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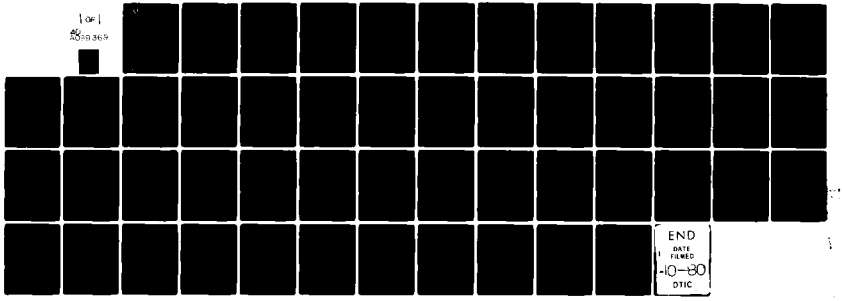

RESEARCH AND DEVELOPMENT TECHNICAL REPORT

DELET-TR-80-12

DATA ACQUISITION SYSTEM FOR PANAMA FIELD TESTS

J. Erickson
T. Redgate
ELECTRONICS TECHNOLOGY & DEVICES LABORATORY

July 1980

ERADCOM

US ARMY ELECTRONICS RESEARCH & DEVELOPMENT COMMAND
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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report covers the design and development of automatic test equipment used to evaluate transistor, microcircuit, and hybrid circuit devices undergoing field tests in the Panama Canal Zone. The devices under test are returned annually to the ERADCOM, Electronics Technology & Devices Lab, Fort Monmouth, for data collection and data processing. The test system is computer-controlled, providing automatic device parameter measurement and data manipulation, which include data editing, data printouts, and device performance summaries.

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INTRODUCTION

This report describes an automatic test system designed specifically to obtain and process data on transistors, microcircuits, and hybrid microcircuits undergoing field tests at the US Tropic Test Center in the Panama Canal Zone. More than 5000 devices have been returned annually to the Electronics Technology & Devices Laboratory (ET&DL), ERADCOM, for data acquisition since the start of the test program in 1970.

The purpose of the Panama tests is to obtain field life test data on both plastic-encapsulated and hermetically-sealed semiconductor devices when operated in "worst case" temperature and humidity field conditions in jungle and sea-shore tropical environments. Field tests are performed near the Caribbean Sea where the air-salt content is very high and in the jungle where the salt content of the atmosphere is very low. Test results are compared with data obtained on similar devices in an autoclave test program at ET&DL. Data correlation is studied to determine acceleration factors. Results of this study have been reported in other technical papers. [1,2,3,4,5]

The test system development evolved from an earlier ET&DL design in which an HP9825A Desk-Top Computer was used for data storage and manipulation but did not perform any tester control functions. In a still earlier ET&DL design, data was recorded on punched tape and then transferred to punched cards for batch processing on a Burroughs B5500 Computer. In the present system, parameter measurements, test fixture operation, data storage and manipulation are all controlled by the HP9825A Desk-Top Computer.

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1. "Field Reliability of Plastic Encapsulated Transistors and Integrated Circuits", B. Reich and E. Hakim, Microelectronics and Reliability, Vol. 10, 1971.
2. "Environmental Factors Governing Field Reliability of Plastic Transistors and Integrated Circuits", B. Reich and E. Hakim, 10th Annual Reliability Physics Symposium Proceedings, April 1972.
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4. "Failure Mechanisms in Gold Metalized Sealed Junction Devices", E. B. Hakim and J. R. Shappirio, Solid State Technology, April 1975.
5. "Panama Field Test Results of Plastic Encapsulated Devices", E. B. Hakim and H. A. Schauer, Plastic Encapsulated/Polymer Sealed Semiconductor Devices for Army Equipment Symposium Proceedings, USAERADCOM, Fort Monmouth, NJ, 10 - 11 May 1978.

SYSTEM DESIGN

The test system measures electrical parameters of transistors, microcircuits, and hybrid circuits. Test instrumentation includes the following: digital multimeter (DMM), digital processor, display station, extended tape memory, printer, desk-top computer, and an in-house-developed test fixture. The measuring and data processing instruments interface using IEEE Standard 488. Computer test programs for the prior ET&DL tester were modified for use with the present test system.

The devices under test are mounted on circuit boards containing either 16 microcircuits, 12 hybrid circuits, or 24 transistors. The test program selects devices sequentially and inserts parameter test circuitry as needed. Display lamps on the test fixture panel are used to track device sequencing.

Parameter measurements for NPN and PNP transistors include I_{CBO}, h_{FE}, and V_{BE}. Microcircuit and hybrid circuit measurements are restricted to digital logic output levels. The microcircuits under test include complementary metal oxide semiconductor (CMOS) NOR Gates, bipolar NAND Gates, and NPN transistor arrays. The hybrid circuits are dual level converters.

The test system is configured as shown in Figure 1. The processor transmits logic signals to the test fixture for device sequencing and test circuit selection. The DMM measures voltage and current parameters and returns test data to the computer for further processing. The display station and extended tape memory are used for editing and storing data summaries. The test system wire list is given in Table 1.

The test fixture (Figure 2) is comprised of a test socket, relay board with display lamps, and a measurement circuit board. Circuit schematics are shown in Figures 3, 4, and 5. The test fixture components are given in Table 2. The test fixture wire list is given in Table 3. Processor control wiring is shown in Figure 6.

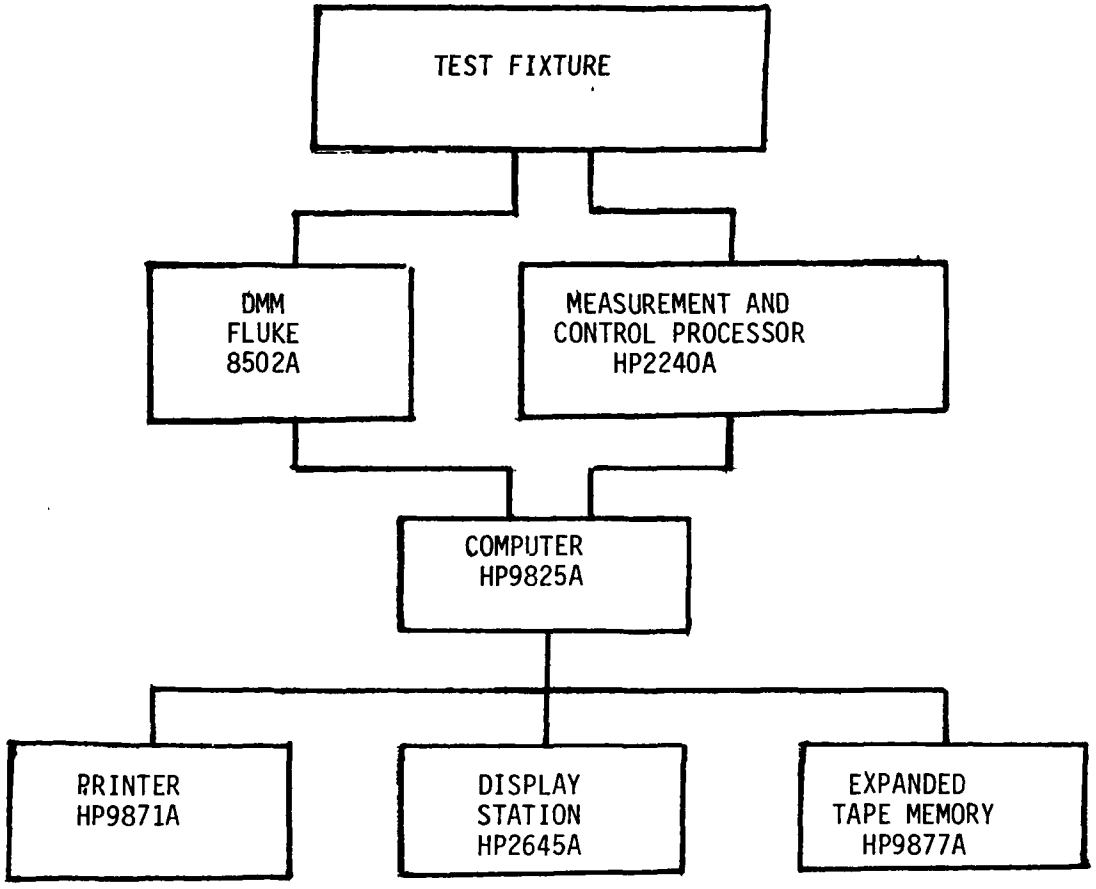

Figure 1. Test System

TABLE 1. TEST SYSTEM WIRE LIST

HP2240A Processor (Slot 2)			to Junction Box			to Test Fixture				
				Wire Color Code					Termination	
Channel	Group	Connector Pin No.	Term. No.	HP Cable	Test Cable	Connector Pin No.	Wire No.	Color Code	Meas. Bd.	Relay Bd.
1	1	40	15	GRY	GRN	15	1	GRY	--	A1
2	1	39	16	VIO/WH	BLK	16	2	ORN/WH	--	A2
3	1	38	17	VIO	RED	17	3	YEL/WH	--	A3
4	1	37	18	BLU/WH	BRN	18	4	GRN	--	A4
Common	1	24	50	WH	WH	49	5	GRY	--	G
18	2	39	14	VIO/WH	WH	14	6	YEL	--	A0
19	2	38	19	VIO	WH	19	7	BLU/WH	--	A5
20	2	37	5	BLU/WH	GRN	5	8	GRN	5	--
21	2	36	6	BLU	BLK	6	9	YEL	6	--
22	2	35	7	GRN/WH	RED	7	10	GRN/WH	7	--
23	2	34	8	GRN	BRN	8	11	YEL/WH	8	--
24	2	33	9	YEL/WH	WH	9	12	GRN/WH	9	--
25	2	32	10	YEL	GRN	10	13	RED	10	--
26	2	31	11	ORN/WH	BLK	11	14	GRN	11	--
27	2	30	12	ORN	RED	12	15	BLK/WH	12	--
28	2	29	13	RED/WH	BRN	13	16	WH	13	--
Common	2	24	49	WH	GRN	47	17	GRY	G	--

