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LAUNCH VEHICLE SYSTEM REQUIREMENTS AND RESTRAINTS FOR THE ERTS-A MISSION

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GSFC — GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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LAUNCH VEHICLE SYSTEM REQUIREMENTS AND RESTRAINTS FOR THE ERTS-A SPACECRAFT

Goddard Space Flight Center

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July 1971

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SECTION 1

GENERAL

Scope

This document defines the technical requirements and restraints imposed by the ERTS spacecraft upon the Delta launch vehicle, shroud system, associated launch complex and range.

1.2 Purpose

The purpose of this document is to set forth the requirements for technical coordination between the various agencies involved in the launch vehicle and launch operations for the ERTS Program.

1.3 Mission Goals and Objectives

The primary goal of the ERTS-A mission is the acquisition of multispectral images of the surface of the earth with the best practical resolution obtainable with near state-of-the-art sensors. To accomplish this goal, two different types of sensors have been selected: a return beam vidicon camera system and a multichannel line scanner. Wideband tape recorders are also included to extend the area of coverage beyond that available from direct transmission to the prime data-acquisition ground stations.

Another goal of the ERTS-A mission is the use of a relay system to transfer measurements from fixed remotely located unattended sensor stations to a central ground station. This goal is satisfied by the inclusion of a data collection system as part of the payload. The system uses simple, low-cost, remote data collection and relay platforms with no tracking or location features.

1.4 Payload

The ERTS payload will consist of four items:

1. A return-beam vidicon camera system (RBVC

2. A multispectral scanner (MSS)

3. A data-collection system (DCS)

4. A wideband video tape-recorder system (WBVTR)

The payload elements are mounted on and in the observatory sensory ring, where a clear earth-facing field of view is available for the sensors as shown in Figure 1-1.

1.4.1 Return-Beam Vidicon (RBV) Camera System

The RBV multispectral camera system consists of: (1) three sensor housings, each containing a 2-inch RBV, a lens, a mechanical shutter, focusing and deflection coils, and associated circuitry; (2) three camera electronics packages containing most of the required synchronizing signals to the cameras; and (3) one video combiner which combines the video output signals to provide one single video output. The three sensor housings are boresighted to each other in the spacecraft to view a common 100 by 100 NM scene on the ground to three different spectral regions. Each lens has a diagonal field of view of 16.25 degrees. Each sensor housing has four mounting feet which attach it to a common baseplate. This baseplate is attached to the observatory.

The optical components employed in the RBV camera system have been chosen to meet ERTS mission requirements. The lens uses refractive elements to obtain a focal length of 126 NM. The aperture provides a f/number of 3.2. The field of view is 16.25 degrees on the diagonal or 11.5 degrees on the side. Exposure is simultaneous for all three vidicons and is effected by a double-blade focal-plane shutter with a running time of 20 milliseconds. Exposure times of 4.0, 5.6, 8.0, 12.0, or 16.0 milliseconds can be acquired on command.

1.4.2 Multispectral Scanner Subsystem (MSS)

The MSS uses an object plane scanner. A flat scan mirror oscillating at 13.6 Hz provides the crosstrack scan. The optics is all reflecting to accommodate the very wide spectral range of sensing. The crosstrack scanning is provided by a high-duty cycle scan mechanism. The scan width is ±50 NM from an orbital altitude of 490 NM. The instantaneous field of view is 0.077 milliradian. Each of the four spectral bands have six detectors. The detectors for bands 1 through 3 are photomultiplier tubes. Band 4 detector is a Silicon

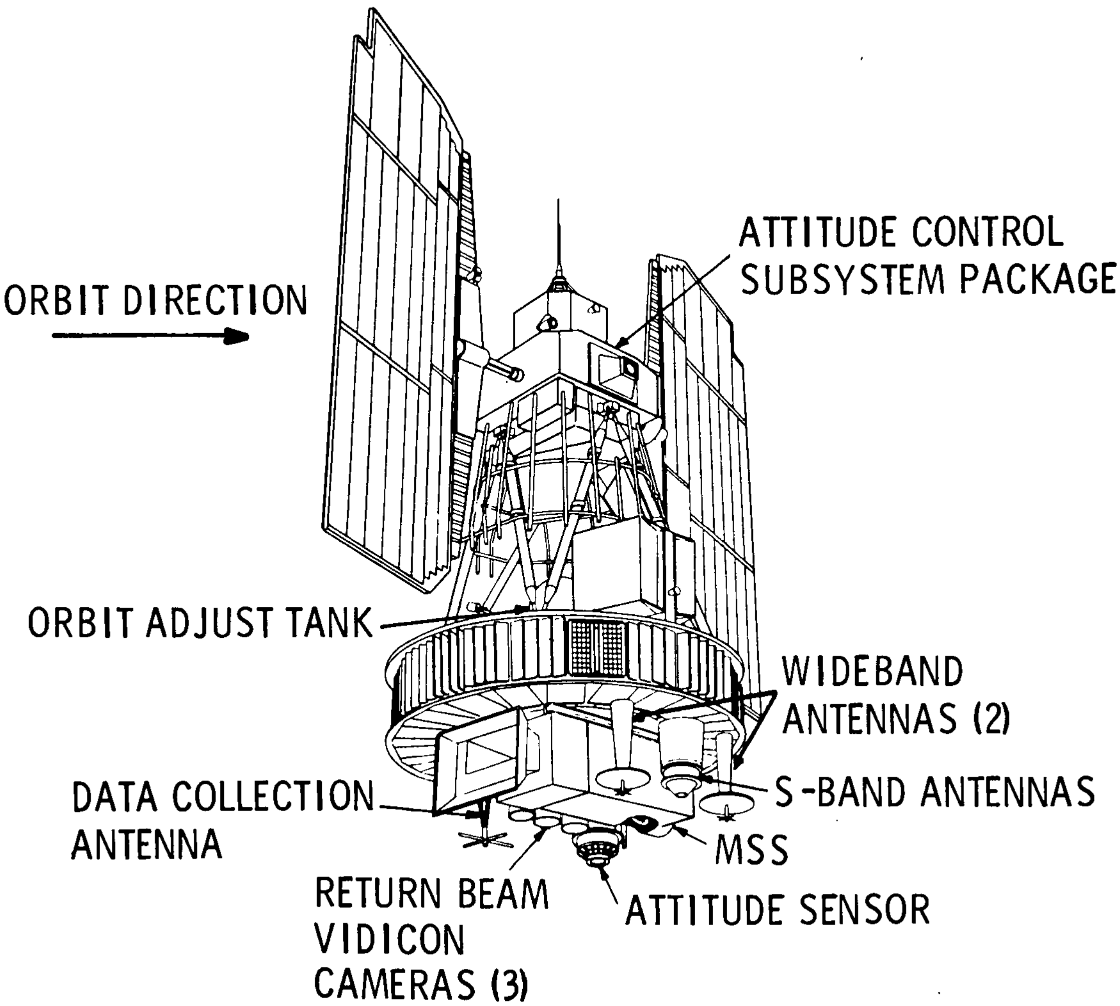

Figure 1-1. Observatory Configuration

photodiode. The primary calibration is provided by a small mirror designed to reflect the sun into the telescope when the spacecraft is in view of the Alaska ground station.

1.4.3 Wideband Video Tape Recorders

The intended application for the recorders is to record and to reproduce video signals from either the RBV camera or the multiplexed signal from the MSS. Two additional narrowband tracks are also provided, an auxiliary track and a search track. The auxiliary track will be used for recording narrowband telemetry data for correlation with the stored wideband data. The search track contains prerecorded data used for determining position of the tape.

1.4.4 Data-Collection Subsystem (DCS)

The Data-Collection Platforms (DCP) are located throughout the continental United States and its coastal waters. Each DCP accepts inputs from eight sensors. The inputs are multiplexed using time division multiplexing. Each input is then coded using pulse code modulation (PCM). The signals are transmitted to the spacecraft on a carrier frequency of 401.55 MHz.

The signal is received at the observatory through a crossed-dipole antenna and passes to the DCS spacecraft receiver subsystem. The receiver is a double heterodyne receiver with a 3-db overall noise figure, an IF bandwidth of 100 KHz and an output center frequency of 1.024 MHz. The 1.024-MHz signal is passed to the unified S-band (USB) premodulation processor where it is combined with other signals for relay to the ground over the USB downlink.

At the three receiving sites (Alaska, Goldstone, and NTTF), the USB downlink signal is received and demodulated. The DCS signal is stripped out of the composite baseband and routed to the DCS receiving site equipment. In the receiving site equipment, the signal is detected and demodulated and then decoded and formatted for transmission over voice data lines to the Operations Control Center (OCC) and the NASA Data Processing Facility (NDPF). At the NDPF, the data are formatted and prepared for dissemination to the users.

.5 Spacecraft System

The ERTS spacecraft system consists of two items, the observatory and the adapter.

The ERTS observatory is a two body configuration connected by a six strut truss assembly. The lower body is the sensory ring assembly, composed of 18 rectangular modular bays in a torus configuration which houses electronic equipment and battery modules. The ring provides support for an orbit-adjust propulsion assembly and recorder electronics on its upper portion. The peripheral section of the ring supports communication antennas and an earth sensor for attitude determination. The center section of the lower portion supports the payload sensors, consisting of three return-beam vidicon cameras and the multispectral scanner.

The upper body is the attitude-control package. The package is a fully contained module, housing the electronics, sensors, and actuators for the stabilization and control of the observatory. Two solar arrays are attached to shafts protruding from the module. The shafts are part of the array drive mechanism which is also contained within the attitude-control package. The VHF command antenna is mounted on the upper surface of the attitude-control system (ACS) package.

Figure 1-2 shows the ERTS configuration and packaging arrangement.

1.5.1 Structure

The sensory-ring structure (torus ring) is composed of 18 aluminum alloy separator castings connected by an upper and lower outboard ring. The lower ring incorporates the separation-band flange to interface with the spacecraft adapter. Three machined lugs are placed on the upper surface of the sensory ring to interface with the strut assemblies. These lugs are equally spaced with one located at the X axis. The X lug also provides the interface for the paddle tie-down assembly.

The adapter structure is a 24-inch-high hollow truncated cone, with a 60-inch outside diameter on the bottom flange, and a 57.12-inch outside diameter on the upper flange. The shell is a magnesium sheet with upper and lower channel shaped stiffening rings, vertical hat section stiffeners, and circumferential intermediate rings. The adapter is of riveted construction. The upper ring provides a flange for mounting to the observatory through the use of the separation band.

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The strut support consists of six tubular assemblies forming a stable framework to support and connect the ACS package to the sensory-ring assembly. The end fittings of the strut supports are inverted to the basic tube and are equipped with monoball units with adjustment nuts, to provide alignment of the ACS package.

The ACS structural assembly is constructed of conventional materials and contains ACS components including the pitch reaction wheel, control-logic box, rate-measuring packages, horizon scanners, solar-paddle drives, and the yaw-rate gyro. The yaw reaction wheel and the pneumatics assembly are also in the ACS structure. The pneumatics assembly consists of the tank, regulator, and six nozzles. The pitch-yaw nozzles are mounted on a standoff to provide plume clearance. A shutter assembly mounted below the structure provides thermal control of the ACS.

The main section of the solar-paddle assembly is a 38.15-inch-wide by 96.0-inch-high aluminum honeycomb panel. The main section is connected at an inboard hinge line to the transition section, which has a socket to receive the solar-assembly drive shaft.

In the launch configuration, the solar paddles are folded back along the hinge line and are connected to each other by hinge-line jaws spaced along the paddle edge. The jaws are latched with pins that are connected to each other by a cable. The cable at the lower end has a rod anchored in the lower latch assembly and tensioned by a spring at the top. Unlatching occurs when a pyrotechnic cutter severs the anchor rod, permitting the cable to be pulled upward by the upper tension spring. This motion withdraws the pins from the jaws, and each array unfolds by means of the paddle hinge-line springs. The opening rate is controlled by the paddle drive motor. The paddles are then latched in the open position.

1.5.2 Attitude-Control Subsystem (ACS)

The ACS is a 3-axis active-control subsystem which maintains the spacecraft alignment with the local earth vertical and orbit velocity vectors. The ACS employs horizon scanners for local roll and pitch attitude sensing, and gyros for sensing yaw rate and for use in a gyrocompassing mode to sense yaw attitude. The torquing is provided by a combination of reaction jets to provide large control torques when required, and fly wheels for fine control and momentum storage.

Two infrared horizon scanners are employed to provide pitch and roll attitude-error sensing. The conical scan axes for the two scanner units are aligned parallel to the roll axis, one directed forward and one aft. The scanning motion is provided by the roll reaction wheels, to which prisms are attached. The yaw channel error signals are derived from two sources: a yaw-axis rate gyro or a yaw gyrocompass.

