TECHNICAL MANUAL

BOOK 1

TECHNICAL DESCRIPTION

NEC CCIS Data Processing Subsystem

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HUGHES INFORMATION SYSTEMS

NEC CCIS

Data Processing Subsystems

Book 1: Technical Description

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.001 DRAFT	Draft release
.001.1 EN	Manual revised to incorporate editorial comments.
.001.2 TO	Manual revised and updated to reflect latest engineering
	changes and editorial comments. Changed 512 Kbyte MOS-
	memory module to 2 Mbyte RAM memory card. Added another
	type of interactive programming terminal.

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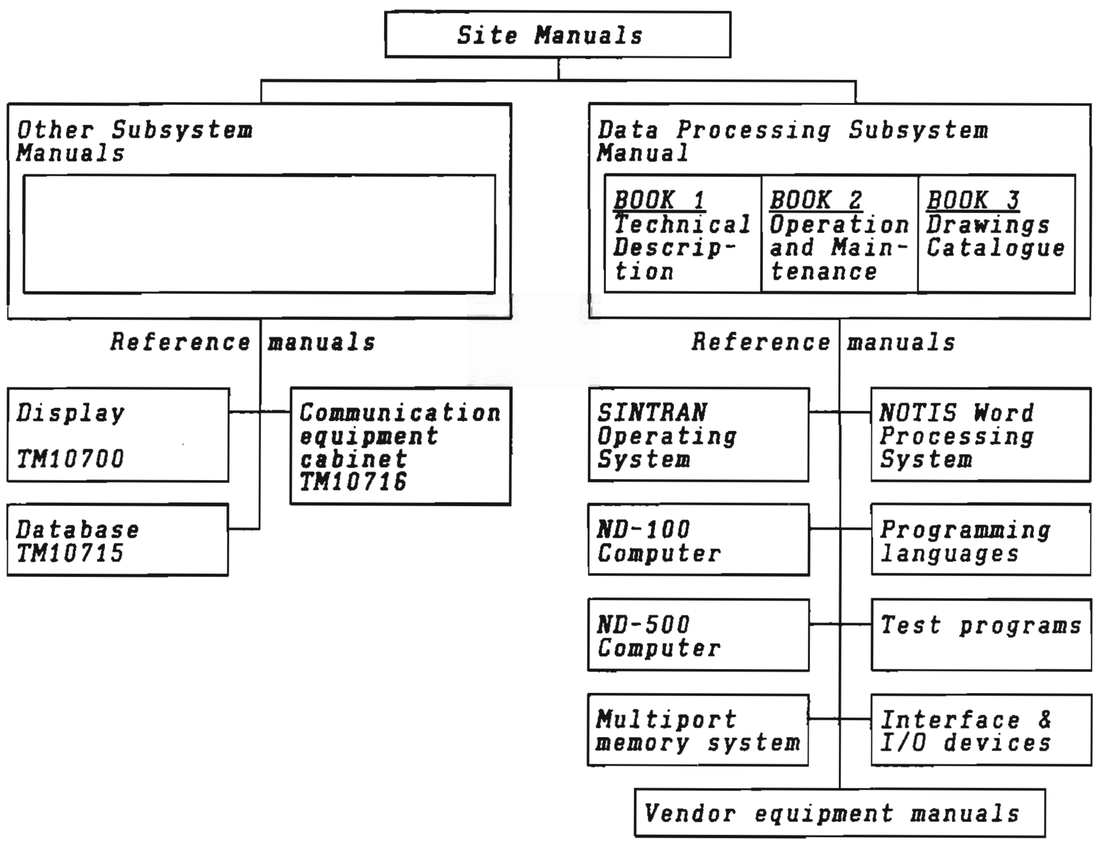
THE READER

This manual is prepared for operators, system administrators and Echelon 1 and 2 maintenance personnel.

PREREQUISITE KNOWLEDGE

The reader need not be familiar with the ND family of computers. However, some knowledge of data technology is required.



The total information plan for the NEC CCIS site

THE SCOPE OF THIS BOOK

Book 1 covers the Data Processing Subsystem (DPS) section of the NEC CCIS sites.

The main purpose of the book is to give the reader enough information about the Data Processing Subsystem to be able to understand and follow the instructions given in Book 2, "Operation and Maintenance".

CHAPTER 1

Chapter 1 explains the purpose of the Subsystem and briefly describes how this purpose is achieved. The chapter also lists the main system parameters and explains the unit identification system. Configuration information is also provided. Configuration drawings for the DPS are contained in Book 3, Chapter 2.

CHAPTER 2

Chapter 2 describes the hardware configurations of the Subsystem.

Each hardware unit is described separately, with special emphasis on data pertaining to the NEC CCIS sites. When needed, reference is made to basic hardware manuals where more information can be found.

CHAPTER 3

This chapter describes the software used in the Subsystem including operating systems, languages, word processing and communication. References are made to relevant software manuals.

CHAPTER 4

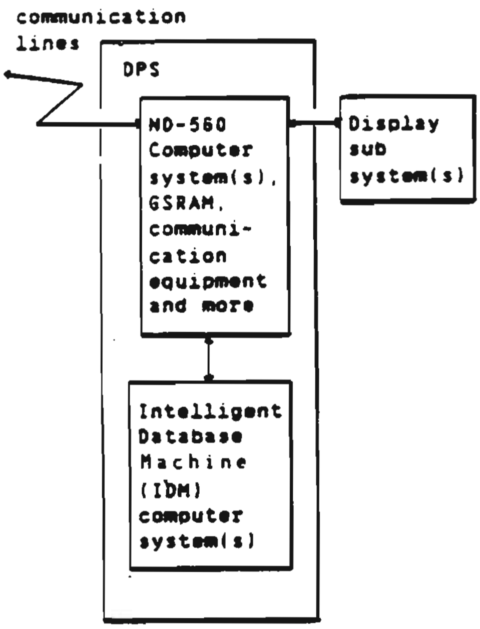
Chapter 4 explains how the Subsystem works. This is done by means of a top-level system block diagram for each site and medium-level function block diagrams providing greater detail.

The top-level system block diagram provides enough information to explain the basic operations of the Subsystem hardware. It gives all data paths and provides plug numbers and all inter-cabinet wiring. It shows all hardware units within their proper cabinets, while still maintaining functional clarity. It also provides reference to medium-level diagrams as well as to individual, basic technical manuals.

The medium-level function block diagrams show all main signal paths within each card as well as source/destination of all input/output signals. Each functional block on the card is briefly explained.

1 INTRODUCTION

1.1 WHAT DOES THE DATA PROCESSING SUBSYSTEM DO?



The Data Processing Subsystem (DPS) provides the distributed processing capability at each NEC CCIS site. Application programs run in general purpose computer systems (ND-560). The application programs handle the processing and transport of information such as messages to or from: other sites, a database or display subsystems.

An incoming message may update the database of a dedicated computer system (IDM) or may be sent to the display subsystem which presents the information to an operator, or both.

The communication lines, database system and display subsystems are all connected, through interfaces, to the interrupt system of the ND-560. Thus they may all initiate actions in the computer.

Processors

The ND-560 employs two main CPUs, an ND-100 CPU (16-bit) and an ND-500/1 CPU (32-bit). They have a Local Shared Random Access Memory (LSRAM). When there is more than one ND-560 on a site (there may be up to four) they have a Global Shared Random Access Memory (GSRAM) in addition to their respective LSRAMs.

With the exception of DMA transfers to or from the GSRAM, all input/output goes through the ND-100 CPU controlled I/O system. Most transfers are DMA transfers set up by the ND-100 and performed by one of several microprocessor based controllers and interfaces.

Operating system

The application programs in the ND-560 are supported and controlled by the SINTRAN III/VSX-500 operating system (ND-10576).

The operating system allows several applications to run concurrently (timesharing), according to a schedule (real-time) or when resources are free (low priority batch).

SINTRAN provides virtual storage of very large programs. In the NEC CCIS configurations, SINTRAN operates far from the limitations on program size and memory size (hard disk or dynamic MOS memory).

SINTRAN includes a file management system with security and backup facilities. It also provides protection for the use of system commands, and system instructions and data (files).

You may use SINTRAN through a menu system (User Environment) or through command language with parameter prompting and line editing facilities.

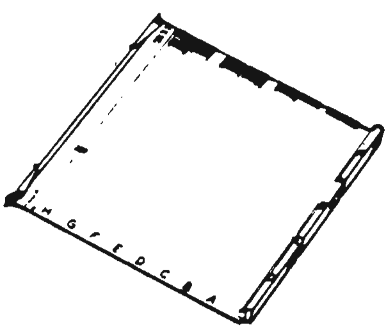
1.2 KEY TECHNICAL DATA

1.2.1 ND-100/CX CPU AND PERIPHERALS (CABINET A)

REFERENCES

See section 4.4 for information about the power supply system. See Book 2, section 1.2 for environmental requirements.

ND-100/CX CPU



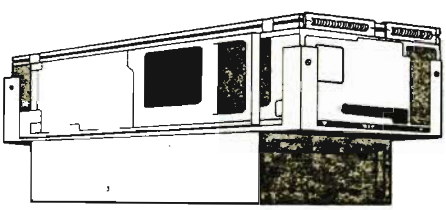
Basic CPU type	: microprogrammed with pipelining
Word length (parallel processing)	: 16 bits
Address modes	: 8
Internal cycle time (min.)	: 150 ns
Interrupt levels	: 16 (vectored)
Context switching time	: 5 µs
Address space (via Memory Management)	: 16M words
User program size (max.)	: 64K words of instructions & data, additional 64K words data
2 Local memory size	: 2 Megabytes (error correction not included)
Local memory access time (max.)	: 320 ns (read), and 200 ns (write)
Cache memory size	: 1K words (paging directory not included)
Cache memory access time	: 110 ns
Bus system band width	: 1.8M words/sec (single bus structure)

Examples: instruction execution times

16 bits integer		
addition	:	*460 ns*
subtraction	:	*460 ns*
multplication	:	*3600 ns*
division	:	*6000 ns*
32 bits floating		
multiplication	:	*14000 ns*
division	:	*14700 ns*

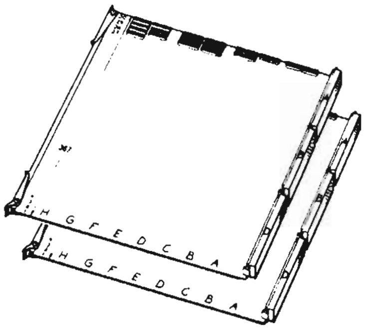
Note that the integer instructions have register operands. The floating point instructions have memory operands. All instructions are found in cache.

DISK DRIVE



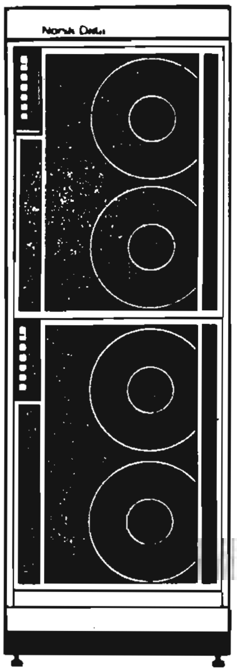
Interface standard	:	SMD (Storage Module Drive)
Data storage capacity	:	140 MB (formatted)
Data transfer rate (peak value)	:	9.677 Mbits/sec
Average rotational latency	:	8.3 ms
Average positional (radial) latency	:	20 ms
Access time (track to track)	:	5 ms
Rotational speed	:	3600 RPM

DISK INTERFACE



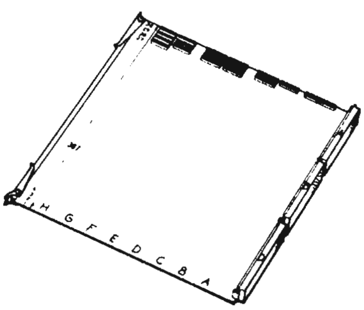
No. of disk drives it can handle	:	4
I/O data access method	:	Direct Memory Access (DMA)
Size of intermediary data buffer	:	8 Kbytes

MAGTAPE DRIVE



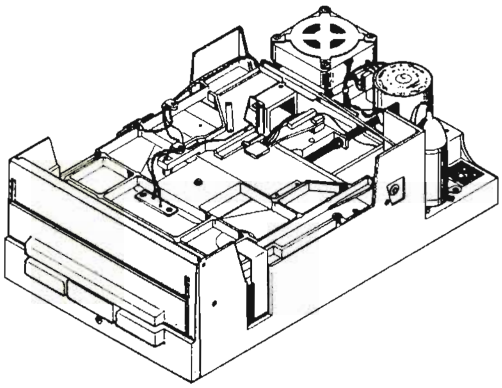
Interface standard	:	PE (Phase Encoded - IBM compatible) and NRZI (Non Return To Zero Inverted - IBM & ANSI compatible)
Character density (on tape)	:	1600 cpi PE and 800 cpi NRZI (characters per inch)
Tape speed	:	75 ips (inches per second)
Data transfer rate (peak)	:	58 Kbytes/sec (NRZI) 118 Kbytes/ sec (PE)
Rewind speed	:	250 ips
Tape reel diameter (max.)	:	10 1/2 in
Average start/stop time	:	5 ms

MAGTAPE CONTROLLER



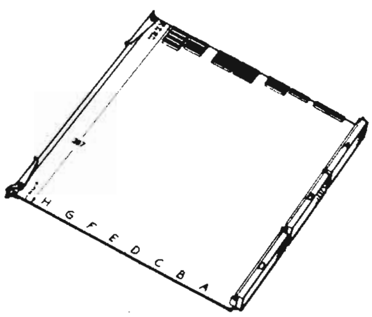
No. of magtape formatters it can handle	:	2
No. of magtape drives per formatter	:	2 (max. 4)
I/O data access method	:	DMA (Direct Memory Access)
Size of intermediary data buffer	:	32 bytes

FLOPPY DRIVE



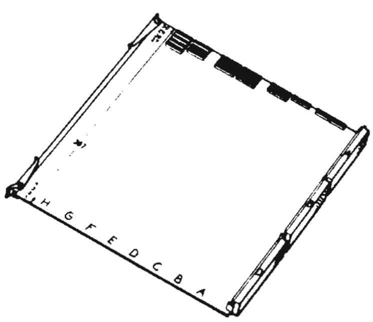
Interface standard	:	IBM
Data storage capacity	:	1.2 MB (user data)
Data format standard	:	IBM 3740, ND SS, IBM SYS 34 and ND DS (8")
Data transfer rate (single sided)	:	250 kbits/sec
Data transfer rate (double sided)	:	512 kbits/sec
Average rotational latency	:	83 ms
Settling time	:	15 millisec
Access time (track to track)	:	3 ms
Rotational speed	:	360 RPM

FLOPPY CONTROLLER



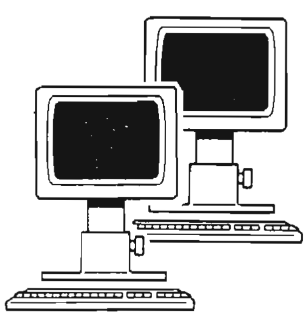
Controller based on microprocessor of type	:	Z80A
No. of floppy drives it can handle	:	4
I/O data access method	:	DMA (Direct Memory Access)
Size of intermediary data buffer	:	3 Kbytes

TERMINAL INTERFACE



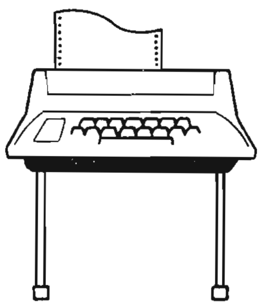
Interface standard	:	Current loop (active) and V.24
No. of serial, full-duplex lines per interface	:	4
Data transfer rate (peak value)	:	50 - 9600 bps (bits per second)
I/O data access method	:	PIO (Programmed Input/Output)
Size of intermediary data buffer	:	1 character (both input and output)

TERMINAL



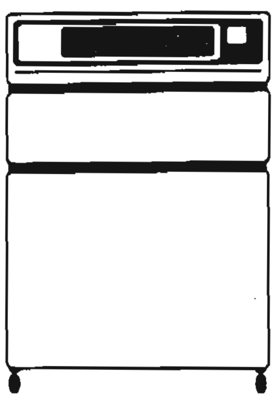
Interface standard	:	Current loop (passive) and V.24
Data transfer rate (peak)	:	50 - 19200 bps (bits per second)
No. of columns on screen	:	80
No. of lines on screen	:	25
Character set	:	256 (ASCII with international keyboard)
Character matrix	:	9 x 7 dots

PRINTER TERMINAL



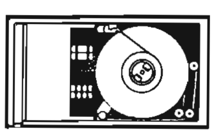
Interface standard	: Current loop (passive)
Data transfer rate (peak)	: 110 - 1200 bps
Printing speed	: 150 cps (characters per second)
No. of characters per line	: 132
No. of lines per inch	: 6-8
Character set	: 128 (ASCII with international keyboard)
Size of intermediary data buffer	: 32 characters (both input and output)

LINE PRINTER WITH CONTROLLER



No. of characters per line	: 132
No. of lines per inch	: 6-8
Character set	: 64 (ASCII)
Printing speed	: 900 lpm (lines per minute)
Size of intermediary data buffer	: 132 characters
I/O data access method	: PIO (Programmed Input/Output)

PAPER-TAPE PUNCH WITH INTERFACE

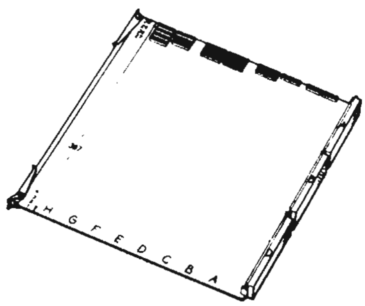


Paper type standard	: ISO
No. of tracks	: 5-8
Paper-tape reel diameter (max.)	: 8 in
Data storage capacity	: 120,000 characters (=300 meters tape)
Paper-tape width	: 11/16 - 1 in.
Printing speed	: 75 cps (characters per second)
Punch direction	: forward (unidirectional)
Size of intermediary data buffer	: 1 character
I/O data access method	: PIO (Programmed Input/Output)

PAPER-TAPE READER WITH INTERFACE

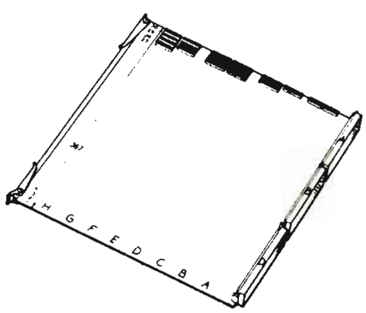
Paper standard	: ISO
No. of tracks	: 5-8
Paper tape width	: 11/16 - 1 in
Read speed	: 100 - 600 cps (characters per second)
Read direction	: forward (unidirectional)
Size of intermediary data buffer	: 1 character
I/O data access method	: PIO (Programmed Input/Output)

GPIB CONTROLLER



Interface standard	: IEEE-488
Controller based on microprocessor type	: Z80A
Max. no. of devices connected to the bus	: 15
Data transfer rate (max.)	: 175 000 bytes/sec
Size of intermediary data buffer	: 8 Kbytes
I/O data access method	: DMA (Direct Memory Access)

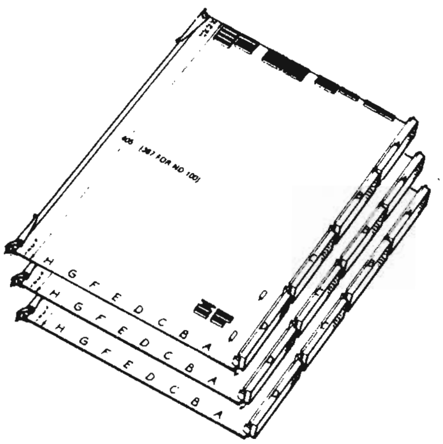
PIOC CONTROLLER



Interface standard	: V.24 and X.21 (implementation of protocols depends on software)
Controller based on microprocessor type	: MC 68000
No. of serial communication lines (full duplex)	: 4
Data transfer rate (max.)	: 800,000 bits/sec (1 line at a time) 200 000 bits/sec (4 lines simultaneously)
Memory size	: 128 Kbytes
I/O data access method	: Memory mapped

1.2.2 ND-560/1 CPU AND LOCAL SHARED MPM-5 MEMORY (CABINET B)

ND-560/1 CPU



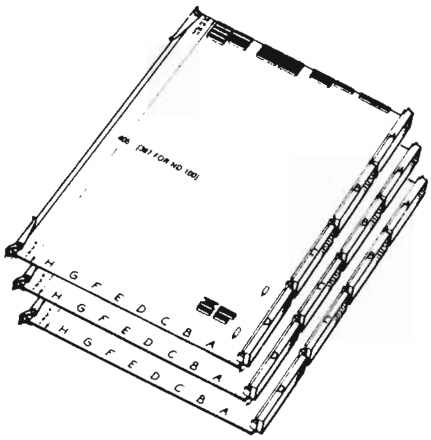
Basic CPU type	: microprogrammed with multi-stage pipelining
Word length (parallel processing)	: 32 bits
Address modes	: 29
Internal cycle time (min.)	: 200 ns
Interrupt levels	: 1 (via interface in ND-100/CX)
Context switching time	: 850 µs
User program size (max.)	: 4 gigabytes instructions and 4 gigabytes data
Address space (max., via Memory Management)	: 32 Mbytes (both for instructions and data)
Cache memory size	: 4K * 32 bits (both for instructions and data)
Cache memory access time	: 110 ns

Examples: instruction execution times

32 bits integer	
addition	*: 290 ns*
subtraction	*: 290 ns*
multiplication	*: 790 ns*
division	*: 6174 ns*
64 bits floating point	
multiplication	*: 690 ns*
division	*: 3430 ns*

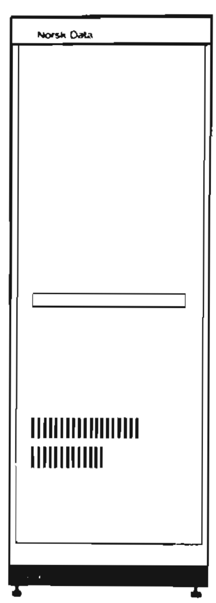
Note that all operands for the floating point instructions are registers, and that all instructions are based on cache.

