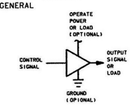
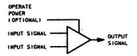
DATE: 10/20/99	NAME: MDU	VERSION: CHG 3
DATE: 11/05/99	NAME: MDU	VERSION: REL 1
DATE: 01/28/00	NAME: VSH	VERSION: REL 2

AMPLIFIERS OR DRIVERS.-

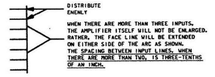
A. GENERAL



B. OPERATIONAL AMPLIFIER

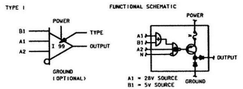


C. AMPLIFIER WITH MORE THAN THREE INPUTS

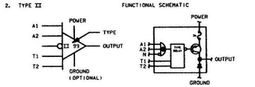


D. HYBRID DRIVERS - THE INSIDE OF EACH DRIVER SYMBOL CONTAINS THE DRIVER TYPE AND NUMBER

1. TYPE I



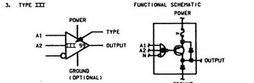
2. TYPE II



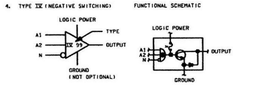
LOGIC INPUT TRUTH TABLE

A1	A2	M	T1	T2	SWITCH STATE
1	1	0	GND	X	ON (40 ms DELAY)
1	1	0	OPEN	GND	ON (1 SEC DELAY)
1	1	0	OPEN	OPEN	ON (4 SEC DELAY)
0	X	X	X	X	OFF
X	0	X	X	X	OFF
X	X	1	X	X	OFF

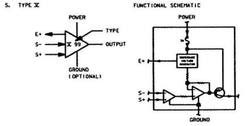
3. TYPE III



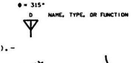
4. TYPE IV (NEGATIVE SWITCHING)



5. TYPE V

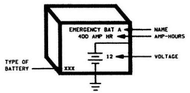


ANTENNA.-



BATTERIES.-

A. STANDARD CELL

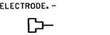


B. PRESSURIZED BATTERY CELL (ISS)

C. CURRENT SOURCE CELL

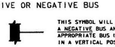
THIS SYMBOL REPRESENTS A CURRENT-REGULATED POWER SUPPLY. THE ARROW SHOULD ALWAYS POINT UP.

BIOMEDICAL ELECTRODE.-



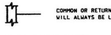
BUSES.-

A. POSITIVE OR NEGATIVE BUS



THIS SYMBOL WILL BE USED FOR EITHER A POSITIVE OR A NEGATIVE BUS AND WILL ALWAYS BE LABELED WITH THE APPROPRIATE BUS (ID). BUSES WILL ALWAYS BE SHOWN IN A VERTICAL POSITION.

B. COMMON OR RETURN BUS

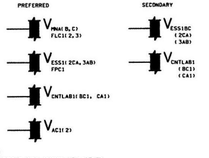


COMMON OR RETURN BUS SYMBOL WILL ALWAYS BE LABELED.

C. BUS WITH MULTIPLE WIRES

D. SHADOWBOXING OF BUSES

SHADOWBOXING OF BUSES WILL BE AS FOLLOWS. NOTICE THAT THERE IS NO REQUIREMENT TO SHOW NOMENCLATURE FOR THE APPROPRIATE SYSTEM BECAUSE IT IS ASSUMED THAT SYSTEM 1 IS FIRST, SYSTEM 2 IS SECOND, AND SYSTEM 3 IS THIRD.



NOTE
BUS SYMBOLS WILL ALWAYS BE LABELED WITH THE APPROPRIATE BUS ID.

CAPACITORS.-

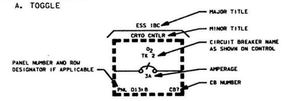
A. FIXED

B. POLARIZED

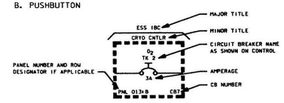
C. VARIABLE

CIRCUIT BREAKERS.-

A. TOGGLE

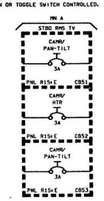


B. PUSHBUTTON



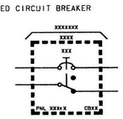
C. COMBINED CIRCUIT BREAKERS

CIRCUIT BREAKERS CAN BE COMBINED OR SHADOWBOXED WHEN THEY HAVE A COMMON MAJOR AND MINOR TITLE AND THE SAME PANEL OR LOCATION NUMBERS. CIRCUIT BREAKERS MAY BE COMBINED BY MECHANICAL LINKAGE, WITH ONLY ONE PUSH BUTTON OR TOGGLE SWITCH CONTROLLED.



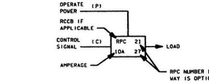
NOTE
THIS EXAMPLE SHOWS PUSHBUTTON CIRCUIT BREAKERS. THE SAME TECHNIQUE COULD ALSO BE USED WITH TOGGLE CIRCUIT BREAKERS.

D. SENSED CIRCUIT BREAKER

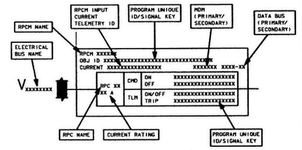


NOTE
MAY BE EITHER TOGGLE OR PUSHBUTTON AND ONE OR MORE PHASES OR POWER SOURCES

E. REMOTE POWER CONTROLLER OR REMOTE-CONTROLLED CIRCUIT BREAKER



F. REMOTE POWER CONTROLLER (ISS)



CRYSTAL.-

DIODES.-

A. GENERAL

B. ZENER

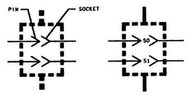
C. TUNNEL

D. CONTROL RECTIFIER (SCR)

DISCONNECTS.-

A. PINS AND SOCKETS

THE STANDARD CONFIGURATION FOR PINS AND SOCKETS IS SHOWN BELOW. IT IS ENCLOSED BY THE SAME DASHED BOX USED FOR CREW COMPONENTS AND THE "CROWSFOOT" SYMBOL IS USED. THE USE OF PIN NUMBERS WILL DETERMINE THE SPACING BETWEEN THE PIN AND SOCKET SYMBOLS.



B. MALE/FEMALE ELECTRICAL DISCONNECT

C. LANYARD DISCONNECT (ELECTRICAL)

D. SURFACE CONTACT ELECTRICAL DISCONNECT

ELECTRICAL FILTERS.-

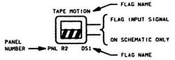
A. STANDARD FILTER

B. DIPLEXER FILTER

FLAGS.-

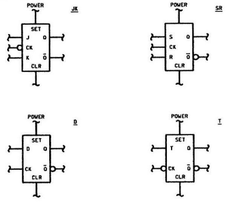
FLAG SYMBOL ARTWORK WILL NOT NECESSARILY REFLECT SWITCH POSITION OF THE ASSOCIATED SWITCH

A. DUAL STATE FLAG



B. THREE-POSITION FLAG

FLIP/FLOP.-



FUSES.-

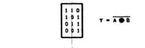
A. GENERAL

B. FUSITOR

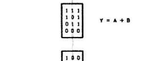
GATES.-

A. AND

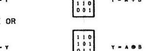
B. NAND



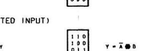
C. OR



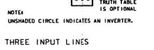
D. NOR



E. EXCLUSIVE OR

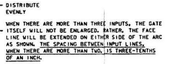


F. AND (INVERTED INPUT)



NOTE:
UNSHADED CIRCLE INDICATES AN INVERTER.

G. MORE THAN THREE INPUT LINES



H. NOT SIGNAL INVERTER.-

GROUNDS.-

A. SYSTEM

B. LOGIC

C. FLOATING

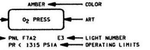
D. FRAME OR SPACECRAFT STRUCTURAL GROUND

HEADSET.-

HEATER.-

LIGHTS.-

A. CAUTION AND WARNING



B. INCANDESCENT

LIGHTS CONT.-

C. ELECTRO LUMINESCENT

NOTE:
IN ADDITION TO THE LIGHT SYMBOLS, THE ACTUAL ARTWORK ASSOCIATED WITH A PANEL LIGHT MAY ALSO BE ADDED.

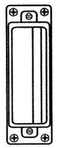
D. FLUORESCENT OR GAS BURNING (NEON)

E. MASTER ALARM

F. SWITCH STATUS

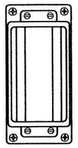
METERS.-

A. METER 1

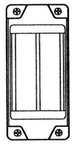


B. METER 2

C. METER 3



D. METER 4



MICROPHONE OR SPEAKER.-

1 ELEC SYM

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN S. JAMES	05/25/99	
DR M. URDIALES	06/10/99	
ENGR J. JASON		ELECTRICAL SYMBOLS
ENGR	2/1/00	
APP	2/1/00	
APP	2/1/00	
CAGE S.K. Symbols	2.7.00	SPACE SHUTTLE / ALL / DWG NO 1.1
LTR F / PCN 4		SIZE B / SCALE 66 X 34 / SHEET 1 OF 1

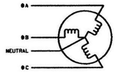
BASIC REV F-4

BASIC REV F-4

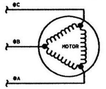
DATE= 08/11/99	NAME= MDU	VERSION= CHN.2
DATE= 12/09/99	NAME= MDU	VERSION= REL.1
DATE= 02/29/00	NAME= VSH	VERSION= REL.2

MOTOR.-

A. NEUTRAL THREE-PHASE AC MOTOR



B. 3Ø DELTA-WOUND BRUSHLESS DC MOTOR



MULTIPLEXER DE-MULTIPLEXER (MDM).-

1. FOR TELEMETERED MEASUREMENTS. MDM SYMBOL NOT USED FOR DI/DF1.

2. MULTIPLEXER DE-MULTIPLEXER (1553) MDM CONTROLLERS CONTAIN SOFTWARE AND MEASUREMENTS TELEMETERED ARE CAPABLE OF EXECUTING COMMANDS.

3. BUS COUPLER

MULTIPLIER OR DIVIDER.-

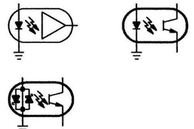
PHASE DETECTOR.-

PHOTOELECTRIC DEVICES.-

A. PHOTODIODE

B. LIGHT EMITTING DIODE (LED)

C. OPTICAL COUPLERS OR OPTOISOLATORS



D. PHOTO TRANSISTOR

E. PHOTOELECTRIC CELL

PHOTOELECTRIC DEVICES CONT.-

F. OPTICAL RECEIVER

THE OPTICAL RECEIVER RECEIVES AN OPTICAL SIGNAL (DATA/VOICE/VIDEO) FROM A FIBER OPTIC LINE AND CONVERTS IT INTO AN ELECTRICAL SIGNAL FOR TRANSMISSION OVER AN ELECTRICAL LINE.

G. OPTICAL TRANSMITTER

THE OPTICAL TRANSMITTER RECEIVES AN ELECTRICAL SIGNAL (DATA/VOICE/VIDEO) AND CONVERTS IT INTO AN OPTICAL SIGNAL FOR TRANSMISSION OVER A FIBER OPTIC LINE

H. FIBER OPTIC LINE DESIGNATOR

POTENTIOMETERS.-

A. STANDARD

B. OPTIONAL

OPTIONAL ARROW AND DIRECTION SHOWN FOR INCREASED RESISTANCE.

C. OFF/ON POTENTIOMETER

NOTE
POTENTIOMETER SYSTEM MAY ALSO BE SHOWN VERTICALLY.

RADIO FREQUENCY.-

A. RF CIRCULATOR

B. RF MIXER

C. RF POWER DIVIDER

RELAYS.-
THE GUIDELINES BELOW WILL BE FOLLOWED FOR RELAYS:

GUIDELINE 1.
ALL RELAY COILS WILL CONTAIN AN ARROW THAT WILL INDICATE THE DIRECTION OF MOTION OF THE WIPER WHEN THE COIL IS ENERGIZED.

GUIDELINE 2.
THE WIPER WILL ALWAYS MOVE TOWARD THE COIL.

GUIDELINE 3.
IF BOTH RULES 1 AND 2 CANNOT BE MET, THEN RULE 1, THE ARROW, WILL ALWAYS TAKE PRECEDENCE.

GUIDELINE 4.
GROUND SYMBOLS WILL ALWAYS BE SHOWN RIGHT SIDE UP.

GUIDELINE 5.
GROUND SYMBOLS WILL BE SHOWN AT THE BOTTOM OF COILS WHENEVER POSSIBLE

GUIDELINE 6.
ALL RELAYS WILL BE SHOWN IN THE DE-ENERGIZED POSITION.

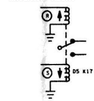
RELAYS CONT.-

A. MOMENTARY CONTACT

B. NONLATCHING RELAY
SHOWN IN THE DE-ENERGIZED POSITION.

C. LATCHING CONTACTS

D. LATCHING RELAY



JOINED RELAYS SHOULD SHOW RESET ARROW POINTING TO GROUND AND SHOULD HAVE THE "S" AND "R" CONSISTENTLY ON THE SAME SIDE THROUGHOUT THE DRAWING. THIS REQUIREMENT IS DESIRABLE BUT NOT MANDATORY

RESISTORS.-

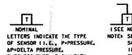
A. FIXED

B. THERMISTOR OR RESISTANCE THERMOMETER

ANY ELEMENT WHOSE SENSING RESISTANCE VARIES WITH TEMPERATURE REGARDLESS OF POLARITY.

SENSORS.-

A.



LETTERS INDICATE THE TYPE OF SENSOR (I.E., P=PRESSURE, ΔP=DELTA PRESSURE, T=TEMPERATURE, Θ=QUANTITY, W=WETNESS, R=RATE, V=VOLTAGE, I=AMPS, D=DEWPOINT, H=POSITION, AND F=FLOW RATE).

NOTE: SENSOR POWER INPUT SHOULD BE SHOWN ONLY IF POWER HAS BEEN GENERATED WITHIN THE SUBSYSTEM FOR THAT APPLICATION.

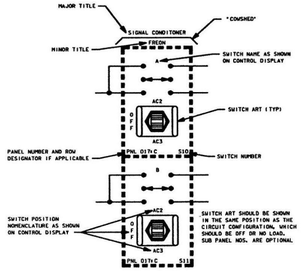
B. POWERED SENSOR (INDUCTIVE PICKUP)

SLIP RING.-

SUMMING NETWORK.-
SIGNS ARE REQUIRED

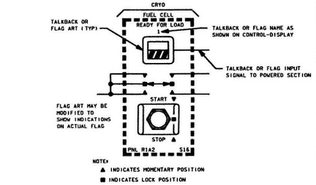
SWITCHES.-
WHERE POSSIBLE, ALL SWITCHES AND RELAYS ARE SHOWN IN THE DE-ENERGIZED POSITION. IF A SWITCH HAS MOMENTARY CONTACTS (SOLID TRIANGLE), THEN THE DE-ENERGIZED POSITION WILL BE THE LATCHING CONTACTS (SOLID CIRCLE)

GUIDELINE 1
ORB SWITCH FORMAT



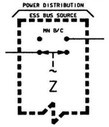
GUIDELINE 2
SWITCH-CONTROLLED FLAG

IF A FLAG IS DIRECTLY CONTROLLED BY A SWITCH, IT MAY BE SHOWN IN THE FOLLOWING MANNER:

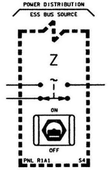


NOTE:
▲ INDICATES MOMENTARY POSITION
■ INDICATES LOCK POSITION

GUIDELINE 3
DIVIDED BOXES CONTINUED IN SEPARATE LOCATIONS

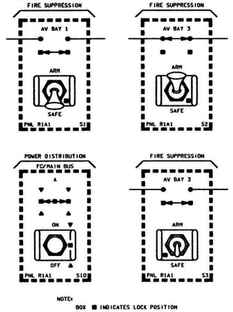


GUIDELINE 3
DIVIDED BOXES CONTINUED IN SEPARATE LOCATIONS



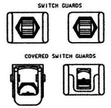
SWITCHES CONT.-

GUIDELINE 4
LEVER LOCK POSITION



NOTE:
BOX ■ INDICATES LOCK POSITION

GUIDELINE 5



A. SWITCH NOMENCLATURE DEFINITIONS
1. MAJOR TITLE - THE TITLE GIVEN TO A GROUP OF SWITCHES OF THE PANEL.
2. MINOR TITLE - THE TITLE GIVEN TO A SUBGROUP OF SWITCHES THAT HAS A MAJOR TITLE.
3. SWITCH NAME - THE NAME OF A GIVEN SWITCH AS IT APPEARS ON THE PANEL.

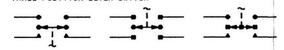
NOTE 1:
IF MORE THAN ONE SWITCH SHOULD HAVE IDENTICAL MAJOR AND MINOR TITLES, THESE SWITCHES MAY BE "STACKED" WITHOUT REPEATING THE MAJOR AND MINOR TITLES.

NOTE 2:
OCCASIONALLY A MINOR TITLE WILL BE LONG AND REQUIRE TWO LINES. THIS IS AN ACCEPTABLE DEVIATION THAT REQUIRES AN ADDITIONAL 2 TENTHS UNDER THE "CONSHED".

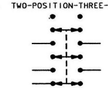
B. SWITCH CONTACT DEFINITIONS APPLICABLE TO MANUALLY OPERATED ONLY
● MAINT ON (MAINTAINED ON)
■ LOCK ON (LOCKED ON)
▼ MOM ON (MOMENTARY ON)
LOCK OFF (LOCKED OFF)

C. TWO-POSITION LEVER SWITCH

D. THREE-POSITION LEVER SWITCH



E. TWO-POSITION-THREE-POLE LEVER SWITCH



F. ROTARY SWITCHES

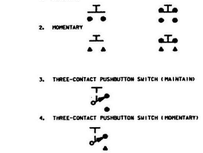
AS A PRACTICE, WHENEVER POSSIBLE, ROTARY SWITCHES SHOULD BE SET UP AND LABELED IN A CLOCKWISE MANNER, WITH THE OFF POSITION ON THE BEGINNING OF THE SWITCH SEQUENCE (IN THE TOP OR BOTTOM IN THE SCHEMATIC). THE SWITCH DIRECTION SHOULD MATCH THE SWITCH ART. (SEE THE FOLLOWING NOTES.)

NOTE 1:
THE BEGINNING OF SWITCH SEQUENCE CAN USUALLY BE DETERMINED BY EITHER A SPACE IN THE SWITCH POSITIONS OR THE BEGINNING OF A NUMERICAL OR ALPHANETICAL SEQUENCE.

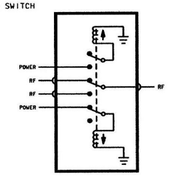
NOTE 2:
WHERE THERE IS NO METHOD OF DETERMINING THE BEGINNING OF A SWITCH SEQUENCE, THE POSITION OF THE SWITCH INDICATOR WILL DETERMINE TOP OR BOTTOM POSITION.

SWITCHES CONT.-

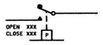
G. PUSHBUTTON SWITCHES



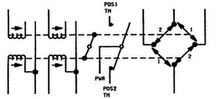
H. COAX SWITCH



I. PRESSURE SWITCH

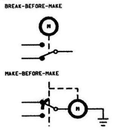


J. RF COAXIAL ANTENNA RELAY



K. MOTOR SWITCHES

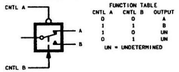
1. BREAK-BEFORE-MAKE



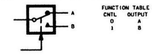
2. MAKE-BEFORE-MAKE

SOLID-STATE SWITCHES

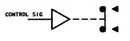
A. DUAL-CONTROL SOLID-STATE SWITCH



B. SINGLE-CONTROL SOLID-STATE SWITCH



C. SOLID-STATE ANALOG SWITCH



1 ELEC SYM 2

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN M. URDIALES	05/03/99	ELECTRICAL SYMBOLS
DR		
CHCK J. JASON		
CHCK	2/1/00	
APP	2/1/00	
APP	2/1/00	SPACE SHUTTLE
CADD S.K. Kimbrell	2/1/00	ALL
LTR 1 DCN 4		86 X 34

DWG NO 1.1

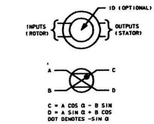
SHEET 2 OF 3

BASIC REV F-4

BASIC REV F-4

DATE: 11/09/99	NAME: MDU	VERSION: REL1
DATE: 01/28/00	NAME: VSH	VERSION: REL2

SYNCHRO RESOLVER.-



TACHOMETER.-

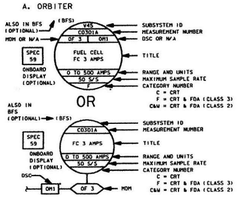
TALKBACKS.-

A. TWO-POSITION

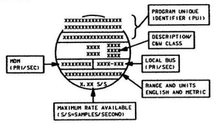
B. THREE-POSITION

TELEMETERED MEASUREMENTS.-
IT IS PREFERABLE TO SHOW TELEMETRY SYMBOLS OUTSIDE OF ALL BOXES AND UNITS. (THIS IS A GUIDELINE, BUT NOT A REQUIREMENT).

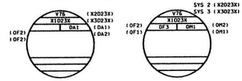
A. ORBITER



B. STATION



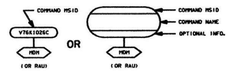
C. SHADOWBOXING TELEMETRY BUBBLES
SHADOWBOXING OF TELEMETRY BUBBLES WILL BE AS FOLLOWS. THE SHADOWBOXED SYSTEM PARAMETERS CAN BE PLACED ON ANY SIDE OF THE BUBBLE. NOTICE THE SECOND AND THIRD SYSTEMS ARE DESIGNATED IF DESIRED.



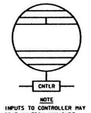
D. STIMULI STATUS, MDM/RAU COMMAND STATUS, OR GPC OUTPUT WITH GPC DOWNLINK.
SHADOWBOXING SAME AS TM BUBBLES

TELEMETERED MEASUREMENTS CONT.-

E. STIMULI OR MDM/RAU COMMAND MISD.
SHADOWBOXING SAME AS TM BUBBLES



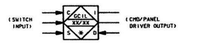
F. FOR SSME TM TRANSMITTED FROM CONTROLLER TO EIU TO GPC



NOTE
INPUTS TO CONTROLLER MAY COME IN FROM ANY SIDE.

F. MEASUREMENTS TO GSE

GCIL GROUND COMMANDS.-



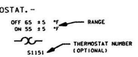
NOTES

1. DESIGNATIONS=
   C - COMMAND DRIVER POWER
   I - INTERLOCK OUTPUT (PRESENT WHEN EITHER COMMAND OR PANEL DRIVER ON)
   D - DRIVER SENSE (WHEN HIGH WILL HOLD DRIVER ON WHEN CREW CONTROL SWITCH IS POSITIONED FROM PANEL TO COMMAND)
   S - SERIES INTERLOCK (WHEN HIGH OR NOT CONNECTED ENABLES COMMAND DRIVER TO BE COMMANDED ON)

   GCIL = DESIGNATES GCIL COMMAND ROUTING

   XX/XX = XX IS THE BOARD DESIGNATOR A3 THRU A-11b
   /XX IS THE DRIVER NUMBER 1-16
   W = PM - FOR S-BAND PM CREW CONTROL SWITCH
   FM = FOR S-BAND FM CREW CONTROL SWITCH
   KU = FOR KU-BAND CREW CONTROL SWITCH
   N = FOR NOT ANY CREW CONTROL SWITCH
   PL = FOR PAYLOAD CREW CONTROL SWITCH
   H = FOR MODE VOLTAGE NOT FROM CREW CONTROL SWITCH (INPUT LINE USED ONLY WITH "H" DESIGNATION)
2. IN THE CREW CONTROL "PM," MODE OR ZBVDC INPUT TO "H", THE SWITCH INPUT POWERS AND ACTIVATES THE PANEL DRIVER WHICH IS ROUTED TO THE OUTPUT.
3. COMMAND NAME WILL BE ADJACENT TO THE SYMBOL.

THERMOSTAT.-

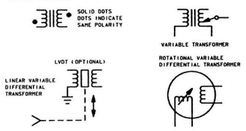


TIME DELAY.-

A. STANDARD

B. ONE SHOT

TRANSFORMERS.-



TRANSISTORS.-

A. NPN

B. PNP TRANSISTOR

C. UNIJUNCTION TRANSISTOR

D. JUNCTION FIELD EFFECT TRANSISTOR (JFET)

E. METAL-OXIDE-SEMICONDUCTOR FIELD EFFECT TRANSISTOR

VARIABLE INDUCTOR.-

WAVE GUIDE.-

1 ELEC SYM 3

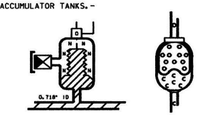
SIGNATURE	DATE	
DSGN M. URDIALES	11/09/99	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DR		
ENGR A. JASON		ELECTRICAL SYMBOLS
ENGR	2/1/00	
APP	2/1/00	
APP	2/1/00	SPACE SHUTTLE / DWG NO 1.1
CADS J.K. Lindner	2-2-00	ALL / SHEET 3 OF 3
LTR F	SPCN 4	66 X 34

BASIC REV F-4

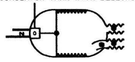
BASIC REV F-4

DATE: 08/15/99	NAME: MDU	VERSION: CHNL 2
DATE: 11/15/99	NAME: MDU	VERSION: CHNL 3
DATE: 01/29/00	NAME: VSH	VERSION: REL 1

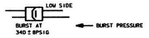
ACCUMULATOR TANKS. -



ACCUMULATOR TANK WITH BELLOWS

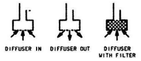


BURST DIAPHRAGM. -



COMPRESSOR. -

DIFFUSERS. -



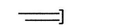
DISCONNECTS. -

A. SELF SEALING

B. QUICK

C. QUICK-DISCONNECT CAPPED

D. FILL AND DRAIN OR TEST POINT - CAPPED



E. BULKHEAD PASSTHROUGH

F. BULKHEAD TERMINATION

G. GAMMA FITTING

EXPLOSIVE INITIATOR. -

A. SPARK IGNITOR

B. MILD DETONATING FUSE (MDF)

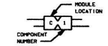
C. SHIELDED MFD

FAN, MOTOR DRIVEN. -

FILTER. -

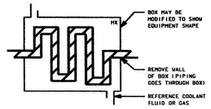
GUILLOTINE. -

A. ELECTRICAL



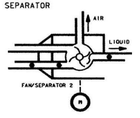
B. GAS-OPERATED

HEAT EXCHANGER. -



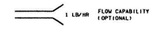
LIQUID/GAS SEPARATOR. -

SEPARATOR



NONPROPULSIVE VENT (NPV). -

NOZZLE. -



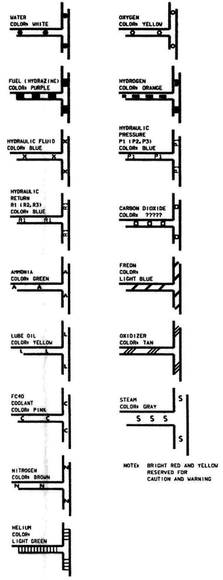
PIPE LEGEND GENERAL. -

A. PLUMBING CONNECTED

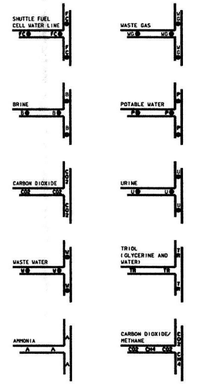
B. PLUMBING CROSSOVER

C. FLEX HOSE

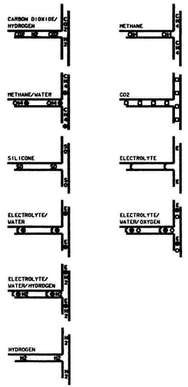
LINE DESIGNATION. -



A. STATION SPECIFIC. -

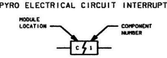


A. STATION SPECIFIC CONT. -



PUMP. -

PYRO ELECTRICAL CIRCUIT INTERRUPTER. -

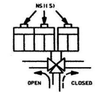


PYROTECHNIC SYMBOLS. -

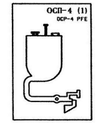
A. PYRO INITIATOR

B. PYRO VALVE WITH SINGLE INITIATOR

C. THREE-WAY PYROTECHNIC VALVE



RUSSIAN PERSONAL FIRE EXTINGUISHER. -



TRANSDUCERS. -

A. TEMPERATURE

B. PRESSURE

VALVES. -

A. MOTOR-CONTROLLED

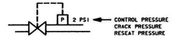
B. MANUAL-CONTROLLED

C. BELLOWS

D. CHECK-VALVE

E. ORIFICE, VENTURI OR FLOW RESISTOR

F. PRESSURE REGULATOR AND PRESSURE CONTROL VALVE
THE SENSOR MUST BE PLACED TO THE SIDE THAT THE PRESSURE IS BEING REGULATED ON.

