The ND Emulator project
Developed for Linux and Windows

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ND Emulator User Manual

3.41 use-7bit-on-symb-files-write <on/off> 10

3.42 float <format> 10

3.43 compare-images <image file> <image file> [report file] 10

3.44 add-parity <input file> <output file> 10

3.45 remove-parity <input file> <output file> 10

3.46 byte-swap <inp.file> <outp.file> 11

3.47 od <format> <iput nfile> 11

3.48 octal-to-decimal <number> 11

3.49 decimal-to-octal <number> 11

3.50 float-test <val1> <val2> 11

3.51 mode <input file> <output file> 12

3.52 exit 13

3.53 quit 13

3.54 debug <level(0=off)> 13

3.55 zz 13

3.56 READ-BINARY <input file> 14

3.57 WRITE-BINARY <page table> <output file> 14

3.58 define-segment <segment number > <name> 14

3.59 load-segment <segment number> <progfile> 14

3.60 list-segments 14

3.61 delete-segment 15

3.62 toggle-rt-program-mode 15

3.63 Set-internal-device-mode <dev> <mode> 15

3.64 list-SINTRAN-commands 15

3.65 SINTRAN-III commands description 15

3.65.1 @set-terminal-type <n> 15

3.65.2 @list-opened-files 15

3.65.3 @close-file <file number (-1=all)> 16

3.65.4 @list-file <file name> 16

1 INTRODUCTION

The ND Emulator can be used freely for non-commercial purposes and may be redistributed provided the receiver is made aware of this. The user manual can be copied without any restrictions.

The ND Emulator has been developed in the 'C' programming language partly using Linux and partly using Windows. The Windows version is running as a 32 bit application without a graphical user interface and is controlled via an interactive user interface in a DOS window. Users of SINTRAN will recognize the command interface with abbreviation of the commands and prompts for missing parameters.
The aim of this emulator project was to emulate the instruction set to see how fast an emulator could execute compared to a ND computer. The next step was to be able to run ND programs like the MAC assembler, an early version of the Fortran compiler (FTN) and QED. To be able to do this it was necessary to also emulate many SINTRAN III monitor calls and make an interface to the Windows and Linux file systems.

Platform
The emulator is developed using Visual Studio running under Windows 10. The emulator should run on Windows XT and newer.
A Linux version is also available.

Multiuser.
You may start several instances of the emulator and each instance will open its private SCRATCHxx file.
A maximum of 8 simultaneous users is allowed.

The emulator has been tested using the following ND programs:

Ref. chapter 15 Working programs

Though some testing has been carried out with these programs the author does not guarantee that the emulator is bug-free. If you get any problems or find errors please do not hesitate to report it to this mail-address:

sundling@getmail.no

Check user SYSTEM for :PROG-files, some of these requires more extensive SINTRAN III emulation and is partly working.

Source file editing
PED is working, but it may be more efficient to use e.g. Notepad to edit source. It is more convenient to mark text, set the cursor to a position etc. (which is not supported by PED). Some special keyboard keys from Tandberg Terminals is not available in the emulator. Most of the ND-programs check for even input parity which is not generated by Notepad. To cope with this issue the command:

<>set-parity-when-reading-SYMB-files <on/off>

MAC, NPL, FORT-100 etc. will now read files generated by Notepad.

Note: QED can read files without parity using MPI(0)

QED can write files without parity using MPO(0)

2 Changes from previous version

Version 1 2017

The TDV-2215 terminal is now emulated (not completely) and PED can be used to edit text files by using terminal type 52..

Several monitor calls have been introduced. Overlay segments function is not tested very intensive…

A number of bugs are fixed

July 12th 2019

Corrected @cre-file command. Will now handle @cre-file xxx.symb like
@cre-file xxx:symb

MON 71 and MON 72 now accepts device number 0
create-file modified to work in Linux
help command now uses S3 file abbr.
MON 15 is start accounting, now disabled. IOT 15 still works
@copy-file now does not destroy dest file if error in opening source
@copy-file filled 2 bytes too many to make a 1024 word page
@copy now does not destroy dest file if error in opening source
@rename-file implemented
MON 66 will now return the number of bytes in the input buffer for stdin
Corrected SKP opcode, was incorrectly corrected before.
Added MON267
IOX on terminal 1

Version December 2019

Corrected MON263 Get device type and attributes
Corrected old close 0161043

Added mon calls 0250 GetDefaultDirectory, 0244 GetDirEntry,
0213 GetDirUserIndexes, 0215 GetObjectEntry, 0232 Rename file
Added new command "norsk-tegnsett" which converts { } [ ] \ | to å Æ Å Ø ø
Better handling of monitor calls BREAK and ECHO and MON310
Corrected MON 63
Added more functionality in TDV 2215 emulation
Added MON 161
Added MON 216, does nothing (write object entry)
Added MON 231 expand file
Added MON 317 (execute command) and MON 220 (direct open)
Added command release-directory (does nothing)
Added MON 220 (same as MON 50) and MON 253 create new version (dummy)

New command virtual-keyboard: Move cursor up/down using wheel and
set cursor position in PED editing area.
Stop on full page implemented (@terminal-mode)
Programs can run on different interrupt levels and switch between them
(ref: 6 Interrupt handling)
Corrected an error in floating instructions
Corrected an error in SUB instruction
Added

@enable-escape-function	(dummy)
@enable-terminal-handling	(dummy)
@sintran-service-program	(help/exit/cc recognized)
@rt-loader	(help/exit/DMAC recognized)

Added partial emulation of Nord Color Terminal emulation

Implemented internal device (200B-277B) and reserve/release for these.
Works with MON 1 and MON 2.

Implemented semaphores (300B-377B) reserve and release.

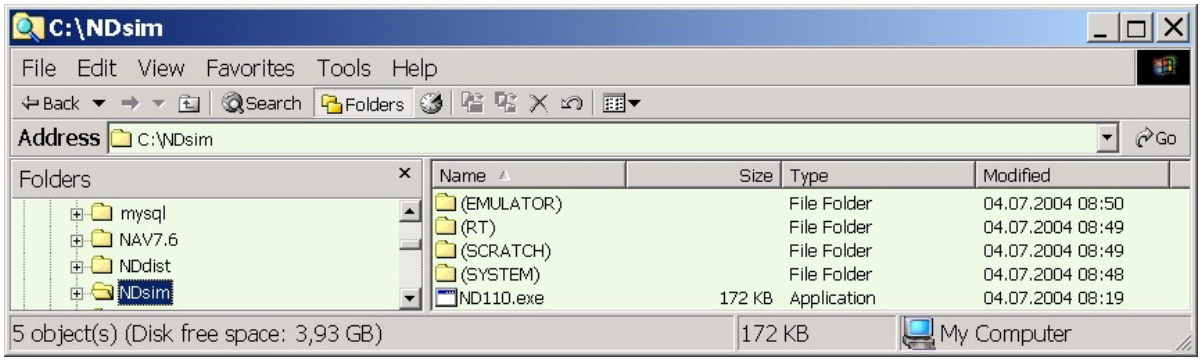
Version January 2020

Beta version XMSG, works on LINUX only

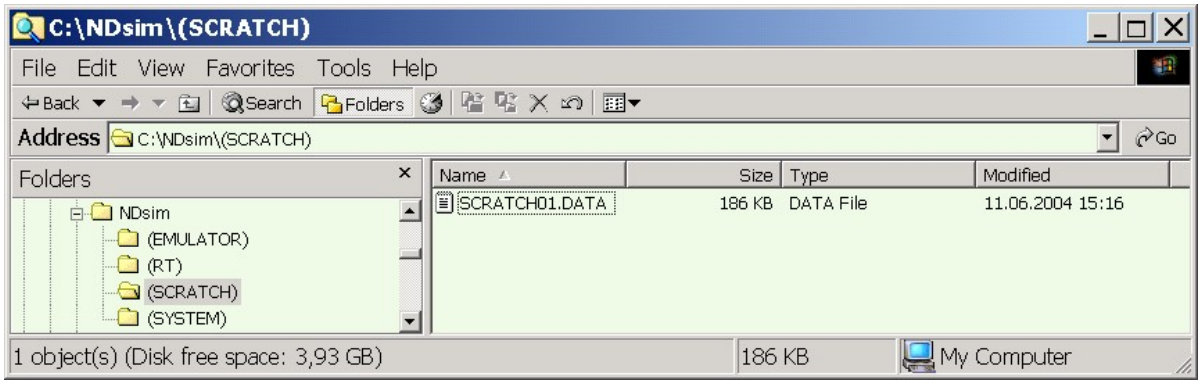
2.1 Getting Started/Installation

NOTE: All folder names and file names (except Ndsim and ND110.exe) should have upper case letters only!

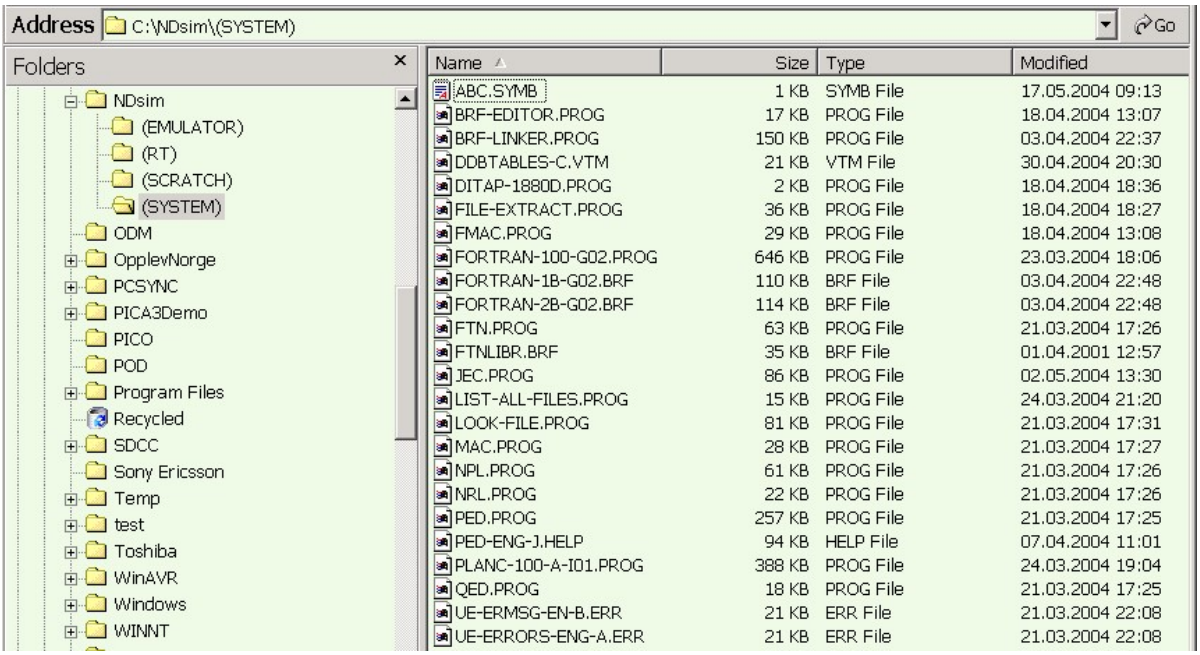
Create a folder called Ndsim. In this folder create the folders as seen in the picture below:



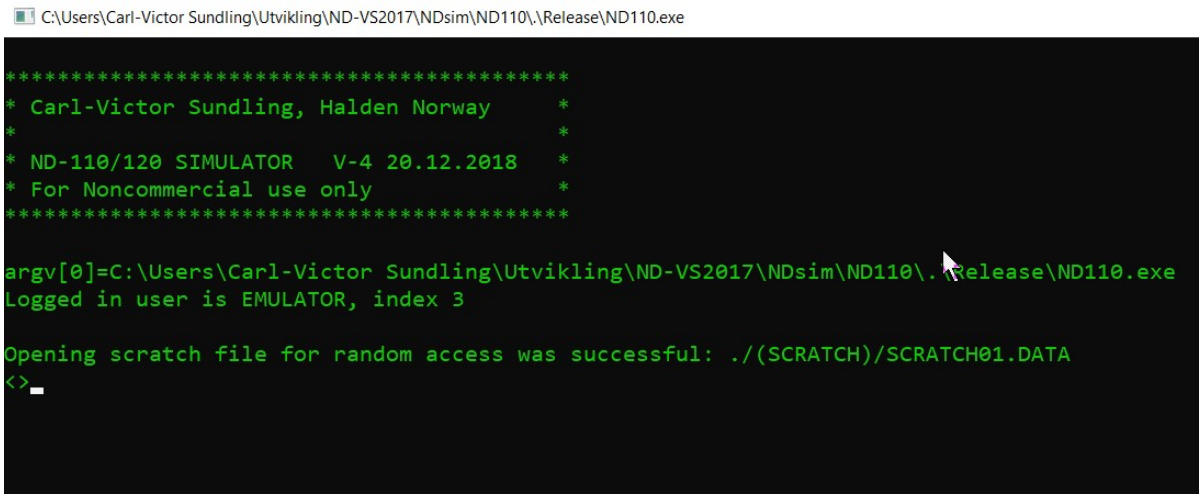
Put the ND110.exe file in the NDsim folder.
Create the file SCRATCH01.DATA in the folder (SCRATCH) as seen in the picture below:



Install the ND executables and their system files (like PED-ENG-J.HELP) in the (SYSTEM) folder.

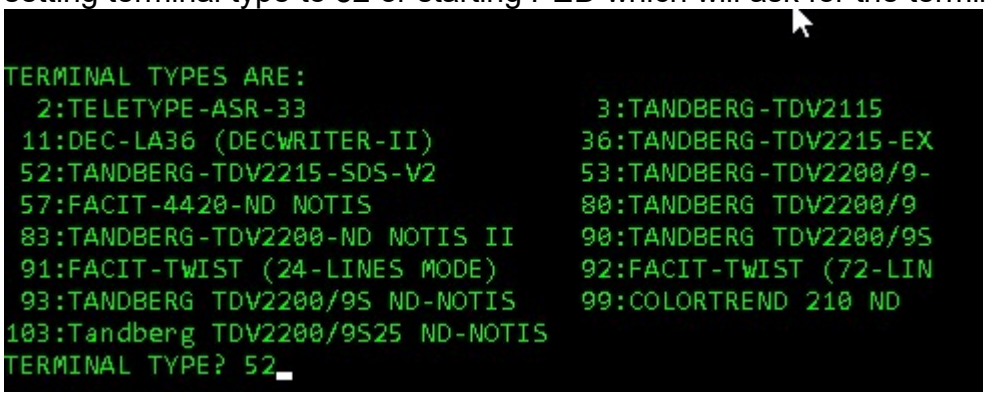


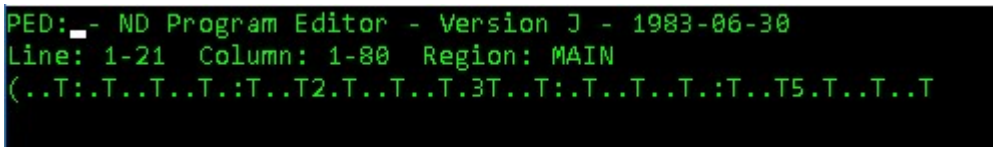
Create a shortcut to the ND110.exe file on your desktop and double click it to start the emulator. The emulator is started in a DOS window and you are automatically logged in as user EMULATOR. Typing QED should now start the QED editor



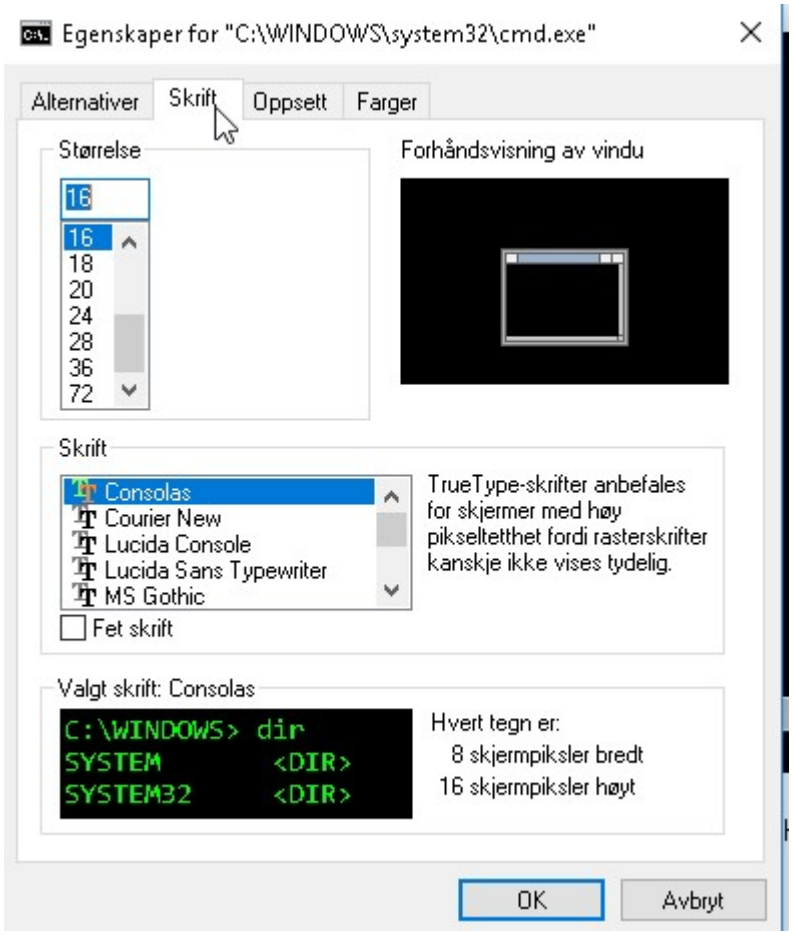
2.2 Terminal emulation

The emulator has a built-in Tandberg TDV-2215 emulator which is activated by setting terminal type to 52 or starting PED which will ask for the terminal type:





The emulator will show status lights at the bottom of the screen.
The font size etc. can be changed:



2.3 Mandatory to know

Read this section before you try to find SINTRAN-III functions that are not emulated.

2.3.1 BG-programs and RT-programs

The emulator is running background programs only, RT programs and most of the monitor calls associated with RT is not implemented. The RT-loader does not exist in the emulator and you can not look at segments.

2.3.2 The file system

SINTRAN-III is using file names coded in upper case and so does the emulator. You may however type lower case file names, they will be converted to upper case.

Many of the monitor calls for doing file-IO is emulated. You may open files for block access or sequential access and create new files. Direct access is not handled as in SINTRAN-III, but the user should not notice any difference.
The monitor calls for setting block size, reading no. of bytes in file etc. are implemented.

The emulator handles different users, i.e. file names can be (USER)FILE:TYPE anf the open monitor calls cope with abbreviated user, file and type as in SINTRAN-III.

Directory names, however, are not emulated. Any attempt to use a (DIR:USER….. notation is simply ignored by the emulator program.

Creating new files using “FILE” (or “file”) works.

The SINTRAN-III file version concept is not emulated, do not use **“; “**in the file names!

The file extension separator is **“.”** , not **“:”** (which is illegal in Windows file names). The ND applications should still use **:** as file separator, the emulator will automatically substitute it with **“.”** when required.

2.3.3 File indexing “NO SUCH PAGE”

In SINTRAN-III it is possible to have files with “holes”, that is: You may write page 1 and page 99 of a file for example and access these randomly. The emulator does not emulate the SINTRAN-III file system with file indexing, it is using the native Windows/Linux file system which can not handle “holes”. When writing e.g. page 99 of a file in the emulator the file will get 99*1024*2 bytes and afterwords it will be legal to access e.g. page 10, even if it has not really been written by the emulator. As long as your program does not use the “NO SUCH PAGE” error return to make decisions in the program logic, you will not have any problems with this nonconformance with SINTRAN-III. If you try to read beyond the maximum number of bytes, you will get an error return “NO SUCH PAGE” as in SINTRAN.
The “hole” syndrome also makes problems when transferring files from a ND-computer to Windows or Linux using ftp. The transfer will terminate because of the

NO SUCH PAGE error before all of the file contents is transferred. This is the case for many :DATA files, but also for :PROG files for 2-bank programs.

A program that fills the holes is available and must be run on a ND-computer.

Note: When making :PROG files in the emulator, e.g. using BRF-LINKER, the program files will be created without holes and need not be fixed to be usable in the emulator later on.

2.3.4 Terminal break strategy

Terminal echo and break strategy is now implemented. (MON 3 and MON 4)

2.3.5 Parity

Many of the ND applications are generating and testing parity on text files. The QED editor is a typical example, you can control parity generation using the MPI(x) and MPO(x) modes. If you want to use e.g. Notepad to edit program files and compile then using e.g. FTN you will get a problem with “PARITY ERROR”.

You may work around this problem by using the command:

set-parity-when-reading-SYMB-files <on/off>

You may now use Notepad to edit files, save and then use it in e.g. MAC, NPL, FTN etc.

The emulator has a feature that will remove parity on output from an emulated ND program. Ref the command 3.41 use-7bit-on-symb-files-write <on/off>
If you activate this function before starting the ND program, output files will be readable by e.g Notepad afterwards.

