INSTRUCTIONS TO OPERATORS IN THE USE

OF MACHINE TEST ROUTINES

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When it is suspected that CSIRAC is not functioning properly, test routines and test procedures using switch board controls have been devised to facilitate the discovery of the section at fault.

It is possible to test the following sections of the machine individually:

(1) Tape Readers
(2) Primary and Control Operations
(3) High Speed (Mercury) Store
(4) Backing (Magnetic Drum) Store
(5) Arithmetic and Logical Functions
(6) Output Punches
(7) Output Teleprinter

These tapes are kept in labelled containers on the inside of the door located at the back of the control desk on the left hand side of the operator's chair.

Underneath the tape containers is a compartment for storage of this booklet along with symbol prints of test tapes.

TEST PROCEDURE

(1) TAPE READER

A circular tape is provided for the 12-hole tape reader which will give a series of patterns displayed on the D-registers when the switchboard controls are set as follows NA = 0 0 1 17, i.e. I ->D, and using NA+SR->K switch.

So that each new pattern displayed on the D-register starts at D0, the test tape should be positioned by using one shot operation until the first row of any pattern is read onto the Input Display. The Sequence Register is then cleared and the machine is allowed to run continuously. The patterns on the Reader test tape have been chosen for their geometric symmetry and any digit channel not reading correctly can be observed on the D-register display.

The test tape for the 5-hole Reader is just a long tape consisting of alternate rows of zeros and all digit configurations. Again the control board is set with NA =0 0 1 17 and using NA+SR→K switch so that the tape configurations are read to successive positions in the D-register. If the Reader is operating correctly a stationary pattern of alternate rows of 0 0 31 31 and zeros will appear on the D-register display, and any change from this pattern will denote an incorrect read.

When using the above tests and incorrect operation is noticed the faulty channel (i.e. p1,p2, etc.) should be noted in the log along with record of whether extra digits appear or some digits are missing.

(2) PRIMARY FACILITIES TEST

This tape tests the machine facilities for correct operation of the Primary Routine, and consists of two parts which are used as separate tests. To feed either section into the machine the method used is the same as for the Primary Routine. NA is set 0 0 1 0 (I ->M) and NA+S->K control switch used. The tape is one-shot until first row appears on Input lights then S register cleared and tape fed in continuously until last order has gone into memory. To make machine execute test the S resister is cleared and NA+S->K switched off.

The first test does not involve the Reader and tests the sources and destinations involved in the Primary Routine. Any configuration is set on NB and the effect of the routine is to place p11 in D1 if there is a p19 on NB or 2p11 in D2 if there is no p19 on NB.

The second test assembles orders from tape into the D-resister for ready inspection in the same manner that the Input Routine assembles orders in the store. It is convenient to use the reader test loop as the tape to be assembled and have a p19 on switchboard I-register. When the machine does the test routine the digit pattern on the test tape is then placed in the lower-ha1f words of the D-register in an easily checked form.

(3) HIGH SPEED (MERCURY) STORE:

It is possible to test the memory from the switchboard by setting different configurations on NB and using NA+SR->K with NA set NB->M.

Firstly set Trigger Selector to last available memory cell, 23,31 then set 31,31,31,24 on NB and fill memory with this pattern. The easiest way to check all locations in the memory is then to set NA to M->PD (0 0 0 0 18), remembering to clear D first, and summate all memory locations in the D-registers. Then set NA to NB->SD(0 0 3 19) and subtract NB from D the correct number of times as determined by the Trigger Selector. If the memory has the right configuration in all cells the D should be zero after these two operations. This checks that all loops in the memory are 'holding'.

To check that we can overwrite correctly in the memory, after filling the memory with 31 31 31 24 NA is set S->M(0 0 23 0) and the S-register configurations sent to memory. Again the memory is checked by zero in the D-register after doing M->PD followed by S->SD.

