



19 APRIL 1968

APOLLO TRAINING

BLOCK II CSM
PROPULSION SUBSYSTEM

FOR TRAINING PURPOSES ONLY





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Questions Relative To The Contents of This Document

Should Be Directed To:

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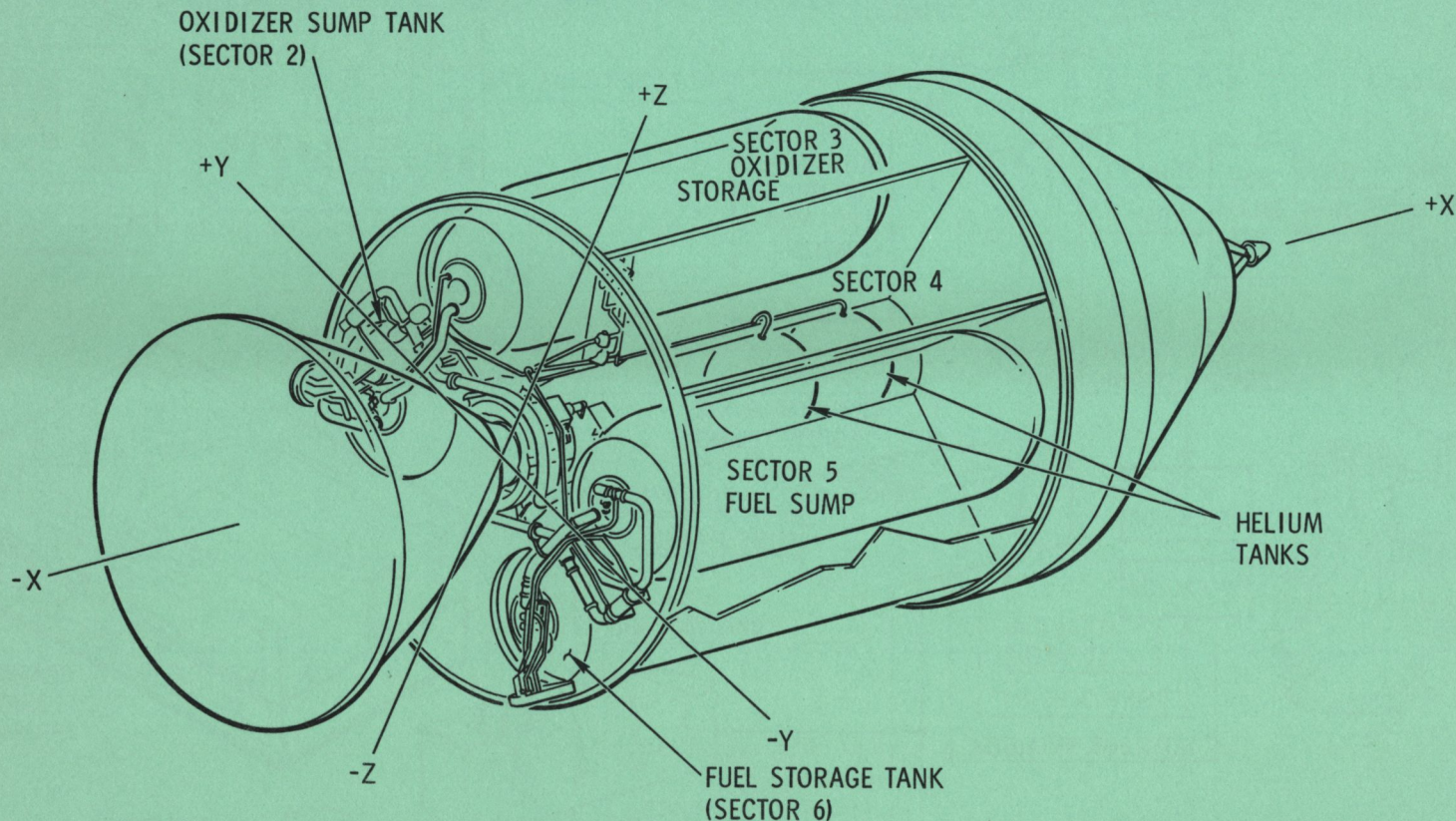
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The following pages contained within this handout package have been revised or added since the 27 February 1968 Block II CSM Propulsion Subsystem Handout Package.

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SERVICE PROPULSION SYSTEM



TYPE OF SYSTEM: NON-THROTTLEABLE, PRESSURE FEED SYSTEM, HYPERGOLIC PROPELLANTS AND ABLATIVE CHAMBER WITH RADIANT COOLED NOZZLE EXTENSION.

SYSTEM DESCRIPTION: ONE SYSTEM CONSISTING OF A PROPELLANT FEED SYSTEM AND ONE ENGINE

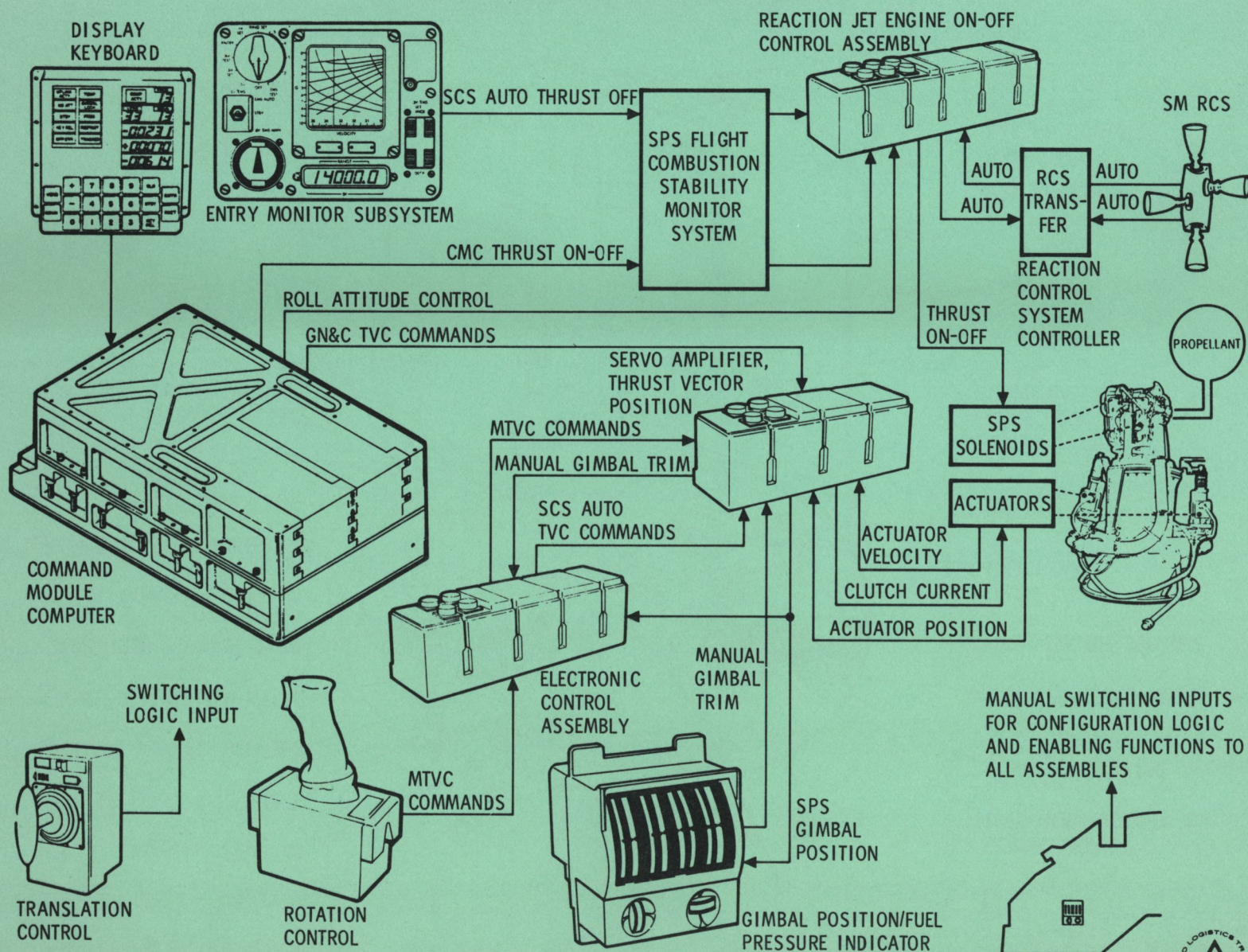
PROPELLANTS - INHIBITED NITROGEN TETROXIDE AND BLENDED HYDRAZINE (50% UDMH & 50% HYDRAZINE)

SYSTEM CONTROLLED BY CMC OR SCS WITH A MANUAL BACK-UP CAPABILITY

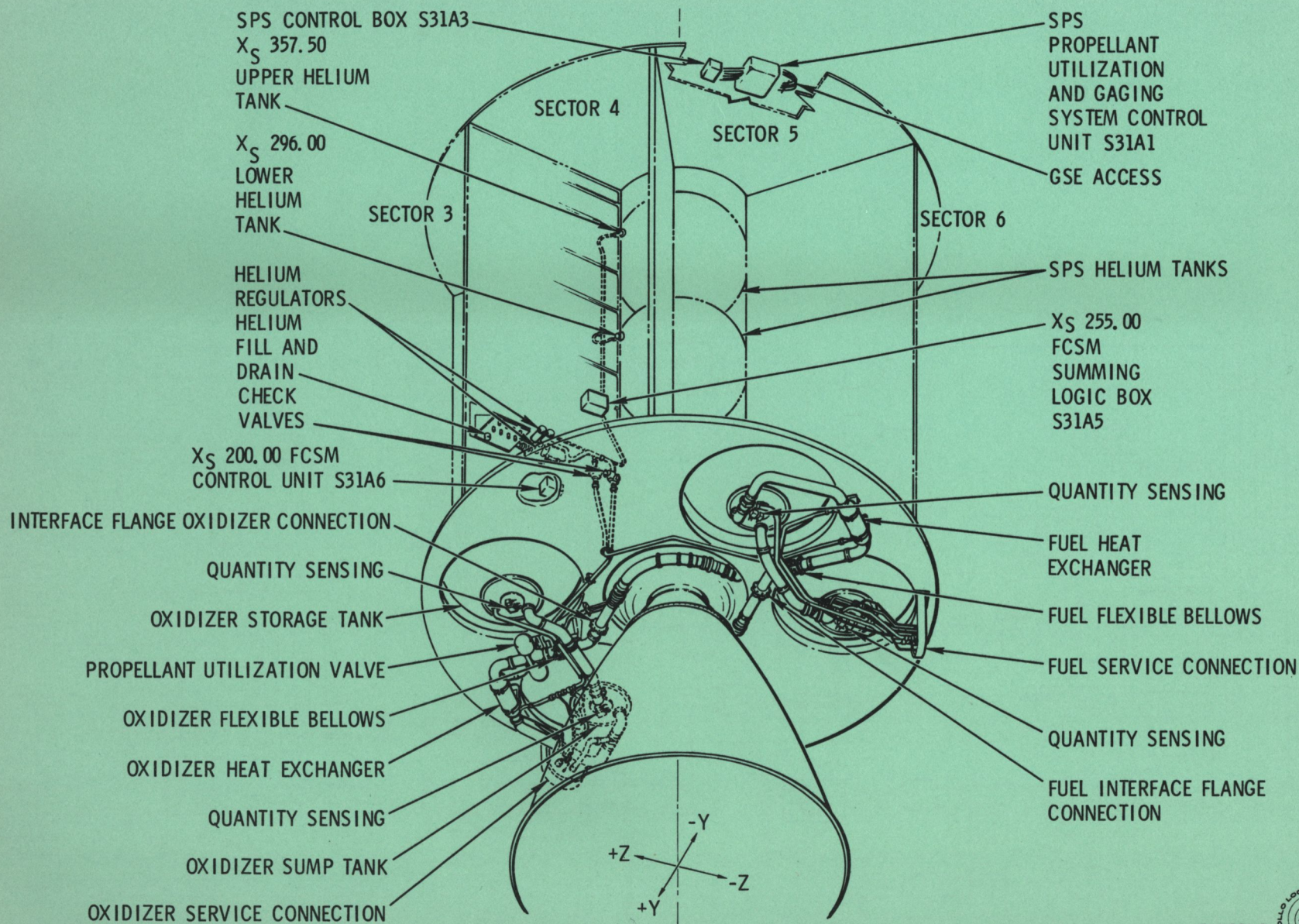
PURPOSE: PROVIDE THRUST FOR X AXIS VELOCITY CHANGES AFTER BOOSTER SEPARATION UNTIL C/M S/M SEPARATION. IN ADDITION SUPPORTS S/M ABORT AFTER THE LAUNCH ESCAPE TOWER HAS BEEN JETTISONED.

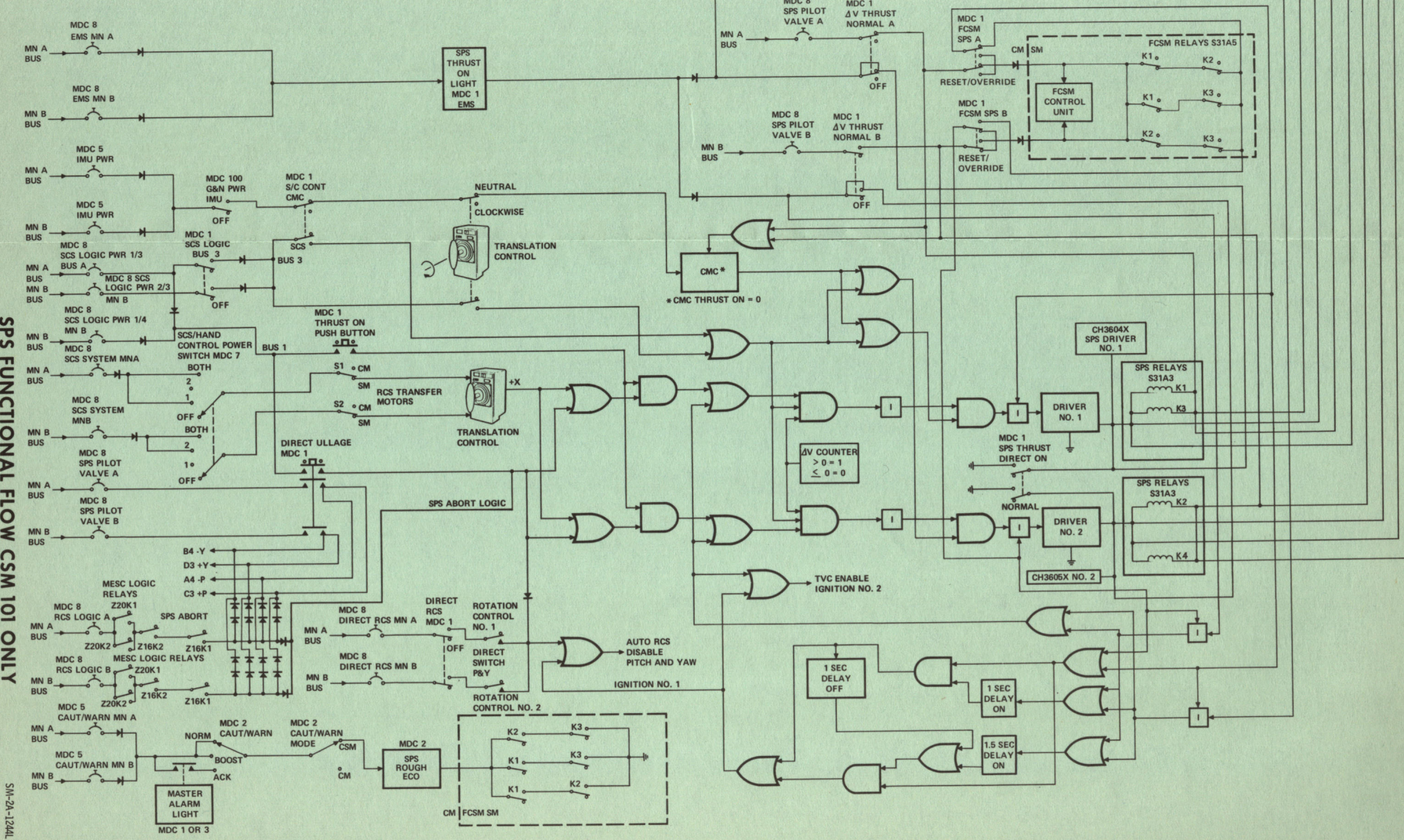
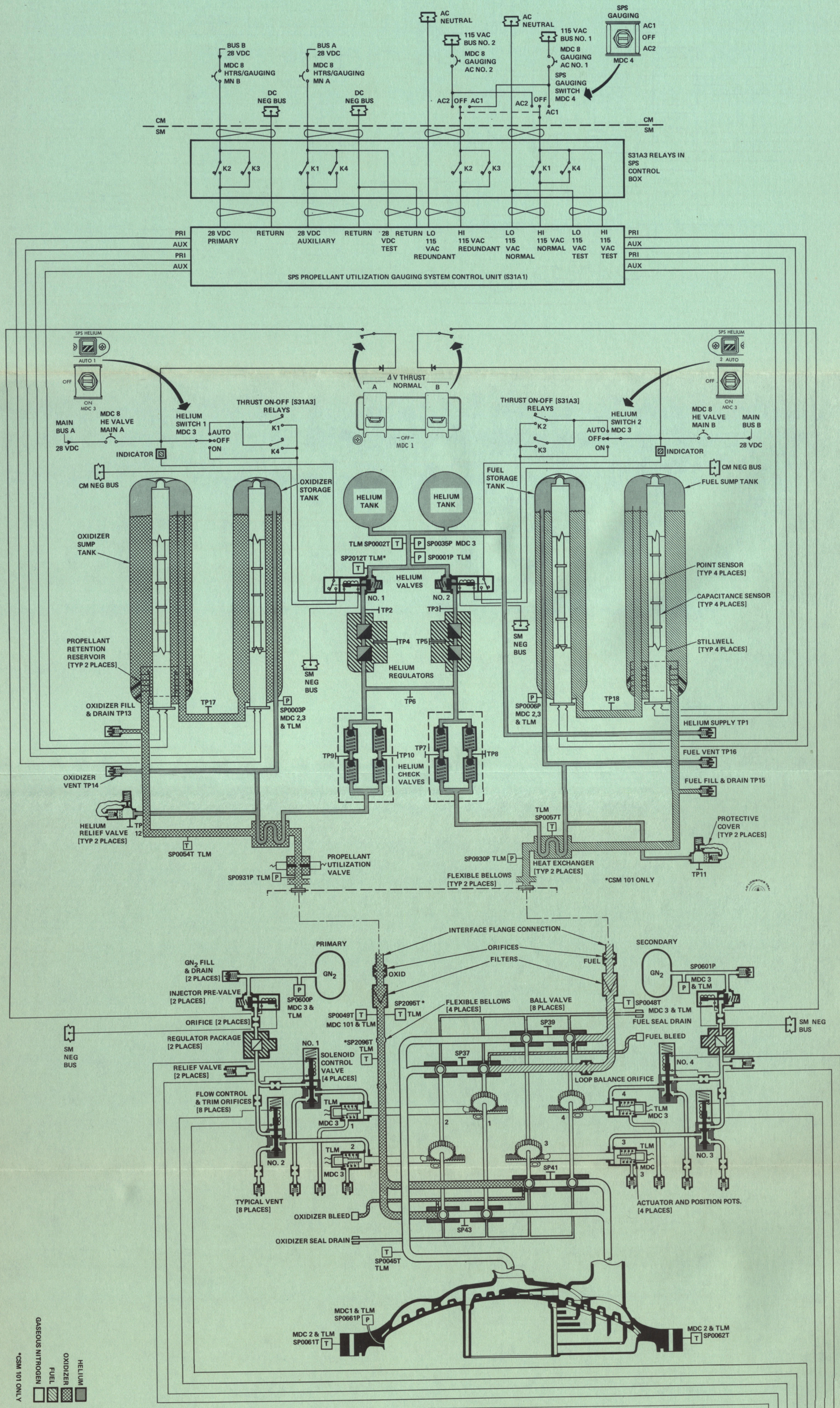
SERVICE PROPULSION SYSTEM

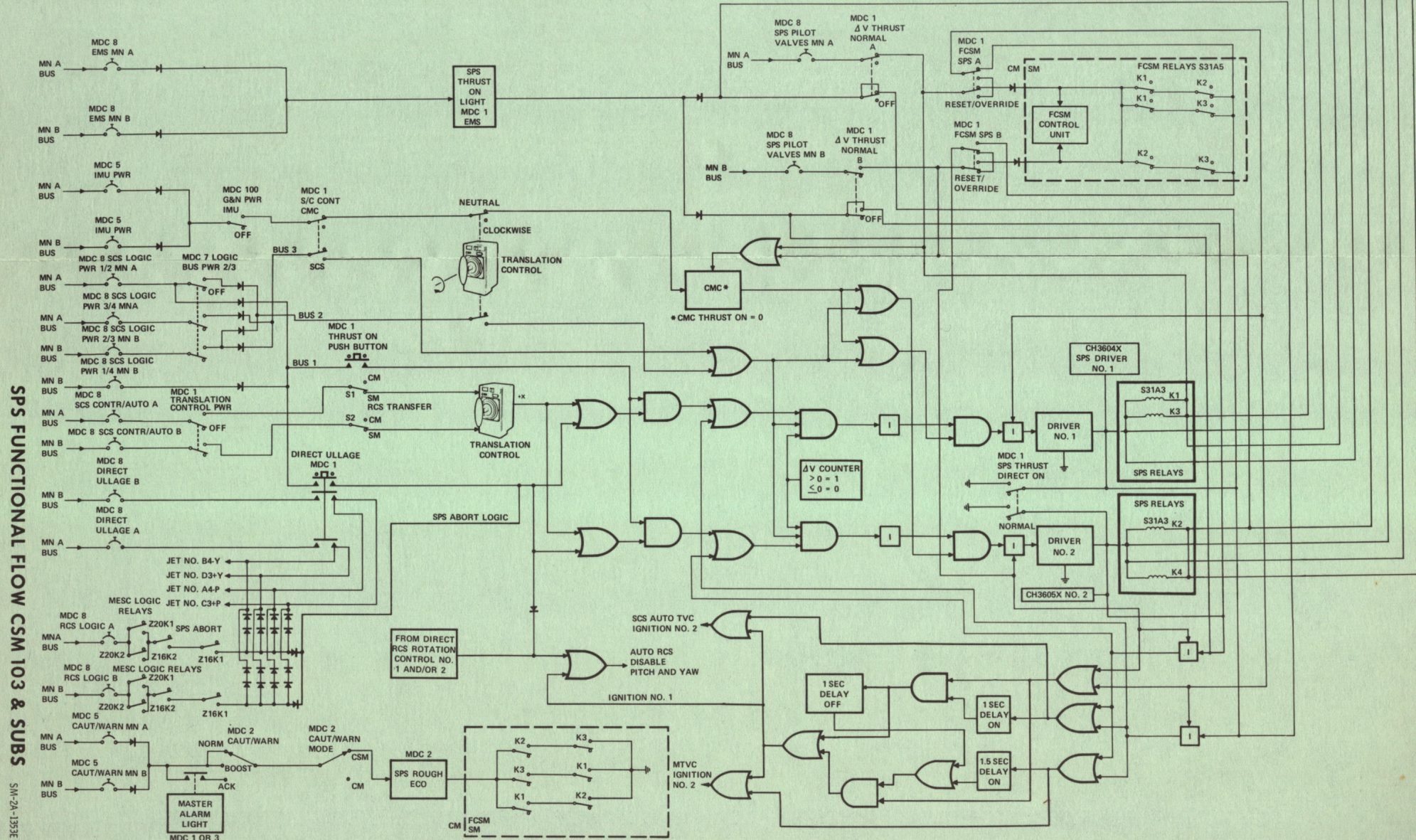
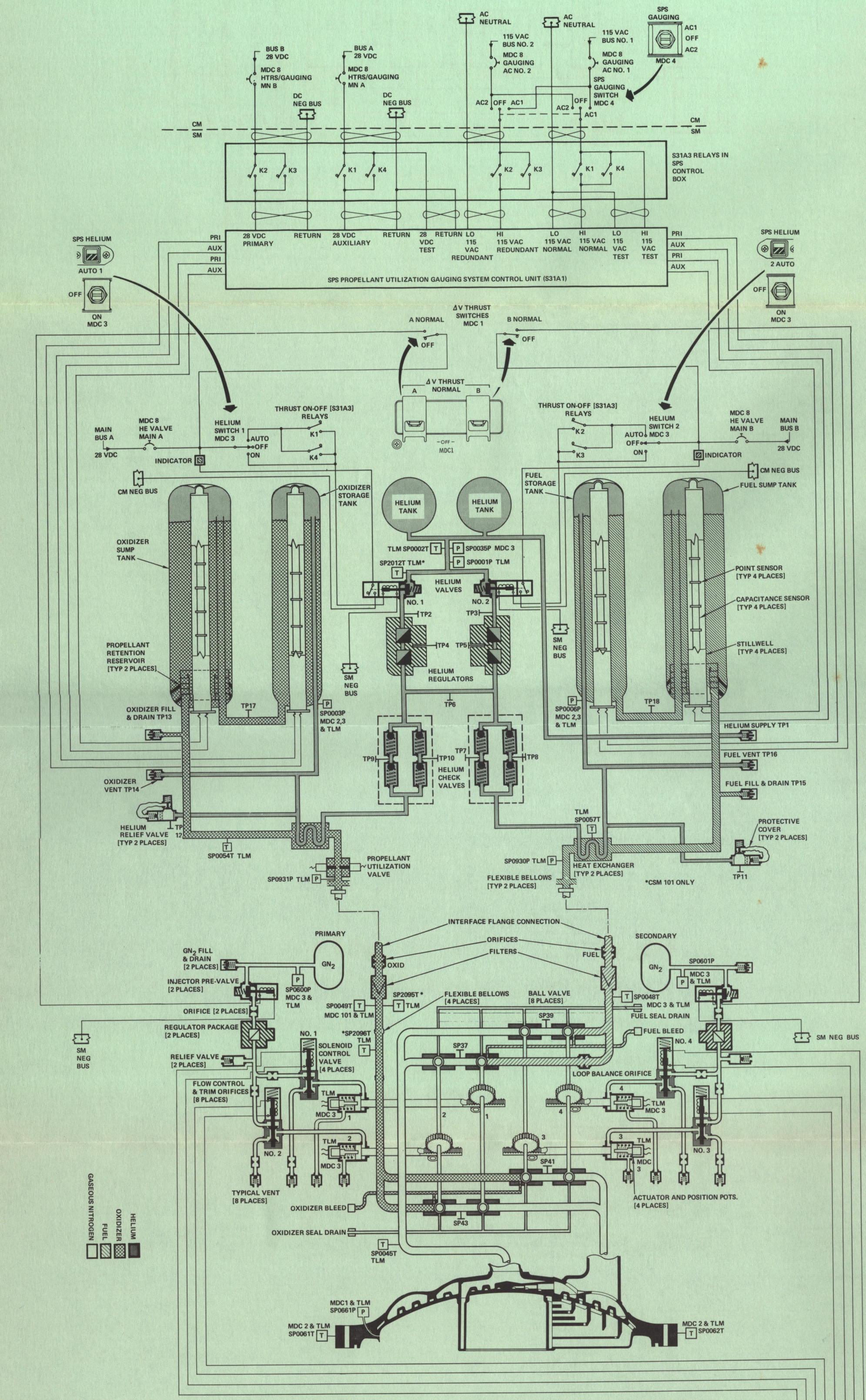
INTERFACE CONTROL

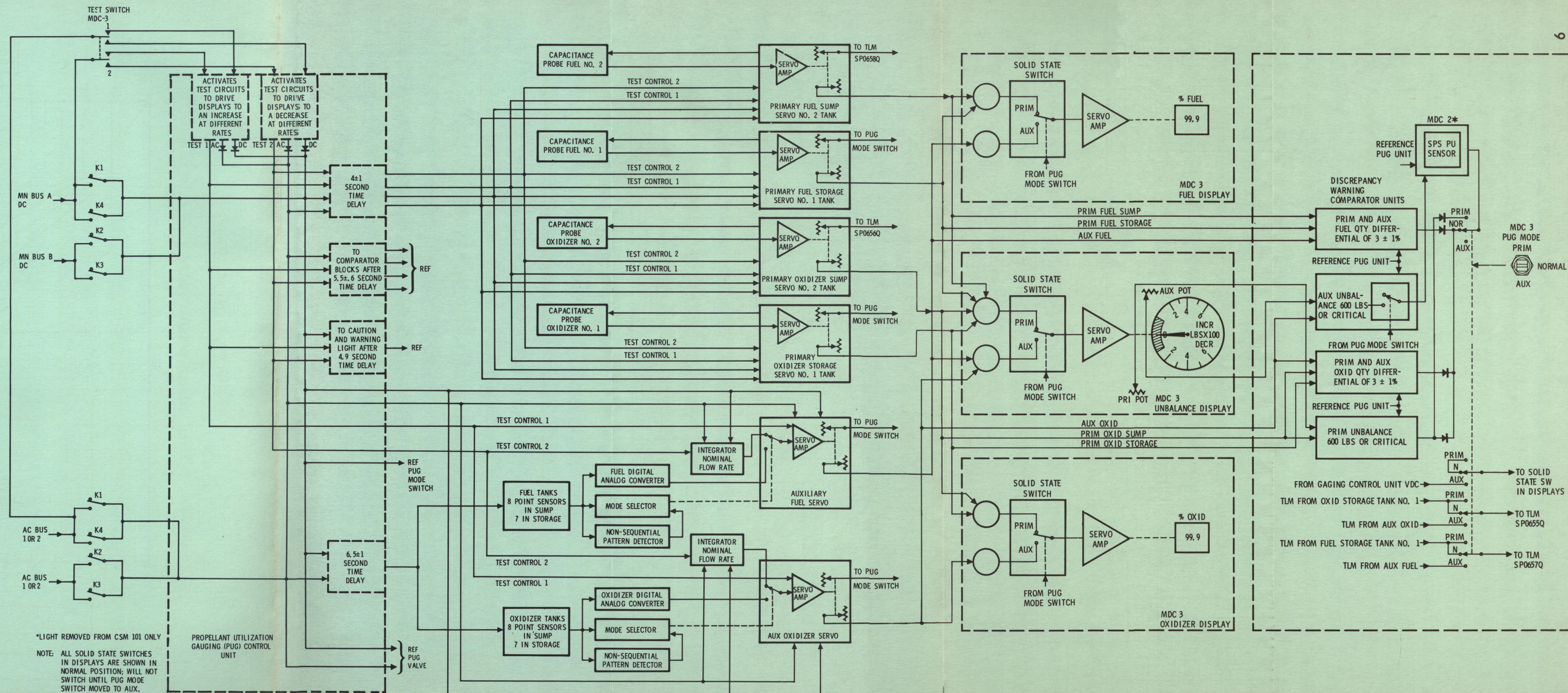


SPS COMPONENT LOCATIONS AFT VIEW

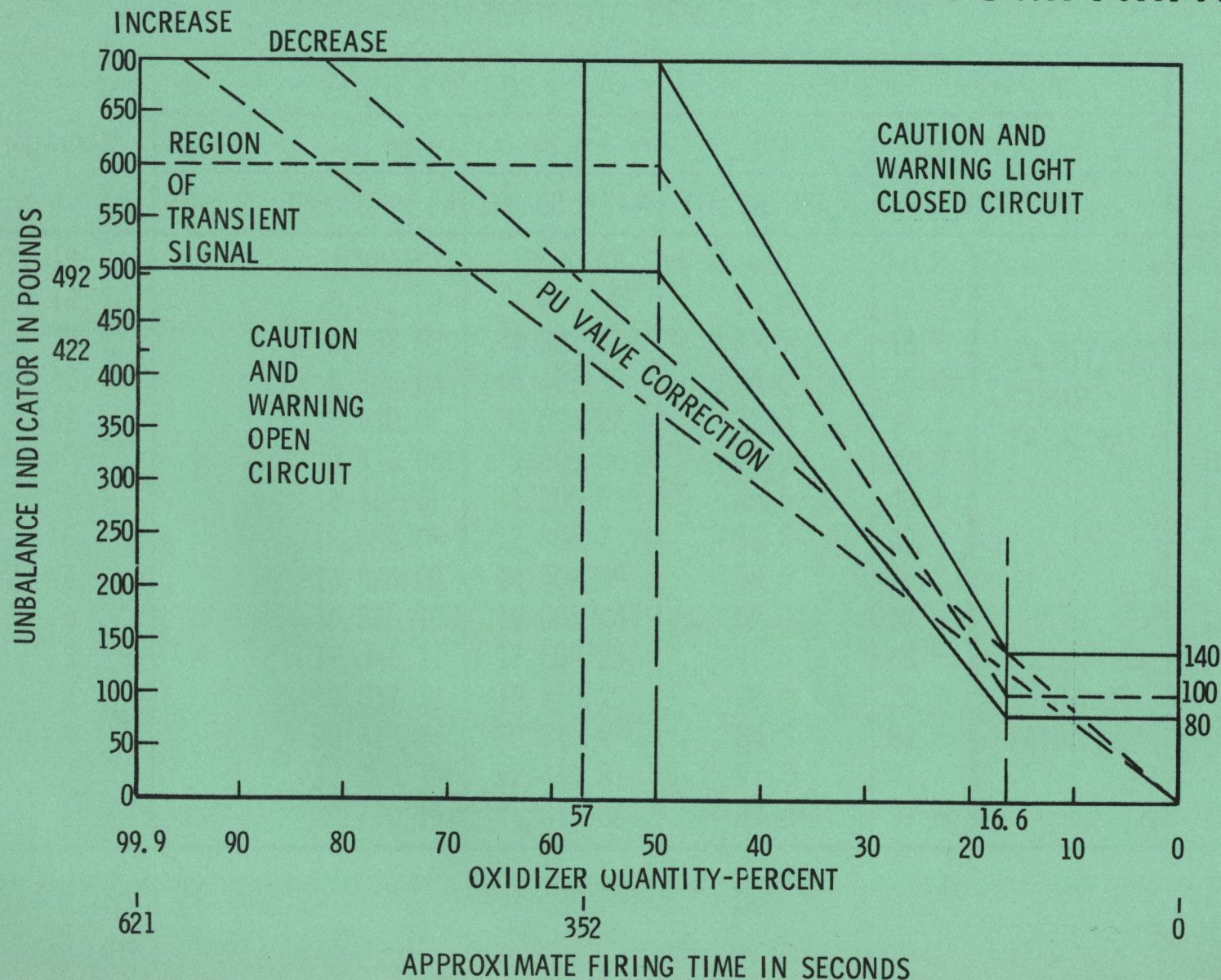








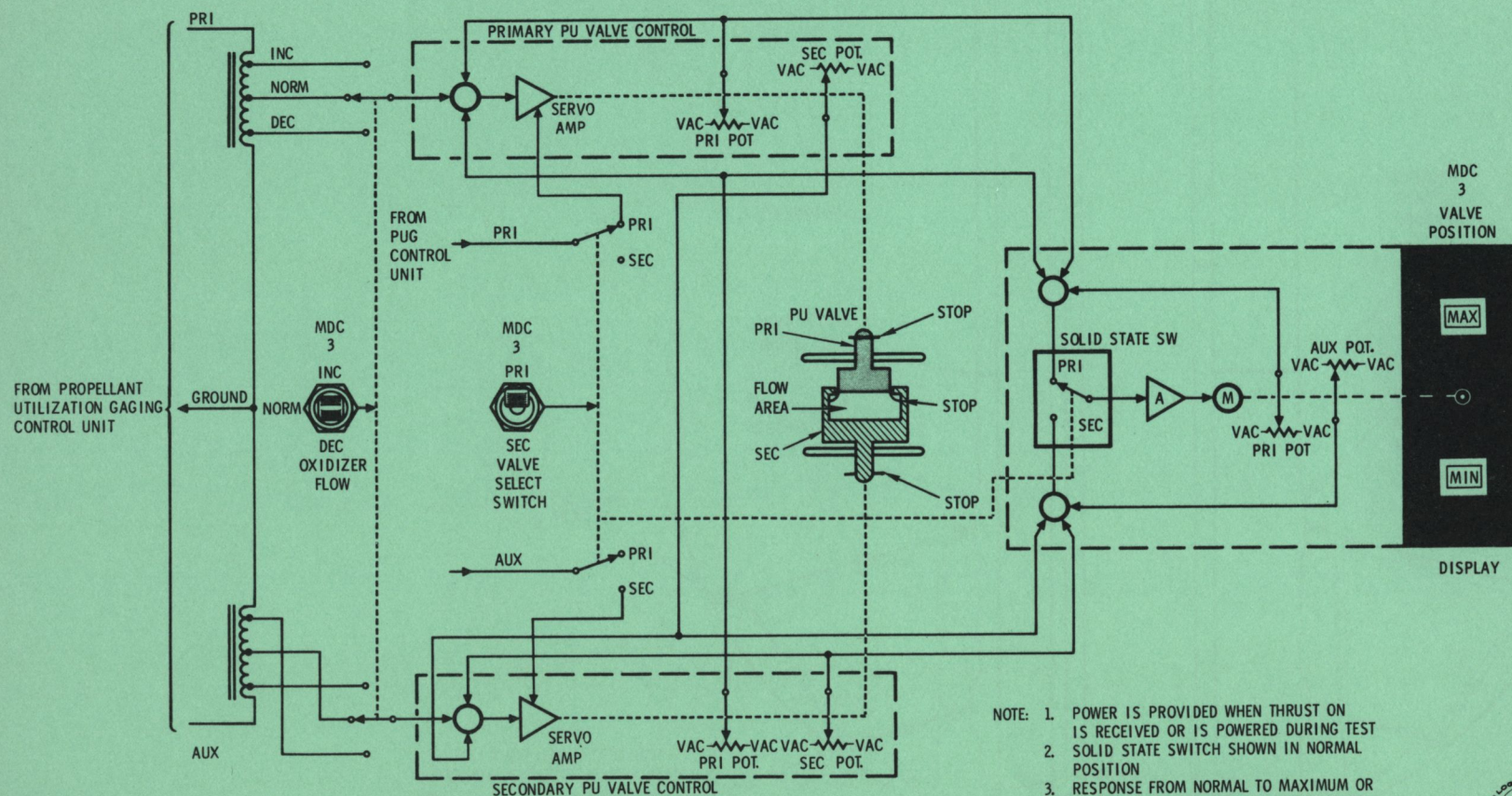
CAUTION AND WARNING CRITICAL PROPELLANT UNBALANCE COMPARATOR



OXIDIZER POINT SENSOR LOCATIONS							
NUMBER	WEIGHT POUNDS		PERCENT MAXIMUM		INCHES		
	TEMP	70°F	65°F	70°F		65°F	
	PRESS.	176.60 PSIA	176.60 PSIA	176.60 PSIA		176.60 PSIA	
15		1,586.01	1,600.84	6.5	6.2	} OXIDIZER SUMP TANK #2	25.36
14		3,172.02	3,201.69	13.0	12.5		41.34
13		4,758.03	4,802.53	19.5	18.7		57.25
12		6,344.04	6,403.38	26.0	25.0		72.07
11		7,930.05	8,004.22	32.5	31.2		86.89
10		9,516.06	9,605.06	39.0	37.5		101.72
9		11,102.07	11,205.91	45.5	43.7		116.54
8		12,688.08	12,806.75	52.0	49.9		131.60
7		14,274.09	14,407.59	58.5	56.2	} OXIDIZER STORAGE TANK #1	10.50
6		15,860.10	16,008.44	65.0	62.4		30.57
5		17,446.11	17,609.28	71.5	68.7		49.55
4		19,032.13	19,210.13	78.0	74.9		68.54
3		20,618.14	20,810.97	84.5	81.2		87.52
2		22,204.15	22,411.81	91.0	87.4		106.51
1		23,790.16	24,012.66	97.4	93.6		125.49

FUEL POINT SENSOR LOCATIONS						
NUMBER	WEIGHT POUNDS		PERCENT MAXIMUM		INCHES	
	TEMP.	70° F	65° F	70° F		65° F
	PRESS.	176.60 PSIA	176.60 PSIA	176.60 PSIA		176.60 PSIA
15	992.08	995.69	6.5	6.2	FUEL SUMP TANK #2	25.36
14	1984.16	1991.38	13.0	12.5		41.34
13	2976.24	2987.07	19.5	18.7		57.25
12	3968.32	3982.76	26.0	25.0		72.07
11	4960.40	4978.45	32.5	31.2		86.89
10	5952.48	5974.14	39.0	37.5		101.72
9	6944.56	6969.83	45.5	43.7		116.54
8	7936.64	7965.52	52.0	49.9		131.60
7	8928.72	8961.71	58.5	56.7	FUEL STORAGE TANK #1	10.48
6	9920.80	9956.90	65.0	62.4		30.55
5	10912.88	10952.59	71.5	68.7		49.54
4	11904.96	11948.28	78.0	74.9		68.52
3	12897.04	12943.97	84.5	81.1		87.51
2	13889.12	13939.65	91.0	87.4		106.49
1	14881.20	14935.34	97.5	93.6		125.48

PROPELLANT UTILIZATION VALVE CONTROL AND FLAG DISPLAY

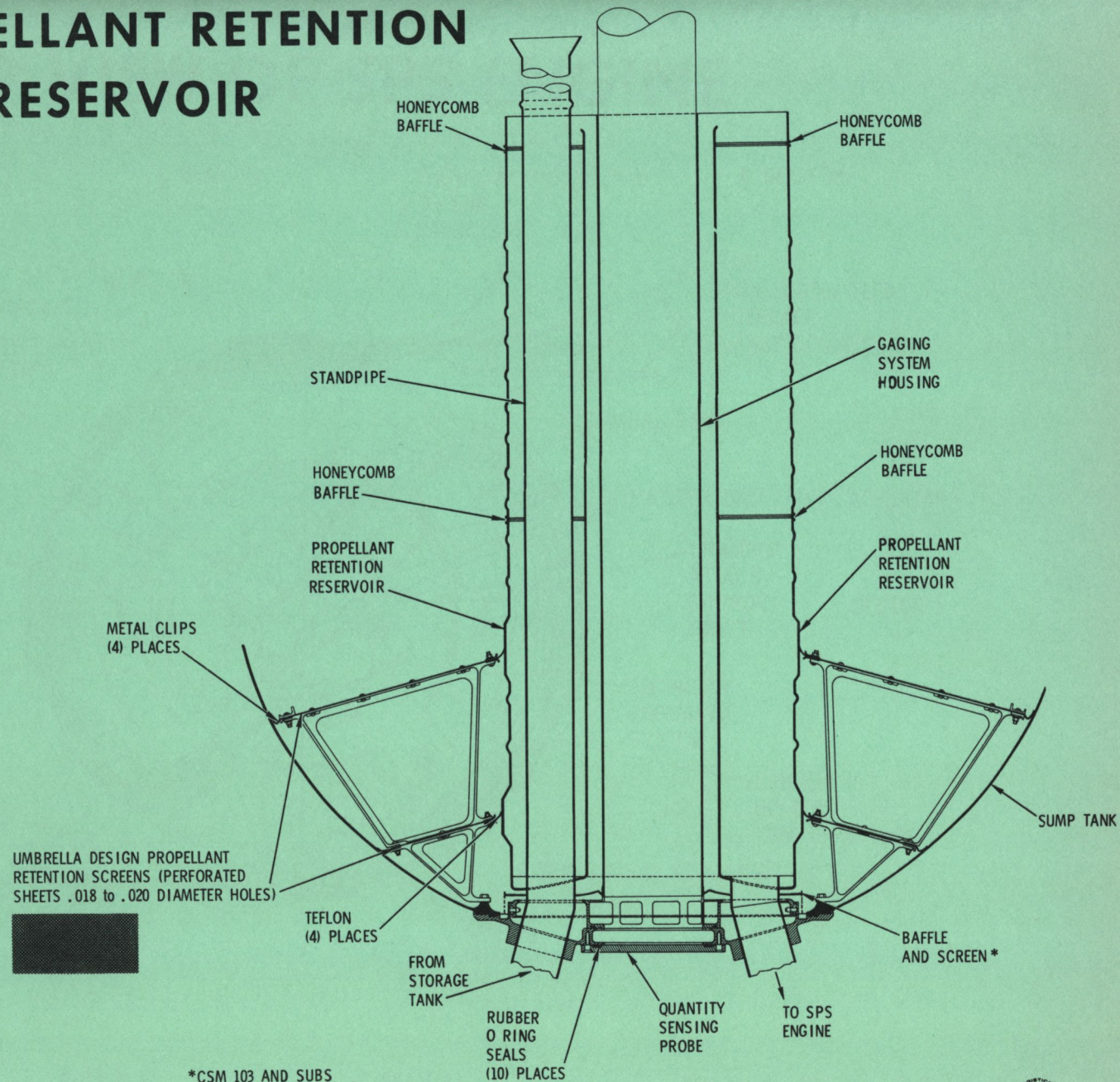


- NOTE: 1. POWER IS PROVIDED WHEN THRUST ON IS RECEIVED OR IS POWERED DURING TEST
2. SOLID STATE SWITCH SHOWN IN NORMAL POSITION
3. RESPONSE FROM NORMAL TO MAXIMUM OR VICE VERSA OR NORMAL TO MINIMUM OR VICE VERSA IS 3.5 SECONDS

