Bendix

Aerospace Systems Division

ALSEP Array E -
Parts Application Analysis -
Power Conditioning Unit

NO.	REV. NO.
ATM 957	
PAGE 1 OF 44	
DATE 6-1-71	

The purpose of this ATM is to document the results of the Parts Application Analysis study performed on the Power Conditioning Unit (PCU).

The PCU is completely redundant (except for the switching circuit) with the redundant modules in standby operation. A previous study provided that, by making the switching circuit redundant, reliability would not be sufficiently increased to justify the additional number of parts.

The stress levels shown were determined on the basis of electronic piece parts operating at their worst case values of resistance, capacitance, etc. and worst case application of voltage and current levels. The circuit board temperature was established at 70°C with no component exceeding the 100°C maximum temperature criteria for semiconductor junctions.

The attached summary sheet demonstrates that all parts (except 4 capacitors) are applied well within both ALSEP and Bendix established derating criteria. From the analysis, it can be concluded that the PCU is designed in a manner to ensure that the reliability and 2 year operational life requirements of the system have been met. The 4 capacitors are listed in Table 1.

This document reflects the design modifications discussed at the CDR of 6/14/71. These modifications include the following:

(a) Addition of 1 zener diode, 1 resistor and 4 hex inverters to the VR/APM module.

(b) Deletion of 11 wet tantalum capacitors from the Inverter Module.

(c) Modification of Output Filter which included addition of two 94 μfd. parallel capacitors to the +29V output line.

Prepared by L. S. Moskowitz
L. S. Moskowitz
ALSEP Reliability

Approved by S. J. Ellison
S. J. Ellison, Manager
ALSEP Reliability

PARTS APPLICATION ANALYSIS SUMMARY

PROJECT: ALSEP
ASSEMBLY: Central Station
SUB ASSEMBLY: PCU
DATE: 6-1-71
SCHEMATIC NO: _____

DEVICE TYPE	TOTAL NO. USED	TOTAL FAILURE RATE	COMMENTS
CAPACITORS	37	.00492	
RESISTORS	102	.00899	
DIODES	41	.05350	
TRANSISTORS	32	.11133	
RELAYS	2	.010	
TRANSFORMERS	6	.012	
THERMOSTATS	1	.0002	
COILS & CHOKES	7	.0014	
NAND Gate Pack	2	.0025	
IC Comparators	2	.0030	

TOTAL ASSEMBLY FAILURE RATE 0.10784 %/1000 HOURS

MEAN-TIME-TO-FAILURE _____ HOURS

MISSION SUCCESS PROBABILITY .981107 (single PCU)

Table I

A. PCU Discrete Parts Derating Summary

Stress	Quantity	Comments
0 - 12%	305	--
13 - 25%	12	--
26 - 35%	17	--
35 - 50%	31	--
51 - 60%	2	Solid Tantalum Capacitor
61 - 70%	4	Allowed 60% - See Note 1

B. PCU Integrated Circuit Load Levels

Load Level	Quantity
0 - 10%	3
11 - 20%	3
21 - 30%	4
41 - 50%	0
51 - 60%	0
61 - 70%	0
71 - 80%	0

Note 1: C4, C5, C25 and C26 in the Output Filter Module operates at 64% of rated stress compared with 60% allowable. This is considered acceptable since the increase in failure is significantly less than adding 4 more capacitors.

PARTS APPLICATION ANALYSIS

CAPACITORS

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUBASSEMBLY:** Switching Module **SCHEMATIC NO:** 2368141

(Capacitors)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 CAPACITANCE VALUE mfd	5 TOLERANCE %	6 MANUFACTURER'S RATED VOLTAGE	7 OPERATING VOLTAGE DC	7 OPERATING VOLTAGE PEAK AC	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) AT 25°C (SEA LEVEL)	13 SOURCE	14 SPECIAL ENVIRONMENT (DEFINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE	17 TOTAL CAPACITOR COUNT PER TYPE	18 TOTAL FAILURE RATE (% / 1000 HRS)
C1	CKR12BX103KM/S	Aerovox	.01	10	100	15		15%		75	Filter	.005	A		.01			.00005
C2	CKR12BX103KM/S	Aerovox	.01	10	100	15		15%			Filter	.005	A		.01			.00005
C3	137D826X9050	Sprague	94	10	50	15		30%			Relay Drive	.020	A		.01			.00020
C4	137D826X9050	Sprague	94	10	50	15		30%			Relay Drive	.020	A		.01			.00020
C5	137D826X9050	Sprague	94	10	50	15		30%			Relay Drive	.010	A		.01			.00020
C6	137D826X9050	Sprague	94	10	50	15		30%			Relay Drive	.020	A		.01			.00020
C7	137D826X9050	Sprague	94	10	50	15		30%			Relay Drive	.020	A		.01			.00020
C8	CSR13G105KM/S	Kemet Sprague	1.0	10	50	3		6%			Relay Drive	.007	A		.01			.00007
C9	CSR13G335KM/S	Kemet Sprague	3.3	10	50	15		30%			300 MS Time Delay	.0148	A		.01			.00014
C10	CKR12BX103KM/S	Aerovox	.01	10	100	15		15%		75	Filter	.005	A		.01			.00005

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 .00136 % / 1000 HRS

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Switching Module **SCHEMATIC NO:** 2368141

(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 T_A or T_C / 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)
Q1	2N2907A	Mot Ray TI	60	200		400	1800			* 45	11%		60		40	32			Set PCU I			A					.0067
Q2	2N2907A	Mot Ray TI	60	200		400	1800			* 45	11%		60		40	32			Set PCU II			A					.0067
Q3	2N2907A	Mot Ray TI	60	200		400	1800			.77	<1%		60		40	5			Auto I Select			A					.0047
Q4	2N2907A	Mot Ray TI	60	200		400	1800			.77	<1%		60		40	5			Auto 2 Select			A					.0047
Q5B	2N2060	Mot Ray TI	60	200		500	860			* 14	2.8%		100		80	32			Auto 2 Relay Drive			A					.00195
Q5A	2N2060	Mot Ray TI	60	200		500	860			* 14	2.8%		100		80	32			Auto I Relay Drive			A					.00195
Q6A	2N2060	Mot Ray TI	60	200		500	860			3.36	<1%		100		80	32			Set I Relay Drive			A					.00195
Q6B	2N2060	Mot Ray TI	60	200		500	860			* .35	<1%		100		80	32			Set I Relay Drive			A					.00195
Q7A	2N2060	Mot Ray TI	60	200		500	860			3.36	<1%		100		80	32			Set II Relay Drive			A					.00195

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

* Power dissipation < 20 milliseconds
NOTE: It is assumed the transient and peak power does not exceed the safe limit.

TOTAL FAILURE RATE = .03255 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Switching Module **SCHEMATIC NO:** 2368141

(Semiconductors)

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT T_A (4)	MAX. TEMP °C: ACTUAL JUNCTION T_J (5)	MAX. TEMP °C: RATED JUNCTION T_J (5)	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 RATE (%/1000 HRS) (26)	TOTAL PER TYPE (27)	COUNT (27)	TOTAL FAILURE RATE (%/1000 HRS) (27)
Q7B	2N2060	Mot Ray TI	60	200		500	860			.35	<1%		100		80	32			Set 2 Relay Drive			A						.00195
Q8	2N2907A	Mot Ray TI	60	200		400	1800			.196	<1%		60		40	32			+12V OV Detect			A						.00470
Q9	2N2907A	Mot Ray TI	60	200		400	1800			.35	<1%		60		40	32			+12 V UV Detect			A						.00470
Q10	2N2907A	Mot Ray TI	60	200		400	1800			50	15%		60		40	32			Fault Relay Drive			A						.00670
Q11A	2N2060	Mot Ray TI	60	200		500	860			.09	<1%		100		80	24			+12 V OV			A						.00195
Q11B	2N2060	Mot Ray TI	60	200		500	860			.07	<1%		100		80	24			+12 V UV			A						.00195
Q12A	2N2060	Mot Ray TI	60	200		500	860			.245	<1%		100		80	30			+12 V Fault Detect			A						.00195
Q12B	2N2060	Mot Ray TI	60	200		500	860			.035	<1%		100		80	30			300 MS Time Delay			A						.00195
Q13	2N2222A	G.E TI	60	175		500	1800			.264	<1%		75		40	30			Fault Signal Relay			A						.00195

(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 .02780 %/1000 HRS.