The emulator also has a command “remove-parity” that will remove on an existing file.
Using QED you can decide to write files with parity on or off (MPO(1) MPO(0)) or read files with no parity (MPI(0))

2.3.6 Users

As mentioned you may have different users. SYSTEM, RT and SCRATCH are mandatory. The user areas are simply folders named (SYSTEM), (RT) and (SCRATCH) and there are no restrictions on the number of pages available.
As in SINTRAN the emulator will search for files in SYSTEM’s user area if not found at the logged in user. Only SYSTEM may write it’s own files, others may read only. Except for user SYSTEM, there ar no restrictions for reading and writing files between the users, friends are not emulated.

2.3.7 2-bank programs

The emulator supports 2-bank programs by emulating the Alternative Page Tabel mechanism. The ALTON and ALTOFF monitor is emulated and bit 0 in the status register may be turned on/off to control which bank to read/write from/to when in ALTON mode. There is no difference in execution time running in 1-bank or 2-bank mode.

2.3.8 Reentrant subsystems

This feature is not supported yet. The PLANC compiler seems to run, but for some commands the REENT monitor call is used and it will stop.

2.3.9 Floating point

The emulator handles both 32 and 48 bit floating point format. (48 bit is currently not supported by the Windows version). The emulation is carried out by converting forth and back between the IEEE floating point format used by the ND computers and the IEEE format used by the Intel processors. Add, subtract, divide and multiply are therefore done by HW in the Intel processor.
The instructions DNZ and NLZ is using a scaling factor that gives a one-to-one result, i.e. 3.000 is converted to 3 and nothing else!

2.3.10 Misc

Spooling files are not implemented.

2.3.11 Instructions not emulated

Stack instructions are not tested very well. 48 bits floating point is not working on Windows.

3 The emulator command interface

Using the emulator interface which is command driven should not be a problem for a user known to SINTRAN-III. As in SINTRAN you may abbreviate the command until ambiguous and you will be asked for missing parameters. Some commands are intended to be identical to SINTRAN and can be executed from an application program through the MON 70 monitor calls. Such commands are preceded by an @ and can be listed by typing help @
Please note that the command interpreter is case sensitive (except for the SINTRAN commands).
If the command interpreter does not recognize a command it will try to locate an application program (.PROG file) at the logged in user's area. If it does not find a match there, it will look in user SYSTEM's area before giving up.
To start QED you only need to type QE , the Fortran compiler can be started by typing FO-100 etc. (This of course is provided that you have not made any files matching the name in your own user area)
If name a file that by some reason matches a command in the emulator, it can be started by typing !name.

Some of the commands have been introduced to be used for developing and debugging the emulator program and may not be very useful for the “normal” user.

3.1 upper-case <on/off>

Using this command you can control whether the characters typed on the keyboard are converted to upper case or not before returned to the calling application using the MON 1 monitor call.
It can be useful if you are working with e.g. mac which does not accept lower case letters. In practice this command works like the Caps Lock function on the keyboard.

3.2 log-in-user <user name>

When entering the emulator you are logged in as user EMULATOR.by default. Use this command to change user.

3.3 list-users

This command will list all known users in the DOS-window.

```
<>li-users

These users are known:

SCRATCH
EMULATOR
RT
SYSTEM
<>
```

3.4 trace-execution <on/off>

This command turns on or the execution trace function in the emulator. In trace mode the emulator will print the values of all the registers for each instruction executed. It also indicates which type of instruction that is executed. It is possible to start tracing when reaching a point in the application and it is possible to define trace areas as well. Trace output is directed to the DOS window where the emulator is running unless opening a trace file.
The trace output may be written to a file which may be investigated e.g. by Word Pad, Notepad or any other text processor program.

Note 1: Turning trace off does not close an open trace file.

Note 2: Turning on trace will influence the execution time.

3.5 trace-monitor-calls <on/off>

Turn on or off the tracing of monitor calls. The emulator will report all monitor calls in the emulator window or on the trace file together with the values of all registers.

Note: The monitor calls MON 1, MON 2, MON 71 and MON 72 are not traced because they are frequently used and generate a lot of output.

3.6 begin-trace-execution-when-at <address>

The trace function will be activated (and stay active) when the P-register reached the instruction at the value indicated by <address> which should be an octal number between 0 and 177777.

3.7 define-trace-area <trace no.> <lower> <upper>

Defines an area where the trace is active. Several trace areas may be active simultaneously. The upper and lower parameters should be octal numbers.

Tracing is not turned on by this command, you will have to activate tracing be the trace-execution command.

The trace areas that are defined can be listed by the “status” command.

3.8 reset-trace-area <trace number>

Deactivates a defined trace area.

3.9 open-trace-file <output file>

Use this command to open the file where the trace output will be written. Writing trace information is enabled via the trace-execution command. The file remains open until explicitly closed or when terminating the emulator program.
To create a new file embrace the file name by “xxxx”.

The default file extension type is .txt and the file will be created in he ND110 folder, not in the logged in user area. To put it elsewhere use standard ../ notation, the command interpreter does not use SINTRAN-III notation.

3.10 close-trace-file

Closes the trace output file. The trace output will now appear in the command interpreter’s DOS window.

3.11 set-break-point <address>

Set breakpoint at <adrress> which should be an octal number between 0 and 177777.
The emulator will stop execution when reaching a breakpoint.
Only one breakpoint can be defined.
To continue after a breakpoint use the command continue-after-breakpoint.

3.12 clear-breakpoint

Clear a defined breakpoint.

3.13 continue-after-breakpoint

Continue execution after having stopped at a breakpoint.

3.14 define-histogram <start-address> <increment>

Defines a histogram:

```
<>def-hist

Start address (octal): 300

Increment (octal): 1000

Histogram area starts at     300, ends at   12300
<>
```

3.15 list-histogram

Running QED and exit at once makes this histogram:

```
<>li-hist

     Area          hits (dec)
-----------------------------
    300 -    1277           0
   1300 -    2277           0
   2300 -    3277        1567
   3300 -    4277        2889
   4300 -    5277          83
   5300 -    6277           0
   6300 -    7277          24
   7300 -   10277         263
  10300 -   11277           0
  11300 -   12277           0

Number of instr. executed: 5381
Inside histogram area    : 4826
Histogram has been cleared!
<>
```

3.16 guard <location>

Using this command the emulator will report whenever the contents of the memory address at <location> changes value. <location> should be an octal number: You may have up to 20 guards active simultaneously.
Guards are working in page table 0 only.
Guards cannot be reset but are cleared when a program is loaded into memory.

3.17 report-memory-reference <location>

Using this command the emulator will report whenever the contents of the memory address at <location> changes value. <location> should be an octal number between 0 and 3177777. Only one report can be active. (works in all page tables)
Enter a negative number to turn off, or use the command reset-report-memory-reference

3.18 reset-report-memory-reference

Deactivates the defined report of a memory reference.

3.19 look-at-memory <page table> <address>

This command is similar to the SINTRAN-III LOOK-AT-MEMORY command. The page table should be 0 or 2 normally which is always used for BG-programs.
The address should be a number between 0 and 177777 octal. (negative numbers are not accepted).

Example:

```
<>lo-im qed

Program low = 0 high = 20435 start = 0 restart = 1
Loaded OK, memory limits (bank 0) are now set to 0 - 20435
JMPi  125002 @ PC=     0 T=     0 A=     0 D=     0 X=     0 L=     0
ST=     0 B=     0
<>loo 0 0

Enter value (octal) or
"text string" or
memory address (octal value): (or /) to set location
Enter q or . and return to terminate

      0/      0 :      12   0/ 12  cntlch  / cntlch  >
0/      1 :   60542 141/142  ASCII a / ASCII b >
0/      2 :   61544 143/144  ASCII c / ASCII d >
0/      3 :   62506 145/106  ASCII e / ASCII F >
0/      4 :   43400 107/  0  ASCII G / cntlch  >
0/      5 :       0   0/  0  cntlch  / cntlch  >
0/      6 :       0   0/  0  cntlch  / cntlch  >
```

Typing return advances to the next address.

Typing a value (octal) deposits the value (16 bits) in the current location and advances to next location.

Typing a value (octal) followed by / sets current location to the value.

Typing a **.** or **q** terminates examination mode.

Note that when 177777 is reached, the next location examined will be I the next page table.

Enter a character string by typing **“abcde”**, (A termination char ‘ is not added)

3.20 find-value-in-memory <value> <page table>

List all the address of values that match <value> in the specified page table. <value> should be an octal number.

3.21 find-nonzero-in-page-table <page table no>

Find and list the memory addresses of all addresses that contains non-zero values. (Used for development purposes)

3.22 fill-memory <value> <from> <to>

Fill the specified memory area with the given value. All numbers should be octal. A simple performance test can be done by fill-mem 0 0 177777 and then typing go 0. After 5 seconds type ESC and the number of instructions and the time pr. instruction is printed.

3.23 copy-memory <from> <bytecount> <ntimes>

Copies <bytecount> bytes starting at memory position <from> the number of times specified by <ntimes>. The memory position should be an octal number.

Note: Works in page table 0 only. (?)

3.24 set-register-value <register> <value>

Set the specified ND CPU register to <value> which should be an octal number. Legal registers are T A D X B L S P (lower case acceptable).

If <register> equals * then all registers are set to <value>

Example:

```
<>set-reg * 0

(Bits in status register not influenced when setting other registers)
Status before:
LDX    54011 @ PC= 20145 T=    15 A=     0 D=     1 X=    55 L=  7370
ST=   142 B=   276
Status now:
LDX    54011 @ PC= 20145 T=     0 A=     0 D=     0 X=     0 L=     0
ST=     0 B=     0
<>
```

3.25 list-register-values

List the values of all registers.
Example:

```
<>li-reg

LDX    54011 @ PC= 20145 T=    15 A=     0 D=     1 X=   161 L=  7370
ST=   140 B=   276
<>
```

3.26 status

Lists information about register values, active trace areas etc.
Example:

```
<>stat

CPU status is: 32 bit ND float format, defined program memory limits
are 0 -   20435
LDX    54011 @ PC= 20145 T=    15 A=     0 D=     1 X=   161 L=  7370
ST=   140 B=   276
```

```
Status bits: K= 0  Z= 0  Q= 0  O= 1  C= 1  M= 0  SSTG= 0  SSPTM= 0
Tracing memory references of address 123
Trace area number   1:     100 -    1777
<>
```

3.27 @mode <input file name> <output file name>

Similar to the SINTRAN III command. Using e.g. PED you can can generate a ”script” to compile and like a program etc.
Example:

The file mode-test:symb contains:

```
@fort-100
sep-data on
comp simple-main,,rrr
exit
```

Doing @mode mode-test term executes the mode file and writes output to the terminal:

```
<>@fort-100
ND-100/NORD-10 ANSI 77 FORTRAN COMPILER - 210191G02
FTN: sep-data on
FTN: comp simple-main,,rrr

- CPU TIME USED: 0.0 SECONDS.  5 LINES COMPILED.
- NO MESSAGES
- PROGRAM SIZE=46 DATA SIZE=77 COMMON SIZE=0
FTN: exit

Time used is 0 secs, 20 milsecs
423364 instructions executed, 0.049603 usec/instruction
<>
<>
End of file on mode input file
<>
```

3.28 ! <image file>

Use this command to start a ND program file in the emulator if the name of the program file you want to start is identical to a command name. If you for example make a program file with the name HELP.PROG, the command interpreter would recognize “help” as the command that lists matching commands of the emulator.