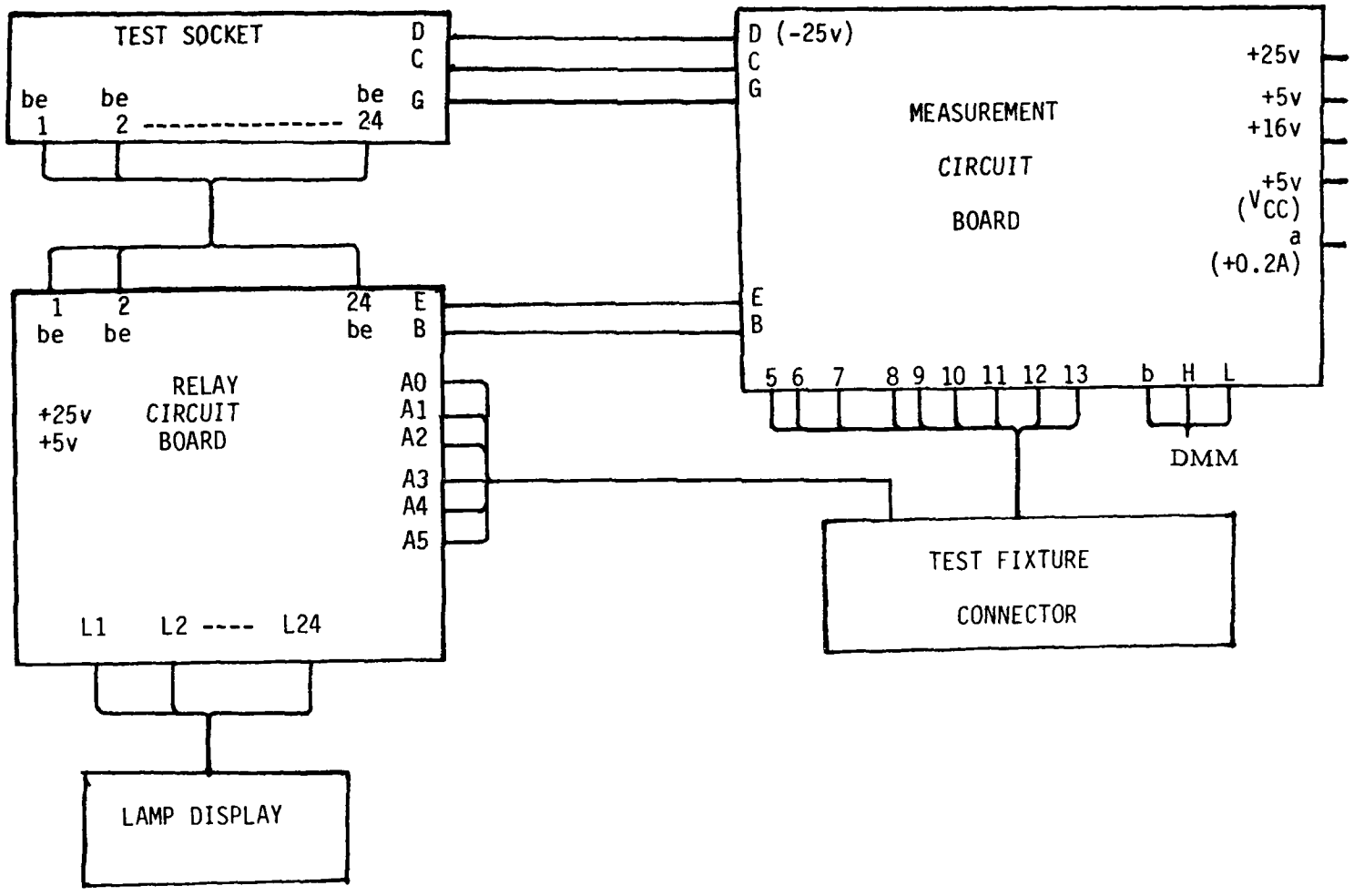

Figure 2. Test Fixture

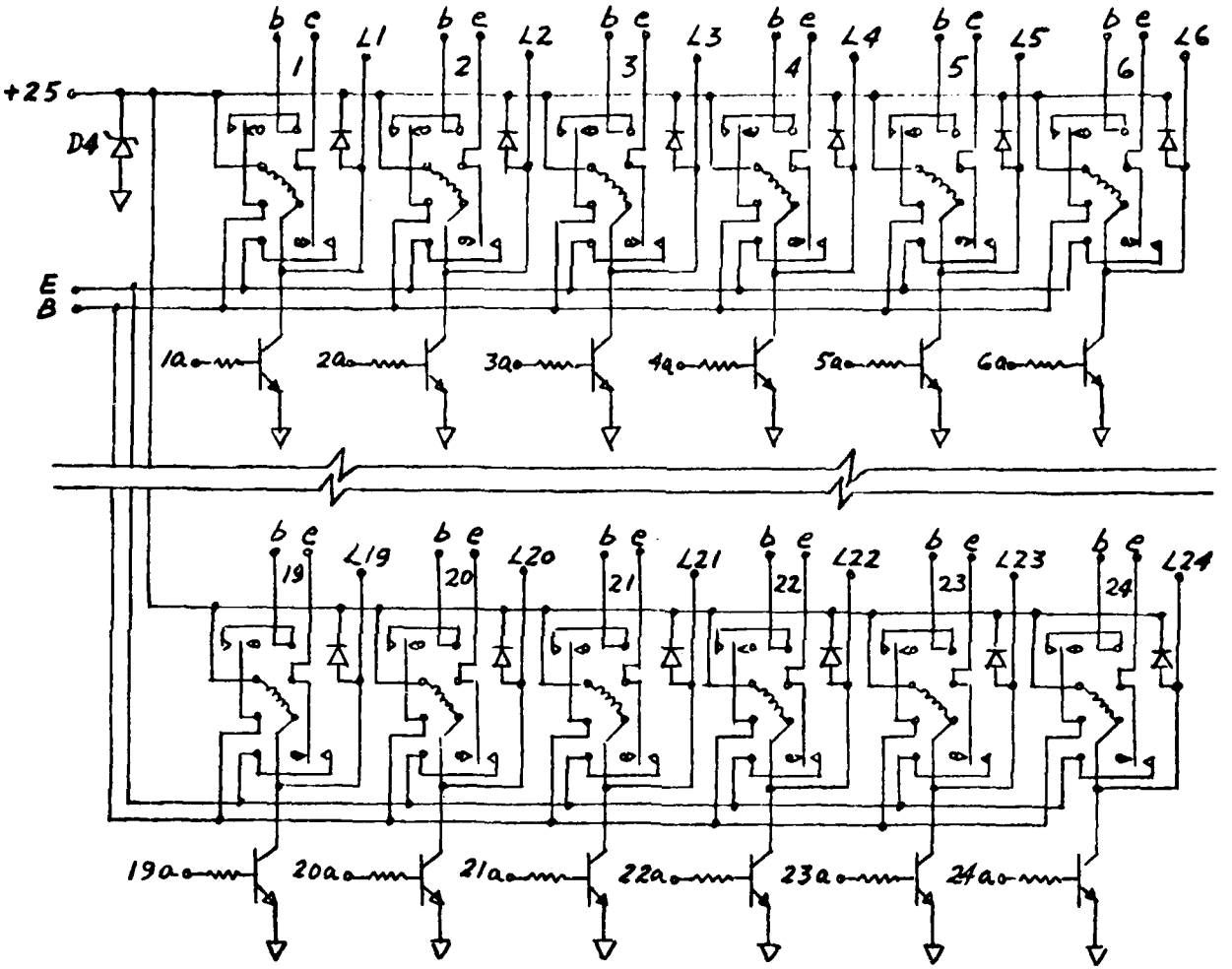

Figure 3. Relay Circuit Board (Device Switching Section)

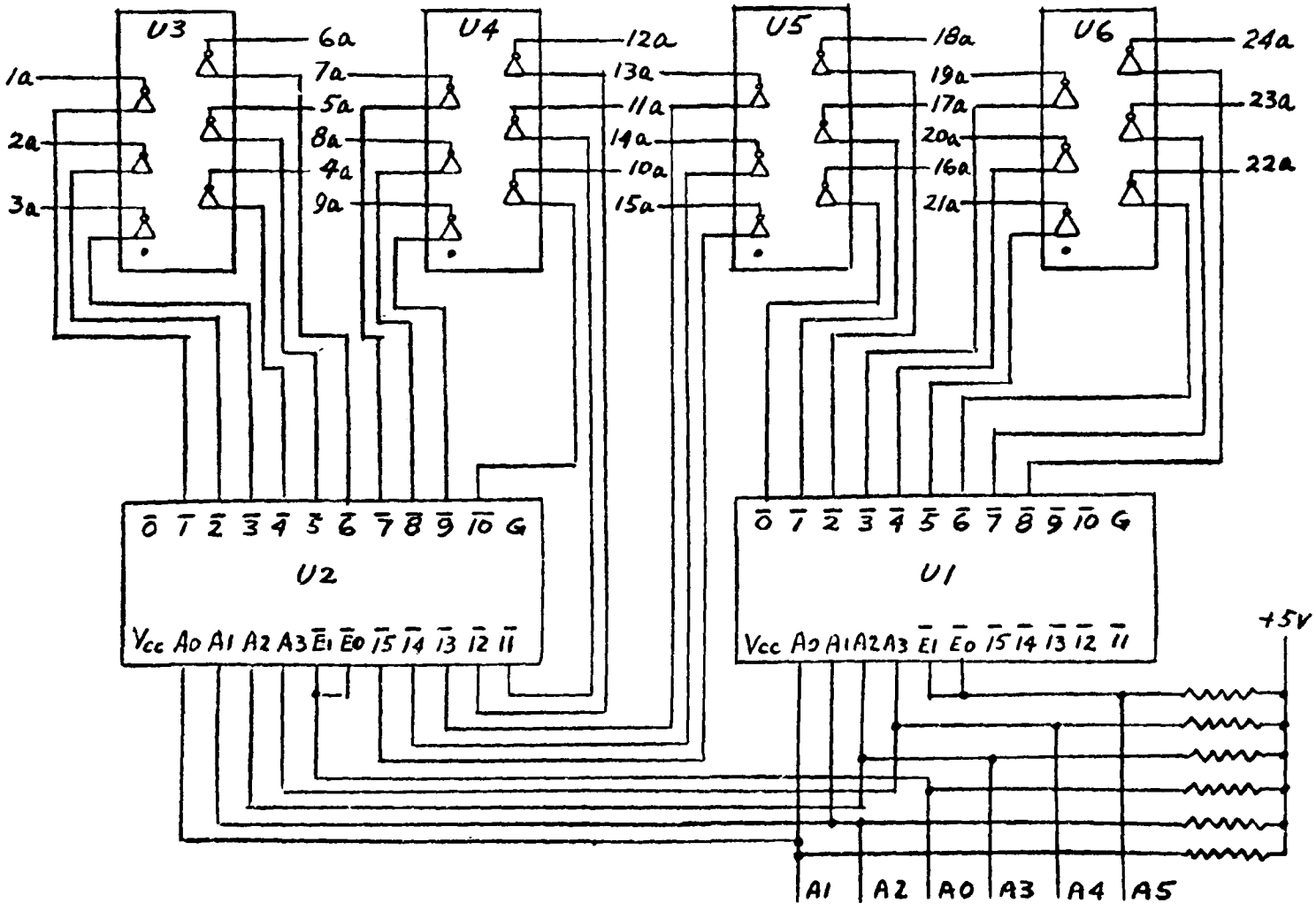

Figure 4. Relay Circuit Board (Device Sequencing Section)

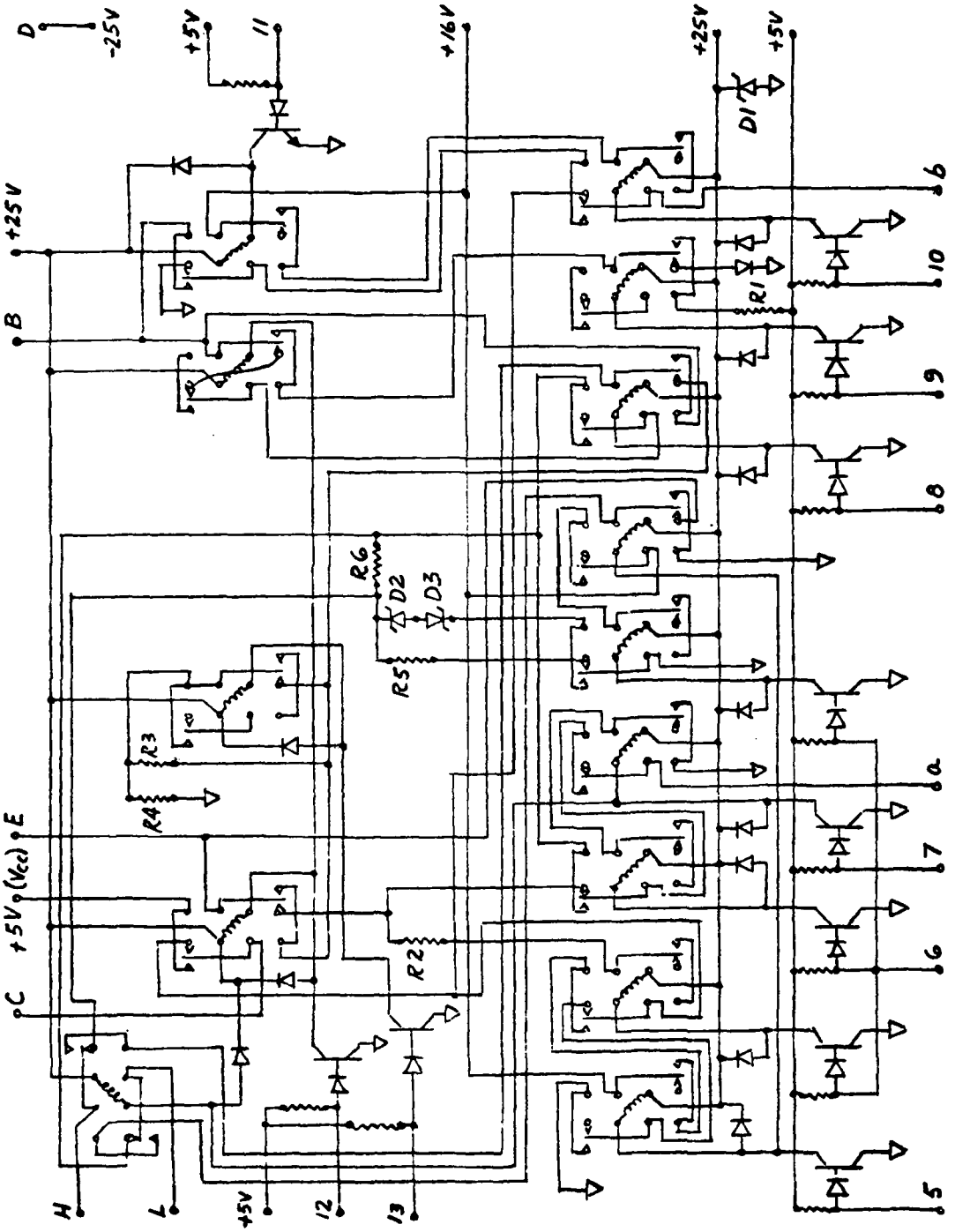

Figure 5. Measurement Circuit Board

TABLE 2. TEST FIXTURE COMPONENTS[1]

TRANSISTORS

All Circuit Boards - 2N2219

DIODES

Relay Circuit Board - all 1N914 except D4(1N973B, 33V Zener)
Measurement Circuit Board - all 1N914 except D1(1N973B), D2, D3(1N963B, 12V Zener selected for 11.8V @ 2mA when connected back to back), D4 (1N270)

RELAYS

All Circuit Boards - DPDT 26Vdc, 600Ω Allied Control Type WKJ-6D

RESISTORS

Relay Circuit Board - all transistor base resistors 1.2KΩ
U1, U2 pull-up resistors 3.3KΩ

Measurement Circuit Board - all transistor base resistors 1.2KΩ

R1 1KΩ
R2 5.62KΩ (1%)
R3 1 MΩ
R4 5.6KΩ
R5 2.225KΩ (1%)
R6 10KΩ

INTEGRATED CIRCUITS

Relay Circuit Board - U1, U2, 9311
U3, U4, U5 7404

INDICATOR LAMPS

Test Fixture - L1 thru L24 28V Type 327

CONNECTOR

Burndy P/N UPC2A28P-4 (28 pin)

Note: 1. All resistors ¼W

TABLE 3. TEST FIXTURE WIRE LIST

Relay Circuit Board

Wire No.	Color Code	From	To		
1	ORN	E	Meas. Bd.	(E)	
2	BLK/WH	B	" "	(B)	
3	GRY	G	" "	(G)	
40	RED/WH	3e	Test Socket	(L)	J1 Socket
41	RED	3b	" "	(N)	
42	GRN/WH	2e	" "	(H)	
43	GRN	2b	" "	(J)	
44	BLU/WH	1e	" "	(D)	
45	BLU	1b	" "	(F)	
46	VIO/WH	6e	" "	(X)	
47	VIO	6b	" "	(Z)	
48	ORN/WH	5e	" "	(T)	
90	ORN	5b	" "	(V)	
91	YEL/WH	4e	" "	(P)	
49	YEL	4b	" "	(R)	
50	RED/WH	9e	" "	(L)	J2 Socket
51	RED	9b	" "	(N)	
52	GRN/WH	8e	" "	(H)	
53	GRN	8b	" "	(J)	
54	BLU/WH	7e	" "	(D)	
55	BLU	7b	" "	(F)	
56	VIO/WH	12e	" "	(X)	
57	VIO	12b	" "	(Z)	
58	ORN/WH	11e	" "	(T)	
59	ORN	11b	" "	(V)	
60	YEL/WH	10e	" "	(P)	
61	YEL	10b	" "	(R)	
62	RED/WH	15e	" "	(M)	J1 Socket
63	RED	15b	" "	(K)	
64	GRN/WH	14e	" "	(I)	
65	GRN	14b	" "	(G)	
66	BLU/WH	13e	" "	(E)	
67	BLU	13b	" "	(C)	
68	VIO/WH	18e	" "	(Y)	
69	VIO	18b	" "	(W)	
70	ORN/WH	17e	" "	(U)	
71	ORN	17b	" "	(S)	
72	YEL/WH	16e	" "	(Q)	
73	YEL	16b	" "	(O)	
74	RED/WH	21e	" "	(M)	J2 Socket
75	RED	21b	" "	(K)	
76	GRN/WH	20e	" "	(I)	
77	GRN	20b	" "	(G)	
78	BLU/WH	19e	" "	(E)	
79	BLU	19b	" "	(C)	

TABLE 3. TEST FIXTURE WIRE LIST (Contd)

Relay Circuit Board

Wire No.	Color Code	From	To	
80	VIO/WH	24e	Test Socket	(Y) J2 Socket
81	VIO	24b	" "	(W)
82	ORN/WH	23e	" "	(U)
83	ORN	23b	" "	(S)
84	YEL/WH	22e	" "	(Q)
85	YEL	22b	" "	(O)

Measurement Circuit Board

4	GRY/WH	C	Test Socket	(J2 a-b, J1 A-B)
35	ORN	D	" "	(J1 a-b)
36	VIO/WH	b	DMM "I"	(HI, pin C)
37	GRY	G	DMM "I"	(LO, pin A)
38	GRY	G	Test Socket	(J2 A-B)
95	ORN	H	DMM "V"	(HI, pin C)
96	GRY	L	DMM "V"	(LO, pin A)
29	GRN/WH	-25V	-25V Power Supply	
30	GRN	+25V	+25V Power Supply	
31	WH	+16V	+16V " "	
32	RED/WH	+5V	+5V " "	
33	VIO	+0.2A	+0.2A " "	
34	GRN	G	G	
39	ORN	+5V(Vcc)	+5V (Vcc) " "	

