ELLIOTT 900 SERIES SIMULATOR

TEST PROGRAMS
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Elliotts provided test programs to users and to their own
maintenance engineers to check for correct operation of
Elliott 900 series computers and to aid in fault diagnosis.

The TEST directory contains examples of these programs to
illustrate how they were used.

DEMOX1.DAT. This shows the use of X.1 ("X1 920 B.C&M ISS 3"),
a program to test the operation of the paper tape reader and
punch. The test program is contained in X1(ISS3).BIN and is
loaded by initial instructions. On entry at 8000 the program
punches two blocks of data and then stops. The operator
should then load the punched tape into the reader and enter at
8031, whereupon the machine will enter a loop in which it
successively inputs and checks one block before punching
another. This cycle continues until either the punch runs out
of tape, the user stops the program manually or an error is
detected.

If an error is detected the program punches two characters
separated by blanks and stops. The first character represents
the code just read and the second the code expected.

Note this program assumes a Mode 1 paper tape reader.

DEMOX2.DAT: This shows X.2 ("903 X2 ISSUE 1"), an 8K store
test for Elliott 920B/903. The program is loaded by initial
instructions. It is entered automatically and writes a
chequerboard pattern from location 2 to location 8030, tests
the pattern then complements each location in turn. If this
is correct the inverse pattern is written and tested. If no
error has been found the program reads a character from tape.
If the character is blank the test is repeated, otherwise the
program reads in its second part and punches a legible message
"920 STORE TEST 1 O.K." This is followed by loading a clear
store program that loops continuously.

If an error is detected, seven characters will be punched:
  a. An erase (255) to mark the start of the group.
  b. Characters 2, 3 and 4 are the binary address of the store
     location that failed.

c. Characters 5, 6 and 7 are the incorrect pattern read from
   that location. (Characters 4 and 7 are the least
   significant bits of each word).

The chequerboard pattern used is

LOCATION	0	1	2	3	4	5	6	7	.	.	.	.	60	61	62	63
0	0	1	1	0	0	1	1	0					0	1	1	0
64	1	0	0	1	1	0	0	1					1	0	0	1
128	1	0	0	1	1	0	0	1					1	0	0	1
192	0	1	1	0	0	1	1	0					0	1	1	0

... et seq.

This pattern imposes the maximum strain on the store – if the
store or its circuits are weak a zero bit might appear as a 1
or a 1 as a zero. By exchanging each zero location with a
"full house" and vice versa and then restoring them to their
original contents the test endeavours to induce errors.

DEMOX3.DAT shows X.3 ("903 X3 ISS 4"), a function test for all
machines except the 920A. The program is loaded by initial
instructions. The program is then entered at 8 and each
function (i.e., instruction) is tested in turn and unless an
error is detected, this cycle is repeated 150 times, at which
point one character is read via the tape reader.

If this character is blank, the test cycle repeats a further
150 times. Otherwise the test cycle is ended and the legible
message "FUNCTION TEST OK" is punched and the program loops
clearing store.

If an error is detected the program continuously punches a
code indicating which test is in error.

```
1.   4    read A=0
2.   5    write A=0
3.   7    jump A=-1
4.   7    jump A=0
5.   9    jump A=0
6.   9    jump A=-1
7.   1    0+0
8.   1    (-1)+0
9.   1    0+(-1)
10.  1    1.0101.. + 0.1010..
11.  1    0.1010.. + 1.0101..
12.  1    1.0101.. + 1.0101..
13.  1    0.1010.. + 0.1010..
```

```
14.   2      -0+0
15.   2      -(-1)+(-1)
16.   2      -0+(-1)
17.   2      -(-1)+0
18.   6      0 & -1
19.   6      -1 & 0
20.   6      -1 & -1
21.   6      &000777 & 777000
22.   10     -1++
23.   0      B := &005252
24.   11
25.   3      Q := &525252
26.   14     14 0
27.   14     14 1        A wrong
28.   14     14 1        Q wrong
29.   14     14 1
30.   14     14 1        A wrong
31.   14     14 1        Q wrong
32.   14     14 8191     A wrong
33.   14     14 8191     Q wrong
34.   14 14  2           Q wrong
35.   14 14  4           Q wrong
36.   14 14  8           Q wrong
37.   14 14  16          Q wrong
38.   14 14  32          A wrong
39.   14 14  8190        Q wrong
40.   14 14  8184        Q wrong
41.   14 14  8184        Q wrong
42.   14 14  8176        Q wrong
43.   14 14  8160        Q wrong
44.   14 14  35          Q wrong
45.   14 14  8157        Q wrong
46.   14 14  8157        A wrong
47.   12     10110011.. * 10110011..  AR wrong
48.   12     10110011.. * 10110011..  A wrong
49.   12     10110011.. * 0           AR wrong
50.   13     10110011.. * 0           A wrong
51.   13     &164121 &534112 / &346315    Q wrong
52.   13     &164121 &534112 / &346315    A wrong
53.   14     &134121 &534123 / &231466    Q wrong
54.   13     &134121 &534123 / &231466    A wrong
55.   13     &777776 &631465 / &000002    A wrong
56.   13     &777776 &631465 / &546315    A wrong
57.   B modification B := +2
```