Typing HELP would start the program since the command interpreter is case sensitive. (The ! feature was introduced at a stage in the development of the emulator when prog-files also was case sensitive)

Example:

```
<>! qed

Program low = 0 high = 20435 start = 0 restart = 1
Loaded OK, memory limits (bank 0) are now set to 0 - 20435
JMPi  125002 @ PC=     0 T=    15 A=     0 D=     1 X=   161 L=  7370
ST=   140 B=   276
```

```
Starting execution at start address 0


QED 4.3

*
```

If the file to execute is not found in the logged in user's area, user SYSTEM will be investigated to see if the file exist there.
Explicitly the user name may be specified:

```
<>! (SYSTEM)NRL

Program low = 0 high = 24631 start
Loaded OK, memory limits (bank 0) a
JMPi  125002 @ PC=     0 T=    15 A
Starting execution at start address

RELOCATING LOADER LDR-1935J
*
```

Note that the program file name is not case sensitive.

3.29 load-image-file <image file>

This command loads a program file into memory, but does not start execution. The parameter <image file> specifies a ND executable :PROG file.

If the file to execute is not found in the logged in user's area, user SYSTEM will be investigated to see if the file exist there.
Explicitly the user name may be specified:
Example:

```
Segment tables cleared
Open file: ./(SYSTEM)/QED.PROG

Program low = 0 high = 20435 start = 0 restart = 1
Loaded OK, memory limits (bank 0) are now set to 0 - 20435
JMPi   125002 @ PC=     0 T=     0 A=     0 D=     0 X=     0 L=
0 ST=     0 B=     0
Check if program loaded on overlay segment:  NO
<>
```

3.30 load-byte-swapped-image-file <image file>

This command is identical to the "load-image" command, except for that it expects the image file to be "byte swapped", that is the byte ordering of the ND file has not been fixed to match the Intel architecture. This command can be used if you by some reason have problems with transferring binary files from the a ND computer.

3.31 set-memory-limits <lower> <upper>

Use this command to set the memory limits of the program area. The values of the lower and upper parameters should be octal numbers between 0 and 177777.

The memory limits are used when dumping memory to file, but only when in 1-bank mode.

3.32 set-2bank-mode <on/off>.

Set the emulator in 2-bank or 1-bank mode. The bank mode only influences how the "dump-memory" command will create the ND :PROG file.
Setting 2-bank mode is relevant only when you e.g. make a 2-bank program using MON ALTON in NPL or MAC and dump it. Making program files using the BRF-LINKER is working as it does on a ND computer.

Some times a program file that is transferred from a ND computer is recognized by the emulator as a 2-bank program even if it is a 1-bank program. In these cases the program will be executable without any problems, but an error messages is printed each time it is invoked.
To get rid of the error message do the following:

```
load-image xxx
set-2b off
dump xxx sa ra
```

3.33 activate-alternative-page-table <APT no.>

This command turns on alternative page table (like MON ALTON). It can be used to e.g. test small programs to see how the alternative page table mechanism works. This command was implemented to test the APT mechanism in the emulator.

3.34 save-image-to-file <image file> <SA> <RA>

Identical to "dump-memory"

3.35 dump-memory <prog.file> <start address> <restart address>

Dumps the emulator's memory to an executable ND file with start and restart addresses that will be used when invoking the program using the ! command. Start and restart address are octal numbers. To create a new ND :prog file, embed the file name in "".

If the emulator is in 1-bank mode the area in page table 0 defined by the "set-memory-limits" determines the area to be dumped to file.

If the emulator is in 2-bank mode the entire contents of page table 0 and 2 will be dumped to the :PROG file. This is done to cope with the problem of files with "holes", ref . 2.3.3.

Switching the emulator between 1-bank and 2-bank mode is done using the command "set-2bank-mode <on/off>".
Using 2-bank mode is only sesible when you make a program that turns on the alternative page table by means of MON ALTON.

2-bank files always use 256 kbytes file space.

3.36 run <start-address>

Start the emulation at the given address which must be an octal number between 0 and 177777.
Identical to “@go”.

3.37 continue-at-restart-address

Continue execution at the restart address (RA) of the currently loaded ND application program.

3.38 help <command> <output file>

List all commands matching <command> to the specified output file. If no outfile is defined, the emulator DOS window will be used for output. To create a new file, embed the file name with “”. You may specify a directory path ../ , the emulator is not using SINTRAN-III user notation for this command.

Example:

```
<>help load,,,,

load-image-file <image file>
load-byte-swapped-image-file <image file>
<>
```

3.39 open-scratch-file

The scratch file (SCRATCH01:DATA) is opened when starting the emulator. If it is closed by some reason it may be reopened using this command.

3.40 check-files

Checks the files present in the logged in user’s area to find files that are accessible as SINTRAN-III files. The example below shows the list of files that are not accepted and which are accepted. Files that are not accepted may be present, but they may not be opened by ND programs.

```
<>log-in sys

Logged out user EMULATOR and logged in user SYSTEM (user 0)

<>check

File:                        FFF-SYMB > File type is missing
File:         A2345678901234567.SYMB > File name is too long
File:                       LLL.SYMBX > File type is too long

These files are known for user SYSTEM:

BRF-EDITOR.PROG
FTNLIBR.BRF
ABC.SYMB
BRF-LINKER.PROG
DDBTABLES-C.VTM
FILE-EXTRACT.PROG
```

```
FMAC.PROG
FORTRAN-100-G02.PROG
FORTRAN-1B-G02.BRF
FORTRAN-2B-G02.BRF
FTN.PROG
LIST-ALL-FILES.PROG
LOOK-FILE.PROG
MAC.PROG
NPL.PROG
NRL.PROG
OOO.SYMB
PED.PROG
PED-ENG-J.HELP
QED.PROG
UE-ERMSG-EN-B.ERR
UE-ERRORS-ENG-A.ERR
LLL.SYMB
KKK.SYMB
<>
```

3.41 use-7bit-on-symb-files-write <on/off>

If 7 bit mode is turned on the emulator will remove the parity bit for each byte when writing to a :SYMB file (works for seq. and random access). This can be convenient if you want to read a file generated by a ND program by e.g. Notepad or Wordpad.

3.42 float <format>

Sets the emulator to emulate 32 bit or 48 bits floating point. 32 bit floating point is default. Format is either 32 or 48.

*** 48 bit float is currently not implemented ***

3.43 compare-images <image file> <image file> [report file]

Compares two ND program files (:PROG) and writes a report of differences in SA, RA, memory limits and the dumped memory area. [report file] is optional.
It is possible to compare both 1-bank and 2-bank program files.

The files names are not using SINTRAN-III user names etc., directory paths ../../ may be specified. File name abbreviation is not possible.

3.44 add-parity <input file> <output file>

Reads the input file byte by byte, generates even parity and writes the result to the output file.

The files names are not using SINTRAN-III user names etc., directory paths ../../ may be specified. File name abbreviation is not possible.

3.45 remove-parity <input file> <output file>

Reads the input file byte by byte, clears bit 7 and writes the result to the output file.

The files names are not using SINTRAN-III user names etc., directory paths ../../ may be specified. File name abbreviation is not possible.

3.46 byte-swap <inp.file> <outp.file>

Reads the input file two bytes at the time from the input file and writes them in the opposite order to the output file.

3.47 od <format> <iput nfile>

Generates an octal byte (8bits) or word (16 bits) dump of the specified input file. The default file name is :BIN. Format is either 8 or 16.
Example:

```
<>od 8 ff
Dump from file ./(EMULATOR)/FF.BIN
      0 (      0):    0   1   0   2   0   3   0   4   0   5   .........
     10 (     12):    0   6   0   7   0  10   0   0   0   0   .........
     20 (     24):    0   0   0   0   0   0   0   0   0   0   .........
     30 (     36):    0   0   0   0   0   0   0   0   0   0   .........
```

Generates an octal word (16 bits) dump of the specified file. The default file name is :BIN.
Example:

```
<>od 16 ff
Dump from file ./(EMULATOR)/FF.BIN
<>
      0 (      0):        1       2       3       4       5
      5 (      5):        6       7      10       0       0
     10 (     12):        0       0       0       0       0
     15 (     17):        0       0       0       0       0
```

3.48 octal-to-decimal <number>

Prints the decimal value of the octal <number>.

3.49 decimal-to-octal <number>

Prints the octal value of the decinal <number>.

3.50 float-test <val1> <val2>

Prints the floating point value represented by the two octal numbers as if value1 resided in the A-register and value 2 in the D-register.

Example:

```
<>flo-test 40000 0

Converted to 0.500000

Convert back to ND format: 40000 , 0

<>
```

Note: 32 bit floating point format only.

3.51 mode <input file> <output file>

NOTE: When directing output to the <output >file the emulator commands and output will still be printed in the console window not on the <output file>. Needs to be fixed.

Using this command is similar to the @MODE command in SINTRAN-III, typically used to compile and link programs etc. The mode file should use lower case letters for the emulator commands which should not be preceded by an @ as in SINTRAN-III mode files.

The emulated SINTRAN-III commands must be preceded by an @, e.g. @li-fi
This command use SINTRAN-III abbreviation of the file name and a user name may be specified, the default file extension is :MODE
You may use e.g. Notepad to generate the mode file.