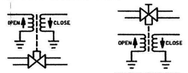


VALVES CONT. -

G. RELIEF VALVE

H. SPRING-LOADED SOLENOID VALVE

I. LATCHING SOLENOID VALVE

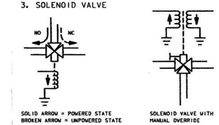


J. THREE-WAY VALVES

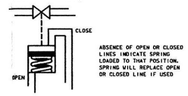
1. MANUAL

2. MOTOR-CONTROLLED VALVE

3. SOLENOID VALVE



K. PNEUMATIC VALVE



L. INTERNALLY RELIEVING VALVE

M. ANEROID

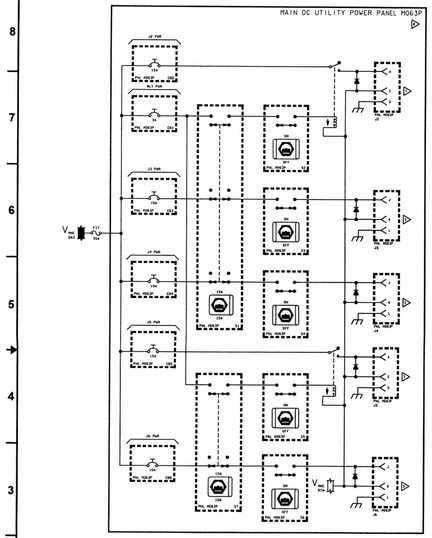
N. MAIN FUEL FLOW VALVE

2 MECH SYM

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSGN M. URDIALES	00/10/99	
DR		
ENGR J. JASON		MECHANICAL SYMBOLS
ENGR	2/1/00	
APP	2/1/00	
APP	2/1/00	
CHKD S.R. Rinkert	2-1-00	SPACE SHUTTLE / ALL / DWG NO 1.2
LTR F SCN 3		66 X 34 / SHEET 1 OF 1

BASIC REV F-4

BASIC REV F-4


MAIN DC UTILITY POWER PANEL MO63P
J2 PWR
J3 PWR
J4 PWR
J5 PWR
J6 PWR
J7 PWR
J8 PWR
J9 PWR
J10 PWR
J11 PWR
J12 PWR
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J14 PWR
J15 PWR
J16 PWR
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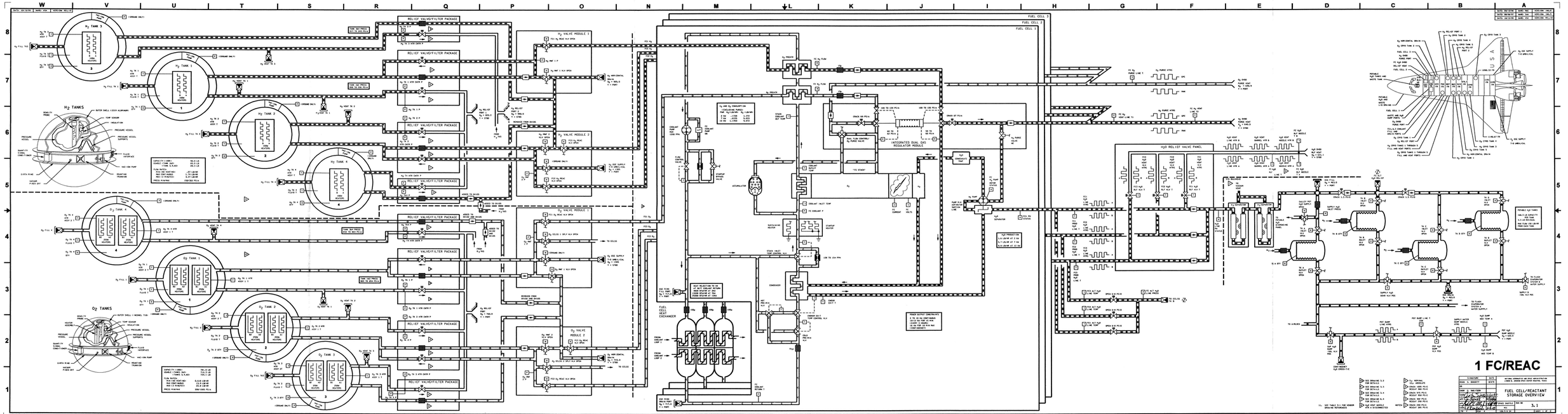
J18 PWR
J19 PWR
J20 PWR
J21 PWR


1 FC/REAC
FUEL CELL/REACTANT STORAGE OVERVIEW
H2 TANKS
O2 TANKS
H2O RELIEF VALVE PANEL
INTEGRATED DUAL GAS REGULATOR MODULE
FUEL CELL 3
FUEL CELL 2
FUEL CELL 1
BASIC REV F-4

DATE/ DESCRIPTION	MARK/ LAR	VERSION/ CSN/ LTR
DATE/ DESCRIPTION	MARK/ MSI	VERSION/ CSN/ LTR
DATE/ DESCRIPTION	MARK/ LAR	VERSION/ REL/ LTR

TOTAL USE DUTIES AND BIT COUNT CHANGE RATES OF INTERABLE DATA FOR VARIOUS CREW SIZES

MICHAEL/ DATA	5 CREW			6 CREW			7 CREW			8 CREW		
	AVG	MAX	MAX	AVG	MAX	MAX	AVG	MAX	MAX	AVG	MAX	MAX
SU USE/ CREW	5,112	5,112	5,112	5,112	5,112	5,112	5,112	5,112	5,112	5,112	5,112	5,112
DATA BITS/ PI/ SEC	5,460	5,460	5,460	7,462	7,462	7,462	9,464	9,464	9,464	11,466	11,466	11,466
SLIDE WIRES	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
CMD PANEL LB/HR	4.56	4.56	4.56	6.47	6.47	6.47	8.38	8.38	8.38	10.29	10.29	10.29
PROBE INCR. MNVR/HR*	1.13	1.26	1.53	1.14	1.31	1.64	1.17	1.36	1.75	1.19	1.39	1.85
LCD BIT INFO. MNVR*	0.4	0.5	0.7	0.4	0.5	0.8	0.5	0.5	0.9	0.5	0.5	0.9

* = w/ONLY QTY REMOVAL

▷ POSSIBLE SOFTWARE BIT CONFIGURATIONS
1 2 3 4 5 6 7 8
1, 2, 3, 4, 5, 6, 7, 8, SYS 2 TO 1, 2, 3, 4, 5, 6
ADDED SYSTEM 2 CHAN 7 AND 8 AND SYSTEM 3 CHANS 5 AND 8
ADD THE CORE PANEL, "W" NUMERICALLY MISSING BIT CHANS,
ADD THE CORE, IF W/ ONE INSTALLED AND 1-7, IF TWIN
INSTALLED

▷ CHART DATA CORRESPONDENCE WITH FLIGHT DATA
SP = SU SHAFT P = SU SYLS P

▷ PROBE/DAA (1553/ECU), PROBE/DAA (1553/ECU) AND
PROBE/DAA (1553/ECU) PROVIDE THE CAPABILITY TO
ENABLE OR DISABLE THE PROBE/DAA (1553/ECU) BUS
OR THROUGH A DISPLAY/CONTROL (CRT/LCD) SEL-
ECTABLE PARAMETER. THE STATUS OF THE PROBE/DAA
(1553/ECU), AND PROBE/DAA PARAMETERS, VALUES OF THESE
PARAMETERS ARE DETERMINED AS FOLLOWS:

PROBE/DAA (1553/ECU) WORD, BIT	PARAMETER STATUS	PROBE/DAA (1553/ECU) WORD, BIT
WORD, BIT	WORD, BIT	WORD, BIT
1	= ENABLE MF	1
0	= STATUS MF	0
1	= STATUS OFF	1
0	= STATUS ON	0

IF SPEC ENABLE = 0 OR SUB P = 0, THEN A "MAY"
BE ENABLED/DISABLED FOR SU CONFIGURATION (1553/ECU/DIS).

15. ITEM NO.'S REFER TO MICHAEL/L HARDWARE NO.'S

▷ CABIN PRESSURE BLEED VALVES (ITEM 1.87)
THESE VALVES ARE SERVOS MOUNTED ON A COMMON HOUSING
AND ARE USED TO VENT THE CABIN PRESSURE 500mA FOLLOWIN
THE FOLLOWING MODES: 1) 0.5 PSIG ± 0.2 PSIG WITH A
TIME ≥ 2 SEC WITH 14.7 PSIA VENTING TO <14.5 PSIA
w/ VENT

▷ POSITIVE PRESSURE RELIEF VALVES (ITEM 1.1)
THESE PRESSURE-COMPENSATED POPPET VALVES ARE SPRING
LOADED TO PREVENT CABIN PRESSURE FROM EXCEEDING 9.0 ±0.5
PSID NORMAL. REVERSE-ED BUTTERFLY VALVES ARE SERVOS
ARE PROVIDED TO CLOSE THE LINE IF THE RELIEF VALVE
FAILS OPEN.

▷ FOR DO-160, PROC AND SPECIFICALLY IN A MICRO CIRCUIT
AND REQUIRED A SIGNAL CONDITIONER TO APPLY IT TO CONTROL
THE CABIN PRESSURE. THE CONDITIONER IS A SEPARATE UNIT
CIRCUIT AND, THEREFORE, DO NOT NEED A SIGNAL CONDITIONER

▷ IF A "DEVICE BY DOME" CONDITION OCCURS, THE COMP WILL
DISPLAY AN "NAV" MESSAGE "NOT OK"

▷ PRESSURE: CABIN PRESSURE 8.7±0.2 PSIA
REST HEIGHT: CABIN PRESSURE 8.7±0.2 PSIA

▷ P_{CA} BLEED SHUT-OFF: INSTALLED IN LINE P_{CA} @ 80 PRESS/EXP PSI
OR PRESSURE FED
BONDED PRESTRIP SEGMENT PROT BAY
P_{CA} BLEED SHUT-OFF VALVE (ITEM 1.87)

5. REFER TO TABLE B-1 FOR (Module INTERFACES)

▷ BTU SPC'S, SPC's, SPC 5:
Fig 15 THE CABIN PRESS AT TIME ZERO WHILE Fig 15 THE CABIN PRESS
DO NOT LATER. THE PRESSURES AND COMP ARE UPDATED EVERY 5 SEC-
ONDS. THE MAXIMUM PRESSURE OF CABIN LEAK RATE IS DEFECTIVE THAN
~ 1/2 PSI w/MIN

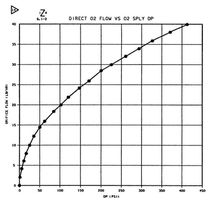
▷ ALARM ANNUNCIATES FOR LOSS OF CABIN PRESSURE (MC'S, THEREFORE,
THE INDICATOR ICON OF APCAP IS ASSUMED.

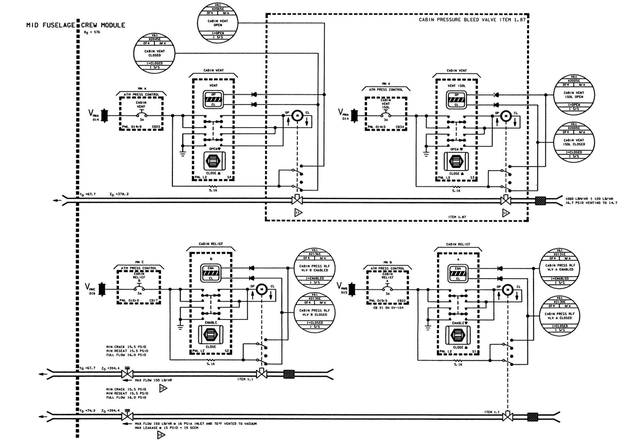
▷ P_{CA} PNEUM. PRESSURE OPERATION: A SUBSYSTEM BARRIER, CATALYTIC
ELECTRODE, BASIC ELECTROLYTE AND METAL CHARTER ELECTRODE ARE
USED TO MEASURE WATER FLOW THROUGH DIFFUSION BARRIER IN
PROPORTION TO THE PARTIAL PRESSURE OF OXYGEN. THE ELECTRO-
CHEMISTRY RESULTS IN A TO SIGC SIGNAL PROPORTIONAL
TO P_{O_2}

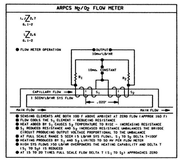
WATCH ▷ CABIN NEGATIVE PRESSURE RELIEF VALVES (ITEM 1.96)
THESE POPPET VALVES PREVENT RELIEF FROM THE FORWARD FUSELAGE
CREW MODULE IF THE CABIN PRESSURE EXCEEDS AMBIENT BY
10.0 PSIG. A REVERSE-BIAS OF 0.5 PSIG IS REQUIRED TO OPEN
THE VALVES TO PREVENT CABIN PRESSURE FROM EXCEEDING
AMBIENT BY 14.7 PSIA. AT FOR AUTOMATIC CUT RELEASE 0.7 PSIA.
A PANELS IS INSTALLED INTO CAP TO ALLOW 0.5 AT ADENS CAP

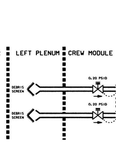
1 PCS

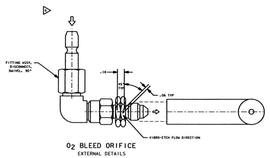
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION / LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS	DRAWN/CHECKED	DATE
	DRAW L. SULLIVAN	06/1985
	DR L. LOGSDON	06/1985
	CHECK J. BOYNE	
PRESSURE CONTROL SYSTEM	APPROVED	
	SPACE SHUTTLE	
DWG NO 6.1	SCALE NONE	SHEET 6-2-00
	SIZE D	REV -

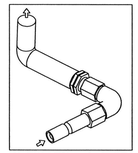








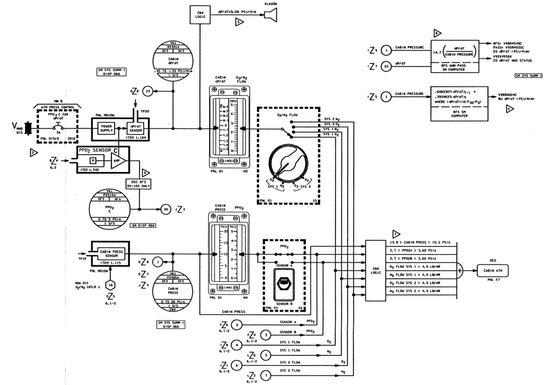


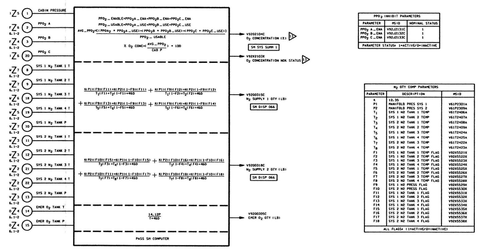


O_2 BLEED ORIFICE SPEC FLOW RATES

ORIFICE SIZE NUMBER	P_{O_2} INLET PRESS PSIA	P_{O_2} NOM. FLOW RATE LB/HR
4.9	115.3 ± 10	.39 LB/HR
6.7	115.3 ± 10	.56 LB/HR

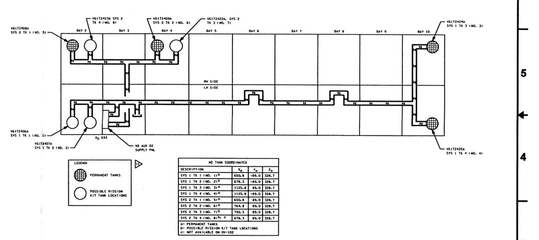
P_{O_2} NOM. FLOW RATE LB/HR	P_{O_2} MAX. LEAKAGE RATE LB/HR
.39 LB/HR	.78 LB/HR
.56 LB/HR	.78 LB/HR



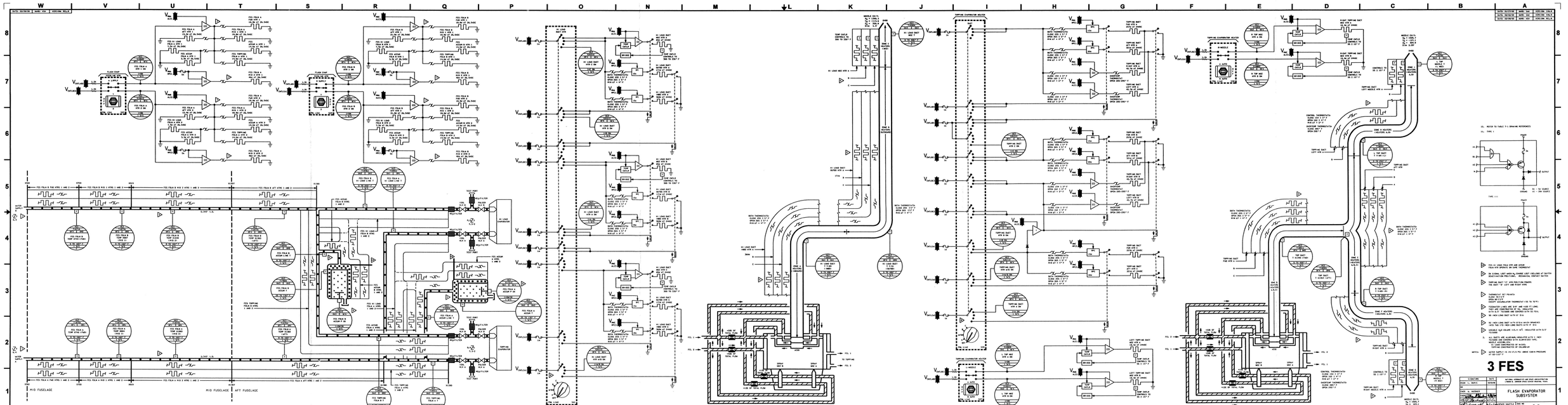


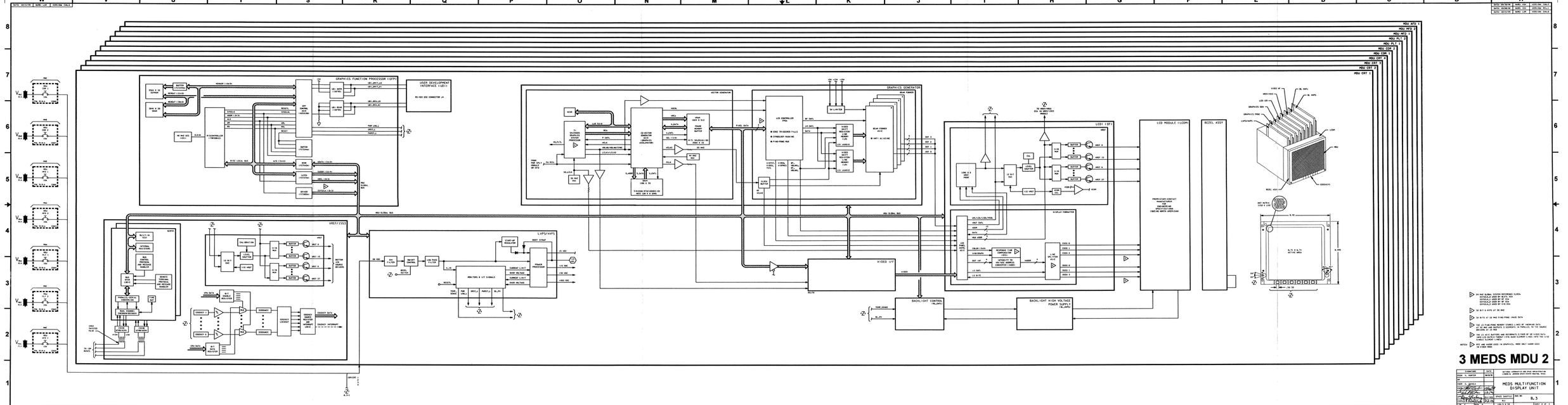
P_{CA} INHIBIT PARAMETERS		
PARAMETER	WORD	NORMAL STATUS
P_{CA} 1 ENA	WORD/BIT#	1
P_{CA} 2 ENA	WORD/BIT#	1
P_{CA} 3 ENA	WORD/BIT#	1
PARAMETER STATUS	1=ACTIVE/0=INACTIVE	

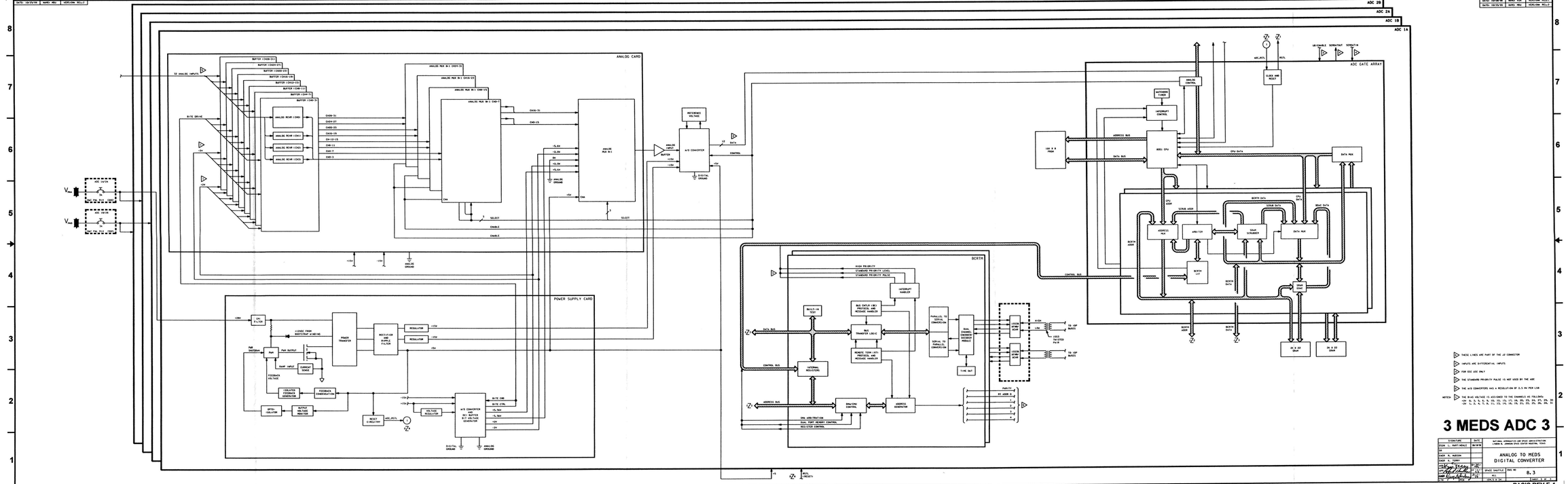
N_2 STY COMP PARAMETERS		
PARAMETER	DESCRIPTION	WORD
A	VALVE	
P_1	MANIFOLD PRESS SYS 1	V83T0030A
P_2	MANIFOLD PRESS SYS 2	V83T0030A
T_1	SYS 1 HE TANK 1 TEMP	V83T0401A
T_2	SYS 1 HE TANK 2 TEMP	V83T0402A
T_3	SYS 1 HE TANK 3 TEMP	V83T0403A
T_4	SYS 2 HE TANK 1 TEMP	V83T0404A
T_5	SYS 2 HE TANK 2 TEMP	V83T0405A
T_6	SYS 2 HE TANK 3 TEMP	V83T0406A
T_7	SYS 3 HE TANK 1 TEMP	V83T0407A
T_8	SYS 3 HE TANK 2 TEMP	V83T0408A
T_9	SYS 3 HE TANK 3 TEMP	V83T0409A
P9	SYS 4 HE TANK TEMP PLAG	V83S0320A
P10	SYS 5 HE TANK TEMP PLAG	V83S0321A
P11	SYS 6 HE TANK TEMP PLAG	V83S0322A
P12	SYS 7 HE TANK TEMP PLAG	V83S0323A
P13	SYS 8 HE TANK TEMP PLAG	V83S0324A
P14	SYS 9 HE TANK TEMP PLAG	V83S0325A
P15	SYS 10 HE TANK TEMP PLAG	V83S0326A
P16	SYS 11 HE TANK TEMP PLAG	V83S0327A
P17	SYS 12 HE TANK TEMP PLAG	V83S0328A
P18	SYS 13 HE TANK TEMP PLAG	V83S0329A
ALL FLAGS	1=ACTIVE/0=INACTIVE	