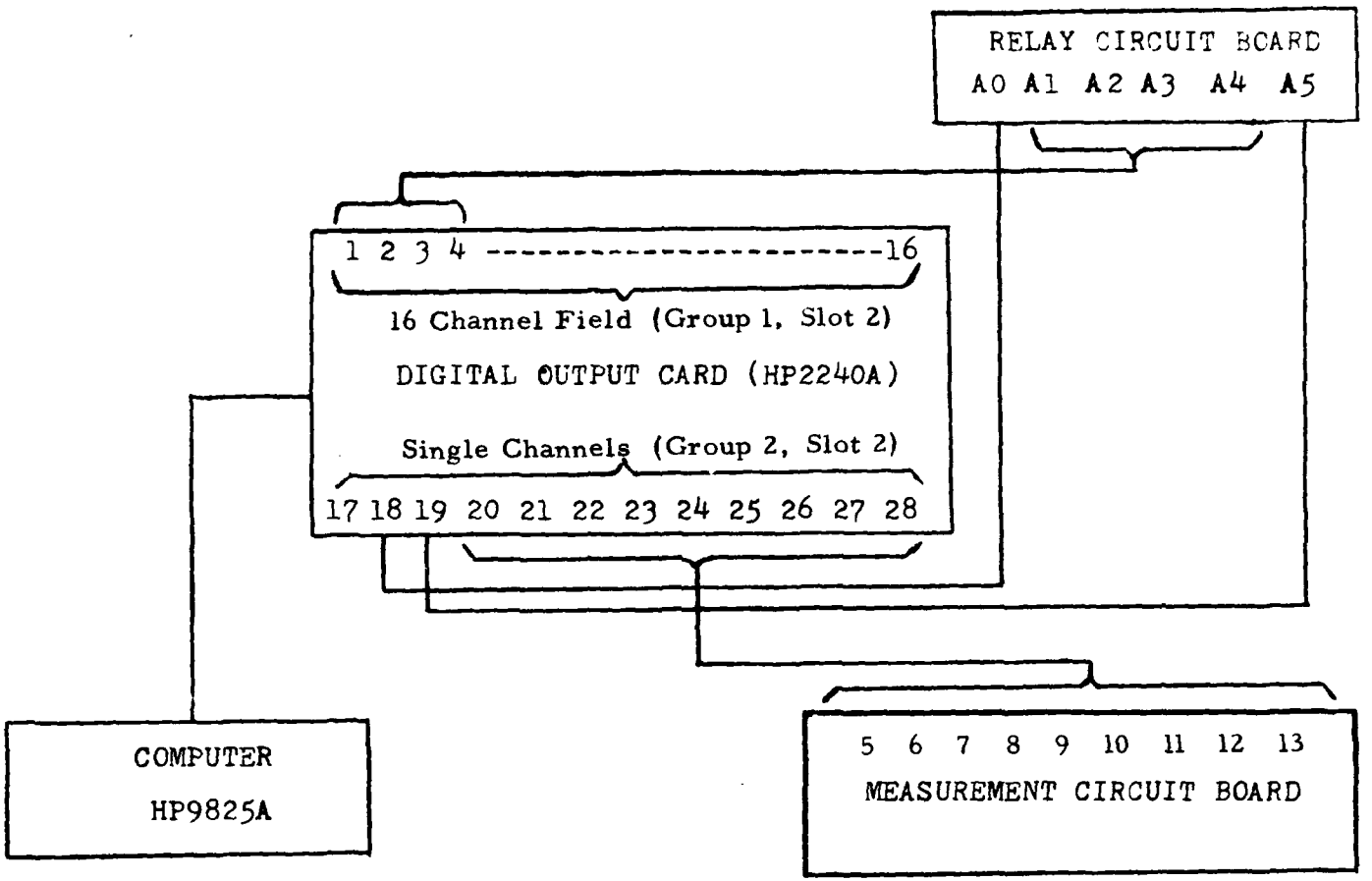

Figure 6. HP2240A Processor Control

TEST SYSTEM OPERATION

Computer programs for the test system are recorded on cassette tape. In the data-taking program, the computer requests information on device type, manufacture, test board number, test bias condition, test hours, and other identifying data. The requested board is then inserted in the test fixture socket for automatic testing.

The processor includes both digital and analog input and output functions. Since the DMM is used to measure electrical parameters, the processor is required only to provide digital output signals for test fixture control. The underutilized processor can be replaced by a HP98032 16 Bit Duplex Interface configured for direct computer control of all relays in the test fixture. A binary output field from the processor controls two decoders on the relay board for relay sequencing of devices under test. Digital logic signals are transmitted to the measurement board relays for sequencing of parameter test circuits.

The DMM is instructed to measure device voltages and transistor leakage currents. This information is transmitted to the computer for further processing, data printout, and data storage. The parameter measurements include: (a) transistor base to emitter voltage V_{BE}, (b) voltage drop measured across a 10 $k\Omega$ resistor in the transistor base circuit for sensing base current, I_B, (c) transistor collector to base leakage current, I_{CBO}, and (d) voltage levels for digital logic output of microelectronic devices and hybrid circuits. Transistor current gain, h_{FE}, is calculated by the computer using the ratio of collector current (fixed at 2mA) and base current. Pass-fail limits are programmed for each parameter measurement.

Test data may be edited to show failure status, device removal from the test board, or other needed information. Failure is shown as "Possible Failure" and curve-tracer tests are then made for verification. Device failure rates and cumulative test hours are determined using a data summary program. New test data in the extended tape memory is transferred to the display station where it is merged with previous data and a data summary printout obtained.

COMPUTER PROGRAMS

A flow chart of test options is shown in Figure 7. Computer programs for transistor, microcircuit, and hybrid circuit data-taking, and data summaries are given in Appendices A, B, C, D, and E. The data-taking programs developed at ET&DL for the earlier tester were modified for the present system; the data format and summary programs were essentially unchanged. The test programs are not in their most concise form. Since certain routines are repeated for each device category, some test programs can be combined to reduce the software requirement. Examples of test data and data summary printouts are given in Appendices F and G. Other test programs include a "Split Board" routine for test boards containing devices from two different manufacturers (Appendix H), and a "Table of Contents" routine for stored data (Appendix I).

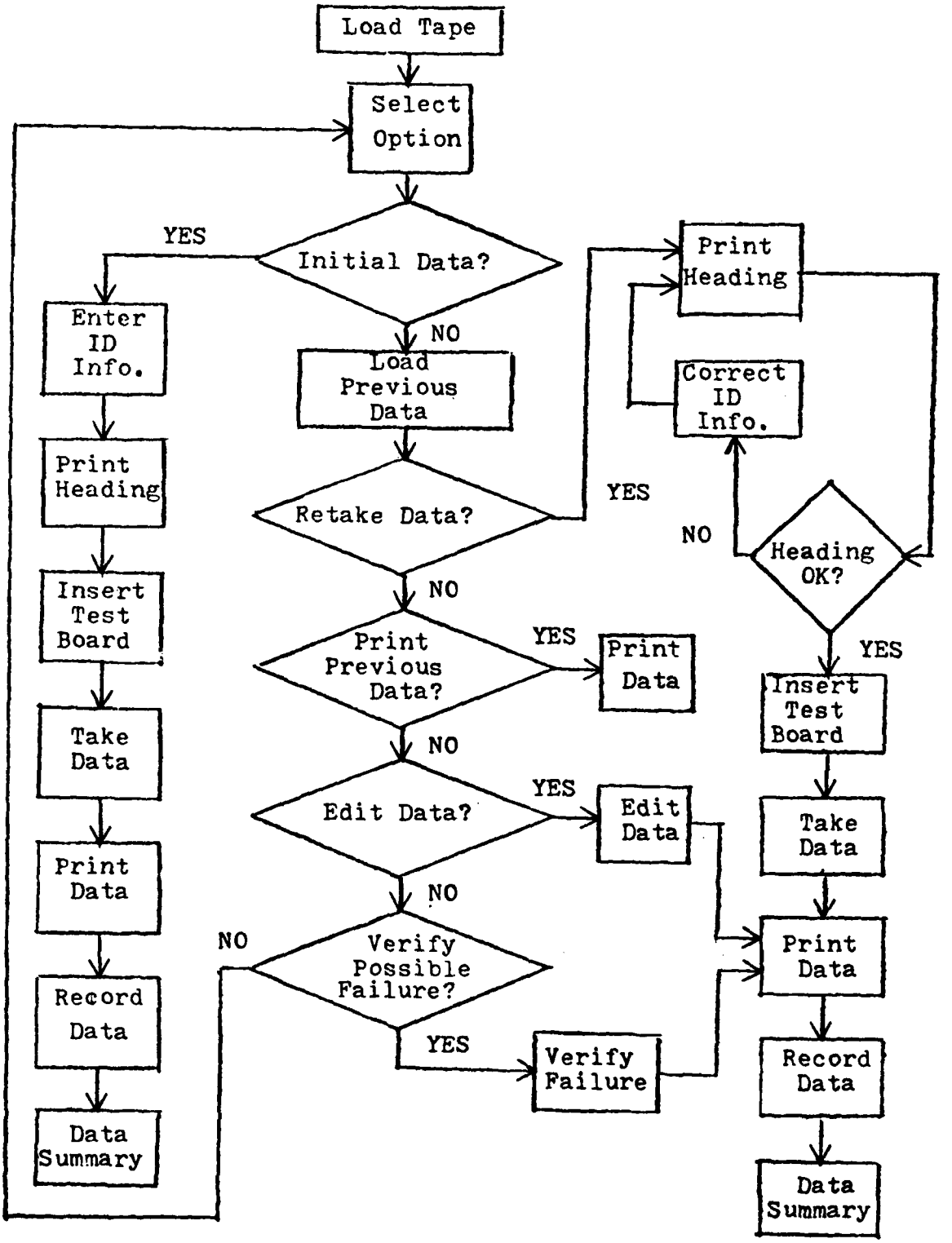

Figure 7. Test Program Flow Chart

CONCLUSIONS

The computer-controlled test system is being used successfully to obtain and process test data on transistors, microcircuits, and hybrid circuits undergoing field tests in Panama. Test data and data summaries may be edited and data printouts obtained for each test board. Data summary information provides a useful history of device reliability and test board status.

ACKNOWLEDGEMENTS

Acknowledgement is given to Mr. Robert Sproat and Mr. James Metz of the Microelectronics Division, ET&DL, and to Mr. Gregory Malinowski of the Microwave and Signal Processing Division, ET&DL -- Mr. Sproat for the original data manipulation software, and all present data format, editing, and data summary software, Mr. Malinowski for his development of the original automatic tester, and Mr. Metz for his work on layout and fabrication of printed circuit boards for the test fixture.

APPENDIX A

TEST PROGRAM FOR TRANSISTORS & NPN TRANSISTOR ARRAY ICS

```
0: "LOAD FUNCTION KEYS & PROGRAM FOR TRANSISTORS & NPN/ICS":
1: trk 1
2: ldk 0
3: dim D$[8]
4: ent "Today's date? ",D$
5: rcf 2,D$
6: ldp 1
```

Program #1

```
0: "DATA TAKER FOR TRANSISTORS AND NPN ICS RETURNED FROM PANAMA":
1: "SEPTEMBER 1979 VERSION":
2: dim A$[68],B$[44],X,Y,T$[5],D$[8]
3: wtb 6,27,69
4: ldf 2,D$
5: trk 0
6: fmt 5,8x,"Data is stored on Transistor Tape, file nos.",f2.0," & ",f2.0,b
7: ent "Do you want instructions?(Y or N)",T$;if flg13;cfg 13;gto -0
8: if T$="N";gto +21
9: if T$#"Y";gto -2
10: prt "What option do"
11: prt "you want?";spc
12: prt "0 Take initial "
13: prt "  data";spc
14: prt "1 Retake data";spc
15: prt "2 Print previous"
16: prt "  data";spc
17: prt "3 Manually edit"
18: prt "  incorrect data";spc
19: prt "4 Verify poss-  "
20: prt "  ible failures";spc ;spc
21: prt "Do not use      "
22: prt "option 0 if     "
23: prt "initial data    "
24: prt "was previously  "
25: prt "recorded.";spc ;spc
26: prt "Enter the number"
27: prt "then press"
28: prt " CONTINUE ";spc ;spc
29: ent "What number?",r8;if flg13;cfg 13;gto -0
30: dsp "Set paper, then press  CONTINUE ";stp
31: wtb 6,27,84,27,70,16,1040
32: gto "INITIAL";if r8>0;gto "LOAD PREVIOUS DATA";if r8>4;gto -3
33: "INITIAL":
34: gsb "Enter ID Info"
35: gsb "Print Heading"
36: ent "Is heading correct?(Y or N)",T$
37: if T$="N";gto -3
38: if T$#"Y";gto -2
39: if r1<3;gto +6
40: cll 'take readings'(1,2,0)
41: wtb 6,12
42: gsb "Print Heading"
43: cll 'take readings'(3,r1,0)
44: gto +2
45: cll 'take readings'(1,r1,0)
46: gsb "Another Printout"
47: gsb "Record"
48: "END":
49: prt "To run the "
50: prt "program again"
51: prt "press RUN ";spc ;spc
52: end
53: "LOAD PREVIOUS DATA":
```

(continue)

```
54: ent "First file # of data",F;if flg13;cfg 13;gto -0
55: ldf F,A$,B$,X,Y
56: Y→r1
57: pos(A$,"NPN/IC")→N
58: dim C$[X,80],C[r1,24-8(N>0),5]
59: ldf F+1,C$,C[*]
60: if r8=2;gto "PRINTOUT PREVIOUS DATA"
61: if r8=3;gto "EDIT INCORRECT DATA"
62: if r8=4;gto "VERIFY FAILURES"
63: "RETEST":
64: ent "Date of retest?(06-19-78)",A$[21,28];if flg13;cfg 13;gto -0
65: gsb "Print Heading"
66: ent "Is heading correct?(Y or N)",T$;if flg13;cfg 13;gto -0
67: if T$="Y";gto +5
68: if T$="N";gsb "Enter ID Info"
69: gsb "Print Heading"
70: ent "Is heading correct?(Y or N)",T$;if flg13;cfg 13;gto -0
71: if T$#"Y";gto -3
72: ent "How many boards to be retested?",r5;if flg13;cfg 13;gto -0
73: if r5>r1;prt "Too many boards";spc ;spc ;gto -1
74: for I=1 to r5
75: for E=1 to 24-8(N>0)
76: 0→C[I,E,4]
77: next E
78: ent "Board # of retested board?",T$;if flg13;cfg 13;gto -0
79: (pos(B$,T$)+10)/11→r6
80: if r6=0;prt "Wrong #, do over";spc ;spc ;gto -5
81: gsb "Device Status"
82: next I
83: cll 'take readings'(1,r6,1)
84: ""→T$
85: ent "Is retested data OK?(Y or N)",T$;if flg13;cfg 13;gto -0
86: if T$="N";gto +4
87: if T$#"Y";gto -2
88: gto +9
89: ""→T$
90: ent "Retest again?(Y or N)",T$;if flg13;cfg 13;gto -0
91: if T$="N";gto +3
92: if T$#"Y";gto -2
93: gto -10
94: prt "Retest was not"
95: prt "successful";spc ;spc
96: gto "END"
97: prt "Another printout"
98: prt "is required in  "
99: prt "order to have a  "
100: prt "complete record "
101: prt "of all data.";spc ;spc
102: gsb "Another Printout"
103: gsb "Record"
104: gto "END"
105: "PRINTOUT PREVIOUS DATA":
106: gsb "Another Printout"
107: gto "END"
108: "EDIT INCORRECT DATA":
109: ent "Device # to be edited?",T$;if flg13;cfg 13;gto -0
110: val(T$)→D
111: for I=1 to r1
112: for J=1 to 24-8(N>0)
113: if C[I,J,4]#D;gto +29
114: gsb "Correct Data"
115: gto +23
116: "Correct Data":
117: dsp "Correct value of ICBO for #",T$
118: ent "",r9;if flg13;cfg 13;gto -0
119: dsp "Correct value of BETA for #",T$
120: ent "",r10;if flg13;cfg 13;gto -0
121: dsp "Correct value of VBE for #",T$
```

