [illegible] "E & G will be connected at the [illegible] interface." "F & H will be connected [illegible] jointly with the [illegible] the [illegible] interface [illegible] vehicle power returns on the [illegible]"
3	3.2.2	Add [illegible] "A, C, E & G will be tied [illegible] instrument electrical [illegible]"
3	3.2.3	Pin D is: Slit width fail-safe [illegible] was: Spare. Pin G is: Cycle counter, [illegible] position [illegible] Mon. [illegible] was: Cycle counter [illegible] (4.5 VDC) Pin e is: Cycle counter [illegible] fail safe monitor [illegible]
4	3.2.3	Pin J [illegible] Delete Pin DD [illegible] [illegible]
5	3.2.4	[illegible]

[redacted]

[redacted]

[illegible]	PARA.	CHANGE
	3.2.4	Pin [illegible] is: Cycle counter & [illegible] [illegible] [illegible] [illegible]
		was: Cycle counter return
		Pin [illegible] Delete Pin DD, [illegible]
		Pin CC [illegible] Delete Pin g [illegible] CC
6	3.2.4	Pin CC is: Position monitor common [illegible] g & DD
		was: Spare
		Pin HH is: Film change monitor
		was: Spare
	3.2.5	Pin A is: #2 T/U shunt A, SRV
		was: #2 T/U control voltage, Ascent Mode
		Pin B is: #1 T/U shunt A, SRV
		was: #1 T/U control voltage, Ascent mode
		Pin F is: #2 T/U shunt [illegible] SRV
		was: #2 T/U control voltage, C/N mode
		Pin J is: #1 T/U shunt B, SRV
		was: #1 T/U control voltage, C/N mode
7	3.2.6	Pin E is: Column 6 drive (spare)
		was: Data 3 column select
		Pin T is: Column 5 drive (spare)
		was: Data 4 column select
		Pin [illegible] is: Column 4 drive ([illegible])
		was: Data 5 column select
		Pin V is: Column 3 drive (Time Code) [illegible]
		was: Data 2 column select

[redacted]

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Program: J-3
Spec. No: T1-S-019B

CHANGE:

PAGE	PARA	CHANGE
7	3.2.6	Pin W is: Column 2 Drive (Time [illegible]) was: Data I column select Pin X is: Column 1 drive (Index) was: Index column select
7	3.2.6	Add Column Describing SLP Pins

Pin		SLP Connector
Pin S	Column 6	UU
T		TT
U		SS
V		RR
W		PP
X		NN
Y	200 PPS	[illegible]
Z	No. 1 INT.	[illegible]
a		A
b		B
c		C
d		D
e		E
f		F
g		H
h		J
i		K
j		L
k		M
m		N
n		P
[illegible]		R
[illegible]		[illegible]
y		[illegible]

TOP SECRET [redacted]

[illegible]
Spec No. [illegible]-0192

11 May 1966

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[illegible]

PAGE	PARA.	CHANGE	SLP CONNECTOR
7	3.2.6 (Cont'd)	Pin v	-X
		w	-Y
		x	-Z
		y	-AA
		z	-BB
8		AA	-CC
		BB	-DD
		CC	-EE
		DD	-FF
		EE	-HH
		FF	-JJ
		GG	-KK
		HH	-LL
9	3.2.7	Same as changes for Pages 7, 8, Para. 3.2.6	
10	3.2.8	Pin Z is: #1 T/U shunt was: #1 T/U control voltage, Ascent mode Pin e is: #2 T/U shunt was: #2 T/U control voltage, Ascent mode	
10	3.2.9	Same as changes for para. 3.2.8	
11	3.2.10	Change "No connection" to read "20 AWG single unshielded" for Pins E, F, G, H, J and K	
12	3.3.1.2.2	Delete sentence under output impedance.	
[illegible]	3.4.1.4	Delete the sentence "The No. 1 and No. 2 [illegible] will be energized for 30 seconds coincident with "A" to "[illegible]" transfer command."	
[illegible]	3.4.1.5	Delete the following sentence: [illegible] T/U voltage return shall [illegible] from the unregulated [illegible]	

[redacted]

TOP SECRET [redacted]

CHANGE:

PAGE	PARA.	CHANGE
17	3.4.1.7	is: 3 second long pulse was: 15 second long pulse
Add	3.4.1.10	Exposure Control No. 1 (P1001-A) Exposure Control No. 2 (P1001-B) Exposure Control No. 3 (P1001-C) Exposure Control No. 4 (P1001-D) "Open Item"
Add	3.4.1.11	Slit Width Fail Safe, No. 1 (P1001-[illegible]) Slit Width Fail Safe, No. 2 (P1001-[illegible]) "Open Item"
Add	3.4.1.12	Slit Width Fail Safe Reset, No. 1 (P1001-[illegible]) Slit Width Fail Safe Reset, No. 2 (P1001-[illegible]) "Open Item"

TOP SECRET [redacted]

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CHANGE:

PAGE	PARA.	CHANGE
Add	3.4.1.13	Filter Control Back-Up, No. 1 (P1001-[illegible]) Filter Control Back-Up No. 2, (P1001-[illegible]) "Open Item"
18	3.5.1	Add "f) Intermediate Roller Rotation"
19	3.5.3	Change paragraph to read "The monitor output shall be a potentiometer with a resistance of 5,000 ohms + 10%. Approximately four fifths (4/5) of the total potentiometer available excursion shall be utilized to cover the full range of available slit positions. Instruments shall be so wired to display minimum voltage for minimum slit position."
21	3.5.9	Change "sired" to "wired" in next to last line.
		Change p[illegible] j to e.
21	3.5.10	a) is: Drive motor voltage A was: Servo amp. output voltage e) is: Drive Motor Voltage B was: Drive Motor Voltage
Add	3.5.14	Filter Position Monitor (P1004 & P[illegible]) The monitor shall be a potentiometer with a resistance of 5,000 ohms + 10%. Approximately four fifths (4/5) of the total potentiometer available excursion shall be utilized to cover the full filter excursion.
Add	3.5.10	i) Take up motor voltage Mon. [illegible]

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Program J-3
Spec. No: T1-5-019B

TOP SECRET [redacted]

CHANGE:

PAGE	PARA.	CHANGE
Add	3.5.15	Slit Width Fail Safe Monitor (P100...
		The slit width fail safe monit... indicate the presence of the ... command.
		Pin F will be shorted to Pin ... counter and slit width fail ... return) when the device is ... reset. (Normal operating condition...
Add	3.5.16	Film Change Monitor (P1004 & P1005 ...
		"Open Item"
Add	3.6.3	Film Direction of C.R. is ... C700364 Rev. A

For Telecon - [redacted]

[redacted]

[illegible]3-05-020D - ELECT. INTERFACE SPEC
FOR SRV SYSTEM

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TS-60-020 [redacted]
Revised b [redacted]
Rev. B 18 Nov. 1965
REV. C 30 Nov. 1965
Rev. D 25 April 1966

ELECTRICAL INTERFACE SPECIFICATION

for the

"J-3" SRV SYSTEM

[redacted]
Contractor

[redacted]
Contractor

[redacted]
Customer

Sheet One of Sixteen

NOTE

This Specification was "PRE-RELEASED" (NOT APPROVED) for comment, discussion and correction on the original and Revision "A". It was APPROVED (Signed-Off) on Revision "B" and final changes which had been agreed upon before Sign-Off were incorporated in Revision "C".
Revision "C" therefore becomes the BASIC DOCUMENT and is to be used as such; Any subsequent revisions of this CONTROLLED DOCUMENT shall be furnished to holders of this present "C" Revision and the changes will be reflected in the Revision table, below.

REVISIONS

REVISION	DESCRIPTION	SIGNATURE/DATE
D	Pg. 2 (Para. 3.2.1) Was: p - Spare W1J1-p q - Spare W1J1-q Is: p-No. 1 T.U. Control (Reduced) W1J1-p to W2P8-Z q-No. 2 T.U. Control (Reduced) W1J1-q to W2P8-c Pag. 4 (Para. 3.2.2) Was: Z Continuity Loop (3) c Continuity Loop (3) Is: Z No. 1 T.U. Control (reduced) (1) c No. 2 T.U. Control (reduced) (1) Pg. 5, 6, 11 & 12 Made all necessary changes to change from W2P3/4A1J1 31 Pin connector to 32 Pin connector	[redacted]

1.0 SCOPE

This document shall define the electrical interface between the ~~"J-3" system as described in T3-5-015,~~ "J-3" system as described in T3-5-016 and the SRV system as described in Specification S0160-00-0007, Recovery Subsystem Specification for A45 Program (Configuration D).

2.0 APPLICABLE DOCUMENTS

None

3.0 REQUIREMENTS

3.1 Electrical Interface Connectors

(a) The Electrical Interface between the "J-3" ~~"J-3, 4"~~ systems and the SRV system will be through six (6) connectors which shall be located per T3-5-024 Interface Drawing. The ~~six (6) connectors~~ are listed below with the LMSC, DISIC cassette and the ~~"J-3, 4"~~ "J-3" cassette half of each connector defined.

~~(b) The LMSC/SRV Connection (P28/W1J-1) shall be an in-flight~~ disconnect type. The P28 connector shall be an LMSC 1308962-505 Disconnect assembly which has a PT06SE-22-55S type insert. The SRV shall provide a compatible mating connector and required disconnect hardware.

3.2 Connector Descriptions and Pin Assignments

3.2.1 P28 (PT06SE-22-55S)

Pin	Function	Route & Destination	Wire Type
A	No. 1 Takeup Control	W2J1-A to W2P8-X	
B	No. 2 Takeup Film Footage Monitor	W2J1-e to W2P8-D	3
C	Relay Reset		
D	DISIC Anti-Backup Control	W2J1-g to W2P12-S	
E	+5 VDC T/M Feed	W2J1-E to W2P12-K W2P8-S W2P2-N	[illegible]
F	Cassette Heater Feed	W2J1-F to W2P8-F	
G	Transfer Signal No. 1		
H	Transfer Signal No. 1 Return		

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Pin	Function	Route & Destination	Wire Type
J	5 VDC T/M Return	W2J1-J to W2P12-U W2P8-a W2P[illegible]-X	5
K	DISIC Takeup Control	W2J1-P to W2P12-U	
L	DISIC Terrain Film Footage Monitor	W2J1-R to W2P12-J	3
M	Arm Signal No. 2		4
N	Arm Signal No. 2 Return		4
P	DISIC Takeup Control Return	W2J1-v to W2P12-P	
R	Spare		
S	Recovery System Structure Ground	W2J1-S	
T	Cassette and Battery Heater Return	W2J1-T to W2P8-T 2A1P3- 2A1P4-	
U	No. 2 Takeup Control	W2J1-U to W2P8-W	
V	No. 1 Anti-Backup Control	W2J1-V to W2P8-U	
W	No. 1 Takeup Control Return	W2J1-W to W2P8-N	
X	Arm Signal No. 1		4
Y	Arm Signal No. 1 Return		4
Z	No. 1 Film Footage Monitor	W2J1-Z to W2P8-L	3
a	Eject. Programmer Gate No. 1		
b	Eject. Programmer Gate Return		
c	Thrust Cone Shorting Loop		
d	Continuity Loop Feed	W2J1-d	
e	Retro Temp Monitor	1A21	
f	Waterseal Monitor	W2J1-f to W2PZ-	
g	Spare	W2J1-u	
h	Eject. Programmer Gate No. 2		
i	No. 2 Anti-Backup Control	W2J1-i to W2P8-J	
j	No. 1 Takeup Control	W2J1-j to W2P8-E	
k	Spare	W2J1-k	
m	No. 2 Takeup Control	W2J1-m to W2P8-V	
n	No. 2 Takeup Control Return	W2J1-n to W2P8-b	
p	No. 1 Takeup Control (Reduced)	W2J1-p to W2P8-Z	
q	No. 2 Takeup Control (Reduced)	W2J1-q to W2P8-c	
r	Battery Voltage Monitor		
s	Transfer Signal No. 2		4
t	Transfer Signal No. 2 Return		4
u	Waterseal Activation Command No. 2 Return	W2J1-b	4
v	Waterseal Activation Command No. 2	W2J1-a	4

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Pin	Function	Route & Destination	Wire
w	DISIC Takeup Control	W2J1-y to W2P12-V	
x	Temp Sensor	W2J1-x to W2P8-A	
y	DISIC Takeup Control Return	W2J1-CC to W2P12-R	
z	T/M Shield Tie	W2J1-z to W2P12-G W2P8-R	
AA	DISIC Stellar Film Footage Monitor	W2J1-AA to W2P12-H	
BB	~~Beacon/T/M AGE Power and Control~~	W2J1-BB to W2P3-a	
CC	Spare		
DD	Battery Heater Feed	W2J1-FF to 2A1P3- 2A1P4-	
EE	Continuity Loop Return	W2J1-EE	
FF	Waterseal Activation Command No. 1	W2J1-DD	
GG	Temp Sensor Return	W2J1-~~GG~~ to W2P8-Y 1A21	
HH	Waterseal Activation Command No. 1 Return	W2J1-HH	

3.2.2 "J-3" ~~"J-2, 3"~~ Cassette Connector 3AJ1 (PT02-16-26P)

Pin	Function	Destination	Wire Ty
A	Temp Sensor Monitor	(1)	
B	No. 2 T/U Rotation Pot Excitation	(2)	
C	No. 1 T/U Rotation Pot Wiper	(2)	
D	No. 2 T/U Film Footage Monitor	(1)	
E	No. 1 T/U Control	(1)	
F	Heater Power	(1)	
G	No. 2 T/U Motor Voltage Monitor	(2)	
H	No. 2 T/U Rotation Pot Wiper	(2)	
J	No. 2 T/U Anti-Backup Control	(1)	
K	No. 1 T/U Rotation Pot Excitation	(2)	
L	~~No. 1 Film~~ Footage Monitor	(1)	
M	No. 1 and No. 2 Rotation Pots Common	(2)	
N	No. 1 and No. 2 Control Return	(1)	
P	No. 1 T/U Motor Voltage Monitor	(2)	
R	Shield Tie	(1)	
S	No. 1 and No. 2 Film Footage Pot Excitation	(1)	
T	Heater Power Return	(1)	

Pin	Fun[redacted]	Destination	Wire Type
U	No. 1 Anti-Backup Control	(1)	
V	No. 2 T/U Control	(1)	
W	No. 2 T/U Control	(1)	
X	No. 1 T/U Control	(1)	
Y	Temp Sensor Return	(1)	
Z	No. 1 Takeup Control (Reduced)	(1)	
a	No. 1 and No. 2 Film Footage Pot Return	(1)	5
b	No. 1 and No. 2 T/U Control Return	(1)	
c	No. 2 Takeup Control (Reduced)	(1)	

(1) Reference Paragraph 3.2.1
(2) Recovery System AGE Connector

3.2.3 DISIC Cassette Connector (PT02SE-14-19P)

Pin	Function	Destination	Wire Type
A	Torque Motor Reverse Voltage	(2)	
B	Torque Motor Reverse Return	(2)	
C	Stellar Rotation Pot Excitation	(2)	2
D	Stellar Rotation Pot Wiper	(2)	3
E	Terrain Rotation Pot Excitation	(2)	2
F	Terrain Rotation Pot Wiper	(2)	3
G	Shield Tie	(1)	
H	Stellar Film Footage Pot Monitor	(1)	3
J	Terrain Film Footage Pot Monitor	(1)	3
K	Film Footage Pots Excitation	(1)	5
L	Film Footage Pots Return	(1)	5
M	Rotation Pots Common	(2)	2
N	Spare		
P	Takeup Control Return	(1)	
R	Takeup Control Return	(1)	
S	Anti-Backup Control	(1)	
T	Spare		
U	Takeup Control	(1)	
V	Takeup Control	(1)	

(1) Reference Paragraph 3.2.1
(2) Reference Paragraph 3.2.6

3.2.4 4A1 Telemeter Connector 4A1J1 (PT07-18-32P) (Mates with W2P3, PT06P-18-32S).