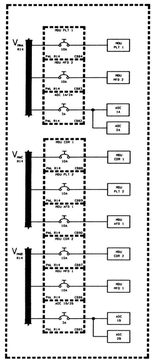
N_2 TANK ZONING/MASS			
DESCRIPTION	T_1	T_2	T_3
SYS 1 TK 1 MAL S/T	600LB	69.0	336.7
SYS 1 TK 2 MAL S/T	576.7	69.0	336.7
SYS 1 TK 3 MAL S/T	1105.4	69.0	336.7
SYS 1 TK 4 MAL S/T	1105.4	69.0	336.7
SYS 2 TK 1 MAL S/T	600.4	69.0	336.7
SYS 2 TK 2 MAL S/T	576.7	69.0	336.7
SYS 2 TK 3 MAL S/T	1105.4	69.0	336.7
SYS 2 TK 4 MAL S/T	1105.4	69.0	336.7
SYS 3 TK 1 MAL S/T	600.4	69.0	336.7
SYS 3 TK 2 MAL S/T	576.7	69.0	336.7
SYS 3 TK 3 MAL S/T	1105.4	69.0	336.7
SYS 3 TK 4 MAL S/T	1105.4	69.0	336.7
▷ PASSIVE TANKS ▷ PASSIVE MISSION SIT TANK LOCATIONS ▷ NOT AVAILABLE ON SM/MM			

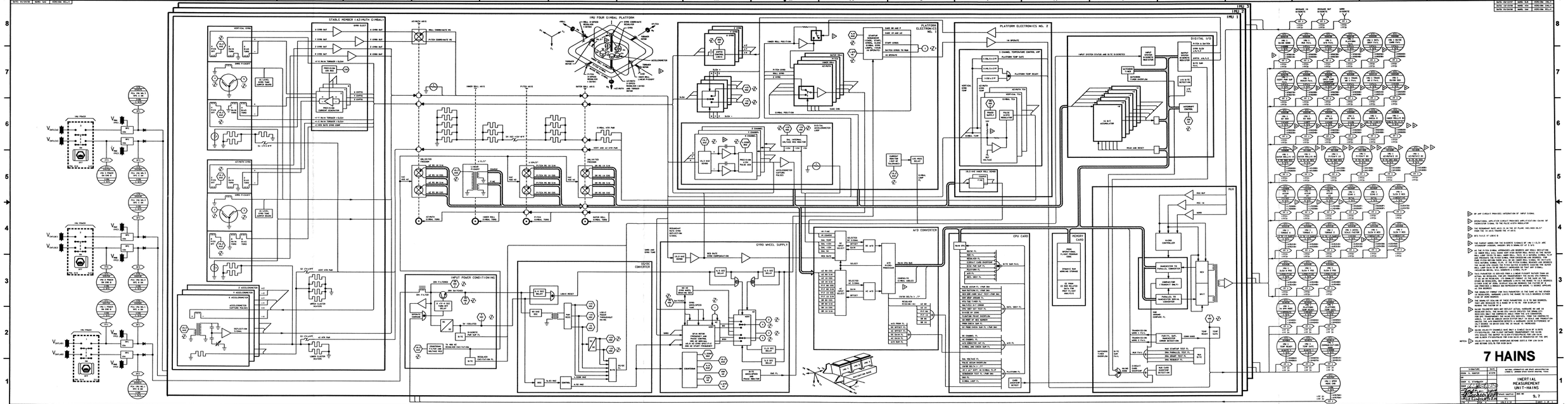

MID FUSELAGE
MID FUSELAGE
AFT FUSELAGE
HI LOAD EVAPORATOR
TOPPING EVAPORATOR
3 FES
FLASH EVAPORATOR SUBSYSTEM
7.3
BASIC REV F-4


MDU AFD
MDU MFD 2
MDU MFD
MDU PLT 2
MDU PLT
MDU COR 2
MDU COR
MDU CAP
MDU CRT 2
MDU CRT
GRAPHICS FUNCTION PROCESSOR (GFP)
USER DEVELOPMENT INTERFACE (UDI)
RS-422 EIA CONNECTOR J4
VECTOR GENERATOR
GRAPHICS GENERATOR
VIDEO I/F
LCD CONTROLLER ASIC
BEAM FORMER ASIC
LCD1 (CRT)
LCD MODULE (LCDM)
BEZEL ASSY
BACKLIGHT CONTROL
BACKLIGHT HIGH VOLTAGE POWER SUPPLY
LVPS/VHPS
MDU GLOBAL BUS
VREF/1553
3 MEDS MDU 2
MEDS MULTIFUNCTION DISPLAY UNIT
8.3
BASIC REV F-4


ADC 2B
ADC 2A
ADC 1B
ADC 1A
ANALOG CARD
32 ANALOG INPUTS
BITE DRIVE
ANALOG MUX
A/D CONVERTER
REFERENCE VOLTAGE
ADC GATE ARRAY
ANALOG CONTROL
WATCHDOG TIMER
INTERRUPT CONTROL
ADDRESS BUS
DATA BUS
1K X 8 PROM
8085 CPU
CPU DATA
DATA MUX
SCRUB ADDR
SCRUB DATA
ADDRESS MUX
ARBITER
DUAL SYNCHRO
BCRTH
BCRTH DATA
BCRTH ADDR
BCRTH I/F
1553 DUAL REDUNDANT BUS
IN & OUT BOARD
POWER SUPPLY CARD
DC/DC CONVERTER
BCRTH
HIGH PRIORITY
STANDARD PRIORITY (LOW)
STANDARD PRIORITY PULSE
INTERRUPT HANDLER
BUILT-IN TEST
BUS CNTLR (BC) PROTOCOL AND MESSAGE HANDLER
BUS TRANSFER LOGIC
REMOTE TERM (RT) PROTOCOL AND MESSAGE HANDLER
PARALLEL TO SERIAL CONVERTER
SERIAL TO PARALLEL CONVERTER
DUAL CHANNEL ENCODER/DECODER MODULE
SYNC OUT
INTERNAL REGISTERS
DMA/CPU CONTROL
ADDRESS GENERATOR
DMA ARBITRATION
DUAL PORT MEMORY CONTROL
REGISTER CONTROL
DATA BUS
CONTROL BUS
ADDRESS BUS
PARITY
BIT MASK 0
TO I/OP BOARDS
THESE LINES ARE PART OF THE I/O CONNECTOR
INPUTS ARE DIFFERENTIAL INPUTS
FOR ESS USE ONLY
THE STANDARD PRIORITY PULSE IS NOT USED BY THE ADC
THE A/D CONVERTERS HAS A RESOLUTION OF 2.5 MV PER LSB
NOTES:
3 MEDS ADC 3
ANALOG TO MEDS DIGITAL CONVERTER
SIZE: B
SPACE SHUTTLE
DWG NO
8, 3
SCALE: NONE
SHEET 1 OF 1
BASIC REV F-4

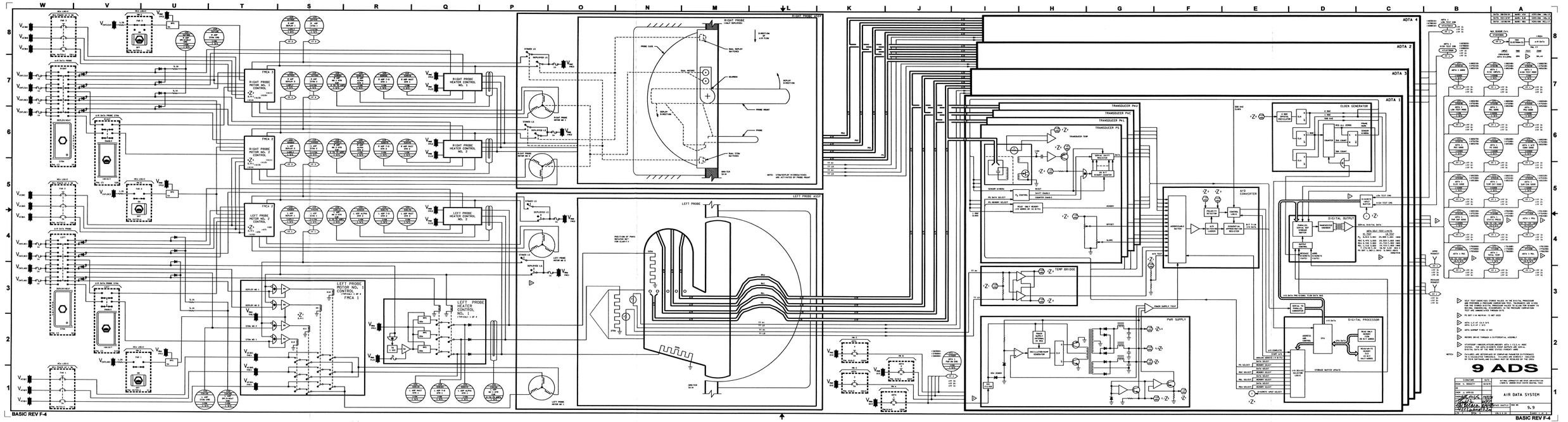
DATE/ INITIAL	NAME/ CO	WORK/DWG TITLE
DATE/ INITIAL	NAME/ CO	WORK/DWG TITLE
DATE/ INITIAL	NAME/ CO	WORK/DWG TITLE

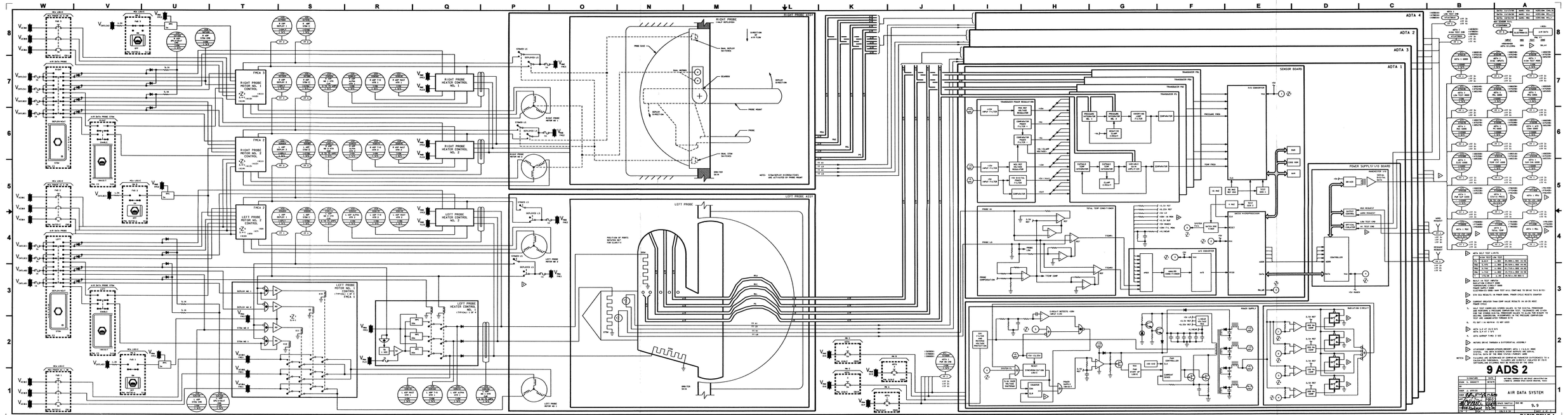




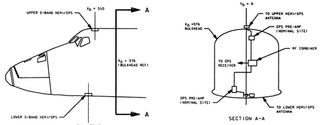
BASIC REV F-4

BASIC REV F-4


W V U T S R Q P O N M L K J I H G F E D C B A
RIGHT PROBE ASSY
RIGHT PROBE
(HALF DEPLOYED)
PROBE CONE
DUAL DEPLOY SWITCHES
DUAL HEATERS
ELEMENTS
PROBE HEIGHT
PROBE
DUAL STEM SWITCHES
MRB/SER SW IN
NOTE: STEM/DEPLOY ELEMENTS/SWITCHES ARE ACTUATED AT PROBE HEIGHT
LEFT PROBE ASSY
LEFT PROBE
REJECTION OF TWO ELEMENTS FOR CLARITY
STEM
PCU
PS
TT
MRB/SER SW IN
RIGHT PROBE HEATER CONTROL NO. 1
RIGHT PROBE HEATER CONTROL NO. 2
LEFT PROBE HEATER CONTROL NO. 2
RIGHT PROBE MOTOR CONTROL NO. 1 (TYPICAL 1 OF 4 FHCA 1
LEFT PROBE MOTOR CONTROL NO. 1 (TYPICAL 1 OF 4 FHCA 1
LEFT PROBE CONTROL NO. 1 (TYPICAL 1 OF 2
ADTA 4
ADTA 2
ADTA 3
ADTA 1
TRANSDUCER PM3
TRANSDUCER PM2
TRANSDUCER PM1
TRANSDUCER PS
TRANSDUCER TEMP
SERIAL DATA REGISTER
BINARY COUNTER
SENSOR WORDS
PS DATA SELECT
PS MEMORY SELECT
SHIFT CHAN 5
COUNTER ENABLE
MEMORY
OFFSET
SLOPE
A/D CONVERTER
MONOSTABLE MULTIVIBRATOR
MULTIPLEXER
CONTROL LOGICS
SEQUENTIAL APPROXIMATION REGISTER
BIT 11 OR DATA
CLOCK GENERATOR
4 MHZ CRYSTAL OSCILLATOR
FRAME WORD SENSOR
DIGITAL OUTPUT
PARALLEL TO SERIAL BUFFER
MEMORY
DIGITAL DATA
ZERO TEST LINE
ACCEL TEST LINE
PS, SLOPE, OFFSET, MEMORY, TEMP, ACCEL TEST
PS BIT 1 OF 11 BITS
BITS 1-4 AT 1 MS
DATA WORDS 1 THRU 5 SEC
RETURN ZERO THROUGH A BUFFER/ATTRIL ASSEMBLY
STARTUP / MEMORY/STORAGE/MEMORY ADTA 1, 2 & 3, 10 MSEC
ADTA 4 STARTUP / MEMORY/STORAGE/MEMORY 10 MSEC
DIGITAL DATA OUT OF THE MAIN SYSTEM STARTUP / MEMORY
INCLUDES ARE DETERMINED BY COMPLIANCE PARAMETER ACTIVITY/DATA
SEE A/A SYSTEMS INSTALLATION MANUAL FOR DETAILS OF INSTALLATION
TO PILOT'S AND STANDBY INSTRUMENTS
SELF TEST EXERCISES STORED VALUES IN THE DIGITAL PROCESSOR AND PERFORMS A PROCESSOR SUPERVISION TEST. TO ENSURE ACCURATE OPERATION OF THE PROCESSOR, THE SYSTEM PERIODICALLY CHECKS ITS INTERNAL COMPUTATIONAL PROCESSING AND THE PRESSURE COMPUTATION
TEST AND UNDECODED TERMINATED
PS BIT 1 OF 11 BITS
BITS 1-4 AT 1 MS
DATA WORDS 1 THRU 5 SEC
RETURN ZERO THROUGH A BUFFER/ATTRIL ASSEMBLY
STARTUP / MEMORY/STORAGE/MEMORY ADTA 1, 2 & 3, 10 MSEC
ADTA 4 STARTUP / MEMORY/STORAGE/MEMORY 10 MSEC
DIGITAL DATA OUT OF THE MAIN SYSTEM STARTUP / MEMORY
INCLUDES ARE DETERMINED BY COMPLIANCE PARAMETER ACTIVITY/DATA
SEE A/A SYSTEMS INSTALLATION MANUAL FOR DETAILS OF INSTALLATION
TO PILOT'S AND STANDBY INSTRUMENTS
NOTES:
9 ADS
AIR DATA SYSTEM
BASIC REV F-4
BASIC REV F-4


RIGHT PROBE ASSY
LEFT PROBE ASSY
ADTA 4
ADTA 2
ADTA 3
ADTA 1
SENSOR BOARD
POWER SUPPLY/I/O BOARD
AIR DATA SYSTEM
9 ADS 2
BASIC REV F-4
BASIC REV F-4

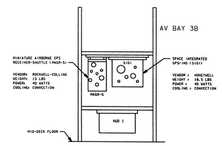
DATE: 12/26/95 | NAME: SAJ | VERSION: REV.F



EXISTING ANTENNAS

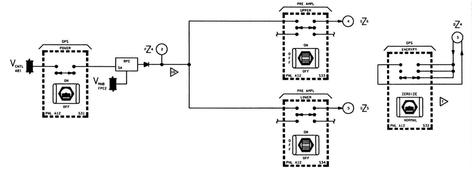
SECTION A-A

PRE-AMP AND RF COMBINER LOCATIONS

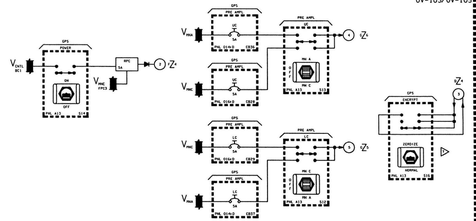


GPS RECEIVER LOCATION

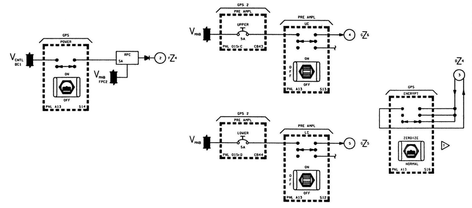
DV-102

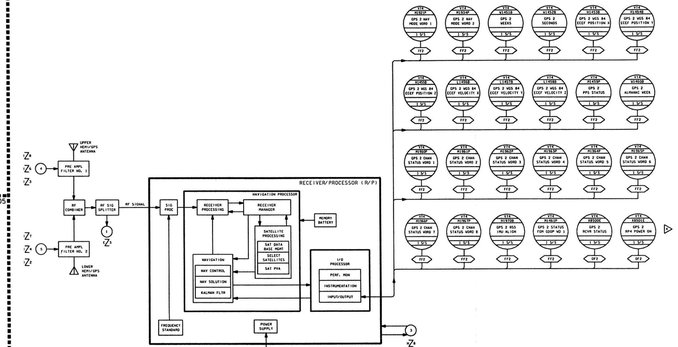


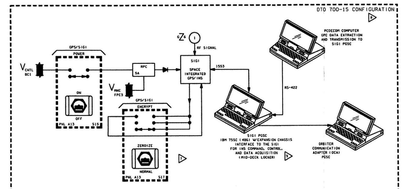
DV-103/DV-104



DV-104







FOR DV-102 GPS POWER MUST BE ON FOR THE PRE-AMPS TO BE POWERED

WHEN MAGR-S/SIGI, THE SIGI WILL BE MOUNTED ADJACENT TO THE MAGR-S IN AV BAY 3B. THE MAGR-S WILL INTERFACE WITH A DEDICATED MDM IN AV BAY 3B PANEL A15. THE SIGI WILL INTERFACE WITH A DEDICATED MDM FOR I/O COMMAND, CONTROL, AND DATA ACQUISITION. THE SIGI MDM WILL BE POWERED FROM MDM FA3 AND WILL BE LOCATED IN AFT FLIGHT DECK PANEL R12. THE SIGI WILL BE MICRONED ON 1&D PB FLASH CARDS AND TRANSMITTED TO THE MCC FOR ANALYSIS VIA THE ORBITER COMMUNICATION ADAPTER I/MID-DECK PCMCIA.

IF IT IS ANTICIPATED THAT THE SPACE INTEGRATED GPS/INS (SIGI) DEVELOPMENT FLIGHT UNIT (DFU) WILL BE FLOWN ON A MISSION, THE MAGR-S WILL BE CONFIGURATION FLIGHTS. THE GPS RF SIGNAL CAN BE MADE AVAILABLE TO THE SIGI DFU VIA THE GPS SPLITTER (PROVIDED AS PART OF THE RF COMBINER) (OPTIONAL) TO SPC-5B AND SPC-5D SLOTS.

AS SECURITY PROTECTION FOR THE MAGR-S PPS FUNCTION, THE CRYPTO-VAR (KOI-18 PANEL A12 OR DV-102, PANEL A13 OR DV-103, DV-104 AND DV-105) MUST BE LOADED WITH THE CURRENT KEY VARIABLE. THE MAGR-S WILL NOT ACCEPT UNKEY LABELED FOR NON-APPROVED LABELING S/CTLS/ACTION WILL SELECTIVELY AN INTERNAL ZEROTYPTION KEY,WHICH CAN ONLY BE RESET BY GROUND PERSONNEL.

THE MAGR-S GPS RECEIVER SHALL BE CAPABLE OF PROCESSING THE PPS FIXED POSITIONING SYSTEM (FPS) EXCRYPTED GPS SATELLITE S/GNALS

* GPS STATUS DISPLAY: LSPEC 851 AND 1801DIGITAL SITUATION DISPLAY (DSD) DISPLAY THE GPS STATUS (SELECTED SATELLITES TRACKED MODES NAV STATE, AND GPS-DERIVED ALT/MACH AND RANGE PARAMETERS TO THE SELECTED TACAN STATION

* DURING ANY GPS, A SINGLE GPS DISCRETE (4749850001) IS AVAILABLE VIA PASS MDM DFI:

  1 "0" = NORMAL RECEIVER TRACKING OF 7 SATELLITES, OR THE UNIT IS POWERED OFF.

  1 "1" = THE RECEIVER IS POWERED, BUT IS TRACKING LESS THAN 4 SATELLITES.

* THE CAPABILITY TO UPDATE THE ONBOARD STATE VECTOR WITH GPS DATA CAN BE ENABLED BY GPC SOFTWARE BIT 1 (GNS VFYS2202K):

  VFYS2202 = 0 NEVER LOCAL
  VFYS2202 = 1 NEVER LOCAL
  VFYS2202 = 2 ALWAYS LOCAL IN MF 5 ON AND 301
  VFYS2202 = 3 ALWAYS LOCAL *

  * IN ORDER TO HAVE THE GPS STATE VECTOR AVAILABLE FOR EMERGENCY LANDING SITES (NO TACAN), THE LOCKOUT FLOW(VFYS2202 WILL BE SET ZERO, TO 3 ALWAYS LOCAL).

* ONE R-BOSE 11 CENT-MODULE SUPPLIED TO THE GPS RECEIVER FOR UNPOSED PROPAGATION OF THE GPS STATE VECTOR, AND FOR RAPID SATELLITE RECOVERY

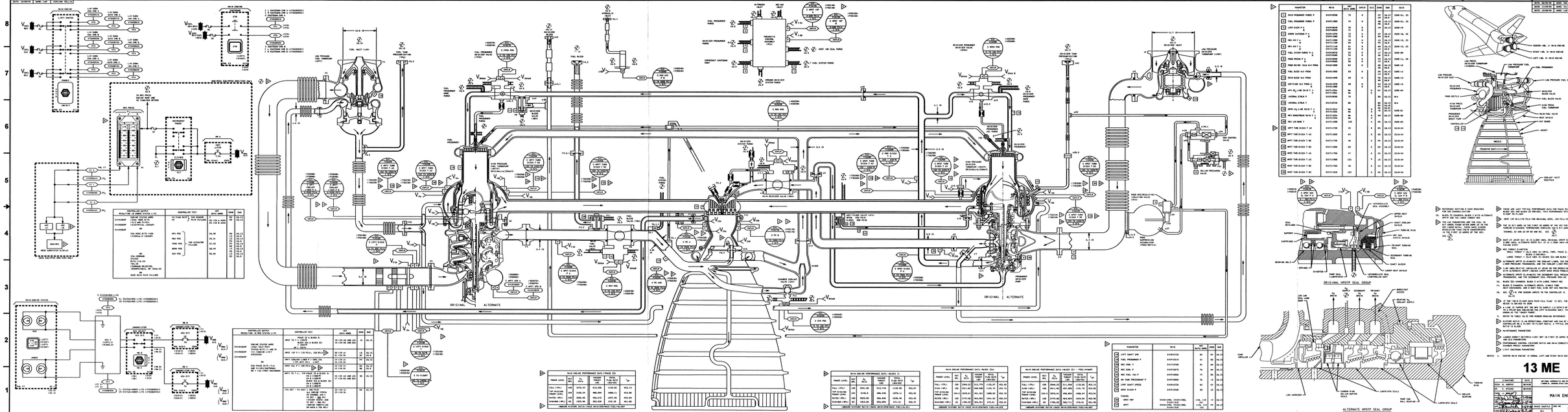
NOTES: 1. THIS SINGLE GPS RECEIVER CONFIGURATION WILL BE FLOWN AS BACKUP TO A FULL COMPLEMENT OF 3 D- SAGMS

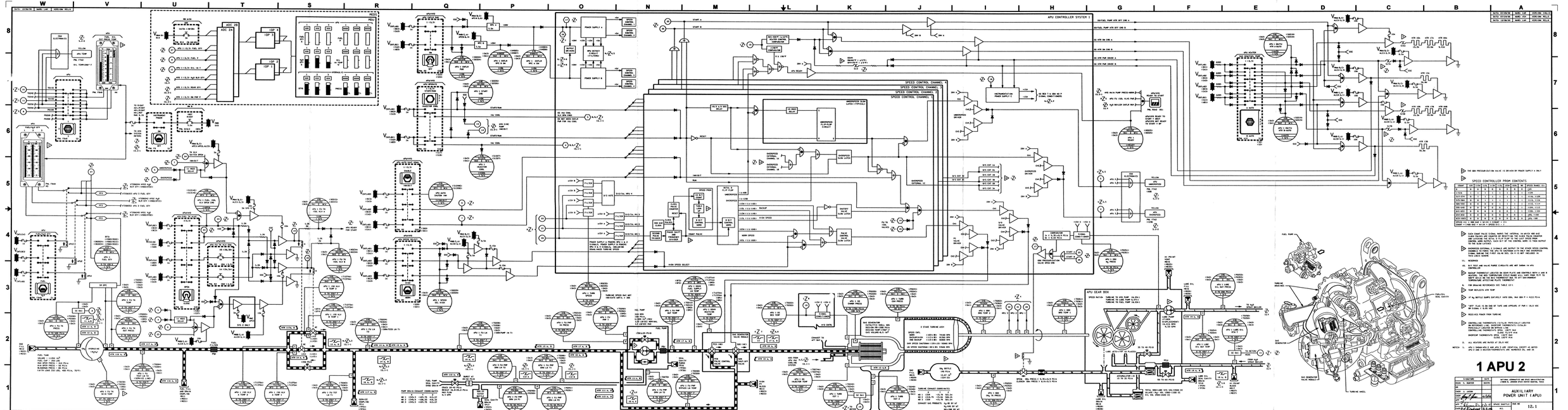
18 MAGR-S

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DESN: G. BLANCHARD	09/94	
DR: C. RILEY		GLOBAL POSITIONING SYSTEM (GPS) 01-27
CHKR: H. HYDEMAN/B.SLD		
CHANGE NO.		
APPROVED BY: [signature]		
CONFIGURATION MANAGEMENT OFFICE: [signature]		