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Switching Module **SCHEMATIC NO:** 2368141

(Semiconductors)

CKT SYM NO. (1)	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY (2)	MANUFACTURER (3)	MAX. TEMP °C: AMBIENT ACTUAL T_A (4)	MAX. TEMP °C: RATED JUNCTION 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)	AVG PWR DISSIPATION (mw): 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 (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 PER TYPE (28)	COUNT (29)	TOTAL FAILURE RATE (%/1000 HRS) (27)
Q14A	2N2060	Mot Ray TI	70	200		500	860			.08	<1%		100		80	12			+5 V Fault Detect			A						.00195
Q14B	2N2060	Mot Ray TI	70	200		500	860			.21	<1%		100		80	12			-12 V Fault Detect			A						.00195
CR1	IN645	GI TRW	70	150		600				16.8	2.8%						225	32	Relay Drive Isola-tion			A						.00127
CR2	IN645	GI TRW	70	150		600				.161	<1%						225	32	Relay Drive Isola-tion			A						.00114
CR3	UTR222	Uni-trode	70	175		2 watt				* 51.5	2.5%						500	0	Relay Drive Isola-tion			A						.00013
CR4	UTR222	Uni-trode	70	175		2 watt				* 52.5	2.5%						500	0	Relay Drive Isola-tion			A						.00013
CR5	IN645	GI TRW	70	150		600				3.5	<1%						225	0	Fault Detect Isola-tion			A						.00125
CR6	UTR222	Uni-trode	70	175		2 watt				* 49	2.5%						500	0	Switch-ing Isola-tion			A						.00013
CR7	IN645	GI TRW	70	150		600				1.05	<1%						225	0	Time Delay			A						.00125

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

(29) *Power Dissipation < 20 milliseconds
NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE .00920 %/1000 HRS.

9068A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Switching Module **SCHEMATIC NO:** 2368141

(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 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 FAIL RATE (%/1000 HRS) (25)	TOTAL COUNT PER TYPE (26)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR8	IN645	GI TRW	70	150		600				.245	<1%						225	11	Time Delay Isolation			A					.00125
VR1	2346295-1		70	175		* 3 watts				27	<1%							8.2	Set 12V Reference			A					.0035
VR2	SIN751A	Dick MOT	70	175		400				0.4	<1%							5.1	Voltage Protection			A					.0035
VR3	SIN751A	Dick MOT	70	175		400				0.4	<1%							5.1	Voltage Protection			A					.0035

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

(28) *Power Dissipation < 20 milliseconds
NOTE: It is assumed the transient and peak power does not exceed the safe limit.

(30) TOTAL FAILURE RATE: .01175 %/1000 HRS.

92698A

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP ARRAY E DATE: 6-1-71

ASSEMBLY: PCU SUB ASSEMBLY: Switching Module SCHEMATIC NO: 2368141

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 1/2 RATED POWER, 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	RWR81530R6PM/	RR Dale	80.6	1	1.0	.450	45%		75	Limit Current	.197	A		.01			.00197
R2	RWR81520R6PM/	PR Dale	80.6	1	1.0	.450	45%			Voltage Divider	.197	A		.01			.00197
R3	RNR55E2501PR/S	Mepco	2.49K	1	0.1	.0004	<1%			Voltage Divider	.170	A		.001			.00017
R4	RNR55E1502FR/S	Mepco	15K		0.1	.0004	<1%			Bias	.170	A		.001			.00017
R5	RNR55E1001FR/S	Mepco	1K	1	0.1	.0016	1.6%			Bias	.170	A		.001			.00017
R6	RNR55E1001FR/S	Mepco	1K	1	0.1	.0016	1.6%			Bias	.170	A		.001			.00017
R7	RNR55E1602FR/S	Mepco	30.1K	1	0.1	.0015	1.5%			Bias	.170	A		.001			.00017
R8	RNR55E1602FR/S	Mepco	30.1K	1	0.1	.0015	1.5%			Bias	.170	A		.001			.00017
R9	RNR55E1003FR/S	Mepco	100K	1	0.1	.0014	1.4%			Load Q6A	.170	A		.001			.00017
R10	RNR55E3011FR/S	Mepco	30.1K	1	0.1	.005	5%			Load Q6B	.170	A		.001			.00017
R11	RNR55E3011FR/S	Mepco	3.01K	1	0.1	.0048	4.8%			Bias	.170	A		.001			.00017
R12	RNR55E1003FR/S	Mepco	100K	1	0.1	.0014	1.4%			Load Q7A	.170	A		.001			.00017
R13	RNR55E3011FR/S	Mepco	30.1K	1	0.1	.0085	8.5%			Load Q7B	.170	A		.001			.00017
R14	RNR55E3011FR/S	Mepco	3.01K	1	0.1	.0014	1.4%			Load Q5A	.170	A		.001			.00017
R15	RNR55E5001FR/S	Mepco	4.99K	1	0.1	.0003	<1%			Load Q5B	.170	A		.001			.00017
R18	RNR55E5001FR/S	Mepco	4.99K	1	0.1	.0034	<1%			Bias	.170	A		.001			.00017
R19	RNR55E3000FR/S	Mepco	33.2K	1	0.1	.0001	2<1%		75	Bias	.170	A		.001			.00017

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 .00659 %/1000 HRS

FORM 9031

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP ARRAY E DATE: 6-1-71

ASSEMBLY: PCU SUB ASSEMBLY: Switching Module SCHEMATIC NO: 2368141

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	12 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)
R20	RNR55E3000FR/S	Mepco	33.2K	1	0.1	.0004	<1%		75	Bias	.170	A						.00017
R21	RNR55E1002FR/S	Mepco	10K	1	0.1	.0018	1.8%			Bias	.170	A						.00017
R22	RNR55E1002FR/S	Mepco	10K	1	0.1	.0018	1.8%			Bias	.170	A						.00017
R23	RNR55E1002FR/S	Mepco	10K	1	0.1	.0016	1.6%			Bias	.170	A						.00017
R24	RNR55E1002FR/S	Mepco	10K	1	0.1	.00015	<1%			Voltage Divider	.170	A						.00017
R25	RNR55E1002FR/S	Mepco	10K	1	0.1	.00019	<1%			Bias	.170	A						.00017
R26	RNR55E30111FR/S	Mepco	3.01K	1	0.1	.00015	<1%			Bias	.170	A						.00017
R27	RNR55E4992FR/S	Mepco	49.9K	1	0.1	.0008	<1%			Limit Current	.170	A						.00017
R28	RNR55E4222FR/S	Mepco	42.2K	1	0.1	.0009	<1%			Bias	.170	A						.00017
R29	RNR55E4222FR/S	Mepco	10K	1	0.1	.0004	<1%			Bias	.170	A						.00017
R30	RNR55E4022FR/S	Mepco	40.2K	1	0.1	.0036	3.6%			Limit Current	.170	A						.00017
R31	RNR55E1001FR/S	Mepco	1K	1	0.1	.0002	<1%			Load Q12	.170	A						.00017
R32	RNR55E5012FR/S	Mepco	30.1K	1	0.1	.0056	5.6%			Bias	.170	A						.00017
R33	RNR55E1782FR/S	Mepco	17.8K	1	0.1	.0001	<1%			Bias	.170	A						.00017
R34	RNR55E9311FR/S	Mepco	9.31K	1	0.1	.00025	<1%			Bias	.170	A						.00017
R35	RNR55E1501FR/S	Mepco	1.5K	1	0.1	.020	20%			Bias	.170	A						.00017
R36	RNR55E4752FR/S	Mepco	47.5K	1	0.1	.0017	1.7%			Bias	.170	A						.00017
R37	RNR55E1003FR/S	Mepco	100K	1%	0.1	.0016	1.6%		75	Bias	.170	A						.00017

19 FAILURE RATE SOURCES (FOR COLUMN #14)

A ATM 605A B _____

C _____ D _____

20 CALCULATED MTBF _____ HRS

21 TOTAL FAILURE RATE .00306 %/1000 HRS

FORM 9091

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

PROJECT: ALSEP DATE: 6-1-71

ASSEMBLY: PCU SUB ASSEMBLY: Switching Module SCHEMATIC NO: 2368141

(Resistors)

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)
R38	RNR55E3832FR/S	Mepco	38.3K	1	0.1	.00023	<1%		75	Bias	.170	A		.001			.00017
R39	RNR55E3832FR/S	Mepco	38.3K	1	0.1	.0005	<1%			Bias	.170			.001			.00017
R40	RNR55E3011FR/S	Mepco	100K	1	0.1	.0002	<1%			Bias	.170			.001			.00017
R41	RNR55E3832FR/S	Mepco	38.3K	1	0.1	.0004	<1%			Bias	.170			.001			.00017
R42	RNR55E3011FR/S	Mepco	100K	1	0.1	.00006	<1%			Load Q14A	.170			.001			.00017
R43	RNR55E3011FR/S	Mepco	100K	1	0.1	.00006	<1%			Bias	.170			.001			.00017
R44	RNR55E3011FR/S	Mepco	100K	1	0.1	.0003	<1%			Load Q12A	.170			.001			.00017
R45	RNR55E3011FR/S	Mepco	100K	1	0.1	.0003	<1%			Bias	.170			.001			.00017
R46	RNR55E1152FR/S	Mepco	16.5K	1	0.1	.0007	<1%			Bias	.170			.001			.00017
R47	RNR55E1501FR/S	Mepco	10K	1%	0.1	.00016	<1%			Bias	.170			.001			.00017
R15	RWR8151780FR	Dale	178	1	1.0	.368	*36%			Limit Current	.178			.01			.00178
R16	RWR8151780FR	Dale	178	1	1.0	.368	*36%		75	Limit Current	.178	A		.01			.00178

FOR USE OF RELIABILITY DEPT.

