JSC-11174

Space Shuttle Systems Handbook

Volume II - Sections 12 through 20

Mission Operations Directorate
Systems Division

Revision D, DCN-2
April 20, 1988

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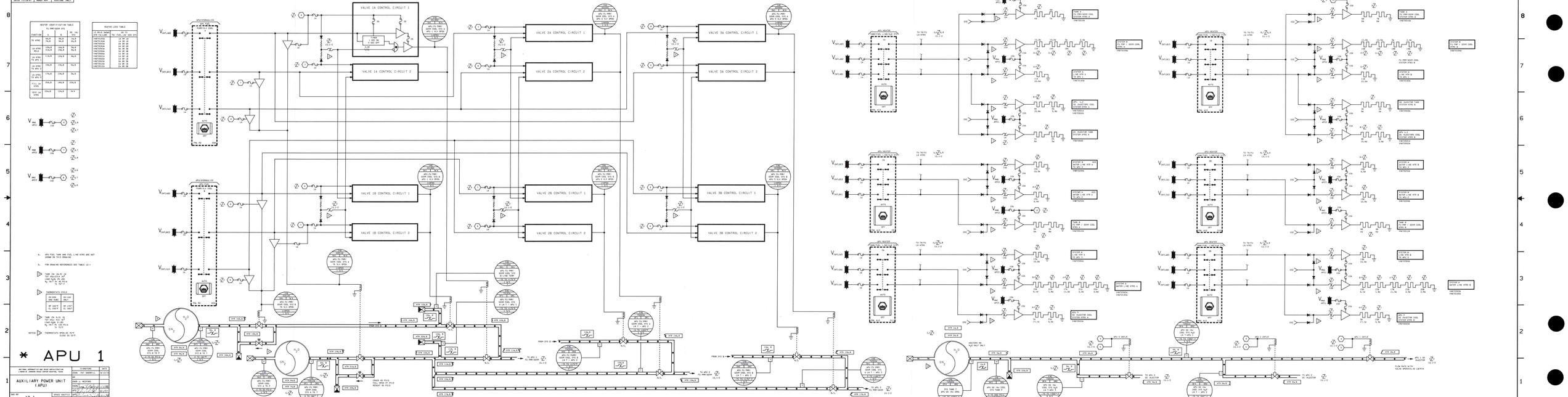
DCN-2, dated April 20, 1988.

NASA
National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

12. APU/HYDRAULICS SYSTEMS


* APU 1
AUXILIARY POWER UNIT (APU)
HEATER IDENTIFICATION TABLE
HEATER LOSS TABLE
VALVE 1A CONTROL CIRCUIT 1
VALVE 1A CONTROL CIRCUIT 2
VALVE 2A CONTROL CIRCUIT 1
VALVE 2A CONTROL CIRCUIT 2
VALVE 3A CONTROL CIRCUIT 1
VALVE 3A CONTROL CIRCUIT 2
VALVE 1B CONTROL CIRCUIT 1
VALVE 1B CONTROL CIRCUIT 2
VALVE 2B CONTROL CIRCUIT 1
VALVE 2B CONTROL CIRCUIT 2
VALVE 3B CONTROL CIRCUIT 1
VALVE 3B CONTROL CIRCUIT 2
APU HYDRAULIC CCS
APU HEATER
BASIC REV D-2
BASIC REV D-2

2 HYD/APU LN SCHEM

HYDRAULIC/APU LINE SCHEMATIC

	SIGNATURE	DATE
SYSTEM ENGR	C. HUMPHREY	6/26/92
QR	R. TUNSTALL	6/8/92
MGR	L. TUNSTALL	6/8/92
CHIEF ENGR		

DWG NO 12.2 | SPACE SHUTTLE | SHT 1 OF 1 | REV

BASIC REV D

NOTES:
1. FOR DRAWING REFERENCES SEE TABLE 12.1
2. NOT ON OV-102
3. TUBE BEND RAD AND QUANTITY APPROXIMATE
4. ALL MATTING AT 28 VDC

LEGEND

APU FUEL (HYDRAZINE)
HYDRAULIC FLUID
WATER
LUBE OIL
NITROGEN
HEATED AND INSULATED
HEATER (NOTE)

NOTE: HEATER TEMPERATURES: 300F/149C ON 510F/266C OFF
NOTE: HEATER TEMPERATURES: 300F/149C ON 510F/266C OFF

NOTE: REFER TO ELECTRICAL EQUIPMENT LIST FOR ACCURATE WATTAGES

VIEW G - 1306 BULKHEAD LOOKING FORWARD

APU H2O COOLING SYSTEM

VIEW C-PORT SIDE LOOKING OUTBOARD

VIEW A 1307 BULKHEAD LOOKING FORWARD

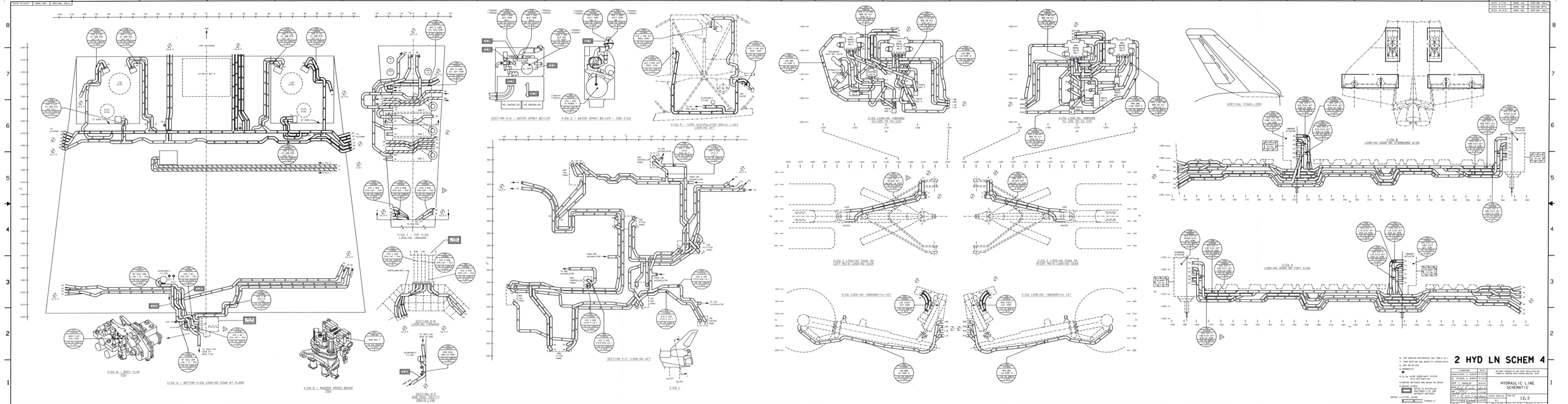
VIEW B - STARBOARD SIDE LOOKING OUTBOARD

VIEW F-APU

VIEW E-APU

VIEW D-APU

BASIC REV D



1. FOR DRAWING REFERENCES SEE TABLE 12-1
2. FOR ZONES SEE ZONE AND SWATH TY APPROPRIATE
3. REF. MS-00-100
4. THERMOSTAT
5. ⅜ ⅝ ¾ HYD EMERGENCY SYSTEM ⅜ ⅝ ¾ HYD UTILITY SYSTEM
6. HEATER MATCHES ARE NICKED ON INSIDE
7. HEATER ELEMENT
   - ELECTRICAL TO ELECTRICAL
   - ELECTRICAL TO HYDRAULIC
   - HEATER MATCHES

NOTES: 1-FLYING LEADS

CLEARANCE	DATE
DESIGN ENGR. M. MURPHY	9/13/82
DRAFTING M. MURPHY	9/13/82
MR. RICHARD A. MURPHY	9/13/82
CHIEF ENGINEER	9/13/82
PROJECT ENGINEER	
PROJECT MANAGER	
QUALITY ASSURANCE	
PRODUCTION CONTROL	
MFG. ENGINEERING	
MFG. MANAGER	

NATIONAL AERONAUTICAL AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

2 HYD LN SCHEM 4

HYDRAULIC LINE SCHEMATIC

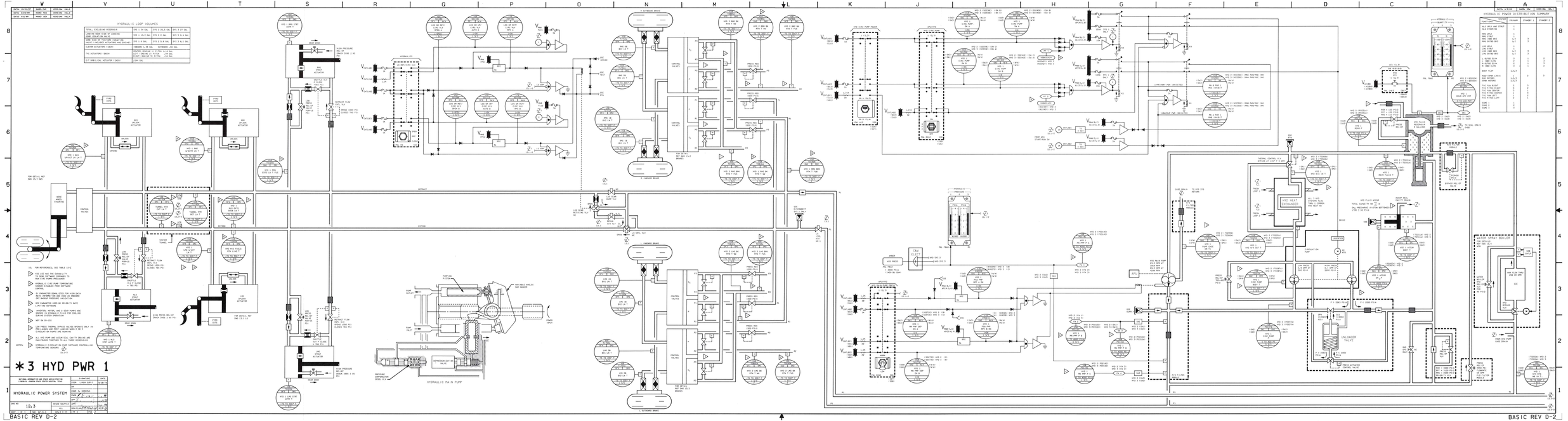
SPACE SHUTTLE | DWG NO. 12.2

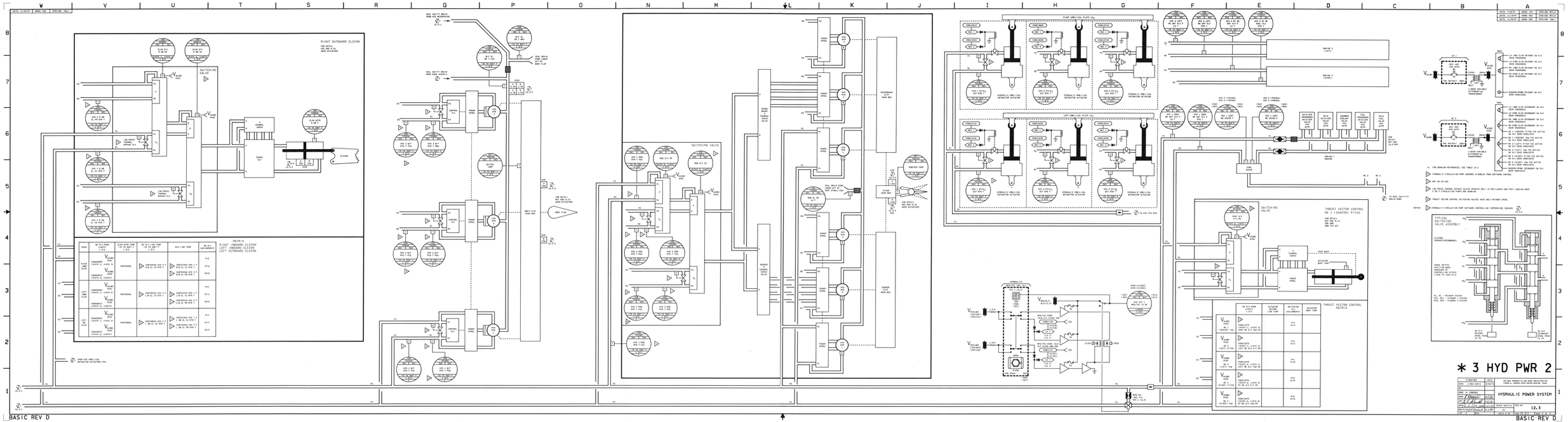
SCALE NTS | SHEET 1 OF 1

DATE/ BY/ W/P	NUMBER/ PAGE	VERSION/ TABLE
DATE/ BY/ W/P	NUMBER/ PAGE	VERSION/ TABLE
DATE/ BY/ W/P	NUMBER/ PAGE	VERSION/ TABLE

BASIC REV D

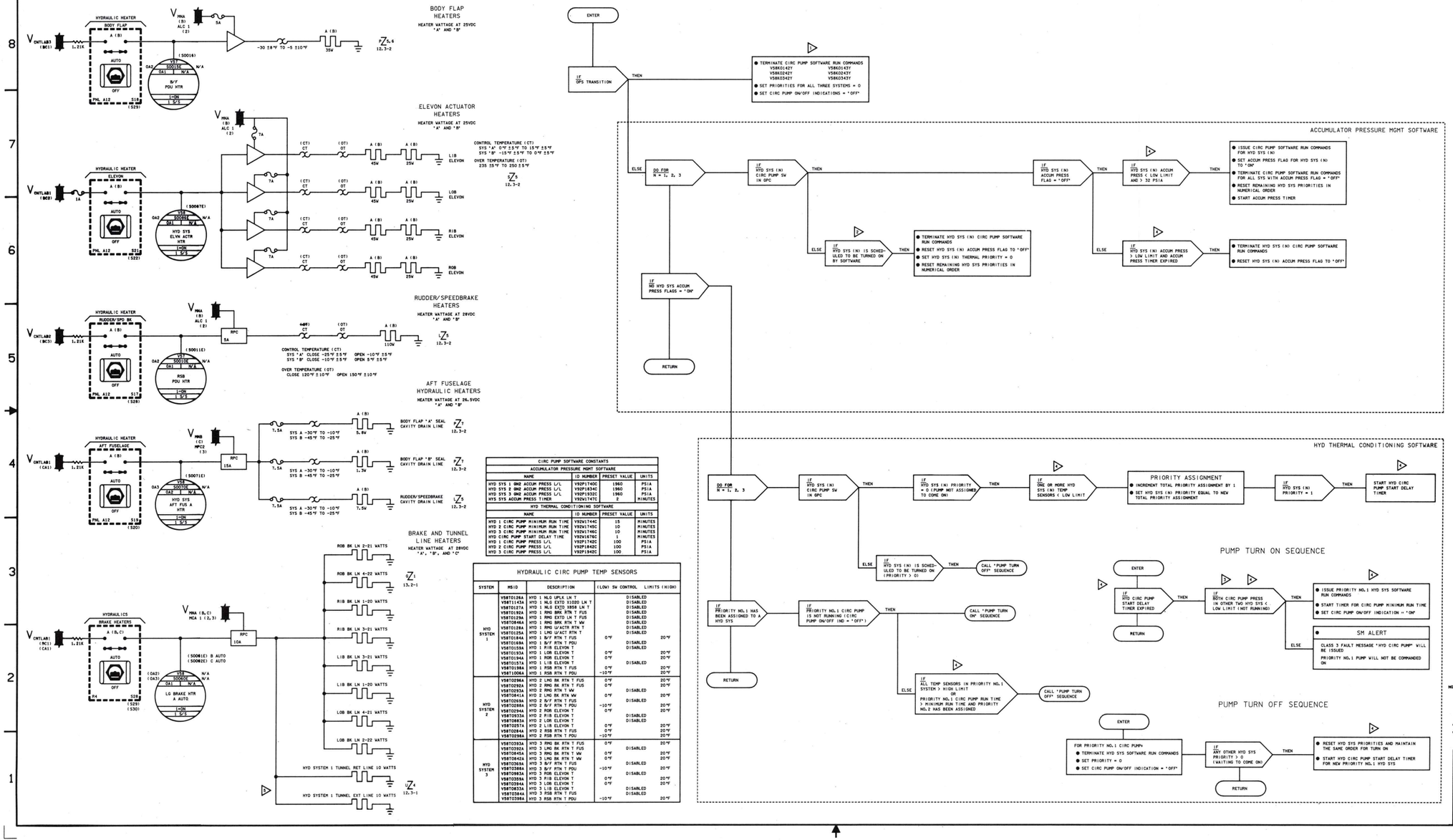
BASIC REV D


HYDRAULIC LOOP VOLUMES
HYDRAULIC POWER DISTRIBUTION SUMMARY
*3 HYD PWR 1
HYDRAULIC POWER SYSTEM
HYDRAULIC MAIN PUMP
BASIC REV D-2
BASIC REV D-2


RIGHT OUTBOARD ELEVON
SWITCHING VALVE
PATRIX
RIGHT INBOARD ELEVON
LEFT INBOARD ELEVON
LEFT OUTBOARD ELEVON
SWITCHING VALVE
RUDDER
BODY FLAP
RIGHT SPEEDBRAKE/ THRUST REVERSER
LEFT SPEEDBRAKE/ THRUST REVERSER
RIGHT WING FLAP
LEFT WING FLAP
RIGHT WING ELEVON
LEFT WING ELEVON
RIGHT OUTBOARD ELEVON
RIGHT INBOARD ELEVON
LEFT INBOARD ELEVON
LEFT OUTBOARD ELEVON
RUDDER
BODY FLAP
SPEEDBRAKE/ THRUST REVERSER
SWITCHING VALVE
THRUST VECTOR CONTROL MC 1 (CENTER) PITCH
THRUST VECTOR CONTROL PATRIX
ENGINE 2 (LEFT)
ENGINE 3 (RIGHT)
ENGINE 1 (CENTER)
* 3 HYD PWR 2
HYDRAULIC POWER SYSTEM
12.3

BASIC REV D

DATE= 10/9/87	NAME= TPM	VERSION= BPTs 7
DATE= 11/18/87	NAME= BJT	VERSION= BPTs 8
DATE= 11/25/87	NAME= DAM	VERSION= INKs 1



CIRC PUMP SOFTWARE CONSTANTS

ACCUMULATOR PRESSURE MGMT SOFTWARE

NAME	ID NUMBER	PRESET VALUE	UNITS
HYD SYS 1 GN2 ACCUM PRESS L/L	V92P1740C	1960	PSIA
HYD SYS 2 GN2 ACCUM PRESS L/L	V92P1834C	1960	PSIA
HYD SYS 3 GN2 ACCUM PRESS L/L	V92P1932C	1960	PSIA
HYS SYS ACCUM PRESS TIMER	V92W1747C	2	MINUTES

HYD THERMAL CONDITIONING SOFTWARE

NAME	ID NUMBER	PRESET VALUE	UNITS
HYD 1 CIRC PUMP MINIMUM RUN TIME	V92W1744C	15	MINUTES
HYD 2 CIRC PUMP MINIMUM RUN TIME	V92W1745C	10	MINUTES
HYD 3 CIRC PUMP MINIMUM RUN TIME	V92W1746C	10	MINUTES
HYD CIRC PUMP START DELAY TIME	V92W1676C	1	MINUTES
HYD 1 CIRC PUMP PRESS L/L	V92P1742C	100	PSIA
HYD 2 CIRC PUMP PRESS L/L	V92P1842C	100	PSIA
HYD 3 CIRC PUMP PRESS L/L	V92P1942C	100	PSIA

HYDRAULIC CIRC PUMP TEMP SENSORS

SYSTEM	MSID	DESCRIPTION	(LOW) SW CONTROL	LIMITS (HIGH)
HYD SYSTEM 1	V58T0126A	HYD 1 MLG UPLK LN T		DISABLED
	V58T1143A	HYD 1 MLG EXTD X1020 LN T		DISABLED
	V58T0127A	HYD 1 MLG EXTD X858 LN T		DISABLED
	V58T0129A	HYD 1 RMG BRK RTN T FUS		DISABLED
	V58T0129A	HYD 1 RMG EXTD LN T FUS		DISABLED
	V58T0484A	HYD 1 RMG BRK RTN T WW		DISABLED
	V58T0128A	HYD 1 RMG UFACTR RTN T		DISABLED
	V58T0125A	HYD 1 LMG UFACT RTN T		DISABLED
	V58T0184A	HYD 1 B/F RTN T FUS	0°F	20°F
	V58T0169A	HYD 1 B/F RTN T PDU		DISABLED
	V58T0159A	HYD 1 PIB ELEVON T		DISABLED
	V58T0193A	HYD 1 LOB ELEVON T	0°F	20°F
	V58T0194A	HYD 1 ROB ELEVON T	0°F	20°F
	V58T0157A	HYD 1 LIB ELEVON T		DISABLED
	V58T0198A	HYD 1 RSB RTN T FUS	0°F	20°F
	V58T1008A	HYD 1 RSB RTN T PDU	-10°F	20°F
HYD SYSTEM 2	V58T0284A	HYD 2 LMG BK RTN T FUS	0°F	20°F
	V58T0292A	HYD 2 RMG BK RTN T FUS	0°F	20°F
	V58T0283A	HYD 2 RMG RTN T WW		DISABLED
	V58T0841A	HYD 2 LMG BK RTN WW	0°F	20°F
	V58T0284A	HYD 2 B/F RTN T FUS		DISABLED
	V58T0288A	HYD 2 B/F RTN T PDU	-10°F	20°F
	V58T0284A	HYD 2 PDB ELEVON T	0°F	20°F
	V58T0933A	HYD 2 PIB ELEVON T		DISABLED
	V58T0883A	HYD 2 LOB ELEVON T		DISABLED
	V58T0257A	HYD 2 LIB ELEVON T	0°F	20°F
	V58T0284A	HYD 2 RSB RTN T FUS	0°F	20°F
	V58T0298A	HYD 2 RSB RTN T PDU	-10°F	20°F
HYD SYSTEM 3	V58T0393A	HYD 3 RMG BK RTN T FUS	0°F	20°F
	V58T0392A	HYD 3 LMG BK RTN T FUS	0°F	20°F
	V58T0845A	HYD 3 RMG BK RTN T WW	0°F	20°F
	V58T0842A	HYD 3 LMG BK RTN T WW	0°F	20°F
	V58T0384A	HYD 3 B/F RTN T FUS		DISABLED
	V58T0388A	HYD 3 B/F RTN T PDU	-10°F	20°F
	V58T0933A	HYD 3 PDB ELEVON T		DISABLED
	V58T0884A	HYD 3 PIB ELEVON T	0°F	20°F
	V58T0394A	HYD 3 LOB ELEVON T	0°F	20°F
	V58T0833A	HYD 3 LIB ELEVON T		DISABLED
	V58T0384A	HYD 3 RSB RTN T FUS		DISABLED
	V58T0398A	HYD 3 RSB RTN T PDU	-10°F	20°F

6. FOR DRAWING REFERENCES, SEE TABLE 12-1

TUNNEL LINE HEATERS ARE ON SYSTEM A ONLY, AND ARE HOT ON OV-102

HYD TEMPERATURE LOW AND HIGH LIMITS, ACCUM PRESS LOW LIMIT ACCUM PRESS TIMER, START UP TIME DELAY, PUMP MINIMUM RUN TIME, CIRC PUMP PRESS LOW LIMIT ALL ARE CHANGEABLE BY TPBU OR ONBOARD ITEM ENTRY - SEE TABLES FOR CONSTANT VALUES

LOW LIMIT MUST BE CHANGED BY ITEM ENTRY OR TPBU TO ALLOW SIMULTANEOUS MANUAL/OPC OPERATIONS

PUMP WOULD BE SCHEDULED FOR TURN ON IF ACCUM PRESS FLAG = ON OR IF PUMP WERE PRIORITY NO.1

NOTES: KSC COMMANDS ARE USED TO RUN THE CIRC PUMPS PRELAUNCH AND REMAIN SET 'ON' UNTIL CLEARED BY THE OPS 2 INITIALIZATION

*3 HYD PWR 3

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN VICKI SL. DOGETT	6/8/78	
DR MONYA D. UPDIALES	7/27/87	
ENGR R. DOREMUS		HYDRAULIC POWER SYSTEM
ENGR		
APP	11/18/87	
APP	12/1/87	SPACE SHUTTLE DWG NO 12.3
OPNPLAN	12-8-87	ALL
LTR D	PCN	66 X 34 PMD 12.3-3 SHEET 3 OF 3

BASIC REV D

FOR DETAILED COMPONENT AND LOGIC INFORMATION REFER TO:

SSSH DWG NO.	SSSH DWG TITLE	VENDOR NAME	VENDOR DWG NO.	VENDOR SHEET NO.	REV	DATE	VENDOR DRAWING TITLE
12.1-1	AUXILIARY POWER UNIT (APU)	ROCKWELL	VS70-460109	ALL	G	1/87	SCHEMATIC DIAGRAM - AUXILIARY POWER UNIT SUBSYSTEM
			V070-465463	ALL	A	6-87	HEATER INSTALLATION - APU SYSTEM, FUEL, AND LUBE OIL
12.1-2	AUXILIARY POWER UNIT (APU)	ROCKWELL	V070-465510	ALL		8/79	TANK AND HEATER ASSEMBLY, APU ACTIVE COOLING SYSTEM, WATER
			VS70-460109	ALL	G	1/87	SCHEMATIC DIAGRAM - AUXILIARY POWERT UNIT SUBSYSTEM
12.2-1	HYD/APU LINE SCHEMATIC	R. I.	V070-585015	1-5	A	4/9/84	HYDRAULIC SUB-SYSTEMS INSTALLATION UPPER AFT FUSELAGE, STATION 1307
12.2-2	HYDRAULIC LINE SCHEMATIC	R. I.	V070-586096	1 - 5	-	8/27/80	HYDRAULIC SUBSYSTEM INSTALLATION - RH WING & ELEVON ACTUATORS
			V070-587006	1	B	8/7/81	HYDRAULIC LINES INSTALLATION - MATING VERTICAL STABILIZER/AFT FUSELAGE
			V070-586095	1 - 4	-	10/1/80	HYDRAULIC SUBSYSTEM INSTALLATION - LH WING AND ELEVON ACTUATORS
			V070-586140	1 - 4	B	1/29/81	HYDRAULIC SUBSYSTEM INSTALLATION - LEFT HAND MLG WHEEL WELL
			V070-586145	1 - 4	B	11/19/85	HYDRAULIC SUBSYSTEM INSTALLATION - RIGHT HAND MLG WHEEL WELL
			VS70-580999	1 - 6	C	7/16/86	SCHEMATIC - HYDRAULIC SUBSYSTEM, ORBITER OV-103
12.3-1	HYDRAULIC POWER SYSTEM	ROCKWELL	VS70-580999	1-6	C	7/16/86	SCHEMATIC - HYDRAULIC SUBSYSTEM, ORBITER OV 103 ONLY
			VS70-580102	1, 2.3, 4, 5, 10, 11, 13	L	7/31/84	SCHEMATIC DIAGRAM - HYDRAULIC CONTROL SUBSYSTEM
			VS70-750589	1-8	D	7/19/83	SCHEMATIC DIAGRAM OI-HYDRAULIC MEASUREMENTS
12.3-2	HYDRAULIC POWER SYSTEM	ROCKWELL	VS70-580999	1-6	C	7/16/86	SCHEMATIC - HYDRAULIC SYSTEM, ORBITER OV-103 ONLY
		ROCKWELL	VS70-580102	4, 5, 6, 8, 9, 10, 12	L	7/31/84	SCHEMATIC DIAGRAM - HYDRAULIC CONTROL SUBSYSTEM
		ROCKWELL	VS70-750589	1-8	D	7/19/83	SCHEMATIC DIAGRAM - OI HYDRAULIC MEASUREMENTS
		JSC	SODB JSC 08934	4.2.4-1 & 2	D AMEND. 211	4/2/87	SHUTTLE OPERATIONAL DATA BOOK, VOLUME I (LOOP VOLUMES)
		ROCKWELL	VS70-958099	43	A		INTEGRATED SYSTEM SCHEMATIC, HYDRAULICS - ORBITER VEHICLES 099, 103, 104, AND SUBS

DWG	SIGNATURE	DATE	DWG	SIGNATURE	DATE
12.1-1,2	ENGR J. W. MEDFORD			ENGR	
	ENGR James W. Medford			ENGR	
12.2-1,2	ENGR T. W. TAMERLER			ENGR	
	ENGR Timothy Tamerler	12/1/87		ENGR	
12.3-1,2	ENGR R. DOREMUS			APP A. J. Belmont	1 Dec 87
	ENGR R. Doremus	12/1/87		APP Richard N. Fitt	12/1/87
	ENGR			OMNIPLAN	
	ENGR			LTR D PCN	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

VENDOR DRAWING REFERENCES

SPACE SHUTTLE
ALL

TBL NO 12-I

PAGE 12.I-1 SHEET 1 OF 2

BASIC REV D

FOR DETAILED COMPONENT AND LOGIC INFORMATION REFER TO:

SSSH DWG NO.	SSSH DWG TITLE	VENDOR NAME	VENDOR DWG NO.	VENDOR SHEET NO.	REV	DATE	VENDOR DRAWING TITLE
12.3-3	HYDRAULIC POWER POWER SYSTEM	JSC	SS-P-0002-580G	6-86 TO 6-112 HYDRAULIC CIRCULATION PUMP AUTO-MATIC CONTROL	G	11/17/86	SPACE SHUTTLE PROGRAM ORBITER PROJECT COMPUTER PROGRAM DEVELOPMENT SPECIFI-CATION VOLUME I, BOOK 4 NAS-9-14000
		ROCKWELL	STS81-0027/V12	6.10 HYDRAULIC CIRC PUMP AUTOMATIC CONTROL SEQUENCE	2Q	9-28-83	ROCKWELL FLIGHT SYSTEM SOFTWARE REQUIREMENTS DOCUMENT
		IBM	NAS-9-16920	SECTION 3.2.1.19 HYDRAULIC CIRCULATION PUMP AUTO-MATIC CONTROL SEQUENCE SST_HYD_ FLD_TEMP	OT11	10/3-86	SPACE SHUTTLE ORBITER AVIONICS SOFTWARE - SOFTWARE DESIGN SPECIFICATION. PART II OPS DETAIL DESIGN SPECIFICATIONS, VOLUME III - APPLICATION. PART 2 - SYSTEMS MANAGEMENT
		ROCKWELL	VS70-580102	8.9,10,12,13	L	7/1/84	SCHEMATIC DIAGRAM - HYDRAULIC CONTROL SUBSYSTEM
			VS70 580109	12,13	E	8-4-86	SCHEMATIC DIAGRAM - HYDRAULIC CONTROL SUBSYSTEM
			EEL	238,239,240	OPER-ATIONAL	4-21-87	ELECTRICAL EQUIPMENT LIST (BRAKE HEATER WATTAGE)
12.4	APU/HYD WATER SPRAY BOILER	HAMILTON STANDARD	SVSK 91674	1-3	P	10/19/87	ELECTRICAL SCHEMATIC, ITEM 642, WSB CONTROLLER
		JSC	SS-P-0002-580G	6-79 TO 6-83 HYDRAULIC WATER BOILER QUANTITY	G	11/17/86	SPACE SHUTTLE PROGRAM ORBITER PROJECT COMPUTER DEVELOPMENT SPECIFICATION, VOLUME 1, BOOK 4 NAS-9-14000
		IBM	M6038119 10 # 03953	50 TO 57 HYDRAULIC WATER BOILER QUANTITY	F		BACKUP FLIGHT SOFTWARE PROGRAM REQUIREMENTS DOCUMENT
		ROCKWELL	VS70-580112	1-4	G	4/11/83	SCHEMATIC DIAGRAM - WATER SPRAY BOILER NO. 1, 2, 3
		HAMILTON STANDARD		ALL		9/16/76	SHUTTLE WATER SPRAY BOILER PRELIMINARY DESIGN REVIEW DOCUMENT
		ROCKWELL	VS70-580999	2 OF 6	C	7/16-86	SCHEMATIC - HYDRAULIC SUBSYSTEM, ORBITER, OV103 ONLY

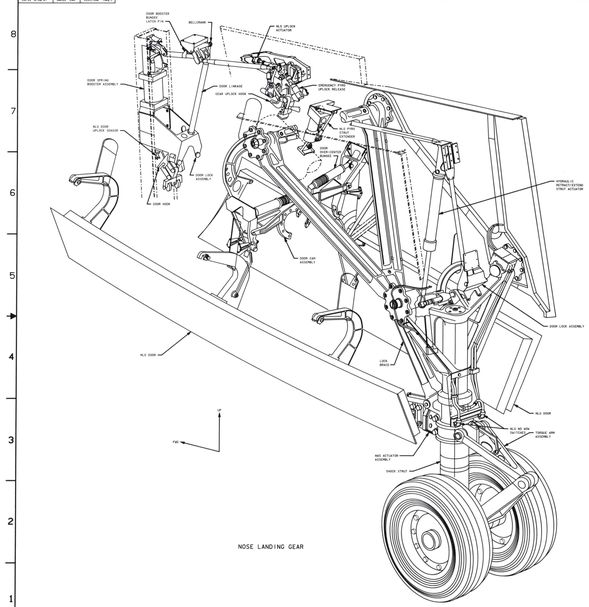
DWG	SIGNATURE		DATE
12.3-3	ENGR	R. DOREMUS	
	ENGR	R Doremus	12/1/87
12.4	ENGR	R. DOREMUS	
	ENGR	R Doremus	12/1/87
	APP	C. J. Stewart	12/1/87
	APP	Richard N. Fitts	12/1/87
	OMNIPLAN		
	LTR D	PCN	

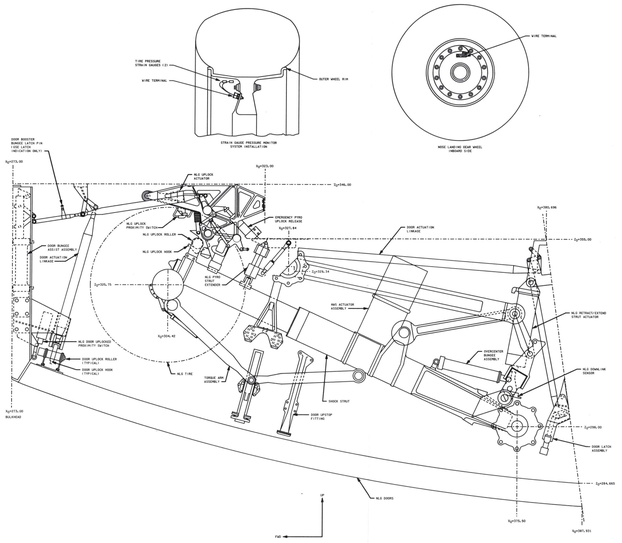
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

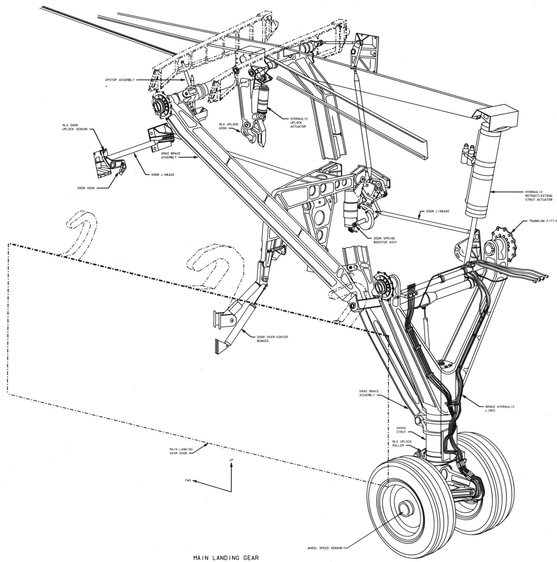
VENDOR DRAWING REFERENCES

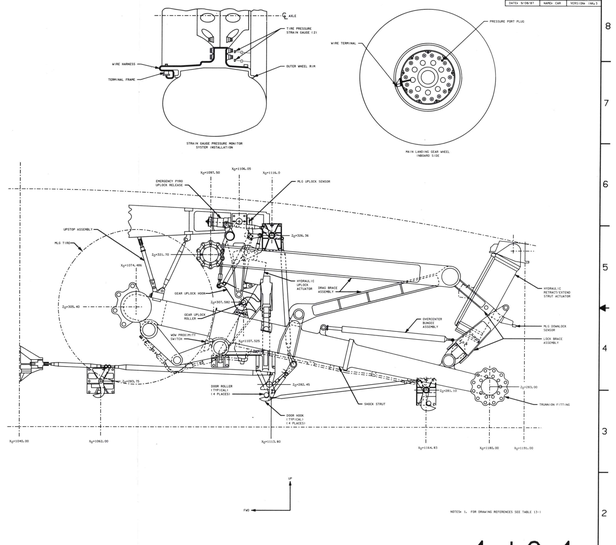
SPACE SHUTTLE	TBL NO 12-I
ALL	PAGE 12.I-2 SHEET 2 OF 2

BASIC REV D







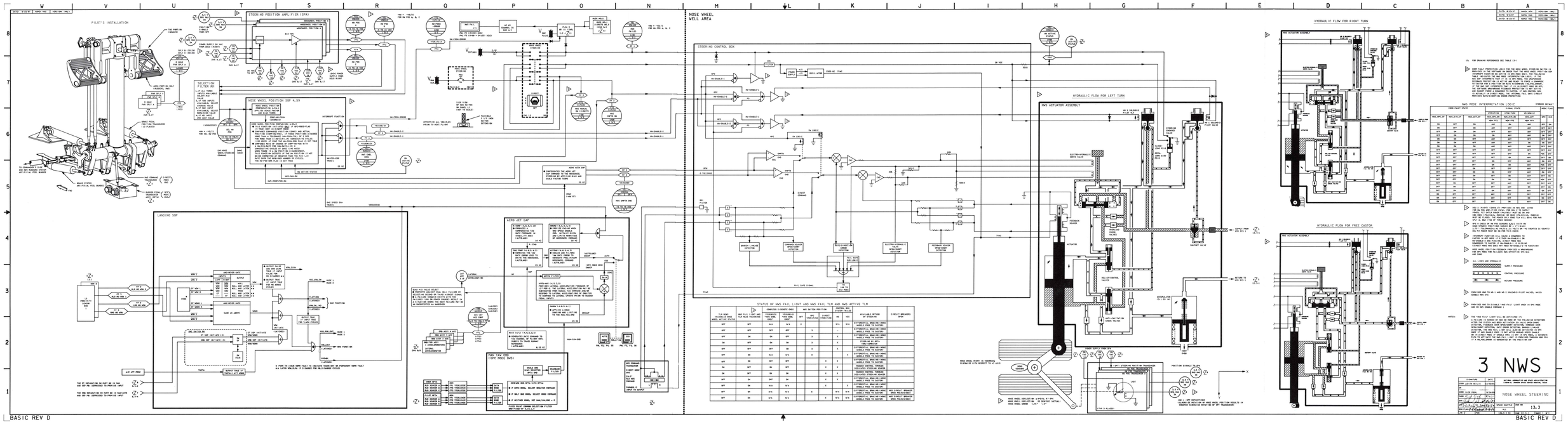


1 LG 1

LANDING GEAR

13.1

BASIC REV D


PILOT'S INSTALLATION
STEERING POSITION AMPLIFIER (SPA)
NOSE WHEEL POSITION SOP 4,59
LANDING SOP
AERO JET DAP
MAIN TAXI CMD (SPC MODE 1&2)
NOSE WHEEL WELL AREA
STEERING CONTROL BOX
HYDRAULIC FLOW FOR LEFT TURN
HYDRAULIC FLOW FOR RIGHT TURN
HYDRAULIC FLOW FOR FREE CASTOR
NWS ACTUATOR ASSEMBLY
3 NWS
NOSE WHEEL STEERING
BASIC REV D

FOR DETAILED COMPONENT AND LOGIC INFORMATION REFER TO:

SSSH DWG NO.	SSSH DWG TITLE	VENDOR NAME	VENDOR DWG NO.	VENDOR SHEET NO.	REV	DATE	VENDOR DRAWING TITLE
13.1-1	LANDING GEAR	ROCKWELL	V070-756015	1		3/10.87	MAIN LANDING GEAR WHEEL - INSTRUMENTED, TIRE PRESSURE, ASSEMBLY
		ROCKWELL	V070-752015	1		3/2/87	NLG WHEEL - INSTRUMENTED, TIRE PRESSURE, ASSY OF
13.1-2	LANDING GEAR	ROCKWELL	VS70-510109	ALL	A	3/20/81	SCHEMATIC DIAGRAM - LANDING GEAR CONTROLS SUBSYSTEM
			VS70 - 510102	ALL	K	7 30 84	SCHEMATIC DIAGRAM - LANDING GEAR CONTROLS SUBSYSTEM
		ROCKWELL	VS70-750202	ALL	J	4/1 87	SCHEMATIC DIAGRAM - OI POWER & CONTROL
		ROCKWELL	VS70-750209	ALL	G	4/1/87	SCHEMATIC DIAGRAM - OI POWER & CONTROL
		ROCKWELL	SPECIFICATION MC476-0134	ALL	A	1:17 75	SPECIFICATION SIGNAL CONDITIONER, STRAIN GAGE
13.2	BRAKES	ROCKWELL	VS70-520109	1, 2, 3	F	8-19 85	SCHEMATIC DIAGRAM - BRAKE & SKID CONTROL SUBSYSTEM
		ROCKWELL	VS70-958099	56-63	B	8.18 86	INTEGRATED SYSTEM SCHEMATIC HYDRAULICS
		ROCKWELL	VS70-580996	4	A	5 30.86	SCHEMATIC-HYDRAULIC SUBSYSTEM, ORBITER OV 102 AA
		ROCKWELL	VS70-730269	1	E	8 9-84	SCHEMATIC DIAGRAM - HEAD UP DISPLAY SUBSYSTEM
13.3	NOSE WHEEL STEERING	ROCKWELL	VS70-510302	1 & 2	D	9-6-85	SCHEMATIC DIAGRAM - NOSE WHEEL STEERING SUBSYSTEM
		ROCKWELL	VS70-510219	1 & 2		8-6-85	SCHEMATIC DIAGRAM - NOSEWHEEL STEERING SUBSYSTEM
		ROCKWELL	STS83-0015A	PAGES: 4-113 to 4-121h AND 4-13 TO 4-28	PCN 1	5-2/86	SPACE SHUTTLE ORBITER OPERATIONAL - LEVEL C - FUNCTIONAL SUBSYSTEM SOFTWARE REQUIREMENTS GUIDANCE, NAVIGATION AND CONTROL - PART E - SUBSYSTEM OPERATING PROGRAMS - FLIGHT CONTROL SENSOR CONTROLLER
		IBM (NASA)	NAS9-16920	3.12.1.4 3.13.1.4 3.13.1.5 3.12.1.5 3.12.2.1	018A	6 5.87	SPACE SHUTTLE PROGRAMS ORBITER AVIONICS SOFTWARE OPERATIONAL (OPS) DETAILED DESIGN SPECIFICATION (DDS) - VOLUME: III-APPLICATIONS PART: 1 - GUIDANCE, NAVIGATION & CONTROL (GN&C)
		ROCKWELL	VS70-958099	52	A		NOSE WHEEL STEERING, NLG UPLOCK & STRUT ACTR FLUIDS CONTROL
			MECH CONSOLE HANDBOOK VOL II JSC-18341	2.19-1 TO 2.19-6	A PCN-2	9.20/85	NWS CONTROL BOX

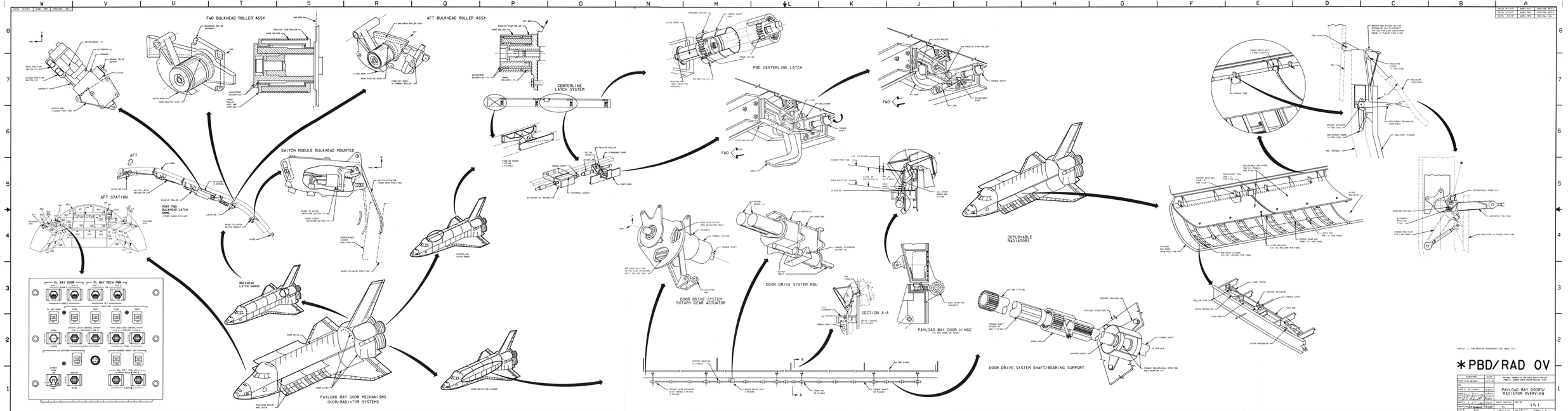
DWG	SIGNATURE	DATE	DWG	SIGNATURE	DATE
13.3	ENGR R. POCH		13.1	ENGR R. DYE	
	ENGR Richard Poch			ENGR	9-24-87
	ENGR		13.2	ENGR R. WALHEIM	
	ENGR			ENGR	9-24-87
	ENGR			APP	9-25-87
	ENGR			APP	9/25/87
	ENGR			OMNIPLAN	
	ENGR			LTR D PCN	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

VENDOR DRAWING REFERENCES

SPACE SHUTTLE	TBL NO 13-1
ALL	
	PAGE 13.1-1 SHEET 1 OF 1

BASIC REV D



*PBD/RAD OV

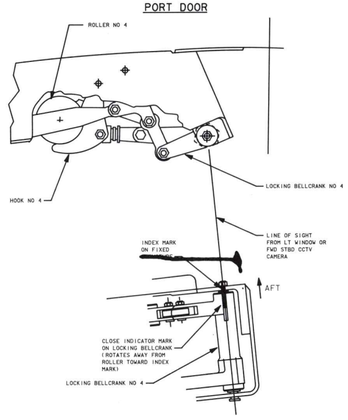
PAYLOAD BAY DOORS/ RADIATOR OVERVIEW

14.1

BASIC REV D

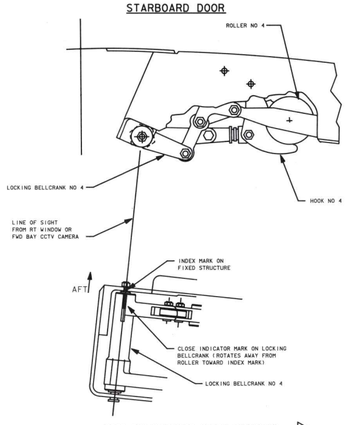
DATE: 12/2/86	NAME: BJT	VERSION: BPT-5
DATE: 4/24/87	NAME: JMB	VERSION: BPT-6
DATE: 8/3/87	NAME: MPM	VERSION: 14A-1

PORT DOOR

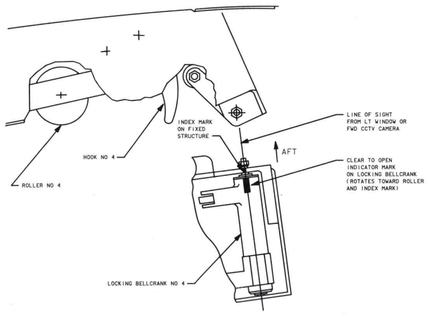


PORT FWD BULKHEAD CLOSE INDICATOR MARKINGS ON NO 4 LATCH ▷

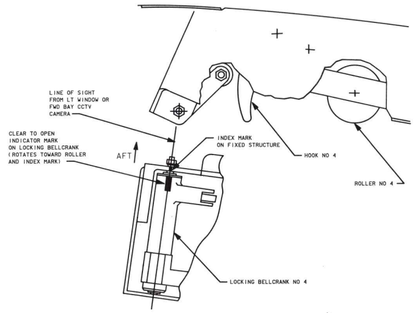
STARBOARD DOOR



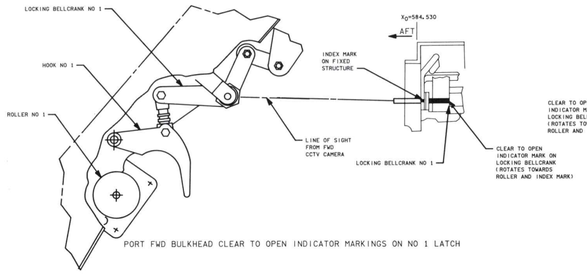
STBD FWD BULKHEAD CLOSE INDICATOR MARKINGS ON NO 4 LATCH ▷



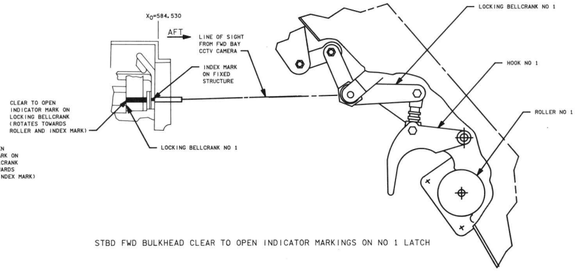
PORT FORWARD BULKHEAD CLEAR TO OPEN INDICATOR MARKINGS ON NO 4 LATCH ▷



STBD FWD BULKHEAD CLEAR TO OPEN INDICATOR MARKINGS ON NO 4 LATCH ▷

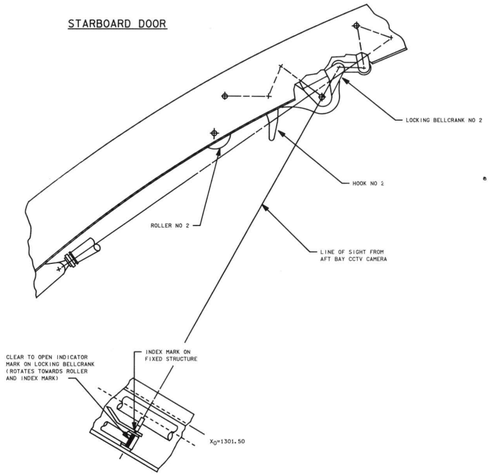


PORT FWD BULKHEAD CLEAR TO OPEN INDICATOR MARKINGS ON NO 1 LATCH

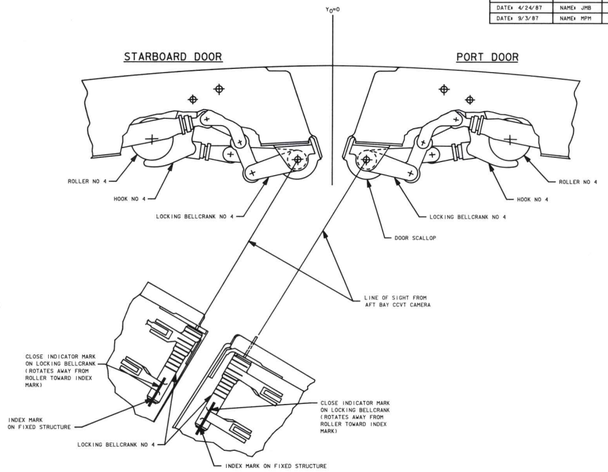


STBD FWD BULKHEAD CLEAR TO OPEN INDICATOR MARKINGS ON NO 1 LATCH

STARBOARD DOOR

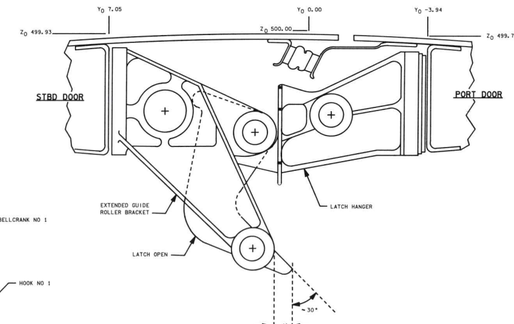


STBD AFT BULKHEAD LATCH
CLEAR TO OPEN INDICATOR MARKINGS ON NO 2 LATCH



STBD AND PORT AFT BULKHEAD
LATCH CLOSE INDICATOR MARKINGS ON NO 4 LATCH

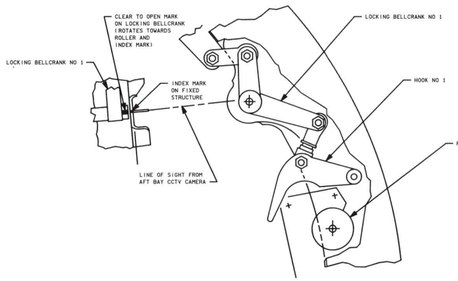
TYPICAL PBD $\underline{\mathrm{C}}$ LATCH



