

FC027  
1/17/69



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# LUNAR MODULE SYSTEMS HANDBOOK

## LM-5 THROUGH LM-9 VEHICLES

JANUARY 17, 1969

### NOTE

No further major revision to the handbook will be issued. Small revisions to individual drawings, figures, tables, or notes will be published as drawing change notices (DCN's) and/or page change notices (PCN's) as required.

PREPARED BY  
**FLIGHT CONTROL DIVISION**

MANNED SPACECRAFT CENTER  
HOUSTON, TEXAS

1 INTRODUCTION

2 STRUCTURES

3 CREW SYSTEMS

4 SEQUENTIAL AND  
PYROTECHNICS

5 ELECTRICAL

6 ENVIRONMENTAL  
CONTROL

7 EMU

8 COMMUNICATIONS

9 INSTRUMENTATION

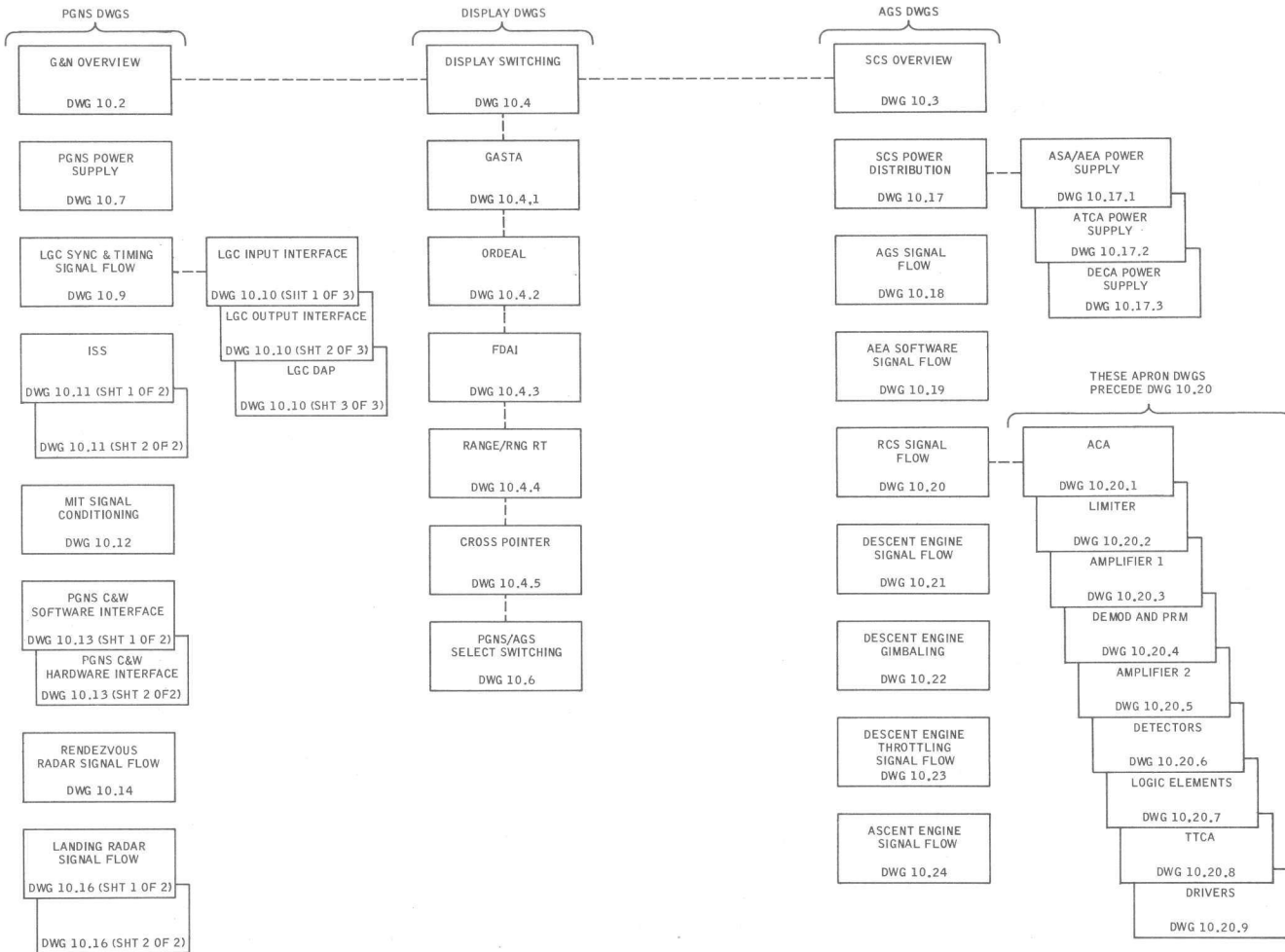
10 GUIDANCE AND  
CONTROL

11 PROPULSION

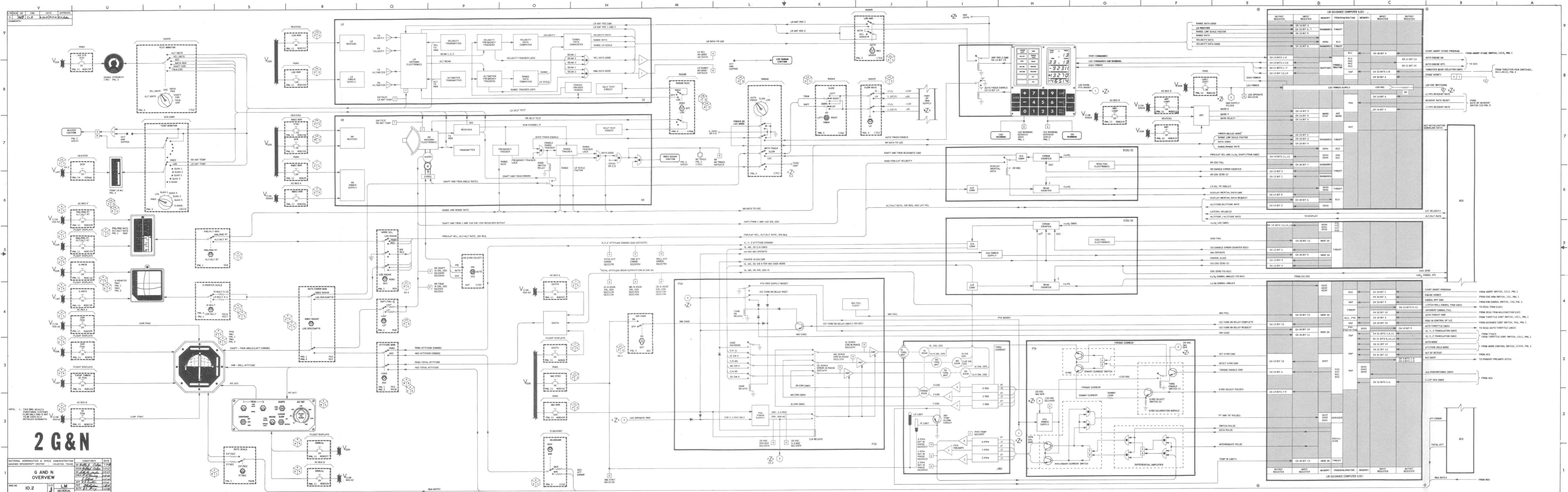
12 REACTION  
CONTROL

This cover revised by Change 4, dated June 2, 1969.

G AND C UNIVERSAL DRAWING TREE



10-1

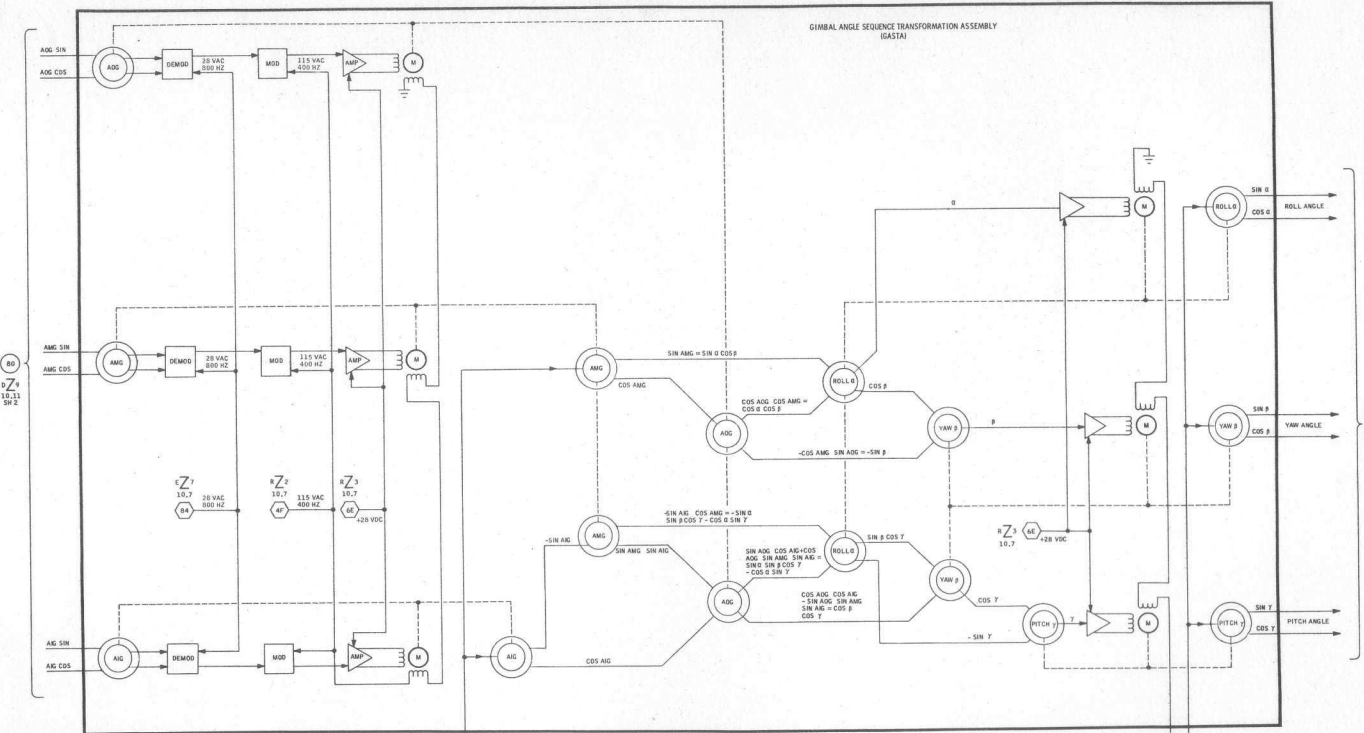


**2 G&N**

DATE	7-20-70
DESIGNED BY	W. C. C. / 11-21-69
ENGINEER	W. C. C. / 11-21-69
CHECKED BY	W. C. C. / 11-21-69
APP. BY	W. C. C. / 11-21-69
REV. BY	W. C. C. / 11-21-69
REV. DATE	11-21-69

UNIVERSAL

GIMBAL ANGLE SEQUENCE TRANSFORMATION ASSEMBLY (GASTA)



