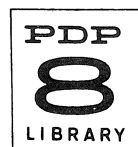


1. IDENTIFICATION
- 1.1 PDP-8 Maindec 826-A
- 1.2 680 8-Bit Character Exerciser
- 1.3 November 8, 1965



2. ABSTRACT

The 680 8-Bit Character Exerciser program further verifies correct operation of the 680 DCS system. This test assumes that the Teletype lines are full duplex. However, if the line outputs are jumpered to the line inputs, the test does verify that the input characters are received as transmitted.

3. REQUIREMENTS

3.1 Storage

3.1.1 Exerciser Program

	ADDRESS	0
Concurrent Output Test	1200 ₈	to 1377 ₈
Output Data Table	1400 ₈	to 1535 ₈
Concurrent Input Test	1600 ₈	to 1616 ₈
Output Switch Register Routine	2000 ₈	to 2074 ₈
Output Buffer	2200	to 2377 ₈
Input Buffer	2400	to 2577 ₈
Interrupt Routine	0001	to 0004

3.1.2 Character Assembly Subroutines (List of Items)

TT8BGN (Start of Subroutines)	3000 ₈	to 3376 ₈
T8IN (TTI Area)	3377 ₈	to 4177 ₈
T8IBF (Input Buffer)	4200 ₈	to 4577 ₈
T80BF (Output Buffer)	4600 ₈	to 4777 ₈
T80BF2 (Second Output Buffer)	5000 ₈	to 5177 ₈
TT8PG0 (Page 0 Constants)	0126 ₈	to 0144 ₈
TTCHAR (Character Register)	0177 ₈	
T8AX1 (Autoindex)	14	
T8AX2 (Autoindex)	15	
T8AX3 (Autoindex)	16	

3.2 Subprograms and/or Subroutines

Digital-8-35-S-B, 680 8-Bit Character Assembly Subroutines

3.3 Equipment

Minimum Configuration PDP-8

680 DCS hardware (including a 110 Baud Clock)

3.4 Miscellaneous

The 110 Baud Clock in CLOCK 2.

4. USAGE

4.1 Loading

4.1.1 If the Binary Loader beginning at address 7777 is in memory, see Section 4.1.2. Otherwise the RIM Loader and/or the Binary Loader must be loaded into memory.

4.1.2 The 680 8-Bit Character Exerciser may now be loaded into memory as follows:

Set 7777₈ in the SWITCH REGISTER
Press the LOAD ADDRESS key
Place the Character Exerciser in the keyboard reader
Press START
Engage the keyboard reader

4.3 Switch Settings (See Section 4.4)

4.4 Start up and/or Entry

4.4.1 Concurrent Output Test

Set the SWITCH REGISTER to 1200

Press the LOAD ADDRESS key.

Set the SWITCH REGISTER equal to the lowest line number to be tested.

Press START; the processor halts at address 1202.

Set the SWITCH REGISTER equal to the number of lines to be tested. *works OK for 2 lines higher no. not tested.*

Press CONTINUE; the program outputs a fixed message on all the lines selected.

4.4.2 Concurrent Input Test

Set the SWITCH REGISTER to 1600.

Press the LOAD ADDRESS key.

Press START; the program scans 128 lines for input and retransmits characters received on the same line as they are received. *Response to keyboard may slow or not present. Raising no. of lines as below, works OK. Response slows down as no. of lines increases.*

Note that the 680 8-Bit Character Assembly subroutines as currently coded will not process 128 lines at 110 Baud. Therefore, it is necessary to do the following before running the Concurrent Input Test:

Set the SWITCH REGISTER to 1616. *✓*

Press the LOAD ADDRESS key.

Set the SWITCH REGISTER equal to the number of lines on the system.

Press the DEPOSIT key.

The Concurrent Input Test may be run as above.

4.4.3 Output the contents of the SWITCH REGISTER.

Set the SWITCH REGISTER to 2000.

Press the LOAD ADDRESS key.

Set the SWITCH REGISTER to the line number to be tested.

Press START; the processor halts at address 2002.

Set SWITCH REGISTER bits 4 through 11 equal to the character to be transmitted, and SW0 as follows:

SW0 - down: Do not test for input.

SW0 - up: Wait for input and verify that it is the same character as transmitted.

Press CONTINUE; the program transmits a carriage return, line feed, the contents of the AC switches 64 times, and then repeats.

Note that since the input is two characters behind the output, (due to the double buffering of the Character Assembly Subroutines), SW0 may not be changed from 0 to a 1 once the program is running. It may, however, be changed from a 1 to a 0 and switches 4 through 11 may be altered at any time.

4.5 Errors In Usage

Hardware malfunctions detected by the program result in a processor halt. The following is a list of these error halts and their meanings:

4.5.1 Address 0002 Not Clock Interrupt

Either an interrupt was received from a device other than Teletype Clock 2 or the IOT 6431 did not skip after an interrupt from Clock 2.

4.5.2 Address 1312 Data Error

The processor halts with a line number displayed in the AC, indicating that a data error has occurred on that line. Press CONTINUE and the processor halts at address 1315 with the character that should have been received in the AC. Press CONTINUE again and the processor halts with the character that is received in the AC.

4.5.3 Address 2060 Data Error (Output AC Switches Routine)

Processor halts with the character transmitted in the AC. This could be a carriage return, a line feed, or the code contained in the SWITCH REGISTER. Press CONTINUE, and the processor halts with the character that is displayed in the AC.

4.5.4 Detection of an Open Input Line.

If the data error halt at address 1312 is consistently executed with a specific line number and the character received is always 0, it indicates that the input line is in a constant "SPACE" or open line state.

4.5.5 Detection of a Constant "MARK"

The 680 Character Exerciser was written with the assumption that the Teletype lines being tested are full duplex. Also, the program assumes that any input received during the Concurrent Output Test is due to the fact that the line outputs are tied to line inputs. Therefore, if there is no input on a line or any of the lines, the program does not consider it an error. Assuming the test is operating with inputs tied to outputs, the only way to be sure that a line is transmitting and receiving is to open the input line in order to force a data error.