C/L LATCH CLEAR OF ROLLER CRITERIA

- TIP OF LATCH POINTING APPROX. 30° AWAY FROM Y AXIS
- TIP OF LATCH APPROX. 1 INCH FROM EXTENDED GUIDE ROLLER

PORT DOOR



PORT AFT BULKHEAD LATCH
CLEAR TO OPEN INDICATOR MARKINGS ON NO 1 LATCH

4. FOR DRAWING REFERENCES SEE TABLE 14-1
3. ALL OPEN MARKINGS ARE WIDER THAN CLOSE MARKINGS
2. ALL MARKINGS ARE WHITE DECALS

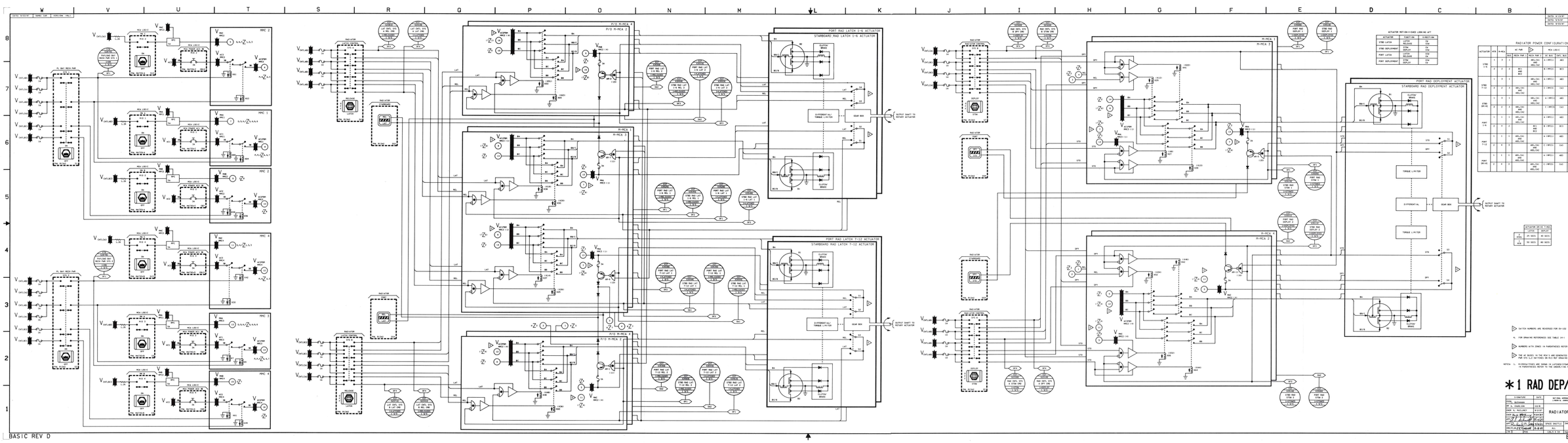
NOTES ▷ THESE MARKINGS SHOULD BE USED WITH CAUTION. NO 1 BELLCRANK MARKINGS ARE BEST INDICATORS DUE TO KINEMATICS ON LATCHING SYSTEM

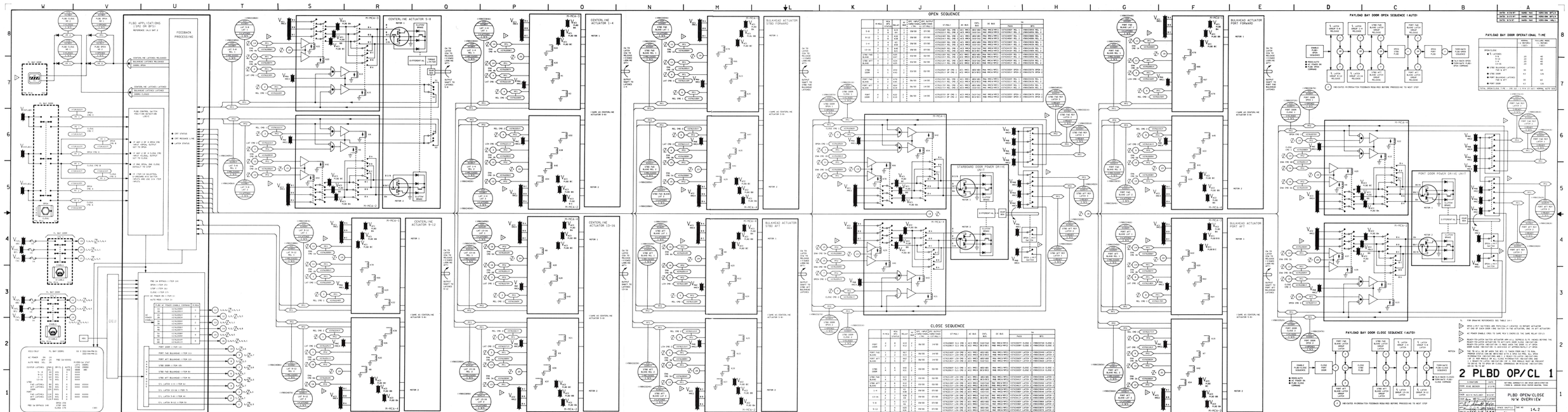
*1 PL LCH 2

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN L. M. BUCHANAN	2/24/81	
DR L. M. BUCHANAN	2/24/81	PL BAY DOOR LATCH CLEAR TO OPEN/CLOSE INDICATIONS
ENGR B. KEVIN McCLINEY	8/22/85	
ENGR Kevin McCliney	9/14/87	
APP [illegible]	9/14/87	SPACE SHUTTLE / ALL / DWG NO 14.1
APP [illegible]	9/14/87	
OPNLPLANSEC [illegible]	9-8-87	
LTR D PCN		66 X 34 / PAGE 14.1-2 / SHEET 2 OF 3

BASIC REV D

BASIC REV D


*1 RAD DEP/STOW 3
RADIATORS DEPLOY/STOW
PORT RAD DEPLOYMENT ACTUATOR
STARBOARD RAD DEPLOYMENT ACTUATOR
PORT RAD LATCH 1-6 ACTUATOR
STARBOARD RAD LATCH 1-6 ACTUATOR
PORT RAD LATCH 7-12 ACTUATOR
STARBOARD RAD LATCH 7-12 ACTUATOR
TORQUE LIMITER
DIFFERENTIAL
GEAR BOX
OUTPUT SHAFT TO ROTARY ACTUATOR
RADIATOR
INSULATION
PMC 1
PMC 2
PMC 3
PMC 4
PL BAY MDCA PWR
MCA LOGIC
MDC
MDM
MDC 1
MDC 2
MDC 3
MDC 4
PORT RAD DEPLOY 1 MDM
PORT RAD DEPLOY 2 MDM
STBD RAD DEPLOY 1 MDM
STBD RAD DEPLOY 2 MDM
PORT RAD LAT 1-6 MDM
PORT RAD LAT 7-12 MDM
STBD RAD LAT 1-6 MDM
STBD RAD LAT 7-12 MDM
P/O M-MCA 4
P/O M-MCA 2
M-MCA 3
M-MCA 2
M-MCA 4
MOTOR
BRAKE
SOLENOID
LATCH
LATCH SENSOR
LATCH SENSOR ASSY
LAT CNTL SYS A LAT ON
LAT CNTL SYS A LAT OFF
LAT CNTL SYS B LAT ON
LAT CNTL SYS B LAT OFF
RAD CNTL SYS A STOW ON
RAD CNTL SYS A STOW OFF
RAD CNTL SYS B STOW ON
RAD CNTL SYS B STOW OFF
RAD CNTL SYS A DEPLOY ON
RAD CNTL SYS A DEPLOY OFF
RAD CNTL SYS B DEPLOY ON
RAD CNTL SYS B DEPLOY OFF
RADIATOR POWER CONFIGURATION
ACTUATOR MOTION (FIXED LOOKING AFT
SWITCH NUMBERS ARE REVERSED FOR SY-102
FOR DRAWING REFERENCES SEE TABLE 14-1
NUMBERS WITH ZONES IN PARENTHESES REFER TO THE UNDERLYING M-MCA
THE AC BUSES 1A THE MCA'S ARE GENERATED BY THE PL BUS MCCA
NOTES: 1. MICROSWITCHES ARE SHOWN IN LATCHED/STOWED POSITION. NUMBERS IN PARENTHESES REFER TO THE UNDERLYING M-MCA
BASIC REV D
BASIC REV D


OPEN SEQUENCE
CLOSE SEQUENCE
PAYLOAD BAY DOOR OPEN SEQUENCE (AUTO)
PAYLOAD BAY DOOR CLOSE SEQUENCE (AUTO)
PAYLOAD BAY DOOR OPERATIONAL TIME
2 PLBD OP/CL 1
PLBD OPEN/CLOSE
H/W OVERVIEW
14.2
BASIC REV D
BASIC REV D

PLBD DISPLAY PROCESSING

AUTO SEQUENCE STATUS CHECK

PLBD OPEN AUTO SEQUENCE

PLBD CLOSE AUTO SEQUENCE

MANUAL SEQUENCE PROCESSING

DESCRIPTION	NEW DOOR STATUS TO DISPLAY	NEW DOOR STATUS TO SELECTED	NO DPS, DSS TO TERMINATED
PBD LATCH/DOOR FAIL INDICATORS		RESET	RESET
POWER ON /TCM	RESET		RESET
POWER OFF /TCM	SET		SET
PBD OPEN/CLOSE COMPLETE /M1 INTERFACE		RESET	
AUTO AND MANUAL MODE /TCMA	RESET		RESET
AUTO AND MANUAL MODE FLAGS	RESET		
COMMON PBD FAIL INDICATOR		RESET	RESET

DESCRIPTION	NEW DOOR STATUS TO DISPLAY	NEW DOOR STATUS TO SELECTED	NO DPS, DSS TO TERMINATED
PBD LATCH/DOOR FAIL INDICATORS		RESET	RESET
POWER ON /TCM	RESET		RESET
POWER OFF /TCM	SET		SET
PBD OPEN/CLOSE COMPLETE /M1 INTERFACE		RESET	
AUTO AND MANUAL MODE /TCMA	RESET		RESET
AUTO AND MANUAL MODE FLAGS	RESET		
COMMON PBD FAIL INDICATOR		RESET	RESET

SEQUENCE	DOOR STATUS
OPEN	OPEN
CLOSE	CLOSED

SEQUENCE	DOOR STATUS
OPEN	OPEN
CLOSE	CLOSED

OPEN SEQUENCE	CLOSE SEQUENCE
LATCH/DOOR: DEPENDENT GROUP	LATCH/DOOR: DEPENDENT GROUP
S/L 1-4	S/L 5-8
S/L 5-8	S/L 1-4
S/L 9-12	S/L 9-12
STBD PWD BKHD S/L 1-4	STBD PWD BKHD S/L 1-4
STBD DOOR	STBD PWD BKHD
PORT DOOR	STBD DOOR
PORT APT BKHD	PORT PWD BKHD
PORT PWD BKHD	PORT APT BKHD

OPEN SEQUENCE	CLOSE SEQUENCE
LATCH/DOOR: DEPENDENT GROUP	LATCH/DOOR: DEPENDENT GROUP
S/L 1-4	STBD PWD BKHD
S/L 5-8	S/L 1-4
S/L 9-12	S/L 9-12
STBD PWD BKHD	STBD PWD BKHD S/L 1-4
STBD DOOR	STBD PWD BKHD
STBD PWD BKHD	STBD DOOR
PORT PWD BKHD	PORT PWD BKHD S/L 1-4
PORT APT BKHD	PORT PWD BKHD
PORT DOOR	PORT APT BKHD

ATTACHMENT	MOTOR NAMEPLATE	MOTOR
PASSENGER LATCH	90	45
BOARDING LATCH	90	45
DOOR DRIVE	63	126

NOTES:
1. FOR DRAWING REFERENCES SEE TABLE 1-1, BOARDING LATCH & TERMINATES
   REFER TO LOGIC IN THE REFERENCED SEQUENCE.

2 PLBD SW OV 2

SIGNATURE	DATE
DSN: B.J.TESSIER JR.	9/4/87
APP: B.J.TESSIER JR.	9/4/87
DRAFT: L. HARRIS	9/4/87
APP: J.A. FERRARO	9/4/87
APP: [illegible]	9/4/87
APP: [illegible]	9/4/87
APP: [illegible]	9/4/87

PROPRIETARY INFORMATION AND DRAWN IDENTIFICATION THERE IS PROPRIETARY INFORMATION ON THIS DRAWING

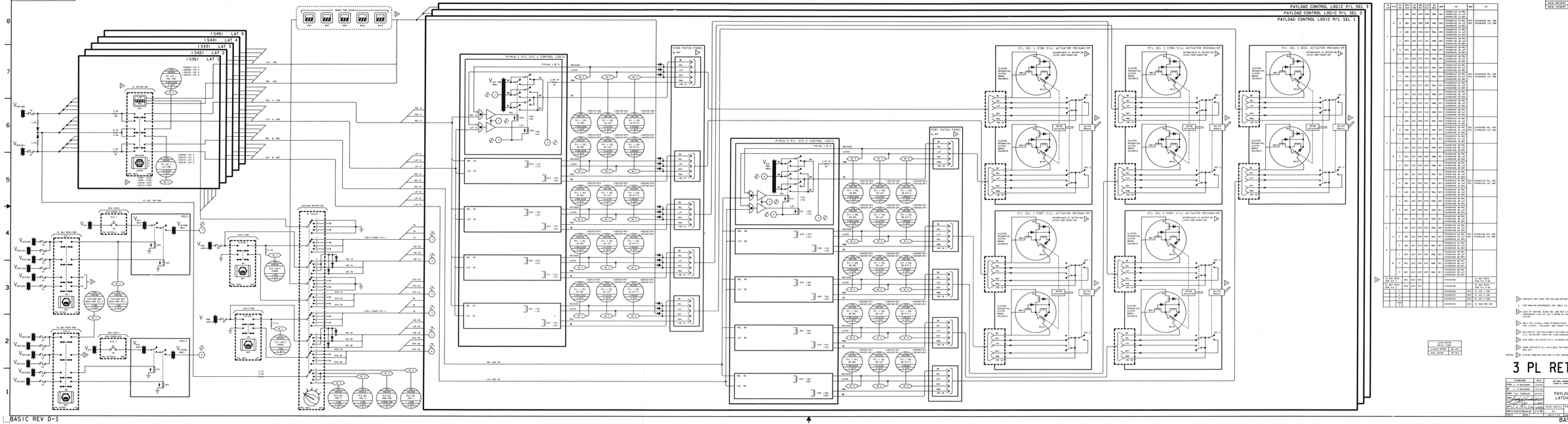
PLBD SOFTWARE OVERVIEW (PASS SM AND BFS)

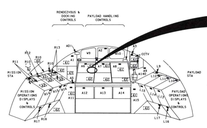
PAGE SHEETS 2 OF 40 | 14.2

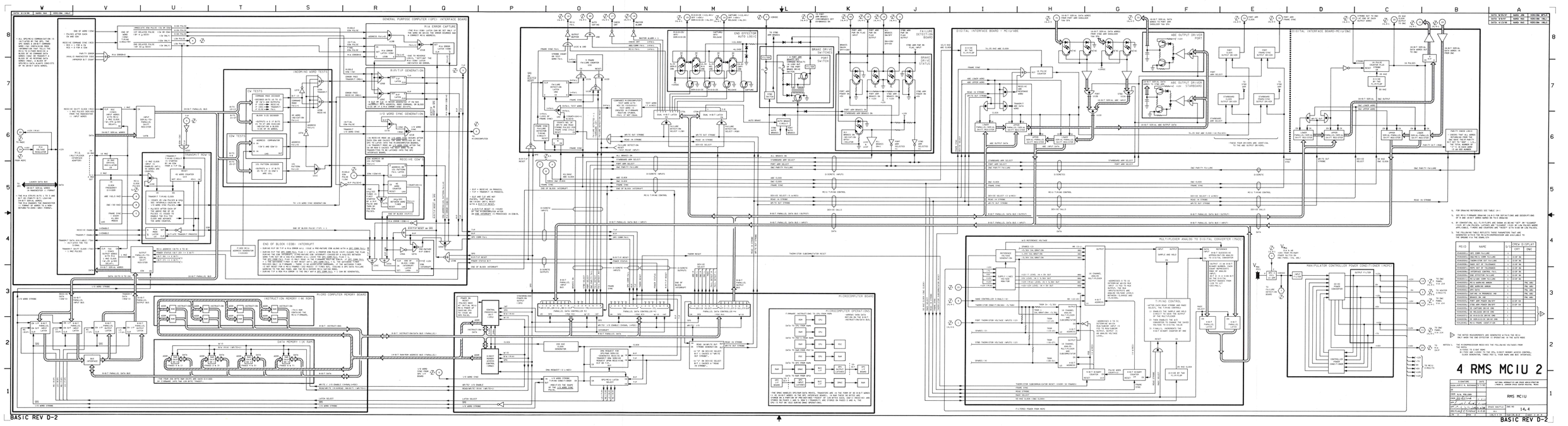
SIZE D | CAGE CODE 80009 | DWG NO 1

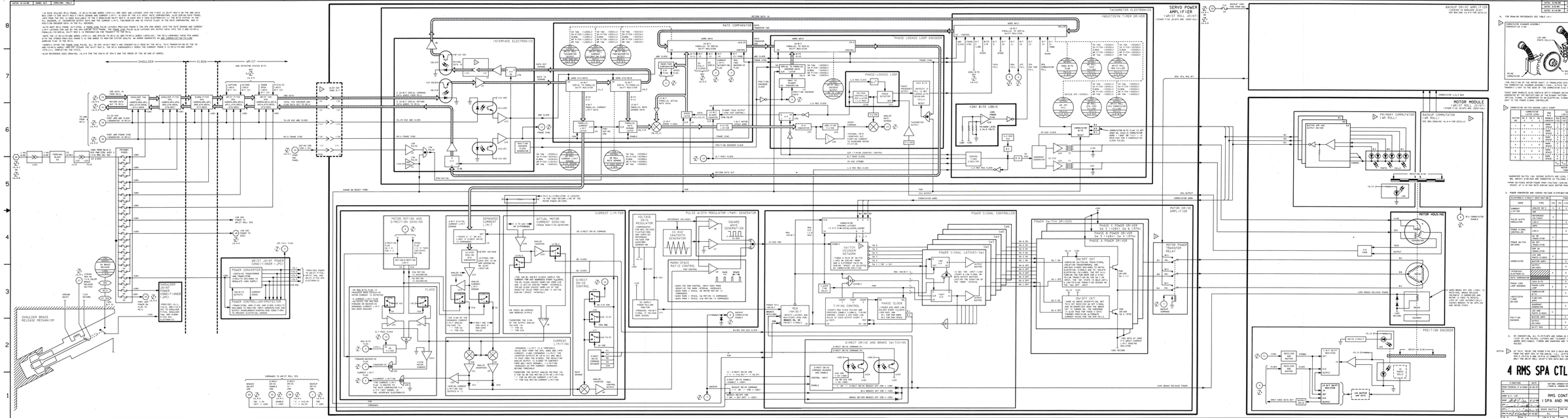
SCALE NTS | REV B.0.0 | SHEET 1 OF 1

BASIC REV D


PAYLOAD CONTROL LOGIC P/L SEL 3
PAYLOAD CONTROL LOGIC P/L SEL 2
PAYLOAD CONTROL LOGIC P/L SEL 1
READY FOR LIFT
(S45) LAT 5
(S44) LAT 4
(S43) LAT 3
(S42) LAT 2
(S36) LAT 1
PL RETENTION
PL SEL 100 PWR
PL BAY MECH PWR
MCA LOGIC
LOGIC PWR
PAYLOAD RETENTION
LOGIC POWER SYS 1
LOGIC POWER SYS 2
PL RELEASE
PL RET LATCH
PL RET LATCH MOTOR
PL RET LATCH MOTOR PWR SYS 1
PL RET LATCH MOTOR PWR SYS 2
PL RET LATCH MOTOR PWR SYS 3
PL RET LATCH MOTOR PWR SYS 4
PL RET LATCH MOTOR PWR SYS 5
PL RET LATCH MOTOR PWR SYS


PAYLOAD HANDLING CONTROLS
PAYLOAD CONTROLS
PAYLOAD CONTROLS
PAYLOAD


4 RMS MCIU 2
RMS MCIU
BASIC REV D-2
GENERAL PURPOSE COMPUTER (GPC) INTERFACE BOARD
I/O WORD SYNC GENERATION
INCOMING WORD TESTS
CW TESTS
COW TESTS
RECEIVE CONT
TRANSMIT ROW
END OF BLOCK (EOB) INTERRUPT
RIP/DP GENERATION
PIA ERROR CAPTURE
INSTRUCTION MEMORY (4K ROM)
DATA MEMORY (1K RAM)
MICROCOMPUTER MEMORY BOARD
MICROCOMPUTER BOARD
MICROCOMPUTER OPERATIONS
END EFFECTOR AUTO LOGIC
FAILURE DETECTION BOARD
DIGITAL INTERFACE BOARD #1 (PORT)
DIGITAL INTERFACE BOARD #2 (STBD)
ABE OUTPUT DRIVER PORT
ABE OUTPUT DRIVER STARBOARD
MULTIPLEXER ANALOG TO DIGITAL CONVERTER (MADC)
MULTIPLATOR CONTROLLER POWER CONDITIONER (MCPC)
TIMING CONTROL
BRAKE DRIVE SWITCHES
FOOT SWITCH
BRAKE DRIVE STATUS
LAUNCH DATA BUS
ENTRY DATA BUS
PCMMU
MDM
GPC
PIA
RIP
DP
ABE
MADC
MCPC
MCIU


4 RMS SPA CTL SYS 3
RMS CONTROL SYSTEM (SPA AND MOTOR CONTROL)
14.4
SERVO POWER AMPLIFIER
WRIST ROLL JOINT
BACKUP DRIVE AMPLIFIER
MOTOR MODULE
WRIST ROLL JOINT
BACKUP COMPUTATOR
PRIMARY COMPUTATOR
MOTOR HOUSING
POSITION ENCODER
TACHOMETER ELECTRONICS
INDUCTOSYN TIMER DRIVER
PHASE LOCKED LOOP ENCODER
INTERFACE ELECTRONICS
RATE COMPARATOR
+28V BITE LOGIC
MOTOR DRIVE AMPLIFIER
POWER SIGNAL CONTROLLER
POWER SWITCH DRIVERS
PHASE C POWER DRIVER
PHASE B POWER DRIVER
PHASE A POWER DRIVER
DIRECT DRIVE AND BRAKE SWITCHING
SHOULDER
ELBOW
WRIST
SHOULDER BRACE RELEASE MECHANISM
BASIC REV D-2

DATE/ INITIALS	NAME/ JOB	DESCRIPTION / LOCN
DATE/ INITIALS	NAME/ JOB	DESCRIPTION / LOCN
DATE/ INITIALS	NAME/ JOB	DESCRIPTION / LOCN

D&C BACKUP CONTROLS

BDA POWER CONDITIONER

BACKUP DRIVE AMPLIFIER

POWER SIGNAL CONTROLLER

PULSE WIDTH MODULATOR (PWM) GENERATOR

PWR SWITCH DRIVERS

SERVO POWER AMPLIFIERS

MOTOR MODULES

ANALOG PROCESSOR

PORT END EFFECTOR (BACKUP PL RELEASE)

4 RMS BDA CTL SYS 4

S/SYSTEM	DATE
MGR'L: N. RICHMAN	11/26/82
DR: L. N. RICHMAN	11/26/82
CHK'D: N. C. LEE	
APPD:	
APPD:	
APPD:	

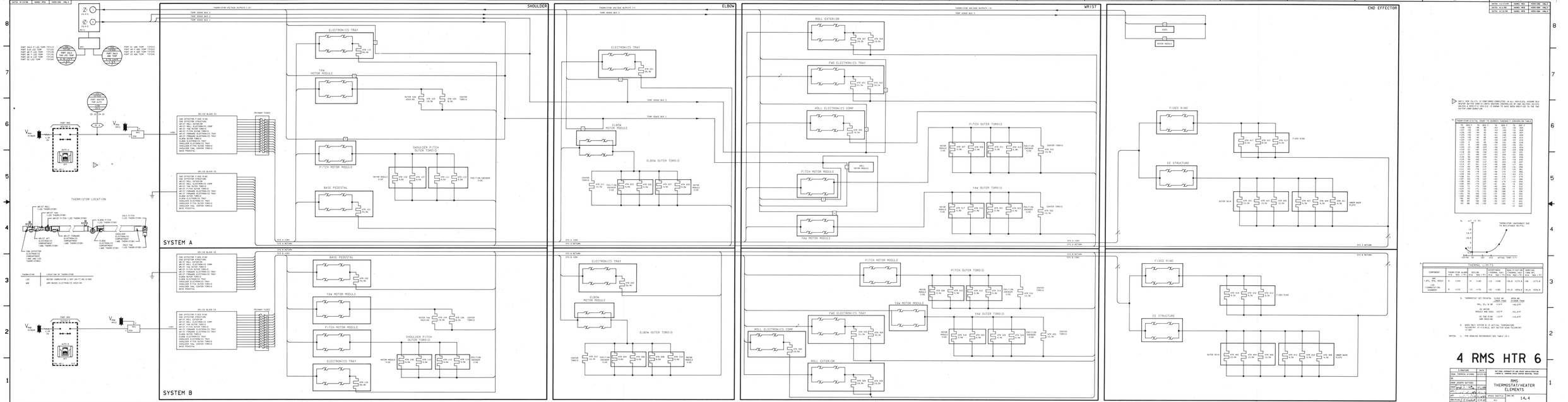
UNIVERSAL COMMUNICATION AND CONTROL SYSTEM
ORBITER & COMMON MECH/ELECTRONICS

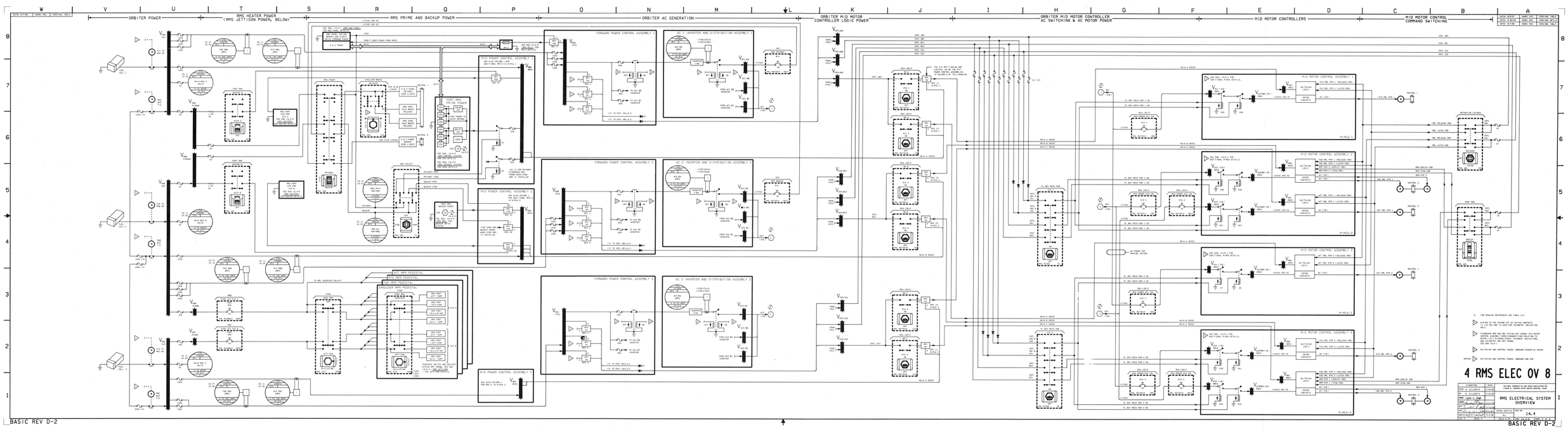
RMS CONTROL SYSTEM
(BDA)

SPACE SHUTTLE | DWG NO: 14.4

SCALE: NONE | SHT 1 OF 1

BASIC REV D


SHOULDER
ELBOW
WRIST
END EFFECTOR
SYSTEM A
SYSTEM B
ELECTRONICS TRAY
YAW MOTOR MODULE
PITCH MOTOR MODULE
BASE PEDESTAL
SHOULDER PITCH OUTER TOROID
ELBOW MOTOR MODULE
ELBOW OUTER TOROID
ROLL EXTERIOR
FWD ELECTRONICS TRAY
ROLL ELECTRONICS COMP
PITCH MOTOR MODULE
PITCH OUTER TOROID
YAW MOTOR MODULE
YAW OUTER TOROID
YAW PITCH MODULE
FIXED RING
EE STRUCTURE
MOTOR MODULE
THERMISTOR LOCATION
4 RMS HTR 6
RMS
THERMOSTAT/HEATER
ELEMENTS
14.4
BASIC REV D-2


ORBITER POWER
RMS HEATER POWER (RMS JETTISON POWER, BELOW)
RMS PRIME AND BACKUP POWER
ORBITER AC GENERATION
ORBITER MID MOTOR CONTROLLER LOGIC POWER
ORBITER MID MOTOR CONTROLLER AC SWITCHING & AC MOTOR POWER
MID MOTOR CONTROLLERS
MID MOTOR CONTROL COMMAND SWITCHING
MID POWER CONTROL ASSEMBLY 1
MID POWER CONTROL ASSEMBLY 2
MID POWER CONTROL ASSEMBLY 3
FORWARD POWER CONTROL ASSEMBLY 1
FORWARD POWER CONTROL ASSEMBLY 2
FORWARD POWER CONTROL ASSEMBLY 3
AC 1 INVERTER AND DISTRIBUTION ASSEMBLY 1
AC 2 INVERTER AND DISTRIBUTION ASSEMBLY 2
AC 3 INVERTER AND DISTRIBUTION ASSEMBLY 3
MID MOTOR CONTROL ASSEMBLY 1
MID MOTOR CONTROL ASSEMBLY 2
MID MOTOR CONTROL ASSEMBLY 3
MID MOTOR CONTROL ASSEMBLY 4
LEFT MPM PEDESTAL
RIGHT MPM PEDESTAL
SHOULDER MPM PEDESTAL
4 RMS ELEC OV 8
RMS ELECTRICAL SYSTEM OVERVIEW
BASIC REV D-2

DATE	SYMBOL	DESCRIPTION
3/30/87	MARK VIII	VERSION: BFTL12
8/3/87	MARK VIII	VERSION: (NRL)
10/23/87	MARK VIII	VERSION: (NRL)

5 RMS/SOFTWARE 1

SIGNATURE	DATE
USAS TERRY FORSYTHE	9/14/70
WILLIAM A. RUSSMAN	9/14/70
DAVE A. HOLLAND	
[illegible]	
[illegible]	
[illegible]	
[illegible]	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

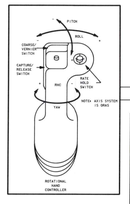
RMS/SOFTWARE OVERVIEW

SPACE SHUTTLE | DWG NO 14.5

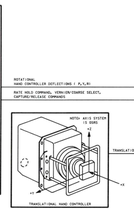
SCALE NONE | SHEET 1 OF 3

BASIC REV D

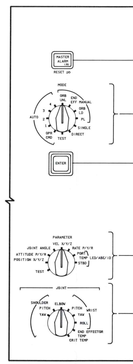
RMS HAND CONTROLLERS/D & C PANEL



TRANSLATIONAL HAND CONTROLLER (THC)



ABU



1. FOR DRAWING REFERENCES SEE TABLE 14-1

PROCEDURES ARE ONLY INVOKED AS CALLS BY THE CALLING ROUTINE AND CONTROL RETURNS BACK TO THE CALLER WHEN THROUGH. PROCEDURES CANNOT BE USED IN EXPRESSIONS.

PROGRAMS ARE SCHEDULED AT A PRESCRIBED RWSOS PRIORITY AND EXECUTE AS TASKS. THEY ARE INVOKED ONLY BY THE SYSTEM SOFTWARE AND EXECUTE UNINTERRUPTED BY THE SCHEDULING ROUTINE AND ARE UNTERRUPTED ONLY BY PROGRAMS OF HIGHER PRIORITY.

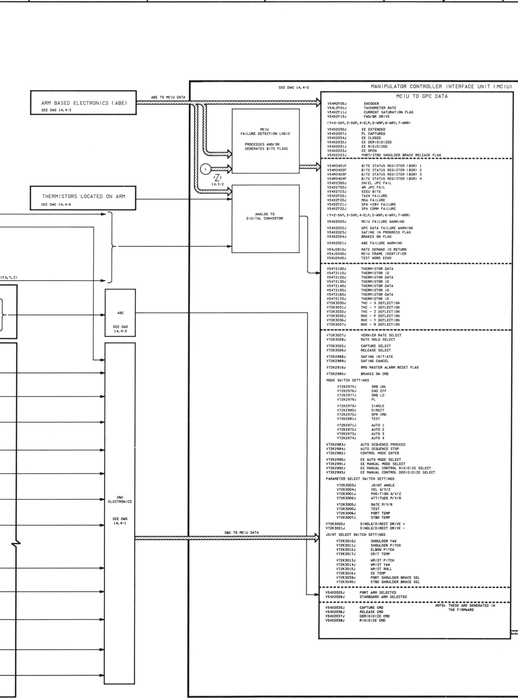
FOOD TRANSACTION ERROR FLAG (S 12) IS ON EVERY PASS THROUGH THE FOOD PROCESSOR EXCEPT WHEN THERE
- NO COMMAND DATA WORD RECEIVED WITHIN 81.92 SEC
- INTERRUPT WORD COUNT
- THE 1ST 3 BITS RECEIVED IN MCIU NOT EQUAL 101
- PARITY BIT FAILURE
- ADDRESS ERROR
- EXCESSIVE GAP TIMING BETWEEN WORDS
- EXCESSIVE BIT TIME FOR COMPLETE 40 WORD MESSAGE

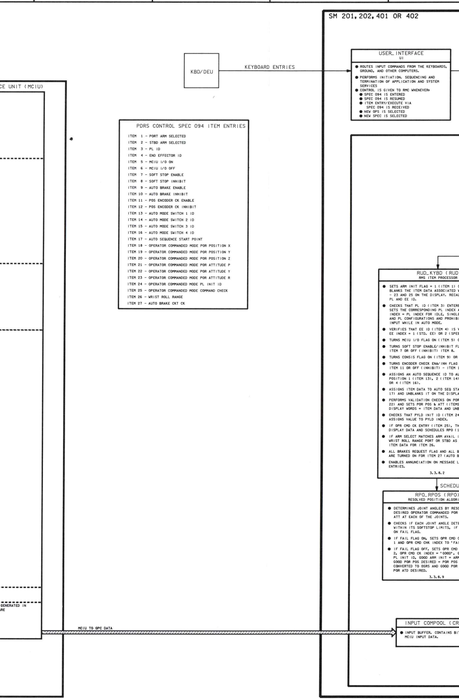
NUMBERS REFER TO DETAILED DESIGN SPEC (DSS) FUNCTIONS

DISPATCHER TABLE

THE DISPATCHER TABLE CALLS ONLY THOSE FUNCTIONS LISTED FOR EACH MODE FOR ANY ONE CYCLE. FOR EXAMPLE, IF THE SOFTWARE IS IN MODE 1 AND THE OPERATOR CHANGES TO MODE 2 AND BACK TO MODE 1 ONLY IN 0.1 SEC, MID AND MAX WOULD BE CALLED BEFORE THE NEXT CYCLE

MODE	ENTRY REQUIREMENTS	FUNCTIONS CALLED	RATE	CASE
SUSPEND	1. MCIU/GPC I/O IS OFF I/O IS ON FOR ALL OTHER MODES	NA SOFTWARE DOES NOT EXECUTE AS FAR AS THE DISPATCHER IS CONCERNED	NA	NA
TEMPERATURE MONITORING	1. HH ARM SELECTED WITH RHC SELECT SWITCH ARM IS SELECTED FOR NON-LIVING MODES	THERMOCOUPLE MONITOR (10.1) DED/STATUS DISPLAY (R6D1) DAP/DISPLAY FUNCTION (R6D)	10.24 10.24 10.24	1 13 1
IDLE	1. SOFTWARE STOP ON, OR 2. SOFTWARE STOP OFF, AND a. BRAKES ON, OR b. ANY ARM SELECTED WITH I/O ON, OR c. 1ST ARM SELECTED THIS PASS # MODE SWITCH INDEX THIS PASS d. MODE SWITCH INDEX THIS PASS ≠ MODE SWITCH INDEX LAST PASS, OR e. ANY ARM SELECTED WITH MODE AND ENCODER ID = 0 ON, OR f. CONFIGURATION = 0 MANUAL OR TEST MODE AND HAND CONTROLLER FAIL TO ON	KINEMATIC DATA GENERATOR (R6D) POSITION HOLD (R6P) HAND CONTROLLER (R6D) REDUNDANCY MANAGEMENT (R6D) REDUNDANCY MANAGEMENT (R6D) TOTAL VELOCITY (R9V) TEMPERATURE MONITOR (10.1) DED/STATUS DISPLAY (R6D1) DAP/DISPLAY FUNCTION (R6D)	10.24 10.24 10.24 10.24 10.24 10.24 10.24 10.24	1 2 3 4 5 6 7 8
SINGLE	1. THE ARM IS AT REST, AND 2. THE SINGLE DRIVE SWITCH IS ON, AND THE MODE IS ON MODE I-I POSITION	KINEMATIC DATA GENERATOR (R6D) POSITION HOLD (R6P) HAND CONTROLLER (R6D) REDUNDANCY MANAGEMENT (R6D) REDUNDANCY MANAGEMENT (R6D) TOTAL VELOCITY (R9V) TEMPERATURE MONITOR (10.1) DED/STATUS DISPLAY (R6D1) DAP/DISPLAY FUNCTION (R6D)	10.24 10.24 10.24 10.24 10.24 10.24 10.24 10.24	1 2 3 4 5 6 7 8
MANUAL/TEST	1. THE ARM IS AT REST, OR 2. IT HAS ARM 1-5 REST AT REST WHEN SWITCHING FROM RHC 3. MODE IS ON MODE I-I POSITION, AND 4. THERE ARE NO INPUT COMMANDS FROM THE HAND CONTROLLER, AND 5. NO HAND CONTROLLER ERRORS EXIST AT TIME OF MODE ENTRY	KINEMATIC DATA GENERATOR (R6D) HAND CONTROLLER (R6D) MECHLIKE RATE ALGORITHM (R6P) TOTAL VELOCITY (R9V) ROLL PITCH YAW TRIM (R6P) TEMPERATURE MONITOR (10.1) DED/STATUS DISPLAY (R6D1) DAP/DISPLAY FUNCTION (R6D) MUTUALLY EXCLUSIVE MODULES	10.24 10.24 10.24 10.24 10.24 10.24 10.24 10.24	1 2 3 4 5 6 7 8
AUTO	1. THE ARM IS AT REST, AND 2. THE SINGLE DRIVE SWITCH IS OFF, AND THERE IS NO ATT/ATTITUDE TO OR ATT/ DESIRED 2 AND COMMAND POSITION	KINEMATIC DATA GENERATOR (R6D) POSITION HOLD (R6P) HAND CONTROLLER (R6D) REDUNDANCY MANAGEMENT (R6D) REDUNDANCY MANAGEMENT (R6D) TOTAL VELOCITY (R9V) TEMPERATURE MONITOR (10.1) DED/STATUS DISPLAY (R6D1) DAP/DISPLAY FUNCTION (R6D) MUTUALLY EXCLUSIVE MODULES	10.24 10.24 10.24 10.24 10.24 10.24 10.24 10.24	1 2 3 4 5 6 7 8





DATE= 8/25/87 | NAME= MAMO MPM | VERSION= 1MAJ.2

DATE= 7/29/87 | NAME= MAC | VERSION= BPT.9
DATE= 8/8/86 | NAME= SKK | VERSION= 1MAJ.2
DATE= 8/25/87 | NAME= MPM | VERSION= 1MAJ.2

RMS SOFTWARE

IDLE, MANUAL, AUTO, SINGLE & TEST MODES

SM 201, 202, 401 OR 402

NOTE: SEQUENCE OF CONTROL MODULE EXECUTION IS FROM TOP TO BOTTOM ALONG THIS LINE

CALLED BY REX (2) 7/6 14.5-1

RKG_KINGEN (RKG)
KINEMATIC DATA GENERATOR

- COMPUTES ARM GEOMETRY PARAMETERS& JOINT ANGLE SINES AND COSINES FOR MANIPULATOR STANDARD COMPUTATIONS FOR USE BY RNP AND RTV.
- DETERMINES ARM TRANSFORMATION MATRICES& FOR TO ORBITER STRUCTURAL, FOR TO ARM REFERENCE AND ORBITER STRUCTURAL TO ARM REFERENCE FOR USE BY RJS, PAS AND RTV.
- COMPUTES FOR POSITION IN ORBITER STRUCTURAL FOR AUTO MODE POSITION FEEDBACK USE BY RAS AND COMPUTES FOR POSITION IN ORBITER BODY AXES FOR DISPLAY BY RDD.
- COMPUTES ARM ATTITUDE EULER ANGLES IN ORBITER STRUCTURAL AXES FOR DISPLAY BY RDD.
- DETERMINES WHEN THE ARM GEOMETRY IS WITHIN EACH OF THE THREE SINGULARITY TOLERANCES AND SETS OR RESETS THE RESPECTIVE SINGULARITY FLAG FOR USE BY RNM, THE FLAGS WERE INITIALIZED TO OFF IN SUSPEND AND TEMP MODES.

3, 3, 8, 6

MANUAL,TEST OR AUTO ON

NOTE: RKP IS CALLED IN MANUAL, AUTO & TEST MODES IN PLACE OF RFP ONLY WHEN COMMANDING (i.e. NOT IN POSITION HOLD SUBMODE)

RFP_POS_HOLD (RFP)
POSITION HOLD

- COMMANDS JOINT RATES NECESSARY TO DRIVE THE ARM TO ITS SNAPSHOT POSITION DURING POSITION HOLD SUBMODE.
- IF ENCODER CHECK FLAG IS ON FOR A PARTICULAR JOINT, THAT JOINT IS NOT COMMANDED.
- OTHERWISE, JOINTS ARE DRIVEN AT A RATE PROPORTIONAL TO THE DIFFERENCE BETWEEN THE CURRENT JOINT ANGLE AND THE ACTUAL JOINT ANGLE.
- THE RATES DETERMINED ABOVE ARE LIMITED TO THE MAX JOINT RATE LIMIT.

3, 3, 8, 13

SINGLE ONLY

RRP_RRATE (RRP)
RESOLVED RATE PROCESSOR

- TAKES EE TRANS RATE CMDS AND EE ROT RATE CMDS FROM RAS DURING AUTO MODES AND FROM RHC DURING MANUAL MODES. IN BOTH MODES, THE ARM DISTANCE COMPUTATIONS AND JOINT ANGLE SINES AND COSINES FROM RAS AND COMPUTES SIX JOINT RATE CMDS TO ACHIEVE THE REQUIRED COORDINATED MOTION OF THE END EFFECTOR.
- THE THREE SINGULARITIES REQUIRE SPECIAL PROCESSING:
  - WHEN NEAR THE SHY SINGULARITY, THE SHY JOINT RATE CMD IS SET TO THE MAX COARSE RATE OR ZERO, DEPENDENT ON THE COMPUTED VALUE OF Y-COMPONENT OF THE VECTOR FROM THE ELBOW SEGMENT FROM THE ELBOW JOINT TO THE WRIST PITCH JOINT, THE REMAINING FIVE BEING COMPUTED NORMALLY.
  - FOR THE WRY SINGULARITY, THE WRR JOINT RATE CMD IS SET TO ZERO, AND THE WRY JOINT RATE CMD IS COMPUTED.
  - FOR THE ELP SINGULARITY, THE SHP JOINT RATE CMD IS SET TO MAX COARSE RATE FOR THAT JOINT RP ZERO, DEPENDENT ON THE COMPUTED VALUE OF Y-COMPONENT OF THE VECTOR FROM THE SEGMENT FROM THE ELBOW JOINT TO THE WRIST PITCH JOINT, THE REMAINING FIVE BEING COMPUTED NORMALLY.
- THE SIX COMPUTED JOINT RATE CMDS ARE THEN SCALED SO THAT NO COMMAND EXCEEDS ITS JOINT'S CORRESPONDING MAX COARSE RATE.

3, 3, 8, 11

RTV_TOTVEL (RTV)
TOTAL VELOCITY

- PERFORMS ACTUAL AND COMMANDED FOR TRANS RATE AND ROT RATE PROCESSING FOR USE BY RDD, TO THE RATE METER AND TO DISPLAY DMA.
- ACTUAL RATE PROCESSING USES SIX ACTUAL JOINT RATES COMPUTED VIA RTE AND DISTANCE COMPUTATIONS, JOINT ANGLE SINES AND COSINES, AND TRANSFORMATION MATRICES FROM RKG AND COMPUTES THE TRANS RATE AND ROT RATE VECTORS IN EITHER PLOS, EOSS OR OBAS DEPENDING ON THE MODE. THE RESULTANT ACTUAL FOR TRANS RATE IS ALSO DETERMINED.
- COMMANDED RATE PROCESSING PRODUCES ZERO FOR RATE COMMANDS IF POSITION HOLD IS ACTIVE OR IF NOT IN MANUAL, AUTO OR TEST MODES. OTHERWISE, IT GETS FOR COMMANDS FROM EITHER RAS (AUTO MODES) OR RJS (MANUAL OR TEST) AND CONVERTED TO EITHER OBAS, PLOS OR EOSS AND THE RESULTANT COMMANDED FOR TRANS RATE IS COMPUTED.

3, 3, 8, 12

RHM_HLTH_MON (RHM)
HEALTH MONITOR

- CALLS RVM.
- IF RHM FIRST PASS FLAG IS ON (SET ON IN SUSPEND MODE INITIALIZATION) AND WHEN UPMOUNDED TO IDLE FROM TEMP MONITOR MODE), PERFORMS FIRST PASS INITIALIZATION:
  - EE DERIGIDIZE, EE RELEASE AND SINGULARITY CHECKS ARE INHIBITED.
  - ALL ARM RELATED FAULT COUNTERS ARE ZEROED.
- PERFORMS EE DERIGIDIZE CHECK AND GENERATES RHM ALARM FLAG FOR MASTER ALARM GENERATION, FAULT ANNUN FLAG AND EE DERIGIDIZE ANNUN FLAG FOR FAULT MESSAGE GENERATION AND EE DERIGIDIZE WARNING FLAG FOR RNC PANEL USE.
- PERFORMS EE RELEASE CHECK AND GENERATES RHM ALARM FLAG FOR MASTER ALARM GENERATION, FAULT ANNUN FLAG AND EE RELEASE WARNING FLAG.
- IF ENCODER CHECK FLAG IS OFF, PERFORMS REACH LIMIT CHECKS AND GENERATES RHM ALARM FLAG, FAULT ANNUN FLAG, REACH LIMIT PSS ANNUN FLAG (1-6), REACH LIMIT MED ANNUN FLAG (1-6) AND REACH LIMIT CAUTION FLAG.
- IF SOFT STOP LIMITS ENABLE/INHIBIT FLAG IS ON, PERFORMS SOFT STOP CHECK FOR EACH JOINT, IF A JOINT IS WITHIN 1.5 DEG OF ITS SOFT STOP LIMIT AND IS ALSO BEYOND ITS SOFT STOP LIMIT, THEN SOFTWARE STOP FLAG IS TURNED ON AND ZERO JOINT RATE COMMANDS ARE ISSUED.
- ON FILTERS SINGULARITY CONDITIONS AND GENERATES RHM ALARM FLAG, FAULT ANNUN FLAG, SINGULARITY ANNUN FLAG AND SINGULARITY CAUTION FLAG.
- CALLS RBM TO ON FILTER ARE RELATED HARDWARE FAILURES (HARDWARE BITE FLAGS 7-34).

3, 3, 8, 14

CALLS

RVM_CONEN (RVM)
CONSISTENCY AND ENCODER CHECKS

- IF ENCODER ENABLE/INHIBIT FLAG IS ON (ENABLED) THEN THE ENCODER CHECKS ARE PERFORMED:
  - IF RHM FIRST PASS FLAG IS ON OR ENCODER CHECK WAS INHIBITED LAST PASS, THE ENCODER CHECK PARAMETERS ARE INITIALIZED.
  - ENCODER CHECK - ON ENCODER CHECK FAILURES OR TACH FAILURES EXIST, THEN ENCODER CHECK 1 & ENCODER CHECK 2 ARE PERFORMED, IF A FAILURE IS DETECTED THEN THE RHM ALARM FLAG AND RVM CHECK BIT FLAG CHANGES STATE.
  - ENCODER CHECK 1 CONSISTS OF COMPARING THE UNTRANSIENCE VALUE OF THE ENCODER TO A 0.25 SECOND INTEGRAL OF THE TACH OUTPUT AND ANNUNCIATING A FAILURE IF THE TWO DIFFER BY MORE THAN 1 DEG (TM SPEC-TOLERABLE & LEVEL-I INITIATORS).
  - ENCODER CHECK 2 (STUCK ENCODER CHECK) ANNUNCIATES FAILURES FOR WHICH THE ENCODER VALUE DOES NOT CHANGE WHEN MOTOR RATE COMMANDED EXCEED .7 RAD/S (TM SPEC-TOLERABLE & LEVEL-I INITIATORS) CONSTANTS ARE IN SPEC-OPERATABLE AND LEVEL-I INITIATORS.
- THE CONSISTENCY CHECK PARAMETERS ARE RESET IF RHM FIRST PASS FLAG IS ON OR BRAKES ON CMD CHANGES FROM ON TO OFF OR LOADED RATE LIMIT CHANGE STATE, OTHERWISE IF THE BRAKES ARE OFF AND NO CONSISTENCY CHECK FAILURES EXIST THE CONSISTENCY CHECK ALGORITHMS ARE PERFORMED:
  - FOR EACH JOINT, IF THE TACH FAIL FLAG IS OFF, THE TACH DATA CONSISTENCY CHECK IS PERFORMED.
  - FOR EACH JOINT, IF THE CORRESPONDING FORWARD/BACKDRIVE FLAG IS OFF (FWD DRIVE) OR IF THE TACH FAIL FLAG IS ON, THE RATE ENCODER CONSISTENCY CHECK IS PERFORMED.
  - RVM ALARM FLAG, ERRANT ANNUN (1-6), CNTL ERROR CAUTION FLAG IS TURNED ON AND IF AUTO BRAKES ENABLE/INHIBIT IS ON, ALL BRAKES RED FLAG IS TURNED ON FOR CONSISTENCY CHECK FAILURES.

3, 3, 8, 21

RJS_HANDCTL (RJS)
HAND CONTROLLER

- RATE HOLD REQUEST FLAG IS SET TO OPPOSITE STATE WHEN RATE HOLD SWITCH CHANGES STATE AND RESET WHEN PL CAPTURE FLAG CHANGES STATE.
- IF RATE HOLD IS REQUESTED, VERNIER SCALING FLAG, MAX PL TRANS RATE, MAX PL ROT RATE, AND PL ROT RATE, RESPECTIVELY, COMMANDS ARE SAVED UNTIL RATE HOLD MODE IS DESELECTED, AFTER AN NO NULL FLAG IS SUBSEQUENTLY RECEIVED, ANY NEW HC COMMANDS ARE BIASED BY THE SAVED VALUES OF THC AND RHC.
- END EFFECTOR COMMANDS ARE COMPUTED AS FOLLOWS EACH HC SAMPLE:
  - EACH HC AXIS COMMAND IS COMPUTED PROPORTIONAL TO THE HC DEFLECTION BY THE RATIO OF THE APPROPRIATE SEL PL RATE COMMAND TO THE MAX HC DEFLECTION AFTER SUBTRACTING OFF THE NULL DEADBAND.
  - THE VECTOR SUM OF THE ABOVE THC AND RHC COMMANDS IS THEN SCALED BY THE APPROPRIATE SEL PL TRANS RATE AND SEL PL ROT RATE, RESPECTIVELY.
  - THE FOR COMMANDS ARE THEN TRANSFORMED TO EE COMMANDS VIA THE VECTOR FROM THE EE TO THE PIVM AND THE TRANSFORMATION MATRIX FROM THE PVM TO THE EE COMPUTED IN RKG.

3, 3, 8, 8

RAS_AUTOSEQ (RAS)
AUTOMATIC SEQUENCE PROCESSOR

- VALIDATES CONDITIONS ARE MET FOR AUTO SEQUENCE READY INDICATION.
- INTERCEPTS AUTO SEQUENCE PROCEED AND STOP COMMANDS FROM THE DAC PANEL.
- GENERATES EE RATE COMMANDS FOR USE BY RRP REQUIRED TO DRIVE THE PDP FROM POINT TO POINT WITHIN AN AUTO SEQUENCE ALONG A STRAIGHT LINE PATH AT A CONSTANT RATE IN FINE OR COARSE RATE AS APPROPRIATE.
- PERFORMS WASHOUT AT PAUSE POINTS OR COMMANDED POINT IN AN GOAS TO BRING THE ARM TO REST WITHIN REQUIRED TOLERANCE.
- UPDATES LAST PT ON SPEC 94 WHEN A POINT HAS BEEN ACHIEVED.

