Bendix

Aerospace Systems Division

ALSEP Array E, Power Distribution Unit, Parts Application Analysis

NO.	REV. NO.
ATM 956	A

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DATE 8-13-71

This ATM document is the Reliability PAA (Parts Application Analysis) of the Bendix designed PDU (Power Distribution Unit). The analysis reflects the part operating stress levels and the failure rates obtained from designs prepared for Array E as of 8-13-71.

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1.0 Introduction

The purpose of this ATM is to document the results of the PDU PAA. The PDU for Array E is an entirely new Bendix design providing optimum redundancy to assure adequate reliability over a two year operating period.

2.0 Configuration

Redundant configurations were developed for the functions shown in Column A. Column B has the remaining PDU functions listed, none of which are redundant.

A	B
Uplink Power Control	Power Dump Power Control
ADP Power Control	Status Telemetry Net
Transmitter Power Control	Temperature Measurement (Transmitter)
DDP Power Control	Motherboard
Experiment Power Control	

3.0 Failure Rates

Failure rates for each functional reliability block diagram section are as follows:

Functional Section	%/1,000 hours
Experiment (each)	.03380
DDP	.03337
Transmitter	.05941
Uplink	.036133
ADP	.032787

Functional Section	%/1,000 hours
Power Dump	.05013
Mother Board	.025232
Telemetry Net Status	.023477
Temperature Measurement (Transmitter)	.00376

The failure rates are for one of two sections where redundancy is provided. Transmitter and power dump power control have the highest failure rates in the group. Transistors contribute approximately 27% to these failure rates and relays contribute about 20% to the failure rates of the transmitter and power dump power controls.

4.0 Analysis Conclusions

Failure rates for 0°C and 65°C were calculated and averaged to provide the resultant failure rate at specific stress levels. Stresses on all parts except relays were extremely conservative. Relay contact loads for certain experiments have tentative loads reaching rated values. The nine items in the "Over 60%" classification in Table I are relays. The infrequent switching requirements of these experiment power control relays justifies their use in this application. Thus, no specific condition or failure rate exists which may be considered an unusually weak link in the PDU functional sections.

In conclusion, the stresses and resultant failure rates are not unduly detrimental to the desired goals of reliable performance over the specified two year operating period.

Table I

PDU Derating Summary

Stress	Quantity	Comments
0 - 12%	321	-
13 - 25%	48	-
26 - 35%	39	-
35 - 50%	7	-
51 - 60%	2	-
Over 60%	9	Relays allowed 100%

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP-E DATE: 8-13-71
ASSEMBLY: C/S SUB ASSEMBLY: PDU SCHEMATIC NO: _____

NON-REDUNDANT FUNCTION BLOCKS

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS
CAPACITORS	6	.011312	
RESISTORS	56	.009587	
DIODES	38	.029080	
TRANSISTORS	16	.018000	
RELAYS	4	.013600	
FUSES	14	.013720	
THERMISTOR	1	.000300	
COILS & CHOKES			
	101	.095599	

TOTAL ASSEMBLY FAILURE RATE .102599 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP-E DATE: _____
ASSEMBLY: C/S SUB ASSEMBLY: PDU SCHEMATIC NO: _____

REDUNDANT FUNCTION BLOCKS

DEVICE TYPE	TOTAL NO. USED *	TOTAL FAILURE RATE	COMMENTS
CAPACITORS	6	.000030	
RESISTORS	96	.048939	
DIODES	104	.069967	
TRANSISTORS	52	.116760	
RELAYS	33	.095060	
TRANSFORMERS			
CONNECTORS			
COILS & CHOKES			
	291	.33073	

*X2 FOR TOTAL PARTS COUNT

TOTAL ASSEMBLY FAILURE RATE .33073 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP
ASSEMBLY: PDU SUB ASSEMBLY: UPLINK
DATE:
SCHEMATIC NO: 2362281
2362292

INCLUDING REDUNDANT UNIT

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS
CAPACITORS	6	.00003	
RESISTORS	25	.006479	
DIODES	26	.01488	
TRANSISTORS	12	.02700	
RELAYS	10	.02380	
TRANSFORMERS			
CONNECTORS			
COILS & CHOKES			
	79	.072266	

TOTAL ASSEMBLY FAILURE RATE .072266 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP
SSEMBLY: PDU SUB ASSEMBLY: ADP
DATE:
SCHEMATIC NO: 2362281
2362241

INCLUDING REDUNDANT UNIT

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS
CAPACITORS	6	.00003	
RESISTORS	23	.004999	
DIODES	26	.014714	
TRANSISTORS	12	.02700	
RELAYS	10	.01883	
TRANSFORMERS			
CONNECTORS			
COILS & CHOKES			
	77	.065573	

TOTAL ASSEMBLY FAILURE RATE .065573 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP DATE: _____
ASSEMBLY: PDU SUB ASSEMBLY: TRANSMITTER SCHEMATIC NO: 2362231

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS
CAPACITORS			
RESISTORS	14	.02278	
DIODES	14	.00865	
TRANSISTORS	6	.01326	
RELAYS	5	.01472	
TRANSFORMERS			
CONNECTORS			
COILS & CHOKES			
	39	.05941	

TOTAL ASSEMBLY FAILURE RATE .05941 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP (Transmitter) DATE: _____
SSEMBLY: PDU SUB ASSEMBLY: Temp. Measurement SCHEMATIC NO: 2362231

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS
CAPACITORS			
RESISTORS	2	.00346	
DIODES			
TRANSISTORS			
RELAYS			
THERMISTER	1	.00030	
CONNECTORS			
COILS & CHOKES			
	3	.00376	

TOTAL ASSEMBLY FAILURE RATE .00376 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP
ASSEMBLY: PDU SUB ASSEMBLY: DDP
DATE:
SCHEMATIC NO: 2362261

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS
CAPACITORS			
RESISTORS	8	.01202	
DIODES	9	.00532	
TRANSISTORS	4	.009	
RELAYS	3	.00703	
TRANSFORMERS			
CONNECTORS			
COILS & CHOKES			
	24	.03337	

TOTAL ASSEMBLY FAILURE RATE .03337 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP DATE:
ASSEMBLY: PDU SUB ASSEMBLY: EXPERIMENT SCHEMATIC NO: 2362221

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS*
CAPACITORS			
RESISTORS	10	.001677	PARTS 50 / F.R. .00840
DIODES	11	.00822	55 / .04120
TRANSISTORS	6	.01350	30 / .06750
RELAYS	3	.01040	15 / .05200
TRANSFORMERS			
CONNECTORS			
COILS & CHOKES			
	30	.03379	150 / .16910

TOTAL ASSEMBLY FAILURE RATE .03379/0.16910 /1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

*Parts and failure rates for five experiment power control modules.

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: _____ DATE: 8-13-71
ASSEMBLY: _____ SUB ASSEMBLY: Power Dump SCHEMATIC NO: 2362228

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS
CAPACITORS	2	.00131	Series Redundant Usage
RESISTORS	34	.00388	
DIODES	20	.00245	
TRANSISTORS	16	.03325	
RELAYS	4	.00924	Each Load Has Quad Red. Contacts
TRANSFORMERS			
CONNECTORS			
COILS & CHOKES			

TOTAL ASSEMBLY FAILURE RATE .05013 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP
ASSEMBLY: PDU SUB ASSEMBLY: MOTHER BOARD
DATE:
SCHEMATIC NO: 2362217

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS
CAPACITORS	4	.011312	
RESISTORS			
DIODES	2	.000200	
TRANSISTORS			
RELAYS			
TRANSFORMERS			
FUSES	14	.01372	
COILS & CHOKES			
	20	.025232	

TOTAL ASSEMBLY FAILURE RATE .025232 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP
ASSEMBLY: PDU SUB ASSEMBLY: TELEMETRY DATE: SCHEMATIC NO: 2362271

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS
CAPACITORS			
RESISTORS	20	.003557	
DIODES	16	.01992	
TRANSISTORS			
RELAYS			
TRANSFORMERS			
CONNECTORS			
COILS & CHOKES			
	36	.023477	

TOTAL ASSEMBLY FAILURE RATE .023477 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY _____

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP-E
ASSEMBLY: PDU
SUB ASSEMBLY: Uplink or ADP Drivers
DATE: 1-21-71
SCHEMATIC NO: 2362281

(Semiconductors)

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	MAX. TEMP °C: JUNCTION RATED T_J (5)	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT (7)	RATED AT 25°C: CASE (8)	ACTUAL: AMBIENT T_A (9)	ACTUAL: CASE T_C (10)	ACTUAL (11)	POWER RATIO: ACTUAL/RATED 25°C Amb.or case (12)	ACTUAL/RATED T_A or T_C (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	V_{CB} ACTUAL V (15)	V_{CEO} RATED V (16)	V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	ACTUAL V (19)	CIRCUIT FUNCTION or APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) 10^{-5} (22)	SOURCE (See below) (23)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL FAIL. RATE (%/1000 HRS) (26)	TOTAL COUNT PER TYPE (27)	TOTAL FAILURE RATE (%/1000 HRS) (27)
Q1 3 5	S2N2907A	T1	65	200			1800			1.8	<1%		60	5	40	5			Switching		275	A				3	.00825
Q7 9 11	S2N2907A	T1	65	200			1800			1.8	<1%		60	5	40	5			Switching		275	A				3	.00825
Q2 4 6	S2N2222A	T1	65	175			1800			7.1	<1%		60	29	N/A	29			Relay Driver		175	A				3	.00525
Q8 10 12	S2N2222A	T1	65	175			1800			7.1	<1%		60	29	N/A	29			Relay Driver		175	A				3	.00525
CR1 CR2	SIN645	G1 TRW	65	150		600				21.7	3.6%						225	29	Blocking		97	A				2	.00194

(29) FAILURE RATE SOURCE (See Column 23)
A ATM 605A C
B D

(28) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE .02894 %/1000 HRS.

