SECTION 10
SUBSYSTEM INFORMATION

(This was Section 12 in the original IUE Flight Operations Manual. It is included here unchanged)

SECTION 12. SUBSYSTEM INFORMATION

12.1 GENERAL

The following sections briefly describe the IUE subsystem and components and provides the operational guidelines for each subsystem.

12.2 POWER

Figures 12-1 and 12-2 illustrate the IUE power module and bus regulation modes.

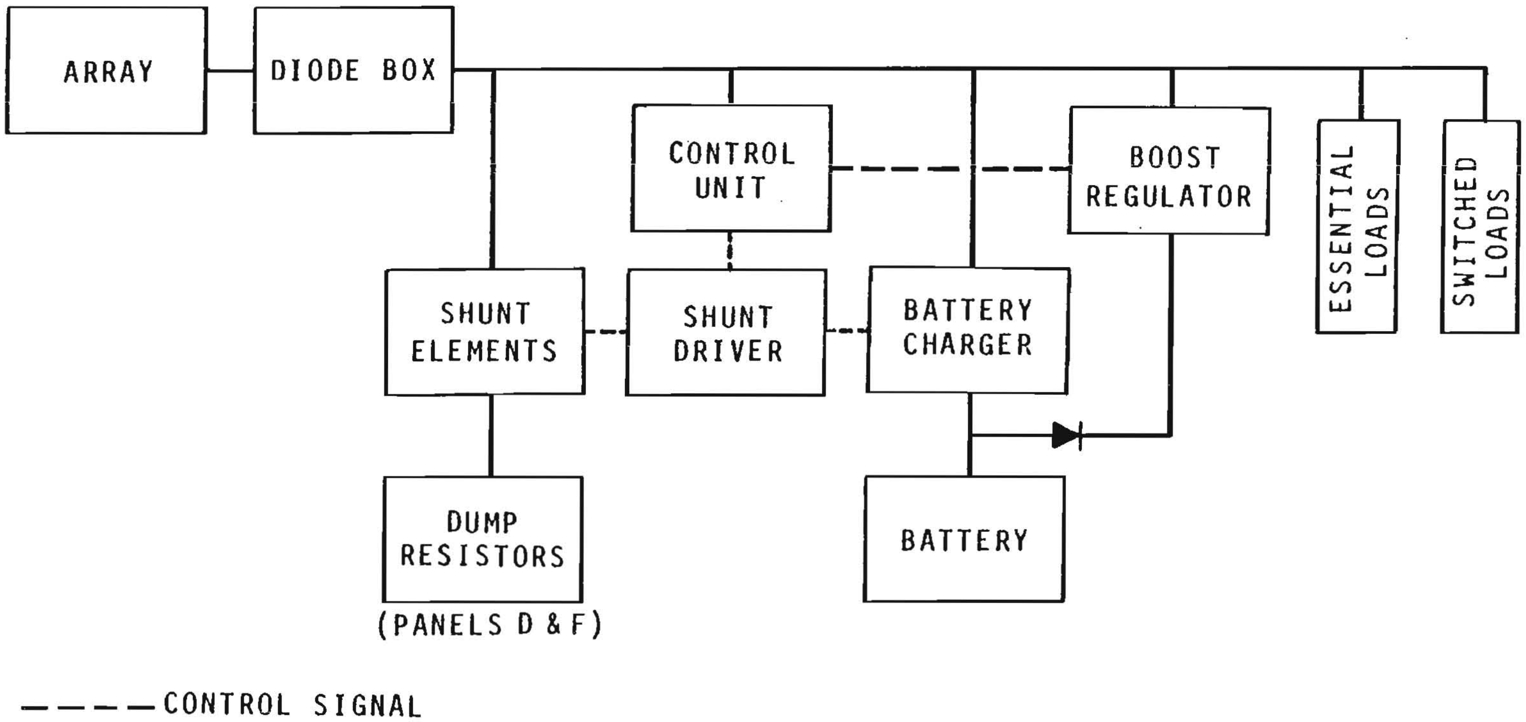


Figure 12-1. Functional Block Diagram - IUE Power Module

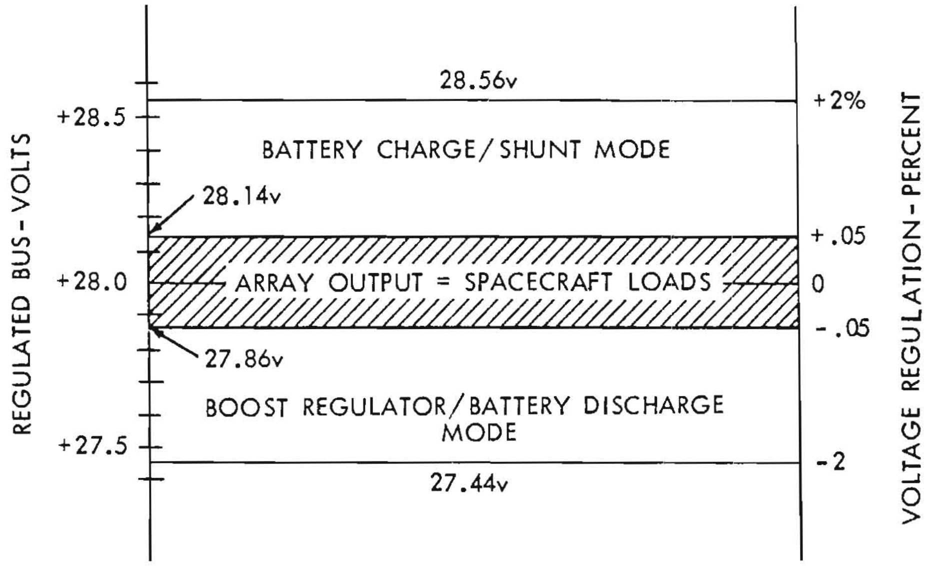


Figure 12-2. Spacecraft 28.0-Volt Bus Regulation Modes

12.3 COMMAND AND COMMAND DISTRIBUTION SUBSYSTEM

12.3.1 GENERAL SUBSYSTEM BLOCK DIAGRAM AND DESCRIPTION

The IUE command subsystem, shown in figure 12-3 consists of redundant command decoders and a Command Relay Unit (CRU). The CRU contains circuit redundancy up to the individual relay and relay driver stage. Three distinct types of commands are available; discrete and serial commands are distributed by decoders A and B, and relay closures are provided by the CRU.

12.3.2 DATA HANDLING SUBSYSTEM

12.3.2.1 IUE Data Handling System. The IUE Data Handling System is composed of two major components, the Data Multiplexer Subsystem (DMS) and the Onboard Computer (OBC). The DMS serves as the spacecraft telemetry encoder and as the input data interface between the OBC and the rest of the spacecraft. The primary function of the OBC is to perform calculations and, based on the results, send attitude control commands to the stabilizations and control system.

In performing its function as encoder, the DMS has access to engineering or scientific data from all onboard systems. By using a time-sharing technique, this data can be made available to the OBC. The computer also has the capability of sending all spacecraft commands through the command system, again on a time-shared basis. Thus, the combined data handling and command systems provide, in addition to their basic tasks, a flexible and powerful backup capability for most of the onboard systems. Figure 12-4 illustrates this concept.

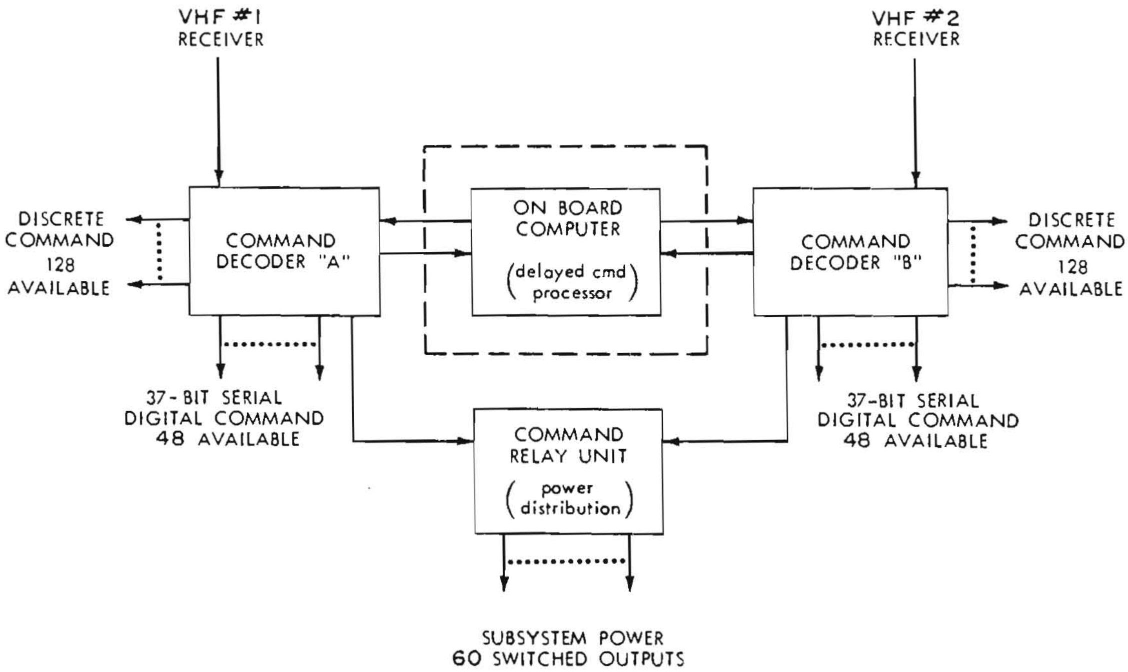


Figure 12-3. Block Diagram, IUE Command Subsystem

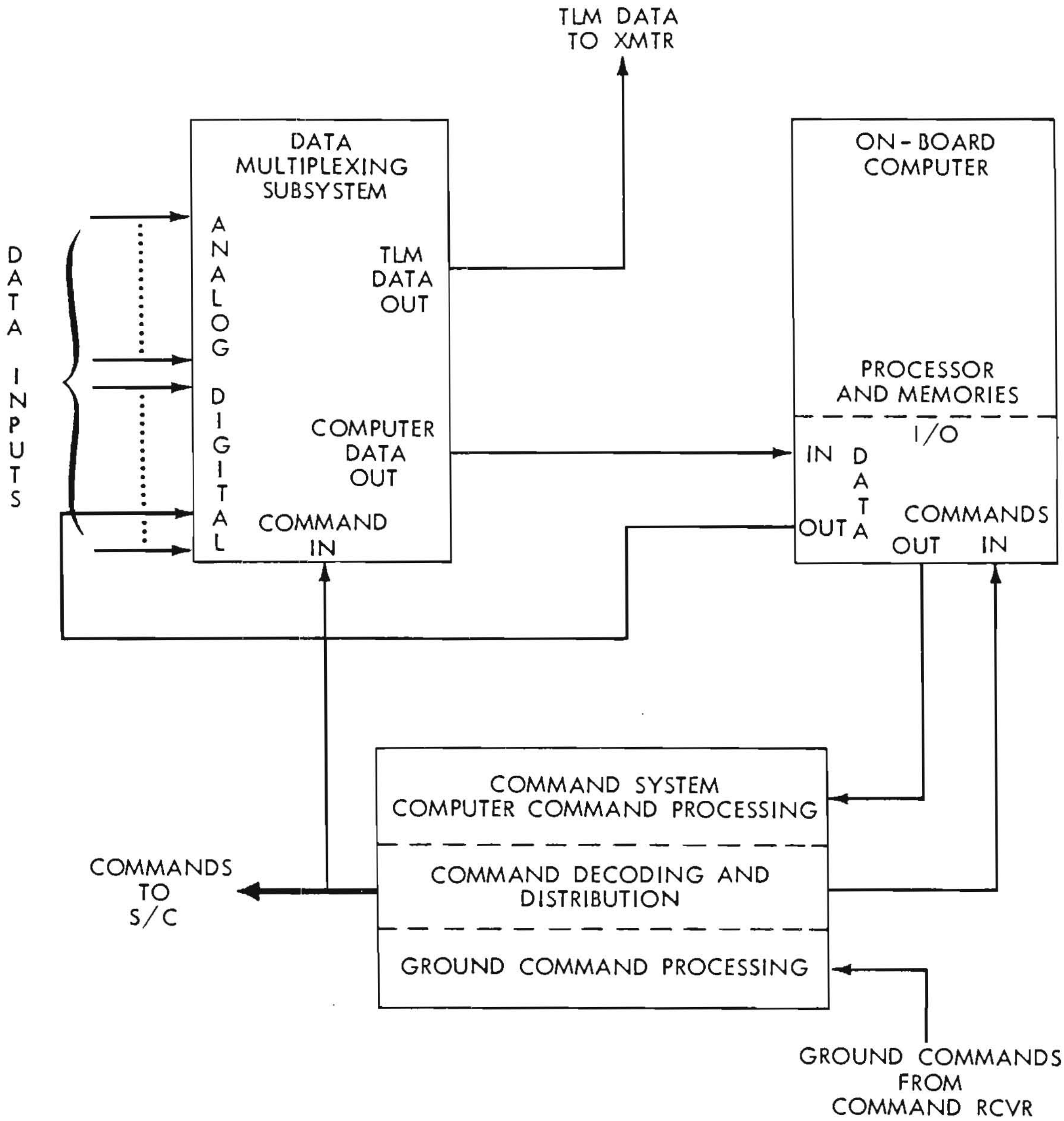


Figure 12-4. Data Multiplexer, Computer, Command System Configuration

12.3.2.2 DMS. The DMS was designed to satisfy the commonality of requirements among several different spacecraft. The resulting design uses solid state memories to generate the telemetry format. The contents of a memory, read out in consecutive order, controls the sequence followed by the multiplexer in the sampling of data. Thus, the DMS can be adapted to any of a variety of missions by using memories tailored to the mission requirements. The basic portion of the DMS, called the dataplexer, contains the main analog and digital multiplexers, the spacecraft clock, and timing and control signal logic all in one box. Provision is also made for convolutional encoding. One or more submultiplexer units, called Subplexers, each in its own box, can be added as required to expand the data handling capacity of the DMS.

