

GCIL and the RCU functions properly. There has been a history of some RCU's not operating properly when a GCIL command was transmitted. The RCU hangs up due to power on reset (POR) not getting done. Should this occur, the RCU should be powered OFF and ON to clear.

F. It is possible for the CCTV monitor to exhibit a fault light if the contrast and brightness settings are too high and if no sync is coming into the monitor.

G. Interactions Between Text and Graphic System and CCTV Command

The text and graphic system (TAGS) and the CCTV system share a 14-bit wide command word out of the MDM. The first two bits are used as an address and TAGS and the CCTV systems have different addresses. However, unexpected interaction may occur if TAGS STANDBY, READY, or PAGE ADVANCE commands are sent during a CCTV command sequence.

When a TAGS command is sent, the TAGS address is set on the MDM, and the last two bits are set depending on what TAGS command was sent. Bits 2 to 6 are reset to 0. These are the bits used by the CCTV systems as its input command. If a CTV OUTPUT/FUNCTION command is sent following a TAGS command, the previously selected CCTV input will have been cleared, and the OUTPUT/FUNCTION command will be acted on with an input select of 0 (FLIGHT DECK CAMERA). This could produce unexpected results.

For example the sequence

```
CCTV FWD BAY - A - SEL
TAGS READY
CCTV DOWNLINK
```

results in the TAGS going to READY and the FLIGHT DECK camera being downlinked.

Bottom line - TAGS commands will set the CCTV input selects to FLIGHT DECK and may cause unexpected CCTV responses. CCTV commands will not affect TAGS.

Workaround - If possible, do not send TAGS commands during CCTV commanding. If TAGS commands are required, INCO/COMM must reselect the CCTV input/source after the TAGS commands are complete.

16.6 CAMERA LENS CAPABILITIES

CCTV LENSES FIELD-OF-VIEW RANGES

(a) Monochrome lens assembly/color lens assembly

Parameter		Horizontal (deg)	Vertical (deg)	Vertical (deg)
Zoom out	Focus far	40.9	30.6	51.5
	Focus near	33.0	24.7	41.25
Zoom in	Focus far	6.6	4.9	8.25
	Focus near	5.8	4.3	7.2

(b) Wide-angle color lens assembly

Parameter		Horizontal (deg)	Vertical (deg)	Vertical (deg)
Zoom out	Focus far	81.1	60.8	101.3
	Focus near	83.3	62.4	104.1
Zoom in	Focus far	29.5	22.1	36.8
	Focus near	29.2	21.9	36.5

LENS OPTICAL CHARACTERISTICS

Lens	Focal length (zoom)	Zoom ratio	Focus distance	F-stop (iris)
Monochrome	18mm to 108mm	6:1	2.5 ft to ∞	f1.6 to f16
Color	18mm to 108mm	6:1	2.5 ft to ∞	f1.6 to f16
Wide Angle	8.2mm to 25mm	3:1	2 ft to ∞	f3.5 to f22

TABLE 16-I.- CCTV COMMANDS

There are four basic command types.

GCIL Commands

4200 VCU MAIN A ON
4201 VCU OFF
4202 VCU MAIN B ON

STAND ALONE Commands

These commands are STAND ALONE. They set bits 7-13 on the RCU command interface but do not depend on bits 2-6.

<u>Stand Alone Commands</u>	<u>Bits 7-13</u>
4207 Audio Interleaver A ON	0010101
4208 Audio Interleaver B ON	0010110
4209 Audio Interleaver AB ON	0010111
4210 Audio Interleaver OFF	0010100
4286 VSU ASYNC	0010011
4287 VSU SYNC	0010010

SOURCE Commands

These are SOURCE commands. They set bits 2-6 on the RCU interface but the RCU takes no actions until all zeros in bits 7-13 is seen. Then the combined command (all 14 bits) is executed.

<u>Source Commands</u>	<u>Bits 2-6</u>
4230 TV FLT DECK Sel	00000
4231 TV Mid Deck Sel	01000
4232 TV FWD BAY (A) Sel	00001
4233 TV KEEL (B) Sel	00101
4234 TV Aft Bay (C) Sel	00010
4235 TV Port RMS Sel	00110
4236 TV STBD RMS (D) Sel	00111
4240 TV Mux 1 Sel	01010
4241 TV Mux 2 Sel	01011
4242 TV PL 1 Sel	01101
4243 TV PL 2 Sel	01110
4244 TV PL 3 Sel	01111
4215 TV SPR INP (VTR PB)	00011
4251 TV Test Pattern Sel	01001
4221 TV CAM ADD 17	10001
4222 TV CAM ADD 18	10010
4223 TV CAM ADD 19	10011
4224 TV CAM ADD 20	10100

TABLE 16-I.- Continued

4225 TV CAM ADD 21	10101
4226 TV CAM ADD 22	10110
4227 TV CAM ADD 23	10111
4228 TV CAM ADD 24	11000
4229 TV CAM ADD 25	11001
4288 TV CAM ADD 26	11010
4289 TV CAM ADD 27	11011
4290 TV CAM ADD 28	11100
4291 TV CAM ADD 29	11101
4292 TV CAM ADD 30	11110
4293 TV CAM ADD 31	11111

OUTPUT/FUNCTION Commands

The OUTPUT/FUNCTION commands affect bits 7-13 and thus cause command execution. The camera address which will be sent along with these commands is specified by bits 2-6. The command is sent to the camera by setting a bit in the 32-bit camera command field to a 1. The OUTPUT/FUNCTION commands are split into four groups.

Group

These commands are acted on by the RCU and NOT issued to the cameras.

<u>Output/Function Commands</u>	<u>Bits 7-13</u>	<u>CAM CMD BIT (0-31)</u>
4204 TV CAM PWR ON	0010000	--
4205 TV CAM PWR OFF	0010001	--
4216 SPR OUT (VTR)	0000101	--
4217 SPR 1 OUTPUT	0000110	--
4218 SPR 2 OUTPUT	0000111	--
4245 TV MUX 1 LEFT	0001000	--
4246 TV MUX 1 RIGHT	0001001	--
4247 TV MUX 2 LEFT	0001010	--
4248 TV MUX 2 RIGHT	0001011	--
4249 TV DOWNLINK	0000011	--
4250 TV PAYLOAD	0000100	--
4262 TV FOCUS STOP	0011101	--
4265 TV ZOOM STOP	0011110	--
4268 TV IRIS STOP	0011100	--
4272 TV TILT STOP	0011001	--
4275 TV PAN STOP	0011000	--

TABLE 16-I.- Concluded

Group 2

These commands are transmitted to the cameras and repeated every field until stopped.

Output/Function Commands	Bits 7-13	CAM CMD BIT (0-31)
4260 TV FOCUS NEAR	0111011	27
4261 TV FOCUS FAR	0111010	26
4263 TV ZOOM IN	0111101	29
4264 TV ZOOM OUT	0111100	28
4266 TV IRIS OPEN	0111001	25
4267 IRIS CLOSE	0111000	24
4270 TV TILT UP	0110110	22
4271 TV TILT DOWN	0110111	23
4273 TV PAN LEFT	0110101	21
4274 TV PAN RIGHT	0110100	20

Group 3

These commands are transmitted to the cameras but only once for every reception of the command.

Output/Function Commands	Bits 7-13	CAM CMD BIT (0-31)
4212 CAM AUX ON	0101111	15
4213 CAM AUX OFF	0101110	14
4278 TV PAN/TILT RESET	0110001	17
4280 TV ALC PEAK	0101000	8
4281 TV ALC NORM	0101001	9
4282 TV ALC AVG	0101010	10
4283 TV GAMMA WHITE STRETCH	0101011	11
4284 TV GAMMA NORM	0101100	12
4285 TV GAMMA BLACK STRETCH	0101101	13

Group 4

These commands are sent to every field that a pan or tilt is commanded. One of them will always be on for a pan or tilt.

Output/Function Commands	Bits 7-13	CAM CMD BIT (0-31)
4276 TV PAN/TILT FAST	0110011	19
4277 TV PAN/TILT SLOW	0110010	18

Camera command bit positions 0 through 7, 16, 30 and 31 are spare.

TABLE 16-II.- CCTV POWER CONSUMPTION

LRU	Current	Power (at 28 V)
TVC ^a	680 mA	19.04 W
RVS ^a	.34 mA	.00952 W .01 W
RCU/VSUB ^b	1.25A VSU loads low	35.0 W
	1.65A VSU loads high	46.2 W
PTU ^b	6.9 mA - IDLE	.19 W
	92.9 mA - PAN	2.60 W
	98.6 mA - TILT	2.76 W
		.19 W - 1 DLE (2.49 W per MTR)
		2.68 W - 1 MTR
MLA ^a	7.3 mA - IDLE	5.17 W - 2 MTR
	+80 mA per MTR	.20 W - 1 DLE
		2.44 W - 1 MTR
		4.48 W - 2 MTR
CLA ^a	170 mA - IDLE	6.72 W - 3 MTR
	+80 mA per MTR	4.76 W - 1 DLE
		7.00 W - 1 MTR
		9.24 W - 2 MTR
		11.48 W - 3 MTR
VFMA ^a	185 mA	5.18 W
TVMA ^a	1.3 A	36.4 W
PTU HTR ^c	-	8.20 W
CAMR HTR ^c	-	19.90 W

^aRef V. FRY 6/23/80 ACCEPTANCE TEST DATA

^bRef Will Fraley 6/24/80

^cRef EEL 1/14/80

TABLE 16-III.- PAYLOAD BAY TV OPERATIONS
(Assumes all cameras are off, no crew OPS)

Forward bay and aft bay used as examples

- 4200 VCU MN A (2 sec startup)
- 4232 TV FWD BAY CAM - SEL
- 4204 TV CAMERA PWR - ON (30 sec warmup)
- 4249 TV DOWNLINK
 - TLM on COMM Management should show:
 - D/L SEL - FWD
 - ALC PEAK/MAN
 - GAMMA SEL - NORM
- 4280 TV ALC - PEAK
 - Picture should appear, on COMM Management
 - ALC should show PEAK/AUT
 - Set ALC and GAMMA as required
 - To switch to another camera
 - Close iris
- 4267 TV IRIS CLOSE
 - Wait 12 sec, picture should go full black
- 4268 TV IRIS STOP
 - If camera is not needed again, 4205 TV CAMERA POWER - OFF could be uplinked
- 4234 TV AFT BAY CAM - SEL
- 4204 TV CAMERA PWR - ON (30 sec warmup)
- 4249 TV DOWNLINK
- 4280 TV ALC - PEAK
 - When TV OPS complete
- 4205 TV CAMERA POWER - OFF
- 4232 TV FWD BAY CAM - SEL
- 4205 TV CAMERA POWER - OFF
- 4201 VCU OFF
 - Will turn all cameras off (with the exception of cabin cameras under crew control)
- Commands to set up a VTR dump (VCU assumed on)
- 4286 VSU ASYNC (if TV is being downlinked, GMT on monitors will go to zero)
- 4210 AUDIO INLV - OFF (if required)
- 4242 TV P/L 3 - SEL
- 4249 TV DOWNLINK
 - Configure FM or KU
 - Inform crew to begin VTR dump
 - When dump is completed
- 4287 VSU SYNC

TABLE 16-IV.- TELEMETRY

V74X0830E	FLT DECK CAM SELECTED	
X0798	MIDDECK CAM SELECTED	
X0799	CABIN CAM 3 SELECTED	
X0825	FWD BAY CAM SELECTED	
X0827	AFT BAY CAM SELECTED	
X0826	KEEL - EVA CAM SELECTED	RCU discretes indicating which camera is selected for downlink.
X0829	PORT RMS CAM SELECTED	
X0828	STBD RMS CAM SELECTED	
X0795	PAYLOAD 1 SELECTED	
X0796	PAYLOAD 2 SELECTED	
X0797	PAYLOAD 3 SELECTED	
X0847	CAMERA OVERTEMP	RCU discrete, indicates VSU has detected a camera overtemp.
X0843	ALC PEAK	
X0844	ALC NORM	
X0845	ALC AVG	RCU discretes. In auto iris mode, one of three is high, with the high discrete indicating the mode. In the manual iris mode, two of three are high, with the low discrete indicating the mode. If VSU asynchronous or off, all will be low.
X0846	GAM WHITE	
X0848	GAM BLACK	RCU discretes, indicating the GAMMA mode.
X4880	VCU PWR MNA	
X4881	VCU PWR MNB	GCIL discretes, indicating which bus is powering the VCU. Mutually exclusive.
X0782	VCU SYNC GEN	RCU discrete. 1 = sync gen A
S0790	SYNC NORM	
S0791	SYNC REVERSE	Switch scan. Position of onboard SYNCH switch.
S0793	GCIL	Switch scan. 1 = CMD on GCIL mode switch.
S0781	DOWNLINK	Switch scan downlink enable/inhibit switch. 1 = inhibit.

