SWTPC 6800/CT-1024/AC-30 Cassette Tape

Diagnostic Programs

　　　These two diagnostic programs have been written to generate and verify respectively cassette tapes generated on the SWTPC 6800 Computer System with the CT-1024 Terminal System and AC-30 cassette tape interface. Diagnostics for other hardware configurations may be written following a similar program step sequence as used in these diagnostics. The programs as they are listed generate and check data written in incremental segments where the recorder motor is actually turned off by the program between repeated recorded segments. Simple program "patches" change the programs to generate and check data written in continuous form as well.

SWTPC Cassette Test Tape Generator TAPWRT-1

　　　This program in its unmodified form has been written to generate a test tape which checks the recorder and interface operation in the incremental (motor start/stop) mode of operation. The recorder used of course must have a "REMOTE" (motor control) jack which is fed by the control logic on the AC-30 cassette interface. The program when initiated sends a command to turn the read logic off if on and turn the record logic on. When the record logic on the cassette interface is initiated and the motor control switch is in the auto position as it should be, there is a delay provided by an adjustable one shot on the cassette interface before "marking" carrier is actually recorded on the tape. This allows the recorder motor to come up to speed before signals are recorded which guarantees the readability of the data stored on the tape. Since the program has no way of knowing when the recorder has come up to speed and the carrier has been turned on, the program has its own software delay one shot subroutine called DELAY which must be slightly greater in length than the delay time of the electrical one shot on the cassette interface. This delay time is set by loading the hexadecimal delay time from the user set data at address A01B. The delay time is approximately 0.2 seconds times the value stored in this address. It has been arbitrarily chosen in this program to be 0F or (0.2 seconds X 0F) = (0.2 X 16) = 3.2 seconds. If you ever write your own programs using the cassette interface in the incremental (start/stop) mode you will probably want to incorporate this subroutine into your own program. You must provide ample start-up delay between the time the recorder motor is turned on and the time "marking" carrier and data is recorded on the tape.

　　　The program then sequentially writes ASCII characters 40_{16} thru 60_{16} inclusive: @ABCDEFGHIJKLMNOPQRSTUVWXYZC\]^_. These characters were chosen because they are all visible to the CT-1024 terminal system when the AC-30 cassette interface is operated in local mode. The program then sends a Control T(14_{16}) which although recorded on the tape is not displayable by the CT-1024 terminal system since it does not display control characters. This character sim1taneously turns off the recorded "marking" carrier and the recorder's motor. After which another adjustable delay loop located at address A02E is provided to give the recorder time to stop. Whether or not you need this second delay loop in your own programs will depend upon whether you will be doing incremental (start/stop) or continuous reading of your recorded tape. If you will be doing incremental reading use the delay, if continuous, it is unnecessary. After the delay the program then branches back to the beginning and repeats itself indefinitely until the system is powered down or

reset. Allowing the program to record data on one side of a spare cassette will give you a convenient cassette interface test tape.

If your system does not have motor control or if you do not wish to check for motor control or if you just want to load a suspicious tape to check for data dropouts you can disable the motor control feature simply by flipping the motor control switch on the AC-30 cassette interface to the manual position. To remove the now unnecessary software delays, use the MIKBUG memory change instruction to change the data in memory locations A01C, and A01D, to 01_{16} (No Operation) instructions before generating the test tape.

The program itself uses 68_{10} words and is loaded within the 128 word RAM used by the MIKBUG operating system on the MP-A Microprocessor/System Board. A program may reside in external RAM memory simultaneously with the program loaded within the 128 word RAM, or the program may be run with no MP-M memory boards installed on the system at all. The program may be loaded either from tape or instruction by instruction using MIKBUG starting from address A014 thru A033, and then from address A048 thru A06B. The program must be loaded in two parts to avoid interfering with the system's push down stack.

<u>To Generate an Incremental (Start/Stop) Tape</u>

1.   Load the TAPWRT-1 program into computer memory as described in the preceding instructions.

2.   Make sure you have MIC, EAR and MOTOR CONTROL connections between the AC-30 cassette interface and the recorder you wish to use.

