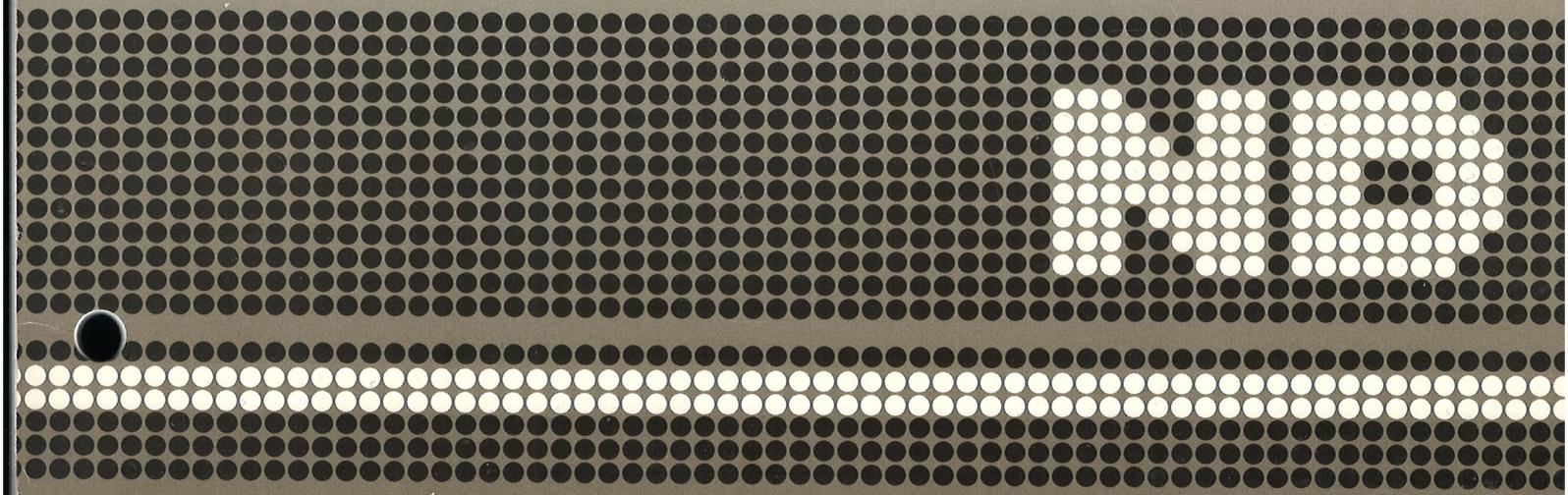




**ND-100 Tracer
User Guide**

ND-30.081.1 EN



THE PRODUCT

The ND-100 Tracer is intended to be a debugging tool for the ND-100 and the ND-110 bus system. It is based upon two cards:

- ND-100 Tracer 3092.
- ND-100 Trace Adapter 3116.

THE READER

The readers of this manual are system programmers and system service personnel. Also persons involved with building up ND-100 or ND-110 systems can use this tool in troubleshooting activities.

THE MANUAL

This manual gives an overview of the ND-100 Tracer including a physical description of the Tracer board and the switch settings.

It also describes:

- The installation
- The startup procedure
- The commands

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Chapter 1 INTRODUCTION

1.1 Versions

The ND-100 Tracer is available in 2 versions:

ND 110049 consists of the ND-100 TRACER part no 324532 print 3092B used for analysing on the ND-110 CPU.

ND 110065 consists of ND 110049 + ND-100 TRACE ADAPTER part no. 324016 print 3116 and 2 cables connecting those two boards, used for analysing on the ND-100 CPU.

1.2 Brief description of data-types, functions and main parts

ND-100 TRACER is a board located in the ND-100 bus. It is a passive receiver of the main data, address and control signals in the bus. It also collects some extra signals from the B-connector of the ND-100/110 CPU. (See physical description, page 4.)

Altogether 61 bits are sampled.

These bits are:

- 16 bits data
- 24 bits physical address
- 6 bits logical page no.
- 4 bits page table no.
- 4 bits interrupt level.
- 1 bit paging on/off
- 1 bit interrupt on/off
- 1 bit access via normal/alternative page table
- 1 bit Instruction fetch or data access.
- 1 bit CPU or DMA access.
- 1 bit read or write access.
- 1 bit IOX cycle performed.

One bus cycle is defined here as one of the following:

- A ND-100 CPU read or write in memory.
- A ND-100 CPU instruction fetch.
- An IOX instruction execution.
- A DMA-device read or write in memory.

TRACER-BUFFER

One of the main parts of the tracer is the TRACER-BUFFER. It is a 4k deep, 80 bits wide, memory where the bits for each bus cycle can be stored. The 80 parallel bits in the tracer-buffer correspond to the 64 bits mentioned above + 16 bits timing information defining the interval between each sample. The tracer-buffer can store information for 4096 bus cycles.

For each bus cycle the 64 bits of information are compared with two independent "masks" to decide whether:

- the cycle is QUALIFIED
- it will cause a trigger-condition
- both QUALIFIED and TRIG
- the cycle is ignored.

QUALIFIERS

QUALIFIERS are masks or filters in the tracer board which decide for each bus cycle whether the information bits will be stored in the tracer-buffer or not. Each qualifier can usually be thought of as a 64 bits word where each bit can have the value 0,1, or X (don't care). Each of these bits corresponds to one of the 64 information bits describing a bus cycle. There are 4 independent qualifiers. If a bus cycle matches at least one of these qualifiers, it is stored in the tracer-buffer.

TRIGGER-CONDITON

Similarly to the 4 qualifiers there are 4 independent 64 bit words used for specification of TRIGGER-CONDITIONS. If a bus cycle matches at least one of the 4 trigger-words a TRIGGER-CONDITION occurs. A trigger-condition informs the tracer to stop collecting data into the traceer-buffer, either immediately or after a selected number of qualified cycles.

Other functions related to trigger and

qualification are:

Trigger if ND-100 stops.

Stop ND-100 if a trigger-condition occurs.
Specification of the location of the
triggerpoint in the trace buffer. (start
trace, end trace or something in between.)

Also see under the description of the
SPECIAL-FUNCTIONS command.

LOCAL MODE or REMOTE MODE

The tracer can be connected directly to a terminal as mentioned above (local mode) or by a RS-232 cable to a terminal interface on a ND computer (remote mode). In remote mode the tracer acts upon instructions from a utility program in the ND computer. The operator then uses this program to specify qualifiers and trigger-words, and to display the contents of the tracer buffer. Messages are then sent to and from the tracer over the RS-232 cable using a special protocol. The advantage of remote mode is that the tracer-buffer contents can be read out from the tracerboard and stored in a file for later inspection.

MONITOR

The tracer board contains a MC68000 microprocessor running a MONITOR program. The monitor lies in a local PROM and RAM memory on the tracer board. It can set the qualifiers and trigger-words, read the tracer-buffer, and communicate with the user through a Notis terminal (TDV2200/9) connected to an interface plug in front of the board.

Other features on the tracerboard used by the monitor are:

- A real time clock with battery backup used to tell current time and date
- A DMA channel to read ND-100 memory.

Qualification and trigger checks are performed by hardware, but are set by the monitor using specifications given by the operator. The specifications are made by editing screen-oriented pictures.

The contents of the tracer-buffer or ND-100 memory can be inspected by the monitor. It will decode the entries in the buffer, and depending on their function, try to display them in an understandable way. Instructions

are disassembled.

1.3 Boards and switch settings

Physical description of the TRACER board (3092)