(continue)

```
122: ent "",r11;if flg13;cfg 13;gto -0
123: prt "Correct values"
124: fmt "for device ",c5,":",/
125: wrt 16,T$
126: fmt c5,f11.3
127: wrt 16,"ICBO=",r9
128: wrt 16,"BETA=",r10
129: wrt 16,"VBE=",r11
130: spc ;spc
131: ""→T$
132: ent "Is data now correct?(Y or N)",T$;if flg13;cfg 13;gto -0
133: if T$="N";gto "EDIT INCORRECT DATA"
134: if T$#"Y";gto -2
135: r9→C[I,J,1];r10→C[I,J,2];r11→C[I,J,3];2→C[I,J,5]
136: ret
137: ""→T$
138: ent "Edit another device?(Y or N)",T$;if flg13;cfg 13;gto -0
139: if T$="N";gto +6
140: if T$#"Y";gto -2
141: 4→I;24-8(N>0)→J
142: next J
143: next I
144: gto "EDIT INCORRECT DATA"
145: gsb "Another Printout"
146: gsb "Record"
147: gto "END"
148: "VERIFY FAILURES":
149: fxd 0
150: for I=1 to r1
151: for J=1 to 24-8(N>0)
152: if C[I,J,5]#-1;gto +13
153: dsp "Is dev",C[I,J,4]→R,"a verified failure?"
154: ent "",T$;if flg13;cfg 13;gto -1
155: if T$="Y";1→C[I,J,5];gto +10
156: if T$#"N";gto -3
157: dsp "Is device",R,"being removed?"
158: ent "",T$;if flg13;cfg 13;gto -1
159: if T$="Y";-2→C[I,J,5];gto +6
160: if T$#"N";gto -3
161: dsp "Is device",R,"to be edited?"
162: ent "",T$;if flg13;cfg 13;gto -1
163: if T$="N";gto +2
164: if T$="Y";str(C[I,J,4])→T$;gsb "Correct Data"
165: next J
166: next I
167: gsb "Another Printout"
168: gsb "Record"
169: gto "END"
170: "Enter ID Info":
171: prt "Insert cartridge"
172: prt "with old test"
173: prt "data into #1"
174: prt "slot of 9877A";spc
175: prt "If no file last"
176: prt "year, enter 0";spc ;spc
177: ent "Last year's file #?",Z;if flg13;cfg 13;gto -0
178: if Z>0;gsb "Last Year"
179: if Z>0;ret
180: ent "Manufacturer? (3 characters)",A$
181: if (len(A$)→T)#3;gto -1
182: A$&"  "→A$
183: ent "Part #? (8 characters)",A$[6]
184: if (len(A$)→T)#13;gto -1
185: A$&" "→A$
186: ent "Origin? (4 characters)",A$[15]
187: if (len(A$)→T)#18;gto -1
188: A$&"  "→A$
189: ent "Date of test? (01-02-78)",A$[21]
```

(continue)

```
190: if (len(A$)→T)#28;gto -1
191: A$&"  Pan "→A$
192: ent "Panama Location? (11 characters)",A$[35]
193: if (len(A$)→T)#45;gto -1
194: A$&" "→A$
195: ent "# Of Previous Hours?",T;if flg13;cfg 13;gto -0
196: if (T+9000→H)>99000;gto -1
197: fxd 0
198: str(H)→A$[47,52]
199: A$&"    "→A$
200: ent "Board type?(NPN, PNP, NPN/IC, etc)",A$[56]
201: pos(A$,"NPN/IC")→N
202: if (len(A$)→T)<57 or T>66;gto -2
203: for I=T to 66
204: A$&" "→A$
205: next I
206: ent "Are devices biased?(Y or N)",A$[67];if flg13;cfg 13;gto -0
207: if A$[67,67]#"Y" and A$[67,67]#"N";gto -1
208: A$&" "→A$
209: ent "How many boards in the group?",r1;if flg13;cfg 13;gto -0
210: "                                                    "→B$
211: if r8=0;dim C$[5,80],C[r1,24-8(N>0),5]
212: for I=1 to r1
213: fxd 0
214: dsp "First device # for board ",I
215: ent "",T;if flg13;cfg 13;gto -1
216: if T<100;"  "&str(T)→T$[1,5]
217: if T<1000 and T>99;" "&str(T)→T$[1,5]
218: if T>999;str(T)→T$[1,5]
219: T$[2,5]&"-"→B$[11I-10,11I-6]
220: str(T+23-8(N>0))→T$[1,5]
221: T$[2,5]&"  "→B$[11I-5,11I]
222: gsb "Device Status"
223: next I
224: for I=1 to 5
225: " "→C$[I,1,80]
226: next I
227: ret
228: "Print Heading":
229: fmt 1,15x,"**********  TEST DATA  **********",/
230: wrt 6,1
231: fmt 2,8x,"MAN.  DEVICE  FROM  TESTED  LOCAL CONDITION  HOURS  BOARD
232: wrt 6,2
233: fmt 8x,c66,/
234: wrt 6,A$[1,66]
235: fmt 8x,"BOARD: ",c44,/
236: wrt 6,B$
237: if A$[67,67]="N";fmt 8x,"NO BIAS IN THE FIELD",/;wrt 6;gto +5
238: fmt 8x,"FIELD BIAS CONDITIONS: V  =10 Volts",4b
239: wrt 6,27,86,0,3
240: fmt 32x,"CE",4b
241: wrt 6,27,86,0,29
242: fmt 8x,"I    (nA)",7x,"BETA",7x,"V   (V)",6x,"DEVICE",4b
243: wrt 6,27,86,0,3
244: fmt 9x,"CBO",24x,"BE",13x,4b
245: wrt 6,27,86,0,14
246: fmt 9x,"V  =16V    V  =5V,I =2mA  I =200mA       No.    STATUS",4b
247: wrt 6,27,86,0,3
248: fmt 10x,"CB",9x,"CE",5x,"C",7x,"B",4b
249: wrt 6,27,86,0,13
250: fmt 6,9x,"(0-1000)",5x,"(25-400)",5x,"(.5-2.5)"
251: fmt 7,7x,"(0-1,000,000)",2x,"(10-400)",5x,"(.5-2.5)"
252: sgn(pos(A$,"Power"))→r16
253: if r16=0;wrt 6.6
254: if r16=1;wrt 6.7
255: wtb 6,27,86,0,14,10
256: ret
257: "take readings":
```

(continue)

```
258: 0→r16→r17
259: if pos(A$,"Power")>0;1→r16
260: if pos(A$,"Old")>0;1→r17
261: for I=p1 to p2
262: if p3=0;gto +4
263: for K=1 to 24-8(N>0)
264: if C[I,K,5]#-3;0→C[I,K,5]
265: next K
266: fmt
267: wrt 701,"DO,2,18,2,0,0;WN,20;DO,2,20,9,1,1,1,1,1,1,1,1,1;WN,20!"
268: red 701,C
269: if pos(A$,"NPN")=0;gto +3
270: wrt 701,"DO,2,26,1,0;WN,20;DO,2,25,1,0;WN,20!"
271: red 701,C;gto +3
272: wrt 701,"DO,2,26,1,0;WN,20!"
273: red 701,C
274: 1→J→K→B;14→V
275: fxd 0;dsp "Insert board ",val(" "&B$[11I-10,11I-7])→D
276: stp
277: wrt 701,"FO,2,1,1,14;WN,20;DO,2,18,2,1,0;WN,20!"
278: red 701,C
279: if pos(A$,"NPN")=0;gto "PNP"
280: "NPN":
281: clr 702;rem 702;flt 6
282: wtb 702,"F3IRΓ0S7D?"
283: red 702,C[I,K,J]
284: gto "run"
285: "2N":
286: wrt 701,"DO,2,26,1,1,;WN,20;DO,2,23,1,0;WN,20;DO,2,20,1,0;WN,20;"
287: wrt 701,"DO,2,21,1,0;WN,20!"
288: red 701,C
289: wtb 702,"F1VRΓ0S2D?"
290: red 702,C[I,K,J]
291: gto "run"
292: "3N":
293: wrt 701,"DO,2,20,1,1;WN,20;DO,2,22,1,0;WN,20!"
294: red 701,C
295: wtb 702,"F1VRΓ0S2D?"
296: red 702,C[I,K,J]
297: "run":
298: if J=1;10^9C[I,K,J]→C[I,K,J]
299: if J=2;if abs(C[I,K,J])<.01;.02002→C[I,K,J]
300: if J=2;20/C[I,K,J]→C[I,K,J]
301: if J=3;C[I,K,J]→C[I,K,J]
302: if J=4;D→C[I,K,J]
303: if C[I,K,5]=-3;gto +6
304: if J#3;gto +5
305: if C[I,K,2]>400;-1→C[I,K,5]
306: if r17=0 and (C[I,K,3]<.5 or C[I,K,3]>2.5);-1→C[I,K,5]
307: if r16=0 and (C[I,K,1]>1000 or C[I,K,2]<25);-1→C[I,K,5]
308: if r16=1 and (C[I,K,1]>10^6 or C[I,K,2]<10);-1→C[I,K,5]
309: if J#4;gto +13
310: gsb "print data line"
311: if K=24-8(N>0);wtb 6,10;gto +17
312: 1+K→K;0→J;D+1→D;B+1→B
313: if N>0;if B=2 or B=5 or B=8 or B=11 or B=14 or B=17 or B=20 or B=23;B+1→B
314: if B<=15;15-B→V;gto +4
315: if B>15;31-B→V
316: fmt
317: wrt 701,"DO,2,18,2,0,1;WN,20!";red 701,C
318: fmt
319: wrt 701,"FO,2,1,1",V,";WN,20;DO,2,22,1,1;WN,20;"
320: wrt 701,"DO,2,23,1,1;WN,20;DO,2,21,1,1;WN,20;"
321: wrt 701,"DO,2,26,1,0;WN,20!";red 701,C
322: J+1→J
323: if J=1;gto "NPN"
324: if J=2;gto "2N"
325: if J=3;gto "3N"
```

(continue)

```
326: fxd 0;dsp "Taking data on device #",D
327: gto "run"
328: fmt
329: wrt 701,"DO,2,18,2,0,0;WN,20!"
330: red 701,C
331: next I
332: ret
333: "PNP":
334: clr 702;rem 702;flt 6
335: wtb 702,"F3IRT0S7D?"
336: red 702,C[I,K,J]
337: gto "run1"
338: "2P":
339: wrt 701,"DO,2,26,1,1;WN,20;DO,2,23,1,0;WN,20;DO,2,25,1,0;"
340: wrt 701,"WN,20;DO,2,20,1,0;WN,20!"
341: red 701,C
342: wtb 702,"KNX-1"
343: wtb 702,"F1VRX1T0S2D?"
344: red 702,C[I,K,J]
345: gto "run1"
346: "3P":
347: wrt 701,"DO,2,20,1,1;WN,20;DO,2,22,1,0;WN,20!"
348: red 701,C
349: wtb 702,"F1VRX1T0S2D?"
350: red 702,C[I,K,J]
351: "run1":
352: if J=1;10^9C[I,K,J]→C[I,K,J]
353: if J=2;if abs(C[I,K,J])<.01;.02002→C[I,K,J]
354: if J=2;20/C[I,K,J]→C[I,K,J]
355: if J=3;C[I,K,J]→C[I,K,J]
356: if J=4;D→C[I,K,J]
357: if C[I,K,5]=-3;gto +6
358: if J#3;gto +5
359: if C[I,K,2]>400;-1→C[I,K,5]
360: if r17=0 and (C[I,K,3]<.5 or C[I,K,3]>2.5);-1→C[I,K,5]
361: if r16=0 and (C[I,K,1]>1000 or C[I,K,2]<25);-1→C[I,K,5]
362: if r16=1 and (C[I,K,1]>10^6 or C[I,K,2]<10);-1→C[I,K,5]
363: if J#4;gto +14
364: gsb "print data line"
365: if K=24;wtb 6,10;gto +18
366: 1+K→K;0→J;D+1→D;V-1→V
367: fmt
368: wrt 701,"DO,2,22,1,1;WN,20;DO,2,23,1,1;WN,20;DO,2,25,1,1;WN,20;"
369: wrt 701,"DO,2,26,1,0;WN,20!"
370: red 701,C
371: wrt 701,"FO,2,1,1",V,";WN,20!"
372: red 701,C
373: if V>=0;gto +4
374: if V<0;15→V
375: wrt 701,"DO,2,18,2,0,1;WN,20!"
376: red 701,C
377: J+1→J
378: if J=1;gto "PNP"
379: if J=2;gto "2P"
380: if J=3;gto "3P"
381: fxd 0;dsp "Taking data on device #",D
382: gto "run1"
383: fmt
384: wrt 701,"DO,2,18,2,0,0;WN,20!"
385: red 701,C
386: next I
387: ret
388: "print data line":
389: if C[I,K,5]#-3;gto +4
390: if r17=0;fmt 12x,"-",12x,"-",12x,"-",10x,fz4.0,4x,"Missing"
391: if r17=1;fmt 12x,"-",12x,"-",23x,fz4.0,4x,"Missing"
392: wrt 6,C[I,K,4];gto +12
393: if C[I,K,2]>999;999→C[I,K,2]
```

(continue)

```
394: fmt 8,f15.2,f12.0,22x,fz4.0,z
395: fmt 9,f15.2,f12.0,f14.3,8x,fz4.0,z
396: if r17=1;wrt 6.8,C[I,K,1],C[I,K,2],C[I,K,4]
397: if r17=0;wrt 6.9,C[I,K,1],C[I,K,2],C[I,K,3],C[I,K,4]
398: fmt 4x,c16
399: if (C[I,K,5]→r11)=-1;wrt 6,"Possible Failure"
400: if r11=1;wrt 6,"Verified Failure"
401: if r11=0;wrt 6,"Good                "
402: if r11=2;wrt 6,"Good*               ";cfg 5
403: if r11=-2;wrt 6,"Good**              ";cfg 6
404: ret
405: "Another Printout":
406: ent "Want another printout?(Y or N)",T$;if flg13;cfg 13;gto -0
407: if T$="N";gto +25
408: if T$#"Y";gto -2
409: sgn(pos(A$,"Old"))→r17
410: 1→r12→r13;r1→r14;if r1>2;2→r12;2→r14
411: for L=1 to r12
412: sfg 5;sfg 6
413: if L=2;3→r13;r1→r14
414: gsb "Print Heading"
415: for I=r13 to r14
416: for K=1 to 24-8(N>0)
417: gsb "print data line"
418: next K
419: wtb 6,10
420: next I
421: if flg5;gto +3
422: fmt /,8x,"* Data was determined to be incorrect and was manually edited."
423: wrt 6
424: if flg6;gto +3
425: fmt 8x,"** Device was good and removed ",c8
426: wrt 6,A$[21,28];cfg 6
427: if L=1 and r1>2;wtb 6,12
428: next L
429: wtb 6,10
430: if r8=2;wrt 6.5,F,F+1,12
431: gto -25
432: ret
433: "Record":
434: ent "Do you want to record data?(Y,N)",T$;if flg13;cfg 13;gto -0
435: if T$="N";ent "Do you want to retest?(Y,N)",T$[2,2]
436: if T$="NN";gto "END"
437: if T$="NY";gto "RETEST"
438: if r8>0;gto +7
439: 1→G
440: fdf G;idf A,A,A,A
441: if A#0;G+1→G;gto -1
442: mrk 1,160;mrk 1,416+(960-320(N>0))r1
443: G→F;5→X;r1→Y
444: wtb 6,10
445: wrt 6.5,F,F+1,12
446: rcf F,A$,B$,X,Y
447: rcf F+1,C$,C[*]
448: ret
449: "Device Status":
450: ent "How many devices are missing?",M;if flg13;cfg 13;gto -0
451: if M>24-8(N>0);gto -1
452: for J=1 to M
453: dsp "Position of missing device",J,"?"
454: ent "",r15;if flg13;cfg 13;gto -0
455: if r15>24-8(N>0);gto -2
456: -3→C[I,r15,5]
457: next J
458: ret
459: "Last Year":
460: ssc 12;trk 0
461: ldf Z,A$,B$,X,Y
```