P-5032A



SPS PROPELLANT RETENTION RESERVOIR

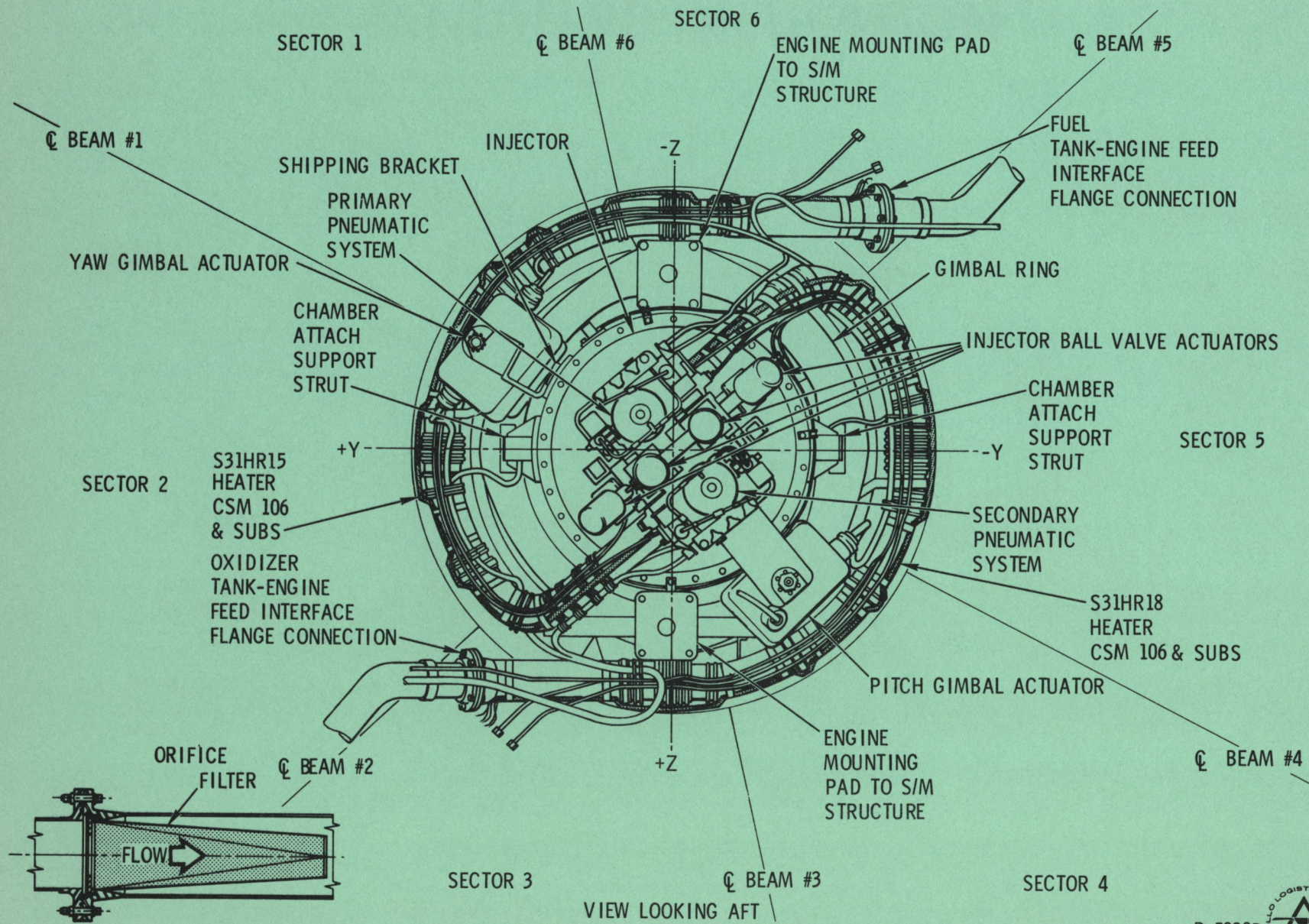


*CSM 103 AND SUBS

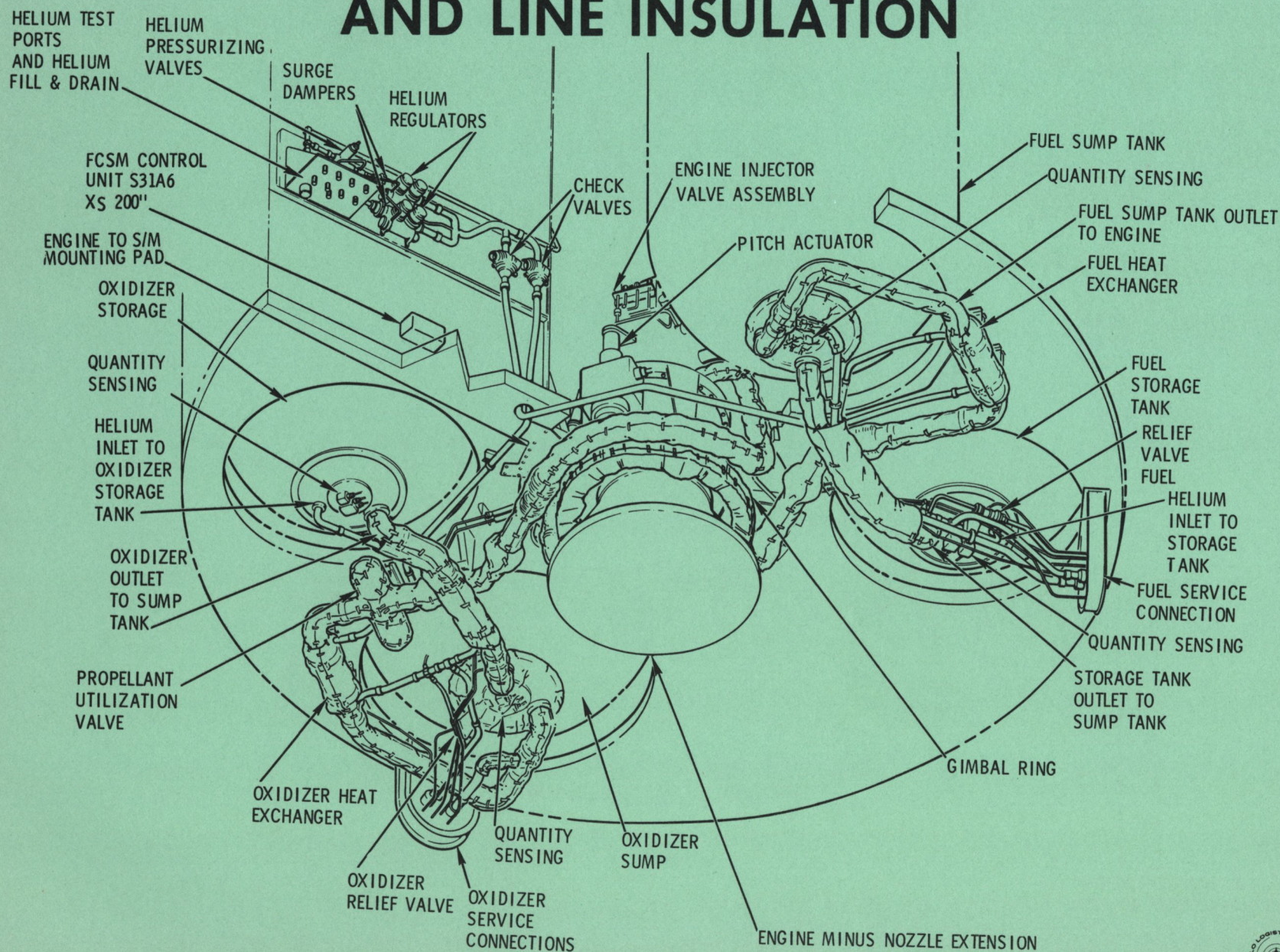
P-5048A



TOP VIEW OF SPS ENGINE

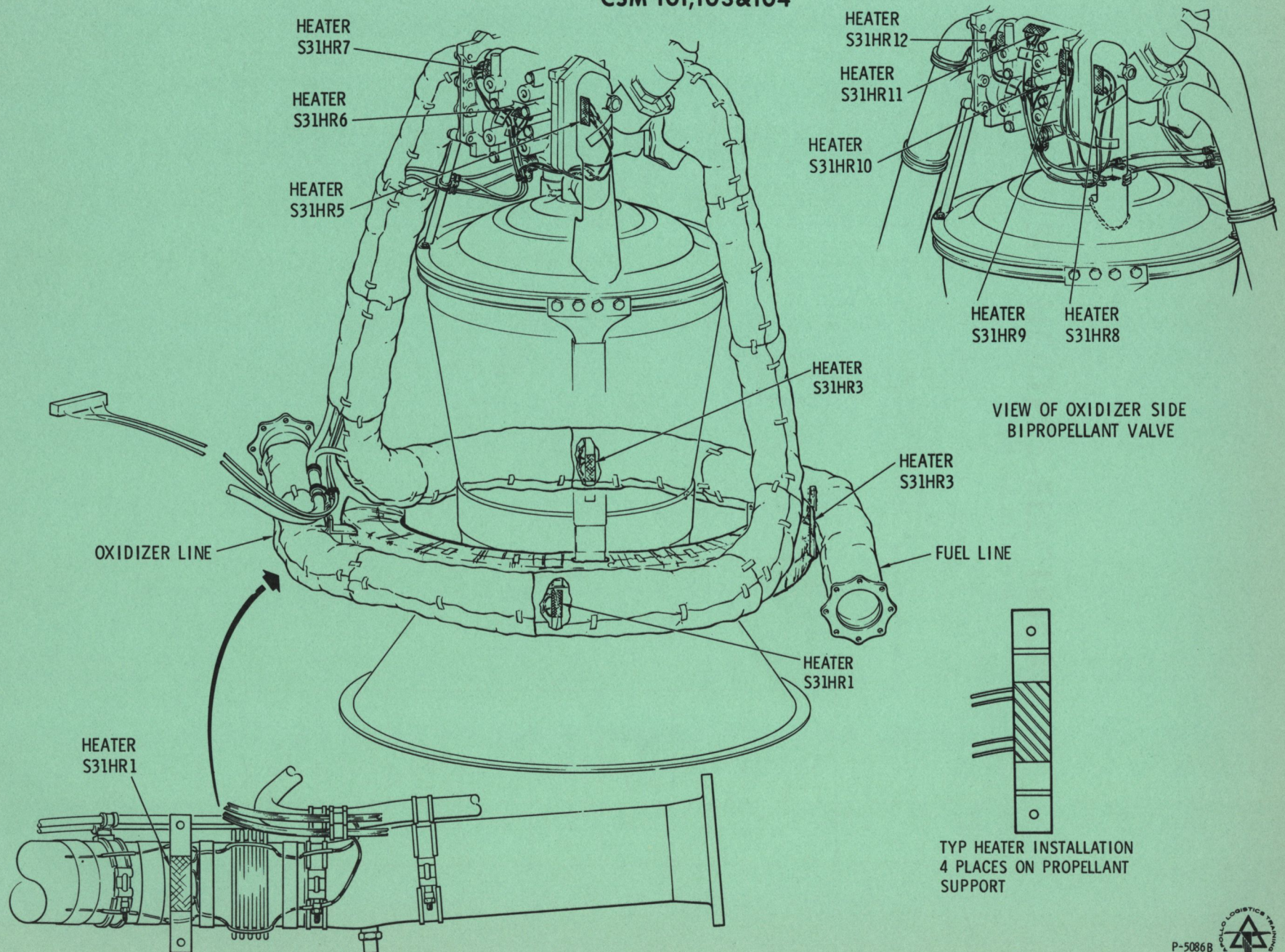


SPS COMPONENT LOCATIONS AFT VIEW AND LINE INSULATION



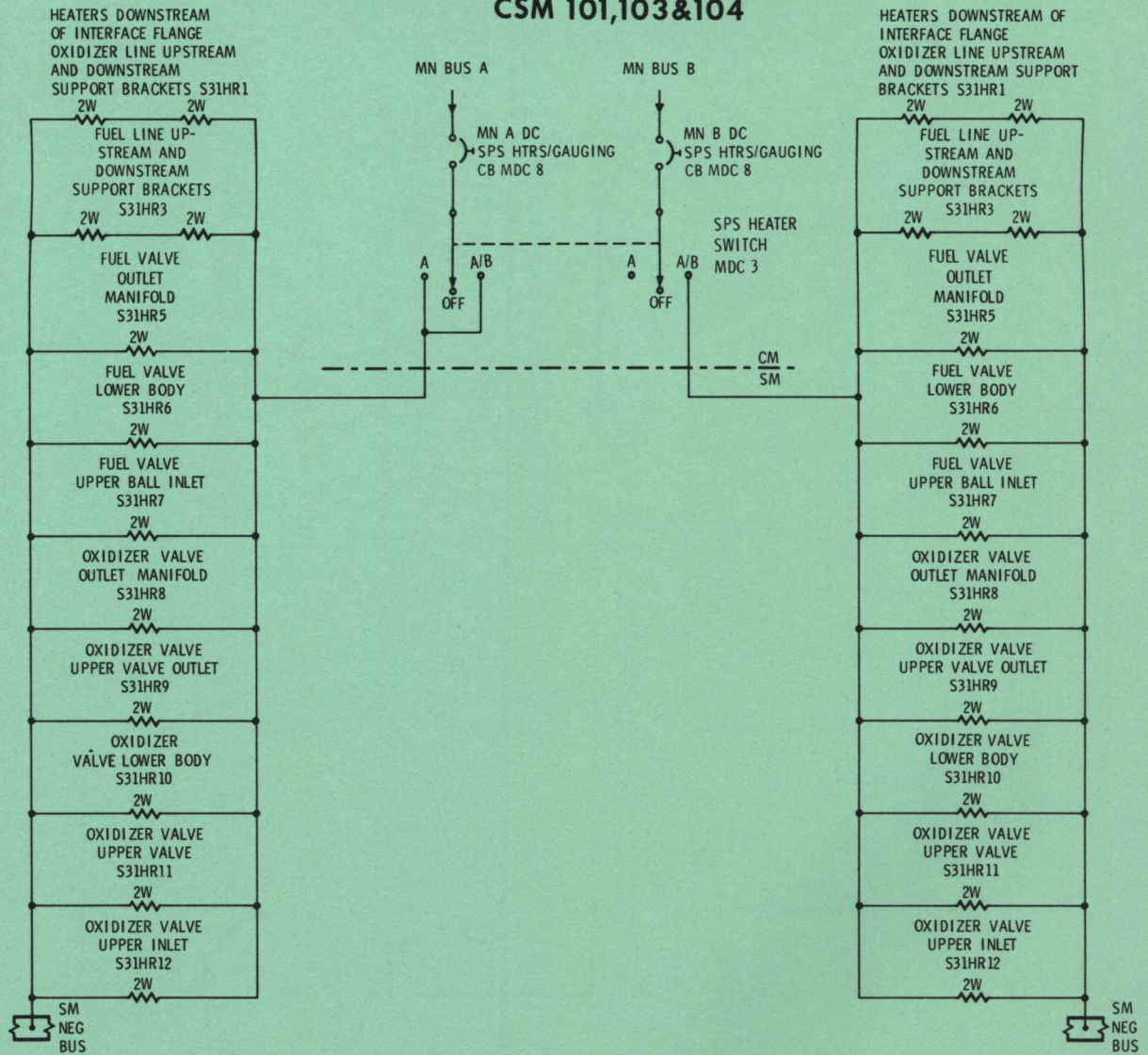
SPS HEATER LOCATIONS

CSM 101,103&104



SPS HEATERS-ELECTRICAL

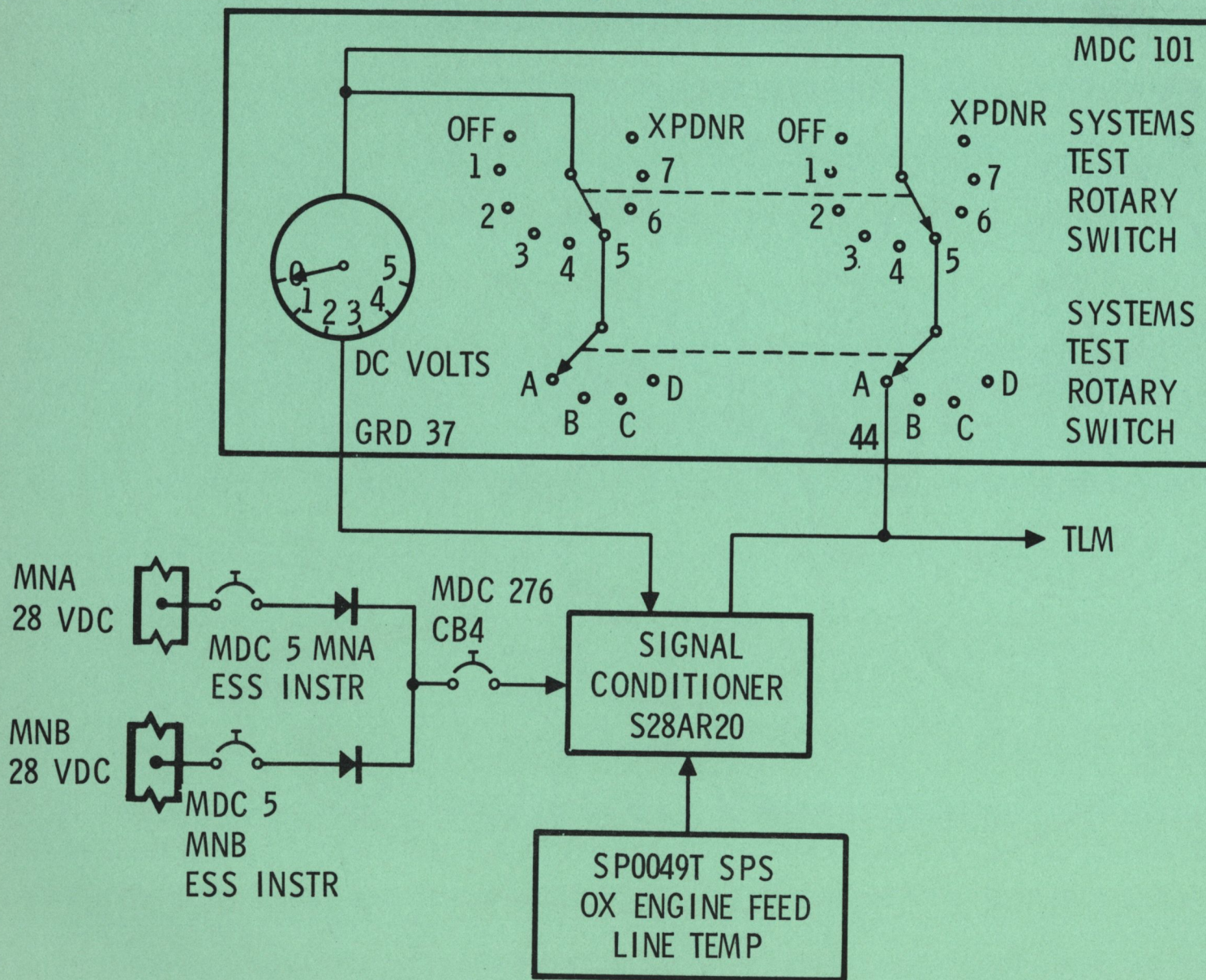
CSM 101,103&104



P-5079G



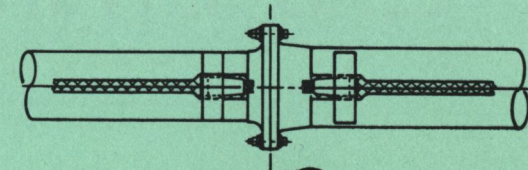
SPS OXIDIZER ENGINE FEED LINE TEMPERATURE MONITORING



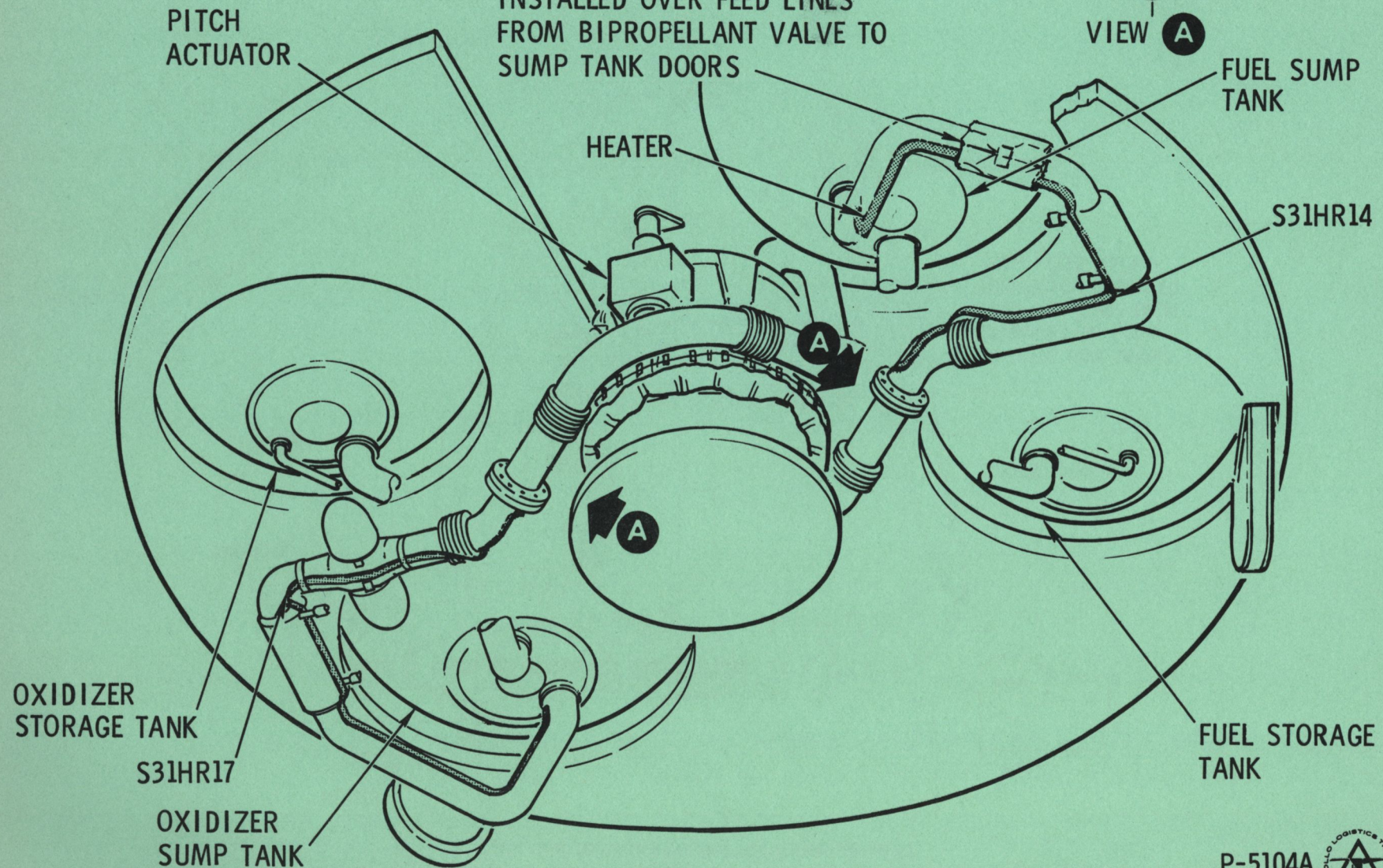
SPS HEATER INSTALLATION, TANK FEED LINES

CSM 106 & SUBS

ALUMINIZED MYLAR INSULATION,
INSTALLED OVER FEED LINES
FROM BIPROPELLANT VALVE TO
SUMP TANK DOORS



VIEW A

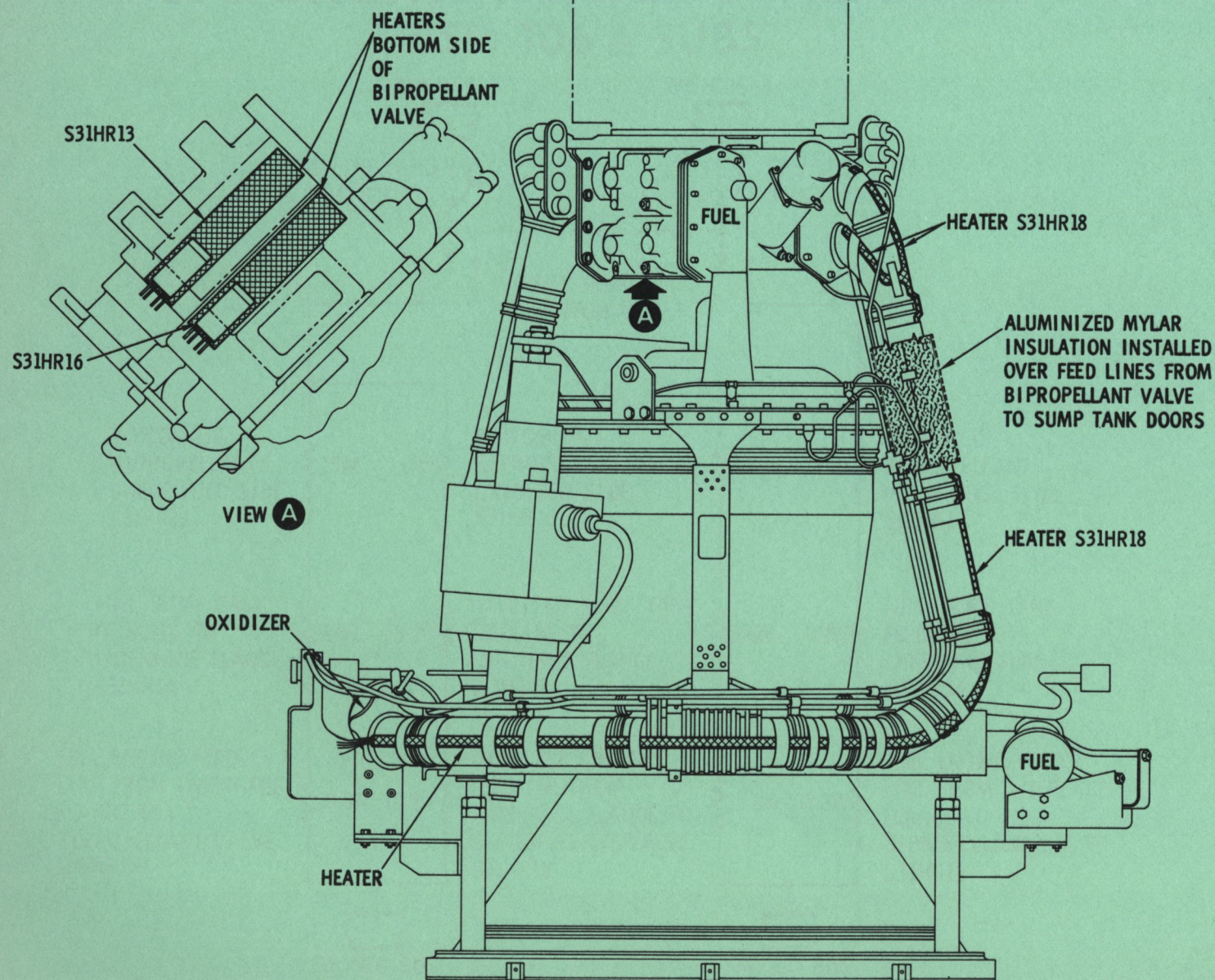


P-5104A



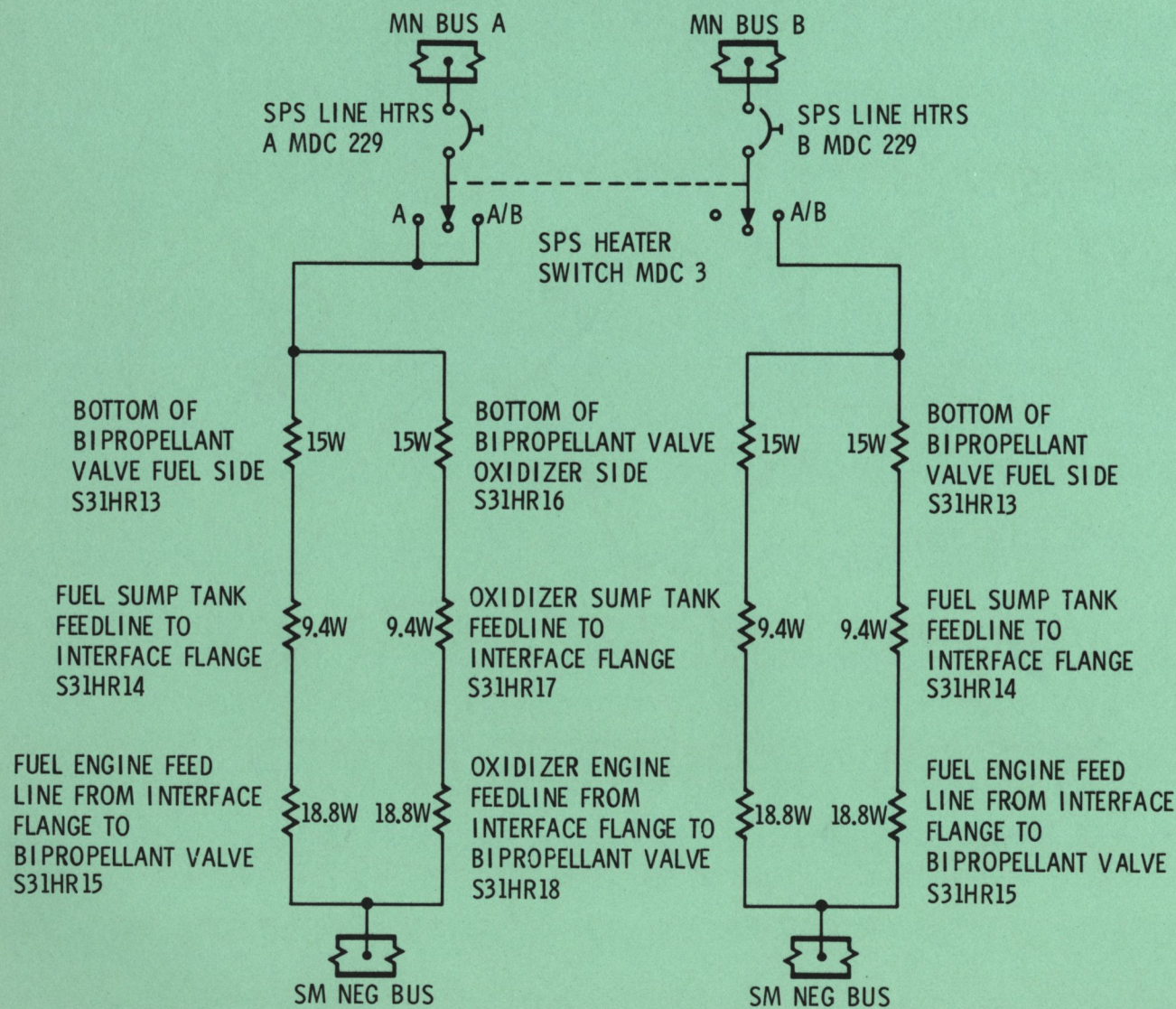
SPS HEATER INSTALLATION ENGINE FEED LINES

CSM 106 & SUBS

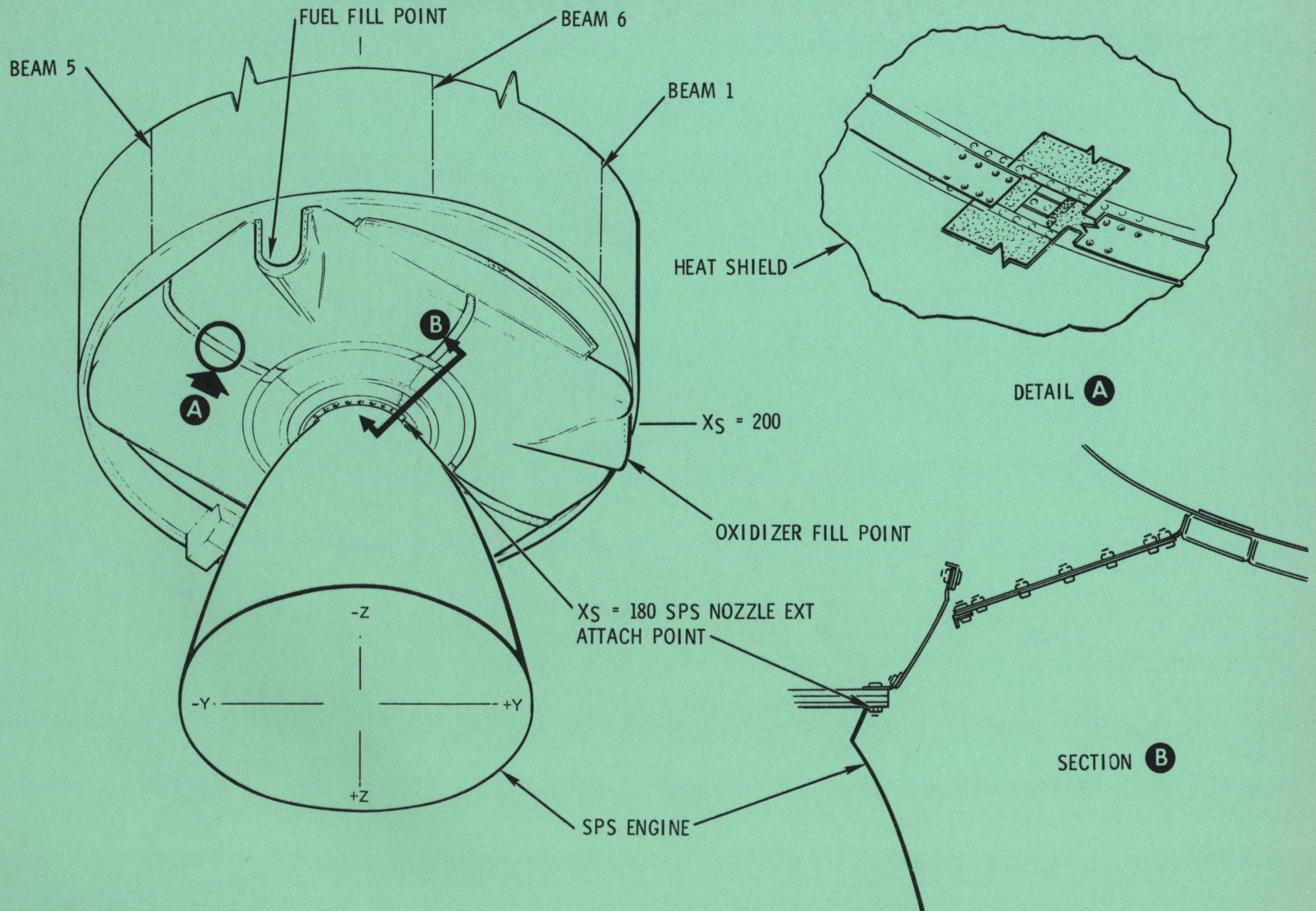


SPS ENGINE HEATER SCHEMATIC

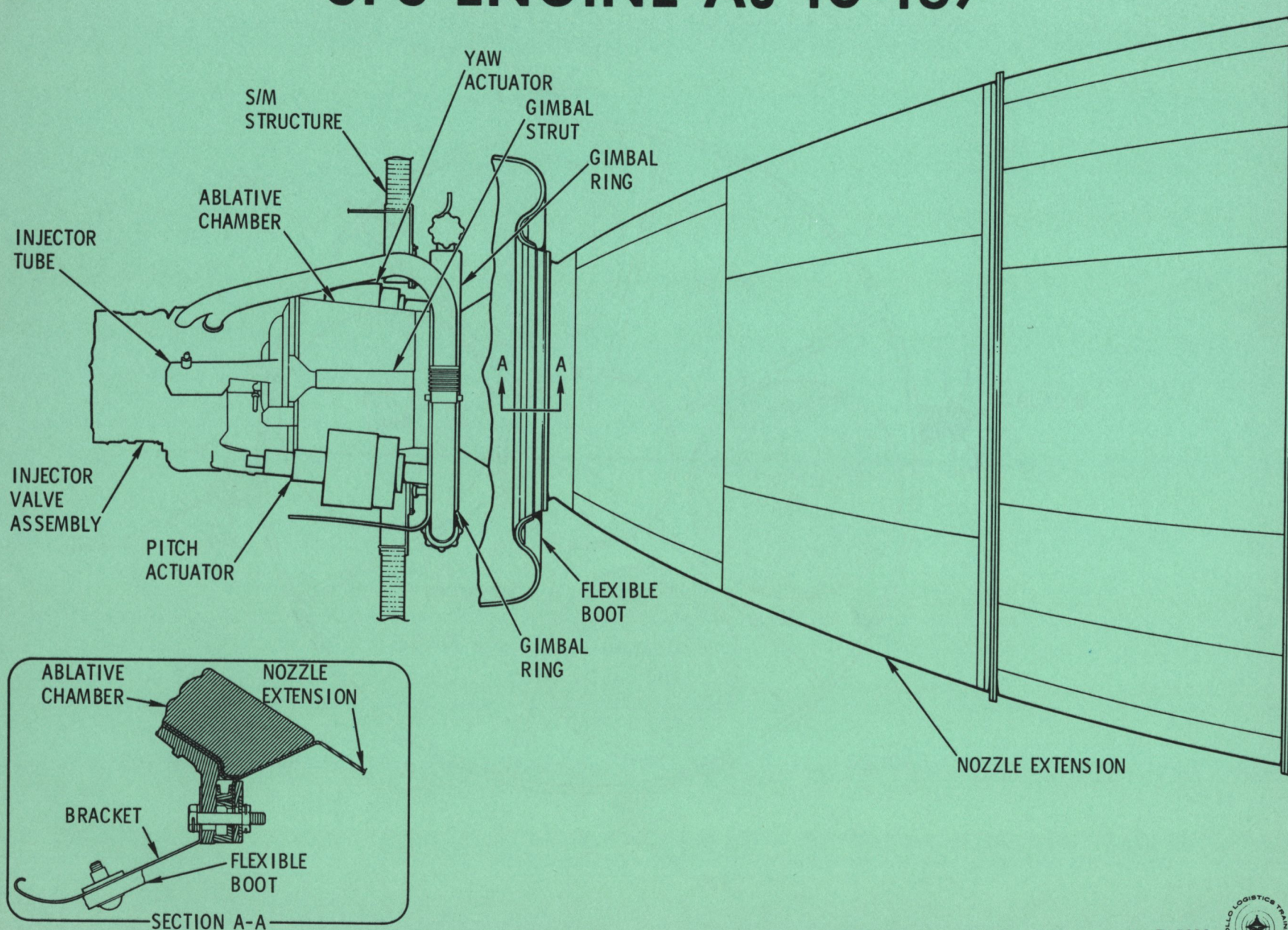
CSM 106 & SUBS



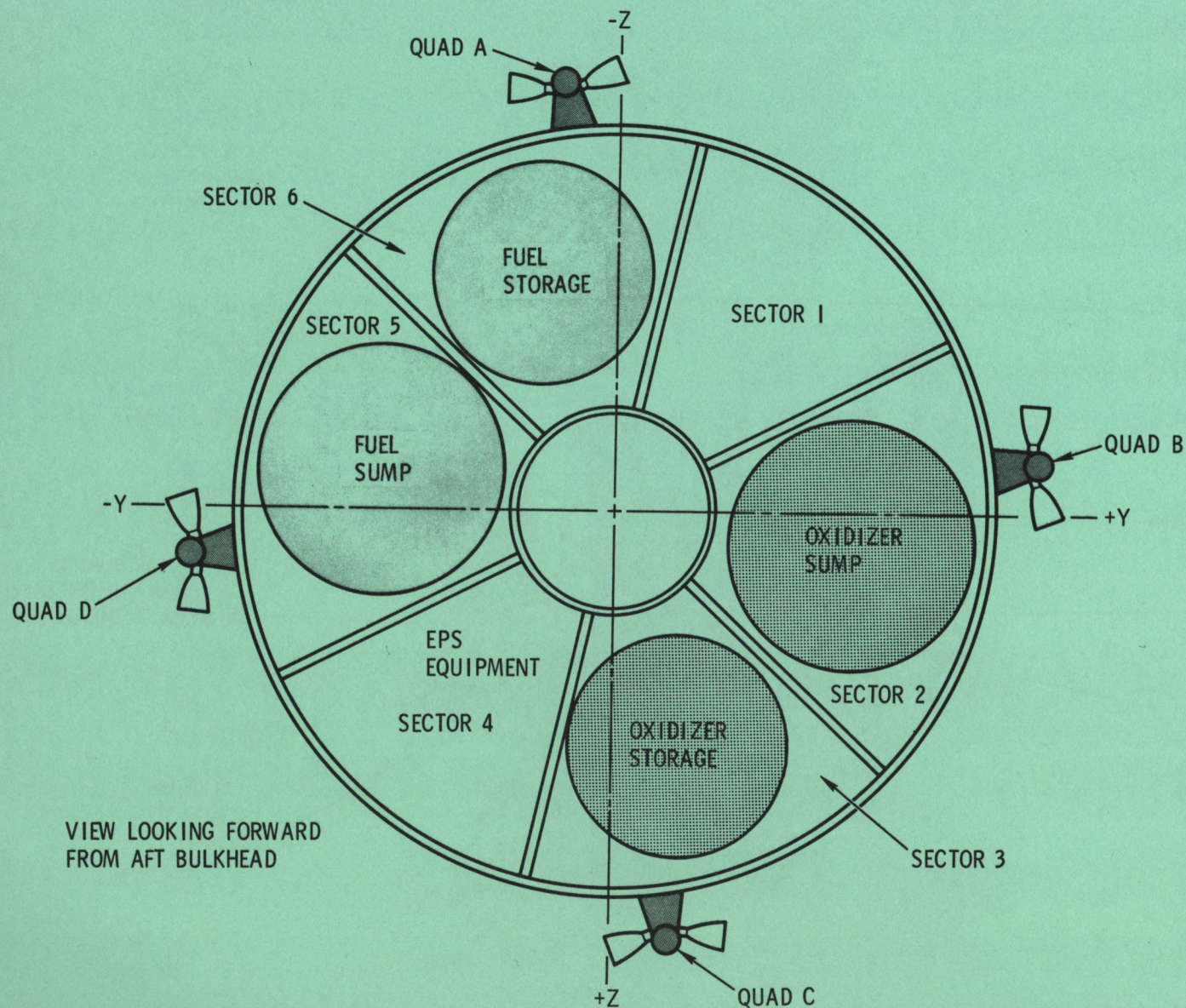
SM SPS NOZZLE AND HEAT SHIELD



SPS ENGINE AJ 10-137

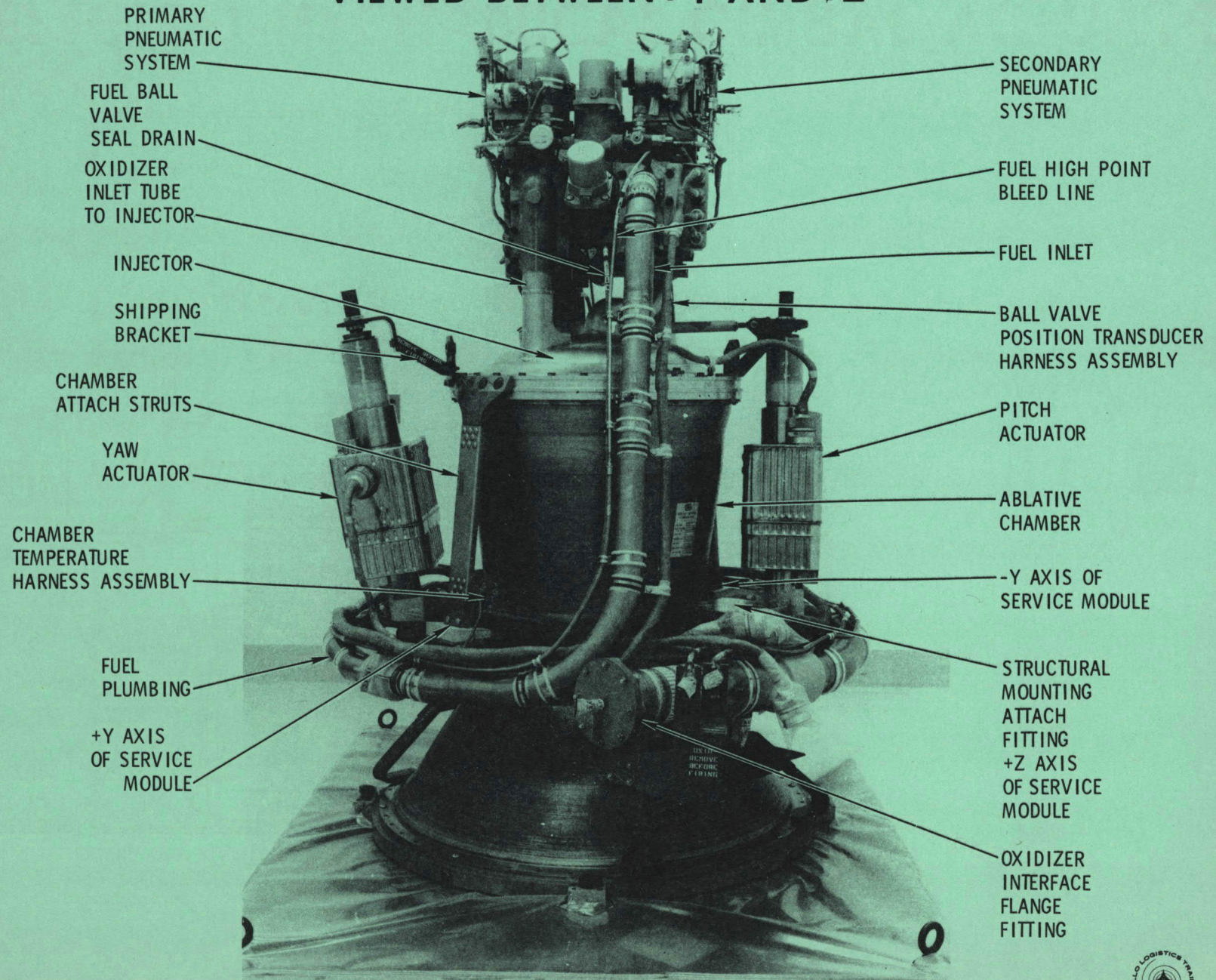


SERVICE MODULE SECTORS

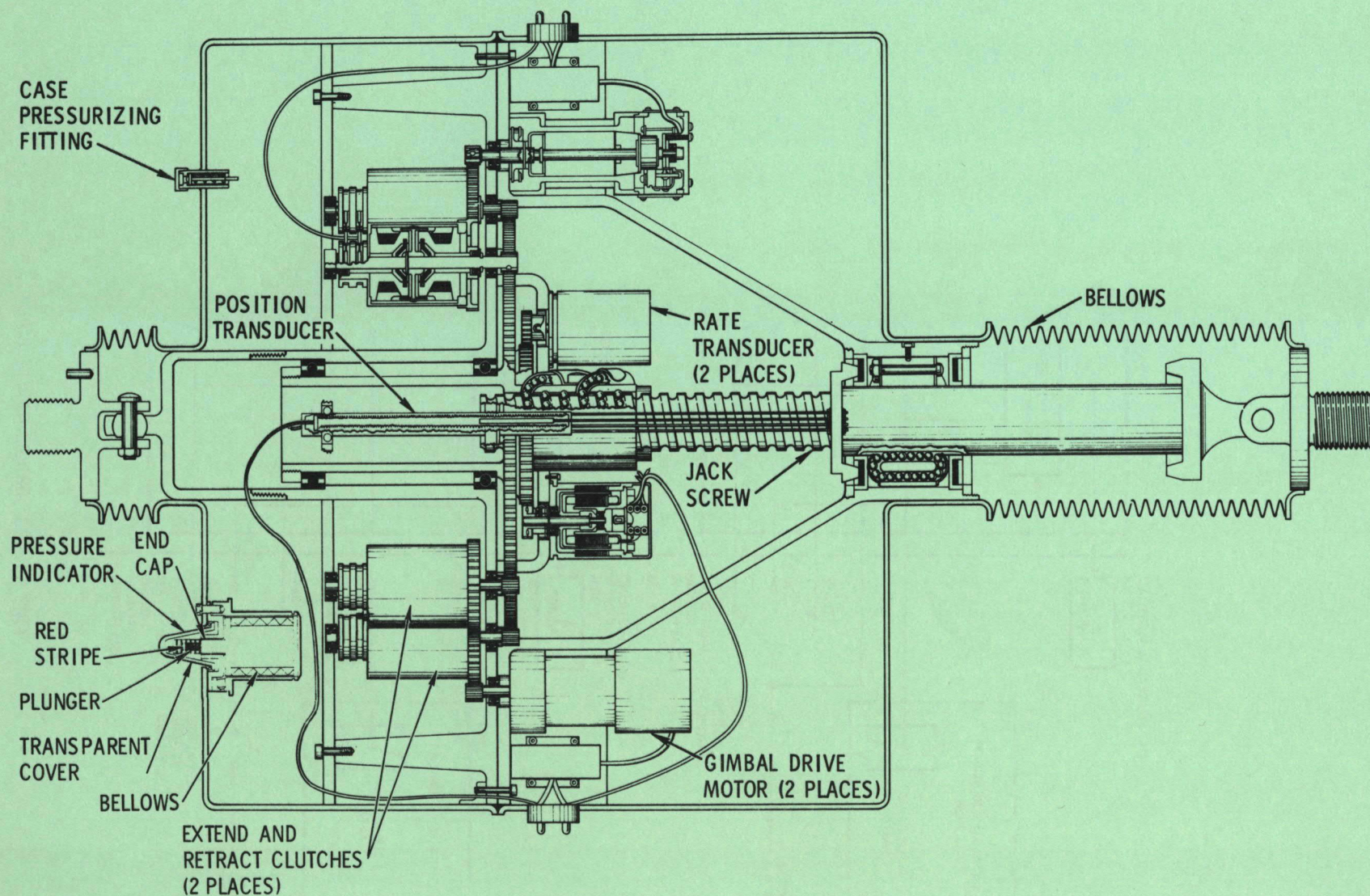


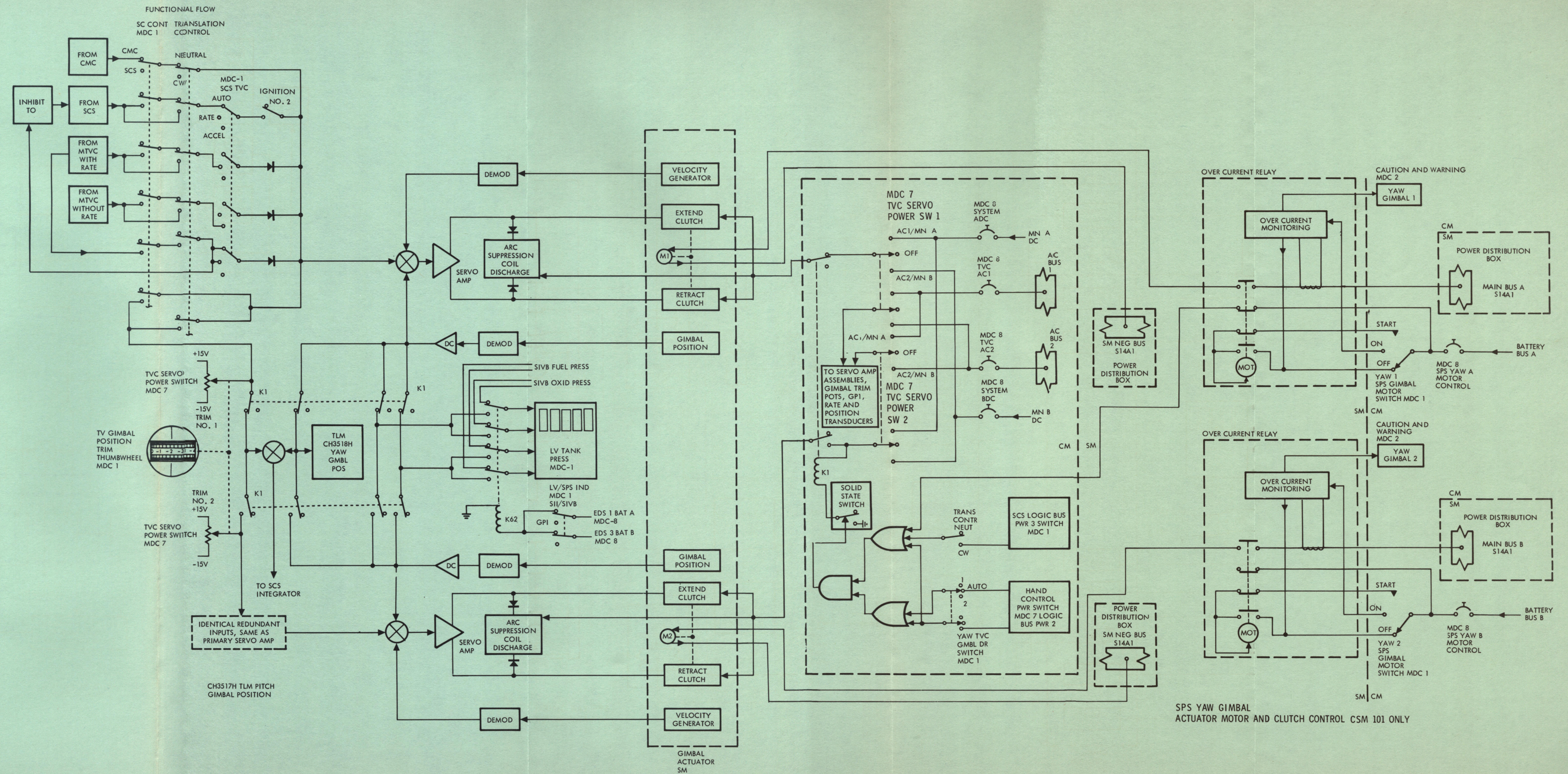
SPS ENGINE

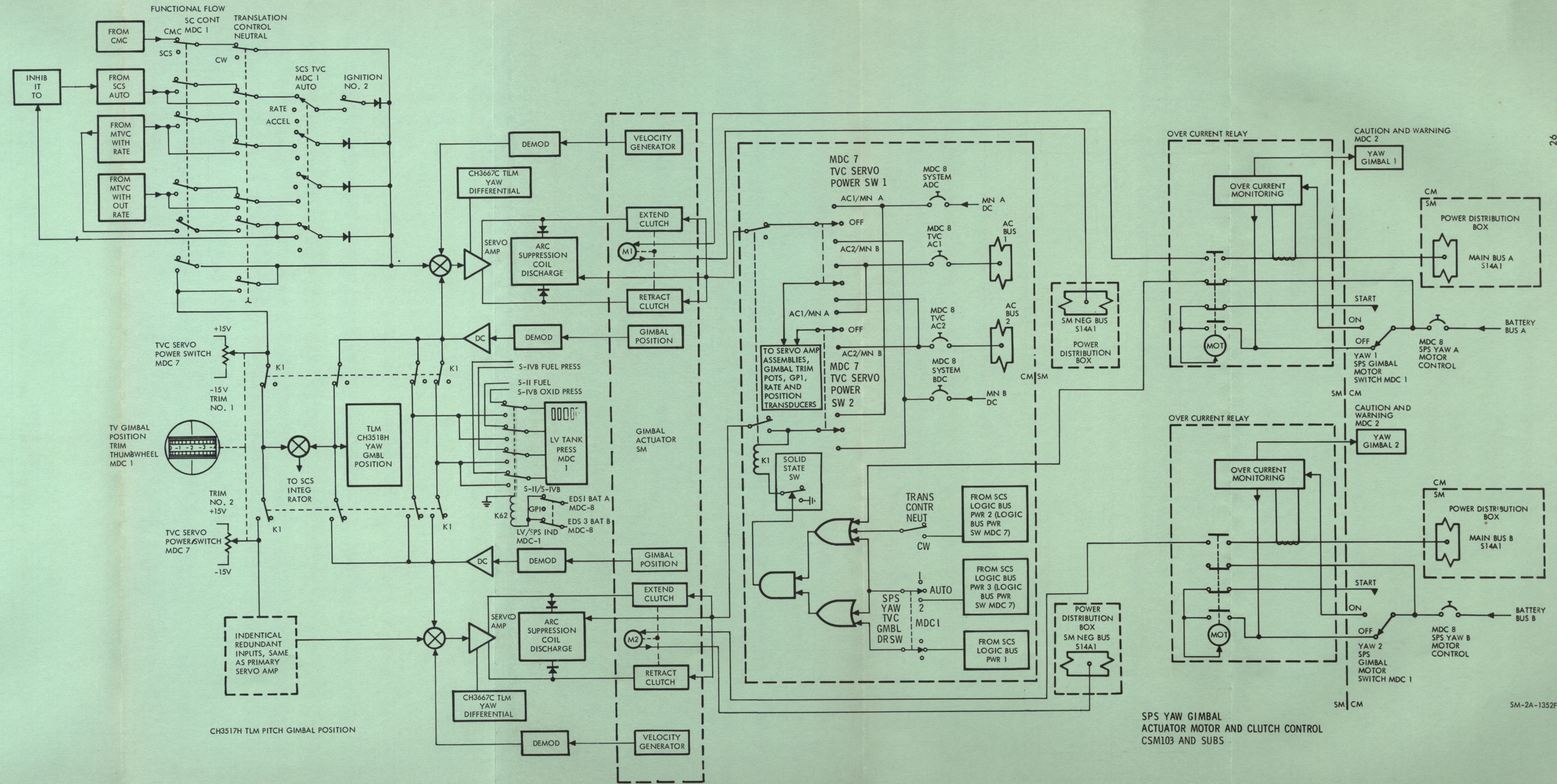
VIEWED BETWEEN +Y AND +Z



SPS ELECTRO-MECHANICAL GIMBAL ACTUATOR



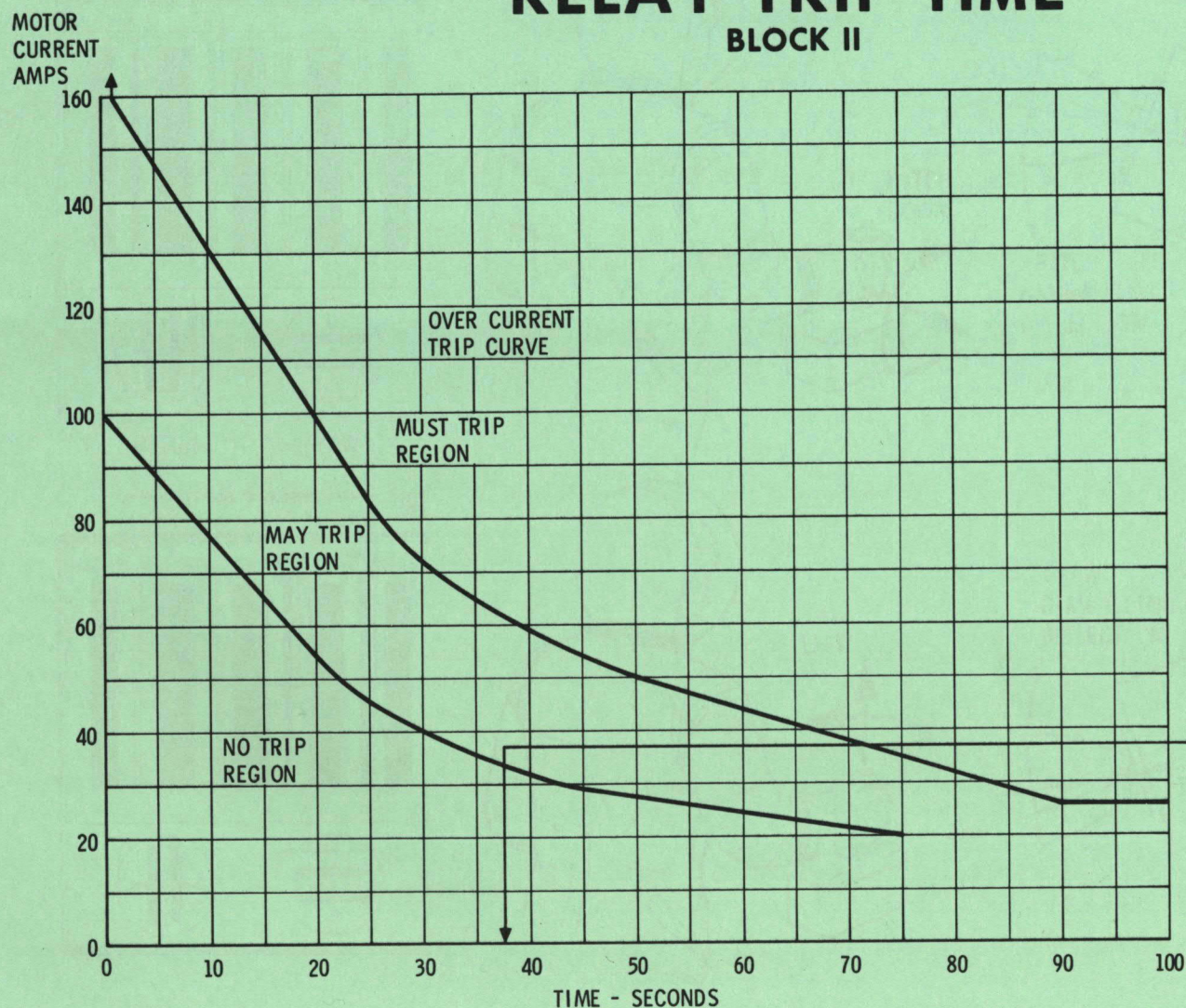




SPS YAW GIMBAL ACTUATOR MOTOR AND CLUTCH CONTROL CSM103 AND SUBS

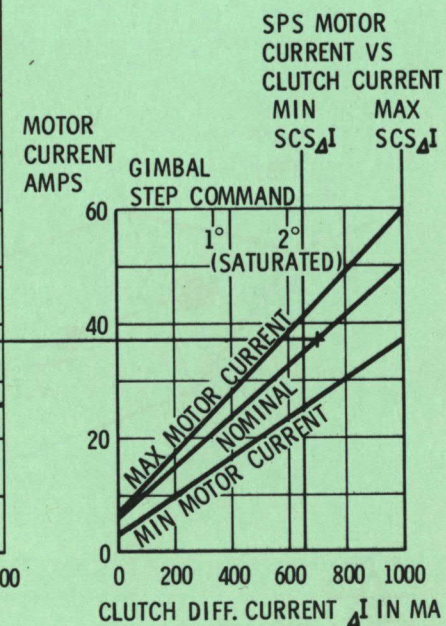
SPS GIMBAL ACTUATOR OVER CURRENT RELAY TRIP TIME

BLOCK II



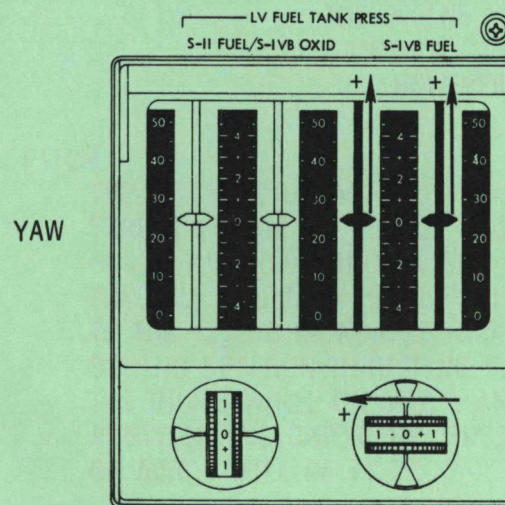
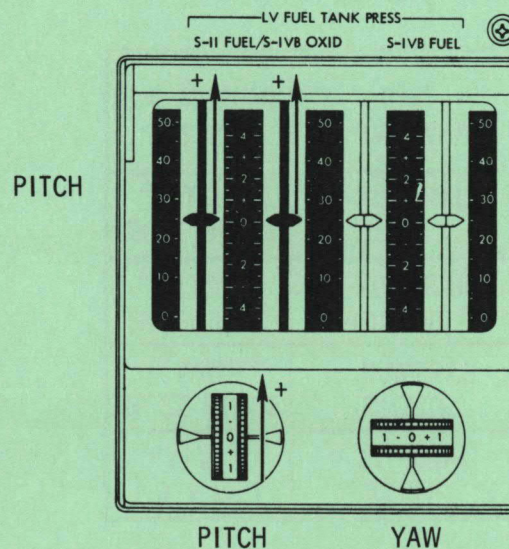
EXAMPLE