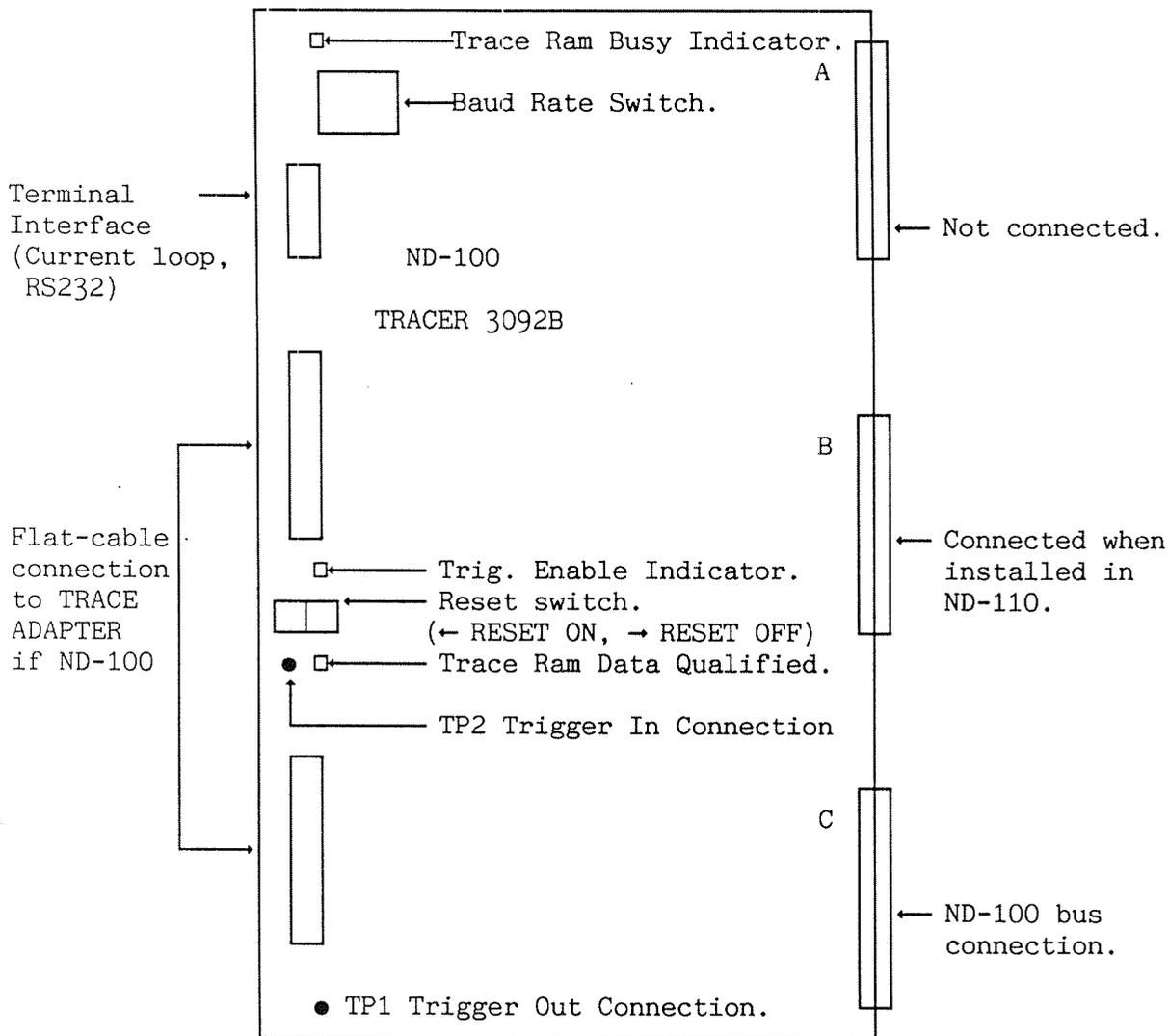


Figure 1. The Tracer board (3092)

The ND-100 TRACER board contains a processor (MC 68000), local PROM and RAM and a terminal interface. Therefore it can run independently of the state of the ND CPU. It also contains the tracer-buffer and the hardware to set up and test for qualification and trigger. It uses signals from two sources in the tracer-running mode.

One source is the ND-100 bus which is connected to the C-connector of the board. Through this it gets the physical addresses, data and read/write signals.

The other source is the MMS-bus connected to the B-connector of the ND CPU. Through this the tracer board gets logical addresses and the rest of the control signals. In a ND-100 system these signals are collected by the TRACER ADAPTER board and transferred by flat cables to the two connectors in front of the tracer.

In a ND-110 system the tracer can collect these signals directly from the B-connector. This requires that it is installed next to the ND-110 CPU, and that they are both connected by a MMS-bus in the B-connector. Trigger-in is qualified with:

'Trig if ND-100 stops?': Y

Switch settings on TRACER board (3092)

The Reset Switch:

The TRACER processor is reset by setting the RESET switch first to ON and then to OFF position.

Baud Rate Switch setting:

Pos.	Baudrate	Pos.	Baudrate	Pos.	Baudrate	Pos.	Baudrate
0	110	4	1200	8	2400	12	75
1	150	5	1800	9	600	13	50
2	300	6	4800	10	200	14	100
3	2400	7	●●●9600	11	134.5	15	100

Table 1. The baud rate switch setting on the Tracer board

Note that the baudrate marked "●●●" is the default value.

Physical description of TRACE ADAPTER board (3116)

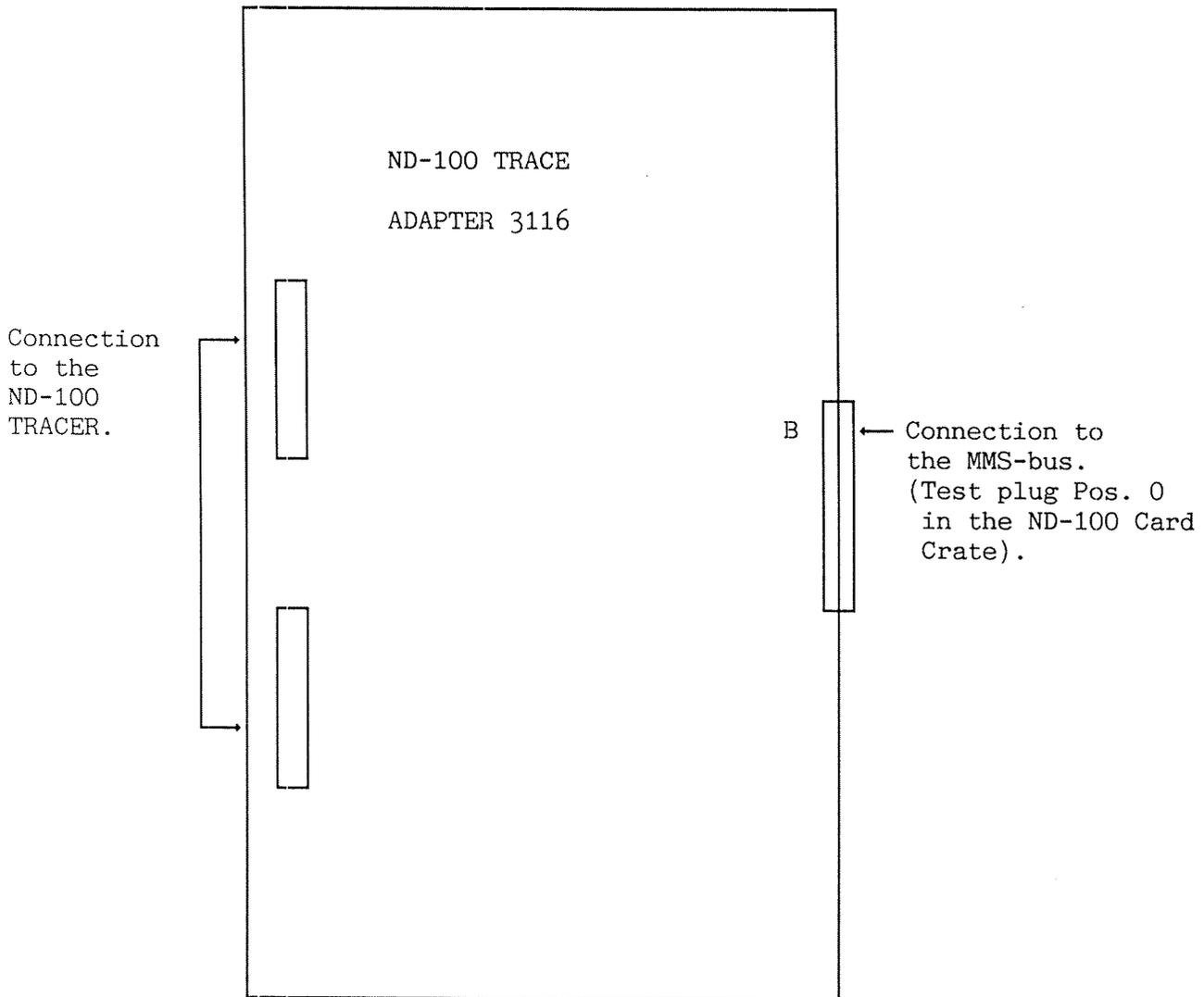


Figure 2. The Trace adapter (3116)

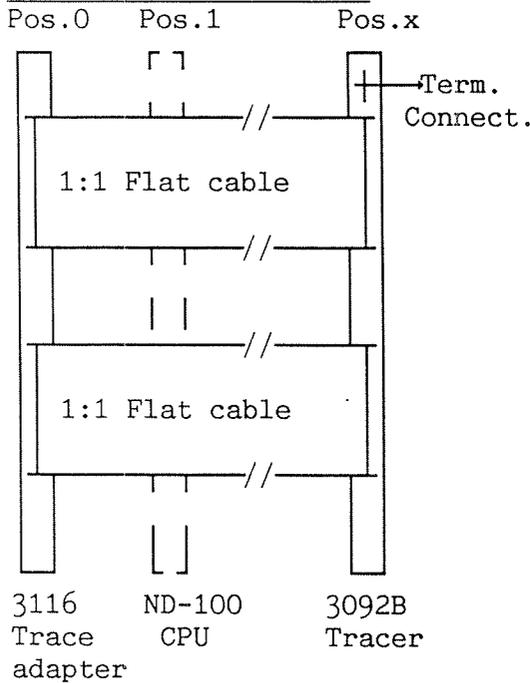
The ND-100 Tracer Adapter is only used with a ND-100 CPU (not ND-110). It is used to collect control signals from the MMS-bus in the ND-100 computer system. Unlike the ND-110, the ND-100 uses a separate card for MMS. The tracer adapter is installed in the test connector (MMS-bus) in position 0 in the Card Crate. The tracer card is installed in a free position after the the MMS-board, and it is connected to the tracer-adapter via two flat cables.