TABLE 16-V.- MCC MONITOR DISPLAY

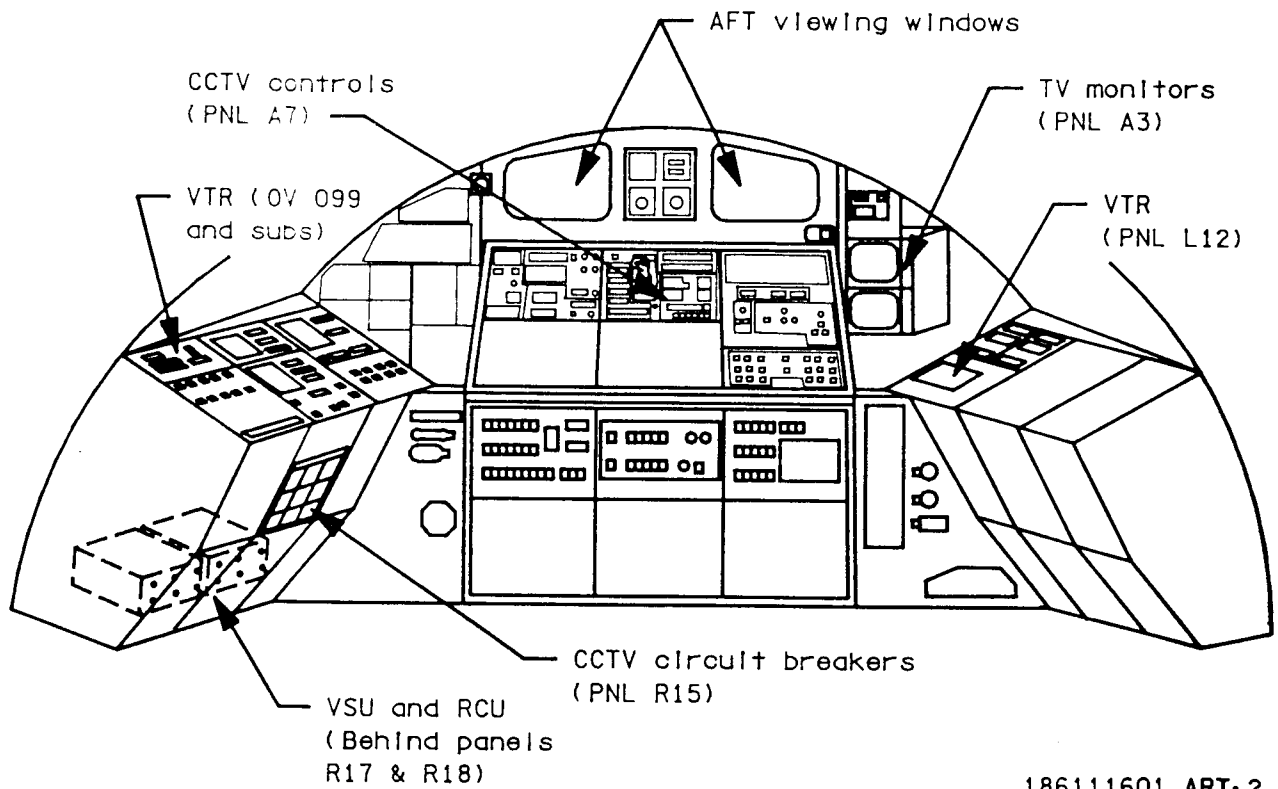
<u>LOC</u>	FLT MID C3 FWD AFT KEEL PRMS SRMS PL1 PL2 PL3			Camera location code For any invalid codes the code will be displayed in decimal.
<u>ALC</u>	PA NA AA PM NM AM	PEAK NORM AVG PEAK NORM AVG	AUT AUT AUT MAN MAN MAN	
<u>PAN</u>				The pan angle in degrees (+ is RIGHT)
<u>TEMP</u>				Temperature of the camera being downlinked; if the VSU has detected an overtemperature, the temperature will flash.
<u>A</u>				Interleaved audio is detected; if no interleaved audio, this will be blank.
<u>ID</u>				Camera serial number
<u>GAM</u>	W N B			White stretch Normal Black stretch
<u>TLT</u>				Tilt angle in degrees (+ is UP)
<u>GMT</u>				Time decoded from video

Since all data on the video monitor display is decoded from the video, in the case of a VTR playback, the data (GMT, etc.) will be the data of the recorded source.

If data are not detected for any of the above parameters, the parameter will be underlined and the last valid data displayed.

TABLE 16-VI.- GENERAL MECHANICAL SPECIFICATIONS

Item	Size (in.)	Weight (lb)
Camera	9.1 x 6.3 x 5.8	9.7
Color lens	7.4 x 5.8 x 5.4	7.75
B&W lens	7.4 x 5.8 x 5.4	6.75
Viewfinder monitor	8 x 4.3 x 3.6	4.0
Pan-tilt unit	16 x 11 x 11	9.0
Video switching unit	13 x 10.5 x 7.8	39.0
Remote control unit	10 x 10 x 7.7	39.0
TV monitor	12.5 x 10 x 7	21.0
Video tape recorder	15 x 19 x 10	49.8
Wide angle lens assy	7.4 x 5.8 x 5.4	8.25



186111601. ART, 2

Figure 16-16.- CCTV component locations (cabin).

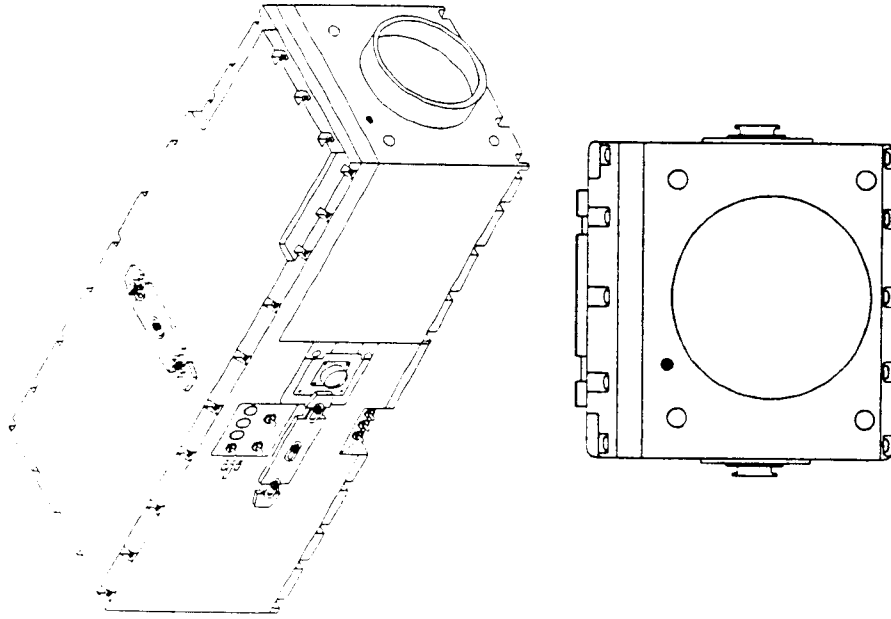
16.7 SOLID STATE COLOR CAMERA (CTVC)

16.7.1 Background

The TVC presently flown onboard is a monochrome, silicon-intensified, tube-type camera. Color video imagery is provided by spinning a color wheel in front of the camera sensor to produce a field sequential output signal from the camera. Special field sequential to NTSC color conversion equipment is required on the ground for distribution and display of the video downlinked from the orbiter. The color television camera (CTVC) features solid state sensor technology, increased zoom range, no image retention, no Sun blooming problem, low maintenance plug-in modules, low power consumption, and longer lifetime and generates true NTSC color.

16.7.2 Physical Description

The CTVC overall size is 16.0 inches long, 5.88 inches wide, and 5.94 inches high. The estimated weight is 18.7 pounds. Power consumption is approximately 34 watts average. The CTVC assembly consists of a lens assembly and an electronics assembly. The two subassemblies are separable enclosures that are secured and connected inside the camera housing. The prism assembly is part of the lens housing and maintains optical alignment. The lens assembly contains a 2/3-inch format wide-angle zoom lens and lens drive motors and electronics in an aluminum housing. Three motors, on pivoting mounts, engage the lens function ring gears on the barrel of the lens. Stepper motors fitted with integral gear head assemblies, together with the spur gear drive to the lens, magnify the output torque and provide the necessary rates for the iris, zoom, and focus functions. Three single turn, high resolution potentiometers are mounted similarly to the stepper motors and provide discrete position information for iris, zoom, and focus functions. Switches and LED's for all camera and lens functions are located on the side of the camera. The prism/CCD assembly consists of a three-piece prism; several planar glass elements, which are use for filtering, polarizing, and path extension; and three CCD imagers mounted on an adapter plate. The three CCD imagers are permanently positioned and attached to the prism using a Fujinon lens. The photo-sensitive area of the green CCD is positioned such that the center pixel coincides with the optical axis of the lens and prism system. The blue and red CCD's are registered with respect to the green CCD such that the center pixels coincide. The lens, prism, and CCD are aligned to place the center of an optical target less than +30 microns at the image plane over the full zoom range of the lens. The prism assembly allows for the enclosure of a two-blade, "bow-tie" shutter wheel to provide optical blanking during vertical image transfer. The shutter wheel is 3.0 inches in diameter and is made of 0.02- inch-thick spring steel. A light shield is provided to prevent dust contamination and limit electrical crosstalk.



186111617.ORT:1

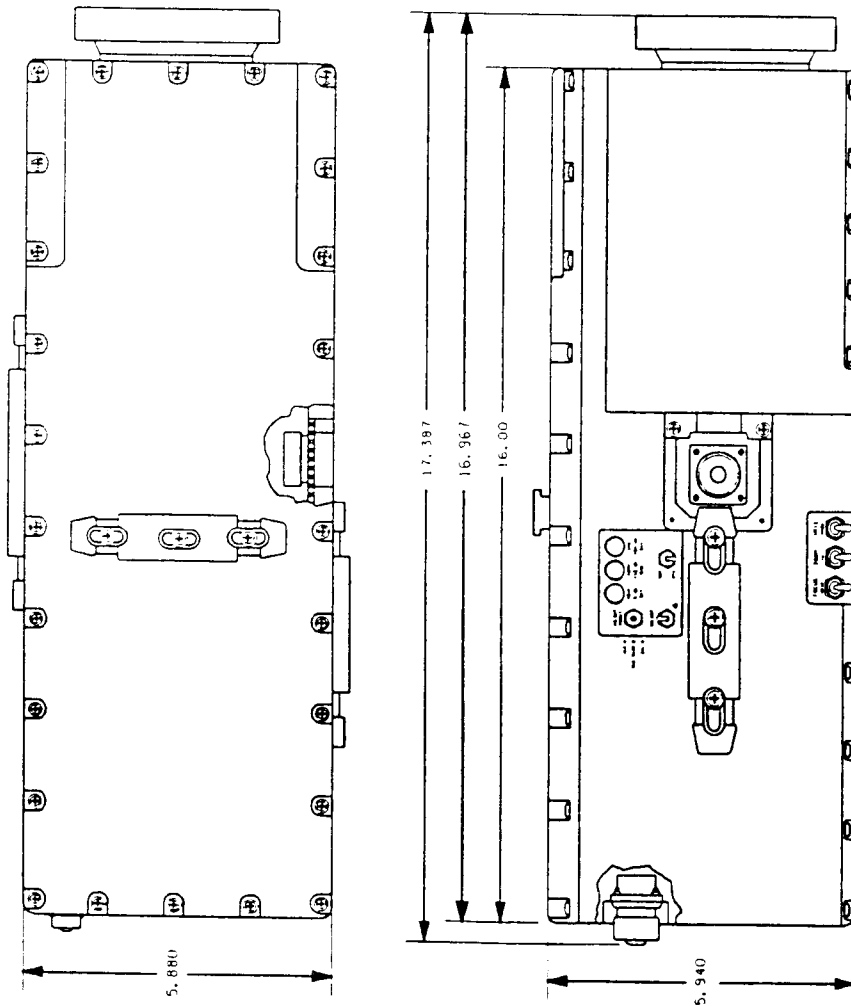
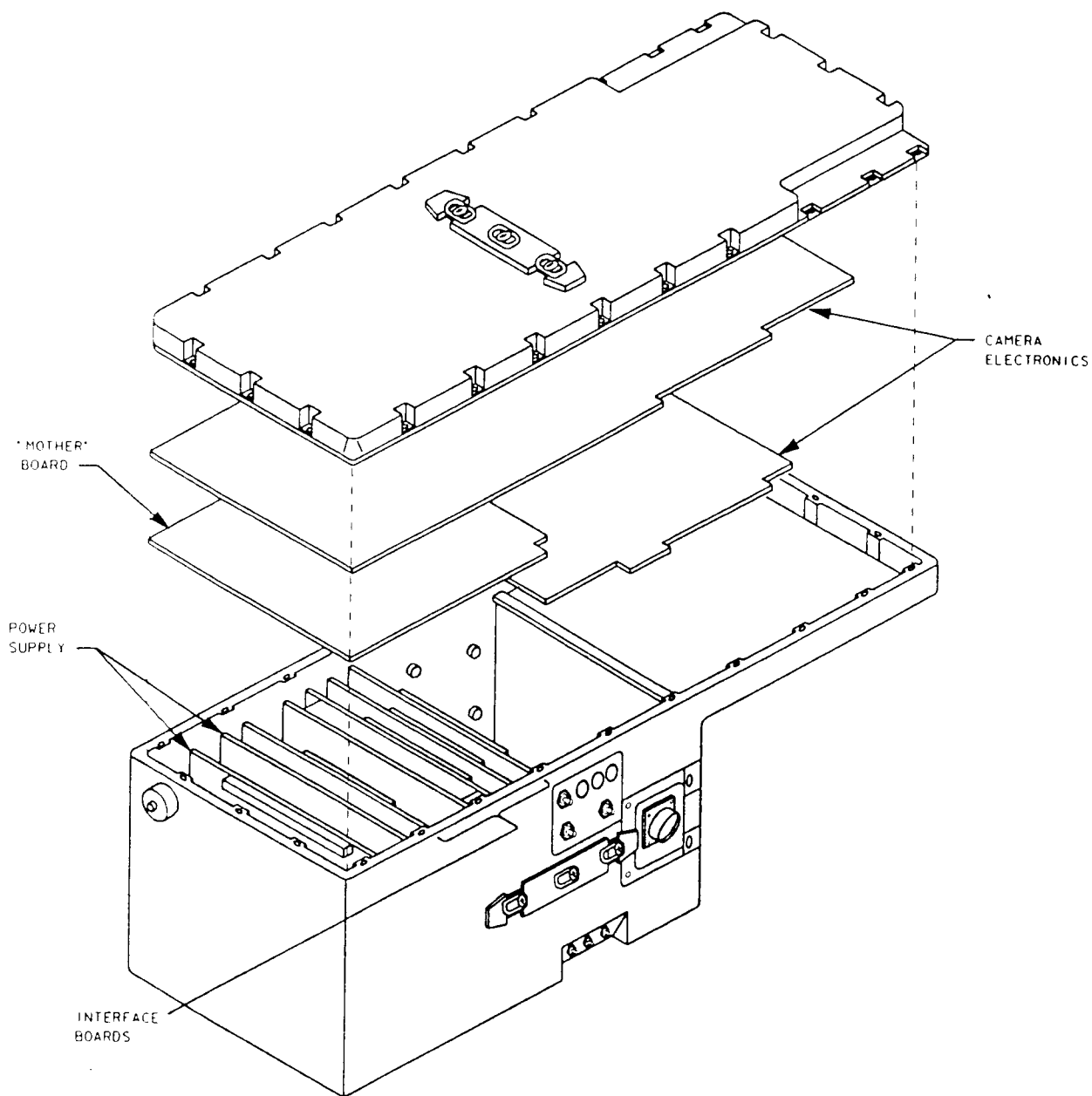


