1. IDENTIFICATION

1.1 Maindec 825

1.2 680 Static Test

1.3 October 22, 1965

2. ABSTRACT

The 680 Static Test verifies correct operation of the 681 and 685 circuits associated with the 680 Data Communications System in a static state. That is, the program does not actually transmit characters, but tests only the logical operation of the hardware. Hardware malfunctions detected by the program result in a processor halt.

3. REQUIREMENTS

3.1 Storage

Test or Routine	Starting Address	End Address
Interrupt Routine	0000	0002
End of Test	0030	0070
Common Display Halt	0074	0107
Line Register Test	0200	0324
TTI Test	0400	0475
TTO TTI Test	0600	0726
Shift the MB Test and	1000	1176
Shift the MB Subroutine	0730	0772
Clock Test	1200	1361
Power Clear Test	1400	1434

3.2 Subprograms and/or subroutines

None

3.3 Equipment

Minimum configuration PDP-8
680 DCS hardware

3.4 Miscellaneous (NB)

Jumper wire from location LMBI-H to LMBI-U on the 685 Panel. (Input to output of line 0).

4. USAGE

4.1 Loading

4.1.1 If the BIN RIM Loader starting at address 7777 is in memory, go to paragraph 4.1.2. Otherwise, the BIN RIM Loader must be loaded into memory.

The 680 Static Test may now be loaded into memory as follows:

4.1.2 Set 7777 in the SWITCH REGISTER.

4.1.3 Press LOAD ADDRESS key.

4.1.4 Place the 680 Static Test in the keyboard reader.

4.1.5 Press the START key on the operator console.

4.1.6 Engage the keyboard reader.

4.3 Switch Settings

Switch 0 - up - cycle all tests except Power Clear Test.

Switch 1 - up - repeat current test (switch 0 overrides switch 1).

Switches 0 and 1 - down - halt at completion of current test and repeat current test if CONTINUE or START is pressed.

Switches 10 and 11 - Indicate which clock to test
00 - Clock 1
01 - Clock 2
10 - Clock 3
11 - Clock 4

4.4 Start up and/or Entry

4.4.1 Line Register Test

Set the SWITCH REGISTER to 0200_8
Press LOAD ADDRESS
Press START

4.4.2 TTI Test

Set the SWITCH REGISTER to 0400_8
Press LOAD ADDRESS
Press START

4.4.3 TTO and TTI Test

Set the SWITCH REGISTER to 0600_8
Press LOAD ADDRESS
Press START

4.4.4 Shift the MB Test

Set the SWITCH REGISTER to 1000_8
Press LOAD ADDRESS
Press START

4.4.5 Clock Test

Set the SWITCH REGISTER to 1200_8
Press LOAD ADDRESS
Set switches 10 and 11 to select the appropriate clock
Press START

4.4.6 To cycle through all of the above tests

Set the SWITCH REGISTER to 0200_8
Press LOAD ADDRESS
Set switch 0 - up
Set switches 10 and 11 to select the appropriate clock
Press START

4.4.7 To cycle any of the above tests by itself

Set the SWITCH REGISTER to the appropriate address
Press LOAD ADDRESS
Set switch 1 - up
Press START

4.4.8 Power Clear Test

Set the SWITCH REGISTER to 1400_8
Press LOAD ADDRESS
Press START
The processor will halt at address 1407
Press START
The processor will halt at address 1433

4.5 Errors in Usage

If the program detects a hardware malfunction, the result will be a processor halt.

4.5.1 ADDRESS 0077 COMMON DISPLAY HALT

The processor will halt with the error address displayed in the AC. Press CONTINUE and the processor will halt at address 102 with the contents of memory address 11 displayed in the AC. Press CONTINUE again, and the processor will halt at address 107 with the contents of memory address 10 displayed in the AC.

The address in the AC on the first halt indicates the type of error.

The contents of the AC on the second halt indicates the correct information as it pertains to the type of error.

The contents of the AC on the third halt indicates the incorrect information as it pertains to the type of error.

4.5.2 Non-Error Halts

ADDRESS 0054	END OF TEST
ADDRESS 1407	POWER CLEAR TEST, WAIT FOR START KEY
ADDRESS 1433	END OF POWER CLEAR TEST

4.5.3 Error Table

The following is a list of error halts included in the program:

ERROR TABLE

Address of Halt	Contents of AC	Error Description
0077	0246	TTSL ERROR
0102	0XXX	LINE REGISTER SHOULD EQUAL
0107	0XXX	LINE REGISTER READ BACK

ERROR TABLE (continued)

Address of Halt	Contents of AC	Error Description
0077	0277	TTINCR ERROR
0102	0XXX	LINE REGISTER SHOULD EQUAL
0107	0XXX	LINE REGISTER READ BACK
0077	0316	TTINCR ERROR
0102	0XXX	LINE REGISTER SHOULD EQUAL
0107	0XXX	LINE REGISTER READ BACK
0077	1170	SHIFT THE MB ERROR
0102	XXXX	CHARACTER ASSEMBLY WORD SHOULD EQUAL
0107	XXXX	CHARACTER ASSEMBLY WORD DOES EQUAL
0203		IOT 6410 (TT DO NOTHING) CLEARED THE AC
0206		IOT TTSL DID NOT CLEAR THE AC
0212	0XXX	IOT TTCL DID NOT CLEAR THE LINE REGISTER OR IOT TTRL DID NOT READ BACK CORRECTLY
0224		IOT TTSL DID NOT SET THE LR TO 177_8 OR IOT TTRL DID NOT READ BACK 177_8
0230		A SECOND TTSL CLEARED THE LINE REGISTER
0254		IOT TTINCR OPERATED AS A TTI INSTRUCTION AND SKIPPED LOCATIONS
0256		IOT TTINCR DID NOT INCREMENT THE LINE REGISTER FROM 177 to 000
0412		IOT TTI DID NOT SKIP
0416		IOT TTI (SAME TTI AS 0412) ONLY SKIPPED 1 LOCATION
0427	XXXX	IOT TTI STATUS WORD = 0000 ALTERED THE STATUS WORD
0432	XXXX	IOT TTI (SAME TTI AS 0426) ALTERED THE CHARACTER ASSEMBLY WORD

ERROR TABLE (continued)