1.4 Installation and Startup

Installation illustration

This illustration shows how to install the TRACER in a ND-100/110 computer with a 22 pos. card crate. (For Compact or Satellite, see the note on the bottom of this page.) The figure is a front view of the cards placed in the Crate.

Installation if ND-100:



Installation if ND-110:

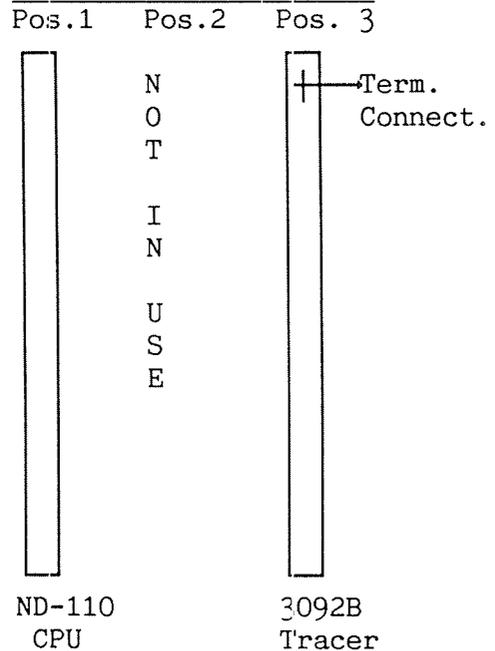


Figure 3. The installation procedure

Pos.0 is the test plug position to the left of the ND-100 CPU. Pos.x should be a free position in the crate after the MMS board. Avoid positions with wiring in the B-connector.

The tracer-adapter (3116) is not needed because the MMS-connection is done via the B-connector. The MMS-bus should be connected between position 1 and 3.

N O T E

On Satellites and Compacts there may not be a position 0. If tracing is wanted, change to a ND-110 CPU.

On Satellites and Compacts position 2 must be used instead of position 3.

Step by step installation procedure

1. Stop the system.

2. Write Protect the discs. The protect switch is normally located at the front of the disc drives.

3. Turn the power off. The power switch is located at the front panel.

If ND-100 CPU.

4 a: Install 3116 board (TRACE adapter) in position 0.

4 b: Install 3092 board (TRACER) in the first free position after the MMS board in the bus.

4 c: Connect 3116 and 3092 by two flat cables between the connectors in the front of the boards.

If ND-110 CPU.

4 a: Make sure that the MMS bus is present between pos. 1 and 3.

4 b: Install the Tracer (3092B) in pos. 3. (for Compacts and Satellites use position 2.)

If ND-110 placed in position 3:

Remove ND-110 from position 3. Install ND-110 in position 1.

If position 3 is occupied by a memory module, move it to the first free position.

5. Install terminal-cable between plug in front of 3092 and a NOTIS terminal.

If current loop: Part no. 325307.

If RS232 : Part no. 325303.

6. Check that the baud rate switch on 3092 is set to the same speed as the terminal.

7. Turn the power on.

8. Do a reset by operating the reset-switch on 3092. The main menu (see figure on the next page) should now be displayed on the connected terminal. If no response, check the cables and switches once more and try a new reset. Also check that the LINE lamp on the terminal is on. You can also try to type <CTRL> Q (xon) and <CTRL> R (restart) on the connected terminal to see if it gives any response.

Example of MAIN MENU display:

This is the MAIN MENU of a tracer with PROM version A01, installed correctly next to a ND-110 CPU.

```

*****                                TRACER-BOARD FOR ND-100    VERSION: A01    *****

          M A I N    M E N U    
      AVAILABLE COMMANDS :

      HELP
      SPECIAL-FUNCTIONS
      TRIG-CONDITIONS-SELECT
      QUALIFICATION-SELECT
      START-TRACE
      DISPLAY-TRACE-CONTENT
      NUMBER-OF-PAGETABLES
      DUMP-PHYSICAL-MEMORY
      MAINTENANCE
      CTRL <R> = RESTART

      > _____

CONFIGURATION: CPU:ND-110. TRACER-CPU BOARDS CONNECTED.
PAGETABLE-MODE:16

```

Figure 4. The MAIN MENU display

1.5 Sequence of commands in normal operation

The tracer must be told if the CPU is running in 4 or 16 page table mode (SINTRAN vers. K-VSX or later uses 16 page tables). This can be set by the command NUMBER-OF-PAGETABLES (default value is 16).

Before starting the trace function you should decide 2 things:

What do you want to fill the tracer-buffer with (QUALIFIFCATION)?

Which condition(s) do you want to cause the tracing to terminate (TRIG)?

Some of the functions in the tracer are meant for advanced users only. They are put into a separate menu called SPECIAL-FUNCTIONS (see page 18). If any of the commands under SPECIAL-FUNCTIONS are to be used they must be specified before the normal TRIG-CONDITION/QUALIFICATION selection.

The trigger-conditions are specified by the TRIG-CONDITION-SELECT command and qualification by the QUALIFICATION-SELECT command. Each will display a picture where you can specify values (or don't care) for data, address and "control bits". You can specify up to 4 independent conditions for both trigger and qualifications. The selection pictures have two main modes with different fields for CPU addresses : PHYSICAL ADDRESS MODE containing physical address and bank number, or LOGICAL ADDRESS MODE containing logical address and page table number.

Example of TRIG-CONDITION-SELECT picture

The trigger-condition selection shown below will cause a TRIG if :

- 1. Anything is written into physical address 1
 - or 2. An IOX cycle with hardware device number 500B occurs with bit 0 set to 0 and bit 3 set to 1.
- In this case PHYSICAL address mode is selected and 2 of maximum 4 select words are in use.

```

*****          SELECT  CONDITION FOR TRIG          *****
                                     Control bits
Data          Physical address  0:   Read  DMA  Data  NPT  IOF  POF
16 BITS (BIN) 16 BITS (OCT)  1: IOX Write CPU Inst. APT  ION  PON
XXXXXXXXXXXXXXXXX 000001      X   1   X   X   X   X   X
XXXXXXXXXXXXXXXXX1XX0 >000500  1   X   X   X   X   X   X

Physical bank no.
8 BITS (HEX)
00
XX

Priority levels
17 16 15 14 13 12 11 10 7 6 5 4 3 2 1 0
X X X X X X X X X X X X X X X
X X X X X X X X X X X X X X X

                                     2 select words used.
Type H for explanation of editing. Type <HOME> to get back to MAIN MENU.
    
```

Figure 5. Example of a TRIG-SELECTION picture

Example of a QUALIFICATION-SELECT picture

In the example shown below, DMA cycles, any activity on priority level 0, or accesses mapped through page-table 1 or 2 are NOT stored into the tracer-buffer. LOGICAL address mode is selected and 1 of maximum 4 select words are in use.

```

*****          SELECT  QUALIFICATION OF TRACEDATA          *****
                                     Control bits
Data          Logical address   0:      Read   DMA   Data   NPT   IOF   POF
16 BITS (OCT) 16 BITS (OCT)   1: IOX  Write  CPU   Inst.  APT   ION   PON
XXXXXXXX      XXXXXX          X      X      1      X      X      X      X

Page tables
17 16 15 14 13 12 11 10 7 6 5 4 3 2 1 0
 X  X  X  X  X  X  X  X  X  X  X  X  X  0  0  X

Priority levels
17 16 15 14 13 12 11 10 7 6 5 4 3 2 1 0
 X  X  X  X  X  X  X  X  X  X  X  X  X  X  X  0

1 select words used.
Type H for explanation of editing. Type <HOME> to get back to MAIN MENU.

```

Figure 6. Example of a QUALIFICATION-SELECT picture

Example of START-TRACE picture

When the specification part (TRIG-CONDITION-SELECT and QUALIFICATION-SELECT) is ready, the tracing can be started by the START-TRACE command.

Before the tracing is started you must first answer three questions:

- Should the tracer stop the ND-100 CPU when a trig occurs?
- Should the tracer trigger if ND-100 stops?
- Should the tracer stop collecting data immediately when a trigger occurs (end trace), or will it continue to collect the specified number of cycles?

Then the tracer goes into a "collect trace mode". The state of tracing and time are displayed continuously. This will continue until the tracer triggers or the trace is aborted manually.

In this case a trace has been taken using the previous qualification and trig set-up. The tracer was set up to trig also if ND-100 stopped, but the tracer did not stop ND-100 when it triggered. 7 bus cycles were collected after the triggering. The trace finished because of a trigger, not by manual break.

```

*****                               S T A R T   T R A C I N G                               *****
      !!!!!! REMEMBER THAT CACHE DATA IS NOT COLLECTED IN TRACE BUFFER !!!!!!

STOP ND-100 if trig ? (y/n):N
TRIG if ND-100 stops? (y/n):Y
Specify location of trig point in trace buffer :7770
(Start trace=0. Endtrace = 7777 <OCT> .)

TRACE STARTED AT:                    14.12.37  24  JANUARY   1986
***   TRACE FINISHED   ***           14.25.01  24  JANUARY   1986

==>  TRIG OCCURED! TRACEBUFFER  FILLED

Type <HOME> to return to main menu!