(continue)

```
462: ssc 1;trk 0
463: str(val(A$[47,52])+9000)→A$[47,52]
464: D$→A$[21,28]
465: Y→r1
466: pos(A$,"NPN/IC")→N;dim C$[5,80],C[r1,24-8(N>0),5]
467: for I=1 to r1
468: fxd 0
469: gsb "Device Status"
470: next I
471: for I=1 to 5
472: " "→C$[I,1,80]
473: next I
474: ret
```

APPENDIX B

TEST PROGRAM FOR BIPOLAR & CMOS ICS & HYBRID CIRCUITS

```
0: "LOAD FUNCTION KEYS & PROGRAM FOR MICROCIRCUITS & HYBRID CIRCUITS":
1: trk 1
2: ldk 0
3: dim D$[8]
4: ent "Today's date? ",D$
5: rcf 2,D$
6: ldp 1
```

Program #1

```
0: "DATA TAKER FOR BIPOLAR AND CMOS ICS AND HYBRID CIRCUITS FROM PANAMA":
1: "SEPTEMBER 1979 VERSION":
2: dim A$[68],B$[44],X,Y,T$[5],D$[8]
3: wtb 6,27,69
4: ldf 2,D$
5: trk 0
6: fmt 5,2b,8x,"This data is stored on IC tape, file nos.",f3.0," & ",f3.0,b
7: ent "Do you want instructions?(Y or N)",T$;if flg13;cfg 13;gto -0
8: if T$="N";gto +21
9: if T$#"Y";gto -2
10: prt "What option do"
11: prt "you want?";spc
12: prt "0 Take initial "
13: prt "  data";spc
14: prt "1 Retake data";spc
15: prt "2 Print previous"
16: prt "  data";spc
17: prt "3 Manually edit"
18: prt "  incorrect data";spc
19: prt "4 Verify poss-  "
20: prt "  ible failures";spc ;spc
21: prt "Do not use      "
22: prt "option 0 if     "
23: prt "initial data    "
24: prt "was previously  "
25: prt "recorded.";spc ;spc
26: prt "Enter the number"
27: prt "then press"
28: prt "CONTINUE ";spc ;spc
29: ent "What number?",r8;if flg13;cfg 13;gto -0
30: dsp "Set paper, then press CONTINUE ";stp
31: wtb 6,27,84,27,70,16,1040
32: gto "INITIAL";if r8>0;gto "LOAD PREVIOUS DATA";if r8>4;gto -3
33: "INITIAL":
34: gsb "Enter ID Info"
35: gsb "Print Heading"
36: ent "Is heading correct?(Y or N)",T$
37: if T$="N";gto -3
38: if T$#"Y";gto -2
39: if r1<3;gto +6
40: cll 'take readings'(1,2,0)
41: wtb 6,12
42: gsb "Print Heading"
43: cll 'take readings'(3,r1,0)
44: gto +2
45: cll 'take readings'(1,r1,0)
46: gsb "Another Printout"
47: gsb "Record"
48: "END":
49: prt "To run the "
50: prt "program again"
51: prt "press RUN ";spc ;spc
52: end
53: "LOAD PREVIOUS DATA":
```

(continue)

```
54: ent "First file # of data",F;if flg13;cfg 13;gto -0
55: ldf F,A$,B$,X,Y
56: Y→r1
57: pos(A$,"HYBRID")→N
58: dim C$[X,80],C[r1,16+8(N>0),4]
59: ldf F+1,C$,C[*]
60: if r8=2;gto "PRINTOUT PREVIOUS DATA"
61: if r8=3;gto "EDIT INCORRECT DATA"
62: if r8=4;gto "VERIFY FAILURES"
63: "RETEST":
64: ent "Date of retest?(06-19-78)",A$[21,28];if flg13;cfg 13;gto -0
65: gsb "Print Heading"
66: ent "Is heading correct?(Y or N)",T$;if flg13;cfg 13;gto -0
67: if T$="N";gsb "Enter ID Info"
68: if T$#"Y";gto -2
69: ent "How many boards to be retested?",r5;if flg13;cfg 13;gto -0
70: if r5>r1;prt "Too many boards";spc ;spc ;gto -1
71: for I=1 to r5
72: for E=1 to 16+8(N>0)
73: 0→C[I,E,4]
74: next E
75: ent "Board # of retested board?",T$;if flg13;cfg 13;gto -0
76: (pos(B$,T$)+10)/11→r6
77: if r6=0;prt "Wrong #, do over";spc ;spc ;gto -2
78: gsb "Device Status"
79: next I
80: cll 'take readings'(r6,r6,1)
81: ""→T$
82: ent "Is retested data OK?(Y or N)",T$;if flg13;cfg 13;gto -0
83: if T$="N";gto +4
84: if T$#"Y";gto -2
85: gto +9
86: ""→T$
87: ent "Retest again?(Y or N)",T$;if flg13;cfg 13;gto -0
88: if T$="N";gto +3
89: if T$#"Y";gto -2
90: gto -10
91: prt "Retest was not"
92: prt "successful";spc ;spc
93: gto "END"
94: prt "Another printout"
95: prt "is required in  "
96: prt "order to have a "
97: prt "complete record "
98: prt "of all data.";spc ;spc
99: gsb "Another Printout"
100: gsb "Record"
101: gto "END"
102: "PRINTOUT PREVIOUS DATA":
103: gsb "Another Printout"
104: gto "END"
105: "EDIT INCORRECT DATA":
106: ent "Device # to be edited?",T$;if flg13;cfg 13;gto -0
107: val(T$)→D
108: for I=1 to r1
109: for J=1 to 16+8(N>0)
110: if C[I,J,3]#D;gto +26
111: gsb "Correct Data"
112: gto +20
113: "Correct Data":
114: dsp "Correct value of Voff for #",T$
115: ent "",r9;if flg13;cfg 13;gto -0
116: dsp "Correct value of Von for #",T$
117: ent "",r10;if flg13;cfg 13;gto -0
118: prt "Correct values"
119: fmt "for device ",c5,":",/
120: wrt 16,T$
121: fmt c6,f7.2,c3
```

(continue)

```
122: wrt 16,"Voff =",r9," V "
123: wrt 16,"Von  =",r10," mV"
124: spc :spc
125: ""→T$
126: ent "Is data now correct?(Y or N)",T$;if flg13;cfg 13;gto -0
127: if T$="N";gto "EDIT INCORRECT DATA"
128: if T$#"Y";gto -2
129: r9→C[I,J,1];r10→C[I,J,2];2→C[I,J,4]
130: ret
131: ""→T$
132: ent "Edit another device?(Y or N)",T$;if flg13;cfg 13;gto -0
133: if T$="N";gto +6
134: if T$#"Y";gto -2
135: 4→I;16+8(N>0)→J
136: next J
137: next I
138: gto "EDIT INCORRECT DATA"
139: gsb "Another Printout"
140: gsb "Record"
141: gto "END"
142: "VERIFY FAILURES":
143: fxd 0
144: for I=1 to r1
145: for J=1 to 16+8(N>0)
146: if C[I,J,4]#-1;gto +13
147: dsp "Is dev",C[I,J,3]→R,"a verified failure?"
148: ent "",T$;if flg13;cfg 13;gto -1
149: if T$="Y";1→C[I,J,4];gto +10
150: if T$#"N";gto -3
151: dsp "Is device",R,"being removed?"
152: ent "",T$;if flg13;cfg 13;gto -1
153: if T$="Y";-2→C[I,J,4];gto +6
154: if T$#"N";gto -3
155: dsp "Is device",R,"to be edited?"
156: ent "",T$;if flg13;cfg 13;gto -1
157: if T$="N";gto +2
158: if T$="Y";str(R)→T$;gsb "Correct Data"
159: next J
160: next I
161: gsb "Another Printout"
162: gsb "Record"
163: gto "END"
164: "Enter ID Info":
165: prt "Insert cartridge"
166: prt "with old test "
167: prt "data into #1"
168: prt "slot of 9877A";spc
169: prt "If no file last"
170: prt "year, enter 0";spc :spc
171: ent "Last year's file #?",Z;if flg13;cfg 13;gto -0
172: if Z>0;gsb "Last Year"
173: if Z>0;ret
174: ent "Manufacturer? (3 characters)",A$
175: if (len(A$)→T)#3;gto -1
176: A$&"  "→A$
177: ent "Part #? (8 characters)",A$[6]
178: if (len(A$)→T)#13;gto -1
179: A$&" "→A$
180: ent "Origin? (4 characters)",A$[15]
181: if (len(A$)→T)#18;gto -1
182: A$&"  "→A$
183: ent "Date of test? (01-02-78)",A$[21]
184: if (len(A$)→T)#28;gto -1
185: A$&"  Pan "→A$
186: ent "Panama location? (11 characters)",A$[35]
187: if (len(A$)→T)#45;gto -1
188: A$&" "→A$
189: ent "# Of Previous Hours?",T;if flg13;cfg 13;gto -0
```

(continue)

```
190: if (T+9000+H)>99000;gto -1
191: fxd 0
192: str(H)→A$[47,52]
193: A$&"    "→A$
194: ent "Board type?(IC, CMOS or HYBRID)",A$[55]
195: pos(A$,"HYBRID")→N
196: if (len(A$)→T)<56 or T>66;gto -2
197: for I=T to 66
198: A$&" "→A$
199: next I
200: ent "Are devices biased?(Y or N)",A$[67];if flg13;cfg 13;gto -0
201: if A$[67,67]#"Y" and A$[67,67]#"N";gto -1
202: ent "Is first reading Hi or Low?(H,L)",A$[68];if flg13;cfg 13;gto -0
203: if A$[68,68]#"H" and A$[68,68]#"L";gto -1
204: ent "How many boards in the group?",r1;if flg13;cfg 13;gto -0
205: "                                                    "→B$
206: if r8=0;dim C$[5,80],C[r1,16+8(N>0),4]
207: for I=1 to r1
208: fxd 0
209: dsp "First device # for board ",I
210: ent "",T;if flg13;cfg 13;gto -1
211: str(T)→T$[1,5]
212: T$[2,5]&"-"→B$[11I-10,11I-6]
213: str(T+15-4(N>0))→T$[1,5]
214: T$[2,5]&"  "→B$[11I-5,11I]
215: gsb "Device Status"
216: next I
217: for I=1 to 5
218: " "→C$[I,1,80]
219: next I
220: ret
221: "Print Heading":
222: fmt 1,15x,"*****************  TEST DATA  *****************",2/
223: wrt 6,1
224: fmt 2,8x,"MAN.  DEVICE  FROM  TESTED  LOCAL CONDITION  HOURS  BOARD"
225: wrt 6,2
226: fmt 8x,c66,/
227: wrt 6,A$[1,66]
228: fmt 8x,"BOARD: ",c44,2/
229: wrt 6,B$;if N>0;wtb 6,27,10
230: if A$[67,67]="Y";fmt 8x,"BIAS IN THE FIELD",2/;gto +2
231: fmt 8x,"NO BIAS IN THE FIELD",2/
232: wrt 6;if N>0;wtb 6,27,10
233: fmt 8x,"V    (V)      V   (mV)   V      =5V     DEVICE",4b
234: wrt 6,27,86,0,3
235: fmt 9x,"off",11x,"on",9x,"supply",4b
236: wrt 6,27,86,0,15
237: fmt 9x,"V  =5V       V  =0V    R =5.6k          No.    STATUS",4b
238: wrt 6,27,86,0,3
239: fmt 10x,"in",12x,"in",8x,"L",4b
240: wrt 6,27,86,0,11
241: wtb 6,27,86,0,16-2(N>0),10
242: ret
243: "take readings":
244: for I=p1 to p2
245: if p3=0;gto +4
246: for K=1 to 16+8(N>0)
247: if C[I,K,4]#-3;0→C[I,K,4]
248: next K
249: fmt
250: wrt 701,"DO,2,18,2,0,0,;WN,20;DO,2,20,9,1,1,1,1,1,1,1,1,1;WN,20;"
251: wrt 701,"DO,2,27,1,0;WN,20;DO,2,24,2,0,0;WN,20;"
252: wrt 701,"DO,2,20,1,0;WN,20;DO,2,22,1,0;WN,20!"
253: red 701,C
254: if pos(A$,"CMOS")>0;wrt 701,"DO,2,28,1,0;WN,20!";red 701,C
255: 1→J→K→B
256: dsp "Insert board ",val(" "&B$[11I-10,11I-7])→D
257: stp
```