TO FSM AND ORIGINAL THROUGH ATTITUDE MONITOR ON SEC 506 10.11 SH 2

RZ 8 28 VAC 400 HZ

RZ 3 115 VAC 400 HZ

RZ 10.7 28 VAC 400 HZ

RZ 10.7 115 VAC 400 HZ

RZ 7 28 VAC 400 HZ

RZ 10.7 115 VAC 400 HZ

RZ 10.7 28 VAC 400 HZ

RZ 7 28 VAC 400 HZ

RZ 10.7 115 VAC 400 HZ

RZ 10.7 28 VAC 400 HZ

RZ 7 28 VAC 400 HZ

RZ 10.7 115 VAC 400 HZ

RZ 10.7 28 VAC 400 HZ

RZ 7 28 VAC 400 HZ

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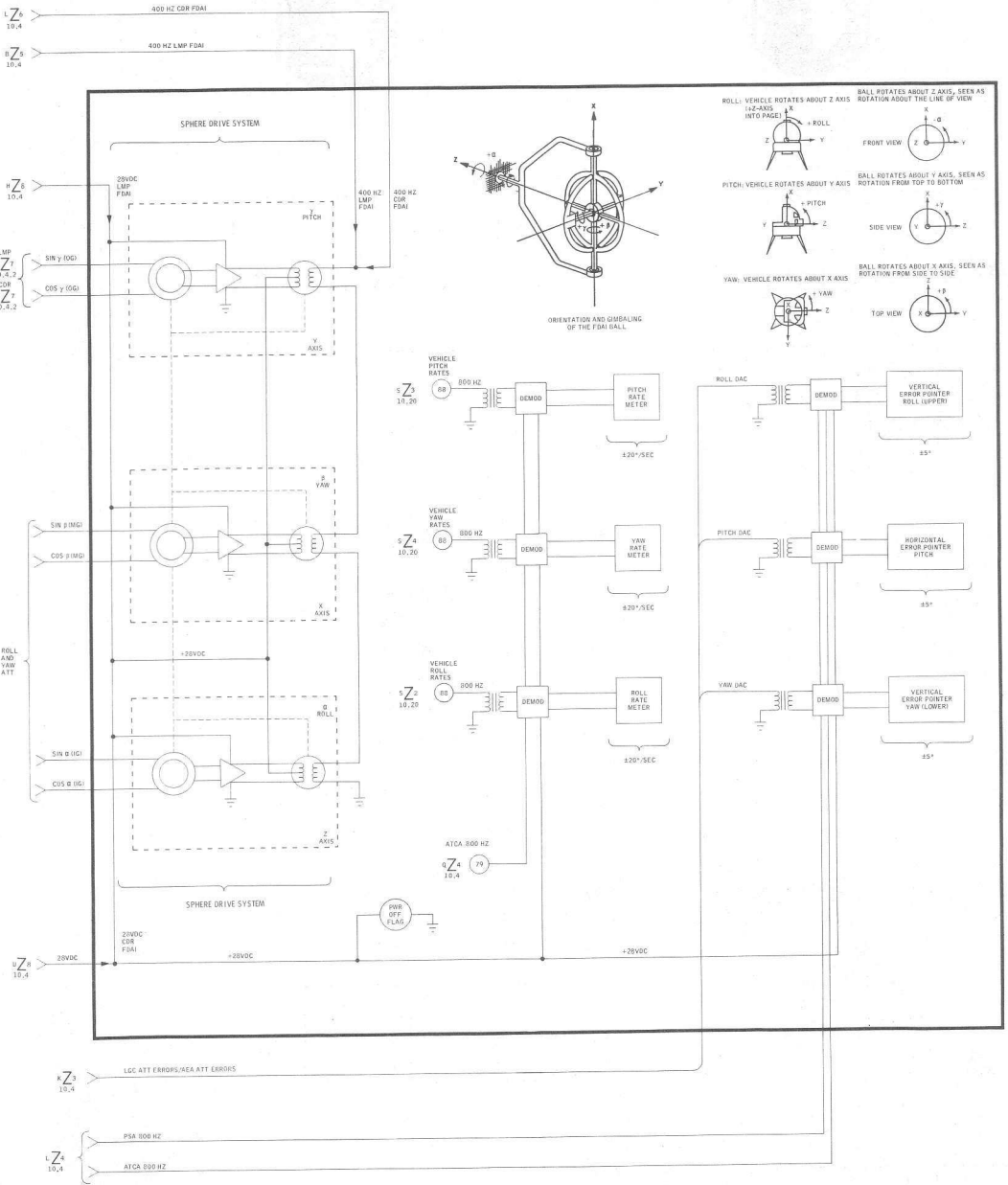
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UNIT	INCHES
TOLERANCE	...
...	...

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BY	W. J. ...
CHKD BY	...
APP'D BY	...
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LT/DCN	BR	ENG	DATE	APPROVAL
C		LM	10/4/62	

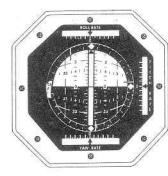
COMMENTS:



# 4.3 FDAI

- 3 FOR FSAI PARTWORK  
 REFERENCE:  $\begin{matrix} 9M1 \\ 7A \\ 1B1 \end{matrix}$   $\begin{matrix} 9M6 \\ 7A \\ 1B1 \end{matrix}$
- 2 FOR ELECTROLUMINESCENT  
 DISPLAY LIGHTS, REFERENCE:  $\begin{matrix} 9Z \\ 31 \end{matrix}$

NOTES: 1. ENG IS REPRESENTATIVE  
 OF BOTH FSAIS (9M1-9M6)



NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER : HOUSTON, TEXAS		SIGNATURES		DATE
FSAI		DR <i>[Signature]</i>		11-21
		DCSR <i>[Signature]</i>		11-23
		ENG <i>[Signature]</i>		11-23
		APP <i>[Signature]</i>		11-23
		PEC <i>[Signature]</i>		11-23
		AUTH <i>[Signature]</i>		11-23