Note: X2 (if ADP included)

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PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP-E DATE: 1-21-71
ASSEMBLY: PDU SUB ASSEMBLY: Uplink and Drivers SCHEMATIC NO: 2362281

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL. or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)	5 TOLERANCE (%)	6 POWER RATING (WATTS) mw	7 MAXIMUM OPERATING POWER (WATTS)	8 POWER RATIO, OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) AT 25°C SOURCE (SEE BELOW)	13 FOR USE OF RELIABILITY DEPT	14 SPECIAL ENVIRONMENTS (DERATING)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R1	RNR55C5622FS	Mepco	56.2K	±1%	100	.86	< 1%	< 1%	65	Relay Driver Bias	0.168 A			.001	.168	1	.000168
4																	
7																	
10																	
13																	
16																	
R2	RNR55E6810FS		681			23.5	23.5%				0.37				370		.000370
5																	
8																	
11																	
14																	
17																	
R3	RNR55C3320FS		332			< .1	< 1%			Relay Driver Bleed	0.168				168		.000168
6																	
9																	
12																	
15																	
18																	

19 FAILURE RATE SOURCES (FOR COLUMN #14)
A ATM 605A B _____
C _____ D _____

20 CALCULATED MTBF _____ HRS

21 TOTAL FAILURE RATE .004236 %/1000 HRS

form 9881
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NOTE: x2 (if ADP included)

PARTS APPLICATION ANALYSIS

CAPACITORS

PROJECT: ALSEP-E
ASSEMBLY: PDU
SUBASSEMBLY: Uplink or ADP Drivers
DATE: 1-21-71
SCHEMATIC NO: 2362281

(Capacitors)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL OF MFR) AND CONSTRUCTION	3 MANUFACTURER	4 CAPACITANCE VALUE mfd	5 TOLERANCE %	6 MANUFACTURER'S RATED VOLTAGE: DC	6 MANUFACTURER'S RATED VOLTAGE: PEAK AC	7 OPERATING VOLTAGE	8 VOLTAGE RATIO: OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE (°C)	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (% / 1000 HRS)	13 SOURCE (SEE BELOW)	14 SPECIAL ENVIRONMENT (DEFINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE x 10^{-6}	17 TOTAL CAPACITOR COUNT PER TYPE	18 TOTAL FAILURE RATE (% / 1000 HRS)	19 FOR USE OF RELIABILITY DEPT.
C1	CKR15Ex823KS 2346236-3	Aerovox	82nf	10	100	6	6	.06	< 1%		Increase Pulse Time	.005	A		.001	5	1	.000005	
C2																			
C3																			
C4																			
C5																			
C6																			

20 FAILURE RATE SOURCES (FOR COLUMN #14)
A ATM 605A B
C D

21 CALCULATED MTBF 3333.333×10^6 HRS

22 TOTAL FAILURE RATE .00003 % 1000 HRS

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NOTE: x2 (if ADP included)

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP - E

ASSEMBLY: PDU

SUB ASSEMBLY: ADP RELAYS

DATE: 1-21-71

SCHEMATIC NO: 2362241

(Semiconductors)

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	MAX. TEMP °C: JUNCTION RATED T_J (5)	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C AMBIENT (7)	AVG PWR DISSIPATION (mw): RATED AT 25°C CASE (8)	AVG PWR DISSIPATION (mw): ACTUAL AMBIENT T_A (9)	AVG PWR DISSIPATION (mw): ACTUAL CASE T_C (10)	AVG PWR DISSIPATION (mw): ACTUAL (11)	POWER RATIO: ACTUAL/RATED 25°C (Amb.or case) (12)	POWER RATIO: ACTUAL T_A or T_C / RATED T_A or T_C (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	MAXIMUM VOLTAGES: V_{CB} ACTUAL V (15)	MAXIMUM VOLTAGES: V_{CEO} RATED V (16)	MAXIMUM VOLTAGES: V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	DIODE PIV: ACTUAL V (19)	CIRCUIT FUNCTION or APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) 10^{-5} (22)	SOURCE (See below) (23)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL FAIL RATE (%/1000 HRS) (26)	TOTAL COUNT PER TYPE (27)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR1	SIN 645	GI TRW	65	150		600				10.1	1.7%							225	29	Isola-		96	A				1	.00096
CR2										10.1	1.7%									Isola-tion		96						.00096
CR3										5.0	0.8%									Induct Kick		94						.00094
CR4										5.0										Induct Kick								.00094
CR9										5.0										Induct Kick								.00094
DR16										5.0										Induct Kick								.00094
CR21										5.0										Induct Kick								.00094
CR22										5.0										Induct Kick								.00094
CR23 CR24										.11	<1%								5	Isola-tion		94	A				2	.00188

(28) FAILURE RATE SOURCE (See Column 23)

A ATM 605A C

B D

(29) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE .00944 %/1000 HRS.

9049A

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PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP-E
ASSEMBLY: PDU
SUB ASSEMBLY: ADP RELAYS
DATE:
SCHEMATIC NO: 2362241

(Semiconductors)

CKT SYM NO.	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY	MANUFACTURER	MAX. TEMP °C: AMBIENT ACTUAL T_A	MAX. TEMP °C: JUNCTION RATED T_J	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE	AVG PWR DISSIPATION (mw): ACTUAL AMBIENT T_A	AVG PWR DISSIPATION (mw): ACTUAL CASE T_C	AVG PWR DISSIPATION (mw): ACTUAL	POWER RATIO: ACTUAL RATED 25°C (Amb.or case)	POWER RATIO: ACTUAL RATED T_A or T_C	MAXIMUM VOLTAGES: V_{CBO} RATED V	MAXIMUM VOLTAGES: V_{CB} ACTUAL V	MAXIMUM VOLTAGES: V_{CEO} RATED V	MAXIMUM VOLTAGES: V_{CE} ACTUAL V	DIODE PIV: RATED V	DIODE PIV: ACTUAL V	CIRCUIT FUNCTION or APPLICATION	PART SPECIAL ENVIRONMENT (Define)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS)	SOURCE (See below)	FAIL. RATE	MULTIPLIER	FINAL RATE (%/1000 HRS)	FAIL. TOTAL	COUNT PER TYPE	TOTAL FAILURE RATE (%/1000 HRS)
CR5	1N5186 2340376-1	Unitrode	65	175		2320				1.9	.1%						100	29	Short		233	A					1	.000233
CR6										12	.5%								Isola-tion		241							.000241
CR7										12	.5%								Isola-tion		241							.000241
CR8										.28	<.1%								Shunt		232							.000232
CR10										15	.65%								Isola-tion		s43							.000243
CR11										1.0	.4%								Shunt		233							.000233
CR12										15	.65%								Isola-tion		243							.000243
CR13										1.9	.1%								Shunt		233							.000233
CR14	↓	↓	↓	↓		↓				15.6	.65%						↓	↓	Isola-tion		244	↓					↓	.000244

28 FAILURE RATE SOURCE (See Column 23)
A ATM 605A C
B D

29 NOTE: It is assumed the transient and peak power does not exceed the safe limit.

30 TOTAL FAILURE RATE .002143 %/1000 HRS.

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PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

(Semiconductors)

PROJECT: ALSEP DATE:

ASSEMBLY: PDU SUB ASSEMBLY: ADP RELAYS SCHEMATIC NO: 2362241

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	JUNCTION RATED T_J (5)	CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C AMBIENT (7)	RATED AT 25°C CASE (8)	ACTUAL AMBIENT T_A (9)	ACTUAL CASE T_C (10)	ACTUAL (11)	POWER RATIO: ACTUAL/RATED 25°C (Amb.or case) (12)	ACTUAL/RATED T_A or T_C (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	V_{CB} ACTUAL V (15)	V_{CEO} RATED V (16)	V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	ACTUAL V (19)	CIRCUIT FUNCTION or APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) (22)	SOURCE (See below) (23)	FAIL. RATE (24)	MULTIPLIER (25)	FAIL. RATE (%/1000 HRS) (25)	TOTAL COUNT PER TYPE (26)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR15	1N5186 2340376-1	Unitrode	65	175		2320				15.6	.65%						100	29	Isolation		244	A				1	.000244
CR17										.28	<.1%								Shunt		232						.000232
CR18										12	.5%								Isolation		241						.000241
CR19										12	.5%								Isolation		241						.000241
CR20										1.9	.1%								Shunt		233						.000233

(22) FAILURE RATE SOURCE (See Column 23)
A ATM 605A C
B D

(29) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE .001191 %/1000 HRS.

9040A

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PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP DATE:

ASSEMBLY: PDU SUB ASSEMBLY: ADP Relays SCHEMATIC NO: 2362241

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)	5 TOLERANCE (%)	6 POWER RATING (WATTS)	7 MAXIMUM OPERATING POWER MW	POWER RATIO OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) AT 50°C SOURCE (SEE BELOW)	13 FOR USE OF RELIABILITY DEPT	14 SPECIAL ENVIRONMENTS (DEFINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R-1 *	RWR81W2R15ES	Dale	2.15	±1%	1.0	20.0 .8	.02 .001	100%	65	C. B. Shunt	.074 A			.001		1	.000074
R-2*	RWR81W2R15FS	Dale	2.15	±1%	1.0	20.0 .8	.02 .001	100%	65	C. B. Shunt	.074 A			.001		1	.000074
R-3	RNR55E2102FS	Mepco	21K	±1%	.1	.001	.01	100%	65	Monitor	.205			.001			.000205
R-4	RNR55E1182FS	↓	11.8K	±1%	.1	.0015	.015	↓	65	↓	.205			.001			.000205
R-5	RNR55E2051FS	↓	20.5K	±1%	.1	.0003	.003	↓	65	↓	.205			.001		↓	.000205

19 *Selected Per 2362290-4

FAILURE RATE SOURCES (FOR COLUMN #14)

A ATM605A B

C D

20 CALCULATED MTBF HRS

21 TOTAL FAILURE RATE .000763 %/1000 HRS

FORM 9201

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PARTS APPLICATION ANALYSIS

(RELAYS)

(Relays)

PROJECT: ALSEP
ASSEMBLY: PDU
SUB ASSEMBLY: ADP Relays
DATE:
SCHEMATIC NO: 2362241

CIRCUIT REFERENCE DESIGNATION 1	TYPE DESIGNATION (CEC, MIL OR MFR) AND CONSTRUCTION 2	MANUFACTURER 3	CONTACT LOAD: RATED VOLTAGE V 4	CONTACT LOAD: RATED CURRENT A 5	CONTACT LOAD: ACTUAL VOLTAGE STEADY STATE V 6	CONTACT LOAD: ACTUAL VOLTAGE PEAK V 7	CONTACT LOAD: ACTUAL CURRENT STEADY STATE A 8	CONTACT LOAD: ACTUAL CURRENT SURGE A 9	TYPE OF LOAD 10	NUMBER OF POLES: TOTAL 11	NUMBER OF POLES: ACTIVE 12	RELAY COIL: POWER MAX. RATED 13	RELAY COIL: POWER ACTUAL 14	RELAY COIL: VOLTAGE MAX. PULL IN 15	RELAY COIL: VOLTAGE MIN. OPER. 16	RATE OF OPERATIONS PER HOUR OR SECOND 17	REQ'D LIFE OPERATIONS 18	MISCELLANEOUS REMARKS x10^{-5} 19	BASIC FAILURE RATE (%/1000 HRS) 20	SOURCE OF F.R. (SEE BELOW) 21	F.R. MODIFIER 22	TOTAL FAILURE RATE (%/1000 HOURS) 23
K-1	(40M37496-33) 422-8038	Teledyne	28	0.5	29	29	40		Resis	2	2	200	128	20	-	<1	10^5	231		A	1	.00231
K-2							54								-			236				.00236
K-3							40								-			231				.00231
K-4							54								-			231				.00231
CB-1 CB-2	(2330151-2) 421-3120						14.5			1	1				-			159			(2)	.00318
CB-3															-			159			1	.00159
CB-4															-			159				.00159
CB-5															-			159				.00159
CB-6															-			159				.00159