19 FAILURE RATE SOURCES (FOR COLUMN #14)

A ATM 605 B

C D

20 * Lower Dissipation Less Than 20ms.

CALCULATED MTBF HRS

21 TOTAL FAILURE RATE .00526 %/1000 HRS

FORM 9291

BS-321A

PARTS APPLICATION ANALYSIS

(RELAYS)

PROJECT: ALSEP

ASSEMBLY: PCU

SUB ASSEMBLY: Switching Module

DATE: 6-1-71

SCHEMATIC NO: 2368141

(Relays)

1 CIRCUIT REFERENCE DESIGNATION	2 TYPE DESIGNATION (CEC, MIL OR MFR) AND CONSTRUCTION	3 MANUFACTURER	CONTACT LOAD: 4 RATED VOLTAGE V	5 RATED CURRENT A	6 ACTUAL VOLTAGE STEADY STATE V	7 ACTUAL VOLTAGE PEAK V	8 ACTUAL CURRENT STEADY STATE A	9 ACTUAL CURRENT SURGE A	10 TYPE OF LOAD	NUMBER OF POLES: 11 TOTAL	12 ACTIVE	RELAY COIL: 13 POWER MAX. RATED	14 POWER ACTUAL	15 VOLTAGE MAX. PULL IN	16 VOLTAGE MIN. OPER.	17 RATE OF OPERATIONS PER HOUR OR SECOND	18 REQ'D LIFE OPERATIONS	19 MISCELLANEOUS REMARKS	20 FAILURE RATE BASIC (%/1000 HRS)	21 SOURCE OF F.R. (SEE BELOW)	22 F.R. MODIFIER	23 TOTAL FAILURE RATE (%/1000 HOURS)
K1	2346264-1 (422-12)	Teledyne	12	10	0	12	1	0	Power Input	2	2		7508	49.1		Less Than 1			A			.005

DEVICE AVERAGE AMBIENT TEMPERATURE °C (24)

FAILURE RATE SOURCES (FOR COLUMN NO. 21) (25): A MIL-STD-217A B ____ C ____ D ____

CALCULATED MTBF ____ HOURS (26)

TOTAL FAILURE RATE .005 %/1000 HRS (27)

BS-321 A

PARTS APPLICATION ANALYSIS

CAPACITORS

PROJECT: ALSEP ARRAY E
ASSEMBLY: PCU
SUBASSEMBLY: Inverter Module
DATE: 6-1-71
SCHEMATIC NO: 2368161

(Capacitors)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 CAPACITANCE VALUE mfd	5 TOLERANCE %	6 MANUFACTURER'S RATED VOLTAGE	7 OPERATING VOLTAGE DC	7 OPERATING VOLTAGE PEAK AC	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) AC-DC-RC (SEE BELOW)	13 SPECIAL ENVIRONMENT (DEFINE)	14 FAILURE RATE MULTIPLIER	15 FINAL FAILURE RATE	16 TOTAL CAPACITOR COUNT PER TYPE	17 TOTAL FAILURE RATE (% /1000 HRS)
C1	CKR12BX103KR	Aerovox	.01	10	100	32		32%		75°	Timing	.006 A	.01				.00006
C2	CKR12BX103KR	Aerovox	.01	10	100	32		32%			Timing	.006 A	.01				.00006
C3	CSR13G564KR	Kemet	.56	10	50	3		6%			Timing	.007 A	.01				.00007
C4	CSR13G564KR	Kemet	.56	10	50	3		6%			Timing	.007 A	.01				.00007
C8	137D946X9050A2	Sprague	94	10	50	16		32%			Storage	.020 A	.01				.00020
C20	137D946X9050A2	Sprague	94	10	100	16		32%		75°	Storage	.020 A	.01				.00020

FOR USE OF RELIABILITY DEPT ONLY

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

21 CALCULATED MTBF _____ HRS

22 TOTAL FAILURE RATE .00066 % 1000 HRS

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP ARRAY E DATE: 6-1-71

ASSEMBLY: PCU SUB ASSEMBLY: Inverter Module SCHEMATIC NO: 2368161

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)	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	RNR55E1002FR/S	Mepco	10K	1	0.1	.002	2%		75	Limit Current	.165	A		.001			.000165
R2	RNR55E1002FR/S	Mepco	10K	1	0.1	.002	2%			Limit Current	.165	A		.001			.000165
R3	RNR55E3012FR/S	Mepco	30.1K	1	0.1	.008	8%			Voltage Divider	.165	A		.001			.000165
R4	RNR55E3012FR/S	Mepco	30.1K	1	0.1	.008	8%			Voltage Divider	.165	A		.001			.000165
R5	RNR55E3011FR/S	Mepco	3.01K	1	0.1	.008	8%			Bias	.165	A		.001			.000165
R6	RNR55E3011FR/S	Mepco	3.01K	1	0.1	.008	8%			Bias	.165	A		.001			.000165
R7	RWR8052R5FM/S	Dale	82.5	1	2	.6	33%			Limit Current	.124	A		.001			.000124
R8	RWR8052R5FM/S	Dale	82.5	1	2	.6	33%			Limit Current	.124	A		.001			.000124
R9	RNR55E4990FR/S	Mepco	499	1	2	.5	25%			Limit Current	.194	A		.001			.000194
R10	RNR55E4990FR/S	Mepco	499	1	2	.5	25%			Limit Current	.194	A		.001			.000194
R11	RWR8052R74FM/S	Dale	2.74	1	2	.7	37%			Limit Current	.158	A		.001			.000158
R12	RWR8052R74FM/S	Dale	2.74	1	2	.7	37%		75	Limit Current	.158	A		.001			.000158

FOR USE OF RELIABILITY DEPT

19 FAILURE RATE SOURCES (FOR COLUMN #16)

A ATM 605A B _____

C _____ D _____

20 CALCULATED MTBF _____ HRS

21 TOTAL FAILURE RATE .001942 %/1000 HRS

FORM 9201

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E
DATE: 6-1-71
ASSEMBLY: PCU
SUB ASSEMBLY: Inverter Module
SCHEMATIC NO: 2368161

(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 PER TYPE	COUNT	TOTAL FAILURE RATE (%/1000 HRS)
Q1	2N2419B	GE	70	175		300				9	< 1%					32			Starter			A						.0022
Q2	2N2419B	GE	70	175		300				9	< 1%					32			Starter			A						.0022
Q3	2N3263 2330040-2	RCA	70	200		75 watts				700	< 1%		150		90	32			Inverter			A						.00390
Q4	2N3263 2330040-2	RCA	70	200		75 watts				700	< 1%		150		90	32			Inverter			A						.00390
Q5	2N3263 2330040-2	RCA	70	200		75 watts				700	< 1%		150		90	32			Inverter			A						.00390
Q6	2N3263 2330040-2	RCA	70	200		75 watts				700	< 1%		150		90	32			Inverter			A						.00390
CR1	SIN5417	Sem-tech	70	200		3300				8	< 1%						200	32	Timing			A						.00140
CR2	SIN5417	Sem-tech	70	200		3300				8	< 1%						200	32	Timing			A						.00140
CR3	SIN5417	Sem-tech	70	200		3300				400	12%						100	2.2	Timing			A						.00021

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 .02301 %/1000 HRS.