Note that this procedure is also likely to display any errors in translating line numbers; i.e., input line 17 is opened and the processor does not halt. The line is then closed again and an error is indicated on line 37. The malfunction is probably in the decoding of line 17.

4.6 Recovery from Such Errors

Pressing CONTINUE causes the program to proceed. It is possible that an error halt will leave some of the output lines in a "SPACE" condition. If this happens, any Teletypes that are tied to these outputs will run freely until the program continues. Also, in the process of opening lines to test for transmitting and receiving, it is possible to get the input of a line out of sequence with the output. In this case, it is necessary that the test be restarted.

5. Restrictions

The Character Assembly Subroutines scan the lines in even multiples of eight lines. Therefore, it is possible that an error could be indicated on a line or lines that have not been selected to be run, i.e., the Output SWITCH REGISTER Routine, if line 1 is selected to be run, the inputs of lines 2, 3, 4, 5, 6, 7 and 10₈ should be placed in the "MARK" state.

6. DESCRIPTION

6.1 Discussion

6.1.1 General

The 680 8-Bit Character Exerciser transmits and/or receives ASCII Teletype data at the line speed of Teletype clock 2 and verifies correct operation of the 680 DCS hardware. The program allows parameters to exercise up to 128 lines and includes three modes of test: Concurrent Output, Concurrent Input, and Output the Switch Register.

6.1.2 Test Descriptions

6.1.2.1 Concurrent Output Test

The Concurrent Output Test will accept parameters to transmit on from 1 to 128 lines. The program assumes that all of the lines selected are full duplex and that any input is due to an output line jumpered to an input line. The following message is transmitted on all lines selected:

```
THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG'S BACK
0123456789 ! " # $ % ' ( ) * + - . / : ; < = > ? @ [ \ ] ^ _
```

If input is received on any of the lines selected, the program verifies that the characters received are received in the same order that they are transmitted. Also, since the input is tested almost independently of the output, it is possible to jumper input lines to output lines in any configuration that is desired, including and/or other than 1 for 1.

6.1.2.2 Concurrent Input Test

The Concurrent Input Test initializes to scan all 128 lines for input. When a character is received on a line, the program transmits the character received on the same line. (See Section 4.4.2.)

6.1.2.3 Output the Switch Register Routine

This routine transmits the code contained in SWITCH REGISTER bits 4 through 11 on the line specified by the contents of the SWITCH REGISTER when the routine is started. The program transmits a carriage return, line feed, the contents of the SWITCH REGISTER 64 times, and then repeats. If SWITCH REGISTER bit 0 is a 1, the program transmits a character, waits for it to be input, and then verifies that the output and the input are equal. Since the input is two characters behind the output, (due to the double buffering of output characters in the Character Assembly Subroutines) the compare mode must be selected at the time the processor halts at address 2003.