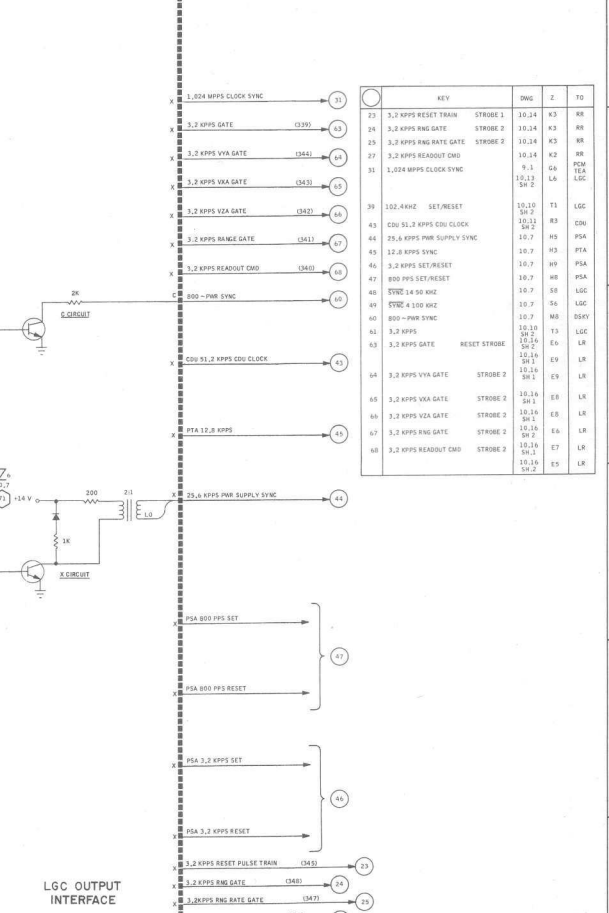
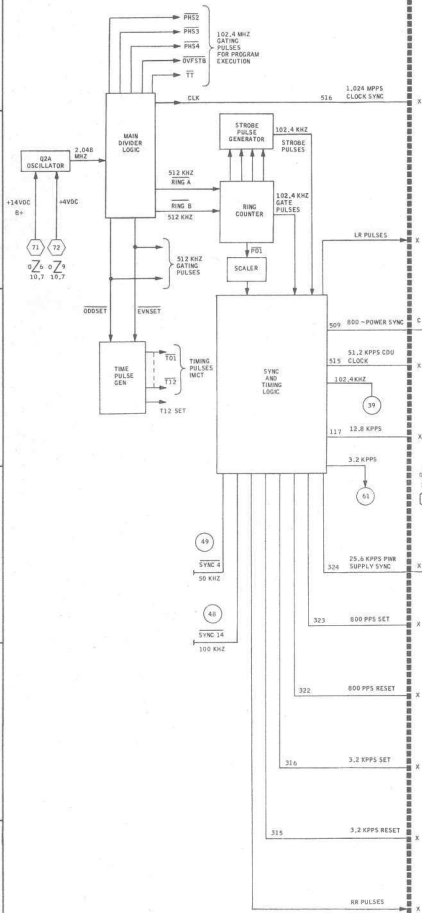
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UNIVERSAL

SHEET OF PAGE 10-7 38 X 48

LGC TIMER

EXTERNAL SYSTEMS

OUTPUTS



KEY		OWG	Z	TO
22	3.2 KPPS RESET TRAIN	STROBE 1	10.14	K3 KR
24	3.2 KPPS RING GATE	STROBE 2	10.14	K3 KR
25	3.2 KPPS RING RATE GATE	STROBE 2	10.14	K3 KR
27	3.2 KPPS READOUT CMD		10.14	K2 KR
31	3.024 MPPS CLOCK SYNC		9.11	S6 PSM
			10.13	L6 LGC
39	102.4KHZ SET/RESET		10.10	T1 LGC
43	CDU 51.2 KPPS CDU CLOCK		10.11	R3 CDU
44	25.6 KPPS PWR SUPPLY SYNC		10.17	H3 PSA
45	12.8 KPPS SYNC		10.17	H3 PTA
46	800 PPS SET/RESET		10.17	H9 PSA
47	800 PPS SET/RESET		10.17	H8 PSA
48	800 SYNC 14 500 SYNC		10.17	S8 LGC
49	800 - PWR SYNC		10.17	S6 LGC
60	800 - PWR SYNC		10.17	MA D5AV
61	3.2 KPPS		10.10	T3 LGC
63	3.2 KPPS GATE	RESET STROBE	10.14	E6 LR
			10.14	S11 LR
64	3.2 KPPS VVA GATE	STROBE 2	10.14	ER LR
65	3.2 KPPS VVA GATE	STROBE 2	10.14	ER LR
66	3.2 KPPS VIA GATE	STROBE 2	10.14	ER LR
67	3.2 KPPS RING GATE	STROBE 2	10.14	EA LR
68	3.2 KPPS READOUT CMD	STROBE 2	10.14	ET LR
			10.16	S1.1 LR
			10.16	S1.2 LR

LGC TIMER

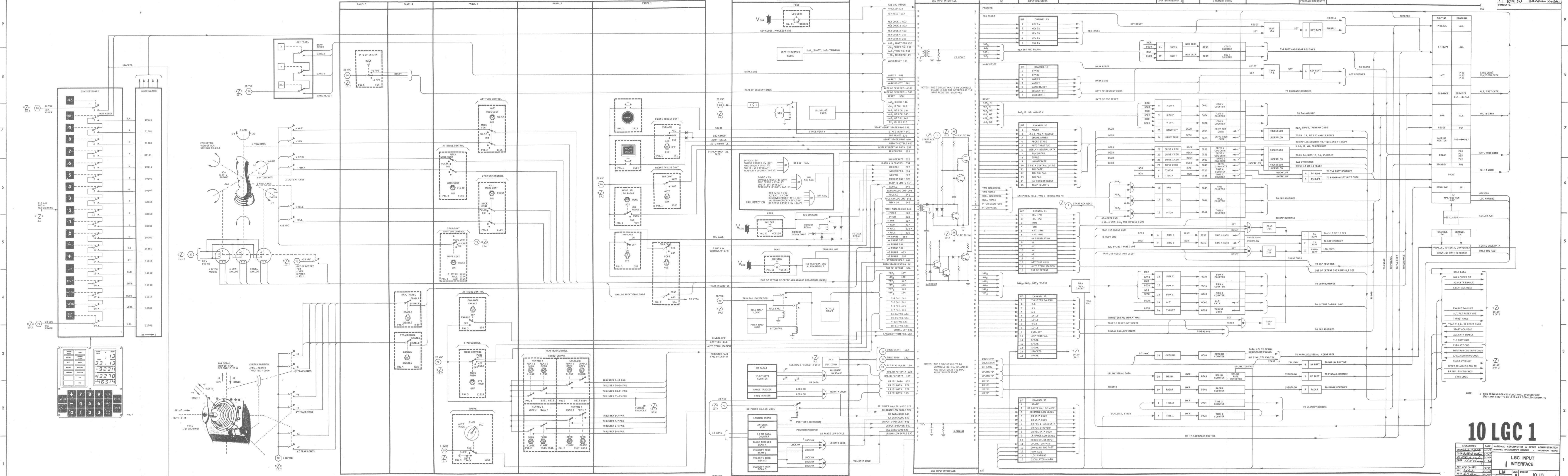
OUTPUTS

# 9 LGC SYNC

SIGNATURES	DATE	NATIONAL AERONAUTICS & SPACE ADMINISTRATION
DR	10/10/77	MANAGING SPACECRAFT CENTER
DCSR	10/10/77	HOUSTON, TEXAS
SC	10/10/77	
ENG	10/10/77	
APP	10/10/77	
REC	10/10/77	
AUTH	10/10/77	

