



APOLLO TRAINING

TELECOMMUNICATION
SUBSYSTEM
BLOCK II

8 APRIL 1968

FOR TRAINING PURPOSES ONLY





APOLLO TRAINING

TELECOMMUNICATION
SUBSYSTEM
BLOCK II

8 APRIL 1968

FOR TRAINING PURPOSES ONLY



SCE

CTE

AUDIO

INTRODUCTION

QUESTIONS RELATIVE TO THE CONTENTS OF THIS
DOCUMENT SHOULD BE DIRECTED TO:

R. E. JONES
G. L. STEINBECK
NORTH AMERICAN ROCKWELL CORP.
SPACE DIVISION
DOWNEY, CALIFORNIA
EXTENSION 4325, 6, or 7

BLOCK II TELECOMMUNICATION SYSTEM FUNCTIONS

I VOICE COMMUNICATIONS

A. ASTRO $\longleftrightarrow$ ASTRO
B. CSM $\longleftrightarrow$ MSFN
C. EVA $\longleftrightarrow$ CSM $\longleftrightarrow$ MSFN
D. LM $\longleftrightarrow$ CSM $\longleftrightarrow$ MSFN
E. ASTRO $\longrightarrow$ DSE $\longrightarrow$ MSFN (PLAYBACK)
F. EVA $\longrightarrow$ DSE $\longrightarrow$ MSFN (PLAYBACK)
G. LM $\longrightarrow$ DSE $\longrightarrow$ MSFN (PLAYBACK)

II DOWN DATA

A. CSM STATUS $\longrightarrow$ MSFN
B. ASTRO STATUS $\longrightarrow$ MSFN
C. EVA STATUS $\longrightarrow$ CSM $\longrightarrow$ MSFN
D. LM STATUS $\longrightarrow$ CSM $\longrightarrow$ MSFN (PLAYBACK)
E. REAL TIME TV $\longrightarrow$ MSFN (INTERFACE ONLY-TV CAMERA DELETED)

III UP DATA

A. REAL TIME COMMANDS (RTC) RELAY CLOSURES
B. COMMAND MODULE COMPUTER (CMC) UPDATING
C. CENTRAL TIMING EQUIPMENT (CTE) UPDATING

IV TRACKING

A. TRANS LUNAR (DOUBLE DOPLER AND PSEUDO RANDOM NOISE RANGING)
B. CSM/LM RENDEZVOUS

V RECOVERY

A. CM VOICE $\longleftrightarrow$ RECOVERY FORCES
B. VHF BEACON $\longrightarrow$ RECOVERY FORCES

TELECOMMUNICATIONS EQUIPMENT

AUDIO

- PERSONNEL COMMUNICATIONS ASSEMBLY
- AUDIO CONTROL PANELS
- AUDIO CENTER

DATA

- CENTRAL TIMING EQUIPMENT (CTE)
- SIGNAL CONDITIONING EQUIPMENT (SCE)
- PULSE CODE MODULATION TELEMETRY (PCM)
- DATA STORAGE EQUIPMENT (DSE)
- FLIGHT QUALIFICATION TAPE RECORDER (FQTR)
- UP DATA LINK (UDL)

RF

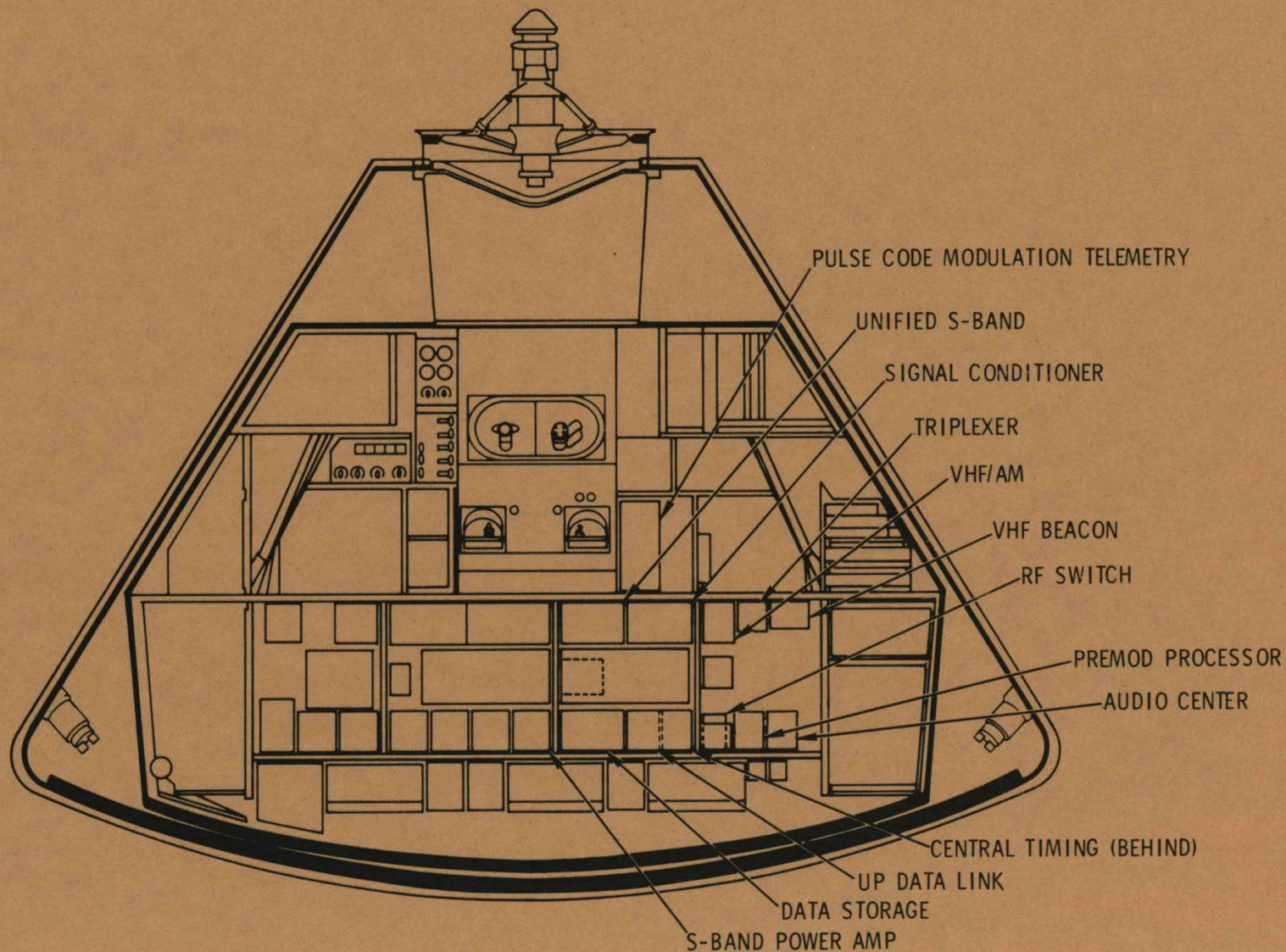
- PREMODULATION PROCESSOR (PMP)
- UNIFIED S BAND EQUIPMENT (USBE)
- VHF/AM TRANSCEIVERS
- VHF RECOVERY BEACON
- RENDEZVOUS RADAR TRANSPONDER (RRT)

ANTENNA (PRESENTED WITH ASSOCIATED RF EQUIPMENT)

- S BAND FLUSH MOUNTED
- S BAND HIGH GAIN
- VHF SCIMITARS
- VHF RECOVERY
- RENDEZVOUS RADAR TRANSPONDER (RRT) BEAM SPLITTER

TELECOMMUNICATIONS EQUIPMENT

LOWER EQUIPMENT BAY BLOCK II

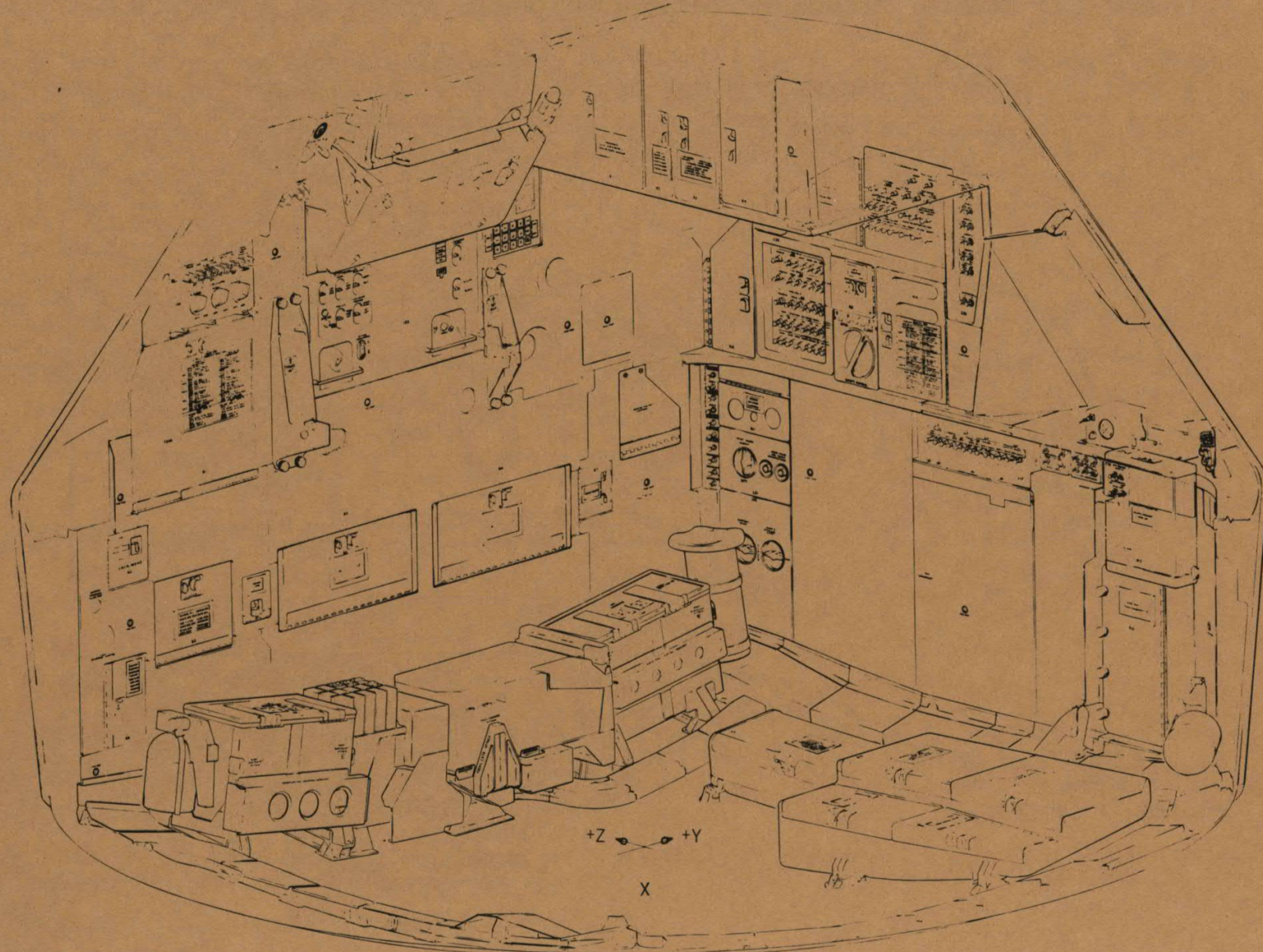


CD-2006 A



APOLLO CM INTERIOR CONFIGURATION

LEB, RHEB, RHFEB, & RIGHT AB



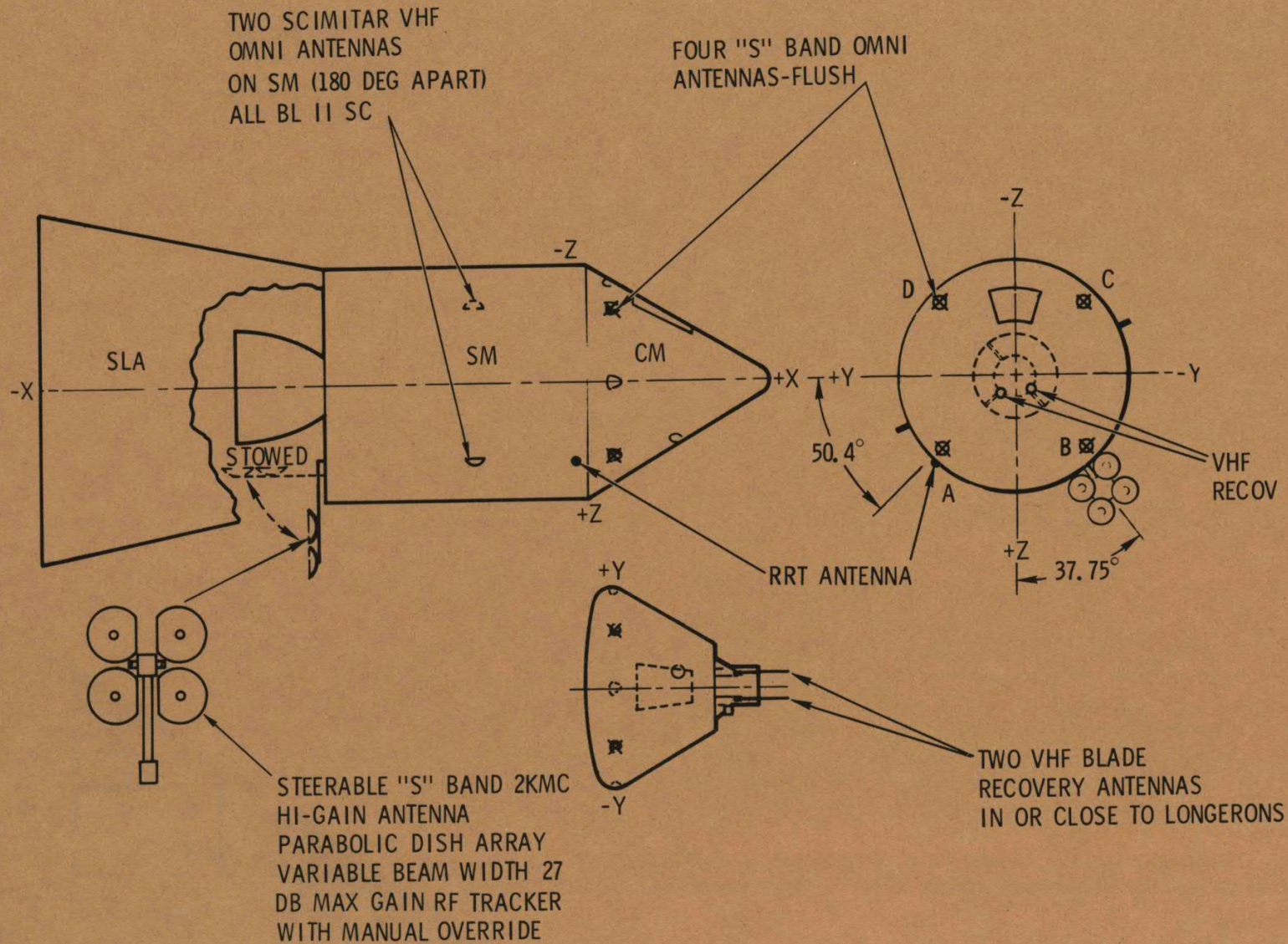
VIEW-LOOKING DOWN & OUTB'D

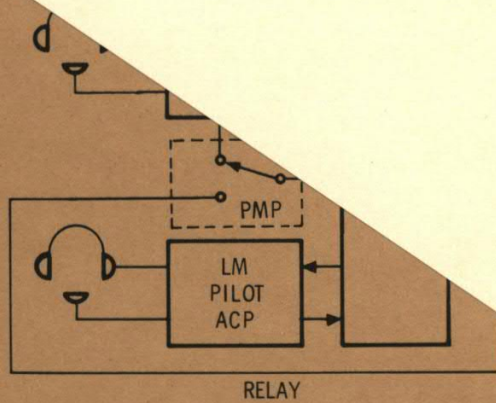
OCT 67

CS-0013A 

ANTENNA

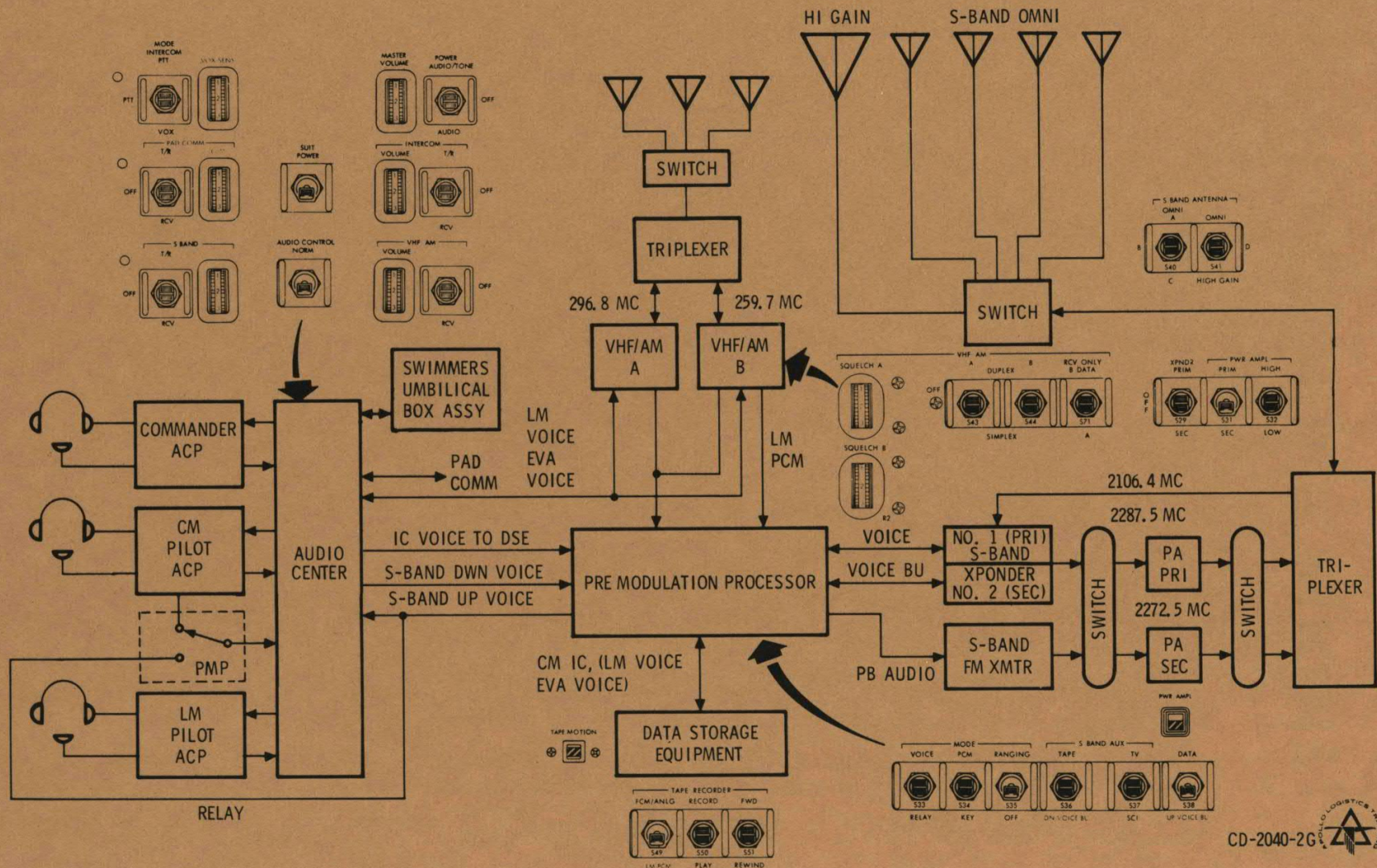
BLOCK II





AUDIO INTERFACES

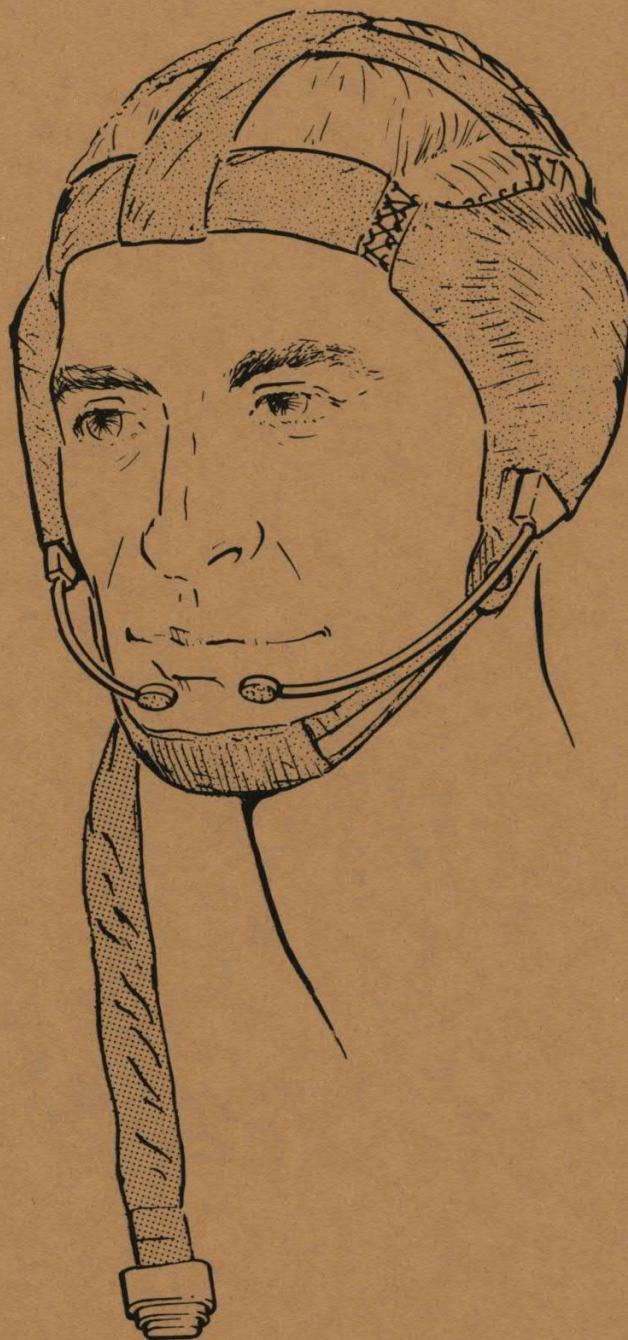
BLOCK II



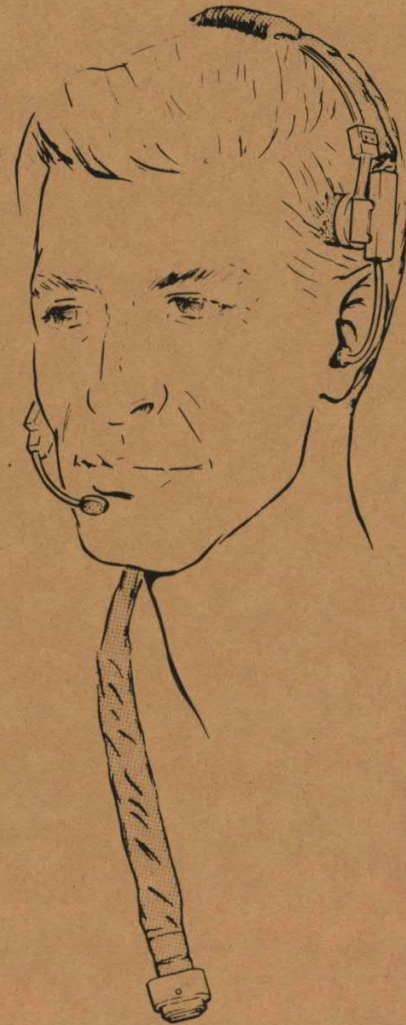
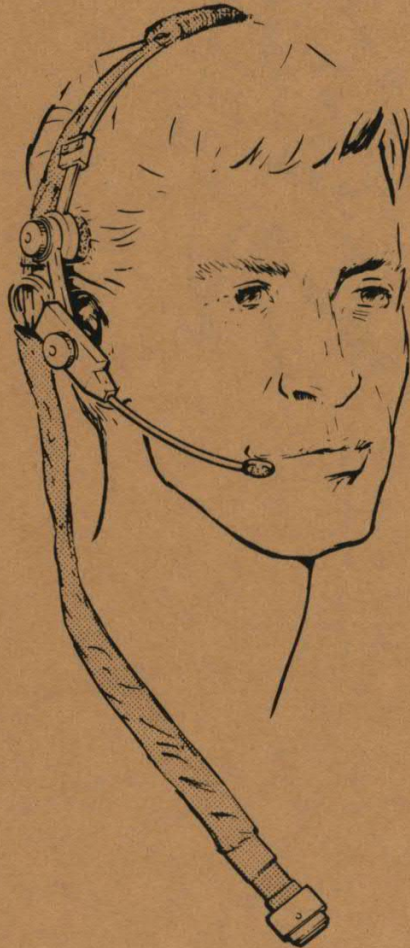
CD-2040-2G



PERSONAL COMMUNICATIONS ASSEMBLY (SOFT HAT)

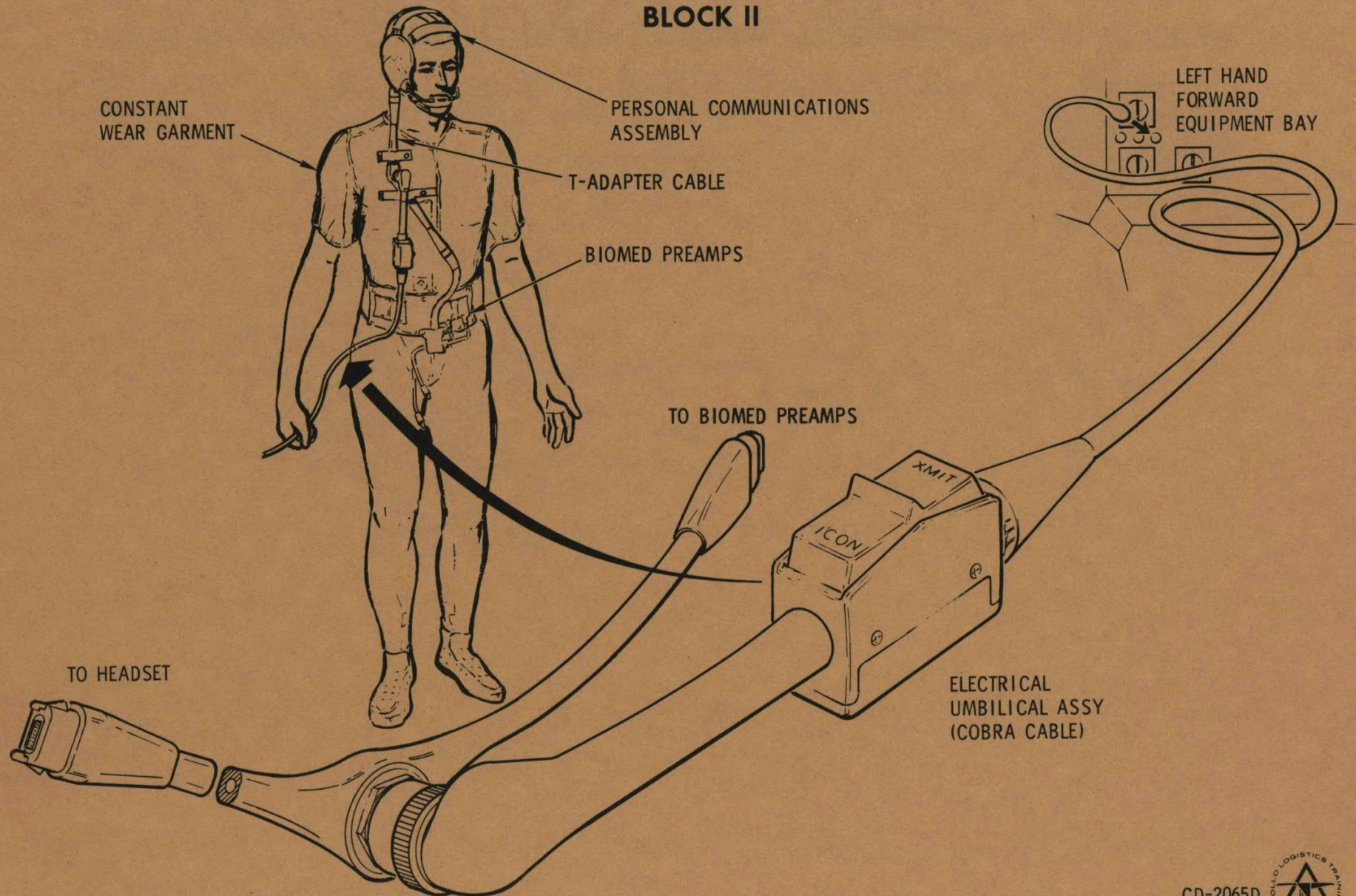


LIGHT WEIGHT HEADSET



ELECTRICAL UMBILICAL (COMM CABLE)

BLOCK II

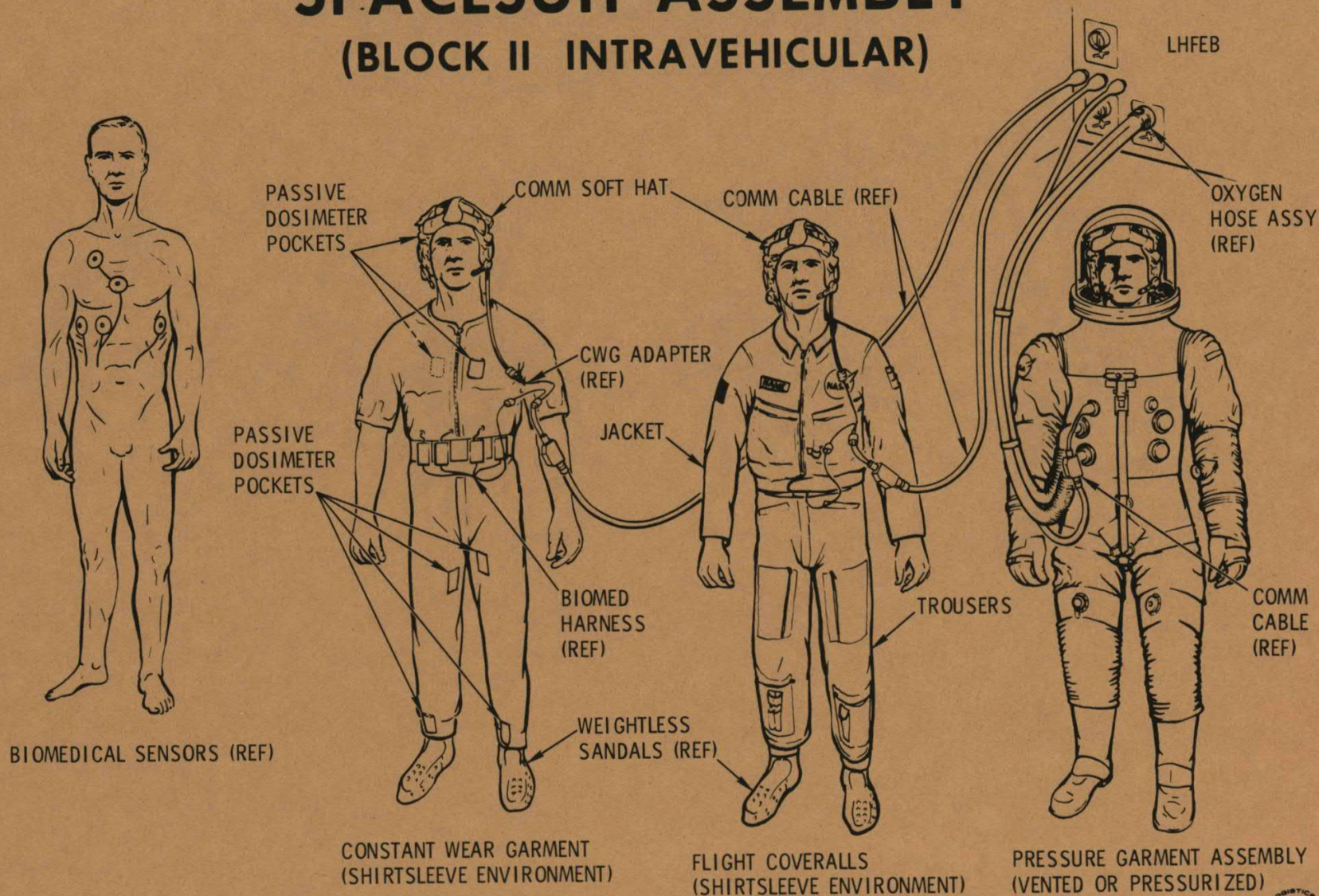


CD-2065D



SPACESUIT ASSEMBLY

(BLOCK II INTRAVEHICULAR)



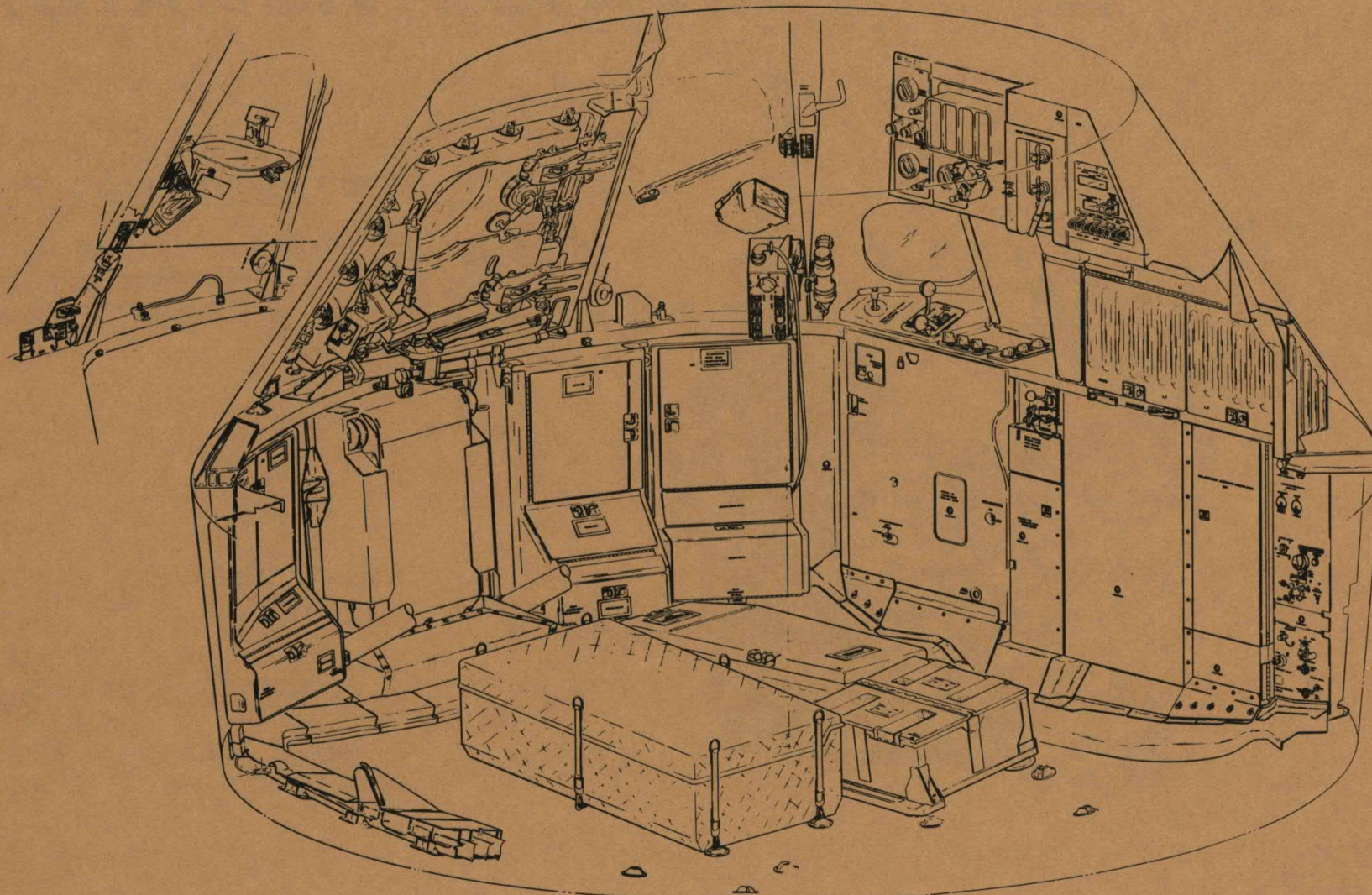
(REF) NOT PART OF SPACESUIT ASSEMBLY

MAY 67

CS-1001 B 

APOLLO CM INTERIOR CONFIGURATION

LHEB, LHFEb, UEB, & LEFT AB



VIEW-LOOKING DOWN & OUTB'D

OCT 67

CS-0014A



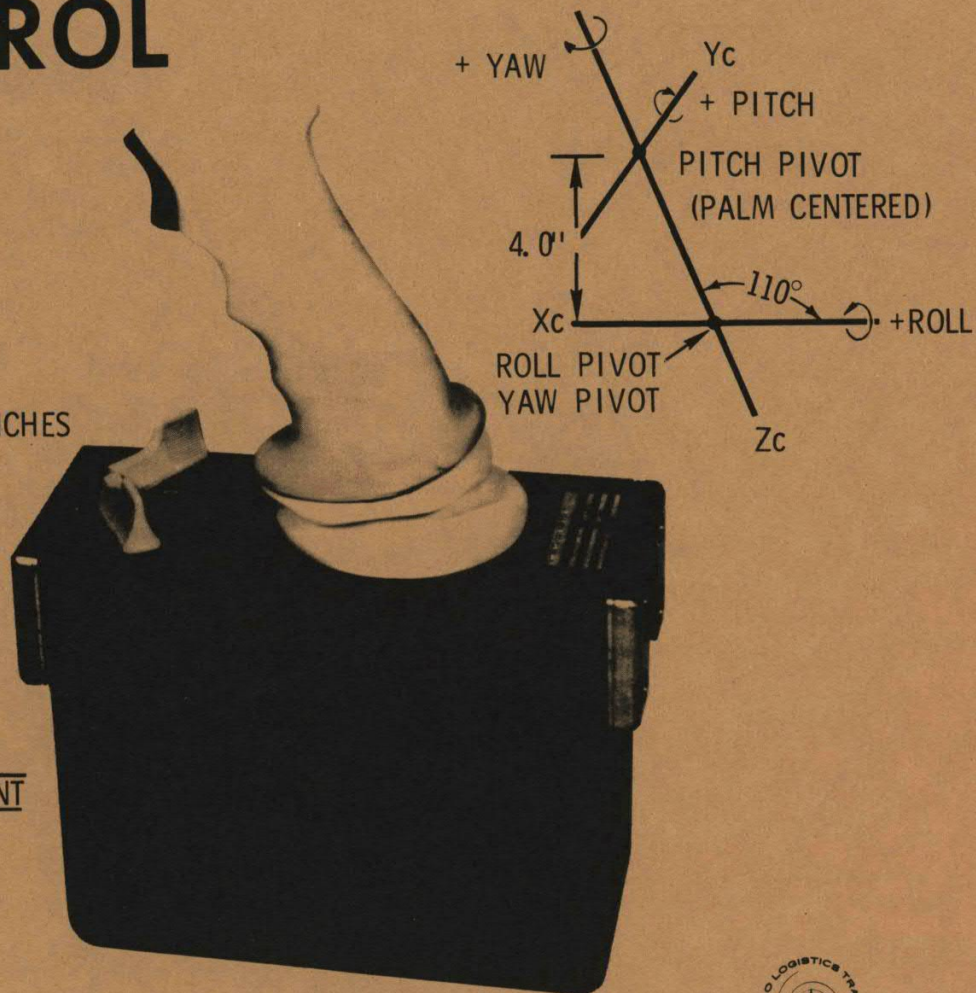
ROTATION CONTROL

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°

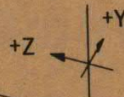


SCS-2002B

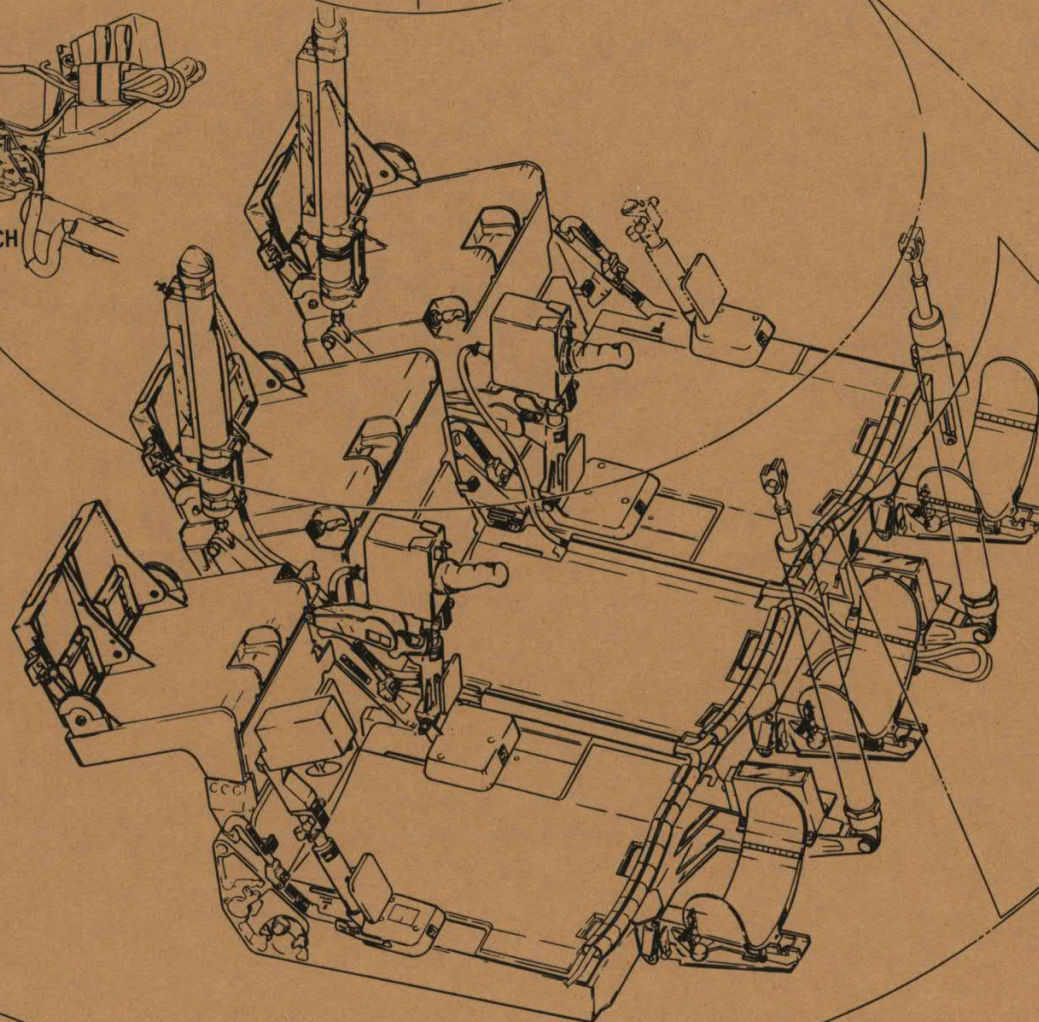


CREW COUCH STRUCTURE

SC 101



VIEW-LOOKING UP AT CENTER CREW COUCH

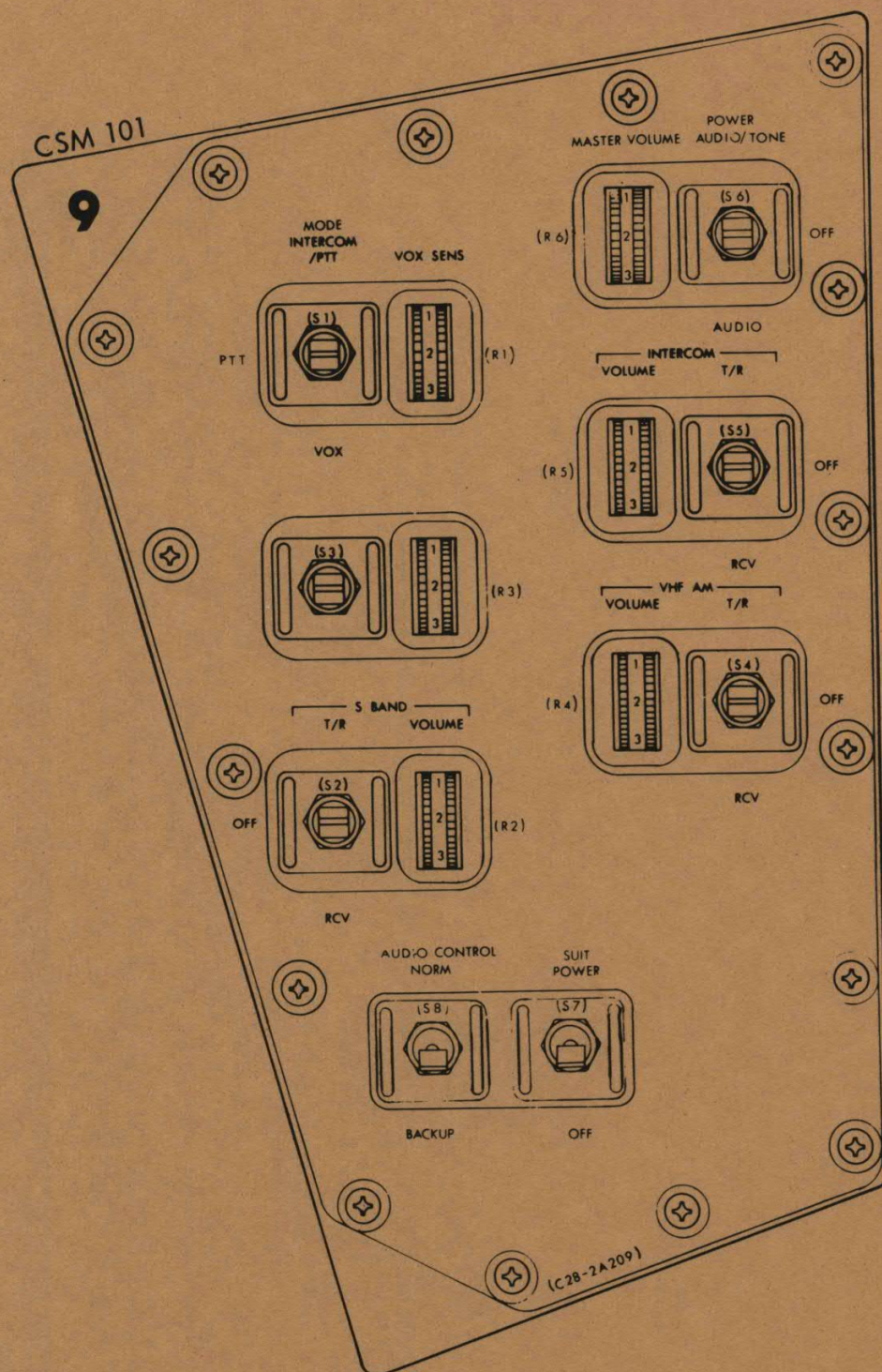


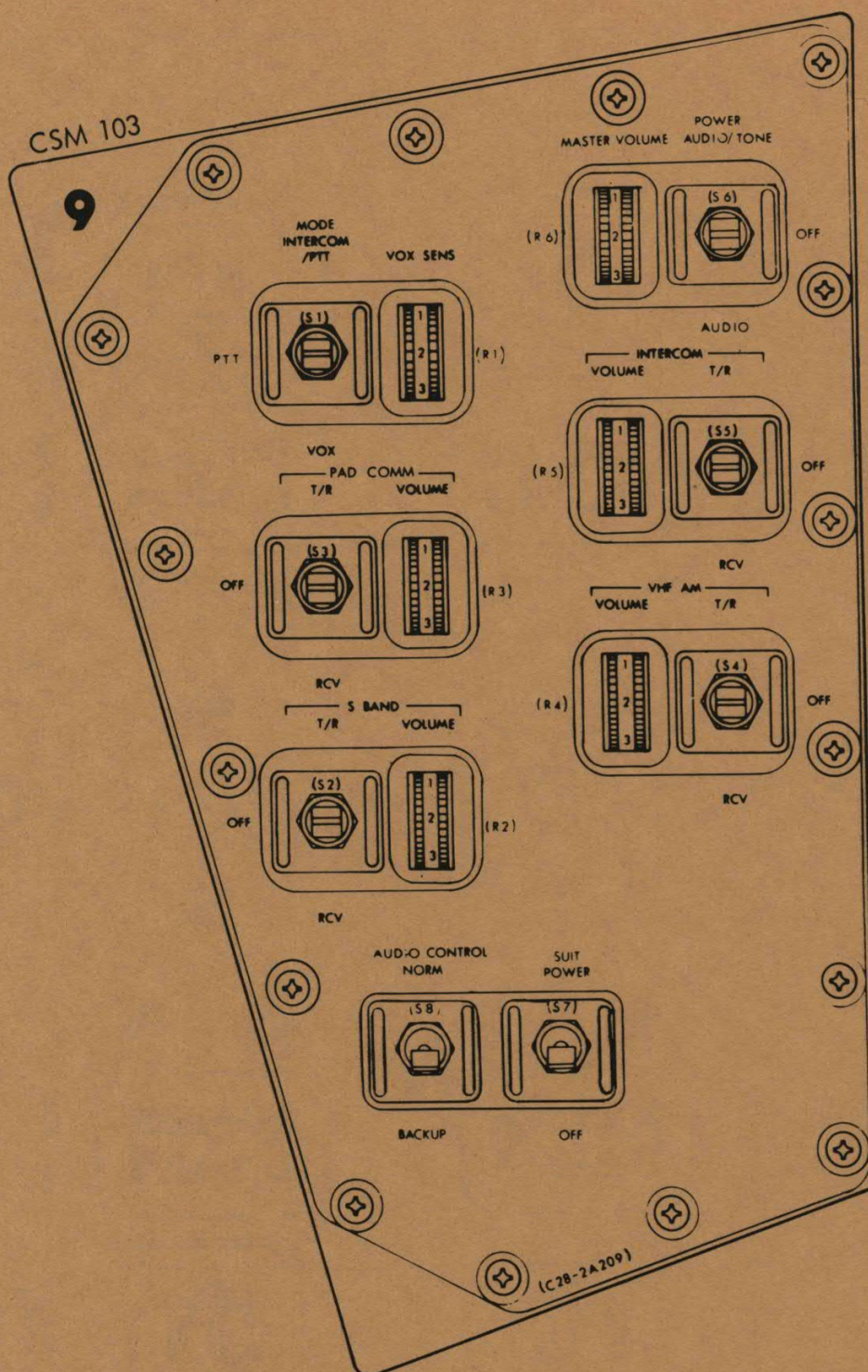
VIEW-LOOKING DOWN & INBOARD

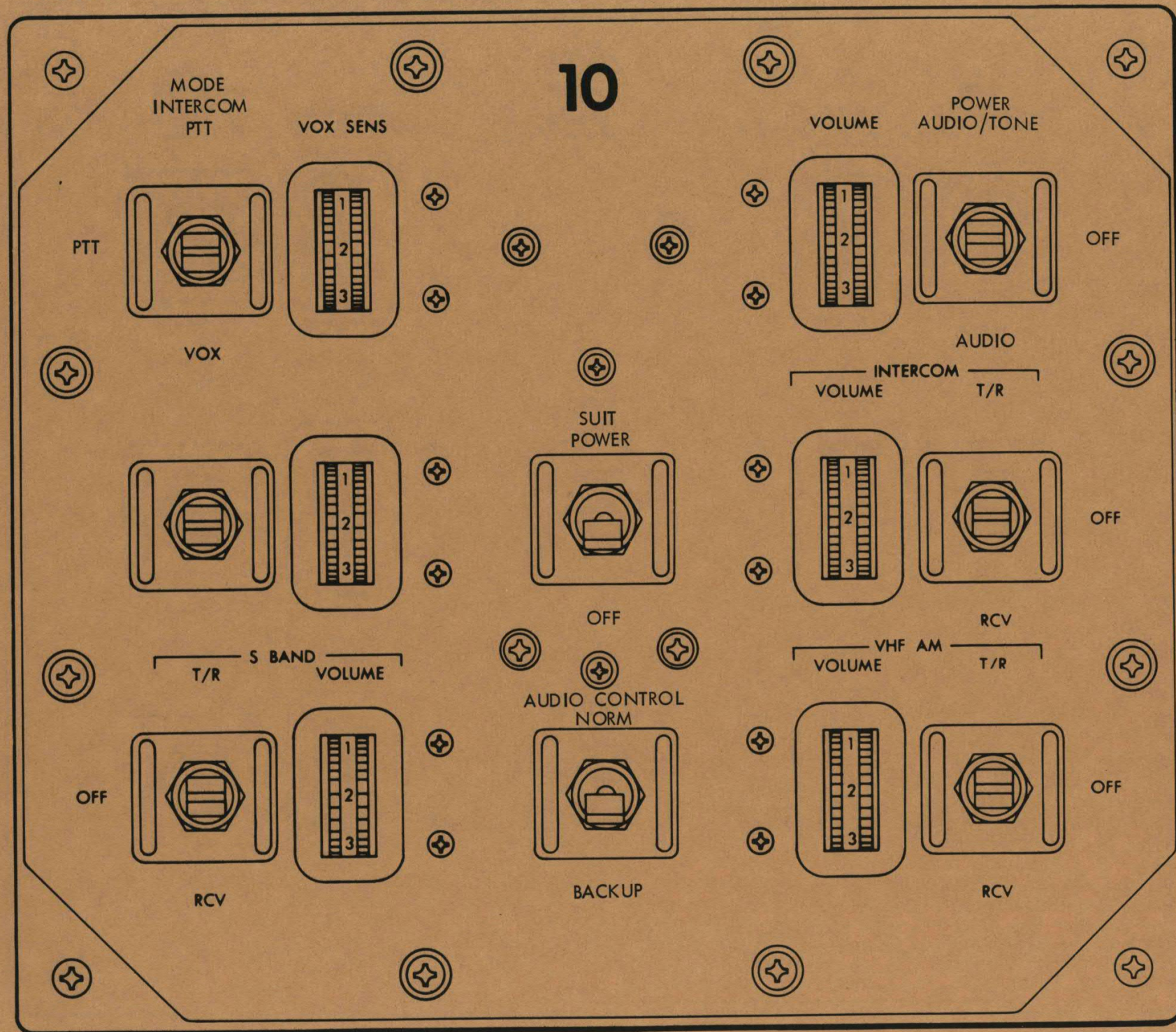
OCT 67

CS-2004B









10



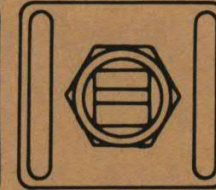
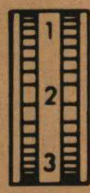
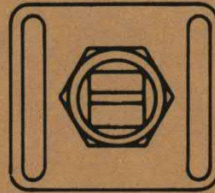
MODE
INTERCOM
PTT

VOX SENS

VOLUME

POWER
AUDIO/TONE

PTT



OFF



VOX

PAD

COMM

VOLUME

T/R



SUIT
POWER

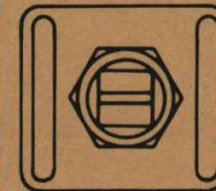
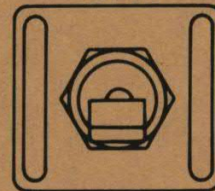
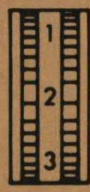
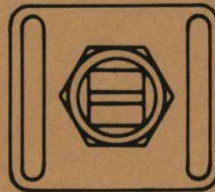
INTERCOM
VOLUME

AUDIO

T/R



OFF



OFF

RCV

T/R

S BAND

VOLUME



OFF



AUDIO CONTROL
NORM



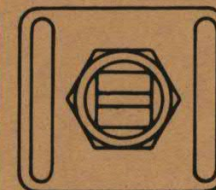
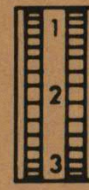
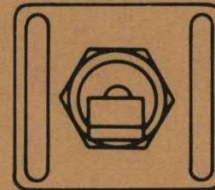
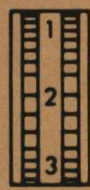
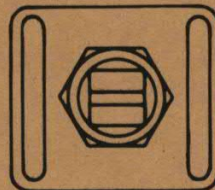
VHF AM
VOLUME