7. METHODS (Not Applicable)
8. FORMAT (Not Applicable)
9. EXECUTION TIME (Not Applicable)
10. PROGRAM
- 10.4 Program Listing

```
/8BIT CHARACTER ASSEMBLY SUBROUTINES
/TYPE 680 TELETYPE LINE MULTIPLEXER
/LMH 7-8-65, 8 BIT
```

```
TIBBGN=3000
TIBPG0=126
TIBBF=4600
TIBF=4200
TIBBF2=5000
TIBAX1=14
TIBAX2=15
TIBAX3=16
TIBCHAR=177
TIBIN=3377
```

```
TII=6402 /TELETYPE INPUT COMMAND
TIO=6404 /TELETYPE OUTPUT COMMAND
TICL=6411 /CLEAR LINE REGISTER
TIRL=6414 /READ LINE REGISTER
TISL=6412 /SET LINE REGISTER, CLR AC
TIBON=6434 /TURN CLOCK ON
TIBOFF=6432 /TURN CLOCK OFF
TIBSKP=6431 /SKIP ON CLOCK FLAG
TIBINCR=6401 /INCREMENT LINE REGISTER
```

```
*TIBPG0
0126 0000 TIBINFL, 0 /INPUT READY FLAG
0127 4177 TIBBFK, TIBBF-1 /IO RESEI INPUT BUFFER POINTER
0130 0000 TIBNL, 0 /-NUMBER OF LINES
0131 4600 TIBK7, TIBBF /K FOR 1ST OUTPUT BUFFER
0132 3021 TIBK8, TIBCOM /IO ENTER COMMON ROUTINE
0133 3151 TIBSOUT, TIBOUI5 /SKIP IF OUTPUT FREE
0134 3200 TIBSIN, TIBINS /SKIP IF INPUT READY
0135 3224 TIBGO, TIBGUS /INITIALIZE ROUTINE
0136 3344 TIBIES, TIBSE /SKIP IF EITHER LINE READY
0137 4600 TIBOUTK, TIBBF /POINTER TO FIRST OUTPUT BUFFER
0140 5000 TIBOTK2, TIBBF2 /POINTER TO 2ND OUTPUT BUFFER
0141 5000 TIBK36, TIBBF2 /K FOR 2ND OUTPUT BUFFER
0142 7770 TIBCNT1, -10 /HOLD MAJOR LOOP COUNTER
0143 0000 TIBCNT2, 0 /MINOR LOOP COUNTER
0144 0000 TIBCNT3, 0 /COUNTER FOR INPUT BUFFER
*TIBBGN
/MULTIPLE LEVEL INTERRUPT ROUTINE
/ALLOWS MULTIPLE LEVEL INTERRUPT TO THIS ROUTINE
/AND UNLIMITED OTHERS
```

```

3000 2334 T0DIS, ISZ 18LC /LEVEL COUNTER
3001 5216 JMP 18DIS3 /2ND LEVEL INTERRUPT
3002 3335 DCA 18SA /SAVE ACCUMULATOR
3003 7010 RAR /GET LINK
3004 3336 DCA 18SVLK /SAVE LINK
3005 1000 TAD Z 0 /INTERRUPT ADDRESS
3006 3337 DCA 18SV0 /SAVE ADDRESS
3007 6414 TTRL /RD LINE NUMBER
3010 3340 DCA 18SVLN /SAVE LINE NUMBER
3011 6434 ITBUN /TO CLEAR FLAG ONLY
3012 6001 T0DIS2, ION /RE-ENABLE PROGRAM INTERRUPT
3013 1350 IAD 18K9 /STARTING LINE-1
3014 6413 TTSL+1 /SET LINE REGISTER, CLEAR AC
3015 5741 JMP I 18K1 /JUMP TO ITI LOOP

/2ND LEVEL INTERRUPT
3016 6434 T0DIS3, ITBUN /CLEAR CLOCK FLAG
3017 6001 ION /RE-ENABLE PROGRAM INTERRUPT
3020 5400 JMP I Z 0 /RETURN TO THE MAIN PROGRAM

/RETURN FROM INPUT ITI LOOP
3021 1342 T0COM, IAD 18MNC /MINOR COUNTER, NUMBER OF LINES/8
3022 3143 DCA Z 18CNT2 /MINOR LOOP COUNTER
3023 1343 IAD 18LN /LINE NUMBER
3024 6413 TTSL+1 /SET LINE NUMBER
3025 1537 T0COM0, TAD I Z 18OUTK /OUTPUT WORD
3026 7450 SNA /SOMETHING TO TRANSMIT
3027 5323 JMP 18COMB /SEE IF WORD AVAILABLE
3030 6405 TTO+1 /INCR. LINE REGISTER AND OUTPUT
3031 3537 DCA I Z 18OUTK /STORE WORD
3032 1414 T0COM1, TAD I Z 18AX1 /PICK UP CHARACTER ASSEMBLY WORD
3033 7110 CLL RAR /PUT BIT 11 IN LINK
3034 7430 SZL /CHARACTER NOT COMPLETED
3035 5301 JMP 18COMB /STORE CHARACTER
3036 7200 CLA /CLEAR AC FOR IAD
3037 2137 T0COM3, ISZ Z 18OUTK /UPDATE OUTPUT ADDR
3040 2140 ISZ Z 18UIK2 /UPDATE 2ND BUFFER ADDRESS
3041 2014 ISZ Z 18AX1 /UPDATE FOR NEXT INPUT LINE
3042 2014 ISZ Z 18AX1 /UPDATE FOR NEXT INPUT LINE
3043 2143 ISZ Z 18CNT2 /ARE ONE-EIGHTH OF LINES CHECKED?
3044 5225 JMP 18COM0 /CHECK NEXT LINE

3045 6414 T0COM4, TTRL /READ LINE NUMBER
3046 3343 DCA 18LN /SAVE LINE NUMBER
3047 2142 ISZ Z 18CNT1 /HAVE ALL LINES BEEN CHECKED
3050 5263 JMP 18COM5 /RESET AND DISMISS
3051 1344 IAD 18K2 /-10
3052 3142 DCA Z 18CNT1 /RESET MAJOR LOOP COUNTER
3053 1345 IAD 18K3 /18IN+1
3054 3014 DCA Z 18AX1 /RESET INPUT LINE POINTER
3055 1350 IAD 18K9 /STARTING LINE-1
3056 3343 DCA 18LN /RESET LINE NUMBER
3057 1131 TAD Z 18K7 /18OBF
3060 3137 DCA Z 18OUTK /RESET OUTPUT LINE POINTER
3061 1141 TAD Z 18K36 /18OBF2
3062 3140 DCA Z 18UIK2 /RESET 2ND BUFFER POINTER

```

3063	6002	T0COM5,	IOF	/TURN OFF INTERRUPT
3064	7240		STA	/-1
3065	1334		IAD 18LC	/LEVEL COUNTER
3066	3334		DCA 18LC	/RESTORE LEVEL COUNTER
3067	1334		IAD 18LC	/LEVEL COUNTER
3070	7700	SMA CLA		/RESTORE AC ETC
3071	5212		JMP 18DIS2	/CHECK INPUT AGAIN, ETC.
3072	1340		IAD 18SVLN	/LINE NUMBER
3073	6413	TTSL+1		/SET LINE REGISTER, CLR AC
3074	1336		IAD 18SVLK	/PICK UP LINK
3075	7104		CLL RAL	/RESTORE LINK
3076	1335		IAD 18SA	/RESTORE ACCUMULATOR
3077	6001		ION	/ENABLE INTERRUPT
3100	5737		JMP 1 18SV0	/RETURN TO MAIN PROGRAM
3101	7112	T0COM6,	CLL NTR	/REMOVE START CODE
3102	3415		DCA 1 Z 18AX2	/STORE CHARACTER
3103	6414		TTRL	/READ LINE NUMBER
3104	3415		DCA 1 Z 18AX2	/STORE LINE NUMBER
3105	1014		IAD 4 18AX1	/PICK UP ADDRESS POINTER
3106	1346		IAD 18K5	/-2
3107	3014		DCA 4 18AX1	/RESET POINTER
3110	3414		DCA 1 Z 18AX1	/ZERO STATUS AND COUNTER WORD
3111	1347		IAD 18K6	/WORD TO RESTORE ASSEMBLY WORD
3112	3414		DCA 1 Z 18AX1	/RESET CHARACTER ASSEMBLY WORD
3113	2126		ISZ Z 18INFL	/SET INPUT READY FLAG
3114	2144		ISZ Z 18CNT5	/HAS END OF BUFFER BEEN REACHED
3115	5237		JMP 18COM3	/UPDATE REGISTERS
3116	1127	T0COM7,	IAD 2 18BFK	/18BF-1
3117	3015		DCA 2 18AX2	/RESET INPUT BUFFER ADDRESS
3120	1130		IAD 18NL	/LENGTH OF BUFFER, NUMBER OF LINES
3121	3144		DCA 2 18CNT3	/RESET LENGTH COUNTER
3122	5237		JMP 18COM3	/UPDATE REGISTERS
3123	1540	T0COM8,	IAD 1 Z 180IK2	/PICK UP DOUBLE-BUFFERED WORD
3124	7440		SZA	/NOTHING TO SEND
3125	5330		JMP .+3	/SEND NEW WORD
3126	6401		TTINCR	/INCREMENT LINE REGISTER
3127	5232		JMP 18COM1	/CONTINUE FOR INPUT
3130	6405		ITO+1	/INCR. LINE REGISTER AND OUTPUT
3131	3537		DCA 1 Z 18OUTK	/STORE WORD
3132	3340		DCA 1 Z 18OUTK2	/ZERO 2ND WORD
3133	5232		JMP 18COM1	/CONTINUE FOR INPUT