```

Figure 7. Example of a START TRACE picture

Inspecting data in the tracer-buffer

When data have been collected in the tracer-buffer, they can be inspected by using the DISPLAY-TRACE-CONTENT command.

This will start by displaying 17 entries around the trigger-point or up to where the trace was aborted. Then you can move forwards or backwards in the tracer-buffer by using the arrows keys or by a MOVE-TO command. If you are looking for anything special you can use the commands GET-FORWARDS or GET-BACKWARDS to set up a value or mask to search for in the tracer-buffer.

Example of DISPLAY-TRACE-CONTENT picture

The trace display shown on the next page shows that the reason for the trig was that a program running on page table 0 on level 1 wrote 0 into physical address 1 (see TRIG-CONDITION-SELECT). The trigger point is marked T0000 in the RELATIVE TO TRIGPOINT column. The command GET-FORWARDS-VALUE has been used to see if the tracer-buffer contains any bus cycles that have read from physical memory address 104772B in bank 1.

DISPLAY TRACE CONTENT															

REL.	PHYSICAL		P	LOGICAL		EXTRA FORMAT		L	I	R	D	I	A	I	P
TO	BANK.	ADDR.	T	ADDR.	DATA	DATA		E	O	/	M	/	P	O	O
TRIG.								V	X	W	A	D	T	N	N

-0011	001	105047	00	025047	050124	LDT *+124		01	R	I	I	P	0001	us	
-0010	001	105173	00	025173	021074	==> " <		01	R	D	I	P	0001	us	
-0007	001	105050	00	025050	140065	SKP IF DA EQL ST		01	R	I	I	P	0000	us	
-0006	001	105052	00	025052	044320	LDA *-060		01	R	I	I	P	0000	us	
-0005	001	104772	00	024772	000000	==> &@&		01	R	D	I	P	0000	us	
-0004	001	105053	00	025053	135124	JPL I *+124		01	R	I	I	P	0001	us	
-0003	001	105177	00	025177	021141	==> " a		01	R	D	I	P	0001	us	
-0002	000	021141	00	021141	150405	PIOF		01	R	I	I	P	0001	us	
-0001	000	021142	**	021142	006000	STA ,X +000		01	R	I	*		0002	us	
T0000	000	000001	**	000001	000000	==> &@&		01	W	D	*		0000	us	
+0001	000	021143	**	021143	150412	PION		01	R	I	*		0000	us	
+0002	000	021144	00	021144	146142	COPY SL DP		01	R	I	I	P	0006	us	
+0003	001	105054	00	025054	124002	JMP *+002		01	R	I	I	P	0001	us	
+0004	001	105056	00	025056	124100	JMP *+100		01	R	I	I	P	0001	us	
+0005	001	105156	00	025156	040226	MIN *-152		01	R	I	I	P	0001	us	
+0006	001	105004	00	025004	151243	==> R #		01	R	D	I	P	0001	us	
+0007	001	105004	00	025004	151244	==> R \$		01	W	D	I	P	0000	us	
	001	104772	XX	XXXXXX	XXXXXX			XX	X	R	X	X	X	X	

> G-F
 GET-FORWARDS-VALUE EDIT FIELDS ! TYPE <HOME> WHEN READY!

Figure 8. Example of a DISPLAY-TRACE-CONTENT picture

If you are running in remote mode (through the TM-MONITOR program) the tracer-buffer contents can be copied from the tracer board and saved on a file for later inspection.

Inspecting physical memory

Physical memory in ND-100 can be inspected by the DUMP-PHYSICAL-MEMORY command (only valid in local mode). This command has the same subcommands as DISPLAY-TRACE-CONTENT for navigating and searching.

Chapter 2 Using the ND-100 Tracer Monitor in Local Mode

NOTE:

This chapter refers to the monitor working in LOCAL MODE !

For extra commands in REMOTE MODE see chapter 3.

2.1 General

The monitor is used to specify the qualification and trigger-conditions he want and to display the trace data after a trig. This is done by a set of screen oriented menus and pictures. Most pictures have a command input line at the bottom of the screen. Available commands in the picture will then be displayed by the command HELP. Commands can be abbreviated using the same rules as in SINTRAN.

2.2 Editing rules

Special editing characters in the command line are :

- <CTRL> D = delete current line
- <CTRL> A and = delete current character
- <LEFT> and <RIGHT> arrows can be used to move the cursor in the field. field.
- <CTRL> R typed at any time in the monitor will have the same effect as pushing the reset switch on the board.

Some pictures have no command line. Their functions are performed by typing the control characters explained in the information fields in the picture.

You will usually return to the main menu by the <HOME>-arrow or <ESC>.

NB! The monitor responds to XON/XOFF characters to start and stop the terminal output. This means that if an XOFF (<CTRL> S) is received from the terminal, the monitor output will "hang" until an XON (<CTRL> Q) is received.

2.3 Main menu

```

*****
                                TRACER-BOARD FOR ND-100   VERSION: A01   *****

        M A I N   M E N U  
      AVAILABLE COMMANDS :

      HELP
      SPECIAL-FUNCTIONS
      TRIG-CONDITIONS-SELECT
      QUALIFICATION-SELECT
      START-TRACE
      DISPLAY-TRACE-CONTENT
      NUMBER-OF-PAGETABLES
      DUMP-PHYSICAL-MEMORY
      MAINTENANCE
      CTRL <R> = RESTART

      > _____

      CONFIGURATION: CPU:ND-100. TRACER-ADAPTER BOARD INSTALLED.
      PAGETABLE-MODE:16
  
```

Figure 9. Example of a MAIN MENU picture

The version letters in the heading (A01) refers to PROM version installed on the tracerboard.

The CONFIGURATION line shows the status of the connection between the tracerboard and the CPU. This connection is required to get LOGICAL ADDRESSES and information about page table, interrupt level and other control signals. The possibilities are:

- CPU:ND-110. TRACER-CPU BOARDS CONNECTED
- CPU:ND-100. TRACER-ADAPTER BOARD INSTALLED

- NO CONNECTION BETWEEN TRACER AND CPU BOARDS

CPU:ND-110. TRACER-CPU BOARDS
CONNECTED

The tracer is placed next to a ND-110 CPU and has connection to it through a B-bus connector.

CPU:ND-100. TRACER-ADAPTER BOARD
INSTALLED

The tracer board is placed anywhere on the ND-100 bus and has connection to a tracer-adapter board through flat cables. The tracer adapter board is installed in position 0 on the bus next to a ND-100 CPU.

NO CONNECTION BETWEEN TRACER AND
CPU BOARDS

Only data and physical address bits contain relevant information. This must be taken into consideration when setting up trigger-conditions and displaying the tracer-buffer.

The PAGETABLE-MODE line contains the value 16 or 4 depending on what is specified in the command NUMBER-OF-PAGETABLES. The tracer cannot find out by itself which page table mode the CPU uses. It must be specified manually. Default is 16.

2.4 Monitor commands detailed description

This section gives a description of the monitor commands:

SPECIAL-FUNCTIONS
TRIG-CONDITIONS-SELECT
QUALIFICATION-SELECT
START-TRACE
DISPLAY-TRACE-CONTENT
NUMBER-OF-PAGETABLES
DUMP-PHYSICAL-MEMORY
MAINTENANCE

2.4.1 SPECIAL-FUNCTIONS

This command calls up a menu of subcommands. It contains parameters for qualification and trigger-condition specification that may be set by advanced users. Some of the commands may require detailed knowledge of ND-100 and the tracer.

Some commands are put here because the use of them is either dependent on or puts limitations on other parameters. If you think you can achieve the desired result by editing QUALIFICATION-and TRIG-CONDITION-SELECT pictures, you can forget these commands. If any of the commands under SPECIAL-FUNCTIONS are to be used they must be specified before the normal TRIG-CONDITION/QUALIFICATION selection.

NOTE that some of the subcommands can not be mixed and they are therefore separated into groups A, B and C. You can select a maximum of one subcommand from each group.