PE-62A

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP DATE: 6-1-71

ASSEMBLY: PCU SUB ASSEMBLY: Inverter Module SCHEMATIC NO: 2368161

(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 28	TOTAL FAILURE RATE (%/1000 HRS) 27
CR4	SIN5417	Sem.	70	200		3300				400	12%							100	2.2	Timing			A					.00021

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 .00021 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

(INDUCTORS & TRANSFORMERS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Inverter Module **SCHEMATIC NO:** 2368161

(Inductors & Transformers)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL. or MFR) AND CONSTRUCTION	3 MANUFACTURER	CONSTRUCTION 4 TYPE OF CASE (SEE BELOW)	5 WIRE SIZE, PRIMARY	6 WIRE SIZE, SECONDARY	7 INSULATION CLASS	8 VA RATING	9 INDUCTANCE AT RATED CUR.	10 SPECIFIED FREQ	11 MISCELLANEOUS	TEMPERATURE (°C) 12 OPERATING AMBIENT (HOT SPOT (SURFACE))	13 RISE (AR METHOD)	14 EST. ACTUAL RISE	15 OPERATING TEMP MAX.	16 ACTUAL	PRIMARY CURRENT 17 RATED	18 PRIMARY VOLTAGE	19 NO. WINDINGS	SECONDARY 20 WINDING NO.	21 VOLTAGE	22 WINDINGS	23 VOLTS	HIPOT READING 24	25 BASIC FAILURE RATE (%/1000 HRS) λ_Z	26 SOURCE (SEE BELOW)	27 TOTAL FAILURE RATE (%/1000 HRS)
																									REL. DEPT USE ONLY		
T1	2346226-1	O. Schott													16	10			3.2					A	.002
T2	2346226-1	O. Schott													16	10			3.2					A	.002

28 TYPE OF CASE
A. HER. SEAL
B. VAC. IMP.
C. ENCAP.
D. OPEN

29 FAILURE RATE SOURCES (FOR COLUMN #26)
A. ATM 605A B. _____
C. _____ D. _____

30 CALCULATED MTBF _____ HRS

31 TOTAL FAILURE RATE .004 %/1000 HRS

NHB Form 9248

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Transformer-Rectifier Module **SCHEMATIC NO:** 2368121

(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)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL RATE (%/1000 HRS) (26)	TOTAL (27)	COUNT PER TYPE (28)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR1	11D479-0684	TRW	70	175		2580				960	37%						100	29	Line Iso-lation		.00041	A						.00041
CR2	11D479-0684	↑	70	175		2580				960	37%						100	29	Line Iso-lation		.00041	A						.00041
CR3	11D479-0684		70	175		2580				960	37%						100	29	Line Iso-lation		.00041	A						.00041
CR4	11D479-0684		70	175		2580				960	37%						100	29	Line Iso-lation		.00041	A						.00041
CR5	SIN5417		70	200		3300				40	1.5%						100	12	Line Iso-lation		.00022	A						.00022
CR6	2368190-1 SIN5417		70	200		3300				84	3%						100	12	Line Iso-lation		.00023	A						.00023
CR7	2368190-2 11D479-0684		70	175		2580				108	4%						100	5	Line Iso-lation		.00023	A						.00023
CR8	2368190-2 11D479-0684	↓	70	175		2580				108	4%						100	5	Line Iso-lation		.00023	A						.00023
CR9	2368190-1 SIN5417	TRW	70	200		3300				84	3%						100	12	Line Iso-lation		.00023	A						.00023

(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 .00278 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Transformer/Rectifier Module **SCHEMATIC NO:** 2368121

(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)	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) (26)	FOR RELIABILITY USE ONLY: TOTAL PER TYPE (27)	FOR RELIABILITY USE ONLY: COUNT (28)	TOTAL FAILURE RATE (%/1000 HRS) (29)
CR10	SIN5417	TRW	70	200		3300				40	1.5%						100	-12	Line Isolation			A						.00022
CR11	2368190-1 SIN5417	↑	70	200		3300				40	1.5%						100	-12	↑			A						.00022
CR12	2368190-1 SIN5417		70	200		3300				84	3%						100	+12				A						.00023
CR13	2368190-2 11D479-0684		70	200		3300				108	4%						100	5				A						.00023
CR14	2368190-2 11D479-0684		70	200		3300				108	4%						100	5				A						.00023
CR15	2368190-1 SIN5417		70	200		3300				84	3%						100	12				A						.00023
CR16	2368190-1 SIN5417		70	200		3300				40	1.5%						100	-12				A						.00022
CR17	SIN 5417		70	200		3300				.5	<1%						100	-12				A						.00021
CR18	SIN 5417	TRW ↓	70	200		3300				.5	<1%						100	12	Line Isolation ↓			A						.00021

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

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

(29) TOTAL FAILURE RATE .00200 %/1000 HRS.

BS-321A

(Semiconductors)

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Transformer/Rectifier **SCHEMATIC NO:** 2368121

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)	FAIL. RATE (%/1000 HRS) (26)	TOTAL PER TYPE (27)	COUNT (28)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR19	SIN 5417	TRW	70	200		3300				.5	< 1%							100	5	Line Isolation			A						.00021
CR20	↑	↑	70	200		3300				.5	< 1%							100	-12	↑			↑						.00021
CR21	↓	↓	70	200		3300				.5	< 1%							100	12	↓			↓						.00021
CR22	SIN 5417	TRW	70	200		3300				.5	< 1%							100	5	Line Isolation			A						.00021

(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 .00084 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

(INDUCTORS & TRANSFORMERS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Transformer/Rectifier Module **SCHEMATIC NO:** 2368121

(Inductors & Transformers)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	CONSTRUCTION 4 TYPE OF CASE (SEE BELOW)	5 WIRE SIZE, PRIMARY	6 WIRE SIZE, SECONDARY	7 INSULATION CLASS	8 VA RATING	9 INDUCTANCE AT RATED CUR.	9 SPECIFIED FREQ	10 MISCELLANEOUS	11 OPERATING AMBIENT	TEMPERATURE (°C) 12 HOT SPOT (SURFACE)	13 RISE (AIR METHOD)	14 EST. ACTUAL RISE	15 OPERATING TEMP MAX.	16 ACTUAL	PRIMARY CURRENT 17 RATED	18 PRIMARY VOLTAGE	19 NO. WINDINGS	SECONDARY 20 WINDING NO.	21 VOLTAGE	22 WINDINGS	HIPOT READING 23 VOLTS	24	25 BASIC FAILURE RATE (%/1000 HRS) λ_b = $C_{\_\_\_}$ $\lambda_{\_\_\_}$	26 SOURCE (SEE BELOW)	27 TOTAL FAILURE RATE (%/1000 HRS)
																									REL. DEPT USE ONLY		
T1	2346228-1	O. Schott		18	22, 26, 30										4 amp		16			5 1-2					A	.002
T2	2346228-1	O. Schott		18	22, 26, 30										4 amp		16			5 1-2					A	.002

28 TYPE OF CASE
A. HER. SEAL
B. VAC. IMP.
C. ENCAP.
D. OPEN

29 FAILURE RATE SOURCES (FOR COLUMN #25)
A. ATM 605 A B. _____
C. _____ D. _____

30 CALCULATED MTBF _____ HRS

31 TOTAL FAILURE RATE .994 %/1000 HRS

BxA 321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP ARRAY E
ASSEMBLY: PCU
SUB ASSEMBLY: Shunt Regulator
DATE: 6-1-71
SCHEMATIC NO: 2368171

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)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R1	RNR55E2801FR/S	Mepco	2.8K	1	0.1	.0000	1<1%		75		Voltage Divider	.168	A		.001			.000168
R2	RNR55E1501FR/S		1.5K		0.1	.001	1%				Bias for Zener							
R6	RNR55E1001FR/S		1K		0.1	.0000	1 <1%				Freq. Comp.							
R7	RNR55E1501FR/S		1.5K		0.1	.0000	1 <1%				Load Q1							
R14	RNR55E4531FR/S		4.53K		0.1	.0001	< 1%				Voltage Divider							
R15	RNR55E1001FR/S		1K		0.1	.0000	5 <1%				Freq. Comp.							
R27	RNR55E4991FR/S		4.99K		0.1	.0000	5 <1%				Load Q2							
R29	RNR55E10002FR/S		10K		0.1	.0000	5 <1%				Load Q9							
R31	RNR55E4990FR/S		499		1.0	.0002	< 1%				Bias Q7							
R32	RNR55E4990FR/S		499		1.0	.0000	5 <1%				Load Q9							
R38	RNR55E10003FR/S		100		0.1	.0000	5 <1%				Freq. Comp.							
R39	RNR55E10002FR/S		10K		0.1	.0000	5 <1%				Bias Q9							
R3	RNR55E1001FR/S		1K		0.1	.004	1%				Bias Q2							
R16	RNR55E3011FR/S	↓	3.01K	↓	0.1	.001	1%		↓		Limits Current	↓	↓		↓			↓
R33	RNR55E3011FR/S	Mepco	3.01K	1	0.1	.001	1%		75		Limits Current	.168	A		.001			.000168