DEMOX3A.DAT shows the use of X.3A ("900 X3A 1/1/71, Binary
Mode 3" ACD), a version of X3 modified for the 920A system.

DEMOX4.DAT shows the use of X.4 ("903 X4 ISSUE 1"), a program
to test whether the contents of an 8K store are preserved over
a power off / on sequence. The program is loaded by initial
instructions. On entry at 8000 a test pattern is written to
store and checked. If no error is found one character is read
from paper tape. If it blank another test cycle is performed,
otherwise a legible message is produced at the punch. If an
error is found two characters are punched, the first
representing the eight least significant bits of the failing
address and the second character the most significant 5 bits
of the 13 bit address.

If when the test halts the machine is power cycled, re-entry
at 8009 will resume checking and confirm the store contents
have not been disturbed.

DEMOX5.DAT shows the use of X.5 ("X5 920B. M&C ISS 3.") to
test interrupt handling.

The program starts in level one and then terminates to level
4. The operator is given 5 seconds to press the Interrupt 3,
2 and 1 buttons on control panel in sequence. As each level
is entered a visible record is punched, and again as the
program descends back through the levels. If the operator
hits the keys in time, the punched sequence should be 4R, 3S,
2S, 1S, 1T, 2T, 3T 4R.

DEMOX6.DAT shows the use of X.6 {"903X6 ISS 2") and
instruction timing test program. X.6 is supplied as T.2
source text and the user is required to append a parameter
tape specifying the instruction to be timed.

The program works by writing 2500 identical instructions in
locations 1000 to 3499. These will be obeyed repeatedly and
every 20th cycle the character 1101100 will be punched to
paper tape to enable the cycles to be timed with a stopwatch.
On a 903, the time taken in seconds will equal the instruction
time in microseconds.

The parameter tape consists of three constants, a, b, c.
If a = 0, the test will expect to read an address tape. This
is only used for instructions 14 and 15. The address tape
should be punched as four digits representing the address.

If a = +1 the program will write the address of the next
location in all those locations containing the instruction to
be timed. This is only used for instructions 7, 8 and 9.

If a = -1 the program will write address 999 in all those
locations containing instructions to be timed.

b denotes the contents of the accumulator during the duration
of the test cycle.

c denotes the instruction to be timed, with the address bits
set to 0.

There are no error indications.

(There is no DEMOX7.DAT - X.7 was a test program for the i/o
system and requires use of a "channel 1 test set".)

DEMOX8.DAT shows testing the program trace facility using X.8
("903 X 8 ISS 3"). The program X8(ISS3).BIN is loaded by
initial instructions and then entered at 8. It reads in paper
tape at about 20 c/s. After a short while, a level one trace
interrupt is set up and reading slows down to about 1 c/s.

If an error occurs a character is punched indicating the
function digits of the last instruction obeyed of the "traced"
program.

DEMOX10.DAT. This shows the use of X.10 ("X10 920 B.M&C. ISS
1."), a variable speed paper tape input/output test. The
program is loaded by initial instructions. On first entry at
8 the program punches two copies of a specimen tape with the
punch operating at varying speeds and then stops. The
specimen tape is then loaded into the reader and the program
re-entered at 32. The program enters a loop in which it
successively inputs and checks one block of tape and punches
another. On alternate cycles reading and punching takes place
at varying speeds. This cycle continues until either the
punch runs out of tape, the program is manually stopped or an
error is detected.

When an error is detected the program with the incorrect
character in A and the correct character in Q.