SIZE	CODE IDENT	DRAWING NO.	REV
D	80	9.18	
SCALE: N/A		SHEET 1 OF 1	

BASIC REV F-4


MAIN ENGINE
LOX TANK
LH2 TANK
MPS PRESS
ORIGINAL
ALTERNATE
FUEL TURBOPUMP
OXIDIZER TURBOPUMP
MAIN ENGINE STATUS
ANNUNCIATOR
MAIN ENGINE CONTROLLER
ENGINE STATUS WORD RESULTING FROM BIT TEST
CONTROLLER OUTPUT RESULTING FROM MEB STATUS LISTS
CONTROLLER TEST
MAIN ENGINE PERFORMANCE DATA (PHASE II)
MAIN ENGINE PERFORMANCE DATA (BLOCK II)
MAIN ENGINE PERFORMANCE DATA (BLOCK IIA)
MAIN ENGINE PERFORMANCE DATA (BLOCK IIA) - POLYIMIDE
PARAMETER
MEB
MPS
ALTERNATE HPOTP SEAL GROUP
ORIGINAL HPOTP SEAL GROUP
13 ME
MAIN ENGINE
BASIC REV F-4



1 APU 2

SIGNATURE	DATE	TITLE
DESIGN: TL MARTIN	00/00/00	TECHNICAL INFORMATION AND DATA ANALYSIS FOR TRAINING, ORDNANCE, SPACE SYSTEMS, AND MORE
CHIEF ENGINEER:		
PROJECT ENGINEER:		AUXILIARY POWER UNIT (APU)
CHIEF ARTIST: JASON		
CHIEF ENGINEER: Jeffrey A. Martin		
PUBLISHER: P.A.S.S. SPACE SAFETY	DWG NO:	12.1
CHIEF ENGINEER: Richard Hoyt	REV:	
SCALE: NONE	SHEET 1 OF 1	

BASIC REV F-4

NOTE: ON FIG'S	NAME: 10A	VOLTS/AN: VOLTS
NOTE: ON FIG'S	NAME: 11A	VOLTS/AN: VOLTS
NOTE: ON FIG'S	NAME: 9A1	VOLTS/AN: VOLTS

3 HYD PWR

HYDRAULIC LOOP VOLUMES

TOTAL: EXCLUDING RESERVOIR	SYS 1: 39 GAL	SYS 2: 25.5 GAL	SYS 3: 27 GAL
LOWEST SEAT SIDE OF LOWEST ROW OF FIRST CLASS SEATS	SYS 1: 25.4 GAL	SYS 2: 1.9 GAL	SYS 3: 1.7 GAL
ENGINE DRIVEN PUMPS (INCLUDES ACTUATORS AND ENGINE VALVE / INCLUDES ACTUATORS AND ENGINE)	SYS 1: 5.7 GAL	SYS 2: 5.5 GAL	SYS 3: 5.5 GAL
ELEVON ACTUATORS: EACH	OUTBOARD: 0.7 GAL	INBOARD: 0.7 GAL	
TVC ACTUATORS: EACH	CENTER (ENGINE): 1.1 GAL	OUTBOARD: 0.9 GAL	
B/T SPRING-DUAL ACTUATOR: EACH	1.08 GAL		

VOLUMES TO SUPPLY SYSTEMS FOR 80 CMD

HYDRAULIC SYSTEMS DECLINE ACCUMULATORS WILL REPLACE PISTON TYPE ACCUMULATORS PER THE FOLLOWING:

04-1001	1000
04-1002	1010
04-1003	1010BB
04-1005	1010BB

FIRST MEDS FLIGHT ON 04-1001 STA 99

LAST MEA MEDS FLIGHT ON 04-1003 STA 99 STORAGE FOR MARCH, 2005

HYD PUMP CASE DRAIN TEMPERATURE TRANSDUCER WILL BE INSTALLED ON THE FOLLOWING HYD PUMP TEMPERATURE TRANSDUCER PER THE FOLLOWING SCHEDULE:

04-1001	STA 99
04-1002	STA 99
04-1003	STA 99
04-1005	ALTER 2 MEA'S

TVC HORNESS FOR 04-01 AND SUBS.

HYDRAULIC SYSTEM PUMP TEMPERATURE SENSOR INTERFACE FOR 04-1001 AND SUBSEQUENT, 04-01-201 AND SUBS, REF SAE LS-3.19

THE 3 WAY FLOW CONTROL VALVE HAS SPECIALLY ADDED PORTS TO ALLOW FOR THE USE OF THE MANUAL GEAR DRIVE ACTUATORS. THE VALVE ALLOWS FLOW IN BOTH DIRECTIONS AT ALL TIMES AND MAINTAINS A DELTA PRESSURE OF APPROXIMATELY 900 TO 1000 PSID.

IF VERSIONS OF #5005-00 OR #5005-01 = 1, THEN IT IS POSSIBLE TO HAVE ONE OR MORE OF #5005-00 AND #5005-01 AND CONTAIN 1 = 1, 2, OR 3. IF #5005-00 AND #5005-01 = 0, THEN NO PUMPS ARE PRESSURIZED.

NOT USED

ADD LOG AND THE CAPABILITY TO SEND SOFTWARE COMMANDS TO MAX FLOW PUMPS RELEASED.

HYDRAULIC SYSTEM PUMP TEMPERATURE SENSOR SIGNALS FROM SOFTWARE CONTROL.

SV PARAMETER (MAX/STDS FOR 4150A DATA NOTE INFORMATION AND USED AS MINIMUM SAT BASELINE PRESSURE INDICATOR

EPC PARAMETER USED BY PRIORITY MUTE LIMITING SOFTWARE

INVERTERS, MOTORS, AND 3 IDLER PUMPS ARE ADDED IN HYDRAULIC FLUID FOR COOLING DURING ENTIRE SYSTEM OPERATION

NOT ON 04-102

LOW PRESS THERMAL BYPASS VALVES NOT SHO LS.3-1.

ALL GAS PUMP, MOTOR SEAL DUCTS INSTALL, AND ALL GAS PUMP/MOTOR HOUSINGS TO BE SHO LS.3-1.

HYDRAULIC CIRCULATION PUMP SOFTWARE CONTROLLING TEMPERATURE SENSORS

NOTES:	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION / LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TEXAS		DESIGN / ENGR'G	DATE
		DRAWN	
		CHKD	
		APP'D	
HYDRAULIC POWER SYSTEM		PROGRAM MANAGER	
DWG NO. 12-3	SPACE SHUTTLE PROGRAM		
SHEET 1 OF 1	SIZE D	SCALE NONE	

BASIC REV F-4

BASIC REV F-4

DATE: 02/23/00	NAME: VOA	HDR/ECMA: CIRCLE
DATE: 02/28/00	NAME: VOA	HDR/ECMA: CIRCLE
DATE: 02/23/00	NAME: VOA	HDR/ECMA: RELLIS

BODY FLAP HEATERS

HEATER WATTAGE AT 250VDC "A" AND "B"

ELEVON ACTUATOR HEATERS

HEATER WATTAGE AT 250VDC "A" AND "B"

RUDDER/SPEEDBRAKE HEATERS

HEATER WATTAGE AT 28VDC "A" AND "B"

AFT FUSELAGE HYDRAULIC HEATERS

HEATER WATTAGE AT 28.5VDC "A" AND "B"

BRAKE AND TUNNEL LINE HEATERS

HEATER WATTAGE AT 28VDC "A", "B", AND "C"

CIRC PUMP SOFTWARE CONSTANTS			
ACCUMULATOR PRESSURE MGMT SOFTWARE			
NAME	ID NUMBER	PRESET VALUE	UNITS
HYD SYS 1 ENT ACCUM PRESS U/L	V52P1547AC	3900	PSIA
HYD SYS 1 ENT ACCUM PRESS L/L	V52P1548AC	3800	PSIA
HYD SYS 1 ENT ACCUM PRESS T/D	V52U1547AC	2	MINUTES
RECIRCULATE PRESSURE MANAGEMENT SOFTWARE CONSTANTS			
NAME	ID NUMBER	PRESET VALUE	UNITS
HYD SYS 1 RIGHT PRESS U/L	V52P1551AC	70	PSIA
HYD SYS 1 RIGHT PRESS L/L	V52P1552AC	50	PSIA
HYD SYS 1 RIGHT PRESS T/D	V52U1551AC	2	MINUTES
HYD THERMAL CONDITIONING SOFTWARE			
NAME	ID NUMBER	PRESET VALUE	UNITS
HYD 1 CIRC PUMP MINIMUM RUN TIME	V52U1756AC	10	MINUTES
HYD 2 CIRC PUMP MINIMUM RUN TIME	V52U1757AC	10	MINUTES
HYD 3 CIRC PUMP MINIMUM RUN TIME	V52U1758AC	10	MINUTES
HYD 3 CIRC PUMP START DELAY TIME	V52U1759AC	15	SECONDS
HYD 1 CIRC PUMP PRESS U/L	V52P1554AC	200	PSIA
HYD 2 CIRC PUMP PRESS U/L	V52P1555AC	200	PSIA
HYD 3 CIRC PUMP PRESS U/L	V52P1556AC	200	PSIA

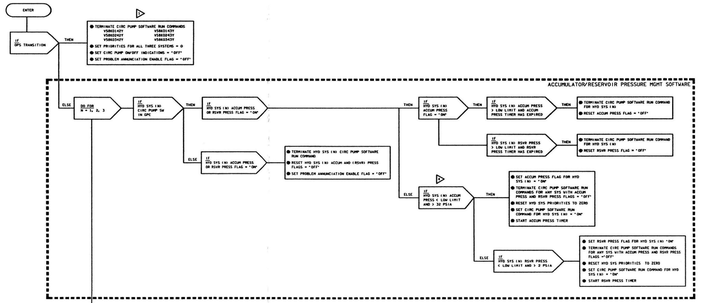
HYDRAULIC CIRC PUMP TEMP SENSORS

SYSTEM	MEAS	DESCRIPTION	LLIM/ULIM	S/W CONTROL LIMITS	T-HOLD
HYD SYSTEM 1	V58T0312A	HYD 1 MLG UPLK LK T		0116ELDS	
	V58T0313A	HYD 1 MLG UPLK LK RTN T		0116ELDS	
	V58T0314A	HYD 1 MAIN ENG GIMBAL T		0116ELDS	
	V58T0315A	HYD 1 MAIN ENG RTN T FUS		0116ELDS	
	V58T0316A	HYD 1 MAIN ENG RTN T FWD		0116ELDS	
	V58T0317A	HYD 1 MAIN ENG RTN T AFT		0116ELDS	
	V58T0318A	HYD 1 LOW UPLKT RTN T		0116ELDS	
	V58T0319A	HYD 1 LOW UPLKT T	0/0	0116ELDS	20/0
	V58T0320A	HYD 1 RUD ELEVON T		0116ELDS	
	V58T0321A	HYD 1 RUD ELEVON T	0/0	0116ELDS	20/0
	V58T0322A	HYD 1 RUD ELEVON T	0/0	0116ELDS	20/0
	V58T0323A	HYD 1 LOB ELEVON T		0116ELDS	
	V58T0324A	HYD 1 LOB ELEVON T	0/0	0116ELDS	20/0
	V58T0325A	HYD 1 RIB ELEVON T	0/0	0116ELDS	20/0
HYD SYSTEM 2	V58T0326A	HYD 2 MLG BK RTN T FUS		0116ELDS	
	V58T0327A	HYD 2 MLG BK RTN T FWD		0116ELDS	
	V58T0328A	HYD 2 MLG BK RTN T AFT		0116ELDS	
	V58T0329A	HYD 2 LWL BK RTN T FUS		0116ELDS	
	V58T0330A	HYD 2 LWL BK RTN T FWD		0116ELDS	
	V58T0331A	HYD 2 LWL BK RTN T AFT		0116ELDS	
	V58T0332A	HYD 2 LOB ELEVON T	0/0	0116ELDS	20/0
	V58T0333A	HYD 2 LOB ELEVON T	0/0	0116ELDS	20/0
HYD SYSTEM 3	V58T0334A	HYD 3 MAIN ENG RTN T FUS		0116ELDS	
	V58T0335A	HYD 3 MAIN ENG RTN T FWD		0116ELDS	
	V58T0336A	HYD 3 MAIN ENG RTN T AFT		0116ELDS	
	V58T0337A	HYD 3 LWL BK RTN T FUS		0116ELDS	
	V58T0338A	HYD 3 LWL BK RTN T FWD		0116ELDS	
	V58T0339A	HYD 3 LWL BK RTN T AFT		0116ELDS	
	V58T0340A	HYD 3 RUD ELEVON T	0/0	0116ELDS	20/0
	V58T0341A	HYD 3 RUD ELEVON T	0/0	0116ELDS	20/0
	V58T0342A	HYD 3 RIB ELEVON T	0/0	0116ELDS	20/0
	V58T0343A	HYD 3 RIB ELEVON T	0/0	0116ELDS	20/0

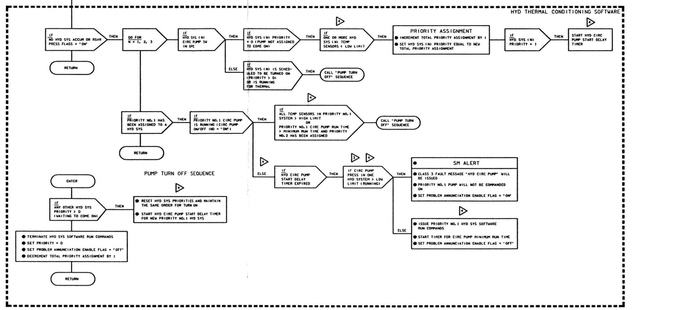
PASS CIRC-PUMP FSW PRE-CONDITIONING LOGIC

MESSAGE	MCID	L/S	LL	HL	PRECONDITION LOGIC
SET CIRC PUMP 1	V58P0537A HYD 1 CP 1	1	108	904	HYD SYS1 ENT ACCM OR HYD SYS1 ENT ACCM PRESS FLAG = "ON" AND HYD CIRC PMP DOWN SM OR PMP SPD CMD = ON (V58D0537EC = 1) (V58D0538EC = 1)
		2	104	908	HYD SYS1 ENT ACCM PRESS TIMER EXPIRED AND HYD CIRC PMP START AND HYD CIRC PMP START AND PMP SPD CMD = OFF (V58D0537EC = 0) (V58D0538EC = 0) (V58D0539EC = 0)
	V58P0537A HYD 2 CP 2	1	108	904	HYD CIRC PMP DOWN SM OR HYD CIRC PMP DOWN SM PMP SPD CMD = ON (V58D0538EC = 1) (V58D0539EC = 1) (V58D0540EC = 1)
		2	104	908	HYD CIRC PMP START AND HYD CIRC PMP START AND PMP SPD CMD = OFF (V58D0538EC = 0) (V58D0539EC = 0) (V58D0540EC = 0)
	V58P0537A HYD 3 CP 3	1	108	904	HYD CIRC PMP DOWN SM OR HYD CIRC PMP DOWN SM PMP SPD CMD = ON (V58D0539EC = 1) (V58D0540EC = 1) (V58D0541EC = 1)
		2	104	908	HYD CIRC PMP START AND HYD CIRC PMP START AND PMP SPD CMD = OFF (V58D0539EC = 0) (V58D0540EC = 0) (V58D0541EC = 0)
CIRC PUMP	THERM CNTRL CIRC PMP ON	0/1	n/a	n/a	PRESSURE OR T/D 5 OR 6 OR 7 OR 8 FAILS TO CLOSE CIRC PUMP PRESSURE CONSTANTS (SYS 1V52P1554AC, SYS 2V52P1555AC, SYS 3V52P1556AC),

ACCUMULATOR/RESERVOIR PRESSURE MGMT SOFTWARE

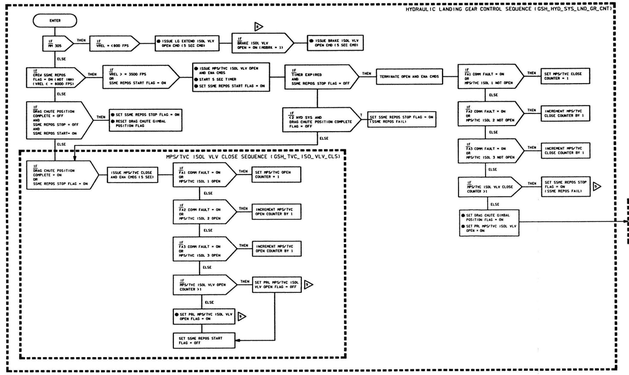


HYD THERMAL CONDITIONING SOFTWARE



PUMP TURN OFF SEQUENCE

HYDRAULIC LANDING GEAR CONTROL SEQUENCE (GSH, HYD, STS, LNG, GR, ENT)



EACH SDRC PITCH AXIS IS COMMANDED DOWN TO 20 DEGREES (5.5 DEG/SEC)

PRI HPS/TVC 1SOL VLV FLAGS ARE SENT TO THE PRI SSP SOFTWARE MODULE

FROM LANDING GEAR SW DRAWING 15.5.4.

1. SEQUENCE IS CALLED AT 6.25 HZ) BEGINNING AT VREL = 8000 FPS
2. FOR DRAWING REFERENCES, SEE TABLE 19-1

TUNNEL LINE HEATERS ARE ON SYSTEM A ONLY, AND ARE NOT ON OV-102

HYD TEMPERATURE LOG AND HYD CIRC PUMPS CONTROL SEQUENCE (SEE LOW LIMIT, HYDRAULIC CIRC PUMP MINIMUM RUN TIME, CIRC PUMP START DELAY TIME, AND HYD SYS PRIORITIES FOR LOGIC DETAILS)

LOW LIMIT MUST BE CHANGED BY FSW PATCH OR SMEC TO ALLOW SUBSEQUENT HYDRAULIC OPERATIONS

1. DELETED

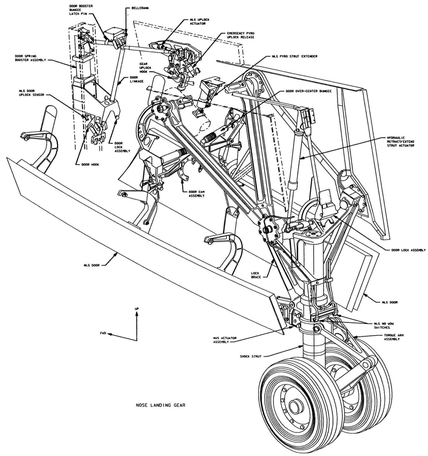
NOTES: ASC COMMANDS ARE USED TO RUN THE CIRC PUMPS (RELEASE AND REMAIN SET "ON" UNTIL CLEARED BY THE OPS 2 INITIALIZATION

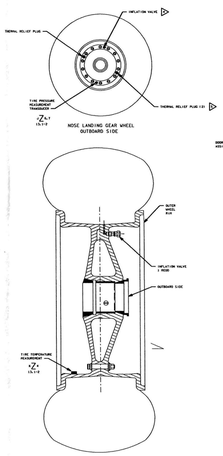
3 HYD PWR 3

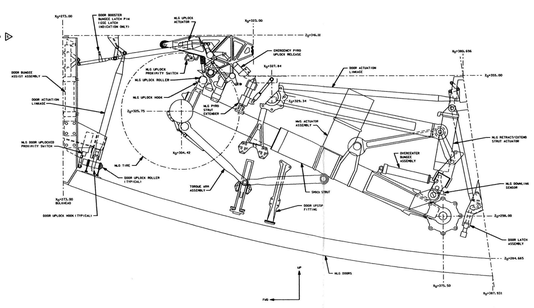
SIGNATURE	DATE	
DOCH K. DOGGETT	10/29/79	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
CK R. ORTIZ-ALES	10/29/79	
CHIEF C. FLYNN		HYDRAULIC POWER SYSTEM
APP		
APP		
APP		
CONFIG		

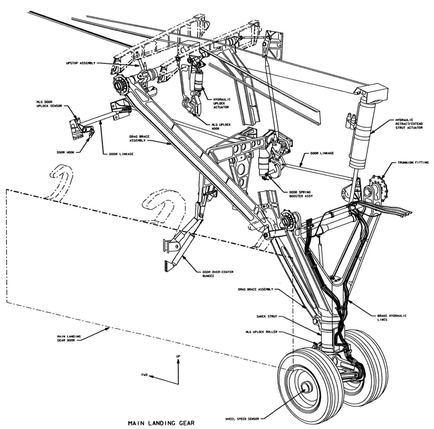
SPACE SHUTTLE	DWG NO	
PROGRAM	FIG	12.3
ALT 7	SHEET	SHEET 1 OF 1

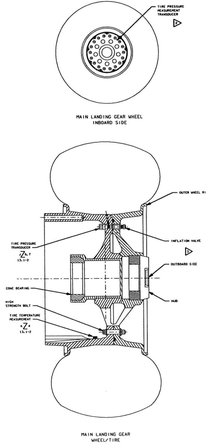
BASIC REV F-4

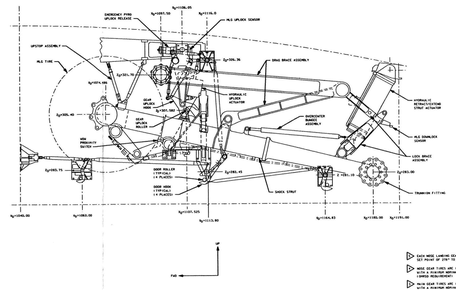








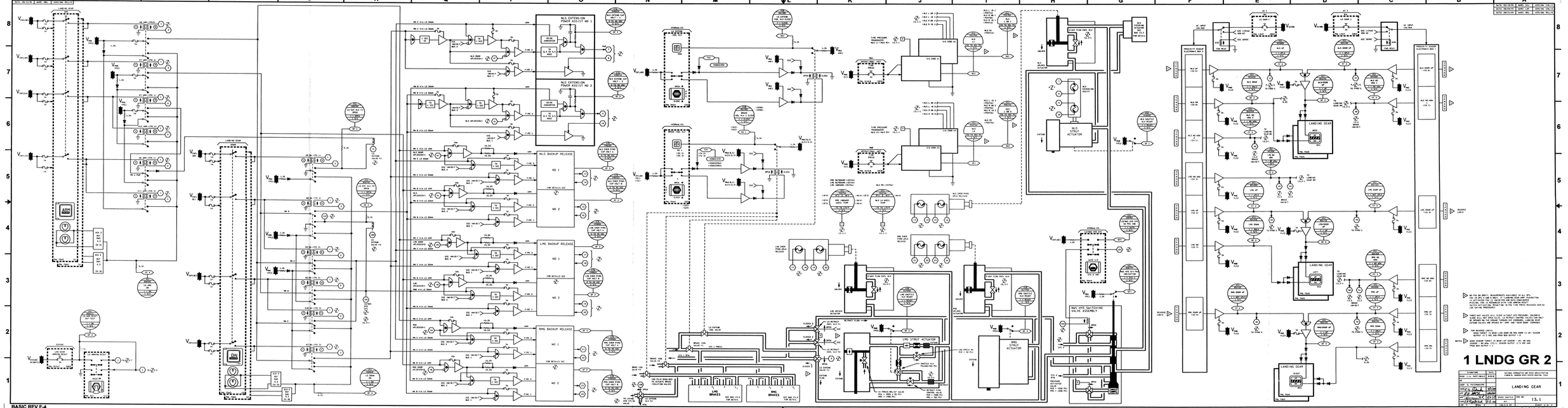


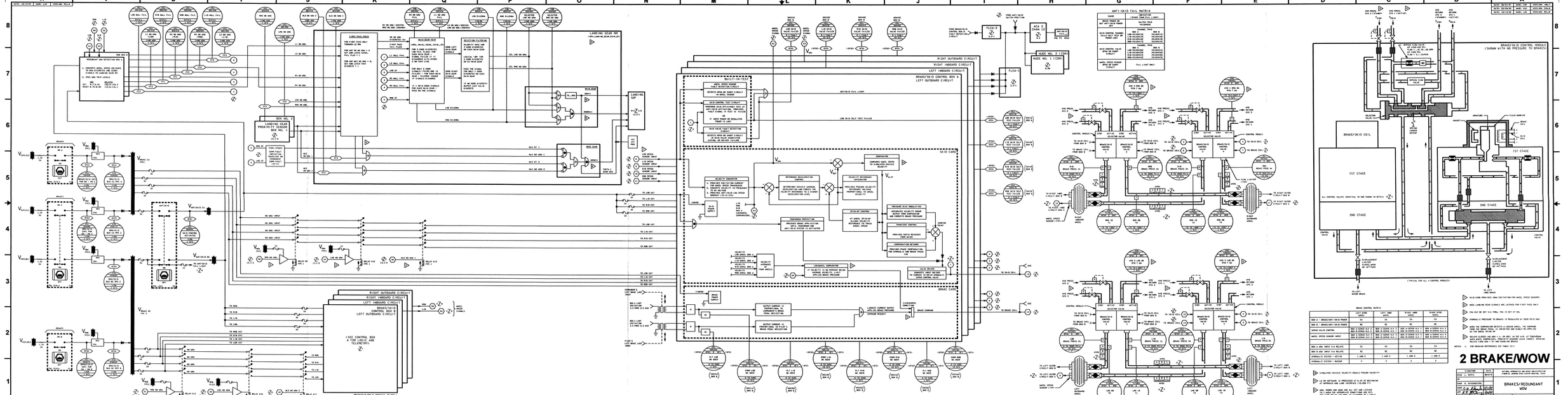


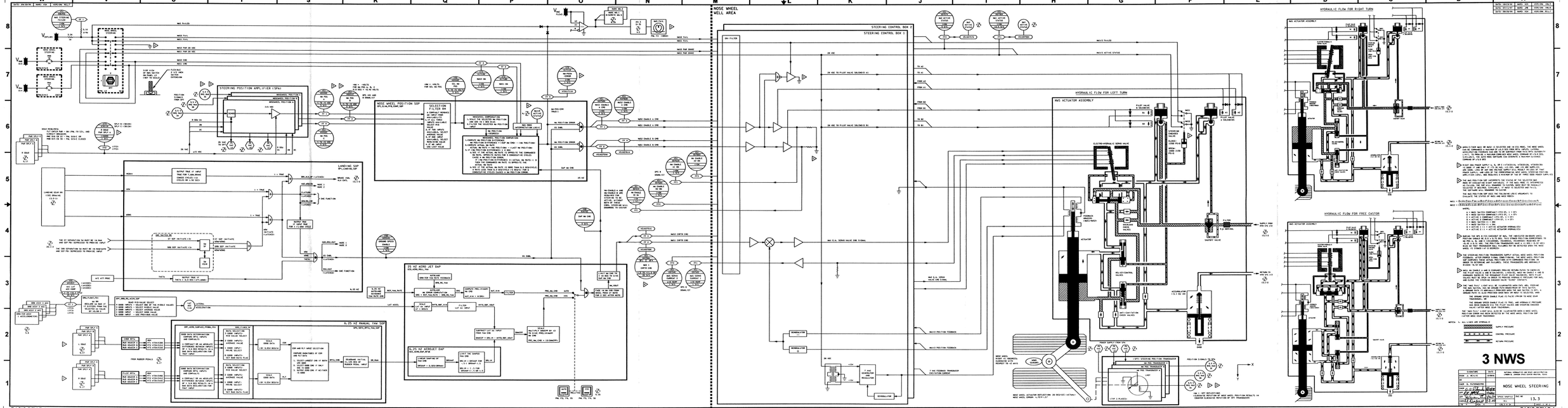
NOTES: L. FOR DIMENSIONAL REFERENCES SEE TABLE 13-1.