DEVICE AVERAGE AMBIENT TEMPERATURE °C 24

FAILURE RATE SOURCES (FOR COLUMN NO. 21) 25
A ATM605B B
C D

CALCULATED MTBF _____ HOURS 26

ADP TOTAL FAILURE RATE .01883 %/1000 HRS 27

BS-321 A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

(Semiconductors)

PROJECT: ALSEP-E
ASSEMBLY: PDU
SUB ASSEMBLY: Uplink Relays
DATE:
SCHEMATIC NO: 2362292

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	MAX. TEMP °C: JUNCTION RATED T_J (5)	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT (7)	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE (8)	AVG PWR DISSIPATION (mw): ACTUAL: AMBIENT T_A (9)	AVG PWR DISSIPATION (mw): ACTUAL: CASE T_C (10)	AVG PWR DISSIPATION (mw): ACTUAL (11)	POWER RATIO: ACTUAL/RATED 25°C Amb.or case (12)	POWER RATIO: ACTUAL/RATED T_A or T_C (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	MAXIMUM VOLTAGES: V_{CB} ACTUAL V (15)	MAXIMUM VOLTAGES: V_{CEO} RATED V (16)	MAXIMUM VOLTAGES: V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	DIODE PIV: ACTUAL V (19)	CIRCUIT FUNCTION or APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) (22)	SOURCE (See below) (23)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL FAIL RATE (%/1000 HRS) (26)	TOTAL COUNT PER TYPE (26)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR1	S1N645	GI TRW	65	150		600				10.1	1.7%							225	29	Isola-tion		.00096	A				1	.00096
CR2										10.1	1.7%									"		.00096						.00096
CR3										5.0	.8%									Induct. Kick		.00094						.00094
CR4										5.0										"								.00094
CR9										5.0										"								.00094
CR16										5.0										"								.00094
CR21										5.0										"								.00094
CR22										5.0										"								.00094
CR23 CR24										.11	<.1%								5	Isola-tion							2	.00188

(22) FAILURE RATE SOURCE (See Column 23)
A ATM 605A
B
C
D

(29) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE .00944 %/1000 HRS.

92498A

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

(Semiconductors)

PROJECT: ALSEP-E
ASSEMBLY: PDU
SUB ASSEMBLY: UPLINK RELAYS
DATE:
SCHEMATIC NO: 2362292

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	MAX. TEMP °C: JUNCTION RATED T_J (5)	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT (7)	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE (8)	AVG PWR DISSIPATION (mw): ACTUAL AMBIENT T_A (9)	AVG PWR DISSIPATION (mw): ACTUAL CASE T_C (10)	AVG PWR DISSIPATION (mw): ACTUAL (11)	POWER RATIO: ACTUAL/RATED 25°C (Amb.or case) (12)	POWER RATIO: ACTUAL T_A or T_C / RATED T_A or T_C (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	MAXIMUM VOLTAGES: V_{CB} ACTUAL V (15)	MAXIMUM VOLTAGES: V_{CEO} RATED V (16)	MAXIMUM VOLTAGES: V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	DIODE PIV: ACTUAL V (19)	CIRCUIT FUNCTION or APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) (22)	SOURCE (See below) (23)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL FAIL RATE (%/1000 HRS) (25)	TOTAL COUNT PER TYPE (26)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR5	1N5186 2340376-1	Unitrode	65	175		2320				3.7	.16%							100	29	Shunt		235	A				1	.000235
CR6										68	2.9%									Isolation		284						.000284
CR7										68	2.7%									"		284						.000284
CR8										7	.3%									Shunt		233						.000233
CR10										23	1%									Isolation		249						.000249
CR11										.01	<.1%									Shunt		232						.000232
CR12										23	1%									Isolation		249						.000249
CR13										3.7	.16%									Shunt		235						.000235
CR14	↓	↓	↓	↓		↓				1.0	<.1%							↓	↓	Isolation		233	↓				↓	.000233

(28) FAILURE RATE SOURCE (See Column 23)
A ATM 605A C
B D

(29) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) UPLINK TOTAL FAILURE RATE .002234 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

(Semiconductors)

PROJECT: ALSEP DATE:

ASSEMBLY: PDU SUB ASSEMBLY: UPLINK RELAYS SCHEMATIC NO: 2362292

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	MAX. TEMP °C: JUNCTION RATED T_J (5)	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT (7)	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE (8)	AVG PWR DISSIPATION (mw): ACTUAL: AMBIENT T_A (9)	AVG PWR DISSIPATION (mw): ACTUAL: CASE T_C (10)	AVG PWR DISSIPATION (mw): ACTUAL (11)	POWER RATIO: ACTUAL RATED 25°C Amb. or case (12)	POWER RATIO: ACTUAL RATED T_A or T_C (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	MAXIMUM VOLTAGES: V_{CB} ACTUAL V (15)	MAXIMUM VOLTAGES: V_{CEO} RATED V (16)	MAXIMUM VOLTAGES: V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	DIODE PIV: ACTUAL V (19)	CIRCUIT FUNCTION or APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) (23)	SOURCE (See below) (22)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL FAIL. RATE (%/1000 HRS) (25)	TOTAL COUNT PER TYPE (26)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR15	1N5186 2340376-1	Unitrode	65	175		2320			1.0	<.1%							100	29	Isolation		233	A				1	.000233
CR17									7.0	.3%									Shunt		238						.000233
CR18									68	2.9%									Isolation		284						.000284
CR19									68	2.9%									"		284						.000284
CR20									.01	<.1%									Shunt		232						.000232

(28) FAILURE RATE SOURCE (See Column 22)
A ATM 605A C
B D

(29) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) UPLINK TOTAL FAILURE RATE .001266 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP DATE: 1-22-71

ASSEMBLY: PDU SUB ASSEMBLY: Uplink Relays SCHEMATIC NO: 2362292

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)	5 TOLERANCE (%)	6 POWER RATING (WATTS)	7 MAXIMUM OPERATING POWER (WATTS)	8 POWER RATIO OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) @ 1°C SOURCE (SEE BELOW)	13 FOR USE OF RELIABILITY DEPT.	14 SPECIAL ENVIRONMENTS (DEFINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R-1*	RWR81W2R15FS		2.15	±1%	1.0	.02	.02	100%	65	C. B. Shunt	.074			.001		1	.000074
R-2*	RWR81W2R15FS		2.15	±1%	1.0	.02	.02	100%	65	C. B. Shunt	.074			.001		1	.000074
R-3	RNR55E2102FS		21K	±1%	.1	.001	.01	100%	65	Monitor	.205			.001			.000205
R4	RNR55E1182FS		11.8K	±1%	.1	.0015	.015		65	"	.205			.001			.000205
R5	RNR55E2051FS		20.5K	±1%	.1	.0003	.003		65	"	.205			.001			.000205
R6	RWR81S1211FR		1.21K	±1%	1.0	.12	.12		65	Shunt Load	.074			.01			.00074
R7	RWR81S1211FR		1.21K	±1%	1.0	.12	.12		65	Shunt Load	.074			.01			.00074

19 *Selected Per 2362290-4

FAILURE RATE SOURCES (FOR COLUMN #12)

A ATM 605A B

C D

20 CALCULATED MTBF HRS

21 TOTAL FAILURE RATE .002243 %/1000 HRS

FORM 9231

BS-321A

PARTS APPLICATION ANALYSIS

(RELAYS)

(Relays)

PROJECT: ALSEP
ASSEMBLY: PDU
SUB ASSEMBLY: Uplink Relays
DATE: 1-22-71
SCHEMATIC NO: 2362292

CIRCUIT REFERENCE DESIGNATION (1)	TYPE DESIGNATION (CEC, MIL OR MFR) AND CONSTRUCTION (2)	MANUFACTURER (3)	CONTACT LOAD: RATED VOLTAGE V (4)	RATED CURRENT A (5)	ACTUAL VOLTAGE STEADY STATE V (6)	ACTUAL VOLTAGE PEAK V (7)	ACTUAL CURRENT STEADY STATE A (8)	ACTUAL CURRENT SURGE A (9)	TYPE OF LOAD (10)	NUMBER OF POLES TOTAL (11)	NUMBER OF POLES ACTIVE (12)	RELAY COIL POWER MAX. RATED (13)	POWER ACTUAL (14)	VOLTAGE MAX. PULL IN (15)	VOLTAGE MIN. OPER. (16)	RATE OF OPERATIONS PER HOUR OR SECOND (17)	REQ'D LIFE OPERATIONS (18)	MISCELLANEOUS REMARKS (19)	BASIC FAILURE RATE (%/1000 HRS) (20)	SOURCE OF F.R. (SEE BELOW) (21)	F.R. MODIFIER (22)	TOTAL FAILURE RATE (%/1000 HOURS) (23)
K-1	(40m37493-33) 422-8033	Teledyne	28	0.5	29	29	202		Resis	2	2	200	128	16/20	-	< 1	10^5	.00382		A	1	.00382
K-2							.76								-			.00280				.00280
K-3							202								-			.00362				.00382
K-4							202								-			.00382				.00382
CB-1 CB-2	(2330151-2) 421-3120						14.5			1	1				-			.00159			(2)	.00318
CB-3															-			.00159			1	.00159
CB-4															-			.00159				.00159
CB-5															-			.00159				.00159
CB-6															-			.00159				.00159

DEVICE AVERAGE AMBIENT TEMPERATURE °C (24)

FAILURE RATE SOURCES (FOR COLUMN NO. 21) (25)
A ATM605B
B
C
D

CALCULATED MTBF _____ HOURS (26)

Uplink .02382
TOTAL FAILURE RATE _____ %/1000 HRS (27)

BS-321 A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP-E
ASSEMBLY: PDU
SUB ASSEMBLY: Transmitter
DATE: 1-23-71
SCHEMATIC NO: 2362231

(Semiconductors)

CKT SYM NO.	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY	MANUFACTURER	MAX. TEMP °C: AMBIENT ACTUAL T_A	MAX. TEMP °C: JUNCTION RATED T_J	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C	AVG PWR DISSIPATION (mw): RATED AT 25°C AMBIENT	AVG PWR DISSIPATION (mw): RATED AT 25°C CASE	AVG PWR DISSIPATION (mw): ACTUAL AMBIENT T_A	AVG PWR DISSIPATION (mw): ACTUAL CASE T_C	AVG PWR DISSIPATION (mw): ACTUAL	POWER RATIO: ACTUAL 25°C (Amb.or case)	POWER RATIO: ACTUAL T_C or T_A RATED	MAXIMUM VOLTAGES: V_{CBO} RATED V	MAXIMUM VOLTAGES: V_{CB} ACTUAL V	MAXIMUM VOLTAGES: V_{CEO} RATED V	MAXIMUM VOLTAGES: V_{CE} ACTUAL V	DIODE PIV: RATED V	DIODE PIV: ACTUAL V	CIRCUIT FUNCTION or APPLICATION	PART SPECIAL ENVIRONMENT (Define)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS)	SOURCE (See below)	FAIL. RATE	MULTIPLIER	FINAL FAIL. RATE (%/1000 HRS)	TOTAL PART TYPE COUNT	TOTAL FAILURE RATE (%/1000 HRS)
CR1	2340376-1 IN5186	Unitrode	65	175		2320				288	12%						100	29	Isolation		10^{-5} 20	A				1	.0002
CR2	SIN645	GI TRW		150		600				5	.8%						225		Induct. Kick		94						.00094
CR3	2340376-1	Unitrode		175		2320				12	.6%						100		Shunt		17						.00017
CR4	2340376-1	"		175		2320				56	3%						100		Isolation		18						.00018
CR5	SIN645	GI TRW		150		600				5	.8%						225		Induct. Kick		94						.00094
CR6	2340376-1	Unitrode		175		2320				4	.2%						100		Shunt		17						.00017
CR7	SIN645	GI TRW		150		600				10	1.7%						225		Isolation		90						.00096
CR8		" "				600				5	.8%						225		Induct. Kick		94						.00094
CR9		" "				600				5	.8%						225		Induct. Kick		94						.00094

FAILURE RATE SOURCE (See Column 23)
A ATM605A C
B D

NOTE: It is assumed the transient and peak power does not exceed the safe limit.

