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.

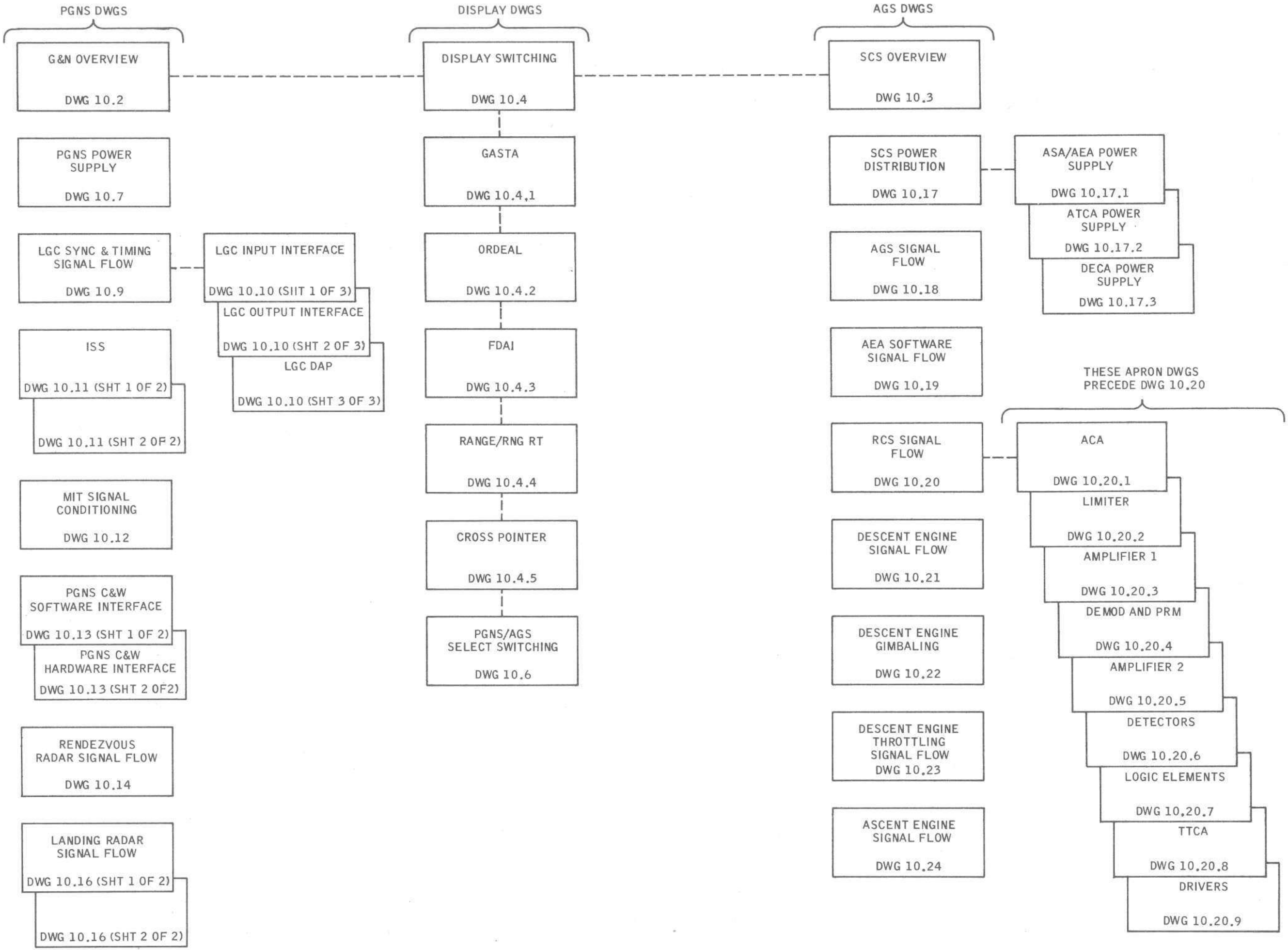
PREPARED BY

FLIGHT CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

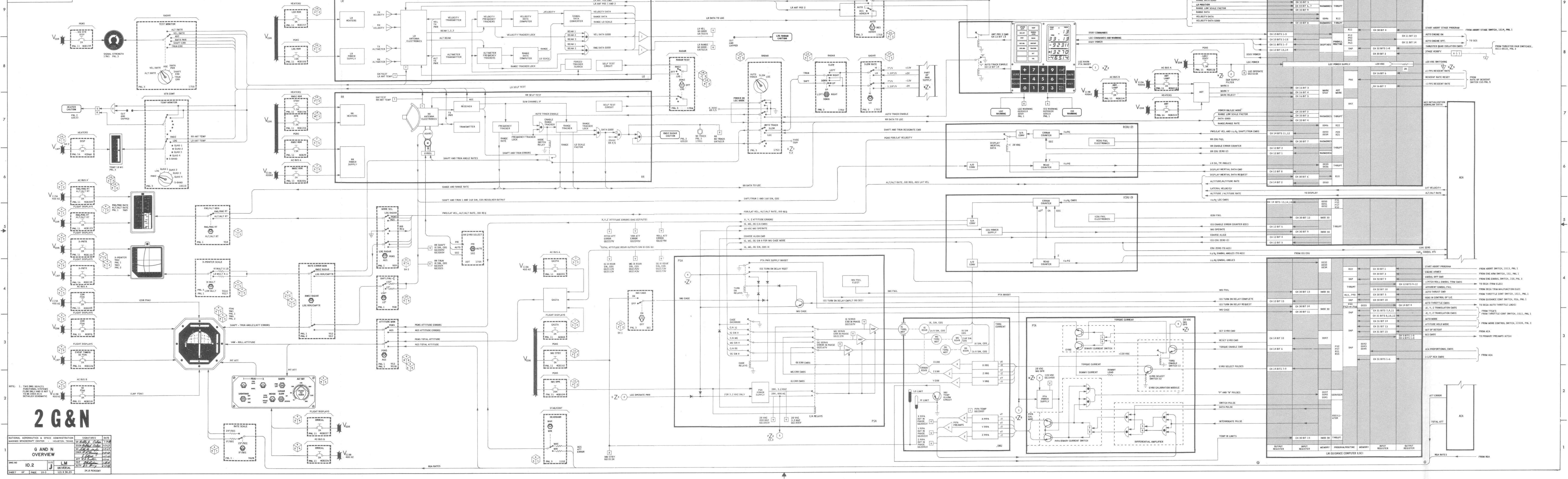
This cover revised by Change 4, dated June 2, 1969.