Address of Halt	Contents of AC	Error Description
0440		IOT TTI SHIFTED THE AC
0442		IOT TTI (SAME TTI AS 0437) CLEARED THE LINK
0456		IOT TTI STATUS WORD = 4000 STATUS WORD WAS NOT INCREMENTED TO 4001
0461	XXXX	IOT TTI (SAME TTI AS 0455) ALTERED THE CHARACTER ASSEMBLY WORD
0470		IOT TTI INCREMENTED THE LINE REGISTER
0604		IOT TTO SKIPPED 1 LOCATION
0605		IOT TTO (SAME TTO AS 0604) SKIPPED 2 LOCATIONS
0607		IOT TTO (SAME TTO AS 0604) DID NOT SHIFT THE AC
0612		IOT TTO (SAME TTO AS 0604) CAUSED THE LINE REGISTER TO INCREMENT
0621		IOT TTO OR TTI (SAME TTO AS 0604) TTO DID NOT SET LINE 0 TO A 1 OR TTI DID NOT COMPLEMENT LINE 0 INTO THE STATUS WORD
0625		IOT TTO (LINK = 1 AC = 0) AC NOT SHIFTED PROPERLY, PROBABLY TTO DID NOT CLEAR LINK
0635	MAKE SURE JUMPER B1H TO B1U ON 685 IS INSTALLED.	IOT TTO OR TTI (SAME TTO AS 0624) TTO DID NOT SET LINE 0 TO A 0 OR TTI DID NOT COMPLEMENT LINE 0 INTO THE STATUS WORD
0637		IOT TTI (SAME TTI AS 0635) STATUS WORD IS OTHER THAN 0000 OR 4000
0652		IOT TTI (STATUS WORD 4003) STATUS WORD DID NOT INCREMENT TO 4004
0655		IOT TTI (SAME TTI AS 0652) CHARACTER ASSEMBLY WORD NOT ZEROS

ERROR TABLE (continued)

Address of Halt	Contents of AC	Error Description
0671		IOT TTO OR TTI (STATUS WORD 4003) TTO DID NOT SET LINE 0 TO A 1 OR TTI DID NOT INPUT LINE 0 INTO THE CHARACTER ASSEMBLY WORD
0673		IOT TTI (SAME TTI AS 0671) CHARACTER ASSEMBLY WORD WAS OTHER THAN 0000 OR 4000
0702		IOT TTI (STATUS WORD 4001) TTI ONLY SKIPPED 1 LOCATION
0711		IOT TTI (STATUS WORD 4002) TTI ONLY SKIPPED 1 LOCATION
0720		IOT TTI (STATUS WORD 4007) TTI ONLY SKIPPED 1 LOCATION
1243		CLOCK SKIP SKIPPED IN ERROR
1252		INTERRUPT WAS RECEIVED WITH THE CLOCK FLAG OFF
1260	MAKE SURE CORRECT SW'S SET. U+Q CLOCK 2 = SW 11	CLOCK FLAG DID NOT SET WITHIN 12 MSEC OR THE CLOCK SKIP IOT DID NOT SKIP
1265		INTERRUPT WAS NOT RECEIVED WITH THE CLOCK FLAG ON
1274		CLOCK ON IOT DID NOT CLEAR THE CLOCK FLAG
1301		CLOCK FLAG DID NOT SET WITHIN 12 MSEC
1305		CLOCK OFF IOT DID NOT CLEAR THE CLOCK FLAG
1313		CLOCK FLAG SET AGAIN AFTER A CLOCK OFF IOT
1316		CLOCK 1 FLAG IS SET
1321		CLOCK 2 FLAG IS SET
1324		CLOCK 3 FLAG IS SET
1332		CLOCK 4 FLAG IS SET
1416		LINE 0 WAS NOT RETURNED TO THE 1 STATE
1421		CLOCK 1 WAS NOT TURNED OFF
1424		CLOCK 2 WAS NOT TURNED OFF
1427		CLOCK 3 WAS NOT TURNED OFF
1432		CLOCK 4 WAS NOT TURNED OFF

4.6 Recovery from Such Errors

Pressing CONTINUE will cause the program to proceed to the next test sequence. However, hardware malfunctions should be repaired as soon as they are detected or erroneous indications may be given in later tests.

5. RESTRICTIONS (Not Applicable)

6. DESCRIPTION

6.1 Discussion

The 680 Static Test consists of several routines that each verify a logical operation of the 681 and 685 hardware. The routines may be run individually or progressively. The output of line 0 must be tied into its own input. Hardware malfunctions detected by the program result in a processor halt.

6.1.1 Test Descriptions

6.1.1.1 Line Register Test (Starting address 200)

The Line Register portion of the 680 Static Test exercises the IOT's associated with line register manipulations and verifies their correct operation.

The IOT's tested are:

Octal	Mnemonic	Description
6410		TT DO NOTHING
6411	TTCL	CLEAR THE LINE REGISTER
6412	TTSL	SET THE LINE REGISTER
6414	TTRL	READ THE LINE REGISTER
6401	TTINCR	INCREMENT THE LINE REGISTER
6413	TTSL+1	CLEAR THEN SET THE LINE REGISTER

6.1.1.2 TTI Test (Starting address 400)

The TTI portion of the 680 Static Test exercises the TTI IOT with the assumption that line 0 is set to the 1 state. This test verifies that the TTI IOT skips 2 locations, that the status and character assembly words are not altered, that the TTI does not shift the AC or clear the LINK, that a status word of 4000 is incremented, and that TTI does not increment the line register.

6.1.1.3 TTO and TTI Test (Starting address 600)

The TTO and TTI portion of the 680 Static Test manipulates line 0 with the TTO IOT and further verifies the correct operation of the TTI IOT. This test verifies that the TTO IOT shifts the AC, changes line 0 from the 1 to the 0 state and back again and that TTO does not skip locations or increment the line register. It also verifies that the TTI IOT reads the complement of line 0 into the status word and line 0 into the character assembly word. The test verifies that status words of 4001, 4002, and 4007 do not appear to be a status word of 4003.

6.1.1.4 SHIFT THE MB TEST (Starting address 1000)

This portion of the 680 Static Test verifies that the logic which shifts the MB will shift all combinations of bits.