TOTAL FAILURE RATE .00544 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP-E DATE: 1-23-71

ASSEMBLY: PDU SUB ASSEMBLY: Transmitter SCHEMATIC NO: 2362231

(Semiconductors)

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	JUNCTION RATED T_J (5)	CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C AMBIENT (7)	RATED AT 25°C CASE (8)	ACTUAL AMBIENT T_A (9)	ACTUAL CASE T_C (10)	ACTUAL (11)	POWER RATIO: ACTUAL RATED 25°C (Amb,or case) (12)	ACTUAL RATED T_A or T_C (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	V_{CB} ACTUAL V (15)	V_{CEO} RATED V (16)	V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	ACTUAL V (19)	CIRCUIT FUNCTION or APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) -5 10 (22)	SOURCE (See below) (23)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL FAIL. RATE (%/1000 HRS) (26)	TOTAL COUNT PER TYPE (27)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR10	2340376-1 IN5186	Unitrode	65	175		2320				288	12%						100	29	Isolation		20	A				1	.0002
CR11	2340376-1 IN5186	Unitrode		175		2320				12	.52%						100		Shunt		17						.00017
CR12	SIN645	GI TRW		150		600				5	.8%						225		Induct. Kick		94						.00094
CR13	↓	" "		↓		↓				10	1.7%						↓	↓	Isolation		96						.00096
CR14	↓	" "		↓		↓				5	.8%						↓	↓	Induct. Kick		94	↓				↓	.00094

(28) FAILURE RATE SOURCE (See Column 23)
A ATM605A C
B D

(29) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE .00321 %/1000 HRS.

9249A

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: _____ DATE: 1-23-71

ASSEMBLY: _____ SUB ASSEMBLY: Transmitter SCHEMATIC NO: 2362231

(Semiconductors)

CKT SYM NO. 1	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY 2	MANUFACTURER 3	MAX. TEMP °C: AMBIENT ACTUAL T_A 4	MAX. TEMP °C: JUNCTION RATED T_J 5	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C 6	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT 7	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE 8	AVG PWR DISSIPATION (mw): ACTUAL AMBIENT T_A 9	AVG PWR DISSIPATION (mw): ACTUAL CASE T_C 10	AVG PWR DISSIPATION (mw): ACTUAL 11	POWER RATIO: ACTUAL RATED 25°C (Amb.or case) 12	POWER RATIO: ACTUAL RATED T_A or T_C 13	MAXIMUM VOLTAGES: V_{CBO} RATED V 14	MAXIMUM VOLTAGES: V_{CB} ACTUAL V 15	MAXIMUM VOLTAGES: V_{CEO} RATED V 16	MAXIMUM VOLTAGES: V_{CE} ACTUAL V 17	DIODE PIV: RATED V 18	DIODE PIV: ACTUAL V 19	CIRCUIT FUNCTION or APPLICATION 20	PART SPECIAL ENVIRON-MENT (Define) 21	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) 22	SOURCE (See below) 23	MULTIPLIER FAIL. RATE 24	FINAL FAIL RATE (%/1000 HRS) 25	TOTAL COUNT PER TYPE 26	TOTAL FAILURE RATE (%/1000 HRS) 27
Q1 Q3	SM2N2907A	T1	65	200			1800			1.8	<1%		60	5	40	5			Switch-ing		275	A			2	.0055
Q4	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	275	↓	↓	↓	1	.00275
Q6	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	275	↓	↓	↓	1	.00275
Q2(A) & B	S2N2060	GE Mot T1				500				7.5	1.5%		100	29	60	29			Relay Driver		113				1	.00113
Q5(A) &(B)	↓	"	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	113	↓	↓	↓	1	.00113

23 FAILURE RATE SOURCE (See Column 23)
A ATM 605A C _____
B _____ D _____

NOTE: It is assumed the transient and peak power does not exceed the safe limit.

TOTAL FAILURE RATE .01326 %/1000 HRS.

9508A

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP-E DATE: 1-23-71
ASSEMBLY: PDU SUB ASSEMBLY: Transmitter SCHEMATIC NO: 2362231

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)		5 TOLERANCE (%)	6 POWER RATING (WATTS)	7 MAXIMUM OPERATING POWER (WATTS) mw	8 POWER RATIO OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) x10⁻⁵	13 SOURCE (SEE BELOW)	14 SPECIAL ENVIRONMENTS (DEFINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R1 △	RNR55C3011FS	Mepco	3010	±1%	1	2.57	<1%	100%	65		Voltage Drop. Resis.	173	A		.001		1	.00173
R2 △	"		3010		1	"	"				" " "	173						.00173
R3	RNR55C3320FS		56.2K		0.1	<0.1	"				Relay Driv. Bleed Resis	173						.00173
R4 *	RWR81R715FS	Dale			1						Circ. Breaker Shunt	63						.00063
R5	RNR55C3320FS	Mepco	21K		0.1	86	≤1%				Relay Driv. Bias Res.	173						.00173
R6	RNR55C3622		681		0.1	23.5	23.5%				Relay Driv. Bias Res.	192						.00192
R7	RNR55C5622FS		56.2K		0.1	<0.1	<1%				Relay Driv. Bleed Res.	173						.00173
R8	RNR55C5622FS		21K		0.1	86	<1%				Relay Driv. Bias Res.	173						.00173
R9	RNR55C6810FS		681		0.1	23.5					Relay Driv. Bias Res.	192						.00192
R10	RNR55C3320FS		56.2K		0.1	<0.1	<1%				Relay Driv. Bleed Res.	173						.00173
R11 *	RWR81WR715FS	Dale			1						Circ. Break. Shunt	063						.00063
R12	RNR55C5622FS	Mepco	21K		0.1	86	<1%				Relay Driv. Bias Res.	173						.00173
R13	RNR55C6810FS		681		0.1	23.5	23.5%				Relay Driv. Bias Res.	192						.00192
R14	RNR55E3320		56.2K		0.1	<0.1	<1%				Relay Driv. Bleed Res.	173						.00173
R15	RNR55E5622FS		21K		0.1	86	<1%				Relay Driv. Bias Res.	173						.00173
R16	RNR55C6810FS		681		0.1	23.5	23.5%				Relay Driv. Bias Res.	192						.00192

FOR USE OF RELIABILITY DEPT

19 * Selected per 2362290-8

FAILURE RATE SOURCES (FOR COLUMN #14)
A ATM605A B
C D

20 CALCULATED MTBF HRS

21 TOTAL FAILURE RATE .02624 %/1000 HRS

FORM 6221
BS-321A

△ - Temp. Measurement

PARTS APPLICATION ANALYSIS

(RELAYS)

PROJECT: ALSEP-E DATE: 1-25-71

ASSEMBLY: PDU SUB ASSEMBLY: Transmitter SCHEMATIC NO: 2362231

(Relays)

CIRCUIT REFERENCE DESIGNATION 1	TYPE DESIGNATION (CEC, MIL OR MFR) AND CONSTRUCTION 2	MANUFACTURER 3	CONTACT LOAD: RATED VOLTAGE V 4	RATED CURRENT A 5	ACTUAL VOLTAGE STEADY STATE V 6	ACTUAL VOLTAGE PEAK V 7	ACTUAL CURRENT STEADY STATE MA 8	ACTUAL CURRENT SURGE A 9	TYPE OF LOAD 10	NUMBER OF POLES: TOTAL 11	NUMBER OF POLES: ACTIVE 12	RELAY COIL: POWER MAX. RATED 13	POWER ACTUAL 14	VOLTAGE MAX. PULL IN 15	VOLTAGE MIN. OPER. 16	RATE OF OPERATIONS PER HOUR OR SECOND 17	REQ'D LIFE OPERATIONS 18	Failure Rate %/100 x 10^{-5} 19	SOURCE (SEE BELOW) 21	QUALITY FACTOR 22	ENVIRONMENT MODIFIER 22	TOTAL FAILURE RATE (%/1000 HOURS) 23
K1 K2	40M37496-33	Teledyne	28	0.5	29	29	424		Resis	2	2	200	128	16/20	-	< 1	5×10	526	A	2		.01052
CB1	2330151-1	↓	↓	↓	↓	↓	14.5	↓	↓	1	1	↓	↓	↓	↓	↓	↓	2	↓	1	↓	.002
CB2	2330151-1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓	.002
CB3	233015101	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓	.002

DEVICE AVERAGE AMBIENT TEMPERATURE °C 24

FAILURE RATE SOURCES (FOR COLUMN NO. 21) 25
A ATM 605B B
C D

CALCULATED MTBF _____ HOURS 26

TOTAL FAILURE RATE .01472 %/1000 HRS. 27

BS-321 A

PARTS APPLICATION ANALYSIS

(MISC. PARTS)

PROJECT: ALSEP-E DATE: 1-12-71

ASSEMBLY: PDU SUB ASSEMBLY: Transmitter SCHEMATIC NO: 2362231

(Misc. Parts)