12.3.2.3 Onboard Computer. The onboard computer to be used on IUE is the GSFC developed Advanced Onboard Processor (AOP). This computer, or its predecessor the OBP, is being used on several Goddard missions. The AOP was developed specifically for the requirements common to the types of mission flown by Goddard. A Special Input Output (SIO) unit is designed for each spacecraft to adapt the AOP to the different mission requirements. Memory capacity can be expanded, in 4 K word modules, to a maximum capacity of 65 K.

12.3.3 COMMUNICATIONS SUBSYSTEM

The communications system consists of two redundant VHF transponder systems, two redundant S-band transmitters with four power amplifiers, and associated antenna systems. A block diagram of the IUE communications system is shown in figure 12-5. The communication subsystem interfaces with the power supply subsystems, telemetry encoder output, and command decoder input. Functionally, this subsystem provides the means for transmission of telemetry data, reception of ground generated commands, and a way of tracking the spacecraft using the Goddard Range and Range Rate system.

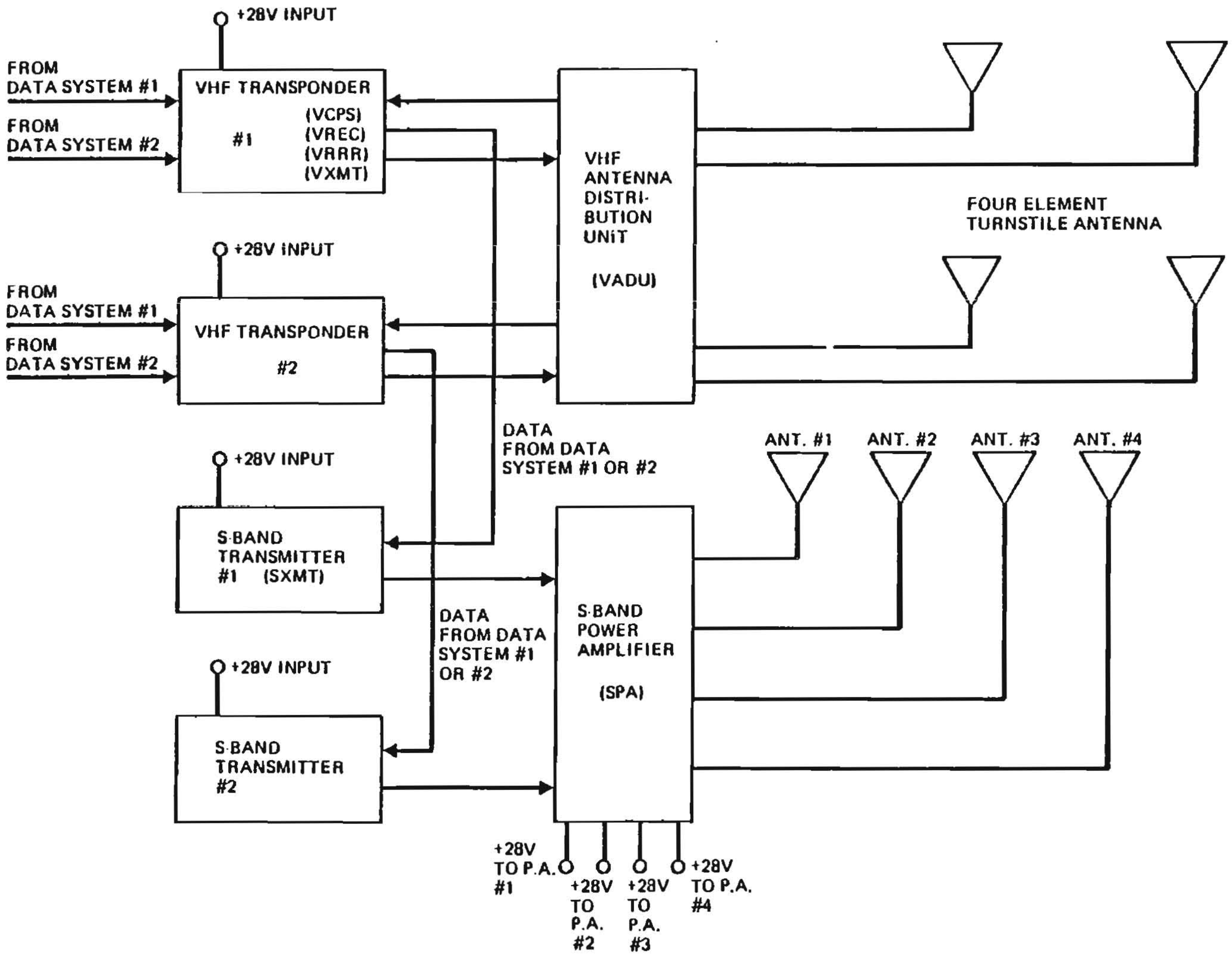


Figure 12-5. Block Diagram of IUE Communications System

12.3.4 SUBSYSTEM OPERATIONAL GUIDELINES

a. DMU

(1) Use DMU No. 2 as the prime unit.

(2) Use crystal defined by register "0" at launch and during normal operations.

(3) Use reset and GO on OBC when changing sample or bit rate.

(4) Do not expect perfect analog to digital conversions at 40 kbit.

(5) Do not expect CPU 1 and 2 flags to be reliable. Flags are "1" when CPU power is on and running lightly, however they go to "0" when the CPU is working hard.

(6) Do not use the 32:1 ratio because the subcom data malfunctions in OBC.

(7) Do not send DMU mode commands faster than every minor frame. The end of each command is used to arm and execute at the next frame. Bits will become garbled if sent too rapidly in succession.

(8) Do not expect the DMU to come on in the predetermined mode if the battery is run down and if it is coming out of an eclipse. Turn the DUM off then on or send serial mode command.

(9) Do not change from the prime DMU to the backup unit at or after launch without great care. The ACS system must be placed in the rate hold mode prior to switching DMU's.

b. Commands

(1) Both uplink and OBC-generated commands must be addressed to the same command decoder.

(2) To maintain reliable CRU relay operations, the same CRU command must not be issued at intervals of less than 5 seconds.

12.4 SUBSYSTEM OPERATIONAL GUIDELINES (ACS)

12.4.1 IRA

a. Do not power common electronics 1 and 2 simultaneously.

b. Always sequence gyros on in series with at least 60 seconds between commands.

c. Never turn off common electronics without first turning off gyro channels.

d. Never transfer gyros from rate to hold/slew mode with vehicle rates in excess of 600 sec/sec.

e. Never turn on gyros with vehicle rates in excess of 5 degrees/sec.

f. Observe temperature limitations.

g. Never operate IRA in RC mode at temperatures above 120^{O}F.

h. Never attempt to use IRA in closed loop operation with temperatures below 80^{O}F.

i. Do not expect final gyro orbit stability until system has thermally stabilized for at least 2 hours.

j. Never operate the spacecraft despin with the sun impinging on the IRA sensor unit.

k. IRA operations between 80^{O}F and 110^{O}F should be in the RC mode.

12.4.2 ENGINE VALVE DRIVERS

Prior to turning on and initializing the following CEA CARDS, ensure that both engine valve drives are off.

a. EVCLA and EVCLB.

b. P&N.

c. C&M.

12.4.3 WHEEL DRIVER CARDS

Prior to turning on and initializing the following WDA and CEA cards, ensure that all wheel drive CRU relays are commanded off.

a. Pitch WD
b. YAW WD
c. Roll WD
d. Red WD
e. DAC A
f. DAC B

12.4.4 WHEEL DRIVE ASSEMBLY POWER SUPPLY

a. Do not simultaneously power PS1 and PS2 via CRU-switched +28Vdc.

b. Always log which power supply was last utilized and the method of shutdown and/or switch to redundant power supply.

c. When switching the relays in the control electronics assembly, wait at least 20 seconds after powering WDA power supply before sending impulse commands to toggle relays.

12.4.5 MODE SWITCHING

When switching from a jet control mode to a wheel control mode always be prepared to unload the wheel momentum in the event the wheel satura es.

12.4.6 JET OPERATION

a. Never operate the hydrazine engines from the OBC or the ground in the continuous mode.

b. Never leave nutation enabled while precessing the spacecraft.

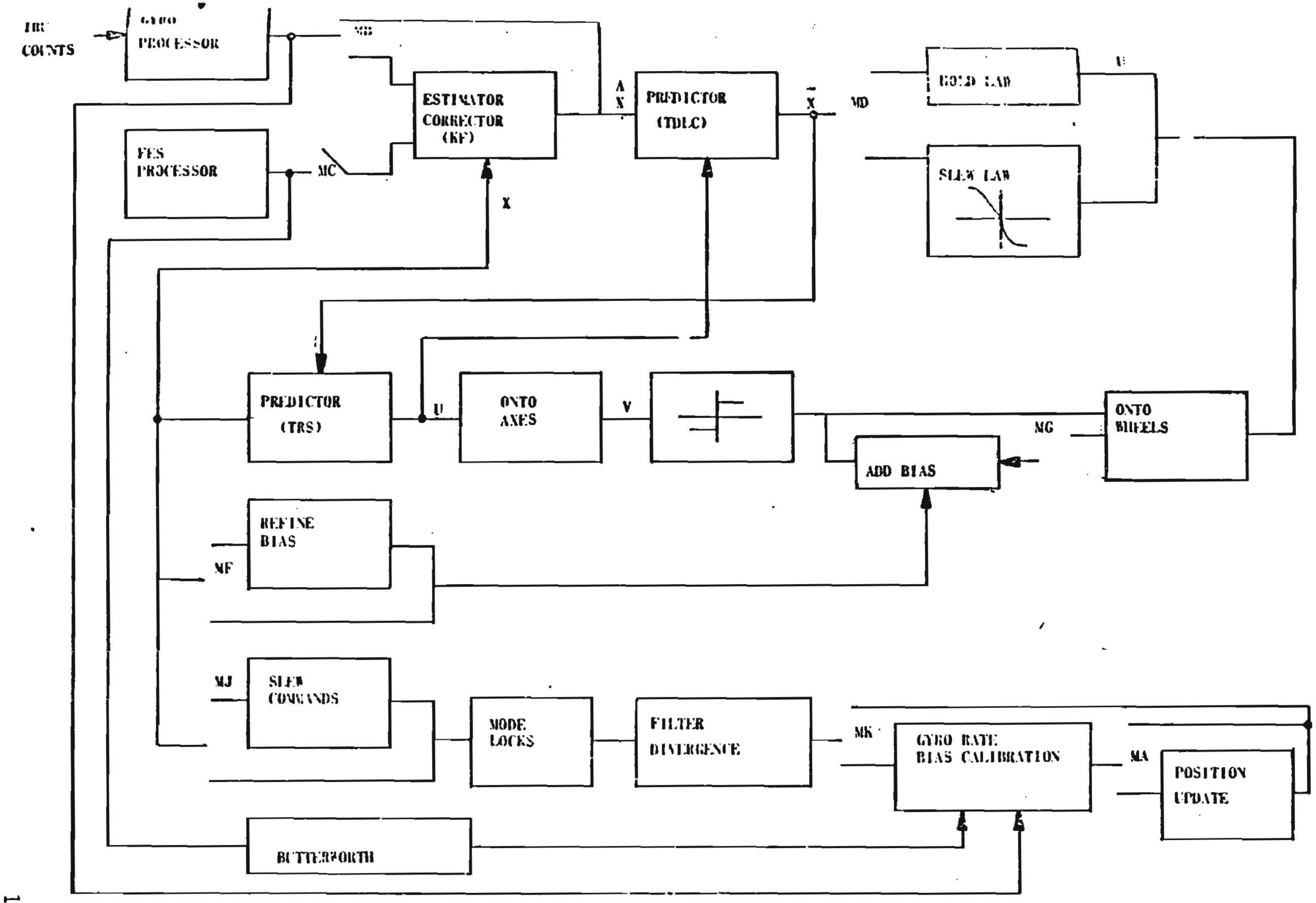
c. Never leave the system unattended with the EVD armed.