Pin	Function
A	SRV Battery No. 1 Monitor +15V DC)
B	Relay K9 Actuate Monitor
C	Unassigned
D	T/C Battery Monitor (+31 V DC)
E	Parachute Cover Off Monitor
F	SRV Battery No. 2 Monitor (+15V DC)
G	Relay K10 Actuate Monitor
H	Beacon AGE Power Feed (+15V DC)
J	T/C Return
K, L, M, N P, R	Spares
S	Return inside 4A1 Telemeter (externally S will be jumpered to T with a 6 inch wire within the W2 harness)
T	Unused Despin B/W Mon. Externally Grounded
U	Retro Rocket Breakwire Monitor
V	Relay K11 Monitor Return
W	T/C Spin Breakwire Monitor
X	P28 Disconnect Monitor
Y	Recovery System Structure Ground
Z	TM Test Power & Control +24V DC Input)
a	Relay Reset (+24V AGE Command)
b	T/C Separation Switch
c	T/C Separation Switch
d	Beacon & TM AGE Power & Control(+24V DC Input)
e	Relay K11 Actuate Monitor
f	4A2 TM Battery Input (+24V DC)
g	4A2 TM Battery Return
h	4A2 TM Battery Return
j	4A2 TM Battery Input (+24 V DC)

3.2.5 4A2 Telemetry Battery Connector (PT1H-12-10P) (Mates with W2P5 PT06P-12-10S)

Pin	Function	Was
A	+28V DC to 4A1 TM	1
B	+28V DC to 4A1 TM	2
C	Continuity Loop	None
D	Continuity Loop	None
E	Battery Return to 4A1 TM	7
F	Battery Return to 4A1 TM	8
G	Battery Activation Command Input	4
H	Activation Return	5
J*	Heater Input	6
K*	Heater Return	5

*Note: J & K will not be wired through the W2 harness. and the function is not required.

3.2.6 Recovery System AGE Connector (PT06PSE-16-26P)

Pin	Function	Destination	Wire Type
A	G Switch Bypass #1 (REC)		
B	G Switch Bypass #2 (REC)		
C	G Switch Bypass #3 (REC)		
D	G Switch Bypass #4 (REC)		
E	Battery Activation Mon. (REC)		
F	Battery Activation Mon. (REC)		
G	Spare		
H	Spare		
J	DISIC Terrain Rotation Pot Excitation	W2P12-E	1
K	Spare		
L	No. 1 T/U Rotation Monitor	W2P8-C.	3

Pin	Function	Destination	Wire Type
M	No. 2 T/U Rotation Monitor	W2P8-H	2
N	No. 1 T/U Rotation Monitor Excitation	W2P8-K	2
P	Spare		
R	Torque Motor Reverse Voltage (DISIC)	W2P12-A	[illegible]
S	Torque Motor Reverse Return (DISIC)	W2P12-B	[illegible]
T	No. 2 T/U Motor Voltage Monitor	W2P8-G	3
U	Terrain Rotation Pot Wiper (DISIC)	W2P12-F	3
V	External Power Batt. #1 (REC)		
W	External Power Batt. #2 (REC)		
X	Rotation Pots Common (DISIC)	W2P12-M	1
Y	Stellar Rotation Pot Excitation (DISIC)	W2P12-C	1
Z	No. 2 T/U Rotation Monitor Excitation	W2P8-B	2
a	No. 1 and No. 2 T/U Rotation Monitor Common	W2P8-M	2
b	No. 1 T/U Motor Voltage Monitor	W2P8-P	3
c	Stellar Rotation Pot Wiper (DISIC)	W2P12-D	3

1,2 - Twisted Triade unshielded
3 - Single shielded
4 - Twisted shielded pair
5 - Twisted unshielded pair

Note: All wiring will be single unshielded unless otherwise noted.

3.3 Electrical Interface Design Requirement

3.3.1 Electrical Power

LMSC shall supply unregulated DC power to the SRV for all interface signals and heater requirements. The power source shall be the main bus and the pyrotechnic bus of a central system and the power shall have the characteristics specified below.

3.3.1.2 DC Power Supply Characteristics

3.3.1.2.1 Steady State Voltages

The main unregulated source and the pyrotechnic source shall have a steady-state voltage, measured at the distribution buses in the vehicle under zero load condition, of +22.0 to 29.5 volts.

The allowable line drop from the main unregulated bus to the SRV interface is 1.0 volt DC with an average load. The pyrotechnic bus shall not be required to comply with the line drop specification during squib activation signals.

3.3.1.2.2 Output Impedance

The total source impedance of the pyrotechnic supply shall not exceed 0.50 ohms at 29.5 volts. The impedance of the source includes line resistance from the distribution buses to the SRV system interface.

3.3.1.3 Load Characteristics

3.3.1.3.1 Power Utilization

Subsystems utilizing power shall be designed to give required performance when supplied with power having the values and tolerances of parameters at the power distribution buses as specified in 3.3.1.2

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3.3.1.3.2 Power Consumption

The current requirements of the SRV system shall not exceed the limits listed in paragraph 3.4 Electrical Interface Function Description where applicable.

3.3.1.4 Pyrotechnic Circuit Shielding

All circuits carrying pyrotechnic power from the battery bus to the individual squibs shall be in continuously shielded twisted pair. The SRV shall return the shields of the pyrotechnic signals to the SRV structure ground.

3.3.1.5 Grounding

The SRV system shall not ground any power signal returns to chassis or structure that are returns for LMSC supplied unregulated or pyrotechnic power. The exception to this requirement shall be the Relay Reset command.

3.4 Electrical Interface Function Description

LMSC shall supply twice minimum all fire current to all pyrotechnics fired at a given time. The required currents shall be based upon nominal squib bridgewire resistances.

3.4.1 Command Descriptions

3.4.1.2 Relay Reset Command (P28-C)

The Relay Reset Command shall be a +24 VDC unregulated command referenced to LMSC unregulated return and SRV structure. The Relay Reset Command shall be a non-flight, pre-launch command of [illegible] 4 seconds or less duration and shall have a current capacity of 2 amps. Upon receipt of the command the SRV system shall be placed in a launch ready condition.

3.4.1.3 Pyrotechnic Commands

The commands listed below shall be supplied from the vehicle pyrotechnic bus and each shall be referenced to their own return. Each command line shall be shorted to the vehicle pyrotechnic return prior to the initiation of the command. Other command requirements are specified below.

3.4.1.3.1 Water Seal Activation Command No. 1 (P28-FF) Return on P28-HH

Function: 2A10 Dimple Motor No. 1 Activation

Signal Description: May be sent anytime after the termination of vehicle powered flight and may be continuous to P28 Electrical Disconnect.

Electrical Requirements: (1)

a) Pulse duration — 5 seconds maximum

b) Current — 4.0 amps minimum

c) Bus voltage during pulse — 8 volts minimum across dimple motor

d) Impedance — 0.4 ± .1 ohms

(1) Command will be current limited and fused with a 1.8 ohm fusistor on LMSC side of P28/W1J-1 interface.

3.4.1.3.2 Water Seal Activation Command No. 2 (P28-v) Return on P28-u

Function: 2A10 Dimple Motor No. 2 Activation

The Water Seal Activation Command No. 2 shall be initiated coincident with Water Seal Activation Command No. 1. See paragraph 3.4.1.3.1 for signal specifications.

3.4.1.3.3 Arm Signal No. 1 (P28-X) Return on P28-Y

Function: T/M battery activate, No. 1 Recovery battery activate, latch relay K1 back-up timer start.

Signal Description: Command shall be initiated 76 ± 0.5 seconds prior to P28 Electrical Disconnect and will be continuous from initiation to electrical disconnect.

Electrical Requirements:

a) Pulse duration — 500 milliseconds maximum
b) Current — 10.4 amps minimum
c) Bus voltage during pulse — 18. volts minimum
d) Impedance — 1.0 ± .1 ohms

3.4.1.3.4 Arm Signal No. 2 (P28-M) Return on P28-N

Function: No. 2 Recovery battery activate, latch relay K2

Signal Description: See paragraph 3.4.1.3.3.

Electrical Requirements:

a) Pulse duration — 500 milliseconds maximum
b) Current — 8.0 amps minimum
c) Bus voltage during pulse — 18. volts minimum
d) Impedance — 1.3 ± .1 ohms

3.4.1.3.5 Transfer Signal No. 1 (P28-G) Return on P28-H

Function: Thrust cone battery No. 1 activation, DISIC Water Seal Dimple motor No. 1 activation, latch relay K3

Signal Description: Command shall be initiated one (1) ± 0.5 seconds prior to P28 Electrical Disconnect and will be continuous to electrical disconnect.

Electrical Requirements:

a) Pulse duration — 250 milliseconds maximum
b) Current — 9.0 amps minimum
c) Bus voltage during pulse — 18. Volts minimum
d) Impedance — 1.5 ± .3 ohms

3.4.1.3.6 Transfer Signal No. 2 (P28-s) Return on P28-t

Function: Thrust cone battery No. 2 activation, DISIC water seal dimple motor No. 2 activation.

Signal Description See Paragraph 3.4.1.3.5

Electrical Requirements: See Paragraph 3.4.1.3.5

3.4.1.4 Battery Heater Feed (P28-DD)

The Recovery Battery Heater Feed shall be +24 VDC unregulated referenced to cassette and battery heater feed return (P28-T). The battery heater feed line shall present an open to the battery heaters until a Recovery Enable command is received by the vehicle. Upon receipt of the Recovery Enable command LMSC will energize the battery heater feed line for a minimum of one orbital period prior to Electrical Disconnect and shall have a current capacity of 3 amps continuous. Exceptional circumstances may result in Recovery Battery activation without a warm-up period.

3.4.2 SRV Beacon Checkout

The SRV Beacon shall be enabled during vehicle pre-launch tests to verify the operating frequency and measure the radiated power. LMSC shall provide the Beacon system with the power and command required for this test. The power and command shall be generated by a non-flight source. In the de-energized condition the Beacon AGE Power Feed (+15V DC) (4A1J1-H) shall present an open circuit to the Beacon.

3.4.2.1 Beacon AGE Power Feed (+15V DC) 4A1J1-H

The Beacon AGE Power Feed shall be LMSC supplied and shall have the following characteristics:

a. Voltage	+13.8V DC to 17.0 V DC
b. Current	0.40 amps capacity minimum 0.20 amps load minimum
c. Duty Cycle	5 minutes maximum duration at 10% duty cycle.

3.4.2.2 Beacon and TM AGE Control (+24V DC) (4A1J1-d)

The Beacon and TM AGE Power and Control shall be +24 V DC unregulated referenced to Recovery System Structure Ground. This function provides for operation of the Beacon and the TM.

3.4.2.3 TM Test Power & Control (+24V DC) (4A1J1-Z)

The TM Test Power & Control (+24V DC) (4A1J1-A) shall be available for operating the telemeter without providing the +15 V DC output from 4A1J1-[illegible]

3.4.3 Data Description

3.4.3.1 Continuity Loop Feed (P28-d) Return on P28-EE

The Continuity Loop is a pre-launch non-flight monitor of the launch ready condition of the SRV system. All functions monitored in the loop shall make the loop continuous when ready for launch; i.e., relays will be monitored through normally closed contacts, connectors must be mated to receptacles etc. LMSC shall activate the continuity loop with +24 VDC unregulated from the launch complex blockhouse and will complete the [illegible] in the blockhouse via the loop return. The continuity loop will be [illegible] isolated from all flight hardware and circuits.

3.4.3.2 Water Seal Monitor (P28-f)

The SRV shall provide monitor circuits which when excited by +5 [illegible] (P28-E) and referenced to 5 VDC return (P28-J) will indicate the [illegible] of the two water seals. The monitor shall provide to LMSC four [illegible] voltage levels,

a) 3.0 volts ± .2 volts - both water seals open

b) 1.5 volts ± .2 volts - both water seals closed

c) 0.5 volts ± .5 volts - No. 1 water seal closed, No. 2 water [illegible]

d) 4.25 volts ± .5 volts - No. 1 water seal open, No. 2 water [illegible]

3.4.3.3 Retro Temp [illegible] (P28-e) Return to P28-J

The SRV shall provide one (1) temp. sensor which will monitor [illegible] Rocket temperature. The temp sensor shall be in series with [illegible] resistor and shall be excited by the + 5 ± .05V DC [illegible]

4.0 QUALITY ASSURANCE PROVISION

Not Applicable

5.0 PREPARATION FOR DELIVERY

Not Applicable

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T3-5-021 - [illegible]
THE JP-J3 DISIC SYSTEM

TOP SECRET

TOP SECRET [redacted]

NO. [redacted]

T3-5-021

12 November 1965

17 March 1966

[redacted]

(16 PAGES)

ELECTRICAL INTERFACE SPECIFICATION

for the

"J2 - J3" DISIC SYSTEM

[redacted]

Contractor

[redacted]

Contractor

[redacted]

Customer

TOP SECRET [redacted]

NO.

1.0 SCOPE

2.0 APPLICABLE DOCUMENTS

3.0 REQUIREMENTS

4.0 QUALITY ASSURANCE PROVISION

5.0 PREPARATION FOR DELIVERY

1.0 SCOPE

This document shall define the electrical interface between the J2 - J3 Systems and the D.I.S.C. as described in T3-5-009C Design Control Specification.

2.0 APPLICABLE DOCUMENTS

The following documents shall form a part of this specification to the extent specified herein. In the event of conflict, this specification shall prevail.

2.1 LMSC Documents

LMSC 447969B	Specification for Electromagnetic Interference Control Requirement and Electrical Interface for Agena Systems.
T3-5-009C	DISIC Design Control Specification.
T3-517	Installation Requirements for Micro-Systems Temperature Sensors.
T3-4-508	Design Control Specification for the Triple Parallel Output Clock Generator.

3.0 REQUIREMENTS

3.1 Electrical Interface Connectors

The "J2 - J3" Systems shall interface electrically with the DISIC through six (6) connectors. The LMSC half of each connector is defined below. The DISIC shall provide a compatible mating connector in each instance, which shall be physically located per T26-100 interface drawing. Connectors with aluminum shells and gold iridite finish will be used wherever possible.

3.2 Connector Description and Pin Assignments

3.2.1 Power & Command Connector P136 (PT06SE-16-26S-011)

A. Spare
B. Spare

C. Spare
D. Spare
E. Spare
F. Spare
G. Spare
H. Spare
J. Spare
K. Operate Command
L. Operate Command
M. Mode 1 Command
N. Mode 1 Command
P. Left Capping Command
R. Right Capping Command
S. Spare
T. 1/250 Exposure Command
U. Relay Reset Command
V. Supply Cassette Brake Release
W. Supply Cassette Brake Release
X. +24 VDC Unregulated
Y. +24 VDC Unregulated
Z. Unreg. Return
a. Unreg. Return
b. Take-up Cassette Motor Excitation
c. Take-up Cassette Motor Excitation

3.2.2 T/M Connector P140 (PT06SE-18-32S-011)

A. Spare
B. Spare
C. Spare
D. Spare
E. Spare
F. Spare
G. Spare
H. Spare
J. Spare
K. 1RPC Cam Monitor
L. Operate Command Monitor
M. Mode 1 Command Monitor
N. Stellar Metering Clutch Command Monitor
P. Terrain Metering Clutch Command Monitor
R. Left Stellar Capping Command Monitor
S. Right Stellar Capping Command Monitor
T. Terrain Capping Command Monitor

U. Left Stellar Platen Position Monitor
V. Right Stellar Platen Position Monitor
W. Terrain Platen Position Monitor
X. Stellar Film Idler Monitor
Y. Terrain Film Idler Monitor
Z. Terrain Shutter Monitor
a. Motor Voltage Monitor
b. Temp. Sensor #1
c. Temp. Sensor #1
d. Temp. Sensor #2
e. Temp. Sensor #2
f. Terrain Exposure Position Monitor
g. Shield Tie
h. T/M Excitation
j. T/M Common

3.2.3 Data Connector P137 (PT06SE-20-41S-011)

A. Spare
B. Spare
C. Spare
D. Spare
E. Spare
F. Shield Tie
G. Array A Return
H. Array A Return
J. #3 Request in (Interrogate)
K. Array B Return
L. Array B Return
M. Index Bit
N. #3 Output Lamp 1
P. " " " 2
R. " " " 3
S. " " " 4
T. " " " 5
U. " " " 6
V. " " " 7
W. " " " 8
X. " " " 9
Y. " " " 10
Z. " " " 11
a. " " " 12
b. " " " 13
c. " " " 14

d. #3 Output Lamp 15
e. " " " 16
f. " " " 17
g. " " " 18
h. " " " 19
i. " " " 20
j. " " " 21
k. " " " 22
m. " " " 23
n. " " " 24
p. " " " 25
q. " " " 26
r. " " " 27
s. " " " 28
t. " " " 29

3.2.4 Supply Cassette Connector, P138 (PT06SE-12-10S-011)

A. Spare
B. Spare
C. Spare
D. Unreg. Return
E. Unreg. Return
F. Spare
G. Brake Release Command
H. Brake Release Command
J. Reset
K. Spare

3.2.5 Take-up Cassette "A" Connector, P139A (PT06SE-14-19S-011)

A. Torque Motor Reverse Voltage Plus
B. Torque Motor Reverse Voltage Return
C. Stellar Rotation Pot Excitation
D. Stellar Rotation Pot Wiper
E. Terrain Rotation Pot Excitation
F. Terrain Rotation Pot Wiper
G. Shield Ties
H. Stellar Film Footage Pot Wiper
J. Terrain Film Footage Pot Wiper
K. Film Footage Pots, High End
L. Film Footage Pots, Low End
M. Rotation Pots Common
N. Spare

P. Unreg. Return
R. Unreg. Return
S. Anti-backup Release
T. Spare
U. Torque Motor Excitation
V. Torque Motor Excitation

3.2.6 Take-up Cassette "B" Connector, P139B (PT06SE-14-19S-011)

A. Torque Motor Reverse Voltage Plus
B. Torque Motor Reverse Voltage Return
C. Stellar Rotation Pot Excitation
D. Stellar Rotation Pot Wiper
E. Terrain Rotation Pot Excitation
F. Terrain Rotation Pot Wiper
G. Shield Tie
H. Stellar Film Footage Pot Wiper
J. Terrain Film Footage Pot Wiper
K. Film Footage Pots High End
L. Film Footage Pots Low End
M. Rotation Pots Common
N. Spare
P. Unreg. Return
R. Unreg. Return
S. Anti-backup Release
T. Spare
U. Torque Motor Excitation
V. Torque Motor Excitation

3.3 Electrical Interface Design Requirements

3.3.1 Power Supply

a. Unregulated Voltage

LMSC shall supply unregulated D.C. voltage as specified in applicable sections of para. 3.2.9 of LMSC 447969B for the operation of the camera system. Power shall be supplied continuously to the camera system during a normal mission which includes pre-launch and launch modes. Power will not be supplied in orbit during that time that the satellite is deactivated.

b. Telemetry Voltage

LMSC shall provide 5 VDC regulated voltage to the DISIC subsystem for telemetry use only. This voltage shall be supplied only during the time the telemetry system is enabled.