The ACS pneumatic system has an operating pressure upstream of the regulator (high pressure side) of 2000 PSIA. The downstream side of the regulator operates at 40 PSIA to 75 PSIA, which is a function of the regulator lock-up characteristics and the ambient temperature. The high-pressure section of the system is proof tested at 3000 PSIA and has 8000 PSIA design burst. The low-pressure section of the system is proof tested at 100 PSIA and has a 260 PSIA design burst. The pneumatic-system storage tank is 10.5 inches in diameter and contains 12.6 pounds of Freon-14 at 2000 PSIA.

1.5.3 Orbit-Adjust System (OAS)

The OAS is a monopropellant, hydrazine, blowdown system with a nominal thrust level of 0.75 lb. The hydrazine and nitrogen gas pressurant are stored in a single tank, separated by a positive expulsion bladder made of ethylene-propylene rubber. Two manually operated fill valves are provided for pressurant and propellant loading and unloading.

The propellant is filtered through a 25-micron absolute filter in the manifold. In addition, there are control valve inlet filters of the same 25-micron size. The control valves are solenoid operated and series redundant. Figure 1-3 is a schematic diagram of the orbit adjust subsystem.

System instrumentation includes one pressure transducer to monitor propellant-tank pressure, and temperature transducers mounted on the external surface of the tank and on each of the thruster catalyst chambers. The OAS propellant tank is 16.5 inches in diameter and will hold a maximum of 67 lbs. of hydrazine pressurized to 660 PSIA maximum. The tank has been burst tested at 1635 PSIA.

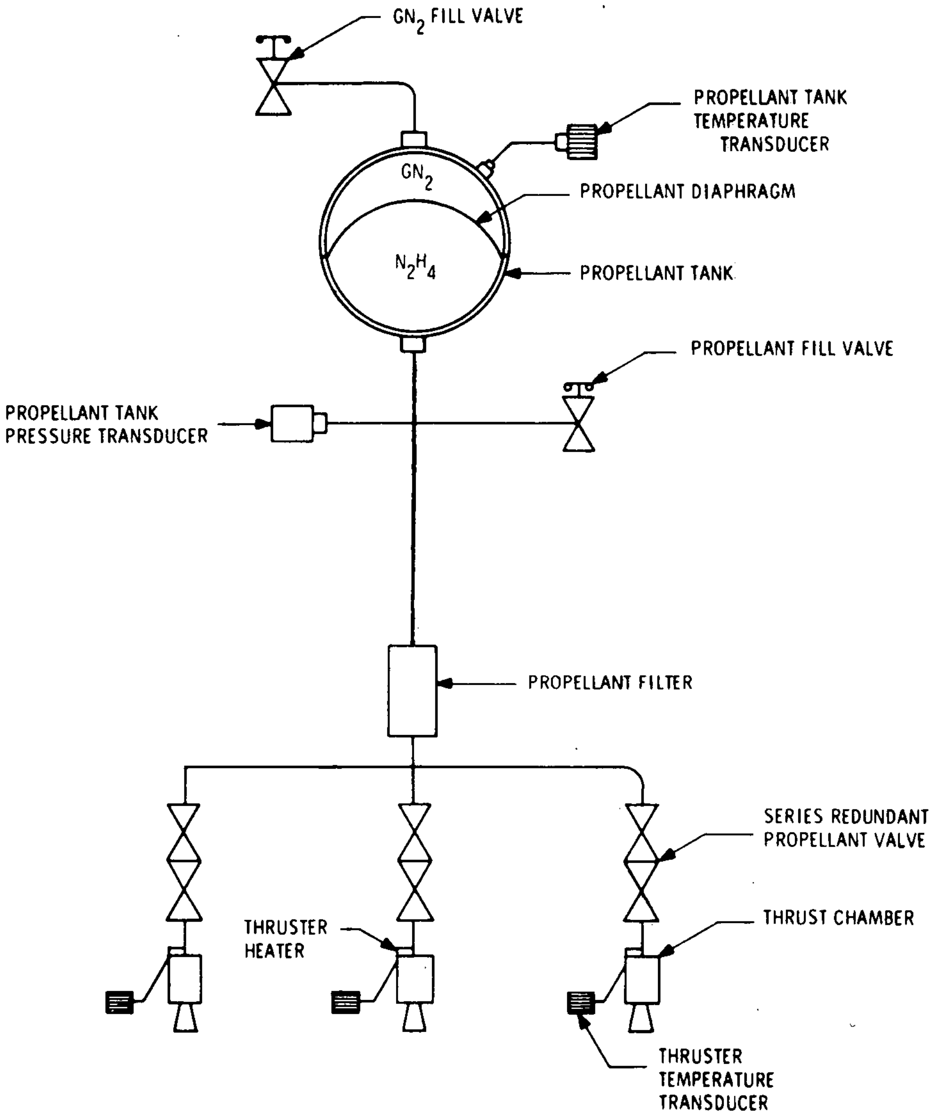


Figure 1-3. Orbit-Adjust Subsystem, Schematic Diagram

1.5.4 Thermal-Control System

The ERTS thermal-control system is required to maintain the temperature of all observatory equipment in the range of 20 ±10°C, with the exception of the ACS which requires 25 ±10°C control, and the OAS which will tolerate temperatures from 5 to 49°C.

The sensory ring achieves thermal control by regulating the heat rejection from the bays with thermally actuated shutters. Other heat-flow paths are restricted by multilayer insulation. Command-operated electrical heaters maintain minimum temperatures during low duty cycle periods.

The center section and its components reject their heat passively. Radiating areas, coatings, thermal capacitance, and low duty cycle heaters will maintain the center section within the temperature requirements.

The thermal-control design for the ACS uses both passive techniques and active shutters to control heat rejection. Exposed components supported with or by the ACS, including the support truss, solar panels, and auxiliary load panels are coated to passively maintain temperature.

1.5.5 Power System

The power system provides the electrical power required to operate the spacecraft and its subsystem from transfer to internal power prior to launch, through the 1 year design point. The power requirements are satisfied with two independently driven solar arrays, eight individual battery modules with a total capacity of 35 ampere-hours, an auxiliary load controller, and two power-control modules.

The power system provides an average regulated bus power of 219 watts for a new array at equinox and 197 watts at the 1-year design point.

1.5.6 Electrical Integration System

The electrical integration system consists of the observatory distribution harness, a power switching module, and a preflight disconnect component.

The harness provides the electrical interfaces between the payload sensors and all other observatory electrical components. The major portion of the harness is located at the top of the sensory ring with interconnections to the bottom loaded sensor equipment. The solar-array and ACS interface segments are routed and clamped external to the truss tubes.

The power switching module is the interface between power, observatory loads, and command subsystems. Its major functions are to provide power and signal switching, load fault protection, and voltage-dropping resistors for limiting the unregulated voltage applied to the orbit-adjust solenoid valves. The switching module is 16 by 10 by 4 inches, and is mounted on the ERTS sensory-ring crossbeam.

The preflight disconnect component provides for remote disconnect of power and monitor circuits (required during the prelaunch phase only) between the adapter and the observatory prior to launch. Demating prior to launch eliminates the requirement for an umbilical quick-pull type disconnect at separation of the shroud or adapter in flight. The preflight disconnect is a motor-driven plug which mounts in the adapter, and the associated receptacle is spring mounted on its base to permit movement in the event of slight misalignment during mating. The plug can be remotely mated or demated to make or break connections to the associated ground equipment.

1.5.7 Magnetic-Moment Compensating Assembly

The magnetic-moment compensating assembly (MMCA) provides a means for generating magnetic dipole moments sufficient to cancel those residual dipole moments that may exist on the spacecraft. The MMCA consists of three mutually perpendicular chargeable permanent magnetic rods which are aligned with the observatory pitch, roll, and yaw axes.

1.5.8 Communications and Data Handling

The communications and data-handling subsystem is composed of the wideband data links, the narrowband telemetry, tracking and command links and the transmission links for the data-collection system.

The wideband-telemetry subsystem transmits the data from the multispectral scanner, return-beam vidicon camera and the wideband video tape recorders. The wideband telemetry subsystem has two down links operating on frequencies of 2265 MHz and 2229.5 MHz.

The narrowband-telemetry tracking and command equipment provides for means for collecting and transmitting housekeeping data from the observatory to the ground stations net, providing a tracking signal for the observatory, receiving commands from either the MSFN or STADAN stations, and implementing those commands aboard the observatory. In addition, it provides the link for transmitting data from the data-collection system to the ground stations. The narrowband telemetry tracking and command equipment operates in S-band with frequencies of 2106.4 MHz uplink and 2287.5 MHz downlink, on VHF with frequencies of 154.20 MHz uplink and 137.86 MHz downlink, and on UHF with a frequency of 401.55 MHz uplink.

The command clock, which is part of the narrowband system, provides an accurate time base for observatory operations; generates time codes for transmission or storage; receives, processes, and stores command information from the command integrator; and executes these commands at predetermined times. Figure 1-4 shows the space to ground RF links. Table 1-1 outlines interface data for the RF links.

1.5.9 Attitude-Measurement Sensor

The attitude-measurement sensor (AMS) is independent of the attitude-control system and is capable of determining observatory attitude in the pitch and roll axes. The AMS detects the radiation level change between the earth atmosphere and the spatial background in the 14- to 16-micron range. The component provides pitch and roll position information to ±0.10 degrees 3 sigma over a measuring range of ±2 degrees. The attitude measurement obtained will be used for post-flight location of image data acquired by the payload sensors.

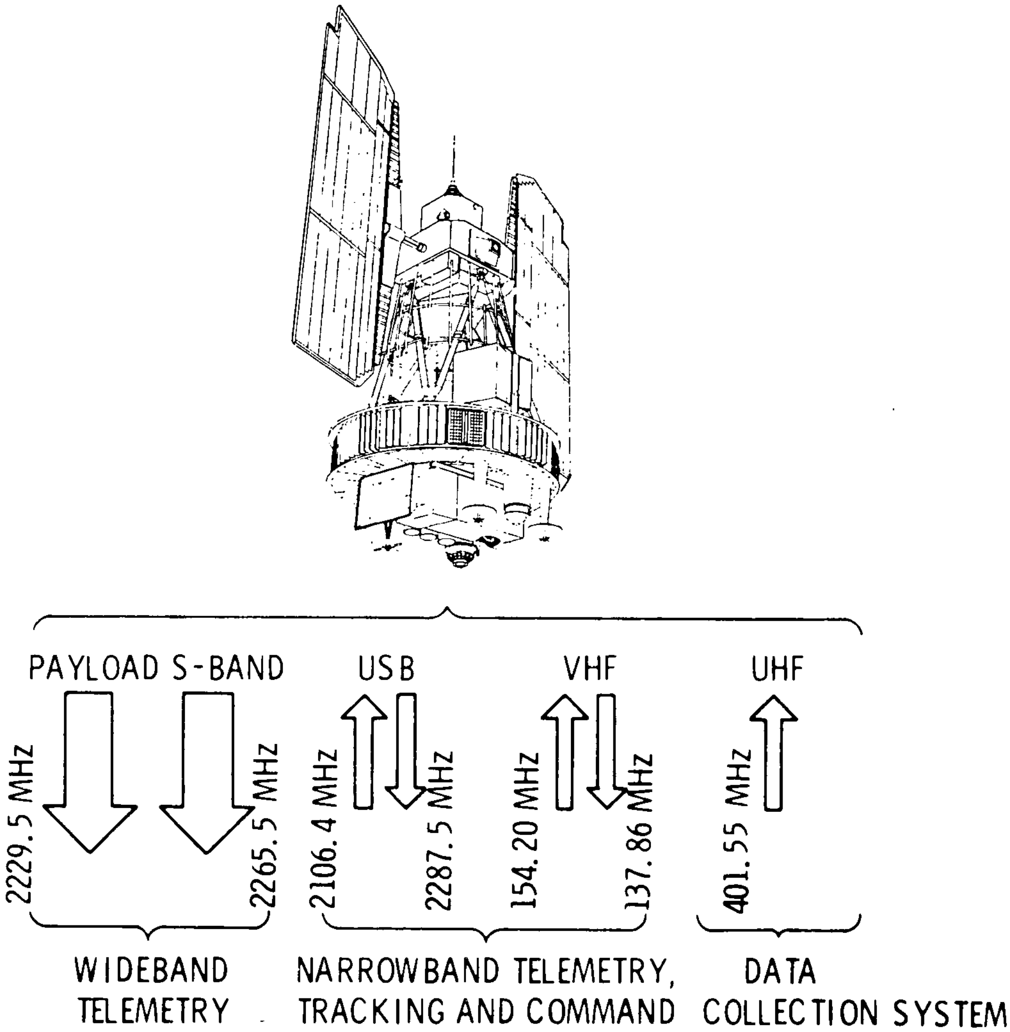


Figure 1-4. Space-to-Ground RF Links

Table 1-1

Data Link Summary

Link Parameter	Wideband Telemetry Downlink		USB		VHF		DCS
	MSS	RBV	Uplink	Downlink	Uplink	Downlink	
Carrier Frequency	2229.5/2265.5 MHz	2265.5/2229.5 MHz	2106.4 MHz	2287.5 MHz	154.20 MHz	137.86 MHz*	401 MHz
Modulation	PCM/FSK	Video/FM	PCM/PSK/PM/ PM-Command PRN/PM-Ranging	PCM/PSK/PM 597 KHz S.C. PCM/FSK/PM 1024 KHz S.C. PCM/PSK/PM 768 KHz S.C. PRN/PM	PCM/FSK AM/AM 8.0 KHz "0" 8.6 KHz "1"	PCM/PM	PCM/FSK
Bandwidth	20 MHz	20 MHz	20 KHz-70 KHz S.C. 3 MHz-PRN	96 KHz-597 KHz S.C. 100 KHz-1024 KHz S.C. 4 KHz-768 KHz S.C. 3 MHz-PRN 5.0 MHz Total Assigned Band	40 KHz	Realtime Data 30 KHz Playback Data 90 KHz Total Assigned Bands	100 KHz
Signal Characteristics	15 MBS	3.5 MHz Video	1 KBPS-70 KHz S.C. 991.666 KBPS PRN	24 KBPS-597 KHz S.C. 5000 BPS-1024 KHz S.C. 1 KBPS-768 KHz S.C.	128 BPS	Realtime Data 1 KBPS Playback Data 24 KBPS	5000 BPS

* The observatory beacon (137.86 MHz) will be operating at launch and during ascent.