CIRCUIT SYMBOL NUMBER 1	TYPE DESIGNATION (CEC, MIL OR MFR) and CONSTRUCTION 2	MANUFACTURER 3	TEMPERATURE RANGE MAX °C 4	TEMPERATURE RANGE MIN °C 5	ELECTRICAL STRESS RATED 6	ELECTRICAL STRESS USE mw 7	PERCENT DUTY CYCLE 8	MAJOR CHARACTERISTICS and APPLICATION 9	FOR RELIABILITY USE ONLY: BASIC FAILURE RATE (%/1000 HOURS) at °C 10	SOURCE (SEE #15) 11	PART SPECIAL ENVIRONMENT (DEFINE) 12	FAILURE RATE MULTIPLIER 13	TOTAL FAILURE RATE (%/1000 HOURS) 14
RT1	2335661-2	Fenwal	228	-40		5.97	100	Temperature sensing	3	D		.01	.0003

15 FAILURE RATE SOURCES (FOR COLUMN 11)
A. _____ B. _____
C. _____ D. Mil Std 217 Chart XXIV

16 CALCULATED MTBF 166.7 x 10^6 HOURS

17 .00030 TOTAL FAILURE RATE _____ %/1000 HOURS

DRD Form 9298

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP
ASSEMBLY: PDU
SUB ASSEMBLY: Digital Data Proc.
DATE:
SCHEMATIC NO: 2362261

(Semiconductors)

CKT SYM NO.	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY	MANUFACTURER	MAX. TEMP °C: AMBIENT ACTUAL T_A	JUNCTION RATED T_J	CASE ACTUAL HOT SPOT T_C	AVG PWR DISSIPATION (mw): RATED AT 25°C AMBIENT	25°C CASE	ACTUAL T_A AMBIENT	ACTUAL T_C CASE	ACTUAL	POWER RATIO: ACTUAL RATED 25°C (Amb.or case)	ACTUAL RATED T_A or T_C	MAXIMUM VOLTAGES: V_{CBO} RATED V	V_{CB} ACTUAL V	V_{CEO} RATED V	V_{CE} ACTUAL V	DIODE PIV: RATED V	ACTUAL V	CIRCUIT FUNCTION or APPLICATION	PART SPECIAL ENVIRONMENT (Define)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) 10^{-5}	SOURCE (See below)	FAIL. RATE	MULTIPLIER	FINAL FAIL RATE (%/1000 HRS)	TOTAL COUNT PER TYPE	TOTAL FAILURE RATE (%/1000 HRS)
CR1	SIN645	GI TRW	65	150		600				10	1.7%						225	29	Isolation		96	A				1	.00096
CR2										5	.8%								Induct. Kick		94						.00094
CR3										5	.8%								"		94						.00094
CR4	2340376-1	Unitrode		175		2320				8	.2%						100		Shunt		13						.00013
CR5	2340376-1	Unitrode		175		2320				10	.4%						100		Isolation		17						.00017
CR6	SIN645	GI TRW		150		600				5	.8%						225		Induct. Kick		94						.00094
CR7										5	.8%								"		94						.00094
CR8	2340376-1	Unitrode		175		2320				8	.35%						100		Shunt		13						.00013
CR9	2340376-1	Unitrode		175		2320				10.3	.45%						100		Isolation		17						.00017

FAILURE RATE SOURCE (See Column 23)
A ATM605A
B
C
D

NOTE: It is assumed the transient and peak power does not exceed the safe limit.

TOTAL FAILURE RATE .00532 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP-E DATE: 1-25-71

ASSEMBLY: PDU SUB ASSEMBLY: Digital Data Processor SCHEMATIC NO: 2362261

(Semiconductors)

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	JUNCTION RATED T_J (5)	CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C AMBIENT (7)	RATED AT 25°C CASE (8)	ACTUAL AMBIENT T_A (9)	ACTUAL CASE T_C (10)	ACTUAL (11)	POWER RATIO: ACTUAL/RATED 25°C (Amb.or case) (12)	ACTUAL T_A or T_C / RATED T_A or T_C (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	V_{CB} ACTUAL V (15)	V_{CEO} RATED V (16)	V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	ACTUAL V (19)	CIRCUIT FUNCTION or APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) (22)	SOURCE (See below) (23)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL RATE (%/1000 HRS) (25)	TOTAL COUNT PER TYPE (26)	TOTAL FAILURE RATE (%/1000 HRS) (27)
Q1 Q3	SM2N2907A "	T1	65	200			1800			1.8	<1%		60	5	40	5			Switching		.5 / 10	A				2	.00550
Q2 Q4	S2N2222A	T1	65	175			1800			7.1	<1%		60	29	N/A	29			Relay Drive		175	A				2	.00350

(28) FAILURE RATE SOURCE (See Column 23)
A ATM605A C
B D

(29) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE .00900 %/1000 HRS.

P248A

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP-E DATE: 1-25-71

ASSEMBLY: PDU SUB ASSEMBLY: Digital Data Processor SCHEMATIC NO: 2362261

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)	5 TOLERANCE (%)	6 POWER RATING MW	7 MAXIMUM OPERATING POWER (WATTS)	8 POWER RATIO OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) AT °C	13 SOURCE (SEE BELOW)	14 SPECIAL ENVIRONMENTS (DEFINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R1	RNR5E5622 FS	Mepco	56.2K	±1%	0.1	0.86	<1%	100%	65	Relay Driv. Bias Res.	.173	A		.001		1	.000173
R2	RNR55E6810FS	Mepco	681		0.1	23.5	23.5%			" " "	.192						.000192
R3 *	RWR81WXXXXFS	Dale			1					Circ Break Shunt	.063						.000063
R4	RNR55E3320FS	Mepco	332		0.1	<0.1	<1%			Relay Driv. Bleed Res	.173						.000173
R5 *	RWR81WXXXXFS	Dale			1.0					Circ Break Shunt	.063						.000063
R6	RNR55E5562FS	Mepco	21K		0.1	86	<1%			Relay Driv. Bias Res	.173						.000173
R7	RNR55E6810FS		56.2K			23.5	23.5%			" " "	.192						.000192
R8	RNR55E3320FS		332			<0.1	<1%			Relay Driv Bleed Res	.173						.000173

FOR USE OF RELIABILITY DEPT

19 * Selected per 2362290-3

FAILURE RATE SOURCES (FOR COLUMN #14)

A ATM605A B

C D

20 CALCULATED MTBF HRS

21 TOTAL FAILURE RATE .001202 %/1000 HRS

FORM 0221

BS-321A

PARTS APPLICATION ANALYSIS

(RELAYS)

(Relays)

PROJECT: ALSEP-E DATE: 1-25-71

ASSEMBLY: PDU SUB ASSEMBLY: Digital Data Processor SCHEMATIC NO: 2362261

CIRCUIT REFERENCE DESIGNATION 1	TYPE DESIGNATION (CEC, MIL OR MFR) AND CONSTRUCTION 2	MANUFACTURER 3	CONTACT LOAD: RATED VOLTAGE V 4	CONTACT LOAD: RATED CURRENT A 5	CONTACT LOAD: ACTUAL VOLTAGE STEADY STATE V 6	CONTACT LOAD: ACTUAL VOLTAGE PEAK V 7	CONTACT LOAD: ACTUAL CURRENT STEADY STATE MA 8	CONTACT LOAD: ACTUAL CURRENT SURGE A 9	TYPE OF LOAD 10	NUMBER OF POLES: TOTAL 11	NUMBER OF POLES: ACTIVE 12	RELAY COIL: POWER MAX. RATED 13	RELAY COIL: POWER ACTUAL 14	RELAY COIL: VOLTAGE MAX. PULL IN 15	RELAY COIL: VOLTAGE MIN. OPER. 16	RELAY COIL: RATE OF OPERATIONS PER HOUR OR SECOND 17	RELAY COIL: REQ'D LIFE OPERATIONS 18	Failure Rate %/100 x 10^{-5} 19	SOURCE OF F.R. (SEE BELOW) 21	F.R. MODIFIER 22	TOTAL FAILURE RATE (%/1000 HOURS) 23
K1	40M37496-33	Teledyne	28	0.5	29	29	150	-	Resis	2	2	200	128	16/ 20		< 1	10^5	303				.00303
CB1	2330151-1	↓	↓	↓	↓	↓	14.5	-	↓	1	1	↓	↓	↓		↓	↓	200				.00200
CB2	2330151-1	↓	↓	↓	↓	↓	14.5	-	↓	1	1	↓	↓	↓		↓	↓	200				.00200

DEVICE AVERAGE AMBIENT TEMPERATURE °C 24

FAILURE RATE SOURCES (FOR COLUMN NO. 21) 25
A ATM605B B _____
C _____ D _____

CALCULATED MTBF _____ HOURS 26

TOTAL FAILURE RATE .00703 %/1000 HRS 27

BS-321 A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP-E

ASSEMBLY: PDU

SUB ASSEMBLY: Experiment

DATE: 1-23-71

SCHEMATIC NO: 2362221

(Semiconductors)

CKT SYM NO. 1	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY 2	MANUFACTURER 3	MAX. TEMP °C: AMBIENT ACTUAL T_A 4	MAX. TEMP °C: JUNCTION RATED T_J 5	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C 6	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT 7	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE 8	AVG PWR DISSIPATION (mw): ACTUAL AMBIENT T_A 9	AVG PWR DISSIPATION (mw): ACTUAL CASE T_C 10	AVG PWR DISSIPATION (mw): ACTUAL 11	POWER RATIO: ACTUAL RATED 25°C (Amb. or case) 12	POWER RATIO: ACTUAL RATED T_A or T_C 13	MAXIMUM VOLTAGES: V_{CBO} RATED V 14	MAXIMUM VOLTAGES: V_{CB} ACTUAL V 15	MAXIMUM VOLTAGES: V_{CEO} RATED V 16	MAXIMUM VOLTAGES: V_{CE} ACTUAL V 17	DIODE PIV: RATED V 18	DIODE PIV: ACTUAL V 19	CIRCUIT FUNCTION or APPLICATION 20	PART SPECIAL ENVIRONMENT (Define) 21	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) 22	SOURCE (See below) 23	FAIL. RATE 24	MULTIPLIER 25	FINAL FAIL. RATE (%/1000 HRS) 25	TOTAL FAIL. PER TYPE 26	COUNT 26	TOTAL FAILURE RATE (%/1000 HRS) 27
CR1	2340376-1	Unitrode	65	175		2320				340	14.7%							100	29	Isolation	100%	22	A				1	.00022
CR2	SIN645	GI TRW		150		600				5.1	.8%							225		Induct. Kick		94						.00094
CR3	SIN645	"		↓		↓				5.1	.8%							↓		Induct. Kick		94						.00094
CR4	SIN645	"		↓		↓				10.1	1.7%							↓		Isolation		96						.00096
CR5	2340376-1	Unitrode		175		2320				18.3	.8%							100		Shunt		17						.00017
CR6	2340376-1	Unitrode		175		2320				371	16.0%							100		Isolation		27						.00027
CR7	SIN645	GI TRW		150		600				5.1	.8%							225		Induct. Kick		94						.00094
CR8	SIN645	" "		↓		↓				5.1	.8%							↓		Induct. Kick		94						.00094
CR9	SIN645	" "		↓		↓				5.1	.8%							↓	↓	Isolation	↓	94	↓					.00094

28 FAILURE RATE SOURCE (See Column 23)
A ATM605A C
B D

29 NOTE: It is assumed the transient and peak power does not exceed the safe limit.

30 TOTAL FAILURE RATE .00632 %/1000 HRS. *

*One of Two (Redundant) Boards for Six Experiments.

