RK05 Maintenance Tips

Contents

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RKØ5 Maintenance Tips

1. Disk Pack

1.1 Pack Handling Tips

1. Since the pack is not a sealed unit it is very vulnerable to dirt - care must be taken to keep it clean. Always store the pack in the plastic bag when not in use. Smoke particles, fingerprint smudges or specs of dust can cause head crashes and catastrophic destruction of the heads and disk surface.

2. Hold the pack by the handle only! If you don't you can:
   1. break off the air vent door
   2. scratch the vent door against the disk surface
   3. Get fingerprints and dirt on the disk surface
   4. Get fingerprints and dirt on the spindle hub

3. Keep the sector/index slots and the spindle mating surface clean. A very small amount of dirt can cause large runout errors. Dirt on the sector slots can cause very strange system problems.

4. Be sure that the plastic retainer button on the pack access door is lifted out of the way when the door is opened. Do not let the button contact the disk hub when the disk is spinning.

5. Never rotate the disk inside the cartridge unless the cartridge is inserted in a drive.

1.2 How to Recognize Bad Packs

A Pack is bad if:

1. Oxide continuously builds up on newly cleaned heads.

2. The pack will not transfer data

3. Bare aluminum is showing through the oxide coating.

4. The rivets on the air vent door are broken.

5. The retainer button is chewed up and plastic shavings are falling into the pack.

Do NOT use bad packs. Turn them into the stockroom for refurbishing.

1.3 Pack Seating

There are three types of plastic housings for RK05 disk packs - two are all-white and the other is two-tone (gray shell and white access door). The three kinds of packs are made from different plastics and have slightly different dimensions. In order to make the drive compatible with all types, four ECO's were made to the RK05 recently. All four ECO's must be installed in any RK05 shipped from DEC. These ECO's can be recognized as follows:

ECO #37 adds a new Duck Bill (stamped Rev C) and adds two new cartridge support posts (stamped Rev B).

ECO's #36 and #41 add a pair of rubber sleeves to the access door opener.

ECO #39 adds a pair of stronger springs to the door opener.

Check all RK05's for these ECO's and be sure they are all installed before operating the drive in a system.

After these ECO's have been installed, do these two things:

1. Insert all types of cartridges available in the drive to be sure that they fit, and that there are no other cartridge receiver alignment problems.

2. Check head/sector alignment using the DEC Alignment Pack.

The cartridge receiver is aligned correctly when there are six points of contact with the pack and three clearance points. The six points of contact are:

1. Two thin rails should touch evenly all along the length of the cartridge.

2. Two cartridge posts in front of drive.

3. Door opener bail.

4. Spring at center top of cartridge.

5. Duckbill (lower slot).

6. Air Duct.

The three clearance points are:

1. Two fat rails on top of cartridge.

2. The four crosspoints on underside of cartridge.

3. The pivot posts and receiver hinge bail.

The position of the pivot posts determines how the top rails ride on the cartridge and also determines the bottom clearances of the four crosspoints and the underside of the cartridge. When tightening these posts it will be necessary to hold their position with an open face wrench while securing the bottom nut with a ½" socket wrench.

One way to check alignment is to insert a pack at a slightly cocked angle. The receiver should guide the pack onto the posts as the door is closing.

If a pack will not seat on the left post, make sure the top rails of the receiver are not pushing the pack away.

NOTE: Remember that the receiver does not hold the cartridge but is only a guide for it. The pack is actually positioned by the two cartridge posts and the lower lip of the duckbill. The pack should not be resting on, nor be tightly squeezed by, the cartridge receiver. The pack should be able to slide easily.

If the receiver is out of adjustment, use the new alignment fixture and procedure (available from the Quality Assurance Lab) to readjust it.

2. Head/Disk Interference

NOTE: The information in this section is provided as a guide for recognizing and resolving head crashes. However, disassembly, inspection or cleaning of packs may be done ONLY by the Quality Assurance Lab.