3.3.2 Load Characteristics

The camera subsystem shall present equipment loads to the vehicle power supplies which satisfy the requirement of para. 3.2.10.1 and 3.2.10.2 of LMSC 447969B. The current requirements of the camera subsystem, including supply and take-up cassettes, shall not exceed 5 amps average with starting surges not to exceed 15 amps, for durations not to exceed 5 sec.

3.3.3 Switched Capacitor Loads.

Switched Capacitor Loads shall have surge current limiting resistors in series.

3.3.4 Inductive Spike Suppression

The use of diodes or other equally effective devices to suppress spikes that result from collapsing d.c. magnetic fields is mandatory in every case where a d.c. current that flows through an inductance is interrupted. The diode or other suppression device shall be mounted as close to the inductance as is possible.

3.3.5 Cable and Harnessing

Cables and harnesses for the camera subsystem and those portions of LMSC cables and harness that interface with the camera subsystem shall be fabricated conforming to the requirements of para 3.2.11.1.1 through 3.2.11.1.4 and para 3.2.6.1.4 through 3.2.6.1.7 of LMSC 447969B, to every extent possible.

3.3.6 AF Signal Circuits

All A.F. signal circuits (0-150 kc) shall be shielded with the shield grounded by LMSC at the vehicle ground point only. Shields shall not be connected in any way which creates a loop having nominally zero ohms impedance. The shields shall be routed through the pin provided on the T/M interface connector P 140-g.

3.3.7 Grounding

The camera subsystem shall not ground any power or signal returns to chassis or structure. The camera subsystem shall conform to and be compatible with grounding requirements of LMSC 447969B para. 3.2.8.1.

3.3.8 Fusing

The +24 VDC unregulated power, (Power & Command connector P 136-X & Y) to the camera subsystem will be fused by LMSC external to the camera subsystem in conformance with para. 3.2.8.4 (c) of LMSC 447969B. The fuse values shall allow for a 20% safety factor over maximum surge current.

3.3.9 Bonding

The camera subsystem shall conform to the bonding requirements of para. 3.2.12.1 through 3.2.12.3.2 and para. 3.2.12.4 through 3.2.12.5 of LMSC 447969B, to every extent possible.

3.4 Command Description

3.4.1 Operate Command

The Operate Command shall be +24 VDC unreg. referenced to unreg. return. It shall be continuous throughout each programmed operation. The camera subsystem shall begin operation upon receipt of the command and shall continue operation to complete a full cycle in event the operate command is removed during a camera cycle. All shutters shall be adequately capped to prevent film fogging after camera shutdown. The command source shall be relay contacts, capable of supplying 2 amps continuously. The command line shall present an open circuit to the camera subsystem in the absence of a command. The camera subsystem shall be insensitive to normal relay contact bounce present at the leading and trailing edge of the command.

3.4.2 Mode 1 Command

The Mode 1 Command will be 24 VDC unreg. signal referenced to unreg. return. The Mode 1 command will condition the camera subsystem so that it will operate at the Mode 1 cycle rate as described in T3-5-009 when an operate command is present. The Mode 1 command will be sent independent of the operate command. The camera subsystem will revert to the Mode 2 condition as described in T3-5-009 upon removal of the mode command. The Mode 1 command source will be relay contacts capable of supplying 2 amps continuously. The Mode 1 command line will present an open circuit to the camera subsystem in the absence of a command. The camera subsystem will be insensitive to normal relay contact bounce present at the leading and trailing edge of the Mode 1 Command.

3.4.3. Terrain Exposure Command

The Terrain Exposure Command will be 24 VDC unreg. signal referenced to unreg. return. Upon receipt of this signal, the terrain exposure shall be changed from 1/500 second to 1/250 second duration. After removal of this command the exposure shall return to the 1/500 second duration. The exposure command will be relay contacts capable of supplying 2 amps continuously.

This command will present an open circuit to the camera subsystem in the absence of a command. The camera subsystem will be insensitive to normal relay contact bounce present at the leading and trailing edge of the terrain exposure command.

3.4.4 Left Capping Command

The capping command shall be +24 VDC unreg referenced to unreg return. It shall be continuous as programmed. The command source shall be relay contacts capable of supplying 2 amps continuously. The command shall present an open circuit to the camera subsystem in the absence of a command. The presence of a command prevents the left stellar capping shutter from being activated by camera operation. The camera subsystem shall be unsensitive to normal relay contact bounce present at the leading and trailing edge of the command.

3.4.5 Right Capping Command

The capping command shall be +24 VDC unreg referenced to unreg return. It shall be continuous as programmed. The command source shall be relay contacts capable of supplying 2 amps continuously. The command shall present an open circuit to the camera subsystem in the absence of a command. The presence of a command prevents the right stellar capping shutter from being activated by camera operation. The camera subsystem shall be unsensitive to normal relay contact bounce present at the leading and trailing edge of the command.

3.4.6 Data Interface

The camera subsystem shall accept signals from the clock generator on interface connect P137 as specified in T3-4-508 DCS Triple Parallel Output Clock Generator.

3.5 <u>Telemetry Signals Description</u>

3.5.1 One Revolution per Cycle Cam Monitor

The one RPC Cam Monitor shall be configured to generate one (1) switch closure for each cycle. The switch closure will be a minimum of 3.125 secs long for any camera cycle rate.

One contact of the monitor switch (Form A contact arrangement) shall be wired to the T/M connector P140-K and the other contact shall be wired to the T/M monitor common bus.

3.5.2 Terrain Idler Monitor

The Terrain Idler Monitor shall be a commutator configured to generate three (3) unequal "on" pulses by use of conducting segments - one of 120° of arc, one of 90° arc, and one of 60° arc, each separated by a 30° non-conducting segment. The commutator shall make a minimum of 1.5 revolutions per metered frame. One contact of the monitor switch shall be wired to the T/M connector P140-Y and the other contact shall be wired to the T/M monitor excitation bus.

3.5.3 Stellar Idler Monitor

The Stellar Idler Monitor shall be a commutator configured to generate six (6) equal "on" pulses by use of conducting segments each of 30° of arc. The commutator shall make a minimum of one-half revolution per metered frame. One contact of the monitor switch shall be wired to the T/M connector P140-X and the other contact shall be wired to the T/M monitor excitation bus.

3.5.4 Operate Relay Monitor

The Operate Relay Monitor shall be configured to indicate the absence or presence of the Operate Command in the camera subsystem. The monitor shall be a Form A contact arrangement wired so that closed contacts indicate the presence of the Operate Command and open contacts indicate the absence of the Operate Command. One contact shall be wired to the T/M connector P140-1 and the other contact shall be wired to the T/M monitor common bus.

3.5.5 Mode 1 Command Monitor

The Mode I Command Monitor shall be configured to indicate the absence or presence of the mode command in the camera subsystem. The monitor shall be a Form A contact arrangement wired so that closed contacts indicate the presence of the Mode I Command and open contacts indicate the absence of [illegible] contact shall be wired to the T/M connector P140-M and the other contact shall be wired to the T/M monitor common bus.

3.5.6 Terrain Shutter Monitor

The Terrain Shutter Monitor shall be configured so that the monitor system shall generate a 150 m second minimum pulse with each shutter opening. The pulse shall have an amplitude of 12 volts ± 3 volts. The input impedance of the LMSC circuit external to the camera subsystem shall be approximately 2000 ohms in parallel with 500 pico farads. The output shall be wired to the T/M connector P140-Z. The terrain shutter monitor system shall use the 24 volts unregulated d.c. as a power source.

3.5.7 Motor Voltage Monitor

The Motor Voltage Monitor shall be 4V ± 1V referenced to T/M monitor common return. The output impedance of the divider shall be a minimum of 2000 ohms referenced to T/M monitor common return. The output shall be wired to the T/M connector P140-a.

3.5.8 Temperature Monitors

The camera subsystem shall provide two temperature sensors (microsystems - PB-3003-0006 - formerly TE-3D), mounted per T3-517 so that they are electrically isolated, 50 megaohms at 50 VDC, from the camera subsystem chassis and electrical system. The temp sensors shall be designated as No. 1 and No. 2. The two leads of each temp sensor shall be wired to the T/M connector P140-b, c; (No. 1) and P140-d, e, (No. 2).

3.5.9 Film Footage Monitor

There will be film footage indicators for the terrain and the stellar take-up cassettes for both the "A" and "B" systems. The indicators will be ± 1% linear potentiometers with a 2000 ohm ± 3% maximum resistance. The terrain and stellar indicators output resistance will be maximum between the wiper and the low end (P139-L) with empty spools.

3.5.10 Stellar Metering Clutch Command

This clutch command monitor shall be a 24 VDC unreg signal that goes to approximately zero volts at the instant the metering clutch is commanded. The monitor signal is taken off the negative side of the metering clutch solenoid coil isolated by 1800 ohms. This signal shall be wired to the T/M connector P140-N.

3.5.11 Terrain Metering Clutch Command

This clutch command monitor shall be a 24 VDC unreg signal (5VDC for TM) that goes to zero volts (T/M) at the instant the metering clutch is commanded. The monitor signal is taken off the negative side of the metering clutch solenoid coil. This signal shall be wired to the T/M connector P140-P.

3.5.12 Left Stellar Capping Command

This capping command monitor shall be a 24 VDC unreg. signal (5 VDC for T/M) that goes to zero volts (T/M) at the instant the capping shutter is commanded. The monitor signal is taken off the negative side of the capping solenoid coil. This signal shall be wired to the T/M connector P140-R.

3.5.13 Right Stellar Capping Command

This capping command monitor shall be a 24 VDC unreg signal (5 VDC for T/M) that goes to zero volts (T/M) at the instant the capping shutter is commanded. The monitor signal is taken off the negative side of the capping solenoid coil. This signal shall be wired to the T/M connector P140-S.

3.5.14 Terrain Capping Command

This capping command monitor shall be a 24 VDC unreg signal (5 VDC for T/M) that goes to zero volts (T/M) at the instant the capping shutter is commanded. The monitor signal is taken off the negative side of the capping solenoid coil. This signal shall be wired to the T/M connector P140-T.

3.5.15 Left Stellar Platen Position

This telemetry shall indicate the position of this platen in the camera subsystem by a switch closure. The switch contact arrangement shall be wired so that closed contacts indicate the platen in the actuated position against film. Open contacts are to indicate the non-actuated platen position. One contact shall be wired to the T/M connector P140-U and the other contact shall be wired to the T/M common bus.

3.5.16 Right Stellar Platen Position

This telemetry shall indicate the position of this platen in the camera subsystem by a switch closure. The switch contact arrangement shall be wired so that closed contacts indicate the platen in the actuated position against film. Open contacts are to indicate the non-actuated platen position. One contact shall be wired to the T/M connector P140-V and the other contact shall be wired to the T/M common bus.

3.5.17 Terrain Platen Position

This telemetry shall indicate the position of this platen in the camera subsystem by a switch closure. The switch contact arrangement shall be wired so that closed contacts indicate the platen in the actuated position against film. Open contacts are to indicate the non-actuated platen position. One contact shall be wired to the T/M connector P140-W and the other contact shall be wired to the T/M common bus.

3.5.18 Terrain Exposure Position Monitor

This telemetry shall indicate the terrain exposure time selection by relay contact closure. The monitor shall be a form A contact arrangement wired so that closed contacts indicate the 1/250 second exposure and open contacts indicate the 1/500 second exposure. One contact shall be wired to the T/M connector P140-I and the other contact shall be wired to the T/M common bus.

3.5.19 Stellar Take-Up Cassette Rotation

Stellar T/U Cassette Rotation monitoring shall be provided by a continuous turn linear potentiometer installed in the T/U cassette so that 2.75 revolutions of the pot is equal to one rev of the cassette to present a varying voltage. Maximum resistance of the potentiometer shall be 2000 ± 3% ohms on the wiper. Connections in P139A and P139B should be made per para 3.2.5 and 3.2.6.

3.5.20 Terrain Take-Up Cassette Rotation

Terrain T/U Cassette Rotation monitoring shall be provided by a continuous turn linear potentiometer installed in the T/U cassette so that 2.75 revolutions is equal to one revolution of the cassette to present a varying voltage. Maximum resistance of the potentiometer shall be 2000 ± 3% ohms on the wiper. Connection in P139A and P139B should be made per para 3.2.5 and 3.2.6.

4.0 QUALITY ASSURANCE PROVISIONS

Not applicable.

5.0 PREPARATION FOR DELIVERY

Not applicable.

T3-5-030 - DESIGN CONTROL SPEC FOR J3 IMC SUBSYSTEM (QTS & ATS INCLUDED)

~~TOP SECRET~~ [redacted]

DESIGN CONTROL SPECIFICATION
FOR
J-3 IMAGE MOTION COMPENSATION SUBSYSTEM
(QTS and ATS Included)

Prepared by: [redacted]

Approved by: [redacted]
Dept. 60-61

[redacted]
Dept. 60-62

[redacted]
Dept. 60-64

[redacted]
Dept. 60-65

~~TOP SECRET~~ [redacted]

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LIST OF ILLUSTRATIONS

1.0 SCOPE

This specification establishes the requirements for the design and testing of the Image Motion Compensation (IMC) function generator. The IMC function generator shall consist of the Forward Motion Compensation (FMC) function generator and the Yaw function generator. The vector diagram of Appendix A defines the FMC function and the Yaw function of the Image Motion Compensation. Figure 1 shows the functional block diagram of the IMC function generator.