Figure 16-17.- Camera configuration.



186111618. ISO, 1

Figure 16-18.- Camera electronics internal configuration.

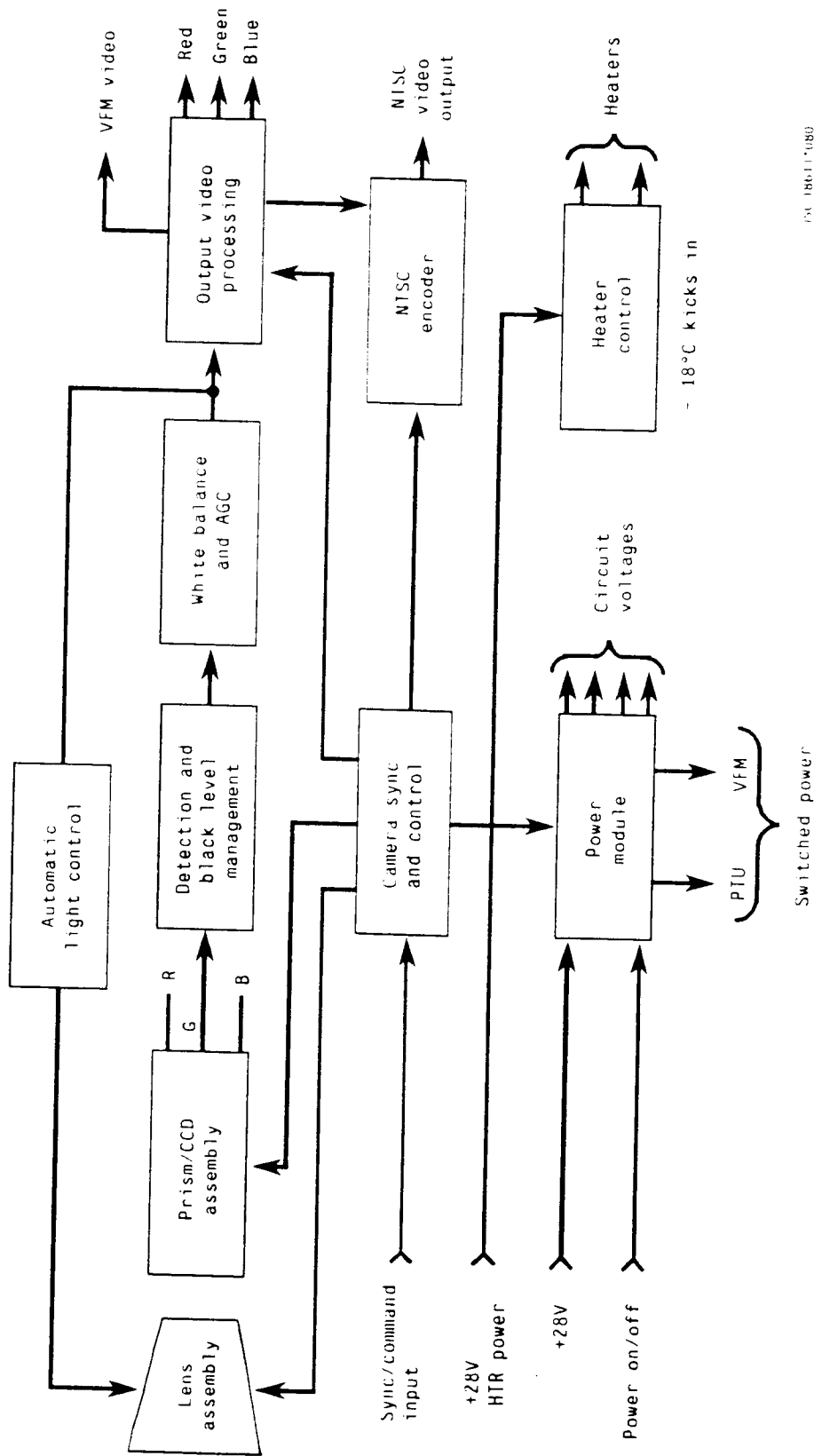


FIG 18611-180

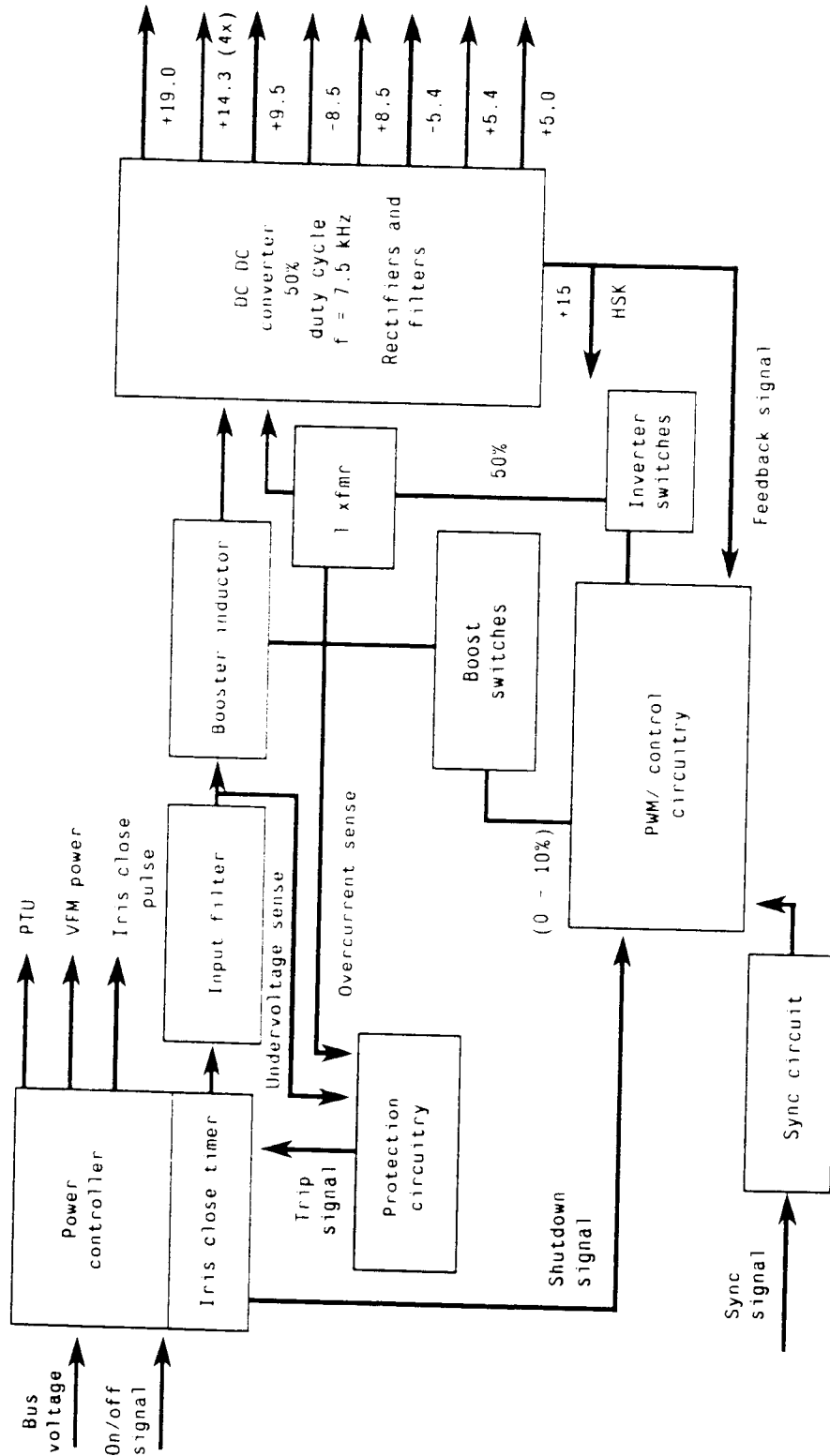
Figure 16-19.- CTVC simplified block diagram.

16.7.3 Camera Location Code

The CTVC has been modified to support either space station or orbiter. On the right side of the camera a switch will toggle between the 5-bit orbiter location or the 7-bit space station location.

16.7.4 Power Switching

The CTVC power supply is controlled by the power controller that receives orbiter bus voltage and is triggered by the ON/OFF command to switch power to the LVPS, the pan/tilt unit (PTU), and the viewfinder module (VFM). The ON/OFF control circuitry activates the iris close timer, iris close pulse, pulse width modulator shutdown, and relay drivers. The circuitry receives the outputs of the protection circuit comparators for fault action. The iris close timer provides a 3-second delay to LVPS turn off, to allow the iris mechanism to close. An OFF command will cause the iris pulse signal to be sent and the start of a 3-second period after which the supply will turn off. Fault-induced shutdowns will not be delayed. Sensing circuits for under- and overvoltage conditions are combined with the iris close timer output to form a common trip signal for the power controller.