2.1 Introduction:

Head/Disk Interference, or HDI (frequently referred to as a head crash) is a result of head contact with the disk surface. Most commonly it is caused by a build up of dirt on the read/write head or a foreign particle in the air stream between the head and disk surface. If the problem is not TOTALLY CORRECTED, it has a propagation effect from drive to drive through pack after pack.

2.2 Recognition:

Head/Disk Interference can be recognized by one or more of the following:

A. Repetitive hard read errors. Because of adverse propagation effect, do not move any pack with this kind of error to another drive. (DO NOT ALLOW USE OF THIS PACK OR DRIVE UNTIL THE PROBLEM IS FULLY RESOLVED). Investigate further for head/disk interference.

B. Uncommon noise from the disk as characterized by audible tinkling sound. The noise will progress to a screech. A screech indicates complete destruction of the heads and pack. However, do not confuse this noise with the squeal of the spindle grounding brushes.

A slight tinkling when initially loading heads is allowed if it goes away in two or three seconds.

C. Disk surface damage (to be evaluated by Q A Lab only).
A pack with any of the following conditions must be replaced:
1. Black deposits or smears that cannot be totally removed with alcohol and Kimwipes.
2. A full circle scratch or any other scratch where the aluminum substrate is visible. NOTE: The disk edge may have aluminum visible and cause no problem.
3. Multiple adjacent concentric scratches regardless of length - check the heads.

D. Read/Write Head Damage
1. Dark brown or black streaks (burned oxide and/or aluminum) anywhere on the white ceramic head. Clean the head. If the head again crashes on a known good, clean disk, replace the head.
2. Discolored epoxy (normally white) at the R/W element which cannot be cleaned off with alcohol.
3. Other. Bent or broken flexures can result from prolonged HDI or mishandling. Replace any head with this type of damage. DO NOT ATTEMPT REPAIR. The ceramic head gimbal spring is adjusted to $\pm$ 1 degree landing attitude. If this attitude is disturbed in any way, the head will consistently crash when loaded on the disk.

NOTE: A pack might be reusable if it has the following conditions - but only after it has been thoroughly cleaned.
1. Imbedded particle with tapered trailing scratch (comet tail).
2. Circular head loading marks at the outer radius of the disk.
3. Many small (less than one inch) concentric polish marks all over the disk surface.

The ultimate test of a good pack is one that does <u>not</u> deposit oxide on the head and <u>does</u> transfer data.

2.3 Recovery:

A. Inspect head and disk packs. Determine which heads and surfaces were involved in the crash. Check all heads and TOTAL pack library for possible spreading of a general crash problem.

B. Replace all damaged heads and disk pack.

C. Clean remaining heads.
   1. If contamination cannot be removed, the head must be replaced.
   2. Check head loading for correct operation by setting drive to READY. Do NOT load by hand since that may cause the heads to crash.

D. Check disk drive air filters for contamination. Replace if necessary.

E. Clean inside of disk drive watching particularly for filings, shaved metal, plastic particles, etc.

F. Mount a known good pack (not the Alignment Pack) on the drive. Turn power on and permit to come READY. Turn power off and check for oxide buildup on heads or other signs of head/disk interference. If satisfactory, turn power back on and run for about 15 minutes. Run the FORMAT program and see if the drive will transfer data.

G. Mount the DEC Alignment Pack. Check and align all heads.

H. If original pack on which the crash occured does not appear damaged, mount it. Turn on power and permit to come READY. Turn power off and check for oxide buildup on the heads.

I. Check the pack and drive thoroughly using the disk pack diagnostics. It will be necessary to reformat the pack. Be sure to run Disk Data for at least 15 minutes.

J. Inspect heads for oxide after 12 hours of run time. If oxide appears, determine cause and correct.

NOTE: Unless <u>all</u> damaged packs and <u>all</u> damaged heads have been removed from the machines involved and the actual cause of the HDI is determined and corrected, the problem WILL reoccur in a short period of time.