12.4.7 ATTITUDE MANEUVERS

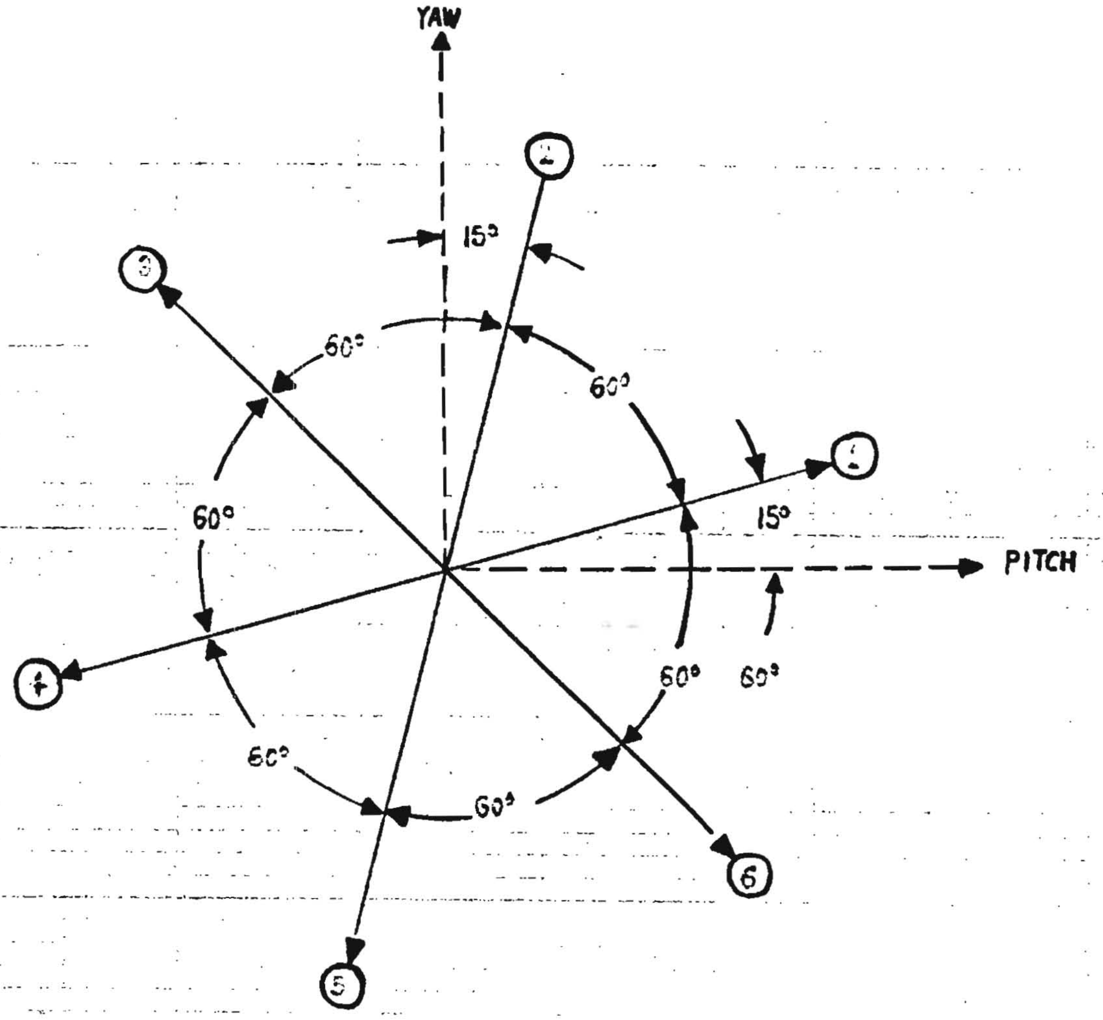
Never operate the spacecraft outside the field-of-view of the fine sun sensors.

12.4.8 OBC/DMU DATA RATE

During all OBC software control modes, never operate the OBC data rate below 20 kbits.



HOLD-SLEW CONTROL



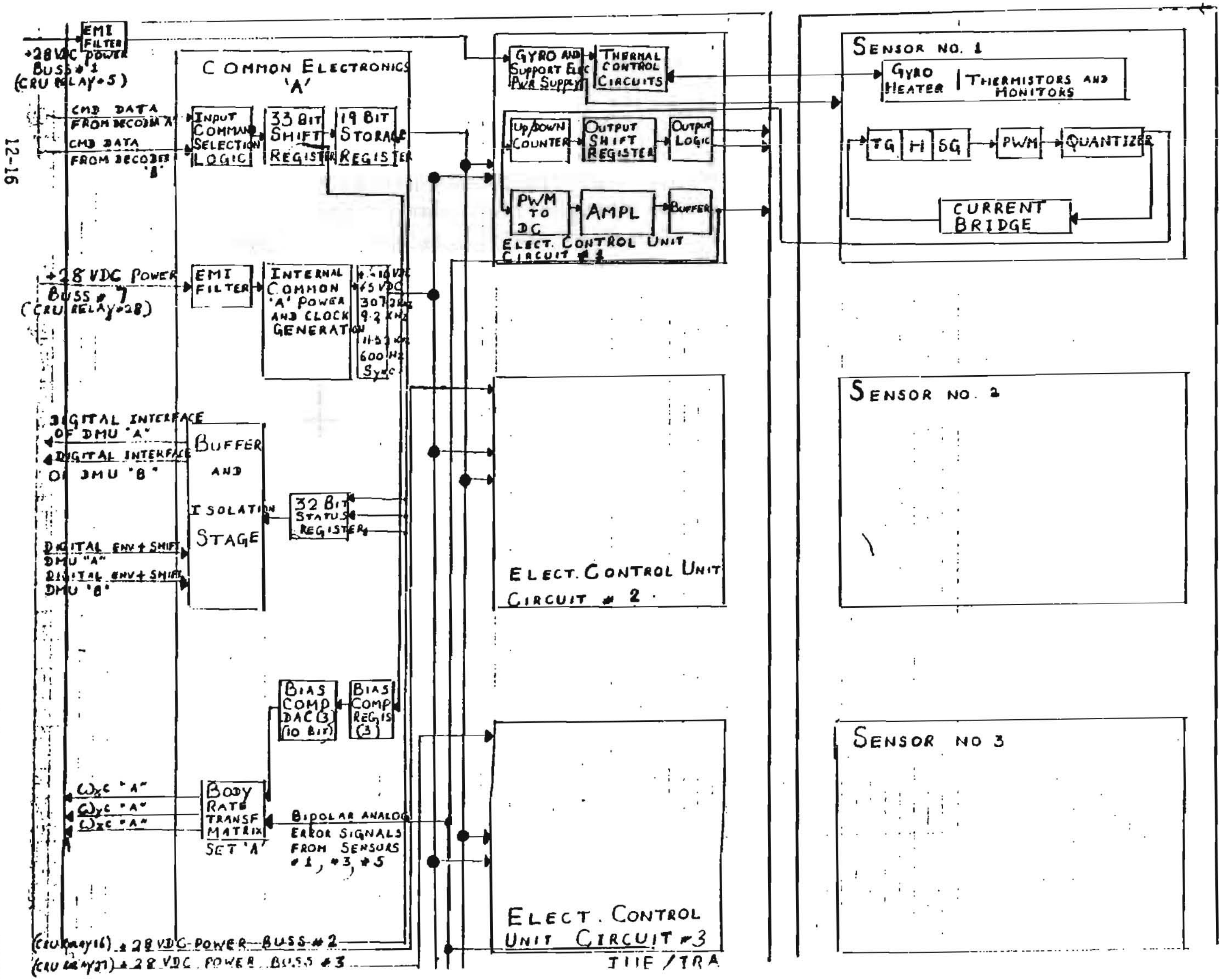
PROJECTIONS OF THE INPUT AXES OF THE SIX GYROS ON SPACECRAFT PITCH-YAW PLANE

INPUT AXES LIE ON A CONE ABOUT ROLL AXIS WITH 85° HALF CONE ANGLE

PROJECTIONS OF THE INPUT AXES OF SIX GYROS

IRA AXIS	MODE			
	RATE		HOLD/SLEW	
	Resolution	Range	Resolution	Range
Roll	$.005^{\circ}$/sec	$\pm$ 2.56°/sec	0.6 $\widehat{sec}$/sec	$\pm$ 307.2 $\frac{\widehat{sec}}{sec}$
Pitch/Yaw	$.00042^{\circ}$/sec	$\pm$ $.213^{\circ}$/sec	.05 $\widehat{sec}$/sec	$\pm$ 25.6 $\widehat{sec}$/sec

- IRABA - Enables the operator to bias the pitch yaw or roll matrix amplifier outputs individually with the range & resolution specified by IRABD.


EMI FILTER
+28VDC POWER BUSS #1 (CRU RELAY #5)
COMMON ELECTRONICS 'A'
CMD DATA FROM DECODER 'A'
CMD DATA FROM DECODER 'B'
INPUT COMMAND SELECTION LOGIC
33 BIT SHIFT REGISTER
19 BIT STORAGE REGISTER
+28 VDC POWER BUSS #7 (CRU RELAY #28)
EMI FILTER
INTERNAL COMMON 'A' POWER AND CLOCK GENERATION
±10 VDC
+5 VDC
307.2 KHz
9.2 KHz
11.52 KHz
600 HZ SYNC
DIGITAL INTERFACE OF DMU "A"
DIGITAL INTERFACE OF DMU "B"
BUFFER AND ISOLATION STAGE
32 BIT STATUS REGISTER
DIGITAL ENV + SHIFT DMU "A"
DIGITAL ENV + SHIFT DMU "B"
BIAS COMP DAC (3) (10 BIT)
BIAS COMP REGIS (3)
BODY RATE TRANSF MATRIX SET 'A'
BIPOLAR ANALOG ERROR SIGNALS FROM SENSORS #1, #3, #5
(CRU RELAY 16) +28 VDC POWER BUSS #2
(CRU RELAY 31) +28 VDC POWER BUSS #3
GYRO AND SUPPORT ELEC PWR SUPPLY
THERMAL CONTROL CIRCUITS
UP/DOWN COUNTER
OUTPUT SHIFT REGISTER
OUTPUT LOGIC
PWM TO DC
AMPL
BUFFER
ELECT. CONTROL UNIT CIRCUIT #1
ELECT. CONTROL UNIT CIRCUIT # 2
ELECT. CONTROL UNIT CIRCUIT #3
SENSOR NO. 1
GYRO HEATER
THERMISTORS AND MONITORS
TG
H
SG
PWM
QUANTIZER
CURRENT BRIDGE
SENSOR NO. 2
SENSOR NO 3
THE/TRA

12.5 IUE SCIENTIFIC INSTRUMENT

12.5.1 DESCRIPTION

The IUE is to contain a 45-cm Ritchey Chretien telescope and will be used exclusively for spectroscopy. The telescope field can be recorded and displayed in the control center so that the observer may identify his target star. The IUE scientific aims are predicated on a capability to obtain both high-resolution spectra of bright objects and low-resolution spectra of faint objects. See figure 12-6 for a block diagram of the scientific instrument. Determining the equivalent widths of weak lines used to measure chemical abundance, or the profiles of strong lines used to study gas motions, requires a spectral resolution of at least 0.2Å; a resolution of 0.1Å or better is highly desirable. Low-dispersion spectroscopy, on the other hand, serves primarily in the observation of faint sources. The observing programs calling for this capability either do not require high resolution for analysis, or they involve sources with intrinsically broad spectral features. The emphasis is placed, therefore, on limiting magnitude rather than resolving power. To meet the scientific objective for this observing mode, the spectrograph should have a limiting magnitude of at least 12, and a fourteenth or fifteenth magnitude limit is highly desirable. Finally, the desire to record complete ultraviolet spectra rather than selected spectral regions dictates the use of spectrographs which have the capability of recording a spectral image rather than spectrum scanners.