SECTION 2

MISSION REQUIREMENTS AND RESTRAINTS

2.1 Launch Vehicle

The ERTS-A will be launched from the Air Force Western Test Range (AFWTR) aboard a Delta 900 launch vehicle. The launch vehicle is identified by the McDonald Douglas Company as a DSV-3N-1. The first stage of the vehicle is a modified Thor booster. Nine Thiokol solid propellant motors are employed for first-stage thrust augmentation. The second stage will consist of an Aerojet General Corporation AJ10-118F liquid-propellant propulsion system. The shroud will be a standard Delta shroud modified to meet the requirements of the ERTS mission.

2.1.1 Launch-Vehicle Extender

A spacer or extender is required between the ERTS spacecraft and the launch vehicle to accommodate the MSS and antennas which extend below the adapter-vehicle interface.

It shall be the responsibility of the launch-vehicle contractor to design and fabricate this extender.

The design of the extender shall include mounting provisions for ERTS payload targets and pickups. Figure 2-1 shows the type and location of these targets and pickups.

2.2 Orbit Requirements

The ERTS-A spacecraft shall be placed into a nominal 490-nautical mile, sun-synchronous, circular orbit.

2.2.1 Orbit Inclination

The mean inclination of the ERTS-A orbit shall be 99.098 degrees with a 3-sigma variation of ±0.1 degree.

2.2.2 Orbit Eccentricity

The ERTS-A orbit shall be circular with a 3-sigma eccentricity of 0.002.

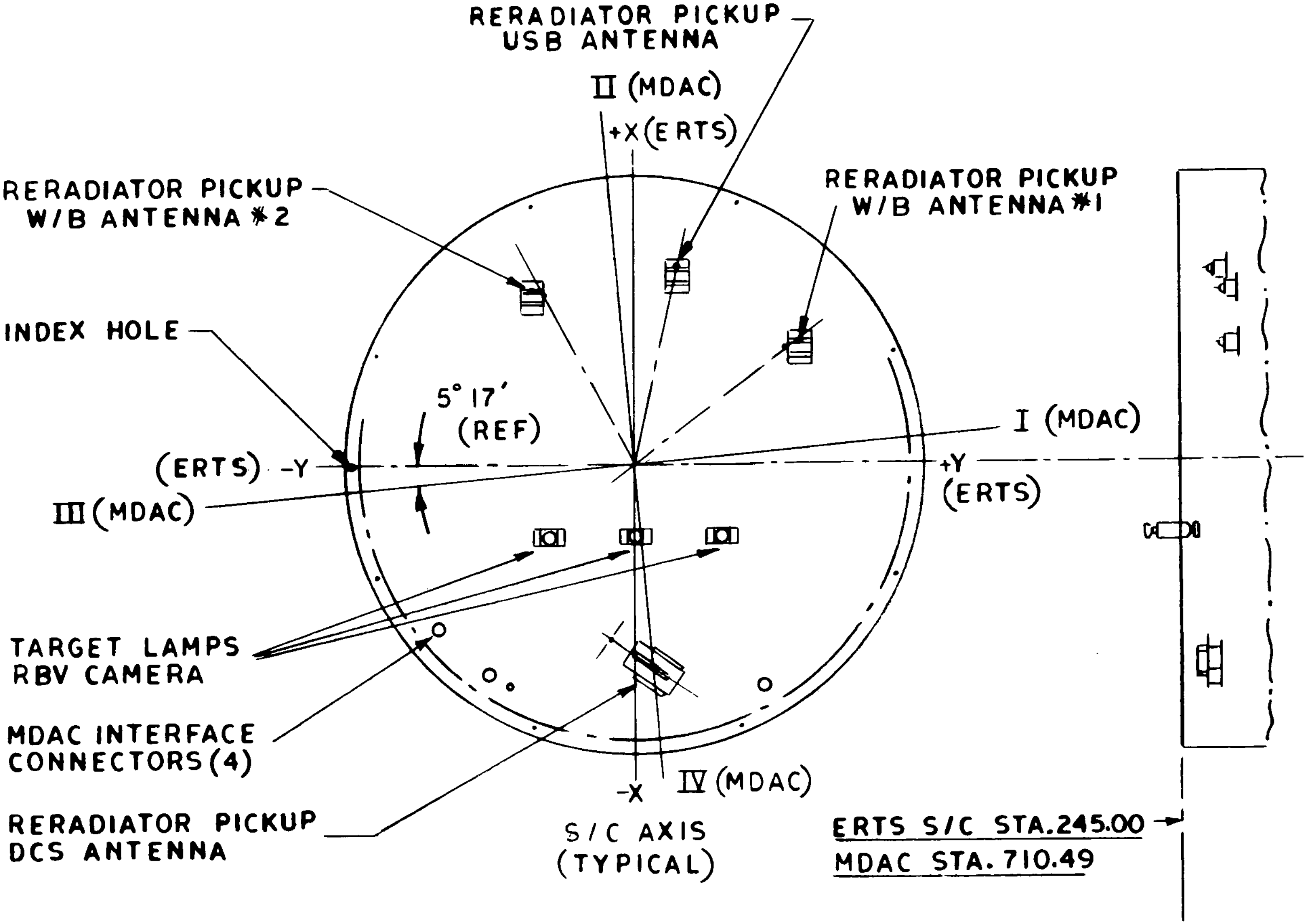


Figure 2-1. Extender Target and Pickup Locations, View Looking Aft

2.2.3 Orbit Semi-Major Axes

The mean semi-major axes of the ERTS-A orbit shall be 3934.026 nautical miles with a 3-sigma variation of $^{+12}_{-13}$ nautical miles.

2.2.4 Osculating Orbital Elements

The osculating orbital elements vary with time. The osculating elements at the injection point and at the first descending nodal crossing for March 22, 1972 are:

Injection Elements

Time: March 22, 1972		18 hrs. 51 min. 10.00 sec. G.M.T.
Semi-major axis	=	7293.9259 Km
Eccentricity	=	0.0009
Inclination	=	99.092121 deg.
Right ascension of ascending node	=	142.86732 deg.
Argument of perigee	=	-15.098416 deg.
Mean anomaly	=	3.2672810 deg.
Injection latitude	=	-11.7 deg.
Injection longitude	=	41.6 deg.

First Descending Node Elements

Time: March 22, 1972		19 hrs. 46 min. 11.3 sec. G.M.T.
Semi-major axis	=	7294.662 Km
Eccentricity	=	0.0001
Inclination	=	99.092490 deg.

Right ascension of ascending node	=	142.90264 deg.
Argument of perigee	=	0.00021129 deg.
Mean anomaly	=	180.0 deg.

2.3 Launch Conditions

The ERTS-A mission requires a southbound equator crossing (descending node) to occur at 9:30 a.m. local time with a maximum variation of $^{-0}_{+30}$ minutes.

2.3.1 Launch Date

The ERTS-A mission contraints dictate an annual launch window starting March 1 and ending June 15.

2.3.2 Restraints on Launch-Vehicle Programmed Events

Figure 2-2 shows the nominal launch sequence of events.

2.3.2.1 Pitchup Maneuver

After completion of the Delta second burn and just prior to observatory separation, the Delta vehicle shall pitch up a nominal 90 degrees to align the vehicle center line to within ±5 degrees of the earth radius. At the completion of this maneuver and before observatory separation the vehicle shall roll 5 degrees counter-clockwise when looking aft to align the observatory roll axis with the orbit plane.

2.3.2.2 Observatory Separation

Separation of the ERTS-A observatory from the Delta vehicle shall be initiated by a signal from the Delta timer. Separation shall be completed not less than 100 seconds before loss of the T/M signal (5 degree min. look-angle) at the tracking station of Tananarive (see Table 2-1).

Lat/Long	Day Night	TLM	Time	Events
			T-X minutes	Components in Launch Status
			T-11	Switch to Battery Power
			(Δ30)	Maximum Hold is 30 Minutes
VAFB			T-0	Launch (0953-0+30)
		VHF	T+220 seconds	Main Engine Cutoff
	DAY		T+224	Start Stage II
			T+241	Fairing Separation
			≈T+355	TLM 5 degree Exit
≈15°N/125°W			≈T+590	Second Stage Cutoff
				Coast
			≈T+2900	MADGAR Acquire
11.8°S/41.6°E			≈T+3468	Restart Stage II
			T+3480	Stage II Cutoff (Injection)
			≈T+3550	Initiate Pitch Up
			≈T+3650	ERTS/Stage II Sep
			≈T+3652.5	Fire Pyros-Paddle Unfold
	NIGHT	VHF	≈T+3667.5	Remove ACS Inhibit
0°N/38.9E			T+3684	Start Ascending Node (Rev 1, 2130-2200 Local Time)
			≈T+3702.5	Remove SAD Inhibit
			≈T+3750	TLM 5 degree Exit
			≈T+4650	Start Day (Sunat Equinox) (First Solar Array Power)
	DAY	USB/VHF	T+5274	Alaska Acquire
			T+6078	Alaska 5 degree Exit

Figure 2-2. Launch Sequence of Events

Table 2-1

Delta Attitude and Attitude Rates at the Instant of Observatory Separation

Axes	Angular Requirements (Delta Coordinates)	Rate Requirements (Max. Allowable)
Roll	0 ±2 degrees	0 ±0.5 deg/sec
Pitch-up	90 ±5 degrees	0 ±0.2 deg/sec
Yaw	0 ±2 degrees	0 ±0.2 deg/sec

2.3.2.3 Post-Separation Maneuver

After observatory separation, a Delta maneuver is required to place the Delta in a circular orbit a minimum of 25 NM below the ERTS injection orbit. Springs in the observatory adapter produce a separation velocity of 4.5 ±0.5 feet per second relative to the Delta vehicle. In satisfying this requirement, the Delta vehicle shall not expend any contaminates in the direction of the ERTS observatory. The nominal orbital elements of the final Delta orbit are required.

2.4 Trajectory Printout Requirements

To support observatory performance studies and contingency planning, trajectory printouts and magnetic-tape trajectories (NRDM 80-1 format) are required for the following configuration, for the time periods indicated:

(a) Launch vehicle: liftoff through completion of the post-separation maneuvers, nominal and 3-sigma trajectories

(b) Spacecraft: orbital parameters after separation, nominal and 3-sigma

In addition, orbital elements are required following separation for the following conditions:

(a) Spacecraft: first Delta burn terminated by propellant depletion

(b) Spacecraft: second Delta burn terminated by propellant depletion

(c) Spacecraft: first Delta burn nominal and no second burn

2.5 Tracking, Communications, and Command Requirements

2.5.1 Tracking

a. C-band radar tracking of the launch vehicle is required from liftoff through the Delta first burn plus 2 minutes; transmission of high-density and low-density tracking data to the GRTS in real time is required.

b. C-band radar-beacon tracking of the Delta for a minimum of 2 minutes starting immediately after completion of the second Delta burn and prior to initiation of the post-separation maneuvers; transmission of the low-density tracking data to GRTS in near real time is required.

c. C-band radar beacon tracking of the Delta for a minimum of 6 minutes after completion of the Delta post-separation maneuvers; the low-density tracking data are to be transmitted to GRTS in near real time.

d. C-band radar tracking of the Delta from available radars for 24 hours after completion of the post-separation maneuvers; the low-density tracking data are to be transmitted to GRTS within 30 minutes after each pass.