9268a

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

(Semiconductors)

PROJECT: ALSEP-E **DATE:** 1-23-71

ASSEMBLY: PDU **SUB ASSEMBLY:** Experiment **SCHEMATIC NO:** 2362221

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	MAX. TEMP °C: JUNCTION RATED T_J (5)	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT (7)	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE (8)	AVG PWR DISSIPATION (mw): ACTUAL: AMBIENT T_A (9)	AVG PWR DISSIPATION (mw): ACTUAL: CASE T_C (10)	AVG PWR DISSIPATION (mw): ACTUAL (11)	POWER RATIO: ACTUAL RATED 25°C (Amb.or case) (12)	POWER RATIO: ACTUAL RATED T_A or T_C (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	MAXIMUM VOLTAGES: V_{CB} ACTUAL V (15)	MAXIMUM VOLTAGES: V_{CEO} RATED V (16)	MAXIMUM VOLTAGES: V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	DIODE PIV: ACTUAL V (19)	CIRCUIT FUNCTION OR APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) 10^{-5} (22)	SOURCE (See below) (23)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL FAIL. RATE (%/1000 HRS) (25)	TOTAL COUNT PER TYPE (26)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR10	SIN645	GI TRW	65	150		600				5.1	.8%							225	29	Induct Kick		94	A				1	.00094
CR11	SIN645	" "	65	150		600				10.1	1.7%							225	29	Isolation		96	A				1	.00096
Q1 Q3 Q5	S2N2907A	T1	65	200			1800			1.8	<1%		60	5	40	5				Switching		275	A				3	.00825
Q2 Q4 Q6	S2N2222A	T1	65	175			1800			7.1	<1%		60	22	N/A	29				Relay Driver		175	A				3	.00525

(28) FAILURE RATE SOURCE (See Column 23)
A ATM605A C
B D

(29) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE .01540 %/1000 HRS.

92494

BS-321A

*One of Two Boards for Six Experiments.

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP-E DATE: 1-25-71

ASSEMBLY: PDU SUB ASSEMBLY: Experiment SCHEMATIC NO: 2362221

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)	5 TOLERANCE (%)	6 POWER RATING (WATTS)	7 MAXIMUM OPERATING POWER (WATTS)	8 POWER RATIO, OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) @ 25°C SOURCE (SEE BELOW)	13 FOR USE OF RELIABILITY DEPT	14 SPECIAL ENVIRONMENTS (DESTINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R1	RNR55E5622FS	Mepco	21K	1%	0.1	< 1	<1%	100%	65	Relay Driv. Bias Res.	.173 A			.001		1	.000173
R2	RNR55E5622FS		21K			< 1	<1%			" " "	.173						.000173
R3 *	RWR81WRXXXFS				1.0					Circ. Breaker Shunt	.063						.000063
R4	RNR55E6810FS		681		0.1	24	24%			Relay Driv. Bias Res	.192						.000192
R5	RNR55E5622FS		56.2K			< 1	<1%			Relay Driv. Bleed Res	.173						.000173
R6	RNR55E3320FS		21K			< 1	<1%			Relay Driv. Bias Res.	.173						.000173
R7	RNR55E6810FS		681			24	24%			Relay Driver " "	.192						.000192
R8	RNR55E6810FS		681			24	24%			" " " "	.192						.000192
R9	RNR55E3320FS		56.2K			1	<1%			" " Bleed Res.	.173						.000173
R10	RNR55E3320FS		56.2K			1	<1%			" " " "	.173						.000173

19 * Select by 2362290-7 Circuit Breaker Kit

FAILURE RATE SOURCES (FOR COLUMN #14)

A ATM605A B _____

C _____ D _____

20 CALCULATED MTBF _____ HRS

21 TOTAL FAILURE RATE .001677 %/1000 HRS

FORM 9021

BS-321A

PARTS APPLICATION ANALYSIS

(RELAYS)

PROJECT: ALSEP-E DATE: 1-25-71

ASSEMBLY: PDU SUB ASSEMBLY: Experiment SCHEMATIC NO: 2362221

(Relays)

CIRCUIT REFERENCE DESIGNATION 1	TYPE DESIGNATION (CEC, MIL OR MFR) AND CONSTRUCTION 2	MANUFACTURER 3	CONTACT LOAD: RATED VOLTAGE V 4	RATED CURRENT A 5	ACTUAL VOLTAGE STEADY STATE V 6	ACTUAL VOLTAGE PEAK V 7	ACTUAL CURRENT STEADY STATE ma 8	ACTUAL CURRENT SURGE A 9	TYPE OF LOAD 10	NUMBER OF POLES TOTAL 11	NUMBER OF POLES ACTIVE 12	RELAY COIL POWER MAX. RATED 13	POWER ACTUAL 14	VOLTAGE MAX. PULL IN 15	VOLTAGE MIN. OPER. 16	RATE OF OPERATIONS PER HOUR OR SECOND 17	REQ'D LIFE OPERATIONS 18	Failure Rate %/100 x 10^{-5} 19	SOURCE (SEE BELOW) 21	OP F.R. 22	F.R. MODIFIER 23	TOTAL FAILURE RATE (%/1000 HOURS) 23
K1	2346262-1	Babcock	32	2	29	29	483		Resis	2	2	1.14	.93	12.5/18	27.5	< 1	10^5	34				.0034
K2	40M37496-33	Teledyne	28	5			545			2	2	.42	.128	16/20	27.5	< 1	10^5	50				.0050
CB1	2330151-1	Teledyne	28	5			14.5			1	1	.42	.128	16/20	--	< 1	10^5	20				.0020

DEVICE AVERAGE AMBIENT TEMPERATURE °C 24

FAILURE RATE SOURCES (FOR COLUMN NO. 21) 25
A ATM605B B
C D

CALCULATED MTBF _____ HOURS 26

TOTAL FAILURE RATE .01040 %/1000 HRS 27

BS-321 A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP-E DATE: 8-13-71

ASSEMBLY: PDU SUB ASSEMBLY: Power Dump SCHEMATIC NO: 2362228

(Semiconductors)

CKT SYM NO. 1	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY 2	MANUFACTURER 3	MAX. TEMP °C: AMBIENT ACTUAL T_A 4	MAX. TEMP °C: JUNCTION RATED T_J 5	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C 6	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT 7	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE 8	AVG PWR DISSIPATION (mw): ACTUAL: AMBIENT T_A 9	AVG PWR DISSIPATION (mw): ACTUAL: CASE T_C 10	AVG PWR DISSIPATION (mw): ACTUAL 11	POWER RATIO: ACTUAL 25°C RATED (Amb. or case) 12	POWER RATIO: ACTUAL RATED T_A or T_C 13	MAXIMUM VOLTAGES: V_{CBO} RATED V 14	MAXIMUM VOLTAGES: V_{CB} ACTUAL V 15	MAXIMUM VOLTAGES: V_{CEO} RATED V 16	MAXIMUM VOLTAGES: V_{CE} ACTUAL V 17	DIODE PIV: RATED V 18	DIODE PIV: ACTUAL V 19	CIRCUIT FUNCTION OR APPLICATION 20	PART SPECIAL ENVIRONMENT (Define) Duty Cycle 21	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) 22	SOURCE (See below) 23	FAIL. RATE 24	MULTIPLIER 25	FINAL FAIL. RATE (%/1000 HRS) 25	TOTAL COUNT PER TYPE 26	TOTAL FAILURE RATE (%/1000 HRS) 27
CR1 CR2	234376-1 TXIN5186	UNI	65	150		2W				20	1%						100	29	Isolation	50%	22	A				2	/00044
CR13 CR14										20	1%							29		50%	22					2	.00044
CR17 CR18										17	1%							5		50%	22					2	.00055
CR15 CR16										34	2%							12		50%	25					2	.00150
CR19 CR20										10	1%							12		50%	22					2	.00040
CR3 CR4			65	150		2W				20	1%							29		< 1%	22					2	.00044
CR5 CR6	S1N645	GI, TRW	65	150		600				5.1	1%						225	29	Induct Kick	< 1%	22					2	.00044
CR7 CR8																					22					2	.00044
CR9 CR10																					22					2	.00044

28 FAILURE RATE SOURCE (See Column 23)
A ATM 605A C
B D

29 NOTE: It is assumed the transient and peak power does not exceed the safe limit.

30 TOTAL FAILURE RATE .00201 %/1000 HRS.

9208A

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP-E DATE: 8-13-71

ASSEMBLY: PDU SUB ASSEMBLY: Power Dump SCHEMATIC NO: 2362228

(Semiconductors)

CKT SYM NO.	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY	MANUFACTURER	MAX. TEMP °C: AMBIENT ACTUAL T_A	MAX. TEMP °C: JUNCTION RATED T_J	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE	AVG PWR DISSIPATION (mw): ACTUAL: AMBIENT T_A	AVG PWR DISSIPATION (mw): ACTUAL: CASE T_C	AVG PWR DISSIPATION (mw): ACTUAL	POWER RATIO: ACTUAL/RATED 25°C (Amb or case)	POWER RATIO: ACTUAL/RATED T_A or T_C	MAXIMUM VOLTAGES: V_{CBO} RATED V	MAXIMUM VOLTAGES: V_{CB} ACTUAL V	MAXIMUM VOLTAGES: V_{CEO} RATED V	MAXIMUM VOLTAGES: V_{CE} ACTUAL V	DIODE PIV: RATED V	DIODE PIV: ACTUAL V	CIRCUIT FUNCTION or APPLICATION	PART SPECIAL ENVIRONMENT (Define)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS)	SOURCE (See below)	FAIL. RATE	MULTIPLIER	FINAL FAIL RATE (%/1000 HRS)	TOTAL COUNT PER TYPE	TOTAL FAILURE RATE (%/1000 HRS)
CR11 CR12	S1N645	GI, TRW	65	150		600				5.1	1%						225	29	Induct Kick	< 1%	22	A				2	.00044
Q1	SM2N2907A	TI	65	200			1800			1.8	.1%		60	5	40	5			1st Stage Driver	< 1%		A				1	.00275
Q3																												
Q5																												
Q9																												
Q11																												
Q13																												
Q15																												
Q2	S2N2222A	TI	65	175			1800			7.1	.4%		60	22	N/A	N/A			Relay Driver								.00175

20 FAILURE RATE SOURCE (See Column 23)
A ATM 605A C
B D

29 NOTE: It is assumed the transient and peak power does not exceed the safe limit.

30 TOTAL FAILURE RATE .02144 %/1000 HRS.

92488A

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP-E DATE: 8-13-71

ASSEMBLY: PDU SUB ASSEMBLY: Power Dump SCHEMATIC NO: 2362228

(Semiconductors)

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	JUNCTION RATED T_J (5)	CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C AMBIENT (7)	RATED AT 25°C CASE (8)	ACTUAL AMBIENT T_A (9)	ACTUAL CASE T_C (10)	ACTUAL (11)	POWER RATIO: ACTUAL/RATED 25°C (Amb.or case) (12)	ACTUAL T_A or T_C / RATED (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	V_{CB} ACTUAL V (15)	V_{CEO} RATED V (16)	V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	ACTUAL V (19)	CIRCUIT FUNCTION or APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) (22)	SOURCE (See below) (23)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL FAIL RATE (%/1000 HRS) (26)	TOTAL COUNT PER TYPE (27)	TOTAL FAILURE RATE (%/1000 HRS) (27)
Q4	S2N2222A	TI	65	175			1900			7.1	.4%		60	22	N/A	N/A			Relay Driver	< 1% Duty Cycle		A					.00175
Q6																												
Q8																												
Q10																												
Q12																												
Q14																												
Q16			〃	〃	〃		〃			〃	〃		〃	〃	〃	〃			〃	〃		〃					.00175

(23) FAILURE RATE SOURCE (See Column 23)
A ATM 605A C
B D

(29) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE .01225 %/1000 HRS.

