2040 SERIES SERVICE MANUAL

The 2040 Dual Disk System Service Kit will provide the Service Center means to isolate defective components or subassemblies by way of utilizing the internal diagnostics of the 2040, program diagnostics and trouble-shooting guides included on diskette and cassette.

Some of the procedures are redundant but each procedure performs different operations even though it seems to be the same procedure;

The service procedures have been broken into categories to enable you to do an overall check or test a particular area of the 2040 system. The procedure relating to the SA 390 drive exercises all areas including alignment capability. Alignment procedures have been deleted due to necessary special tools and training. Commodore will provide this training in designated locations and times. You will be notified of schedule.

We have also included in the 2040 Service Kit, a price list for SA 400.

1.0 Position the computer and 2040 near one another in an open work area.

2.0 Locate the power switch on each machine and place the rocker switch in the OFF position (the white dot on the switch not visable).
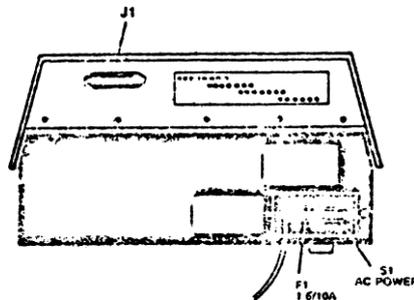
3.0 Plug the power cord into an AC outlet. Power on the 2040 System without connecting to the 2001. Check the three (3) LEDs located on the front panel. (fig. 1) They should turn on momentarily. If all the LEDs do not extinguish then a problem has developed in the system. The diagram below indicates possible location of the defective component.

    LEDs   Possible Defective Component

    ● ● ●   6532's, 6530, 6504
    ○ ● ●   6332 at L1
    ● ● ○   6332 at H1

4.0 Power 2040 System OFF before replacing any components. After changing components and problems still exist, replace Digital Logic assembly.

5.0 Connect a PET to IEEE cable between the systems.

6.0 Apply power to the 2001 and note the power on message. Power on the 2040, the LEDs on the front panel should light momentarily.

7.0 Before you start testing the 2040 system, it's a good idea to load the
    PET DOS SUPPORT program into the 2001. The program is designed for
    easier accessability to the commands of the 2040 system. See Appendix B
    for detail description of the use of PET DOS SUPPORT.

7.1 To load a program from mini-diskette:

7.1.1 Place the "2040 System Test" diskette in drive 0 of the 2040 system and
      close the door.

      TYPE: LOAD"*",8 [RETURN]

      Drive 0 on the 2040 system will initialize the diskette and load the
      first program on the diskette. Note the error LED on the front panel of
      the 2040. If an error occurs then some problem occured. Power OFF the
      2001 system then back on. Repeat this step. Be sure to remove diskette
      before turning power OFF.

7.1.2 If you are unsuccessful the second time to load the program from drive 0,
      try to load the program from drive 1. The procedure is as follows:

      1. Insert 2040 Test mini-diskette into drive 1.

      2. TYPE: OPEN 1,8,15,"I1" [RETURN]

         This will initilize the mini-diskette on drive 1.

      3. When the cursor returns to the screen

         TYPE: LOAD"1: PET*",8 [RETURN]

         The program, should now load in the 2001. If the error light turns
         on, you have isolated the defect to the Digital Logic or analog
         assembly. By trying to load the program from both drives eliminated
         drive failure. Proceed to step 7.2 for loading procedures from
         cassette tape.

      4. TYPE: RUN [RETURN]

         The screen will now display PET DOS SUPPORT. See Appendix B for
         detail description of the use of PET DOS SUPPORT.

      5. To load the first test program use the following procedure:

         TYPE: ↑LOG* [RETURN]

         The Logic Diagnostic program, will be called from storage on the
         mini-diskette and be loaded into the 2001.

      6. Proceed to 8.0 for operating instructions of the Logic Diagnostic
      test.

7.2 To load a program from cassette tape.

7.2.1 Connect the C2N unit to the tape interface connector on the 2001 or use
      the internal cassette unit.

7.2.2 Place the 2040 SYSTEM TEST/C tape in the cassette and rewind the tape.

7.2.3 Load the first program on the tape by depressing the "SHIFT" key and
      "RUN/STOP" key simultaneously. When the program finishes loading, the
      2001 will display PET DOS SUPPORT program. See appendix B for detail
      description of the use of PET DOS SUPPORT.