/CONSTANTS

3134	7777	T0LC,	-1	/INTERRUPT LEVEL COUNTER
3135	0000	T0SA,	0	/SAVE ACCUMULATOR
3136	0000	T0SVLK,	0	/SAVE LINK
3137	0000	T0SV0,	0	/SAVE PROGRAM COUNTER
3140	0000	T0SVLN,	0	/SAVE LINE NUMBER
3141	3377	T0K1,	T0IN	/START OF ITI SERIES
3142	0000	T0MNO,	0	/MINOR LOOP COUNTER, NO OF LINES/8
3143	0000	T0LN,	0	/LINE NUMBER
3144	7770	T0K2,	-10	/TO RESET MAJOR LOOP COUNTER
3145	3400	T0K3,	T0IN+1	/TO RESET INPUT LINE POINTER
3146	7776	T0K5,	-2	/FOR SUBTRACTION
3147	2000	T0K6,	2000	/TO RESET 8-BIT ASSEMBLY WORD
3150	0000	T0K9,	0	/STARTING LINE-1

```

/PSEUD OPERATIONS
/SKIP IF OUTPUT IS FREE AND TRANSMIT CHARACTER AT TICHAR
/OTHERWISE DONT
/LINE NUMBER MUST BE IN AC. 24US MIN. 42US MAX.
TOSOF=JMS I Z TOSOUT
TOUTS, 0
3151 0000
3152 0370 AND T8K10 /177
3153 1371 IAD T8SL /-STARTING LINE NO.
3154 1141 TAD Z T8K36 /OUTPUT BUFFER ADDR
3155 3372 DCA T8WA /WORK AREA
3156 1772 TAD I T8WA /OUTPUT CHARACTER
3157 7640 SZL CLA /SKIP IF FREE
3160 5751 JMP I TOUTS /EXIT
3161 1177 TAD Z TICHAR /PICK UP CHARACTER
3162 0373 AND T8K11 /8 BITS ONLY
3163 1374 TAD T8K12 /1400 FOR STOP CODE
3164 7104 CLL RAL /CREATE START CODE
3165 3772 DCA I T8WA /STORE CHARACTER IN TABLE
3166 2351 ISZ TOUTS /INDEX EXIT
3167 5751 JMP I TOUTS /EXIT
3170 0177 T8K10, 177 /FOR LINE NUMBER
3171 0000 T8SL, 0 /-STARTING LINE NUMBER
3172 0000 T8WA, 0 /WORK AREA
3173 0377 T8K11, 377 /FOR EIGHT BIT CODE
3174 1400 T8K12, 1400 /FOR STOP CODE
XIT8BGN+200
/SKIP IF CHARACTER AVAILABLE AND RETURN WITH LINE NO. IN AC, CH
/OTHERWISE DO NOT SKIP. 15 US MIN, 40 US MAX, 37.2US NORMAL IF I
TOSIR=JMS I Z TOSIN
TINS, 0
3400 0000
3401 6002 IOF
3402 7240 CLA CMA /SET AC TO -1 FOR IAD
3403 1126 TAD Z T8INFL /INPUT FLAG COUNTER
3404 7510 SPA /SOMETHING AVAILABLE
3405 5221 JMP T8INON /EXIT
3406 3126 DCA Z T8INFL /RESTORE FLAG COUNTER
3407 2223 ISZ T8CN14 /END OF BUFFER? STARTS AT -N-1
3410 5215 JMP .+5 /GET CHARACTER
3411 1130 TAD Z T8NL /-NUMBER OF LINES
3412 3223 DCA T8CN14 /RESET COUNTER
3413 1127 TAD Z T8BFK /BUFFER ADDRESS-1
3414 3016 DCA Z T8AX3 /RESET ADDRESS
3415 1416 TAD I Z T8AX3 /PICK UP CHARACTER
3416 3177 DCA Z TICHAR /STORE CHARACTER
3417 1416 TAD I Z T8AX3 /PICK UP LINE NUMBER
3420 2200 ISZ T8INS /INDEX EXIT
3421 6001 T8INON, ION
3422 5600 JMP I T8INS /EXIT
3423 0000 T8CNT4, 0 /-NO OF LINES
/INITIALIZATION
/ENTER WITH NUMBER OF LINES IN AC
/FORMAT
/
T8INIT=JMS I Z T8GO
3424 0000 T8GO, 0