6.1.1.5 CLOCK TEST (Starting address 1200. Switches 10 and 11 indicate which clock)

This portion of the 680 Static Test verifies that the clock IOT's function correctly in that they will turn on the appropriate clock without turning on any of the other clocks and that they will turn off the appropriate clock. The program also verifies the skip and interrupt functions.

6.1.1.6 POWER CLEAR TEST (Starting address 1400)

This portion of the 680 Static Test verifies correct operation of the power clear function. The program sets line 0 to a 0 state, turns on all of the clocks, and then halts. Press START, and the program verifies that line 0 is returned to the 1 state and all clocks are turned off. It is not included as one of the tests that are run with SW0 up.

7. METHODS (Not Applicable)

8. FORMAT (Not Applicable)

9. EXECUTION TIME (Not Applicable)

10. PROGRAM

10.4 Program Listing

```
                /STATIC TEST PDP-8 680
                /TYPE 680 TELETYPE LINE MUX

                /THE OUTPUT OF LINE 0
                /MUST BE JUMPERED TO IIS
                /OWN INPUT

                /IOT DEFINITIONS
                TTI=6402                /TELETYPE INPUT COMMAND
                TTO=6404                /TELETYPE OUTPUT COMMAND
                TTCL=6411               /CLEAR LINE REGISTER
                TTRL=6414               /READ LINE REGISTER
                TTSL=6412               /SET LINE REGISTER
                TTINCR=6401             /INCREMENT LINE REGISTER

                /STARTING ADDRESSES OF TESTS

                /POWER CLEAR TEST 1400

                /CLOCK IOT'S
                TT1ON=6424
                TT1OFF=6422
                TT1SKP=6421
                TT2ON=6434
                TT2OFF=6432
                TT2SKP=6431
                TT3ON=6444
                TT3OFF=6442
                TT3SKP=6441
                TT4ON=6454
                TT4OFF=6452
                TT4SKP=6451
                /SW0 = CYCLE ALL TESTS
                /SW1 = REPEAT CURRENT TEST
                /BOTH DOWN, STOP, REPEAT CURRENT TEST
                /INTERRUPT ROUTINE
                *1
0001  5402              JMP I .+1             /GO TO INTERRUPT
0002  0001              .-1                   /FOR INTERRUPT POINTER

                        /END OF TEST ROUTINE

                *30
0030  5030  ENDTST,     JMP .                 /FOR JMS
0031  7200              CLA                   /ZERO AC
0032  1030              TAD .-2               /GET RETURN ADDRESS
0033  0056              AND ONESIX /CLR TO PAGE NUMBER
0034  7112              CLL RTR               /POSITION
0035  7012              RTR                   /PAGE NUMBER
0036  7012              RTR                   /OVER
0037  7010              RAR                   /7 BITS
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0040  1061            TAD TSPNTR /GENERATE CURRENT TEST POINTER
0041  3060            DCA ONESIX+2          /SAVE IT FOR INDIRECT
0042  1460            TAD I ONESIX+2        /GET START CURRENT TEST
0043  3057            DCA ONESIX+1          /FOR RESTART
0044  2060            ISZ ONESIX+2          /ADVANCE TO GET NEXT TEST
0045  1460            TAD I ONESIX+2        /GET NEXT TEST POINTER
0046  3060            DCA ONESIX+2          /FOR START NEXT TEST
0047  7404            OSR                   /GET SWITCHES
0050  7510            SPA                   /START NEXT TEST SET?
0051  5460            JMP I ONESIX+2        /YES
0052  0070            AND FORTST /CLR TO BIT 1
0053  7450            SNA                   /NOT STOP SET?
0054  7402            HLT                   /HALT, WAIT START
0055  5457            JMP I ONESIX+1        /RESTART CURRENT TEST
0056  1600  ONESIX,    1600
0057  0000            0                     /RESTART TEST ADDRESS
0060  0000            0                     /START NEXT TEST POINTER
0061  0061  TSPNTR,    .                     /CONSTANT AND PAGE NO.IS TE
0062  0200            LINREG                /START LINE REGISTER TEST
0063  0400            TSTTTI                /START TTI TEST
0064  0600            TSTTO                 /START TTO TTI TEST
0065  1000            SHIFMB                /START SHIFT THE MB TEST
0066  1200            CLOCK                 /START CLOCK TEST
0067  0200            LINREG                /RESTART LINE REGISTER TEST
0070  2000  FORTST,    2000                  /FOR ANDING SW1

                /ERROR HALT DATA ERROR

                *74
0074  5074  ERROR,     JMP .
0075  7200            CLA
0076  1074            TAD .-2
0077  7402            HLT
0100  7200            CLA
0101  1011            TAD Z 11
0102  7402            HLT
0103  7200            CLA
0104  1010            TAD Z 10
0105  7402            HLT
0106  7200            CLA
0107  5474            JMP I ERROR
                /TYPE 680 STATIC TEST
                /LINE REGISTER TEST
                                      /PAGE 1, ADDRESS 200
                *200
0200  7240  LINREG,    CLA CMA               /SET ONES IN AC
0201  6410            6410                  /TT DO NOTHING
0202  7450            SNA                   /DO NOTHING CLEAR AC
0203  7402            HLT                   /YES, ERROR 1
0204  6412            TTSL                  /TTSL SHOULD CLEAR AC
0205  7440            SZA                   /DID IT
0206  7402            HLT                   /NO, ERROR 2
0207  6411            TTCL                  /CLEAR LINE REGISTER
0210  6414            TTRL                  /READ LINE REGISTER
0211  7440            SZA                   /LINE REGISTER CLEAR
0212  7402            HLT                   /NO, ERROR 3
0213  1322            TAD ONE77             /0177
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0214  6412            TTSL                /SET LINE REGISTER
0215  6414            TTRL                /READ LINE REGISTER
0216  3010            DCA Z 10            /SAVE READ BACK