2.0 APPLICABLE DOCUMENTS

The latest revision of the following documents, unless otherwise specified, shall form a part of this specification to the extent specified herein:

T3-5-028	Design Control Specification for the A/P J-3 System
T3-6-029	Design Control Specification, J-3 Telemetry and Instrumentation Subsystem
T3-6-033	Design Control Specification, J-3 Power Distribution Subsystem
T3-5-019	Electrical Interface Specification for the J-3 Constant [illegible] System
T3-5-023	Electrical Interface Specification for Advanced Projects Payload and Program [redacted] Agena Orbital Vehicle
T3-6-002	General Specification for Payload Qualification and Acceptance

3.0 DESIGN REQUIREMENTS

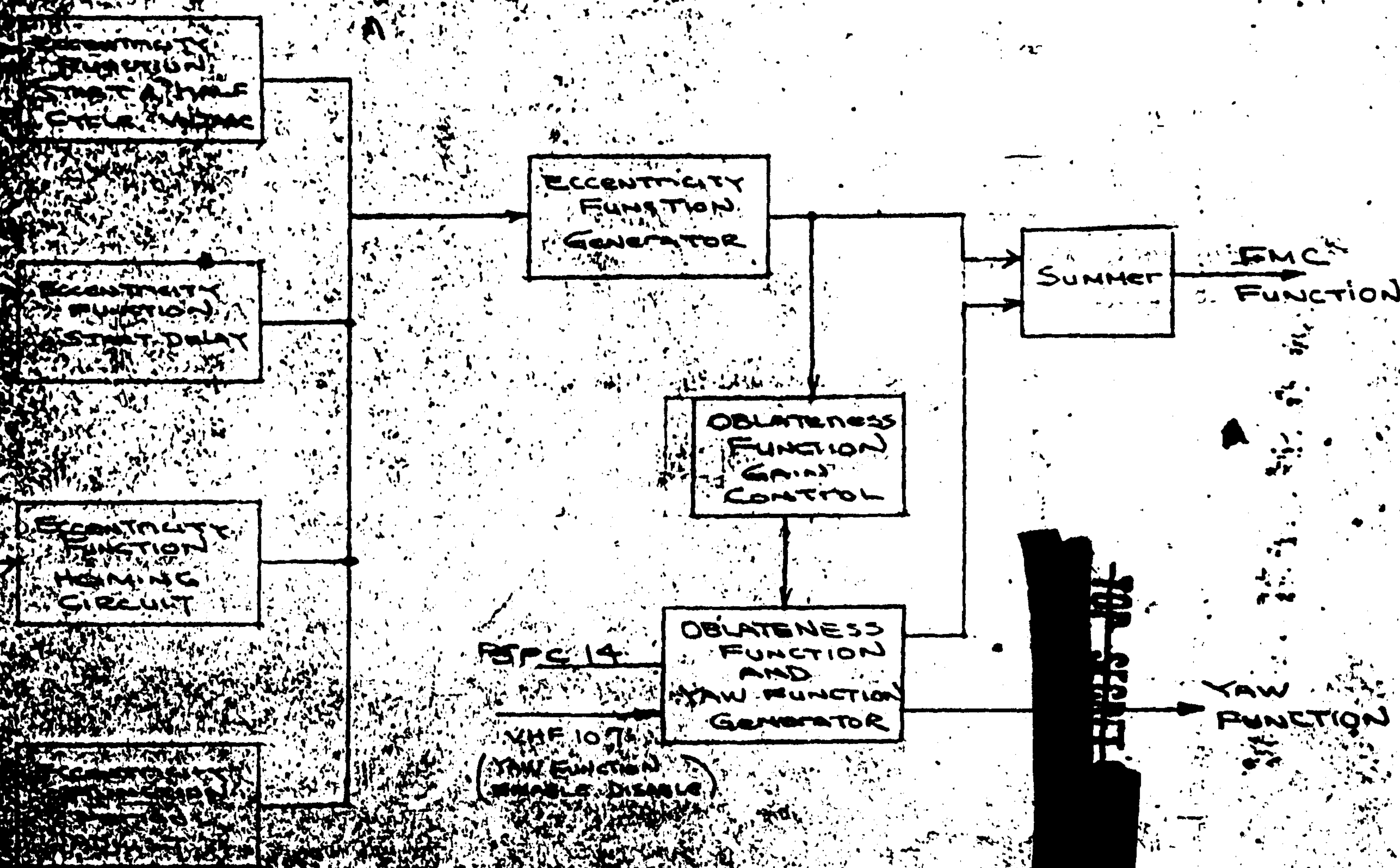
3.1 General

3.1.1 Workmanship

Each component, including all parts and accessories, shall be constructed and finished in a high-quality manner.

3.1.2 Parts Selection

Wherever practical, components which have been qualified to the [illegible] level shall be used. In the event an LMSC-approved part cannot be [illegible] and components shall be purchased to a design control specification, [illegible] control drawings, or envelope drawings. Detailed [illegible] testing, shall be performed to ensure pro[illegible]



ECCENTRICITY FUNCTION START DELAY
ECCENTRICITY FUNCTION HOMING CIRCUIT
ECCENTRICITY FUNCTION GENERATOR
OBLATENESS FUNCTION GAIN CONTROL
OBLATENESS FUNCTION AND YAW FUNCTION GENERATOR
PSPC 14
VHF 107
(YAW FUNCTION ENABLE DISABLE)
SUMMER
FMC FUNCTION
YAW FUNCTION

[redacted]

3.1.3 Identification [redacted]

The assembly shall have proper identification with serial numbers.

3.1.4 Protective Treatment

Any material which is subject to deterioration when exposed to environmental conditions likely to occur during service usage shall be protected in a manner compatible with performance requirements.

3.1.5 Component Derating

Adequate component derating practice shall be adhered to per good reliability practice.

3.1.6 General Power Distribution and Instrumentation Requirement

The general requirements specified in the following documents shall be followed in the design:

a. T3-5-028 Design Control Specification, A/P J3 System.

b. T3-6-029 Design Control Specification, J-3 Telemetry and Instrumentation Subsystem.

c. T3-6-033 Design Control Specification, J-3 Power Distribution Subsystem.

3.1.7 Limited Operating Life (LOL) and Limited Calendar Life (LCL)

The calendar life of the assembly, which includes storage life, [illegible] life, and 14-day orbit life shall be 12 months minimum. The operating life of the assembly, which includes ground operating life and orbit operating life, shall be 500 hours minimum.

3.2 Interface Requirements

The electrical interface of the IMC function generator subsystem shall be in accordance with the latest revision of the following specifications:

a. T3-5-028 Design Control Specification, A/P J-3 System.

b. T3-5-019 Electrical Interface Specification for the J-3 [illegible] Rotator System.

c. T3-5-023 Electrical Interface Specification for the J-3 [illegible]

d. T3-6-002 General Specification for Payload [illegible] Acceptance.

3.3 Power Requirements

3.3.1 IMC Function [redacted]ement.

The following power shall be available at the IMC function generator interface:

a. Unregulated 24 vdc:	21 to 29 vdc
b. Telemetry Voltage:	5 vdc, 1 percent
c. AC voltage:	112.3 to 117 v rms
	400 $\pm$ 0.8 cps ("A" phase)

The power consumption shall be:

a. Unregulated 24 vdc:	12 watts average during operation
b. Telemetry Voltage:	1/2 watt maximum
c. 115 Volts, 400 cps:	9 watts maximum.

3.3.2 Ground Isolation

The voltage source ground used for the FMC function shall be isolated from unregulated voltage ground and 400 cps ground by more than 500 kilo-ohms.

A minimum dc isolation of one megohm shall exist between the case and all grounds.

3.4 FMC Function Generator Requirements

3.4.1 General

The FMC function generator shall generate a function to control the CR camera system for compensation of $\mathcal{V}$FMC defined in Appendix A. The FMC function shall be the sum of the eccentricity function and the oblateness function. The eccentricity function shall be FMC, assuming spherical earth, and the oblateness function shall compensate for the earth oblateness factor relative to the satellite altitude.

3.4.2 Eccentricity Function Generator

3.4.2.1 General

The eccentricity function generator shall generate a cosine function with control of amplitude, level, period and starting time.

3.4.2.2 Start Delay Circuit

The starting time of the eccentricity function shall be controlled by the start delay circuit. The start delay circuit shall be initiated with SPC 27. Capability shall be provided for delaying the start time of the eccentricity function after SPC 27 is received in nominally 25 second, 50 second, and 200 second increments. The maximum time delay capability shall be nominal 500 seconds for the 25 second increment, nominal 1000 seconds for the 50 second increment, and nominal 4,000 for the 200 second increment. Only one of the three delay increment shall be used during a mission and there shall be 20 selectable time delay for each of the delay increment. This start delay time shall be selectable in flight with a real time command (ANA/15).

a. 25 to 500 seconds in 25 second increment.

b. 50 to 1,000 seconds in 50 second increment

c. 200 to 4,000 seconds in 200 second increment.

The delays shall be repeatable within 0.5 percent over a temperature range of 70 ± 25°F, and one percent over a temperature range of 30 to 110°F. Capability for selecting any one of three delay increments using an AGE command shall be provided in the qualification unit. After the start delay circuit has timed out, the start delay circuit shall send a start signal to the eccentricity function generator.

3.4.2.3 Eccentricity Function Generator

After receiving a start signal from the start delay circuit, the function generator shall generate a cosine curve with a period of 2,400 to 4,800 seconds. The period shall be easily adjustable within 5 percent of the required period prior to launch (R-8 day). The period shall be repeatable within 0.5 percent over a temperature range of 70 ± 25°F, and one percent over a temperature range of 30 to 100°F. The eccentricity function generator shall automatically stop after completion of the period. The eccentricity function shall not start until the next start signal is received.

3.4.2.4 Eccentricity Function Start and Half Cycle Voltages

The start and half cycle voltages of the eccentricity function (cosine curve) which determine the amplitude and level of the cosine curve shall be adjustable in flight with ANA 11 and ANA 12 respectively. The start voltage and half cycle voltages shall each have twenty (20) selectable voltages within the voltage ranges specified below. For the normal mission, the start voltage range shall be between 1.[illegible] and 3.75 vdc and the half cycle voltage range shall be between 2.0 and 3.75 vdc. For the mapping mission, the minimum voltage of the start and half cycle voltage shall be ground adjustable (R-15 day) down to 1.2 vdc and the maximum voltage of the start and half cycle voltage shall be ground adjustable (R-15 day) between 2.0 and 3.75 vdc. Because the start voltage range and the half cycle voltage range overlaps, capability shall exist for generating both a positive or a negative cosine curve. Adjustment of either voltage (start voltage or half cycle voltage) using ANA 11 or ANA 12 shall not affect the adjustment of the other voltage by more than 0.2 percent. The adjustment shall be repeatable within 0.4 percent over a temperature range of 70 ± 25°F, and within 0.8 percent over the temperature range of 30 to 100°F.

3.4.2.5 Homing Circuit

The eccentricity function generator shall automatically stop after 360 ± 1° (non cumulative) of the cosine curve has been generated. When SPC 14 is received and the programmer is not at its home position, the function generator shall slew to the home position within eight minutes from any position of the cosine curve.

3.4.2.6 Eccentricity Function Output

The output of the eccentricity function shall conform to the calculated cosine curve within ± 0.8 percent. The calculated cosine curve shall be based on calibration of the period, start, and half-cycle voltages, and start delay. The output voltage shall never drop below the minimum value of the start voltage when the unregulated 24 vdc is applied to the FMC programmer.

3.4.3 Oblateness Function Generator Requirement

3.4.3.1 General

The oblateness function generator shall generate a cosine function with the amplitude and level controlled by the eccentricity function output.

3.4.3.2 Oblateness Function Gen[redacted]

The oblateness function generator shall be started with SPG-14 and shall stop automatically after 86.5 ± 1 minutes. The function generator shall generate two cycles of cosine curve during this period. The starting position shall be easily and independently adjustable.

3.4.3.3 Amplitude and Level

The amplitude and level of the oblateness function shall be proportional to the eccentricity function output. Gain control shall be provided to adjust the maximum value of the oblateness function from 0.04 to 0.10 of the eccentricity function output. The gain shall be easily adjustable prior to launch (R-8 day). The minimum value of the cosine curve shall be function ground. The gain setting shall be stable within 1 percent over the temperature range of 30 to 100°F.

3.4.3.4 Oblateness Function Output

The oblateness function output shall conform to the calculated curve to within ± 1.0 percent of E_{max}, with a fixed E_{max}. E_{max} shall be defined as the maximum value of the cosine curve. Equation 3 in Appendix C gives the equation for the oblateness function output.

3.4.4 FMC Function Output

The FMC function output shall be the sum of the eccentricity function output and the oblateness function output. A drawing of an example of the FMC function output is shown in Appendix B. Appendix C shows the equation of FMC function output.

3.4.4.1 Accuracy

The FMC function output shall conform to the calculated value, using the equation of Appendix C and calibrated values of the variables, to within 1.0 per cent (1.85 [illegible]) over the temperature range of 70 ± 25°F.

3.4.4.2 Output Impedance

The output impedance shall be less than 10 ohms.

3.4.4.3 FMC Function Ground

The FMC function return shall be brought out to the interface connector, and shall be isolated from all other grounds except telemetry ground by 500 kilo-ohms.

3.4.4.4 Fixed Voltage Output

During the time the A to B transfer signal is applied to the FMC function generator, the FMC function generator shall provide a fixed output voltage between 1.1 to 1.15 vdc.

3.5 Yaw Function Generator Requirements

3.5.1 General

The yaw function generator shall generate a function to yaw the Agena, through the Agena guidance system, for compensation of V_{cross} defined in Appendix A. The purpose of the yaw function generator shall be to align the X axis of the Agena to the V_{FMC} direction defined in Appendix A.

3.5.2 Yaw Function Generator

The yaw function generator shall be started with Brush 14 and shall automatically stop after 86.5 $\pm$ 1 minutes. The yaw function shall be a sinusoidally amplitude-modulated 400 cps carrier with a modulation period of 86.5 $\pm$ 1 minutes. The phase of the carrier shall reverse at the minimum value of the modulation signal (every 180°). A drive system for the oblateness function generator may be used for the yaw function generator.

3.5.3 Yaw Function Amplitude

The yaw function amplitude shall be easily adjustable prior to launch (R-8 day). The adjustment range shall be from 20 to 25 mv rms at the maximum value.

3.5.4 Phase Shift Requirement

The maximum phase shift between the function output carrier and the 400 cps 115 v rms input shall be less than 0 $\pm$ 5° or 180 $\pm$ 5°.

3.5.5 Starting Phase

The starting phase shall be independently adjustable over the complete modulation signal period.

3.5.6 Output Impedance

The output impedance of the yaw function shall be less than 100 ohms.

3.5.7 Yaw Function Accuracy

The demodulated yaw function shall conform to a calculated sinusoid within the value specified below for different ranges of phase angle of a standard sine function and temperature.

Phase Angle (Std. sine function)	Max. Function Error (70 ± 25°F)	Max. Functional Error (30 to 1[illegible]°F)
0 to 45°	± 0.25 mv rms	± 0.5 mv rms
45 to 135°	± 0.5 mv rms	± 1.0 mv rms
135 to 225°	± 0.25 mv rms	± 0.5 mv rms
225 to 315°	± 0.5 mv rms	± 1.0 mv rms
315 to 360°	± 0.25 mv rms	± 0.5 mv rms

3.5.8 Yaw Function Output Enable and Disable

A circuit shall be provided for alternately enabling and disabling the yaw function output with a real time command, VHF 107. When the yaw function is disabled, the output shall be zero volts with output impedance of 100 ohms maximum.

3.6 Relay Reset

The relay reset umbilical command shall be used to reset the IMC function generator to the launch condition.

3.7 Telemetry Monitor Requirements

3.7.1 Monitor Items

Sufficient monitors for telemetry read-out shall be provided to determine the status of the IMC function generator, as well as certain critical [illegible] monitors. The following shall be the minimum parameters to be monitored:

a. Eccentricity function Start Relay select position.

b. Eccentricity function Start Voltage select position.

c. Eccentricity function Half-Cycle Voltage select position.

d. Eccentricity function Drive system monitor.

e. Obliqueness function and Yaw Function drive system monitor.

f. FMC function Output Voltage monitor.

g. Brush 27 and Brush 14 function monitor.

h. Yaw function Enable/Disable monitor.

3.7.2 Signal Conditioning

Wherever practical, signal conditioning and multiplexing from 0 to 5 vdc but shall be performed in the Instrumentation and Telemetry subsystem instead of in the FMC function generator.

3.7.3 Monitor Code

For Items (a), (b), and (c) of paragraph 3.7.1, above, a 5 by 5 code shall be used. The monitor points shall use 1, 2, 3, 4, and 5 vdc, with ± 0.2 vdc tolerance.

3.8 AGE Monitor and Commands

A separate AGE monitor and command connector shall be provided for monitoring and commanding during test.

3.8.1 AGE Command

AGE commands shall be provided for stopping the eccentricity function and obliqueness function/yaw function drives independently anywhere within the function period. An AGE command for selecting the start delay increments specified in paragraph 3.4.2.2 shall be provided for the qualification unit.

3.8.2 AGE Monitors

The following monitors shall be the minimum provided at the AGE con-[illegible]

a. [illegible] eccentricity function start delay function.

b. [illegible] pulse generator (normal mode and slow mode)

c. [illegible] Voltage monitor

d. [illegible] Half-Cycle Voltage monitor

e. Eccentricity function Voltage Regulator monitor

f. Eccentricity function Output Voltage monitor

g. Oblateness function Maximum Voltage monitor

h. Oblateness function Output Voltage monitor

i. DC/DC converter output monitor

3.9 Mechanical Requirements

3.9.1 Assembly Size

The IMC function generator shall not exceed 600 cubic inches in size.

3.9.2 Weight

The total weight of the IMC function generator shall not exceed 10 pounds.

3.9.3 Mechanical Adjustments

The IMC function generator shall be packaged in such a way that normal adjustments can be easily performed.

3.9.4 Thermal Control

The thermal environment shall be controlled to $70 \pm 25^{\circ}F$.