Gr. Used.	Command.	Parameters.
	RESET-ALL-SPECIAL FUNCTIONS	
A	PAGE-TABLE-ACCESS-ONLY-MODE	
B	QUALIFY-DATA-DIFFERENT-THAN	
B	QUALIFY-DATA-INTERVAL	
B	QUALIFY-LOGICAL-ADDR-INTERVAL	
B	QUALIFY-PHYSICAL-ADDR-INTERVAL	
B	ARM-BY-FIRST-QUALIFIER-WORD	
C	TRIG-DATA-DIFFERENT-THAN	
C	TRIG-DATA-INTERVAL	
C	TRIG-LOGICAL-ADDR-INTERVAL	
C	TRIG-PHYSICAL-ADDR-INTERVAL	
C	SEQUENCE-TRIG	
C	INTERRUPT-OFF-LONGER-THAN-TRIG	
C	GIVE-LEVEL17-INTERRUPTS	
	EXIT	
>		

Figure 10. Example of a SPECIAL-FUNCTIONS picture

Subcommands

RESET-ALL-SPECIAL-FUNCTIONS	FUNCTION: All previously specified special-function parameters are ignored.
PAGE-TABLE-ACCESS-ONLY-MODE	GROUP: A. FUNCTION: When this mode is set the data and addresses are taken from the B-connector of the ND-100 CPU and not the ND-100 bus. Only references in the page index tables in the memory management system will be checked by hardware for qualification and trig, and collected in the tracer-buffer. It can be used to stop the ND-100 if the page tables are overwritten. The tracer-buffer will not contain the rest of the memory references of the program that writes in the page tables. To find the cause of this type of error, OPCOM has to be used from the CPU console to dump registers and active level. LIMITATION: This function can only be used

when connected to a ND-100 CPU (not ND-110).

QUALIFY-DATA-DIFFERENT-THAN

GROUP: B.

PARAMETERS: 16-bit data value (octal).

FUNCTION: When this mode is set the DATA field of the QUALIFICATION-SELECT picture is taken as an inverted value.

EXAMPLE: If 0 is set in the data field, only bus cycles that match the rest of the qualifier word and have a data value different from 0 will be collected in the tracer-buffer.

SIDE EFFECTS: When this parameter is set only 1 qualifier word can be used in QUALIFICATION-SELECT picture (in normal mode up to 4 words).

QUALIFY-DATA-INTERVAL

GROUP: B.

PARAMETERS: Lower limit and upper limit as 16-bit octal data values.

FUNCTION: When this mode is set the DATA field of the QUALIFICATION-SELECT picture is taken as an interval.

EXAMPLE: If 123B is set in lower limit and 374B is set in upper limit, only bus cycles that match the rest of the qualifier word and have a data value between 123B and 374B will be collected in the tracer-buffer.

LIMITATIONS: Not all combinations of lower and upper limit can be used. The qualification "mask logic" has no lower and upper limit registers so the specified interval will have to be checked and maybe split up by the monitor to find a valid set of bit masks. Some intervals cannot be defined by the 4 available qualifier word and then the monitor will display the message:

'Interval uses too many select words!'

Then you have to try to change one of the limits. The user is requested to use the "try and see" strategy. Tip: All intervals starting at 0 or ending at -1 are allowed.

SIDE EFFECTS: When this parameter is set only 1 qualifier word can be used in

QUALIFICATION-SELECT picture (in normal mode up to 4 words).

QUALIFY-LOGICAL-ADDR-INTERVAL
QUALIFY-PHYSICAL-ADDR-INTERVAL

GROUP: B.

PARAMETERS, FUNCTIONS, LIMITATIONS, and SIDE EFFECTS are the same for these two subcommands as for QUALIFY-DATA-INTERVAL, only referring to logical address or physical address instead of datafield.

EXTRA LIMITATION: For LOGICAL-ADDR-INTERVAL the interval can not cross a page limit.

EXTRA SIDE EFFECT: When one of these fields is used it is not possible to switch between logical and physical address mode in the QUALIFICATION-SELECT picture.

ARM-BY-FIRST-QUALIFIER-WORD

GROUP: B.

FUNCTION: When this mode is set, the 1st qualifier word in the QUALIFICATION-SELECT picture is taken as an ARM word. This means that no check for trigger-condition and no collection of trace data are performed before a bus cycle matches within the ARM word.

TRIG-DATA-DIFFERENT-THAN

GROUP: C.

PARAMETER, FUNCTION, and SIDE EFFECTS are the same as for QUALIFY-DATA-DIFFERENT-THAN, except referring to TRIG data instead of QUALIFY data.

TRIG-DATA-INTERVAL
TRIG-LOGICAL-ADDR-INTERVAL
TRIG-PHYSICAL-ADDR-INTERVAL

GROUP: C.

PARAMETER, FUNCTION, LIMITATIONS, and SIDE EFFECTS are the same as for the corresponding QUALIFY INTERVALS, only referring to TRIG-CONDITION specifications instead of QUALIFICATION.

SEQUENCE-TRIG

GROUP: C.

PARAMETERS:

'Give number of events in sequence? (2-4):'

'Only qualified events significant (Y/N)?'

FUNCTION: In this mode a trig will occur if a sequence-counter reaches a specified value (between 2 and 4).

When using this function, qualifier and trigger-words work in a special way.

It can operate in two different modes:

'Only qualified events significant (Y/N)?' Y

A bus cycle that matches the trigger-words will INCREMENT the sequence-counter. A bus cycle that matches the qualifier-words but not the trigger-words will RESET the sequence-counter to 0. Bus cycles that don't match either trig or qualifier-words have no effect on the sequence counter.

'Only qualified events significant (Y/N)?' N

In this mode qualification have no effect on the sequence counter. A bus cycle that matches the trigger-words will INCREMENT the sequence-counter. A buscycle that doesn't match the trigger-words will RESET the sequence-counter to 0. (The same as the previous mode with all qualifiers set to 'X'.)

In both modes all bus cycles that match either a qualifier or trigger-word will be stored in the tracer-buffer.

INTERRUPT-OFF-LONGER-THAN-TRIG GROUP: C.

PARAMETERS:

'Max. IOF time = 2**N microsec. N=?(OCT)'

FUNCTION: This function can be used to TRIG the tracer when the ND-100 CPU runs with interrupt system turned off for longer than a specified period. The time period has to be specified as a power of 2 micro seconds.

Value of N and the corresponding time:

0 ILLEGAL	10 = 256.00 us	20 = 65.536 ms	30 = 16.777 s
1 ILLEGAL	11 = 512.00 us	21 = 131.072 ms	31 = 33.554 s
2 = 4.00 us	12 = 1.024 ms	22 = 262.144 ms	32 = 67.108 s
3 = 8.00 us	13 = 2.048 ms	23 = 524.288 ms	33 = 134.217 s
4 = 16.00 us	14 = 4.096 ms	24 = 1.048 s	34 = 268.435 s
5 = 32.00 us	15 = 8.192 ms	25 = 2.097 s	35 = 536.870 s
6 = 64.00 us	16 = 16.384 ms	26 = 4.194 s	36 = 1073.741 s
7 = 128.00 us	17 = 32.768 ms	27 = 8.388 s	37 = 2147.483 s

Table 2. IOF time table

GIVE-LEVEL17-INTERRUPTS

GROUP: C.

PARAMETERS:

'Interrupt interval = 2**N microsec. N=?(OCT)'

FUNCTION: This function can be used to issue periodic hardware interrupts to ND-100 on level 17B from the tracer. This will only be useful if you have a direct-task program or driver in ND-100 that should run at a fixed interval for performance measurement or any other reason.

It also requires that ND-100 has enabled interrupt from level 17B and that the P register and Paging Control Register on level 17B contain correct values. The specification of the period between interrupts follows the same rules as the period in INTERRUPT-OFF-LONGER-THAN-TRIG.

EXIT

FUNCTION: Return to MAIN MENU.

2.4.2 TRIG-CONDITIONS-SELECT

This command is used to specify combinations of address, data, and control signals that cause a trigger-condition. It is possible to specify from 1 to 4 independent trigger-conditions (called "select words").

Each select word is split up into 5 fields. In PHYSICAL ADDRESS MODE these fields are named:

- DATA
- PHYSICAL ADDRESS
- CONTROL BITS
- PHYSICAL BANK NO.
- PRIORITY LEVELS

In LOGICAL ADDRESS MODE, the fields PHYSICAL ADDRESS and PHYSICAL BANK NO. are replaced by LOGICAL ADDRESS and PAGETABLE.

Example of TRIG-CONDITION-SELECT picture

This trigger-condition selection will cause a trigger if:

1. Anything is written into physical address 1

or

2. An IOX cycle with hardware device number 500B occurs with bit 0 set to 0 and bit 3 set to 1.

PHYSICAL ADDRESS MODE is selected and 2 of a maximum of 4 select words are used (see the screen picture on the next page).

```

*****          SELECT  CONDITION FOR TRIG          *****
                                     Control bits
Data          Physical address  0:      Read  DMA  Data  NPT  IOF  POF
16 BITS (BIN) 16 BITS (OCT)   1: IOX  Write CPU  Inst. APT  ION  PON
XXXXXXXXXXXXXXXXX 000001      X      1      X      X      X      X
XXXXXXXXXXXXXXXXX1XX0 >000500  1      X      X      X      X      X

Physical bank no.
8 BITS (OCT)
000
XXX

Priority levels
17 16 15 14 13 12 11 10 7 6 5 4 3 2 1 0
X  X  X  X  X  X  X  X  X  X  X  X  X  X  X
X  X  X  X  X  X  X  X  X  X  X  X  X  X  X

2 select words used.
Type H for explanation of editing. Type <HOME> to get back to MAIN MENU.