RCV

T/R



OFF



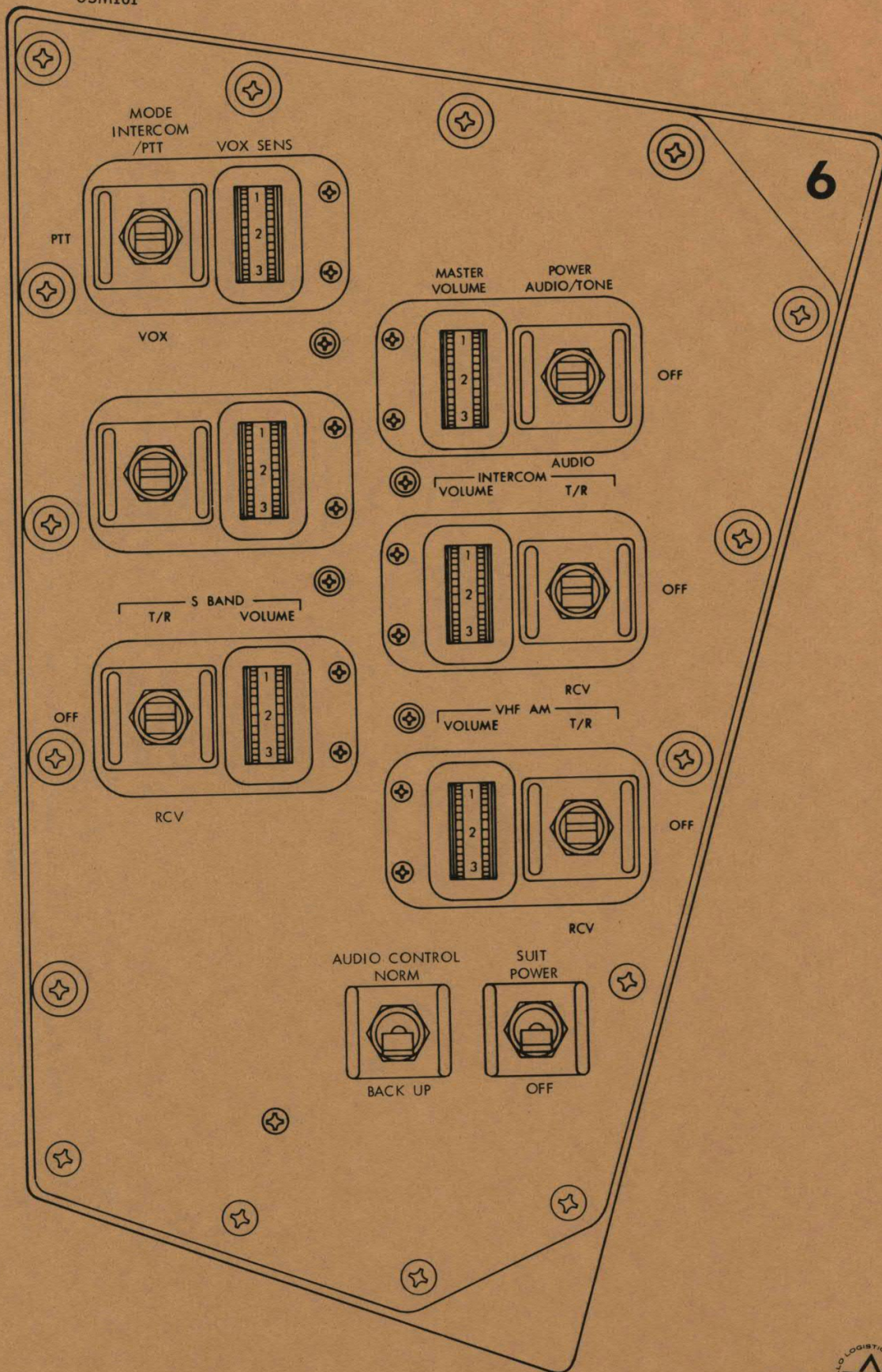
OFF

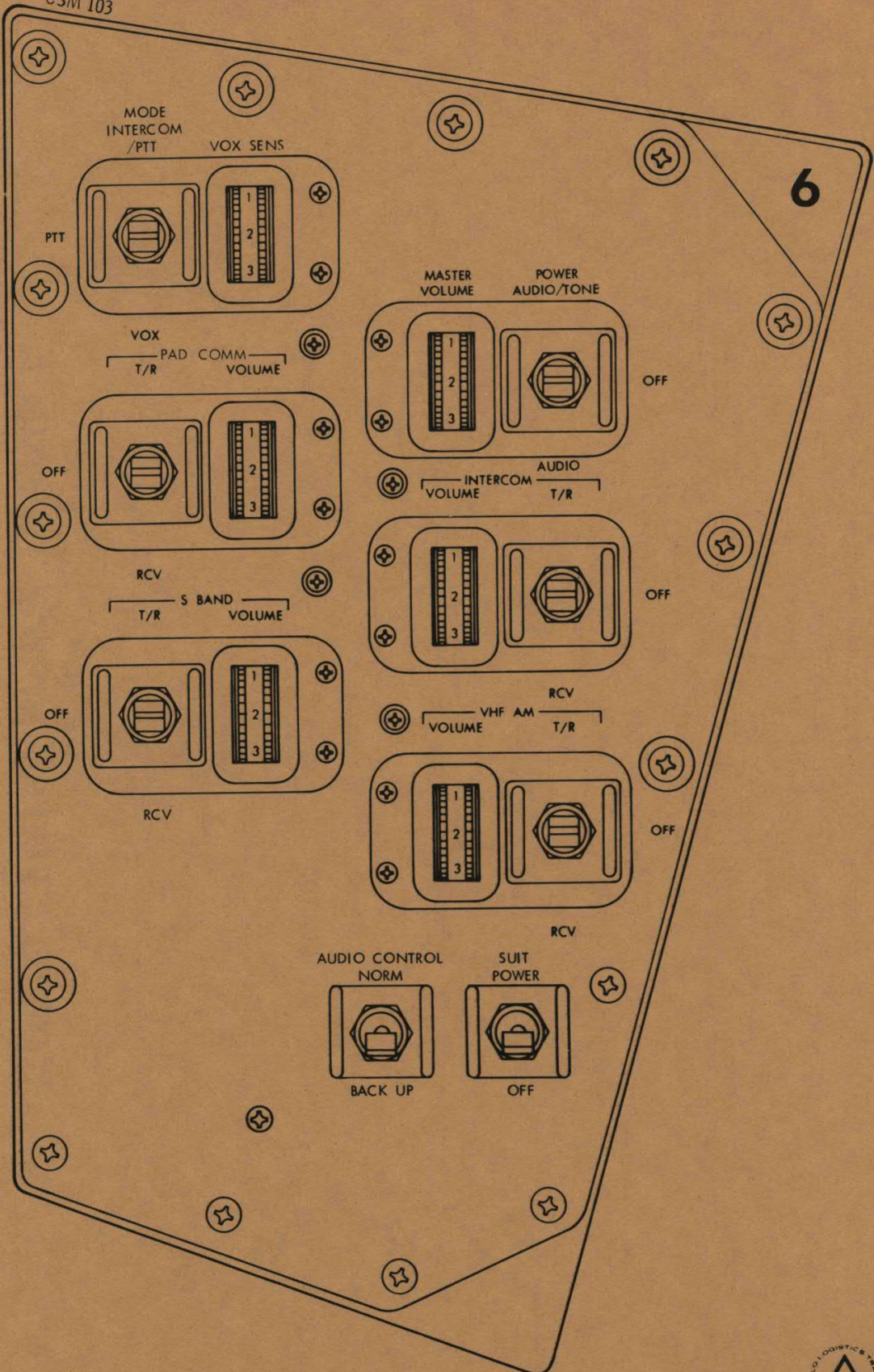
RCV

BACKUP

RCV



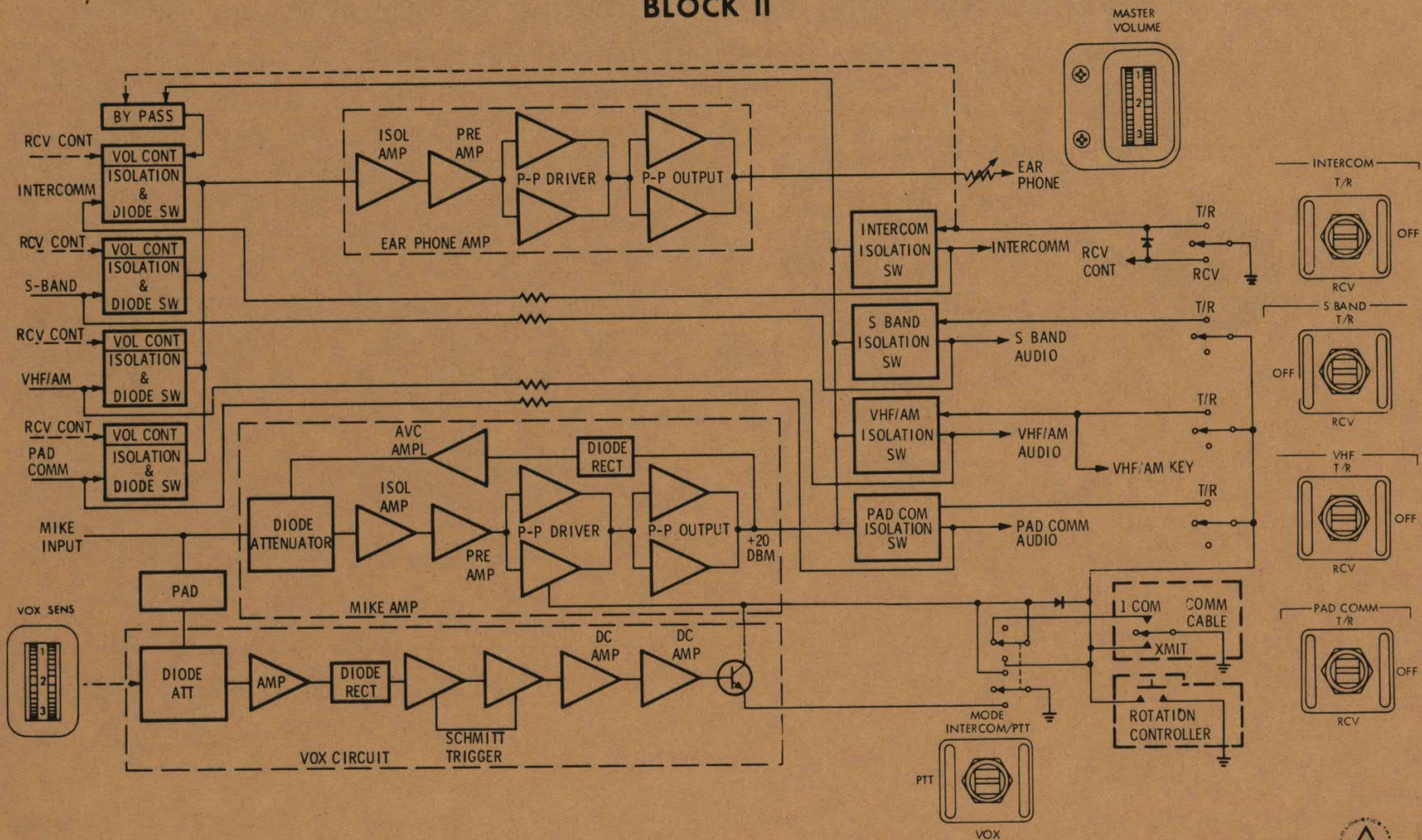




6

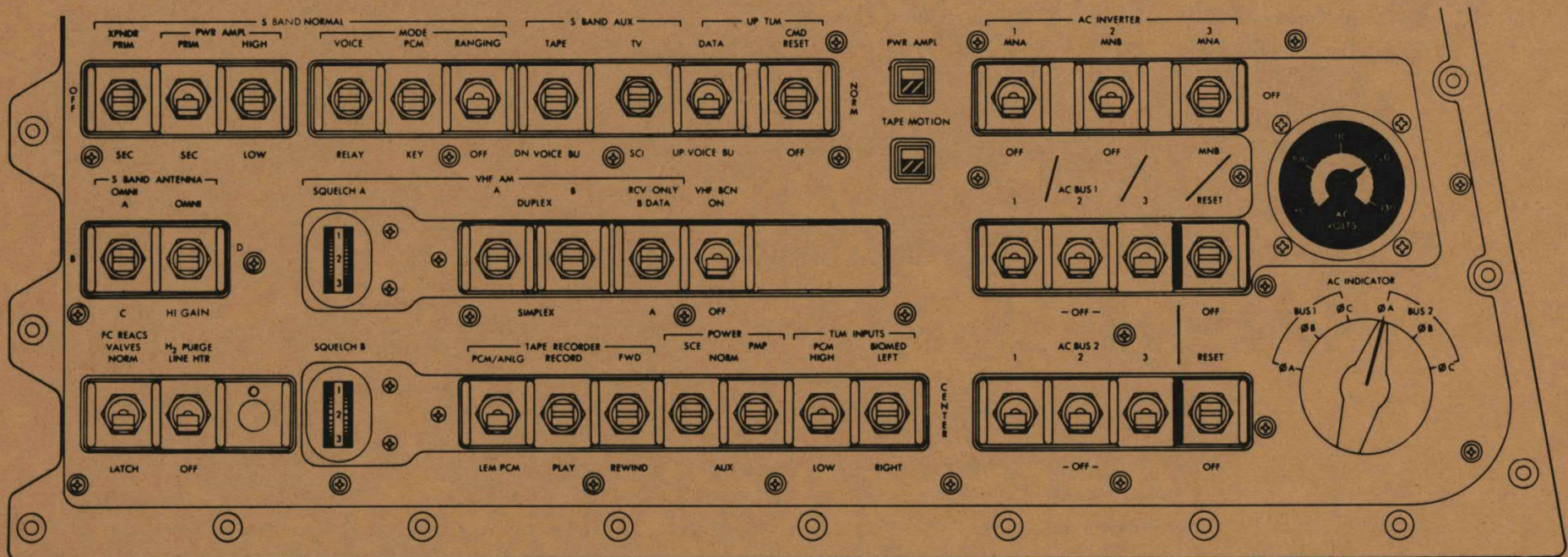
AUDIO CENTER BLOCK DIAGRAM

BLOCK II

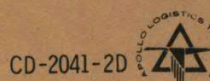


CSM 103

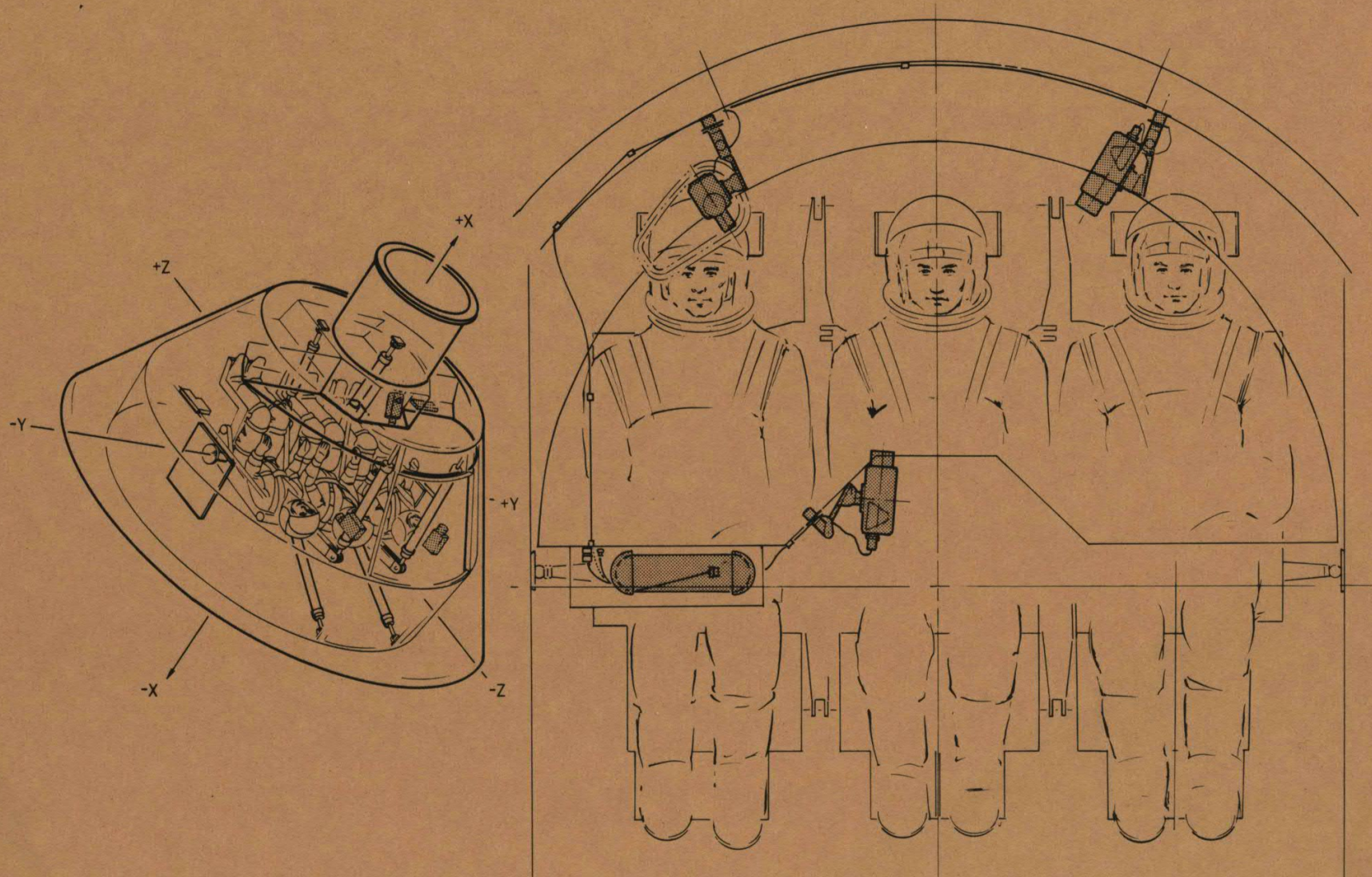
3



RECOVERY VHF OMNI



TV CAMERA LOCATIONS

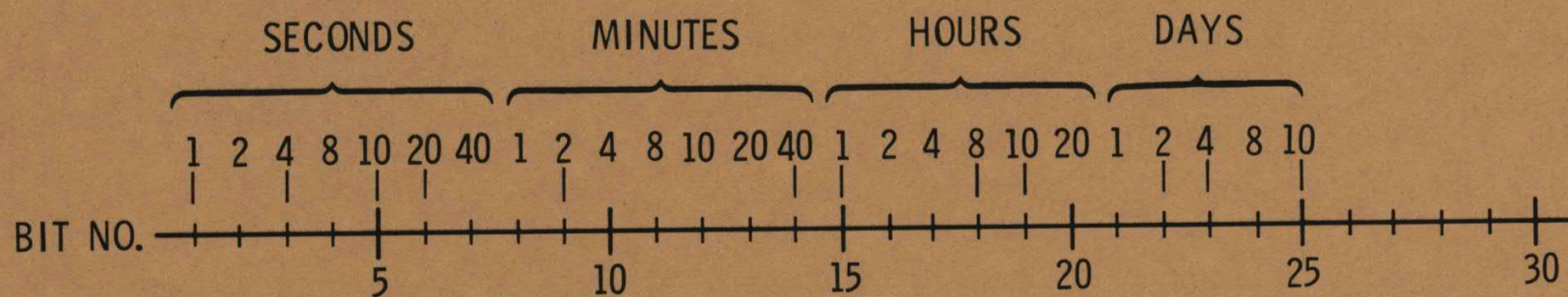




TE

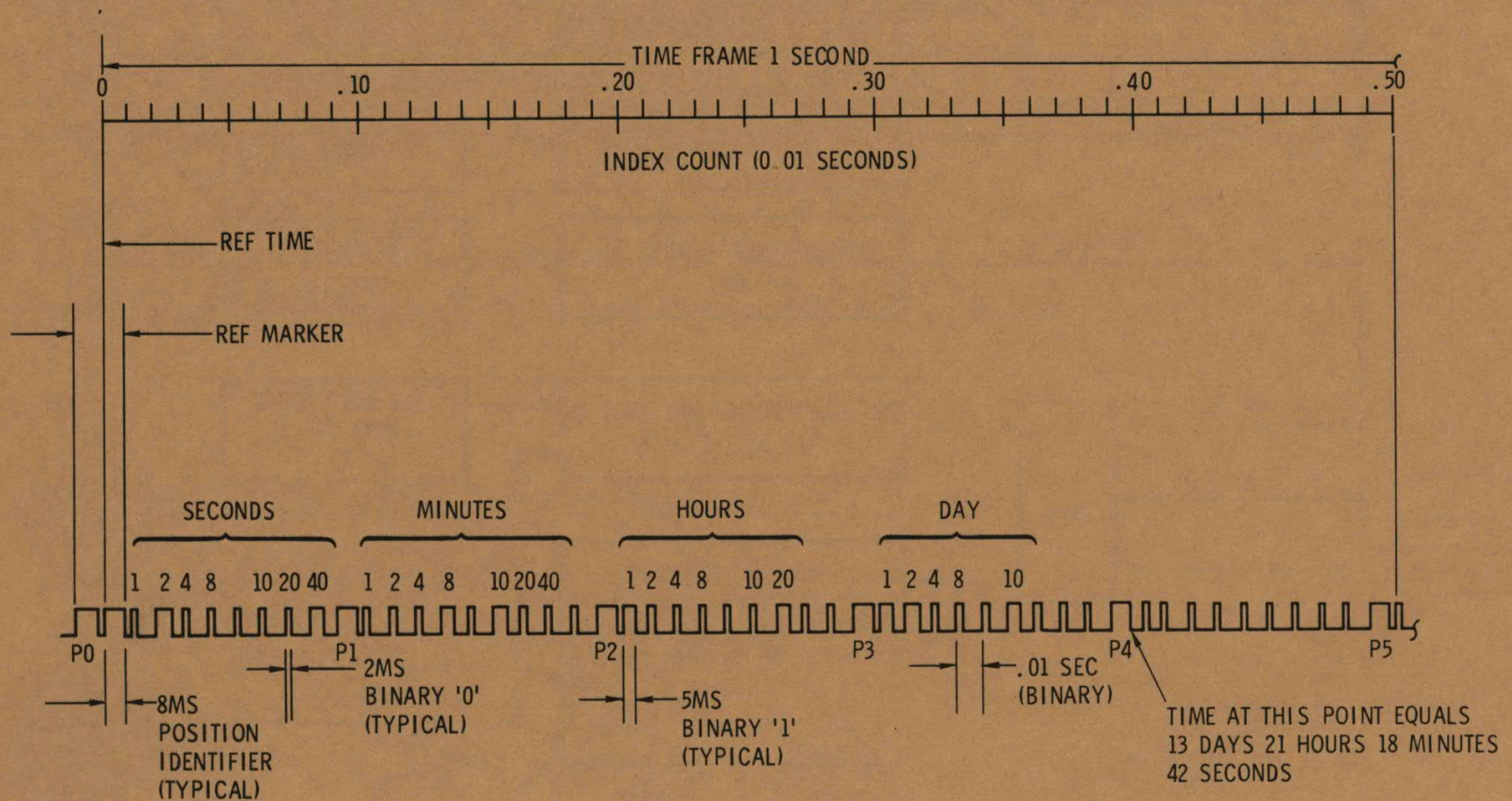


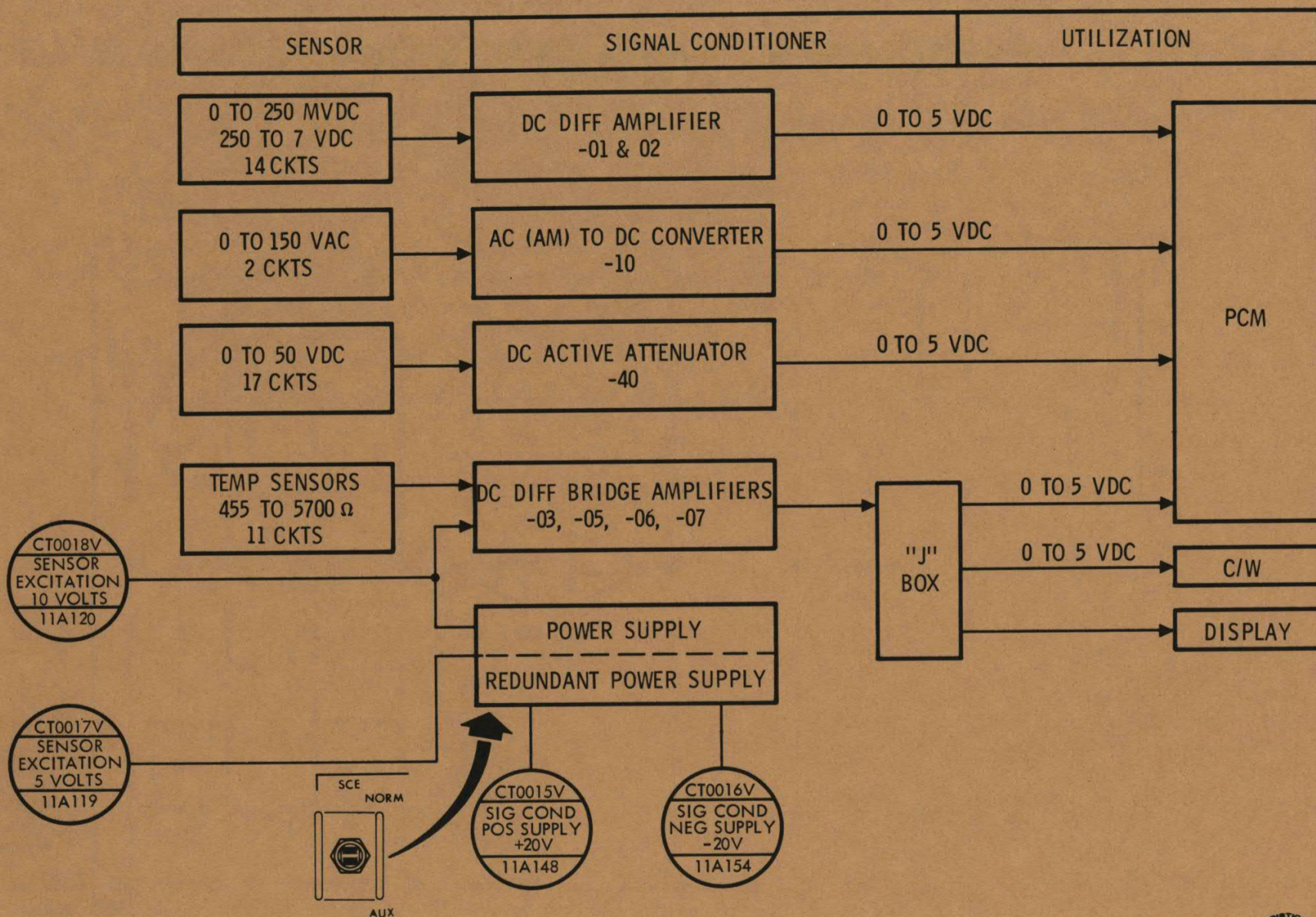
BLK II CTE 25 BIT PARALLEL TIME CODE



EXAMPLE: 16 DAYS 19 HOURS 42 MINUTES 35 SECONDS

CTE SERIAL OUTPUT

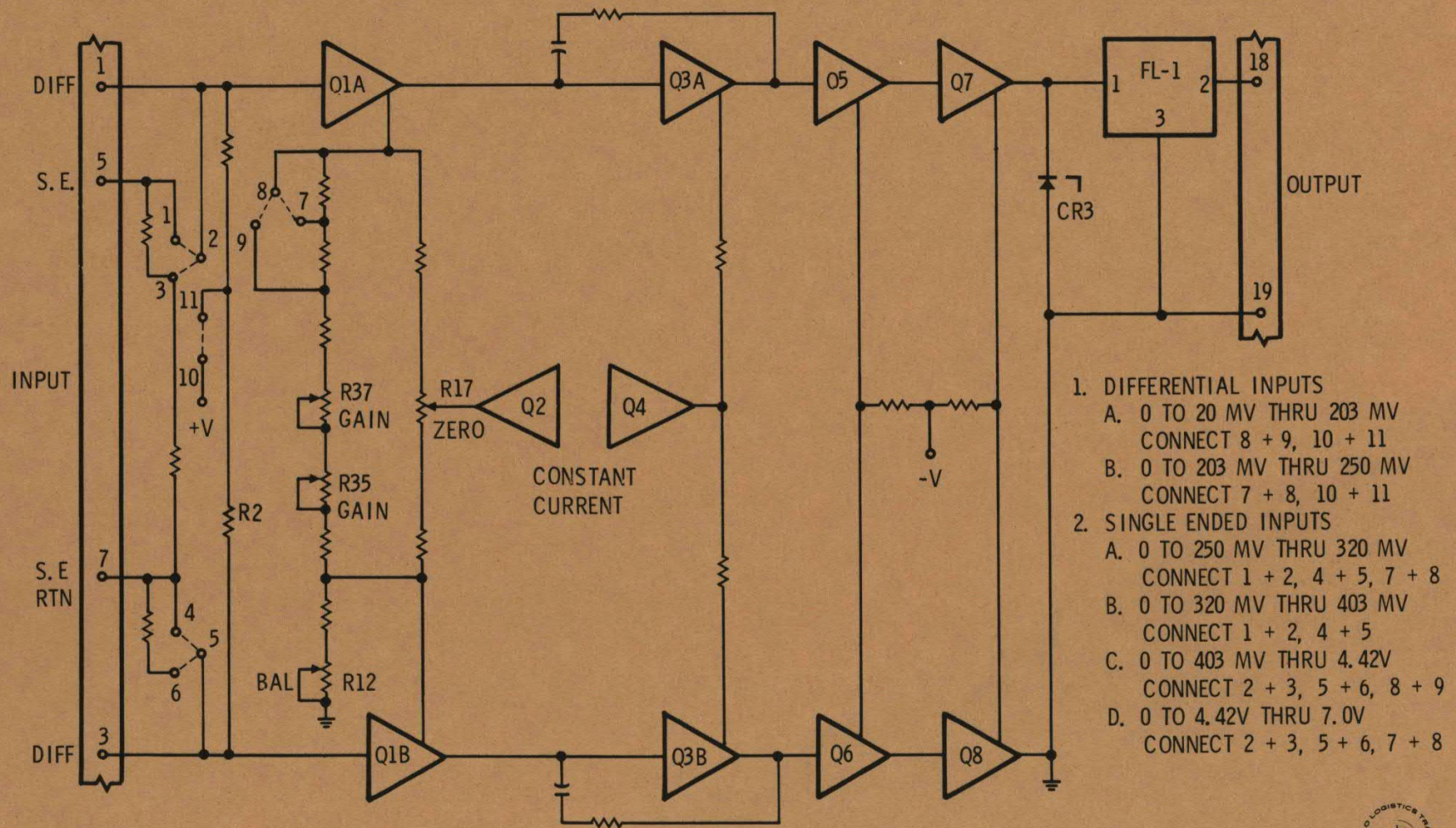




CD-2045B



DC DIFFERENTIAL AMPLIFIER



CD-177E





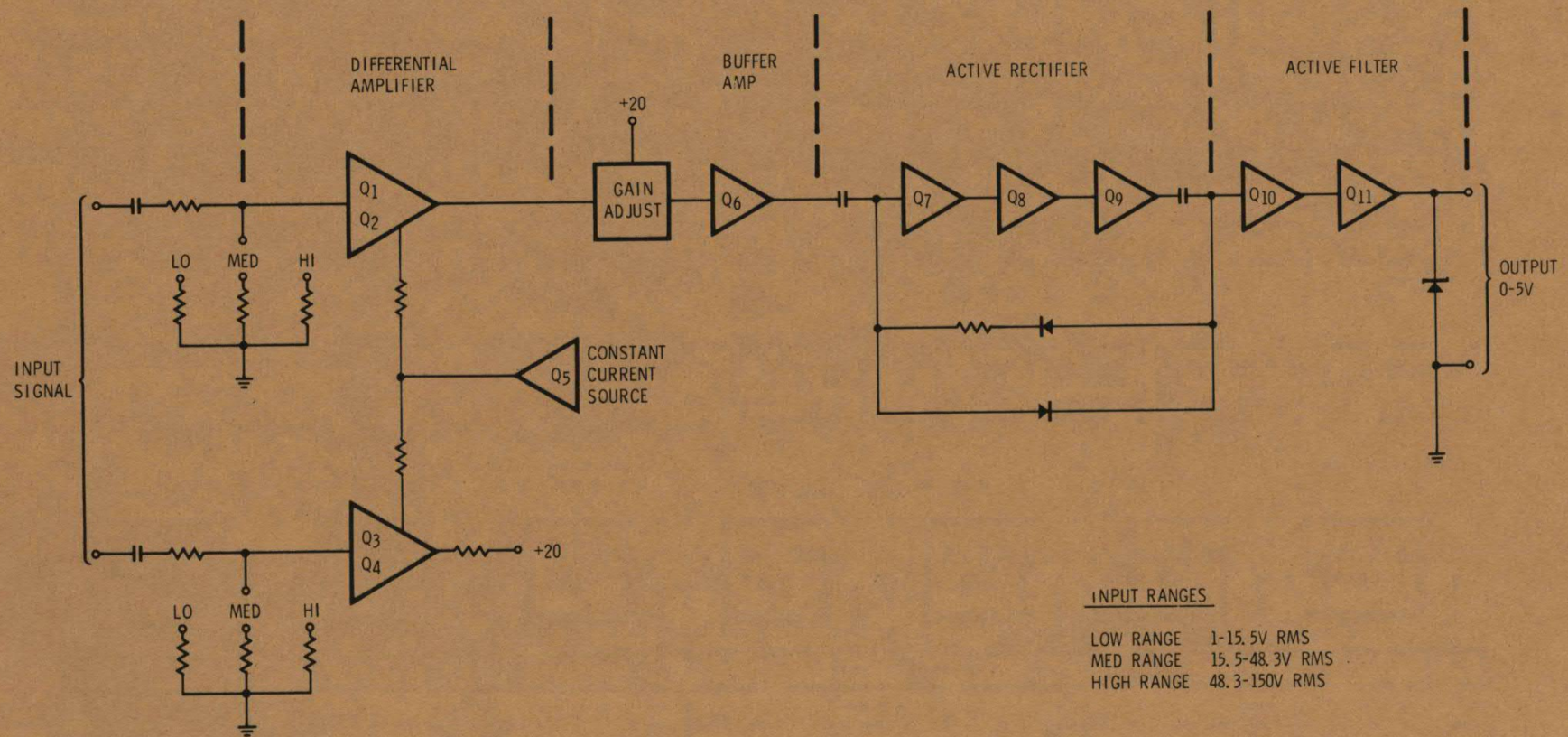
INPUT RANGES

LOW RANGE 1-15.5V RMS
MED RANGE 15.5-48.3V RMS
HIGH RANGE 48.3-150V RMS

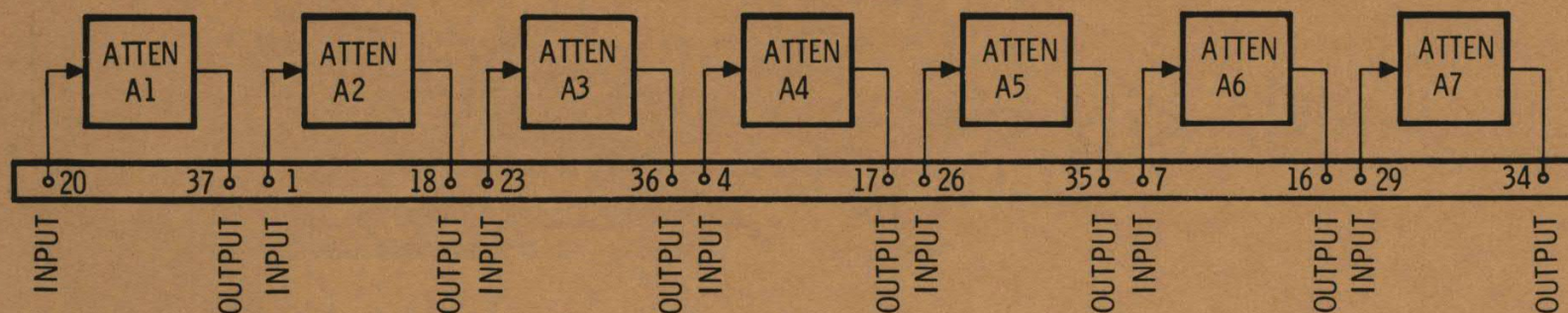
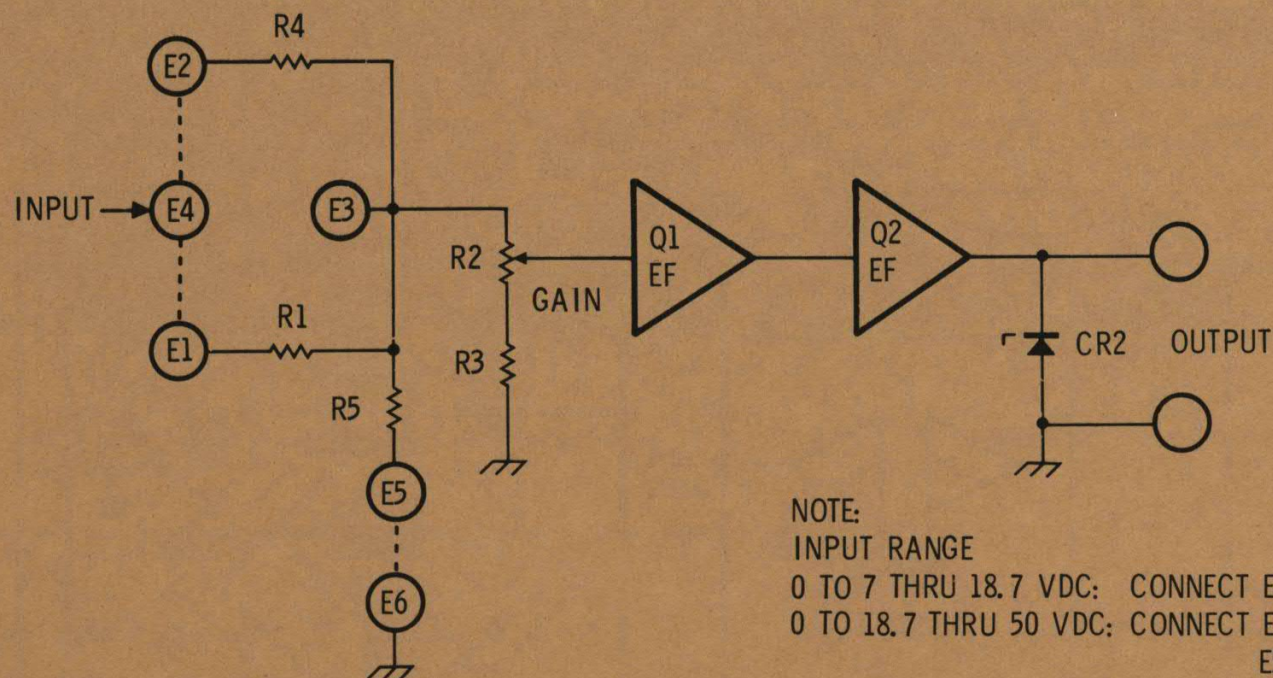
CD-2105A 

S.C.E. AC TO DC CONVERTER

BLOCK II



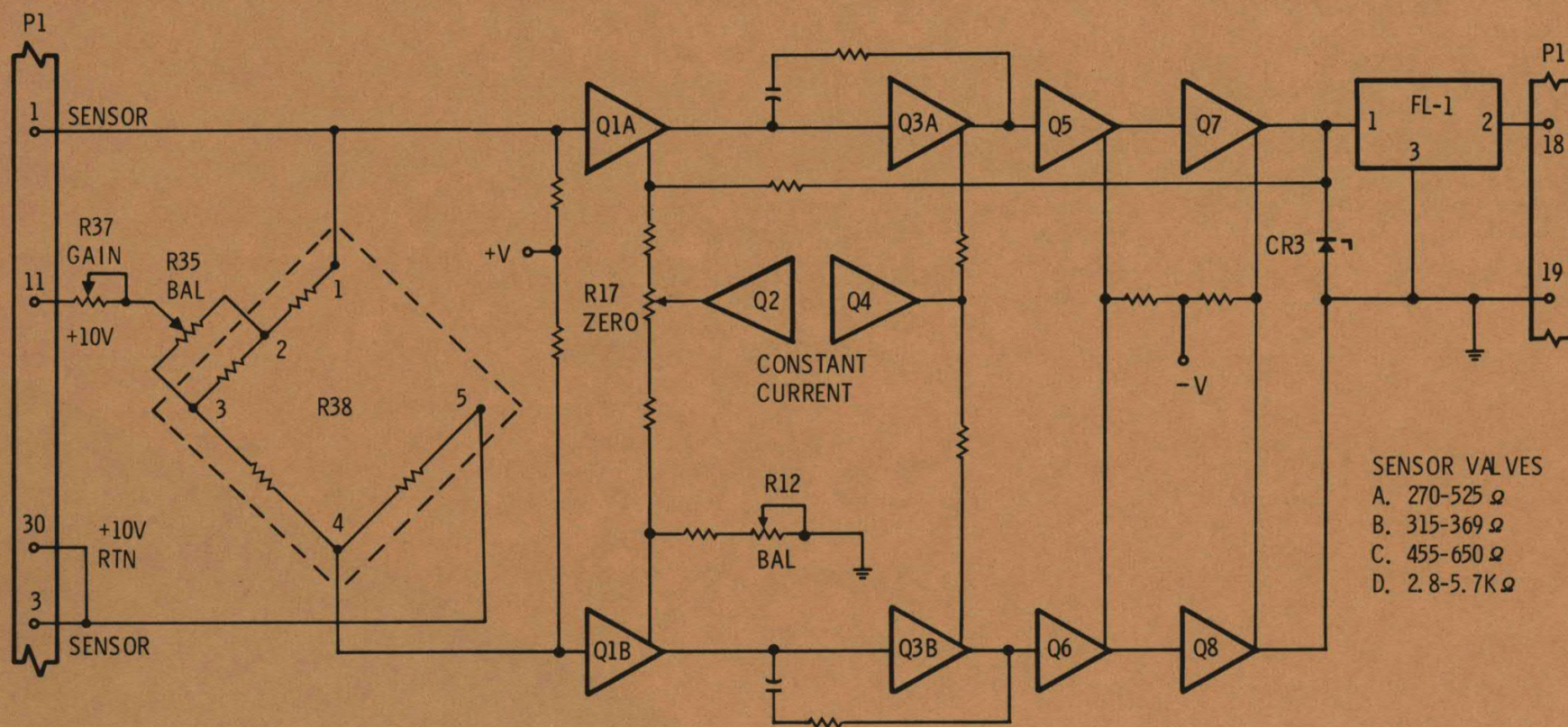
DC ACTIVE ATTENUATOR MODULE



CD-173C



DC DIFFERENTIAL BRIDGE AMPLIFIER



LOCK DIAGRAM

SYNCH SELECT
DIG PAR
NORMAL
SELECTED

NORMAL
REDUCED

FMP

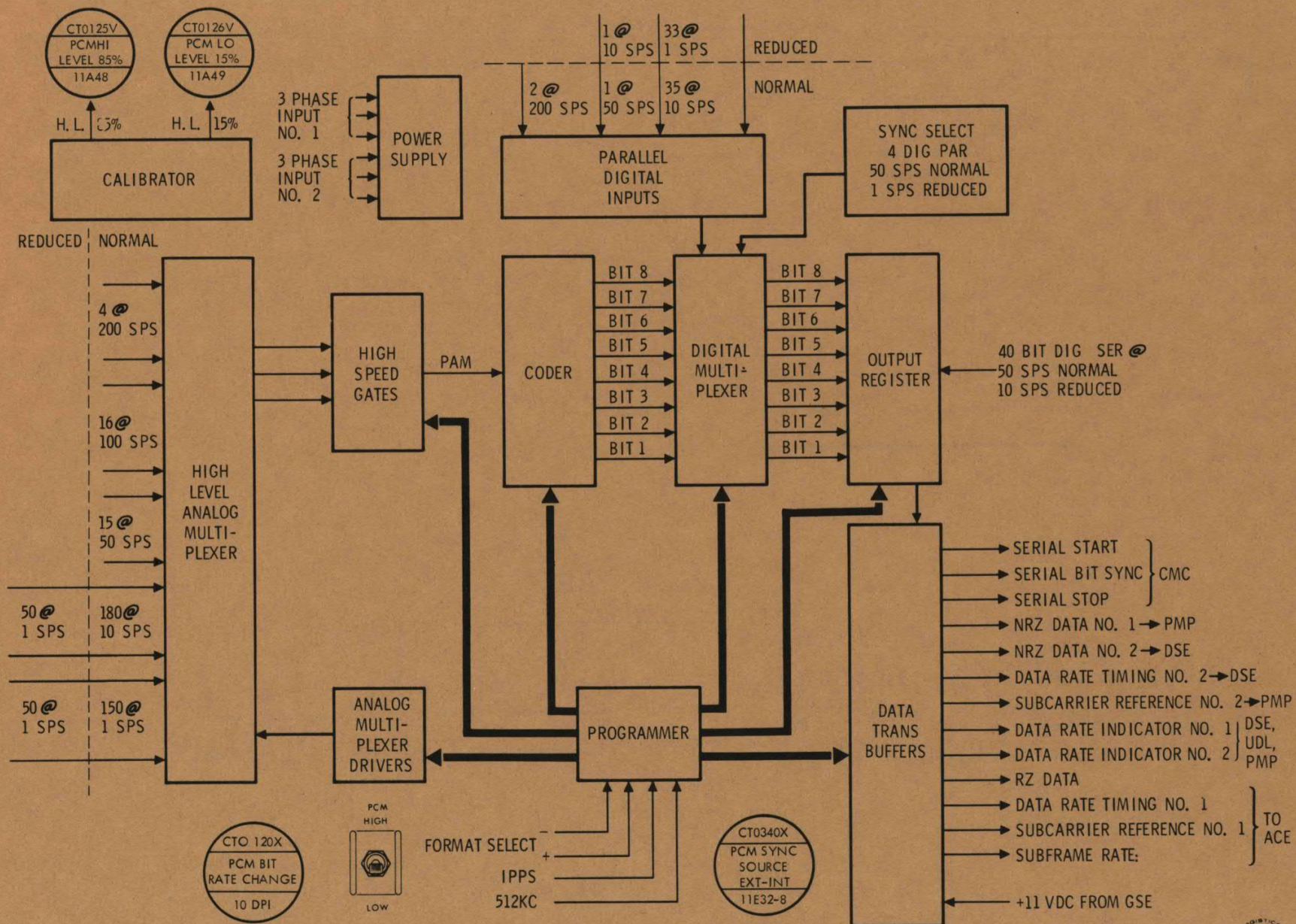
UDL

FQTR

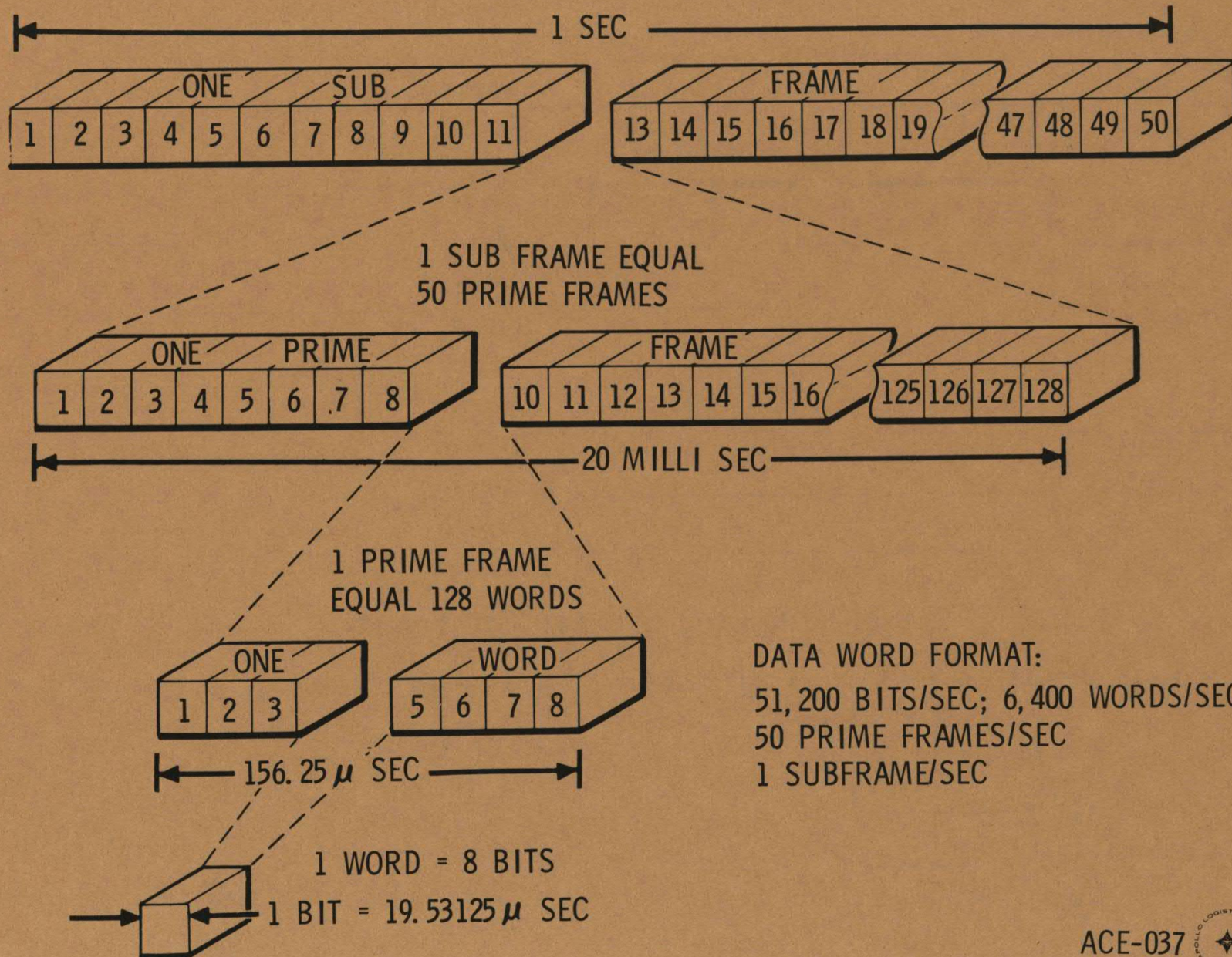
DSE

PCM

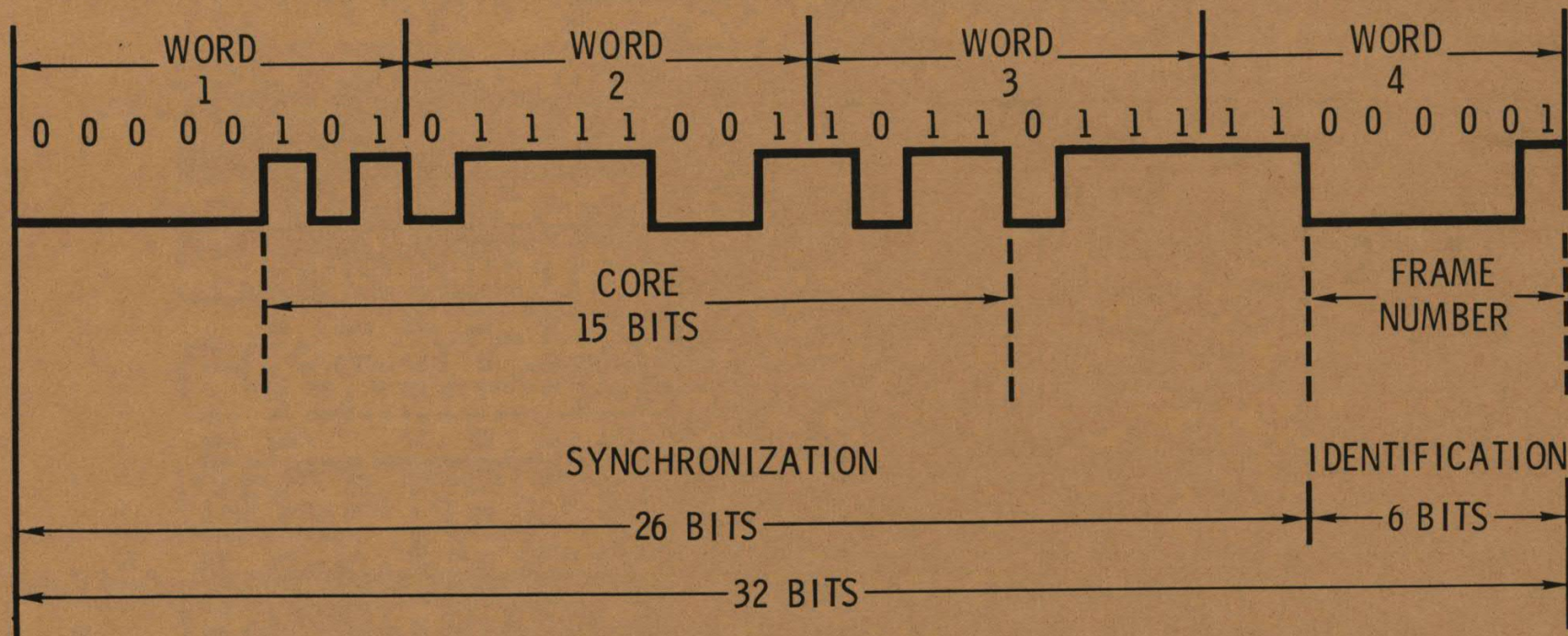
PCM BLOCK DIAGRAM



PCM FORMAT



PCM PRIME FRAME SYNCHRONIZATION



PRIME FRAME NUMBER IN BINARY FORM

EXAMPLE: 1 0 0 0 0 1 = PRIME FRAME 1
 $2^0 = 1$

EXAMPLE: 2 1 1 0 0 1 0 = PRIME FRAME 50
 $2^1 = 2$
 $2^4 = 16$
 $2^5 = 32$
 50

PCM NORMAL FORMAT PRIME FRAME NO. 1

BLOCK II

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
				22A	22A	22A	22A	11A	11A	11A	11A	12A	12A	12A	12A
				1	2	3	4	1	2	3	4	1	2	3	4
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
11A	22D	22D	10D	12A	12A	12A	12A	11A	11A	11A	11A	51A	51A	51A	51DS
5	1	2	1	5	6	7	8	6	7	8	9	1	2	3	1
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
51DS	51DS	51DS	51DS	22A	22A	22A	22A	11A	11A	11A	11A	12A	12A	12A	12A
2	3	4	5	1	2	3	4	10	11	12	13	9	10	11	12
49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
11A	22D	22D	10A	12A	12A	12A	12A	11A	11A	11A	11A	51A	51A	51A	51A
14	1	2	1	13	14	15	16	15	16	17	18	4	5	6	7
65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
11D	11D	11D	11D	22A	22A	22A	22A	11A	11A	11A	11A	12A	12A	12A	12A
2	2	2	2	1	2	3	4	19	20	21	22	1	2	3	4
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
11A	22D	22D	10A	12A	12A	12A	12A	11A	11A	11A	11A	51A	51A	51A	51A
23	1	2	2	5	6	7	8	24	25	26	27	8	9	10	11
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112
11D	11D	11D	51D	22A	22A	22A	22A	11A	11A	11A	11A	12A	12A	12A	12A
3	4	5	2	1	2	3	4	28	29	30	31	9	10	11	12
113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
11A	22D	22D	10A	12A	12A	12A	12A	11A	11A	11A	11A	51A	51A	51A	51A
32	1	2	3	13	14	15	16	33	34	35	36	12	13	14	15

SIGNIFICANT
DIGIT

NO. OF
ZEROS

22A
1

CHANNEL

A - ANALOG
DS-DIGITAL SERIAL
DP-DIGITAL PARALLEL

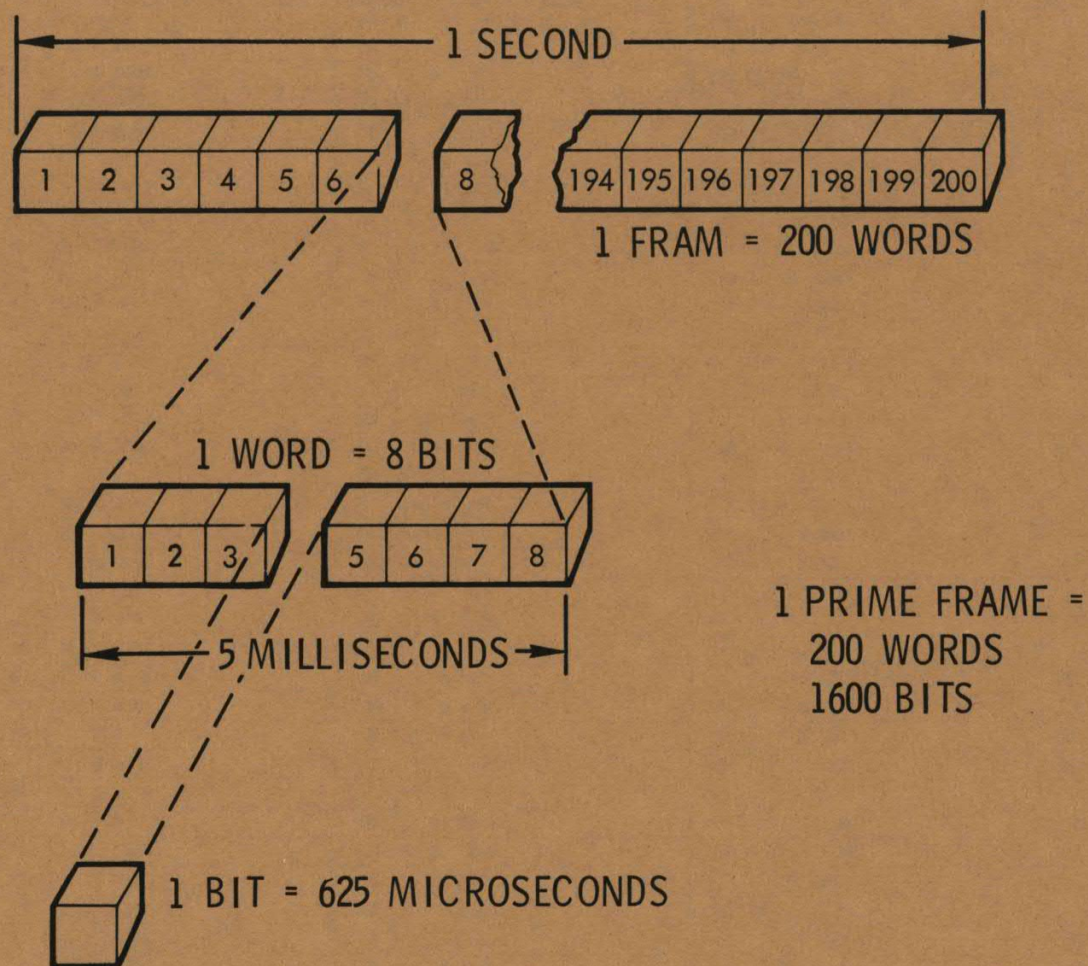
CD-2024B



BLOCK II PCM

NORMAL FORMAT																								
WORD	CHANNEL					WORD	CHANNEL					WORD	CHANNEL					WORD	CHANNEL					
1	SYNC 51/10 DPIA					33	51/11 DSIB					65	11/10 DP 2A	11/10 DP 6	11/10 DP 13	11/10 DP 20	11/10 DP 27	97	11/10 DP 3	11/10 DP 10	11/10 DP 17	11/10 DP 24	11/10 DP 31	
2	SYNC 51/10 DPIB					34	51/11 DSIC					66	11/10 DP 2B	11/10 DP 7	11/10 DP 14	11/10 DP 21	11/10 DP 28	98	11/10 DP 4	11/10 DP 11	11/10 DP 18	11/10 DP 25	11 DP 32	
3	SYNC 51/10 DPIC					35	51/11 DSID					67	11/10 DP 2C	11/10 DP 8	11/10 DP 15	11/10 DP 22	11/10 DP 29	99	11/10 DP 5	11/10 DP 12	11/10 DP 19	11/10 DP 26	11 DP 33	
4	SYNC & FRAME ID (51/10 DPID)					36	51/11 DSIE					68	11/10 DP 2D	11/10 DP 9	11/10 DP 16	11/10 DP 23	11/10 DP 30	100	51/11 DP 2					
5	22A1					37	22A1					69	22A1					101	22A1					
6	22A2					38	22A2					70	22A2					102	22A2					
7	22A3					39	22A3					71	22A3					103	22A3					
8	22A4					40	22A4					72	22A4					104	22A4					
9	11/10A 1	11A 37	11/10A 73	11/10A 109	11A 145	41	11/10A 10	11/10A 46	11A 82	11/10A 118	11/10A 154	73	11A 19	11/10A 55	11/10A 91	11A 127	11/10A 163	105	11A 28	11A 64	11A 100	11A 136	11A 172	
10	11/10A 2	11A 38	11/10A 74	11/10A 110	11A 146	42	11/10A 11	11/10A 47	11A 83	11/10A 119	11/10A 155	74	11A 20	11/10A 56	11/10A 92	11A 128	11/10A 164	106	11A 29	11A 65	11A 101	11A 137	11A 173	
11	11/10A 3	11/10A 39	11/10A 75	11/10A 111	11/10A 147	43	11/10A 12	11/10A 48	11/10A 84	11/10A 120	11/10A 156	75	11/10A 21	11/10A 57	11/10A 93	11/10A 129	11/10A 165	107	11A 30	11A 66	11A 102	11A 138	11A 174	
12	11/10A 4	11/10A 40	11/10A 76	11/10A 112	11/10A 148	44	11/10A 13	11/10A 49	11/10A 85	11/10A 121	11/10A 157	76	11/10A 22	11/10A 58	11/10A 94	11/10A 130	11/10A 166	108	11A 31	11A 67	11A 103	11A 139	11A 175	
13	12A1					45	12A9					77	12A1					109	12A9					
14	12A2					46	12A10					78	12A2					110	12A10					
15	12A3					47	12A11					79	12A3					111	12A11					
16	12A4					48	12A12					80	12A4					112	12A12					
17	11A 5	11A 41	11A 77	11A 113	11A 149	49	11A 14	11A 50	11A 86	11A 158	11A 122	81	11A 23	11A 59	11A 95	11A 131	11A 167	113	11A 32	11A 68	11A 104	11A 140	11A 176	
18	22DP1					50	22DP1					82	22DP1					114	22DP1					
19	22DP2					51	22DP2					83	22DP2					115	22DP2					
20	10/10 DP1	SRC "0"	SRC "1"			52	10A1, 10A4, 10A146					84	10A2, 10A5, 10A149					116	10/10A3, 10/10A6, 10/10A150					
21	12A5					53	12A13					85	12A5					117	12A13					
22	12A6					54	12A15					86	12A6					118	12A14					
23	12A7					55	12A14					87	12A7					119	12A15					
24	12A8					56	12A16					88	12A8					120	12A16					
25	11A 6	11A 42	11A 78	11A 114	11A 150	57	11A 15	11A 51	11A 87	11A 123	11A 159	89	11A 24	11A 60	11A 96	11A 132	11A 168	121	11A 33	11A 69	11A 105	11A 141	11A 177	
26	11A 7	11A 43	11A 79	11A 115	11A 151	58	11A 16	11A 52	11A 88	11A 124	11A 160	90	11A 25	11A 61	11A 97	11A 133	11A 169	122	11A 34	11A 70	11A 106	11A 142	11A 178	
27	11A 8	11A 44	11A 80	11A 116	11A 152	59	11A 17	11A 53	11A 89	11A 125	11A 161	91	11A 26	11A 62	11A 98	11A 134	11A 170	123	11A 35	11A 71	11A 107	11A 143	11A 179	
28	11A 9	11A 45	11A 81	11A 117	11A 153	60	11A 18	11A 54	11A 90	11A 126	11A 162	92	11A 27	11A 63	11A 99	11A 135	11A 171	124	11A 36	11A 72	11A 108	11A 144	11A 180	
29	51A1					61	51A4					93	51A8					125	51A12					
30	51A2					62	51A5					94	51A9					126	51A13					
31	51A3					63	51A6					95	51A10					127	51A14					
32	51/11 DSIA					64	51A7					96	51A11					128	51A15					

PCM REDUCE FORMAT



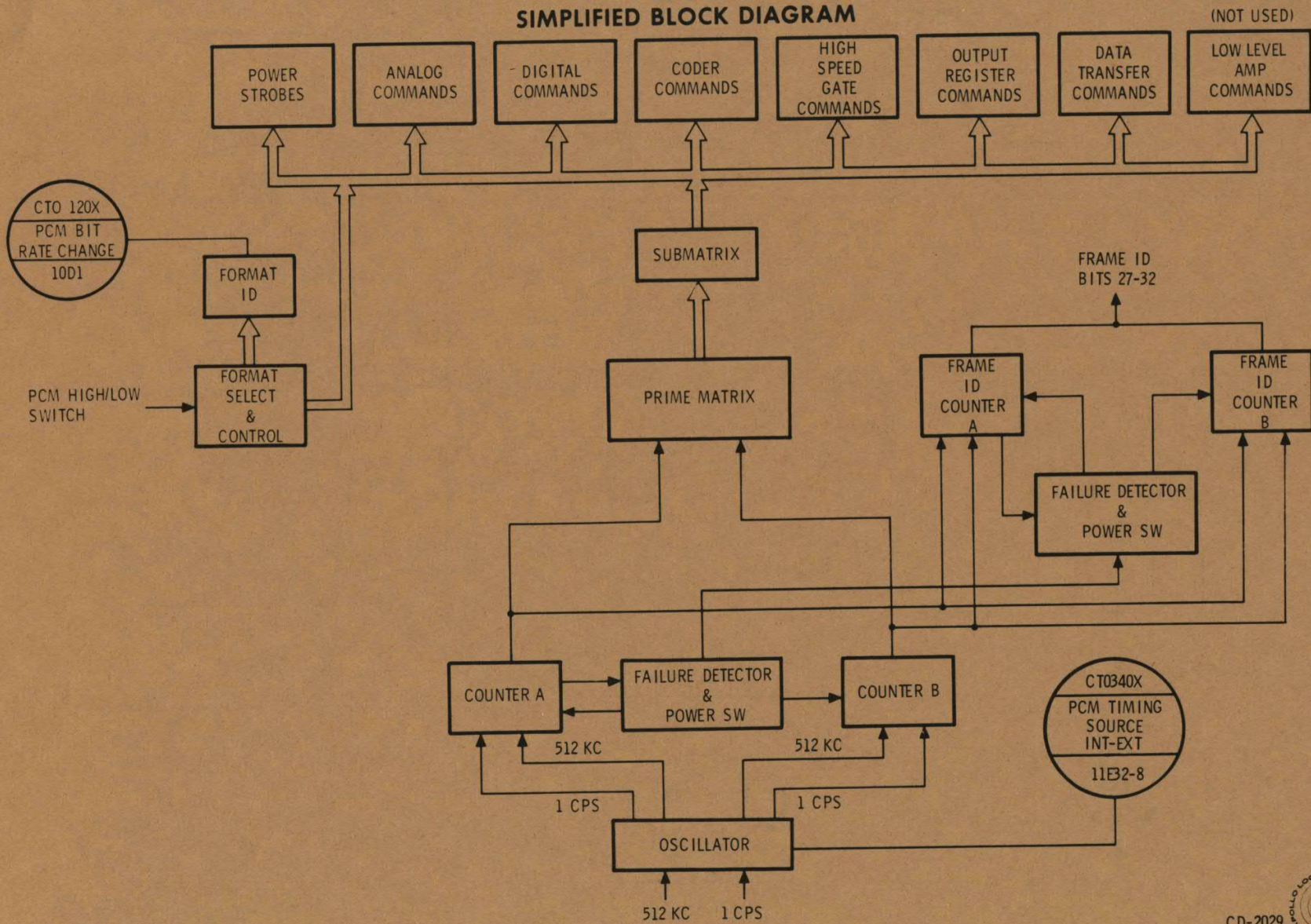
BLOCK II PCM

REDUCED FORMAT									
WORD	CHANNEL	WORD	CHANNEL	WORD	CHANNEL	WORD	CHANNEL	WORD	CHANNEL
1	SYNC 51/10 DP1A	41	11/10 DP4	81	11/10 DP26	121	11/10 DP2A	161	11/10 DP18
2	SYNC 51/10 DP1B	42	11/10 DP5	82	11/10 DP10	122	11/10 DP2B	162	11/10 DP19
3	SYNC 51/10 DP1C	43	11/10 DP24	83	11/10 DP11	123	11/10 DP2C	163	11/10 DP30
4	SYNC & FRAME ID 51/10 DP1D	44	11/10 DP25	84	11/10 DP12	124	11/10 DP2D	164	11/10 DP31
5	11/10 A1	45	11/10 A109	85	11/10 A46	125	11/10 A154	165	11/10 A91
6	11/10 A2	46	11/10 A110	86	11/10 A47	126	11/10 A155	166	11/10 A92
7	11/10 A3	47	11/10 A111	87	11/10 A48	127	11/10 A156	167	11/10 A93
8	11/10 A4	48	11/10 A112	88	11/10 A49	128	11/10 A157	168	11/10 A94
9	51/11 DS1A	49	51/11 DS1A	89	51/11 DS1A	129	51/11 DS1A	169	51/11 DS1A
10	51/11 DS1B	50	51/11 DS1B	90	51/11 DS1B	130	51/11 DS1B	170	51/11 DS1B
11	51/11 DS1C	51	51/11 DS1C	91	51/11 DS1C	131	51/11 DS1C	171	51/11 DS1C
12	51/11 DS1D	52	51/11 DS1D	92	51/11 DS1D	132	51/11 DS1D	172	51/11 DS1D
13	51/11 DS1E	53	51/11 DS1E	93	51/11 DS1E	133	51/11 DS1E	173	51/11 DS1E
14	51/11 DP2	54	51/11 DP2	94	51/11 DP2	134	51/11 DP2	174	51/11 DP2
15	10/10 A123	55	10/10 A126	95	10/10 A129	135	10/10 A132	175	10/10 A135
16	10/10 A138	56	10/10 A141	96	10/10 A144	136	10/10 A147	176	10/10 A150
17	10/10 A3	57	10/10 A6	97	10/10 A9	137	10/10 A12	177	10/10 A15
18	10/10 A18	58	10/10 A21	98	10/10 A24	138	10/10 A27	178	10/10 A30
19	10/10 A33	59	10/10 A36	99	10/10 A39	139	10/10 A42	179	10/10 A45
20	10/10 A48	60	10/10 A51	100	10/10 A54	140	10/10 A57	180	10/10 A60
21	10/10 DP1 (FORMAT ID)	61	11/10 DP6	101	11/10 DP27	141	11/10 DP15	181	11/10 DP20
22	SRC "0"	62	11/10 DP7	102	11/10 DP28	142	11/10 DP16	182	11/10 DP21
23	11/10 A39	63	11/10 A147	103	11/10 A84	143	11/10 A21	183	11/10 A129
24	11/10 A40	64	11/10 A148	104	11/10 A85	144	11/10 A22	184	11/10 A130
25	11/10 A73	65	11/10 A10	105	11/10 A118	145	11/10 A55	185	11/10 A163
26	11/10 A74	66	11/10 A11	106	11/10 A119	146	11/10 A56	186	11/10 A164
27	11/10 A75	67	11/10 A12	107	11/10 A120	147	11/10 A57	187	11/10 A165
28	11/10 A76	68	11/10 A13	108	11/10 A121	148	11/10 A58	188	11/10 A166
29	51/11 DS1A	69	51/11 DS1A	109	51/11 DS1A	149	51/11 DS1A	189	51/11 DS1A
30	51/11 DS1B	70	51/11 DS1B	110	51/11 DS1B	150	51/11 DS1B	190	51/11 DS1B
31	51/11 DS1C	71	51/11 DS1C	111	51/11 DS1C	151	51/11 DS1C	191	51/11 DS1C
32	51/11 DS1D	72	51/11 DS1D	112	51/11 DS1D	152	51/11 DS1D	192	51/11 DS1D
33	51/11 DS1E	73	51/11 DS1E	113	51/11 DS1E	153	51/11 DS1E	193	51/11 DS1E
34	51/11 DP2	74	51/11 DP2	114	51/11 DP2	154	51/11 DP2	194	51/11 DP2
35	11/10 DP3	75	11/10 DP8	115	11/10 DP13	155	11/10 DP29	195	11/10 DP22
36	SRC "1"	76	11/10 DP9	116	11/10 DP14	156	11/10 DP17	196	11/10 DP23
37	10/10 A63	77	10/10 A66	117	10/10 A69	157	10/10 A72	197	10/10 A75
38	10/10 A78	78	10/10 A81	118	10/10 A84	158	10/10 A87	198	10/10 A90
39	10/10 A93	79	10/10 A96	119	10/10 A99	159	10/10 A102	199	10/10 A105
40	10/10 A108	80	10/10 A111	120	10/10 A114	160	10/10 A117	200	10/10 A120