3.9.5 Environmental Requirements

The unit shall be designed and packaged to withstand the acceleration, shock, sinusoidal vibration, random vibration, and ascent thermal altitude testing conditions specified in paragraph 4.3 of this specification. The unit shall be capable of operation in the orbit thermal altitude testing conditions specified in paragraph 4.3.5 of this specification.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Classification of Tests

The inspection and testing of the IMC function generator shall be classified as follows:

a. Qualification Test (See paragraph 4.3)

b. Acceptance Test (See paragraph 4.4)

4.2 General

The general test requirements specified in this paragraph shall apply to both qualification and acceptance testing.

4.2.1 Receiving Inspection

Each unit shall be inspected for compliance with drawings and flight quality standards regarding workmanship and cleanliness.

4.2.2 Atmospheric Condition

Unless otherwise specified herein, all tests shall be performed at the following atmospheric condition:

a. Temperature: $60^{\circ}F$ to $95^{\circ}F$

b. Pressure: 710 to 810 mm of Hg

c. Relative Humidity: less than 80 percent

4.2.3 Pre-Test Adjustment

Prior to performing any test specified herein the following adjustments shall be made. No further adjustments shall be made during testing.

4.2.3.1 Eccentricity Function Period

Verify that the eccentricity function period is adjustable between 2400 and 4800 seconds, and set the period to 3600 seconds nominal.

4.2.3.2 Oblateness Function Starting Position

The starting position of the oblateness function shall be set so that the start voltage setting defined in paragraph 3.4.2.4 is the starting voltage.

4.2.3.3 Oblateness Function Gain Control

Verify that the oblateness function gain control is adjustable as specified in paragraph 3.4.3.3. The gain control shall be set at 0.10.

0.10

4.2.3.4 Yaw Function Amplitude

Verify that the yaw function maximum amplitude is adjustable between 20 and [illegible] mv rms as specified in paragraph 3.5.3. The maximum output shall be adjusted to 22 mv rms.

4.2.3.5 Yaw Function Starting Phase

The starting phase of the yaw function shall be set at zero volts going from "in phase" to "out of phase" with the 400 cps 115 volts rms input.

4.2.4 Pre-Test Calibration

The following pre-test calibrations shall be performed prior to performing any test specified herein. These calibration data shall be part of the base line data.

a. Each step of each start delay increment.

b. The eccentricity function period.

c. Each step of the eccentricity function start voltage with the half-[illegible] cycle voltage set at midpoint.

d. Each step of the eccentricity function half-cycle voltage with the start voltage set at midpoint.

e. Oblateness function period.

f. Oblateness function gain control setting.

g. All telemetry monitors.

4.2.5 Functional Testing

The following functional testing requirements shall apply to both acceptance and qualification testing. The following are considered minimum testing requirements.

4.2.5.1 Power Requirements

Verify compliance with paragraph 3.3.1.

4.2.5.2 Ground Isolation

Verify that the function ground shall be isolated from unregulated 24 [illegible] dc ground and 400 cps 115 volts rms ground by 500 kilo-ohms minimum [illegible] 400 cps 115 volts rms ground and the 24 volts dc unregulated [illegible] isolated by more than 500 kilo-ohms. A minimum dc isolation [illegible] shall exist between the case and all other grounds.

4.2.5.3 Eccentricity Function Start Delay

Sufficient tests shall be performed on each increment [illegible] ability of the start delay circuit in compliance with the applicable requirements of paragraph 3.4.2.2.

4.2.5.4 Eccentricity Function

A minimum of one complete cycle shall be run to verify compliance with pre-test calibration data and applicable requirements of paragraphs 3.4.2.3 and 3.4.2.6.

4.2.5.5 Eccentricity Function Start and Half-Cycle Voltages

Verify compliance with the pre-test calibration data and applicable requirements of paragraph 3.4.2.4.

4.2.5.6 Homing

The eccentricity function shall be slewed at the start of the eccentricity function to verify the requirements of paragraph 3.4.2.5.

4.2.5.7 Voltage Regulator

The output voltage of any DC/DC converter and regulator circuits shall be monitored.

4.2.5.8 Oblateness Function

A minimum of one complete cycle shall be run to verify compliance with paragraph 3.4.3 of this specification.

4.2.5.9 FMC Function Output

The FMC function output shall be monitored to verify compliance with paragraph 3.4.4 of this specification.

4.2.5.10 Yaw Function

A minimum of one complete cycle shall be run to verify compliance with paragraphs 3.5.2, 3.5.4, 3.5.6, 3.5.7 and pre-test calibration data.

4.2.5.11 Yaw Function Output Enable and Disable

Tests shall be performed to verify compliance with 3.5.8 of this specification.

4.2.6 Performance Record

The IMC function generator shall be tested under the conditions of paragraph 4.3.2, and base line data shall be recorded. Base line tests including the functional testing specified in paragraph 4.2.5 shall be repeated before and after each phase of environmental testing and during environmental [illegible]

4.2.7 Failure During [redacted]

The test shall be stopped if a failure occurs during testing. No replacement, adjustment, maintenance, or repairs are authorized during test without approval of the Cognizant Design Engineer. A complete record of any failure and actions taken shall be included in the test report.

4.2.8 Test Report

Preparation of the test report shall be the responsibility of the testing organization. The report shall document the test arrangement and test conditions in detail. The description shall include sufficient detail so that the test can be repeated independently of other information sources. Photographs of the test arrangement shall be included, if possible. The report shall contain a record of all measurements and observations, including laboratory ambient conditions. The sequence of testing shall be recorded. Degradation of equipment performance during testing shall be recorded, even though still within limits at the conclusion of testing.

4.3 Qualification Testing

The following environmental testing shall be performed per the requirements of T3-6-002, General Specification for Payload Qualifications and Acceptance. This requirement of the specification shall apply in case of conflict between T3-6-002 and this specification.

4.3.1 Acceleration Testing

The IMC function generator shall be tested per paragraphs 4.3 and 4.3.[illegible] (b) of T3-6-002. The IMC function generator shall not be operated during acceleration testing, but the 24 volts dc and ac power shall be applied to the unit.

4.3.2 Shock Testing

The IMC function generator shall be tested per paragraphs 4.[illegible] and 4.6.[illegible] of T3-6-002. The unit shall not be operated during the shock test, but the 24 volts dc unregulated power and ac power shall be applied to the unit.

4.3.3 Sinusoidal Vibration Tes[redacted]

The IMC function generator shall be tested per paragraphs 4.1 and 4.1.3 of T3-6-002. The unit shall not be operated during sinusoidal vibration testing, but the 24 volts dc and ac power shall be applied to the unit.

4.3.4 Random Vibration Testing

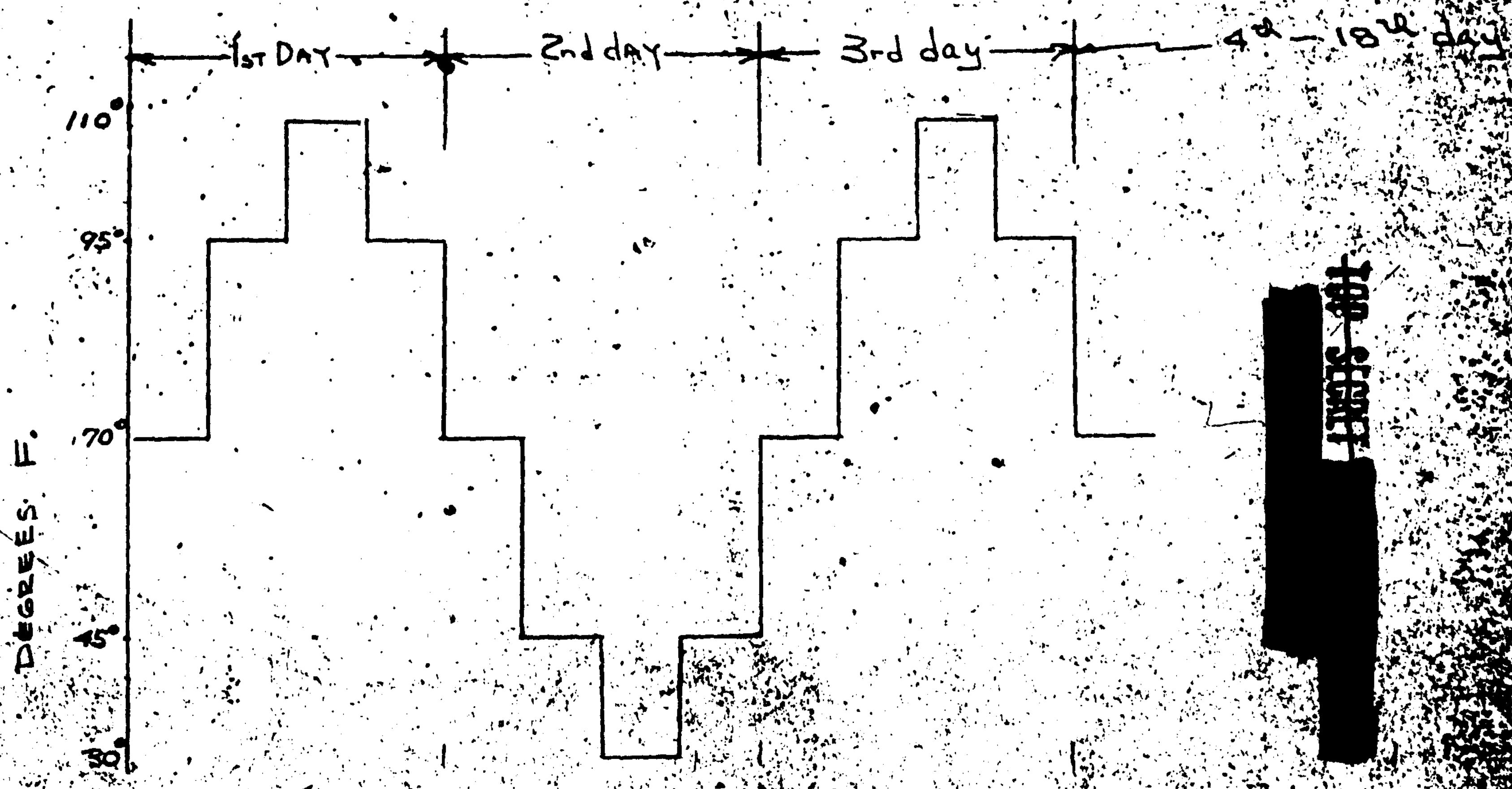
The IMC function generator shall be tested per paragraphs 4.2 and 4.2.1.(d) of T3-6-002. The unit shall not operate during random vibration testing, but the 24 volts dc and ac power shall be applied to the unit.

4.3.5 Thermal Altitude Test

The FMC function generator shall be thermal altitude tested after completion of the acceleration, shock, sinusoidal vibration, and random vibration testing. The FMC function generator shall be mounted on a test fixture consisting of a plate whose temperature can be controlled and maintained within ± 5 degrees F in the temperature range of 0° to 125 degrees F. Fixture attachment points shall be at the normal equipment mounting points. At least three (3) temperature sensors shall be placed in contact with the equipment and test fixture. The heat source of the test facilities shall be so located that intense radiant heat shall not fall directly on the equipment under test.

After installation of the unit in the thermal altitude chamber, a vacuum of at least 10^{-3} mm of Hg shall be achieved in 180 seconds. During this period, the maximum pressure reduction rate shall be 15 mm of Hg per second for a maximum period of 30 seconds. Pressure reduction shall continue until a pressure of 10^{-5} mm of Hg or less is achieved. Temperature elevation to 125°F shall be started at approximately the same time as the start of evacuation. The temperature shall be stabilized at 125°F for [illegible] minutes. The unit shall not be operated during this ascent simulation, but 24 volts dc and ac power shall be applied to the unit.

The FMC function generator shall remain in the thermal altitude chamber for [illegible] days. The ambient temperature shall be cycled through 30 to 110 degrees F, [illegible] in Figure 2.



~~TOP SECRET~~ [redacted]

FIGURE 2

THERMAL – ALTITUDE TEST PROGRAMMING

The FMC function and the Yaw function shall be recycled every 90 minutes. Data recording shall be made once at each temperature after the temperature has stabilized. The programming and monitoring details shall be defined in the test procedure.

4.4 Acceptance Testing

Each unit shall be given an acceptance test to ensure compliance with the design requirements of this specification. The requirements of paragraph 4.2 of this specification shall apply.

4.4.1 Sinusoidal Vibration

Each unit shall be subjected to sinusoidal vibration of the following amplitudes in one of the three major mutually perpendicular axes and for a period of 5 minutes with constant octave sweep rate.

Frequency	Amplitude
15 - 400 cps	1 g zero-to-peak acceleration
400 - 2000 cps	2.5 g zero-to-peak acceleration