**LGC SYNC AND TIMING SIGNAL FLOW**

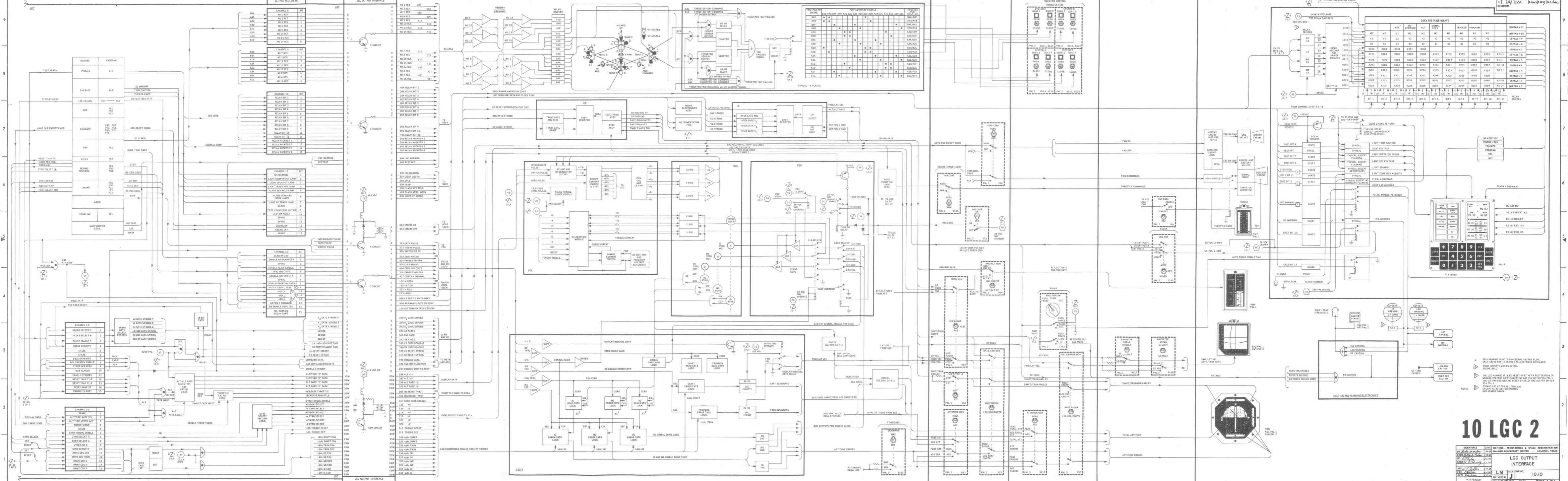
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UNIVERSAL		
35	30 X 40	PAGE 10-13A SHEET 1 OF 1



# 10 LGC 1

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DESIGNED BY	W. J. ...
CHECKED BY	...
APP. BY	...
DATE	11/27/67
DESIGNED BY	...
CHECKED BY	...
APP. BY	...

NATIONAL AERONAUTICS & SPACE ADMINISTRATION  
 WASHINGTON, TEXAS  
 LGC INPUT INTERFACE  
 SIZE DWG NO. 10.10  
 UNIVERSAL J  
 24.6 PERCENT



# 10 LGC 2

SIGNATURES: [Blank] DATE: [Blank] NATIONAL AERONAUTICS & SPACE ADMINISTRATION  
LGC 2 OUTPUT INTERFACE  
UNIVERSAL L.M. [Blank] 10.10  
313 X 38 25 PAGE 10-15 SHEET 2 OF 3

- 4 THIS DRAWING DEPICTS FUNCTIONAL SYSTEM FLOW ONLY AND IS NOT TO BE USED AS A DETAILED SCHEMATIC ENGINE BELL
- 5 THIS DRAWING WILL BE RESET BY EITHER A RESTORATION OF NORMAL VOLTAGE OR BY SELECTING ASG VIA BIT 95A PAL. THE ISS WARNING WILL BE RESET BY SELECTING ASG VIA SWITCH VIA PAL 1
- 6 230VAC 50/60 HZ FOR ALL DISPLAYS EXCEPT AS NOTED FOR CAUTION AND STATUS POWER



Table with columns: NAME, NO, FROM, TO. Lists various channels and their bit definitions.