```

3225	0321	AND T8K14	/37
3226	3130	DCA Z T8NL	/STORE NUMBER OF LINES
3227	1130	TAD Z T8NL	/NUMBER OF LINES
3230	0322	AND T8K15	/7
3231	7640	SZA CLA	/MULTIPLE OF 8?
3232	1323	TAD T8K16	/10
3233	1130	TAD Z T8NL	/NUMBER OF LINES
3234	0324	AND T8K17	/370
3235	7041	CIA	/-TWO'S COMP NUMBER OF LINES
3236	3130	DCA Z T8NL	/-N, CONSTANT
3237	1130	TAD Z T8NL	/-N
3240	3144	DCA Z T8CNT3	/INPUT COUNTER
3241	1326	TAD T8K20	/T8IN-1
3242	3014	DCA Z T8AX1	/TO STORE ITI TABLE
3243	1327	TAD T8K21	/T80BF-1
3244	3015	DCA Z T8AX2	/TO CLEAR OUTPUT AREA
3245	1343	TAD T8K37	/T80BF2-1
3246	3016	DCA Z T8AX3	/TO CLEAR DOUBLE BUFFER
3247	1130	TAD Z T8NL	/-N
3250	3223	DCA T8CN14	/FOR COUNTING
3251	1330	T8G02, TAD T8K22	/ITI+INCR
3252	3414	DCA I Z T8AX1	/STORE ITI
3253	3414	DCA I Z T8AX1	/ZERO STATUS AND COUNTER WORD
3254	1331	TAD T8K23	/ASSEMBLY RESET WORD
3255	3414	DCA I Z T8AX1	/RESET ASSEMBLY WORD
3256	3415	DCA I Z T8AX2	/ZERO OUTPUT WORD
3257	3416	DCA I Z T8AX3	/CLEAR DOUBLE BUFFER
3260	2223	ISZ T8CN14	/COUNTER
3261	5251	JMP T8G02	/DO NEXT LINE
3262	1332	TAD T8K24	/JMP I Z T8K8
3263	3414	DCA I Z T8AX1	/STORE FINAL JUMP
3264	1130	TAD Z T8NL	/-N
3265	7012	RTR	/DIVIDE BY 4
3266	7010	RAR	/DIVIDE BY 8
3267	0333	AND T8K25	/17
3270	1334	TAD T8K26	/7760, MAKE NUMBER NEGATIVE
3271	3735	DCA I T8K27	/T8MNC
3272	7240	STA	/-1
3273	3223	DCA T8CN14	/SET COUNTER TO SKIP 1ST TIME
3274	1127	TAD Z T80FK	/T8IBF-1
3275	3015	DCA Z T8AX2	/SET INPUT BUFFER POINTER
3276	1336	TAD T8K28	/-10
3277	3142	DCA Z T8CNT1	/MAJOR LOOP COUNTER
3300	1337	TAD T8K30	/T8IN+1
3301	3014	DCA Z T8AX1	/SET ITI POINTER
3302	1131	TAD Z T8K7	/T80BF
3303	3137	DCA Z T8OUTK	/1ST OUTPUT BUFFER POINTER
3304	1141	TAD Z T8K36	/T80BF2
3305	3140	DCA Z T8OUTK2	/2ND OUTPUT BUFFER POINTER
3306	7240	STA	/-1
3307	1624	TAD I T8G05	/STARTING LINE NO.
3310	3740	DCA I T8K33	/T8K9, STARTING LINE NO. -1
3311	1740	TAD I T8K33	/T8K9
3312	7040	CMA	/MAKE NEGATIVE
3313	3741	DCA I T8K34	/T8SL, -STARTING LINE NO.
3314	3126	DCA Z T8INFL	/CLEAR INPUT FLAG COUNTER
3315	7240	STA	/-1
3316	3742	DCA I T8K35	/T8LC, RESET INTERRUPT LEVEL COUNTER

```

3317 2224    ISZ T8GUS          /INDEX EXII
3320 5624    JMP I T8GOS        /EXII

/CONSTANTS
3321 0377    T8K14,            377          /FOR LINE NUMBER
3322 0007    T8K15,            7           /FOR EVEN MULTIPLE OF 8
3323 0010    T8K16,            10          /FOR EVEN MULTIPLE OF 8
3324 0370    T8K17,            370         /FOR EVEN MULTIPLE OF 8
3325 0001    T8K18,            1           /FOR COMPLEMENTING
3326 3376    T8K20,            T8IN-1      /FOR STORING TII'S
3327 4577    T8K21,            T8BUF-1     /FOR OUTPUT AREA
3330 6403    T8K22,            TII+1       /TII + INCREMENT
3331 2000    T8K23,            2000        /ASSEMBLY RESET WORD
3332 5532    T8K24,            JMP I Z T8K8 /FOR FINAL JUMP
3333 0017    T8K25,            17          /FOR -N/8
3334 7760    T8K26,            7760        /FOR MAKING NEGATIVE
3335 3142    T8K27,            T8MNC       /FOR -N/8
3336 7770    T8K28,            -10         /FOR MAJOR LOOP COUNTER
3337 3400    T8K30,            T8IN+1      /FOR TII POINTER
3340 3150    T8K33,            T8KY        /FOR STARTING LINE-1
3341 3171    T8K34,            T8SL        /-STARTING LINE NO.
3342 3134    T8K35,            T8LC        /FOR INTERRUPT LEVEL COUNTER
3343 4777    T8K37,            T8BUF2-1    /FOR DOUBLE BUFFER

/SKIP IF CHARACTER AVAILABLE FROM EITHER OF TWO TYPES OF LINES
/OTHERWISE DO NOT SKIP. 31.5US MIN, 70.5US MAX, 60US NORMAL
/IF READY
T8IE=JMS I Z T8IES
T8SE, 0
3344 0000    T8SIR
3345 4534    T8SIR              /CHECK 8-BIT CODE
3346 5351    JMP .+3             /CHECK 5-BIT CODE
3347 2344    ISZ T8SE           /INDEX EXII
3350 5744    JMP I T8SE         /EXII
