https://ntrs.nasa.gov/search.jsp?R=19700004895 2020-03-12T01:35:35+00:00Z

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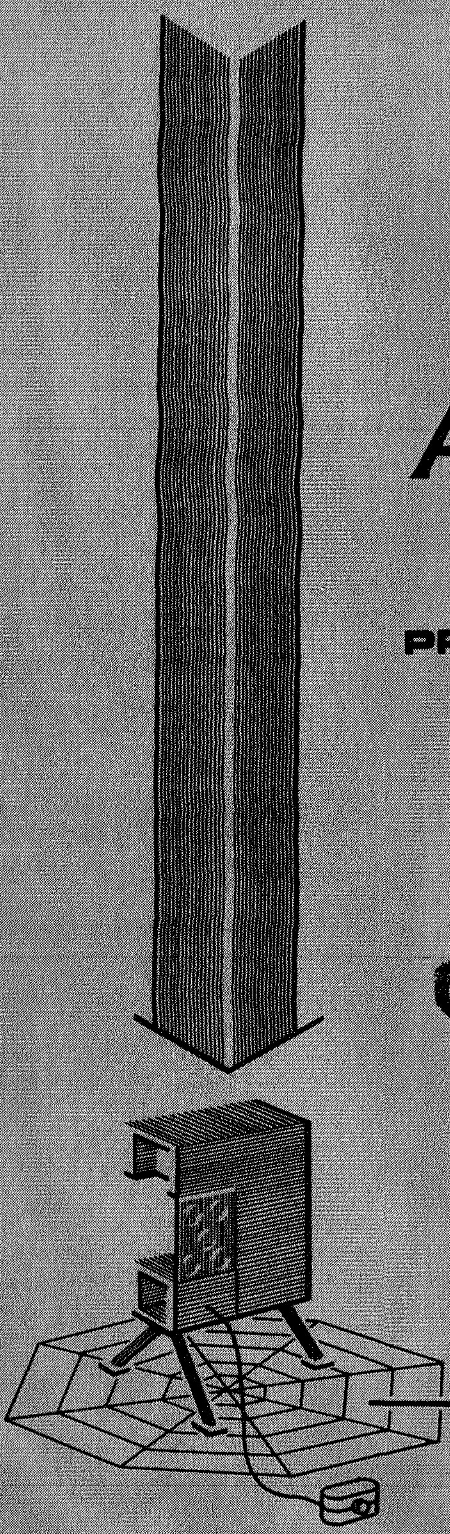
final report

volume 2

appendix



ALSEP/SIDE/CCGE

contract no. S1966-14

PRIME CONTRACT NO. NAS 9-5911

CASE FILE
COPY

TIME-ZERO corporation

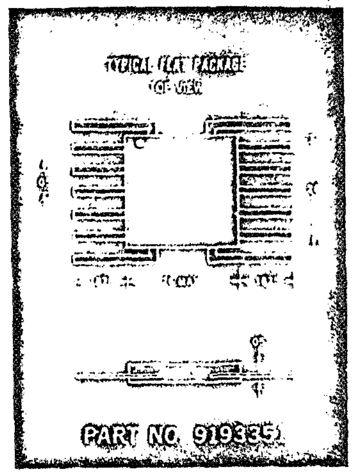
NASA CR 102047

APPENDIX I

Data Sheets - Applicable Fairchild IC's

DTμL933 DUAL FOUR-INPUT EXTENDER ELEMENT

FAIRCHILD DIODE-TRANSISTOR MICROLOGIC



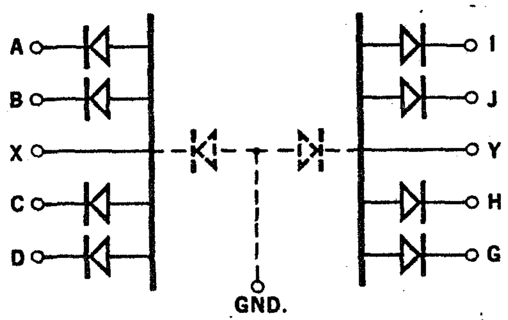
The DTμL 933 is a Dual Input-Extender consisting of two independent diode arrays identical in every respect to the input diodes of the DTμL Gate and Buffer elements. DTμL 933 elements may be used to extend fan-in capability to more than 20 without adversely affecting the noise immunity or load driving capability of the element to which they are connected.

Good practice dictates that extension interconnection paths be as short as possible to minimize the effects of distributed capacitance on circuit performance. The effects of capacitance are summarized on the back page.

Typical input capacitance of DTμL 933 is 2 pf and output capacitance is 5 pf.

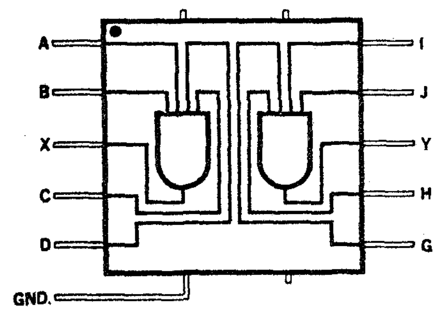
For complete test sequence and test values, please refer to the composite DTμL specification

SCHEMATIC DIAGRAM

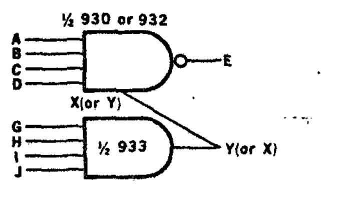


FLAT PACKAGE LAYOUT

(TOP VIEW)



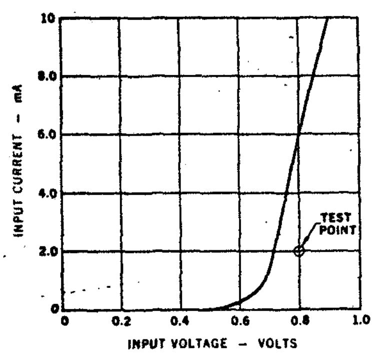
LOGIC EXAMPLE



POSITIVE LOGIC $E = \overline{A\ B\ C\ D\ G\ H\ I\ J}$

NEGATIVE LOGIC $E = \overline{A + B + C + D + G + H + I + J}$

FORWARD VOLTAGE VS. FORWARD CURRENT + 25°C



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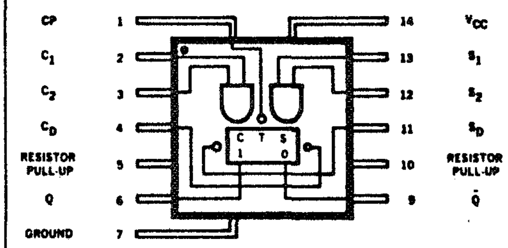
FAIRCHILD MICROLOGIC® LOW POWER DIODE TRANSISTOR INTEGRATED CIRCUITS

LPDTμL 9040 CLOCKED FLIP-FLOP

DESCRIPTION

The LPDTμL 9040 element is a directly coupled, dual-rank flip-flop suitable for use in counters, shift registers and other storage applications. Either R-S or J-K mode operation is possible. Direct set and clear inputs are provided which override all other data inputs.

LOGIC DIAGRAM SHOWING FLAT OR DUAL-IN LINE PACKAGE PIN ASSIGNMENT



SYNCHRONOUS ENTRY TRUTH TABLES

R-S MODE OPERATION

INPUTS @t_n				OUTPUTS @t_{n+1}	
S_1	S_2	C_1	C_2	Q	$\overline{Q}$
13	12	2	3	6	9
L	X	L	X	NC	NC
L	X	X	L	NC	NC
X	L	L	X	NC	NC
X	L	X	L	NC	NC
L	X	H	H	L	H
X	L	H	H	L	H
H	H	L	X	H	L
H	H	X	L	H	L
H	H	H	H	AMBIGUOUS	

J-K MODE OPERATION

INPUTS @t_n		OUTPUTS @t_{n+1}	
S_1	C_1	Q	$\overline{Q}$
13	2	6	9
L	L	NC	NC
L	H	L	H
H	L	H	L
H	H	TOGGLES	

ASYCHRONOUS ENTRY TRUTH TABLE

INPUTS		OUTPUTS	
S_D	C_D	Q	$\overline{Q}$
11	4	6	9
H	H	NC	NC
H	L	L	H
L	H	H	L
L	L	H	H

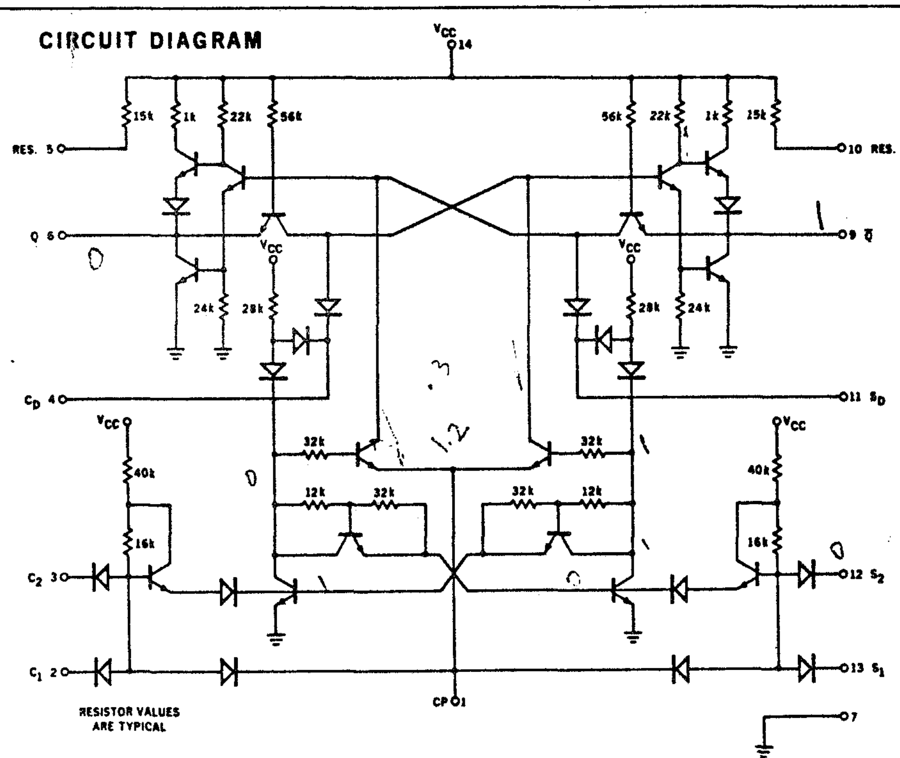
Symbols

H - Most positive logic level
L - Most negative logic level
X - Either H or L can be present
NC - No change in state

NOTES:

1. For J-K mode operation connect Pin 6 to Pin 3 and Pin 9 to Pin 12.
2. Asynchronous entries override all synchronous entries.

CIRCUIT DIAGRAM



LOADING RULES

INPUT	*NORMALIZED UNIT LOADS (U.L.)
S_1 S_2 / C_1 C_2	0.75 U.L.
S_D C_D	2.5 U.L.
CP	2.5 U.L.

OUTPUT	FAN-OUT
Q, $\overline{Q}$	10 U.L. 7 U.L. WITH RESISTOR PULL-UP CONNECTED

*1UNIT LOAD EQUALS 1-LPDTμL 9041 OR 9042 INPUT LOAD

LPDTμL 9040, 9041 AND 9042
LOW POWER DIODE TRANSISTOR MICROLOGIC® INTEGRATED CIRCUITS

GENERAL DESCRIPTION

The Fairchild LPDTμL Micrologic® Integrated Circuit Family consists of a set of compatible, integrated logic circuits specifically designed for low power, medium speed applications.

The circuits are fabricated with a silicon monolithic substrate using standard Fairchild Planar* epitaxial processes.

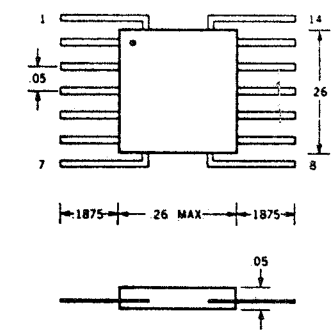
Packaging options include the Flat package and the Dual In-Line package.

Important features of the LPDTμL Micrologic® integrated circuits include the following:

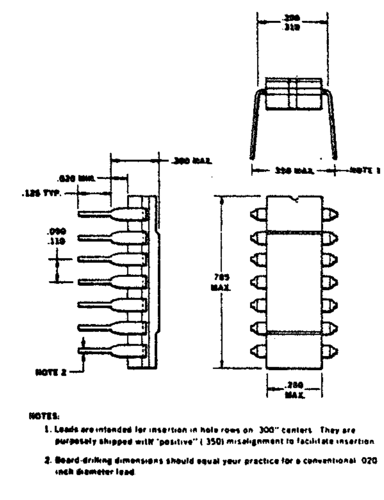
- Reliable operation over the full military temperature range of -55°C to +125°C
- Typical power drains of less than 1 mW per gate (50% duty cycle) for the logic gate elements and less than 4 mW for the clocked flip-flop.
- Single power supply requirement—5 volts optimum, 4.5 to 5.5 volts range.
- Guaranteed fan-out of 10 LPDTμL unit loads or 1 standard Fairchild DTμL unit load, over the full temperature and supply voltage range.
- Guaranteed minimum of 450 mV noise immunity at the temperature extremes.
- Typical logic gate propagation delays of 60 ns and binary clock rate of 2.5 MHz.
- Emitter follower outputs providing good capacitive drive capability.

TYPICAL FLAT PACKAGE

TOP VIEW



TYPICAL DUAL IN-LINE PACKAGE



*Planar is a patented Fairchild process.

ORDER INFORMATION

To order Low Power Diode Transistor Micrologic® integrated circuit elements specify U31XXXX51X for flat package and U6AXXXX51X for Dual In-Line package where XXXX is 9040, 9041 or 9042.

FAIRCHILD SEMICONDUCTOR
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313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

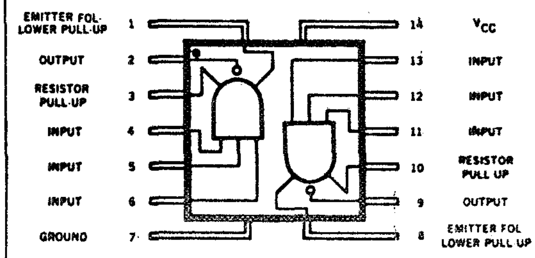
COPYRIGHT FAIRCHILD SEMICONDUCTOR 1967 • PRINTED IN U.S.A. 2320-342-37 10M
MANUFACTURED UNDER ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 291877, 3015048, 3025589, 3064167, 3108359, 3117260; OTHER PATENTS PENDING.

LPDTμL 9041 – DUAL 3 INPUT NAND GATE

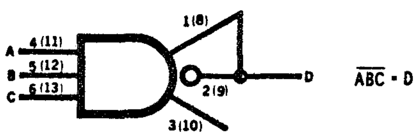
DESCRIPTION

The LPDTμL 9041 element consists of two, 3-input positive logic NAND gates suitable for general logic gate and inverter applications. The unique feature of this gate is that the output transistor collector and the emitter follower pull-up are not internally connected. This allows the user to tie collectors to a common node for the wired "OR" logic function.

LOGIC DIAGRAM SHOWING FLAT OR DUAL-IN-LINE PACKAGE PIN ASSIGNMENT



POSITIVE LOGIC NAND GATE

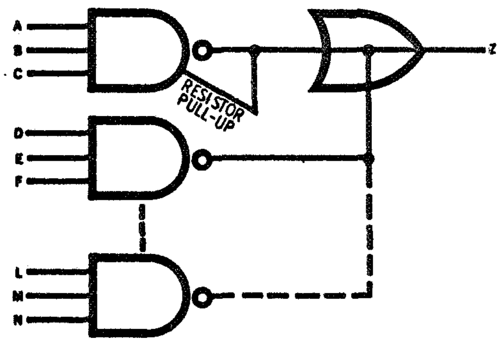


$\overline{ABC} = D$

EACH INPUT = 1 UNIT LOAD
OUTPUT FAN-OUT = 10 UNIT LOADS
= 7 U.L. WITH RESISTOR PULL-UP CONNECTED

EITHER THE EMITTER FOLLOWER OR RESISTOR PULL-UP MUST BE CONNECTED TO THE OUTPUT TO ESTABLISH THE HIGH LEVEL.

WIRED 'OR' APPLICATION

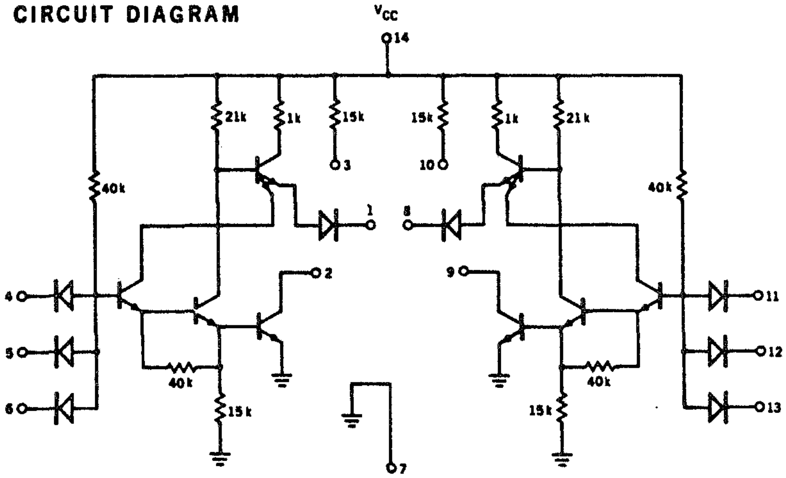


$\overline{ABC} + \overline{DEF} + \cdots + \overline{LMN} = Z$

OUTPUT FAN-OUT = 10 - 3 (NO. OF RESISTOR PULL-UPS)

ONE PULL-UP RESISTOR IS REQUIRED FOR EVERY 8 GATES CONNECTED TO THE COMMON "OR" NODE.

CIRCUIT DIAGRAM



RESISTOR VALUES ARE TYPICAL

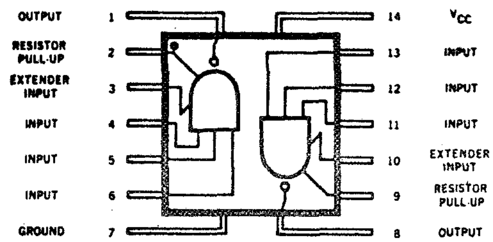
LPDTμL 9042 – DUAL 3 INPUT NAND GATE WITH EXTENDER INPUTS

DESCRIPTION

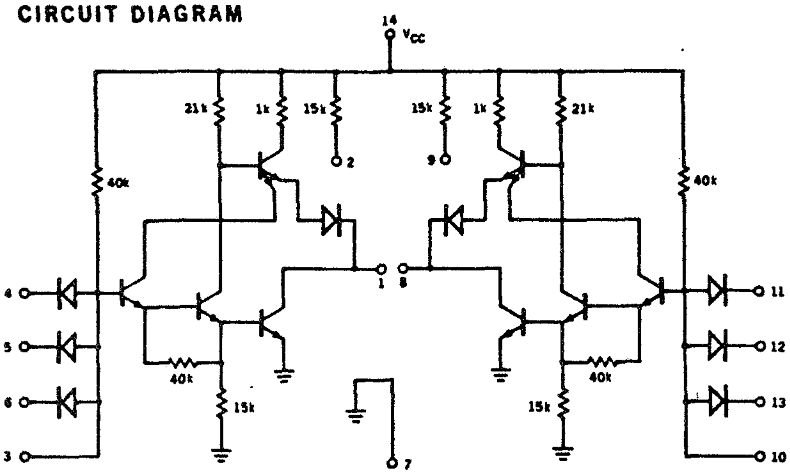
The LPDTμL 9042 element consists of two 3-input positive logic NAND gates with extender inputs. This element in the family allows the user to implement logic applications requiring a gate fan-in exceeding three.

The DTμL 9933 4-input extender element or equivalent—may be used to provide additional diode inputs. Any capacitance added to the extender input will increase the turn-on delay of the LPDTμL 9042 gate. Typically, the increase is 10 ns/picofarad. Turn-off delay is not affected.

LOGIC DIAGRAM SHOWING FLAT OR DUAL-IN-LINE PACKAGE PIN ASSIGNMENT

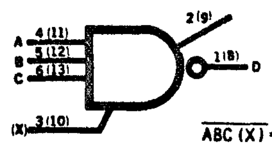


CIRCUIT DIAGRAM



RESISTOR VALUES ARE TYPICAL

POSITIVE LOGIC NAND GATE



$\overline{ABC(X)} = D$

EACH INPUT = 1 UNIT LOAD

OUTPUT FAN-OUT = 10 UNIT LOADS

= 7 UNIT LOADS WITH RESISTOR PULL-UP CONNECTED

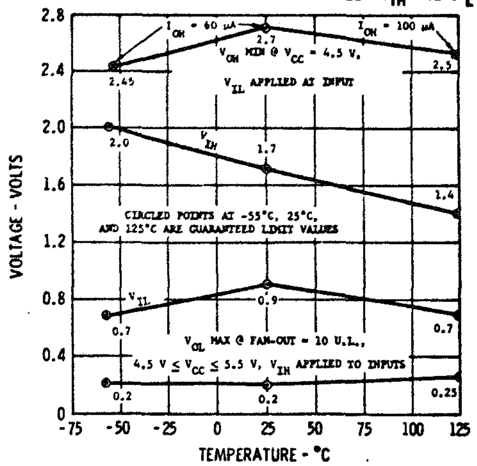
BUFFER ELEMENT

For applications requiring a fan-out exceeding ten, the Fairchild DTμL 9930 Dual 4-Input Gate may be used. The DTμL 9930 will drive 44 LPDTμL unit loads, while maintaining the same output logic levels as the low power circuits.

The input of a DTμL 9930 requires the equivalent of 10 LPDTμL unit loads. Therefore, a low power circuit can drive only one DTμL 9930 input.

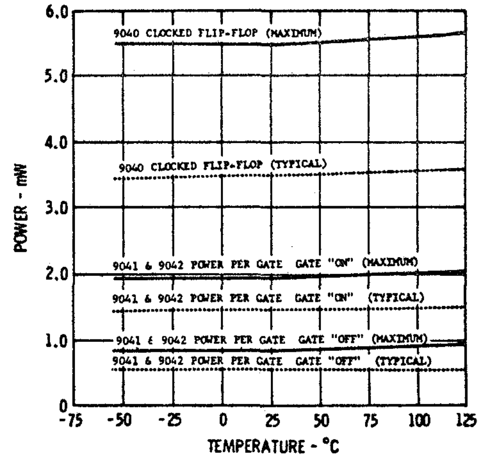
OPERATING VOLTAGE CHARACTERISTICS

WORST CASE OUTPUT LOGIC LEVELS - V_{OH} AND V_{OL}
INPUT THRESHOLD LEVELS - V_{IH} AND V_{IL}

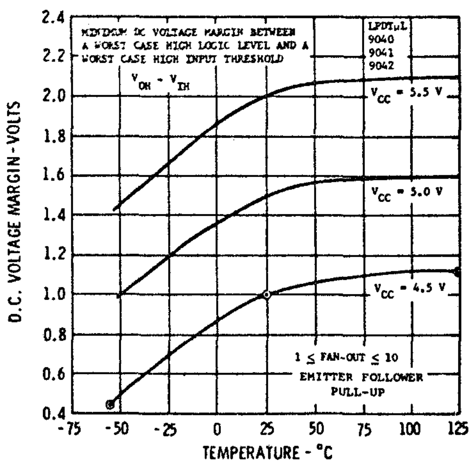


POWER CHARACTERISTICS

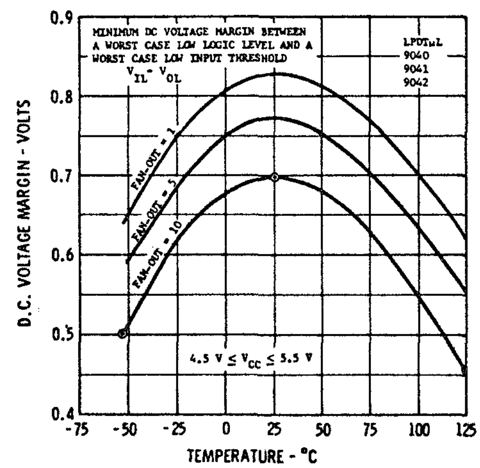
VCC = 5V
EMITTER FOLLOWER PULL-UP



HIGH LEVEL NOISE IMMUNITY



LOW LEVEL NOISE IMMUNITY



APPENDIX II

Master Drawing List

	FINAL ASSY

PARTS DISPOSITION
1. USE 3. CANNOT BE REWORKED
2. REWORK 4. RECORD 5.

DWG. NO. MDL 609770-102 REV A

REVISIONS

DISP	EFF	REV	DESCRIPTION	BY	CK	DATE	APPD
4	27&UP ML323-7&UP	A	INCORPORATED EOS NC1, NC2 & RCO REVISION TO ELIMINATE DUPLICATIONS & GENERAL UPDATE			10/15/68	

SHEET	REV	A	A			A	A		A											A							
INDEX	SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

INTERPRET THIS DRAWING PER STANDARDS IN MIL-D-70327
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± .1; .XX ± .03; .XXX ± .010; .XXXX ± .0050
ANGLES: ± 0° 30'
√ SURFACE ROUGHNESS

HOLE DIA.	TOLERANCE
.0135 THRU .125	+ .004 − .001
.126 THRU .250	+ .005 − .001
.251 THRU .500	+ .006 − .001
.501 THRU .750	+ .008 − .001
.751 THRU 1.000	+ .010 − .001
1.000 THRU 2.000	+ .012 − .001
2.001 AND OVER	LINEAR

CONTRACT NO. 51966-14
DRAWN
CHECK W. Tyler 8-2-68
MECH ENGR 8-2-68
ELECT ENGR W. Tyler 8-2-68
PROJ 8-2-68
APPD
DESIGN ACTIVITY APPD
CUSTOMER

ML
MARSHALL LABORATORIES
TORRANCE, CALIFORNIA

TITLE
TOP ASSEMBLY ML323-6 &UP
ALSEP/SIDE/CCGE -
MASTER DRAWING LIST FOR,

SIZE	CODE IDENT NO.	DWG NO.	REV
A	13126	MDL 609770-102	A

SCALE — RELEASED AUG 8 1968 SHEET 1 OF 25

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
	X									1	609770-102	A	Suprathermal ION Detector	R
		X								1	609544-1		Pin Leg	
3		X								1	609428-102	B	Exterior Chassis	E
4														
5			X							1	609416-101	E	Assy-Weldment	E
6				X						1	609392-101	B	Front Panel	D
7					X					1	609392-1	B	Front Panel	D
8					X					1	609392-2	B	Plate	D
9				X						1	609393-1	B	Rear Panel	C
10				X						1	609394-1	C	End Panel	D
11				X						1	609395-101	C	Bottom Panel	D
12					X					1	609395-1	C	Bottom	D
13					X					1	609395-2	C	Angle	D
14					X					2	609395-3	C	Angle	D
15					X					1	609498-1	A	Plate Bottom	B
16				X						1	609396-101	B	Channel Corner Support Front	C
17					X					1	609396-1	B	Channel	C
18					X					1	609396-2	B	Base	C
19					X					1	609396-3	B	Top	C
20				X						1	609397-101	A	Channel Corner Support Rear	C
21					X					1	609397-1	A	Channel	C
22					X					1	609397-2	A	Base	C
23				X						1	609398-1	A	Mounting Bracket	B
24			X							1	609416-1	E	Plate	E
25				X						1	609399-1	A	Mounting Tab	C
					X					1	609399-2	A	Base Plate	C
					X					1	609399-3	A	Vertical Plate	C
28					X					2	609399-4	A	Support	C
29				X						1	609400-1	B	Doubler	C
30				X						1	609401-1	A	Support Reel	B
31				X						1	609409-1	A	Channel	B
32				X						2	609389-1	B	Pin Guide	B
33				X						1	609457-1	N/C	Shelf	C
34				X						1	609462-1	N/C	CCGE Cover Retainer	B
35				X						2	609533-1	A	Bracket	B
36				X						2	609532-2	A	Bracket	B
37				X						1	609534-101	A	Stiffener Assy	C
38					X					1	609534-1	A	Stiffener	C
39					X					2	609506-1	N/C	Bracket Connector	B
40														
41				X						1	609532-1	B	Plate Front	D
42				X						2	609504-1	N/C	Retainer Guide	B
43				X						REF	T609543-101	A	Drill Fixture	F
44		X								2	609596-1	N/C	Retainer	C
45		X								1	609701-1		Leg, Support Pan	C
46		X								3			Accelecometer Sensor	
47		X								2	609410-1	N/C	Hinge Pin	B
48		X								2	609413-1	N/C	Hinge Bracket	B
49		X								1	609763-102	N/C	Lanyard	C
50		X								4	609599-1	N/C	Spring Torsion	B

MODEL NO.

TITLE—	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 ϕUP	A	13126	MDL 609770-102	A
SCALE		RELEASED	SHEET 2 OF	

LINE NO.	ASSEMBLY POSITION									QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
	1	2	3	4	5	6	7	8	9					
			X							2	609417-1	N/C	Spring	C
2			X							1	609414-1	N/C	Spring	B
3			X							REF	609561	N/C	Finish External Chassis	R
4														
5														
6														
7		X								1	609564-101	A	Finish Thermal Spacer	H
8			X							1	609563-1	A	Thermal Spacer	F
9			X							1	609531	N/C	MIrrors Second Surf	D
10			X							1	609564-1	A	Glass Epoxy SHT	H
11			X							1	609564-2	A	Glass Epoxy SHT	H
12			X							1	609564-3	A	Glass Epoxy SHT	H
13			X							1	609564-4	A	Glass Epoxy SHT	H
14			X							1	609564-5	A	GRD Lug	H
15			X							1	609299-101	A	Upper Tube	C
16				X						1	609299-1	A	Tube	C
17				X						1	609299-3	A	Base	C
18			X							1	609299-102	A	Upper Tube	C
19				X						1	609299-2	A	Tube	C
20				X						1	609299-3	A	Base	C
21			X							2	609576-1	N/C	Screw	C
22			X							1	609317-1		Bubble Level	
23			X							1	609412-1	A	Carrying Tool	B
24			X							1	609513-101	N/C	Solenoid Assembly	D
25				X						1	609429-1	A	Latch	B
26				X						1	609430-1	N/C	Rod	F
27				X						1	609471-1	B	Solenoid Assembly	D
28				X						1	609564-6	A	Terminal Board Assembly	D
29				X						2	609543-1	N/C	Frame	D
30			X							1	609543-101	N/C	Grid	D
31			X							1	609564-7	A	Insulator, .008 Thk. Glass Epoxy Lam	H
32			X							6	609543-3	N/C	Bracket	D
33			X							A/R	SP30425-2	N/C	Wire Constantan	B
34			X								609564-8	A	Board Glass Epoxy Lam .062 Thk.	H
35			X								609564-9	A	.032 Epoxy Board Spacer	H
36														
37														
38		X								1	609766-1	N/C	Cradle	C
39		X								1	609767-1	N/C	Housing - Wire Storage	C
40		X								1	609768-1	N/C	Strap, Retaining	B
41		X								1	609769-1	N/C	Detent, Ground Screen	B
42		X								1	609569-1	N/C	Stud Nut	C
43		X								1	609571-101	N/C	Blanket Insulator	F
44			X							1	609571-1	N/C	Aluminized Mylar	F
45			X							10	609571-2	N/C	Silk Mesh	F
46			X							11	609571-3	N/C	Aluminized Mylar	F
47			X							1	609571-4	N/C	Insulator	F
48		X								1	SK609704-3	N/C	Shipping Leg	A
49		X								1	SK609704-2	N/C	Shipping Leg	A
50		X								1	SK609704-1	N/C	Shipping Leg	A

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323 - 6 & up	A	13126	MDL 609770-102	
SCALE		RELEASED	SHEET 3 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
3														
4		X								1	609551-1	N/C	Bracket Retainer MTG	B
5														
6		X								1	609989-101	N/C	Cover, Dust	D
7			X							1	609989-1	N/C	Bracket	D
8			X							2	609989-2	N/C	Cover, Dust	D
9			X							1	609989-3	N/C	Cover, Latch	D
10			X							1	609989-4	N/C	Plate Stiffener	D
11			X							1	609989-5	N/C	Angle (.003 Aluminum Foil)	D
12														
13														
14														
15		X								1	609439-102	A	Assy Ground Screen	E
16			X							1	609439-101	A	Screen Assy	E
17			X							9	609433-1	N/C	Rod	B
18			X							1	609436-101	A	Extractor	D
19				X						1	609436-1	A	Cap	D
20				X						1	609436-2	A	Rod	D
21			X							1	609434-1	N/C	Hub	C
22			X							1	609435-101	N/C	Tube Assy	D
23				X						1	609435-1	N/C	Tube	D
24				X						1	609435-2	N/C	Collar	D
25				X						1	609435-3	N/C	Base	D
26			X							1	609764-1	N/C	Spring Retainer	C
			X							1	609765-2	N/C	Spring	C
28														
29		X								1	609444-1	N/C	Spring	B
30										[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31											[illegible]		[illegible]	
32		X								1	609549-1	N/C	Nameplate	C
33														
34														
35		X								1	609448-101	N/C	Lockout Plug	C
36										[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
37										[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
38														
39														
40														
41		X								1	609480-103	A	Outboard Leg Assy	C
42			X							1	609554-1	N/C	Stop Leg	C
43			X							1	609553-1	N/C	Yoke Leg Outboard	C
44			X							1	609555-2	N/C	Leg	B
45			X							1	609492-1	N/C	Spring	B
46			X							1	609700-1	N/C	Collar, Leg Support	C
47			X							1	609702-1	N/C	Pin, Leg Pivot	B
48														
49														
50														

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 ¢UP	A	13126	MDL 609770-102	•
SCALE		RELEASED	SHEET 4 OF	

LINE NO.	ASSEMBLY POSITION									QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
	1	2	3	4	5	6	7	8	9					
1		X								1	609480-104	A	Outboard Leg Assy.	C
2			X							1	609554-1	N/C	Stop Leg	C
3			X							1	609553-2	N/C	Yoke Outboard Leg	C
4			X							1	609555-2	N/C	Leg	B
5			X							1	609492-1	N/C	Spring	B
6			X							1	609700-1	N/C	Collar, Leg Support	C
7			X							1	609702-1	N/C	Pin, Leg Pivot	B
8		X								1	609481-102	A	Inboard Leg Assy	C
9			X							1	609554-1	N/C	Stop Leg	C
10			X							1	609552-1	N/C	Yoke Inboard Leg	C
11			X							1	609555-1	N/C	Leg	B
12			X							1	609492-1	N/C	Spring	B
13			X							1	609700-1	N/C	Collar, Leg Support	C
14			X							1	609702-1	N/C	Pin, Leg Pivot	B
15		X								1	609775-101	A	Cover CCIG	F
16			X							1	609775-1	A	Lower Cover	F
17			X							1	609775-2	A	Upper Cover	F
18			X							1	609775-3	A	Tab	F
19			X							1	609558-1	N/C	Spring	B
20			X							1	609775-4	A	Stiffener	F
21			X							1	609775-5	A	Bracket	F
22		X								1	609559-1	N/C	Spring	B
23		X								1	609560-1	N/C	Leg Extension	C
24		X								2	609560-2	N/C	Leg Extension	C
25														
26														
27														
28														
29		X								1	609512-104	D	Assy Internal Chassis	J
30			X							1	609493-101	B	Chassis Internal	J
31				X						1	609493-1	B	Wrap	J
32				X						1	609493-2	B	Gusset	J
33				X						1	609493-3	B	Bracket Angle	J
34				X						1	609493-4	B	Channel	J
35			X							1	609776-1	N/C	Thermal Bumper Support	B
36			X							4	609512-1	D	Space Rod	J
37			X							4	609490-1	N/C	Rod Threaded	C
38			X							1	609499-1	N/C	Strap	B
39			X							1	609288-1	N/C	Bracket Pivot	C
40			X							1	609296-1	N/C	Bracket Pivot	D
41			X							1	609502-1	B	Cover Front	F
42			X							1	609503-1	B	Cover Rear	F
43			X							1	609583-101	A	Insulator - 700 Blivet	C
44				X						2	609583-1	A	Insulator	C
45				X						1	609583-2	A	Copper Foil	C
46			X							1	609583-102	A	Insulator - 700 Blivet	C
47				X						1	609583-3	A	Insulator	C
48				X						1	609583-4	A	Copper Foil	C
49				X						1	609583-5	A	Mylar	C
50														

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 & up	A	13126	MDL 609770-102	A
	SCALE	RELEASED	SHEET 5 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1			X							1	609512-2	D	Insulator	J
2			X							4	609512-3	D	Tape	J
3			X							1	609770-1	N/C	Spacer	R
4			X							1	609512-4	D	Insulator..004 Mylar	J
5			X							4	609512-5	D	Spacer	J
6			X							1	609578-101	A	Terminal Board Assembly	F
7				X						1	609577-101	N/C	Terminal Board	C
8					X					2	609529-1	N/C	Bracket	B
9					X					1	609376-1	A	Bracket	B
10					X					1	609577-1	N/C	Board	C
11			X							1	609590-101	N/C	Assy Gauge	D
12				X						2	609589-1	N/C	Bracket	B
13				X						1	609550-1	N/C	Bracket	B
14				X						1	609500-1	F	CCIG INTERFACE CONTROL	D
15					X					2	609505-1	A	PIN GUIDE	B
16					X					1	609454-101	E	CABLE ASSY	C
17														
18														
19														
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21														
22														
23														
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MODEL NO.

MASTER DRAWING LIST ML323 - 6 & up	SIZE A	CODE IDENT NO. 13126	DWG NO. MDL 609770-102	REV A
	SCALE	RELEASED	SHEET 6 OF	

ML FORM 204

LINE NO.	POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1			X							1	609754-101	NC	Low Energy Detector Assy	E
2				X						1	609278-101	B	Channel	F
3				X						1	609280-1	A	Curved Plate Inner	C
4				X						1	609281-1	B	Curved Plate Outer	C
5				X						1	609282-1	A	Bracket Magnet	C
6				X						4	609283-1	N/C	Spacer Non Metallic	B
7				X						2	609306-1	B	Plate Cross Field	B
8				X						2	609307-1	A	Plate Pole	B
9				X						1	609320-2	B	Cover	D
10				X						1	609320-3	B	Cover	D
11				X						1	609320-5	B	Cover	D
12				X						1	609337-101	A	Aperture Assy.	C
13					X					1	609274-4	N/C	Housing	D
14					X					1	609338-4	A	Aperture	C
15														
16				X						1	609337-102	A	Aperture Assy	C
17					X					1	609274-2	N/C	Housing	D
18					X					1	609338-2	A	Aperture	C
19														
20				X						1	609337-103	A	Aperture Assy	C
21					X					1	609274-2	N/C	Housing	D
22					X					1	609437-101	A	Aperture Subassy	C
23						X				1	609338-1	A	Aperture	C
24						X				1	609432-1	A	Adapter	C
25				X						1	609592-1	NC	Plate. Anchor	B
26				X						1	609754-1	NC	Insulator	E
27				X						1	609754-2	NC	Insulator	E
28				X						1	609754-3	NC	Strap Grounding	E
29				X						2	609597-1	NC	Plate Path Shortener	B
30														
31				X						1	609337-104	A	Aperture Assy	C
32					X					1	609274-2	NC	Housing	D
33					X					1	609338-1	A	Aperture	C
34														
35				X						1	609337-105	A	Aperture Assy	C
36					X					1	609338-1	A	Aperture	C
37					X					1	609274-5	NC	Housing	D
38														
39				X						1	609337-106	A	Aperture Assy	C
40					X					1	609274-2	NC	Housing	D
41					X					1	609437-101	A	Aperture Subassy	C
42						X				1	609338-1	A	Aperture	C
43						X				1	609432-1	A	Adapter	C
44														
45				X						1	609749-2	N/C	Cover CPA	C
46				X						REF	T609279-102	B	Fixture Assy	D
47				X						1	609595-101	N/C	Assy-Aperture	C
48					X					1	609594-1	N/C	Housing	C
49					X					1	609593-1	N/C	Aperture	C
50				X						REF	T609598-1	N/C	Fixture	C

MODEL NO.

TITLE—	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 & up	A	13126	MDL 609770-102	
	SCALE	RELEASED	SHEET 7 OF	

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1			X							1	609511-101	B	High Energy Detector Assy	F
				X						1	609273-101	B	Channel	D
3				X						1	609275-1	A	Curved Plate Outer	C
4				X						1	609276-1	A	Curved Plate Inner	C
5				X						1	609320-1	B	Cover	D
6				X						1	609320-4	B	Cover	D
7				X						1	609333-101	A	Aperture Assy	C
8					X					1	609274-3	N/C	Housing	D
9					X					1	609334-3	A	Aperture	C
10														
11				X						1	609333-102	A	Aperture Assy	C
12					X					1	609274-1	N/C	Housing	D
13					X					1	609334-2	A	Aperture	C
14														
15				X						1	609333-104	A	Aperture Assy	C
16					X					1	609274-1	N/C	Housing	D
17					X					1	609334-1	A	Aperture	C
18														
19														
20				X						1	609511-1	B	Insulator	F
21				X						REF	609277-101	N/C	Fixture Assy	D
22														
23			X							1	609517-103	A	Channeltron Assy H.E.	D
24				X						AR	609517-1	N/C	Copper Shield	D
25				X						1	609297-1	A	Bracket Support	D
26				X						1	609290-1	N/C	Plate Channeltron	C
				X						2	609777-1	N/C	Collar	C
28				X						1	609301-104	B	Channeltron Preamp & Disc.	F
29					X					1	609301-1	B	Shield	F
30					X					1	609301-2	B	Header	F
31					X					1	W7142	D	Module	E
32					X					1	W7142X1	D	Module P/L	A
33					X					1	609757-102	NC	Assy Channeltron	C
34						X				1	609744-101	NC	Potting Cup	C
35							X			1	609744-1	NC	Cup	C
36														
37			X							1	609518-103	A	Channeltron Assy L.E.	D
38				X						1	609289-1	A	Bracket Support	D
39				X						1	609290-1	N/C	Plate	C
40				X						2	609777-1	N/C	Collar	C
41				X						AR	609518-1	N/C	Copper Shield	D
42				X						1	609301-105	B	Channeltron Preamp & Disc.	F
43					X					1	609301-1	B	Shield	F
44					X					1	609301-2	B	Header	F
45					X					1	W7142	D	Module	E
46					X					1	W7142-1	D	Module P/L	A
47					X					1	609757-102	NC	Assy Channeltron	C
48						X				1	609744-101	NC	Potting Cup	C
49							X			1	609744-1	NC	Cup	C
50														

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 dup	A	13126	MDL 609770-102	A
SCALE		RELEASED	SHEET 8 OF	

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
[illegible]			X							1	609519-101	B	Blivet Assy 100	F
2				X						1	609482-101	NC	Rail	D
3				X						1	609484-1	NC	Rail	D
4				X						1	T609520-3	NC	Insulator	R
5				X						1	T609522-2	NC	Insulator	R
6				X						1	T609522-101	NC	Matrix No. 2	F
7				X						1	T609521-101	NC	Matrix No. 1	R
8				X						1	T609520-101	NC	Hookup Board	R
9				X						1	T609520-2	NC	Positioning Board	R
10				X						4	T609367-1	NC	Spacer	R
11				X						3	W7082	A	Module	F
12				X						1	W7082X1	NC	Module P/L	A
13				X						1	W7092	A	Module	E
14				X						1	W7092X1	NC	Module P/L	A
15				X						1	W7091	A	Module	F
16				X						1	W7091X1	NC	Module P/L	A
17				X						1	W7103	B	Module	E
18				X						1	W7103X1	NC	Module P/L	A
19				X						1	W7100	NC	Module	E
20				X						1	W7100X1	NC	Module P/L	A
21				X						1	W7099	B	Module	E
22				X						1	W7099X1	NC	Module P/L	A
23				X						1	W7098	C	Module	E
24				X						1	W7098X1	NC	Module P/L	A
25				X						1	W7102	C	Module	E
26				X						1	W7102X1	B	Module P/L	A
27				X						1	W7179	A	Module	E
28				X						1	W7179X1	NC	Module P/L	A
29				X						1	W7094	A	Module	E
30				X						1	W7094X1	NC	Module P/L	A
31				X						1	W7097	B	Module	E
32				X						1	W7097X1	NC	Module P/L	A
33				X						1	W7101	B	Module	E
34				X						1	W7101X1	NC	Module P/L	A
35				X						4	W7114	A	Module	E
36				X						1	W7114X1	NC	Module P/L	A
37				X						8	W7081	B	Module	E
38				X						1	W7081X1	NC	Module P/L	A
39				X						1	W7096	A	Module	E
40				X						1	W7096X1	NC	Module P/L	A
41				X						1	W7125	NC	Module	E
42				X						1	W7125X1	NC	Module P/L	A
43				X						1	W7161	NC	Module	E
44				X						1	W7161X1	NC	Module P/L	A
45				X						1	W7124	NC	Module	E
46				X						1	W7124X1	NC	Module P/L	A
47				X						1	W7122	A	Module	E
48				X						1	W7122X1	NC	Module P/L	A
49				X						1	W7178	A	Module	E
50				X						1	W7178X1	NC	Module P/L	A

MODEL NO.

TITLE—	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML323-6	A	13126	MDL 609770-102	
SCALE		RELEASED	SHEET 9 OF	

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
				X						1	W7123	NC	Module	H
2				X						1	W7123X1	NC	Module P/L	A
3				X						1	W7086	A	Module	E
4				X						1	W7086X1	NC	Module P/L	A
5				X						1	W7090	A	Module	E
6				x						1	W7090X1	NC	Module P/L	A
7				X						1	W7089	D	Module	E
8				X						1	W7089X1	C	Module P/L	A
9				X						1	W7088	A	Module	E
10				X						1	W7088X1	NC	Module P/L	A
11				X						2	W7084	A	Module	E
12				X						1	W7084X1	NC	Module P/L	A
13				X						1	W7095	A	Module	E
14				X						1	W7095X1	NC	Module P/L	C
15				X						1	W7085	B	Module	E
16				X						1	W7085X1	NC	Module P/L	A
17				X						5	W7083	A	Module	E
18				X						1	W7083X1	NC	Module P/L	A
19				X						1	W7117	A	Module	E
20				X						1	W7117X1	NC	Module P/L	A
21				X						1	W7116	NC	Module	E
22				X						1	W7116X1	NC	Module P/L	A
23				X						1	W7130	NC	Module	C&D
24				X						1	W7130X2	NC	Module P/L	A
25				X						2	W7148	A	Module	C&E
26				X						1	W7148X1	NC	Module P/L	A
27				X						1	W7160	C	Module	F
28				X						1	W7160X2	A	Module P/L	A
29				X						7	W7130	NC	Module	C&D
30				X						1	W7130X1	A	Module P/L	A
31				X						1	W7153	A	Module	C&D
32				X						1	W7153X1	A	Module P/L	A
33				X						1	W7093	A	Module	E
34				X						1	W7093X1	NC	Module P/L	A
35														
36														
37				X						R	609312	C	Schematic Diag. 100	R
38				X						R	609368	NC	Conn. Pin Assign	A
39														
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MODEL NO.

TITLE—	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 dup	A	13125	MDL 609770-102	
	SCALE	RELEASED	SHEET 10 OF	

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1			X							1	609523-102	B	Blivet Assy 200	EAA
[illegible]				X						2	609483-1	NC	Rail	D
3				X						1	T609524-3	NC	Insulator	R
4				X						1	T609524-2	NC	Positioning Board	R
5				X						1	T609525-101	NC	Matrix No. 1	R
6				X						1	T609524-101	NC	Hook Up Board	R
7				X						4	T609369-1	NC	Spacer	R
8				X						1	T609526-101	NC	Matrix No. 2	R
9				X						1	T609526-1	NC	Insulator	R
10				X						1	W7140	A	Module	E
11				X						1	W7140X1	NC	Module P/L	A
12				X						1	W7112	A	Module	E
13				X						1	W7112X1	NC	Module P/L	A
14				X						1	W7180	NC	Module	E
15				X						1	W7180X1	NC	Module P/L	A
16				X						1	W7110	B	Module	E
17				X						1	W7110X1	NC	Module P/L	A
18				X						1	W7177	B	Module	EE
19				X						1	W7177X1	C	Module P/L	A
20				X						1	W7109	B	Module	E
21				X						1	W7109X1	NC	Module P/L	A
22				X						1	W7108	B	Module	E
23				X						1	W7108X1	NC	Module P/L	A
24				X						2	W7081	B	Module	E
25				X						1	W7081X1	NC	Module P/L	A
26				X						1	W7113	A	Module	E
27				X						1	W7113X1	NC	Module P/L	A
28				X						1	W7111	NC	Module	E
29				X						1	W7111X1	NC	Module P/L	A
30				X						1	W7181	B	Module	E
31				X						1	W7181X1	NC	Module P/L	A
32				X						1	W7087	C	Module	E
33				X						1	W7087X1	NC	Module P/L	A
34				X						1	W7176	A	Module	F
35				X						1	W7176X1	D	Module P/L	A
36				X						2	W7105	A	Module	E
37				X						1	W7105X1	NC	Module P/L	A
38				X						6	W7148	A	Module	C&E
39				X						1	W7148X1	NC	Module P/L	A
40				X						1	W7127	B	Module	E
41				X						1	W7127X1	A	Module P/L	A
42				X						1	W7118	A	Module	E
43				X						1	W7118X1	A	Module P/L	A
44				X						3	W7151	NC	Module	C&F
45				X						1	W7151X1	B	Module P/L	A
46				X						1	W7154	B	Module	F
47				X						1	W7154X1	C	Module P/L	A
48				X						1	W7172	B	Module	D
49				X						1	W7172X1	B	Module P/L	A
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MODEL NO.

TITLE— MASTER DRAWING LIST ML 323-6VUP	SIZE A	CODE IDENT NO. 13126	DWG NO. MDL 609770-102	REV
	SCALE	RELEASED	SHEET 11 OF	

ML FORM 204

LINE NO.	POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1				X						1	W7134	A	Module	E
2				X						1	W7134X1	B	Module P/L	A
3				X						1	W7164	NC	Module	D
4				X						1	W7164X1	A	Module P/L	A
5				X						17	W7137	B	Module	E
6				X						1	W7137X1	B	Module P/L	A
7				X						2	W7155	NC	Module	E
8				X						1	W7155X2	B	Module P/L	A
9				X						2	W7138	A	Module	E
10				X						1	W7138X1	NC	Module P/L	A
11				X						1	W7139	B	Module	E
12				X						1	W7139X1	C	Module P/L	A
13				X						1	W7133	B	Module	E
14				X						1	W7133X1	F	Module P/L	A
15				X						1	W7162	A	Module	E
16				X						1	W7162X1	A	Module P/L	A
17				X						1	W7160	C	Module	E
18				X						1	W7160X2	A	Module P/L	A
19														
20														
21				X						R	609313	E	Schematic Diag. 200	E
22				X						R	609368	NC	Conn Pin Assign	A
23				X						5	SP30275-102	B	Capacitor	C
24				X						1	" -103	B	Capacitor	C
25														
26														
27														
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MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 dup	A	13126	MDL 609770-102	
	SCALE	RELEASED	SHEET 12 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION									QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
	1	2	3	4	5	6	7	8	9					
1			X							1	609527-102	B	Blivet Assy 300	EAA
2				X						1	609484-1	NC	Rail	D
3				X						1	609497-1	NC	Rail	D
4				X						1	T609528-3	NC	Insulator	R
5				X						1	T609529-101	NC	Matrix	R
6				X						1	T609528-2	NC	Positioning Board	R
7				X						1	T609528-101	NC	Hook Up Board	R
8				X						2	T609373-1	NC	Spacer	R
9				X						1	SP30389-101	A	Transformer	C
10				X						1	W7156	NC	Module	F
11				X						1	W7156X1	NC	Module P/L	A
12				X						1	W7106	A	Module	E
13				X						1	W7106X1	NC	Module P/L	A
14				X						1	W7104	B	Module	E
15				X						1	W7104X1	NC	Module P/L	A
16				X						1	W7081	B	Module	E
17				X						1	W7081X1	NC	Module P/L	A
18				X						1	W7128	NC	Module	E
19				X						1	W7128X1	NC	Module P/L	A
20				X						1	W7121	A	Module	E
21				X						1	W7121X1	NC	Module P/L	A
22				X						1	W7129	NC	Module	E
23				X						1	W7129X1	NC	Module P/L	A
24				X						1	W7163	B	Module	F
25				X						1	W7163X2	C	Module P/L	A
26				X						2	W7160	C	Module	F
27				X						1	W7160X2	A	Module P/L	A
28				X						1	W7189	B	Module	E
29				X						1	W7189X1	C	Module P/L	A
30				X						1	W7191	NC	Module	F
31				X						1	W7191X1	A	Module P/L	A
32				X						1	W7120	A	Module	E
33				X						1	W7120X1	A	Module P/L	A
34				X						1	W7115	A	Module	E
35				X						1	W7115X1	NC	Module P/L	A
36				X						1	W7159	NC	Module	F
37				X						1	W7159X1	A	Module P/L	A
38				X						1	W7157	NC	Module	E
39				X						1	W7157X1	B	Module P/L	A
40				X						1	W7146	NC	Module	F
41				X						1	W7146X1	NC	Module P/L	A
42				X						1	W7141	NC	Module	F
43				X						1	W7141X1	NC	Module P/L	A
44				X						1	W7119	A	Module	E
45				X						1	W7119X1	NC	Module P/L	A
46				X						1	W7144	NC	Module	E
47				X						1	W7144X1	A	Module P/L	A
48				X						1	W7136	A	Module	E
49				X						1	W7136X1	E	Module P/L	A
50														

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6	A	13126	MDL 609770-102	
SCALE		RELEASED	SHEET 13 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
				X						1	W7126	NC	Module	E
				X						1	W7126X1	NC	Module P/L	A
3				X						1	W7157	NC	Module	E
4				X						1	W7157X2	B	Module P/L	A
5				X						1	W7192	NC	Module	E
6				X						1	W7192X1	NC	Module P/L	A
7				X						1	W7132	NC	Module	F
8				X						1	W7132X1	B	Module P/L	A
9				X						3	W7190	A	Module	F
10				X						1	W7190X1	NC	Module P/L	A
11				X						2	W7158	A	Module	ED
12				X						1	W7158X1	E	Module P/L	A
13				X						1	W7135	A	Module	E
14				X						1	W7135X1	NC	Module P/L	A
15				X						6	W7188	A	Module	F
16				X						1	W7188X1	NC	Module P/L	A
17				X						3	W7188	A	Module	F
18				X						1	W7188X2	A	Module P/L	A
19				X						1	W7221	NC	Module	E
20				X						1	W7221X1	NC	Module P/L	A
21				X						1	W7220	NC	Module	E
22				X						1	W7220X1	NC	Module P/L	A
23				X						1	W7219	NC	Module	E
24				X						1	W7219X1	NC	Module P/L	A
25				X						1	W7218	A	Module	E
26				X						1	W7218X1	NC	Module P/L	A
				X						2	SP30265/22000	B	Diode	A
28														
29				X						R	609314	D	Schematic Diag. 300	E
30				X						R	609368	NC	Conn Pin Assign	A
31				X						1	SP30275-102	B	Capacitor	C
32				X						AR	609527-1	B	Mylar	F
33														
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MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 [illegible]	A	13126	MDL 609770-102	
SCALE		RELEASED	SHEET 14 OF	

ML FORM 201

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1			X							1	609356-104	G	Blivet Assy 500	F
2				X						1	609486-101	NC	Housing	D
3					X					1	609486-1	NC	Housing	D
4					X					2	609486-3	NC	Boss	D
5					X					2	609486-4	NC	Boss	D
6					X					1	SP30368	A	Choke	C
7				X						1	W7215	C	Module	F
8				X						1	W7215X1	A	Module P/L	A
9				X						1	W7170	A	Module	D
10				X						1	W7170X1	A	Module P/L	A
11				X						1	W7169	NC	Module	F
12				X						1	W7169X1	C	Module P/L	A
13				X						1	W7150	A	Module	E
14				X						1	W7150X1	C	Module P/L	A
15				X						1	W7147	NC	Module	E
16				X						1	W7147X1	C	Module P/L	A
17				X						1	W7149	D	Module	F
18				X						1	W7149X1	G	Module P/L	A
19				X						1	609358-1	A	Etch Card	EE
20				X						R	609370	F	Schematic Diag 400 & 500	E
21				X						A/R	609356-1	G	Insulator	F
22				X						R	SP30408-101		Fixture Foaming	
23				X						1	609354-103	D	Blivet Assy 400	D
24					X					1	609485-101	NC	Housing	D
25						X				1	609485-1	NC	Housing	D
26						X				2	609485-2	NC	Boss	D
27						X				2	609485-3	NC	Boss	D
28					X					1	609355-1	A	Circuit Master	D
29					X					1	W7152	D	Module	E
30					X					1	W7152X1	F	Module P/L	A
31					X					A/R	609354-1	D	Insulator	D
32					X					1	SP30370	B	Choke	C
33					X					R	T609566-104	NC	Jig-Fixture Foaming	D
34														
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MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6	A	13126	MDL 609770-102	
SCALE		RELEASED	SHEET 15 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1			X							1	609359-102	D	Bilvet Assy 600	D
				X						1	609486-102	NC	Housing	D
3					X					1	609486-2	NC	Housing	D
4					X					1	609486-5	NC	Boss	D
5					X					2	609486-6	NC	Boss	D
6				X						1	609374-101	C	Matrix Assy	D
7				X						2	T609375-1	NC	Spacer	D
8				X						1	T609362-101	C	Hook Up Board	D
9				X						1	T609362-2	C	Positioning Board	D
10				X						1	W7163	B	Module	F
11				X						1	W7163X1	A	Module P/L	A
12				X						1	W7182	D	Module	E
13				X						1	W7182X1	E	Module P/L	A
14				X						2	W7131	NC	Module	D
15				X						1	W7131X1	NC	Module P/L	A
16				X						2	W7145	A	Module	E
17				X						1	W7145X1	B	Module P/L	A
18				X						2	W7173	NC	Module	F
19				X						1	W7173X1	B	Module P/L	A
20				X						2	W7174	NC	Module	ED
21				X						1	W7174X1	NC	Module P/L	A
22														
23				X						1	609362-3	C	Insulator	D
24				X						R	609371	E	Schematic Diag. 600	D
25				X						AR	609359-1	D	Insulator	D
26				X						R	609368	NC	Conn Pin Assign	A
7														
28				X						1	609359-2	D	Sub Assy (TB)	D
29														
30														
31														
32														
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MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6	A	13125	MDL 609770-102	
SCALE		RELEASED	SHEET 16 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1			X							1	609540-102	C	Blivet Assy 800	EE
2				X						1	609473-1	A	Board Etched	F
3				X						1	609488-1	NC	Rail	D
4				X						1	609489-2	NC	Rail	D
5				X						1	609540-9	C	Board	EE
6				X						1	609540-1	C	Shield Side	EE
7				X						1	609540-2	C	Shield Bottom	EE
8				X						1	609540-3	C	Shield Top	EE
9				X						1	609540-4	C	Shield Partition	EE
10				X						1	609540-5	C	Shield Partition	EE
11				X						1	609540-6	C	Insulator	EE
12				X						REF	WL609450	B	Wire List	A
13				X						1	609540-8	C	Shield Tube Cover	EE
14				X						1	609540-10	C	Insulator Connector	EE
15				X						1	W7216	A	Module	D
16				X						1	W7216X1	B	Module P/L	A
17				X						1	W7211	NC	Module	D
18				X						1	W7211X1	NC	Module P/L	A
19				X						1	W7235	NC	Module	D
20				X						1	W7235X1	A	Module P/L	A
21				X						1	W7213	NC	Module	E
22				X						1	W7213X1	A	Module P/L	A
23				X						1	W7210	NC	Module	F
24				X						1	W7210X1	NC	Module P/L	A
25				X						1	W7214	A	Module	E
26				X						1	W7214X1	NC	Module P/L	A
27				X						1	W7232	NC	Module	F
28				X						1	W7232X1	NC	Module P/L	A
29				X						2	W7231	A	Module	E
30				X						1	W7231X1	C	Module P/L	A
31				X						1	W7193	NC	Module	F
32				X						1	W7193X1	NC	Module P/L	A
33				X						1	W7225	B	Module	F
34				X						1	W7225X1	C	Module P/L	A
35				X						1	W7226	A	Module	D
36				X						1	W7226X1	C	Module P/L	A
37				X						1	W7228	NC	Module	FD
38				X						1	W7228X1	D	Module P/L	A
39														
40				X						R	609547	A	Schematic Diag. 800	E
41														
42														
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MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV.
MASTER DRAWING LIST ML 323- 6	A	13126	MDL 609770-102	
SCALE		RELEASED	SHEET 17 OF	

ML FORM 204

LINE NO.	POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1			X							1	609541-103	C	Blivet Assy 900	F
2				X						1	609488-2	NC	Rail Internal	D
				X						1	609489-2	NC	Rail External	D
4				X						1	609421-1	B	Etch Card	EF
5				X						1	W7237	NC	Module	E
6				X						1	W7237X1	NC	Module P/L	A
7				X						1	W7194	NC	Module	E
8				X						1	W7194X1	NC	Module P/L	A
9				X						1	W7223	NC	Module	DD
10				X						1	W7223X1	C	Module P/L	A
11				X						1	W7195	NC	Module	EE
12				X						1	W7195X1	NC	Module P/L	A
13				X						1	W7187	D	Module	E
14				X						1	W7187X1	D	Module P/L	A
15				X						1	W7183	C	Module	E
16				X						1	W7183X2	D	Module P/L	A
17				X						1	W7196	NC	Module	CF
18				X						1	W7196X1	NC	Module P/L	A
19				X						3	W7212	NC	Module	F
20				X						1	W7212X1	NC	Module P/L	A
21				X						1	609541-4	B	Terminal Board	F
22				X						R	609542	B	Schematic Diag. 900	E
23				X						A/R	609541-1	B	Insulator	F
24				X						A/R	609541-2	B	Board	F
25				X						1	609541-3	B	Board	F
26				X						R	609368	NC	Conn pin assign	A
27				X						R	SP30428-101	A	Fixture Potting	F
28				X						1	609541-5	B	Board	F
29				X						1	609587-101	A	Blivet Assy 700	J
30					X					1	609758-1	NC	Rail Top	D
31					X					1	609760-1	NC	Rail Exterior	D
32					X					1	609761-1	NC	Rail Interior	D
33					X					1	W7197	NC	Module	EF
34					X					1	W7197X1	NC	Module P/L	A
35					X					1	W7198	NC	Module	EE
36					X					1	W7198X1	NC	Module P/L	A
37					X					1	W7171	B	Module	EE
38					X					1	W7171X1	B	Module P/L	A
39					X					1	W7184	C	Module	EE
40					X					1	W7184X1	C	Module P/L	A
41					X					1	W7183	C	Module	E
42					X					1	W7183X1	E	Module P/L	A
43					X					1	609759-1	NC	Rail Bottom	D
44					X					1	609587-1	A	Board Assy	J
45						X				1	609588-1	NC	Board Module	E
46						X				1	SK609999-1	NC	Spacer - Terminal	A
47							X			7	SP30405-3	A	Terminal Modified	B
48						X				1	SK609999-2	NC	Spacer - Terminal	A
49							X			3	SP30405-3	A	Terminal Modified	B
50						X				1	SK609999-3	NC	Spacer - Terminal	A

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 [illegible]	A	13126	MDL 609770-102	
SCALE		RELEASED	SHEET 18 OF	

ML FORM 204

LINE NO.	POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1						X				1	SK609999-4	NC	Spacer - Terminal	A
2						X				2	SK609999-5	NC	Spacer - Terminal	A
3						X				3	SK609999-6	NC	Spacer - Terminal	A
4						X				[illegible]	SK609999-7	NC	Spacer - Terminal	A
5						X				2	SK609999-8	NC	Spacer - Terminal	A
6						X				1	SK609999-9	NC	Spacer - Terminal	A
7					X					1	609587-2	A	Spacer	J
8					X					1	609587-3	A	Clamp	J
9					X					9	SK609698-1	NC	Tubing	A
10														
11				X						1	SP30265/22000	B	Diode	A
12														
13														
14					X					1	SK609696-1	NC	Plate	A
15					X					1	SK609696-2	NC	Plate	A
16					X					1	SK609696-3	NC	Plate	A
17					X					R	SK609699-1	NC	Tooling Position BD	C
18														
19					X					R	609586	NC	Schematic Diag 700	D
20														
21														
22				~~X~~						~~1~~	~~609500-101~~	~~NC~~	~~Assy-Gauge~~	~~D~~
23					~~X~~					~~1~~	~~609500-1~~	~~F~~	~~CCGE Interface Control~~	~~D~~
24						~~X~~				~~1~~	~~60935[illegible]-101~~	[illegible]	~~Cable Assy~~	~~C~~
25						~~X~~				[illegible]	~~609503-1~~	~~A~~	~~Pin Guide~~	~~B~~
26					~~X~~					~~1~~	~~609550-1~~	~~NC~~	~~Bracket~~	~~B~~
27					~~X~~					~~2~~	~~609580-1~~	~~NC~~	~~Bracket~~	~~B~~
28														
29														
30														
31														
32			~~X~~							~~1~~	~~609578-101~~	~~A~~	~~Terminal Board Assy~~	~~F~~
33				~~X~~						~~1~~	~~609577-101~~	~~NC~~	~~Terminal Board~~	~~C~~
34					~~X~~					~~1~~	~~609577-1~~	~~NC~~	~~Board~~	~~C~~
35					~~X~~					~~1~~	~~609376-1~~	~~A~~	~~Bracket~~	~~B~~
36					~~X~~					~~2~~	~~609329-1~~	~~NC~~	~~Bracket~~	~~B~~
37														
38														
39														
40														
41														
42		X								REF	609012	NC	MOD KIT 10168 ALSEA/SMS/CCGE	C
43		X								A/R	609779-1	NC	SHIM-BRACKET	B
44		X								A/R	609779-2	NC	SHIM-BRACKET	B
45		X								A/R	609779-3	NC	SHIM-BRACKET	B
46														
47														
48														
49														
50					X					REF	546353	NC	TEST SPEC (ML323-3 & Up)	A

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6&UP	A	13126	MDL 609770-102	A
	SCALE	RELEASED	SHEET 19 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1					X					Ref	S46820	NR	Test Specification (Blivet 100)	A
2						X				"	S46368	NC	Test Specification (W7081-X1)	A
3						X				"	S46369	NC	Test Specification (W7082-X1)	A
4						X				"	S46370	NC	Test Specification (W7083-X1)	A
5						X				"	S46371	A	Test Specification (W7084-X1)	A
6						X				"	S46372	NC	Test Specification (W7085-X1)	A
7						X				"	S46373	NC	Test Specification (W7086-X1)	A
8						X				"	S46375	NC	Test Specification (W7088-X1)	A
9						X				"	S46376	NC	Test Specification (W7089-X1)	A
10						X				"	S46377	NC	Test Specification (W7090-X1)	A
11						X				"	S46378	NC	Test Specification (W7091-X1)	A
12						X				"	S46379	A	Test Specification (W7092-X1)	A
13						X				"	S46380	A	Test Specification (W7093-X1)	A
14						X				"	S46381	NC	Test Specification (W7094-X1)	A
15						X				"	S46382	NC	Test Specification (W7095-X1)	A
16						X				"	S46383	A	Test Specification (W7096-X1)	A
17						X				"	S46384	NC	Test Specification (W7097-X1)	A
18						X				"	S46385	NC	Test Specification (W7098-X1)	A
19						X				"	S46385	NC	Test Specification (W7099-X1)	A
20						X				"	S46387	A	Test Specification (W7100-X1)	A
21						X				"	S46388	A	Test Specification (W7101-X1)	A
22						X				"	S46389	B	Test Specification (W7102-X1)	A
23						X				"	S46390	NC	Test Specification (W7103-X1)	A
24						X				"	S46401	NC	Test Specification (W7114-X1	A
25						X				"	S46403	NC	Test Specification (W7116-X1)	A
26						X				"	S46404	A	Test Specification (W7117-X1)	A
27						X				"	S46409	NC	Test Specification (W7122-X1)	A
28						X				"	S46410	NC	Test Specification (W7123-X1)	A
29						X				"	S46411	NC	Test Specification (W7124-X1)	A
30						X				"	S46412	A	Test Specification (W7125-X1)	A
31						X				"	S46418	A	Test Specification (W7130-X2)	A
32						X				"	S46532	A	Test Specification (W7130-X2)	A
33						X				"	S46437	B	Test Specification (W7148-X1)	A
34						X				"	S46442	NC	Test Specification (W7153-X1)	A
35						X				"	S46814	NC	Test Specification (W7160-X2)	A
36						X				"	S46450	A	Test Specification (W7161-X1)	A
37						X				"	S46467	NC	Test Specification (W7178-X1)	A
38						X				"	S46468	NC	Test Specification (W7179-X1)	A
39						X				50	SP30112-F	L	Header	C
40						X				9	SP30112-BB	L	Header	C
41						X				1	SP30112-CC	L	Header	C
42														
43						X				Ref	SP30347-9	E	Fixture	J
44						X				R	T609752-1	NC	Fixture - Foaming	D
45						X				R	T609752-2	NC	Fixture-Foaming	D
46						X				R	T609566-101	NC	Jig Fixture Foaming	D
47						X				R	T609572-101	NC	Jig Fixture Matrix	D
48														
49														
50														

MODEL NO.