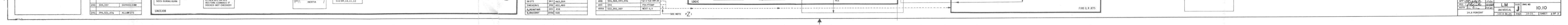
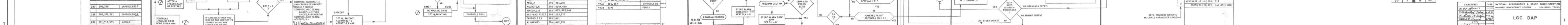
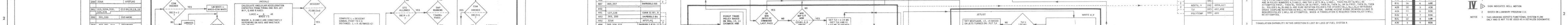
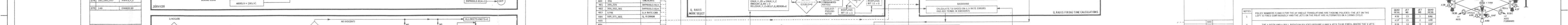
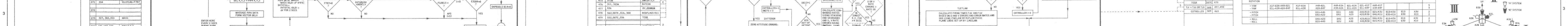
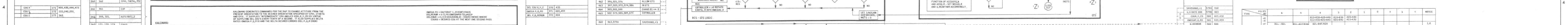
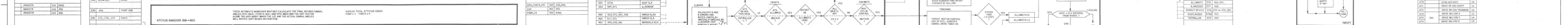
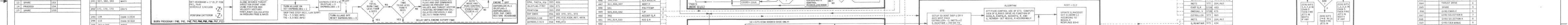
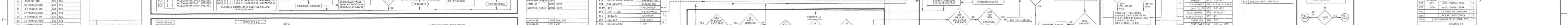
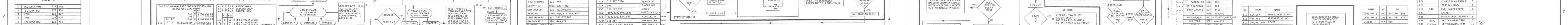
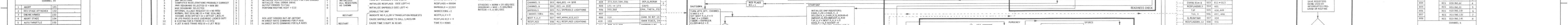
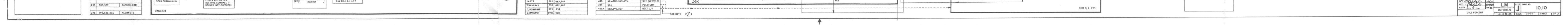
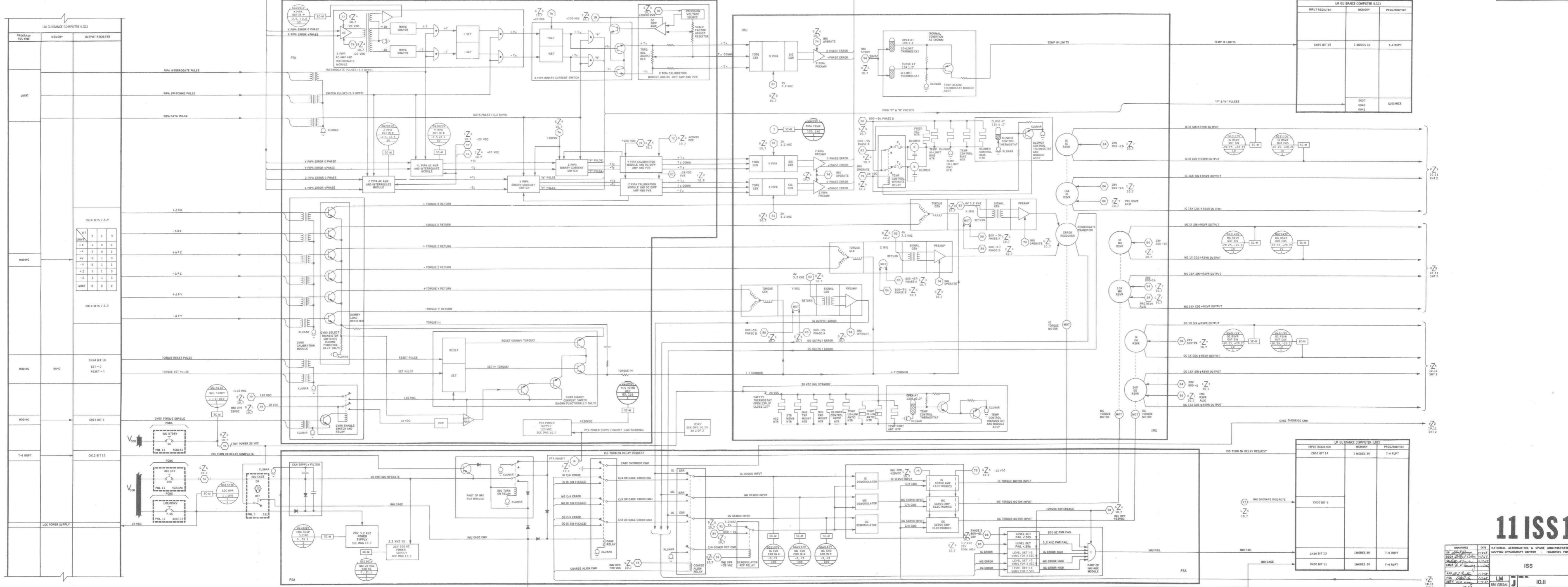


Table with columns: NAME, NO, FROM, TO. Lists various channels and their bit definitions.



NOTES: 1. POLICY NUMBERS 5 AND 6 FOR THE 4V AND 4Z TRANSLATION ARE TRACKING POLICES... 2. THE 4V AND 4Z RELATION POLICES REQUIRE 4V AND 4Z TO BE FIRST... 3. TRANSLATION CAPABILITY IN THIS DIRECTION IS LOST BY LOSS OF FUEL SYSTEM... 4. TRANSLATION CAPABILITY IN THIS DIRECTION IS LOST BY LOSS OF FUEL SYSTEM... 5. THE 4V AND 4Z RELATION POLICES REQUIRE 4V AND 4Z TO BE FIRST...



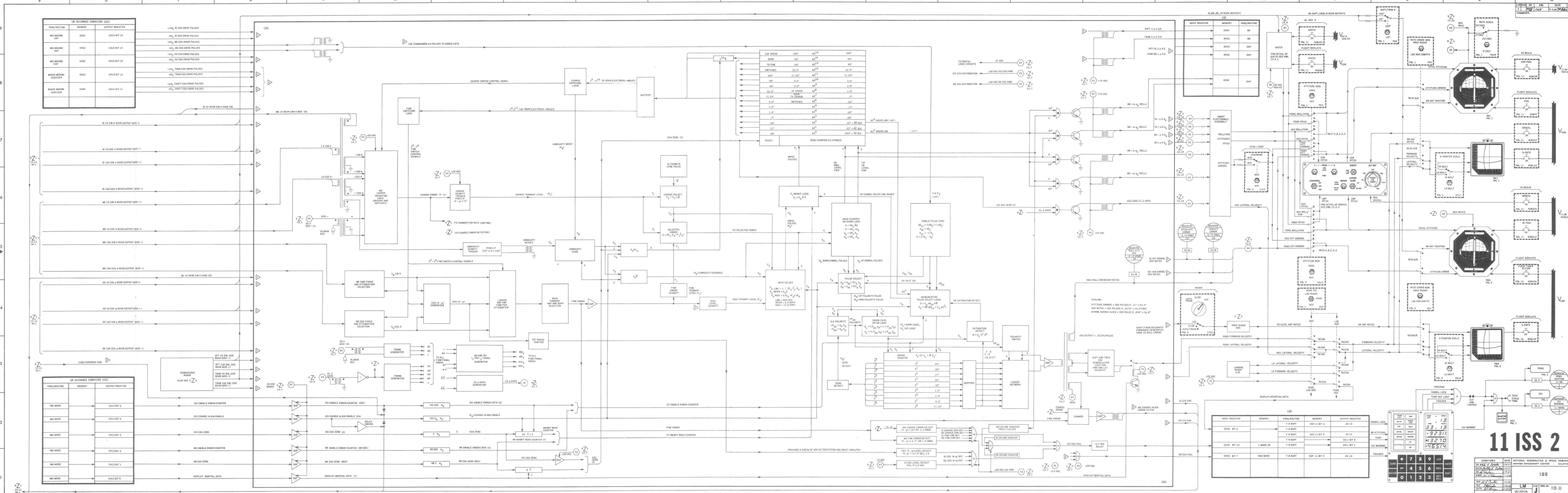
CH4 BITS 7,8,9

BIT	7	8	9
DRIVE	1	0	0
+X	1	0	0
-X	1	0	1
+Y	0	1	0
-Y	0	1	1
+Z	1	1	0
-Z	1	1	1
NONE	0	0	0

CH4 BITS 7,8,9

LM GUIDANCE COMPUTER (LGC)