1. SATURATED SCS AMPLIFIER OUTPUT CURRENT OF 700 MA CAUSES SPS GIMBAL MOTOR TO DRAW 37 AMPS, OVER CURRENT RELAY TRIPS IN 37.5 SECONDS NOMINAL

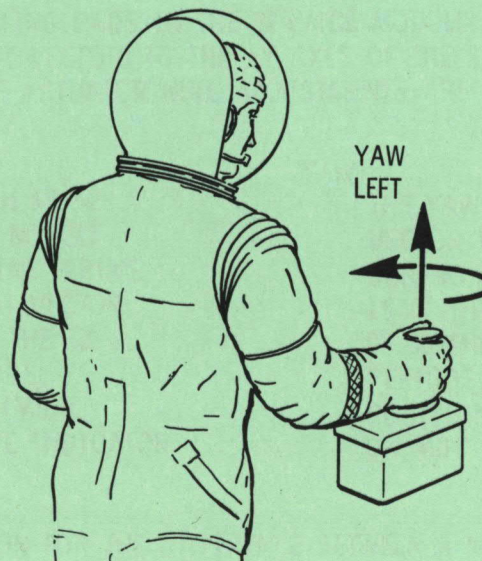
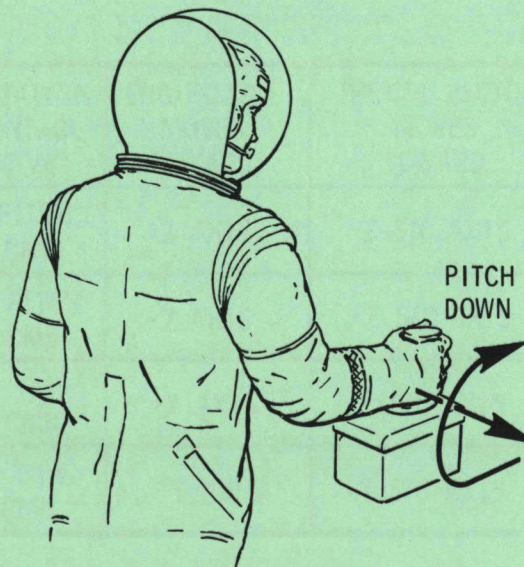


SPS GIMBALLING

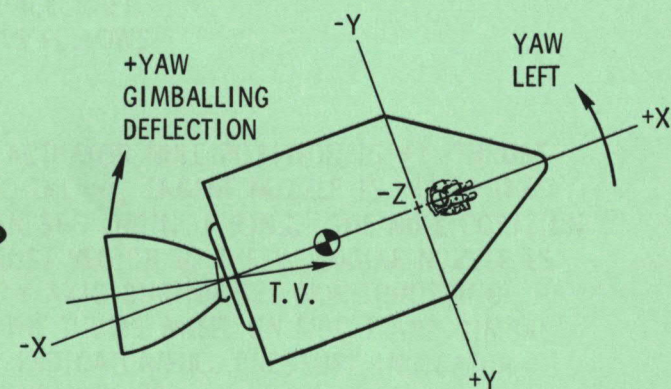
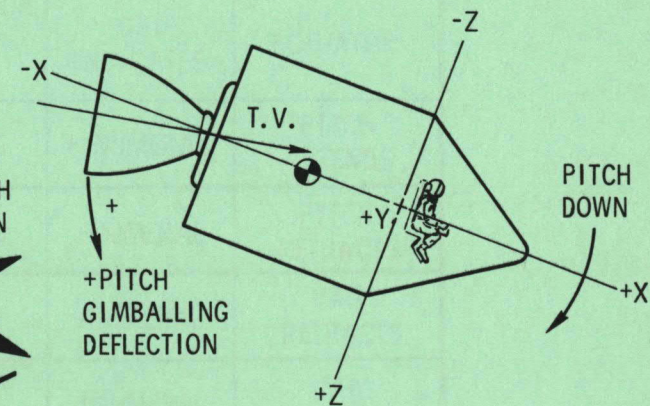
GPI AND TRIM THUMBWHEELS



MTVC COMMANDS



CSM ROTATIONS



GIMBALLING OF THE SERVICE PROPULSION ENGINE

S/C MOTION DESIRED	GPI THUMBWHEEL	ROTATION CONTROL (MTVC)	ENG NOZZLE MOVES TOWARD	THRUST VECTOR MOVES TOWARD	GPI INDICATES	ACTUATOR
PITCH NOSE DOWN	+ NUMERAL (UP)	-PITCH CMD	+Z AXIS	-Z S/C AXIS	+ NUMERAL	PITCH EXTENDS
PITCH NOSE UP	- NUMERAL (DOWN)	+ PITCH CMD	-Z AXIS	+Z S/C AXIS	-NUMERAL	PITCH RETRACTS
YAW NOSE RIGHT	- NUMERAL (RIGHT)	+ YAW CMD	+Y AXIS	-Y S/C AXIS	-NUMERAL	YAW RETRACTS
YAW NOSE LEFT	+ NUMERAL (LEFT)	- YAW CMD	-Y AXIS	+Y S/C AXIS	+NUMERAL	YAW EXTENDS

THE ENGINE MOUNTING PADS IN THE SERVICE MODULE ARE CANTED 4° (THRUST VECTOR) TO THE +Y AXIS OF THE SPACECRAFT. HOWEVER THE ACTUATOR NULL ADJUSTMENTS ARE AS FOLLOWS:

PITCH

THE PITCH ACTUATOR NULL POSITION IS $+2^{\circ}$ THRUST VECTOR TO THE +Z, ENGINE NOZZLE -2° TO THE -Z DURING AN SPS ENGINE FIRING. THE NULL POSITION IS $+1.5^{\circ}$ THRUST VECTOR TO THE +Z, ENGINE NOZZLE -1.5° TO THE -Z DURING SPS NON-THRUSTING PERIODS, THE THUMB WHEEL ON MDC 1 AND GIMBAL POSITION INDICATOR/FUEL PRESSURE INDICATOR ON MDC 1 WILL BE $+1.5^{\circ}$.

YAW

THE YAW ACTUATOR NULL POSITION IS $+1^{\circ}$ THRUST VECTOR TO THE +Y, ENGINE NOZZLE IS -1° TO THE -Y DURING AN SPS ENGINE FIRING. THE NULL POSITION IS 0° THRUST VECTOR TO THE Y, ENGINE NOZZLE IS 0° TO THE Y AXIS DURING SPS NON-THRUSTING PERIODS, THE THUMB WHEEL ON MDC 1 AND GIMBAL POSITION INDICATOR/FUEL PRESSURE INDICATOR ON MDC 1 WILL BE 0° .

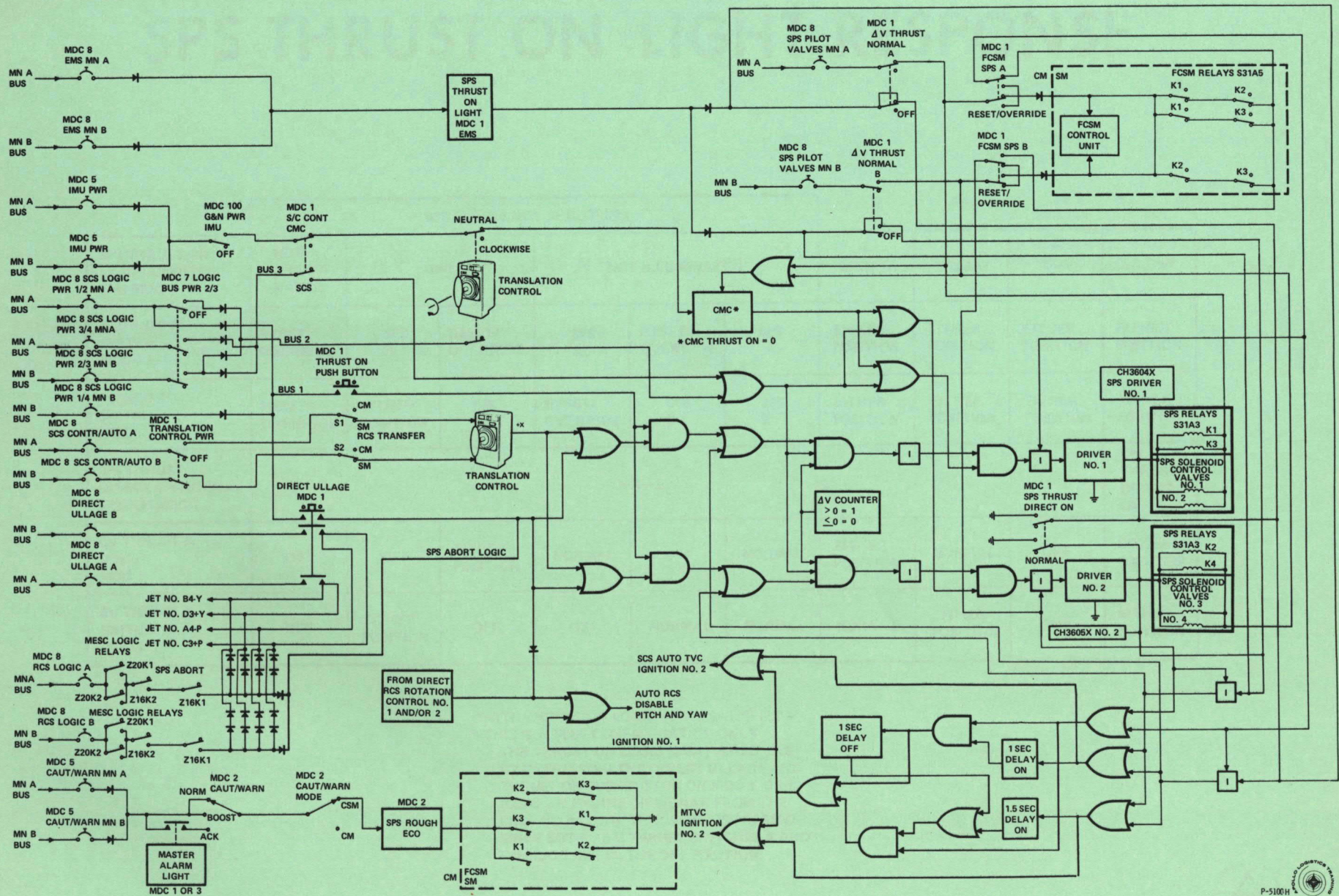
THE REASON FOR THE DIFFERENCE BETWEEN A NON SPS ENGINE FIRING VERSUS AN SPS ENGINE FIRING IS DUE TO DEFLECTIONS OF ENGINE AND VEHICLE STRUCTURE.

CSM 101



SPS THRUST ON-OFF LOGIC

CSM 103 AND SUBS



MDC-1 SWITCH CONFIGURATION AND SPS THRUST ON LIGHT RESPONSE

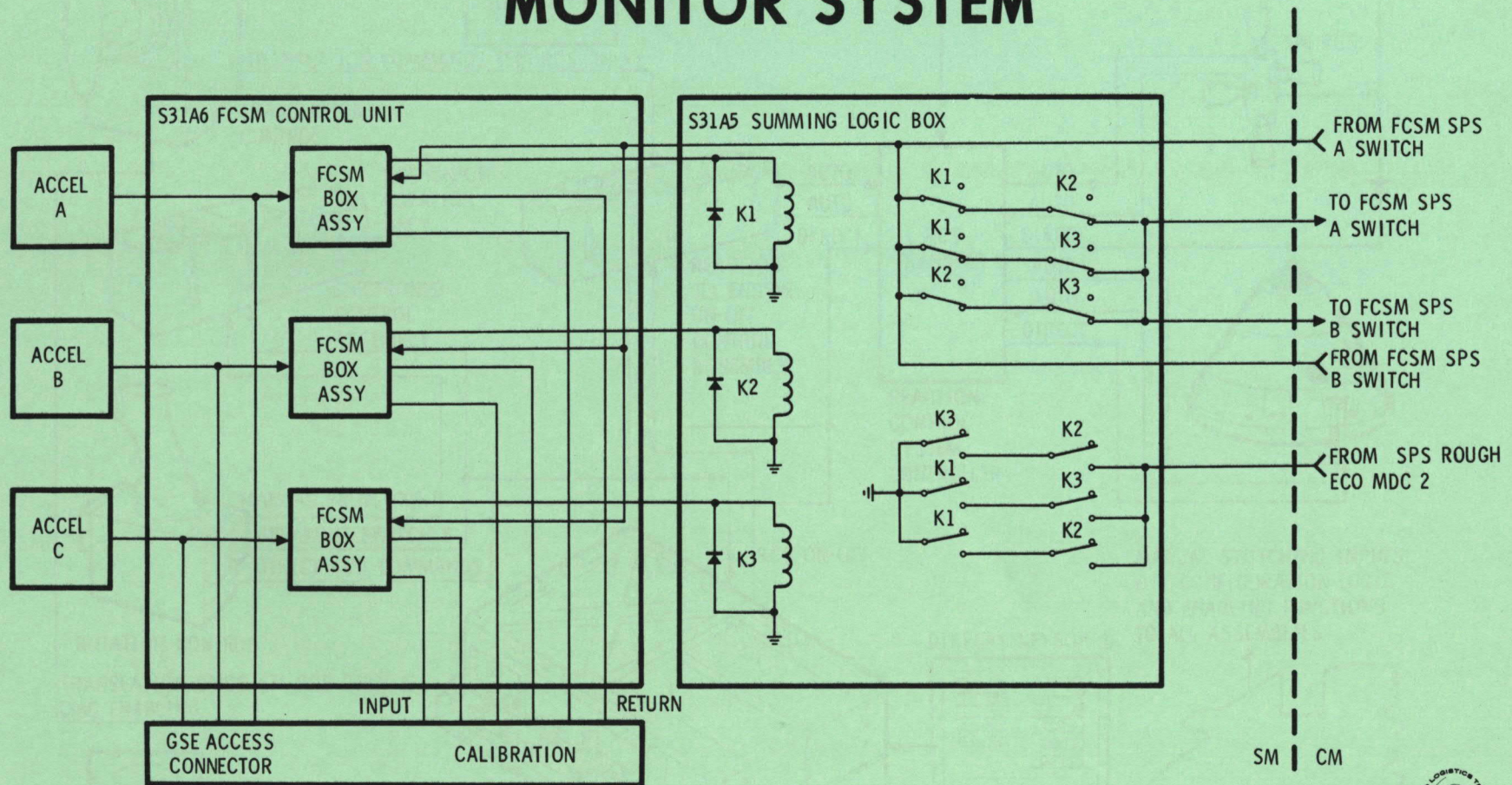
	SPS ENGINE NOT THRUSTING									
SPS THRUST ON LAMP CONDITION EMS MDC-1	NOT ILLUMI-NATED	DIM		NOT ILLUMINATED			* BRIGHT	* BRIGHT	** DIM	BRIGHT
FCSM SPS A SWITCH MDC-1	RESET/OVERRIDE	SPS A	RESET/OVERRIDE	SPS A	RESET/OVERRIDE	SPS A	EITHER POSITION	EITHER POSITION	EITHER POSITION	EITHER POSITION
FCSM SPS B SWITCH MDC-1	RESET/OVERRIDE	EITHER POSITION	SPS B	RESET/OVERRIDE	SPS B	SPS B	EITHER POSITION	EITHER POSITION	EITHER POSITION	EITHER POSITION
SPS THRUST DIRECT ON-NORMAL SWITCH MDC-1	NORMAL									SPS THRUST DIRECT ON
ΔV THRUST A SWITCH MDC-1	OFF	OFF	EITHER POSITION	NORMAL	OFF	NORMAL	EITHER POSITION	NORMAL	OFF	EITHER POSITION
ΔV THRUST B SWITCH MDC-1	OFF	EITHER POSITION	OFF	OFF	NORMAL	NORMAL	NORMAL	EITHER POSITION	OFF	EITHER POSITION

*WITH THRUST ON LOGIC IN SCS SATISFIED

**THIS IS A TEST CONFIGURATION ONLY

THE THRUST ON LOGIC IS SATISFIED (SCS)
BY DEPRESSING THE DIRECT ULLAGE AND
THRUST ON PUSHBUTTON ON MDC-1, OR BY
(G&N) AN ENGINE ON SIGNAL FROM THE
CMC. NO ACTUAL THRUSTING IS PRESENT,
SINCE BOTH ΔV THRUST SWITCHES A AND B
ON MDC-1 ARE IN THE OFF POSITION

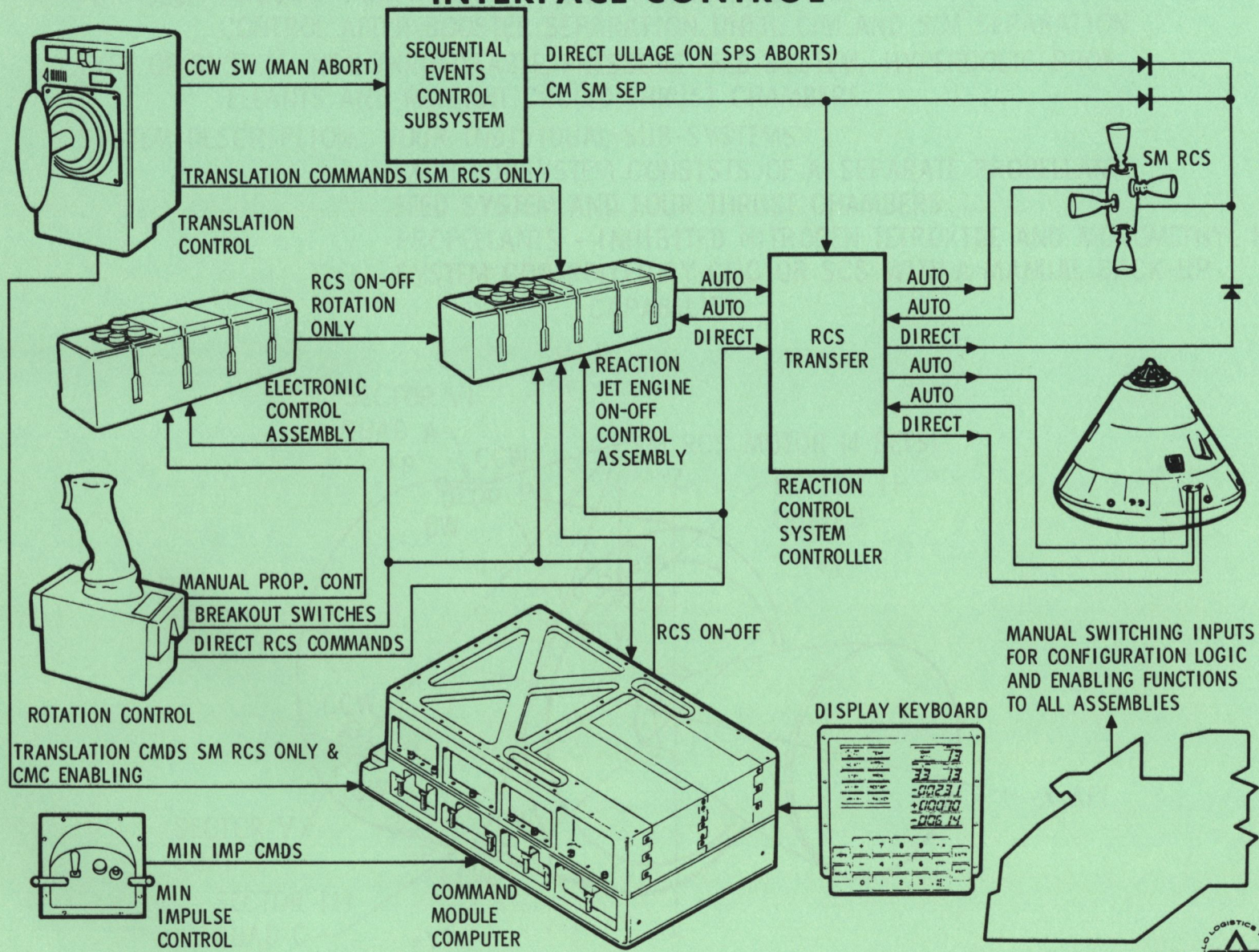
SPS FLIGHT COMBUSTION STABILITY MONITOR SYSTEM



P-5070D



CSM REACTION CONTROL SYSTEM INTERFACE CONTROL



P-6078



S/M REACTION CONTROL SYSTEM

PURPOSE: PROVIDE POWER FOR ATTITUDE AND/OR TRANSLATION

CONTROL AFTER BOOSTER SEPARATION UNTIL C/M AND S/M SEPARATION

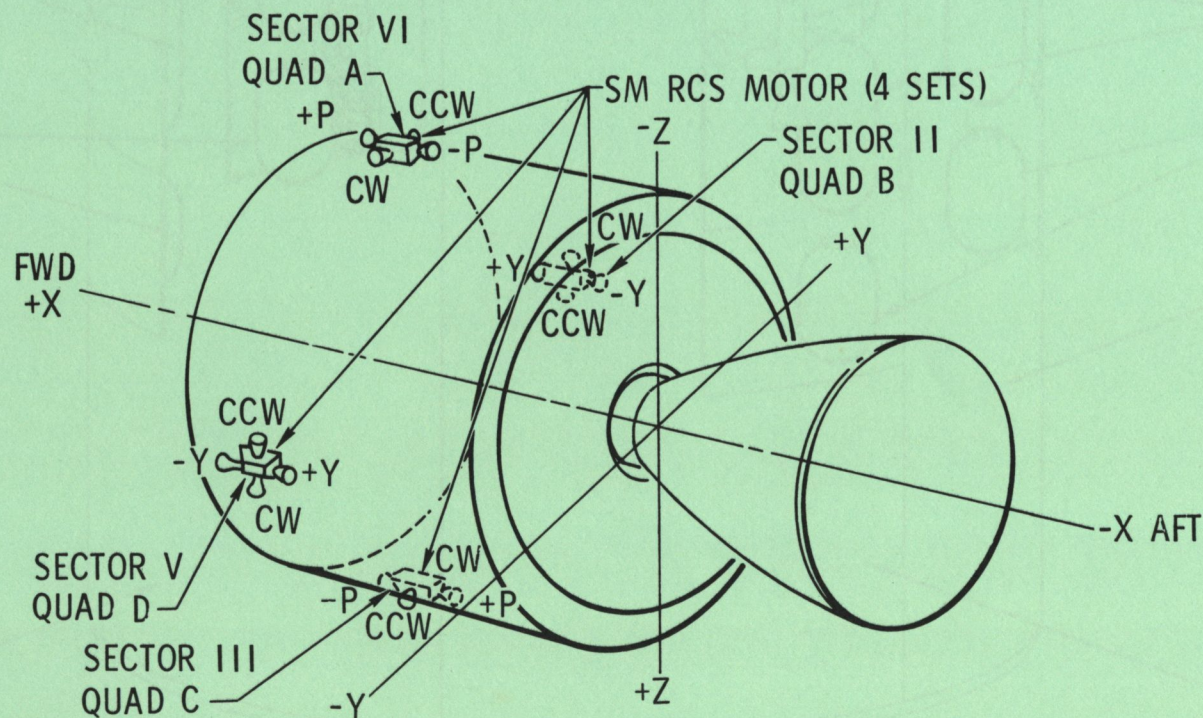
TYPE OF SYSTEM: NON THROTTLEABLE, PRESSURE FEED SYSTEM, HYPERGOLIC PROPELLANTS AND RADIANT COOLED THRUST CHAMBERS.

SYSTEM DESCRIPTION: FOUR INDIVIDUAL SUB-SYSTEMS

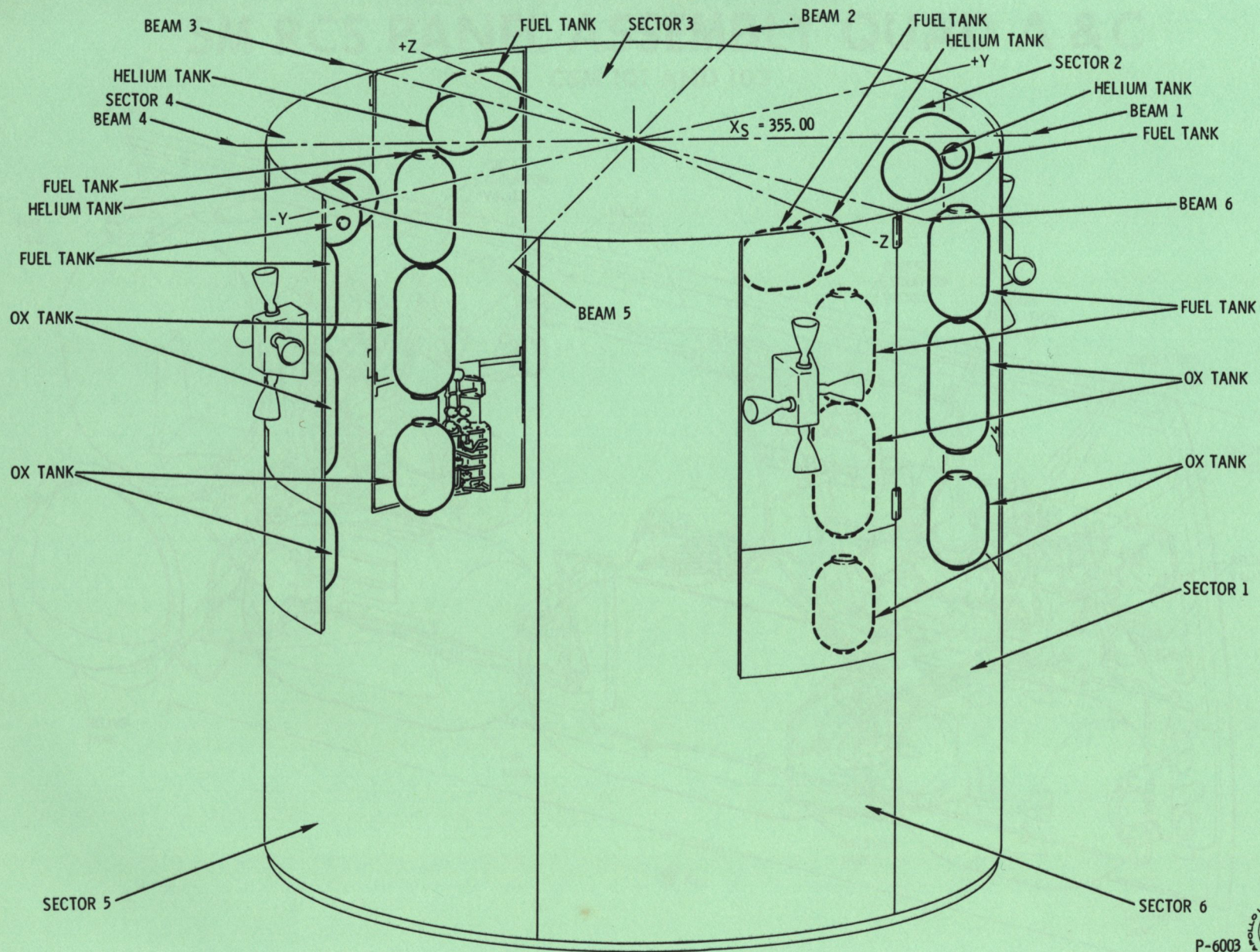
EACH SUBSYSTEM CONSISTS OF A SEPARATE PROPELLANT FEED SYSTEM AND FOUR THRUST CHAMBERS