TITLE—	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6	A	13126	MDL 609770-102	
	SCALE	RELEASED	SHEET 20 OF	

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1					X					Ref	S46857	NR	Test Specification (Blivet 200)	A
2						X				"	S46368	NC	Test Specification (W7081-X1)	A
3						X				"	S46374	NC	Test Specification (W7087-X1)	A
4						X				"	S46392	NC	Test Specification (W7105-X1)	A
5						X				"	S46395	A	Test Specification (W7108-X1)	A
6						X				"	S46396	A	Test Specification (W7109-X1)	A
7						X				"	S46397	NC	Test Specification (W7110-X1)	A
8						X				"	S46398	A	Test Specification (W7111-X1)	A
9						X				"	S46399	NC	Test Specification (W7112-X1)	A
10						X				"	S46400	NC	Test Specification (W7113-X1)	A
11						X				"	S46405	A	Test Specification (W7118-X1)	A
12						X				"	S46414	B	Test Specification (W7127-X1)	A
13						X				"	S46422	B	Test Specification (W7133-X1)	A
14						X				"	S46423	NC	Test Specification (W7134-X1)	A
15						X				"	S46426	B	Test Specification (W7137-X1)	A
16						X				"	S46427	B	Test Specification (W7138-X1)	A
17						X				"	S46428	A	Test Specification (W7139-X1	A
18						X				"	S46429	C	Test Specification (W7140-X1)	A
19						X				"	S46437	B	Test Specification (W7148-X1)	A
20						X				"	S46440	C	Test Specification (W7151-X1)	A
21						X				"	S46443	B	Test Specification (W7154-X1)	A
22														
23						X				"	S46531	B	Test Specification (W7155-X2)	A
24						X				"	S46812	A	Test Specification (W7160-X2)	A
25						X				"	S46451	B	Test Specification (W7162-X1)	A
26						X				"	S46453	C	Test Specification (W7164-X1)	A
27						X				"	S46461	NC	Test Specification (W7172-X1)	A
28						X				"	S46465	C	Test Specification (W7176-X1)	A
29						X				"	S46466	A	Test Specification (W7177-X1)	A
30						X				"	S46469	NC	Test Specification (W7180-X1)	A
31						X				"	S46470	A	Test Specification (W7181-X1)	A
32						X				1	SP30112-B	L	Header	C
33						X				17	SP30112-F	L	Header	C
34						X				2	SP30112-BB	L	Header	C
35						X				32	SP30112-CC	L	Header	C
36						X				3	SP30112-DD	L	Header	C
37														
38						X				Ref	SP30347-10	E	Fixture	J
39						X				R	T609752-4	NC	Fixture Foaming	D
40						X				R	T609566-102	NC	Jig Fixture Foaming	D
41						X				R	T609573-101	NC	Jig Fixture Matrix	D
42														
43														
44														
45														
46														
47														
48														
49														
50														

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6	A	13126	MDL 609770-102	
	SCALE	RELEASED	SHEET 21 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1					X					Ref	S46858	N	Test Specification (Blivet 300)	A
2						X				Ref	S46368	NC	Test Specification (W7081-X1)	A
3						X				Ref	S46391	B	Test Specification (W7104-X1)	A
4						X				Ref	S46393	NC	Test Specification (W7106-X1)	A
5						X				Ref	S46402	A	Test Specification (W7115-X1)	A
6						X				Ref	S46406	A	Test Specification (W7119-X1)	A
7						X				Ref	S46407	A	Test Specification (W7120-X1)	A
8						X				Ref	S46408	A	Test Specification (W7121-X1)	A
9						X				Ref	S46413	B	Test Specification (W7126-X1)	A
10						X				Ref	S46415	A	Test Specification (W7128-X1)	A
11						X				Ref	S46417	NC	Test Specification (W7129-X1)	A
12						X				Ref	S46420	A	Test Specification (W7132-X1)	A
13						X				Ref	S46535	NC	Test Specification (W7135-X1)	A
14						X				Ref	S46425	NC	Test Specification (W7136-X1)	A
15						X				Ref	S46430	A	Test Specification (W7141-X1)	A
16						X				Ref	S46433	A	Test Specification (W7144-X1)	A
17						X				Ref	S46435	NC	Test Specification (W7146-X1)	A
18						X				Ref	S46445	NC	Test Specification (W7156-X1)	A
19						X				Ref	S46446	A	Test Specification (W7157-X1)	A
20						X				Ref	S46534	A	Test Specification (W7157-X2)	A
21						X				Ref	S46447	B	Test Specification (W7158-X1)	A
22						X				Ref	S46448	NC	Test Specification (W7159-X1)	A
23						X				Ref	S46814	NC	Test Specification (W7160-X2)	A
24						X				Ref	S46530	A	Test Specification (W7163-X2)	A
25														
26														
27						X				Ref	S46477	NC	Test Specification (W7188-X1)	A
28						X				Ref	S46424	NC	Test Specification (W7188-X2)	A
29						X				Ref	S46478	A	Test Specification (W7189-X1)	A
30						X				Ref	S46479	NC	Test Specification (W7190-X1)	A
31						X				Ref	S46480	A	Test Specification (W7191-X1)	A
32						X				Ref	S46481	NC	Test Specification (W7192-X1)	A
33						X				Ref	S46513	A	Test Specification (W7218-X1)	A
34						X				Ref	S46514	A	Test Specification (W7219-X1)	A
35						X				Ref	S46515	B	Test Specification (W7220-X1)	A
36						X				Ref	S46516	A	Test Specification (W7221-X1)	A
37														
38														
39						X				2	SP30112-B	L	Header	C
40						X				1	SP30112-C	L	Header	C
41						X				18	SP30112-F	L	Header	C
42						X				3	SP30112-AA	L	Header	C
43						X				2	SP30112-BB	L	Header	C
44						X				19	SP30112-CC	L	Header	C
45						X				1	SP30112-DD	L	Header	C
46						X				4	SP30112-EE	L	Header	C
47						X				Ref	SP30347-11	E	Matrix Jig	J
48						X				R	T609752-3	NC	Foaming Fixture	D
49						X				R	T609566-103	NC	Jig Fixture Foaming	D
50						X				R	T609574-101	NC	Jig Fixture Foaming	D

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6	A	13126	MDL 609770-102	
SCALE		RELEASED	SHEET 22 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION									QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
	1	2	3	4	5	6	7	8	9					
1				X						R	S46859	NC	Test Spec (500)	A
2					X					1	609321-1	NC	Header	C
3					X					Ref	S46441	A	Test Spec (W7152-X1)	A
4					X					Ref	T609752-5	NC	Fixture Foaming (400)	D
5					X					Ref	609752-6	NC	Fixture Foaming (500)	D
6					X					1	SP 30112-CC	L	Header	C
7					X					1	609308-1	A	Header	C
8					X					1	SP30112-AA	L	Header	C
9					X					1	SP 30112-B	L	Header	C
10					X					Ref	S46436	C	Test Spec (W7147X1)	A
11					X					Ref	S46438	C	Test Spec (W7144X1)	A
12					X					Ref	S46439	B	Test Spec (W7150X1)	A
13					X					Ref	S46458	B	Test Spec (W7169X1)	A
14					X					Ref	S46459	C	Test Spec (W7170X1)	A
15					X					Ref	S46728	A	Test Spec (W7215X1)	A
16				X						Ref	S46799	NC	Test Spec (600)	A
17					X					4	SP 30112-CC	L	Header	C
18					X					2	SP 30112-EE	L	Header	C
19					X					Ref	S46434	C	Test Spec (W7145-X1)	A
20					X					Ref	S46789	A	Test Spec (W7174-X1)	A
21					X					Ref	S46788	NC	Test Spec (W7173-X1)	A
22					X					Ref	S46471	B	Test Spec (W7182-X1)	A
23					X					Ref	S46419	A	Test Spec (W7131-X1)	A
24					X					Ref	S46452	A	Test Spec (W7163-X1)	A
25														
26														
27					X					R	T609575-101	NC	Jig Fixture Matrix (600)	D
28					X					R	T609567-101	NC	Jig Fixture Foaming 600 & 500	D
29					X					R	T609752-7	NC	Fixture Foaming	D
30					X					R	SP30347-12		Jig Fixture	
31				X						R	S46846	NR	Test Spec (700)	A
32					X					1	SP 30112-F	L	Header	C
33					X					1	609305-1	NC	Header	C
34					X					2	609300-1	NC	Header	C
35					X					1	609302-1	B	Header	C
36					X					1	609322	A	Header	C
37					X					R	S46460	NC	Test Spec (W7171-X1)	A
38					X					R	S46472	NC	Test Spec (W7183-X1)	A
39					X					R	S46473	A	Test Spec (W7184X1)	A
40					X					R	S46837	NC	Test Spec (W7197X1)	A
41					X					R	S46838	NC	Test Spec (W7198-X1)	A
42					X					R	T609748	A	Fixture Potting	F
43					X					R	T609752-8	NC	Fixture Foaming	C
44					X					R	T609752-9	NC	" "	D
45														
46				X						R	S46860	NC	Test Spec (800)	A
47					X					R	S46782	A	Test Spec (W7213-X1)	A
48					X					R	S46783	A	Test Spec (W7214-X1)	A
49					X					R	S46728	A	Test Spec (W7216-X1)	A
50					X					R	S46523	NC	Test Spec (W7225-X1)	A

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6	A	13126	MDL 609770-102	
	SCALE	RELEASED	SHEET 23 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1					X					R	S46524	A	Test Spec (W7226X1)	A
2					X					R	S46780	NC	Test Spec (W7211X1)	A
3					X					R	S46526	A	Test Spec (W7228X1)	A
4					X					R	S46779	A	Test Spec (W7210X1)	A
5					X					R	S46529	A	Test Spec (W7231X1)	A
6					X					R	S46462	A	Test Spec (W7232X1)	A
7					X					R	S46813	NC	Test Spec (W7193X1)	A
8					X					R	S46486	NC	Test Spec (W7235X1)	A
9					X					R	SP30275-100	B	Capacitor (10pf)	C
10					X					R	SP30428	C	Reed Relay	B
11					X					R	T609752-10-11	NC	Fixture Foaming	D
12					X					R	T609566-105	NC	Jig Fixture Foaming	D
13														
14				X						R	S46862	NR	Test Spec (900)	A
15					X					R	S46816	NC	Test Spec (W7194X1)	A
16					X					R	S46824	NR	Test Spec (W7195X1)	A
17					X					R	S46781	NC	Test Spec (W7212X1)	A
18					X					R	S46521	A	Test Spec (W7223X1)	A
19					X					R	S46533	NC	Test Spec (W7183X2)	A
20					X					R	S46476	B	Test Spec (W7187X1)	A
21					X					R	S46825	NC	Test Spec (W7196X1)	A
22					X					R	S46488	A	Test Spec (W7237X1)	A
23					X					R	T609752-12-13	NC	Fixture Foaming (900)	D
24					X					R	T609566-106	NC	Jig Fixture Foaming	D
25														
26														
27														
28														
29														
30														
31														
32														
33														
34														
35														
36														
37														
38														
39				X						1	609496	NC	Cir Master Connector	D
40				X						1	609504-101	NC	Adapter cable assy	C
41					X					1	609516-1	NC	Cable Clamp	B
42				X						1	609514-102	NC	Adapter Cable Assy	C
43														
44				X						1	609515	NC	Conn Modified	B
45														
46														
47														
48														
49														
50														

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6	A	13126	MDL 609770-102	
	SCALE	RELEASED	SHEET 24 OF	

ML FORM 204

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1		X								Ref	609546 sht 1/5	NC	CCGE Electrometer System Diagram	F
2										"	609546 sht 2	"	Sch Diagram Electrometer Ampl.	D
3										"	609546 sht 3	"	Sch. Diagram Electrometer Com Amp	D
4										"	609546 sht 4	"	Sch Diag. Electrometer P.S.	D
5										"	609546	"	Sch. Diag. Electrometer Drft Correc	D
6										"	609585	"	Sch Diag. -3500 P.S.	D
7										"	609154	C	Lo Voltage Power Supply	E
8										"	609157	NC	Strobe Gate Sch. Diagram	E
9		X								"	609158	NC	Comm. System Sch. Diag. Detch Desn	R
10														
11		X								"	609160	NC	Sch. Diag. Log A/D Conv. Positive	E
12		X								"	609161	"	Sch. Lo Energy curved plate Anal.	D
13													Step voltage generator	
14		X								"	609162	"	Sch. Diag. hi energy CDA step	E
15													voltage generator	
16		X								"	609163	"	Vel. Filt. Decoding Logic Diag.	E
17		X								"	609164	"	Sch. Ground Plane Step volt. Gen.	E
18		X								"	609165	"	Lo Energy & Hi Energy Calib. Pul.	E
19		X								"	609166	"	Status Sub Comm Sch. Diag.	F
20														
21														
22														
23														
24														
25		X								Ref	609174	NC	Sch. Diag. Channeltron Pre Amp	C
26		X								"	609584	NC	Sch Diag. -4500 P.S.	D
27														
28														
29		X								"	609177	"	Log Countrate Sch. Diag.	D
30		X								"	609178	"	Hi & Lo Energy Accululators	E
31		X								"	609279	B	Fixture-Align. L.E. DET	
32		X								"	609423	NR	Comp MTG Plate Side DET	
33													OPT Align Bench	
34		X								"	609424	NR	Comp Adapter Side DET	
35													OPT Alignment Bench	
36		X								"	609425	NR	Assy Fixture Mount to	
37													OPT Alignment Bench	
38		X								"	609451	NR	Jig-Aderture Assy	
39		X								"	609452	NR	Jig-Aperture Sub Assy	
40														
41														
42														
43														
44														
45														
46														
47														
48														
49														
50										Ref	609200	B	Simplified Block Diagram ALSEP	R

MODEL NO.

TITLE--	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 Two	A	13126	MDL 609770-102	
SCALE		RELEASED	SHEET 25 OF	

LINE NO.	POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1		X								Ref	DS 609150	NC	Electrometer Design Spec	A
2		X								"	DS 609151	NC	Calibration Current Gen.	A
3														
4		X								"	DS 609153	A	CCGE 4500 V Power Supply	A
5		X								"	DS 609154	NC	System Power Supply	A
6		X								"	DS 609155	NC	CCIG Detachable Section	A
7		X								"	DS 609156	NC	Input Isolation	A
8		X								"	DS 609157	A	Digital Programmer/Readout	A
9		X								"	DS 609158	A	Command System	A
10		X								"	DS 609159	NC	CCGE Sensor & Seal	A
11		X								"	DS 609160	NC	Log A/D Converter	A
12		X								"	DS 609161	NC	Low Energy CPA Stepper	A
13		X								"	DS 609162	NC	Velocity Filter Stepper	A
14		X								"	DS 609164	NC	Ground Plane Stepper	A
15		X								"	DS 609165	NC	Calibration Pulser	A
16		X								"	DS 609166	NC	Status Sub Comm.	A
17														
18														
19														
20														
21		X								"	DS 609170	C	Experiment Test Set	A
22														
23														
24														
25		X								"	DS 609174	NC	Channeltron Preamplifier	A
26		X								"	DS 609175	NC	3500 V Power Supply	A
27		X								"	DS 609176	A	Discrim. Deadtime Circuit	A
28		X								"	DS 609177	NC	Log Countrate Meter	A
29		X								"	DS 609178	NC	Accumulator	A
30		X								"	DS 609179	NC	Dust Cover Circuit	A
31		X								"	DS 609180	NC	Heater & Control Circuit	A
32														
33														
34														
35		X								Ref	609445	C	Block Diagram Expr. Package	E R
36														
37														
38														
39														
40														
41														
42														
43														
44														
45														
46														
47														
48														
49														
50														

MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST ML 323-6 dup	A	13126	MDL 609770-102	
	SCALE	RELEASED	SHEET 26 OF	

ML FORM 204

APPENDIX III

Test Procedures

SIDE/CCGE Test Procedure and Typical Test Data Results (System 7, ML 323-5)

PARTS DISPOSITION		SPEC NO.	REV
1. USE 2. REWORK	3. CANNOT BE REWORKED 4. RECORD 5.	S 46853	A

REVISIONS

DISP	EFF	REV	DESCRIPTION	BY	CK	DATE	APPROVAL
4	RCO	A	General Revision	R. RIVAS	R Rivas	5/20/68	A.K.

REV A

SPEC NO. S 46853

SHEET INDEX	REV	A		A	A			A	A				A						A		A	A				
	SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
SHEET INDEX	REV	A												A												
	SHEET	26	27	28	29	30	31	32	33	34	35	36	37	38												

CONTRACT NO. 51966-14	
PREP D. Aalami	2-28-68
CK R Rivas	3/1/68
ENGR A.K.	3/26/68
APPD [signature]	3/1/68
APPD	
QC APPD Walter E. Tyler	2-28-68
DESIGN APPD [signature]	
CUSTOMER	

M L — **MARSHALL LABORATORIES**, TORRANCE, CALIFORNIA

TITLE: ALSEP/SIDE/ CCGE ML 323-3& Up Test Specification, For

SIZE	CODE IDENT NO.	SPECIFICATION NO.	REV
A	13126	S 46853	A

RELEASED MAR 26 1968 — SHEET 1 OF 38

ML FORM 202

6-090-c

1.0 SCOPE

The following is the detailed Test Specification for the Suprathermal Ion Detector/Cold Cathode Gauge Experiment for the Apollo Lunar Surface Experiment Package. This specification follows, in general, the Integrated Test Plan dated 5 August 1966.

1.1 Purpose

The intent of this specification is to provide a detailed step by step procedure whereby a technical individual who is familiar with the Experiment Test Set and the Experiments to be tested may be certain of determining the status of every functional circuit and device included in the Experiment. In addition, the Test Specification provides steps interpeted to determine the accuracy with which those functions are performed.

1.2 Complete Test

The complete test of the SIDE/CCGE will include the performance of every one of the steps described in Section 3.0, hereof. As such the tests will require an extended length of time to perform. For that reason, the complete tests need be performed only for acceptance testing, performance verification and, at other times, as directed by Rice University or the Program Office.

1.3 Test Organization

The test is organized so as to verify the performance of each of the Experiment subsystems separately. The order in which the subsystems are tested is arbitrary, unless otherwise noted.

2.0 APPLICABLE DOCUMENTS

2.1 The following documents, of the issue and revision in effect on the date of invitation for bids, form a part of this specification to the extent specified herein:

Specifications

Experiment Performance Specification
Integrated Test Plan
609170 DS, Design Specification, Experiment Test Set
Facilities and Equipment Requirements

Drawings

609445 Block Diagram SIDE/CCGE

2.2 **Precedence of Governing Documents.** Unless otherwise specified, when a requirement of an applicable specification is in conflict with a requirement specified herein, the requirement specified herein shall apply. When a requirement specified herein, the requirement specified on the drawing shall apply.

3.0 REQUIREMENTS (Read Notes, Section 6.0)

3.1 Procedural

The test operator shall record in the unit history log the date, time and location of test and his name. He shall record the Test Specification paragraph number and the resultant test data for each performed. The data may be recorded in column fashion with one column for pass and one column for reject. It is necessary to record the approximate value of voltage, current, rise time, etc., observed during the test. A check mark in the appropriate column is sufficient. The ETS printer may be used to record any data for ease in data reduction/review. Side frame counter may be speeded up to the side frame of interest, if desired. Lock out plug must be plugged in during test unless otherwise specified. ETS command system may be cleared as required.

3.1.1 Equipment

A. Experiment Test Set, Model ML 324
B. Unit History Log
C. 110 volt 60 cycles single phase AC Power, 15 amperes Minimum
D. Test Data Sheets, pages 1 through 13.

3.2 Subsystem One Testing

3.2.1 Power Supply Testing

3.2.1.1 With operating power off, temporarily disconnect Alsep Simulator cable. Measure resistance between the following points. Specification: $> 10^7\ \Omega$ (decreasing to $> 2 \times 10^6\ \Omega$ at +80°C)

Between Alsep Power Ground (J17-21) (connect only (-) terminal of meter to J17-21)	and	HP Return (J17-33); Side Ground (CCGE case); Alsep Sig GND (J17-11)
Between HP Return (J17-33)	and	Side Ground (CCGE case); Alsep Sig. GND. (J17-11)
Between Side Ground (CCGE case)	and	Alsep Sig. GND (J17-11)

3.2.1.2 Make certain lock-out plug P-18 is connected. Apply 29v (variable) power. (See paragraphs 6.4 and 6.5)

3.2.1.3 Observe and record voltage across VR on ETS at Side frame 0. Convert voltage measurement into operating current by using the conversion factor 10 ma/mv.

3.2.1.4 Observe and record operating voltage across +29V and + 29v return on ETS, at SIDE frame 0.

3.2.1.5 Using data in step 3.2.1.3 and 3.2.1.4, calculate the system operating power. Specification: 3.77 watts to 11.2 watts. (3.77 watts to 5.8 watts

3.2.1.5 (continued . . .)

at room temperature).

3.2.2 Experiment Sequencing. Turn off instrument operating power. Then reapply power using "29 volt fixed" setting. Adjust ETS ALSEP Simulator Unit controls for 1,060 bits per second. All other controls in normal (center) position. Turn "parity" switch off. This will "initialize" the SIDE. Read paragraph 6.3.

3.2.2.1 Observe real time SIDE frame display. Number displayed will increment by 1 approximately 1 per second. (Do not measure time interval). (Clear ETS command system).

3.2.2.2 Transmit command number 2, (BE). Observe real time SIDE frame display. Specification: range of SIDE frame counter, 0 to 10, continuous, increasing only. (Clear ETS command system)

3.2.2.3 Transmit command 5 (ACE). Observe real time SIDE frame display. Specification: range of SIDE frame counter 0 to 79, continuous, increasing only. (Clear ETS command system).

3.2.2.4 Transmit command 3 (ABE). Observe real time SIDE frame counter, Specification: range of SIDE frame counter 0 to 39, continuous, increasing only. (Clear ETS Command System)

3.2.2.5 Transmit command number 8 (DE). Observe real time SIDE frame counter. Will reset and begin counting from 000.

3.2.2.6 Operate shift pulse, even frame mark and data demand pulse amplitude controls to 5.5V. Operate shift pulse, even frame mark and data demand pulse rise time controls to 2 μ sec. Observe real time SIDE frame counter. Specification: SIDE frame counter shall continue to increment approximately once per second.

3.2.2.7 Operate Shift pulse, even frame mark and data demand pulse amplitude controls to 2.5 V. Operate Shift pulse, even frame mark and data demand pulse rise time controls to 10 μ sec. Observe real time SIDE frame counter. Specification: SIDE frame counter shall continue to increment approximately once per second.

3.2.2.8 Return amplitude and rise time controls to normal (center), position and clear ETS command system.

3.2.2.9 Change ETS bit rate to 530 pulses per second. Observe real time SIDE frame counter. SIDE frame counter shall increment approximately once per 2 seconds. Do not attempt to measure this rate.

3.2.2.10 Operate ETS bit rate switch to 1,060 bits per second.

3.2.3 Command System

NOTE: In this section, Status is verified at real-time SIDE frame 033. Set display storage SIDE frame select thumb wheels to SIDE frame number 033 and depress Frame Select Display. Repeat step 3.2.2 (Initialize). Observe "STATUS". Specification: 000. Observe Analog subcom. Specification: 0 to 137.

3.2.3.1 Operate ETS command amplitude controls to the 2.5 volt position. Operate ETS command rise time controls to the 10 microsecond position.

3.2.3.2 Transmit command BCD. Observe "STATUS". Specification: 0014. Observe Analog subcom. Specification: 195 to 212.

3.2.3.3 Transmit command E. Observe "STATUS". Specification: 0000.

3.2.3.4 Clear ETS command system.

3.2.3.5 Transmit command AB. Observe "STATUS". Specification 0003.

3.2.3.6 Transmit command E. Clear ETS command system.

3.2.3.7 Operate ETS command amplitude control to 5.5 volt position. Operate ETS command rise time controls to the 2 microsecond position.

3.2.3.8 Transmit command BCD. Observe "STATUS". Specification: 0014.

3.2.3.9 Transmit command E. Observe "STATUS". Specification: 0000

3.2.3.10 Clear ETS command system.

3.2.3.11 Transmit command AB. Observe "STATUS". Specification: 0003.

3.2.3.12 Transmit command E. Clear ETS command system.

3.2.3.13 Return all command system switches to normal (center) positioning.

3.2.4 Digital Control System

NOTE: In this section, Status is verifed at real-time SIDE Frame 003.

3.2.4.1 Set display storage SIDE frame select thumbwheels to SIDE frame number 003. Repeat step 3.2.2 (Initialize). Observe "STATUS", SIDE frame 003 (mode register). Specification: 0000.

3.2.4.2 Transmit command 6 (BCE). Observe "STATUS" SIDE frame 003. Specification: 0006. Clear ETS command system.

3.2.4.3 Transmit command 8 (DE). Observe "STATUS", SIDE frame 003. Specification: 0008. Clear ETS Command system.

3.2.4.4 Transmit command 4 (CE). Observe "STATUS", SIDE frame 003. Specification: 0004. Clear ETS command system.

3.2.4.5 Transmit command 1 (AE). Observe "STATUS", SIDE frame 003. Specification: 0001. Clear ETS command system.

3.2.5 One Time Command System Monitoring

NOTE: In this section, Status is verified at real-time SIDE frame 007.

Set SIDE frame select thumb wheels to 007. Repeat 3.2.2. Observe "STATUS". Specification: 0003.

3.2.5.1 Transmit command B. Observe "STATUS". Specification: 0003.

3.2.5.2 Transmit command E. Observe "STATUS". Specification: 0001. (Clear ETS Command System)

3.2.5.3 Transmit command D. Observe "STATUS". Specification: 0001.

3.2.5.4 Transmit command E. Observe "STATUS". Specification: 0000. (Clear ETS Command System)

3.2.5.5 Repeat 3.2.2. Transmit Command D. Observe "STATUS". Specification: 0003

3.2.5.6 Transmit command E. Observe "STATUS". Specification : 0002 (Clear ETS command system. Depress Real-Time Display)

3.2.6 A/D Converter

Repeat step 3.2.2. Print a tape covering side frame 000 to 127 and mark it "Tape No. 1". Check Tape No. 1 for SIDE frames as noted in Table I.

3.2.7 Readout System

3.2.7.1 Apply oscilloscope input terminals to "DIG DA" interface monitor panel. Connect the oscilloscope signal return lead to "SG RET". Set oscilloscope display for two volts per centimeter vertical deflection, 5 microsecond per centimeter horizontal deflection. Synchronize oscilloscpe so as to inspect a rising edge of the waveform observed. Specification:

a. voltage transition, 0v to 3.5v ≤ peak ≤ 5.5v.
b. rise time, 2 to 10 microseconds. (10% to 90% of peak value).

3.2.7.2 Re-synchronize scope to view falling edge of waveform observed. Specification:

a. voltage transistion, 0v to 3.5v ≤ peak ≤ 5.5v.
b. fall time, 2 to 20 microseconds. (10% to 90% of peak value).

3.2.8 Duty Cycle Monitor Circuit (See Notes, paragraphs 6.4 and 6.5)

3.2.8.1 Observe Analog Subcom, SIDE frame 065. Specification: 200 ± 5.

3.2.8.2 Operate ETS power supply control to variable and adjust voltage to 25v ± 0.5 volts. Observe analog subcom, SIDE frame 065. Specification: 206 ± 5.

3.2.8.3 Operate variable voltage to 33v ± 0.5 volts. Observe Analog subcom, SIDE frame 065. Specification: 192 ± 5.

3.3 Low Energy Ion Detector System

Check Tape No. 1 for SIDE frames as noted below.

3.3.1 Low Energy Curve Plate Analyzer Stepper (Word 8)

3.3.1.1 Observe LECPA volts, SIDE frame 0. Specification: 207 ± 3.

3.3.1.2 Observe LECPA volts, SIDE frame 19. Specification: 207 ± 3.

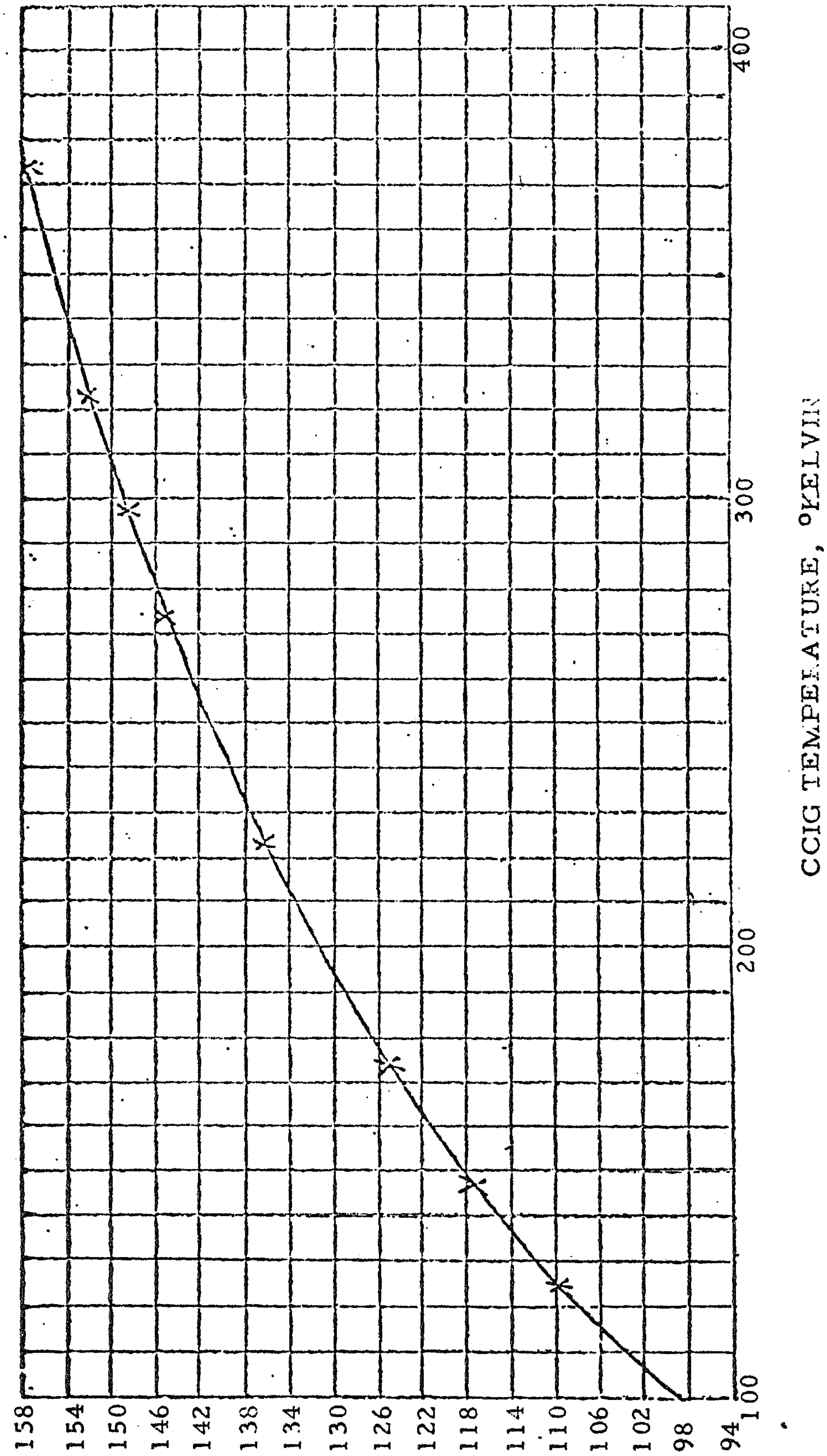
TABLE I (Paragraph 3.2.6)

WORD TWO (Analog Subcom Values)

(Tape No. 1)

SIDE Frame	Function	A/D	Tolerance	Readout	Tolerance
0	+5	+5v	± 3%	214	±3
2	Temp 1 (CCIG)			See Chart I	(148 ± 8 @+25°c)
4	Temp 2 (Blivet 200)			See Chart II	(88 ± 8 @+25°c)
6	Temp 3 (Blivet 500)			See Chart II	(88 ± 8 @+25°c)
11	Temp 4 (Blivet 100)			See Chart III	(88 ± 8 @+25°c)
12	Temp 5 (Blivet 300)			See Chart III	(88 ± 8 @+25°c)
14	Solar Cell			078	± 78
16	+60v	+6v	± 3%	221	± 3
17	+30v	+3v	±3%	195	± 3
18	+5v	+5v	±5%	214	± 3
19	GND	0v		004	± 4
20	-5v	-5v	± 3%	214	± 3
21	-30v	-30v	± 3%	195	± 3
22	Temp 6 (Blivet 800)			See Chart III	(88 ± 8 @+25°c)
25	+30 MV Cal	+30 MV	± 6.5%	027	± 7
26	+AD Ref	6.7v	± 7%	225	± 5
27	+ 1vCal	+1v	±1.5%	155	± 2
28	+ 12vCal	+12v	±1.5%	246	± 2
30	-AD Ref	6.7v	± 7%	225	± 5
37	-1vCal	-1v	±1.5%	155	± 2
39	-12vCal	-12v	±1.5%	246	±2
46	-30 MV Cal	-30 MV	±6.5%	027	+7, -15

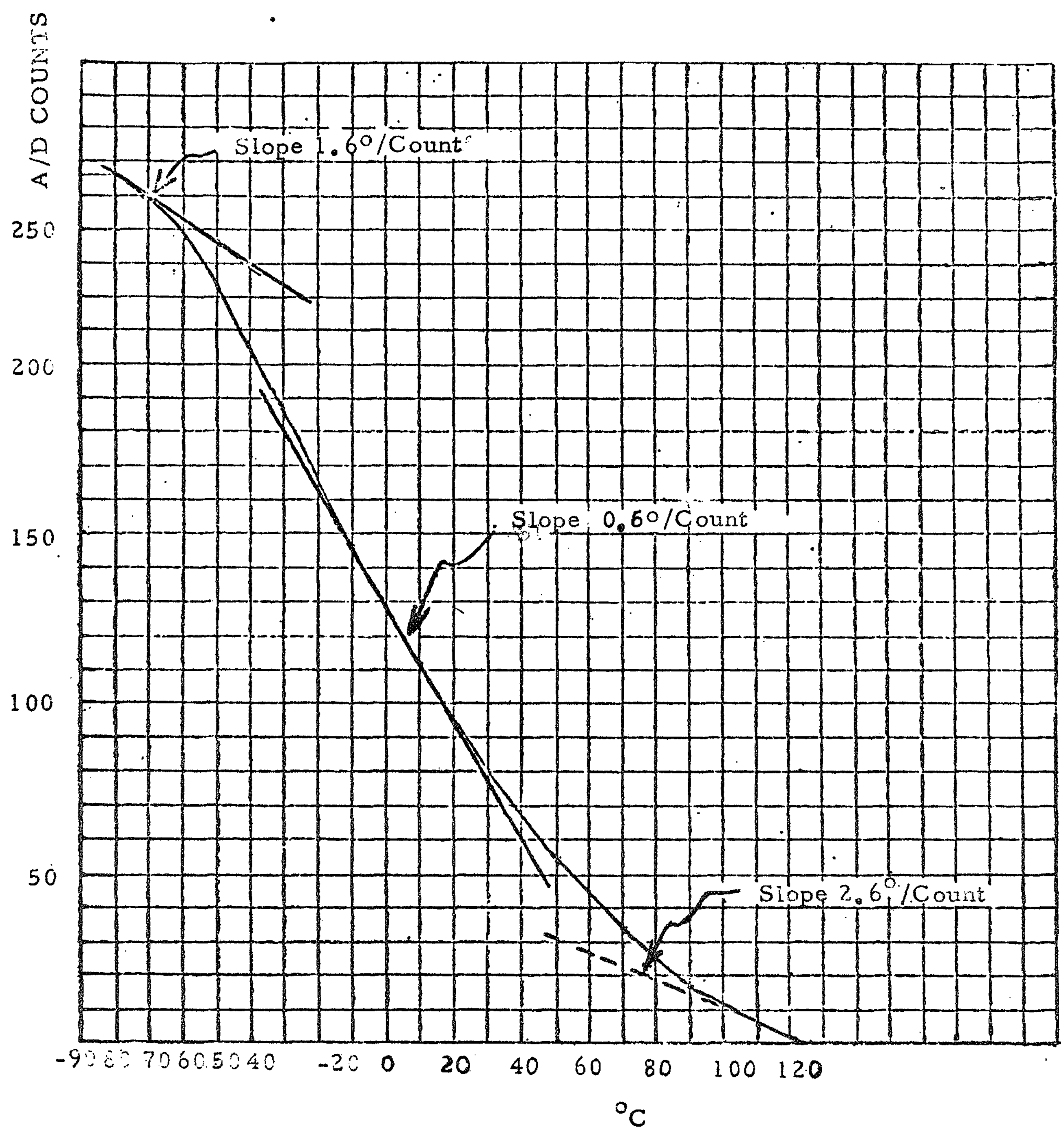
CHART 1



M L — MARSHALL LABORATORIES, TORRANCE CALIFORNIA	TITLE ALSEP/SIDE/CCGE ML 323-3 & UP Test Specification For,	SPECIFICATION NO. S 46853 — REV
CODE IDENT NO 13126		SHEET 9 OF

CHART II

Temperature Sensor
Extended Range
Temp. 2 & 3



TEMPERATURE
EXTENDED RANGE

M L — MARSHALL LABORATORIES, TORRANCE CALIFORNIA	TITLE ALSEP/SIDE/CCGE ML 323-3 & UP Test Specification For,	SPECIFICATION NO. S 46853	REV
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CHART III

TEMP 1 = CCGE

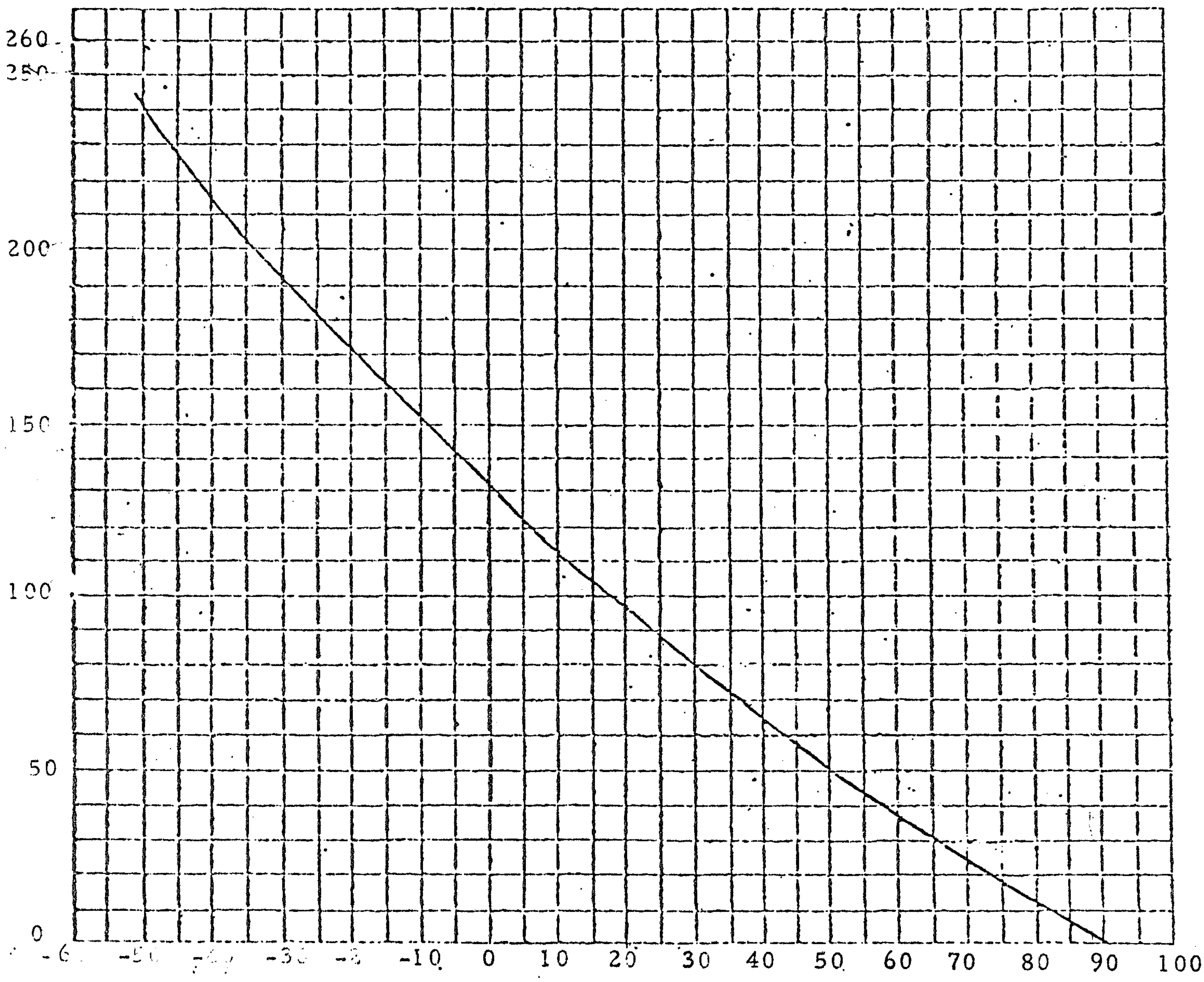
TEMP 2)
TEMP 3) = -50 → 90°C

TEMP 4)
TEMP 5) = Extended Range
TEMP 6)

Temperature Sensor Curve
Temp. 4, 5, 6

Max Slope = 3 counts/°C

Min 1.1 counts/°C



3.3.1.3 Observe "LECPA VOLTS", SIDE frame 20, Specification: 166 ± 4.

3.3.1.4 Observe "LECPA VOLTS", SIDE frame 40, Specification: 127 ± 5.

3.3.1.5 Observe "LECPA VOLTS", SIDE frame 70, Specification: 86 ± 9.

3.3.1.6 Observe "LECPA VOLTS", SIDE frame 90. Specification: 46 ± 13.

3.3.1.7 Observe "LECPA VOLTS", SIDE frame 100. Specification: ≤ 30.

3.3.1.8 Observe "LECPA VOLTS", SIDE frame 122. Specification: ≤ 15.

3.3.1.9 Transmit command 10 (BDE). Observe "LECPA VOLTS" any SIDE frame. Specification: ≤ 15. (Clear ETS, Command System.)

3.3.1.10 Transmit command 10 (BDE) again. Observe "LECPA VOLTS" any SIDE frame ≤ 40. Specification: ≥ 122. (Clear ETS command system.)

3.3.2 Velocity Filter (Word 7)

3.3.2.1 On Tape No. 1, observe "VEL FILT VOLTS", SIDE frame 000 to 127. Compare Tape No. 1 with Table II.

3.3.2.2 Transmit command 4 (CE). Print a tape for SIDE frame 000 to 127 and mark it Tape No. 2. Compare Tape No. 2 with Table III. (Clear ETS command system.)

3.3.2.3 Transmit command 9 (ADE). Observe "VEL FILT VOLTS" any SIDE frame < 119. Specification: ≤ 4. (Clear ETS, command system.)

3.3.2.4 Transmit command 9 (ADE) again. Observe "VEL FILT VOLTS", any SIDE frame < 40. Specification: ≥ 87. (Clear ETS, command system.)

3.4 High Energy Ion Detector

3.4.1 High Energy Curve Plate Analyzer (Word 3)

Check Tape No. 1 for SIDE frames as noted in Paragraph 3.4.1.1.

3.4.1.1 Observe "HECPA VOLTS", frame 0 through 127, and compare with Table IV. Enter Pass/Fail data in ruled columns for each 20 SIDE frame sub-sequence.

3.4.1.2 Repeat 3.2.2. Transmit command 11 (ABDE). Observe "HECPA VOLTS" any SIDE frame < 120. Specification: ≤ 80. (Clear ETS command system.)

3.4.1.3 Transmit command 11 (ABDE) again. Observe "HECPA VOLTS" any SIDE frame < 120. Specification: ≥ 161. (Clear ETS command system.)

3.5 Ground Plane Stepper

3.5.1 Repeat 3.2.2. Send command ABE. Print a tape covering SIDE frame 012 to 016 for 24 cycles and mark it "Tape No. 3".

3.5.2 Compare Tape No. 3 with Table V at Analog Sub Com (Word 2) and Status (Word 6). (Clear ETS Command system)

TABLE II (Paragraph 3.3.2.1)

Velocity Filter Volts ... Normal Mode

(Tape No. 1)

SIDE FRAME	READOUT	TOLERANCE
000	214	±3
001	210	"
002	206	"
003	202	"
004	198	"
005	194	"
006	188	"
007	184	"
008	179	"
009	174	"
010	168	"
011	163	"
012	158	"
013	150	"
014	143	±4
015	136	"
016	130	"
017	122	"
018	116	"
019	112	"
020	192	±3
021	190	"
022	186	"
023	182	"
024	178	"
025	173	"
026	169	"
027	164	"
028	159	±4
029	154	"
030	148	"
031	142	"
032	138	"
033	130	"
034	122	"
035	116	"
036	108	±5
037	102	"
038	096	"
039	092	±3
040	173	"
041	169	"
042	165	"
043	162	"
044	158	"
045	153	±4

TABLE II (continued)

(TAPE No. 1)

SIDE Frame	READOUT	TOLERANCE
046	147	±4
047	144	"
048	140	"
049	134	"
050	128	"
051	122	"
052	117	"
053	109	±5
054	102	"
055	095	"
056	088	"
057	081	±6
058	076	±7
059	073	"
060	152	±5
061	149	"
062	146	"
063	142	"
064	137	"
065	133	"
066	127	"
067	124	"
068	119	"
069	114	"
070	108	±6
071	102	"
072	097	"
073	089	"
074	082	±7
075	075	±8
076	068	"
077	061	±10
078	056	±11
079	052	"
080	133	±4
081	129	"
082	125	"
083	122	"
084	118	±5
085	113	"
086	107	±6
087	103	"
088	099	"
089	093	"
090	088	"
091	082	±7
092	078	"

TABLE II (continued)

SIDE Frame	READOUT	TOLERANCE
093	068	±9
094	062	"
095	054	±11
096	046	±12
097	041	±15
098	035	"
099	032	±18
100	112	±6
101	108	"
102	105	"
103	101	"
104	097	±7
105	093	"
106	087	"
107	082	"
108	078	±8
109	073	"
110	067	"
111	062	±9
112	056	±10
113	048	±11
114	041	±14
115	034	"
116	027	±17
117	020	±20
118	015	+21, -15
119	011	+23, -11
120	> 195	
121	"	
122	"	
123	"	
124	"	
125	"	
126	"	
127	"	

(Paragraph 3.3.2.2)

TABLE III
VELOCITY FILTER VOLTS
(AMU < 20 MODE)
(Tape No. 2)

SIDE Frame	Readout	Tolerance	SIDE Frame	Readout	Tolerance
60 & 0	214	±3	107 & 47	103	±6
61 & 1	210	"	108 & 48	99	"
62 & 2	206	"	109 & 49	93	"
63 & 3	202	"	110 & 50	112	"
64 & 4	198	"	111 & 51	108	"
65 & 5	194	"	112 & 52	105	"
66 & 6	188	"	113 & 53	101	"
67 & 7	184	"	114 & 54	97	±7
68 & 8	179	"	115 & 55	93	"
69 & 9	174	"	116 & 56	87	"
70 & 10	192	"	117 & 57	82	"
71 & 11	190	"	118 & 58	78	±8
72 & 12	186	"	119 & 59	73	"
73 & 13	182	"	120	> 195	--
74 & 14	178	"	121	"	--
75 & 15	173	"	122	"	--
76 & 16	169	"	123	"	--
77 & 17	164	"	124	"	--
78 & 18	159	±4	125	"	--
79 & 19	154	"	126	"	--
80 & 20	173	±3	127	"	--
81 & 21	169	"			
82 & 22	165	"			
83 & 23	162	"			
84 & 24	158	"			
85 & 25	153	±4			
86 & 26	147	"			
87 & 27	144	"			
88 & 28	140	"			
89 & 29	134	"			
90 & 30	152	±5			
91 & 31	149	"			
92 & 32	146	"			
93 & 33	142	"			
94 & 34	137	"			
95 & 35	133	"			
96 & 36	127	"			
97 & 37	124	"			
98 & 38	119	"			
99 & 39	114	±5			
100 & 40	133	±4			
101 & 41	129	"			
102 & 42	125	"			
103 & 43	122	"			
104 & 44	118	±5			
105 & 45	113	"			
106 & 46	107	±6			

TABLE IV
HECPA VOLTS

(Paragraph 3.4.1.1)

(Tape No. 1)

	SIDE Frame							Readout	Tolerance
a)	000, (after first cycle), 121-127							≤ 80	
b)	001,	021,	041,	061,	081,	101,	000 (first cycle)	252	±3
c)	002,	022,	042,	062,	082,	102		250	"
d)	003,	023,	043,	063,	083,	103		247	"
e)	004,	024,	044,	064,	084,	104		244	"
f)	005,	025,	045,	065,	085,	105		240	"
g)	006,	026,	046,	066,	086,	106		236	"
h)	007,	027,	047,	067,	087,	107		232	"
i)	008,	028,	048,	068,	088,	108		227	"
j)	009,	029,	049,	069,	089,	109		221	"
k)	010,	030,	050,	070,	090,	110		214	"
l)	011,	031,	051,	071,	091,	111		206	"
m)	012,	032,	052,	072,	092,	112		195	"
n)	013,	033,	053,	073,	093,	113		181	"
o)	014,	034,	054,	074,	094,	114		155	"
p)	015,	035,	055,	075,	095,	115		248	"
q)	016,	036,	056,	076,	096,	116		235	"
r)	017,	037,	057,	077,	097,	117		223	"
s)	018,	038,	058,	078,	098,	118		204	"
t)	019,	039,	059,	079,	099,	119		189	"
u)	020,	040,	060,	080,	100,	120		164	"

3.5.3 Transmit command number 1 (AE). Clear ETS Command System. Send command 2 (BE). Observe "STATUS", SIDE frame 0. Number shall remain fixed on any one of the 24 possible values indicated in Table V. Clear ETS Command System.

3.5.4 Transmit command number 1 (AE) again. Clear ETS command system. Send command 2 (BE). Observe "STATUS" SIDE frame 0. Number should again sequence as in paragraph 3.5.2 above. (Do not compare numbers again, but simply indicate presence or absence of sequencing). Clear ETS command system.

3.6 High Voltage Power Supplies

3.6.1 -3.5 KV Supply

3.6.1.1 NOTE: This test cannot be performed unless the SIDE is under vacuum greater than 5 X 10^{-6} torr. Lockout plug must be removed in order to enable the -3.5 KV supply.

3.6.1.2 Repeat 3.2.2. Print a tape for SIDE frames 000 to 127 and mark it "Tape No. 4".

3.6.1.3 Check tape No. 4 for Word 2 of SIDE frames 23,55,87 or 119. Spec: 213 ± 9.

3.6.1.4 Transmit command number 14 (BCDE). Observe "Analog Subcom", SIDE frames 23, 55, 87 or 119. Specification: < 120. (Clear ETS Command System).

3.6.1.5 Transmit command number 14 (BCDE) again. Observe Analog Subcom as in 3.6.1.4. Specification: 213 ± 9. (Clear ETS Command System).

3.6.2 4.5 KV Supply

3.6.2.1 NOTE: This test cannot be performed unless SIDE is under vacuum greater than 5 X 10^{-6} torr. Lockout plug must be removed in order to enable the 4.5 KV supply.

3.6.2.2 Check Tape No. 4 for Word 2 of SIDE frames 8,40,72 or 104. Spec: 266 ± 7.

3.6.2.3 Transmit command number 13 (ACDE). Observe "Analog Subcom", SIDE frames 8,40,72 or 104. Specification: <120. Clear ETS Command System.

TABLE V
(Tape No. 3)

(paragraphs: 3.5.1 & 3.5.2)

Ground Plane Step Counting Sequence

STEP	Analog Subcom (SF 13 or 15)	Tolerance	"STATUS" (SF 12, 14 or 16)
1	229	±3	0
2	230	"	1
3	231	"	2
4	232	"	3
5	233	"	4
6	234	"	5
7	235	"	6
8	238	"	7
9	242	"	8
10	246	"	9
11	248	"	10
12	254	+1, -3	11
13	229	±3	16
14	228	"	17
15	227	"	18
16	226	"	19
17	226	"	20
18	225	"	21
19	222	"	22
20	218	"	23
21	214	"	24
22	201	"	25
23	190	"	26
24	137	±13	27

3.6.2.4 Transmit command number 13 (ACDE) again. Observe "Analog subcom", as in 3.6.2.3. Specification: 226 ± 7. (Clear ETS command System)

3.7 Accumulators and Calibration Sources

Repeat 3.2.2. Transmit command 12 (CDE). (Clear ETS command system). Disregard first cycle.

3.7.1 Print a tape for SIDE frame 120 to 127 and mark it "Tape No. 5". Compare Tape No. 5 with Table VI.

3.7.2 Transmit command Number 7 (ABCE). Clear ETS command system. Transmit command number 12 (CDE) again. Clear ETS command system. Disregard first cycle. Print a tape for SIDE frame 120 through 127 and mark it Tape No. 6. Compare Tape No. 6 with Table VII.

3.7.3 Repeat paragraph 3.2.2 and discard data for the first few cycles until electrometer is stabilized. Print a tape for SIDE frame 000 to 127 and mark it "Tape No. 7". Compare Tape No. 7 with Table VII-a.

3.7.4 Verify side frames 1, 3, 5, 7, 9, 41, 73, 105 on Tape No. 7 (Word 2). Specification: < 20. Above steps must be performed in a vibration free environment.

3.7.5 Verify Electrometer range with Tape No. 7.
"Status", SIDE frame 9
Specification = Range 1-0
Range 2-2
Range 3-3

3.8 Log Count Rate Meters

3.8.1 Transmit command 7 (ABCE), then transmit command 12 (CDE). Clear ETS command system after each command sent.

3.8.2 Observe voltages at J17-18 (LELCRM) and J17-19 (HELCRM) with respect to J17-11 (ALSEP SIG. GND). Compare with Table VIII.

3.9 Solar Cell

3.9.1 Repeat 3.2.2. Observe "Analog Subcom", SIDE frame 14. Specification: 0 (Make sure Dust Cover is closed).

3.9.2 Transmit Command DE and observe "Analog Subcom", SIDE frame 14. Specification: 78 ± 78, depending on illumination level of incident light on solar cell. (Clear ETS command system).

3.10 Dust Cover and Seal

3.10.1 Repeat 3.2.2. Observe "Analog Subcom", SIDE frame 67. Specification: > 196.

3.10.2 Transmit command BE. Clear ETS Command System. Then transmit command AE and observe "Analog Subcom" SIDE frame 67. Specification: 186 ± 10. Clear ETS command system.

3.10.3 Send command DE and observe "Analog Subcom", SIDE frame 067. Specification: ≤136. (Clear ETS command system).

3.10.4 Repeat 3.2.2. Observe "Analog Subcom" SIDE frame 067. Specification: > 196.

3.10.5 Transmit command DE. Observe "Analog Subcom", SIDE frame 067. Specification: 156 ± 20. (Clear ETS command system).

3.11 Power Surge

3.11.1 Measure power-on surge current with oscilloscope (using differential pre-amp) by monitoring voltage across V_R on ETS front panel differentially. Set scope horizontal scale to 5 mSec/cm and vertical scale to 20 mv/cm. Use conversion factor of 10 ma/mv. Specification: less than 450 ma.

3.11.2 Use the same setup and conversion factor as in 3.11.1. Transmit command DE. Measure Dust Cover Surge current through V_R. Specification: Less than 150 ma.

3.11.3 Repeat 3.2.2

3.11.4 Use the same setup and conversion factor as in 3.11.1. Transmit Command DE. Measure Dust Cover steady state current through V_R. Specification: Less than 170 ma.

3.12 +29V Noise

3.12.1 Measure +29V noise by oscilloscope with differential pre-amp. Monitor noise across +29V and +29V return on ETS front panel differentially. Set scope vertical scale to 50 mv/cm. Specification: <150 mv P-P

4.0 QUALITY ASSURANCE PROVISIONS

The requirement section of this specification shall form the Quality Assurance Provisions.

5.0 PREPARATION FOR DELIVERY

Not applicable

6.0 NOTES

6.1 Before each command is transmitted from the ETS, all indicator lights in command ETS system must be out.

6.2 Effect of each command may show only after waiting for one complete SIDE frame after transmission of "E". This will take approximately 1.2 seconds.

6.3 Verify CIR at SF 1, 5, 13, 17, 21, 29, 33, 37, 45, 49, 53, 61, 65, 69, 77, 81, 93, 97, 101, 109, 113, 117, or 125, before executing a command.