DEMOX12.DAT This shows X.12 ("X12, ISSUE 3") a version of X.2
for an Elliott 920M with 8 or 16K of 5 microsecond store. The

program is loaded under initial instructions (reading in mode
1) and is self triggering. The program can be re-entered at
8. To soak test a module, enter at 10 with the number of the
module in the accumulator. Note any error indication is
preceded by the code 101010 as a marker, otherwise is the same
as for X.202.

The chequerboard pattern used is

```
LOCATION    0 1 2 3 4 5
    0       1 0 0 1 0 1 . . .
   64       1 1 1 1 0 0 . . .
  128       0 0 0 0 1 1 . . .
  192       0 1 1 0 1 0 . . .
  256       0 1 1 0 1 0 . . .
  320       0 0 0 0 1 1 . . .
... et seq.
```

DEMOX17.DAT. This shows X.17 ("X17 19/8/69, Binary" XACD) a
version of chequerboard test X.2 for an Elliott 920M with 8 or
16K of 2 microsecond store.

The chequerboard pattern used is

```
LOCATION    0 1 2 3 4 5 6 7 . . . . 60 61 62 63
    0       1 1 1 1 0 0 0 0          0  0  0  0
   64       1 0 0 1 0 1 1 0          0  1  1  0
  128       1 0 0 1 0 1 1 0          0  1  1  0
  192       1 1 1 1 0 0 0 0          0  1  1  0
... et seq.
```

(These different chequerboard tests reflect the fact that
different core store organisations were used in the 920M and
therefore a different pattern is required from that used with
the 920B to maximize the stress on the store under test.)

DEMOX50.DAT demonstrates the teleprinter test X.50 ("903 X50
ISSUE 2"). The program is loaded by initial instructions and
has 5 phases each with its own entry point.

The first phase is to type out an output pattern that stresses
the mechanical aspects of a teleprinter.

The second phase is a simple input test of each key on the
teleprinter keyboard in turn. If an error occurs the text
"ERR" is output and the process restarts. Note that the demo

takes input from a binary file via the paper tape reader to
produce the exact sequence of codes required by this test.

The third phase is a simple line echo test. The user inputs
text until either a semicolon is type or 70 characters have
been input. The program then types back the line to the
teleprinter.

The fourth phase is an echo check. This simply echoes back
any character typed by the user.

The fifth and final phase is a check of the teleprinter reader
and punch. A copy of the output from phase 1 should be
punched, then read back. If an error occurs, the message
ERR
X
Y
Is output and the program stops. X is the eight-bit pattern
of the correct character and Y is the eight-bit pattern of the
character received.

DEMOX51.DAT shows another variable speed paper tape test, X.51
("903 X51 ISSUE 1"). The program is loaded by initial
instructions. On first entry at 21 a specimen tape is
produced. The specimen tape is then loaded into the reader
and the program re-entered at 22. The program successively
reads in blocks of 256 characters and punches another block.
The first 8192 characters are read and punched at full speed
and the next 8192 are read and punched at varying speeds. This
cycle continues until either the punch runs out of tape, the
program is manually stopped or an error is detected.

Entry at 23 tests reading only (i.e., with a tape loop in the
reader) and entry at 24 tests punching only.

Errors are indicated by punching two characters separated by
blanks: the first character is the correct code, the second
the code read in.

Note that the demo shows an error being detected: after the
last correct block the program encounters runout inserted by
the simulator rather than the expected next block.

DEMOX52.DAT. This shows the use of X.52 ("903 X52 ISSUE 1") a
test program for 903 incremental graph plotters. The test is
distributed as a loader and relocatable binary tape with an

attached data tape. Entry points are 21 to 28 each of which
draws a test pattern at increasing sizes, 1X, 4X, 6X, 8X, 10X,
15X, 20X, 22X respectively. On triggering at one of these
entry points the data tape is read in and the pattern plotted
repeatedly.

DEMOX202.DAT. This shows the use of X.202 ("903 X202 BIN 18
12 66"), a chequerboard test for machines with extended stores
beyond the basic 8K. The program is read in under initial
instructions and then a parameter tape loaded before entering
the test. The program reads the tape skipping blanks until
the first non-blank, which should be a digit (in 920, 900 or
903 telecode) and the appropriate module is tested. When the
test is complete, assuming no errors are found, the tape is
read again. A blank causes the test to be repeated. A
further digits results in a message being punched to confirm
the successful test and then testing of the module specified
by the digit just read begins. The process continues until an
error, the tape runs out or a 920 telecode stop code is
encountered. (The demo uses an ENTER command to patch this to
be a test for a 903/900 telecode halt code; on a real 903
using a 903/900 telecode halt character causes a processor
hang rather than a dynamic stop).