2.5.2 Telemetry

It is mandatory that the following launch-vehicle performance parameters and events be monitored for the times indicated:

(a) Attitude and rate data from liftoff to completion of miss distance assurance maneuver

(b) X, Y, Z axis accelerometer data from the ERTS adapter/extender interface from liftoff through Delta first burn

(c) Reception, display, and near real time reporting of telemetry data which indicate occurrence of the following events:

(1) Liftoff

(2) Shroud jettison

(3) First-stage/second-stage separation

(4) Second stage, first ignition

(5) Second stage, first cutoff

(6) Second stage, second ignition

(7) Second stage, second cutoff

(8) Separation

(9) Start post-separation maneuver sequence

(10) End post-separation maneuver sequence

2.5.3 Communications

The following communications are required between GSFC and the launch range:

a. One FDX teletype for transmission of low density radar tracking data

b. One FDX teletype for the transmission of orbital parameters, mark event confirmations, and vectors

c. One voice-band data circuit for the transmission of high-density tracking data

d. One voice-band data circuit for the transmission of spacecraft housekeeping-telemetry data

e. One voice circuit for computer coordination

f. One voice circuit for spacecraft status

g. One voice circuit for launch-vehicle status and mark event announcements

h. One voice circuit for range/network coordination.

SECTION 3

DESIGN REQUIREMENTS AND RESTRAINTS

3.1 Configuration Definition

3.1.1 Observatory

Figure 1-2 shows the general arrangement of the observatory, with locations and types of the principal equipment. The interface design specification control drawing shall show details governing the interface design.

3.1.2 Adapter

Figure 3-1 shows the general arrangements of the observatory adapter. GE is responsible for the detailed design, construction, and acceptance testing of this adapter. The interface design specification control drawing shall show details which govern the interface design.

The Delta telemetry system will monitor separation of the observatory from the adapter.

3.1.3 Aerodynamic Shroud

The ERTS-A mission will use the standard Delta shroud modified for the ERTS mission. Figure 3-2 shows the general arrangement of the shroud. Figure 3-3 lists shroud-access requirements. Specific details shall be shown in the official mechanical interface drawings prepared by the launch-vehicle contractor.

3.1.3.1 RF Transmissibility

Several RF communications links between the observatory and the NASA telemetry area at WTR are necessary during the time the observatory is installed on the vehicle at the launch pad and during part of the ascent phase. The ERTS observatory requires that losses through the shroud be less than 3 db for frequencies between 120 and 2500 MHz for:

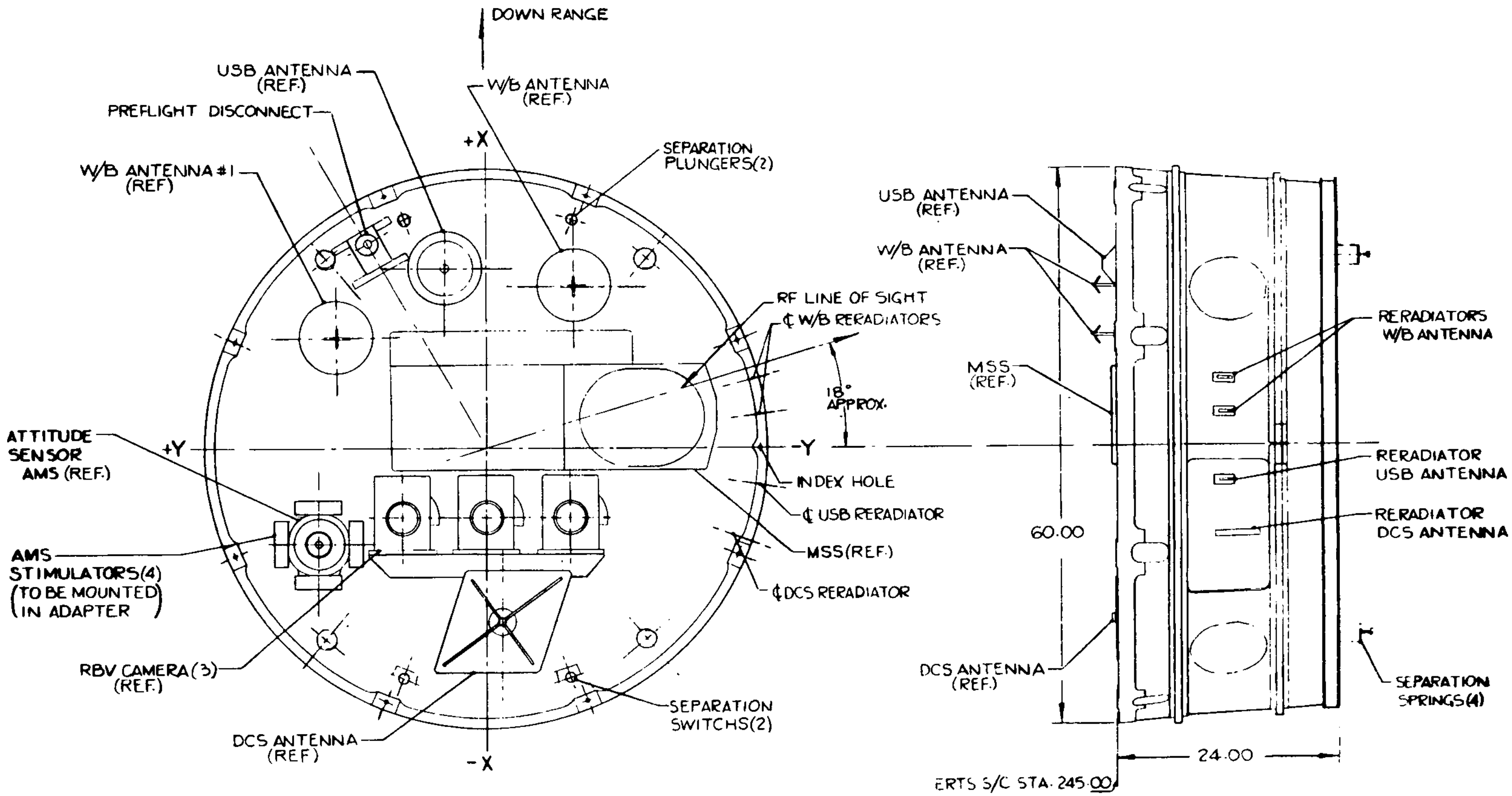


Figure 3-1. General Arrangement of the Adapter, View Looking Forward

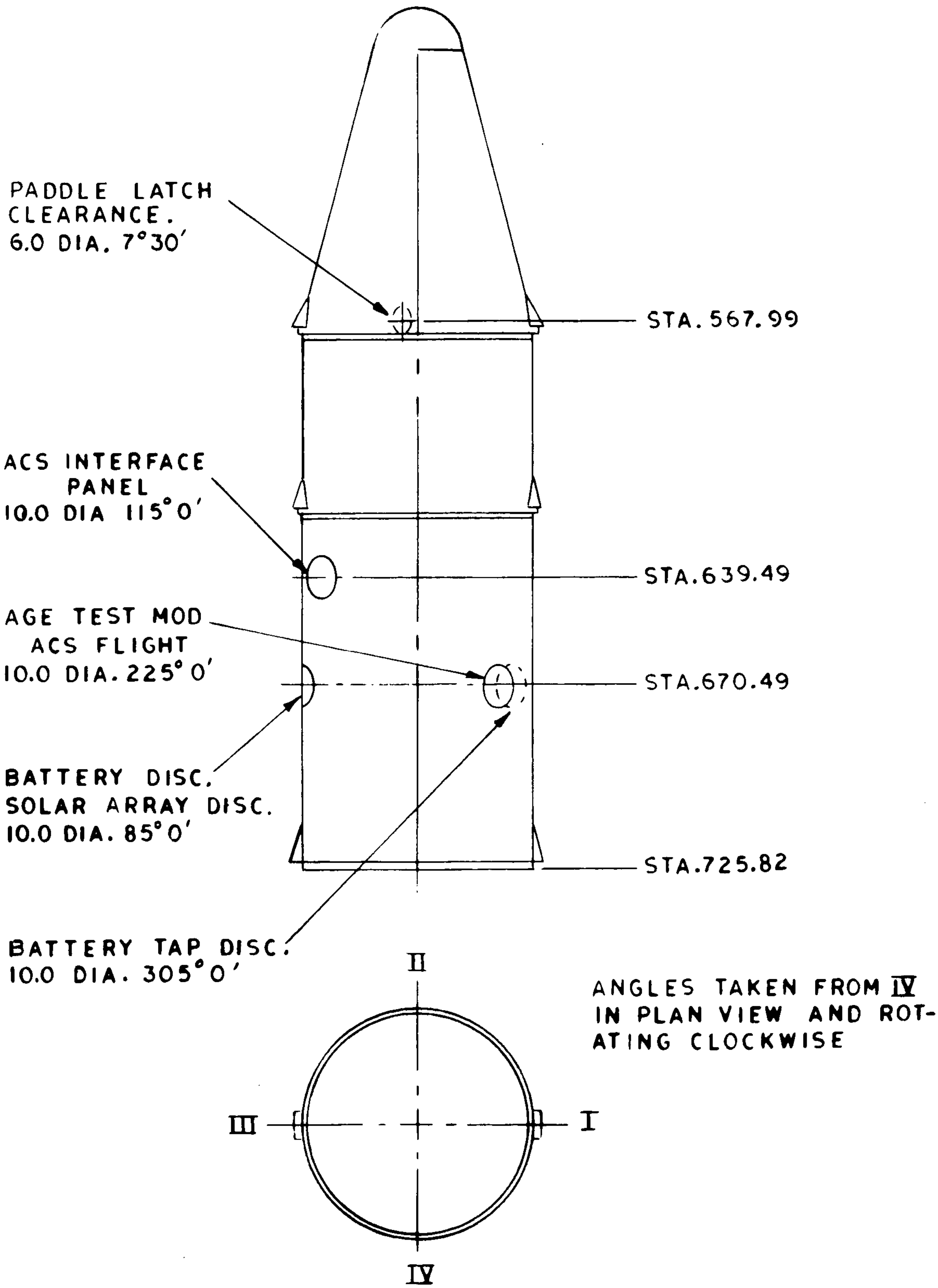
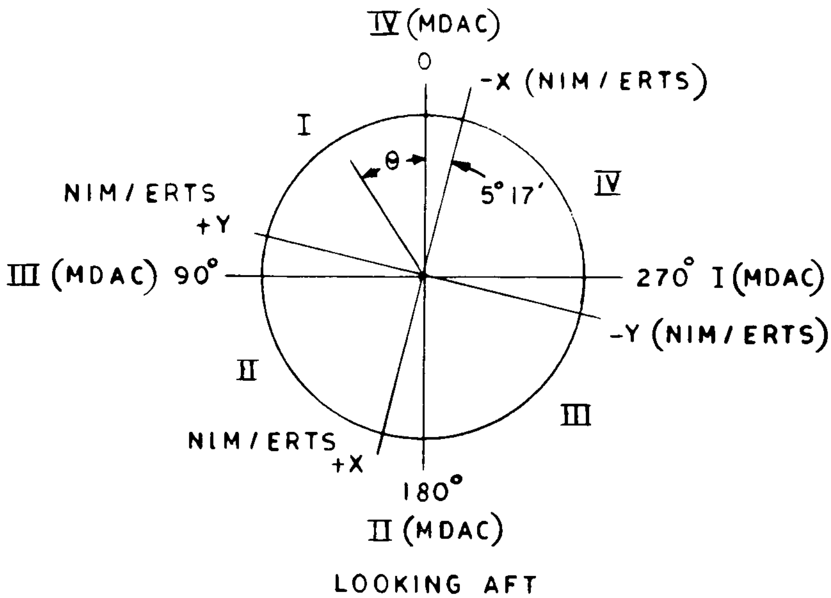


Figure 3-2. ERTS Shroud Configuration, Plan View, Looking Forward



ITEM	ACCESS DOOR FUNCTION	QTY.	DIA.	STATION GE	STATION MDAC	AZIMUTH
1	PADDLE LATCH / SHROUD CLEARANCE (NE)	1	6.0	102.50	567.99	7° 30'
2	NIMIT/ERTS/ACS IF PANEL (NE)	1	10.0	174.18	639.67	115°
3	ESMR CLEAR CHECK (N)	1	10.0	181.50	646.99	235°
4	BATTERY TAP DISCONNECT (N) BATTERY DISCONNECT (E) SOLAR ARRAY DISC. (E)	1	10.0	205.00	670.49	85°
5	AGE TEST MODULE (E) ACS FLIGHT (E)	1	10.0	205.00	670.49	225°
6	SOLAR ARRAY DISC. (N) BATTERY RETURN DISC. (N) ACS FLIGHT (N)	1	10.0	205.00	670.49	265°
7	AGE TEST MODULE (N) BATTERY TAP DISC. (E)	1	10.0	205.00	670.49	305°

Figure 3-3. Shroud-Access Requirements

E

(a) Approximately 90 degrees on either side of the RF line of sight

(b) Between Delta stations 703 and 560

Table 3-1 lists frequencies and powers of the transmitters used during checkout. The 137.86 MHz CW transmitter will operate continuously during ascent with a power output of 300 MW; all other observatory transmitters are turned off during ascent. All observatory transmitters and the command transmitter will operate during the launch countdown.