```

Figure 11. Example of a TRIG-CONDITION-SELECT picture

Explanation of the different fields

DATA

This 16-bit field contains one of the four functions described below, depending on the values of the control bit field:

- Instruction code fetched from memory during an instruction fetch cycle.
- Data transported to or from memory in a CPU read or write instruction.
- Data transported to or from memory in a DMA cycle.
- Data transported between CPU and an interface in an IOX cycle.

PHYSICAL ADDRESS

Only used in PHYSICAL ADDRESS MODE. 16 least significant bits of the physical memory address for all memory cycles. For IOX cycles this field contains the hardware device number.

PHYSICAL BANK NO	Only used in PHYSICAL ADDRESS MODE. 8 most significant bits of the physical memory address for all memory cycles.
LOGICAL ADDRESS	Only used in LOGICAL ADDRESS MODE. 16 least significant bits of the logical memory address for all memory cycles when the CPU is running in paging-ON mode. The 10 least significant bits (displacement within page) are the same for physical and logical addresses. The logical address does not apply to DMA cycles.
PAGETABLES	Only in LOGICAL ADDRESS MODE. 16 or 4 bits, (depending on what is specified in the NUMBER-OF-PAGETABLES command) each representing one page table. A page table is the hardware page index-table number that the logical address is mapped through, in paging-on mode, to get the physical address. They are edited by setting a "1" or "X" in the page tables where a trig can occur and a "0" in page tables that will be ignored.
PRIORIITY LEVELS	16 bits each representing one hardware priority level. They are edited by setting a "1" or "X" in the levels where a trig can occur and a "0" in levels that will be ignored.

CONTROL BITS

This field can be seen as a 7 bit binary integer where "0" and "1" values have the following meaning for the different bits:

Bit no.	Value.		Explanation
	0	1	
7		IOX	Bit set when an IOX or IOXT cycle is executed. (NOT when the IOX instruction is fetched from memory). For IOX cycles the information in the address field is the hardware device number. (Only 10 least signif. bits valid in logical address). The data field contains the value transferred between the A register and the device.
6	Read	Write	Bus direction of dataflow. Instruction fetch is always read.
5	DMA	CPU	CPU or DMA device causing the memory access. NB! For DMA accesses only data, bus direction, and physical address, contain relevant information.
4	Data	Inst.	Memory access decoded as instruction-fetch or data.
3	NPT.	APT.	Data access mapped through NORMAL or ALTERNATIVE page table when running in 2-bank mode.
2	IOF	ION	Interrupt system turned OFF or ON.
1	POF	PON	Paging system turned OFF or ON.

Table 3. Control bits explanation

Setting a bit to "X" means "don't care".

Interaction between fields in one trig word and between different trig words

The 5 fields for one select word are "ANDed" together. It means that there must be match on all 5 fields at the same time to cause a trig.

Trig will occur if there are match with all fields in at least one select word.

NOTE

Remember to fill in all fields. If there are "0" in all values of the interrupt level field the select word can never cause a trig (not even for DMA accesses, IOX accesses or in interrupt off mode). There are NO warnings if you specify combinations that can not occur.

If you have a ND-100 CPU (not ND-110 CPU) keep the prefetch mechanism in mind (see description in chapter 4) when you set up

trigger-conditions to avoid false triggering. (The instruction after a SKP-instruction may be fetched and cause a trig even if it is not executed.)

Editing rules

Typing a "H" anywhere in the TRIG-CONDITION-SELECT picture will display this information.

```

=====
= AVAILABLE FUNCTIONS FOR NAVIGATING AND EDITING =
=====
Legal input in fields are digits or X (don't care)
Navigate in current select word using arrows:
  <UP> / <DOWN> = previous / next field
  <LEFT> / <RIGHT> = previous / next digit
Switch between LOGICAL and PHYSICAL address mode:
  <CTRL> A
Change radix mode on current field:
  <CTRL> O = OCTAL
  <CTRL> Z = HEXADECIMAL
  <CTRL> B = BINARY
Move current editing between select-words:
  <CTRL> N = next word
  <CTRL> P = previous word
  <CTRL> C = clear (delete) current word
Set all bits to 0 or X (don't care):
  <CTRL> U = 0 in all fields in current word
  <CTRL> V = X in all fields in current word
  <CTRL> D = 0 in current field
  <CTRL> fF = X in current field

TYPE <HOME> TO GET BACK TO EDITING

```

Figure 12. The editing rules

"Arrows" keys can be used to move around in one field or between the different fields for one trigger-word:

```

<UP> / <DOWN>      = previous / next field
<LEFT> / <RIGHT>  = previous / next digit
                    within field.

```

Control bits, page tables, and interrupt levels are each regarded as one field.

Switching between PHYSICAL and LOGICAL address mode is done by typing <CTRL> A.

The fields; DATA, PHYSICAL ADDRESS, LOGICAL ADDRESS and PHYSICAL BANK NO. are integer data that can be specified in one of the radix modes:

OCTAL
HEXADECIMAL
BINARY

The radix mode can be changed for each field individually by typing:

<CTRL> O = OCTAL,
<CTRL> Z = HEXADECIMAL or
<CTRL> B = BINARY

when the cursor is in the field.

In addition to numerical digits "X" can be typed in as a "don't care digit", which will give match for all values of that digit. You may also see digits displayed as "\$" .It means that some but not all bits in this digit are "dont't care bits". This may happen if radix mode is changed on fields with "don't care digits".

If you want to specify more than one trigger-condition you can:

- edit the next select word by typing
<CTRL> N ,
- move back to the previous word with
<CTRL> P,
- clear current select word by <CTRL> C.

When you start using a select word all bits are set to 0. To make editing of a trigger-word easier these functions are implemented to set all bits in a group to 0 or X (don't care):

- <CTRL> U = 0 in all fields in current word
- <CTRL> V = X in all fields in current word
- <CTRL> D = 0 in current field
- <CTRL> F = X in current field

2.4.3 QUALIFICATION-SELECT

This command is used when you want a filter to select which of the bus cycles will be collected in the trace buffer. Specification of the QUALIFICATION is done in the same way as the TRIG-CONDITIONS. The difference is that when a bus cycle matches one of the trigger-words a trigger-condition occurs, when it matches a qualifier word it is stored in the tracer-buffer.

The use of QUALIFICATION

- Ignore level 0 activity except for DMA cycles.
- Collect only DMA or IOX cycles.
- Collect only activity on page table 5 and 10 on level 1.
- Collect all monitor call fetches.

NOTE

Trig and qualification are independent. The trigger-word's specification does not have to match within a qualifier to cause a trig. After a trigger-condition has occurred all trigger-words work as qualifiers. Then a bus cycle will be stored in the tracer-buffer if it matches either a qualifier or a trigger-word.

2.4.4 START-TRACE

When trigger-condition and qualification pictures have been edited ready, tracing of bus cycles can start. This command will first clear old information in the tracer-buffer. Then some questions must be answered:

'STOP ND-100 if trig ? (y/n):'

A 'y' here will cause the tracer to assert the stop signal to the ND-100 CPU when a trigger-condition occurs. This can be used if you want to look around in the ND-100 memory or display registers that were valid when the trig occurred. The execution of the ND-100 CPU can be continued by typing a "!" on the ND-100 console.

'TRIG if ND-100 stops? (y/n):'

This will be an extra trigger-condition in addition to the trigger-condition select-words. A 'y' will cause a trig in the tracer if the ND-100 CPU stops. A 'y' here is also used as a qualifier for external trig. External trig must be wired to TP2 and is active low.

'Specify location of trigger-point in trace buffer :'
'(Start trace=0. Endtrace = 7777 <OCT> .)'

The tracer-buffer contain 10000B entries. The tracer can continue to collect a number of qualified bus cycles after a trigger-condition has occurred before the tracing stops. You can here specify the trigger-point location (between 0 and 7777 octal). 0 means that the trigger-point is first, 7777 that it is last in the trace buffer.

When this question is answered, the tracing will start. The tracing operation will continue until a TRIG occurs or it is aborted by the user typing <ESC>.

The state of tracing will be displayed continuously and can have the following values :

***** TRACE RUNNING *****

and one of the subfunctions:

'==> ARM WORD LOADED! WAITING FOR ARM CONDITION'
Can be seen if special ARM function is used.

'==> WAITING FOR TRIG CONDITION'
Normal state when collecting data in tracer-buffer.

***** TRACE FINISHED *****

and one of the subfunctions:

' ==> TRIG OCCURED! WAITING FOR TRACEBUFFER TO BE FILLED'
Displayed when triggering has occurred but not enough qualified events have occurred to fill the rest of the tracer-buffer. (Only seen when 'end trace' is NOT selected')

'==> TRIG OCCURED! TRACEBUFFER FILLED '
Normal state after a trig.

***** TRACE ABORTED *****

Tracing aborted by a user break , not by trig.

2.4.5 DISPLAY-TRACE-CONTENT

After a trace the tracer-buffer can be inspected by this command.