3.   Set the AC-30 switches so the Motor Control switch is on Manual with the Record Select switch flipped to drive the correct set of jacks. Flip the Record OFF/ON and READ OFF/ON switches to clear the Ready lights if they are ON. The switches <u>must</u> then be returned to their normal center position. The Local/Remote switch should be set on Remote and the Power switch must of course be ON.

4.   Insert a previously erased tape into your recorder and rewind to the be- ginning of the tape. Put the recorder in the Play mode for about 20 seconds to advance past the leader on the tape. Stop the recorder.

5.   Flip the Motor Control switch to the AUTO position.

6.   Put your <u>recorder</u> in the Record mode. The tape should <u>not</u> move since the recorder motor is now controlled by the AC-30 interface and your computer.

7.   When you are ready for the program to start, enter a G for go on your terminal's keyboard. The tape should move for a few seconds, stop, then move again, repeatedly until stopped. All data written to tape will be simultaneously displayed on the terminal's display.

Since the program counter is set when the program is initially loaded, the program is initiated as described in the "Go to User's Program" section of the Engineering Note 100. Once initiated, the program can be stopped only by depressing the "RESET" button. The program may then be re-started after resetting the program counter to A014 as described in the "Display contents of MPU Registers Function" section of Engineering Note 100.

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To Generate a Continuous Data Tape

1.   Load the TAPWRT-1 program into computer memory as described in the preceding instructions.

2.   Using the MIKBUG memory change function, change the data in memory locations A01C, and A01D to 01_{16} (No Operation) instructions.

3.   Make sure you have MIC, EAR and if you wish, MOTOR CONTROL connections between the AC-30 cassette interface and the recorder you will be using.

4.   Set the AC-30 switches so the Motor Control switch is on Manual with the Record Select switch flipped to drive the correct set of jacks. Flip the Record OFF/ON and READ OFF/ON switches to clear the Ready lights if they are ON. The switches must then be returned to their normal center position. The Local/Remote switch should be set on Remote and the Power switch must of course be ON.

5.   Insert a previously erased tape into your recorder and rewind to the beginning of the tape. Put the recorder in the Play mode for about 20 seconds to advance past the leader on the tape. Stop the recorder.

6.   Put your recorder in the Record mode. The tape should move since the recorder motor is under manual control.

7.   After recording about 10 seconds of "marking" data, enter a G for go on your terminal's keyboard. The tape should move continuously to the end of the tape unless stopped sooner. All data written to tape will be simultaneously displayed on the terminal's display.

Since the program counter is set when the program is initially loaded, the diagnostic is initiated as described in the "Go to User's Program" section of the Engineering Note 100. Once initiated, the program can be stopped only by depressing the "RESET" button. The program may then be re-started after resetting the program counter to A014 as described in the "Display contents of MPU Registers Function" section of Engineering Note 100.

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                          NAM    TAPWRT-1
                    *SWTPC Cassette Test Tape Generator

   E1D1              OUTEE  EQU    $E1D1
   E07E              PDATA1 EQU    $E07E

   A014              ORG    $A014
   A014 CE A0 69  START    LDX    #OFF
   A017 BD E0 7E            JSR    PDATA1
   A01A 86 0F               LDA A  #$0F
   A01C 8D 2F               BSR    DELAY
   A01E C6 40               LDA B  #$40
   A020 17        LOOP2     TBA
   A021 BD E1 D1            JSR    OUTEE
   A024 5C                  INC B
   A025 C1 60               CMP B  #$60
   A027 26 F7               BNE    LOOP2
   A029 86 14               LDA A  #$14        (record off)
   A02B BD E1 D1            JSR    OUTEE
   A02E 86 08               LDA A  #$08
   A030 8D 1B               BSR    DELAY
   A032 20 E0               BRA    START