(continue)

```
258: wrt 701,"FO,2,1,1,14;WN,20;DO,2,18,2,1,0;WN,20!";red 701,C
259: "1":
260: clr 702;rem 702;flt 6
261: wtb 702,"F1VRT0S2D?"
262: red 702,C[I,K,J]
263: gto "run"
264: "2":
265: wrt 701,"DO,2,24,1,1;WN,20!";red 701,C
266: wtb 702,"F1VRT0S2D?"
267: red 702,C[I,K,J]
268: "run":
269: D(J=3)+((J=1)+10^3(J=2))C[I,K,J]→C[I,K,J]
270: if J=2 and A$[68,68]="L";C[I,K,1]→T; .001C[I,K,2]→C[I,K,1];1000T→C[I,K,2]
271: if C[I,K,4]=-3;gto +2
272: if J=2 and C[I,K,1]<1.5 or C[I,K,1]>5.1 or C[I,K,2]>750;-1→C[I,K,4]
273: if J=3;gsb "print data line"
274: if J=3 and K=24-8(N=0);wtb 6,10;gto +20
275: if J=3;if N>0;if sgn((-1)^K)=1;D-.1→D
276: if J=3;1+K→K;0→J;D+1→D;B+1→B
277: if J=1 or J=2;gto +12
278: if N=0;if B=2 or B=5 or B=8 or B=11 or B=14 or B=17 or B=20 or B=23;B+1→B
279: if N>0;if sgn((-1)^K)=1;D-.9→D
280: if B<=15;15-B→V;gto +4
281: if B>15;31-B→V
282: fmt
283: wrt 701,"DO,2,18,2,0,1;WN,20!";red 701,C
284: fmt
285: wrt 701,"DO,2,24,1,0;WN,20!"
286: red 701,C
287: wrt 701,"FO,2,1,1",V,";WN,20!"
288: red 701,C
289: J+1→J
290: if J=1;gto "1"
291: if J=2;gto "2"
292: if J=3;fxd 1;dsp "Taking data on device #",D
293: gto "run"
294: fmt
295: wrt 701,"DO,2,18,2,0,0;WN,20!";red 701,C
296: next I
297: ret
298: "print data line":
299: if C[I,K,3]=0;gto +15
300: if C[I,K,4]#-3;gto +4
301: if N>0;fmt 12x,"-",13x,"-",22x,fz6.1,4x,"Missing";gto +2
302: fmt 12x,"-",13x,"-",22x,fz4.0,4x,"Missing"
303: wrt 6,C[I,K,3];gto +11
304: if N>0;gto +2
305: fmt f15.3,f14.2,20x,fz4.0,z;gto +2
306: fmt f15.3,f14.2,20x,fz6.1,z
307: wrt 6,C[I,K,1],C[I,K,2],C[I,K,3]
308: fmt 4x,c16
309: if (C[I,K,4]→r11)=-1;wrt 6,"Possible Failure"
310: if r11=1;wrt 6,"Verified Failure"
311: if r11=0;wrt 6,"Good                "
312: if r11=2;wrt 6,"Good*               ";cfg 5
313: if r11=-2;wrt 6,"Good**               ";cfg 6
314: ret
315: "Another Printout":
316: ent "Want another printout?(Y or N)",T$;if flg13;cfg 13;gto -0
317: if T$="N";gto +24
318: if T$#"Y";gto -2
319: 1→r12→r13;r1→r14;if r1>2;2→r12;2→r14
320: for L=1 to r12
321: sfg 5;sfg 6
322: if L=2;3→r13;r1→r14
323: gsb "Print Heading"
324: for I=r13 to r14
325: if N>0;for K=1 to 24;gto +2
```

(continue)

```
326: for K=1 to 16
327: gsb "print data line"
328: next K
329: wtb 6,10
330: next I
331: if flg5;gto +3
332: fmt 2/,8x,"* Data was determined to be incorrect and was manually edited"
333: wrt 6
334: if flg6;gto +3
335: fmt /,8x,"** Device was good and removed ",c8
336: wrt 6,A$[21,28];cfg 6
337: if L=1 and r1>2;wtb 6,12
338: next L
339: if r8=2;wrt 6.5,10,10,F,F+1,12
340: gto -24
341: ret
342: "Record":
343: ent "Do you want to record data?(Y,N)",T$;if flg13;cfg 13;gto -0
344: if T$="N";ent "Do you want to retest?(Y,N)",T$[2,2]
345: if T$="NN";gto "END"
346: if T$="NY";gto "RETEST"
347: if r8>0;gto +6
348: 1→G
349: fdf G;idf A,A,A,A
350: if A#0;G+1→G;gto -1
351: mrk 1,160;mrk 1,416+(512+256(N>0))r1
352: G→F;5→X;r1→Y
353: wrt 6.5,10,10,F,F+1,12
354: rcf F,A$,B$,X,Y
355: rcf F+1,C$,C[*]
356: ret
357: "Device Status":
358: dsp "# of missing dev. f/BOARD",B$[11I-10,11I-7]
359: ent "",M;if flg13;cfg 13;gto -1
360: if M>16+8(N>0);gto -1
361: for J=1 to M
362: dsp "Position of missing device",J,"?"
363: ent "",r15;if flg13;cfg 13;gto -0
364: if r15>16+8(N>0);gto -2
365: if N=0;-3→C[I,r15,4];gto +5
366: r15*2-1→r18
367: -3→C[I,r18,4]
368: r18+1→r18
369: -3→C[I,r18,4]
370: next J
371: ret
372: "Last Year":
373: ssc 12;trk 0
374: ldf Z,A$,B$,X,Y
375: ssc 1;trk 0
376: str(val(A$[47,52])+9000)→A$[47,52]
377: D$→A$[21,28]
378: Y→r1
379: pos(A$,"HYBRID")→N;dim C$[5,80],C[r1,16+8(N>0),4]
380: for I=1 to r1
381: fxd 0
382: gsb "Device Status"
383: next I
384: for I=1 to 5
385: " "→C$[I,1,80]
386: next I
387: ret
```

APPENDIX C

DATA SUMMARY PROGRAM FOR TRANSISTORS

```
0: "EDIT CONTROL - Panama Data - 6 Sept 1979":
1: "Merges new (1978) test data with old summary data":
2: "permits editing of data, recalculates failure rate, prints new":
3: "summary sheets and records all data on new cartridge":
4: prt "Insert cartridge"
5: prt "with old"
6: prt "summary data"
7: prt "into left drive;"
8: prt "fresh cartridge"
9: prt "into right drive"
10: spc
11: prt "Insert cartridge"
12: prt "with new test"
13: prt "data into #1"
14: prt "slot of 9877A"
15: spc
16: prt "Terminal Setup:"
17: prt " REMOTE - Down"
18: prt " AUTO LF - Down"
19: prt " DUPLEX - Full"
20: prt " PARITY - None"
21: prt " BAUD RATE -2400"
22: prt " Other keys - up"
23: spc ;spc
24: ent "File # of Old Summary Data",E
25: ssc 1
26: rcf 3,E
27: ldp 1
```

Program #1

```
0: ssc 1;trk 0
1: ldf 3,E
2: ldk 2
3: wtc 10,32
4: dim A$[68],B$[44],X,Y,L$[70],T$[70],N$[70],S$[12],E$[4],D$[4]
5: dim Q$[4]
6: fxd 0
7: str(E)→E$;E$[2]→E$
8: wtb 10,27,104,27,74,27,"&p"&E$&"plu2C"
9: wtb 10,27,"&pls3dF"
10: wtb 10,27,65
11: wrt 10,char(30)
12: wtb 10,27,104
13: gsb "READ"
14: if pos(N$,"BOARD")=0;gto -1
15: wtb 10,27,70,27,65,27,65
16: dsp "New data for ",N$[pos(N$,"B"),pos(N$,"-")-1],"?"
17: ent "",Q$;if flg13;cfg 13;gto -1
18: if Q$="N";gsb "MAN EDIT"
19: if Q$="N";gto "F RATE"
20: if Q$#"Y";gto -3
21: ent "File # of New Data?",F;if flg13;cfg 13;gto +0
22: 24→Z;ssc 12;trk 0
23: ldf F,A$,B$,X,Y
24: if pos(A$[50],"/")>0;16→Z
25: if pos(N$,B$[6,8])=0;prt "Wrong file";prt "Try again";spc ;spc ;gto -4
26: dim C$[X,80],C[Y,Z,5]
27: "LOAD":
28: ldf F+1,C$,C[*]
29: for I=1 to Y
30: for J=1 to Z
31: C[I,J,5]→C
32: if C=-3; 1+r3→r3
```

(continue)

```
33: if C=-2;1+r4→r4
34: if C=1;1+r1→r1
35: if C=0 or C=2;1+r2→r2
36: next J
37: next I
38: fxd 0
39: "*"&A$[20,29]&"*"&A$[47,49]&","&A$[50,53]&"*"→L$
40: if (r1+r2+r4+r7)>9;L$&str(r7)→L$
41: if r7<10;L$&" "&str(r7)→L$
42: L$&" *"→L$
43: gsb "READ"
44: gsb "H"
45: 8000(r1+r2+r4)+H→H
46: "                "→T$
47: str(H)→S$;S$[2]→S$
48: if (len(S$)+L)>3;S$[1,L-3]&","&S$[L-2,L]→S$
49: if L>6;S$[1,L-6]&","&S$[L-5]→S$
50: S$→T$[11-len(S$),10]
51: L$&T$&" * "→L$
52: str(r1+val(N$[40,41]))→r5)→S$
53: if len(S$)=3;S$[2]→S$
54: L$&S$&" *                & *"→L$
55: wtb 10,27,76
56: wrt 10,L$
57: wrt 10,char(30)
58: wtb 10,27,104
59: gsb "MAN EDIT"
60: "F RATE":
61: gsb "READ"
62: if pos(N$,"TESTING")>0;sfg 1;wtb 10,27,66;gsb "MAN EDIT"
63: if num(N$[1,1])=30;sfg 1;gsb "MAN EDIT"
64: if flg1;gto "RECORD"
65: if N$[1,1]#"*";gto -4
66: gsb "H"
67: val(N$[40,41])→N
68: if H=0;0→r6;gto +3
69: if N=0;2.3*10^5/H→r6;gto +2
70: (3+N)*10^5/H+2.3*10^(-3)*log(N)→r6
71: fxd 2
72: str(r6)→N$[47,51]
73: fxd 0
74: str(N)→S$;if N<9;" "&S$→S$;S$→N$[39,41]
75: wtb 10,27,65
76: wrt 10,N$
77: gto "F RATE"
78: "READ":
79: wtb 10,27,100,17
80: fmt
81: red 10,N$
82: ret
83: "H":
84: 0→H
85: if N$[29,29]=",";10^6 val(N$[28,28])→H
86: if N$[33,33]=",";10^3 val(N$[30,32])+H→H
87: val(N$[34,36])+H→H
88: ret
89: "MAN EDIT":
90: wtb 10,27,104,27,103
91: dsp "Release 'REMOTE' key"
92: stp
93: dsp "Edit data"
94: stp
95: dsp "Depress 'REMOTE' key"
96: stp
97: wtc 10,32;wait 500
98: wtb 10,27,104
99: ret
100: "RECORD":
```

(continue)

```
101: ent "File # for New Summary Data?",D
102: str(D)→D$;D$[2]→D$
103: wtb 10,27,104
104: wtb 10,27,"&p"&D$&"p2u2C"
105: wtb 10,27,"&p3s2dM"
106: wtb 10,27,"&p2u5C"
107: dsp "Press 'CONT'< when cursor stops"
108: stp
109: wtb 10,27,104,27,76
110: wrt 10,"          ********** STATISTICAL SUMMARY **********"
111: wtb 10,27,76,27,76,27,76,27,66,27,66
112: wrt 10,"    MANUF.                    PART NO.                    TYPE"
113: wtb 10,27,80,27,80,27,66,27,76
114: gsb "READ"
115: if pos(N$,"BOARD")=0;gto -1
116: wtb 10,27,76,27,66,27,76
117: wrt 10,"      File No. - ",D$
118: wtb 10,27,76,27,76,27,66,27,76,27,76,27,76,27,76,27,76,27,76,27,76
119: wrt 10,"*****************************************************"
120: wrt 10,"*          *        *    *              *    *          *"
121: wrt 10,"* READ OUT * HOURS  * NO.*ACCUMULATED* NO * FAIL. RATE *"
122: wrt 10,"*   DATE   *   ON   * OF *   DEVICE   * OF *          *"
123: wrt 10,"*          *  TEST  *DEV.*   HOURS    *FAIL* % per 1000 *"
124: wrt 10,"* MO-DAY-YR*        *    *             *    *   Hours  *"
125: wrt 10,"*          *        *    *             *    *          *"
126: cfg 1
127: wrt 10,"*****************************************************"
128: dsp "INSERT PAPER"
129: stp
130: wtb 10,27,104,27,76,32,32,32,32,32,32,27,89,27,77,27,90
131: wtb 10,27,"&p3s4dM"
132: ssc 1;trk 0;E+1→E;rcf 3,E
133: dsp "Press 'CONT', when type. stops"
134: stp
135: wtb 10,27,71
136: wtb 10,27,89,12,27,90,27,68,27,68,27,80,27,80,27,71,27,"&p3s4dB"
137: wtb 10,27,89,27,69,27,90,27,68,27,68,27,80,27,80,27,71,27,"&p3s4dB"
138: ldp 1
```

APPENDIX D

DATA SUMMARY PROGRAM FOR NPN TRANSISTOR ARRAY ICS

```
0: "EDIT CONTROL - Panama Data - 6 Sept 1979":
1: "Merges new (1978) test data with old summary data":
2: "permits editing of data, recalculates failure rate, prints new":
3: "summary sheets and records all data on new cartridge":
4: prt "Insert cartridge"
5: prt "with old"
6: prt "summary data"
7: prt "into left drive;"
8: prt "fresh cartridge"
9: prt "into right drive"
10: spc
11: prt "Insert cartridge"
12: prt "with new test"
13: prt "data into #1"
14: prt "slot of 9877A"
15: spc
16: prt "Terminal Setup:"
17: prt " REMOTE - Down"
18: prt " AUTO LF - Down"
19: prt " DUPLEX - Full"
20: prt " PARITY - None"
21: prt " BAUD RATE -2400"
22: prt " Other keys - up"
23: spc ;spc
24: prt "If no summary";prt "exists, enter 0";spc ;spc
25: ent "File # of Old Summary Data",E
26: ssc 1
27: if E>0;rcf 3,E;ldp 1
28: dim F,S$[12]
29: ent "Date of Initial Tests?",S$;if flg13;cfg 13;gto -0
30: ent "File # of New Data?",F;if flg13;cfg 13;gto -0
31: rcf 3,F,S$
32: ldp 4
```

Program #1

```
0: ssc 1;trk 0
1: ldf 3,E
2: ldk 2
3: wtc 10,32
4: dim A$[68],B$[44],X,Y,L$[70],T$[70],N$[70],S$[12],E$[4]
5: dim Q$[4]
6: fxd 0
7: str(E)→E$;E$[2]→E$
8: wtb 10,27,104,27,74,27,"&p"&E$&"plu2C"
9: wtb 10,27,"&pls3dF"
10: wtb 10,27,65
11: wrt 10,char(30)
12: wtb 10,27,104
13: gsb "READ"
14: if pos(N$,"BOARD")=0;gto -1
15: wtb 10,27,70,27,65,27,65
16: dsp "New data for ",N$[pos(N$,"B"),pos(N$,"-")-1],"?"
17: ent "",Q$;if flg13;cfg 13;gto -1
18: if Q$="N";gsb "MAN EDIT"
19: if Q$="N";gto "F RATE"
20: if Q$#"Y";gto -3
21: ent "File # of New Data?",F;if flg13;cfg 13;gto +0
22: 16→Z;ssc 12;trk 0
23: ldf F,A$,B$,X,Y
24: if pos(N$,B$[6,8])=0;prt "Wrong file";prt "Try again";spc ;spc ;gto -3
25: dim C$[X,80],C[Y,16,5]
26: "LOAD":
27: ldf F+1,C$,C[*]
```