2.4 Prevention:

A. Proper cleaning of R/W heads.

B. Insure air filtering system has no leaks and filters are clean. A dirty filter will cause contamination build up and excessive heating of the drive unit.

C. Insure no foreign particles are being generated within a drive due to interference between disk and cartridge or between sector slots and index/sector transducer.

D. Careful handling of disk packs. Bumping of disk packs against file cabinets or drive front covers can bend the sector disks.

E. Disk packs must be kept clean. Always place the pack in a plastic bag whenever the pack is taken out of a drive.

The best way to reduce the number of head crashes is to keep all equipment clean - the packs, the heads and the interior of the drive. If a crash occurs, don't spread it around. Stop using both the pack and the drive on which it occured until the problem is resolved.

3. Head Alignment

3.1 Head Alignment Tips:
There are a number of tolerances in the mechanical circle between the pack which rides on a spindle, which is mounted on the base casting, which in turn holds the linear transducer, which relates to the voice coil assembly, which in turn holds the heads, which determines the area of the cartridge being read. Head and sector alignments become the major adjustments in determining the final position of the head relative to the disk surface.

A few points on head alignment should be noted:
1. Heads should always be clean before alignment is started.
   A. This can be done with cleaning kit supplied, but only wrap the Texwipe around the wand one time - more than once may cause damage to head because it will be too thick.
   B. Support the little box on the head very gently with your finger to avoid damage to gimbal when cleaning.
   C. If scrubbing action is required to remove a dirty spot leave the Texwipe protruding beyond the tip of the wand so that a corner of the wand can be used for gentle scrubbing.

D. It is a good idea to go over the head with a clean Kimwipe as soon as it is cleaned to remove liquid before it dries and forms a film on the head.

2. When doing head alignments or adjustments, hold the head assembly while releasing the servo switch. It was found that the switch may inject a noise spike into the servo system causing the head to fly forward at full speed. Light pressure on the assembly when releasing the switch will prevent this. It was also noted that if you have fat fingers, you can touch the I.C. adjacent to the switch and cause the same action - BE CAREFUL.

3. If it becomes necessary to load the heads on one another, place a piece of paper between the heads to prevent the R/W elements from grinding against each other.

4. Head locking screws have a nylock insert which prevents their moving once tightened. They are reusable up to about a dozen times. When initially inserting the screws, run the nylock screw through the head clamping hole completely (without a head in) to cut the nylock. This will allow predictable torquing forces when clamping the screw to the head with the torque wrench.

5. Head adjustment screws should be backed off after locking so not to apply forward pressure to the head assembly.

6. Insure track indicator scale is aligned.

7. When heads are realigned or replaced, note if there are any grooves or indentations in the clamping area. Heads that have grooves in this area must be replaced.

   NOTE: The grooves can be caused whenever head alignment is done without the proper torque wrench.

8. It has been suspected that some head alignment problems on drives below serial number 7650 may have been due to the positioner head moving slightly during shipment. A special torque wrench (available from the Quality Assurance Lab) is now being used to tighten the hold down bolts sufficiently. If a drive will not stay in alignment, it may be necessary to tighten these bolts.

This wrench must be set to required torque - 65 in-pounds. When the set torque is reached, the wrench clicks and moves freely through a few degrees of arc. It is then possible to continue applying the torque in excess of the set torque. Don't do it. Release the torque wrench and it will automatically reset itself to click again at the set torque. Don't over torque.

9. It was found recently that the plenum cover screws have a drastic effect on head/sector alignment. If any plenum cover screw is loosened or tightened, it changes the stress pattern in the base plate and may throw the alignment out of spec. Any time a plenum cover screw is touched, check the head/sector alignment and readjust if necessary.