3, 3, 8, 10

RSC_SINCTL (RSC)
SINGLE JOINT CONTROL

- PERFORMS SINGLE JOINT RATE PROCESSING FOR THE SELECTED JOINT (JOINT SWITCH INDEX 1-6).
- MAINTAINS SELECTED JOINT IN POSITION HOLD IF IN MANUAL OR TEST TRANSITION AND NO ENCODER CHECK EXISTS FOR THE SELECTED JOINT AND ALSO:
  - THE SELECTED JOINT IS CHANGED OR
  - THE SELECTED JOINT IS NOT BEING COMMANDED AND THE JOINT IS AT REST
- COMMANDS THE SELECTED JOINT TO RAMP TO ZERO RATE USING FINE OR COARSE JOINT RATE LIMIT DOUBLE (3 CYCLES OR 15 CYCLES, RESPECTIVELY).

3, 3, 8, 7

TEMP MONITOR MODE

RIT_TEMP (RIT)
TEMPERATURE PROCESSOR

- FOR EACH VALID THERMISTOR (0 BASED ON THE ARM AVAILABLE MAP OF 4 VALUES EACH PASS) THE FOLLOWING PROCESSING IS PERFORMED:
  - IF AN UPPER OR LOWER TEMPERATURE LIMIT IS EXCEEDED, THE RESPECTIVE FLAGS, FAULT ANNUN FLAG AND THE ASSOCIATED TEMP FLAG IS TURNED ON IF THE FAILURE EXISTS FOR (24 COUNTS (1 MIN).
  - THE WORST CASE TEMPERATURE DEVIATION FROM THE LIMIT AND ITS ID ARE SAVED FOR DRIT TEMP DISPLAY USE BY RDD, AND THE PORT OR STBD TEMP CAUTION IS TURNED ON IF ANY TEMP DEVIATION IS > ZERO.
- RBM IS CALLED TO ON FILTER MCIU RELATED HARDWARE FAILURES (HARDWARE BITE FLAGS 1-6).

3, 3, 8, 15

CALLS

RBM_HDWFT (RBM)
HARDWARE FAULT ANNUNCIATION FILTERING

- EACH OF THE 34 HARDWARE FAULTS - 1 THRU 6 WHEN CALLED BY RIT, 7 THRU 34 WHEN CALLED BY RHM - IS FILTERED FOR ITS ASSOCIATED FAULT SET AND THE APPROPRIATE BIT IN THE FAULT ANNUNCIATION TABLE SET IF THE FAILURE IS PRESENT FOR TWO OR MORE CYCLES BEFORE MESSAGE GENERATION

MCIU MADC	1
MCIU MCPC	2
MCIU ICF	3
CNCT COMM FAIL	4
THERM CNT FAIL	5
DPC COMM FAIL	6
ABE COMM FAIL	7
SPA DPC FAIL	8-13
SPA PWR FAIL	14-19
SPA COMM FAIL	20-25
MSA FAIL	26-31
JPC FAIL	32-33
EE FAIL	34

3, 3, 8, 22

CALLS

RDD_DDISP (RDD)
DEDICATED DISPLAY

- THE MASTER ALARM DISCRETE IS TURNED ON IF RIT ALARM FLAG OR RHM ALARM FLAG OR RVM ALARM FLAG OR RYE ALARM FLAG IS ON.
- CHECK CNT CAUTION DISCRETE IS TURNED ON IF RYE CHECK CNT FLAG OR RVM CHECK CNT FLAG IS ON.
- THE SIX JOINT ANGULAR TRANSLATION RATE AND CMD FOR RESULTANT TRANSLATION RATE ARE DIVIDED BY THE SCALE FACTOR IN EFFECT (.25 OR 2.5 DEG) AND LIMITED TO A MAX VALUE OF 1.0.
- THERMISTOR TEMP AND CRITICAL TEMP DATA FIELDS, SIGN FIELDS AND DECIMAL FIELDS ARE PROCESSED FOR THE SELECTED ARM AND THERMISTOR INDEX IF AN ARM IS SELECTED.
- THE SIGN FIELD, DECIMAL FIELD AND DATA FIELD VALUES FOR EACH OF THE THREE DISPLAY WINDOWS IS SELECTED BASED ON THE PARAMETER MATRIX INDEX IF AN ARM IS SELECTED OR PORT TEMP OR STBD TEMP IS SELECTED.
- THE DATA FIELD IS CONVERTED TO A BINARY CODED DECIMAL FORMAT AND IS USED FOR PLACEMENT OF THE DECIMAL POINT AND SIGN FIELD FOR CORRECT SIGN OF DISPLAY.
- IF FAULT ANNUN FLAG IS ON, A FAULT MESSAGE MASKS IS ISSUED FOR EACH OF THE 96 ANNUNCIATION FLAGS THAT IS ON WHILE THE CORRESPONDING LAST PASS ANNUNCIATION FLAG IS OFF.

3, 3, 8, 17

RNC_ENCODE (RNC)
MCIU ENCODER

- JOINT CURRENT LIMITS ARE DETERMINED FOR EACH OF THE SIX JOINTS BASED ON WHETHER OR NOT CURRENT LIMPING IS REQUIRED, THE APPROPRIATE LIMIT (14 OR 15) IS USED.
- THE SIX JOINT RATE CMDS ARE CONVERTED TO MOTOR RATE CMDS BY MULTIPLYING BY THE GEAR RATIOS AND CONVERTING TO RADIANS AND THE LAST FOUR VALUES OF EACH ARE SAVED IN A FOUR-LEVEL STACK.
- THE MOST RECENT SET OF MOTOR RATE CMDS ARE THEN CALIBRATED FOR THE MOTOR TORQUE-SPEED CHARACTERISTIC CURVE, ROUNDED UP TO THE NEXT LOWER INTEGER AND LIMITED TO A RANGE OF +2048 TO 2047. THE SIGN OF MOTOR RATE CMDS 1 THRU 5 IS INVERTED FOR CORRECT PHASING.
- THE RATE DEMAND ID IS INCREMENTED MODULO 128 AND THE LATEST FOUR VALUES ARE SAVED IN A FOUR-LEVEL STACK.
- THE SIX MOTOR RATE CMDS AND JOINT CURRENT LIMITS ARE REORDERED WITH SHY BEING 6 AND WRR BEING 1 TO MATCH THE ORDER OF TRANSDUCTION TO THE ABE.
- THE ACTUAL RMS RESULTANT VELOCITY AND CMD FOR RESULTANT VELOCITY ARE CONVERTED TO UNSIGNED INTEGERS (+ 255 TO DRIVE THE RATE METERS.
- FOUR DECIMAL INTEGER DIGITS FOR EACH OF THE THREE DISPLAYS ARE DETERMINED WITH LEADING ZERO SUPPRESSION RESULTING FROM THE INPUT DATA FIELD AND THE INPUT DECIMAL FIELD WORDS.
- THE SIX CONSISTENCY CHECK ERRANT FLAGS, THE SIX ENCODER CHECK FAIL FLAGS AND THE SIX RATE AND THE EE RELEASE WARNING ARE PACKED INTO A SINGLE 16 BIT WORD.
- THE SIX TACH DATA CHECK FAIL AND THE SIX RATE ENVELOPE CHECK FAIL FLAGS ARE PACKED INTO A SINGLE 16 BIT WORD.

3, 3, 8, 16

USER INTERFACE (UI)

- UPDATES PDRS CONTROL SPEC 094 AND PDRS STATUS DISPLAYS ONS AT 1 HZ
- RMS MESSAGE PROCESSOR
- COORDINATION OF GROUND COMMUNICATION BY WAY OF DOMAIN/LIST

OUTPUT WRITE COMPOOL (CRE_MCO)
GPC TO MCIU DATA

MCIU	PARAMETER NAME	SOURCE
V72X2936J	MANUAL ORBITER UNLOADED MODE SELECTED	RXY
V72X2936K	MANUAL EE MODE SELECTED	
V72X2936L	MANUAL ORB LOADED MODE SELECTED	
V72X2936M	MANUAL EE MODE SELECTED	
V72X2936J	DPM CMD MODE SELECTED	
V72X2936K	AUTO 1 MODE SELECTED	
V72X2936L	AUTO 2 MODE SELECTED	
V72X2936J	AUTO 3 MODE SELECTED	
V72X2936J	AUTO 4 MODE SELECTED	
V72X2936J	TEST MODE SELECTED	
V72X2936J	SINGLE MODE SELECTED	
V72X2936J	CHECK CRT CAUTION	RDD,RXY
V72X2936J	MASTER ALARM DISCRETE	RDD
V72X2936J	X10 SCALE DISCRETE	RDD
V72X2936J	ALL BRAKES REQUEST	RVM
V72X2941J	AUTO SEQ READY FLAG	RXY,RAS
V72X2942J	AUTO SEQ IN PROGRESS FLAG	
V72X2940J	RATE HOLD SELECTED	RXY,RJS
V72X2938J	MIN RATE FLAG	RCO
V72L2933J	ACTUAL POR RESULTANT VELOCITY	RNC
V72L2934L	COMMANDED POR RESULTANT VELOCITY	
V54H544AP	ACTUAL RMS VELOCITY	
V54H544BP	DATA FOR DISPLAY FIELDS	
V54H544AP	DATA FOR DISPLAY FIELDS	
V72X2937E	SOFTWARE STOP FLAG	RXY,RHM
V72X2938J	EE DERIGIDIZE WARNING FLAG	
V72X2937J	EE RELEASE WARNING FLAG	
V72X2930J	REACH LIMIT CAUTION FLAG	
V72X2931J	SINGULARITY CAUTION FLAG	
V72X2936J	CONTROL ERROR CAUTION	RVM,RXY
V72X2931J	PORT TEMP CAUTION FLAG	RIT
V72X2932J	STBD TEMP CAUTION FLAG	
V72L2000J	TEST WORD	REX
V54X2800J	RATE CMD ID	RNC
V54X2729J	WR ROLL RATE DEMAND	
V54X2718J	WR ROLL CURRENT LIMIT	
V54X2680J	WR YAW RATE DEMAND	
V54X2610J	WR YAW CURRENT LIMIT	
V54X2541J	WR PITCH RATE DEMAND	
V54X2520J	WR PITCH CURRENT LIMIT	
V54X2404J	EL PITCH RATE DEMAND	
V54X2415J	EL PITCH CURRENT LIMIT	
V54X2300J	SH PITCH RATE DEMAND	
V54X2310J	SH PITCH CURRENT LIMIT	
V54X2200J	SH YAW RATE DEMAND	
V54X2210J	SH YAW CURRENT LIMIT	

MCIU

(1) 7/6 14.5-1

ARM BASED ELECTRONICS (ABE) DWG. 14.4-3

RMS DAC PANEL (2) 7/6

BRAKES — SOFTWARE STOP

AUTO 1	SMB UAL		
AUTO 2	END EFF		
AUTO 3	SMB LO		
AUTO 4	PAYLOAD		
DPM CMD	SINGLE		
TEST	D-RECT		

MCIU	DERIGIDIZE		
ABE	RELEASE		
DPC DATA			
S-ANGULAR	CHECK CRT		
CNTL ERR	REACH LIM		
STBD TEMP	PORT TEMP		

READY / IN PROG / AUTO SEQ

MASTER ALARM

ACT CMD RATE

FPS .25 .2 .1 0

MIN OFF — HOLD OFF

SCALE X10

-88.88 -88.88 -88.88

XXXX/094/ PDRS CONTROL XX X DDD/Hhh:Mm:Ss DDD/Hhh:Mm:Ss

RMS SEL= XXXX RMS PWR XXX END: HH

PORT IX SOFT SHDF TX BX

STBD X I/O ON SX AUTO BRAKE SX LOS

3 PL ID XX OFF KX POS ENC CK 11X 12X

4 END EFF X AUTO MODES LT START PT XXX

1 2 3 4 LAST PT XXX

13 XX 14 XX 15 XX 16 XX

OPS MODE

END PBS END ATT

18 X =XXXX 24 PL INIT ID XX

19 Y =XXXX 21 Y =XXX

20 Z =XXXX 22 Y =XXX CMD OX 25 XXXX

23 R =XXX

RMS STG/DPLY 26 WR RANGE X

SHLD X X X X AUTO BRAKE CK OTK

RMS LAT/REC/ROY

ATT X X X X X X

MID X X X X X X

FWD X X X X X X

XXX/ /096 PDRS STATUS XX X DDD/Hhh:Mm:Ss DDD/Hhh:Mm:Ss

RMS SEL= XXXX

	X/P	Y/Y	Z/R
TRANS RATES ACT	+XX.XXS	+XX.XXS	+XX.XXS
CMD	+XX.XX	+XX.XX	+XX.XX
ROT RATES ACT	+XX.XX	+XX.XX	+XX.XX
CMD	+XX.XX	+XX.XX	+XX.XX
POSITIONS ACT	+XXXXXS	+XXXXXS	+XXXXXS
ATTITUDES ACT	+XXX.XS	+XXX.XS	+XXX.XS

JOINTS	SY	SP	EP	WP	VY	WR	MCIU MADC
REACH LIMIT							MCPC
ABE - TACH							ICF
SPA							ABE/MCIU
MTR DR							CHECK CRT
MTR PWR							END EFF
CONTROL ERR							TEMP CRT
EX CRT-POS							ENG/MCIU

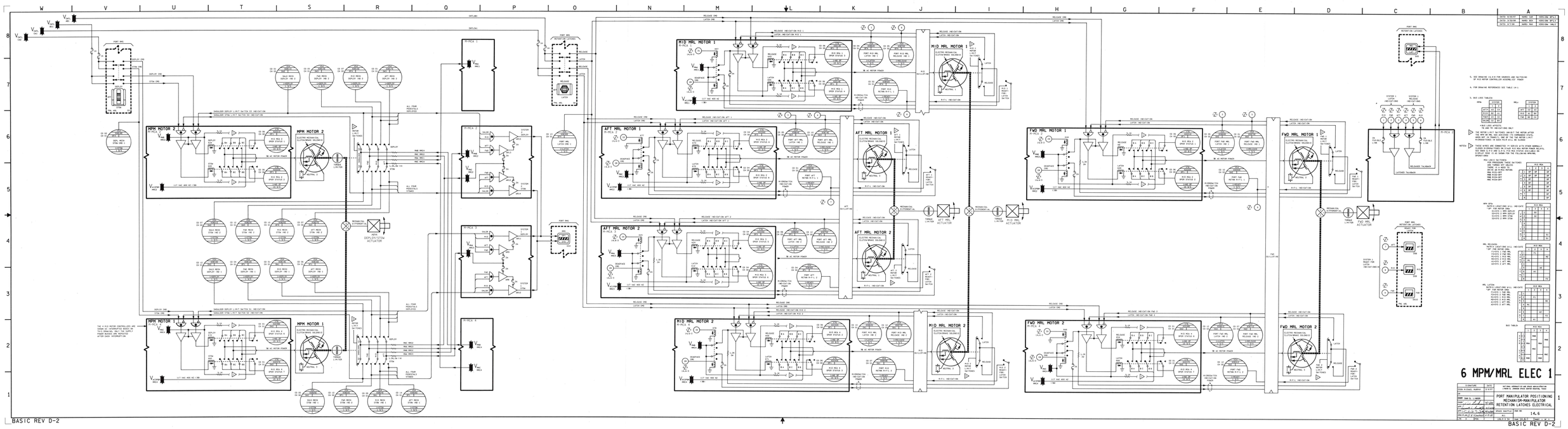
1. FOR DRAWING REFERENCES SEE TABLE 14-1

5 RMS/SW OV 2

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DOUG M. GILLESPIE	1/26/87	
DR L. N. BUCHANAN	8/8/78	RMS/SOFTWARE OVERVIEW
DWGR [signature]	8/26/87	
DWGR N.N. PULLEN		
APPL [signature]	8/26/87	SPACE SHUTTLE DWG NO 14.5
APPL [signature]	8/27/87	ALL
DWG APPROVAL [signature]	8-27-87	SHEET 1 OF 2
CM 3 ENG		REV 14.5-2 PAGE 14.5-2 SHEET 2 OF 2

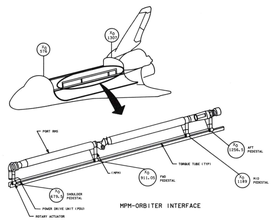
BASIC REV D

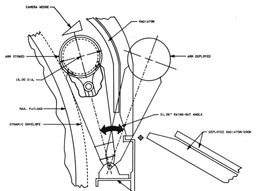
BASIC REV D

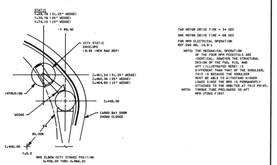

6 MPM/MRL ELEC 1
PORT MANIPULATOR POSITIONING MECHANISM-MANIPULATOR RETENTION LATCHES ELECTRICAL
14.6
BASIC REV D-2
MPM MOTOR 1
MPM MOTOR 2
MID MRL MOTOR 1
MID MRL MOTOR 2
AFT MRL MOTOR 1
AFT MRL MOTOR 2
FWD MRL MOTOR 1
FWD MRL MOTOR 2
PORT MRL RETENTION LATCHES
MID MRL ACTUATOR
AFT MRL ACTUATOR
FWD MRL ACTUATOR
MPM DEPLOY/STOW ACTUATOR
MECHANICAL DIFFERENTIAL
LATCHED TALBACK
RELEASED TALBACK
BUS TABLES
MPM DATA
MRL RELEASED
MRL LATCH
BUS TABLE
BASIC REV D-2

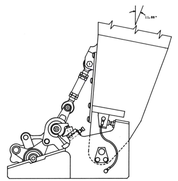
DATE: 9/20/87	BASIC REV:	HOOD DWG. NO.:
DATE: 11/09/87	BASIC REV: D	HOOD DWG. NO.: SPEC 2
DATE: 8/20/87	BASIC REV:	HOOD DWG. NO.: SPEC 1

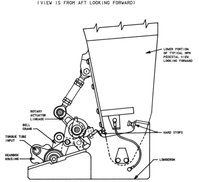
GENERAL MPM OPERATION

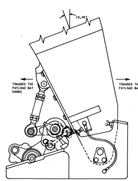




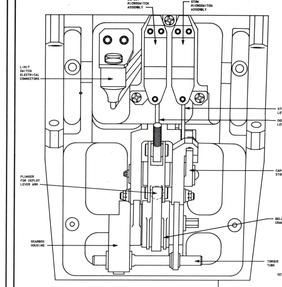


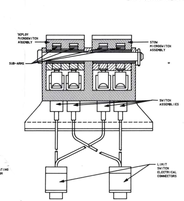


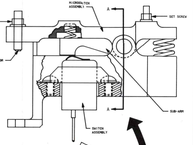


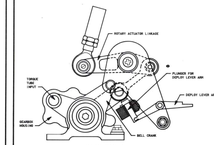


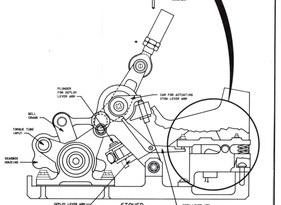
LIMIT SWITCH OPERATION





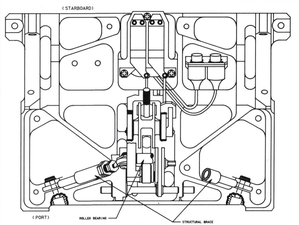


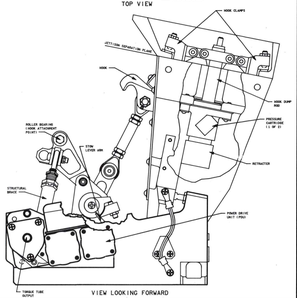


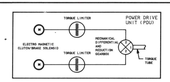


MPM

SHOULDER PEDESTAL DESIGN

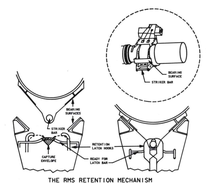


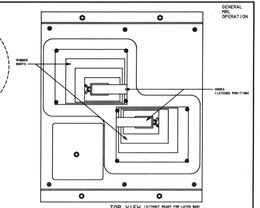


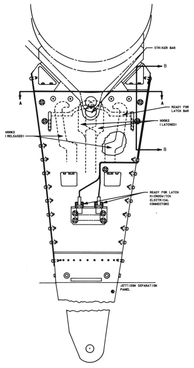


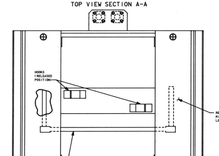
MRL

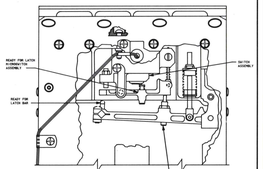
GENERAL PDU OPERATION



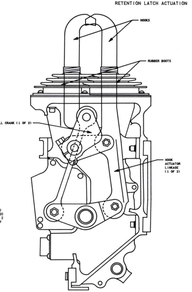


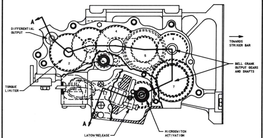


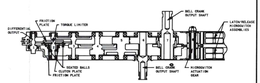


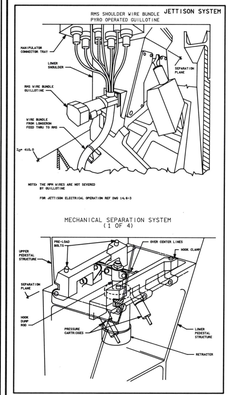


RETENTION LATCH ACTUATION







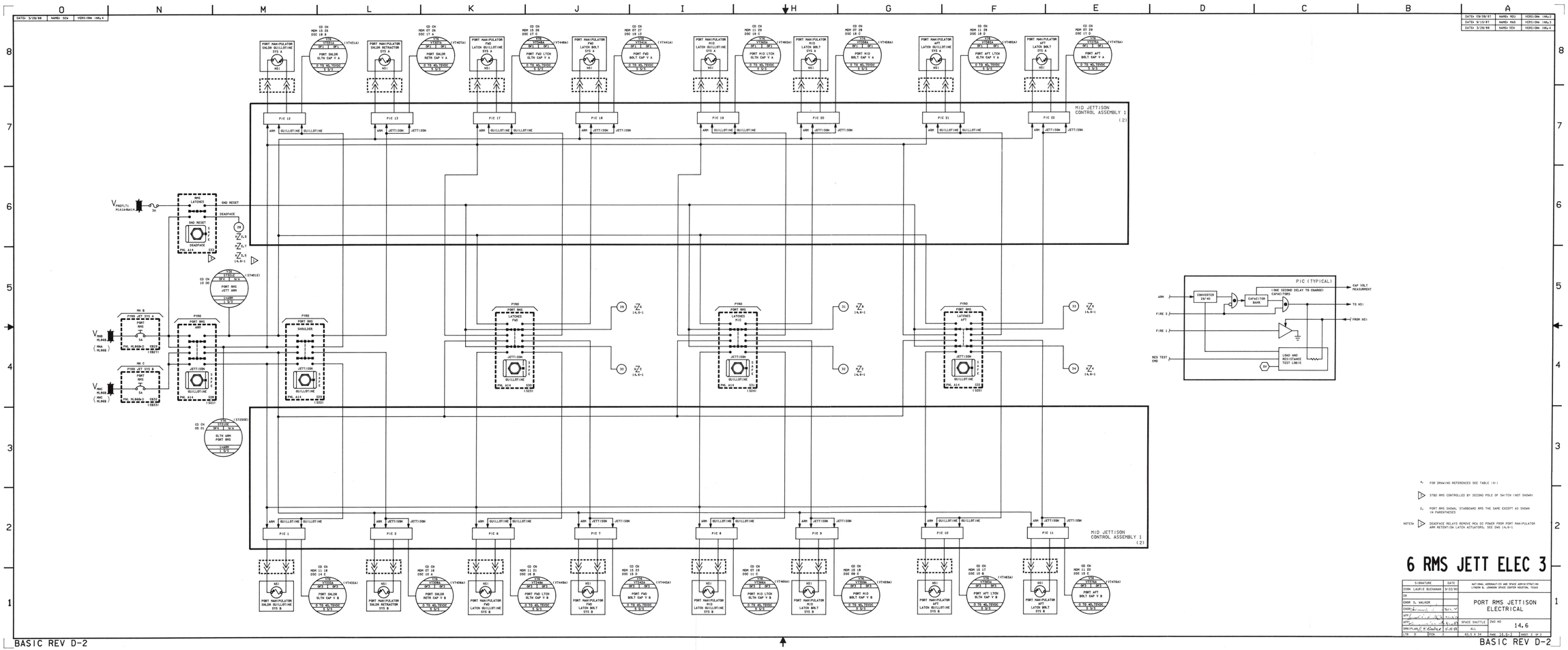


WITH 'L' REFER TO TABLE 1+/- FOR DRAWING REFERENCES

6 MPM/MRL MECH 2

SIGNATURE	DATE	ORIGINAL DRAWINGS OR BOOK ARRANGEMENT
JOHN T. SCHMITT	11/87	JOHN T. SCHMITT, ROCKWELL INTERNATIONAL
APPR.		
APPR. R. D. MILLER		PORT MANIPULATOR POSITIONING MECHANISM MANIPULATOR RETENTION LATCHES MECHANICAL
APPR. R. D. MILLER	11-6-87	
APPR. [illegible]	11-6-87	
APPROVED R. D. MILLER	11-6-87	SPACE SHUTTLE DWG NO. 14-6
APPROVED [illegible]	11-6-87	
SCALE: NONE		CONTRACT NO. NAS9-17900 SHEET 1 OF 1

BASIC REV D



K. FOR DRAWING REFERENCES SEE TABLE (4-1)

STBD RMS CONTROLLED BY SECOND POLE OF SWITCH (NOT SHOWN)

Σ. PORT RMS SHOWN, STARBOARD RMS THE SAME EXCEPT AS SHOWN IN PARENTHESES

NOTES: DEADFACE RELAYS REMOVE MCA DC POWER FROM PORT MANIPULATOR ARM RETENTION LATCH ACTUATORS. SEE DWG 14.6-1

6 RMS JETT ELEC 3

SIGNATURE	DATE
JOHN LAURIE BUCHANAN	9/22/87
CK	
EMORY S. WALKER	
ENGR	
APPR	
APPR	
DRW/PLNG R. Gaulke	9.16.87
LTR D ECN 7	

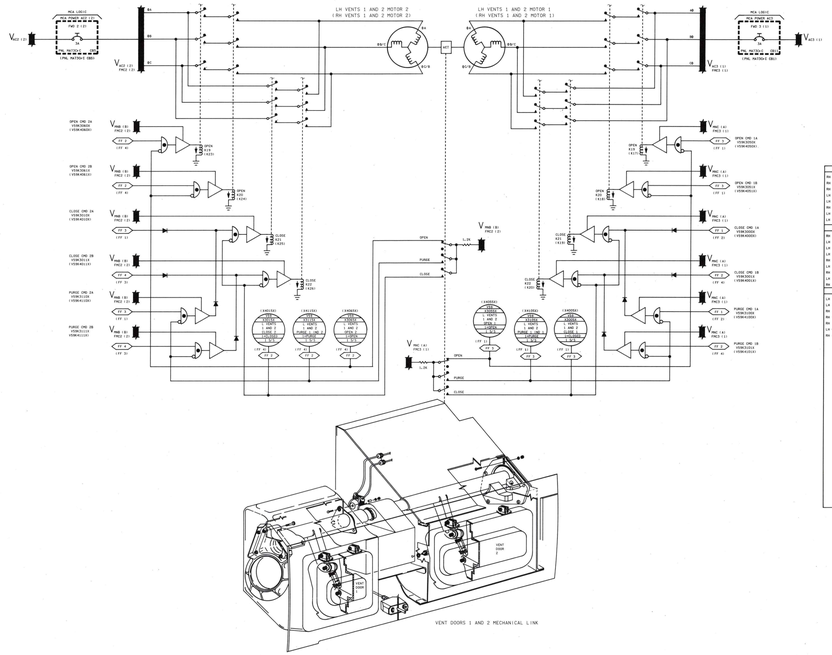
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

PORT RMS JETTISON ELECTRICAL

SPACE SHUTTLE | DWG NO 14.6
ALL
ED.3.3.34 PAGE 14.6-3 SHEET 3 OF 3

BASIC REV D-2

BASIC REV D-2



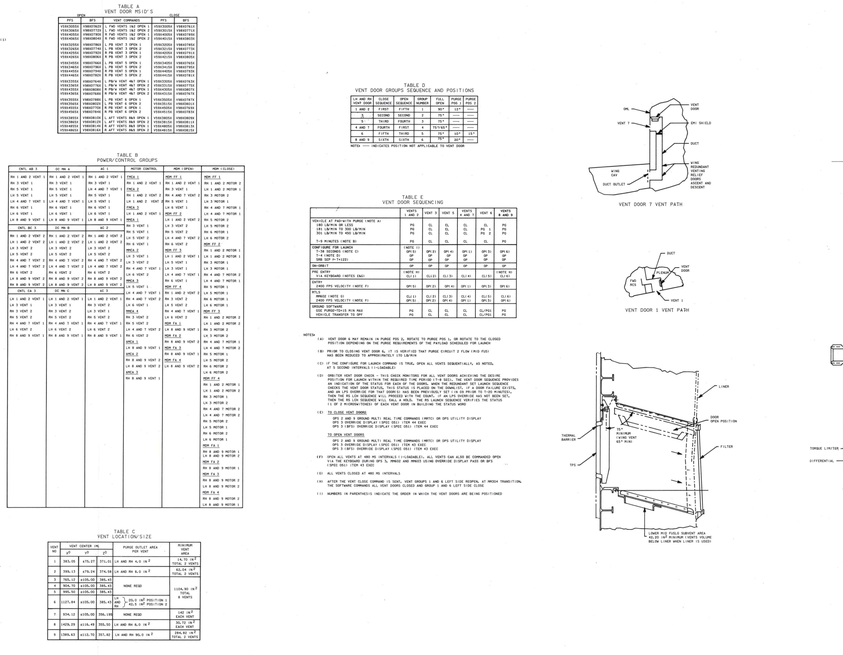


TABLE A
VENT DOOR MS/D'S

OPEN	CLOSE				
#1's	#2's	VENT COMMANDS	PP's	MP's
V55K10002	V88D70021	PVA VENTS 1&2 OPEN 1	V55K30001	V88D70412
V55K10003	V88D70022	PVA VENTS 1&2 OPEN 2	V55K30002	V88D70413
V55K10004	V88D70023	PVA VENTS 1&2 OPEN 3	V55K30003	V88D70414
V55K10005	V88D70024	PVA VENTS 1&2 OPEN 4	V55K30004	V88D70415
V55K10006	V88D70025	PB VENT 1 OPEN 1	V55K30005	V88D70416
V55K10007	V88D70026	PB VENT 1 OPEN 2	V55K30006	V88D70417
V55K10008	V88D70027	PB VENT 1 OPEN 3	V55K30007	V88D70418
V55K10009	V88D70028	PB VENT 1 OPEN 4	V55K30008	V88D70419
V55K10010	V88D70029	PB VENT 2 OPEN 1	V55K30009	V88D70420
V55K10011	V88D70030	PB VENT 2 OPEN 2	V55K30010	V88D70421
V55K10012	V88D70031	PB VENT 2 OPEN 3	V55K30011	V88D70422
V55K10013	V88D70032	PB VENT 2 OPEN 4	V55K30012	V88D70423
V55K10014	V88D70033	PB VENT 2 OPEN 5	V55K30013	V88D70424
V55K10015	V88D70034	PB VENT 2 OPEN 6	V55K30014	V88D70425
V55K10016	V88D70035	PB VENT 2 OPEN 7	V55K30015	V88D70426
V55K10017	V88D70036	PB VENT 2 OPEN 8	V55K30016	V88D70427
V55K10018	V88D70037	PB VENT 2 OPEN 9	V55K30017	V88D70428
V55K10019	V88D70038	PB VENT 2 OPEN 10	V55K30018	V88D70429
V55K10020	V88D70039	PB VENT 2 OPEN 11	V55K30019	V88D70430
V55K10021	V88D70040	PB VENT 2 OPEN 12	V55K30020	V88D70431
V55K10022	V88D70041	PB VENT 2 OPEN 13	V55K30021	V88D70432
V55K10023	V88D70042	PB VENT 2 OPEN 14	V55K30022	V88D70433
V55K10024	V88D70043	PB VENT 2 OPEN 15	V55K30023	V88D70434
V55K10025	V88D70044	PB VENT 2 OPEN 16	V55K30024	V88D70435
V55K10026	V88D70045	PB VENT 2 OPEN 17	V55K30025	V88D70436
V55K10027	V88D70046	PB VENT 2 OPEN 18	V55K30026	V88D70437
V55K10028	V88D70047	PB VENT 2 OPEN 19	V55K30027	V88D70438
V55K10029	V88D70048	PB VENT 2 OPEN 20	V55K30028	V88D70439
V55K10030	V88D70049	PB VENT 2 OPEN 21	V55K30029	V88D70440
V55K10031	V88D70050	PB VENT 2 OPEN 22	V55K30030	V88D70441
V55K10032	V88D70051	PB VENT 2 OPEN 23	V55K30031	V88D70442
V55K10033	V88D70052	PB VENT 2 OPEN 24	V55K30032	V88D70443
V55K10034	V88D70053	PB VENT 2 OPEN 25	V55K30033	V88D70444
V55K10035	V88D70054	PB VENT 2 OPEN 26	V55K30034	V88D70445
V55K10036	V88D70055	PB VENT 2 OPEN 27	V55K30035	V88D70446
V55K10037	V88D70056	PB VENT 2 OPEN 28	V55K30036	V88D70447
V55K10038	V88D70057	PB VENT 2 OPEN 29	V55K30037	V88D70448
V55K10039	V88D70058	PB VENT 2 OPEN 30	V55K30038	V88D70449
V55K10040	V88D70059	PB VENT 2 OPEN 31	V55K30039	V88D70450
V55K10041	V88D70060	PB VENT 2 OPEN 32	V55K30040	V88D70451

TABLE B
POWER/CONTROL GROUPS

CNTL HB 3	CC HB 4	AC 1	MOTOR CONTROL	MDM 1 (ENG)	MDM 1 (LOSS)
RH 1 AND 2 VENT 1	RH 1 AND 2 VENT 3	RH 1 AND 2 VENT 1	MDLA 1	MDR FT 1	
RH 1 VENT 2	RH 1 VENT 4	RH 1 AND 2 VENT 2		RH 1 AND 2 VENT 1	RH 1 AND 2 MOTOR 2
RH 1 VENT 3	RH 1 VENT 5	LH 1 AND 2 VENT 1	MDLA 2	RH 1 VENT 2	RH 1 AND 2 MOTOR 1
LH 1 VENT 1	LH 1 VENT 3	RH 1 VENT 3		RH 1 AND 2 VENT 3	RH 1 MOTOR 2
LH 1 AND 2 VENT 2	LH 1 AND 2 VENT 5	LH 1 AND 2 VENT 2	MDLA 3	RH 1 VENT 4	RH 1 MOTOR 1
RH 2 VENT 1	RH 2 VENT 3	RH 1 VENT 4		RH 1 AND 2 VENT 4	RH 2 AND 3 MOTOR 2
RH 2 VENT 2	RH 2 VENT 4	LH 1 VENT 3	MDLA 4	RH 1 VENT 5	RH 2 AND 3 MOTOR 1
LH 2 VENT 1	LH 2 VENT 3	LH 1 VENT 4		LH 1 AND 2 VENT 3	RH 2 MOTOR 2
LH 2 VENT 2	LH 2 VENT 4	LH 1 VENT 5	MDLA 5	LH 1 AND 2 VENT 4	RH 2 MOTOR 1
LH 1 AND 2 VENT 3	RH 4 AND 5 VENT 3	RH 4 AND 5 VENT 1		LH 1 VENT 1	RH 3 MOTOR 2
RH 4 AND 5 VENT 1	RH 4 AND 5 VENT 4	RH 4 AND 5 VENT 2	MDLA 6	LH 1 VENT 2	RH 3 MOTOR 1
RH 4 VENT 2	RH 4 VENT 5	LH 4 AND 5 VENT 1		LH 1 VENT 3	LH 1 AND 2 MOTOR 2
LH 4 AND 5 VENT 2	RH 5 AND 6 VENT 3	LH 4 AND 5 VENT 2	MDLA 7	LH 1 VENT 4	LH 1 AND 2 MOTOR 1
LH 4 VENT 1	RH 5 AND 6 VENT 4	RH 5 AND 6 VENT 1		LH 1 VENT 5	LH 2 MOTOR 2
DATA HB 3	CC HB 5	AC 2	MDLA 8	RH 4 AND 5 VENT 1	LH 2 MOTOR 1
LH 1 AND 2 VENT 4	LH 1 AND 2 VENT 6	LH 1 AND 2 VENT 3		RH 4 AND 5 VENT 2	LH 3 MOTOR 2
LH 3 VENT 1	LH 3 VENT 4	RH 3 VENT 1	MDLA 9	RH 4 VENT 3	LH 3 MOTOR 1
RH 3 VENT 2	LH 3 VENT 5	RH 3 VENT 2		RH 4 AND 5 VENT 3	LH 4 AND 5 MOTOR 2
RH 3 VENT 3	RH 3 VENT 5	RH 3 VENT 3	MDLA 10	RH 4 VENT 4	LH 4 AND 5 MOTOR 1
RH 4 VENT 3	RH 4 AND 5 VENT 5	RH 4 AND 5 VENT 3		RH 4 VENT 5	LH 4 MOTOR 2
RH 4 AND 5 VENT 4	RH 4 AND 5 VENT 6	RH 4 AND 5 VENT 4	MDLA 11	RH 5 AND 6 VENT 1	LH 4 MOTOR 1
		LH 4 AND 5 VENT 3		RH 5 AND 6 VENT 2	LH 5 MOTOR 2
		LH 4 VENT 4	MDLA 12	RH 5 VENT 3	LH 5 MOTOR 1
		LH 4 VENT 5		RH 5 AND 6 VENT 3	LH 6 MOTOR 2
		RH 5 AND 6 VENT 1	MDLA 13	RH 5 VENT 4	LH 6 MOTOR 1
		RH 5 AND 6 VENT 2		RH 5 AND 6 VENT 4	RH 1 MOTOR 2
		LH 5 AND 6 VENT 1	MDLA 14	RH 5 VENT 5	RH 1 MOTOR 1
		LH 5 AND 6 VENT 2		RH 6 VENT 1	RH 2 MOTOR 2
		RH 6 VENT 3	MDLA 15	RH 6 VENT 2	RH 2 MOTOR 1
		RH 6 AND 7 VENT 1		RH 6 VENT 3	RH 3 MOTOR 2
		RH 6 AND 7 VENT 2	MDLA 16	RH 6 AND 7 VENT 1	RH 3 MOTOR 1
		LH 6 AND 7 VENT 1		RH 6 AND 7 VENT 2	RH 4 MOTOR 2
		LH 6 AND 7 VENT 2	MDLA 17	RH 6 AND 7 VENT 3	RH 4 MOTOR 1
		RH 6 AND 7 VENT 3		RH 6 AND 7 VENT 4	RH 5 MOTOR 2
		RH 6 AND 7 VENT 4	MDLA 18	RH 6 VENT 4	RH 5 MOTOR 1
		LH 6 AND 7 VENT 3		RH 6 VENT 5	RH 6 MOTOR 2
		LH 6 AND 7 VENT 4	MDLA 19	RH 7 VENT 1	RH 6 MOTOR 1
				RH 7 VENT 2	LH 1 MOTOR 2
			MDLA 20	RH 7 VENT 3	LH 1 MOTOR 1
				RH 7 AND 8 VENT 1	LH 2 MOTOR 2
			MDLA 21	RH 7 AND 8 VENT 2	LH 2 MOTOR 1
				RH 7 AND 8 VENT 3	LH 3 MOTOR 2
			MDLA 22	RH 7 AND 8 VENT 4	LH 3 MOTOR 1
				RH 7 VENT 4	LH 4 MOTOR 2
			MDLA 23	RH 7 VENT 5	LH 4 MOTOR 1
				RH 8 AND 9 VENT 1	LH 5 MOTOR 2
			MDLA 24	RH 8 AND 9 VENT 2	LH 5 MOTOR 1
				RH 8 AND 9 VENT 3	LH 6 MOTOR 2
			MDLA 25	RH 8 AND 9 VENT 4	LH 6 MOTOR 1
				RH 8 VENT 4	MDR FX 1
			MDLA 26	RH 8 VENT 5	RH 1 MOTOR 2
				RH 9 AND 10 VENT 1	RH 1 MOTOR 1
			MDLA 27	RH 9 AND 10 VENT 2	RH 2 MOTOR 2
				RH 9 AND 10 VENT 3	RH 2 MOTOR 1
			MDLA 28	RH 9 AND 10 VENT 4	RH 3 MOTOR 2
				RH 9 VENT 4	RH 3 MOTOR 1
			MDLA 29	RH 9 AND 10 VENT 5	RH 4 MOTOR 2
				RH 10 VENT 1	RH 4 MOTOR 1
			MDLA 30	RH 10 VENT 2	RH 5 MOTOR 2
				RH 10 VENT 3	RH 5 MOTOR 1
			MDLA 31	RH 10 AND 11 VENT 1	RH 6 MOTOR 2
				RH 10 AND 11 VENT 2	RH 6 MOTOR 1
			MDLA 32	RH 10 AND 11 VENT 3	LH 1 MOTOR 2
				RH 10 AND 11 VENT 4	LH 1 MOTOR 1
			MDLA 33	RH 11 VENT 1	LH 2 MOTOR 2
				RH 11 VENT 2	LH 2 MOTOR 1
			MDLA 34	RH 11 VENT 3	LH 3 MOTOR 2
				RH 11 VENT 4	LH 3 MOTOR 1
			MDLA 35	RH 11 VENT 5	LH 4 MOTOR 2
				RH 12 VENT 1	LH 4 MOTOR 1
			MDLA 36	RH 12 VENT 2	LH 5 MOTOR 2
				RH 12 VENT 3	LH 5 MOTOR 1
			MDLA 37	RH 12 VENT 4	LH 6 MOTOR 2
				RH 12 VENT 5	LH 6 MOTOR 1
			MDLA 38	LH 1 VENT 1	MDR FX 2
				LH 1 VENT 2	RH 1 MOTOR 2
			MDLA 39	LH 1 VENT 3	RH 1 MOTOR 1
				LH 1 VENT 4	RH 2 MOTOR 2
			MDLA 40	LH 1 VENT 5	RH 2 MOTOR 1
				LH 2 VENT 1	RH 3 MOTOR 2
			MDLA 41	LH 2 VENT 2	RH 3 MOTOR 1
				LH 2 VENT 3	RH 4 MOTOR 2
			MDLA 42	LH 2 VENT 4	RH 4 MOTOR 1
				LH 2 VENT 5	RH 5 MOTOR 2
			MDLA 43	LH 3 VENT 1	RH 5 MOTOR 1
				LH 3 VENT 2	RH 6 MOTOR 2
			MDLA 44	LH 3 VENT 3	RH 6 MOTOR 1
				LH 3 VENT 4	LH 1 MOTOR 2
			MDLA 45	LH 3 VENT 5	LH 1 MOTOR 1
				LH 4 VENT 1	LH 2 MOTOR 2
			MDLA 46	LH 4 VENT 2	LH 2 MOTOR 1
				LH 4 VENT 3	LH 3 MOTOR 2
			MDLA 47	LH 4 VENT 4	LH 3 MOTOR 1
				LH 4 VENT 5	LH 4 MOTOR 2
			MDLA 48	LH 5 VENT 1	LH 4 MOTOR 1
				LH 5 VENT 2	LH 5 MOTOR 2
			MDLA 49	LH 5 VENT 3	LH 5 MOTOR 1
				LH 5 VENT 4	LH 6 MOTOR 2
			MDLA 50	LH 5 VENT 5	LH 6 MOTOR 1
				LH 6 VENT 1	MDR FX 3
			MDLA 51	LH 6 VENT 2	RH 1 MOTOR 2
				LH 6 VENT 3	RH 1 MOTOR 1
			MDLA 52	LH 6 VENT 4	RH 2 MOTOR 2
				LH 6 VENT 5	RH 2 MOTOR 1
			MDLA 53	RH 7 VENT 1	RH 3 MOTOR 2
				RH 7 VENT 2	RH 3 MOTOR 1
			MDLA 54	RH 7 VENT 3	RH 4 MOTOR 2
				RH 7 VENT 4	RH 4 MOTOR 1
			MDLA 55	RH 7 VENT 5	RH 5 MOTOR 2
				RH 8 VENT 1	RH 5 MOTOR 1
			MDLA 56	RH 8 VENT 2	RH 6 MOTOR 2
				RH 8 VENT 3	RH 6 MOTOR 1
			MDLA 57	RH 8 AND 9 VENT 1	MDR FX 4
				RH 8 AND 9 VENT 2	RH 1 MOTOR 2
			MDLA 58	RH 8 AND 9 VENT 3	RH 1 MOTOR 1
				RH 8 AND 9 VENT 4	RH 2 MOTOR 2
			MDLA 59	RH 8 AND 9 VENT 5	RH 2 MOTOR 1
				RH 9 VENT 1	RH 3 MOTOR 2
			MDLA 60	RH 9 VENT 2	RH 3 MOTOR 1
				RH 9 VENT 3	RH 4 MOTOR 2
			MDLA 61	RH 9 VENT 4	RH 4 MOTOR 1
				RH 9 VENT 5	RH 5 MOTOR 2
			MDLA 62	RH 10 VENT 1	RH 5 MOTOR 1
				RH 10 VENT 2	RH 6 MOTOR 2
			MDLA 63	RH 10 VENT 3	RH 6 MOTOR 1
				RH 10 VENT 4	LH 1 MOTOR 2
			MDLA 64	RH 10 VENT 5	LH 1 MOTOR 1
				RH 11 VENT 1	LH 2 MOTOR 2
			MDLA 65	RH 11 VENT 2	LH 2 MOTOR 1
				RH 11 VENT 3	LH 3 MOTOR 2
			MDLA 66	RH 11 VENT 4	LH 3 MOTOR 1
				RH 11 VENT 5	LH 4 MOTOR 2
			MDLA 67	RH 12 VENT 1	LH 4 MOTOR 1
				RH 12 VENT 2	LH 5 MOTOR 2
			MDLA 68	RH 12 VENT 3	LH 5 MOTOR 1
				RH 12 VENT 4	LH 6 MOTOR 2
			MDLA 69	RH 12 VENT 5	LH 6 MOTOR 1

TABLE C
VENT LOCATION/SIZE

VENT NO	VENT CENTER LN,			PURGE OUTLET AREA PER VENT	MINIMUM AREA
	Z"	Y"	Z"		
1	384.59	476.27	371.31	LH AND RH 4.5 IN.^{2}	14.14 IN.^{2} TOTAL 2 VENTS
2	396.13	478.16	374.56	LH AND RH 4.5 IN.^{2}	63.16 IN.^{2} TOTAL 8 VENTS
3	396.13	439.38	396.44	NONE REQD	1104.96 IN.^{2} TOTAL 8 VENTS
4	404.76	439.38	395.43		
5	395.76	439.38	394.43		
6	1327.94	439.38	395.43	LH 3.5 IN.^{2} OUT POSITION 1 RH 3.5 IN.^{2} OUT POSITION 2	
7	374.12	439.38	396.59	NONE REQD	140 IN.^{2} TOTAL 8 VENTS
8	1424.35	439.48	395.92	LH AND RH 6.5 IN.^{2}	26.52 IN.^{2} EACH VENT
9	1394.82	439.76	397.43	LH AND RH 6.5 IN.^{2}	194.16 IN.^{2} TOTAL 8 VENTS

TABLE D
VENT DOOR GROUPS SEQUENCING AND POSITIONS

LH AND RH VENT DOOR	CLOSE	OPEN	SNAP ACTION	FULL OPEN	PURGE POS 1	PURGE POS 2
1 AND 2	0.1957	7.1750	1	90+	15°	----
3	0.2286	0.2286	2	0+	----	----
4, 5	0.1181	7.0873	3	75+	----	----
6	0.1181	7.0873	4	75+	----	----
7	0.2756	7.1750	5	75+	15°	45°
8 AND 9	0.1476	5.0709	6	75+	45°	----

NOTE: "+" INDICATES POSITION NOT APPLICABLE TO VENT DOOR

TABLE E
VENT DOOR SEQUENCING

	START 1 AND 2	VENT 1	VENT 2	START 3 AND 4	VENT 3	VENT 4
PDA/CLA AT PAB WITH PURGE 1 MFTS AS SHOWN (1) (2) (3) LB/MIN TO ONE LB/MIN (4) LB/MIN TO ONE LB/MIN	PB PB	CL CL	CL CL	CL PB	CL CL	PB PB
T-0 MINUTES (MFTS 8)	PB	CL	CL	CL	CL	PL
START/PURGE FOR LAUNCH (1) (2) (3) (4) (5) (6) T-0 (MFTS 2) T-0 MINUTES (MFTS 3)	(MFTS 1) OP OP OP	OP OP OP	OP/CL OP OP	OP/CL OP OP	OP/CL OP OP	OP/CL OP OP
ON-ORBIT	OP	OP	OP	OP	OP	OP
PRE ENTRY T-0 KEYBOARD 1 (MFTS 5&6)	(MFTS 4) CL(1)	CL(1)	CL(1)	CL(1)	CL(1)	CL(1)
LANDING (PPS SELECTED 1 (MFTS 7)	OP(1)	OP(1)	OP(1)	OP(1)	OP(1)	OP(1)
RTLS T-0 (MFTS 2) (PPS SELECTED 1 (MFTS 7)	OP(1)	OP/CL(1)	CL(1)	CL(1)	OP/CL(1)	CL(1)
ABORTED SOFTWARE (1) (2) (3) (4) (5) (6) PURGE 1 MFTS 9&10 CLOSE TRANSFER TO OPT	PB PB	CL CL	CL CL	CL/PB PB	CL CL	PB PB

NOTES:

(A) VENT DOOR 8 MAY REMAIN IN PURGE POS 2, INDICATE TO PURGE POS 1, OR REVERT TO THE CLOSED POSITION DEPENDING ON THE PURGE REQUIREMENTS OF THE PAYLOAD SCHEDULED FOR LAUNCH.

(B) PRIOR TO CLOSING VENT DOOR 6, AT 15 HEPTAD THAT PURGE CIRCUIT 2 FLOW (-PVG2 PUT) HAS BEEN REDUCED TO APPROXIMATELY 125 LB/MIN.

(C) IF THE CONFIGURE FOR LAUNCH COMMAND IS TRUE, OPEN ALL VENTS SEQUENTIALLY, AS NOTED, AT 5 SECOND INTERVALS (+15 SECONDS).

(D) OMS/TVC VENT DOOR CHECK - THIS CHECK MONITORS FOR ALL VENT DOORS ASSUMING THE SEQUENCING OF THE VENT DOORS IS NOMINAL. THE CHECK CONSISTS OF A TIMER AND A SET OF MDM DISCRETES AS AN INDICATION OF THE STATUS (OR DOOR OF THE DOORS). WHEN THE COMMAND TO OPEN A DOOR SEQUENCE CHECKS THE VENT DOOR STATUS, THIS STATUS IS PLACED IN THE DISCRETE. IF A DOOR FAILURE EXISTS, THE TIMER WILL TIME OUT AND THE DISCRETE WILL BE SET TO INDICATE THE FAILURE. THE TIMER WILL BE SET TO TIME THE 90 LCH SEQUENCE WILL PROCEED WITH THE START. IF AN LCH SEQUENCE HAS NOT BEEN SET, THE TIMER WILL BE SET TO TIME THE 90 LCH SEQUENCE. THE DISCRETE WILL INDICATE THE STATUS (1 OF 2 POSSIBILITIES) OF EACH VENT DOOR IN BUILDING THE STATUS WORD.

(E) TO CLOSE VENT DOORS:
OPS 2 AND 8 GROUND MULTI REAL TIME COMMANDS (-MVC1) OR OPS UTILITY DISPLAY
OPS 2 OVERHEAD DISPLAY (SPEC 051) ITEM 45 EXEC
OPS 2 DATA OVERHEAD DISPLAY (SPEC 053) ITEM 44 EXEC

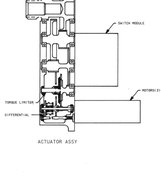
TO OPEN VENT DOORS:
OPS 2 AND 8 GROUND MULTI REAL TIME COMMANDS (+MVC1) OR OPS UTILITY DISPLAY
OPS 2 OVERHEAD DISPLAY (SPEC 051) ITEM 45 EXEC
OPS 2 DATA OVERHEAD DISPLAY (SPEC 053) ITEM 44 EXEC

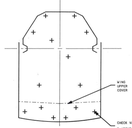
(F) OPEN ALL VENTS AT ONE PB INTERVAL(+15SECONDS). ALL VENTS CAN ALSO BE COMMANDED OPEN BY OPS 2 GROUND MULTI REAL TIME CMD (+MVC1) OR OPS 2 PRESS AND MNEMO DISPLAY PAGE OR OPS 2 SPEC 051 ITEM 45 EXEC.

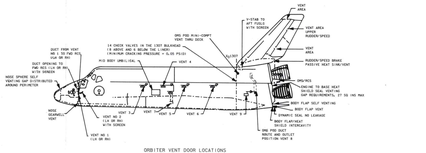
(G) ALL VENTS CLOSED AT MED MI INTERVALS.