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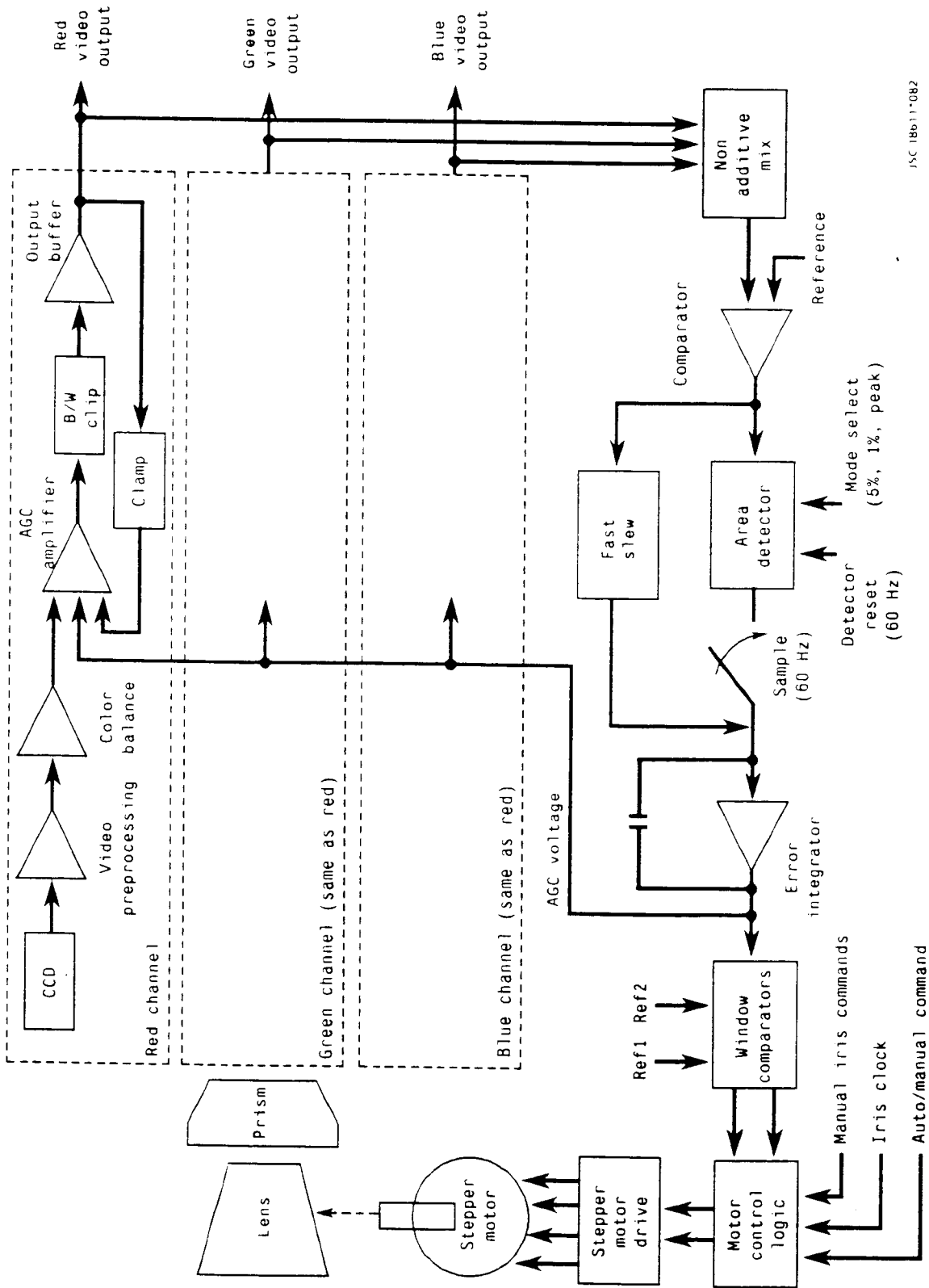
Figure 16-20.- CVTC LVPS block diagram.

16.7.5 Video Detection

Photoelectronically and thermally generated electrons are integrated by three (green, red, blue) CCD's. The pixel video detector outputs a frame transfer that can be thought of as an amplitude modulated carrier. The thermal electrons known as dark current are corrected and integrated to establish a black level reference. The video is then driven by process blanking to remove unwanted signals present due to imager clocking. After blanking, the video is amplified and corrected for black level shading. A feedback clamp looped around the video amplifier maintains black level reference. The signal is then sent to the automatic gain control circuitry.

16.7.6 Automatic Gain/Light Control

The color balance amplifiers (CBA) and automatic light control/automatic gain control (ALC/AGC) circuitry accepts red, green, and blue video outputs from the video detection and provides color-balanced video of fixed amplitude to the video processing circuitry. The CTVC provides three preset color balance settings which are manually selected by uplink or off the side panel. The red and blue channels are provided with adjustment potentiometers which are used to compensate for variations in the response of the prism, CCD imagers, and video preprocessing circuitry. The potentiometers are set during camera test and then staked to prevent subsequent adjustment. The settings are daylight, fluorescent, and tungsten. The ALC/AGC circuit maintains the video signal at a predetermined level by controlling the lens aperture and the gain of an AGC amplifier. Automatic feedback control in conjunction with three detector settings (5 percent, 1 percent, and peak) maintains the correct video output level. The area detector circuit, which is part of the control loop, keeps a commanded fraction of the picture raster at a predetermined signal level. On the side of the camera the functions for ALC, gain, and balance are selectable via switches. The FUNCTION SELECT switch is a three-position toggle switch. Its purpose is to enable the SELECT switch to command (in a sequencing fashion) either the ALC, MANUAL GAIN, or BALANCE functions, and at the same time assign the three associated indicators to display either ALC, MANUAL GAIN, or BALANCE status. (If the FUNCTION SELECT switch is in the ALC position, the ALC status will be indicated by an illuminated PEAK, NORM, or AVG lamp. The ALC status may be changed by momentarily depressing the SELECT switch.) SELECT is a two-position momentary switch which is spring loaded to the UP position. It works in conjunction with the FUNCTION SELECT switch to command the ALC, MANUAL GAIN, and BALANCE functions.



JSC 18611-082

Figure 16-21.- ALC/AGC block diagram.

16.7.7 Command/Telemetry Processor

Functions performed by the command/telemetry (CMD/TLM) processor include local remote command reception, command decoding, encoding of camera status of insertion during the vertical interval and display by the local light emitting diodes (LED's), generation of pan/tilt control commands and position data, generation of motor control signals for the lens assembly, and generation of the SMPTE color bar pattern. Also provided are specialized timing signals required by other circuits in the camera that include sample and hold signals for the ALC/AGC control, modified blanking signals for video processing, triggers to enable the temperature pulse width modulator and lens data analog to digital converter, and a half field gate used for dark current sampling.

- 14 COMMAND FUNCTIONS AVAILABLE
- FOCUS NEAR/FAR CONTROL
 - ZOOM IN/OUT CONTROL
 - IRIS OPEN/CLOSE CONTROL
 - GAMMA LINEAR/BLACK STRETCH SELECT
 - COLOR BALANCE - SUN SELECT
 - COLOR BALANCE - CAB SELECT
 - COLOR BALANCE - BAY SELECT
 - ALC PEAK MODE SELECT
 - ALC NORM MODE SELECT
 - ALC AVG MODE SELECT
 - MAN GAIN - 0 DB SELECT
 - MAN GAIN - 12 DB SELECT
 - MAN GAIN - 24 DB SELECT

Figure 16-22.- Local commanding.

GENERATES 2-MHZ VITS DATA CLOCK

GENERATES CONTROL SIGNALS REQUIRED FOR INSERTION OF DOWNLINK VITS DATA ON THE FOLLOWING LINES:

- LINE 12 - LENS DATA (ZOOM, FOCUS, IRIS)
- LINE 14 - PAN/TILT DATA
 - GENERATES PAN/TILT ANGLE MAGNITUDE AND SIGN DATA
- LINE 16 - GAMMA/CAMERA MODE DATA
 - IN ADDITION TO EXISTING 7 BITS OF A7 CONTROL PANEL STATUS, GENERATES 13 BITS OF CAMERA STATUS UNIQUE TO THE CTVC. ENCODES EXISTING STATUS TO PROVIDE PROPER CONTROL OF THE A7 PANEL STATUS INDICATORS.
- LINE 17 - CAMERA ID DATA (SERIAL NUMBER, LOCATION)
 - (LOCATION CODE DATA MAY BE INCREASED FROM 5 BITS TO 7 BITS FOR USE WITH FUTURE SYSTEMS.)
- LINE 18 - CAMERA TEMPERATURE DATA
 - GENERATES CONTROL SIGNALS FOR TEMPERATURE PULSE WIDTH MODULATOR.
- LINE 19 - VERTICAL INTERVAL TEST SIGNAL
 - GENERATES CONTROL SIGNALS FOR INSERTION OF VITS DATA.

Figure 16-23.- Telemetry generation.

16.7.7.1 Command Reception and Decoding

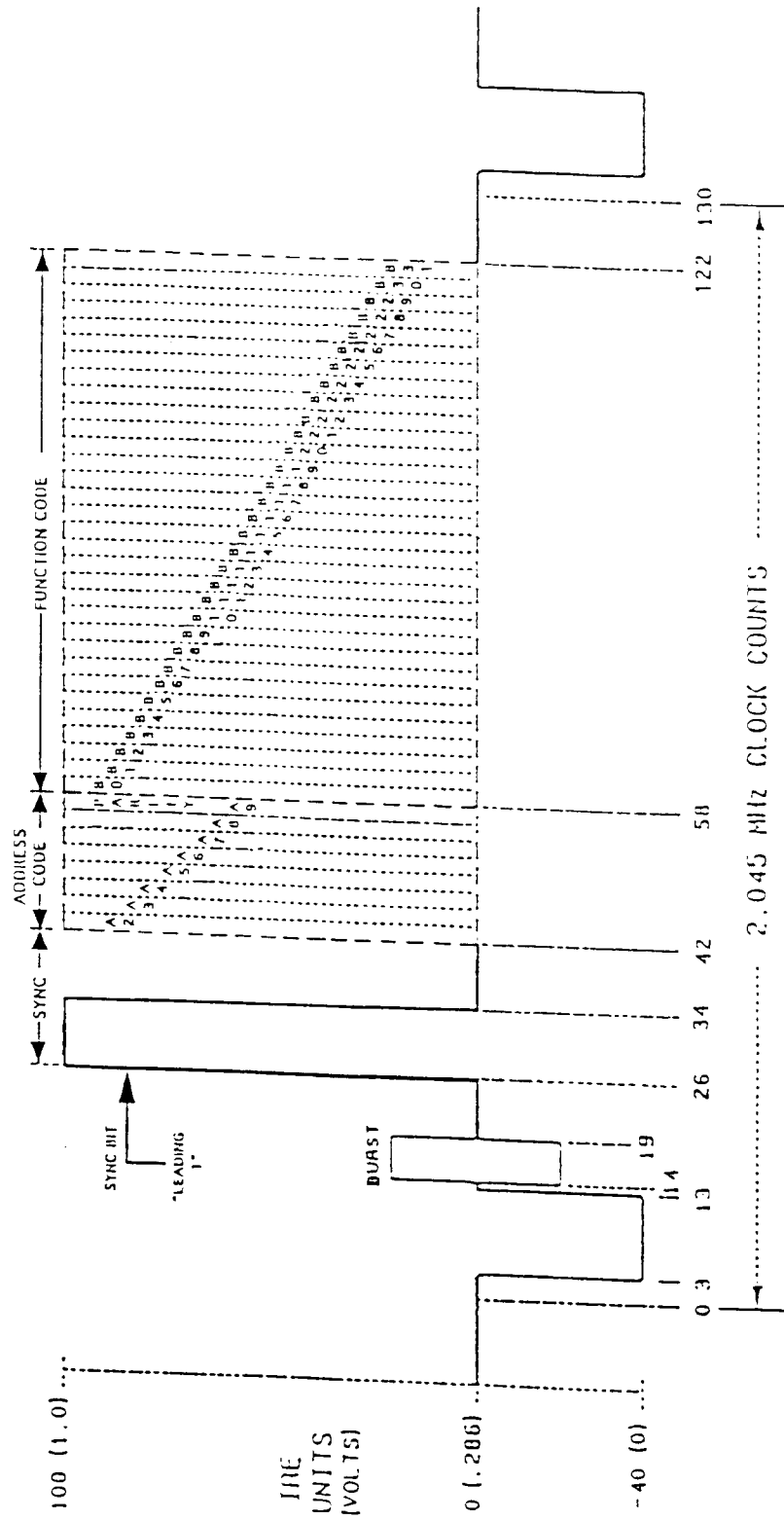
Remote control of gamma, gain, ALC mode, color bar mode, color balance, shutter mode, and lens assembly functions are generated by the CCTV system RCU and distributed to each camera location. The commands may appear on lines 11 and 13 of both fields and consist of an 8-bit sync word, an 8-bit address field, and a 32-bit command field. The leading sync bit of the command is detected and used to synchronize the command receiver clock with the clock of the RCU. The 8 sync bits are then shifted into the sync shift register and compared to the hard-wired sync code. If the sync word is OK, the command bit counter is enabled, and the address word is shifted into the address shift register (counts 0-7). The command address is compared with the destination camera address. If the correct address has been received, the command bit counter will continue counting. During counts 7-39, the input command clock is enabled, and the entire command word is shifted into the input command shift register. At count 44, the command is latched into the command decoder. Finally, at count 48, the command receiver is reset and waits for the next sync word. If, during counts 0-7, an address error is found, the system will reset. The command decoder decodes and executes all of the gamma, gain, ALC mode, color bar mode, color balance, and shutter mode commands encoded in the 32-bit uplink command. The motor control commands in the uplink are decoded by the pan command decoder, the tilt command decoder, the zoom motor controller, the focus motor controller, and the iris motor controller. The command decoder also decodes the commands controlled by the local camera switch panel. These commands are GAIN, ALC mode, color balance, and shutter mode. All of the above logic for the CMD/ TLM processor is accomplished using 10 erasable programmable logic devices (EPLD's). The EPLD encodes the command status data for insertion on line 17 of the vertical interval test signals (VITS's) and provides the drivers for the three local camera status LED's.