Table 3-1

Observatory Transmitters and Receivers Requiring RF Transmissibility of Shroud

Nominal Frequency (MHz)	Power (watts)	Function
Transmitters		
137.86	2	VHF
2229.5	20	WB Tlm 1
2265.5	20	WB Tlm 2
2287.5	1	USB
Receivers		
154.2		VHF Command
2106.4		USB Command
401.55		DCS

3.1.4 Mechanical and Electrical Interface Drawings

The launch vehicle project shall generate and maintain mechanical and electrical interface drawings. It is required that six copies each of these drawings be forwarded to the ERTS spacecraft project office for review.

3.2 Mass and Stiffness Properties

3.2.1 Mass Properties

The ERTS Project shall report current weight and mass properties for the observatory and adapter to the GSFC Launch Vehicle Project for use in trajectory and performance analysis. The following properties are included for reference only.

Weight (Including Adapter and Fuel):	2130 lbs
Moment-of-Inertia (Slug-ft):	
(Observatory Coordinate Axes)	
Iox roll	402
Ioz yaw	150
Ioy pitch	408
Center of Gravity	
X roll (inches)	0.23
Z yaw (station)	203.29
Y pitch (inches)	-0.09

3.2.2 Stiffness Properties

The ERTS Project will provide the Launch Vehicle Project with the vibration modes for the cantilevered observatory and adapter combination.

3.3 Mechanical Interface Requirements

3.3.1 Alignment and Tolerance

The spacecraft imposes no launch-vehicle-alignment requirements beyond those outlined in the following section.

The Launch Vehicle Project is responsible for informing the GSFC/ERTS Project of any spacecraft/launch-vehicle alignment required to ensure acceptable flight performance of the launch vehicle.

3.3.2 Flatness Requirements

The top surface of the launch-vehicle extender at the eight ERTS spacecraft adapter bolt-hole locations shall be coplanar to within 0.005 inches total tolerance. Verification is required on the erected vehicle prior to spacecraft mating.

Shims may be used to meet this flatness requirement.

3.4 Electrical Interface Requirements

3.4.1 Observatory/Adapter

The electrical interface at the observatory/adapter separation plane is considered a part of the observatory system.

3.4.2 Spacecraft/Launch Vehicle

The interface design specification control drawings supplied by the ERTS Project shall contain specific engineering details of the electrical interface between the spacecraft system and the launch-vehicle system. Table 3-2 lists the observatory functions and other electrical interface data. Figure 3-4 shows the routing of the conductors through the various interface connectors and junction boxes.

3.5 Electrical Requirements

3.5.1 Instrumentation

Table 3.2 is a list of the interface conductors between the Delta launch vehicle and the ERTS spacecraft and shows operating voltage, maximum current, and shielding requirements.

Figure 3-4 shows the desired arrangement of the interface connectors and conductor cabling.

Table 3-2

Electrical Interface Requirements

CONDUCTOR NUMBER	FUNCTION	ORIGIN	TERMINATION	SHIELDING	VOLTAGE	CURRENT (AMPS.)
1	-33 Volt Battery Charging Supply (neg)	Umbilical	Observatory	Twisted with #3	33.0	7.0
2	-33 Volt Battery Charging Supply (neg)	Umbilical	Observatory	Twisted with #4	33.0	7.0
3	-33 Volt Battery Charging Return (pos)	Umbilical	Observatory	Twisted with #1	33.0	7.0
4	-33 Volt Battery Charging Return (pos)	Umbilical	Observatory	Twisted with #2	33.0	7.0
5	Battery Charging Monitor (pos)	Umbilical	Observatory	Twisted with #6	33.0	0.01
6	Battery Charging Monitor (neg)	Umbilical	Observatory	Twisted with #5	33.0	0.01
7	Telemetry Supply (neg)	Umbilical	Observatory	Twisted with #8	24.5	0.04
8	Telemetry Return (pos)	Umbilical	Observatory	Twisted with #7	24.5	0.04
9	Gas Tank Temper-ature Signal (neg)	Umbilical	Observatory	None	6.0	0.001
10	Gas Tank Pressure Signal (neg)	Umbilical	Observatory	None	6.0	0.001
11	Gas Manifold Pressure Signal (neg)	Umbilical	Observatory	None	6.0	0.001
12	Dump Supply (neg)	Umbilical	Observatory	Twisted with #13	24.5	1.0
13	Dump Return (pos)	Umbilical	Observatory	Twisted with #12	24.5	1.0
14	Orbit Adjust Tank Temp. Signal (neg)	Umbilical	Observatory	None	6.0	0.001
15	Orbit Adjust Tank Pressure signal (neg)	Umbilical	Observatory	None	6.0	0.001
16	Orbit Adjust Manifold Pressure Signal (neg)	Umbilical	Observatory	None	6.0	0.001
17	Unipoint Ground	Umbilical	Observatory	None	0.0	0.006

Table 3-2 (continued)

CONDUCTOR NUMBER	FUNCTION	ORIGIN	TERMINATION	SHIELDING	VOLTAGE	CURRENT (AMPS.)
18	All Batteries on Signal (neg)	Umbilical	Observatory	None	12.0	1.0
19	Separation Switch By-Pass Relay Reset (neg)	Umbilical	Observatory	None	12.0	0.1
20	Command Enable Control (neg)	Umbilical	Observatory	None	24.0	0.1
21	Payload Off Signal (neg)	Umbilical	Observatory	None	24.0	1.0
22	Umbilical Isolate Operate Signal (neg)	Umbilical	Observatory	None	24.0	1.0
23	RMP #1 Emergency Off Signal (neg)	Umbilical	Observatory	None	12.0	0.4
24	RMP #2 Emergency Off Signal (neg)	Umbilical	Observatory	None	12.0	0.4
25	Continuity Loop	Umbilical	Observatory	None	24.5	0.1
26	Continuity Loop	Umbilical	Observatory	None	24.5	0.1
30	Preflight Disconnect Mate Supply (pos)	Umbilical	Adapter	Twisted with #31 & #32 & Shielded	28.0	5.0
31	Preflight Disconnect Demate Supply (pos)	Umbilical	Adapter	Twisted with #30 & #32 & Shielded	28.0	5.0
32	Preflight Disconnect Return (neg)	Umbilical	Adapter	Twisted with #30 & #32 & Shielded	28.0	5.0
33	Preflight Disconnect Position Monitor (mated)	Umbilical	Adapter	None	28.0	0.1
34	Preflight Disconnect Position Monitor (Demated)	Umbilical	Adapter	None	28.0	0.1
40	RBV Target #1 Supply (pos)	Umbilical	Extender	Twisted with #41 and Shielded	6.3	0.2
41	RBV Target #1 Return (neg)	Umbilical	Extender	Twisted with #40 and Shielded	6.3	0.2

Table 3-2 (continued)

CONDUCTOR NUMBER	FUNCTION	ORIGIN	TERMINATION	SHIELDING	VOLTAGE	CURRENT (AMPS.)
42	RBV Target #2 Supply (pos)	Umbilical	Extender	Twisted With #43 and Shielded	6.3	0.2
43	RBV Target #2 Return (neg)	Umbilical	Extender	Twisted With #42 and Shielded	6.3	0.2
44	RBV Target #3 Supply (pos)	Umbilical	Extender	Twisted with #45 and Shielded	6.3	0.2
45	RBV Target #3 Return (neg)	Umbilical	Extender	Twisted with #44 and Shielded	6.3	0.2
46	AMS Target #1 Supply (pos)	Umbilical	Adapter	Twisted with #47 and Shielded	48.0	2.0
47	AMS Target #1 Return (neg)	Umbilical	Adapter	Twisted with #46 and Shielded	48.0	2.0
48	AMS Target #2 Supply (pos)	Umbilical	Adapter	Twisted with #49 and Shielded	48.0	2.0
49	AMS Target #2 Return (neg)	Umbilical	Adapter	Twisted with #48 and Shielded	48.0	2.0
50	Controls Scanner Stim. B1 Supply (pos)	Umbilical	Fairing (light side)	Twisted with #51 and Shielded	60.0	3.5
51	Controls Scanner Stim. B1 Return (neg)	Umbilical	Fairing (light side)	Twisted with #50 and Shielded	60.0	3.5
52	Controls Scanner Stim. B2 Supply (pos)	Umbilical	Fairing (heavy side)	Twisted with #53 and Shielded	60.0	3.5
53	Controls Scanner Stim. B2 Return (neg)	Umbilical	Fairing (heavy side)	Twisted with #52 and shielded	60.0	3.5
54	Controls Scanner Stim. A1 Supply (pos)	Umbilical	Fairing (light side)	Twisted with #55 and Shielded	26.0	1.5
55	Controls Scanner Stim. A1 Return (neg)	Umbilical	Fairing (light side)	Twisted with #54 and Shielded	26.0	1.5
56	Controls Scanner Stim. A2 Supply (pos)	Umbilical	Fairing (heavy side)	Twisted with #57 and Shielded	26.0	1.5
57	Controls Scanner Stim. A2 Return (neg)	Umbilical	Fairing (heavy side)	Twisted with #56 and Shielded	26.0	1.5

Table 3-2 (continued)

CONDUCTOR NUMBER	FUNCTION	ORIGIN	TERMINATION	SHIELDING	VOLTAGE	CURRENT (AMPS.)
60	Observatory Separation Tm Signal Supply	Delta	Adapter	Twisted with #61 and Shielded	5.0	0.1
61	Observatory Separation Tm Signal Return	Delta	Adapter	Twisted with #60 and Shielded	5.0	0.1
70	Observatory Separation Pyro Supply (pos)	Delta	Adapter	Twisted with #71 and Shielded	28.0	6.0
71	Observatory Separation Pyro Return (neg)	Delta	Adapter	Twisted with #70 and Shielded	28.0	6.0
72	Observatory Separation Pyro Supply (pos)	Delta	Adapter	Twisted with #73 and Shielded	28.0	6.0
73	Observatory Separation Pyro Return (neg)	Delta	Adapter	Twisted with #72 and Shielded	28.0	6.0
74	Observatory Separation Pyro Supply (pos)	Delta	Adapter	Twisted with #75 and Shielded	28.0	6.0
75	Observatory Separation Pyro Return (neg)	Delta	Adapter	Twisted with #74 and Shielded	28.0	6.0
76	Observatory Separation Pyro Supply (pos)	Delta	Adapter	Twisted with #77 and Shielded	28.0	6.0
77	Observatory Separation Pyro Return (neg)	Delta	Adapter	Twisted with #76 and Shielded	28.0	6.0
80	Wide Band Transmission Sys. #1 Reradiator	Adapter	Extender	Coaxial 2229.5 MHz		
81	Wide Band Transmission Sys. #2 Reradiator	Adapter	Extender	Coaxial 2265.5 MHz		
82	Unified S-Band System Reradiator	Adapter	Extender	Coaxial 2106.4/2287.5MHz		
83	Data Collection System Reradiator	Adapter	Extender	Coaxial 401.55 MHz		