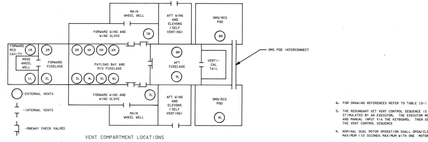
(H) AFTER THE VENT DOOR COMMAND IS ISSUED, VENT GROUPS 2 AND 8 LEFT SIDE RESPIRA, AT MECH TRANSITION, THE SOFTWARE COMMANDS ALL VENT DOORS CLOSED AND GROUP 2 AND 8 LEFT SIDE CLOSE.

(I) NUMBERS IN PARENTHESIS INDICATE THE ORDER IN WHICH THE VENT DOORS ARE SEQ'ED TO CLOSED









4. FOR DRAWING REFERENCES REFER TO TABLE 15-1

5. THE PERMANENT SET VENT CONTROL SEQUENCE IS BASICALLY A SUMMARY SEQUENCE (MFC), WHICH CALLS OUT THE SEQUENCE FOR THE VENT DOORS, THE PURGE VALVES, AND THE VENT AND PURGE (MFC) 9-6 THE KEYBOARD, TIMER SWITCH AND CUTOUT SWITCH

6. NORMAL SEQ. INTER OPERATION SHALL OPEN/CLOSE EACH VENT GROUP WITHIN 5 SECONDS MAXIMUM (15 SECONDS MAXIMUM ALTN. MOTOR FAILURE)

7. THE ACTUATOR LIMIT SWITCHES ARE MOUNTED EXTERNAL TO THE GEAR CASE AND ADJUSTMENT OF THE OPEN/CLOSE POSITIONS ARE ASSEMPLISHED BY INSTALLATION OF SHIMS BETWEEN THE ADJUSTMENT MECHANISM TO POSITIVE LOCKED IN THE ADJUSTED POSITION

8. ACTUATORS ARE POWERED EXTERNAL TO THE GEAR CASE AND READILY REMOVABLE WITHOUT OPENING GEAR CASE

NOTICH 1: VENT SYSTEM REQUIREMENTS
ORIGINAL SPECIFICATIONS

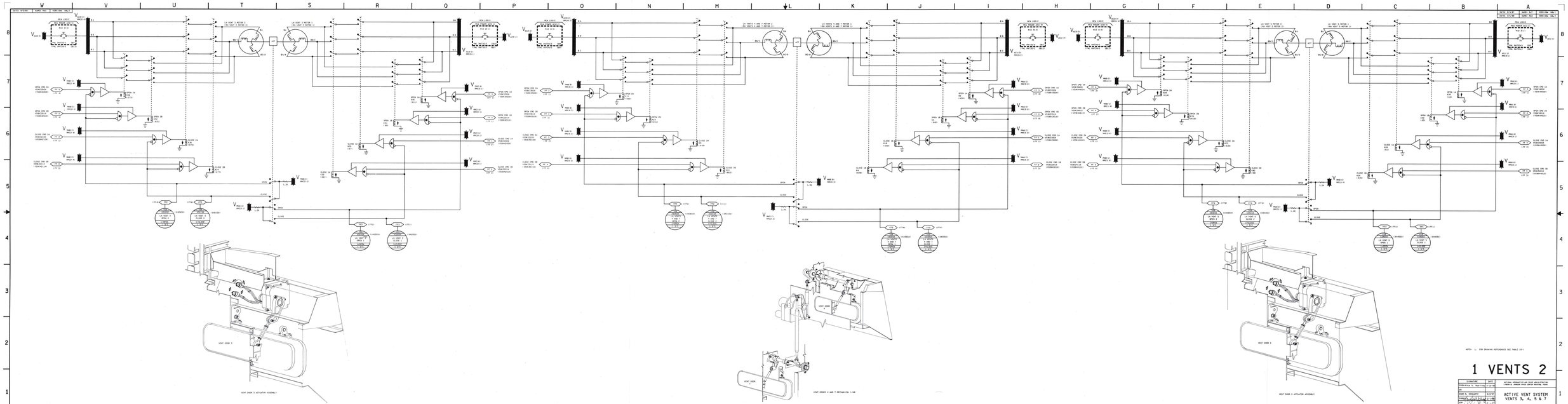
- MAINTAIN FLEXIBLE PURGE DISTRIBUTION FOR VARIETY OF PAYLOAD APPLICATIONS
- CONTROLS COMPARTMENT VENTING AND CONTAMINATION BY INCORPORATING A POSITIVE IF REQUIRED SEAL
- CONTROLS COMPARTMENT PRESSURES DURING BOOST VENTING AND ENTRY REPRESSURIZATION
- CONTROLS THE RATE OF INGRESSING DYNAMIC AND SURFACE EFFLUENTS

NOTICH 2: DESIGN REQUIREMENTS

- PROVIDES FOR MOLECULAR VENTING OF VEHICLE UNPRESSURIZED VOLU TO ATTAIN DEFICIENCY OF LESS THAN 5 X 10-5 TORR ACTION AT HIGH ALTITUDE AFTER LIFT-OFF

1 VENTS 1

SIGNATURE	DATE	
DSN: TORO 13FEB75E		MATERIAL APPROACH AND SPACE APPLICATIONS NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
CHKD BY:		
CHKD A.S. SCHAEFFLI		ACTIVE VENT SYSTEM VENT 1 AND 2
APP'D BY:		
APP'D BY:		
APP'D BY:	



NOTES: 1. FOR DRAWING REFERENCES SEE TABLE 15-1

1 VENTS 2

ELEMENTS	DATE
ESCM Mike A., Sept-Aug	8-15-96
ED	
DAVE N. STEWART	9-27-97
[illegible]	9-27-97
[illegible]	9-27-97
[illegible]	9-27-97
[illegible]	9-27-97
[illegible]	9-27-97

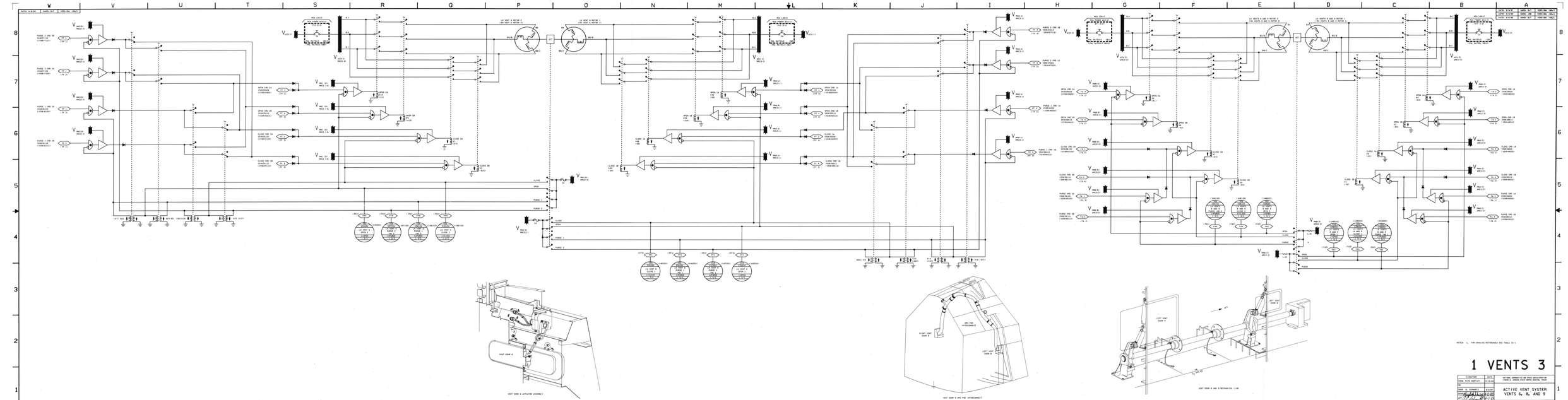
NOTHING APPEARING ON THIS SHEET AUTHORIZED FOR USE UNLESS SIGNED BELOW. THIS IS AN ORIGINAL DRAWN SPACE SHUTTLE MATERIAL, PROPRIETARY TO ROCKWELL INTERNATIONAL CORP.

ACTIVE VENT SYSTEM
VENTS 3, 4, 5 & 7

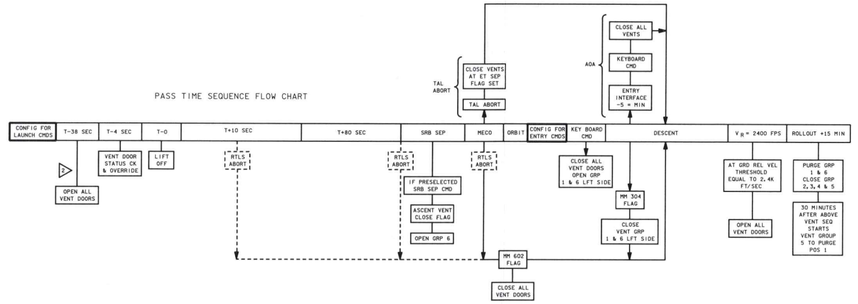
SPACE SHUTTLE | DWG NO. 15-1

SCALE NONE | SHEET 1 OF 1

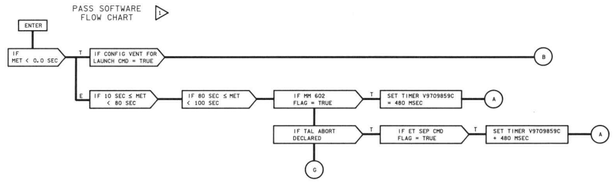
BASIC REV D-2

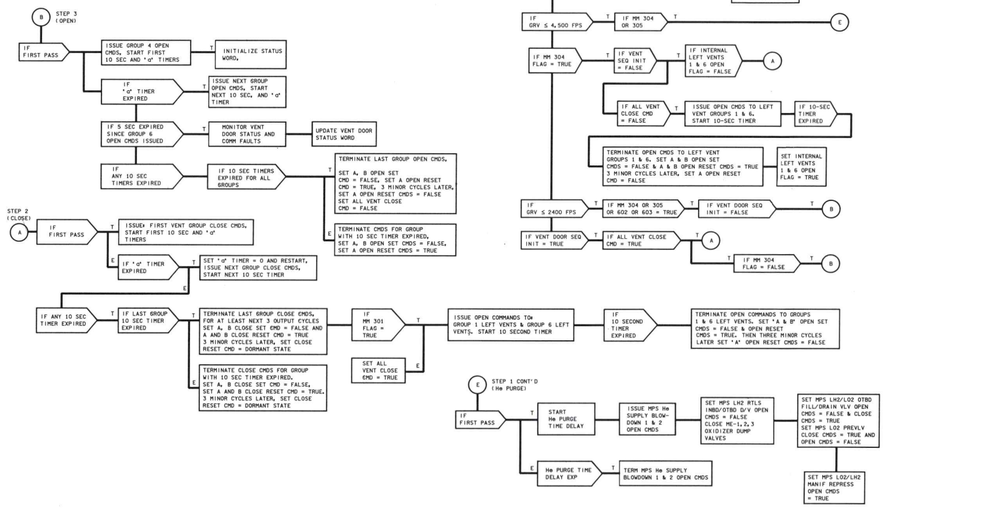

W V U T S R Q P O N M L K J I H G F E D C B A
8 7 6 5 4 3 2 1
DATA W/B/R
HARD BIT
VERSION ONLY
OPEN 2ND 2A
OPEN 2ND 2B
CLOSE 2ND 2A
CLOSE 2ND 2B
PURGE 2 2ND 2A
PURGE 2 2ND 2B
PURGE 1 2ND 2A
PURGE 1 2ND 2B
LH VENT A MOTOR 2
(NO VENTS A AND B MOTOR 2)
LH VENTS A AND B MOTOR 2
(NO VENTS A AND B MOTOR 2)
LH VENTS A AND B MOTOR 1
(NO VENTS A AND B MOTOR 1)
MCA LOGIC
FINAL POSITION TIMER
OPEN 1A
OPEN 1B
CLOSE 1A
CLOSE 1B
PURGE 1
PURGE 2
OPEN 2A
OPEN 2B
CLOSE 2A
CLOSE 2B
LEFT VENT DOOR A
LEFT VENT DOOR B
RIGHT VENT DOOR A
RIGHT VENT DOOR B
VENT DOOR A ACTUATOR ASSEMBLY
VENT DOOR B DRIVE POD (ATTACH)56007
VENT DOOR B AND D MECHANICAL 1:1R
NOTES: 1. FOR DRAWING REFERENCES SEE TABLE 10-1
1 VENTS 3
ACTIVE VENT SYSTEM
VENTS 6, 8, AND 9
15.1
BASIC REV D-2

PASS TIME SEQUENCE FLOW CHART



PASS SOFTWARE FLOW CHART





3. FOR DRAWING REFERENCES REFER TO TABLE 15-I

NOTES: ▷ THE OPEN COMMAND SIGNAL IS HIGH FOR TEN SECONDS. IT IS MONITORED FOR FOUR SECONDS

▷ DUE TO OI 8 SOFTWARE CHANGES, DRAWING LOGIC IS INCOMPLETE. IT WILL BE UPDATED WHEN SOFTWARE REQUIREMENTS ARE COMPLETED

1 VENTS 1

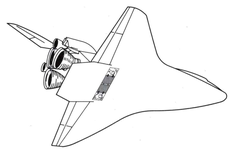
SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN TERRI FORSYTHE		
DR J.M. BLANCHARD	9/21/87	VENT DOOR SOFTWARE
ENGR R.B. SCHWARTZ	9/21/87	
ENGR [signature]	9.21.87	
APP [signature]	9.21.87	
APP [signature]	10/16/87	SPACE SHUTTLE / DWG NO 15.1
ORB/PLAN [signature]	9.21.87	ALL
LTR D PCN		66 P 34 / PAGE 15.-4 / SHEET 4 OF 4

BASIC REV D

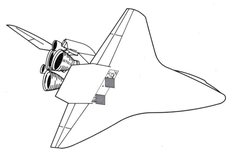
DATE: 8/8/96	NAME: BOX	VERSION: CMLS

DATE: 08/22/97	NAME: BOX	VERSION: CMLS
DATE: 9/8/97	NAME: BOX	VERSION: CMLS
DATE: 9/15/97	NAME: BOX	VERSION: CMLS

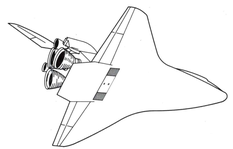
ORB/ET UMBILICAL CLOSEOUT DOOR
OPERATIONAL SEQUENCE



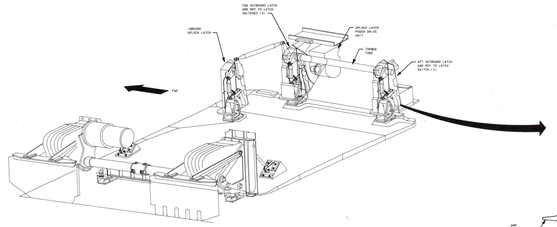
1. DOORS OPEN CENTERLINE LATCHES LOCKED



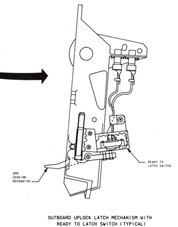
2. DOORS IN TRANSIT TO CLOSED POSITION AND CENTERLINE LATCHES STAGED



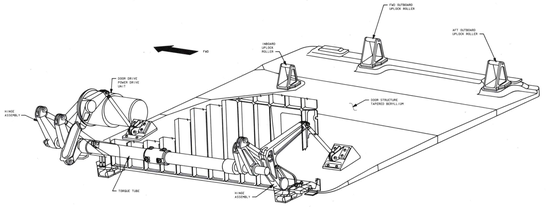
3. DOORS CLOSED, LATCHED AND CENTERLINE LATCHES STAGED



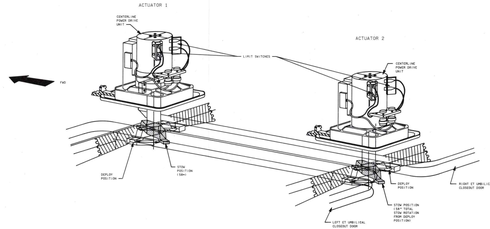
ET UMBILICAL UPLOCK LATCHING
MECHANISMS



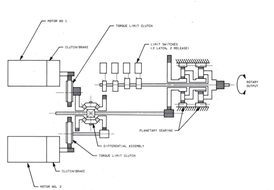
OUTBOARD UPLOCK LATCH MECHANISM WITH
READY TO LATCH SWITCH (TYPICAL)



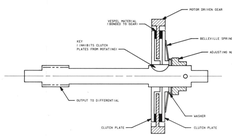
ET UMBILICAL CLOSEOUT DOOR
DRIVE MECHANISM



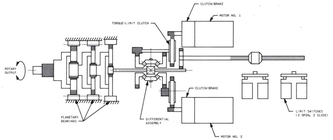
CENTERLINE LATCHES



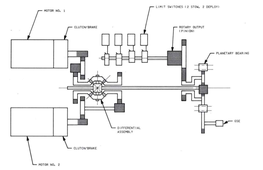
ET UMBILICAL UPLOCK LATCH
POWER DRIVE UNIT



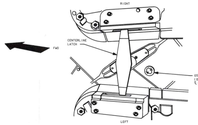
TORQUE LIMITER FOR DOOR DRIVE
ACTUATOR AND UPLOCK LATCH ACTUATOR



DOOR DRIVE ACTUATOR
POWER DRIVE UNIT



CENTERLINE LATCH ACTUATORS
POWER DRIVE UNIT



CENTERLINE LATCH IN DEPLOY POSITION

MOTOR SPECIFICATIONS

ACTUATOR	PEAK TORQUE (IN-LBS)	MAX OPERATING TORQUE (IN-LBS)	STALL POWER (W)	STALL POWER (W)	STALL POWER (W)
			1 MOTOR	2 MOTORS	3 MOTORS
ET/ORB UMBILICAL LATCH	4,500	3,150 (70%)	49 WATTS	100 WATTS	147 WATTS
ET/ORB UMBILICAL UPLOCK LATCH	11,400	9,120 (80%)	49 WATTS	98 WATTS	147 WATTS
DOOR DRIVE ACTUATORS	11,400	9,120 (80%)	100 WATTS	200 WATTS	300 WATTS

ACTUATOR	SUPPLY VOLTAGE	MAX ACTUATOR RUNNING TIME			MAX MOTOR STALL TIME
		1 MOTOR	2 MOTORS	3 MOTORS	
ET/ORB UMBILICAL LATCH	270 - 34 VDC	6 SEC	12 SEC	12 SEC	60 SEC
ET/ORB UMBILICAL UPLOCK LATCH	240V 3Φ LINE	6 SEC	12 SEC	12 SEC	60 SEC
DOOR DRIVE ACTUATOR	34 VDC 3Φ LINE	24 SEC	48 SEC	48 SEC	60 SEC

○ 28 V DC REMOTES ARE ON PANEL R13L AT FLT DT V PANELS

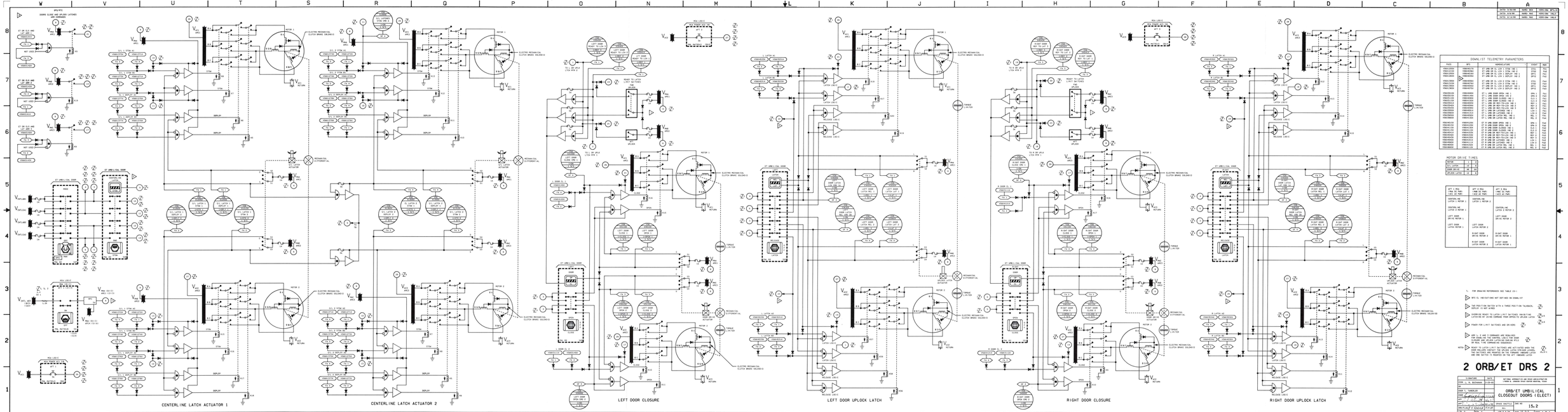
1/ FOR DRAWING REFERENCES SEE TABLE 15-1

2 ORB/ET DOORS 1

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS 77058
DRAWN: G.L. HEIDELBERGER	06/28/96	
CHECK: T. TAMBOLINI		ORBITER/ET UMBILICAL CLOSEOUT DOORS
APPROVED:		
APPROVED:		
APPROVED:		SPACE SHUTTLE DWG NO 15.2
SCALE: NONE	SHEET 1 OF 1	

BASIC REV D-2

BASIC REV D-2



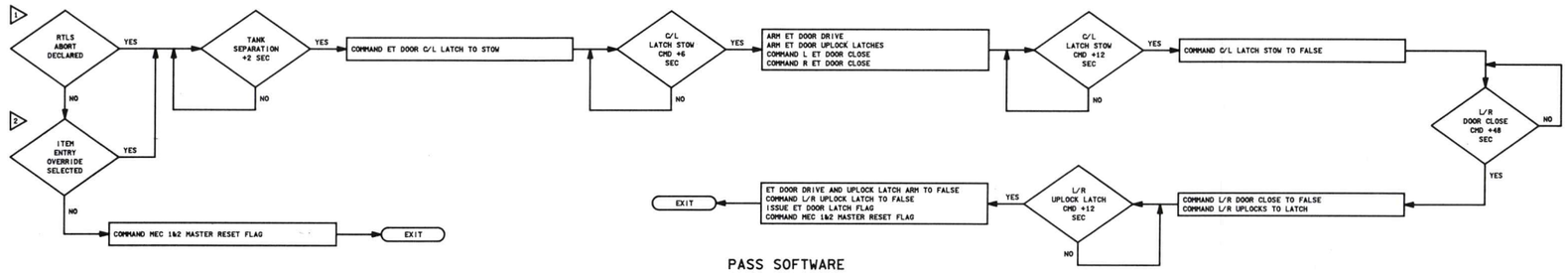
DOOR CLOSE AND UPLOCK LATCHES ARM COMMANDS

DATA BANK	HARD BIT	CONTINUITY
DATA BANK	HARD PAS	CONTINUITY
DATA BANK	HARD PAS	CONTINUITY

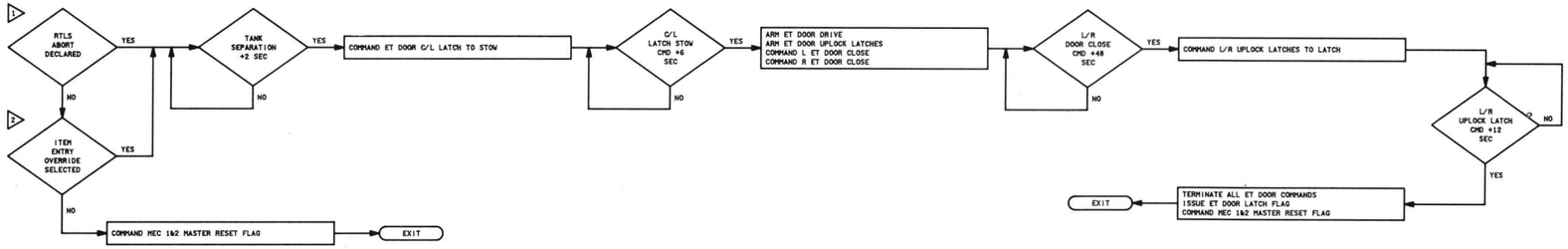
DOWNLIST TELEMETRY PARAMETERS

PASS	BPS	NOMENCLATURE	EVENT	PASS
V06C12C02	V06C04C02	ET UMB DR CL 1 CLOSE CMD (NO.)	CMD	P22
V06C12C03	V06C04C03	ET UMB DR CL 1 OPEN CMD (NO.)	CMD	P22
V06C12C04	V06C04C04	ET UMB DR CL 1 DISPLAY (NO.)	BPCL	P22
V06C12C05	V06C04C05	ET UMB DR CL 1 CLOSE (NO.)	CL	P22
V06C12B02	V06C04B02	ET UMB DR CL 2 CLOSE CMD (NO.)	CMD	P22
V06C12B03	V06C04B03	ET UMB DR CL 2 OPEN CMD (NO.)	CMD	P22
V06C12B04	V06C04B04	ET UMB DR CL 2 DISPLAY (NO.)	BPCL	P22
V06C12B05	V06C04B05	ET UMB DR CL 2 CLOSE (NO.)	CL	P22
V06C01E04	V06C43E03	LT L UMB DOOR OPEN (NO.)	OPN /	P22
V06C01E05	V06C43E04	LT L UMB DOOR CLOSED (NO.)	CLS /	P22
V06C01E06	V06C43E05	LT L UMB DR MID-TRAVEL (NO.)	MID /	P22
V06C01E07	V06C43E06	LT L UMB DR RET-TO-LCH (NO.)	RET /	P22
V06C01E08	V06C43E07	LT L UMB DR LATCHED (NO.)	LCH /	P22
V06C01E09	V06C43E08	LT L UMB DR LATCH REL (NO.)	REL /	P22
V06C01E10	V06C43E09	LT L UMB DR LATCH REL (NO.)	REL /	P22
V06C01E11	V06C43E10	LT L UMB DR LATCH REL (NO.)	REL /	P22

DATE: 3/18/88	NAME: JDF	VERSION: INK 3
DATE: 4/5/88	NAME: BCH	VERSION: INK 4
DATE: 4/12/88	NAME: MAG	VERSION: INK 5



PASS SOFTWARE



BFS SOFTWARE

4. FOR DRAWING REFERENCES SEE TABLE 15-1
3. MEC-MASTER EVENTS CONTROLLER
2. SPEC 51 OVERRIDE DISPLAY IS AVAILABLE IN OPS 1, 3, AND 6. HOWEVER, CREW INITIATED DOOR CLOSURE BY ITEM ENTRY IS ONLY LEGAL IN MM104, MM105, AND MM106
1. SOFTWARE WILL AUTOMATICALLY CLOSE DOORS FOR AN RTLS DURING MM602

NOTES:

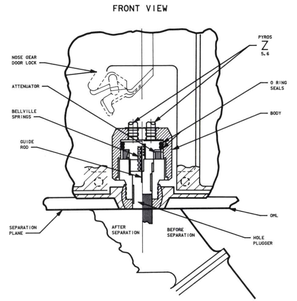
2 ET DOOR S/W 3

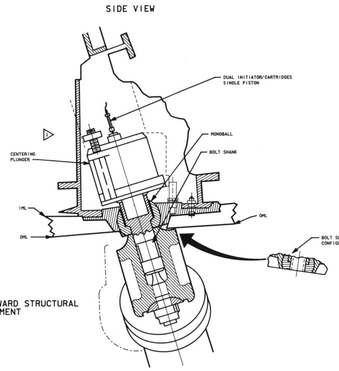
SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN B. J. TEDDER JR.	7/20/87	
DR		
ENGR T. TAMERLER	8/05/87	ET DOOR SOFTWARE PASS & BFS
ENGR	7/5/88	
APP	7/5/88	
APP	4/14/88	SPACE SHUTTLE / DWG NO 15.2
OMNIPLAN S.K. Kimbler	4.14.88	OV 102
LTR D PCN 2		44 X 34 / PAGE 15.2-3 / SHEET 3 OF 3

BASIC REV D-2

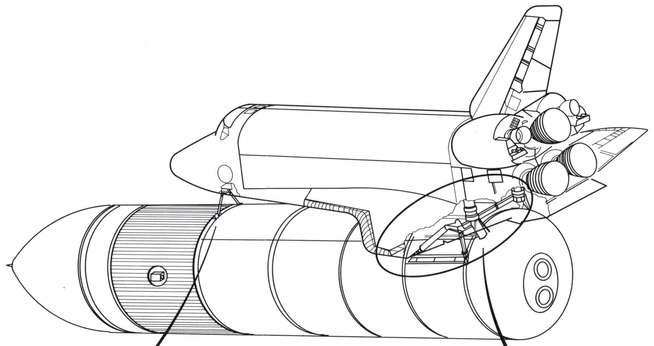
DATE= 05/06/87	NAME= MDU	VERSION= 1Rb.3

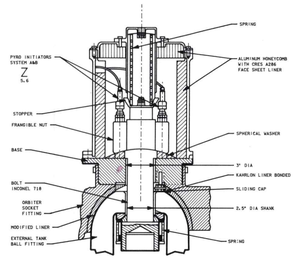
DATE= 05/18/87	NAME= CAR	VERSION= 1Rb.1
DATE= 05/25/87	NAME= BJT	VERSION= 1Rb.2
DATE= 05/26/87	NAME= MDU	VERSION= 1Rb.3



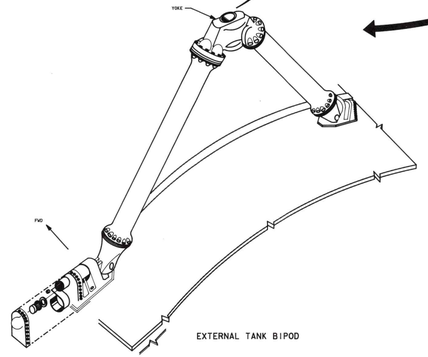


ORBITER / ET FORWARD STRUCTURAL ATTACHMENT

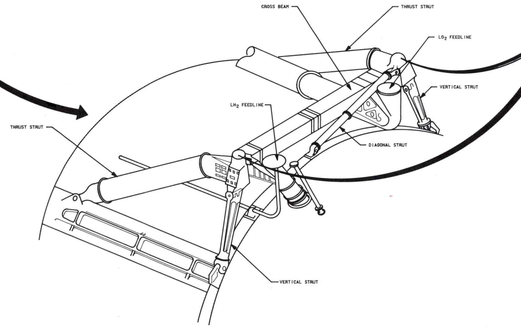




ORBITER / ET AFT STRUCTURAL ATTACHMENT



EXTERNAL TANK BIPOD



EXTERNAL TANK AFT STRUTS

3. FOR DRAWING REFERENCES SEE TABLE 15-1

▷ FWD BOLT SHEARING WILL CAUSE ET BIPOD TO ROTATE +30° FORWARD

NOTES: ▷ FWD BOLT SHEARING WILL ACTIVATE CENTERING PLUNGER BUT WILL NOT MOVE HOMEBALL EVEN WITH THE OUTER MOLDLINE

3 ORB/ET SEP 1

SIGNATURE		DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSRM	A.A. NEELY	5/31/87	
DR	A.A. NEELY	5/31/87	
CHKR K. P. ASHBY			ORBITER ET SEPARATION MECHANICAL
CHKR		5/31/87	
APP		6/1/87	
APP		6/6/87	SPACE SHUTTLE PROGRAM
DRM-PLN.P.F. Caldwell		6-8-87	ALL
VA D	OPEN		15.3
			82.5 X 34 FORM 15.3-1 SHEET 1 OF 3

BASIC REV D

BASIC REV D

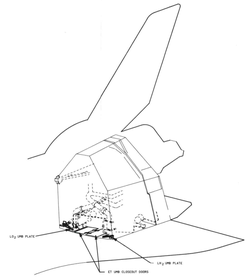
DATE: 8/15/97	NAMS: 100	10001396 - VOL 1
DATE: 9/15/97	NAMS: 101	10001396 - VOL 2
DATE: 10/3/97	NAMS: 102	10001396 - VOL 3

1. FOR DRAWING REFERENCES SEE TABLE 1.0-1

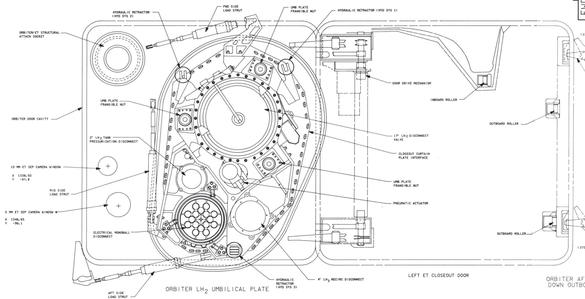
3 ORB/ET SEP 3

NOTHING HEREON TO BE RELEASED OR SHOWN TO ANYONE OUTSIDE NASA WITHOUT PROPER CONTRACTUAL CLEARANCE	CLEARANCE	DATE
	DSMS 100 - ORB ET	10/97
ORBITER/ET SEPARATION MECHANICAL	DSMS 101 - ORB ET	10/97
	DSMS 102 - ORB/ET	10/97
	MANEUVERS (7 DOF)	10/97
	MPS/OMS/RCS	10/97
	ET	10/97
	ORBITER	10/97
	GNC/SW	10/97
	CONTROL	10/97
	PROPULSION	10/97
	STRUCTURES	10/97
	THERMAL	10/97
	ELECTRICAL	10/97
	ECLSS	10/97
	MECHANISMS	10/97
	PAYLOADS	10/97
	OPERATIONS	10/97
	SYSTEMS MGMT	10/97
	MISSION DESIGN	10/97
	GROUND OPS	10/97
	FLIGHT OPS	10/97
	PROGRAM	10/97

REF ID: 15.3	SPACE SHUTTLE	APPROVED BY:
	PCN:	
NAMS: 6.4.4	FOR: 25.12	DATE: 10/3/97

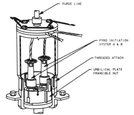


ORBITER AFT FUSELAGE

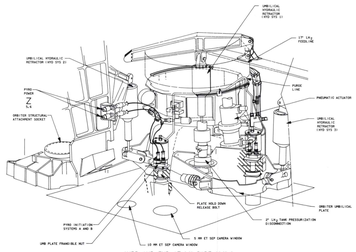


ORBITER LH_2 UMBILICAL PLATE

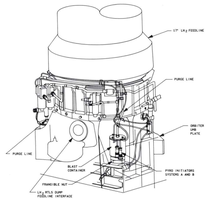
ORBITER LO_2 UMBILICAL PLATE



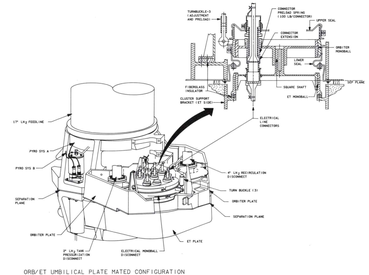
UMBILICAL PLATE ASSEMBLY ATTACH CAN/ITER (TYPICAL)



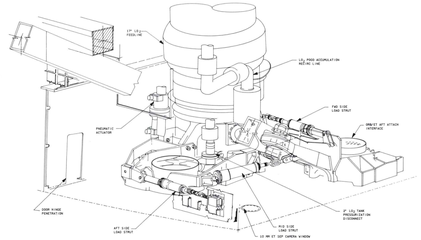
INBD AND FWD AT LH SIDE (LH_2) ROTATED 45° CCW



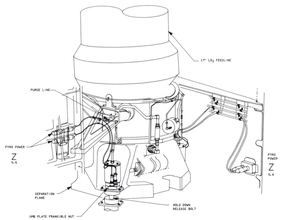
AFT AND OUTBD AT LH SIDE (LH_2) ROTATED 135° CCW



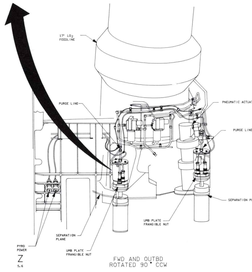
ORB/ET UMBILICAL PLATE MATED CONFIGURATION



INBD AND FWD RH SIDE (LO_2)



AFT AND INBD AT RH SIDE (LO_2) ROTATED 135° CCW



FWD AND OUTBD ROTATED 90° CCW

BASIC REV D

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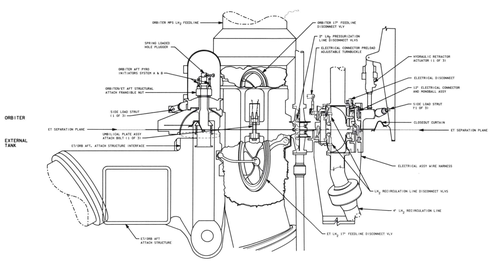
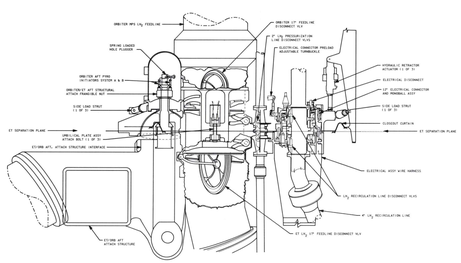
DATE: 09/28/87	NAME: ALT	VERSION: ORIG
DATE: 09/28/87	NAME: NSC	VERSION: ORIG



ORBITER/ET UMBILICAL PLATES MATED

SEPARATION SEQUENCE I

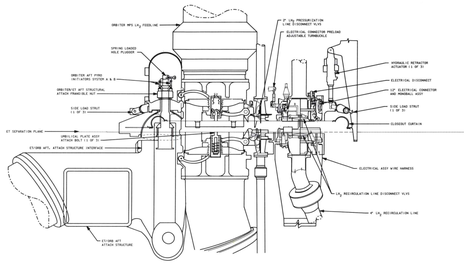
- MPS 17" FEEDLINE VALVE-OPEN
- 8" LH_2 RECIRC D/CONNECT VALVE-OPEN
- 8" LH_2 PRESURIZATION D/CONNECT VALVE-OPEN
- ELECTRICAL HYDRAULIC D/CONNECTORS-MATED
- ELECTRICAL MANDELL D/CONNECTS-MATED



ORBITER/ET UMBILICAL PLATES MATED

SEPARATION SEQUENCE II

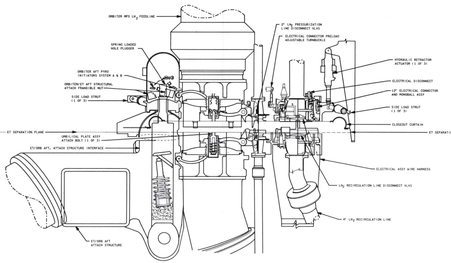
- MPS 17" FEEDLINE VALVE-CLOSED



ORBITER/ET UMBILICAL PLATES RETRACTED

SEPARATION SEQUENCE III

- UMBILICAL PLATES
  - TRUNNION BOLTS-7 PLCS
  - BOLTS SEVERED
- UMBILICAL HYDRAULIC
  - ORBITER MPS RETRACT (1.5 INCHES)
  - 8" LH_2 RECIRC D/CONNECT VALVE-CLOSED
  - 8" LH_2 PRESURIZATION VALVE-CLOSED
  - ELECTRICAL MANDELL D/CONNECTS-DEMATED



ORBITER/ET AFT STRUCTURAL SEPARATION

SEPARATION SEQUENCE IV

- BALL SOCKET INTERFACE
- TRUNNION BOLTS FIRED
- BOLTS SEVERED

NOTES: 1. FOR DRAWING REFERENCES SEE TABLE S-I

3 ORB/ET SEP 3

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TEXAS
CHIEF ENGINEER, ALL MSFC	9/17/87	
DR. SANDRA M. REID	9/17/87	ORBITER ET SEPARATION MECHANICAL
MGR., S.R. ASSOC.		
MANAGER, ET PROJ. OFFICE	9/17/87	
MGR, ET SEP. PROJ.	9/17/87	
MANAGER, SHUTTLE PROJECTS OFFICE	9/17/87	DRAWING NO. 15.3
MANAGER, SHUTTLE PROGRAM OFFICE	9/17/87	SHEET 1 OF 1

BASIC REV D

BASIC REV D

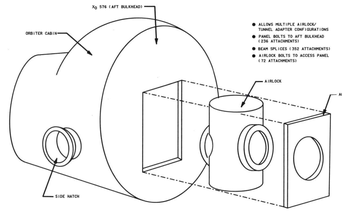
DATE: 9/19/97	NAME: RGE	VERSION: ORB-5
DATE: 12/3/97	NAME: RGE	VERSION: ORB-5
DATE: 12/4/97	NAME: RGE	VERSION: ORB-5

5 HATCH 1

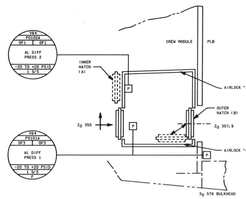
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS	SIGNATURE	DATE
	ERSEN VICKI S. 2000277	8/19/97
	DR	
	CHAR. A. MODFING	
	CHAR. A. MODFING	12/17

DATE= 12/3/97 | NAME= VCD | VERSION= ORB-X

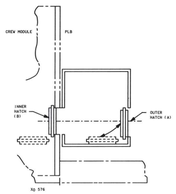
DATE= 6/27/97 | NAME= CAR | VERSION= ORB-3
DATE= 11/19/97 | NAME= BJT | VERSION= ORB-3/LS
DATE= 12/1/97 | NAME= VCD | VERSION= ORB-X



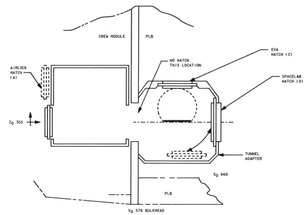
MANUFACTURING ACCESS PANEL



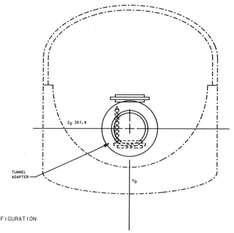
AIRLOCK CREW MODULE CONFIGURATION

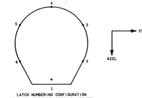


AIRLOCK PLB CONFIGURATION

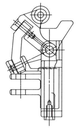


AIRLOCK TUNNEL ADAPTER CONFIGURATION

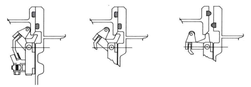


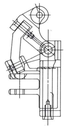


LATCH NUMBERING CONFIGURATION (PAYLOAD BAY SIDE, LOOKING INBOARD)

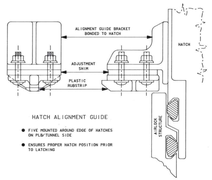


DOUBLE ACTING LATCH
● HAS A LOCK CAM TO BREAK SEAL
● USED FOR LATCHES 3,4 AND 6 (INNER) 2 AND 4 (OUTER)

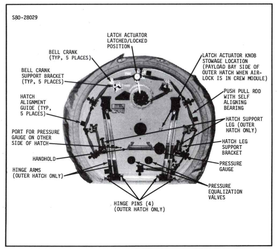




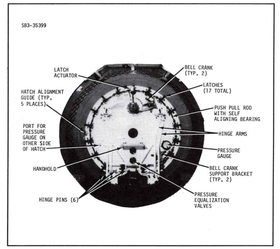
SINGLE ACTING LATCH
● USED FOR LATCHES 1,3 AND 5 (INNER) 1,3,4 AND 5 (OUTER)



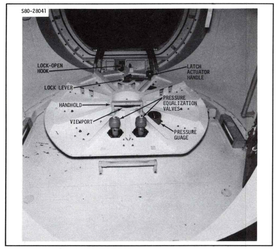
HATCH ALIGNMENT GUIDE
● FIVE MOUNTED AROUND EDGE OF HATCHES ON FLIR/TUNNEL SIDE
● ENSURES PROPER HATCH POSITION PRIOR TO LATCHING



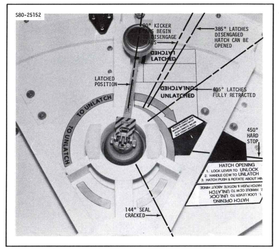
AIRLOCK HATCHES (PAYLOAD BAY SIDE)



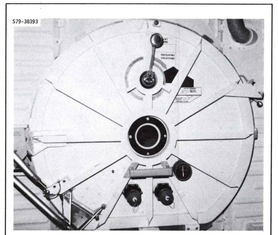
TUNNEL ADAPTER HATCH



AIRLOCK OUTER/TUNNEL ADAPTER HATCH OPENING (FROM AIRLOCK/TUNNEL ADAPTER SIDE)
● PULL IN AND ROTATE DOWN ENGAGE LOCK-OPEN HOOK



ALL HATCHES UNLOCKING/UNLATCHING (FROM CREW MODULE/TUNNEL ADAPTER SIDE)
● ACTUATOR HANDLE SHOWN IN LATCHED/LOCKED POSITION
● FLIP LOCK LEVER OVER 180° TO UNLOCKED POSITION
● SNAP KNOB ON ACTUATOR HANDLE AND ROTATE CW
° 60° ROTATION - THE TWO LATCH ROLLERS CAMS START TO DISENGAGE THE SEALS
° 144° ROTATION - THE SEAL IS CRACKED
° 450° ROTATION - END OF ACTUATOR TRAVEL AND HARD STOP, HATCH OPENS



AIRLOCK INNER HATCH OPENING (FROM CREW MODULE SIDE)
● PULL OUT APPROX 6 INCHES
● PIVOT UPWARDS AND TO THE LEFT
● ENGAGE HOLD-OPEN LATCH
● HINGE PINS MAY BE REMOVED IF NECESSARY TO ENSURE PROPER REALIGNMENT WHEN CLOSING HATCH

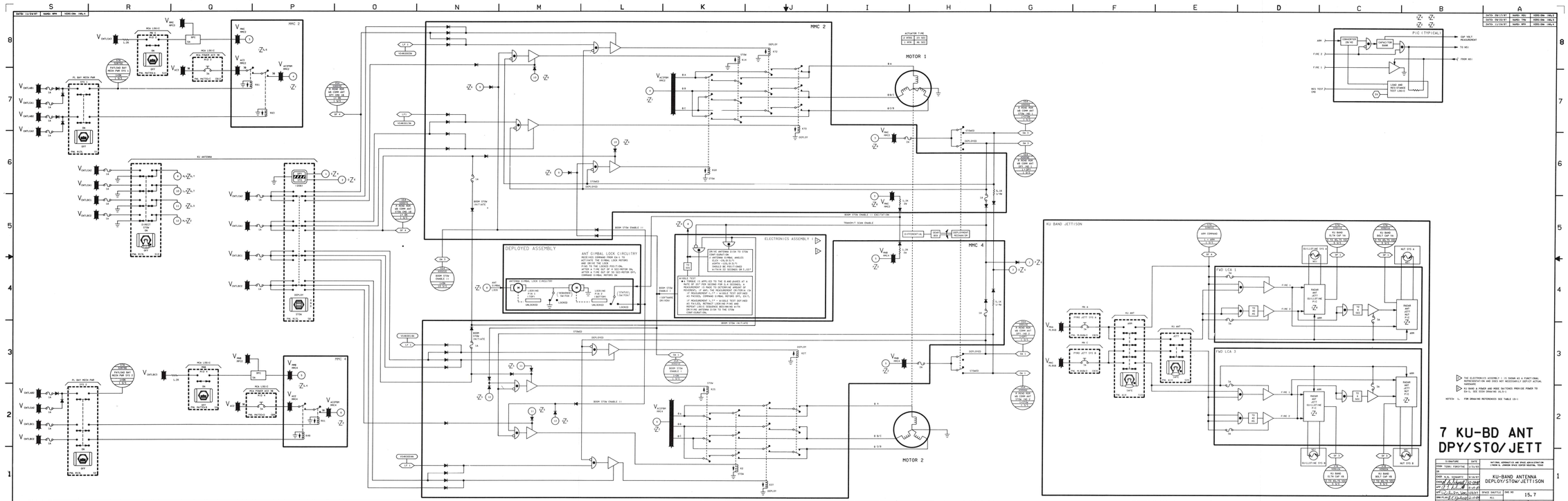
NOTE: 1. FOR DRAWING REFERENCES SEE TABLE 15-1

5 HATCH 2

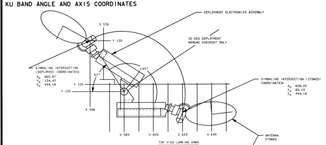
SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN: V.CRUZ, S. DOUGETTE	6/26/95	
DR		
CHKR: J. HOSTING		HATCHES (AIRLOCK AND SPACELAB)
CHKR: [signature]	7/13/95	
APP: [signature]	7/13/95	
APP: [signature]	7/13/95	SPACE SHUTTLE | DRD NO
DISPLAY: [signature]	12-01-97	15.5
SIZE B | CODE 1		SCALE NONE | PAGE 15-5 | SHEET 4 OF 7

BASIC REV D-1

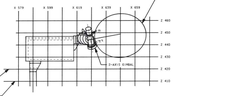
BASIC REV D-1


DEPLOYED ASSEMBLY
ANT GIMBAL LOCK CIRCUITRY
ELECTRONICS ASSEMBLY 1
MMC 2
MMC 4
MOTOR 1
MOTOR 2
PPRC 2
PPRC 4
KU ANTENNA
KU-BAND JETTISON
7 KU-BD ANT
DPY/STO/JETT
KU-BAND ANTENNA
DEPLOY/STOW/JETTISON
BASIC REV D
BASIC REV D-1

KU BAND ANGLE AND AXIS COORDINATES

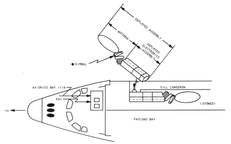


TOP VIEW LOOKING DOWN

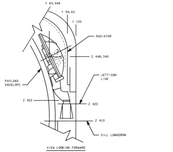


LOOKING OUTBOARD AT RH SIDE

KU BAND LOCATION COORDINATES

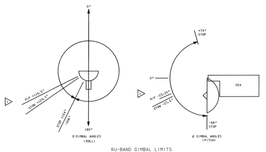


PAYLOAD BAY

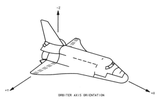


VIEW LOOKING FORWARD

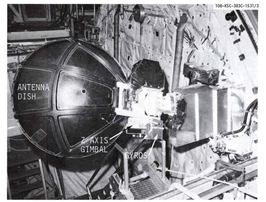
MOUNTED CONFIGURATION



KU-BAND GIMBAL LIMITS



ORBITER AXIS ORIENTATION



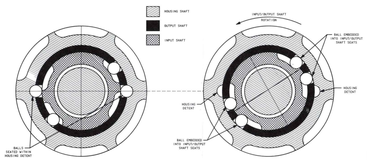
STARBOARD SIDE VIEW LOOKING INBOARD

KU BAND ANTENNA-STOWED POSITION

DEPLOYMENT MECHANISM

SIDE VIEW LOOKING OUTBOARD

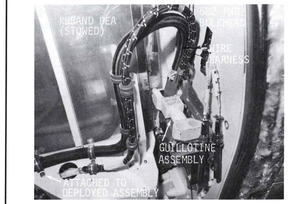
DEPLOYMENT MECHANISM



TOP VIEW LOOKING DOWN

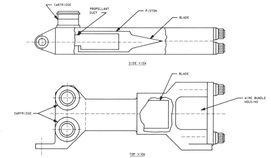
DEPLOYMENT MECHANISM ASSEMBLY

KU BAND JETTISON SYSTEM



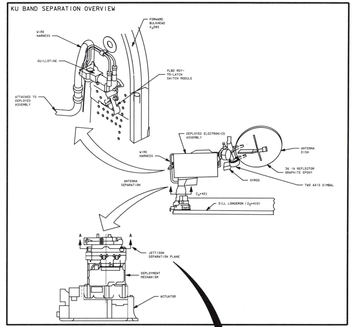
SIDE VIEW LOOKING INBOARD

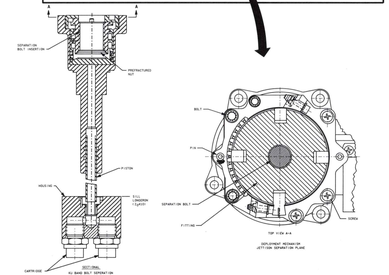
KU BAND GUILLOTINE



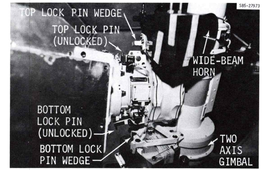
KU-BAND GUILLOTINE ASSEMBLY

KU BAND SEPARATION OVERVIEW

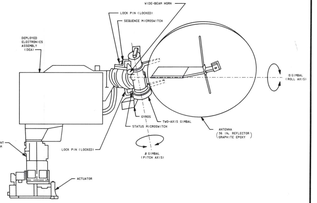




GIMBAL MECHANISM



GIMBAL LOCK MECHANISM



GIMBAL MECHANISM OVERVIEW

▷ THE PHOTOS UNDER PLUS (+)Y/(-)Y IS PHOTO CLOSE VIEW OF STOWED ANTENNA POSITION, WHEN THE ANTENNA PROCEED THE PAY PLOT(+)Y, IS CLOSE TO THE PAYLOAD BAY DOOR. THE ANTENNA IS IN THE CONNECTED ANTENNA POSITION

