



Parts Application Analysis  
Dual 90 Channel Multiplexer  
ALSEP Array A-2

NO.	REV. NO.
ATM 860	A
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DATE 5/25/70	

This ATM 860 Revision A supersedes ATM 860, dated 3/19/70.

ATM 860 A reflects changes that have been made in the 90 Channel Multiplexer since the release of ATM 860. The changes in the circuitry of the multiplexer's sequencer board were made to fix an interface compatibility problem. The problems are described in FAR's A2 and A4, and the changes are per ECN's 2338919D and 2338919E.

As a result of the changes three parts were eliminated, C1, R4 and CR2; two changes were made in part values, R5 reduced from 56K to 10K and C2 reduced from 560pf to 100pf; and a 100pf capacitor, renumbered C1, was added. The reliability as a result of these changes has increased due to a lower part count. All parts are still applied well within the derating criteria for ALSEP.

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**Aerospace  
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The purpose of this ATM is to document the results of the parts application analysis study conducted on the Dual 90 Channel Multiplexer. This multiplexer represents the Bendix designed unit which utilizes MOS-FET integrated circuits.

The Multiplexer was integrated with the Dynatronics A/D Converter. The design now provides complete redundancy for ALSEP Housekeeping engineering status data.

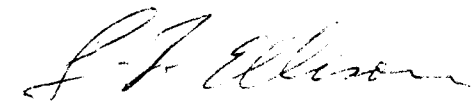
The stress levels shown were determined on the basis of electronic piece parts operating at their nominal values of resistance, capacitance, etc., and nominal application of voltage and current signal levels. A conservative temperature average of 55° C was used for determining device ratings. The resultant stress ratios provided the basis for determining the devices' failure rate. In addition, all stress levels were evaluated in terms of maximum applied voltage and current levels, to preclude misapplication during peak or transient transitional periods.

The attached summary sheets demonstrate that all parts are applied well within the derating criteria established for ALSEP. From the analysis, it can be concluded the multiplexer is designed in a matter to ensure a reliable and long operational life.

(Prepared by)

  
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PARTS APPLICATION ANALYSIS

RESISTORS

PROJECT: A2 ALSEP  
ASSEMBLY: 90 CH Multiplexer

SUB ASSEMBLY: Sequencer

DATE: 5/25/70  
SCHEMATIC NO: 2338919

(Resistors)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
CIRCUIT SYMBOL NUMBER	TYPE DESIGNATION (MIL OR MFR) CONSTRUCTION	MANUFACTURER	RESISTANCE VALUE (OHMS)	TOLERANCE (%)	POWER RATING (WATTS)	MAXIMUM OPERATING POWER (WATTS)	POWER RATIO OPERATING/RAISED DUTY CYCLE	MAXIMUM TEMPERATURE °C	CIRCUIT FUNCTION APPLICATION	BASIC FAILURE RATE (%/1000 HRS) (SEE BELOW)	SPECIAL ENVIRONMENTS (IF ANY)	FAILURE RATE MULTIPLIER	FINAL FAILURE RATE (%/1000 HRS)	TOTAL RESISTOR COUNT PER TYPE	TOTAL FAILURE RATE (%/1000 HRS)		
R1	RCR07G103JS	Allen Bradley	10K	±5	.25	1mw	<10%	55°C	Base Dr. Resistor	.0167 A		.01	1	.000167			
R2	RCR07G153JS	↑	15K	±5	.25	1mw	<10%	↑	Emitter Bias	↑		↑	1	↑			
R3	RCR07G223JS		22K	±5	.25	3mw	<10%		Pull-up Resistor				1				
R5	RCR07G103JS		10K	±5	.25	2mw	<10%		Neg. Pullup Resistor				1				
R6	RCR07G155JS		1.5M	±5	.25	1.mw	<10%		" " "				1				
R7	RCR07G563JS		56K	±5	.25	2mw	<10%		" " "				1				
R8	RCR07G563JS		56K	±5	.25	2mw	<10%		" " "				1				
R9	RCR07G103JS		10K	±5	.25	1mw	<10%		Base Drive Resistor				1				
R10	RCR07G103JS		10K	±5	.25	1.5mw	<10%		Emitter Bias				1				
R11	RCR07G103JS		10K	±5	.25	5mw	<10%		Collector Bias				1				
R12	RCR07G202JS		2K	±5	.25	13mw	<10%		Pullup Resistor				1				
R13	RCR07G104JS		100K	±5	.25	1.5mw	<10%		Neg. Pull up Resistor				1				
R14	RCR07G753JS		75K	±5	.25	2mw	<10%						1				
R15	RCR07G753JS		75K	±5	.25	2mw	<10%						1				
R16	RCR07G753JS		75K	±5	.25	2mw	<10%						1				
R17	RCR07G753JS	↓	75K	±5	.25	2mw	<10%	↓				↓	1	↓			
R18	RCR07G753JS	Allen-Bradley	75K	±5	.25	2mw	<10%	55°C		↓		↓	1	↓			
19 FAILURE RATE SOURCES (FOR COLUMN #14) A. ATM 605 _____ B. _____ C. _____ D. _____										20 CALCULATED MTBF _____ HRS				21 TOTAL FAILURE RATE : .002889 %/1000 HRS			