3.2 Head Alignment Procedure

All head alignments must be made with the new DEC Alignment Pack (marked RK05-AC). The procedure for using this pack is described in A-SP-RK05-Ø-20. Important points to know about the head alignment procedure are:

1. Run the Alignment Pack for 30 minutes to temperature stabilize it before performing the alignment.
2. Dirt on spindle disk mating surface can cause excessive runout problems and should be cleaned and rechecked prior to starting alignment.
3. Alignment should only be done in temperature ranges of 60-80^{O}F.
4. Always use the head alignment torque wrench.
5. Alignment should not be touched unless greater than 15% error is seen using DEC Alignment Pack.
6. Index timing pulse can be either polarity since the winding in the head may be either way.
7. Index/sector adjustment is to be done so the average of both is 70 usec. Not so that either one falls within the 60 to 80 usec range. 60 and 66 is not acceptable and 70 and 76 is not acceptable. 73 and 67 are acceptable.
8. Care must be taken when doing head alignment not to exert excessive force on the positioner assembly when tightening or adjusting head screws. It is possible to damage the bearings with too much force.
9. Triggering for IBM pack was on INDEX. For the DEC pack it is on the SECTOR. Use of SECTOR with DEC Alignment Pack allows for average alignment of all sectors. Trigger on INDEX for DEC Alignment Pack when checking runout only.

10. Handle the alignment pack with care.
11. Always remove the shipping brackets before operating or aligning the drive.
12. If the sector timing adjustment cannot be made because the heads are too far out, replace the heads, do not bend them. Bending of heads is not allowed for any reason whatsoever.

3.3 Cylinder Address Conversion Table.

The cylinder addresses listed in the alignment procedure and maintenance manual are in decimal notation. Here's a decimal to octal conversion table for the most commonly used cylinders. Always use the octal numbers in conjunction with the diagnostic.

Track Address

Decimal	Octal
0	0
4	4
64	100
85	125
105	151
125	175
202	312

3.4 PDP-11 Oscillating Seek Program.

The PDP-11 program listed below is a handy aid when checking the servo signals or performing head alignment. After toggling in the program and patching the drive unit number, the program will cause the drive to seek back and forth between the cylinder addresses set in the left and right bytes of the switch register. Setting the same cylinder address in both bytes will make the drive stay on that cylinder.

Operating Instructions.

1. Toggle program starting at location 1000.

2. Toggle registers RØ-R6.

3. Toggle the drive unit number into bits (15-13) of location 1032:
   XX0000 will select drive XX, surface Ø
   XX0020 will select drive XX, surface 1

4. If error checking or other changes are to be added, change the NOP's in location 1050 and 1052 to jump to (ADDITIONAL) code address. Jump back to location 1054 at the end of added code.

5. Load address 1000; start.

6. Set desired cylinder addresses (0-312) into the LEFT and RIGHT BYTES of the switch register.

7. Leave ZEROES in the LEFT switch register BYTE while setting up the G-938 card. DECIMAL 2, 4, 64 and 202 cylinder seeks may then be accomplished by setting octal 2, 4, 100 and 312 into the RIGHT switch register BYTE.

8. CAUTION!! EXCEEDING octal 312 in either BYTE will require a program restart unless error code has been added. (see 4).

9. Setting the SAME cylinder address in both BYTES will result in continuous seeks to THAT address.

10. This program may be modified using the CORE and MOD commands of the UPDATE program. UPDATE may also be used to output the modified version of any program to Dectape, Decpack or DEC papertape.