1 LG

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
EDGAR L. C. BUCKHANNON	5/2/88	JOHNSON SPACE CENTER HOUSTON, TEXAS
APPROVED		
CHIEF, ENGINEERING DIVISION		
CHIEF, ENGINEERING DIVISION		
CHIEF, ENGINEERING DIVISION


1 LNDG GR 2
LANDING GEAR
BASIC REV F-4


BRAKE/SKID CONTROL MODULE
(SHOWN WITH NO PRESSURE TO BRAKES)
1ST STAGE
2ND STAGE
ALL CONTROL VALVES IDENTICAL TO ONE SHOWN IN DETAIL
TYPICAL FOR ALL 4 CONTROL MODULES
ANTI-SKID FAIL MATRIX
BRAKE CONTROL MATRIX
2 BRAKE/WOW
BRAKES/REDUNDANT WOW
BRAKE/SKID CONTROL BOX A
LEFT INBOARD CIRCUIT
RIGHT INBOARD CIRCUIT
LEFT OUTBOARD CIRCUIT
RIGHT OUTBOARD CIRCUIT
BRAKE CARD
SKID CARD
BASIC REV F-4

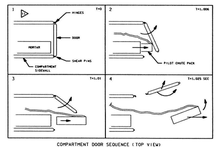

NOSE WHEEL WELL AREA
STEERING CONTROL BOX 2
STEERING CONTROL BOX 1
STEERING POSITION AMPLIFIER (SPA)
NOSE WHEEL POSITION SOP
LANDING GEAR SOP
6.25 HZ AERO JET GAP
6.25 HZ MANUAL TAX SOP
6.25 HZ AEROJET GAP
HYDRAULIC FLOW FOR RIGHT TURN
HYDRAULIC FLOW FOR LEFT TURN
HYDRAULIC FLOW FOR FREE CASTOR
NWS ACTUATOR ASSEMBLY
3 NWS
NOSE WHEEL STEERING
BASIC REV F-4

4 D CHUTE MECH

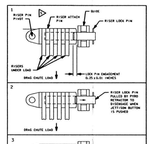
DATE: 03/09/81	NAME: TU	ADDL/INIT: BPLT
DATE: 03/10/81	NAME: AM	ADDL/INIT: MAL1
DATE: 03/13/81	NAME: LAR	ADDL/INIT: WILLS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TEXAS		SIGNATURE	DATE
		Chief, S. MARTIN	03/13/81
		OR	
		CHIEF, D. PATTERSON	
DRAG CHUTE MECHANICAL		CHIEF, J. [illegible]	03/13/81
		CHIEF, J. [illegible]	03/13/81
DOC NO: 13, 4	SPACE SHUTTLE PROGRAM	CHIEF, [illegible]	03/13/81
		CHIEF, [illegible]	03/13/81
	N/A	CHIEF, [illegible]	03/13/81
SHEET 1 OF 1	CR/S/C NO. N/A	CHIEF, [illegible]	03/13/81

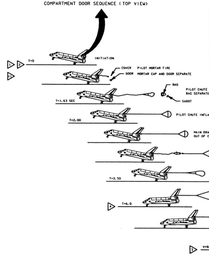
BASIC REV F-4



COMPARTMENT DOOR SEQUENCE (TOP VIEW)

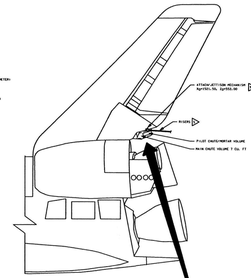


ATTACH/JETTISON MECHANISM DRAG CHUTE JETTISON SEQUENCE (TOP VIEW)

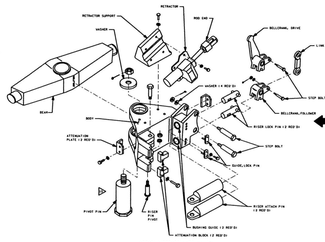


NOMINAL SEQUENCE OF DRAG CHUTE DEPLOYMENT, INFLATION, AND JETTISON

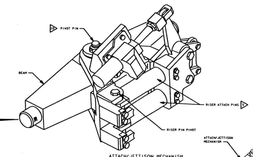
DRAG CHUTE CONFIGURATION



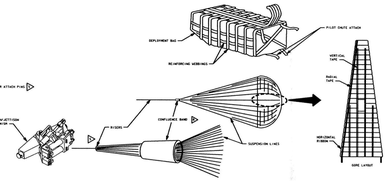
DRAG CHUTE SYSTEM



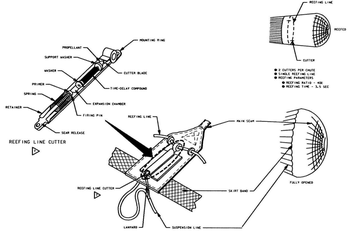
ATTACH/JETTISON MECHANISM EXPLODED VIEW



ATTACH/JETTISON MECHANISM



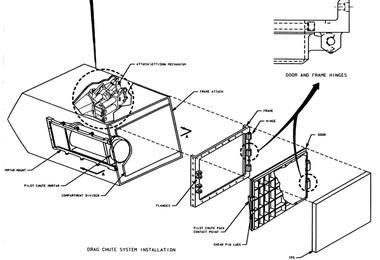
PARACHUTE ASSEMBLY COMPONENTS



REEFING LINE CUTTER

MAIN DRAG CHUTE REEFING

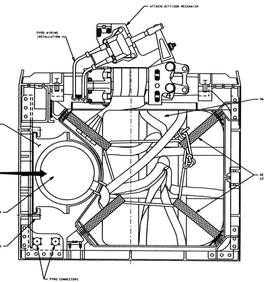
ORBITER DRAG CHUTE CONTROL ASSEMBLY LOCATION



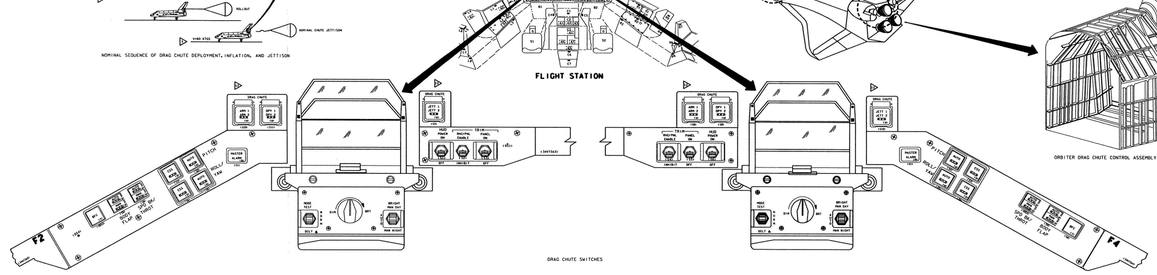
DRAG CHUTE SYSTEM INSTALLATION

DOOR AND FRAME HINGES

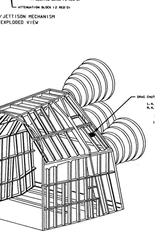
PILOT CHUTE MORTAR



PARACHUTE COMPARTMENT VIEW LOOKING FORWARD SECTION A-A



DRAG CHUTE SWITCHES

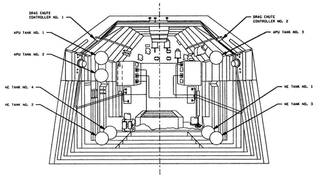


- ALL PB'S ARE GUARDED. WHEN LIFTED, THE GUARDS REMAIN UP.
- THERE IS A 3MC SECOND DUPLICATION DELAY BETWEEN PUSHING THE RISER RELEASE PB AND FIRING THE ACTUATING VALVES IN THE T-0 LINE.
- THE PIVOT PIN FAILS WHEN A LOAD BETWEEN 10000 LBS AND 12000 LBS (1.4PPS ISO RESULTING IN CHUTE SEPARATION.
- ALL DRAG CHUTE LOADS ARE TAKEN IN THE ATTACH/JETTISON MECHANISM AND ARE NOT CARRIED THRU DISTRIBUTED IN THE ORBITER FULL STRUCTURE.
- THE COMPLIANCE BAND REMAINS AT A FIXED DISTANCE FROM THE ATTACH/JETTISON MECHANISM (-0, 2 FT).
- THE CLOSED FIT EXPLOSIVE
  - TIME DELAY: 4.50 SECONDS
- THE RESTRAINT PATH IS DIRECTED VIA THE PATH OF DRAG FORCE (SEE TO TOTAL DRAG FORCE AVAILABLE WITH FULL INFLATION.
- THE RISER ATTACH PINS EXIST WHILE 20 PSIGNS (INSTALLING PIN WITH A LOADING OF 8,000 LBS) AND THE RISER RELEASE PB IS ARMED. THE RISER RELEASE PB IS ARMED AT 20 PSIGNS AND FIRED AT 8.0 PSIGNS.
- THE MAXIMUM STRUCTURAL LOAD THAT THE ORBITER TAIL SECTION CAN TAKE WITHOUT DAMAGE IS 120000 LBS. THE MAXIMUM DRAG CHUTE LOAD THAT THE CHUTE IS EXPECTED TO SEE EXCEEDS 180,000 LBS.
- NOMINAL JETTISON OF THE DRAG CHUTE IS 60 KNOTS GROUND SPEED
- THE MAXIMUM DEPLOYMENT VELOCITY FOR THE DRAG CHUTE SYSTEM IS 200 KNOTS. THE MAXIMUM DEPLOYMENT DYNAMIC PRESSURE IS 200 KNOTS GROUND SPEED.

NOTES:
1. NOMINAL DEPLOYMENT OF THE DRAG CHUTE IS AT 195 KNOTS, 10° ATTITUDE, AND MAXIMUM DECELERATION. DEPLOY THE CHUTE AT 10-15 SECS THEREAFTER.

BASIC REV F-4

DATE: 09/29/78	NAME: VSH	VERSION: ROLL 8
DATE: 04/28/81	NAME: JFB	VERSION: ROLL 8
DATE: 04/29/81	NAME: VSH	VERSION: ROLL 8



AFT COMPARTMENT, LOOKING FORWARD

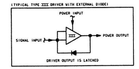
DRAG CHUTE BUS FAILURE MATRIX	DEP 1 DRAG CHUTE ARM	PLT 1 DRAG CHUTE ARM	DEP 1 SPFV/JETT FIRE 1	DEP 2 SPFV/JETT FIRE 2	PLT 1 SPFV/JETT FIRE 1	PLT 2 SPFV/JETT FIRE 2
PMB 515		X				
PMC 516	X					
CKTL 801				X		
CKTL 802			X			
CKTL 061						X
CKTL 062					X	

CHUTE AVIONICS SWITCH COMMAND	RESULT OF SWITCH COMMAND (NORMAL)
ARM PWR	ENABLES CHARGING OF SPFV/JETT CAP BANKS
SPFV/JETT PBI	PBIL 1: ENABLES THE HOI RET PATHS PBIL 2: ENABLES THE HOI PWR PATHS

- AN ARM, A FIRE 1, AND A FIRE 2 COMMAND ARE ALL REQUIRED FOR CHUTE DEPLOY AND JETTISON
- 10. SUBSEQUENT TO ARMING THE DRAG CHUTE SYSTEM, BOTH PBI 72 & 73 MUST BE DEPRESSED TO ENABLE THE DEPLOY AND JETT FIRE SEQUENCES. THE CHUTES ARE FIRED ON PBI 72 SHOULD UNSTICK THAT THE *ARMED FOR DEPLOY IS ENABLED, WHILE THE CHUTE ARE FIRED ON PBI 73 SH UNSTICK THAT THE *ARMED FOR JETT IS ENABLED
- 9.
- CAPACITOR BANK CONSISTS OF TEN 680µF CAPACITORS IN PARALLEL EQUIVALENT TO 6800µF
- REFERENCE SSSH DRAWING 4.3.1 HCA LIGHTING
- LOAD AND RESISTANCE TEST TELEMETRY IS AVAILABLE DURING PRE-FLIGHT ONLY STRAINED VIA PRE-FLIGHT BUS
- 5 VDC AND 28 VDC SOURCES ARE POWERED VIA CEC AND PRE-FLIGHT BUS
- CONNECTORS ARE UNPLUGGED, CAPPED, AND STOWED
- NON-AUTOLAND HARDWARE IS INSTALLED ON OV-105 ONLY. CPC SOFTWARE CAN ARM, DEPLOY, AND JETTISON THE DRAG CHUTE VIA THE NON - AUTOLAND HARDWARE WHEN AUTOLAND HARDWARE IS NOT INSTALLED. THE AUTOLAND HARDWARE, LAYERS AND SIGNALS, MUST NOT BE RECONNECTED TO SUPPORT ISS MISSIONS CONTROLLER NO. 2 COMMANDS ARE SHOWN IN PARENTHESIS
- ALL RESISTOR VALUES ARE 5.1K OHMS±1 WATTS, UNLESS OTHERWISE NOTED
- NOTES 1. TYPE 222 DRIVER WITH AN EXTERNAL DIODE CONNECTED FROM POWER OUTPUT LEAD TO INPUT LEADS. DIODE THE DRIVES 15 CHUTE/225 SPEAKS AND SIGNAL LEADS POWERED. THE DIODE PROTECTS DRIVER FROM BEING DESTROYED BY BACK EMF WHEN THE POWER TO DRIVER IS REMOVED. THE DIODE ALSO PREVENTS THE DRIVER FROM BEING ALL BEING LATCHED (SIGNAL) WHEN THE DRIVING INPUT SIGNAL IS REMOVED FROM THE DRIVER.

THE DRIVER IS RESET / TURNED OFF FROM THE "LATCHED" STATE BY REMOVING POWER FROM THE "POWER INPUT" LEAD - USUALLY ACCOMPLISHED BY PULLING THE APPROPRIATE CB

1 TYPICAL TYPE 222 DRIVER WITH EXTERNAL DIODE)

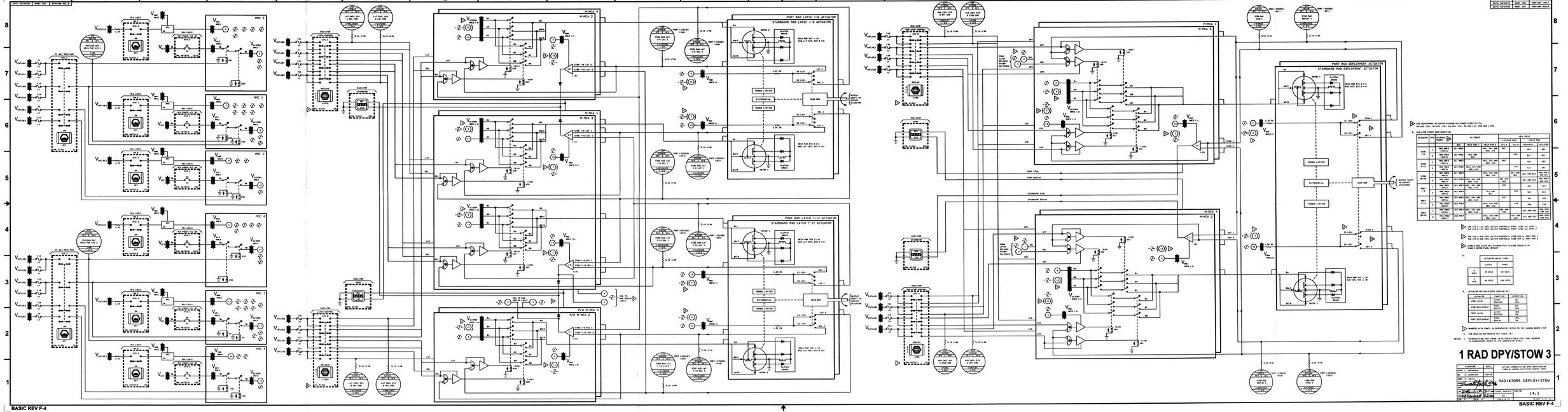


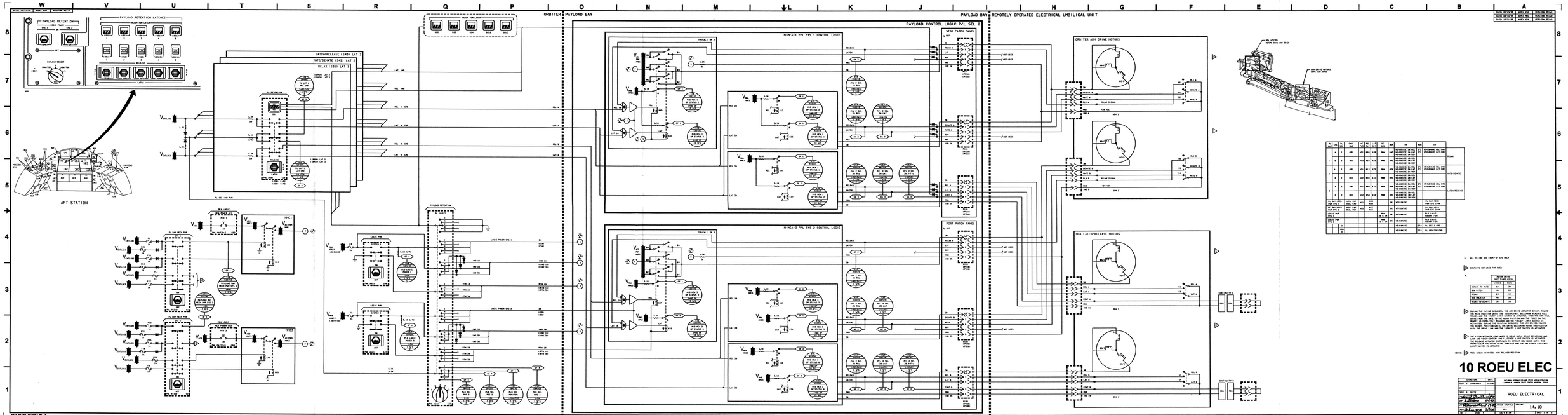
4 D CHUTE ELECT 2

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
DESN: G. PUGLIESE	5/1/81	LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DR: A. TORRES, JR.	9/8/78	
CHKR: G. PUGLIESE		DRAG CHUTE ELECTRICAL
CHKR: [illegible]	[illegible]	
APPROVED: [illegible]	[illegible]	
APPROVED: [illegible]	[illegible]	
CONFIG: [illegible]	82-09	SPACE SHUTTLE
ITA: 2	SHT: 1	SCALE: NONE

DWG NO: 13.4

SHEET 1 OF 2

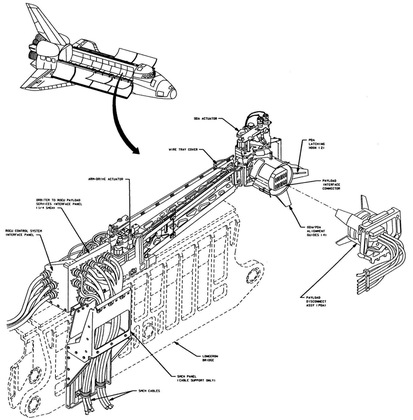

1 RAD DPY/STOW 3
RADIATORS DEPLOY/STOW
PORT RAD LATCH 1-6 ACTUATOR
STARBOARD RAD LATCH 1-6 ACTUATOR
PORT RAD LATCH 7-12 ACTUATOR
STARBOARD RAD LATCH 7-12 ACTUATOR
PORT RAD DEPLOYMENT ACTUATOR
STARBOARD RAD DEPLOYMENT ACTUATOR
PI-MCA 1
PI-MCA 2
PI-MCA 3
PI-MCA 4
PI-MCA 5
PI-MCA 6
PI-MCA 7
PI-MCA 8
I/O PI-MCA 1
I/O PI-MCA 2
PRPC 1
PRPC 2
PRPC 3
PRPC 4
PRPC 5
PRPC 6
MCA LOGIC
MCA DRIVER
MCA MOTOR
MCA PWR SYS 1 (3)
MCA PWR SYS 2 (4)
MCA PWR SYS 3 (1)
MCA PWR SYS 4 (2)
RAD LAT SYS 1 (3)
RAD LAT SYS 2 (4)
RAD LAT SYS 3 (1)
RAD LAT SYS 4 (2)
RAD DPY SYS 1 (3)
RAD DPY SYS 2 (4)
RAD DPY SYS 3 (1)
RAD DPY SYS 4 (2)
STBD RAD LATCH 1-6 ACTUATOR
STBD RAD LATCH 7-12 ACTUATOR
STBD RAD DEPLOY ACTUATOR
PORT RAD LATCH 1-6 ACTUATOR
PORT RAD LATCH 7-12 ACTUATOR
PORT RAD DEPLOY ACTUATOR
TORQUE LIMITER
DIFFERENTIAL
GEAR BOX
OUTPUT SHAFT TO RETURN ACTUATOR
OUTPUT SHAFT TO DEPLOY ACTUATOR
MOTOR 1
MOTOR 2
SLIDING BRAKE
SLIDING BRAKE
RELEASE ACTUATOR
LATCH
RADIATOR
RAD LATCH
RAD DPY
STBD
PORT
LAT
REL
DPY
STOW 1
STOW 2
STOW 3
STOW 4
STOW 5
STOW 6
STOW 7
STOW 8
STOW 9
STOW 10
STOW 11
STOW 12
DPY 1
DPY 2
DPY 3
DPY 4
DPY 5
DPY 6
DPY 7
DPY 8
DPY 9
DPY 10
DPY 11
DPY 12
STBD STOW
STBD DEPLOY
PORT STOW
PORT DEPLOY
RAD DEPLOYMENT ACTUATOR HYDROSTATIC PHASE DETECTIVITY
(M1-000-1 CELL, M1-001-1 CELL, M1-004-1 CELL, M1-005-1 CELL, PER MAY 1/1/00)
RADIATOR PHASE CONFIGURATION
AC PHASE
MCA LOGIC
LATCHING CMD
LOCKUP CMD
MCA
MCA PWR SYS 1
MCA PWR SYS 2
SYS 3
SYS 4
RELEASED
LATCHED
DEPLOYED
STOWED
ACTUATOR DRIVE TIMES
LATCH
PANEL
ACTUATOR MOTOR HINGES LOOK-OUT AFT
ACTUATOR
STBD LATCH
STBD DEPLOYMENT
PORT LATCH
PORT DEPLOYMENT
DIRECTION
STOW
DEPLOY
WARNING WITH ZONES IN PARENTHESES REFER TO THE CHASSIS BOARDS ITEM
FOR DRAWING REFERENCES SEE TABLE 14-1
NOTES: 1. WARNINGS/LEDS ARE SHOWN IN ILLUMINATED POSITION. WARNING IN PARENTHESES REFER TO THE CHASSIS LED PCA.
SIGNATURE
DATE
DESIGN
DRAWN
CHECK
APPROVED
ACTUAL SIGNATURES OR DATE IDENTIFICATION STAMPS ON ORIGINAL MAY EXCEED MINIMUM TRACE
SPACE SHUTTLE
SIZE
CODE IDENT NO.
SCALE
DWG NO.
14.1
REV
SHEET 1 OF 1
BASIC REV F-4


ORBITER PAYLOAD BAY
PAYLOAD BAY REMOTELY OPERATED ELECTRICAL UMBILICAL UNIT
PAYLOAD CONTROL LOGIC P/L SEL 2
PAYLOAD RETENTION
PAYLOAD RETENTION LATCHES
AFT STATION
M-MCA-1 P/L SYS 1 CONTROL LOGIC
M-MCA-3 P/L SYS 2 CONTROL LOGIC
STBD PATCH PANEL
PORT PATCH PANEL
ORBITER ARM DRIVE MOTORS
DSA LATCH/RELEASE MOTORS
10 ROEU ELEC
ROEU ELECTRICAL
14.10

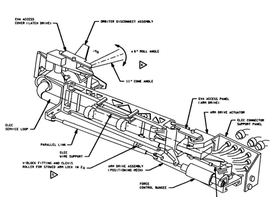
BASIC REV F-4

AUTO CAD/ECN	MANU-MAT	OPERATIONAL MOD
AUTO 09/28/89	MANU-MAT	OPERATIONAL MOD 2
AUTO 09/28/89	MANU-MAT	OPERATIONAL MOD 3
AUTO 10/27/89	MANU-MAT	OPERATIONAL MOD 4

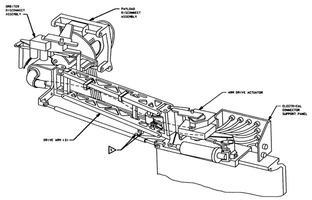
ROEU CONFIGURATION



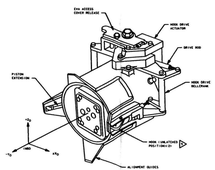
ROEU ORBITER INTERFACE - INBOARD FACE
DEMATED POSITION



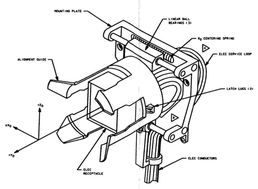
ORBITER ARM-DRIVE MECHANISM (ODM) - OUTBOARD FACE
DEMATED POSITION



ORBITER ARM-DRIVE MECHANISM (ODM) - OUTBOARD FACE
MATED AND LATCHED POSITION

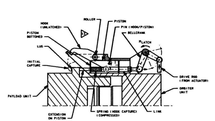


ORBITER DISCONNECT ASSEMBLY (ODA)

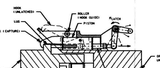


PAYLOAD DISCONNECT ASSEMBLY (PDA)

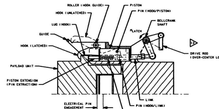
LATCHING OPERATIONS



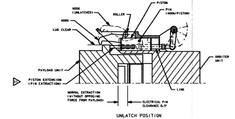
READY-TO-LATCH



HOOK CAPTURE

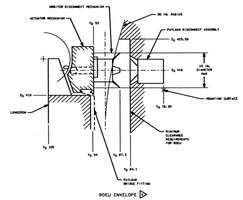


LATCHED POSITION

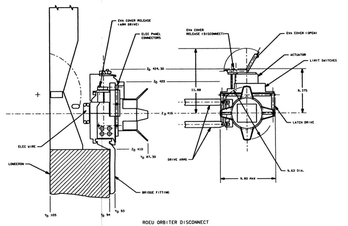


UNLATCH POSITION

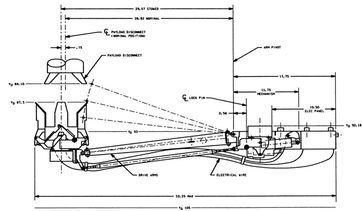
ROEU ENVELOPE



ROEU ENVELOPE



ROEU ORBITER DISCONNECT



ROEU DEMATED (STOWED)
PLAN VIEW

1. A RADIAL ROLLER CONTROLS HOOK ELEMENTS (1) THE PISTON SPRINGS PULL ON ARM/ROLLER CAMMED LUG AND LATCH THE PAYLOAD SIDE OF THE SYSTEM.
2. IN THE FULLY LATCHED POSITION, THE DRIVE RODS ARE IN AN OVER-CENTER LOCK POSITION RELATIVE TO THE ACTUATOR BELLCRANK.
3. THE LATCHING PISTONS HAVE AN EXTENSION AT ONE END THAT PUSHES (DO NOT PULL) ON THE ORBITER TO PULL THE PDA PINS FROM THE SEA VALVE SUPPLIED THE PAYLOAD SPECIALIST.