0217  1010            TAD Z 10
0220  7040            CMA                 /COMPLEMENT READ BACK
0221  1322            TAD ONE77           /AC SHOULD = -1
0222  7040            CMA                 /COMPLIMENT IT
0223  7440            SZA                 /ALL BITS COME BACK
0224  7402            HLT                 /NO, ERROR 4
0225  6412            TTSL                /SHOULD NOT CLEAR LR
0226  6414            TTRL                /READ LINE REGISTER
0227  7650            SNA CLA             /DID SECOND TTSL CLEAR LR
0230  7402            HLT                 /YES, ERROR 5
0231  3011            DCA Z 11            /SET 11 TO 0
0232  1323            TAD K128            /-128
0233  3012            DCA Z 12            /FOR COUNTING
0234  1011  SETLOP,   TAD Z 11            /GET NEXT CONSTANT TO SET
0235  6413            TTSL+1              /CLR LR THEN SET IT
0236  6414            TTRL                /READ LR
0237  3010            DCA Z 10            /SAVE READ BACK
0240  1010            TAD Z 10
0241  7040            CMA                 /COMPLEMENT READ BACK
0242  1011            TAD Z 11            /AC SHOULD BE -1
0243  7040            CMA                 /AC SHOULD BE 0
0244  7440            SZA                 /READ BACK WHAT WAS SENT
0245  4074            JMS Z ERROR                     /NO, ERROR 6
0246  2011            ISZ Z 11            /ADVANCE TO NEXT LINE
0247  2012            ISZ Z 12            /TESTED ALL LINE NUMBERS
0250  5234            JMP SETLOP          /NO, TEST NEXT LINE NUMBER
0251  6401            TTINCR              /INCREMENT LINE REGISTER
0252  6414            TTRL                /LINE REGISTER SHOULD BE 0
0253  7410            SKP                 /SKIP
0254  7402            HLT                 /ERROR 7, TTINCR PUT US HERE
0255  7440            SZA                 /LINE REGISTER ALL ZEROS
0256  7402            HLT                 /NO, ERROR8
0257  3011            DCA Z 11            /CLEAR 11
0260  3012            DCA Z 12            /CLEAR 12
0261  1324            TAD K127            /-127
0262  3013            DCA Z 13
0263  2011  INCLOP,   ISZ Z 11            /11 SHOULD = LR AFTER TTINCR
0264  1012            TAD Z 12            /12 IS LR BEFORE TTINCR
0265  6413            TTSL+1              /CLEAR LR AND SET IT
0266  6401            TTINCR              /INCREMENT LR
0267  6414            TTRL                /READ LR
0270  3010            DCA Z 10            /SAVE READ BACK
0271  1010            TAD Z 10
0272  7040            CMA                 /COMPLEMENT READ BACK
0273  1011            TAD Z 11            /ADD CORRECT READ BACK
0274  7040            CMA                 /AC SHOULD BE ZEROS
0275  7440            SZA                 /LR INCREMENT CORRECTLY
0276  4074            JMS Z ERROR                 /NO, ERROR 9
0277  2012            ISZ 12              /SET NEXT LINE NUMBER
0300  2013            ISZ 13              /TESTED ALL LINE NUMBERS
0301  5263            JMP INCLOP /NO
0302  3011            DCA 11
0303  1324            TAD K127            /-127
0304  3012            DCA 12
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0305  6401          INCL2,    TTINCR            / INCR LR
0306  6414              TTRL                    /READ LR
0307  3010              DCA Z 10                /SAVE READ BACK
0310  1010              TAD Z 10
0311  7040              CMA                     /COMPLEMENT READ BACK
0312  1011              TAD Z 11                /ADD CORRECT LINE NO
0313  7040              CMA                     /AC SHOULD BE ZERO
0314  7440              SZA                     /LR INCREMENT OK
0315  4074              JMS Z ERROR                       /NO, ERROR
0316  2011              ISZ Z 11                /11 = LR AFTER TTINCR
0317  2012              ISZ Z 12                /TESTED INCR. TO 177
0320  5305              JMP INCL2
0321  4030              JMS Z ENDTST                      /END LINE REG TEST

0322  0177  ONE77,     0177
0323  7600  K128,      7600                    /-128
0324  7601  K127,      7601                    /-127
            /INITIAL TTI TEST
                                  /PAGE 2 ADDRESS 400
            *400
0400  7201  TSTTTI,    CLA IAC                 /CLEAR AC TO +1
0401  3272              DCA FORISZ /SET IN TEST LOCATION
0402  1202              TAD .                   /RESET INSTRUCTIONS
0403  3207              DCA .+4                 /THAT TEST TTI
0404  1273              TAD FORPL2              /JUST IN CASE OF
0405  3210              DCA .+3                 /A PREVIOUS DISASTER
0406  6402              TTI
0407  0000              0                       /TAD INSTR
0410  0000              0                       /ISZ INSTR
0411  7440              SZA                     /WAS TAD EXECUTED
0412  7402              HLT                     /YES, ERROR
0413  7240              CLA CMA                 /SET AC = -1
0414  1272              TAD FORISZ /ADD TEST LOCATION
0415  7440              SZA                     /WAS ISZ EXECUTED
0416  7402              HLT                     /YES, ERROR
0417  6411              TTCL                    /SET TO LINE 0
0420  3223              DCA .+3
0421  3224              DCA .+3
0422  6402              TTI
0423  0000              0
0424  0000              0
0425  1223              TAD .-2
0426  7440              SZA                     /DID TTI CHANGE TTI +1
0427  7402              HLT                     /YES, ERROR
0430  1224              TAD .-4
0431  7440              SZA                     /DID TTI CHANGE TTI +2
0432  7402              HLT                     /YES, ERROR
0433  7121              STL IAC                 /SET AC = 1  SET LINK
0434  6402              TTI
0435  0000              0
0436  0000              0
0437  7450              SNA                     /DID TTI SHIFT THE AC
0440  7402              HLT                     /YES,  ERROR