PROPELLANTS - INHIBITED NITROGEN TETROXIDE AND MONOMETHYL HYDRAZINE

SYSTEM CONTROLLED BY CMC OR SCS WITH A MANUAL BACK-UP CAPABILITY

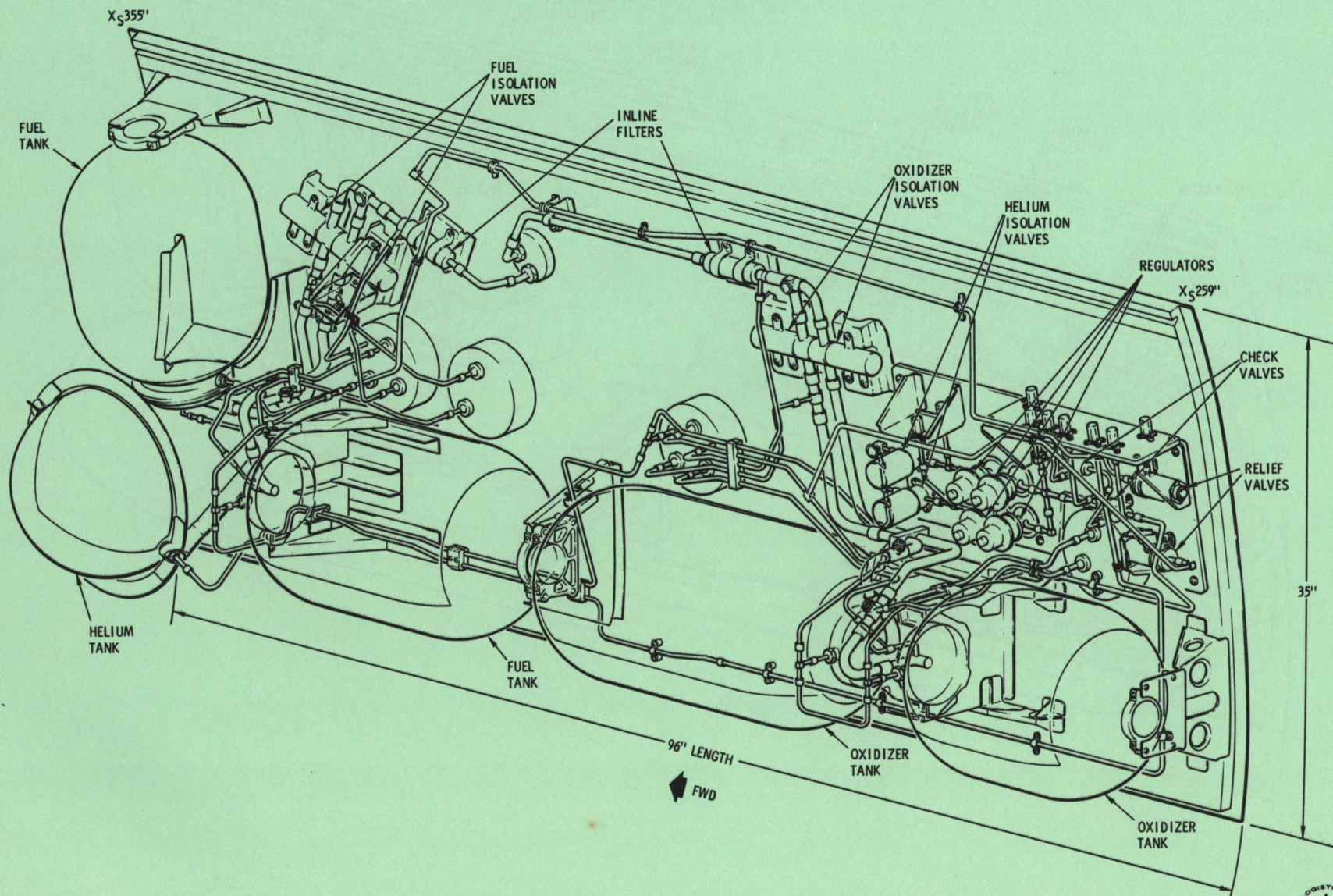


SM RCS QUADS



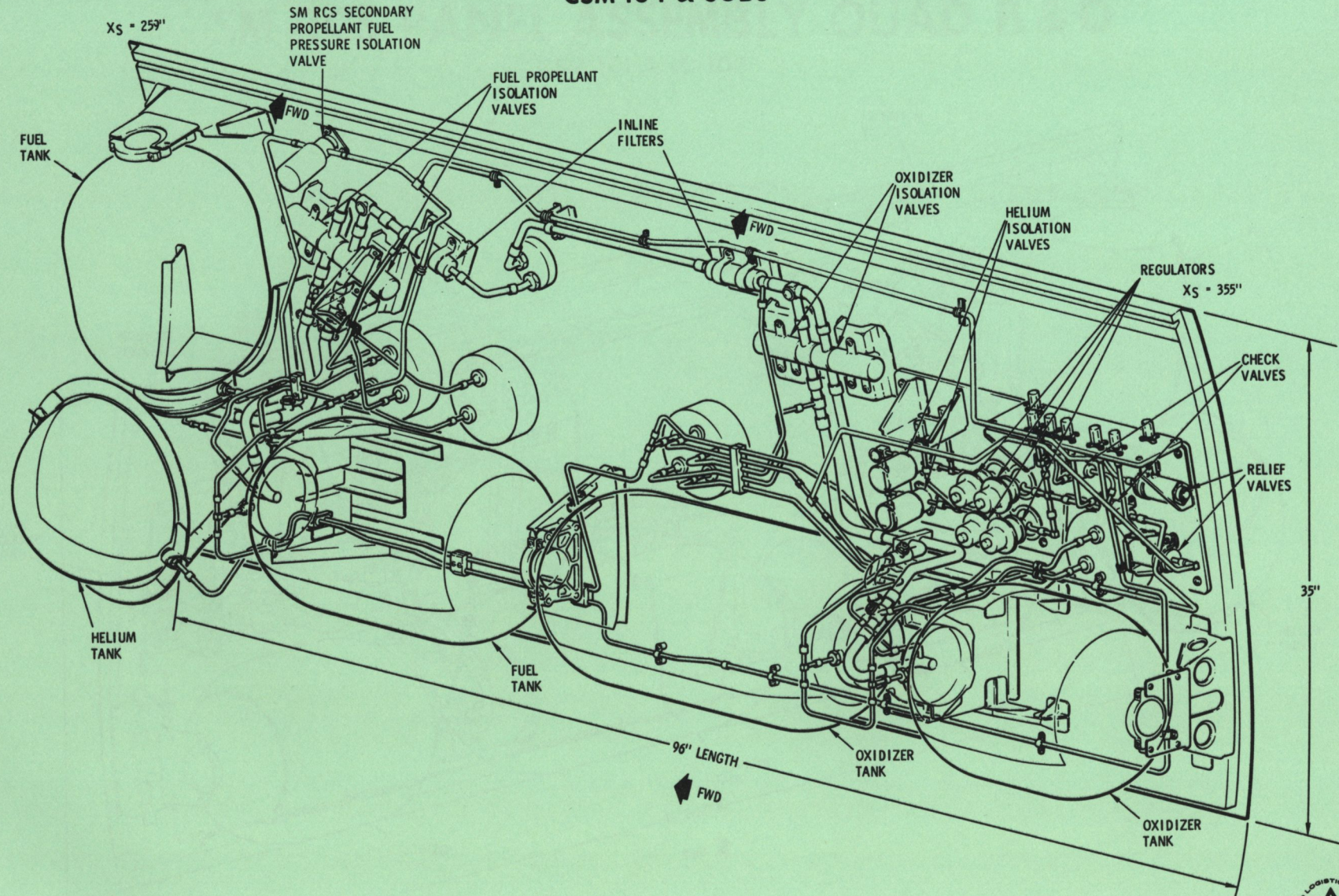
SM RCS PANEL ASSEMBLY QUAD A & C

CSM 101 AND 103



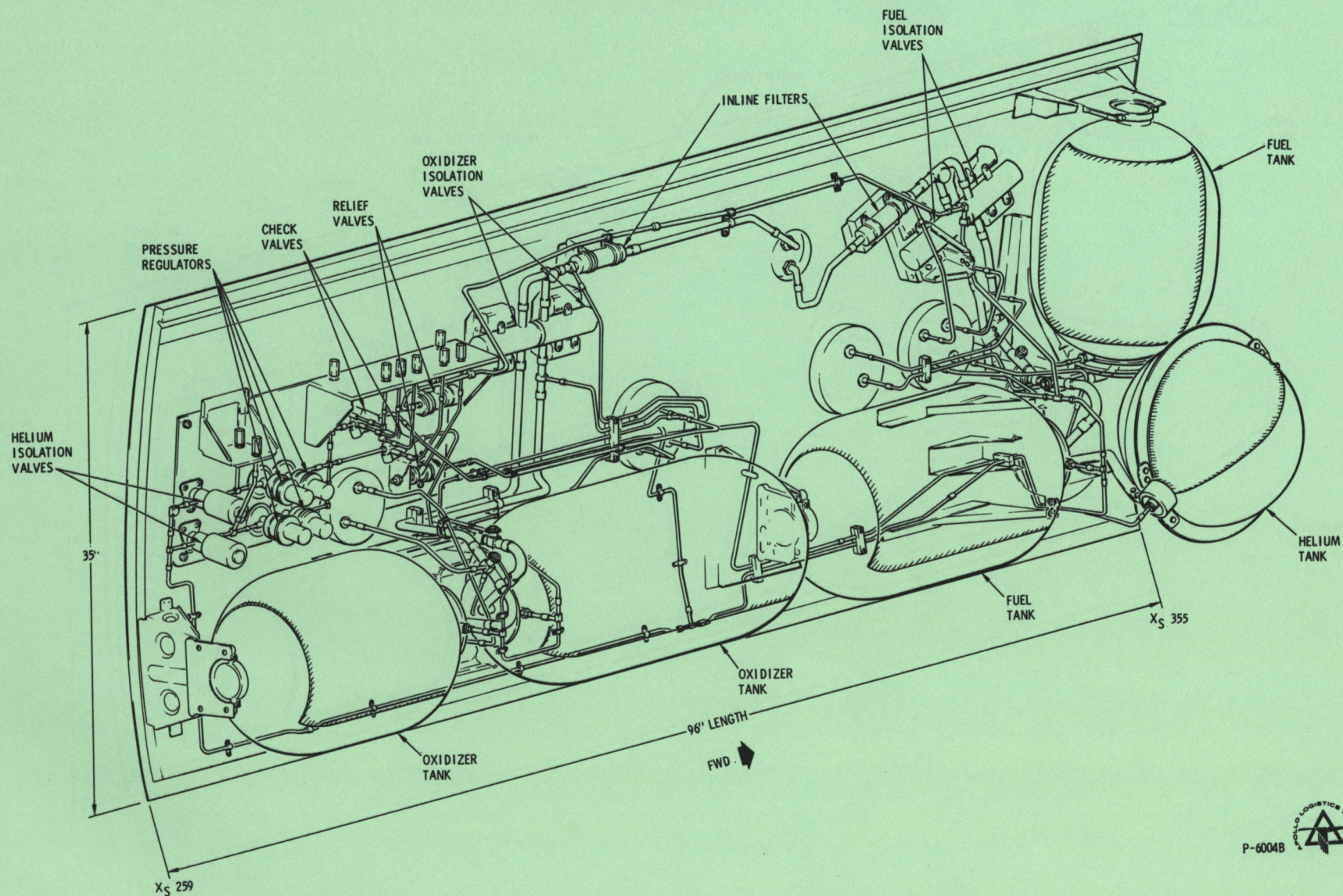
SM RCS PANEL ASSEMBLY QUAD A & C

CSM 104 & SUBS

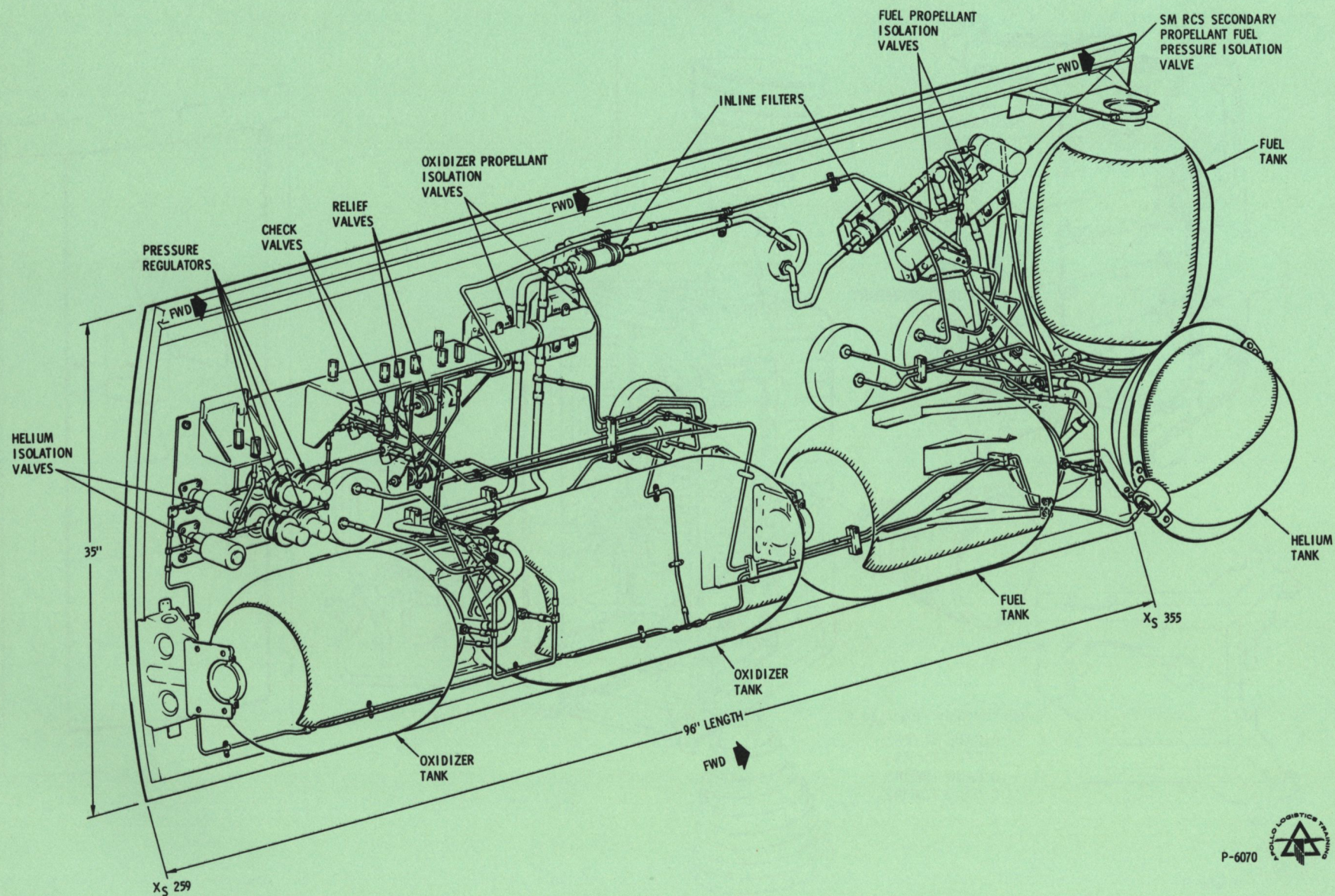


SM RCS PANEL ASSEMBLY QUAD B & D

CSM 101 AND 103

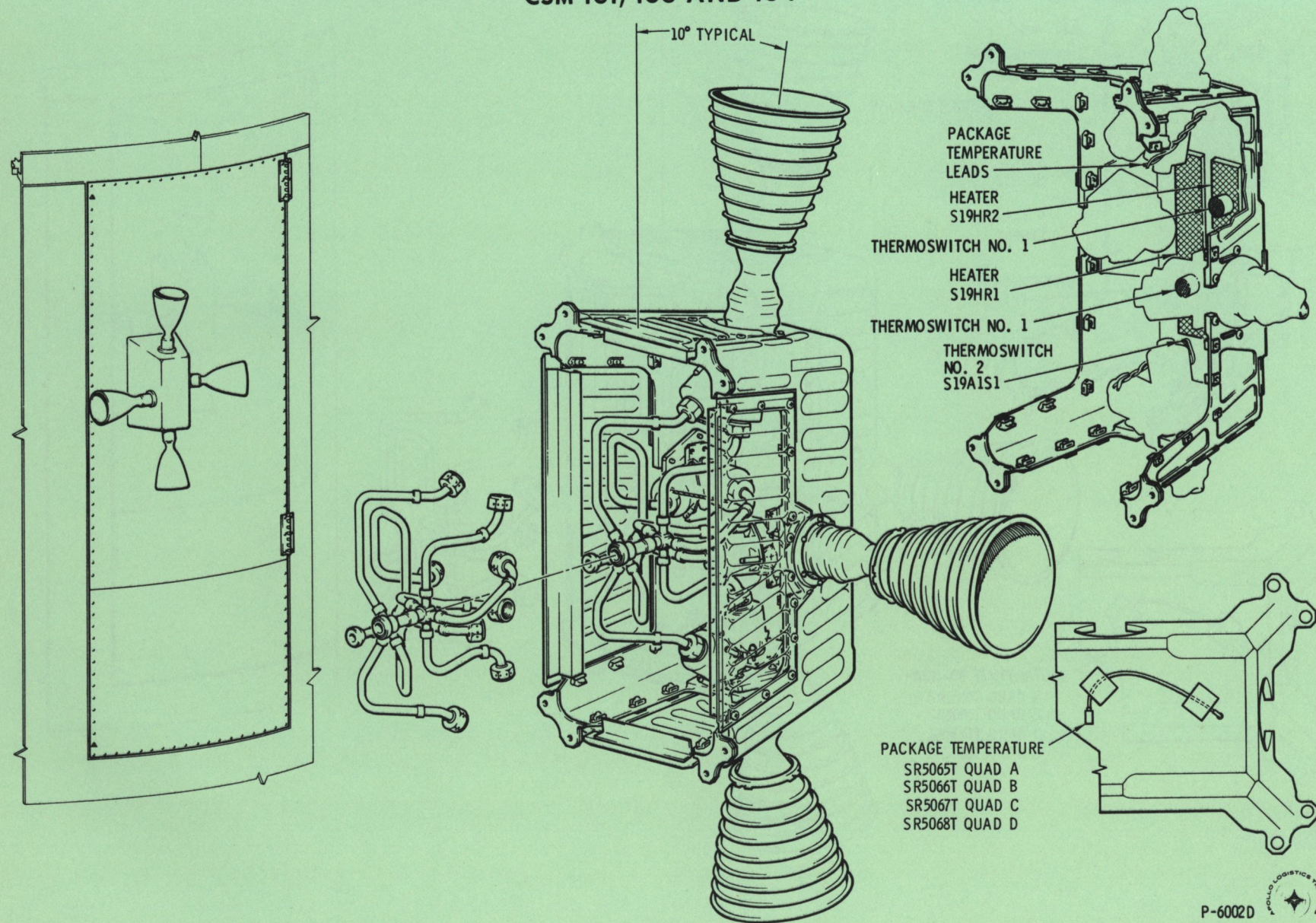


CSM 104 & SUBS



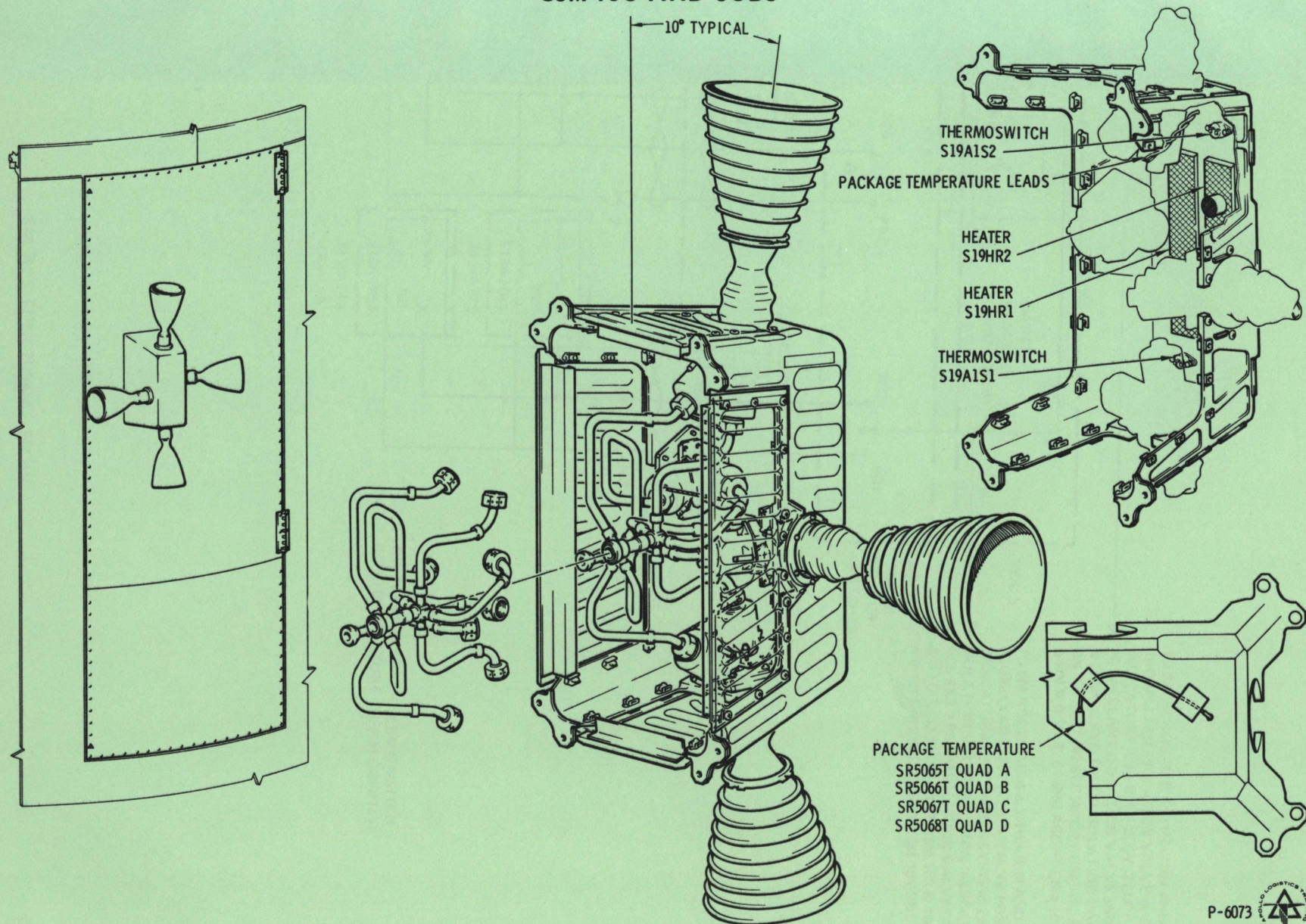
SM RCS ENGINE HOUSING

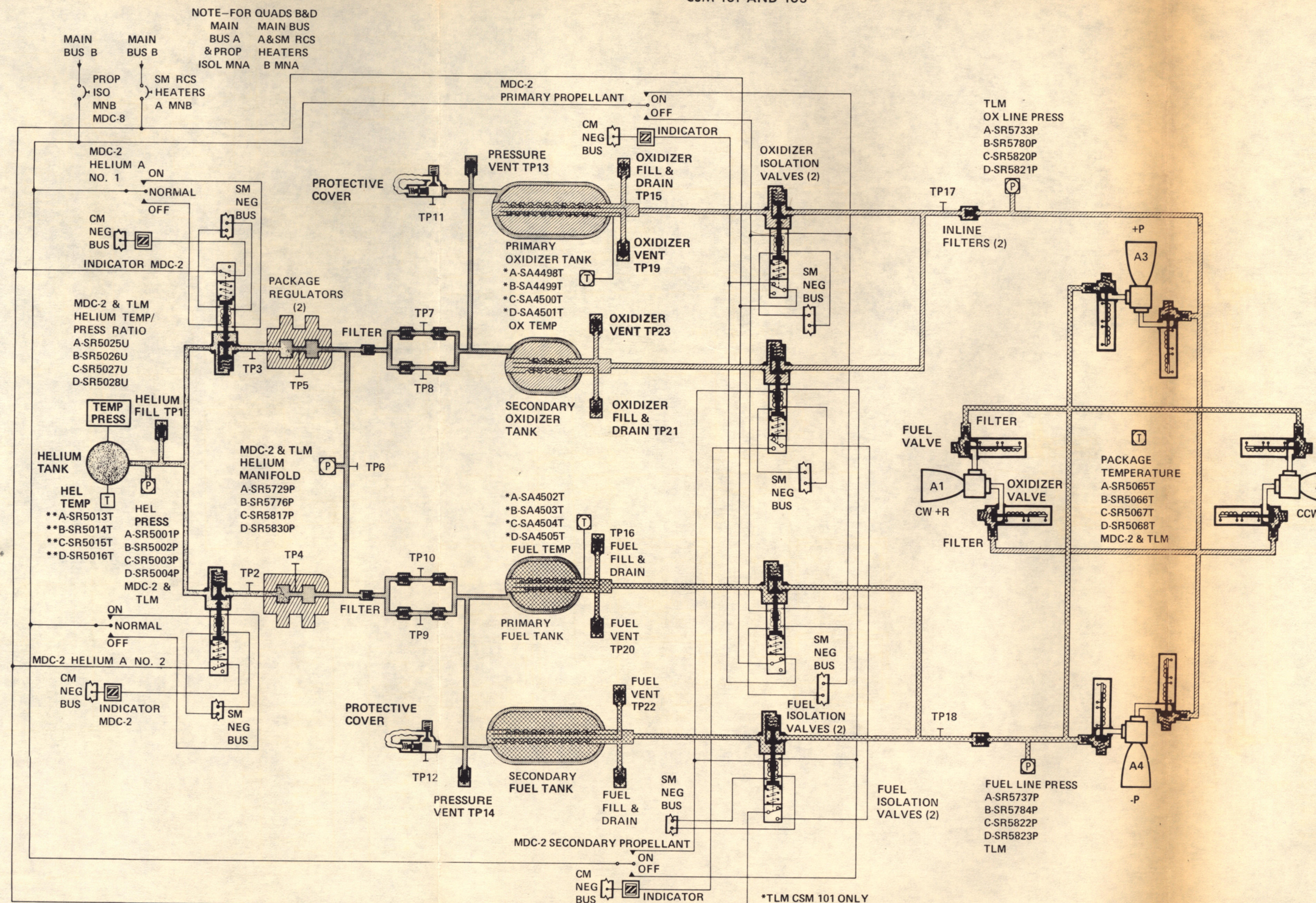
CSM 101, 103 AND 104



SM RCS ENGINE HOUSING

CSM 106 AND SUBS

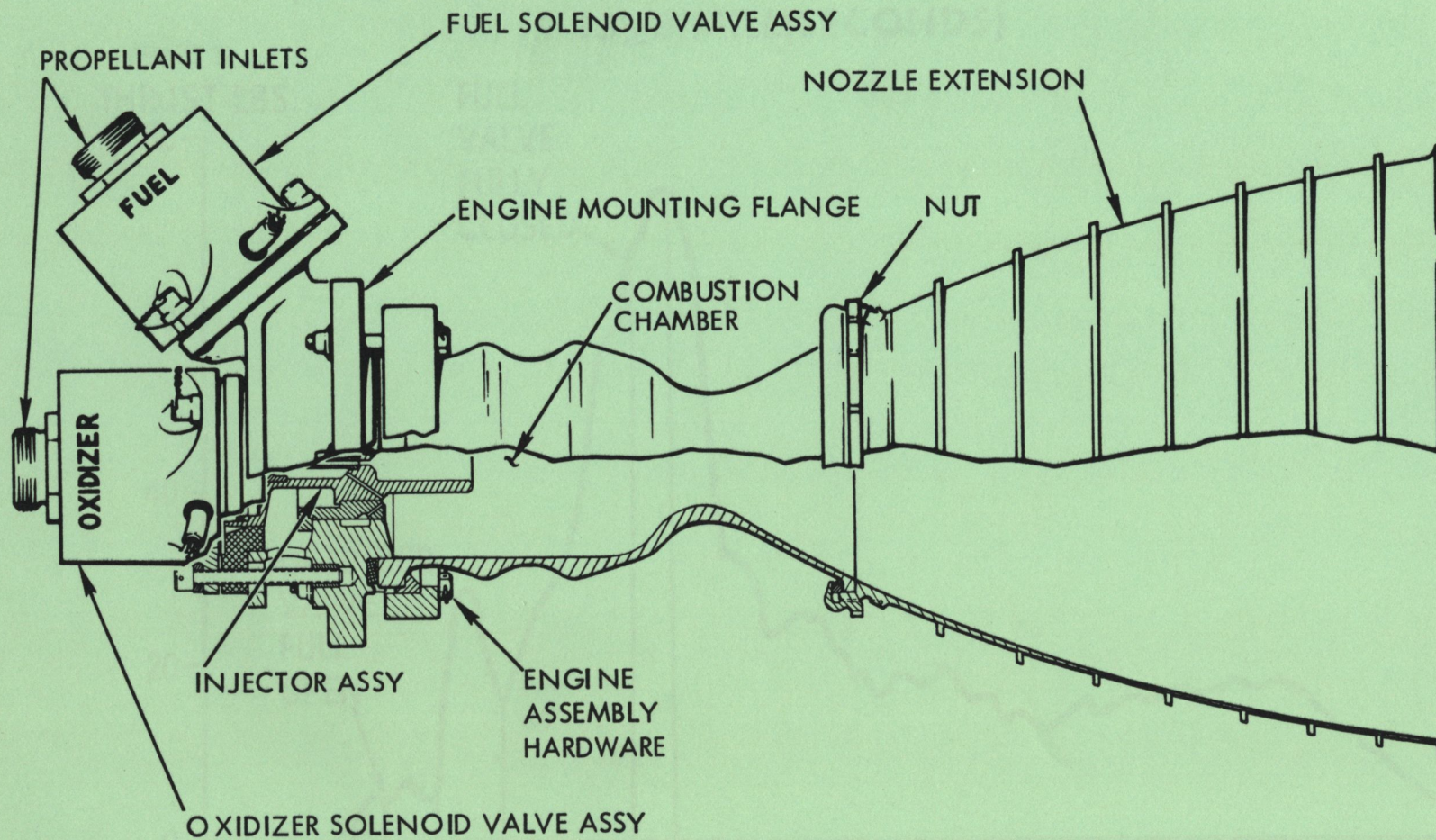




**TLM ONLY CSM 101,
MDC-2 AND TLM, 103 AND SUBS

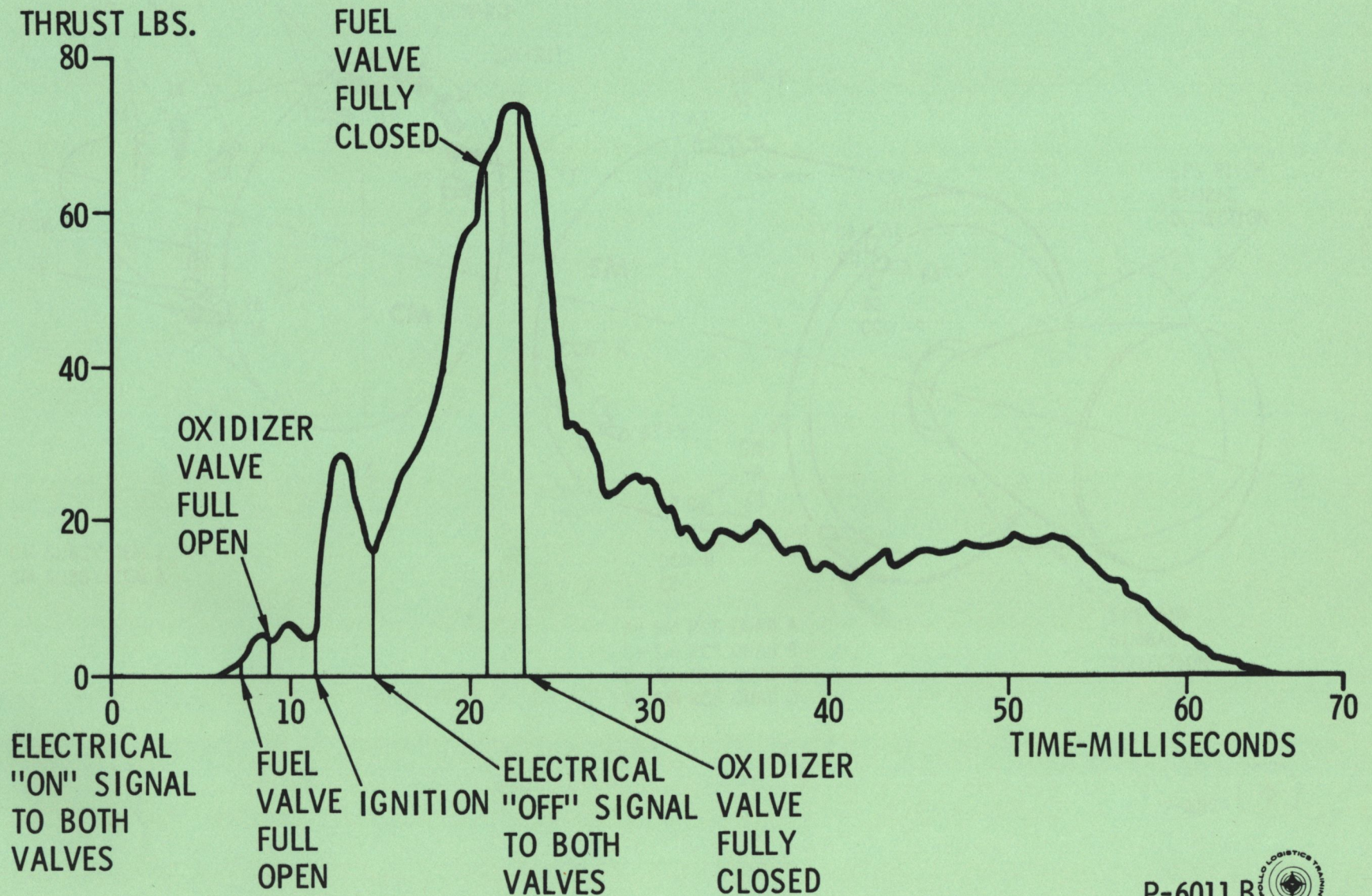


S/M RCS ENGINE CUTAWAY



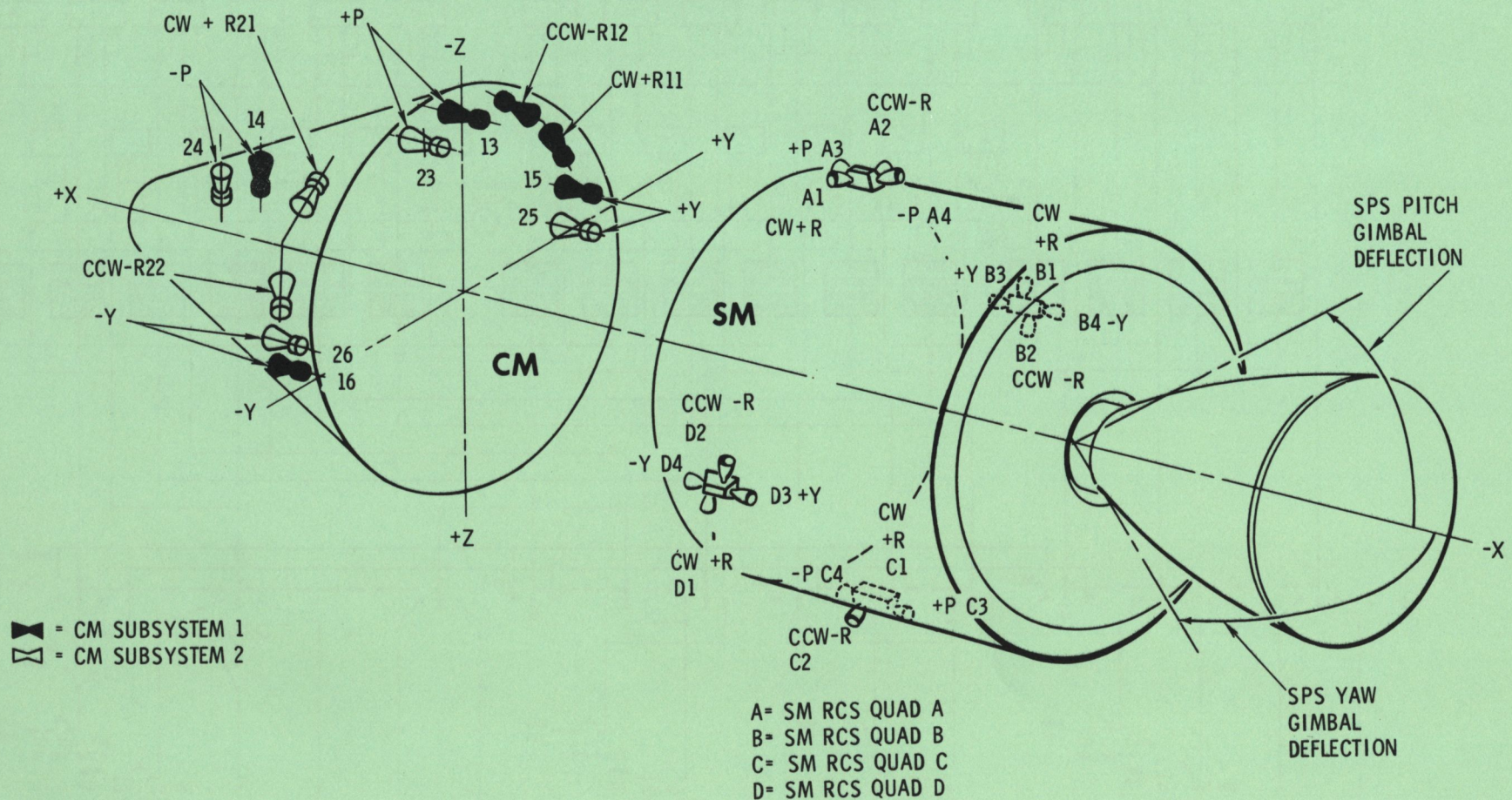
S/M RCS ENGINE-MINIMUM TOTAL IMPULSE

(CONTROLLER REACTION JET ON-OFF ASSEMBLY
15±3 MILLISECONDS)



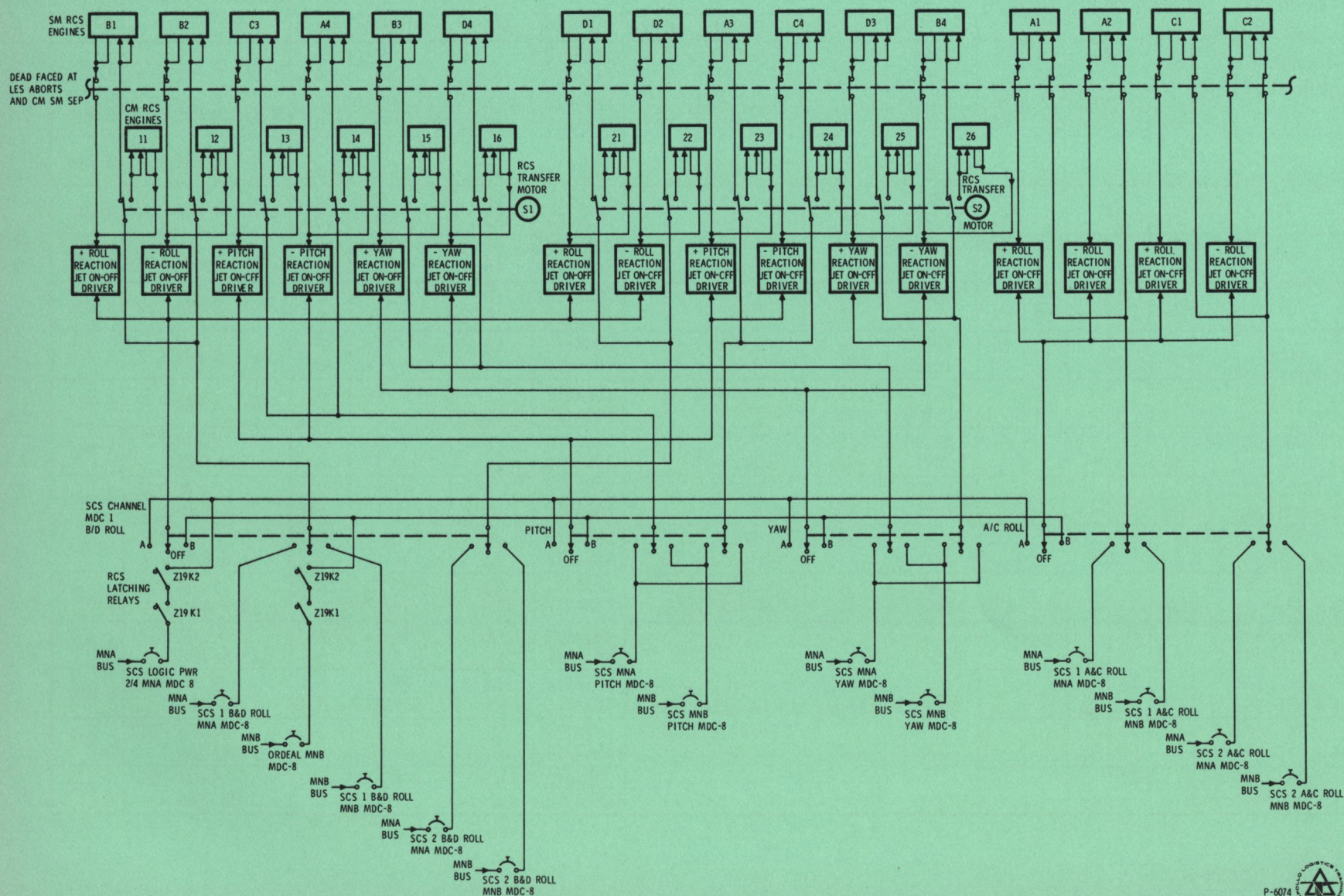
CM SM ENGINE LOCATIONS

CSM 101 & SUBS



CSM RCS AUTO CONTROL

CSM 101 ONLY



SM CM RCS ENGINE POWER SUPPLIES

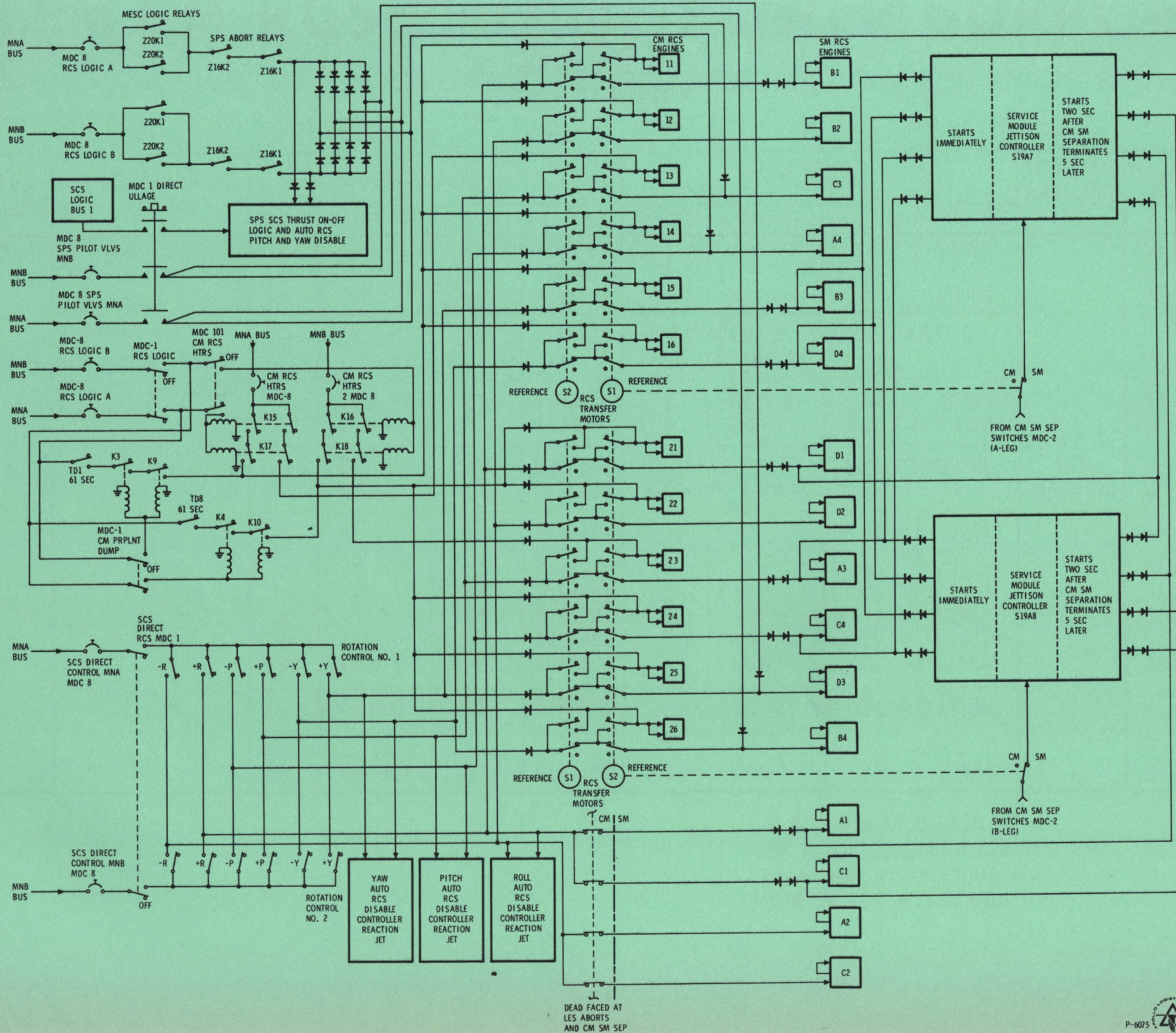
AUTOMATIC

CSM 101 ONLY

BUS POWER	CIRCUIT BREAKER PANEL 8	SM ENGINE				CM ENGINE				SM ENGINE UTILIZATION FOR TRANSLATION MANUEVERS						CHANNEL SWITCHES PANEL 1	TRANSFER MOTOR
		QUAD	MANEUVER	SCS NO.	PROP NO.	SYSTEM	MANEUVER	SCS NO.	PROP NO.	-X	+X	-Y	+Y	-Z	+Z		
MN A	SCS MN A PITCH	C A	+P -P	C3 A4	S19A3B3 S19A1B3	1 1	+P -P	13 14	C19B7 C19B11		C3 A4					PITCH POSITION A	S1 S1 S2 S2
MN B	SCS MN B PITCH	A C	+P -P	A3 C4	S19A1B1 S19A3B1	2 2	+P -P	23 24	C19B8 C19B12	A3 C4							
MN B	SCS MN B PITCH	C A	+P -P	C3 A4	S19A3B3 S19A1B3	1 1	+P -P	13 14	C19B7 C19B11		C3 A4					PITCH POSITION B	S1 S1 S2 S2
MN A	SCS MN A PITCH	A C	+P -P	A3 C4	S19A1B1 S19A3B1	2 2	+P -P	23 24	C19B8 C19B12	A3 C4							
MN A	SCS MN A YAW	B D	+Y -Y	B3 D4	S19A2B3 S19A4B3	1 1	+Y -Y	15 16	C19B9 C19B1	B3 D4						YAW POSITION A	S1 S1 S2 S2
MN B	SCS MN B YAW	D B	+Y -Y	D3 B4	S19A4B1 S19A2B1	2 2	+Y -Y	25 26	C19B10 C19B2		D3 B4						
MN B	SCS MN B YAW	B D	+Y -Y	B3 D4	S19A2B3 S19A4B3	1 1	+Y -Y	15 16	C19B9 C19B1	B3 D4						YAW POSITION B	S1 S1 S2 S2
MN A	SCS MN A YAW	D B	+Y -Y	D3 B4	S19A4B1 S19A2B1	2 2	+Y -Y	25 26	C19B10 C19B2		D3 B4						
MN A	SCS MN A 1 B&D ROLL	B B	CW+R CCW-R	B1 B2	S19A2B2 S19A2B4	1 1	CW+R CCW-R	11 12	C19B5 C19B3					B1 B2		B&D ROLL POSITION A	S1 S1
MN B	SCS MN B 1 B&D ROLL	B B	CW+R CCW-R	B1 B2	S19A2B2 S19A2B4	1 1	CW+R CCW-R	11 12	C19B5 C19B3					B1 B2			
MN A	SCS MN A 2 B&D ROLL	D D	CCW-R CW+R	D2 D1	S19A4B4 S19A4B2	2 2	CCW-R CW+R	22 21	C19B4 C19B6					D1 D2		B&D ROLL POSITION A	S2 S2
MN B	SCS MN B 2 B&D ROLL	D D	CCW-R CW+R	D2 D1	S19A4B4 S19A4B2	2 2	CCW-R CW+R	22 21	C19B4 C19B6					D1 D2			
MN A	SCS MN A 1 A&C ROLL	A A	CW+R CCW-R	A1 A2	S19A1B4 S19A1B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS							A1 A2			A&C ROLL POSITION A	
MN B	SCS MN B 1 A&C ROLL	A A	CW+R CCW-R	A1 A2	S19A1B4 S19A1B2								A1 A2				
MN A	SCS MN A 2 A&C ROLL	C C	CCW-R CW+R	C2 C1	S19A3B2 S19A3B4								C1 C2				
MN B	SCS MN B 2 A&C ROLL	C C	CCW-R CW+R	C2 C1	S19A3B2 S19A3B4								C1 C2				

CSM RCS DIRECT CONTROL

CSM 101 ONLY



SM CM RCS ENGINE POWER SUPPLIES

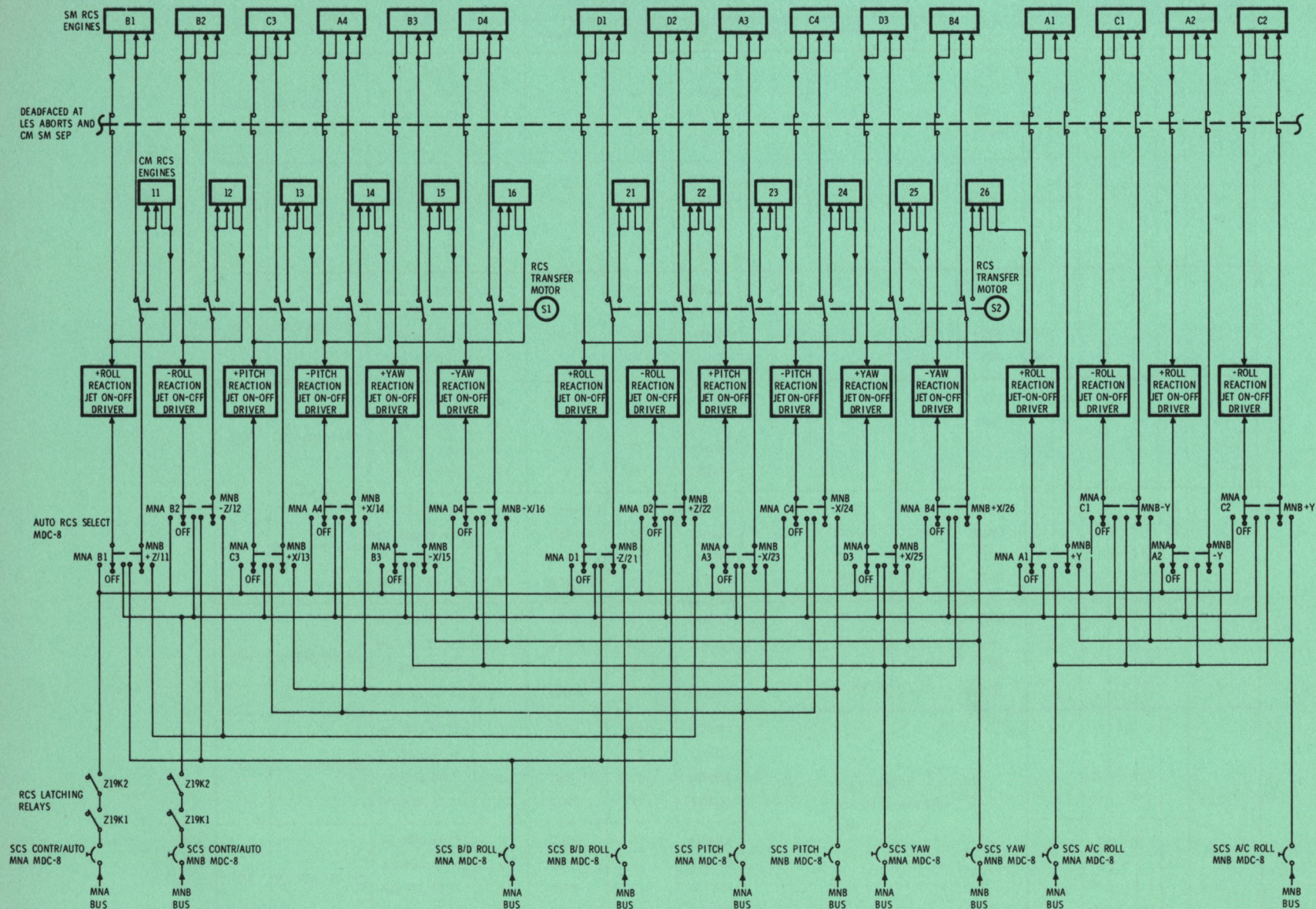
DIRECT
CSM 101 ONLY

BUS POWER	CIRCUIT BREAKER PANEL 8	SM ENGINE				CM ENGINE				CHANNEL SWITCHES PANEL 1	TRANSFER MOTOR
		QUAD	MANEUVER	SCS NO.	PROP NO.	SYSTEM	MANEUVER	SCS NO.	PROP NO.		
MN A	SCS MN A DIRECT CONTROL C15A6CB42 ROTATION CONTROL NO. 1	C	+P	C3	S19A3B3	1	+P	13	C19B7	DIRECT RCS SWITCH PANEL 1	S2 & S1
		D	-Y	D4	S19A4B3	1	-Y	16	C19B1		S2 & S1
MN B	SCS MN B DIRECT CONTROL C15A6CB41 ROTATION CONTROL NO. 2	B	+Y	B3	S19A2B3	1	+Y	15	C19B9		S2 & S1
		A	CCW-R	A2	S19A1B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS					S2 & S1 S2 & S1
		B	CCW-R CW+R	B2 B1	S19A2B4 S19A2B2	1 1	CCW-R CW+R	12 11	C19B3 C19B5		
		A	CW+R CW+R	A1 C1	S19A1B4 S19A3B4	DEADFACED AT CM SM SEPARATION AND LES ABORTS					S2 & S1
		A	-P	A4	S19A1B3	1	-P	14	C19B11		
		C	-P	C4	S19A3B1	2	-P	24	C19B12		S1 & S2
		A	+P	A3	S19A1B1	2	+P	23	C19B8		S1 & S2
		B	-Y	B4	S19A2B1	2	-Y	26	C19B2		S1 & S2
D	+Y	D3	S19A4B1	2	+Y	25	C19B10	S1 & S2			
D	CCW-R	D2	S19A4B4	2	CCW-R	22	C19B4	S1 & S2			
		C	CCW-R	C2	S19A3B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS					
		D	CW+R	D1	S19A4B2	2	CW+R	21	C19B6	S1 & S2	

SM RCS DIRECT ULLAGE CB
SPS PILOT VLVS MN A FOR
JETSA4ANDC3, SPS PILOT VLVS
MN B CB FOR JETSB4ANDD3.

CSM RCS AUTO CONTROL

CSM 103 AND SUBS



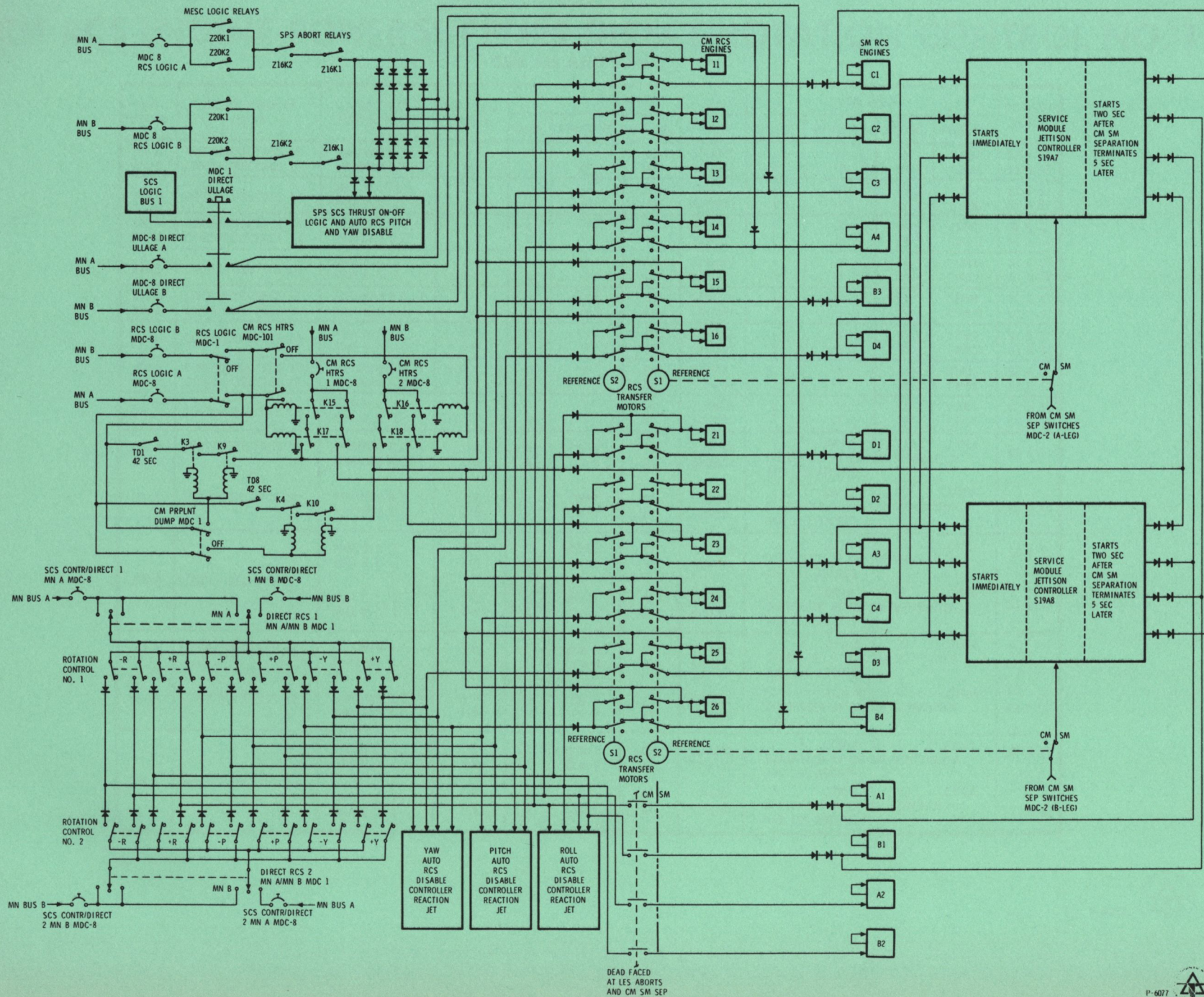
SM CM RCS ENGINE POWER SUPPLIES AUTOMATIC

CSM 103 & SUBS

BUS POWER	CIRCUIT BREAKER MDC 8	AUTORCS SELECT SWITCHES MDC 8	SM ENGINE				CM ENGINE				SM ENGINE UTILIZATION FOR TRANSLATION MANEUVERS						TRANSFER MOTOR
			QUAD	MANEUVER	SCS NO.	PROP. NO.	SYSTEM	MANEUVER	SCS NO.	PROP. NO.	-X	+X	-Y	+Y	-Z	+Z	
MNA	SCS MNA PITCH	PITCH C3 +X13	C	+P	C3	S19A3B3	1	+P	13	C19B7		C3					S1
		PITCH A4 +X14	A	-P	A4	S19A1B3	1	-P	14	C19B11		A4					S1
		PITCH A3 -X23	A	+P	A3	S19A1B1	2	+P	23	C19B8	A3						S2
		PITCH C4 -X24	C	-P	C4	S19A3B1	2	-P	24	C19B12	C4						S2
MNB	SCS MNB PITCH	PITCH C3 +X13	C	+P	C3	S19A3B3	1	+P	13	C19B7		C3					S1
		PITCH A4 +X14	A	-P	A4	S19A1B3	1	-P	14	C19B11		A4					S1
		PITCH A3 -X23	A	+P	A3	S19A1B1	2	+P	23	C19B8	A3						S2
		PITCH C4 -X24	C	-P	C4	S19A3B1	2	-P	24	C19B12	C4						S2
MNA	SCS MNA YAW	YAW D3 +X25	D	+Y	D3	S19A4B1	2	+Y	25	C19B10		D3					S2
		YAW B4 +X26	B	-Y	B4	S19A2B1	2	-Y	26	C19B2		B4					S2
		YAW B3 -X15	B	+Y	B3	S19A2B3	1	+Y	15	C19B9	B3						S1
		YAW D4 -X16	D	-Y	D4	S19A4B3	1	-Y	16	C19B1	D4						S1
MNB	SCS MNB YAW	YAW D3 +X 25	D	+Y	D3	S19A4B1	2	+Y	25	C19B10		D3					S2
		YAW B4 +X26	B	-Y	B4	S19A2B1	2	-Y	26	C19B2		B4					S2
		YAW B3 -X15	B	+Y	B3	S19A2B3	1	+Y	15	C19B9	B3						S1
		YAW D4 -X16	D	-Y	D4	S19A4B3	1	-Y	16	C19B1	D4						S1
MNA	SCS MNA B/D ROLL	B/D ROLL B1 +X11	B	CW+R	B1	S19A2B2	1	CW+R	11	C19B5						B1	S1
		B/D ROLL D2 +Z22	D	CCW-R	D2	S19A4B4	2	CCW-R	22	C19B4						D2	S2
		B/D ROLL D1 -Z21	D	CW+R	D1	S19A4B2	2	CW+R	21	C19B6					D1		S2
		B/D ROLL B2 -Z12	B	CCW-R	B2	S19A2B4	1	CCW-R	12	C19B3					B2		S1
MNB	SCS MNB B/D ROLL	B/D ROLL B1 +X11	B	CW+R	B1	S19A2B2	1	CW+R	11	C19B5						B1	S1
		B/D ROLL D2 +Z22	D	CCW-R	D2	S19A4B4	2	CCW-R	22	C19B4						D2	S2
		B/D ROLL D1 -Z21	D	CW+R	D1	S19A4B2	2	CW+R	21	C19B6					D1		S2
		B/D ROLL B2 -Z12	B	CCW-R	B2	S19A2B4	1	CCW-R	12	C19B3					B2		S1
MNA	SCS MNA A/C ROLL	A/C ROLL A1 +Y	A	CW+R	A1	S19A1B4	DEAD FACED AT CM SM SEPARATION AND LES ABORTS							A1			
		A/C ROLL C2 +Y	C	CCW-R	C2	S19A3B2								C2			
		A/C ROLL C1 -Y	C	CW+R	C1	S19A3B4								C1			
		A/C ROLL A2 -Y	A	CCW-R	A2	S19A1B2								A2			
MNB	SCS MNB A/C ROLL	A/C ROLL A1 +Y	A	CW+R	A1	S19A1B4								A1			
		A/C ROLL C2 +Y	C	CCW-R	C2	S19A3B2								C2			
		A/C ROLL C1 -Y	C	CW+R	C1	S19A3B4								C1			
		A/C ROLL A2 -Y	A	CCW-R	A2	S19A1B2								A2			

CSM RCS DIRECT CONTROL

CSM 103 AND SUBS



SM CM RCS ENGINE POWER SUPPLIES DIRECT ROTATION CONTROL NO. 1

CSM 103 AND SUBS

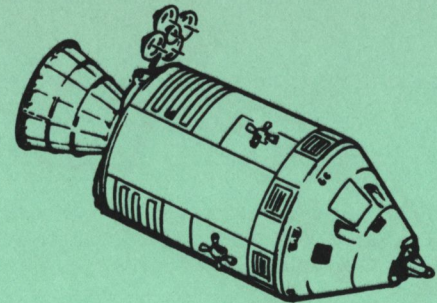
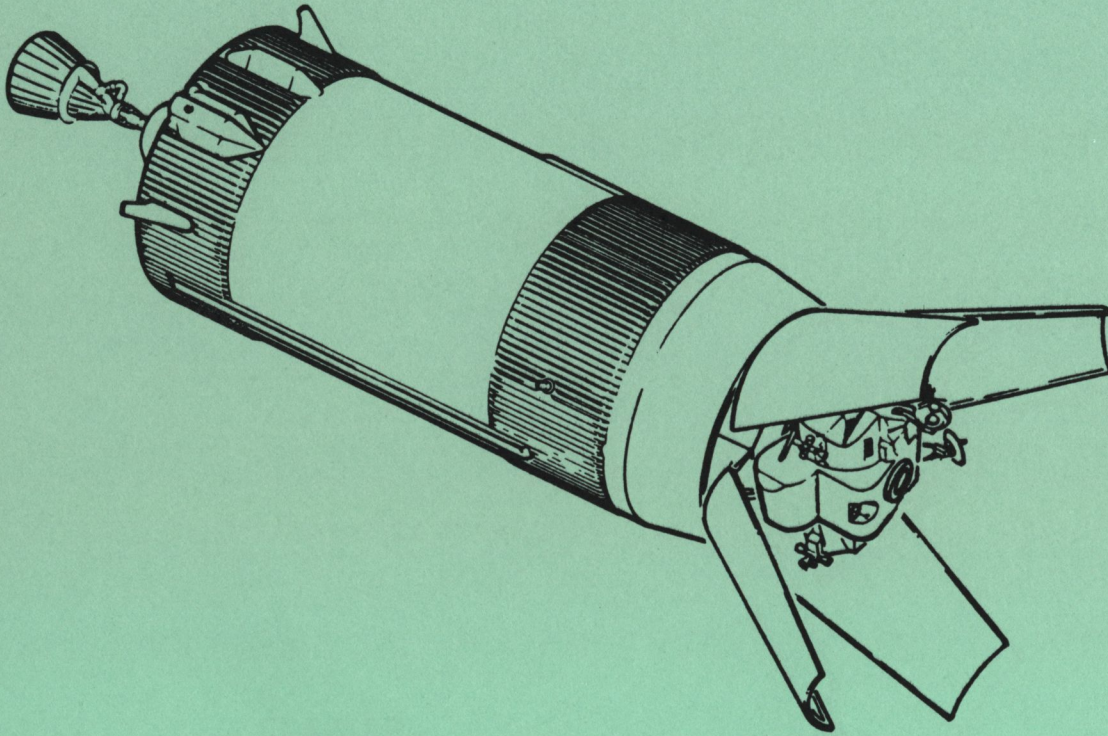
BUS POWER	CIRCUIT BREAKER MDC-8	DIRECT RCS SWITCH MDC 1	ROTATION CONTROL	SM ENGINE				CM ENGINE				TRANSFER MOTOR
				QUAD	MANEUVER	SCS NO.	PROP NO.	SYSTEM	MANEUVER	SCS NO.	PROP NO.	
MN A	CONTR/DIRECT RCS 1A	MNA/MNB R.C. 1	I+P	C	+P	C3	S19A3B3	1	+P	13	C19B7	S2 & S1
MN B	CONTR/DIRECT RCS 1B	MNA/MNB R.C. 1	I+P	A	+P	A3	S19A1B1	2	+P	23	C19B8	S1 & S2
MN A	CONTR/DIRECT RCS 1A	MNA R.C. 1	I+P	C	+P	C3	S19A3B3	1	+P	13	C19B7	S2 & S1
		MNA R.C. 1	I+P	A	+P	A3	S19A1B1	2	+P	23	C19B8	S1 & S2
MN A	CONTR/DIRECT RCS 1A	MNA/MNB R.C. 1	I-P	A	-P	A4	S19A1B3	1	-P	14	C19B11	S2 & S1
MN B	CONTR/DIRECT RCS 1B	MNA/MNB R.C. 1	I-P	C	-P	C4	S19A3B1	2	-P	24	C19B12	S1 & S2
MN A	CONTR/DIRECT RCS 1A	MNA R.C. 1	I-P	A	-P	A4	S19A1B3	1	-P	14	C19B11	S2 & S1
		MNA R.C. 1	I-P	C	-P	C4	S19A3B1	2	-P	24	C19B12	S1 & S2
MN A	CONTR/DIRECT RCS 1A	MNA/MNB R.C. 1	I+Y	B	+Y	B3	S19A2B3	1	+Y	15	C19B9	S2 & S1
MN B	CONTR/DIRECT RCS 1B	MNA/MNB R.C. 1	I+Y	D	+Y	D3	S19A4B1	2	+Y	25	C19B10	S1 & S2
MN A	CONTR/DIRECT RCS 1A	MNA R.C. 1	I+Y	B	+Y	B3	S19A2B3	1	+Y	15	C19B9	S2 & S1
		MNA R.C. 1	I+Y	D	+Y	D3	S19A4B1	2	+Y	25	C19B10	S1 & S2
MN A	CONTR/DIRECT RCS 1A	MNA/MNB R.C. 1	I-Y	D	-Y	D4	S19A4B3	1	-Y	16	C19B1	S2 & S1
MN B	CONTR/DIRECT RCS 1B	MNA/MNB R.C. 1	I-Y	B	-Y	B4	S19A2B1	2	-Y	26	C19B2	S1 & S2
MN A	CONTR/DIRECT RCS 1A	MNA R.C. 1	I-Y	D	-Y	D4	S19A4B3	1	-Y	16	C19B1	S2 & S1
		MNA R.C. 1	I-Y	B	-Y	B4	S19A2B1	2	-Y	26	C19B2	S1 & S2
MN A	CONTR/DIRECT RCS 1A	MNA/MNB R.C. 1	I+R	C	CW+R	C1	S19A3B4	1	CW+R	11	C19B5	S2 & S1
		MNA/MNB R.C. 1	I+R	A	CW+R	A1	S19A1B4	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
MN B	CONTR/DIRECT RCS 1B	MNA/MNB R.C. 1	I+R	D	CW+R	D1	S19A4B2	2	CW+R	21	C19B6	S1 & S2
		MNA/MNB R.C. 1	I+R	B	CW+R	B1	S19A2B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
MN A	CONTR/DIRECT RCS 1A	MNA R.C. 1	I+R	C	CW+R	C1	S19A3B4	1	CW+R	11	C19B5	S2 & S1
		MNA R.C. 1	I+R	A	CW+R	A1	S19A1B4	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
		MNA R.C. 1	I+R	D	CW+R	D1	S19A4B2	2	CW+R	21	C19B6	S1 & S2
		MNA R.C. 1	I+R	B	CW+R	B1	S19A2B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
MN A	CONTR/DIRECT RCS 1A	MNA/MNB R.C. 1	I-R	C	CCW-R	C2	S19A3B2	1	CCW-R	12	C19B3	S2 & S1
		MNA/MNB R.C. 1	I-R	A	CCW-R	A2	S19A1B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
MN B	CONTR/DIRECT RCS 1B	MNA/MNB R.C. 1	I-R	D	CCW-R	D2	S19A4B4	2	CCW-R	22	C19B4	S1 & S2
		MNA/MNB R.C. 1	I-R	B	CCW-R	B2	S19A2B4	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
MN A	CONTR/DIRECT RCS 1A	MNA R.C. 1	I-R	C	CCW-R	C2	S19A3B2	1	CCW-R	12	C19B3	S2 & S1
		MNA R.C. 1	I-R	A	CCW-R	A2	S19A1B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
		MNA R.C. 1	I-R	D	CCW-R	D2	S19A4B4	2	CCW-R	22	C19B4	S1 & S2
		MNA R.C. 1	I-R	B	CCW-R	B2	S19A2B4	DEADFACED AT CM SM SEPARATION AND LES ABORTS				