PARTS APPLICATION ANALYSIS

RESISTORS

PROJECT: ALSEP A2  
 ASSEMBLY: 90 CH Multiplexer

SUB ASSEMBLY: Sequencer

DATE: 5/25/70  
 SCHEMATIC NO: 2338919

(Resistors)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
CIRCUIT SYMBOL NUMBER	TYPE DESIGNATION (MIL OR MFR) AND CONSTRUCTION	MANUFACTURER	RESISTANCE VALUE (OHMS)	TOLERANCE (%)	POWER RATING (WATTS)	OPERATING POWER (WATTS)	POWER RATIO OPERATING/ RATED	MAXIMUM DUTY CYCLE	BULK AFR TEMPERATURE °C	CIRCUIT FUNCTION OR APPLICATION	BASIC FAILURE RATE (%/1000 HRS) AT SOURCE (SEE BELOW)	SPECIAL ENVIRONMENTS (DRAFTING)	FAILURE RATE MULTIPLIER	TOTAL FAILURE RATE (%/1000 HRS)	TOTAL RESISTOR COUNT PER TYPE	TOTAL FAILURE RATE (%/1000 HRS)	
R19	RCR07G753JS	AllenBradley	75K	± 5	0.25	2mw	<10%		55°C	Neg. Pullup Resistor	.0167 A		.01			.000167	
R20	RCR07G753JS	↑	75K	↑	↑	2mw	<10%	↑			↑		↑			↑	
R21	RCR07G753JS		75K			2mw	<10%										
R22	RCR07G753JS		75K			2mw	<10%										
R23	RCR07G753JS		75K			2mw	<10%										
R24	RCR07G753JS		75K			2mw	<10%										
R25	RCR07G104JS		100K			1.5 mw	<10%										
R26	RCR07G563JS		56K			2mw	<10%										
R27	RCR07G753JS		75K			2mw	<10%										
R28	RCR07G753JS		75K			2mw	<10%										
R29	RCR07G753JS		75K			2mw	<10%										
R30	RCR07G753JS		75K			2mw	<10%										
R31	RCR07G753JS		75K			2mw	<10%										
R32	RCR07G753JS	↓	75K	↓	↓	2mw	<10%				↓		↓			↓	
R33	RCR07G753JS	AllenBradley	75K	± 5	0.25	2mw	<10%			Neg. Pullup Resistor	.0167 A		.01			.000167	
R34	RCR07G563JS	" "	56K	+ 5	0.25	10mw	10%				.0167 A		.01			.000167	
RT1	2335661-2	Fenwall				5mw			55°C		.03 C		.1			.00300	
19											20		21				
FAILURE RATE SOURCES (FOR COLUMN #14) A ATM 605 B _____ C MIL-HDBK-217A D _____											CALCULATED MTBF _____ HRS		TOTAL FAILURE RATE .005672 %/1000 HRS				



PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: A2 ALSEP  
ASSEMBLY: 90 CH Multiplexer