16.7.7.2 INCO Uplink Commands

When the CTVC is first powered up, the camera will be in the manual gain (MAN GAIN) menu. The first uplink command sent should be to command the CTVC to the ALL OFF MENU. To command the CTVC to the ALL OFF MENU from the MAN GAIN menu, send function code 01001 (same as TVC ALC NORM command). The ALL OFF MENU will be used as a starting point for ground controllers to implement uplink commands. When in the ALL OFF MENU, the previously selected modes are still active. After MENU and MODE commands are sent, the CTVC should always be returned to the ALL OFF MENU. All OFF means that all three orbiter A7 panel pushbutton indicator lamps (ALC, MAN GAIN, and BAL) are off.

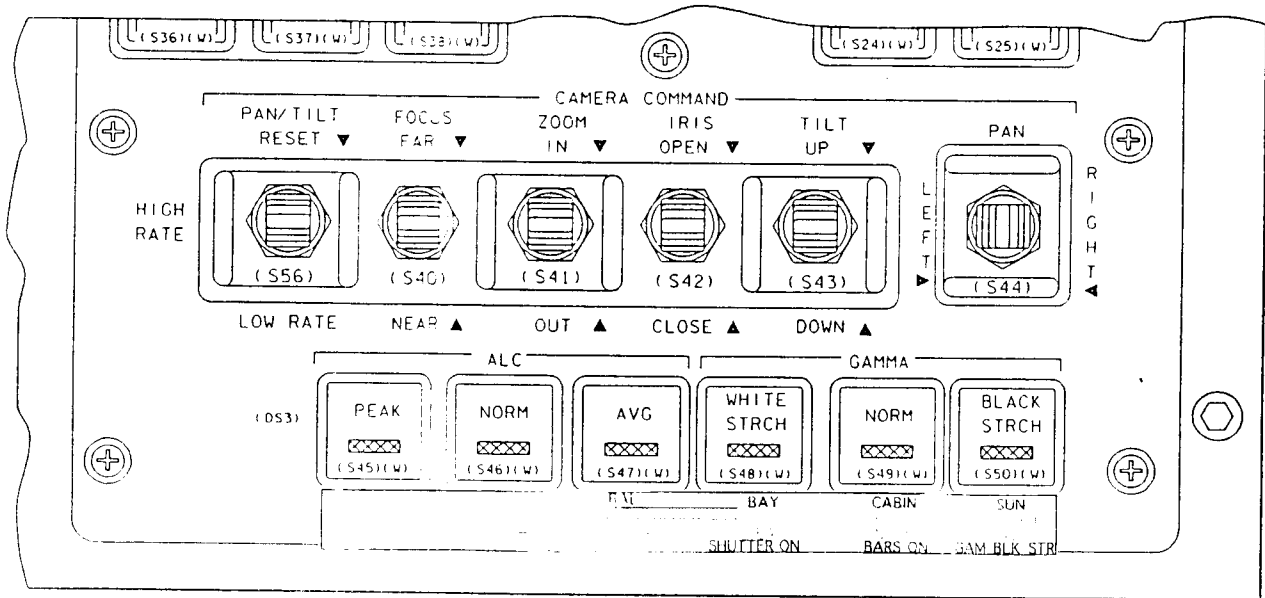
TABLE 16-VII.- INCO UPLINK COMMANDS USED TO SELECT CTVC MENUS AND MODES

Command Description	Function code				
	A9	A10	A11	A12	A13
ALL OFF MENU select (following CTVC power on)	0	1	0	0	1
	(Same as TVC ALC NORM command)				
Mode selections within menu					
SHUTTER ON	0	1	0	1	1
	(Same as TVC GAMMA WHITE STRETCH command)				
SHUTTER OFF	0	1	0	1	1
	(Same as TVC GAMMA WHITE STRETCH command)				
BARS ON	0	1	1	0	0
	(Same as TVC GAMMA NORMAL command)				
BARS OFF	0	1	1	0	0
	(Same as TVC GAMMA NORMAL command)				
GAMMA LINEAR	0	1	1	0	1
	(Same as TVC GAMMA BLACK STRETCH command)				
GAMMA BLACK STRETCH	0	1	1	0	1
	(Same as TVC GAMMA BLACK STRETCH command)				
Below commands valid after the CTVC is commanded to the ALL OFF MENU					
ALC menu select	0	1	0	0	0
	(Same as TVC ALC PEAK command)				
Mode selections within menu					
ALC PEAK	0	1	0	1	1
	(Same as TVC GAMMA WHITE STRETCH command)				
ALC NORMAL	0	1	1	0	0
	(Same as TVC GAMMA NORMAL command)				
ALC AVERAGE	0	1	1	0	1
	(Same as TVC GAMMA BLACK STRETCH command)				
RETURN TO (ALL OFF) MENU	0	1	1	0	0
	(Same as TVC ALC PEAK command)				
Manual gain menu select	0	1	0	0	1
	(Same as TVC ALC NORM command)				
Mode selections within menu					
0 dB GAIN	0	1	0	1	1
	(Same as TVC GAMMA WHITE STRETCH command)				
+12 dB GAIN	0	1	1	0	0
	(Same as TVC GAMMA NORMAL command)				
+24 dB GAIN	0	1	1	0	1
	(Same as TVC GAMMA BLACK STRETCH command)				
RETURN TO (ALL OFF) MENU	0	1	0	0	1
	(Same as TVC ALC NORM command)				
White balance menu select	0	1	0	1	0
	(Same as TVC ALC AVG command)				
Mode selections within menu					
BAY	0	1	0	1	1
	(Same as TVC GAMMA WHITE STRETCH command)				
CABIN	0	1	1	0	0
	(Same as TVC GAMMA NORMAL command)				
SUN	0	1	1	0	1
	(Same as TVC GAMMA BLACK STRETCH command)				
RETURN TO (ALL OFF) MENU	0	1	0	1	0
	(Same as TVC ALC AVG command)				



CTVC crew commands on line 11 onboard panel A7 initiated and line 13 unblink initiated.
Command "turnaround talkback" telemetry.
Vertical interval data (VID) format.
Output from camera.

Figure 16-24.- Composite sync/command line format (lines 11 and 13).



186111626. PNL 1

Orbiter panel switch functions

The Shuttle Color Television Camera DECAL was designed to assist crew members in the operation of the new Shuttle Solid-State Color Television Cameras. The decal is located on the A7 Panel and will be used in conjunction with the switch S45 through S50 push button indicators to help provide crew members with a reference to indicate CTVC menu and mode selections. There are four menus and three mode selections per menu which are as follows:

MENUS	MODE SELECTIONS		
	1.	2.	3.
1. BAL	BAY	CABIN	SUN
2. MAN GAIN	0dB	+12dB	+24dB
3. ALC	PEAK	NORM	AVG
4. (ALL OFF)	SHUTTER ON/OFF	BARS ON/OFF	GAM BLK STR/Linear

The CTVC menu selections ALC, MAN GAIN, and BAL can be accessed by pressing either switch S45, S46, or S47. The ALL OFF menu can be accessed by deselecting whichever switch S45, S46, or S47 is illuminated. The ALL OFF menu will be used as a starting point for ground controllers to implement uplink commands. After mode selection is completed, the menu switches should be returned to the ALL OFF menu. The previously selected modes are still active. ALL OFF means that all three menu select push button indicator lamps (ALC, MAN GAIN, BAL) are off.

Figure 16-25.- Panel A7 switches/labeling with CTVC decal.

Menu Selection Example

Commanding the CTVC into an Automatic Light Control (ALC) menu can be accomplished by pressing switch S45 (the push button indicator will become illuminated). At this point the crew member can select one of three ALC mode selections PEAK, NORM, or AVG by pressing switch S48, S49, or S50, respectively, which will then illuminate indicating the mode selected.

MENU	MODE SELECTIONS		
	1.	2.	3.
ALC (on)	PEAK	NORM	AVG

Exiting the above ALC menu can be accomplished by either pressing switch S46 (MAN GAIN menu select) or switch S47 (BAL menu select). Prior to selecting either the MAN GAIN or BAL menu, exiting the ALC menu can also be accomplished by pressing switch S45 a second time. Pressing switch S45 a second time causes the push button indicator lamp to extinguish and returns the CTVC to the ALL OFF menu.

The MAN GAIN and BAL menus are selected and deselected in the similar manner as in the above example.

After menu and mode selections have been made, always return the menu selection to the ALL OFF menu.

ALL OFF MENU

To enter this menu the crew member deselects the selected ALC, MAN GAIN, or the BAL menu. When none of these three switches are illuminated, the crew member has entered the ALL OFF menu. At this point three additional modes can be selected.

- Pressing switch S48 turns on the anti-vertical smearing SHUTTER wheel. The switch S48 will become illuminated. The SHUTTER can be turned off by pressing switch S48 a second time.
- The color BARS ON test pattern can be turned on by pressing switch S49. The switch S49 will become illuminated. Pressing switch S49 a second time causes the indicator lamp to extinguish, turns the color bars off, and reselects the CTVC video picture output.
- The last mode that is available in the ALL OFF menu is the selection between GAM BLK STR (Gamma Black Stretch) and Linear. GAM BLK STR is the normal operating mode which is indicated by switch S50 illuminated. When first entering the ALL OFF menu, switch S50 will be illuminated. Pressing switch S50 will extinguish its indicator lamp and the camera enters the Linear mode. To exit the Linear mode and return to the GAM BLK STR mode, press switch S50 a second time. This causes switch S50 to illuminate and places the camera back into the normal operating GAM BLK STR mode.

Figure 16-25.- Concluded.

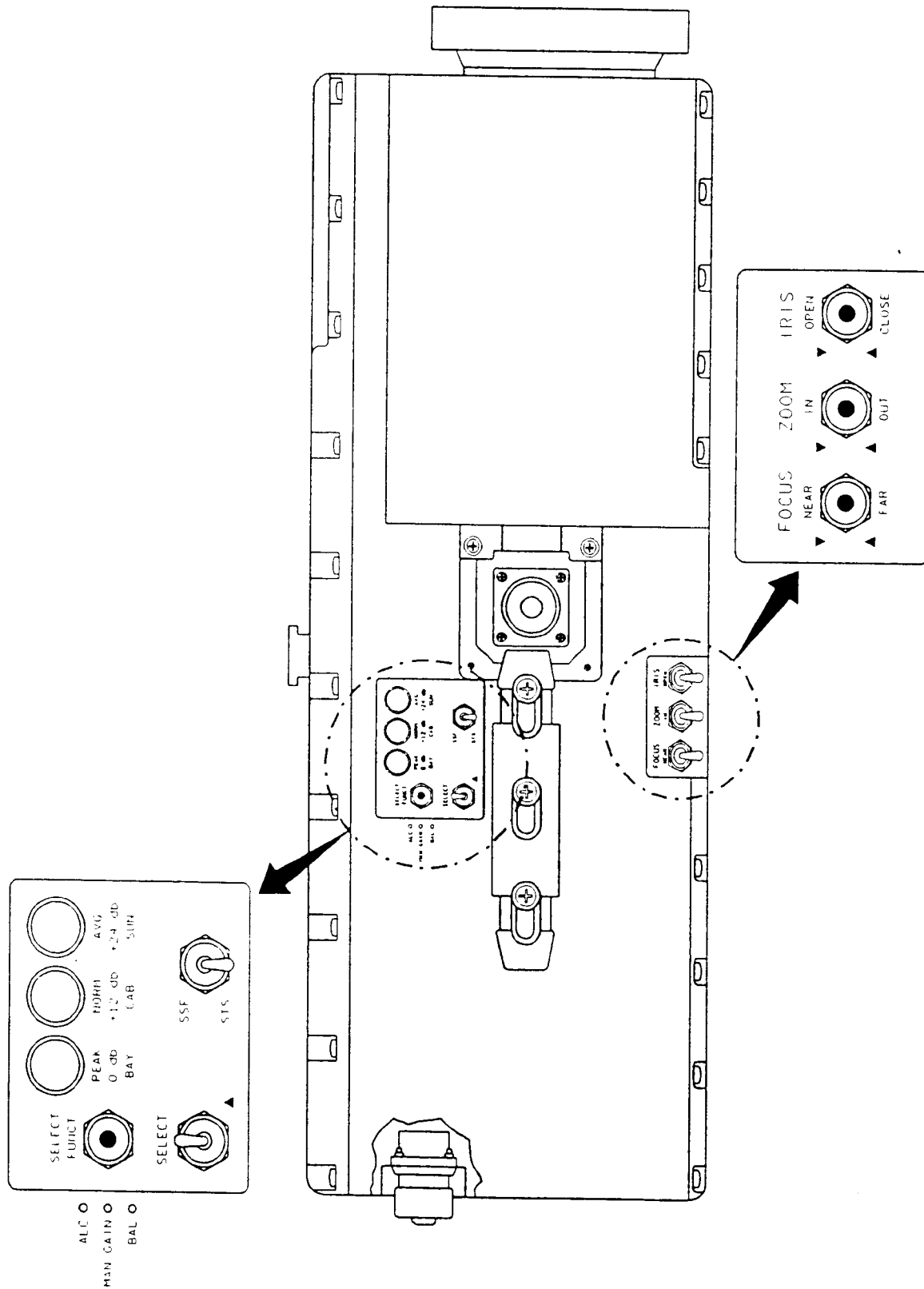


Figure 16-26.- External switch orientation.