SM CM RCS ENGINE POWER SUPPLIES DIRECT ROTATION CONTROL NO. 2

CSM 103 AND SUBS

BUS POWER	CIRCUIT BREAKER MDC-8	DIRECT RCS SWITCH MDC 1	ROTATION CONTROL	SM ENGINE				CM ENGINE				TRANSFER MOTOR
				QUAD	MANEUVER	SCS NO.	PROP NO.	SYSTEM	MANEUVER	SCS NO.	PROP NO.	
MN B	CONTR/DIRECTRCS 2B	MNA/MNB R.C. 2	2+P	C	+P	C3	S19A3B3	1	+P	13	C19B7	S2 & S1
MN A	CONTR/DIRECTRCS 2A	MNA/MNB R.C. 2	2+P	A	+P	A3	S19A1B1	2	+P	23	C19B8	S1 & S2
MN B	CONTR/DIRECTRCS 2B	MNA R.C. 2	2+P	C	+P	C3	S19A3B3	1	+P	13	C19B7	S2 & S1
		MNA R.C. 2	2+P	A	+P	A3	S19A1B1	2	+P	23	C19B8	S1 & S2
MN B	CONTR/DIRECTRCS 2B	MNA/MNB R.C. 2	2-P	A	-P	A4	S19A1B3	1	-P	14	C19B11	S2 & S1
MN A	CONTR/DIRECTRCS 2A	MNA/MNB R.C. 2	2-P	C	-P	C4	S19A3B1	2	-P	24	C19B12	S1 & S2
MN B	CONTR/DIRECTRCS 2B	MNA R.C. 2	2-P	A	-P	A4	S19A1B3	1	-P	14	C19B11	S2 & S1
		MNA R.C. 2	2-P	C	-P	C4	S19A3B1	2	-P	24	C19B12	S1 & S2
MN B	CONTR/DIRECTRCS 2B	MNA/MNB R.C. 2	2+Y	B	+Y	B3	S19A2B3	1	+Y	15	C19B9	S2 & S1
MN A	CONTR/DIRECTRCS 2A	MNA/MNB R.C. 2	2+Y	D	+Y	D3	S19A4B1	2	+Y	25	C19B10	S1 & S2
MN B	CONTR/DIRECTRCS 2B	MNA R.C. 2	2+Y	B	+Y	B3	S19A2B3	1	+Y	15	C19B9	S2 & S1
		MNA R.C. 2	2+Y	D	+Y	D3	S19A4B1	2	+Y	25	C19B10	S1 & S2
MN B	CONTR/DIRECTRCS 2B	MNA/MNB R.C. 2	2-Y	D	-Y	D4	S19A4B3	1	-Y	16	C19B1	S2 & S1
MN A	CONTR/DIRECTRCS 2A	MNA/MNB R.C. 2	2-Y	B	-Y	B4	S19A2B1	2	-Y	26	C19B2	S1 & S2
MN B	CONTR/DIRECTRCS 2B	MNA R.C. 2	2-Y	D	-Y	D4	S19A4B3	1	-Y	16	C19B1	S2 & S1
		MNA R.C. 2	2-Y	B	-Y	B4	S19A2B1	2	-Y	26	C19B2	S1 & S2
MN B	CONTR/DIRECTRCS 2B	MNA/MNB R.C. 2	2+R	C	CW+R	C1	S19A3B4	1	CW+R	11	C19B5	S2 & S1
		MNA/MNB R.C. 2	2+R	A	CW+R	A1	S19A1B4	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
MN A	CONTR/DIRECTRCS 2A	MNA/MNB R.C. 2	2+R	D	CW+R	D1	S19A4B2	2	CW+R	21	C19B6	S1 & S2
		MNA/MNB R.C. 2	2+R	B	CW+R	B1	S19A2B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
MN B	CONTR/DIRECTRCS 2B	MNA R.C. 2	2+R	C	CW+R	C1	S19A3B4	1	CW+R	11	C19B5	S2 & S1
		MNA R.C. 2	2+R	A	CW+R	A1	S19A1B4	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
		MNA R.C. 2	2+R	D	CW+R	D1	S19A4B2	2	CW+R	21	C19B6	S1 & S2
		MNA R.C. 2	2+R	B	CW+R	B1	S19A2B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
MN B	CONTR/DIRECTRCS 2B	MNA/MNB R.C. 2	2-R	C	CCW-R	C2	S19A3B2	1	CCW-R	12	C19B3	S2 & S1
		MNA/MNB R.C. 2	2-R	A	CCW-R	A2	S19A1B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
MN A	CONTR/DIRECTRCS 2A	MNA/MNB R.C. 2	2-R	D	CCW-R	D2	S19A4B4	2	CCW-R	22	C19B4	S1 & S2
		MNA/MNB R.C. 2	2-R	B	CCW-R	B2	S19A2B4	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
MN B	CONTR/DIRECTRCS 2B	MNA R.C. 2	2-R	C	CCW-R	C2	S19A3B2	1	CCW-R	12	C19B3	S2 & S1
		MNA R.C. 2	2-R	A	CCW-R	A2	S19A1B2	DEADFACED AT CM SM SEPARATION AND LES ABORTS				
		MNA R.C. 2	2-R	D	CCW-R	D2	S19A4B4	2	CCW-R	22	C19B4	S1 & S2
		MNA R.C. 2	2-R	B	CCW-R	B2	S19A2B4	DEADFACED AT CM SM SEPARATION AND LES ABORTS				

NORMAL CSM/LV SEPARATION

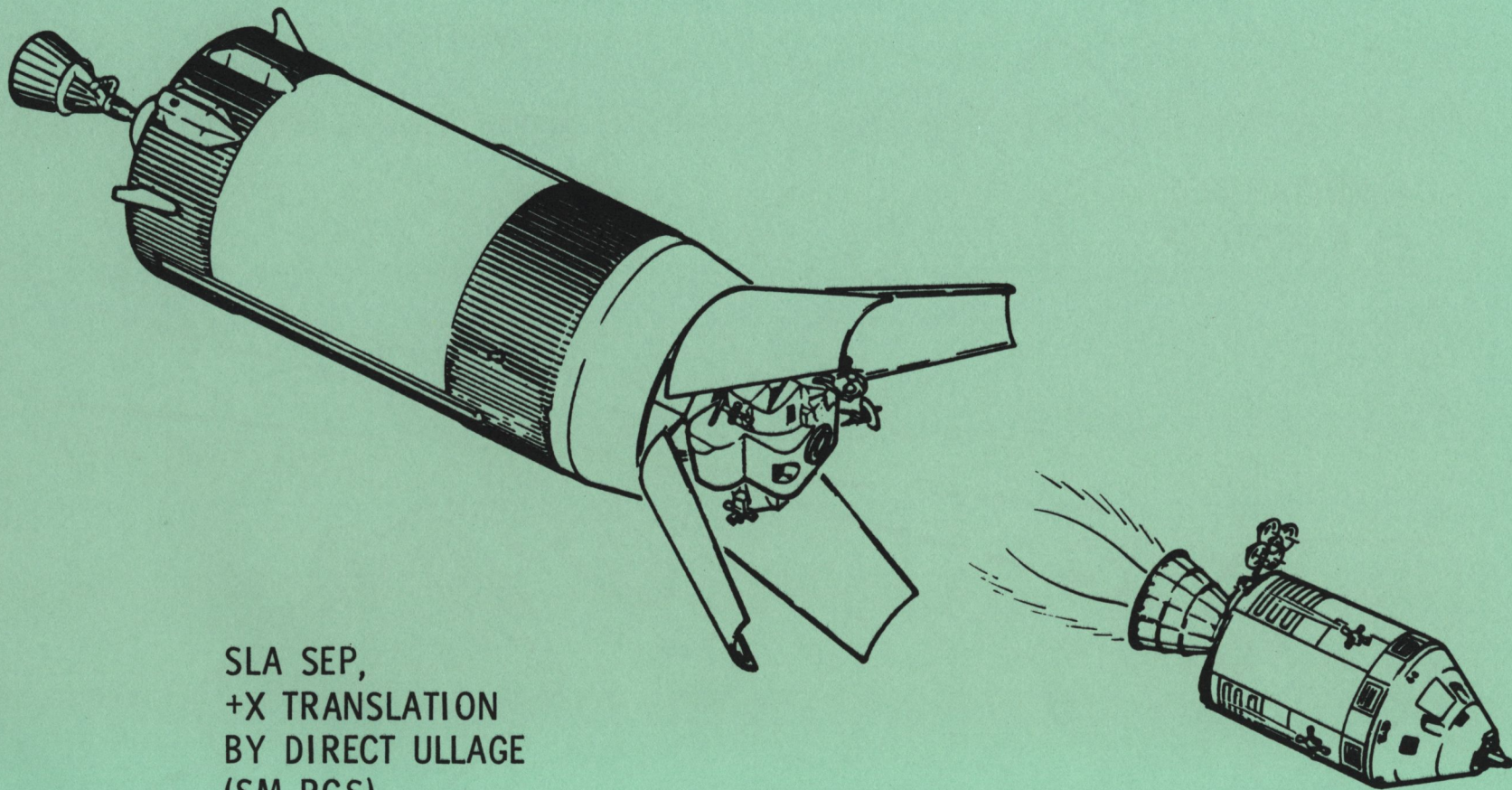


SEQ-542B



SPS ABORT

(TWR JETT TO NORMAL CSM/LV SEP)



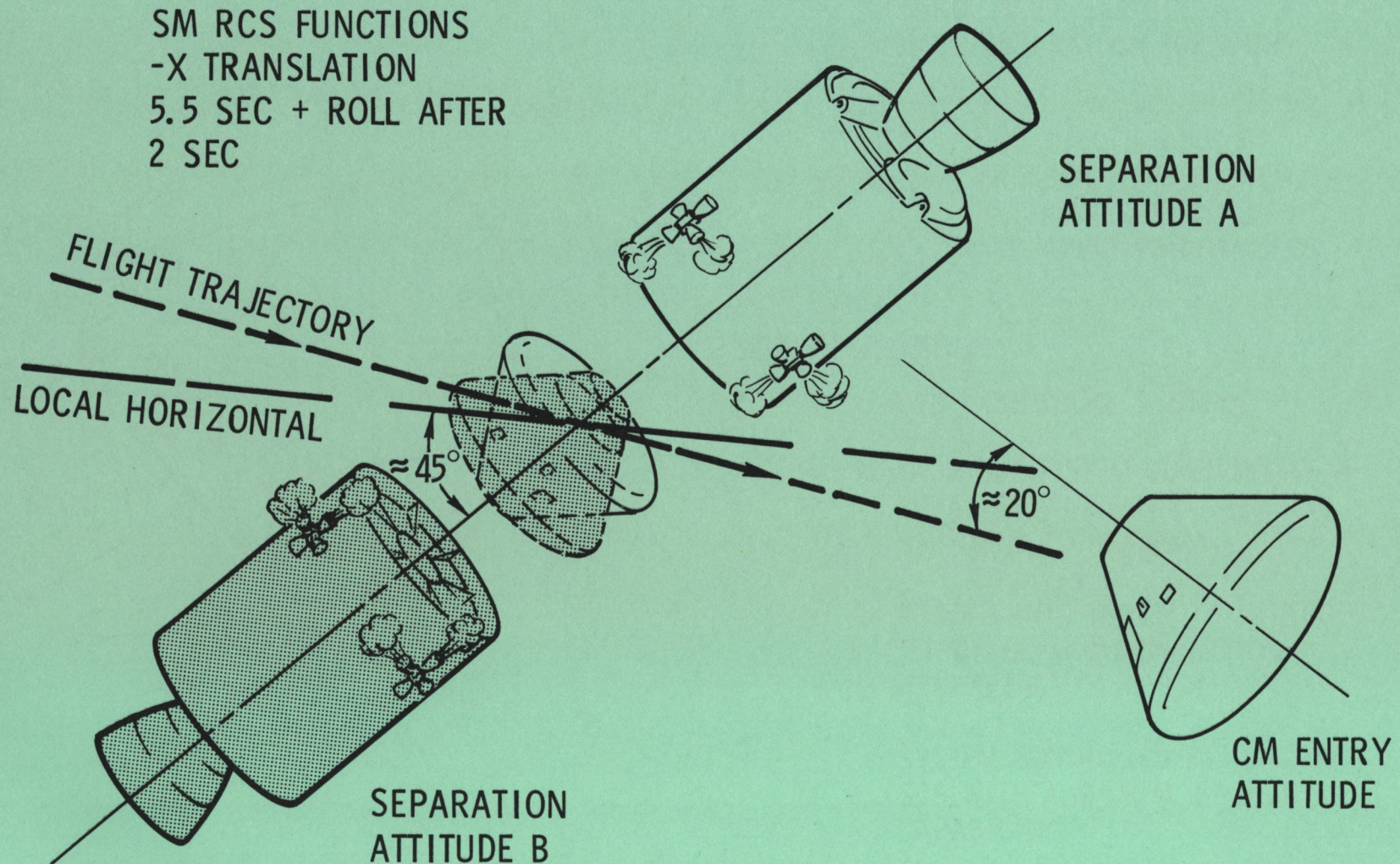
SLA SEP,
+X TRANSLATION
BY DIRECT ULLAGE
(SM RCS)

SEQ-540



NORMAL CM-SM SEPARATION AND SM JETTISON

BLOCK II



CM REACTION CONTROL SYSTEM

PURPOSE: PROVIDE THRUST FOR ATTITUDE
CONTROL AFTER SERVICE
MODULE SEPARATION FOR ENTRY

TYPE OF SYSTEM: NON THROTTLEABLE
PRESSURE-FEED SYSTEM,
HYPERGOLIC PROPELLANTS
AND ABLATIVE CHAMBERS

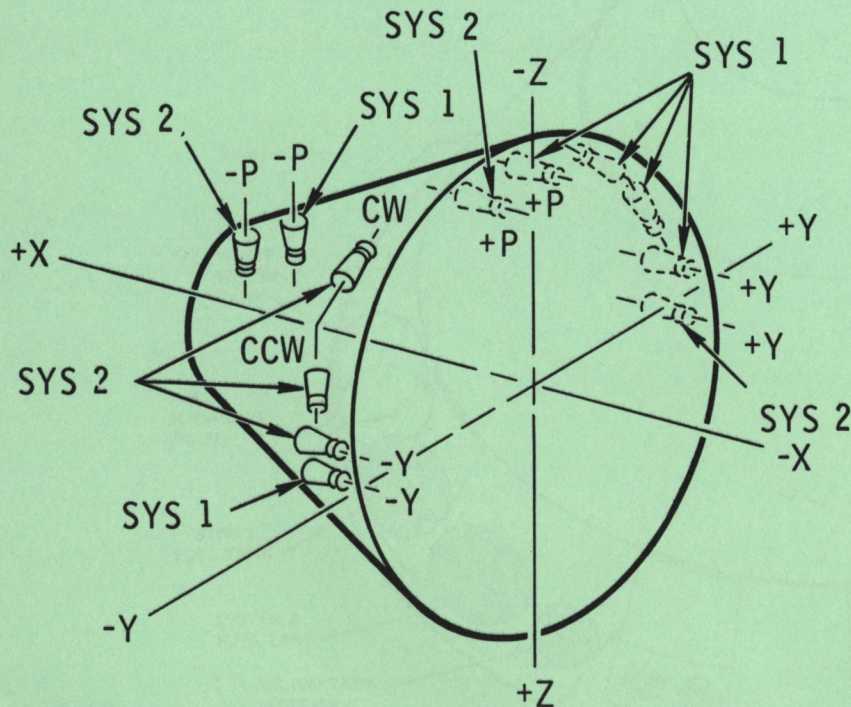
SYSTEM DESCRIPTION:

TWO INDIVIDUAL SYSTEMS

EACH SUBSYSTEM CONSISTS OF A
SEPARATE PROPELLANT FEED AND
SIX THRUST CHAMBERS

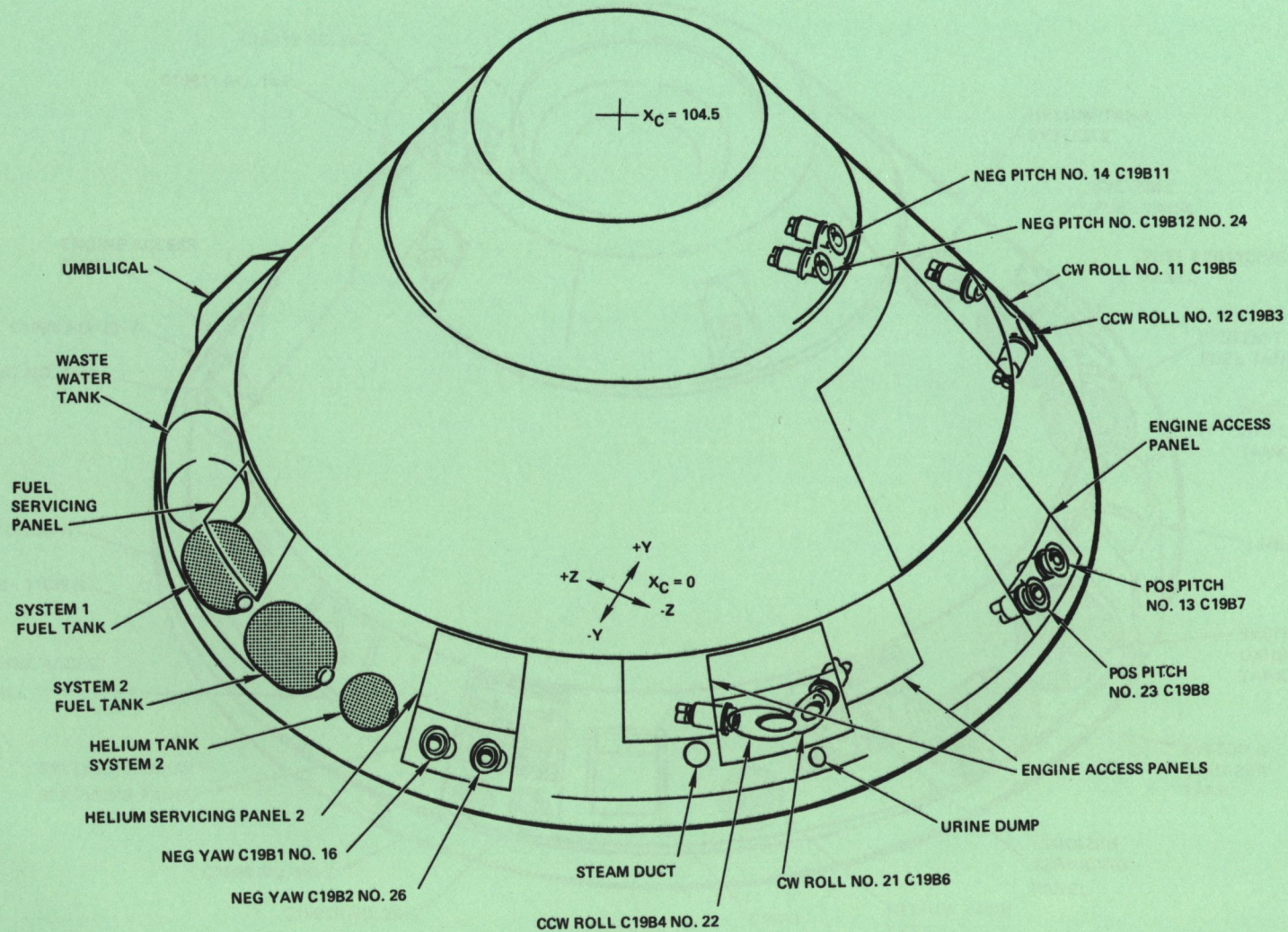
PROPELLANTS-INHIBITED NITROGEN
TETROXIDE AND MONOMETHYL
HYDRAZINE

SYSTEM CONTROLLED BY CMC OR
SCS WITH A MANUAL BACKUP
CAPABILITY



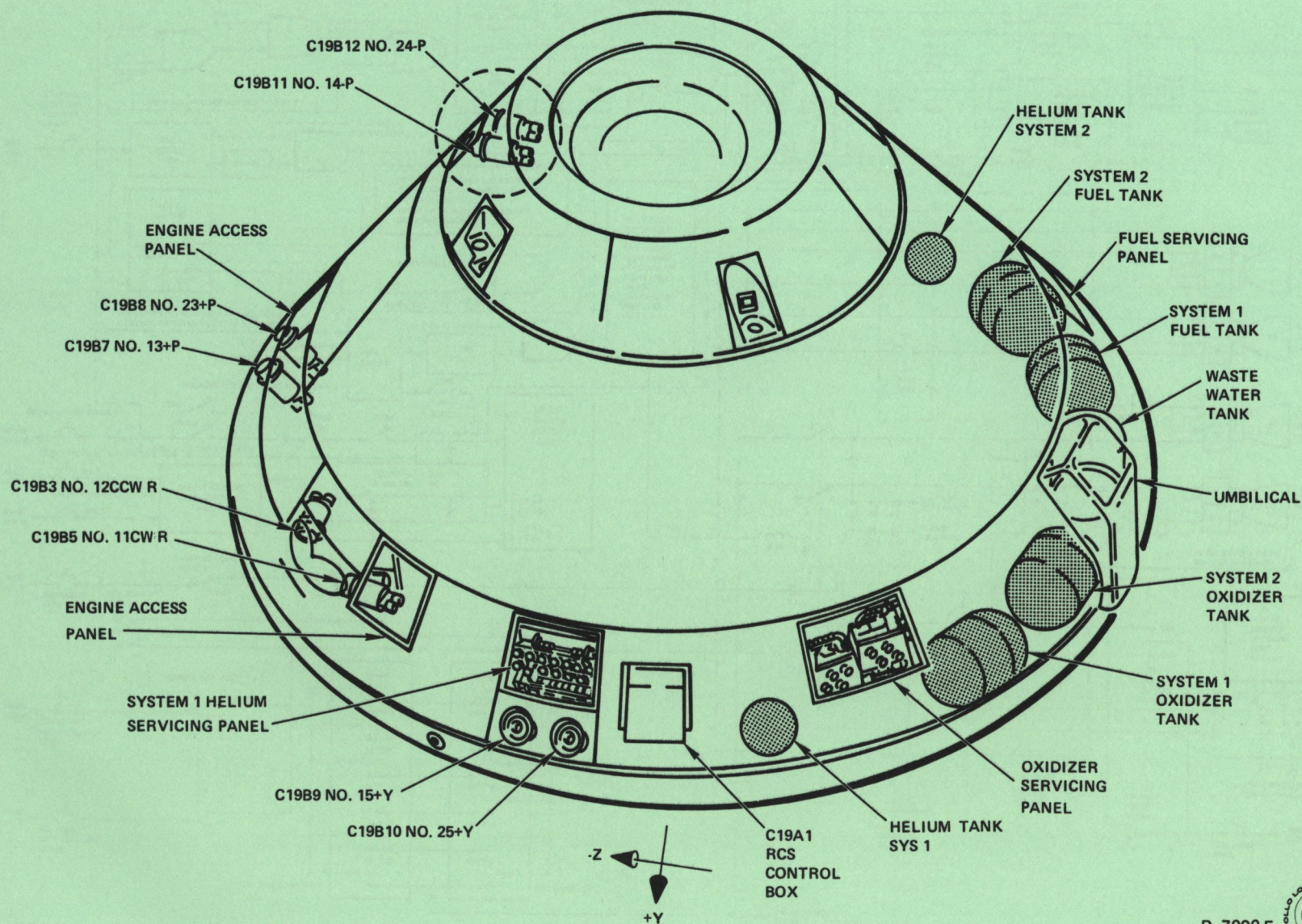
CMRCS COMPONENT LOCATION

VIEW A



CMRCS COMPONENT LOCATION

VIEW B

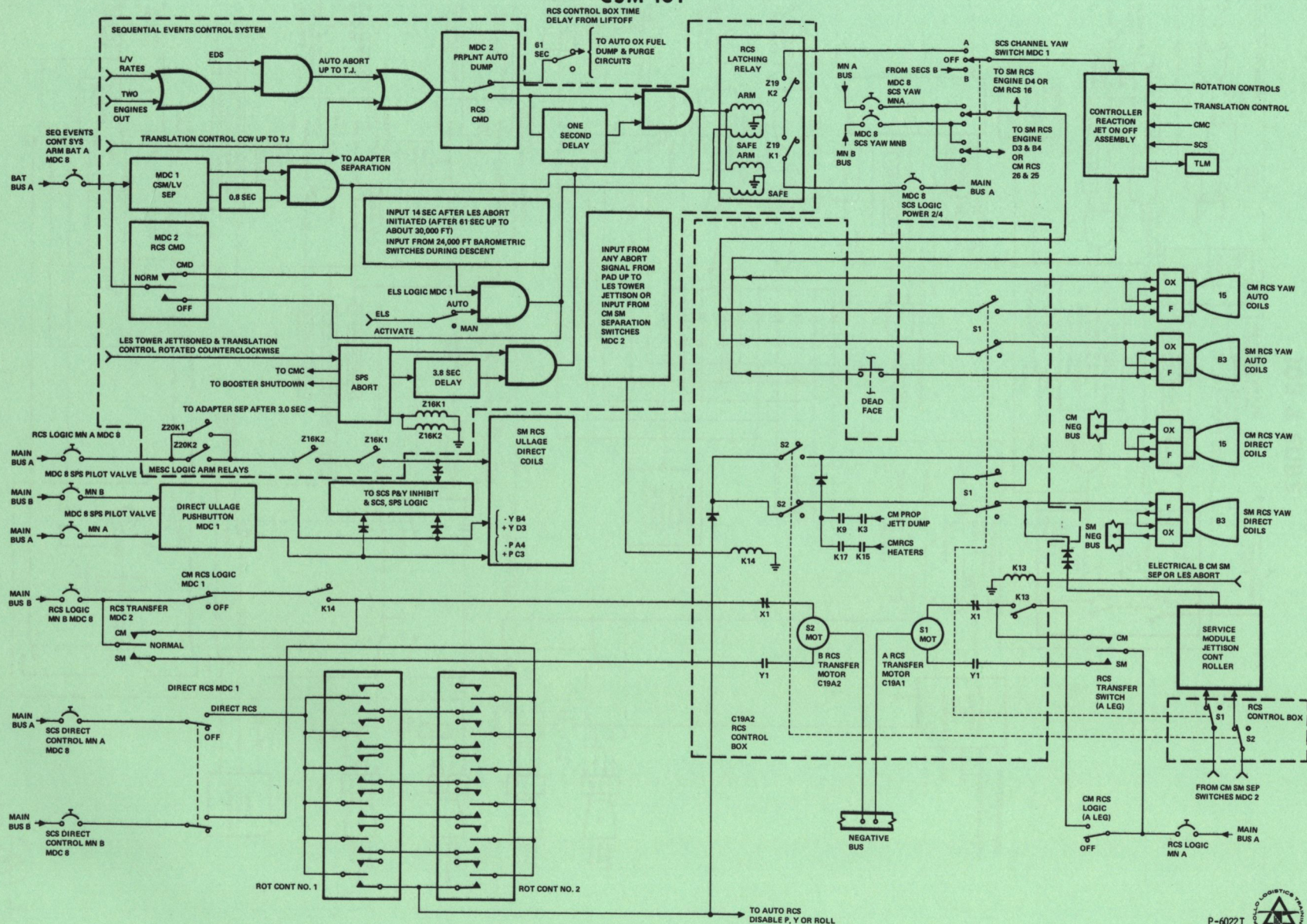


P-7028 E



RCS ELECTRICAL CONTROL

CSM 101

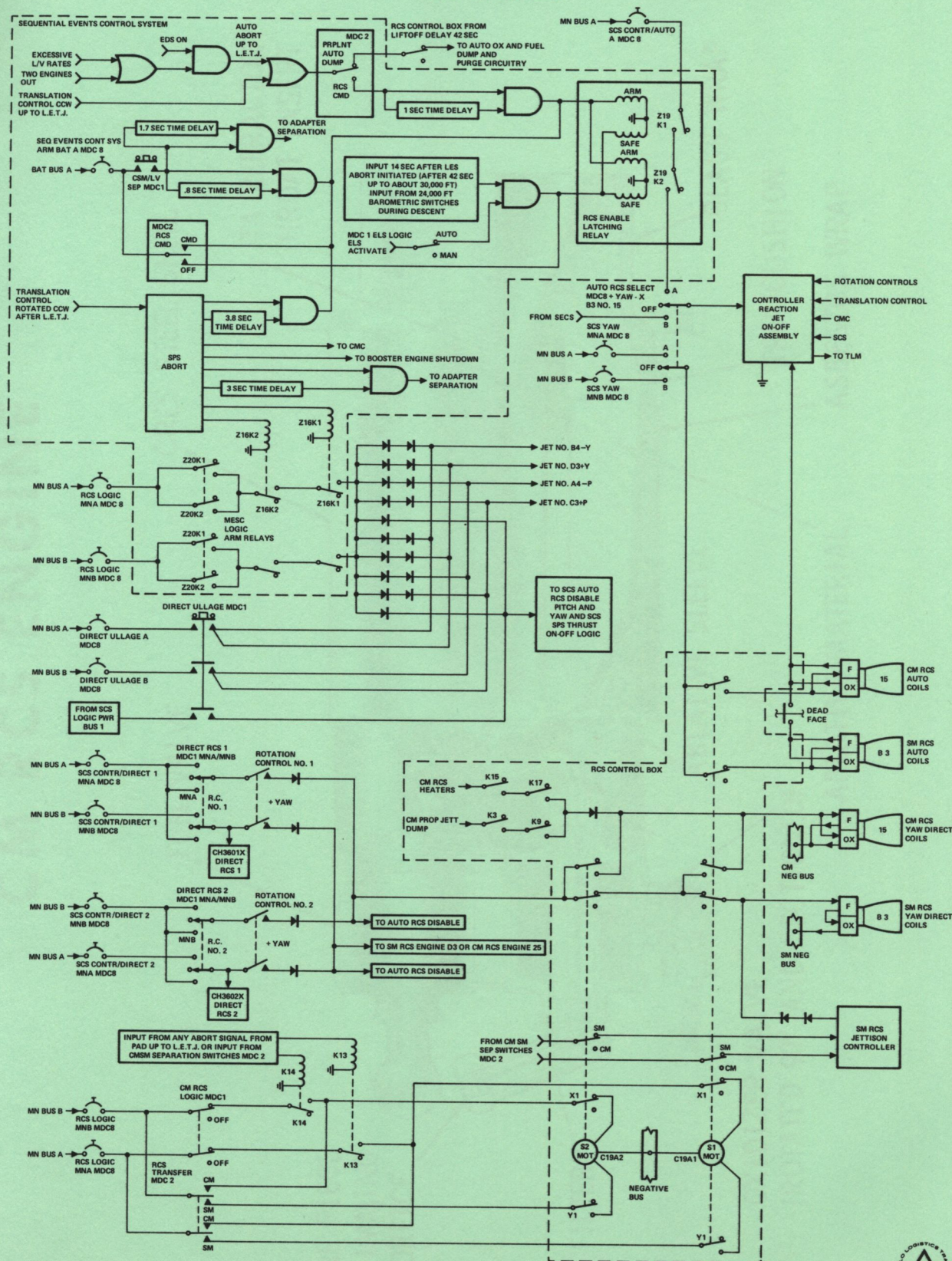


P-6022T

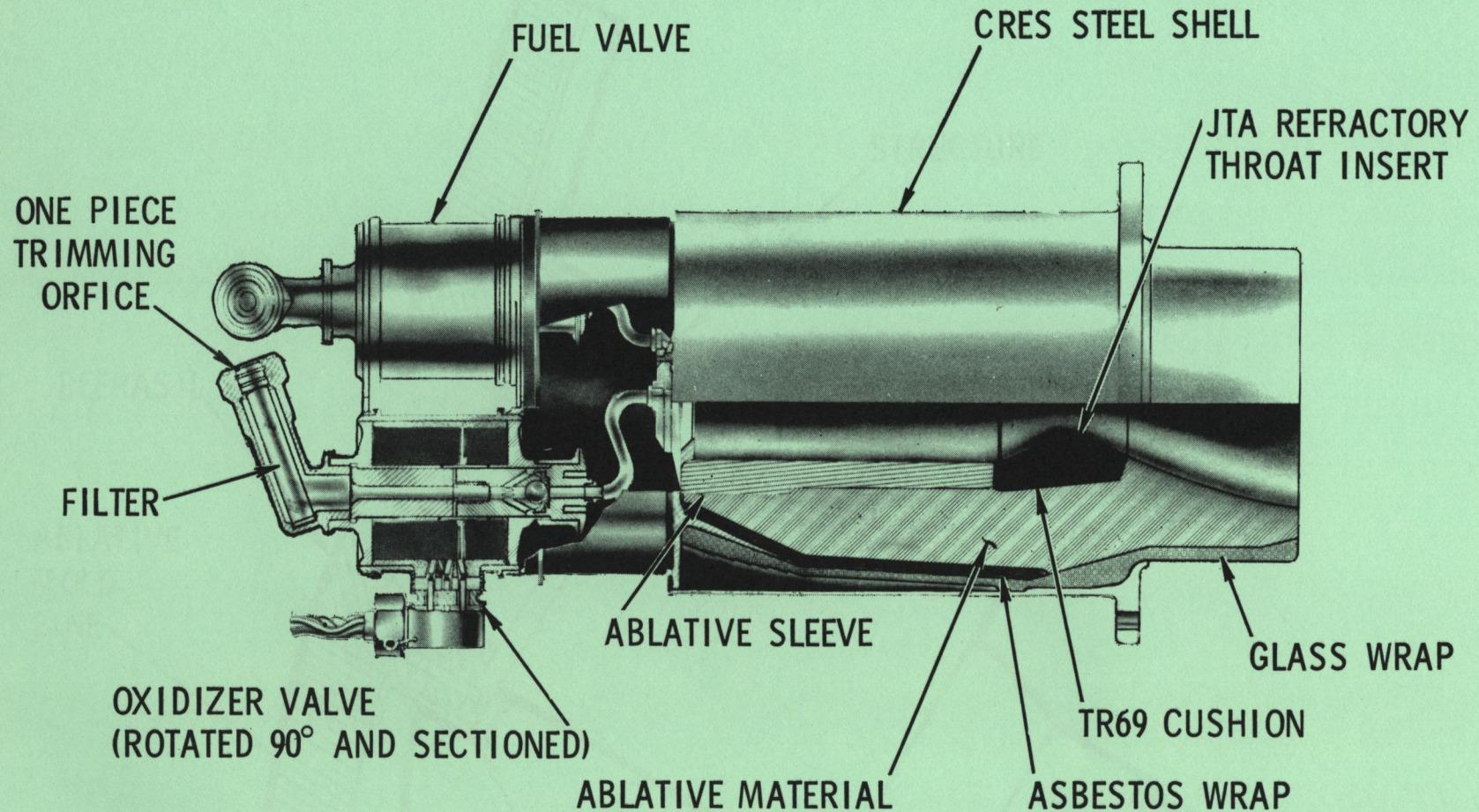


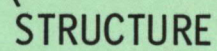
RCS ELECTRICAL CSM CONTROL

103 & SUBS

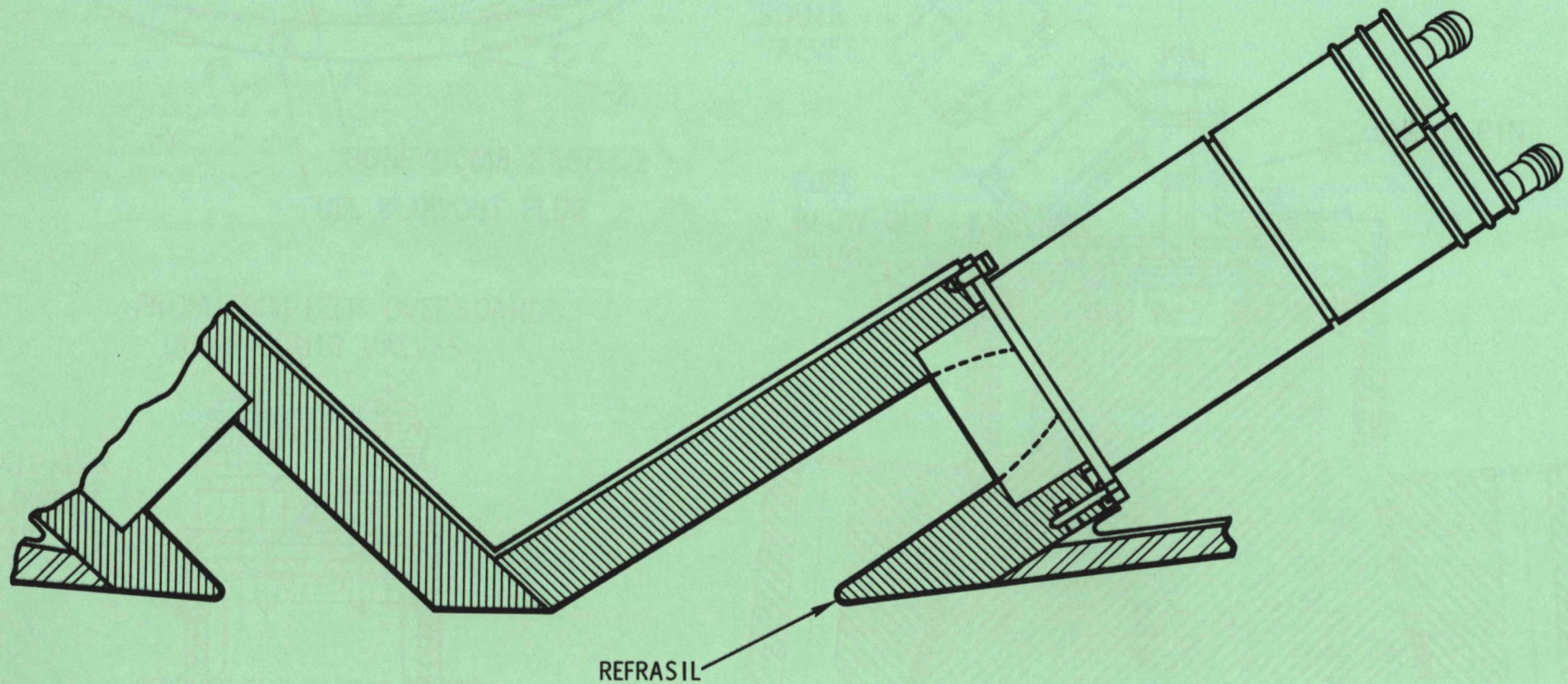


CM RCS ENGINE



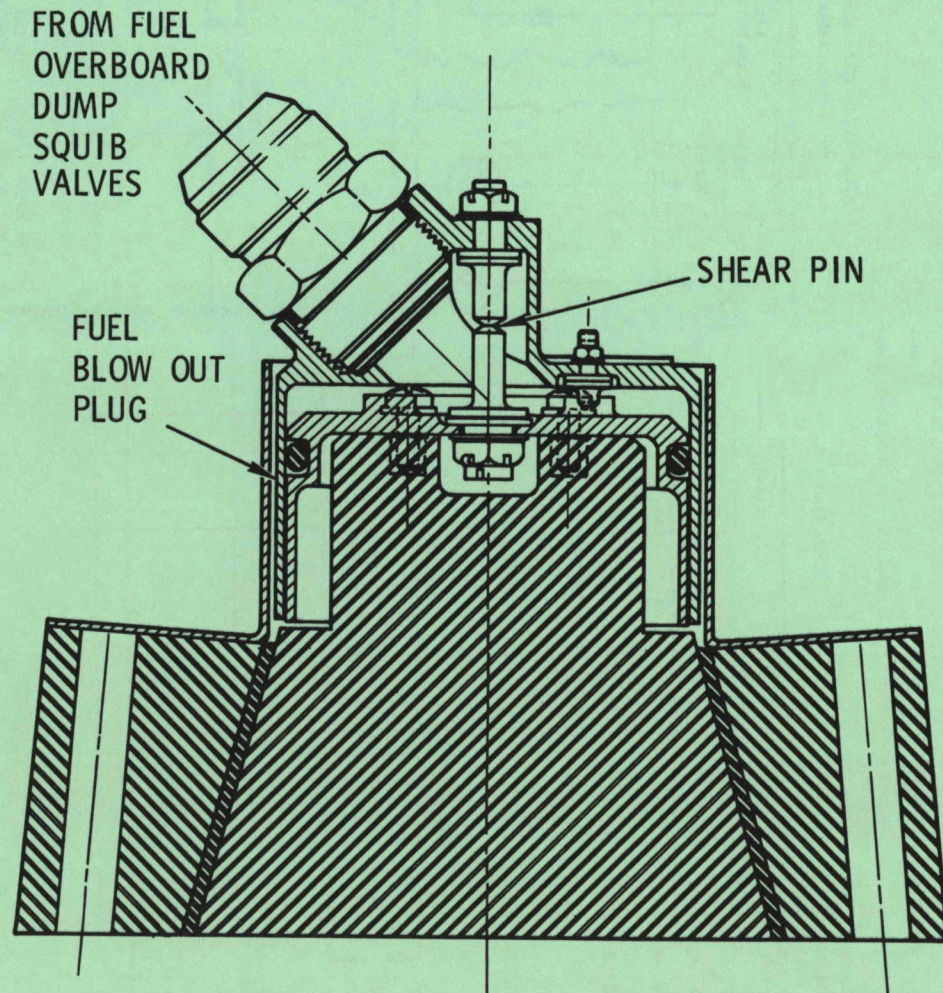
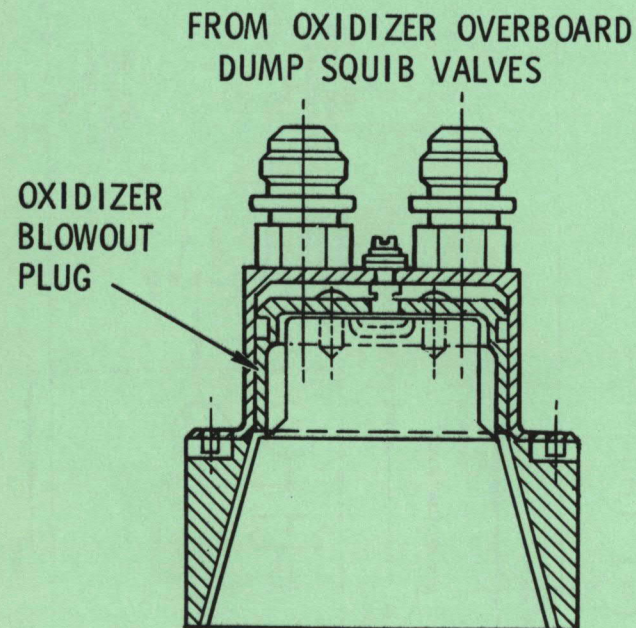
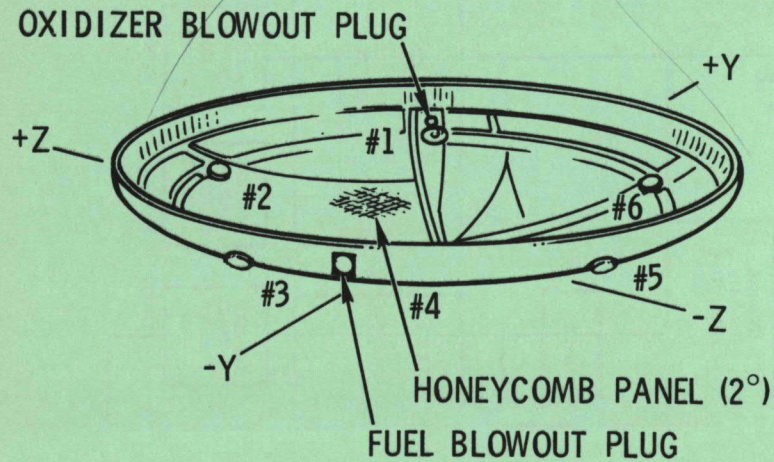


C/M RCS TYPICAL NOZZLE EXTENSION ROLL



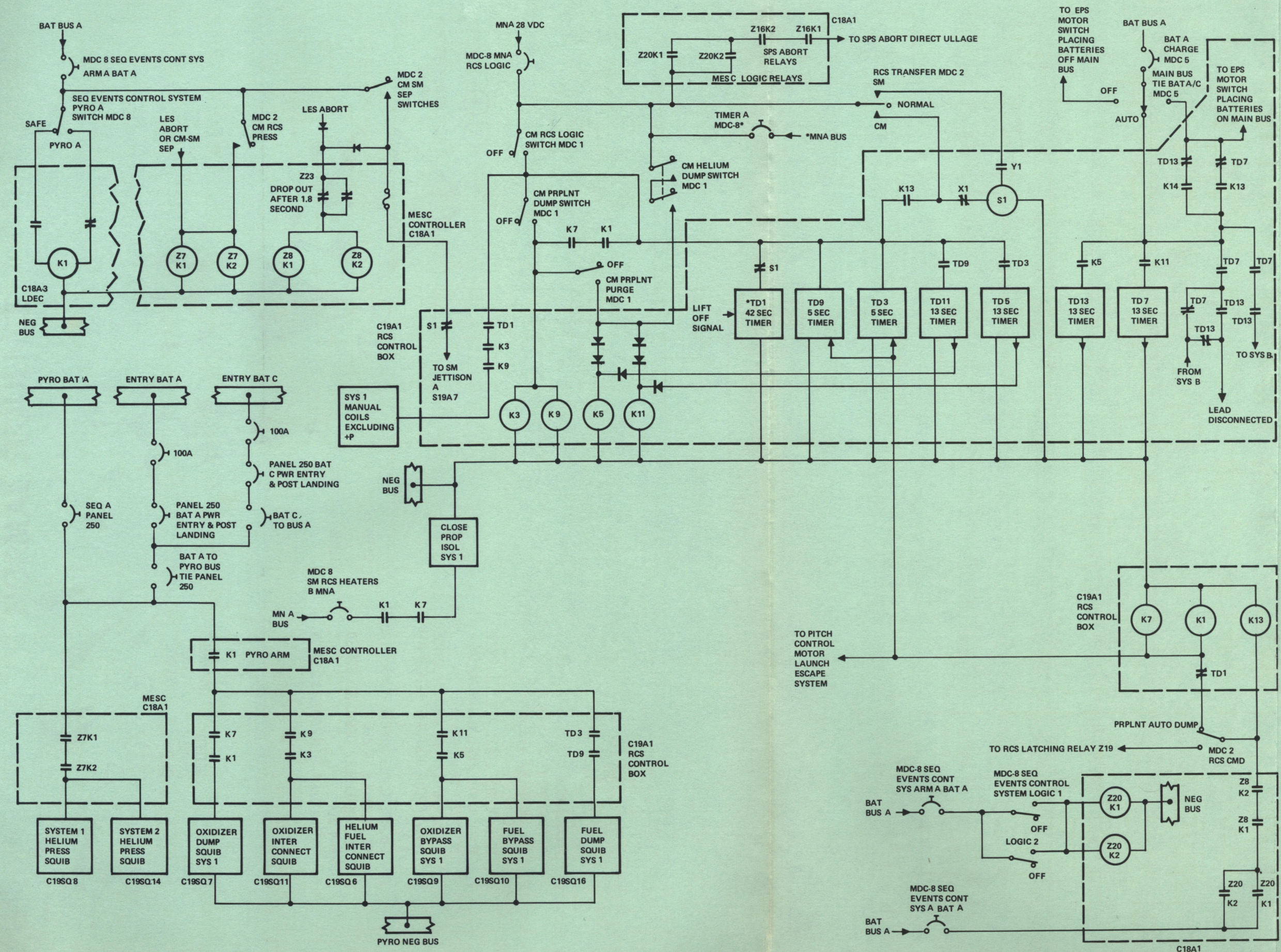
CMRCS RAPID FUEL AND OXIDIZER OVERBOARD DUMP PLUGS

BLOCK II

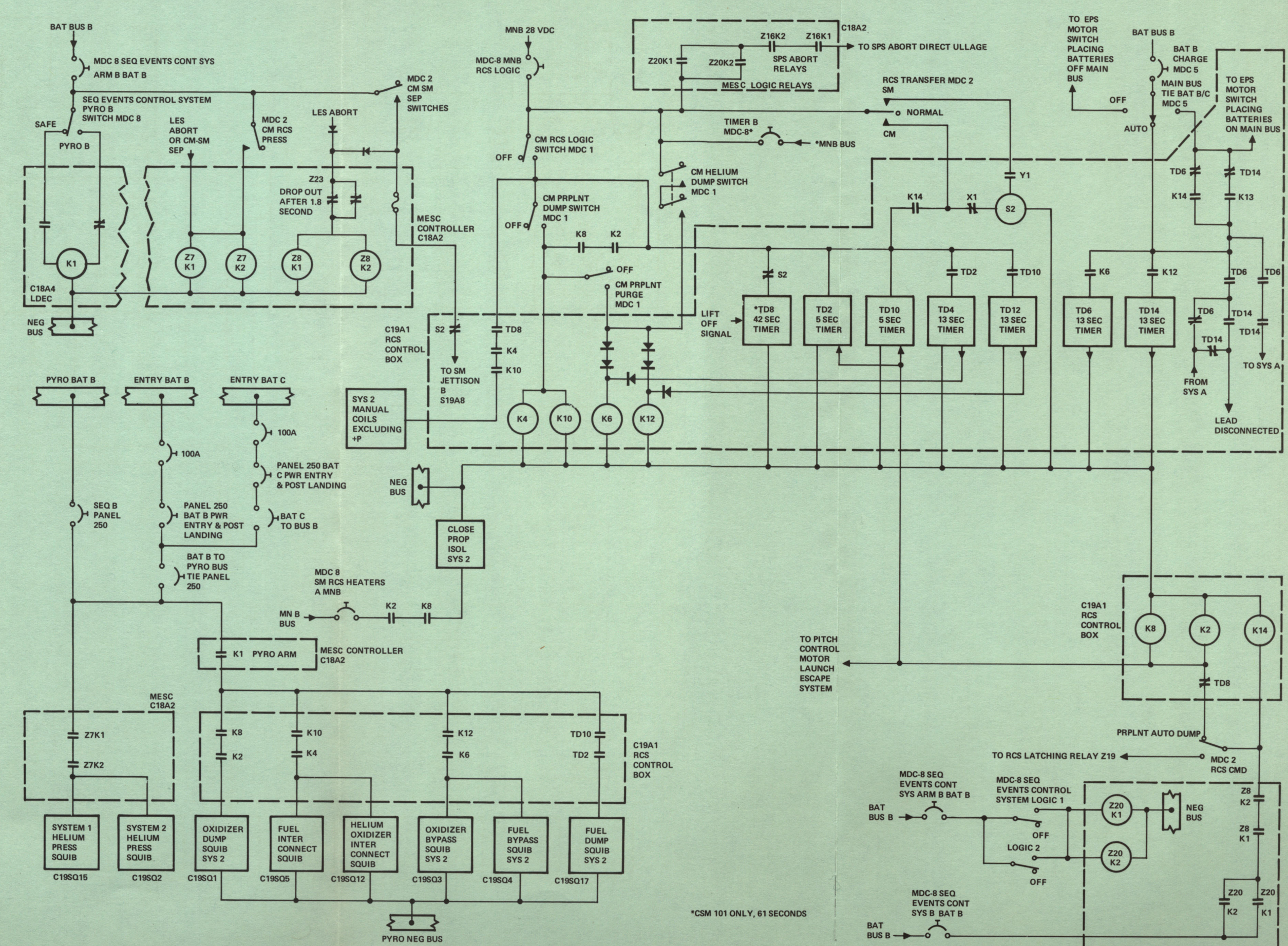


P-7009B





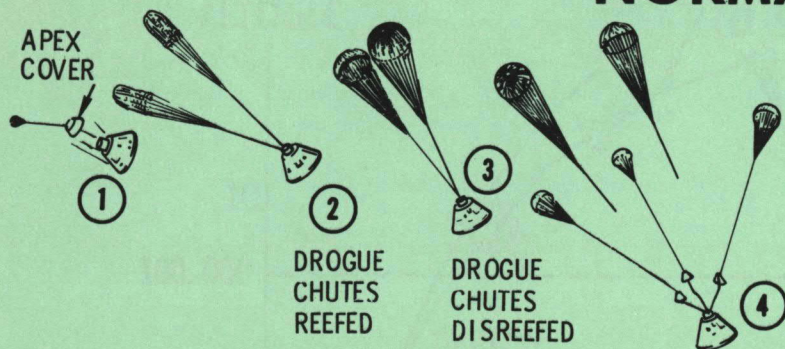
*CSM 101 ONLY, 61 SECONDS



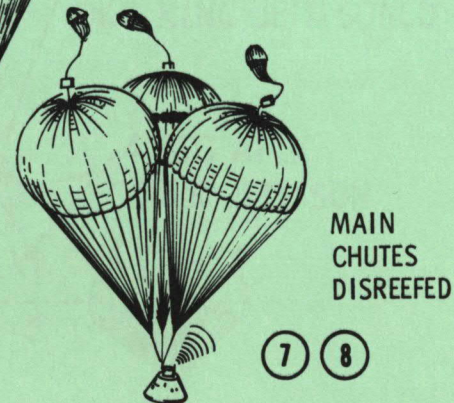
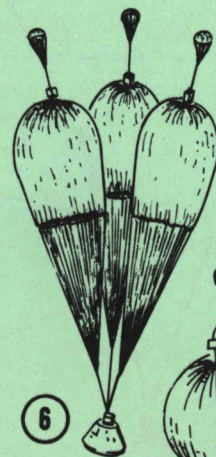
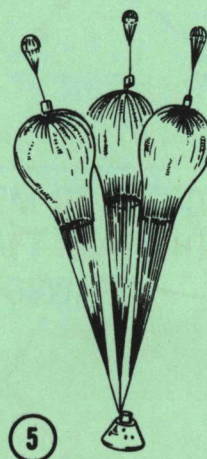
*CSM 101 ONLY, 61 SECONDS