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 .002688 %/1000 HRS

Form 9221

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

(Semiconductors)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Shunt Regulator **SCHEMATIC NO:** 2368171

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_J or T_A / 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	SOURCE (See below) 23	FAIL. RATE 24	MULTIPLIER 25	FINAL FAIL. RATE (%/1000 HRS) 26	TOTAL PER TYPE 27	COUNT	TOTAL FAILURE RATE (%/1000 HRS) 27
Q1	S2N2222A	TI	70	175			1800			.0006	<1%						4.9			Amp.			A					.00510
Q2	SM2N2907A	Mot TI Ray	70	200			1800			.0021	<1%						12			Amp.								.00195
Q7	2368192-1	RCA	70	200			85 watts			16 watts	19%						12			Reg.								.00720
Q8	SM2N2907A	Mot TI Ray	70	200			1800			162	9%						12			Amp.								.01340
Q9	S2N2222A	TI	70	175			1800			.0016	<1%						12			Amp.								.00510
VR1	2346295-2	TRW GI	70	175			3 watts			30	1%						7.1			Ref.			A					.00335

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

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

24 TOTAL FAILURE RATE .03610 %/1000 HRS.

2368A

BS-321A

PARTS APPLICATION ANALYSIS

CAPACITORS

PROJECT: ALSEP ARRAY E
DATE: 6-1-71
ASSEMBLY: PCU
SUBASSEMBLY: Shunt Regulator
SCHEMATIC NO: 2368171

(Capacitors)

1 Circuit Symbol Number	2 Type Designation (Mil. or Mfr.) and Construction	3 Manufacturer	4 Capacitance Value mfd	5 Tolerance %	6 Manufacturer's Rated Voltage	7 Operating Voltage DC	7 Operating Voltage Peak AC	8 Voltage Rated/ Operating/ Rated	9 Maximum Duty Cycle	10 Bulk Air Temperature (°C)	11 Circuit Function or Application	12 Basic Failure Rate (%/1000 Hrs) at 50% Stress (See Below)	13	14 Special Environment (Defined)	15 Failure Rate Multiplier	16 Final Failure Rate	17 Total Capacitor Count Per Type	18 Total Failure Rate (%/1000 Hrs)
C1	CSR13G564KM/R	Kemet	1.0	10	50	1.5		3%		75	Freq. Comp.	.006	A		.01			.00006
C2	CKR13BX104KM/S	Aerovox	.01	10	100	10		10%		75	Freq. Comp.	.005	A		.001			.000005
C5	CKR13BX104KM/S	Aerovox	.01	10	100	14		14%		75	Freq. Comp.	.005	A		.001			.000005

FOR USE OF RELIABILITY DEPT. ONLY

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

21 CALCULATED MTBF _____ HRS

22 TOTAL FAILURE RATE .00007 % 1000 HRS

BS-321A

PARTS APPLICATION ANALYSIS

(MISC. PARTS)

PROJECT: ALSEP ARRAY E

DATE: 6-1-71

ASSEMBLY: PCU

SUB ASSEMBLY: Shunt Regulator

SCHEMATIC NO: 2368171

(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
RT2	2335661-2	Fenwal				5 mw	100	Senses regulator Temperature	.03	D		.01	.0003

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

16 CALCULATED MTBF _____ HOURS

17 TOTAL FAILURE RATE: .0003 %/1000 HOURS

DFD Form 9236

BS-321A

PARTS APPLICATION ANALYSIS

(MISC. PARTS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** APM **SCHEMATIC NO:** 2368171

(Misc. Parts)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (CEC, MIL OR MFR) and CONSTRUCTION	3 MANUFACTURER	4 TEMPERATURE RANGE MAX	5 TEMPERATURE RANGE MIN	6 ELECTRICAL STRESS RATED	7 ELECTRICAL STRESS USE	8 PERCENT DUTY CYCLE	9 MAJOR CHARACTERISTICS and APPLICATION	FOR RELIABILITY USE ONLY: 10 BASIC FAILURE RATE (%/1000 HOURS) at ___°C	11 SOURCE (SEE #15)	12 PART SPECIAL ENVIRONMENT (DEFINE)	13 FAILURE RATE MULTIPLIER	14 TOTAL FAILURE RATE (%/1000 HOURS)
S1	2345265-2	TI Klixon	80°F	60°F	5 amp	Ext-Int Dump	< 1%	External power dump at 80°F and internal dump at 60°F	.02	A		.01	.0002
RT1	2335661-2	Fenwal				5mw	100	Temperature Sensing	.03	A		.01	.0003

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

16 CALCULATED MTBF _____ HOURS

17 TOTAL FAILURE RATE .0005 %/1000 HOURS

DRD Form 9234

BS-321A

PARTS APPLICATION ANALYSIS

CAPACITORS

PROJECT: ALSEP ARRAY E

DATE: 6-1-71

ASSEMBLY: PCU

SUBASSEMBLY: APM

SCHEMATIC NO: 2368171

(Capacitors)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 CAPACITANCE VALUE mfd	5 TOLERANCE %	6 MANUFACTURER'S RATED VOLTAGE	7 OPERATING VOLTAGE DC	7 OPERATING VOLTAGE PEAK AC	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) AT 25°C (SEE BELOW)	13 SOURCE	14 SPECIAL ENVIRONMENT (DESIGNS)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE	17 TOTAL CAPACITOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
C3	CKR13BX104KM/S	Aerovox	0.1	10%	50	15.5		33%		75	Freq. Comp.	.040	A		.001			.00004
C4	CSR136X102KM/S	Kemet Sprague	1.0	10%	50	5		5%			Filter	.006	A		.001			.0000006
C6	CSR136102KM/S	Kemet Sprague	1.0	10%	50	5		10%			Filter	.006	A		.001			.000006
C7	CKR12BX103KM/S	Aerovox	0.01	10%	100	5		5%			Filter	.005	A		.001			.000005
C8	CSR13G562KR/S	Kemet Sprague	5.6	10%	50	16		32%		75	Freq. Comp.	.040	A		.001			.00004

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 .000085 % 1000 HRS

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP ARRAY E DATE: 6-1-71

ASSEMBLY: PCU SUB ASSEMBLY: APM SCHEMATIC NO: 2368171

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 (DESTINE)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R5	RNR55E1001FR/S	Mepco	1K	1	0.1	.00005	<1%	75		Load Q4	.167	A		.001			.000167
R8	RNR55E9092FR/S		90.9K			.00005	<1%			Voltage Divider	.167						.000167
R9	RNR55E2001FR/S		2K			.001	1%			Deleted	.167						.000167
R10	RNR55E1502FR/S		15K			.00005	<1%			Bias	.167						.000167
R11	RNR55E1501FR/S		1.5K			.001	1%			Load Q3	.167						.000167
R12	RNR55E1002FR/S	Mepco	10K		0.1	.00005	<1%			Voltage Divider	.167						.000167
R13	RWR8054990FM/S	Dale	499		2.0	.008	<1%			Load Q4	.061						.000061
R17	RWR8054990FM/S	Dale	499		2.0	.008	<1%			Bias Q6	.061						.000061
R18	RNR55E1002FR/S	Mepco	10K		0.1	.00005	<1%			Bias Q4	.167						.000167
R21	RNR55E1002FR/S		10K			.00005	<1%			Voltage Divider	.167						.000167
R22	RNR55E1002FR/S		10K			.00005	<1%			Voltage Divider	.167						.000167
R23	RNR55E1002FR/S		10K			.00005	<1%			Bias Q3	.167						.000167
R4	RNR55E3011FR/S		3.01K			.00005	<1%			Limit Current	.167						.000167
R20	RNR55E2322FR/S		23.2K			.00005	<1%			Bias Q6	.167						.000167
R24	RNR55E1000FR/S		100			*.015	15%			Bias Q5	.167						.000167
R25	RNR55E3011FR/S		3.01K			.00005	<1%			Limits Current	.167						.000167
R26	RNR55E1002FR/S		10K			.0025	2%			Time Constant	.167						.000167
R30	RNR55E1002FR/S	Mepco	10K	1	0.1	.00004	<1%		75	Limits Current	.167	A		.001			.000167

FOR USE OF RELIABILITY DEPT

19 FAILURE RATE SOURCES (FOR COLUMN #14)

A ATM 605 A B

C D

20 * Power dissipation for 2×10^{-6} seconds at power turn on.