	ROEU WEIGHTS
ROEU	14,75 LBS
PDA	56.50 LBS (+KG)

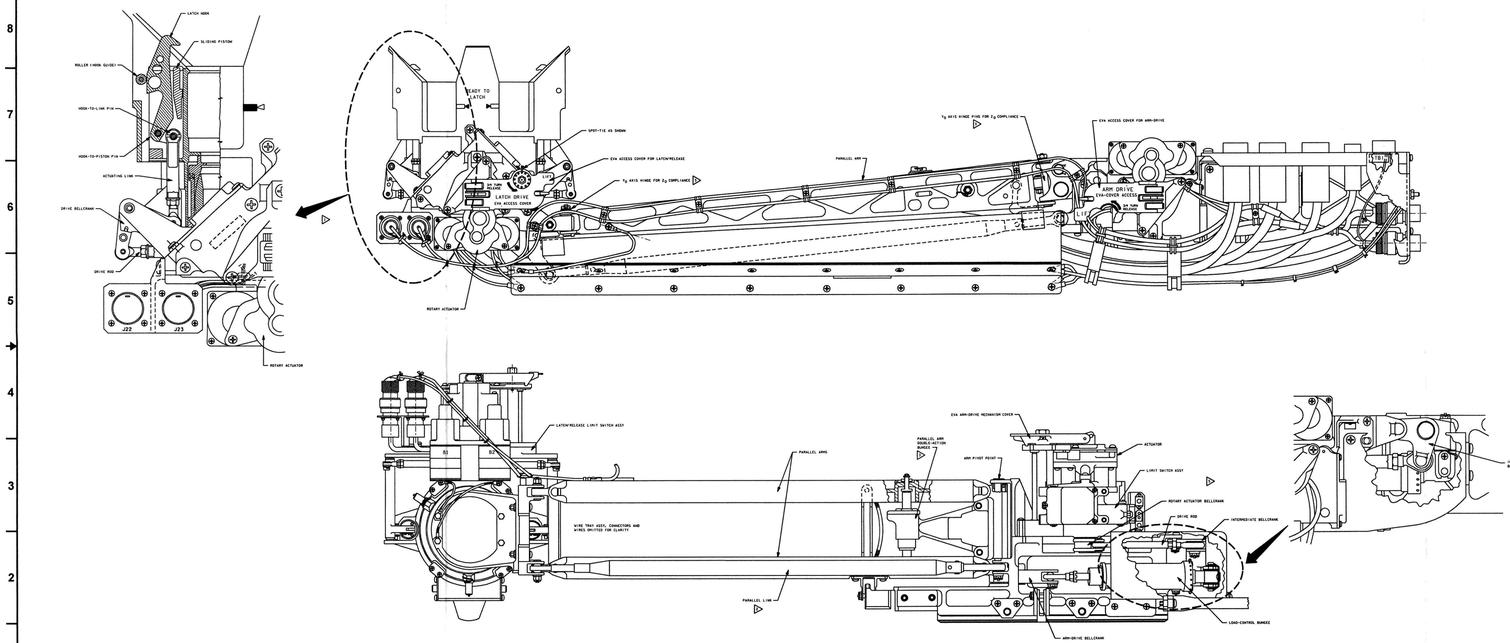
4. THE LATCHING MECHANISM APPLIES +KGBLBS OF PULL-IN/PUSH-OUT FORCE FOR THE FINAL ENGAGEMENT/SEPARATION OF THE SEA AND PDA.
5. THE SEA PROVIDES THE MEANS FOR THE ELECTRICAL UMBILICAL. THE PDA PROVIDES THE LATCHING LUGS.
6. THE SEA PROVIDES THE MEANS FOR THE ELECTRICAL UMBILICAL. THE PDA PROVIDES THE PINS.
7. THE SEA IS SUPPORTED BY A SPHERICAL BEARING WHICH ALLOWS FOR AN ANGULAR MISALIGNMENT OF 3° BETWEEN THE SEA AND THE ORBITER WITH A 6° ROLL ABOUT THE Y_O CENTERLINE OF THE SEA.
8. THE SEA IS POSITIONED IN THE FULLY DEPLOYED POSITION BY OVER-CENTER DRIVE LINKS AND THE PAYLOAD LATCHES. THE LINKS ARE 3 IN SELECT FITTING AND CLEVIS ROLLER FOR THE Z_O DIRECTION
9. THE PDA ALLOWS FOR A 0.5" DISPLACEMENT IN THE X_O AXIS BY MEANS OF SLOTTED HOLES IN THE PDA.
10. THE SEA ALLOWS FOR A NUTATING CONE ANGLE OF 0.7°, TRUNK TOP SEA ARM IS NOT ARM FROM THE SEA ALONG THE Y_O AXIS WITH RESPECT TO THE ORBITER Y_O INITIAL POSITION
11. THE DRIVE MOTOR AND GEAR TRAIN HOUSING FOR THE ARM-DRIVE MECHANISM APPLIES TORQUE TO THE ARM LEGS TO MAINTAIN THE FORCE OF INTERFACE DURING THE SEA AND PDA INITIAL ALIGNMENT PHASE.

NOTES: THE ROEU CAN BE MOUNTED ON A STANDARD ORBITER DEVICE AND CAN BE INSTALLED FACING FORWARD OR AFT, PARTICLE IS THE LEFT-HANDED MODE AND PARTICLE IS THE RIGHT-HANDED MODE

10 ROEU MECH 2

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
DESIGN ENGR. R. EDAM-KOCH	04/88	GEORGE C. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALABAMA
DES. ENGR. M. TEDDER	04/88	
CHIEF ENGR. R. SMITH	04/88	REMOTELY OPERATED ELECTRICAL UMBILICAL MECHANICAL
PROJECT ENGR.		
PROJECT MGR.		
PROGRAM MGR.		
MANAGER, SPACE SHUTTLE PROGRAM		DWG NO. 14.10
ASSISTANT ADMINISTRATOR		REV.
SCALE: NONE		SHEET 1 OF 1

BASIC REV F-4



DATE: 05/29/98	NAME: VSH	VERSION: REL1
DATE: 04/28/98	NAME: MH	VERSION: REL2
DATE: 09/21/98	NAME: VSH	VERSION: REL3

6. THE ROEU HAS 2 SEPARATE EVA INTERFACES TO ALLOW FOR EVA MATE/DEMATE AND LATCH/RELEASE. BOTH EVA INTERFACES OPERATE THE SAME. AFTER THE LATCH HOOK IS ROTATED TO THE LATCHED POSITION, THE LATCH DRIVE ROTATES A HINGE LIKE MOTION. A DETENT WILL HOLD IT. THIS MOTION DEPRESSES A SHAFT THAT DISENGAGES THE MOTORS FROM THE GEAR BOXES TO ALLOW MANUAL OPERATION OF THE LATCH MECHANISM. AN EVA TOOL IS USED TO MOVE THE LATCH DRIVE FROM THE DETENTED POSITION TO THE DESIRED POSITION. THE LATCH DRIVE MUST BE ROTATED TO THE DESIRED POSITION, THE LATCH HOOK ROTATED TO THE NEUTRAL POSITION AND THE COVER IS CLOSED AND SECURED.

7. RELEASE OPERATION: AFTER THE LATCH HOOKS PULL THE SEB AND PDA TOWARD THE ROEU AND COMPRESS THE BUMPERS AND THE SEB IS IN THE DESIRED DIRECTION, THE INTERMEDIATE BELLCRANK DRIVES UNTIL THE SPRING COMPRESSION FORCE ON THE BUMPER IS COMPLETELY RELEASED. AN INTERMEDIATE BELLCRANK IS USED TO ENSURE THAT THE LOAD ON THE MOTOR IS MINIMIZED, SO THE BRAKES PRESTRIP AND WILL ENSURE THAT NO Y_B AXIS TORQUE IS APPLIED TO THE PAYLOAD DUE TO SPRING FORCE

8. BRAKE/DRIVE OPERATION: THE INITIAL ARM-DRIVE ACTUATOR ROTATION MOVES THE ACTUATOR BELLCRANK AND THE DRIVE LINK WITHOUT MOVING THE ARMS UNTIL THE BRAKES ARE RELEASED. DURING THIS TIME, THE ARM SEES NO MOTION UNTIL THE PRELOAD ON THE BUMPER IS TAKEN UP BY THE INTERMEDIATE BELLCRANK TRAVEL. THE BELLCRANK CONTINUES TO DRIVE UNTIL THE BRAKES ARE ENGAGED AND THE FINAL POSITION OF THE INTERMEDIATE BELLCRANK ACTUATES THE MATE LIMIT SWITCH

▷ ARM-DRIVE MECHANISM THE ROTARY ACTUATOR IS ATTACHED TO A DRIVE ROD. THE DRIVE ROD IS ATTACHED TO AN INTERMEDIATE BELLCRANK WHICH ATTACHES TO A LOAD-CONTROL SPRING CARTRIDGE ASSEMBLY. THE BUMPER IS ATTACHED TO THE ARM-DRIVE BELLCRANK

4. IN THE STOWED POSITION, THE DRIVE ROD IS AT AN OVER-CENTER POSITION. THE LOAD IS TRANSFERRED TO THE ACTUATOR BELLCRANK AND THE BUMPER IS IN TENSION

▷ THE SEM ALLOWS FOR THERMAL AND STRUCTURAL DISTORTIONS WHILE HOLDING IN THE Y_B AXIS BY A 1" KEY SLOT IN THE PAYLOAD AT BOTH MATE/DEMATE INTERFACES. THE SEM ALSO HAS A SPOT-TIE FEATURE (TRUNNION) IS USED TO MAINTAIN THE NOMINAL CENTERED POSITION

▷ THE PARALLEL LINK ON THE DRIVE ARM MAINTAINS THE CENTERLINE OF THE SEM NOMINAL TO THE Y_B AND Z_B PLANE AS THE PDA/TRUNNION ARM DRIVES TO THE MATE/DEMATE POSITION

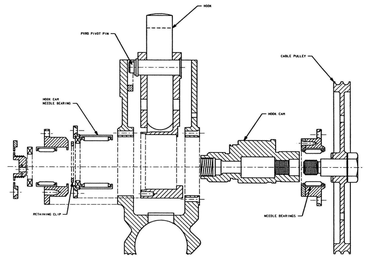
NOTES: ▷ LATCH/SEB MECHANISM THE SEM HOOK MECHANISM CONSISTS OF A PAYLOAD ATTACHMENT PIN AND A LATCH HOOK. WHEN THE HOOK IS ROTATED TO WITH ATTACHMENT PINS, THE PISTONS (SEM/4-5 DRIVING) THAT APPLY A FORCE TO ANOTHER ATTACHMENT PIN THAT CONNECT THE HOOK TO THE PISTONS. AS THE HOOK ROTATES, THE PISTONS ARE PULLED IN TOWARD THE ARM TENDS TO DAMAGE THE HOOKS. THE 5 LIMIT SWITCHES ARE CONNECTED TO DRIVE BELLCRANKS WHICH ARE DRIVEN BY DRIVE RODS CONNECTED TO A COMMON ACTUATOR BELLCRANK

10 ROEU MECH 3

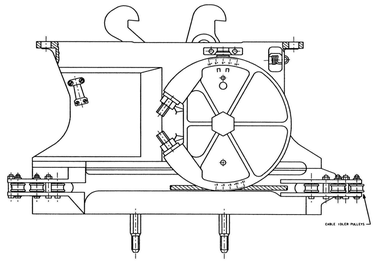
SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DESIGN K. HUNTER	10/2/98	
DRAFT		
CHECK K. SMITH		ROEU MECHANICAL
APP. [illegible]	10-7-98	
APP. [illegible]	10-7-98	
APP. [illegible]	10-7-98 SPACE SHUTTLE	DWG NO 14.10
DATE OF RELEASE 10-7-98	NO.	
SIZE D	CODE 4	SCALE 3/4 SHEET OF

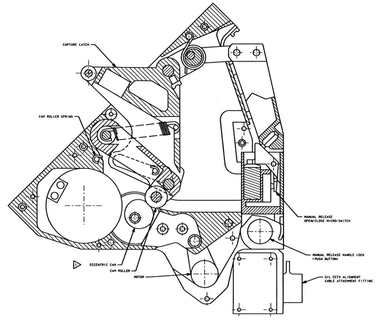
BASIC REV F-4

BASIC REV F-4

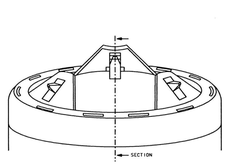


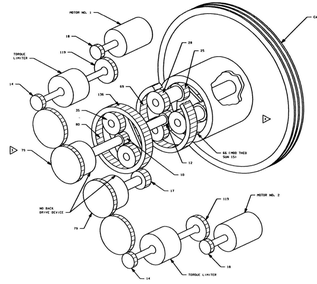
ACTIVE HOOK CROSS SECTION
(EXPLODED VIEW)



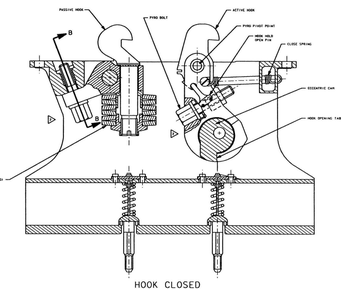


CAPTURE LATCH ASSEMBLY

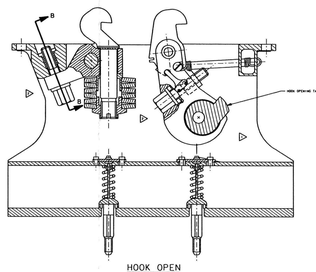




STRUCTURAL HOOK POWER DRIVE UNIT
(1 UNIT/ 5 HOOKS)

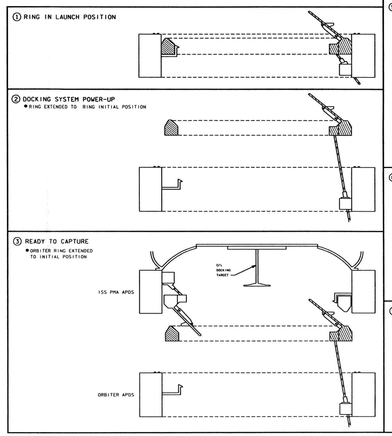


STRUCTURAL HOOK ASSEMBLY



HOOK CLOSED

HOOK OPEN



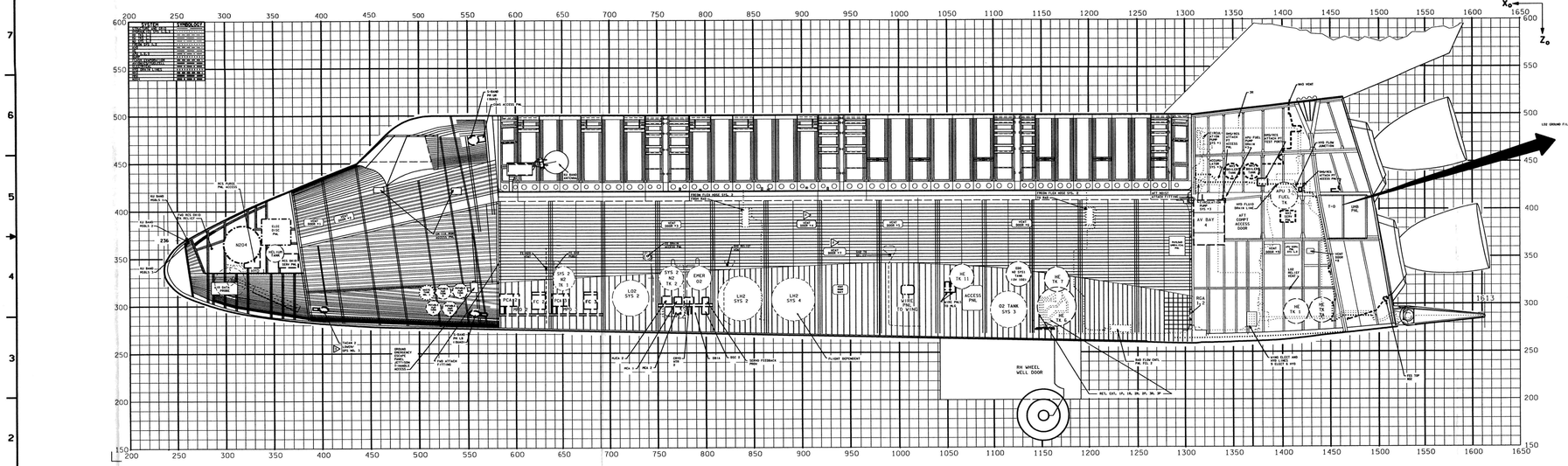
DOCKING SEQUENCE

NOTES:
1. HOOK OPEN, CLOSE, 1/4 RETAIN SENSOR IS DRIVEN BY PDU MOTOR
2. NUMBERS REPRESENT GEAR TEETH
3. ALL ENG. VS. CR FOR DETAILS ON HOOK PYRO INITIATION AND CONTROL SEE ENG. VS. CR
4. WITH HOOKS CLOSED, AS THE ECCENTRIC CAM ROTATES, THE CAM ROLLER WILL DROP ALLOWING THE CAPTURE LATCH TO CLOSE. THE CAM ROTATES THE SAME DIRECTION TO OPEN AND CLOSE THE LATCH

1 LAT/HKS/SEQ 3

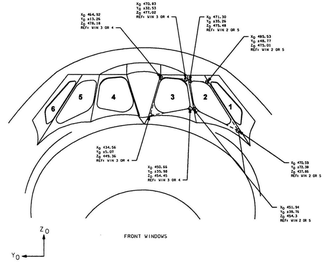
SIGNATURE	DATE	NASA/JSC/ENGINEERING AND OPERATIONS DIRECTORATE/MISSION OPERATIONS DIRECTORATE
PREPARED BY: R.TOBIAS	9/96	
CHK BY: J.TOLTIS	9/96	
CHIEF, ENGINEERING BRANCH: R. STEVENSON	9/96	ORBITER DOCKING SYSTEM/CAPTURE LATCH, HOOKS, SEQUENCE
CHIEF, MISSION OPERATIONS BRANCH: J. McCULLOUGH	9/96	
CHIEF, FLIGHT DESIGN AND DYNAMICS BRANCH: J. CARPENTER	9/96	DWG NO. 15.1
CHIEF, GNC AND SENSORS BRANCH: R. KLAUS	9/96	SCALE: NONE
CHIEF, AVIONICS SYSTEMS DIVISION: J. GARMAN	9/96	SHEET 1 OF 1

BASIC REV F-4

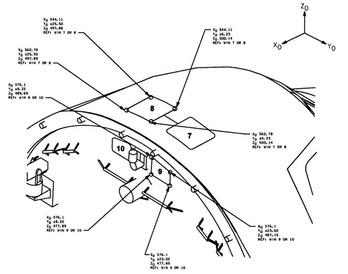


BASIC REV F-4

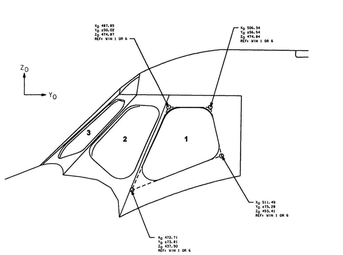
BASIC REV F-4



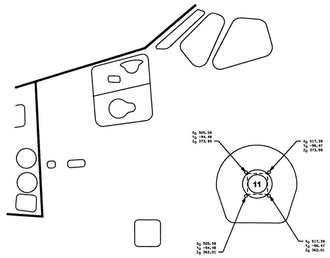
FRONT WINDOWS



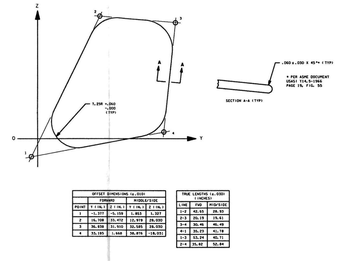
AFD AND OVERHEAD WINDOWS



SIDE WINDOWS



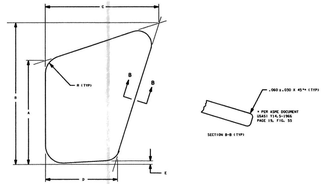
SIDE HATCH WINDOW



OFFSET (DIMENSIONS +/-.010")					
	ORIGIN		MIDDLE/SIDE		
POINT	X (-IN.)	Z (+IN.)	X (-IN.)	Z (+IN.)	
1	+1.777	+5.159	1.853	1.327	
2	16.158	25.432	15.978	24.000	
3	36.938	31.500	35.585	26.000	
4	55.150	31.500	54.895	19.727	

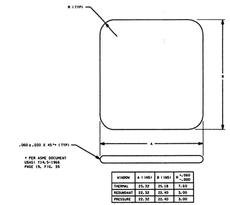
TRUE LENGTHS (+.030") (+INCHES)		
LINE	FWD	MID/SIDE
1-2	42.65	26.93
2-3	20.14	19.51
3-4	20.15	20.19
4-5	36.78	41.46
5-1	53.24	52.71
2-5	24.57	32.84

THERMAL WINDOW SHAPES



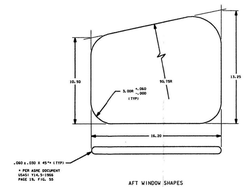
		A	B	C	D	E	R +.060 -.000
PRESSURE	FORWARD	29.37	34.84	25.92	16.23	.82	5.75
	MIDDLE/SIDE	35.44	37.47	24.88	25.42	18.12	5.75
REDUNDANT	FORWARD	29.35	34.86	25.94	16.24	.80	5.75
	MIDDLE/SIDE	35.38	37.54	24.90	25.43	17.85	5.75

PRESSURE/REDUNDANT WINDOW SHAPES

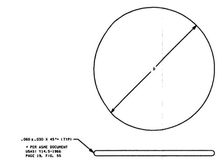


WINDOW	A (-.060)	B (-.060)	R +.060 -.000
THERMAL	25.32	24.28	5.50
REDUNDANT	25.32	25.50	5.50
PRESSURE	25.32	25.50	5.50

OVERHEAD WINDOW SHAPES



AFT WINDOW SHAPES



WINDOW	R (-.06)
THERMAL	11.00
REDUNDANT	11.00
PRESSURE	11.00

SIDE HATCH WINDOW SHAPES

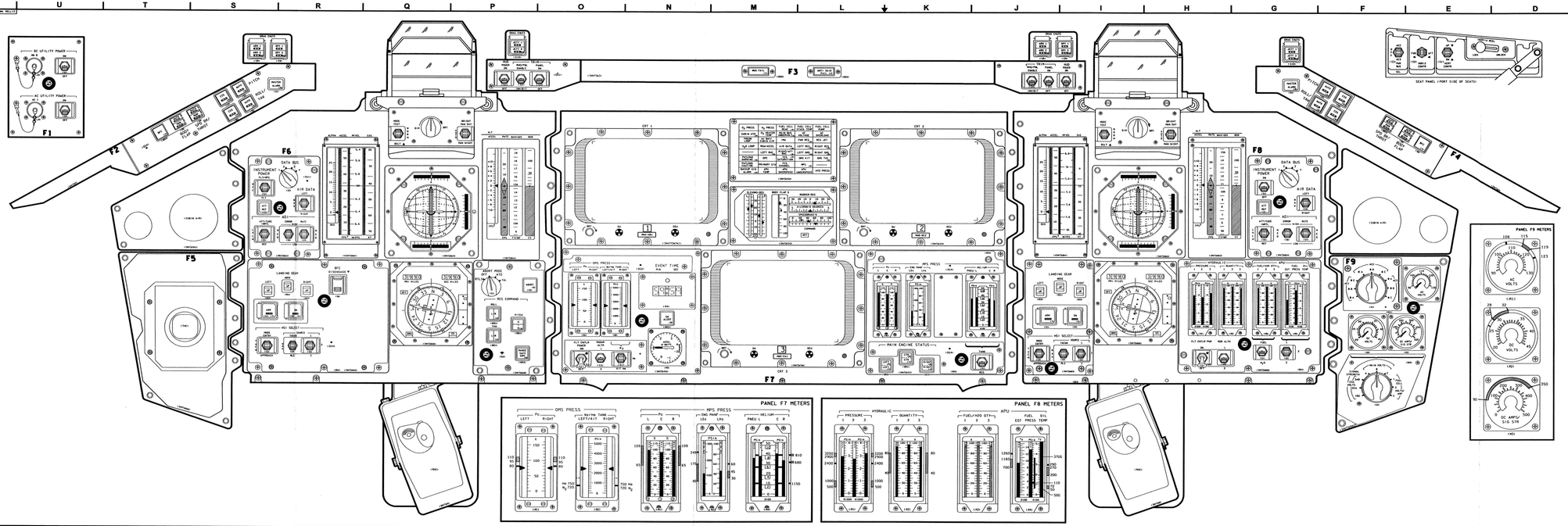
5 ORB WINDOW

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DESN: G. SMITH	8/4/81	
DR		ORBITER WINDOWS
CHKR: A. SMITH		
APP: [illegible]	10/28/81	
APP: [illegible]	10/28/81	
APP: [illegible]	7-6-82	SPACE SHUTTLE
APP: [illegible]	7-6-82	
NEXT ASSY	USED ON	