An echelle spectrograph has been selected to obtain the high resolution spectra desired for brighter objects. With this type of instrument, a high dispersion is easily achieved, and it has the additional advantage that the format of the spectrum consists of a series of adjacent spectral orders displayed next to each other in a raster-like pattern. This format makes efficient use of the sensitive area of the SEC vidicon television

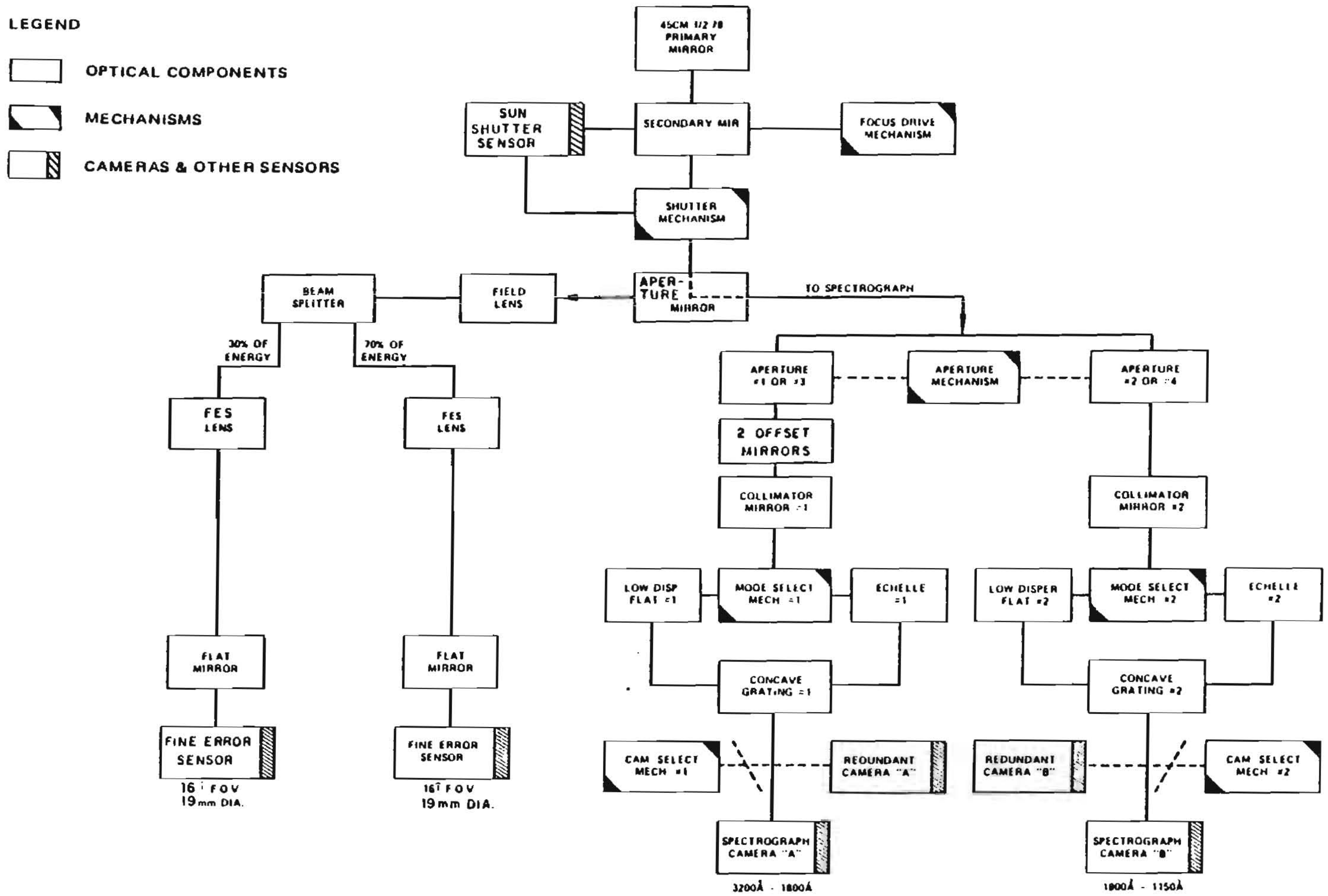


Figure 12-6 Optical Block Diagram IUE Scientific Instrument

tubes which will be used to integrate and record the spectrum. Since the echelle spectrograph design contains a high dispersion echelle grating in series with a low dispersion grating, the instrument is easily converted into a low resolution spectrograph by simply inserting a plane mirror in front of the echelle, leaving the low dispersion grating to act alone.

In order to achieve the dispersion required in the high resolution mode, it has been necessary to split the spectrum from 1150 to 3200Å into two ranges, and two exposures are required to record the entire spectrum.

This should not affect observing efficiency significantly, however. The grating blaze angles and other design parameters can be separately optimized for the two spectral ranges, greatly improving the optical efficiency. Two exposures would frequently be required in any case in order to expose optimally both the short and long wavelenth portions of the ultraviolet spectrum.

12.5.2 POINTING RESTRICTIONS (BETA ANGLE)

a. Beta and roll angles are not universally understood or defined. If doubt exists, verify definitions very precisely and accurately.

b. If the sun leaves the DSS field-of-view, automatic shutdown procedures may be initiated (Problem near $\beta = 0^o$).

c. For maneuver $15^o \geq \beta \geq 0^o$, advise POD that the sun will leave the DSS field-of-view. Disable OCC and OBC alarms. Assure that the proper "safe attitude" exists.

d. Thermal defocus of the telescope may occur for long dwells of attitudes at β angles less than 45 degrees. Permission to refocus telescope requires project approval. It is unlikely that approval will be granted. Check with Resident Astronomers about defocus effects near $\beta = 0^o$.

12.5.3 SUBSYSTEM OPERATIONAL GUIDELINES

a. Do not turn on Deck Htr. No. 1 (CRU, 46) without Mec. Elec. No. 1 being "ON".

b. Do not turn on Deck Htr. No. 2 (CRU55) without Mec. Elec. No. 2 on.

c. Do not turn on "Focus Launch Hold" (CRU40).

d. Do not send a real time (keyboard typed-in) command while building an expose command sequence.

e. Do not send any commands to the S/I except by approved procedure except for IMP 47.

f. Do not turn on a prime and redundant S/I system at the same time unless directed to do so by the approved test procedure.

g. Do not change the mechanism position while cameras are in any mode except "OFF" or "STANDBY".

h. Do not attempt to turn on the wavelength calibration lamp without LPS1 being "ON".

i. Do not send successive "IDENTICAL" serial commands to LVSW without a 5 second wait interval (i.e., no damage would result but the command would be ineffective).

j. Do not send any mechanism commands while the S/C is in spin mode.

k. Do not execute any procedure that addresses the focus drive mechanism without the approval of D.C. Evans.

l. With SS-04, if the temperature of the primary mirror is below 0^oC, sun-shutter status display must be questioned because of "need switch" problems.

12.5.3.1 <u>Bright Light Constraints</u>

a. It is known to be safe to observe objects as bright as +1 mv FES1 and +2 mv FES2.

b. The FES design implies that any object in the sky can safely be observed except the sun.

c. Do not observe objects brighter than the +1 or +2 visual magnitude limits without approval from the project (via Resident Astronomers).

d. Do not observe the earth or moon. If an earth or moon passage is predicted during a maneuver, close the sun shutter or EXEC FESSAFE.

e. Avoid observing brightest objects at the end of an observing period.

f. Proper selection of observing time will allow any object in the sky, outside the sun avoidance region, to be observed for 11 consecutive hours with neither sunlight or earthlight entering the telescope.

g. Earthlight entering the telescope can be sensed by the FES units and may affect pointing accuracy or cause stray light contamination of the object being observed.

h. OBC must be configured for bright light protection prior to any large angle maneuver (outside FES field-of-view). If OBC bright light worker is off, FESSAFE must be executed prior to start of large manuevers.

(1) Verify that OBC format looks at proper FES.

(2) Normal OBC safe action should be to close the sun shutter only, not to turn off the FES or put cameras to standby.

(3) OBC bright level is actuated by FES reading (TFESCT) of 28,000 or higher. Bright light actions may occur for:

(a) Field camera: (20KHz, 8 samples per frame): -1mv.
(20KHz, 1 sample per frame): +2mv.

(b) Primary Mode: (Fast Track overlap): +5mv.
(Slow Track overlap): +7mv.
(Fast Track underlap): -1mv.

(4) If a bright object is expected to be in the target field, the FES should be put in Field mode 20KHz, 8 samples per frame, or in FESSAFE until attitude is stable. After a Field map at 20 KHz, 8 samples per frame (identify star field), the OBC workers can be disabled.

i. Bright light protection is built into the FES CCIL procedures. Resident AStronomer advice will be needed to avoid the automatic protection.

12.5.3.2 Mechanism Constraints

a. Focus Drive

(1) Project approval is required before operating focus drive.

(2) Use CCIL procedures only:

(a) FOCREG sets command register.

(b) FPLANE moves coil configuration one step from location defined by FOCREG.

(3) FPLANE will not be an available mission procedure. It requires a special procedure file load.

(4) Review focus test plan prior to actuation. The image should never be moved away from the focal plane.

b. Camera Select

(1) Camera select may not be used without project approval.

(2) Camera select must be on and disabled if the deck heaters are on; otherwise, the selector may be drawing full power.

c. Mechanism Actuator should be restricted to quiescent conditions. Large power transients may occur at actuation. Do not actuate mechanisms during camera readout, maneuvers, hold on FES and gyro, unless absolutely necessary.

d. Aperture shutter should remain closed unless specifically needed for science operations. Failure closed will have less mission impact than failure open. Resident Astronomer approval is sufficient for operation.

e. Sun Shutter use is 'technically' unconstrained as long as it operates in the normal (rate controlled) mode. However, closing the sun shutter interrupts all light entering the instrument.

(1) Warn the POD before closing the sun shutter.

(2) Verify that closing the sun shutter will not effect any FES operations.

(3) Fiducial/back-hole lamps cannot be observed with the sun shutter closed.

(4) If the normal (rate controlled) mode is inoperable, the sun shutter use will be restricted and perhaps prohibited (except for sunlight protection). Do not use backup mode without prior project approval (normal mode is current limited; backup mode may blow a fuse).

(5) Operate only via CCIL procedures.

(6) Hazardous action consists of switching CRU 30 when CRU 20 is on because is will short the fuse to ground.

(7) Relay configuration (see (6) and footnote) is as follows:

	CRU9	CRU20*	CRU30*	
	OFF	OFF	OFF	No. +28 V power.
	OFF	OFF	ON	No. +28 V power.
	OFF	ON*	OFF	Backup-direct drive, close.
	OFF	ON*	ON	Backup-direct drive, open.
normal mode	ON	OFF	OFF	Normal rate controlled operation (Commands via EEA mech elect)

---

* Do not switch 30 when 20 is on. "Make before break" CRU relay characteristics will blow fuse by connecting fuse from +28 V to ground.

Do not use backup mode if normal mode has failed, without project approval. Normal mode is current limited; backup may blow a fuse.

	CRU9	CRU20*	CRU30*	
Do not use:	ON	OFF	ON	Normal mode reduced torque (ground via 170 Ω resistor)
Do not use:	ON	ON*	OFF	DD close overrides normal (bad practice, diode protection)
Do not use:	ON	ON*	ON	4.5W in 170 Ω no action (bad practice, nonsense)

f. Sun shutter is spring loaded to open. If the power if off, or any indicator for other than closed, the shutter is probably opened.

(1) Sun shutter read switch problems occur at low temperatures ($T \simeq -5^{o}C$). If the power is on in the normal mode and the command to close is issued, then a status indication changing from open to slew implies that the shutter is closed. The shutter will draw full power until the status reads close. (Note that close and shut are interchangeable words/meanings.)

(2) Sun shutter power should remain on for normal mode at all times so that automatic closure by the sun sensor will occur if attitude control is lost.

g. Normal modes (mechanisms) are as follows:

(1) Focus drive = off.