5.0 PREPARATION FOR DELIVERY

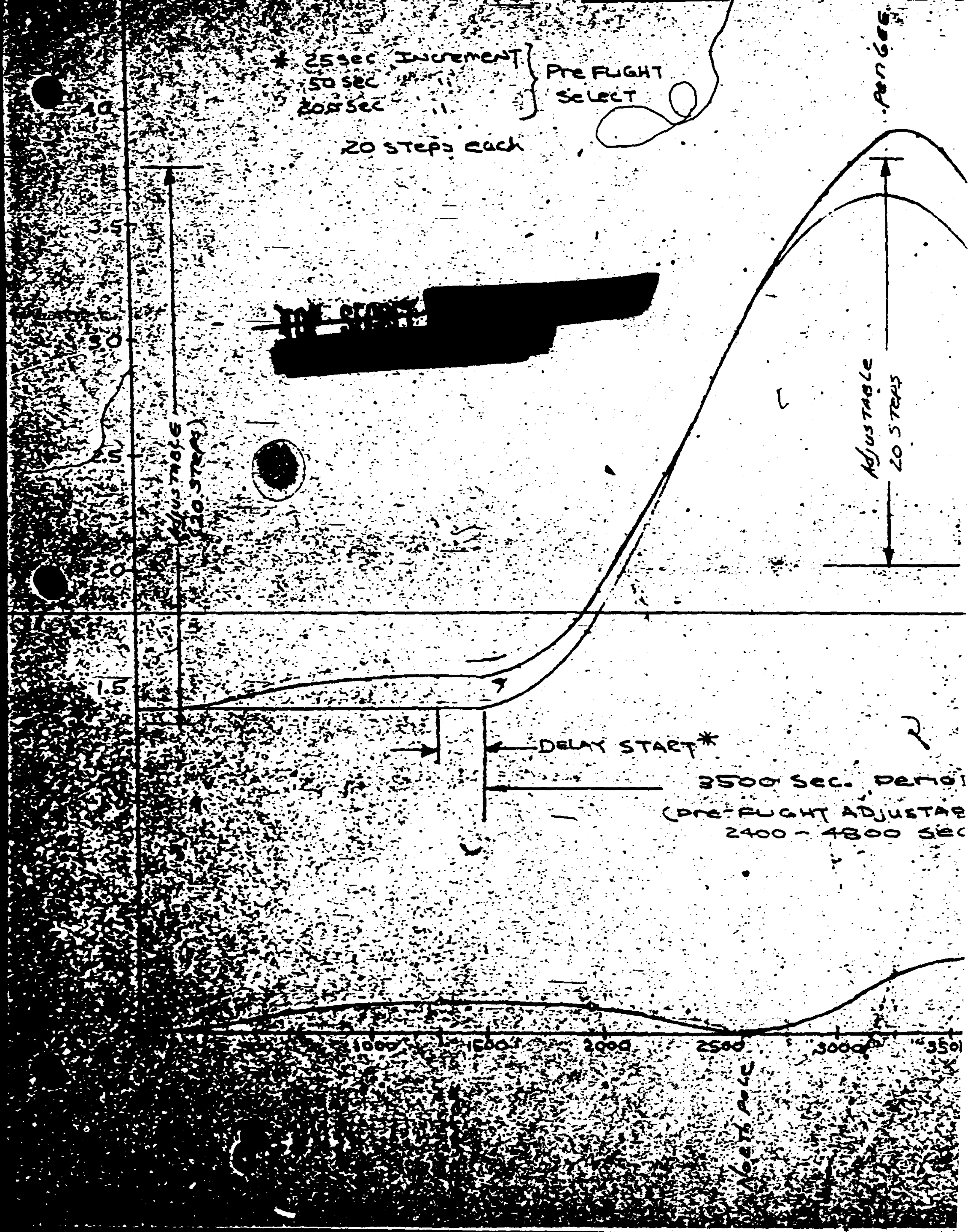
Not Applicable

6.0 NOTES

Not Applicable

APPENDIX B

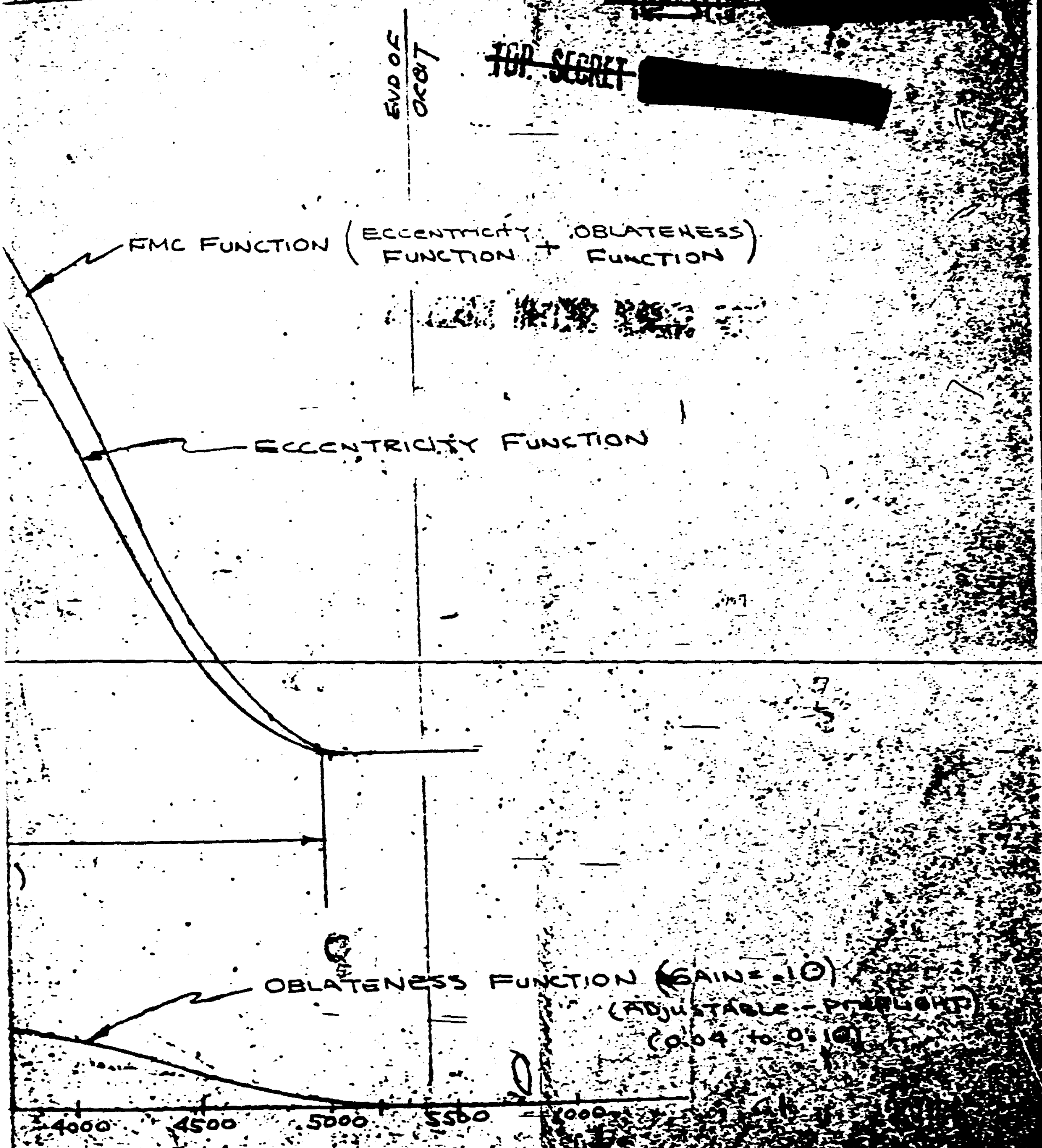
EXAMPLE OF FMC F



NCTION OUTPUT

~~TOP SECRET~~ [redacted]

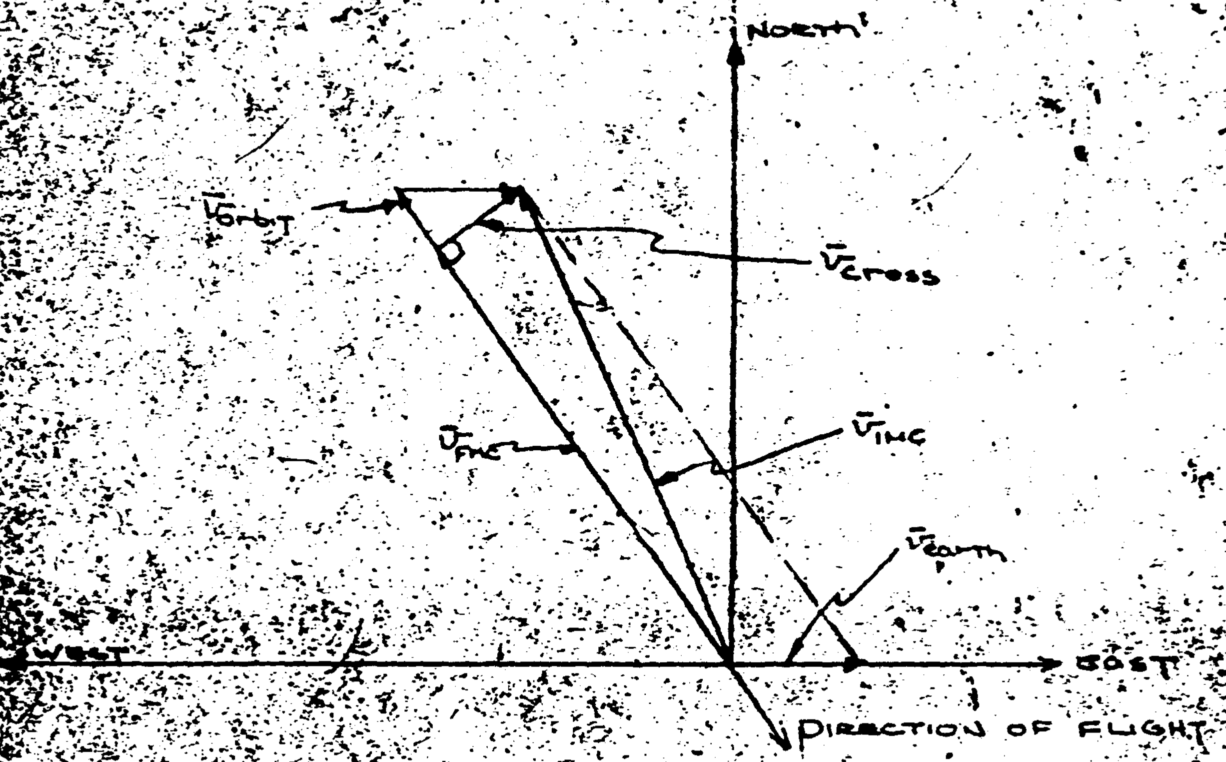
~~TOP SECRET~~ [redacted]



TOP SECRET [redacted]

APPENDIX A TOP SECRET [redacted]

IMC VECTOR DIAGRAM [redacted]



$\bar{V}_{earth}$ — Earth rotation velocity vector referred to the satellite

$\bar{V}_{orbit}$ — Forward ground track velocity referred to the satellite

$\bar{V}_{IMC}$ — Image motion velocity referred to the satellite ($\bar{V}_{earth} + \bar{V}_{orbit}$)

$\bar{V}_{cross}$ — Cross track velocity component of $\bar{V}_{IMC}$ (yaw compensation)

$\bar{V}_{FMC}$ — Forward motion component of $\bar{V}_{IMC}$ (Forward motion compensation)

APPENDIX C

DERIVATION OF FMC FUNCTION OUTPUT EQUATION

a. Eccentricity function output, E_{ef}

$$E_{ef} = \frac{E_s + E_{hc}}{2} + \frac{E_s - E_{hc}}{2} \cos 2\pi f_1 t \quad \text{— (1)}$$

where

E_s = start voltage

E_{hc} = half cycle voltage

f_1 = Reciprocal of the eccentricity function period

t = Time after start delay completion

b. Oblateness function maximum voltage, $E_{of_{max}}$

$$E_{ofmax} = K\,E_{ef} \quad \text{— (2)}$$

where

K = gain control (0.0[illegible] - 0.10)

c. Oblateness Function output, E_{of}

$$E_{of} = \frac{E_{ofmax}}{2}\left[1 + \cos 2\pi f_2 (t - \Delta t)\right] \quad \text{— (3)}$$

f_2 = Reciprocal of the oblateness function period.

Δt = Delta time between oblateness function start (SPC 14) and eccentricity function start.

d. FMC function output, E_{fmc}

$$E_{fmc} = E_{cf} + E_{of}$$

$$E_{fmc} = \frac{E_s + E_{hc}}{2} + \frac{E_s - E_{hc}}{2} \cos 2\pi f_1 t + \frac{E_{ofmax}}{2} \left[1 + \cos 2\pi f_2 (t \pm \Delta t)\right] \quad (4)$$

Substituting equations (1) and (2) into (4):

$$E_{fmc} = \frac{E_s + E_{hc}}{2} + \frac{E_s - E_{hc}}{2} \cos 2\pi f_1 t + \frac{K}{2} \left\{ \frac{E_s + E_{hc}}{2} + \frac{E_s - E_{hc}}{2} \cos 2\pi f_1 t \right.$$

$$\left. \left(1 + \cos 2\pi f_2 (t \pm \Delta t)\right) \right\}$$

$$E_{fmc} = \left(\frac{E_s + E_{hc}}{2} + \frac{E_s - E_{hc}}{2} \cos 2\pi f_1 t \right) \left(1 + \frac{K}{2} + \frac{K}{2} \cos 2\pi f_2 (t \pm \Delta t) \right)$$

TOP SECRET

[illegible] INTERFACE SPEC -
A/P P/L & PROGRAM [redacted]

TOP SECRET

TRACKING, TELEMETRY, COMMANDS, POWER

AND

PYROTECHNIC INTERFACE SPECIFICATION

FOR

ADVANCED PROJECTS PAYLOAD

AND

PROGRAM [redacted] AGENA ORBITAL VEHICLE

Prepared by: [redacted]

[redacted] -9-66

Advenced Projects Manager

[redacted]

INDEX

1.0 SCOPE

1.1 This document shall define the electrical interface requirements of Advanced Projects Payload Systems and the Program [redacted] Agena Orbital Vehicles. Specifically, the areas affecting tracking, telemetry, commands, power, and pyrotechnics are discussed. The requirements defined in this specification will allow both the Advanced Projects Payload Systems, J-1, as described in Requirements Specification T3-4-001, and J-3, as described in Requirements Specification T3-5-016 to be electrically compatible with [redacted] Agena Orbital Vehicles 1641 and up as described in LMSC Detail Specification, Program [redacted] Satellite System.

2.0 APPLICABLE DOCUMENTS

2.1 The following documents shall form a part of this specification to the extent specified herein. In the event of conflict, this specification shall prevail:

SPECIFICATIONS:

LMSC 447969B - Specification for Electromagnetic Interference Control Requirements and Electrical Interface for Agena Systems.

DRAWINGS:

1324217 - Interface-Payload/Vehicle (Mechanical)

3.0 REQUIREMENTS:

3.1 Electrical Interface Connectors

The Payload Systems (hereafter known as the Payload)/Program [redacted] Agena Orbital Vehicle (hereafter known as the Vehicle) electrical interface shall consist of six (6) connectors. The payload connectors shall be physically located per LMSC 1324217 Interface, Payload/Vehicle (Mechanical) interface drawing. The vehicle shall provide compatible mating connectors wired to flexible electrical cables. The payload connectors and functions are described below:

3.2 Connector D[redacted]ignments

3.2.1 Pyro Power Connector
AJ-20X (PT07SE-18-11P (011))

Vehicle Function	J-1 Function	J-3 Function
A Continuity Loop	None	Pre-launch c/o
B Pyro Shield Tie	None	Same as vehicle
C Pyro Bus Return	None	Same as vehicle
D +24 VDC Pyro Bus	None	Same as vehicle
E Pyro Shield Tie	None	Same as vehicle
F Pyro Bus Return	None	Same as vehicle
G Continuity Loop	None	Same as vehicle
H Pyro Shield	None	Same as vehicle
J Pyro Bus Return	None	Same as vehicle
K +24 VDC Pyro Bus	None	Same as vehicle
L +24 VDC Pyro Bus	None	Same as vehicle

Note: Pins G and A shall be jumpered on vehicle side.

Pins C and D are a twisted shielded pair with pin B as the shield [illegible]

Pins F and L are twisted shielded pair with pin E as the shield [illegible]

Pins J and K are a twisted shielded pair with pin H as the shield [illegible]

The J-1 Payload System does not have an AJ-20X interface connector. The [illegible] payload system receives pyro power through the pyro signal connector AJ-2[illegible] Reference paragraph 3.2.2.

3.2.2 Pyro Signal Connector
AJ-21X (PT07R-22-21 PW (011))

Vehicle Function	J-1 Function	J-3 Function
A Pyro Bus Return	Same as Vehicle	[illegible]
B Pyro Bus Return	Same as Vehicle	[illegible]
C Pyro Shield Tie	Same as Vehicle	[illegible]

Vehicle Function	J-1 Function	J-3 Function
D Transfer to Exp. No. 2	Switch Recovery	Spare
	sequence signals	
E Transfer to Exp. No. 2	from "A"SRV circuits	Spare
	to "B" SRV circuits	
F Arm Signal	A & B SRV/Arm. Funct.	Same as J-1
G Arm Signal	A & B SRV Arm Funct.	Same as J-1
H AP Orbit Mode Signal	Payload to Orbit	Same as J-1
J AP Orbit Mode Signal	and Door	Same as J-1
K Separation Signal	A & B SRV/Payload Sep.	Same as J-1
L Separation Signal	A & B SRV/Payload Sep.	Same as J-1
M Continuity Loop	Prelaunch c/o	Same as J-1
N Disconnect Signal	None - Spare	A & B P28 Conn. Disconnect
P +24 VDC Pyro Bus	Same as vehicle	Spare
R +24 VDC Pyro Bus	Same as vehicle	Spare
S In-Flight Reset	Door Eject	Same as J-1
T In-Flight Reset	Door Eject	Same as J-1
U Transfer Signal	A & B SRV Transfer Function	Same as J-1
V Transfer Signal	A & B SRV Transfer Function	Same as J-1
W Disconnect Signal	Spare.	A & B P28 Conn. Disconnect
X Continuity Loop	Pre-launch c/o	Same as J-1

NOTE: Pins M and X shall be jumpered on vehicle side.

Pins A and B shall be twisted shielded pair with pin C as the shield tie.

Pins R and E shall be twisted shielded pair with pin C as the shield tie.

3.2.3 Primary Power Connector
AJ-22X ([illegible]-22-21P (01))

Vehicle Function		J-1 Function	J-3 Function
A	+24 VDC Unreg.	Primary Power	Same as J-1
B	+24 VDC Unreg.	Primary Power	Same as J-1
C	+24 VDC Unreg.	Primary Power	Same as J-1
D	+24 VDC Unreg.	Primary Power	Same as J-1
E	+28 VDC Reg.	Primary Power	Spare
F	-28 VDC Reg.	Primary Power	Spare
G	+28 VDC Reg.	Primary Power	Spare
H	+28 VDC Reg.	Primary Power	Spare
J	AC Shield Tie	Primary Power	Same as J-1
K	115V 400 Hz ϕB Ret.	Primary Power Ret.	Same as J-1
L	115V 400 Hz ϕA	Primary Power Ret.	Same as J-1
M	115V 400 Hz ϕC	Primary Power	Same as J-1
N	Unreg. Return	Primary Power Ret.	Same as J-1
P	Unreg. Return	Primary Power Ret.	Same as J-1
R	Unreg. Return	Primary Power	Same as J-1
S	Unreg. Return.	Primary Power	Same as J-1
T	Reg. Ret.	Primary Power Ret.	Spare
U	Reg. Ret.	Primary Power Ret.	Spare
V	115V 400 Hz ϕ A	Primary Power	Same as J-1
W	115V 400 Hz ϕ A	Primary Power	Same as J-1
X	115V 400 Hz ϕ B Ret.	Primary Power Ret.	Same as J-1

[illegible]

 [redacted]

3.2.3 Primary Power Connector (Continued)

Notes: Pins A and N are a twisted pair.

Pins B and P are a twisted pair.

Pins C and R are a twisted pair.

Pins D and S are a twisted pair.

Pins K, L, and M are a twisted shielded triad with pin J as the shield tie.

Pins V, W, and X are a twisted shielded triad with pin J as the shield tie.

Pins E and F and T are a twisted triad.

Pins G and H and U are a twisted triad.