CALCULATED MTBF HRS

21 TOTAL FAILURE RATE .002702 %/1000 HRS

FORM 9091

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP ARRAY E
ASSEMBLY: PCU
SUB ASSEMBLY: APM
DATE: 6-1-71
SCHEMATIC NO: 2368171

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 (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)
R34	RNR55E1001FR/S	Mepco	10K	1	.1	.0005	<1%		75	Limits Current	1167	A			.001			.000167
R41	RNR55E1003FR/S	Mepco	100K	1	.1	.0003	<1%			Time Constant	.167	A			.001			.000167
R42	RNR55E2003FR/S	Mepco	200K	1	.1	.00009	<1%			~~Bras~~ Resistor	.167	A			.001			.000167
R43	RNR55E1001FR/S	Mepco	1K	1	.1	.002	2%		75	Pull Up	.167	A			.001			.000167

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

20 CALCULATED MTBF HRS

21 TOTAL FAILURE RATE: .000668 %/1000 HRS

FORM 925:
BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E

DATE: 6-1-71

ASSEMBLY: PCU

SUB ASSEMBLY: APM

SCHEMATIC NO: 2368171

(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 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	FAIL. RATE (%/1000 HRS)	TOTAL PER TYPE	COUNT	TOTAL FAILURE RATE (%/1000 HRS)
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
Q3	S2N2222A	TI	70	175			1800			.000	2 < 1%					5			Amp.			A						.00510
Q4	S2N2222A	TI	70	175			1800			.000	2 < 1%					16			Amp.									.00510
Q5	S2N2907A	Mot TI Ray	70	200			1800			126	7%					16			Amp.									.01320
Q6	2368192-1	RCA	70	200			85 watts			21 watts	24%					16			Dump									.00730
VR2	SIN751A	Dickson Mot.	70	175		400				.0007	<1%							5.1	Voltage Ref.									.00290
VR3	SIN751A	Dickson Mot.	70	175		400				.0007	<1%							5.1	Voltage Ref.									.00290
VR4	SIN751A	Dickson Mot.	70	175		400				.0003	<1%							5.1	Voltage Ref.									.00290
VR5	SIN751A	Dickson Mot.	70	175		400				.0007	<1%							5.1	Voltage Ref.									.00290
CR1	SIN645	Dickson Mot.	70	150		600				.00126	<1%						225	9.1	Voltage Prot.			A						.00125

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

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

30 TOTAL FAILURE RATE .04365 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E
DATE: 6-1-71
ASSEMBLY: PCU
SUB ASSEMBLY: APM
SCHEMATIC NO: 2368171

(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 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)	SOURCE (See below) (23)	FAIL. RATE (24)	MULTIPLIER (25)	FINAL FAIL RATE (%/1000 HRS) (26)	TOTAL COUNT PER TYPE (28)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR2	SIN645	Dickson Mot.	70	150		600				.00226	<1%					225		9.1	Voltage Protect.			A						.00125

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

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

(31) TOTAL FAILURE RATE .00125 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

(MICROCIRCUITS)

PROJECT: ALSEP ARRAY E
ASSEMBLY: PCU
SUB ASSEMBLY: APM
DATE: 6-1-71
SCHEMATIC NO: 2368171

(Microcircuits)

CKT SYM NO. (1)	TYPE DESIGNATION (2)	MANUFACTURER (3)	TYPE (4)	MAX TEMP °C: ACTUAL AMBIENT (5)	MAX TEMP °C: RATED JUNCTION (6)	MAX TEMP °C: ACTUAL JUNCTION (7)	VOLTAGES: DERATED MAXIMUM (8)	VOLTAGES: ACTUAL (9)	VOLTAGES: DERATED MINIMUM (10)	INPUTS: FAN IN % (11)	INPUTS: % OF MAX I OR V (12)	OUTPUTS: FAN OUT % (12)	OUTPUTS: LOADING % (14)	SPEED: % OF MAX (15)	CLOCK WIDTH: MIN / ACTUAL % (16)	CIRCUIT FUNCTION OR APPLICATION (17)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) (18)	SOURCE (See below) (19)	FAILURE RATE MULTIPLIER (20)	TOTAL PER TYPE (21)	TOTAL FAILURE RATE (%/1000 HRS) (22)
U1	LM111	NSC	Linear IC	70	150	73.7	5.3	5	4.7				10			Comparator		A			.0036
U3	LM111	NSC	Linear IC	70	150	76.2	5.3	5	4.7				10			Comparator		A			.0038
U1A	5401J	TI	Nand Gate Open Col.	70	125	80	5.3	5	4.7			10				Flip-Flop		A			.000375
U1B	5401J	TI	Nand Gate Open Col.	70	125	80	5.3	5	4.7			15				Flip-Flop		A			.000375
U1C	5401J	TI	Nand Gate Open Col.	70	125	80	5.3	5	4.7			20				Inverter		A			.000375
U1D	5401J	TI	Nand Gate Open Col.	70	125	80	5.3	5	4.7			20				Inverter		A			.000375
U2B	5404	TI	Hex Inv.	70	125	80	5.3	5	4.7			25				Increase Current Drive		A			.00025
U2C	5404	TI	Hex Inv.	70	125	80	5.3	5	4.7			25				Increase Current Drive		A			.00025
U2D	5404	TI	Hex Inv.	70	125	80	5.3	5	4.7			25				Increase Current Drive		A			.00025

(23) FAILURE RATE SOURCE (See Column 19)
A ATM 605
B
C
D

(24) NOTE: DERATED VOLTAGE IS DETERMINED BY:
$V_{MAX} = V_{NOM} + .6 (V_{RATED\ MAX} - V_{NOM})$
$V_{MIN} = V_{NOM} - .6 (V_{NOM} - V_{RATED\ MIN})$

(25) TOTAL FAILURE RATE .00945 %/1000 HRS

BxA 679

PARTS APPLICATION ANALYSIS

(MICROCIRCUITS)

PROJECT: ALSEP ARRAY E
ASSEMBLY: PCU
SUB ASSEMBLY: APM
DATE: 6-7-71
SCHEMATIC NO: 2368171

(Microcircuits)

CKT SYM NO. (1)	TYPE DESIGNATION (2)	MANUFACTURER (3)	TYPE (4)	MAX TEMP °C: ACTUAL AMBIENT (5)	MAX TEMP °C: RATED JUNCTION (6)	MAX TEMP °C: ACTUAL JUNCTION (7)	VOLTAGES: DERATED MAXIMUM (8)	VOLTAGES: ACTUAL (9)	VOLTAGES: DERATED MINIMUM (10)	INPUTS: FAN IN % (11)	INPUTS: % OF MAX I OR V (12)	OUTPUTS: FAN OUT % (13)	OUTPUTS: LOADING % (14)	SPEED: % OF MAX (15)	CLOCK WIDTH: MIN / ACTUAL % (16)	CIRCUIT FUNCTION OR APPLICATION (17)	FOR RELIABILITY USE ONLY: RATE (%/1000 HRS) (18)	SOURCE (See footnote) (19)	FAIL. RATE MULTIPLIER (20)	TOTAL PER TYPE (21)	TOTAL FAILURE RATE (%/1000 HRS) (22)
U2E	5404	TI	Hex. Inv.	70	125	80	5.3	45	4.7			25				Increase Current Drive	A			.00025

(23) FAILURE RATE SOURCE (See Column 19)
A ATM605A
B
C
D

(24) NOTE: DERATED VOLTAGE IS DETERMINED BY:
$V_{MAX} = V_{NOM} + .6 (V_{RATED\ MAX} - V_{NOM})$
$V_{MIN} = V_{NOM} - .6 (V_{NOM} - V_{RATED\ MIN})$

(25) TOTAL FAILURE RATE .00025 %/1000 HRS

8xA 679

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP ARRAYE
ASSEMBLY: PCU
SUB ASSEMBLY: Ripple Off Logic
DATE: 6-1-71
SCHEMATIC NO: 2368171