G AND C UNIVERSAL DRAWING TREE



LTR	DCN	DR	ENG	DATE		APPROVAL
B		NLB	CL	8-20-69	8-28-69	W. A. Lalim

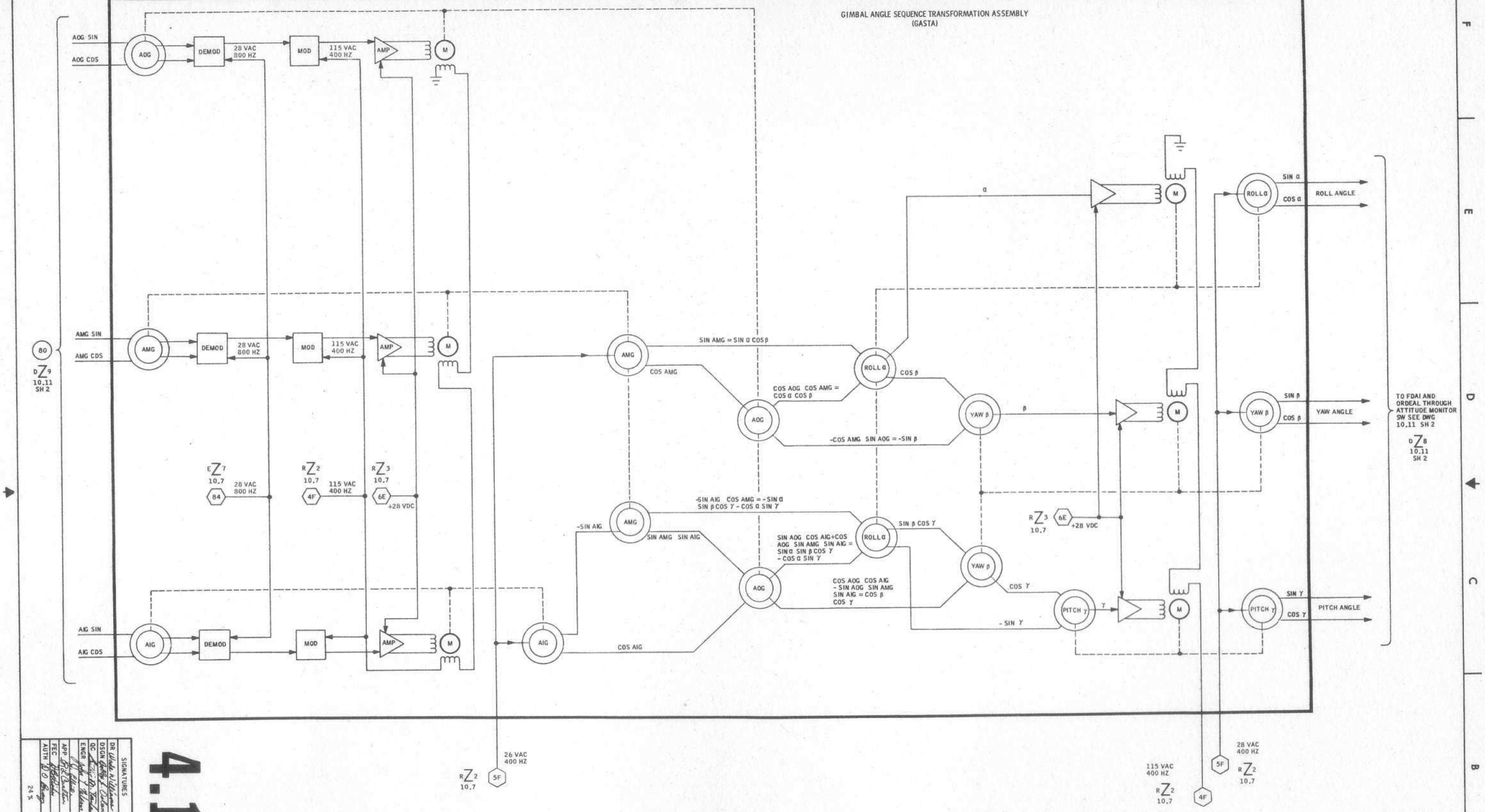
COMMENTS:



NOTE: 1. THIS DWG DEPICTS FUNCTIONAL SYSTEMS FLOW ONLY AND IS NOT TO BE USED AS A DETAILED SCHEMATIC

2 G&N

NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS	SIGNATURES	DATE
G AND N OVERVIEW	DR Bobby J. Osban	1-17-69
	DSGN Bobby J. Osban	1-17-69
	QC	1-17-69
	ENGR	1-17-69
	J. Elliott	1-17-69
	APP R L Carlton	1-17-69
	FEC	1-18-69
	AUTH	1-17-69
DWG NO 10.2 · SIZE J · LM UNIVERSAL		
SHEET OF · PAGE 10-3 · 121 X 38.25	24.8 PERCENT	


GIMBAL ANGLE SEQUENCE TRANSFORMATION ASSEMBLY
(GASTA)

4.1 GASTA

SIGNATURES	DATE
DR Wade Williams	1-17-69
DSGN Gerald L. Carlson	1-17-69
QC	1-17-69
ENGR John T. Wilson	1-17-69
J. Ellis	1-17-69
APP R. L. Carlton	1-17-69
FEC	1-17-69
AUTH D. O. Berg	1-17-69