3.2.4 Command Connector
(AI-23X (PT07SE-22-55P (011))

Vehicle Function	J-1 Function	J-3 Function
A VHF Cmd 101	Spare	CR No. 1 Exposure Control Override
B VHF Cmd 102	Spare	CR No. 2 Exposure Control Override
C VHF Cmd 103	Spare	CR No. 1 Filter Control
D VHF Cmd 104	Spare	CR No. 2 Filter Control
E KIK-Zorro 38	Same as J-1	Early A to B Transfer
F KIK-Zorro 39	Spare	DISIC Early A to B Transfer
G AP Data Enable	Spare	AP TLM Commutators ON for Tape Recording
H AP Recovery Enable	Spare	SRV Battery Heater ON
J VHF Cmd 105	Spare	Exposure Control Delay
K SPC 51	P.G. Lights ON	Exposure Control
L AMA 14/VHF Cmd 11A	Yaw Prog. Enable/ Disable	DISIC Mode Select
M VHF Cmd 107	Spare	Yaw Programmer Enable/ Disable
N VHF Cmd 113	Spare	DISIC East/West/Both/OFF

Vehicle Function		J-1 Function	J-3 Function
P	SPC 52	Spare	Exposure Control
R	T/R Shield Return	Same as vehicle	Same as vehicle
S	AP to Tape Recorder Track 1	TLM Data	Same as J-1
T	VHF Cmnd 116	Spare	Emergency Ops. Select/ Mode By-Pass
U	AP to Tape Recorder Track 2	TLM Data	Same as J-1
V	Spare	Spare	Spare
W	AHA 6/VHF Cmnd 106	V/H Ramp Select	CR Prog. Select
X	AP Umb. Cmnd No. 3 (J100-4G)	Stereo Operate	Same as J-1
Y	AP Umb. Cmnd No. 1 (J100-4D)	Spare	Continuity Loop Power
Z	SPC 17	(a) Clock Interrogate (b) Switch Chan. 18 to clock from IR roller mon.	CR Dynamic TLM Enable
a	SPC 27	V/H Programmer Start	Same as J-1
b	SPC 28	Redundant OFF & PG Lights OFF all programs.	Redundant OFF, all programs
c	SPC 29	Commutator & TLM Pwr. ON	Intermix advance
d	SPC 30	Program 1 - ON	Same as J-1
e	SPC 31	Program 1 - OFF	Same as J-1
f	SPC 32	Program 2 - ON	Same as J-1
g	SPC 33	Program 2 - OFF	Same as J-1
h	SPC 34	Program 3 - ON	Same as J-1
i	SPC 35	Program 3 - OFF	Same as J-1
j	SPC 36	Program 4 - ON	Same as J-1
k	SPC 37	Program 4 - OFF	Same as J-1

[redacted]

Vehicle Function	J-1 Function	J-3 Function
m SFC 38	Program 5 - ON	Same as J-1
n SFC 39	Program 5 - OFF	Same as J-1
p SFC 40	Program 6 - ON	Same as J-1
q SFC 41	Program 6 - OFF	Same as J-1
r SFC 42	Program 7 - ON	Same as J-1
s SFC 43	Program 7 - OFF	Same as J-1
t SFC 44	Program 8 - ON	Same as J-1
u SFC 45	Program 8 - OFF	Same as J-1
v SFC 46	Program 9 - ON	Same as J-1
w SFC 47	Program 9 - OFF	Same as J-1
x SFC 48	Intermix Cntrl.	DISIC ON
y SFC 49	Cont. TLM Channels Enable	DISIC OFF
z SFC 50	Commutator & TLM Pwr. OFF	Exposure Control
A SFC 14	(a) V/H Delay Homing Cmnd. (b) Yaw Prog. Start	(a) V/H delay reset (b) V/H oblateness st (c) Exposure control reset (d) Yaw Programmer start
BB [illegible] Umb. Cmnd No. 2	Arm By-pass No. 2	Same as J-1
CC AMA 8/VHF Cmnd 108	V/H Ramp Amp. Select	OP Select No. 1
DD AMA 9/VHF Cmnd 109	Program Select	OP Select No. 2
EE AMA 10/VHF Cmnd 110	V/H Ramp Start Select	CR Mode Select
FF AMA 11/VHF Cmnd 111	OP. Mode Select	V/H Start level selec
[illegible] AMA 12/VHF Cmnd 112	Intermix 1 Select	V/H half-cycle level
[illegible] AMA 13/VHF Cmnd 113	Intermix 2 Select	V/H Delay Select

3.2.4 Command Connector (Continued)

NOTE: SPC = Stored Program Command

AUA - S-Band Analog Command

VHF Cmnd = VHF Digital Decoder Command

3.2.5 . Telemetry Connector
AJ-24X (PT07SE-22-558 (011))

Vehicle Function	J-1 Function	J-3 Function
A Spare	Spare	Spare
B, AP 245	Redundant TLM	Spare
C Spare	Spare	Spare
D AP 4	Link I, Chan. 4	Spare
E AP 237	Redundant TLM	Spare
F AP 238	Redundant TLM	Spare
G AP 239	Redundant TLM	Spare
H AP 240	Redundant TLM	Spare
J AP Umb. Mon. 6	Pad Temp Mon	Same as J-1
K AP 241	Redundant TLM	Spare
L AP 242	Redundant TLM	Spare
M AP 243	Redundant TLM	Spare
N AP 244	Redundant TLM	Spare
P AP 231	Redundant TLM	Spare
R AP 232	Redundant TLM	Spare
S AP 233	Redundant TLM	Spare
T AP 234	Redundant TLM	Spare
U AP 235	Redundant TLM	Spare
V AP 236	Redundant TLM	Spare
W Link I TLM ON Sig.	+ 28 VDC TLM Pwr. ON	TLM [illegible]

Vehicle Function	J-1 Function	J-3 Function
X Link I TIM ON Sig.	Commutator ON	TIM Commutators ON and Cont. Clock Readout
Y Umb. TIM Signal Rat.	Same as Vehicle	Same as J-1
Z AP Umb. Mon. 1	Continuity Loop and TIM ON Mon.	Spare
a AP 15-2	Spare	Link II, Chan. 15
b AP 16-2	Spare	Link II, Chan. 16
c AP 246	Redundant T/M	Spare
d A 218 8	Separation Mon.	Spare
e AP 7	Link I, Chan. 7	Same as J-1
* f Thrust Mon. No. 1	Spare	Same as Vehicle
g AP 9	Link I, Chan. 9	Same as J-1
* h Thrust Mon. No. 2	Spare	Same as Vehicle
i AP 10	Link I, Chan. 10	Same as J-1
* j Thrust Mon. No. 3	Spare	Same as Vehicle
k AP 6	Link I, Chan. 6	Same as J-1
m Spare	Spare	Spare
n AP 13	Link I, Chan. 13	Same as J-1
p ~~AP 13~~	Link I, Chan. 13	Same as J-1
q AP 11	Link I, Chan. 11	Same as J-1
r AP 8	Link I, Chan. 8	Same as J-1
s AP 18	Link I, Chan. 18	Same as J-1
* t Thrust Mon. No. 4	Spare	Same as Vehicle
u TIM Sig. Ret.	Same as Vehicle	Same as Vehicle
v TIM Sig. Ret.	Same as Vehicle	Same as Vehicle

* Tentative

Vehicle Function	J-1 Function	J-3 Function
v TLM Shield Tie	Same as Vehicle	Same as Vehicle
x TLM Shield Tie	Same as Vehicle	Same as Vehicle
y AP Umb. Cmnd. No. 4	Arm By-pass No. 2	Same as J-1
z AP Relay Reset	Same as Vehicle	Same as Vehicle
AA AP Relay Reset	Same as Vehicle	Same as Vehicle
* BB Thrust Mon. No. 5	Spare	Same as Vehicle
* CC Thrust Mon. No. 6	Spare	Same as Vehicle
DD AP Umb. Mon. No. 4	Spare	Continuity Loop
EE Relative Humidity Mon.	Same as Vehicle	Same as Vehicle
FF Relative Humidity Ret.	Same as Vehicle	Same as Vehicle
GG AP Umb. Mon. No. 5	+28V Pad c/o Mon.	AP Orbit Mode Mon.
HH AP Cmnd. No. 5	+28V Pad c/o	AP Orbit Mode Control

* Tentative

3.2.6 Test Connector (Flight Functions) J-1 (PTB-55PBW)

Vehicle Function	J-1 Function	J-3 Function
A Roll Program Input	Yaw Programmer Voltage Output	Same as J-1
B Roll Program Ret.	Yaw Programmer Return	Same as J-1
C Shield Tie	Yaw Programmer Shield Tie	Same as J-1
D thru HH	Flight Spares	Same as J-1

3.3 Electrical Interface Requirements

3.3.1 Electrical Power

The vehicle shall supply ± regulated DC and unregulated DC for primary power, unregulated DC for pyrotechnic power and 115 V 400 Hz single phase power to the payload. Power shall be supplied continuously during a normal mission which includes pre-launch and launch modes except that pyrotechnic power will be removed from the payload interface when the vehicle internal/external power switch is in the external position. The payload and all of its subsystems including GFE systems shall be capable of operating without impairment of function when supplied from the main bus of a central system with power within the limits and characteristics specified in the following subsections and under the conditions of power utilization prescribed by Section 3.3.1.2.

3.3.1.1 Power Supply Characteristics

3.3.1.1.1 Steady State Voltages

The steady state voltages of the central power supplies measured at distribution buses in the vehicle shall be within the limits specified below at zero load.

a. Primary unregulated DC +22.0 to +29.5 volts.

b. Pyrotechnic unregulated DC +22.0 to +29.5 volts.

c. Regulated Positive DC 27.74 to 28.87 volts

d. Regulated Negative DC 27.74 to 28.87 volts

e. 400 Hz, 1Ø 112.7 to 117.3 VAC rms

The allowable line drops from the vehicle distribution buses to the payload Primary Power connector is 0.5 volt DC and 1.0

volt AC with an average load as described in 3.3.1.2.1. The pyrotechnic bus shall not be required to comply with the line drop specification during squib activation signals.

3.3.1.1.2 AC Supply Characteristics

3.3.1.1.2.1 Wave Form Distortion

The total non-fundamental frequency content of the voltage wave form of the vehicle AC supply measured as distortion of the fundamental shall not exceed 5% for noise-free linear loads from zero to rated load for frequencies above the fundamental supply frequency.

3.3.1.1.2.2 Amplitude Modulations

The amplitude modulation of the AC supply shall not exceed 7 volts p-to-p over a period of not less than 1 second for noise-free linear loads for frequencies below the fundamental supply frequency. These limits shall not be exceeded for DC input voltages as specified in 3.3.1.1.1.

3.3.1.1.2.3 Voltage Transients

The dynamic regulation of the vehicle AC supply shall be such that, under the worst combination of step function changes in all input voltages within prescribed limits and in load current from no load to rated load or vice-versa, the peak output voltage shall remain within +100 volts and -50 volts of 162.6 volts and shall recover to 115V ± 2% within 300 milliseconds.

3.3.1.1.2.4 Frequency

The frequency of the vehicle AC supply shall be maintained between

399.992 and 400.008 Hz. These limits shall apply for steady state conditions and under worst combinations of step function changes in input voltages within prescribed limits and in load current from no load to rated load or vice versa.

3.3.1.1.3 Pyrotechnic Power Supply Characteristics

The pyrotechnic power supply shall be capable of supplying 60 amps for 5 milliseconds while maintaining a bus voltage of 14 to 29.5 volts at the payload pyro power connector. The payload pyrotechnic power requirements exist during ascent, recovery sequences, and upon receipt by the payload of either secure commands.

3.3.1.1.4 Regulated Supply Characteristics

3.3.1.1.4.1 Output Impedance

The output impedance of the Regulated DC supply shall not exceed 0.1 ohm open-circuit and 0.4 ohm with a 4 Hz to 200K Hz load.

3.3.1.1.4.2 Transient Response

The dynamic regulation of the vehicle regulated supply shall be such that, under the worst combination of step function changes in all input voltages within prescribed limits and in load current from no load to rated load or vice-versa the peak output voltage shall remain within ± 5 volts of ± 28.3 volts and shall recover with a time constant (63% response) of 10 milliseconds.

3.3.1.2 Load Characteristics

3.3.1.2.1 J-1 Primary Power Consumption

The current requirements of the J-1 payload system shall not exceed the limits listed below for the mode 1 (all systems in operation) and mode 2 (all systems quiescent) conditions.

Unregulated Current:

A. Mode 1 (not to exceed 5 hrs.) with a duty cycle of 20 min. ON 70 min. OFF.)

1. Average - 12 amps

2. Peaks - 25 amps max. not to exceed 200 milliseconds.

B. Mode 2 (continuous during mission)

1. Average - 1.5 amps

2. Peaks - None

Plus Regulated DC Current

A. Mode 1 (not to exceed 5 hrs.) with a duty cycle of 20 min ON 70 min OFF.)

1. Average - 5 amps

2. Peaks - 10 amps max. not to exceed 200 milliseconds.

B. Mode 2 (continuous during mission)

1. Average - 0.6 amps

2. Peaks - None

Minus Regulated DC Current:

A. Mode 1 (not to exceed 5 hrs.) with a duty cycle of 20 min ON 70 min. OFF.)

1. Average - 0.25 amps

2. Peaks - None

B. Mode 2 (continuous during mission)

1. Average - 0.02 amps

2. Peaks - None

AC Current:

Mode 1 and Mode 2 - 150 milliamps average

All continuous power requirements shall be minimized and subject to design review by [redacted] CSS.

3.3.1.2.2 J-3 Primary Power Consumption

The current requirements of the J-3 Payload system shall not exceed the limits listed below for Mode 1 (all systems in operation) Mode 2 (all systems quiescent) and Mode 3 (secondary system in operation).

Unregulated Current:

A. Mode 1 (not to exceed 5 hrs. with a duty cycle of 20 min ON, 70 min. OFF.)

1. Average - 30 amps
2. Peaks - 60 amps not to exceed 500 milliseconds.

B. Mode 2 (continuous during mission)

1. Average - 3 amps
2. Peaks - none

C. Mode 3 (not to exceed 15 hours with a duty cycle of 45 min ON, 45 min OFF.)

1. Average - 8 amps
2. Peaks - 12 amps not to exceed 200 milliseconds.

AC Current

A. Mode 1 (not to exceed 5 hrs. with a duty cycle of 20 min ON, 70 min. OFF.)

Phase C

1. Average - 0.6 amps
2. Peaks - 0.85 amps not to exceed 500 milliseconds

B. Mode 2 (continuous during mission)

Phase A

1. Average - 0.1 amps
2. Peaks - none

c. Mode 3 (not to exceed 15 hrs.)

None required for secondary system.

All continuous power requirements shall be minimized and subject to design review by Program [redacted] CHE.

3.3.1.2.1 Load Impedance

a. The impedances presented by each payload subsystem to the vehicle DC power supply shall be essentially linear and noise-free to the greatest extent possible.

b. The loads presented to the vehicle AC supply by each payload subsystem shall have a power factor as near unity as practicable for all modes. Loads shall not be presented with steady state power factors less than 0.80 lagging and 0.95 leading, nor with unsymmetrical half wave loading.

3.3.1.3 Switched Capacitor Loads

Switched capacitor loads shall have surge current limiting resistors in series.

3.3.1.4 Inductive Spike Suppression

The use of diodes (or other equally effective devices) to [illegible] spikes that result from collapsing magnetic fields is [illegible] in every case where a current that flows through an [illegible] is interrupted. The diode (or other suppression device) [illegible] mounted as close to the inductance as possible.

3.3.1.5 Cables and Harnesses

Cables and Harnesses for the payload system shall [illegible] conforming to the applicable [illegible] 3.2.1 [illegible] [illegible]

3.3.1.6 AF Signal Circuits

AF signal circuits (0-150 KC) which require shielding for proper operation shall be shielded with the shield grounded at the vehicle ground point only. Shields shall not be connected in any way which creates a loop having nominally zero ohms impedance. The shields shall be routed through the pins provided on various interface connectors (see paragraph 3.2).

3.3.1.7 Grounding

Neither the payload nor any of its subsystems shall ground any power or signal returns to chassis or structure. All airborne ground return leads shall be grounded to the vehicle frame through the vehicle ground point. (See LMSC 4479698, Paragraph 3.2.8.1). However R.F. by-pass devices may be utilized to control EMI.

3.3.1.8 Bonding

The payload and its subsystems shall conform to applicable portions of bonding requirements of paragraph 3.2.12.1 - 3.2.12.2.2 and paragraphs 3.2.12.3 - 3.2.12.5 of LMSC 4479698 to every extent possible.