6.3.1 Verify MR at SF 3, 11, 15, 19, 23, 27, 31, 35, 43, 47, 51, 55, 59, 63, 67, 75, 79, 83, 87, 91, 95, 99, 107, 111, 115, or 119 after executing Command E.

6.4. Procedure for changing from "+29V Fixed" To "+29V variable".

6.4.1 Turn Experiment power switch OFF.

6.4.2 Set SIDE voltage variable control to zero.

6.4.3 Depress +29v fixed-variable switch so that "Variable" setting is effected.

6.4.4 Turn Experiment power switch ON.

6.4.5 Increase SIDE voltage by slowly turning SIDE voltage variable control to desired setting. Do not exceed +34v setting.

6.5 Procedure for changing from "+29v variable" To "+29v Fixed".

6.5.1 Turn SIDE voltage OFF by turning SIDE voltage variable control to zero.

6.5.2 Turn Experiment Power Switch OFF.

6.5.3 Depress +29v Fixed-Variable switch so that "Fixed" setting is effected.

6.5.4 Turn Experiment Power Switch ON.

6.6 Experiment Failure

If the experiment fails any paragraph of the test, the test shall be stopped, pending instructions from the Rice or Marshall Laboratories Program Manager.

TABLE VI

CALIBRATION READOUTS

(Tape No. 5)

SIDE Frames	"STATUS"	HE Ion CTS	LE Ion CTS
120	000	632800 ± 14000	2 ± 2
121	001	2 ± 2	154 ± 4
122	002	154 ± 4	19775 ± 400
123	003	19775 ± 400	632800 ± 14000
124	000	632800 ± 14000	2 ± 2
125	000	2 ± 2	154 ± 4
126	002	154 ± 4	19775 ± 400
127	003	19775 ± 400	632800 ± 14000

TABLE VII (Paragraph 3.7.2)

(Tape No. 6)

Side Frame		STATUS	HE Ion CTS	LE Ion CTS
120 & 124	a	0000	999998 ± 1	2 ± 2
	b	"	2 ± 2	2 ± 2
	c	"	2 ± 2	2 ± 2
	d	"	2 ± 2	2 ± 2
	e	"	2 ± 2	2 ± 2
	f	"	2 ± 2	2 ± 2
	g	"	2 ± 2	2 ± 2
	h	"	2 ± 2	2 ± 2
	i	"	2 ± 2	2 ± 2
	j	"	2 ± 2	2 ± 2
121 & 125	a	0001*	2 ± 2	154 ± 4
	b	"	154 ± 4	308 ± 8
	c	"	308 ± 8	462 ± 12
	d	"	462 ± 12	616 ± 16
	e	"	616 ± 16	770 ± 20
	f	"	770 ± 20	924 ± 24
	g	"	924 ± 24	1078 ± 28
	h	"	1078 ± 28	1232 ± 32
	i	"	1232 ± 32	1386 ± 36
	j	"	1386 ± 36	1540 ± 40
122 & 126	a	0002	1540 ± 40	19775 ± 400
	b	"	19775 ± 400	39550 ± 800
	c	"	39550 ± 800	59324 ± 1200
	d	"	59324 ± 1200	79099 ± 1600
	e	"	79099 ± 1600	98874 ± 2000
	f	"	98874 ± 2000	118649 ± 2400
	g	"	118649 ± 2400	138424 ± 2800
	h	"	138424 ± 2800	158199 ± 3200
	i	"	158199 ± 3200	177974 ± 3600
	j	"	177974 ± 3600	197749 ± 4000
123 & 127	a	0003	197749 ± 4000	632800 ± 14000
	b	"	632800 ± 14000	999998 ± 2
	c	"	999998 ± 2	632797 ± 14000
	d	"	632797 ± 14000	999998 ± 2
	e	"	999998 ± 2	632797 ± 14000
	f	"	632797 ± 14000	999998 ± 2
	g	"	999998 ± 2	632797 ± 14000
	h	"	632797 ± 14000	999998 ± 2
	i	"	999998 ± 2	632797 ± 14000
	j	"	632797 ± 14000	999998 ± 2

* In 125 a. through j., 0000

TABLE VII a (Paragraph 3.7.1)
(Tape No. 7)

WORD 2 (Analog Subcom)

(See Notes Below)

CCGE Range	SF 120	SF 121	SF 122	SF 123	SF 124	SF 125	SF 126	SF 127
1	226 ± 4	< 100	< 20	< 20		170 ± 10		246 ± 6
2	197 ±2	< 100	< 20	< 20		166 ± 6		250 ± 6
3	192 ± 2	< 100	< 20	< 20		166 ± 6		250 ± 6

NOTES:

Range 1 = Most sensitive range

During Acceptance Test, 4.5 KV supply will be turned off. Therefore, CCGE shall be in Range 1.

A/D Readings in SIDE frame 120 (Electrometer Range Voltage) are measured at 20°C. Refer to calibration (Table IX) of electrometer range for other temperatures.

NOTES:

Specification given for SIDE frame 121, 122, and 123 are for typical lab conditions. When unit is in a vibration free environment, specification shall be as follows:

SIDE Frame	121	122	123
Word 2 reading for range 1, 2, 3	< 80	0	0

TABLE VIII (Paragraph 3.6.2)

Log Countrate Meter Data

SIDE	Frame	"HELCR" & "LELCR"
a	120	< 0.2 V
b	121	1.42V ± 0.2 V
c	122	3.33V ± 0.2 V
d	123	4.44V ± 0.4 V
e	124	< 0.2 V
f	125	1.42V ± 0.2 V
g	126	3.33V ± 0.2 V
h	127	4.44V ± 0.4 V

NOTE: Above voltage to be final value at end of noted SIDE frame..

TABLE IX

ELECTROMETER RANGE CALIBRATION

RANGE	-55°C (counts)	+25°C (counts)	+90°C (counts)	TOLERANCE (counts)
1	215	226	231	± 10
2	198	196	194	± 2
3	192	191	189	± 2

TEST DATA SHEET

(Part of Unit History Log)

Operator ______________________ Witness ______________________

Date ______________________ Location ______________________

Time Start ______________________ Time End ______________________

PARAGRAPH		Pass	Fail	DATA
3.2.1.1	Isolation Resistance			
3.2.1.1	Isolation Resistance			
3.2.1.3	Operating Current			
3.2.1.4	" Voltage			
3.2.1.5	" Power			

3.2.2.1	Side - Frame Display			Not Applicable
3.2.2.2	Command 2			↑
3.2.2.3	Command 5			
3.2.2.4	Command 3			
3.2.2.5	Command 8			
3.2.2.6				
3.2.2.7				↓
3.2.2.9	530 PPS			Not Applicable

3.2.3	Status (CIR)			
3.2.3	Analog Subcom (OTC)			
3.2.3.2	Status (CIR) Com BCD			
3.2.3.2	Analog Subcom (Com BCD)			
3.2.3.3	Status (CIR) Comm 14			
3.2.3.5	Status (CIR) Comm AB			
3.2.3.8	Status (Comm BDC)			
3.2.3.9	Status (Comm E)			
3.2.3.11	Status (Comm AB)			

SIDE Frame 3, Status (Mode Register)

3.2.4.1	No Comm.			
3.2.4.2	(Comm 6)			
3.2.4.3	(Comm 8)			
3.2.4.4	(Comm 4)			
3.2.4.5	(Comm 1)			

SIDE Frame 7, Status (Dust Cover & Seal)

3.2.5	No Comm (Seal)			
3.2.5.1	Comm B ↑			
3.2.5.2	Comm 2			
3.2.5.3	Comm D ↓			
3.2.5.4	Comm 4 (Seal)			
3.2.5.5				
3.2.5.6				

TEST DATA SHEET (continued)

PARAGRAPH

3.2.6 See Table I

SIDE Frame	(Tape 1)	Pass	Fail	DATA
0	Analog Subcom			
2				
4				
6				
11				
12				
14				
16				
17				
18				
19				
20				
21				
22				
25				
26				
27				
28				
30				
37				
39				
46	Analog Subcom			

PARAGRAPH

3.2.7.1a				
3.2.7.1b				
3.2.7.2a				
3.2.7.2b				

PARAGRAPH

3.2.8.1	SF 65 (Analog Subcom)			
3.2.8.2	"			
3.2.8.3	"			

PARAGRAPH Tape 1 (Paragraph 3.3.1.1 thru 3.3.1.8)

3.3.1.1	LE volts, SF 0			
3.3.1.2	LE volts, SF 19			
3.3.1.3	LE volts, SF 20			
3.3.1.4	LE volts, SF 40			
3.3.1.5	LE volts, SF 70			
3.3.1.6	LE volts, SF 90			
3.3.1.7	LE volts, SF 100			
3.3.1.8	LE volts, SF 122			
3.3.1.9	LE volts, OFF (comm 10)			
3.3.1.10	LE volts ON (comm 10)			

TAPE I

TEST DATA SHEET (continued)

PARAGRAPH

3.3.2.1 See Table II, Velocity Filter Volts

SIDE Frame	(Tape 1)	Pass	Fail	DATA
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				

TEST DATA SHEET (continued)

PARAGRAPH

3.3.2.1 (continued)

SIDE Frame	(Tape 1)	Pass	Fail	DATA
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				

TEST DATA SHEET (continued)

PARAGRAPH

3.3.2.1 (continued)

SIDE Frame	(Tape 1)	Pass	Fail	DATA
88				
89				
90				
91				
92				
93				
94				
95				
96				
97				
98				
99				
100				
101				
102				
103				
104				
105				
106				
107				
108				
109				
110				
111				
112				
113				
114				
115				
116				
117				
118				
119				
120				
121				
122				
123				
124				
125				
126				
127				

TEST DATA SHEET (continued)

PARAGRAPH

3.3.2.2 Velocity Filter Volts, Comm 4 See Table III

SIDE Frame	(Tape 2)	Pass	Fail	DATA
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				

PARAGRAPH

3.3.2.2 (continued)

SIDE Frame	(Tape 2)	Pass	Fail	DATA
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				

TEST DATA SHEET (Continued)
PARAGRAPH

3.3.2.2 (continued)

SIDE Frame	(Tape 2)	Pass	Fail	DATA
88				
89				
90				
91				
92				
93				
94				
95				
96				
97				
98				
99				
100				
101				
102				
103				
104				
105				
106				
107				
108				
109				
110				
111				
112				
113				
114				
115				
116				
117				
118				
119				
120				
121				
122				
123				
124				
125				
126				
127				

PARAGRAPH		PASS	FAIL	DATA
3.3.2.3	VF Volts OFF (comm 9)			
3.3.2.4	VF Volts ON (comm 9)			

PARAGRAPH

3.4 See Table IV

HE Volts	(Tape 1)	PASS 1	2	3	4	5	6	7	FAIL 1	2	3	4	5	6	7	DATA
3.4.1.1a																
3.4.1.1b																
3.4.1.1c																
3.4.1.1d																
3.4.1.1e																
3.4.1.1f																
3.4.1.1g																
3.4.1.1h																
3.4.1.1i																
3.4.1.1j																
3.4.1.1k																
3.4.1.1l																
3.4.1.1m																
3.4.1.1n																
3.4.1.1o																
3.4.1.1p																
3.4.1.1q																
3.4.1.1r																
3.4.1.1s																
3.4.1.1t																
3.4.1.1u																

		Pass	Fail	Data (Not Required)
3.4.1.2	HE Volts OFF (comm 11)			
3.4.1.3	HE Volts ON (comm 11)			

PARAGRAPH

3.5.2 See Table V

Ground Plane Counter

Step	(Tape 3)	Pass	Fail	DATA
1	Anal. Sub c. (SF13) Status (even SF's)			
2	↑			
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23	↓			
24	Anal. Sub c. (SF13) Status (even SF's)			

PARAGRAPH (See Table V)

3.5.3	Gnd Plane Step, OFF			

3.5.4	Gnd Plane Step On - Status			

3.5 KV Supply

(Tape 4)

3.6.1.3	Anal. Sub. SF23, 55, 87, 119			
3.6.1.4	Channel HV OFF (comm 14)			
3.6.1.5	Channel HV ON (comm 14)			

3.6.2.2	4.5 KV Sply SF8, 40, 72, 104			
3.6.2.3	CCIG HV OFF (comm 13)			
3.6.2.4	CCIG HV ON (comm 13)			

PARAGRAPH

3.7.1 See Table VI (Accum Calib)

(Tape 5)		Pass	Fail	DATA
3.7.1a	Status			
3.7.1a	HE Ion Counts			
3.7.1a	LE Ion Counts			
3.7.1b	Status			
3.7.1b	HE Ion Counts			
3.7.1b	LE Ion Counts			
3.7.1c	Status			
3.7.1c	HE Ion Counts			
3.7.1c	LE Ion Counts			
3.7.1d	Status			
3.7.1d	HE Ion Counts			
3.7.1d	LE Ion Counts			
3.7.1e	Status			
3.7.1e	HE Ion Counts			
3.7.1e	LE Ion Counts			
3.7.1f	Status			
3.7.1f	HE Ion Counts			
3.7.1f	LE Ion Counts			
3.7.1g	Status			
3.7.1g	HE Ion Counts			
3.7.1g	LE Ion Counts			
3.7.1h	Status			
3.7.1h	HE Ion Counts			
3.7.1h	LE Ion Counts			

PARAGRAPH

Accum. Calib. (X10 Mode)

* 3.7.2 See Table VII

(Tape 6)

			a	b	c	d	e	f	g	h	i	j
3.7.2	120	Status										
3.7.2	120	HE Ion Counts										
3.7.2	120	LE Ion Counts										
3.7.2	121	Status										
3.7.2	121	HE Ion Counts										
3.7.2	121	LE Ion Counts										
3.7.2	122	Status										
3.7.2	122	HE Ion Counts										
3.7.2	122	LE Ion Counts										
3.7.2	123	Status										
3.7.2	123	HE Ion Counts										
3.7.2	123	LE Ion Counts										
3.7.2	124	Status										
3.7.2	124	HE Ion Counts										
3.7.2	124	LE Ion Counts										
3.7.2	125	Status										
3.7.2	125	HE Ion Counts										
3.7.2	125	LE Ion Counts										
3.7.2	126	Status										
3.7.2	126	HE Ion Counts										
3.7.2	126	LE Ion Counts										
3.7.2	127	Status										
3.7.2	127	HE Ion Counts										
3.7.2	127	LE Ion Counts										

Paragraph	(Tape 7)			
3.7.3	CCGE			

(Tape 7)

3.7.4	CCGE			

(Tape 7)

3.7.5	Electrometer Range			

*Note: Mark ✓ For Pass, X For Fail

PARAGRAPH

3.8.2 See Table VIII

		Pass	Fail	DATA
3.8.2. a	HELCR			
3.8.2. a	LELCR			
3.8.2. b	HELCR			
3.8.2. b	LELCR			
3.8.2. c	HELCR			
3.8.2. c	LELCR			
3.8.2. d	HELCR			
3.8.2. d	LELCR			
3.8.2. e	HELCR			
3.8.2. e	LELCR			
3.8.2. f	HELCR			
3.8.2. f	LELCR			
3.8.2. g	HELCR			
3.8.2. g	LELCR			
3.8.2. h	HELCR			
3.8.2. h	LELCR			

PARAGRAPH

3.9.1	Solar-Cell OFF			
3.9.2	Solar-Cell ON			

3.10.1	Dust Cover & Seal OFF			
3.10.2	Seal ON and Dust Cover OFF			
3.10.3	Dust Cover and Seal ON			
3.10.4	Dust Cover and Seal OFF			
3.10.5	Dust Cover ON and Seal OFF			

3.11.1	Power ON Surge			
3.11.2	Dust Cover Surge			
3.11.4	Dust Cover Steady State Cur.			

3.12.1	+29V Noise			

System 6

TEST DATA SHEET
(Part of Unit History Log)

Operator R. Rivas Witness P. Bailey

Date 28 April, 1969 Location ML

Time Start 10:50 Time End 11:45 Am

PARAGRAPH		Pass	Fail	DATA
3.2.1.1	Isolation Resistance	✓		2.4 Meg, exceeded (ok)
3.2.1.1	Isolation Resistance	✓		[illegible]
3.2.1.3	Operating Current	✓		185 MA
3.2.1.4	" Voltage	✓		28.41
3.2.1.5	" Power	✓		5.25 watts

3.2.2.1	Side - Frame Display	✓		Not Applicable
3.2.2.2	Command 2	✓		↑
3.2.2.3	Command 5	✓		
3.2.2.4	Command 3	✓		
3.2.2.5	Command 6	✓		
3.2.2.6		✓		
3.2.2.7		✓		↓
3.2.2.9	530 PPS	✓		Not Applicable

3.2.3	Status (CIR)	✓		
3.2.3	Analog Subcom (OTC)	✓		068
3.2.3.2	Status (CIR) Com BCD	✓		014
3.2.3.2	Analog Subcom (Com BCD)	✓		201
3.2.3.3	Status (CIR) Comm 14	✓		
3.2.3.5	Status (CIR) Comm AB	✓		003
3.2.3.8	Status (Comm BDC)	✓		014
3.2.3.9	Status (Comm E)	✓		000
3.2.3.11	Status (Comm AB)	✓		003

SIDE Frame 3, Status (Mod. Register)

3.2.4.1	No Comm.	✓		
3.2.4.2	(Comm 6)	✓		006
3.2.4.3	(Comm 8)	✓		008
3.2.4.4	(Comm 4)	✓		004
3.2.4.5	(Comm 1)	✓		001

SIDE Frame 7, Status (Dust Cover & Seal)

3.2.5	No Comm (Seal)	✓		003
3.2.5.1	Comm B ↑	✓		003
3.2.5.2	Comm 2	✓		001
3.2.5.3	Comm D ↓	✓		001
3.2.5.4	Comm 4 (Seal)	✓		000
3.2.5.5		✓		003
3.2.5.6		✓		002

ML MARSHALL LABORATORIES TORRANCE CALIFORNIA	TITLE ALSEP/SIDE/CCGE ML 323-3 & up Test Specification Data	SPECIFICATION NO. S [illegible]	REV A
CODE IDENT NO 13126		SHEET [illegible] OF	

ML FORM 291

TEST DATA SHEET (continued)

PARAGRAPH

3.2.6 See Table I

SIDE Frame	(Tape 1)	Pass	Fail	DATA
0	Analog Subcom	✓		215
2		✓		147
4				87
6				86
11				85
12				85
14				0
16				221
17				195
18				212
19				0
20				215
21				196
22				83
25				24
26				226
27				155
28				247
30				226
37				155
39				247
46	Analog Subcom	✓		25

PARAGRAPH

3.2.7.1a		✓		4.4V 7 usec
3.2.7.1b		✓		
3.2.7.2a		✓		4.4V 12 usec
3.2.7.2b		✓		

PARAGRAPH

3.2.8.1	SF 65 (Analog Subcom)	✓		202 28.4V
3.2.8.2	"	✓		25.52V 209
3.2.8.3	"	✓		33.05V 194

PARAGRAPH Tape 1 (Paragraph 3.3.1.1 thru 3.3.1.8)

3.3.1.1	LE volts, SF 9	✓		207
3.3.1.2	LE volts, SF 19	✓		207
3.3.1.3	LE volts, SF 29	✓		166
3.3.1.4	LE volts, SF 40	✓		125
3.3.1.5	LE volts, SF 70	✓		86
3.3.1.6	LE volts, SF 90	✓		45
3.3.1.7	LE volts, SF 100	✓		006
3.3.1.8	LE volts, SF 122	✓		0
3.3.1.9	LE volts, OFF (comm 10)	✓		
3.3.1.10	LE volts ON (comm 10)	✓		

(TAPE 1)

PARAGRAPH

3.3.2.1 See Table II, Velocity Filter Volts

SIDE Frame	(Tape 1)	Pass	Fail	DATA
0		✓		213
1		✓		210
2		✓		206
3		✓		202
4		✓		198
5		✓		194
6		✓		188
7		✓		184
8		✓		179
9		✓		174
10		✓		168
11		✓		162
12		✓		157
13		✓		149
14		✓		142
15		✓		134
16		✓		127
17		✓		121
18		✓		115
19		✓		112
20		✓		193
21		✓		189
22		✓		185
23		✓		182
24		✓		178
25		✓		173
26		✓		169
27		✓		164
28		✓		159
29		✓		153
30		✓		148
31		✓		142
32		✓		137
33		✓		129
34		✓		122
35		✓		114
36		✓		107
37		✓		101
38		✓		95
39		✓		92
40		✓		173
41		✓		169
42		✓		165
43		✓		161

PARAGRAPH

3.3.2.1 (continued)

SIDE Frame	(Tape 1)	Pass	Fail	DATA
44		✓		157
45		✓		153
46		✓		147
47		✓		144
48		✓		139
49		✓		133
50		✓		125
51		✓		122
52		✓		117
53		✓		109
54		✓		102
55		✓		94
56		✓		87
57		✓		81
58		✓		76
59		✓		72
60		✓		152
61		✓		149
62		✓		145
63		✓		141
64		✓		137
65		✓		133
66		✓		127
67		✓		123
68		✓		118
69		✓		113
70		✓		107
71		✓		101
72		✓		97
73		✓		88
74		✓		82
75		✓		74
76		✓		67
77		✓		61
78		✓		56
79		✓		53
80		✓		132
81		✓		128
82		✓		125
83		✓		121
84		✓		117
85		✓		112
86		✓		106
87		✓		103

TEST DATA SHEET (continued)

PARAGRAPH

3.3.2.1 (continued)

SIDE Frame	(Tape 1)	Pass	Fail	DATA
88		✓		98
89		✓		93
90		✓		87
91		✓		82
92		✓		77
93		✓		69
94		✓		63
95		✓		55
96		✓		49
97		✓		43
98		✓		38
99		✓		35
100		✓		112
101		✓		108
102		✓		105
103		✓		101
104		✓		97
105		✓		92
106		✓		86
107		✓		83
108		✓		78
109		✓		73
110		✓		68
111		✓		62
112		✓		58
113		✓		49
114		✓		44
115		✓		36
116		✓		31
117		✓		25
118		✓		22
119		✓		19
120		✓		213
121		✓		210
122		✓		206
123		✓		202
124		✓		198
125		✓		218
126		✓		217
127		✓		215

TEST DATA SHEET (continued)

PARAGRAPH

3.3.2.2 Velocity Filter Volts, Comm 4 See Table III

SIDE Frame	(Tape 2)	Pass	Fail	DATA
0		✓		213
1		✓		210
2		✓		206
3		✓		202
4		✓		198
5		✓		194
6		✓		188
7		✓		184
8		✓		179
9		✓		174
10		✓		193
11		✓		189
12		✓		186
13		✓		182
14		✓		178
15		✓		173
16		✓		167
17		✓		164
18		✓		159
19		✓		153
20		✓		172
21		✓		169
22		✓		165
23		✓		161
24		✓		157
25		✓		153
26		✓		149
27		✓		144
28		✓		139
29		✓		133
30		✓		152
31		✓		149
32		✓		145
33		✓		141
34		✓		137
35		✓		133
36		✓		127
37		✓		124
38		✓		118
39		✓		113
40		✓		132
41		✓		128
42		✓		125
43		✓		121

PARAGRAPH

3.3.2.2 (continued)

SIDE Frame	(Tape 2)	Pass	Fail	DATA
44		✓		117
45		✓		113
46		✓		106
47		✓		103
48		✓		98
49		✓		93
50		✓		112
51		✓		108
52		✓		105
53		✓		101
54		✓		97
55		✓		93
56		✓		86
57		✓		83
58		✓		78
59		✓		73
60		✓		213
61		✓		210
62		✓		206
63		✓		202
64		✓		198
65		✓		194
66		✓		188
67		✓		184
68		✓		179
69		✓		174
70		✓		193
71		✓		189
72		✓		185
73		✓		182
74		✓		178
75		✓		173
76		✓		167
77		✓		164
78		✓		159
79		✓		153
80		✓		173
81		✓		169
82		✓		165
83		✓		161
84		✓		157
85		✓		153
86		✓		147
87		✓		144

TEST DATA SHEET (Continued)

PARAGRAPH

3.3.2.2 (continued)

SIDE Frame	(Tape 2)	Pass	Fail	DATA
88		✓		139
89		✓		133
90		✓		152
91		✓		149
92		✓		145
93		✓		141
94		✓		137
95		✓		133
96		✓		127
97		✓		123
98		✓		118
99		✓		113
100		✓		132
101		✓		128
102		✓		125
103		✓		121
104		✓		117
105		✓		113
106		✓		107
107		✓		103
108		✓		98
109		✓		93
110		✓		112
111		✓		108
112		✓		105
113		✓		101
114		✓		97
115		✓		92
116		✓		86
117		✓		83
118		✓		79
119		✓		73
120		✓		213
121		✓		210
122		✓		206
123		✓		202
124		✓		198
125		✓		218
126		✓		217
127		✓		215

PARAGRAPH		PASS	FAIL	DATA
3.3.2.3	VF Volts OFF (comm 9)	✓		
3.3.2.4	VF Volts ON (comm 9)	✓		

PARAGRAPH

3.4 See Table IV

HE Volts	(Tape 1)	PASS 1	PASS 2	PASS 3	PASS 4	PASS 5	PASS 6	PASS 7	FAIL 1	FAIL 2	FAIL 3	FAIL 4	FAIL 5	FAIL 6	FAIL 7	DATA
3.4.1.1a																0
3.4.1.1b																253
3.4.1.1c																250
3.4.1.1d																247
3.4.1.1e																244
3.4.1.1f																240
3.4.1.1g																234
3.4.1.1h																232
3.4.1.1i																227
3.4.1.1j																221
3.4.1.1k																214
3.4.1.1l																206
3.4.1.1m																195
3.4.1.1n																180
3.4.1.1o																155
3.4.1.1p																248
3.4.1.1q																235
3.4.1.1r																223
3.4.1.1s																204
3.4.1.1t																189
3.4.1.1u																163

		Pass	Fail	Data (Not Required)
3.4.1.2	HE Volts OFF (comm 11)	✓		
3.4.1.3	HE Volts ON (comm 11)	✓		

PARAGRAPH

3.5.2 See Table V

Ground Plane Counter

Step	(Tape 3)	Pass	Fail	DATA	
1	Anal. Sub c. (SF13) Status (even SF's)	✓		230	0
2	↓	✓		230	1
3		✓		231	2
4		✓		232	3
5		✓		232	4
6		✓		234	5
7		✓		236	6
8		✓		238	7
9		✓		241	8
10		✓		246	9
11		✓		249	10
12		✓		254	11
13		✓		230	16
14		✓		229	17
15		✓		228	18
16		✓		227	19
17		✓		226	20
18		✓		225	21
19		✓		222	22
20		✓		218	23
21		✓		214	24
22		✓		200	25
23	↓	✓		189	26
24	Anal. Sub c. (SF13) Status (even SF's)	✓		130	27

PARAGRAPH (See Table V)

3.5.3	Gnd Plane Step, OFF	✓		001

3.5.4	Gnd Plane Step On - Status	✓		002

3.5 KV Supply

(Tape 4)

3.6.1.3	Anal. Sub. SF23, 55, 87, 119			N/A
3.6.1.4	Channel HV OFF (comm 14)			
3.6.1.5	Channel HV ON (comm 14)			

3.6.2.2	4.5 KV Sply SF8, 40, 72, 104			N/A
3.6.2.3	CCIG HV OFF (comm 13)			
3.6.2.4	CCIG HV ON (comm 13)			

TEST DATA SHEET (continued)

PARAGRAPH

3.7.1 See Table VI (Accum Calib)

(Tape 5)

		Pass	Fail	DATA
3.7.1a	Status	✓		0
3.7.1a	HE Ion Counts	✓		632616
3.7.1a	LE Ion Counts	✓		0
3.7.1b	Status	✓		1
3.7.1b	HE Ion Counts	✓		0
3.7.1b	LE Ion Counts	✓		154
3.7.1c	Status	✓		2
3.7.1c	HE Ion Counts	✓		155
3.7.1c	LE Ion Counts	✓		19785
3.7.1d	Status	✓		3
3.7.1d	HE Ion Counts	✓		19769
3.7.1d	LE Ion Counts	✓		632631
3.7.1e	Status	✓		0
3.7.1e	HE Ion Counts	✓		632615
3.7.1e	LE Ion Counts	✓		0
3.7.1f	Status	✓		0
3.7.1f	HE Ion Counts	✓		0
3.7.1f	LE Ion Counts	✓		154
3.7.1g	Status	✓		2
3.7.1g	HE Ion Counts	✓		155
3.7.1g	LE Ion Counts	✓		19785
3.7.1h	Status	✓		3
3.7.1h	HE Ion Counts	✓		19769
3.7.1h	LE Ion Counts	✓		632630

PARAGRAPH Accum., Calib. (X10 Mode)

* 3.7.2 See Table VII

(Tape 6)

			a	b	c	d	e	f	g	h	i	j
3.7.2	120	Status	0	0	0	0	0	0	0	0	0	0
3.7.2	120	HE Ion Counts	999996	0	0	0	0	0	0	0	0	0
3.7.2	120	LE Ion Counts	0	0	0	0	0	0	0	0	0	0
3.7.2	121	Status	1	1	1	1	1	1	1	1	1	1
3.7.2	121	HE Ion Counts	0	155	310	465	620	775	930	1085	1239	1393
3.7.2	121	LE Ion Counts	154	309	463	617	772	927	1082	1237	1392	1547
3.7.2	122	Status	2	2	2	2	2	2	2	2	2	2
3.7.2	122	HE Ion Counts	1548	19769	39581	59393	79205	99017	118829	138641	158453	178625
3.7.2	122	LE Ion Counts	19785	39582	59411	79208	99021	118850	138647	158472	178273	198096
3.7.2	123	Status	3	3	3	3	3	3	3	3	3	3
3.7.2	123	HE Ion Counts	198077	632615	999996	633996	999996	633996	999996	633996	999996	633996
3.7.2	123	LE Ion Counts	632631	999996	633013	999996	633013	999996	633013	999996	633012	999996
3.7.2	124	Status	0	0	0	0	0	0	0	0	0	0
3.7.2	124	HE Ion Counts	999996	0	0	0	0	0	0	0	0	0
3.7.2	124	LE Ion Counts	0	0	0	0	0	0	0	0	0	0
3.7.2	125	Status	0	0	0	0	0	0	0			0
3.7.2	125	HE Ion Counts	0	155	310	465	620	775	930	1085	1239	1393
3.7.2	125	LE Ion Counts	154	309	463	617	772	927	1082	1237	1392	1547
3.7.2	126	Status	2	2	2	2	2	2	2	2	2	2
3.7.2	126	HE Ion Counts	1548	19769	39581	59393	79205	99017	18829	138641	158457	178265
3.7.2	126	LE Ion Counts	19785	39582	59410	79207	99019	18849	138645	158472	78287	198084
3.7.2	127	Status	3	3	3	3	3	3	3	3	3	3
3.7.2	127	HE Ion Counts	198077	632615	999996	633997	999996	633997	999996	633997	[illegible]	633996
3.7.2	127	LE Ion Counts	632631	999996	633012	999996	633012	999996	633012	999996	633012	999996

Paragraph (Tape 7)

				120	121	122	123	124	125	126	127
3.7.3	CCGE	✓		223	0	0	0	165	168	247	247

(Tape 7)

3.7.4	CCGE	✓		all zeros

(Tape 7)

3.7.5	Electrometer Range	✓		0

*Note: Mark ✓ For Pass, X For Fail

PARAGRAPH

3.8.2 See Table VIII

		Pass	Fail	DATA
3.8.2. a	HELCR			~~.026~~ .014
3.8.2. a	LELCR			~~.016~~ .010
3.8.2. b	HELCR			1.410
3.8.2. b	LELCR			1.372
3.8.2. c	HELCR			3.362
3.8.2. c	LELCR			3.343
3.8.2. d	HELCR			4.379
3.8.2. d	LELCR			4.423
3.8.2. e	HELCR			.014
3.8.2. e	LELCR			.010
3.8.2. f	HELCR			1.410
3.8.2. f	LELCR			1.371
3.8.2. g	HELCR			3.362
3.8.2. g	LELCR			3.343
3.8.2. h	HELCR			4.380
3.8.2. h	LELCR			4.423

PARAGRAPH

		Pass	Fail	DATA
3.9.1	Solar-Cell OFF	✓		000
3.9.2	Solar-Cell ON	✓		091
3.10.1	Dust Cover & Seal OFF	✓		201
3.10.2	Seal ON and Dust Cover OFF	✓		186
3.10.3	Dust Cover and Seal ON	✓		062
3.10.4	Dust Cover and Seal OFF	✓		201
3.10.5	Dust Cover ON and Seal OFF		✓	161
3.11.1	Power ON Surge			310
3.11.2	Dust Cover Surge			N/A
3.11.4	Dust Cover Steady State Cur.			140MA (+180 of)
3.12.1	+29V Noise			.015MV P/P

APPENDIX IV

Low Energy Step Voltage Generator Error Analysis

ALSEP 30 JUNE

LOW ENERGY CPA STEP VOLTAGE GENERATOR

BLOCK DIAGRAM

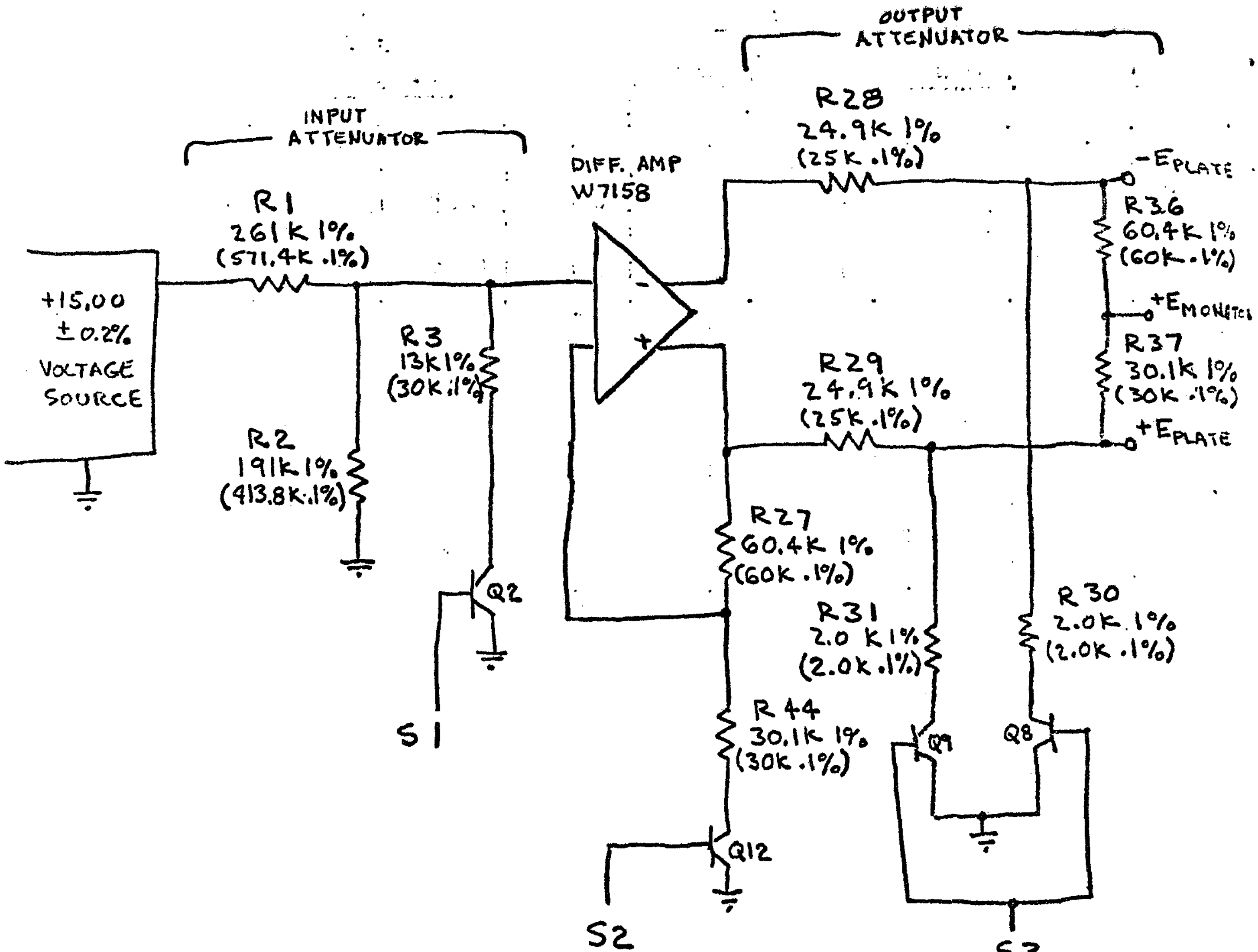


FIGURE 1

COMPONENT DESIGNATIONS REFERENCE DWG NO. 609161.

VALUES SHOWN ARE AS-BUILT FOR SYSTEM NO. 2.

VALUES SHOWN IN PARENTHESES ARE FOR REFERENCE, AND ARE THE VALUES SPECIFIED FOR FLIGHT TYPE SYSTEMS.

ALSEP
(LOW ENERGY CPA)
CONTROL CONDITIONS

30 JUNE

TABLE A

ENERGY STEP No.	INPUT ATTENUATOR S1 (Q2)	TRANSFER FUNCTION	SENS-ITIVITY	FEEDBACK FUNCTION S2 (Q12)	DIFF. AMP GAIN	SENS-ITIVITY	OUTPUT ATTENUATOR S3 (Q8, Q9)	TRANSFER FUNCTION	SENS-ITIVITY
1	OFF	.423	1.15	ON	3.00	1.33	OFF	.643	.71
2	OFF	.423	1.15	OFF	1.00	1.00	OFF	.643	.71
3	ON	.0446	1.91	ON	3.00	1.33	OFF	.643	.71
4	ON	.0446	1.91	OFF	1.00	1.00	OFF	.643	.71
5	ON	.0446	1.91	ON	3.00	1.33	ON	.0712	1.86
6	ON	.0446	1.91	OFF	1.00	1.00	ON	.0712	1.86

(TP) THE INPUT ATTENUATOR TRANSFER FUNCTION, $G = \frac{E_o}{E_i}$; WHERE E_i IS THE INPUT FROM THE 15.00V VOLTAGE SOURCE, E_o IS THE INPUT TO THE DIFFERENTIAL AMPLIFIER.

THE OUTPUT ATTENUATOR TRANSFER FUNCTION HAS THE AMPLIFIER OUTPUT AS E_i, AND E_{PLATE} WITH RESPECT TO GROUND AS E_o.

(TP) THE SENSITIVITIES SHOWN REPRESENT A WORST CASE SUMMATION OF THE SENSITIVITIES FOR EACH RESISTOR AFFECTING THE OUTPUT. THE SENSITIVITY IS DEFINED AS THE PERCENT CHANGE IN THE

4

ALSEP 30 JUNE
(LOW ENERGY CPA)
OUTPUT CAUSED BY A 1% CHANGE IN
ALL RESISTOR VALUES.

PLATE VOLTAGE SENSITIVITY AND ERROR TABULATION

TABLE B

ENERGY STEP NO.	TOTAL CONTROL SENS-ITIVITIES	DIFF. AMP TEMP DRIFT	REF POWER SOURCE TOLERANCE	SYSTEM POWER SUPPLY EFFECT	ANTICIPATED MAXIMUM PLATE VOLTAGE ERROR	AS-BUILT NOMINAL PLATE VOLTAGE	SPECIFIED NOMINAL PLATE VOLTAGE
1	3.19%	3.8 mv	.2%	4.0 mv	3.36%	±12.22 V	±12.15 V
2	2.86%	1.4 mv	.2%	4.0 mv	3.19%	±4.07 V	±4.05V
3	3.95%	3.8 mv	.2%	4.0 mv	4.75%	±1.290 V	±1.350V
4	3.62%	1.4 mv	.2%	4.0 mv	5.02%	±0.430 V	±0.450V
5	5.10%	3.8 mv	.2%	4.0 mv	10.5%	±0.143 V	±0.150V
6	4.77%	1.4 mv	.2%	4.0 mv	16.3%	±0.0476 V	±0.050V

ALSEP
(LOW ENERGY CPA)

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MONITOR AND A/D CONVERTER ERROR TABULATION

TABLE C

ENERGY STEP NO.	MONITOR NETWORK SENS-ITIVITY	ANTICIPATED MAXIMUM MONITOR ERROR	MONITOR AS-BUILT NOMINAL VOLTAGE	A/D CONVERSION ERROR *	ANTICIPATED READOUT UNCER-TAINTY	MONITOR VOLTAGE FOR FLIGHT TYPE SYSTEMS
1	1.33%	4.69%	4.07V	1 COUNT	±3 COUNTS	4.05 V
2	1.33%	4.52%	1.36V	1 COUNT	±3 COUNTS	1.35 V
3	1.33%	6.08%	0.429V	1 COUNT	±4 COUNTS	0.45 V
4	1.33%	6.35%	0.143V	1 COUNT	±4 COUNTS	0.150V
5	1.33%	11.8 %	0.0474V	2.7 MV	± 7 COUNTS	0.050V
6	1.33%	17.6 %	0.0158V	2.7 MV	± 13 COUNTS	0.0167V

* A/D CONVERTER INTRODUCES AN ERROR OF ONE COUNT FOR INPUT SIGNALS GREATER THAN 100 MV, AND INTRODUCES 2.7 MV OF ERROR FOR INPUTS LESS THAN 100 MV. THE CONVERSION RATE IS 2.7% PER COUNT.

ALSEP
(LOW ENERGY CPA)

EXPERIMENTAL ERROR ANALYSIS

5 JULY

TABLE D

LOW ENERGY CPA GENERATOR LAB DATA S/N 2.

ENERGY STEP NO.	POSITIVE PLATE VOLTAGE MEASURED VALUE	AS-BUILT NOMINAL PLATE VOLTAGE	% ERROR	ANTICIPATED ERROR
1	+12.14 V	+12.22	-.65%	3.36%
2	+4.096	+4.07	+.64%	3.19%
3	+1.286	+1.290	-.31%	4.75%
4	+0.438	+0.430	+1.86%	5.02%
5	+0.145	+0.143	+1.59%	10.5%
6	+0.0509	+0 0476	+6.93%	16.3%
	NEGATIVE PLATE VOLTAGE			
1	-12.09	-12.22	+1.06%	3.36%
2	-4.047	-4.07	+.56%	3.19%
3	-1.244	-1.290	+3.57%	4.75%
4	-0.3959	-.430	+7.9%	5.02%
5	-0.1372	-0.143	+3.86%	10.5%
6	-0.0424	-0.0476	+10.95%	16.3%
	MONITOR (A/D) OUTPUT VOLTAGE			
1	+4.079	+4.07	+.22%	4.69%
2	+1.386	+1.357	+2.15%	4.52%
3	+0.4447	+0.429	+3.3%	6.08%
4	+0.1622	+0.143	+13.4%	6.35%
5	+0.0511	+0.0474	+7.8%	11.8%
6	+0.0199	+0.0158	+26%	17.6%

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APPENDIX V

Velocity Filter Step Voltage Generator Error Analysis

VELOCITY FILTER STEP VOLTAGE GENERATOR

BLOCK DIAGRAM

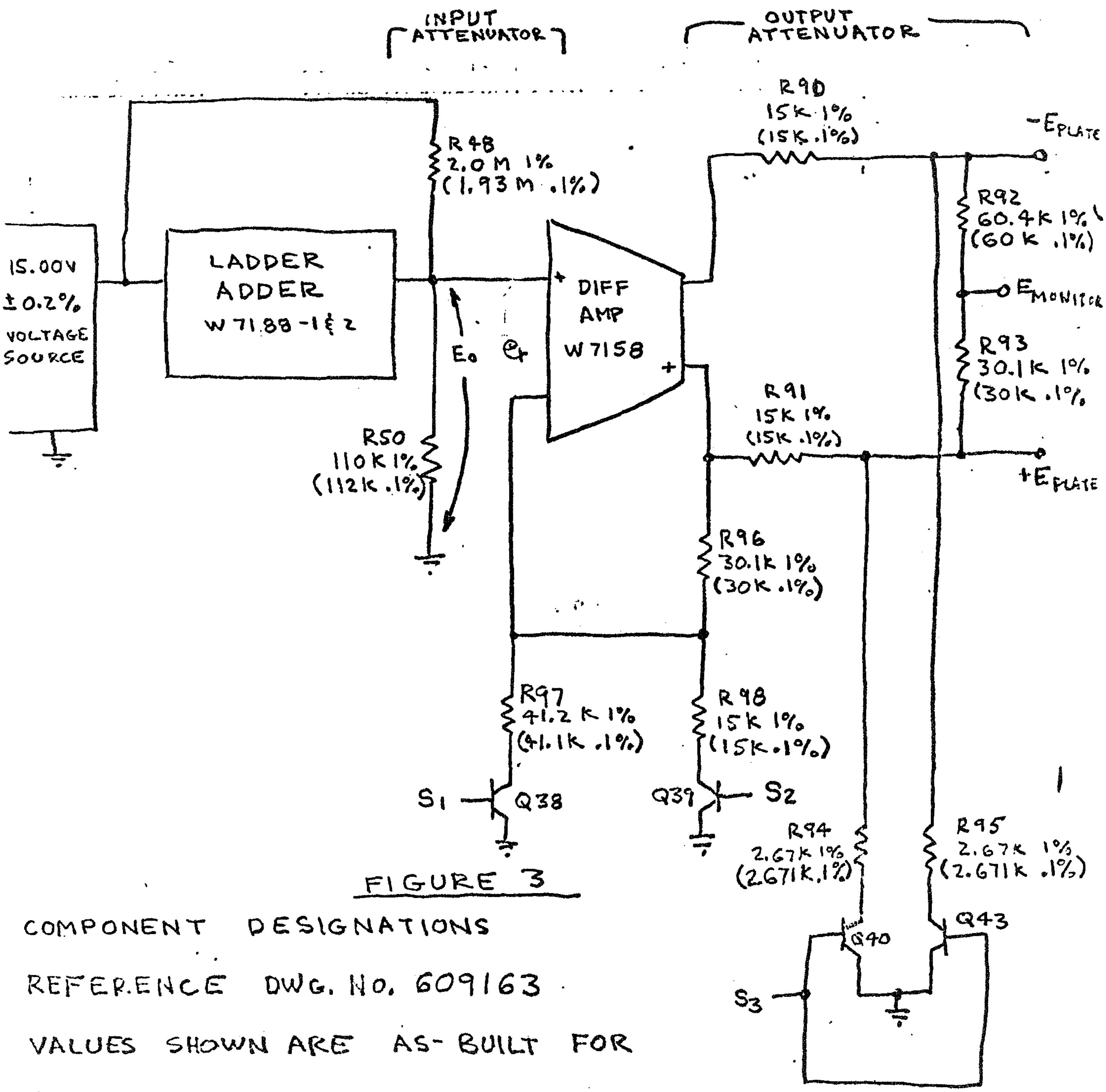


FIGURE 3

COMPONENT DESIGNATIONS

REFERENCE DWG. NO. 609163

VALUES SHOWN ARE AS-BUILT FOR SYSTEM NO. 2. VALUES SHOWN IN PARENTHESES ARE FOR REFERENCE, AND ARE THE VALUES SPECIFIED FOR FLIGHT TYPE SYSTEMS.

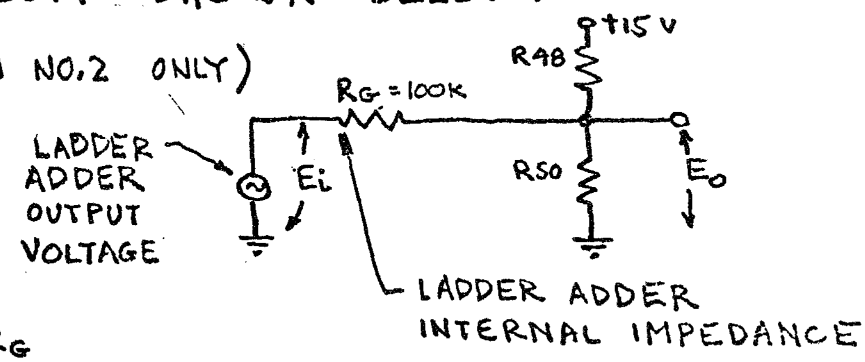
ALSEP
(VELOCITY FILTER)
CONTROL CONDITIONS

5 JULY

TABLE I.

ENERGY STEP NO.	LADDER ADDER OUTPUT VOLTAGE	LADDER ADDER SENSITIVITY	INPUT ATTENUATOR TRANSFER FUNCTION *	INPUT ATTENUATOR SENSITIVITY	FEEDBACK FUNCTION S1 (Q38)	FEEDBACK FUNCTION S2 (Q39)	FEEDBACK FUNCTION DIFF AMP GAIN	FEEDBACK FUNCTION SENSITIVITY	OUTPUT ATTENUATOR S3 (Q40, Q43)	OUTPUT ATTENUATOR TRANSFER FUNC.	OUTPUT ATTENUATOR SENSITIVITY
1	SEE TABLE J.	1.00	$E_o = \frac{2E_i + 1.5V}{3.92}$	.94% + 3.9 mV	OFF	ON	3	1.33	OFF	.75	.25%
2	↓	1.00	↓	↓	ON	OFF	$\sqrt{3}$	.84	OFF	.75	.25%
3	↓	1.00	↓	↓	OFF	OFF	1	1.00	OFF	.75	.25%
4	↓	1.00	↓	↓	OFF	ON	3	1.33	ON	.144	1.70%
5	↓	1.00	↓	↓	ON	OFF	$\sqrt{3}$	.84	ON	.144	1.70%
6	↓	1.00	↓	↓	OFF	OFF	1	1.00	ON	.144	1.70%

*INPUT ATTENUATOR TRANSFER FUNCTION IS BASED ON EQUIVALENT CIRCUIT SHOWN BELOW:
(VALUES FOR SYSTEM NO. 2 ONLY)



$$E_o = \frac{E_i R_{48} + 15V R_G}{\frac{R_G R_{48}}{R_{50}} + R_G + R_{48}}$$

FIGURE 4

ALSEP
(VELOCITY FILTER)
CONTROL CONDITIONS (CONTINUED)

6 JULY

LADDER ADDER OUTPUT VOLTAGE
TABLE J.
REFERENCE FIGURE 4 FOR LOCATION OF OUTPUT VOLTAGE

VELOCITY STEP NO.	Decoded States – F_N									Decimal F	OUTPUT VOLTAGE (Ei OF EQUATION IN FIG. 4)
	256	128	64	32	16	8	4	2	1		
1	1	1	0	0	1	0	0	0	0	400	11.72V
2	1	0	1	1	0	1	0	0	1	361	10.57V
3	1	0	1	0	0	0	1	0	0	324	9.48V
4	1	0	0	1	0	0	0	0	1	289	8.46V
5	1	0	0	0	0	0	0	0	0	256	7.50V
6	0	1	1	1	0	0	0	0	1	225	6.59V
7	0	1	0	1	1	1	1	0	0	188	5.51V
8	0	1	0	1	0	1	0	0	1	169	4.94V
9	0	1	0	0	1	0	0	0	0	144	4.22V
10	0	0	1	1	1	1	0	0	1	121	3.54V
11	0	0	1	1	0	0	1	0	0	100	2.93V
12	0	0	1	0	1	0	0	0	1	81	2.37V
13	0	0	1	0	0	0	0	1	1	67	1.964V
14	0	0	0	1	1	0	0	0	1	49	1.435V
15	0	0	0	1	0	0	1	0	0	36	1.054V
16	0	0	0	0	1	1	0	0	1	25	0.732V
17	0	0	0	0	1	0	0	0	0	16	0.468V
18	0	0	0	0	0	1	0	0	1	9	0.264V
19	0	0	0	0	0	0	1	0	0	4	0.117V
20	0	0	0	0	0	0	0	0	1	1	0.029V

ALSEP
(VELOCITY FILTER)

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PLATE VOLTAGE SENSITIVITY AND ERROR TABULATION

TABLE K.

ENERGY STEP NO.	TOTAL CONTROL SENS-ITIVITIES (AT PLATES)	DIFF AMP TEMP DRIFT	REF POWER SOURCE TOLERANCE	SYSTEM POWER SUPPLY EFFECT	ANTICIPATED MAXIMUM PLATE VOLTAGE ERROR
1	3.52% + 11.4 mv	3.8 mv	0.2%	4.0 mv	3.72% + 19.2 mv
2	3.03% + 6.6 mv	2.2 mv	0.2%	4.0 mv	3.23% + 12.8 mv
3	3.19% + 3.8 mv	1.4 mv	0.2%	4.0 mv	3.39% + 9.2 mv
4	4.97% + 11.4 mv	3.8 mv	0.2%	4.0 mv	5.17% + 19.2 mv
5	4.48% + 6.6 mv	2.2 mv	0.2%	4.0 mv	4.68% + 12.8 mv
6	4.64% + 3.8 mv	1.4 mv	0.2%	4.0 mv	4.84% + 9.2 mv

MONITOR AND A/D CONVERTER ERROR TABULATION

THIS TABLE LISTS THE FIRST & LAST VELOCITY STEPS FOR COMPARISON

TABLE L.

ENERGY STEP NO.	VELOCITY STEP NO.	MONITOR NETWORK SENSITIVITY	ANTICIPATED MAXIMUM MONITOR ERROR	MONITOR AS-BUILT NOMINAL VOLTAGE	A/D CONVERSION ERROR	ANTICIPATED READOUT UNCERTAINTY
1	1	1.33%	5.11%	4.77V	1 COUNT	3 COUNTS
1	20		6.08%	0.299V	1 COUNT	4 COUNTS
2	1		4.64%	2.76V	1 COUNT	3 COUNTS
2	20		5.74%	0.173V	1 COUNT	4 COUNTS
3	1		4.82%	1.593V	1 COUNT	3 COUNTS
3	20		6.20%	0.0997V	2.7 mV	4 COUNTS
4	1		6.84%	0.917V	1 COUNT	4 COUNTS
4	20		11.83%	0.0574V	2.7 mV	7 COUNTS
5	1		6.41%	0.529V	1 COUNT	4 COUNTS
5	20		12.17%	0.0331V	2.7 mV	8 COUNTS
6	1		6.66%	0.306V	1 COUNT	4 COUNTS
6	20	1.33%	13.84%	0.0191V	2.7 mV	11 COUNTS

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(VELOCITY FILTER)

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NOTE: TABLE L OUTLINES THE ANTICIPATED ERROR FOR SYSTEM NO. 2, WITH ALL ERRORS ACCOUNTED FOR. THE FOLLOWING TABLE (M) WAS A PRELIMINARY ESTIMATE, AND DOES NOT ACCOUNT FOR THE INPUT ATTENUATOR SENSITIVITY.

TABLE M

ENERGY STEP NO. 1

VEL. STEP NO.	NOMINAL PLATE-TO-PLATE VOLTAGE	ERROR AT PLATES (RESPECT TO GROUND) %	PLUS VOLTS %×10	% ERROR AT PLATES	NOMINAL MONITOR OUTPUT VOLTAGE (.167Ep)	MONITOR NETWORK SENSITIVITY	ANTICIPATED MAXIMUM MONITOR ERROR	A/D ERROR	A/D READOUT UNCERTAINTY
1	29.0	2.58%	7.8 mv, .04	2.62%	4.83	1.33%	3.95%	1 COUNT	3 COUNTS
2	26.3		.04 %	2.62%	4.38		3.95%		
3	23.8		.05 %	2.63%	3.97		3.96%		
4	21.4		.05	2.63%	3.57		3.96%		
5	19.2		.06	2.64%	3.20		3.97%		
6	17.1		.07	2.65%	2.85		3.98%		
7	14.5		.08	2.66%	2.42		3.99%		
8	13.3		.07 %	2.67%	2.22		4.00%		
9	11.6		.10	2.68%	1.93		4.01%		
10	10.0		.12	2.70%	1.67		4.03%		
11	8.59		.14	2.72%	1.433		4.05%		
12	7.30		.16	2.74%	1.218		4.07%		
13	6.40		.18 %	2.76%	1.068		4.09%		
14	5.13		.23 %	2.81%	.856		4.14%		
15	4.25		.27	2.85%	.709		4.18%		
16	3.50		.33 %	2.91%	.583		4.24%		
17	2.89		.42 %	3.00%	.482		4.33%		
18	2.41		.48 %	3.06%	.402		4.39%		
19	2.07		.56 %	3.14%	.345		4.47%		
20	1.87	2.58%	7.8 mv, .62	3.20%	.312 V	1.33%	4.53%	1 COUNT	3 COUNTS

ALSEP 6 JULY

(VELOCITY FILTER)

TABLE M (CONT.)

ENERGY STEP NO. 2

VEL STEP NO.	NOMINAL PLATE-TO-PLATE VOLTAGE	ERROR AT PLATES (RESPECT TO GROUND) %	PLUS VOLTAGE %x 1.5	% ERROR AT PLATES	NOMINAL MONITOR OUTPUT VOLTAGE (.167 EP)	MONITOR NETWORK SENSITIVITY	ANTICIPATED MAXIMUM MONITOR ERROR	A/D ERROR	A/D READOUT UNCERTAINTY
1	16.7	2.09%	6.2 MV .06	2.15%	2.78V	1.33%	3.48%	1 COUNT	3 COUNTS
2	15.2	↑	.06%	2.15	2.54	↑	3.48	↑	↑
3	13.7		.07	2.16	2.285V		3.49		
4	12.4		.07	2.16	2.070		3.49		
5	11.1		.08	2.17	1.850		3.50		
6	9.86		.09	2.18	1.645		3.51		
7	8.36		.11	2.20	1.395		3.53		
8	7.66		.12	2.21	1.278		3.54		
9	6.68		.14	2.23	1.115		3.56		
10	5.78		.16	2.25	.965		3.58		
11	4.16		.19	2.28	.827		3.61		
12	4.21		.22	2.31	.702		3.64		
13	3.49		.25	2.34	.615		3.67		
14	2.96		.31	2.40	.494		3.73		
15	2.45		.38	2.47	[illegible]		3.80		
16	2.02		.46	2.55	[illegible]		3.88		
17	1.67		.56	2.65	.279		3.98		
18	1.31		.67	2.76	.232		4.09		
19	[illegible]	↓	.78	2.87	.200	↓	4.20	↓	↓
20	1.08	2.09%	6.2 MV .86	2.95%	.130	1.33%	4.28%	1 COUNT	3 COUNTS

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(VELOCITY FILTER)

TABLE M (CONT.)

ENERGY STEP NO. 3

VEL. STEP NO.	NOMINAL PLATE-TO-PLATE VOLTAGE	ERROR AT PLATES (RESPECT TO GROUND) % PLUS VOLTAGE (1% × 1.7)		% ERROR AT PLATES	NOMINAL MONITOR OUTPUT VOLTAGE (.167 Ep)	MONITOR NETWORK SENSITIVITY	ANTICIPATED MAXIMUM MONITOR ERROR	A/D ERROR	A/D READOUT UNCERTAINTY
1	9.65V	2.25%	5.4 mV .08 %	2.33 %	1.610V	1.33%	3.66%	1 COUNT	3 COUNTS
2	8.77		.09	2.34	1.463		3.67		
3	7.93		.10	2.35	1.323		3.68		
4	7.14		.11	2.36	1.192		3.69		
5	6.39		.13	2.38	1.067		3.71		
6	5.69		.14	2.39	0.950		3.72		
7	4.93		.17	2.42	.806		3.75		
8	4.42		.18	2.43	.738		3.76		
9	3.86		.21	2.46	.644		3.79		
10	3.39		.24	2.49	.557		3.82		
11	2.86		.28	2.53	.477		3.86		
12	2.43		.33	2.58	.406		3.91		
13	2.13		.38	2.63	.355		3.96		
14	1.71		.47	2.72	.285		4.05		
15	1.42		.57	2.82	.237		4.15		
16	1.17		.69	2.94	.1952		4.27		
17	.963		.84	3.09	.1607		4.42		
18	.805		1.00	3.25	.1343		4.58		
19	.691		1.17	3.42	.1153		4.75		
20	.624V	2.25%	5.4 mV 1.30	3.55%	.1042	1.33%	4.88%	1 COUNT	3 COUNTS

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(VELOCITY FILTER)

TABLE M (CONT.)

ENERGY STEP NO. 4

VEL. STEP No.	NOMINAL PLATE-TO-PLATE VOLTAGE	ERROR AT PLATES (RESPECT TO GROUND) %	PLUS VOLTAGE (%x 1.5)	% ERROR AT PLATES	NOMINAL MONITOR OUTPUT VOLTAGE (.167 Ep)	MONITOR NETWORK SENSITIVITY	ANTICIPATED MAXIMUM MONITOR ERROR	A/D ERROR	A/D READOUT UNCERTAINTY
1	5.57V	4.03%	7.8 mV .21%	4.24%	.929V	1.33%	5.57%	1 COUNT	4 COUNTS
2	5.06	↑	↑ .23	4.26	.844	↑	5.59	↑	↑
3	4.58		.26	4.29	.765		5.62		
4	4.12		.28	4.31	.687		5.64		
5	3.69		.32	4.35	.616		5.68		
6	3.29		.36	4.39	.548		5.72		
7	2.79		.42	4.45	.466		5.78		
8	2.55		.46	4.49	.426		5.82		
9	2.23		.52	4.55	.372		5.88		
10	1.93		.61	4.64	.322		5.97		
11	1.65		.71	4.74	.275		6.07		
12	1.40		.84	4.87	.2335		6.20		
13	1.23		.95	4.98	.2052		6.31		
14	.987		1.19	5.22	.1647		6.55		
15	.817		1.43	5.46	.1364		6.79	↓	↓
16	.673		1.74	5.77	.1123		7.10	1 COUNT	4 COUNTS
17	.556		2.11	6.14	.0927		7.47	2.7 mV [illegible]	4 COUNTS
18	.464		2.52	6.55	.0775		7.88	2.7 mV 3.47%	5 COUNTS
19	.399	↓	↓ 2.83	6.86	.0665	↓	8.19	2.7 mV 4.0[illegible]%	5 COUNTS
20	.360V	4.03%	7.8 mV 3.35	7.38	.0601V	1.33%	8.71 %	2.7 mV 4.5[illegible]	5 COUNTS

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(VELOCITY FILTER)

TABLE M (CONT.)