Error indications and the chequerboard pattern used are as for
X.2.

DEMOX212.DAT. This shows X.212 ("X212 920 M ISS2") a version
of X.202 for an Elliott 920M with 8 or 16K of 5 microsecond
store. The program is loaded under initial instructions and is
self triggering. The program can be re-entered at 8. To soak
test a module, enter at 10 with the number of the module in
the accumulator. Note any error indication is preceded by the
code 101010 as a marker, otherwise is the same as for X.202.

DEMOX217.DAT. This shows X.217 ("X217 920 M ISS2") a version
of chequerboard test X.212 for an Elliott 920M with 8 or 16K
of 2 microsecond store.

DEMOX400.DAT. This shows X.400 ("X400 ISS1"), a combined
function and store test. The program is loaded under initial
instructions and entered at 16. The function test (X.3) is
started and unless an error is detected it is repeated 150
times. Upon completion a character is read from tape reader.

If it is a blank the store test (X.4) is initiated and on
completion a further character is read. If this is also blank
the function test repeats, hence the program will alternate
function test with store test. If the character input is not
a blank a legible message is produced and the remainder of the
test tape (a clear store) is read in an executed before the
program stops. The error indications are as for X.3 and X.4.

The program can also be entered at 18 to run a continuous soak
test.

DEMOX402.DAT. This shows X.402 ("903 X402 BIN 19 1 67"), a
version of X.4 for use with extended stores. It operates with
a parameter tape identically to X.202 and gives error messages
in the same form as X.4. Note: there is a bug in the program.
If a halt code is on the parameter tape, the second entry to
confirm store contents after a power of and on sequence fails
with a processor hang, so the demonstration relies on the
first phase running out of tape to read to trigger the second
phase.

DEMOXINIT.DAT. This shows the use of XINIT ("903 XINIT ISS 1
SCB"), a program to check that correct handling of initial
instructions. This test must be run on a machine with more
than 8K of store. It checks that the initial instructions are
protected from overwriting at level 1, but not other levels,
and then when overwritten, the value in core persists over
machine resets.

DEMOXPTS1.DAT. This shows the use of XPTS1 ("903 XPTS1 RLB
ISSUE 1"), a test program for machines with a dual paper tape
station.

XPTS1 is loaded by initial instructions.

The operator then enters the program at different addresses
depending upon the width of the tape to be used in the test:
        8 hole tape, enter at 21.
        7 hole tape, enter at 24.
        5 hole tape, enter at 27.

The operator then re-enters the program at 30 to punch a block
of test data at full speed. This is then fed into the reader.
A further re-entry at 32 reads this data at full speed and
checks it.

The program can be made to punch tape at varying speeds by
entry at 39. It can be made to read tape (i.e., a loop made
from a block punched by entry at 30) at varying speeds by
entry at 37.

The program will also test a machine with two paper tape
readers and punches, in which case further entry points can be
used, making the full set of entries as follows:

         30: Punch data to PUNCH1 at full speed
         31: Punch data to PUNCH2 at full speed
         32: Check PUNCH1 output on READER1 at full speed.
         33: Check PUNCH1 output on READER2 at full speed.
         34: Check PUNCH2 output on READER1 at full speed.
         35: Check PUNCH2 output on READER2 at full speed.
         36: Check PUNCH1 output on READER1 alternating with
              checking PUNCH2 output on READER2 cyclically, at
              varying speeds.
         37: Repeatedly check READER1 (e.g., with a tape loop
              punch by entry at 32) at varying speeds.
         38: Repeatedly check READER2 (e.g., with a tape loop
              punch by entry at 32) at varying speeds.
         39: Repeatedly punch data on PUNCH1 at varying speeds.
         40: Repeatedly punch data on PUNCH2 at varying speeds.

If an error is detected the program punches two characters
separated by blanks and stops. The first character represents
the code just read and the second the code expected.

DEMOXMT70.DAT. This shows the use of XMT70 "XMT70 ISSUE 1"
which provides users and engineers with a means to construct
simple programs to exercise Elliott 903 magnetic tape units.

XMT70 is loaded by initial instructions. The program to be
run can either be read in from paper tape by entry at 22 or
from the teleprinter by entry at 23. (Entry at 21 is to open
a 903 multiplexor and not required in the simulator).