3351 3377    T8SIR              /CHECK 5-BIT CODE
3352 5744    JMP I T8SE         /EXII
3353 2344    ISZ T8SE           /INDEX EXII
3354 5744    JMP I T8SE         /EXII

PAUSE

/TYPE 680 TELETYPE LINE MULTIPLEXER 8 BIT
/EXERCISEK
/KFN 10/15/65

/START AT 1200
/WITH STARTING LINE NUMBER IN SWITCHES
/COMPUTER WILL HALT
/SET SWITCHES = 10 NUMBER OF LINES
/CONTINUE
/PROGRAM WILL RUN UNTIL AN ERROR
/IS DETECTED OR UNTIL STOP

/INTERRUPT ROUTINE

X0001
0001 6431    INRUPT,            T8SKP      /WAS II 8 BIT CLOCK
0002 7402    HLT                /NO, UNKNOWN INTERRUPT
0003 5404    JMP I .+1          /YES, PROCESS INTERRUPT
0004 3000    T8DIS              /TT8BGN

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*1200
1400 7604 DQSTBT, CLA OSR /GET STARTING LINE
1401 3230 DCA STRLIN /SAVE IT
1402 7402 HLT /HALT, WAIT NUMBER OF LINES
1403 7604 CLA OSR /GET NO OF LINES
1404 3334 DCA NUMLIN /SAVE IT
1405 1334 TAD NUMLIN /NO LINES
1406 7041 CIA /2'S COMPLEMENT
1407 3335 DCA LINDEX /SAVE FOR COUNTING
1410 1335 TAD LINDEX /SET UP
1411 3350 DCA NDEX /INDICES
1412 1336 TAD OUTDEX /FOR INITIAL
1413 1230 TAD STRLIN /SET UP OF
1414 3011 DCA Z 11 /INPUT AND
1415 1340 TAD INPUX /OUTPUT BUFFERS
1416 1230 TAD STRLIN
1417 3012 DCA Z 12
1420 1342 DCBFLP, TAD CHARAC /ADDRESS OF CHAR TABLE
1421 3411 DCA I Z 11 /TO OUTPUT BUFFER
1422 1342 TAD CHARAC /ADDRESS TO COMPARE
1423 3412 DCA I Z 12 /CHAR TO INPUT BUFFER
1424 2350 ISZ NDEX /GOT ALL LINES
1425 5220 JMP DCBFLP /NO
1426 1334 TAD NUMLIN /SET NO OF LINES IN AC

1427 4535 T8INIT /INITIALIZE ITY
1430 0000 STRLIN, 0 /STARTING LINE NUMBER
1431 6434 T8ON /TURN CLOCK ON
1432 6001 ION /TURN INTERRUPTS ON
1433 3350 DCA NDEX /GET IN SYNC
1434 2350 ISZ NDEX
1435 5234 JMP .-1
1436 7200 CLA
1437 1230 TAD STRLIN /FORM START UP
1440 1337 TAD OUTDEX+1 /OUTPUT BUFFER
1441 3343 DCA CUROUT
1442 1230 TAD STRLIN /GET FIRST LINE NO.
1443 3344 DCA CURLIN
1444 1335 TAD LINDEX
1445 3350 DCA NDEX
1446 1743 OILOOP, TAD I CUROUT /GET POINTER FOR NEXT OUTPUT
1447 3345 DCA SAVCUR
1450 1745 TAD I SAVCUR /GET NEXT OUTPUT CHARACTER
1451 3177 DCA Z T1CHAR
1452 1344 TAD CURLIN /GET LINE NUMBER
1453 4533 T8SOF /CHECK FOR FREE OUTPUT
1454 7410 SKP /OUTPUT NOT FREE
1455 2743 ISZ I CUROUT /ADD 1 TO CHARACTER POINTER
1456 1743 TAD I CUROUT
1457 7041 CIA /HAS CURRENT
1460 1346 TAD LSTCHR /LINE REACHED
1461 7440 SZA /THE END OF OUTPUT
1462 5265 JMP .+3 /NO
1463 1342 TAD CHARAC /YES RESET POINTER
1464 3743 DCA I CUROUT /TO FIRST CHARACTER
1465 2343 ISZ CUROUT /ADVANCE TO NEXT LINE
1466 2344 ISZ CURLIN /ADVANCE TO NEXT LINE

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1267	7200	CLA		/CLEAR FOR TAD
1270	2350	ISZ NDEX		/TESTED ALL LINED FOR FREE
1271	5246	JMP OTLOOP		/NO, TRY NEXT LINE
1272	4534	INLOOP,	TBSIR	/ANY INPUT AVAILABLE
1273	5236	JMP STRLIN+0		/NO, OUTPUT AGAIN
1274	3344	DCA CURLIN		/YES, SAVE LINE NO.
1275	1344	TAD CURLIN		
1276	1341	TAD INPDEX+1		/FIND INPUT POINTER
1277	3343	DCA CUROUT		/FOR THE LINE
1300	1743	TAD I CUROUT		/GET INPUT POINTER
1301	3345	DCA SAVCUR		
1302	1177	TAD ITCHAR		/GET NEXT INPUT CHARACTER
1303	0347	AND LSTCHR+1		/37
1304	7041	CIA		
1305	1745	TAD I SAVCUR		/CHARACTER INPUT
1306	7450	SNA		/EQUAL CHARACTER EXPECTED
1307	5322	JMP INCINP		/YES, INCREMENT POINIER
1310	7200	CLA		
1311	1344	TAD CURLIN		/LINE NUMBER TO AC
1312	7402	HLT		/HAL!
1313	7200	CLA		
1314	1745	TAD I SAVCUR		/CHARACTER EXPECTED TO AC
1315	7402	HLT		/HAL!
1316	7200	CLA		
1317	1177	TAD Z TICHAR		/CHARACTER RECEIVED
1320	0347	AND LSTCHR+1		
1321	7402	HLT		/HAL!
1322	2743	INCINP,	ISZ I CUROUT	/ADVANCE INPUT POINTER
1323	7200	CLA		
1324	1743	TAD I CUROUT		/GET INCREMENTED POINTER
1325	7041	CIA		
1326	1346	TAD LSTCHR		/LINE AT END OF
1327	7440	SZA		/INPUT CHARACTERS