(continue)

```
28: for I=1 to Y
29: for J=1 to Z
30: C[I,J,5]→C
31: if C=-3;1+r3→r3
32: if C=-2;1+r4→r4
33: if C=1;1+r1→r1
34: if C=0 or C=2;1+r2→r2
35: next J
36: next I
37: fxd 0
38: "*"&A$[20,29]&"*"&A$[47,49]&","&A$[50,53]&"*"&str(r1+r2+r4)&" *"→L$
39: gsb "READ"
40: gsb "H"
41: 8000(r1+r2+r4)+H→H
42: "                "→T$
43: str(H)→S$;S$[2]→S$
44: if (len(S$)→L)>3;S$[1,L-3]&","&S$[L-2,L]→S$
45: if L>6;S$[1,L-6]&","&S$[L-5]→S$
46: S$→T$[11-len(S$),10]
47: L$&T$&" * "→L$
48: str(r1+val(N$[40,41]))→r5)→S$
49: if len(S$)=3;S$[2]→S$
50: L$&S$&" *              &  *"→L$
51: wtb 10,27,76
52: wrt 10,L$
53: wrt 10,char(30)
54: wtb 10,27,104
55: gsb "MAN EDIT"
56: "F RATE":
57: gsb "READ"
58: if pos(N$,"TESTING")>0;sfg 1;wtb 10,27,66;gsb "MAN EDIT"
59: if num(N$[1,1])=30;sfg 1;gsb "MAN EDIT"
60: if flg1;gto "RECORD"
61: if N$[1,1]#"*";gto -4
62: gsb "H"
63: val(N$[40,41])→N
64: if H=0;0→r6;gto +3
65: if N=0;2.3*10^5/H→r6;gto +2
66: (3+N)*10^5/H+2.3*10^(-3)*log(N)→r6
67: fxd 2
68: str(r6)→N$[47,51]
69: fxd 0
70: str(N)→S$;if N<9;" "&S$→S$;S$→N$[39,41]
71: wtb 10,27,65
72: wrt 10,N$
73: gto "F RATE"
74: "READ":
75: wtb 10,27,100,17
76: fmt
77: red 10,N$
78: ret
79: "H":
80: 0→H
81: if N$[29,29]=".";10^6val(N$[28,28])→H
82: if N$[33,33]=".";10^3val(N$[30,32])+H→H
83: val(N$[34,36])+H→H
84: ret
85: "MAN EDIT":
86: wtb 10,27,104,27,103,
87: dsp "Release 'REMOTE' key"
88: stp
89: dsp "Edit data"
90: stp
91: dsp "Depress 'REMOTE' key"
92: stp
93: wtc 10,32;wait 500
94: wtb 10,27,104
95: ret
```

(continue)

```
96: "RECORD":
97: wtb 10,27,104
98: wtb 10,27,"&p"&E$&"p2u2C"
99: wtb 10,27,"&p3s2dM"
100: wtb 10,27,"&p2u5C"
101: dsp "Press 'CONT' < when cursor stops"
102: stp
103: wtb 10,27,104,27,76
104: wrt 10,"          ********** STATISTICAL SUMMARY **********"
105: wtb 10,27,76,27,76,27,76,27,66,27,66
106: wrt 10,"    MANUF.                PART NO.                    TYPE"
107: wtb 10,27,80,27,80,27,66,27,76
108: gsb "READ"
109: if pos(N$,"BOARD")=0;gto -1
110: wtb 10,27,76,27,66,27,76
111: wrt 10,"      File No. - ",E$
112: wtb 10,27,76,27,76,27,66,27,76,27,76,27,76,27,76,27,76,27,76,27,76
113: wrt 10,"*************************************************************"
114: wrt 10,"*          *       *    *              *    *              *"
115: wrt 10,"* READ OUT * HOURS  * NO.*ACCUMULATED* NO * FAIL. RATE *"
116: wrt 10,"*   DATE   *   ON   * OF *   DEVICE   * OF *              *"
117: wrt 10,"*          *  TEST  *DEV.*   HOURS    *FAIL* & per 1000 *"
118: wrt 10,"* MO-DAY-YR*       *    *              *    *   Hours      *"
119: wrt 10,"*          *       *    *              *    *              *"
120: cfg 1
121: wrt 10,"*************************************************************"
122: dsp "INSERT PAPER"
123: stp
124: wtb 10,27,104,27,76,32,32,32,32,32,32,27,89,27,77,27,90
125: wtb 10,27,"&p3s4dM"
126: ssc 1;trk 0;E+1→E;rcf 3,E
127: dsp "Press 'CONT', when type. stops"
128: stp
129: wtb 10,27,71
130: wtb 10,27,89,12,27,90,27,68,27,68,27,80,27,80,27,71,27,"&p3s4dB"
131: wtb 10,27,89,27,69,27,90,27,68,27,68,27,80,27,80,27,71,27,"&p3s4dB"
132: ldp 1
```

Program #4

```
0: ssc 1;trk 0
1: ldk 2
2: wtc 10,32
3: dim A$[68],B$[44],X,Y,L$[70],T$[70],N$[70],E$[4]
4: dim Q$[4],E,S$[12]
5: ldf 3,E,S$
6: fxd 0
7: E→F
8: 16→Z;ssc 12;trk 0
9: ldf F,A$,B$,X,Y
10: dim C$[X,80],C[Y,16,5]
11: A$[34,45]→T$
12: if T$[1,1]=" ";T$[2]→T$;gto -0
13: fmt 1,4x,c3,17x,c8,17x,c12
14: wrt 10.1,A$[1,3],A$[6,13],A$[55,66]
15: wrt 10,"      "&"TEST CONDITIONS - "&T$&"              PANAMA"
16: wrt 10,"      "&"PACKAGE -"
17: wrt 10,"      "&"CONSTRUCTION -"
18: wrt 10,"      "&"COMMENTS -"
19: wrt 10,"      "&"BOARD "&B$
20: wrt 10,"* ",S$," *       0 *",str(r7)," *          0 *  0 *    *.00 %  *"
21: "LOAD":
22: ldf F+1,C$,C[*]
23: for I=1 to Y
24: for J=1 to Z
25: C[I,J,5]→C
26: if C=-3;1+r3→r3
27: if C=-2;1+r4→r4
28: if C=1;1+r1→r1
```

(continue)

```
29: if C=0 or C=2;1+r2→r2
30: next J
31: next I
32: fxd 0
33: "*"&A$[20,29]&"*"&A$[47,49]&","&A$[50,53]&"*"&str(r1+r2+r4)&" *"→L$
34: gsb "READ"
35: gsb "H"
36: 8000(r1+r2+r4)+H→H
37: "                "→T$
38: str(H)→S$;S$[2]→S$
39: if (len(S$)→L)>3;S$[1,L-3]&","&S$[L-2,L]→S$
40: if L>6;S$[1,L-6]&","&S$[L-5]→S$
41: S$→T$[11-len(S$),10]
42: L$&T$&" * "→L$
43: str(r1+val(N$[40,41])→r5)→S$
44: if len(S$)=3;S$[2]→S$
45: L$&S$&" *              &  *"→L$
46: wtb 10,27,76
47: wrt 10,L$
48: wrt 10,char(30)
49: wtb 10,27,104
50: gsb "MAN EDIT"
51: "F RATE":
52: gsb "READ"
53: if pos(N$,"TESTING")>0;sfg 1;wtb 10,27,66;gsb "MAN EDIT"
54: if num(N$[1,1])=30;sfg 1;gsb "MAN EDIT"
55: if flg1;gto "RECORD"
56: if N$[1,1]#"*";gto -4
57: gsb "H"
58: val(N$[40,41])→N
59: if H=0;0→r6;gto +3
60: if N=0;2.3*10^5/H→r6;gto +2
61: (3+N)*10^5/H+2.3*10^(-3)*log(N)→r6
62: fxd 2
63: str(r6)→N$[47,51]
64: fxd 0
65: str(N)→S$;if N<9;" "&S$→S$;S$→N$[39,41]
66: wtb 10,27,65
67: wrt 10,N$
68: gto "F RATE"
69: "READ":
70: wtb 10,27,100,17
71: fmt
72: red 10,N$
73: ret
74: "H":
75: 0→H
76: if N$[29,29]=",";10^6 val(N$[28,28])→H
77: if N$[33,33]=",";10^3 val(N$[30,32])+H→H
78: val(N$[34,36])+H→H
79: ret
80: "MAN EDIT":
81: wtb 10,27,104,27,103
82: dsp "Release 'REMOTE' key"
83: stp
84: dsp "Edit data"
85: stp
86: dsp "Depress 'REMOTE' key"
87: stp
88: wtc 10,32;wait 500
89: wtb 10,27,104
90: ret
91: "RECORD":
92: wtb 10,27,104
93: wtb 10,27,"&p"&E$&"p2u2C"
94: wtb 10,27,"&p3s2d0M"
95: wtb 10,27,"&p2u5C"
96: dsp "Press 'CONT' when cursor stops"
```

(continue)

```
97: stp
98: wtb 10,27,104,27,76
99: wrt 10,"          ********** STATISTICAL SUMMARY **********"
100: wtb 10,27,76,27,76,27,76,27,66,27,66
101: wrt 10,"    MANUF.                    PART NO.                    TYPE"
102: wtb 10,27,80,27,80,27,66,27,76
103: gsb "READ"
104: if pos(N$,"BOARD")=0;gto -1
105: wtb 10,27,76,27,66,27,76
106: wrt 10,"      File No. - ",E$
107: wtb 10,27,76,27,76,27,66,27,76,27,76,27,76,27,76,27,76,27,76,27,76
108: wrt 10,"*************************************************************"
109: wrt 10,"*          *          *    *          *    *              *"
110: wrt 10,"* READ OUT * HOURS    * NO.*ACCUMULATED* NO * FAIL. RATE *"
111: wrt 10,"*   DATE   *   ON     * OF *  DEVICE   * OF *              *"
112: wrt 10,"*          *  TEST    *DEV.*   HOURS   *FAIL* % per 1000 *"
113: wrt 10,"* MO-DAY-YR*          *    *           *    *   Hours      *"
114: wrt 10,"*          *          *    *           *    *              *"
115: cfg 1
116: wrt 10,"*************************************************************"
117: dsp "INSERT PAPER"
118: stp
119: wtb 10,27,104,27,76,32,32,32,32,32,32,27,89,27,77,27,90
120: wtb 10,27,"&p3s4dM"
121: ssc 1;trk 0;E+1→E;rcf 3,E
122: dsp "Press 'CONT', when type. stops"
123: stp
124: wtb 10,27,71
125: wtb 10,27,89,12,27,90,27,68,27,68,27,80,27,80,27,71,27,"&p3s4dB"
126: wtb 10,27,89,27,69,27,90,27,68,27,68,27,80,27,80,27,71,27,"&p3s4dB"
127: ldp 4
```

APPENDIX E

DATA SUMMARY PROGRAM FOR BIPOLAR & CMOS ICS & HYBRID CIRCUITS

```
0: "EDIT CONTROL - Panama Data - 6 Sept 1979":
1: "Merges new (1978) test data with old summary data":
2: "permits editing of data, recalculates failure rate, prints new":
3: "summary sheets and records all data on new cartridge":
4: prt "Insert cartridge"
5: prt "with old"
6: prt "summary data"
7: prt "into left drive;"
8: prt "fresh cartridge"
9: prt "into right drive"
10: spc
11: prt "Insert cartridge"
12: prt "with new test"
13: prt "data into #1"
14: prt "slot of 9877A"
15: spc
16: prt "Terminal Setup:"
17: prt " REMOTE - Down"
18: prt " AUTO LF - Down"
19: prt " DUPLEX - Full"
20: prt " PARITY - None"
21: prt " BAUD RATE -2400"
22: prt " Other keys - up"
23: spc ;spc
24: prt "If no summary";prt "exists, enter 0";spc ;spc
25: ent "File # of Old Summary Data",E
26: ssc 1
27: if E>0;rcf 3,E;ldp 1
28: dim F,S$[12]
29: "          "→S$
30: ent "Date of Initial Tests?",S$
31: ent "File # of New Data?",F;if flg13;cfg 13;gto -0
32: rcf 3,F,S$
33: ldp 5
```

Program #1

```
0: ssc 1;trk 0
1: ldf 3,E
2: ldk 2
3: wtc 10,32
4: dim A$[68],B$[44],X,Y,L$[70],T$[70],N$[70],S$[12],E$[4],D$[4]
5: dim Q$[4]
6: fxd 0
7: str(E)→E$;E$[2]→E$
8: wtb 10,27,104,27,74,27,"&p"&E$&"plu2C"
9: wtb 10,27,"&pls3dF"
10: wtb 10,27,65
11: wrt 10,char(30)
12: wtb 10,27,104
13: gsb "READ"
14: if pos(N$,"OAHD")=0;gto -1
15: wtb 10,27,70,27,65,27,65
16: dsp "New data for ",N$[pos(N$,"B"),pos(N$,"-")-1],"?"
17: ent "",Q$;if flg13;cfg 13;gto -1
18: if Q$="N";gsb "MAN EDIT"
19: if Q$="N";gto "F RATE"
20: if Q$#"Y";gto -3
21: ent "File # of New Data?",F;if flg13;cfg 13;gto +0
22: 16→%;ssc 12;trk 0
23: ldf F,A$,B$,X,Y
24: if pos(N$,B$[6,8])=0;prt "Wrong file";prt "Try again";spc ;spc ;gto -3
25: dim C$[X,80],C[Y,16,4]
26: "LOAD":
```

(continue)

```
27: ldt F+1,C$,C[*]
28: for I=1 to Y
29: for J=1 to Z
30: C[I,J,4]→C
31: if C=-3;1+r3→r3
32: if C=-2;1+r4→r4
33: if C=1;1+r1→r1
34: if C=0 or C=2;1+r2→r2
35: next J
36: next I
37: fxd 0
38: "*"&A$[20,29]&"*"&A$[47,49]&","&A$[50,53]&"*"→L$
39: if (r1+r2+r4+r7)>9;L$&str(r7)→L$
40: if r7<10;L$&" "&str(r7)→L$
41: L$&" *"→L$
42: gsb "READ"
43: gsb "H"
44: 8000(r1+r2+r4)+H→H
45: "                "→T$
46: str(H)→S$;S$[2]→S$
47: if (len(S$)→L)>3;S$[1,L-3]&","&S$[L-2,L]→S$
48: if L>6;S$[1,L-6]&","&S$[L-5]→S$
49: S$→T$[11-len(S$),10]
50: L$&T$&" * "→L$
51: str(r1+val(N$[40,41])→r5)→S$
52: if len(S$)=3;S$[2]→S$
53: L$&S$&" *                &  *"→L$
54: wtb 10,27,76
55: wrt 10,L$
56: wrt 10,char(30)
57: wtb 10,27,104
58: gsb "MAN EDIT"
59: "F RATE":
60: gsb "READ"
61: if pos(N$,"TESTING")>0;sfg 1;wtb 10,27,66;gsb "MAN EDIT"
62: if num(N$[1,1])=30;sfg 1;gsb "MAN EDIT"
63: if flg1;gto "RECORD"
64: if N$[1,1]#"*";gto -4
65: gsb "H"
66: val(N$[40,41])→N
67: if H=0;0→r6;gto +3
68: if N=0;2.3*10^5/H→r6;gto +2
69: (3+N)*10^5/H+2.3*10^(-3)*log(N)→r6
70: fxd 2
71: str(r6)→N$[47,51]
72: fxd 0
73: str(N)→S$;if N<9;" "&S$→S$;S$→N$[39,41]
74: wtb 10,27,65
75: wrt 10,N$
76: gto "F RATE"
77: "READ":
78: wtb 10,27,100,17
79: fmt
80: red 10,N$
81: ret
82: "H":
83: 0→H
84: if N$[29,29]=",";10^6 val(N$[28,28])→H
85: if N$[33,33]=",";10^3 val(N$[30,32])+H→H
86: val(N$[34,36])+H→H
87: ret
88: "MAN EDIT":
89: wtb 10,27,104,27,103
90: dsp "Release 'REMOTE' key"
91: stp
92: dsp "Edit data"
93: stp
94: dsp "Depress 'REMOTE' key"
```