Example: (file list depending on what is in the user area)

Contents of mode file:

```
@li-fi,,,
npl
@FLO48
@DEV SIMULATOR-1,,100
MAC
)9ASSM 100
)9END
)9TSS
set-mem 0 177777
dump "SIM" 0 1

<>mode comp,,,

<>@li-fi,,,

FILE 0 : (EMULATOR)AIM:6502
FILE 1 : (EMULATOR)AIM:PROG
FILE 2 : (EMULATOR)BCD:SYMB
FILE 9 : (EMULATOR)COMP-AIM:MODE
FILE 10 : (EMULATOR)COPFTEST:SYMB
FILE 11 : (EMULATOR)D:PROG
FILE 12 : (EMULATOR)D2TEST:PROG
FILE 13 : (EMULATOR)DO:PROG
FILE 19 : (EMULATOR)GETRT:SYMB
FILE 20 : (EMULATOR)GETRTDESC:SYMB
FILE 31 : (EMULATOR)SIMULATOR-1:SYMB
FILE 32 : (EMULATOR)SIMULATOR-2:SYMB
FILE 36 : (EMULATOR)SUB1:SYMB
FILE 37 : (EMULATOR)TEST-BFILL:SYMB
FILE 38 : (EMULATOR)TEST-BYTEMOVE:PROG
FILE 39 : (EMULATOR)TEST-BYTEMOVE:SYMB
FILE 40 : (EMULATOR)TEST-FORT:MODE
```

```
FILE 41 : (EMULATOR)TEST-FORTRAN:MODE
FILE 42 : (EMULATOR)TEST-FTN:MODE
FILE 54 : (EMULATOR)ZZZ:SYMB
<>npl
Open file: ./(SYSTEM)/NPL.PROG

NORD PL NOVEMBER 1979

@FLO48
@DEV SIMULATOR-1,,100
 WARNING: SUBROUTINE ENTRYPOINT CHANGED TO ,SA

- END OF COMPILATION
0 ERRORS DETECTED
Time used is 0 secs, 654 milsecs
77080764 instructions executed, 0.008498 usec/instruction
<>
<>MAC
Open file: ./(SYSTEM)/MAC.PROG

- MAC -
)9ASSM 100
 **** 000000 DIAGNOSTICS ****

)9END
)9TSS
Time used is 0 secs, 381 milsecs
45645257 instructions executed, 0.008369 usec/instruction
<>
<>set-mem 0 177777

Memory limits are now       0 -  177777
<>dump AIM 0 1
Open file: ./(EMULATOR)/AIM.PROG
Successfully saved program code to file

<>
End of file on mode input file
<>
```

3.52 exit

Terminates the emulator program.

3.53 quit

Terminates the emulator program.

3.54 debug <level(0=off)>

If set to a nonzero (positive) value the emulator will print some debug information, mostly from the emulation of the monitor calls.
Used for emulator debugging purposes.

3.55 zz

Do not use this command!

3.56 READ-BINARY <input file>

Not implemented.

3.57 WRITE-BINARY <page table> <output file>

Write the memory content in the specified page table to the specified file. The default file type is :BIN
Page table is either 0,1,2 or 3. Page table 0 contains program code and data if running 1-bank programs and program code if running 2-bank programs. When running 2-bank programs data will be found in page table 2.
The entire memory is dumped. (64K 16 bit words).

In SINTRAN page table 1 is used for the OS. In the emulator page table 0 is used for user programs.

3.58 define-segment <segment number > <name>

This command is used to associate a segment name with a segment number.
An alternative way to define segments/names is to use a text editor, e.g. Notepad or run PED in the ND emulator. You may add, change or delete segments using a text editor.
NOTE: If using QED type MPI(0) before you read the file and type MPO(0) before you write back to turn off the parity bit check when reading and parity bit generation when writing.

3.59 load-segment <segment number> <progfile>

This command creates a file on user SYSTEM and requires that a segment has been defined on beforehand. The name of the file will be like this:

SEGFILE_200.SGNO	25.09.2017 10.59	SGNO-fil	129 kB
SEGFILE_201.SGNO	25.09.2017 11.00	SGNO-fil	133 kB
SEGFILE_202.SGNO	25.09.2017 11.00	SGNO-fil	103 kB
SEGFILE_203.SGNO	25.09.2017 21.19	SGNO-fil	28 kB
SEGFILE_204.SGNO	25.09.2017 11.00	SGNO-fil	141 kB

The name is SEGFILE_xxx. SGNO where xxx is the segment number.
The second parameter <progfile> must be a program file, :PROG, linked as a 2-bank program. Refer to the ND manual:

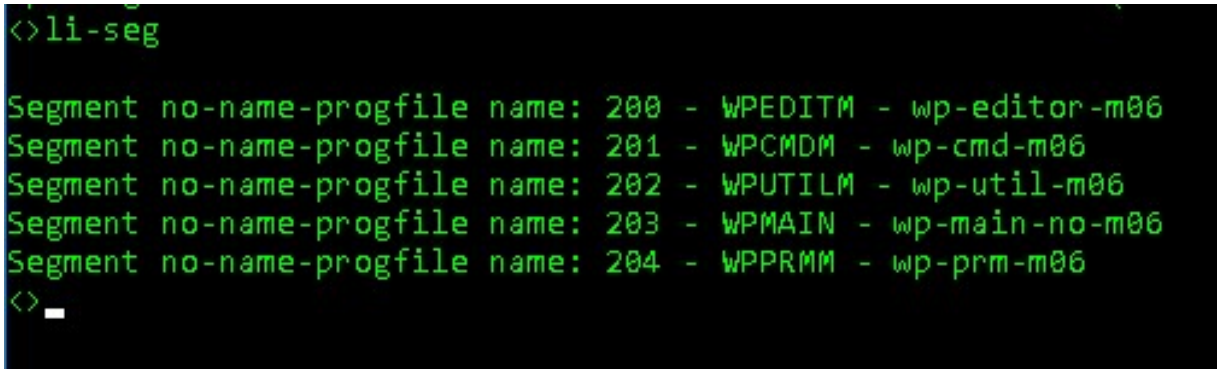
ND-60.196.3 BRF-LINKER
http://sintran.com/sintran/library/libsw/ND-60196-3-EN.pdf

3.60 list-segments

This command will list the defined segments from the segment file.

./(SYSTEM)/SEGFILE.SIN3

Example:



3.61 delete-segment

Not used, use a text editor instead and edit the contents of the **(SYSTEM)/SEGFILE.SIN3**.

3.62 toggle-rt-program-mode

Some RT-programs are dumped to a :PROG file that can be loaded by the RT-LOADER. (instead of loading :BRF modules in the RT-LOADER). Such programs may be executed in the emulator. Background programs use normal PIT 0 and alternative PIT1. RT-programs typically use alternative page-table 2 (MON 33 / MON 34), but the emulator will load program data (2-bank) to PIT 1. Using the toggle command the MON 33 (ALTON) will force the emulator to use PIT 1 instead.
The program code of the RT program will run in PIT 0.

3.63 Set-internal-device-mode <dev> <mode>

Used to switch between byte or word mode when reading/writing to an internal device. In word mode 2 bytes are taken from the A-register. In byte mode only the rightmost 8 bits are taken from the A-register.
<dev> is the internal device numer 200B…277B.

3.64 list-SINTRAN-commands

List the commands that are implemented to be SINTRAN-III identical (at least close to).

3.65 SINTRAN-III commands description

3.65.1 @set-terminal-type <n>

Use this command to set the terminal type.
PED is dependant of recognizing a terminal type. (PED will show a list of recognized terminal types, chose 52)

At start the emulator sets terminal type 0.

3.65.2 @list-opened-files

Lists the files that are currently open. When issued as a command from the emulator command interpreter only the scratch file should be open.

```
<>@li-op

    100: ./(SCRATCH)/SCRATCH01.DATA Opened for access   2, block size 512 bytes

<>
```

When issued from a ND program all files currently open will be listed.

```
PED:@li-op

   100: ./(SCRATCH)/SCRATCH01.DATA Opened for access   2, block size 2048 bytes
   101: ./(SYSTEM)/UE-ERRORS-ENG-A.ERR Opened for access   2, block size 2048 bytes

PED:
```

The format is somewhat different from SINTRAN-III output.

3.65.3 @close-file <file number (-1=all)>

Closes a specified file where file number typically is 100, 101 … (octal).
If file number is -1 all open files except the scratch-file will be closed.

3.65.4 @list-file <file name>

List all files matching <file name> in the DOS window.

```
<>@li-fi (sys)fo,,,

FILE 12 : (SYSTEM)FORTRAN-100-G02:PROG          661504 bytes
FILE 13 : (SYSTEM)FORTRAN-1BANK:BRF             111695 bytes
FILE 14 : (SYSTEM)FORTRAN-2BANK:BRF             115786 bytes<>@li-fi
(sys):brf,,,

FILE 0 : (SYSTEM)BASLIBR-H00:BRF               23135 bytes
FILE 13 : (SYSTEM)FORTRAN-1BANK:BRF             111695 bytes
FILE 14 : (SYSTEM)FORTRAN-2BANK:BRF             115786 bytes
FILE 16 : (SYSTEM)FTNLIBR:BRF                   35158 bytes
FILE 17 : (SYSTEM)FTNRTLIBR-2094F:BRF           26817 bytes
FILE 19 : (SYSTEM)JEC-1BANK-B00:BRF             6414 bytes
FILE 20 : (SYSTEM)JEC-2BANK-B00:BRF             6416 bytes
FILE 27 : (SYSTEM)MON-CALL-1B-A00:BRF           6120 bytes
FILE 28 : (SYSTEM)MON-CALL-2B-A00:BRF           6159 bytes
FILE 31 : (SYSTEM)NO-FILE-GIVEN:BRF             0 bytes
FILE 37 : (SYSTEM)PASCAL-2LIB-J:BRF             26131 bytes
FILE 38 : (SYSTEM)PASCAL-COD-J:BRF              156365 bytes
FILE 40 : (SYSTEM)PASCAL-LIB-J:BRF              25881 bytes<>
```

3.65.5 @new <user name>

Works similar to the NEW command in SINTRAN-III, except for that user RT also may switch to any user as SYSTEM can. When starting the emulator user EMULATOR is logged in. To change to user SYSTEM use the command log-in-user.

3.65.6 @who

Prints the current user:

```
<>@who

===>   1   EMULATOR
<>
```

NOTE:
If you have started several instances of the emulator you will see just one user!

3.65.7 @place-binary <.BPUN file>

Loads a .BPUN file into memory.

```
<>fmac
- MACF -
IMAGE-FILE : 100

)9ASSM BPUN-TEST,1,033/STARX, SAT 1; SAA 100;MON 2;MON 65;MON 2;MON 65;MON 0

ENDX, 123

)LINE
 **** 000000 DIAGNOSTICS ****
*:000043  ENDX:000042  STARX:000033

STARX<*
?

)9ASSM 1,0,BPUN-TEST

)BPUN STARX ENDX

)9TSS

<>@place bp:brf
Open file: ./(EMULATOR)/BPUN-TEST.BRF
oooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooooo
oooo
177777/146101
134021
146157
134017
146156
134015
006000
146051
146206
```

```
142006
124003
173401
124371
134005
146615
131023
151077
160473
146145
004016
134006
155570
004373
134003
060371
125010
170404
164403
164402
175235
124376
164400
146142
000000
125001
000033
177777!
Found end of preamble (!)
Load start address is 33
Data word count is 11
Checksum is 11002
Action is 0
<>run 33
@@
<>
```

3.65.8 @place-image-file <.PROG file>

Loads a PROG-file image into memory without starting execution.

```
<>place qed

Segment tables cleared
Open file: ./(SYSTEM)/QED.PROG

Program low = 0 high = 20435 start = 0 restart = 1
Loaded OK, memory limits (bank 0) are now set to 0 - 20435
JMPi   125002 @ PC=     0 T=     0 A=     0 D=     0 X=     0 L=     0 ST=     0 B=     0
Check if program loaded on overlay segment:  NO
```

3.65.9 @go <address>

Start the emulation at the given address which must be an octal number between 0 and 177777.
Identical to “run”.