1330	5272	JMP INLOOP		/NO, TEST FOR MORE INPUT
1331	1342	TAD CHARAC		/RESET INPUT POINTER
1332	3743	DCA I CUROUT		/TO FIRST CHARACTER
1333	5272	JMP INLOOP		/TEST FOR MORE INPUT
1334	0000	NUMLIN,	0	/NUMBER OF LINES
1335	0000	LINDEX,	0	/2'S COMPLEMENT NU OF LINES
1336	2177	OUTDEX,	BUFR-1	/FOR FILLING OUTPUT BUFFER
1337	2200	BUFR		/FOR CHECKING OUTPUT BUFFER
1340	2377	INPDEX,	INBUFR-1	/FOR FILLING INPUT BUFFER
1341	2400	INBUFR		
1342	1400	CHARAC,	CODES	/START OF 8 BIT CODES
1343	0000	CUROUT,	0	/TEMP STORAGE BUFFER POINIER
1344	0000	CURLIN,	0	/TEMP STORAGE CURRENT LINE NO.
1345	0000	SAVCUR,	0	/TEMP STORAGE CHARACTER POINTER
1346	1536	LSTCHR,	NUMCOD+1	/FOR DETECTING END OF CHARACTER
1347	0377	377		/FOR ANDING ITCHAR
1350	0000	NDEX,	0	/FOR COULING
		BUFR=2200		
		INBUFR=2400		
		/8 BIT CODES OUIPUT BY DCISIT		
		x1400		
1400	0215	CODES,	215	/CARRIAGE RETURN
1401	0212	212		/LINE FEED

1402	0212	212	/LINE FEED
1403	0324	324	/T
1404	0310	310	/H
1405	0305	305	/E
1406	0240	240	/SPACE
1407	0321	321	/Q
1410	0325	325	/U
1411	0311	311	/I
1412	0303	303	/C
1413	0313	313	/K
1414	0240	240	/SPACE
1415	0302	302	/B
1416	0322	322	/R
1417	0317	317	/O
1420	0327	327	/W
1421	0316	316	/N
1422	0240	240	/SPACE
1423	0306	306	/F
1424	0317	317	/O
1425	0330	330	/X
1426	0240	240	/SPACE
1427	0312	312	/J
1430	0325	325	/U
1431	0315	315	/M
1432	0320	320	/P
1433	0305	305	/E
1434	0304	304	/D
1435	0240	240	/SPACE
1436	0317	317	/O
1437	0326	326	/V
1440	0305	305	/E
1441	0322	322	/R
1442	0240	240	/SPACE
1443	0324	324	/T
1444	0310	310	/H
1445	0305	305	/E
1446	0240	240	/SPACE
1447	0314	314	/L
1450	0301	301	/A
1451	0332	332	/Z
1452	0331	331	/Y
1453	0240	240	/SPACE
504		/D	
1455	0317	317	/O
1456	0307	307	/G
1457	0247	247	/APOSTROPHE
1460	0323	323	/S
1461	0240	240	/SPACE
1462	0302	302	/B
1463	0301	301	/A
1464	0303	303	/C
1465	0313	313	/K
1466	0215	215	/CARRIAGE RETURN
1467	0212	212	/LINE FEED
1470	0260	260	/O
1471	0261	261	/1
1472	0262	262	/2
1473	0263	263	/3

1474	0264	264	/4
1475	0265	265	/5
1476	0266	266	/6
1477	0267	267	/7
1500	0270	270	/9
1501	0271	271	/9
1502	0240	240	/SPACE
1503	0241	241	
1504	0242	242	
1505	0243	243	
1506	0244	244	
1507	0245	245	
1510	0246	246	
1511	0247	247	
1512	0250	250	
1513	0251	251	
1514	0252	252	
1515	0253	253	
1516	0254	254	
1517	0255	255	
1520	0256	256	
1521	0257	257	
1522	0272	272	
1523	0273	273	
1524	0274	274	
1525	0275	275	
1526	0276	276	
1527	0277	277	
1530	0300	300	
1531	0333	333	
1532	0334	334	
1533	0335	335	
1534	0336	336	
1535	0337	NUCOD, 33/	
		/CHARACTER ECHO	
		/START AT 1600	
		/PROGRAM INITIALIZES FOR 128 LINES	
		/PROGRAM WAITS FOR INPUTS	
		/TRANSMITS	
		/THE CHARACTERS RECEIVED	
		/THEN WAITS FOR MORE INPUTS	
		/PROGRAM RUNS UNTIL "STOP"	
		 /ECHO	
		/INPUT CHARACTERS	
		/THEN OUTPUT THEM	
		 x1600	
1000	7200	ECHOTS, CLA	
1001	1216	TAD ONE28	/AC=128
1002	4535	T8INIT	/SETUP FOR 128 LINES
1003	0000	ECHLIN, 0	/LINE NUMBER 0 STARTING LINE
1004	6434	TT8ON	/CLOCK ON
1005	0001	ION	/ENABLE INTERRUPTS
1006	4534	T8SIR	/SKIP IF INPUT
1007	5206	JMP .-1	/INPUT NOT READY, WAIT

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1010 3215 DCA ECHDEX /SAVE LINE NUMBER
1011 1215 TAD ECHDEX /GET LINE NUMBER
1012 4533 T88OF /OUTPUT
1013 5211 JMP .-2 /NOT FREE TRY AGAIN
1014 5206 JMP ECHLIN+3 /WAIT MORE INPUT
1015 0000 ECHDEX, 0

1016 0200 ONE20, 0200
/TRANSMIT AC SWITCHES
/START AT 1000
/WITH SWITCHES = LINE NUMBER
/COMPUTER WILL HALT
/SW0 = 0 COMPUTER WILL NOT COMPARE INPUT
/SW0 = 1 COMPUTER COMPARES INPUT AGAINST OUTPUT
/SW4 TO SW11 = CHARACTER TRANSMITTED
/SW0 MAY NOT BE ALTERED ONCE RUNNING
/SW4 TO SW11 MAY BE ALTERED
/PROGRAM TRANSMITS CARRIAGE RETURN/LINE FEED
/THE SW7 TO SW11 64 TIMES
/THEN CARRIAGE RETURN LINE FEED/64 CHARACTERS
/PROGRAM RUNS UNTIL "STOP"