   A048              ORG    $A048
   A048 A0 14               FDB    START
   A04A           TMP       RMB    3

   A04D CE A0 4A  DELAY     LDX    #TMP
   A050 6F 00               CLR    0,X
   A052 6F 01               CLR    1,X
   A054 6F 02               CLR    2,X
   A056 6C 00     LOOP3     INC    0,X
   A058 2A FC               BPL    LOOP3
   A05A 6F 00               CLR    0,X
   A05C 6C 01               INC    1,X
   A05E 2A F6               BPL    LOOP3
   A060 6F 01               CLR    1,X
   A062 6C 02               INC    2,X
   A064 A1 02               CMP A  2,X
   A066 26 EE               BNE    LOOP3
   A068 39                  RTS

   A069 13        OFF       FCB    $13,$12,$04
   A06A 12 04

                          END

 NO ERROR(S) DETECTED

    SYMBOL TABLE:
 DELAY  A04D   LOOP2  A020   LOOP3  A056   OFF     A069   OUTEE E1D1
 PDATA1 E07E   START  A014   TMP    A04A
```

The program listings in the original document were hand assembled with a few syntax errors. These listing are from the TSC 6800 Assembler. The resulting opcodes are identical with the original.

SWTPC Cassette Tape Read Diagnostic TAPRED-1

This program reads and verifies tapes generated by the TAPWRT-1 program. The tapes may be either incremental or continuous. This program checks both types without program modifications. The first thing the program does is disable the computer's control interface echo. This prevents the tape read data from being displayed on the screen during the program. It then turns the cassette interface's read circuitry ON and looks for an @ to be read from the tape. When it reads one, it looks for all subsequent characters to be read in correct order as written by the TAPWRT-1 program. If they are, it outputs a / to the terminal's display for each string of characters read. If any one of the characters is read incorrectly including the control T (14_{16}) which follows each string of alphanumeric data, an X is output to the terminal's display. The program repeats this verification sequence until the tape is exhausted or the computer system is reset. If an error is found, the tape can be manually backed up several frames and the data displayed on the terminal's display with the AC-30 cassette interface operated in the Local mode for manual verification. Consistent error data on repeated reads indicates a record error while inconsistent error data on repeated reads indicates a read error.

This program should initially be used to verify proper operation of the AC-30 cassette interface but may be used to check the reliability of the tapes themselves once the reliability of the interface has been established. When checking for bad tapes, the test data should be recorded continuously not incrementally for thorough testing.

The program itself uses 88_{10} words and is loaded within the 128 word RAM used by the MIKBUG operating system on the MP-A Microprocessor /System Board. A program may reside in external RAM memory simultaneously with the diagnostic loaded within the 128 word RAM, or the diagnostic may be run with no MP-M memory boards installed on the system at all. The diagnostic may be loaded either from tape or instruction by instruction using MIKBUG starting from address A048, thru A07E.

To Read a Test Tape Generated by The TAPWRT-1 Program

1.   Load the TAPRED-1 program into computer memory as described in the preceding instructions.

2.   Make sure you have MIC, EAR and if you wish MOTOR CONTROL connections between the AC-30 cassette interface and the recorder you wish to use.