3.65.10 @recover <prog file>

Loads and starts a program file, default file type is PROG. The emulator will search for the program file in the logged in user file folder. If it is not found, it will search for the file in user (SYSTEM).
A simpler way of starting a program is to simple type the file name at the commend prompt, e.g. <>qed instead of <>@recover qed. If you have named the program file such that it matches an emulator command the command will have priority.

OR: You may type <>! qed

3.65.11 @delete-file <file name>

Identical to the SINTRAN-III command. The file name may be abbreviated, ambiguous file name will be detected. The default file type is SYMB.

@DELETE-FILE TEST-1	Deletes the file TEST-1.SYMB of current user
@DELETE-FILE (user)TEST-1	Deletes the file TEST-1.SYMB of (user)
@DELETE-FILE TEST-1:BRF	Deletes the file TEST-1.BRF of current user

The file to delete must be upper-case in the file folder, but may be lower case in the command. (it will be converted to upper case.)

3.65.12 @create-file <file name>

Creates a file in tge logged-in user folder. Tge default file type is SYMB.
(this command needs further development!)

3.65.13 @set-file-access <file name> <public> <friend> <own>

The emulator does not actually emulate file access. It is introduced because some ND programs use the command.

3.65.14 @copy-file <to file> <from file>

Copies a file to another. Default file type is SYMB.

Copies from file test to file xxx which is created:

```
<>@COP-FILE "eee" COPF
Create file ./(EMULATOR)/EEE.SYMB
```

```
Open file: ./(EMULATOR)/EEE.SYMB
Open file: ./(EMULATOR)/COPFTEST.SYMB
21 bytes copied
<>
```

File type is BRF, destination file exists:

```
<>@COP-FILE sub1:brf sub1-xx:brf
Open file: ./(EMULATOR)/SUB1.BRF
Open file: ./(EMULATOR)/SUB1-XX.BRF
193 bytes copied
<>
```

3.65.15 @copy <to file> <from file>

Copies bytes from source file to destination file. Default file type is :SYMB.

3.65.16 @cc

Used to e.g. write comments in mode-files.

3.65.17 @rename-file <file> <new file name>

Rename a file. Default file type is :SYMB.

3.65.18 @terminal-mode <cap.lett> <delay after CR> <stop on full page>

Stop on full page is emulated.

3.65.19 @hold <unit> <n>

Works as in SINTRAN III

3.65.20 @create-user <user name>

Creates a new user by adding a new directory (USER).

3.65.21 @delete-user <user name>

Deletes a user (the directory) if there are no files.

3.65.22 @release-directory <name>

This command does nothing.

3.65.23 @list-directores-entered

The emulator will always print PACK-ONE when using this command. Some monitor calls returns the default directory etc., the emulator will then return PACK-ONE. Some ND programs use monitor calls where a directory name is present, the emulator will ignore this name and use the default directory name PACK-ONE instead.

3.65.24 @sintran-service-program

Emulates a few of the commands in the SINTRAN service program. It is emulated to be able to run some mode-files that installs systems as user environment etc.

```
<>@sin-serv
SINTRAN-SERVICE-PROGRAM (not emulated)
*help,,
help
exit
cc
```

3.65.25 @rt-loader

Emulates a few of the commands in the RT-loader. It is emulated to be able to run some mode-files that installs systems as user environment etc.
DMAC may be started, but cannot read/write segments etc.

```
<>@rt-lo
RT-LOADER (not emulated)
@help,,
help
exit
dmac
@dmac

* DMAC-1915D *
)9TSS
MON 164, save segment 7 (nothing done)
MON 164, save segment 7 (nothing done)
MON 133, exit from segment 0 with LREG=0, terminate program
```

3.65.26 @disable-escape-function

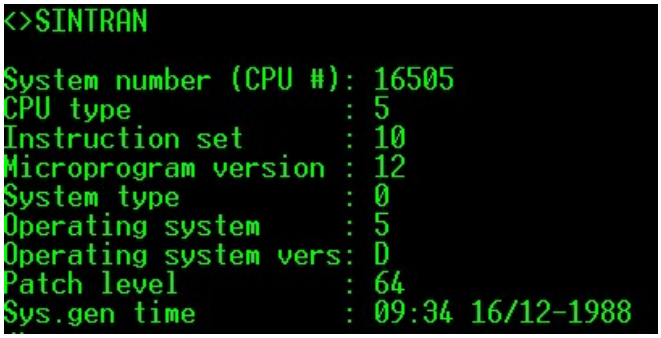
This command has no function in the emulator.

3.65.27 @enable-terminal-handling

This command has no function in the emulator.

3.66 SINTRAN-info

Lists the information about the SINTRAN III operating system and the CPU. The data is fetched from a real ND computer.The data can be rretrieved from a user program by the monitor call GetSystemInfo (MON 262).
The command <>float <format> will change the value for the CPU type . (4 or 5).
The PLANC compiler is using this information..



3.67 find-in-file <file> <w1> <w2>

This command can be used to find two consecutive 16 bit numbers in a file.
The numbers shoukd be entered as octal numbers.

3.68 BCD-test <value 1> <operation> <value 2>

This command adds/subtracts/multiplies/divides two ASCII BCD numbers and is used for test purpose.

BCD-test <value 1> <operation> <value 2>
<>BCD 1234.45 + 679

Result is : 1913.45 (No. of decimals: 2)
<>

3.69 test-input

This command can be used to check the keycodes of the keyboard

<>te-inp

Type ESC to exit

Key: 100(dec), 64(hex), 144(oct)
Key: 0(dec), 0(hex), 0(oct)
Key: 115(dec), 73(hex), 163(oct)
Key: 0(dec), 0(hex), 0(oct)
Key: 97(dec), 61(hex), 141(oct)
Key: 0(dec), 0(hex), 0(oct)

3.70 CPU-type <cpu type no.> <instruction set no.>

<>CPU 1 10

System number (CPU #): 16505
CPU type : 1
Instruction set : 10
Microprogram version : 12
System type : 0

```
Operating system       : 5  SINTRAN III VSX-500
Operating system vers  : D
Patch level            : 64
Sys.gen time           : 09:34 16/12-1988
<>
```

3.71 set-parity-when-reading-SYMB-files <on/off>

If you generate a source file using Notepad ND programs like QED, NPL, PED and MAC will report parity errors because they are testing each byte for even parity when reading the ASCII signs. This command will tell the emulator to generate ASCII code with even parity which is accepted by the programs.

3.72 check-monitor-call <number>

Prints a list of the monitor calls that are implemented in the emulator. Enter 555 to print the complete list.

3.73 silent-mode <on/off>

When turning ailent mode off the emulator will write extra information when e.g. starting a program etc. At start-up silent mode is on.

3.74 more

Simply copies the contens of the specified file to the console window. Default file type is SYMB.

3.75 get-entries <file name>

Read entries listed by BRF Linker - 10721B00 by the command LIST-ENTRIES-DEFINED.

3.76 trace-entries <on/off>

Trace entries read by the get-entries-defined command.

3.77 virtual-keyboard-definition <file>

In development.

3.78 use-virtual-keyboard <on/off>

Works in Windows only, e.g. in PED and FILE-MANAGER. In PED you may position the cursor in the editing area by clicking the left mouse key. You may also scroll up and down using the scroll wheel.

3.79 Norsk-tegnsett <ja/nei>

Works in Windows only. Converts the characters: (input and output)

```
'}';   /* å */
'{';   /* æ */
']';   /* Å */
'[';   /* Æ */
```

```
'|';   /* ø */
'\\';  /* Ø */
```

3.80 show-echo-and-break-strategy

Prints tthe last used echo and break tables.

3.81 Set-active-level <level>

Sets current actve interrupt level before starting a program

<>Set-active 1
PIE is set to 1 and PID to 1 , Interrupt system turned on

Sets the PIE and PID registers and turns o the interrupt system.

3.82 disable-escape

Disables ESC when running programs.

3.83 enable-escape

Enables ESC when running programs.

4 Stopping a running ND application

The ESC button will terminate the running application if ESC has not been disabled by the ND monitor call for this purpose, but only if the program comes to a MON 1 instruction. (In SINTRAN-III it will be stopped unconditionally)

To stop a program that goes into an endless loop, type cntl-C on the keyboard. (cntl-C will not terminate the application if it is currently in MON 1).

If unable to stop using any of these methods simply kill the DOS window.

5 Planned development

5.1 Reentrant subsystems

Emulate the monitor call that enables reentrant subsystems.

6 Interrupt handling

Part of the interrupt system is emulated included these instructions:

TRA TRR IRR IRW MST MCL ION IOF PION PIOF WAIT

There are 16 register sets, one for each interrupt level making it possible to run a program switching between different interrupt levels.

7 Monitor calls emulated

Use the command <>check-monitor-call <number> (555= all) to get a list of the monitor calls that are implemented in the emulator

7.1 Nonconformance monitor calls

To be written….

8 List of emulator commands

<>help,,
List matching commands to output file:
upper-case <on/off>
close-trace-file
open-trace-file <output file>
trace-execution <on/off>
look-at-memory <page table> <address>
test-font-set
run <start-address>
set-memory-limits <lower> <upper>
save-image-to-file <image file> <SA> <RA>
copy-memory <from> <bytecount> <ntimes>
define-trace-area <trace no.> <lower> <upper>
reset-trace-area <trace number>
status
report-memory-change <address>
set-break-point <address>
clear-breakpoint
continue-after-breakpoint
@recover <prog file>
help <command> <output file>
fill-memory <value> <from> <to>
quit
load-image-file <image file>
find-value-in-memory <value> <page table>
step-execution [optional start address]
define-histogram <start-address> <increment>
list-histogram
zz
reset-report-memory-reference
set-register-value <register> <value>
exit
list-register-values
float <32 or 48 bits>
trace-monitor-calls <on/off>
READ-BINARY <input file>