11. Repetitive RESTORES may be accomplished by changing the ELEVEN in location 1060 to a THIRTY-ONE.

RK05 OSCILLATING SEEK PROGRAM

STARTING ADDRESS 1000

DISK ADDRESS (15-13)
CHANGE LOCATION 1032 IF
DISK IS OTHER THAN DRIVE
ZERO

R0	WORK
R1	177570 (SR)
R2	1014 (SUBROUTINE)
R3	177404 RKCS
R4	177412 RKDA
R5	JSR WORK
R6	4000 STACK POINTER

```
1000      11100      MOV SR, R0        START
           300       SWAB, R0
          4512       JSR, (R2)
         11100       MOV SR, R0
          4512       JSR, (R2)
1Ø12       772       BR, START

1014       241       CLC               SUBROUTINE
         42700       BIC     MASK OUT LOWER BYTE
           377       *       MASK OUT LOWER BYTE
          6000       ROR     ROTATE SR DATA INTO CYLINDER
          6000       ROR     ADDRESS SLOT
          6000       ROR

1030      62700      ADD DA, R0
         XX0000      *       XX  = DISK ADD (15-13)

1034      105713     TSTB    RKCS
          100376     BPL     BRANCH IF CONTROLLER IS BUSY
           32737     BIT
             100     *       MASK (ACCESS READY)
          177400     *       RKDS

1046       1774      BEQ     BRANCH IF NOT READY

1050        240      NOP     JUMP MAY BE INSERTED FOR
1052        240      NOP     MODIFICATION

1054       10014     MOV  R0,RKDA
           12713     MOV  11,RKCS (SEEK AND GO)
              11           OR  31, RKCS (RESTORE AND GO)

1062        205      RTS
```

4. Compatibility

Head alignment and sector/index timing are the two major causes of incompatibility between drives. To insure that two or more drives are compatible with each other, all drives must be set up using the new alignment procedure. Other things that can cause incompatibility are:

1. Low power supply voltages.
2. Dirty mating surfaces between pack and drive.
3. Head cables reversed in one drive.

After insuring that all drives are adjusted properly, you can verify compatibility by using the conversion mode of RK11 Disk Data (or similar RK8/e program) and performing the following steps:

1. Insert cartridges in all drives to be checked for compability. Label the packs A, B, C, etc.
2. Write (and write check) a random pattern over the full surface of each disk.
3. Move all the cartridges to different drives and read them back without error. Then write and write check as in step 2.
4. Repeat step 3 until all the packs have been read error free by all the other drives.

For example, to check compatibility among three drives:

		Drive Number Ø	1	2	
Step 1	Insert Packs	A	B	C	Write/Write check
Step 2	Rotate packs	C	A	B	Read/Write/Write check
Step 3	Rotate packs	B	C	A	Read/Write/Write check
Step 4	Rotate packs	A	B	C	Read/Write/Write check

5. Positioner

A few points to know about the positioner are:
There are precision surfaces on the positioner and spindle - when replacement is necessary be very careful not to bang it around or drop it.

When one is replaced, insure it is returned in the same box the new one arrived in. Otherwise it will be damaged and not reworkable.

The glass slide attached to the carriage-coil assembly is not field replaceable. It must be aligned parallel to the motion of the carriage, i.e., matched to the carriage, bearings and ways and requires a special fixture. If the slide is damaged, the complete positioner must be replaced. The photo cell transducer can, however, be replaced.

Positioners do make audible noises while in operation due to the fact that they operate in an audible range.

There are plastic tires which are used in the positioner which the voice coil assembly rides on. These tires tend to develop a flat spot when remaining in one position for a period of time. It is most noticable in the track 180 area since this is one complete revolution of the time from the home position. (The flat spot can develop at any position that the carriage holds for more than ten minutes). This, in itself, is not a problem and is present to some extent in every RK05. Seek failures around cylinder 180 are caused by bad bearings - not the flat spot.

The coils in the positioner assembly should at no time rub against the magnet pole pieces. The assembly can rub if the spring loaded carriage is pressed hard enough - don't do it.

6. Adjustment Check List

6.1 Servo Signals (Adj. Pots are listed in sequence from module connector down).

Signal	Test Pt.	Adj. Pots	Do NOT adjust Unless outside this range	If adj. is necessary, set to this value
		G938		
CA	AS1	R66	9 to 11	10v P-P
CO	AS1	R64	± 0.2	0V
SA	AM1	R31	9 to 11	10v P-P
SO	AM1	R29	± 0.2	0v
LSA	AJ1	R80	3.0 to 3.5	3.3v
LSO	AJ1	R78	± 0.1	0V
VA	AM1	R76	3.1 to 3.3	3.2 msec
VO	AM1	R73	± 0.2	0V
		H604		
Accel.	AH1	R15	13 to 15	14 msec.