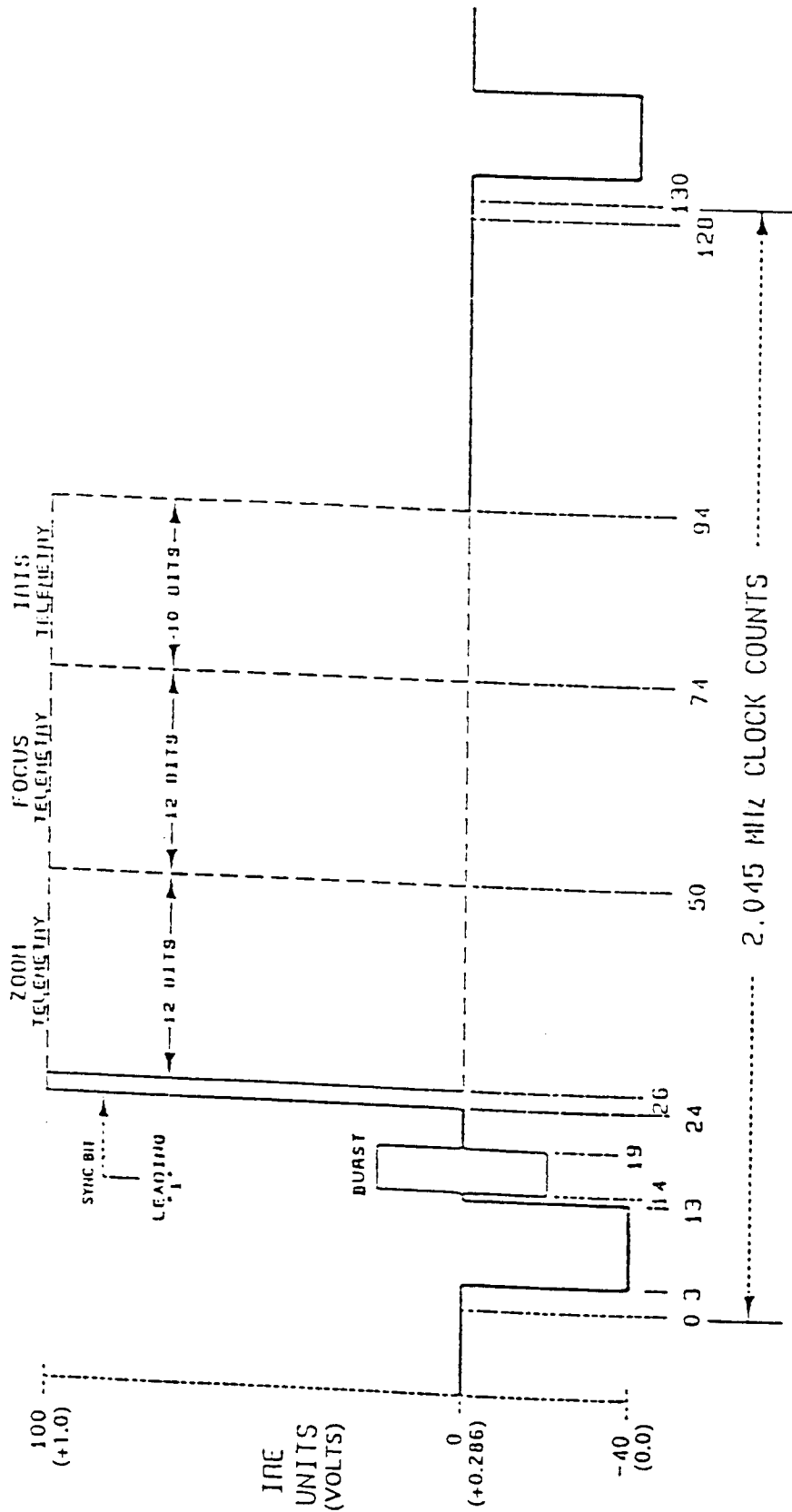
Camera switch functions

- FOCUS - This is a three-position momentary switch which is spring loaded to the center position. Holding the switch in either the NEAR or FAR position will result in a continuous driving (in the appropriate direction) of the focus drive motor until a stop is reached or the switch is released.
- ZOOM - Operates similarly to FOCUS switch.
- IRIS - Operates similarly to FOCUS switch.
- SELECT FUNCT - This is a three-position toggle switch. Its purpose is to enable the SELECT switch to command (in a sequencing fashion) either the ALC, MANUAL GAIN, or BALANCE functions, and at the same time, assign the three associated indicators to display either ALC, MANUAL GAIN, or BALANCE status. (If the FUNCTION SELECT switch is in the ALC position, the ALC status will be indicated by an illuminated PEAK, NORM, or AVG lamp. The ALC status may be changed by momentarily depressing the SELECT switch.)
- SELECT - This is a two-position momentary switch which is spring loaded to the UP position. It works in conjunction with the FUNCTION SELECT switch to command the ALC, MANUAL GAIN, and BALANCE functions.
- SSF/STS - This is a two-position toggle switch.
STS - 5-bit location code (shuttle)
SSF - 7-bit location code (station)

Figure 16-26.- Concluded.

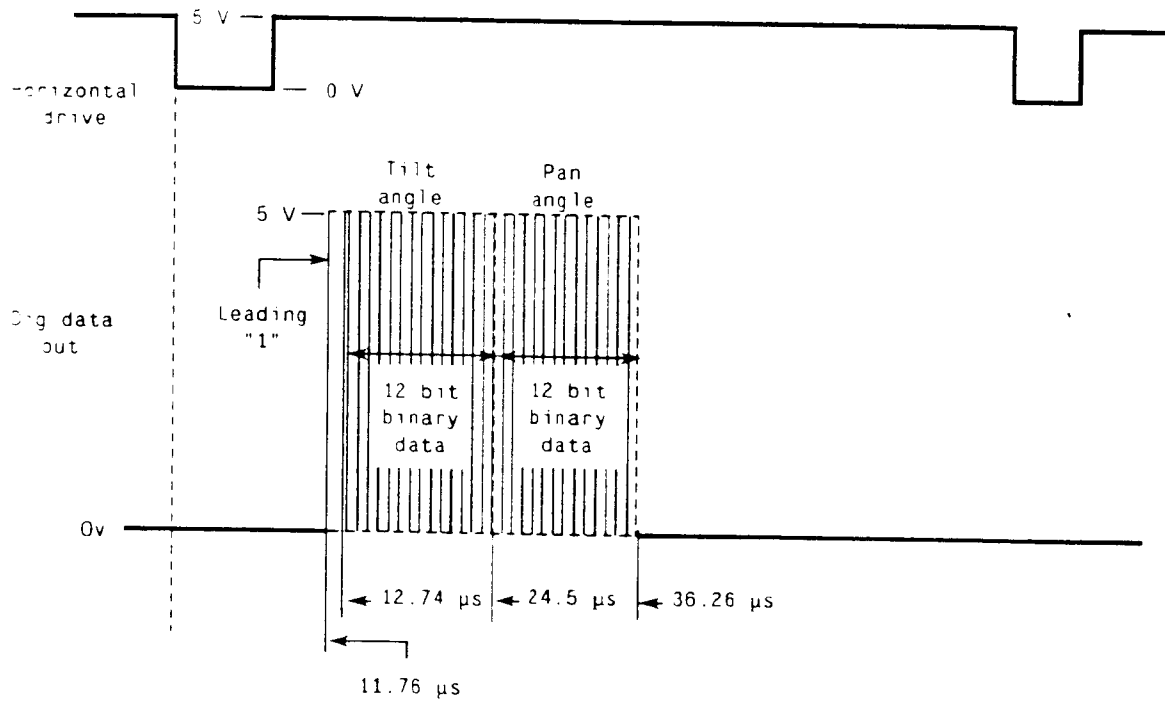
16.7.7.3 Telemetry VITS

Camera telemetry is inserted into the vertical interval during lines 12, 14, 16, 17, and 18. The TLM associated with each of these lines is lens data, pan/tilt data, camera operating mode data, camera address and signal to noise (S/N) data, and temperature data, respectively.



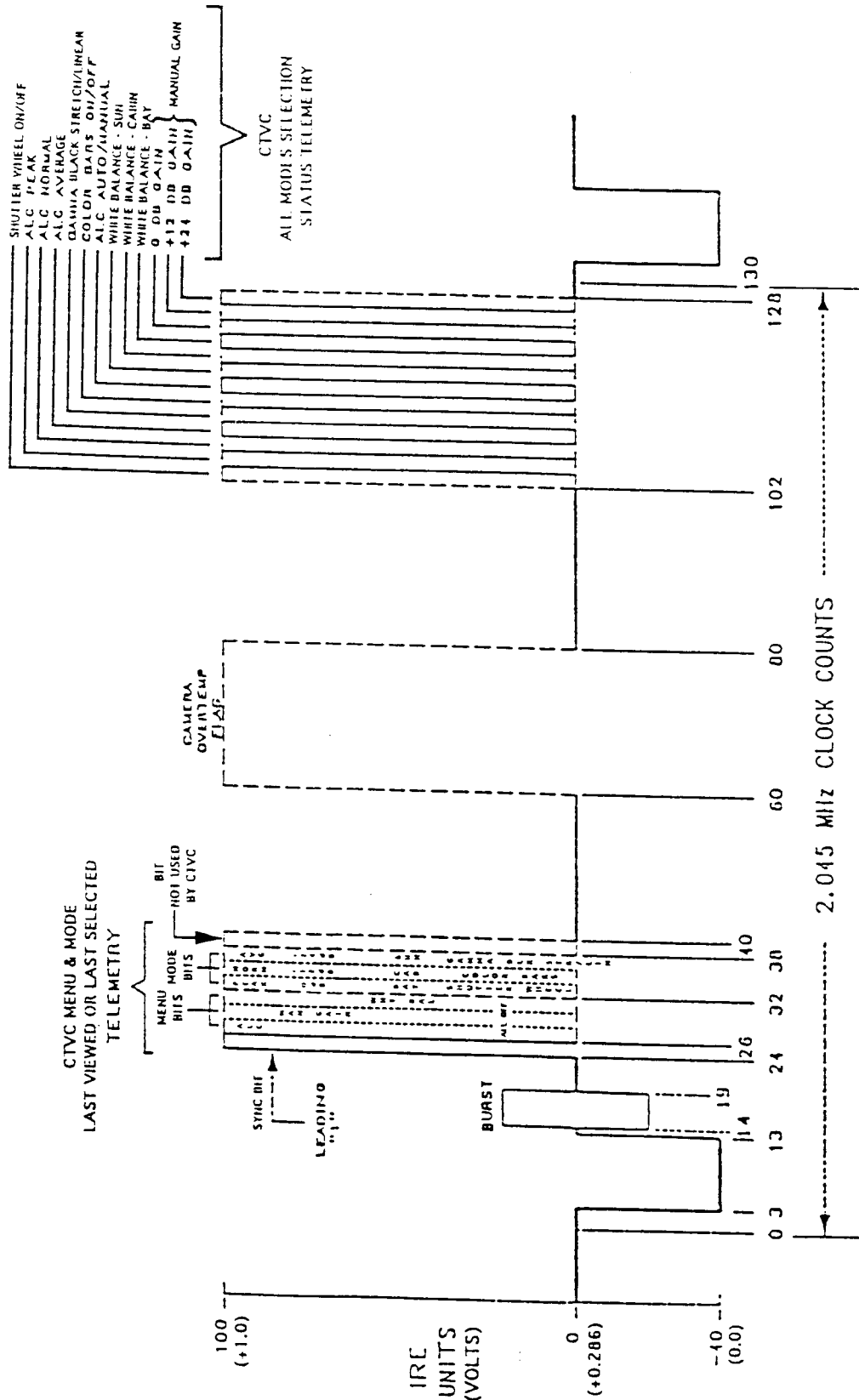
CTVC line 12 lens assembly telemetry.
Vertical interval data (VID) format.
Output from camera.

Figure 16-27.- Line 12 lens data format.