ENERGY STEP NO. 5

VEL. STEP NO.	NOMINAL PLATE-TO-PLATE VOLTAGE	ERROR AT PLATES (RESPECT TO GROUND) % PLUS	ERROR AT PLATES (RESPECT TO GROUND) VOLTAGE	% ERROR AT PLATES	NOMINAL MONITOR OUTPUT VOLTAGE (.167 E_p)	MONITOR NETWORK SENSITIVITY	ANTICIPATED MAXIMUM MONITOR ERROR	A/D ERROR	A/D READOUT UNCERTAINTY
1	3.22V	3.54%	6.2 mV (.29%)	3.83%	.537V	1.33%	5.16%	1 COUNT	3 COUNTS
2	2.92V	↑	↑ .32	386	.487	↑	5.19	↑	↓
3	2.64V		.35	3.89	.441		5.22		↓
4	2.38V		.39	3.93	.397		5.26		3 [illegible]
5	2.13V		.44	3.98	.355		5.31		4 [illegible]
6	1.90V		.49	4.03	.317		5.36		↑
7	1.61V		.55	4.12	.269		5.45		
8	1.47V		.53	4.17	.245		5.50		
9	1.29V		.72	4.26	.215		5.59		
10	1.11V		.84	4.38	.1352		5.71		
11	.934V		.95	4.52	.1592		5.85		
12	.811V		1.15	4.69	.1353		6.02	↓	↓
13	.710V		1.31	4.85	.1135		6.18	1 COUNT	4 COUNTS
14	.570V		1.63	5.17	.0951		6.50	2.7 mV (2.3%)	5 COUNTS
15	.472V		1.97	5.51	.0797		6.84	2.43	5 COUNTS
16	.389V		[illegible]	5.93	.0649		7.26	4.17	6 COUNTS
17	.321V		2.90	6.44	.0536		7.77	5.04	6 COUNTS
18	.268V		3.47	7.01	.0447		8.34	6.04	7 COUNTS
19	.230V	↓	↓ 4.04	7.58	.0384	↓	8.91	↓ 7.	7 COUNTS
20	.208V	3.54%	6.2 mV (4.47)	8.01%	.0347	1.33%	9.34%	2.7 mV (7.75%)	8 COUNTS

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(VELOCITY FILTER)

TABLE M (CONT.)

ENERGY STEP NO. 6

VEL STEP NO	NOMINAL PLATE-TO-PLATE VOLTAGE	ERROR AT PLATES (RESPECT TO GROUND) % PLUS	VOLTAGE %x1.5	% ERROR AT PLATES	NOMINAL MONITOR OUTPUT VOLTAGE (.167 E_P)	MONITOR NETWORK SENSITIVITY	ANTICIPATED MAXIMUM MONITOR ERROR	A/D ERROR	A/D READOUT UNCERTAINTY
1	1.86 V	3.70%	5.4 mV	4.14%	.310 V	1.33%	5.47%	1 COUNT	4 COUNTS
2	1.69	↑	.98%	4.18	.282	↑	5.51	↑	↑
3	1.53		.53	4.23	.255		5.56		
4	1.37		.[illegible]	4.29	.2285		5.62		
5	1.23		.66	4.3[illegible]	.2050		5.69		
6	1.10		.79	4.44	.1835		5.77		
7	.930		.87	4.57	.1552		5.90		
8	.851		.95	4.[illegible]5	.1420		5.98		
9	.743		1.[illegible]	4.79	.1240		6.12	↓	
10	.642		1.26	4.96	.1070		6.29	1 COUNT	↓
11	.551		[illegible]	5.17	.0919		6.50	2.7 mV 2.94%	4 COUNTS
12	.468		1.73	5.43	.0781		6.76	3.45	4 COUNTS
13	.409		[illegible]	[illegible].48	.0683		7.01	3.15	5 COUNTS
14	.329		2.46	6.16	.0549		7.49	4.72	5 COUNTS
15	.272		[illegible].13	6.65	.0453		8.01	5.96	6 COUNTS
16	.224		3.62	7.[illegible]	.0374		8.65	7.22	6 COUNTS
17	.185		4.[illegible]	8.08	.0309		9.41	8.74	7 COUNTS
18	.155		5.22	8.92	.0259		10.25	10.4	8 COUNTS
19	.133	↓	[illegible]	9.75	.0222	↓	11.11	12.15	9 COUNTS
20	.120 V	3.70%	5.4 mV	10.44%	.0203	1.33%	11.77%	[illegible] 13.0	10 COUNTS

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(VELOCITY FILTER)

EXPERIMENTAL ERROR ANALYSIS

TABLE N.

ENERGY STEP	VELOCITY STEP	MEASURED DATA	CALCULATED AS-BUILT OUTPUT	% ERROR	ANTICIPATED MAX. PLATE VOLTAGE ERROR
1	1	28.59V	28.60V	-.03%	3.78%
1	20	1.772	1.792	-1.12%	4.75%
2	1	16.42	16.52	-.61%	3.31%
2	20	1.015	1.034	-1.84%	4.41%
3	1	9.526	9.54	-.15%	3.49%
3	20	0.5862	0.597	-1.85%	4.87%
4	1	5.463	5.49	-.55%	5.51%
4	20	0.3382	0.344	-1.75%	10.50%
5	1	3.137	3.170	-1.04%	5.08%
5	20	0.1937	0.1985	-2.42%	10.84%
6	1	1.820	1.830	-.55%	5.33%
6	20	0.1118V	0.1147	-2.53%	12.51%

APPENDIX VI

High Energy Step Voltage Generator Error Analysis

ALSEP 5 JULY

HIGH ENERGY CPA STEP VOLTAGE GENERATOR

BLOCK DIAGRAM

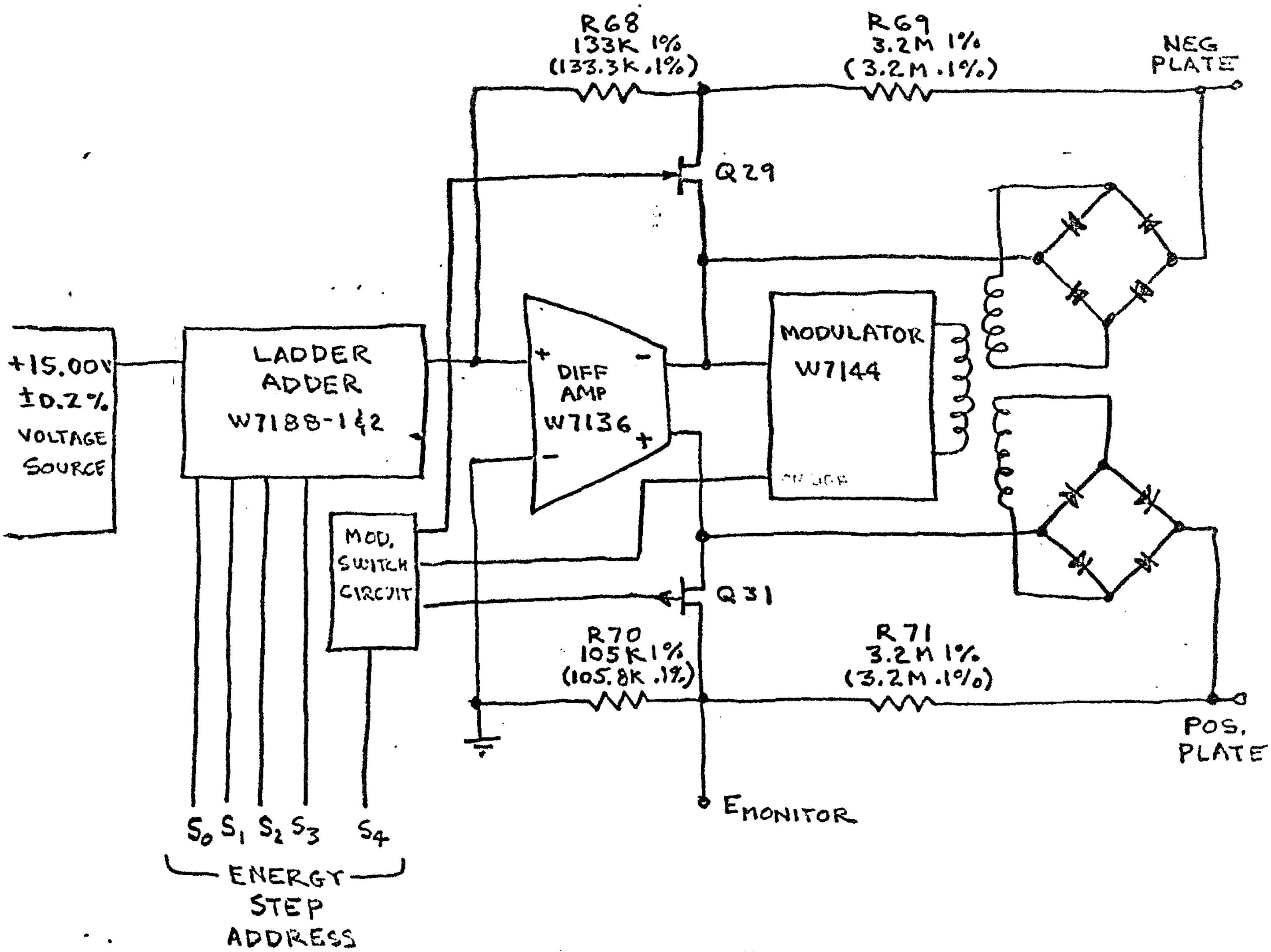

FIGURE 2

COMPONENT DESIGNATIONS REFERENCE DWG. NO. 609162

VALUES SHOWN ARE AS-BUILT FOR SYSTEM NO. 2

VALUES SHOWN IN PARENTHESES ARE FOR REFERENCE, AND ARE THE VALUES SPECIFIED FOR FLIGHT TYPE SYSTEMS.

THROUGHOUT ALL BLOCKS OF THIS SUBSYSTEM, 1% RESISTORS HAVE BEEN SUBSTITUTED FOR 0.1% RESISTORS.

ALSEP
(HIGH ENERGY CPA)
CONTROL CONDITIONS

5 JULY

TABLE E.

ENERGY STEP No.	SWITCH ADDRESS S_0 S_1 S_2 S_3 S_4	LADDER ADDER OUTPUT VOLTAGE	AMP GAIN	NOMINAL PLATE VOLTAGE *	SENSITIVITY OF LADDER ADDER	SENSITIVITY OF FEEDBACK NETWORK
1	0 1 1 1 0	13.12V	33.3	437 V	1.00	1.00
2	1 0 1 1 0	12.18V		406 V		
3	0 0 1 1 0	11.25V		375 V		
4	1 1 0 1 0	10.32V		344 V		
5	0 1 0 1 0	9.38V		312V		
6	1 0 0 1 0	8.43V		281V		
7	0 0 0 1 0	7.50V		250V		
8	1 1 1 0 0	6.57V		219V		
9	0 1 1 0 0	5.62V		187V		
10	1 0 1 0 0	4.68V		156V		
11	0 0 1 0 0	3.75V		125V		
12	1 1 0 0 0	2.81V		93.6V		
13	0 1 0 0 0	1.87V		62.5V		
14	1 0 0 0 0	0.938V	33.3	31.2V		
15	0 1 0 1 1	9.38V	1.33	12.5V		
16	1 1 1 0 1	6.57V		8.75V		
17	1 0 1 0 1	4.68V		6.25V		
18	1 1 0 0 1	2.81V		3.75V		
19	0 1 0 0 1	1.87V		2.50V		
20	1 0 0 0 1	0.938V	1.33	1.25V	1.00	1.00

* THE NOMINAL PLATE VOLTAGE IS WITH RESPECT TO GROUND, AND WILL CARRY THE SIGN OF THE ASSOCIATED PLATE. +437 V FOR THE POSITIVE PLATE, −437V FOR THE NEGATIVE PLATE.

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(HIGH ENERGY CPA)
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PLATE VOLTAGE SENSITIVITY AND ERROR TABULATION

TABLE F

ENERGY STEP NO.	TOTAL CONTROL SENS-ITIVITIES	DIFF. AMP TEMP DRIFT	REF POWER SOURCE TOLERANCE	ANTICIPATED MAXIMUM PLATE VOLTAGE ERROR
1	2.00%	204mv	0.2%	2.25%
2				2.25%
3				2.25%
4				2.26%
5				2.27%
6				2.27%
7				2.28%
8				2.29%
9				2.31%
10				2.33%
11				2.36%
12				2.42%
13				2.53%
14		204mv		2.85%
15		8.2mv		2.27%
16				2.29%
17				2.33%
18				2.42%
19				2.53%
20	2.00%	8.2mv	0.2%	2.86%

ALSEP
(HIGH ENERGY CPA)

5 JULY

MONITOR AND A/D CONVERTER ERROR TABULATION

TABLE G.

ENERGY STEP NO.	MONITOR NETWORK SENS-ITIVITY	MONITOR NOMINAL OUTPUT	ANTICIPATED MAXIMUM MONITOR ERROR	A/D CONVERSION ERROR	ANTICIPATED READOUT UNCER-TAINTY
1	1.94%	13.95 V	4.19%	1 COUNT	3 COUNTS
2		12.97 V	4.19%		
3		12.00 V	4.19%		
4		11.00 V	4.20%		
5		9.97 V	4.21%		
6		8.98 V	4.21%		
7		7.98 V	4.22		
8		7.00 V	4.23		
9		5.98 V	4.25		
10		4.98 V	4.27		
11		3.995V	4.30		
12		2.99 V	4.36		
13		2.00 V	4.47		
14		0.997V	4.79%		
15		12.35V	4.21%		
16		8.55V	4.23		
17		6.16V	4.27		
18		3.70V	4.36		
19		2.47V	4.47		
20	1.94%	1.235V	4.60%	1 COUNT	3 COUNTS

ALSEP
(HIGH ENERGY CPA)

5 JULY

EXPERIMENTAL ERROR ANALYSIS

HIGH ENERGY CPA GENERATOR S/N 2

TABLE H.

POSITIVE PLATE DATA (RESPECT TO GROUND)

ENERGY STEP NO.	MEASURED DATA	SPECIFIED OUTPUT	% ERROR	ANTICIPATED ERROR
1	+436.5 V	437.5V	-.23%	2.25%
2	404.9	406.2	-.32%	2.25%
3	373.5	375.0	-.40	2.25%
4	341.9	343.7	-.52	2.26%
5	310.5	312.5	-.64	2.27
6	279.5	281.2	-.60	2.27
7	248.2	250.0	-.72	2.28
8	218.5	218.7	-.09	2.29
9	187.1	187.5	-.21	2.31
10	155.4	156.2	-.51	2.33
11	121.9 [illegible]	125.0	-2.48	2.36
12	92.5	93.75	-1.33	2.42
13	62.4	62.50	-0.16	2.53
14	31.19	31.25	-.19	2.85
15	12.40	12.50	-.80	2.27
16	8.73	8.750	-.23	2.29
17	6.244	6.250	-.10	2.33
18	3.734	3.750	-.43	2.42
19	2.490	2.500	-.40	2.53
20	1.249V	1.250 V	-.08%	2.86 %

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ALSEP
(HIGH ENERGY CPA)

5 JULY

EXPERIMENTAL ERROR ANALYSIS (CONT.)

HIGH ENERGY CPA GENERATOR S/N 2

TABLE H. (CONT.)

NEGATIVE PLATE DATA (RESPECT TO GROUND)

ENERGY STEP NO.	MEASURED DATA	SPECIFIED OUTPUT	% ERROR	ANTICIPATED ERROR
1	-436.8 V	-437.5 V	+.17 %	2.25%
2	-405.7	-406.2	+.12	2.25
3	-374.3	-375.0	+.19	2.25
4	-342.7	-343.7	+.29	2.26
5	-311.3	-312.5	+.26	2.27
6	-280.4	-281.2	+.29	2.27
7	-248.9	-250.0	+.44	2.28
8	-219.1	-218.7	-.18	2.29
9	-187.8	-187.5	-.16	2.31
10	-156.7	-156.2	-.32	2.33
11	-125.3	-125.0	-.24	2.36
12	-93.76	-93.75	-.11	2.42
13	-62.42	-62.50	+.13	2.53
14	-31.31	-31.25	-.19	2.85
15	-12.45	-12.50	+.42	2.27
16	-8.760	-8.750	-.12	2.29
17	-6.263	-6.250	-.21	2.33
18	-3.746	-3.750	+.11	2.42
19	-2.492	-2.500	+.32	2.53
20	-1.243V	-1.250V	+.16	2.86 %

ALSEP
(HIGH ENERGY CPA)

5 JULY

EXPERIMENTAL ERROR ANALYSIS (CONT.)

HIGH ENERGY CPA GENERATOR S/N 2

TABLE H (CONT.)

MONITOR OUTPUT DATA

ENERGY STEP NO.	MEASURED DATA	SPECIFIED OUTPUT	% ERROR	ANTICIPATED ERROR
1	13.96	13.95	+0.07%	4.19%
2	12.95	12.97	- .15	4.19
3	11.94	12.00	- .50	4.19
4	10.93	11.00	- .45	4.20
5	9.931	9.97	-.40	4.21
6	8.937	8.98	-.44	4.21
7	7.937	7.98	-.49	4.22
8	6.937	7.00	-.33	4.23
9	5.984	5.98	+.67	4.25
10	4.970	4.98	-.20	4.27
11	4.009	3.995	+.22	4.30
12	2.959	2.99	-1.08	4.36
13	1.997	2.00	-.15	4.47
14	0.9994	0.997	+.20	4.79
15	12.40	12.35	+.40	4.21
16	8.732	8.65	+.95	4.23
17	6.246	6.18	+.97	4.27
18	3.737	3.70	+1.05	4.36
19	2.491	2.47	+.85	4.47
20	1.252	1.235	+1.38%	4.80%

APPENDIX VII

Ground Plane Step Voltage Generator Error Analysis

GROUND PLANE STEP VOLTAGE GENERATOR

BLOCK DIAGRAM

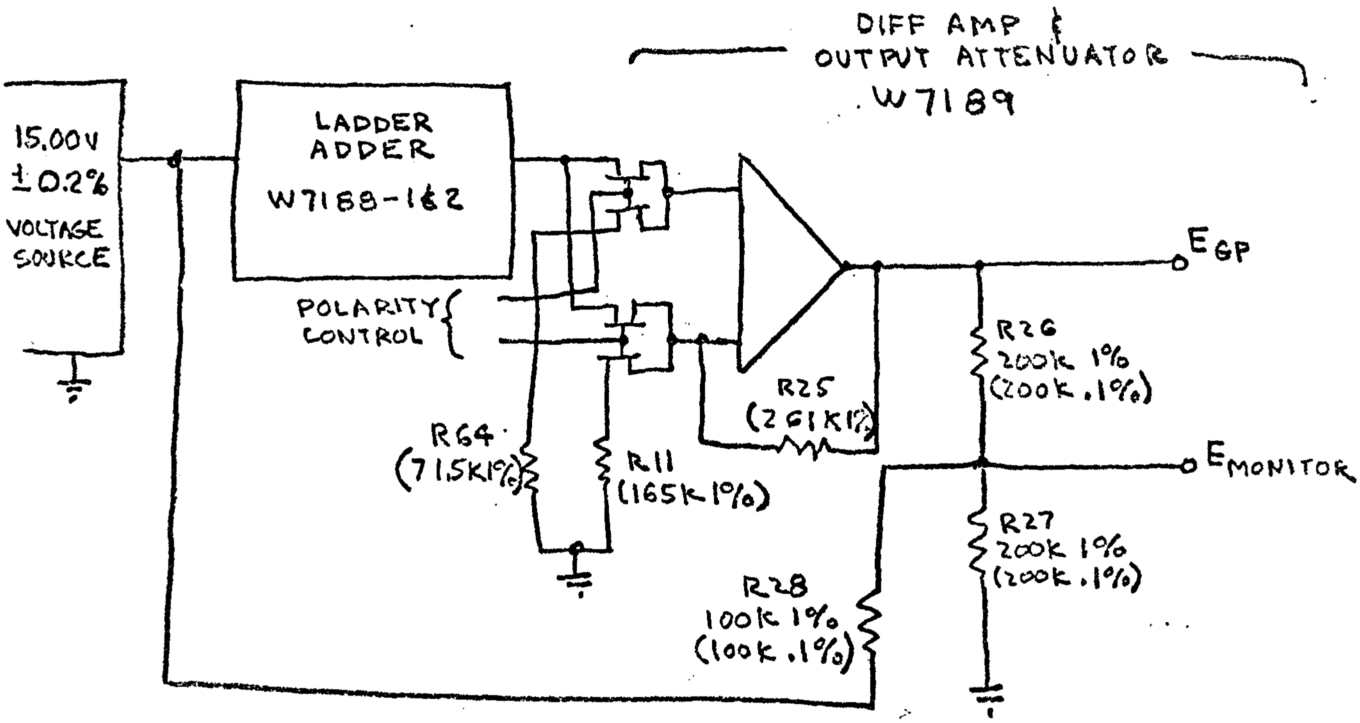


FIGURE 5

COMPONENT DESIGNATIONS REFERENCE DWG. NO. 609164

VALUES SHOWN ARE AS BUILT FOR SYSTEM NO. 2.

VALUES SHOWN IN PARENTHESES ARE FOR REFERENCE, AND AND ARE THE VALUES SPECIFIED FOR FLIGHT TYPE SYSTEMS.

ERROR TABULATION

15 V REF. SOURCE	0.2 %
LADDER ADDER SENSITIVITY	1.0 %
DIFF AMP & FEEDBACK	1.0 % + 3 mv
	2.2% + ≈ 0

ALSEP
(GROUND PLANE)

6 JULY

MONITOR AND A/D CONVERTER ERROR TABULATION

$$E_{MONITOR} = \frac{15V + \frac{E_{GP}}{3}}{2}$$

TABLE O.

VOLTAGE STEP	E_{GP}		2.2% $E_P/4$	A/D MONITOR VOLTAGE	REFERENCE ERROR 1% $\frac{15V}{2}$ x 1%	Total ERROR mV	% A/D ERROR (e_o)	A/D COUNTS ERROR
1	0		0	7.5V	75 MV	75		2 COUNTS
2	0.6		3.2 MV	7.65		78		
3	1.2		6.6 MV	7.8		84		
4	1.8		9.9 MV	7.95		85		
5	2.4		13.2 MV	8.1		88		
6	3.6		20 MV	8.4		95		
7	5.4		30 MV	8.85		105		
8	7.8		43 MV	9.45		118		
9	10.2		56 MV	10.05		131		
10	16.2		89 MV	11.55		164		
11	19.8		110 MV	12.45		185		
12	27.6		115 MV	14.40		190	1.3%	
13	0		0	7.5		75		
14	-0.6		-3.2 MV	7.35		78		
15	-1.2		6.6 MV	7.20		84		
16	-1.8		9.9 MV	7.05		85		
17	-2.4		13.2 MV	6.90		88		
18	-3.6		20 MV	6.60		95		
19	-5.4		30 MV	6.15		105		
20	-7.8		43 MV	5.55		118		
21	-10.2		56 MV	4.95		131	2.6%	2 COUNTS
22	-16.2		89 MV	3.45		164	4.8%	3 COUNTS
23	-19.8		110 MV	2.55		185	7.2	±3 "
24	-27.6		115 MV	0.60	75 MV	190	32%	±13 "

9164

3 mv
0

ALSEP — 6 JULY

(GROUND PLANE)

EXPERIMENTAL ERROR ANALYSIS

TABLE P.

VOLTAGE STEP	MEASURED DATA	SPECIFIED OUTPUT	% ERROR	ANTICIPATED ERROR
1	0.000	0.00	0.00	(APPROX 2.2%)
2	+0.595	+0.60	-.83%	
3	+1.200	+1.20	0.00	
4	+1.795	+1.80	-.33%	
5	+2.397	+2.40	-.13%	
6	+3.597	+3.60	-.08%	
7	+5.400	+5.40	0.00	
8	+7.796	+7.80	0.07%	
9	+10.14	+10.20	-.59%	
10	+16.14	+16.20	-.37%	
11	+19.75	+19.80	-.26%	
12	+27.55	+27.60	-.18%	
13	0.000	0.00	0.00	
14	-0.605	-0.60	-.83%	
15	-1.219	-1.20	-1.58%	
16	-1.820	-1.80	-1.11%	
17	-2.430	-2.40	-1.25%	
18	-3.645	-3.60	-1.25%	
19	-5.469	-5.40	-1.28%	
20	-7.895	-7.80	-1.22%	
21	-10.27	-10.20	-.69%	
22	-16.34	-16.20	-.88%	
23	-20.00	-19.80	-1.01%	
24	-27.90	-27.60	-1.07%	

SPECIFIED VOLTAGE TOLERANCE ±5%

SAMPLE DEVELOPMENT OF SENSITIVITY AND ERROR CALCULATIONS

NOTE: THE LOW ENERGY CPA STEP VOLTAGE GENERATOR WILL BE USED AS AN EXAMPLE.

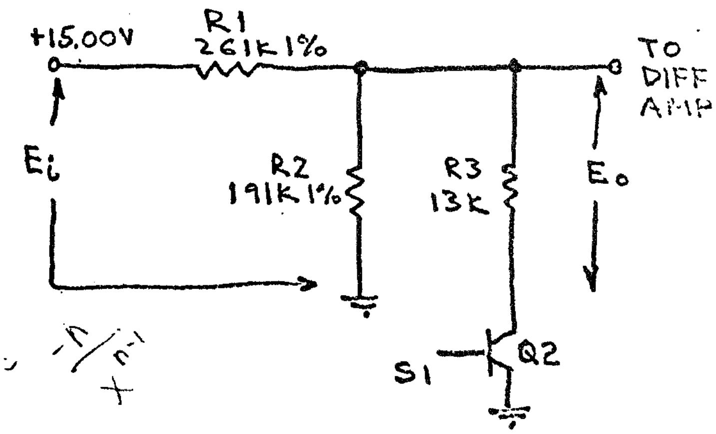


FIGURE 6

INPUT ATTENUATOR:

FOR S_1 (Q2) OFF:

$$A = \frac{E_o}{E_i} = \frac{R_2}{R_1 + R_2}$$

$$\frac{\partial A}{\partial R_1} = -\frac{R_2}{(R_1+R_2)^2}$$

$$\frac{\frac{\partial A}{A}}{\frac{\partial R_1}{R_1}} = \frac{-\frac{R_2 (R_1+R_2)}{R_2}}{\frac{(R_1+R_2)^2}{R_1}}$$

$$\boxed{\frac{\frac{\partial A}{A}}{\frac{\partial R_1}{R_1}} = -\frac{R_1}{R_1+R_2}}$$

TYPICAL FOR A TWO RESISTOR NETWORK

$$\frac{\partial A}{\partial R_2} = \frac{(R_1+R_2) - R_2}{(R_1+R_2)^2} = \frac{R_1}{(R_1+R_2)^2}$$

$$\frac{\frac{\partial A}{A}}{\frac{\partial R_2}{R_2}} = \frac{\frac{R_1 (R_1+R_2)}{R_2}}{\frac{(R_1+R_2)^2}{R_2}}$$

$$\boxed{\frac{\frac{\partial A}{A}}{\frac{\partial R_2}{R_2}} = +\frac{R_1}{R_1+R_2}}$$

ALSEP
(SAMPLE SENSITIVITY DEVELOPMENT)

7. JULY

INPUT ATTENUATOR

FOR S_1 (Q_2) ON: (REF FIG. 6)

$$A = \frac{E_o}{E_i} = \frac{R_2 \| R_3}{R_2 \| R_3 + R_1} = \frac{\frac{R_2 R_3}{R_2 + R_3}}{\frac{R_2 R_3}{R_2 + R_3} + R_1} = \frac{R_2 R_3}{R_2 R_3 + R_1 R_2 + R_1 R_3}$$

$$\frac{\partial A}{\partial R_1} = - \frac{R_2 R_3 (R_2 + R_3)}{(R_2 R_3 + R_1 R_2 + R_1 R_3)^2}$$

$$\frac{\frac{\partial A}{A}}{\frac{\partial R_1}{R_1}} = - \frac{\frac{\cancel{R_2 R_3}(R_2 + R_3)\cancel{(R_2 R_3 + R_1 R_2 + R_1 R_3)}}{\cancel{R_2 R_3}}}{\frac{(R_2 R_3 + R_1 R_2 + R_1 R_3)^{\cancel{2}}}{R_1}}$$

$$\boxed{\frac{\frac{\partial A}{A}}{\frac{\partial R_1}{R_1}} = - \frac{R_1 (R_2 + R_3)}{R_2 R_3 + R_1 R_2 + R_1 R_3}}$$

$$\frac{\partial A}{\partial R_2} = \frac{(R_2 R_3 + R_1 R_2 + R_1 R_3) R_3 - R_2 R_3 (R_3 + R_1)}{(R_2 R_3 + R_1 R_2 + R_1 R_3)^2}$$

$$\frac{\frac{\partial A}{A}}{\frac{\partial R_2}{R_2}} = \frac{\frac{\left[(R_2 R_3 + R_1 R_2 + R_1 R_3)\cancel{R_3} - R_2 \cancel{R_3}(R_3 + R_1)\right]\cancel{(R_2 R_3 + R_1 R_2 + R_1 R_3)}}{\cancel{R_2}\,\cancel{R_3}}}{\frac{(R_2 R_3 + R_1 R_2 + R_1 R_3)^{\cancel{2}}}{\cancel{R_2}}}$$

$$\boxed{\frac{\frac{\partial A}{A}}{\frac{\partial R_2}{R_2}} = \frac{R_1 R_3}{R_2 R_3 + R_1 R_2 + R_1 R_3}}$$

IN A SIMILAR MANNER

$$\boxed{\frac{\frac{\partial A}{A}}{\frac{\partial R_3}{R_3}} = \frac{R_1 R_2}{R_2 R_3 + R_1 R_2 + R_1 R_3}}$$

ALSEP
(SAMPLE SENSITIVITY DEVELOPMENT)

7 JULY

FOR NETWORK OF FIGURE 6 S_1(Q2) OFF —

SENSITIVITY DUE TO R_1:

$$\frac{\partial A / A}{\partial R_1 / R_1} = -\frac{R_1}{R_1+R_2} = -\frac{261k}{261k+191k} = -.578$$

SENSITIVITY DUE TO R_2:

$$\frac{\partial A / A}{\partial R_2 / R_2} = \frac{R_1}{R_1+R_2} = +.578$$

TOTAL (WORST CASE) SENSITIVITY FOR E_0 (S_1 OFF)

$$S = |-.578| + |+.578| = \boxed{1.156}$$

VALUE ENTERED IN TABLE A.

THIS VALUE IS DEFINED AS THE PERCENT CHANGE IN THE OUTPUT FOR A 1% CHANGE IN ALL RESISTOR VALUES.

FOR NETWORK OF FIGURE 6 S_1(Q2) ON —

SENSITIVITY DUE TO R_1:

$$\frac{\partial A / A}{\partial R_1 / R_1} = -\frac{R_1(R_2+R_3)}{R_2R_3+R_1R_2+R_1R_3} = -\frac{261k(191k+13k)}{191k\times13k+261k\times191k+261k\times13k} = -\frac{532}{24.8+498+33.9}$$

$$\frac{\partial A / A}{\partial R_1 / R_1} = -.957$$

SENSITIVITY DUE TO R_2:

$$\frac{\partial A / A}{\partial R_1 / R_1} = \frac{R_1R_3}{R_2R_3+R_1R_2+R_1R_3} = \frac{33.9}{557} = .061$$

SENSITIVITY DUE TO R_3:

$$\frac{\frac{\partial A}{A}}{\frac{\partial R_3}{R_3}} = \frac{R_1 R_2}{R_2 R_3 + R_1 R_2 + R_1 R_3} = \frac{498}{557} = .894$$

TOTAL (WORST CASE) SENSITIVITY FOR E_o (S_1 ON)

$$S = |-.957| + |.061| + |.894| = \boxed{1.912}$$ VALUE ENTERED IN TABLE A.

FEEDBACK NETWORK

FOR S2 (Q12) OFF:

FEEDBACK NETWORK CONSISTS OF R27. AMPLIFIER GAIN IS 1.0 AND SENSITIVITY IS A FUNCTION OF R27 ONLY

$$\boxed{S = 1.00\%}$$

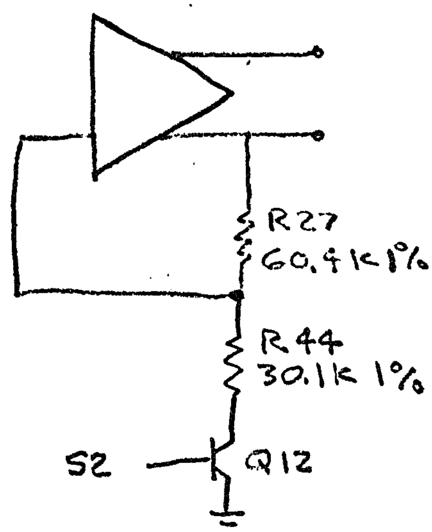


FIGURE 7

FOR S2 (Q12) ON:

FEEDBACK NETWORK CONSISTS OF R27 & R44

$$\frac{\frac{\partial A}{A}}{\frac{\partial R_{27}}{R_{27}}} = -\frac{R_{27}}{R_{27} + R_{44}} = -\frac{60.4K}{60.4K + 30.1K} = -.67$$

$$\frac{\frac{\partial A}{A}}{\frac{\partial R_{44}}{R_{44}}} = +\frac{R_{27}}{R_{27} + R_{44}} = +.67$$

ALSEP
(SAMPLE SENSITIVITY DEVELOPMENT) 7 JULY

TOTAL (WORST CASE) SENSITIVITY FOR FEEDBACK NETWORK (S_2 ON)

$$S = |-.67| + |+.67| = \boxed{1.33}$$

OUTPUT ATTENUATOR

FOR S3(Q8) OFF:

$$\frac{\partial A / A}{\partial R_{28} / R_{28}} = -\frac{R_{28}}{R_{28} + R_E} = -\frac{25k}{25k + 45k}$$

$$\frac{\partial A / A}{\partial R_{28} / R_{28}} = -.357$$

$$\frac{\partial A / A}{\partial R_E / R_E} = +.357$$

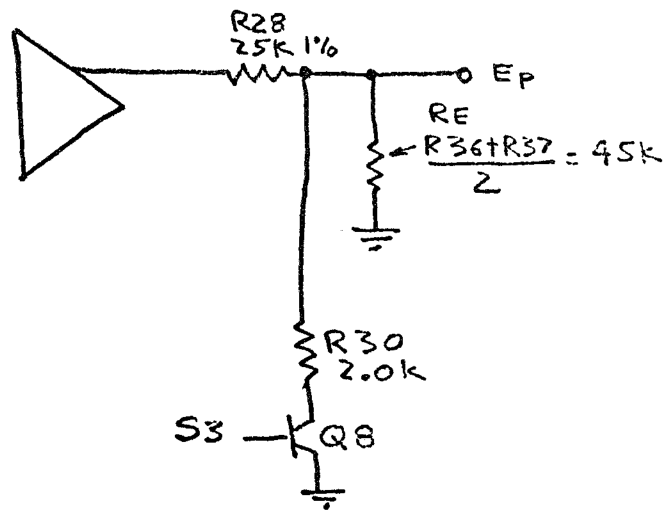


FIGURE 8

TOTAL (WORST CASE) SENSITIVITY FOR OUTPUT ATTEN. (S3 OFF)

$$S = |-.357| + |+.357| = \boxed{.714}$$

FOR S3 (Q8) ON:

$$\frac{\partial A / A}{\partial R_{28} / R_{28}} = -\frac{R_{28}(R_{30} + R_E)}{R_{30} \times R_E + R_{28}R_{30} + R_{28}R_E} = \frac{-25k(2.0k + 45k)}{2.0k \times 45k + 25k \times 2.0k + 25k \times 45k}$$

$$\frac{\partial A / A}{\partial R_{28} / R_{28}} = -\frac{117}{9.0 + 5.0 + 112} = -.93$$

SENSITIVITY DUE TO R_{30}:

$$\frac{\frac{\partial A}{A}}{\frac{\partial R_{30}}{R_{30}}} = \frac{R_{28} R_E}{R_{30} R_E + R_{28} R_{30} + R_{28} R_E} = \frac{112}{126} = .89$$

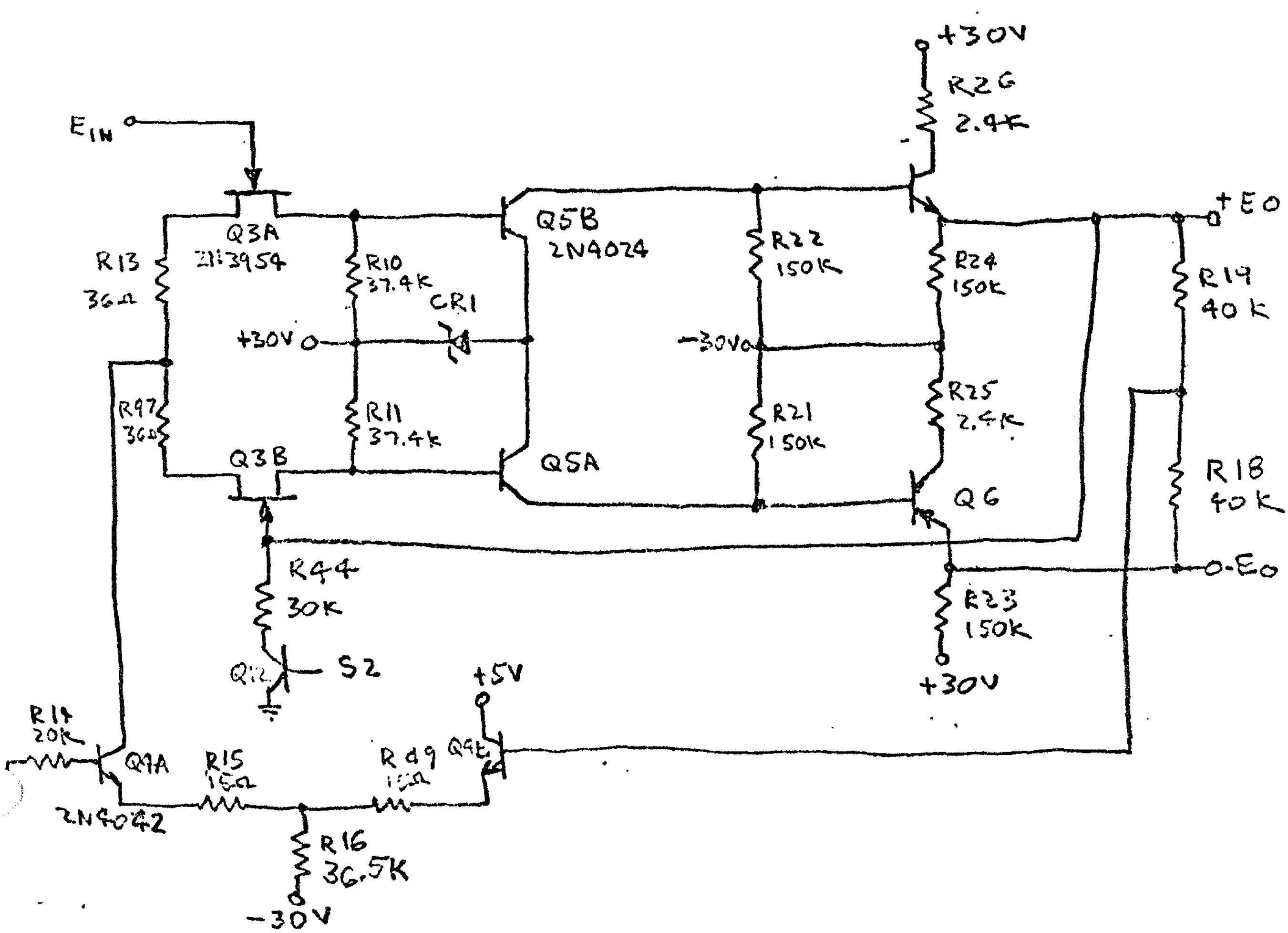
SENSITIVITY DUE TO R_E:

$$\frac{\frac{\partial A}{A}}{\frac{\partial R_E}{R_E}} = \frac{R_{28} R_{30}}{R_{30} R_E + R_{28} R_{30} + R_{28} R_E} = \frac{5}{126} = .04$$

TOTAL SENSITIVITY FOR OUTPUT ATTENUATOR:

$$S = |-.93| + |+.89| + |+.04| = \boxed{1.86}$$

DIFFERENTIAL AMPLIFIER TEMP DRIFT ERROR



ALSEP 7 JULY

FOR Q3A & Q3B, THE TRANSISTOR SPECIFICATION STATES: GATE - SOURCE VOLTAGE DIFFERENTIAL CHANGE WITH TEMPERATURE:

$T_A = +25°C$ TO $-55°C$ $\Delta V_{GS} = 0.8$ MV MAX

$T_A = +25°C$ TO $+125°C$ $\Delta V_{GS} = 1.0$ MV MAX

FOR Q5A & Q5B TRANSISTOR SPECIFICATION STATES:

$T_A = -55°C$ TO $+25°C$ $|\Delta(V_{BE1} - V_{BE2})| = 0.8$ MV MAX

$T_A = 25°C$ TO $+125°C$ $|\Delta(V_{BE1} - V_{BE2})| = 1.0$ MV MAX

SINCE GAIN OF FIRST STAGE ≈ 5, THE V_{BE} TEMP DRIFT FOR Q5 REFLECTED BACK TO V_{GS} OF Q3 BECOMES $\frac{1.0\,mV}{5} = 0.2$ mV

TEMP DRIFT VOLTAGE AT Q3 ≅ 1.0 mV + 0.2 mV = 1.2 mV MAXIMUM FOR A 75° TEMPERATURE EXCURSION EITHER SIDE OF +25°C. WHEN DIFF AMP IS IN GAIN OF ONE, THIS TEMP DRIFT APPEARS AS 1.2 mV ADDED TO EITHER OUTPUT. WHEN DIFF AMP IS IN GAIN OF 3, TEMP DRIFT APPEARS AS 3 × 1.2 mV = 3.6 mV AT EITHER OUTPUT.

FOR Q4A & Q4B TRANSISTOR SPECIFICATION STATES

$\Delta(V_{BE1} - V_{BE2}) = 3\,\mu V/°C$

FOR 75° EXCURSION, $3\,\mu V/°C \times 75°C = .225$ mV. THIS IS A COMMON MODE OFFSET

TOTAL TEMP DRIFT = 1.2 mV + .2 mV = 1.4 mV FOR GAIN = 1
= 3.6 mV + .2 mV = 3.8 mV FOR GAIN = 3

EO

1
K

1B
ΣK

EO

ALSEP 7 JULY

SYSTEM POWER SUPPLY EFFECT

CHANGE IN −30V SUPPLY BY 3% (.9V)

ALTERS CURRENT THROUGH R16 BY:

$$\Delta I_{R16} = \frac{.9V}{36.5K} = 25\,\mu a$$

WHICH CHANGES I_{B4B}

$$\Delta I_{B4B} = \frac{\Delta I_c}{h_{FE}} = \frac{12\,\mu a}{100} = .12\,\mu a$$

A .12μa CHANGE IN R18 AND R19 CAUSES

$$\Delta E_o = .12\,\mu a \times 20k = \boxed{2.5\ mv}$$

ALSO, THE CHANGE IN I_{R16} CAUSES A CHANGE IN V_{BE4B}

$$\Delta V_{BE4B} = \frac{26\,mv\,(1+\beta)\,\Delta I_B}{I_c}$$

$$= \frac{26\,mv\,(1+200)(.12\,\mu a)}{415\,\mu a}$$

$$\boxed{\Delta V_{BE4B} = 1.5\ mv}$$

TOTAL COMMON MODE OFFSET DUE TO 3% CHANGE IN POWER SUPPLY:

$$2.5\,mv + 1.5\,mv = \boxed{4.0\ mv}$$

APPENDIX VIII

ETS Master Drawing List

APPLICATION	
NEXT ASSY	FINAL ASSY

PARTS DISPOSITION
1. USE 3. CANNOT BE REWORKED
2. REWORK 4. RECORD 5. ....

DWG. NO. MDL 609659 REV B

REVISIONS

DISP	EFF	REV	DESCRIPTION	BY	CK	DATE	APPD
4	RCO	A	General Up date			5/3/67	
4	RCO	B	REVISED AND UPDATED	FL		7/11/67	

SHEET INDEX	REV	B	B	B	B	B	B
	SHEET	1	2	3	4	5	6

INTERPRET THIS DRAWING PER STANDARDS IN MIL-D-70327
DIMENSIONS ARE IN INCHES
TOLERANCES ON

DECIMALS: .X ± .1; .XX ± .03; .XXX ± .010; .XXXX ± .0050
ANGLES: ± 0° 30′

SURFACE ROUGHNESS

HOLE DIA.	TOLERANCE
.0135 THRU .125	+ .004 − .001
.126 THRU .250	+ .005 − .001
.251 THRU .500	+ .006 − .001
.501 THRU .750	+ .008 − .001
.751 THRU 1.000	+ .010 − .001
1.000 THRU 2.000	+ .012 − .001
2.001 AND OVER	LINEAR

CONTRACT NO.	S1966-14	
DRAWN	F. Lutz FTL	11-10-66
CHECK	M. Kepler MK	11-10-66
MECH ENGR	G. Kaden GK	11-10-66
ELECT ENGR		11-14-66
PROJ MGR		11-15-66
APPD		
DESIGN ACTIVITY APPD		
CUSTOMER	Rice University	

M L

MARSHALL LABORATORIES
TORRANCE, CALIFORNIA

TITLE
EXPERIMENT TEST SET
ALSEP/SIDE/CCGE
MASTER DRAWING LIST FOR,

SIZE	CODE IDENT NO.	DWG NO.	REV
A	13126	MDL 609659	B

SCALE | RELEASED NOV 22 1966 | SHEET 1 OF 6

ML FORM 34A

6-090-AH

LINE NO.	ASSEMBLY POSITION									QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
	1	2	3	4	5	6	7	8	9					
1										ref.	609250	NC	Block Diagram, ETS System	E
2	X									1	609660-101	NC	Cable Assy., Monitor/Data Proc.	D
3														
4														
5														
6	X									1	609660-101	NC	Cable Assy, ALSEP Sim/Monitor	D
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18	X									1	609660-103	NC	Cable Assy, Data Proc/Display	D
19														
20														
21														
22	X									1	609660-104	NC	Cable Assy, Data Proc/Printer	D
23														
24														
25														
26	X									1	609660-105	NC	Cable Assy, Data Proc/Dataphone	D
27														
28														
29														
30														
31														
32														
33														
34														
35														
36														
37														
38										ref.	609170 DS	NC	Specification, ETS	
39														
40	X										609507	NC	Cable Assy - Interface Test	
41		X									609508	NC	Cable - Interface Test	
42		X									609509	NC	Box - Adapter	
43														
44														
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MODEL NO.

TITLE	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST Experiment Test Set ALSEP/SIDE/CCGE	A	13126	MDL 609659	B
	SCALE		RELEASED	SHEET 2 OF

L FORM 204

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1	X									1	609605-101	A	Assy, ETS Display Unit	E
2														
3														
4														
5		X								1	609602-1	A	Extrusion, Modified	C
6		X								1	609603-1	A	Extrusion, Modified	C
7		X								1	609604-1	B	Front Panel	D
8		X								1	609612-1	A	Filter, Engraved	D
9		X								1	609612-2	A	Filter, Engraved	D
10		X								1	609612-3	A	Filter, Engraved	D
11		X								10	609619-1	A	Bracket, Lamp Mts.	B
12		X								1	609622-1	A	Panel, Power Supply	C
13		X								1	609623-102	B	Instrument Case, Modified	D
14			X							2	609653-1	NC	Bracket, Instrument Case	B
15		X								1	609624-1	NC	Mtg. Strip	B
16		X								2	609625-1	A	Spacer, Mtg. Strip	A
17		X								1	609626-101	A	Connector Panel Assy.	D
18		X								1	609628-1	A	Rear Panel	D
19		X								1	609633-1	A	Engraving, Front Panel	D
20		X								1	609632-1	C	Chassis, Modified	D
21		X								1	609632-2	C	Chassis, Modified	D
22		X								1	609646-1	A	Box, Line Filter	C
23										ref.	609667	NC	Schematic Diagram	R
24										ref.	609681	NC	Wire List	A
25		X								1	609690-1	A	Bracket, Card Holding	C
26														
27														
28														
29														
30														
31														
32														
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MODEL NO.

TITLE— MASTER DRAWING LIST Experiment Test Set ALSEP/SIDE/CCGE	SIZE A	CODE IDENT NO. 13126	DWG NO. MDL 609659	REV B
	SCALE	RELEASED	SHEET 3 OF	

LINE NO.	ASSEMBLY POSITION									QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
	1	2	3	4	5	6	7	8	9					
1	X									1	609606-101	A	Assy, ETS Data Proc. Unit	E
2														
3														
4														
5		X								1	609613-1	A	Panel, Power Supply	D
6		X								1	609616-1	A	Front Panel	D
7		X								1	609623-101	B	Instrument Case, Modified	D
8			X							2	609653-1	NC	Bracket, Instrument Case	B
9		X								1	609624-1	NC	Mtg. Strip	B
10		X								2	609625-1	A	Spacer, Mtg. Strip	A
11		X								1	609627-101	B	Connector Panel Assy.	D
12		X								1	609628-1	A	Rear Panel	D
13		X								1	609631-1	NC	Engraving, Front Panel	D
14		X								1	609632-1	C	Chassis, Modified	D
15		X								1	609632-2	C	Chassis, Modified	D
16		X								1	609646-1	A	Box, Line Filter	C
17		X								1	609647-1	NC	Panel, 5V Power Supply	B
18		X								2	609675-101	A	Card Assy, Timing Input Interface	D
19		X								2	609676-101	A	Card Assy, Comm. Input Interface	D
20		X								1	609676-102	A	Card Assy, Comm. Input Interface	D
21		X								3	609677-101	A	Card Assy, Printer Interface	D
22		X								1	609677-102	A	Card Assy, Printer Interface	D
23		X								1	609678-101	A	Card Assy, Dataphone Interface	D
24		X								1	609692-1	NC	Cover, Fan	B
25										ref.	609685	C	Schematic, Processor Control Ckt.	R
26										ref.	609686	B	Schematic, Printer Control Ckt.	R
27										ref.	609687	B	Schematic, Dataphone Control Ckt.	R
28										ref.	609671	A	Schematic, Timing Input Interface	D
29										ref.	609672	NC	Schematic, Comm. Input Interface	D
30										ref.	609673	A	Schematic, Printer Interface	D
31										ref.	609674	NC	Schematic, Dataphone Interface	D
32										ref.	609682	NC	Wire List	A
33		X								2	609690-1	A	Bracket, Card Holding	C
34														
35														
36														
37														
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TITLE—	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST Experiment Test Set ALSEP/SIDE/CCGE	A	13126	MDL 609659	B
	SCALE	RELEASED	SHEET 4 OF	

LINE NO.	ASSEMBLY POSITION									QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
	1	2	3	4	5	6	7	8	9					
1	X									1	609607-101	A	Assy, ETS ALSEP Simulator	E
2														
3														
4														
5		X								1	609614-1	A	Panel, Power Supply	D
6		X								1	609615-1	A	Panel, 50V Power Supply	C
7		X								1	609617-1	B	Front Panel	E
8		X								1	609618-1	A	Engraving, Front Panel	E
9		X								1	609623-101	B	Instrument Case, Modified	D
10			X							2	609652-1	NC	Bracket, Instrument Case	B
11		X								1	609624-1	NC	Mtg. Strip	B
12		X								2	609625-1	A	Spacer, Mtg. Strip	A
13		X								1	609629-1	A	Rear Panel	D
14		X								1	609630-101	B	Connector Panel Assy.	D
15		X								1	609632-1	C	Chassis, Modified	D
16		X								1	609632-2	C	Chassis, Modified	D
17		X								1	609646-1	A	Box, Line Filter	C
18		X								5	609655-101	A	Card Assy, Comm. Generator	D
19			X							5	W4193	A	Module, One Shot	E
20				X						5	SP 30112-B	L	Header, Module	C
21										ref.	W4193X5	A	P/L, Module	A
22		X								3	609656-101	A	Card Assy, Shaper Line Driver	D
23		X								9	609657-101	NC	Switch Assy, Amplitude	C
24		X								9	609658-101	NC	Switch Assy, Risetime	C
25		X								1	609691-101	NC	Switch Assy, BPS	C
26										ref.	609668	B	Schematic, ALSEP Simulator	R
27										ref.	609670	NC	Schematic, Shaper Line Drvr. Card	D
28										ref.	609680	A	Schematic, Comm. Gen. Card	D
29										ref.	609683	NC	Wire List	A
30		X								2	609690-1	A	Bracket, Card Holding	C
31		X								1	609679-1	NC	Panel, Relay Mtg.	C
32										ref.	S40491	NC	Test. Spec. Module W4193-5	A
33														
34														
35														
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MODEL NO.

TITLE— MASTER DRAWING LIST Experiment Test Set ALSEP/SIDE/CCGE	SIZE A	CODE IDENT NO. 13126	DWG NO. MDL 609659	REV B
	SCALE	RELEASED	SHEET 5 OF	

LINE NO.	ASSEMBLY POSITION 1	2	3	4	5	6	7	8	9	QTY	DRAWING NUMBER	REV LTR	DRAWING TITLE	DWG SIZE
1	X									1	609608-101	A	Assy, ETS Monitor Unit	E
2														
3														
4		X								1	609620-1	A	Front Panel	E
5		X								1	609623-101	B	Instrument Case, Modified	D
6			X							2	609652-1	NC	Bracket, Instrument Case	B
7		X								1	609634-1	NC	Support, DVM	C
8		X								1	609634-2	NC	Support, DVM	C
9		X								2	609635-1	NC	Mtg. Flange, DVM	C
10		X								1	609642-101	NC	Connector Panel Assy.	D
11		X								4	609643-1	A	Standoff, Connector Panel	B
12		X								2	609645-1	NC	Spacer, DVM Support	A
13		X								1	609654-1	NC	Rear Panel	D
14		X								1	609611-1	NC	Engraving, Front Panel	F
15										ref.	609669	A	Schematic, Monitor Unit	E
16										ref.	609684	NC	Wire List	A
17														
18														
19	X									1	609609-101	A	Assy, ETS Printer Unit	E
20														
21														
22		X								1	609644-1	NC	Front Panel, Top	D
23		X								1	609644-2	NC	Front Panel, Bottom	D
24		X								1	609650-101	NC	Instrument Case Modified	D
25			X							1	609648-1	NC	Bracket, Printer Tray	B
26			X							1	609648-2	NC	Bracket, Printer Tray	B
27		X								1	609649-1	A	Tray, Printer	D
28		X								1	609693-1	NC	Bracket, Printer Panel	B
29														
30														
31														
32	X									1	609610-101	A	Assy. EtS Oscillo/Counter Unit	E
33														
34														
35		X								1	609621-101	NC	Front Panel Assy.	D
36		X								2	609636-1	NC	Spacer, Counter Frame	C
37		X								1	609637-1	A	Oscilloscope Case, Modified	C
38		X								2	609638-1	NC	Spacer, Oscilloscope Case	C
39		X								1	609639-1	A	Mtg. Frame, Top	D
40		X								1	609640-1	A	Mtg. Frame, Bottom, Oscilloscope	C
41		X								1	609641-1	NC	Mtg. Frame, Bottom, Counter	C
42														
43														
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MODEL NO.

TITLE—	SIZE	CODE IDENT NO.	DWG NO.	REV
MASTER DRAWING LIST Experiment Test Set ALSEP/SIDE/CCGE	A	13126	MDL 609659	B
	SCALE	RELEASED	SHEET 6 OF	

APPENDIX A

Typical Sine and Random Vibration Test Reports and Requirements

MARSHALL LABORATORIES

TO: Distribution

DATE: 23 June 1967

SUBJECT: ALSEP/SIDE/CCGE
Sine & Random Vibration Test Report

FROM: S. Pollack

INTEROFFICE CORRESPONDENCE

Reference:
1) Simulated Test Model P/N 609298 Serial No. ML322-100
2) Test Spec S-46594 Rev. B (Attached)
3) Approved Engineering Test Lab (AETL) Report (Attached) Vib. 5966-1 Dated 6/19/67 (Test performed 6/14/67)

Purpose

The purpose of this test is to evaluate the integrity of the new thermal isolation structure design (The inner electronic package attachment to outer support housing).

Test Model Configuration

The sine and random vibration test of a simulated test model, reference 1, was conducted at AETL, June 14, containing the following design features and package variations:

1) Plastic bottom (G10 material) outer box
2) Plastic internal to external housing tie down bolts (G10 material)
3) Simulated foam filled blivets with equivalent lead weights
4) Plastic set screws used to couple outer housing to thermal spacer
5) Two sample Reed Relays on top of thermal spacer
6) 1 mounted bubble level & 1 astronaut spacer handle attachment on top of thermal
7) 1 mounted dust cover relay (Dust cover was omitted)
8) Secondary surface mirrors (11 - 1" squares)
9) A mounted top screen grid
10) CCIG & cable reel mounted with captive front cover
11) No legs were utilized
12) Outer box contained numerous skin cutouts

Test Performed

1) Sine vibration in Y-Y Axis
   (a) from 5 cps to 100 cps 2 octaves per minute at a 2g level
   (b) from 5 cps to 100 cps 2 octaves per minute at a 5g level

(c) From 5 cps to 100 cps 1 octave per minute in accordance with Figure 3 of S-46594.

2) Random vibration in Y-Y axis (Not Run)

3) Sine in Z-Z Axis performed similar to Item 1 (Y-Y Axis)

4) Sine and random vibration in X-X Axis (Not Run)

5) Random in Z-Z Axis performed in accordance with specification S-46594 paragraph 3.5.2

Conclusion

The tests performed showed the integrity of the new thermal isolation structure design essentially sound. Due to this modified configuration, however, other areas showed some minor weaknesses that are enumerated in the remaining sections below.

The Reed Relays (2), Dust cover Solenoid and Bubble Level showed no evidence of degradation.

Remarks

The following items represent the various potential problem areas found during this test coupled with corrective action to be taken.

Problem Areas	Recommended Fixes
I Thermal Spacer - Lexan (Fractured several screw hole areas)	a. Provide thicker cross-section b. Provide additional screws c. Add inserts (where omitted) d. Increase screw edge distance e. Use pan head screws
II Plastic tension bolts (Tendency to loosen)	a. Provide bolt with square cross-section b. Use lock washers c. Make out of one piece eliminating extra attachment d. Epoxy end of bolt
III Blivet Foam (Partial foam disintigration)	a. Provide conformal coat spray of foam (ECCO Foam 200)
IV CCIG (Tends to float under random vibration)	a. Provide positioning and locking pins to hold CCIG firmly in place
V Top section of inner wrap around (crack developed)	a. Blivets 400, 500, & 600 to be tied together b. Inner most web section to be tied to vertical member with "S" bracket
VI Screws (Tendancy to backout of instrument)	a. Screw Lock (Locktite) Bonding to be used.

Distribution

D. Aalami
G. Copper
D. Norris
W. Sandstrom
W. Smith
File 1.4.1.6.7

Account No. VIB 5966

Report No. VIB 5966-1

P. O. No. 21227

Date 6/19/67

APPROVED ENGINEERING TEST LABORATORIES
5320 W. 104th St., Los Angeles, Calif. 90045
AETL

Government Contract No. NAS9-5911
Priority Rating DX-A2

COMPANY

Marshall Laboratories
3530 Torrance Blvd.
Torrance, California

DESCRIPTION OF TEST SPECIMEN

One (1) Side Vibration Test Model of Ion Detector, Part Number 609298, Serial Number ML322-100, was submitted for testing.

TEST EQUIPMENT & INSTRUMENTATION

M. B. Electronics Vibration Exciter, M/N C-60, S/N 119
M. B. Electronics Amplifier, M/N T452, S/N 148, 17.5 kva
M. B. Electronics Automatic Control Console, M/N T 388, 80 channel
M. B. Electronics Automatic Vibration Exciter Control, M/N N572
M. B. Electronics Accelerometer Integrator/Amplifier, M/N N504
Minneapolis Honeywell Oscillograph, 12 channel, M/N 906B Visicorder
M. B. Electronics Charge Amplifiers (5), M/N N293, 1 to 1300 g's
M. B. Electronics Accelerometers (2), M/N MB305, S/N's 16334 & 182029
Endevco Accelerometers (3); M/N 2242M4, S/N 6824; M/N 2215, S/N 2801; M/N 2214, S/N 6436, Piezoelectric

TEST PROCEDURES AND TEST RESULTS

The test specimen was installed in the specially designed test fixture and mounted to the electrodynamic vibration exciter as shown in Photographs 1 and 2 of this test report. The test specimen was subjected to R & D Vibration testing, in accordance with Marshall Laboratories Specification No. S 46594, Revision B, dated 5/23/57, as modified by verbal instructions from Marshall Laboratories personnel during the test.

The test specimen was subjected to sinusoidal vibration in the Y axis. Three (3) sinusoidal sweeps were performed, at the following frequencies and vibratory levels:

APPROVED ENGINEERING TEST LABORATORIES
5320 W. 104th St., Los Angeles, Calif. 90045
AETL

TEST PROCEDURES AND TEST RESULTS (continued)

Axis	Frequency (cps)	Vibratory Level	Duration	Run #
Y	10 - 100	± 2 g's	2 minutes	1
	5 - 20	0.37 " DA		
	20 - 100	± 5 g's	2 minutes	2
	5 - 20	0.37 " DA		
	20 - 60	± 7.15 g's		
	60 - 100	± 8.5 g's	4.5 minutes	3

During the Y axis vibration, the vibratory levels were controlled and monitored by means of five (5) accelerometers, located on the test specimen as shown in Figure 1 of this test report. The outputs from the accelerometers were recorded on the oscillograph, and all oscillograph recordings were forwarded to Marshall Laboratories at the conclusion of the test for evaluation.

The test specimen was then re-mounted in the X axis (See Photographs 1 and 2) and subjected to three (3) sinusoidal runs, at the frequencies and vibratory levels as shown above, with the exception that the runs are identified as numbers 4, 5, and 6, respectively. The accelerometer locations are shown in Figure 2 of this test report. The oscillograph recordings were forwarded to Marshall Laboratories for evaluation.

At the conclusion of the sinusoidal vibration in the X axis, the test specimen was subjected to random vibration in the X axis, at the following frequencies and power spectral densities:

Frequency (cps)	Power Spectral Density	Duration	Total Accel.
23 - 60	+ 12 db/octave		
60 - 150	0.387 g^2/cps		
150 - 530	- 12 db/octave		
530 - 2000	0.00185 g^2/cps	5 minutes	7.8 g RMS

The power spectral density versus frequency plot recorded was forwarded to Marshall Laboratories at the conclusion of the test.

TEST PROCEDURES AND TEST RESULTS (continued)

During all vibration testing, the test specimen was monitored for any evidence of failure by Marshall Laboratories personnel. At the conclusion of the random vibration test in the X axis, the testing was discontinued by Marshall Laboratories personnel pending further evaluation of the test specimen.