7.2.4 Load the Logic Diagnostic program, from cassette tape by depressing the
      "SHIFT" key and "RUN/STOP" key simultaneously.

      The 2001 will display:

      SEARCHING
      FOUND LOGIC DIAGNOSTIC
      LOADING

7.2.5 The Logic Diagnostic program will load from cassette tape and execute.
      The entire loading process should take approximately one minute.

8.0 LOGIC DIAGNOSTIC TEST

8.1 Follow the instructions that appear on the display of the 2001. If the
    logic components on the Digital board are in working order, the front panel
    LEDs will randomly blink. If a problem has been detected a slow distinct
    pattern will be present. Reference the chart on the screen of the 2001 to
    isolate defective component.

    FAIL STATES OF DIAGNOSTICS

    STATE   COMPONENTS - POSITION

    ● ● ●   6532 - E1, Cl
    ● ● ○   6332 - Kl
    ● ○ ●   6332 - H1
    ● ○ ○   2114 - C4 to F4, C5 to F5
    ○ ● ●   6532 - E1, C1, Connector P1
    ○ ● ○   6530 - K3, 6504 - H3
    ○ ○ ●   6530 - K3

    When the program detects an error condition, it will loop on the address
    where the error has occured. The select line on the chip will toggle at a
    steady rate. In the case of a RAM failure, the select line will toggle the
    1K blocks. Note, the block with the error condition and replace one of the
    two RAMs in the block.

8.2 If you are unable to isolate the failure replace the digital logic board.

8.3 Turn power off before replacing any components on the 2040 system.

8.4 Power the 2040 system back on.

8.5 Depress the "RUN/STOP" key on the 2001, then depress the "SHIFT" key and
    "CLEAR/HOME" key simultaneously. The 2001 display will now be blank.

8.6 To restart the "LOGIC DIAGNOSTIC" program:

    TYPE: RUN [RETURN]

8.7 When the program has been run for 15 minutes and no failures have occured
    you can assume the Digital Logic board is O.K.

9.0 "READ/WRITE" TEST:

The Read/Write test allows you to verify the Read/Write heads of the
drive. Gross alignment errors and the analog board are also checked.

9.1 Load the READ/WRITE test program from:

a) mini-diskette

or

b) cassette

9.1.1 FROM MINI-DISKETTE

TYPE: ↑READ* [RETURN]

NOTE: Be sure to initialize drive before trying to load a program.

9.2 FROM CASSETTE TAPE

TYPE: LOAD"READ/WRITE" [RETURN]

When the cursor returns to the screen:

TYPE: RUN [RETURN]

The 2001 screen will instruct you to:

9.3 Insert formatted mini-diskettes labeled "A" in both drives and close the
drive doors.

NOTE: You may create an "A" mini-diskette by formatting a blank
mini-diskette on a known good 2040 system.

9.4 The first part of this program initializes both drives and checks the
stepper motors. Answer the question yes or no. If the answer is yes the
program will continue to the next check. If the answer is no a malfunction
has been detected. Possible failures are Drive Unit, Analog Assembly, Bad
Media, or 6522.

To verify a drive failure, connect a good drive unit in place of the
suspected drive. You do not have to remove the drive in question. Set the
good drive on top of the suspected drive and connect it to the appropriate
connectors. This procedure allows you to verify the drive without
disassembly of the 2040.

9.5 The second part of the program actually reads a sector on each track. The
left side of the display shows two numbers, 0 and 1. These are the drive
numbers. The graph displays tracks that have been tested. A black square or
squares indicates one of the following devices is bad. Replace in order.

1. Bad Media
2. Bad Analog
3. Bad Drive

NOTE: Remember to turn power off and remove diskettes before changing
assemblies.

9.6 To complete the "Read/Write" program, the screen will ask you to repeat the
    test or to format the mini-diskette. The formatting of the mini-diskette is
    the last procedure of the test.