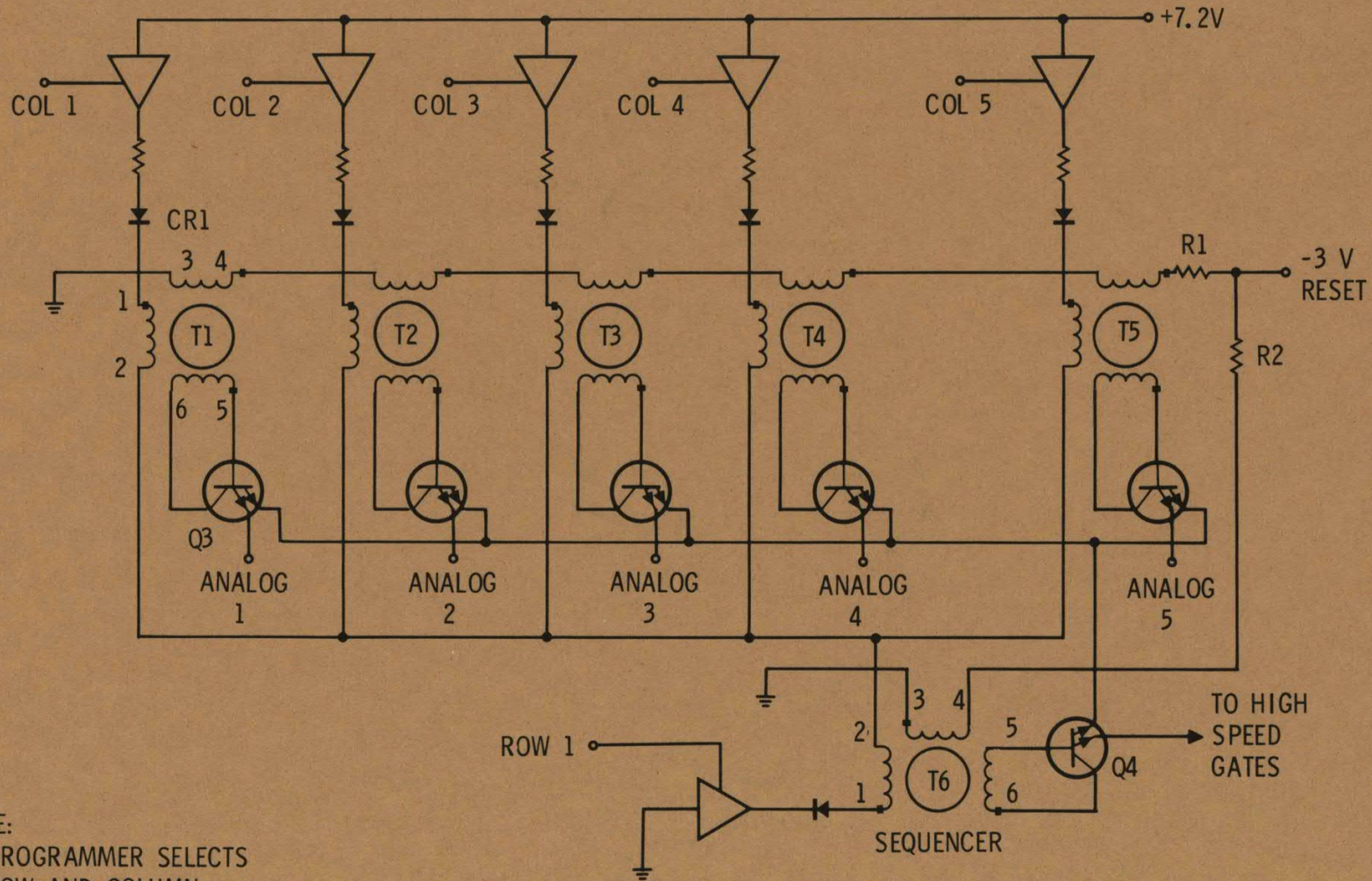


BLOCK II PCM PROGRAMMER

SIMPLIFIED BLOCK DIAGRAM



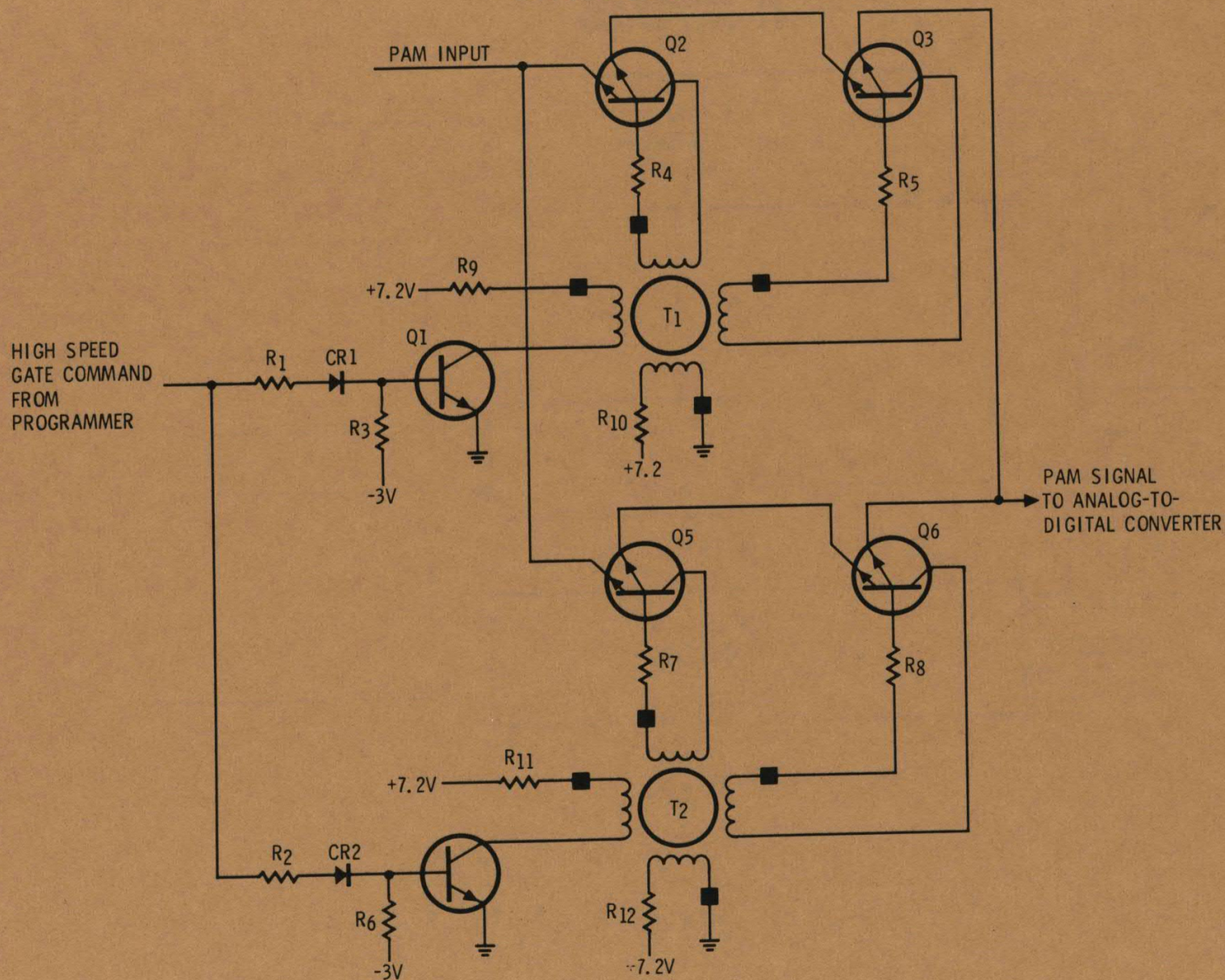
PCM PRIMARY MULTIPLEXER GATES



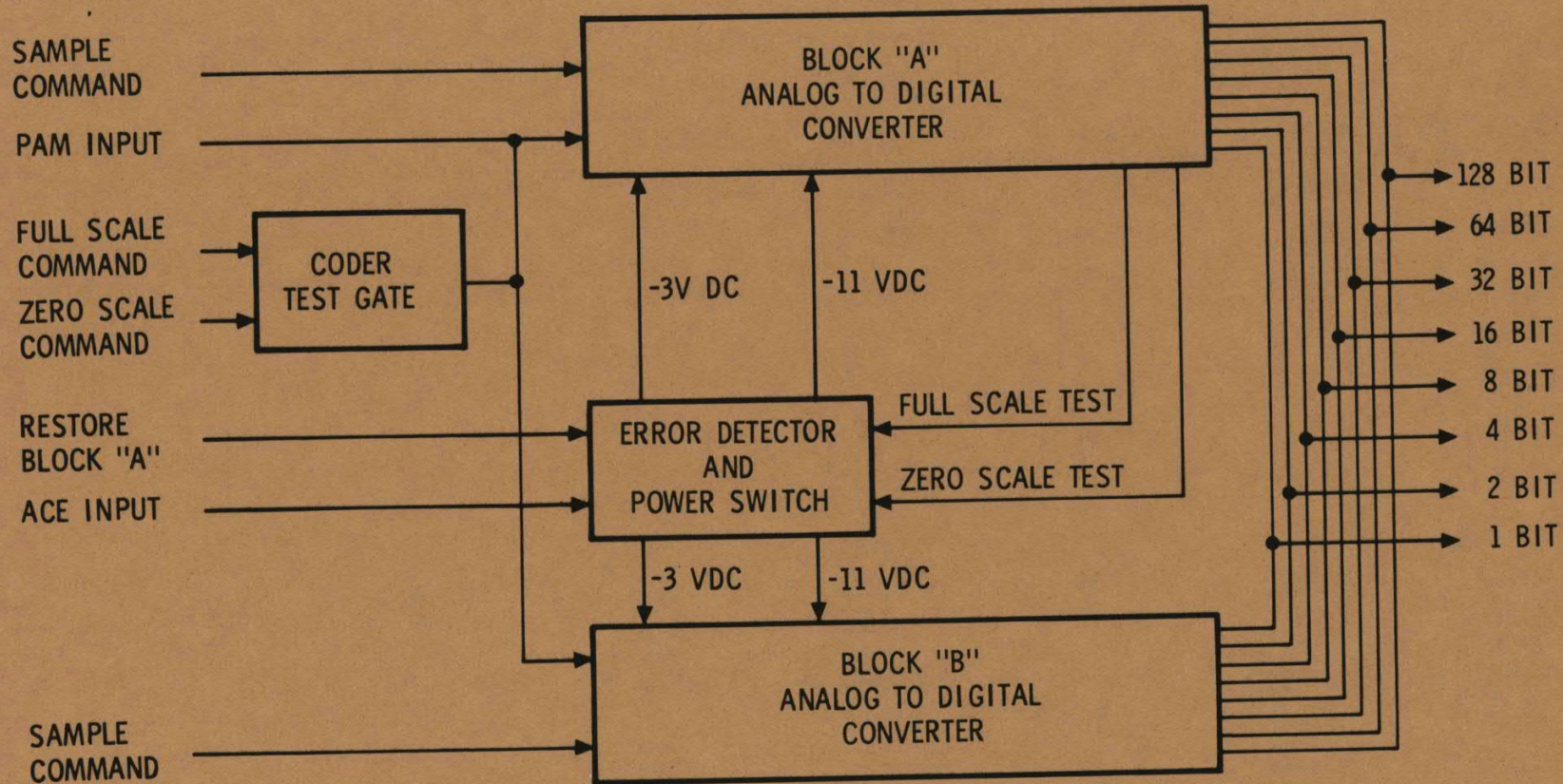
NOTE:
PROGRAMMER SELECTS
ROW AND COLUMN.

PCM HIGH SPEED GATES

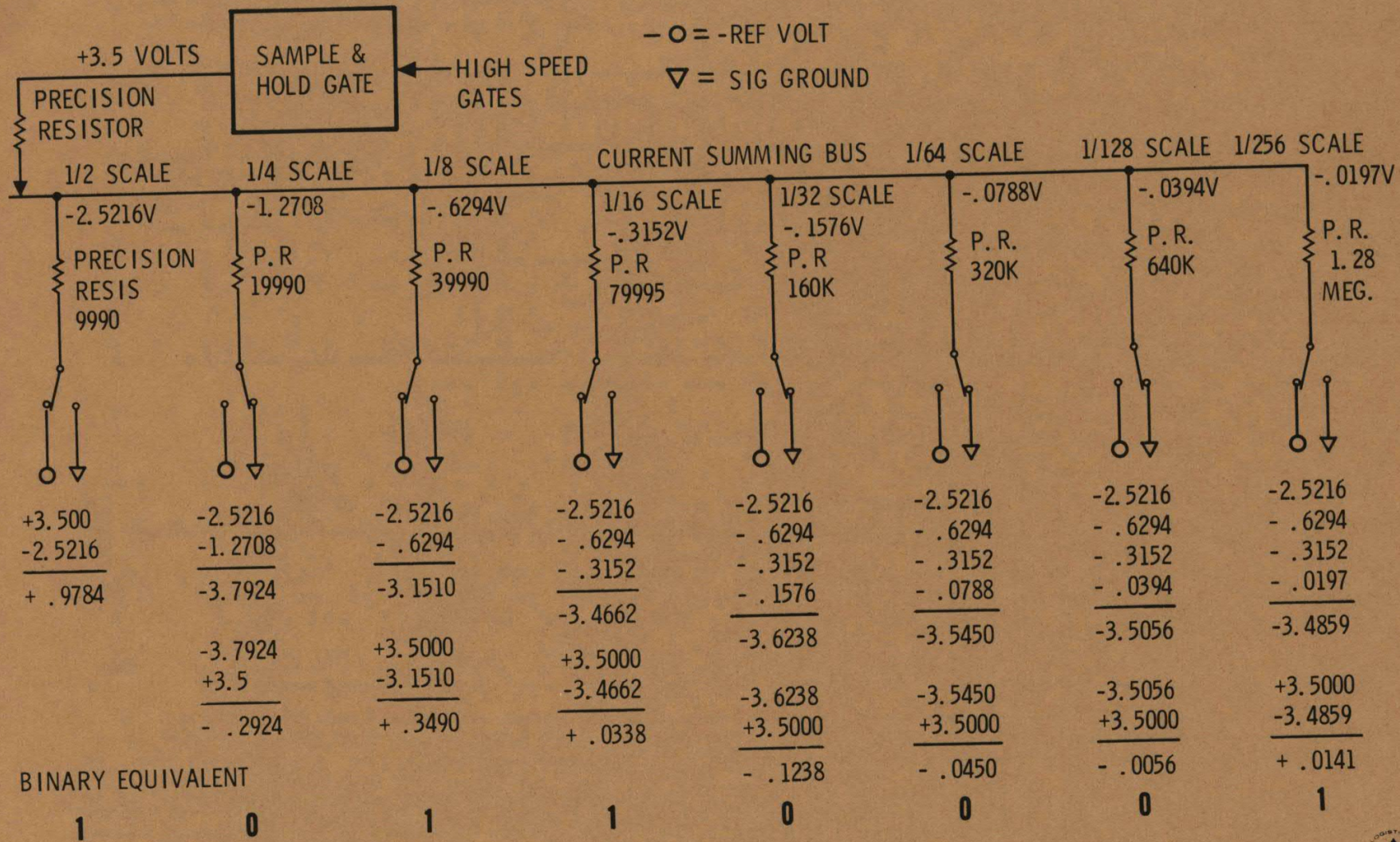
BLOCK II



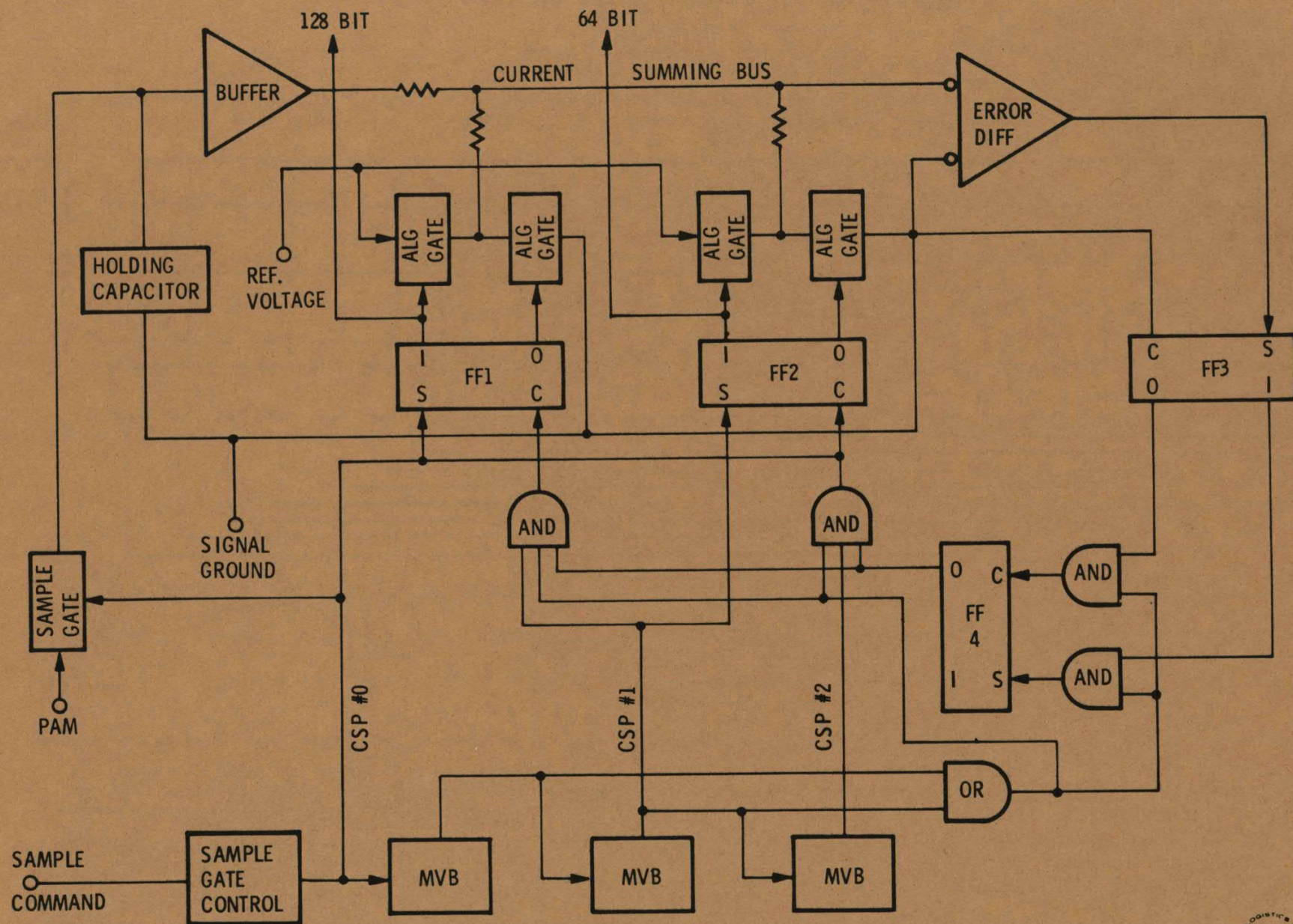
PCM CODER BLOCK DIAGRAM BLOCK II



EXAMPLE CODING OF 3.5 VOLT ANALOG SIGNAL

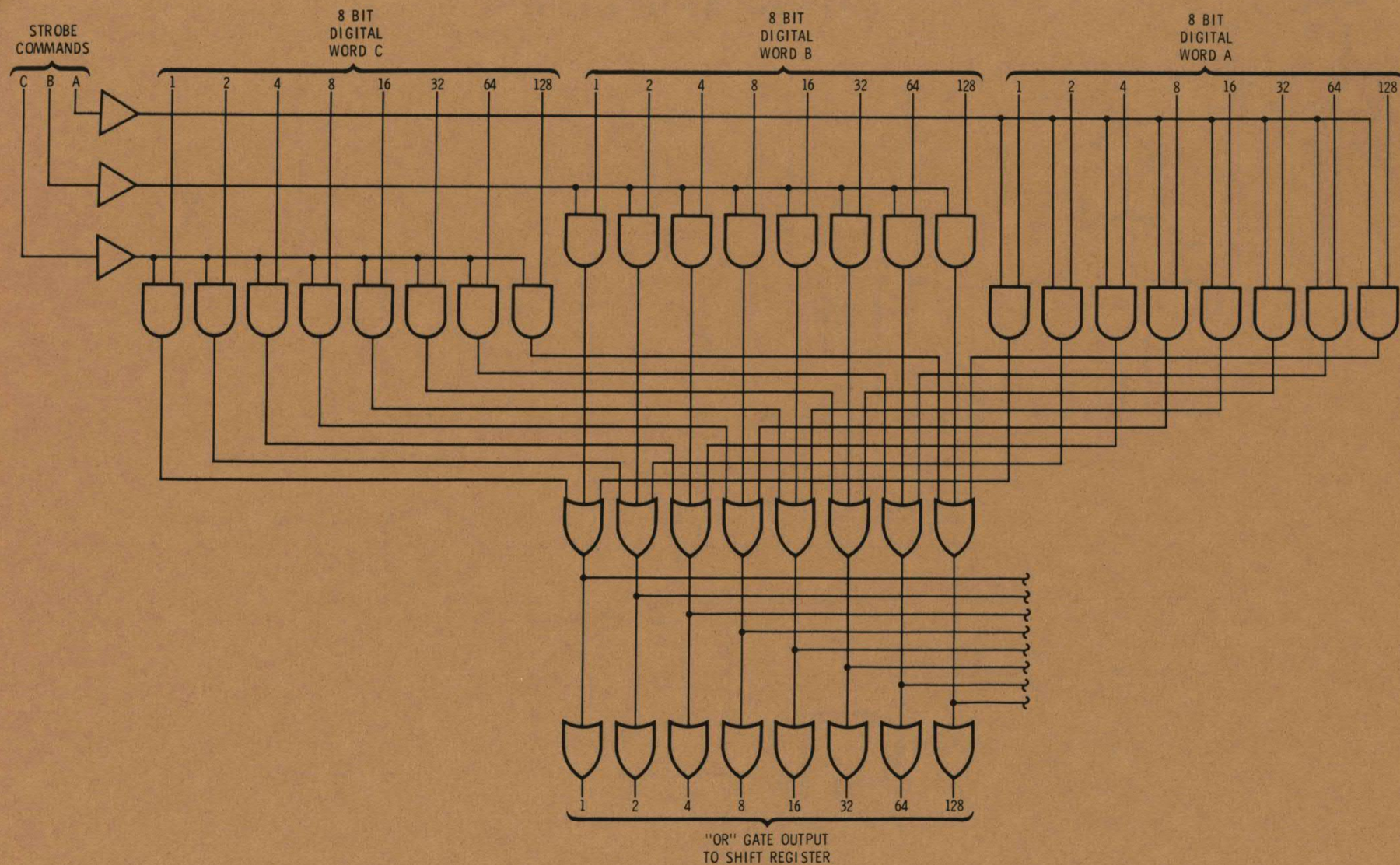


PCM COVER LOGIC

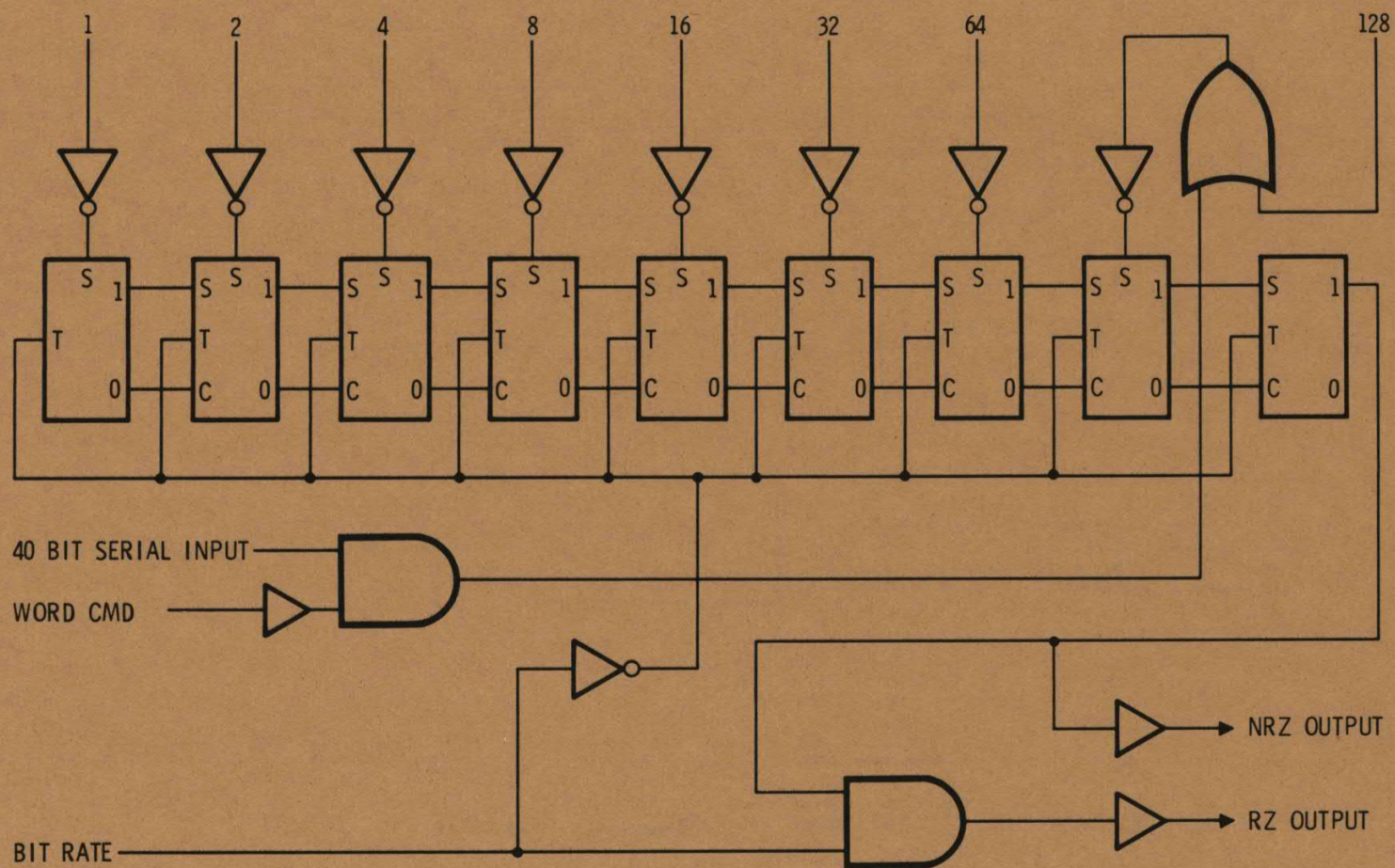


DIGITAL MULTIPLEXER GATES

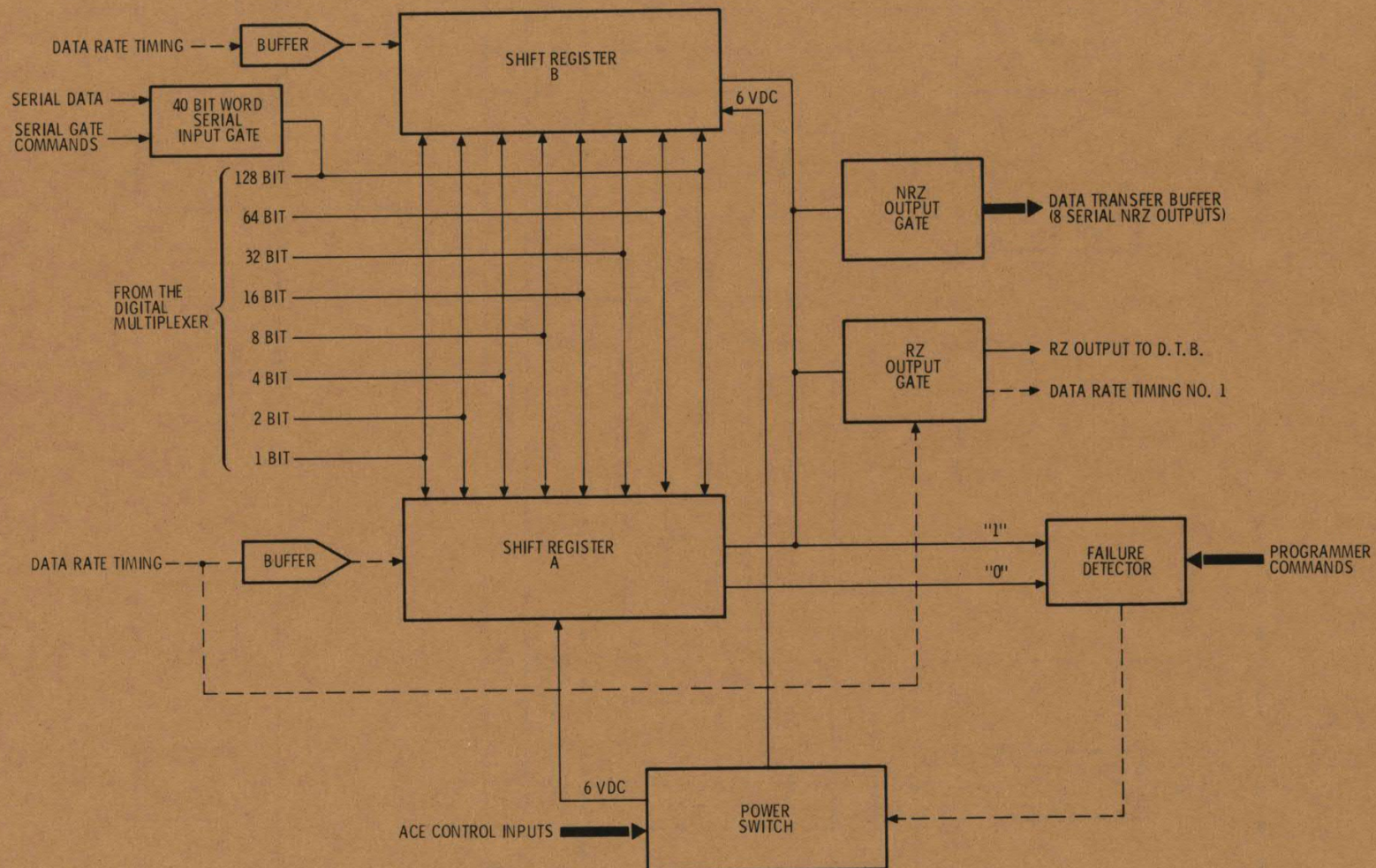
BLOCK II



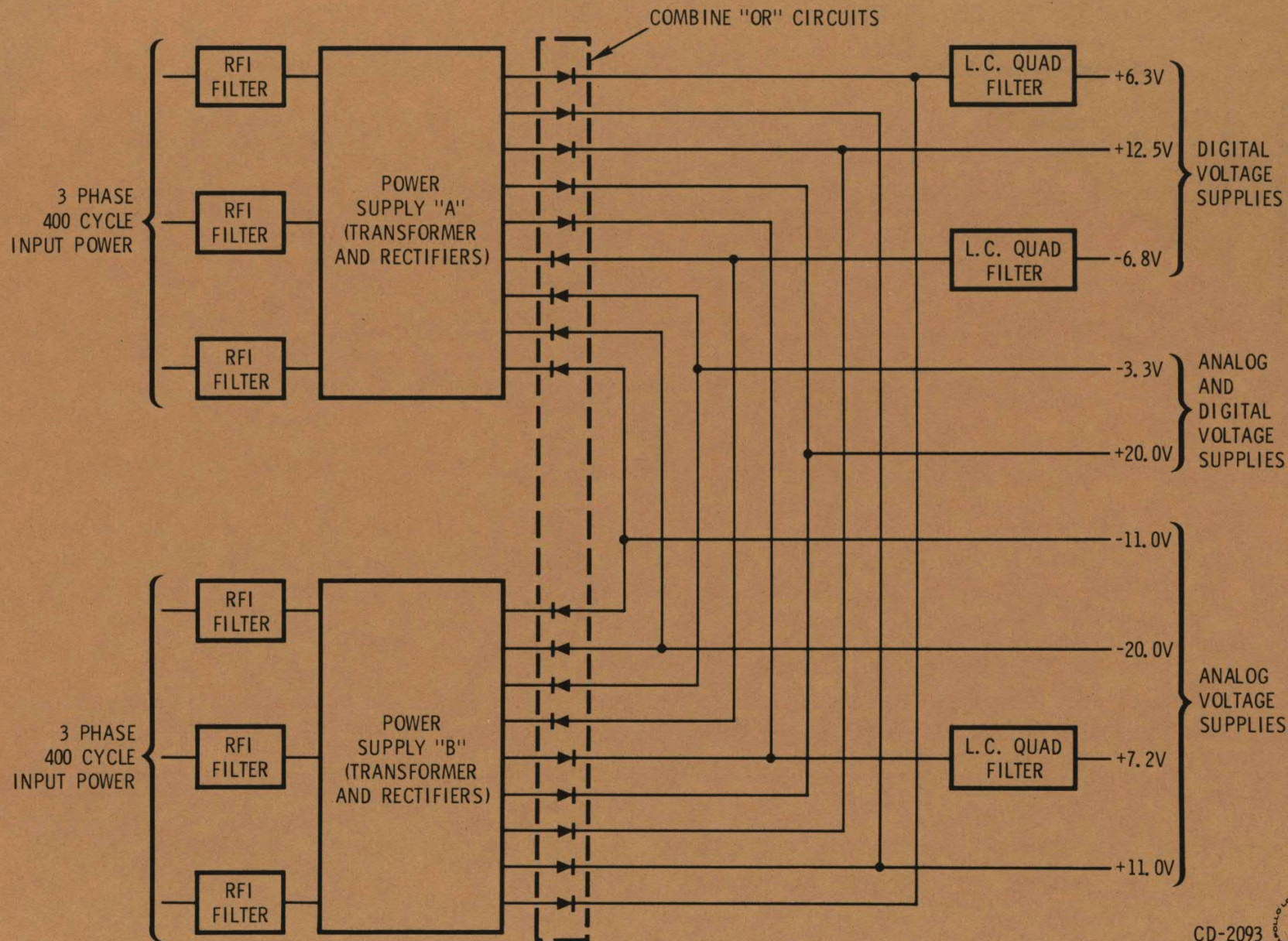
SIMPLIFIED BLOCK DIAGRAM

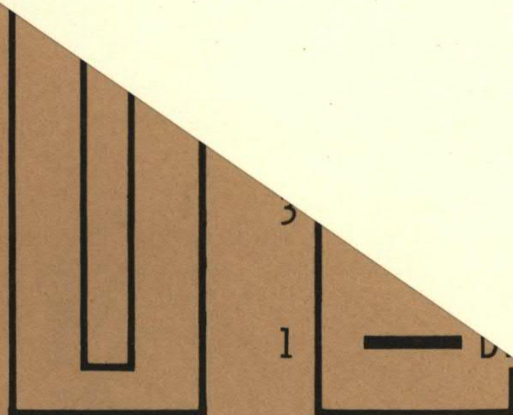


OUTPUT REGISTER BLOCK DIAGRAM BLOCK II



PCM POWER SUPPLY BLOCK II





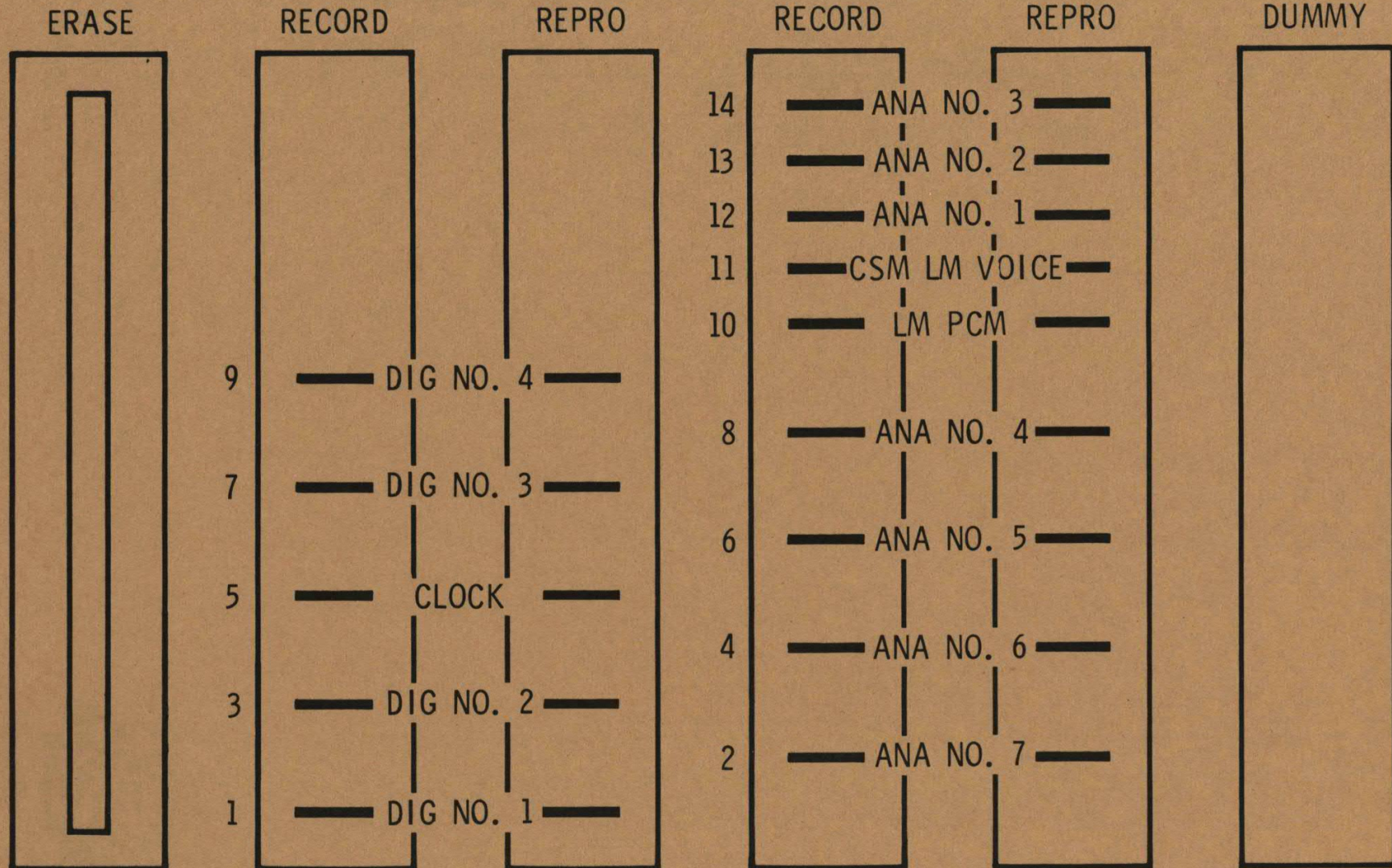
97 A



DSE HEAD LAYOUT

DIGITAL

ANALOG



CD-2097 A

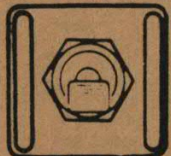


DSE SIMPLIFIED SWITCHING CIRCUITS

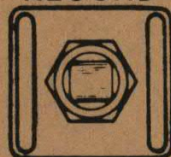
SPACECRAFT CONTROL PANEL

DSE LOGIC CIRCUITS

PCM/ANLG

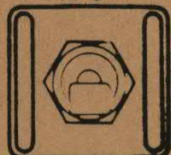


LM PCM
RECORD



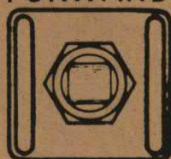
PLAY

PCM
HIGH

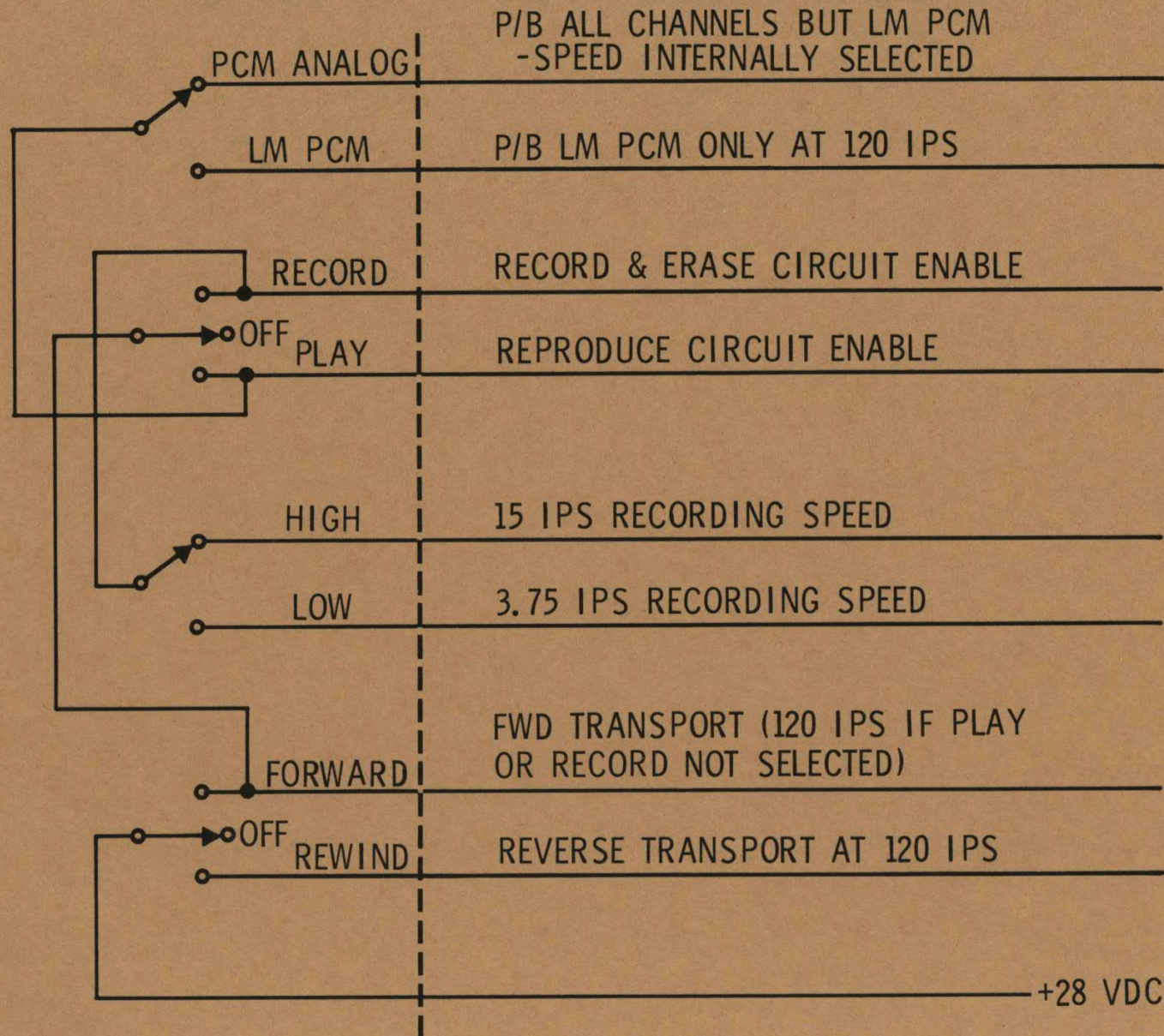


LOW

FORWARD



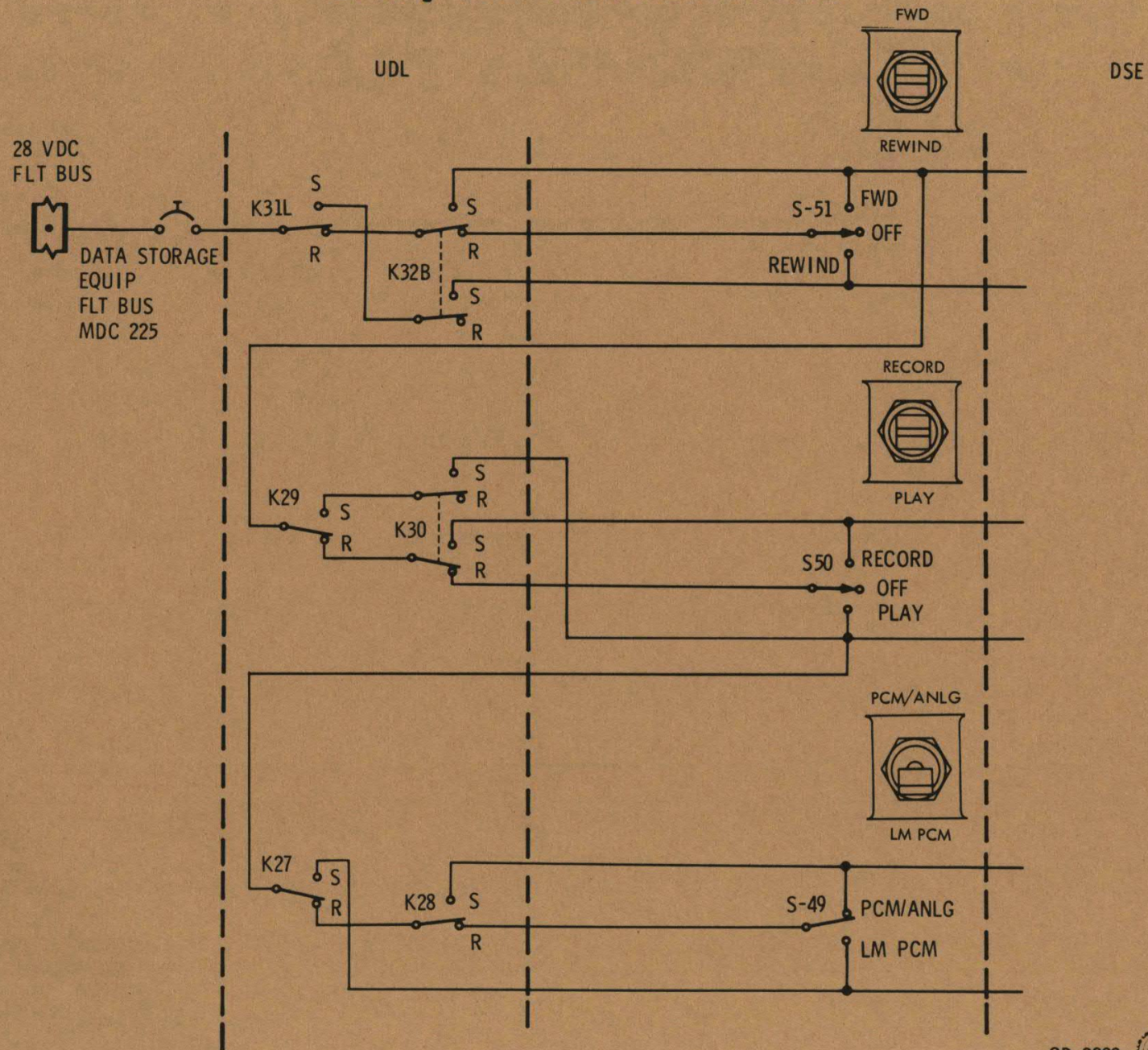
REWIND



CD-2109A



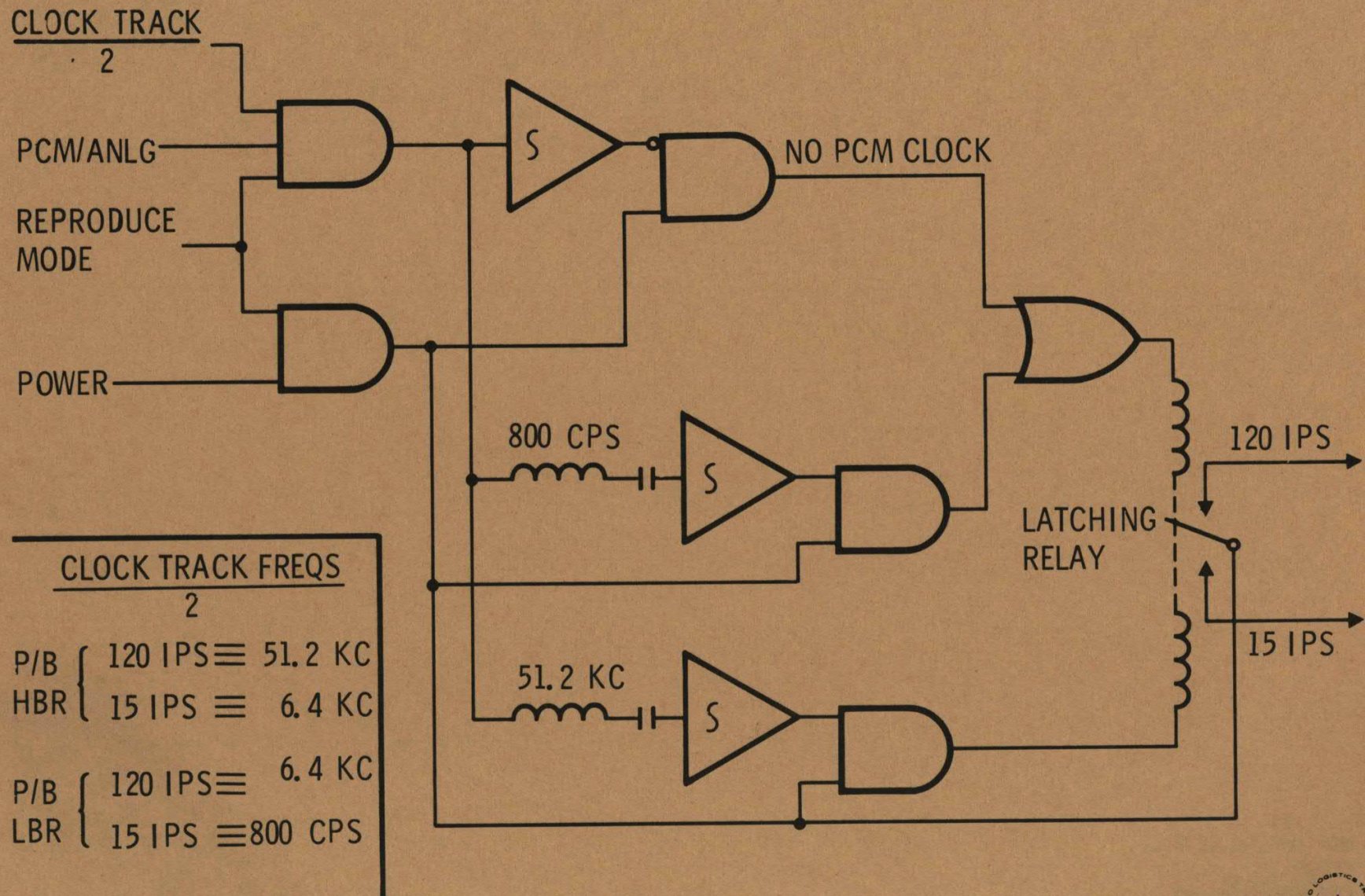
DSE/UDL INTERFACE



D.S.E. TAPE SPEED

	RECORD		PLAYBACK			
DETERMINED BY	PCM BIT-RATE SWITCH (S55)	PCM BIT-RATE SWITCH (S55)	DATA CLOCK TRACK	DATA CLOCK TRACK	DATA CLOCK TRACK	TAPE PLAYBACK MODE SWITCH (S49)
STATUS	HIGH	LOW	MISSING (FAILURE)	400 $\frac{\text{BIT}}{\text{SEC}}$ OR 107 $\frac{\text{BIT}}{\text{IN}}$	12,800 $\frac{\text{BIT}}{\text{SEC}}$ OR 854 $\frac{\text{BIT}}{\text{IN}}$	LM PCM
TAPE SPEED	15 IPS	3.75 IPS	120 IPS	120 IPS	15 IPS	120 IPS