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* Do not switch 30 when 20 is on. "Make before break" CRU relay characteristics will blow fuse by connecting fuse from +28 V to ground.

Do not use backup mode if normal mode has failed, without project approval. Normal mode is current limited; backup may blow a fuse.

(2) Aperture mechanism = shut, on and disabled.

(3) Sun shutter = on, (normal mode) and open.

(4) Mode selectors = on and disabled.

(5) Camera selectors = off or on and disabled if deck heater on.

12.5.3.3 Lamps

a. Do not turn Fiducial/Back Hole (FBH) lamps on when a camera is in expose. The back hole lamps are inside the spectrograph. Which cameras and lamp power supply are on affect which FBH lamps come on.

b. Wavelength calibration lamp is a nonredundant, limited life unit. POD approval (policy enforcement) is required before use. Record time of use in OCC log. (OBC automatically records time of use.)

c. Do not use the lamp any longer than necessary.

d. Do not warm up the lamp. Turn the lamp on and off with the exposure (or use the lamp itself to control the exposure time).

e. Wavelength calibration lamp only operates from Lamp Power Supply one (LSP1).

f. High Voltage (HV) lamps (Wavelength Calibration Lamp (WCL), UV Flood (UVF)):

(1) Do not turn on (attempt to turn on) more than one HV lamp at a time. The first lamp on will get all the supply current.

(2) Do not switch lamps in a single :SIMODE command.

```
Example:  Not -  :SIMODE  WLC        But -  :SIMODE WLC
                 :SIMODE  UVF               :SIMODE STBY
                                            :SIMODE UVF
```

Note: UVF will not come on and the WLC will remain on. High voltage relays do not switch rapidly.

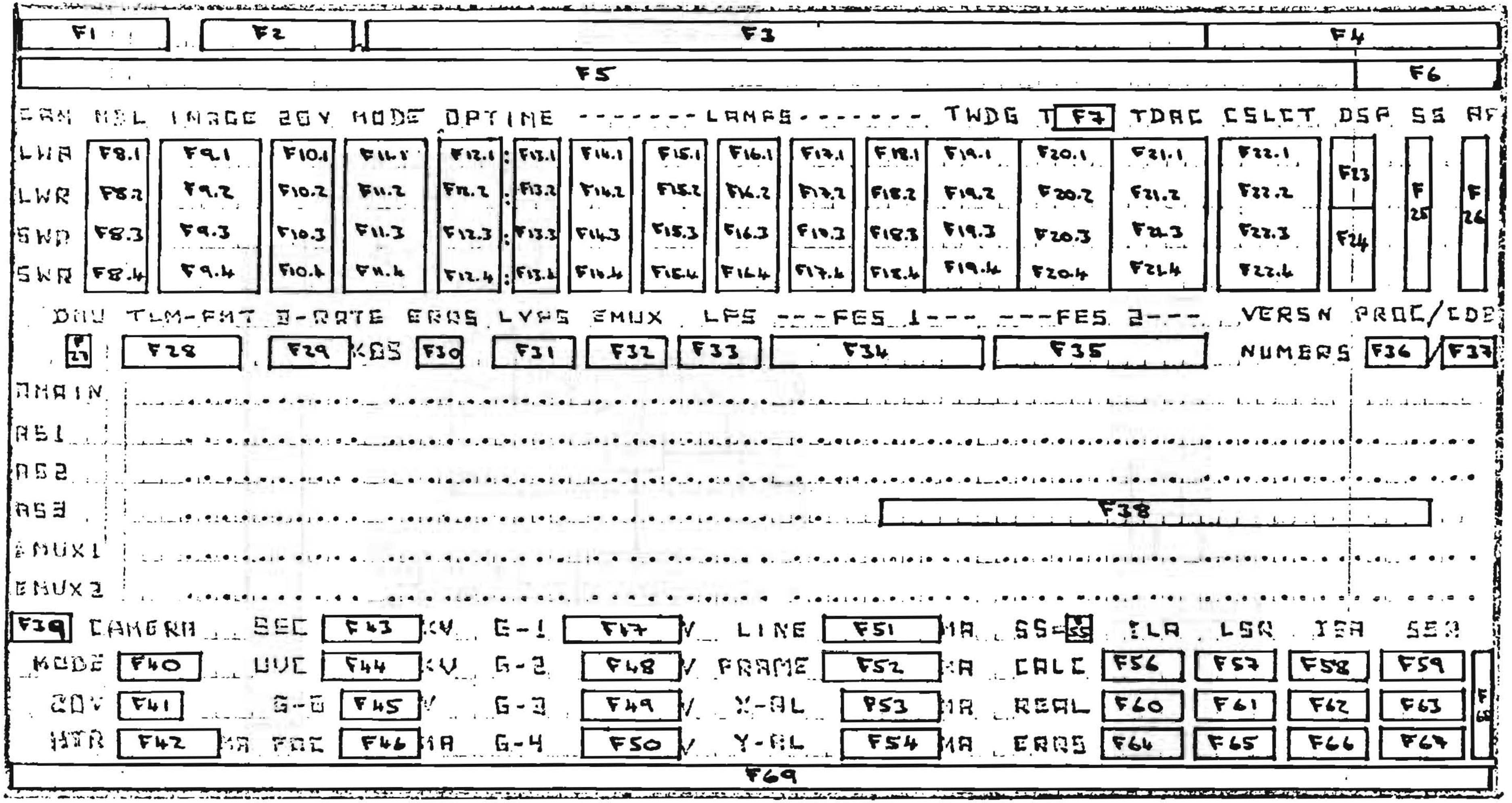
12.5.4 CAMERA SAFETY

No camera should be left inactive for long periods. A read, followed by a prepare and read, should be carried out at least every 2 weeks where possible and certainly no less frequently than every 2 months. If there are compelling reasons why a camera must be left inactive for longer than 2 months the UK should be consulted.

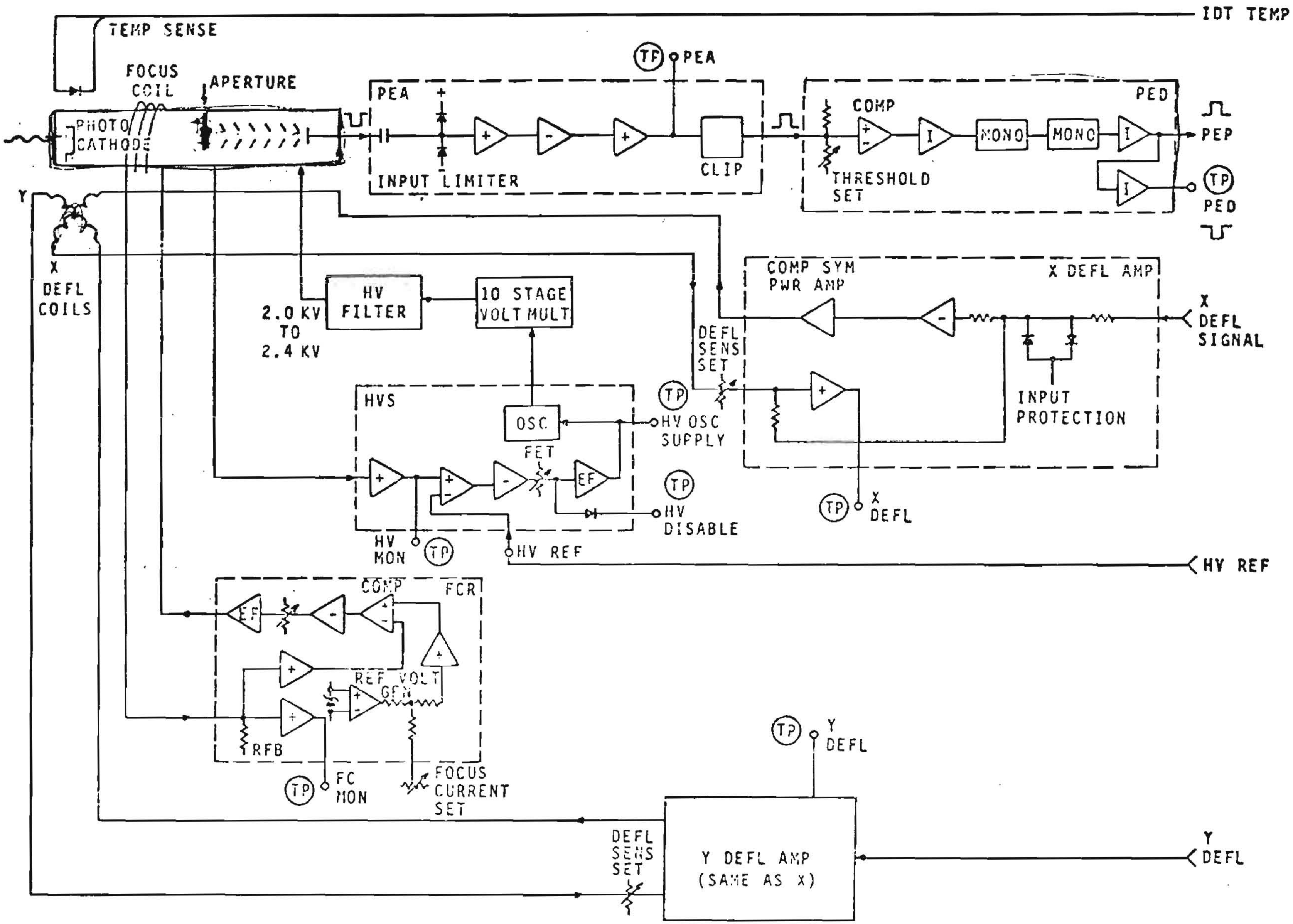
The read will tend to pump the residual gasses in the sec and prevent an excessive build up. However, repeated reads without a prepare sequence can cause an accumulation of positive ion signal on the target with a risk of cross-over. Therefore a read-only operation should normally be followed by a prepare sequence so that any incipient corss-over event will tend to be discharged by the redistributed secondary electrons generated during the flood.

For certain operations, such as setting up the flood time, it may be necessary to carry out several reads without a proper prepare sequence. This should be restricted to a maximum of 5 reads.

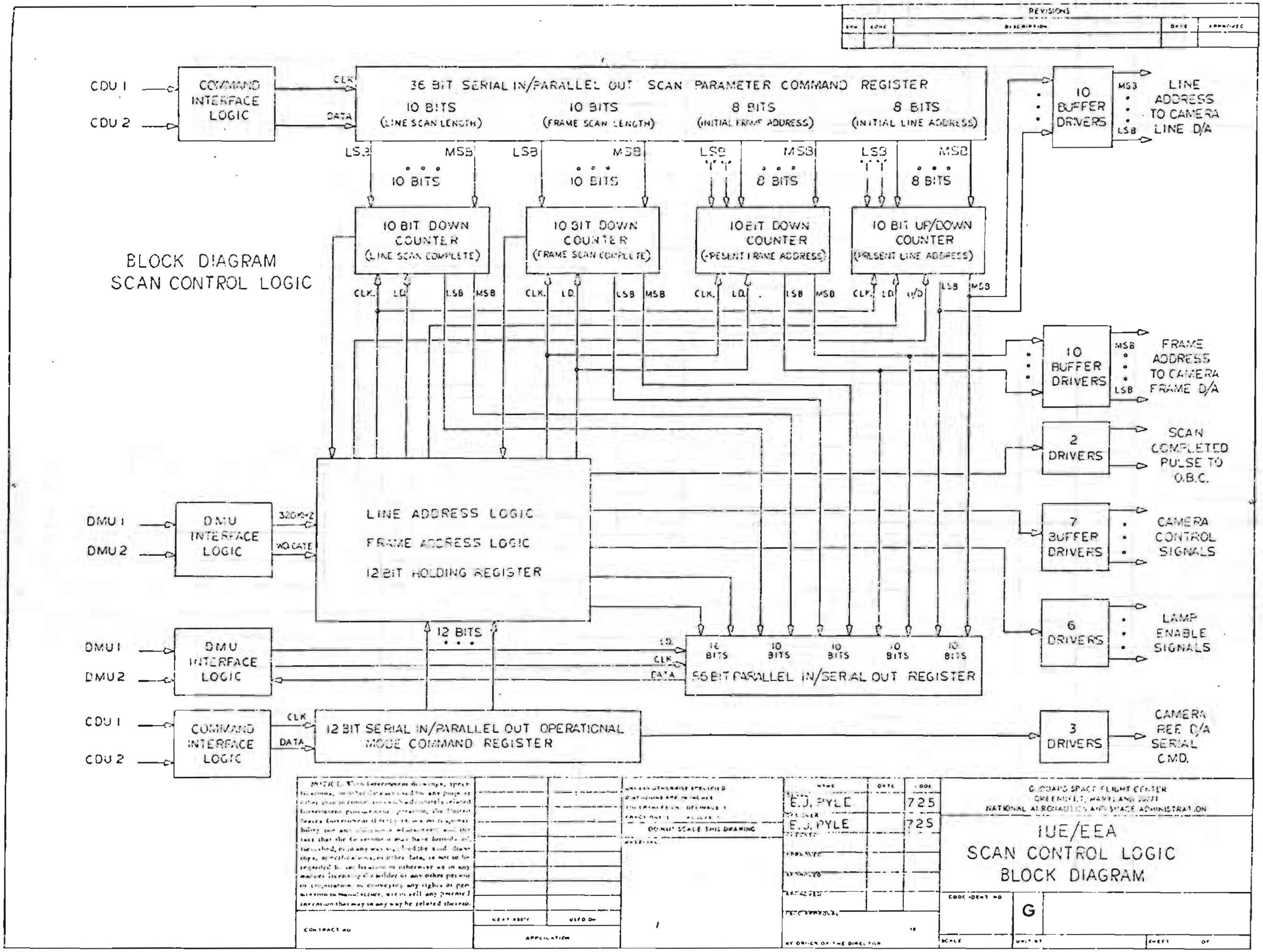
Whenever a camera is run after being inactive for 7 days or more the first action should be to carry out a read in order to reduce the ion signal before a subsequent exposure. However, this should normally be followed by a prepare sequence.