    Upon completion of this test you will have checked the validity of the
    Digital Logic assembly, Analog assembly and parts of the drives. You should
    be able to load programs from mini-diskettes at this time. If not, repeat
    previous tests or consult Commodore Customer Service.

10.0 2040 TEST/ADJUST

    The "Test/Adjust" program was designed to allow the user to test the
    function of the 390 Drives for correct operation. The program also contains
    the software to allow a trained user to align the SA 390 drives in the 2040
    system. The program is menu oriented which allows the user to test specific
    functions of the Drive or to run the chain of tests to insure proper
    operation. Reference Appendix A for detailed explaination of each section.

10.1 Load the "Test/Adjust" program from mini-diskette by inserting the
     2040 Test Diskette mini-diskette into Drive 0.

     TYPE: ↑TEST* [RETURN]

     NOTE: Be sure to initilize the drive before attempting to load the
     program.

10.2 The "Test/Adjust" program is now displaying the first menu. For simplicity
     the program has been broken down into catagories.

     Procedure 1

     SA 390 Test and Checkout is a step by step procedure through all the
     different tests performed on the disks;

     Procedure 2

     SA 390 Adjustment and Alignment. This procedure will allow you to do all
     mechanical adjustments pertaining to the drive.

     NOTE: Special tools and training are necessary for Head Alignment and
     Carriage Limiter Adjustment. DO NOT proceed with these two factory
     adjustments unless you have been trained.

     Procedure 3

     2040 Drive Compatibility. This procedure will allow you to check the
     alignment compatibility between the drives. It will format a mini-diskette
     on one drive and attempt to read it on the other.

     Procedure 4

     SA 390 Test Menu. Allows the user to individually select a test for all
     known problems without running through all the tests. After the selected
     test is completed it is a good idea to do a complete test.

     Procedure 5

     SA 390 Adjustment Menu. Allows the user to do the individual adjustments
     without going through all the adjustment procedures.

     NOTE: Special tools and training are needed for Head Alignment and
     Carriage Limiter adjustment. DO NOT proceed with these two adjustments
     unless you have been authorized by the factory.

11.0 FINAL SYSTEM TEST

    The Final System Test performs an overall test of the system. This test is
    divided into two parts, first part being file handeling, read and write to
    and from different tracks, and exercises the 390 drives. Second part
    checks for soft errors,(soft errors are errors that are corrected by
    firmware). This procedure will detect all soft errors and will print out
    on the screen how many soft errors have accured for each track of the
    diskette.

11.1 Insert the 2040 SYSTEM TEST Diskette into Drive 0 and initilize the
    diskette.

11.2 TYPE: ↑FI* [RETURN]

11.3 You will be instructed to insert the two formated "A" diskettes and press
    RETURN.

11.4 The program will first execute a new command on Drive 0 then on Drive 1 to
    check the mechanial movement of the drives. After the mechanical test the
    program will go thru a sequence of reads and writes.

11.5 If the test fails, note the failure and return to the appropriate test
    proceedure for finding the defective component. Continue to the next part
    of the test by pressing the "C" key.

11.6 The screen will inform you to insert the 2040 SYSTEM TEST diskette into
    drive 0 and press RETURN.

11.7 The program will now load the diagnostic code to check for soft errors.
    Asterisks will be written across the screen during the loading of the
    machine code.

11.8 Remove the 2040 SYSTEM TEST diskette and insert the "S" diskettes in both
    drives. Press RETURN when ready.

11.9 The "S" diskettes contain a worst case pattern that covers the entire
    diskette. This part of the program attempts to read the entire diskette
    without obtaining a soft error. If a soft error occurs, the quanty of the
    soft errors and the track number on uhich they occure will be printed on
    the screen. Two complete passes of each drive is nessary to complete the
    test.

11.10 If an error has occured restart the test by pressing the "R" key and
     noting the error on the second pass. If the error still occurs verify
     that all modifications have been done on the 2040 SYSTEM and the head
     alignment is correct.