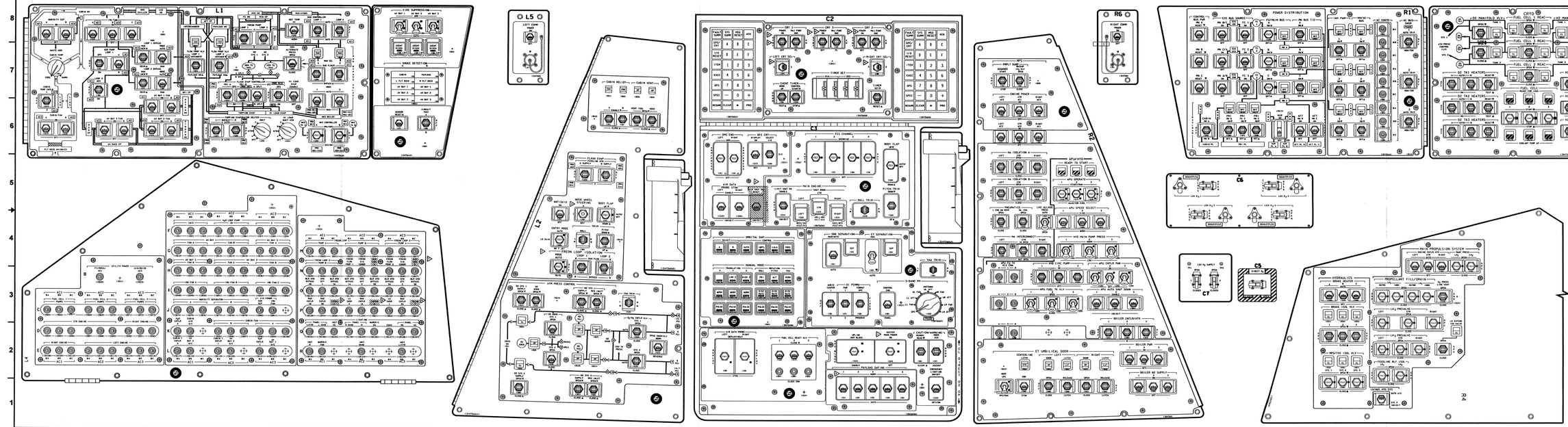
DWG NO: 19.5

SIZE: D | SCALE: NONE | SHEET 1 OF 1

BASIC REV F-4

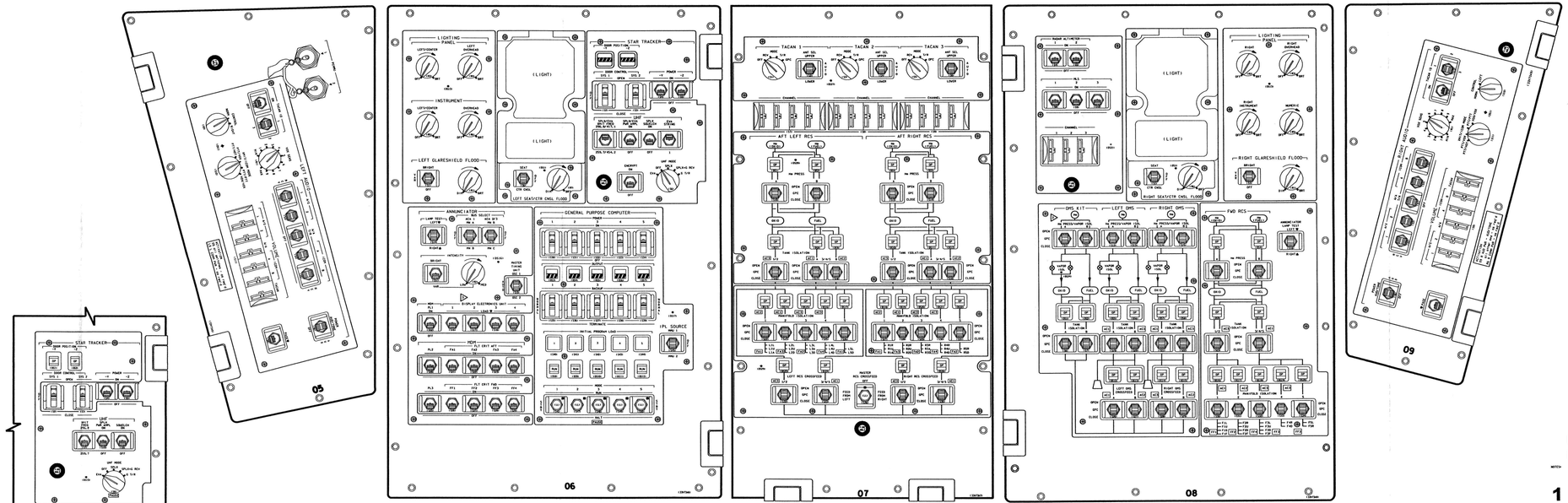

F1
F2
F3
F4
F5
F6
F7
F8
F9
SEATS
PANEL F7 METERS
PANEL F8 METERS
PANEL F9 METERS
FLIGHT STATION
AFT STATION
ORBITER PANEL CONFIGURATION
1 D&C FWD
DISPLAYS AND CONTROLS FORWARD STATIONS
20. 1

BASIC REV F-4



BASIC REV F-4

BASIC REV F-4



FOR MEDS FLIGHTS, THIS IS LABELED "INTEGRATED DISPLAY PROCESSOR"

OMS KIT VALVES NOT INSTALLED BUT SWITCHES LEFT ON

NOTES: 1. REFER TO TABLE 20-I FOR HONEYWELL DRAWING REFERENCES

1 D&C FWD 4

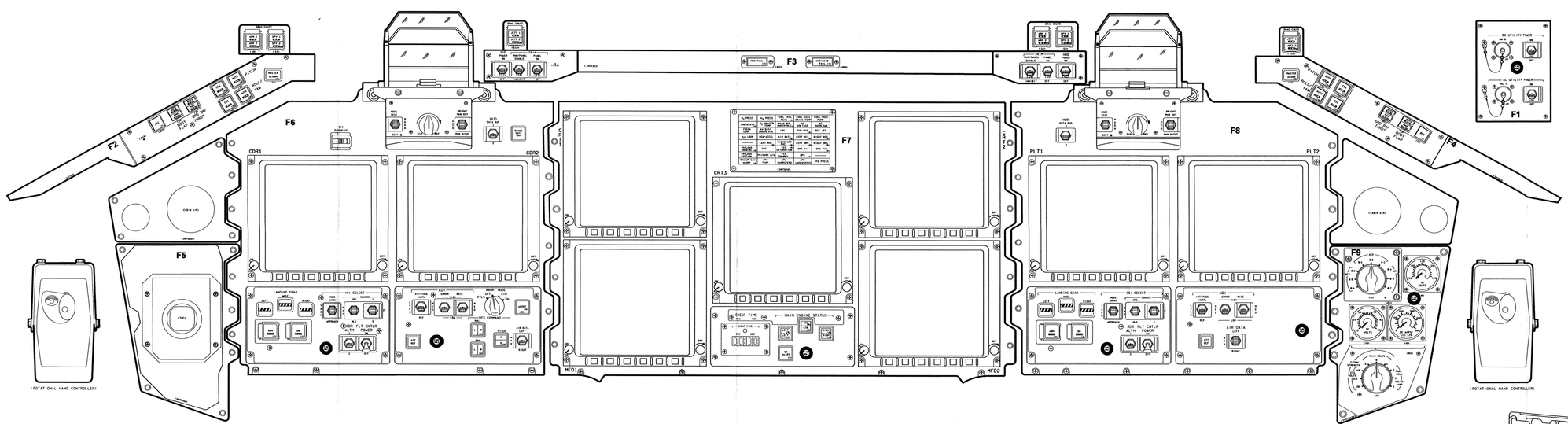
SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
DSN		
DR C. RILEY	03/88	DISPLAYS AND CONTROLS FORWARD STATIONS
CHKR H. FRANCHINE		
ENGINEERING APPROVAL	DATE	
Jim Smith	7/1/88	
APPROVED		
Jeff Hanks	7/1/88	
CHIEF, CREW STATION DESIGN BRANCH		
SCALE	NONE	SPACE SHUTTLE
SIZE	D	
		SHEET 1 OF 1

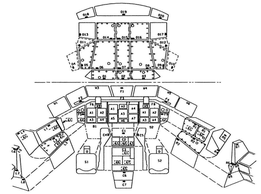
DWG NO. 20.1

BASIC REV F-4

BASIC REV F-4

DATE	BY	DESCRIPTION
DATE: 08/29/78	NAME: TEK	DESCRIPTION: INITIAL
DATE: 10/27/78	NAME: HSU	DESCRIPTION: INITIAL
DATE: 10/27/78	NAME: HSU	DESCRIPTION: INITIAL





ORBITER PANEL CONFIGURATION

NOTES:

1. THIS SHEET REFLECTS THE FIRST MEDS CONFIGURATION ONLY. CURRENTLY ONLY BH CAT MAY BOTH OPERATE, OTHERS RESTRICTED WELL BY UPGRADED SWITCH LOGIC.
2. DOOM INDICATOR LEGENDS ARE AS FOLLOWS:

DOOM INDICATOR LEGENDS	DOOM LAMP COLOR	TYPE	LEGEND
ATT	AMBER	4 STATE (3 BI)	ATTITUDE
ALT	AMBER	4 STATE (3 BI)	ALTITUDE
V, H, R	AMBER	4 STATE (3 BI)	V/H/RNG
RNG	AMBER	4 STATE (3 BI)	RANGE
VEL	AMBER	4 STATE (3 BI)	VELOCITY
DRA	AMBER	4 STATE (3 BI)	DRAG ACCEL
ENE	AMBER	4 STATE (3 BI)	ENERGY
CRS	AMBER	4 STATE (3 BI)	CROSSRANGE
TGT	AMBER	4 STATE (3 BI)	TARGET
HDG	AMBER	4 STATE (3 BI)	HEADING
HSI	GRN-R, AMB	5 STATE (3 BI)	HSI-UP/DOWN
HSI	GRN-R, AMB	5 STATE (3 BI)	HSI-LEFT/RIGHT
RNG	RED-R, AMB	3 STATE (1 BI)	RANGE-IN/OUT

● R.H. INDICATES A BARBER POLE
↱ INDICATES "+ve TRANSIT" OR THAT HEIGHT OF THE TAS STATES IS EXERCISED

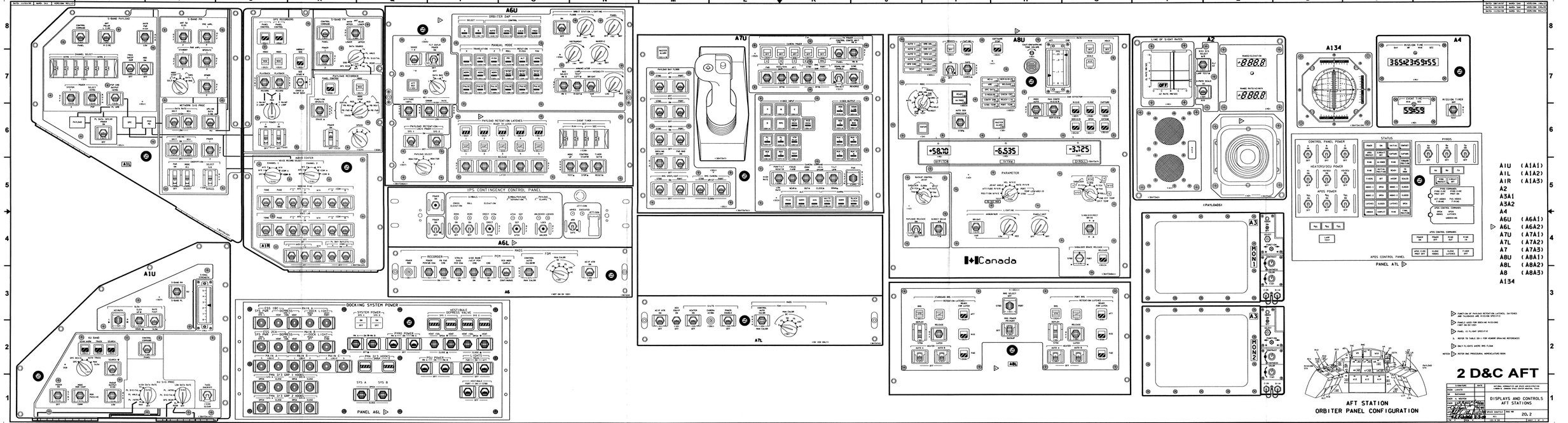
3. SCRIBE ◎ INDICATES THE LOWER POSITION OF A LOWER LOCK SWITCH AND USED TO MARK SWITCH CUTOUTS.

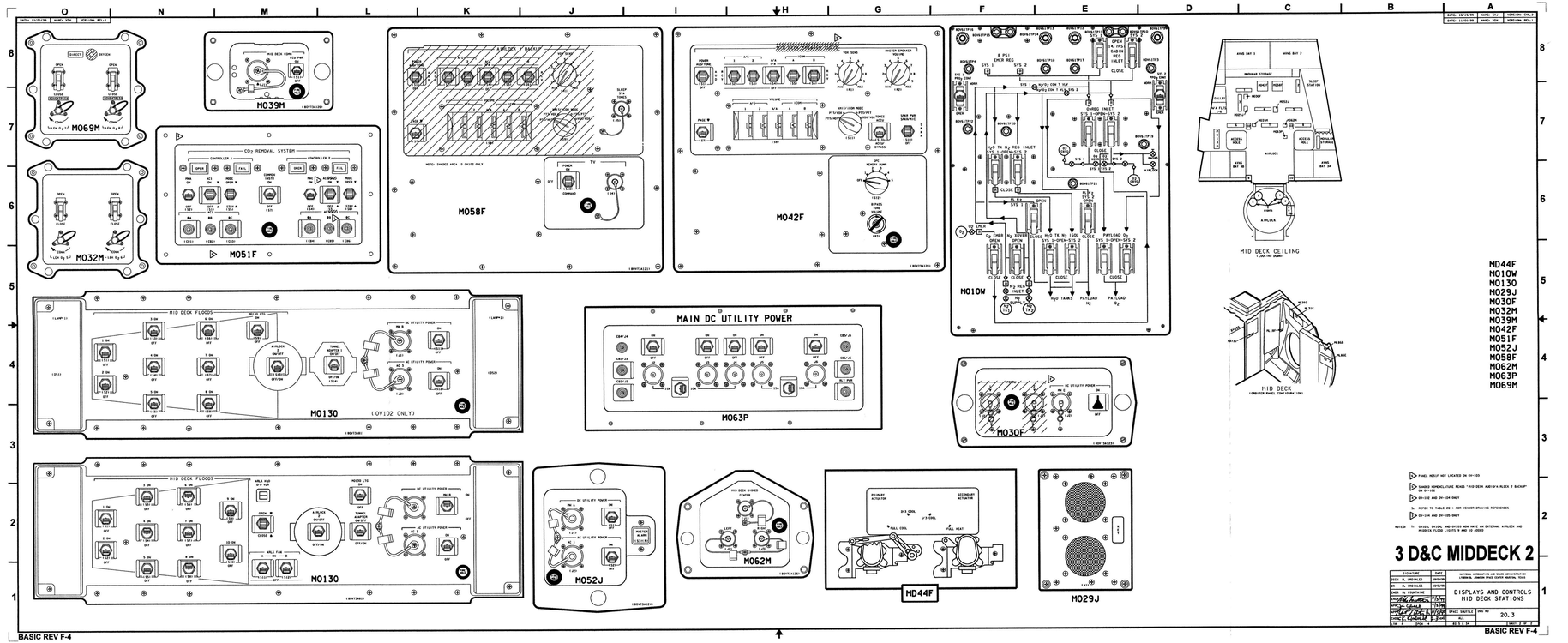
NOTES: 1. SYMBOLISM ◎ ● INDICATES MOMENTARY SWITCH POSITION

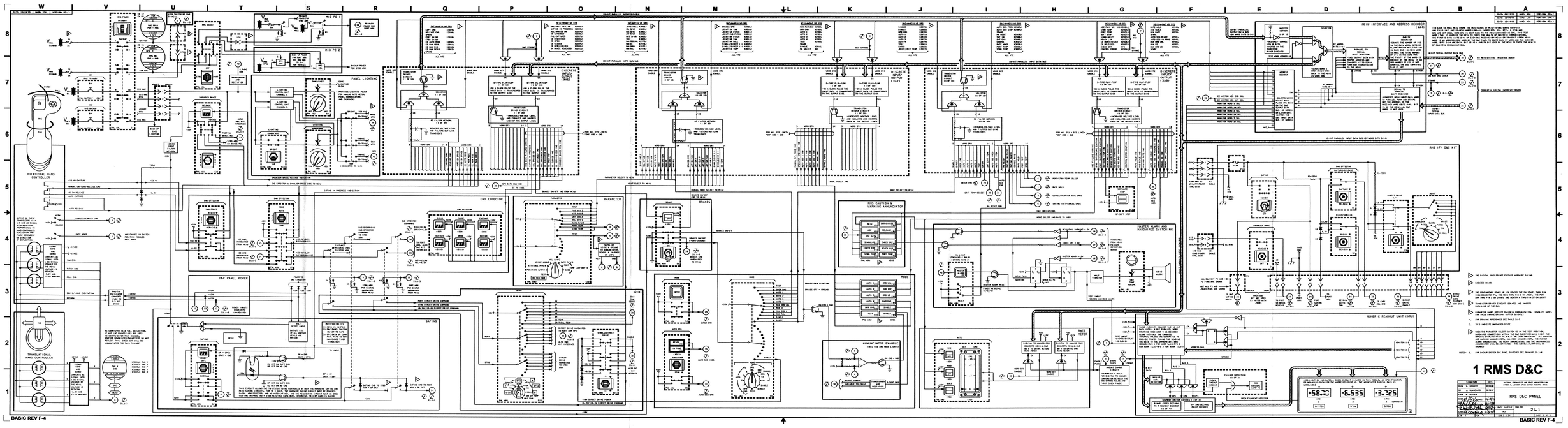
1A D&C FWD

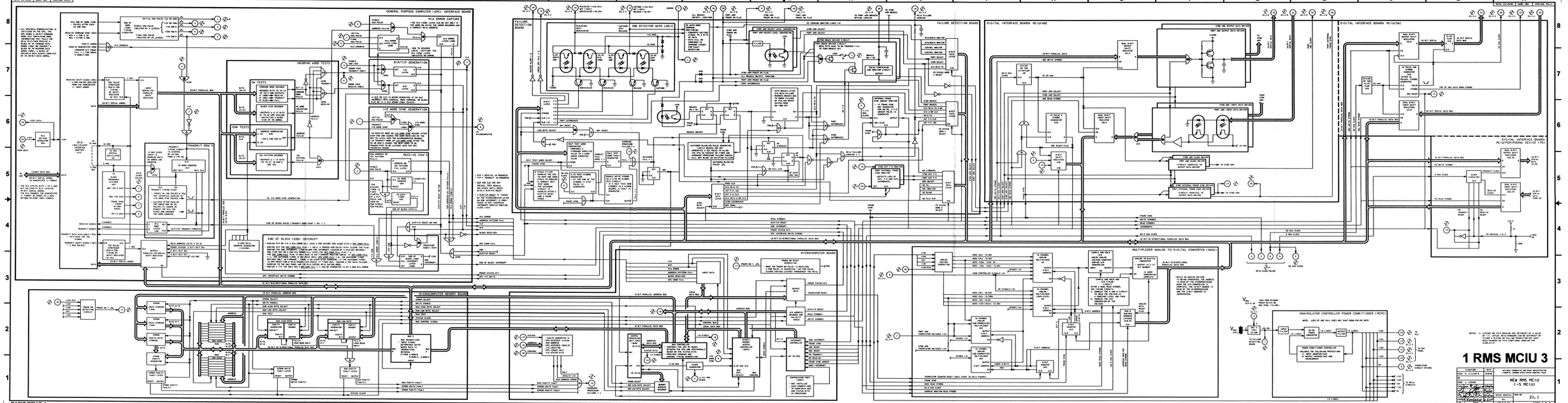
DESIGNED	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
DOUG A. ELLISTON	DRAWN	LYNDON B. JOHNSON SPACE CENTER HOUSTON, TEXAS
CHK		
DWG IS WILLIAMS		DISPLAYS AND CONTROLS FORWARD STATIONS
APPROVED		
APPROVED		DWG NO. 20, 1A
APPROVED		
1 REV.	10 1 78	SHEET 1 OF 1

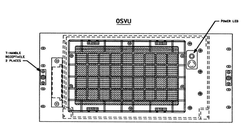
BASIC REV F-4

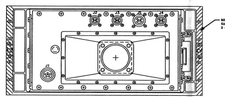

A1U
A1L
A1R
A6U
A7U
A8U
A2
A134
A4
A6L
A7L
A8L
A3
PANEL A6L
PANEL A7L
Canada
2 D&C AFT
AFT STATION
ORBITER PANEL CONFIGURATION
DISPLAYS AND CONTROLS
AFT STATIONS
20, 2
BASIC REV F-4


M069M
M039M
M032M
M051F
M058F
M042F
M010W
MID DECK CEILING
MD44F
M010W
M013O
M029J
M030F
M032M
M039M
M042F
M051F
M052J
M058F
M062M
M063P
M069M
MID DECK FLOODS
M0130
(OV102 ONLY)
MAIN DC UTILITY POWER
M063P
M030F
M052J
M062M
MD44F
M029J
MID DECK
3 D&C MIDDECK 2
DISPLAYS AND CONTROLS
MID DECK STATIONS
20.3
BASIC REV F-4

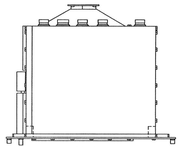

1 RMS D&C
RMS D&C PANEL
BASIC REV F-4
BASIC REV F-4

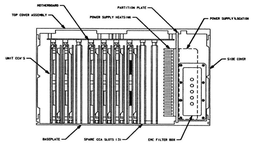

GENERAL PURPOSE COMPUTER (GPC) INTERFACE BOARD
PIA ERROR CAPTURE
INCOMING WORD TESTS
I/O WORD SYNC GENERATION
RECEIVE CDH'S
TRANSMIT CDH'S
END OF BLOCK (EOB) INTERRUPT
RS-422 MUX INTERFACE ADDRESSING (1553B)
FAILURE DETECTION BOARD
END EFFECTOR AUTO LOGIC
RS-422 MUX INTERFACE ADDRESSING (1553B)
DIGITAL INTERFACE BOARD MCIU#ABE
DIGITAL INTERFACE BOARD MCIU#DNC
DIGITAL INTERFACE BOARD MCIU#PORT/STBD/PMCS/PDGF
MICROCOMPUTER BOARD
MICROCOMPUTER MEMORY BOARD
MULTIPLEXER ANALOG TO DIGITAL CONVERTER (MADC)
MANIPULATOR CONTROLLER POWER CONDITIONER (MCPC)
1 RMS MCIU 3
NEW RMS MCIU
(-5 MCIU)
BASIC REV F-4
BASIC REV F-4

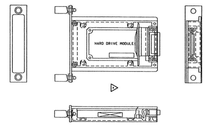


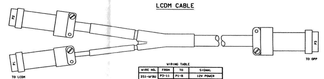


NO.	DESCRIPTION	PINS
J1	POWER	6
J2	NET USER	25
J3	SCSI	50
J4	VIDEO	15
J5	MIO	37

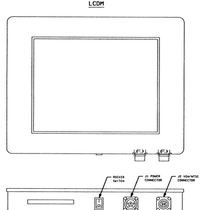


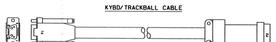




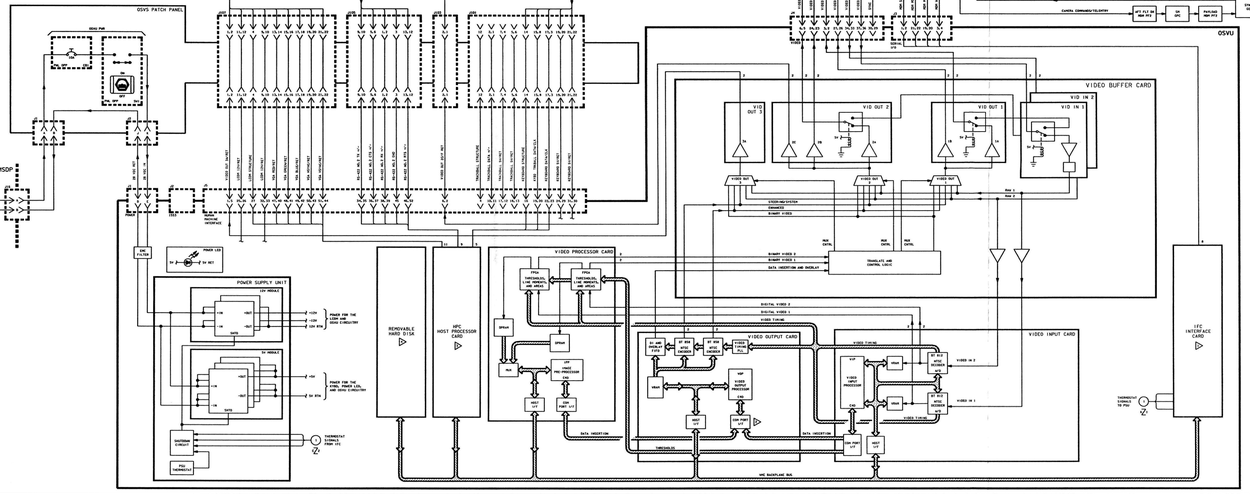


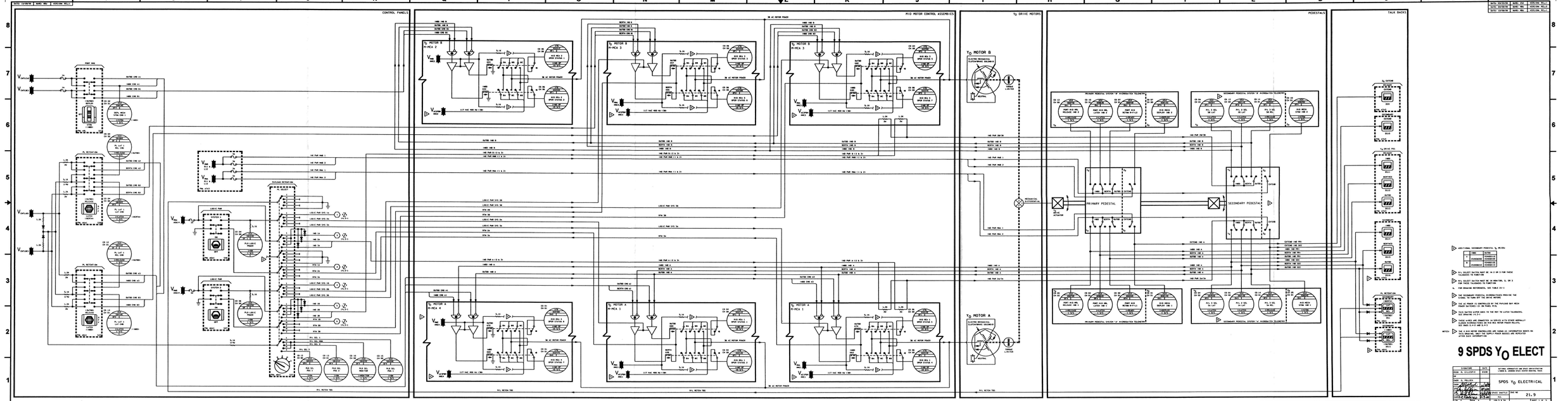
WIRING TABLE			
WIRE NO.	FROM	TO	SIGNAL
#24 w/Bk	P3-11	P1-9	LCDV PWRGD
#24 W	P3-12	P1-6	LCDV RETURN
#22 w/Bk	P3-13	P1-4	LCDV PWRGD
#22 W	P3-14	P1-1	LCDV RETURN
#22 Bl	P3-1	P2-6	+12 VOLT SW
#22 G	P3-2	P2-5	LCDV OUT VA SET
#22 R	P3-3	P2-4	LCDV STRUCTURE
#24 w/Bk	P3-4	P2-12	LCDM STRUCTURE
#24 W	P3-5	P2-11	VGA RED
#24 w/Bk	P3-6	P2-10	VGA RED RET
#22 w/Bk	P3-7	P2-9	VGA GREEN
#22 W	P3-8	P2-15	VGA GREEN RET
#24 w/Bk	P3-9	P2-14	VGA BLUE
#24 w/Bk	P3-10	P2-13	VGA BLUE RET
#22 w/Bk	P3-15	P3-5	VGA HSYNC
#22 W	P3-16	P3-10	VGA HSYNC RET
#24 w/Bk	P3-17	P3-4	VGA VSYNC
#24 W	P3-18	P3-12	VGA VSYNC RET