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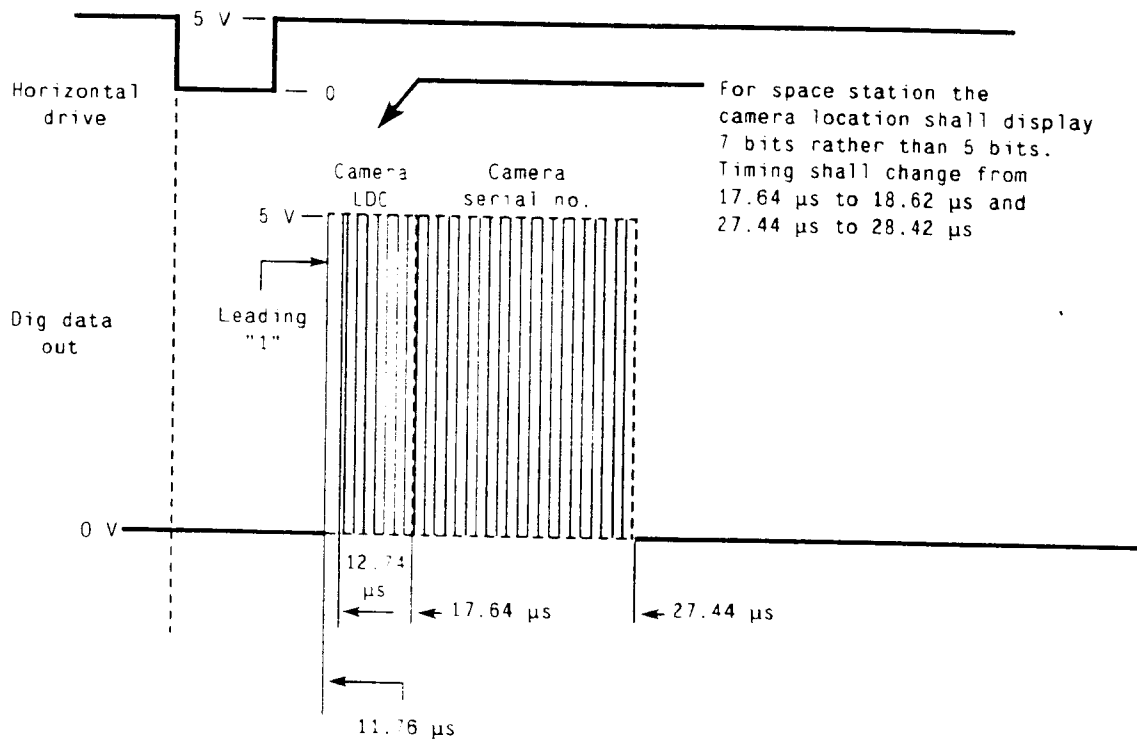
Figure 16-28.- Line 14 pan/tilt data format.



CTVC line 16 camera modes status telemetry vertical interval data (VID) format with VSU inserted camera overtemp flag (output from VSU).

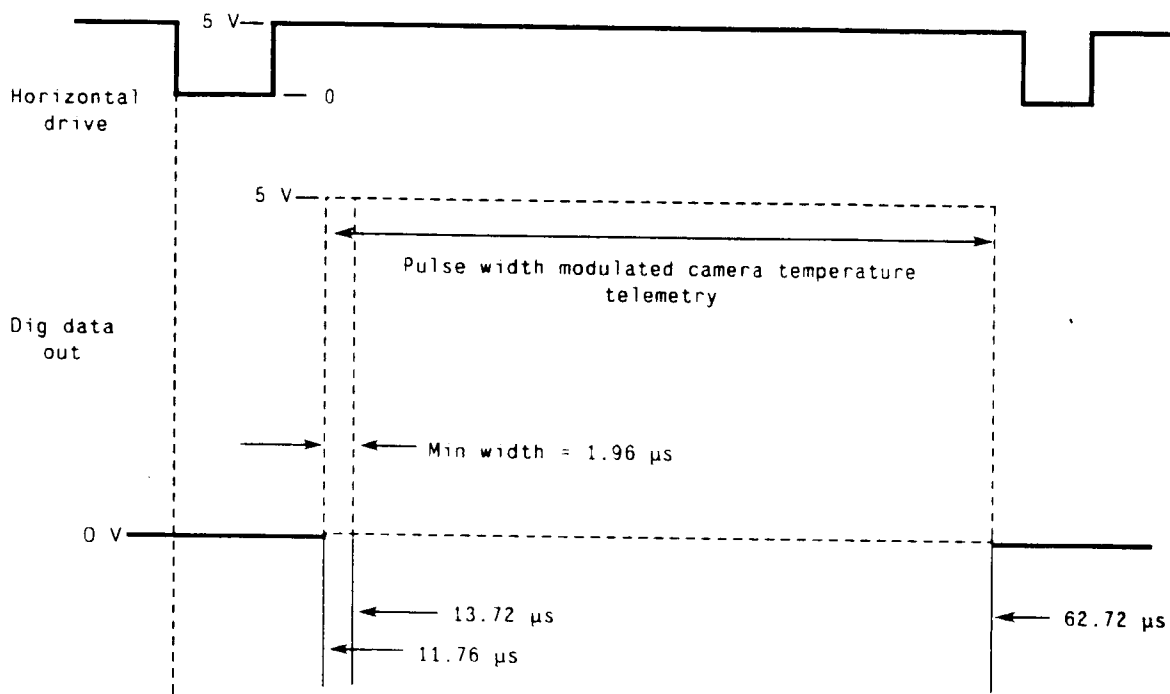
- NOTES:
1. The camera overtemp pulse width is approximate.
 2. The camera overtemperature flag is inserted onto the downlink video line 16 at the VSU, when any powered-on CCTV camera temperature exceeds +45° C.

Figure 16-29.- Line 16 camera command status data format.



JSC 18611*089 16

Figure 16-30.- Line 17 camera ID data format.



JSC 18611*088.16

Figure 16-31.- Line 18 camera temperature.

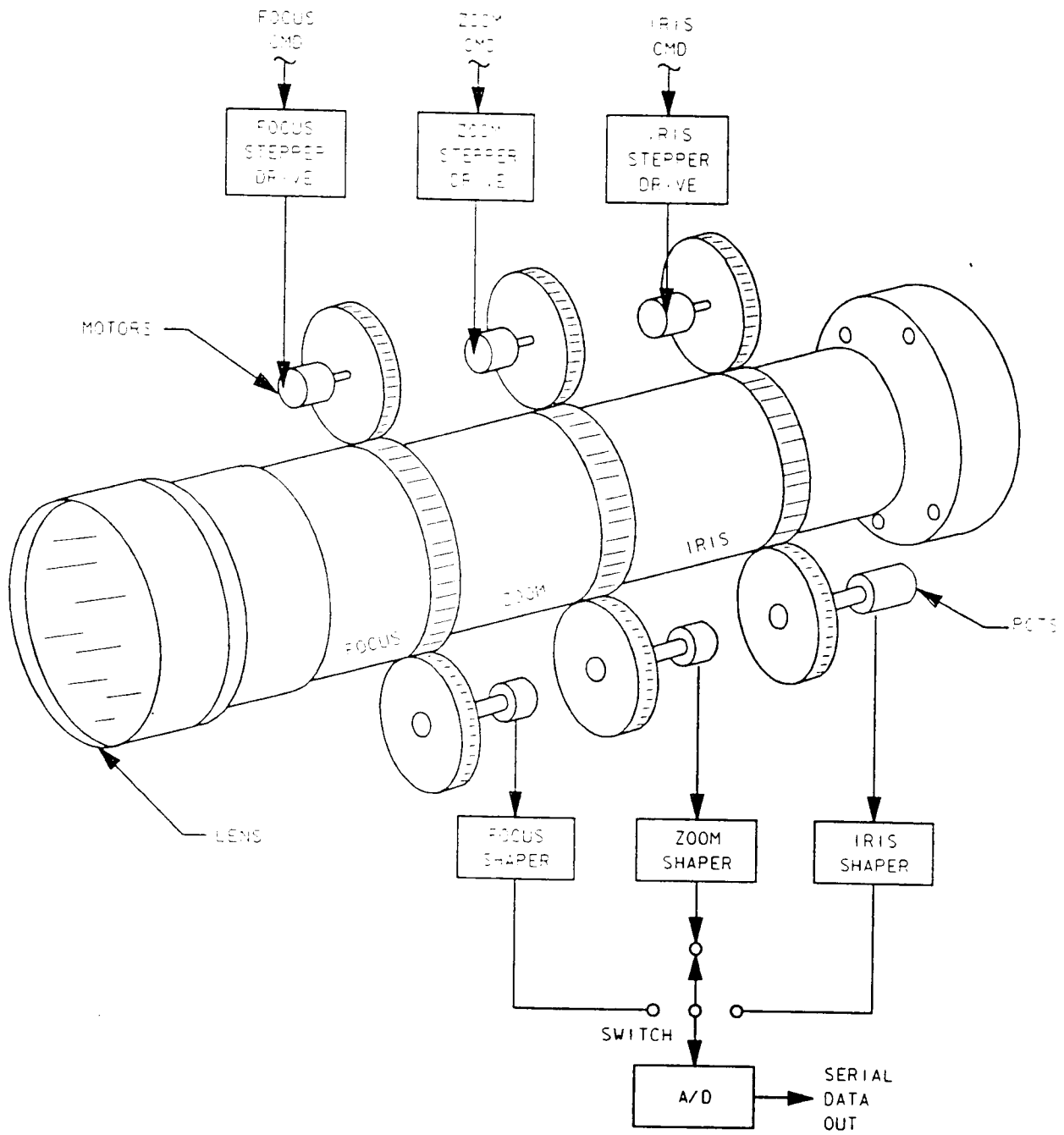
16.7.7.4 Pan/Tilt Control

The CMD/TLM provides the circuitry to decode the remote pan/tilt (P/T) commands and to generate the pan/tilt control clocks (fast and slow) and the resettable counters that derive relative pan and tilt angles for insertion on line 14. The remote commands consist of P/T fast, P/T slow, P/T reset, pan right, pan left, tilt up, and tilt down. Limit switch closures associated with the PTU are also accepted by the CMD/TLM processor. These are the right and left limit switches and the up and down limit switches. If a limit switch is enabled, the P/T control clock will be inhibited and the position counter will stop counting. The P/T control provides an 11-bit counter to monitor pan and tilt position. It also generates a sign bit for the counter to determine the direction of motion away from zero. A P/T reset command resets the counter to zero.

16.7.7.5 Lens Motor Control

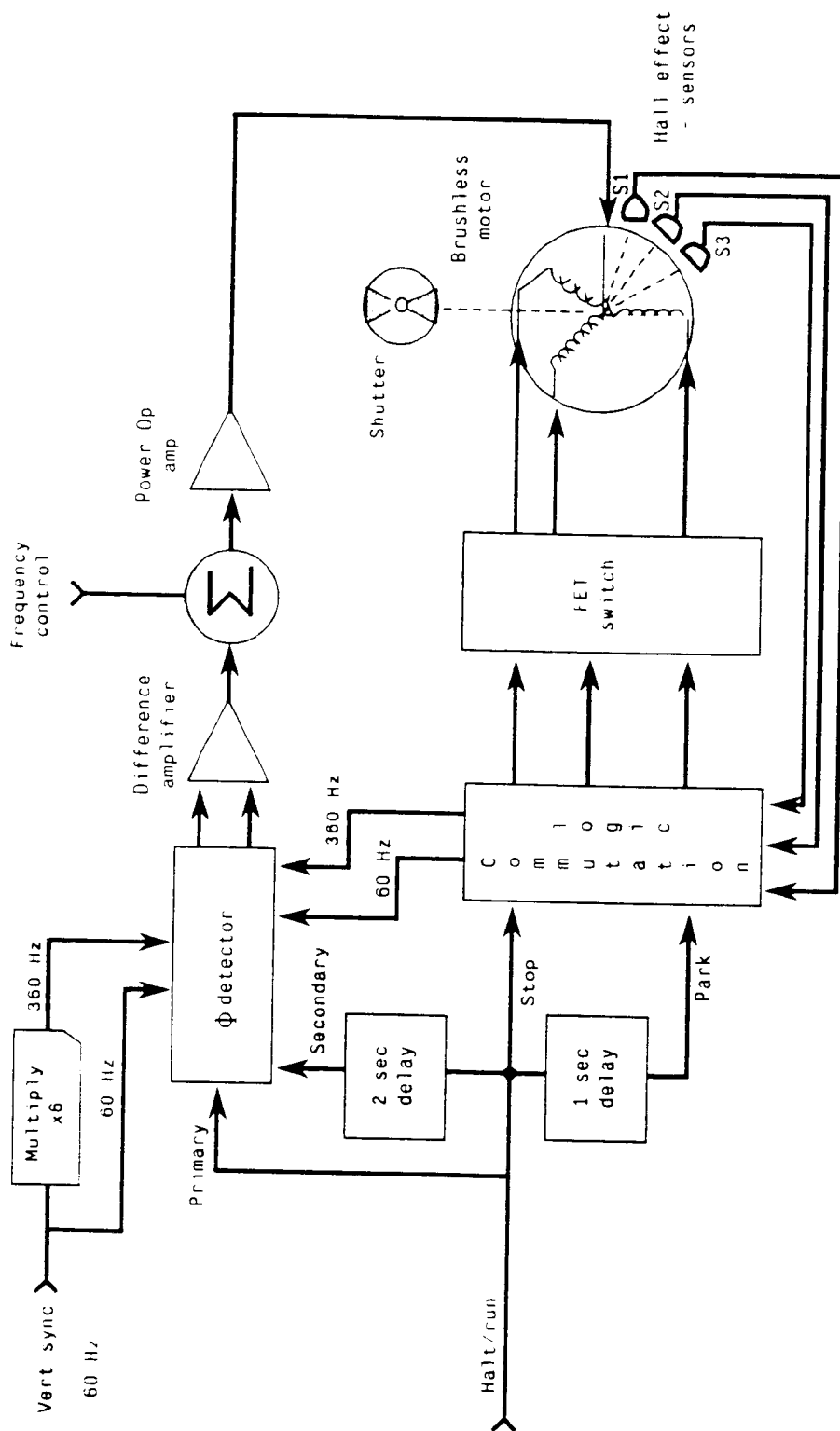
The CMD/TLM processor also provides the necessary circuitry to decode and enact local and remote lens motor commands. These commands are iris open and close, focus near and far, and zoom in and out. As in the P/T commands, there are end-of-motion limit switches associated with each of these commands. The CMD/TLM processor responds to these commands and generates the necessary motor drive clocking signals. Each motor requires four separate clocks, each a different phase. The relationship of the phases of the clocks determines the direction in which the motor will turn. The focus and zoom motor controllers run at 120 Hz. The iris motor controller on the other hand operates at two rates, 120 Hz and 60 Hz. Unlike the focus and zoom controls, the iris controller also responds to open and close commands from the ALC/AGC control. Commands from ALC will automatically select the 120 Hz clock. Local or remote commands will automatically select the 60 Hz clock. In addition, the remote or local commands will cause a command to be transmitted to the command decoder that will force the camera into the manual gain, 0 dB mode. Finally, the iris controller will respond to a pulse transmitted just prior to powerdown. This command, POWER OFF PRESET, is latched and forces the iris to close at the 120-Hz rate. Enough time is allowed for the iris to close fully from a fully open position before power is lost. The focus, zoom, iris, and shutter interface to the lens assembly is made via gear-driven stepper motors. One motor is dedicated to each function of focus, zoom, and iris. A second series of three gears attaches to three potentiometers to read a voltage indicative of position of focus, zoom, and iris. The voltages are shaped, selected via analog switches, routed to the A-D, and eventually output as a serial data stream. A rotating shutter wheel (not shown in figure 3-32) is located between the lens assembly and the CCD sensor. The servo drives the shutter wheel in synchronism with an externally furnished horizontal sync pulse.