24 %

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GASTA

LM
UNIVERSAL
30 X 40

DWG. NO. 10.4.1

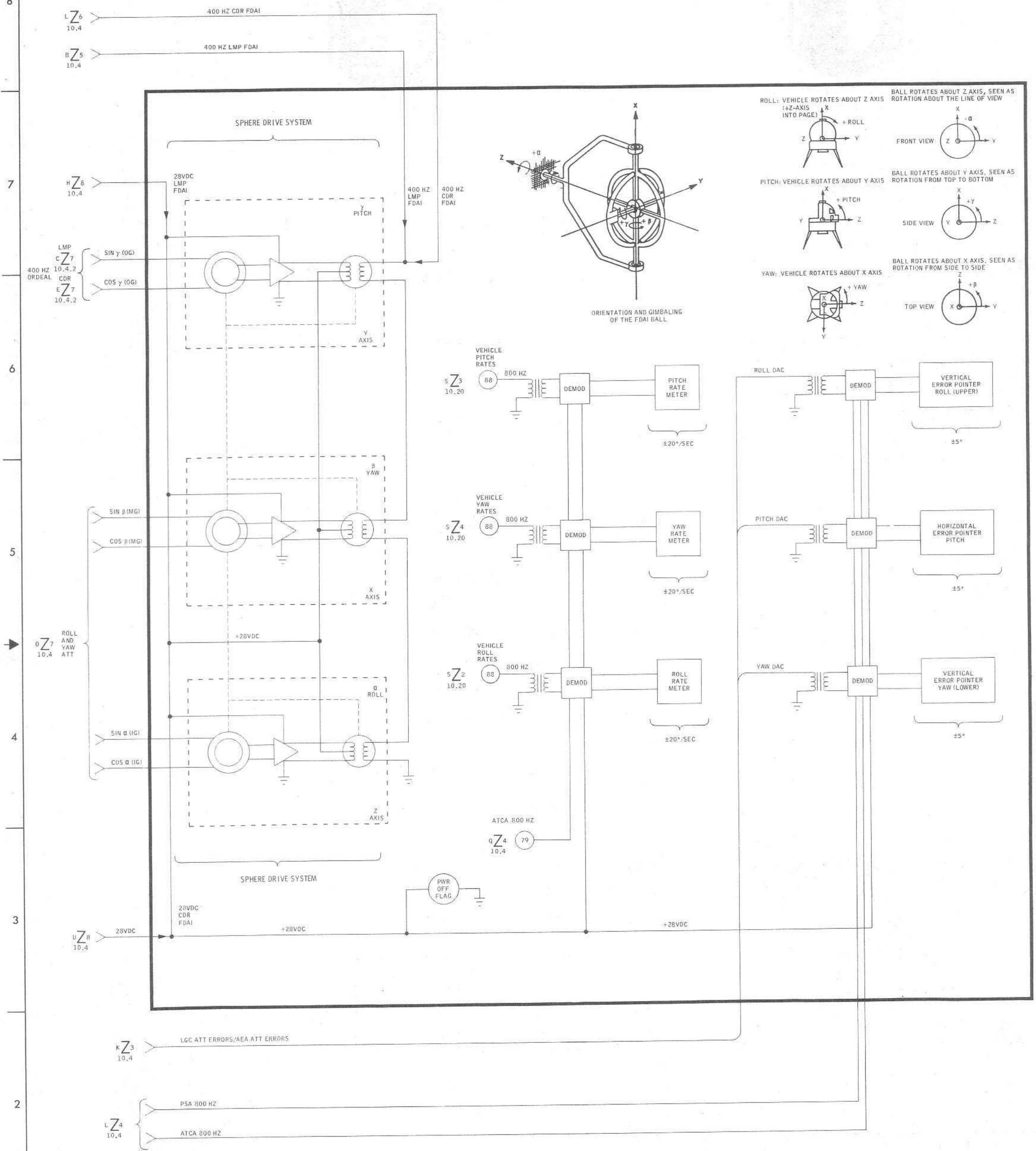
PAGE 10-5A SHEET 1 OF 1

LTR	DCN	DR	ENGR	DATE	APPROVAL
A		L.S.Q.		7-8-69	

COMMENTS:

LTR	DCN	DR	ENG	DATE		APPROVAL
C		LSD	Bad	2/20/70	2/21/70	G. E. Hannigan

COMMENTS:

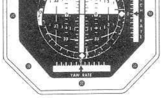


4.3 FDAI

3 FOR FDAI ARTWORK REFERENCE: 9M1 K Z6 10.1 9M6 G Z6 10.1

2 FOR ELECTROLUMINESCENT DISPLAY LIGHTS, REFERENCE: Q Z1 3.1

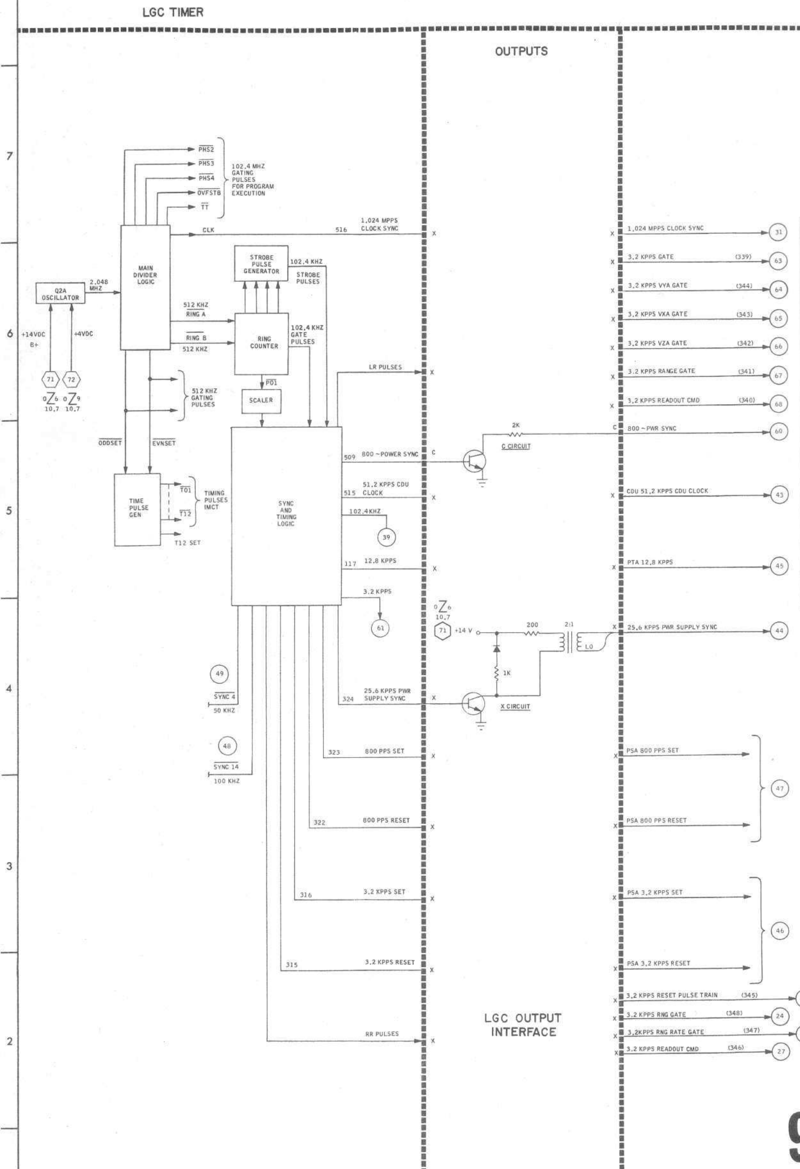
NOTES: 1 DWG IS REPRESENTATIVE OF BOTH FDAI'S (9M1-9M6)



		SIGNATURES	DATE
NATIONAL AERONAUTICS & SPACE ADMINISTRATION MANNED SPACECRAFT CENTER · HOUSTON, TEXAS		DR M Smith	1-9-69
FDAI		DSGN Bobby [illegible]	1-9-69
		QC Betty M. [illegible]	1-17-69
		ENGR Barry Elliott	1-17-69
		APP R. L. Carlton	1-17-69
DWG NO 10.4.3	LM	FEC [illegible]	1-17-69
	UNIVERSAL	AUTH [illegible]	1-17-69
SHEET OF	PAGE 10-7	30 X 40	

LTR	DCN	DR	ENG	DATE		APPROVAL
A	2	VFJ	C&H	8-28-69	9-28-69	W.D. Lal

COMMENTS:



○	KEY		DWG	Z	TO
23	3.2 KPPS RESET TRAIN	STROBE 1	10.14	K3	RR
24	3.2 KPPS RNG GATE	STROBE 2	10.14	K3	RR
25	3.2 KPPS RNG RATE GATE	STROBE 2	10.14	K3	RR
27	3.2 KPPS READOUT CMD		10.14	K2	RR
31	1.024 MPPS CLOCK SYNC		9.1	G6	PCM TEA
			10.13 SH 2	L6	LGC
39	102.4KHZ SET/RESET		10.10 SH 2	T1	LGC
43	CDU 51.2 KPPS CDU CLOCK		10.11 SH 2	R3	CDU
44	25.6 KPPS PWR SUPPLY SYNC		10.7	H5	PSA
45	12.8 KPPS SYNC		10.7	H3	PTA
46	3.2 KPPS SET/RESET		10.7	H9	PSA
47	800 PPS SET/RESET		10.7	H8	PSA
48	$\overline{SYNC}$ 14 50 KHZ		10.7	S8	LGC
49	$\overline{SYNC}$ 4 100 KHZ		10.7	S6	LGC
60	800 ~ PWR SYNC		10.7	M8	DSKY
61	3.2 KPPS		10.10 SH 2	T3	LGC
63	3.2 KPPS GATE	RESET STROBE	10.16 SH 2	E6	LR
			10.16 SH 1	E9	LR
64	3.2 KPPS VYA GATE	STROBE 2	10.16 SH 1	E9	LR
65	3.2 KPPS VXA GATE	STROBE 2	10.16 SH 1	E8	LR
66	3.2 KPPS VZA GATE	STROBE 2	10.16 SH 1	E8	LR
67	3.2 KPPS RNG GATE	STROBE 2	10.16 SH 2	E6	LR
68	3.2 KPPS READOUT CMD	STROBE 2	10.16 SH.1	E7	LR
			10.16 SH.2	E5	LR

LGC TIMER

OUTPUTS

9 LGC SYNC

SIGNATURES	DATE
DR Vicki L. Sparks	1-15-69
DSGN Charles J. Gibson	1-17-69
QC Betty M. Taylor	1-17-69
ENGR W. V. Penning	1-17-69
[illegible] Elliott	1-17-69
APP R. L. Carlton	1-17-69
FEC D. B. Raker	1-17-69
AUTH [illegible]	1-17-69
23%	

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LGC SYNC AND TIMING SIGNAL FLOW