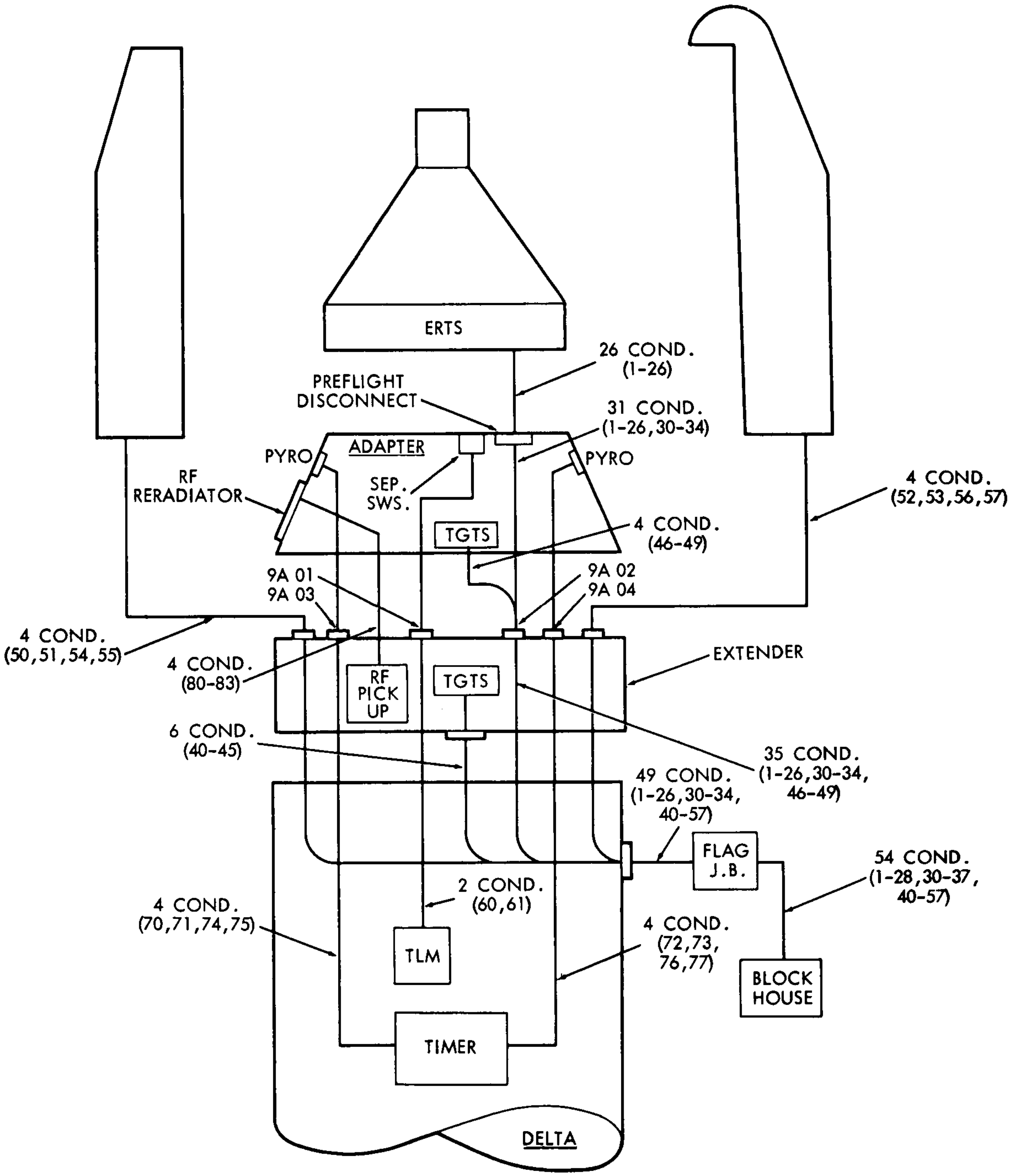


Figure 3-4. Routing of the Conductors

3.5.2 Spacecraft Power Supplied by Launch Vehicle

The power requirements for pyrotechnics and instrumentation are defined in Table 3-3. It is required that all leads to the separation bolt cutters be grounded until the separation signal is sent.

Table 3-3

Observatory Power Supplied by Vehicle

Observatory Function	+28 v Unregulated		+28 v Telemetry	
	Load	Duty Cycle	Load	Duty Cycle
Observatory separation pyrotechnics (0.2-ohm impedance each)	24 amp (6 amp each) min	1 sec min		
Observatory separation switches				Continuous until observatory separation

3.6 Environmental Requirements

3.6.1 Spacecraft Thermal Environment

The spacecraft shall be provided with a thermal environment controlled at 68 ±10° F at all time up to the time of launch. Continuous measurement of cooling air inlet temperature and flow rate are required.

During ascent, the maximum inside shroud temperature shall not exceed +210° F for all spacecraft stations from 21.8 to 247.0 (Delta stations 49.62 to 715.82).

3.6.2 Humidity

The water content of the air used to control the spacecraft environment shall not exceed 35 percent relative humidity at 65° F. Continuous measurement of cooling-air relative humidity is required.

3.6.3 Contamination Control

The spacecraft shall be provided an environment equal to or better than a class 100,000 clean room at all times up to the time of launch. Continuous measurement of the contamination level of the spacecraft environment is required up to the time of shroud installation.

All air-conditioning and vent holes in the forward end of the Delta vehicle shall be covered to eliminate all air transfer between the launch vehicle and the inside of the spacecraft adapter.

All materials used inside the vehicle extender shall not outgas at any time from spacecraft installation on the vehicle to observatory separation.

All post-separation maneuvers performed by the Delta vehicle shall be done in a way which ensures no contamination of the observatory.

3.7 Clearance Requirements

Static and dynamic clearance between the spacecraft and the vehicle shroud shall be determined by the Launch Vehicle Project.

Clearances in critical locations between the spacecraft and shroud for critical loading conditions will be included on the mechanical interface drawing. It will be the responsibility of the launch vehicle contractor to generate and maintain this drawing.

SECTION 4

4.1 Test Requirements

4.1.1 General

This section outlines test requirements which may be unique to the ERTS Program. Other general test requirements calling for joint ERTS Project and Launch Vehicle Project planning will be outlined at a later date.

4.1.2 Spacecraft/Extender/Shroud Interface Test

The purpose of this test will be to verify proper location of access ports on the flight shroud and to demonstrate adequate static clearance between the spacecraft and the shroud. The ERTS flight adapter and a simulated observatory (hat-tree) will be shipped to MDAC/WTR for this test. It will be the responsibility of the launch vehicle contractor to generate the procedures covering this test. It is required that these procedures be reviewed and approved by the ERTS Project Office.

4.1.3 Flatness Test

Prior to installing the spacecraft on the launch vehicle, the launch vehicle contractor shall conduct a flatness test of the forward ring of the vehicle extender. All eight ERTS mounting pads on the vehicle extender shall be coplanar to within 0.005 inch total tolerance.

4.1.4 Separation-Circuit Test

A test of the Delta provided separation firing circuit will be made to ensure that the pyro firing system is capable of providing a minimum of 6 amperes for each squib bridge wire.

At the launch pad, after the ERTS spacecraft has been assembled on the Delta, a separation-band bolt-cutter firing-circuit test shall be conducted using simulated separation-band bolt-cutter squibs. The squib simulators will be furnished for this test by the GSFC ERTS Project. Each simulator will consist of an actual separation-band bolt cutter from which one of the two ignition squibs and the powder charge have been removed. The individual squib bridge wire firing current will be measured by ERTS/GE personnel. Fuse protection for the Delta firing-system circuitry is an integral part of the ERTS simulator and instrumentation, which will be provided by ERTS/GE. The rating for these fuses shall be specified by the GSFC/Delta Project.

4.2 Analysis

4.2.1 Shroud/Spacecraft Clearance Analysis

The Launch Vehicle Project shall provide a shroud/spacecraft clearance analysis to ensure that the shroud will not interfere with the spacecraft during ascent.

4.2.2 Mass Properties Report

The Delta Launch Vehicle Project shall provide the weight, center-of-gravity location, moment of inertia, and products of inertia of the Delta vehicle at the time of spacecraft separation. This information is required to size and evaluate the separation-system springs.

4.2.3 Flight-Evaluation and Performance Data

Post-flight reporting of the Delta attitude and rates, at the time of observatory separation is required.

4.2.4 Shroud Air-Conditioning

The ERTS project requires facilities in the blockhouse to monitor temperature, rate of air flow, and relative humidity of the air supplied to the inlet of the shroud. These data are to be available throughout the countdown to liftoff.

4.2.5 Dynamic Analysis

Using the mathematical model of the ERTS-A spacecraft supplied by GE, the launch vehicle contractor shall provide a dynamic analysis for the complete vehicle/spacecraft combination. Analysis contents are:

A. The dynamic data for the spacecraft and the launch vehicle to be used for forming space-vehicle dynamic models for the following critical flight events:

1. Liftoff

2. Maximum ALPHA-Q

3. MECO minus 6 seconds

4. Delta engine cutoff

B. The lateral and/or longitudinal vibration modes and frequencies for the ERTS-A space vehicle for the critical flight events in (A) in the foregoing. Sufficient vehicle/spacecraft modes shall be established to cover the critical spacecraft-loading and shroud-clearance conditions. The modal analysis shall be summarized in a form similar to that used for the Nimbus D dynamic analysis. The following data shall be included:

1. Space-vehicle mode shapes and frequencies

2. Space-vehicle modal parameters

3. Space-vehicle forcing functions

4. Modal participation factors for spacecraft

5. Unit loads at the Delta-extender/spacecraft-adapter interface

6. Rigid body accelerations at the Delta-extender/spacecraft-adapter interface

C. The maximum dynamic displacements of the spacecraft relative to the shroud, determined by using the calculated modal data and the forcing functions associated with the critical events listed in (A) in the foregoing.

D. The ERTS-A structural dynamic analysis report, which will present the results of tasks (A), (B), and (C).

It is requested that the MECO-6 condition be analyzed first and forwarded to the ERTS Project Office by September 1, 1971, and that the remainder of the analysis be completed by October 15, 1971.

SECTION 5

LAUNCH-BASE REQUIREMENTS AND RESTRAINTS

5.1 Transportation and Handling Criteria

5.1.1 Observatory/Adapter Procedures

The flight observatory and adapter are assembled at the manufacturer's plant and shipped, maintained, and confidence-tested as an assembled unit. Separation-band removal and subsequent separation of the observatory and adapter prior to flight is an emergency action only.

5.1.2 Electro-Explosive Devices

Pre-launch and launch operations will involve two kinds of spacecraft electro-explosive devices: (1) separation-band bolt cutters, and (2) rod cutters in the solar-paddle unfold release mechanism. The configuration of the electro-explosive devices in each phase of handling is:

(a) During shipping, the bolt cutters and the rod cutter are assembled, but with shorting caps installed and grounded.

(b) During the radio-frequency interference (RFI) test and simulated countdown with the flight spacecraft, the bolt cutters are assembled to the spacecraft assembly with shorting caps installed. Another pair of bolt cutters are installed adjacent to the separation-band bolts and are electrically connected to the Delta firing circuits. Firing of these redundant bolt-cutter assemblies will not initiate observatory separation.

(c) During the simulated countdown, the rod cutters are assembled to the observatory and armed. The solar platforms are clamped to prevent the release of the latch and subsequent opening of the solar platforms if the cable cutters should fire.

(d) It will be the responsibility of the launch-vehicle contractor to connect the bolt cutters. It will be the responsibility of the spacecraft contractor to arm the rod cutters.

5.1.3 Spacecraft Handling at Launch Base

The spacecraft, a transportation dolly, and a protective cover will be delivered to the launch base. Vehicle-system personnel shall be responsible for hoisting the spacecraft to the greenhouse level and for the mating of the spacecraft to the vehicle. This activity shall be monitored by ERTS project personnel.

The ERTS spacecraft contractor (GE) shall be responsible for removing the spacecraft from the dolly, and for attaching the slings, and shall furnish a cover handling sling.

5.1.4 Spacecraft Cover Removal

Removal and installation of the spacecraft cover in the gantry greenhouse will require a crane facility. The requirements for the crane are:

(a) Crane hook must be capable of travel to the launch-vehicle center line.

(b) Crane-hook height to be a minimum of 18 feet above the adapter/extender interface.

(c) Liftload capacity must be 3000 pounds.

5.2 Umbilical and Test Plugs

5.2.1 Electrical Umbilical

Table 5-1 outlines the ERTS umbilical wiring requirements.

5.2.2 Reradiating Antennas

There is no requirement at this time for the installation of reradiating antennas on the gantry.

5.3 Launch-Base Sequencing

5.3.1 Spacecraft Laboratory Operations

The flight observatory will be subjected to battery conditioning, leak testing, and confidence testing in the spacecraft laboratory.