LOCAL SHARED MULTIPORT MEMORY 5 (MPM-5)



Basic memory type	:	Dynamic Random Access Memory with multiple ports.
Word length	:	32 bits (error correction not included)
Memory size (max. theoretical)	:	32 Mbytes
Memory size (actual)	:	1 - 3 Mbytes
Number of ports	:	3 (1 for ND-100/CX, 2 for ND-560/1 CPU)
Memory access time (max.)	:	400 ns (read), 450 ns (read with error correction) 100 ns (buffered write)
Memory band width	:	17 Mbytes/sec (single bus structure)

1.2.3 GLOBAL SHARED MPM-5 MEMORY (CABINET C)



Refer to the preceding section (1.2.2) for primary specifications.

Memory size (actual)	:	1 - 2 Mbytes
Number of ports	:	4-8 (1 for each ND-100/CX CPU, and 1 for each ND-560/1 CPU)

1.3 UNIT IDENTIFICATION

1.3.1 HARDWARE UNITS BY TYPE

All main hardware units, such as printed cards, power supplies, and peripheral equipment, have a product number. This product number consists of the letters ND followed by three digits. An index number in parenthesis () is used to uniquely identify units appearing more than once. In some cases, a short descriptive group of letters is added for easier identification.

The third Programmable Input/ Output Contoller is called:

ND-857(3) PIOC

The 900 LPM Line Printer (there is only one) is called:

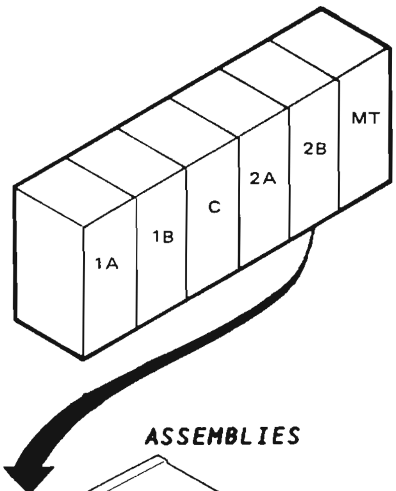
ND-433 PRINTER

> ***NOTE***
>
> *Although the numbers presented above are still used in connection with NEC CCIS, Norsk Data changed their hardware numbers late in 1985. The new number is determined by putting the number 10 in front and the number 0 after the old number. The ND-857(3) PIOC will then become ND-108570(3).*

1.3.2 HARDWARE UNITS BY LOCATION

Any unit from a cabinet down to a component can be identified according to its location. This is done by means of a location number in the following manner.

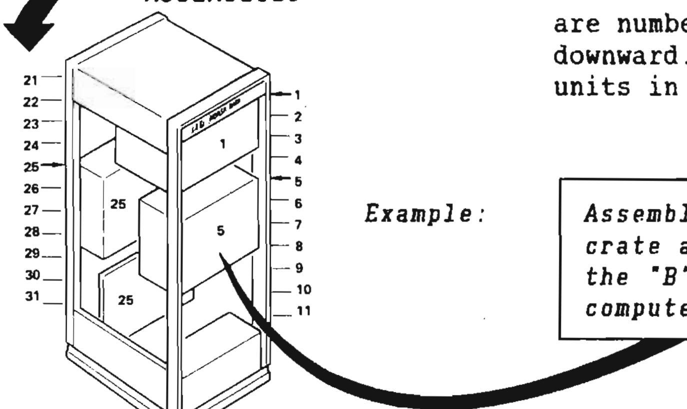
CABINETS



Cabinet locations are given in appendix H of the Installation Design Package (not part of this DPS manual). ND-560 computers are numbered 1 through 4 from left to right. Each ND-560 has two cabinets, indexed A and B. They are referred to as cabinet 1A, 1B etc. throughout the DPS manual; however, they may also be referred to as cabinet A-1, B-1 etc. The GSRAM is referred to as cabinet "C" and the cabinet with the two magnetic tape drives and formatter as cabinet "MT".

Cabinets on each site are also identified in the drawings of Book 3, Chapter 2.

ASSEMBLIES



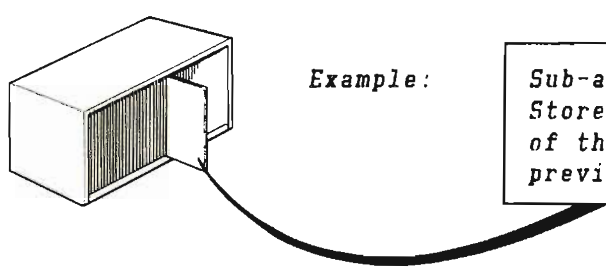
Assemblies mounted in the front of a cabinet are numbered 1 through 11 from the top downward. Numbers 21 through 31 are used for units in the rear of a cabinet.

Example:

> *Assembly 2B-5 is the ND-500/1 CPU card crate about halfway down at the front of the "B" cabinet of the second ND-560 computer.*

SUB-ASSEMBLIES

A sub-assembly is, for example, a circuit card assembly or a plug group. The sub-assembly is designated by a one or two digit number.



Example:

> *Sub-assembly 2B-5-17 is the "Control Store" circuit card assembly in slot 17 of the card crate mentioned in the previous example.*

Complete assembly and sub-assembly identification is found in Book 3, Chapter 3, "Units in the cabinets".

1.3.3 SOFTWARE UNITS

Software units are identified by the letters ND, a five digit number and a short description.

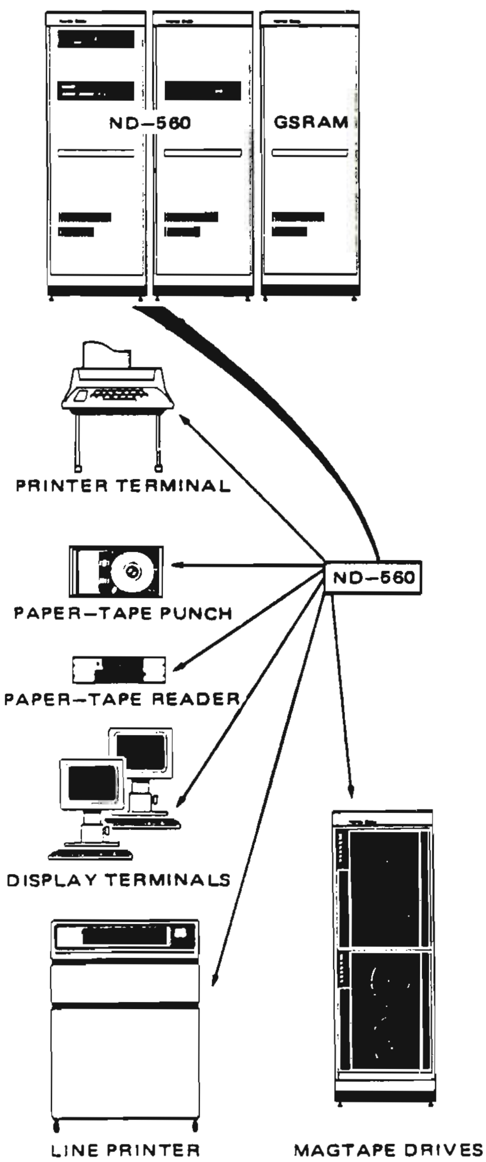
NOTIS Word Processsing System is called:

ND-10079 NOTIS WP

> *NOTE*
>
> *Although the numbers presented above are still used in connection with NEC CCIS, Norsk Data changed their software numbers late in 1985. The new number is determined by putting the number 2 in front of the old number. The ND-10079 will then become ND-210079.*

1.4 DATA PROCESSING SUBSYSTEM CONFIGURATION

1.4.1 GENERAL



This section describes the main building blocks of the DPS and identifies optional equipment within them. Refer to the drawings in Chapter 2, Book 3.

The main building blocks of the Data Processing Subsystems are the ND-560 computers and the Global Shared Random Access Memories (GSRAMs). An ND-560 computer consists of two cabinets and various peripherals. Some circuit card assemblies and some peripherals are options. The varying number of options present results in 19 types of ND-560 computers and 4 types of GSRAMs.

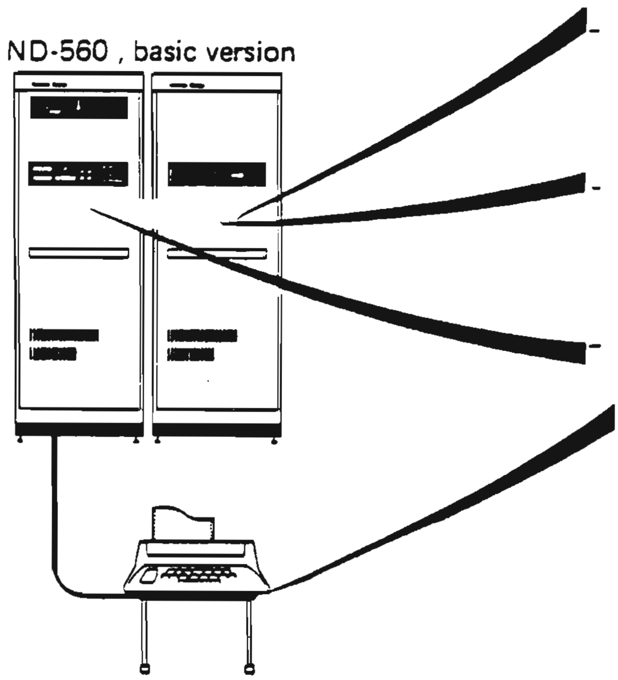
The options are listed in tables. The tables show whether or not an option is present in a certain version (type) of the ND-560 and the GSRAM.

The relevant parts of the tables are referenced in Book 3, Chapters 3 "Unit allocations" and 4 "Cabling", whenever options are dealt with.

1.4.2 THE ND-560 COMPUTER SYSTEM

There is a total of 38 ND-560 computers distributed among the 19 sites of NEC CCIS. The number of interface cards, memory cards and external cables varies. All other parts of the computers are identical, including internal cabling.

The basic version includes a:



- complete ND-500 CPU card crate with:
  - CPU
  - MMS
  - Cache
- Multiport Memory (MPM-5) with:
  - Controller
  - 3 ports
  - 1Mb RAM
- ND-100 card crate with:
  - CPU
  - Printer terminal
  - MMS/cache
  - 2 Megabytes RAM 2
  - Floppy-disk drive
  - Floppy-disk controller/formatter
  - Hard-disk controller
  - Hard-disk drive
  - ND-100/500 interface
  - Four-terminal interface (IF)
  - Line driver w/octobus
  - PIOC
  - GPIB

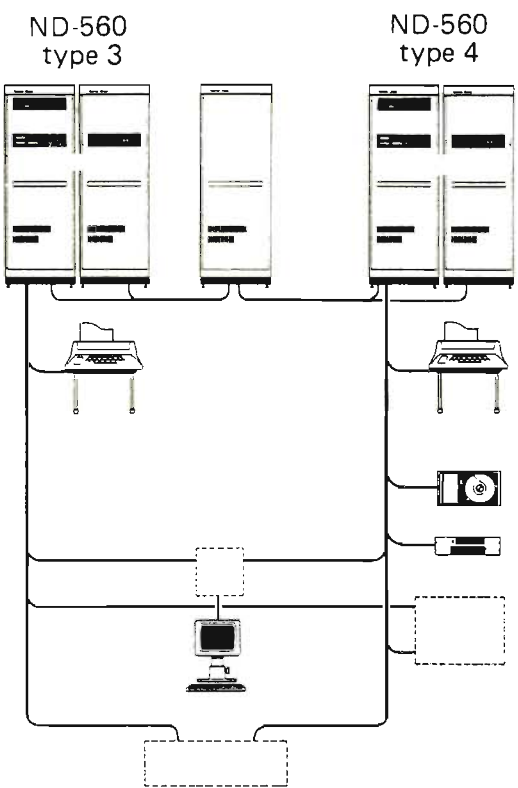
The computers are identified by the site number and the computer number. The two-cabinet ND-560 computers are numbered 1 through 4 from left to right. The number of computers on your site may be found in Chapter 2 of Book 3 in the section covering your site.

To identify the options present you must use two tables. The first gives you the computer type and the second shows which options are present in this computer type.

Use the site number (206-400R) and the computer number (1-4) to find the computer type (1-19) in table 1.

Computer number	Site number																		
	206	207	209	210	211	212	213	314	315	316	318	320	321	322	323	324	325	400M	400R
1	1	19	1	1	1	1	2	5	17	5	5	3	3	3	15	3	3	7	11
2		19						6	18	6	6	4	4	4	16	4	4	8	14
3		19							9						9				12
4		10																	13

Table 1. Computer types



Site 320 layout

The table shows, for example, that site 320 has two computers, one of type 3 and one of type 4.

Having the computer type (1-19), you may now enter table 2 and find the options present in this computer type. Except for the optional circuit card assemblies listed in table 2 the computers are identical.

If you have difficulty understanding the tables, try to follow the example given after table 2. You may also wish to refer to Book 3, figure 12, "Units in card crate A-5" and figure 16, "Units in card crate B-25".

Cabinet-Crate-Slot	Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A-05-05	Magtape controller	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-
-10	Four terminal IF	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-11	Paper tape read IF	-	-	-	x	-	x	-	x	x	-	-	x	-	-	-	-	-	-	-
-11	Paper tape punch IF	x	x	-	x	-	x	-	x	x	-	-	x	-	-	-	-	-	-	-
-14	2nd GPIB controller	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
-16	2nd PIOC	x	x	x	x	x	x	x	x	-	x	x	-	-	x	x	x	x	x	x
-17	3rd PIOC	-	x	-	-	x	x	x	x	-	-	-	-	-	-	x	x	x	x	x
-18	4th PIOC	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x
-19	5th PIOC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
A-05-22	Line printer IF	-	-	-	-	-	-	x	-	-	x	-	x	-	x	-	x	-	x	x
B-25-23	1MB RAM	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x
B-25-24	1MB RAM	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x

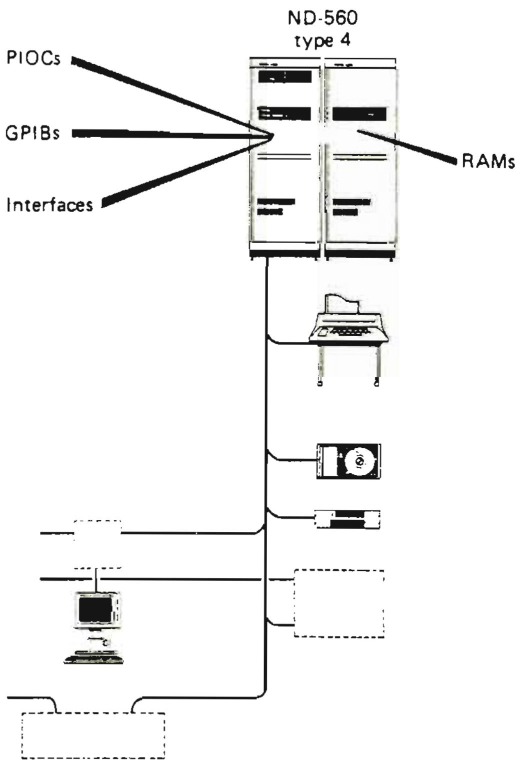
Computer type (see table 1)

LEGEND:

IF...............Interface
x ....Present
- ....Not present
1Mb RAM ND-382
Four-terminal IF.ND-362
GPIB ....ND-855 (General Purpose Interface Bus, interface to database system)

Line printer IF........ND-655
Magtape controller.....ND-557
Paper tape punch IF....ND-352
Paper tape reader IF...ND-351

Table 2. Options in the computers



In table 2 you will find that computer type 3 includes the second GPIB controller and the second PIOC.

Also, according to table 2, computer type 4 has a paper-tape reader interface, a paper-tape punch interface, the second GPIB controller and the second PIOC. Thus, the layout for site 320 can be summarized in the diagram at the left.

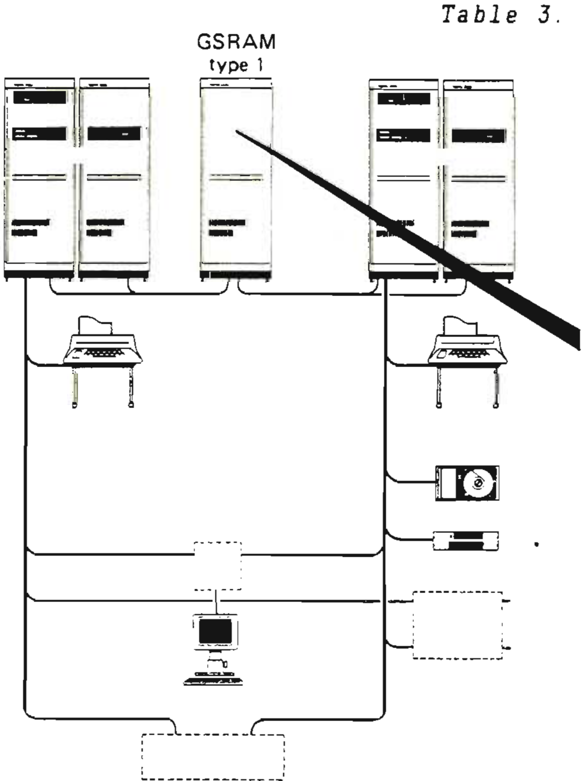
1.4.3 GLOBAL SHARED RANDOM ACCESS MEMORY (GSRAM)

In the following, please refer to Book 3, figure 19, "Units in card crate C-25".

The GSRAM is present only on sites with more than one ND-560. The GSRAMs exist in 4 versions (types). The basic version has ports for 2 computers, 1 Mb RAM and a controller. The other versions have additional RAM and - except on site 400M - additional ports.

Cabinet / Crate / Slot	Description	206	207	209	210	211	212	213	314	315	316	318	320	321	322	323	324	325	400M	400R
N/A	Basic GSRAM	-	x	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
C-25-09,	Port 3 Data	-	x	-	-	-	-	-	-	x	-	-	-	-	-	x	-	-	-	x
-10,	Port 3 Instr.	-	x	-	-	-	-	-	-	x	-	-	-	-	-	x	-	-	-	x
-12,	Port 4 Data	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
-13,	Port 4 Instr.	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
C-25-24,	1 Mb RAM	-	x	-	-	-	-	-	-	x	-	-	-	-	-	x	-	-	x	x

Table 3. Options in GSRAM



The table shows, for example, that site 320 includes only the basic GSRAM. The basic GSRAM includes only the cards not marked with an asterisk (*) in figure 19, Book 3. They are:

- MPM-5 controller C-25-1
- 4 MPM-5 ports C-25-(3, 4, 6, 7)
- Dynamic RAM 1 Mb C-25-25

1.4.4 FREE-STANDING PERIPHERALS

The basic ND-560 includes a hard disk, a printer terminal and a floppy-disk drive. The optional peripherals are listed in table 4.

To identify optional peripherals, determine the computer type (1-19) using table 1, then use this number to enter table 4.

You determined earlier, for example, that site 320 contained computer types 3 and 4. Table 4 shows that computer types 3 and 4 share the first data terminal.

Description		Computer type (see table 1)																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1st data terminal	(ND-242E)	x	x	x[2]	x[2]	x[2]	x[2]	x[2]	x[2]	x[2]	x	x	x	x	x	-	x[2]	-	x[2]	-
2nd data terminal	(ND-242E)	-	-	-	-	-	-	-	-	-	x	x	x	x	x	-	-	-	-	-
3rd data terminal	(ND-242E)	-	-	-	-	-	-	-	-	-	x[1]	-	x[2]	-	x[2]	-	-	-	-	-
1st magtape drive	(ND-529)	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-
2nd magtape drive	(ND-529)	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-
Magtape formatter	(ND-536)	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-
Line printer	(ND-432)	-	-	-	-	-	-	x	-	-	x	-	x	-	x	-	x	-	x	x
Paper-tape punch	(ND-303)	x	x	-	x	-	x	-	x	x	-	-	x	-	-	-	-	-	-	-
Paper-tape reader	(ND-301)	-	-	-	x	-	x	-	x	x	-	-	x	-	-	-	-	-	-	-

LEGEND:

x Present
- Not present

[1] Shared by two type 19 computers on the site
[2] Shared with another computer on the site

Table 4. Optional peripherals

2 HARDWARE CONFIGURATION AND DESCRIPTION

2

2.1 GENERAL

The Norsk Data part of the DPS consists of ND-560 computers. Where there are two or more computers on a site there is also a Global Shared Random Access Memory (GSRAM) Figure 1 shows a large configuration which has two or more ND-560 computers. A small configuration is shown in figure 2 and described in the accompanying text.

Each ND-560 computer in a large configuration has direct access to both database systems. Access to communication lines and display subsystems are provided through the communication interface cabinet. An AB switch makes it possible for two ND-560 computers to share a terminal.

Refer to section 2.2 of this book for more information about the GSRAM and to section 2.3 for details about the ND-560 computer.