LM
UNIVERSAL
30 X 40

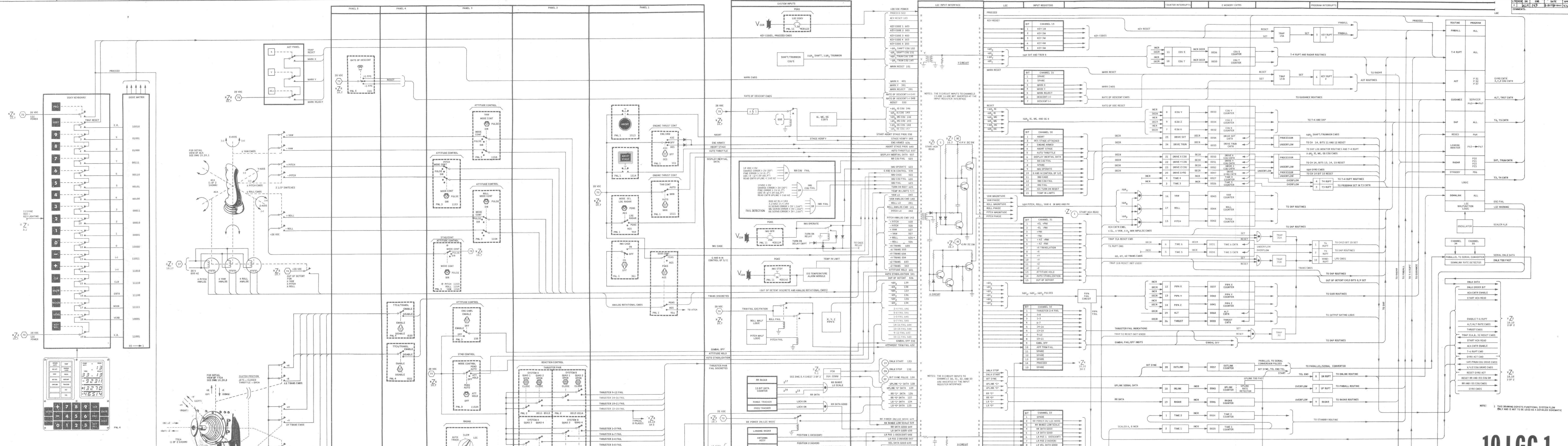
DWG. NO. 10.9

PAGE 10-13A

SHEET 1 OF 1

LTR	DCN	DR	ENG	DATE		APPROVAL
A		H Smith	CV	8-28-69	8-28-69	H. Lo

COMMENTS:



NOTE: 1 THIS DRAWING DEPICTS FUNCTIONAL SYSTEM FLOW ONLY AND IS NOT TO BE USED AS A DETAILED SCHEMATIC

10 LGC 1

SIGNATURES	DATE
DR Malcolm G. Smith	1-9-69
DSGN Bobby J. Osborn	1-17-69
QC Betty G. Taylor	1-17-69
ENGR W. K. Denning	1-17-69
APP R L Carlton	1-17-69
FEC D. Fisher	1-17-69
AUTH D D Bray	1-17-69
24.8 PERCENT	

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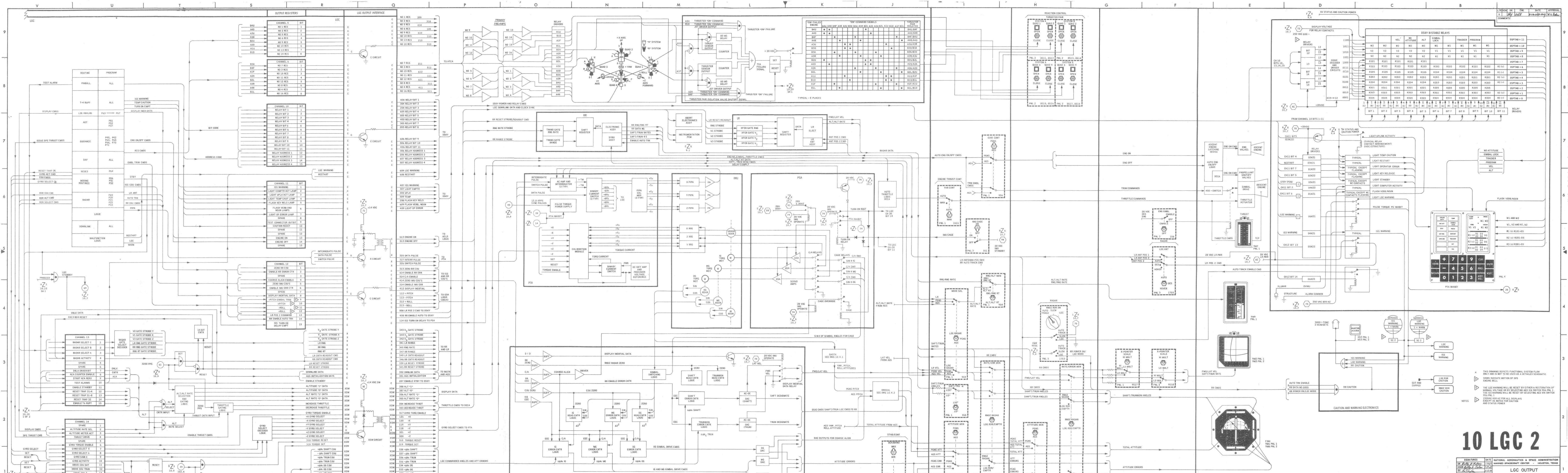
LGC INPUT INTERFACE

LM
UNIVERSAL
SIZE J
DWG NO 10.10
121 X 38.25
PAGE 10-14
SHEET 1 OF 3

LTR	DCN	DR	ENG	DATE		APPROVAL
B		HRJ	OLH	8-28-69	8-28-69	W.A. Loden

COMMENTS:



4 THIS DRAWING DEPICTS FUNCTIONAL SYSTEM FLOW ONLY AND IS NOT TO BE USED AS A DETAILED SCHEMATIC

3 SIGNS INDICATE MOTION OF DPS ENGINE BELL

2 THE LGC WARNING WILL BE RESET BY EITHER A RESTORATION OF NORMAL VOLTAGE OR BY SELECTING AGS VIA SWITCH 9S6 PNL 1. THE ISS WARNING WILL BE RESET BY SELECTING AGS VIA SWITCH 9S6 PNL 1

NOTES 1 250VAC 800 HZ FOR ALL DISPLAYS EXCEPT AS NOTED FOR CAUTION AND STATUS POWER

10 LGC 2

SIGNATURES	DATE
DR Bobby J. Osborn	1-14-69
DSGN Bobby J. Osborn	1-17-69
QC Taylor	1-17-69
ENGR H. L. Sanning	1-17-69
APP H. L. Carlton	1-17-69
FEC	1-17-69
AUTH	1-17-69
24.8 PERCENT	