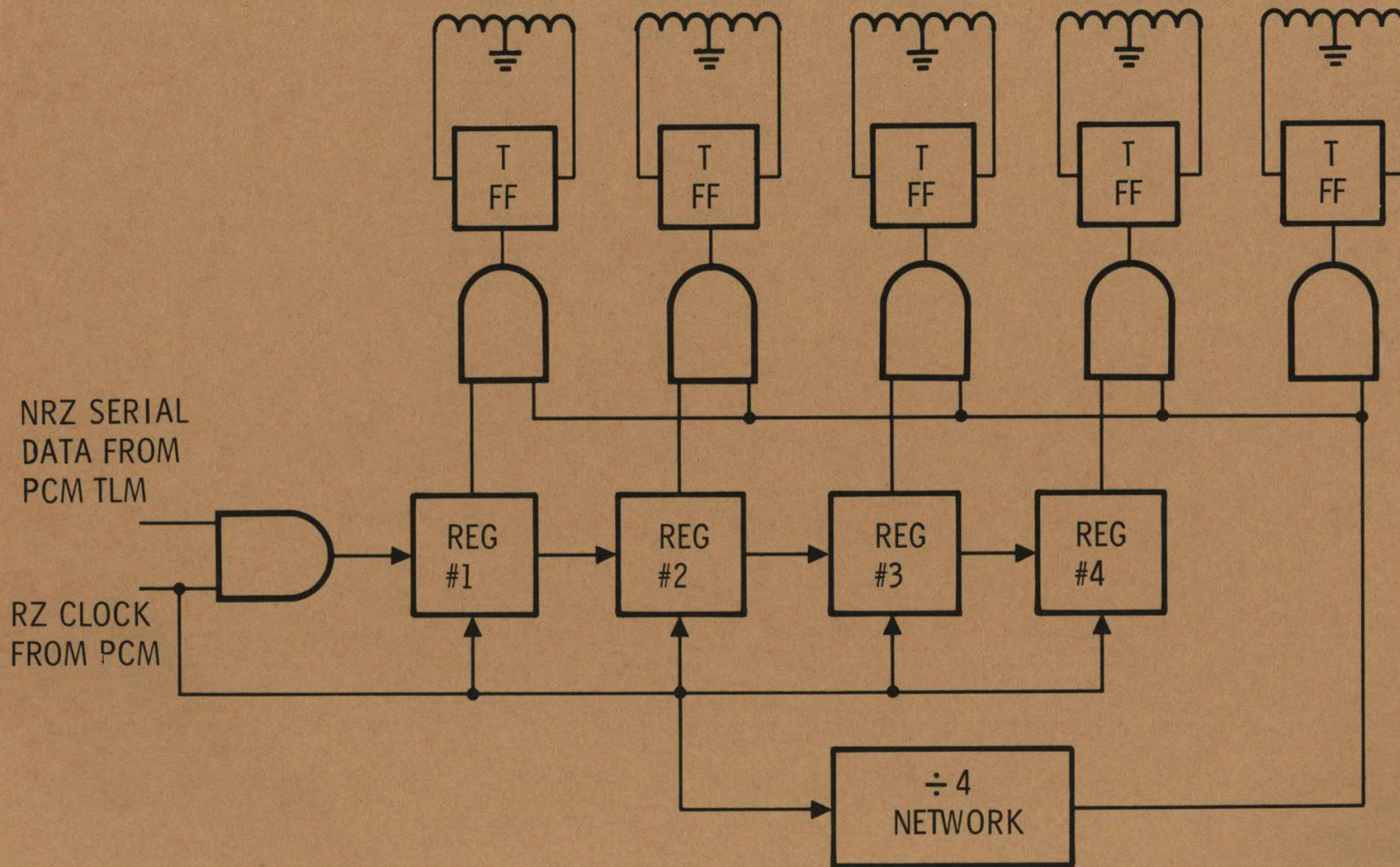
D.S.E. AUTO SPEED SELECT



CD-2074A

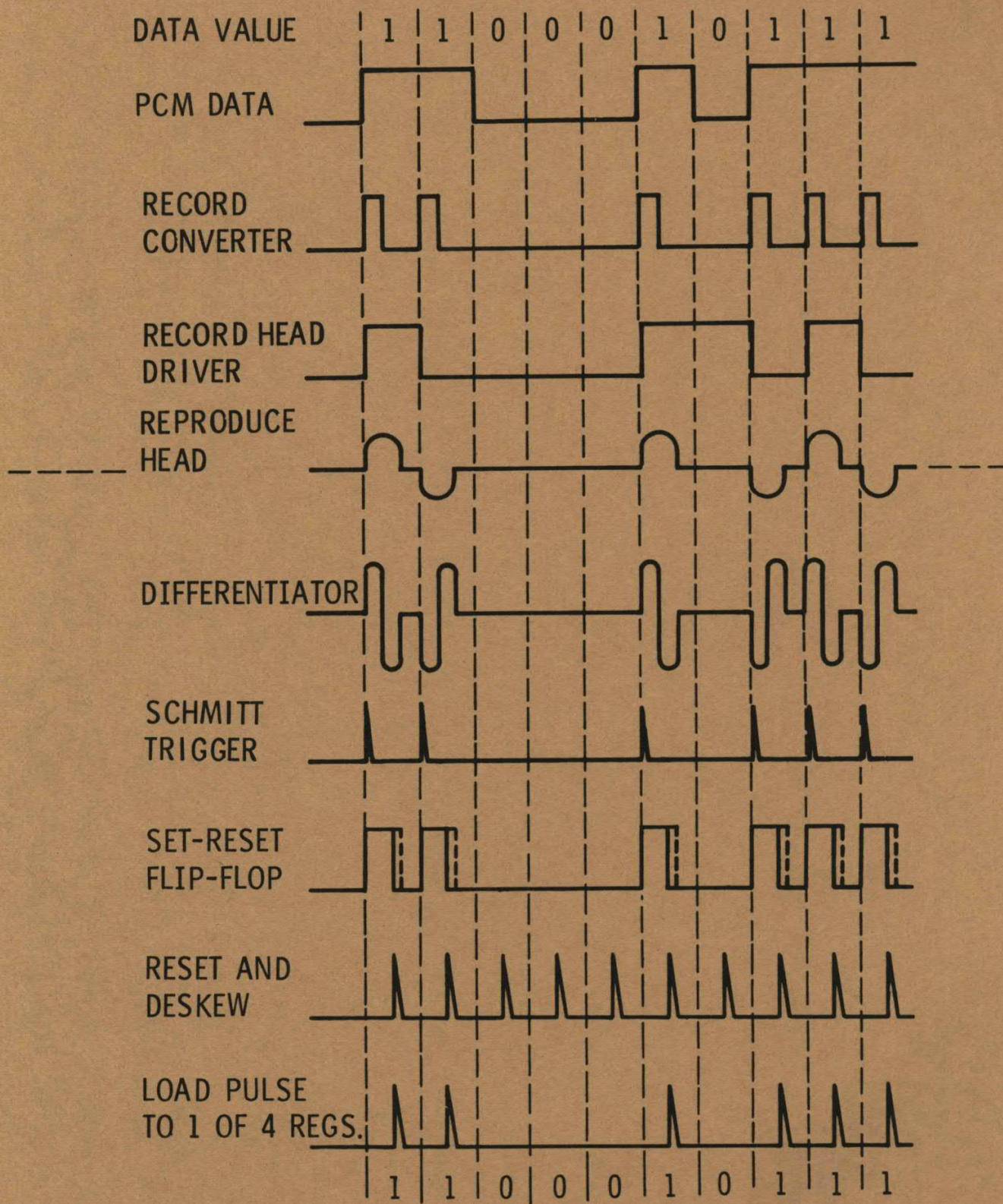


D.S.E. DIGITAL RECORD CONVERTER



D.S.E. WAVE FORMS

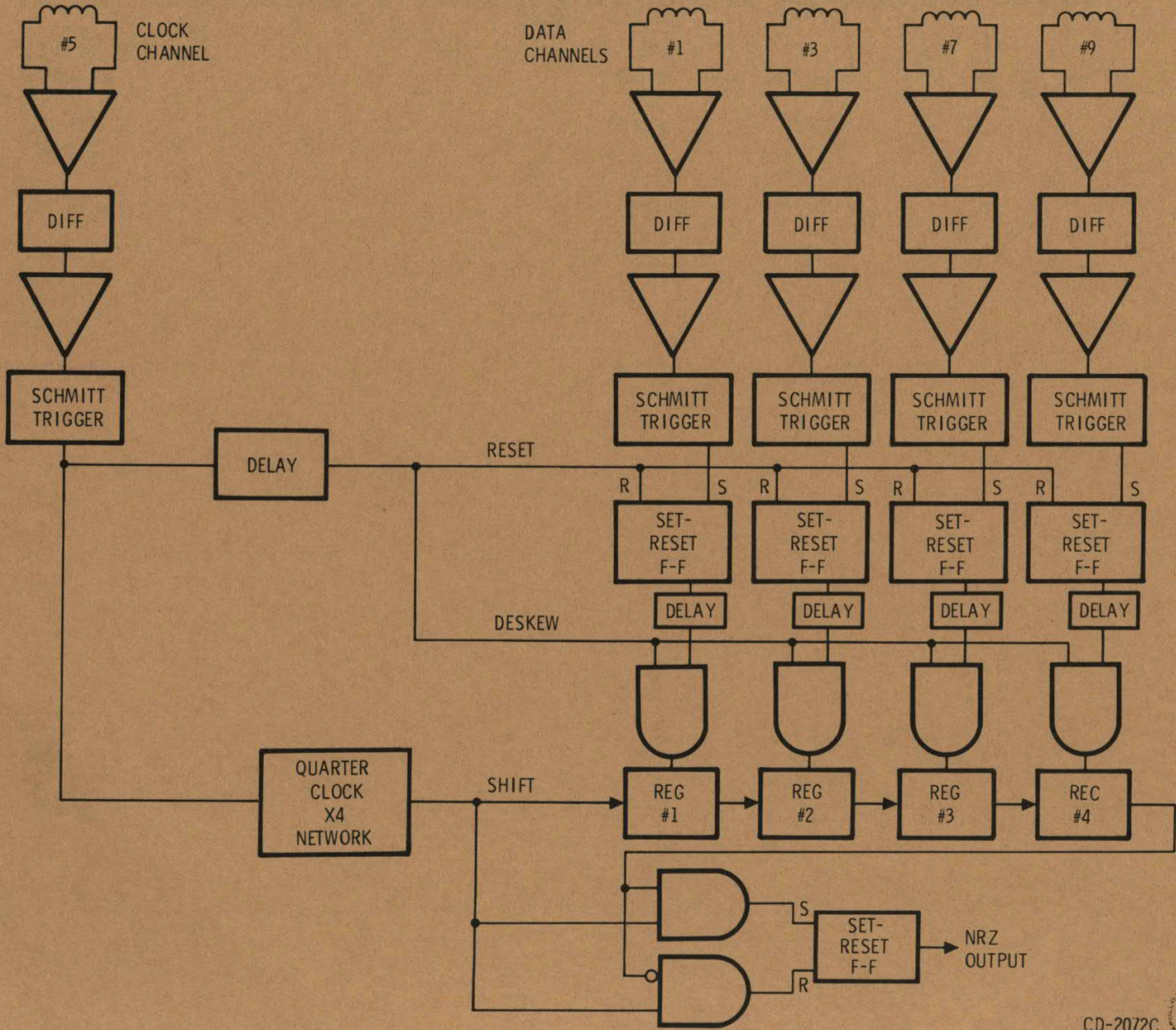
58



CD-2071C

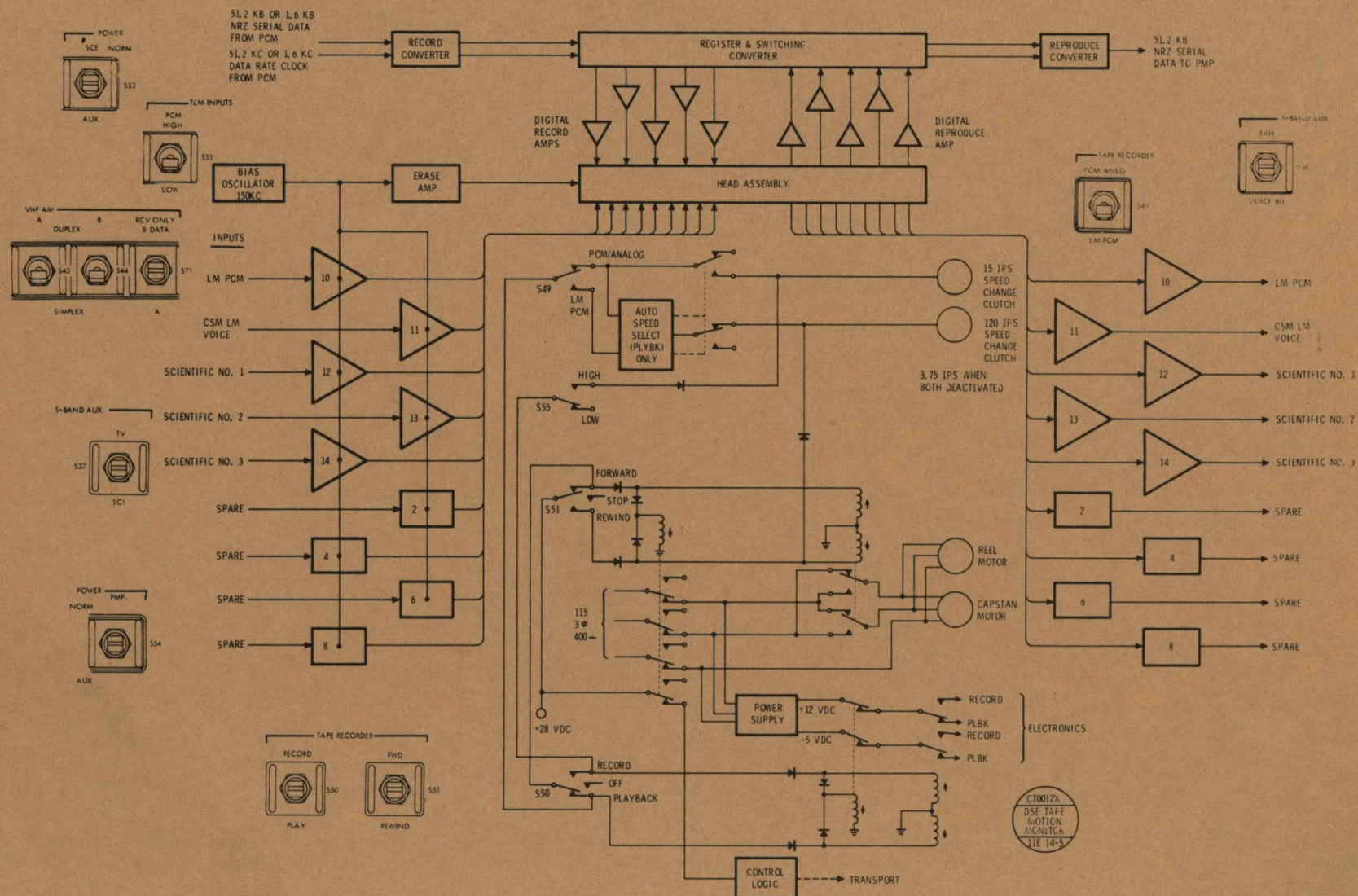


D.S.E. DATA REPRODUCE CIRCUITRY



DATA STORAGE EQUIPMENT BLOCK DIAGRAM

BLOCK II



CM PL

SM VIBRATIONS

CM POSITION

CM
STRUCTURAL
FORCES

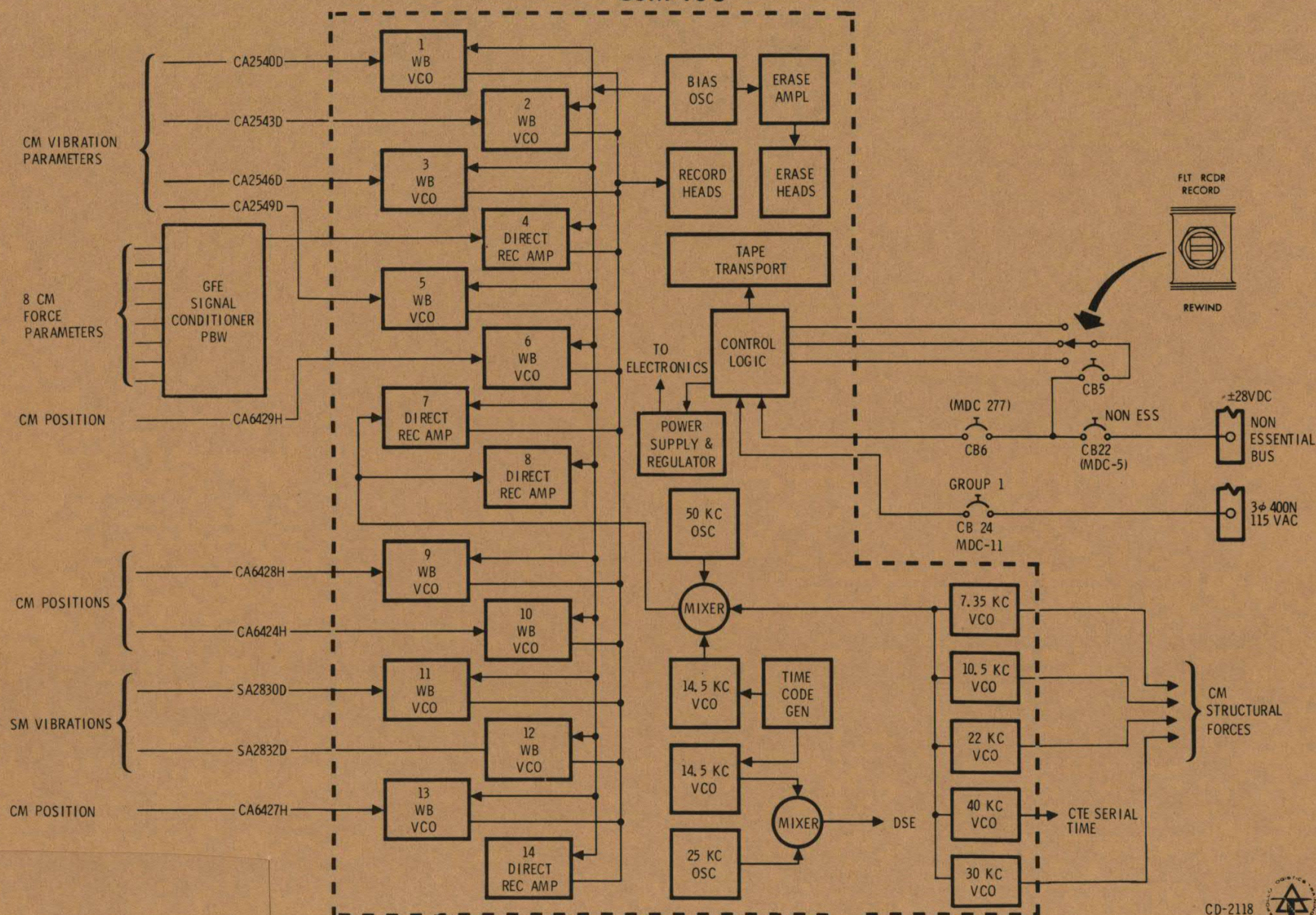
SERIAL
TIME

CD-2118



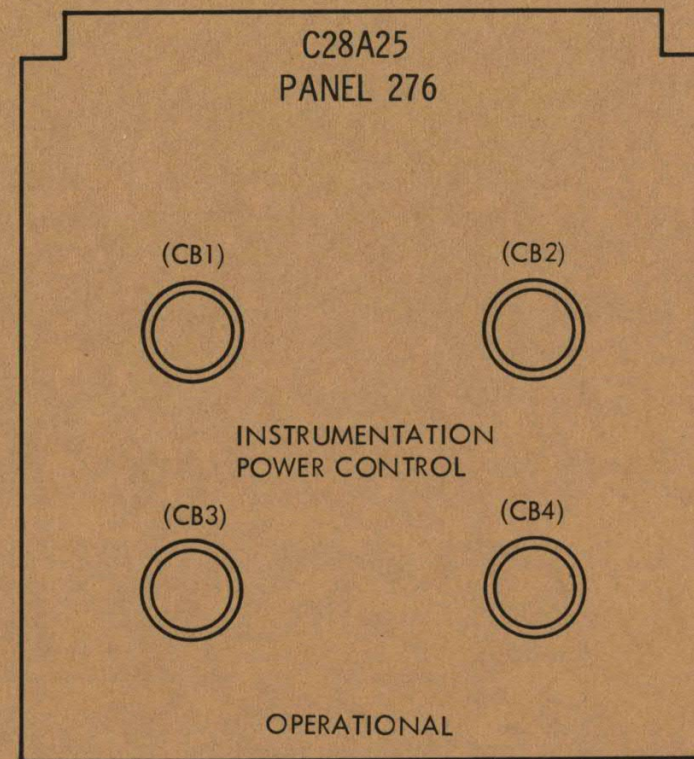
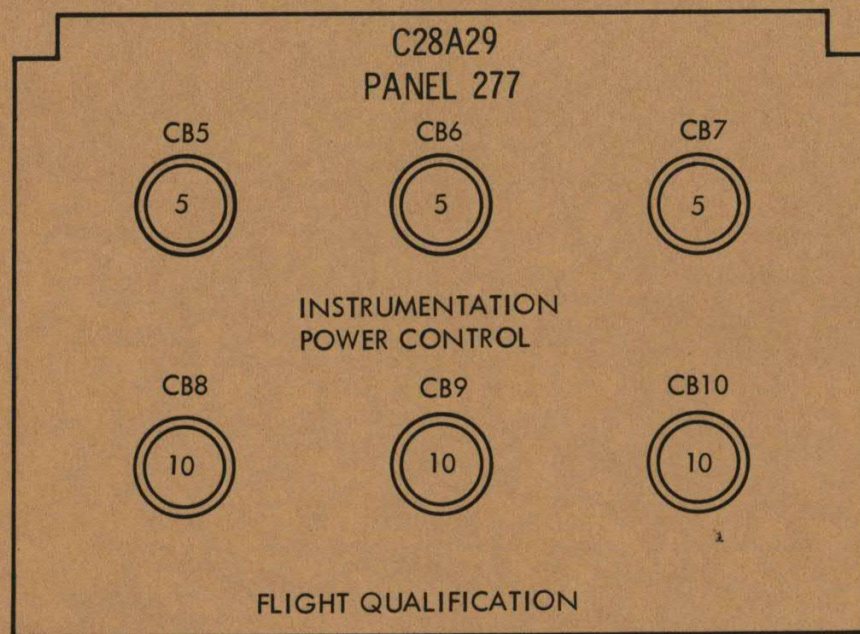
FLIGHT QUALIFICATION TAPE RECORDER

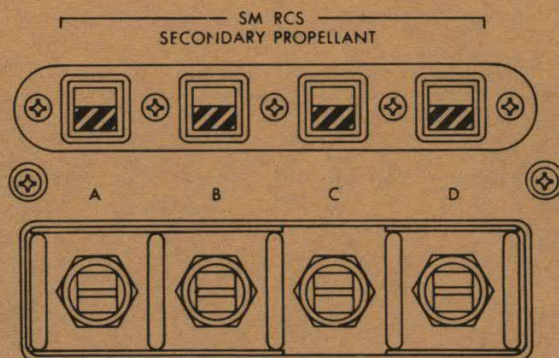
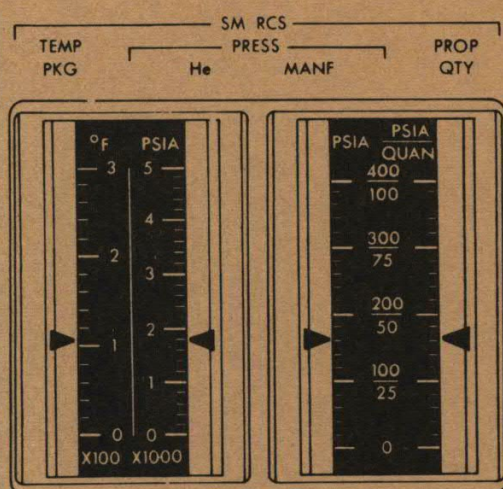
CSM 103



CD-2118

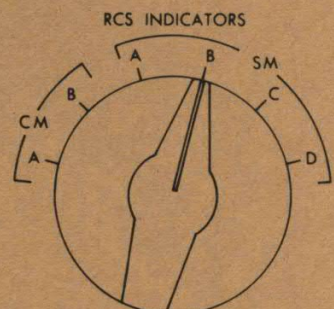
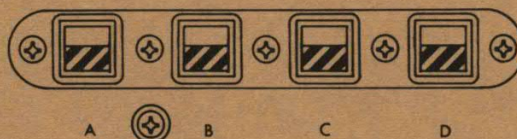






- OFF -

HELIUM 1

UP TLM
ACCEPTFLT RCDR
RECORD

BLOCK

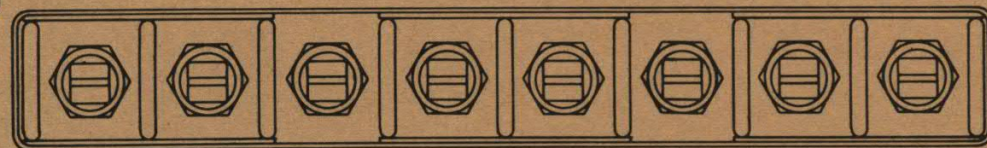
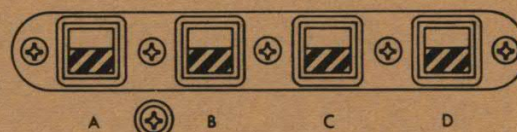
REWIND

- OFF -
HELIUM 2

SM RCS HEATERS

A B C D

AUTO AUTO

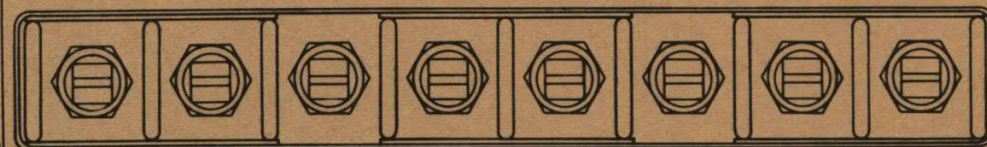


ON

ON
CM RCS PRPLNT- OFF -
PROPELLANT

RCS

CMD ON TRNFR CM



OFF

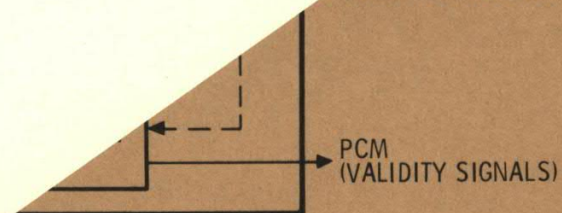
SM

OFF

- OFF -

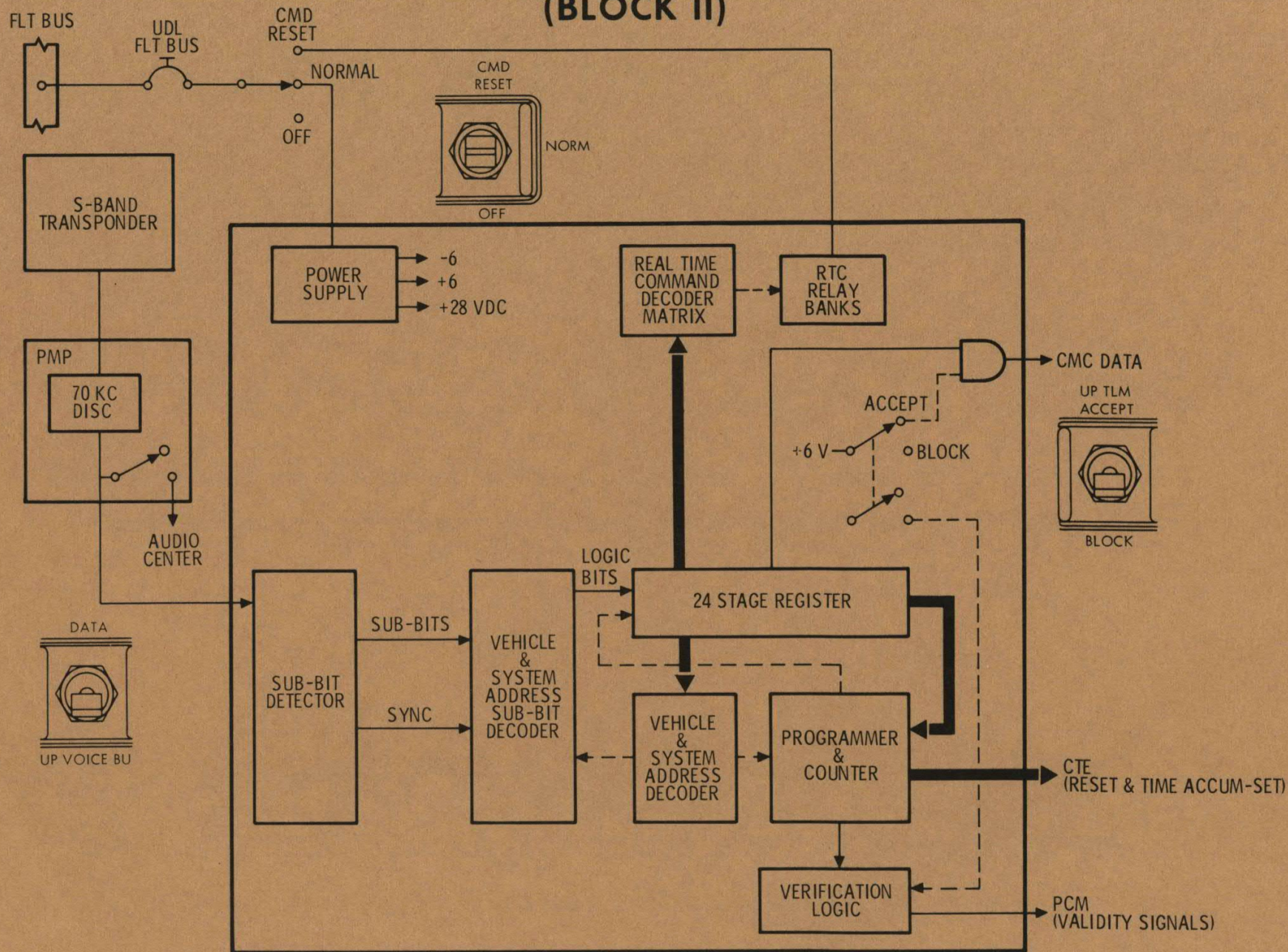


IE
(RESET & TIME ACCUM-SET)

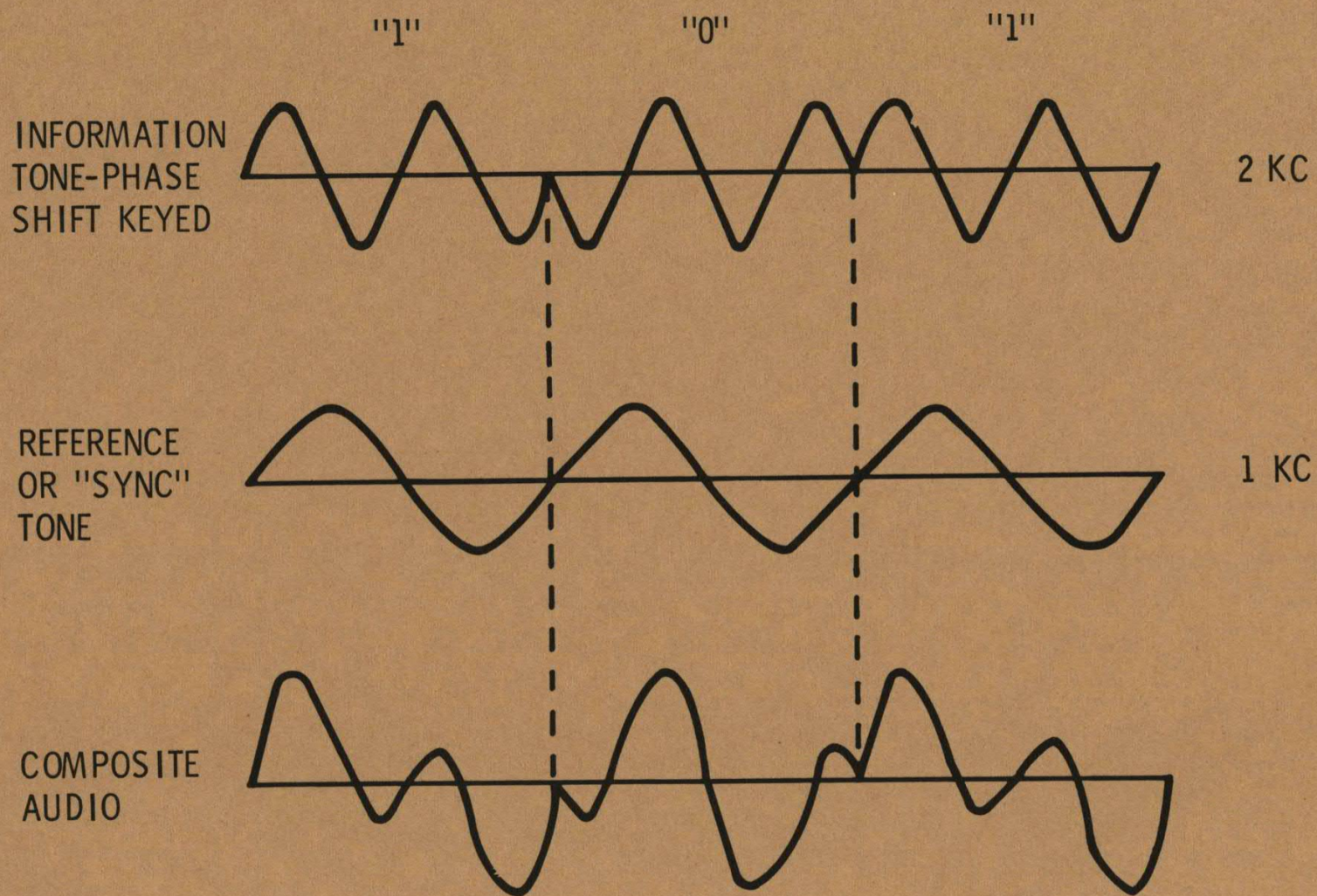


CD-2049C 

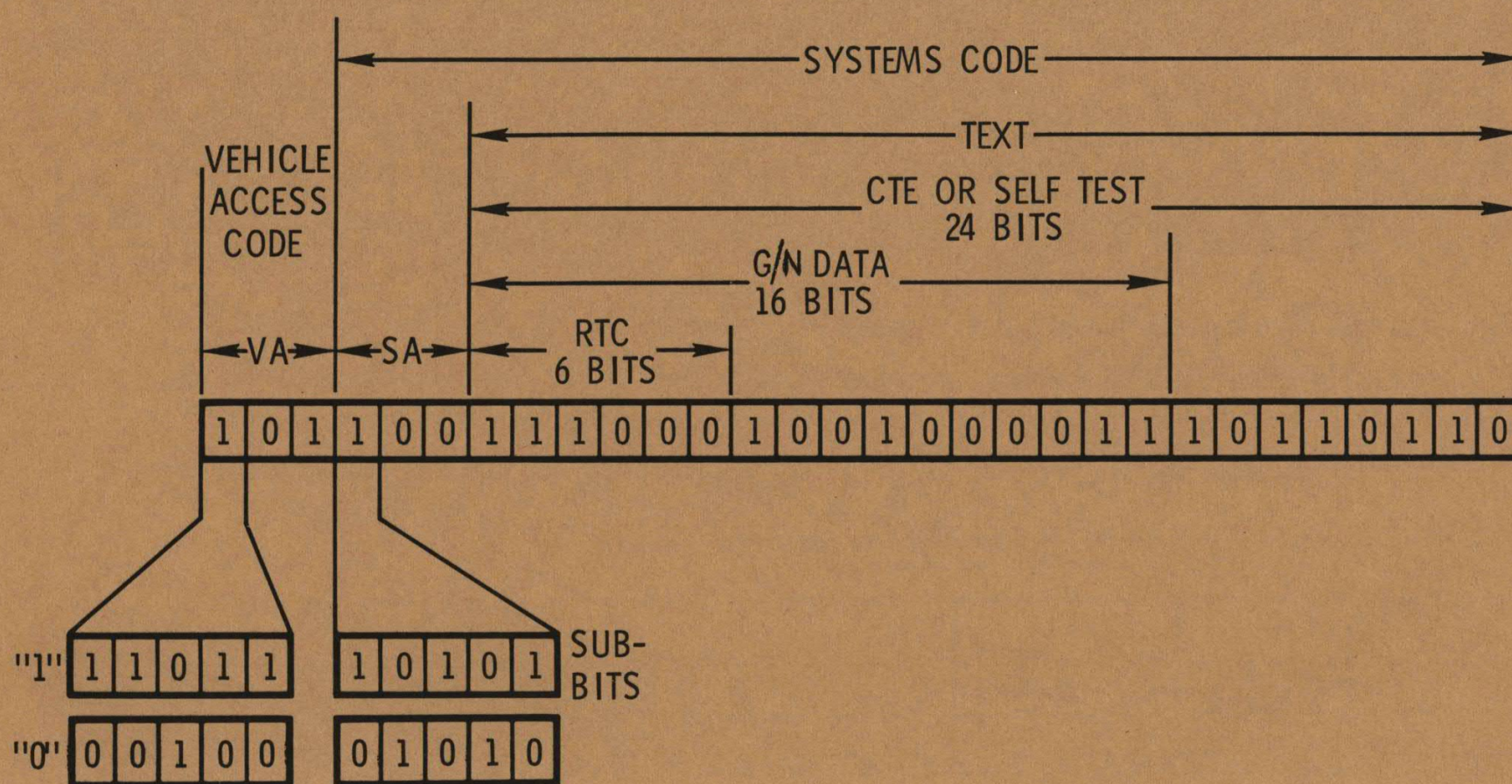
UP-DATA LINK (BLOCK II)



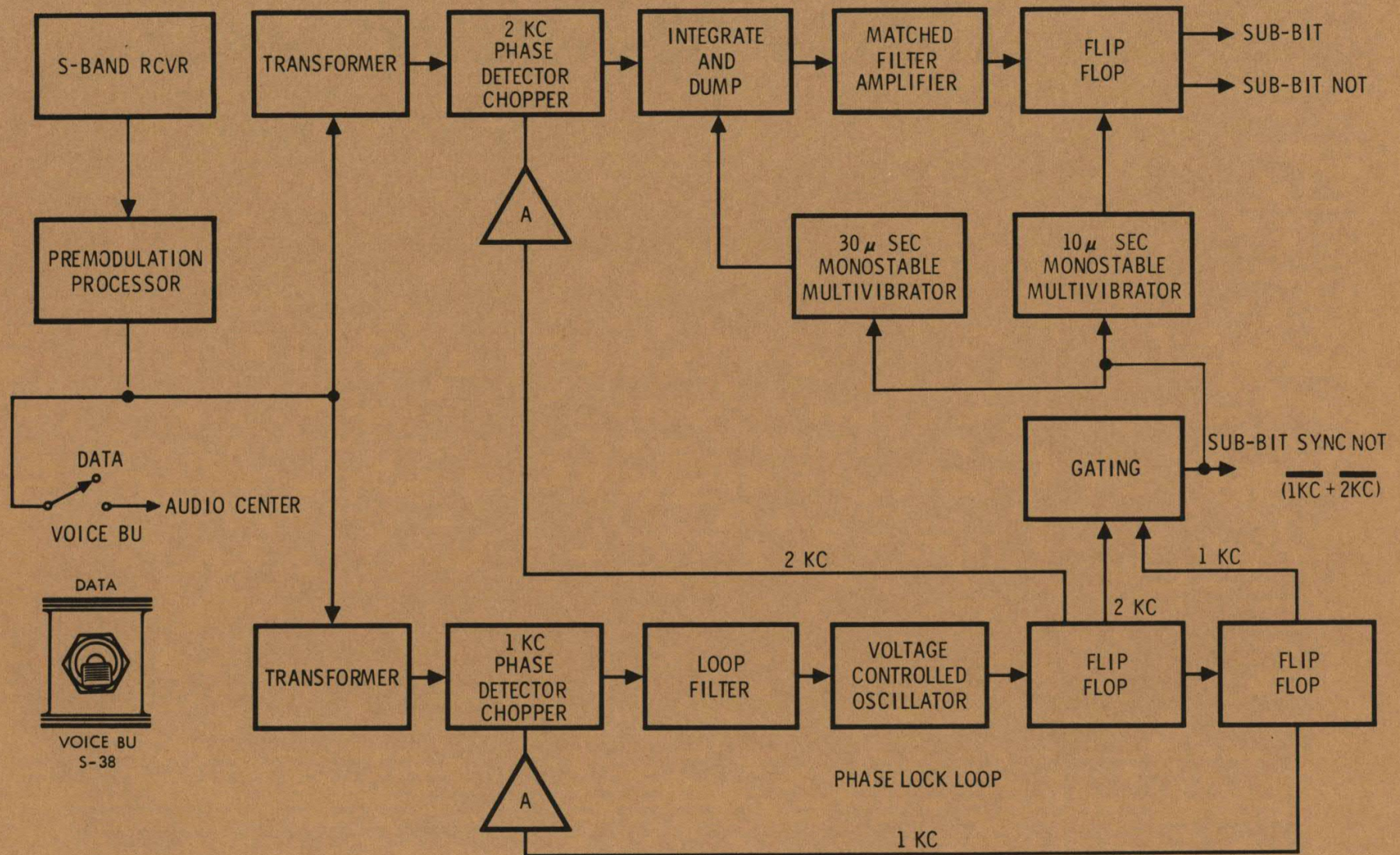
UP-DATA LINK MODULATION



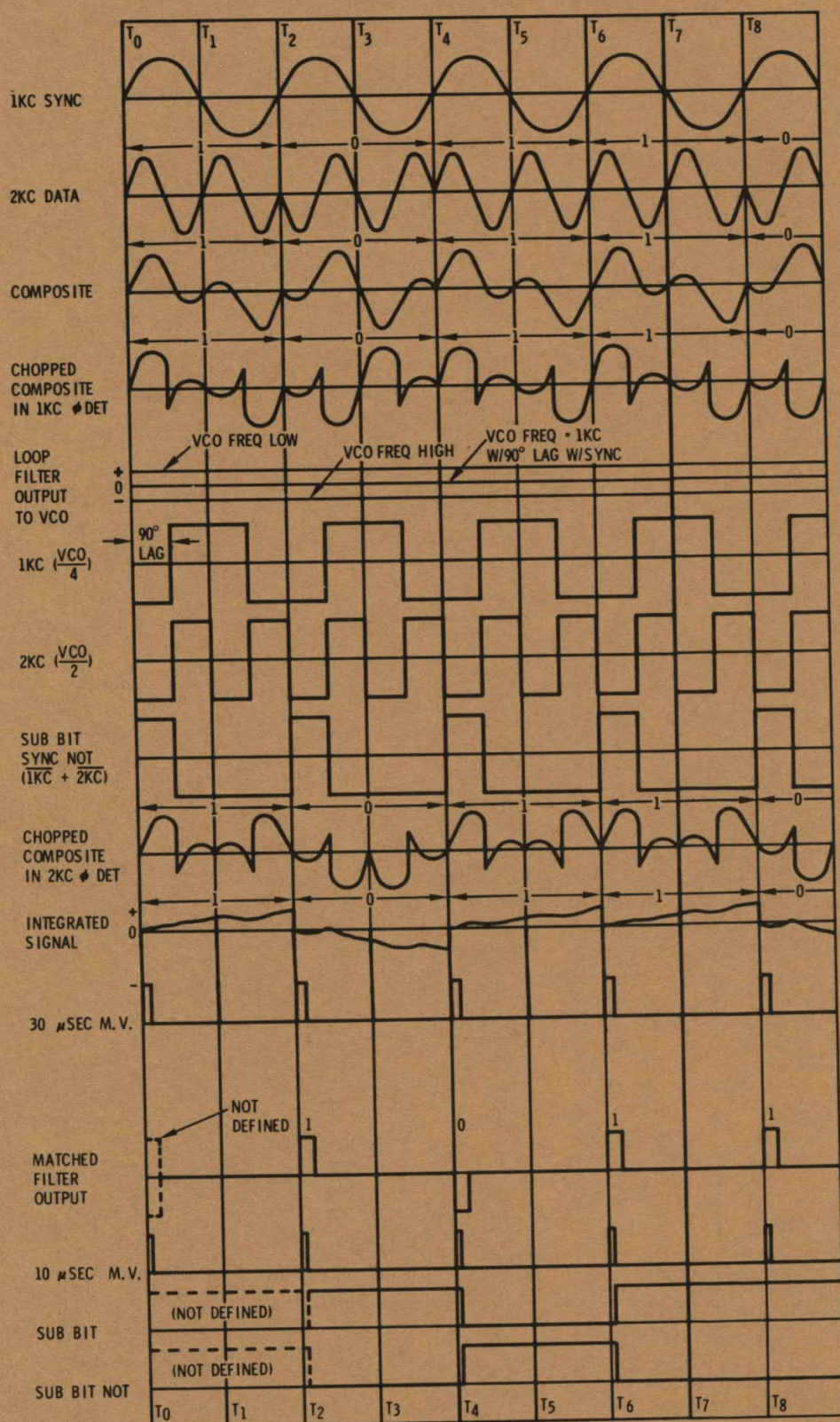
UP-DATA LINK MESSAGE FORMAT



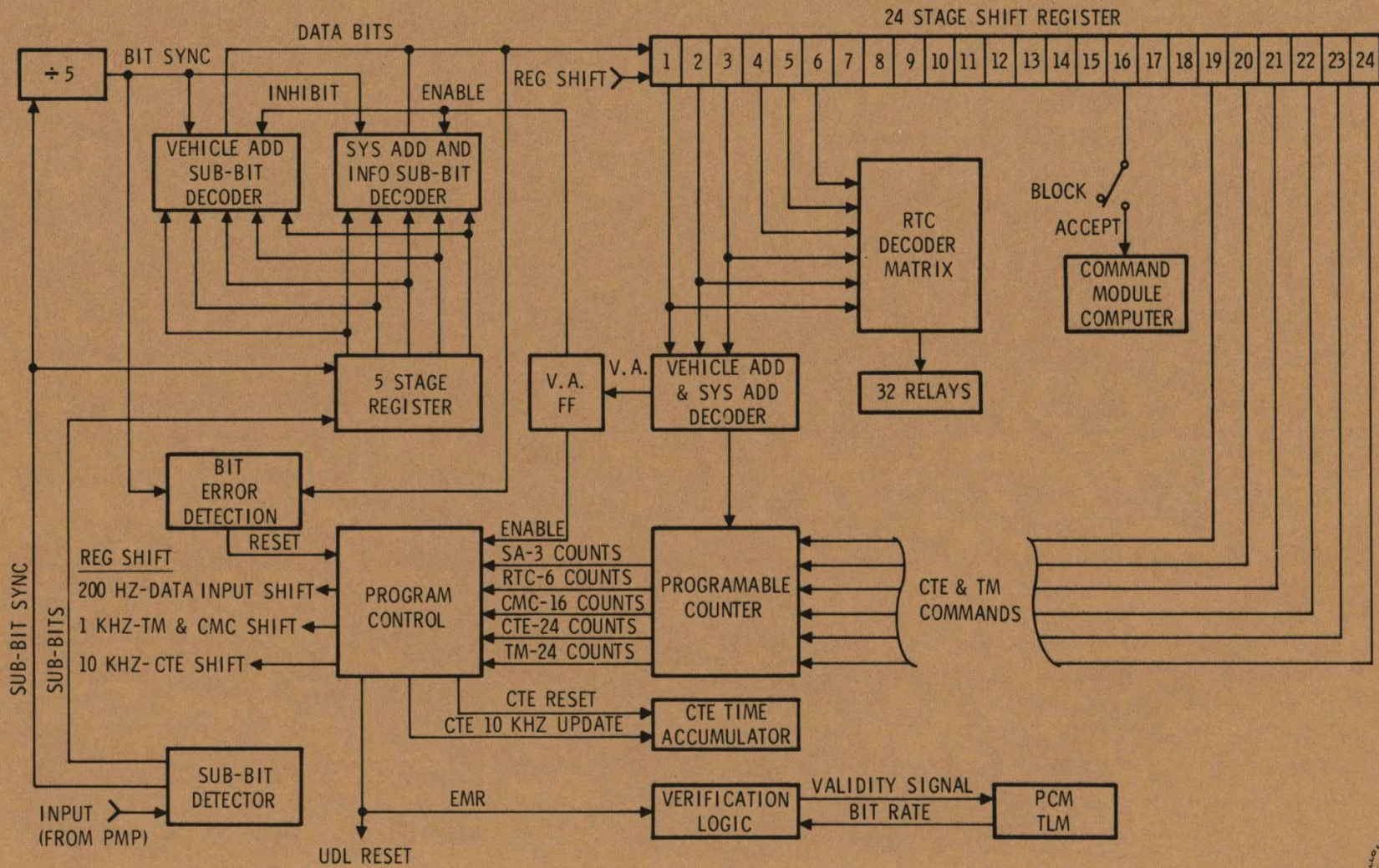
SUB-BIT DETECTOR



WAVEFORMS OF SUB-BIT DETECTOR



UDL DECODER



CD-2077C

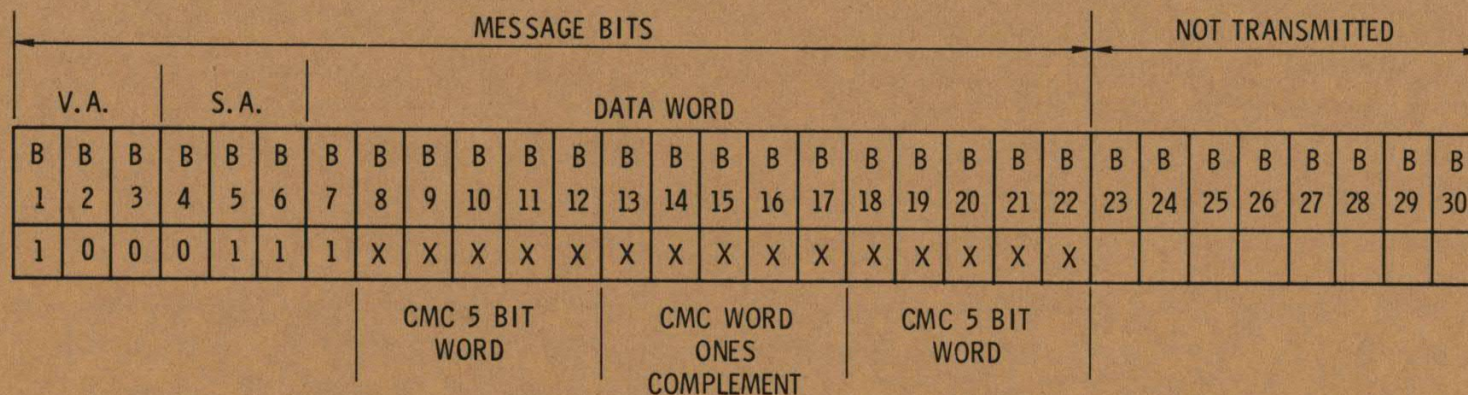


UDL RTC MESSAGE FORMAT

MESSAGE BITS												NOT TRANSMITTED																	
V.A.			S.A.			DATA WORD																							
B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	0	0	1	1	0	2 ²	2 ¹	2 ⁰	2 ²	2 ¹	2 ⁰					(REAL TIME COMMANDS-INTERNAL RELAYS)													
1	0	0	1	0	1	0	1	1	0	0	0					(SALVO RESET RTC'S 00, 04, 10, 14, 20)													
1	0	0	1	0	1	1	1	1	0	0	0					(SALVO RESET RTC'S 40, 44, 50, 54, 60, 64, 70, 74)													
1	0	0	1	0	1	0	1	1	0	1	0					(SALVO RESET RTC'S 02, 06, 12, 16, 22, 26, 32, 36)													
1	0	0	1	0	1	1	1	1	0	1	0					(SALVO RESET RTC'S 42, 46, 52, 56, 62, 66, 72, 76)													

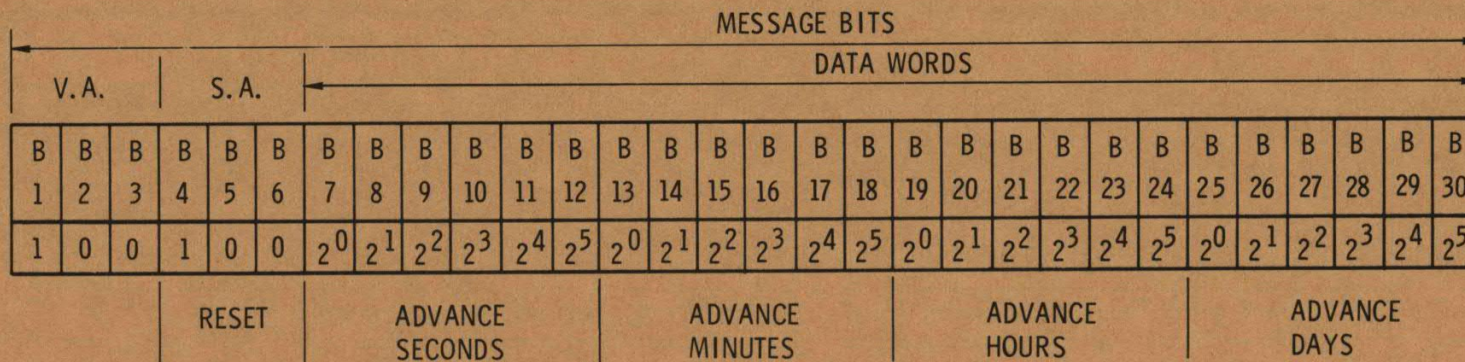
1. RTC BITS B7 THRU B10 GROUNDS ONE OF 16 SELECT LINES WHILE BITS B11 AND B12 PROVIDES A 28 VDC PULSE FOR 30 MILLISECONDS ON ONE OF THE SET OR RESET LINES
2. RTC DATA WORD BIT CONFIGURATION CAN BE DETERMINED BY TRANSFORMING THE RTC OCTAL NUMBER TO A 6 BIT BINARY NUMBER
3. TOTAL TIME FROM MESSAGE ENTRY TO VERIFICATION IS 90 MILLISECONDS

UDL CMC MESSAGE FORMAT



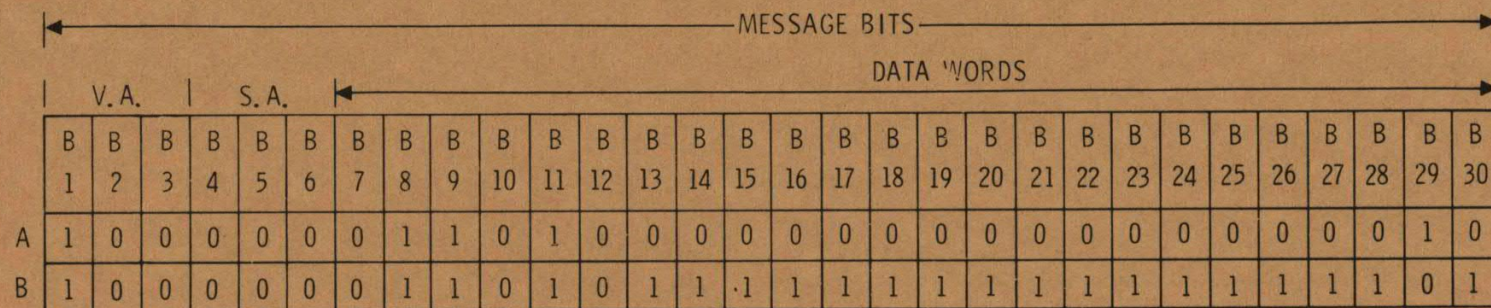
1. INFO BIT B7 IS ALWAYS A "1"
2. TOTAL TIME FROM MESSAGE ENTRY TO VERIFICATION IS 126 MILLISECONDS

UDL CTE MESSAGE FORMAT



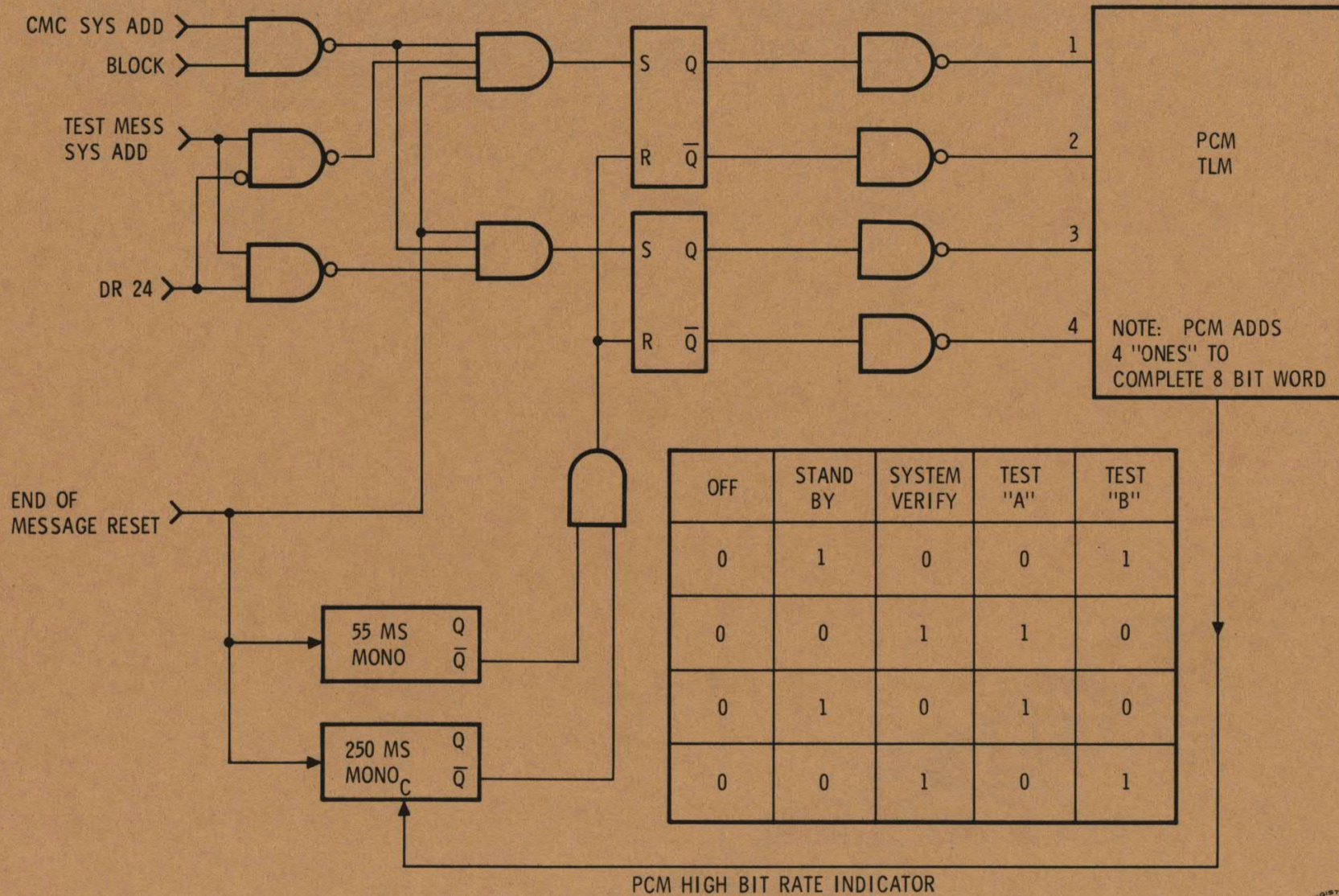
1. SYSTEM ADDRESS (S.A.) GENERATES 24 PULSES (ONLY ONE PULSE REQUIRED) TO RESET CTE, PULSE WIDTH IS 50 MICROSECONDS AND PULSE RATE IS 200 HZ
2. CTE COUNTUP PULSES ARE GENERATED TO SECONDS LINE FIRST, MINUTES LINE NEXT, HOURS LINE NEXT, AND DAYS LINE LAST AT 10 KHZ RATE
3. NUMBER OF COUNTUP PULSES IS THE DECIMAL EQUIVALENT OF A SIX-BIT BINARY NUMBER
4. MAXIMUM TIME INPUT IS 19 DAYS, 23 HOURS, 59 MINUTES AND 59 SECONDS
5. TOTAL TIME FROM MESSAGE ENTRY TO VERIFICATION IS 169 MILLISECONDS MAXIMUM

UDL TEST MESSAGE FORMATS



1. TEST MESSAGES A & B EXERCISE ALL PROCESS, TRANSFER AND PROGRAM CONTROL LOGIC AND IF NO ERRORS OCCUR, MAIN REGISTER POSITION 24 WILL CONTAIN THE CORRECT BIT INFORMATION FOR A TEST A OR TEST B VERIFICATION SIGNAL
2. TOTAL TIME FROM MESSAGE ENTRY TO VERIFICATION IS 172 MILLISECONDS MAXIMUM

UDL VERIFICATION LOGIC



USBE FM

3-SC1
SCO'S

→ TO DSE

→ TO DSE

→ TO USBE FM

ISC

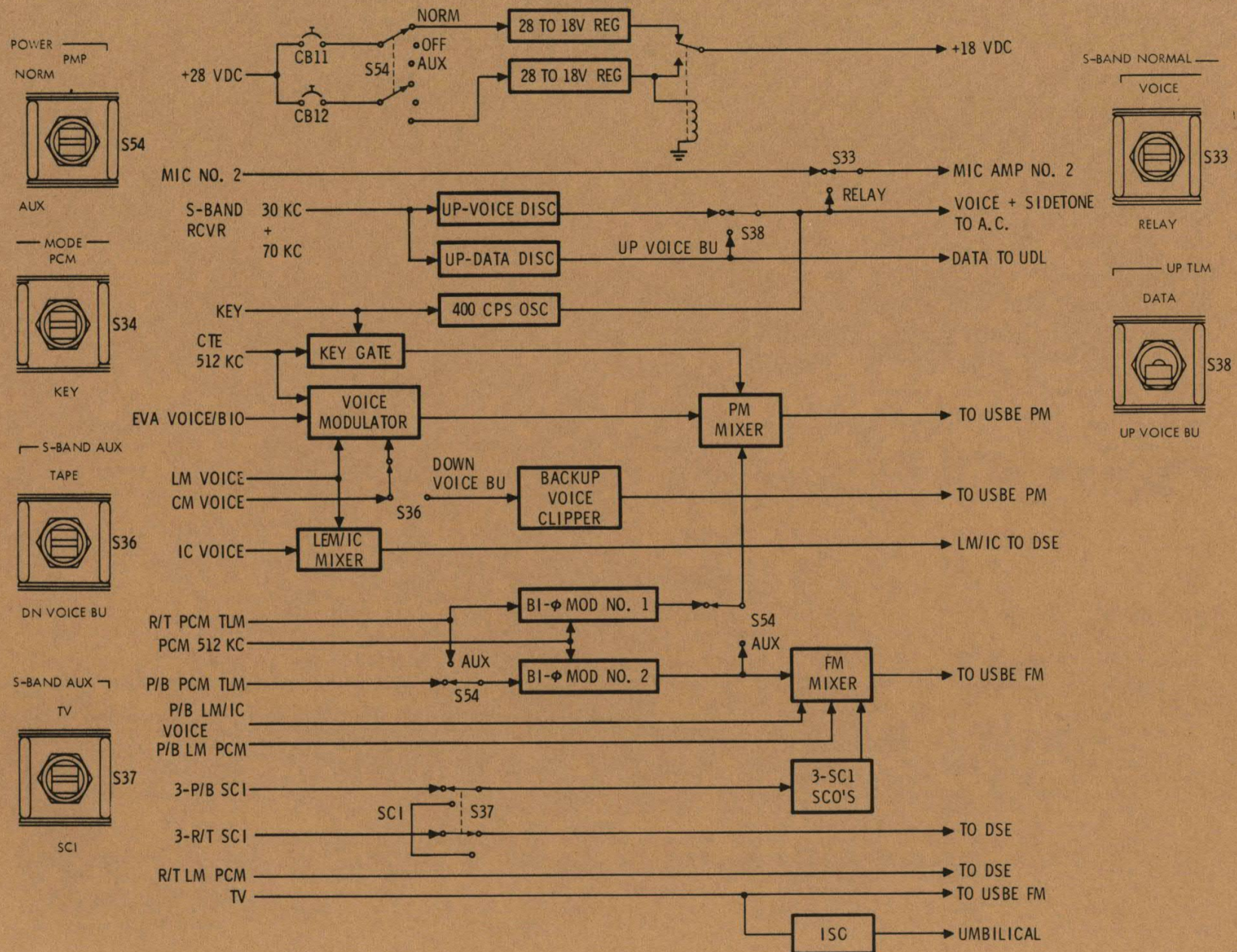
→ UMBILICAL

CD-2027F



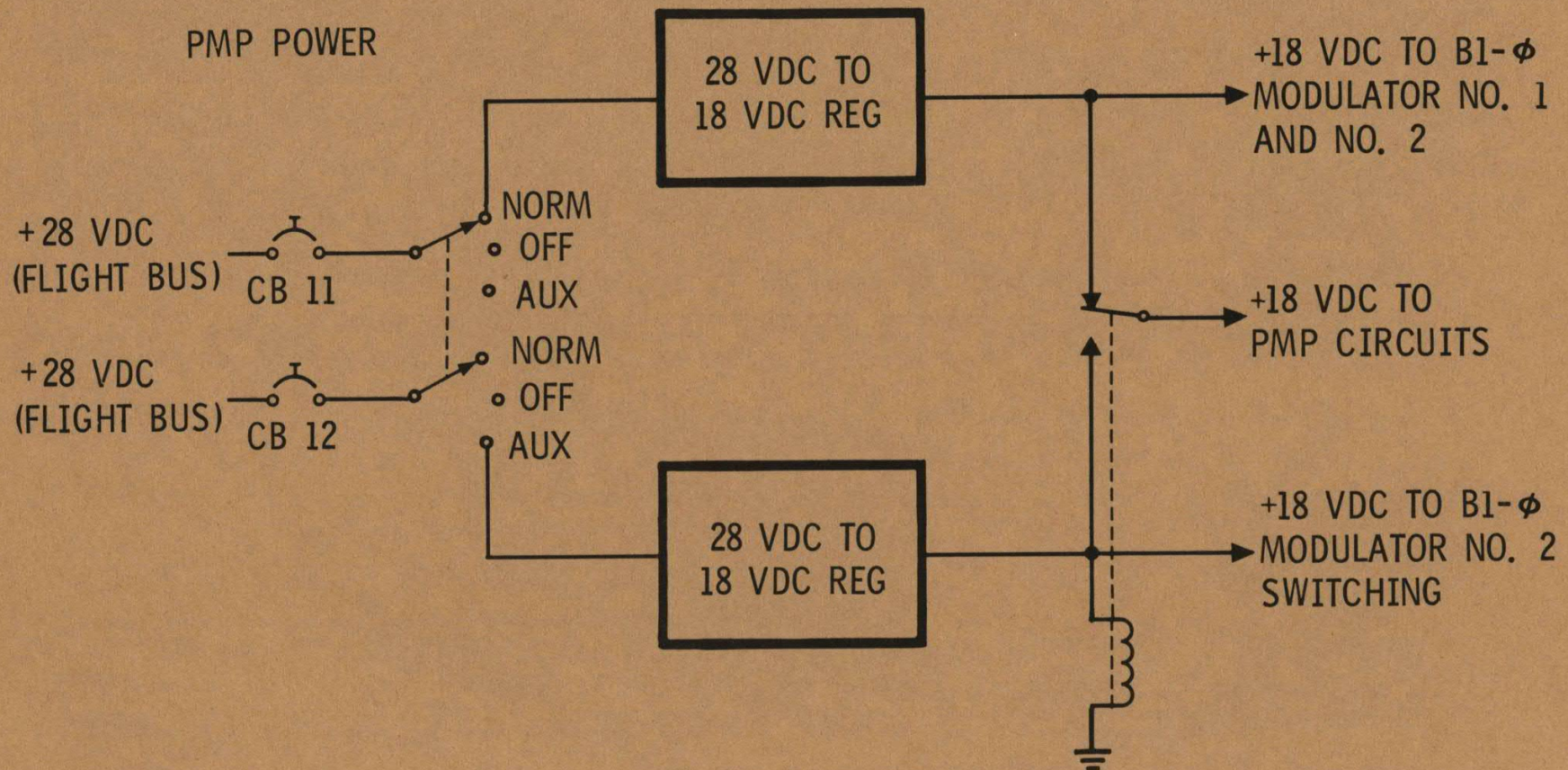
PMP BLOCK DIAGRAM

BLOCK II



PMP POWER SUPPLY

BLOCK II

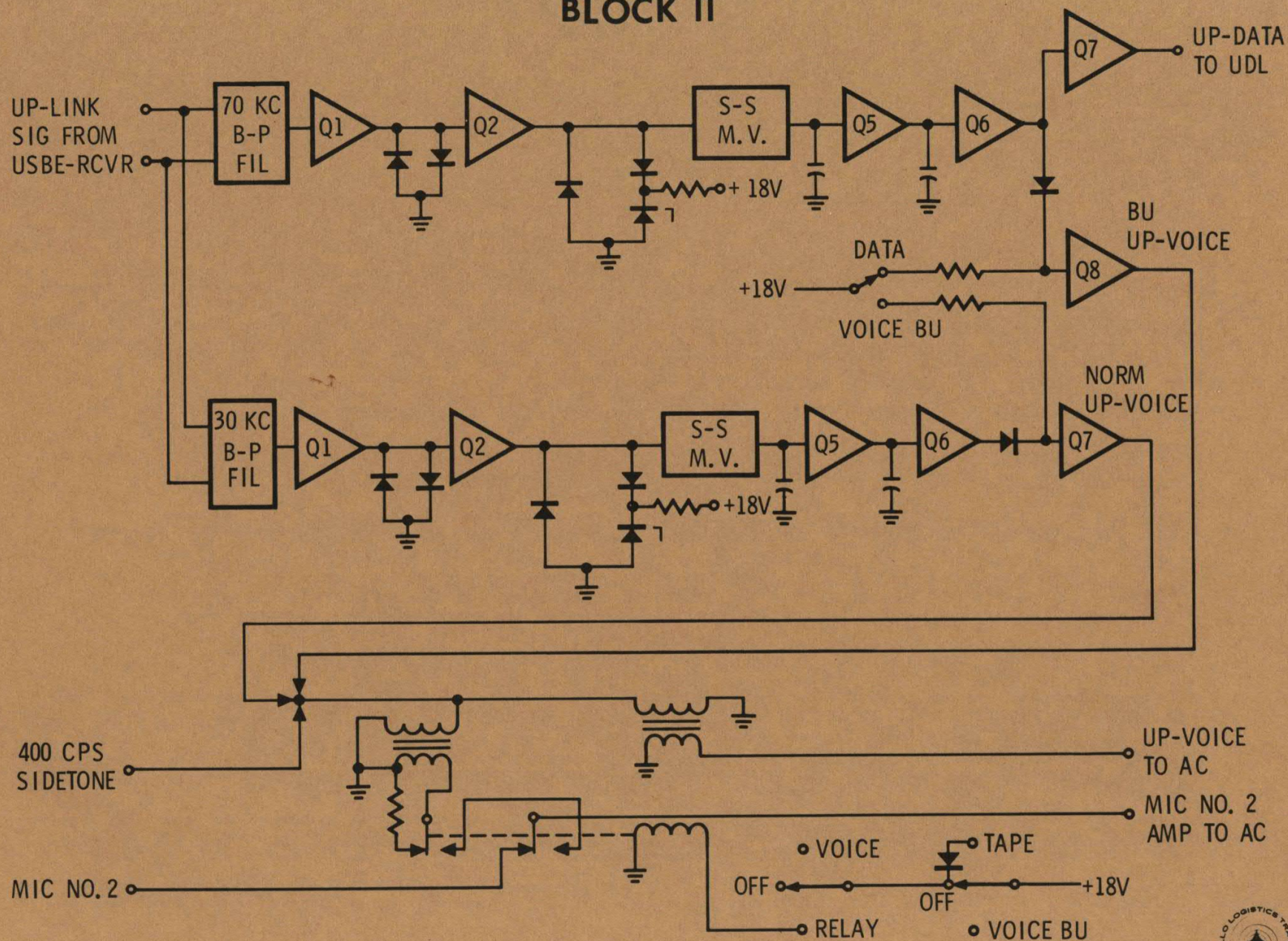


CD-2028B



PMP UP-LINK DETECTORS

BLOCK II



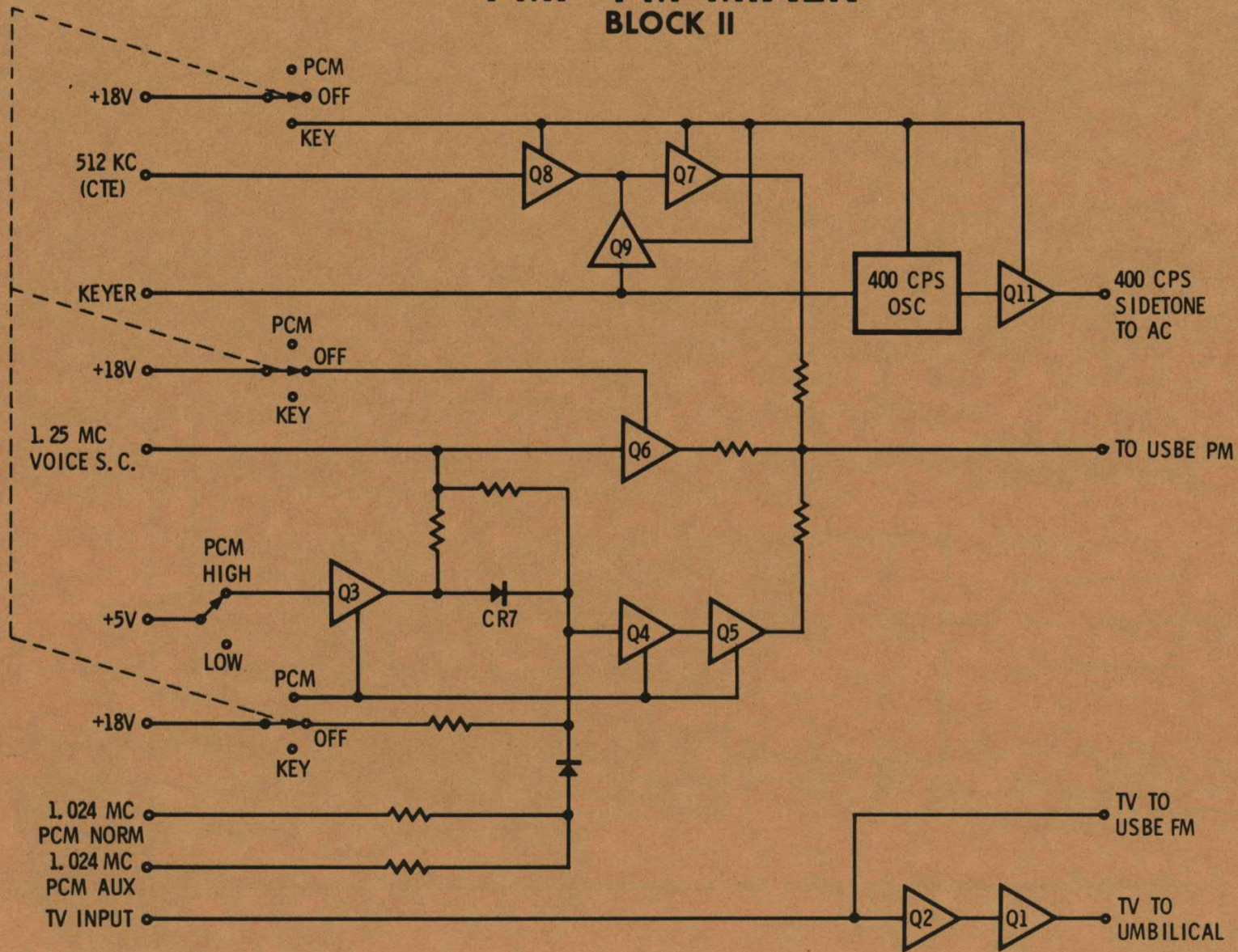
CD-2030A



BLOCK II



PMP PM MIXER BLOCK II

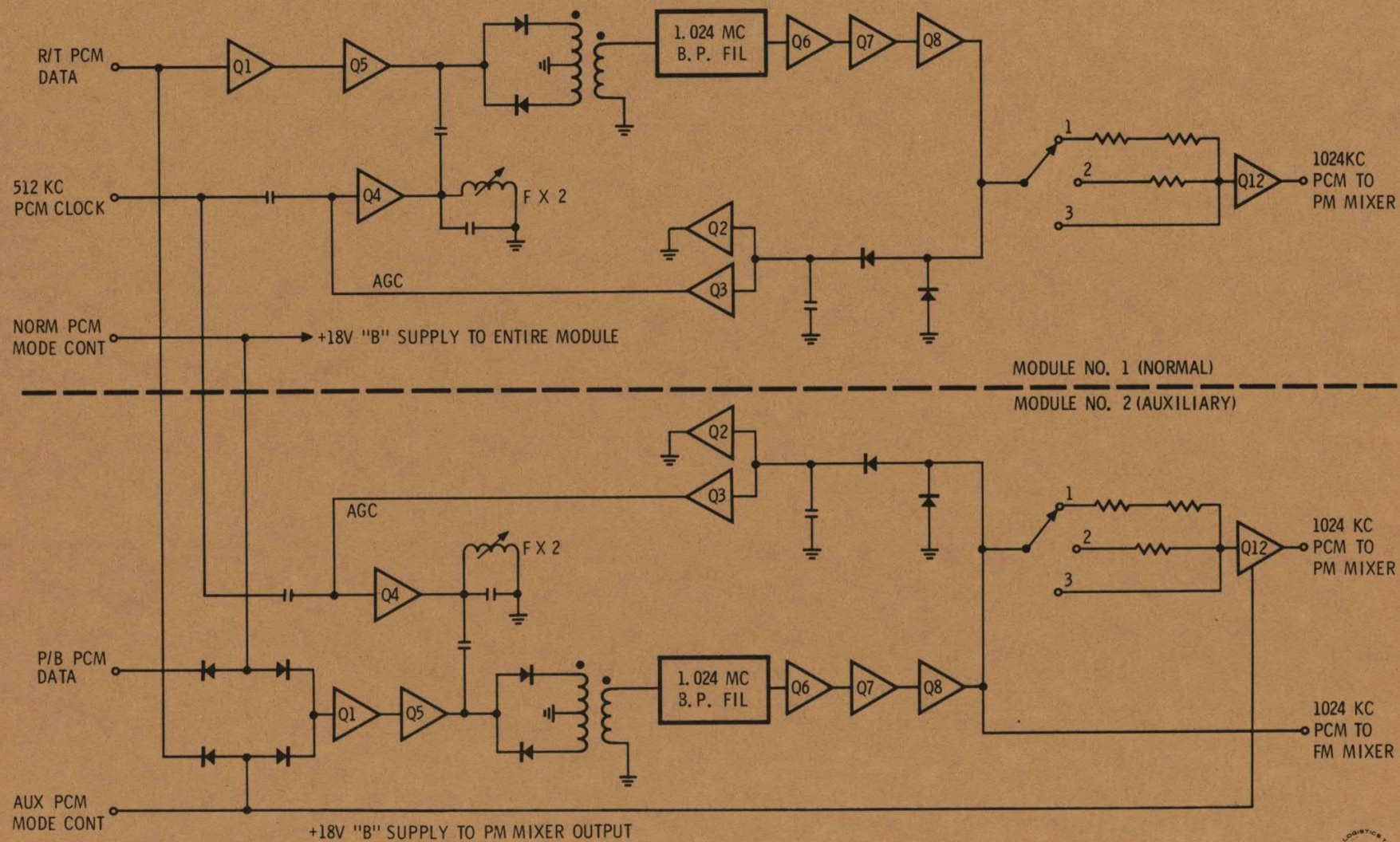


CD-2033A



PMP BI-PHASE MODULATORS

BLOCK II

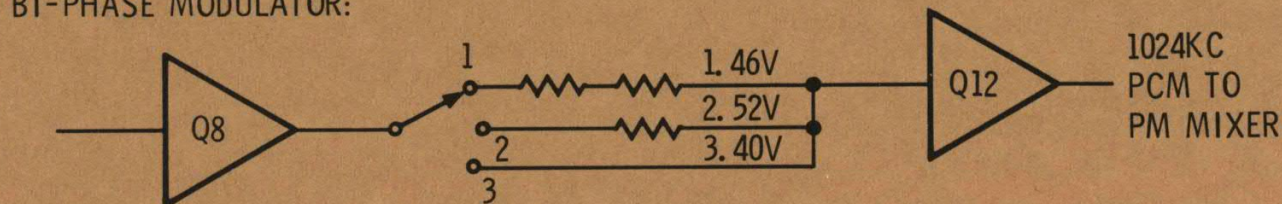


CD-2031

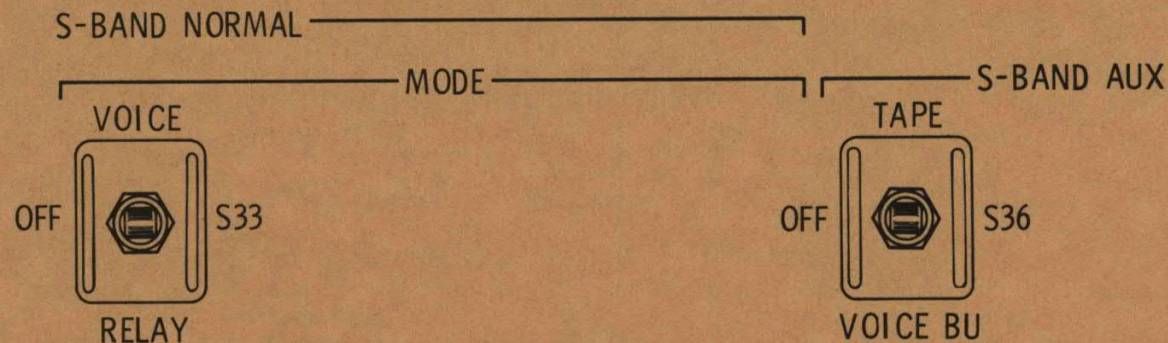


DATA MODULATION LEVELS

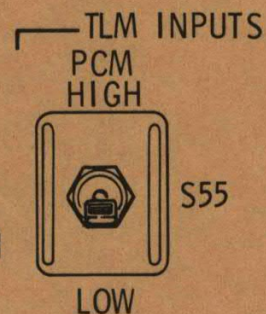
BI-PHASE MODULATOR:



PANEL 3:



1. (LOW BIT RATE W/CM VOICE)
S33 = VOICE, S36 = OFF/TAPE, S55 = LOW
2. (LOW BIT RATE W/BU VOICE, OR HIGH BIT RATE W/CM OR RELAY VOICE)
S33 = X, S36 = VOICE BU, S55 = LOW, OR
S33 = VOICE/RELAY, S36 = OFF/TAPE, S55 = HIGH
3. (NO VOICE CALLED FOR)
S33 = OFF, S36 = OFF/TAPE, S55 = X

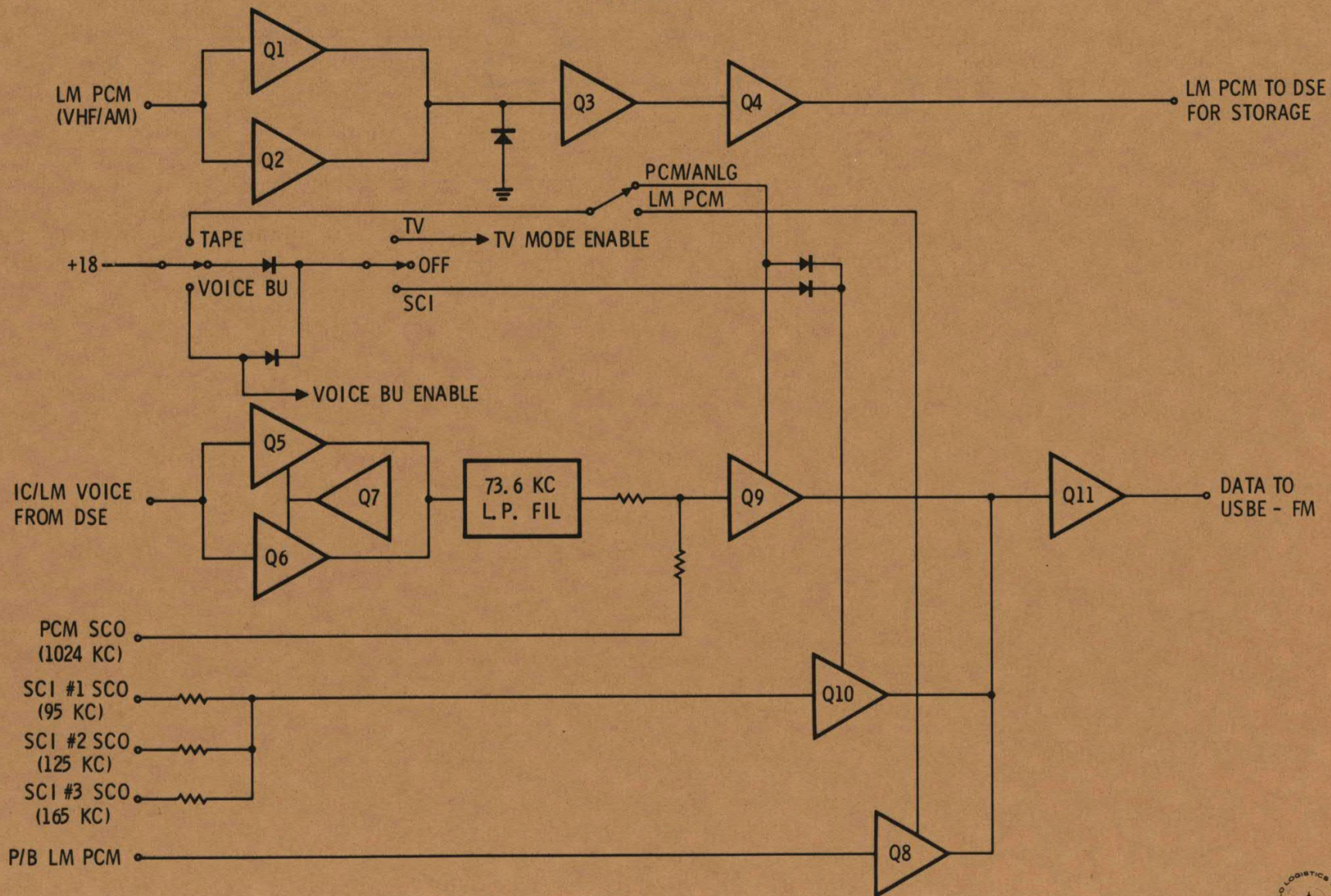


CD-2054C



PMP FM MIXER

BLOCK II

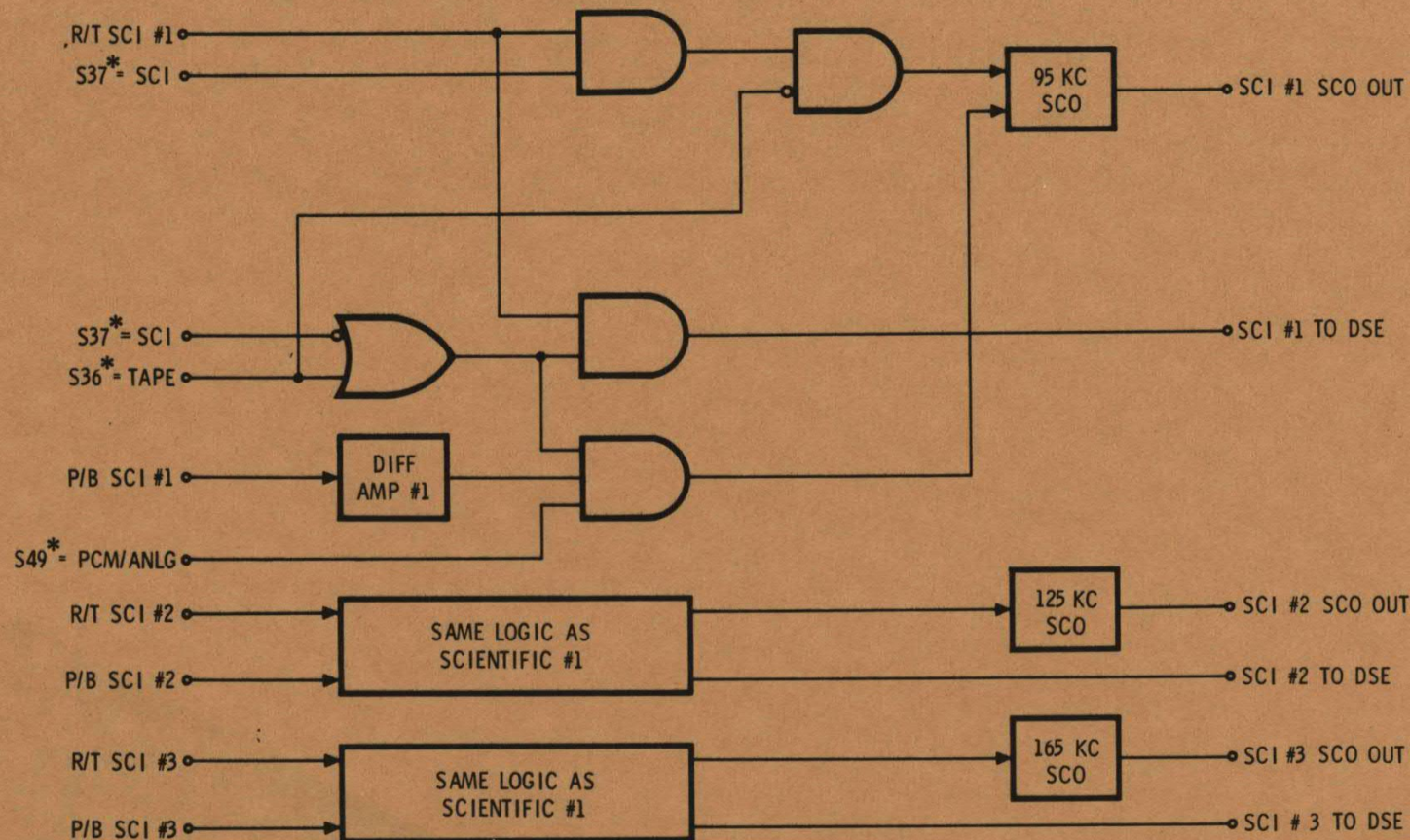


CD-2035B

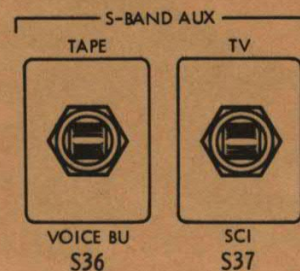


PMP SCIENTIFIC SCO'S

BLOCK II

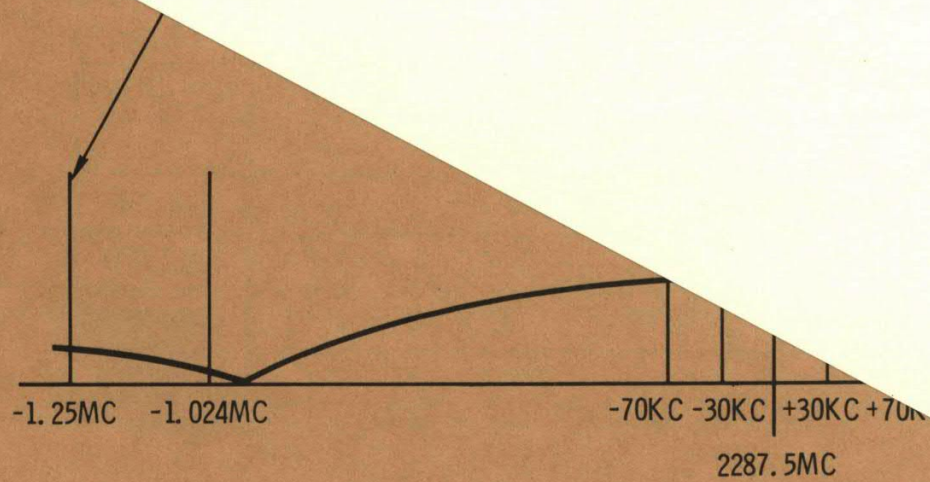


*SWITCHES:
(MDC #3)



CD-2036B





RRT

BCN

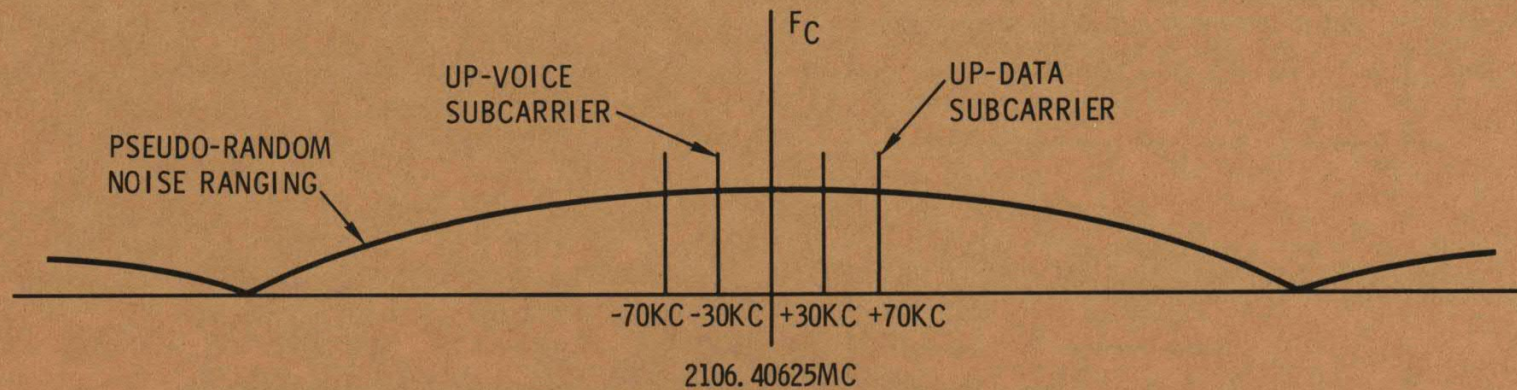
VHF/AM

S-BAND PA

S-BAND XPONDER

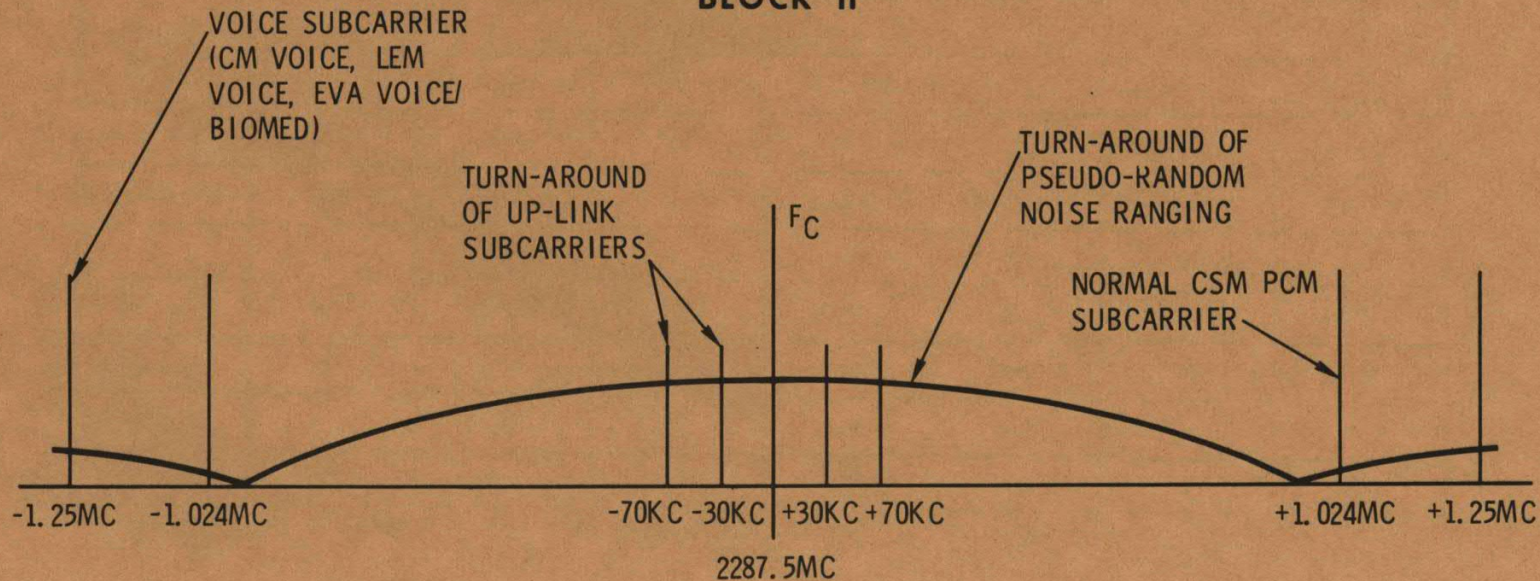
S-BAND UP-LINK SPECTRUM

BLOCK II



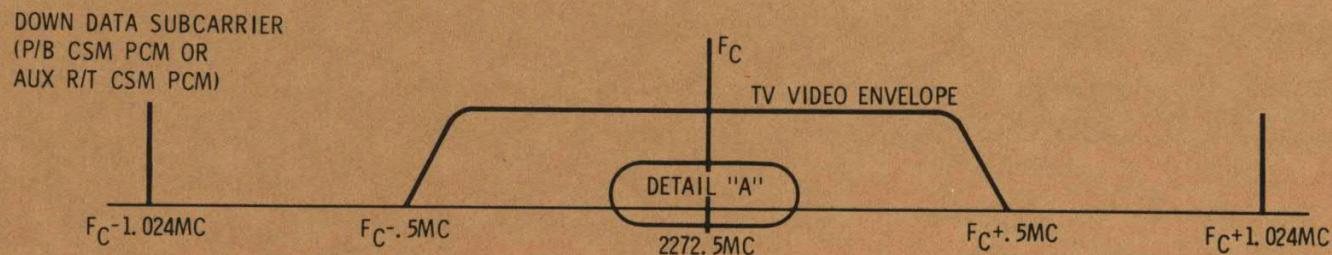
S-BAND PM DOWN-LINK SPECTRUM

BLOCK II

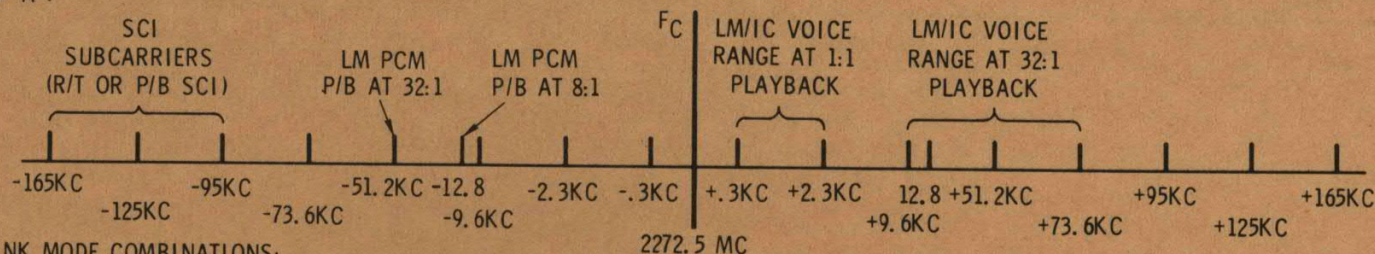


S-BAND FM DOWN-LINK SPECTRUM

BLOCK II



DETAIL "A":



DOWNLINK MODE COMBINATIONS:

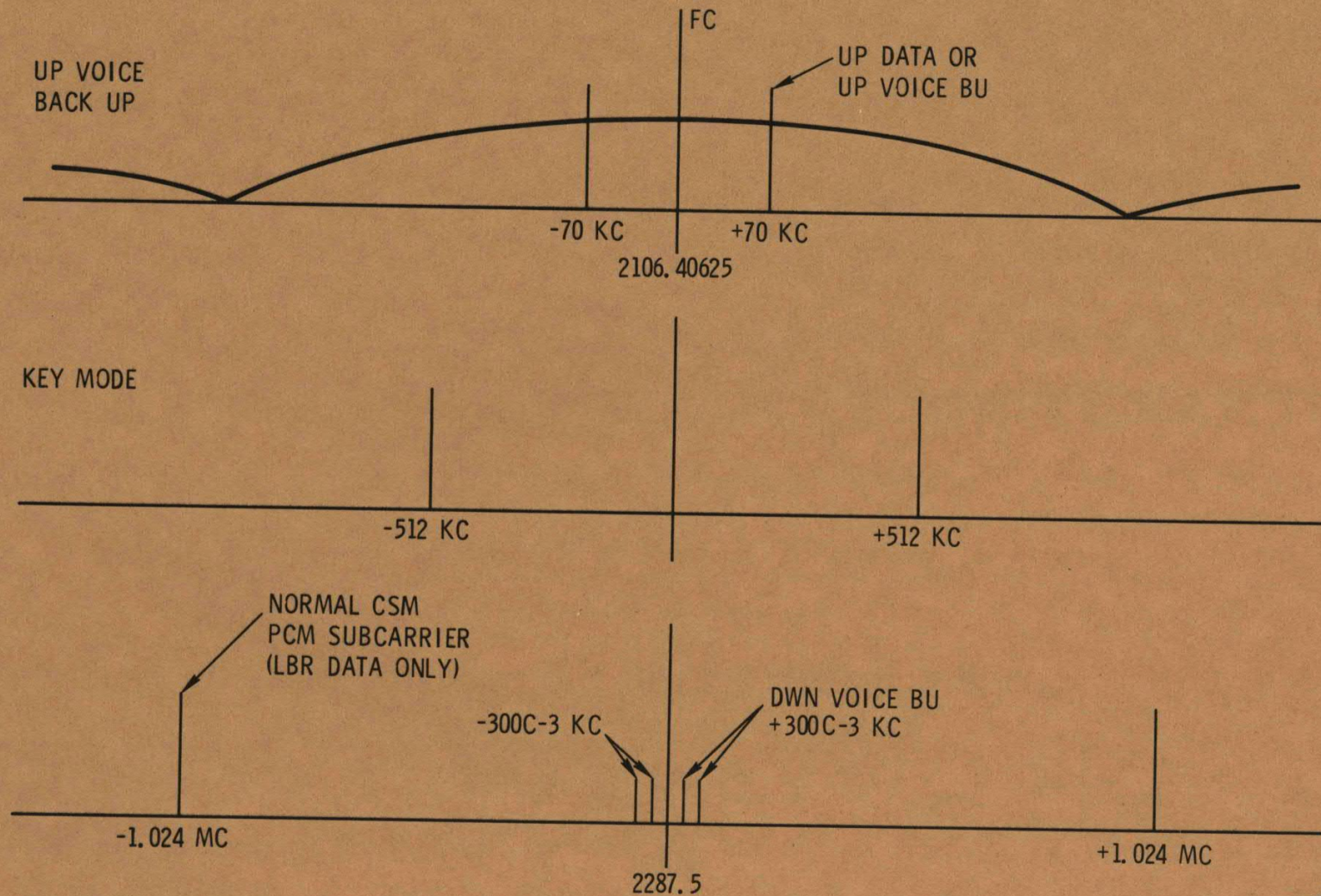
IF WE HAVE:	DO WE HAVE?						
	P/B CSM PCM	R/T CSM PCM	TV	R/T SCI	P/B SCI	LEM PCM	LEM/IC VOICE
P/B CSM PCM	NO	NO	NO	NO	YES	NO	YES
R/T CSM PCM*	NO	NO	NO	MAYBE**	MAYBE**	NO	MAYBE**
TV	NO	NO	NO	NO	NO	NO	NO
R/T SCI	NO	YES*	NO	NO	NO	NO	NO
P/B SCI	YES	YES*	NO	NO	NO	NO	YES
LEM PCM	NO	NO	NO	NO	NO	NO	NO
LEM/IC VOICE	YES	YES*	NO	NO	YES	NO	NO

*AUXILIARY MODE (S54 = AUX)

**DEPENDS UPON SETTINGS OF S36, S37, AND S49.

S-BAND BACK-UP SPECTRUM

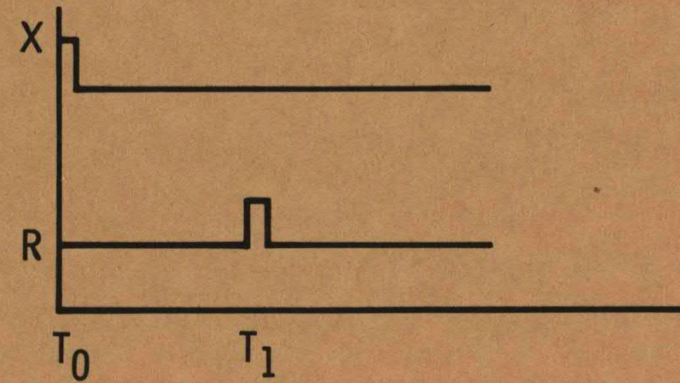
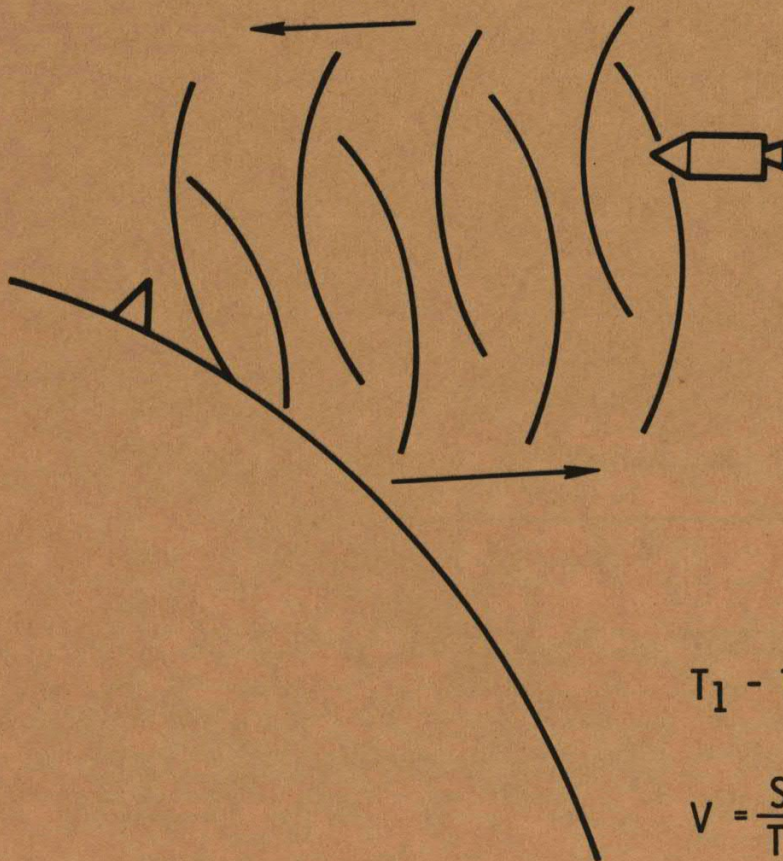
BLOCK II



CD-2098B



PSEUDO RANDOM NOISE RANGING

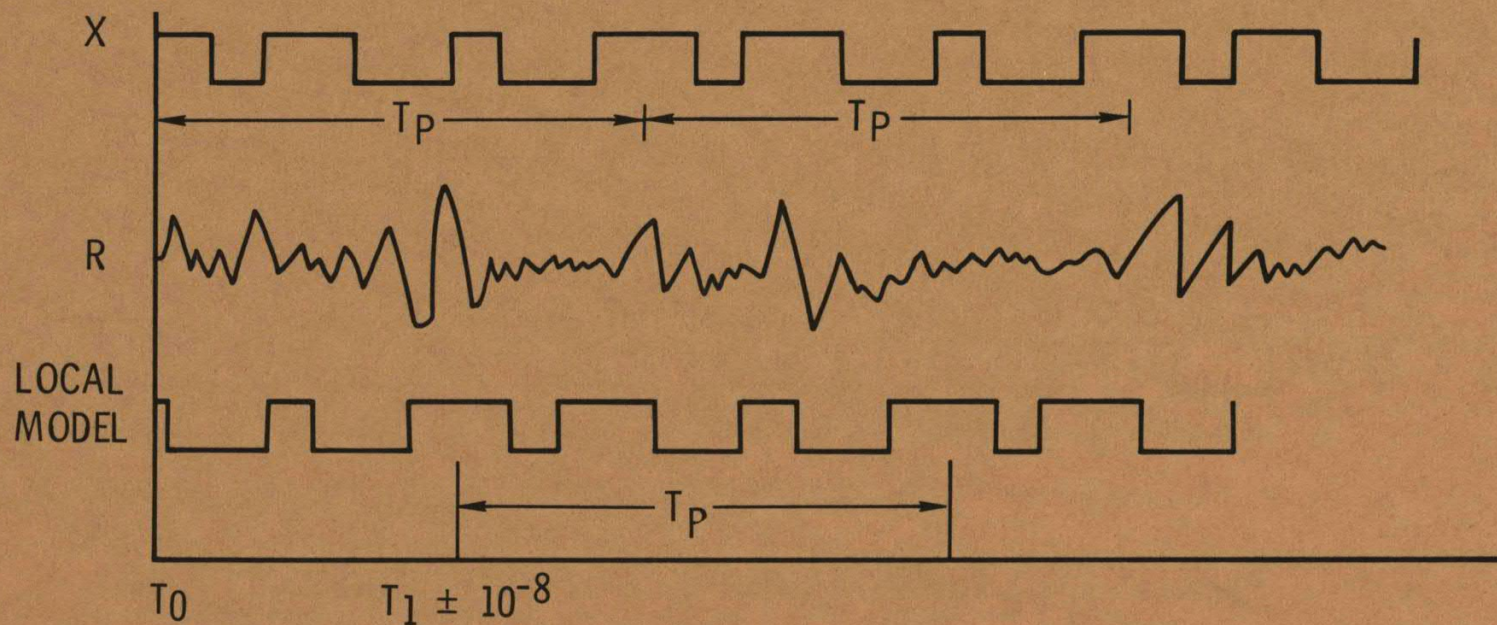


$$T_1 - T_0 = T_{TOT} = 2 T_{PROP} + T_{EQUIP}$$

$$V = \frac{S}{T} = C, S = CT, S = \frac{C}{2} T_{PROP} = \frac{C}{2} [T_{TOT} - T_{EQUIP}]$$

$$S, \frac{ds}{dt} = V, \frac{ds^2}{dt^2} = \frac{dv}{dt} = A$$

P.R.N. CODE USE



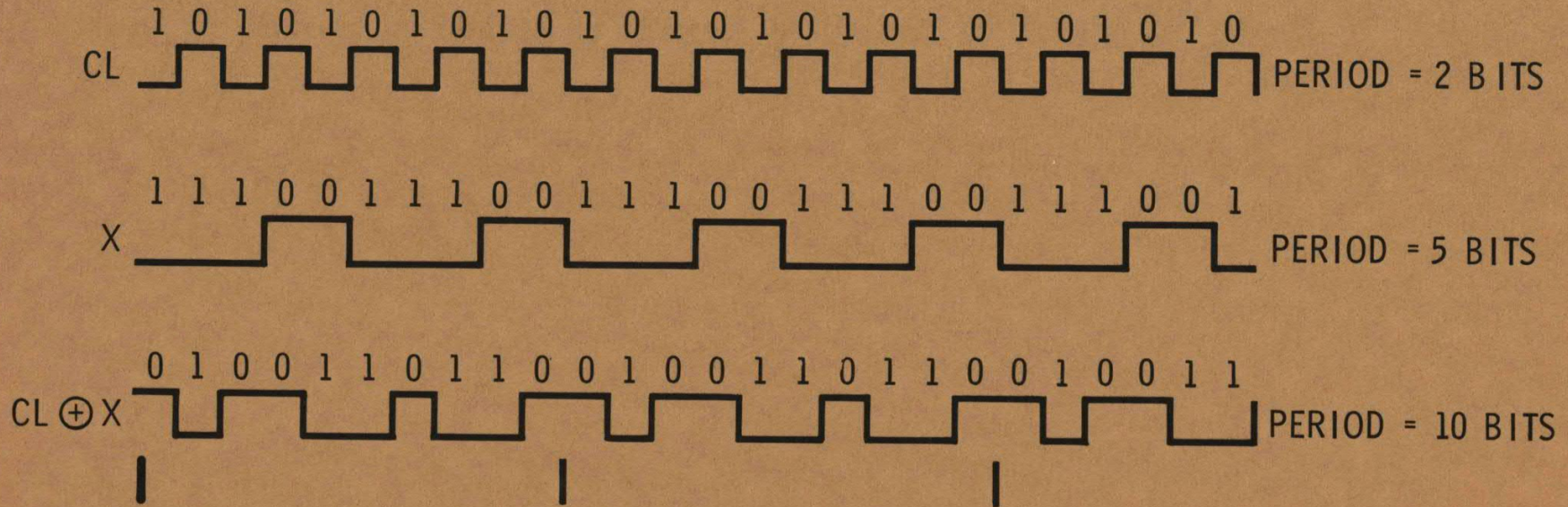
$$T_1 - T_0 = T_{TOT} < T_p, \text{ BASIC BIT TIME } \cong 1.042 \mu\text{SEC}$$

CL $\oplus$ X $\oplus$ A $\oplus$ B $\oplus$ C

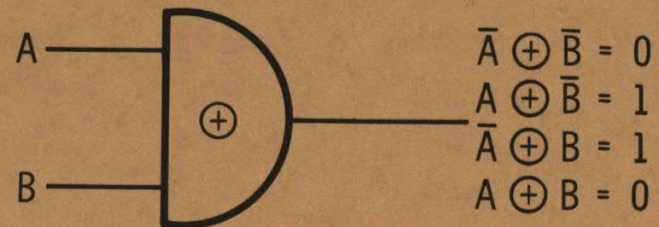
$$\begin{array}{l} 2 \times 11 \times 31 \times 7 \times 15 = 71,610 \text{ BITS } \cong .075 \text{ SEC } \equiv 6.8\text{K MILE} \\ 2 \times 11 \times 31 \times 63 \times 127 = 5,456,682 \text{ BITS } \cong 5.68 \text{ SEC } \equiv 528\text{K MILE} \end{array}$$



PRN CODE GENERATION



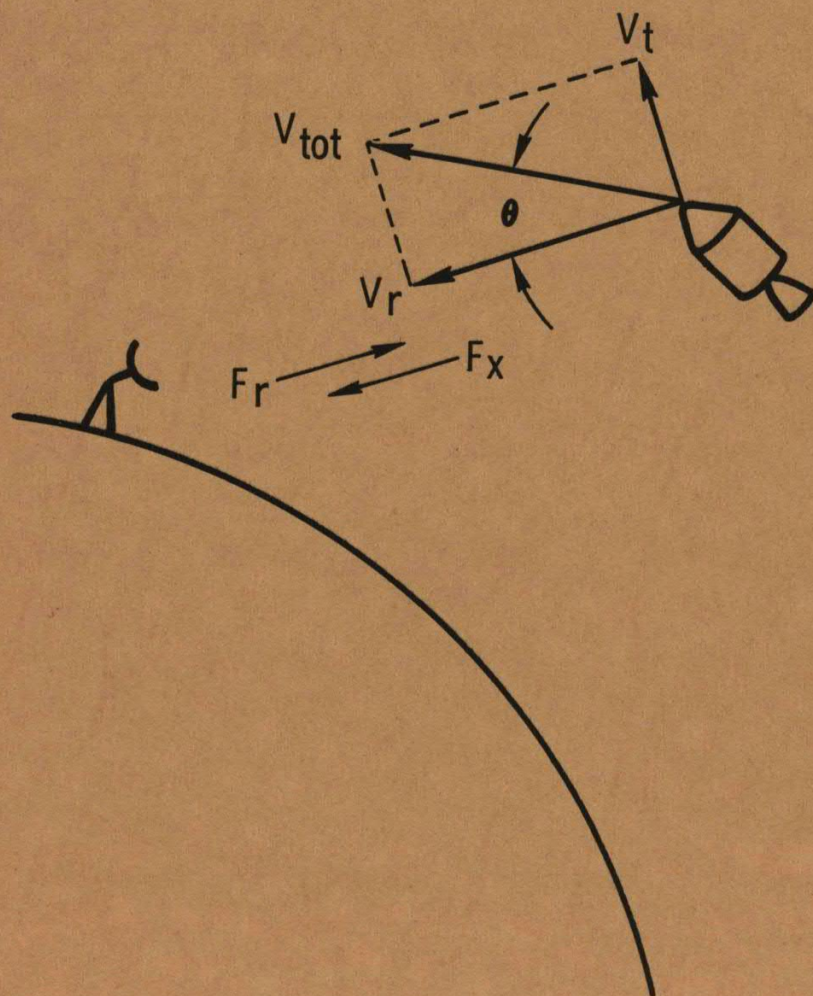
EXCLUSIVE "OR" ($\oplus$) OR "ADD WITHOUT CARRY" (AWC)



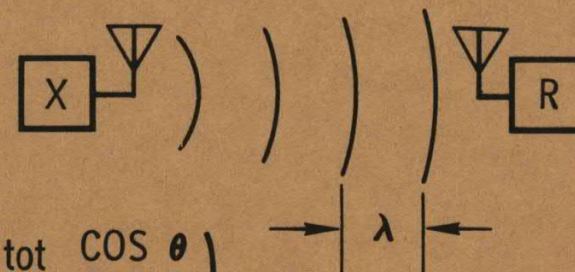
CD-2019



DOUBLE DOPPLER RANGING



$$F = \frac{C}{\lambda}$$



$$F_a = F_0 \left(1 \pm \frac{V_{tot} \cos \theta}{C} \right)$$

$$V_{tot} = \frac{(F_a - F_0) C}{F_0 \cos \theta}$$

$$S_{tot} = \frac{1}{2} \int (V dt) + S_{INITIAL}$$

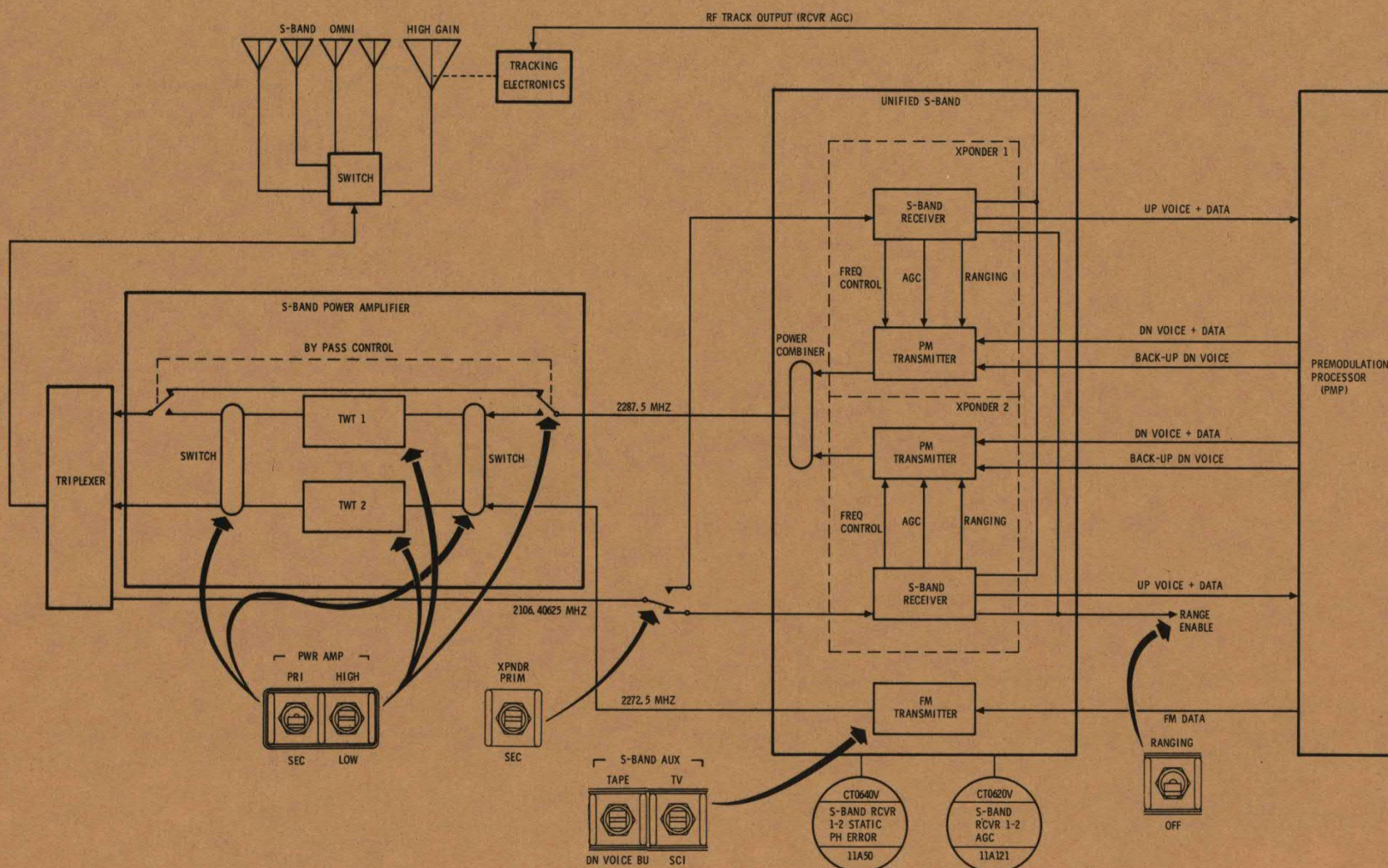
$$A = \frac{dv}{dt}$$

$$\frac{F_r}{F_x} = \frac{2106.40625}{2287.5} = \frac{108 \text{ VCO} + 1^{st} \text{ IF}}{120 \text{ VCO}} =$$

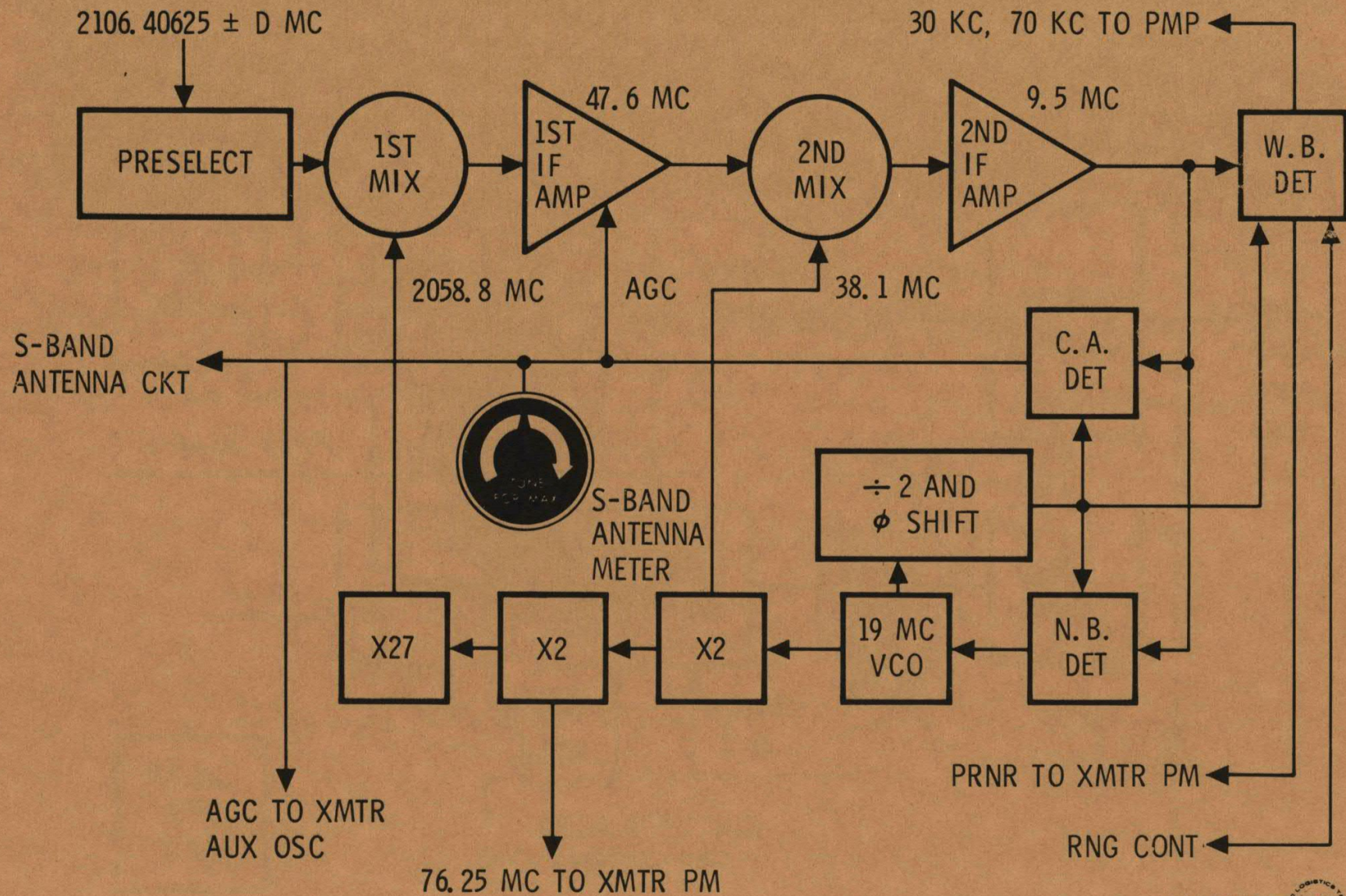
$$\frac{(108 + 2) \text{ VCO} + 2^{nd} \text{ IF}}{120 \text{ VCO}} = \frac{(108 + 2 + 1/2) \text{ VCO}}{120 \text{ VCO}}$$