(continue)

```
95: stp
96: wtc 10,32;wait 500
97: wtb 10,27,104
98: ret
99: "RECORD":
100: ent "File # for New Summary Tape?",D;if flg13;cfg 13;gto -0
101: str(D)+D$;D$[2]+D$
102: wtb 10,27,104
103: wtb 10,27,"&p"&D$&"p2u2C"
104: wtb 10,27,"&p3s2dM"
105: wtb 10,27,"&p2u5C"
106: dsp "Press CONT < when cursor stops"
107: stp
108: wtb 10,27,104,27,76
109: wrt 10,"        ********** STATISTICAL SUMMARY **********"
110: wtb 10,27,76,27,76,27,76,27,66,27,66
111: wrt 10,"    MANUF.              PART NO.                    TYPE"
112: wtb 10,27,80,27,80,27,66,27,76
113: gsb "READ"
114: if pos(N$,"BOARD")=0;gto -1
115: wtb 10,27,76,27,66,27,76
116: wrt 10,"       File No. - ",D$
117: wtb 10,27,76,27,76,27,66,27,76,27,76,27,76,27,76,27,76,27,76,27,76
118: wrt 10,"************************************************************"
119: wrt 10,"*          *        *   *            *    *            *"
120: wrt 10,"* READ OUT * HOURS  * NO.*ACCUMULATED* NO * FAIL. RATE *"
121: wrt 10,"*   DATE   *   ON   * OF *  DEVICE    * OF *            *"
122: wrt 10,"*          *  TEST  *DEV.*   HOURS    *FAIL* % per 1000 *"
123: wrt 10,"* MO-DAY-YR*        *   *            *    *   Hours    *"
124: wrt 10,"*          *        *   *            *    *            *"
125: cfg 1
126: wrt 10,"************************************************************"
127: dsp "INSERT PAPER"
128: stp
129: wtb 10,27,104,27,76,32,32,32,32,32,32,27,89,27,77,27,90
130: wtb 10,27,"&p3s4dM"
131: ssc 1;trk 0;E+1+E;rcf 3,E
132: dsp "Press CONT , when type. stops"
133: stp
134: wtb 10,27,71
135: wtb 10,27,89,12,27,90,27,68,27,68,27,80,27,80,27,71,27,"&p3s4dB"
136: wtb 10,27,89,27,69,27,90,27,68,27,68,27,80,27,80,27,71,27,"&p3s4dB"
137: ldp 1
```

Program #5

```
0: ssc 1;trk 0
1: ldk 2
2: wtc 10,32
3: dim A$[68],B$[44],X,Y,L$[70],T$[70],N$[70],E$[4],D$[4],S$[12]
4: dim Q$[4],E,R$[12]
5: ldf 3,E,R$
6: fxd 0
7: E+F
8: 16+Z;ssc 12;trk 0
9: ldf F,A$,B$,X,Y
10: if pos(A$,"HYBRID")>0; 24+Z
11: dim C$[X,80],C[Y,Z,4]
12: wtb 10,27,104,27,74
13: A$[34,45]+T$
14: if T$[1,1]=" ";T$[2]+T$;gto -0
15: if T$[len(T$)+T,T]=" ";T$[1,T-1]+T$;gto -0
16: T$&", Panama, "+T$
17: if A$[67,67]="N";T$&"No Bias"+T$
18: if A$[67,67]="Y";T$&"Biased"+T$
19: fmt 1,6x,c3,17x,c8,16x,c12
20: wrt 10.1,A$[1,3],A$[6,13],A$[55,66]
21: wrt 10,"          "&"TEST CONDITIONS - "&T$
22: wrt 10,"          "&"PACKAGE - Epoxy DIP"
```

(continue)

```
23: wrt 10,"      "&"CONSTRUCTION - ALUM."
24: dsp "Date Code for BOARD ",B$[1,pos(B$,"-")-1]
25: ent "",T$
26: wrt 10,"      "&"COMMENTS - Date Code "&T$
27: wrt 10,"      "&"BOARD "&B$
28: "LOAD":
29: 1df F+1,C$,C[*]
30: for I=1 to Y
31: for J=1 to Z
32: C[I,J,4]→C
33: if C=-3;1+r3→r3
34: if C=-2;1+r4→r4
35: if C=1;1+r1→r1
36: if C=0 or C=2;1+r2→r2
37: next J
38: next I
39: r1+r2+r4→r7
40: wrt 10,"* "&R$&" *      0 *",str(r7)," *          0 *  0 *    0.00 %  *"
41: wrt 10,char(30)
42: wtb 10,27,71,27,65,27,65
43: fxd 0
44: val(A$[47,52])→T
45: "          "→T$
46: str(T)→G$;S$[2]→S$
47: if (len(S$)→L)>3;S$[1,L-3]&","&S$[L-2,L]→S$
48: S$→T$[7-len(S$),6]
49: "*"&A$[20,29]&"* "&T$&" *"&str(r7)&" *"→L$
50: gsb "READ"
51: gsb "H"
52: gsb "G"
53: [val(A$[47,52])-G)r7+H→H
54: "          "→T$
55: str(H)→S$;S$[2]→S$
56: if (len(S$)→L)>3;S$[1,L-3]&","&S$[L-2,L]→S$
57: if L>6;S$[1,L-6]&","&S$[L-5]→S$
58: S$→T$[11-len(S$),10]
59: L$&T$&" * "→L$
60: str(r1+val(N$[40,41])→r5)→S$
61: if len(S$)=3;S$[2]→S$
62: L$&S$&"  *          %  *"→L$
63: if H>0;wtb 10,27,76;gto +2
64: wtb 10,27,65
65: wrt 10,L$
66: wrt 10,char(30)
67: wtb 10,27,104
68: gsb "MAN EDIT"
69: "F RATE":
70: gsb "READ"
71: if pos(N$,"TESTING")>0;sfg 1;wtb 10,27,66;gsb "MAN EDIT"
72: if num(N$[1,1])=30;sfg 1;gsb "MAN EDIT"
73: if flg1;gto "RECORD"
74: if N$[1,1]#"*";gto -4
75: gsb "H"
76: val(N$[40,41])→N
77: if H=0;0→r6;gto +3
78: if N=0;2.3*10^5/H→r6;gto +2
79: (3+N)*10^5/H+2.3*10^(-3)*log(N)→r6
80: fxd 2
81: str(r6)→N$[47,51]
82: fxd 0
83: str(N)→S$;if N<9;" "&S$→S$;S$→N$[39,41]
84: wtb 10,27,65
85: wrt 10,N$
86: gto "F RATE"
87: "READ":
88: wtb 10,27,100,17
89: fmt
90: red 10,N$
```

(continue)

```
91: ret
92: "H":
93: 0→H
94: if N$[29,29]=",";10^6*val(N$[28,28])→H
95: if N$[33,33]=",";10^3*val(N$[30,32])+H→H
96: val(N$[34,36])+H→H
97: ret
98: "G":
99: 0→G
100: if N$[16,16]=",";10^3*val(N$[14,16])→G
101: val(N$[17,19])+G→G
102: ret
103: "MAN EDIT":
104: wtb 10,27,104,27,103
105: dsp "Release 'REMOTE' key"
106: stp
107: dsp "Edit data"
108: stp
109: dsp "Depress 'REMOTE' key"
110: stp
111: wtc 10,32;wait 500
112: wtb 10,27,104
113: ret
114: "RECORD":
115: ent "File #  for New Summary",D
116: str(D)→D$;D$[2]→D$
117: wtb 10,27,104
118: wtb 10,27,"&p"&D$&"p2u2C"
119: wtb 10,27,"&p3s2dM"
120: wtb 10,27,"&p2u5C"
121: dsp "Press 'CONT'< when cursor stops"
122: stp
123: wtb 10,27,104,27,76
124: wrt 10,"          ********** STATISTICAL SUMMARY **********"
125: wtb 10,27,76,27,76,27,76,27,66,27,66
126: wrt 10,"    MANUF.                PART NO.                    TYPE"
127: wtb 10,27,80,27,80,27,66,27,76
128: gsb "READ"
129: if pos(N$,"BOARD")=0;gto -1
130: wtb 10,27,76,27,66,27,76
131: wrt 10,"      File No. - ",D$
132: wtb 10,27,76,27,76,27,66,27,76,27,76,27,76,27,76,27,76,27,76,27,76,27,76
133: wrt 10,"*****************************************************"
134: wrt 10,"*          *       *    *             *    *          *"
135: wrt 10,"* READ OUT * HOURS  * NO.*ACCUMULATED* NO * FAIL. RATE *"
136: wrt 10,"*   DATE   *   ON   * OF *  DEVICE   * OF *          *"
137: wrt 10,"*          *  TEST  *DEV.*   HOURS   *FAIL* % per 1000 *"
138: wrt 10,"* MO-DAY-YR*        *    *            *    *   Hours  *"
139: wrt 10,"*          *       *    *            *    *          *"
140: cfg 1
141: wrt 10,"*****************************************************"
142: dsp "INSERT PAPER"
143: stp
144: wtb 10,27,104,27,76,32,32,32,32,32,32,27,89,27,77,27,90
145: wtb 10,27,"&p3s4dM"
146: ssc 1;trk 0;E+2→E;rcf 3,E,R$
147: dsp "Press 'CONT', when type. stops"
148: stp
149: wtb 10,27,71
150: wtb 10,27,89,12,27,90,27,68,27,68,27,80,27,80,27,71,27,"&p3s4dB"
151: wtb 10,27,89,27,69,27,90,27,68,27,68,27,80,27,80,27,71,27,"&p3s4dB"
152: ldp 5
```

APPENDIX F

TYPICAL TEST DATA

MAN.	DEVICE	FROM	TESTED	LOCAL CONDITION		HOURS	BOARD
TI	SKA8029	CONT	09-28-79	Pan	Jungle	46176	NPN

BOARD: 2425-2448 2449-2472

FIELD BIAS CONDITIONS: V_{CE}=10 Volts

I_{CBO} (nA) V_{CB}=16V (0-1000)	BETA V_{CE}=5V, I_C=2mA (25-400)	V_{BE} (V) I_B=200mA (.5-2.5)	DEVICE No.	STATUS
45.00	84	1.227	2425	Good
53.00	25	1.215	2426	Good*
49.00	86	1.211	2427	Good
49.00	82	1.201	2428	Good
51.00	81	1.201	2429	Good
47.00	103	1.225	2430	Good
39.00	93	1.204	2431	Good
-	-	-	2432	Missing
-	-	-	2433	Missing
40.00	85	1.190	2434	Good
-	-	-	2435	Missing
38.00	98	1.188	2436	Good
44.00	76	1.184	2437	Good
51.00	79	1.189	2438	Good
53.00	106	1.173	2439	Good
59.00	76	1.187	2440	Good
59.00	111	1.186	2441	Good
6649.00	-9	1.185	2442	Verified Failure
42.00	75	1.166	2443	Good
43.00	85	1.176	2444	Good
43.00	119	1.170	2445	Good
42.00	104	1.193	2446	Good
48.00	79	1.177	2447	Good
42.00	76	1.170	2448	Good
38.00	75	1.255	2449	Good
38.00	80	1.226	2450	Good
33.00	91	1.221	2451	Good
36.00	67	1.213	2452	Good
38.00	92	1.218	2453	Good
36.00	85	1.264	2454	Good
35.00	79	1.210	2455	Good
-	-	-	2456	Missing
-	-	-	2457	Missing
30.00	82	1.202	2458	Good
30.00	89	1.216	2459	Good
30.00	88	1.203	2460	Good
32.00	85	1.190	2461	Good
34.00	83	1.184	2462	Good
35.00	97	1.178	2463	Good
34.00	89	1.180	2464	Good
35.00	82	1.186	2465	Good
-	-	-	2466	Missing
32.00	124	1.172	2467	Good
32.00	74	1.174	2468	Good
-	-	-	2469	Missing
30.00	83	1.187	2470	Good
30.00	44	1.165	2471	Good
31.00	103	1.175	2472	Good

* Data was determined to be incorrect and was manually edited.

Data is stored on Transistor Tape, file nos. 27 & 28

APPENDIX G

TYPICAL DATA SUMMARY

MANUF	PART NO.	TYPE
T.I.	SKA8029	NPN

TEST CONDITIONS - SKUNK HOLLOW PANAMA
PACKAGE - EPOXY (NEW)
CONSTRUCTION - ALUM - GOLD WIRES - NO DIECOATING
COMMENTS - FROM TI - PEM TYPE TESTED
BOARD - 2425-2448 2449-2472

FILE 38

READ OUT DATE MO-DAY-YR	HOURS ON TEST	NO. OF DEV.	ACCUMULATED DEVICE HOURS	NO. OF FAIL	FAIL. RATE % per 1000 Hours
/03-12-73/	0	48	0	0	0.00 %
/07-19-73/	2,856	48	137,088	0	1.68 %
/02-28-74/	7,992	48	383,616	0	0.60 %
12-12-74	14,040	47	667,872	1	0.60 %
09-15-75	19,776	45	925,992	1	0.43 %
04-01-76	23,476	45	1,092,491	2	0.46 %
02-15-77	29,176	44	1,343,292	5	0.60 %
07-31-78	37,176	41	1,671,292	5	0.48 %
09-28-79	46,176	41	2,040,292	6	0.52 %

APPENDIX H

SPLIT BOARD ROUTINE

```
0: "FIXING FILES 1 THRU 8 TO ACCOUNT FOR SPLIT BOARDS":
1: trk 0
2: dim C$[5,80],C[2,16,4]
3: cll 'edit'(2,2,9,16)
4: cll 'edit'(4,1,1,8)
5: cll 'edit'(6,2,9,16)
6: cll 'edit'(8,1,1,8)
7: end
8: "edit":
9: ldf p1,C$,C[*]
10: for J=p3 to p4
11: 0→C[p2,J,1]→C[p2,J,2]→C[p2,J,3]→C[p2,J,4]
12: next J
13: rcf p1,C$,C[*]
14: ret
```

APPENDIX I

TABLE OF CONTENTS ROUTINE

```
0: "PRINT TABLE OF CONTENTS OF DATA ON TAPE":
1: dim A$[68],B$[44],X,Y,T$[50],D$[20]
2: ent "Title of tape?",T$
3: " "&T$&" "→T$
4: for I=1+len(T$) to 50
5: " "→T$[I,I]
6: next I
7: fmt 25x,"CONTENTS OF TAPE ENTITLED - ",c50,2/
8: wrt 6,T$
9: ent "Today's date?(29 June 1978)",D$
10: fmt 89x,c20,2/
11: wrt 6,D$
12: fmt "FILE #";wrt 6
13: trk 0
14: for I=1 to 199 by 2
15: fdf I
16: idf A,A,A,A
17: if A=0;199→I;gto +4
18: ldf I,A$,B$,X,Y
19: fmt f4.0,",",3x,c68,3x,c44
20: wrt 6,I,A$,B$
21: next I
22: end
```