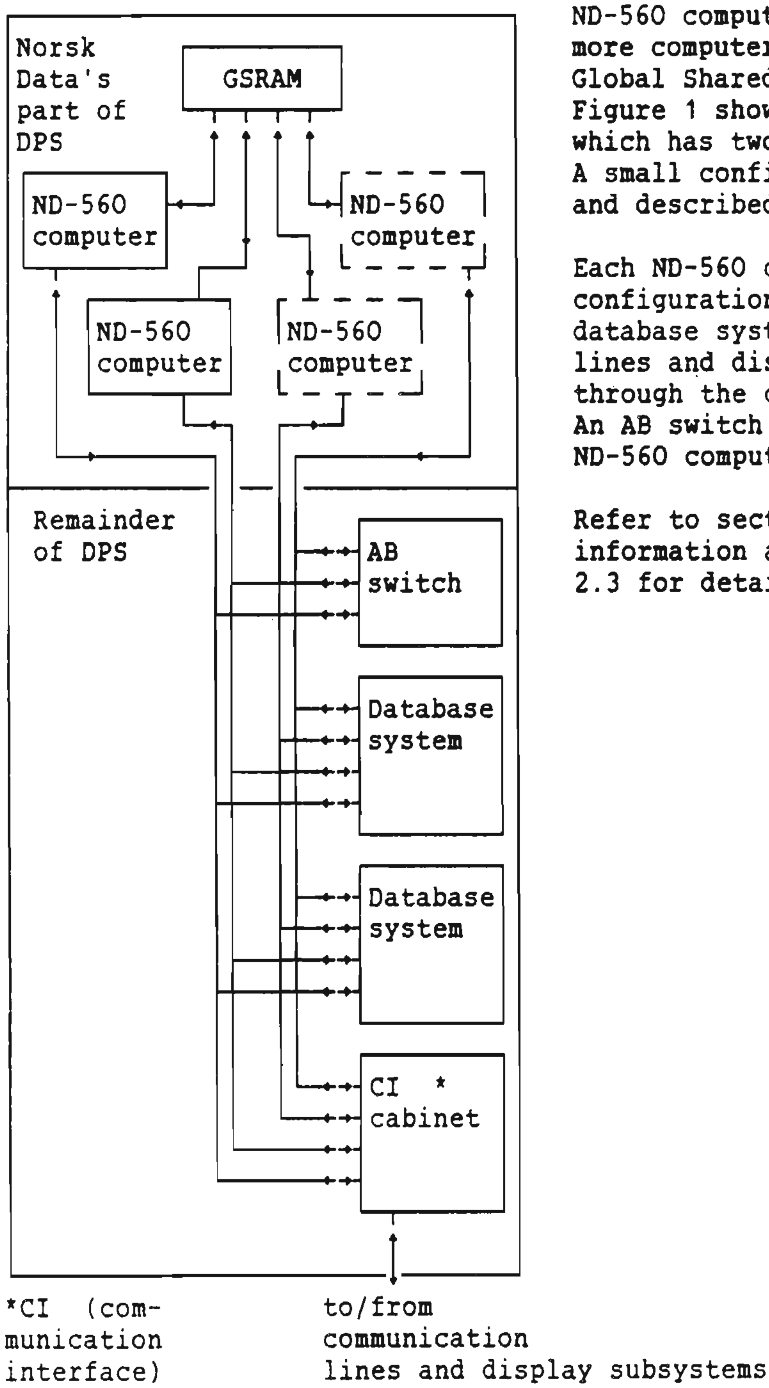


Figure 1. Large DPS configuration

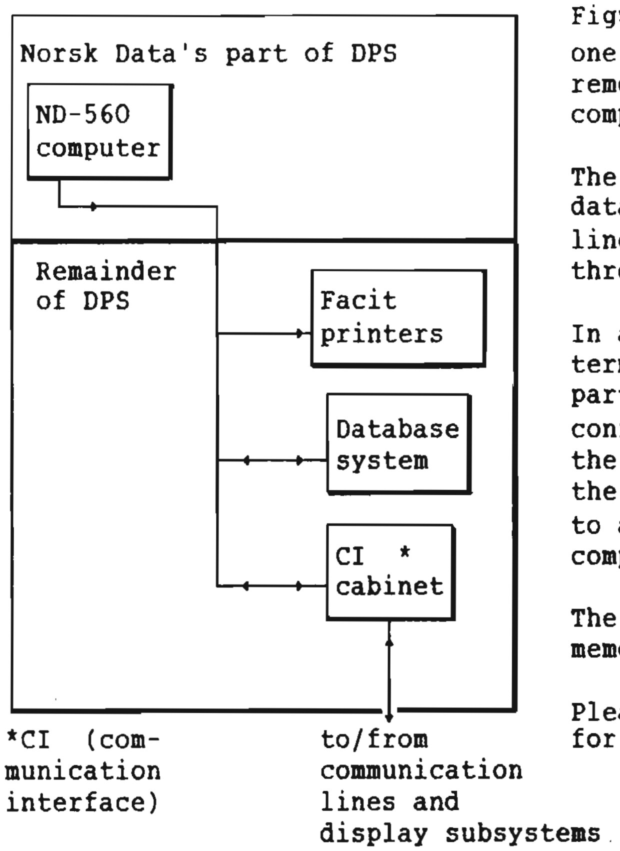


Figure 2. Small DPS configuration

Figure 2 shows a small configuration with one ND-560 computer, one database system and remote paper-tape readers. Only the ND-560 computer is dealt with here.

The ND-560 computer has direct access to the database system. Access to communication lines and display subsystems is provided through the communication interface cabinet.

In a large configuration, there is a printer terminal and possibly a line printer as part of the ND-560 computer. In a small configuration there are no line printers in the ND-560 but there are 4 Facit printers in the remainder of the DPS which are connected to a four-terminal interface in the ND-560 computer.

The ND-560 computer has a local shared memory of 1 Mbyte.

Please refer to section 2.3 of this book for more about the ND-560 computer.

2.2 GLOBAL SHARED RANDOM ACCESS MEMORY (GSRAM)

The GSRAM is an intelligent memory bank, complete with cabinet, power supply and interfaces (ports). The GSRAM is only found in DPSs with two or more ND-560 computers.

It can hold shared data or act as a communication buffer between ND-560 computers. The ND-100 CPU in the ND-560 computer may also run programs in the GSRAM.

On request, the GSRAM can grant two consecutive memory cycles to the same CPU (semaphore cycles). This is an important feature for communication between CPUs.

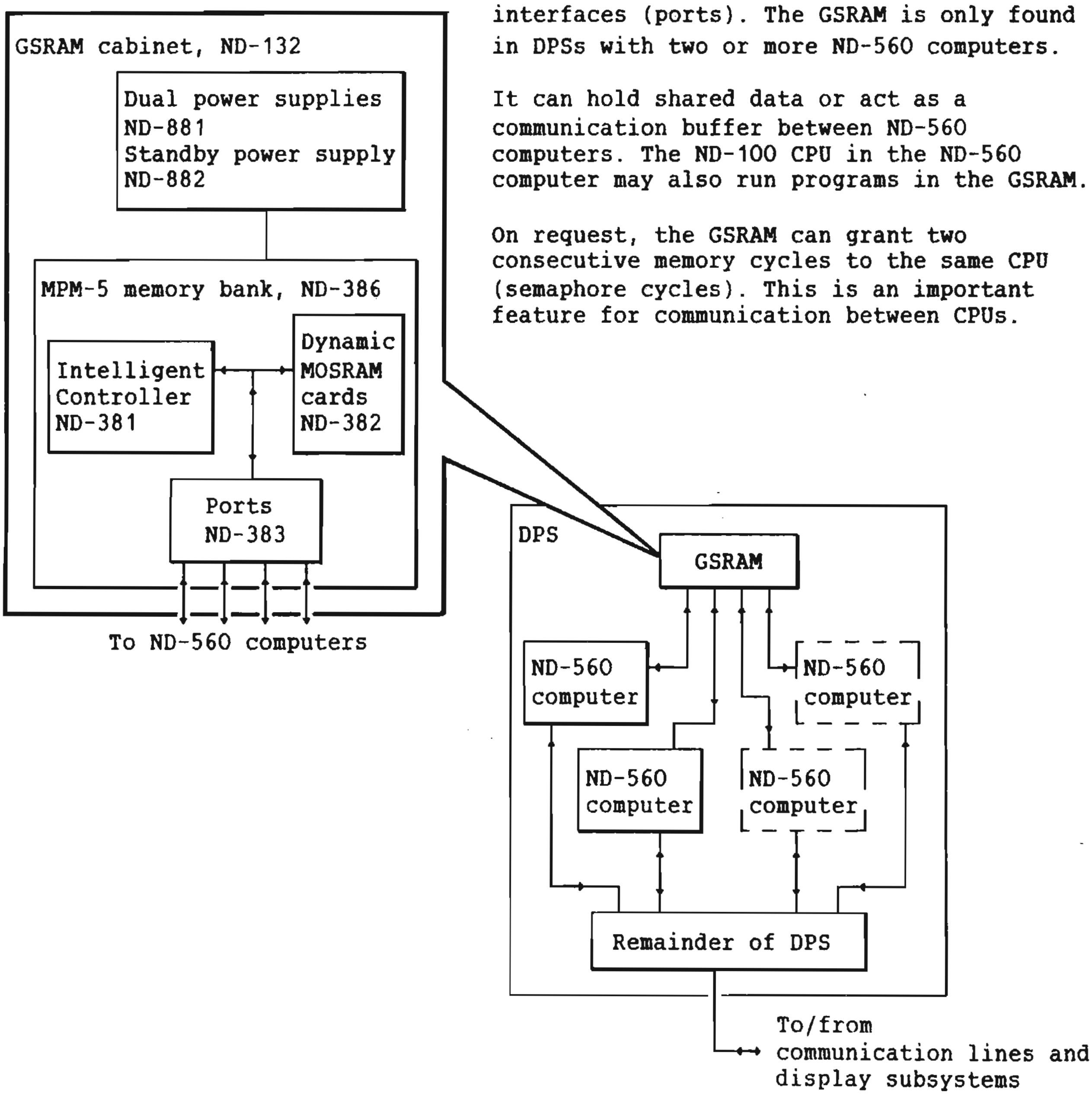


Figure 3. GSRAM overview

Each ND-560 computer requires 2 ports, one for the ND-100 memory channel and one for the ND-500 data memory channel. The GSRAM has room and cables for a third port per ND-560 computer; the ND-500 instruction memory port. There are up to two RAMs (2 Mb) in the GSRAM.

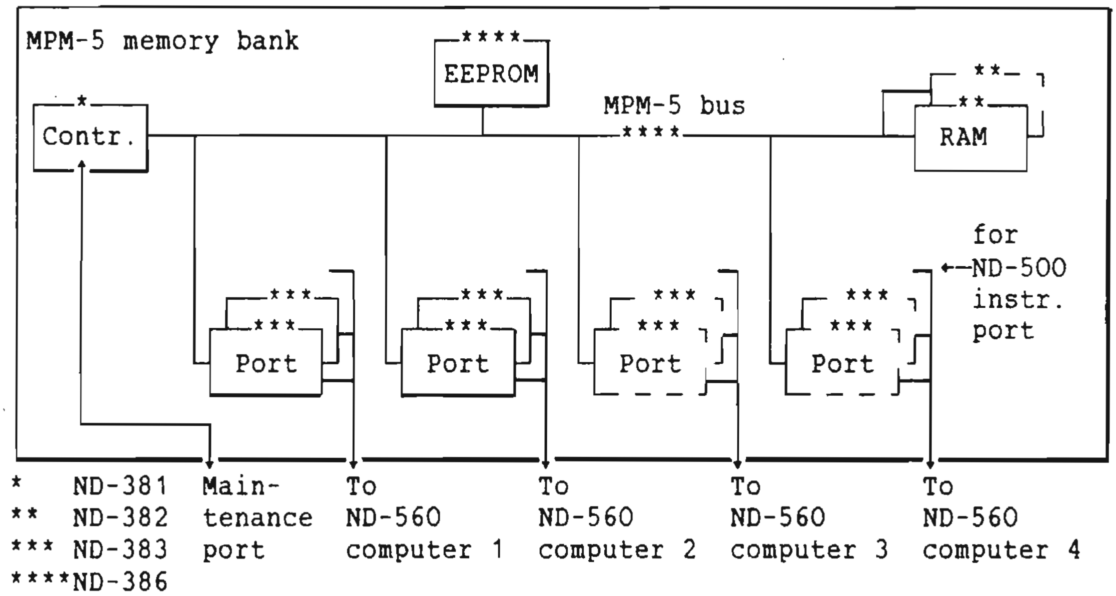


Figure 4. GSRAM

Access time on the port (from request to data-ready) is 400 ns for read and 120 ns for write. The transfer rate on the MPM-5 bus is 17 Mbytes per second.

The various ports and RAMs may have different functions, such as how they interpret an address (interleave) and which addresses they serve. This information is stored in an EEPROM on the mother board (backwiring). When a port or a RAM is replaced, this information is automatically transferred to all ports and RAMs.

In addition to read and write operations, MPM-5 corrects 1-bit errors and saves error information. From a terminal on the MPM-5 maintenance port, an operator can run internal tests and check or correct configuration parameters such as port functions.

A normal read operation is performed in the following manner: a port receives a request and an address from a computer and passes on the request on a private line to the controller; the controller grants the request and passes it on to the RAM when the MPM-5 bus is free; the port then puts the address out on the MPM-5 bus; the RAM serving this address checks the error correction code of the 32-bit data word in this address and returns the word to the port.

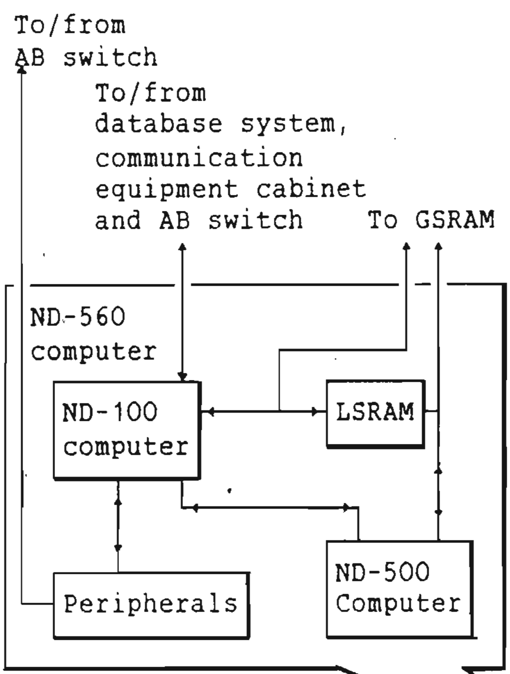
In a write operation the computer does not have to wait for the operation to be completed. The data and the address are buffered on the port and passed on to the RAM when the bus request is granted by the controller. The RAM adds an error correction code to the data before it is stored.

2.3 ND-560 COMPUTER

"ND-560 computer" is a common name for each of the 38 computer systems used in the NEC CCIS DPSs. Although there are 19 different versions of the ND-560 computer, they are all standard commercial products. The only difference between the versions is the number of optional plug-in units present. This section describes an ND-560 computer with all options present.

In the following, it is important to know that the term ND-100 means both Norsk Data's 16-bit CPU card and the 16-bit computer concept including a large number of cards and other equipment. The term ND-500 means Norsk Data's 32-bit computer.

The ND-560 computer has four main parts, the ND-100 computer, the peripherals, the ND-500 computer and the LSRAM (MPM-5). ND-560 computer input/output goes either through the ND-100 to the communication equipment cabinet or via the GSRAM to another ND-560 computer.



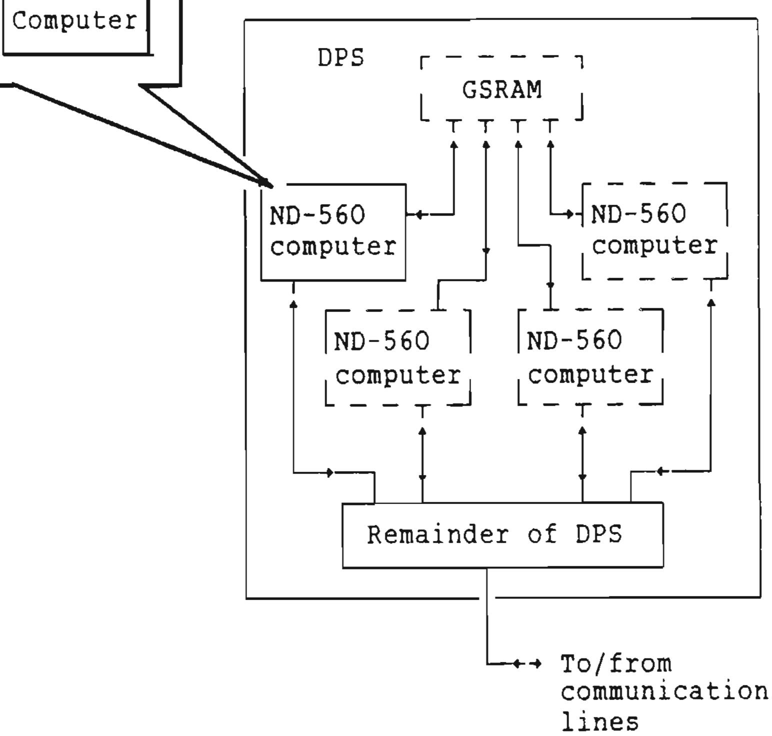


Figure 5. ND-560 computer overview

In figure 6 the ND-560 computer is shown with the equipment organized according to which cabinet it is located in.

32-bit ND-560/1 CPU

The ND-500 cabinet is shown on the right with the 32-bit CPU in the lower part.

LSRAM

The LSRAM in the upper part of the block is where this 32-bit CPU shares data with the 16-bit CPU in the ND-100 cabinet.

16-bit ND-100 CPU

The ND-100 cabinet is in the middle with the CPU (bottom left), interfaces, controllers and some peripherals (bottom right).

Peripherals

The freestanding peripherals such as the magnetic tape unit and the printer terminal are shown at the bottom and on the left and are all connected to the ND-100 cabinet.

ND-number

At the top of each block there is an ND-xxx number. This number refers to the part of section 2.4 that describes the item.

Input/Output

The cards in the ND-100 cabinet communicate via the ND-100 bus. The ND-100 CPU (bottom left) controls the bus and supervises all others connected to it. The ND-100 CPU does this by reading from - or writing in - certain registers on the other cards. Each register has a unique address set by switches on the card. Any card on the bus may interrupt the CPU and thereby initiate a control or supervision function.

Communication

All communication to the display subsystems and data networks goes via the PIOC(s) (Cabinet A, top right) and the communication equipment in the CI cabinet.

GSRAM

Connection to the GSRAM (optional) is made via the LSRAM, Cabinet B (top). The Memory is organized so that the ND-100 local memory has the lowest addresses, the LSRAM the next to lowest, the GSRAM next to highest and the internal PIOC memory the highest addresses. Addresses are selected by switches or soft switches (EEPROMS).

Memory channels

Cards on the ND-100 bus may access all memory through memory channels with 16 data bits. The ND-560/1 CPU (bottom right) has 32-bit memory channels and can access only the LSRAM and the GSRAM.

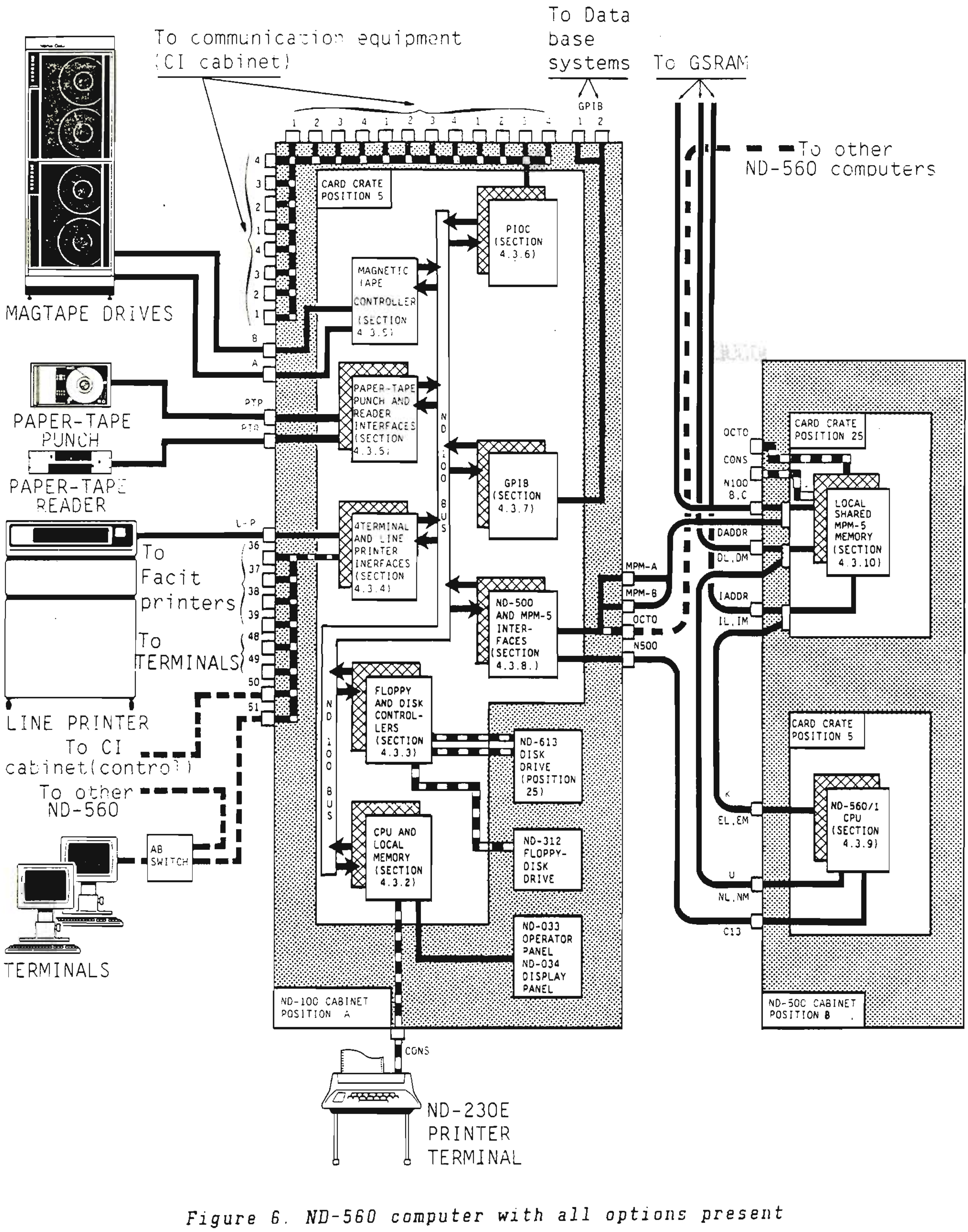


Figure 6. ND-560 computer with all options present

2.4 INDIVIDUAL UNITS IN CABINET A

The following sections give a short description of each hardware unit in a standard computer and GSRAM. In addition, the physical position of each unit is shown.