Table 5-1

Blockhouse to ERTS Umbilical Connections

CONDUCTOR NUMBER	FUNCTION	BLOCKHOUSE AGE CONNECTOR & PIN	AGE CONNECTOR WIRE SIZE - AWG	UMBILICAL CONNECTOR & PIN	DELTA/ADAPTER CONNECTOR & PIN	VOLTAGE AT OBSERVATORY	CURRENT (AMPS.)	PERMISSIBLE VOLTAGE DROP
1*	-33 Volt Battery Charging Supply (Neg.)	A2J1-S	12	Later	J9A02-s	33.0	7.0	5.0
2*	-33 Volt Battery Charging Supply (Neg.)	A2J1-a	12		J9A02-q	33.0	7.0	5.0
3*	-33 Volt Battery Charging Return (Pos.)	A2J1-Z	12		J9A02-t	33.0	7.0	5.0
4*	-33 Volt Battery Charging Return (Pos.)	A2J1-h	12		J9A02-r	33.0	7.0	5.0
5	Battery Charging Monitor (Pos.)	A2J1-A	16		J9A02-e	33.0	0.01	0.1
6	Battery Charging Monitor (Neg.)	A2J1-B	16		J9A02-f	33.0	0.01	0.1
7	Telemetry Supply (Neg.)	A2J1-j	16		J9A02-d	24.5	0.04	0.076
8	Telemetry Return (Pos.)	A2J1-u	16		J9A02-c	24.5	0.04	0.076
9	Gas Tank Temperature Signal (Neg.)	A2J1-W	12		J9A02-a	6.0	.0001	0.05

Table 5-1 (continued)

10	Gas Tank Pressure Signal (Neg.)	A2J1-n	12		J9A02-Z	6.0	0.0001	0.05
11	Gas Manifold Pressure Signal (Neg.)	A2J1-d	12		J9A02-Y	6.0	0.0001	0.05
12	DUMP Supply (Neg.)	A2J1-r	12		J9A02-h	24.5	1.0	5.0
13	DUMP Return (Pos.)	A2J1-s	12		J9A02-i	24.5	1.0	5.0
14	Orbit Adjust Tank Temp. Signal (Neg.)	A2J1-m	16		J9A02-n	6.0	0.0001	0.05
15	Orbit Adjust Tank Pres. Signal (Neg.)	A2J1-p	16		J9A02-m	6.0	0.0001	0.05
16	Orbit Adjust Manifold Pres. Signal (Neg.)	A2J1-t	16		J9A02-G	6.0	0.0001	0.05
17	UNIPOINT GROUND	A2J1-P	16		J9A02-b		0.001	0.025
18	All Batteries ON Signal (Neg.)	A2J1-E	16		J9A02-p	12.0	1.0	5.0
19	Separation Switch Bypass Relay Reset (Neg.)	A2J1-k	12		J9A02-g	12.0	0.1	5.0
20	Command Enable Control (Neg.)	A2J1-D	16		J9A02-X	24.0	0.1	5.0
21	Payload OFF Signal (Neg.)	A2J1-l	16		J9A02-K	24.0	1.0	5.0
22	Umbilical Isolate Operate Signal (Neg.)	A2J1-F	12		J9A02-j	24.0	1.0	5.0

Table 5-1 (continued)

23	R.M.P. #1 Emergency OFF Signal (Neg.)	A2J1-k	16		J9A02-k	12.0	0.4	5.0
24	R.M.P. #2 Emergency OFF Singal (Neg.)	A2J1-J	16		J9A02-W	12.0	0.4	5.0
25	Continuity Loop	A2J1-b	16		J9A02-L	24.5	0.1	1.0
26	Continuity Loop	A2J1-e	16		J9A02-H	24.5	0.1	1.0
27	Umbilical Isolate Return (Pos.)	A2J1-q	16	**Junction Box-Flag Top	NONE		1.1	5.0
28	Ground Command Return (Pos.)	A2J1-K	12	**Junction Box-Flag Top	NONE		1.0	5.0
30	Preflight Disconnect mate Supply (Pos.)	A2J1-g	12	Later	J9A02-D	28.0	5.0	5.0
31	Preflight Disconnect Demate Supply (Pos.)	A2J1-Y	12		J9A02-B	28.0	5.0	5.0
32	Preflight Disconnect Return (Neg.)	A2J1-R	12		J9A02-C	28.0	5.0	5.0
33	Preflight Disconnect Position Monitor (Mated)	A2J1-T	16		J9A02-E	28.0	0.1	5.0
34	Preflight Disconnect Position Moniotr (Demated)	A2J1-L	16		J9A02-A	28.0	0.1	5.0
35	Preflight Disconnect Voltage Control Mate	A2J1-i	16	***Junction Box-Flag Top	NONE	28.0	0.01	0.07

Table 5-1 (continued)

36	Preflight Disconnect Voltage Control Demate	A2J1-o	16	***Junction Box-Flag Top	NONE	28.0	0.01	0.07
37	Preflight Disconnect Voltage Control Return	A2J1-f	16	***Junction Box-Flag Top	NONE	28.0	0.01	0.07
40	RBV Target #1 Supply (Pos.)	A2J2-J	16	Later	Later	6.3	0.2	5.0
41	RBV Target #1 Return (Neg.)	A2J2-K	16			6.3	0.2	5.0
42	RBV Target #2 Supply (Pos.)	A2J2-L	16			6.3	0.2	5.0
43	RBV Target #2 Return (Neg.)	A2J2-M	16			6.3	0.2	5.0
44	RBV Target #3 Supply (Pos.)	A2J2-R	16			6.3	0.2	5.0
45	RBV Target #3 Return (Neg.)	A2J2-S	16			6.3	0.2	5.0
46	AMS Target #1 Supply (Pos.)	A1J2-T	16		J9A02-R	48.0	2.0	5.0
47	AMS Target #1 Return (Neg.)	A2J2-U	16		J9A02-S	48.0	2.0	5.0
48	AMS Target #2 Supply (Pos.)	A2J2-Y	16		J9A02-V	48.0	2.0	5.0
49	AMS Target #2 Return (Neg.)	A2J2-Z	16		J9A02-U	48.0	2.0	5.0
50	Controls Scanner Stim.B1 Supply (Pos.)	J1-D	12		DELTA/FAIRING	60.0	3.5	5.0
51	Controls Scanner Stim. B1 Return (Neg.)	J1-E	12		Later	60.0	3.5	5.0
52	Controls Scanner Stim B2 Supply (Pos.)	J1-F	12			60.0	3.5	5.0

Table 5-1 (continued)

53	Controls Scanner Stim. B2 Return (Neg.)	J1-G	12			60.0	3.5	5.0
54	Controls Scanner Stim. A1 Supply (Pos.)	J1-B	12			26.0	1.5	2.5
55	Controls Scanner Stim. A1 Return (Neg.)	J1-A	12			26.0	1.5	2.5
56	Controls Scanner Stim. A2 Supply (Pos.)	J1-H	12			26.0	1.5	2.5
57	Controls Scanner Stim. A2 Return (Neg.)	J1-C	12			26.0	1.5	2.5

*A 1000 Mfd, 100 volt filter capacitor, furnished by the General Electric Co., is to be connected between conductors 1 - 2, and 3 - 4 respectively as near to the umbilical junction box as practicable.

**Conductors number 27 and 28 are to be terminated at the flag junction box by connection to conductors number 3 and 4.

***Conductors numbers 35, 36, and 37 are to be terminated at the flag junction box by connection to conductors number 30, 31, and 32, respectively.

5.3.2 Pad Checkout

Prior to launch, pad facilities used in the pre-launch and launch activities shall be inspected.

5.3.3 Countdown Activity

During the countdown, provisions shall be made for the following spacecraft tests:

- Activate RF link and check prior to gantry removal
- Observatory confidence test after gantry removal
- Observatory terminal count

These tasks constitute a continuous block of time from observatory turn-on to lift-off. During this period, the observatory VHF beacon transmitter is on and radiating continuously.

5.3.4 Launch Activities Schedule

An integrated activities schedule of launch-base operations for the Delta launch vehicle and spacecraft is required. This schedule shall be prepared jointly by the vehicle and spacecraft projects and shall present an itemized daily schedule of tasks. The schedule shall include starting and completion time, identification of applicable written procedure, and designation of agency responsibility.

5.3.5 Pad Cabling Requirements

Table 5-1 lists the ERTS observatory pad cabling requirements. Space for two consoles shall be made available in the blockhouse. The first console consists of three standard relay racks and is 72 inches wide, 28 inches deep, and 72 inches high. This console will contain battery charging controls, calibration and test equipment controls, observatory-monitoring instruments, and spaces for 2 MOPS units which should be installed by WTR personnel prior to the beginning of checkout tests. Table 5-2 lists connectors furnished with this console for connection to the pad wiring. The power requirement for this console is two circuits of 115 volts, 60 Hz, 30 amperes and will be fed to connectors A1J1 and A3J1.

Table 5-2

Connectors for First Console

Console Connector No.	Console Connector Part	Pad Wiring Connector Part
A2J1	MS3102A-40-9S	MS3106A-40-9P
A2J2	MS3102A-28-15S	MS3106A-28-15P
A1J1	MS3102A-22-22P	MS3106A-22-22S
A3J1	MS3102A-22-22P	MS3106A-22-22S

The second console will be 24 inches wide, 28 inches deep, and 72 inches high. This console will contain the power supplies and controls for the attitude-control stimulators which are to be installed in the Delta fairing. Table 5-3 lists connectors furnished with this console for connection to the pad wiring.

Table 5-3

Connectors for Second Console

Console Connector No.	Console Connector Part	Pad Wiring Connector Part
J1	MS3102A-22-23S	MS3106A-22-23P
J2	MS3102A-18-10P	MS3106A-18-10S

The power requirement for this console is one circuit of 115 volts, 60 Hz, 20 amperes and will be fed to connector J2.

The pad wiring half of the console connectors will be furnished by the ERTS project to the Delta project when needed, prior to the installation of the pad wiring.

5.4 Hydrazine Loading Cart

The hydrazine loading cart is required for loading the orbit adjust subsystem with propellant, and pressurizing the subsystem to flight pressure. In the event of a launch abort, the loading cart is to be used for unloading and decontamination of the orbit adjust subsystem with a water and alcohol flush, and vacuum dry. The cart is a self-contained mobile unit, requiring only external electrical power for operation of the vacuum pump. The cart envelope will be 4 feet by 6 feet and 5 feet high. The weight, when loaded, will not exceed 1800 lb. The cart will be equipped with flexible fluid transfer and nitrogen pressurization hoses 30 feet long.

5.4.1 Passivation of Orbit-Adjust Subsystem

A passivation test of the orbit-adjust subsystem will be conducted in the spacecraft assembly area just prior to transporting the spacecraft to the launch pad. This test will consist of loading the OAS with hydrazine and observing the tank pressure for 24 hours, The hydrazine loading cart will be used to conduct this test.

5.4.2 Orbit-Adjust-Subsystem Servicing

Servicing of the OAS for flight will take place on R-10 day. It is required that provisions be made to perform this task in the spacecraft assembly building.

5.5 WTR Ground Station Requirements

The following paragraphs outline the WTR Ground Station requirements.

5.5.1 Building Layout Requirements

Figure 5-1 shows the ERTS-A equipment layout requirements for the Spacecraft Assembly Building.

5.5.2 Power and Air Conditioning Requirements

Table 5-4 lists the power and air conditioning requirements for the ERTS-A Ground Station.

5.5.3 RF Link Requirement

Figure 5-2 shows the RF link requirements between the Spacecraft Assembly Building and the ERTS-A Launch Vehicle Gantry.