0441  7420              SNL                     /DID TTI CLEAR THE LINK
0442  7402              HLT                     /YES,  ERROR
0443  7200              CLA
0444  1274              TAD INCRK
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0445  3250            DCA .+3
0446  3251            DCA .+3
0447  6402            TTI
0450  4000            4000
0451  0000            Ø
0452  1275            TAD INCRK+1             /3776
0453  1250            TAD .-3
0454  7040            CMA
0455  7440            SZA                     /DID TTI +1 INCREMENT
0456  7402            HLT                     /NO, ERROR
0457  1251            TAD .-6
0460  7440            SZA                     /WAS TTI +2 CHANGED
0461  7402            HLT                     /YES, ERROR
0462  6411            TTCL                    /CLEAR LINE REGISTER
0463  6402            TTI
0464  0000            Ø
0465  0000            Ø
0466  6414            TTRL                    /READ LINE REGISTER
0467  7440            SZA                     /TTI INCREMENT LINE REGISTER
0470  7402            HLT                     /YES, ERROR
0471  4030            JMS Z ENDIST                        /END INITIAL TTI


0472  0000  FORISZ,   Ø
0473  2272  FORPL2,   ISZ FORISZ /TO CHECK IF TTI+2 IS EXECUTED
0474  4000  INCRK,    4000                    /TO CHECK IF TTI+1 IS INCRE
0475  3776            3776
            /INITIAL TTO TEST, 2ND TTI TESI
            *600
                                    /PAGE 3 ADDRESS 600
0600  6411  TSTTO,    TTCL                    /SET LINE REGISTER TO Ø
0601  7201            CLA IAC                 /SET AC TO +1
0602  6404            TTO                     /TELETYPE OUTPUT 1
0603  5206            JMP .+3                 /SHOULD EXECUTE HERE
0604  7402            HLT                     /RETURN EITHER OF THESE
0605  7402            HLT                     /TWO LOCATIONS IS ERROR
0606  7440            SZA                     /DID AC SHIFT PROPERLY
0607  7402            HLT                     /NO, ERROR
0610  6414            TTRL                    /READ LINE REGISTER
0611  7440            SZA                     /DID LR GET INCREMENTED
0612  7402            HLT                     /YES, ERROR
0613  3215            DCA .+2                 /CLEAR TTI +1
0614  6402            TTI                     /READ TTY LINE
0615  0000            Ø                       /SHOULD NOT CHANGE
0616  0000            Ø
0617  1215            TAD .-2                 /DID TTO TRANSMIT A 1
0620  7440            SZA                     /AND TTI READ COMPLEMENT
0621  7402            HLT                     /NO, ERROR EITHER TTO OR TTI
0622  7120            STL                     /SET LINK
0623  6404            TTO                             /TELETYPE OUTPUTØ
0624  7440            SZA                     /AC SHIFT PROPERLY
0625  7402            HLT                     /NO, ERROR
0626  3230            DCA .+2
0627  6402            TTI                     /TELETYPE INPUT
0630  0000            Ø
0631  0000            Ø
0632  1230            TAD .-2                 /GET STATUS WORD TTI+1
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0633  7104            CLL RAL                 /CLEAR L, BIT Ø TO L
0634  7420            SNL                     /DID TTO & TTI WORK PROPERLY
0635  7402            HLT                     /NO, ERROR
0636  7440            SZA                     /STATUS SHOULD NOT BE INCRE
0637  7402            HLT                     /STATUS WORD ERROR
0640  1324            TAD KOF3                /4003
0641  3244            DCA .+3                 /SET STATUS WORD
0642  3245            DCA .+3                 /CLEAR CHAR ASSEM WORD
0643  6402            TTI
0644  4003            4003
0645  0000            Ø
0646  1244            TAD .-2                 /GET STATUS WORD
0647  7040            CMA                     /COMPLEMENT STATUS
0650  1325            TAD KOF3+1 /4005
0651  7440            SZA                     /STATUS INCREMENT PROPERLY
0652  7402            HLT                     /NO, HALT
0653  1245            TAD .-6                 /Ø BIT IN THE
0654  7440            SZA                     /CHARACTER ASSEMBLY WORD
0655  7402            HLT                     /NO, HALT
0656  7201            CLA IAC                 /AC = +1
0657  6404            TIO                     /SET LINE Ø TO A 1
0660  1324            TAD KOF3                /4003
0661  3264            DCA .+3                 /SET STATUS WORD
0662  3265            DCA .+3                 /CLEAR ASSEMBLY WORD
0663  6402            TTI                     /INPUT LINE Ø
0664  4003            4003
0665  0000            Ø
0666  1265            TAD .-1                 /GET ASSEMBLY WORD
0667  7104            CLL RAL                 /SET BIT Ø INTO LINK
0670  7420            SNL                     /RECEIVE A 1 ON LINE Ø
0671  7402  AHALT,     HLT                     /NO, ERROR
0672  7440            SZA                     /PICK UP ANY OTHER BITS
0673  7402            HLT                     /YES, ERROR
0674  1322            TAD KOF1                /4001
0675  3301            DCA .+4
0676  1271            TAD AHALT
0677  3302            DCA .+3
0700  6402            TTI
0701  4001            4001
0702  7402            HLT
0703  1323            TAD KOF2                /4002
0704  3310            DCA .+4                 /SET STATUS WORD
0705  1271            TAD AHALT               /HLT
0706  3311            DCA .+3                 /CHARACTER ASSEMBLY WORD
0707  6402            TTI                     /TELETYPE INPUT
0710  4002            4002                    /STATUS WORD
0711  7402            HLT                     /HALT IF 2 LOOKS LIKE 3
0712  1326            TAD KOF7                /4007
0713  3317            DCA .+4                 /SET STATUS WORD
0714  1271            TAD AHALT               /HLT
0715  3320            DCA .+3                 /GET ASSEMBLY WORD