2.4.1 ND-132, 11-MODULE CABINET, ND-100/ND-500

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-30.008	*ND-100 Hardware Maintenance Manual*

The ND-132 cabinet contains the following main parts:

- power distribution unit
- power control panel
- six fans at the top

The power distribution unit is positioned at the bottom of the cabinet. This unit is equipped with the main power switch and circuit breakers. The six fans at the top of the cabinet blow the air out of the cabinet. The power control panel is positioned at the back of the cabinet and has different control connections to the main power unit.

Physical dimensions:

- width: 600 mm
- height: 1688 mm
- depth: 910 mm

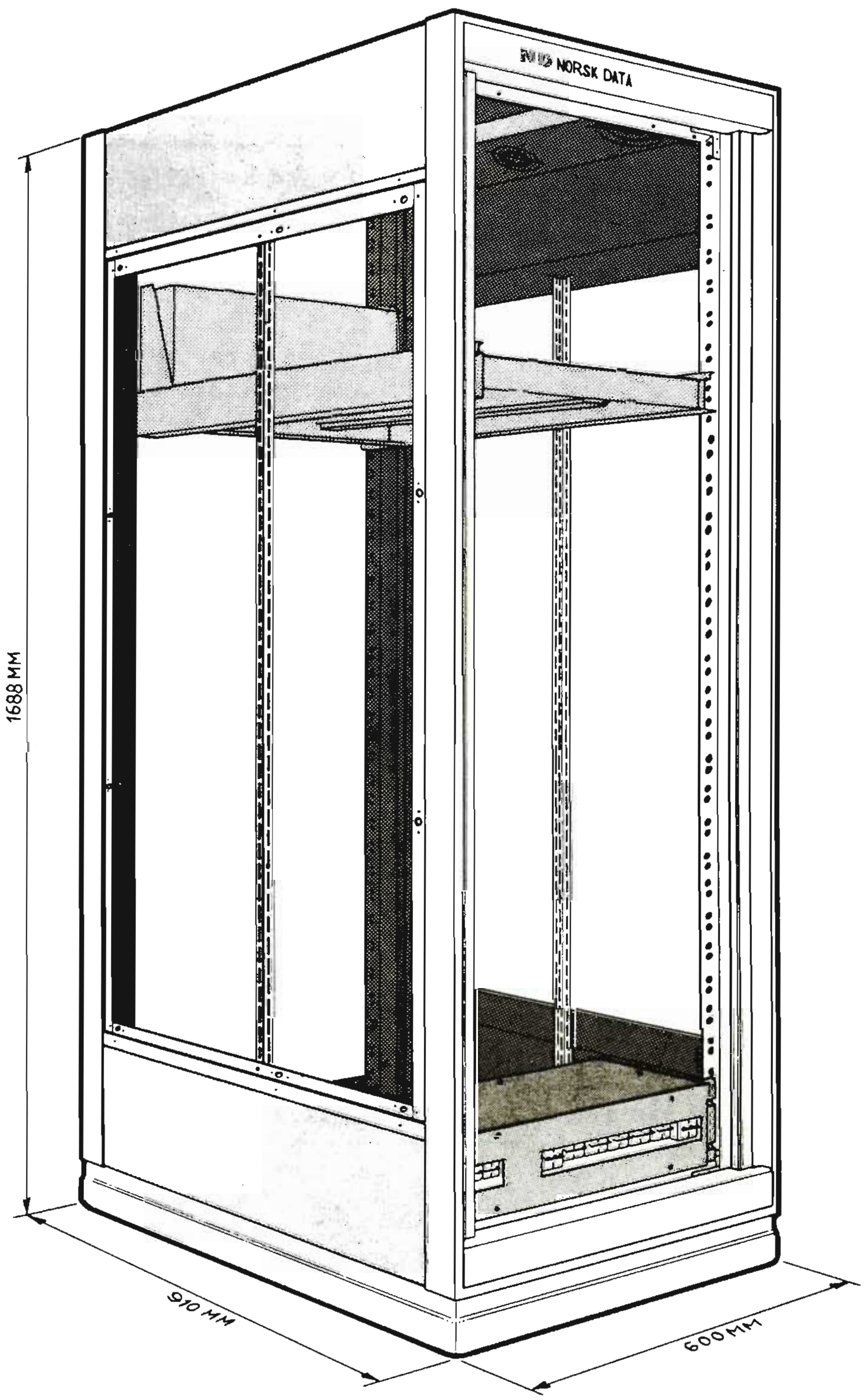


Figure 7. The 11-module cabinet for ND-100/ND-500

2.4.2 ND-033, OPERATOR PANEL FOR ND-100

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-06.015.02	*ND-100 Functional Description*

The Operator Panel is one of the possible communication links between the operator and the ND-100 computer.

THE PANEL LOCK KEY

The Panel Lock Key has three positions:

LOCK

When placed in this position, the operator panel control switches are disabled. This is the normal position for an operating machine. AC power is applied to the computer.

ON

In this position, the panel switches can be operated. AC power is applied to the computer.

STANDBY

In this position, the AC power supply is disabled. Standby voltage is applied to memory and display.

NOTE

Automatic restart may be initiated after power failure only if the lock key is set to the LOCK position.

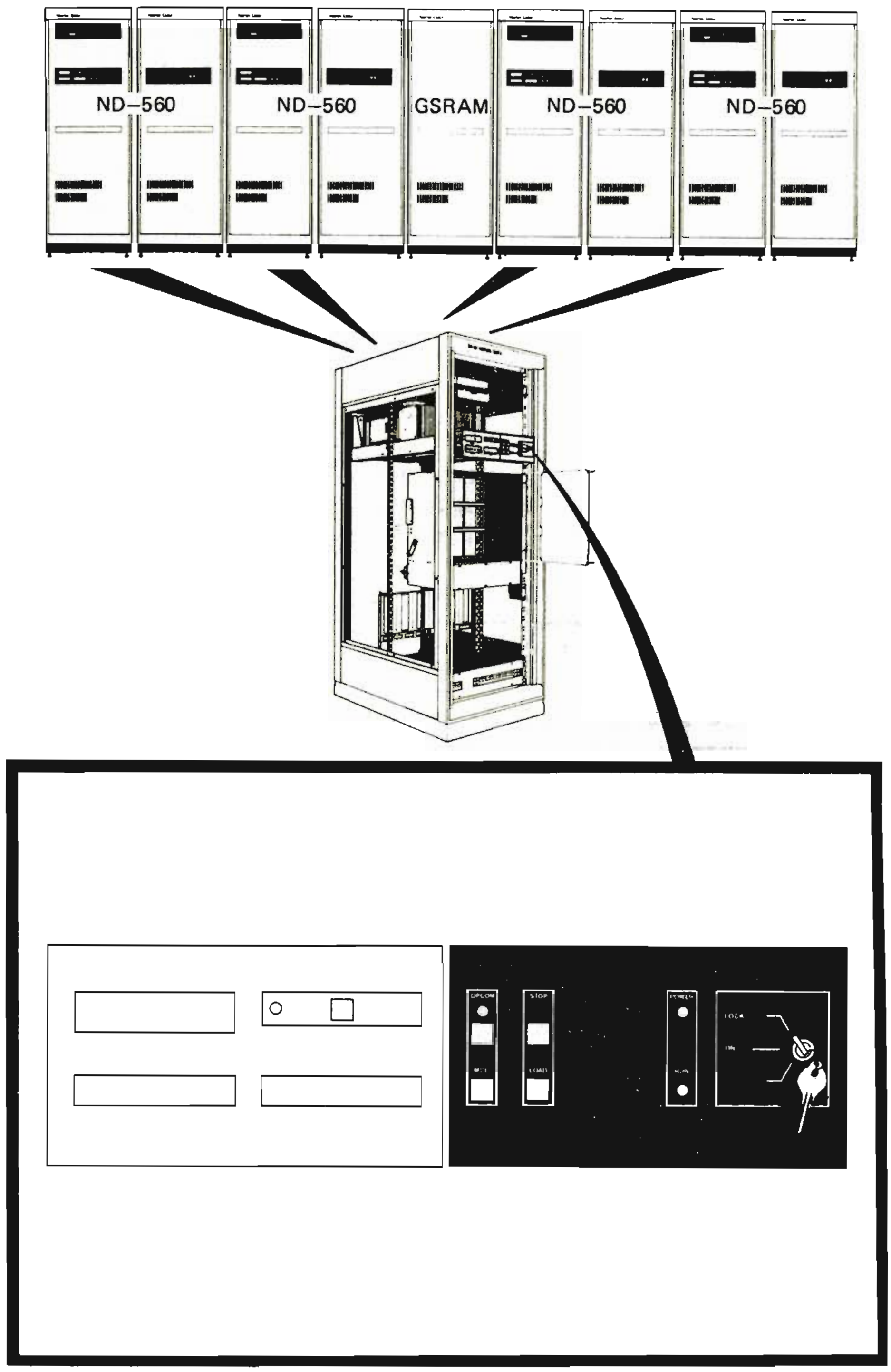


Figure 8. Location of the operator panel

BUTTONS AND INDICATORS

OPCOM — Indicates that the Operator's Communication Microprogram is running. This light may also be lit in RUN mode by pressing the OPCOM button. (OPCOM and RUN light at the same time).

The OPCOM light will always be lit when the computer is not running. When OPCOM and RUN are lit at the same time, input from the printer terminal only interacts with the OPCOM microprogram. Output to the printer terminal may come from OPCOM or the active program.

MCL (MASTER CLEAR) — When activated, the microprogram initiates a CPU self-test and applies Master Clear to various parts of the CPU and the input/output system. The STOP mode is entered and the OPCOM indicator lights up.

> *NOTE*
>
> *Pressing the MCL button will destroy the running program.*

STOP — Pressing this switch causes the CPU to enter STOP mode and to turn the OPCOM light on. The instruction currently being executed is completed before the stop mode is entered. The program continues when a key is pressed on the printer terminal.

LOAD — When this switch is pressed, a microprogram sequence is initiated; that is, a load sequence is initiated from the device indicated by the Automatic Load Descriptor (ALD).

POWER ON — Indicates that +5 Volts is present in the rack.

RUN — Indicates that the CPU is running.

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2.4.3 ND-034, DISPLAY PANEL FOR ND-100

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-06.015.02	*ND-100 Functional Description*

Display panel

The ND-100 computer display panel (in cabinet A) is controlled by an independent microprocessor which is located on the Memory Management System card. The microprocessor receives data to be displayed from the CPU microprogram and from a digital clock driven by the system RT-clock on the CPU board. The cache hit-rate and the degree of utilization of the CPU are also monitored by the display microprocessor.

The ND-034 can be used only if the machine has the Memory Management System card installed. In addition to the Memory Management System and cache memory, this card contains a display processor. The display processor controls the activity on the display. The display panel may be placed outside the cabinet (in another room for instance). It, therefore, has an 'OPCOM' button which has the same function as the corresponding button on the operator panel; that is, setting the CPU in Operator's Communication Mode.

Operated from the Printer terminal

The display is operated from the printer terminal in OPCOM mode. Hence the display shows the result of the last OPCOM command. The information is updated at a rate of about 1 kHz, while the keyboard gives the information only once at the time the command is given. Thus, the display is continuously updated even after leaving the OPCOM mode.

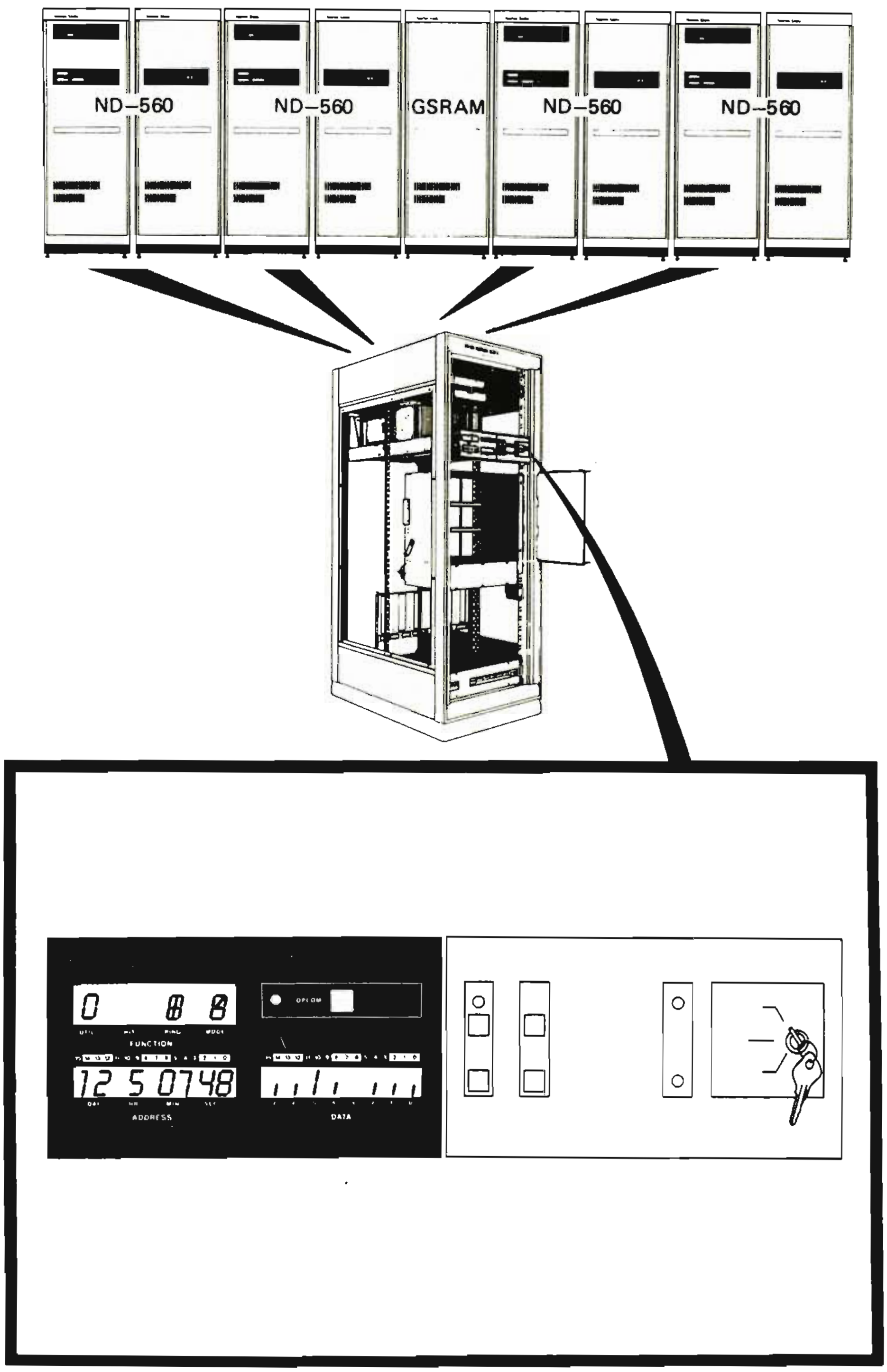

Figure 9. Location of the display panel

Debugging

The display makes debugging and service easy for maintenance personnel. However, it is also of great value to the operator running a SINTRAN III system. A trained eye can see at a glance if the system works properly. This 'all-is-well' indication is impossible without the display.

In the basic state, the following information is displayed:

- Utilization (= not idle on level 0)
- Hit rate in cache
- Program rings entered (with afterglow)
- Interrupt and paging status indications (with afterglow)
- Active levels (with afterglow)
- Copy of system calendar/clock

The active level indication is invaluable for checking whether SINTRAN is working properly.

THE DIFFERENT DISPLAY FUNCTIONS

DATA field

The DATA field displays information in binary or octal format. The possible contents are:

Active Levels (binary only)

The active levels in the computer are shown. There are 16 positions, one for each level. The display is provided with afterglow so that it is possible to observe a single instruction on a program level.

Register Contents

If a "Register Examine" is done, the contents of the register are shown.

Memory Contents

When a "Memory Examine" is done, the contents of the examined cell are shown.

Bus Information

If the BUS command is given to display memory access on the ND-100 bus, the data present on the bus is shown and updated continually.

ADDRESS Field Calendar Clock	A clock that tracks the operating system clock is shown displaying the day, hour, minute and second. This clock is adjusted by the 'UPDATE' command under SINTRAN III. Under the load procedure, this clock will be read by the operating system and used as the system clock. The clock is also connected to the stand-by power and remains correct even in the case of power failure.
Current Program Counter	The "Register Examine" command also indicates the current program counter.
Memory Address	The "Memory Examine" command also gives the address of the memory location being examined.
FUNCTION Field	The FUNCTION display shows which operator command is actually displayed in the ADDRESS and DATA fields. After initialization (Master Clear), if no specific command has been given, utilization, hit rate, ring, and status information are presented.

2.4.4 ND-055, 20-SLOT CARD CRATE FOR ND-100

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-06.014	*ND-100 Reference Manual*

The card crate positions are numbered from 0 to 23. Positions 0 and 23 are used for bus terminations. Position no. 2 is not used. At the back of the crate there are 3 plug rows, called A, B and C. The C-plug row is the main ND-100 bus and consists of a backplane print with the different interconnections and power distributions. The A and B plug rows are used for I/O connections and special connections between cards.

- **width: 440 mm**
- **height: 555 mm**
- **depth: 309 mm**

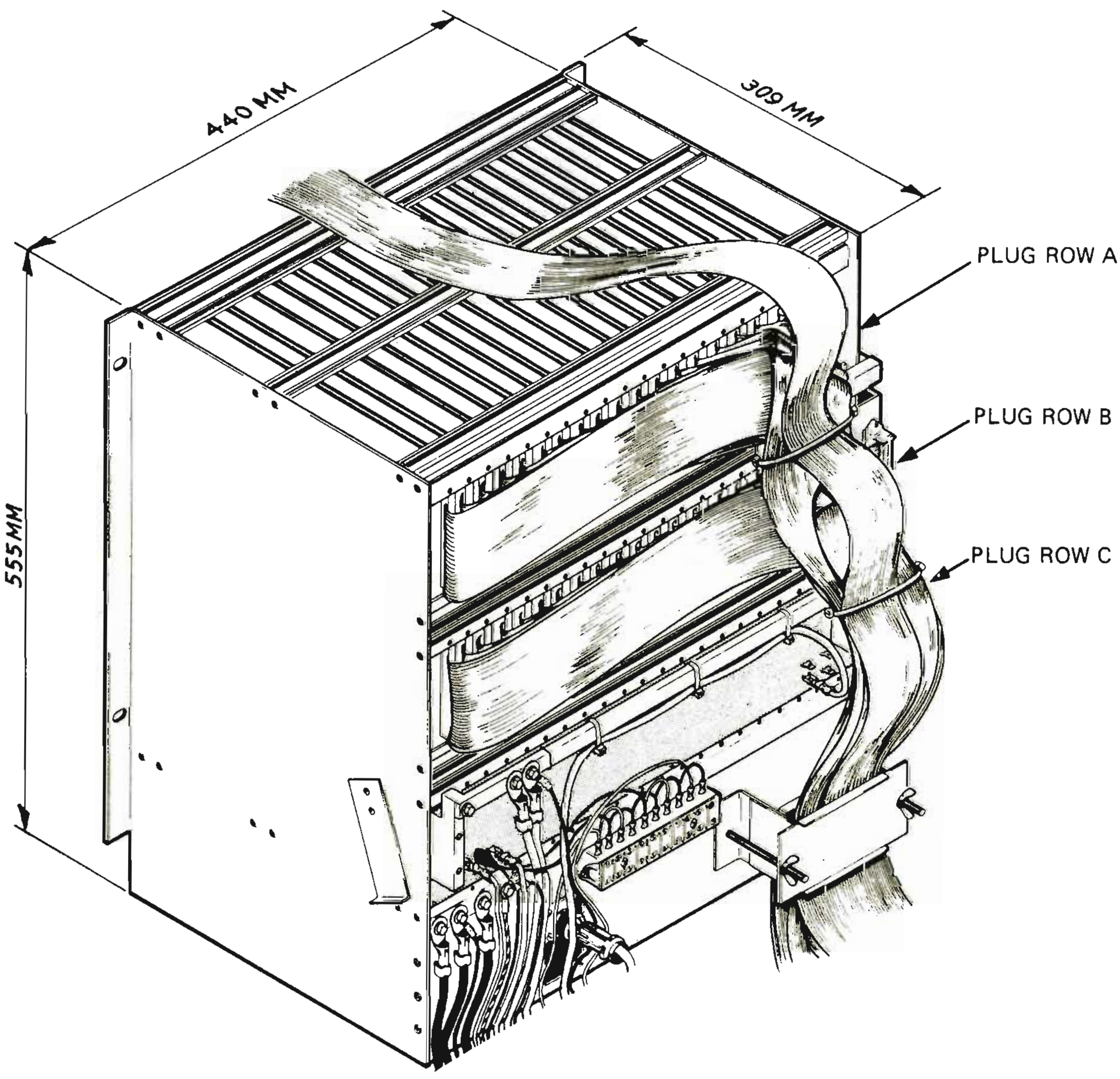

Figure 10. The 20-slot card crate for ND-100

2.4.5 ND-100 CX, CPU CARD FOR ND-100

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-06.015.02	*ND-100 Functional Description*

INTRODUCTION

The ND-100 is a 16-bit, general purpose single-board computer. The maximum address space is 64K words (128 Kbytes) without the Memory Management System (MMS). With the MMS card plugged in, the address space is 16M words. The ND-100 CPU runs the operating system SINTRAN III.