WRITE-BINARY <page table> <output file>
COMPARE-BINARY <file 1> <file 2>
begin-trace-execution-when-at <address>
load-byte-swapped-image-file <image file>
guard <page table> <address>
use-7bit-on-symb-files-write <on/off>
@mode <file name> <output file>
continue-at-restart-address
! <image file>
octal-to-decimal <number>
decimal-to-octal <number>
compare-images <image file1> <image file2> [report file]
add-parity <input file> <output file>
remove-parity <input file> <output file>
float-test <val1> <val2>
activate-alternative-page-table <APT no.>
find-nonzero-in-page-table <page table no>
@set-terminal-type <n>
set-2bank-mode <on/off> <page table>
@go <address>
dump-memory <prog.file> <start address> <restart address>
od <8 or 16 bit> <input file>
byte-swap <inp.file> <outp.file>
@list-opened-files
@close-file <file number (-1=all)>
open-scratch-file
debug <level(0=off)>
log-in-user <user name>
list-users
@list-file <file name>
check-files
@new <user name>
@who
list-segments
define-segment <no> <name>
delete-segment <no>
load-segment <segno> <prog-file>
clear-internal-segment-table
SINTRAN-info
find-in-file <file> <w1> <w2>
BCD-test <value 1> <operation> <value 2>
test-input
@place-image-file <:PROG file>
@place-binary <:BPUN file>
CPU-type <cpu type no.> <instruction set no.>
set-parity-when-reading-SYMB-files <on/off>
check-monitor-call <number(555=all)>
@delete-file <file name>
@copy-file <to file> <from file>
list-SINTRAN-commands

silent-mode <on/off>
@create-file <file>
more <file>
find-text-in-file <file> <text-string>
@copy <to file> <from file>
@hold <unit> <n>
@create-user <user name>
@delete-user <user name>
get-entries <file name>
trace-entries <on/off>
@cc
@rename-file <file> <new file name>
@ show-echo-and-break-strategy
norsk-tegnsett <nei/ja>
@release-directory <name>
use-virtual-keyboard
virtual-keyboard-definition <file>
@terminal-mode <cap.lett> <delay after CR> <stop on full page>
set-active-level <level>
@set-file-access
toggle-rt-program-mode
@list-directories-entered
@rt-loader
@sintran-service-program
disable-escape
enable-escape
@enable-escape-function
@enable-terminal-handling

9 The PREP2B program

When transferring files from the ND computer e.g. using ftp an error will occur if the files has “holes”, i.e. missing pages. If a file for example has page 0,1,2 and 10 written, pages 3,4,5,6,7,8 and 9 is not accessible. This is the way the SINTRAN-III file system works, while Windows and Linux do not allow files with “holes” in them.
The emulator does not emulate the SINTRAN-III file system, which means that it is actually possible to access a file written by an emulator program even if the page is not written. If you for example open a file and write page 10, you will be able to read pages 0-9 as well number 10.

To be able to transfer files using ftp from a ND computer it will need some preparation if it has missing pages. Typically 2-bank program files need to be prepared, other files like :DATA files can be candidates for preparation as well.

The program PREP2B reads a file and writes the contents to another file checking for empty pages in the input file and writing dummy data if found.

The program looks like this:

```
      PROGRAM RFIL
```

```
      INTEGER*2 IDATA(1024)
      INTEGER*2 NPAGES
      INTEGER*4 NBYTES
C     INTEGER ERRCODE
      INTEGER*2 IFILE, OFILE
      CHARACTER*80 INNFILE, OUTFILE
      OUTPUT(1)'This program reads a :PROG file dumped in 2-bank mode'
      OUTPUT(1)'and writes it to the specified output file while'
      OUTPUT(1)'filling in the missing file pages that cause problems'
      OUTPUT(1)'when trying to ftp these type of files (NO SUCH PAGE)'
      OUTPUT(1)'Output file size will be 129 pages ~ 250 kbytes'

      WRITE(1)6412B,'Enter input file name: '
      INPUT(1)INNFILE
      WRITE(1)6412B,'Enter output file name: '
      INPUT(1)OUTFILE

      IFILE = 7
      OFILE = 8
      OPEN(IFILE,STATUS='OLD',FILE=INNFILE, ACCESS = 'RX'
     C , ERR=666)
      CALL        RMAX(IFILE,NBYTES)
      output(1)'Bytes in input file: ', NBYTES
      OPEN(OFILE ,FILE=OUTFILE, ACCESS = 'WX', ERR= 777)
      CALL SETBS(OFILE,1024)
      CALL SETBS(IFILE,1024)

      IF ( ERRCODE .NE. 0 ) THEN
           OUTPUT(1)'SETBS error'
      ELSE
        NPAGES = (NBYTES+1)/2048
        NPAGES = NPAGES + 1
        OUTPUT(1)'Total pages to write: ',NPAGES
          DO FOR I = 1,NPAGES
                 CALL  RFILE(IFILE,0,IDATA,I-1,1024)
                 IF ( ERRCODE .NE. 0 ) THEN
                      OUTPUT(1)'No data found bl.no : ',I-1,
     C                 ' ..write data to fill missing page'
                   DO FOR J = 1,1024
                        IDATA(J) = 333
                   ENDDO
                   CALL  WFILE(OFILE,0,IDATA,I-1,1024)
                   IF ( ERRCODE .NE.0 ) THEN
                        OUTPUT(1)'Write failed on bl.no: ',I-1
                        OUTPUT(1)'Terminate! (check user space?)'
                        CLOSE(IFILE)
                        CLOSE(OFILE)
                        GO TO 9999
                   ENDIF
                 ELSE
                     OUTPUT(1)'Success on block: ',I-1
                   CALL  WFILE(OFILE,0,IDATA,I-1,1024)
                   IF ( ERRCODE .NE.0 ) THEN
                        OUTPUT(1)'Write failed on bl.no: ',I-1
                        OUTPUT(1)'Terminate! (check user space?)'
                        CLOSE(IFILE)
                        CLOSE(OFILE)
                        GO TO 9999
                   ENDIF
                 ENDIF
          ENDDO
```

```
      ENDIF

      CLOSE(IFILE)
      GO TO 9999

666   OUTPUT(1)'OPEN input file', INNFILE,' failed'
      GO TO 9999
777   OUTPUT(1)'OPEN output file', OUTFILE,' failed'
      CLOSE(IFILE)
9999  OUTPUT(1)'PROGRAM END'
      END
      EOF
```

10 System devices

The files TERMINAL.SYMB and LINE-PRINTER.SYMB should reside on user SYSTEM.

TERMINAL

You may open TERMINAL, e.g. in mac

)9ASSM XXX,TERM,0

Which is identical to

)9ASSM XXX,TERM,0

The file number for TERMINAL is always 1.

LINE-PRINTER

Is currently not working, you will get an error message NOT WRITE ACCESS.
The intention is to print directly to a printer. Future extension.

11 Segment overlay

Segment overlay makes it possible to run program code that is larger than 64k words.
The maximum data space (bank 2) is 64k words.
The program code is placed on different segments and the emulator will switch between these segments automatically when required.
The commands

<>list-segments
<>load-segment

are important when generating segment overlay programs.

The file:

(SYSTEM)SEGFIL.SIN3

Contains the number, name and associated program names of all defined segments and is a readable file that can be edited e.g. by PED or QED or a text editor like Notepad.

The command <>list-segments will print the contents of the file:

```
<>li-seg

Segno / name / progfile name

200 / WPEDITM / wp-editor-m06
201 / WPCMDM / wp-cmd-m06
202 / WPUTILM / wp-util-m06
203 / WPMAIN / wp-main-no-m06
204 / WPPRMM / wp-prm-m06
300 / T1 / segtest
302 / T2 / sub1
303 / T3 / test3
777 / TS / testtest
** Missing parameter in line 10
555 / FTY / kkkk
<>
```

In the example below we will use the two segments 300 and 302
An example of how to generate an overlay program in Fortran.
This program is printing a text on the screen, then calling a subroutine residing on another program segment SUB1. This subroutine (SUB1) will print a message and return to the main program on segment MAIN. Before the main program terminates it will print a second message.

The main program code:

```
    PROGRAM SIMPLE
    WRITE (1,*) 'This is the main program'
    CALL SUB1
    WRITE (1,*) 'this is the main program again'
    END
```

The subroutine

```
  SUBROUTINE SUB1
  WRITE (1,*) 'This is SUB1'
  END
```

The files reside on the on user (EMULATOR) on SIMPLE-MAIN.SYMB and SUB1:SYMB.

Compiling using the FORTRAN-100 compiler

Type fort-100 at the emulator command line. When the compiler starts it will print

ND-100/NORD-10 ANSI 77 FORTRAN COMPILER - 210191G02
FTN:

Compiling the main program:

```
ND-100/NORD-10 ANSI 77 FORTRAN COMPILER - 210191G02
FTN: separate-data on
FTN: compile simple-main,,simple-main
- CPU TIME USED: 0.0 SECONDS.  5 LINES COMPILED.
- NO MESSAGES
- PROGRAM SIZE=46 DATA SIZE=77 COMMON SIZE=0
FTN: compile sub1,,sub1
- CPU TIME USED: 0.0 SECONDS.  3 LINES COMPILED.
- NO MESSAGES
- PROGRAM SIZE=19 DATA SIZE=29 COMMON SIZE=0
FTN: ex
```

Linking:

```
<>brf-linker
- BRF Linker -  10721B00
Brl: prog-file simple-main/T1
Brl: define #dclc 2000 d
Brl: load simple-main
FREE: P 000656-177777     D 002114-177777
Brl: load fort-2b
FORTRAN-2BANK-G02 32-BIT FLOATING
PLANC-2BANK-H00
FREE: P 032301-177777     D 011307-177777
Brl: exi
SUB1.....32304 U
                        !! restart brf-linker to load the second program
<>brf-linker
Brl: pro-file sub1/T2
Brl: define #dclc 14000 d
Brl: link-to simple-main
Brl: load sub1
FREE: P 000623-177777     D 014034-177777
Brl: load fort-2b
FORTRAN-2BANK-G02 32-BIT FLOATING
PLANC-2BANK-H00
FREE: P 032040-177777     D 023227-177777
Brl: exit
5PTAB....13511 U  linked from SIMPLE-MAIN
5TR32AP..24310 U  linked from SIMPLE-MAIN
5EXCINF..14033 U  linked from SIMPLE-MAIN
5ESTACK..23334 U  linked from SIMPLE-MAIN
5STACK....1053 U  linked from SIMPLE-MAIN
5FIO_BL..14031 U  linked from SIMPLE-MAIN
5USFILB..21070 U  linked from SIMPLE-MAIN
5CNCT....21071 U  linked from SIMPLE-MAIN
5ALTREC..24420 U  linked from SIMPLE-MAIN
```

```
SUB1.......600 P  linked to   SIMPLE-MAIN
<>
```

Create segments if not existing:
Use PED and edit the file (SYSTEM)SEGFILE:SIN3

Load segments.

```
<>load-segment 300 simple-main
      The emulator will output some info…..
<>load-segment 302 sub1
      The emulator will output some info…..

<>simple
This is the main program
This is SUB1
this is the main program again
```

12 IOX on terminal 1

The emulator will report illegal instruction if finding IOX except for TERMINAL 1 I/O. (IOX 300 – IOX 307)
This makes it possible to poll the keyboard for input.

IOX 300 reads a character
IOX 302 checks the input status
IOX 305 outputs a character

The other IOX instructions work, but has no real operation.
Parity is not generated on input or output.
cntrl-C is not aborting the program,typing a | will abort the program.