The input consists of lines of commands as follows:

     Magnetic tape system actions
     OC <bits> .   Output control word
     WW <bits> .   Write a word to tape
     WB <pattern> <length> . Write block to tape
     RW .   Read a word from tape
     RB <length> .   Read a block from tape

```
     CB .                        Close block
     IS .                        Input status
     IW .                        Wait for interrupt

     Control
     CP <pattern> <length> .    Compare block read with pattern
     CP /S <bits> .             Compare status with bit pattern
     CP /D <bits> .             Compare last word read with bit
                                pattern
     PR M <text> $ .            Print text message
     PR S .                     Print last status word
     L/n/                       Declare label n
     J /n .                     Unconditional jump to label n
     JF /n .                    Jump to label if last CP had a
                                zero result
     LP /n .                    Loop for n cycles
     JB .                       Jump back to start of matching
                                LP (max nesting 16 deep)
     CT /OC <bits> .            Set bits 1 and 2 of command word
                                (handler number) to loop count
                                modulo 4
     WT <delay> .               Wait in delay units of 100 usec
     WT .                       Wait for operator to continue by
                                entry at 9
     GO                         Run program
```

```
<bits>     specify a bit pattern e.g., 1/5/18
<pattern> /A    alternate 1's and 0's
          /B    random
          /F    full house (all 1's)
          /Z    all zeros
<length>  /n    size of block to write (not to exceed 256)
```

space : and / are separators and may be used anywhere
. and line feed are group terminators
$ terminates message strings
* cancels the current function
() begin and end comment fields
halt code stops assembly, wait for re-entry at 9
^ newline in message strings.

Note that IW should not be used to wait for short interrupts,
e.g., between successive RW commands.

The example program shows 5 blocks being written then read
back, followed by a write, backspace, read sequence that sets
up and tests for various status conditions.

DEMOXMT71.DAT runs XMT71 "XMT71 ISSUE 1" a demanding
functional test of the magnetic tape system.

XMT71 is a sum-checked binary tape loaded by initial
instructions. Entry is at 26 to test handler 0, 27 for
handler 1, 28 for handler 2 and 29 for handler 3 if it is
required to stop after any error is detected. The
Alternatively, entry points 22-25 run the same tests without
stopping.

Operating in the simulator the tests will not produce errors,
indeed this program was used to check out the magnetic tape
simulation!

The program produces operator instructions and error reports.
Continuation from these is by entry at 9. This is illustrated
in the script: it responds to instructions to remove and
replace the write permit ring in handler 0.

The test continues until it has filled the tape, whereupon it
gives a report, rewinds the tape and starts again.

DEMOXMT72.DAT. This runs XMT72 "XMT72 ISSUE 1" a general
engineering test of the Elliott 903 magnetic tape system.

The test exercises each handler in turn reading and writing
data and repositioning using the backspace facility.

The operator can set the error output mode by the following
entry points:
        27   Output all errors.
        28   Output all errors and await re-entry at 9.
        29   Suppress error reports.

By default all errors are output.

The operator can specify different values than the defaults
for various parameters by entry at 26.

The test is run by entry at the following locations:
        21   Open multiplexor (not needed in simulator)
        22   Select odd parity, write using block transfer.
        23   select odd parity, write using word-by- word
              transfers.
        24   Select even parity, write using block transfer.

        25   Select even parity, write using word-by-word
              transfers.
Entry at 30 produces a dump to paper tape of the last written
and read data area.

Entry at 31 restarts the reading phase of the test after an
error.

Entry at 32 produces an error summary on the teleprinter.

DEMOXMT73.DAT runs XMT73 "XMT73 ISSUE 1" an interchangeability
test for the magnetic tape system. Selecting each handler in
turn the program writes a number of blocks of random data.
When writing is completed on each handler it is rewound. When
all the handlers have been written, the data is read back and
checked. If errors occur they are reported on the
teleprinter. When the data has been read and checked on all
the handler, the operator is instructed to move each tape
cyclically to the next handler in sequence and the reading
check repeated by entry at 30.

Entry points:
        21   Open multiplexor (not required in simulator).
        22   Start test, wait after error.
        23   Start test, continue after error.
        24   Input number of blocks required (default 1000).
        25   Output error summary.
        26   Restart handler phase.
        27   Restart block phase.
        28   Abandon handler.
        29   Abandon block.
        30   Restart reading phase.
        31   Dump written/read data.
        32   Select even parity.