Example of a DISPLAY-TRACE-CONTENT picture:

*****											DISPLAY TRACE CONTENT											*****										
REL.	PHYSICAL			P		LOGICAL		EXTRA		FORMAT		L	I	R	D	I	A	I	P	TIME												
TO	BANK.	ADDR.	T	ADDR.	DATA	DATA					E	O	/	M	/	P	O	O	INTERV.													
TRIG.											V	X	W	A	D	T	N	N														
-0011	001	105047	00	025047	050124	LDT	*+124				01	R	I	I	P	0001	us															
-0010	001	105173	00	025173	021074	==>	" <				01	R	D	I	P	0001	us															
-0007	001	105050	00	025050	140065	SKP	IF DA EQL ST				01	R	I	I	P	0000	us															
-0006	001	105052	00	025052	044320	LDA	*-060				01	R	I	I	P	0000	us															
-0005	001	104772	00	024772	000000	==>	&@&@				01	R	D	I	P	0000	us															
-0004	001	105053	00	025053	135124	JPL	I *+124				01	R	I	I	P	0001	us															
-0003	001	105177	00	025177	021141	==>	" a				01	R	D	I	P	0001	us															
-0002	000	021141	00	021141	150405	PIOF					01	R	I	I	P	0001	us															
-0001	000	021142	**	021142	006000	STA	,X +000				01	R	I	*		0002	us															
T0000	000	000001	**	000001	000000	==>	&@&@				01	W	D	*		0000	us															
+0001	000	021143	**	021143	150412	PION					01	R	I	*		0000	us															
+0002	000	021144	00	021144	146142	COPY	SL DP				01	R	I	I	P	0006	us															
+0003	001	105054	00	025054	124002	JMP	*+002				01	R	I	I	P	0001	us															
+0004	001	105056	00	025056	124100	JMP	*+100				01	R	I	I	P	0001	us															
+0005	001	105156	00	025156	040226	MIN	*-152				01	R	I	I	P	0001	us															
+0006	001	105004	00	025004	151243	==>	R #				01	R	D	I	P	0001	us															
+0007	001	105004	00	025004	151244	==>	R \$				01	W	D	I	P	0000	us															

Figure 13. Example of a DISPLAY-TRACE-CONTENT picture

All fields except for the time interval field contain OCTAL numbers.

Explanation of the different fields

REL. TO TRIG.

Shows address in tracer-buffer relative to the trigger-point. T0000 is the trigger-point. Negative values were stored before and positive values after the trigger-point.

PHYSICAL ADDRESS

Displayed as BANK number + displacement within bank. (1 bank is 64k 16 bit words.) For IOX cycles this field contain hardware device number.

LOGICAL ADDRESS

Displayed as page table number (PIT) + 16-bit logical address. The displacement within page is the same for physical and logical addresses. The logical address does not apply to DMA cycles.

Note that page table field is not correct when connected to the first version of ND-110 CPU (K-print or later ok) .

DATA

The 16-bit word read or written to or from memory in instruction fetch, read/write or DMA cycles. For IOX cycles this field contains data transferred between an interface register and current CPU A-register.

EXTRA FORMAT DATA

Field containing data disassembled when the instruction fetch bit is set, otherwise the ASCII value of the data.

CONTROL BITS

These are represented by.

IOX : I or space
 Read/Write: R or W
 DMA / CPU : D or space
 Data/Inst.: D or I
 APT./NPT. : A or space
 ION / IOF : I when ION else space
 PON / POF : P when PON else space

TIME INTERVAL

This field contains information on the approximate time elapsed since the previous qualified memory access was stored in the trace buffer. The counter counts in microseconds from 0 to 999 us, then in milliseconds from 1 to 999 ms and finally in seconds.

The Qualification can be set to unique start and end conditions, and the trace can be started. When the tracer-buffer is inspected the time between those two events is displayed.

NOTE

Intervals are measured as integers and decimals discarded. I.E. 1.9 ms is displayed as 1 ms. 774,6 ms is displayed as 774 ms.

The monitor decodes the control-bits to try to sort out relevant data and addresses. Data

that are not applicable are displayed as '**

When the monitor can not find the trigger-point in the trace buffer, it logically takes the last stored entry as trigger-point. (I.e. when tracing is aborted manually!)

Available commands to display and search in the tracer-buffer

NEXT-PICTURE / PREVIOUS-PICTURE (or the <UP> / <DOWN> arrows):

This will move the display-window to the next/previous 16 (20B) entries in the tracer-buffer.

MOVE-TO

This will move the display-window to a tracer-buffer address. All tracer-buffer-addresses are relative to the trigger-point. Entries stored prior to the trigger-point must be specified as negative values (ex. -2445), after the trigpoint values are positive.

GET-BACKWARDS-VALUE / GET-FORWARDS-VALUE

This command will bring up a line of fields corresponding to the data-fields, the address-fields and the control-bit-fields in the tracer-display. This line can be entered with digits or 'X' to specify what you want to search for. When the editing is completed, the tracer-buffer is searched from current address and forwards or backwards according to the command. If a match is found, the display-window is moved to that tracer-buffer address.

<CTRL> G

This will continue the search specified in the last GET command.

NOTE

Searching and moving will NOT cross the last/first entry stored in the tracer-buffer.

2.4.6 NUMBER-OF-PAGETABLES

The tracer must be told if the CPU is running in 4 or 16 page table mode. (SINTRAN vers. K-VSX or later uses 16 page tables) This can be set by the command NUMBER-OF-PAGETABLES (default value is 16).

2.4.7 DUMP-PHYSICAL-MEMORY

The tracer can read the ND-100 memory through a DMA interface that reads 1 word pr. transfer. This command can display and decode the contents of the physical memory. It has the same subcommands for moving around and searching as the DISPLAY-TRACE-CONTENT command. Moving and searching are done within one memory bank (64k word) at a time. There is a command SET-BANK-NUMBER to move to another bank.

NOTE

Remember that the tracer acts as a normal DMA device on the bus. If you try to read uninitialized or nonexistent memory, the ND-100 CPU will get a MEMORY PARITY ERROR or MEMORY OUT OF RANGE internal interrupt, and SINTRAN will probably go to ERRFATAL (STOP). Therefore this command must be used with great care when SINTRAN is running.

The last page in bank 0 is never used by SINTRAN and is not initialized except if a memory test program has been run before SINTRAN is started.

2.4.8 MAINTENANCE

This contains some subcommands for verification of the tracer board itself and is not used in normal operation. Commands exist for testing the tracer-buffer, updating the internal clock, and looking at the internal program memory.

Chapter 3 REMOTE MODE

The tracer monitor can run in 2 modes:

LOCAL or REMOTE.

LOCAL mode is when a terminal is connected directly to the interface plug on the tracer board. Then the monitor performs all the interactive user communication, displays menus, trace information etc.

In REMOTE mode a cable from the tracer's interface plug is connected to a ND-100 RS-232 interface instead of to a terminal. The RS-232 interface and the tracer can be located in the same computer, or they can be located in separate computers. Now the tracer monitor is simulated for the user by a ND-100 application program called TM-MONITOR. This program reserves the line connected to the tracer. All the editing and picture displays are done in ND-100 and only packed data blocks containing tracer-buffer content, set-up information, status, and commands are passed between the tracer and ND-100.

The advantage of REMOTE mode

The advantage of REMOTE mode is that tracer set-up and tracer-buffer contents can be saved on disc files for later inspection or documentation of special conditions. In LOCAL mode the tracer-buffer contents are lost when the power is turned off in the system.

3.1 Missing commands in remote mode

The commands DUMP-PHYSICAL-MEMORY and MAINTENANCE do not exist in the TM-MONITOR program.

3.2 Changed commands in remote mode

START-TRACE

This command will send blocks of tracer set-up information to the tracer board. When trace is running the TM-MONITOR will poll the line to get the status of the tracer. This means that it takes a moment from the trig occurs until it is reported by the program.

DISPLAY-TRACE-CONTENT

can use two different strategies when displaying and searching through the tracer-buffer.

COPY-TRACE-FROM-TRACER

READ-TRACE-FROM-FILE

If one of these commands are used, the program's local tracer-buffer is always used by GET and display operations.

OPEN-PATH-TO-TRACER

If only this command is executed, blocks of tracer-buffer contents are fetched over the line when needed for display. If you display the same picture twice, no fetching is necessary the second time.

GET-FORWARDS/BACKWARD

This command will ask the trace board to make the search and report back if a match is found. The second strategy will save the time it takes to copy the entire buffer if you don't want to save it on file, but you may have some extra halts in the display when data is fetched.

3.3 Extra commands in remote mode

OPEN-PATH-TO-TRACER

PARAMETER:

'Peripheral file name of tracer?'

FUNCTION: This command reserves the peripheral file where the cable from the tracer should be connected (see page 42 for installation details). A control character is sent to the tracer to set it in remote mode.

Then a message is sent to the tracer to check for a response and get some information about the it's state. If OK the message

'Contact established!'

will be displayed. This command must be performed with no errors before the commands START-TRACE, COPY-TRACE-FROM-TRACER or DISPLAY-TRACE-CONTENT are executed.