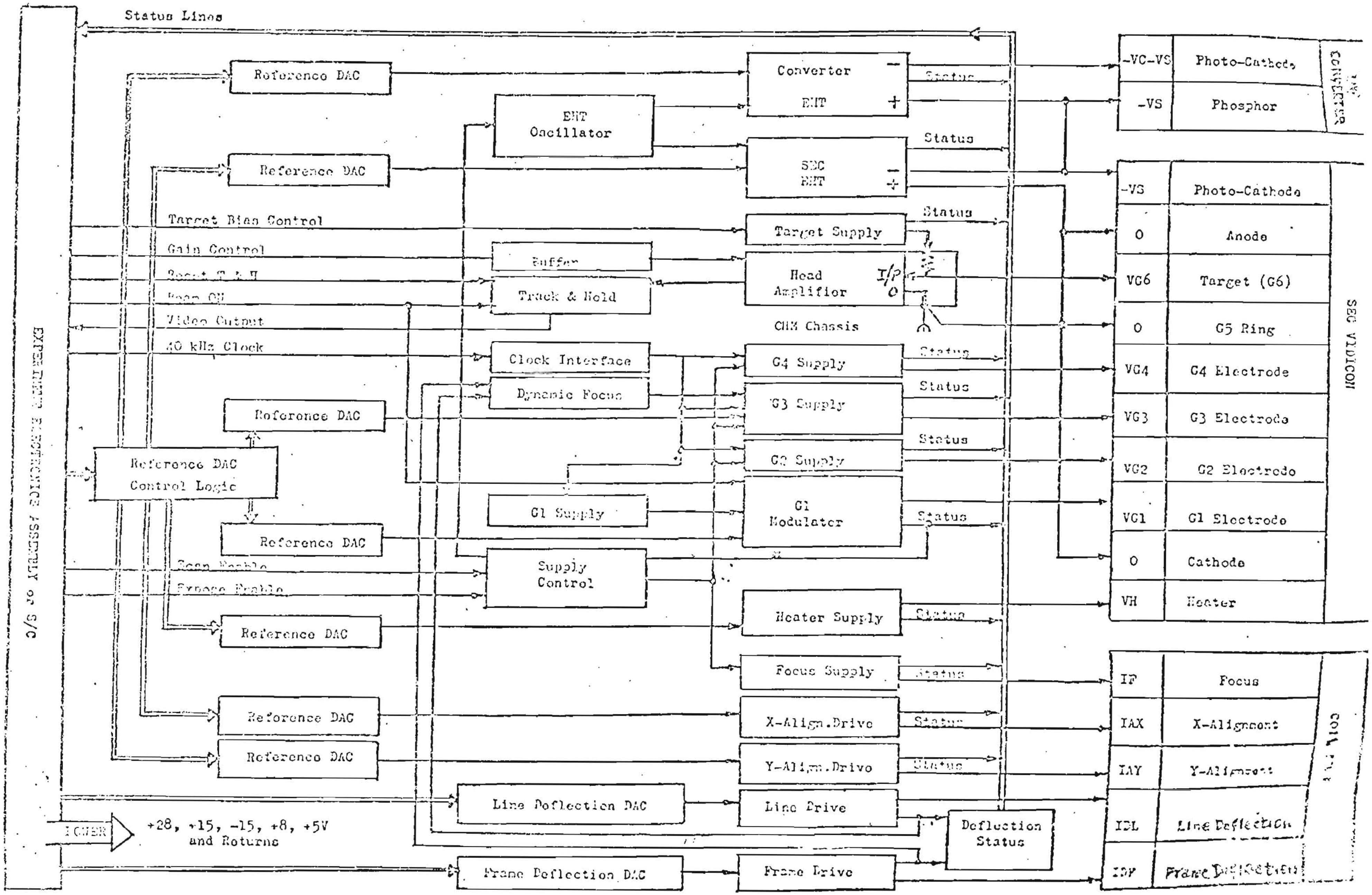


Camera Operational Display Fields

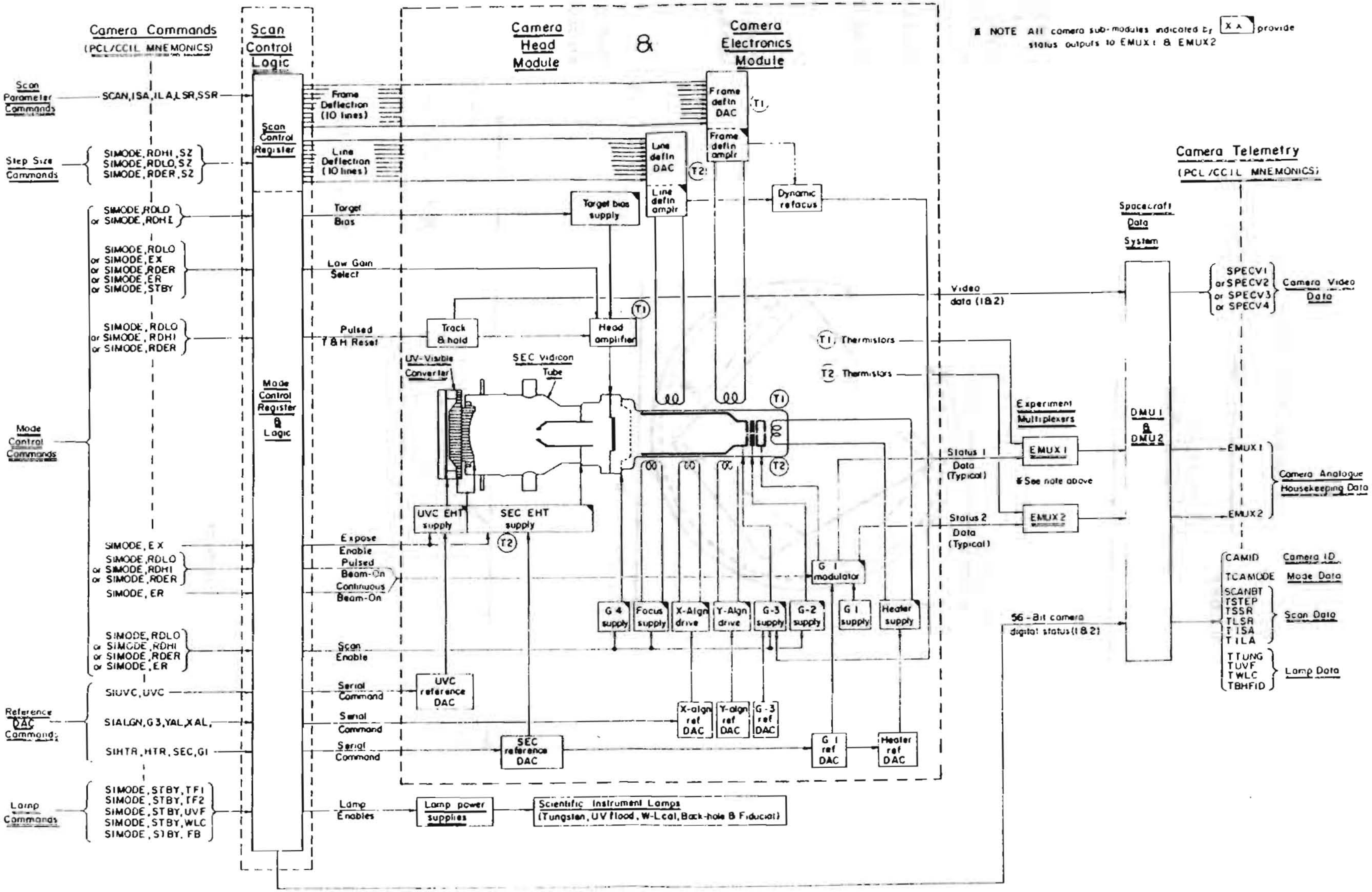


Functional Block Diagram IUE-FES Sensor Head

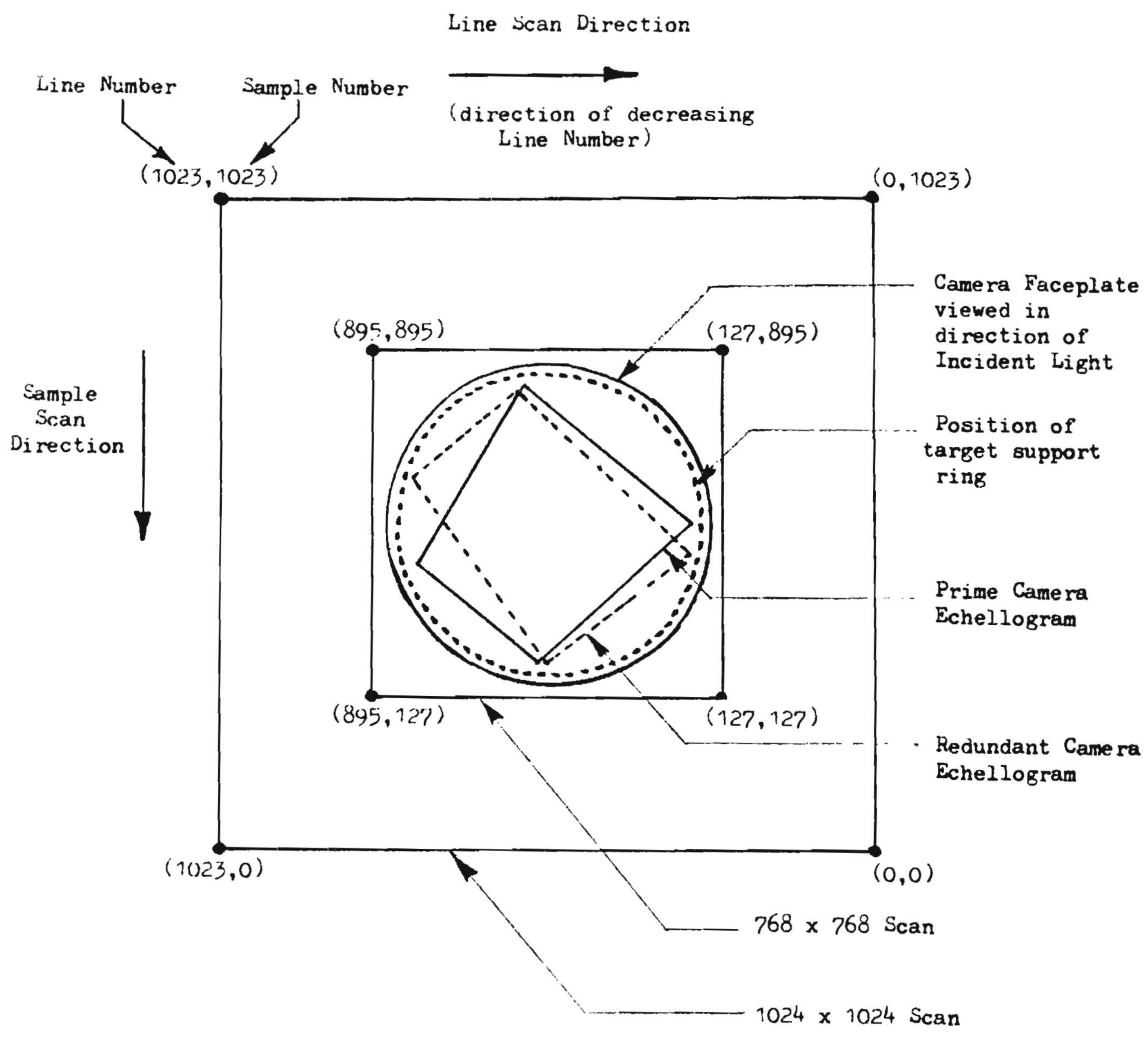

REVISIONS
CDU 1
CDU 2
COMMAND INTERFACE LOGIC
CLK
DATA
36 BIT SERIAL IN/PARALLEL OUT SCAN PARAMETER COMMAND REGISTER
10 BITS (LINE SCAN LENGTH)
10 BITS (FRAME SCAN LENGTH)
8 BITS (INITIAL FRAME ADDRESS)
8 BITS (INITIAL LINE ADDRESS)
LSB
MSB
10 BITS
8 BITS
10 BIT DOWN COUNTER (LINE SCAN COMPLETE)
10 BIT DOWN COUNTER (FRAME SCAN COMPLETE)
10 BIT DOWN COUNTER (PRESENT FRAME ADDRESS)
10 BIT UP/DOWN COUNTER (PRESENT LINE ADDRESS)
CLK.
LD.
U/D
BLOCK DIAGRAM
SCAN CONTROL LOGIC
10 BUFFER DRIVERS
LINE ADDRESS TO CAMERA LINE D/A
FRAME ADDRESS TO CAMERA FRAME D/A
2 DRIVERS
SCAN COMPLETED PULSE TO O.B.C.
7 BUFFER DRIVERS
CAMERA CONTROL SIGNALS
6 DRIVERS
LAMP ENABLE SIGNALS
3 DRIVERS
CAMERA REF. D/A SERIAL CMD.
DMU 1
DMU 2
DMU INTERFACE LOGIC
320KHZ
WD GATE
LINE ADDRESS LOGIC
FRAME ADDRESS LOGIC
12 BIT HOLDING REGISTER
12 BITS
56 BIT PARALLEL IN/SERIAL OUT REGISTER
12 BITS
10 BITS
12 BIT SERIAL IN/PARALLEL OUT OPERATIONAL MODE COMMAND REGISTER
DO NOT SCALE THIS DRAWING
E.J. PYLE
725
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
IUE/EEA
SCAN CONTROL LOGIC
BLOCK DIAGRAM
G
APPLICATION
BY ORDER OF THE DIRECTOR



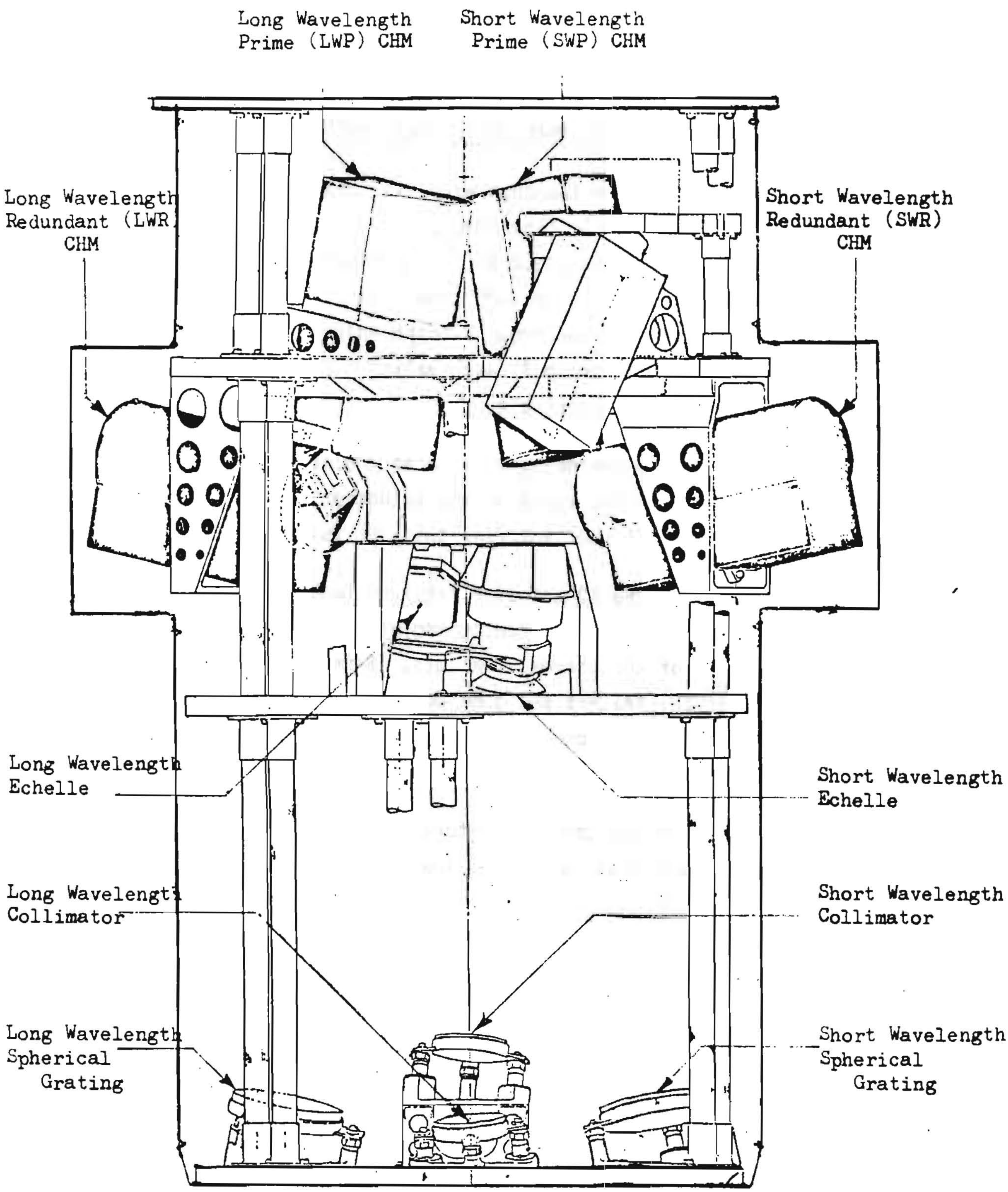
Simplified Single Camera System



Camera Sub-System Commands and Telemetry
(Excluding power)



Camera Scan Formats



CHM Locations within the Spectrograph

12.6 SUBSYSTEM OPERATIONAL GUIDELINES (HAPS)

a. HAPS will be launched with all tank-pair latch values closed (see figure 12-7), tank groups 1 and 3 (F-B, D-H) pressurized to 400 psi, and tank group 2 (C-G) pressurized to 200 psi. The initial pressurization of the HAPS lines (and any subsequent repressurization) must first open the group 2 latch value, close it, and then open either the group 1 or group 3 latch valves. Failure to follow this procedure may destroy a latch valve.