3.4 Electrical Interface Command and Function Descriptions

3.4.1 Operational Commands

3.4.1.1 [illegible] Commands (AJ-23X Pins A, B, C, D, J, M, N, T)

a. Signal Description. Unsecure, real time commands may be [illegible]itiated during vehicle acquisition and shall be disabled [illegible] all other times. Minimum time between the trailing edge [illegible] leading edge of consecutive commands shall be 1 second.

b. Electrical Requirements

1. Duration 350 ± 100 ms.

2. Source Current Capacity - 2 A maximum

3. Command Voltage - +24 Unregulated referenced to unregulated return.

4. The command lines shall present an open circuit to the payload in the absence of a command.

3.4.1.2 Analog S-band commands (AJ23X - Pins L, W, CC, DD, EE, FF, GG, [illegible]

a. Signal Description - The unsecure real time commands may be initiated during vehicle acquisition and shall be disabled at all other times. Minimum time between trailing and leading edge of consecutive commands shall be 1 second.

b. Electrical Requirements

1. Pulse Duration - 1 second maximum

2. Source Current Capacity - 2 amps maximum

3. Command Voltage - 24 VDC unregulated referenced to unregulated return.

4. The command lines shall present an open circuit to the payload in the absence of a command.

NOTE: All S-band commands are backed up by VHF commands. Payload circuits requiring S-band commands shall be capable of satisfactory operation when commanded from either source. [illegible] Para. 3.4.1.1 Sec. B.

3.4.1.3 S-band Secure Commands [illegible] 38 and 39 [illegible]

a. Signal Description - Secure real time commands [illegible] initiated during [illegible] at all other times including ascent. The command source will generate only one command output per acquisition.

D. Disable circuits, to protect payload functions from repeated commands, if required, shall be in the payload system.

b. Electrical Requirements

1. Duration - 1 second minimum but may be as long as 15 minutes.

2. Source Current - capacity 2 amps maximum.

3. Command Voltage +24 VDC unreg. referenced to unreg. return.

3.4.1.4 Stored Program Commands (AJ23M Pins K, P, Z, a - z, AA)

a. Signal Description - The stored Program Command source shall be the vehicle orbital programmer. The commands are stored in the form of square holes in 35 mm tape. The tape speed and position shall be kept synchronized with the orbital period so commands shall occur at the desired times. The commands shall take the form of a momentary ground pulse.

b. Electrical Requirements

1. Duration = 12.5 ± 2.5 seconds.

2. Source Current Capacity - 300 ma per command, with a 1 amp max. limit for each set of 13 SPC's.

NOTE: It is intended that the stored program commands control latching relays with coil resistance of 600 ohms nominal. The [illegible] [illegible] not contiguous for their duration.

 [redacted]

3.4.2 Recovery Signals

The recovery signals shall be considered by the payload systems as a sequence of signals that are time related. The signals shall be generated in order: Arm, Transfer, Disconnect, Separate and Transfer to Experiment No. 2. The Arm, Transfer, Disconnect and Separate Signals shall be terminated simultaneously and their signal lines will be shorted together after removal of power and prior to Recovery Timer Reset.

A recovery signal sequence is required for each of the two Satellite Recovery Vehicles, known as the A and B SRV's, that form a part of the J-1 and J-3 payload systems. The recovery timer accuracy between events shall be 0.5 seconds or 0.11 percent, whichever is greater.

NOTE: For differences in recovery signal requirements of the J-1 and J-3 payload systems reference paragraphs 3.2.2, 3.4.2.3 and 3.4.2.5. SRV recovery may be effected without an AP Recovery Enable Signal but this does not negate the requirement for the AP Recovery Enable Signal.

3.4.2.1 Arm Signal (AJ-21x pins F & G)

a. Signal Description. The Arm signal shall be the initial signal of the recovery sequence. Upon receipt of the Arm signal the J-1 and J-3 payloads and an SRV shall activate the functions required at this time to prepare for the ejection of that SRV.

b. Electrical Description

1. Time of Initiation - T-76 seconds

2. Duration - 104 seconds

3. Source Current Capacity - 2 amps max.

4. Signal Voltage - +24 VDC unregulated referenced to unregulated return.

3.4.2.2 Transfer Signal (AJ-21X Pin U & V)

a. Signal Description - The transfer signal shall be the second signal of the recovery sequence. Upon receipt of the transfer signal the J-1 and J-3 payloads and an SRV shall activate those functions required at this time to prepare for the ejection of that SRV.

b. Electrical Description

1. Time of Initiation - T-1 second

2. Duration - 29 seconds

3. Source Current Capacity - 2 amps max.

4. Signal Voltage - +24 VDC unregulated referenced to unregulated return.

3.4.2.3 Disconnect Signal (AJ-21X pins N & W)

a. Signal Description - The disconnect signal shall be the third signal of the recovery sequence. Upon receipt of the Disconnect signal the J-3 payloads shall cause the P26 interface connector between the payload and an SRV to be disconnected. The J-1 payloads disconnect the P26 interface connector by [illegible] a delay circuit at the time of the Transfer signal, [illegible] 3.4.2.2

 [redacted]

b. Electrical Description

1. Time of Initiation - T-0 seconds

2. Duration - 28 seconds

3. Source Current Capacity - 2 amps max.

4. Signal Voltage - +24 VDC unregulated referenced to unregulated return.

3.4.2.4 Separation Signal (AJ-21X pins K & L)

a. Signal Description. The Separate signal shall be the fourth signal of the recovery sequence. Upon receipt of the separate signal the J-1 and J-3 payload systems shall cause the physical separation of the payload and an SRV.

b. Electrical Description

1. Time of Initiation - T + 1 second

2. Duration - 27 seconds

3. Source Current Capacity - 2 amps max.

4. Signal Voltage - +24 VDC unregulated referenced to unregulated return.

3.4.2.5 Transfer to Experiment No. 2 (AJ-21X pins D & D)

a. Signal Description - The Transfer to Experiment No. 2 command shall be the fifth and last command of the recovery sequence and is required for J-1 payload systems only. [illegible] on the Arm, Transfer, Disconnect and Separate lines shall [illegible] removed from the payload system interface prior to [illegible] the Transfer to Experiment No. 2 Signal. [illegible] signal the J-1 payload shall switch all "A" [illegible] sequence signal lines to the "B" SRV circuit [illegible] for a "B" SRV recovery.

b. Electrical Description

1. Time of Initiation - T+88 seconds

2. Duration - 34 seconds

3. Source Current Capacity - 2 amps max.

4. Signal Voltage - +24 VDC unregulated referenced to unregulated return.

3.4.3 Special Purpose Commands

3.4.3.1 In-flight Reset (AJ-21X Pins S & T)

a. Signal Description - The In-flight reset signal shall be initiated by the physical separation of the vehicle and the booster adapter, nominally 2.5 seconds after the separation command (160 seconds after lift off). Exact time is mission peculiar.

b. Electrical Description

1. Duration - 1 second minimum required. Signal may be continuous for duration of mission.

2. Source Current Capacity - 2 amps max.

3. Signal Voltage - +24 VDC unregulated referenced to unregulated return.

NOTE: To conserve vehicle power the payload shall remove all loads from the In-flight reset command as soon as practicable, after receipt of the command.

3.4.3.2 AP Orbit Mode Signal (AJ-21X Pins H & J)

a. Signal Description - The AP Orbit Mode Signal shall be initiated by the vehicle to indicate the end of powered flight, nominally 430 seconds after Lift-off. Exact time is mission peculiar. Upon receipt of the signal the payload shall be placed in a mission ready condition.

b. Electrical Description

1. Duration - 5 seconds ± 1 second

2. Source Current Capacity - 2 amps max.

3. Signal Voltage - +24 VDC unregulated referenced to unregulated return.

3.4.3.3 AP Data Enable (AJ-23X Pin G)

a. Signal Description - The AP Data Enable signal shall be initiated by the vehicle each time payload functions are to be tape recorded. The exact times shall be coordinated on a per mission basis.

b. Electrical Description

1. Duration - Continuous during the tape recording of desired data - 10% of an Orbit period maximum.

2. Source Current Capacity - 1 amp max.

3. Signal Voltage - +24 VDC unregulated referenced to unregulated return.

3.4.3.4 AP Recovery Enable (AJ-23X Pin H)

a. Signal Description - The AP Recovery Enable Signal shall be initiated by the vehicle at the time of enabling a Primary recovery sequence or at the time of executing a Lifeboat U1 or U2 recovery sequence.

b. Electrical Description

1. Duration - 1 sec. min required. Command may be continuous from initiation to Recovery timer event No. 12 (3 hrs.)

2. Source Current Capacity - 2 amp max.

3. Signal Voltage - +24 VDC unregulated referenced to unregulated return.

3.4.3.5 Link I TLM ON Signal (AJ-24X Pins W & X)

a. Signal Description - The Link I TLM ON Signal shall be initiated by the vehicle to indicate that the Link I TLM system is operating. The signal shall be generated during each acquisition.

b. Electrical Description

1. Duration - continuous during each acquisition (15 minutes average)

2. Source Current capacity - 1 amp max.

3. Signal Voltage - +24 VDC unregulated referenced to unregulated return.

3.4.4 Telemetry Data

The vehicle shall provide TLM channels as required for in-flight monitoring of the payload system.

3.4.4.1 Primary Telemetry Data (AJ-24X Pins a, b, e, g, i, k, n, p, q, r and s.

Payload generated TLM data shall conform to the following requirements. Channel 13, Link I shall be required for Ascent & Orbit monitoring - all other channels shall be required for Orbit Monitoring only.

a. Electrical Requirements

1. Signal Voltage Range - 0 to 5 VDC referenced to TLM signal return.

2. Payload Circuit Impedance - 10 kilo-ohms max. measured

from a data line to TLM signal return.

3. TLM Input Impedance - 1 megohm ± 10%.

3.4.4.2 A218 (Payload SRV Separation Monitors)

a. Monitor Description - The payload shall provide a TLM monitor to the vehicle that will indicate payload-SRV physical separation. The monitor shall provide three discrete voltage levels referenced to TLM signal return.

b. Electrical Description

1. 0.3 volts both SRV's on board.

2. 1.3 volts "A" SRV ejected.

3. 4.7 volts "B" SRV ejected.

3.4.4.3 Thrust Monitors (AJ-24X- f, h, j, t, BB, CC

a. Monitor Description - The vehicle shall provide a monitor from each thrust valve. The monitor shall indicate thrust valve activation.

b. Electrical Description

1. Pulse duration - 15 milliseconds each.

2. Pulse Repetition Rate - Determined by external torques [illegible] on vehicle (1 to 10 pps avg.)

3. Pulse Configuration - +24 VDC unreg. continuous [illegible] VDC during pulse.

4. Source Impedance - 10 kilo-ohms minimum in series [illegible] voltage source.

5. Payload Impedance - 20 kilo-ohms minimum [illegible] to TLM signal return

3.4.4.4 AP to Tape Recorder Track 1 (AJ-23X Pin S)

The vehicle shall provide on orbit tape recording capability for the payload system. Tape recorder Track 1 shall be available to the payload a minimum of 10 percent of each orbit and during each recovery sequence commencing with the Arm Signal and terminating after the Separate signal. The payload data to be recorded shall have a maximum pulse repetition rate of 24 pps and shall meet the electrical requirements of paragraph 3.4.4.1 a. 1 and 2. The payload data on AJ-23X pin S shall be monitored in real time during vehicle powered flight.

3.4.4.5 AP to Tape Recorder Track 2 (AJ-23X Pin U)

The vehicle shall provide on orbit tape recording capability for the payload system. Tape recorder track 2 shall be available to the payload during each recovery sequence commencing with the Arm Signal and terminating after the Separation Signal. The payload data to be recorded shall have a maximum pulse repetition rate of 24 pps and shall meet the electrical requirements of paragraph 3.4.4.1, a 1 and 2. The payload data on AJ-23X Pin U shall be monitored in real time during vehicle powered flight.

3.4.5 Payload Umbilical Requirements

The vehicle shall provide umbilical lines for control and monitoring of the payload during pre-launch and count-down activities. Payload umbilical commands and certain designated monitors shall be terminated at a single control panel in each launch complex.

3.4.5.1 Umbilical Commands

3.4.5.1.1 AP Umbilical Commands No. 1 (AJ-23X Pin Y)

Electrical Requirement

1. Command Duration - 5 secs or less

2. Command Source - Momentary Switch

3. Command Voltage - +24 VDC unregulated referenced to vehicle unregulated return.

4. Command Current - 2 amps max.

3.4.5.1.2 AP Umbilical Command No. 2 (AJ-23X Pin BB)

Electrical Requirement

Reference paragraph 3.4.5.1.1

3.4.5.1.3 AP Umbilical Command No. 3 (AJ-23X Pin X)

Electrical Requirement

1. Command Duration - continuous for required duration to exceed 5 minutes.

2. Command Source - ON/OFF switch

3. Command Voltage - +24 VDC unregulated referenced to vehicle unregulated return.

4. Command Current - 2 amps max.

3.4.5.1.4 AP Umbilical Command No. 4 (AJ-24X Pin Y)

Electrical Requirement

Reference paragraph 3.4.5.1.1

3.4.5.1.5 AP Umbilical Command No. 5 (AJ-24X Pin BB)

Electrical Requirements

Reference paragraph 3.4.5.1.1

3.4.5.1.6 AP Delay Reset Command (AJ-24X Pins z & AA)

Electrical Requirements

1. Command Duration - 5 secs. or less
2. Command Source - Momentary switch
3. Command Voltage - +24 VDC unregulated referenced to vehicle unregulated return.
4. Command Current - 5 amps min.

3.4.5.2 Auxiliary Umbilical Commands

3.4.5.2.1 Stored Program Commands

AGE shall provide umbilical command capability for SPC's 14, 17, 28, 29, 49 and 50. The command source shall be on the payload control panel in each launch complex. For electrical requirements reference paragraph 3.4.1.4 sec. b.

3.4.5.2.2 S-band Analog Commands

AGE shall provide test connector command and monitor capability for ANA 6, 8, 9, 10, 11, 12, 14 and 15. For electrical requirements reference paragraph 3.4.1.2. These lines may be terminated on the Communications Control Panel.

3.4.5.2.3 VHF Commands

AGE shall provide test connector command capability for VHF commands 101, 102, 103, 104, 105, 107 and 113.

3.4.6 Yaw Programmer (J-1 Pins A, B)

a. Signal Description - The payload shall generate an amplitude modulated 400 Hz sinusoidal carrier referenced to ø A of the 115V AC source. The signal shall cause the vehicle to Yaw ± 3.5° about the orbit ground track. The payload shall provide real time enable/disable control of the yaw function output voltage.

b. Electrical Description

1. Function duration = 86.5 ± 1 minute/per orbit.

2. Phase Shift (ϕ A to Yaw Function) 0 ± 5° and 180 [illegible]

3. Function Voltage - 22.5 millivolts max. based on 1.6[illegible] millivolts per quarter degree of yaw.

4. Output Impedance (Enabled) 100 ohms max. at function voltage.

5. Output Impedance (Disabled) 100 ohms max. at zero volts

NOTE: Appropriate security measures shall be taken to prevent disclosure of payload yaw programmer input to vehicle guidance system. For electrical requirements reference paragraph [illegible]

3.4.7 Umbilical Monitors

The vehicle shall provide umbilical monitor lines for the payload for use during pre-launch and countdown activities.

3.4.7.1 AP Mon. No. 1 and TLM ON Mon. (AJ-2[illegible]X Pin Z)

AGE shall provide on each payload control panel two lamp indicators. One shall be wired to +24 VDC unregulated voltage and one shall be wired to unregulated return. These shall [illegible] a switch interrupt capability on this line at the payload control panels.

3.4.7.2 AP Mon. No. 4

AGE shall provide on each payload control panel a lamp indicator wired to unregulated return.

3.4.7.3 AP Mon. No. 5

AGE shall provide on each payload control [illegible] indicator wired to unregulated [illegible]

3.4.7.4 AP Mon. No. [illegible] [illegible]

AGE shall [illegible]

Point termination designated AP Mon. 6.

3.4.7.5 Relative Humidity Monitor (AJ-24X Pin EE)

AGE shall provide on each payload control panel a Red Test point termination designated R.H. Mon.

3.4.7.6 Relative Humidity Return (AJ-24X Pin FF)

AGE shall provide on each payload control panel a Black Test point termination designated R.H./AP 6 Ret.

3.4.7.7 AP Telemetry Umbilical Monitors

AGE shall provide eight (8) umbilical lines for pre-launch recording of payload functions.

Provisions shall be made to monitor payload data from all eight lines simultaneously in real time. Data shall be recorded on oscillographs which provide permanent paper recordings.

The monitor lines shall be "T" spliced on vehicle side of AP-24X to Pins e, AP 7 Mon.

g, AP 9 Mon.

i, AP 10 Mon.

k, AP 6 Mon.

n, AP 13 Mon.

b, AP 8 Mon.

s, AP 18 Mon.

4.0 QUALITY ASSURANCE

Not Applicable

5.0 PREPARATION FOR DELIVERY