11.11 After the completion of all the tests the 2040 SYSTEM has been exercized
     to the known limits of the software.

APPENDIX

A   Adjustment Procedures
B   PET DOS SUPPORT
C   Component Cross Reference [currently missing]
D   SA 390 Parts List [currently missing]

APPENDIX A - ADJUSTMENT PROCEDURES

A.0 HEAD STEPPER TEST

This test insures free operation and correct motion of the head carriage and stepper motor. The test first moves the head out to track 0 and then it moves the head in to track 34. The final portion of the test moves the head in and out between track 34 and track 0. If the drive does not respond as outlined above, there are two probable causes.

1. Bad stepper motor (replace the drive).

2. Improper stepper control (check stepper control circuits. Possible bad 6522).

A.1 LED TEST

This test checks the LED on the drive specified. The tests are on, off, and blinking. If the LED does not respond properly then skip (use yes responses) to the blink portion and check the signals to the LED. Possible failures are:

1. Signal to LED (replace the drive).

2. No signal to LED (could be the analog board, cables or the 6532 (EI) replace the faulty part).

A.2 WRITE PROTECT 91ITCH TEST

This test allows the user to check the function of the write protect switch on the disk drive. The drive's LED will be on for protected and off for not protected.
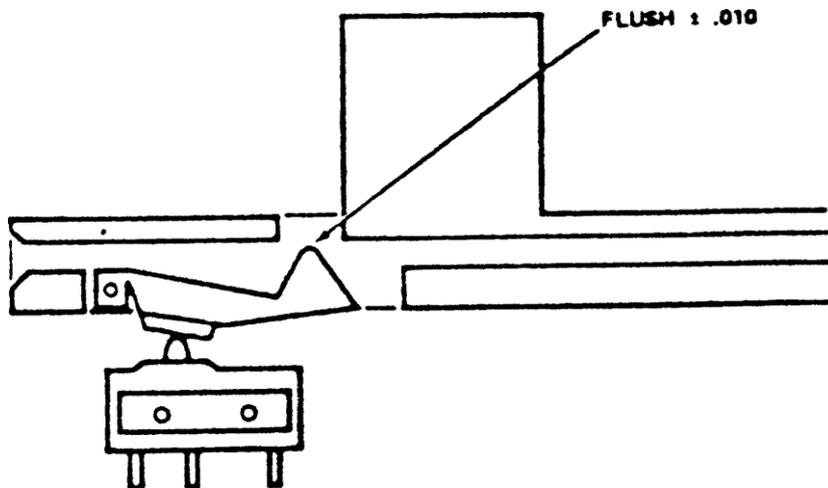
Failure of this test can be caused by the following:

1. Bad switch (replace drive).
2. Improperly adjusted switch.
3. Bad electronics (check 6530 UK3).

A.3 MOTOR SPEED ADJUSTMENT

Motor Test - will check motor operation and speed calibration. Adjust the motor speed pot with small flat blade screw driver until proper strobe pattern is stationary. Adjusting pot clockwise will move strobe counter-clockwise.

Turn the pot R-12 located on the motor control PCB until the dark lines on the spindle pulley appear motionless. For 60 HZ use the outside ring of lines. For the 50 HZ observe the inside ring. Reference Figure 4.

NOTE: This adjustment can be made only in an area where there is flourescent lighting.
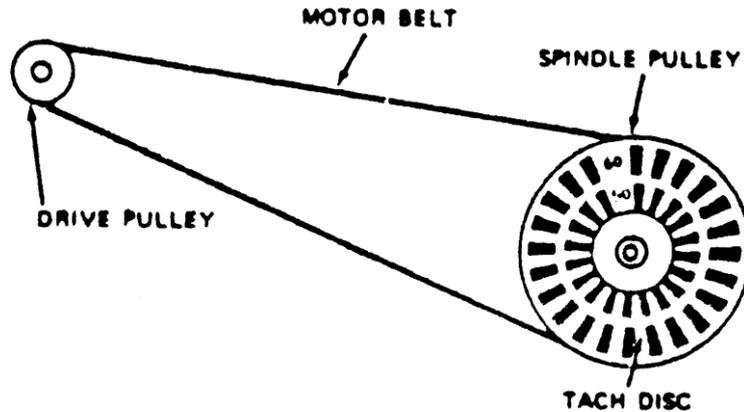
A.4 MOTOR SPEED TEST

This test checks the speed of the spindle motor to insure it is within tolerance. If the drive fails this test it should be replaced or if possible, realigned.