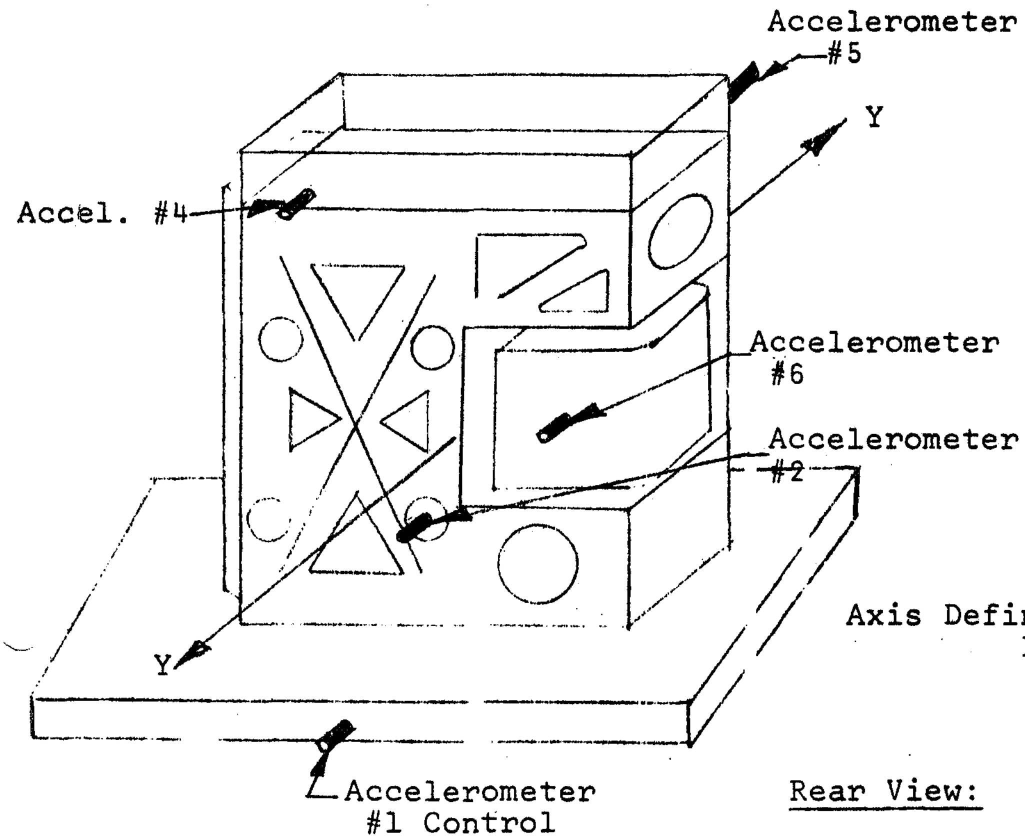
STATE OF CALIFORNIA
COUNTY OF LOS ANGELES } ss.

Aaron Cohen, Lab Director, being duly sworn, deposes and says: That the information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

SUBSCRIBED and sworn to before me this 19 day of June, 1967

Notary Public in and for the County of Los Angeles, State of California.
JAN LEWIS
My Commission Expires May 2, 1970

JAN LEWIS
NOTARY PUBLIC, CALIFORNIA
PRINCIPAL OFFICE IN
LOS ANGELES COUNTY

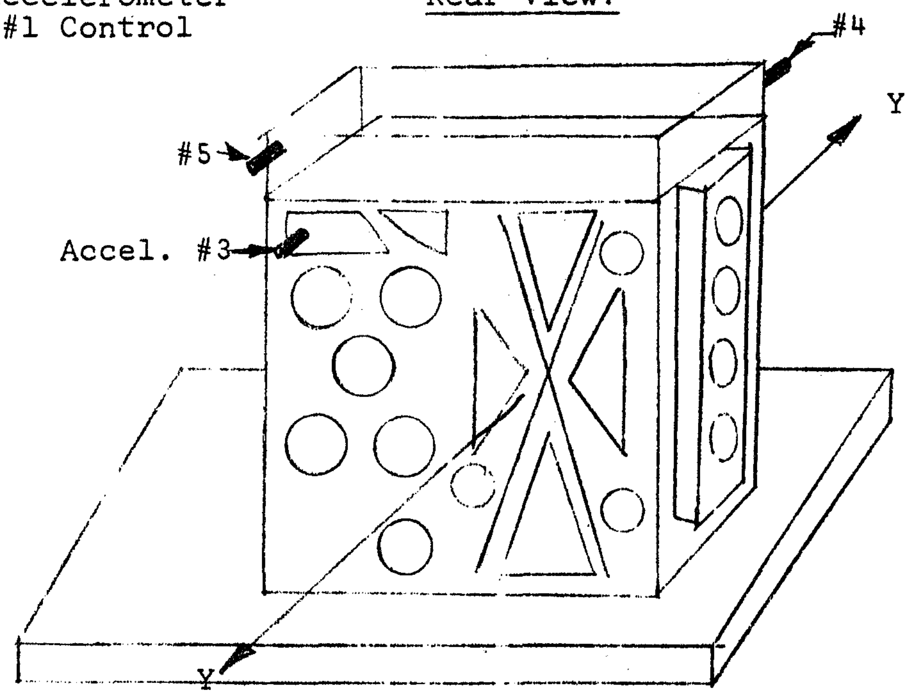


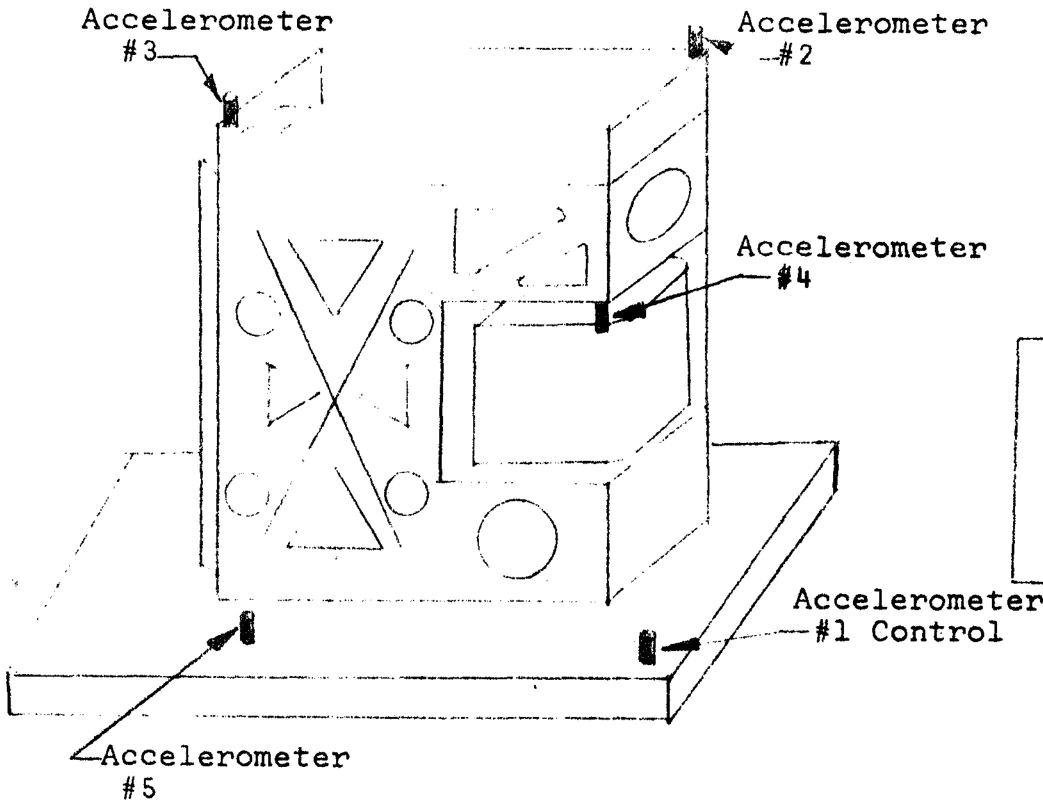
Accel. #	Visicorder Channel #
2	2
3	5
4	3
5	4

Figure 1

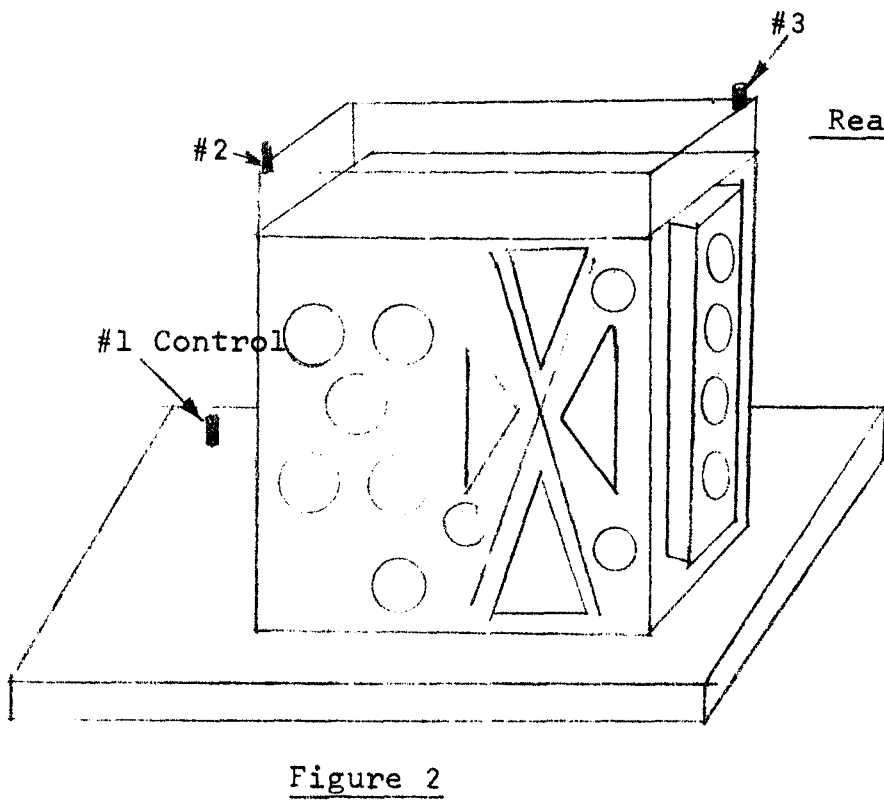
Axis Definitions & Accelerometer Locations - Y Axis

Rear View:





Accel. #	Visicorder Channel #
2	2
3	3
4	5
5	4



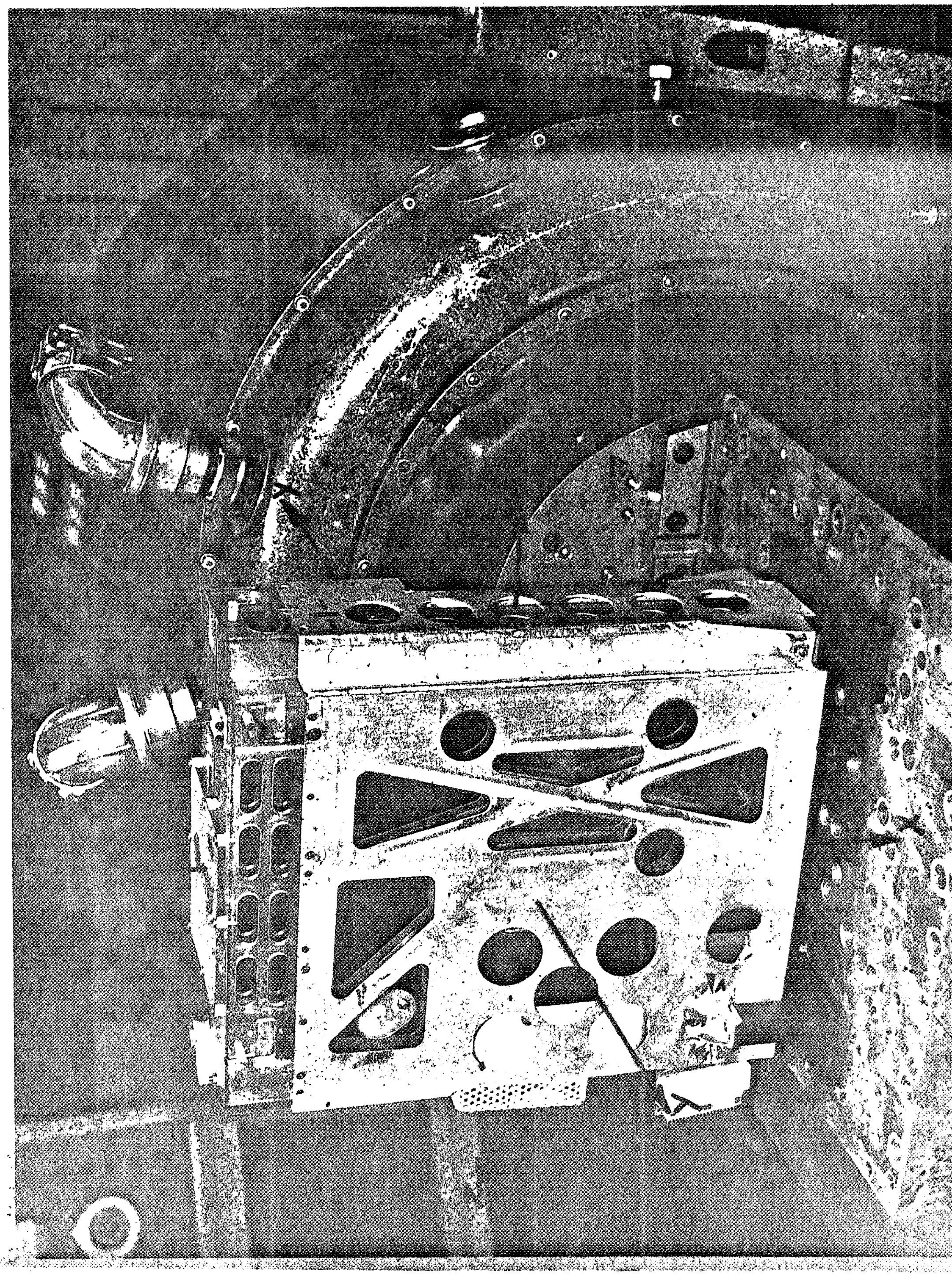
Rear View

Figure 2

Axis Definitions & Accelerometer Locations
X Axis

PHOTOGRAPH 1

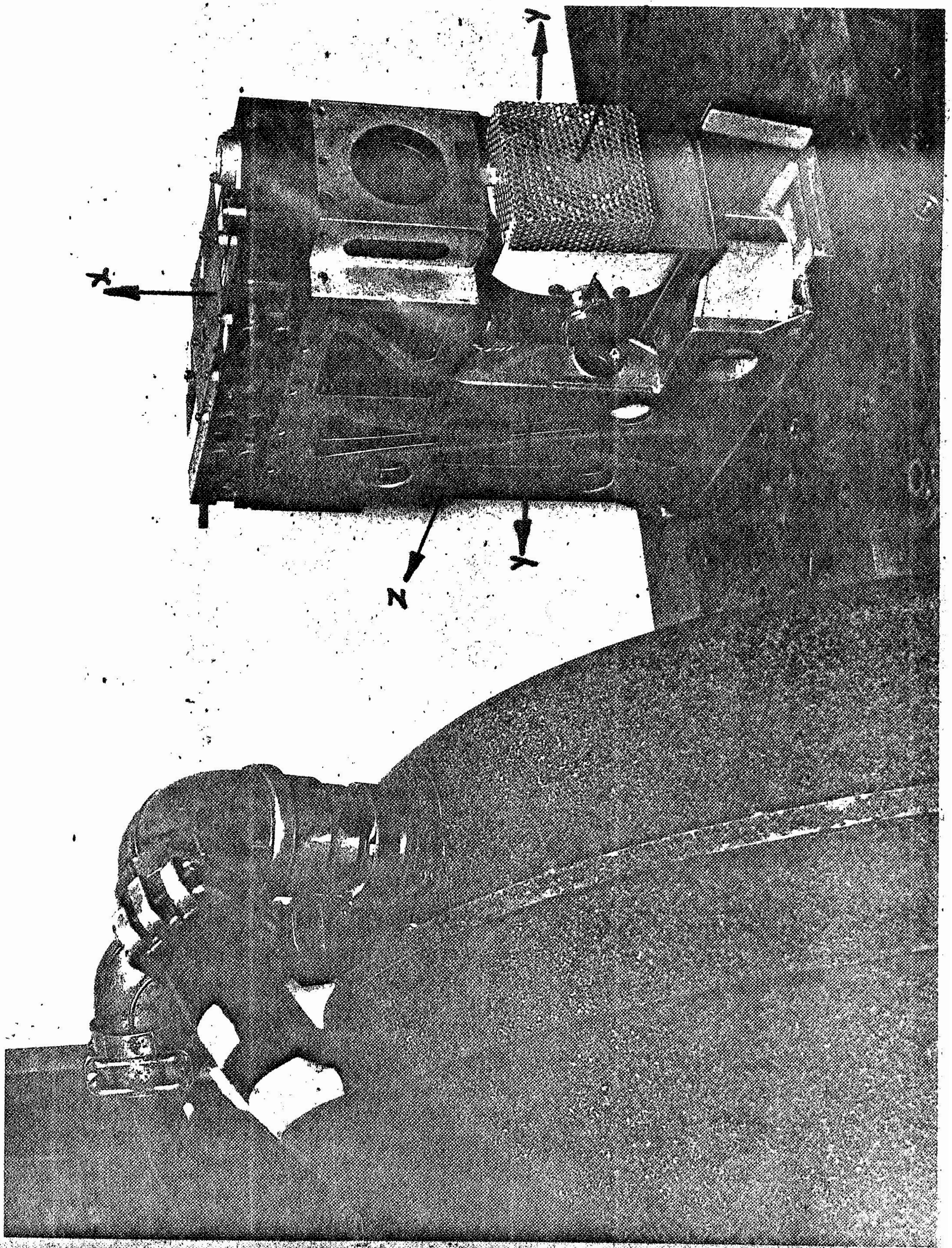
SPECIMEN MOUNTING CONFIGURATION
& AXIS DEFINITIONS (Y AXIS)



APPROVED ENGINEERING TEST LABORATORIES

PHOTOGRAPH 2

REAR VIEW - SPECIMEN IN Y AXIS



Marshall Labs . VIG 5966-1 Photo 1

5-6 hours

Sam Pollack
23 February 1968

INTERIM QUAL VIBRATION TEST REQUIREMENT FOR S/N 4 ALSEP SIDE

OBJECTIVE

1. To evaluate the electrical and mechanical integrity of Blivets 700 and 900 when subjected to a Qual level sinusoidal vibration test.

2. To evaluate secondary surface mirror cement.

3. To evaluate dust cover with or without securing lanyard pin.

TESTS - REQUIREMENTS

1. Sine-Vibration test shall be in accordance with test profile, Figure 1. Axis of vibration are shown in Figure 2. All 3 axis are to be vibrated.

   1.1 Use of a strip chart recorder shall be employed to obtain vibration input to ALSEP/SIDE (Test sample). Also provisions for 2-3 pick ups shall be provided for test sample outputs ("Q").

   1.2 Test report shall be provided.

   1.3 Photos as required by Marshall Laboratories.

INTERIM QUAL VIBRATION SINUSOIDAL

TEST FOR ALSEP/SIDE, S/N 1

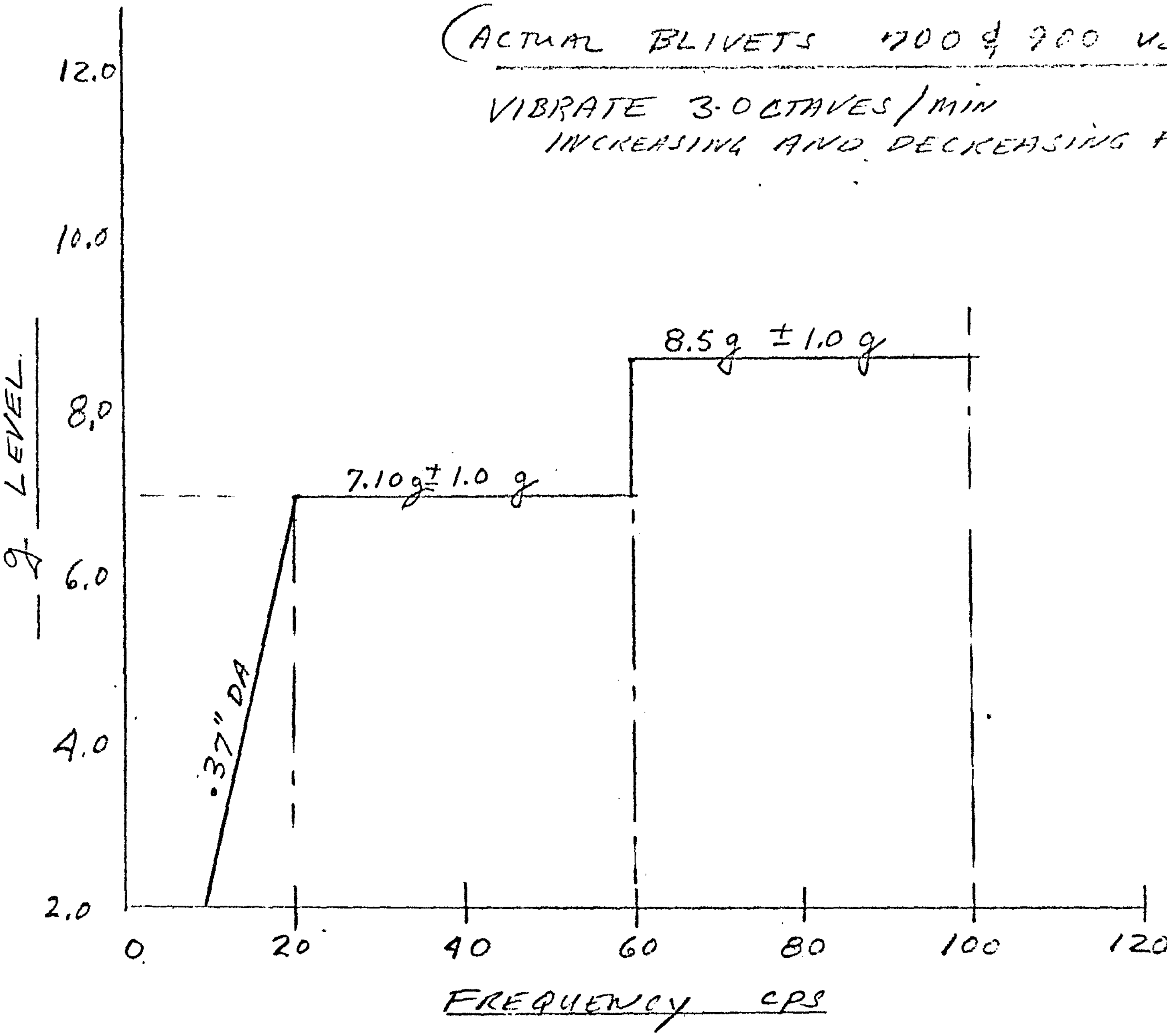


FIGURE # 1

2/23/68

INTERIM S/N 4 MODIFIED QUAL TEST

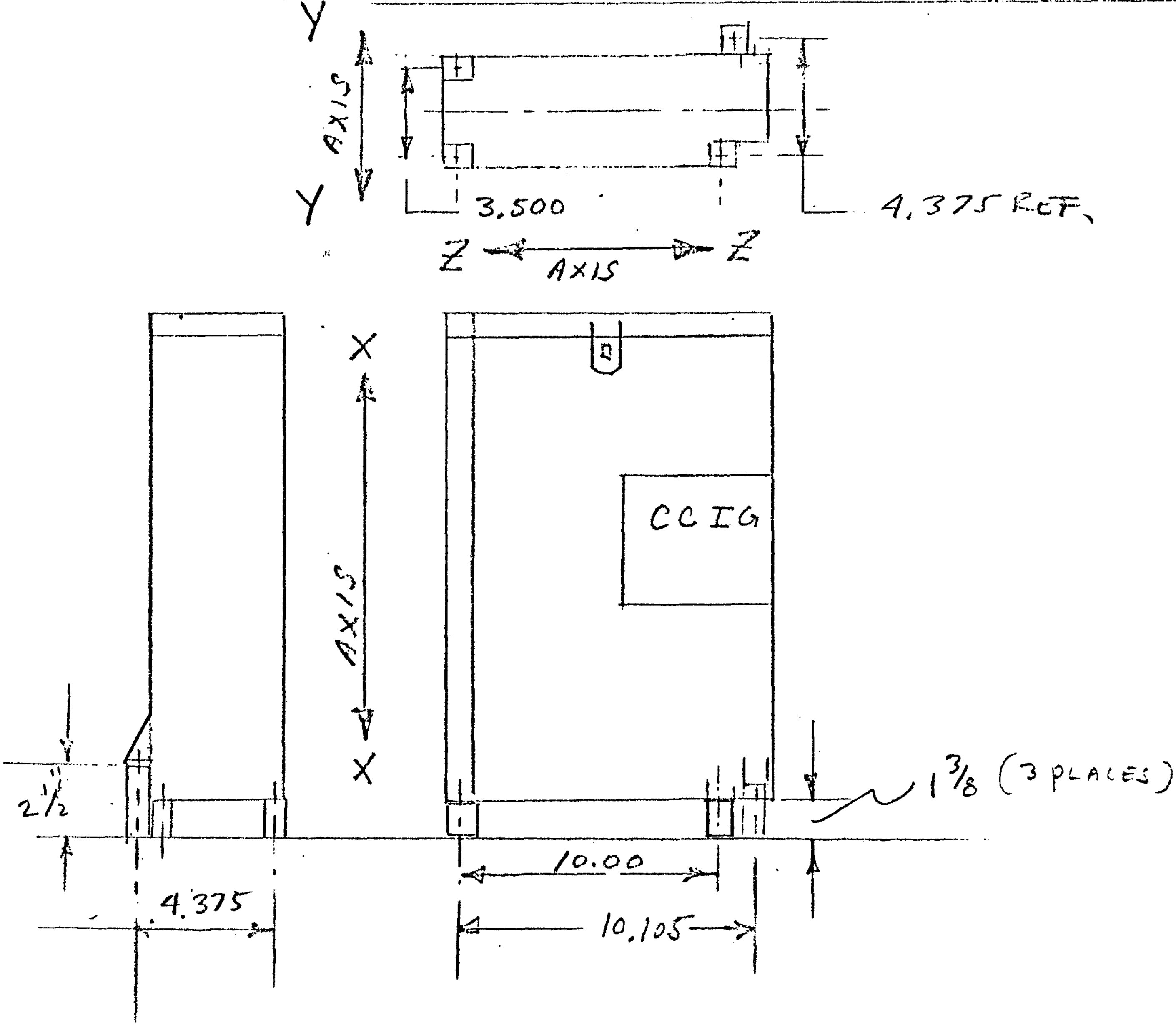


FIGURE #2

APPROVED ENGINEERING TEST LABORATORIES
5320 W. 104th St., Los Angeles, Calif. 90045
AETL

Account No.	533-7404
Report No.	533-7404-1
P.O. No.	25824
Date	6/10/68

Priority Rating: DX-A2

COMPANY

Marshall Laboratories
3530 Torrance Boulevard
Torrance, California 90503

DESCRIPTION OF TEST SPECIMENS

Two (2) Alsep/Sides, Part Number, Blivet 700, Systems 7 and 5, were submitted for testing.

TEST EQUIPMENT AND INSTRUMENTATION

Endevco Corporation Accelerometer, M/N 2213 M5, S/N EC 48, No. D39
Endevco Corporation Accelerometer, M/N 2213 M5, S/N EC 60, No. D43
Endevco Corporation Accelerometer, M/N 2214, S/N 6436, No. D31
Endevco Corporation Accelerometer, M/N 3314, S/N 9510, No. D30
M. B. Electronics Accelerometer Integrator/Amplifier, M/N N504 T1
M. B. Electronics Automatic Vibration Exciter Control, M/N N572
M. B. Electronics Vibration Exciter, M/N C-60, S/N 119, No. D10
M. B. Electronics Amplifier, M/N T452, S/N 148, Range: 17.5 kva
Endevco Corporation Dynamonitor, M/N 2702B, S/N DA 54, No. D120
M. B. Electronics Charge Amplifiers (3), M/N N293, No.'s, E181, 182, 184
Minneapolis Honeywell Oscillograph, 12 Channel, M/N 906B Visicorder

TEST PROCEDURES AND TEST RESULTS

The test specimens were subjected to sinusoidal vibration in accordance with the instructions of Marshall Laboratories representatives present during the test program.

The test specimens were installed on the vibration exciter and simultaneously subjected to sinusoidal vibration for a period of 2.4 minutes in each of the three mutually perpendicular axes, as shown in Figure 1 of this test report. The frequencies and vibratory levels were as follows:

Frequency (cps)	Vibratory Level
5 - 20	0.284" DA
20 - 60	± 5.5 g's
60 - 100	± 6.5 g's
100 - 60	± 6.5 g's
60 - 20	± 5.5 g's
20 - 5	0.284" DA

During vibration, the outputs from the control accelerometer mounted on the test fixture, and three monitor accelerometers located on the test specimen as shown in Figure 1, were recorded on a Visicorder. The visicorder recordings obtained were forwarded to Marshall Laboratories under separate cover.

At the conclusion of vibration in each axis, the test specimens were visually examined for evidence of damage or deterioration.

The test specimens complied with the specification requirements in all respects. There was no evidence of damage or deterioration noted as a result of vibration testing.

JAN LEWIS
NOTARY PUBLIC, CALIFORNIA
PRINCIPAL OFFICE IN
LOS ANGELES COUNTY

STATE OF CALIFORNIA
COUNTY OF LOS ANGELES } ss.

Art Edelstein, Lab. Director, being duly sworn deposes and says: That the information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

SUBSCRIBED and sworn to before me this 10th day of June, 1968

Notary Public in and for the County of Los Angeles, State of California.
JAN LEWIS
My Commission Expires May 2, 1970

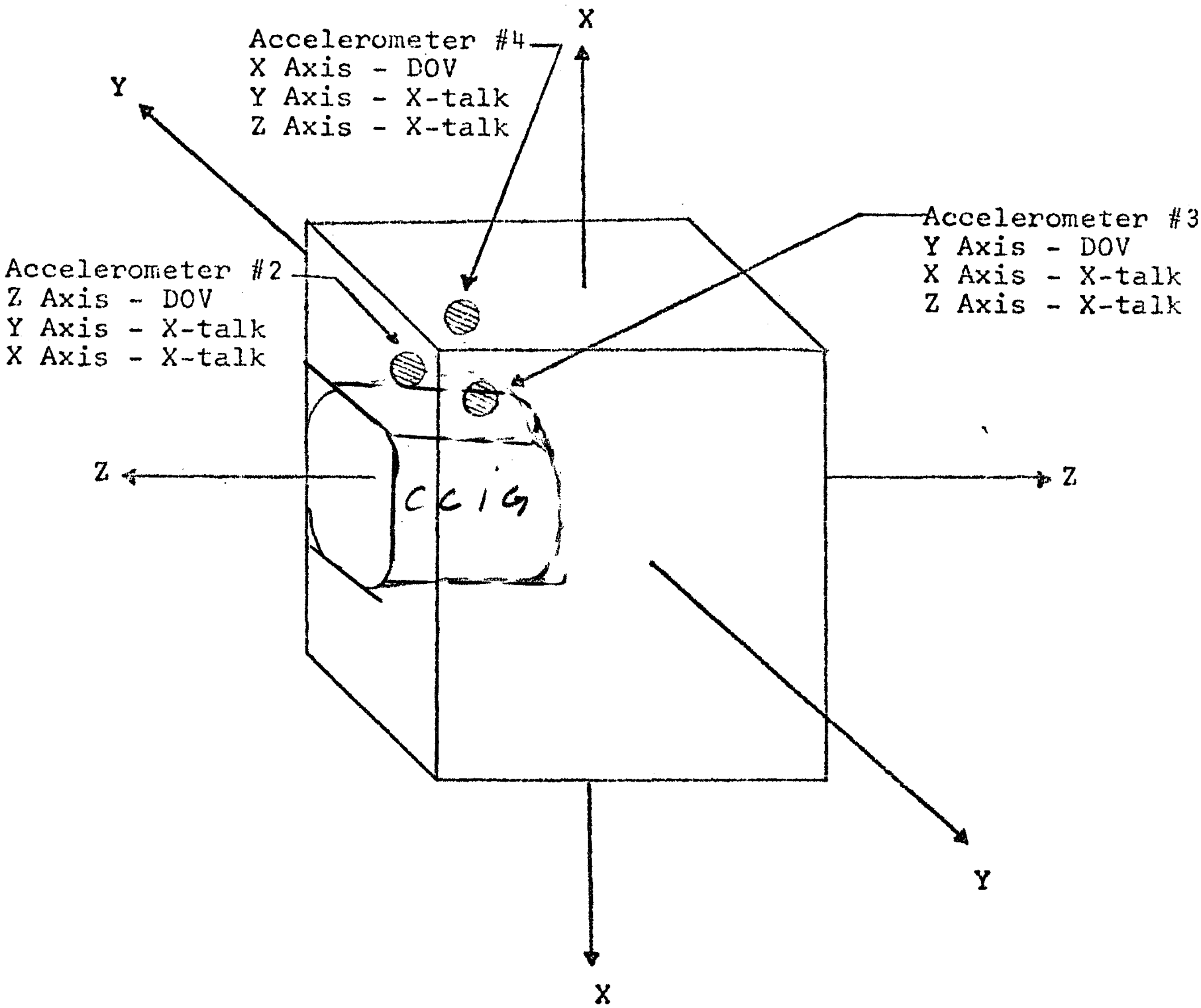
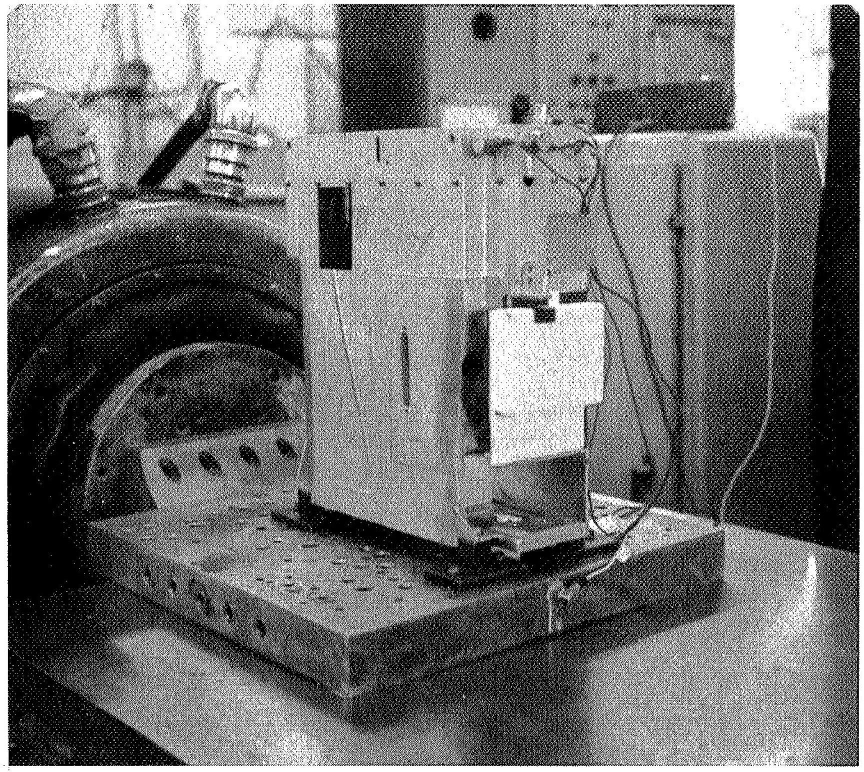
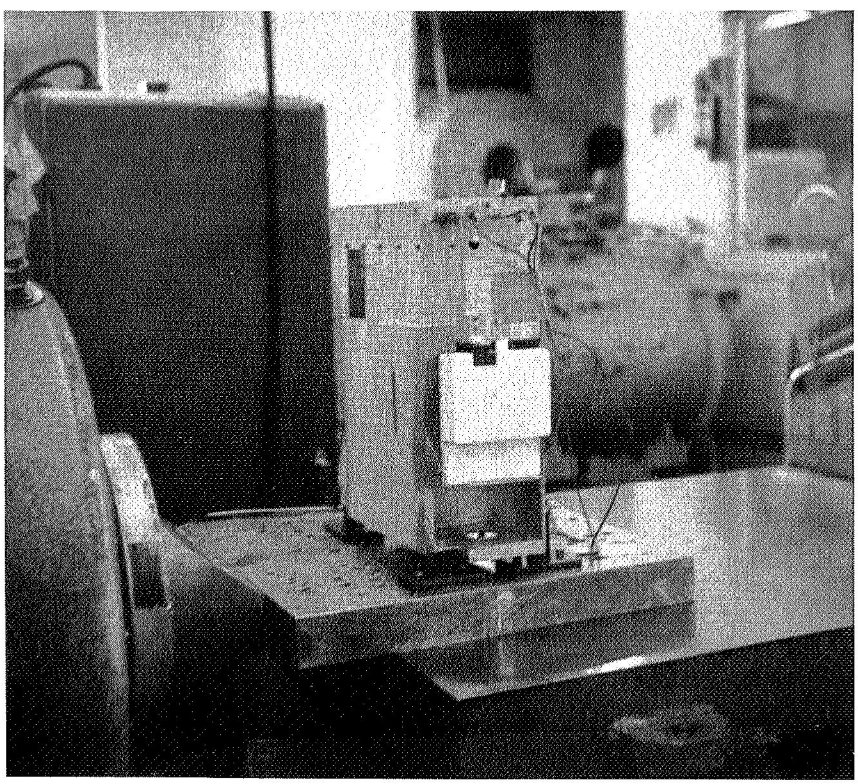


FIGURE 1

AXIS IDENTIFICATION AND
ACCELEROMETER LOCATIONS



X-X AXIS



Y-Y AXIS

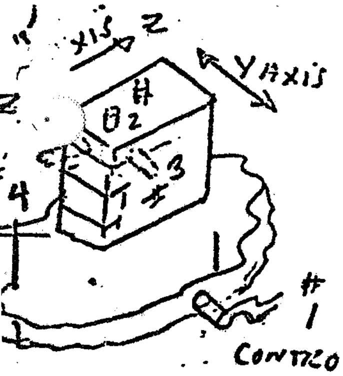
AETL-VIBRATION- 2 BLIVETS 700 FOR S/N 7 AND S/N 5
ALSO EVALUATED NEW CCIG COVER ACCEPTANCE LEVELS 6/7/68

SINE-VIBRATION ACCEPTANCE LEVELS

ALSEP / SIDE (MODIFIED CONFIG) 2 - 700 & ~~500~~ BLIVETS

SWEEP RATE 4 OCTAVES/MIN. 6/6/68

(X, Y & Z AXIS)



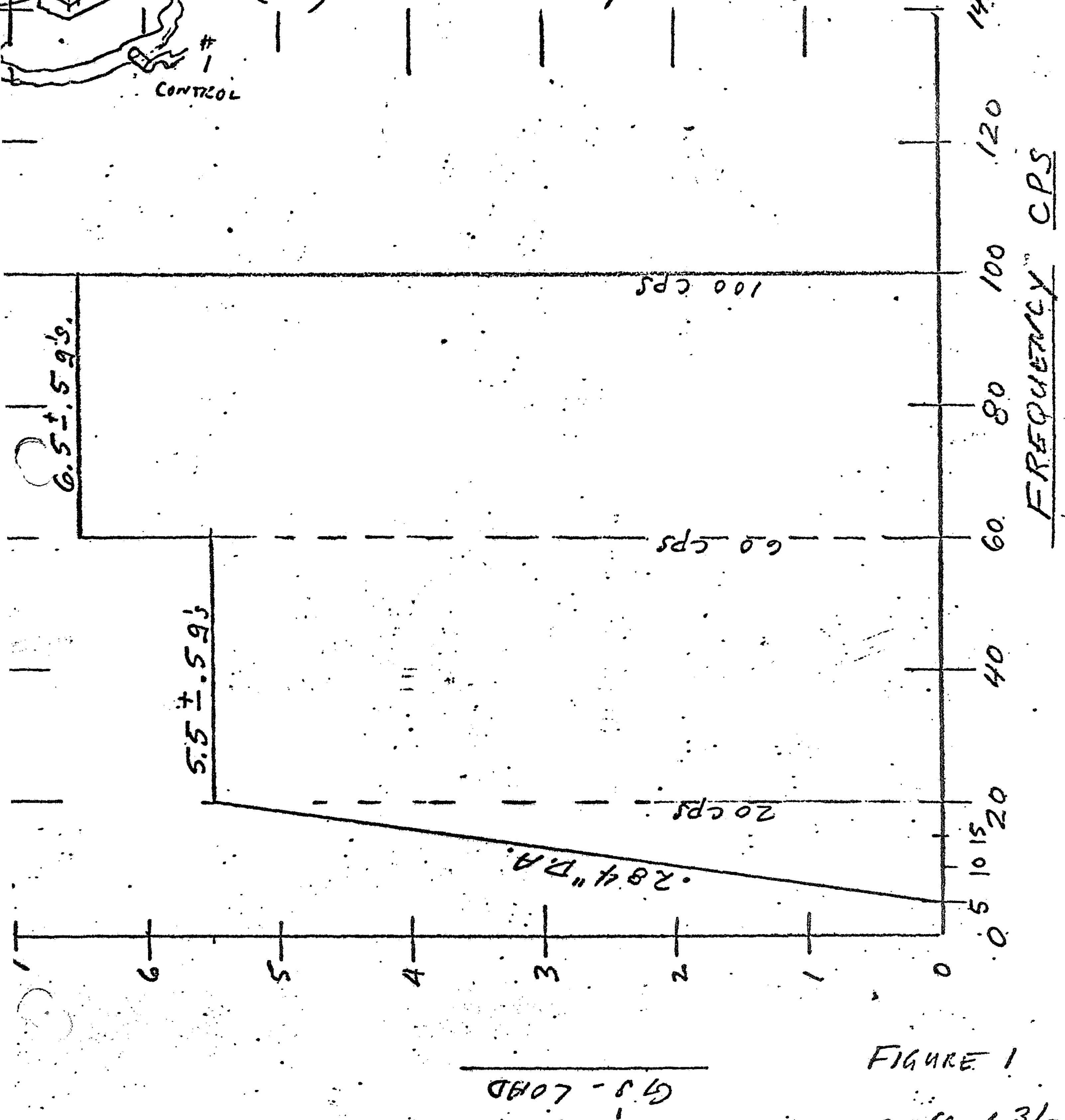


FIGURE 1

8Bolleck 3/7/68

The following documents provide additional information on ALSEP/SIDE/CCGE Vibration tests:

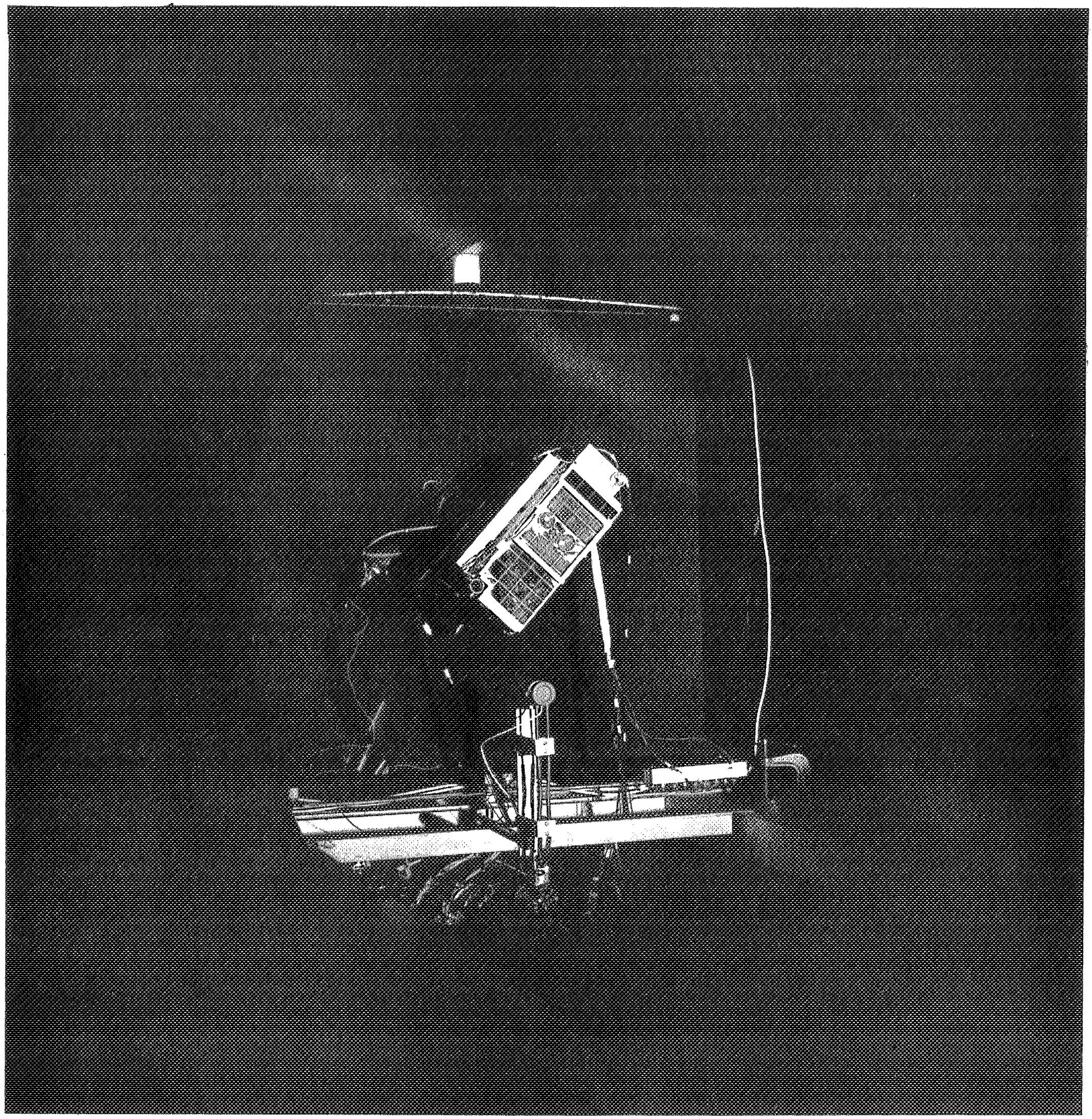
a) ML Memo, dated October 23, 1967 and November 6, 1967 (from S. Pollack) - "ALSEP/SIDE Vibration Testing at Bendix"

b) Bendix Memo, dated October 25, 1967 (from G. R. Frank) - "Typical Chronological Timed Sequence of Events Occuring during a Vibration Test"

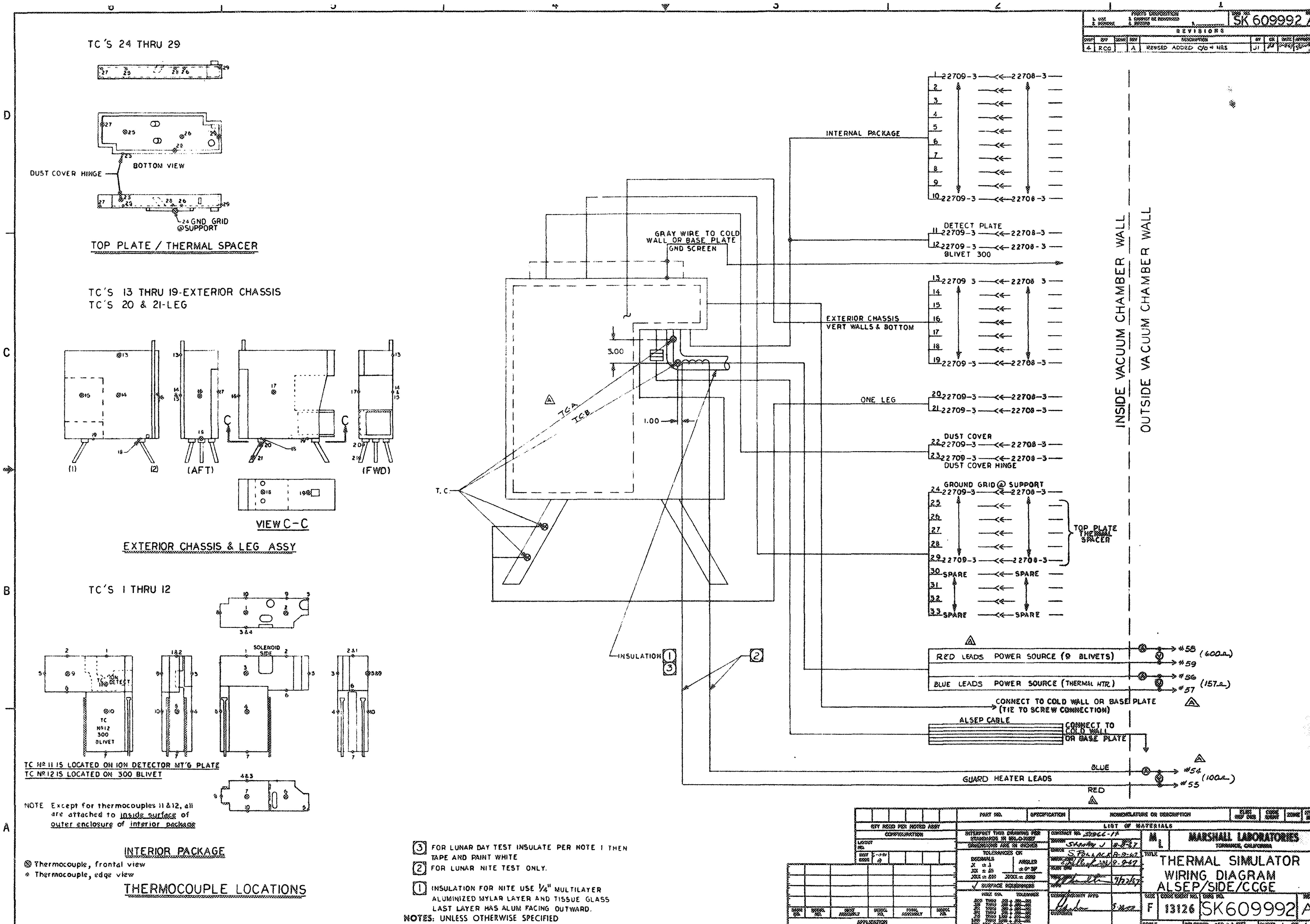
c) ML Memo, dated 23 June 1967 (from S. Pollack) - "Sine and Random Vibration Test Report"

APPENDIX B

Thermal Control



APOLLO LUNAR SURFACE EXPERIMENT
(SUPRATHERMAL ION DETECTOR)
LUNAR DAYTIME THERMAL TEST SIMULATION
NOTE: SECONDARY SURFACE MIRRORS 1 INCH SQUARES



SK 609992 A
REVISIONS
4 RCG A REVISED ADDED C/O # NRS
TC'S 24 THRU 29
BOTTOM VIEW
DUST COVER HINGE
24 GND GRID @SUPPORT
TOP PLATE / THERMAL SPACER
TC'S 13 THRU 19-EXTERIOR CHASSIS
TC'S 20 & 21-LEG
(1)
(2)
(AFT)
(FWD)
VIEW C-C
EXTERIOR CHASSIS & LEG ASSY
TC'S 1 THRU 12
SOLENOID SIDE
TC NR 11 IS LOCATED ON ION DETECTOR MT'G PLATE
TC NR 12 IS LOCATED ON 300 BLIVET
NOTE Except for thermocouples 11 & 12, all are attached to inside surface of outer enclosure of interior package
INTERIOR PACKAGE
⊗ Thermocouple, frontal view
• Thermocouple, edge view
THERMOCOUPLE LOCATIONS
GRAY WIRE TO COLD WALL OR BASE PLATE
GND SCREEN
3.00
1.00
TC A
TC B
T. C
INSULATION 1 3
2
INTERNAL PACKAGE
DETECT PLATE
BLIVET 300
EXTERIOR CHASSIS VERT WALLS & BOTTOM
ONE LEG
DUST COVER
DUST COVER HINGE
GROUND GRID @ SUPPORT
TOP PLATE THERMAL SPACER
1 22709-3 22708-3
10 22709-3 22708-3
11 22709-3 22708-3
12 22709-3 22708-3
13 22709-3 22708-3
19 22709-3 22708-3
20 22709-3 22708-3
21 22709-3 22708-3
22 22709-3 22708-3
23 22709-3 22708-3
24 22709-3 22708-3
29 22709-3 22708-3
30 SPARE SPARE
33 SPARE SPARE
INSIDE VACUUM CHAMBER WALL
OUTSIDE VACUUM CHAMBER WALL
RED LEADS POWER SOURCE (9 BLIVETS)
BLUE LEADS POWER SOURCE (THERMAL HTR)
#58 (600Ω)
#59
#56 (157Ω)
#57
CONNECT TO COLD WALL OR BASE PLATE (TIE TO SCREW CONNECTION)
ALSEP CABLE
CONNECT TO COLD WALL OR BASE PLATE
BLUE
GUARD HEATER LEADS
RED
#54 (100Ω)
#55
3 FOR LUNAR DAY TEST INSULATE PER NOTE 1 THEN TAPE AND PAINT WHITE
2 FOR LUNAR NITE TEST ONLY.
1 INSULATION FOR NITE USE 1/4" MULTILAYER ALUMINIZED MYLAR LAYER AND TISSUE GLASS LAST LAYER HAS ALUM FACING OUTWARD.
NOTES: UNLESS OTHERWISE SPECIFIED
LIST OF MATERIALS
MARSHALL LABORATORIES
TORRANCE, CALIFORNIA
THERMAL SIMULATOR
WIRING DIAGRAM
ALSEP/SIDE/CCGE
F 13126 SK609992 A

Preliminary
B5

PREPARED FOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

SPACE ENVIRONMENT EFFECTS LABORATORY

REPORT NUMBER 44-07-24 JOB NUMBER 1-3419-1

ALSEP/SUPRATHERMAL ION DETECTION EXPERIMENT, THERMAL MODEL TEST

TEST NUMBER 21-E-67

Prepared by: J. Rosow
J. Rosow
Technical Writer

Approved by: J. Cavalier for
F. R. Holt
Assistant Technical Supervisor

Approved by: C. E. Gist
C. E. Gist
Technical Supervisor

BROWN & ROOT-NORTHROP

August 23, 1967

APPEND

ALSEP/SUPRATHERMAL ION DETECTION EXPERIMENT, THERMAL MODEL TEST

OBJECT

The object of this test was to determine the effects of a simulated lunar environment upon the ALSEP/Suprathermal Ion Detection Experiment Thermal Model. The test article was to be subjected to simulated "lunar noon" and "lunar day/worst case" conditions.

SUMMARY OF RESULTS

The two phases of thermal vacuum testing were conducted over a period of 43.5 hours. During the first phase, "lunar noon" conditions were maintained. During the second phase, "lunar day/worst case" conditions were maintained.

TEST DATES

August 16 through August 17, 1967

ITEM TESTED

Apollo Lunar Surface Experiment Package / Suprathermal Ion Detection Experiment, Thermal Model

INSTRUMENTATION

1. The test was performed in Chamber E, SEEL
2. 1 Genarco ME-6 Solar Simulator
3. 46 copper constantan thermocouples:
   - 7 on the LN_2 liner
   - 6 on the lunar plane
   - 4 on the lunar plane fins
   - 29 on the test article
4. 1 Veeco ion gauge with Veeco ion gauge controller, Model RG-21X
5. 2 Consolidated Ohmics Devices, Inc. 150°F Reference Junction Boxes
6. Beckman Digital Data System
7. Hy-Cal 8400 Series Radiometer

WITNESSES

F. R. Holt	BRN/SEEL
S. E. Cavalier	BRN/SEEL
J. W. Clepper	BRN/SEEL
L. S. McCullough	BRN/SEEL
W. A. Parkan	NASA/SEES

PROCEDURE

The ALSEP/SIDE Thermal Model was subjected to two phases of thermal vacuum testing in Chamber E for a period of 43.5 hours.

Prior to the test, the lunar plane was equipped with four 8-in fins. A 2500-watt quartz lamp and one thermocouple were installed on each fin. The test article was then mounted on the lunar plane, which was positioned at a 90° angle to the solar beam for the "noon condition" portion of the test. Twenty-nine thermocouples were attached to the test article, and 6 were attached to the lunar plane. The LN_2 liner was equipped with 7 thermocouples. Because the Pacific Data System 1020 Computer was out of order, all thermocouples were connected to the Beckman Digital Data System and printed out in millivolts. It was, therefore, necessary to convert each thermocouple reading from millivolts to Engineering Units individually. Figure 1 illustrates the relationship between time and the temperatures recorded by two strategic thermocouples.

The Thermal Model of the ALSEP/SIDE package used in the test was provided with a heater which controlled the internal temperature of the test article and simulated the heat that would normally have been produced by the internal instrumentation of the operating SIDE package. This heater was to be supplied with 5.4 watts of power throughout the test.

During both phases of the test, the chamber pressure was maintained below the required maximum of 1 x 10^{-5} torr, and the solar simulator was operated at 1 $\pm$ .05 solar constants. The temperature of the lunar plane was maintained at the desired +250°F during most of the test. Sufficient data were recorded during the test to formulate graphs depicting the rate and degree of changes in temperature and pressure during the entire 43.5 hours of testing. (Figures 1 and 2)

RESULTS

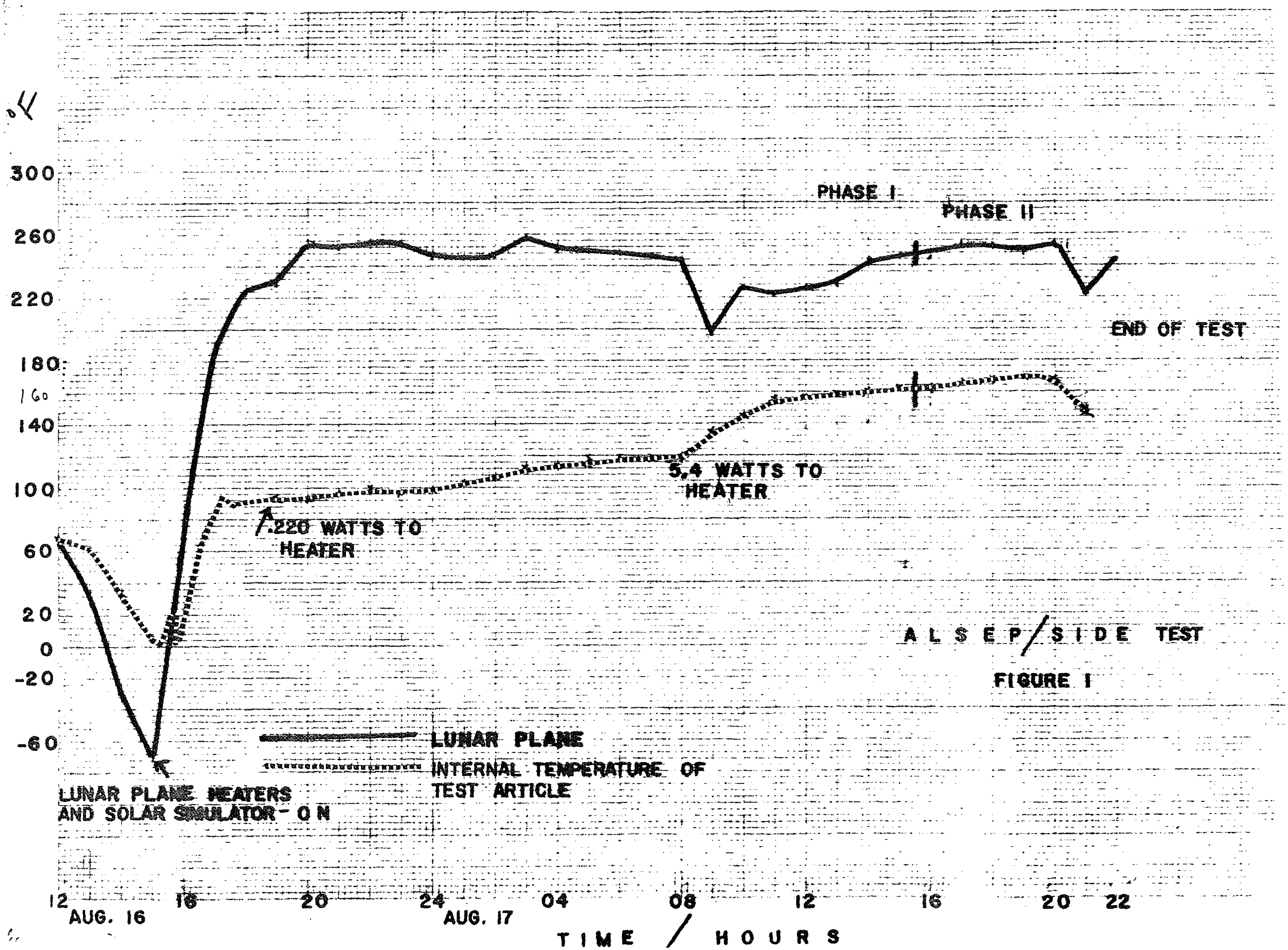
The desired chamber environment was maintained during the entire test.

On the morning of August 16, the chamber was pumped down below the 10^{-5} torr range. At 1500 hours on the same day, the solar simulator and the lunar plane heaters were turned on to operate during the entire test. The high temperatures soon caused the freshly painted lunar plane to outgas considerably, resulting in higher pressure readings for a short time. (see Figure 2)

During Phase I, the power to the test article heater was erroneously set at .220 watts instead of the required 5.4 watts. This condition was corrected later in Phase I, and 5.4 watts of power were supplied to the test article heater during the remaining portions of the test.

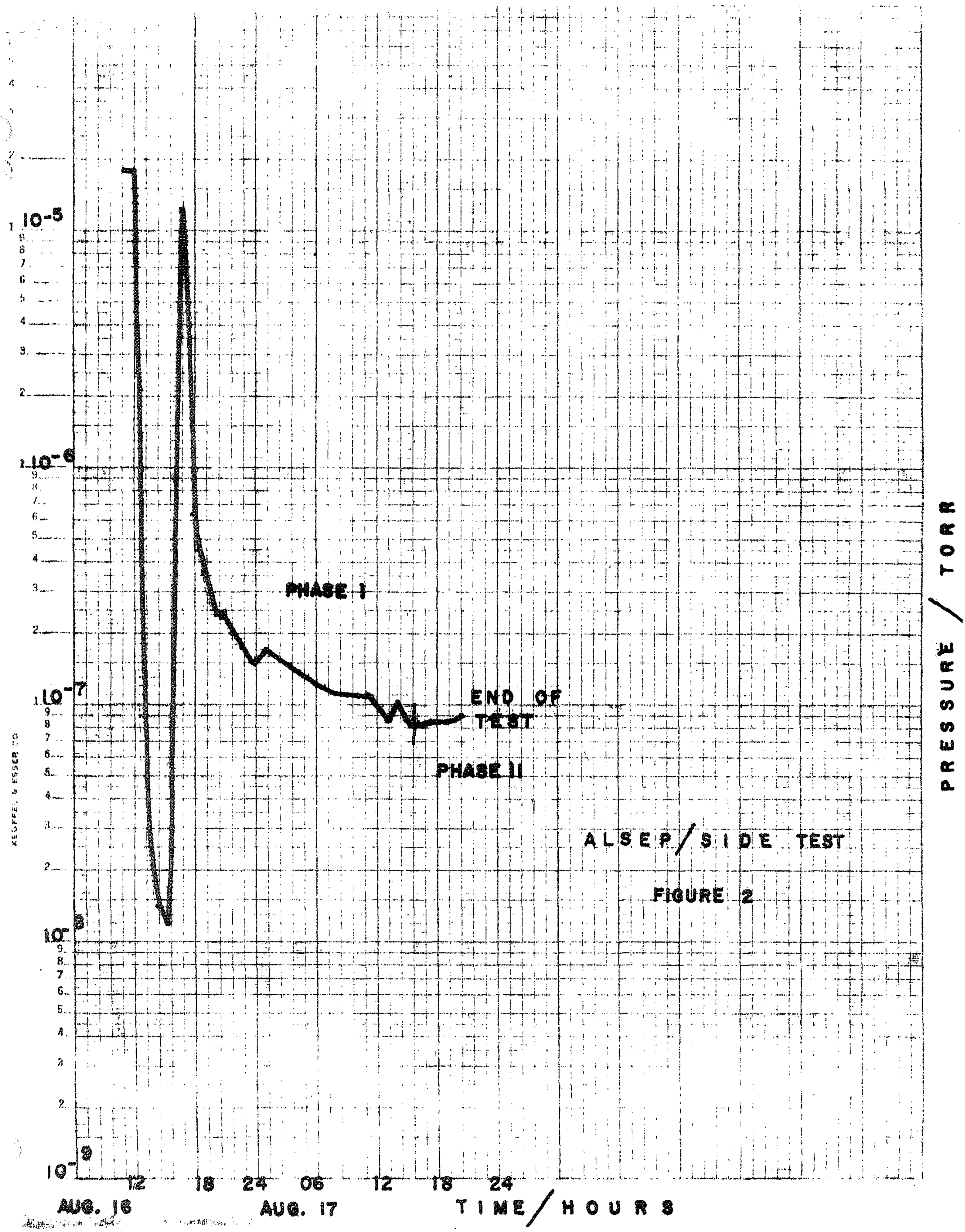
At 1500 hours on August 17, the lunar plane was rotated 10° to form an 80° angle with the solar beam; and Phase II of the test was started. During this part of the test, "lunar day/worst case conditions" were simulated. Temperatures and pressures similar to those of Phase I were maintained. At 2030 hours, August 17, the solar simulator and the 5.4 watts of power to the test article heater were turned off. This ended the test.