0716  6402            TTI                     /TT INPUT
0717  4007            4007                    /STATUS WORD
0720  7402            HLT                     /HALT IF 7 LOOKS LIKE 3
0721  4030            JMS Z ENDTST                    /END OF INITIAL
```

```
0722  4001  KOF1,     4001
0723  4002  KOF2,     4002
0724  4003  KOF3,     4003
0725  4005            4005
0726  4007  KOF7,     4007
            /11 TTI INSTRUCTIONS FOR SHIFMB
            *730
0730  5330            JMP .
0731  6402  TTITAB,   TTI                    /TELETYPE INPUT INSTRUCTION
0732  4003            4003                   /STATUS WORD
0733  0000            0                      /CHARACTER ASSEMBLY
0734  6402            TTI
0735  4003            4003
0736  0000            0
0737  6402            TTI
0740  4003            4003
0741  0000            0
0742  6402            TTI
0743  4003            4003
0744  0000            0
0745  6402            TTI
0746  4003            4003
0747  0000            0
0750  6402            TTI
0751  4003            4003
0752  0000            0
0753  6402            TTI
0754  4003            4003
0755  0000            0
0756  6402            TTI
0757  4003            4003
0760  0000            0
0761  6402            TTI
0762  4003            4003
0763  0000            0
0764  6402            TTI
0765  4003            4003
0766  0000            0
0767  6402            TTI
0770  4003            4003
0771  0000            0
0772  5730            JMP I TTITAB-1                  /EXIT
            /SHIFT THE MB TEST, START SHIFT IN ONES
            *1000
1000  6411  SHIFMB,   TTCL                   /CLEAR LINE REGISTER
1001  7201            CLA IAC                /AC = 1
1002  6404            TTO                    /SET LINE 0 TO A 1
1003  1373            TAD K13                /-13
1004  3013            DCA Z 13               /FOR COUNTING
1005  3011            DCA Z 11               /CLEAR SIMULATED SHIFT
1006  4344            JMS TTISHF /LOAD (11) INTO SHFREG AND TTI
1007  7120            STL                    /SET LINK TO
1010  4355            JMS SHIF11 /SIMULATE TTI SHIFT
1011  1353            TAD SHFREG /GET TTI RESULTS
1012  3010            DCA Z 10               /INTO LOC 10
1013  4362            JMS COMP11 /COMPARE LOC 10 AND LOC 11
1014  2013            ISZ Z 13               /FILLED WITH ALL ONES
1015  5206            JMP .-7                /NO, REPEAT
```

```
                /SHIFT IN ZEROS
1016  7240              CLA CMA
1017  3011              DCA Z 11                /SET LOC 11 TO ONES
1020  6404              TTO                     /SET LINE Ø TO A Ø
1021  1373              TAD K13                 /-13
1022  3013              DCA Z 13                /FOR COUNTING
1023  4344              JMS TTISHF /LOAD 11 INTO SHFREG AND TTI
1024  7100              CLL                     /CLEAR LINK
1025  4355              JMS SHIF11 /SIMULATE TTI SHIFT
1026  1353              TAD SHFREG /GET TTI RESULTS
1027  3010              DCA Z 10                /INTO LOC 10
1030  4362              JMS COMP11 /COMPARE 10 AGAINST 11
1031  2013              ISZ Z 13                /FILLED WITH ALL ZEROS
1032  5223              JMP .-7                 /NO, REPEAT

                /FLOAT A SINGLE ONE BIT
1033  1273              TAD BITØ                /4000
1034  3011              DCA Z 11                /PRESET (11)
1035  7100              CLL                     /LINK = LINE Ø
1036  4275              JMS GENTTI /GENERATE 11 TTI INSTRUCTIONS
1037  1273              TAD BITØ                /4000
1040  3011              DCA Z 11                /RESET (11)
1041  7100              CLL                     /LINK = LINE Ø
1042  4322              JMS COMTTI /COMPARE TTI RESULTS
                /FLOAT A SINGLE Ø BIT
1043  7201              CLA IAC                 /AC=1
1044  6404              TTO                     /SET LINE Ø TO 1
1045  1274              TAD BITØ+1 /3777
1046  3011              DCA Z 11                /SET CONTENTS 11
1047  7120              STL                     /LINK=LINE Ø
1050  4275              JMS GENTTI /GENERATE 11 TTI INSTRUCTION
1051  1274              TAD BITØ+1 /3777
1052  3011              DCA Z 11                /RESET CONTENTS OF 11
1053  7120              STL                     /LINK = LINE Ø
1054  4322              JMS COMTTI /COMPARE 11 TTI AGAINST (11)

                /SHIFT ALL COMB
1055  7200              CLA                     /AC = Ø
1056  6404              TTO                     /SET LINE Ø TO Ø
1057  3013              DCA Z 13                /INITIALIZE 13
1060  1013  SHFALL,     TAD Z 13
1061  3011              DCA Z 11                /SET 11 = TO NEXT SHIFT
1062  4344              JMS TTISHF /(11) TO SHFREG AND TTI
1063  7100              CLL                     /LINK = LINE Ø
1064  4355              JMS SHIF11 /SIMULATE TTI SHIFT
1065  1353              TAD SHFREG /GET TTI RESULT
1066  3010              DCA Z 10                /INTO 10
1067  4362              JMS COMP11 /COMPARE (10) = (11)
1070  2013              ISZ Z 13                /TESTED ALL COMBINATIONS
1071  5260              JMP SHFALL /NO, REPEAT
1072  4030              JMS Z ENDTST
1073  4000  BITØ,       4000
1074  3777              3777
```

```
                /SET UP 11 TTI INSTRUCTIONS
1075  5275  GENTTI,   JMP .                    /SET UP TTI TAB
1076  7204            GLK                      /GET LINK
1077  3014            DCA Z 14                 /SAVE LINK
1100  1372            TAD K11                  /-11
1101  3012            DCA Z 12                 /FOR COUNTING
1102  1375            TAD TABTTI /FIRST TTI+1-1
1103  3015            DCA Z 15                 /FOR STORING
1104  1374  FILLIT,   TAD AKOF3                /4003
1105  3415            DCA I Z 15 /TTI+1
1106  1011            TAD Z 11                 /FOR TTI+2 SHIFTING
1107  3415            DCA I Z 15               /TTI+2