3.   Set the AC-30 switches so the Motor Control switch is on Manual with the RECORD SELECT switch flipped to drive the correct set of jacks. Flip the RECORD OFF/ON and READ OFF/ON switches to clear the Ready lights if they are ON. The switches must then be returned to their normal center position. The Local/Remote switch should be set on Remote and the Power switch must of course be ON.

4.   Insert a previously recorded TAPWRT-1 tape into your recorder and rewind to the beginning of the tape. Stop the recorder.

5.   When you are ready for the program to start, enter a G for go on your terminal's keyboard and put your recorder in the play mode. The tape should move and after the first block of data is read either a / or X will be displayed on the terminal's display. The / indicates a correct read while an X indicates an incorrect one.

Since the program counter is set when the program is initially loaded, the diagnostic is initiated as described in the "Go to User's Program" section of t e Engineering Note 100. Once initiated, the program can be stopped only by d pressing the "RESET" button. The program may then be re-started after resetting the program counter to A04A as described in the "Display contents of MPU Registers Function" section of Engineering Note 100.

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                            NAM     TAPRED-1
                         * SWTPC Cassette Tape Read Diagnostic
E1D1                        OUTEEE  EQU     $E1D1
E1AC                        INEEE   EQU     $E1AC


A014                        ORG     $A014
A014              TMP       RMB     3
A017 C6 02        DELOUT    LDA B   #$02
A019 CE A0 14               LDX     #TMP
A01C 6F 00                  CLR     0,X
A01E 6F 01                  CLR     1,X
A020 6F 02                  CLR     2,X
A022 6C 00        LOOPA     INC     0,X
A024 2A FC                  BPL     LOOPA
A026 6F 00                  CLR     0,X
A028 6C 01                  INC     1,X
A02A 2A F6                  BPL     LOOPA
A02C 6F 01                  CLR     1,X
A02E 6C 02                  INC     2,X
A030 E1 02                  CMP B   2,X
A032 26 EE                  BNE     LOOPA
A034 BD E1 D1               JSR     OUTEEE
A037 39                     RTS


A048                        ORG     $A048
A048 A0 4A                  FDB     START
A04A 86 3C        START     LDA A   #$3C
A04C B7 80 07               STA A   $8007
A04F 86 11                  LDA A   #$11        (read on)
A051 BD E1 D1               JSR     OUTEEE
A054 C6 40        REDO      LDA B   #'@
A056 BD E1 AC     LOOP1     JSR     INEEE
A059 11                     CBA
A05A 26 FA                  BNE     LOOP1
A05C 5C           LOOP2     INC B
A05D C1 60                  CMP B   #$60
A05F 27 08                  BEQ     RECOFF
A061 BD E1 AC     CYCLE     JSR     INEEE
A064 11                     CBA
A065 26 12                  BNE     ERROR
A067 20 F3                  BRA     LOOP2
A069 C6 14        RECOFF    LDA B   #$14
A06B BD E1 AC               JSR     INEEE
A06E 11                     CBA
A06F 26 08                  BNE     ERROR
A071 86 2F                  LDA A   #'/
A073 8D A2                  BSR     DELOUT
A075 C6 40                  LDA B   #'@
A077 20 E8                  BRA     CYCLE
A079 86 58        ERROR     LDA A   #'X
A07B 8D 9A                  BSR     DELOUT
A07D 20 D5                  BRA     REDO
                            END

NO ERROR(S) DETECTED
    SYMBOL TABLE:
CYCLE  A061    DELOUT A017    ERROR  A079    INEEE  E1AC    LOOP1  A056
LOOP2  A05C    LOOPA  A022    OUTEEE E1D1    RECOFF A069    REDO   A054
START  A04A    TMP    A014
```