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 (DE-TIME)	15 FAILURE RATE MULTIPLIER	16 FINAL FAILURE RATE (%/1000 HRS)	17 TOTAL RESISTOR COUNT PER TYPE	18 TOTAL FAILURE RATE (%/1000 HRS)
R35	RNR55E1002FR/S	Mepco	10K	1%	0.1	.00005	<1%	75		Current Limit	.167	A		.001			.000167
R36	RNR55E1912FR/S	Mepco	19.1K	1%	0.1	.00005	<1%	↑		Deleted	.167	A		.001			.000167
R37	RNR55E1002FR/S	Mepco	10K	1%	0.1	.00005	<1%	↓		Current Limit	.167	A		.001			.000167
R40	RNR55E1001FR/S	Mepco	1K	1%	0.1	.00005	<1%	75		Deleted	.167	A		.001			.000167

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 .00068 %/1000 HRS

FORM 9581
BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

(Semiconductors)

PROJECT: ALSEP ARRAY E
ASSEMBLY: PCU
SUB ASSEMBLY: Sensing Module
DATE: 6-1-71
SCHEMATIC NO: 2368151

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)	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 PER TYPE (26)	FOR RELIABILITY USE ONLY: COUNT (27)	TOTAL FAILURE RATE (%/1000 HRS) (27)
CR1	SIN5417	TRW	70	175		900				30							100	8	Bridge Rectifier		A							.00021
CR2	↑	↑	↑	↑		↑				↑							↑	↑	↑		↑							↑
CR3																												
CR4																												
CR5																												
CR6																												
CR7																												
CR8	↓	↓	↓	↓		↓				↓							↓	↓	↓		↓							↓
CR9	SIN5417	TRW	70	175		900				30							100	8	Bridge Rectifier		A							.00021

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

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

(27) TOTAL FAILURE RATE .00189 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Sensing Module **SCHEMATIC NO:** 2368151

(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)	FOR RELIABILITY USE ONLY: SOURCE (See below)	FOR RELIABILITY USE ONLY: FAIL. RATE	FOR RELIABILITY USE ONLY: MULTIPLIER	FOR RELIABILITY USE ONLY: FINAL FAIL RATE (%/1000 HRS)	FOR RELIABILITY USE ONLY: TOTAL COUNT PER TYPE	TOTAL FAILURE RATE (%/1000 HRS)
CR10	SIN5417	TRW	70	175				900		30							100	8	Bridge Rect.			A					.00021
CR11																												
CR12																												
CR13																												
CR14																												
CR15																												
CR16																												
CR17																												
CR18	SIN5417	TRW	70	175				900		30							100	8	Bridge Rect.			A					.00021

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 .00189 %/1000 HRS.

92484

BS-321A

PARTS APPLICATION ANALYSIS

CAPACITORS

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUBASSEMBLY:** Sensing Module **SCHEMATIC NO:** 2368151

(Capacitors)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	4 CAPACITANCE VALUE mfd	5 TOLERANCE %	6 MANUFACTURER'S RATED VOLTAGE	7 OPERATING VOLTAGE DC	7 OPERATING VOLTAGE PEAK AC	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) AT 35°C (SEE BELOW)	13 FOR USE OF RELIABILITY DEPT.	14 SPECIAL ENVIRONMENT (DEFINE) FAILURE RATE MULTIPLIER	15 FINAL FAILURE RATE	16 TOTAL CAPACITOR COUNT PER TYPE	17 TOTAL FAILURE RATE (%/1000 HRS)
C1	CSR13G105KM/S	Kemet Sprague	1.0	10	50	16		32%		75	EMI Filters	.0143 A		.001			.0000143
C2			1.0	10	50	16		32%			EMI Filters	.0143 A		.001			.0000143
C3			1.0	10	50	16		32%			Filter	.0143 A		.001			.0000143
C4			1.0	10	50	16		32%			Filter	.0143 A		.001			.0000143
C5			1.0	10	50	16		32%			EMI Filters	.007 A		.001			.000007
C6	CSR13G105KM/S	Kemet Sprague	1.0	10	50	16		32%		75	EMI Filters	.007 A		.001			.000007

20 FAILURE RATE SOURCES (FOR COLUMN #14)

A ATM 605A B _____

C _____ D _____

21 CALCULATED MTBF _____ HRS

22 TOTAL FAILURE RATE .0000712 % 1000 HRS

BS-321A

PARTS APPLICATION ANALYSIS

(INDUCTORS & TRANSFORMERS)

PROJECT: ALSEP ARRAY E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Sensing Module **SCHEMATIC NO:** 2368151

(Inductors & Transformers)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	CONSTRUCTION 4 TYPE OF CASE (SEE BELOW)	5 WIRE SIZE, PRIMARY	6 WIRE SIZE, SECONDARY	7 INSULATION CLASS	8 VA RATING	9 INDUCTANCE AT RATED CUR.	10 SPECIFIED FREQ	11 MISCELLANEOUS	TEMPERATURE (°C) 12 OPERATING AMBIENT	13 HOT SPOT (SURFACE)	14 RISE (AIR METHOD)	15 EST. ACTUAL RISE	16 OPERATING TEMP MAX.	PRIMARY CURRENT 17 ACTUAL	18 RATED	19 PRIMARY VOLTAGE	SECONDARY 20 NO. WINDINGS	21 WINDING NO.	22 VOLTAGE	23 WINDINGS	HIPOT READING 24 VOLTS	25 BASIC FAILURE RATE (λb/1000 HRS) / C = SOURCE (SEE BELOW)	26	27 TOTAL FAILURE RATE (λ/1000 HRS)
																									REL. DEPT USE ONLY	
L1	2346224-1	Schott						16V							4.2									A	.0002
L2	2346224-1	Schott						16V							4.2										.0002
T1	2346227-1	Schott													4.2										.0020
T2	2346227-1	Schott													4.2										.0020
T3	2346227-1	Schott													4.2										.0020
T4	2346227-1	Schott													4.2										.0020
T5	2346227-1	Schott													4.2										.0020
T6	2346227-1	Schott													4.2										.0020
T7	2346227-1	Schott													4.2										.0020
T8	2346227-1	Schott													4.2									A	.0020

28 TYPE OF CASE
A. HER. SEAL
B. VAC. IMP.
C. ENCAP.
D. OPEN

29 FAILURE RATE SOURCES (FOR COLUMN #25)
A. MIL-STD-217A B. _____
C. _____ D. _____

30 CALCULATED MTBF _____ HRS

31 TOTAL FAILURE RATE .0164 %/1000 HRS

BxA 321A

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP Array E **DATE:** 6-1-71

ASSEMBLY: PCU **SUB ASSEMBLY:** Sensing Module **SCHEMATIC NO:** 2368151

(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)	RATED AT: ACTUAL AMBIENT T_A (9)	RATED AT: ACTUAL CASE T_C (10)	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)	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) (26)	TOTAL COUNT PER TYPE (27)	TOTAL FAILURE RATE (%/1000 HRS) (27)
VR1	SIN757A	Mot Dickson	60	175		400				.0003	1%							9.1				A						.00335
VR2	SIN757A	Mot Dickson	60	175		400				.0003	1%							9.1				A						.00335
VR3	SIN757A	Mot Dickson	60	175		400				.0003	1%							9.1				A						.00335

(22) 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 .01005 %/1000 HRS.