COPY-TRACE-FROM-TRACER

PARAMETER:

'COPY ENTIRE BUFFER (Y/N)'

If 'N', the two following parameters must be answered as well:

'FROM OCTAL ADDRESS (-7777B:7777B)'

'TO OCTAL ADDRESS (-7777B:7777B)'

FUNCTION: The contents of the tracer-buffer in the ND-100 tracer board is copied over the RS-232 line to a memory buffer in the TM-MONITOR program in ND-100. To copy the entire buffer takes approximately 5 minutes on a 9600 baud line. When copying is finished the user is asked if he wants to save the trace contents on file.

SAVE-TRACE-ON-FILE

PARAMETER: File name. The default file type is :TRAC.

FUNCTION: Save the contents of the local tracer-buffer on a file. Each file needs 24 pages of disc space.

READ-TRACE-FROM-FILE

PARAMETER: File name. The default file type is :TRAC.

FUNCTION: Read tracer-buffer contents previously written by SAVE-TRACE-ON-FILE. This tracer-buffer contents can now be displayed by DISPLAY-TRACE-CONTENT.

SAVE-SETUP-ON-FILE

PARAMETER: File name. The default file type is :STUP.

FUNCTION: The parameters set in the pictures SPECIAL-FUNCTIONS, TRIG-CONDITION-SELECT, and QUALIFICATION-SELECT can be saved on a disc file by this command.

READ-SETUP-FROM-FILE

PARAMETER: File name. The default file type is :STUP.

FUNCTION: A ready made tracer set-up written to file by the command SAVE-SETUP-ON-FILE can be read back by this command. When issuing a START-TRACE command this TRIG and QUALIFICATION set-up is sent directly to the tracer board without having to be edited. If required this set-up can be inspected and modified in the normal way.

PRINT-TRACE-ON-FILE

PARAMETERS: File name. The default file type is :PRNT.

'FROM OCTAL ADDRESS (-7777B:7777B)' and
'TO OCTAL ADDRESS (-7777B:7777B)'

FUNCTION: This command produces a file containing a part of the tracer-buffer contents in an ASCII decoded format similar to the DISPLAY-TRACE-CONTENT command. This file can be read by a normal editor or printed on a printer.

NOTE

The printout of an entire tracer-buffer by this command requires 165 pages of disc space.

3.4 Switching between LOCAL and REMOTE mode

Switching the tracer board from local to remote mode is done automatically by the OPEN-PATH-TO-TRACER command in TM-MONITOR program. To switch it back to local mode, when a terminal is connected directly to the board, you can type <CTRL> R on the terminal or push the reset button on the tracer.

The trace contents is not destroyed by any of these changes of modes. This means that if you have run in local mode and have got something in the tracer-buffer that you want to save, you can connect it in remote mode and use the commands OPEN-PATH-TO-TRACER, COPY-TRACE-FROM-TRACER, and SAVE-TRACE-ON-FILE in the TM-MONITOR program.

If you are running the TM-MONITOR program on the same machine as the tracer board is installed, and the TRIG or a bug makes the system stop, you can either restart your system or connect the tracer locally to display the trace content.

3.5 Installation and requirements to run in REMOTE mode

Hardware requirements:

- 1 ND-100 TRACER board.
- 1 cable ND100-ND100 RS 232. Part no. 325424.
- 1 free terminal-line switched to RS 232. The terminal-line should run on the same baud rate as the ND-100 tracer board and with even parity.

Software requirements:

- The program TM-MONITOR:PROG needs 120 pages of disc space. It must be run on a Notis terminal.
- The terminal line to the tracer must be set up by user SYSTEM as follows:

<DEVNO> should be substituted with the actual logical device number (decimal).

```
@SET-PERIPHERAL-FILE "TRACER" <DEVNO>D
@SET-FILE-ACCESS TRACER RW,RW,RWD
@SINTRAN-SERVICE
@REMOVE-FROM-BACK-TABLE <DEVNO>D I Y Y Y
@CHANGE-BUFFER-SIZE<DEVNO>D I 1000B Y Y Y
@EXIT
```

The following lines should be put in LOAD-MODE:MODE file. (They must be performed for each warm start.)

```
@SINTRAN-SERVICE
@CHANGE-DATA <DEVNO>D I Y N N
ECH/O
.
@EXIT
```

Chapter 4 How to avoid "strange" behaviour of the Tracer

This section gives some hints about possible misleading or missing information in the tracer-buffer, and also about missing or false triggering.

CACHE OR PAGE TABLE ACCESSES

The tracer only detects accesses going on the ND-100 bus where it is located. Read or write only in cache or page tables are not seen.

NOTE

To avoid confusion when looking in the tracer-buffer, you must always turn the ND-100 cache OFF before tracing is started.

PREFETCH

The ND-100 CPU (separate CPU and MMS board) uses prefetch on instructions. This means that while one instruction is decoded the contents of the next address is fetched as an instruction from memory. This may lead to "false" instructions in the trace after sequencing instructions as JMP, JPL, SKP, MIN, WAIT and so on.

The data operated on by an instruction may often be found a few locations after the instruction in the tracer-buffer. Changes in some CPU conditions, such as paging and interrupt system, may cause the microprogram to fetch the same instruction two or three times before it is executed (it does not trust that the prefetch was correct).

This means that the user has to watch the sequence of logical addresses and type of instructions carefully to sort out manually which instructions have been executed and which are false prefetches. This can be quite difficult if some SKP, JMP and MIN follow each other in the trace. Prefetching should also be kept in mind when setting up trigger-conditions to avoid false triggering.

ACCESSES IN SHARED MEMORY

When the tracer is located on the local ND-100 bus, memory accesses coming from other channels to a shared memory are not seen by the tracer board and therefore not stored in the tracer-buffer. This includes accesses from ND-500 and DMA interfaces located in

other crates.

IOX INTERNALLY ON THE CPU BOARD

IOX cycles going to the console or the internal real time clock are not stored in the tracer-buffer.

DMA

For DMA accesses only the following contain relevant information:

PHYSICAL ADDRESS, DATA, and R/W BIT.

The PAGE TABLE field

The page table field is not correct when connected to the first version of ND-110 CPU. For correct values use 3090 K print or later versions. 3095 prints are OK.

If the message

NO CONNECTION BETWEEN TRACER AND CPU BOARDS

is displayed in the MAIN-MENU, only DATA and PHYSICAL ADDRESS bits contain relevant information. This must be taken into consideration when setting up trigger-conditions and displaying the tracer-buffer.

'*** TRACE ABORTED ***'	32
'*** TRACE FINISHED ***'	32
'*** TRACE RUNNING ***'	32
'Contact established!'	39
'COPY ENTIRE BUFFER (Y/N)'	39
'FROM OCTAL ADDRESS (-7777B:7777B)'	39
'FROM OCTAL ADDRESS (-7777B:7777B)'	40
'Give number of events in sequence? (2-4):'	21
'Interrupt interval = 2**N microsec. N= ? (OCT)'	23
'Interval uses too many select words!'	20
'Max. IOF time = 2**N microsec. N= ?(OCT)'	23
'Only qualified events significant (Y/N)?'	21, 22
'Peripheral file name of tracer?'	38
'TO OCTAL ADDRESS (-7777B:7777B)'	39, 40
'Trig if ND-100 stops?'	5
<CTRL> A and 	15
<CTRL> B	29
<CTRL> C	29
<CTRL> D	15, 29
<CTRL> F	29
<CTRL> G	35
<CTRL> N	29
<CTRL> O	29
<CTRL> P	29
<CTRL> R	15
<CTRL> U	29
<CTRL> V	29
<CTRL> Z	29
ARM word	21
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SKP-instruction	28
SPECIAL-FUNCTIONS.	18
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Test connector	6
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TM-MONITOR	37
Tracer adapter	6
TRACER-BUFFER	2
TRIG-CONDITIONS-SELECT.	24
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TRIG-DATA-INTERVAL	21
TRIGGER-CONDITON	2
trigger-point	33
TRIG-LOGICAL-ADDR-INTERVAL	21
TRIG-PHYSICAL-ADDR-INTERVAL	21

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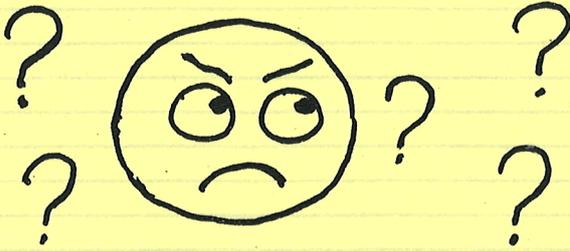
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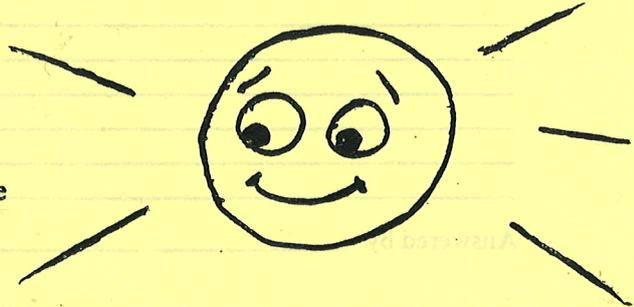


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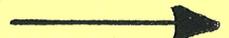
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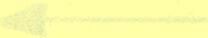
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