FUNCTIONAL MODULES

Central processing module

In addition to the CPU, the CPU module contains:

- A real-time clock
- A terminal interface with switch-selectable speeds, 50-9600 bps
- Power fail detection and automatic restart circuits

Processor

The ND-100 CPU is controlled by a microprogram. The following features are implemented in the microprogram:

- All instructions
- Operator communication
- Built in test routines
- Bootstrap loaders
- The address arithmetic

This program is stored in a 4K x 64 bits Programmable Read Only Memory (PROM). This memory is called the microprogram control store.

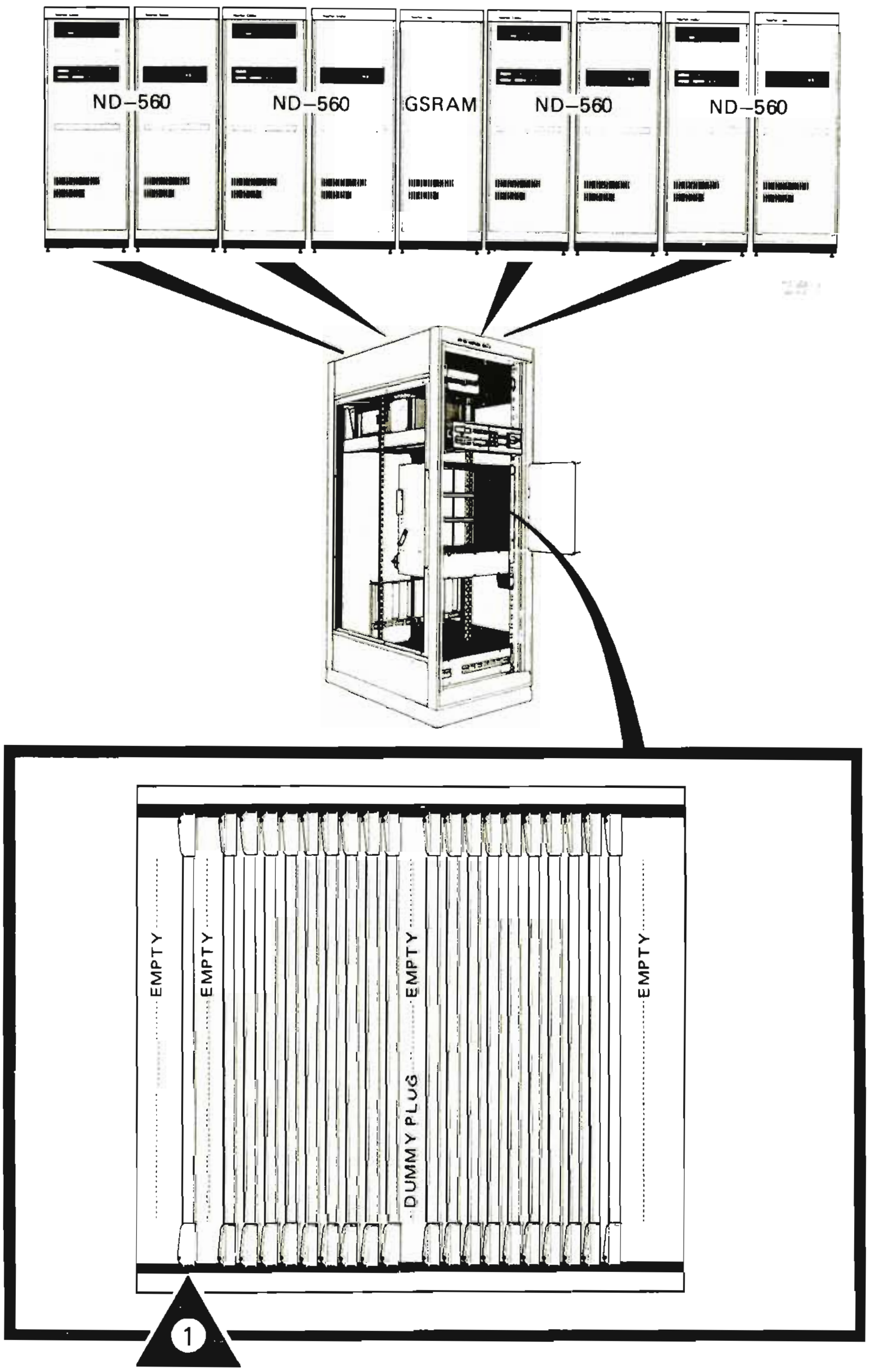

Figure 11. The location of the ND-100 CPU

Map PROM	Bits 6 - 15 of the machine instruction word are used to address this PROM. The output is loaded into the microprogram sequencer which uses it as the address to the microprogram control store.
Microprogram sequencer	The microprogram sequencer has a built-in stack and can do microbranching, micro-subroutines and repetitive microinstruction execution.
Pipeline register	The pipeline register is placed at the output of the microprogram control store. The execution of a microinstruction is performed by activating the different control lines at the output of the pipeline register. While the current microinstruction is executing, the next will be ready at the pipeline input. Most of the CPU elements are Large Scale Integration (LSI) or Medium Scale Integration (MSI) chips, which are directly controlled by the bits from the pipeline register.
ALU unit	Some of the output lines from the pipeline register are used to control the Arithmetic Logic Unit (ALU). The ALU performs different arithmetic, logic and manipulative operations on data in the working registers or from the internal data bus.
Register file	The ND-100 CPU has 16 program levels corresponding to 16 register blocks. These blocks together are called the register file. Each register block consists of 16 registers (16 bits). The 8 upper registers are the scratch registers used by the microprogram only. Registers 0 - 7 are the working registers consisting of a status register, program counter and 6 other registers used in different addressing modes and in floating point operations.
Interrupt system	The ND-100 system has 16 priority interrupt levels corresponding to the 16 program levels. The interrupts can be divided into two main categories: - External/Internal hardware interrupts on levels 10 - 15. - Microprogram controlled interrupts on all levels.

Interrupt controller

The interrupt controller takes care of all interrupts on levels 10 - 15. Based upon these interrupts, the controller gives out a 5-bit vector specifying the interrupt. This vector, together with a fixed code, go into the interrupt address buffer. The interrupt buffer gives a branch address to the microprogram control store via the microprogram sequencer to start the interrupt program. The program level is controlled from two 16-bit registers:

- PIE = Priority interrupt enable

- PID = Priority interrupt detect

Context switching

The running program level register block is placed in the ALU. When an interrupt on a higher level occurs, the working register part (X,T,A,L,B,P,D and the STS registers) will be written to the register file. The working registers of the new program level will be copied into the ALU register block. The eight scratch registers will not be saved under a level change. The switching takes 5 microseconds.

Daisy chain system

Input/Output cards on the same interrupt level will be given priorities depending on their positions: Nearest CPU - highest priority.

Bus control unit

The ND-100 bus is controlled by the CPU-card. All requests for the ND-100 bus and allocation of this bus are handled here.

Interconnections

The ND-100 CX CPU card has three connectors:

- The A-connector (64 pins) has connections to the printer terminal and to the operator panel.

- The B-connector (64 pins) has connections to the MMS card with cache memory (16-bits virtual address and 16-bits data).

- The C-connector (96 pins) is the connection to the ND-100 bus.

2.4.6 ND-032. MEMORY MANAGEMENT SYSTEM CARD FOR ND-100 WITH CACHE BUFFER MEMORY

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-06.015.02	*ND-100 Functional Description*

The Memory Management System (MMS) card is necessary for running the SINTRAN III/VS (Virtual Storage) operating system. The SINTRAN III/VS operating system includes:

- 64K words (128 Kbytes) virtual address range for each user, independent of physical memory capacity
- Dynamic allocation/reallocation of programs in memory
- Memory protection

The Memory Management System may be divided into two systems:

- The paging system
- The memory protection system

Paging system

The paging system maps a 16-bit virtual address (describing a user's 64K word virtual storage) onto a 19-bit physical address, thus extending the physical address space to 512K words. The paging system also has an extended mode which handles physical memory space up to 16M words (32 Mbytes). This mode gives a 24-bit physical address.

The implementation of paging is based on dividing physical memory into 1K word pages which, under operating system control, are assigned to active programs. Four page tables of 64K words each, hold the physical page numbers assigned to an active program. These tables are located in high-speed registers, reducing paging overheads to practically zero.

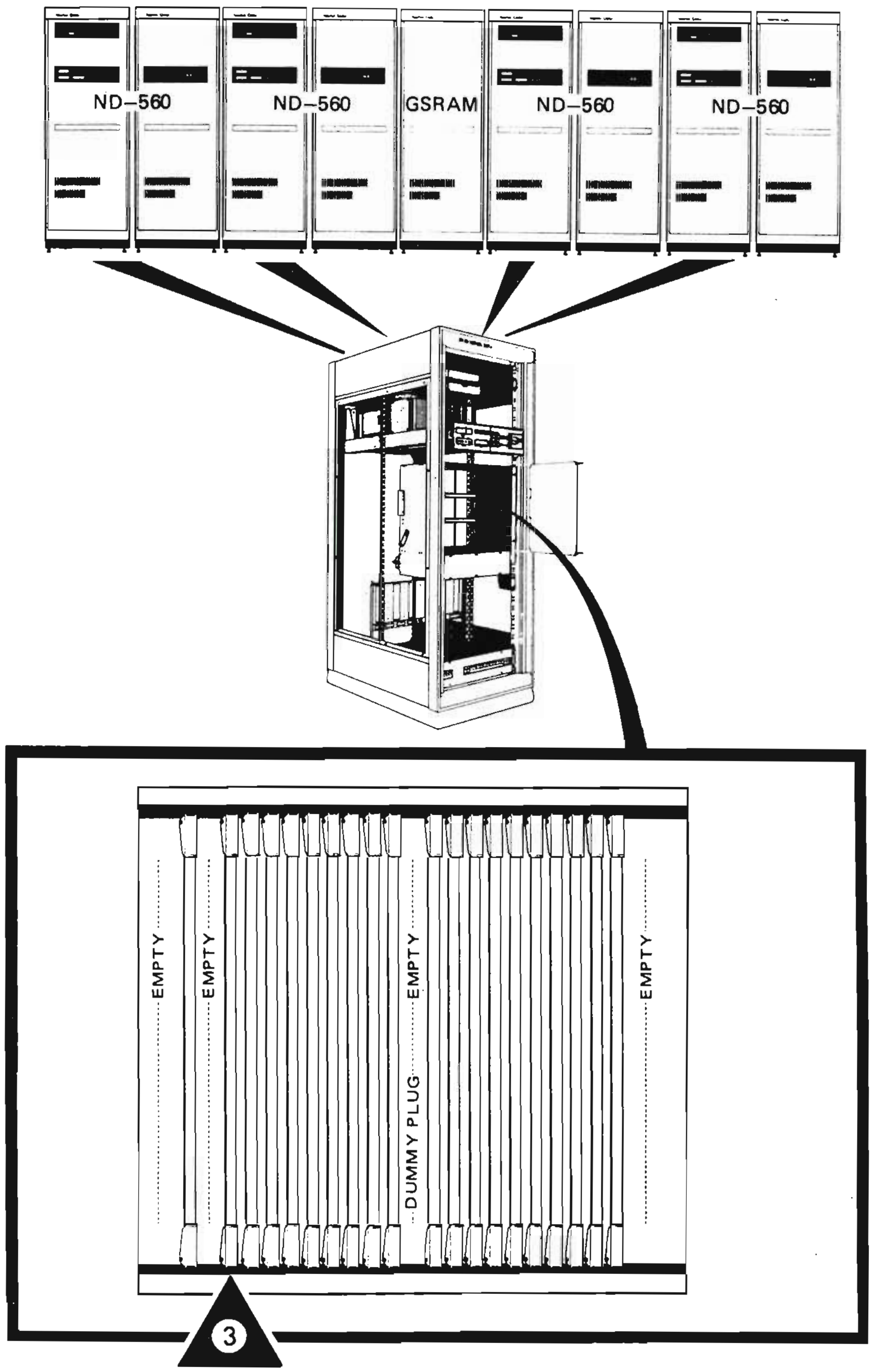

Figure 12. Location of the memory management module

Memory Protection System

The Memory Protection System may again be divided into two subsystems

- The Page Protect System
- The Ring Protect System

The Page Protect System allows for a page to be protected from read, write or instruction-fetch accesses or any combination of these.

The Ring Protect System places each page and each user on one of four priority rings. A page on one specific ring may not be accessed by a program that is assigned a lower priority ring number. This system is used to protect system programs from user programs, the operating system from its subprograms and the system kernel from the rest of the operating system.

Cache Memory

The cache is a memory buffer located between the main memory and the CPU. The contents of the cache will generally be a copy of the data most recently processed.

The idea behind cache is that recently used data will soon be needed again and should, therefore, be readily available to the CPU in order to increase operating speed.

The presence of cache memory reduces average memory access time significantly. Cache is a high-speed bipolar memory with a cycle time of 150 nanoseconds. Access time is virtually zero because it works in parallel with the microprogram.

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2.4.7 ND-065, ND-100/500 INTERFACE CARD

For detailed description, refer to the following manual(s):	
No.:	*Title:*
ND-05.011	*ND-500 Hardware Description*

INTRODUCTION

The communication between ND-100 and ND-500 is based upon two interface modes - LOCKED and UNLOCKED. In the LOCKED mode, the ND-560 CPU has control of the communications. In the UNLOCKED mode, the ND-100 CPU has control of the communication.

TEST mode can be entered only while in the UNLOCKED mode. In the TEST+UNLOCKED mode, the ND-100 CPU controls the interface and output to the ND-560 CPU is disabled.

REGISTERS

Memory Address Register

The Memory Address Register (MAR) is a 24-bit register. It points to locations in the ND-100 local memory. It is the address pointer within the mailbox where the next data transfer between ND-100 and ND-500 shall take place. The data transfers are executed via Direct Memory Access (DMA).

Limit registers

The Lower Limit Register (LLR) and the Upper Limit Register (ULR) define the limits in the mailbox. They are actually a command block for the ND-500 in the ND-100 local memory.

Data register

This is a 16-bit register. It acts as a transfer register between the ND-500 and the ND-100 memory in DMA transfers from ND-500 to ND-100. In DMA transfers from ND-100 to ND-500, the DATAX register is used as an intermediary register.

TAG-in/TAG-out registers

TAG-in and TAG-out registers are located on both interfaces. These registers are used to control the communication. The TAG-bus carries the two-way comunication between the ND-500 and ND-100 interfaces. The TAG-in register controls the interface it is on and the TAG-out register is used to transfer control information to the other interface.

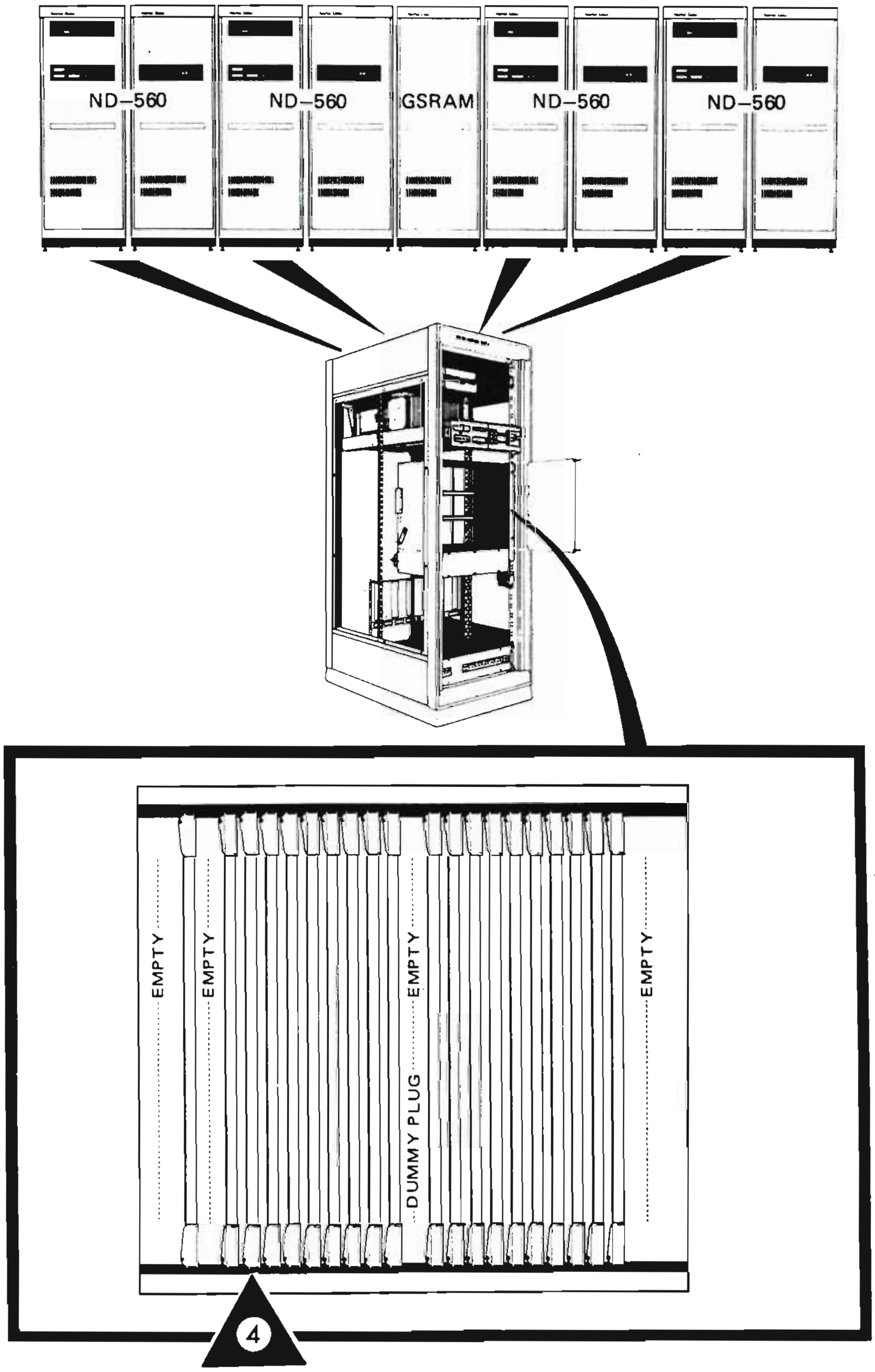

Figure 13. Location of the ND-100/500 interface card

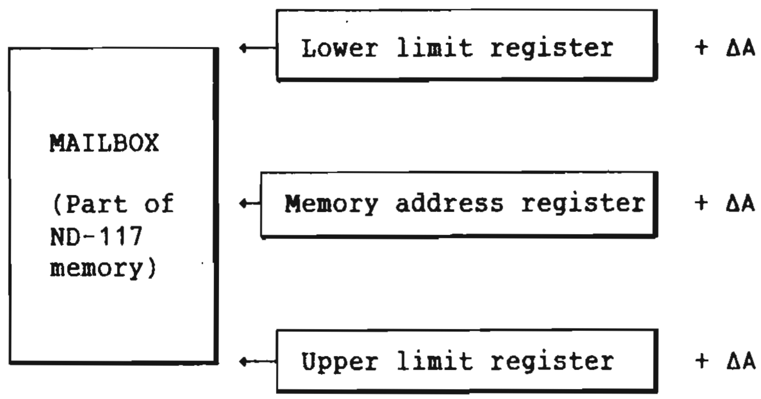

Figure 14. ND-065 memory reference registers

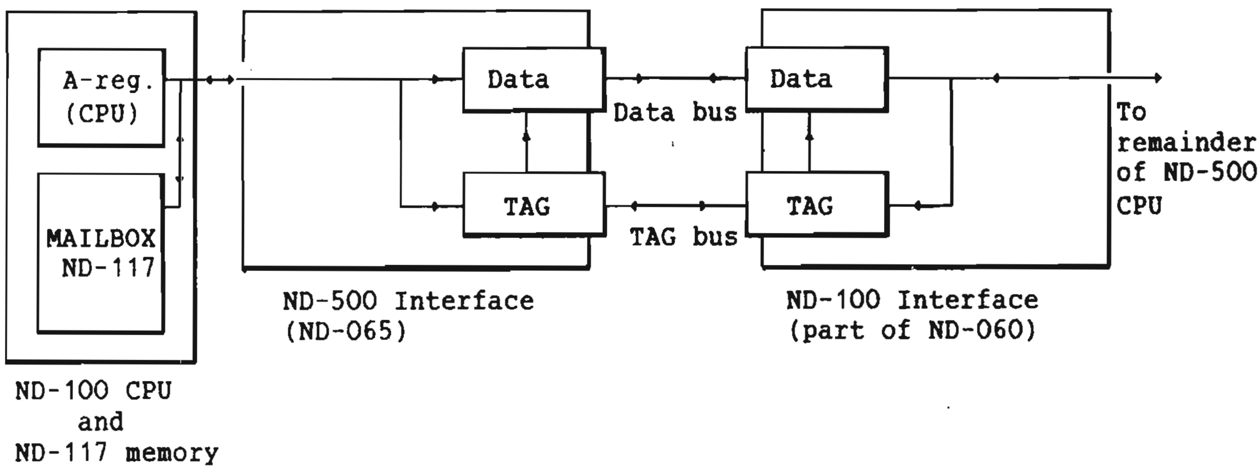

Figure 15. ND-065 interface system

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2.4.8 ND-529/536/557 MAGTAPE DRIVE, 75 IPS/ DUAL DENSITY FORMATTER/ MAGTAPE CONTROLLER CARD

For detailed description, refer to the following manual(s):

No.:	Title:
ND-12.012	Interface to Pertec Magnetic Tape with Formatter
Vendor 104931	Pertec Operating and Service Manual

INTRODUCTION

The ND-529 Magtape Drive, the ND-536 Dual Density Formatter, and the ND-557 Magtape Controller constitute a high performance magnetic tape system, using vacuum buffered columns for gentle tape handling. The tape system features ANSI and industry compatible 800 bpi NRZI/1600 bpi PE format capability.