SUB ASSEMBLY: Sequencer

DATE: 5/25/70  
SCHEMATIC NO: 2338919

(Semiconductors)

CKT SYM NO.	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY	M A N U F A C T U R E R	MAX. TEMP °C				AVG PWR DISSIPATION (mw)					POWER RATIO		MAXIMUM VOLTAGES				DIODE PIV		CIRCUIT FUNCTION OR APPLI- CATION	PART SPECIAL ENVIRON- MENT (Define)	FOR RELIABILITY USE ONLY									
			A M B I E N T T <sub>A</sub>	R A T E D T <sub>J</sub>	J U N C T I O N T <sub>J</sub>	A C T U A L R O T S P O T T <sub>C</sub>	C A S E	RATED AT					A C T U A L R A T E D 25°C (Amb.or case)	A C T U A L R A T E D T <sub>A</sub> OR T <sub>C</sub>	V C B O R A T E D	V C B A C T U A L	V C B O R A T E D	V C E A C T U A L	R A T E D			A C T U A L	R A T E (%) / 1000 HRS	S O U R C E R A T E (%) / 1000 HRS (See below)	F A I L U R E R A T E (%) / 1000 HRS	M U L T I P L I C A T I O N F A C T O R	T O T A L F A I L U R E R A T E (%) / 1000 HRS				
								35°C		A M B I E N T T <sub>A</sub>	C A S E	A C T U A L R O T S P O T T <sub>C</sub>																A C T U A L	A C T U A L	A C T U A L	A C T U A L
								A M B I E N T T <sub>A</sub>	C A S E																						
Q1, Q4	Dual Transistor PNP 2335190-1	TI	55°C	175°C		250 mW	207 mw	1 mw	<10%	<10%	25v				20v		Switch		0.0054	C		1	.00053								
Q2, Q3	Dual Transistor NPN 2335191-1	TI	55°C	175°C		250 mw	207 mw	1.0 mw	<10%	<10%	215v				45v		Switch		0.0054	C		1	.00079								
A1	12 Bit Serial Parallel resistor 2340330-1	AMI	55°C	150°C		635 mw	482 mw	168 mw	35%								Data converter		.15	B		1	.15								
A2	↓	AMI	55°C	150°C		635 mw	482 mw	168 mw	35%								Data Conver- ter		.15	B		1	.15								
A3	Six Channel Multiplexer	AMI	55°C	150°C		475 mw	364 mw	16 mw	<10%	<10%							Multi- plexing		0.0085	B		1	.0085								
A4	↓	AMI	55°C	150°C		475 mw	364 mw	16 mw	<10%	<10%							Multi- plexing		0.0085	B		1	.0085								
A5	↓	AMI	55°C	150°C		475 mw	364 mw	16 mw	<10%	<10%							Multi- plexing		0.0085	B		1	.0085								
NG1	Logic Quad Nand Gate 2340328-1	AMI	55°C	150°C		685 mw	482 mw	2mw	<10%	<10%							Gate inverting		0.0085	B		1	.0085								
NG2	Logic Quad Nand Gate 2340328-1	AMI	55°C	150°C		685 mw	482 mw	2mw	<10%	<10%							Date inverting		0.0085	B		1	.0085								

28 FAILURE RATE SOURCE (See Column 23)  
A ATM 605 c ATM 507  
B AMI

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

30 TOTAL FAILURE RATE .34250 %/1000 HRS.

BS-321A

- Notes on duty cycles:
- 1) SPOIC's have one output stage always on
  - 2) WL02C gates and MX02D multiplexers have a duty cycle of 1/150.