REFER FOR DRAWING REFERENCES REFER TO TABLE 29-1

7 KU BAND MECH

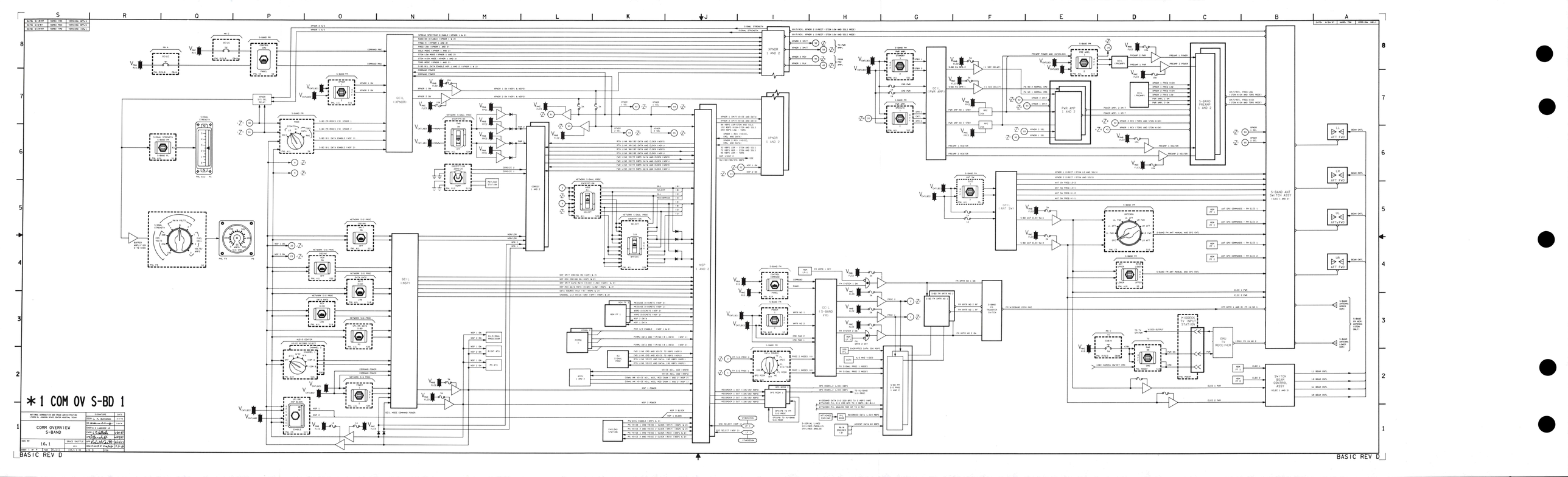
SIGNATURE	DATE
DON BARBARA BOWEN	2/9/82
DM BARBARA BOWEN	2/9/82
DOMM M. TORRETTO	2/9/82
PROJ MGR [illegible]	2-9-82
PROJ ENGR [illegible]	2-9-82
MISSION OPS MGR [illegible]	2-9-82
MGR-PLAN & CONTROL [illegible]	2-9-82

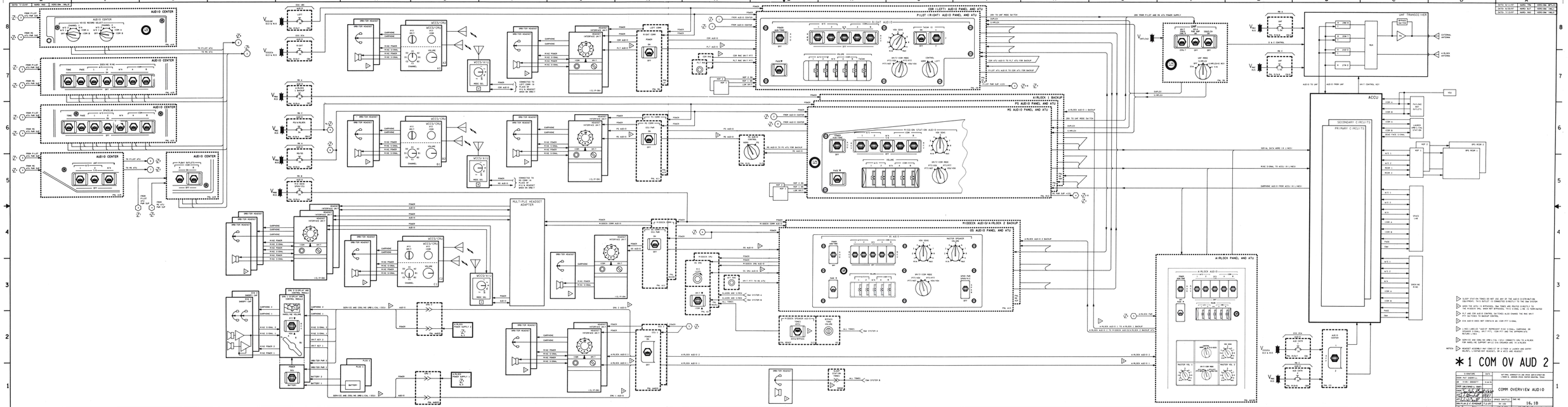
KU BAND MECHANICAL

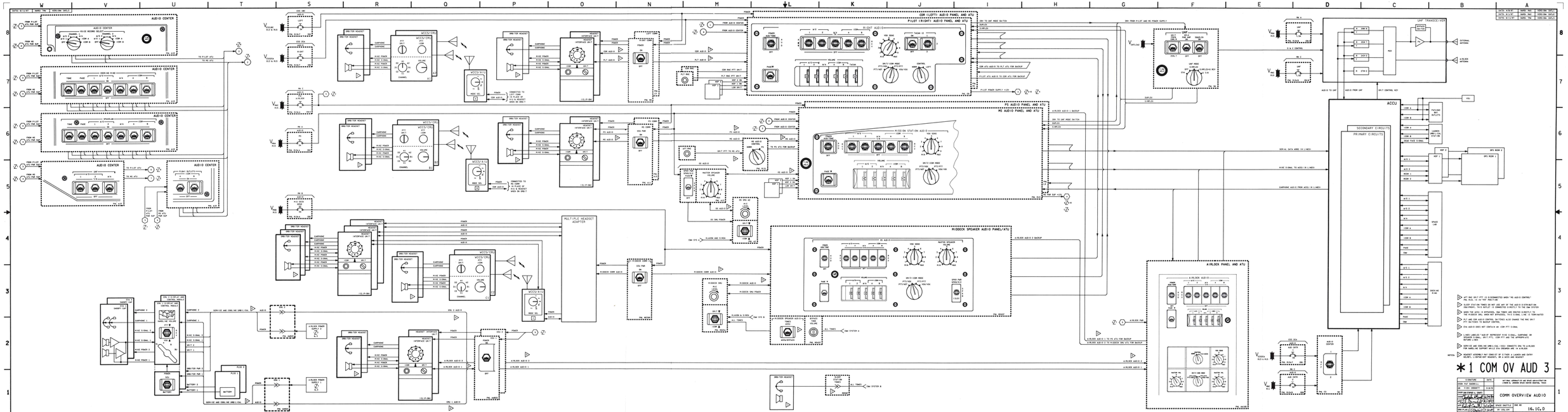
NO.	DATE	MATERIAL APPROVED FOR SPACE QUALIFICATION UNDER N. JOHNSON SPACE CENTER MATERIAL TEST	
TRACK SHUTTLE	BASE NO.	15.7	
ALL			
SHEET 1 OF 1			

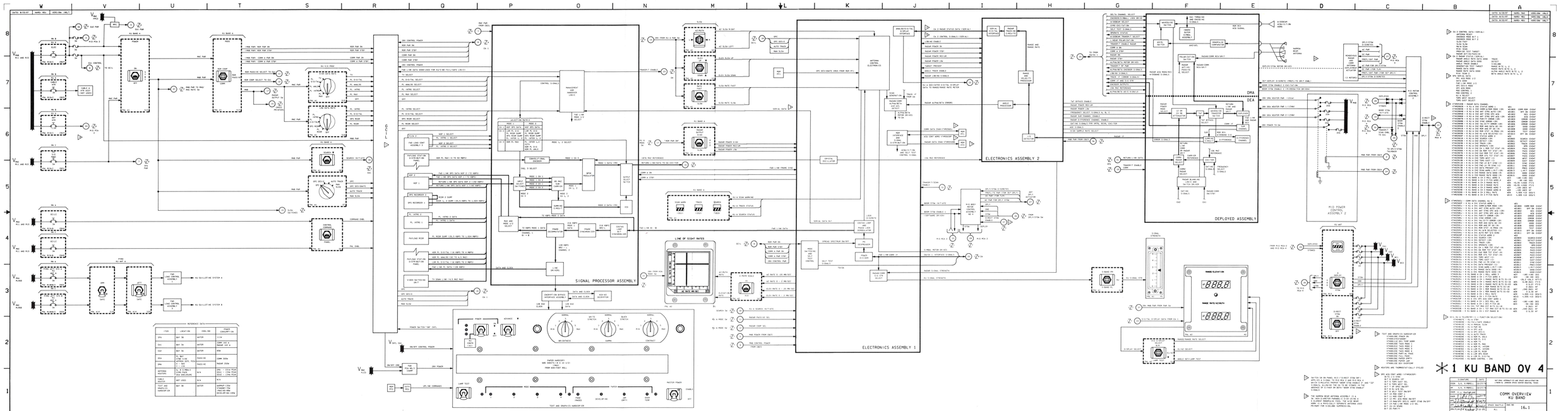
BASIC REV D

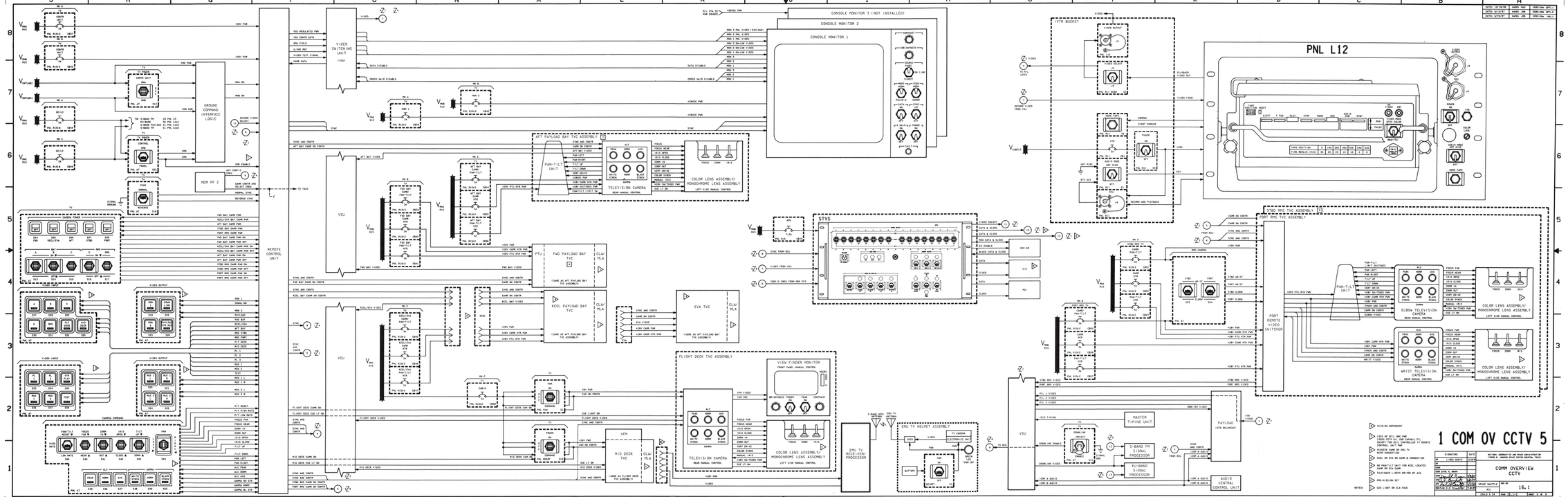
16. COMMUNICATIONS SYSTEMS

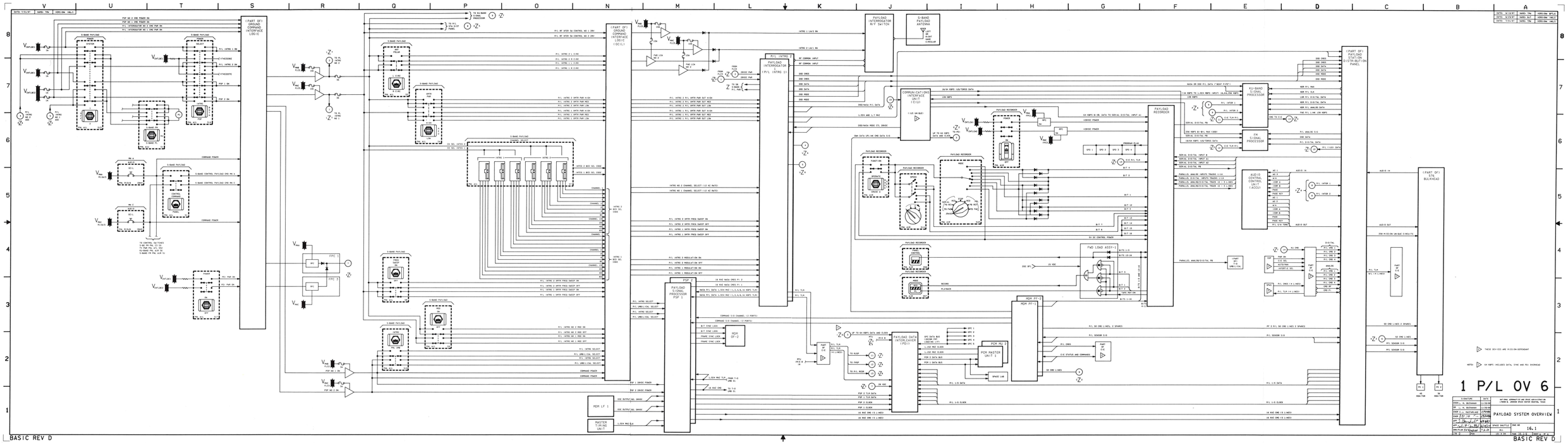

*1 COM OV S-BD 1
COMM OVERVIEW S-BAND
16.1
BASIC REV D
BASIC REV D

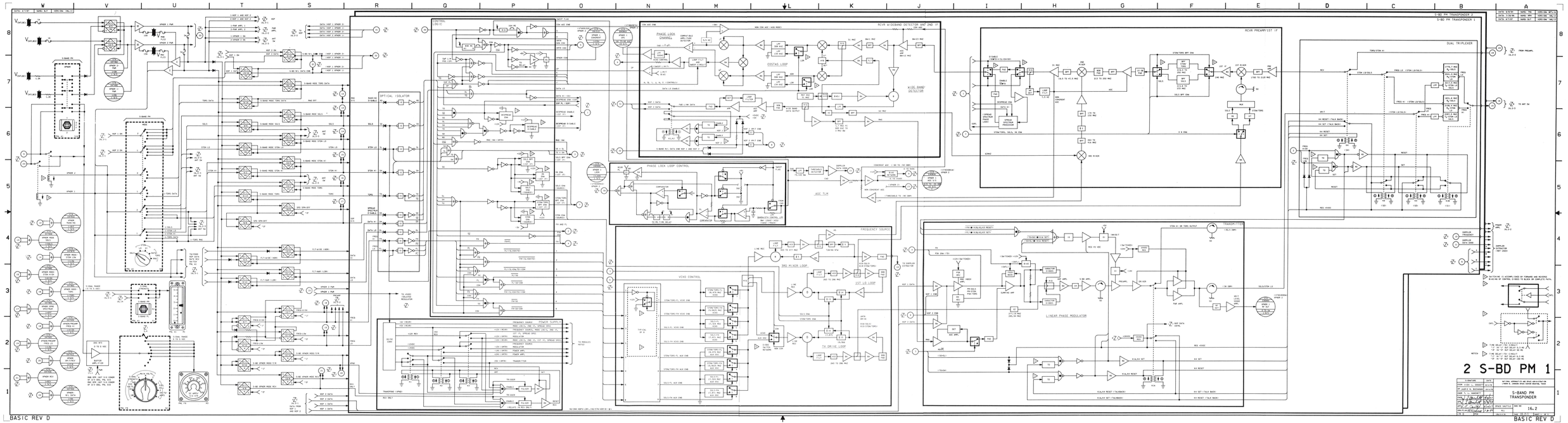

AUDIO CENTER
AUDIO CENTER
AUDIO CENTER
AUDIO CENTER
AUDIO CENTER
PILOT (RIGHT) AUDIO PANEL AND ATU
PS AUDIO PANEL AND ATU
MS AUDIO PANEL AND ATU
HIDDEN AUDIO-A/BLOCK 2 BACKUP
MS AUDIO PANEL AND ATU
A/BLOCK PANEL AND ATU
MULTIPLE HEADSET ADAPTER
UHF TRANSCEIVER
ACCU
SECONDARY CIRCUITS
PRIMARY CIRCUITS
* 1 COM OV AUD 2
COMM OVERVIEW AUDIO
16.1B
BASIC REV D

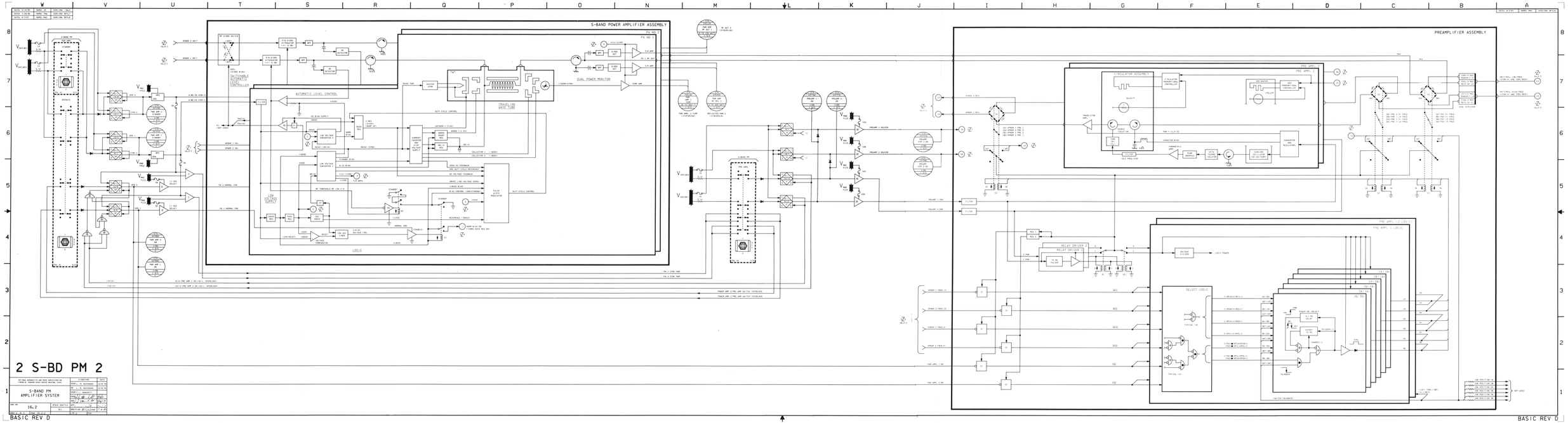

AUDIO CENTER
AUDIO CENTER
AUDIO CENTER
AUDIO CENTER
AUDIO CENTER
MULTIPLE HEADSET ADAPTER
CDR (LEFT) AUDIO PANEL AND ATU
PILOT (RIGHT) AUDIO PANEL AND ATU
PS AUDIO PANEL AND ATU
MS AUDIO PANEL AND ATU
MIDDECK SPEAKER AUDIO PANEL/ATU
AIRLOCK PANEL AND ATU
ACCU
SECONDARY CIRCUITS
PRIMARY CIRCUITS
UHF TRANSCEIVER
* 1 COM OV AUD 3
COMM OVERVIEW AUDIO
BASIC REV D

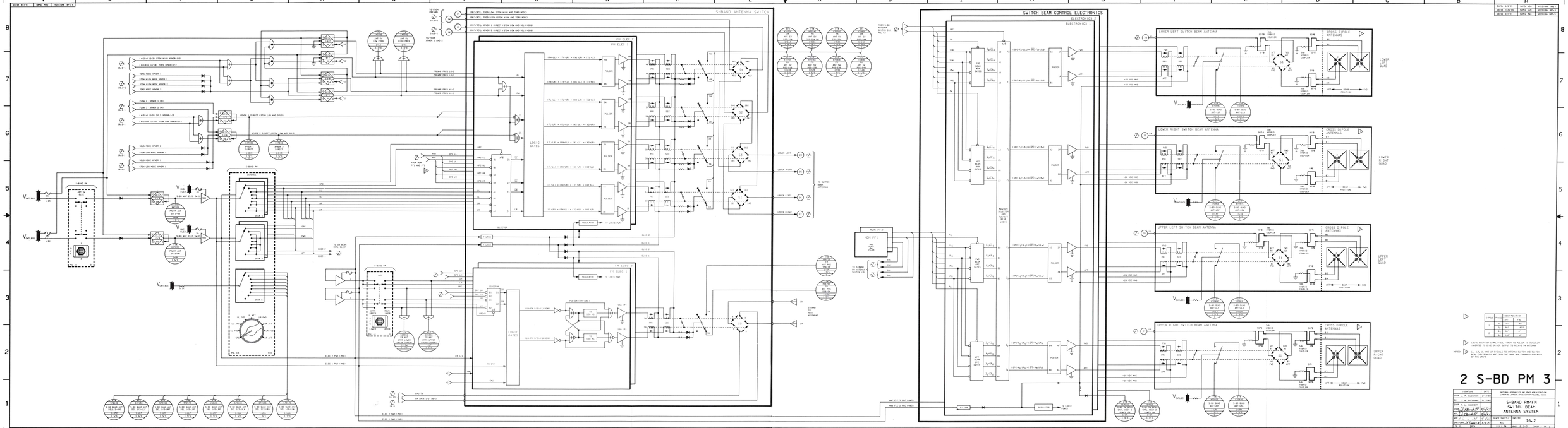

SIGNAL PROCESSOR ASSEMBLY
ELECTRONICS ASSEMBLY 1
ELECTRONICS ASSEMBLY 2
DEPLOYED ASSEMBLY
MID POWER ASSEMBLY 2
1 KU BAND OV 4
COMM OVERVIEW KU BAND
BASIC REV D

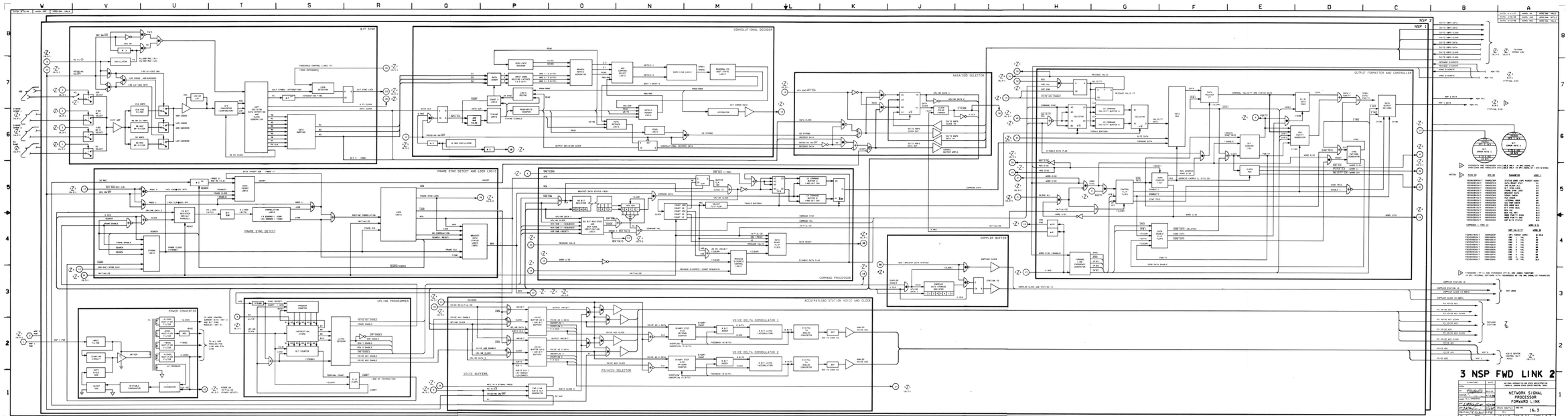

PNL L12
CONSOLE MONITOR 3 (NOT INSTALLED)
CONSOLE MONITOR 2
CONSOLE MONITOR 1
VIDEO SWITCHING UNIT
GROUND COMMAND INTERFACE LOGIC
REMOTE CONTROL UNIT
MDM PF 2
PAN-TILT UNIT
TELEVISION CAMERA REAR MANUAL CONTROL
COLOR LENS ASSEMBLY/ MONOCHROME LENS ASSEMBLY LEFT SIDE MANUAL CONTROL
FWD PAYLOAD BAY TVC
KEEL PAYLOAD BAY TVC
EVA TVC
FLIGHT DECK TVC ASSEMBLY
VIEW FINDER MONITOR
MID DECK TVC
VTR
VTR BUCKET
STBD MPM PTU ASSEMBLY
PORT MPM PTU ASSEMBLY
PORT REMOTE VIDEO SWITCHER
ELBOW TELEVISION CAMERA
WRIST TELEVISION CAMERA
STBD MPM PTU ASSEMBLY
MASTER TIMING UNIT
PAYLOAD 15TH BLKHEAD
S-BAND FM SIGNAL PROCESSOR
KU-BAND SIGNAL PROCESSOR
AUDIO CENTRAL CONTROL UNIT
EMU TV RECEIVER/ PROCESSOR
EMU TV HELMET ASSEMBLY
1 COM OV CCTV 5
COMM OVERVIEW CCTV
BASIC REV D

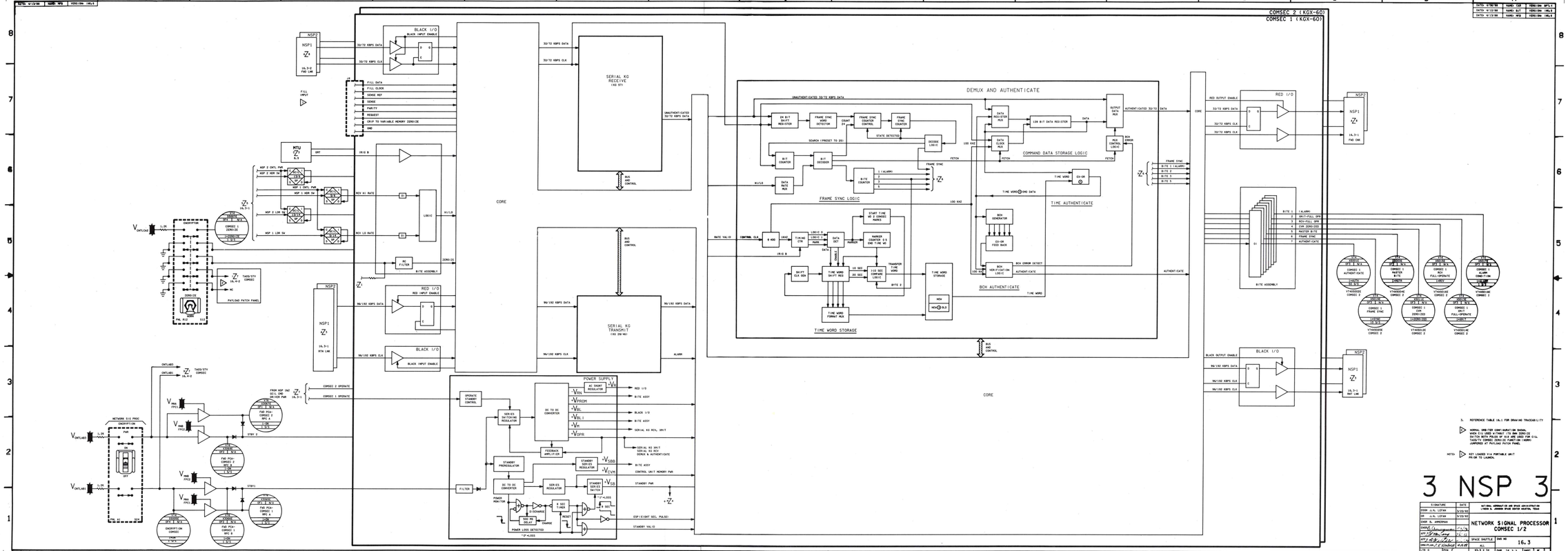

P/L OVERVIEW
PAYLOAD SYSTEM OVERVIEW
S-BAND PAYLOAD
KU-BAND SIGNAL PROCESSOR
KA SIGNAL PROCESSOR
AUDIO (CENTRAL CONTROL UNIT) (CCU)
PAYLOAD RECORDER
PAYLOAD INTERROGATOR R/F SWITCH
S-BAND PAYLOAD ANTENNA
COMMUNICATIONS INTERFACE UNIT (CIU)
PAYLOAD INTERROGATOR
PAYLOAD DATA INTERLEAVER (PDI)
PCM MASTER UNIT
PCM PF-1
PCM PF-2
FWD LOAD ASSY-1
(PART OF) PAYLOAD STATION DISTRIBUTION PANEL
(PART OF) STA BULKHEAD
(PART OF) GROUND COMMAND INTERFACE LOGIC
(PART OF) GROUND COMMAND INTERFACE LOGIC (GCIL)
MDM LF 1
MASTER TIMING UNIT
PAYLOAD INTERROGATOR PROCESSOR (PIP-1)
PIP-1
P/L INTRG
P/L INTRG 1
P/L INTRG 2
FWD LOAD ASSY-2
PAYLOAD DATA INTERLEAVER (PDI)
PCM MASTER UNIT 1
SPARE LRU
S-BAND CONTROL PAYLOAD CMD MD-1
S-BAND CONTROL PAYLOAD CMD MD-2
TO CONTROL SWITCHES ON PAYLOAD PNL A1
TO PDP PNL A7/A8
KU-BAND PNL A1/A2
S-BAND PNL A3/A4
TO KU-BAND SIGNAL PROCESSOR
TO P/L OVERHEAD PANEL
TO KU BAND SIGNAL PROCESSOR
TO KA SIGNAL PROCESSOR
TO P/L INTRG 1
TO P/L INTRG 2
TO KA SIGNAL PROCESSOR
TO P/L INTRG 1
TO P/L INTRG 2
TO P/L INTRG 1
TO P/L INTRG 2
TO KU SIGNAL PROCESSOR

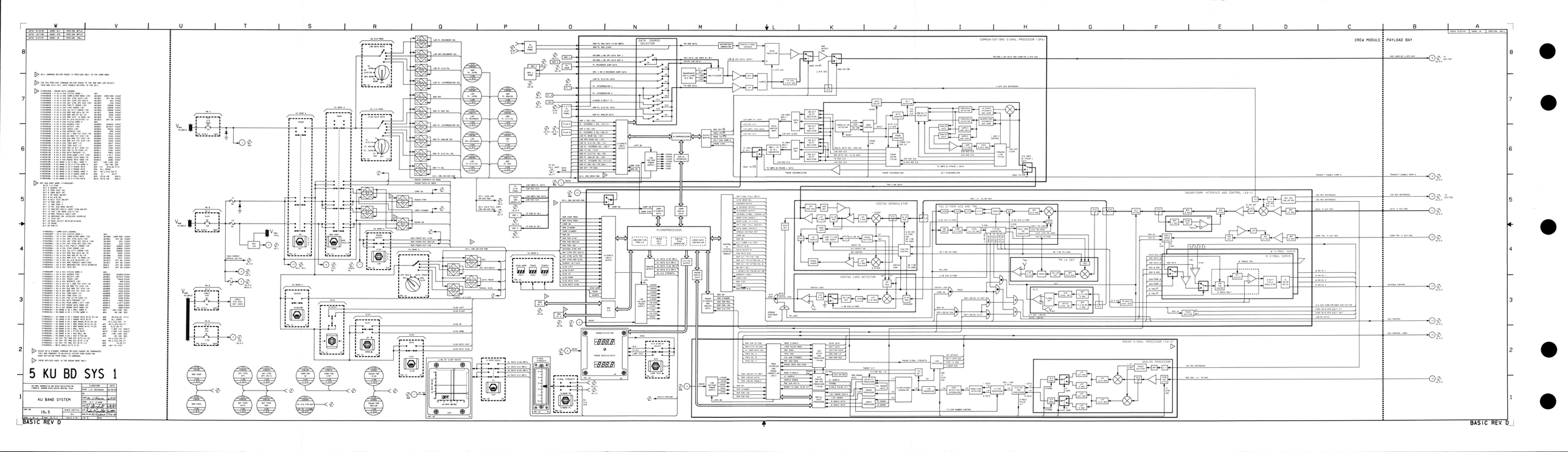

2 S-BD PM 1
S-BAND PM TRANSPONDER
S-BD PM TRANSPONDER 2
S-BD PM TRANSPONDER 1
BASIC REV D
BASIC REV D


S-BAND POWER AMPLIFIER ASSEMBLY
PREAMPLIFIER ASSEMBLY
2 S-BD PM 2
S-BAND PM
AMPLIFIER SYSTEM
BASIC REV D
BASIC REV D


S-BAND ANTENNA SWITCH
SWITCH BEAM CONTROL ELECTRONICS
ELECTRONICS 2
ELECTRONICS 1
S-BAND PM
PM ELEC 2
PM ELEC 1
LOWER LEFT SWITCH BEAM ANTENNA
LOWER RIGHT SWITCH BEAM ANTENNA
UPPER LEFT SWITCH BEAM ANTENNA
UPPER RIGHT SWITCH BEAM ANTENNA
CROSS DIPOLE ANTENNAS
LOWER LEFT QUAD
LOWER RIGHT QUAD
UPPER LEFT QUAD
UPPER RIGHT QUAD
2 S-BD PM 3
S-BAND PM/FM SWITCH BEAM ANTENNA SYSTEM
16.2
BASIC REV D


BIT SYNC
CONVOLUTIONAL DECODER
NASA/DOD SELECTOR
OUTPUT FORMATTER AND CONTROLLER
FRAME SYNC DETECT AND LOCK LOGIC
FRAME SYNC DETECT
COMMAND PROCESSOR
DOPPLER BUFFER
POWER CONVERTER
UPLINK PROGRAMMER
ACCU/PAYLOAD STATION VOICE AND CLOCK
VOICE BUFFERS
PSC/ACCU SELECTOR
VOICE DELTA DEMODULATOR 1
VOICE DELTA DEMODULATOR 2
NSP 2
NSP 1
3 NSP FWD LINK 2
NETWORK SIGNAL PROCESSOR FORWARD LINK
16.3
BASIC REV D-2


COMSEC 2 (KGX-60)
COMSEC 1 (KGX-60)
CORE
BLACK I/O
RED I/O
SERIAL KG RECEIVE
SERIAL KG TRANSMIT
DEMUX AND AUTHENTICATE
FRAME SYNC LOGIC
COMMAND DATA STORAGE LOGIC
TIME AUTHENTICATE
BCH AUTHENTICATE
TIME WORD STORAGE
POWER SUPPLY
BITE ASSY
BITE ASSEMBLY
NSP1
NSP2
NTU
LOGIC
PAYLOAD PATCH PANEL
ENCRYPTION
DECRYPTION
NETWORK SIG PROC
REFERENCE TABLE 16.1 FOR DRAWING TRACEABILITY
NOMINAL ORBITER COMP/DUPLICATOR BOXES
KEY LOADED VIA PORTABLE UNIT PRIOR TO LAUNCH.
3 NSP 3
NETWORK SIGNAL PROCESSOR
COMSEC 1/2
SPACE SHUTTLE
DWG NO
16.3
BASIC REV D-2


5 KU BD SYS 1
KU BAND SYSTEM
16.5
CREW MODULE
PAYLOAD BAY
DATA SOURCE SELECTOR
MICROPROCESSOR
COMPLIMENTING SIGNAL PROCESSOR (SPA)
COSTAS DEMODULATOR
COSTAS LOCK DETECTOR
TAU DITHER ACQ AND TRK
RADAR/COMM INTERFACE AND CONTROL (EA-13)
RADAR SIGNAL PROCESSOR (EA-12)
ANALOG PROCESSOR
KU BAND A
KU BAND B
KU BAND C
KU BAND D
KU BAND E
KU BAND F
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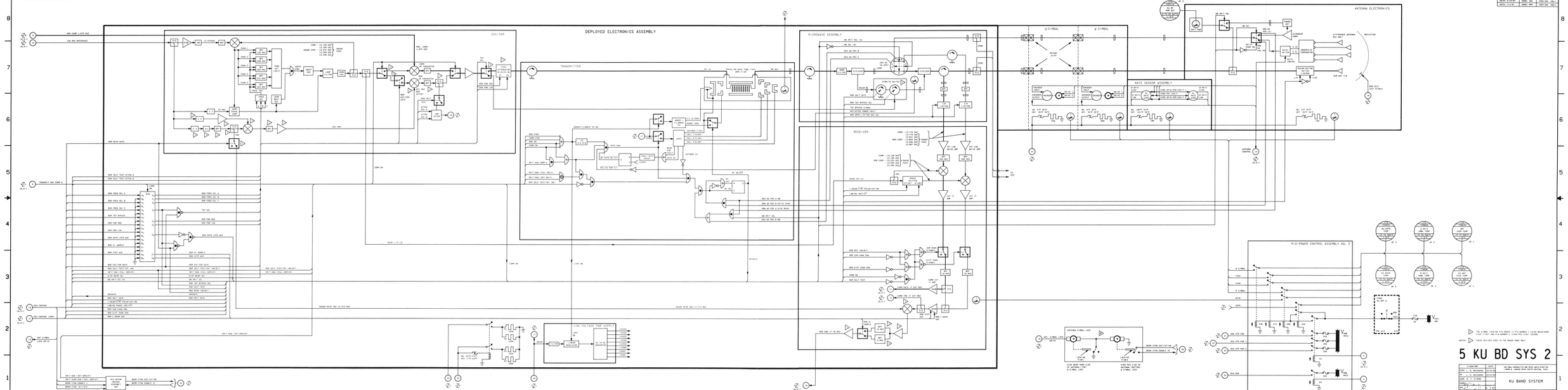
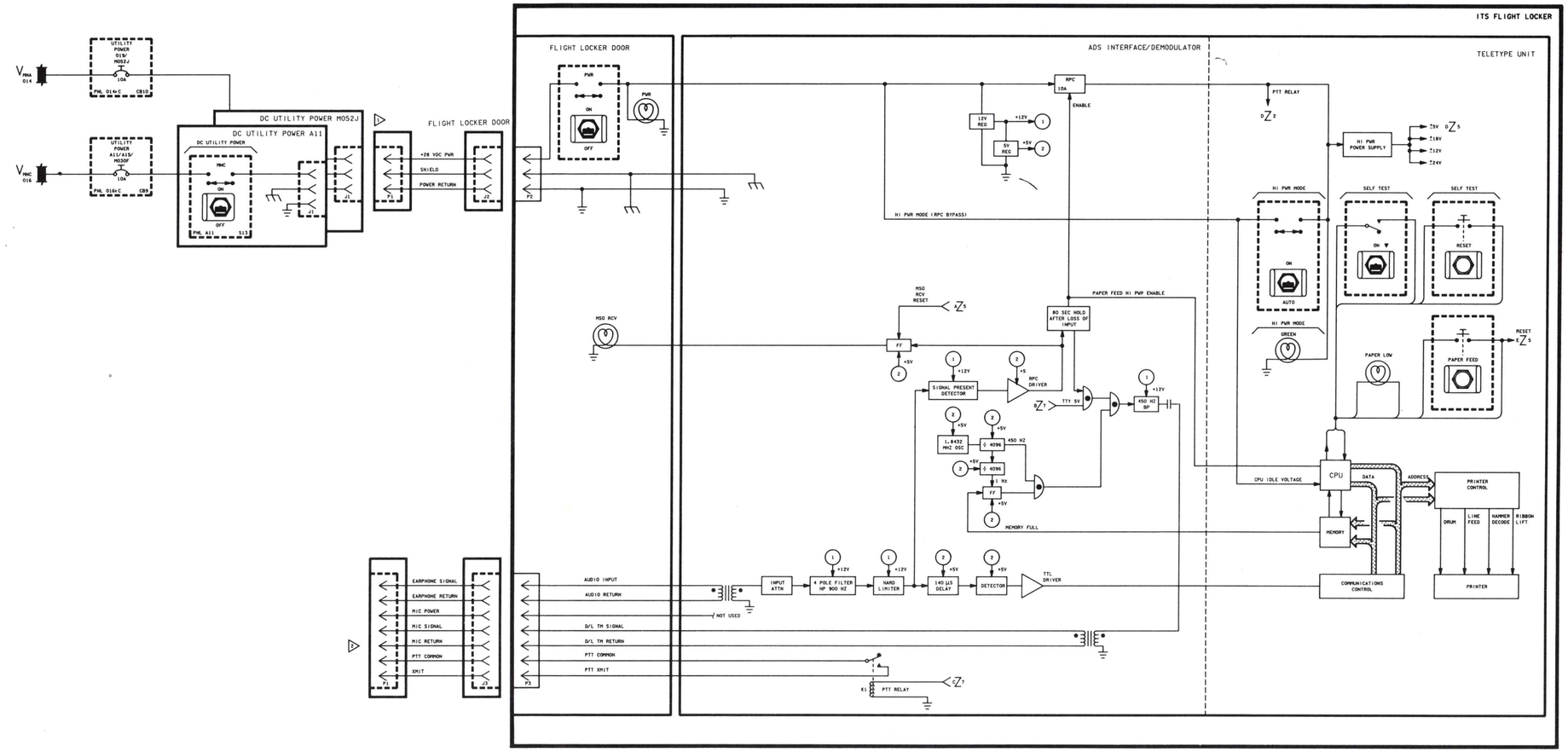
BASIC REV D
BASIC REV D


DEPLOYED ELECTRONICS ASSEMBLY
EXCITER
TRANSMITTER
MICROWAVE ASSEMBLY
RECEIVER
ANTENNA ELECTRONICS
Q GIMBAL
ß GIMBAL
RATE SENSOR ASSEMBLY
MID-POWER CONTROL ASSEMBLY NO. 2
LOW VOLTAGE PWR SUPPLY
ANTENNA GIMBAL LOCK
5 KU BD SYS 2
KU BAND SYSTEM
16.5
BASIC REV D



NOTE: ▷ NORMALLY CONNECTED TO P5 ATU, MAY BE CONNECTED TO ANY ATU, CABLE LENGTH PERMITTING

▷ MAY BE CONNECTED TO ANY DC UTILITY OUTLET NORMALLY CONNECTED TO EITHER OF THE TWO SHOWN

6 ITS

SIGNATURE	DATE
DSGN VICKI DODGETT	1/31/84
DR	
ENGR A. WILLIAMS	
ENGR	
APP	
APP	
OMNIPLAN	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

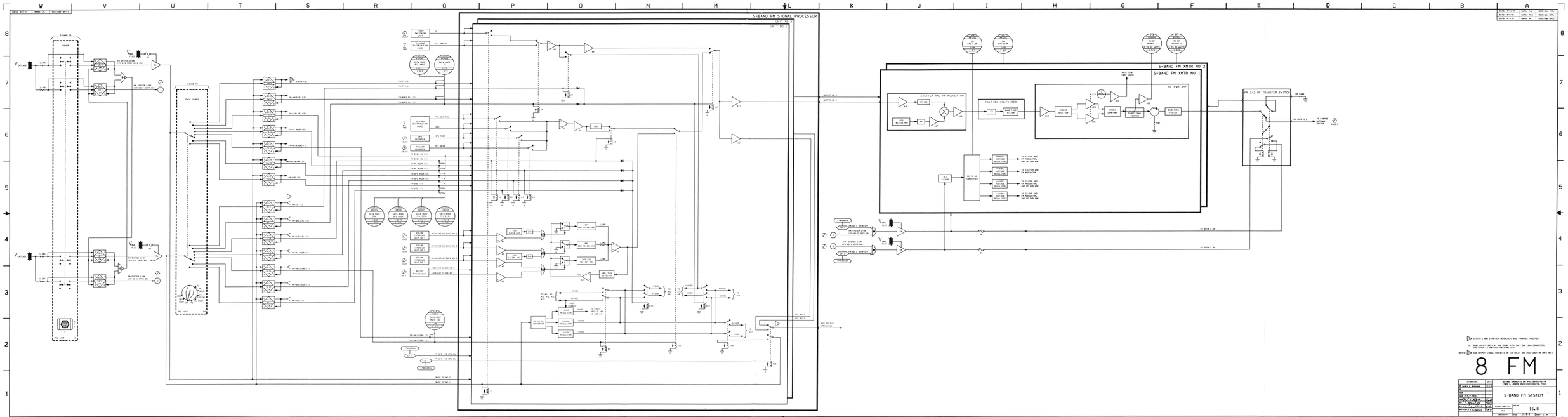
INTERIM TELEPRINTER SYSTEM

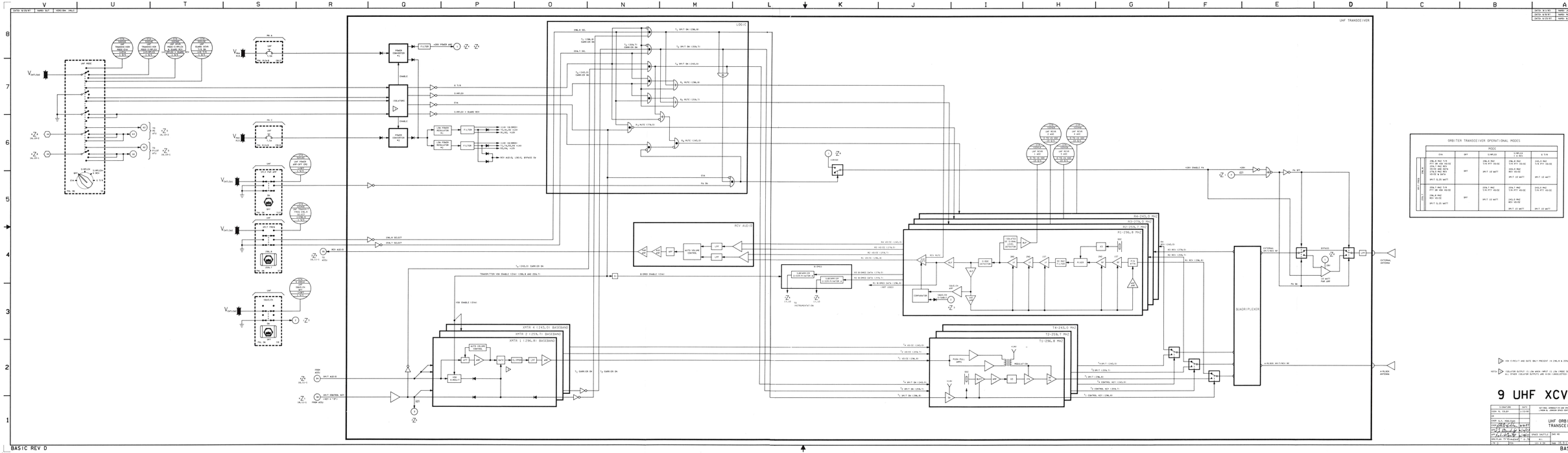
SPACE SHUTTLE | DWG NO 16.6

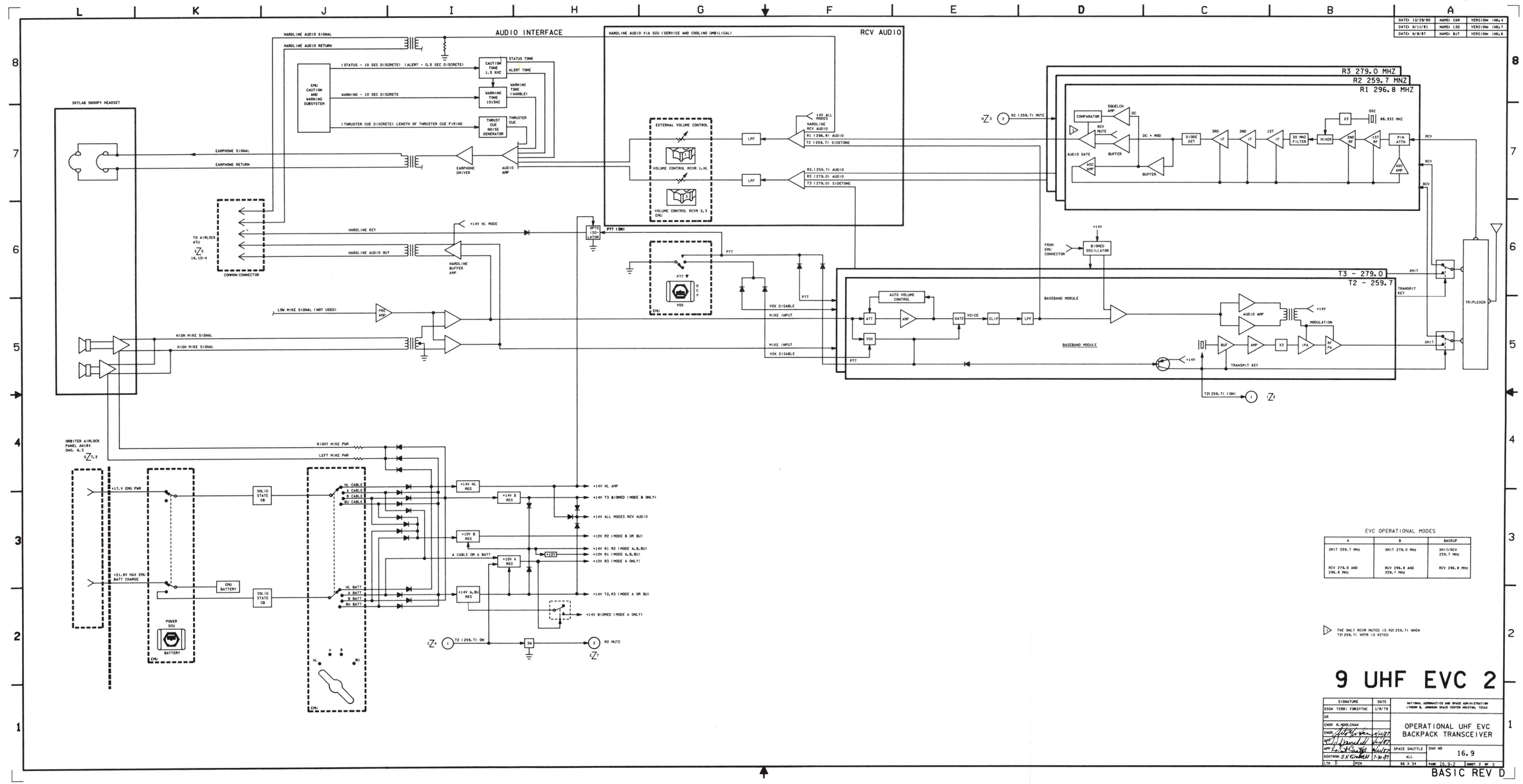
ALL | PAGE 16.6-1 | SHEET 1 OF 1

LTR D | PCN | 68 X 34

BASIC REV D


S-BAND FM SIGNAL PROCESSOR
UNIT NO 1
S-BAND FM XMTR NO 2
S-BAND FM XMTR NO 1
EXCITER AND FM MODULATOR
MULTIPLEXER/FILTER
RF PWR AMP
RF 1/2 RF TRANSFER SWITCH
S-BAND FM
8 FM
S-BAND FM SYSTEM
16.8
BASIC REV D


UHF TRANSCEIVER
LOGIC
XMTR 4 (243.0) BASEBAND
XMTR 2 (259.7) BASEBAND
XMTR 1 (296.8) BASEBAND
R4-243.0 MHZ
R3-259.7 MHZ
R2-276.5 MHZ
R1-296.8 MHZ
T4-243.0 MHZ
T3-259.7 MHZ
T2-276.5 MHZ
T1-296.8 MHZ
QUADRIPLEXER
DIPLEXER
BCV AUDIO
ORBITER TRANSCEIVER OPERATIONAL MODES
MODE
EVA
OFF
S-SPLEX
S-SPLEX + S BCN
S TLM
9 UHF XCVR 1
UHF TRANSCEIVER
UHF MODE
UHF ANTENNA
EXTERNAL ANTENNA
ANTENNA SWITCHING
SWITCH
PWR AMP
PWR DIVIDER
LOW POWER REGULATOR
FILTER
MIX
OSCILLATOR
AUTO VOLUME CONTROL
COMPARATOR
QUADRATURE HYBRID
PHASE LOCK LOOP
VOLTAGE CONTROLLED OSCILLATOR
PHASE SHIFTER
DIGITAL TO ANALOG CONVERTER
ANALOG TO DIGITAL CONVERTER
MULTIPLEXER
DEMULTIPLEXER
SWITCH
LIMITER
DETECTOR
AMPLIFIER
ATTENUATOR
DELAY
INVERTER
AND GATE
OR GATE
FLIP FLOP
SHIFT REGISTER
COUNTER
DECODER
ENCODER
MODULATOR
DEMODULATOR
SUMMING AMPLIFIER
INTEGRATOR
DIFFERENTIATOR
SAMPLE AND HOLD
ANALOG SWITCH
TRANSMIT/RECEIVE
TRANSMIT ONLY
RECEIVE ONLY
S BAND PSK
S BAND FM
KU BAND
UHF
VHF
TACAN
MLS
GPS
ANTENNA
ANTENNA SWITCHING
SWITCH
MIX
OSC
PWR AMP
PWR DIVIDER
LOW PWR REGULATOR
FILTER
MOD
DEMOD
VCO
PLL
AGC