Should any of the above give non-zero results in the D-register then inspection of the memory monitor will show which loop is at fault. After doing S->M remember that each memory location has in it a number p11 larger than its cell number except n,11 and n,27 which have n,11 and n,27 respectively. That is

cell 2 10 contains 2 11 p11
" 2 11 " 2 11 p11
" 2 12 " 2 13 p11

etc.

It should be remembered that these tests require the memory to operate under more difficult conditions than those imposed by a normal programme, and that occasional failure to perform these tests does not mean that the machine will not perform a programme correctly.

In the second test where again one or two cells fail to change from 31 31 31 24 to So appropriate S-register configuration and they are not used as working space then they would function quite correctly in a programme.

In the first test, the memory is required to hold 85% of all possible digits. If it should fail in just one or two loops to hold all the digits then a normal programme which usually requires less than 50% of a11 possible digits would most likely read in correctly.

(4) BACKING (MAGNETIC DRUM) STORE.

The drum can tested for both writing and reading operations although it must be realized that to test the write operation we have to read out the drum contents.

It is usua1 to test first for correct write operation and this test leaves a suitable configuration on the drum for the read test.

Drum write Test:

The Drum Write Test tape is fed into the Machine in the usua1 manner and, comes to a stop order prior to commencing programme, here it should be checked that the Drum Writing Power is on. The handset register NB is then set to configuration to be written onto the Drum namely, 10 21 10 21, the NA register is used as a source for the optional stop in the programme. With any digit on NA_ the programme will test a11 drum locations serially from 0 to 31,31 then stop, with NA zero the programme continues testing starting again at location 0 after reaching 31,31.

The programme tests the drum in the following manner:
10 21 10 21 is written on the drum location 0 MA(0)
MA(0) is read out and checked.
21 10 21 10 is written on MA(0)
MA(0) is read out and checked.
Then 10 21 10 21 is written on drum location 1 MA(1)
MA(1) is read out and checked.
21 10 21 10 is written on MA(1)
MA(1) is read out and checked.
10 21 10 21 is written on MA(1)
MA(1) is read out and checked.

Tne programme then proceeds to check all further drum locations, the even numbered locations being tested the same as MA(0) and the odd ones the same as MA(1), stopping when MA(1024) is reached if NA has anything on it or commencing again at M(0) if NA is zero.

At the end of testing the drum with the Drum Write Test each even location contains 10 21 10 21 and each odd location 21 10 21 10 this pattern being ideal for the Drum Read Test. Any errors in writing on the drum will cause the programme to come to either 0 1 ZA T stop order or 0 2 ZA T stop order, the (0,1) or (0,2) being displayed on the Interpreter neons. Should this occur then the contents of the current drum location being tested is displayed on the Drum Output neons. At 0 1 ZA T this should have been 10 21 10 21 and at 0 2 ZA T, 21 10 21 10, the extra or missing digits should be noted and recorded, e.g. suppose that at 0 2 ZA T the Drum Output showed 20 10 23 10 then record should read “p16 missing p7 extra on Drum Write Test." Using the start button will let the programme continue testing further drum locations and at any other stops the erroneous digits should be recorded if they differ from those at prior stops.

Drum Read Test:

It will probably be obvious that should the Write Test show up an error we cannot be certain whether it is caused by a wrong write operation or whether in testing what has been written on the drum there has been a wrong read operation. However should the Write Test programme operate correctly and it is desired to test the Read operation more comprehensively then the Drum Read test should be used. This programme does not require Drum Writing Power on as it uses the configuration written on the drum by the Drum Writing Test. The programme is inserted in the usual manner and comes to a stop order prior to doing the actual programme. Provision is made to test a11 or any block of drum locations by using the NB register. The lowest address to be tested is set in p1 units on NB and the highest address in p11 units so to test all of the drum NB is set to 31 31 p11 and 0 p1 i.e. 31 31 0 0 or if locations 100 to 400 only want to be tested then NB=400p11 plus 100p1 i.e.12 16 3 4.