TRACING PAPER NO. 1227-1G4
CROSS SECTION-10X10 TO ½ INCH
MADE IN USA



A L S E P / S I D E TEST

FIGURE I



ALSEP/SIDE TEST

FIGURE 2

GENERAL SPECIFICATION GUIDE FOR OCLI SI-100 MIRRORS FOR USE AS THERMAL CONTROL DEVICES

- October, 1967 -

The SI-100 mirror was recently developed by Optical Coating Laboratory for use as a thermal control device in spacecraft.

In the space environment, controlled heating or cooling of hardware can be achieved by the control of thermal radiation incident on the space package. A reduction of the absorptance of thermal radiation coupled with high infrared emittance is essential for realizing low stabilization temperatures. Due to its high intensity, the sun is the primary source of this thermal radiation; thermal control in space, therefore, has to deal mainly with the control of solar irradiation.

SI-100 mirrors have been designed to reflect nearly all of the incident solar radiation. Total absorptance of solar radiation is held to less than 6%; in addition, these mirrors are highly emitting at temperatures below several hundred degrees Fahrenheit; average emittance beyond 7μ is approximately 85%. When mounted properly, SI-100 mirrors are instrumental in controlling stabilization temperatures of satellites and/or space hardware in the space environment. In applications where extremely low stabilization temperatures are desirable, these mirrors have been found to be the most efficient devices available. SI-100 mirrors have been used very successfully, for example, on programs such as the "Lunar Orbitor."

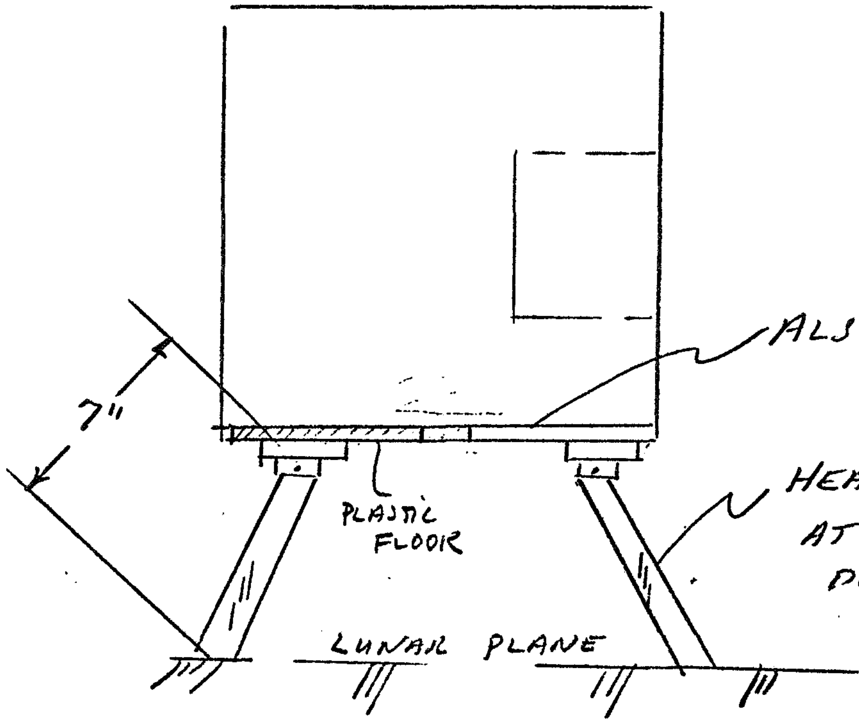
Weight considerations coupled with requirements for ease of handling and mounting dictate the size of SI-100 mirrors. In other words, mirrors have to be thin enough so that they do not present a weight problem; in addition, because they are thin, individual mirrors cannot be large or the problem of handling them would become insurmountable.

Mirrors manufactured and coated by OCLI to data have been for the most part, 0.008" thick fused silica or microsheet flats; cylindrical mirrors to cover external tubing on satellites have also been produced. Using past requirements and existing tooling as a basis, OCLI has chosen a size of approximately 1" x 1" as a standard item; a number of mirrors, 1-1/2" x 1-1/2", have also been produced.

SI-100 mirrors are generally attached to hardware by use of a room temperature vulcanizing (general classification of RTV-) cement of the type manufactured by General Electric and Dow Corning. Users of SI-100 mirrors have found that small mirrors can easily be assembled into panels using existing solar cell cover slip assembly techniques.

(1) THERMAL CONSIDERATIONS 12/19/67

WITH NEW LEG SUPPORT DESIGN APPEND



LUNAR NIGHT

FIBER GLASS HEAT LEAK RATE

BASED ON ACTUAL TEST (LUNAR NITE)

WITH LUNAR PLANE AT -250°F THE ALSEP/SIDE BASE MEASURED APPROX -190°F AERO THERM'S HEAT LEAK CALCULATION SHOWS A LEAK RATE OF APPROX .05 BTU/HR FOR ALL 3 LEGS.

LOSS DUE TO LEG IS AT SURVIVAL $\dfrac{.05 \text{ BTU/hr} \times 100}{3 \text{ LEGS} \times 10.3 \text{ BTU/hr}} \cong .2\%$

FASTENING LEG TO PLASTIC FLOOR OR DIRECT TO ALUMINUM BASE STRUCTURE WOULD NOT AFFECT THERMAL CONFIGURATION

APPEND.

(2)

THERMAL CONSIDERATIONS

CONTINUED

LUNAR DAY

HEAT DISSIPATION FOR A LUNAR DAY CALCULATED BY AEROTHERM IS APPROX 360 BTU/hr

THE LEG LOSS HERE IS AGAIN CONSIDERED NEGLIGIBLE (.05 BTU/hr)

THE CRITICAL FACTOR IN OBTAINING THIS LOW HEAT LOSS THROUGH THE LEG IS ESSENTIALLY THE 7" LENGHT of FIBER GLASS TUBE WHICH HAS A CONDUCTANCE factor of .0002 BTU/hr°F.

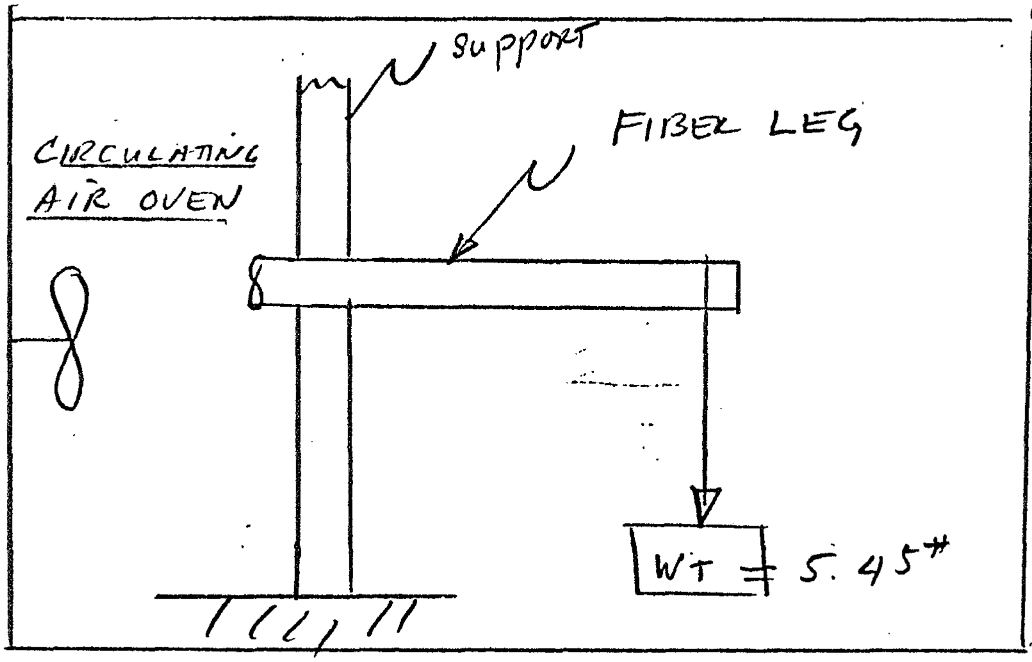
NO CHANGE IN LEG SIZE OR MATL IS BEING CONTEMPLATED PENDING RESULTS OF 250°F TEMP CREEP TEST.

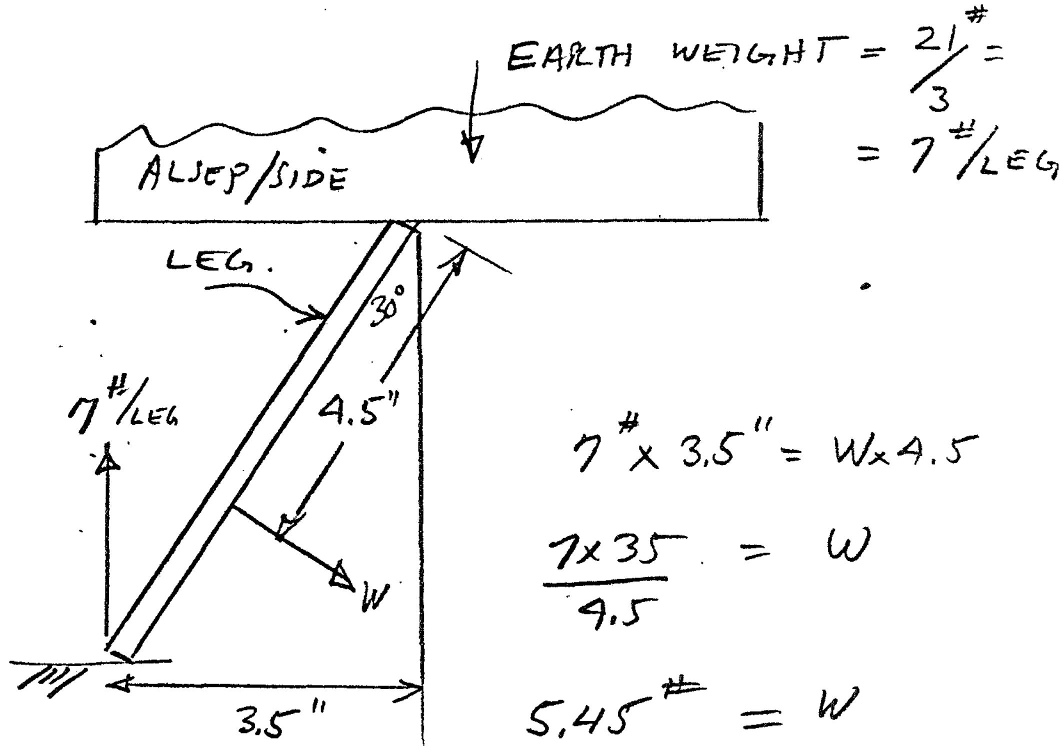
(3)

THERMAL LEG TEST

CONFIGURATION (CREEP EVALUATION OF FIBER GLASS LEG)

STARTED 12/18/67
OVEN TEMP 250°F





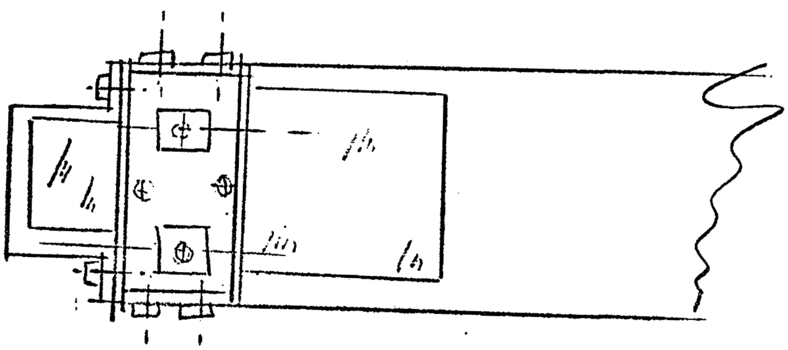
$7^{\#} \times 3.5'' = W \times 4.5$

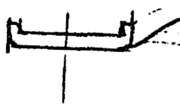
$\frac{7 \times 35}{4.5} = W$

$5.45^{\#} = W$

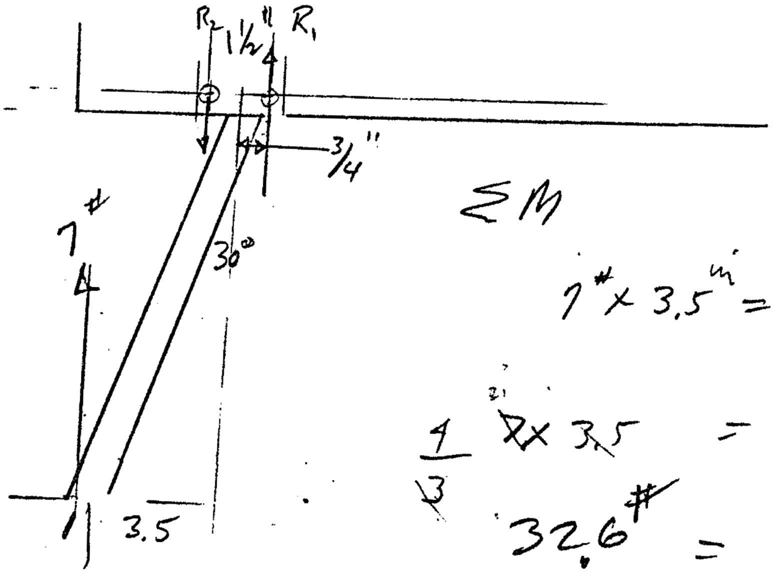
(4)

NEW DESIGN FEATURES





.040 FORMED ALUM T6 HARDNESS. RIBBED ON ALL SIDES



\# 8 SCREW
MINOR DIA = .0120
STRESS AREA = .0139
THICK of AL = .070

ΣM

$7^{\#} \times 3.5'' = R_1 \frac{3}{4}$

$\frac{4}{3}$ ~~2~~ 21 $\times 3.5 = R_1$

$32.6^{\#} = R_1$

$S = \frac{P}{A} = \frac{32.6\times}{.070 \times .012 \times 2} = 19,500$ PSI.

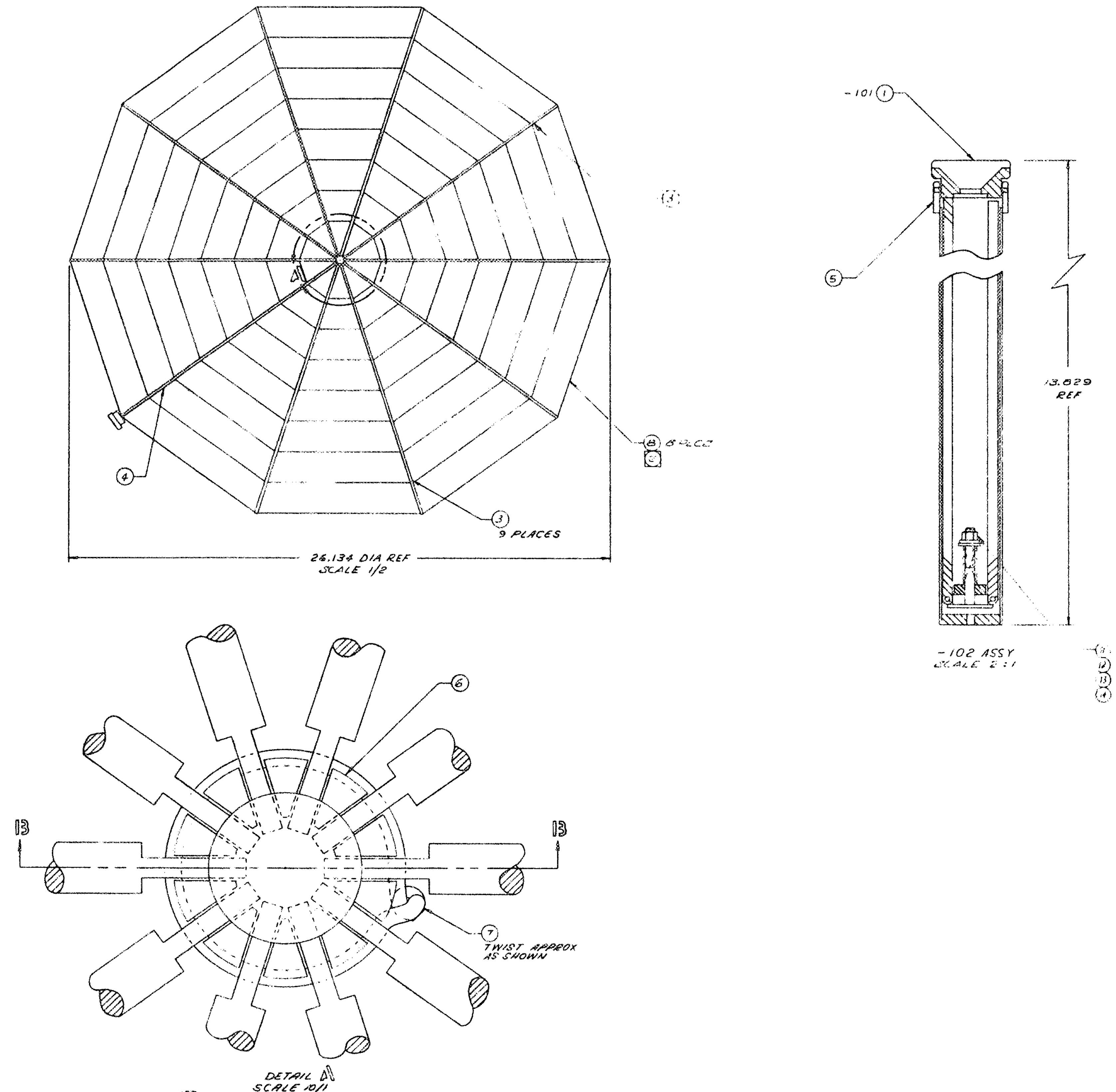
ASSUMING ONLY 2 SCREWS

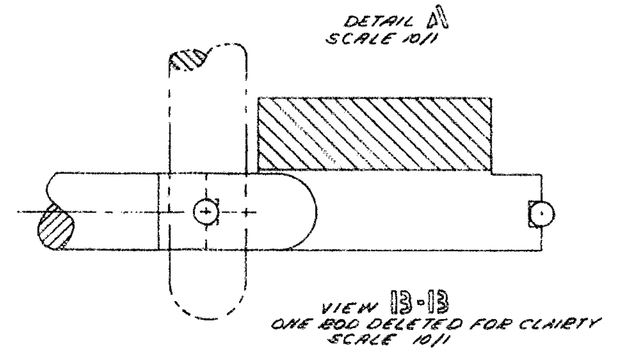
FEATURES OF ABOVE DESIGN

1 LEGS ATTACHED TO ALUMINUM HOUSING SIDES. BY APPROX 6 SCREWS (PAN HEADS)
2 STIFFENER - RIBBED OR FLANGED ON ALL SIDES
3 INCREASED BEARING SURFACE APPROX DOUBLED
4 FASENED TO GLASS FIBER SURFACE. FOR EXTRA STRENGTH
5. NO DEGRADATION OF THERMAL CHARACTERISTICS.
6. CAN BE EASILY RETROFITTED

APPENDIX C

Drawings:	Assembly, Ground Screen
	Interface Control Drawing
	Assembly, Blivet 100
	Positioning/Hookup Board - Blivet 100
	Matrix Assembly No. 1, Blivet 100





[9] MAINTAIN SPRING LOAD OF [illegible] POSITION.

[2] BOND ITEM 8 TO ITEMS 3 & 4 PER ML SPEC S40109.

1. IDENTIFY PER ML SPEC S40111 CL IV.

NOTES: UNLESS OTHERWISE SPECIFIED.

102	101	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	ITEM NO.
1		MS21043-06		NUT, SELF-LOCKING (6-32)	14
1		MS15795-806		WASHER FLAT #6	13
1		609765-2		SPRING	12
1		609764-1		SPRING RETAINER	11
	AR		S40109	CONDUCTIVE EPOXY	10
REF	REF		S40111	SPEC IDENTIFICATION	9
	AR	28 AWG 7/36 STRAND, TINNED COPPER, TEFLON INSUL		WIRE	8
	AR	MS20995C41		WIRE, LOCK	7
	1	609434-1		HUB	6
1		609435-101		TUBE	5
	1	609436-101		EXTRACTOR	4
	9	609433-1		ROD	3
—		609439-102		GROUND SCREEN ASSY	2
1	—	609439-101		SCREEN ASSY	1

LIST OF MATERIALS

CONTRACT NO. 51966-18

DRAWN D. HUNT 2-8-67

MARSHALL LABORATORIES
TORRANCE, CALIFORNIA

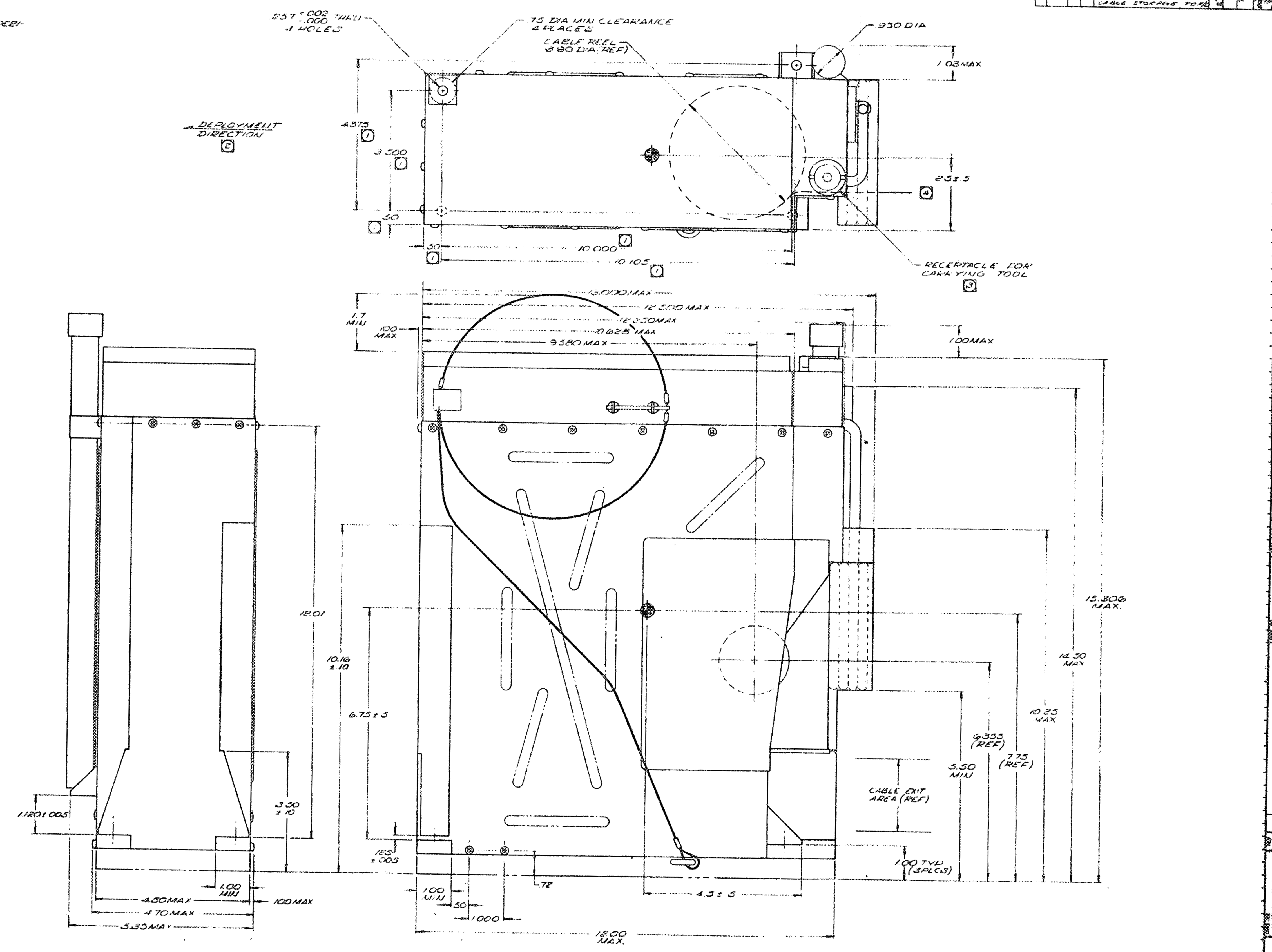
TITLE: ASSEMBLY - GROUND SCREEN ALSEP/SIDE/CCGE

SIZE E | CODE IDENT NO. 13126 | DWG NO. 609439 | REV A

SCALE NOTED | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

1. HOLE LOCATION WILL BE CONTROLLED BY MASTER TOOL. BENDIX WILL FURNISH MASTER TOOL (TD-2323521-01).
2. EXPERIMENT WILL BE REMOVED FROM ALSEP AND CARRIED ACROSS THE LUNAR SURFACE IN DIRECTION INDICATED.
3. RECEPTACLE TO MATE WITH EXPERIMENT LIFTING TOOL SHALL BE LOCATED IN AREA SHOWN.
4. CABLE SHALL EXIT AS SHOWN
5. SEE IC314105 FOR INTERFACE CONTROL SPECIFICATION

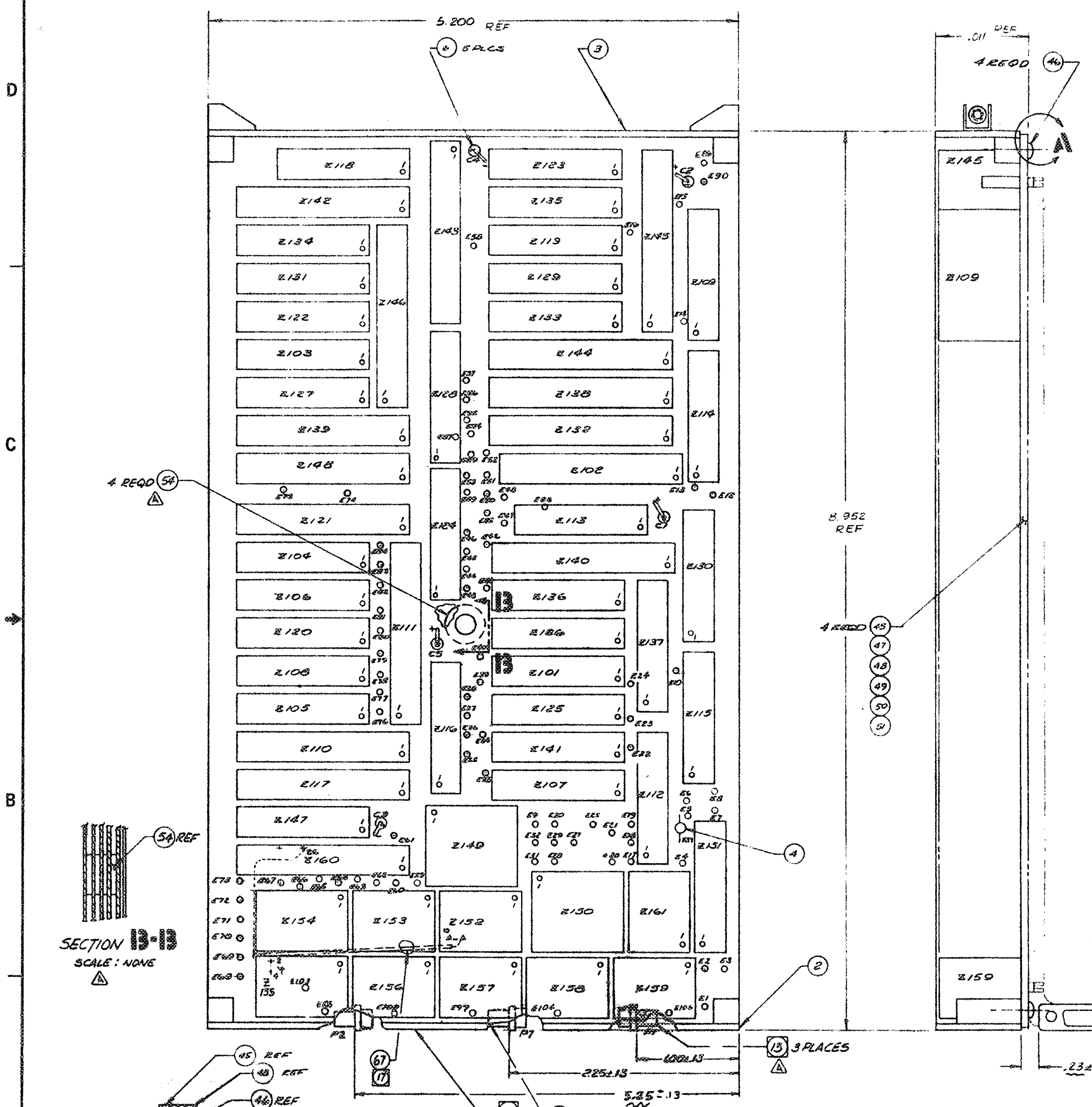


NOTES: UNLESS OTHERWISE SPECIFIED

MARSHALL LABORATORIES
TORRANCE, CALIFORNIA

INTERFACE CONTROL DRAWING - ALSEP / LSGE

E 13126 609778 A



WIRE LIST		
NO	FROM	TO
1	P1-1	E80
2	2	E34
3	3	E56
4	4	E16
5	5	E50
6	6	E14
7	7	E42
8	8	E89
9	9	E25
10	10	E53
11	11	E6
12	12	E17
13	13	E71
14	14	E69
15	15	E73
16	16	E29
17	17	E46
18	18	E7
19	19	E52
20	20	E75
21	21	E63
22	22	E55
23	23	E4
24	24	E50
25	25	E85
26	26	E90
27	27	E51
28	28	E88
29	29	E79
30	30	E33
31	31	E35
32	32	E41
33	33	E103
34	34	E94
35	35	E68
36	36	E74
37	37	E48
38	38	E24
39	39	E81
40	40	E15
41	41	E72
42	42	E66
43	43	E82
44	44	E43
45	45	E76
46	46	E67
47	47	E5
48	48	E64
49	49	E78
50	50	E83
51	P1-51	E44
52	P2-1	E12
53	2	E3
54	3	E86
55	4	E57
56	5	E1
57	6	E47
58	7	E8
59	8	E22
60	9	E21
61	10	E2
62	11	E98
63	12	E49
64	13	E59
65	14	E28
66	15	E64
67	16	E45
68	17	E84
69	18	E31
70	19	E20
71	20	E32
72	21	E18
73	22	E27
74	23	E102
75	24	E19
76	P2-25	
77	P7-1	E30
78	2	E61
79	3	E58
80	4	E10
81	5	E37
82	6	E13
83	7	E7
84	8	E87
85	9	E39
86	10	E60
87	11	E70
88	12	E88
89	13	E3
90	14	E38
91	15	E9
92	16	E77
93	17	E36
94	18	E62
95	P7-19	

WIRE LIST		
NO.	FROM	TO
96	P7-20	
97	21	
98	22	
99	23	
100	24	
101	P7-25	

QTY	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	REF DES	CODE IDENT	ZONE	ITEM NO.
REF	609368		CONNECTOR PIN ASSIGNMENT				68
AR	AWG 28	MIL-W-16878	WIRE, HOOK-UP TYPE 'E'				67
REF	T609572-101		JIG FIXTURE MATRIX				66
REF	T609566-101		JIG-FIXTURE				65
REF		S40111	SPEC, IDENTIFICATION				64
REF		S40126	SPEC, SOLDER				63
REF		S40094	SPEC, FAB				62
REF		S40091	SPEC, CONFORMAL COATING				61
REF		S40092	SPEC, FOAM				60
REF		S40149	SPEC, BONDING				59
REF		S40081	SPEC, ASSY				58
REF		S40072	SPEC, FAB				57
REF	609312		SCHEMATIC				56
REF	SP30347-9		JIG, MATRIX				55
4	5602-18-32		SPACER				54
1	T609520-3		INSULATOR (CLEAR MYLAR .004 THK BLACK IMAGE, SEE NOTE 18)				53
AR	SN 63/37	QQ-S-571	SOLDER				52
1	T609522-2		INSULATOR				51
1	T609522-101		MATRIX NO. 2				50
1	T609521-101		MATRIX NO. 1				49
1	T609520-101		HOOK-UP BOARD				48
1	T609520-2		POSITIONING BOARD				47
4	MS35214-3		SCREW PAN HEAD 2-56 x 1/4 LG				46
4	T609367-1		SPACER				45
3	MCDD1-51P6B1-18.0	(MICRO-DOT)	CONNECTOR	P1, P2, P7			44
1	W7093-X1		MODULE	Z160			43
1	W7153-X1		MODULE	Z154			42
7	W7130-X1		MODULE	Z152, Z153, Z155 - Z159			41
-101	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	ELEC REF DES	CODE IDENT	ZONE	ITEM NO.

18 PUNCH .10 DIA HOLES FOR TERMINALS DESIGNATED "E" & INSTALL BETWEEN RIBBON & WIRE

17 CUT RIBBON AT Z160-26 PUSH THRU. WIRE (ITEM 67) FROM Z152-10 TO Z160-26 RIBBON

16. USE JIG FIXTURE T609566-101 FOR ASSEMBLING USE JIG FIXTURE T609572-101 FOR MATRIX ASSEMBLING.

A 15 SPOT BOND ITEM 53 TO ITEM 48 PER ML SPEC S40149, TYPE II

A 14 PIGTAILS NOT USED TO BE CUT AT CONNECTOR

A 13 IDENTIFY PER ML SPEC S40111, TYPE III, CL III

12. FOR CONN. PIN ASSIGN. SEE 609368

11. FOR TEST SPEC SEE 546820

10. SOLDER PER ML SPEC S40126

9. USE JIG FIXTURE SP30347-9 FOR FAB & ASSY

8. FAB ITEMS 49 & 50 PER ML SPEC S40094

A 7 CONFORMAL COAT ITEM 48 PER ML SPEC S40091, CLASS 1, TYPE 1 @ 170°F, AFTER ELECTRICAL TEST

6. FOAM IN PLACE COMPONENT CAVITIES ONLY PER ML SPEC S40092, CLASS 1, TYPE 1, CURE 1, 170°F 1 HOUR

5. BOND ITEMS 45, 47 THRU 51 PER ML SPEC S40149, TYPE II

4. ASSEMBLE COMPONENTS TO MATRIX PER ML SPEC S40081

3. MFG PER ML SPEC S40072

2. FOR SCHEMATIC SEE DWG 609312

A 1 IDENTIFY PER ML SPEC S40111, CLASS I, TYPE III, (609519-101)

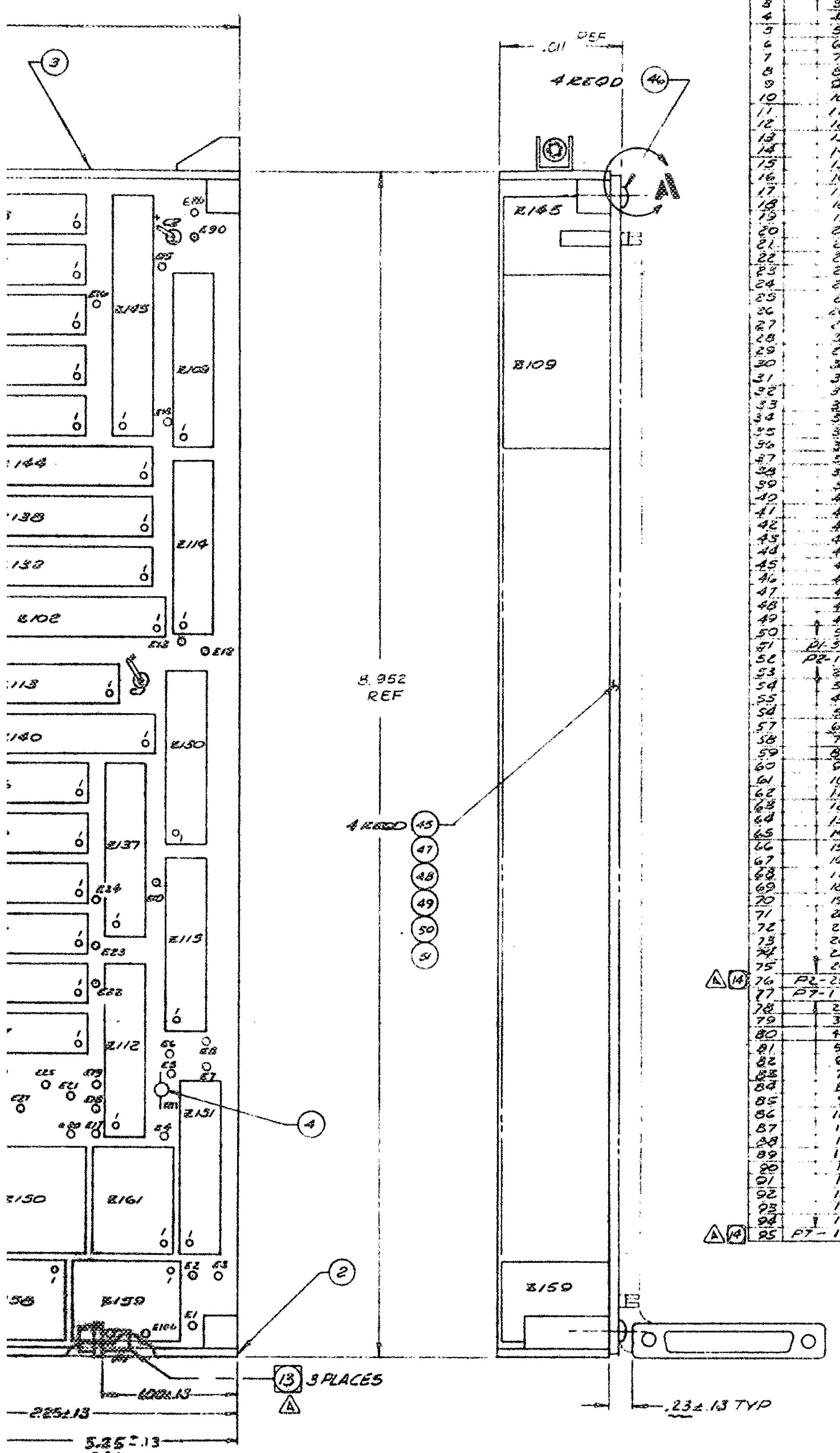
NOTES: UNLESS OTHERWISE SPECIFIED

-101		609512-104	
-101		609512-104	
-101		609512-103	
DASH NO.		NEXT ASSEMBLY	
APPLICATION			

1. USE 2. CANNOT BE REWORKED 3. REPAIR 4.	PHOTO REPRODUCTION			609519	B

REVISIONS

CODE	SYM	ZONE	REV	DESCRIPTION	BY	CK	DATE	APPROVED
4	SU1 SUP ML393 -2E		A	INCORPORATED EO NC1 & NC2. VELLUM SIZE WAS F				
2	SHEETUP ...		B	INC. EO A1 THRU A4				



WIRE LIST NO	FROM	TO
1	P1-1	E80
2	2	E84
3	3	E56
4	4	E16
5	5	E90
6	6	E74
7	7	E42
8	8	E89
9	9	E28
10	10	E53
11	11	E6
12	12	E17
13	13	E71
14	14	E69
15	15	E73
16	16	E29
17	17	E46
18	18	E7
19	19	E52
20	20	E75
21	21	E63
22	22	E56
23	23	E4
24	24	E50
25	25	E85
26	26	E90
27	27	E51
28	28	E88
29	29	E79
30	30	E33
31	31	E35
32	32	E41
33	33	E103
34	34	E94
35	35	E68
36	36	E74
37	37	E48
38	38	E24
39	39	E81
40	40	E15
41	41	E72
42	42	E66
43	43	E82
44	44	E49
45	45	E76
46	46	E67
47	47	E5
48	48	E54
49	49	E78
50	50	E83
51	P1-51	E44
52	P2-1	E12
53	2	E3
54	3	E86
55	4	E57
56	5	E1
57	6	E47
58	7	E8
59	8	E22
60	9	E21
61	10	E2
62	11	E65
63	12	E49
64	13	E59
65	14	E28
66	15	E64
67	16	E45
68	17	E64
69	18	E31
70	19	E20
71	20	E32
72	21	E18
73	22	E27
74	23	E102
75	24	E19
76 (A, 14)	P2-25	
77	P7-1	E30
78	2	E61
79	3	E58
80	4	E10
81	5	E37
82	6	E13
83	7	E7
84	8	E87
85	9	E39
86	10	E60
87	11	E70
88	12	E88
89	13	E3
90	14	E38
91	15	E9
92	16	E77
93	17	E86
94	18	E62
95 (A, 14)	P7-19	

WIRE LIST NO.	FROM	TO
96	P7-20	
97	21	
98	22	
99	23	
100	24	
101	P7-25	

(14, A)

-101	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	ELEC REF DES	CODE IDENT	ZONE	ITEM NO.
REF	609368		CONNECTOR PIN ASSIGNMENT				68
AR	AWG 28	MIL-W-16878	WIRE, HOOK-UP TYPE 'E'				67
REF	T609572-101		JIG FIXTURE MATRIX				66
REF	T609566-101		JIG-FIXTURE				65
REF (A)		S40111	SPEC, IDENTIFICATION				64
REF		S40126	SPEC, SOLDER				63
REF		S40094	SPEC, FAB				62
REF		S40091	SPEC, CONFORMAL COATING				61
REF		S40092	SPEC, FOAM				60
REF		S40149	SPEC, BONDING				59
REF		S40081	SPEC, ASSY				58
REF		S40072	SPEC, FAB				57
REF	609312		SCHEMATIC				56
REF (A)	SP30347-9		JIG, MATRIX				55
4	5602-18-32		SPACER				54
1 (A)	T609520-3		INSULATOR (CLEAR MYLAR .006 THK BLACK IMAGE, SEE NOTE 10)				53
AR	SN63/37	QQ-S-571	SOLDER				52
1	T609522-2		INSULATOR				51
1	T609522-101		MATRIX NO. 2				50
1	T609521-101		MATRIX NO. 1				49
1	T609520-101		HOOK-UP BOARD				48
1	T609520-2		POSITIONING BOARD				47
4	MS35214-3		SCREW PAN HEAD 2-56 x 1/4 LG				46
4	T609367-1		SPACER				45
3	MCDD1-51P6B1-18.0 (MICRO-DOT)		CONNECTOR	P1, P2, P7			44
1	W7098-X1		MODULE	Z160			43
1	W7153-X1		MODULE	Z154			42
7	W7130-X1		MODULE	Z152, Z153, Z155 – Z159			41
-101	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	ELEC REF DES	CODE IDENT	ZONE	ITEM NO.

-101	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	ELEC REF DES	CODE IDENT	ZONE	ITEM NO.
1	W7160-X2		MODULE	Z151			40
2	W7148-X1			Z149, 150			39
1	W7180-X2			Z152			38
1	W7116-X1			Z148			37
1	W7117-X1			Z147			36
5	W7083-X1			[illegible]			35
1	W7085-X1			Z141			34
1	W7095-X1			Z140			33
2	W7084-X1			[illegible]			32
1	W7088-X1			Z136			31
1	W7089-X1			Z132			[illegible]
1	W7090-X1			Z129			29
1	W7086-X1			Z128			28
1	W7123-X1			Z124			27
1	W7178-X1			Z123			[illegible]
1	W7122-X1			Z121			[illegible]
1	W7124-X1			Z120			[illegible]
1	W7161-X1			Z117			[illegible]
1	W7125-X1			[illegible]			[illegible]
1	W7096-X1			[illegible]			[illegible]
8	W7081-X1			[illegible]			[illegible]
4	W7114-X1			[illegible]			[illegible]
1	W7101-X1			[illegible]			[illegible]
1	W7097-X1			Z111			[illegible]
1	W7094-X1			Z110			[illegible]
1	W7179-X1			Z109			[illegible]
1	W7108-X1			Z108			[illegible]
1	W7098-X1			Z107			[illegible]
1	W7099-X1			Z106			[illegible]
1	W7100-X1			Z105			[illegible]
1	W7103-X1			Z104			[illegible]
1	W7091-X1			Z103			[illegible]
1	W7092-X1			Z102			[illegible]
3	W7082-X1		MODULE	[illegible]			[illegible]
5	350D186X9015B2	SPRAGUE	CAPACITOR 18UF, 15V	C1-C5			[illegible]
REF		S46820	TEST SPEC				[illegible]
1	44005	YSI PRECISION THERMISTOR	THERMISTOR	RT1			[illegible]
1	609482-101		RAIL				[illegible]
1	609484-1		RAIL				[illegible]
	609519-101		ASSEMBLY				1
-101	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	[illegible]			

LIST OF MATERIALS

QTY REQD PER NOTED ASSY				
CONFIGURATION				
LAYOUT NO.				
DIST CODE	AH			
-101	609512-104	609770-101	ML393-4 SUP	
-101	609512-104	607880-102	ML393-2	
-101	609512-103	609880-103	ML393-2	
NEXT ASSY	MODEL NO.	NEXT ASSY	FINAL ASSEMBLY	MODEL NO.
APPLICATION				

INTERPRET THIS DRAWING PER STANDARDS IN MIL-D-7327. DIMENSIONS ARE IN INCHES. TOLERANCES ON DECIMALS .X ± .1, .XX ± .03, .XXX ± .010; ANGLES ± 0° 30'. SURFACE ROUGHNESS.

CONTRACT NO. SP66-14

DRAWN 7-28-67; CHECK 7-24-67; 7-28-67; 7-28-67

MARSHALL LABORATORIES

TITLE: ASSEMBLY BLIVET #100 ALSEP/SIDE/CCGE

SIZE H | CODE IDENT NO. 13126 | DWG NO. 609519 | B

SCALE 2X1

NOTES: UNLESS OTHERWISE SPECIFIED

(10) IDENTIFY PER ML SPEC S40111, CLASS I, TYPE III. (609519-101)

8. FOR SCHEMATIC SEE DWG 609312

3. MFG PER ML SPEC S40072

4. ASSEMBLE COMPONENTS TO MATRIX PER ML SPEC S40081

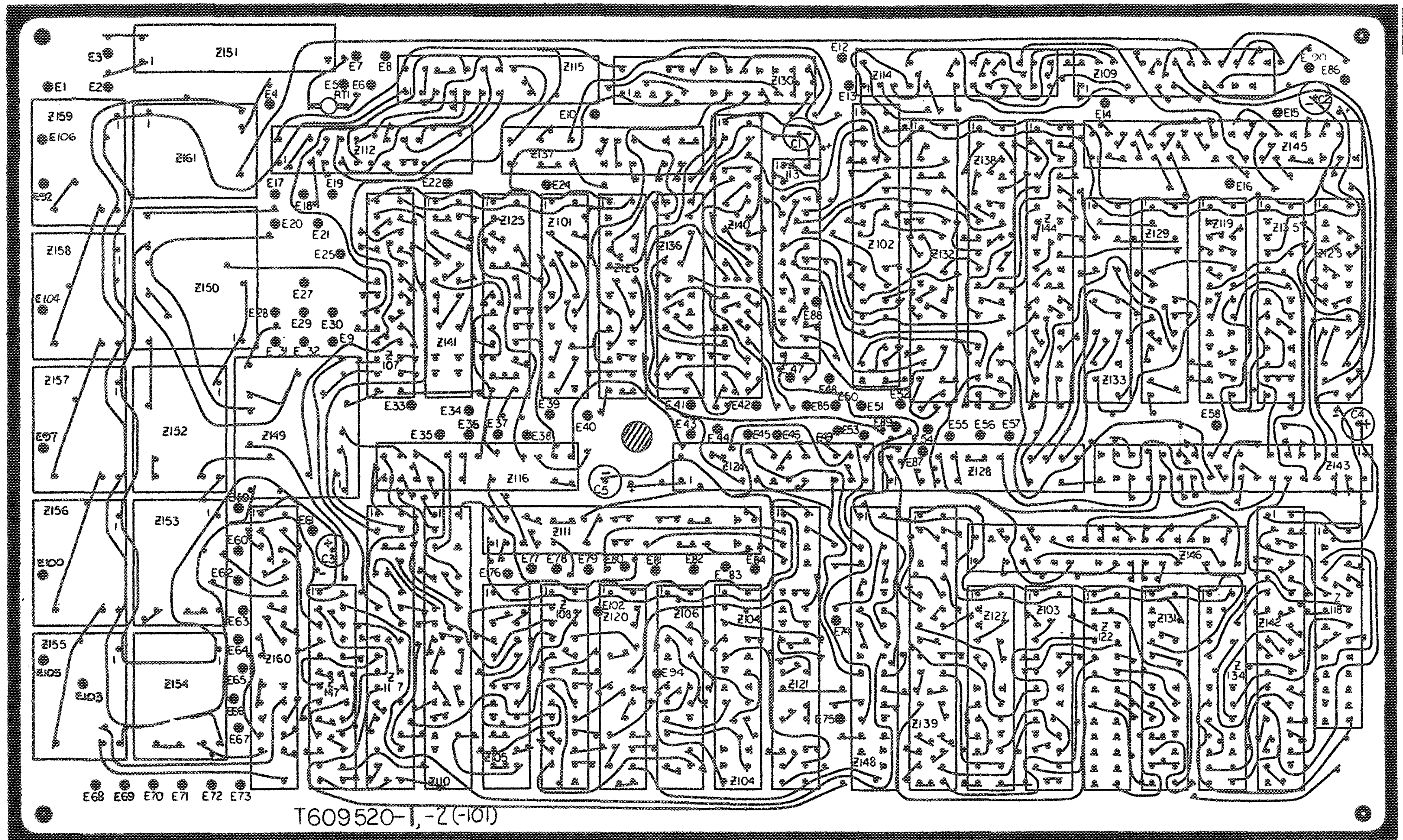
5. BOND ITEMS 45, 47 THRU 51 PER ML SPEC S40149, TYPE II

6. FOAM IN PLACE COMPONENT CAVITIES ONLY PER ML SPEC S40092, CLASS 1, TYPE 1, CURE 1, 170°F 1 HOUR

(A) 7. CONFORMAL COAT ITEM 46 PER ML SPEC S40091, CLASS 1, TYPE 1 @ 170°F, AFTER ELECTRICAL TEST

8. FAB ITEMS 49 & 50 PER ML SPEC S40094

9. USE JIG FIXTURE SP30347-9 FOR FAB & ASSY



7

TERMINALS NOT USED	SPARE TERMINALS
E11, E23, E26, E91, E93, E95, E96, E98, E99, E101	E92, E97, E100, E104, E105, E106

7

TABULATION CHART

SYM	HOLE DIA	NO. REQD	SPECIAL INSTRUCTIONS
•	.040	AR	PUSH THRU
•	.040	AR	MODULE & COMPONENT LEAD
●	.067	96	TERMINAL NEARSIDE
●	.125	4	BOARD MTG
(hatched)	.187	1	CENTER MTG

4.000 ±.005
1 3

7 DRILL/PUNCH ALL HOLES TO TABULATION CHART AND TRIM TO INSIDE EDGE OF BLACK IMAGE WITHIN ±.010

NOTES: UNLESS OTHERWISE SPECIFIED

6	REF	REF	340896	PROTECTIVE FINISH	5
2 5	REF	REF	MIL-P-18177	PLASTIC SHEET, GLASS EPOXY RESIN	4
	96		3650-037	TERMINAL	3
		1	T609542-2	POSITIONING BOARD	2
	1		T609520-1	HOOK-UP BOARD	1

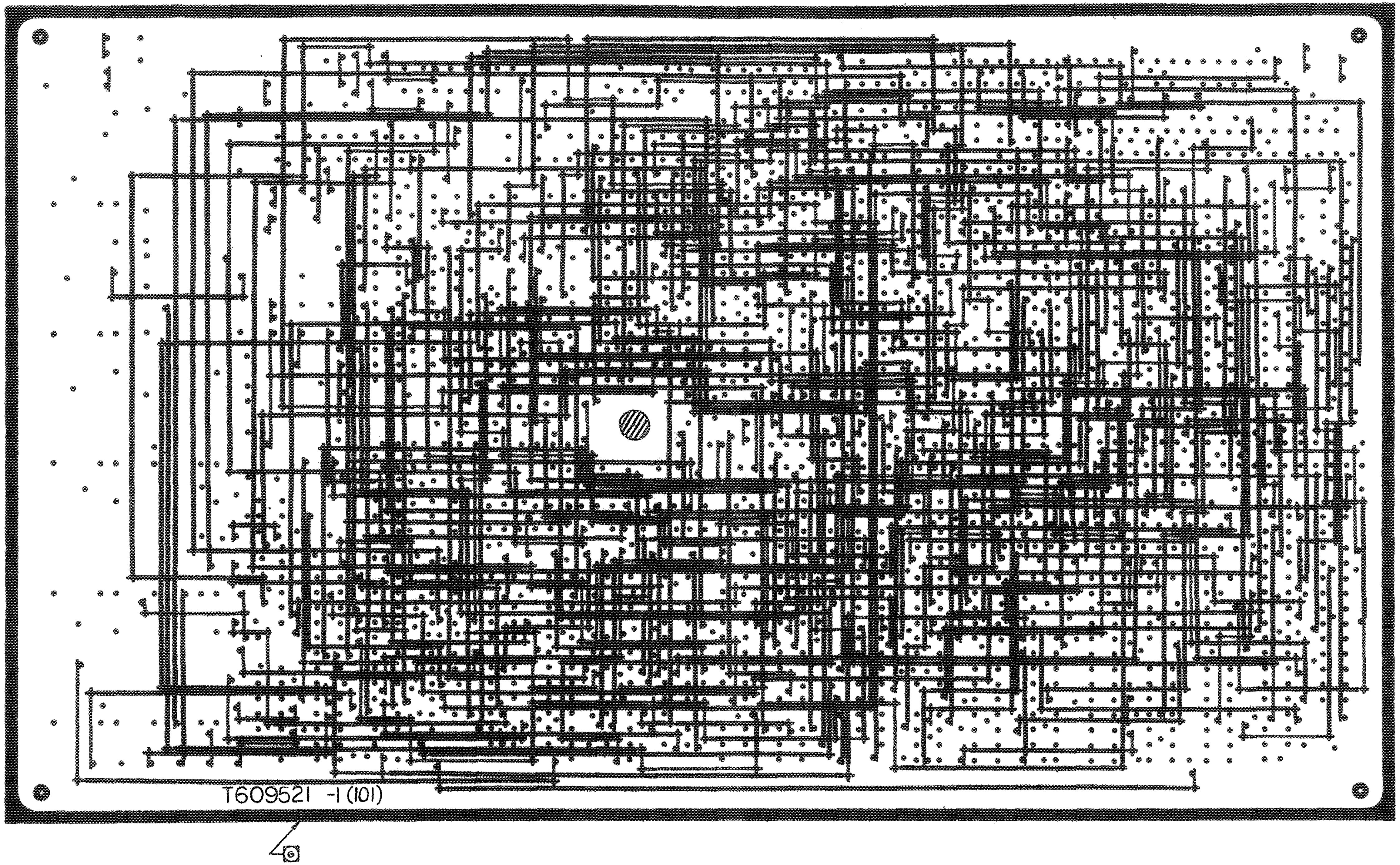
LIST OF MATERIALS

MARSHALL LABORATORIES

POSITIONING/HOOK-UP BOARD - BLIVET 100

R 13126 T609520

T609520



4.000 ±.005
1 2

T609521 -2 ONLY

TAB CHART		
SYM	HOLE DIA.	NO. REQ'D
•	.040	AR
•	.040	AR
◎	.125	4
⊘	.187	1

6

TABULATION CHART			
SYM	HOLE DIA.	NO. REQ'D	SPECIAL INSTRUCTION
•	.029	AR	FEED THRU
•	.029	AR	MODULE & COMPONENT LEADS
•	.029	AR	PUSH THRU
✣	.040	AR	WELD JUNCTION
—			WIRE, NEARSIDE
—			WIRE, FARSIDE
—			INSULATED WIRE, NEARSIDE
—			INSULATED WIRE, FARSIDE
◎	.125	4	BOARD MTG
⊘	.187	1	CENTER MTG

T609521 -1 ONLY

6

6 DRILL/PUNCH ALL HOLES TO TABULATION CHART AND TRIM TO INSIDE EDGE OF BLACK IMAGE WITHIN ±.010

5. USE ASSEMBLY FIXTURE SP30347-9 WHEN FABRICATING THE MATRIX

4 SPOT POT INTERCONNECT MATRIX WIRING AS NECESSARY PER MARSHALL LABORATORIES SPECIFICATION S40...9, CLASS II TYPE 1

3. REPRODUCE ON 0.007 INCH THICK SENSITIZED MYLAR USING CLOSE REGISTER OF NEGATIVES OBTAINED IN NOTES 1 AND 2. DOUBLE BURN SENSITIZED MYLAR FOR BROWN ON TWO TONES WITH RED APPEARING BROWN AND BLACK APPEARING BLACK.

2 PHOTO REDUCE -1 ARTWORK SUCH THAT NOTED REDUCTION DIMENSION SCALES 4.000 ± .005 INCHES (ONE REVERSE READING NEGATIVE) USING RED FILTER AND STABLE BASE PANCROMATIC FILM

1 PHOTO REDUCE -1 ARTWORK SUCH THAT NOTED REDUCTION DIMENSION SCALES 4.000 ± .005 INCHES (ONE REVERSE READING NEGATIVE) USING STABLE BASE FILM.

NOTES: UNLESS OTHERWISE SPECIFIED

	T609 -2		INSULATOR, MYLAR (.007)		7
AR		AMS3654	TUBING		6
REF		S40094	MATRIX FAB, ASSY-SPEC		5
REF		S40379	SPOT POTTING-SPEC	4	4
REF	SP30347-9		JIG-MATRIX		3
AR		S40138	WIRE, CLASS I, TYPE IV		2
1	T609521 -1		WAFER, MYLAR (.007)		1
101	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION		

LIST OF MATERIALS

MARSHALL LABORATORIES

MATRIX ASSY NO. 1
BLIVET 100

R 13126 T609521

SCALE 4/1 SHEET 1 OF 1

T609521

APPENDIX D

Ground Screen Deployment Procedure

ALSEP/SIDE/CCGE Special Handling Instructions

CCIG Lanyard and Cable Stowing Procedure

FOLD-UP PROCEDURE FOR ALSEP/SIDE GROUND SCREEN

1. Slowly lift ground screen (G.S.) off flat table (See Figure 1) by holding extractor in one hand (use clean white gloves).

2. Place palm of other hand immediately under hub of G.S.

3. Slowly close palm of hand (holding hub) folding all rods upward to a closed position. Note, use other hand to guide and assist in this step.

4. Drape all wire loops downward. (Caution do not put sharp bends in wire)

5. Lay ground screen (in folded position) horizontially over mylar (See Figure 2) . Slowly and tightly roll mylar sleeve around ground screen rods (mylar sleeve may be removed from ground screen tube on SIDE Package). Hand wind mylar around rods until smooth and tight.

6. Slowly insert gound screen (Hub End) into ground screen tube.

7. Proceed to insert G.S. into tube in a continuous twisting motion. Caution: do not wrinkle up mylar sleeve. If wrinkles occur reassemble as necessary (steps 5, 6 and 7).

8. Then snap ground screen tube into spring clips on side of ALSEP/SIDE Package with extractor on top (store unit in this configuration) . (For prototype only - omit for all flight units.)