b. Near the beginning of life of the spacecraft, record a thermocouple temperature-time trace of the actuation of each thruster when used in the normal mode and file this for future reference.

c. All of the 12 thruster catalyst beds have thermocouples. The catalyst beds are thermally isolated from the thruster valves and are outside of the thermal blankets. Some of the catalyst beds have electrical heaters and some do not. About 30 minutes is required to heat a catalyst bed by electric power alone. Is excess power is available, the catalyst bed heaters can be left on.

d. Do not let the temperature of any part of the system, which is wet from hydrazine, fall below $+5^{o}C$.

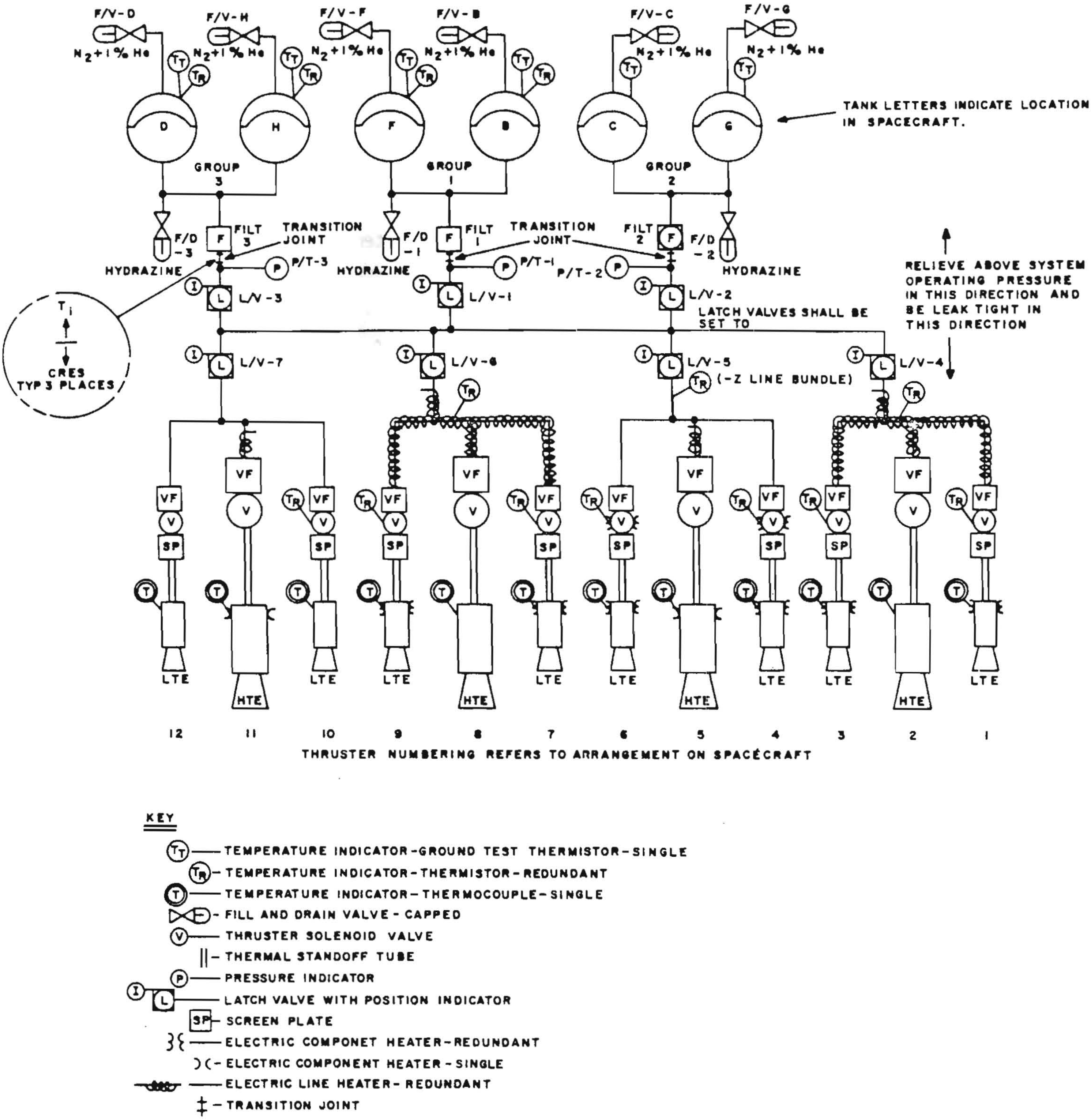


Figure 12-7. Hydrazine Auxilary Propulsion System

12.7 SUBSYSTEM OPERATIONAL GUIDELINES (OBC)

The following lists the on-board computer subsystem operational guidelines (see figure 12-8):

a. A Data Block 10 will not be processed while a Data Block 11 is in progress, and it will not be saved for processing later.

b. A new FES reference should be established following any maneuver.

c. A command flight gyro is trimmed after ground roll update (if desired); otherwise, there is no trim.

d. Have Maneuver Processor on, or turn it on, when aborting a slew or cycle slew hold.

e. If slew axis code is ØØ, a data block is rejected if found.

f. If Worker 2 (EXPS) is off, Data Block 14 must be loaded before turning it on.

g. If the OBC goes into the monitor mode while exposing, ground must end the exposure.

h. In Workers 2, 4, and 5 (Maneuver Processor, Bright Light, and Pointing Constraint) the default condition sent to Worker 12 (Safe Commands) is a "close shutters" command only. This must be changed by a patch if "FES shutdown" and "Camera in standby" commands are desired.

i. Worker 5 (Pointing Constraint) should be disabled during an eclipse of the sun.

j. If a patch is made to code, the ground must compute new parity words and disable Worker 6, make the patch, send the new parity values, and then turn the worker back on (Memory Parity).