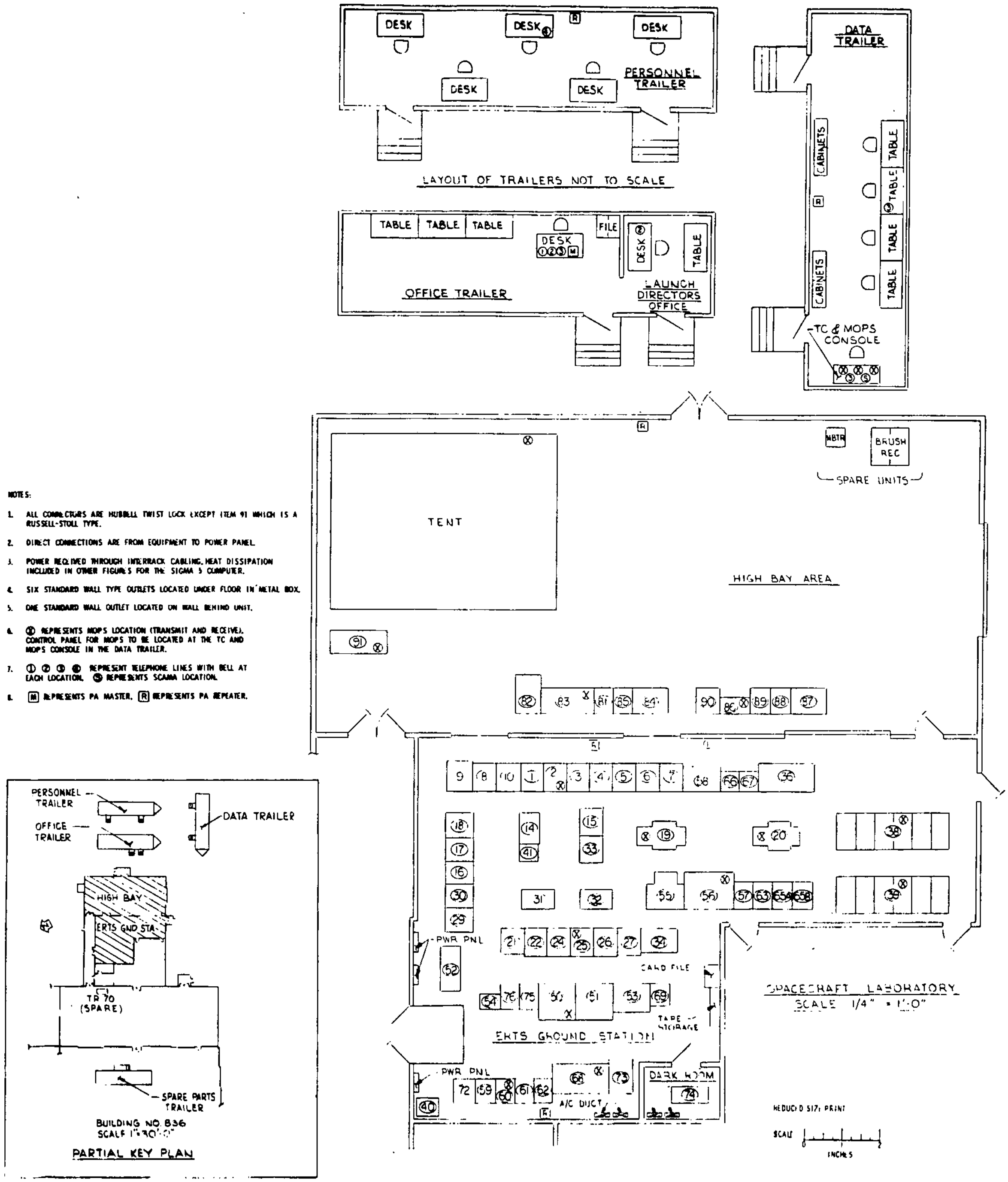


Figure 5-1. ERTS-A Equipment Layout Requirements

B

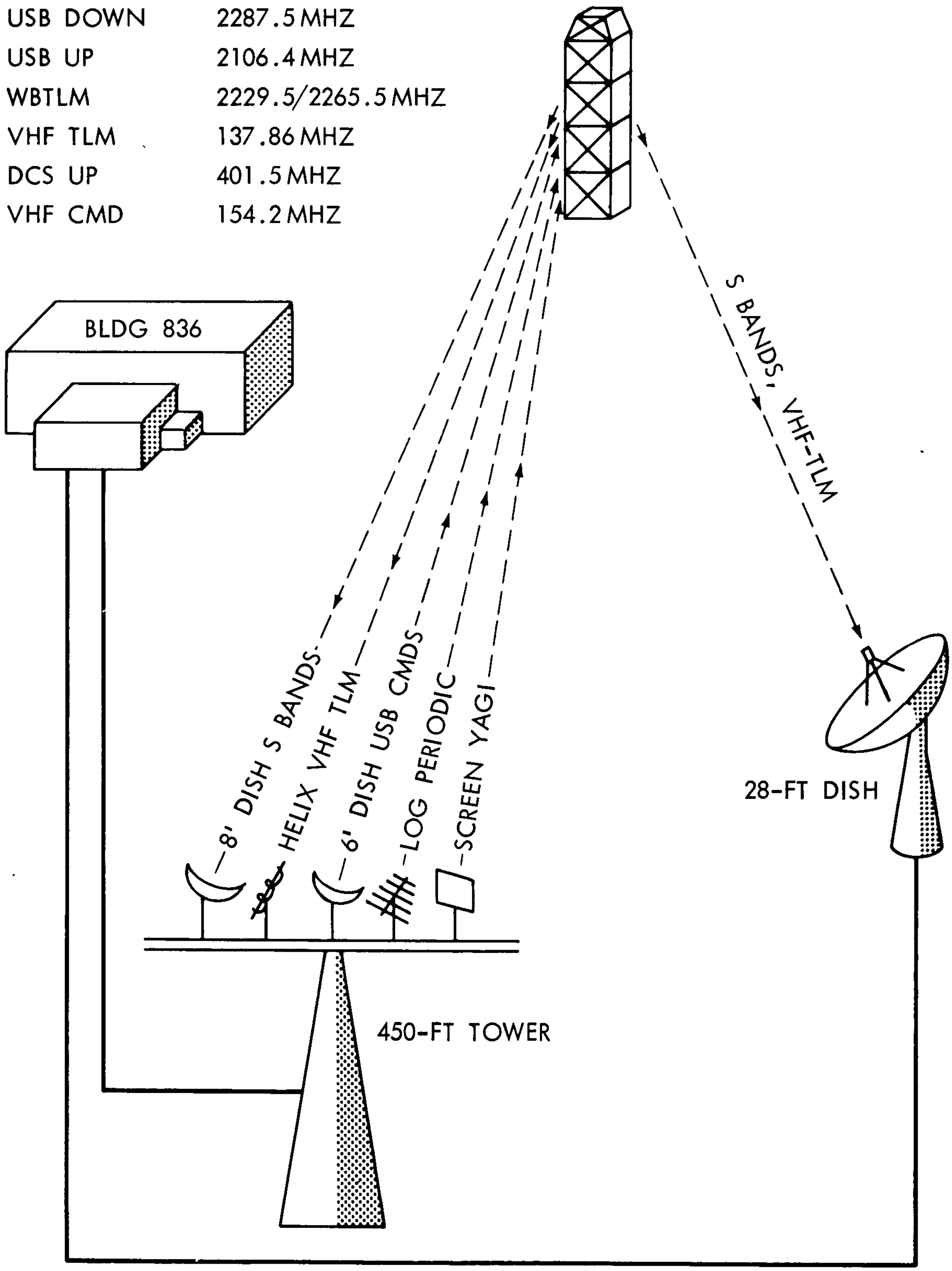


Figure 5-2. RF Link Requirements

Table 5-4

ERTS-A Ground Station Power and Air Conditioning Requirements

Item No.	Description	Circuit Requirements: Volts	BKR Amps-Poles	No. of Phases	No. of Wires	Connector Type On Equipment	KVA	KBTU/Hr	Remarks
1	Σ5 I/O	208	30-3	3	5	Direct	4.5	15.2	
2	Σ5 CPU	208	30-3	3	5	Direct	2.6	9.0	
3	Σ5 MIOP	208	30-3	3	5	Direct	2.6	9.0	
4	Σ5 MEM	—	—	—	—	—	—	—	See Note 3
5	Σ5 MEM	—	—	—	—	—	—	—	See Note 3
6	Σ5 PWR	208	30-3	3	5	Direct	3.1	10.6	
7	Σ5 MEM	—	—	—	—	—	—	—	See Note 3
8	Disk Controller	120	20-1	1	3	45115	1.1	3.7	
9	Disk	208	30-3	3	5	45115	1.4	4.9	
10	RAD	208	30-3	3	5	Direct	1.9	6.6	
11	(Not Assigned)								
12	(Not Assigned)								
13	(Not Assigned)								
14	Σ5 TTY	—	—	—	—	—	—	—	Receives Power From Sigma 5 CPU
15	Card Reader	120	20-1	1	3	3331	0.8	2.9	
16	Mag Tape Unit (Slave)	120	30-1	1	3	3331	1.3	4.5	
17	Mag Tape Unit (Slave)	120	30-1	1	3	3331	1.3	4.5	
18	Mag Tape Unit Master	120	30-1	1	3	3331	1.8	6.1	
19	Line Printer	120	30-1	1	3	3331	1.8	6.1	
20	Line Printer	120	30-1	1	3	3331	1.8	6.1	
21	Σ3A PCM	120	30-1	1	3	3331	0.8	2.9	
22	Σ3A CPU	208	30-3	3	5	45115	2.5	8.5	
23	(Not Assigned)								
24	Peripheral SW 1	208	30-3	3	5	45115	1.9	6.6	
25	Peripheral SW 2	208	30-3	3	5	45115	1.2	4.1	
26	Σ3B CPU	208	30-3	3	5	45115	2.6	9.0	
27	Σ3B PCM	120	30-1	1	3	3331	0.7	2.4	
28	(Not Assigned)								
29	Mag Tape Unit (Master)	120	30-1	1	3	3331	1.8	6.1	
30	Mag Tape Unit (Slave)	120	30-1	1	3	3331	1.3	4.5	
31	Σ3A TTY	—	—	—	—	—	—	—	Receives Power From Sigma 3A CPU
32	Σ3B TTY	—	—	—	—	—	—	—	Receives Power From Sigma 3B CPU
33	Card Reader	120	20-1	1	3	3331	0.8	2.9	
34	CIEU	120	30-1	1	3	Junction Box	1.8	6.1	
35	(Not Assigned)								
36	REC I/F Unit	120	30-1	1	3	3331	0.8	2.9	
37	(Not Assigned)								
38	6 Brush Recorders	120	20-1	1	3	See Note 4	2.2	7.4	2 CKT'S Required
39	6 Brush Recorders	120	20-1	1	3	See Note 4	2.2	7.4	2 CKT'S Required

Table 5-4 (continued)

Item No.	Description	Circuit Requirements: Volts	BKR Amps-Poles	No. of Phases	No. of Wires	Connector Type On Equipment	KVA	KBTU/Hr	Remarks
40	Key Punch	120	15-1	1	3	See Note 5	0.4	1.2	
41	Comp. Aux Rack	120	20-1	1	3	3331	1.2	4.1	
42	(Not Assigned)								
43	(Not Assigned)								
44	(Not Assigned)								
45	(Not Assigned								
46	(Not Assigned)								
47	(Not Assigned)								
48	(Not Assigned)								
49	(Not Assigned)								
50	RBV BTE	208	50-3	3	5	26516	6.0	20.5	
51	RBV QLM, UPASS	120	30-1	3	3	3331	2.4	8.2	Receives Power From RBV BTE
52	TR70	120	30-1	1	3	3331	2.3	7.8	3 CKT Required
53	EBR	–	–	–	–	–	–	–	Receives Power From RBV BTE
54	TTY	–	–	–	–	–	–	–	Receives Power From RBV BTE
55	Command Printer	120	30-1	1	3	3331	1.6	5.3	
56	Command Console	120	20-1	1	3	Junction Box	0.7	2.4	
57	CPTS	120	20-1	1	3	3331	1.2	4.1	
58	DDU	120	20-1	1	3	3331	1.1	3.7	
59	DCS BTE	120	30-1	1	3	3331	2.4	8.2	
60	DCS Test Equipment	–	–	–	–	–	–	–	Receives Power From DCS BTE
61	DCS RSE	120	30-1	1	3	3331	2.4	8.2	
62	DCS RSE Test Equipment	–	–	–	–	–	–	–	Receives Power From DCS RSE
63	VHF Stadan	120	30-1	1	3	3331	0.6	2.1	
64	(Not Assigned)								
65A	USB	120	30-1	1	3	3331	0.6	2.1	
65B	USB	120	30-1	1	3	3331	0.7	2.4	
66	NBTR 1	120	30-1	1	3	3331	0.6	2.1	
67	NBTR 2	120	30-1	1	3	3331	0.6	2.1	
68	MSS	120	30-1	1	3	3331	2.4	8.2	
69	RF Patch Rack	–	–	–	–	–	–	–	No Power Required
70	(Not Assigned)								
71	(Not Assigned)								
72	WB RCVR	120	30-1	1	3	3331	0.6	2.1	
73	FR1928	120	30-1	1	3	3331	2.5	8.6	
74	MSS Photo Recorder	120	30-1	1	3	3331	2.5	8.6	
75	QLM	–	–	–	–	–	–	–	Receives Power From RBV BTE
76	Computer	–	–	–	–	–	–	–	Receives Power From RBV BTE
77	(Not Assigned)								
78	(Not Assigned)								

Table 5-4 (continued)

Item No.	Description	Circuit Requirements						KBTU/Hr	Remarks
		Volts	BKR Amps-Poles	No. of Phases	No. of Wires	Connector Type ON Equipment	KVA		
79	(Not Assigned)								
80	(Not Assigned)								
	Total - Ground Station						79.4	271.0	
81	Time STD	120	15-1	1	3	Std Outlet	1.8	6.1	
82	PDP-9	120	30-1	1	3	3331	2.0	7.0	
83	PDP-9 Console	120	20-1	1	3	3331	1.1	3.9	
84	PDP-9 XMSN Elec.	120	30-1	1	3	3331	1.9	6.6	
85	ERTS Adapter	120	15-1	1	3	Std Outlet	1.2	4.1	
86	670 Typewriter	—	—	—	—	—	—	—	Receives Power From 670 Computer
87	670 Computer (2 Bays)	120	50-1	1	3	Junction Box	8.4	28.6	2 CKT'S Required
88	670 Third Bay	120	30-1	1	3	Junction Box	3.0	10.2	
89	BCN Rack	120	15-1	1	3	Std Outlet	1.3	4.3	
90	603 MTU	208	30-3	3	5	3521	3.0	10.2	
91	EST Console	120	50	1	3	RS3128	5.0	17.0	
92	(Not Assigned)								
93	(Not Assigned)								
94	(Not Assigned)								
95	(Not Assigned)								
96	(Not Assigned)								
97	(Not Assigned)								
98	(Not Assigned)								
99	(Not Assigned)								
100	(Not Assigned)								
	Total - High Bay						28.7	98.0	