DATE> 12/29/80	NAME> CAR	VERSION> INK 4
DATE> 6/15/81	NAME> LSD	VERSION> INK 7
DATE> 6/8/87	NAME> BJT	VERSION> INK 8

EVC OPERATIONAL MODES

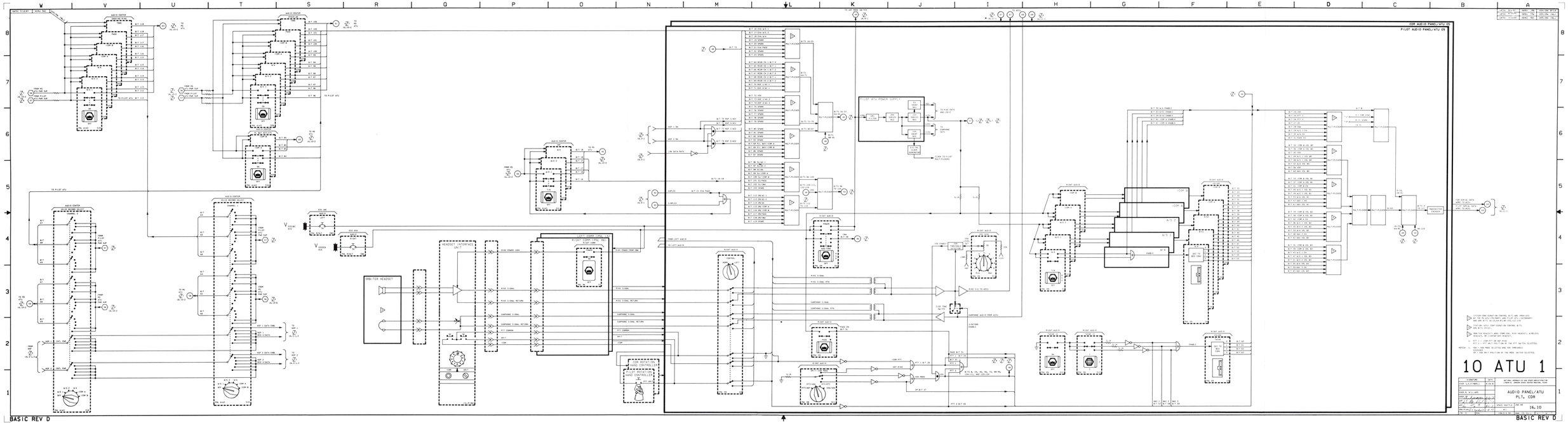
A	B	BACKUP
XMIT 259.7 MHz	XMIT 279.0 MHz	XMIT/RCV 259.7 MHz
RCV 279.0 AND 296.8 MHz	RCV 296.8 AND 259.7 MHz	RCV 296.8 MHz

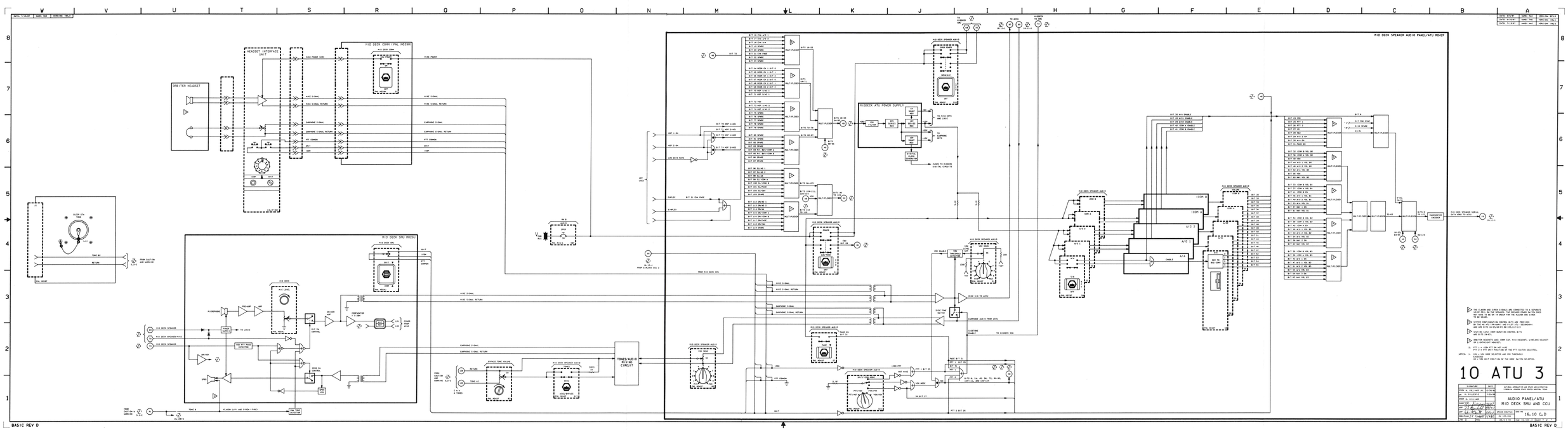
▷ THE ONLY RCVR MUTED IS R2(259.7) WHEN T2(259.7) XMTR IS KEYED

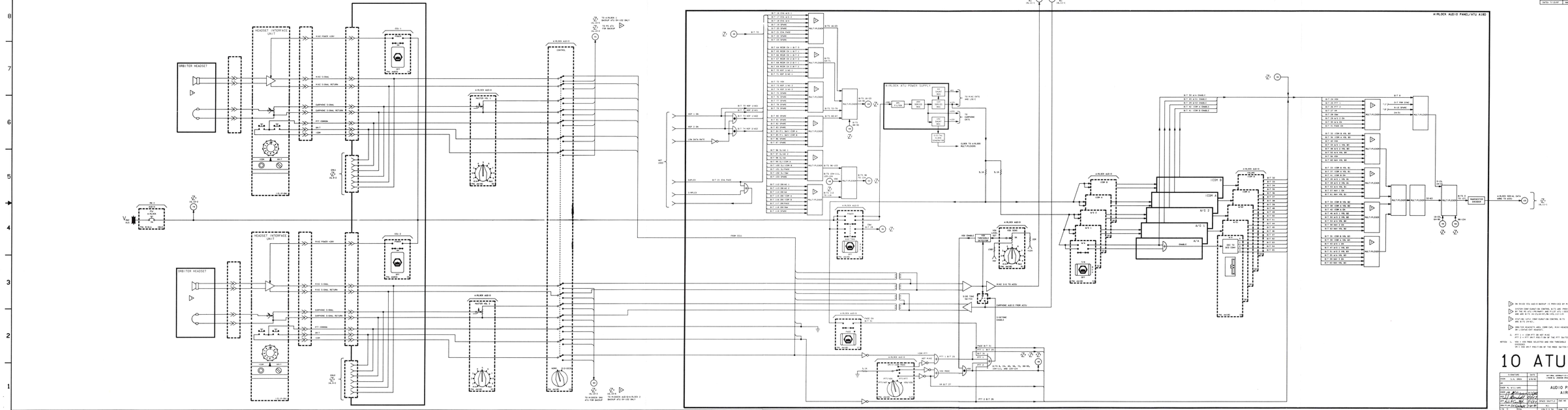
9 UHF EVC 2

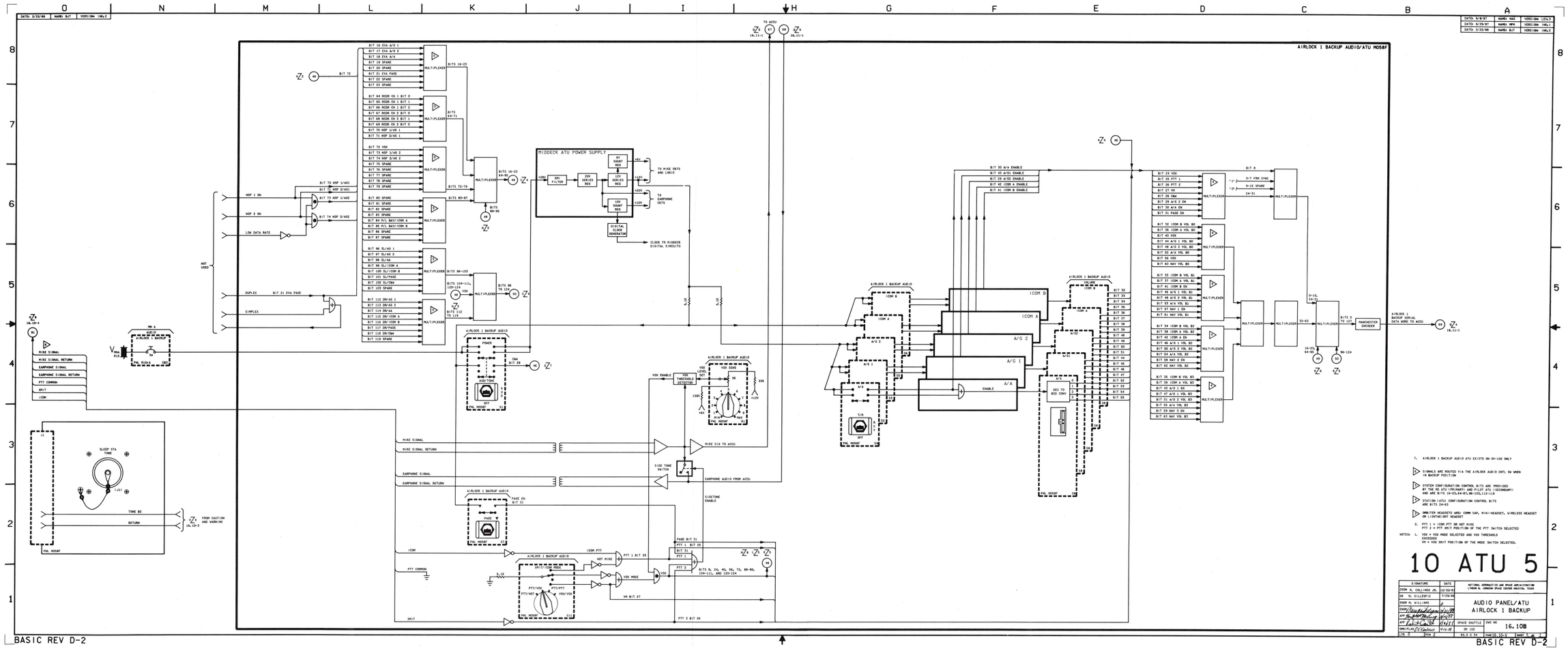
SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN TERRI FORSYTHE	1/8/79	
DR		OPERATIONAL UHF EVC BACKPACK TRANSCEIVER
ENGR R. MOOLCHAN		
ENGR	2/11/87	
APP	2/11/87	SPACE SHUTTLE
APP	2/11/87	ALL
KENTRON S.K. KIMBALL	7-30-87	66 X 34
LTR D PCN		DWG NO 16.9
		PAGE 16.9-2 SHEET 2 OF 2

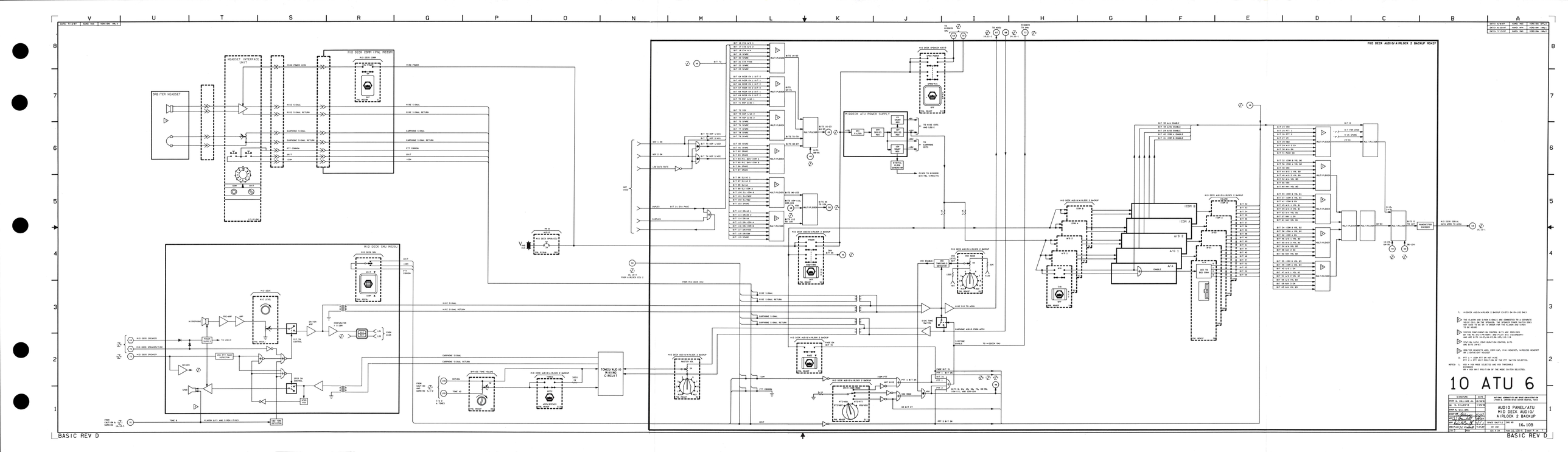
BASIC REV D

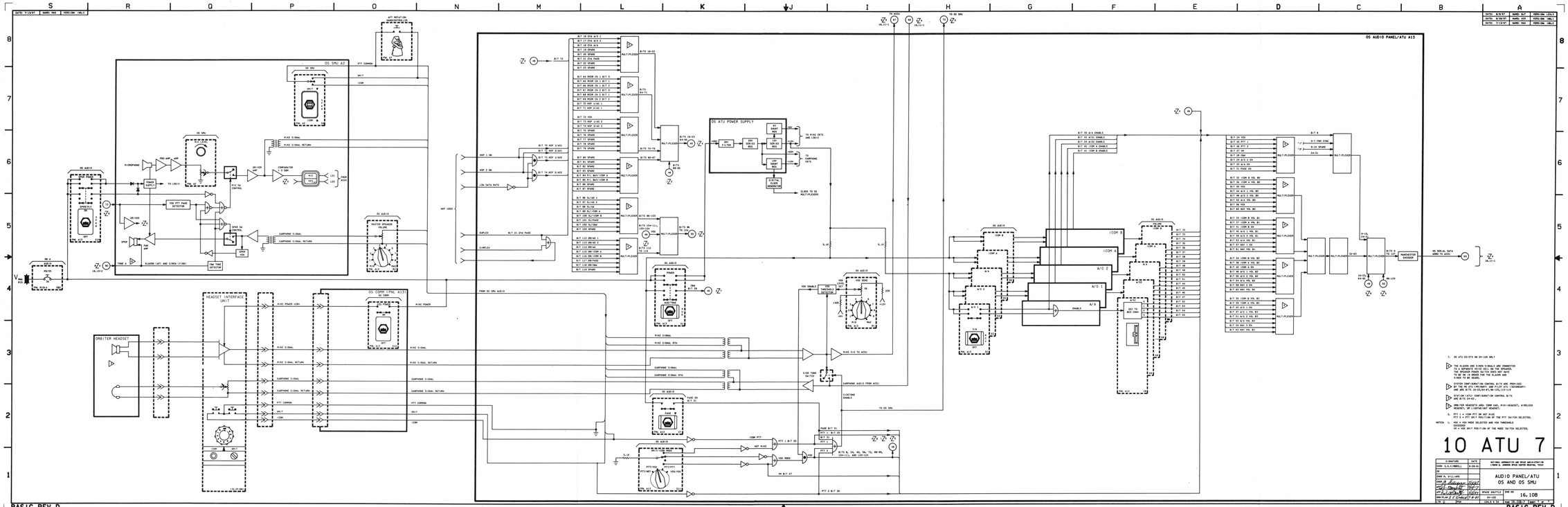

AUDIO PANEL/ATU 10
PILOT AUDIO PANEL/ATU 09
10 ATU 1
AUDIO PANEL/ATU
PLT, COR
16.10
SIGNATURE
DATE
DRAWN
CHECKED
APPROVED
ENGR MGR
PROJ MGR
QUALITY
STRUCTURES
ELECTRICAL
MECHANICAL
SYSTEMS
STRUCTURES
ELECTRICAL
MECHANICAL
SYSTEMS
CHANGE NO.
SHEET
OF
BASIC REV D
BASIC REV D


MID DECK SPEAKER AUDIO PANEL/ATU MD42F
MID DECK COMM PANEL MD39F
HEADSET INTERFACE UNIT
ORBITER HEADSET
MID DECK SPU MD29F
MIDDECK ATU POWER SUPPLY
AUDIO PANEL/ATU
MID DECK SMU AND CCU
10 ATU 3
SPACE SHUTTLE
16.10 G.D


AIRLOCK AUDIO PANEL/ATU A1B2
ORBITER HEADSET
HEADSET INTERFACE UNIT
AIRLOCK AUDIO CONTROL
AIRLOCK AUDIO
AIRLOCK ATU POWER SUPPLY
AUDIO PANEL/ATU AIRLOCK
10 ATU 4
BASIC REV D


AIRLOCK 1 BACKUP AUDIO/ATU MOD8F
MIDDECK ATU POWER SUPPLY
10 ATU 5
AUDIO PANEL/ATU
AIRLOCK 1 BACKUP
BASIC REV D-2


MID DECK AUDIO/AIRLOCK 2 BACKUP MD42F
ORBITER HEADSET
HEADSET INTERFACE UNIT
MID DECK COMM PNL MD39P
MID DECK SPKR MD39J
MID DECK SPEAKER AUDIO
MIDDECK ATU POWER SUPPLY
MID DECK AUDIO/A/L/BCK 2 BACKUP
TONES/AUDIO MIXING CIRCUIT
10 ATU 6
AUDIO PANEL/ATU
MID DECK AUDIO/
AIRLOCK 2 BACKUP
16.108
BASIC REV D


OS AUDIO PANEL/ATU A13
OS SMU A2
OS COMM (PNL A13)
HEADSET INTERFACE UNIT
ORBITER HEADSET
OS POWER SUPPLY
10 ATU 7
AUDIO PANEL/ATU
OS AND OS SMU
16.108
BASIC REV D

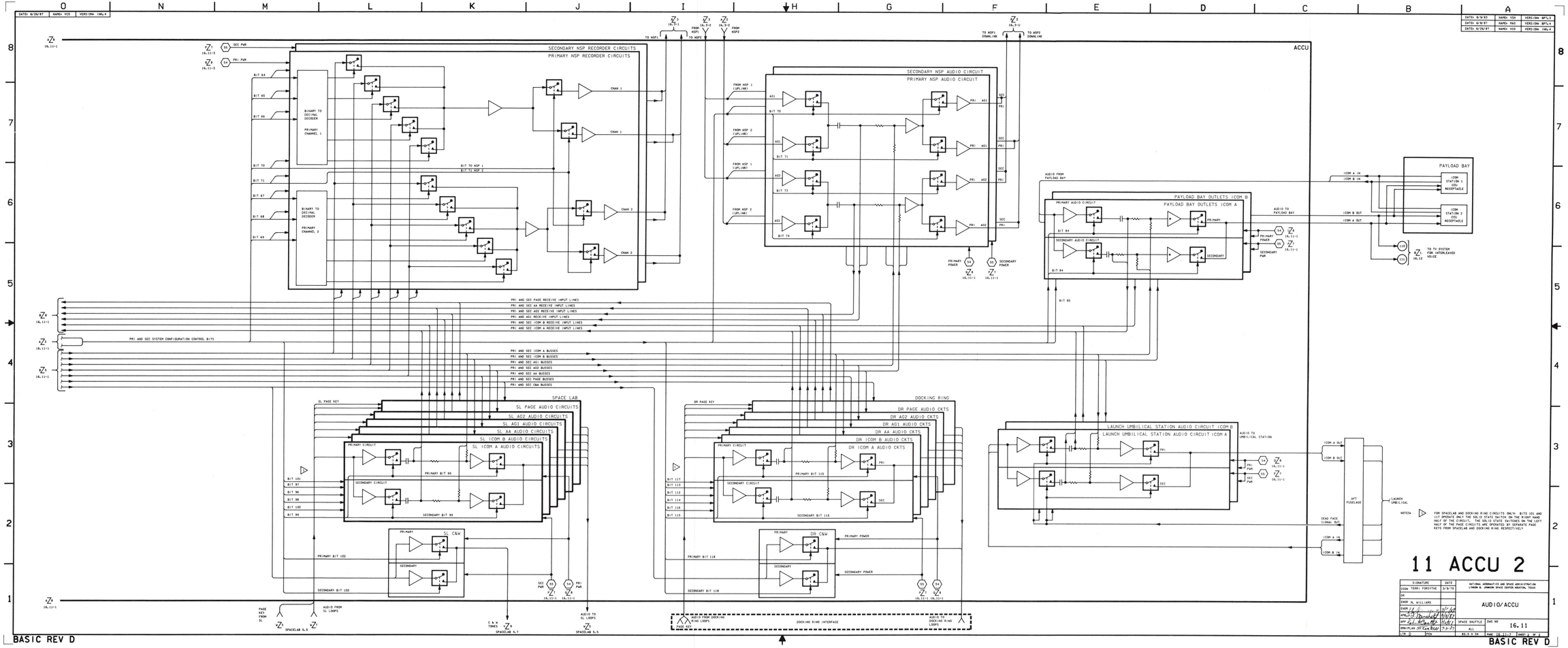
DATE/ BY/ RT	NAME/ SSN	VERS/ DN/ DFTS
DATE/ 6/15/87	NAME/ XXX	VERS/ DN/ DFTS
DATE/ 6/15/87	NAME/ XXX	VERS/ DN/ ONLY

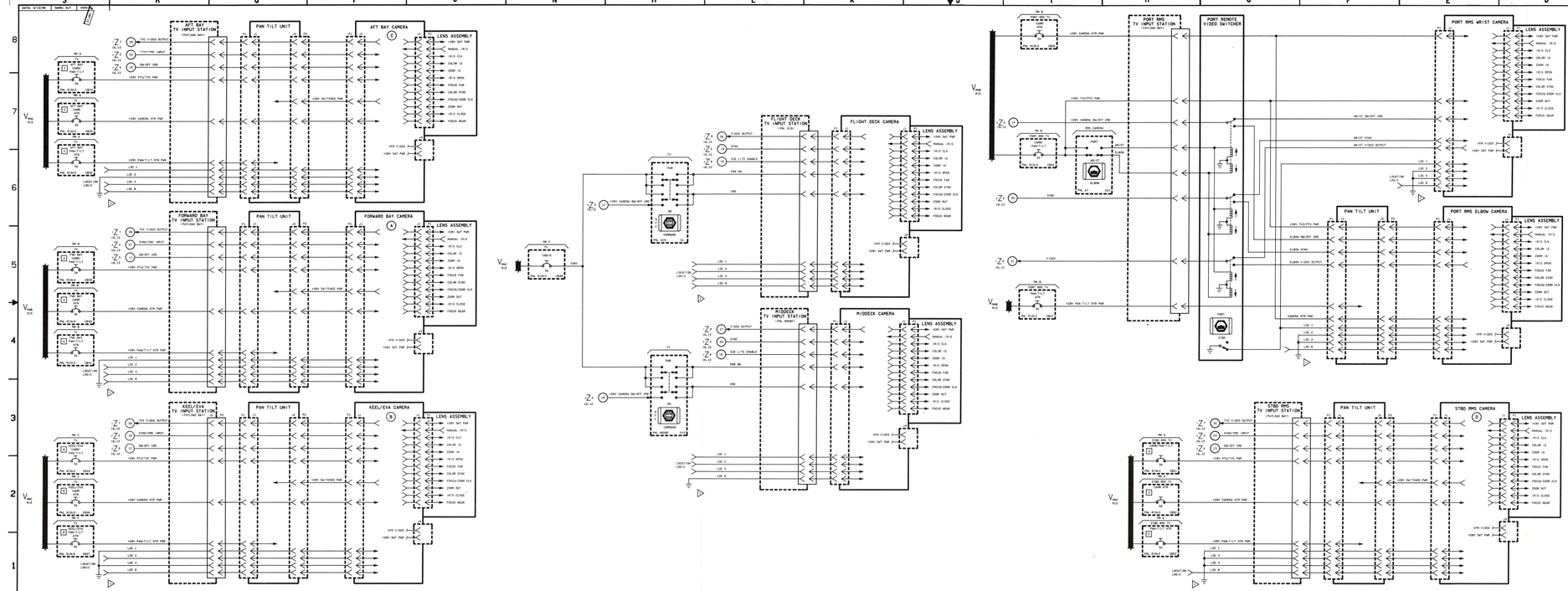
11 ACCU 1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS	SIGNATURE	DATE
	DSGN	
	DR	
AUDIO/ACCU	CHKR R. WILLIAMS	
	APPD	
DWG NO 16.11	SPACE SHUTTLE	
SIZE B SCALE NONE SHEET 1 OF 1	MSC	
DO B ONLY	FSCM NO	

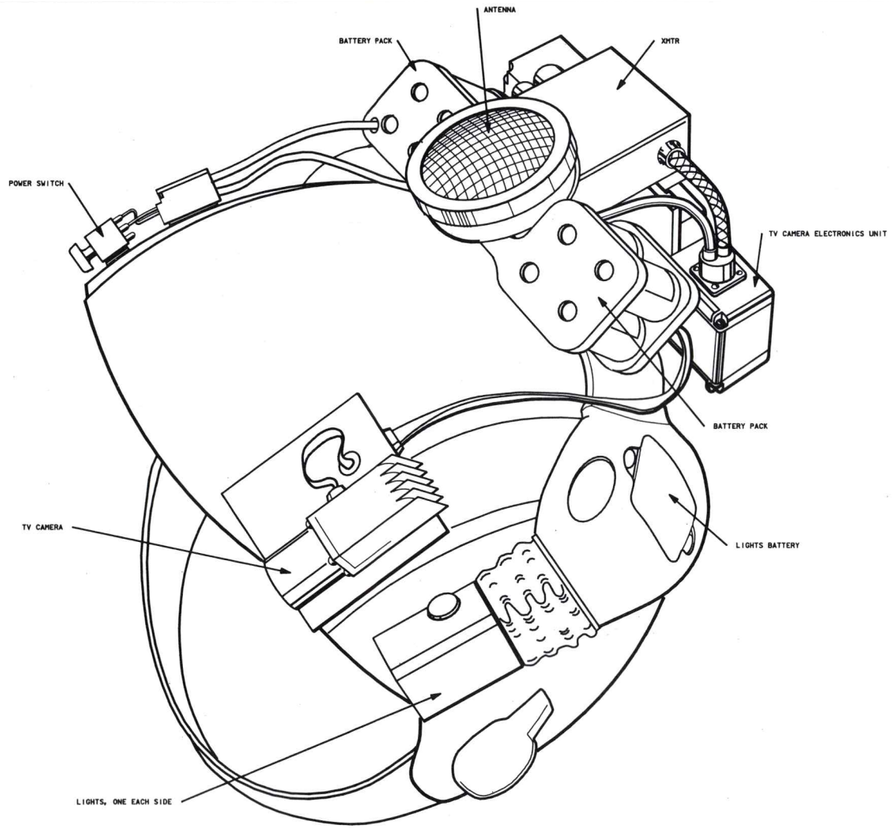
BASIC REV D

BASIC REV D

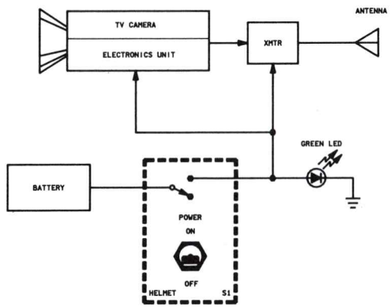

ACCU
SECONDARY NSP RECORDER CIRCUITS
PRIMARY NSP RECORDER CIRCUITS
SECONDARY NSP AUDIO CIRCUIT
PRIMARY NSP AUDIO CIRCUIT
PAYLOAD BAY OUTLETS ICOM B
PAYLOAD BAY OUTLETS ICOM A
PAYLOAD BAY
SPACE LAB
SL PAGE AUDIO CIRCUITS
SL AG2 AUDIO CIRCUITS
SL AG1 AUDIO CIRCUITS
SL AA AUDIO CIRCUITS
SL ICOM B AUDIO CIRCUITS
SL ICOM A AUDIO CIRCUITS
DOCKING RING
DR PAGE AUDIO CKTS
DR AG2 AUDIO CKTS
DR AG1 AUDIO CKTS
DR AA AUDIO CKTS
DR ICOM B AUDIO CKTS
DR ICOM A AUDIO CKTS
LAUNCH UMBILICAL STATION AUDIO CIRCUIT ICOM B
LAUNCH UMBILICAL STATION AUDIO CIRCUIT ICOM A
PRI AND SEC SYSTEM CONFIGURATION CONTROL BITS
PRI AND SEC PAGE RECEIVE INPUT LINES
PRI AND SEC AA RECEIVE INPUT LINES
PRI AND SEC AG2 RECEIVE INPUT LINES
PRI AND SEC AG1 RECEIVE INPUT LINES
PRI AND SEC ICOM B RECEIVE INPUT LINES
PRI AND SEC ICOM A RECEIVE INPUT LINES
PRI AND SEC ICOM A BUSSES
PRI AND SEC ICOM B BUSSES
PRI AND SEC AG2 BUSSES
PRI AND SEC AG1 BUSSES
PRI AND SEC AA BUSSES
PRI AND SEC PAGE BUSSES
PRI AND SEC CMW BUSSES
SL C&W
DR C&W
AFT FUSELAGE
LAUNCH UMBILICAL
DEAD FACE UMBILICAL PLUG
DOCKING RING INTERFACE
AUDIO FROM DOCKING RING LOOPS
AUDIO TO DOCKING RING LOOPS
AUDIO TO SL LOOPS
AUDIO FROM SL LOOPS
C & W TONES
PAGE KEY FROM SL
SPACELAB 5,9
SPACELAB 4,7
SPACELAB 5,5
TO MDF1
TO MDF2
FROM MDF1
FROM MDF2
TO MDF1 DOWNLINK
TO MDF2 DOWNLINK
AUDIO FROM PAYLOAD BAY
AUDIO TO PAYLOAD BAY
AUDIO TO UMBILICAL STATION
TO TV SYSTEM FOR INTERLEAVED VOICE
PRIMARY POWER
SECONDARY POWER
SEC PWR
PRI PWR
ICOM A IN
ICOM B IN
ICOM B OUT
ICOM A OUT
ICOM STATION 1 EDU RECEPTACLE
ICOM STATION 2 EDU RECEPTACLE
NOTE:
FOR SPACELAB AND DOCKING RING CIRCUITS ONLY, BITS 101 AND 117 OPERATE ONLY THE SOLID STATE SWITCH ON THE RIGHT HAND HALF OF THE CIRCUIT. THE SOLID STATE SWITCHES ON THE LEFT HALF OF THE PAGE CIRCUITS ARE OPERATED BY SEPARATE PAGE KEYS FROM SPACELAB AND DOCKING RING RESPECTIVELY
11 ACCU 2
AUDIO/ACCU
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
SPACE SHUTTLE
16.11
DWG NO
ALL
SHEET 1 OF 2
BASIC REV D

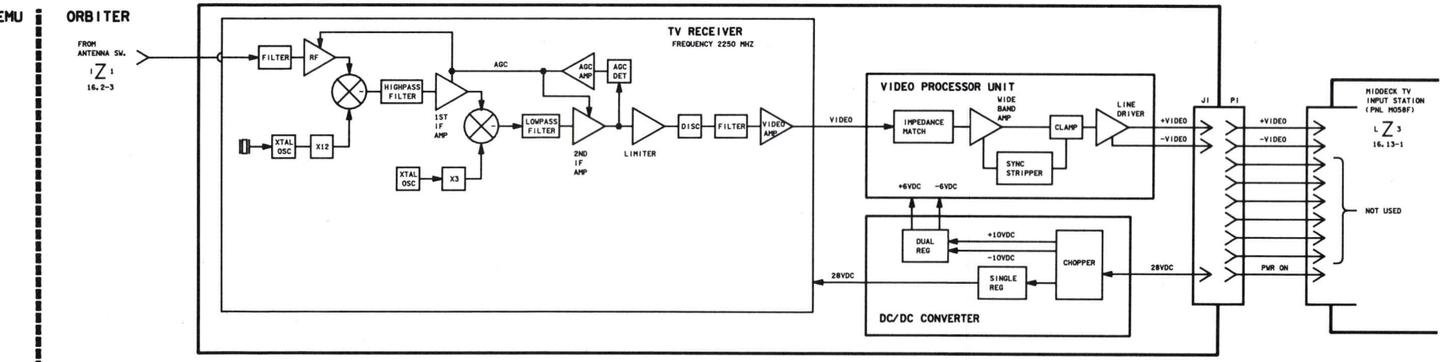

TV INPUT STATION
(PAYLOAD BAY)
AFT BAY CAMERA
FORWARD BAY CAMERA
KEEL/EVA CAMERA
FLIGHT DECK CAMERA
MIDDECK CAMERA
PORT REMOTE VIDEO SWITCHER
PORT RMS WRIST CAMERA
PORT RMS ELBOW CAMERA
STBD RMS CAMERA
PAN TILT UNIT
LENS ASSEMBLY
+28V SAT PWR
MANUAL IRIS
IRIS CLK
COLOR I/O
ZOOM IN
IRIS OPEN
FOCUS FAR
COLOR SYNC
FOCUS/ZOOM CLK
ZOOM OUT
IRIS CLOSE
FOCUS NEAR
+28V PAN/TILT MTR PWR
+28V CAMERA MTR PWR
+28V PTU/PTC PWR
+28V SWITCHED PWR
ON/OFF CMD
SYNC/CMD INPUT
TVC VIDEO OUTPUT
VTR VIDEO
LOCATION
LOC 1
LOC 2
LOC 3
LOC 4
LOC 5
LOC 6
LOC 7
LOC 8
WRIST ON/OFF CMD
WRIST SYNC
WRIST VIDEO OUTPUT
ELBOW ON/OFF CMD
ELBOW SYNC
ELBOW VIDEO OUTPUT
CAMERA MTR PWR
VIDEO
SYNC
PWR ON
CMD
CUE LITE ENABLE
+28V CAMERA ON/OFF CMD
+28V PAN TILT MTR PWR
+28V TVC/PTU PWR
+28V SAT PWR
WRIST
ELBOW
PORT
STBD
NOTE: LOCATION BIT 16 IS ALWAYS OPEN
13 TV 1
TV/CAMERA MONITOR
SPACE SHUTTLE
16.13
BASIC REV D-2

DATE> 12/11/81	NAME> SHO	VERSION> BPT: 3
DATE> 6/1/87	NAME> VCO	VERSION> INK: 5
DATE> 8/1/87	NAME> MFB	VERSION> INK: 6



EMU TV HELMET ASSEMBLY

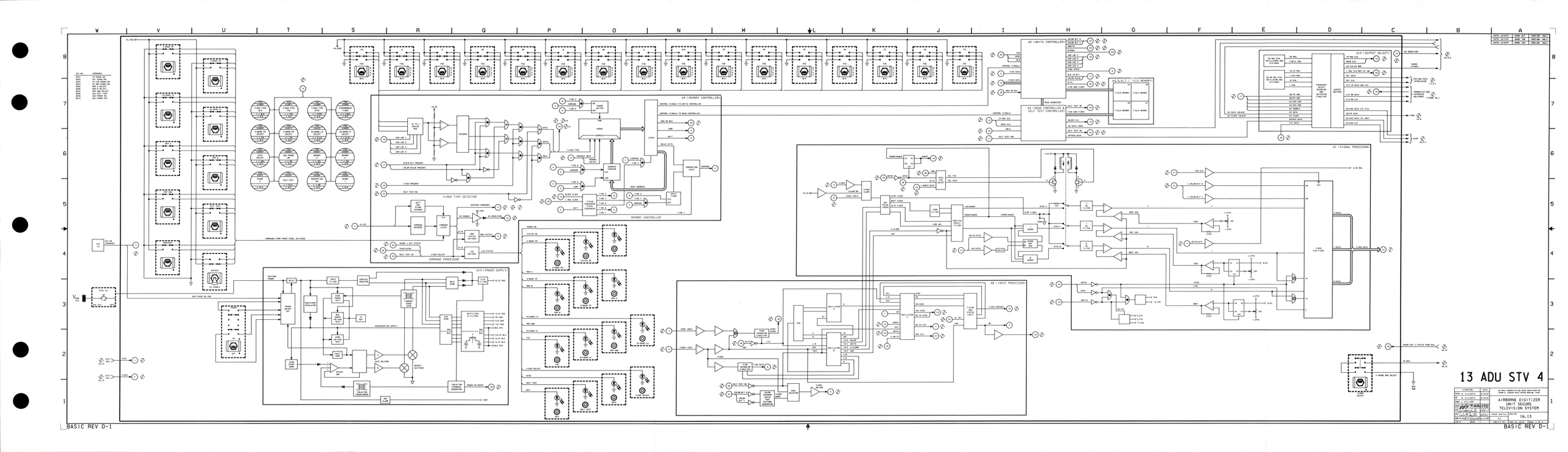


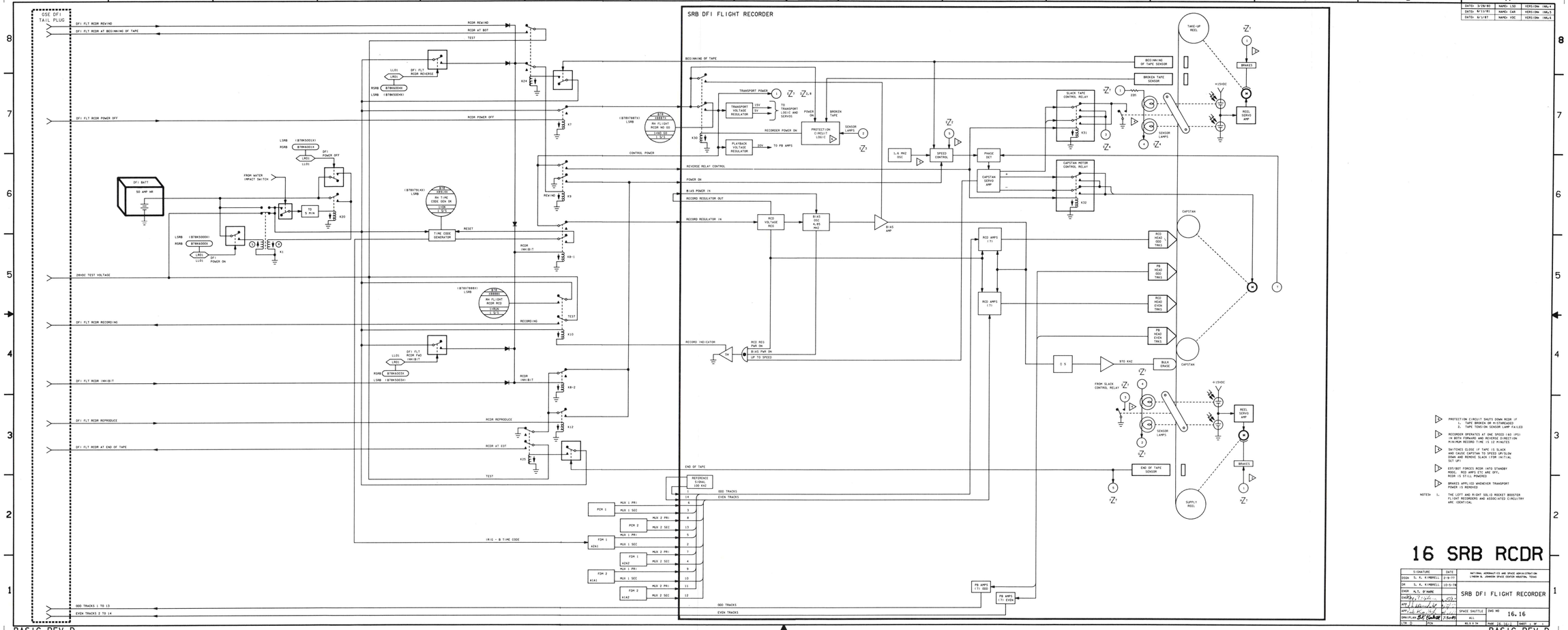


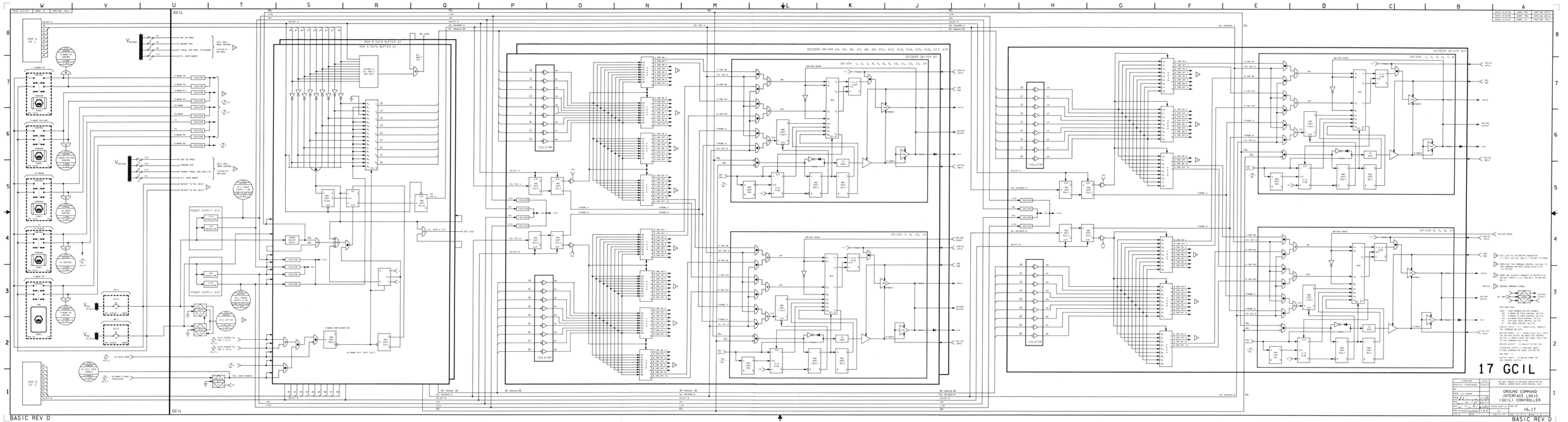
TV/EMU

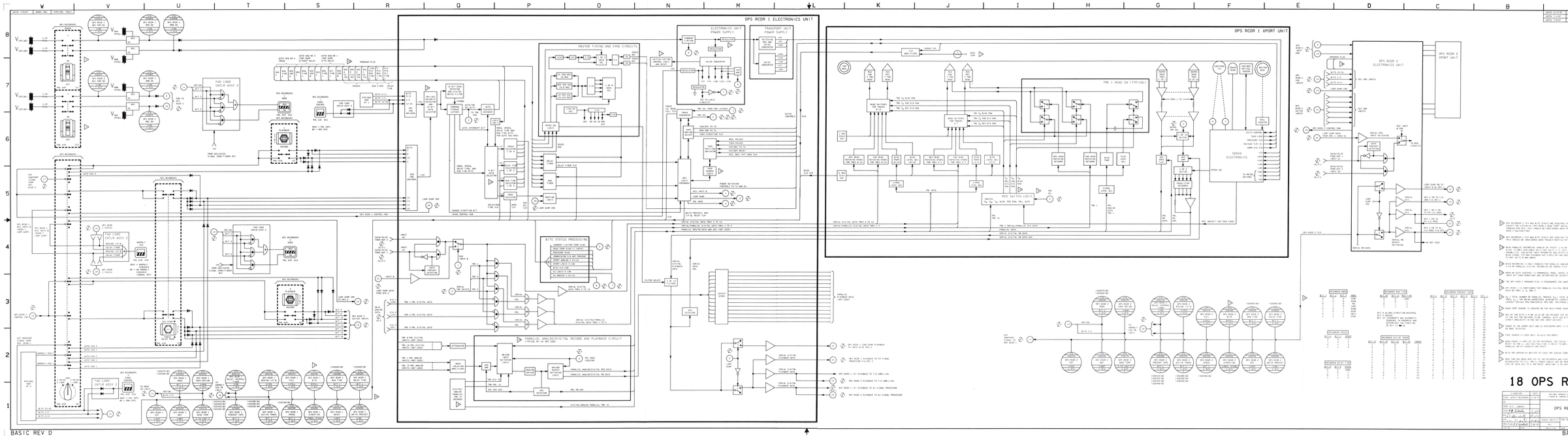
SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN H. BLATCH	11/21/80	
DR		
ENGR R. MOOLCHAN		TV/EMU
ENGR	6/4/87	
APP J. Mitchell	6/4/87	
APP Robert Cuthbert	6/4/87	SPACE SHUTTLE / DWG NO 16.13
OMNIPLANS R. Kimbrough	7-30-87	ALL
LTR D PCN		44 X 34 / PAGE 16.13-3 / SHEET 3 OF 4

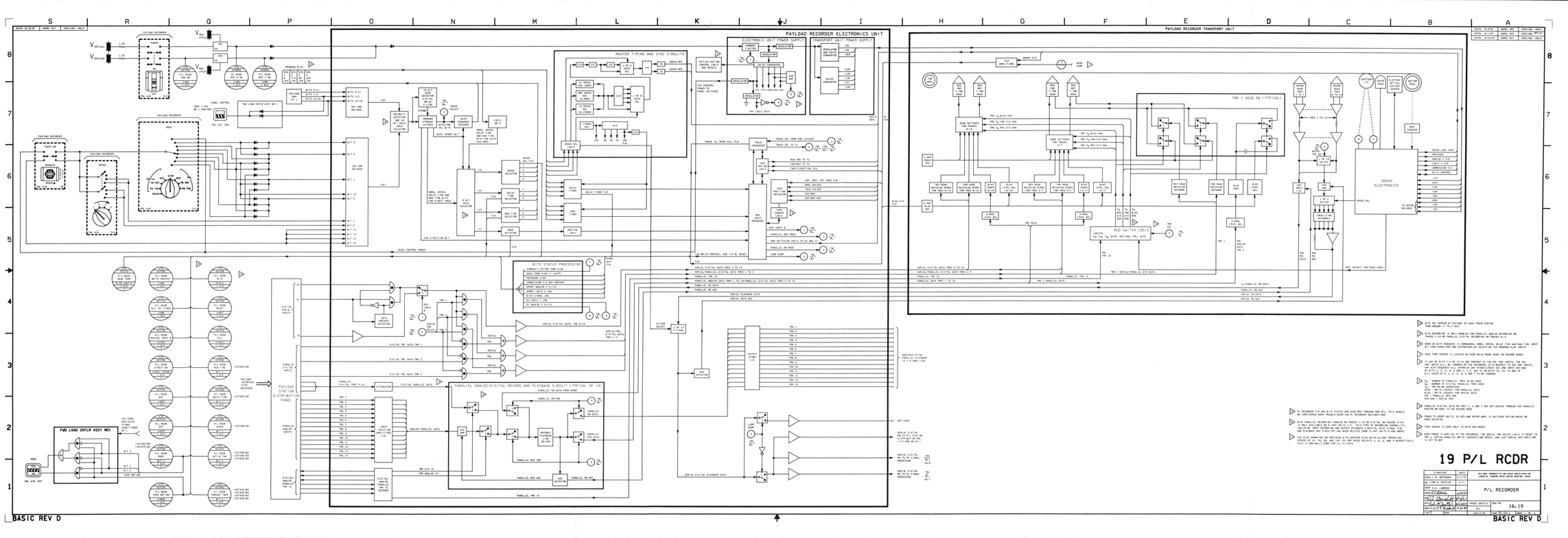
BASIC REV D


13 ADU STV 4
AIRBORNE DIGITIZER UNIT SECURE TELEVISION SYSTEM
A8 (MEMORY CONTROLLER)
A8 (INPUT PROCESSOR)
A11 (VISIONAL PROCESSOR)
A14 (POWER SUPPLY)
A2 (WRITE CONTROLLER)
A5 (READ CONTROLLER & SELF TEST CONTROLLER)
A1 (OUTPUT SELECT)
VIDEO TYPE DETECTOR
MEMORY CONTROLLER
COMMAND PROCESSOR
HOUSEKEEPING SUPPLY
BASIC REV D-1


GSE DFI TAIL PLUG
DFI FLT RCDR REWIND
DFI FLT RCDR AT BEGINNING OF TAPE
DFI FLT RCDR POWER OFF
28VDC TEST VOLTAGE
DFI FLT RCDR RECORDING
DFI FLT RCDR INHIBIT
DFI FLT RCDR REPRODUCE
DFI FLT RCDR AT END OF TAPE
ODD TRACKS 1 TO 13
EVEN TRACKS 2 TO 14
SRB DFI FLIGHT RECORDER
RCDR REWIND
RCDR AT BOT
TEST
RCDR POWER OFF
CONTROL POWER
REVERSE RELAY CONTROL
POWER ON
BIAS POWER IN
RECORD REGULATOR OUT
RECORD REGULATOR IN
RECORD INDICATOR
BEGINNING OF TAPE
END OF TAPE
RCDR INHIBIT
RCDR REPRODUCE
RCDR AT EOT
IRIG - B TIME CODE
ODD TRACKS
EVEN TRACKS
TRANSPORT VOLTAGE REGULATOR
PLAYBACK VOLTAGE REGULATOR
PROTECTION CIRCUITS LOGIC
SENSOR LAMPS
TO TRANSPORT LOGIC AND SERVOS
TO PB AMPS
SPEED CONTROL
PHASE DET
CAPSTAN SERVO AMP
CAPSTAN MOTOR CONTROL RELAY
SLACK TAPE CONTROL RELAY
BEGINNING OF TAPE SENSOR
BROKEN TAPE SENSOR
END OF TAPE SENSOR
REEL SERVO AMP
BRAKES
TAKE-UP REEL
SUPPLY REEL
RCD VOLTAGE REG
BIAS OSC 105 KHZ
BIAS AMP
RCD AMPS (7)
PB AMPS (7) ODD
PB AMPS (7) EVEN
RCD REG PWR ON B105 PWR ON UP TO SPEED
REFERENCE OSCILLATOR 100 KHZ
970 KHZ
BULK ERASE
FROM SLACK CONTROL RELAY
FROM WATER IMPACT SWITCH
50 AMP HR
TIME CODE GENERATOR
PCM 1
PCM 2
FDM 1
FDM 2
MUX 1 PRI
MUX 1 SEC
MUX 2 PRI
MUX 2 SEC
PROTECTION CIRCUIT SHUTS DOWN RCDR IF
1. TAPE BROKEN OR MISTHREADED
2. TAPE TENSION SENSOR LAMP FAILED
RECORDER OPERATES AT ONE SPEED (60 IPS) IN BOTH FORWARD AND REVERSE DIRECTION
MINIMUM RECORD TIME IS 12 MINUTES
SWITCHES CLOSE IF TAPE IS SLACK
TAPE TENSION MONITORED TO PREVENT SLOW DOWN AND REMOVE SLACK FROM INITIAL SET UP)
ERP/BIT FORCES RCDR INTO STANDBY
RCDR POWER OFF, ETC ARE OFF.
RCDR IS STILL POWERED
BRAKES APPLIED WHENEVER TRANSPORT POWER IS REMOVED
NOTES: 1. THE LEFT AND RIGHT SOLID ROCKET BOOSTER FLIGHT RECORDERS AND ASSOCIATED CIRCUITRY ARE IDENTICAL
16 SRB RCDR
SRB DFI FLIGHT RECORDER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
SPACE SHUTTLE
DWG NO 16.16
BASIC REV D