9249A

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP-E DATE: 8-13-71

ASSEMBLY: PDU SUB ASSEMBLY: Power Dump SCHEMATIC NO: 2362228

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or HFR) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)	5 TOLERANCE (%)	6 POWER RATING (WATTS)	7 MAXIMUM OPERATING POWER (WATTS)	8 POWER RATIO, OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) AT 40°C	13 SOURCE (SEE BELOW)	14 SPECIAL ENVIRONMENTS (DEFINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R1	RNR55E1212FS	MEPCO	12.1K	1%	0.1	.035	35%	<1%	65	Cap. Charging	.173	A		.001		1	.000173
R2	RNR55E121FS		12.1K			.035	35%			Cap. Charging							.000173
R3	RNR55E2102FS		21K			neg	< 1%			Driver Bias							.000173
R11																	.000173
R19																	.000173
R27																	.000173
R7																	.000173
R15																	.000173
R23																	.000173
R31	↓		↓			↓	↓			↓	↓						.000173
R4	RNR55E5622FS		56.2K			neg	< 1%			Base Drive Limiting	.173						.000173
R8																	.000173
R12																	.000173
R16																	.000173
R20																	.000173
R24																	.000173
R28																	.000173
R32	↓	↓	↓	↓	↓	↓	↓		↓	↓	↓	↓	↓	↓	↓	↓	.000173

FOR USE OF RELIABILITY DEPT

19 FAILURE RATE SOURCES (FOR COLUMN #14)

A ATM 605A B

C D

20 CALCULATED MTBF _____ HRS

21 TOTAL FAILURE RATE .002114 %/1000 HRS

(FORM 9881)

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP-E DATE: 8-13-71

ASSEMBLY: PDU SUB ASSEMBLY: Power Dump SCHEMATIC NO: 2362228

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or Mfr) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)	5 TOLERANCE (%)	6 POWER RATING (WATTS)	7 MAXIMUM OPERATING POWER (WATTS)	8 POWER RATIO, OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) @ 40°C SOURCE (SEE BELOW)	13 FOR USE OF RELIABILITY DEPT	14 SPECIAL ENVIRONMENTS (DETINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R5	RNR55E6810FS	MEPCO	681	1%	0.1	.022	22%	>1%	65	Base Drive Limiting	.173	A		.001		1	.000173
R9																	.000173
R13																	.000173
R17																	.000173
R21																	.000173
R25																	.000173
R29																	.000173
R33	"		"			"	"			"							.000173
R6	RNR55E3320FS		332			.001	1%			Driver Bleed							.000173
R10																	.000173
R14																	.000173
R18																	.000173
R22																	.000173
R26																	.000173
R30																	.000173
R34	"	"	"	"	"	"	"	"	"	"	"	"		"		"	.000173

19. FAILURE RATE SOURCES (FOR COLUMN #14)
A ATM 605A B
C D

20. CALCULATED MTBF HRS

21. TOTAL FAILURE RATE .001768%/1000 HRS

FORM 9201

BS-321A

PARTS APPLICATION ANALYSIS

(RELAYS)

PROJECT: ALSEP-E DATE: 8-13-71

ASSEMBLY: PDU SUB ASSEMBLY: Power Dump SCHEMATIC NO: 2362228

(Relays)

CIRCUIT REFERENCE DESIGNATION 1	TYPE DESIGNATION (CEC, MIL OR MFR) AND CONSTRUCTION 2	MANUFACTURER 3	CONTACT LOAD: RATED VOLTAGE V 4	CONTACT LOAD: RATED CURRENT A 5	CONTACT LOAD: ACTUAL VOLTAGE STEADY STATE V 6	CONTACT LOAD: ACTUAL VOLTAGE PEAK V 7	CONTACT LOAD: ACTUAL CURRENT STEADY STATE A 8	CONTACT LOAD: ACTUAL CURRENT SURGE A 9	TYPE OF LOAD 10	NUMBER OF POLES: TOTAL 11	NUMBER OF POLES: ACTIVE 12	RELAY COIL: POWER MAX. RATED 13	RELAY COIL: POWER ACTUAL 14	RELAY COIL: VOLTAGE MAX. PULL IN 15	RELAY COIL: VOLTAGE MIN. OPER. 16	RELAY COIL: RATE OF OPERATIONS PER HOUR OR SECOND 17	RELAY COIL: REQ'D LIFE OPERATIONS 18	MISCELLANEOUS REMARKS 19	BASIC FAILURE RATE (%/1000 HRS) 20	SOURCE OF F.R. (SEE BELOW) 21	F.R. MODIFIER 22	TOTAL FAILURE RATE (%/1000 HOURS) 23
K1	(40M37496-33) 4228030	Teledyne		0.5	29	.25			Rest.	2	2	200	128	20	28	neg	52			A	1	.00231
K2	↓	↓		↓	↓	↓			↓	↓	↓	↓	↓	↓	↓	↓	↓			↓	/	.00231
K3	↓	↓		↓	↓	↓			↓	↓	↓	↓	↓	↓	↓	↓	↓			↓	/	.00231
K4	↓	↓		↓	↓	↓			↓	↓	↓	↓	↓	↓	↓	↓	↓			↓	/	.00231

DEVICE AVERAGE AMBIENT TEMPERATURE °C 24: 65

FAILURE RATE SOURCES (FOR COLUMN NO. 21) 25: A ATM 605A B ____ C ____ D ____

CALCULATED MTBF ____ HOURS 26

TOTAL FAILURE RATE .00924 %/1000 HRS 27

BS-321 A

PARTS APPLICATION ANALYSIS

CAPACITORS

PROJECT: ALSEP

ASSEMBLY: PDU SUBASSEMBLY: Power Dump

DATE: 8-13-71

SCHEMATIC NO: 2362228

(Capacitors)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 CAPACITANCE VALUE &/or SIZE	5 TOLERANCE %	6 MANUFACTURER'S RATED VOLTAGE	OPERATING VOLTAGE DC	OPERATING VOLTAGE PEAK AC	7 VOLTAGE RATIO, OPERATING/ RATED	8 MAXIMUM DUTY CYCLE %	9 BULK AIR TEMPERATURE (°C)	10 CIRCUIT FUNCTION OR APPLICATION	11 BASIC FAILURE RATE (%/1000 HRS) AT 50°C TO 125°C (SEE BELOW)	12	13 SPECIAL ENVIRONMENT (DEFINE) FAILURE RATE MULTIPLIER	14 FINAL FAILURE RATE	15 TOTAL CAPACITOR COUNT PER TYPE	16 TOTAL FAILURE RATE (%/1000 HRS)
C1	CSR	Sprague	1.0	±10	10	5	5	0.5	100	65	+ 5V Storage	.065	A	.01			.000656
C2	CSR	Sprague	1.0	±10	10	5	5	0.5	100	65	+ 5V Storage	.065	A	.01			.000655

FOR USE OF RELIABILITY DEPT

20 FAILURE RATE SOURCES (FOR COLUMN #14)

A ATM 605A B

C D

21 CALCULATED MTBF HRS

22 TOTAL FAILURE RATE .001312 %/1000 HRS

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP DATE: 6/30/71

ASSEMBLY: PDU SUB ASSEMBLY: Mother Board SCHEMATIC NO:

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)	5 TOLERANCE (%)	6 POWER RATING (WATTS)	7 MAXIMUM OPERATING POWER (WATTS)	8 POWER RATIO OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) AT 25°C	13 SOURCE (SEE BELOW)	14 SPECIAL ENVIRONMENTS (DEFINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	16 TOTAL RESISTOR COUNT PER TYPE	17 TOTAL FAILURE RATE (%/1000 HRS)
R1	RNR55E2051FS	MEPCO	2.05K	1	.1	.01	10%		65°C	Circuit Breaker Holding Circuit	.173	A			.001		.000173
R2	RNR55E2051FS	MEPCO	2.05K	1	.1	.01	10%		65°C	Circuit Breaker Holding Circuit	.173	A			.001		.000173
																	.000346

FOR USE OF RELIABILITY DEPT

19 FAILURE RATE SOURCES (FOR COLUMN #14)

A ATM 605A B

C D

20 CALCULATED MTBF HRS

21 TOTAL FAILURE RATE .000346 %/1000 HRS

Form 9251

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP

ASSEMBLY: PDU

SUB ASSEMBLY: Mother Board

DATE: 6/30/71

SCHEMATIC NO: 2362217

(Semiconductors)

CKT SYM NO. 1	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY 2	MANUFACTURER 3	MAX. TEMP °C: AMBIENT ACTUAL T_A 4	MAX. TEMP °C: JUNCTION RATED T_J 5	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C 6	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT 7	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE 8	AVG PWR DISSIPATION (mw): ACTUAL: AMBIENT T_A 9	AVG PWR DISSIPATION (mw): ACTUAL: CASE T_C 10	AVG PWR DISSIPATION (mw): ACTUAL 11	POWER RATIO: ACTUAL/RATED 25°C (Amb.or case) 12	POWER RATIO: ACTUAL/RATED T_A or T_C 13	MAXIMUM VOLTAGES: V_{CBO} RATED V 14	MAXIMUM VOLTAGES: V_{CB} ACTUAL V 15	MAXIMUM VOLTAGES: V_{CEO} RATED V 16	MAXIMUM VOLTAGES: V_{CE} ACTUAL V 17	DIODE PIV: RATED V 18	DIODE PIV: ACTUAL V 19	CIRCUIT FUNCTION or APPLICATION 20	PART SPECIAL ENVIRONMENT (Define) 21	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) 22	SOURCE (See below) 23	FAIL. RATE 24	MULTIPLIER 25	FINAL FAIL. RATE (%/1000 HRS) 26	TOTAL COUNT PER TYPE 26	TOTAL FAILURE RATE (%/1000 HRS) 27
CR-1	2360376-1	Unit-rode	65°C			2320				10	.4%						100	5			.0001	A					.0001
CR-2	2360376-1	Unit-rode	65°C			2320				10	.4%						100	5			.0001	A					.0001