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/TRANSMIT AC SWITCHES
x2000
2000 7604 TRANSR, CLA OSR /GET LINE NO
2001 3205 DCA TRALIN /T5INIT+1
2002 7402 HLT /WAIT FOR CHARACTER
2003 7001 IAC /AC=NO OF LINES (1)
2004 4535 T5INIT /INITIALIZE I/O ROUTINES
2005 0000 TRALIN, 0 /LINE NUMBER
2006 6434 TT8ON /TURN CLOCK ON
2007 6001 ION /ENABLE INTERRUPTS
2010 3271 DCA TRADEX /GET IN SYNC
2011 2271 ISZ TRADEX
2012 5211 JMP .-1
2013 1267 TAD K64 /-64
2014 3271 DCA TRADEX /FOR COUNTING
2015 1272 TAD TRADEX+1 /CARRIAGE RETURN
2016 3274 DCA TRACHR /OUTPUT CARRIAGE RETURN
2017 4232 JMS TRAOUT /OUTPUT
2020 1273 TAD TRADEX+2 /LINE FEED
2021 3274 DCA TRACHR /OUTPUT CHARACTERS
2022 4232 JMS TRAOUT /OUTPUT
2023 7604 CLA OSR /GET CHARACTER IN SWITCHES
2024 0270 AND THRE77 /CLEAR ALL BUT LWR 8
2025 3274 DCA TRACHR /OUTPUT CHARACTER
2026 4232 JMS TRAOUT /OUTPUT
2027 2271 ISZ TRADEX /OUTPUT 64 CHARACTERS
2030 5223 JMP .-5 /TEST SWITCHES AGAIN
2031 5213 JMP TRALIN+6 /OUTPUT CAR. RET./LINE FEED
2032 5232 TRAOUT, JMP
2033 0000 DCA
2034 1274 TAD TRACHR /GET OUTPUT CHARACTER
2035 3177 DCA TTCHAR /FOR OUTPUTTING
2036 1205 TAD TRALIN /LINE NUMBER
2037 4533 T88OF
2040 5233 JMP .-5 /OUTPUT NOT FREE, TRY AGAIN

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2041	7604	THASW0,	CLA OSR	/GET SWITCHES
2042	7004	RAL		/BIT 0 TO LINK
2043	7620	SNL CLA		/0 SET
2044	5632	JMP I TRAQUI		/NO, EXIT
2045	4534	TRAWAT,	T0SIR	/SKIP IF INPUT
2046	2045	JMP.-1		/NO INPUT, WAIT
2047	7200	CLA		
2050	1177	TAD TICHAR		/GET CHARACTER
2051	0270	AND THRE77		/CLEAR STOP BIT
2052	7041	CMA IAC		
2053	1274	TAD TRACHR		/CHARACTER RECEIVED=SENT
2054	7450	SNA		
2055	5632	JMP I TRAQUI		/EXIT
2056	7200	CLA		
2057	1274	TAD TRACHR		/CHARACTER SENT
2060	7402	HLT		/HALT
2061	7200	CLA		
2062	1177	TAD TICHAR		/CHARACTER RECEIVED
2063	0270	AND THRE77		/TO LAST 8 BITS
2064	7402	HLT		/HLT
2065	7200	CLA		
2066	5632	JMP I TRAQUI		/EXIT
2067	7700	K04,	7700	/-64
2070	0377	THRE77,	3//	/FOR ANDING
2071	0000	TRADEX,	0	/FOR COUNTING
2072	0215	215		/CARRIAGE RETURN
2073	0212	212		/LINE FEED
2074	0000	TRACHR,	0	/CHARACTER STORAGE

BUFR	2200
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CHARAC	1342
CODES	1400
CURLIN	1344
CUROUT	1343
DOBFLP	1220
DUSTST	1200
ECHDEX	1615
ECHLIN	1603
ECHOTS	1600
INBUFR	2400
INCINP	1322
INLOOP	1272
INPDEX	1340
INRUPT	0001

K04	2067
LINDEX	1335
LSTCHR	1346
NUCOD	1535
NUEX	1350
NUMLIN	1334
ONE20	1616
OIL00P	1246
OUTDEX	1336

SAVCUR	1345
SIRLIN	1230
THRE77	2070
TRACHR	2074
TRADEX	2071
TRALIN	2005

TRANSR	2000
TRAOUT	2032
THASW0	2041
TRAWAT	2045
TICHAR	0177
TICL	6411
TII	6402
TIINCR	6401
TIO	6404
TIRL	6414
TISL	6412
TIBBGN	3000
TIBOFF	6432
TIBON	6434
TIBPQ0	0126
T0SIR	3377
TAAX1	0014
TAAX2	0015

TAAX3	0016
T0BPK	0127
T0CNT1	0142
T0CNT2	0143
T0CNT3	0144
T0CNT4	3223
T0COM	3021
T0COM0	3025
T0COM1	3032
T0COM3	3037
T0COM4	3045
T0COM5	3063
T0COM6	3101
T0COM7	3116
T0COM8	3123
T0DIS	3000
T0DIS2	3012
T0DIS3	3016
T0G0	0135
T0G00	3224
T0G02	3251
T0IBF	4200
T0IES	0136
T0IN	3377
T0INFL	0126

T0INIT	4535	T0K26	3334	T00BF	4600
T0INON	3221	T0K27	3335	T00BF2	5000
T0INS	3200	T0K28	3336	T00TK2	0140
T0K1	3141	T0K3	3145	T0OUTK	0137
T0K10	3170	T0K30	3337	T0OUTS	3151
T0K11	3173	T0K33	3340	T0SA	3135
T0K12	3174	T0K34	3341	T0SE	3344
T0K14	3321	T0K35	3342	T0SIE	4536
T0K15	3322	T0K36	0141	T0SIN	0134
T0K16	3323	T0K37	3343	T0SIR	4534
T0K17	3324	T0K5	3146	T0SKP	6431
T0K18	3325	T0K6	3147	T0SL	3171
T0K2	3144	T0K7	0131	T0SOF	4533
T0K20	3326	T0K8	0132	T0SOUT	0133
T0K21	3327	T0K9	3150	T0SVLK	3136
T0K22	3330	T0LC	3134	T0SVLN	3140
T0K23	3331	T0LN	3143	T0SV0	3137
T0K24	3332	T0MNC	3142	T0WA	3172
T0K25	3333	T0NL	0130	D	

11. DIAGRAMS (Not Applicable)

12. REFERENCES

12.1 Other Library Programs

Digital-8-35-S-B

680 8-Bit Character Assembly Subroutines