A.5 HEAD ALIGNMENT

NOTE: This adjustment is not normally required even on head replacement due to the pre-aligned head and carriage assembly, but if the stepper motor mounting screws are accidently loosened, if parts damage has occured or you are experiencing interchange problems use the following procedure to check and adjust the head alignment.

Remove and adjust drive 0 first. The drive may be removed by extracting the four (4) phillips screws from the bottom of the 2040 system and by removing the head and edge connectors from the analog board.

Once drive 0 is adjusted, replace drive 1 with it. The analog board can be removed from, drive 1 by removing the connectors and extracting the two (2) phillips screws securing it in place. The analog board will slide off its mounts. Remove drive 1 by extracting the four (4) phillips screws holding the drive in place and sliding the drive out through the front panel.

Take a piece of cardboard (approximately 5" x 15" size) and lay it across the analog board extending to the right edge of the 2040 system. Locate the drive under test on the cardboard and connect the head and edge connectors to the analog. Place the drive in a horizontal position (on its left side). Now you are ready to adjust the drive.

Use a dual trace scope and adjust the scope as follows:

```
Mode:       Add
Sweep:      20 MS
Volts/Div:  50 MV
Probes:     3-X1
Trigger:    External
```

Connect channel 1 probe to TP4, channel 2 probe to TP3, on the analog. NOTE ANALOG PARTS LOCATION FOR LOCATION. Connect trigger probe to pin 9 on position UN5 of the digital board. Adjust the trigger level during the head alignment for a lobe pattern on the display.

Head alignment check with the scope should be performed in a horizontal position. Adjustments may be made from underneath or the drive may be put in a vertical position, then returned to a horizontal position for the check. Adjust stepper motor by loosening two clamp screws and slightly twisting the motor in the desired direction. Tighten with torque driver (#10). The initial head alignment should be made for maximum output and equal lobe sizes on scope display.

If either "hysteresis checks" result in unequal lobe sizes, then adjust to split the difference between the two lobes. If this occurs, repeat the alignment check to assure that all positions result in appropriate lobe patterns. Appropriate patterns are lobes which are within 90% in size of each other. Note diagrams.