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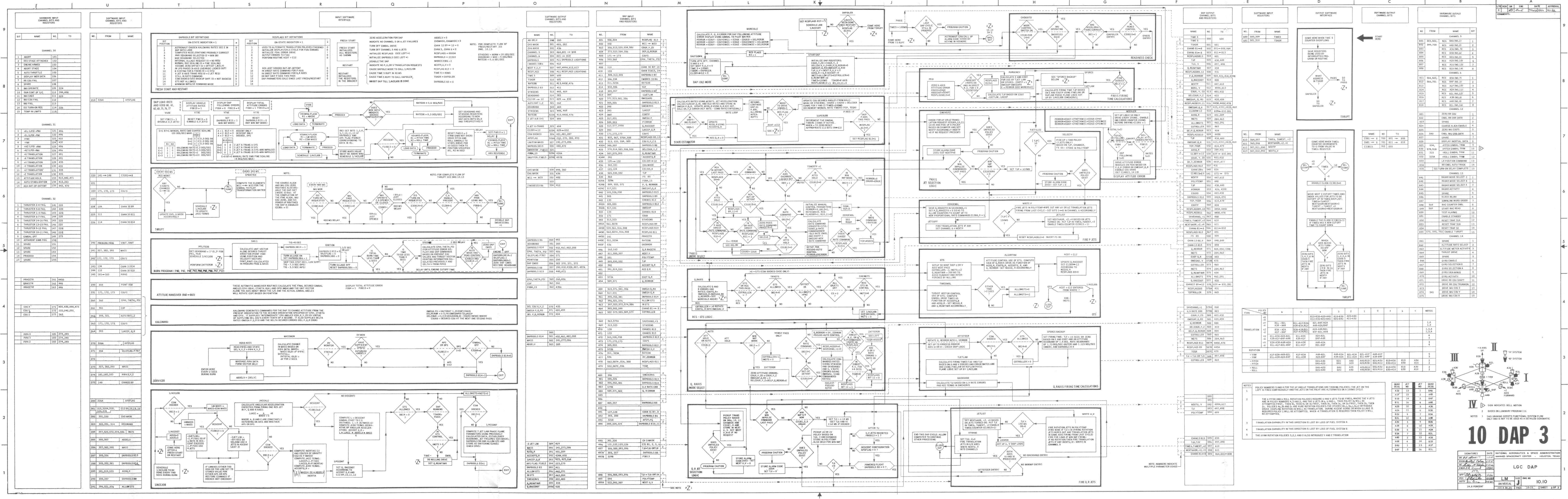
LGC OUTPUT INTERFACE

LM UNIVERSAL
SIZE J
DWG NO. 10.10
121 X 38.25
PAGE 10-15
SHEET 2 OF 3



NOTES	
1	POLICY NUMBERS 5 AND 4 FOR THE ±Y AND ±Z TRANSLATIONS ARE TACKING POLICIES- THE JET ON THE LEFT IS FIRED CONTINUOUSLY AND THE JETS ON THE RIGHT ARE ALTERNATED ON A 100MS CYCLE
2	THE ± PITCH AND ± ROLL ROTATION POLICIES REQUIRE U AND V JETS TO BE FIRED, WHERE THE V JETS ARE IN POLICY NUMBERS 4,3 AND 2, AND THE U JETS IN a, b AND c. THUS POLICY 4a WILL BE ATTEMPTED FIRST, THEN 4b, THEN 4c OR 3a FIRST, THEN 3b, THEN 3c, OR 2a FIRST, THEN 2b, THEN 2c. POLICIES 4a,3b AND 2c ARE PURE ROTATION POLICIES-THE OTHERS (4b,c,3a,c,2a,b) INTRODUCE CROSS COUPLING ROTATION AS WELL AS TRANSLATION. DURING ASCENT BURNS OR WHEN ULLAGE IS REQUIRED POLICY 1 WILL BE ATTEMPTED. WHEN -X TRANSLATION IS REQUIRED THEN POLICY 0 WILL BE ATTEMPTED.
3	TRANSLATION CAPABILITY IN THIS DIRECTION IS LOST BY LOSS OF FUEL SYSTEM A
4	TRANSLATION CAPABILITY IN THIS DIRECTION IS LOST BY LOSS OF FUEL SYSTEM B
5	THE ±YAW ROTATION POLICIES 3,2,1 AND 0 ALSO INTRODUCE Y AND Z TRANSLATION

QUAD DESG	JET NO	JET NO	QUAD DESG
A1U	13	1	B4U
A1F	15	2	A4D
B1D	14	3	B4F
B1L	16	4	A4R
A2D	10	5	A3U
A2A	11	6	B3D
B2U	9	7	B3A
B2L	12	8	A3R
A3U	5	9	B2U
A3R	8	10	A2D
B3D	6	11	A2A
B3A	7	12	B2L
A4D	2	13	A1U
A4R	4	14	B1D
B4U	1	15	A1F
B4F	3	16	B1L

3 SIGN INDICATES BELL MOTION

NOTES
2 BASED ON LUMINARY PROGRAM 116
1 THIS DRAWING DEPICTS FUNCTIONAL SYSTEM FLOW ONLY AND IS NOT TO BE USED AS A DETAILED SCHEMATIC

10 DAP 3

SIGNATURES	DATE
DR	1-9-69
DSGN Bobby J. Osborn	6-17-69
QC Bettie M Taylor	1-17-69
ENGR B.R. Durand	1/17/69
APP	1/17/69
FEC	1/17/69
AUTH Don Bray	1-7-69
24.8 PERCENT	