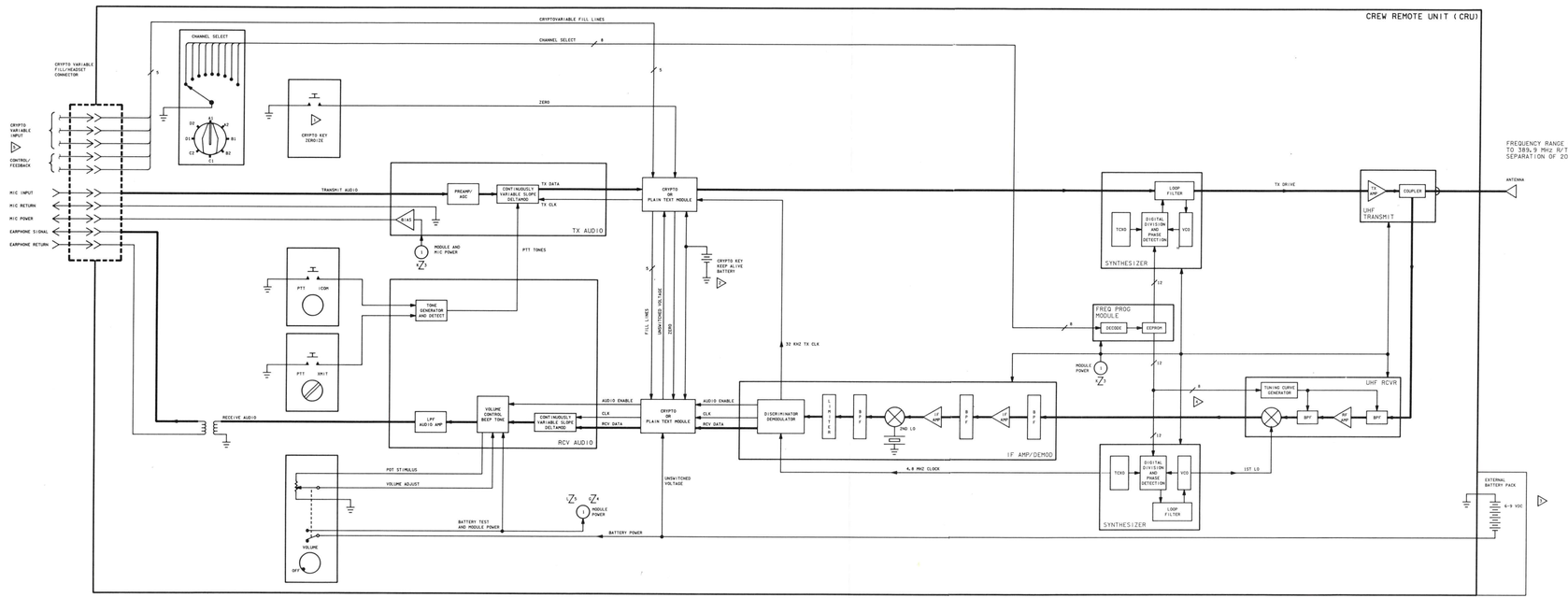

GCIL
BASIC REV D
17 GCIL
GROUND COMMAND INTERFACE LOGIC
(GCIL) CONTROLLER
16.17


OPS RCDR 1 ELECTRONICS UNIT
OPS RCDR 1 XPORT UNIT
OPS RCDR 2 ELECTRONICS UNIT
OPS RCDR 2 XPORT UNIT
ELECTRONICS UNIT POWER SUPPLY
TRANSPORT UNIT POWER SUPPLY
MASTER TIMING AND SYNC CIRCUIT
BITE STATUS PROCESSING
PARALLEL ANALOG/DIGITAL RECORD AND PLAYBACK CIRCUIT
SERVO ELECTRONICS
FWD LOAD CNTLR ASSY 2
FWD LOAD CNTLR ASSY 1
18 OPS RCDRS
OPS RECORDERS
OPS RECORDER CONTROL PWR
BASIC REV D

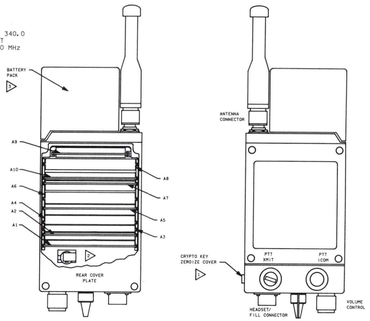

PAYLOAD RECORDER ELECTRONICS UNIT
PAYLOAD RECORDER TRANSPORT UNIT
MASTER TIMING AND SYNC CIRCUITS
ELECTRONIC UNIT POWER SUPPLY
TRANSPORT UNIT POWER SUPPLY
BITE STATUS PROCESSING
PARALLEL ANALOG/DIGITAL RECORD AND PLAYBACK CIRCUIT (TYPICAL OF 14)
PAYLOAD STATION DISTRIBUTION PANEL
FWD LOAD CNTLR ASSY MO1
SERVO ELECTRONICS
TRK 1 HEAD SW (TYPICAL)
RCD SATION LOGIC
19 P/L RCDR
P/L RECORDER
SPACE SHUTTLE
16.19
BASIC REV D

DATE: 4/25/87	NAME: BJT	VERSION: 1Rev.2

DATE: 4/11/87	NAME: BJT	VERSION: BRD.3
DATE: 4/24/87	NAME: VCO	VERSION: 1Rev.1
DATE: 4/25/87	NAME: BJT	VERSION: 1Rev.2



FREQUENCY RANGE 340.0 TO 389.9 MHz R/T SEPARATION OF 20 MHz



CRU ASSEMBLY

A2 XMIT AUDIO MODULE
A3 RCV AUDIO MODULE
A4 CRYPTO MODULE/PLAIN TEXT
A4 COMPACT MODULE/PLAIN TEXT
A5 IF AMP/DEMOD MODULE
A6 SYNTHESIZER MODULE
A7 UHF RCVR MODULE
A8 UHF TRANSMIT MODULE
A9 UHF TRANSMIT MODULE
A10 FREQUENCY PROGRAMMING MODULE

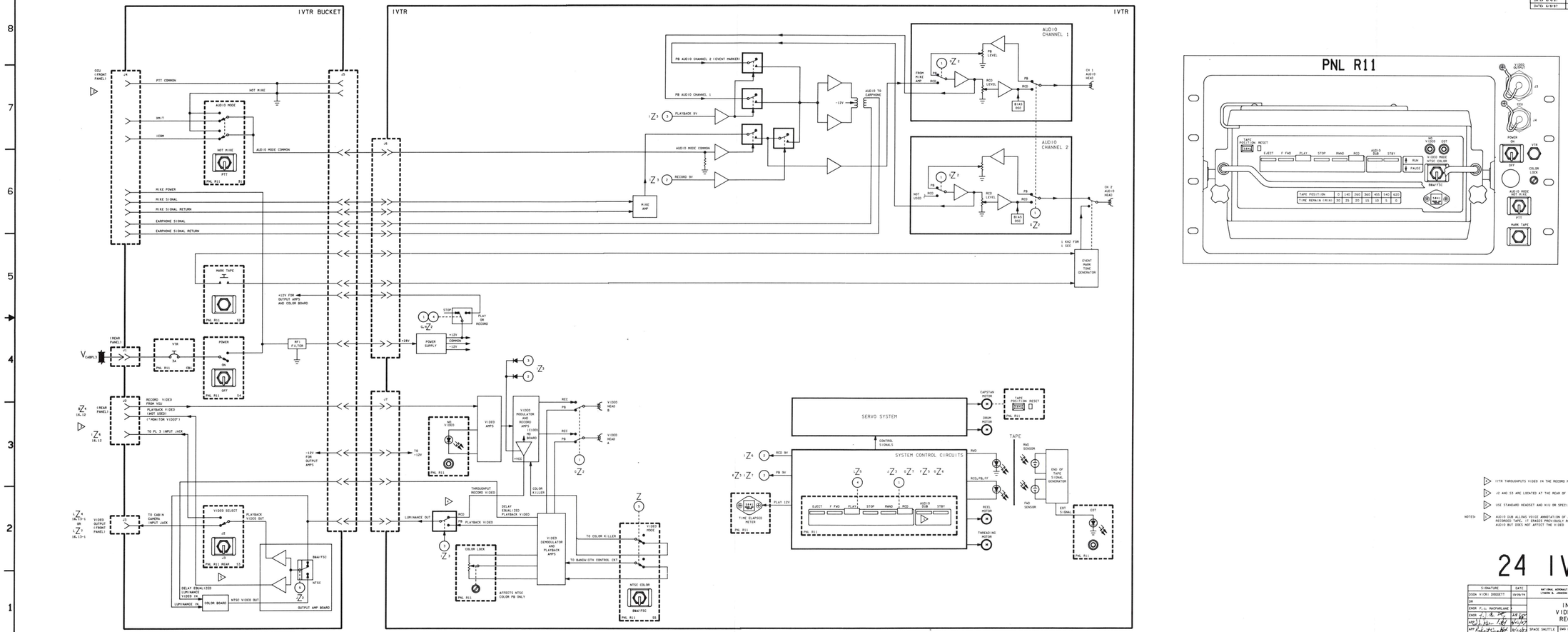
NOTES:

1. THE CRYPTO FILL EQUIPMENT IS OSE AND IS ONLY USED DURING CRYPTOVARIABLE KEY LOADING PROCEDURE PRELAUNCH
2. THE TUNING CURVE GENERATOR FREQUENCY CONTROL INFORMATION IS A 10 BIT WORD. THE FIRST TWO BITS ARE THE BCD CODE FOR THE HUNDREDS, THE EIGHT LINES SHOWN ARE THE BCD REPRESENTATION OF THE TENS AND ONES UNITS OF THE SELECTED FREQUENCY IN MHZ
3. THE BATTERY PACK ASSEMBLY IS MADE UP OF FIVE PARALLEL STACKS OF 6 IN SERIES AND IS REPLACEABLE IN FLIGHT. TYPICAL LIFETIME IS 30-32 HOURS IN THE PLAIN TEXT MODE
4. THE CRYPTO KEY KEEP ALIVE POWER SOURCE IS A STACK OF THREE SILVER OXIDE CELLS ARRANGED IN SERIES, THEY ARE INSTALLED + POLARITY DOWN AS SHOWN ON THE REAR ASSEMBLY VIEW. FREQ/RED ONLY FOR CRYPTO OPERATION.
5. THE CRYPTO KEY ZERO/IZE PUSHBUTTON HAS A SPRING-LOADED COVER LOCATED ON THE LEFT SIDE OF THE CASE

20 WCCS CRU 2

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN: V.C. ORTIZ	4/25/87	WIRELESS CREW COMM SYS CREW REMOTE UNIT
DR:		
ENGR: J. STAFFORD		
CHCK:		
APP:		SPACE SHUTTLE DWG NO: 16.20
APP:		ALL
ORG: FLAN SYSTEMS	7/8/87	
CTR # FCD		SIZE B SCALE NONE PAGE 16.20-2 SHEET 2 OF 2

REV D



PNL R11

NOTES:
1. IVTR THROUGHPUTS VIDEO IN THE RECORD MODE ONLY
2. J2 AND J3 ARE LOCATED AT THE REAR OF THE RECORDER
3. USE STANDARD HEADSET AND M/U OR SPECIAL CABLE TO ATU
4. AUDIO DUB ALLOWS VOICE ANNOTATION OF A PREVIOUSLY RECORDED TAPE. IT ERASES PREVIOUSLY RECORDED AUDIO BUT DOES NOT AFFECT THE VIDEO

DATE=	NAME=	VERSION=
DATE= 5/19/87	NAME= MDU	VERSION= BPTL1
DATE= 6/4/87	NAME= MAG	VERSION= IMAGE
DATE= 6/8/87	NAME= BJT	VERSION= IMAL1

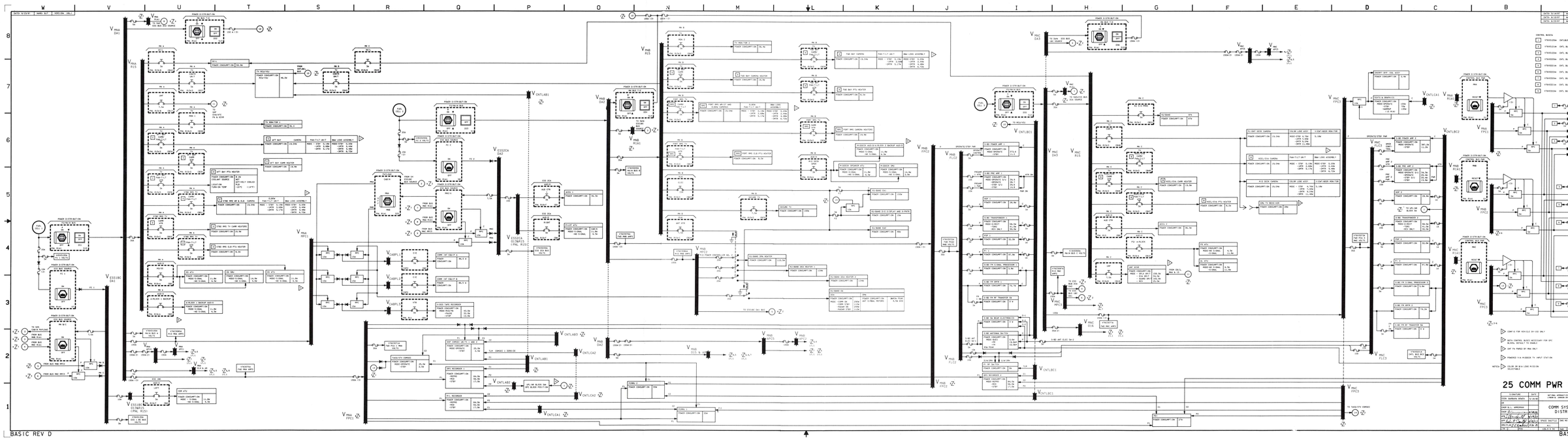
24 IVTR

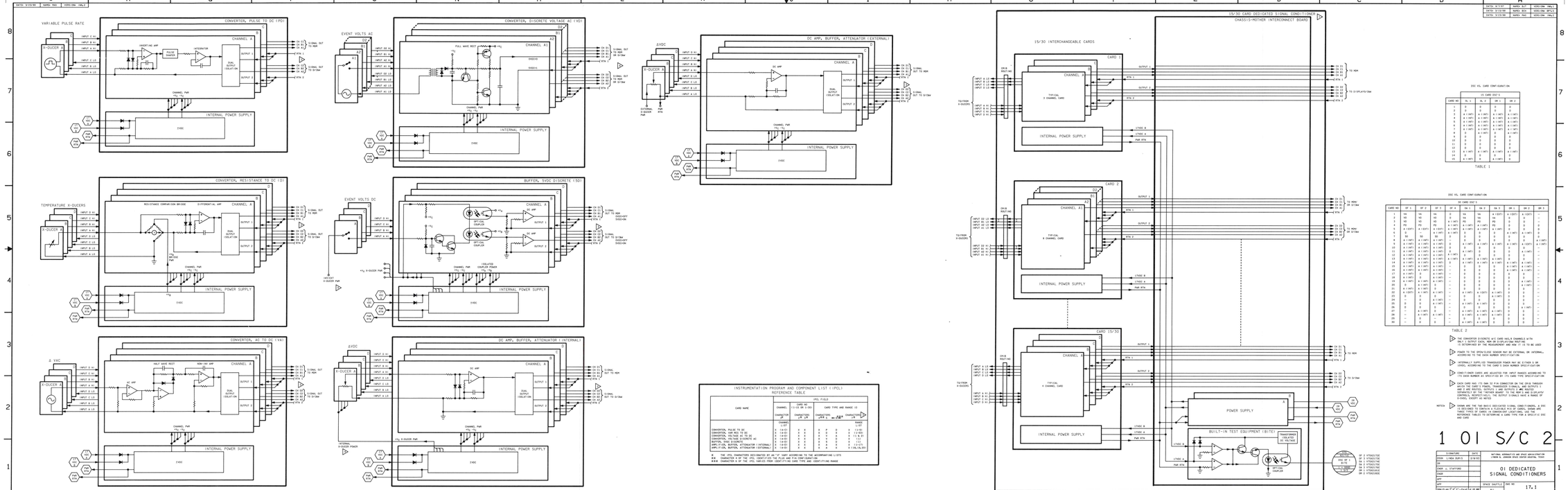
SIGNATURE	DATE	
DSGN V.I.K.: DOGGETT	06-19-79	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DR		
ENGR F.J.G. MASTARLANO		INTERIM VIDEO TAPE RECORDER
ENGR		
APP		
APP		SPACE SHUTTLE
DRAWING RELEASED		ALL
LTR	ECN	82 3 3 54

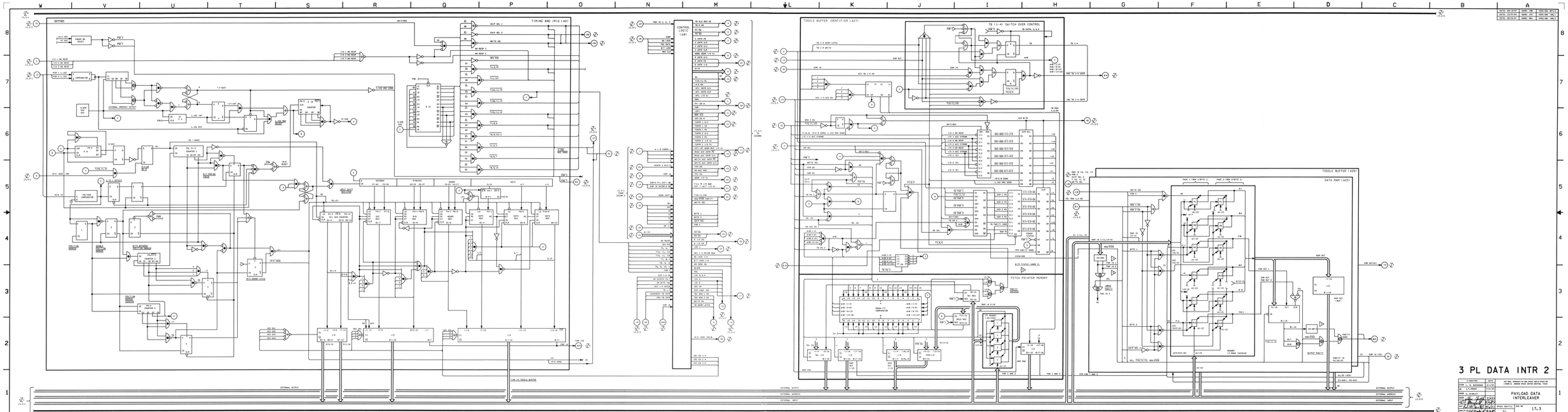
DWG NO 16.24

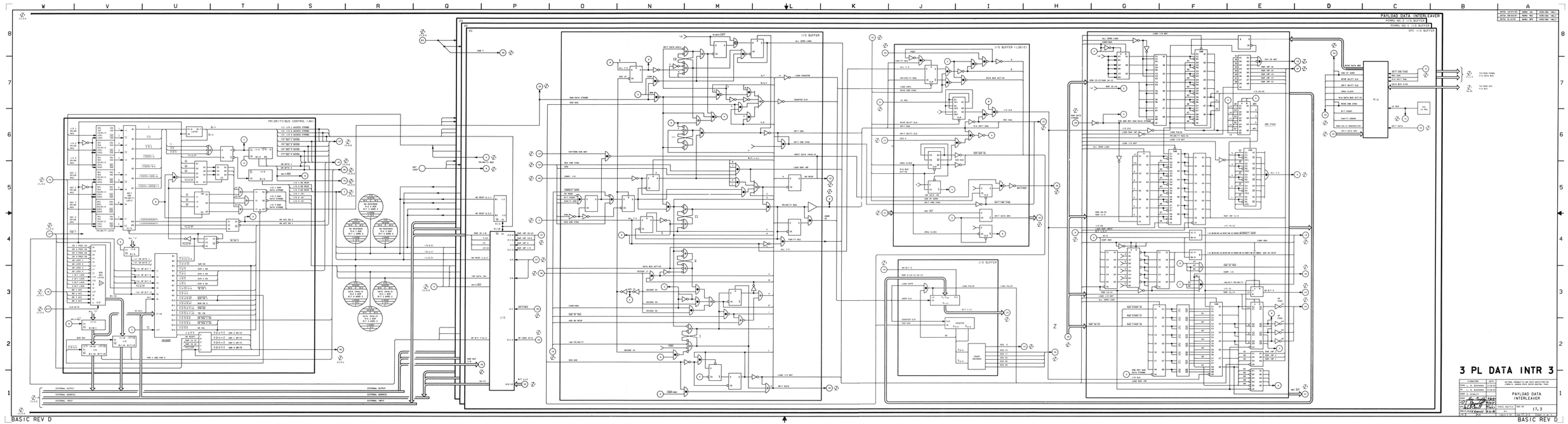
PAGE [illegible] SHEET 1 OF 1

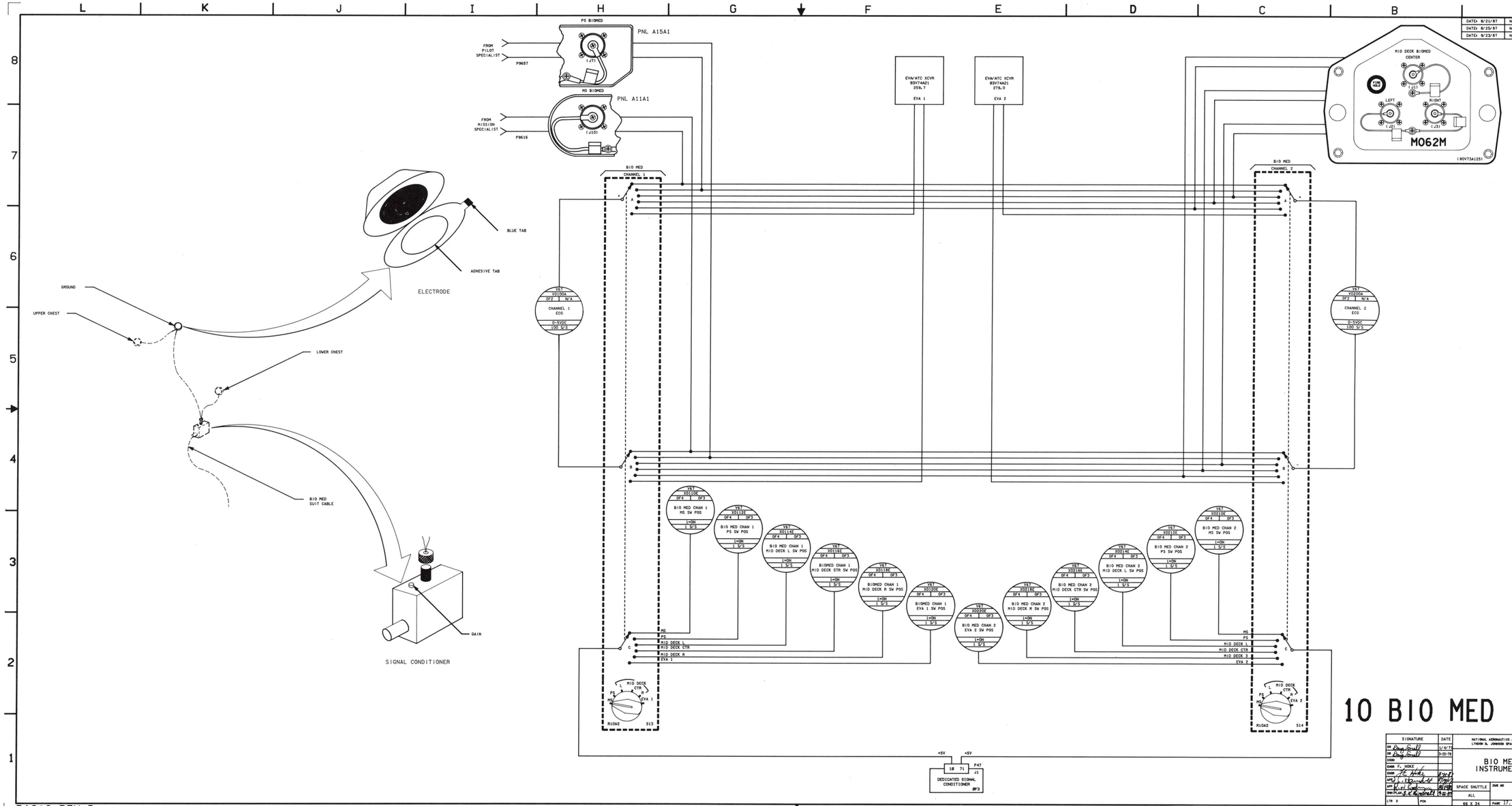
BASIC REV D


25 COMM PWR DIST 1
COMM SYSTEM POWER DISTRIBUTION
14.25
BASIC REV D


VARIABLE PULSE RATE
CONVERTER, PULSE TO DC (PDT)
EVENT VOLTS AC
CONVERTER, DISCRETE VOLTAGE AC (VDT)
TEMPERATURE X-DUCERS
CONVERTER, RESISTANCE TO DC (TDT)
EVENT VOLTS DC
BUFFER, 5VDC DISCRETE (SDT)
Δ VAC
CONVERTER, AC TO DC (VAT)
Δ VDC
DC AMP, BUFFER, ATTENUATOR (-EXTERNAL)
DC AMP, BUFFER, ATTENUATOR (-INTERNAL)
5VDC
DC AMP, BUFFER, ATTENUATOR (-EXTERNAL)
INSTRUMENTATION PROGRAM AND COMPONENT LIST (-IPCL)
REFERENCE TABLE
15/30 CARD DEDICATED SIGNAL CONDITIONER
CHASSIS-MOTHER INTERCONNECT BOARD
15/30 INTERCHANGEABLE CARDS
INTERNAL POWER SUPPLY
BUILT-IN TEST EQUIPMENT (BITE)
POWER SUPPLY
TABLE 1
TABLE 2
1 01 S/C 2
01 DEDICATED SIGNAL CONDITIONERS
BASIC REV D-2


TIMING AND IRIG (A21)
TOGGLE BUFFER IDENTIFIER (A27)
TOGGLE BUFFER (A26)
DATA RAM (A25)
FETCH POINTER MEMORY
3 PL DATA INTR 2
PAYLOAD DATA INTERLEAVER
17.3
BASIC REV D


PAYLOAD DATA INTERLEAVER
PCMPU NO 2 I/O BUFFER
PCMPU NO 1 I/O BUFFER
GPC I/O BUFFER
I/O BUFFER
I/O BUFFER (LSDECI)
PRIORITY/BUS CONTROL (ASC)
3 PL DATA INTR 3
PAYLOAD DATA INTERLEAVER
BASIC REV D
BASIC REV D



DATE: 8/21/87	NAME: CAR	VERSION: INR-6
DATE: 8/25/87	NAME: MPM	VERSION: INR-7
DATE: 9/23/87	NAME: MDJ	VERSION: INR-8

10 BIO MED INST

SIGNATURE	DATE
DR Doug Snell	1/4/78
DR Doug Snell	5-22-79
DSGN	
DSGN F. NOKE	
CHKR F. Noke	6/4/87
APP'D J. Rodriguez	6/29/87
APP'D R. A. Smith	6/29/87
DRFTR S. K. Kimbrell	9-22-87
LTR D	PCN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

BIO MEDICAL INSTRUMENTATION

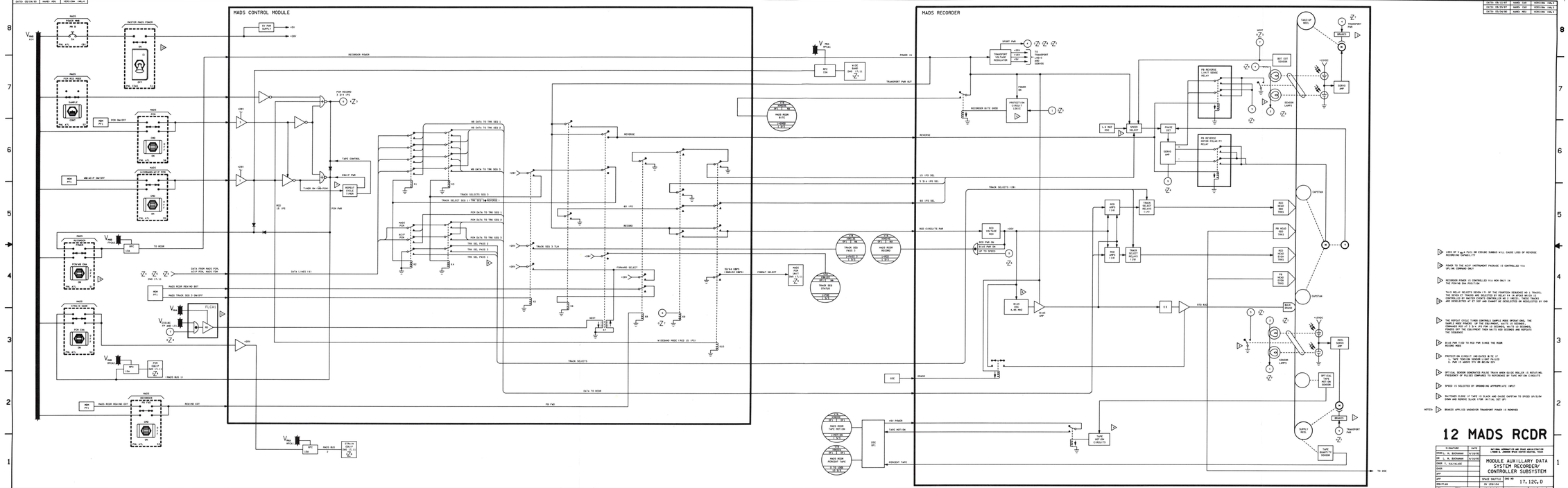
SPACE SHUTTLE | SWS NO. 17.10

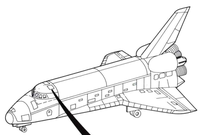
ALL

66 X 34 | PAGE 17.10-1 | SHEET 1 OF 1

BASIC REV D

BASIC REV D


MADS CONTROL MODULE
MADS RECORDER
12 MADS RCDR
MODULE AUXILLARY DATA SYSTEM RECORDER/ CONTROLLER SUBSYSTEM
17.12C.0
BASIC REV D
LOSS OF 5 or 6.1 FLC OR ESS/MC BUSBUS WILL CAUSE LOSS OF REVERSE RECORDING CAPABILITY
POWER TO THE AICP INSTRUMENT PACKAGE IS CONTROLLED VIA AP1/48 (OMM#2 ONLY)
RECORDER POWER IS CONTROLLED VIA MDR ONLY IN THE POWER ON POSITION
THIS RELAY SELECTS SEVEN VS OF THE TRANSFER SEQUENCE HI-1 TRACKS, ONE VS OF THE TRANSFER SEQUENCE HI-1 TRACK AND ONE VS OF THE TRANSFER SEQUENCE HI-1 TRACK. THESE TRACKS CONTROLLED BY MASTER EVENTS CONTROLLER AT 3 HRS/21 HRS/45 HRS. TRACKS ARE DESELECTED AT EOT AND CANNOT BE DESELECTED OR RESELECTED BY CMD
THE REPEAT CYCLE TIMER CONTROLS SAMPLE MODE OPERATIONS. THE SAMPLE MODE POWERS UP THE ELECTRONIC, WAITS 10 SECONDS, RECORDS FOR 10 SECONDS, AND THEN POWERS DOWN THE ELECTRONICS. POWERS OFF THE ELECTRONIC THEN WAITS FOR 300 SECONDS AND REPEATS THE SEQUENCE
B1A1 PWR FUSE TO MDS PWR DIODE THAT THE MDR RECORD NEED
PROTECTION CIRCUIT INDICATES BITE IF 1. TAPE TENSION SENSOR LIMIT FAILED 2. PWR IS ABOVE 31V OR BELOW 22V
OPTICAL SENSOR GENERATES PULSE TRAIN WHEN GUIDE ROLLER IS ROTATING. FREQUENCY OF PULSES COMPARED TO REFERENCE BY TAPE MOTION CIRCUITS
SPEED IS SELECTED BY GROUNDING APPROPRIATE INPUT
SWITCHES CLOSE IF TAPE IS BLACK AND CAUSE CAPSTAN TO SPEED UP/SLOW DOWN AND REMOVE SLACK (FOR INITIAL SET UP).
NOTES: BRAKES APPLIED WHENEVER TRANSPORT POWER IS REMOVED
MODULE AUXILLARY DATA SYSTEM RECORDER/ CONTROLLER SUBSYSTEM
SPACE SHUTTLE
SCALE: N/A
SHEET 1 OF 1

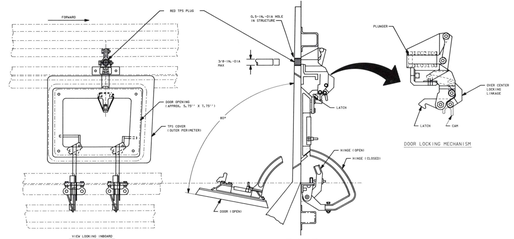


EGRESS WINDOW DANGER NOMENCLATURE

OBITER ESCAPE SYSTEM
EXTERIOR MARKINGS
ALL DIMENSIONS IN INCHES

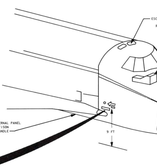
BACKGROUND -ORANGE YELLOW NO. 13538
BORDER AND LETTERS -BLACK NO. 17038

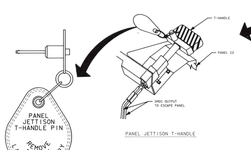
EXTERIOR PANEL JETTISON T-HANDLE
DIMENSIONS ARE APPROXIMATE

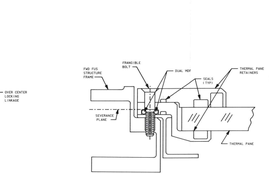


EXTERNAL PANEL JETTISON T-HANDLE ACCESS DOOR OPERATION

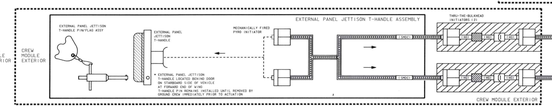
- TO OPEN DOOR, PUSH RED (MAX DIA 3/8 in) THROUGH RED TPS PLUG (WT), ACCESS DOOR RELEASE BUTTON IS DEPRESSED
- LOCKING MECHANISM LINKAGE ROTATES CAM/LATCH LINK
- ACTION RELEASES DOOR AND CAM BREAKS SEAL AND PUSHES DOOR OPEN

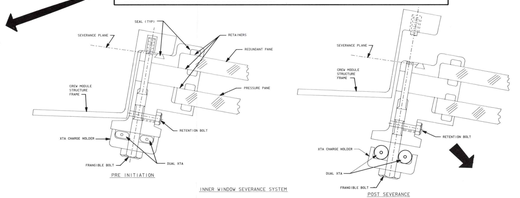


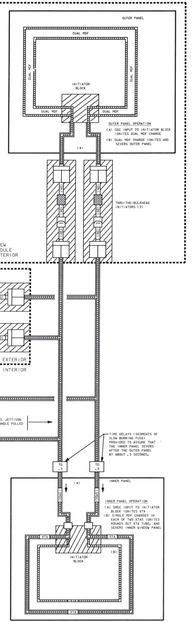


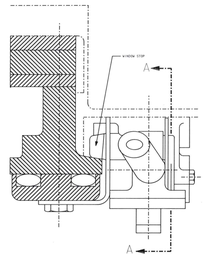


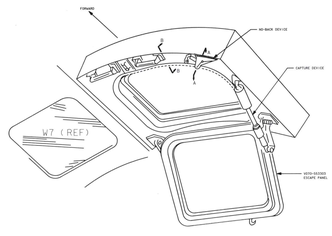
OUTER WINDOW SEVERANCE SYSTEM







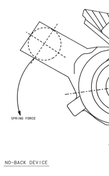


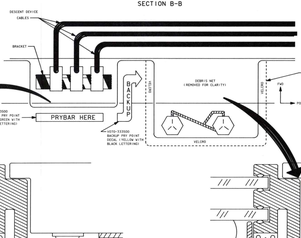


INNER WINDOW OPERATION

- WHEN CABIN TO ATMOSPHERIC dP 1.5-2.75 PSID, THE NO-BACK DEVICE ALLOWS THE WINDOW TO HELVE THE WINDOW FULL OPEN FOR EGRESS.
- WHEN CABIN TO ATMOSPHERIC dP 1.5-2.75 PSID, AND THE WINDOW IS HELVED OPEN, THE NO-BACK DEVICE IS DESIGNED TO PREVENT SUBSEQUENT WINDOW CLOSING DURING CABIN PRESSURE EQUALIZATION.
- WHEN CABIN TO ATMOSPHERIC dP 1, 0.44 PSID, THE NO-BACK DEVICE WILL ALLOW THE WINDOW TO BE HELVED. THE NO-BACK DEVICE WILL NOT ALLOW THE WINDOW OPEN TO ENGAGE THE NO-BACK DEVICE DURING CABIN PRESSURE EQUALIZATION.
- AFTER CABIN PRESSURE EQUALIZATION, THE WINDOW WILL NOT FIRE UNTIL OPEN TOR WINDOW.

SECTION A-A





INNER WINDOW OPENING

MAXIMUM CABIN TO ATMOSPHERIC dP (PSID)	FORCE OPPOSING WINDOW OPENING (LBF)	WINDOW OPENING (IN.)	NO-BACK TOOTH ENGAGED	PRYBAR FORCES (LB) PRIMARY END	PRYBAR FORCES (LB) BACKUP END	CABIN BLEED TIME (SEC)
0.25	155	FULL OPEN	NA	NA	NA	NA
0.44	272	0.18	1	NA	NA	5
1.14	706	0.57	2	19	42	8
1.14	706	0.18	1	19	42	12
2.35	1455	0.57	2	39	86	13
2.35	1455	0.18	1	39	86	24
3.3	2043	0.57	2	55	120	23
3.3	2043	0.18	1	55	120	34

- WINDOW OPENING BEYOND THE SECOND TOOTH OF THE NO-BACK DEVICE CANNOT BE ACHIEVED WITH THE PRYBAR AND WOULD NOT APPRECIABLY REDUCE THE TIME REQD FOR CABIN PRESSURE EQUALIZATION.

NOTES:
1. WINDOW PRESSURED AT 69 KDR, STS-5 69 MAS SL 58 PSID
2. WINDOW PRESSURED AT 65#, STS-1,3,4,5,7 UP TO MANNED PSIN 14.52 TO 14.76 PSID
3. WINDOW PRESSURED AT 47 KSC
4. THE FOLLOWING ACRONYMS ARE USED ON THIS DRAWING
   N.A. = NOT AVAIL
   SPEC = SHIELDING MILD DETONATING CHARGE - 20 GR/FT
   CSC = CONTAINED DETONATING CHARGE (10,000 GR/FT)
   NTA = EXPANDING TUBE ASSEMBLY
   MDF = MILD DETONATING FUSE
5. APPROX. ∆ = MAX INDICATES DIRECTION OF FLOW OF CREW WORK SYSTEMS AND BOOK ACTIVATED

REFER FOR DETAILED COMPONENT AND LOGIC INFORMATION SEE TABLE 18-11

1 ESC PNL

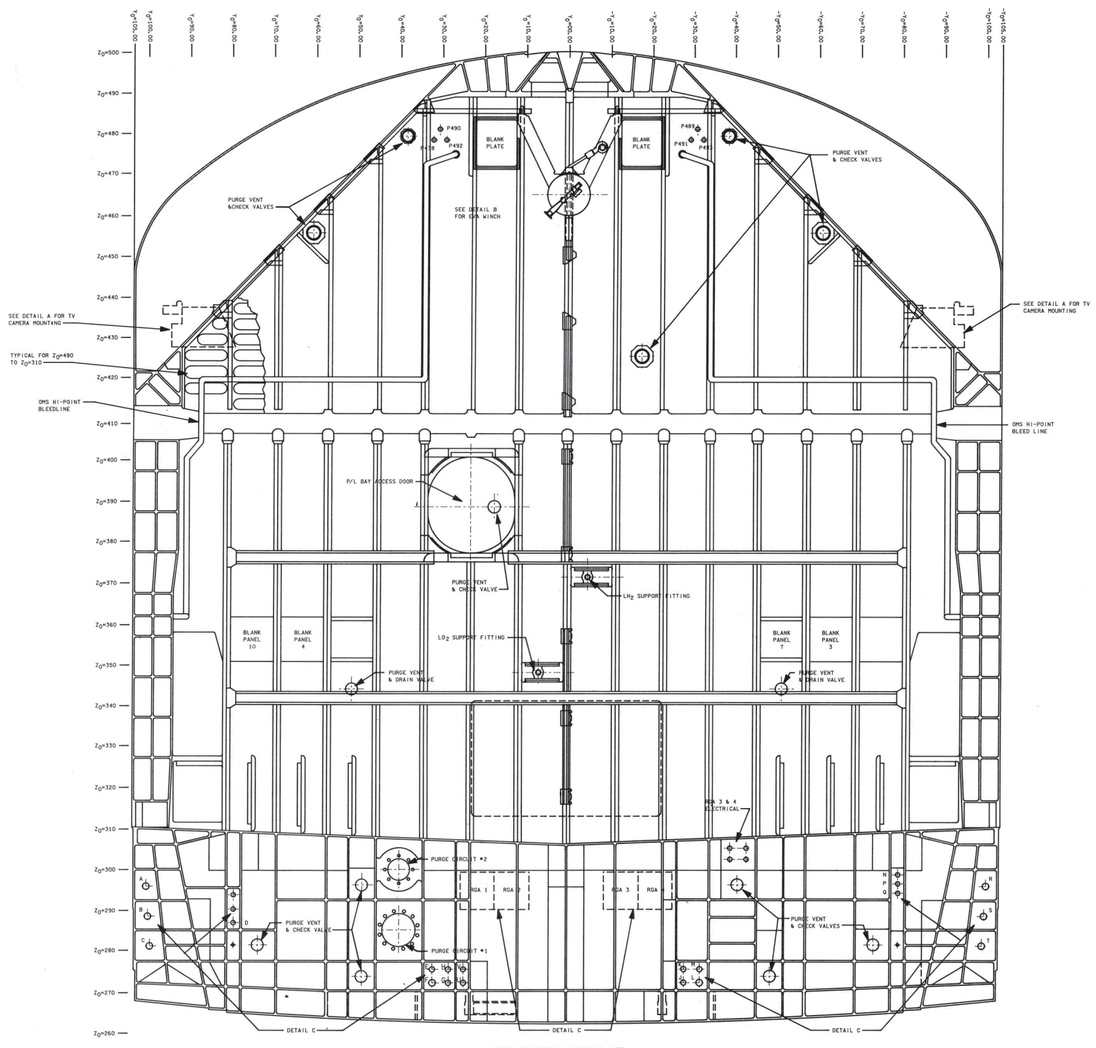
S ENGINEER	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Edgar T. Ellis, Jr.	12-15-72	LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DR		
CHAR. R. DYE		ESCAPE PANEL
APP'D: C. C. KELLY	12-15-72	
APP'D: R. C. HOOVER	12-15-72	
APP'D: C. C. KELLY	12-15-72	SPACE SHUTTLE
APP'D: R. C. HOOVER	12-15-72	
APP'D: Donald Slayton	12-15-72	
S/E	DSN/I	

SHEET NO. 18.1

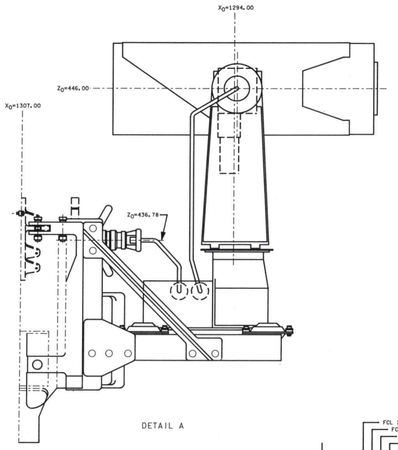
LT-15-FDN-3

BASIC REV D-1

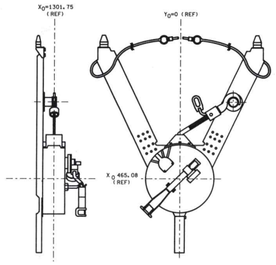
DATE▸ 6/23/87	NAME▸ MPM	VERSION▸ BPTx3
DATE▸ 9/11/87	NAME▸ VCO	VERSION▸ INRx1
DATE▸ 10/9/87	NAME▸ TMW	VERSION▸ INRx2



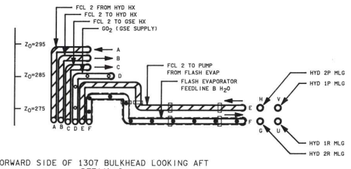
1307 BULKHEAD LOOKING AFT



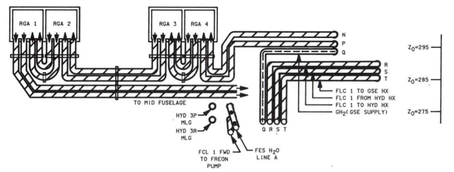
DETAIL A

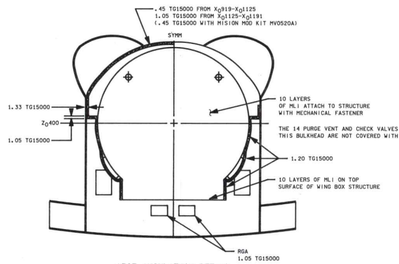


DETAIL B



FORWARD SIDE OF 1307 BULKHEAD LOOKING AFT
DETAIL C





1307 INSULATION DETAIL
LOOKING AFT FROM 1191 TO 1307
SCALE 1/20

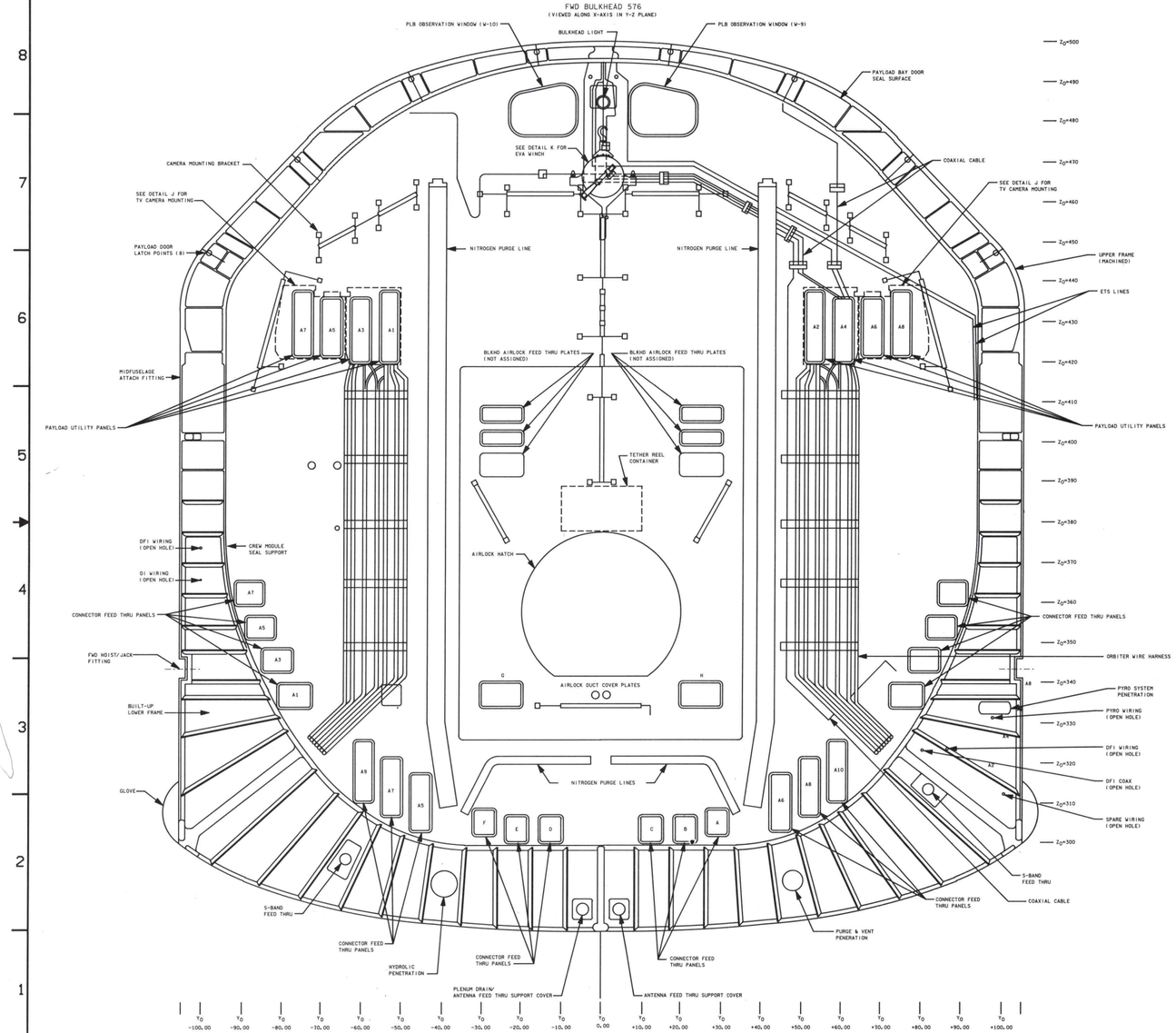
NOTES▸ THIS DRAWING IS ONLY APPROXIMATE

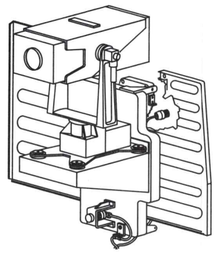
PLV OV 1

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN MICHAEL MURPHY	7/25/83	
DR	7/25/83	PAYLOAD BAY OVERVIEW 1307 BULKHEAD LOOKING AFT
ENGR W. ANDERSON		
ENGR	11/19/87	
APP	11/19/87	
APP	11/20/87	SPACE SHUTTLE / DWG NO 19.1
OPNL PLAN	12/09/87	ALL
LTR D PCN		66 X 34 / PAGE 19.1-1 / SHEET 1 OF 6

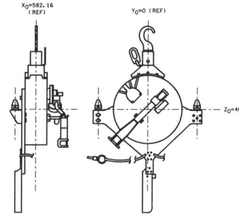
BASIC REV D

BASIC REV D

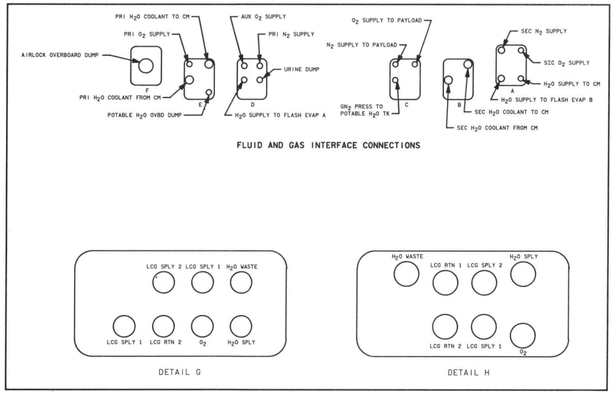




DETAIL J



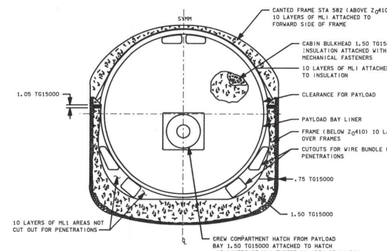
DETAIL K



FLUID AND GAS INTERFACE CONNECTIONS

DETAIL G

DETAIL H



582 INSULATION DETAIL

LOOKING FWD AT 582 & CABIN BULKHEAD 576
SCALE 1/20

NOTES: 1. THIS DRAWING IS ONLY APPROXIMATE

DATE: 9/11/87	NAME: TPM	VERSION: INK 1
DATE: 10/8/87	NAME: TPM	VERSION: INK 2

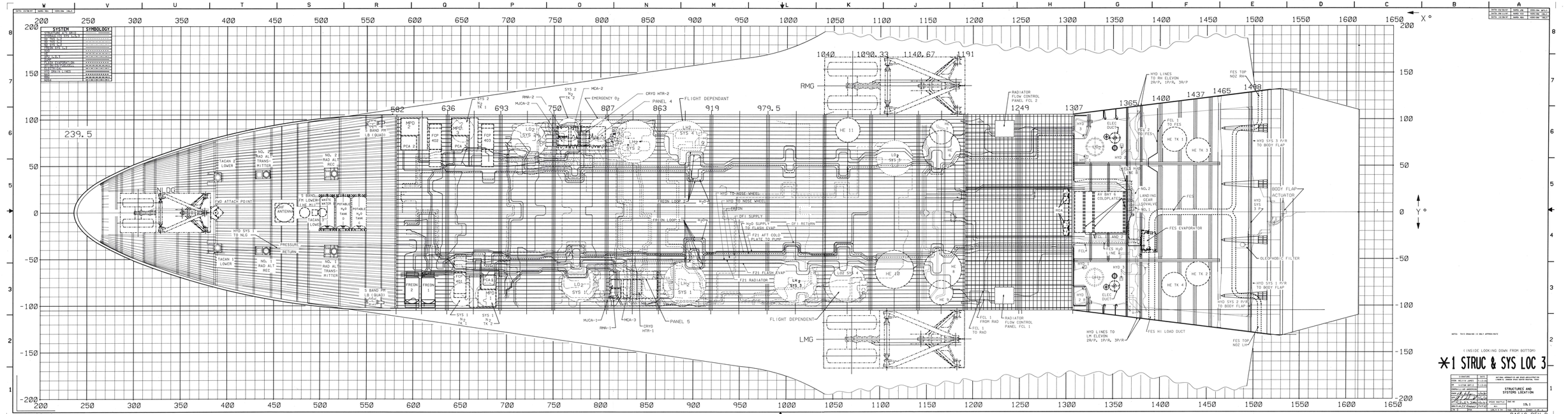
SIGNATURE	DATE	
DSGN MICHAEL MURPHY	8/2/83	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DR MICHAEL MURPHY	8/2/83	
ENGR WILLIAM ANDERSON	9/5/87	PAYLOAD BAY OVERVIEW 582/576 BULKHEAD LOOKING AFT
ENGR	11/2/87	
APP	11/2/87	
APP	11/2/87	SPACE SHUTTLE
OPNPLAN B.K. Kincheloe	12-24-87	ALL
LTR D	PCN	121 X 34