CM RCS SQUIB VALVE CONTROL

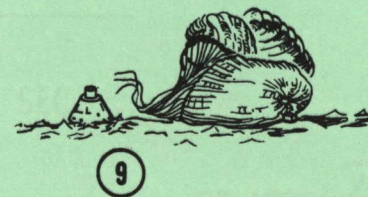
EARTH LANDING SYSTEM NORMAL SEQUENCE



1. APEX COVER JETTISONED AT 24,000 FT
+.4 SEC (TLM)
2. DROGUE CHUTES DEPLOYED REEFED
AT 24,000 FT +2 SEC (TLM)
3. DROGUE CHUTE SINGLE STAGE DISREEF
8 SEC
4. MAIN CHUTE DEPLOYED REEFED VIA
PILOT CHUTES AND DROGUE CHUTES
RELEASED AT 10,000 FT (TLM)
5. MAIN CHUTE INITIAL INFLATION
6. MAIN CHUTE FIRST STAGE DISREEF
6 SEC
7. VHF RECOVERY ANTENNAS AND FLASHING
BEACON DEPLOYED 8 SEC
8. MAIN CHUTE SECOND STAGE DISREEF
10 SEC
9. MAIN CHUTES RELEASED & LM PRESS PYRO
VALVE CLOSED AFTER SPLASH DOWN (TLM)



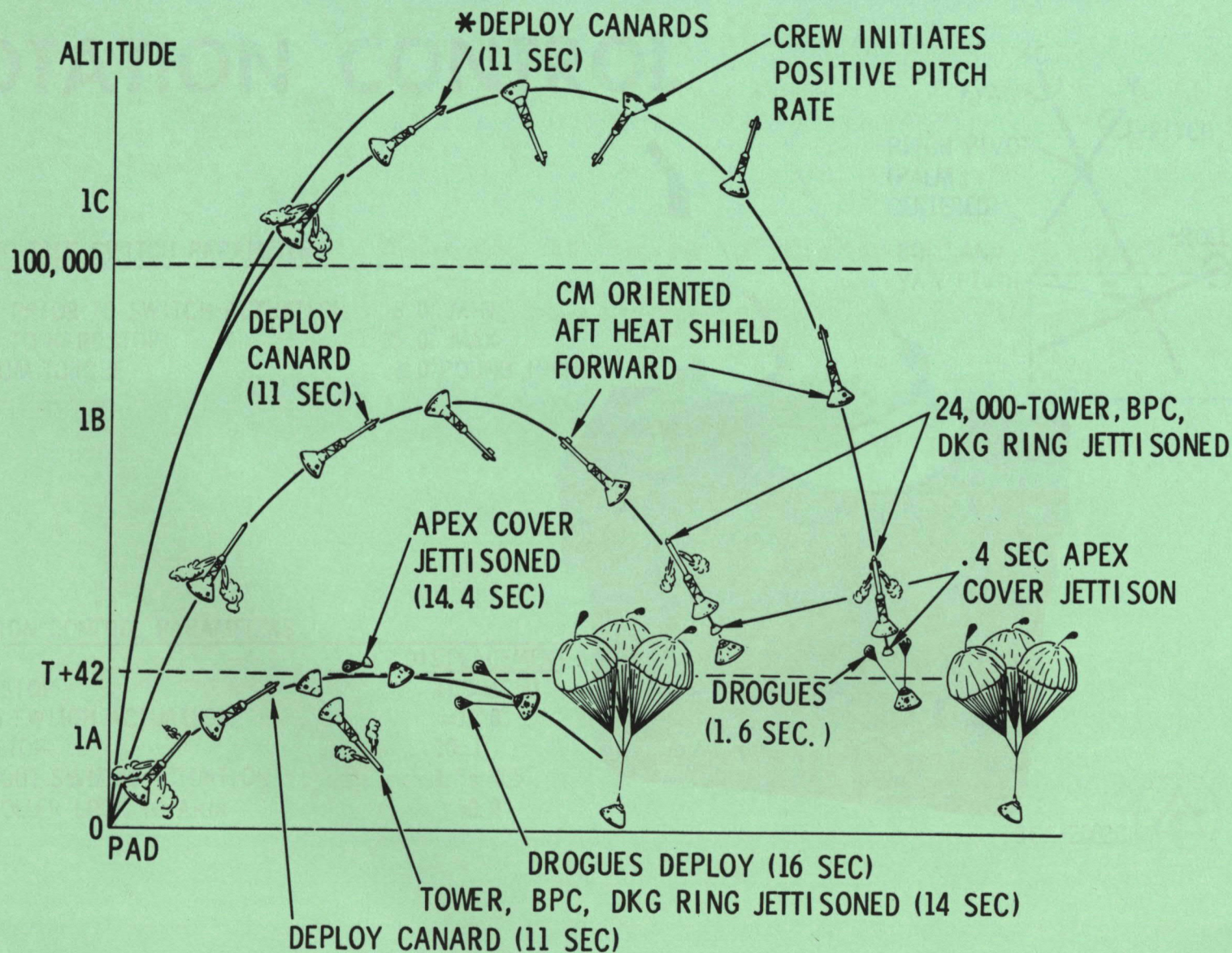
SPLASH DOWN VELOCITIES:
3 CHUTES - 31 FT/SEC
2 CHUTES - 36 FT/SEC



SEQ-547B



LAUNCH ESCAPE VEHICLE OPERATION



*RETAINING TOWER IS OPTIONAL

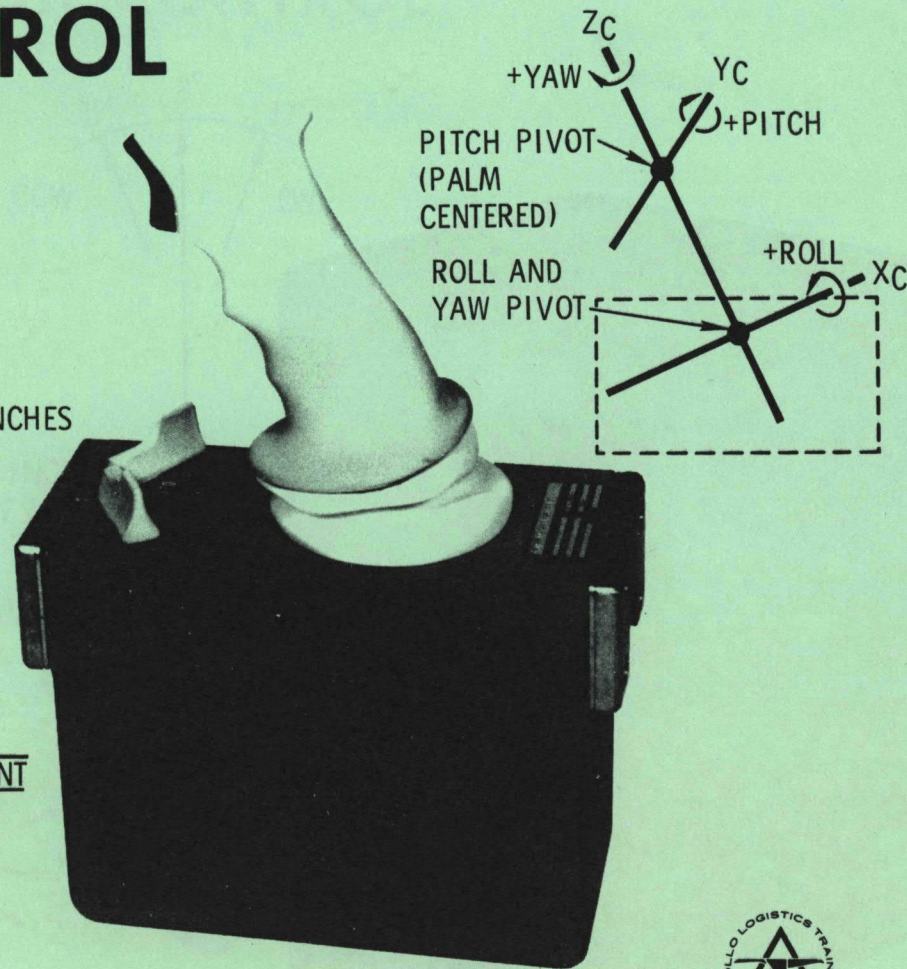
ROTATION CONTROL

PUSH TO TALK SWITCH PARAMETERS

TRAVEL PRIOR TO SWITCH ACTUATION	8.0° MIN
TRAVEL TO HARDSTOP	25.0° MAX
MAXIMUM TORQUE	1.0 POUND INCHES

ROTATION CONTROL PARAMETERS

	<u>DISPLACEMENT</u>
HARD STOP	11.5±0.50
DIRECT SWITCH ACTUATION	≈11.0°
SOFT STOP	10±1°
BREAKOUT SWITCH ACTUATION	1.5± 0.5°
CONTROLLER LOCK TO ARM	50.0°



SCS-2002C

TRANSLATION CONTROL

CW & CCW CONTROL MOTION LIMITS

HARD STOP, DETENT & SWITCH CLOSURE
FORCE INTO DETENT
OUT OF DETENT

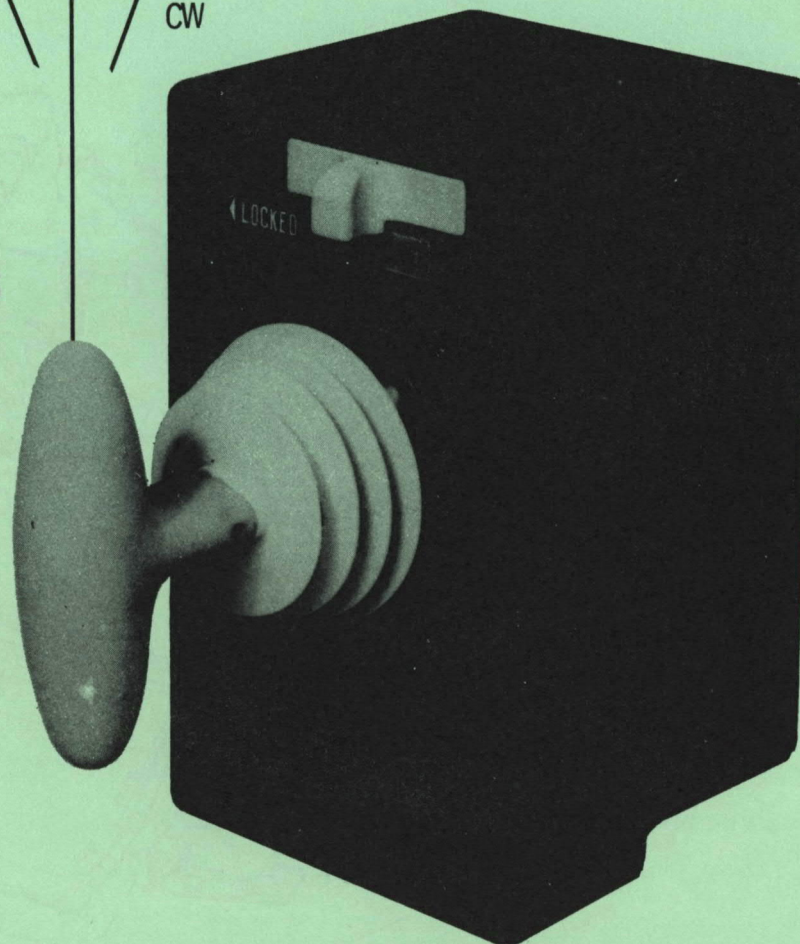
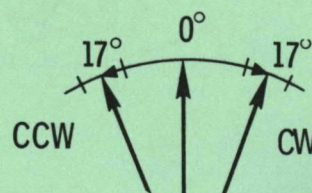
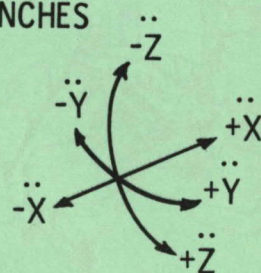
$17^{\circ} \pm 2^{\circ}$
 15 ± 5.0 LB INCHES
6 LB INCHES MIN

TRANSLATION CONTROL MOTION LIMITS (+ OR - COMMANDS)

MECHANICAL STOP - 0.5 ± 0.075 ARC INCHES

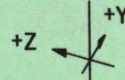
SWITCH CLOSURE - $0.375 \begin{matrix} +0.025 \\ -0.075 \end{matrix}$ ARC INCHES

FORCE - 1.5 ± 0.33 POUNDS

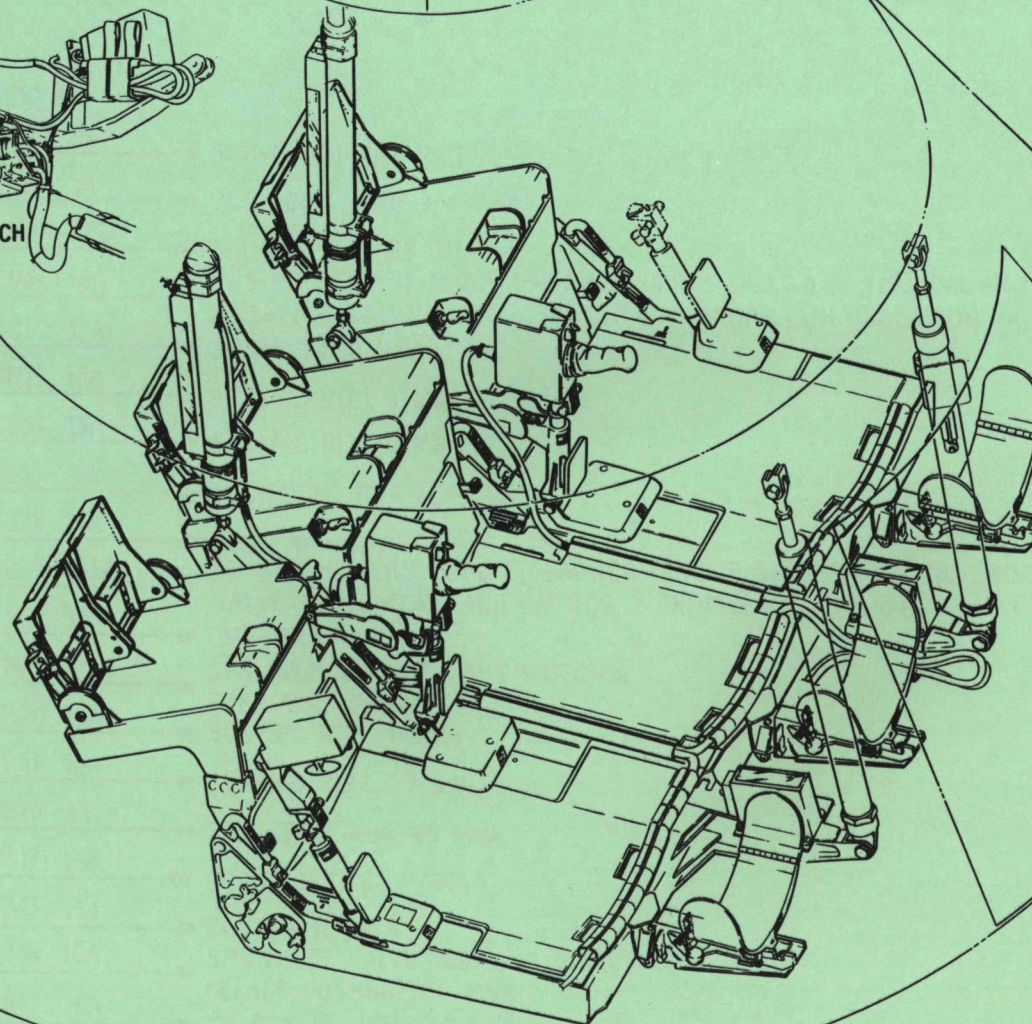


CREW COUCH STRUCTURE

SC 101



VIEW-LOOKING UP AT CENTER CREW COUCH



VIEW-LOOKING DOWN & INBOARD

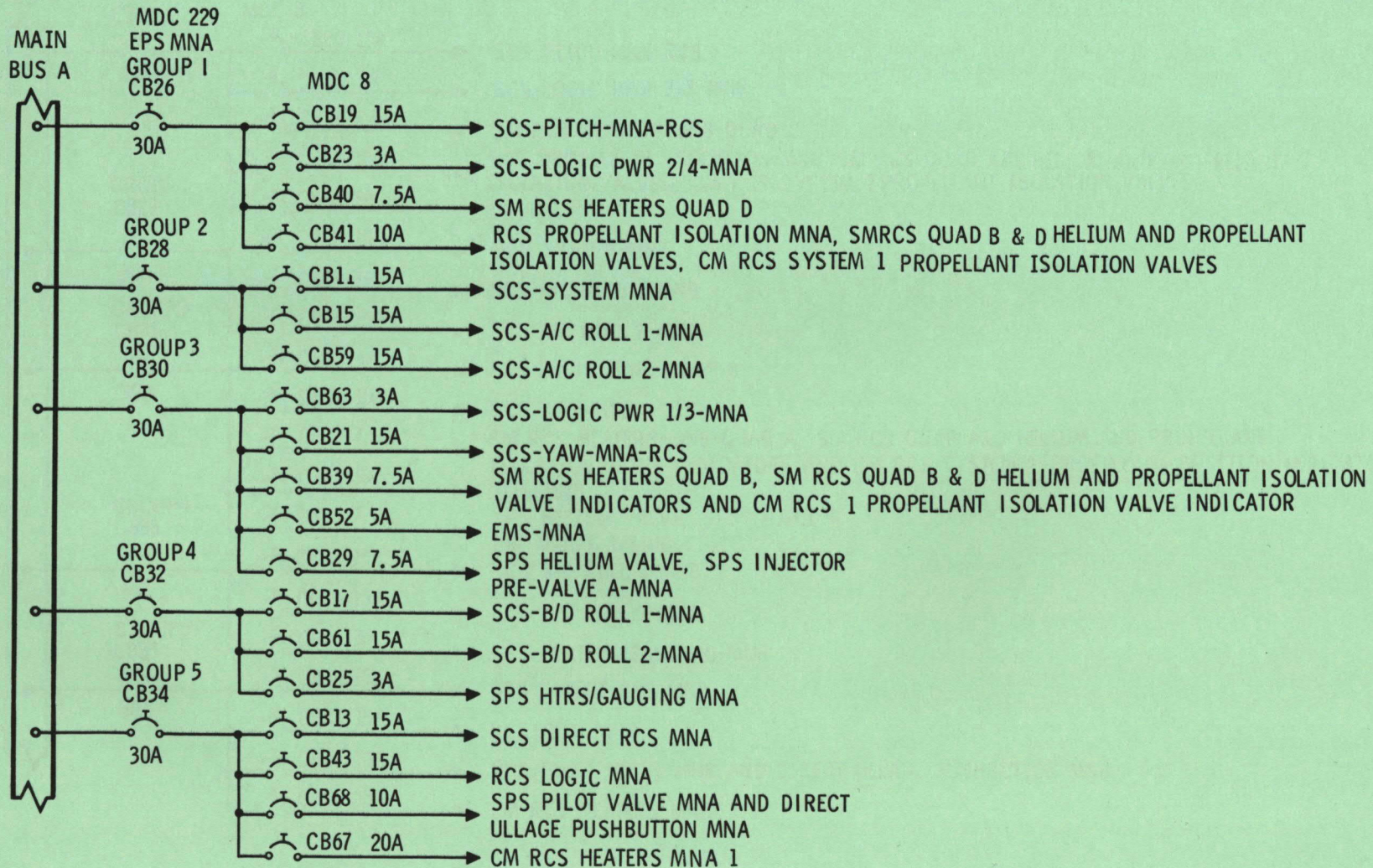
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CS-2004B



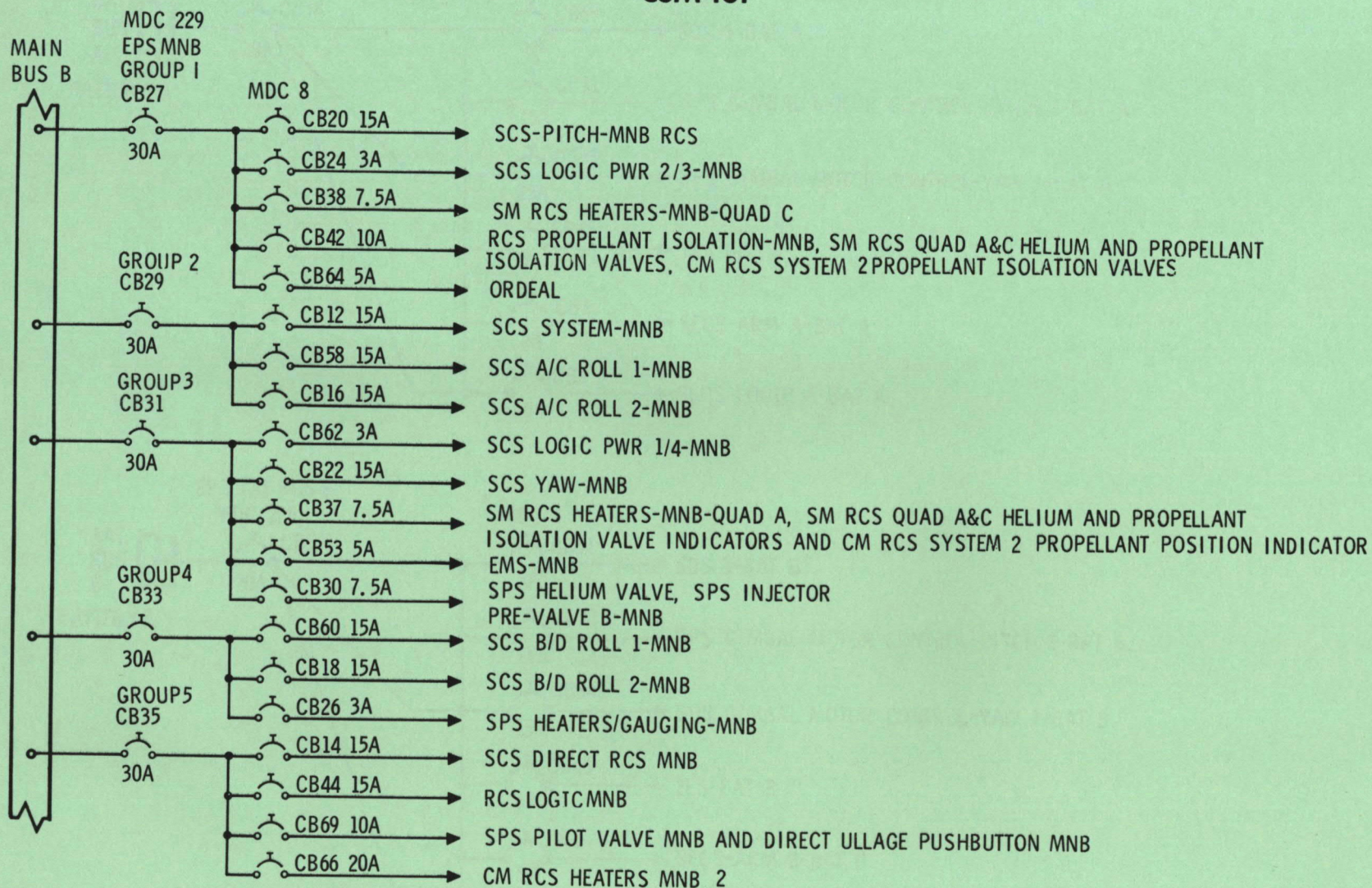
MAIN A DC POWER

CSM 101



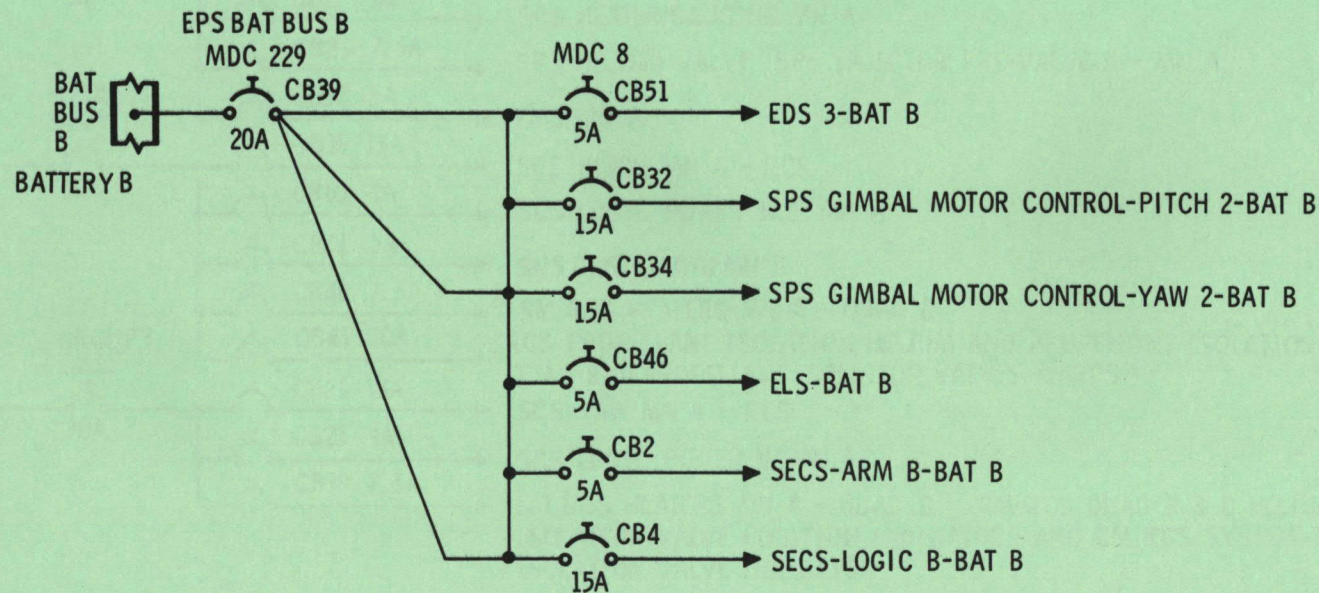
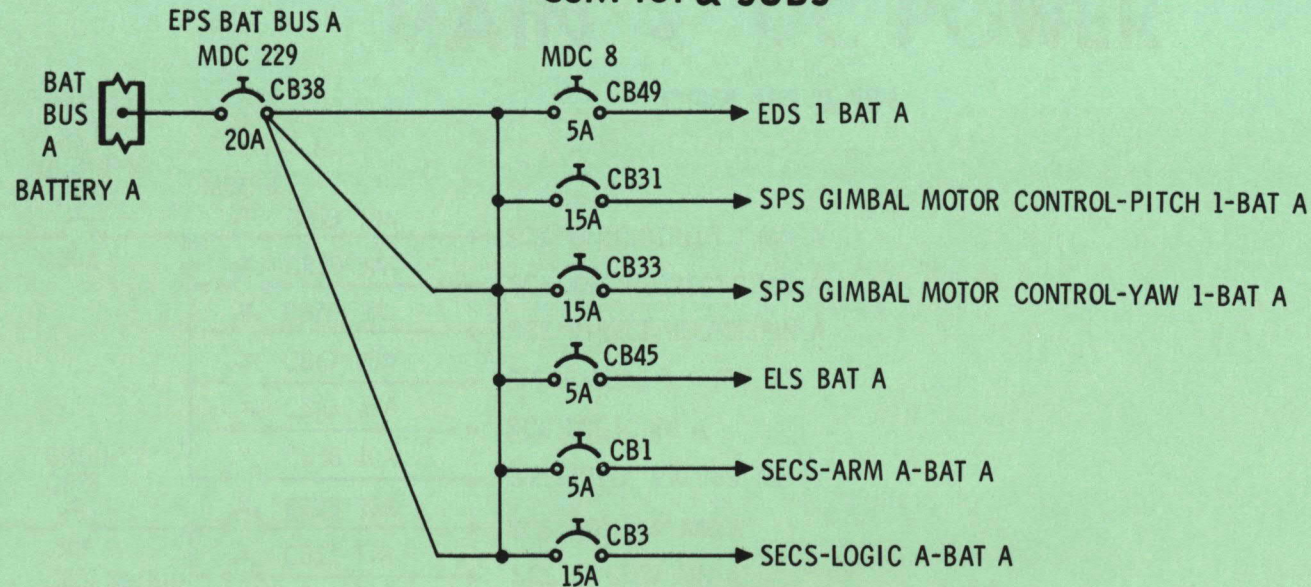
MAIN B DC POWER