28 FAILURE RATE SOURCE (See Column 23)

A ATM 605 A C

B D

29 NOTE: It is assumed the transient and peak power does not exceed the safe limit.

30 TOTAL FAILURE RATE .0002 %/1000 HRS.

9949A

BS-321A

PARTS APPLICATION ANALYSIS

CAPACITORS

(Capacitors)

PROJECT: ALSEP DATE: 1-26-71

ASSEMBLY: PDU SUBASSEMBLY: Mother Board SCHEMATIC NO: 2362217

1 Circuit Symbol Number	2 Type Designation (Mil. or Mfr) and Construction	3 Manufacturer	4 Capacitance Value mfd	4 Tolerance %	5 Manufacturer's Rated Voltage	6 Operating Voltage DC	6 Operating Voltage Peak AC	7 Voltage Ratio: Operating/Rated	8 Maximum Duty Cycle	9 Bulk Air Temperature (°C)	10 Circuit Function or Application	11 Basic Failure Rate (%/1000 Hrs) At 25°C Derated Below	12 Special Environment (Describe)	13 Failure Rate Multiplier	14 Final Failure Rate	15 Total Capacitor Count Per Type	16 Total Failure Rate (%/1000 Hrs)
C1	CLR25BK700TGP	GE	70µf	+50 -15	75	30	30	40%	1%	65	Voltage Reserve for Relay Operation	.05 A		.1		1	.005
C2	CLR25BK700TGP	GE	70µf	+50 -15	75	30	30	40%	<1%	65	Voltage Reserve for Relay Operation	.05 A		.1		1	.005
C3	2346240-12	Sprague	33µf	±10	10	5	5	50%		65	Circuit Breaker	.0656 A		.01			.000656
C4	2346240-12	Sprague	33µf	±10	10	5	5	50%		65	Holding Circuit	.0656 A		.01			.000656

FOR USE OF RELIABILITY DEPT.

20 FAILURE RATE SOURCES (FOR COLUMN #14)
A ATM 605A B
C D

21 CALCULATED MTBF 10^{12} HRS

22 TOTAL FAILURE RATE .011312 % 1000 HRS

BS-321A

PARTS APPLICATION ANALYSIS

(MISC. PARTS)

PROJECT: ALSEP - E
ASSEMBLY: PDU
SUB ASSEMBLY: Mother Board
DATE: 1-26-71
SCHEMATIC NO: 2362217

(Misc. Parts)

CIRCUIT SYMBOL NUMBER (1)	TYPE DESIGNATION (CEC, MIL OR MFR) and CONSTRUCTION (2)	MANUFACTURER (3)	TEMPERATURE RANGE MAX (4)	TEMPERATURE RANGE MIN (5)	ELECTRICAL STRESS RATED (6)	ELECTRICAL STRESS USE (7)	PERCENT DUTY CYCLE (8)	MAJOR CHARACTERISTICS and APPLICATION (9)	FOR RELIABILITY USE ONLY: BASIC FAILURE RATE (%/1000 HOURS) at ___°C (10)	SOURCE (SEE #15) (11)	PART SPECIAL ENVIRONMENT (DEFINE) (12)	FAILURE RATE MULTIPLIER (13)	TOTAL FAILURE RATE (%/1000 HOURS) (14)
F1	2346200-14	Little-			.5		< 1	For 310 mA line PDM Power Control	.01	D		.098	.00098
F2	2346200-15	Fuse			.66		< 1	For 665 mA line PDM Power Control					.00098
F3	2346200-15				.3		>99	PSE/ASE/ EXP #6					.00098
F4	2346200-15				.3		< 1	6					.00098
F5	2346200-15				.2		>99	217 mA 3					.00098
F6	2346200-15				.1		< 1	103 3					.00098
F7	2346200-15				.30		>99	310 4					.00098
F8	2346200-15				.00		< 1	0.0 4					.00098
F9	2346200-15				.34		>99	338 5					.00098
F10	2346200-15				.14		< 1	145 5					.00098
F11	2346200-15				.30		>99	310 1					.00098
F12	2346200-15	"			.14		< 1	148 1	"	"		"	.00098
F14	2346200-15	Little-			.48		>99	483 2					.00098
F15	2346200-15	Fuse			.41		< 1	279/414 mA 2	.01	D		.098	.00098

(15) FAILURE RATE SOURCES (FOR COLUMN 11)
A. _____ B. _____
C. _____ D. Mil Std 217 Chart XXIV

(16) CALCULATED MTBF _____ HOURS

(17) TOTAL FAILURE RATE .01372 %/1000 HOURS

DRD Form 9258

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP - E
ASSEMBLY: PDU
SUB ASSEMBLY: TELEMETRY
DATE: 1-29-71
SCHEMATIC NO: 2362271

(Semiconductors)

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	MAX. TEMP °C: JUNCTION RATED T_J (5)	MAX. TEMP °C: CASE ACTUAL HOT SPOT T_C (6)	AVG PWR DISSIPATION (mw): RATED AT 25°C: AMBIENT (7)	AVG PWR DISSIPATION (mw): RATED AT 25°C: CASE (8)	AVG PWR DISSIPATION (mw): ACTUAL: AMBIENT T_A (9)	AVG PWR DISSIPATION (mw): ACTUAL: CASE T_C (10)	AVG PWR DISSIPATION (mw): ACTUAL (11)	POWER RATIO: ACTUAL RATED 25°C (Amb. or case) (12)	POWER RATIO: ACTUAL T_A or T_C RATED (13)	MAXIMUM VOLTAGES: V_{CBO} RATED V (14)	MAXIMUM VOLTAGES: V_{CB} ACTUAL V (15)	MAXIMUM VOLTAGES: V_{CEO} RATED V (16)	MAXIMUM VOLTAGES: V_{CE} ACTUAL V (17)	DIODE PIV: RATED V (18)	DIODE PIV: ACTUAL V (19)	CIRCUIT FUNCTION or APPLICATION (20)	PART SPECIAL ENVIRONMENT (Define) (21)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) (22)	FOR RELIABILITY USE ONLY: SOURCE (See below) (23)	FOR RELIABILITY USE ONLY: FAIL. RATE (24)	FOR RELIABILITY USE ONLY: MULTIPLIER (25)	FOR RELIABILITY USE ONLY: FINAL FAIL. RATE (%/1000 HRS) (25)	FOR RELIABILITY USE ONLY: TOTAL COUNT PER TYPE (26)	FOR RELIABILITY USE ONLY: TOTAL FAILURE RATE (%/1000 HRS) (27)
CR1 CR2	S1N645	GI TRW	65	150		600				71	11.8%						225	29	Isolation		$.5 \times 10^{-5}$	A				2	.00160
CR3 CR4																												
CR5 CR6																												
CR7 CR8																												
CR9 CR10																												
CR11 CR12																												
VR1 VR2	S1N757A	TI		175		400				< 1	< 1%						9.1	4.48	Voltage Limiting		258	A				2	.00516
VR3 VR4																												

(28) FAILURE RATE SOURCE (See Column 23)
A ATM 605 A C
B D

(29) NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE .01992 %/1000 HRS.

9340a

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP - E
ASSEMBLY: PDU
SUB ASSEMBLY: TELEMETRY
DATE: 1-28-71
SCHEMATIC NO: 2362271

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)	5 TOLERANCE (%)	6 POWER RATING (WATTS)	7 MAXIMUM OPERATING POWER (WATTS)	8 POWER RATIO OPERATING/ RATED	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) @ 25°C	13 SOURCE (SEE BELOW)	14 SPECIAL ENVIRONMENTS (DEFINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R1	RNR55E1913FS	MEPCO	191K	1%	100	4	4%	100%	65	Operation Identification	.172	A		.001		1	.000172
R2	RNR55E9312FS		93.1K			9	9%				.172						.000172
R3	RNR55E4422FS		44.2K			16	16%				.172						.000172
R5	RNR55E2102FS		21K			33	33%				.199						.000199
R6	RNR55E1912FS		191K			4	4%				.172						.000172
R7	RNR55E9312FS		93.1K			9	9%				.172						.000172
R8	RNR55E4422FS		44.2K			16	16%				.172						.000172
R10	RNR55E2102FS		21K			33	33%				.199						.000199
R11	RNR55E1912FS		191K			4	4%				.172						.000172
R12	RNR55E9312FS		93.1K			9	9%				.172						.000172
R13	RNR55E4422FS		44.2K			16	16%				.172						.000172
R15	RNR55E2102FS		21K			33	33%				.199						.000199
R16	RNR55E4422FS		44.2K			16	16%				.172						.000172
R17	RNR55E2102FS		21K			33	33%				.199						.000199
R19	RNR55E2102FS		21K			33	33%				.199						.000199
R20	RNR55E1182FS		11.8K			2.4	2.4%				.172						.000172

FOR USE OF RELIABILITY DEPT

19 FAILURE RATE SOURCES (FOR COLUMN #14)
A ATM 605 A B
C D

20 CALCULATED MTBF _____ HRS

21 TOTAL FAILURE RATE .002887 %/1000 HRS

FORM 9881
BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP - E
ASSEMBLY: PDU
SUB ASSEMBLY: TELEMETRY
DATE: 1-28-71
SCHEMATIC NO: 2362271

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL OR MFR) AND CONSTRUCTION	3 MANUFACTURER	4 RESISTANCE VALUE (OHMS)	5 TOLERANCE (%)	6 POWER RATING (WATTS) MW	7 MAXIMUM OPERATING POWER (WATTS) MW	8 POWER RATIO, OPERATING/ RATED %	9 MAXIMUM DUTY CYCLE	10 BULK AIR TEMPERATURE °C	11 CIRCUIT FUNCTION OR APPLICATION	12 BASIC FAILURE RATE (%/1000 HRS) AT 50°C SOURCE (SEE BELOW)	13 FOR USE OF RELIABILITY DEPT	14 SPECIAL ENVIRONMENTS (DEFINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R4	RNR55E2051FS	MEPCP	2.05K	1%	100	10	10	100%	65	Line Voltage Reduction	.168 A			.001		1	.000168
R9																	
R14																	
R18																	

19 FAILURE RATE SOURCES (FOR COLUMN #14)
A ATM 605 A B
C D

20 CALCULATED MTBF HRS

21 TOTAL FAILURE RATE .00067 %/1000 HRS

FORM DES:
BS-321A