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP A2  
 ASSEMBLY: 90 CH Multiplexer

SUB ASSEMBLY: Sequencer

DATE: 5/25/70  
 SCHEMATIC NO: 2338919

(Semiconductors)

CKT SYM NO.	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY	MANUFACTURER	MAX. TEMP °C			AVG PWR DISSIPATION (mw)			POWER RATIO		MAXIMUM VOLTAGES				DIODE PIV		CIRCUIT FUNCTION OF APPLICATION	PART SPECIAL ENVIRONMENT (Define)	FOR RELIABILITY USE ONLY										
			AMBIENT TA	ACTUAL TJ	JUNCTION TJ	CASE TC	RATED AT			ACTUAL RATED 25°C (Amb. or case)	ACTUAL RATED TA or TC	VCBO RATED V	VCB ACTUAL V	VCEO RATED V	VCE ACTUAL V	RATED V			ACTUAL V	CIRCUIT FUNCTION OF APPLICATION	RATE (%/1000 HRS)	SOURCING RATE (%/1000 HRS) (See T-1 below)	FAILURE RATE (%/1000 HRS)	FIT (PER TYPE)	TOTAL FAILURE RATE (%/1000 HRS)				
							25°C																			ACTUAL TA	ACTUAL TC	ACTUAL TA	ACTUAL TC
							AMBIENT	CASE	ACTUAL																				
NG3	Logic Quad Nand Gate 2340328-1	AMI	52°C	150°C		685 mw	482 mw	1mw	<10%	<10%						Gate inverting		0085	B		1	.0085							
CR1	Zener Diode SIN746A	Dickson	52°C	150°C		400 mw	400 mw	1mw	<10%	<10%				3.3 V	2.8 V	Volt reference		00195	A		1	.00195							
CR3		FCH	52°C	200°C		360 mw	298 mw	1mw	<10%	<10%				75V	10V	Voltage clipping		00217	A		1	.00217							
CR4		FCH	52°C	200°C		360 mw	298 mw	1mw	<10%	<10%				75V	10V	Voltage reduction		00217	A		1	.00217							

18 FAILURE RATE SOURCE (See Column 23)  
 A ATM 605 C \_\_\_\_\_  
 B AMI D \_\_\_\_\_

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

20 TOTAL FAILURE RATE .01479 %/1000 HRS.

PARTS APPLICATION ANALYSIS

(SEMICONDUCTORS)

PROJECT: ALSEP A2  
 ASSEMBLY: 90 CHANNEL MUX

SUB ASSEMBLY: Board Nos. 1 & 2

DATE: 5/25/70  
 SCHEMATIC NO: 2341954

(Semiconductors)

CKT SYM NO.	TYPE DESIGNATION, SEMICONDUCTOR, POLARITY	M A N U F A C T U R E R	MAX. TEMP °C		AVG PWR DISSIPATION (mw)			POWER RATIO		MAXIMUM VOLTAGES				DIODE FIV		CIRCUIT FUNCTION or APPLI-CATION	PART SPECIAL ENVIRON-MENT (Define)	FOR RELIABILITY USE ONLY								
			A M B I E N T T <sub>A</sub>	J U N C T I O N T <sub>J</sub>	C A S E H O T S P O T T <sub>C</sub>	RATED AT 25°C			A C T U A L R A T E D 25°C (Amb.or case)	A C T U A L R A T E D T <sub>A</sub> or T <sub>C</sub>	V <sub>CB0</sub> R A T E D	V <sub>CB</sub> A C T U A L	V <sub>CE0</sub> R A T E D	V <sub>CE</sub> A C T U A L	R A T E D			A C T U A L	R A T E (%/1000 HRS)	S O U R C E (See below)	F A U L T R A T E (%/1000 HRS)	M I N I M A L T O T A L T	P E R T Y P E	TOTAL FAILURE RATE (%/1000 HRS)		
						A	C	A																	A	A
BRD No. 1 X1-X9	MX02D 234032329-1	AMI	55°C	150°C		475 mw	364 mw	16 mw	<10%	<10%								Multi-plexing	0085	B		9	.0765			
BRD No. 2 X1-X8	MX02D 234032329	AMI	55°C	150°C		475 mw	364 mw	16 mw	<10%	<10%								Multi-plexing	0085	B		1	.0680			
22 FAILURE RATE SOURCE (See Column 23) A _____ C _____ B <u>AMI</u> D _____																	23 NOTE: It is assumed the transient and peak power does not exceed the safe limit.					24 TOTAL FAILURE RATE <u>.1445</u> %/1000 HRS.				