The shutter wheel is driven under instruction of its Hall effect sensors via the commutation logic and FET switches. One of the Hall effect sensors is used as a phase generator. The output of the phase detector is looped around via a differential amplifier, a Power Op Amp, to control the speed of the motor as shown in the figure 16-33.



186111635. ISO. 1

Figure 16-32.- Lens.

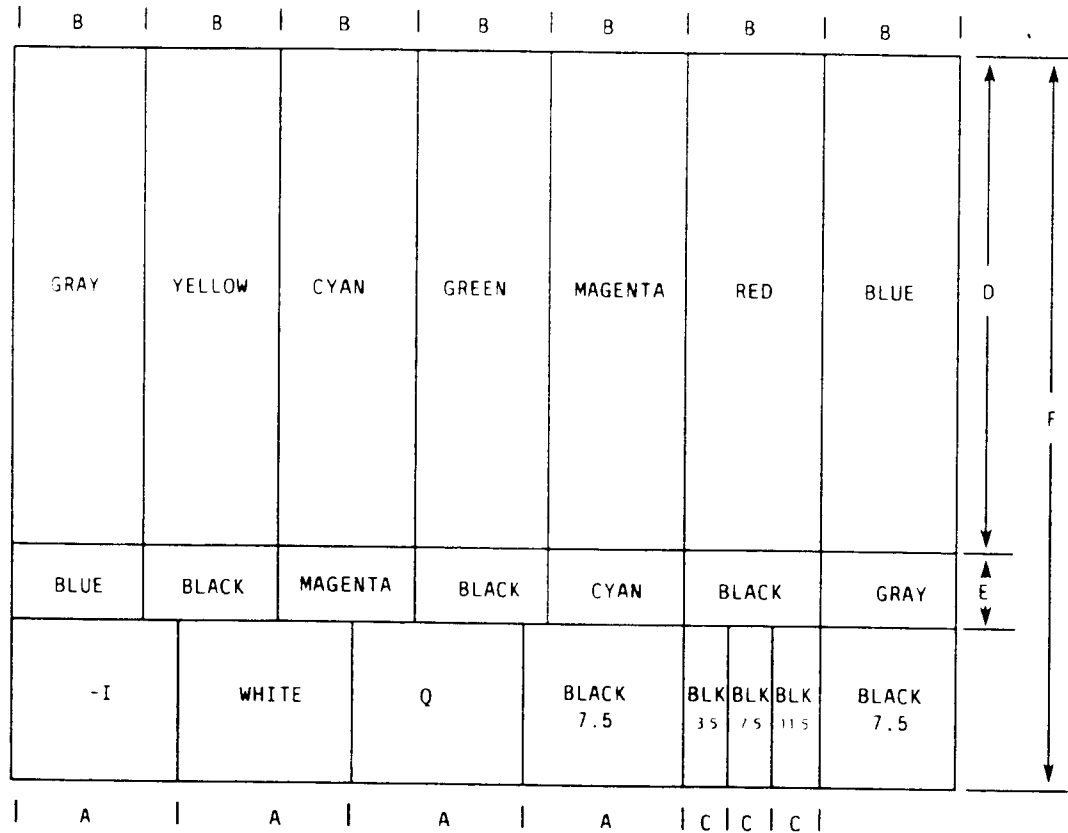


JSC 18611-085

Figure 16-33.- Shutter servo.

16.7.7.6 Color Bar Generation

The CMD/TLM processor contains the necessary timing required to generate the color bar test pattern for insertion in the downlink video. It consists of seven distinct color bars with a duration of 7.52 μ sec each. The colors from left to right are gray, yellow, cyan, green, magenta, red, and blue. See figure 16-34, SMPTE color bar pattern.



A - 9.40 μ s D - 10.30 ms
 B - 7.52 μ s E - 1.21 ms
 C - 2.51 μ s F - 15.41 ms

NOTES: 1. Vertical blanking period = 20 H (1.271 ms)
 2. Horizontal blanking period = 10.9 μ s

JSC 18611*086.16

Figure 16-34.- SMPTE color bar pattern.

16.7.7.7 Power ON Reset

During powerup, a POWER ON RESET signal is received by the CMD/TLM processor. In addition to initializing the CMD/TLM for proper operation, the signal also configures the operating modes of the camera to an initial known condition. The CMD/TLM will reset the camera as follows:

- Manual gain mode selected
- 0 dB mode selected
- Color balance - Daylight selected
- Shutter - Disabled
- Gamma - Linear
- Color bars - Disabled
- Pan/tilt control clock - Disabled
- Pan/tilt position counters - Disabled
- Iris, focus, and zoom motors - Disabled
- Command receiver counters and shift registers - Cleared

16.7.8 Synchronization

The CTVC composite video output may be synchronized in frequency to the master composite sync signal distributed throughout the orbiter by the RCU. This signal also provides camera command data from both ground and crew. In the event of loss of master sync, the CTVC will continue to provide NTSC composite video signal which conforms to EIA STD RS-170A but which is asynchronous with the balance of the orbiter video system. See figure 16-35.

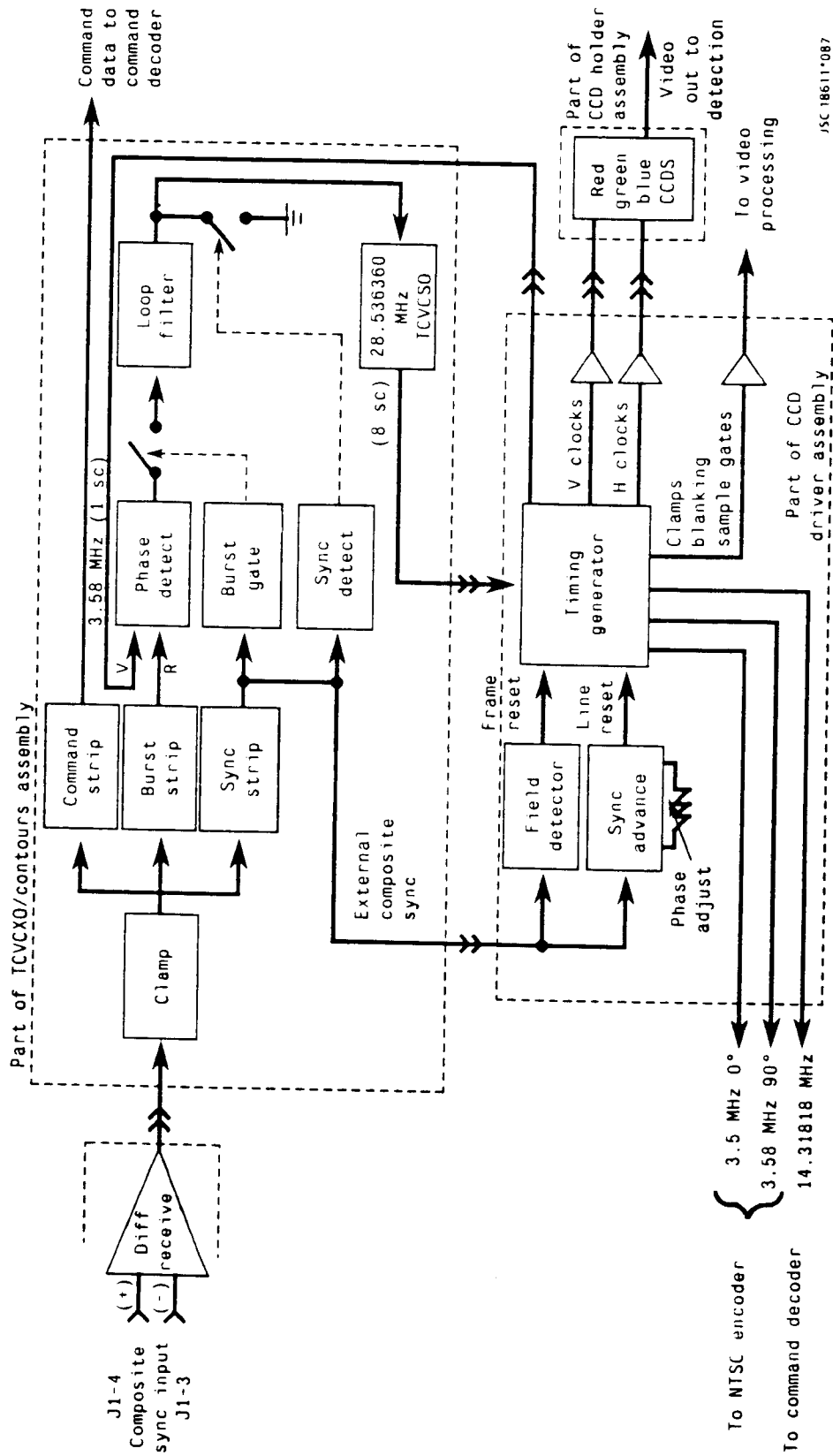


Figure 16-35.- Synchronization.

16.7.9 RGB Video Processing

The video from the green channel generated from the ALC/AGC first undergoes a one-line delay to place it in phase with the red and blue channels; the green channel CCD has been mechanically displaced by one line to permit development of the vertical contour signal. From this point, all three component channels (RGB) undergo identical processing and provide the following functions:

- Aperture compensation
- Gamma compensation
- Black level restoration
- Black/white clipping
- SMPTE color bar generation
- Video/color bar switching
- Sync, VITS and digital data insertion
- Sync and command line receiver
- NTSC and RGB line drivers
- Vertical contour generation

16.7.10 NTSC Color Encoder

This is used to convert red, green, and blue component video signals to a composite video signal encoded in NTSC format. The encoder consists of two major paths, the luminance channel and the chrominance channel. Both channels require individual matrixes, low pass filters, and modulators. The modulators are used to generate chrominance signal (color information). Following blanking, the chrominance signal is summed to the delayed luminance signal to form the NTSC composite video signal. The NTSC signal is sent to the RGB video processor where it is output from the camera through the NTSC output driver circuitry.

Composite picture signal, nominal 1V P-P into 75-OHM load impedance, black negative, multiplexed with following vertical interval telemetry information.

Vertical interval line number	Field number	Signal information
11	1/2	CAMERA CONTROL COMMANDS
12	1/2	LENS FUNCTION STATUS
13	1/2	CAMERA CONTROL COMMANDS
14	1/2	PAN-TILT ANGLE STATUS
16	1/2	CAMERA STATUS
17	1/2	CAMERA LOCATION - S/N IDENTIFICATION
18	1/2	CAMERA TEMPERATURE VIA PWM SIGNAL
19	1	VITS-MOD. STAIRCASE, 2T PULSE, AND BAR WINDOW
	2	VITS-MULTIBURST

Figure 16-36.- NTSC/green video output.

Parameter	Horizontal (deg)	Vertical (deg)
ZOOM IN	10.6	8.0
ZOOM OUT	77.0	61.0
FOCUS DISTANCE	1 foot to infinity	
F-STOP	F1.7 to F16	
FOCAL LENGTH	5.5mm to 47mm	
ZOOM	8.5 to 1	

Figure 16-37.- Camera lens capability.