Even amplitude (100%) on track

Left 80% of right + 1 mil off track toward TK0

Left 60% of right + 2 mil off track toward TK0

Left 40% of right + 3 mil off track toward TK0

Right 80% of left - 1 mil off track toward 34

Right 60% of left - 2 mil off track toward 34

Right 40% of left - 3 mil off track toward 34
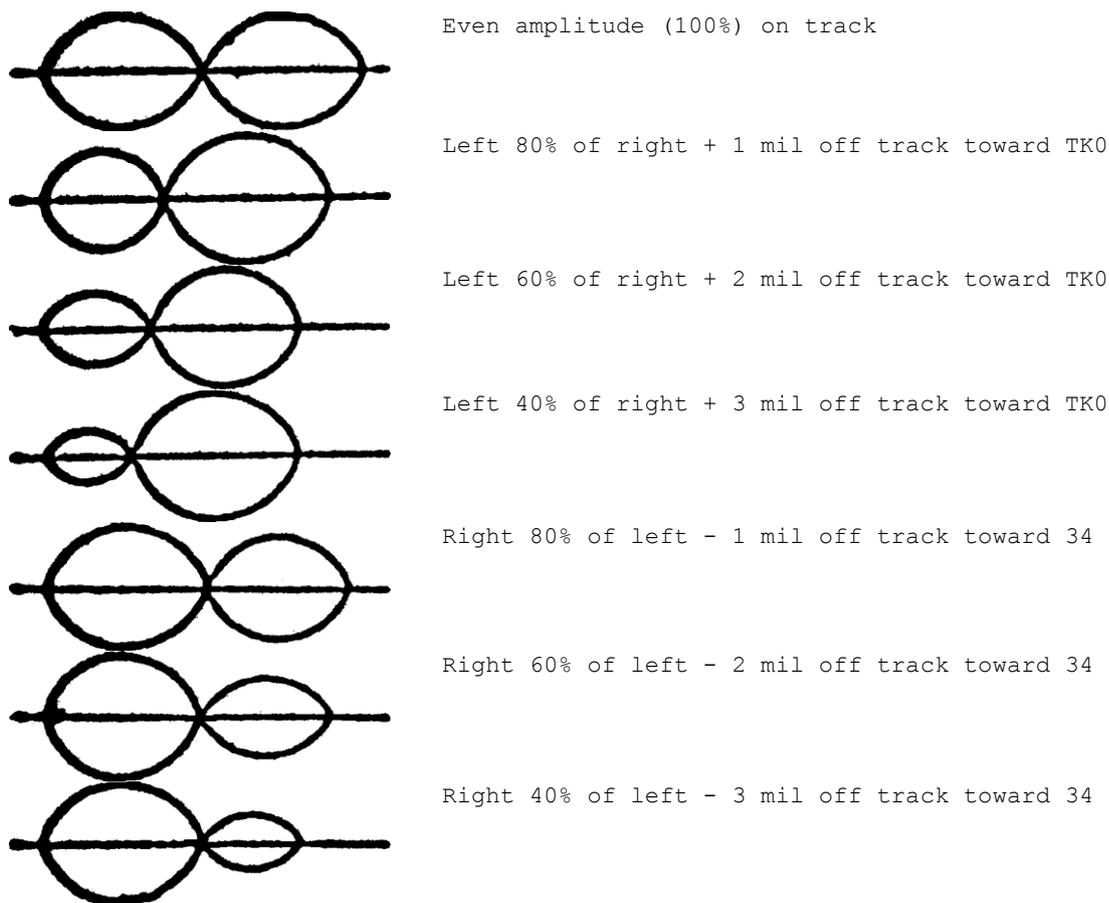
A.6 HEAD ALIGNMENT CHECK

This test is simply a validate of the system test diskette.

This diskette has a file that encompasses the entire disk. If any errors occur
then there may be an alignment problem. Either replace the drive or align it.

NOTE: Insure your diskette is in good condition before using this test.

A.7 WRITE PROTECT SWITCH ADJUST

Use write protect adjustment tool or diskette to adjust write-protect
switch. Drive LED will detect protected--LED on and unprotected--LED off.

1. Loosen write protect switch screws and slightly tighten pivot screw
   (closest to spindle).

2. Insert tool until "shim stock" notch is even with opening in top of disk
   guide.

3. Raise switch with hex driver until switch closes (watch drive LED).

4. Tighten screws with torque driver (#11).

5. Push tool in all the way until it bottoms against the Platen stop (this
   will now line up the unprotect slot).

6. Remove write protect tool.

7. Close door.

APPENDIX B - PET DOS SUPPORT PROGRAM

DOS SUPPORT PROGRAM WEDGE - by Robert J. Fairbairn

The purpose of this program is to aid the PET 2001 User in operating the 2040
Dual Floppy Disk System. This instruction sheet has been written with the
assumption that the reader has a working knowledge of the PET 2001 and the
2040.

NOTE: This program has been placed in the public domain. Please refer all
comments and suggestions to the Editor.

The normal method with which the PET communicates with an IEEE Buss device is
by the BASIC commands OPEN, PRINT, GET, INPUT and CLOSE. These statements are
somewhat verbose in nature and therefore more prone to operator error. There is
also the limitation that INPUT and GET cannot be used in direct mode due to
shared buffer areas. These isiosyncrasies create a strained 2001/USER/2040
interface which has been greatly improved with the WEDGE 3.1 program.

WEDGE 3.1 may-be loaded (saved) as if it were a normal BASIC program. Note
should be made of the fact that the 2040 has a special load file name '*'
which if used immediatly after power up (reset) executes the following:

1. Initalizes Drive 0
2. Loads the first file on that drive

Thus if the command LOAD"*",8 is executed and the WEDGE program is the first
directory entry it will be loaded. When the WEDGE program is executed it
relocates itself up into the highest available RAM memory locations, links
into the CHRGET routine and adjusts BASIC's top of memory pointer down. This
technique uses about 350 bytes of the Users memory but normal machine
operations may proceed without having to reload the WEDGE program until such
time that a system reset is performed.