CSM 101



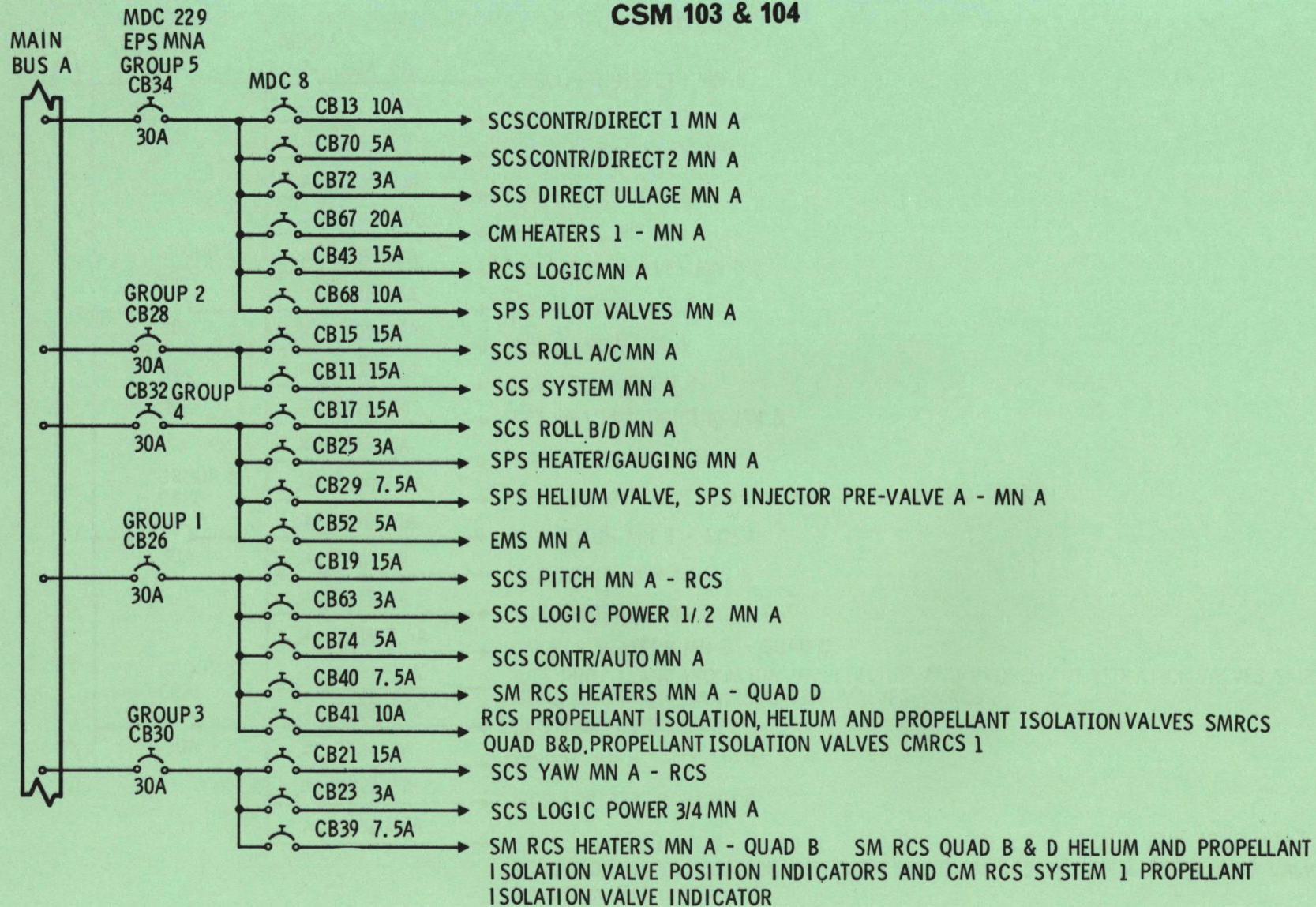
BATTERY A&B POWER

CSM 101 & SUBS



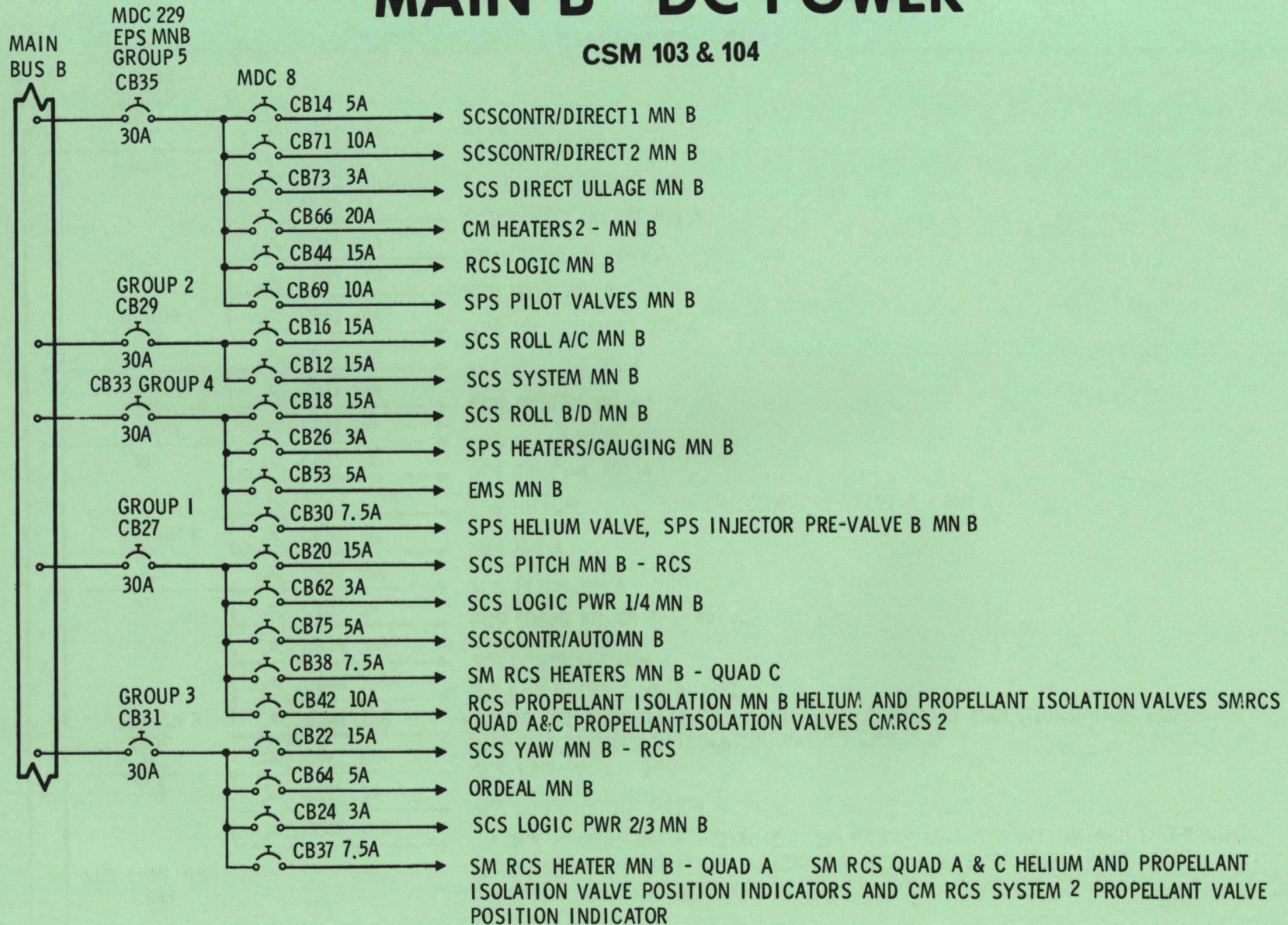
MAIN A DC POWER

CSM 103 & 104



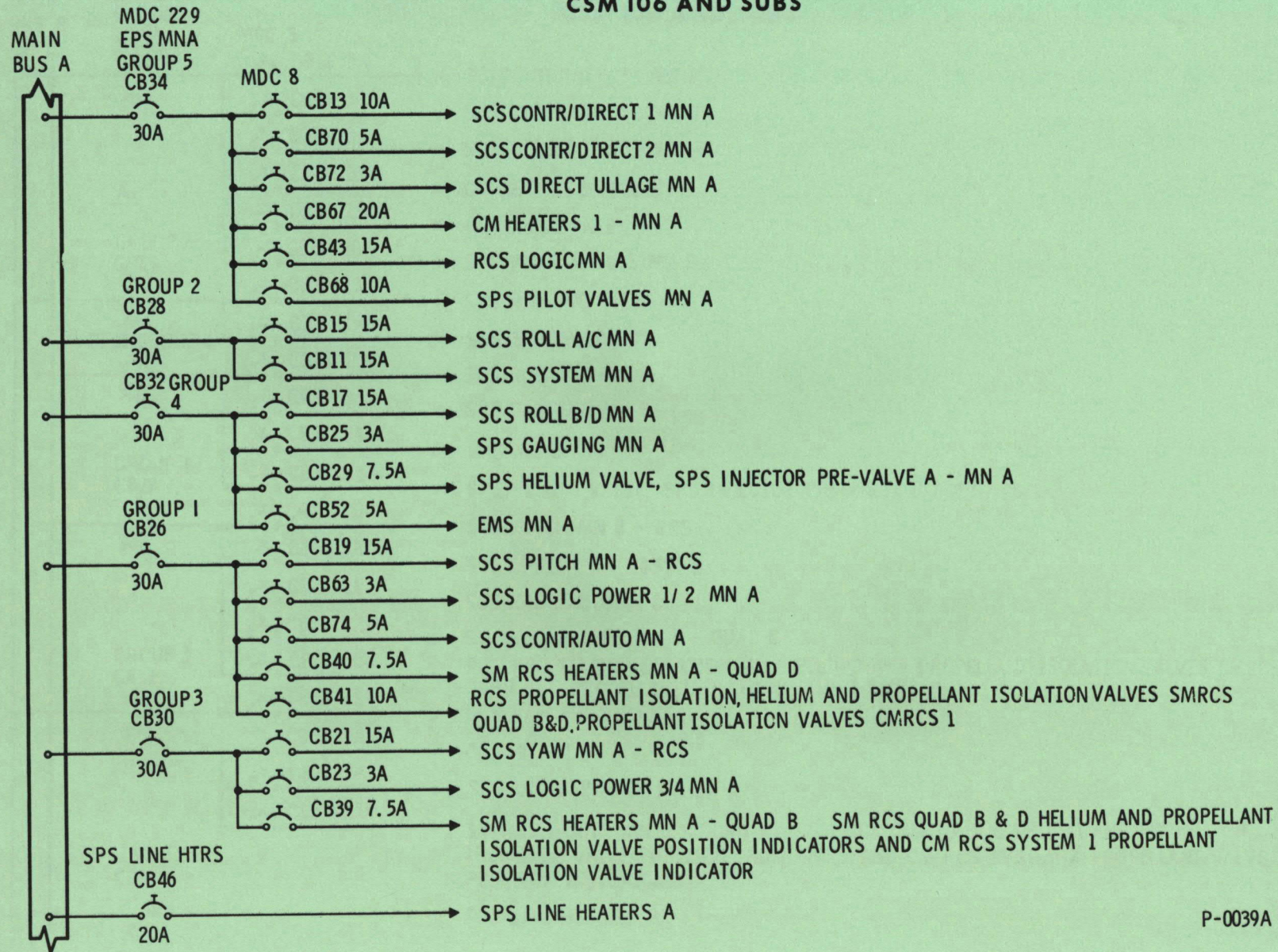
MAIN B DC POWER

CSM 103 & 104



MAIN A DC POWER

CSM 106 AND SUBS

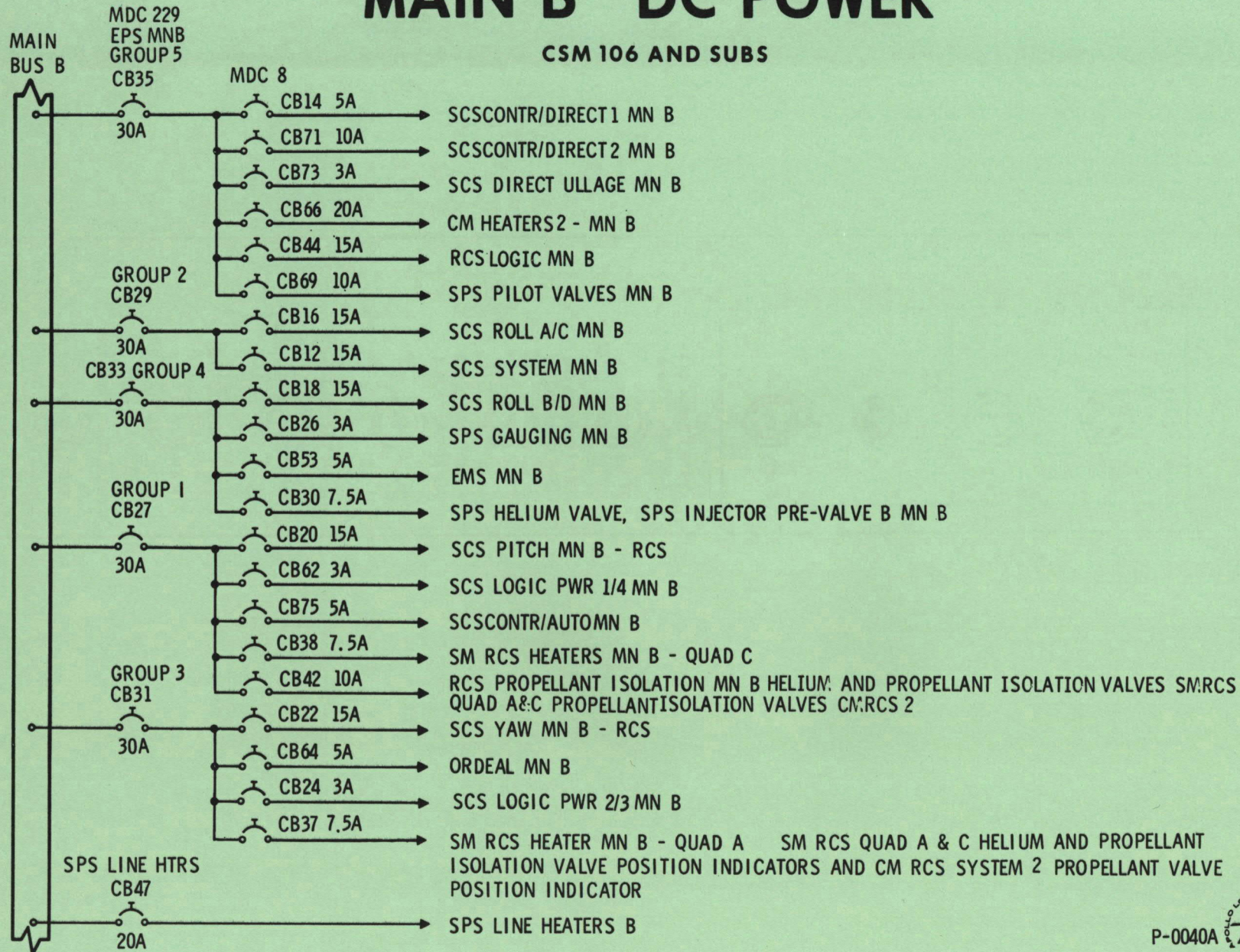


P-0039A



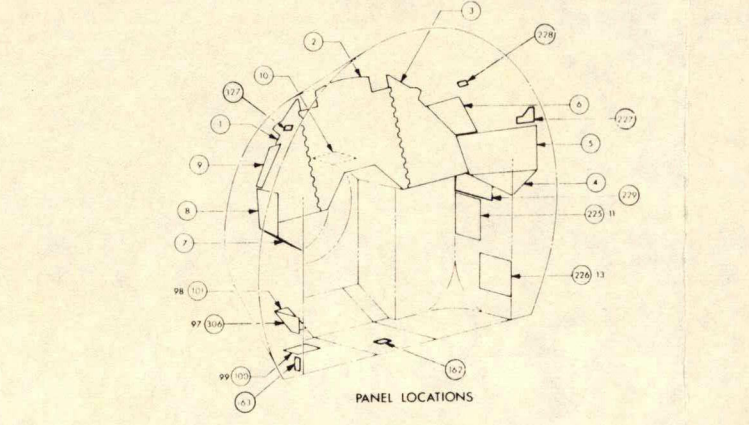
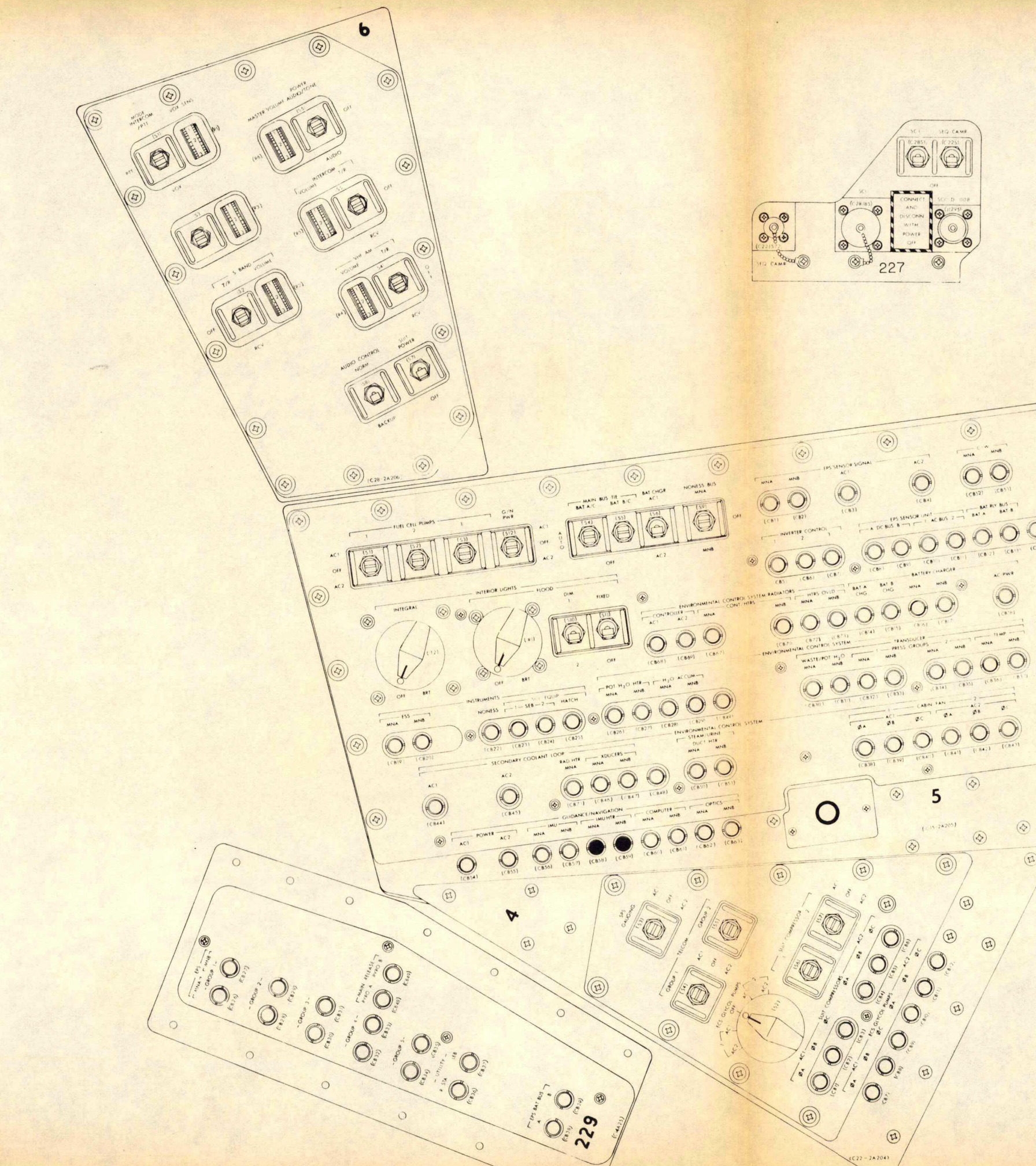
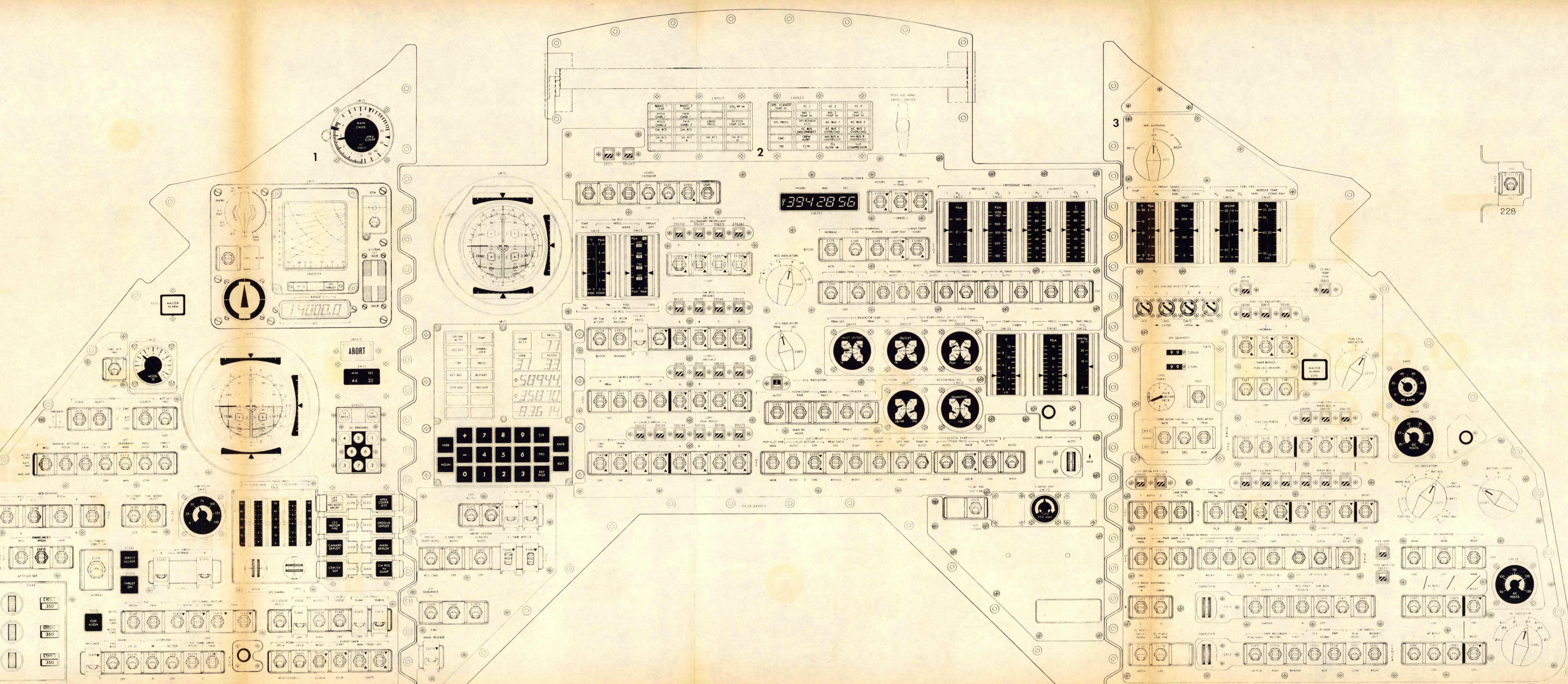
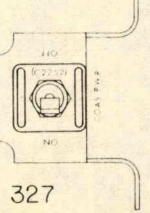
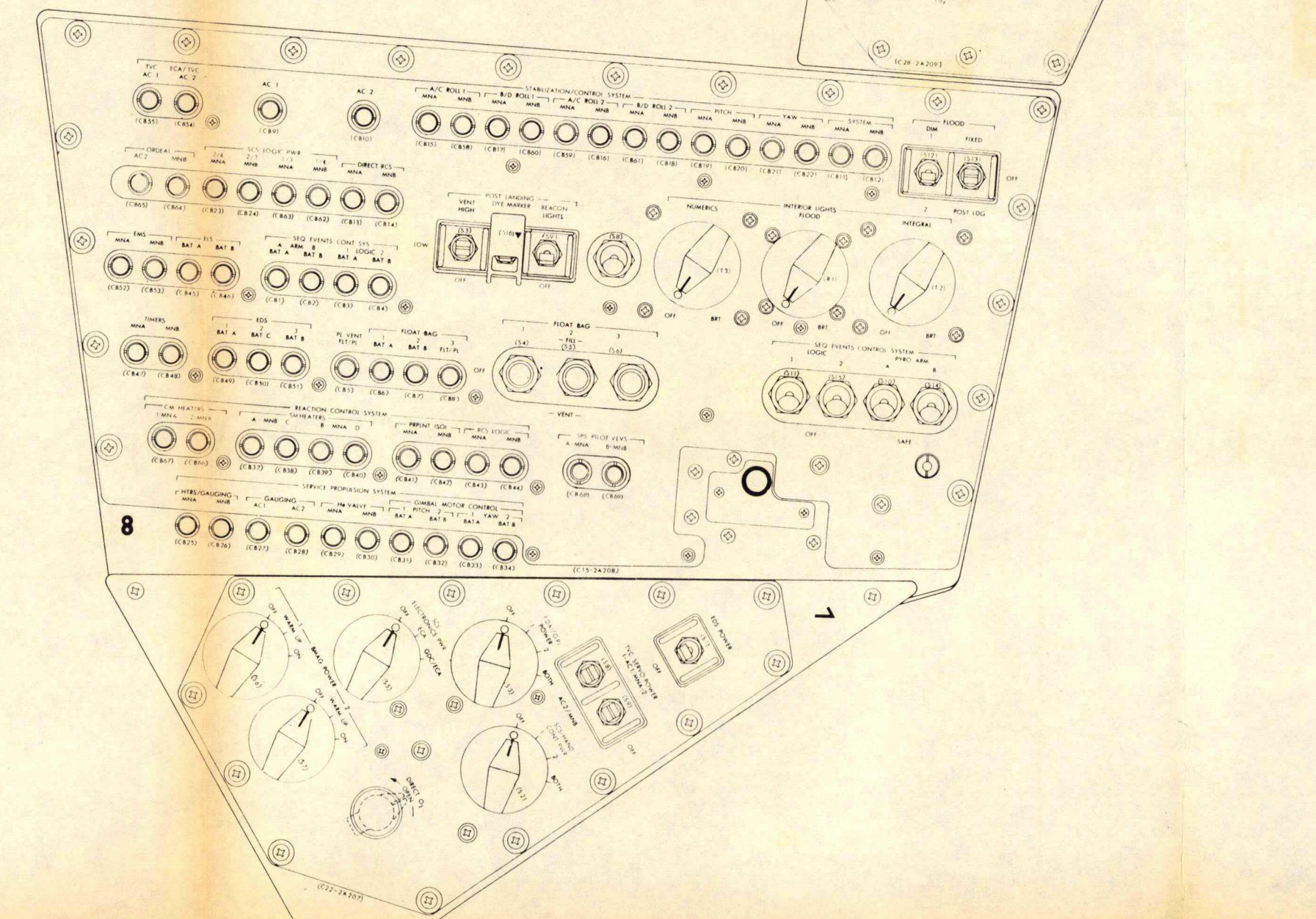
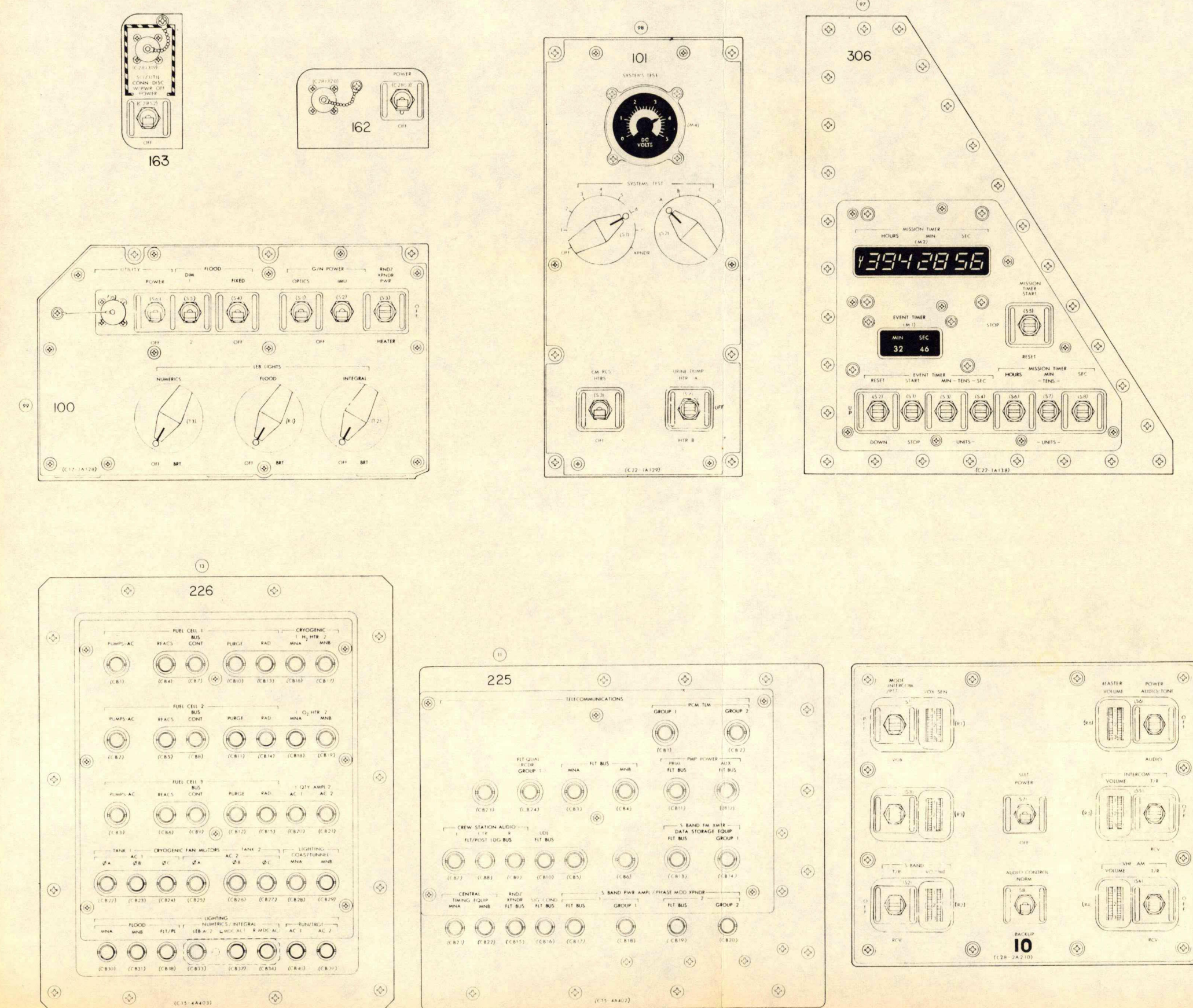
MAIN B DC POWER

CSM 106 AND SUBS



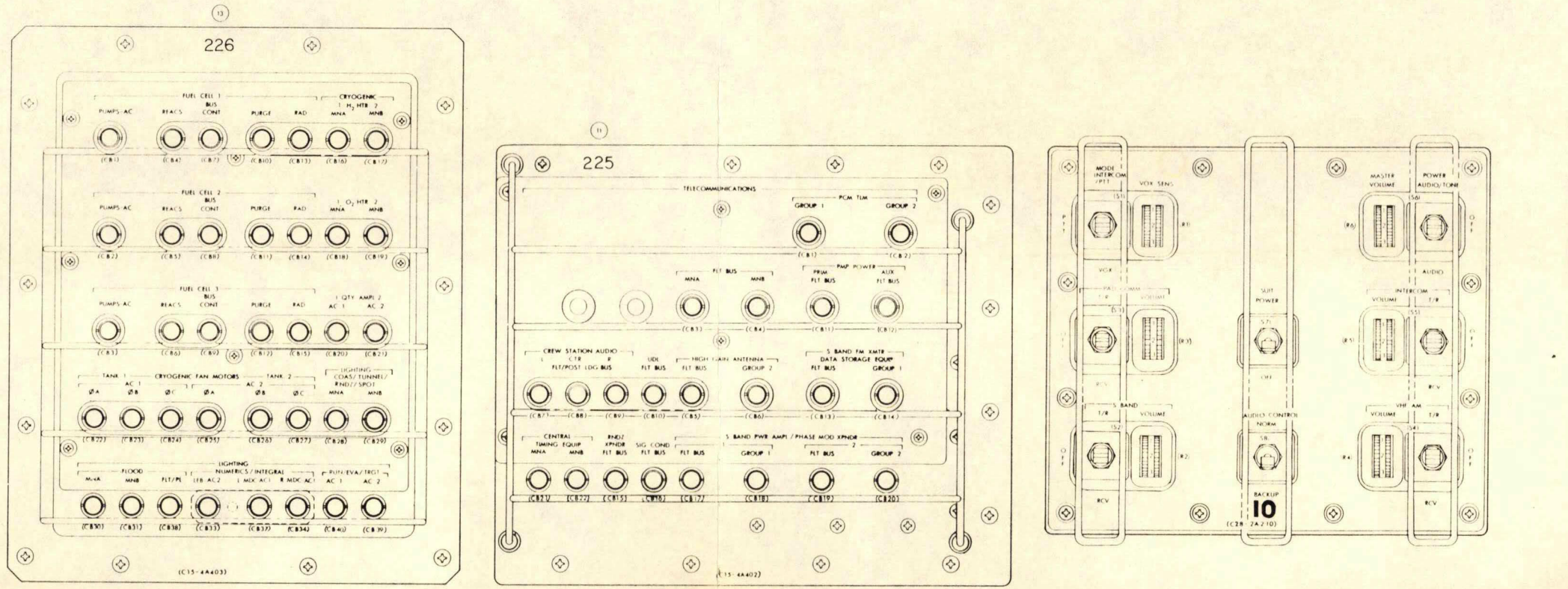
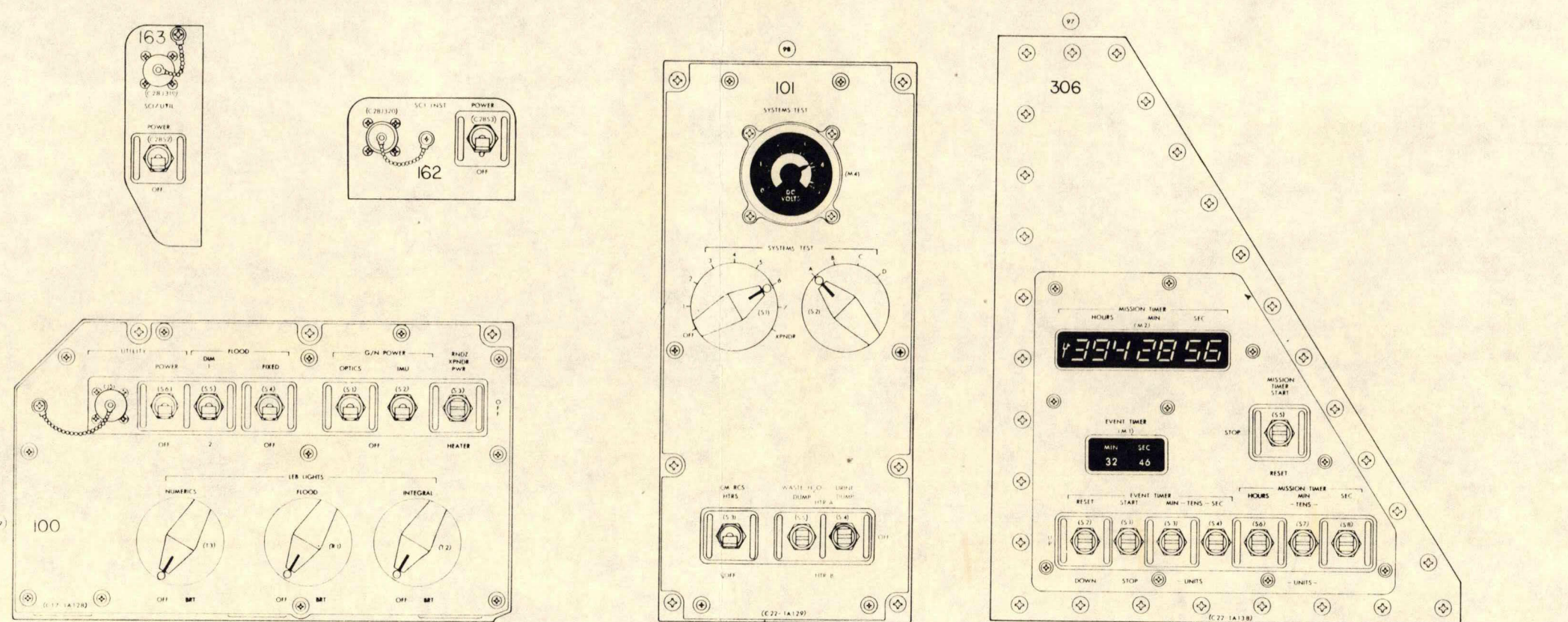
P-0040A



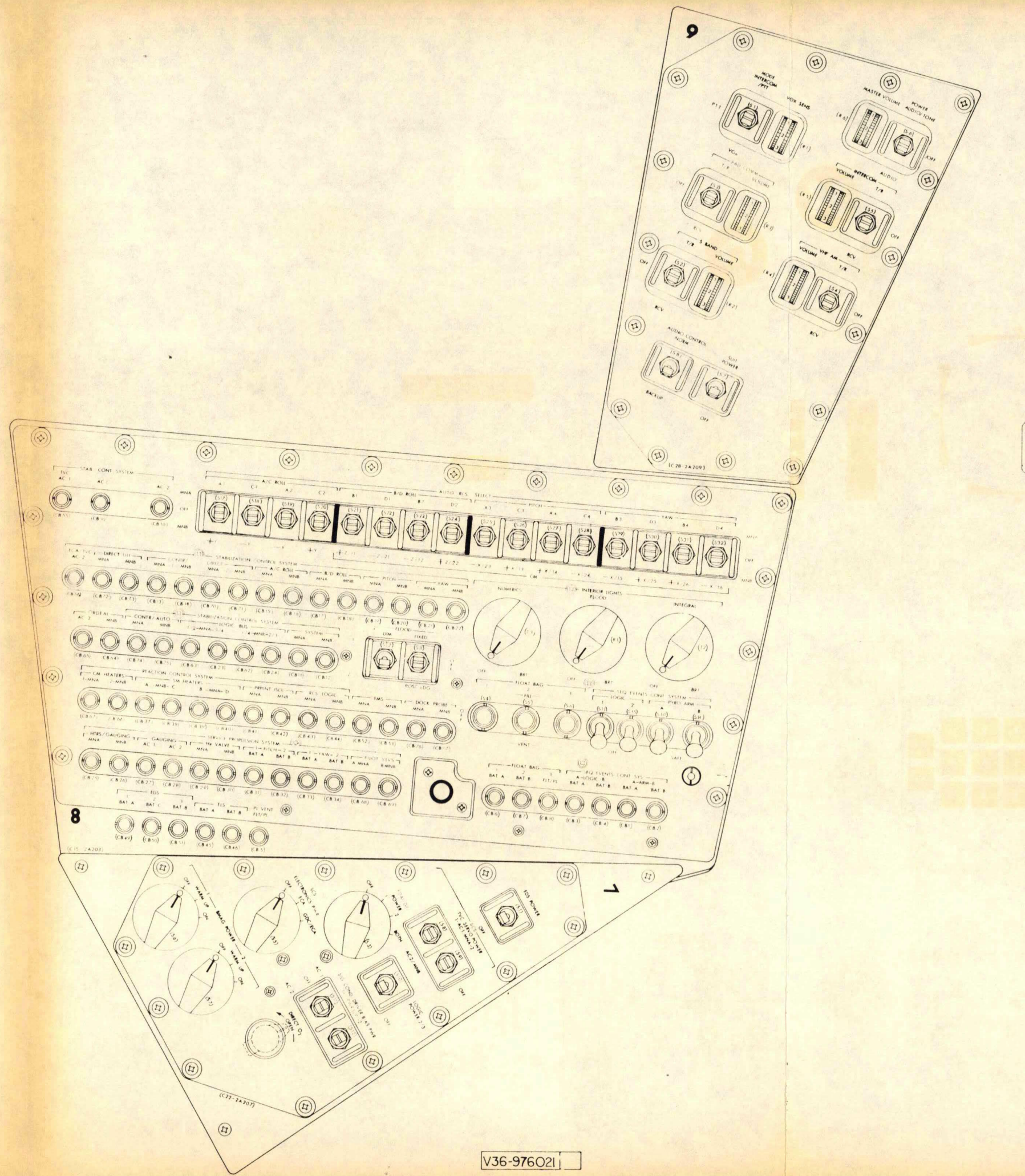


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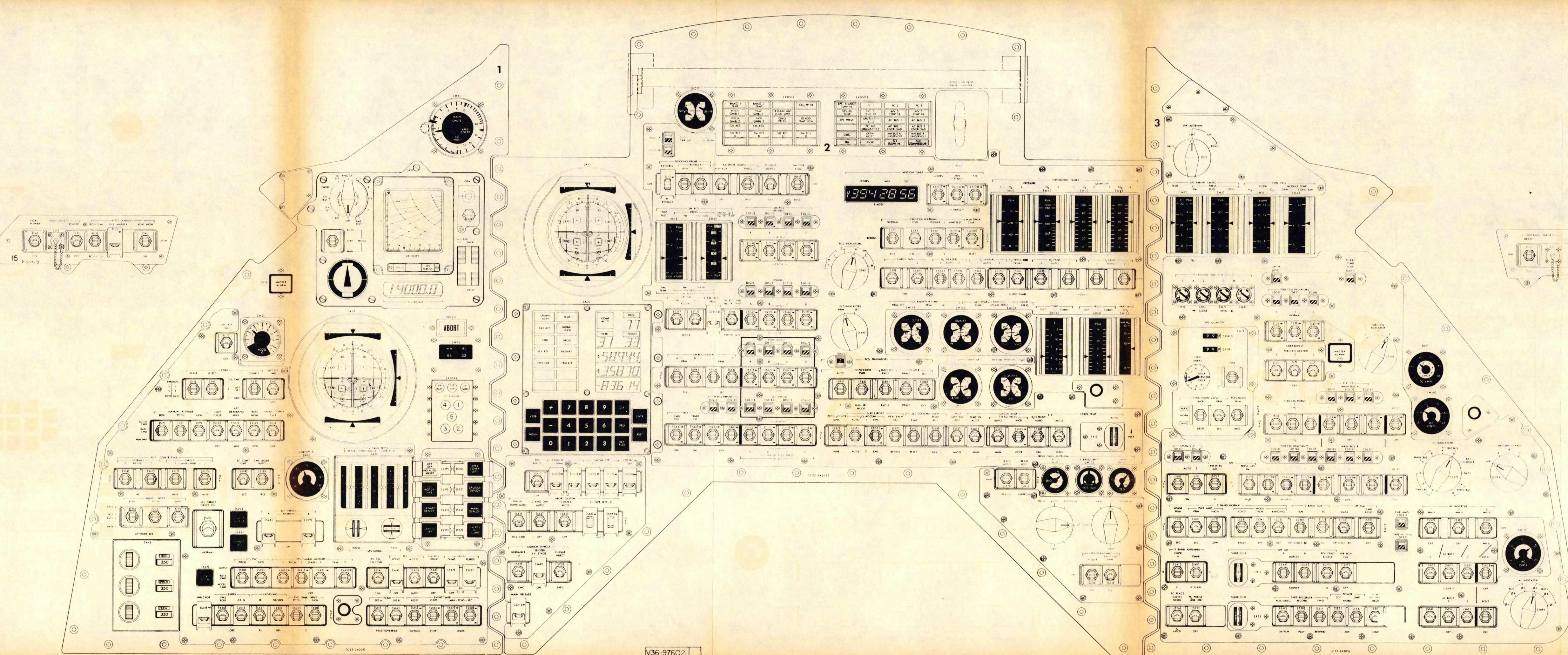
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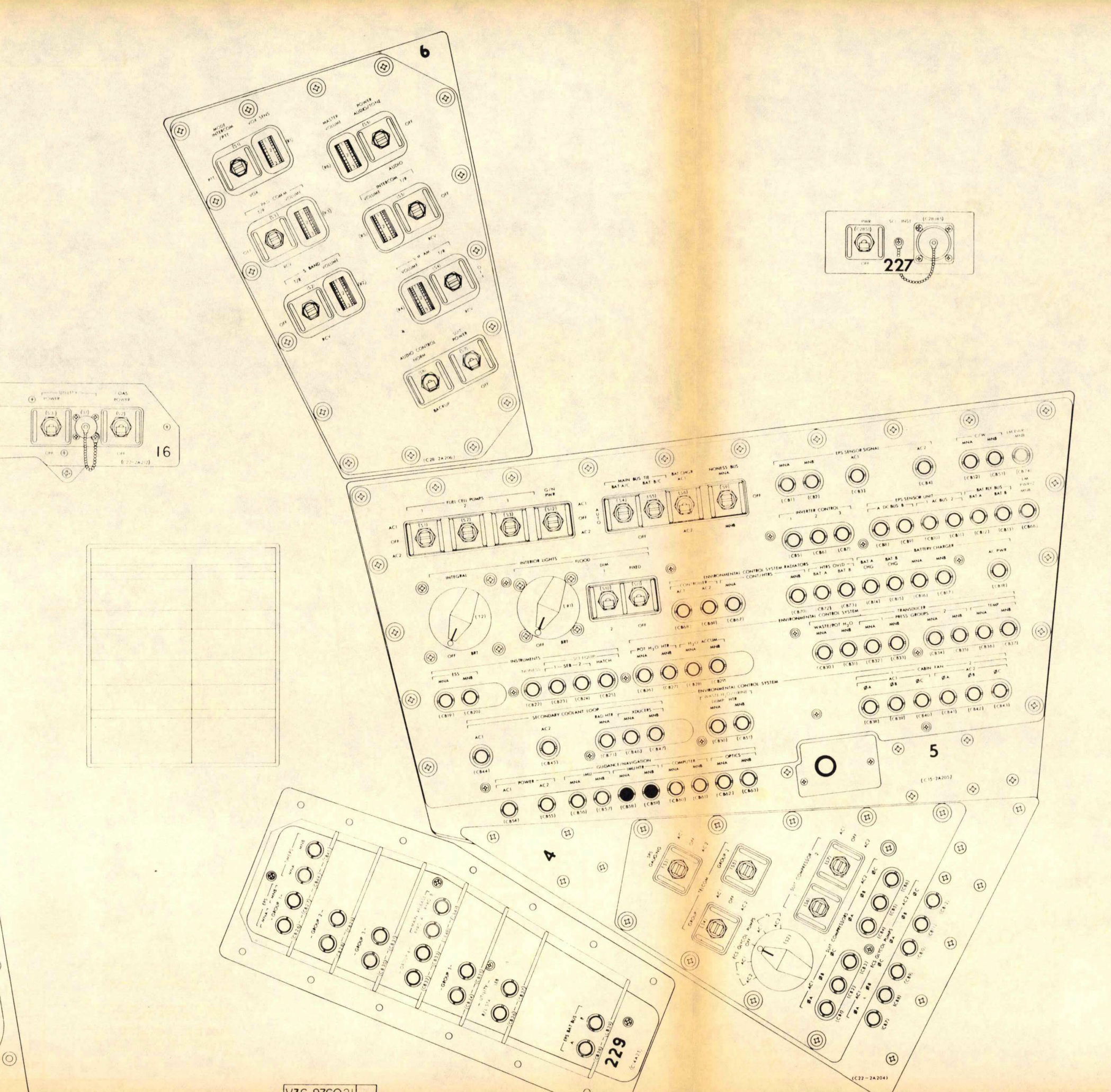
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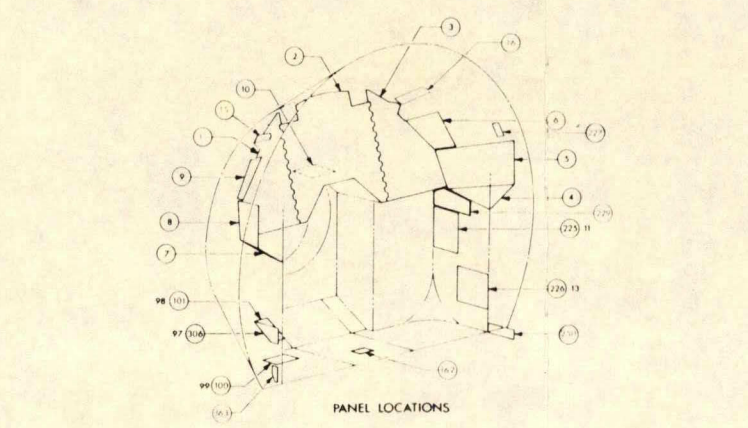
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V36-976023



V36-976024



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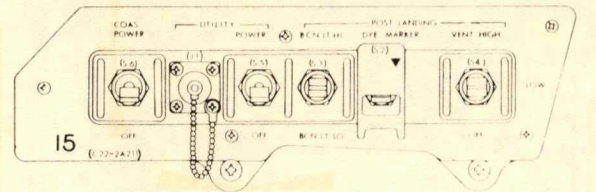
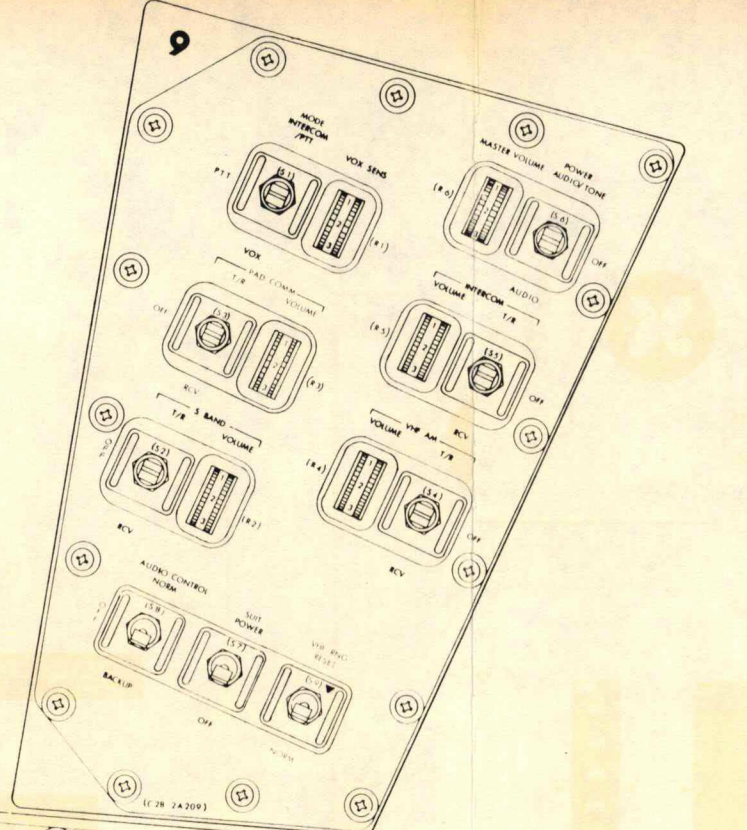
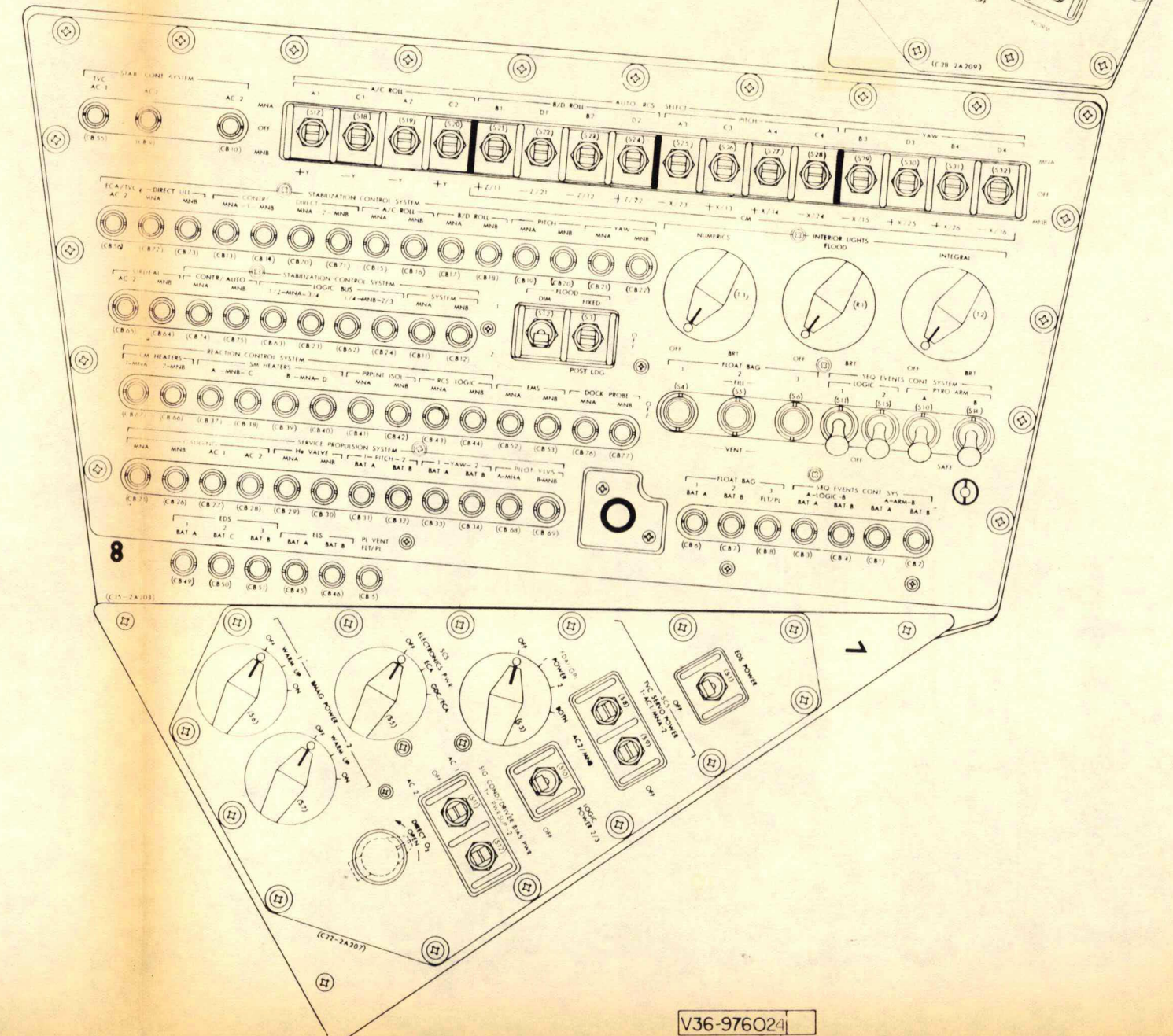
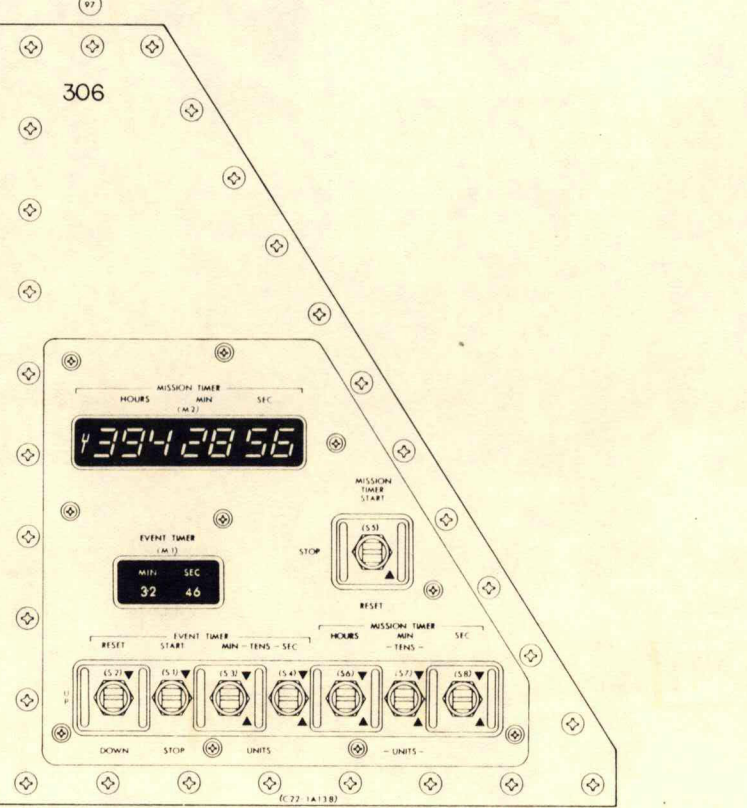
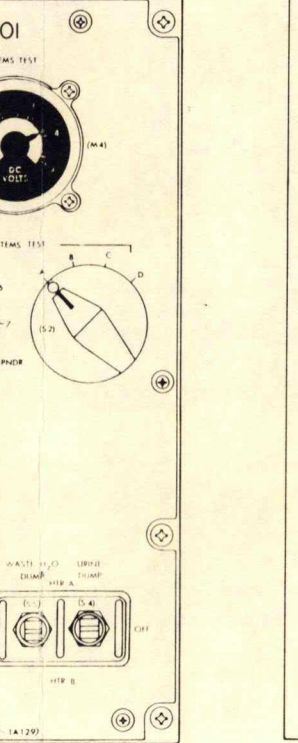
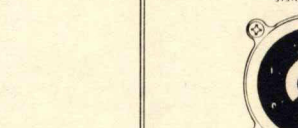
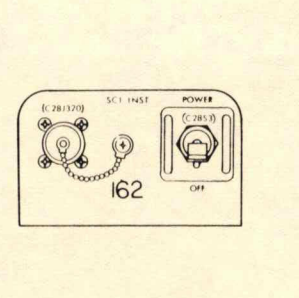
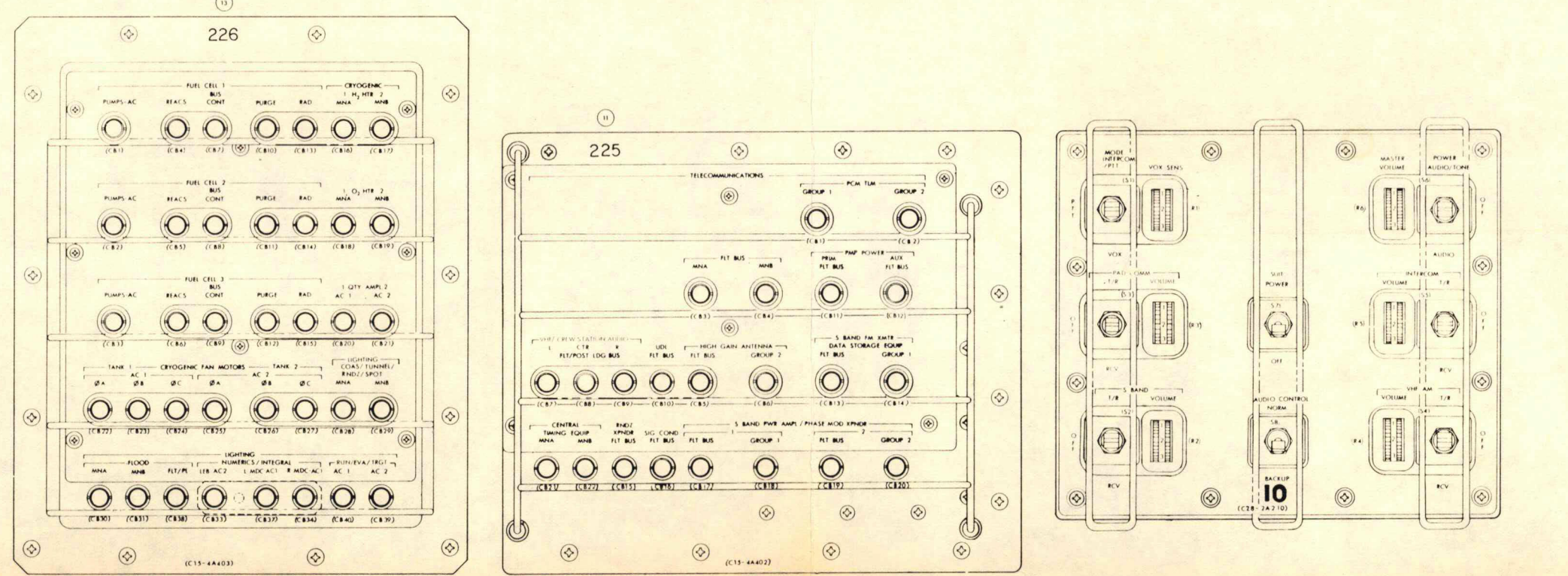
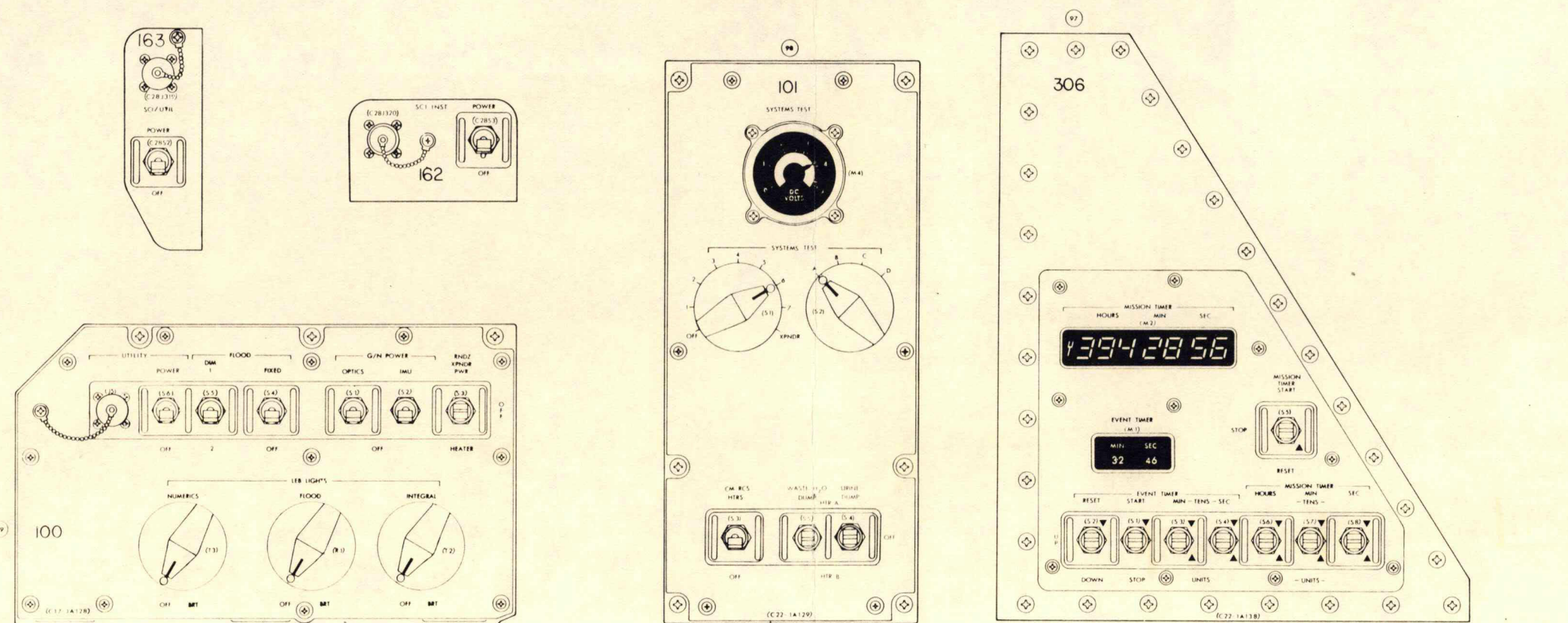
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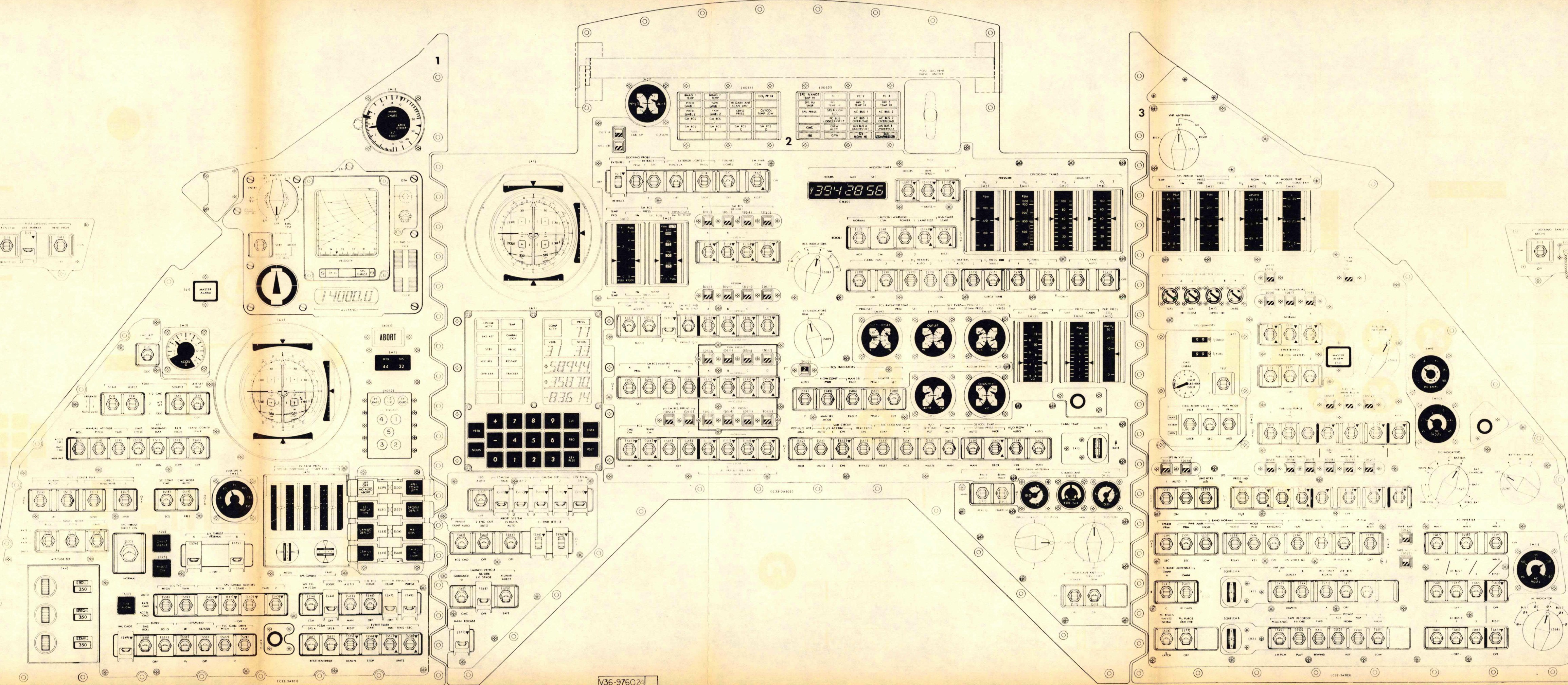
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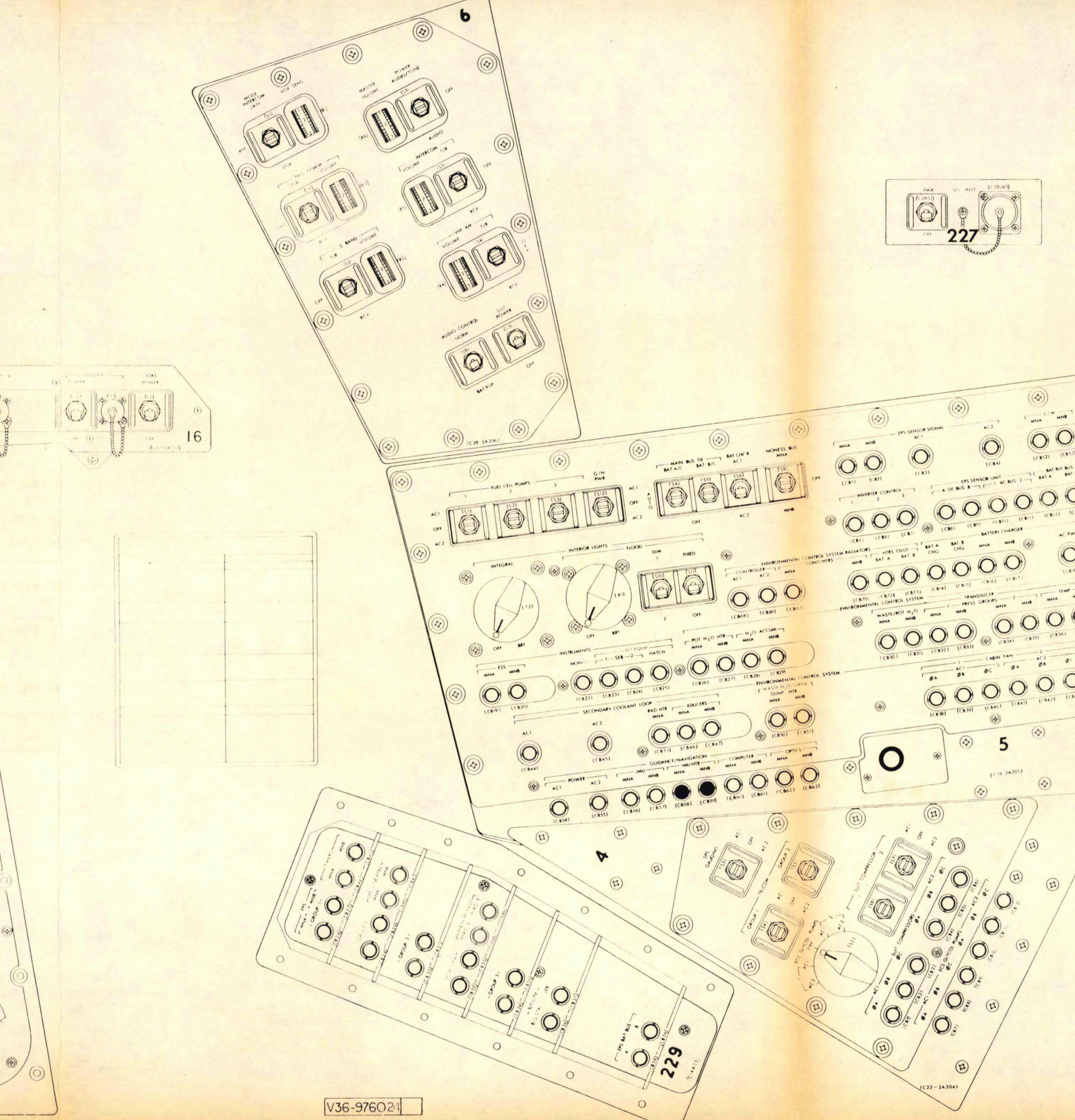
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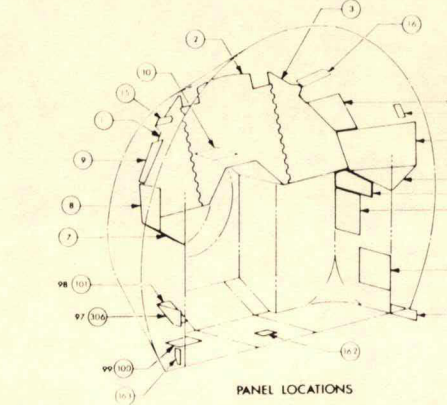
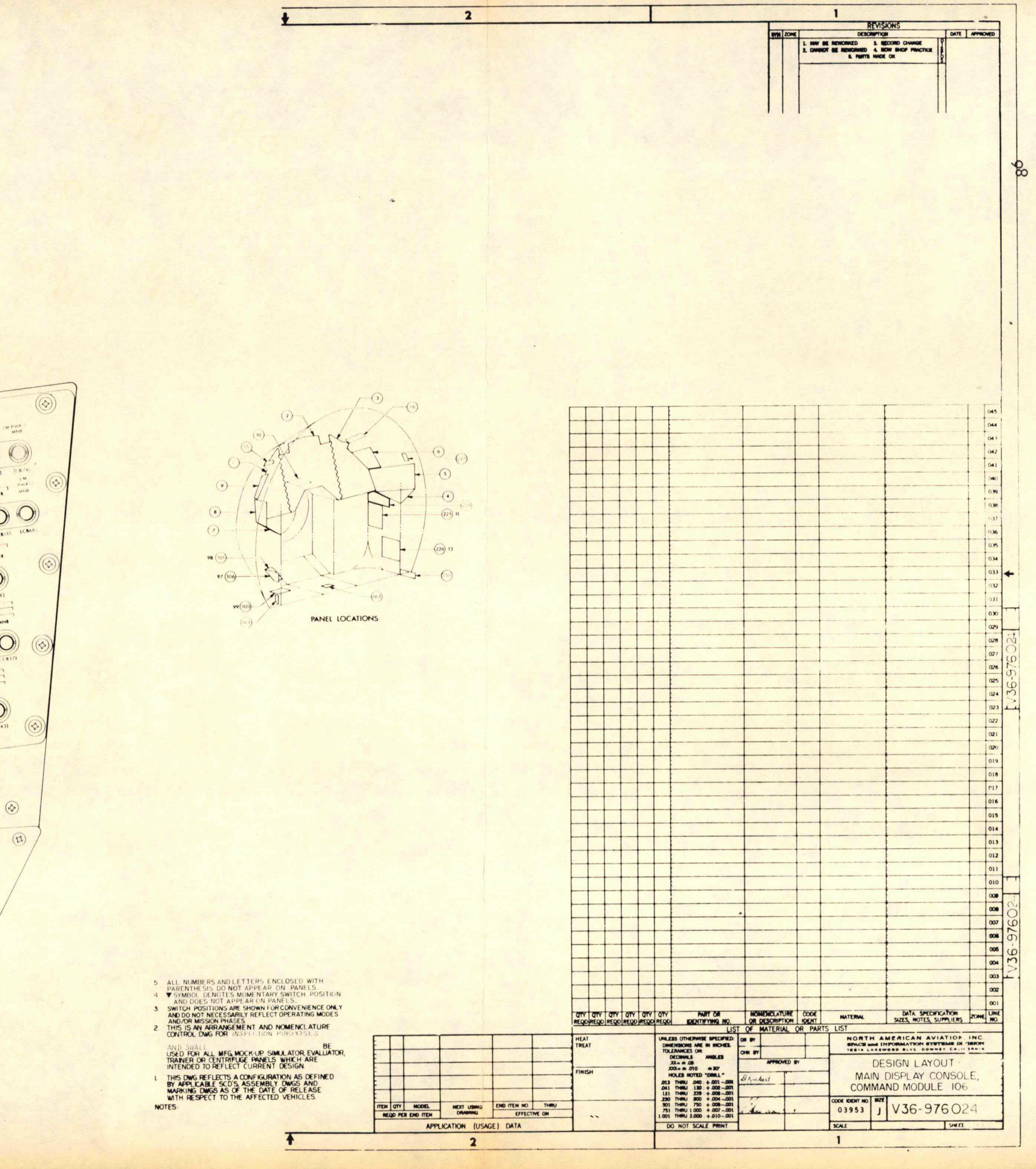
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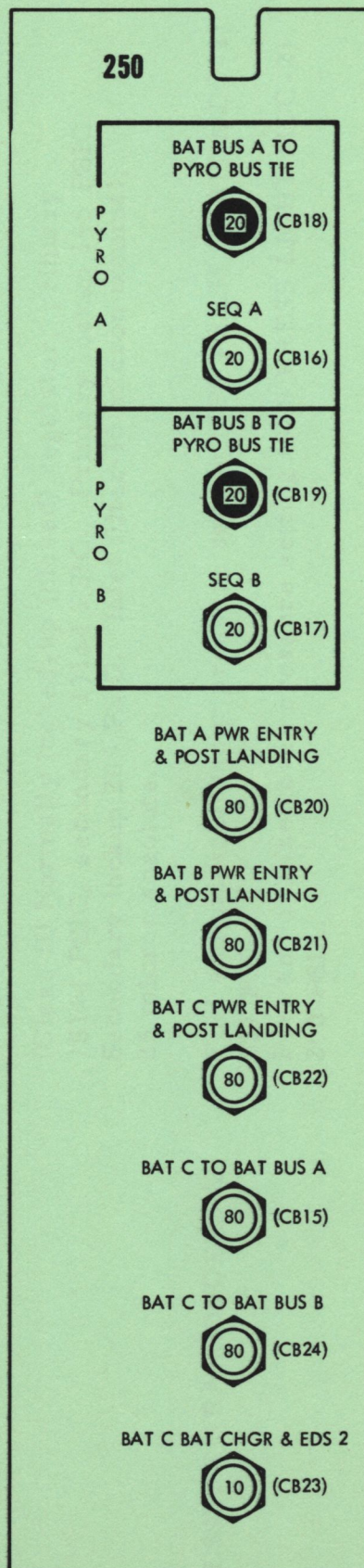
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ITEM	DESCRIPTION	QUANTITY	REMARKS
1	CONTROL PANEL 100	1	
2	CONTROL PANEL 101	1	
3	CONTROL PANEL 15	1	
4	CONTROL PANEL 162	1	
5	CONTROL PANEL 163	1	
6	CONTROL PANEL 225	1	
7	CONTROL PANEL 226	1	
8	CONTROL PANEL 227	1	
9	CONTROL PANEL 306	1	
10	CONTROL PANEL 8	1	
11	CONTROL PANEL 9	1	

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CSM 101



SPS DATA

HELIUM TANKS (2)	3600±50 PSIA fill pressure, 4400 maximum operating pressure, capacity 19.4 cubic ft. each. Inside diameter 40" and a wall thickness of .46".
REGULATOR UNITS (2)	Working regulator, (Class I) primary 186±4 PSIG, secondary 191±4 PSIG. Primary lockup 195 PSIG. Secondary lockup 200 PSIG. Inlet filter 10 micron nominal, 25 micron absolute. (Class II) Normally locked-up (closed) regulator, primary 181±4 PSIG, secondary 191±4 PSIG. Primary lockup 195 PSIG. Secondary lockup 205 PSIG. Inlet filter 10 micron nominal, 25 micron absolute.
PRESSURE TRANSDUCERS (2)	Fuel and oxidizer under pressure setting (SPS PRESS LIGHT MDC-2) 157 PSIA. Fuel and oxidizer over pressure setting (SPS PRESS LIGHT MDC-2) 200 PSIA.
PROPELLANT UTILIZATION VALVE CONTROL (2)	Increase position - Approximately 3% more than nominal flow Normal position - Nominal flow Decrease position - Approximately 3 1/2% less than nominal flow Response time, normal to increase or vice versa or normal to decrease or vice versa is 3.5 seconds.
QUANTITY SENSING SYSTEM ACCURACY	Indicators - Different between actual quantity and total quantity indicated for each propellant not to exceed ±.35% of full tank plus +.35% of propellant remaining separately to total fuel and oxidizer separately. TLM - Difference between actual quantity on each tank and that represented to TLM be within ±.35% of full tank plus +.35% of propellant remaining.