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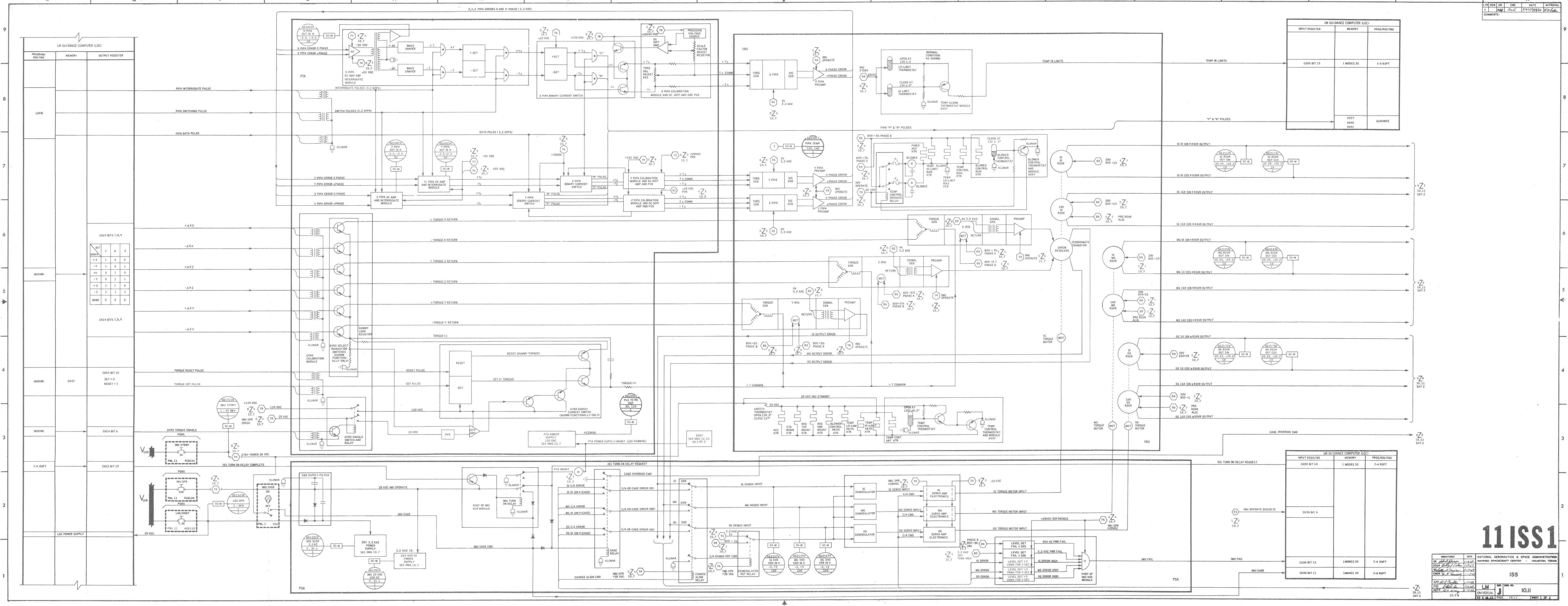
LGC DAP

LM	SIZE	DWG NO
UNIVERSAL	J	10.10
121 X 38.25	PAGE 10-16	SHEET 3 OF 3



11 ISS1

SIGNATURES	DATE
DR John R. Johnson	1-13-69
DSGN Bobby J. Dilbeck	1-17-69
QC	1-17-69
ENGR H. K. Fanning	1-17-69
APP R. L. Carlton	1-17-69
FEC	1-17-69
AUTH	1-17-69
25.5%	

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ISS

LM UNIVERSAL
SIZE J
DWG NO. 10.11
99 X 38.25
PAGE 10-17
SHEET 1 OF 2

LM UNIVERSAL
REV A

7 WHEN READ CTR IS WITHIN ≈ 0.1 DEG HIGH SCHMITT STOPS, FINE TAKES OVER. F_1 GETS ψ WITHIN TWO BITS OF θ.

6 RR CDU DRIVE PULSES REPRESENT (1) RR SHAFT AND TRUNNION DESIGNATE CMDS OR (2) FORWARD AND LATERAL VELOCITY (IF CH12B8 IS SET, DISPLAY INERTAL 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)

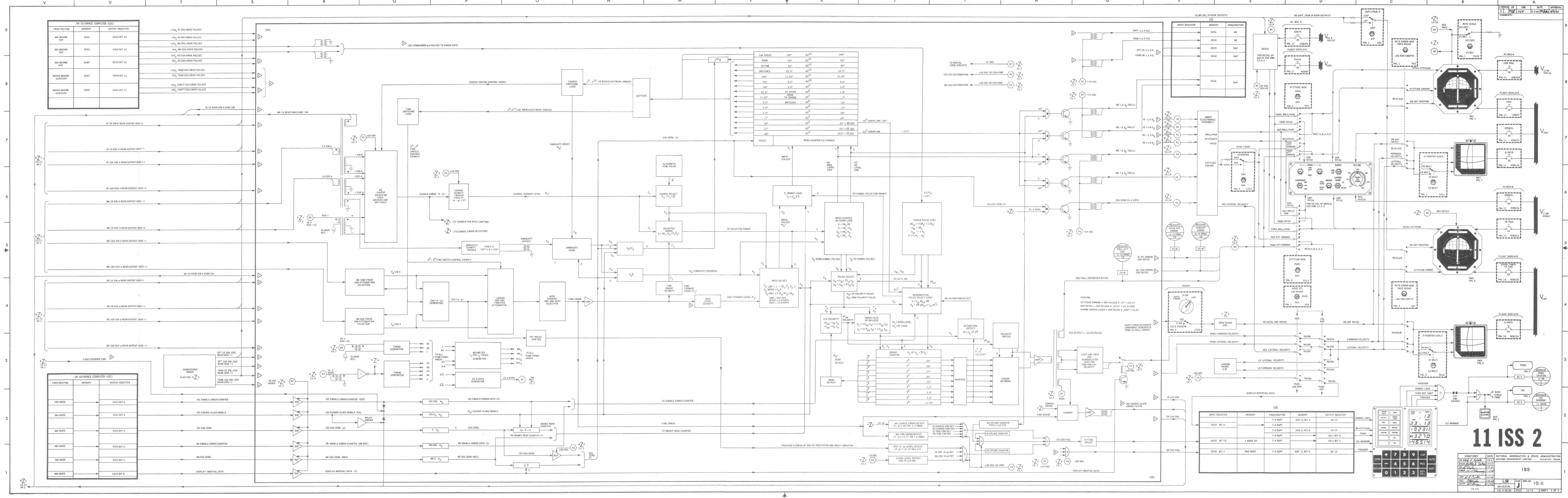
3 PROVIDES A GROUND PATH TO THE COARSE ALIGN RELAYS AND INHIBITS THE ERROR COUNTER ENABLE DISCRETE