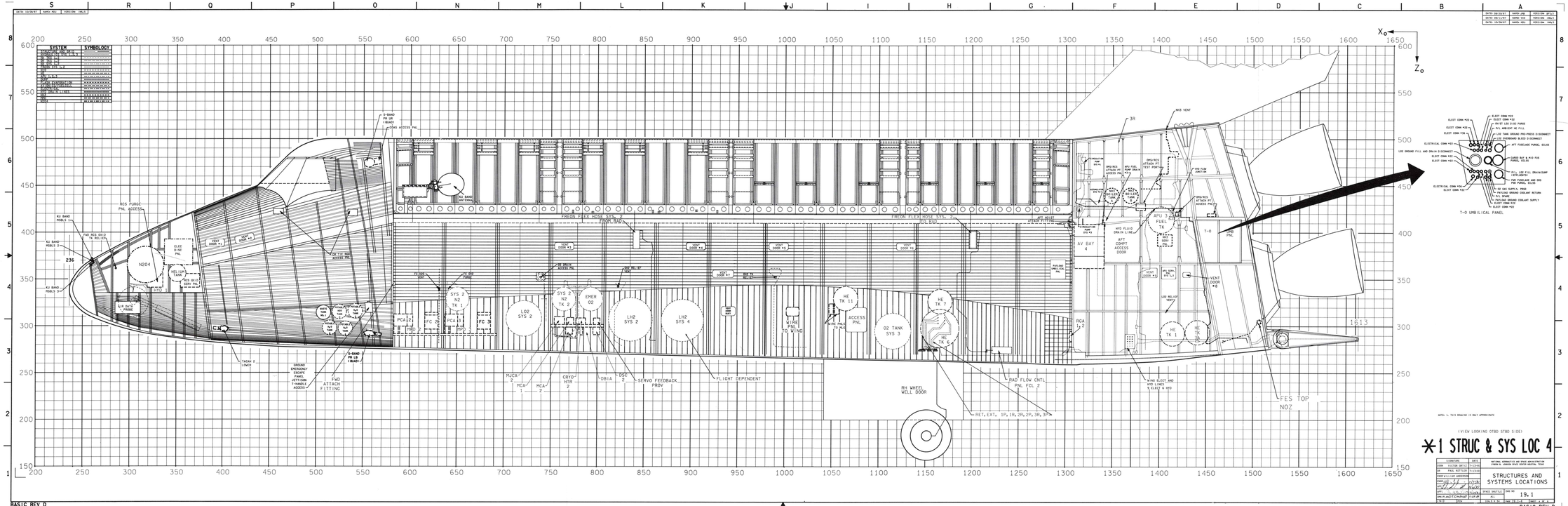
DWG NO 19.1

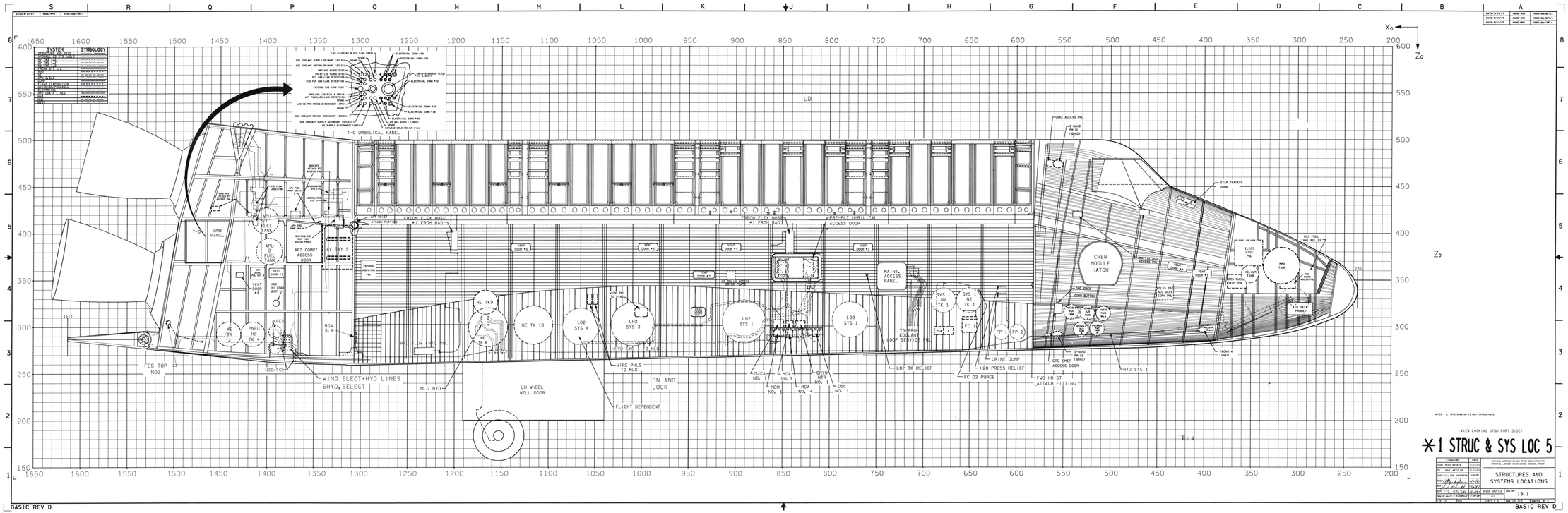
PAGE 12.1-2 SHEET 2 OF 6

BASIC REV D

BASIC REV D


SYSTEM
SYMBOLOGY
239.5
582
636
693
750
807
863
919
979.5
1040
1090.33
1140.67
1191
1249
1307
1365
1400
1437
1465
1498
RMG
LMG
X °
Y °
N DG
MID ATTACH POINT
ACAN 2 LOWER
ACAN 3 LOWER
ACAN 1 LOWER
ANTENNA
S BAND FM LOWER (LINE BILITY)
WASTE WATER
POTABLE H2O TANK D
POTABLE H2O TANK C
S BAND PM LB (QUAD)
NO. 2 RAD ALT REC
NO. 2 RAD ALT TRANS-MITTER
NO. 1 RAD ALT REC
NO. 1 RAD ALT TRANS-MITTER
HYD SYS 1 TO NLG
PRESSURE
RETURN
MPD 2
MPD 1
PCA 2
PCA 1
FCA 401
FREON 2
FREON 1
LO2 SYS 3
LO2 SYS 2
LO2 SYS 4
LO2 SYS 1
LH2 SYS 2
LH2 SYS 4
LH2 SYS 3
LH2 SYS 1
SYS 2 N2 TK 2
SYS 2 N2 TK 1
RMA-2
MJCA-2
MCA-2
EMERGENCY O2
CRYO HTR-2
PANEL 4
FLIGHT DEPENDANT
HE 11
HE 6
HE 10
HE 9
HYD 3
HYD 2
HYD 1
ELEC DUCT
FCL 1 TO FES
FCL 2 TO FES
HE TK 1
HE TK 3
HE TK 2
HE TK 4
HYD LINES TO RM ELEVON 2R/P, 1P/R, 3R/P
RADIATOR FLOW CONTROL PANEL FCL 2
FES TOP NOZ RH
HYD SYS 3 P/R TO BODY FLAP
BODY FLAP ACTUATOR
HYD SYS 3 P/R
OLEO HOD C FILTER
HYD SYS 1 P/R TO BODY FLAP
HYD SYS 2 P/R TO BODY FLAP
FES TOP NOZ LH
AV BAY 2 COLDPLATES
NO. 2 LANDING GEAR (OVALVE NO. 1
FES
FES EVAPORATOR
FCL 1 AND 2
FCL 1 FES HYD LINE
FES HI LOAD DUCT
HYD LINES TO LM ELEVON 2R/P, 1P/R, 3P/R
RADIATOR FLOW CONTROL PANEL FCL 1
FCL 1 FROM RAD
FCL 1 TO RAD
HYD TO NOSE WHEEL
FREON
OFI SUPPLY
OFI RETURN
HYD SUPPLY TO FLASH EVAP
F21 AFT COLD PLATE TO PUMP
F21 FLASH EVAP
F21 RADIATOR
FREON LOOP
MJCA-1
RMA-1
MCA-3
CRYO HTR-1
PANEL 5
FLIGHT DEPENDENT
NOTE: THIS DRAWING IS ONLY APPROXIMATE
(INSIDE LOOKING DOWN FROM BOTTOM)
#1 STRUC & SYS LOC 3
STRUCTURES AND SYSTEMS LOCATION
19-1
BASIC REV D


SYSTEM
SYMBOLOGY
FREON FLEX HOSE SYS 2 FROM RAD
FREON FLEX HOSE SYS 1 TO RAD
RCS PURGE PNL ACCESS
KU BAND MDBLS 2
KU BAND MDBLS 1
KU BAND MDBLS 3
FWD RCS OXID TK REL VLVS
S-BAND PM LB 1 QUAD
GPC ACCESS PNL
S-BAND OMNI ANTENNA
N204
ELEC DISC PNL
HELIUM TANK
RCS ID 02 MANIFOLD
A/R DATA PNDRS
OMS DOOR #1
OMS DOOR #2
OX FIX RAIL ACCESS PNL
FWD ATTACH FITTING
GROUND EMERGENCY ENTRY PANEL JETTISON T-HANDLE ACCESS
TACAN 2 LINES
PCA 2
PCA 1
FC 2
FC 1
FC 3
SYS 2 N2 TK 1
SYS 2 N2 TK 2
EMER O2
LOZ SYS 2
LH2 SYS 2
LH2 SYS 4
MJCA 2
MJCA 1
MCA 1
MCA 2
CRYO HTR 2
OBIA
DSC 2
SERVO FEEDBACK PROV
FLIGHT DEPENDENT
WIRE PNL TO WING
HE TK 11
ACCESS PNL
O2 TANK SYS 3
HE TK 7
HE TK 6
RH WHEEL WELL DOOR
RAD FLOW CNTL PNL FCL 2
RET, EXT, 1P, 1R, 2P, 2R, 3P, 3R
WING ELECT AND MPS LINES & ELECT & MPS
FES TOP NOZ
3R
MPS VENT
MPS/RCS ATTACH PT ACCESS PNL
MPS/RCS ATTACH PT TEST PORT
APU FUEL TANK 2
APU FUEL TANK 1
MPS FLOW SWITCH
MPS/RCS ATTACH PT ACCESS PNLS
APU 3 FUEL TK
MPS PNL
MPS FLUID DRAIN LINE
AFT COMPT ACCESS DOOR
AV BAY 4
VENT DOOR #3
APU VENT
APU REL VLV 3
LH2 RELIEF VENT
VENT DOOR #2
RGA 3
1613
T-0
PAYLOAD UMBILICAL PNL
AFT HEAT ATTACH FITTING
ELECT CONN #22
ELECT CONN #22
H2 VENT LSO SYSC PURGE
ELECT CONN #24
H2 FILL AND VENT MPS FILL
ELECT CONN #26
LSO TANK GROUND PRE-PRESS D/SCONNECT
LSO D/STRBARD BLEED D/SCONNECT
ELECTRICAL CONN #23
AFT FUSELAGE PURGE, D/S,SS
LSO GROUND FILL AND VENT D/SCONNECT
ELECT CONN #23
CARGO BAY & M/D FUS PURGE, D/S,SS
ELECT CONN #23
FILL, LSO FILL D/SCONNECT
ELECT CONN #23
FWD FUSELAGE AND OMS POD PURGE, D/S,SS
ELECTRICAL CONN #24
ELECT CONN #23
GN2 GAS SUPPLY, PRSD
PAYLOAD GROUND COOLANT RETURN
ELECT CONN #22
PAYLOAD GROUND COOLANT SUPPLY
ELECT CONN #22
ELECT CONN #22
T-0 UMBILICAL PANEL
NOTE: 1. THIS DRAWING IS ONLY APPROXIMATE
(VIEW LOOKING OTBD STBD SIDE)
#1 STRUC & SYS LOC 4
STRUCTURES AND SYSTEMS LOCATIONS
SPACE SHUTTLE
DWG NO
19.1
SHEET 4 OF 4
BASIC REV D



*1 STRUC & SYS LOC 5

STRUCTURES AND SYSTEMS LOCATIONS

SIGNATURES	DATE
DESIGN MGR: BECKER	11-13-81
QA: PAUL SETTLER	11-13-81
CHAN ACCEPTANCE: HOUSTON	11-19-81
APP'D: [illegible]	11-19-81
APP'D: [illegible]	11-19-81
APP'D: [illegible]	11-19-81
CRS/PLAN: [illegible]	11-19-81

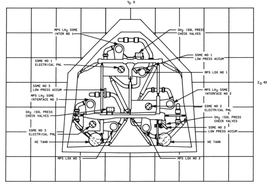
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

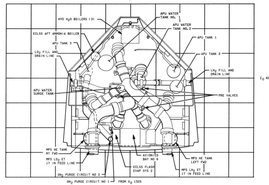
SPACE SHUTTLE

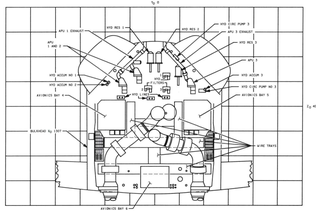
DWG NO: 19.1

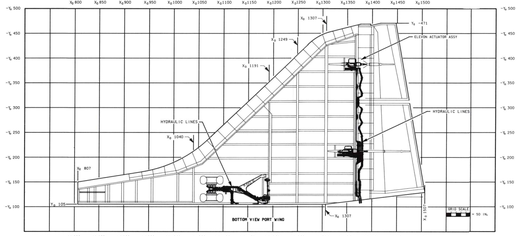
SCALE: 1/4 IN. = 1 FT

SHEET 1 OF 1

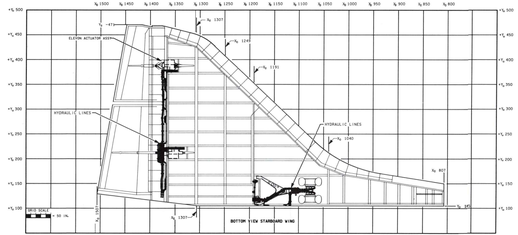




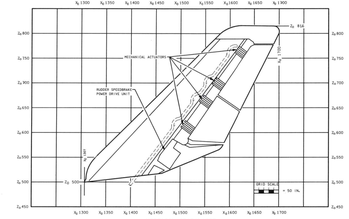




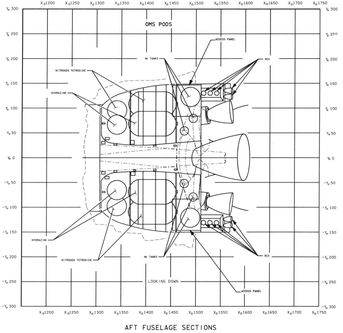
LEFT WING (LOOKING UP)



RIGHT WING (LOOKING UP)



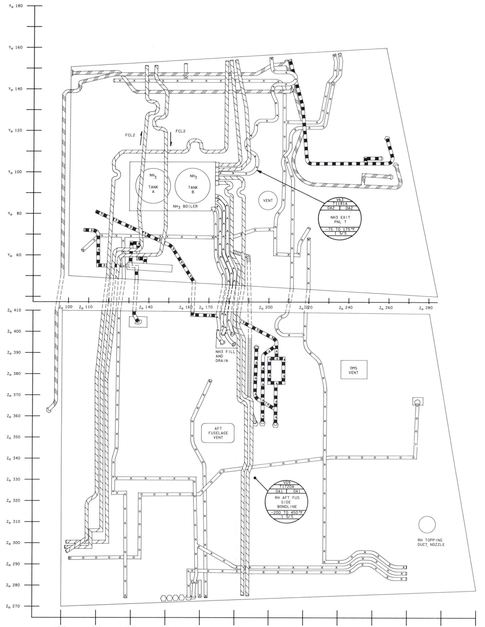
VERTICAL STABILIZER



AFT FUSELAGE SECTIONS

LEGEND

- APPROX x_0
- FROM
- TO CL/OB
- OMS FUEL LINES
- APU FUEL (UNPRESS)
- HYDRAULIC FLUID
- MEC LIN
- OXYGEN



AFT FUSELAGE RIGHT SIDE LOOKING OUT

NOTES: 1. THIS DRAWING IS ONLY APPROXIMATE

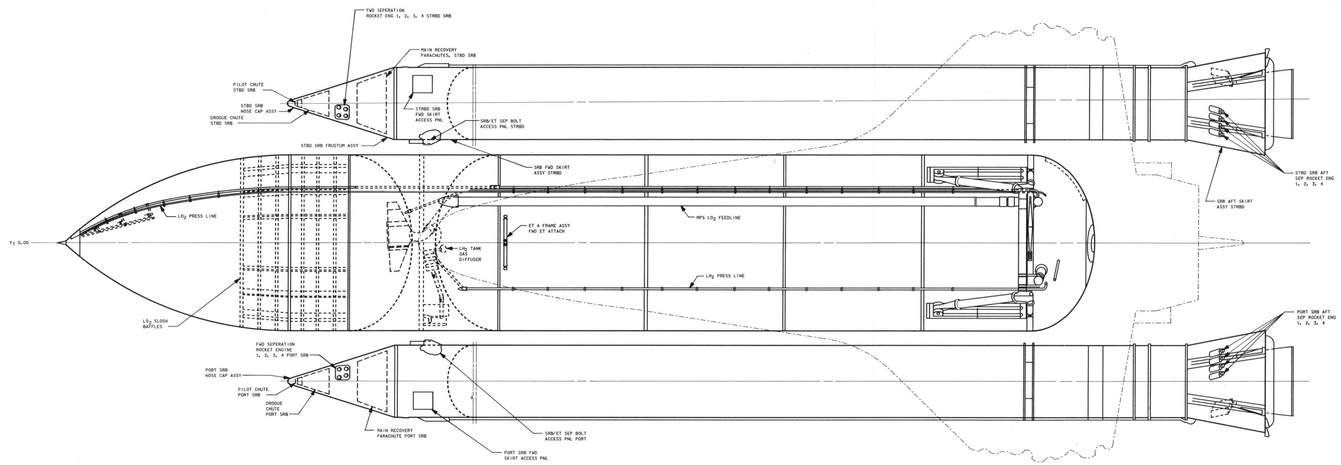
1 WINGS/AFT 6

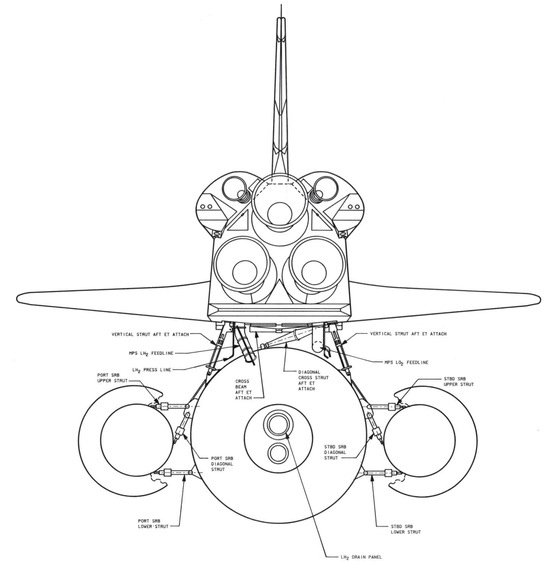
SIGNATURE	DATE	NOTICE: INFORMATION ON THIS DRAWING/PAGE IS SUBJECT TO RESTRICTIONS ON THE COVER OR TITLE PAGE OF THIS DOCUMENT
DOM-LITTON 28712		
DOM WILLIAM ANDERSON 3/8/87		STRUCTURES AND SYSTEMS LOCATION
DPCA		SPACE SHUTTLE
DPCA		DWG NO 19.1
DOM-ROCKWELL		SIZE D REV

BASIC REV D

DATE= 11/18/87	NAME= BJT	VERSION= IMAGE

DATE= 9/5/87	NAME= MPR	VERSION= IMAGE
DATE= 9/24/87	NAME= MPR	VERSION= IMAGE
DATE= 11/18/87	NAME= BJT	VERSION= IMAGE





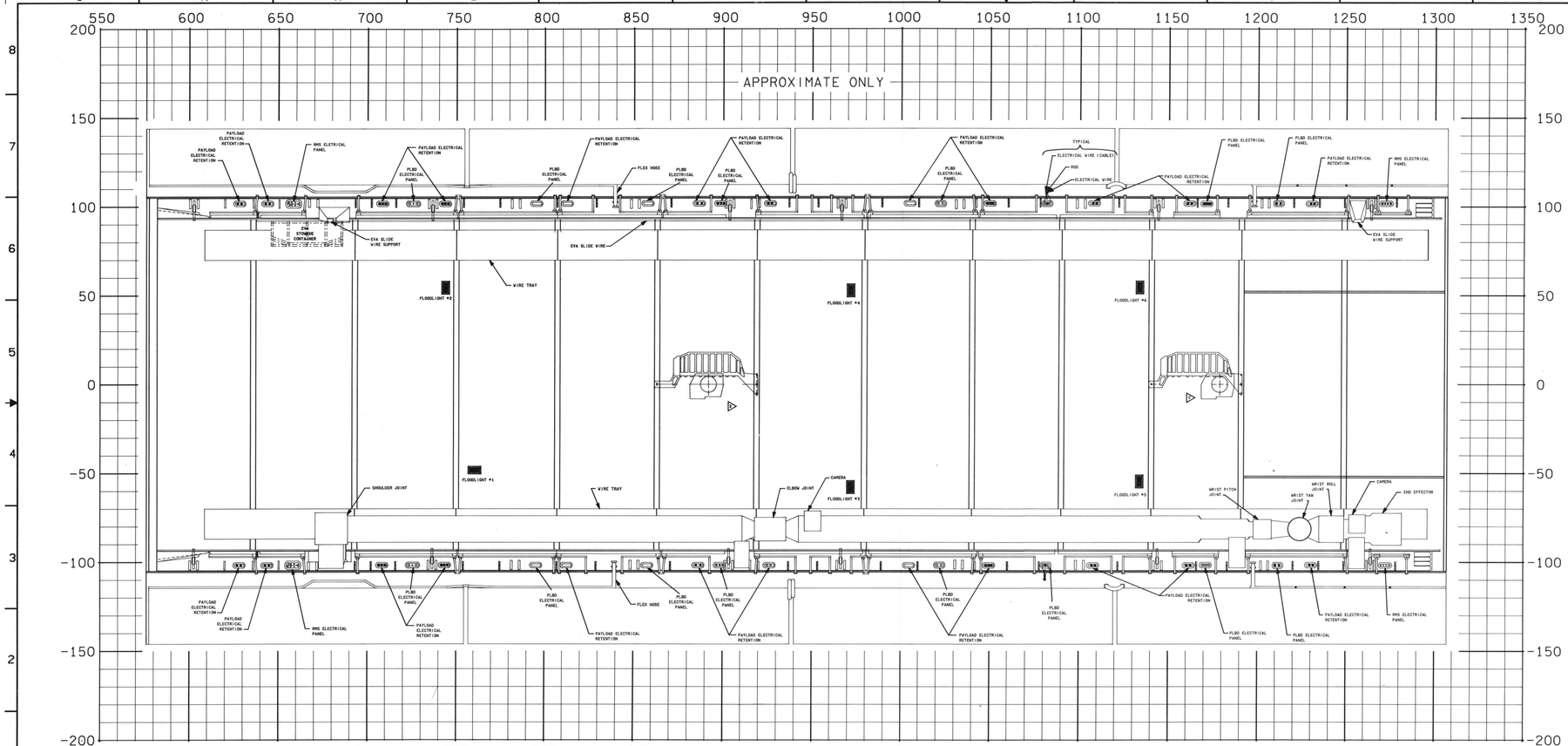
NOTES: 1. THIS DRAWING IS ONLY APPROXIMATE

2 SRB/ET

SIGNATURE	DATE	
DESIGN		NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
DR VICTOR A. MEISENHELDER	1/5/87	LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN R. WALKER	9/3/87	SRB/ET CONFIGURATION
CHKR [illegible]	11/2/87	
APP [illegible]	11/2/87	
APP [illegible]	11/2/87	SPACE SHUTTLE / DWG NO 19.2
DRFT/LAY [illegible]	11-18-87	ALL
LTR D / PCN		48.5 x 34 / PAGE 19.2-1 / SHEET 1 OF 1

BASIC REV D

BASIC REV D



TYPICAL PAYLOAD KEEL FITTING CONFIGURATION. A PAYLOAD KEEL FITTING CAN BE UNDERTED BETWEEN SUCCESSIVE FRAMES AS PARTICULAR FLIGHT DICTATES.

NOTES: 1. THIS DRAWING IS ONLY APPROXIMATE

(TOP LOOKING DOWN)

3 PLB OVERVIEW

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN PAUL KETTLER	5/1/81	
DR PAUL KETTLER	5/1/81	PAYLOAD BAY OVERVIEW (LOOKING INBOARD AND DOWN)
ENGR K. VALREIN	5/5/87	
ENGR [signature]	11/1/87	
APP [signature]		SPACE SHUTTLE / DWG NO 19.3
APP [signature]		ALL
ORG PLBP/Engineering		SIZE B X 34 / PAGE 19.3-1 / SHEET 1 OF 3
LTR D / TITLE		

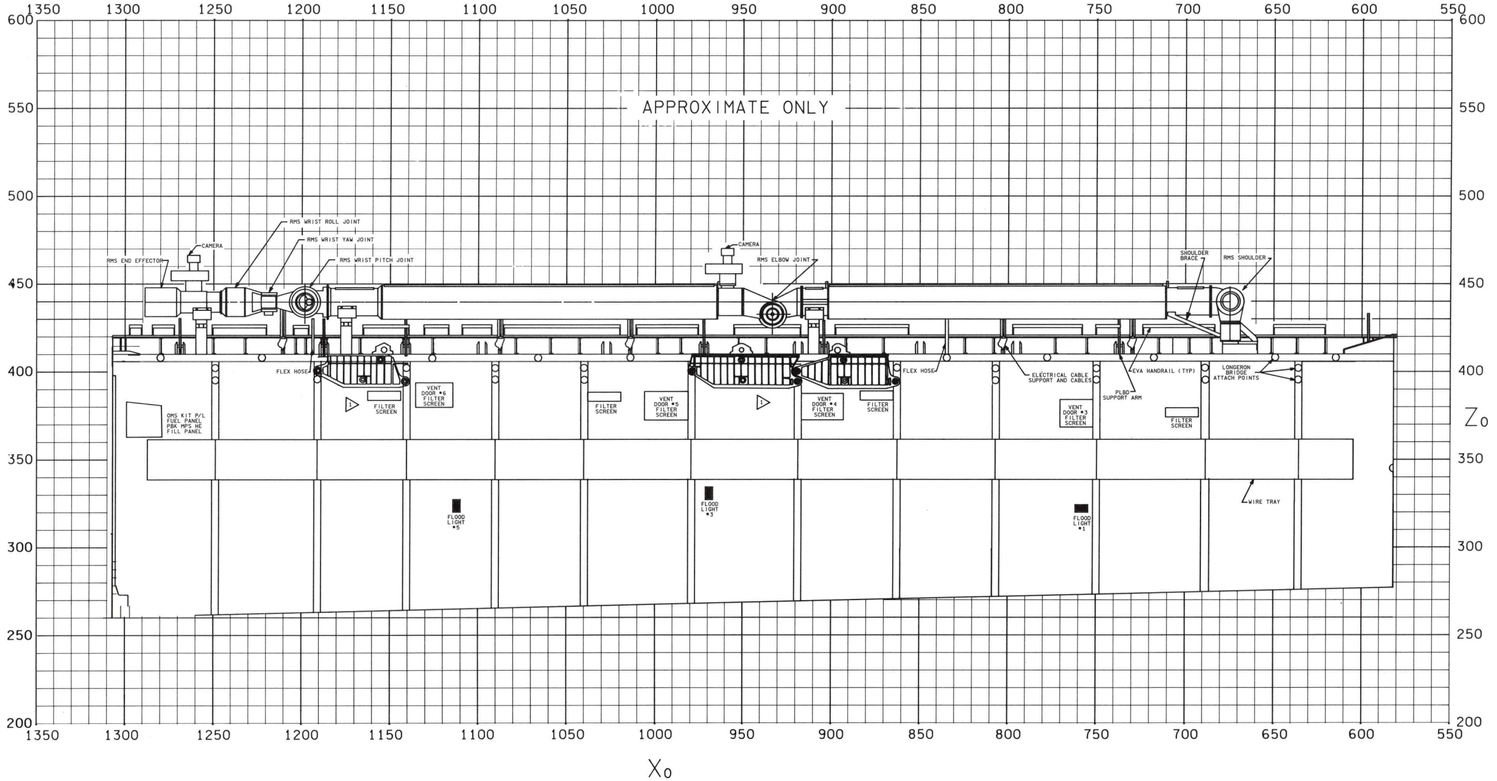
DATE: 5/5/87	NAME: MFB	VERSION: Intg B
DATE: 9/24/87	NAME: MFM	VERSION: Intg B

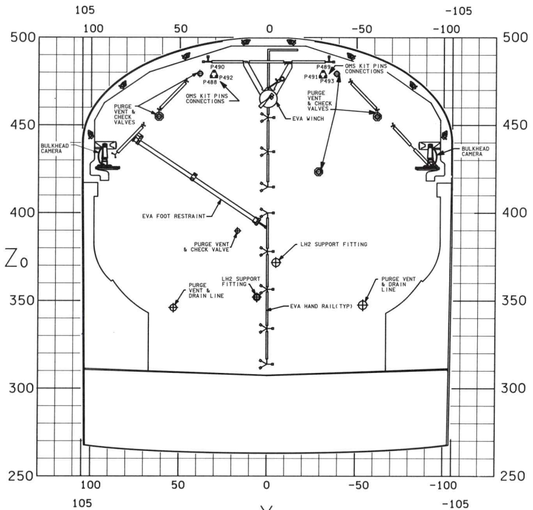
BASIC REV D

BASIC REV D

DATE	NAME	VERSION
DATE 12/12/81	NAME M.B.	VERSION INR 3
DATE 9/04/87	NAME MDU	VERSION INR 7
DATE 09/29/87	NAME MDU	VERSION INR 8

P/L BAY PORT SIDE
(LOOKING OUTBOARD)





LOOKING AFT
AT X_0 1307

NOTES:
2. THIS DRAWING IS ONLY APPROXIMATE
TYPICAL PAYLOAD LONGERON BRIDGE CONFIGURATION. PAYLOAD LONGERON BRIDGES CAN BE LOCATED BETWEEN ADJACENT FRAMES

PORT SIDE

3 P/L BAY 2

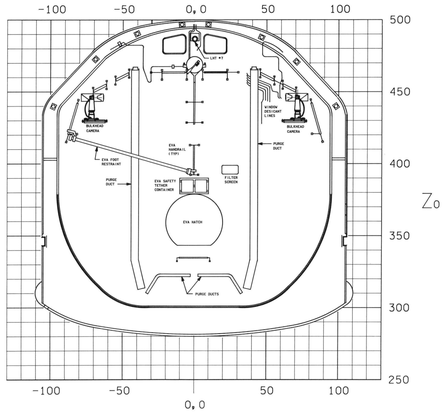
SIGNATURE	DATE
DSGN THOMAS LENERS	7/13/81
DR JACK HEBERLIG JR.	7/27/81
ENGR R. WALHEIM	9/4/87
ENGR [signature]	9/4/87
APP [signature]	9/04/87
APP [signature]	9/04/87
DPM/PLAN [signature]	10/5/87
LTR D	PCN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS

PAYLOAD BAY
OVERVIEW PORT SIDE

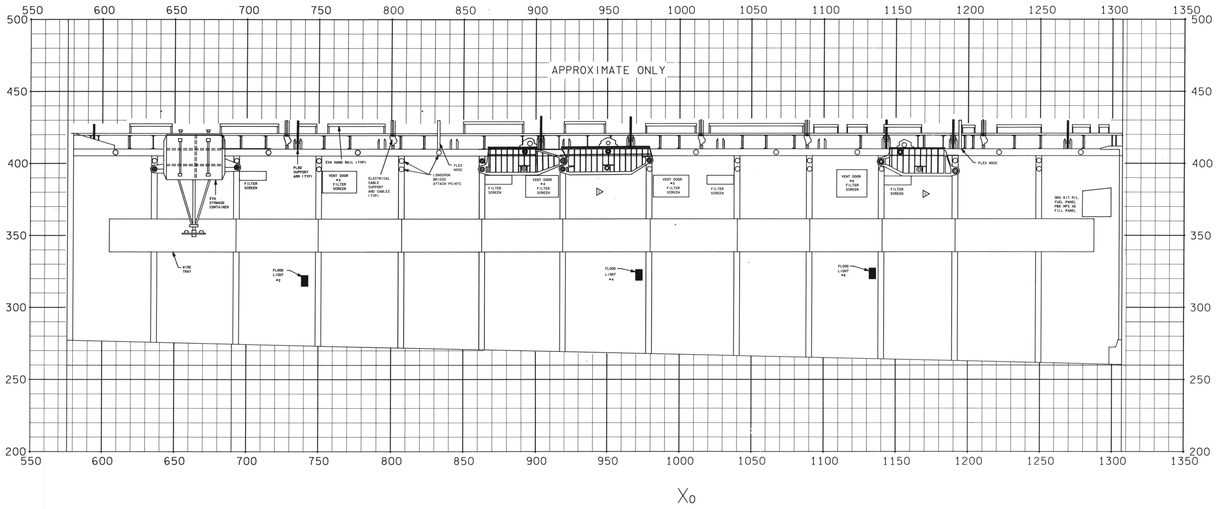
SPACE SHUTTLE | DWG NO 19.3
ALL
66 X 34 | PAGE 19.3-2 | SHEET 2 OF 3

BASIC REV D



582 BULKHEAD
(LOOKING FWD)

P/L BAY STARBOARD SIDE
(LOOKING OUTBOARD)



NOTES:

1. THIS DRAWING IS ONLY APPROXIMATE

2. TYPICAL PAYLOAD LONGERON BRIDGE CONFIGURATION. PAYLOAD LONGERON BRIDGES CAN BE LOCATED BETWEEN ADJACENT FRAMES

STARBOARD SIDE

3 PLB 0V 3

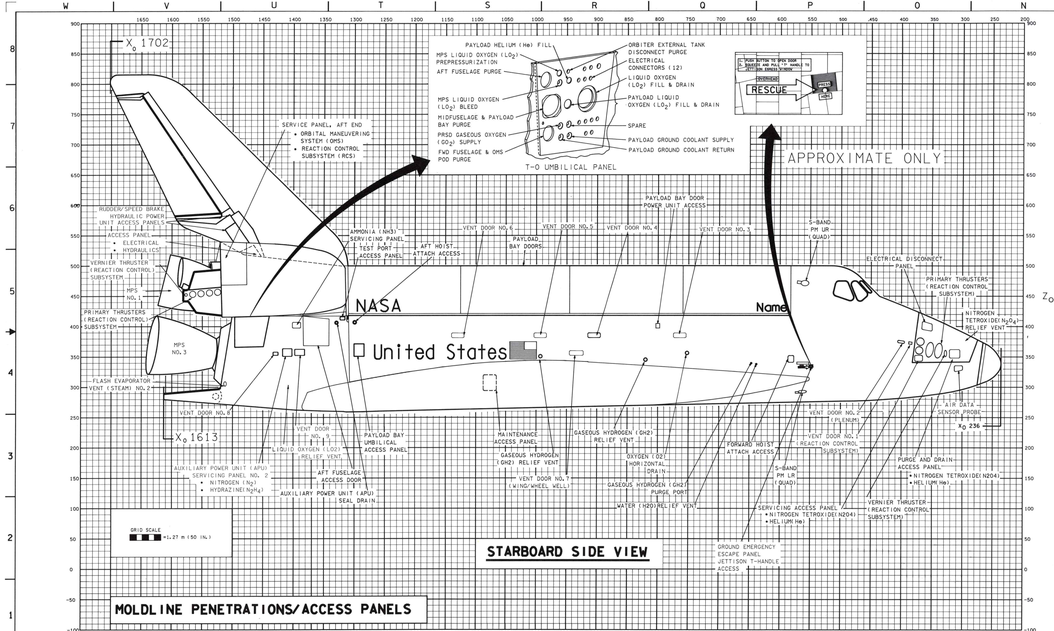
SIGNATURE	DATE
DON MIKE BECKER	7/6/83
DR	
DAVE A. WELKER	8/24/87
CHAR Ky Smith	7/7/83
engr Jeff Bell	7/7/83
APPVL C. D. SAMMONS	10/6/83
MGR/CHIEF ENGR/SUP Kevin Bell	10/6/83
CM	DATE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TEXAS

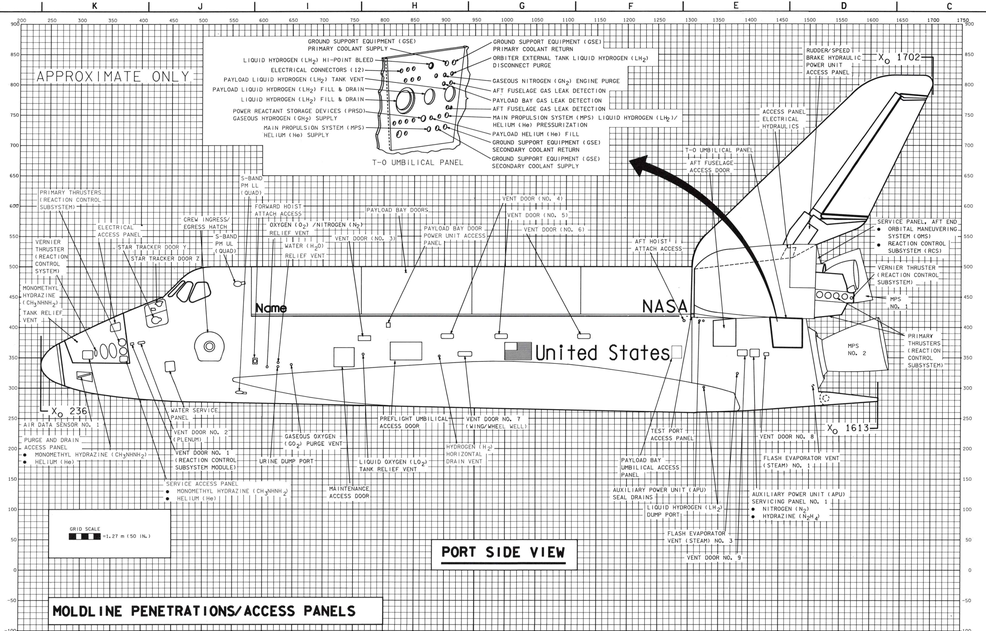
PAYLOAD BAY
OVERVIEW STARBOARD SIDE

SPACE SHUTTLE | DWG NO | 19.3
SIZE | CODE IDENT NO | SHEET 1 OF 1

BASIC REV D



BASIC REV D



BASIC REV D

DATE	REVISION	NAME	NO.	VEHICLE(S) AFFECTED
04/84	PRELIMINARY RELEASE	NAME	NO.	VEHICLE(S) AFFECTED
08/84	CHANGE PER MCR	NAME	NO.	VEHICLE(S) AFFECTED

NOTE: THIS DRAWING IS ONLY APPROXIMATE

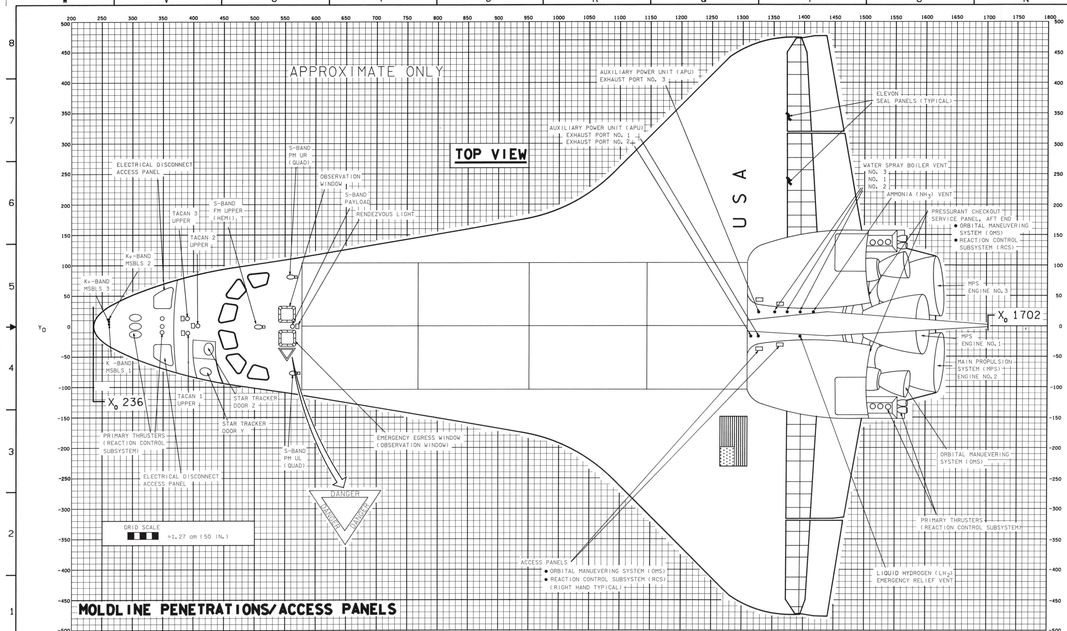
4 EXT SIDES

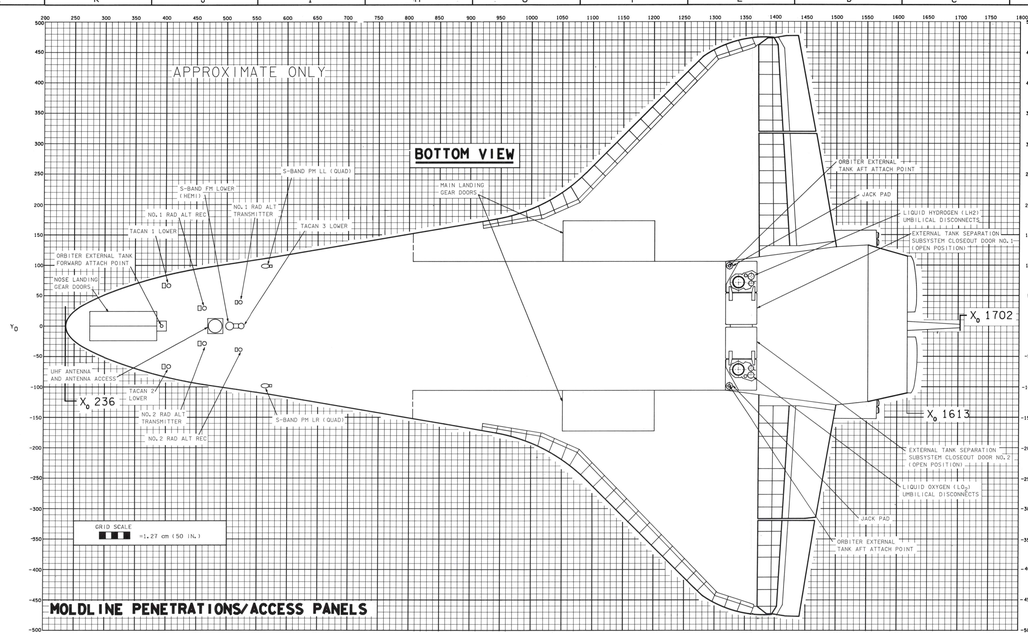
SIGNATURE	DATE	MATERIAL APPROVED FOR STAGE IDENTIFICATION
ORIG. MADE MEDIUM	04/84	CHANGE NO. DESCRIBE STAGE IDENTIFIED, TYPICAL, ETC.
APP.		
CHIEF DL ENGINEER	04/84	EXTERNAL SIDE VIEWS
APP. Ralph Ferrell	8/13/84	
APP. Jack Hall	8/13/84	
APP. Bill Peters	8/13/84	
APP. Bob Thomas	8/13/84	
MFG PLAN CERTIFICATION		
MFG PLAN CERTIFICATION		
NO. 4	DATE	
NO. 3	DATE	
NO. 2	DATE	
NO. 1	DATE	

PRIME CONTRACTOR: ROCKWELL INTERNATIONAL SPACE DIVISION, DOWNEY, CALIFORNIA

DRAWING NO. 19.4

SHEET 1 OF 1





DATE	NAME	ORG
DATE: 09/30/87	NAME: BPH	ORG: DA-8
DATE: 09/30/87	NAME: TPA	ORG: DA-8
DATE: 09/30/87	NAME: TCS	ORG: DA-8

NOTES: 1. THIS DRAWING IS ONLY APPROXIMATE

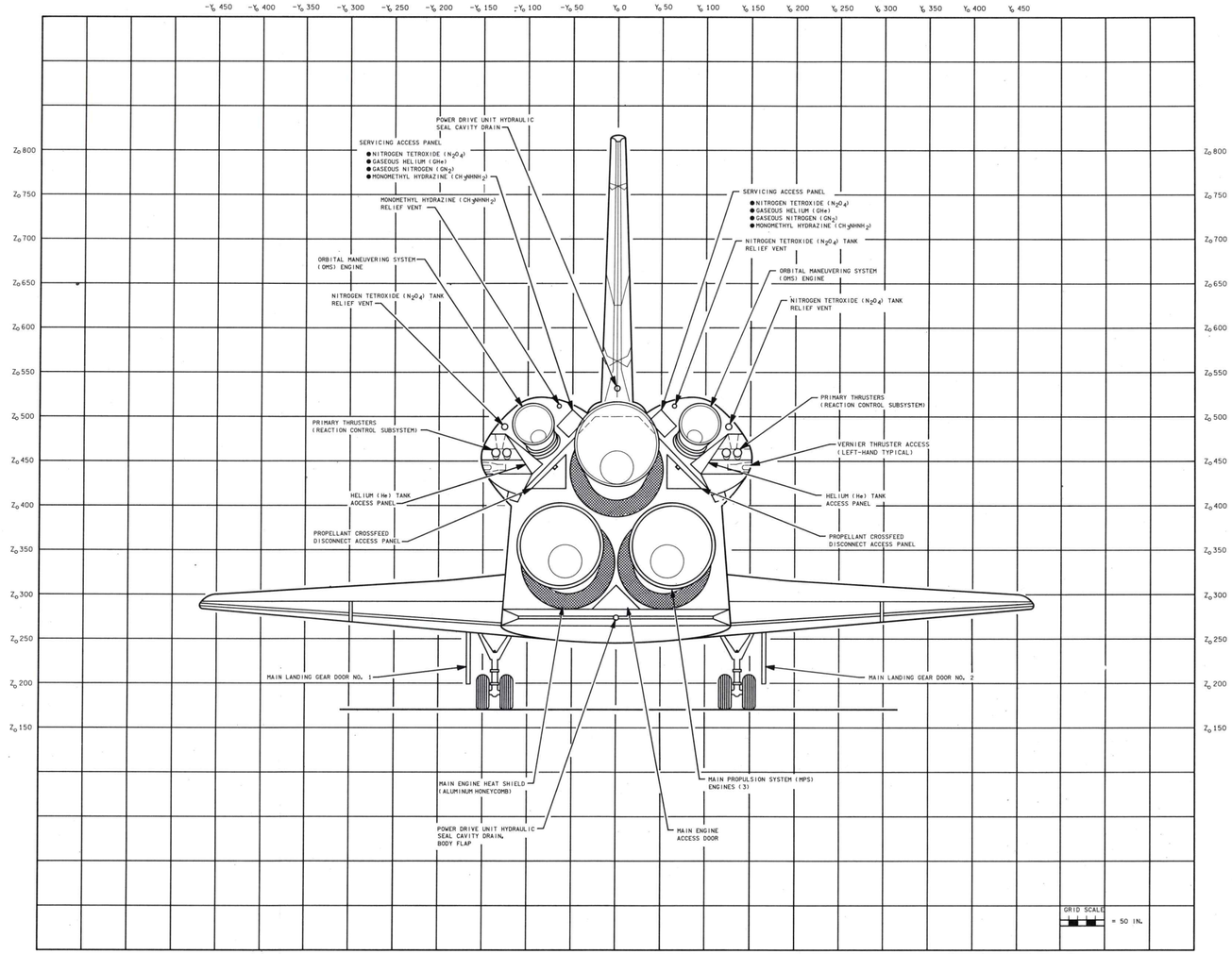
*4 TOP/BOTTOM

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DRAWN TOM LEDFORD	09/30/87	
CHK		
LEAD R. MILNER		EXTERNAL VIEWS TOP/BOTTOM
MANAGER [illegible]	[illegible]	
MANAGER [illegible]	[illegible]	
MANAGER [illegible]	[illegible]	
MANAGER [illegible]	[illegible]	
NO.	DATE	REVISION

SHEET 19.4 OF 19.4 SHEETS

DATE	NAME	VERSION
DATE 08/18/87	NAME MAG	VERSION BPT3
DATE 09/05/87	NAME MPM	VERSION INK1
DATE 09/29/87	NAME MDU	VERSION INK2

APPROXIMATE ONLY



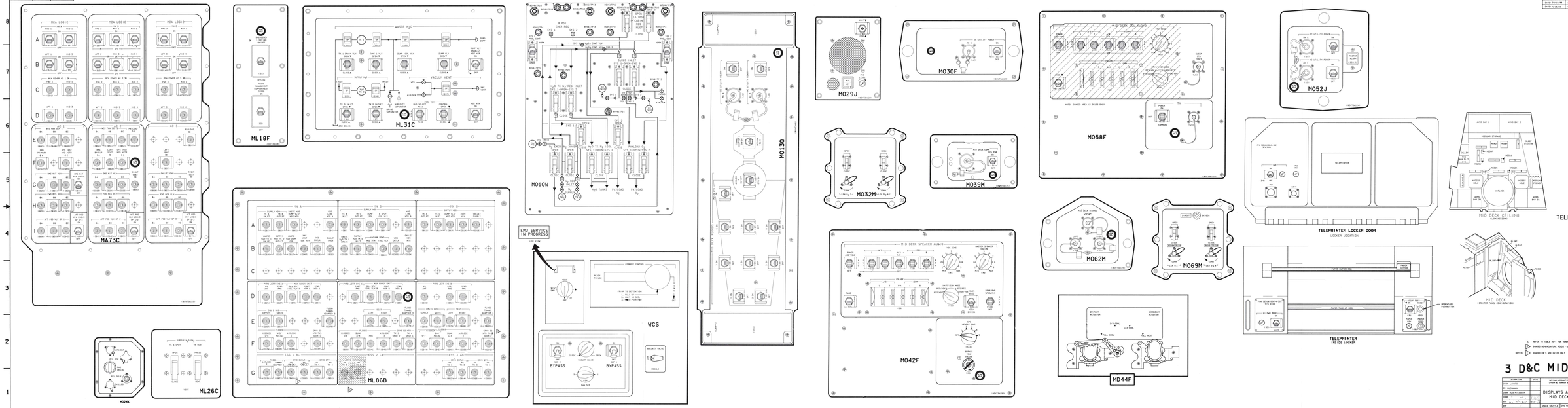
AFT FUSELAGE (LOOKING FWD)

NOTE: THIS DRAWING IS ONLY APPROXIMATE

* 4 EXT PENETR 3

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS		SIGNATURE	DATE
	DSGN	Brenda Mahaffey	10/31/84
EXTERNAL PENETRATIONS/TILE (AFT)	DR	Brenda Mahaffey	10/31/84
	ENGR	R. WALHEIM	9/4/87
	ENGR	Ray Walheim	11/19/87
	APP	[illegible]	11/19/87
DWG NO 19.4	SPACE SHUTTLE	APP	11/19/87
	ALL	OMNIPLAN	6-24-87
SHEET 1 OF 1 PAGE 19.4-3	66 X 34	LTR	PCN

BASIC REV D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ML18F
ML31C
M010W
M013O
M029J
M030F
M032M
M039M
M042F
MD44F
M052J
M058F
M062M
M069M
TELEPRINTER;
ML86B
ML26C
MD24K
EMU SERVICE IN PROGRESS
WCS
3 D&C MIDDECK
DISPLAYS AND CONTROLS MID DECK STATIONS
SPACE SHUTTLE
20.3
BASIC REV D-2

DATE:	NAME:	VERSION:
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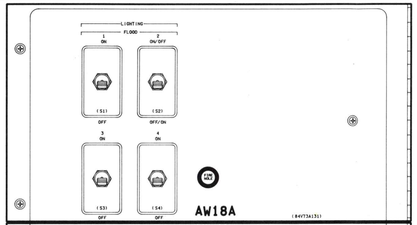
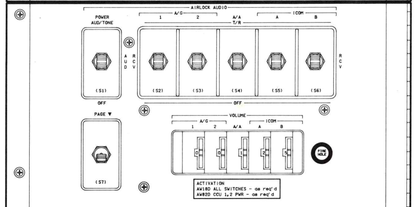
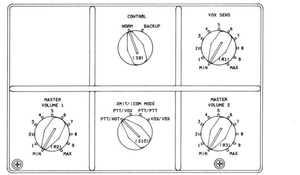
6/25/87	MDU	1WL4
7/01/87	TMW	1WL5



AW18A





Space Shuttle Systems Handbook

Vol.II

Sections 12 through 20

Rev D,
DCN-2
April 20,
1988

SD
MOD
JSC
NASA