The WEDGE program functions by capturing the data that the PET operating system
passes to BASIC, before the interpreter has a chance to parse it. Thus we can
look for the escape characters and process the command without the use or
knowledge of the BASIC interpreter.

There are four escape characters that are recognized by the WEDGE program. They
will be processed only when they are found in column one of an input line,
otherwise a SYNTAX ERROR will occur.

ESCAPE CHARACTERS

> - Passes commands to the Disk.
/ - LOAD's a program.
↑ - LOAD's and RUN's a program.

The greater than symbol when used preceeding a 2040 Disk command, passes that
command directly to the floppy disk system. See the following examples.

Thus:
>I0
is the same as: PRINT#15,"I0"
and:
>S0:FILE1
is equal to: PRINT#15,"S0:FILE1"

As you can see the > symbol is a substitute for the PRINT#15 statement.
Remember that an OPEN statement is required before a PRINT may be executed
but no OPEN is required for the WEDGE.

The second function of the > escape character is the directory list command. As
you know the directory of a minidisk can be loaded with a LOAD"$0",8. This LOAD
will destroy any program you might have in memory. To avoid the destruction of
the current program the WEDGE prints the directory on the screen.

>$0

Means - Display the entire directory of Drive 0

>$1:Q*

Means - Display the directory entries of all files on Drive 1 that have names
starting with the letter Q.

The third function of the > escape character is the error channel interrogation
feature. The error channel is read by typing a > followed immediately by a
RETURN. This is equivilent to the following program segment.

10 OPEN 15,8,15
20 INPUT#15,ER,MSG$,DRV,SEC
30 ?ER","MSG$","DRV","SEC

The LOAD / and LOAD-RUN ↑ escape characters operate the same as their BASIC
counterparts only with a simpilified syntax as follows,

/WUMPUS

- The above ccmmand will load the program file WUMPUS. Both drives will be
  searched if required.

↑1:COPY DISK FILES

- This command will load the program COPY DISK FILES fram Drive 1 (if it is
  there) and execute it.

The following requirements and limitations are placed on the WEDGE program
user.

1. The WEDGE commands may only be used in direct mode.

2. Programs using GET or INPUT should disable the WEDGE by a POKE 1022,128
   statement. This may also be done by typing the > followed by a K and a
   RETURN.

3. The WEDGE is restored by a POKE1022,08.

4. You may also disable the WEDGE by typing >K.

NOTE: For Users that have a business keyboard PET (CBM) the at key "@" may be
used in place of the >. This eliminates shifting for the escape character.

```
5 SYS2153
10 PRINT"{CLR}"TAB(11)"{17 CBM-@}"
20 PRINTTAB(11)"{RVS ON} PET DOS SUPPORT "
30 PRINTTAB(14)"NOW  LOADED"
40 PRINTTAB(9)" COMMANDS FOLLOWING"
50 PRINTTAB(7)"A > OR @ IN COLUMN 1 WILL"
60 PRINTTAB(9)"BE PASSED TO THE DISK.{DOWN}"
90 PRINTTAB(7)"CMD      DESCRIPTION"
140 PRINTTAB(7)"$    DIRECTORY BOTH DRIVES"
150 PRINTTAB(7)"$0   DIRECTORY DRIVE 0"
160 PRINTTAB(7)"$1   DIRECTORY DRIVE 1.{DOWN}"
180 PRINTTAB(7)" ALL 2040 COMMANDS MAY BE"
190 PRINTTAB(7)"ENTERED AS IF THEY WERE IN"
200 PRINTTAB(7)"A PRINT# STATEMENT."
220 PRINTTAB(11)"{DOWN}{RVS ON}SPECIAL COMMANDS"
230 PRINTTAB(7)"{DOWN}/    LOAD A PROGRAM"

240 PRINTTAB(7)" ↑    RUN A PROGRAM"
250 PRINT" SPECIAL COMMANDS START IN COL 1 AND"
260 PRINT"ARE FOLLOWED BY A 2040 FILENAME."
270 NEW

READY.
```