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

DETAIL SHEET 10.11.2



11 ISS 2

SIGNATURES	DATE
DR Vick L. Sprake	1-14-69
DSGN Bobby J. Osborn	1-17-69
QC	1-17-69
ENGR	1-17-69
APP R L Carlton	1-17-69
FEC	1-17-69
AUTH D D Bray	1-17-69

25.5%

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ISS

LM
UNIVERSAL
SIZE J
DWG NO. 10.11
121 X 38.25
PAGE 10-18
SHEET 2 OF 2

20.1ACA

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ACA

DWG NO 10.20.1

LM

UNIVERSAL

30 X 40

SHEET 1 OF 1

PAGE 10-32

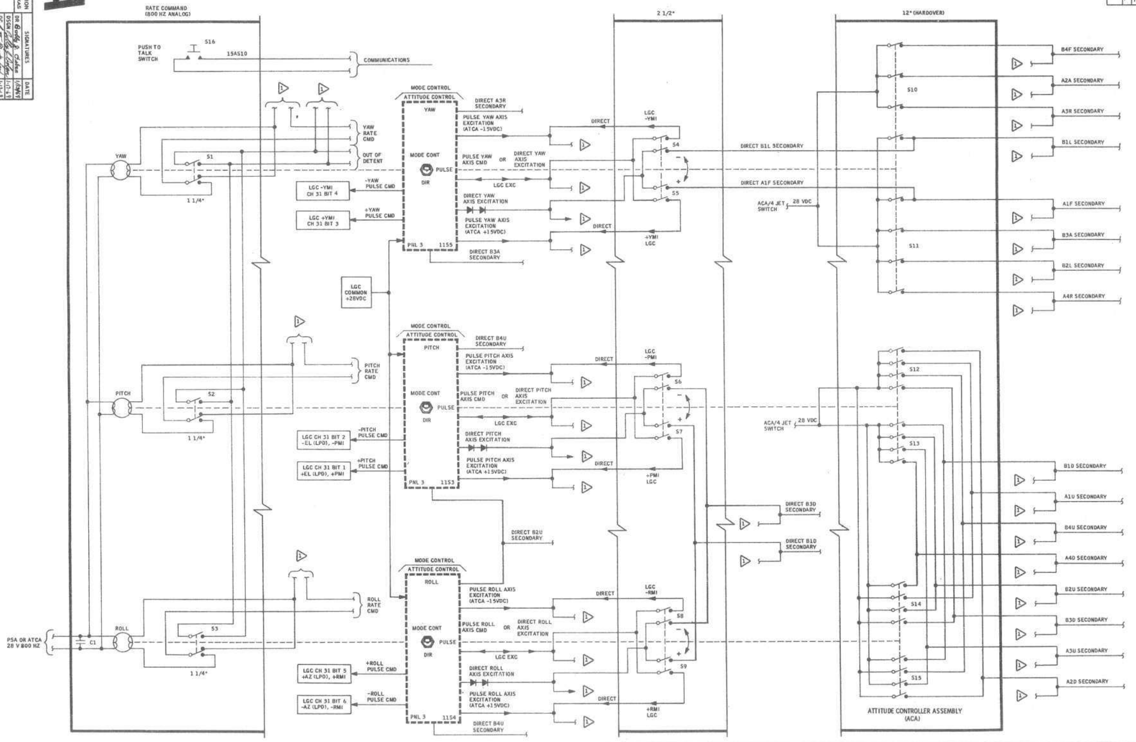
SIGNATURES	DATE
DR	1/15/69
DSGN	1-17-69
QC	1-17-69
ENGR	1-17-69
APP	1-17-69
FEC	1-17-69
AUTH	1-17-69

22.5 PERCENT

LTR	DCN	OR	ENG	DATE	APPROVAL
B					

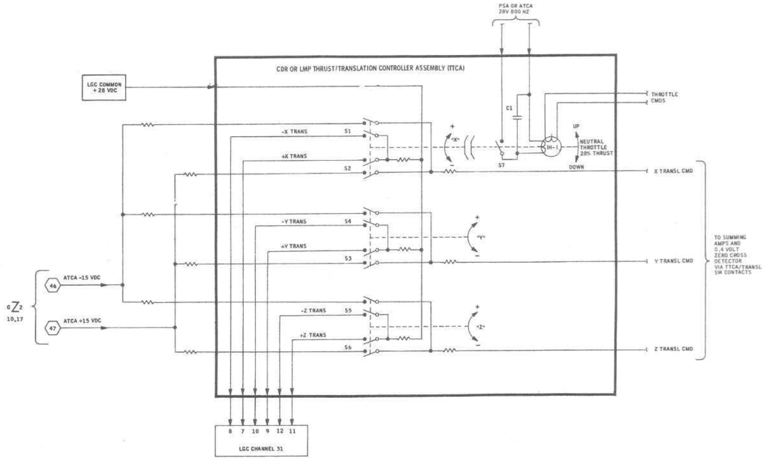
COMMENTS:

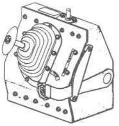
1 IDENTICAL INPUT OR OUTPUT FROM OTHER ACA (CDR OR LMP)



LTR	DCN	DR	ENG	DATE		APPROVAL
A		MGS	DES	4/8/69	4/8/69	

COMMENTS:





20.8 TTCA

SIGNATURES	DATE
DR	1-6-69
DSGN	1-17-69
QC	1-17-69
ENGR Don R. Clark	1-17-69
APP R L Carlton	1-17-69
FEC	1-17-69
AUTH	1-17-69

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TTCA

LM
UNIVERSAL
30 X 40

DWG. NO. 10.20.8

PAGE 10-39

SHEET 1 OF 1