$$= \frac{110.5}{120} = \underline{\underline{\frac{221}{240}}}$$

S-BAND BLOCK DIAGRAM

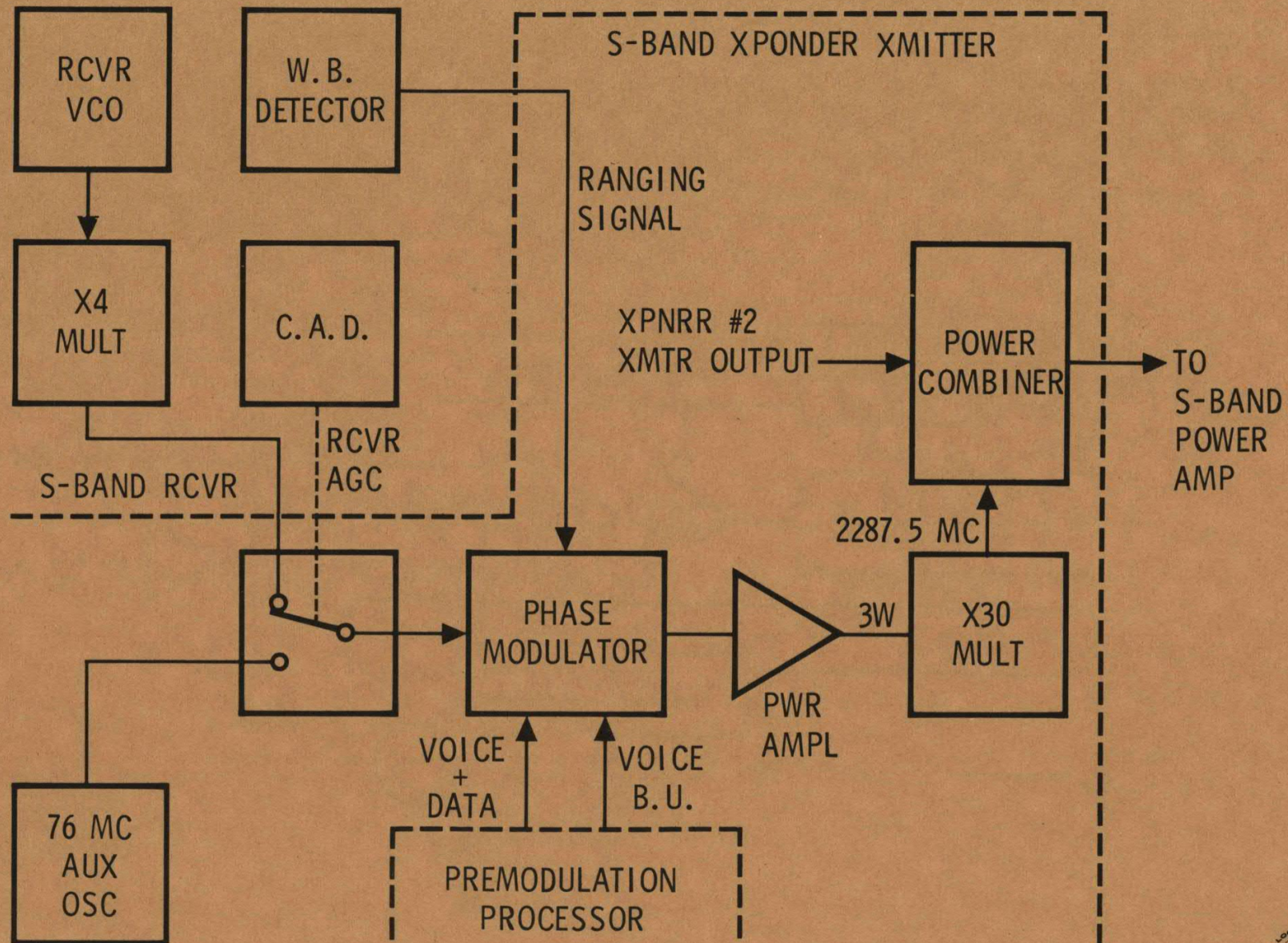


S-BAND RECEIVER



CD-2073A

S-BAND PM TRANSMITTER

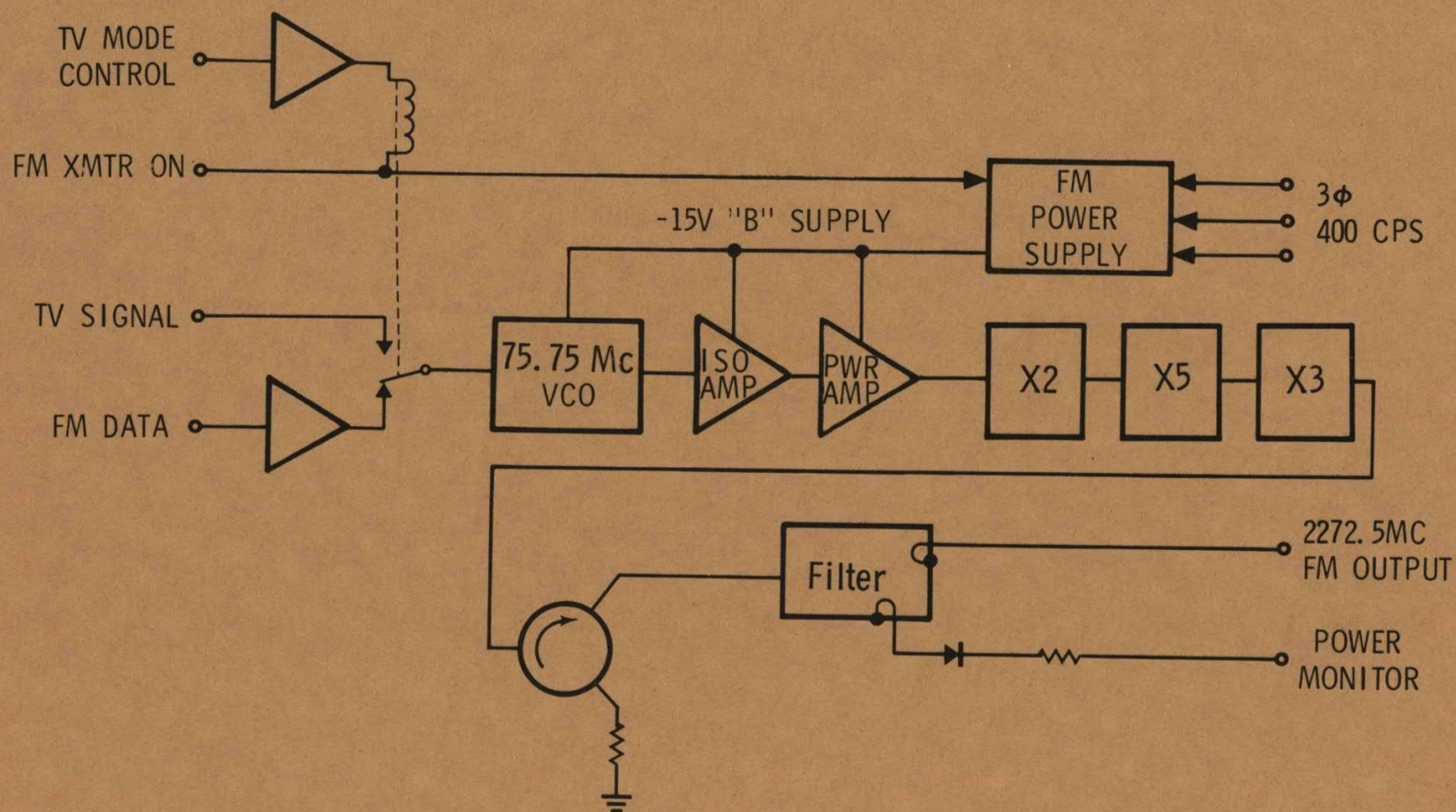


CD-2081B

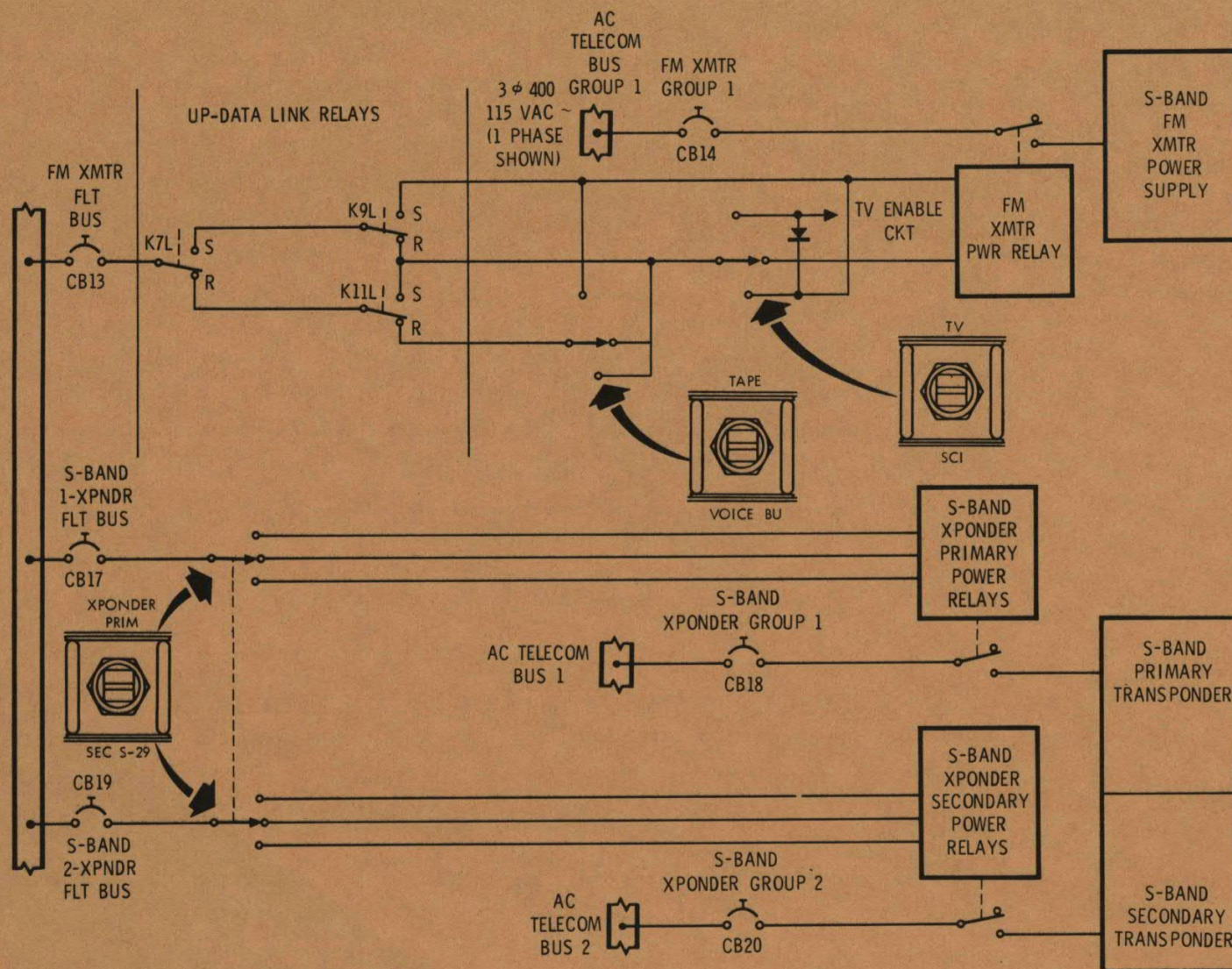


S-BAND FM TRANSMITTER

BLOCK II



CD-2037A



RRT

BCN

VHF/AM

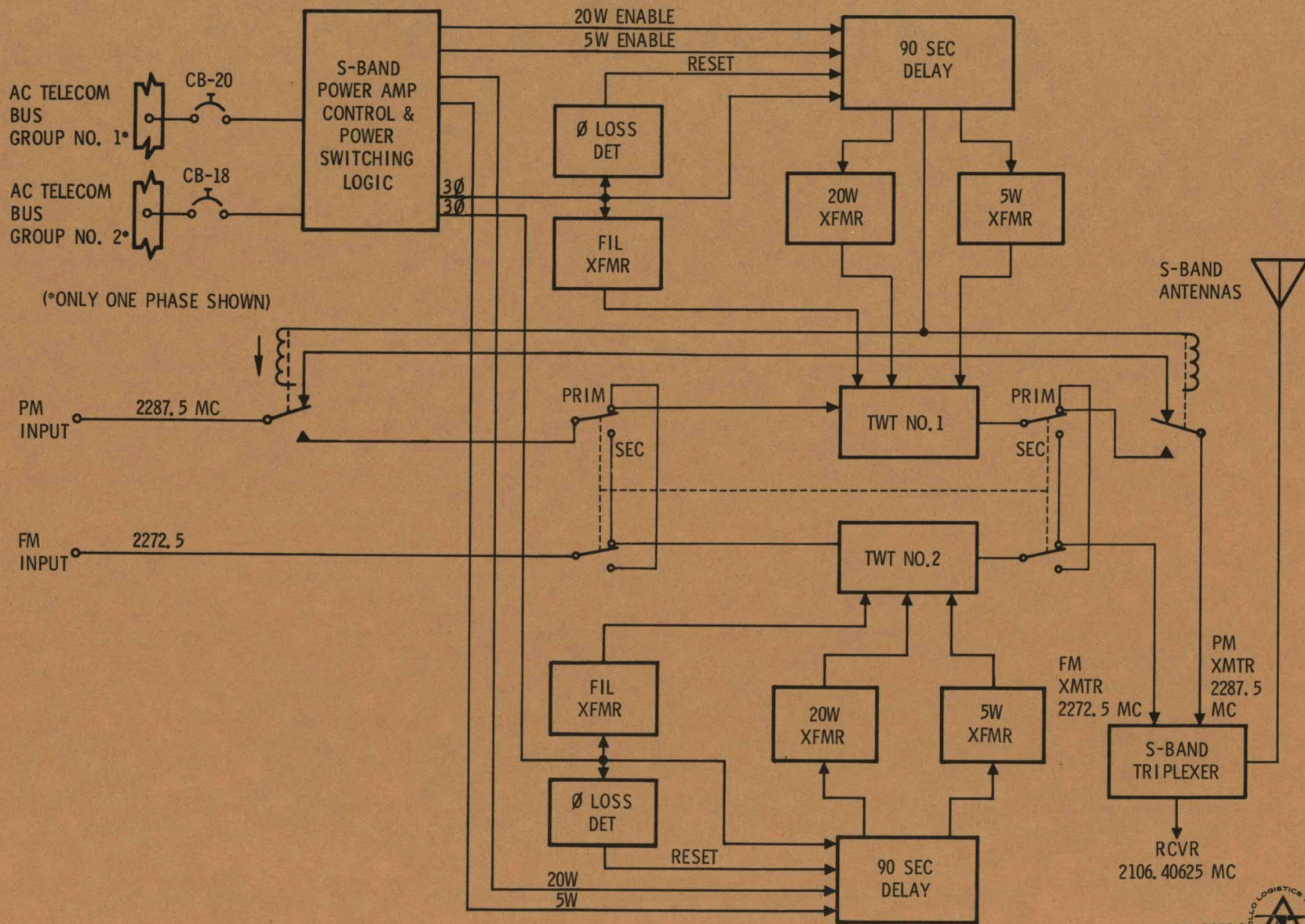
S-BAND PA

PWR DISTR



S-BAND POWER AMPLIFIER

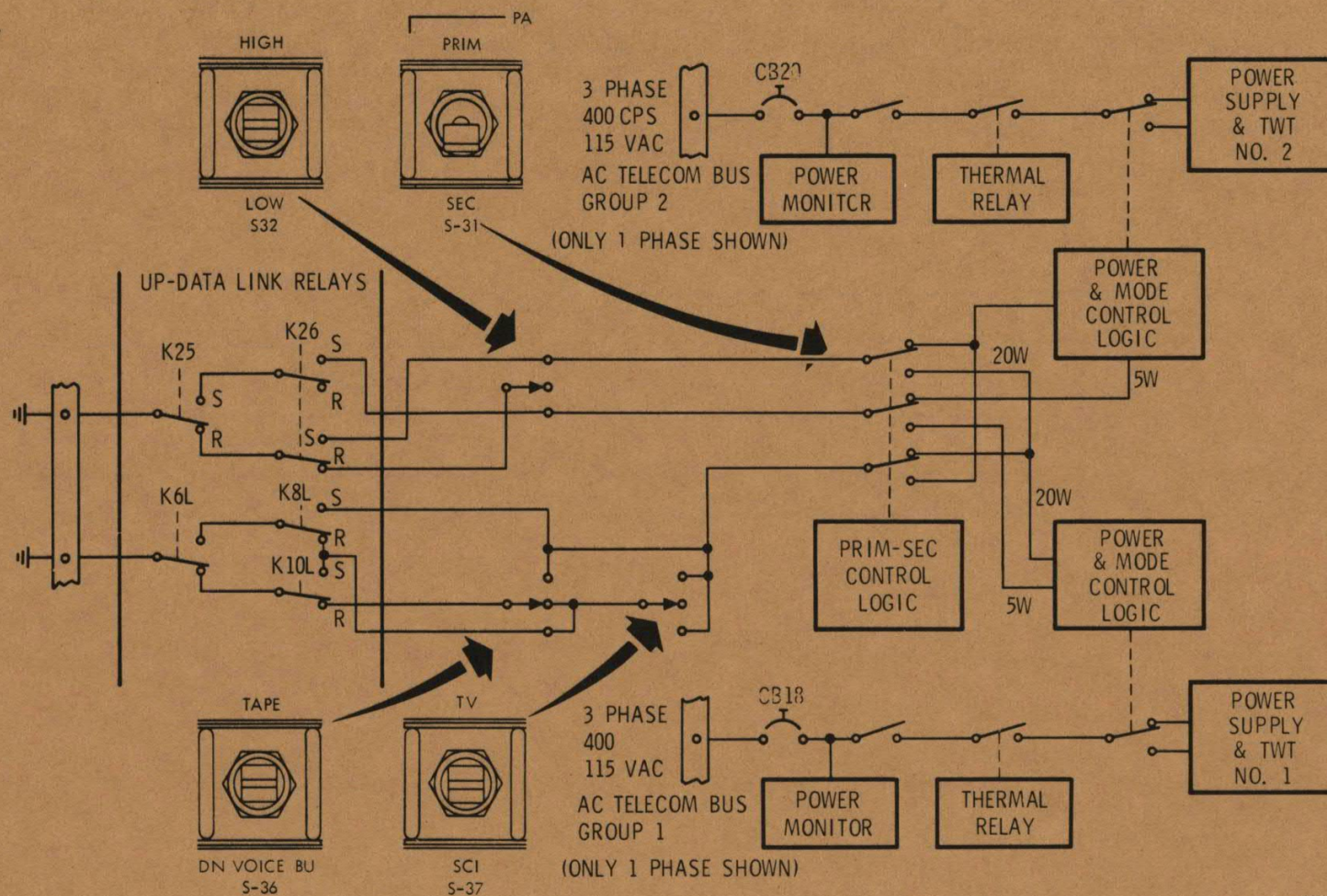
BLOCK II



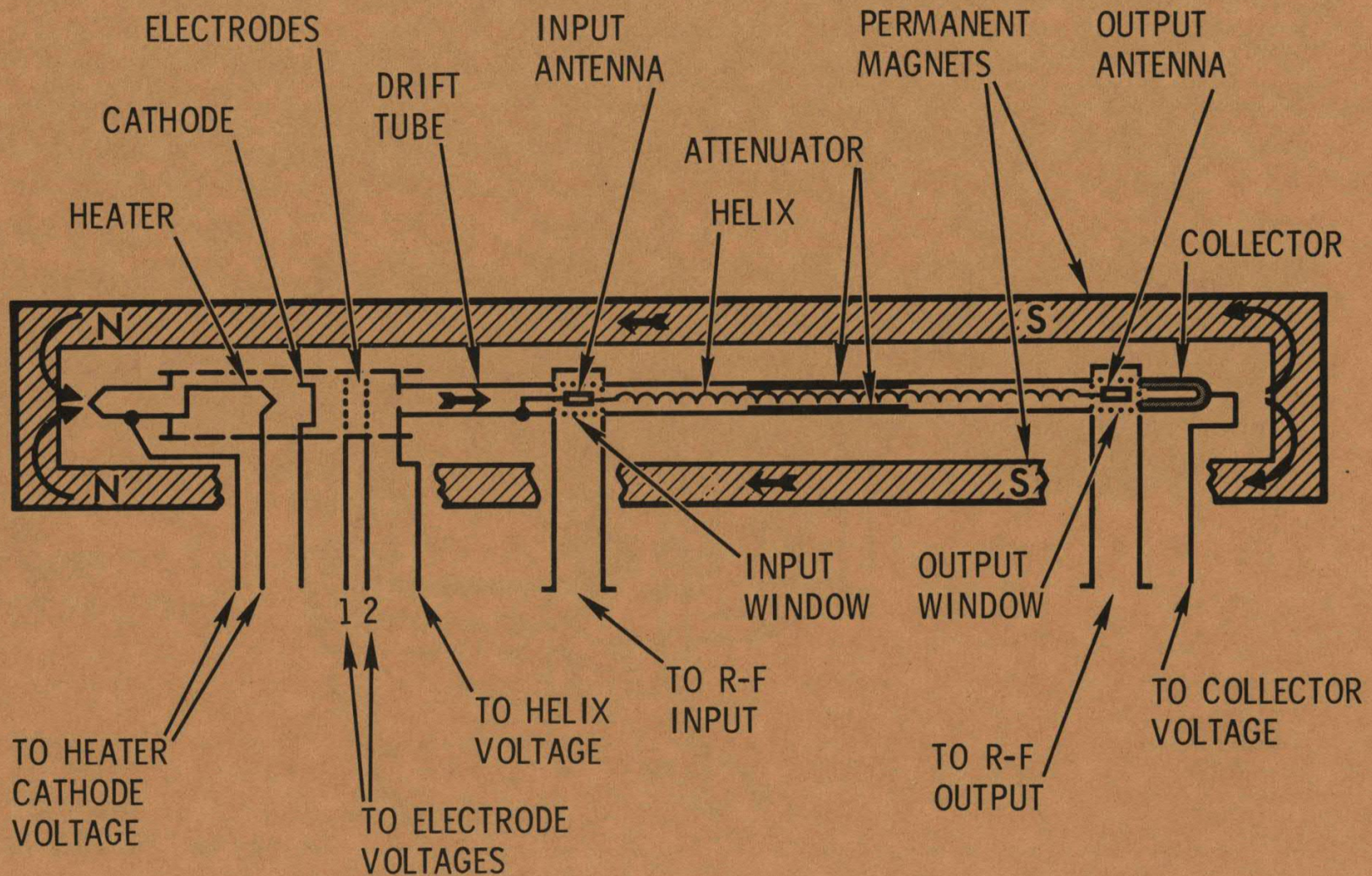
CD-2082C



S-BAND POWER AMPLIFIER CONTROL & POWER SWITCHING



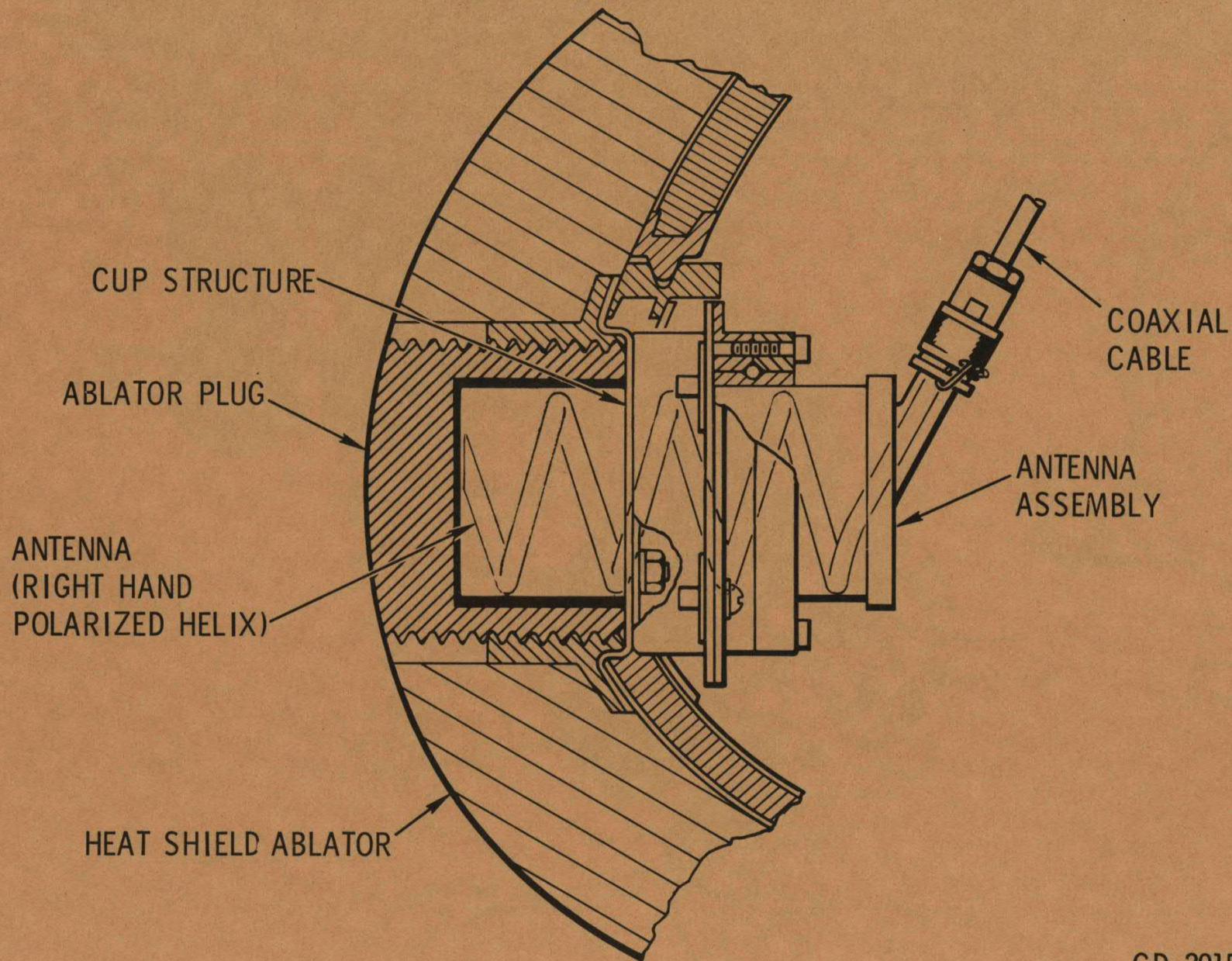
TWT SCHEMATIC



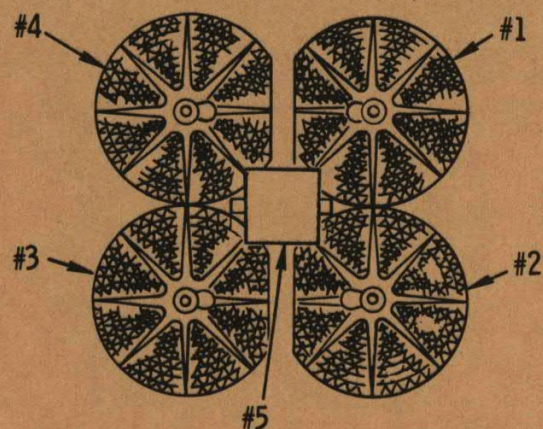
CD-197



S-BAND FLUSH MOUNTED ANTENNA

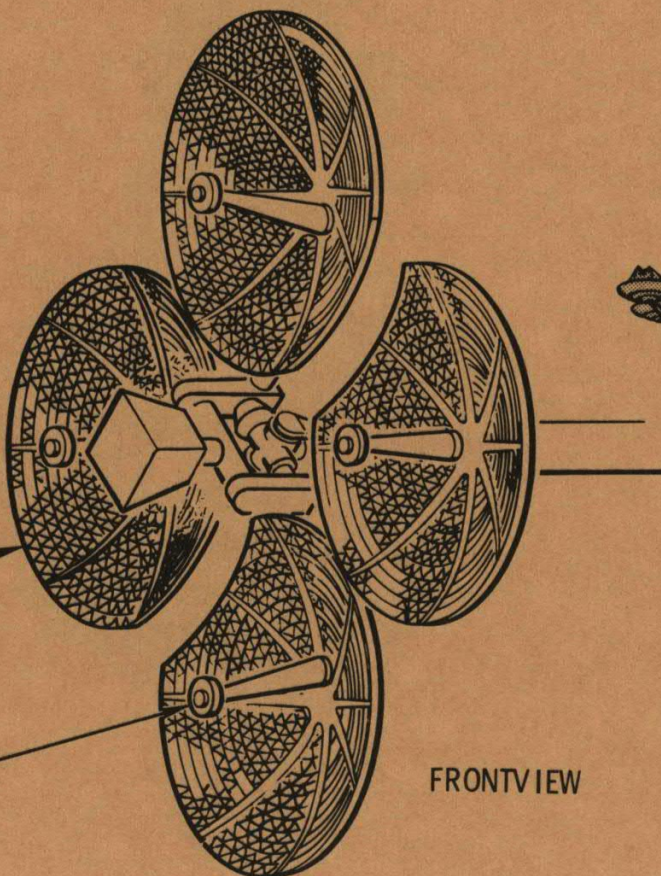


BLOCK II S-BAND HI GAIN ANTENNA

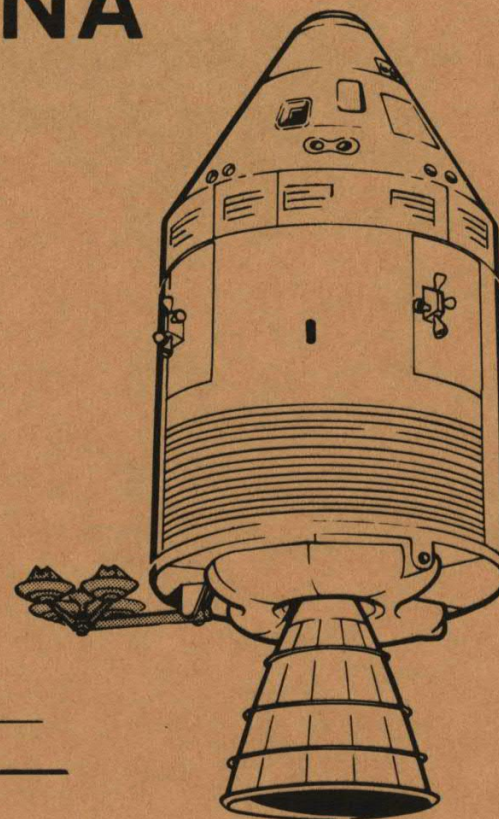


SOLAR RIB
REFLECTORS
≈ 31" DIA

FEEDHORNS
10° OFFSET



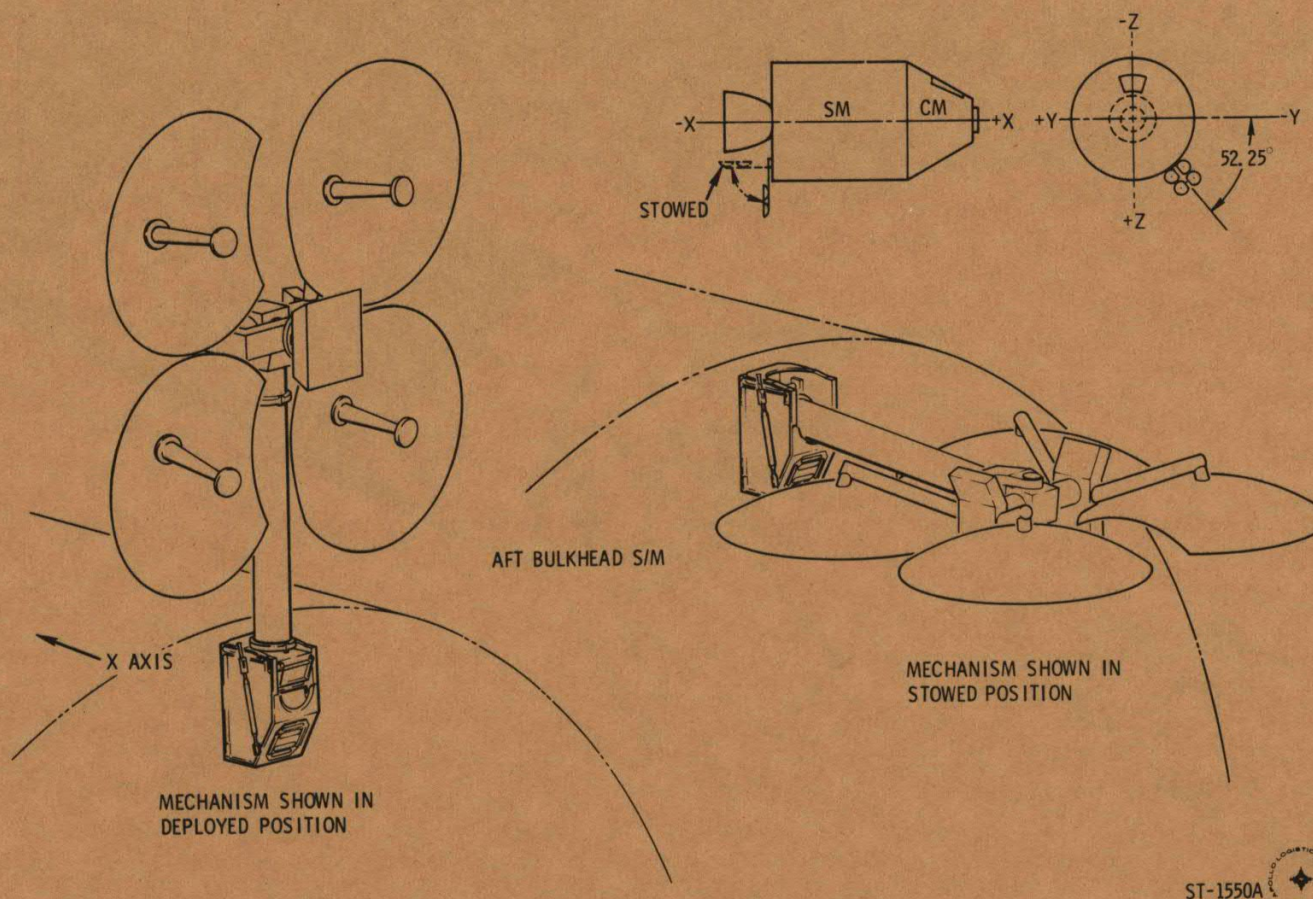
FRONTVIEW



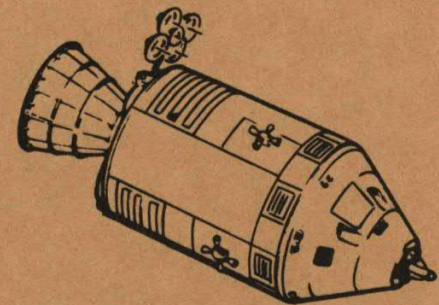
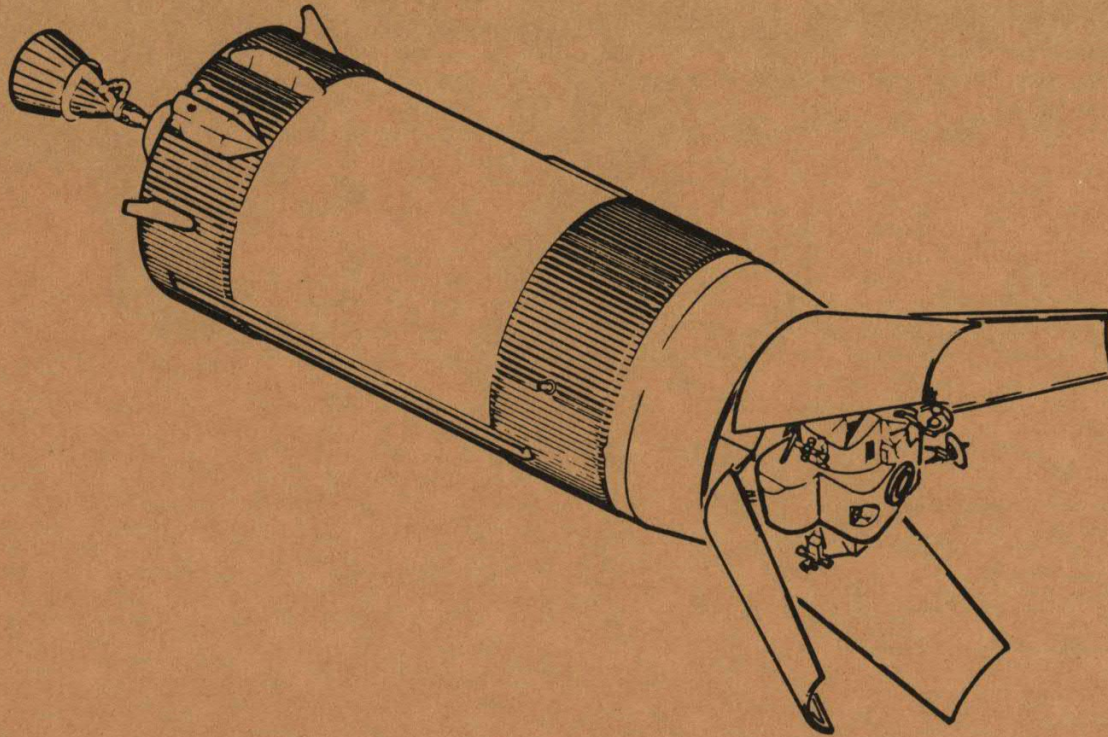
CD-2001C



HIGH GAIN ANTENNA

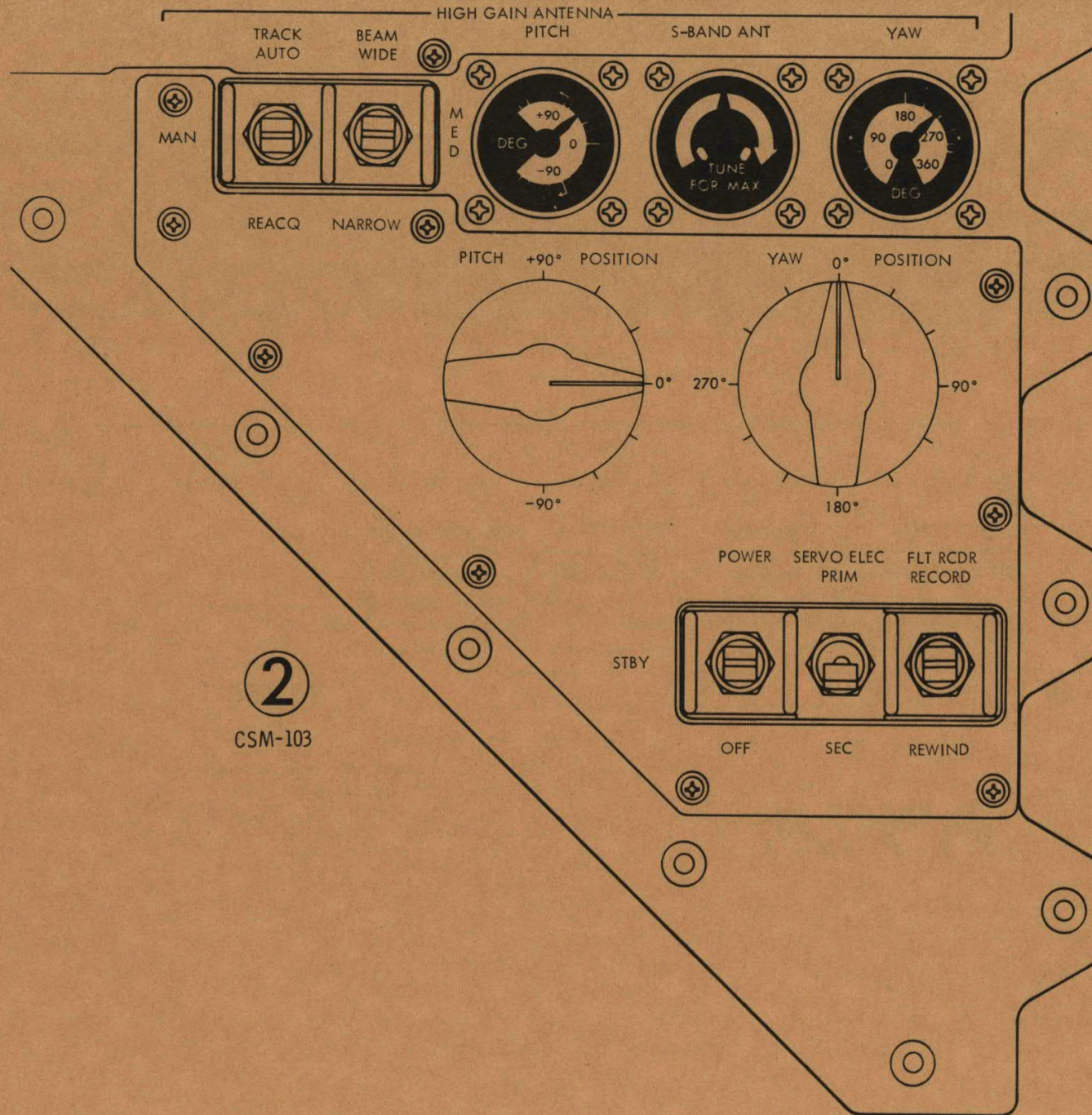


NORMAL CSM/LV SEPARATION



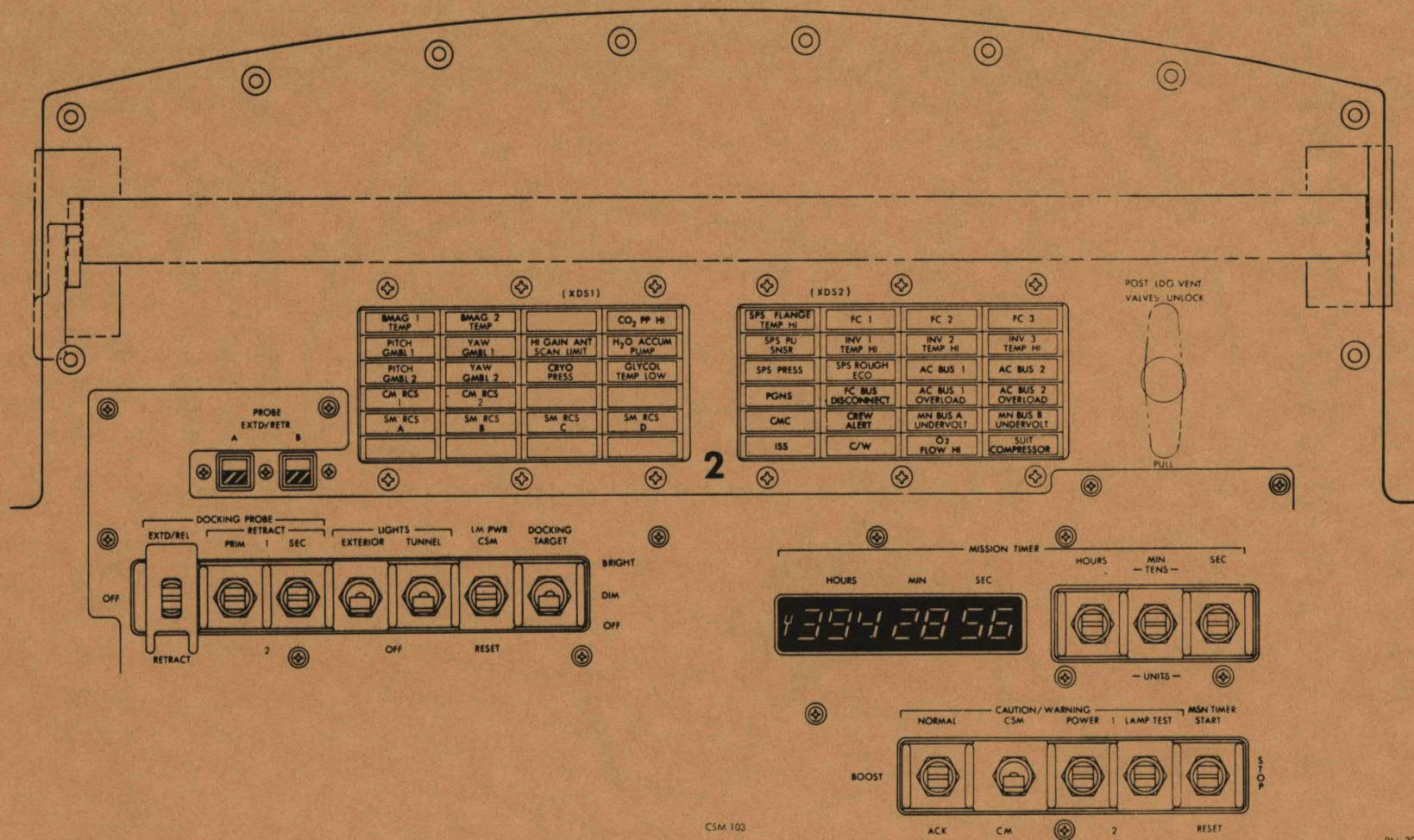
SEQ-542B





2

CSM-103

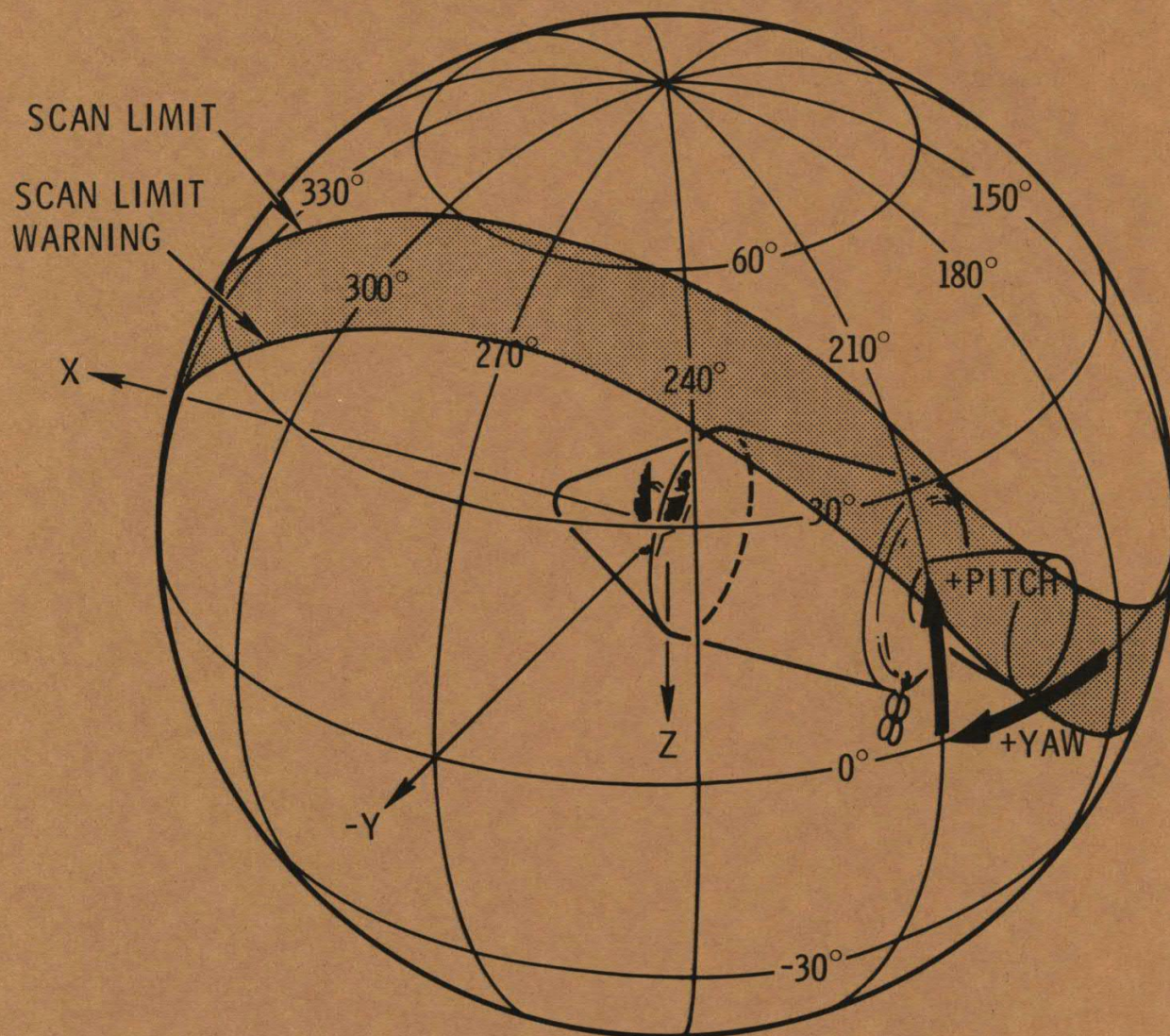


CSM 103

PH-2C-3

HIGH GAIN ANTENNA YAW-PITCH COORDINATE SYSTEM

105



YAW - MEASURED IN XY PLANE,
FROM +X TOWARD +Y, 0 TO 360 DEGREES
(SIMILAR TO LONGITUDE)

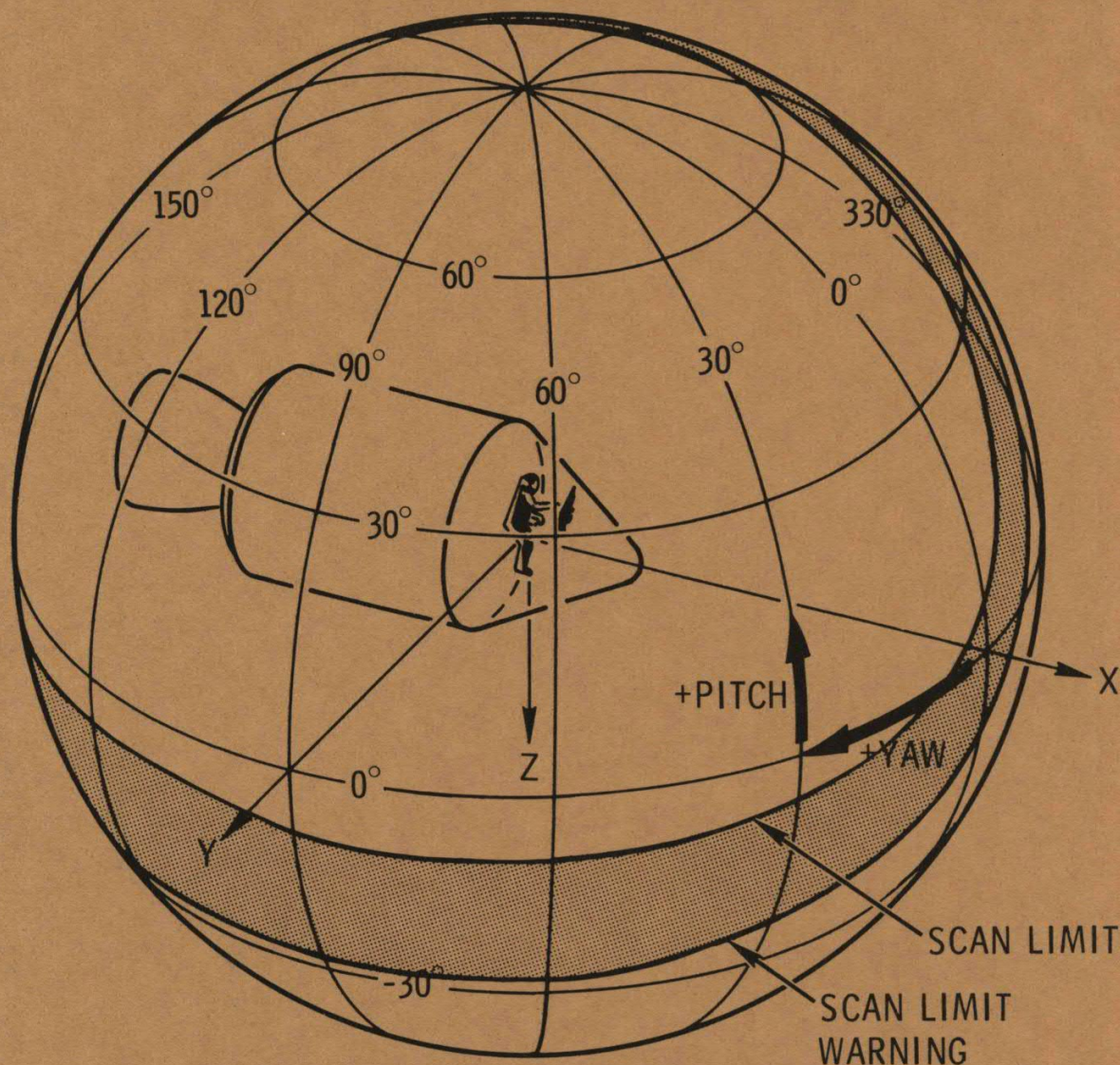
PITCH - MEASURED ABOVE XY PLANE, 0 TO 90 DEGREES
OR BELOW XY PLANE 0 TO -90 DEGREES,
(SIMILAR TO LATITUDE)

NOTE: ORDER TO ROTATION MUST BE YAW FIRST,
THEN PITCH

CD-2102A
CD-2102-1



HIGH GAIN ANTENNA YAW-PITCH COORDINATE SYSTEM



YAW - MEASURED IN XY PLANE,
FROM +X TOWARD +Y, 0 TO 360 DEGREES
(SIMILAR TO LONGITUDE)

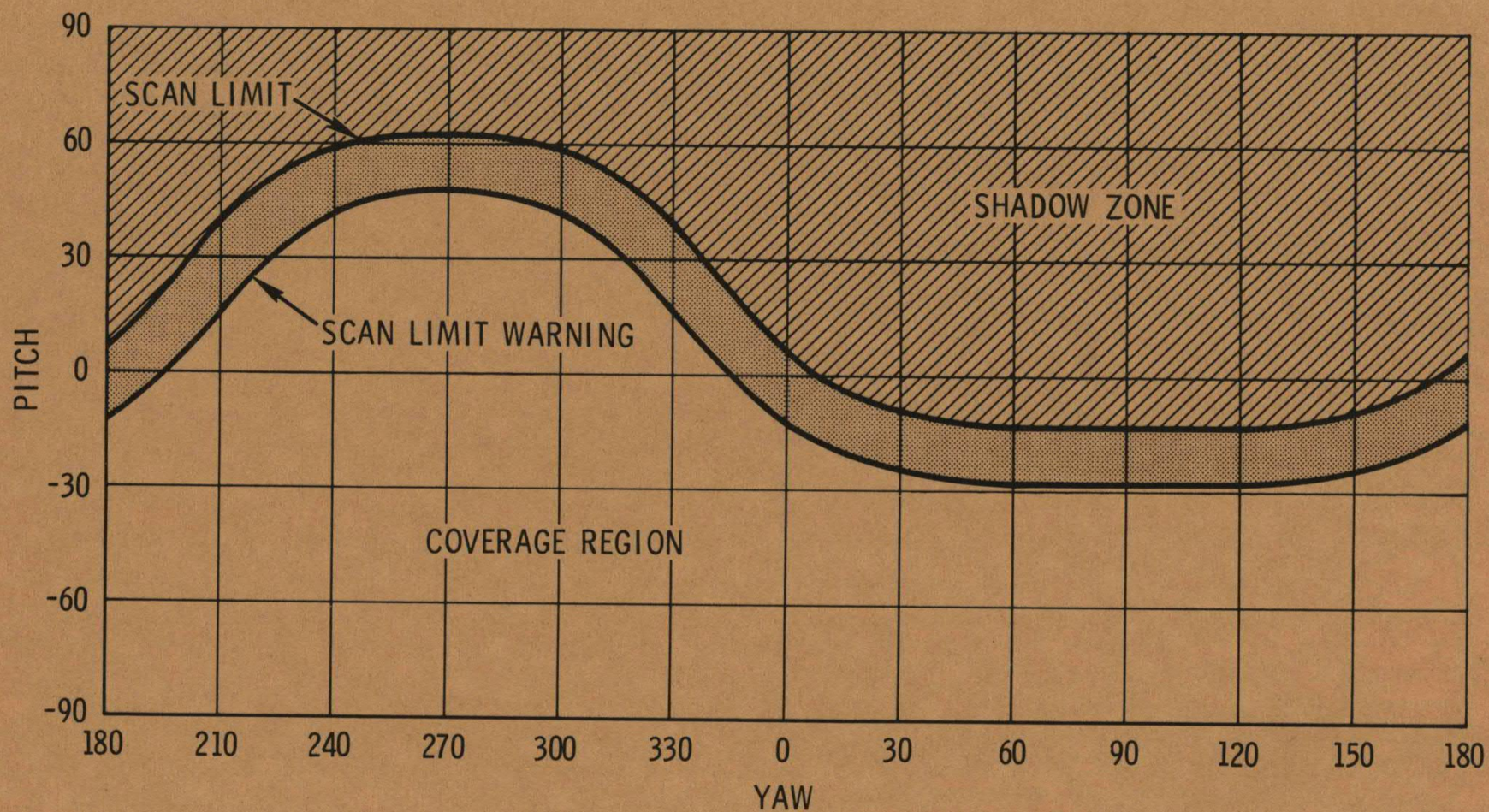
PITCH - MEASURED ABOVE XY PLANE, 0 TO 90 DEGREES
OR BELOW XY PLANE 0 TO -90 DEGREES,
(SIMILAR TO LATITUDE)

NOTE: ORDER OF ROTATION MUST BE YAW FIRST.
THEN PITCH

CD-2101A
CD-2101-1



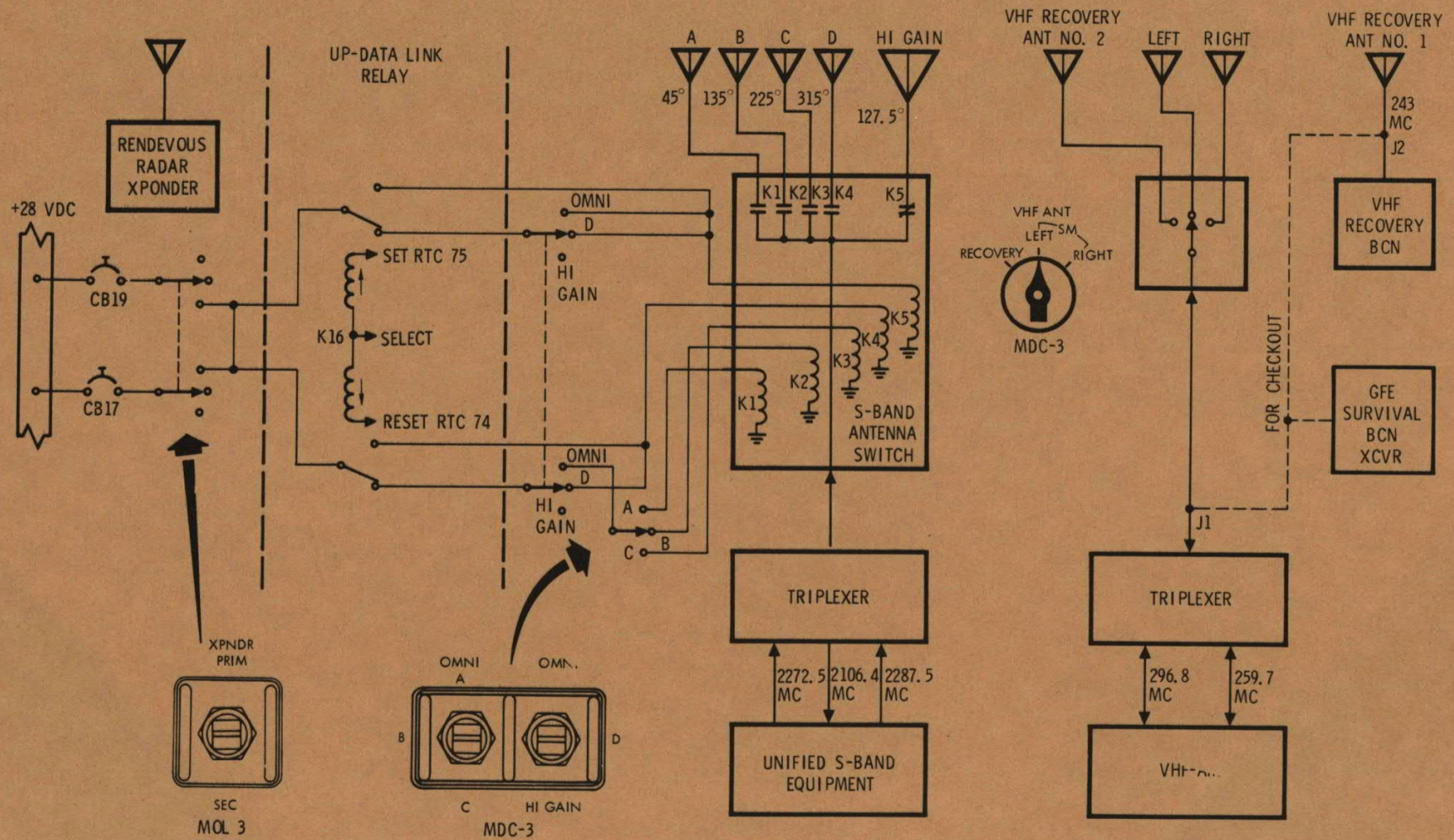
HIGH GAIN ANTENNA SHADOW ZONE



CD-2100



ANTENNA INTERFACES



AUDIO

DATA
STORAGE
EQUIP

CD-2125 

108 A

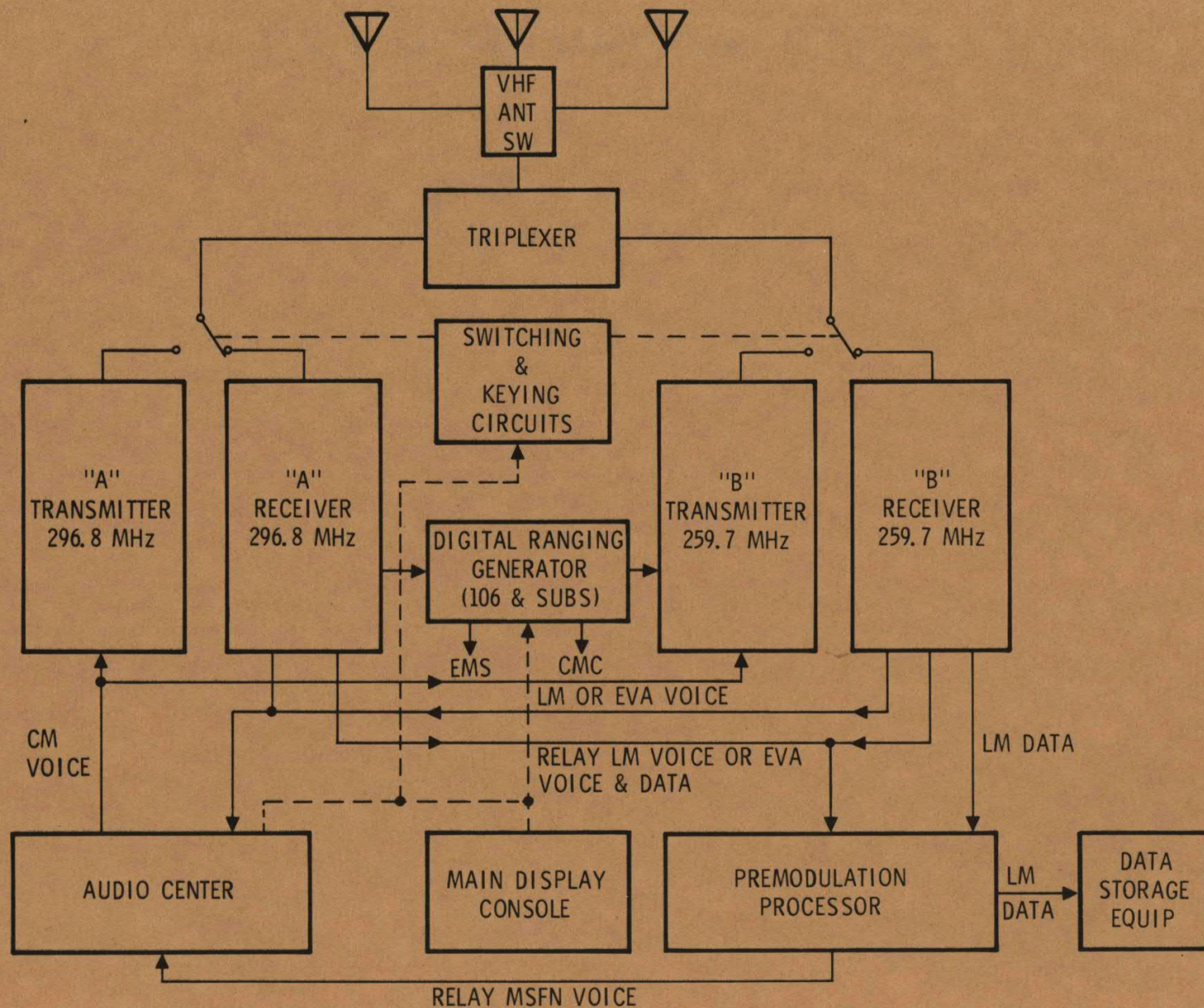
RRT

BCN

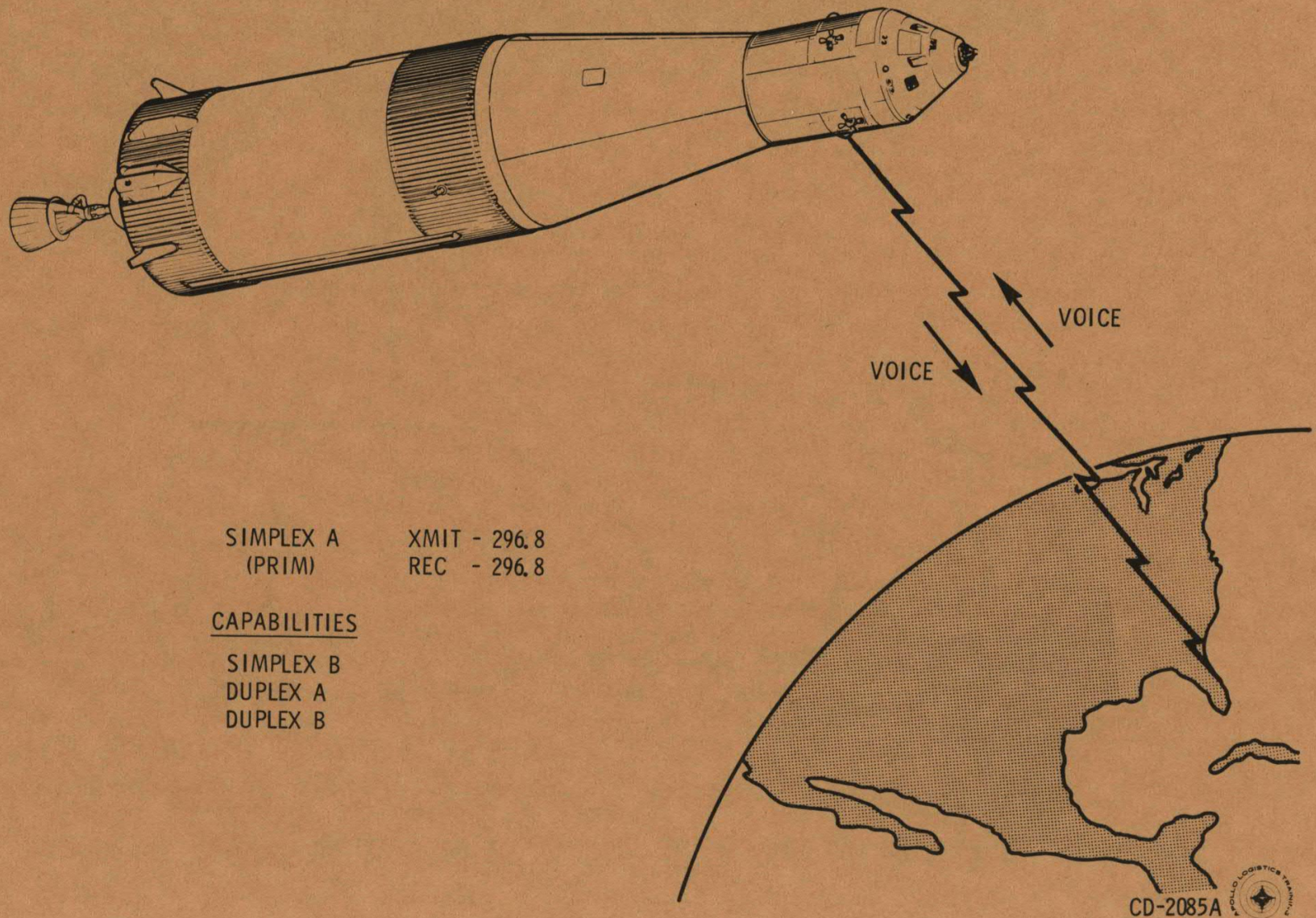
VHF/AM

PWR DISTR

VHF/AM BLOCK DIAGRAM



CSM-MSFN VHF/AM COMM MODE



SIMPLEX A XMIT - 296.8
(PRIM) REC - 296.8

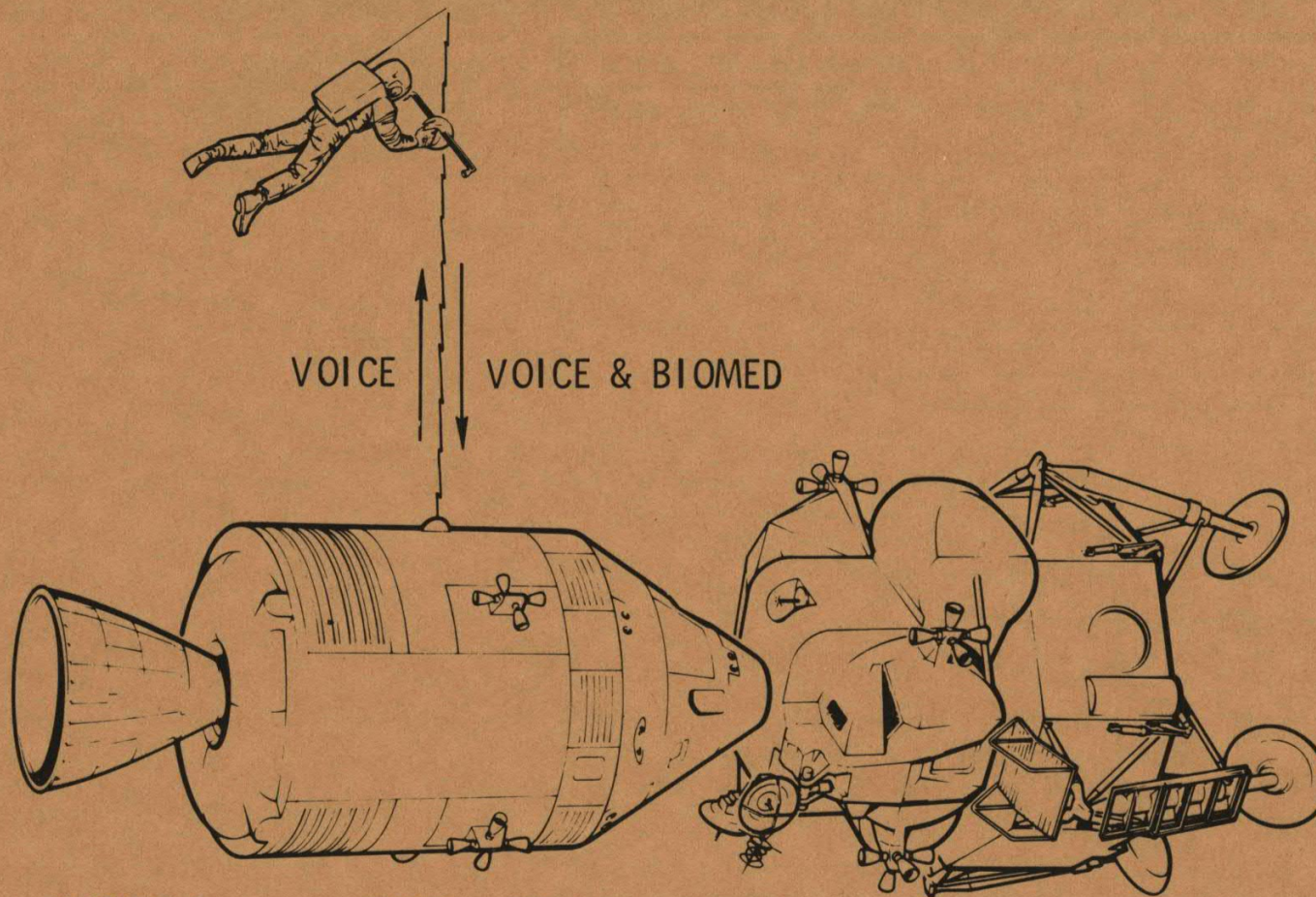
CAPABILITIES

SIMPLEX B
DUPLEX A
DUPLEX B

CD-2085A



CSM-EVA VHF/AM COMM MODE



DUPLEX A
(PRIM)

XMIT - 296.8
REC - 259.7

DUPLEX B
(BACK-UP)