BS-321A

PARTS APPLICATION ANALYSIS

RESISTORS

(Resistors)

PROJECT: ALSEP ARRAY E — DATE: 6-1-71

ASSEMBLY: PCU — SUB ASSEMBLY: Sensing Module — SCHEMATIC NO: 2368151

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 Source (See B 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)
R1	RWR8051200FR/S	Dale	120	1	2W	.020	1%		75	Current Limit	.061 A			.001			.000061
R2	RNR55E1002FR/S	Mepco	49.9	1	0.1	.0001	<1%		↑	Current Limit	.167			↑			.000167
R3	RNR55E46R4FR/S	Mepco	46.4	1	0.1	.002	2%			Voltage Divider	.167						.000167
R4	RNR55E46R4FR/S	Mepco	46.4	1	0.1	.002	2%			Voltage Divider	.167						.000167
R6	RNR55E49R9FR/S	Mepco	49.9	1	0.1	.020	20%			Current Limit	.254						.000254
R5	RNR55E1002FR/S	Mepco	10K	1	0.1	.0001	<1%			Current Limit	.167						.000167
R7	RNR55E1002FR/S	Mepco	10K	1	0.1	.023	23%			Current Limit	.254						.000254
R8	RNR55E2002FR/S	Mepco	20K	1	0.1	.001	1%			Voltage Divider	.167						.000167
R9	RNR55E2002FR/S	Mepco	20K	1	0.1	.001	1%			Voltage Divider	.167						.000167
R10	RWR81S80R6FR/S	Dale	178	1	1	.050	5%			Rect. Load	.061						.000061
R11	RNR55E1002FR/S	Mepco	221	1	0.1	.003	3%			Rect. Load	.167						.000167
R12	RNR55E2322FR/S	Mepco	10K	1	0.1	.004	4%			Voltage Divider	.167						.000167
R13	RNR55E49R9FR/S	Mepco	49.9	1	0.1	.020	20%			Current Limit	.254						.000254
R14	RNR55E2322FR/S	Mepco	23.2	1	0.1	.020	20%		↓	Voltage Divider	.254			↓			.000254
R15	RNR55E49R9FR/S	Mepco	49.9	1	0.1	.0005	<1%		75	Current Limit	.167 A			.001			.000167

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

20 CALCULATED MTBF _____ HRS

21 TOTAL FAILURE RATE .002641 %/1000 HRS

FORM 9051

BS-321A

PARTS APPLICATION ANALYSIS

(RELAYS)

PROJECT: ALSEP
DATE: 6-1-71
ASSEMBLY: PCU
SUB ASSEMBLY: Sensing Module
SCHEMATIC NO: 2368151

(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	RATE OF OPERATIONS PER HOUR OR SECOND 17	REQ'D LIFE OPERATIONS 18	MISCELLANEOUS REMARKS 19	FAILURE RATE BASIC (%/1000 HRS) 20	SOURCE OF F.R. (SEE BELOW) 21	F.R. MODIFIER 22	TOTAL FAILURE RATE (%/1000 HOURS) 23
K1	BR20DXH1V2	Babcock	12	1	0	12	0	0	Error Detection	2	2	360 Mills		9	8				A			.005

DEVICE AVERAGE AMBIENT TEMPERATURE °C 24

FAILURE RATE SOURCES (FOR COLUMN NO. 21) 25
A MIL - STD - 217A B _____
C _____ D _____

CALCULATED MTBF _____ HOURS 26

TOTAL FAILURE RATE .005 %/1000 HRS 27

BS-321A

PARTS APPLICATION ANALYSIS

CAPACITORS

PROJECT: ALSEP Array E
ASSEMBLY: PCU
SUBASSEMBLY: Output Filter Module
DATE: 6-1-71
SCHEMATIC NO: 2368183

(Capacitors)

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	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) AT 50% RATED (SEE BELOW)	13 SPECIAL ENVIRONMENT (DEFINE)	14 FAILURE RATE MULTIPLIER	15 FINAL FAILURE RATE	16 TOTAL CAPACITOR COUNT PER TYPE	17 TOTAL FAILURE RATE (%/1000 HRS)
C1	CSR13G105KR/S	Kemet/ Sprague	1.0	10	50	16		32%		75	Filter	A					.0001860
C2	CSR13G105KR/S	↑	1.0		50	16		32%		↑	↑	↑					.0001860
C3	CSR13G105KR/S		1.0		50	16		32%									.0001860
C4	1370946X9050A2		94.0		45	29		64%									.0002000
C5	1370946X9050A2		94.0		45	29		64%									.0002000
C6	CSR136105KR/S		1.0		50	29		58%									.0005291
C7	CSR13F226KR/S		22.0		50	29		58%									.0005291
C8	CSR13G105KR/S		1.0		50	12		24%									.0001683
C9	CSR13F226KR/S		22.0		35	12		34%									.0001860
C10	CSR13G105KR/S		1.0		50	5		10%									.0000704
C11	CSR13F226KR/S		22.0		15	5		33%									.0001860
C12	CSR13G105KR/S		1.0		50	-12		24%									.0001683
C13	CSR13F336KR/S		22		35	-12		34%									.0001860
C14	CSR13G105KR/S		1.0		50	16		32%									.0001860
C15	CSR13G105KR/S		1.0		50	16		32%									.0001860
C16	CSR13G105KR/S		1.0		50	-12		34%									.0001860
C17	CSR13F226KR/S		22.0		35	-12		34%									.0001860
C18	CSR13G105KR/S	↓	1.0		50	5		10%		↓	↓	↓					.0000704
C19	CSR13F226KR/S	Kemet/ Sprague	22.0	10	15	5		33%		75	Filter	A					.0001860

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 .004081 % 1000 HRS

BS-321A

PARTS APPLICATION ANALYSIS

CAPACITORS

PROJECT: ALSEP Array E
ASSEMBLY: PCU
SUBASSEMBLY: Output Filter Module
DATE: 6-1-71
SCHEMATIC NO: 2368183

(Capacitors)

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 85°C	12 SOURCE (SEE BELOW)	13 SPECIAL ENVIRONMENT (DEFINE)	14 FAILURE RATE MULTIPLIER	15 FINAL FAILURE RATE	16 TOTAL CAPACITOR COUNT PER TYPE	17 TOTAL FAILURE RATE (% /1000 HRS)
C20	CSR13G105KR/S	Kemet/ Sprague	1.0	10	50	12		24%		75	Filter		A					.0001683
C21	CSR13F22GKR/S	↑	22.0		35	12		34%		↓	↓		↑					.0001860
C22	CSR13G105KR/S		1.0		50	29		58%										.0005291
C23	CSR13G105KR/S		1.0		50	16		32%										.0001860
C24	CSR13F226KR/S		22.0		50	29		58%										.0005291
C25	137D946X9050A2	↓	94.0		45	29		64%		↓	↓		↓					.0002000
C26	1370946X9050A2	Kemet/ Sprague	94.0	10	45	29		64%		75	Filter		A					.0002000

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 .001998 X 1000 HRS

BS-321A

PARTS APPLICATION ANALYSIS

(INDUCTORS & TRANSFORMERS)

PROJECT: ALSEP Array E
ASSEMBLY: PCU
SUB ASSEMBLY: Output Filter Module
DATE: 6-1-71
SCHEMATIC NO: 2368183

(Inductors & Transformers)

1 CIRCUIT SYMBOL NUMBER	2 TYPE DESIGNATION (MIL or MFR) AND CONSTRUCTION	3 MANUFACTURER	CONSTRUCTION 4 TYPE OF CASE (SEE BELOW)	5 WIRE SIZE, PRIMARY	6 WIRE SIZE, SECONDARY	7 INSULATION CLASS	8 VA RATING	9 INDUCTANCE AT RATED CUR.	10 SPECIFIED FREQ	11 MISCELLANEOUS	TEMPERATURE (°C) 12 OPERATING AMBIENT (OR SPOT (SURFACE))	13 RISE (ΔR METHOD)	14 EST. ACTUAL RISE	15 OPERATING TEMP MAX.	16 ACTUAL	PRIMARY CURRENT 17 RATED	18 PRIMARY VOLTAGE	19 NO. WINDINGS	SECONDARY 20 WINDING NO.	21 VOLTAGE	22 WINDINGS	HIPOT READING 23 VOLTS	24	25 BASIC FAILURE RATE (%/1000 HRS) / SOURCE (SEE BELOW)	26	27 TOTAL FAILURE RATE (%/1000 HRS)
																									REL. DEPT USE ONLY		
L1	2346225	O. Schott						10 MH	16 V						2									A	.0002		
L2	2346225	↑						10 MH	16 V						2									↑	.0002		
L3	2346224							10 MH	29 V						1.9										.0002		
L4	2346225							10 MH	12 V						.147										.0002		
L5	2346225							10 MH	5 V						.43										.0002		
L6	2346225							10 MH	-12 V						.05										.0002		
L7	2346225							10 MH	16 V						2										.0002		
L8	2346225							10 MH	-12 V						.05										.0002		
L9	2346225							10 MH	5 V						.43										.0002		
L10	2346225							10 MH	12						147										.0002		
L11	2346224	↓						10 MH	29						1.9									↓	.0002		
L12	2346225	O. Schott						10 MH	16						2									A	.0002		

28 TYPE OF CASE
A. HER. SEAL
B. VAC. IMP.
C. ENCAP.
D. OPEN

29 FAILURE RATE SOURCES (FOR COLUMN #26)
A. ATM605A B. _____
C. _____ D. _____

30 CALCULATED MTBF _____ HRS

31 TOTAL FAILURE RATE .0024 %/1000 HRS

DD FORM 3248

BxA 321A