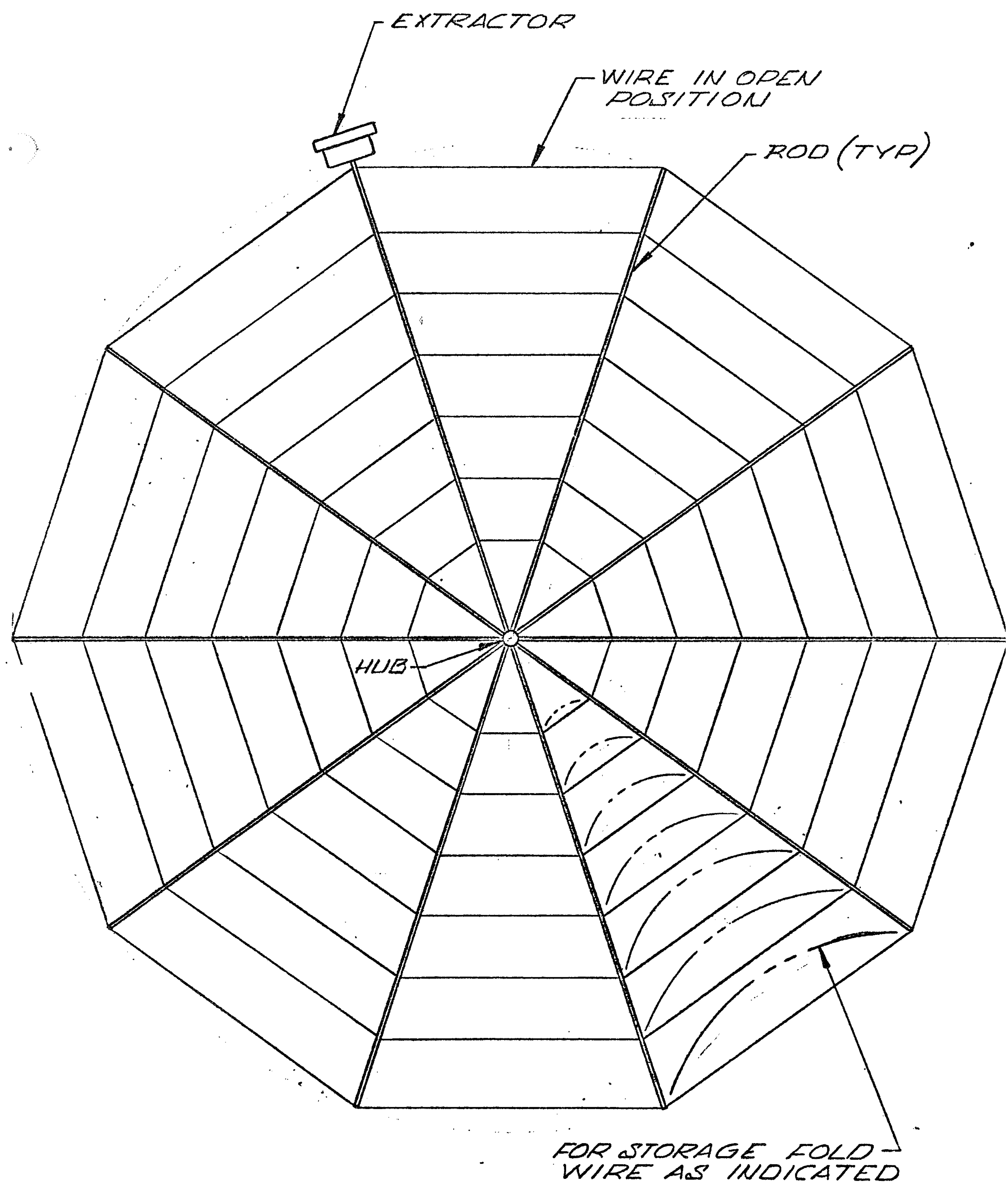
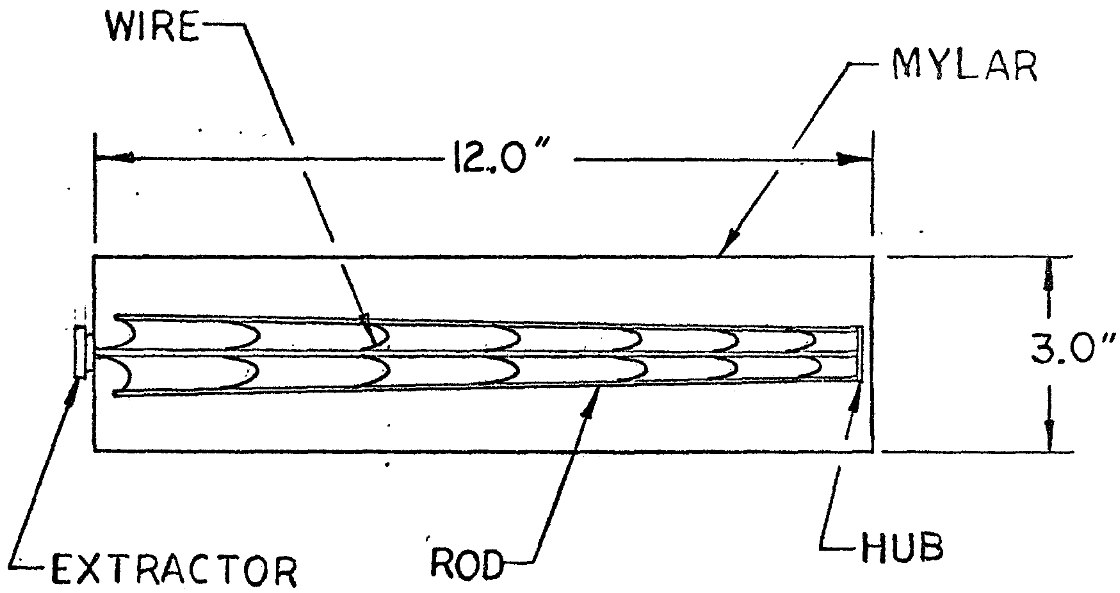

EXTRACTOR
WIRE IN OPEN POSITION
ROD (TYP)
HUB
FOR STORAGE FOLD WIRE AS INDICATED

FIG 1



PRIOR TO ROLL UP

FIGURE 2

ALSEP/SIDE/CCGE SPECIAL HANDLING INSTRUCTIONS

1.0 Operation: Installation of SIDE/CCGE unit into carring case.

Insure that the outboard mounting tab on SIDE is down and located in the front of the carring case.

2.0 Operation: Handling the SIDE unit or the CCIG unit.

White gloves must be used at all times when handling the SIDE or CCIG unit. The exterior is coated with "S13-G" thermal paint which is degraded if touched by unprotected hands.

3.0 Operation: Standing the SIDE unit on anything except the central station platform.

The SIDE unit is equipped with four 4" aluminum legs to support the SIDE unit in the standing position for bench testing, etc. Remove the auxiliary legs only when deploying the standard legs of for tie down operations on the platform (normal flight conditions).

4.0 Operation: Cleaning SIDE unit:

Finger smudges or marks on the SIDE or CCIG units may be removed by rubbing lightly with a soft cloth using "BON AMI" cleaner and water.

The second surface mirrors on the thermal spacer may be cleaned by using a soft cloth and isopropyl alcohol.

PROCEDURE FOR STOWING CCIG LANYARD AND CABLE

I. First operation; stow Lanyard per steps below:

1) With CCIG in position, hold lanyard straight out horizontally per Figure 1 (Note: Use clean white gloves turnout stowing procedure).

2) Twist lanyard 180° clockwise to form a 3" loop at the end. Per Figure 2.

3) Fold loop under to form a complete circle of 3" per Figure 3.

4) Repeat steps 2 through 4 to obtain a total of 5 loops. See Figure 4.

5) Fold loops down flat against side of CCIG and hold in place with tape temporarily.

II. Second operation; stow CCIG cable per steps below:

1) With CCIG in housing, coil cable counter clock wise into a 3" dia bundle, until all cable slack is removed. See Figure 5.

2) Remove tape from lanyard coil and combine this coil with the CCIG cable coils. See Figure 6.

3) Fold down and hold in place while securing cover.

CCIG LANYARD AND CABLE STOWING

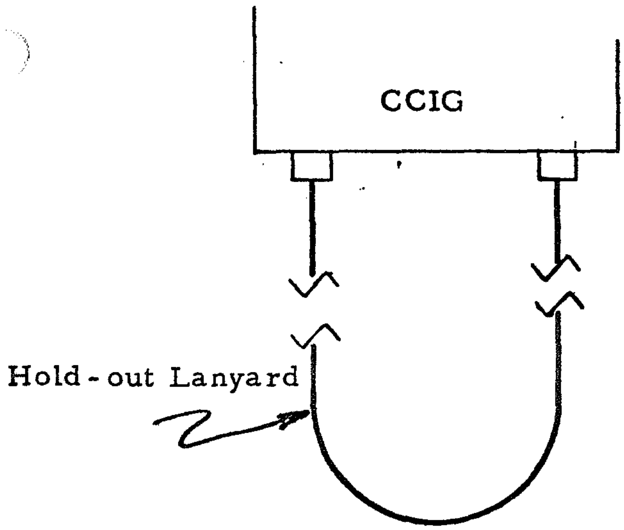


FIGURE 1

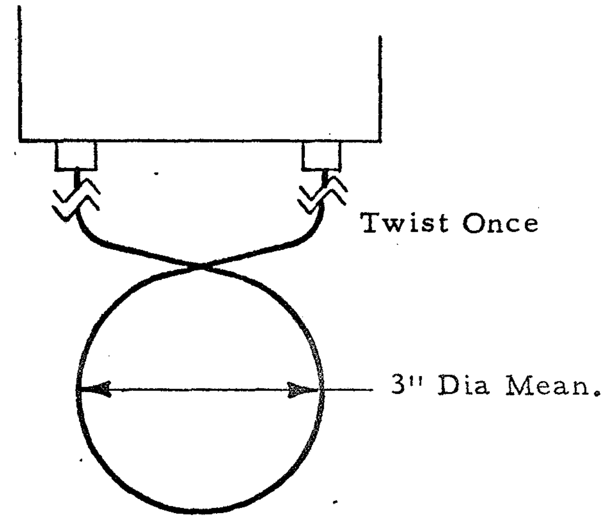


FIGURE 2

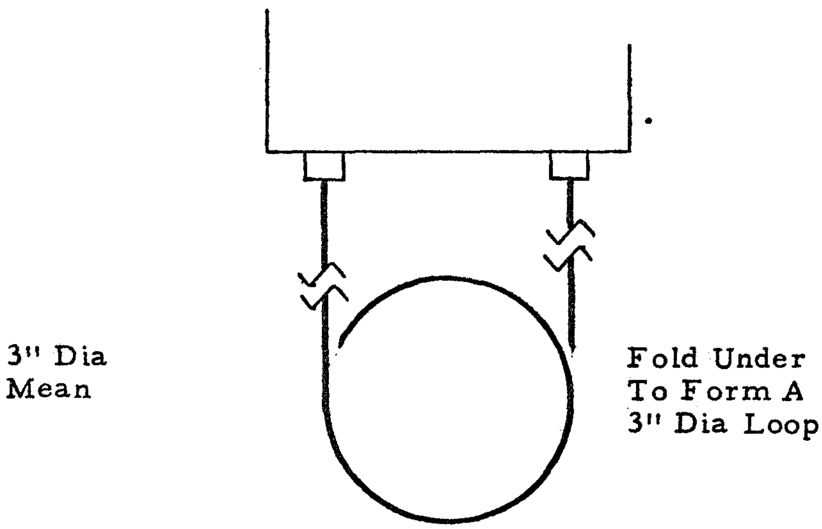


FIGURE 3

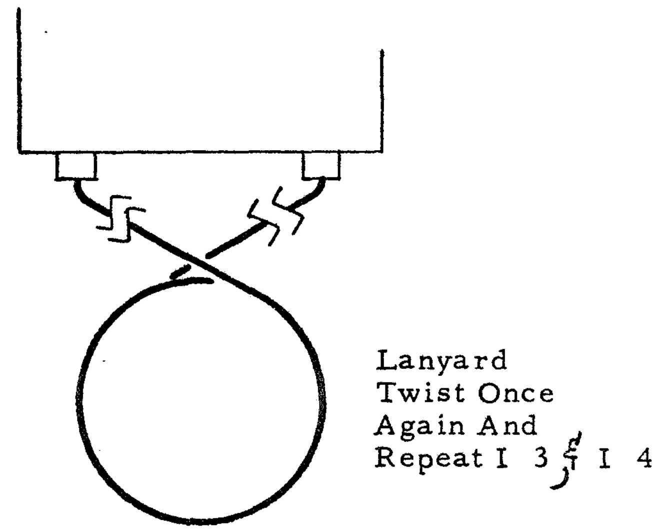


FIGURE 4

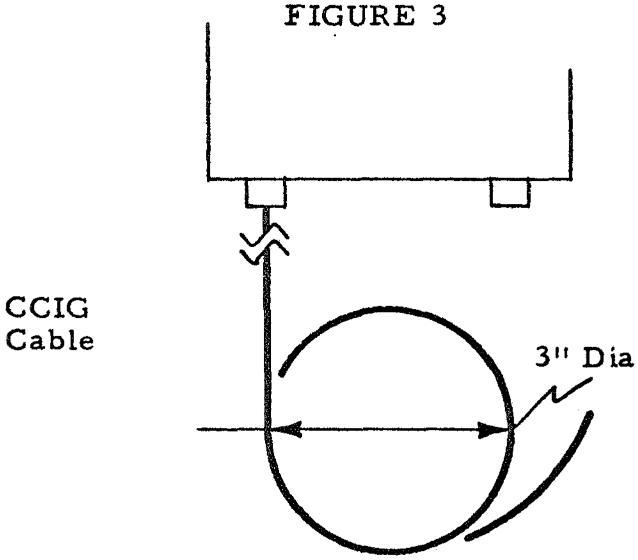


FIGURE 5

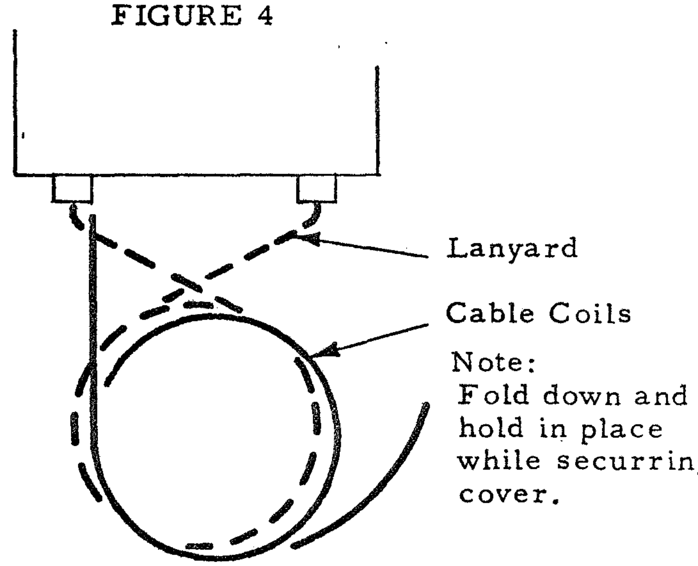


FIGURE 6

APPENDIX E

Typical Assembly Plan: Chassis Assembly

APPLICATION	
NEXT ASSY	FINAL ASSY

PARTS DISPOSITION
1. USE 3. CANNOT BE REWORKED
2. REWORK 4. RECORD 5. ....

DWG. NO. AP 609512 REV

REVISIONS

DISP	EFF	REV	DESCRIPTION	BY	CK	DATE	APPD

SHEET	REV						
INDEX	SHEET	1	2	3	4	5	6

INTERPRET THIS DRAWING PER STANDARDS IN MIL-D-70327
DIMENSIONS ARE IN INCHES
TOLERANCES ON

DECIMALS: .X ± .1; .XX ± .03; .XXX ± .010; .XXXX ± .0050
ANGLES: ± 0° 30′

SURFACE ROUGHNESS

HOLE DIA.	TOLERANCE
.0135 THRU .125	+ .004 − .001
.126 THRU .250	+ .005 − .001
.251 THRU .500	+ .006 − .001
.501 THRU .750	+ .008 − .001
.751 THRU 1.000	+ .010 − .001
1.000 THRU 2.000	+ .012 − .001
2.001 AND OVER	LINEAR

CONTRACT NO.	S1966-14	
DRAWN	R. Burns	
CHECK	Lutz	
MECH ENGR		
ELECT ENGR	Don Aslay	7/8/67
PROJ MGR	W Sandstrom	7/8/67
APPD	W. Tyler	8-4-67
DESIGN ACTIVITY APPD		
CUSTOMER		

ML
MARSHALL LABORATORIES
TORRANCE, CALIFORNIA

TITLE
CHASSIS ASSEMBLY
ALSEP/SIDE/CCGE
ASSEMBLY PLAN FOR,

SIZE	CODE IDENT NO.	DWG NO.	REV
A	13126	AP 609512	

SCALE | RELEASED AUG 4 1967 | SHEET 1 OF 7

MARSHALL LABORATORIES A SUBSIDIARY OF MARSHALL INDUSTRIES	**ASSEMBLY PLAN**
PART NAME CHASSIS ASSEMBLY	PART NUMBER AP 609512
JOB NUMBER 6-095	SERIAL NUMBER

APPROVALS/DATE

ENG	PROD	QC
[signature]	[signature]	[signature]

STEP	OPERATION	SPEC/PRINT REFERENCE	DATE COMPLETED	OPERATOR/ INSPECTOR
1	Rivet 609490-1	609490		
	Threaded Rods (4)	609512		
	& 609512 - Epoxy	609493		
	Spacers To 609493-101			
	Interior Chassis			
2	Install Chassis			
	Terminal E1 Thru			
	E4			
3	Solder Resistor	S40126		
	R1 Between			
	Terminals E3 & E4			
4	Visual Inspection			
5	DCASR Inspection			
6	Mount Semiconductors	609445		
	CR1, CR2 & CR3, Hard			
	Wire Semiconductors			
	Per 609445 Block			
	Diagram			
7	Visual Inspection			
8	DCASR Inspection			
9	Install 609356-102	609356		
	Blivet Assy (400 & 500)			

MARSHALL LABORATORIES

A SUBSIDIARY OF MARSHALL INDUSTRIES

ASSEMBLY PLAN

PART NAME CHASSIS ASSEMBLY	PART NUMBER AP 609512
JOB NUMBER 6-095	SERIAL NUMBER

APPROVALS/DATE

ENG	PROD	QC

STEP	OPERATION	SPEC/PRINT REFERENCE	DATE COMPLETED	OPERATOR/ INSPECTOR
10	Hard Wire Leads	S40126		
	From Blivet 400 & 500	609445		
	To Semiconductors			
	Per Block Diagram			
	609445			
11	Visual Inspection			
12	DCASR Inspection			
13	Install 609346-102	609346		
	Blivet Assy (200)			
14	Install 609345-102	609345		
	Blivet Assy (100)			
	Mate Connectors			
	P1-J1 & P2-J2			
15	Install 609350-102	609350		
	Blivet Assy (300)			
	Mate Connectors			
	P3-J3 & P7-J7			
16	~~Install 609499-102~~	609449		
	~~Terminal Board &~~			
	~~Hard Wire Leads~~			
	~~To R1~~			
17	Visual Inspection			
18	DCASR Inspection			

MARSHALL LABORATORIES A SUBSIDIARY OF MARSHALL INDUSTRIES	**ASSEMBLY PLAN**
PART NAME . CHASSIS ASSEMBLY	PART NUMBER AP 609512
JOB NUMBER 6-095	SERIAL NUMBER

APPROVALS/DATE

ENG	PROD	QC

STEP	OPERATION	SPEC/PRINT REFERENCE	DATE COMPLETED	OPERATOR/ INSPECTOR
19	Install 609499-1	609499		
	Bracket			
20	Hard Wire 609500-1	609500		
	To 609379-102	S40126		
	Blivet Assy. (700 & 900)			
	Per Block Diagram 609445			
21	Visual Inspection			
22	DCASR Inspection			
23	Install Wired			
	Assembly Per			
	Step 20. Mate Connector			
	P12-J12			
24	Install 609472-101	609472		
	Blivet Assy (800)			
	Mate Connectors			
	P15-J15 & P16-J16			
~~25~~	~~Install 609359-102~~	~~609359~~		
	~~Blivet Assy (6 00)~~			
	~~Mate Connectors~~			
	~~P6-J6 & P13-J13~~			
~~26~~	~~Pre-Assemble 609296-1~~	~~609296~~		
	~~Pivot BKT To 609517-101~~			
	~~Channeltron Using~~			

MARSHALL LABORATORIES A SUBSIDIARY OF MARSHALL INDUSTRIES	**ASSEMBLY PLAN**
PART NAME CHASSIS ASSEMBLY	PART NUMBER AP 609512
JOB NUMBER 6-095	SERIAL NUMBER

APPROVALS/DATE

ENG	PROD	QC

STEP	OPERATION	SPEC/PRINT REFERENCE	DATE COMPLETED	OPERATOR/ INSPECTOR
	4-40 Shoulder Screws			
	Install & Mate			
	Connectors P10-J10			
27	Pre Assemble 609288-1	609288		
	Pivot BKT to 609518-101	609518		
	Channeltron Using 4-40			
	Shoulder Screws			
	Install & Mate			
	Connectors P9-J9			
28	Hard Wire High	S40126		
	Voltage Lead From	609445		
	700 Blivet To			
	Channeltrons Per			
	Block Diagram 609445			
29	Visual Inspection			
30	DCASR Inspection			
31	Install 609510-101	609510		
	Low Energy ION			
	Detector Assy.			
32	Hard Wire Velocity	S40126		
	Filter To Chassis	609445		
	Terminals E1 & E2			
	Hard Wire Leads			
	Of Connector P8 To			
	Chassis Terminals			

MARSHALL LABORATORIES A SUBSIDIARY OF MARSHALL INDUSTRIES	ASSEMBLY PLAN
PART NAME CHASSIS ASSEMBLY	PART NUMBER AP 609512
JOB NUMBER 6-095	SERIAL NUMBER

APPROVALS/DATE

ENG	PROD	QC

STEP	OPERATION	SPEC/PRINT REFERENCE	DATE COMPLETED	OPERATOR/ INSPECTOR
	& Low Energy			
	CPA Per Block			
	Diagram 609445			
	Mate Connectors			
	J8-P8			
33	Visual Inspection			
34	DCASR Inspection			
35	Mate Connectors			
	P11-J11, P4-J4 &			
	P5-J5, Spot T1E			
	All Connectors			
36	Install 609511-101	609511		
	High Energy ION			
	Detector			
37	Hard Wire High	S40126		
	Voltage Leads	609445		
	From 300 Blivet			
	To High Energy			
	CPA Per Block			
	Diagram 609445			
38	Visual Inspection			
39	DCASR Inspection			

MARSHALL LABORATORIES A SUBSIDIARY OF MARSHALL INDUSTRIES	ASSEMBLY PLAN
PART NAME CHASSIS ASSEMBLY	PART NUMBER AP 609512
JOB NUMBER 6-095	SERIAL NUMBER

APPROVALS/DATE

ENG	PROD	QC

STEP	OPERATION	SPEC/PRINT REFERENCE	DATE COMPLETED	OPERATOR/ INSPECTOR
40	Spot Bond & Spot			
	Tie As Required			
	Check Torque Value			
	On All Screws			
41	Visual Inspection			
42	DCASR Inspection			

APPENDIX F

Special Studies and Calculations

EMPIRICAL TESTING AND STRESS ANALYSIS OF ALSEP LEGS, NEW DESIGN

3 JANUARY 1968

BY

M. POYER, S. POLLACK, G. COOPER

OF

MARSHALL LABORATORIES
3530 Torrance Boulevard
Torrance, California

STRESS ANALYSIS, ALSEP LEGS - NEW DESIGN 3 JANUARY 1968

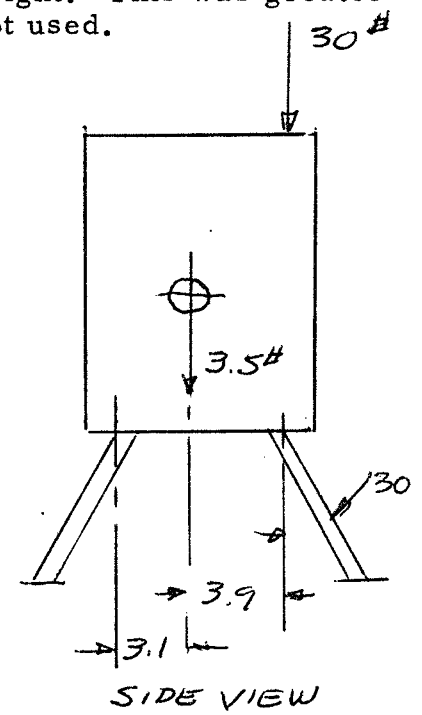
1.0 Reference: File 1.4.1.6.7 - Stress Analysis ALSEP Legs (no date)

Summary:

As a result of failures of the fiberglass materials at lunar high temperatures, the design of the legs has been modified from that analyzed in the reference report. The primary modification was to change the leg fitting materials from fiberglass to magnesium. In addition, an aluminum reinforcing plate was added across the bottom of SIDE where the double legs previously attached to a fiberglass plate. Also, a second attach screw was added to each body attach fitting.

For loading, the lunar weight of the astronaut was added over the legs under consideration, in addition to lunar SIDE weight. This was greater than earth weight per leg, so earth weight was not used.

All stress levels calculated are adequately safe.



2.0 I. Body Reactions and Loads. (Nomenclature as before)

Using lunar weights, and full astronaut weight over single leg:

(1) $\Sigma F = 0$

$30 + 3.5 = R_L + R_R$

(2) $\Sigma M = 0$

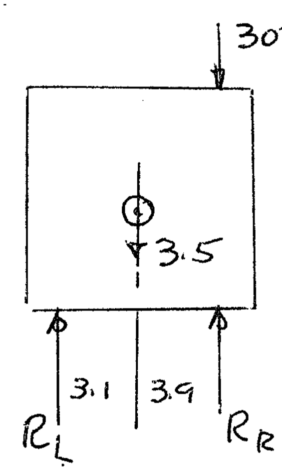
$\Sigma M_{R_L}: \; 7R_R = 7\,(30) + 3.1\,(3.5)$

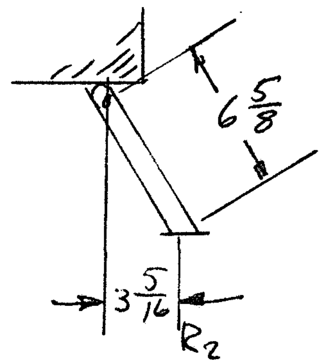
$R_R = \dfrac{210 + 10.9}{7} = \underline{31.6 \text{ lb}}$

$R_L = 33.5 - 31.6 = 1.9 \text{ lb}$

Moment on right leg:

$M_R = (3.31)\,(31.6) = 109 \text{ lb - in}$

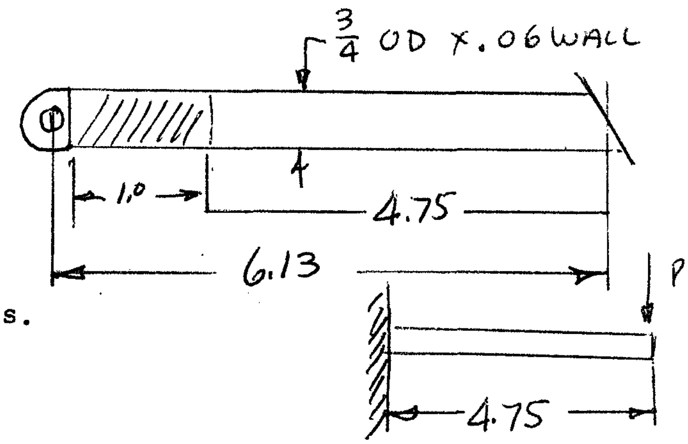




Moments for earth weight, without astronaut weight, are as before (27.9 lb-in for right leg)

3.0 II. Stresses on Right Leg & Fitting

3.1 The leg fitting now extends 1" into the fiberglass leg tube.



Equivalent load P is found from total length and moment load:

$$P = \frac{M}{L} = \frac{109}{6.13} = 17.8 \text{ lbs.}$$

For the contilever beam:

$S = \frac{MC}{I}$ where $M = (17.8)(4.75) = 84.5$ lb-in
$I = 8.85 \times 10^{-3}$ in^4
$C = 3/8$ in

$$S = \frac{84.5\ (3)}{8\ (8.85)} \times 10^3 = 3580 \text{ psi} \leftarrow$$

Allowable flexure stress for the fiberglass,

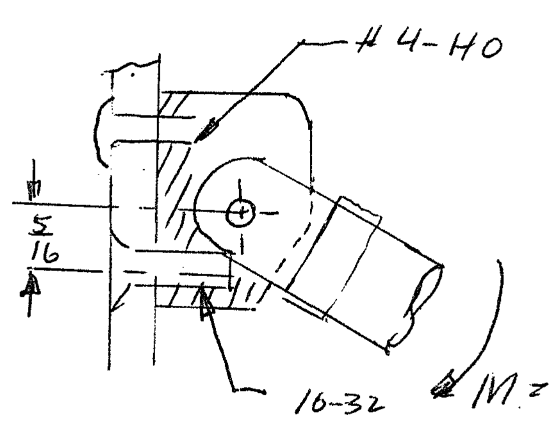
$S_{Room\ Temp} = 70,000$ psi

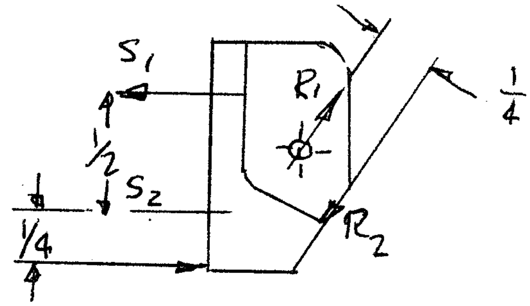
$S_{160^oF} = 22,000$ psi

Therefore, if the leg temperature is not greater than 160°F at deployment, the leg has a safety margin of 6:1.

3.2 Fittings

The fittings are magnesium. Addition of the No. 4 screw changes the reactions from previous calculations.





3.3 The moment is induced through couple R_1 and R_2, and reacted by the corner of the fitting and the two screws, both of which are in combined shear and tension

$$\leq M_C: \quad .25\ S_2 + .75\ S_1 = 109^{\#}/\text{IN}$$

With 3 unknowns and 2 equations, this is statically indeterminant. However, the forces at S_1 and S_2 can be proportioned from geometry:

$$\frac{S_1}{S_2} = \frac{.75}{.25}, \qquad S_1 = 3S_2$$

$$.25\ S_2 + .75\ (3)\ S_2 = 109$$

$$S_2 = \frac{109}{2.5} = 43.6 \text{ lbs}$$

$$S_1 = 3\ S_2 = 3(43.6) = \underline{131 \text{ lbs.}}$$

3.4 S_1 is No. 4-40 stainless steel screws:

Tension on steel screw: (tensile area = .006 in^2)

$$S_{S_1} = \frac{F}{A} = \frac{131}{6} \times 10^3 = 21{,}800 \text{ psi} \leftarrow$$

Allowable S_S = 19000 psi.

Shear on No. 10 screw: (F = 218 lbs)

A_S = .0174

$$S_S = \frac{F}{A} = \frac{43.6}{174} \times 10^4 = 250 \text{ psi} \leftarrow$$

3.5 Shear on threads is negligible.

Therefore, screws will adequately take loads.

Stress on pin: (pin is 1/8 dia stainless)

$$F = \frac{M}{d} = \frac{109}{1/4} = 436 \text{ lbs}$$

$$A = \frac{\pi}{4}\left(\frac{1}{64}\right) = .0123 \text{ in}^2$$

3.6 For double shear:

$$S_S = \frac{F}{2A} = \frac{436}{246} \times 10^4 = 17{,}750 \text{ psi} \leftarrow$$

Allowable S_S = .6 (75,000) = 45000 psi ←

3.7 Pin load on magnesium fitting

Bearing stress - area = dia x thickness of part:

$$A = 2\left(\frac{1}{8}\right)\left(\frac{1}{8}\right) = 1/32$$

$$S_B = \frac{F}{A} = \frac{436}{1/32} = 13,\ 950 \text{ psi} \leftarrow$$

3.8 Allowable bearing stress (ultimate) = 50,000 psi ←

3.9 Stresses on the fitting in the leg are proportionally higher than previously calculated:

$$\frac{F}{F^2} = \frac{436}{112} = 3.9 \text{ x greater}$$

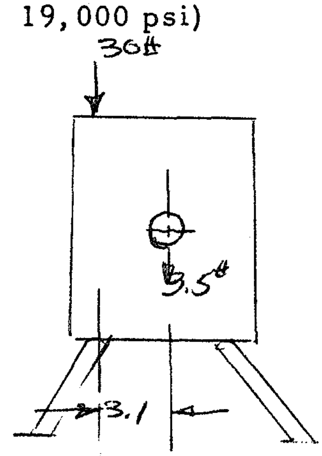
S_B = 7,5000 (3.9) = 29,300 psi (allowable = 50,000 psi)

S_B = 1,300 (3.9) = 5,070 psi (allowable = 19,000 psi)

4.0 III. Stresses on Left Legs

The entire lunar weight of the astronaut will be put over the left legs.

F on left leg due to CG = 1.9 lb (see page 2)



F_2 (total) = 30 + 1.9 = 31.9 lbs

L_L per leg = $\frac{31.9}{2}$ = 16 lbs

M_L + 16 (4.5) = 72 lb-in

4.1 Stress previously calculated on legs and fittings may be scaled up by the ratio.

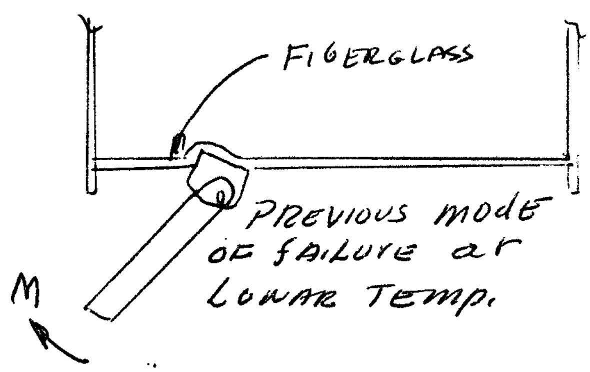
$$\frac{M_1}{M_2} = \frac{72}{26.3} = 2.73$$

4.2 Leg (at notch)

S = 430 (2.73) = 1170 psi ←

Allowable at 160 F = 22,000 psi

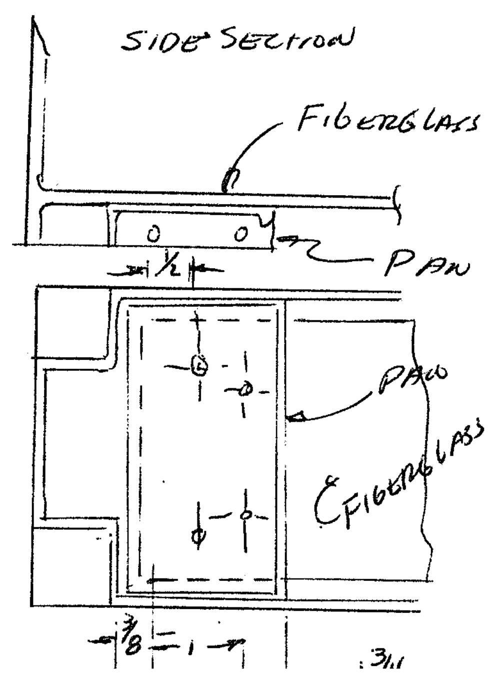
5.0 Leg - Support Pan

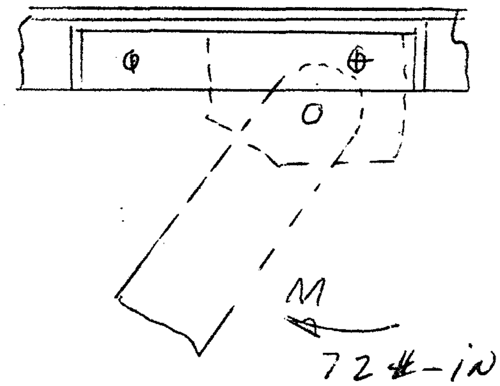


The left legs were previously attached to a fiberglass sheet in the bottom of the housing, which failed as shown. An aluminum pan has been added under the fiberglass to provide stiffness.

The pan is attached to the housing side walls (under the bottom) with 2 No. 4-40 screws per side. The leg fitting holes are common through the pan and the fiberglass.

The Fiberglass is .10 in thick, expoxied in glass and edge supported, so adds considerable strength at room temperature.

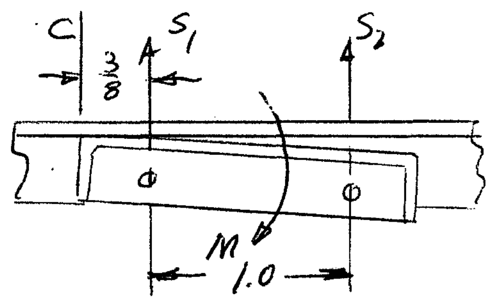




5.1 Loading on side screws of pan; worst case, entire load on pan:

$\leq M_C$: $.375\ S_1 + 1.375\ S_2 = 72$

5.2 Assuming the pan remains straight and pivots slightly about point C, then the deflections at S_1 and S_2 are



SHEAR LOADING ON SCREWS

$\frac{2}{1} = \frac{1.375}{.375}$, ∴ $2 = 3.67 \quad 1$

and $= \frac{F\ L}{A\ E}$ (F = force S)

$2 = \frac{F_2\ L_2}{A_2\ E_2} \qquad 1 = \frac{F_1\ L_1}{A_1\ E_1}$

$F_2 = 3.67\ F_1$

Since all L, A & e's are equal,

$F_2 = 3.67\ F_1$ and $S_2 = 3.67\ S_1$

5.3 Substituting in moment equation:

$.375\ S_1 + 1.375\ (3.67)\ S_1 = 72$

$S_1 = \frac{72}{5.425} =$ 13.3 lbs

$S_2 = 3.67\ (13.3) =$ 4817 lbs

5.4 These loads are distributed half on each side:

$$S_1 \text{ / screw} = \frac{13.3}{2} = 6.65 \text{ lbs}$$

$$S_2 \text{ / screw} = \frac{48.7}{2} = 24.3 \text{ lbs}$$

Shear area for No. 4-40 screw = 6×10^{-3} in.^{2}

$$S_{S_1} = \frac{F}{A} = \frac{6.65}{6} \times 10^3 = 1100 \text{ psi} \leftarrow$$

$$S_{S_2} = \frac{24.3}{6} \times 10^3 = 4040 \text{ psi} \leftarrow$$

5.5 Allowable shear stress for stainless = 45,000 psi

Bearing stress in aluminum at screws:

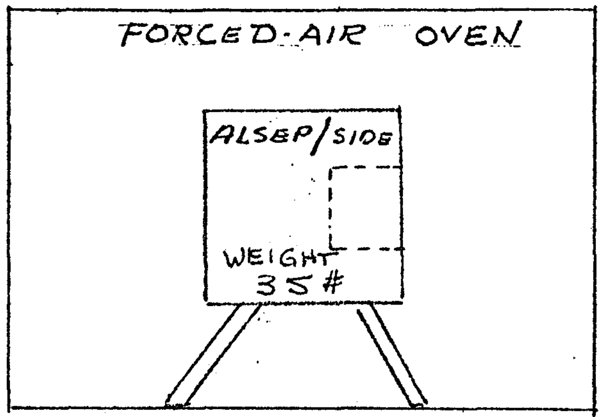
Area = dia x thickness (.112) (.05) = 5.6×10^{-3} in^2

$$S_{B_2} = \frac{24.3}{5.6} \times 10^3 = 4350 \text{ psi} \leftarrow$$

Allowable bearing stress = 46,000 psi ←

ALSEP/SIDE THERMAL TEST SET-UP

TEST NO. 1

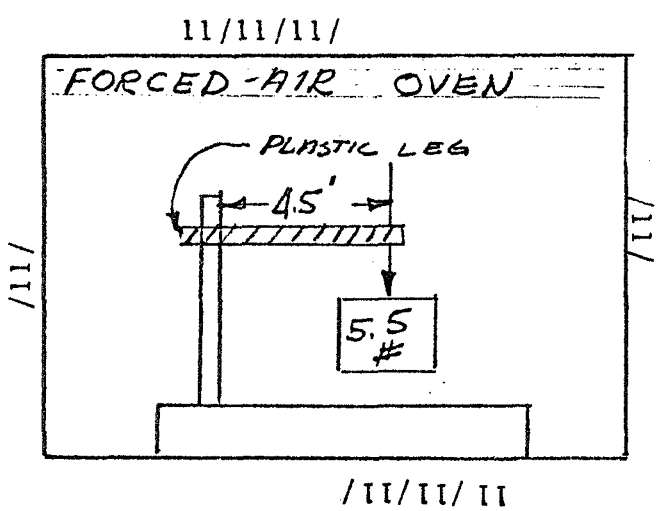


DATA

1) Oven Temp --- 250°F
2) Total Weight --- 35
(1.5 x earth weight)
3) Time In Oven --- 72 HRS

NEW LEG & SUPPORT CONFIGURATION

TEST NO. 2



1) Oven Temp --- 250°F
2) Weight --- 5.5 at 4.5"
(25 in)
Estimated Earth Weight
3) Time in Oven --- 7 Days

FIGURE 1

6.0 THERMAL TESTING

Initial thermal testing of the ALSEP/SIDE Housing and Leg Configuration indicated that a temperature creep problem existed. Corrective steps were taken to remedy this situation as discussed in the proceeding stress analysis. To substantiate this redesign, thermal tests were conducted as follows:

6.1 The new leg configuration was placed in a forced air type oven with a simulated weight of 35 pounds. (ALSEP moon weight plus (+) astronaut moon weight for a period of 72 hours at a temperature of 250°F, See Test 1 of Figure 1). A review of the leg and leg components, after completion of this test, showed no evidence of deformation or degradation of leg performance.

6.2 In addition to the above test a temperature test of an individual cantilevered leg was performed. An equivalent earth weight (5.5) was suspended 4.5 inches from the support end for a period of 7 days at 250°F. Slight bowing of legs took place, approximately .06" to .200" permanent deflection was experienced (See Figure 2).

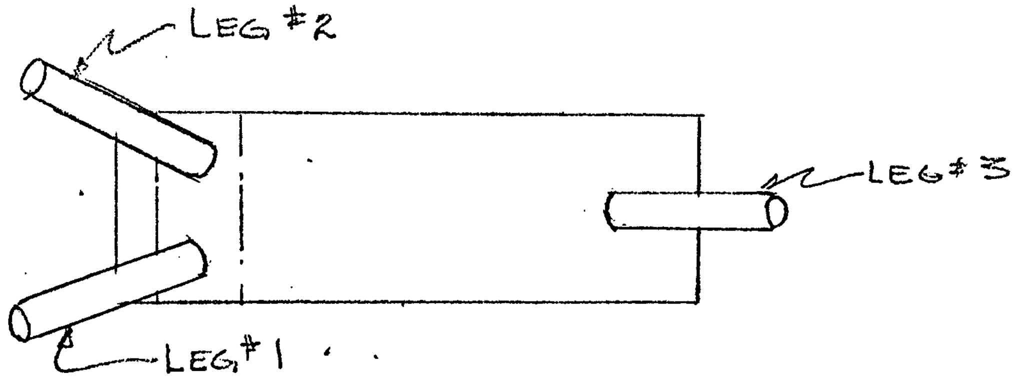
7.0 CONCLUSION

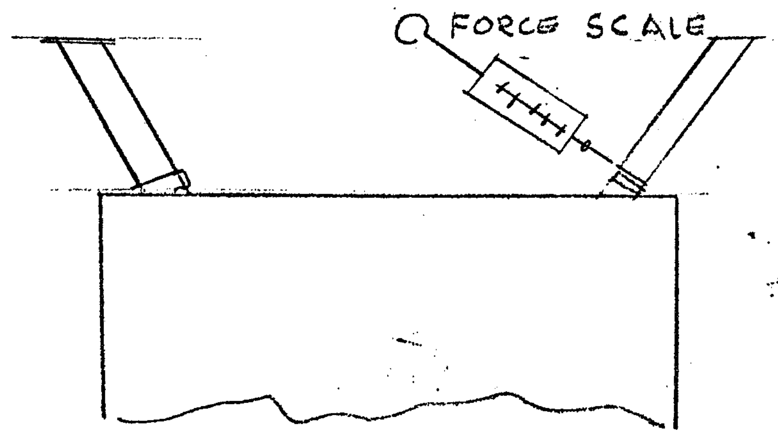
The stress analysis completed with the actual simulated temperature load tests performed at Marshall Laboratories indicated relatively high structural integrity of the leg and leg supports.

Since the actual moon loads shall be 1/6 of the earth loads, a high contidence level of this design configuration is believed.

8.0 LEG SPRING RETURN MODIFICATION AND TEST

To insure adequate extension of the ALSEP/SIDE Legs the extension springs (P/N 609—) were modified to provide an extension force of 20 ounce in lieu of 10 ounce. See Figure 3 for the test method and actual force values obtained.





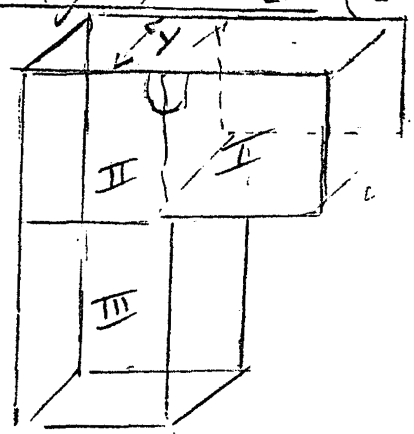
TEST LOADS IN LBS.				
ORIGINAL SPRING LOAD	3/4 #	3/4"	1/2"	OLD SPRINGS
MODIFIED SPRING LOAD	1 1/4 #	1 1/4 #	1 1/4	NEW SPRINGS
LEGS	1	2	3	

S. Pollack
3/19/68

APPENDIX F-2

CONCURRED WITH METHOD D Aalami, G. Cooper.

SUBJECT; OUT GASSING RATE OF INNER PACKAGE of ALSEP/SIDE (EMPTY ENVELOPE.



TO FIND OUTGASSING TIME OF ENCLOSURE

V = VELOCITY OF LIGHT
= 2.998×10^8 METERS/SEC.
= 186,280 MILES/SEC
= 984×10^6 ft/SEC.

Y = DIST BETWEEN WALLS

A_T = LATERAL SURFACE AREA TOTAL ENCLOSURE

A_0 = LATERAL SURFACE AREA OPENING.

$R_A = \frac{A_0}{A_T} = \frac{\text{OPEN AREA LATERAL}}{\text{TOTAL AREA LATERAL}}$ (RATIO)

N = TOTAL NUMBER OF MOLECULES AT A GIVEN PRESSURE IN A GIVEN AREA

T = TIME OF OUT GASSING.

$$= \frac{(N_1 - N_2)}{\left(\frac{V\ ft/sec}{Y\ ft}\right)(R)}$$

$$T = \frac{\text{Number}}{\frac{ft/sec}{ft}} = \text{SEC}$$

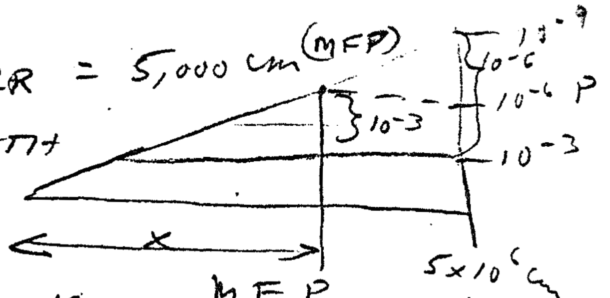
FROM NCR VACUUM PUMP DATA

1) AT ATMOSPHERIC PRESSURE
1 CC AIR = 3×10^{19} MOLECULES

2) AT 1 MICRON (10^{-3} TORR) PRESSURE
1 CC AIR = 4×10^{13} MOLECULES
MEAN FREE PATH IS --- 5 CM

3) AT 10^{-9} TORR PRESSURE
1 CC AIR = 4×10^{7} MOLECULES
MEAN FREE PATH IS ---- 5×10^6 CM
(30 MILES +)

4) CALCULATED
AT 10^{-6} TORR = 5,000 CM (MFP)
MEAN FREE PATH
MOLECULE/$\times 10^{10}$

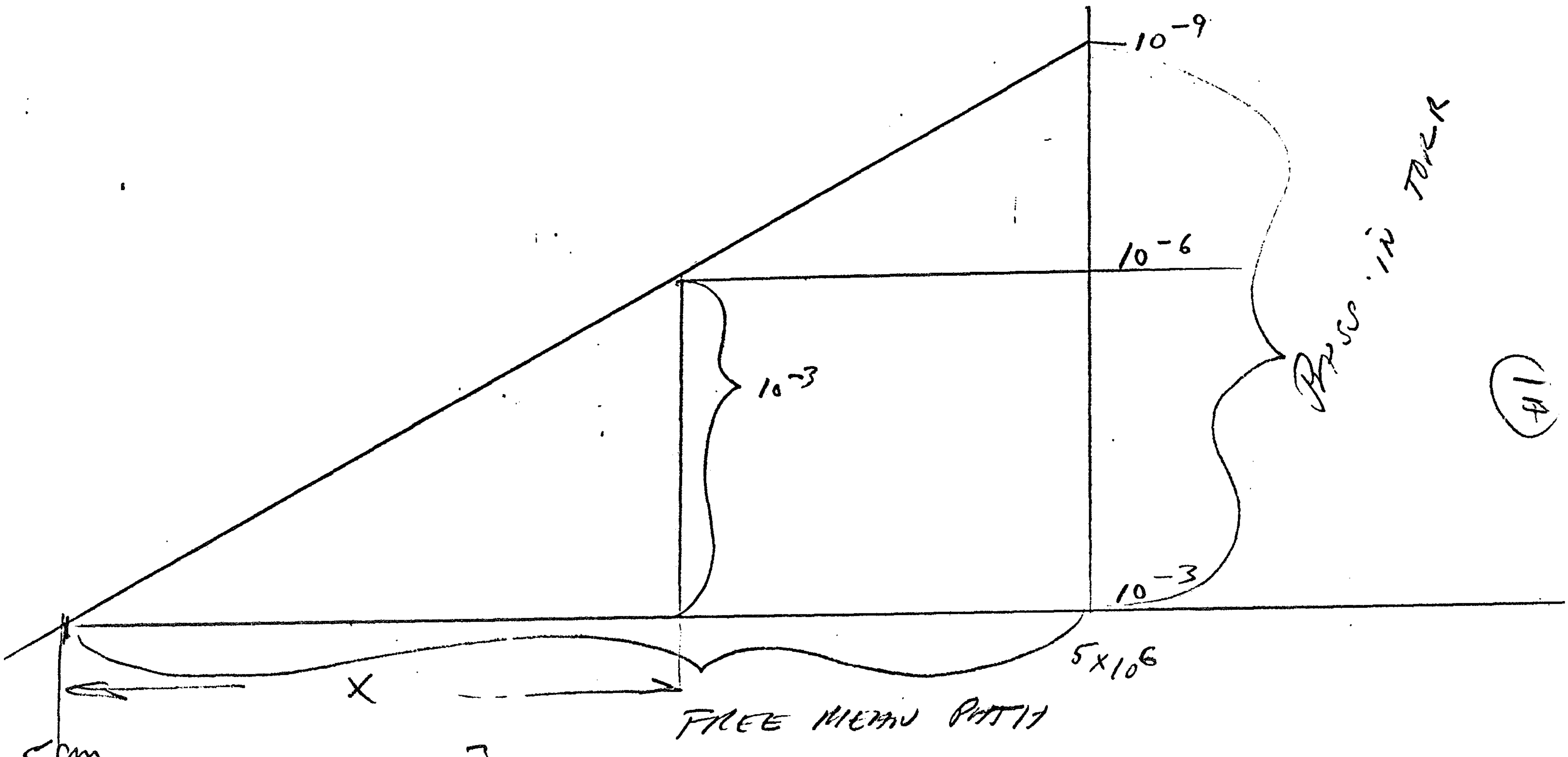


1CC AIR = ~ 4×10^{10}

$$\frac{10^{-6}}{10^{-3}} = \frac{5 + N}{(5 \times 10^6 - 5)}$$

$N = 5 \times 10^{-3}$ CM (MEAN FREE PATH

PRESS VS FREE MEAN PATH OF MOLECULES.



$$\frac{10^{-3}}{10^{-3}} = \frac{5cm + x}{(5\times10^6 - 5)}$$

$(5\times10^6 - 5)\,10^{-3} - 5cm = x$

$5\times10^3 - 5 = x = $ 5 X 10³ cm MEAN FREE PATH @ 10⁻⁶ TORR

3/19/68

SPollu

TIME FOR AREA I

1) $T_I = \dfrac{N_1 - N_2}{\left(\dfrac{V_{light}\ ft/sec}{Y\ ft}\right)(R)}$ (@ 10^{-3} TORR, @ 10^{-6} TORR; $\times\frac{1}{3}$)

2) $T_I = \dfrac{(4 \times 10^{13}) - (4 \times 10^{10})}{\dfrac{(10 \times 10^{8})\ ft/sec}{1\ ft}\ (.03)}$

3) $T_I = \dfrac{(4000 \times 10^{10}) - \cancel{(4 \times 10^{10})}}{(10 \times 10^{8} \times .03)}$

4) $T_I = \dfrac{4000 \times 10^{\cancel{10}\ 2}}{.3 \times \cancel{10^{8}}}$

5) $T_I = 1,3,333 \times 10^{2}$ SEC.

$T_I = \dfrac{1,333,300\ \text{sec}}{3600\ \text{sec/hr} \times 24\ \text{hr/DAY}}$

6) $T_I = 15.4$ DAYS

$R_I = \dfrac{A_{O_I}}{A_{T_I}}$

$R_I = \dfrac{3\ in^2}{100\ in^2} = \underline{\underline{.03}}$

$A_{T_I} = (5" \times 4")2 + (4 \times 5)2 + (3 \times 3)2$

$A_{T_I} = 2[20 + 20 + 9]$

$A_{T_I} = 2[49]$

$A_{T_I} = 98 = \sim \underline{100}\ in^2$ LATER AREA TOTAL

$A_{O_I} = 2 \times 1 + 1 \times 1$

$A_{O_I} = \underline{\underline{3\ in^2}}$

$V = 984 \times 10^{6}$

$V = \sim 1,000 \times 10^{6}$

$V = 10 \times 10^{8}$ ft/sec

Y = SIDE DIST (3 AXIS)

$\cancel{3} \times 4" = 12" = 1\ ft$

THIS IS FOR OUTGASING 11 CLOSED EMPTY CHAMBER WITH 3 in² opening.
RTV + FOAM OUT-GASSING, BLIVET AND SHEET METAL
LABYRINTHS [illegible]

TIME FOR AXEH $_{II}$

S. Pillay

Time = T

$$T_{II} = \frac{N_1 - N_2}{\left(\frac{V}{Y}\right)(R)}$$

$$T_{II} = \frac{(4\times10^{13}) - (4\times10^{10})}{\left(\frac{10\times10^{8}}{1.5}\right)(.0196)}$$

$$T_{II} = \frac{4\times10^{15}}{(10^{9})(.02)} \times 1.5 =$$

$$T_{II} = \frac{3\times10^{15}}{10^{9}\,(3600\times24)}$$

$$T_{II} = \frac{1}{.12\times24} = \frac{1}{.12\times.24}$$

$$T_{II} = 35\ \text{DAYS}$$

$$R_{A_{II}} = \frac{A_{0_{II}}}{A_{T_{II}}}$$

$$R_{A_{II}} = \frac{2}{102} = .0196$$

$$A_T = (6''\times3'')2 + (6\times4)2 + (3\times3)$$

$$A_{T_{II}} = 36 + 48 + 18$$

$$A_{T_{II}} = 102\ \text{in.}$$

$$A_{0_{II}} = 2\ \text{in.}$$

$$V = 10\times10^{8}\ \text{ft/sec}$$

$$Y = 6''\times 3\ \text{AXLE} = 18''$$

$$Y = \frac{18}{12} = 1.5\ \text{ft.}$$

TIME FOR AREA III

$$T_{III} = \frac{N_1 - N_2}{\frac{V}{Y}(R)}$$

$$T_{III} = \frac{(4\times10^{13}) - (4\times10^{10})}{\left(\frac{10^9\ ft^2/sec}{.2}\right)\times(.01)\times 8.65\times10^4}$$

$$T_{III} = \frac{.2\times4\times10^{13}}{10^9\times.01\times8.65\times10^4}$$

$$T_{III} = \frac{.8000}{.0865}$$

$$T_{III} = 9.26 \text{ DAYS}$$

$$R_{A_{III}} = \frac{A_{O_{III}}}{A_{T_{III}}}$$

$$R_{A_{III}} = \frac{2\ in^2}{208\ in^2} = .0096 \sim .01$$

$$A_{T_{III}} = (8''\times6'')2 + (8\times4)2 + (6\times4)2$$

$$A_{T_{III}} = (48)2 + (32)(2) + (24)2$$
$$= 96 + 64 + 48$$
$$= 208\ in^2$$

$$A_{O_{III}} = 2\ in^2$$

$$Y = \frac{6''}{1}\times\frac{1}{3} = \frac{2''}{12} = \frac{1'}{6} = .167$$

$$Y = \sim .2$$

TOTAL TIME IS BASED ON THE GREATEST INDIVIDUAL AREA TIME ie $T_{II} \sim$ 35 DAYS (EMPTY CONTAINER)

SOLENOID TESTING

24 May 1968

SOLENOID FORCES

	20 volts	28 volts
Number 1	5 grams	95 grams
Number 2	36 grams	133 grams
Number 3	20 grams	161 grams
Number 4	56 grams	191 grams
Number 5	50 grams	191 grams

SOLENOID TESTS

Remarks:

Resistance 186Ω at 25°C (77°F)
192Ω at 77°F 20 seconds later

Solenoid (for S/N 7 system) Measurements taken 5/22/68

Checked up and down scale (Repeats o.k.)

Present 2500 turns - Taken by Jim Peterson and Sam Pollack 5/22/68

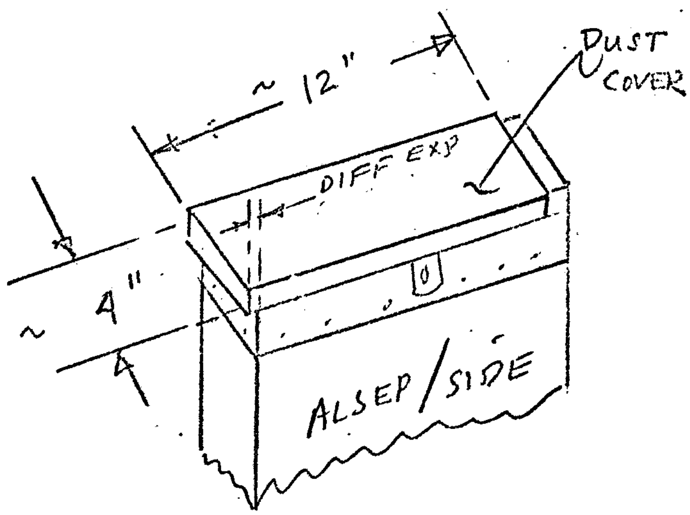
Pull-In Voltage	Milliamperes	Voltage in Watts
16.3	85	1.382
17	89	1.51
18	94	1.7
19	99.5	1.89
20	105	2.1
21	110	2.31
22	115	2.53
23	120	2.76
24	125	3.62
25	130	3.25
26	135	3.51
27	140	3.78
28	140	4.03
29	147	4.26
30	150	3.5

SAM [illegible]
5/20/68

THERMAL EXPANSION CALCULATIONS
(BETWEEN DUST COVER & THERMAL SPACER)

PROBLEM STICKING OF DUST COVER DURING COLD TEST AT BENDIX.

CONSIDERATIONS



TEMPERATURE RANGE Rm Temp = 80°F
COLD TEMP = −80°F

$T_2 - T_1 = \Delta T = -160°F$

STAINLESS = $10.4 - 6.4 \times 10^{-6}$ in/in/°F
ALUMINUM = $13.7 - 11.7 \times 10^{-6}$ /°F
LEXAN = 37.5×10^{-6}

ASSUME DIFF. EXP ON LONG AXIS

LEXAN

$\Delta l_1 = l \alpha (t_2 - t_1)$

$\Delta l_1 = 12''(3.75 \times 10^{-5})[80 - (-80°F)]$

$\Delta l_1 = 12(3.75 \times 10^{-5})(160)$

$\Delta l_1 = .072$ in

ALUMINUM $\alpha_{Alum} = 10.8 - 13.4$ in/in °F $\times 10^{-6}$ @ 200°F

$\Delta l_2 = l \alpha (t_2 - t_1)$

$\Delta l_2 = 12(10 \times 10^{-6})(160)$ 120 200 024000

$\Delta l_2 = .01920$

ANSWER

DIFF EXP = $\Delta l = \Delta l_1 - \Delta l_2 = .072 - .019 = (\approx .053$ in$)$

S. Pollack
5/20/68

(Continued)

ASSUME DIFF. EXP ON NARROW AXIS

LEXAN

$\Delta l_1 = l \alpha (t_2 - t_1)$

$\Delta l_1 = 4(3.75 \times 10^{-5})(160)$

$\Delta l_1 = .024$

ALUM

$\Delta l_2 = l \alpha (t_2 - t_1)$

$\Delta l_2 = 4 \times (10 \times 10^{-6})(160)$

$\Delta l_2 = .0064$

Net $\Delta l = \Delta l_1 - \Delta l_2 = .024 - .0064$

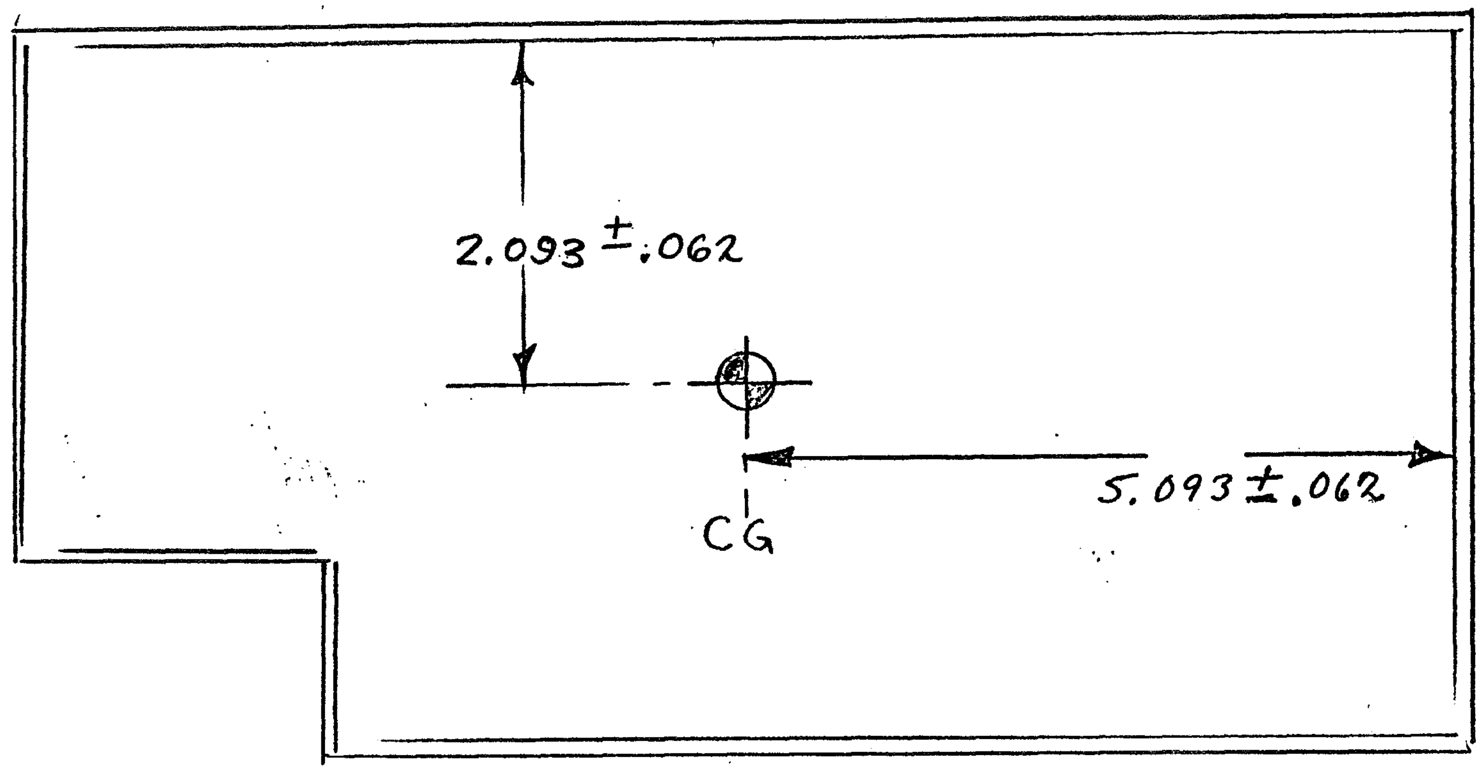
$\Delta l = \sim .0176''$ Answer

BOTH AXIS SHOW A NEGLIGIBLE AMOUNT OF THERMAL EXPANSION CONSIDERING THE PRESENT LARGE CLEARANCE ALLOWED BETWEEN THE DUST COVER EDGES AND THE THERMAL SPACER SURFACE.