6.2 Data Window (G180)

Signal	Test Pt.	Adj. Pot	Do NOT Adjust Unless outside This range	If adj. is necessary, set to this value
Open Loop	TPI	R54	480 to 520	500 nsec
Closed Loop (PDP-8 or PDP11	TPI	R55	430 to 450	440 nsec
Closed Loop PDP-15	TPI	R55	380 to 400	390 nsec

6.3 DEC Alignment Pack Signals

Signal	Test Pt.	Adj. Pot	Do NOT Adjust Unless outside This Range	If adj. is necessary, set to this value
Index/Sector	Trigger on AR2. Look at G180, TP3 & TP4	M7700 R6	Average: 68 to 72, or either head outside 60 to 80.	70 usec average, with both heads between 60 usec and 80 usec.
Head Alignment	Trigger on AS2, Look at G180, TP3 & TP4	Head Adjust Screws	Error > 15%	6%
Head Alignment	G 180 TP3 & TP4	None	Replace head if in minimum amplitude is not produced	1 v. minimum

6.4 Power Supply

Signal	Test Pt.	Adj. Pot	Do NOT adjust unless outside this range	If adj. is necessary, set to this value
+15	H743 J1-1 or AD2	+15reg. R17	14.5 to 15.5	+15V
-15	H743 J1-2 or AB2	-15reg. R17	-14.5 to -15.5	-15V
+5	H743 J1-3 or AA2	+5 reg. R7	4.85 to 5.15	+5V

Abstract:

The RK11 Logic Test is for checking out basically the functional logic of the Controller. Used correctly, it can be an effective analytic and diagnostic tool.

Requirements:

1) PDP 11 with 8K memory
2) RK11
3) Drive (RKØ5) or simulator

Note: There is a mode of operation wherein the drive-independent logic can be checked and simulator or drive is not required for that.

Time Required:

Error free first pass on PDP 11/20 with core: 2 mins. The time is considerably less on 11/40, 45 and MOS or Bipolar memories.

Starting Address:

200 for any mode of operation.

Program Control Modes:

1) Paper Tape
2) DDP Dump Mode
3) DDP Chain Mode
4) ACT 11

1) Paper Tape:

In the start of the program, a question

DRIVES TO BE TESTED?

is asked, to which the user should reply with drive members to be tested.

Eg: for 3 drives 0, 1, 2

DRIVES TO BE TESTED? 0, 1, 2 (CR)

Drives do not have to be in logical order, thus for drives 2 and 4.

DRIVES TO BE TESTED? 2, 4 (CR)

If only one drive is to be selected, it should be so indicated.

If only the drive-independent logic of the controller is to be tested and no drive is available, the reply should be just a "carriage return."

2) DDP Dump Mode:

On starting, the following message would appear

REPLACE DRØ DDP-PAK BY OTHER

After the DDP pack has been replaced, "carriage return" should be typed in. On this, the previous question (Drives to be tested?) appears and should be answered as indicated before.

The DDP pack should be replaced or that drive should not be tested.

3) DDP Chain Mode:

Since in this mode, the program is chain-loaded from the pack on drive Ø, that drive is not tested and the message appears to that effect.

DRØ NOT TESTED

4) Act 11

The program is loaded by the Monitor and all available drives are tested.

Switch Options=

SW 15 = Halt on error

If set, the program halts on encountering an error, after typing out the error message and pertinent information. Pressing "continue" restores normal operation of the program.

SW 14: Loop on test.

The program loops on the sub-test that is being executed when the switch is put on. Switch 14 is usually used in conjunction with SW 15.

SW 13 = Inhibit error printouts.

Note that this switch does not inhibit all type-outs, but only error message print-outs. Used usually with SW 14 (looping on test) on SW 9 (looping on error).

SW 12 = Lock on the sector in error.

Used only for Tests 47, 50, 51 where "WRITE" and "READ" of the entire disk is done. The program loops on the sector that showed error. Eg: if there was an error while doing a "READ" on sector 4, cylinder 27 then "READ" of the same sector, cylinder is done as long as the switch is set.