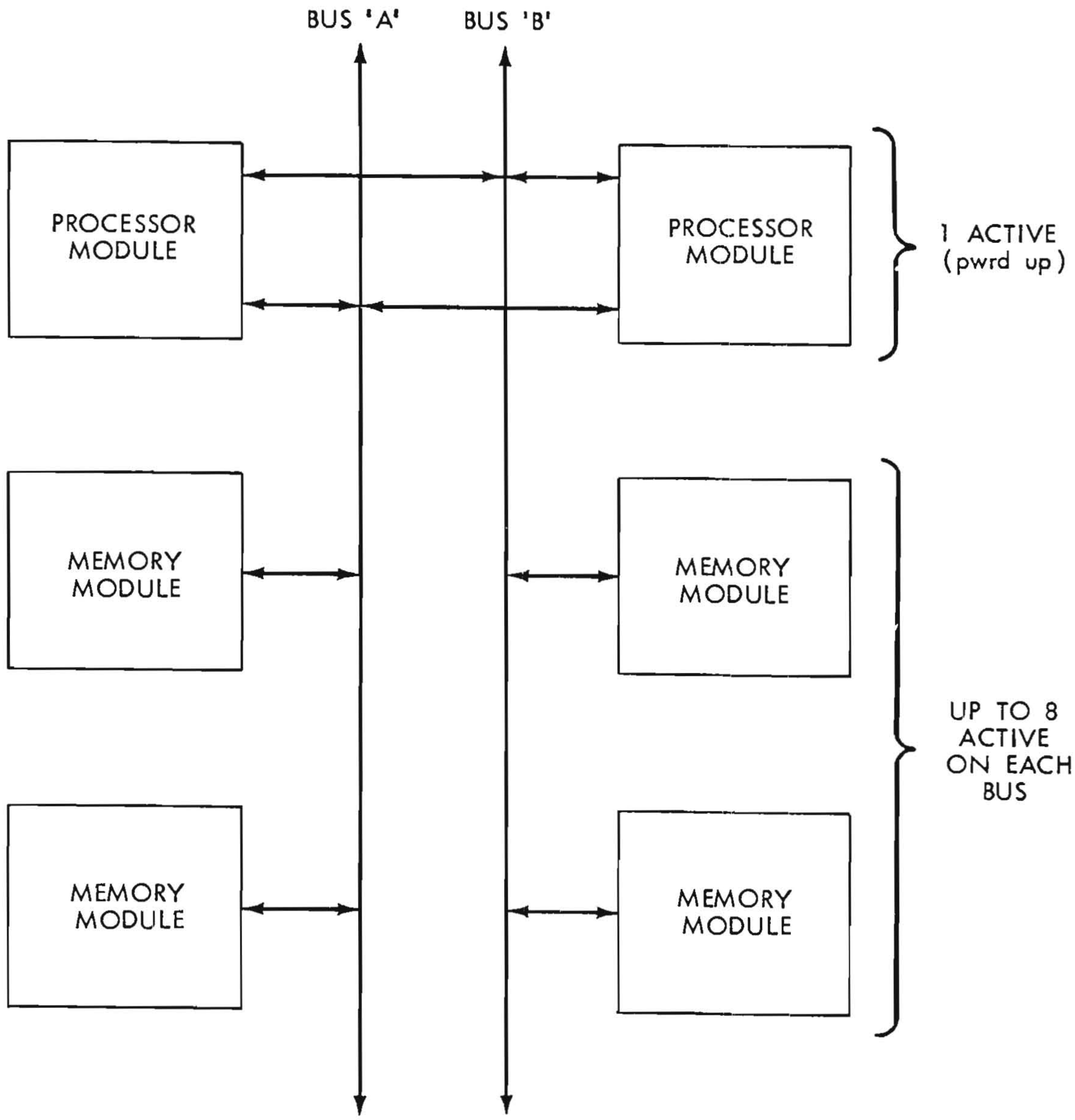


Figure 12-8. AOP System Block Diagram

k. Executive request 14 must be enabled in order for Worker 9 (Rate Arrest) to turn on Wheel Speed Hold after an error is detected.

l. Worker 12 (Safe Commands) must be on if commands are going to be requested from Workers 2, 4, 5, or from Executive request 12.

m. There can be eight commands maximum in Data Block 17. It must be loaded prior to turning on Worker 13 (Delay). Consecutive commands with delay time zero are sent on 30 msec. centers. Do not send real-time commands while building this data block or any OBC delayed command sequence.

n. A Data Block 19 and Executive request 16 must precede turning on Worker 19 (Sun Acquisition/Delta V). Cycle the Worker 19 after aborting a Delta V burn.

o. A Data Block 20 and Executive request 16 must precede turning on Worker 20 (Precession). Ground must configure the jet system before turning on this worker. Precession needs exclusive use of the machine.

p. A Data Block 21 and Executive request 16 must precede turning on Worker 21 (Nutation). Ground must configure the jet system before turning on this worker. Nutation needs exclusive use of the machine.

q. There can be no more than one ACS Worker on at a time.

r. The OBC input rate cannot be less than 2.5 kbits. To do Attitude Control backup the input rate should be either 40 or 20 kbits.

s. The multiplex ratio can vary from 1 to 16.

t. A Delta V burn can be aborted with an Executive request 17.

u. Do not do a hardware dump while running.

v. At 40 kbit TLM rate (loss of sync with S/C TLM):

(1) Can not use wheel speed hold mode.

(2) Can not use FSS sun presence (or lack of sun) to shutdown the S/I.

12.8 THERMAL

To Be Determined

12.9 <u>TARGET ACQUISITION AND FINE ERROR SENSING</u>

12.9.1 FINE ERROR SENSOR (FES)

The FES system described meets the acquisition and fine guidance requirements of the IUE (see figure 12-9). Two redundant image dissector sensors, each capable of multi-mode operation, accomplish the dual role of a field camera and target recognition and acquisition, and of a fine error sensor for pointing error generation. These detectors receive and share light energy reflected from the mirrored surface of the entrance plate via a reimaging optical subsystem. A beam splitter in the optical path provides a 70:30 energy ratio to the two sensors. This causes one sensor to be about one magnitude more sensitive than the other. The reasons for this sensitivity advantage are to ensure that at least one Fine Error Sensor (FES) has guidance capability to plus 14 m, and to allow the other FES to guide on somewhat brighter stars.

12.9.2 SUBSYSTEM OPERATIONAL GUIDELINES (FES)

a. Do not set command parameters direclty. Limit checking is not performed until a command is sent and the parameters can be set out of limits.

b. Use FES procedures to set individual parameters.
Example: EXEC FESTHD, 6
will indicate parameter out of limits
FESTHD = 6 will set FESTDH as a t and no error warning
will occur until :FES is sent (or attempted to be sent).

c. Do not turn on (or attempt to turn on) both FES units simultaneously. The FESON procedure will turn off the other FES. (The FESON procedure may not be in the mission procedure file.)

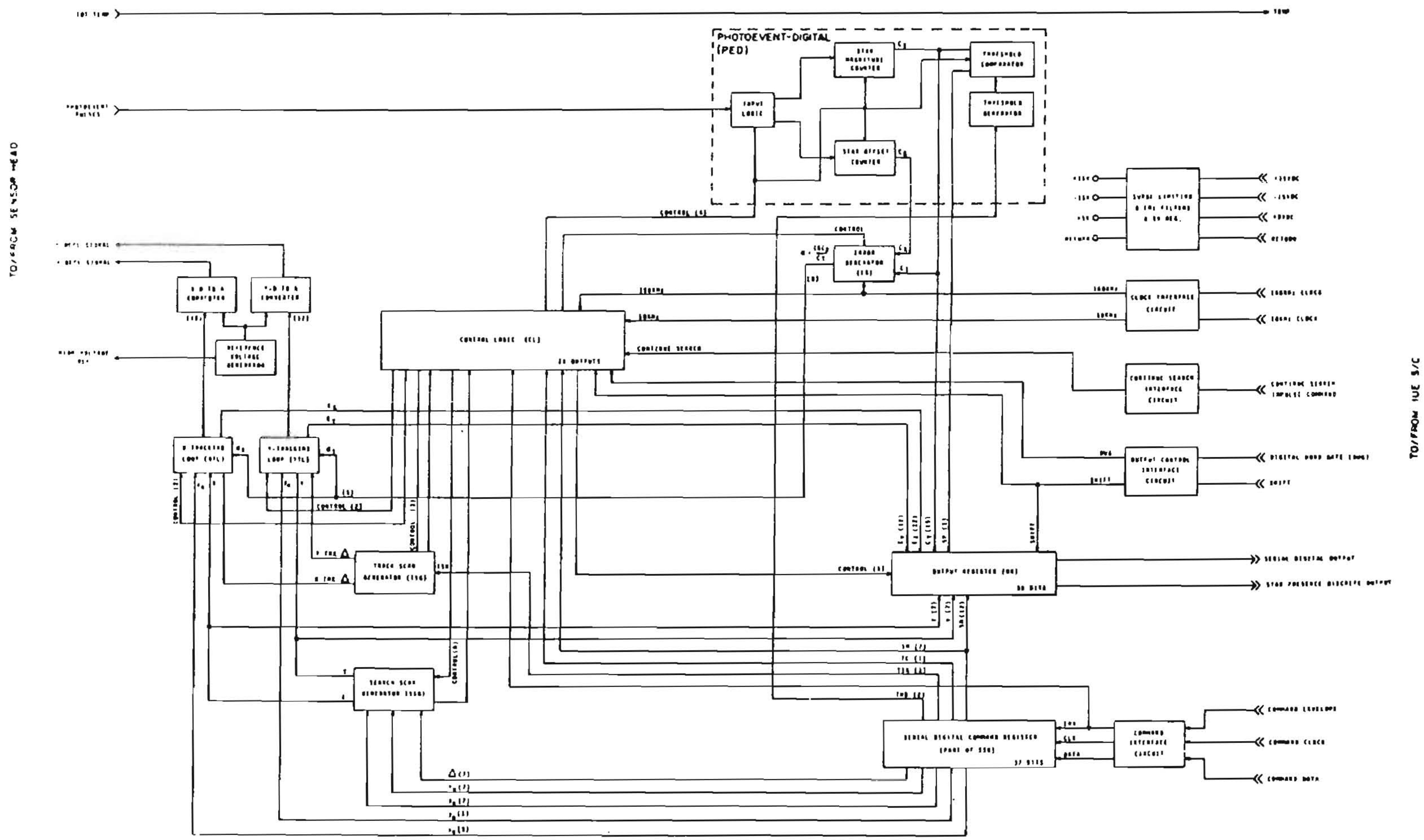


Figure 12-9. FES Block Diagram

d. Do not turn off an FES, except for emergencies. FESSAFE or closing the sun shutter are adequate for bright light protection. FESSAFE is not satisfactory protection for direct sunlight.

e. If direct sunlight is a possibility, because the attitude is unknown and DSS sun presence is lost, turn FES off and set cameras to STBY even if the sun shutter is closed.

f. FES cannot capture at rates above 18 arc-sec/sec and may have difficulty above 12 arc-sec/sec. FES cannot follow faster than 10 arc-sec/sec for fainter objects.

g. Make sure OBC and DMU formats are selected for the operating FES.

h. Do not use mixed (FES1 and FES2) indirect addressed for Field Maps, because the OCC S/W will intermix the data.

i. Use FES1 for observing bright objects because it recieves 30 percent of the light; whereas, FES2 receives 10 percent.

j. Read the fine print very carefully when reviewing axes orientation and display vectors. Confusion of definitions has occurred in the past.

k. FES2(S/N04) background noise is sensitive to word gate rates in primary track (this may or may not be an advantage/disadvantage). Normally, the lowest sample rates should be used. One DMU and two OBC samples per frame at 20 kHz are acceptable. At 40 kHz there are 8 samples per frame and 2 OBC samples per frame are acceptable; background counts as high as 40 occur in primary track.

l. Do not have OBC sample the FES during field camera maps. Two samples per frame will not be sent to the ground if this occurs.

m. If objects brighter than +5 visual magnitude are expected, set $\left\{ \begin{array}{l} \text{FESTSR} = 0 \\ \text{FLAP} = 1 \end{array} \right\}$ prior to initiating a track mode.