THE MAGTAPE DRIVE

The ND-529 high performance Magtape system is a new generation of cost effective vacuum tape transports. The transport uses 3" wide vacuum columns, which minimizes the audible noise level generated by the vacuum pump system. Consequently, while still maintaining industry standard tape tension, the vacuum pressure is 50% less than competitive models. The savings in vacuum pump requirements result in a much quieter unit which also consumes far less power than other similar units.

The vacuum pump system maintains a positive air pressure in the tape compartment area and also makes sure that the air is well filtered. This standard feature provides the tape with the cleanest operating environment possible, and assures together with the vacuum-type cleaner, the highest possible data reliability.

Reel servo "hunting" is eliminated by a unique servo motor control design. Besides keeping the tape reels still, this feature eliminates unnecessary power consumption.

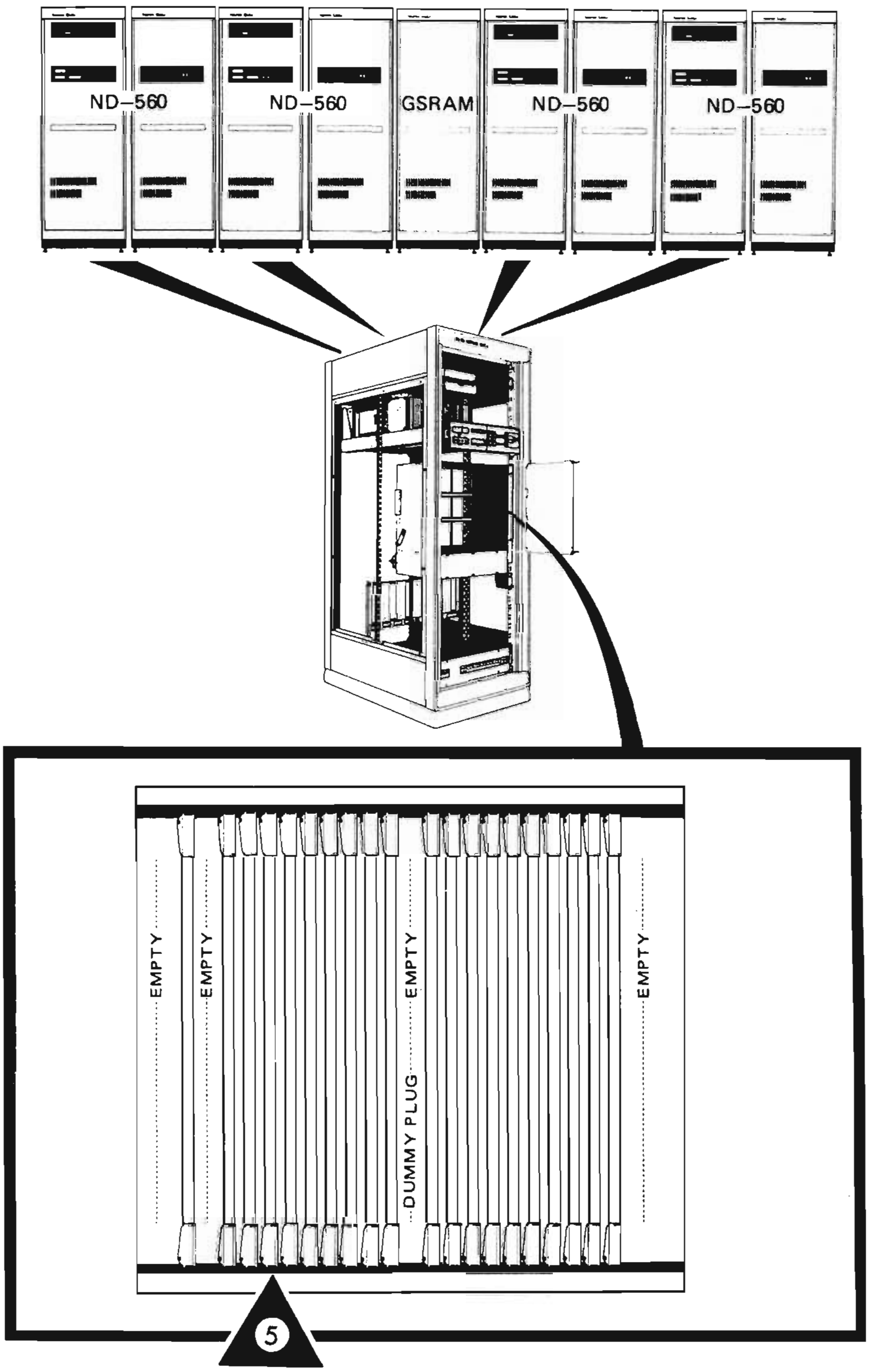

Figure 16. Location of the magtape drive with formatter and controller card

The single capstan drive system carefully smooths out both acceleration and deceleration. The design of the tape path assures that the sensitive tape oxide is in contact with only the tape cleaner and the head.

Exceptional care goes into the mounting of the head and tape guides to minimize tolerance buildup, thus guaranteeing tape interchangability. A special, digital deskewing technique provides reliable reading in both forward and reverse directions.

SPECIFICATIONS

Drive

Type	:Pertec Model 9640-98-75
Recording mode (industry compatible)	:1600 bpi Phase Encoded, 800 bpi NRZI
Magnetic head	:Dual gap (with Erase Head)
Tape speed (standard)	:75 ips (1.9 m/s)
Instantaneous speed variations	:+/-3%
Long term speed variation	:+/-1%
Rewind time (2400 ft)	:115 sec. nominal, 250 ips (6.36 m/s)
Tape cleaner	:Perforated plate type connected to vacuum supply
Stop/start time at 75 ips	:5.0 +/- 0.35 ms
Start/stop displacement	:4.826 +/- 0.508 mm
Beginning-of-tape and end-of-tape detectors	:Photoelectric - industry compatible
Dimensions (maximum):	
Height	:1606 mm
Width	:582 mm
Overall Depth	:930 mm
Operating Temperature	:5^{0}C to 43^{0}C
Relative Humidity	:20 to 80%
Vibration	:Not applicable
Power:	
Volts AC	:220 +/- 10V
Frequency	:50 +/- 2 Hz
Watts (average)	:Stand-by (unloaded) : 75 W
	Stand-by (loaded) :325 W
	At 75 ips :450 W
	Maximum :850 W

Tape (Computer Grade)

Width	:12.6492 +/-0.0508 mm
Thickness	:0.0381 mm
Tape tension	:2.224 N +/-0.139 N
Reel diameter	:25.67 cm (maximum)

FORMATTER

Mechanical and electrical specifications for the formatter are given in table 5.

Description	*PE*	*NRZI*
Recording mode (ANSI, industry compatible) ...	*PE*	*NRZI*
Packing density	*1600 bpi*	*800 bpi*
Number of channels	*9 (8 data, 1 parity)*	*9*
Data rate variation (tracking oscillator) ..	*+/- 10%*	*--*
Deskewing buffer	*4 bits/channel*	*--*
Preamble	*41 char.-40 zeros,1 one*	*--*
Postamble	*41 char.-1 one, 40 zeros*	*--*
ID burst (1600 frpi)	*Channel P*	*--*
File mark (3200 frpi)	*Channel P, 0, 2,5,6 and 7*	*--*
Inter-record gap	*15.2 mm (nominal)*	*15.2 mm (nominal)*
Parity	*Odd*	*Odd*
Calculated MTBF-dual density	*10200 hrs*	*10200 hrs*

Table 5. Specifications for the formatter

2.4.9 ND-559, DISK CONTROLLER

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-11.017	*ECC Disk Controller/ND-100*

INTRODUCTION

The disk controller is designed to handle from one to four disks. The actual disk unit is the ND-613 with a formatted storage capability of 140 Mbytes. The controller consists of two cards, the SMD-control card and the SMD-data card.

FUNCTION

The controller converts the DMA data flow from ND-100 local memory to a serial bit stream. Data from the disk unit is converted from a serial bit pattern to a parallel data word. A First In First Out (FIFO) register is located in the controller and permits the data path to be exceeded for short intervals. The transfer rate from the controller to the disk unit is 9.67 Mbits/sec.

ECC Polynomial

The Error Correction Control (ECC) register is a shift register with several inputs, several feedbacks and one output. It can correct error bursts up to 11 bits in a data stream from the disk unit.

DMA transfer

The transfer is divided into three parts:

- Initialization
- Transfer
- Termination

Read from disk

An initialization is first made of the Programmable Input/Output (PIO). The signals for "on-cylinder" and "sector" from the disk unit are checked.

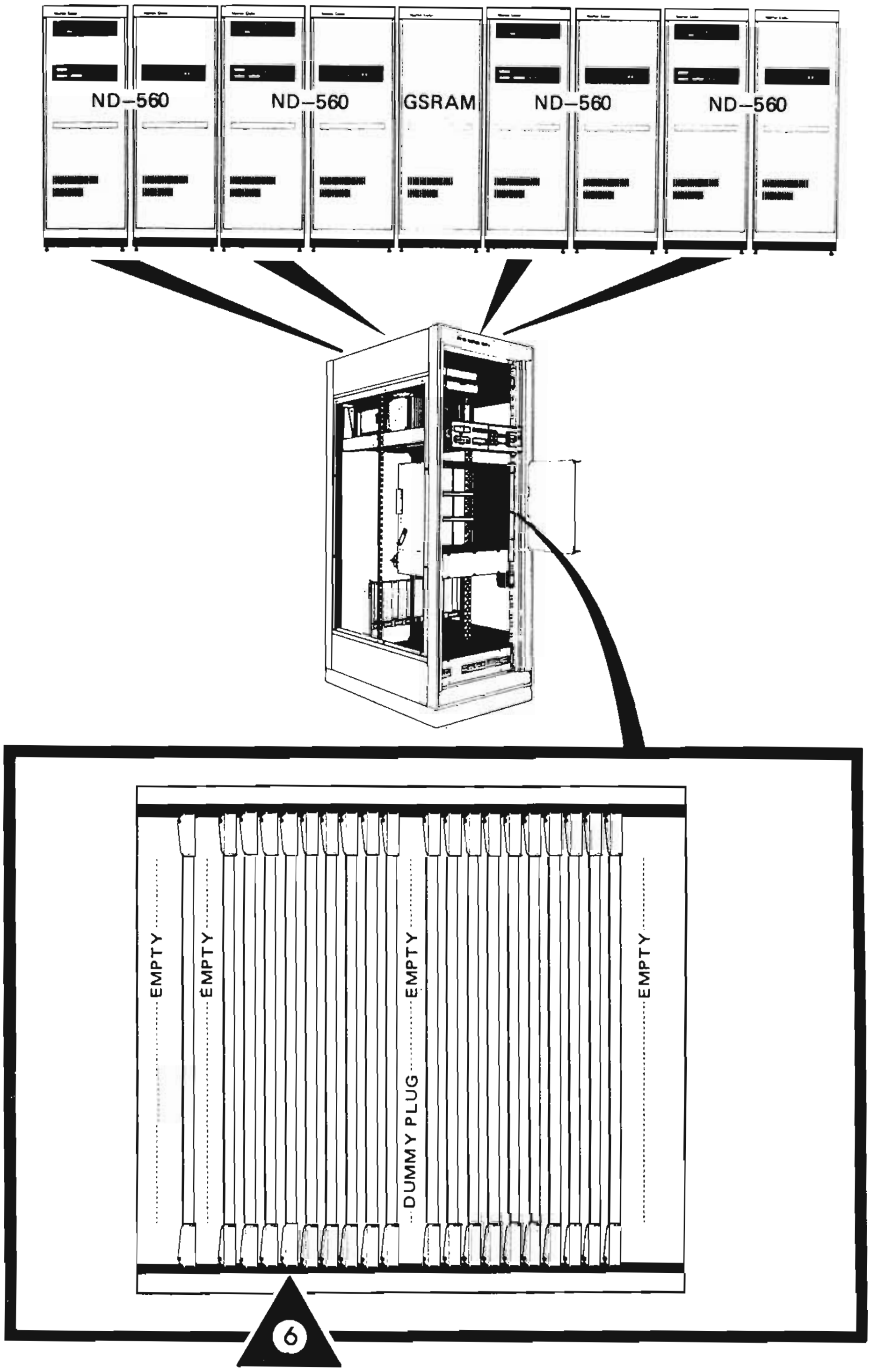

Figure 17. Location of the disk controller

If they are logically correct, a sector address check is made and the first word is loaded into the buffer. The disk controller then gives a bus request to the ND-100 and, if the bus can be used by the disk controller, the controller receives a bus GRANT signal from the ND-100 computer. The controller generates the address to start in ND-100 local memory and the transfer can begin. The word counter is set to the correct number of words and is decremented for each word being transmitted on the ND-100 bus. When the counter is 0, the transfer is terminated. The "end of operation" is generated when the START latch is reset. (Interrupt to ND-100). This situation can occur in two conditions:

- Normal end of operation
- Abnormal end of operation

Abnormal end of operation can be caused by different conditions:

- Loss of READY signal from the selected device during an operation
- Address mismatch
- The wrong line is activated from the selected device
- Timeout condition

Interface lines

The signal interface between the controller and the disk unit consists of control lines and read/write data lines. The data format is a serial NRZ-code.

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2.4.10 ND-367, FLOPPY DRIVE CONTROLLER/FORMATTER

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-11.015	*Floppy Disk Controller - 3027*

INTRODUCTION

The ND-367 is a microprocessor based controller/formatter which performs control functions and data transfer between the CPU and a floppy disk drive.

FEATURES

- Single board intelligent controller/formatter
- Single/double density
- Single/double sided
- Soft sectoring - 8, 15 or 26 sectors
- Programmable formats
- IBM compatible formats
- Single command copy and formatting
- 3 Kbyte buffer
- Self-test
- Up to 1.2 Mbyte storage per diskette
- Extensive retrieval procedure after error
- Programmable, fast data verification
- Up to 4 drives on one controller
- DMA data transfer

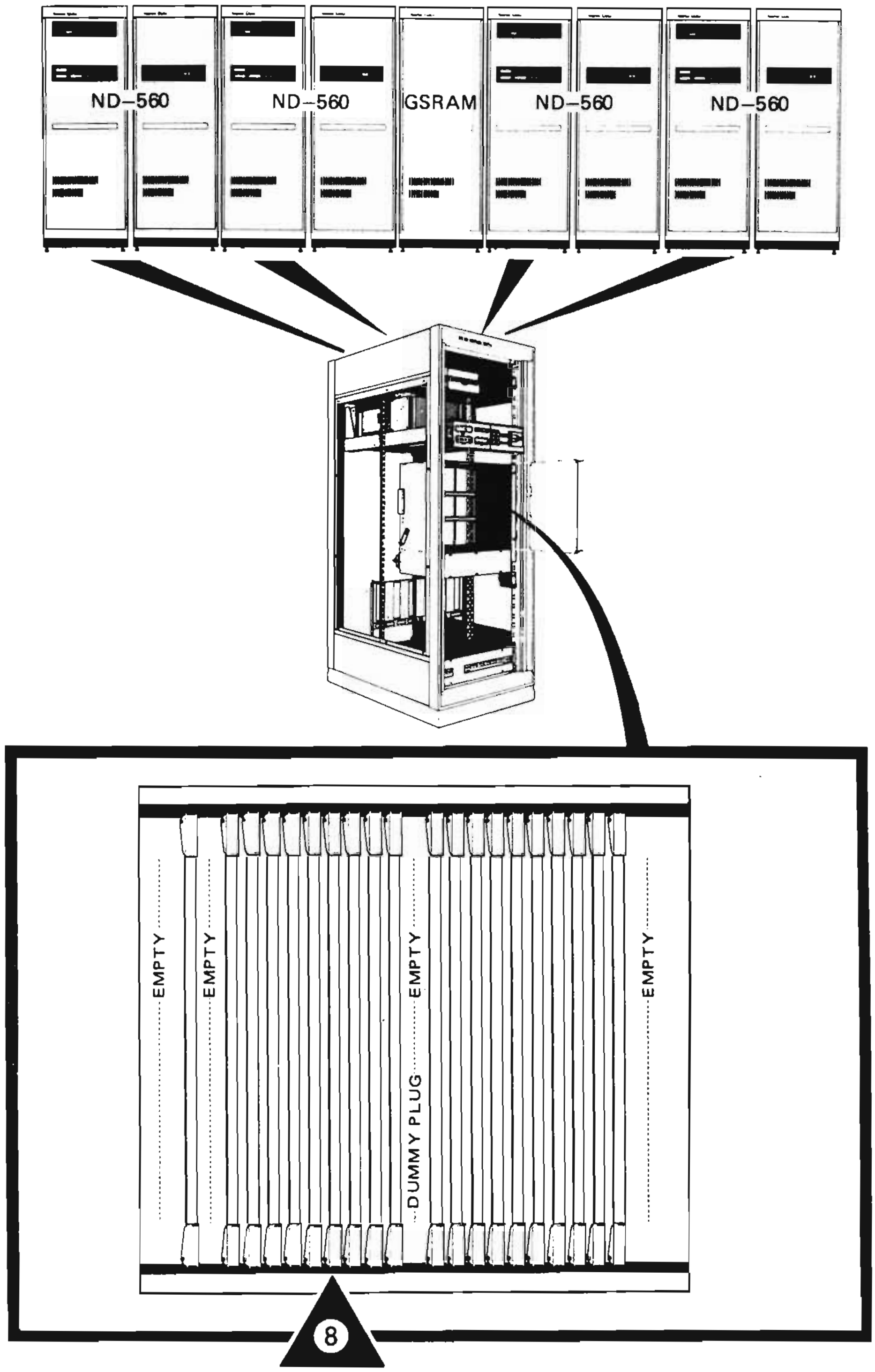

Figure 18. Location of the floppy drive controller/formatter

PRODUCT DESCRIPTION

The ND-367 floppy-disk controller consists of an interface to an ND-100 bus and a complete floppy disk controller, both based on an 8-bit microprocessor.

The ND-100 interface has programmed I/O and DMA control logic. Initialization of transmission takes place through programmed I/O, while all data transmission is done by DMA.

The controller is designed up around a floppy controller chip. It has a data separator with analog phase-locked loop and programmable precompensation for writing in double density. The controller is also equipped with a "data compare" circuit for quick verification of data.

Formatting of diskettes as well as copying from one diskette to another takes place within the controller itself, in order to reduce the load on the ND-100 bus.

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2.4.11 ND-362, FOUR-TERMINAL INTERFACE

For detailed description, refer to the following manual(s):	
No.:	*Title:*
ND-30.008	*ND-100 Hardware Maintenance Manual*
ND-06.016	*ND-100 Input/Output System*

INTRODUCTION

Each channel is a full duplex, asynchronous interface to the machine, capable of acting as either a 20 mA current loop or an RS-232. Baud rates from 50 to 9600 baud are available.

20 mA current loop or RS-232-C is switch selectable for each channel. The rate is either thumbwheel selectable for each group of four channels or programmable for each channel. Parity, character length and stop-bits are programmable for each channel.

In current loop mode, each channel is electrically isolated from the others and from the rest of the system. The interface is the active current-supplying part in the current-loop interface.

In RS-232-C mode, signal ground is connected to system ground.

With modification, there may be a maximum of 64 asynchronous channels for the ND-100 system.

SPECIFICATIONS

Available baud rates	9600	200
	4800	150
	2400	134.5
	1800	110
	1200	75
	600	50
	300	

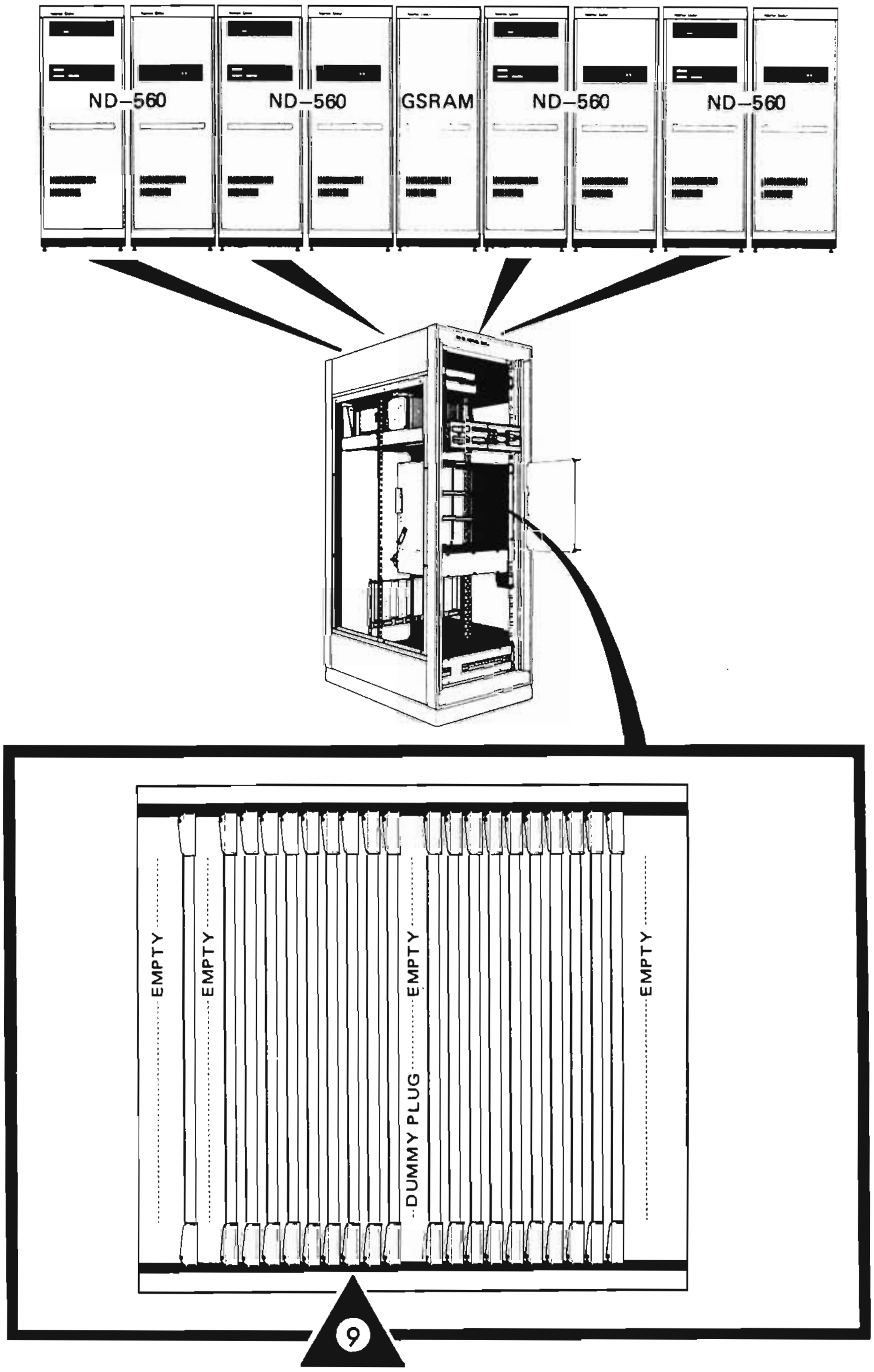

Figure 19. Location of the four-terminal interface

Character length	*Parity even*	*Parity none*	*Stop bits 1*	*Stop bits 1 1/2*	*Stop bits 2*
5 bits	x	x	x	x	
6 bits	x	x	x		x
7 bits	x	x	x		x
8 bits	x	x	x		x

Table 6. Parity and stop bits for various character lengths

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2.4.12 ND-858, ADAPTER CARD FOR TWO INTERFACE CARDS

FUNCTION

The adapter card is an interface between the ND-100 bus and standard NORD-10/S interface cards. It can take two interface cards mounted in card-edge connectors on the card. The adapter card has a standard interface to the ND-100 bus with latched addresses. 16 data lines and 10 address lines go to the NORD-10/S interface connectors. In addition, there are two clock signals (307.2KHz and 19.2KHz) used for serial interface cards. An interrupt transceiver makes it possible to choose between interrupt levels from 10 to 13.