SW 11: Inhibit iterations

When set, each subtest is executed only once.

SW 10: Bell on error.

Used in conjunction with SW 13 (inhibit error type-outs) so that even when there is no error message an indication as whether an error occurred or not could be given.

SW 9: Loop on error

The sub-test is looped from the point of error to the previous "SCOPE" statement. This switch is different from SW 14 - loop on test. "Loop on test" loops on the entire test, whereas "Loop on error" loops from the point of error, thus providing a tight scope loop.

SW 8: Select sub-test

This switch in conjunction with switches 0 to 7 is used to select a sub-test for execution. Thus, if Test 56 is to be selected switch register would be 000476.

Program Structure:

There are three distinct parts of the program.

1) Initial Set-up Phase:

Setting up of initial pointers, vectors, tables etc. is done in this section. It is in this section that the decision is made about the program mode - paper tape, DDP chain, dump or ACT11. Relevant questions and instructions are given. Flags are set up to indicate which drives are to be tested.

2) Drive-Independent Controller Tests:

In this section, that part of the controller is checked which does not depend on signals from the drive. These tests consist of basic bit-banging of registers, count patterns through registers, controller initializing logic, addressing logic, byte addressing etc. Since drive signals are not required, it is not necessary to have a drive to execute this section of the program.

3) Drive-Dependent Controller Tests:

This section forms the major part of the program, wherein most of the controller logic is checked.

Just before entering this section, the program finds out which drive is to be checked. If in DDP chain mode, drive Ø , if present, is skipped and the next available drive is selected.

At the end of this section, a check is made if all the drives present have been tested. If not, control is transferred to the beginning of this section.

Thus, one pass of the program involves doing

1) Drive-independent tests once
2) Drive-dependent tests for all the available (selected) drives.

Quick Verifying Mode:

Whenever the program is normally started (SA=200) the first pass is a quick verifying one, in which none of the subtests are iterated.

Subsequent passes are iterative, i.e. subtests underto specified iterations (usually 50). If these iterations are to be inhibited SW 11 should be set.

End of Pass:

At the end of every pass, a message is printed

END PASS XXXXXX

where XXXXXX = pass number.

Loops:

There are two kinds of loops:

1) SW 14: Looping is done for the entire subtest.

For example,

```
TST16:   SCOPE
          :
TST17:   SCOPE
```

If SW 14 is set, looping is done from TST 17 to TST 16.

SW 9: Loop on Error.

Here looping is done from the point of error to the previous SCOPE statement.

```
TST16 =     SCOPE
              ⋮
            ERROR 16
              ⋮
            ERROR 17
              ⋮
TST17:      SCOPE
```

If there is an error at "ERROR 16" looping is done from that point back to TST16. Thus SW 9 provides a tighter scope loop than SW 14.

Scope Handler:

The IOT trap is used by the SCOPE statement. When SCOPE is executed, an IOT trap occurs to memory location "$SCOPE". The scope handler starts at "$SCOPE." Depending on the switch settings, this handler decides if looping is to be done, iterations are to be inhibited etc. This handler also keeps track of the test numbers for correct sequencing and other pointers.

Error Handler:

In EMT trap, instruction is used for the error statement (eg. ERROR S). The lower byte of the EMT is encoded to give different error messages at different points. When the error statement (EMT) is executed, a trap to memory address "$ERROR." The handler strips the EMT instruction and recovers the lower byte which is a pointer to the Error Table. The pointer to the Error Table is used if an error message is to be typed out. Depending on the switch settings, the handler makes a decision about halting on error, inhibiting type-outs, bell on error or loop on error.

If an error message is to be printed, an exit is made to the "Error Message Typeout Routine" located at $ERRTYP.