1110  2015            ISZ Z 15                 /STEP PAST TTI INSTR.
1111  1014            TAD Z 14                 /GET LINK
1112  7110            CLL RAR                  /LINK = LINE Ø
1113  1011            TAD Z 11                 /GET LAST TTI+2
1114  7010            RAR                      /FOR NEXT TTI+2
1115  3011            DCA Z 11                 /RESET 11
1116  2012            ISZ Z 12                 /RESET 11 TTI
1117  5304            JMP FILLIT /NO
1120  4776            JMS I TABTTI+1           /EXECUTE TTI INSTRUCTIONS
1121  5675            JMP I GENTTI             /EXIT

                /COMPARE RESULTS OF TTI INSTRUCTIONS
1122  5322  COMTTI,   JMP .
1123  7204            GLK                      /GET LINK
1124  3014            DCA Z 14
1125  1372            TAD K11                  /-11
1126  3012            DCA Z 12                 /FOR COUNTING
1127  1375            TAD TABTTI /FIRST TTI
1130  3015            DCA Z 15                 /FOR GETTING TTI'S +2
1131  2015  COMPIT,   ISZ Z 15                 /STEP PAST STATUS WORD
1132  1415            TAD I Z 15 /GET TTI +2
1133  3010            DCA Z 10                 /FOR COMPARING
1134  1014            TAD Z 14                 /GET LINK
1135  7110            CLL RAR                  /LINK = LINE Ø
1136  4355            JMS SHIF11 /SIMULATE TTI SHIFT
1137  4362            JMS COMP11 /COMPARE (10) AND (11)
1140  2015            ISZ Z 15                 /STEP PAST TTI INSTR.
1141  2012            ISZ Z 12                 /COMPARED ALL
1142  5331            JMP COMPIT /NO
1143  5722            JMP I COMTTI             /EXIT

1144  5344  TTISHF,   JMP .                    /SET (11) INTO SHFREG, TTI
1145  1011            TAD Z 11                 /GET 11
1146  3353            DCA SHFREG /INTO TTI+2
1147  1374            TAD AKOF3                /4003
1150  3352            DCA .+2                  /INTO TTI+1
1151  6402            TTI                      /TELETYPE INPUT
1152  4003            4003                     /STATUS WORD
1153  0000  SHFREG,   Ø                        /ASSEMBLY WORD
1154  5744            JMP I TTISHF             /EXIT
1155  5355  SHIF11,   JMP .                    /SIMULATE TTI L=LINE Ø
1156  1011            TAD Z 11                 /GET 11
1157  7010            RAR                      /SHIFT AND SET BIT Ø
1160  3011            DCA Z 11                 /BACK INTO 11
1161  5755            JMP I SHIF11             /EXIT
1162  5362  COMP11,   JMP .                    /COMPARE LOC 10 AGAINST 11
```

```
1163  1010            TAD Z 10                /GET TTI RESULTS
1164  7041            CMA IAC                 /2'S COMPLEMENT
1165  1011            TAD Z 11                /ADD SIMULATED RESULTS
1166  7440            SZA                     /AC SHOULD = 0
1167  4074          JMS Z ERROR         /IT DOES NOT ERROR
1170  7200            CLA                     /JUST IN CASE
1171  5762            JMP I COMP11            /EXIT

1172  7765  K11,      7765                    /-13
1173  7763  K13,      7763                    /-13
1174  4003  AKOF3,    4003                    /FOR TTI +1
1175  0731  TABTTI,   TTITAB
1176  0730             TTITAB-1
            /CLOCK TEST, SWITCHES 10+11 INDICATE CLOCK
            *1200
1200  7604  CLOCK,    CLA OSR                 /GET CLOCK NUMBER
1201  0334            AND THREE               /CLR TO CLOCK NUMBER
1202  3335            DCA KLOCK               /SAVE IT
1203  1335            TAD KLOCK               /GET CLOCK NUMBER
1204  1336            TAD KLOCK+1             /+ TABLE ADDRES
1205  3337            DCA KLOCK+2             /= TABLE POINTER
1206  1737            TAD I KLOCK+2           /GET IOT POINTER
1207  3010            DCA Z 10                /FOR INDIRECT
1210  1410            TAD I 10                /SKIP ON CLOCK
1211  3241            DCA SKIP1               /SET FIRST CLOCK SKIP
1212  1241            TAD SKIP1
1213  3257            DCA SKIP2               /SECOND
1214  1257            TAD SKIP2
1215  3272            DCA SKIP3               /THIRD
1216  1272            TAD SKIP3
1217  3300            DCA SKIP4               /FOURTH
1220  1300            TAD SKIP4
1221  3303            DCA SKIP5               /FIFTH
1222  1303            TAD SKIP5
1223  3311            DCA SKIP6               /SIXTH
1224  1311          TAD SKIP6
1225  3267          DCA RUPTOK+1
1226  1410            TAD I 10                /TURN CLOCK ON
1227  3253            DCA ONONE               /SET UP FIRST CLOCK ON
1230  1253            TAD ONONE
1231  3266            DCA RUPTOK              /SECOND
1232  1266          TAD RUPTOK
1233  3271          DCA RUPTOK+3
1234  1410            TAD I 10                /TURN OFF CLOCK
1235  3240            DCA OFFONE              /SET UP FIRST CLOCK OFF
1236  1240            TAD OFFONE
1237  3302            DCA OFFTWO              /SECOND

1240  6422  OFFONE,   TTIOFF                  /TURN CLOCK OFF
1241  6421  SKIP1,    TTISKP                  /SKIP, IS CLOCK ON?
1242  7410            SKP                     /NO
1243  7402            HLT                     /CLOCK SKIP SKIPPED
1244  1360            TAD ADDRS
1245  3002            DCA Z 2                 /FOR INTERRUPT
1246  6001            ION
1247  7000            NOP                     /WAIT
1250  6002            IOF                     /INTERRUPT NOT IS OK
1251  7410            SKP                     /SKP ERROR HALT
1252  7402  NORUPT,   HLT                     /INTERRUPT IN ERROR
```

```
1253  6424  ONONE,    TT1ON                  /TURN CLOCK ON
1254  3337             DCA KLOCK+2
1255  2337             ISZ KLOCK+2            /WAIT
1256  5255             JMP .-1
1257  6421  SKIP2,     TT1SKP                 /SKIP WORK
1260  7402             HLT                    /DID NOT SKIP ON CLOCK
1261  1361             TAD ADDRS+1            /ADDRESS FOR INTERRUPT