<u>SWTPC 6800/AC-30 Calibrate Tape Generator Program FIVPNT-1 and Calibration</u>
<u>Procedure</u>

   To set the calibration adjustment on the AC-30 cassette interface it is wise
to generate a calibration tape containing a continuous string of ASCII fives. An
ASCII five (35_{16}) has a bit sequence of 0011 0101 which when combined with the
UART's start and stop bits gives a good alternating bit pattern for calibrating the
cassette interface. The program presented here also records a non-displayable
rubout ($7F_{16}$) between fives to aid in resynchronization of data should an incorrect
read ever take place. An alternative to this program is to operate the cassette
interface in the LOCAL mode and manually thru the terminal's keyboard enter the
fives. There is no need to enter the rubouts when the fives are written to tape
this way. To generate a calibration tape on a SWTPC 6800 Computer/CT-1024 Terminal
System with the cassette interface connected between the two use the following
procedure:

1.   Load the FIVPNT-1 program into computer memory.

2.   Make sure you have MIC, EAR and if you wish, MOTOR CONTROL connections
     between the AC-30 cassette interface and the recorder you will be using.

3.   Set the AC-30 switches so the Motor Control switch is on Manual with the
     Record Select switch flipped to drive the correct set of jacks. Flip the
     Record OFF/ON and READ OFF/ON switches to clear the Ready lights if they are
     ON. The switches must then be returned to their normal center position. The
     Local/Remote switch should be set on Remote and the Power switch must of
     course be ON.

4.   Insert a previously erased tape into your recorder and rewind to the be-
     ginning of the tape. Put the recorder in the Play mode for about 20 seconds
     to advance past the leader on the tape. Stop the recorder.

5.   Put your recorder in the Record mode. The tape should move since the recorder
     motor is under manual control.

6.   After recording about 10 seconds of "marking" data, enter a G for go on your
     terminal's keyboard. The tape should move continuously to the end of the tape
     unless stopped sooner. All data written to tape will be simultaneously
     displayed on the terminal's display. If your system's record status light
     does not come on after entering the G then the terminal system did not decode
     the received RECORD ON command and forward it to the cassette interface. If
     you system is wired to decode these commands then something is wrong, if it
     is not wired for decode then you will need to manually set the RECORD latch
     using the front panel toggle switch.

   Since the program counter is set when the program is initially loaded, the
diagnostic is initiated as described in the "Go to User's Program" section of the
Engineering Note 100. Once initiated, the program can be stopped only by depressing
the "RESET" button. The program may then be re-started after resetting the program
counter to A04F as described in the "Display contents of MPU Registers Function"
section of Engineering Note 100.

```
                          NAM    FIVPNT-1
                     * SWTPC 6800 Calibrate Tape Generator Program

        E07E              PDATA1  EQU    $E07E

        A048                      ORG    $A048
        A048 A0 4F                FDB    START
        A04A 13           STR5    FCB    $13,$12,$7F,$35,$04
        A04B 12 7F
        A04D 35 04

        A04F CE A0 4A     START   LDX    #STR5
        A052 BD E0 7E     LOOP1   JSR    PDATA1
        A055 09                   DEX
        A056 09                   DEX
        A057 20 F9                BRA    LOOP1

                                  END

        NO ERROR(S) DETECTED

            SYMBOL TABLE:
        LOOP1  A052    PDATA1 E07E    START  A04F    STR5   A04A
```

To calibrate your cassette interface, you will need to read back the just generated calibration tape from your terminal:

1. Set the AC-30 switches so the Motor Control switch is on Manual with the Read select switch flipped to feed the correct set of jacks. Flip the Record OFF/ON and Read OFF/ON switches so as to clear the Record ready and set the Read ready latches. The Local/Remote switch should be set on Local and the power switch must of course be ON.

2. Be sure your terminal's framing (stop-bit) error detection circuits are not disabled for this test to insure accurate calibration.

3. Insert the previously recorded calibrate tape into the selected Read recorder and rewind to the beginning of the tape. Put the recorder in the Play mode and watch the terminal's screen. When data starts appearing on the screen adjust trimmer resistor R16 midway between errored read settings of the control. Setting the trimmer too far clockwise will cause errors just as will setting it too far counterclockwise. Proper operation is indicated by reading a continuous string of 5's.

If you are using the SWTPC 6800 Computer system with something other than an RS-232 300 baud terminal and the cassette interface is not installed in series between the terminal and computer, then the diagnostic will have to be rewritten to operate thru a separate selected interface. Reading the cassette tape back to the terminal in the LOCAL mode probably will not be applicable either so you will need to write a computer program to read the data from the tape and in some way tell you if it is being read accurately. Be sure to check incoming characters for the proper reception of the stop bit when you are reading tape data. Trimmer resistor R16 is adjusted just as before.

If you are using another computer system with the SWTPC CT-1024 terminal system or equivalent RS-232 300 baud terminal then all you will need to do is re-write the FIVPNT-1 program using your computer's own instruction set.