Trap Handler:

Many commonly used routines in the program are called through the "TRAP" instruction. On execution of the "TRAP" a trap to "$TRAP" occurs. The Trap Handler is located at "$TRAP." The Trap Handler will pick up the lower byte of the "TRAP" instruction and use it to index through the Trap Table for the starting address of the desired routine. Then, using that address, an exit is made to that routine.

```
                        ;;*****************************************************
                        ;*TEST 71        SIMULATE & CHECK NXS ERROR
                        ;*THIS TEST SIMULATES NON-EXISTENT SECTOR ERROR & CHECKS THAT
                        ;*IT IS DETECTED BY NXS BIT OF RKER,  IT IS CHECKED THAT
                        ;*WHEN NXS SETS HE & ERR OF RKER ALSO SETS, AND ALL THREE
                        ;*CAN BE CLEARED BY CONTROL RESET,
                        ;;*****************************************************
021366  000004         TST71:  SCOPE
021370  016700  161326          MOV     RKCS,R0
021374  012710  000001          MOV     #1,@R0
021400  016701  161314          MOV     RKER,R1
021404  016777  161336  161316  MOV     DRIVAD,@RKDA    ;GET ADRES OF DRIVE
021412  052777  000014  161310  BIS     #14,@RKDA       ;SET BITS FOR SECTOR 12 (DECIMAL)
021420  012777  177777  161276  MOV     #-1,@RKWC       ;READ 1 WORD
021426  012777  003002  161272  MOV     #OUTBUF,@RKBA   ;INTO THIS BUS ADRES
021434  012710  000005          MOV     #5,@R0          ;READ, GO (FROM NX SECTOR)
021440  000240                  NOP                     ;NXS ERROR SHOULD OCCUR NOW.
021442  032711  000040          BIT     #40,@R1         ;DID NXS BIT SET IN RKER?
021446  001006                  BNE     1$              ;YES, BRANCH
021450  004767  001730          JSR     PC,GT2RG        ;GO GET RKCS, RKER
021454  012767  000040  157476  MOV     #40,$REG2       ;THIS BIT (NXS) IN RKER DID NOT SET
021462  104130                  ERROR   130             ;NXS BIT DID NOT SET ON SIMULATING
                                                        ;NXS ERROR
021464  022710  140204  1$:     CMP     #140204,@R0     ;DID HE & ERR BITS SET?
021470  001403                  BEQ     2$              ;YES, BRANCH
021472  004767  001706          JSR     PC,GT2RG        ;GO GET RKCS, RKER
021476  104131                  ERROR   131             ;HE OR ERR BIT DID NOT SET WHEN
                                                        ;NXS ERROR OCCURED
021500  012710  000001  2$:     MOV     #1,@R0          ;CNTRL RESET
021504  005711                  TST     @R1             ;DID CNTRL RESET CLEAR NXS BIT?
021506  001405                  BEQ     3$              ;YES, BRANCH
021510  010167  157440          MOV     R1,$REG0        ;GET ADRES OF RKER
021514  011167  157436          MOV     @R1,$REG1       ;GET RKER CONTENTS
021520  104125                  ERROR   125             ;CNTRL RESET DID NOT CLEAR
                                                        ;NXS BIT IN RKER
021522  022710  000200  3$:     CMP     #200,@R0        ;WERE HE & ERR BITS CLEARED?
021526  001405                  BEQ     TST72                   ;YES,EXIT
021530  010067  157420          MOV     R0,$REG0        ;GET ADRES OF RKCS
021534  011067  157416          MOV     @R0,$REG1       ;GET RKCS CONTENTS
021540  104125                  ERROR   125             ;RKCS BITS ERR OR HE WERE NOT
                                                        ;CLEARED BY CNTRL RESET
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CNTRL RESET DIDN'T CLEAR REGISTER

PC	REGADD	RECVD
021520	177402	000000

CNTRL RESET DIDN'T CLEAR REGISTER

PC	REGADD	RECVD
021540	177404	000200

'ERR BIT' DIDN'T SET IN RKER

PC	RKCS	RKER	ERR BIT
021462	140204	000040	000040

HE OR ERR DIDN'T SET

PC	RKCS	RKER
021476	140204	000040