1262  3002             DCA Z 2                /FOR JMP I 2
1263  6001             ION                    /TURN INTERRUPTS ON
1264  7000             NOP                    /WAIT
1265  7402             HLT                    /NO, INTERRUPT
1266  6424  RUPTOK,    TT1ON                  /CLOCK ON
1267  6421          TT1SKP              / CLOCK FLAG SET
1270  5267             JMP .-1                /NO, WAIT
1271  6424          TT1ON                /CLOCK ON, CLEAR CLOCK FLAG
1272  6421  SKIP3,     TT1SKP                 /FLAG CLEAR?
1273  7410             SKP                    /YES
1274  7402             HLT                    /FLAG NOT CLEARED BY TTXON
1275  3337             DCA KLOCK+2
1276  2337             ISZ KLOCK+2            /WAIT FOR CLOCK
1277  5276             JMP .-1
1300  6421  SKIP4,     TT1SKP                 /FLAG ON AGAIN?
1301  7402             HLT                    /NO
1302  6422  OFFIWO,    TT1OFF                 /TURN CLOCK OFF
1303  6421  SKIP5,     TT1SKP                 /FLAG CLEAR?
1304  7410             SKP                    /YES
1305  7402             HLT                    /FLAG NOT CLEARED BY TTXOFF
1306  3337             DCA KLOCK+2            /WAIT
1307  2337             ISZ KLOCK+2
1310  5307             JMP .-1
1311  6421
              SKIP6,       TT1SKP                /CLOCK ON?
1312  7410             SKP                    /NO
1313  7402             HLT                    /TTXOFF DID NOT TURN CLOCK
1314  6421             TT1SKP                 /ALL
1315  7410             SKP                    /CLOCKS
1316  7402             HLT                    /SHOULD BE OFF
1317  6431             TT2SKP                 /AT THIS POINT
1320  7410             SKP
1321  7402             HLT
1322  6441             TT3SKP
1323  7410             SKP
1324  7402             HLT
1325  6411          TTCL                   /SET LINE
1326  7201          CLA IAC             / 0 TO A
1327  6404          TTO         /1 FOR TEST 2
1330  6451             TT4SKP
1331  4030             JMS Z ENDTST           /END OF CLOCK TEST
1332  7402             HLT
1333  4030             JMS Z ENDTST           /END OF CLOCK TEST

1334  0003  THREE,     0003                   /FOR ANDING
1335  0000  KLOCK,     0                      /CLOCK NUMBER
1336  1340             KTABLE                 /TABLE ADDRESS
1337  0000             0                      /FOR INDIRECT
1340  1343  KTABLE,    TTONE-1                /IOT'S FOR CLOCK 1
1341  1346             TTTWO-1                /IOT'S FOR CLOCK 2
```

```
1342  1351              TTHREE-1          /IOT'S FOR CLOCK 3
1343  1354              TTFOUR-1          /IOT'S FOR CLOCK 4
1344  6421  TTONE,     TT1SKP            /CLOCK 1 SKIP
1345  6424              TT1ON             /CLOCK 1 ON
1346  6422              TT1OFF            /CLOCK 1 OFF
1347  6431  TTTWO,     TT2SKP            /CLOCK 2 SKIP
1350  6434              TT2ON             /CLOCK 2 ON
1351  6432              TT2OFF            /CLOCK 2 OFF
1352  6441  TTHREE,    TT3SKP            /CLOCK 2 SKIP
1353  6444              TT3ON             /CLOCK 3 ON
1354  6442              TT3OFF            /CLOCK 3 OFF
1355  6451  TTFOUR,    TT4SKP            /CLOCK 4 SKIP
1356  6454              TT4ON             /CLOCK 4 ON
1357  6452              TT4OFF            /CLOCK 4 OFF
1360  1252  ADDRS,     NORUPT
1361  1266              RUPTOK
                /POWER CLEAR TEST

                *1400
1400  7200  PWRCLR,    CLA
1401  6411              TTCL              /SET TO LINE 0
1402  6404              TTO               /LINE 0 TO A 0
1403  6424              TT1ON             /CLOCK 1 ON
1404  6434              TT2ON             /CLOCK 2 ON
1405  6444              TT3ON             /CLOCK 3 ON
1406  6454              TT4ON             /CLOCK 4 ON
1407  7402              HLT               /HALT, WAIT START
1410  3212              DCA .+2           /CLEAR STATUS
1411  6402              TTI               /TELETYPE INPUT
1412  0000              0                 /STATUS WORD
1413  0000              0
1414  1212              TAD .-2           /GET STATUS WORD
1415  7440              SZA               /LINE 0 A 1?
1416  7402              HLT               /NO
1417  6421              TT1SKP            /CLOCK ON?
1420  7410              SKP
1421  7402              HLT               /YES
1422  6431              TT2SKP            /CLOCK ON?
1423  7410              SKP
1424  7402              HLT               /YES
1425  6441              TT3SKP            /CLOCK ON/
1426  7410              SKP
1427  7402              HLT               /YES
1430  6451              TT4SKP            /CLOCK ON?
1431  7410              SKP
1432  7402              HLT               /YES
1433  7402              HLT               /END POWER CLEAR TEST
1434  5200              JMP PWRCLR        /ONLY 1 PASS


ADDRS   1360
AHALT   0671
AKOF3   1174
BIT0    1073
CLOCK   1200
COMPIT  1131
COMP11  1162
```

```
COMITI  1122
ENDTST  0030
ERROR   0074
FILLIT  1104
FORISZ  0472
FORPL2  0473
FORTST  0070
GENTTI  1075
INCLOP  0263
INCL2   0305
INCRK   0474
KLOCK   1335
KOF1    0722
KOF2    0723
KOF3    0724
KOF7    0726
KTABLE  1340
K11     1172
K127    0324
K128    0323
K13     1173
LINREG  0200
NORUPT  1252
OFFONE  1240
OFFTWO  1302
ONESIX  0056
ONE77   0322
ONONE   1253
PWRCLR  1400
RUPTOK  1266
SETLOP  0234
SHFALL  1060
SHFREG  1153
SHIFMB  1000
SHIF11  1155
SKIP1   1241
SKIP2   1257
SKIP3   1272
SKIP4   1300
SKIP5   1303
SKIP6   1311

TABTTI  1175
THREE   1334
TSPNTR  0061
TSTTO   0600
TSTTTI  0400
TTCL    6411
TTFOUR  1355
TTHREE  1352
TTI     6402
TTINCR  6401
TTISHF  1144
TTITAB  0731
TTO     6404
TTONE   1344
TTRL    6414
TTSL    6412
TTTWO   1347
TT1OFF  6422
TT1ON   6424
TT1SKP  6421
TT2OFF  6432
TT2ON   6434
TT2SKP  6431
TT3OFF  6442
TT3ON   6444
TT3SKP  6441
TT4OFF  6452
TT4ON   6454
TT4SKP  6451
```

11. DIAGRAMS (Not Applicable)

12. REFERENCES (Not Applicable)