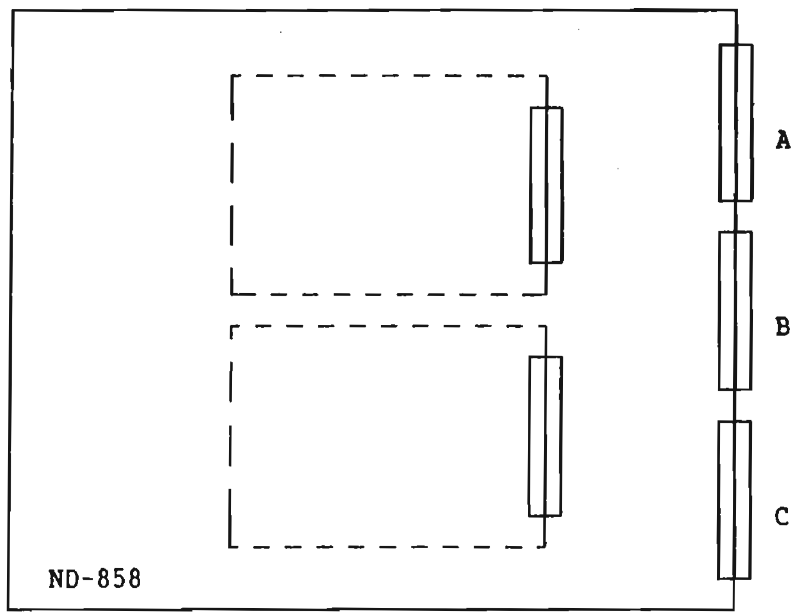

Figure 20. Adapter card for two interface cards

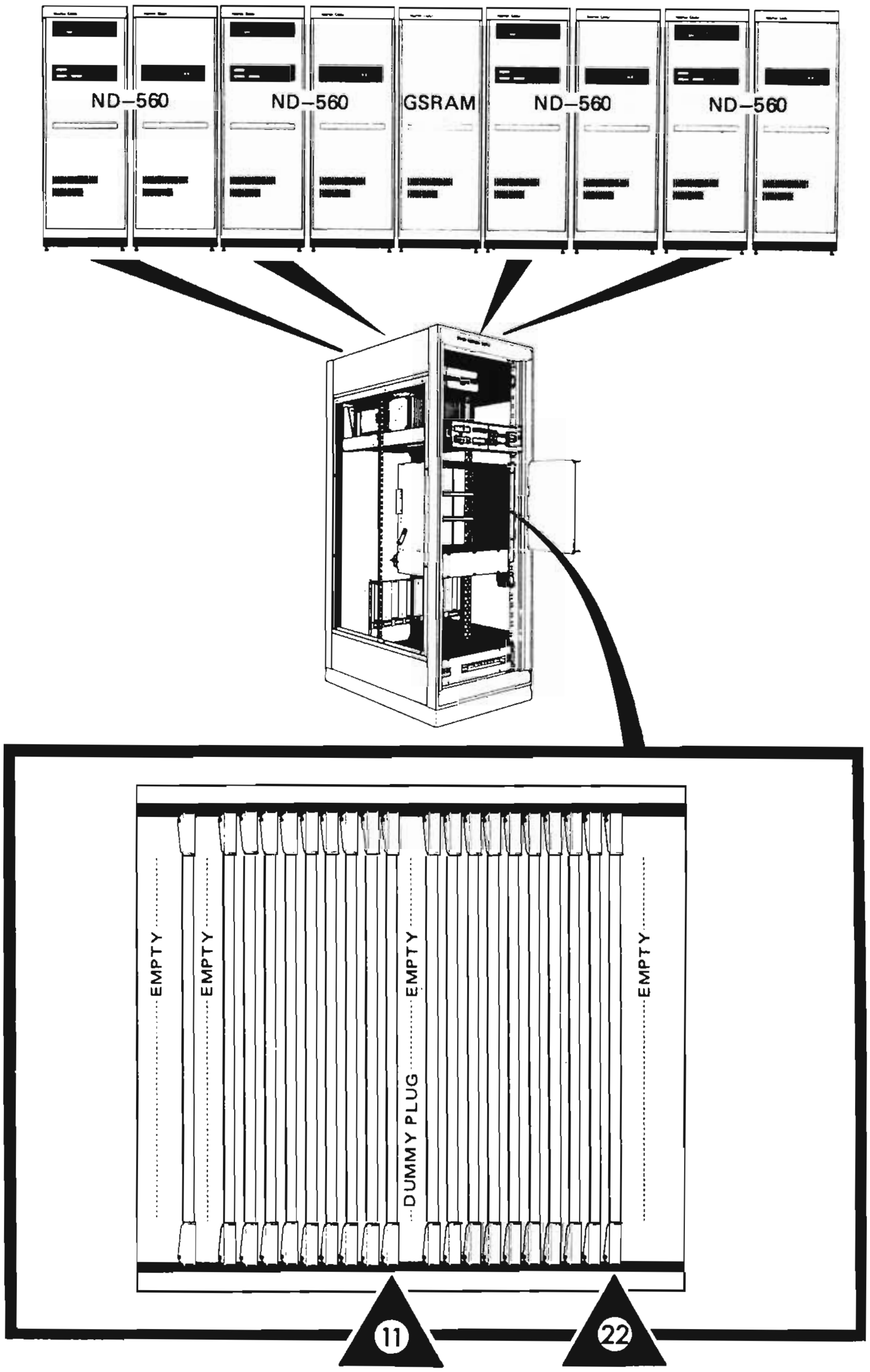

Figure 21. Location of the adapter card

2.4.13 ND-351, PAPER-TAPE READER INTERFACE

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-06.012	*NORD-10/S Input/Output System*

FUNCTION

The paper-tape reader interface is an 8 bit parallel data-transmission register to the **NORD-10/S adapter card.** It is a NORD-10/S Input/Output card and is placed on the adapter card to work properly in the ND-100 system. The data byte is clocked from the paper-tape reader through the system and a ready-for-transfer is generated to the ND-100 computer via the adapter card (interrupt). The ND-100 then reads the data byte before the next byte arrives from the paper-tape reader. An interrupt identification code is generated on the card.

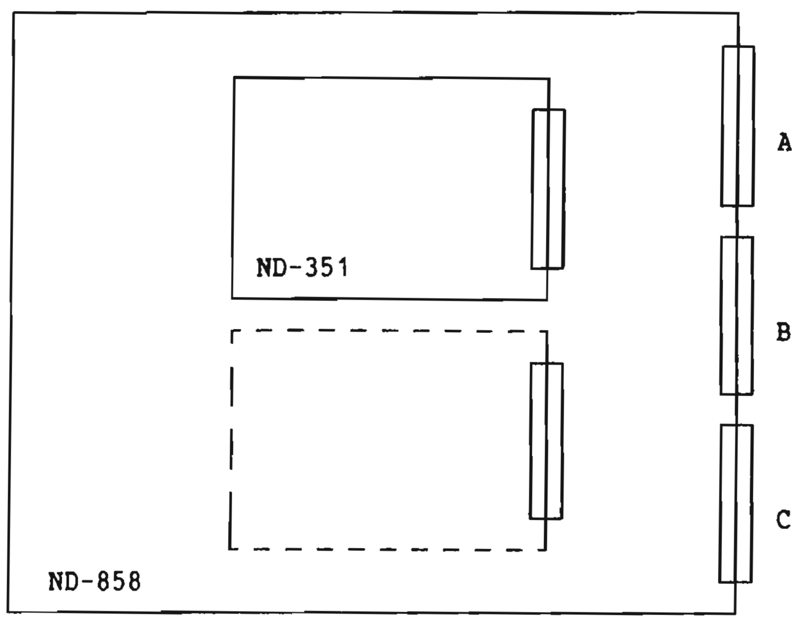

Figure 22. Paper-tape reader interface

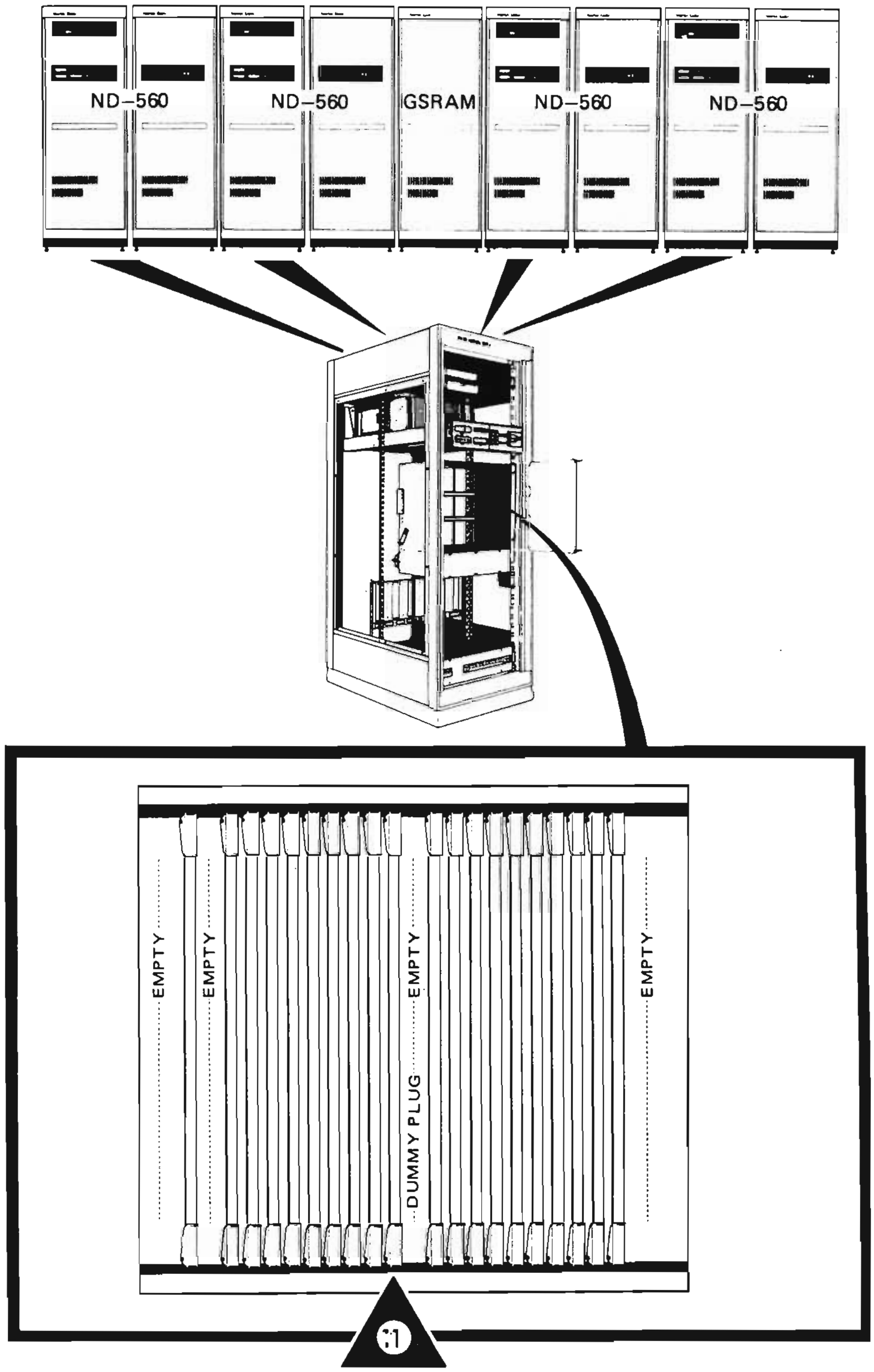

Figure 23. Location of the paper-tape reader interface

2.4.14 ND-352, PAPER-TAPE PUNCH INTERFACE

For detailed description, refer to the following manual(s):	
No.:	Title:
ND-06.012	NORD-10/S Input/Output System

FUNCTION

The paper-tape punch interface is located on the adapter card together with the paper-tape reader interface. It is an 8-bit parallel interface to the paper-tape punch device. One byte of data is transmitted at a time and the clocking signal is controlled from the ND-100 bus. A ready-for-transfer signal is generated when data has been written to the punch and the interface is ready for a new transfer. An interrupt identification code is generated on the card.

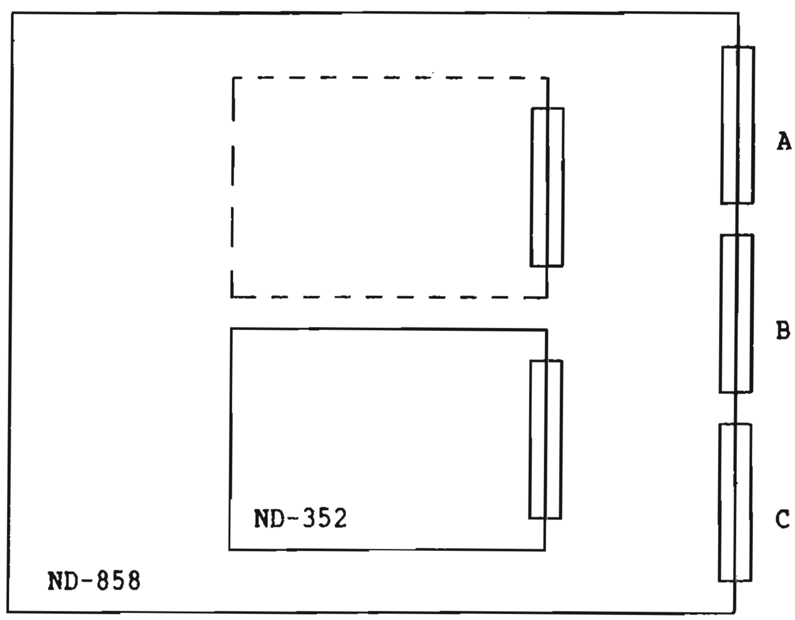

Figure 24. Paper-tape punch interface

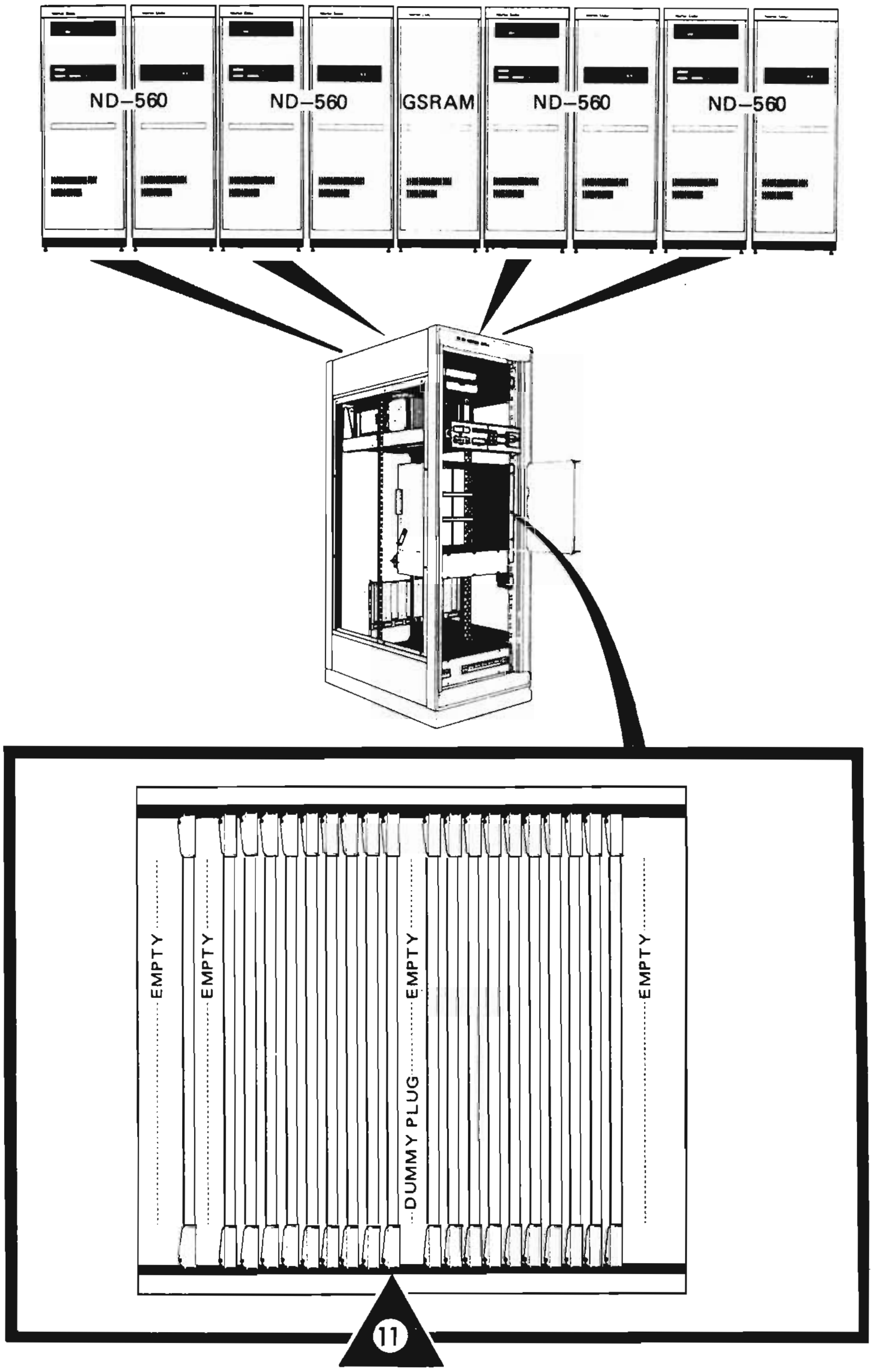

Figure 25. Location of the paper-tape punch interface

2.4.15 ND-855, GENERAL PURPOSE INTERFACE BUS CARD (GPIB)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-12.023	*GPIB User Guide*

INTRODUCTION

The GPIB system is an IEEE-488 and IEC-625 standard multi-user interface system for programmable instrumentation. It is intended for applications like laboratory instrumentation in hospitals and research institutions, and for automatic test systems.

The GPIB system on the ND-100 is a multi-user system with a maximum of 16 users (including the ND-100 CPU). The microprocessor on the GPIB module takes care of creating new users, deleting old users, reserving devices for a user, enabling for a new device that has been connected to the bus, deleting old devices, etc.

The standard version (ND-855) allows for:

- maximum 15 devices on one bus

- maximum 175 Kbytes/s data rate

Using the GPIB remote option creates a differential bus 100 meters long (maximum). Thus, 13 devices may be connected to the ND-100 and another 14 devices connected to the remote box. This permits 28 devices to be connected to each other, using only one interface card.