Upon starting, the programme proceeds to test each location as determined by NB by adding current drum location to A register 6 times then subtracting to A register 6 times and ZA->T, testing the resultant contents of A register, as this should be zero – any wrong read operation will cause the machine to stop. When this occurs it is possible to make the programme read out the contents of this location continuously to the A register by putting NA=p1. In this manner the drum output can be observed in the A register or on the Drum Output neons and any intermittent digits can be noted and recorded. Clearing NA allows the programme to continue and test successive locations, after reaching the highest location set on NB commences again at lowest location, thus programme wi11 cycle continuously testing desired section of drum.

(5) ARITHMETIC TEST:

This tape is designed to test all the arithmetic and logical operations along with the constants NA,NB,K,S etc. It is fed into the machine in the usual manner and comes to a stop order at the start of the programme, NA is then set to 0,0,1,0 and any configuration set on NB.

When started the programme executes 14 different groups of commands using NB as a parameter and places the resultant of the first in D1, the second in D2 and so on, the last being placed in D14. The resultant of each group of commands should be zero except those placed in D4,D5,D6 which are dependent on the contents of NB and should not vary individually but change together as NB is varied. The only other exception is contents of D11 which should always be zero except when NB is set with p15 as its least significant digit in which case D11 should contain p1.

After completing the 14 groups of commands the programme enters a 'hoot' loop the duration of which is determined by a count in D0 and upon exit from this loop returns to the start and commences to repeat operation, thus cycling indefinitely. As a marginal check on the machine it is advisible to vary the main H.T. voltage 2% above and below correct setting, this tends to increase the frequency of an intermittent error thus making it more obvious. The control knob to change this voltage is situated on the top, left hand side of the control desk and is labeled 210 V REG. the monitoring device is the second meter from right of the top row on computer power supply cubicle also labelled 210 V REG. Normally the pointer is vertical at zero mark, and by using control knob slowly can be made to read either side of normal setting, the ±2% settings are marked in red.

After the programme is read in and arrives at stop order the following procedure is suggested in using the arithmetic test.
First adjust the +210 REG control until meter reads +2%
Check NA is set to 0 0 1 0.
Set NB to 31 31 31 31
Start machine and check D register configurations for correct operation for a short period, say 10 seconds. With machine still running, change NB and again observe D for correct operation. Note that with the machine running when changing NB it is possible to get a non zero configuration in the D register, this is not a machine error. Several other NB settings should be made, each time observing the D registers for correct operation. The suggested NB settings are
31 31 31 31, 16 0 0 0, 20 0 0 0, 0 0 0 1, 16 0 0 1, 1 31 16 0. If the above test shows correct machine operation stop programme and using control knob slowly change 210 V REG to -2% setting and repeat the above procedure. Should any errors be evident in this test the NB setting should be noted along with the particular D register or registers which show incorrect configurations. It is most important that after using the Arithmetic Test the 210 V REG control must be adjusted so that monitoring meter reads zero.

(6) OUTPUT PUNCH TEST:

This tape is fed into machine in standard manner coming to a stop order prior to commencing programme. When started 20 rows of all possible digits are punched followed by 2 blank rows then ten pairs of alternating al1 digit and no digit rows plus enough blank rows so that the tape can be torn off without having to run clutch, the programme then comes to a stop.

The first part of the punched tape enables a check to be made that every digit is always being punched and the s6cond part that no extra digits arc being punched. If the Start button is used again the above punch out is repeated. This test is suitable for both 12-hole and 5-hole output punches.

(7) TELEPRINTER TEST:

This programme which is fed into the machine in standard manner, tests the teleprinter by sending a11 possible codes to teleprinter in both lower and upper case. The results should be as follows:

0123456789+-.)(ijk then Greek letters,

ABCDEFGHIJKLMNOPQRSTUVWXYZ then capital lambda.

These two rows are repeated until computer is stopped.