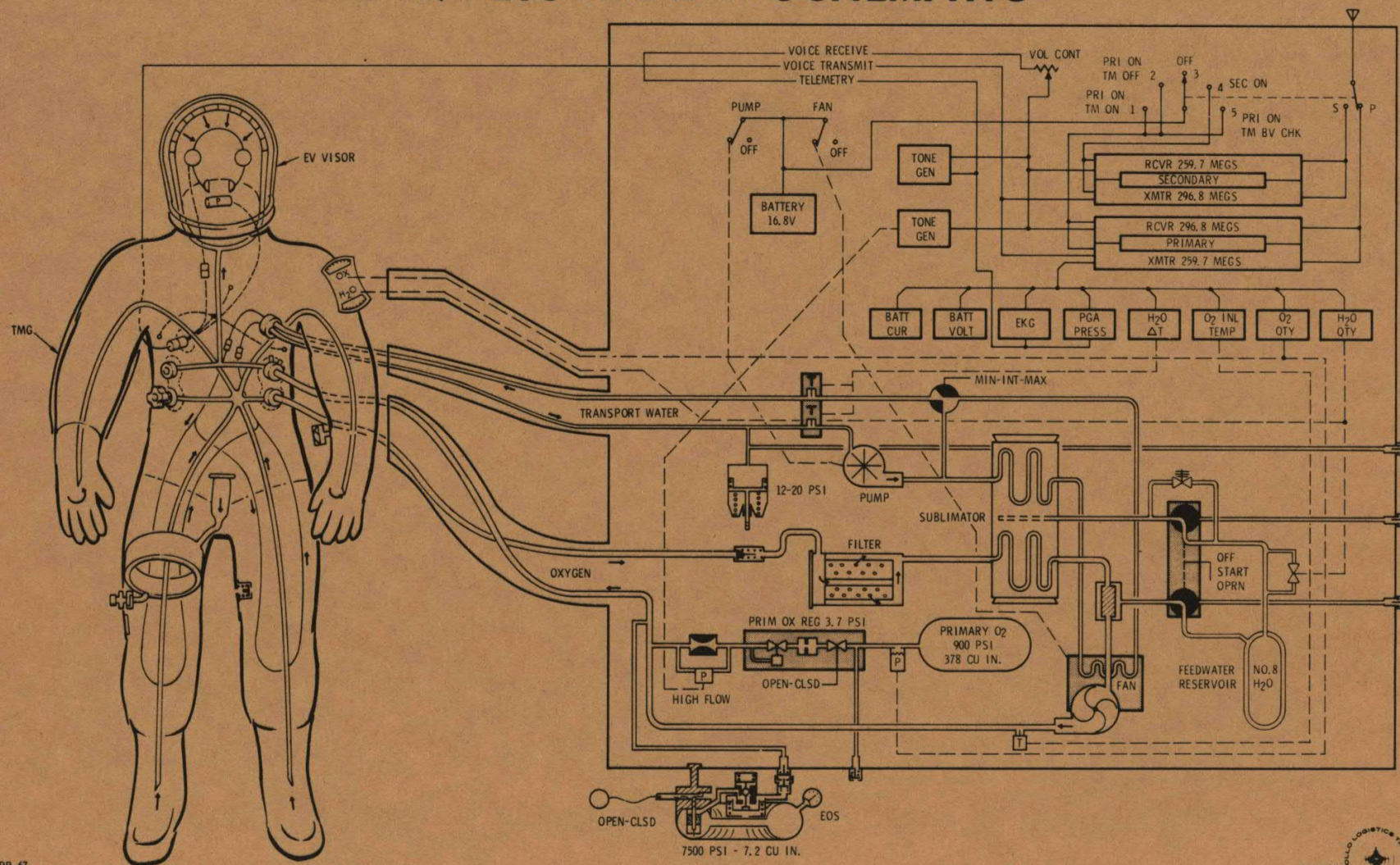
XMIT - 259.7
REC - 296.8

NOTE: NO BIOMED IN BACK-UP MODE

CD-2084A



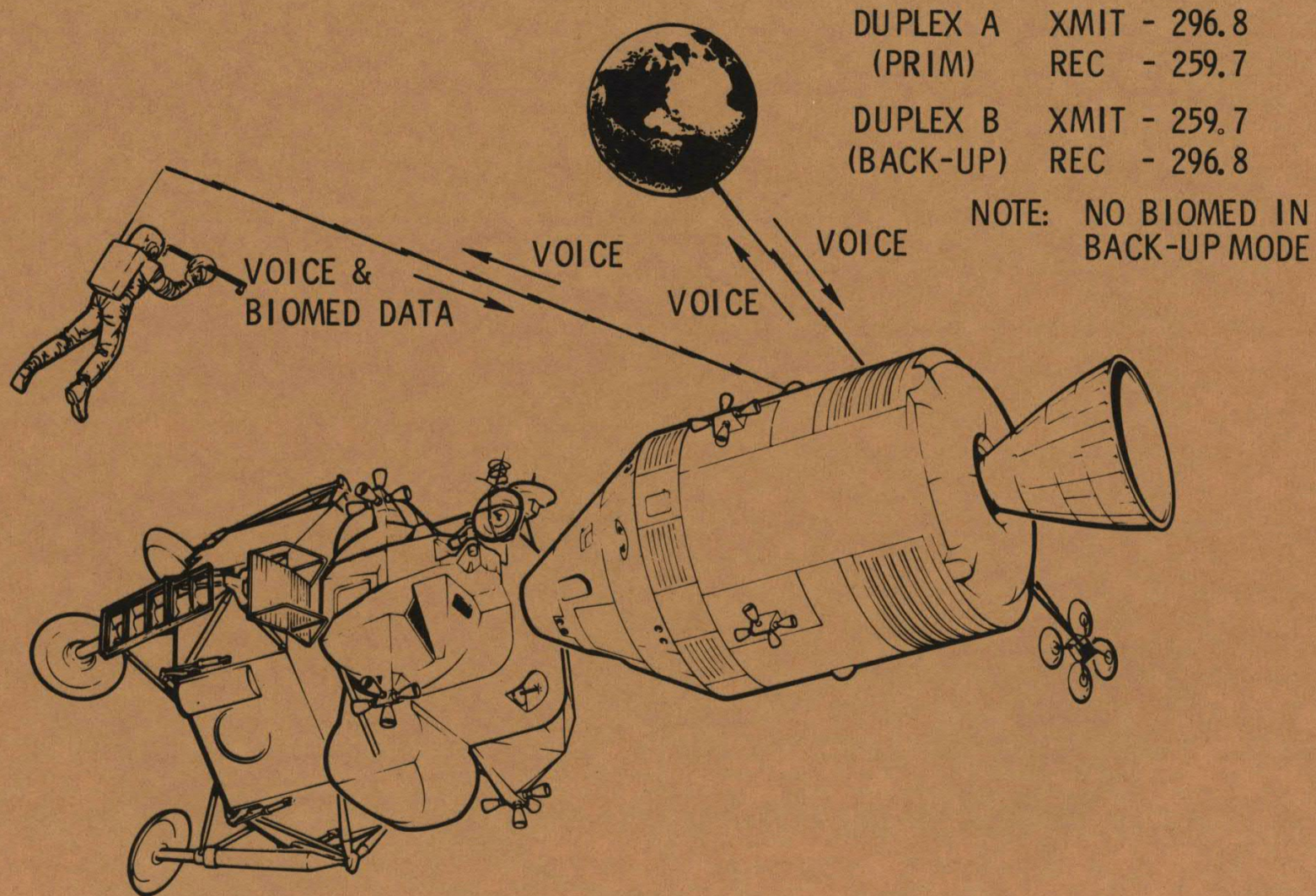
EMU/PLSS FLOW & SCHEMATIC



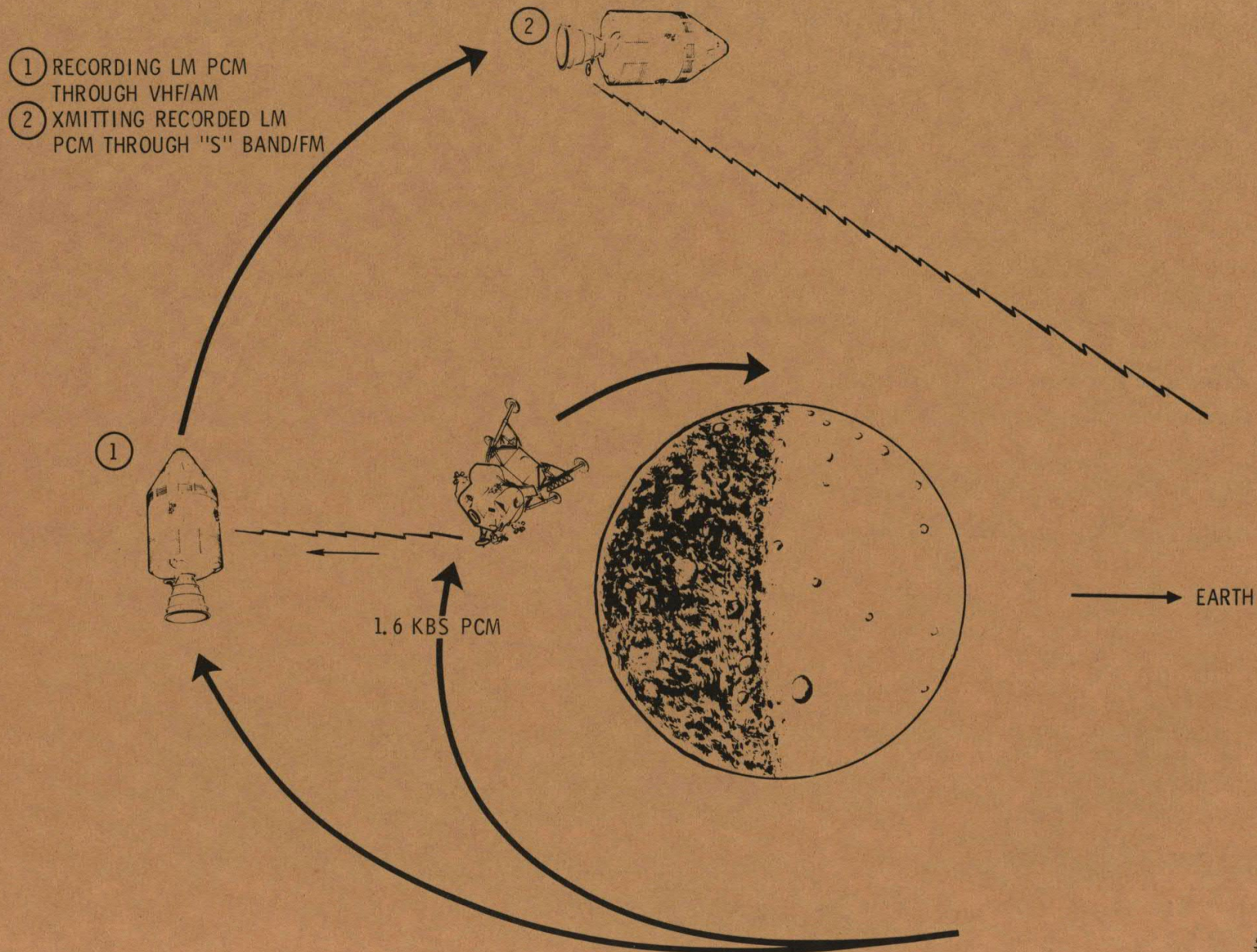
APR 67

CS-1502 

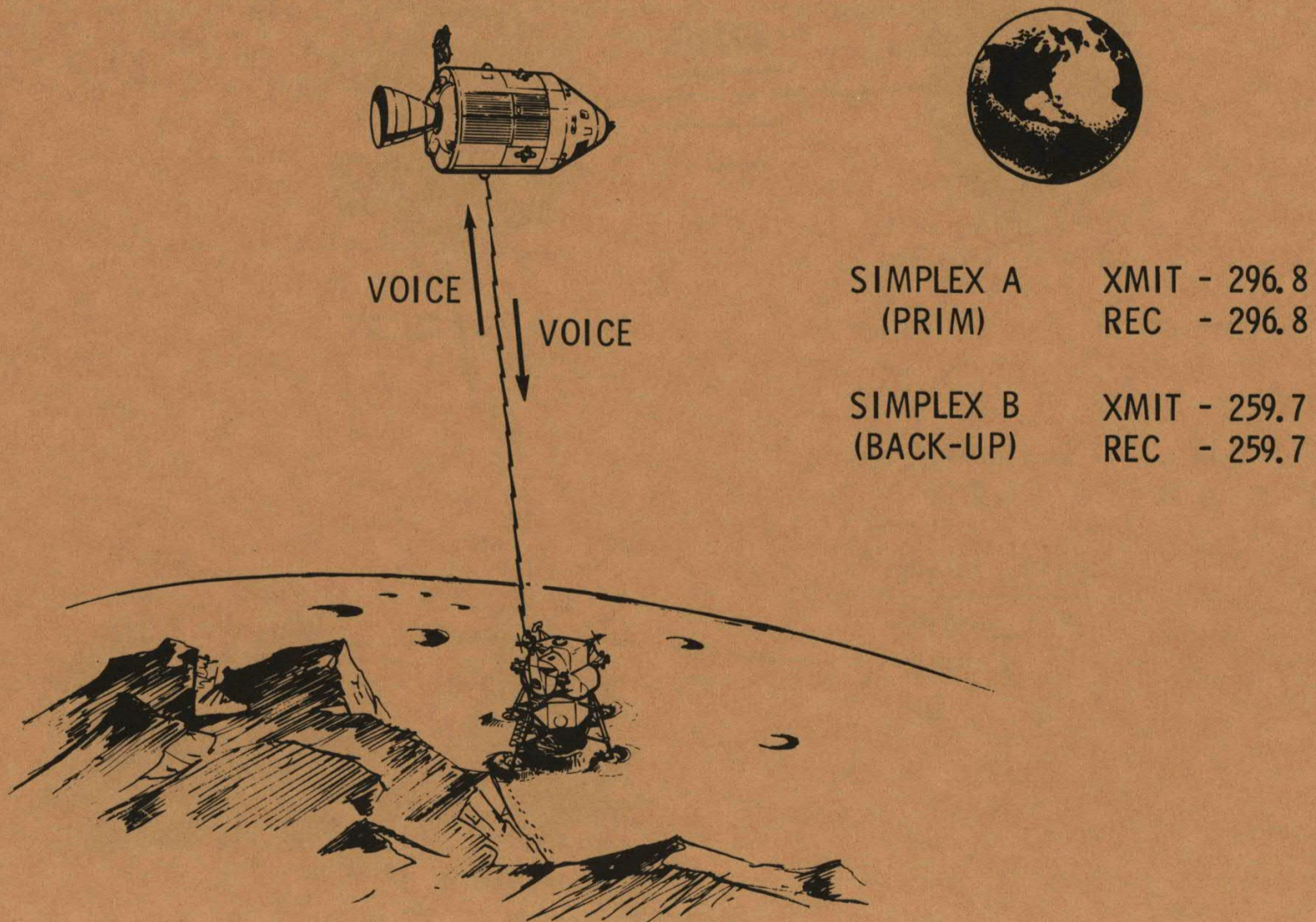
MSFN-CSM-EVA VHF/AM COMM MODE S-BAND RELAY MODE



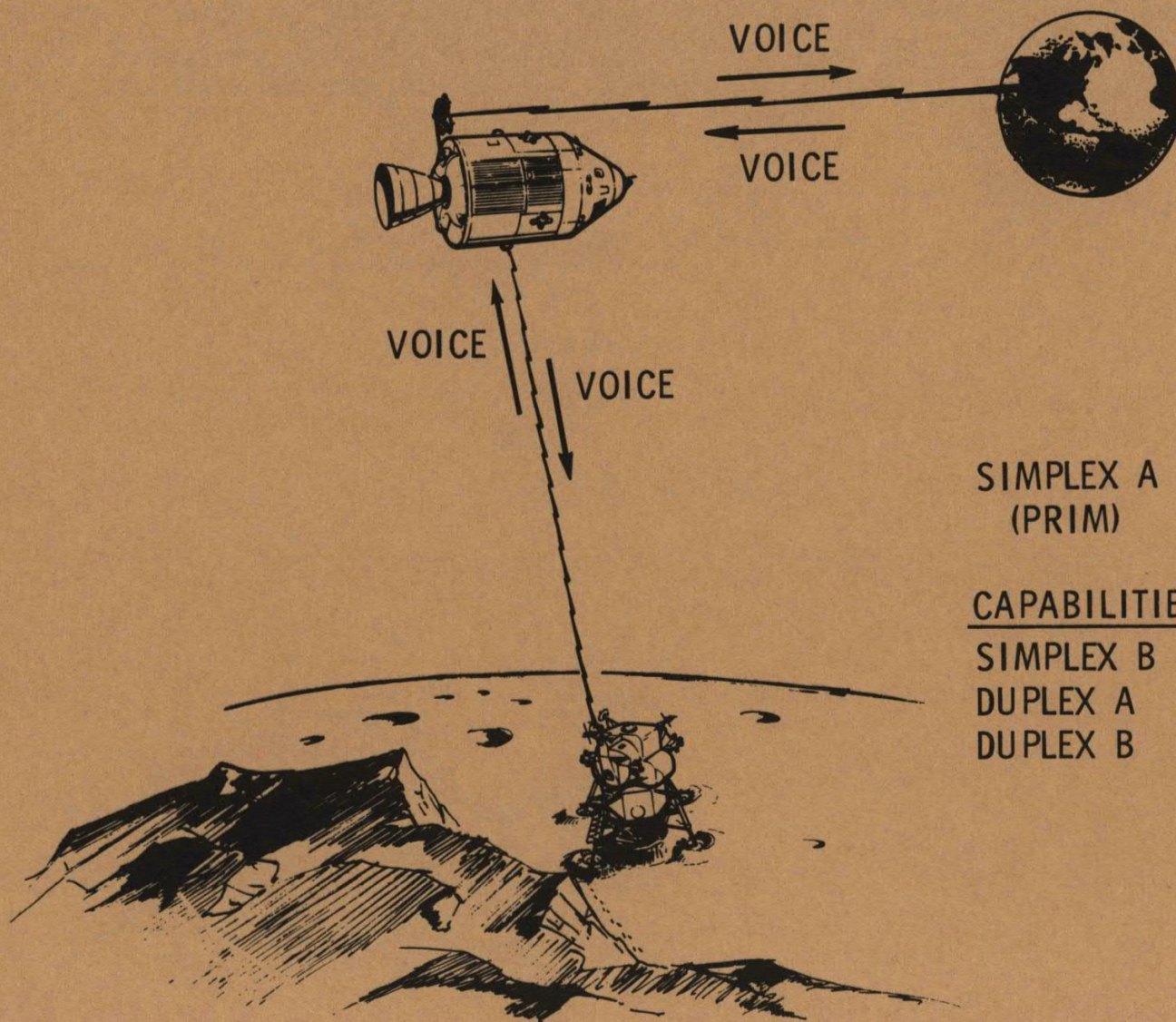
LEM-CSM VHF/AM DATA REC



CSM-LEM VHF/AM COMM MODE



MSFN-CSM-LEM VHF/AM COMM MODE S-BAND RELAY MODE



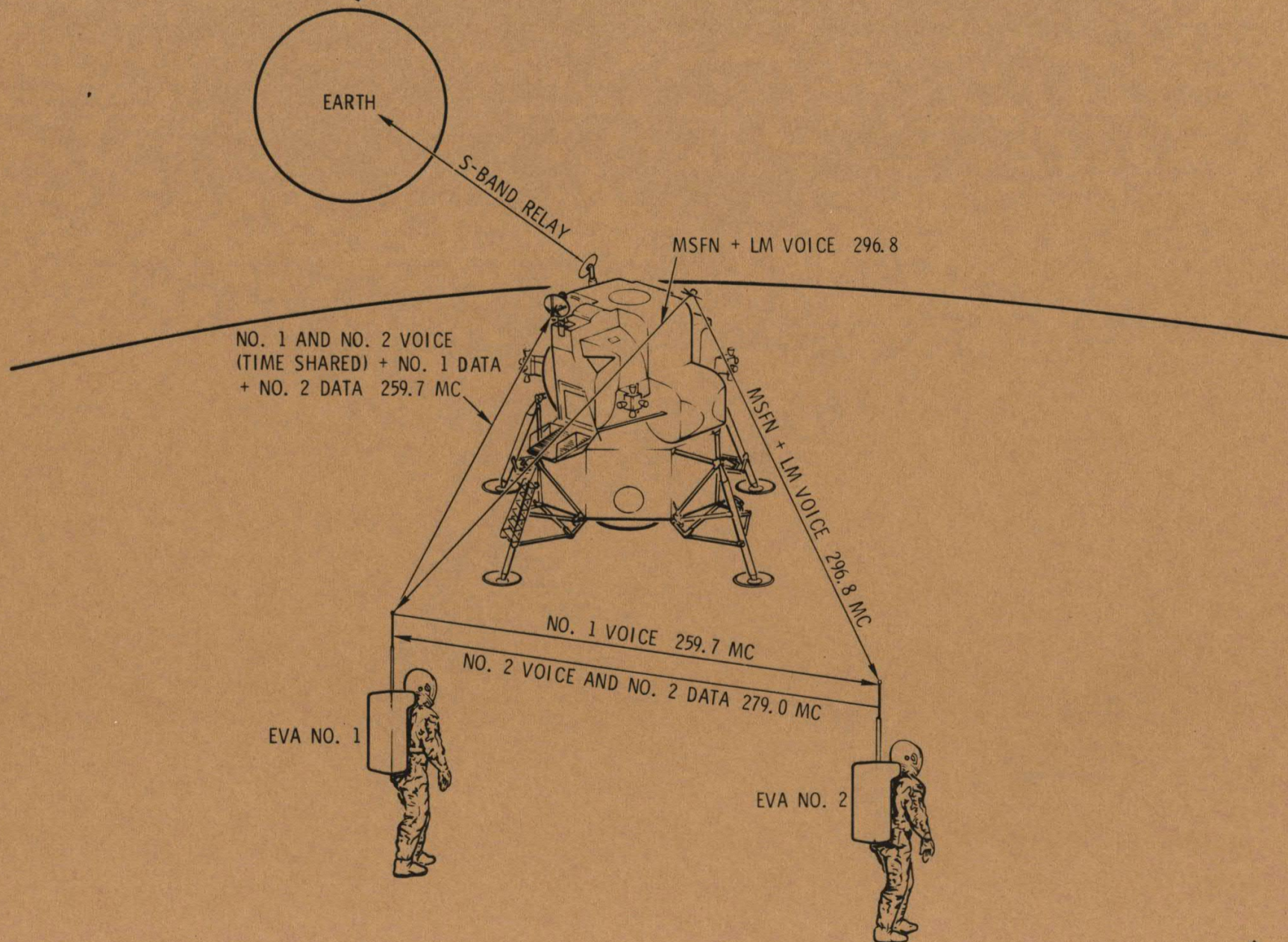
SIMPLEX A
(PRIM)

XMIT - 296.8
REC - 296.8

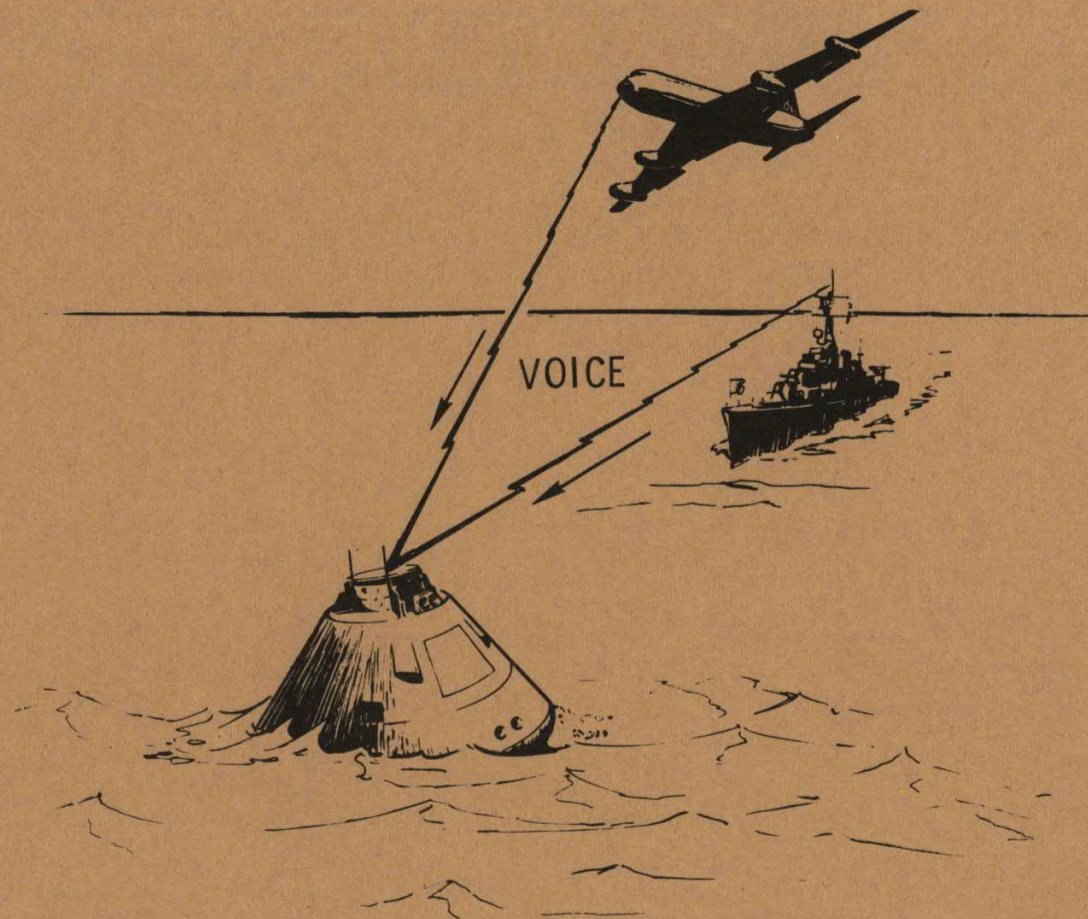
CAPABILITIES

SIMPLEX B
DUPLEX A
DUPLEX B

EVA/LM DUAL RELAY MODE



RECOVERY-CSM VHF/AM REC MODE



REC A

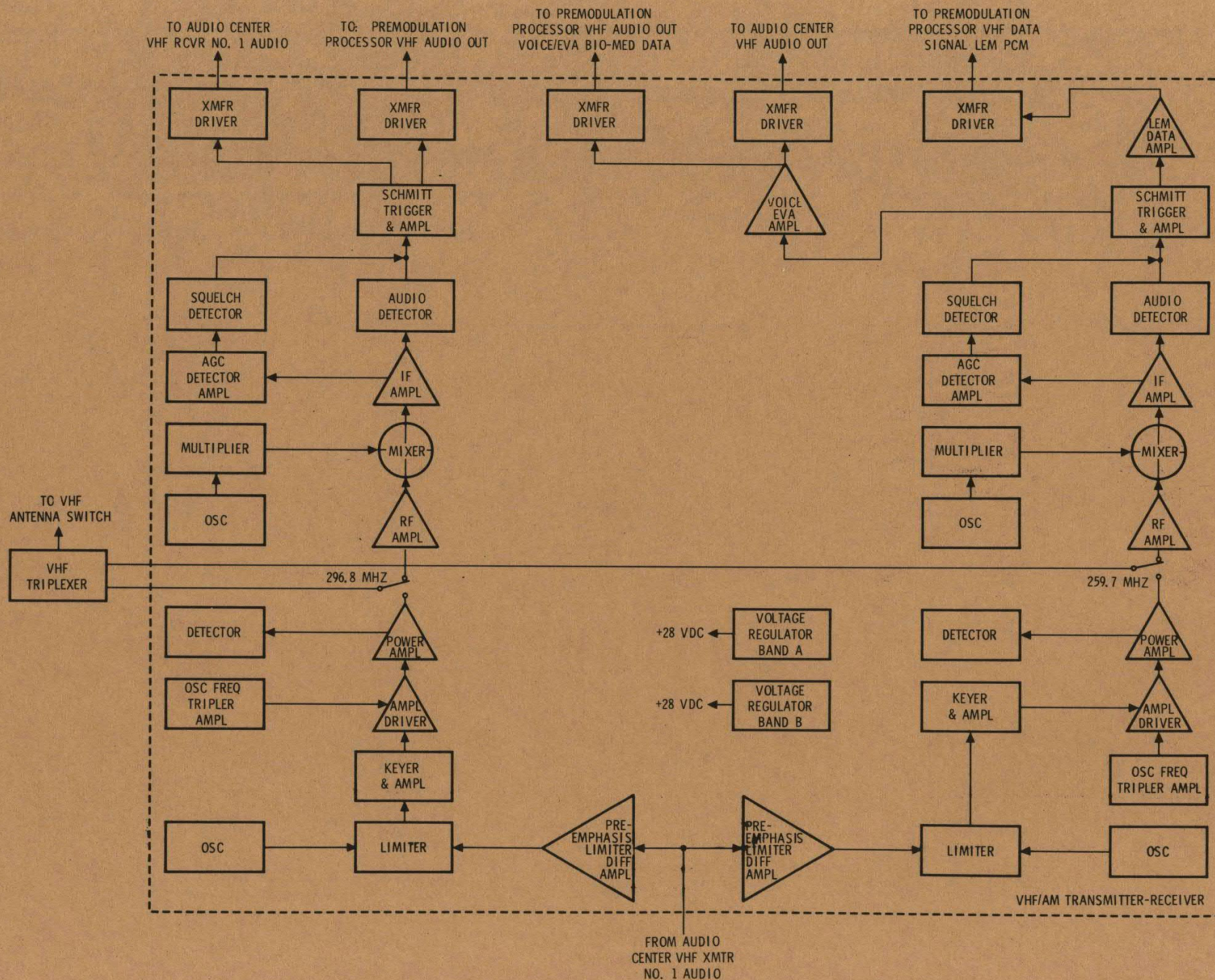
REC-296.8

VHF/AM COMM MODES

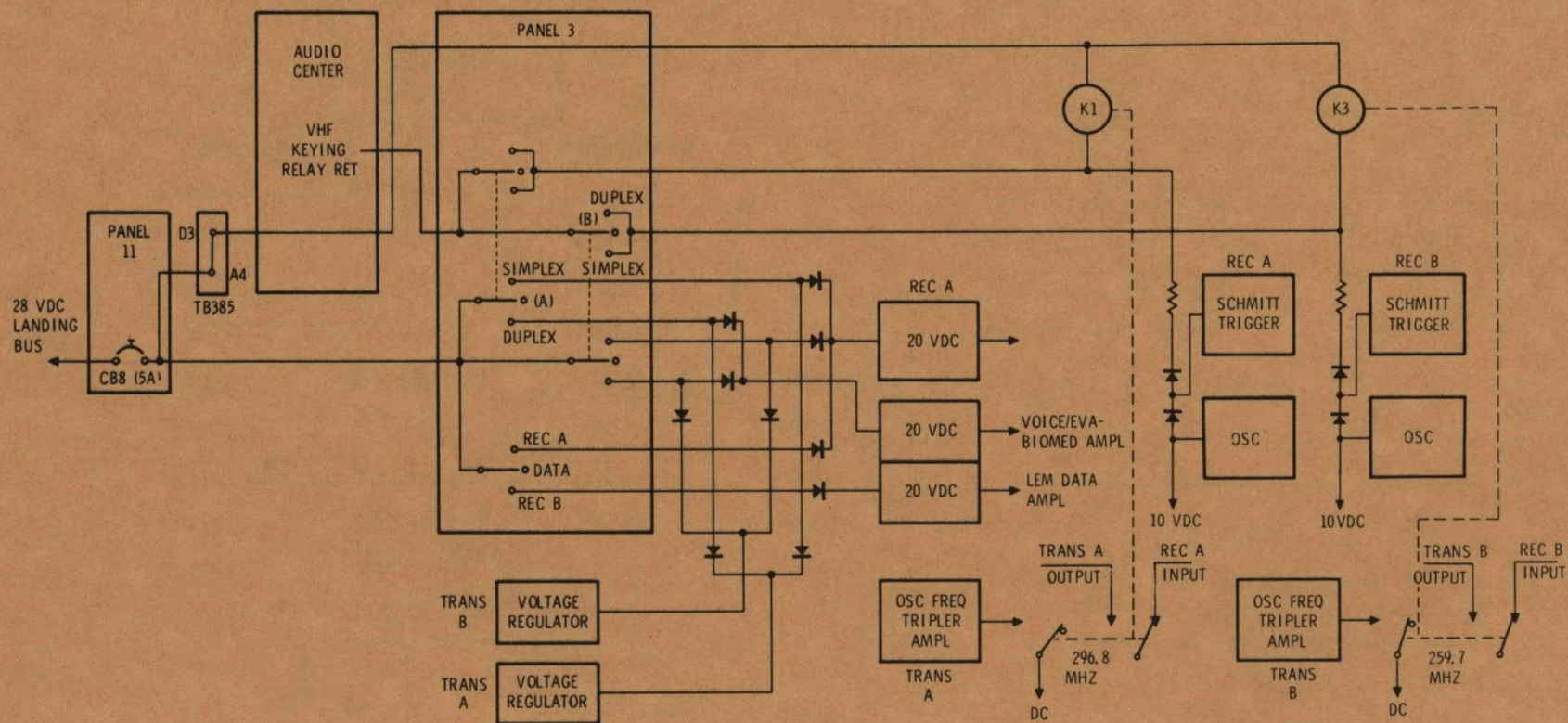
FROM-TO-FROM		VHF MODE	INFORMATION	FREQUENCY (MHZ)	
				XMIT	REC
CSM	EVA	DUP A	VOICE	296.8	259.7
EVA	CSM	DUP A	VOICE & BIO MED DATA	296.8	259.7
CSM	EVA (BU)	DUP B	VOICE	259.7	296.8
EVA	CSM (BU)	DUP B	VOICE	259.7	296.8
CSM	MSFN	SIM A	VOICE	296.8	296.8
MSFN	CSM	SIM A	VOICE	296.8	296.8
CSM	LEM	SIM A	VOICE	296.8	296.8
LEM	CSM	SIM A	VOICE	296.8	296.8
CSM	LEM (BU)	SIM B	VOICE	259.7	259.7
LEM	CSM (BU)	SIM B	VOICE	259.7	259.7
MSFN	CSM-LEM	SIM A	VOICE	296.8	296.8*
MSFN	CSM-EVA	DUP A	VOICE	296.8	259.7*
MSFN	CSM-EVA	DUP A	VOICE & DATA	296.8	259.7*
LEM	CSM	REC B	1.6 KBS-PCM		259.7
RECOVERY	CSM	REC A	VOICE		296.8

*S-BAND RELAY MODE

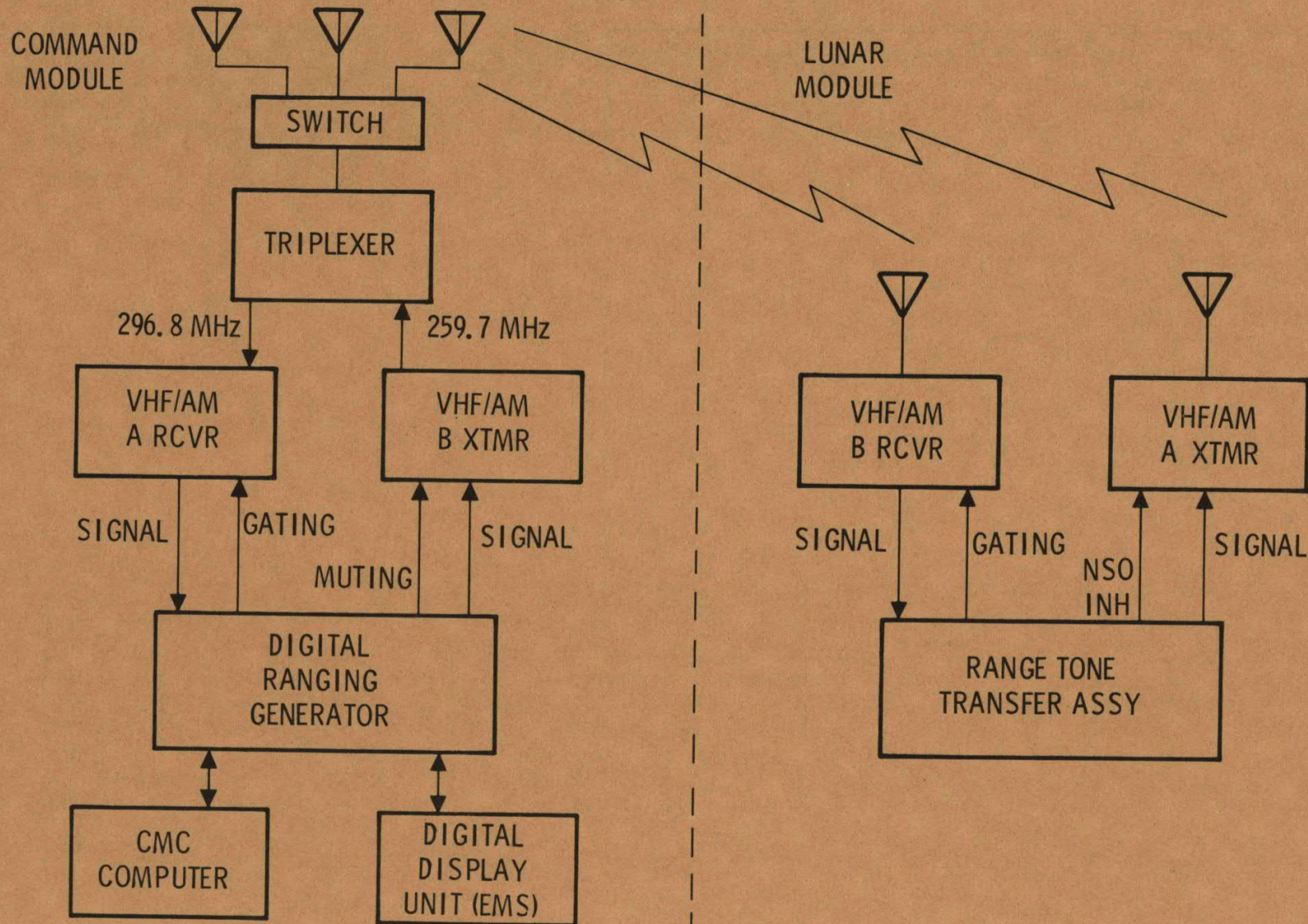
CD-2069B 



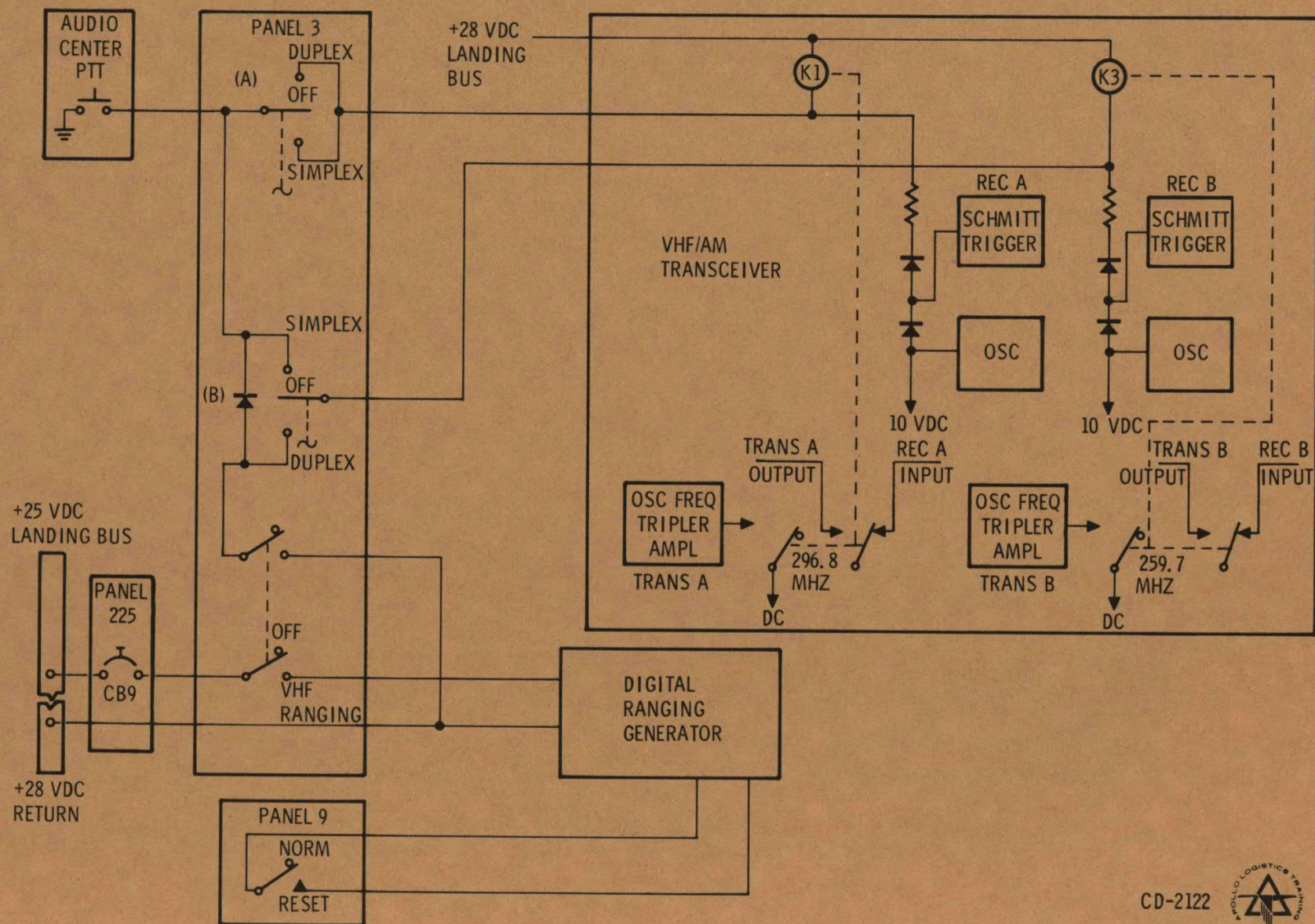
VHF AM CONTROL & POWER SWITCHING



VHF RANGING BLOCK DIAGRAM



VHF/AM RANGING CONTROL & POWER SWITCHING

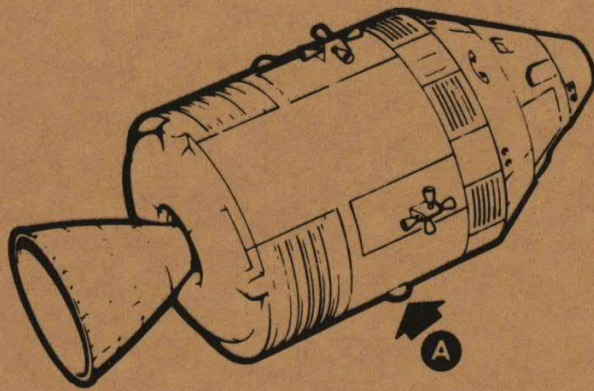


CD-2122

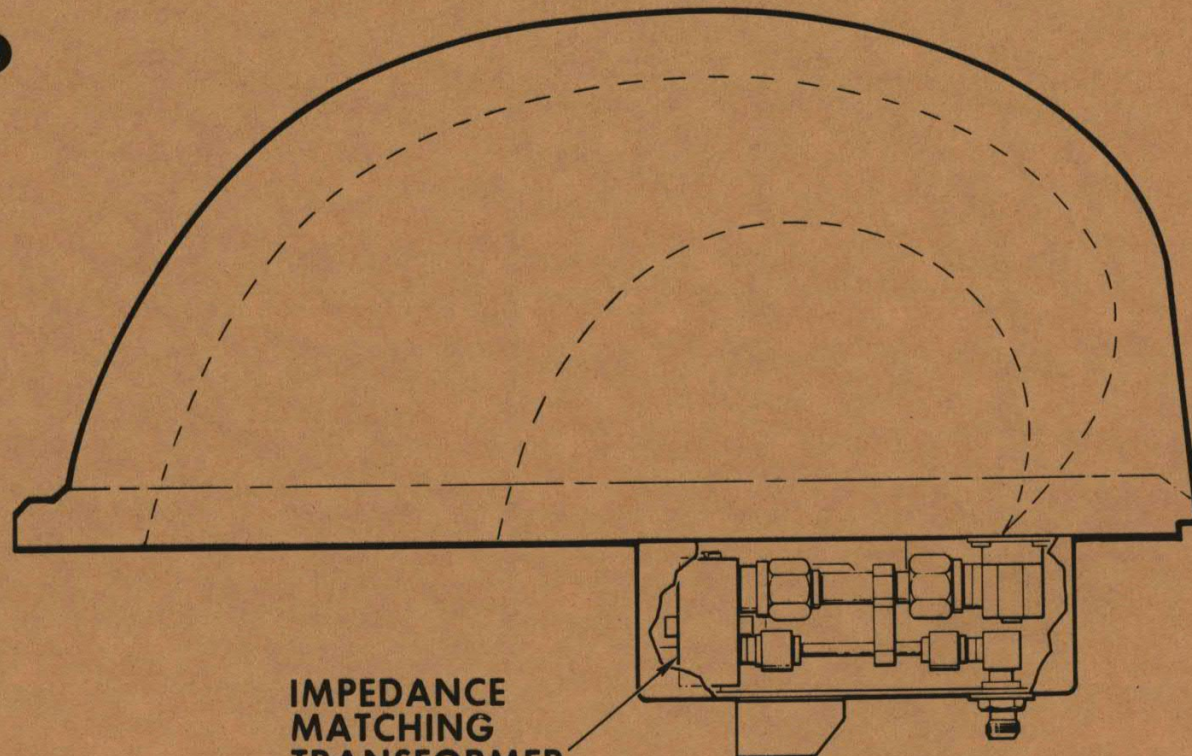


SCIMITAR ANTENNA

BLOCK II



DETAIL A

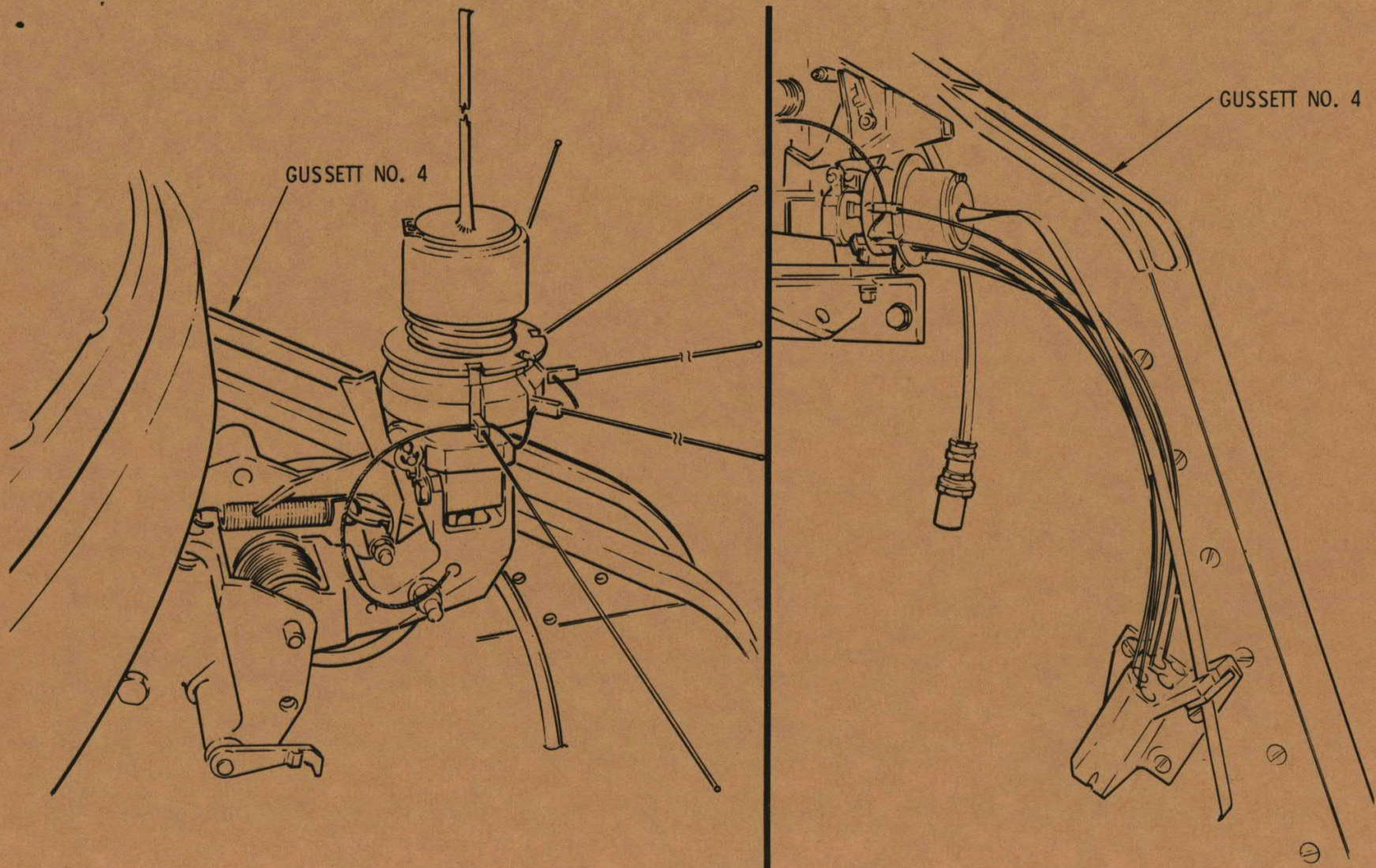


IMPEDANCE
MATCHING
TRANSFORMER

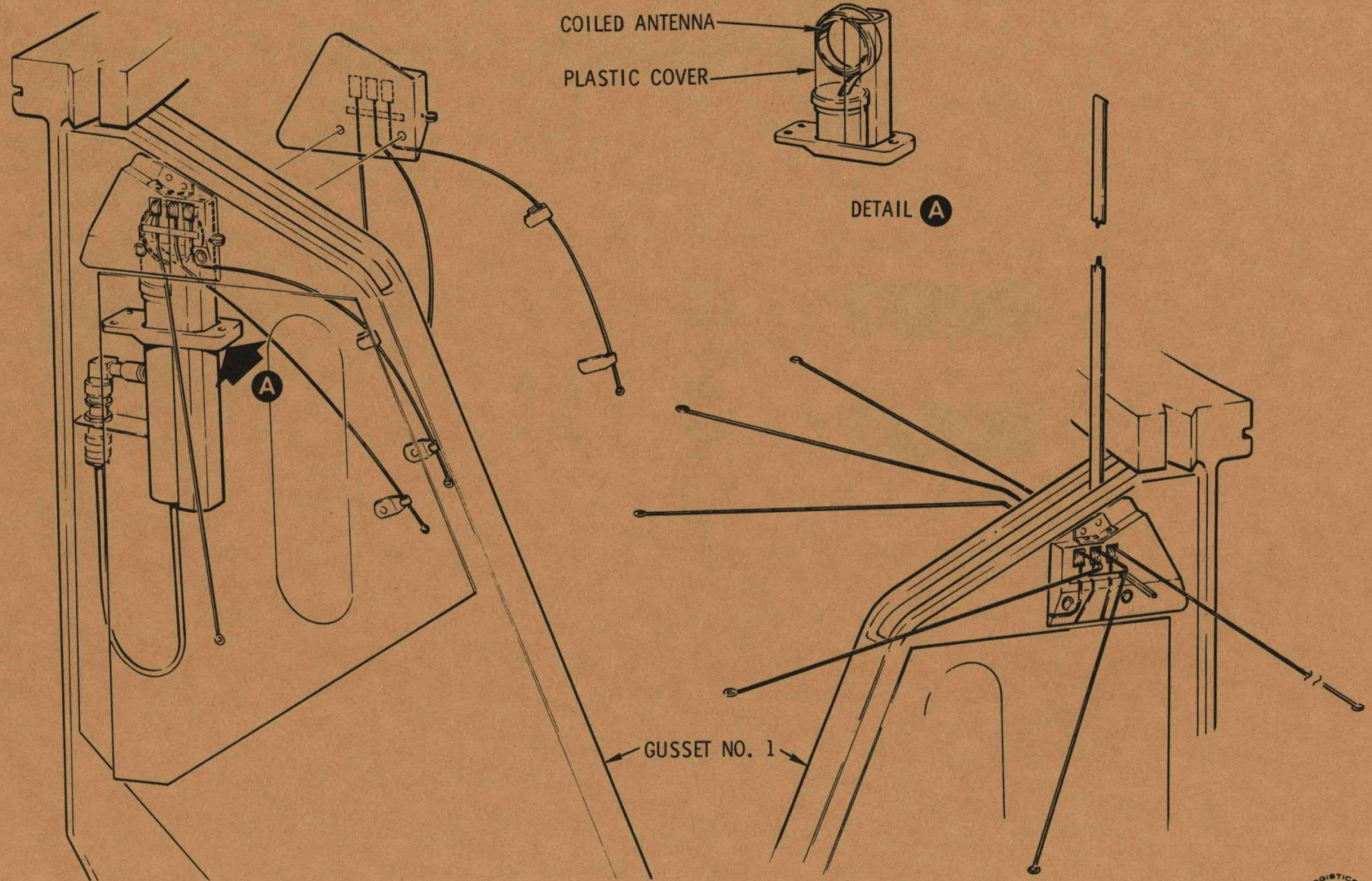
CD-2004A

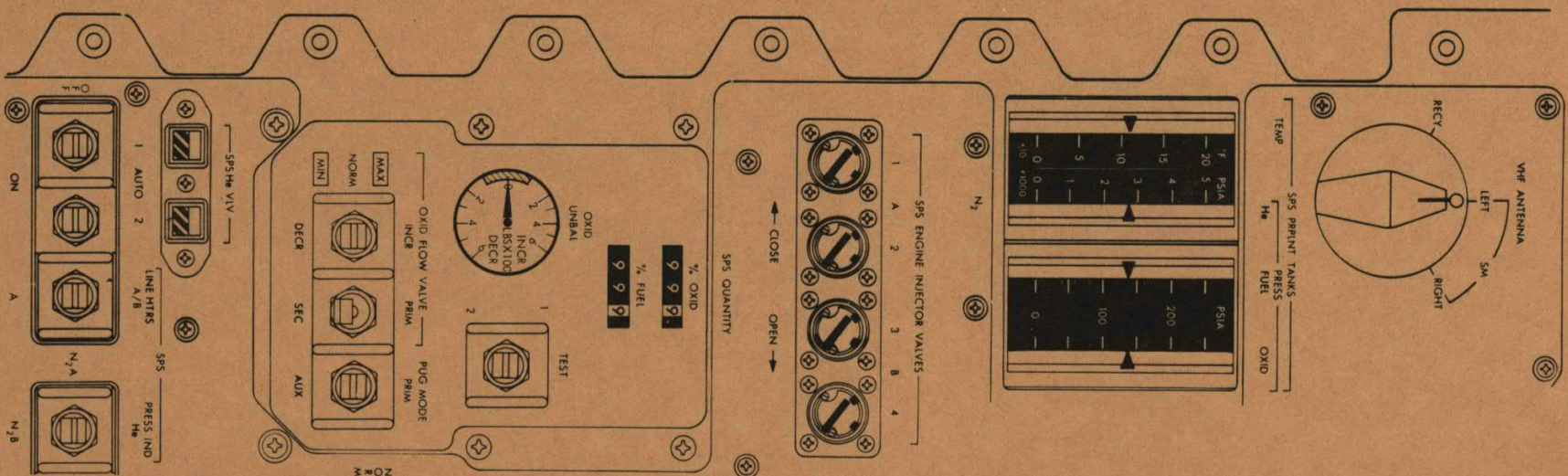


VHF RECOVERY ANTENNA NO. 1



VHF RECOVERY ANTENNA NO. 2





3

CSM 103

CD-2062B



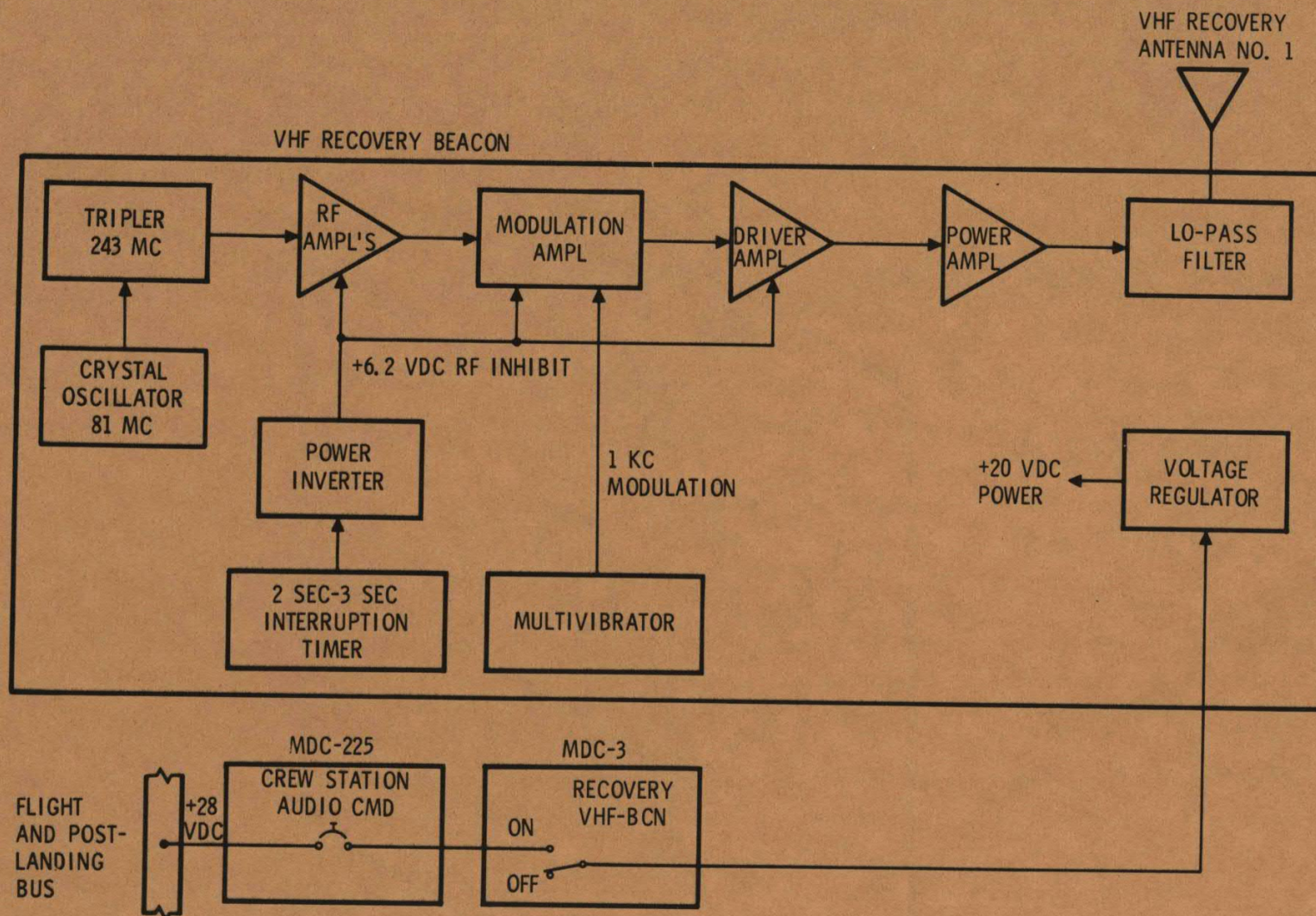
127

RRT

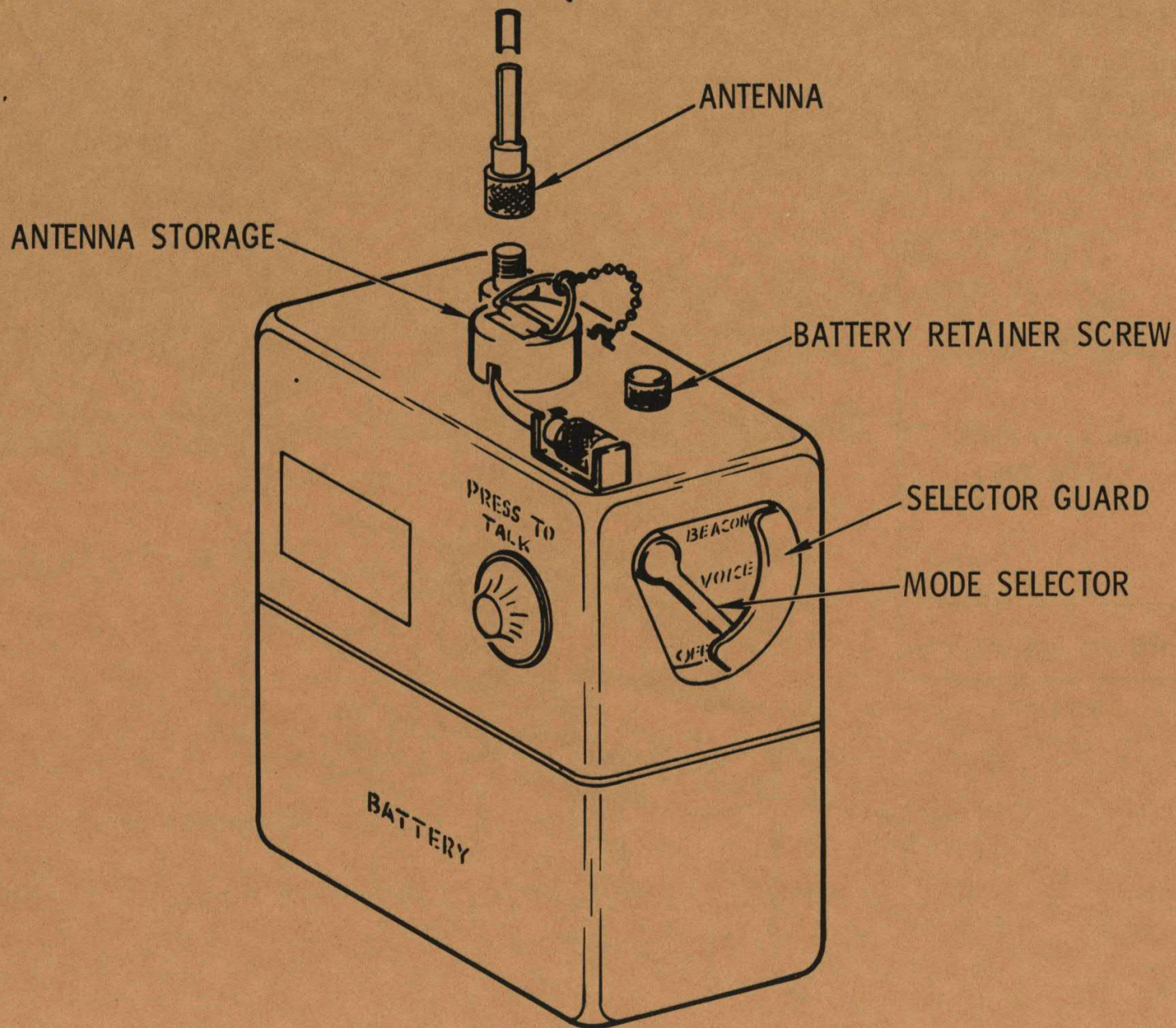
BCN

PWR DISTR

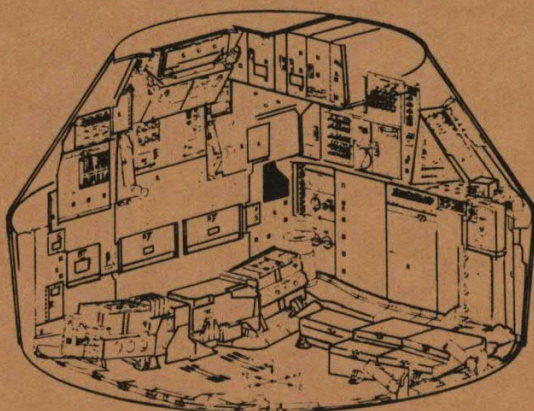
VHF RECOVERY BEACON EQUIPMENT



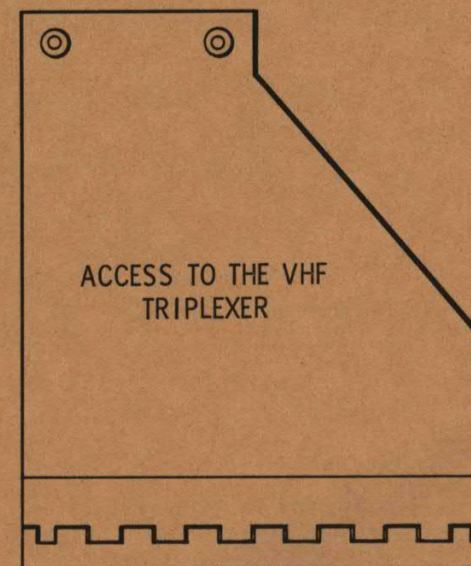
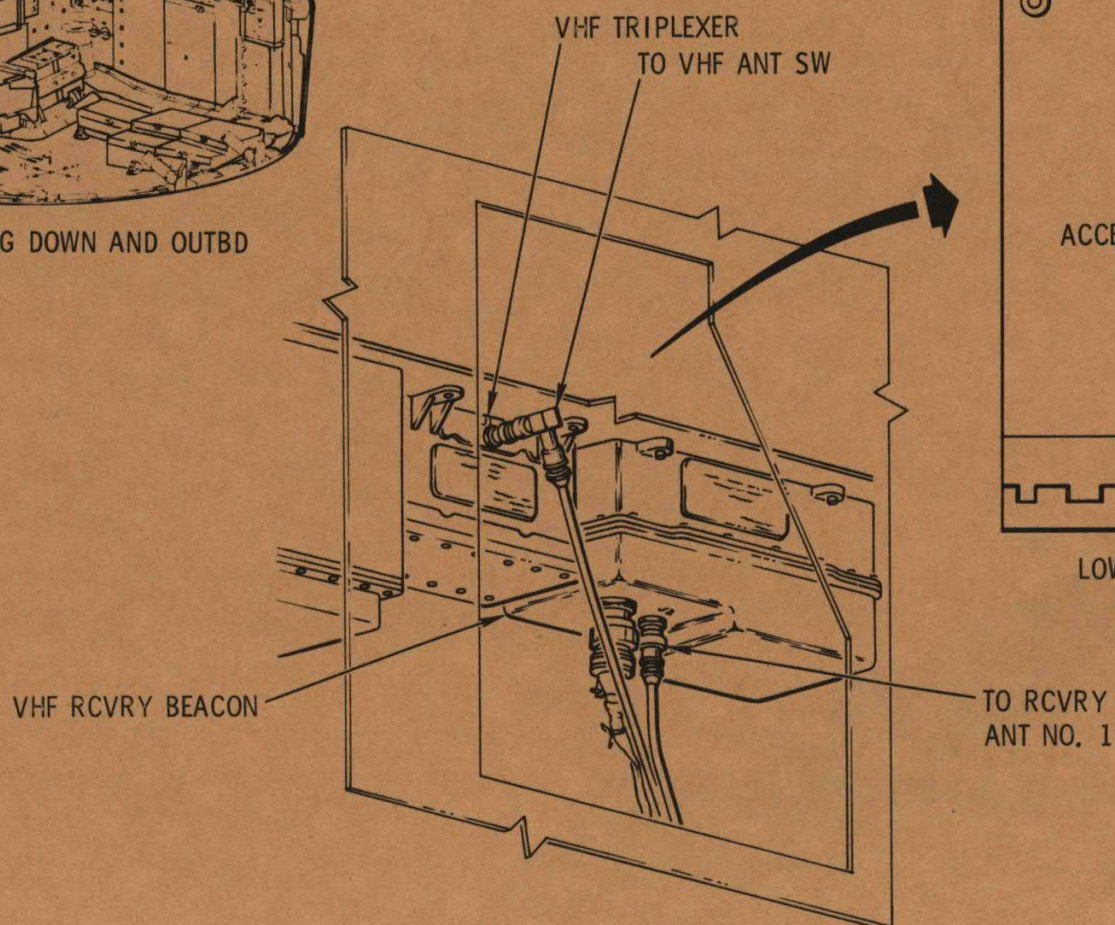
SURVIVAL BEACON / TRANSCEIVER RADIO



SURVIVAL BEACON ACCESS



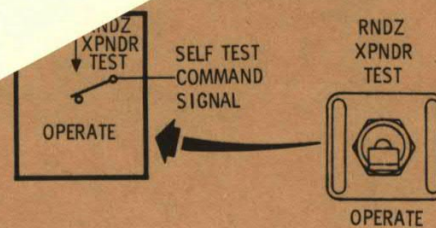
VIEW LOOKING DOWN AND OUTBD



ACCESS TO THE VHF
TRIPLEXER

LOWER EQUIPMENT BAY
(LEB)