Example program:

```
10/
TREAD=300;
TWRIT=305;
TNOOP=301;
TOSTA=306;
TISTA=302;
TSETI=303;      % SET INPUT CONTROL
TSETO=304;      % Set output control
TRET0=304;      % Return 0

START, IOX TISTA;       % Read input status
JAZ START;              % Bit 3 is data ready
IOX TREAD;              % Read terminal data
IOX TWRIT;              % Write to terminal
JMP START
MON 0

)FILL
?
```

```
*:
START:
)LINE
```

Use MAC to assemble the program, exit Mac and start it by typing run 10.

13 A small benchmark program

```
      PROGRAM BM
      LOGICAL FLAGS(8191)
      INTEGER i,PRIME,k,COUNT,ITER

50    FORMAT(' 10 iterations')
      DO 92 ITER=1,10
      COUNT=0
      DO 10 I = 0,8191
10    FLAGS(I)=.TRUE.
      DO 91 i = 0,8191
      IF(FLAGS(I) .EQ. .FALSE. ) GOTO 91
      PRIME = I+I+3
      K= I+PRIME
20    IF (k .GT. 8190 ) GOTO 90
      FLAGS(K) = .FALSE.
      K = K + PRIME
      GOTO 20
90    COUNT = COUNT+1
91    CONTINUE
92    CONTINUE
      WRITE(1,200) COUNT
200   FORMAT (1X,I6,' primes')
      STOP
100   FORMAT (1X,I6)
      END
      EOF
```

Running this Sieve program will print the result:
1900 primes
STOP 0

The time used is ~41 mS on Windows 10 with an Intel Core i5-8250 @ 1.6 GHz. Runnning the test in LINUX using Virtual Box on the same computer takes ~91 mS.

The benchmark program is found in user (BENCHMARK).

The table below shows some results from tests on different mini- and microprocessor programs. Times are in seconds.

My own measurements:

Fortran ND-500	1.4
Fortran ND-100	3.3
BASIC ND-10/S	52.0

```
PASCAL ND-10/S                27.0
PEARL ND-100                  4.9
NORD PL                       2.4
MAC ND-100                    1.1
```

Check A High-Level Language Benchmark by Jim Gilbreath
BYTE Sep 1981, p.180

```
Assembly lang. 8086  @ 8MHz   1.9
Assembly lang. 68000 @ 8MHz   1.12
C PDP-11/70                   1.52
Onyx C (UNIX) Z8000           3.2
Fortran HP-3000               34.0
PASCAL MT+ MYCRON Z80         30.0
Microsoft MBASIC Z80          1920.0
Apple Integer BASIC 6502      2320.0
```

14 Instruction test program

The Norsk Data program TPE-MONITOR has been slightly modified to run in the emulator as well as the test program INSTRUCTION-TEST-C03:TEST. The instruction test program requires an emulator that can handle switching between different interrupt levels which is not possible when running under SINTRAN. When trying to run a test TPE-MONITOR will print an error message ”Not available under SINTRAN”.
The emulator has been modified to handle context swicthing and some patches removes the restrictions.

Running STACK instruction test fails
Running CX instruction test fails for MOVEW instruction, probably because it is using the paging system which is not emulated.

Running TPE
Log on to user TPE:

```
      <>log tpe
      Logged out user EMULATOR and logged in user TPE-MON (user 17)

      <>my-tpe
      TPE Monitor, ND-100 series - Version: B01 - 1988-10-07


      The command HELP gives you the full list of available commands

Load the patched instructions test program:

      TPE> my-inst-c03

Now set parameters using the file SETPAR:SYMB

      TPE>mode set,,,
```

```
TPE>SET-PARAM n, y, 1, y, n, y
TPE>
```

```
Typing ARG will now test the argument instructions SAA AAA etc.
```

14.1 Patches in TPE-MONITOR:PROG and INSTRUCTION-TEST-C03:TEST

TPE-MONITOR:

To fix an error message **** Not enough physical memory **** patch location 14260 to 0:
The patch in location 434 (IOF) is required to run the CX instruction test.

```
<>load-image tp-2
<>loo 1 14260

Note: Background programs use PT 1 and 2

Enter value (octal) or
"text string" or
memory address (octal value): (or /) to set location
Enter q or . and return to terminate

PT 1/  14260 :  124005 250/  5  ASCII ( (with parity bit on) / cntlch
nibles: a|8|0|5  >0
PT 1/  14261 :  144151 310/151  ASCII H (with parity bit on) / ASCII i
nibles: c|8|6|9  >434/
PT 1/    434 :  150401 321/  1  ASCII Q (with parity bit on) / cntlch
nibles: d|1|0|1  >0

<>dump ”my-tpe” 0 0
<>
```

INSTRUCTION-C03:TEST patches to avoid ” Not available under SINTRAN”, change 4 to 0 at these locations:

66113:	4	> RUN
66125:	4	> ARGUMENT-INSTRUCTIONS
66132:	4	>MEMORY-REFERENCE-INSTRUCTIONS
66137:	4	>SEQUENCING-INSTRUCTIONS
66144:	4	>REGISTER-INSTRUCTIONS
66151:	4	>BIT-INSTRUCTIONS
66156:	4	>SHIFT-INSTRUCTIONS
66163:	4	>32-BITS-FLOATING-INSTRUCTIONS
66170:	4	>48-BITS-FLOATING-INSTRUCTIONS
66175:	4	>PRIVILEGED-INSTRUCTIONS
66202:	4	>BYTE-INSTRUCTIONS
66207:	4	>PHYSICAL-MEMORY-INSTRUCTIONS
66214:	4	>BCD-INSTRUCTIONS

```
66221:      4       >CX-INSTRUCTIONS
66226:      4       >STACK-INSTRUCTIONS
66233:      4       >SEGMENT-INSTRUCTIONS
66240:      4       >INTERNAL-INTERRUPTS
```

Do:

```
<>load-image in-c03:test
<>loo 1 66113

Note: Background programs use PT 1 and 2

Enter value (octal) or
"text string" or
memory address (octal value): (or /) to set location
Enter q or . and return to terminate

PT 1/  66113 :       4   0/  4  cntlch  / cntlch  nibles: 0|0|0|4  >0
```

Now change all the above locations to 0, type . and CR, then do:

```
<>dump ”my-inst-c03:test” 66000 66000
```

15 Working programs

A number of programs have been retrieved from images using the ”ndfs-tool” made by T. Arntsen. (images can be found at NDWiki).

http://www.ndwiki.org/wiki/User:TArntsen#Software_for_ND-100

Not all programs will run successfully. Many of 2-bank programs seem to be corrupted in some way. Reason: The ND-floppy is not read properly, the NDfs tool is faulty or the emulator is bad. A typical problem reading 2-bank programs is the NO SUCH PAGE error. The SINTRAN file system allows ”holes” in the file which is typically the case when generating 2-bank programs.
A Fortran test program using multisegment is working, WP and other multisegment program are not working.
The :PROG files are 32 bit subsystems, some programs like QED will also run in 48 bit mode. The compilers may generate 48 bit code if told to and the linkers may link such code.
Some programs that requires 48-bit instruction set is listed separately and will run properly on Linux only.

USER SYSTEM

Program	Version	Execution mode
QED	4.3	1-bank
NRL	LDR-1935J	1-bank
FTN	FTN-2090I	1-bank

BRF-EDITOR	83.12.01	1-bank
PLANC	July 22,1988 Version I	2-bank
FORTRAN	2101191G02	2-bank
BRF-LINKER	10721B00	2-bank
PED	Version J 1983-06-30	2-bank
NPL	NOVEMBER 1970	1-bank
LOOK-FILE	2244E 16.12.1983	1-bank
FILE-MANAGER	ND-10581B	2-bank
LIST-ALL-FILES	???	1-bank
MAC	???	1-bank
FMAC	???	1-bank
DMAC	DMAC-1915D	1-bank
XMSG-COMMAND	210373M 1988.04.12	1-bank
TF-LIB-COMPRESS	???	1-bank
DITAP	1880D	1-bank
PERFORM	G00	1-bank
SERVER-ADM	VERSION 27	1-bank
PC-LINK	??	1-bank
VTM-COMPOUND-D-C	??	1-bank
NDP-COMPILER	Version 4.2, February 6 1985	

*1 The compiler is able to generate 48-bit code. The :BRF library is 32 bit (to be checked)
*2 Is able to link 48 bit programs

USER ND-GAMES **Extracted from** ND-GAMES.image.gz **Underline = works**

LABYRINT — Works on Windows and Linux, use terminal type 52 (<>*@set-t-typ 52*)
Make sure that the terminal window has sufficient number of lines

YATZY — Works on Linux but needs 48 bits floating point, <>*float 48*
Windows: Probably using a RND function which fails because it needs 48 bit floting point format

FYR-LAUS — Starts on Linux but when firing projectile it displays @ and seems to hang. Also needs 48 bit floating point
Running on Windows: Not hanging but running in 32 bit floating point format results in bad numbers when trying to change angle and speed.

BREAKOUT: — Seems to run on Windows with terminal type 52. The ball is not moving. (Does not take lower case input!)
Also runs on Linux with terminal type 52. The ball is not moving correctly and different from 32 bit floating to 48 bit floating.

BACKGAMMON: — Gives a BASIC run time error on Windows. Gives a NLZ error on Linux using floating point format 48, prints some output, but does not take input. Use Terminal type 52. Need to debug terminal type…..

CASTLE: — Works on Windows and Linux, use Terminal type 52.

FIDO-48-NO — Starts on Linux with terminal type 52 and floating point format 48
Draws a figure but then prints an error:
Energi :
ARGUMENT TO LN WAS <= 0
N LINE
Probably a BASIC program. An error in the flp. Emulation?

Other applications: (not working at all)

BONDESJAKK:PROG (looks like a 2-bank program)
DIGGER-48-NO:PROG
KALENDER:PROG
LIST-RANKING:PROG
MACMAN-48-NO:PROG
MASTERMIND-48-NO:PROG
ORM:PROG
SPILL-48:PROG
TERRANOVA-48-NO:PROG
TRON-48-NO:PROG

16 Nord Color Terminal emulation

The emulation of the NCT does not include;

- the 4 user definable symbol blocks
- the user definable BG/FG/CU colors
- the user definable symbol size
- the “windowing” function
- cursor lock/follow

The FG/BG colors are limited to what is available for a terminal window (Windows/Linux).

A test program “NCT-EDITOR” is available to do simple drawing:

<>@set-terminal-type 777
<>(NCT)NCT-EDITOR
** IFA NORD COLOR TERMINAL EDITOR V.2. ***
(enter HELP now to list available commands)
NCT:NCT TERM Accepts UPPER CASE ONLY!

The screen is now cleared, type a CR and the following appears: (Windows version)

Type APPEND to enter editing mode.

control-u set write direction to up
control-d set write direction to down
control-r set write direction to right
control-d set write direction to left
control-w leave editing mode
control-z toggle blink (works on Linux only)
control-f set Foreground Color number

control-b	set Background Color number
control-y	set symbol block number