SPS DATA

HELIUM RELIEF VALVE (2)	Diaphragm rupture 219±6 PSIG Filter, 10 micron, 25 micron absolute Relief valve relieves at 212 psig minimum to 225 psig maximum Relief valve reseats at 208 PSIG minimum Flow capacity 3 lbs/minute maximum at 60°F and 225 PSIG Bleed device closes when increasing pressure reaches no greater than 150 PSIG in cavity and reopens when decreasing pressure has reached no less than 20 PSIG.
OXIDIZER STORAGE TANK #1	Total tank capacity 11,284.69 lbs. Fill pressure 110 PSIA Height 154.47" Inside diameter 45" Wall thickness .054"
OXIDIZER SUMP TANK #2	Total tank capacity 13,923.72 lbs. = 57% Fill pressure 110 PSIA Height 153.8" Inside diameter 51" Wall thickness .054"
FUEL STORAGE TANK #1	Total tank capacity 7058.36 lbs. Fill pressure 110 PSIA Height 154.47" Inside diameter 45" Wall thickness .054"
FUEL SUMP TANK #2	Total tank capacity 8708.10 lbs. = 57% Fill pressure 110 PSIA Height 153.8" Inside diameter 51" Wall thickness .054"

SPS DATA

TOTAL PROPELLANT (IN TANKS)	OXIDIZER 25,208.41 lbs = 103.4% FUEL 15,766.46 lbs = 103.4%
	99.9% oxidizer gaugeable = 24,389.10 lbs. 99.9% fuel gaugeable = 15,252.70 lbs.
ALL PROPELLANT TANKS	Pressurized to 10±5 PSIG when empty to prevent collapsing of tanks (negative pressure of .5 PSIG will collapse tanks).
INTERFACE FLANGE FILTER (2)	500 micron absolute
GN ₂ BIPROPELLANT VALVE CONTROL SYSTEMS (2)	GN ₂ vessel pressure 2500±50 PSI at 68°F, 2900 PSI at 130°F. Support 43 valve actuations Regulator - Single stage, dynamic 187 PSIG minimum, lockup 195 to 225 PSIG Relief Valve - Relieves at 350±15 PSI Reseats at not less than 250 PSI
HEATERS CSM 101, 103 AND 104	12 heaters, 2 elements in each heater, each element rated at 2 watts SPS heater switch position A/B on MDC-3 supplies 28 vdc to 24 elements SPS heater switch position A on MDC-3 supplies 28 vdc to 12 elements
HEATERS CSM 106 AND SUBS	6 heaters, 2 elements in each heater, 3 elements in series on the fuel side rated at 15 watts, 9.4 watts and 18.8 watts, 3 elements in series on the oxidizer side rated at 15 watts, 9.4 watts and 18.8 watts. SPS heater switch position A/B on MDC-3 supplies 28 VDC to 12 elements. SPS heater switch position A on MDC-3 supplies 28 VDC to 6 elements.

SPS DATA

ENGINE (1)

750 second service life
Support 50 starts
Expansion ratio = 6 to 1 at ablative chamber exit area
= 62.5 to 1 at nozzle extension exit area
Chamber cooling - Ablation and film cooled
Nozzle Extension - Radiation cooled
Injector Type - Baffled, unlike impingement
Oxidizer Lead 8°
Length 152.82"
Nozzle extension exit diameter 94.4"
Weight - Approximately 650 lbs.
Injector Flange Temperature - Illuminate SPS FLANGE TEMP Hi
(Caution and Warning on MDC-2) at 480°F
SPS P_c transducer, displayed on MDC-1 through SPS P_c α switch to
SPS P_c α on MDC-1. Green range on indicator 65 to 125%
(corresponds to PSIA). Normal 95 to 105 PSIA.

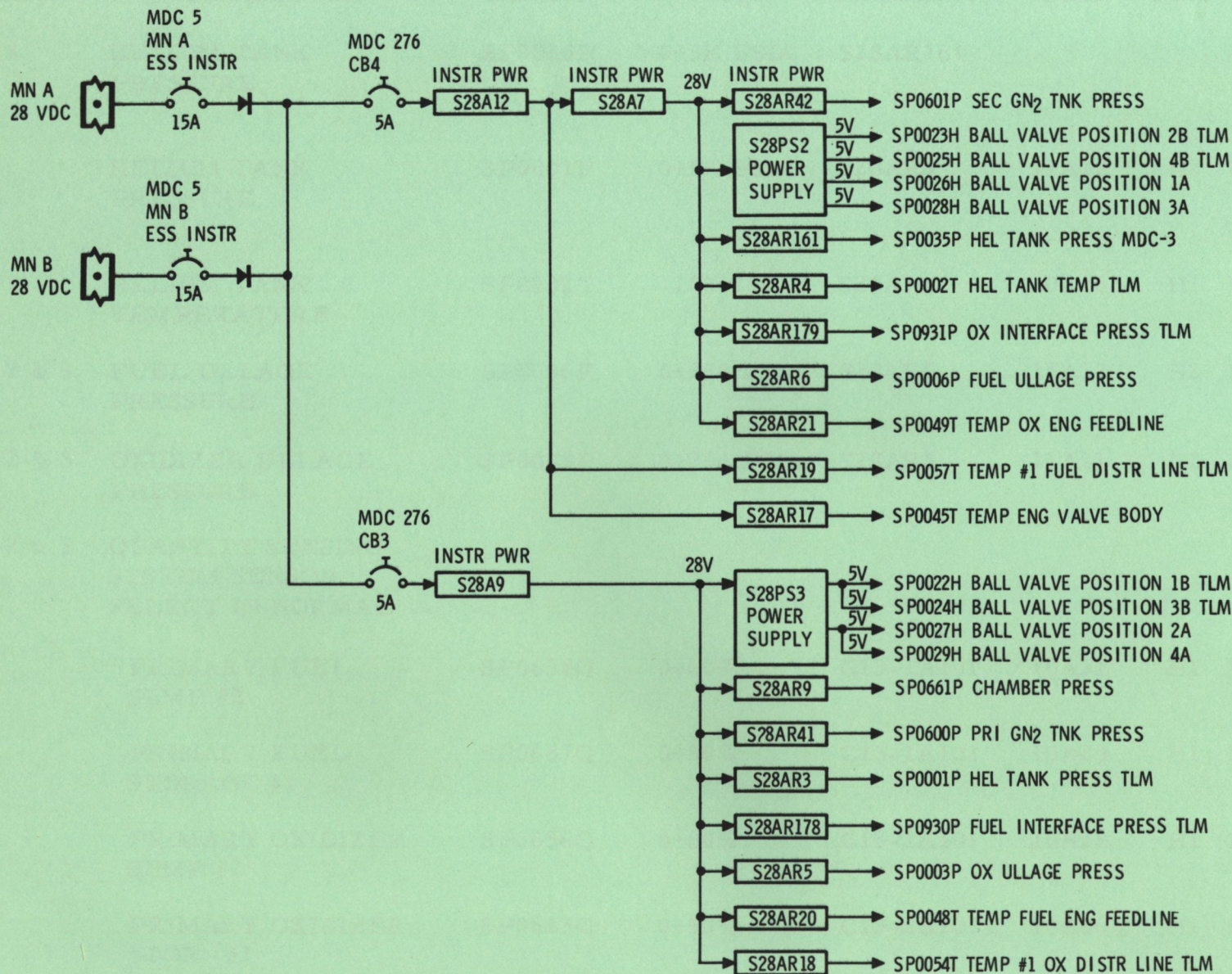
GIMBAL ACTUATORS

Structural mounting pad offset 4° to +Y.
About Z-Z axis $\pm 4\ 1/2 + 1/2 - 0^\circ$ with additional 1° for snubbing, (yaw) null
1° to +Y thrust vector during engine thrusting.
About Y-Y axis $\pm 4\ 1/2 + 1/2 - 0^\circ$ with additional 1° for snubbing, (pitch) null
2° to +Z thrust vector during engine thrusting.
Overcurrent relays (4)
Overcurrent dependent upon temperature during start transient,
steady state and gimbal angle change.
Quiescent current of 60+10-5 milliamps
Pressurized to 3.0 to 5.0 PSI of dry air
Deflection rate .12 radians per second (low side) 6.87° per second to
.132 radians per second (high side) 7.56° per second

FLIGHT COMBUSTION STABILITY MONITOR SYSTEM

180±18 g's peak to peak for 70±20 milliseconds, or 360 g's for
30 milliseconds, 500 to 5000 cycles per second

SPS INSTRUMENTATION POWER



SPS MEASUREMENTS

Crew Display	Measurement	Measurement Number	Range	Signal Conditioner	Channel Code	Bit Rate	Operating Range
MDC 3	HELIUM TANK PRESSURE	SP0035P	0+5K PSIA	S28AR161			3600±50 PSIA & DECREASE
	HELIUM TANK PRESSURE	SP0001P	0+5K PSIA	S28AR3	11A10	H2 PCM	3600±50 PSIA & DECREASE
	HELIUM TANK TEMPERATURE	SP0002T	-100+200°F	S28AR4	10A16	H1 PCM	VARIABLE
MDC 2 & 3	FUEL ULLAGE PRESSURE	SP0006P	0+250 PSIA	S28AR6	11A12	H2 PCM	} 170 to 195 PSIA
MDC 2 & 3	OXIDIZER ULLAGE PRESSURE	SP0003P	0+250 PSIA	S28AR5	11A11	H2 PCM	
MDC 2 & 3	QUANTITY SENSING SYSTEM SENSOR SELECT IN NORMAL						
	PRIMARY FUEL SUMP #2	SP0658Q	0+60%	C13-1A101	10A31	H1 PCM	} VARIABLE
	PRIMARY FUEL STORAGE #1	SP0657Q	0+50%	C13-1A101	10A29	H1 PCM	
	PRIMARY OXIDIZER SUMP #2	SP0656Q	0+60%	C13-1A101	10A28	H1 PCM	
	PRIMARY OXIDIZER STOR. #1	SP0655Q	0+50%	C13-1A101	10A26	H1 PCM	

Crew Display	Measurement	Measurement Number	Range	Signal Conditioner	Channel Code	Bit Rate	Operating Range
SENSOR SELECT IN PRIMARY							
	PRIMARY FUEL SUMP #2	SP0658Q	0+60%	C13-1A101	10A31	H1 PCM	} VARIABLE
	PRIMARY FUEL STOR. #1	SP0657Q	0+50%	C13-1A101	10A29	H1 PCM	
	PRIMARY OX. SUMP #2	SP0656Q	0+60%	C13-1A101	10A28	H1 PCM	
	PRIMARY OX. STOR. #1	SP0655Q	0+50%	C13-1A101	10A26	H1 PCM	
SENSOR SELECT IN AUXILIARY							
	PRIMARY FUEL SUMP #2	SP0658Q	0+60%	C13-1A101	10A31	H1 PCM	} VARIABLE
	PRIMARY OX. SUMP #2	SP0656Q	0+60%	C13-1A101	10A28	H1 PCM	
	AUX FUEL	SP0657Q	0+100%	C13-1A101	10A29	H1 PCM	
	AUX OXIDIZER	SP0655Q	0+100%	C13-1A101	10A26	H1 PCM	
	TEMP #1 OX. DISTR. LINE	SP0054T	0+200°F	S28AR18	10A44	H1 PCM	} +27°F MIN +100°F MAX
	TEMP #1 FUEL DIST. LINE	SP0057T	0+200°F	S28AR19	10A59	H1 PCM	
	FUEL INTERFACE PRESSURE TO ENGINE	SP0930P	0+300 PSIA	S28AR178	11A152	H1 PCM	} VARIABLE
	OXIDIZER INTERFACE PRESSURE TO ENGINE	SP0931P	0+300 PSIA	S28AR179	11A161	H1 PCM	

Crew Display	Measurement	Measurement Number	Range	Signal Conditioner	Channel Code	Bit Rate	Operating Range
MDC 3	TEMP FUEL ENGINE FEEDLINE	SP0048T	0+200°F	S28AR20	10A117	H2 PCM	+45 to +75°F CSM 101 , 103 and 104 +70 to +90°F CSM 106 and subs. Redline markings at +27 and +100°F.
MDC 101	TEMP OX ENGINE FEEDLINE	SP0049T	0+200°F	S28AR21	10A120	H2 PCM	1.125 VDC=45°F 1.812 VDC=70°F 1.95 VDC=75°F 2.362 VDC=90°F
	TEMP ENGINE VALVE BODY	SP0045T	0+200°F	S28AR17	10A37	H1 PCM	+27°F min. +100°F max.
MDC 3	PRIMARY GN ₂ TANK PRESS	SP0600P	0+5K PSIA	S28AR41	10A10	H1 PCM	2500±50 PSIA AND DECREASE
MDC 3	SECONDARY GN ₂ TANK PRESS	SP0601P	0+5K PSIA	S28AR42	10A11	H1 PCM	
	BALL VALVE POSITION 1B	SP0022H	0+90 DEG	C13-1A101	11A31	H1 PCM	OPEN OR CLOSED (0° or 90°)
MDC 3	BALL VALVE POSITION 1A	SP0026H	0+90 DEG				
	BALL VALVE POSITION 2B	SP0023H	0+90 DEG	C13-1A101	11A32	H1 PCM	
MDC 3	BALL VALVE POSITION 2A	SP0027H	0+90 DEG				
	BALL VALVE POSITION 3B	SP0024H	0+90 DEG	C13-1A101	11A33	H1 PCM	

Crew Display	Measurement	Number	Range	Conditioner	Code	Rate	Operating Range
MDC 3	BALL VALVE POSITION 3A	SP0028H	0+90 DEG				} OPEN OR CLOSED (0° or 90°)
	BALL VALVE POSITION 4B	SP0025H	0+90 DEG	C13-1A101	11A34	H1 PCM	
MDC 3	BALL VALVE POSITION 4A	SP0029H	0+90 DEG				
MDC 1	CHAMBER PRESSURE	SP0661P	0+150 PSIA	S28AR9	12A14	H1 PCM	95 to 105 PSIA during burn.
MDC 2	ENGINE INJECTOR FLANGE TEMP NO. 1	SP0061T	0+600°F	COLLINS C13-1A106	10A47	H1 PCM	} ILLUMINATES SPS FLANGE TEMP HI ON MDC 2 AT 480°F
	ENGINE INJECTOR FLANGE TEMP No. 2	SP0062T	0+600°F	COLLINS C13-1A106	10A49	H1 PCM	
	GIMBAL POSITION PITCH 1 OR 2	CH3517H	-5.0 to +5.0 DEG	SCS	12A8	H1 PCM	
	GIMBAL POSITION YAW 1 OR 2	CH3518H	-5.0 to +5.0 DEG	SCS	12A10	H1 PCM	} VARIABLE
	YAW DIFFERENTIAL CURRENT**	CH3667C	-0.835 to +0.835 AMP	SCS	12A16	H1 PCM	
	PITCH DIFFERENTIAL CURRENT**	CH3666C	-0.835 to +0.835 AMP	SCS	22A4	H1 PCM	
	SPS SOLENOID DRIVER #1	CH3604X	EVENT	SCS	11E4-4	E2 PCME	} OFF ON EVENT
	SPS SOLENOID DRIVER #2	CH3605X	EVENT	SCS	11E9-4	E2 PCME	
	LOWER SURFACE HELIUM TANK 2*	SA4497T	0+100°F		10A80	H1 PCM	} VARIABLE
					F-12 2HL-46	FQ	
	UPPER SURFACE HELIUM TANK 1*	SA4496T	0+100°F		10A77	H1 PCM	
					F-12 2HL-45	FQ	
					*CSM 101 ONLY		
					**CSM 103 AND SUBS		

Crew Display	Measurement	Measurement Number	Range	Signal Conditioner	Channel Code	Bit Rate	Operating Range
	TEMP BAY 2 OX TANK SURFACE	SA2377T	-100+200°F		10A142	H1 PCM	} VARIABLE
	TEMP BAY 3 OX TANK SURFACE	SA2378T	-100+200°F		10A137	H1 PCM	
	TEMP BAY 5 FUEL TANK SURFACE	SA2379T	-100+200°F		10A139	H1 PCM	
	TEMP BAY 6 FUEL TANK SURFACE	SA2380T	-100+200°F		10A140	H1 PCM	
	OX TRANSFER LINE ENTRY SUMP TANK	SA2400T	-100+200°F		10A143	H1 PCM	
	FUEL TRANSFER ENTRY SUMP TANK	SA2401T	-100+200°F		10A145	H1 PCM	
	NOZZLE OUTER SKIN NO. 1 TEMP*	SP0050T	-260+2500°F		11A131	H1 FQ	
	PITCH GIMBAL ACTUATOR CASE TEMP*	SP2055T	-100+200°F		11A133	H1 FQ	
	SPS HELIUM PRESSURI- ZATION PANEL TEMP*	SP2012T	-100+200°F		11A132	H1 FQ	
	OX LINE INTERFACE TEMP DOWNSTREAM OF INTERFACE*	SP2095T	-100+200°F		11A134	H1 FQ	
	OX ENGINE FEED LINE HALF WAY BETWEEN GIMBAL RING HEATERS*	SP2096T	-100+200°F		11A135	H1 FQ	

*CSM 101 ONLY

SMRCS DATA

HELIUM TANKS (4)	4150±50 PSIG at 70±5° during servicing, after servicing setting on launch pad 70±10°F. Capacity 1.35 lbs. Internal volume of 910±5 cubic inches Weight 11.5 lbs.
REGULATOR UNITS (8)	Filter 25 micron nominal, 40 micron absolute Primary 181±3 PSIG with a normal lock-up of 183±5 PSIG. Secondary lock-up of 187±5 PSIG. From lock-up pressure do not drop below 182 PSIG or rise above 188 PSIG.
*HELIUM COMMON MANIFOLD PRESSURE TRANSDUCERS (4)	Illuminate Caution and Warning light on MDC-2 (SMRCS A, B, C, D). Under pressure 145 PSIA nominal
**SECONDARY FUEL PRESSURE TRANSDUCERS (4)	Over pressure 215 PSIA nominal
CHECK VALVES - FILTERS	40 micron nominal, 74 micron absolute, one at inlet to check valve assembly, one at each test port.
HELIUM RELIEF VALVES (8)	Diaphragm rupture at 228±8 PSIG Filter, 10 micron nominal, 25 micron absolute Relief valve relieves at 236.5±11.5 PSIG. Relief valve reseats at not less than 220 PSIG. Flow capacity .3 lbs/minute at 248 PSIG at 60°F. Bleed device closes when increasing pressure reaches no more than 179 PSIG in the cavity and a helium flow of less than 20 standard cubic centimeters per hour across the bleed device and relief valve assembly combined. The bleed device shall reopen when decreasing pressure has reached no less than 20 PSIG.
PRIMARY FUEL TANK (4)	Combined propellant and ullage volume of 69.1 lbs, initially at 65°F at 150 PSIG, resulting in a tank pressure of no more than 215 PSIA when heated to 85°F. Outside diameter 12.62" maximum Length 23.717" + .060" - .000" Wall thickness .017" to .022" Helium inlet port 1/4", fill and drain port 1/2"

*CSM 101 and 103

**CSM 104 and subs

SMRCS DATA

PRIMARY OXIDIZER TANK (4)	Combined propellant and ullage volume of 137.0 lbs., initially at 65°F at 150 PSIG, resulting in a tank pressure of no more than 215 PSIA when heated to 85°F. Outside diameter 12.62" maximum Length 28.558" + .060" - .000" Wall thickness .017" to .022"
SECONDARY FUEL TANK (4)	Combined propellant and ullage volume of 45.2 lbs., initially at 65° F at 150 PSIG, resulting in a tank pressure of no more than 205 PSIA when heated to 105° F. Outside diameter 12.62" maximum Length 17.329" + .040" - .000" Wall thickness .022" to .027"
SECONDARY OXIDIZER TANK (4)	Combined propellant and ullage volume of 89.2 lbs., initially at 65°F at 150 PSIG, resulting in a tank pressure of no more than 205 PSIA when heated to 105°F. Outside diameter 12.65" maximum Length 19.907" + .040" - .000" Wall thickness .022" to .027"
IN LINE FILTERS (8)	5 micron nominal, 15 micron absolute
ENGINE (16)	1000 second service life, 500 seconds continuous, capable of 10,000 operational cycles. Expansion ratio 40 to 1 at nozzle exit Cooling - Film and radiation Injector - Pre-mix ignitor one on one unlike impingement, 8 fuel annulus for film cooling of pre-mix ignitor, main chamber 8 on 8 unlike impingement, 8 fuel for film cooling of combustion chamber wall Nozzle extension - L 605 cobalt base Nozzle exit diameter - 5.6". Fuel lead Automatic coils - Connected in parallel Direct coils - Connected in series Weight - 4.99 lbs. Length - 13.375" Filters - Each injector valve inlet, 100 micron nominal, 250 micron absolute

SMRCS DATA

PACKAGE TEMPERATURE
TRANSDUCER (4)

Illuminate Caution and Warning light on MDC-2 (SMRCS A, B, C, D)
75°F nominal

205° nominal

HEATER THERMO-SWITCH
CSM 101, 103, and 104

#2

Open at 134°F

Close at 115°F

Minimum spread 9°F

36±3.6 Watts per element nominal

Two #1 thermo-switches per quad and one #2 thermo-switch per quad.

#1

Open at 118°F

Close at 70°F

36±3.6 Watts per element

HEATER THERMO SWITCH
CSM 106 and Subs

Open at 134°F

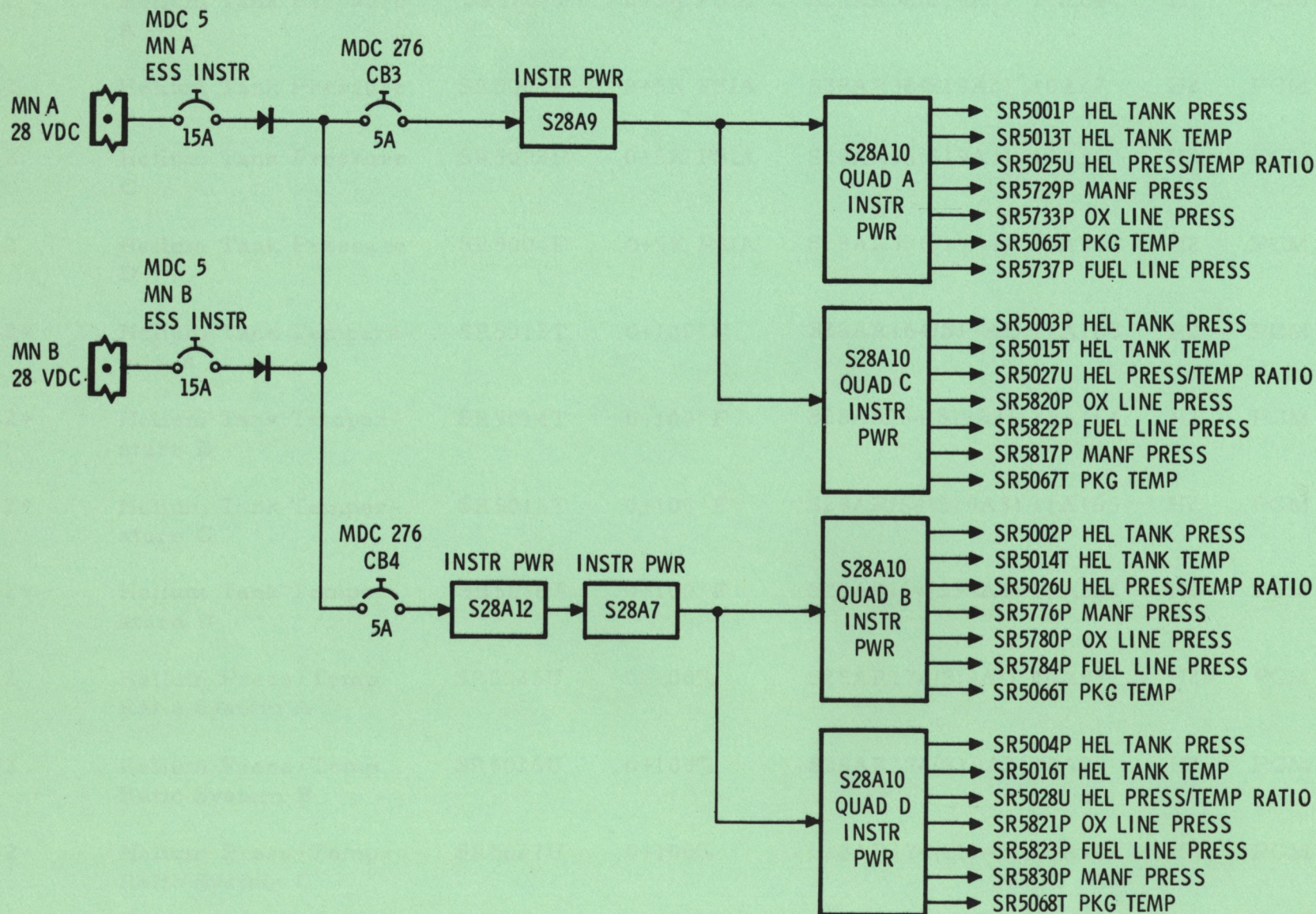
Close at 115°F

Minimum Spread 9°F

36±3.6 watts per element nominal

Two per quad

SM RCS INSTRUMENTATION POWER



SMRCS MEASUREMENTS

Crew Display	Measurement	Measurement Number	Range	Signal Conditioner	Channel Code	Bit Rate		Operating Range
MDC-2	Helium Tank Pressure A	SR5001P	0+5K PSIA	S28AR36(S19A1)	10A24	H1	PCM	4150±50 PSIA and Decrease
MDC-2	Helium Tank Pressure B	SR5002P	0+5K PSIA	S28AR36(S19A2)	10A27	H2	PCM	
MDC-2	Helium Tank Pressure C	SR5003P	0+5K PSIA	S28AR36(S19A3)	10A30	H2	PCM	
MDC-2	Helium Tank Pressure D	SR5004P	0+5K PSIA	S28AR36(S19A4)	10A33	H2	PCM	
MDC-2*	Helium Tank Temperature A	SR5013T	0+100°F	S28AR164(S19A1)	11A163	H2	PCM	VARIABLE
MDC-2*	Helium Tank Temperature B	SR5014T	0+100°F	S28AR164(S19A2)	11A164	H2	PCM	
MDC-2*	Helium Tank Temperature C	SR5015T	0+100°F	S28AR164(S19A3)	11A165	H2	PCM	
MDC-2*	Helium Tank Temperature D	SR5016T	0+100°F	S28AR164(S19A4)	11A166	H2	PCM	
MDC-2	Helium Press/Temp Ratio System A	SR5025U	0+100%	S28AR174(S19A1)	10A93	H2	PCM	VARIABLE
MDC-2	Helium Press/Temp Ratio System B	SR5026U	0+100%	S28AR174(S19A2)	10A99	H2	PCM	
MDC-2	Helium Press/Temp Ratio System C	SR5027U	0+100%	S28AR174(S19A3)	10A102	H2	PCM	
MDC-2	Helium Press/Temp Ratio System D	SR5028U	0+100%	S28AR174(S19A4)	10A105	H2	PCM	

*CSM 103 AND SUBS (TLM CSM 101 AND SUBS)

Crew Display	Measurement	Number	Range	Conditioner	Code	Rate	PCM	Range
MDC-2 CSM 101 & 103	Manifold Pressure A	SR5729P	0+400 PSIA	S28AR44(S19A1)	11A39	H2	PCM	178 to 192 PSIA
MDC-2 CSM 101 & 103	Manifold Pressure B	SR5776P	0+400 PSIA	S28AR44(S19A2)	11A40	H2	PCM	
MDC-2 CSM 101 & 103	Manifold Pressure C	SR5817P	0+400 PSIA	S28AR44(S19A3)	11A46	H2	PCM	
MDC-2 CSM 101 & 103	Manifold Pressure D	SR5830P	0+400 PSIA	S28AR44(S19A4)	11A130	H2	PCM	
	Oxidizer Line Pres- sure A	SR5733P	0+300 PSIA	S28AR170(S19A1)	11A91 11A23**	H2 H1**	PCM	
MDC-2 CSM 104 & subs	Secondary Fuel Pres- sure A**	SR5737P	0+400 PSIA	S28AR171(S19A1)	11A92	H2	PCM	
	Fuel Line Pressure A*	SR5737P	0+300 PSIA*	S28AR171(S19A1)	11A92	H2	PCM	
	Oxidizer Line Pres- sure B	SR5780P	0+300 PSIA	S28AR170(S19A2)	11A93 11A24**	H2 H1**	PCM PCM	
MDC-2 CSM 104 & subs	Secondary Fuel Pres- sure B**	SR5784P	0+400 PSIA	S28AR171(S19A2)	11A94	H2	PCM	
	Fuel Line Pressure B*	SR5784P	0+300 PSIA*	S28AR171(S19A2)	11A94	H2	PCM	
	Oxidizer Line Pres- sure C	SR5820P	0+300 PSIA	S28AR170(S19A3)	11A109 11A27**	H2 H1**	PCM PCM	
MDC-2 CSM 104 & subs	Secondary Fuel Pres- sure C**	SR5822P	0+400 PSIA	S28AR171(S19A3)	11A111	H2	PCM	
	Fuel Line Pressure C*	SR5822P	0+300 PSIA*	S28AR171(S19A3)	11A111	H2	PCM	
	Oxidizer Line Pres- sure D	SR5821P	0+300 PSIA	S28AR170(S19A4)	11A110 11A28**	H2 H1**	PCM PCM	
MDC-2 CSM 104 & subs	Secondary Fuel Pres- sure D**	SR5823P	0+400 PSIA	S28AR171(S19A4)	11A112	H2	PCM	
	Fuel Line Pressure D*	SR5823P	0+300 PSIA*	S28AR171(S19A4)	11A112	H2	PCM	

*CSM 101 and 103

**CSM 104 and subs

Crew Display	Measurement	Number	Range	Conditioner	Signal	Channel	Bit Rate	Operating Range
	Main Oxidizer Outlet Temperature A*	SA4498T	0+120°F	S28AR150(S19A1)	F-12 2HL-	4710A82	H1 FQ H1 PCM	VARIABLE
	Main Oxidizer Outlet Temperature B*	SA4499T	0+120°F	S28AR150(S19A2)	F-12 2HL-	4810A55	H1 FQ PCM	
	Main Oxidizer Outlet Temperature C*	SA4500T	0+120°F	S28AR150(S19A3)	F-12 2HL-	4910A56	H1 FQ PCM	
	Main Oxidizer Outlet Temperature D*	SA4501T	0+120°F	S28AR150(S19A4)	F-12 2HL-	5010A58	H1 FQ PCM	
	Main Fuel Outlet Temperature A*	SA4502T	0+120°F	S28AR154(S19A1)	F-12 2HL-	5110A124	H1 FQ PCM	
	Main Fuel Outlet Temperature B*	SA4503T	0+120°F	S28AR154(S19A2)	F-12 2HL-	5210A125	H1 FQ PCM	
	Main Fuel Outlet Temperature C*	SA4504T	0+120°F	S28AR154(S19A3)	F-12 2HL-	5310A127	H1 FQ PCM	
	Main Fuel Outlet Temperature D*	SA4505T	0+120°F	S28AR154(S19A4)	F-12 2HL-	54-0A128	H1 FQ PCM	
MDC-2	A Package Temperature	SR5065T	0+300°F	S28AR40(S19A1)	10A136		H1 PCM	75°F NOMINAL to 205°F NOMINAL
MDC-2	B Package Temperature	SR5066T	0+300°F	S28AR40(S19A2)	10A17		H1 PCM	
MDC-2	C Package Temperature	SR5067T	0+300°F	S28AR40(S19A3)	10A19		H1 PCM	
MDC-2	D Package Temperature	SR5068T	0+300°F	S28AR40(S19A4)	10A20		H1 PCM	
	Direct RCS Switch No. 1 Enable**	CH3601X	EVENT	SCS	11E24-3		E2 PCM	OFF ON EVENT
	Direct RCS Switch No. 2 Enable**	CH3602X	EVENT	SCS	11E24-4		E2 PCM	

*CSM 101 only

**CSM 103 and subs

HELIUM TANKS (2)	4150±50 PSIG at 70±5° during servicing, setting on launch pad 70±10°F Capacity .57 lbs. Inside diameter 8.84" Wall thickness .105". Internal volume of 365±5 cubic inches at 4150±50 PSIG
HELIUM ISOLATION SQUIB VALVE FILTER	Remove 98% of all particles whose two smallest dimensions are greater than 40 microns. Remove 100% of all particles whose two smallest dimensions are greater than 74 microns.
REGULATOR UNITS (4)	Filter 25 micron nominal, 40 micron absolute Primary 291±4 PSIG, lockup pressure minimum of 287 PSIG and not to exceed 302 PSIG. Secondary lockup 287 to 302 PSIG
CHECK VALVE FILTERS	40 micron nominal, 74 micron absolute, one at inlet to check valve assembly, one each at test port (CSM 104 and subs)
HELIUM RELIEF VALVES (4)	Diaphragm rupture at 340±8 PSIG Filter, 10 micron nominal, 25 micron absolute Relief valve relieves at 346±14 PSIG Relief valve reseats at no less than 327 PSIG Flow capacity .3 lb/minute at 60°F and 346±14 PSIG Bleed device closes when increasing pressure has reached no more than 179 PSIG in the cavity and a helium flow of less than 20 standard cubic centimeters per hour across the bleed device and relief valve assembly combined. Bleed device shall reopen when decreasing pressure has reached no less than 20 PSIG.
FUEL AND OXIDIZER PRESSURE TRANSDUCERS* (4)	Illuminates Caution and Warning light on MDC-2 (CMRCS 1 or 2) after helium isolation squib valve actuation.
HELIUM MANIFOLD PRESSURE TRANSDUCERS** (4)	Under pressure 260 PSIA nominal Over pressure 330 PSIA nominal
FUEL TANKS (2)	See SMRCS secondary fuel tank
OXIDIZER TANKS (2)	See SMRCS secondary oxidizer tank

*Deleted on CSM 104 and subs

**CSM 104 and subs

CMRCS DATA

VALVE ISOLATION (4) BURST DIAPHRAGM

Rupture at 241 ± 14 PSIG within 2 seconds after rupture pressure is reached at any temperature between 40 to 105°F
Filter, 75 micron nominal, 100 micron absolute

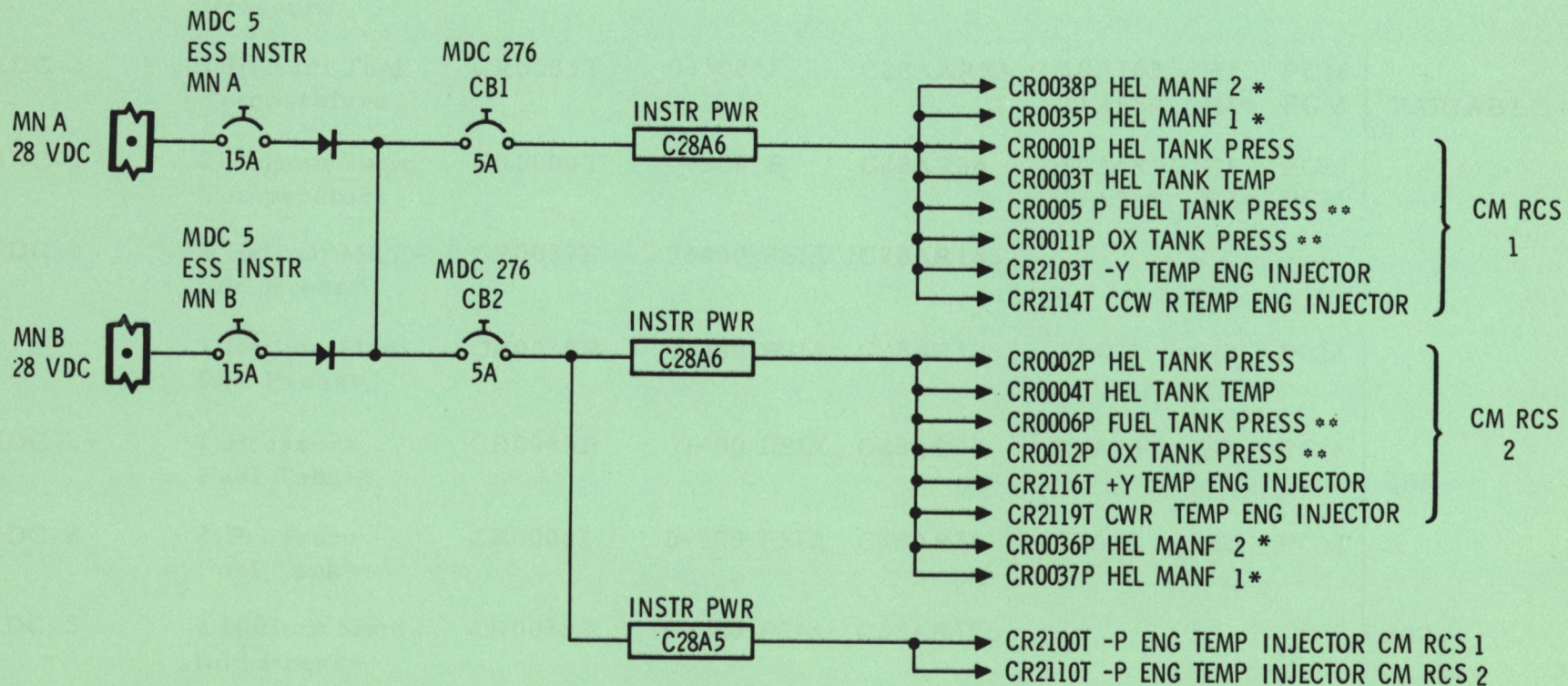
ENGINE (12)

200 second service life, 3000 operational cycles
Expansion ratio 9 to 1
Cooling - Ablation
Injector - 16 on 16 splash plate
Combustion chamber - Refrasil ablative sleeve and graphite base throat insert.
Automatic and direct coils - Connected in parallel
Weight 8.3 lbs.
Length 11.65" maximum
Nozzle exit diameter 2.13"
Nozzle extension - Ablative refrasil

OXIDIZER AND FUEL BLOWOUT PLUG

Pin shear at approximately 200 PSI.

CM RCS INSTRUMENTATION POWER



* CSM 104 AND SUBS

** DELETED ON CSM 104 AND SUBS

P-7027E

CMRCS MEASUREMENTS

Crew Display	Measurement	Measurement Number	Range	Signal Conditioner	Channel Code	Bit Range	Operating Range
MDC-2	1 Helium Tank Pressure	CR0001P	0+5K PSIA	C28AR31	10A18	H2 PCM	4150±50 PSIA and DECREASE
MDC-2	2 Helium Tank Pressure	CR0002P	0+5K PSIA	C28AR32	10A21	H2 PCM	
MDC-2	1 Helium Tank Temperature	CR0003T	0+300 °F	C28AAR33	10A103 11A55*	H1 PCM H2* PCM	VARIABLE
MDC-2	2 Helium Tank Temperature	CR0004T	0+300 °F	C28AR34	10A48 11A56*	H1 PCM H2* PCM	
MDC-2	1 Helium Manifold Press*	CR0037P	0+400 PSIA	C28AR185			
	1 Helium Manifold Press*	CR0035P	0+400 PSIA	C28AR183	11A21	H2 PCM	
MDC-2	1 Pressure Fuel Tank**	CR0005P	0+400 PSIA	C28AR35	11A13	H2 PCM	285
MDC-2	2 Pressure Fuel Tank**	CR0006P	0+400 PSIA	C28AR36	11A21	H2 PCM	to
MDC-2	2 Helium Manifold Press*	CR0038P	0+400 PSIA	C28AR186			302
	2 Helium Manifold Press*	CR0036P	0+400 PSIA	C28AR184	11A22	H2 PCM	PSIA
MDC-2	1 Pressure Oxidizer Tank**	CR0011P	0+400 PSIA	C28AR38	11A22	H2 PCM	
MDC-2	2 Pressure Oxidizer Tank**	CR0012P	0+400 PSIA	C28AR39	11A55	H2 PCM	

*CSM 104 and subs

**Deleted on CSM 104 and subs

Crew Display	Measurement	Measurement Number	Range	Signal Conditioner	Channel Code	Bit Rate	Operating Range
MDC-101	1-P Temperature Engine #14 Injector	CR2100T	-50+50°F	C28AR402			Pre-heat required if below +48°F approx- imately 4.9 vdc. If heating required heat until 48°F is reached or 20 minutes whichever is reached first.
MDC-101	1-Y Temperature Engine #16 Injector	CR2103T	-50+50°F	C28AR274			
MDC-101	1 CCWR Temper- ature Engine #12 Injector	CR2114T	-50+50°F	C28AR273			
MDC-101	2-P Temperature Engine #24 Injector	CR2110T	-50+50°F	C28AR403			
MDC-101	2+Y Temperature Engine #25 Injector	CR2116T	-50+50°F	C28AR272			
MDC-101	2CWR Temperature Engine #21 Injector	CR2119T	-50+50°F	C28AR404			
	RCS Activate Signal A Z19	CD0170X	EVENT	Seq.	11E22-3	E2 PCM	OFF - ON EVENT
	RCS Activate Signal B Z19	CD0171X	EVENT	Seq.	11E23-3	E2 PCM	

CMRCS MEASUREMENTS

Crew Display	Measurement	Measurement Number	Range	Signal Conditioner	Channel Code	Bit Rate	Operating Range
	CMRCS Pressurize Signal A Z7	CD0173X	EVENT	Seq.	11E22-7	E2 PCM	OFF - ON EVENT
	CMRCS Pressurize Signal B Z7	CD0174X	EVENT	Seq.	11E23-5	E2 PCM	OFF - ON
	DIRECT RES SWITCH NO. 1 ENABLE**	CH3601X	EVENT	Seq.	11E24-3	E2 PCM	OFF ON
	DIRECT RCS SW SWITCH NO. 2 ENABLE**	CH3602X	EVENT	Seq.	11E24-4	E2 PCM	EVENT

**CSM 103 and subs

ABBREVIATIONS

AC	ALTERNATING CURRENT	ISO	ISOLATION
ACCEL	ACCELERATION	ISOL	ISOLATION
ACK	ACKNOWLEDGE	JETT	JETTISON
AMP	AMPLIFIER	LBS	POUNDS
AUTO	AUTOMATIC	LDEC	LUNAR DOCKING EVENT CONTROLLER
AUX	AUXILIARY	LES	LAUNCH ESCAPE SYSTEM
BAT	BATTERY	LO	LOW
CAUT/WARN	CAUTION/WARNING	LV	LAUNCH VEHICLE
CCW	COUNTERCLOCKWISE	MAX	MAXIMUM
CL	CENTERLINE	MESC	MASTER EVENT SEQUENCE CONTROLLER
CM OR C/M	COMMAND MODULE	MDC	MAIN DISPLAY CONSOLE
CMC	COMMAND MODULE COMPUTER	MIN	MINIMUM
CMD	COMMAND	MN	MAIN
CONT	CONTROL	MOT	MOTOR
CW	CLOCKWISE	M1	MOTOR 1
DC	DIRECT CURRENT	M2	MOTOR 2
DEC	DECREASE	N	NORMAL
DEM0D	DEM0DULATOR	NEG	NEGATIVE
ECO	ENGINE COMBUSTION	NO.	NUMBER
EDS	EMERGENCY DETECTION SYSTEM	NORM	NORMAL
EMS	ENTRY MONITOR SYSTEM	OX	OXIDIZER
EPS	ELECTRICAL POWER SUBSYSTEM	OXID	OXIDIZER
FCSM	FLIGHT COMBUSTION STABILITY MONITOR	POT	POTENTIOMETER
FT	FEET	PRI	PRIMARY
GN ₂	GASEOUS NITROGEN	PRIM	PRIMARY
GPI	GIMBAL POSITION INDICATOR	PROP	PROPELLANT
GRD	GROUND	PSI	POUNDS PER SQUARE INCH
GSE	GROUND SUPPORT EQUIPMENT	PSIA	POUNDS PER SQUARE INCH ABSOLUTE
He	HELIUM	PSIG	POUNDS PER SQUARE INCH GAUGE
HI	HIGH	PU	PROPELLANT UTILIZATION
HR	HEATER	PUG	PROPELLANT UTILIZATION GAUGING
IMU	INERTIAL MEASUREMENT UNIT	PWR	POWER
INC	INCREASE	RCS	REACTION CONTROL SUBSYSTEM
IND	INDICATOR	ROT	ROTATION
		S	SWITCH

ABBREVIATIONS (Cont' d)

S/C	SPACECRAFT	T. J.	TOWER JETTISON
SCS	STABILIZATION CONTROL SYSTEM	TLM	TELEMETRY
SEC	SECOND	TP	TEST PORT
SEC	SECONDARY	TV	THRUST VECTOR
SEP	SEPARATION	TVC	THRUST VECTOR CONTROL
SEQ	SEQUENCER	V	VOLTS
SM OR S/M	SERVICE MODULE	X _C	COMMAND MODULE STATION
SPS	SERVICE PROPULSION SUBSYSTEM	XPDNR	TRANSPONDER
SW	SWITCH	X _S	SERVICE MODULE STATION
TEMP	TEMPERATURE		