INPUT REGISTER	MEMORY	PROGRAM ROUTINE
CH30 BIT 14	1 MODES 30	T-4 RUPT
CH30 BIT 15	1 MODES 30	T-4 RUPT
CH30 BIT 11	1 MODES 30	T-4 RUPT



- 7 WHEN READ CTR IS WITHIN  $\approx 0.1$  DEG HIGH SCHMITT STOPS, FINE TAKES OVER.  $F_1$  GETS  $\psi$  WITHIN TWO BITS OF  $\theta$ .
- 6 RR CDU DRIVE PULSES REPRESENT (1) RR SHAFT AND TRUNNION DESIGNATE CMDS OR (2) FORWARD AND LATERAL VELOCITY (IF CH12B8 IS SET, DISPLAY INERTIAL DATA)
- 5 ISS CDU DRIVE PULSES REPRESENT (1) COARSE ALIGN CMDS, (2) MODE 1 DAP ERRORS, (3) MODE 2 DAP ERRORS, OR (4) DAP BODY RATES
- 4 GIMBAL DRIVE RATE IS LIMITED TO EITHER 35.5°/SEC (READ CTR AT 800 KPPS)
- 3 PROVIDES A GROUND PATH TO THE COARSE ALIGN RELAYS AND INHIBITS THE ERROR COUNTER ENABLE DISCRETE
- 2 THE RR CDU FAIL CIRCUITRY IS IDENTICAL TO THE ISS CDU FAIL CIRCUITRY WITH THE EXCEPTION OF POWER INPUT AS SHOWN
- 1 THE MIDDLE GIMBAL (MG) CDU SHOWN IN THIS DRAWING IS REPRESENTATIVE OF THE INNER GIMBAL (IG), OUTER GIMBAL (OG) RENDEZVOUS RADAR SHAFT AND RENDEZVOUS RADAR TRUNNION CDU'S

NOTES

11 ISS 2

LM UNIVERSAL  
REV A

ISS

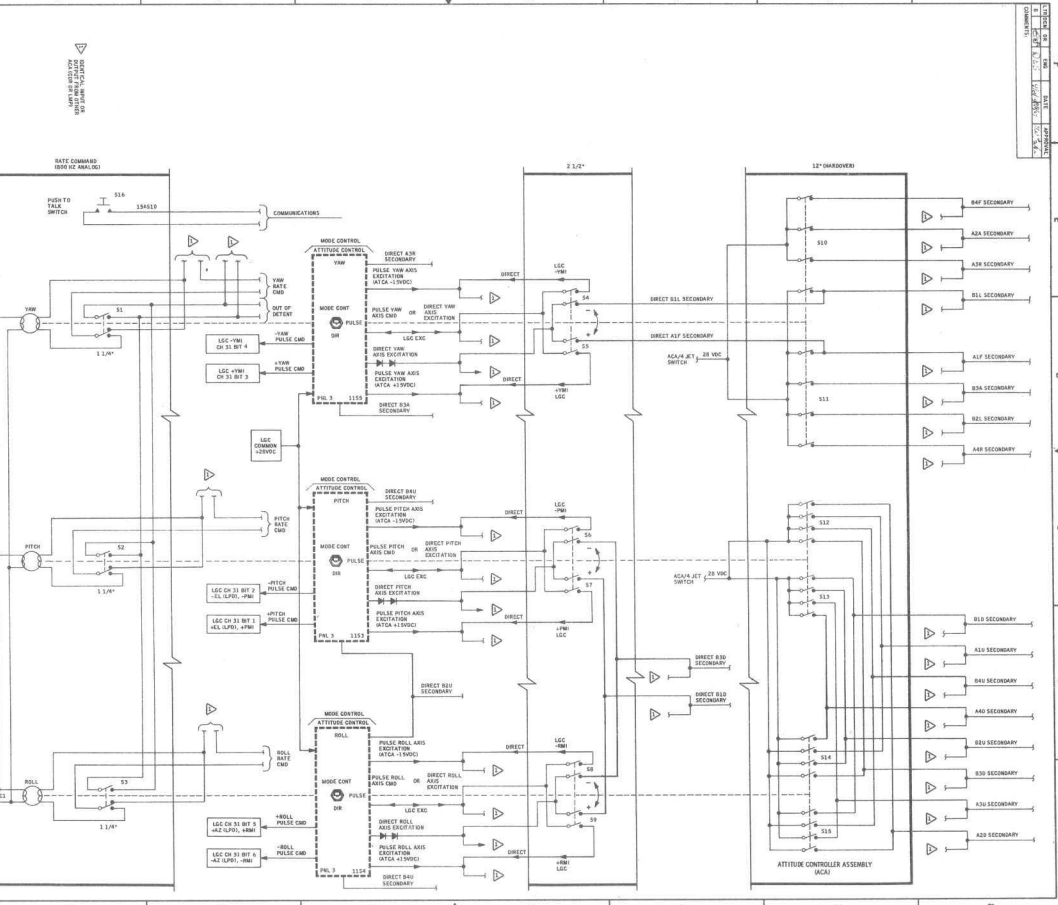
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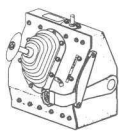
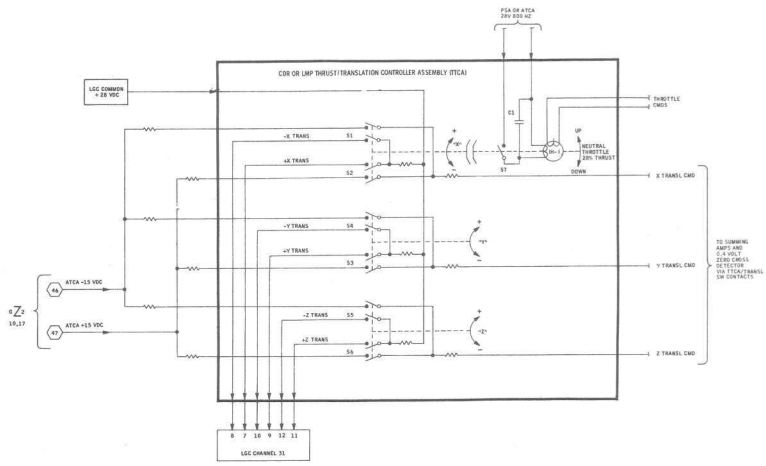
LM UNIVERSAL  
REV A