ON
& SELF-
OSCILLATOR

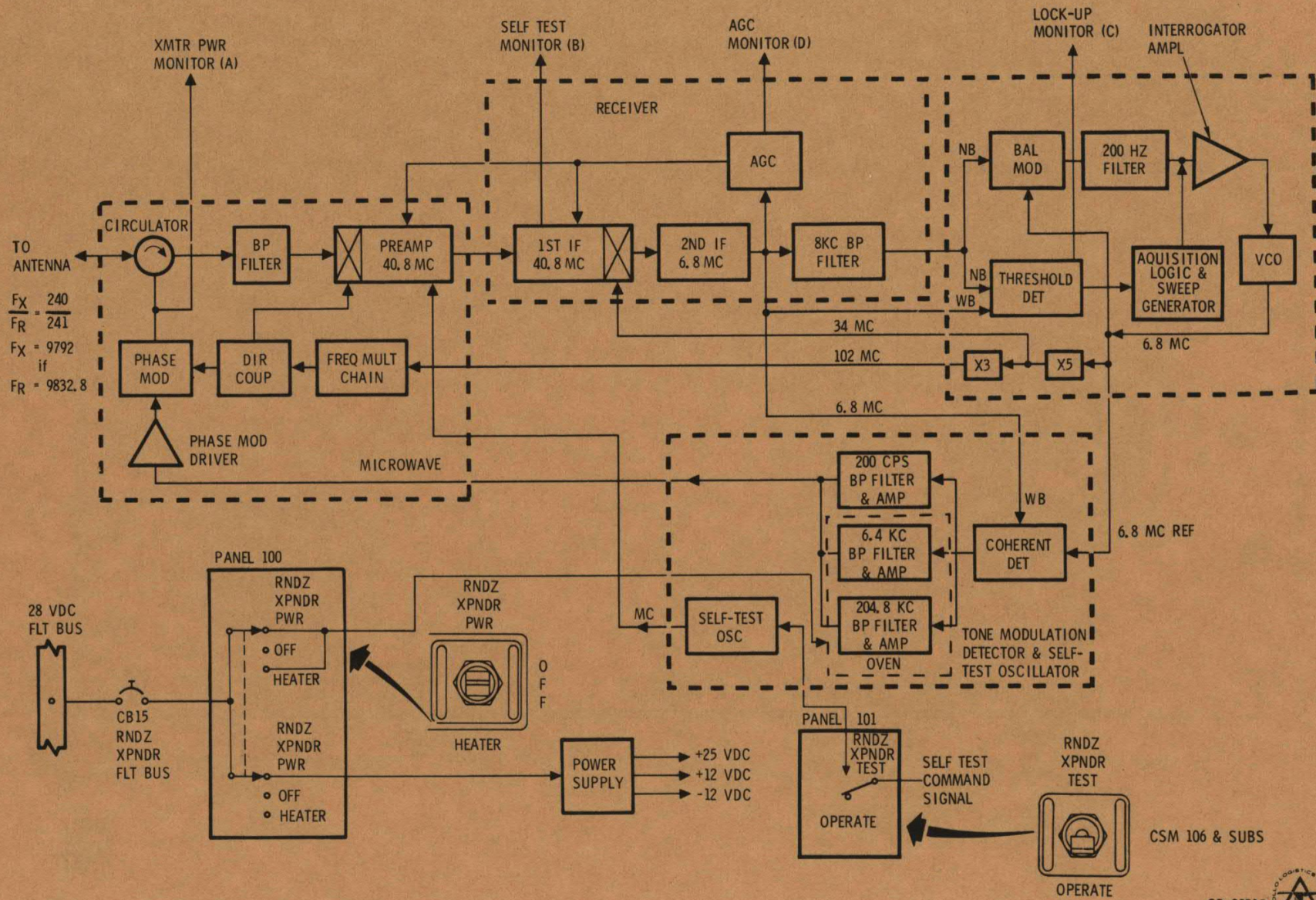


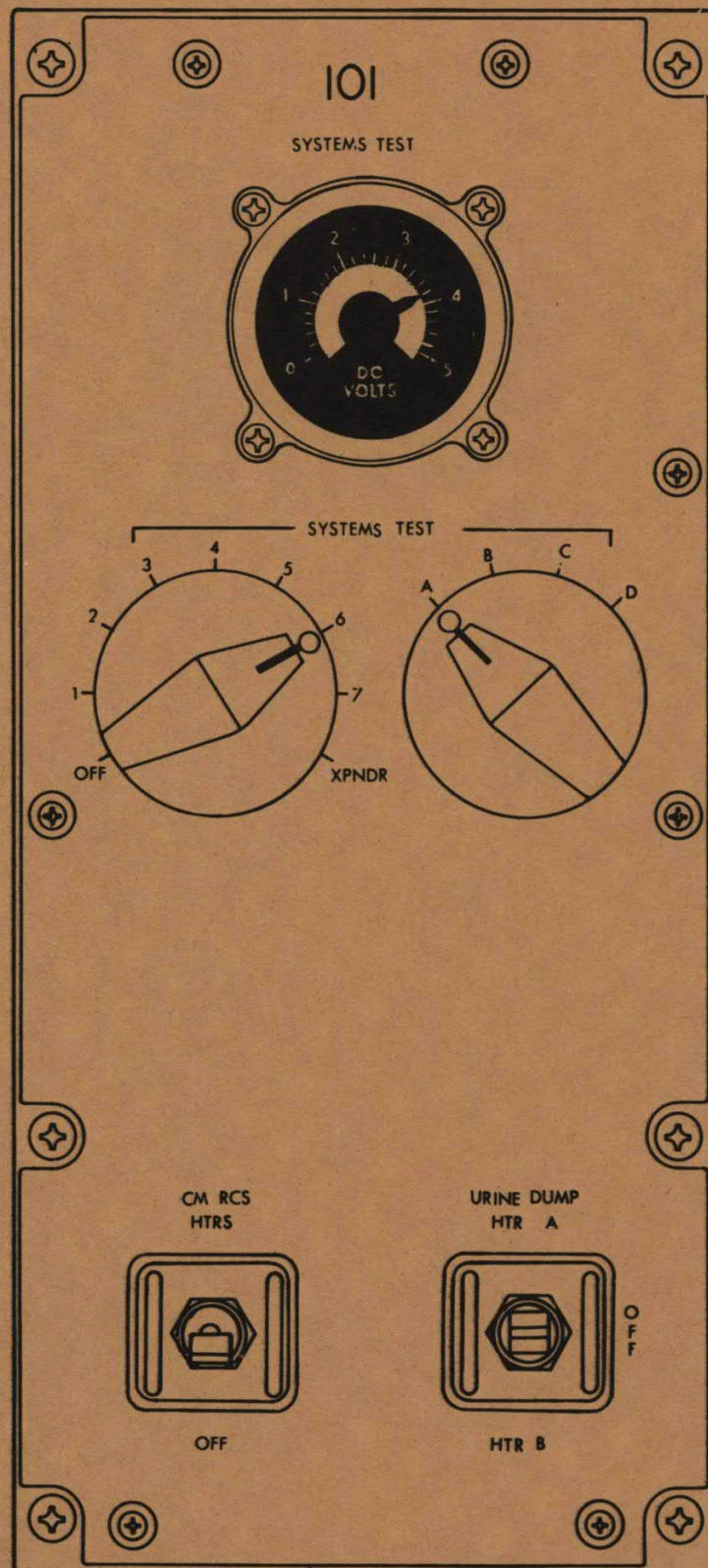
CSM 106 & SUBS

CD-2051D



RRT FUNCTIONAL BLOCK DIAGRAM

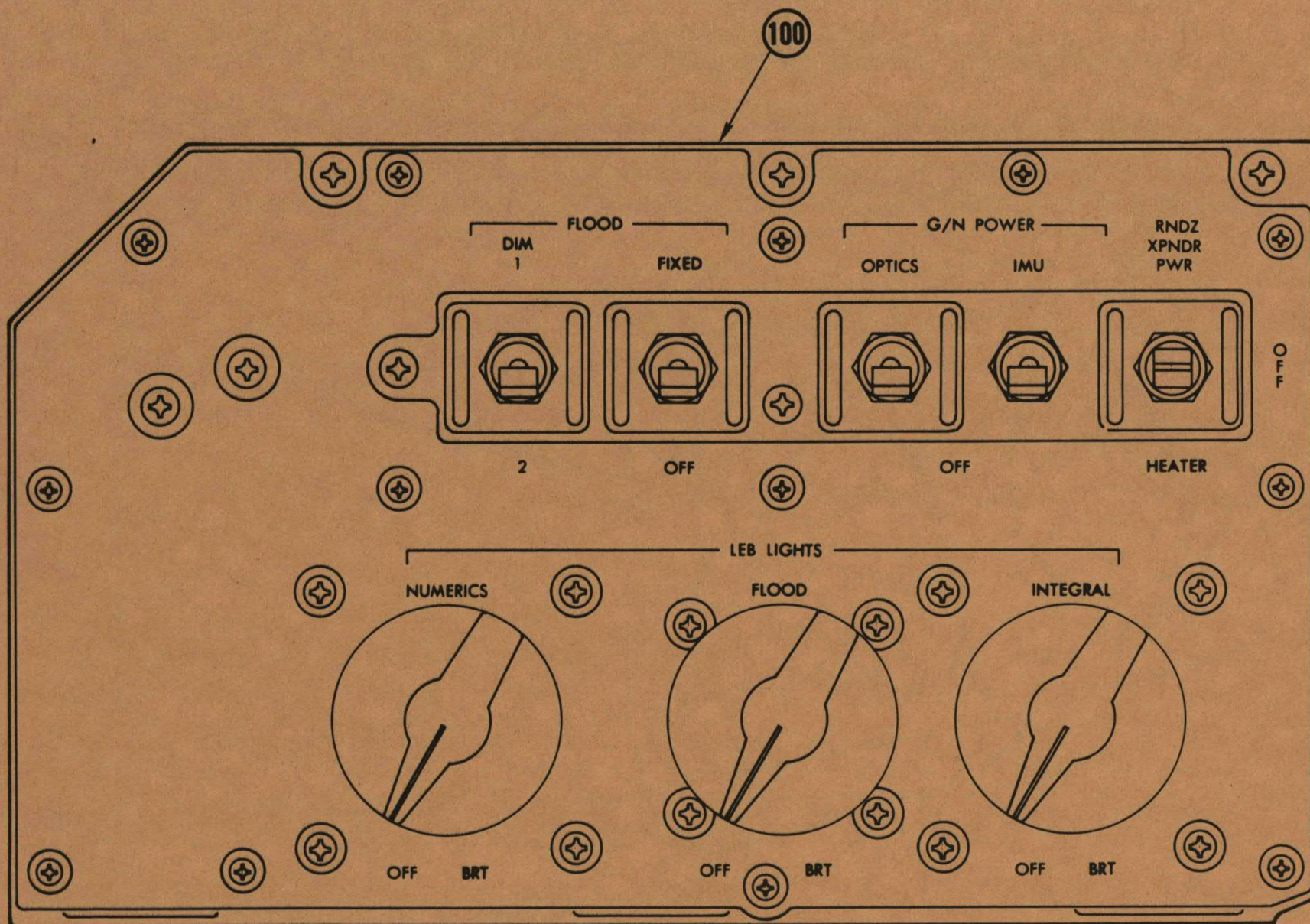




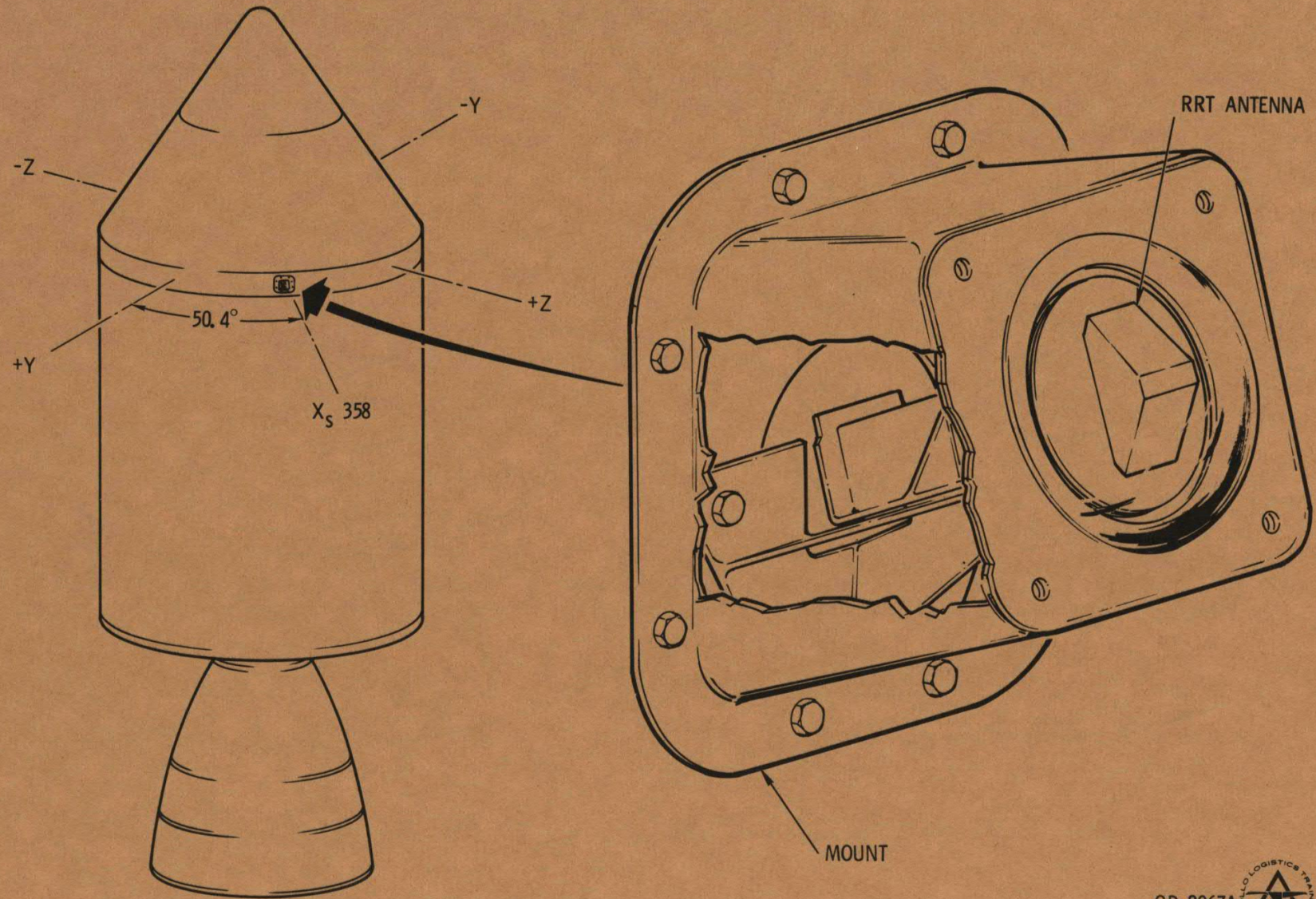
CSM 103

PN-101-3

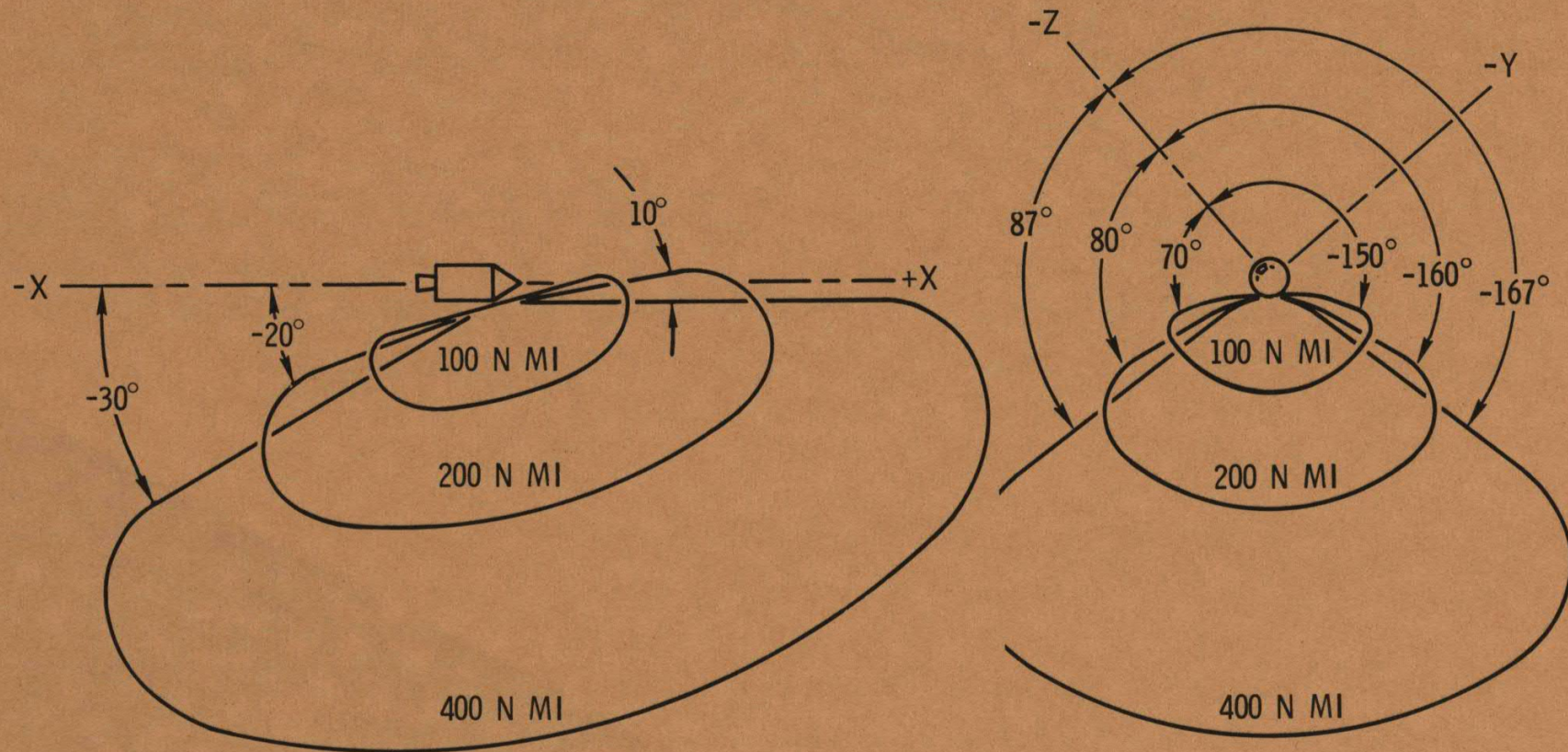


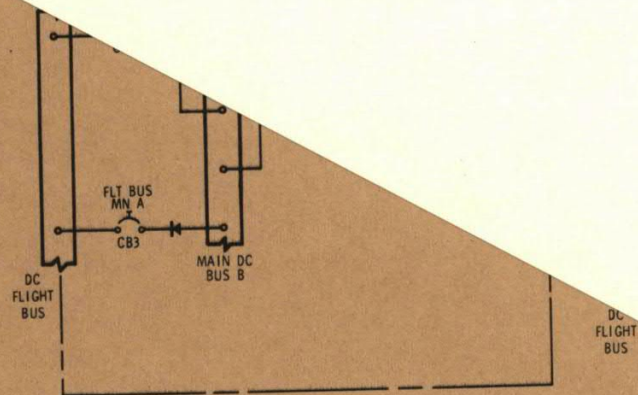


RRT ANTENNA

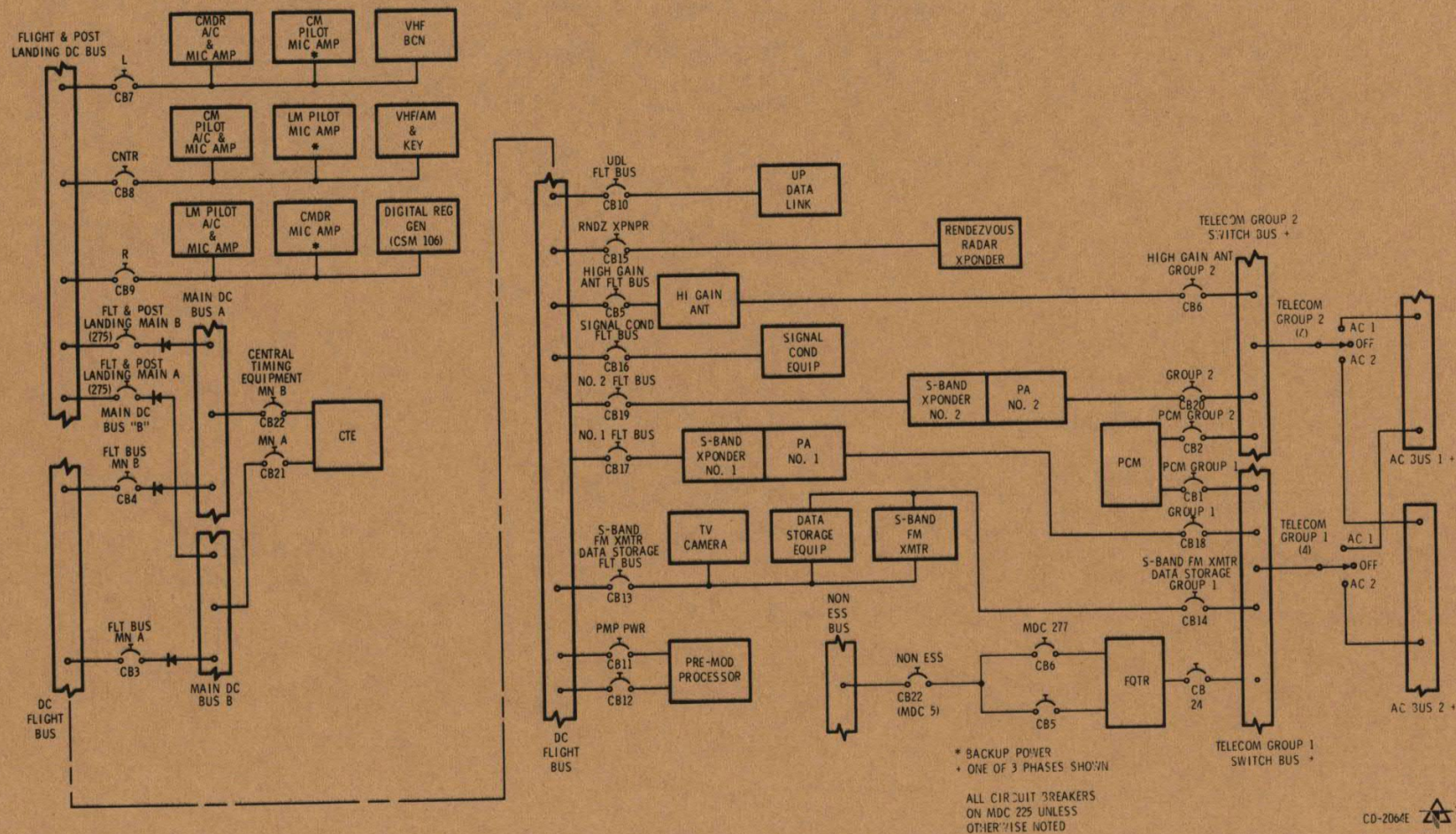


RRT ANTENNA COVERAGE



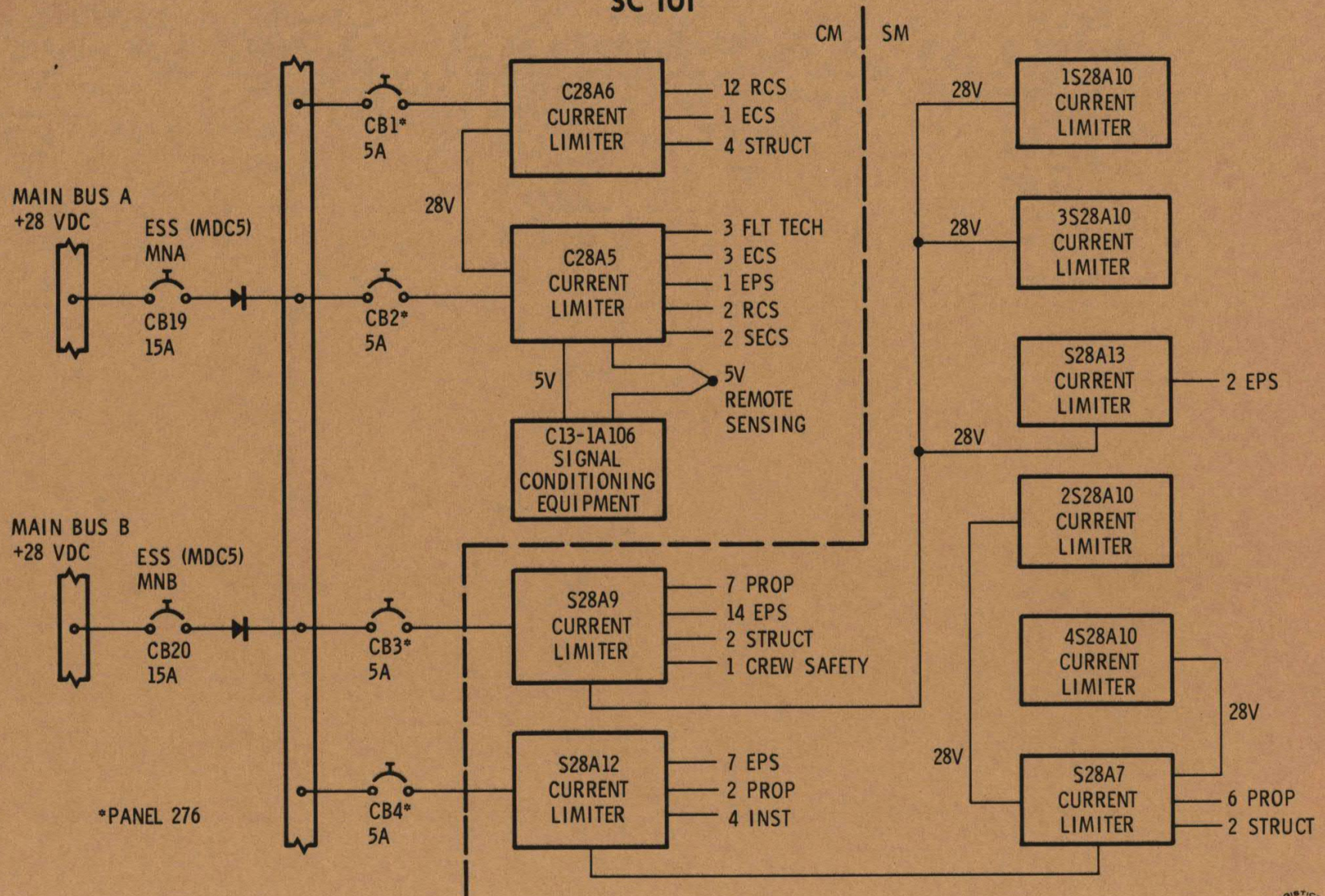


TELECOMM POWER DISTRIBUTION

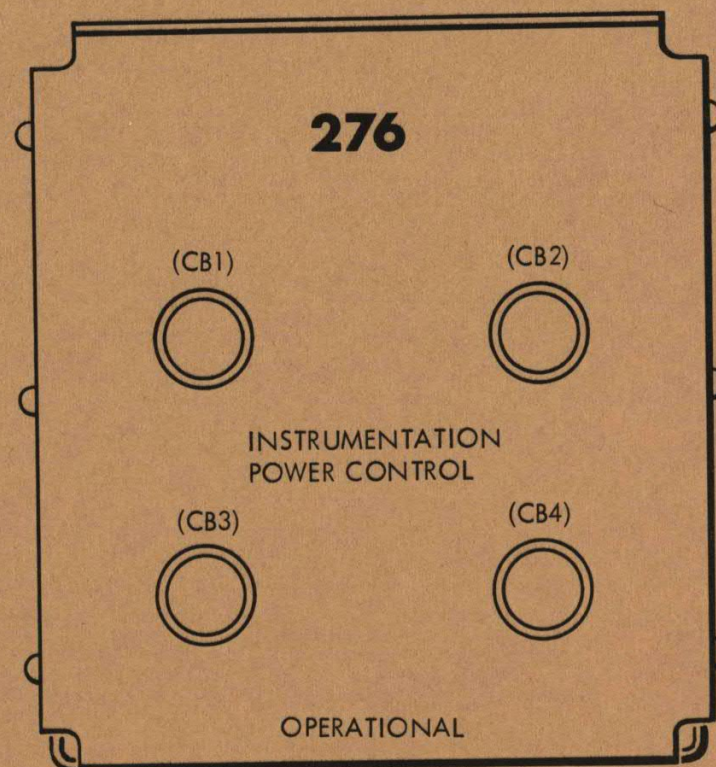
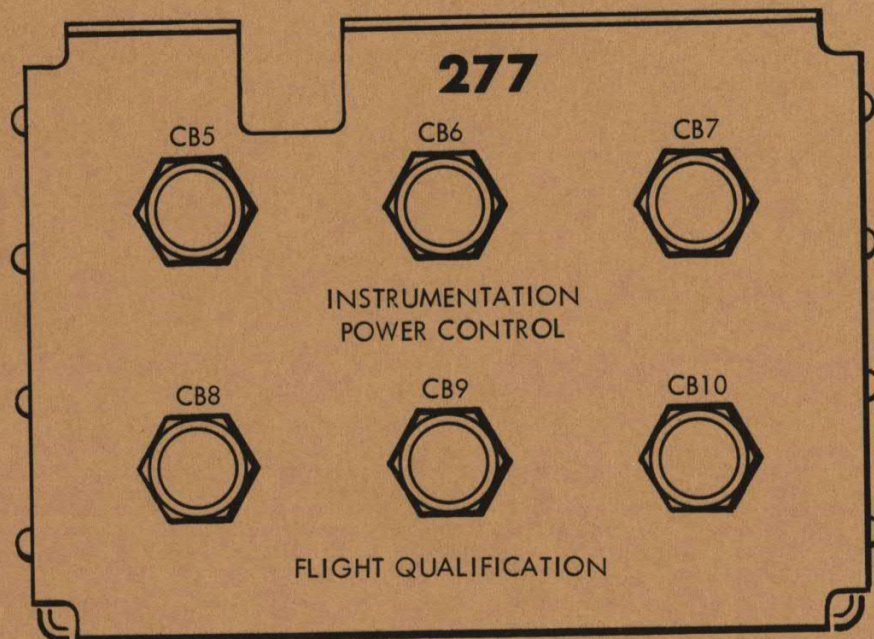


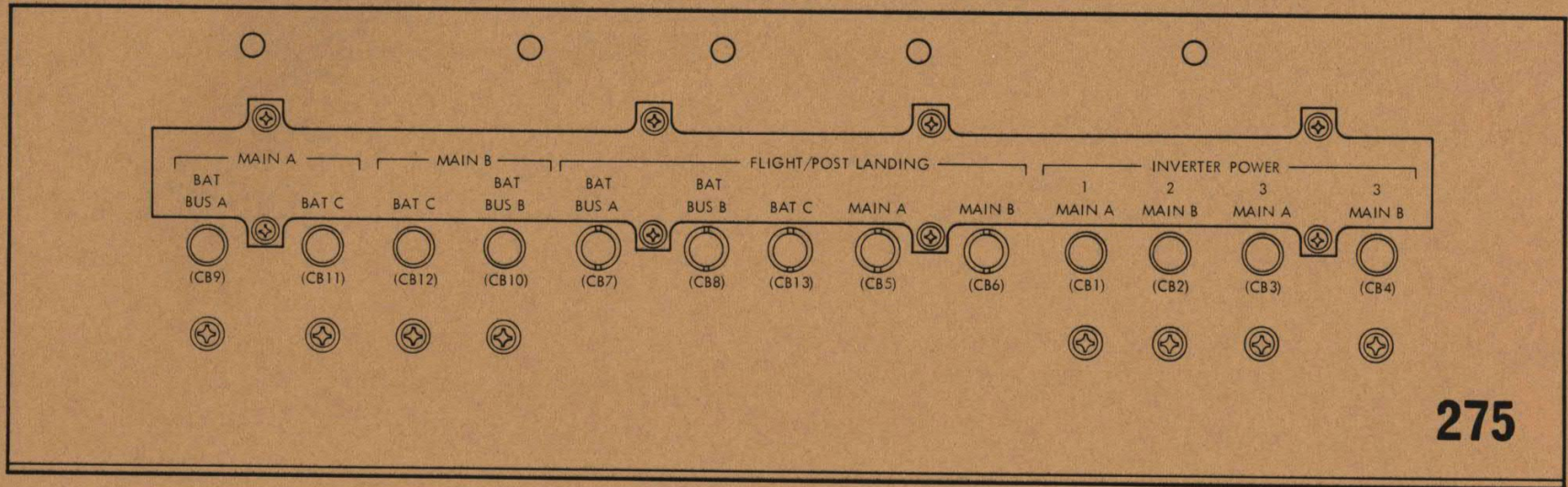
INSTRUMENTATION POWER DISTRIBUTION

SC 101

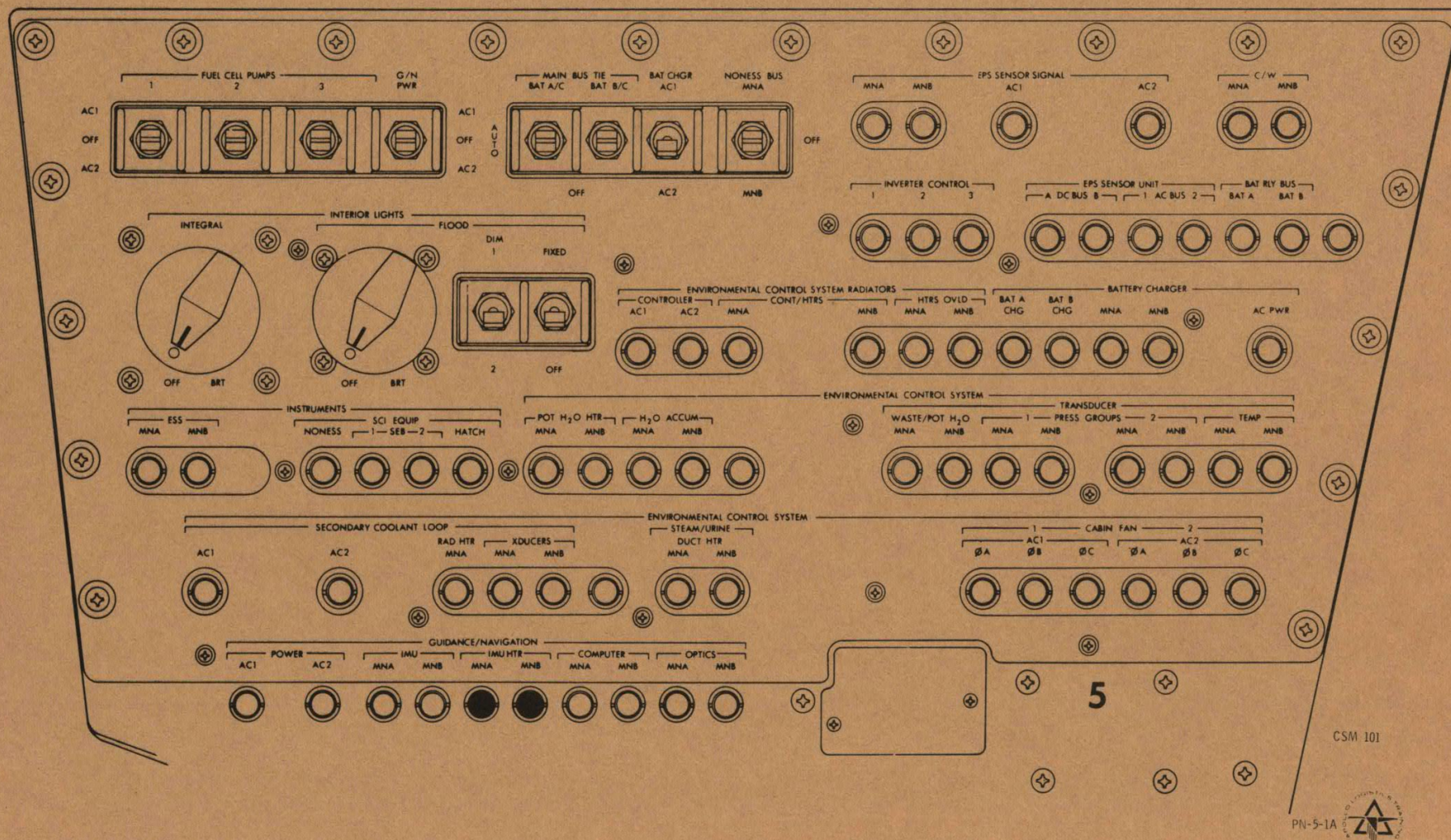


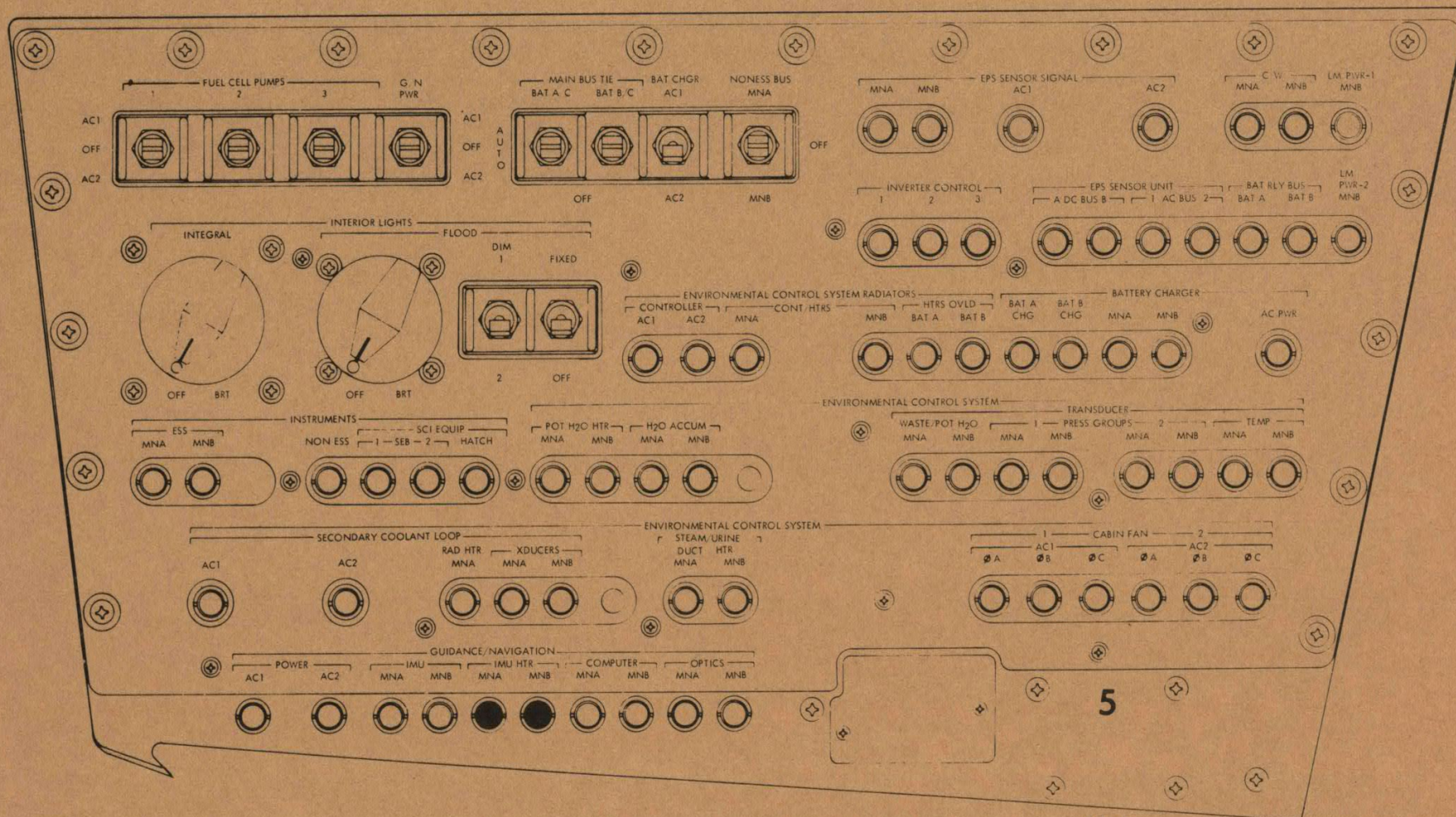
INSTRUMENTATION POWER CONTROL PANELS



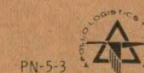


275

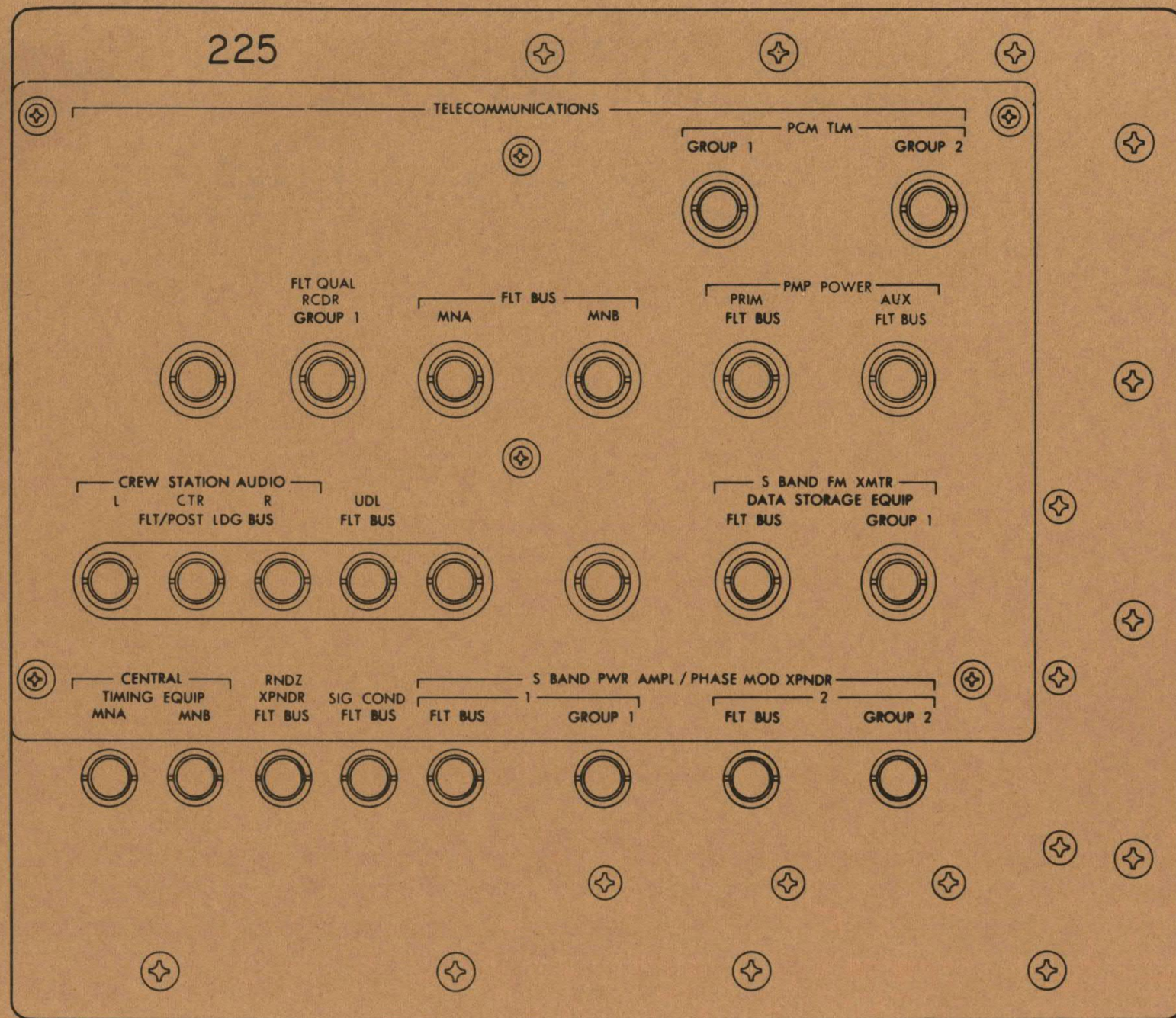


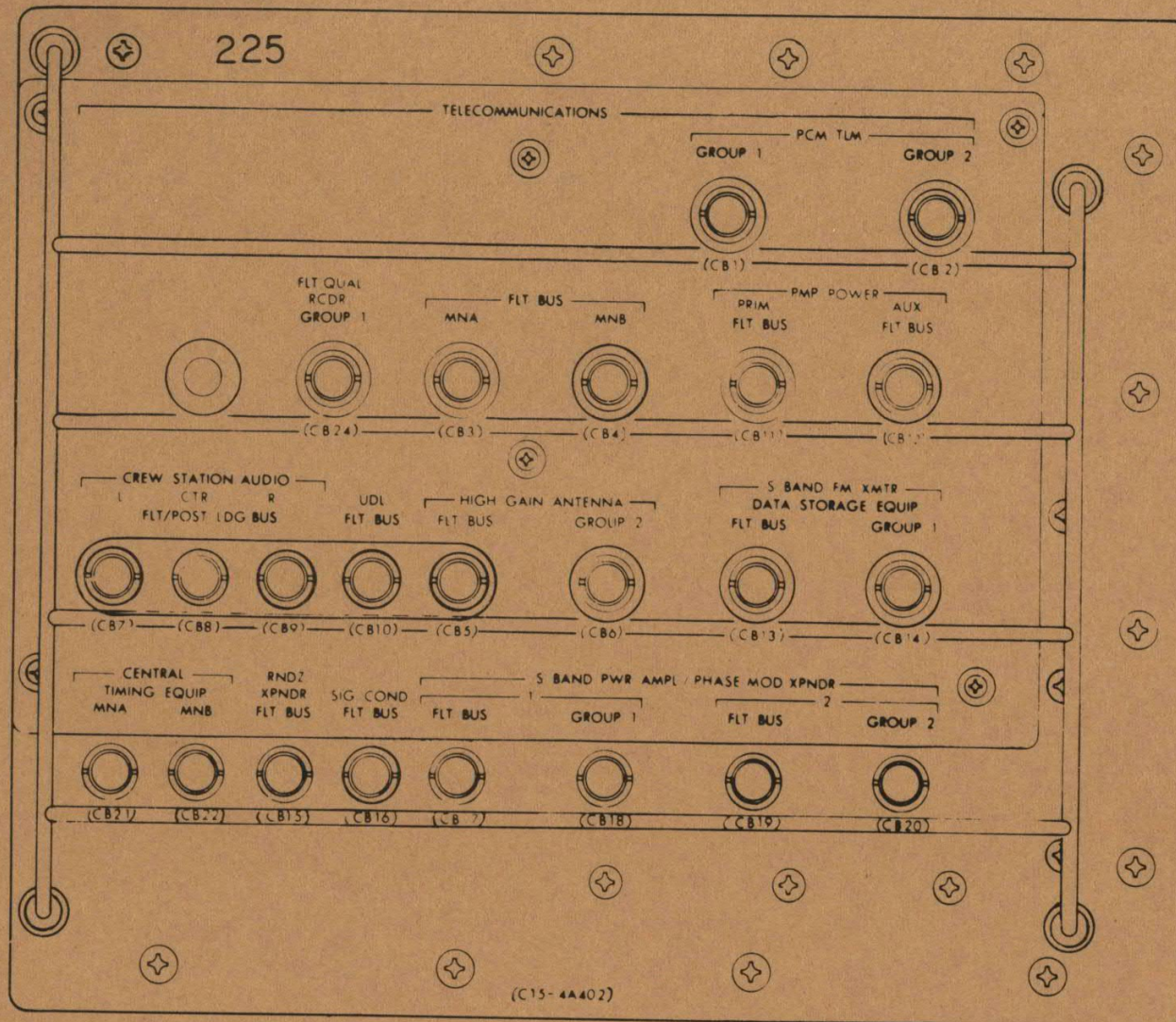


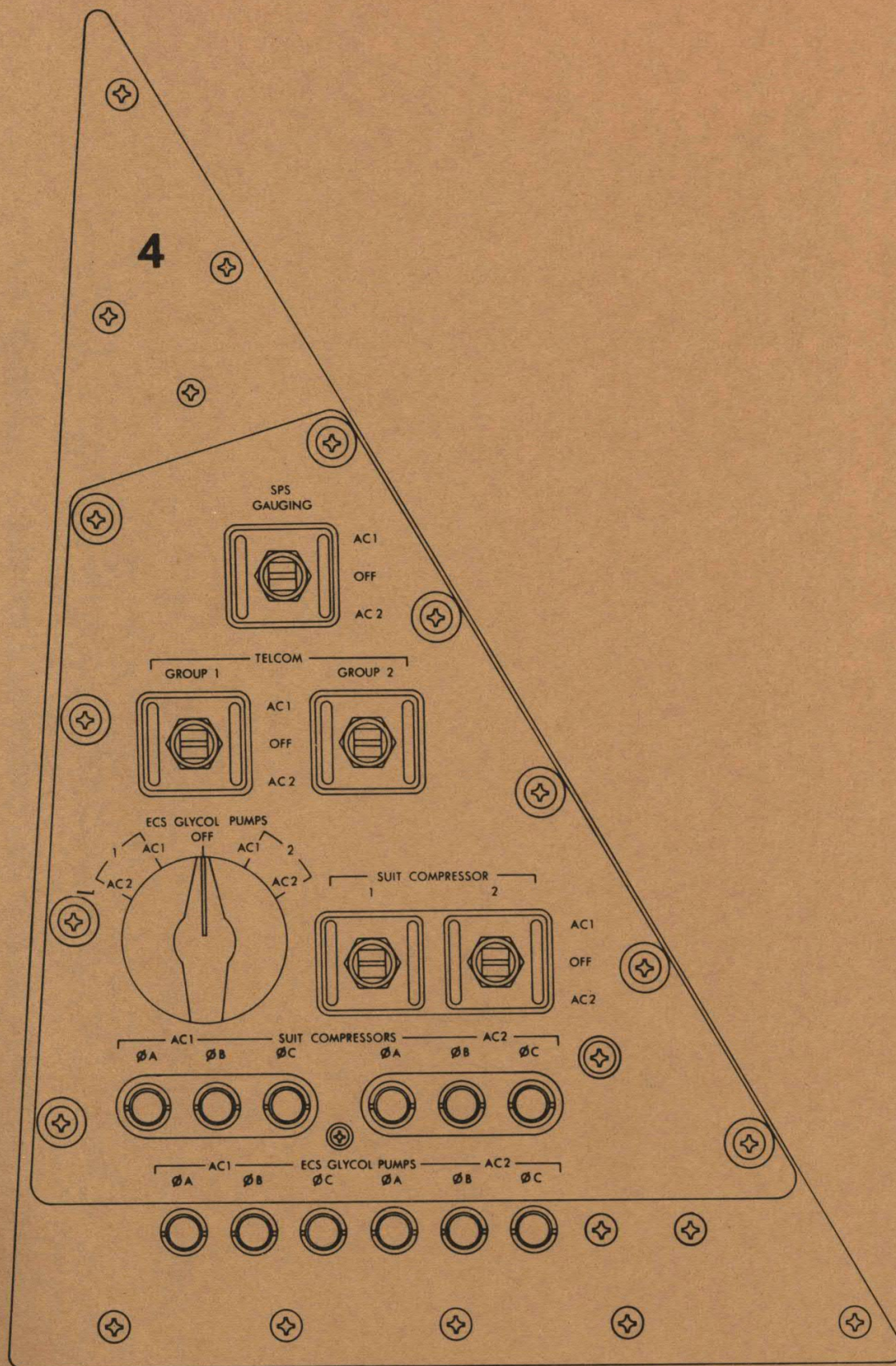
CSM 103



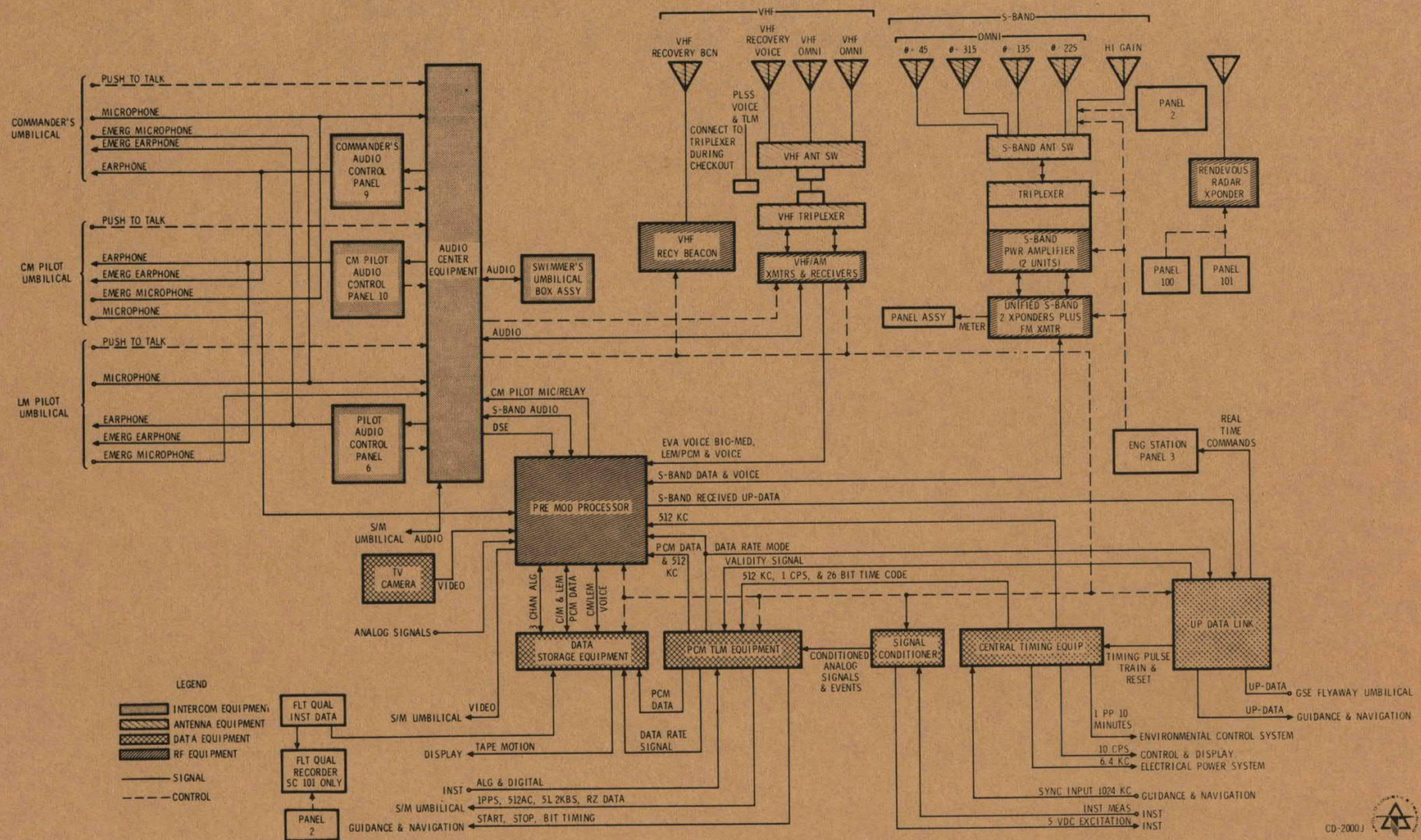
PN-5-3







BLOCK II TELECOMMUNICATIONS SYSTEM



TELECOMMUNICATIONS SYSTEM

A-1

Abbreviations and Acronyms.

ac	- alternating current (noun)
a-c	- alternating current (adj)
ACE	- Automatic Checkout Equipment
ACP	- Audio Control Panel
AGC	- Apollo Guidance Equipment
AGC	- Automatic Gain Control
AGE	- Aerospace Ground Equipment
ALC	- Automatic Load Control
AM	- Amplitude Modulation
AMP	- Ampere or Amplifier
AMPL	- Amplifier
AMR	- Atlantic Missile Range
ANL	
ANLG or	- Analog
Auto	- Automatic
AVC	- Automatic Volume Control
BCD	- Binary Coded Decimal
BCN	- Beacon (Transmitter only; (no receiver)
Biomed	- Biomedical
bps	- bits per second
BU	- Backup
CI	- Communications Instrumentation
CCTV	- Closed Circuit Television
CLM	- Core Logic Module
CM	- Command Module
C/O	- Checkout
Coax	- Coaxial
COMM	- Communications
Compen	- Compensator
Cont	- Control or Continued
CPLR	- Coupler
CRC	- Collins Radio Company
CSM	- Command and Service Modules
CTE	- Central Timing Equipment
CW	- Continuous Wave
db	- decibel
dbm	- decibels with respect to one milliwatt
dbw	- decibels with respect to one watt
dc	- direct current (Noun)
d-c	- direct current (Adj)
Deg	- degree
DET	- Detector
DISCR	- Discriminator
DRI	- Data Rate Indicator
DRM	- Drafting Room Manual
DS	- Data Storage
DSE	- Data Storage Equipment
DSIF	- Deep Space Instrumentation Facility

EKC	- Emergency Key Communications.
EMER	- emergency
EMI	- Electromagnetic Interference
EU	- electronic unit
EVA	- Extra Vehicular Activity
EVC	- Extra Vehicular Crewman
EVSTC	- Extra Vehicle Spacecraft Telemetry & Communications
f_c	- center frequency
FDT	- Full Duplex Teletype Circuit
FM	- Frequency Modulation
FOV	- Field of Vision
FQ	- Flight Qualification
fs	- full scale
FSK	- Frequency Shift Keyed
FWD	- Forward
gc	- gigacycles
GFE	- Government Furnished Equipment
GMT	- Greenwich Mean Time
G&N	- Guidance and Navigation Subsystem
GND	- Ground
GSE	- Ground Support Equipment
GSFC	- Goddard Space Flight Center
HF	- High Frequency
HGA	- High Gain Antenna
H _i	- high
HSD	- High Speed Data
Hz	- Hertz (cycles per second)
IC	- Intercom
IF	- Intermediate Frequency
IFM	- In-Flight Maintenance
in.	- inch
IPS	- Instrumentation Power System
ips	- inches per second
IRIG	- Inter-Range Instrumentation Group
IRIG	- Inertial Rate Integrating Gyro
k	- kilo (1000)
kbs	- kilobits per sec
kHz	- kiloHertz (kilocycle)
kmHz	- kilomegaHertz (kilomegacycles)
LAD	- Los Angeles Division
lb	- pound(s)
LCC	- Launch Control Center
LEB	- Lower Equipment Bay
LEM	- Lunar Excursion Module
LF	- Low Frequency
LOS	- Line of Sight
LSB	- Lower Side Band
LSB	- Least Significant Bit
MAX.	- maximum
MCC	- Mission Control Center
MDC	- Main Display Console

MDP	- Main Display Panel
MED	- medium
mHz	- megaHertz
mike	- microphone
mil	- 1/1000 of a measure (e.g. milliradian)
min	- minimum
MOD	- Modulator
MSFN	- Manned Spacecraft Flight Network
mv	- millivolt
mw	- milliwatt
NAND	- negative AND (boolean)
nb	- narrow band
NEG	- negative
NLT	- not less than
nmi	- nautical miles
NMT	- no more than
NRZ	- non return to zero
NSIF	- Near Space Instrumentation Facility
OMNI	- omnidirectional
OSC	- oscillator
PA	- Power Amplifier
PAM	- Pulse Amplitude Modulation
PCM	- Pulse Code Modulation
PDM	- Pulse Duration Modulation
PEP	- Peak Envelope Power
pf	- picofarad
pf	- pulse frequency
PLBK	- playback
PLSS	- Portable Life Support System
PM	- Phase Modulation
PMP	- Premodulation Processor
PMR	- Pacific Missile Range
POT	- Potentiometer
p-p	- peak-to-peak
PPM	- Pulse Position Modulation
pps	- pulses per second
prf	- pulse repetition frequency
PRIM	- Primary
PRN	- Pseudo-Random Noise
PSK	- Phase Shift Keyed
PTT	- Push-to-Talk
PWR	- Power
R	- Range
RC	- Radio Command
RCDR	- Recorder
RCS	- Reaction Control Subsystem
RCV	- Receive
RCVR	- Receiver
R&D	- Research and Development
REC	- Receive
REG	- Regulated
RF	- Radio Frequency

7

RFI	- Radio Frequency Interference
RMS	- Root Mean Square
RNDZ	- Rendezvous
RNG	- Ranging
RTTV	- Real Time Television
RZ	- Return to Zero
S-Band	- 1550 to 4000 mHz
SC	- Signal Conditioning
SC	- Spacecraft
SCE	- Signal Conditioning Equipment
SCI	- Scientific
SCIN	- Combined Scimitar and Notch Antennas
sco	- subcarrier oscillator
SCS	- Stabilization and Control Subsystem; Spacesuit Com-
SEC	- Secondary
SENS	- Sensitivity
SEP	- Spacecraft Electronic Package
SIG	- Signal
SITE	- Spacecraft Instrumentation Test Equipment
SLA	- Spacecraft LEM Adapter
SM	- Service Module
S+N/N	-
SPCS	- Spacecraft Personal Communications System
SPDT	- Single Pole, Double Throw
SP3T	- Single Pole, Triple Throw
sps	- samples per second
SSB	- Single Sideband
STBY	- Standby
SYNC	- Synchronization
SW	- Switch
Temp	- Temperature
TLM	- Telemetry
T/M	- Telemeter
TR	- Transmit-Receive
TV	- Television
TWT	- Traveling Wave Tube
UDL	- Up-Data Link
UHF	- Ultra High Frequency (300 to 3000 mHz)
USBE	- Unified S-Band Equipment
uv	- microvolt
uw	- microwatt
V	- Voice
v	- volt
vac	- volts, alternating current
VCO	- Voltage-Controlled Oscillator
vdc	- volts, direct current
VGP	- Vehicle Ground Point
VHF	- Very High Frequency (30 to 300 mHz)
VHF/AM	- VHF/audio modulated
vol	- volume
VOX	- voice-operated relay
VSWR	- Voltage Standing Wave Ratio
W	- word

wpm	- words per minute
X-Band	- 7000 to 10,900 MHz
XCVR	- Transceiver
XFMR	- Transformer
XMIT	- Transmit
XMTR	- Transmitter
XPONDER	- Transponder
XSTR	- Transistor
XTAL	- Crystal

Definitions

Biphase modulation	- An RF modulation technique where PCM wave-form modulates a carrier or sub-carrier by switching its phase positively when the wave-form is positive, and negatively when the wave-form is zero or negative.
Closed Circuit Television	- A television system which does not include an RF link between the camera and monitor.
Coherent Transponder	- The phase of the transmitted signal has a definite, known relationship to the phase of the received signal.
Commutator	- As used herein, an electronic switch which converts a group of parallel signals, each on a separate parallel channel, to a serial train of signals on a single serial channel.
Decommutator	- As used herein, an electronic switch which converts a serial train of signals on a single serial channel to a group of parallel signals each on a separate parallel channel.
Near Earth	- Altitudes up to 8000 nautical miles.
Operational Instrumentation	- Instrumentation used to obtain information for assessment of crew status, spacecraft performance, and environmental conditions.
Predetection Recorder	- Magnetic tape recorder which records the received signal at the receiver IF output before demodulation.

Pseudo-Random Noise Ranging	- A JPL-developed technique of determining range of the spacecraft from a DSIF station utilizing pseudo-random noise modulation.
R&D Instrumentation	- Instrumentation used for the development and qualification of the spacecraft and its systems.
Real Time TV Transmission	- TV information is transmitted as it is obtained with no appreciable delay; as opposed to tape-stored or slow scan techniques.
Scientific Instrumentation	- Instrumentation used for scientific observation, measurement or experimentation not related to spacecraft system operation.
Signal Conditioner	- Circuitry required to change the form of the electrical signal furnished by the sensor or data source to a form suitable for use by the telemetry coder.
Slant Range	- Range directly to the object.
Television Frame Transceiver Transponder	- A single complete TV picture. - Transmitter and receiver combination. - Transmitter and receiver: transmits reply to proper received signal or transmitter output is some function of the received signal.
Triplexer	- Frequency-shares a single antenna by three or more units of equipment.
Video Signal	- Television signal containing picture information before coding or modulation; may or may not contain sweep synchronization information.