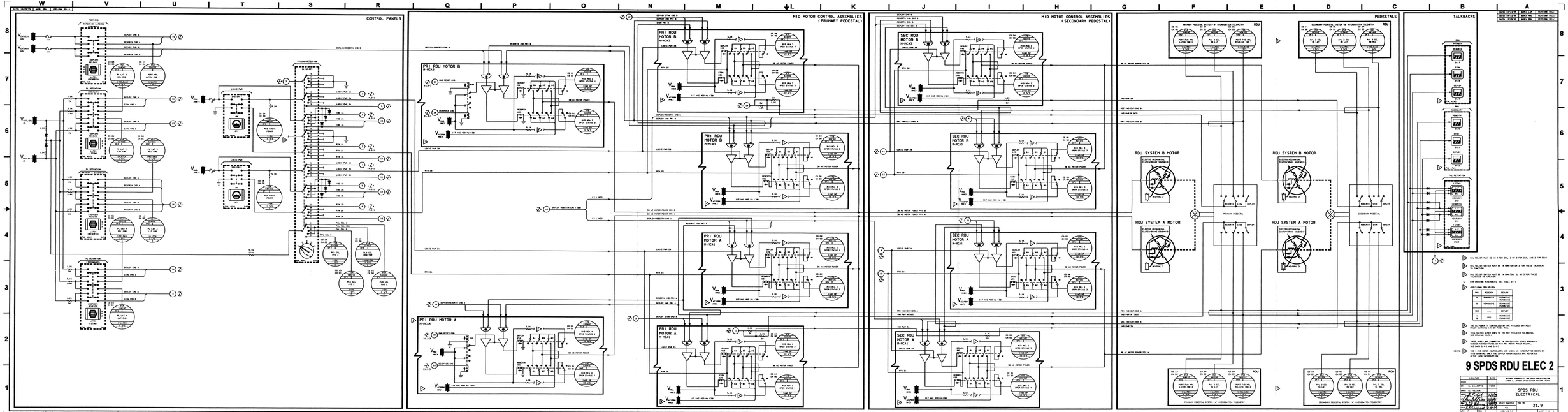




WIRING TABLE			
WIRE NO.	FROM	TO	SIGNAL
#24 BK	P1-14	P2-17	KEYBOARD DATA
P1-9	P1-10& P2-24&		
#22 W	P1-8	P2-3	KEYBOARD CLOCK
#22 BK	P1-15& P2-16&		
#24 BK	P1-7	P2-1	TRACKBALL DATA
#24 W	P1-5	P2-8	TRACKBALL CLOCK
#24 BK	P1-3	P2-25	5V POWER
#24 R	P1-2	P2-23	5V RETURN
#22 BL	P1-13	P2-21	5V POWER
#22 G	P1-12	P2-22	5V RETURN
N/C	P1-11	P2-19	KYBD STRUCTURE


OSVS PATCH PANEL
MSDP PWR
MSDP
MSDP
FROM MSDP
TO LCDM
TO PDSU
TO VTR
TO EXTERNAL/TRACKBALL
VIDEO PROCESSING UNIT
TO 1553
FROM CAMERAS
VIDEO INPUTS
VIDEO OUTPUTS
VIDEO OUT A (COMPOSITE)
VIDEO OUT B (COMPOSITE)
VIDEO OUT B (CONFIG/SEL)
MAIN A TO CAMS
CAMERA COMMANDS/TELEMETRY
SYNC SIGNAL DISTRIBUTION
TO CAMERAS
OSVU
VIDEO BUFFER CARD
VID OUT 2
VID OUT 1
VID IN 2
VID IN 1
VIDEO PROCESSOR CARD
VIDEO OUTPUT CARD
VIDEO INPUT CARD
VIDEO SYSTEM PRIMARY
VIDEO SYSTEM BACKUP
DIGITAL VIDEO 2
DIGITAL VIDEO 1
VIDEO TIMING
DATA INSERTION
TIMECODE
VIDEO SYSTEM PRIMARY
VIDEO SYSTEM BACKUP
DATA INSERTION AND OVERLAY
TRANSLATE AND CONTROL LOGIC
POWER SUPPLY UNIT
REMOVABLE HARD DISK
VPU HOST PROCESSOR CARD
VPU INTERFACE CARD
THERMISTOR TO PDU
MSDP
MSDP
MSDP


CONTROL PANELS
M/D MOTOR CONTROL ASSEMBLIES
Y_O DRIVE MOTORS
PEDESTALS
TALK BACKS
PRIMARY PEDESTAL
SECONDARY PEDESTAL
Y_O MOTOR B
Y_O MOTOR A
M-MCA 1
M-MCA 2
M-MCA 3
M-MCA 4
9 SPDS Y_O ELECT
SPDS Y_O ELECTRICAL
21.9
BASIC REV F-4

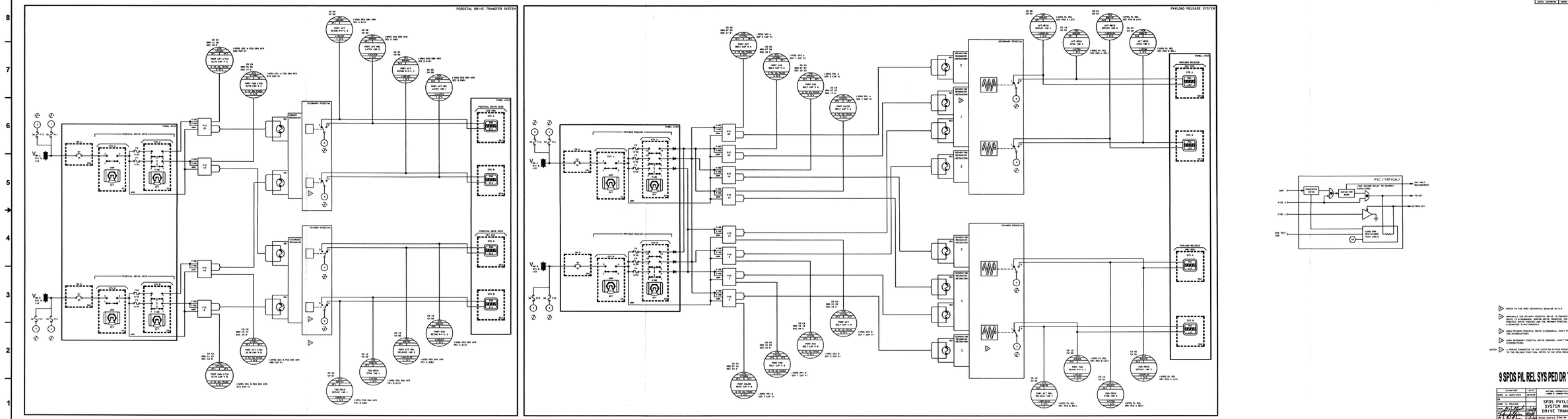


9 SPDS RDU ELEC 2

SIGNATURE	DATE	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION GEORGE C. MARSHALL SPACE FLIGHT CENTER
DRAWN: M. FULLERTON	4/2/08	
CHECKED: J. HOLLOWAY	4/2/08	SPDS RDU ELECTRICAL
ENGINEER: [illegible]	4/2/08	
DESIGN AGENT: [illegible]	4/2/08	SPDS RDU ELECTRICAL
PROJECT ENGINEER: [illegible]	4/2/08	SIZE: D
QUALITY ASSURANCE: [illegible]	4/2/08	SCALE: NONE
		DWG NO: 21.9
		REV:
		SHEET 1 OF 1

BASIC REV F-4

BASIC REV F-4



NOTES:

1. REFER TO THE VPRS MECHANICAL DRAWING 21.9-4
2. MANUALLY THE PRIMARY PEDESTAL DRIVE IS ENABLED AND SECONDARY PEDESTAL DRIVE IS DISENABLED, DURING DRIVE TRANSFER, THE SECONDARY PEDESTAL DRIVE IS ENABLED AND THE PRIMARY PEDESTAL DRIVE IS DISABLED SIMULTANEOUSLY
3. WHEN PRIMARY PEDESTAL DRIVE IS DISENGAGED, SHAFT PRESSURE CLOSES THE HYDROSTATICS
4. WHEN SECONDARY PEDESTAL DRIVE ENGAGES, SHAFT PRESSURE CLOSES THE HYDROSTATICS
5. A SPRING CONNECTED TO THE EJECTION PISTON PUSHES THE HYDROSTATICS TO THE RELEASE POSITION, REFER TO THE VPRS MECHANICAL DRAWING

9 SPDS P/L REL SYS PED DR TRANS SYS 3

SIGNATURE	DATE	NATIONAL HYDRAULICS AND EJECTOR CORPORATION
EDGAR G. TOWN-WATER	08/08/88	A PENNSYLVANIA CORPORATION
DR		
CHKD		SPDS PAYLOAD RELEASE
CHKD		SYSTEM AND PEDESTAL
APPD		DRIVE TRANSFER SYSTEM
APPD		
APPD		

SPACE SHUTTLE	END ITM
	ALL

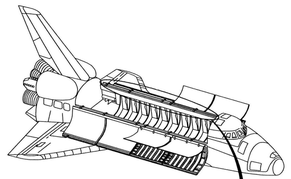
SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	19.5	21.9	F

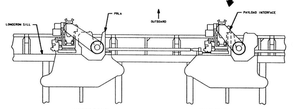
SCALE: NONE | SHEET 1 OF 1

BASIC REV F-4

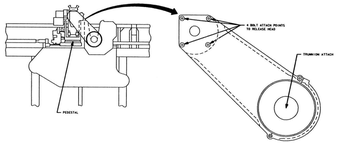
NASA 20339-B MARC NSI 4201.04a (5).2
NASA 20339-B MARC NSI 4201.04a (5).3
NASA 10398-B MARC NSI 4201.04a (5).4

PEDESTAL CONFIGURATION

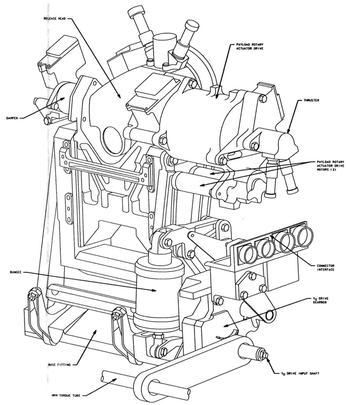




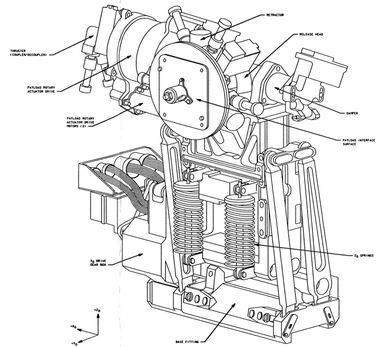
SPDS ORBITER INTERFACE - PORT SIDE



PAYLOAD INTERFACE PLATE

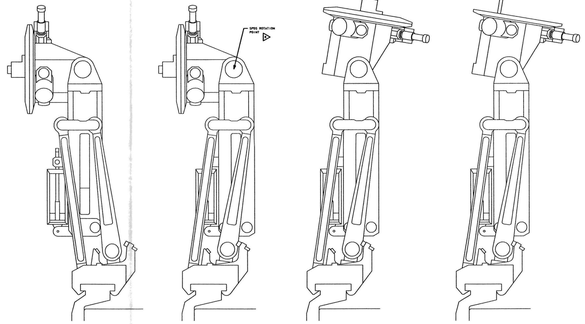


OUTBOARD FACE

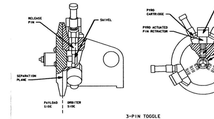


INBOARD FACE

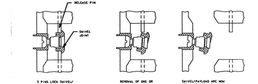
SPDS OPERATION



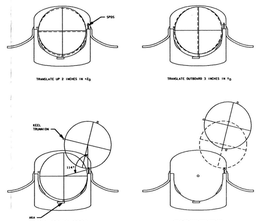
SPDS PAYLOAD DEPLOYMENT AND RELEASE MOTION



3-PIN TOGGLE
PAYLOAD RELEASE MECHANISM



PAYLOAD RELEASE SEQUENCE



PAYLOAD DEPLOYMENT SEQUENCE

1. FOR DRAWING REFERENCES, SEE TABLE S1-1

▷1 THE SPDS ROTATION PIVOT IS ALIGNED TO A 51 IN. ARC.

▷2 UNLOADED SPDS MOTOR RUN TIMES

FROM STOWED TO 114°	300 SEC@ 0 MOTORS 400 SEC@ 1 MOTOR NA SEC@ 2 MOTORS
Y_B DRIVE FROM 114° TO FULL EXTENSION (DEPLOY)	NA SEC@ 0 MOTORS NA SEC@ 1 MOTOR NA SEC@ 2 MOTORS
FROM DEPLOY EXTENSION TO	0 SEC@ 0 MOTORS 0 SEC@ 1 MOTOR 0 SEC@ 2 MOTORS
FROM ROTATION TO STOW	0 SEC@ 0 MOTORS 0 SEC@ 1 MOTOR

▷3 THE SECONDARY PEDESTAL (S PED) IS SHOWN IN THE Y_B DIRECTION TO COMPENSATE FOR TYPICAL EXPANSION OF THE STRUCTURE

▷4 THE SPDS PEDESTALS (S/P) ARE PRELOADED AT ONE OF THE FOLLOWING 3 (1) SHIMS ARE USED BASED ON THE ACTUAL MEASURED GAP

PRELOAD IS ACCOMPLISHED WITH 2 BOLTS TIGHTENED WITH 1000 FT-LBS OF TORQUE. THE PRELOAD IS MEASURED BY MEASURING THE GAP PRIOR TO PRELOAD. THE GAP IS MEASURED AT THE ELECTRICAL CONNECTOR. THE GAP IS MEASURED BETWEEN THE ELECTRICAL CONNECTOR FLANGE (1/8") UNDER BEFORE THE PRELOAD RELEASE MECHANISM) AND ARTICULATED TOP PRELOAD INTERFACE PLATE TO DETERMINE THE SHIM THICKNESS REQUIRED.

▷5 THE PAYLOAD ROTARY DRIVE ACTUATOR ROTATES THE RELEASE MECHANISMS FROM THE STOWED POSITION (14°) (197 HARDSTOP) TO THE DEPLOYED POSITION (114°) FROM THE STOWED POSITION TO ORIGINAL TO RELEASE.

▷6 THE Y_B DRIVE SYSTEM PROVIDES 2 INCH OUTBOARD MOTION OF THE PAYLOAD AT THE SPDS PEDESTAL. THE Y_B DRIVE SYSTEM IS ALSO USED FOR THE PAYLOAD ROTARY DRIVE ACTUATOR (PRDA). IT UNFOLDS 7 IN MID-BAY BOOMS REMOVED FOR KEEL TRUNNION CLEARANCE

NOTES: ▷7 THE COMPRESSION Z_B STRIKER IS THE ORBITER MOTION ASSESSMENT TO RELEASE OF THE ASSOCIATE RETRACTOR LATCHES

9 SPDS MECH O/V 4

SIGNATURE	DATE
DESIGN: R.G. TISDEN JR.	7/14/88
DRAFTING:	
CHK: R. FELLER	
CHIEF, [illegible]	7/15/88
CHIEF, [illegible]	7/15/88
CHIEF, [illegible]	7/15/88
CHIEF, [illegible]	7/15/88

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

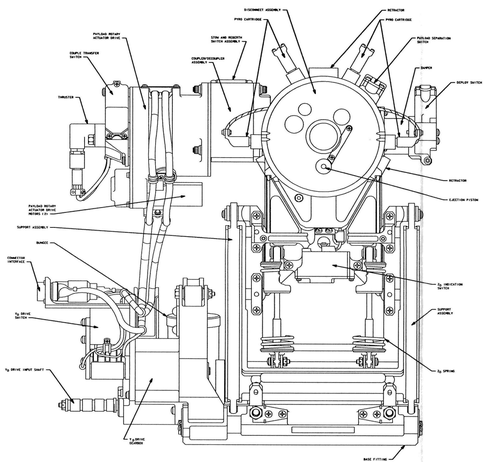
STABILIZED PAYLOAD DEPLOYMENT SYSTEM MECHANICAL OVERVIEW

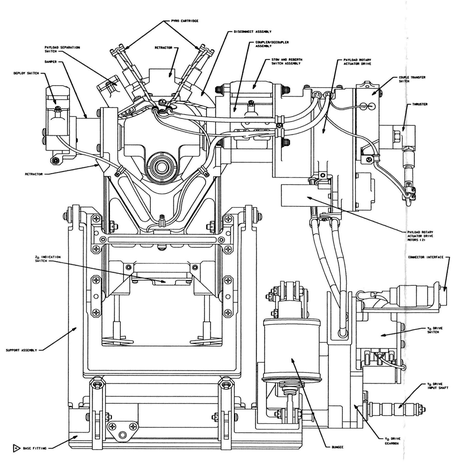
SIZE: D | CODE IDENT NO: 80124 | DWG NO: 21-9

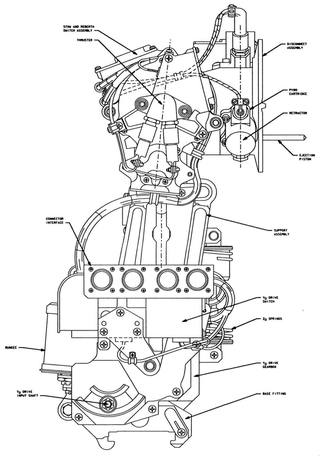
SCALE: NONE | SHEET 1 OF 1

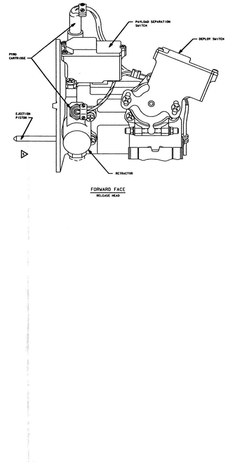
BASIC REV F-4

PEDESTAL DESIGN

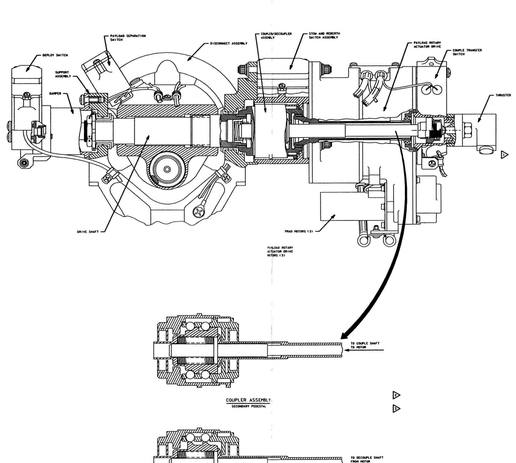








ROTARY DRIVE TRANSFER SYSTEM



NOTES:

1. FOR DRAWING REFERENCES, SEE TABLE III-1.

2. RELEASE IS ACCOMPLISHED OVER A NOSE DIAMETER INTO-STIM SWITCH ASSEMBLY. WHEN THE PAYLOAD IS SEPARATED FROM THE PEDESTAL, IT RELEASES THE PAYLOAD, THE PAYLOAD IS SEPARATED FROM THE PEDESTAL BY THE PAYLOAD SEPARATION SWITCH. THE ELECTRIC PISTON TRAVELS 1.75" + 1/8"(0.5) BEFORE THE PAYLOAD RELEASE HEAD RETRACTS. THE ELECTRIC PISTON IS ATTACHED TO THE PAYLOAD SEPARATE PLATE TO PERMANENTLY ATTACHED TO THE PAYLOAD.

3. THE BASE FITTING CLAMPS ONTO THE RELEASE HEAD VIA THE CONNECTOR INTERFACE. THE CONNECTOR INTERFACE ALSO CAN BE LOCATED THROUGHOUT THE PAYLOAD BAY.

4. FOR THE SECONDARY PEDESTAL, THE COUPLER IS HYDRAULLY ENGAGED FROM THE PAYLOAD ROTARY ACTUATOR DRIVE. THE COUPLER IS ATTACHED TO THE PAYLOAD ROTARY ACTUATOR TO THE DRIVE SHAFT.

5. FOR THE PRIMARY PEDESTAL, THE DECOUPLER IS HYDRAULLY ENGAGED TO THE PAYLOAD ROTARY ACTUATOR DRIVE. IF THE PAYLOAD ROTARY ACTUATOR DRIVE IS NOT USED, THE DECOUPLER ATTACHES FROM THE DRIVE SHAFT.

NOTES 6. THE TRANSFER IS A PYROMOTIVELY DRIVEN TRAY THAT INITIATES ELECTRICAL POWER AND COMMUNICATIONS BETWEEN THE PAYLOAD AND PEDESTAL TO THE SECONDARY PEDESTAL VIA THE COUPLER/DECOUPLER. THE TRANSFER IS ACTUATED BY THE DEPLOY SWITCH DURING DEPLOYMENT. IF FAILS, THIS IS A ONE-TIME-ONLY, NON-REVERSIBLE OPERATION. THE TRANSFER IS ATTACHED TO DECOUPLER AND THE SECONDARY TO COUPLER SIMULTANEOUSLY.

9 SPDS MECH O/V 5

SIGNATURE	DATE	NAVAL SYSTEMS AIR DEVELOPMENT CENTER, WARMINSTER, PENNSYLVANIA 18974
DSN N.S. 5330/01 (8)	5/6/88	
APP		STABILIZED PAYLOAD DEPLOYMENT SYSTEM MECHANICAL OVERVIEW
DRAWN G. PALUCH		
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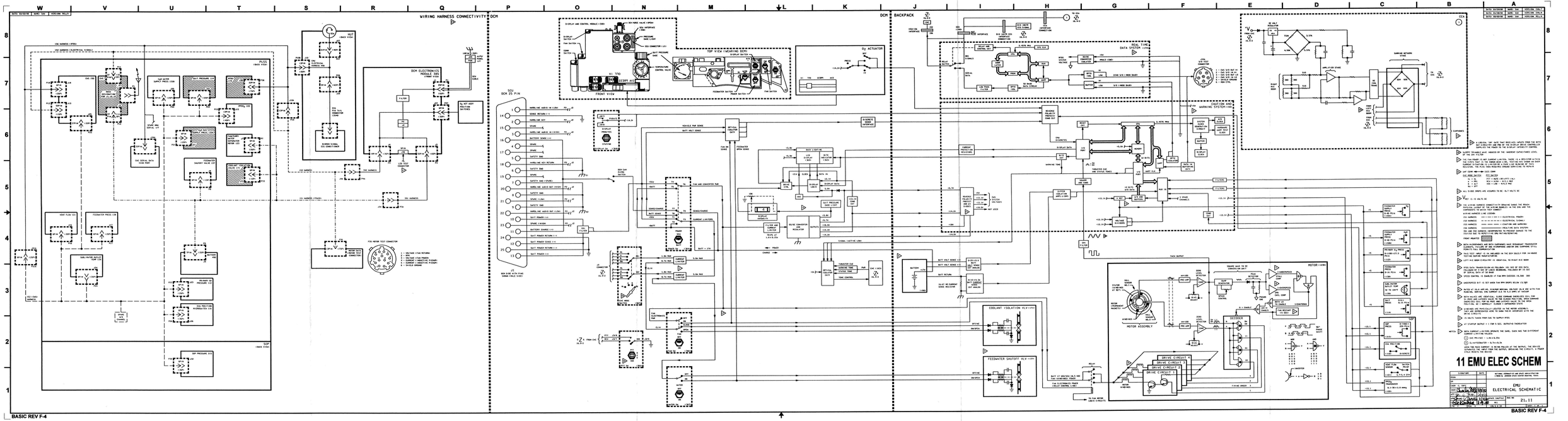
WIRING HARNESS CONNECTIVITY DCH
DCH BACKPACK
PLSS (BACK PACK)
SOP (BACK VIEW)
DCH ELECTRONICS MODULE (DEM)
FRONT VIEW
TOP VIEW (WEARING DCH)
BACKPACK
DATA SYSTEM (DTA)
CAUTION AND WARNING SYSTEM (CWS)
MOTOR ASSEMBLY
11 EMU ELEC SCHEM
EMU
ELECTRICAL SCHEMATIC
BASIC REV F-4