ISS

DATE: 10-11-64  
DESIGNED BY: [Signature]  
CHECKED BY: [Signature]  
ENGINEER: [Signature]

FORM NO. <b>10-20-1</b>	REV. <b>1</b>	DATE <b>10/20/51</b>	DRAWN BY <b>LMH</b>		CHECKED BY <b>JLS</b>
			DATE		
<b>20.1 AGCA</b>					
ORIGINAL MANUFACTURE & TEST COMPLETION DATE CONTROL MANUFACTURE & TEST COMPLETION DATE ASSEMBLY MANUFACTURE & TEST COMPLETION DATE INSPECTION MANUFACTURE & TEST COMPLETION DATE REVISIONS:					
1. ROLL CONTROL SYSTEM 2. PITCH CONTROL SYSTEM 3. YAW CONTROL SYSTEM 4. RATE COMMAND 5. COMMUNICATIONS 6. ATTITUDE CONTROL SYSTEM 7. RATE COMMAND ANALOG 8. ATTITUDE CONTROL SYSTEM 9. RATE COMMAND ANALOG 10. ATTITUDE CONTROL SYSTEM 11. RATE COMMAND ANALOG 12. ATTITUDE CONTROL SYSTEM 13. RATE COMMAND ANALOG 14. ATTITUDE CONTROL SYSTEM 15. RATE COMMAND ANALOG 16. ATTITUDE CONTROL SYSTEM 17. RATE COMMAND ANALOG 18. ATTITUDE CONTROL SYSTEM 19. RATE COMMAND ANALOG 20. ATTITUDE CONTROL SYSTEM 21. RATE COMMAND ANALOG 22. ATTITUDE CONTROL SYSTEM 23. RATE COMMAND ANALOG 24. ATTITUDE CONTROL SYSTEM 25. RATE COMMAND ANALOG 26. ATTITUDE CONTROL SYSTEM 27. RATE COMMAND ANALOG 28. ATTITUDE CONTROL SYSTEM 29. RATE COMMAND ANALOG 30. ATTITUDE CONTROL SYSTEM 31. RATE COMMAND ANALOG 32. ATTITUDE CONTROL SYSTEM 33. RATE COMMAND ANALOG 34. ATTITUDE CONTROL SYSTEM 35. RATE COMMAND ANALOG 36. ATTITUDE CONTROL SYSTEM 37. RATE COMMAND ANALOG 38. ATTITUDE CONTROL SYSTEM 39. RATE COMMAND ANALOG 40. ATTITUDE CONTROL SYSTEM 41. RATE COMMAND ANALOG 42. ATTITUDE CONTROL SYSTEM 43. RATE COMMAND ANALOG 44. ATTITUDE CONTROL SYSTEM 45. RATE COMMAND ANALOG 46. ATTITUDE CONTROL SYSTEM 47. RATE COMMAND ANALOG 48. ATTITUDE CONTROL SYSTEM 49. RATE COMMAND ANALOG 50. ATTITUDE CONTROL SYSTEM 51. RATE COMMAND ANALOG 52. ATTITUDE CONTROL SYSTEM 53. RATE COMMAND ANALOG 54. ATTITUDE CONTROL SYSTEM 55. RATE COMMAND ANALOG 56. ATTITUDE CONTROL SYSTEM 57. RATE COMMAND ANALOG 58. ATTITUDE CONTROL SYSTEM 59. RATE COMMAND ANALOG 60. ATTITUDE CONTROL SYSTEM 61. RATE COMMAND ANALOG 62. ATTITUDE CONTROL SYSTEM 63. RATE COMMAND ANALOG 64. ATTITUDE CONTROL SYSTEM 65. RATE COMMAND ANALOG 66. ATTITUDE CONTROL SYSTEM 67. RATE COMMAND ANALOG 68. ATTITUDE CONTROL SYSTEM 69. RATE COMMAND ANALOG 70. ATTITUDE CONTROL SYSTEM 71. RATE COMMAND ANALOG 72. ATTITUDE CONTROL SYSTEM 73. RATE COMMAND ANALOG 74. ATTITUDE CONTROL SYSTEM 75. RATE COMMAND ANALOG 76. ATTITUDE CONTROL SYSTEM 77. RATE COMMAND ANALOG 78. ATTITUDE CONTROL SYSTEM 79. RATE COMMAND ANALOG 80. ATTITUDE CONTROL SYSTEM 81. RATE COMMAND ANALOG 82. ATTITUDE CONTROL SYSTEM 83. RATE COMMAND ANALOG 84. ATTITUDE CONTROL SYSTEM 85. RATE COMMAND ANALOG 86. ATTITUDE CONTROL SYSTEM 87. RATE COMMAND ANALOG 88. ATTITUDE CONTROL SYSTEM 89. RATE COMMAND ANALOG 90. ATTITUDE CONTROL SYSTEM 91. RATE COMMAND ANALOG 92. ATTITUDE CONTROL SYSTEM 93. RATE COMMAND ANALOG 94. ATTITUDE CONTROL SYSTEM 95. RATE COMMAND ANALOG 96. ATTITUDE CONTROL SYSTEM 97. RATE COMMAND ANALOG 98. ATTITUDE CONTROL SYSTEM 99. RATE COMMAND ANALOG 100. ATTITUDE CONTROL SYSTEM 					





# 20.8 TTCA

SIGNATURES		DATE	NATIONAL AERONAUTICS & SPACE ADMINISTRATION
DR	Rev. 01	10/21/80	MANAGED SPACECRAFT CDP DR - HOUSTON, TEXAS
DR	Rev. 02	10/21/80	
DR	Rev. 03	10/21/80	
DR	Rev. 04	10/21/80	
DR	Rev. 05	10/21/80	
DR	Rev. 06	10/21/80	
DR	Rev. 07	10/21/80	
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DR	Rev. 15	10/21/80	
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LM	DWG. NO.	10.20.8
UNIVERSAL	PAGE	10-39
30.8.40	SHEET	1 OF 1