[signature]

DUST COVER STUDY

PROPOSED DUST COVER WEIGHT & CG



WEIGHT 62 gms ± 3 gms

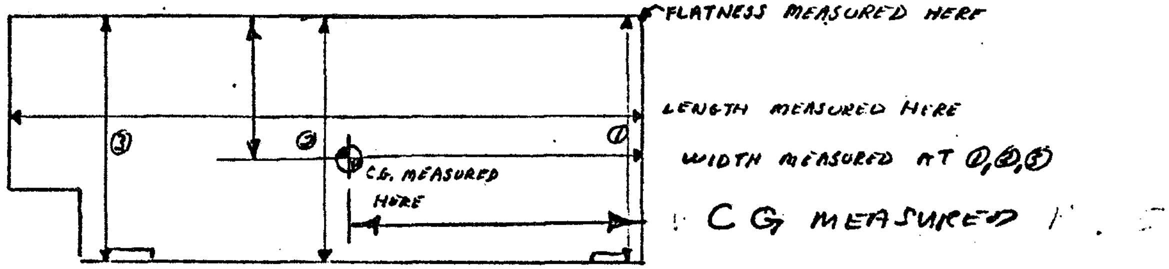
CONFIGURATION OF DUST COVER
FOR ABOVE MEASUREMENTS

1 COVER PAINTED WITH 3M
2. CONTAINS LATCH
3. MODIFIED WITH FRONT MYLAR & REAR ALUM SKIRT
4. NO HINGE PIN
5 NO HINGE BRACKET
6. NO SPRINGS

5/28/68

DUST COVER CHECK

(WITH EPOXY BORD IN PLACE AND NO HARDWARE)



COVER	WEIGHT	WIDTH 1	WIDTH 2	WIDTH 3	LENGTH	FLATNESS	C.G. L	C.G. W
1.)	51.1G	4.423	4.410	4.417	10.46	.080 ~~.15~~	5.034	2.090 ~~2.127~~
2.)	51.9G	4.423	4.423	4.423	10.46	.04	5.035 ~~5.063~~	2.060 ~~2.021~~
3.)	52.25G	4.423	4.423	4.139	10.46	.03	5.035 ~~5.006~~	2.070 ~~2.050~~
DWG. DIM.		4.420			10.480			

UNPAINTED ORIGINAL DESIGN
NO SPRINGS, NO LATCH
NO HINGE & NO HINGE PINS

J. RHODES

MODIFIED DUST COVER

COVER	WEIGHT	WIDTH 1	WIDTH 2	WIDTH 3	LENGTH	FLATNESS	C.G. L	C.G. W
1)	61 gms		← ACTUAL →				5.085	2.085
B/P Proposed	(62 ± 3 gms)		← PROPOSED →				5.093 ±.062	2.093 ±.062

PAINTED MODIFIED COVER WITH LATCH
MODIFIED WITH MYLAR SKIRT
NO HINGE PIN WITH NO SPRINGS

J Peterson

[illegible signature]

DUST COVER PAINT PEELING STUDY

Summary
of
Paint Peeling Test with 3-M Velvet

Paint Used:	3-M Velvet Coating, 100 Series No. 101-A-10 White VC-3-44 Lot
Primer Used:	GE SS-4044 Clear Silicone Primer
Test Samples:	Aluminum, Lexan and Glass Epoxy Board. All Mating Combination of Painted Samples Used ie. AL to AL, Al to Glass Board etc.
Temperature:	Cold test - Room Temperature to $-90^{\circ}F$ High Test - Room Temperature to $+250^{\circ}F$

TEST SET-UP

Results:	No peeling encountered See Attached Details

SAMPLE 3-M PAINT TESTS

1. Cut (2 each) samples of aluminum, glass fiber board and lexan approximately 2" x 2".

2. Prepared the surfaces with No. 240 grit emery cloth and cleaned with alcohol.

3. Primed with GE SS-4044 Clear Silicone Primer. Air dried for 30 minutes.

4. Spray painted three coats of 3M velvet coating 100 series, No. 101-A-10 White. Air dried 15 minutes between second and third coat, 13 hours after final coat.

5. Clamped samples together in the following order - lexan, aluminum-aluminum, glass fiber board, glass fiber board and lexan.

6. Clamped samples were then subjected to -75°C for 2 hours. Upon releasing clamps, samples fell apart by their own weight. No deterioration of the paint was noted.

7. One of each sample was then exposed to long wave ultra violet at a distance of 1/2 inch and at80°C, for 4 hours.

8. Also one of each sample was held at -75°C while a 110°C hooded lamp was placed one half inch over the set up for 3 hours. No deterioration was noted. Then the temperature was allowed to drift up to 25°C.

9. Continuing with the samples which were at -75°C for 3 hours, the temperature was raised to 115°C for 17 hours, then dropped again to -75°C in about 45 minutes and then allowed to drift up to 25°C. No deterioration was noted.

10. For the last test the aluminum and glass board samples were painted side up and the lexan was painted side down resting on the other two. A 250 gram weight was then added. After the test no bonding or sticking action was noted.

Testing Performed by Jim Peterson

Concurred by Sam Pollack

ALSEP/SIDE STRESS AND DEFLECTION OF EXTERNAL BOX

Stress of Flat Plate $S = K \frac{P}{t^2}$

$S_m = \frac{.497 \times 20}{.0016}$

$S = 6{,}200$ psi

Alum Alloys
Marks Handbook
6-68

52-S 5052

12,000 psi accept yield

27,000 psi ultimate

Deflection of Flat Plate

$Y_m = K_1 \frac{Pr^2}{Et^3}$

$Y_m = \frac{(.0277)(20)(36\ in^2)}{10 \times 64}$

Y .03105" Deflection

Ref. Marks Handbook

t = 040" thickness

$t^2 = .0016$"

P = 20 #

$\frac{R}{r} = \frac{12}{6} = 2.0$

K = .497

$K_1 = .0277$

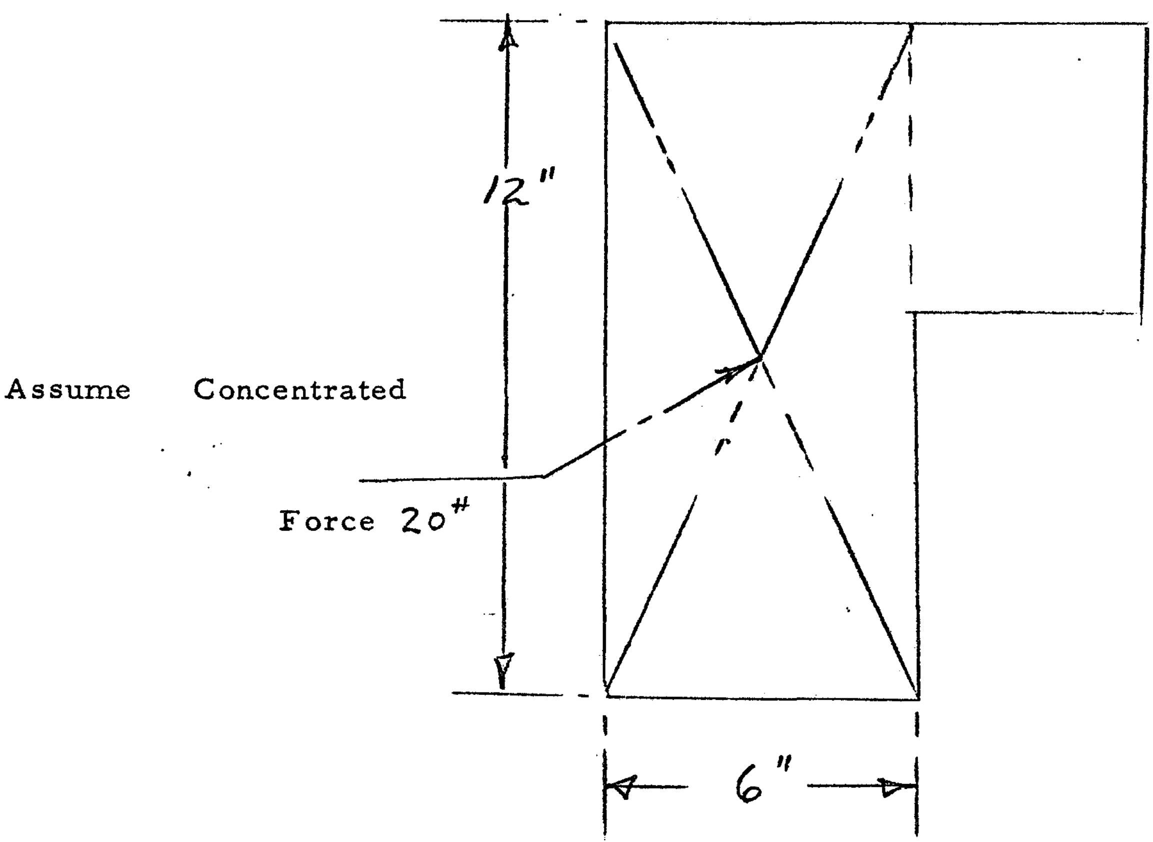
$E = 10 \times 10^6$ psi

$t^3 = 64 \times 10^{-6}$

r = 6"

$r^2 = 36\ in^2$

SKETCH SIDE OF ALSEP BOX



ASSUME STRESS ABOVE ELASTIC LIMITS 13,000 psi

$$S = K \frac{P}{t^2}$$

Yield of Alum = 12,000 psi

$$t = \sqrt{\frac{KP}{S}} = \sqrt{\frac{.497 \times 20}{13,000}}$$

$$t = \sqrt{7.65 \quad 10^{-4}}$$

$$t = 2.76 \times 10^{-2}$$

t = .0276 in thickness

Deflection MAX

$$y = K_1 \frac{Pr^2}{Et^3}$$

$$Y = \frac{(.0277)\ (20)\ (36)}{10 \times 19.7}$$

Y = .120 in.

Flat Plate Force

$S = \frac{P}{t^2}$

$P = \frac{S \quad t^2}{K}$

$P = \frac{13,000\ (.0016)}{.497}$

$P = 41.8$

P = 42 #

With 13,000 PSI (12,000 psi is elastic limit)

Find max force to reach yield stress with wall thickness of

$t = .040,\ t^2 = .0016$

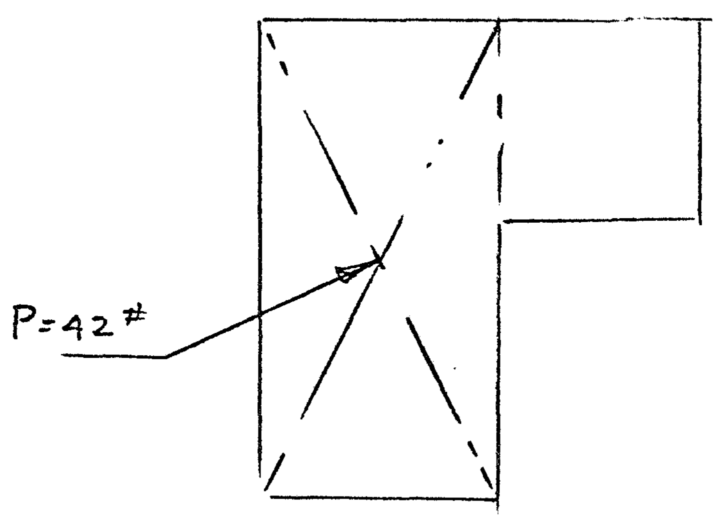
$S = 13,000$ psi

$K = .497$

$P = 42$

Side of External Box

F - 42



CHANNELTRON STRESS REPORT
(SYLGARD ENCAPSULATION)

The following covers the calculations for possible thermal stresses set-up in the channeltron due to thermal expansion of the potting material (sylgard 182 Dow Corning Material).

Two (2) considerations are given here for discussion:

1) During temperature increase of the channeltron module the supporting sylgard cavity increases in diameter as a possibility, there-by reducing thermal expansion stresses on channeltron.

2) The sylgard expands with temperature in a manner that provides tensile stresses on channeltron neck.

The second consideration is discussed and analyized in this report.

The forces acting on the channeltron are illustrated in Figure 1.

<u>Ref Material</u> (Attached)

1. Sketch of channeltron in letter from W.A. Smith dated 6 June 1967
2. Dow Corning bulletin on Sylgard 182

<u>Engineering Data</u>

1. Temperature Range 20°C to 80°C
2. Coef. of Exp. (Sylgard 182) = 300 X 10^{-6} inch per °C
3. Coef. of Exp. (Glass) $\sim$ 50 x 10^{-7} inch per °F(Marks handbook)
4. * Glass strength tensile = 10,000 psi (" ")
   (common glass) Compressive = 50,000 psi (" ")
5. Sylgard strength tensile = 800 - 1000 psi (See Reference 2)
6. Young modules of elasticity of Sylgard 182 = 90 psi

* Although compressive strength is shown

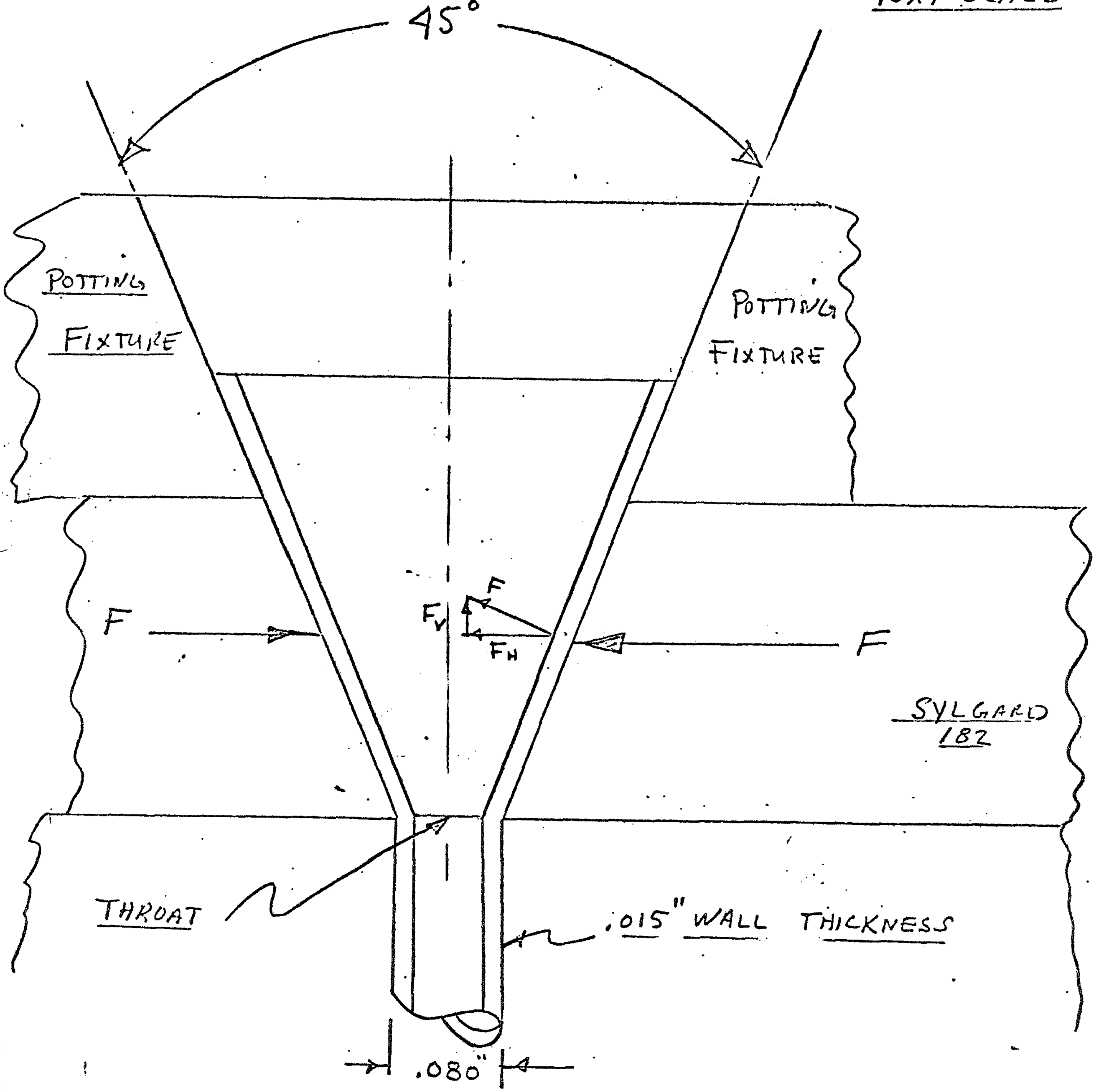
Glass Basically Fails in Tension

Reference Marks Handbook

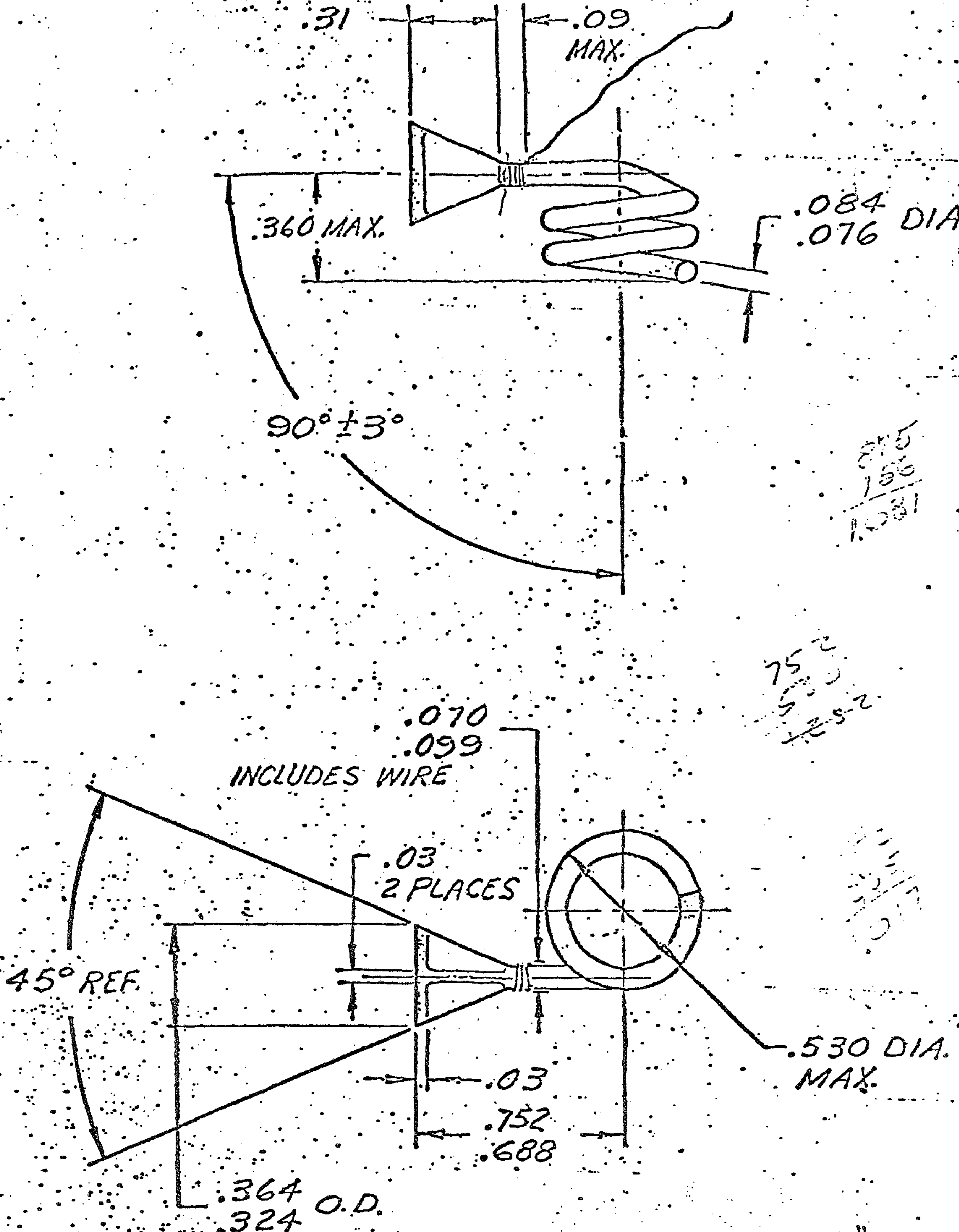
7/18/63

CHANNELTRON SYLGARD SUPPORT

10X1 SCALE



SIZE	CODE IDENT NO.	DWG NO.	REV
A	13126	FIG 1	
SCALE	RELEASED	SHEET 2	OF



.015 " THICK WALL

REF 2

Information about

Electronic Materials

SYLGARD 182 Potting and Encapsulating Resin

Sylgard® 182 resin is a low viscosity, solventless silicone resin designed for potting, filling, embedding and encapsulating. It is supplied as a nearly colorless fluid that flows easily, even around intricate parts.

Features of the Fluid Resin

Sylgard 182 resin is easy to process and use. The resin and its curing agent blend readily, and the low viscosity of the catalyzed material (under 4,000 centipoises) coupled with its long pot life (about 8 hours at 77 F) make it practical to use in automatic dispensing equipment.

Neither the resin nor the curing agent is known to produce any toxic effect upon contact with the skin, nor to give off any noxious fumes during mixing or curing.

Sylgard 182 resin cures at moderate temperatures, and without exotherm. When mixed with the correct amount of curing agent, the resin will cure in 4 hours at 65 C (149 F); cure can be accelerated by using higher temperatures. The rate of cure is constant regardless of sectional thickness, or the degree of confinement.

Features of the Cured Resin

When set up, Sylgard 182 resin needs no further after-bake. It can be placed in service at once, at any operating temperature between −65 C to 200 C. Other features of the cured resin are:

- *transparency* — embedded parts can be inspected visually;
- *easy repairability* — sections of the resin can be cut out for replacement of components; new resin can be poured in place and cured to re-form a tight seal;
- *physical and electrical stability* — retains properties from −65 to 200 C (−85 to 392 F), over a wide range of frequency and humidity;
- *firmness and flexibility* — Shore A Scale hardness of approximately 40; elongation of approximately 100 percent;
- *mechanical strength* — tensile strength in the range of 800 to 1,000 psi;
- *good damping qualities* — low transmission of vibration and shock;
- *self-extinguishing* — as tested in accordance with ASTM D 635;
- *no depolymerization* — will not depolymerize when heated in confined space;
- *fungus resistance* — non nutrient when tested in accordance with MIL-E-5272.

SPECIFICATIONS FOR SYLGARD 182 RESIN
(These values are Dow Corning quality control standards)

As Supplied	
ASTM D-1298, Specific Gravity at 25° C	1.05±0.03
ASTM D-445, Viscosity at 25° C centistokes	4,000 to 6,500
Shelf Life at 25° C, minimum	1 year
Pot Life at 25° C (with 10 pph curing agent added), minimum	8 hours
APHA Color, maximum	250
Cured properties using 10 parts by weight of curing agent to 100 parts by weight of resin.	
After 4 Hours at 65° C:	
ASTM D-792, Method A, Specific Gravity	1.05±0.03
ASTM D-676 Hardness, Shore A Scale Durometer points, minimum	35
ASTM D-149 Electric Strength*, volts per mil, minimum	500
ASTM D-150 Dielectric Constant, maximum, at 10^2 cps	2.88
at 10^5 cps	2.88
ASTM D-150 Dissipation Factor, maximum, at 10^2 cps	0.002
at 10^5 cps	0.002
ASTM D-257 Volume Resistivity, ohm-cm, minimum	1×10^{13}
After 1 hour at 150° C:	
ASTM D-412 Die C, Tensile Strength, psi, minimum	800
ASTM D-412 Die C, Elongation, % minimum	100

* Tested on specimen 0.062 inch thick, using ¼-inch standard ASTM electrodes, 500 volts per second rate of rise.

(Continued on next page)

The information and data contained herein are based on information we believe reliable. You should thoroughly test any application, and independently conclude satisfactory performance before commercialization. Suggestions of uses should not be taken as inducements to infringe any particular patent.

DOW CORNING

BULLETIN: 07-214 DATE: AUGUST, 1966
ELECTRONICS PRODUCTS DIVISION
DOW CORNING CORPORATION
MIDLAND, MICHIGAN 48640
ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK

SYLGARD 182 POTTING & EMBEDDING RESIN
REF 2

TYPICAL PHYSICAL PROPERTIES

(These values are not intended for use in preparing specifications)

As Supplied

Color	Light Straw
Silicone Resin Content, percent	100
Specific Gravity at 25 C (77 F)	1.05
Viscosity at 25 C, centistokes	5,500
Viscosity, immediately after adding curing agent, centistokes	3,900
Shelf Life at 25 C	1 year
Pot Life* at 25 C (with curing agent added)	8 hours

* Time required for catalyzed viscosity to double at 25 C.

As Cured (4 hours at 65 C)

Color	Transparent; colorless to light straw
Hardness, Shore A Scale	40
Specific Gravity	1.05
Thermal Conductivity, cal per [(cm) (degree C) (sec)]	3.5×10^{-4}
Linear Coefficient of Thermal Expansion, in/in/degree C (—55 to 150 C)	300×10^{-6}
MIL-I-16923 C Thermal Shock Resistance, from —55 to 155 C	Passes 10 cycles
Weight Loss*, percent,	
after 1,000 hrs at 150 C (302 F)	1.6
after 1,000 hrs at 200 C (392 F)	3.2
Water Absorption, percent after 7 days immersion at 25 C (77 F)	0.10
Brittle Point, degrees C, lower than	—70
Refractive Index	1.430
Radiation Resistance, Cobalt 60 Source	Still usable after exposure to 200 megarads; hard and brittle after 500 megarads
Flammability (ASTM D 635)	Self-extinguishing

* Specimen size: 1 inch by 1½ inches by 1/16 inch thick.

TYPICAL ELECTRICAL PROPERTIES

(These values are not intended for use in preparing specifications)

General Data*

	As Cured	Cured, then Aged 1,000 hours at 200 C (392 F)
ASTM D 150 Dielectric Constant, 60 cps	2.70	2.65
10^6 cps	2.70	2.65
ASTM D 150 Dissipation Factor, 60 cps	0.001	0.001
10^6 cps	0.001	0.001
ASTM D 257 Volume Resistivity, ohm-cm	2×10^{15}	2×10^{14}
ASTM D 149 Electric Strength, volts per mil†	550	600

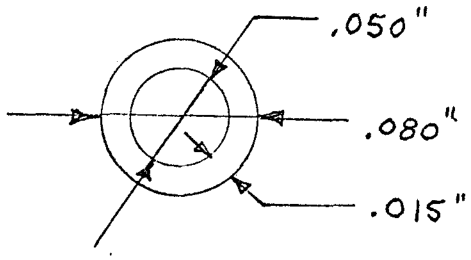
* 0.062 inch-thick specimens, cured 4 hours at 65 C.
† ¼ inch Standard ASTM Electrode, 500 volts per second rate of rise.

High Frequency Data‡

Properties	at —55 C	at 23 C	at 150 C
Dielectric Constant (ASTM D 150)			
at 1×10^9 cps	2.90	2.79	2.50
at 3×10^9 cps	2.86	2.77	2.48
at 8.5×10^9 cps	2.81	2.73	2.45
Dissipation Factor (ASTM D 150)			
at 1×10^9 cps	0.0200	0.0081	0.0026
at 3×10^9 cps	0.0240	0.0120	0.0040
at 8.5×10^9 cps	0.0290	0.0199	0.0073

‡ These values were determined at the Massachusetts Institute of Technology Laboratory for Insulation Research.

AREA OF THROAT



D_1 = OD = .0 80" 00

D_2 = ID = .0 80" -.030 = .050" ID

.015" inch wall thickness

AREA OF THROAT OR BASE OF CONE

$$A_t = \frac{\pi D^2}{4} - \frac{\pi D_2^2}{4} = \frac{\pi}{4}(D_1^{\,2} - D_2^{\,2})$$

$$A_t = \frac{\pi}{4}((.080)^2 - (.050)^2)$$

$$A_t = \frac{\pi}{4}(.0064 - .0025)$$

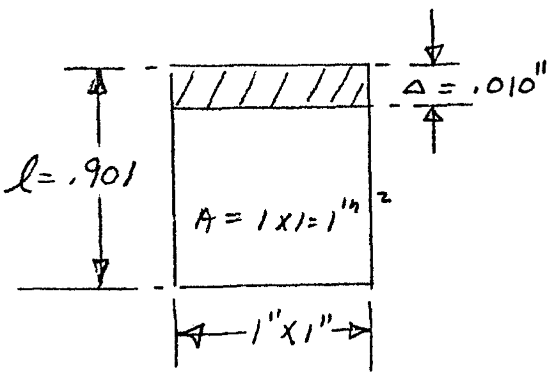
$$A_t = \underline{\pi}\ (\ .10010)$$

$$A_t = 3.14 \times .001$$

$$A_t = .00314\ in^2$$ Area of Throat of Channeltron

MARSHALL LAB TEST
OF SYLGARD FOR
YOUNGS MODULES OF ELASTICITY

(Not Available In Sylgard Bulletin)



Young Modules of Elasticity

$$Y = \frac{\text{Stress}}{\text{Strain}} = \frac{F/A}{\Delta/l}$$

$$Y = \frac{Fl}{A\ \Delta}$$

$$Y = \frac{1 \times .90\text{lin}}{1\ \text{in}^2\ \ .010}$$

$$Y = 90 \text{ psi}$$

Force due to sylgard on the contact area (see page 5 for lateral contact area)

The force exerted on this surface is

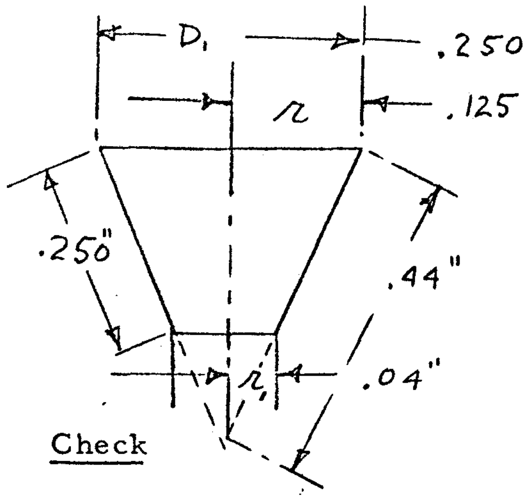
$F = 90 \times .2 \times .010 = .18^{\#}$

$F = .18^{\#}$

Assume $F = .2^{\#}$

LATERAL CONTACT AREA CONE

BY SYLGARD



Lateral Area Total Cone

$A_L = 1/2\ \pi\ Dl$

$A_L = 1/2\ \pi\ (.250)\ (.44)$

$A_L = .173$

Lateral Area Top Section of Cone

$A_T = 1/2\ \ D\ \ (3.4)$

$= 1/2\ \ .04\ (3.4)$

$= .0426$

$$\begin{array}{r} 1.73 \\ -\ .043 \\ \hline \end{array}$$

Check

$A_{Net} = \pi\ S\ (r + r_1)$

$A = \pi\ .25\ \ (.125) + (.04)$

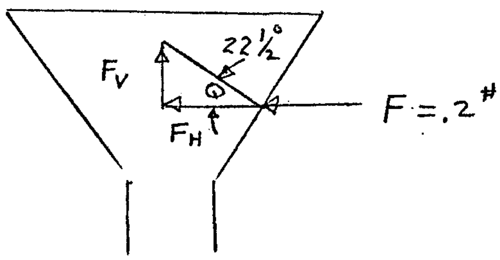
$A = \pi\ .25\ \ (.165)$

$A = .130 in^2$ (Check Only)

Net Surface = $.130 in^2$

ASSUME AREA ~ .20 in^2

STRESS ON GLASS THROAT



$F_v = F = .2^{\#}$

$F_v = F_H \text{ Tan } Q$

$F_v = (.2)\ (\text{Tan } 22\text{-}1/2)$

$F_v = (.2)\ (.414)$

$F_v = .08$

$F_v = .1^{\#}$

Glass Throat

$$\text{Stress} = \frac{F_v}{A \text{ Throat}}$$

$$8 . = \frac{.1}{.003} = 30 \text{ psi}$$

Assume Worst Case

$$S = \frac{.5}{.001} = 500 \text{ psi}$$ (strength of glass = 10,000 psi in tension)

Over 20X Safety Factor

CONCLUSION

Based on these calculations a safety factor of 20 is evident on the stresses believed to be exerted by the expansion of Sylgard on the Channeltron Throat.

During the freezing cycle the stresses would be reduced accordingly.

If the 1st consideration (mentioned earlier) is believed to be true, then the analysis would still apply for the freezing cycle with no severe stress on the glass throat due to sylgard.

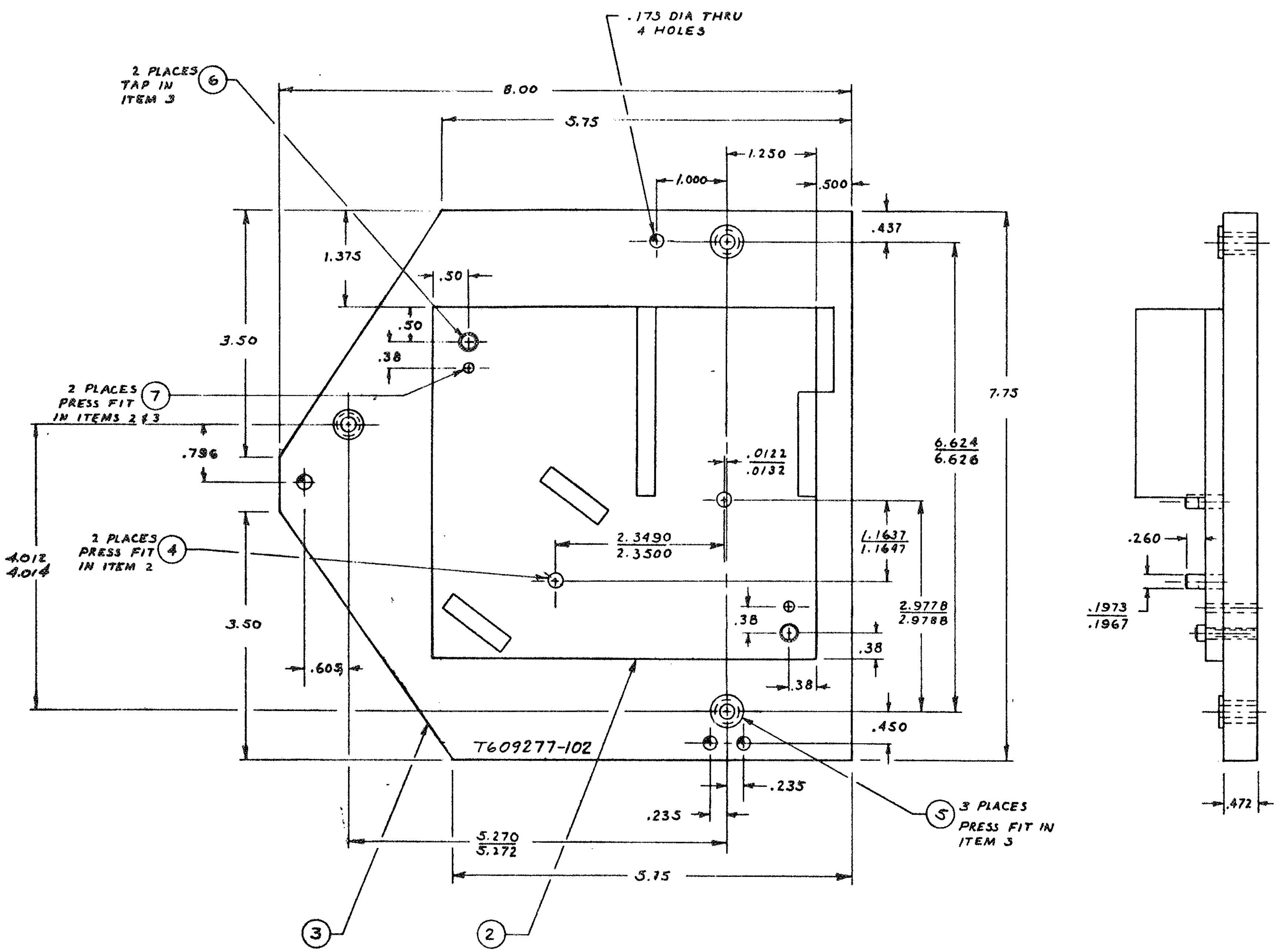
APPENDIX G

Assembly Drawings, High & Low Energy Detection
Alignment Fixtures

PARTS DISPOSITION: 1. USE 2. REWORK 3. CANNOT BE REWORKED 4. RECORD							DWG NO. T609277	REV A

REVISIONS

DISP	EFF	ZONE	REV	DESCRIPTION	BY	CK	DATE	APPROVAL



4. REMOVE ALL BURRS & BREAK ALL SHARP EDGES .010 R MAX.

3. IDENTIFY PER ML SPEC S40111. CL IX, TYPE III.

[2] MAT'L: 2024 OR 6061 AL. ALLOY

[1] MAT'L: STEEL CRES

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD PER NOTED ASSY -102	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	ELEC REF DES	CODE IDENT	ZONE	ITEM NO.
REF		S40111	SPEC IDENT				8
2			DOWEL 1/8 DIA x 1/2 LG				7
2			SCREW #10-24 x 1/2 LG				6
3			DRILL BUSHING ACE .1875 I.D. x 5/16 OD x 1/2 LG, HEAD TYPE				5
2	T609277 -7		LOCATOR PIN [2] .1973/.1967 DIA X 1/2 LG				4
1	T609277 -6		ADAPTER PLATE [1]				3
1	T609277 -101		FIXTURE ASSY				2
-	T609277 -102		ASSEMBLY				1

LIST OF MATERIALS

CONFIGURATION — LAYOUT NO. — DIST CODE 6090 A

DASH NO.	MODEL NO.	NEXT ASSEMBLY	MODEL NO.	FINAL ASSEMBLY	MODEL NO.

APPLICATION

INTERPRET THIS DRAWING PER STANDARDS IN MIL-D-70327
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .1; XX ± .03; XXX ± .010; XXXX ± .0050
ANGLES: ± 0° 30'
125 √ SURFACE ROUGHNESS

HOLE DIA.	TOLERANCE
.0135 THRU .125	+ .004 -.001
.126 THRU .250	+ .005 -.001
.251 THRU .500	+ .006 -.001
.501 THRU .750	+ .008 -.001
.751 THRU 1.000	+ .010 -.001
1.001 THRU 2.000	+ .012 -.001
2.001 AND OVER	LINEAR

CONTRACT NO. S1966-1J
DRAWN PITER — DATE 8-15-67
CHECK
MECH ENG S. Cooper 8-15-67
ELEC ENG
PROJ ENGR / APPR [signature] 8/18/67
DESIGN ACTIVITY APPD
CUSTOMER

MARSHALL LABORATORIES
TORRANCE, CALIFORNIA

TITLE: ASSEMBLY JIG FIXTURE HIGH ENERGY DETECTOR ALSEP / SIDE / CCGE

SIZE	CODE IDENT NO.	DWG NO.	REV
D	13126	609277	A

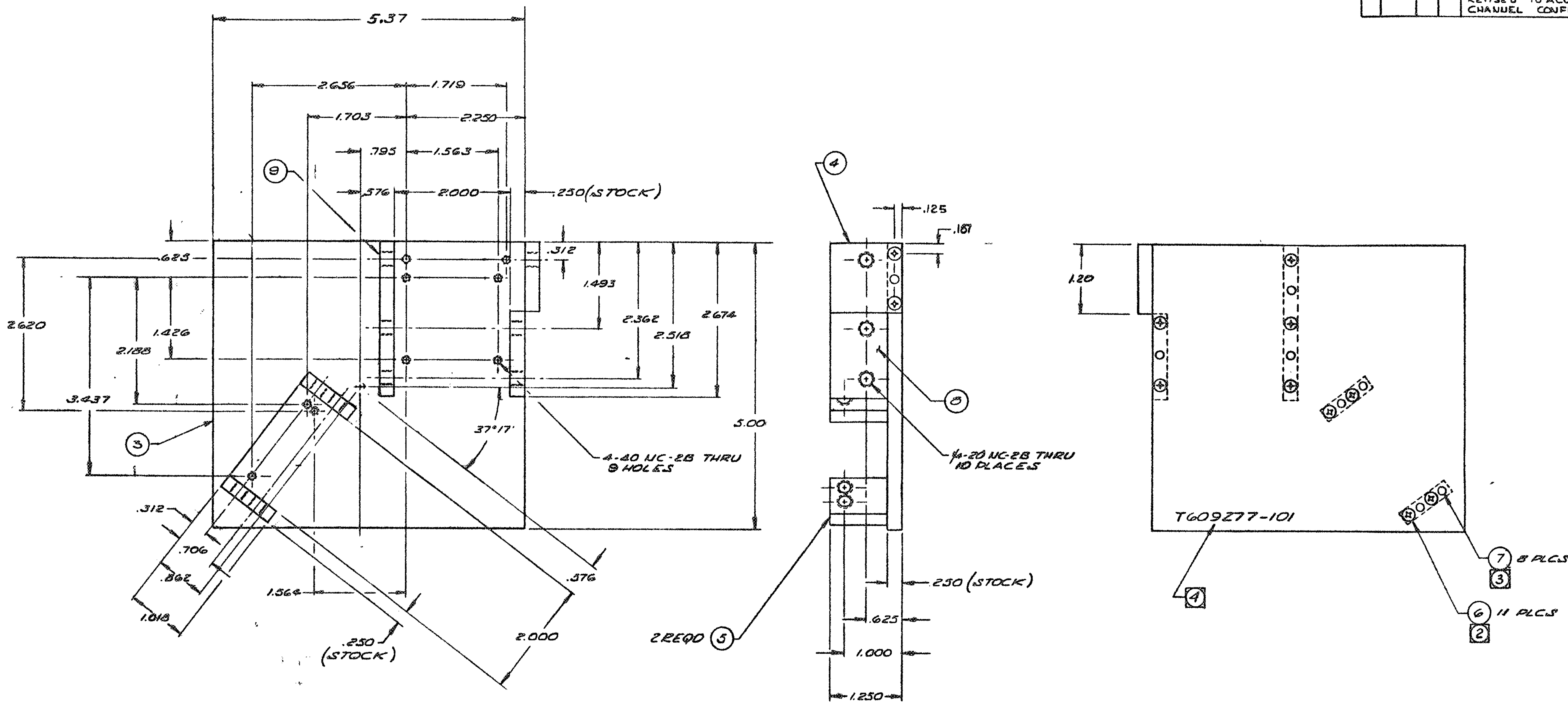
SCALE 1/1 — RELEASED JAN 9 1968 — SHEET 2 OF

ML FORM 199

PARTS DISPOSITION	DWG NO.	REV
1. USE 2. REWORK 3. CANNOT BE REWORKED 4. RECORD	T609277	A

REVISIONS

DISP	EFF	ZONE	REV	DESCRIPTION	BY	CK	DATE	APPROVAL
4	RCO		A	ADDED SHT 2 (-102) REVISED TO ACCEPT NEW CHANNEL CONFIGURATION				



REF	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	ELEC REF DES	CODE IDENT	ZONE	ITEM NO.
REF		S40111	SPEC IDENT.				10
1	T609277-5		SIDE (1)				9
1	T609277-4		SIDE (1)				8
8			DOWEL PIN 1/8 DIA x 1/2 LG				7
11			SCREW 4-40 x 1/2 LG FLAT HD				6
2	T609277-3		SIDE (1)				5
2	T609277-2		SIDE (1)				4
1	T609277-1		BASE (1)				3
							2
	T609277-101		ASSEMBLY				1
-101	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	ELEC REF DES	CODE IDENT	ZONE	ITEM NO.

QTY REQD PER NOTED ASSY — CONFIGURATION — LIST OF MATERIALS

LAYOUT NO. — DIST CODE 6090 A

DASH NO. | MODEL NO. | NEXT ASSEMBLY | MODEL NO. | FINAL ASSEMBLY | MODEL NO. — APPLICATION

(4) IDENTIFY PER ML SPEC S40111, CL.II TYPE III, APPROX WHERE SHOWN

(3) AFTER POSITIONING ITEMS 4,5,8 & 9 DOWEL IN POSITION USING ITEM 7

(2) DRILL & CSK ITEMS 3/4 FOR 4-40 FLAT HEAD SCREWS DRILL & TAP ITEMS 3,5,7 & 9 FOR 4-40 SCREW x .25 MIN. DEPTH LOCATED APPROX AS SHOWN

(1) MATL: 2024-T3 AL ALLOY

NOTES: UNLESS OTHERWISE SPECIFIED

INTERPRET THIS DRAWING PER STANDARDS IN MIL-D-70327
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS: X ± .1, XX ± .03, XXX ± .010, XXXX ± .0050; ANGLES ± 0° 30'
125 SURFACE ROUGHNESS

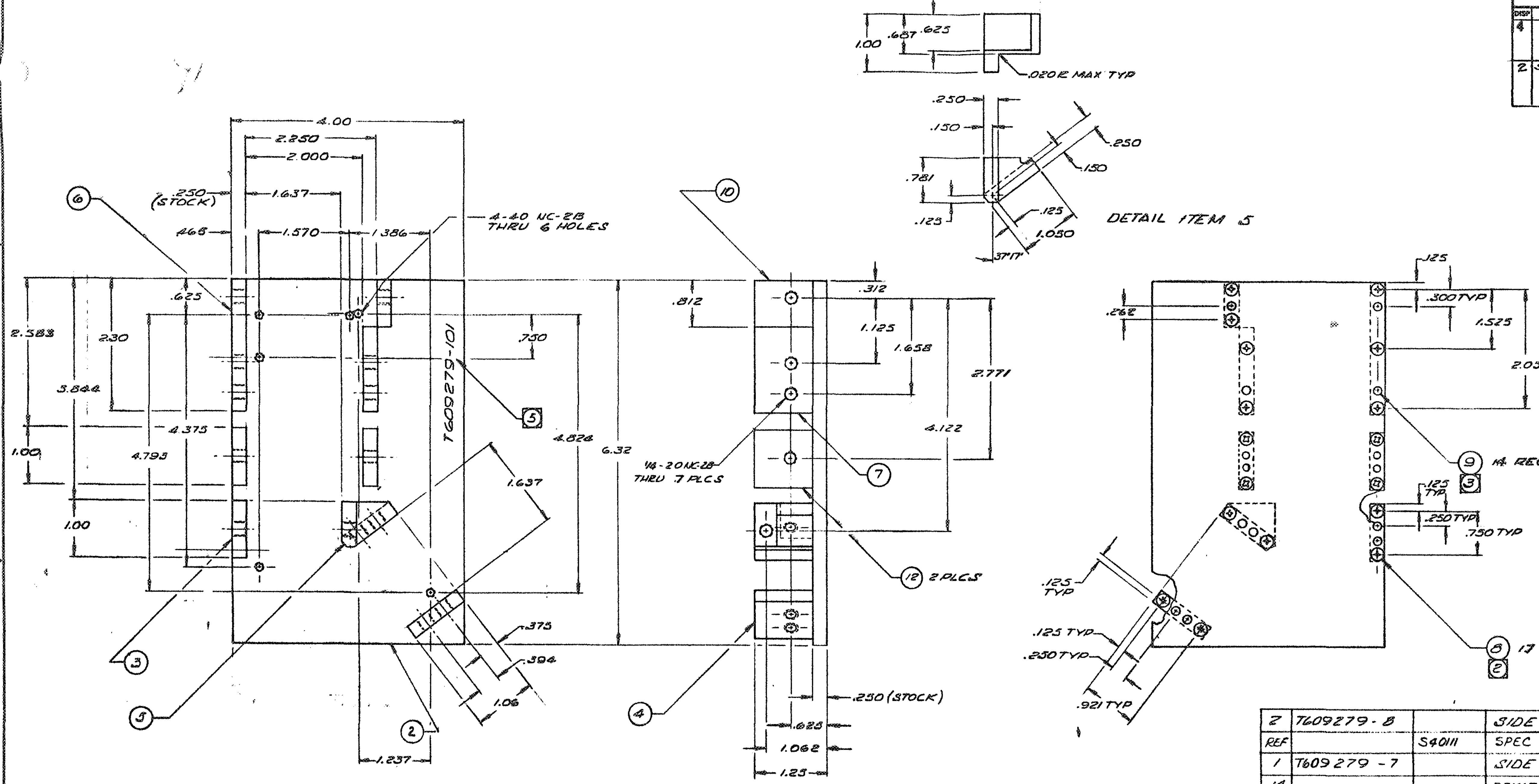
CONTRACT NO. 31966-14
DRAWN — DATE 9/27/66
CHECK — 10-12-66
MECH ENG — 10-14-66
ELEC ENG
PROJ ENGR — 10-13-66
APPD
DESIGN ACTIVITY APPD
CUSTOMER

MARSHALL LABORATORIES
TORRANCE, CALIFORNIA

TITLE: FIXTURE, ALIGNING. HIGH ENERGY DETECTOR–ALSEP/SIDE/CCGE

SIZE D | CODE IDENT NO. 13126 | DWG NO. T609277 | REV A

SCALE 1/1 | RELEASED OCT 17 1966 | SHEET 1 OF 2



PARTS DISPOSITION: 1. USE 2. REWORK 3. CANNOT BE REWORKED 4. RECORD				DWG NO. T609279				REV B
DISP	EFF	ZONE	REV	DESCRIPTION	BY	CK	DATE	APPROVAL
4	RCO		A	ADDED SHT 2 (-102) REVISED TO CONFORM TO NEW CHANNEL CONFIGURATION	MP			
2	S/N 12 UP		B	ADDED NEW ITEM 12 WITH CORRESPONDING DIMS & HARDWARE - ITEM 8 WAS 18 REQD ITEM 9 WAS 10 REQD. ADDED ITEM 12 TO NOTES 2 & 3	BB			

NOTES: UNLESS OTHERWISE SPECIFIED

1. MATL: 2024-T3 AL ALLOY
2. DRILL & CSK ITEM 2 FOR 4-40 FLAT HEAD SCREWS. DRILL & TAP ITEMS 3,4,5,6,7,10 & 12 FOR 4-40 SCREW x .25 MIN DP
3. AFTER POSITIONING ITEMS 3,4,5,6,7,10 & 12 DOWEL IN POSITION USING ITEM 9
4. BREAK ALL SHARP EDGES .010 MAX & REMOVE ALL BURRS.
5. IDENTIFY PER ML SPEC S40111, CL IV, TYPE III, APPROX WHERE SHOWN

LIST OF MATERIALS

QTY REQD PER NOTED ASSY -101	PART NO.	SPECIFICATION	NOMENCLATURE OR DESCRIPTION	ELEC REF DES	CODE IDENT	ZONE	ITEM NO.
2	T609279-8		SIDE .250 STOCK (1)				12
REF		S40111	SPEC IDENT.				11
1	T609279-7		SIDE .250 STOCK (1)				10
14			DOWEL PIN 1/8 DIA x 3/8 LG				9
17			SCREW FLAT HD 4-40 x 7/16 LG				8
1	T609279-6		SIDE .250 STOCK (1)				7
1	T609279-5		SIDE .250 STOCK (1)				6
1	T609279-4		CORNER (1)				5
1	T609279-3		SIDE .250 STOCK (1)				4
1	T609279-2		SIDE .250 STOCK (1)				3
1	T609279-1		BASE .250 STOCK (1)				2
—	T609279-101		ASSEMBLY				1

INTERPRET THIS DRAWING PER STANDARDS IN MIL-D-70327
DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS .X ± .1, .XX ± .03, .XXX ± .010, .XXXX ± .0050; ANGLES ± 0° 30'
125 SURFACE ROUGHNESS

HOLE DIA.	TOLERANCE
.015 THRU .125	+ .004 −.001
.126 THRU .250	+ .005 −.001
.251 THRU .500	+ .006 −.001
.501 THRU .750	+ .010 −.001
.751 THRU 1.000	+ .013 −.001
1.001 THRU 2.000	+ .013 −.001
2.001 AND OVER	LINEAR

CONTRACT NO. 51966-14
DRAWN — DATE 9-28-66
CHECK — 10-10-66
MECH ENG — 10-10-66
PROJ ENGR — 10-11-66
DESIGN ACTIVITY APPD — 10-13-66
CUSTOMER

LAYOUT NO.
DIST CODE 6-090 A

DASH NO.	MODEL NO.	NEXT ASSEMBLY	MODEL NO.	FINAL ASSEMBLY	MODEL NO.

APPLICATION

ML MARSHALL LABORATORIES
TORRANCE, CALIFORNIA

TITLE FIXTURE, ALIGNING, LOW ENERGY DETECTOR- ALSEP/SIDE/CCGE

SIZE D — CODE IDENT NO. 13126 — DWG NO. T609279 — REV B
SCALE 1/1 — RELEASED OCT 13 1966 — SHEET 1 OF 2

ML FORM 89

APPENDIX H

Paint Specifications

Materials List

S-13, S-13G AND S-13H PAINT SPECIFICATIONS

Formulation:

Material	Parts by Weight S-13	S-13G	S-13H
SP500 zinc oxide (New Jersey Zinc)	240	-	-
PS7-treated SP500 zinc oxide	-	240	373
General Electric RTV-602 silicone	100	100	100
Toluene, U.S.P.	175	175	200
	515	515	673

The zinc oxide, the RTV-602, and 100 parts by weight of the toluene are premixed and charged to a porcelain ball mill in a quantity sufficient to just fill the void space when the mill is one-half full of grinding stones 0.5 in. in diameter. The paint is ground for 4 hr at approximately 70% critical speed. The critical speed (rpm) is given by: $w_{c_s} = \frac{54.2}{\sqrt{R}}$, where R is the radius of the mill in feet. The basic charge is then removed, and the remaining toluene is added to the mill. The mill residue and the solvent are ground until the contents are uniformly thin, but not for more than 5 min. The contents are then added to the main charge, and the whole charge is mixed thoroughly. NOTE: THE SRC-05 CATALYST IS NOT ADDED UNTIL THE PAINT IS APPLIED.

Preparation of Paint for Application: The paint is furnished without the SRC-05 catalyst. The catalyst is added as 1 part SRC-05 in 10 parts of toluene: The catalyst solution is added to the paint with thorough stirring. A low catalyst concentration is recommended in order to ensure optimum stability to ultraviolet irradiation in vacuum. A concentration of 0.4% based upon RTV-602 provides optimum stability without greatly sacrificing terminal-cure properties, although a coating prepared at this concentration represents the lower limit without sacrificing cure and physical properties. Somewhat better physical properties are obtained with a catalyst concentration of 0.5% based on RTV-602 and still better properties are obtained at 0.75% SRC-05. The parts by weight of paint to which 1 part of SRC-05 catalyst and 10 parts of toluene are added are given in the following table for several catalyst concentrations.

SRC-05 CATALYST-TO-PAINT RATIOS

SRC-05 Concentration*	Parts by Weight of Paint**		
	S-13	S-13G	S-13H
0.4	1290	1290	1680
0.5	1030	1030	1350
0.75	690	690	900
1.0	515	515	675

*based on RTV-602 solids

**(to which 1 part SRC-05 in 10 parts toluene is added)

The catalyst solution is added only as the paint is used and to only the amount that can be applied in a 30 min period. Allow the catalyzed paint to set for 10 to 15 minutes before application to the primed surfaces. The paint should be thoroughly stirred before transfer to other containers or before addition of catalyst.

Preparation of Surfaces for Painting: Standard surface cleaning procedures should be used to prepare the surface for application of the S-13 paint. S-13 paint can, in general, be applied to any surface to which the required primer can be applied. The primer, General Electric's proprietary SS-4044, can be applied to either anodized or zinc chromate-primed surfaces. It is preferable that it be applied to clean bare metal or to anodized surfaces, however. Greasy surfaces should be cleaned with standard detergent and water prior to priming; they should be thoroughly dry.

Application of Paint: The primer can be spray-applied (Binks model 18 or comparable gun) at about 30 psi. Only about 0.5 mil of primer is required (just enough to provide a base for the S-13 paint). The primer should be allowed to air-dry for 1 to 2 hours before application of the S-13 paint.

The S-13 paint can be spray-applied with a Binks model 18 spray gun (or comparable gun) at a gas pressure of about 60 psi. Unless missile-grade air is available, prepurified nitrogen or prepurified air must be used. The S-13 paint should be allowed to air-cure 16 hours before handling. IT IS IMPERATIVE THAT DUST AND DEBRIS BE KEPT OFF THE SURFACE DURING THE CURING PROCESS.

The wet film thickness of the paint can be measured by either the Pfund or the Interchemical wet-film thickness gage, or a suitable bridge-type gage. Dry film thickness can be measured with a Fischer Permascope nondestructive thickness tester, type ECTH.

Reapplication: Soiled or damaged areas can be recoated. Soiled areas must be cleaned thoroughly with detergent and water and dried before application of additional S-13 paint. Damaged or gouged areas can be recoated by making a paste of S-13 in which the bulk of the solvent is omitted. Such a material can be trowelled or brushed over the damaged areas and cures tack-free within a few hours.

Storage of the Paint: The paint is supplied in various quantities. Since the paint cannot be mixed with catalyst solutions in larger lots than can be applied at one time, it may be desirable to store the paint in smaller containers. If smaller containers are utilized, only glass, nickel, or unlined, unleaded, unsoldered steel cans can be used. The caps, tops, or closures of these containers should not possess gummed seals or any material soluble in toluene (we use unplasticized Mylar and aluminum-foil seals).

Physical Properties: Paint S-13 (and S-13G and S-13H) is rubbery and resilient. Therefore, it can be gouged by a sharp tool with little effort. Its adherence is excellent when a primer is used but is very poor when applied directly to a metal substrate, in which case it can be stripped from the substrate in one piece. Because of the resiliency of the surface, dirt tends to cling to the surface. Dirt can be easily removed by wiping with a water-moistened CLEAN, SOFT cloth. NOTE: S-13-TYPE COATINGS SHOULD NEVER BE CLEANED WITH ORGANIC SOLVENTS. S-13 coatings withstand more than 10 thermal-shock cycles consisting of immersion in liquid nitrogen followed by rapid heating to 200°F. The paint can be torsionally stressed to 90° without failure and withstands repeated bending to 180°.

Optical Properties: Minimal solar absorptance is not obtained until a thickness of nearly 10 mils is reached. The following tabulation is provided as a guide for S-13. Similar values have been obtained for S-13H; the α_s of S-13G is about 0.01 higher for each thickness.

Thickness (±0.25 mil)	Solar Absorptance (±0.01)
1	0.30
2	.25
3	.23
4	.21
5	.20
6	.19
8	.18
9	.17
10	0.17

A working range of 5 to 8 mils is recommended. For coatings of 5 mils or thicker, the total hemispherical emittance is 0.85 or better at 300°K.

IIT Research Institute
10 West 35 Street, Chicago, Illinois 60616
312/225-9630

CATALYZING S-13 TYPE PAINTS

While recent experiments have shown the catalyst concentration is not as critical a factor in the stability of S-13 type coatings as it was once thought to be, we would still like to recommend keeping within 10 per cent of the figures below.

Basic formula: catalyst SRC-05 0.5 per cent by weight of non-volatile vehicle solids, or 0.5 lb. solid catalyst to 100 lb. RTV-602 solids.

S-13 type paints are normally formulated on a basis of 20 per cent non-volatile vehicle by weight of total paint, so 100 lb. RTV-602 solids is in 500 lb. of paint.

The catalyst required then becomes $\frac{.5}{500}$ or 0.1 per cent by weight of total paint.

To simplify handling we furnish the catalyst as ten per cent concentration in toluene or, for small quantities of paint, at one per cent concentration in toluene.

The required mixture then becomes ten parts paint to one part of one per cent catalyst or 100 parts of paint to one part of ten per cent catalyst (by weight). One pint of paint averages 700 grams which calls for 70 grams of one per cent catalyst or seven grams of ten per cent catalyst for the pint of paint.

If the catalyst is to be measured by volume, use 80cc of one per cent catalyst to the pint of paint or 8cc of ten per cent catalyst.

Keep the catalyst solutions cool and in the dark except when actually mixing.

F. Rogers
9/12/67

MATERIALS LIST FOR ALSEP/SIDE/CCGE

METALLIC MATERIALS

Aluminum Alloy 5052-H32 per Spec QQ-A-318c
Aluminum Alloy 5052-H34 per Spec QQ-A-318c
Aluminum Alloy 6061-T6 per Spec QQ-A-327b
Aluminum Alloy 2024-T3 per Spec QQ-A-355c
Aluminum Alloy 3003-H14 per Spec WW-T-788c-1
Stainless Type 301, 303, and 304 per Spec QQ-S-766c
Stainless Type 302 per Spec QQ-W-423
Gold Plating Mil-P-55110 and Mil-G-45204A
Magnesium AZ31B-H24 per Spec QQ-M-44
Copper Plating Mil-C-14550
Silver Plating QQ-S-365A
Copper-Constantan Awg 28 and Awg 24 thermocouple wire
Platinum black deposition ML Spec S40368
Alloy 180 wire, ribbon, and rod material
Electroless nickel Mil-C-26074A
Phospher bronze
Solder 60/40 ML Spec S40126
Gold plating over copper-Dalic process(Gold touch-up process)

NON-METALLIC MATERIALS

Epoxy Board - Mil-P-18177
Lexan - Polycarbonate
Nylon
Foam - Eccofoam FPH
Sealant - RTV 60
Epoxy - Epibond 1210
Epoxy - Hysol 4268
G10 Glass fiber board
Sealant - RTV 108
Glyptol 1202 G.E. synthetic resin
Glyptol thinner 1500 or 6710 G.E.
Epibond 1210
Spot bonding and potting RTV 102
Hysol 4238 ML Spec S40109
Protective welding board wafers Krylon ML Spec S40396
Fused silicon glass mirror, Lockheed Spec LAC 43-4322
Mirror coating (silver under inconel) OCLI SI-100
Loctite sealant ML Spec S40244
Silk mesh and silk thread
Alumuminized mylar 3 mil and 1/4 mil
Sylgard 182 potting material Dow Corning

MISCELLANEOUS MATERIALS

Paint S-13G ITT
G.E. Silicon primer finish S-13G paint
Gold tape Y-91845 Scotch-3M
Connector material Microdot MCDB series
Silver conductive paint or coating (G-C Silver) ML Spec S40402
Freon cleaning agent
Tri-chloroethelene cleaning agent

ALSEP/SIDE MATERIAL LIST ADDITION

ITEM	DESCRIPTION
1	Foam-Eccofoam FPH
2	Epoxy-Epibond 121
3	Sealant-RTV 108 GE
3A	Sealant-RTV 118 GE
4	Glyptol 1202 GE Synthetic
5	Glyptol Thinner 1500 or 6710 GE
6	Crylon, Protective Spray
7	Silk Mesh and Silk Thread
8	Sylgard 182 Potting Material - Dow Corning
9	Paint S-13G Illinois Institute of Technology
10	GE Silicon Primer Finish S13-G Paint
11	Gold Tape Y-9184S-Scotch 3M
12	Connector Material Microdot, MCDB Series Diallyl Phtalate MIL-M-14F
13	Epibond 1210 (Repeat - See item number 1)
14	No-Mar Nylon Tip Set Screw
15	Delrin 100