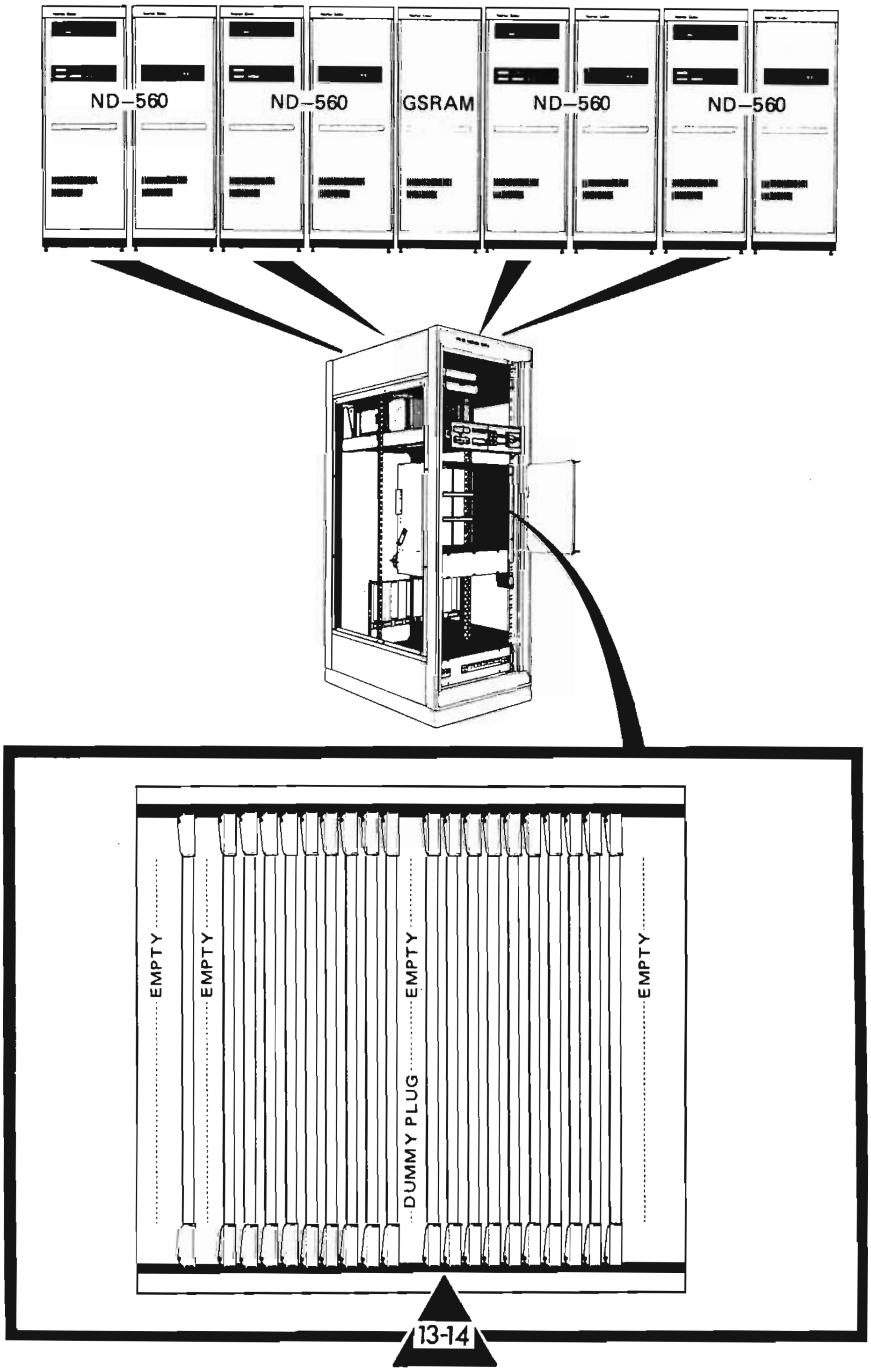

Figure 26. Location of the GPIB card

SOFTWARE

The GPIB system is delivered with a GPIB software packet based on FORTRAN callable routines for the different functions of the module.

There are routines for:

- Reading data from device(s)
- Writing data to device(s)
- Transferring data between devices
- Triggering and clearing device(s)
- Setting device(s) in local mode
- Parallel configuration of device(s)
- Pass control to device(s)
- Configuring of the parallel or serial poll status for GPIB module
- Reserving device(s) for a user
- Releasing device(s) for a user
- Listing system device(s)
- Listing device(s) reserved for a user

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2.4.16 ND-857, PROGRAMMABLE I/O CONTROLLER CARD (PIOC), 4 LINES, FOR ND-100

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-60.161	*PIOC Software Guide*
ND-02.003	*PIOC Hardware Reference Manual*

INTRODUCTION

The ND-857 Programmable I/O Controller is an interface card for the ND-100. It includes MONITOR, PLANC and X-MESSAGE for the PIOC. It is capable of handling 4 full duplex communication lines and relieves the ND-100 of much of the communication protocol overhead. It is equipped with a local processor, MC 68000, and a 128 Kbyte Random Access Memory (RAM), with debugging facilities. The RAM is also accessible directly from the ND-100 and each communication channel has DMA access to the local RAM.

FEATURES

- 4 full duplex channels with DMA in both directions

- RS 232 C (V.24/V.28) and RS 422 (V.11=X.21) interface on all channels

- Synchronous HDLC, SDLC or BISYNC and asynchronous modes

- Speed up to 800 kbits/s on one line or 200 kbit/s on all lines simultaneously, depending on protocol overhead

- 128 Kbyte shared memory with single error correction

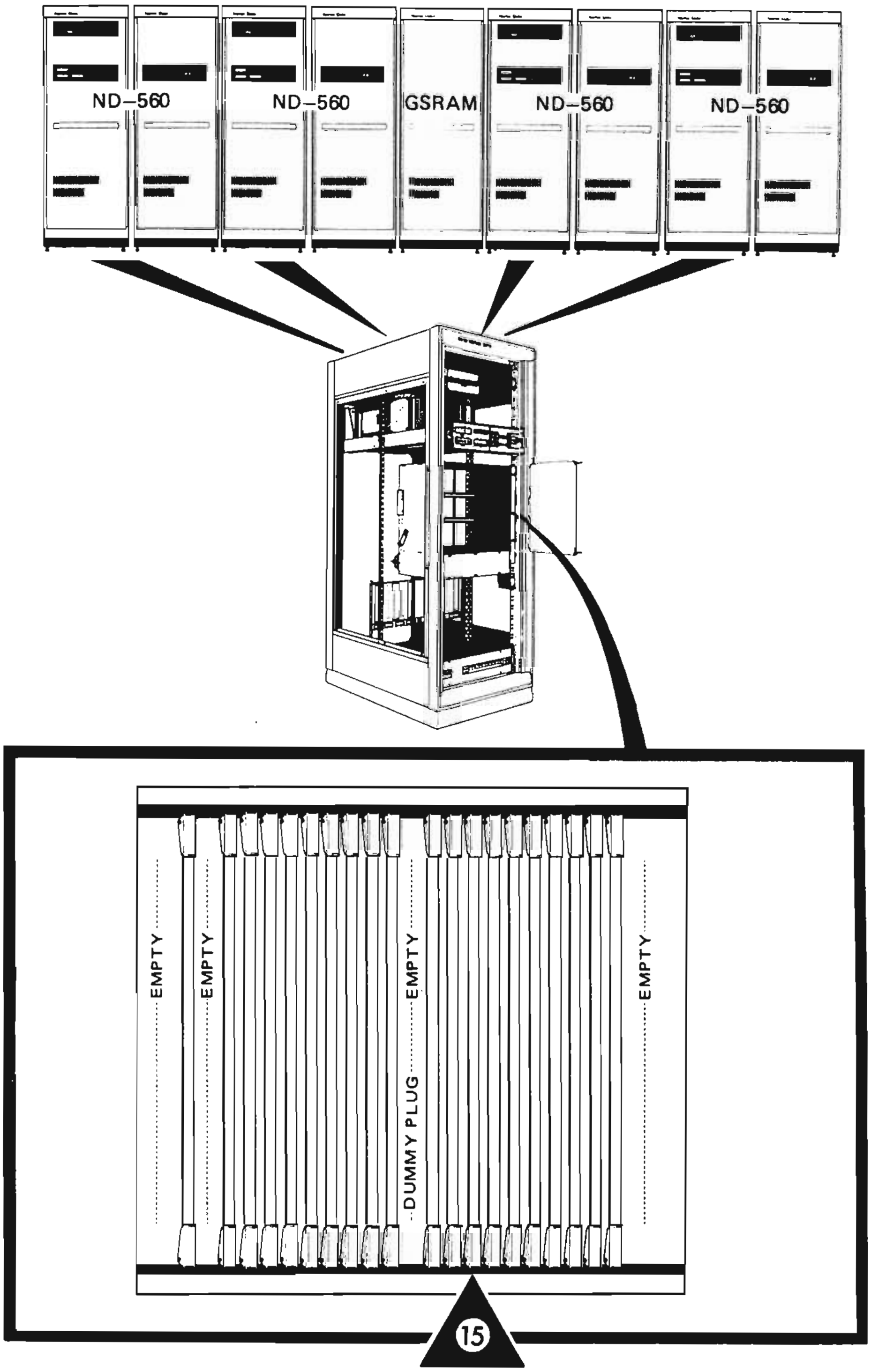

Figure 27. Location of the PIOC cards

SOFTWARE

Users are free to develop their own PIOC programs in MC 68000 assembly code in a high level language, PLANC.

The PIOC and ND-100 will operate on common memory. This memory must be allocated as a continuous 64K word segment in SINTRAN III. The RT-loader must be used for defining continuous segments. The PIOC MONITOR must be used when loading the segments.

Programs to be loaded in PIOC must be compiled by the PLANC-PIOC compiler which will produce a relocatable module in ND Relocatable Format (NRF). NRF modules must be linked together by the ND Linkage-Loader (NLL) to one module, ready for loading and execution by PIOC MONITOR.

The PIOC MONITOR is a program running in the ND-100 for loading, supervising and controlling the PIOC. A specific monitor call in SINTRAN III is used by the MONITOR for communication with the PIOC.

HARDWARE

64K words in PIOC

The 64K words in PIOC are directly accessible from the ND-100. ND-100 and MC 68000 communicate via addresses in the common memory. One mailbox is used for each direction and each mailbox has a status word which takes up one bit.

The RAM memory is equipped with a protection mechanism to protect against writing from input DMA and 68000 user.

The I/O circuits on the card are only accessible from MC 68000.

Line interface

The line interface consists of four equivalent ports and can handle duplex channels. The serial controllers may be programmed for either asynchronous or synchronous transmission and can be used for both bit-oriented (HDLC), and byte-oriented procedures. A maintenance mode may be set directly from the program.

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2.4.17 ND-640, MPM-5 LINE DRIVER W/OCTOBUS

DRIVER FUNCTION

The line driver card is the interface between the ND-100 bus and the Multiport Memory (MPM-5) unit. The interface to the ND-100 bus consists of Data/Address transceivers and a latch register for the address (multiplexed bus). The signals to the multiport memory are split into data and address lines. Control signals for memory enable and read/write functions are also applied. From the line driver card to the MPM-5 there are differential line transmitters and receivers to prevent environmental noise on the transmission lines. These signals are transmitted from the A-bus connection. There is an interface on the MPM-5 unit which also does a valid address check. The data format has 16 bits data and two parity bits, one for each byte.

OCTOBUS FUNCTION

The octobus is a serial transmission line between the different ND-100 computers. The data format includes an identification code for each ND-100. It also contains a software protocol for status and control. The octobus also functions as an interrupt channel between the different ND-100 computers. Every ND-100 in the octobus chain has to have an octobus controller, which is an integrated circuit on the line driver card.

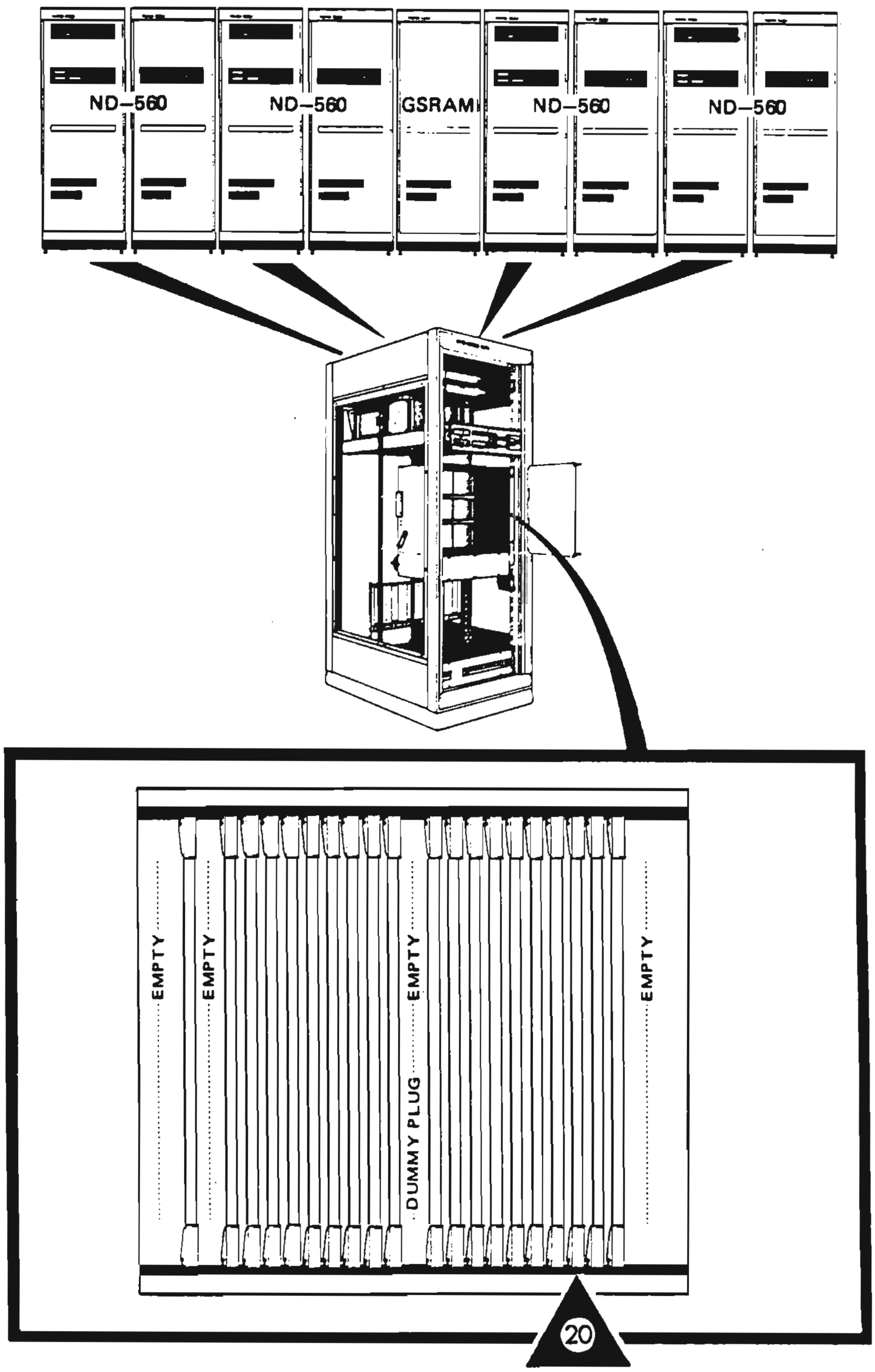

Figure 28. Location of the MPM-5 line driver with octobus

2 2.4.18 ND-389, 2 MB RAM MEMORY CARD

For detailed description, refer to the following manual(s):	
No.:	*Title:*
06.014	*ND-100 Reference Manual*
06.015	*ND-100 Functional Description*

INTRODUCTION

2 The 2 MB RAM memory cards are used as primary storage in the ND-100 computer system.

FEATURES

The memory modules are designed according to user requirements, data reliability, high density and flexibility.

For each 16-bit word, 6 Error Correction Control (ECC) bits are generated. The 6 ECC bits guarantee that single-bit errors are corrected and double-bit errors are detected. All single-bit errors are assigned an error code, making it possible to log all memory failures.

For minimum interaction with other system parts, the modules contain refresh and memory cycle control logic.

- 6-bit Error Correction Code increases data reliability
  - all single bit errors are reported and corrected
  - all double bit errors are reported
- Modular and flexible design
- Requires one crate position
- Internal cycle control/timing
- Asynchronous operation
- Internal refresh address register
- Maintenance test features

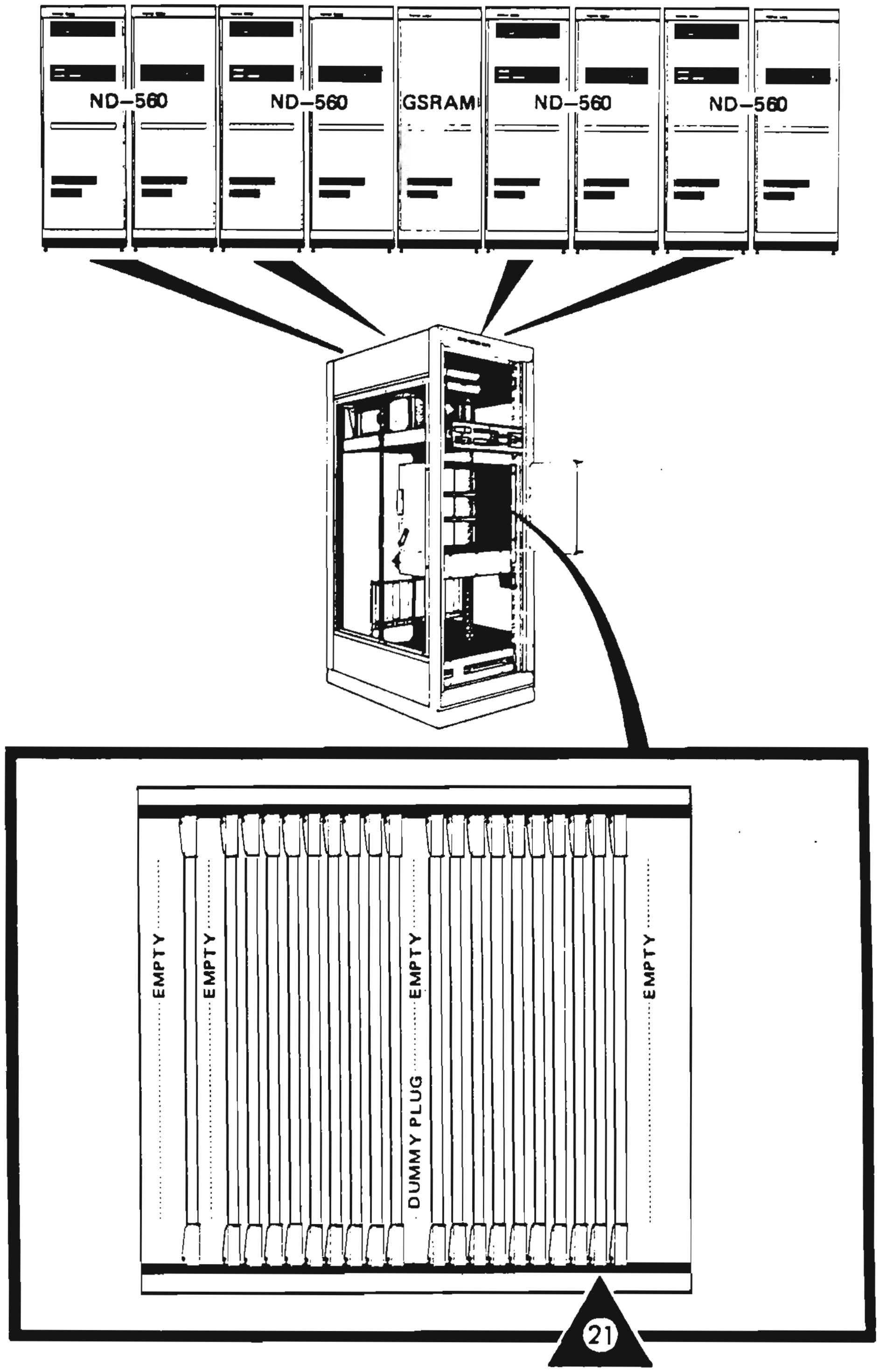

Figure 29. Location of the 2 MB RAM memory | 2

SPECIFICATIONS

Data format	16 bit data 6 Error Correction Control (ECC) bits
Memory cycle times	Read access time........270 nanoseconds Write access time.......170 " Bus hold time...........500 "
Power	Power requirements........+ 5 Volts Stand-by power............15 minutes
	Add 30 nanoseconds if error correction must be performed

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2.4.19 ND-655, LINE PRINTER CONTROLLER CARD

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-06.012	*NORD-10/S Input/Output System*

INTRODUCTION

The line printer controller card is located on an ND-858 adapter card in the ND-100. The controller is an 8-bit parallel interface to the line printer. The interface is prepared to be connected to a DMA controller which has a word counter and the necessary logic to communicate with the data channel.

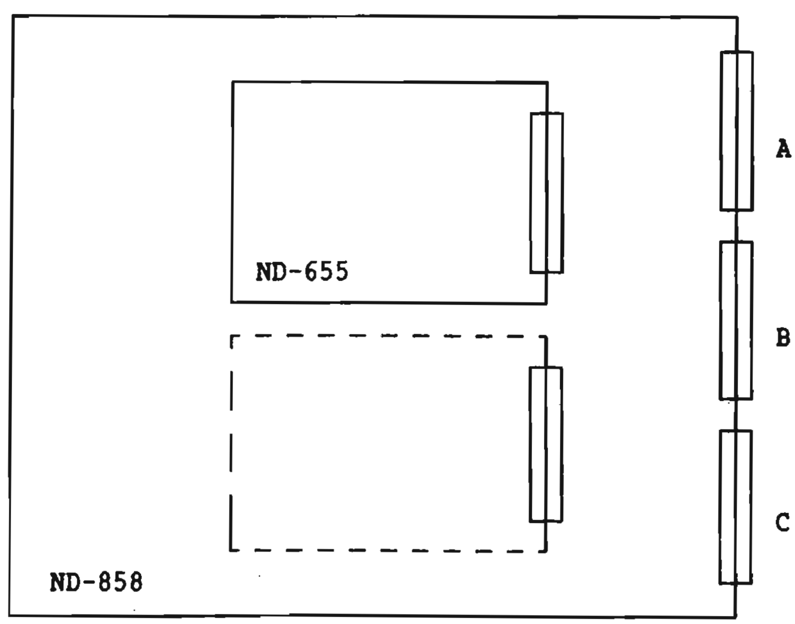

Figure 30. Line printer controller card

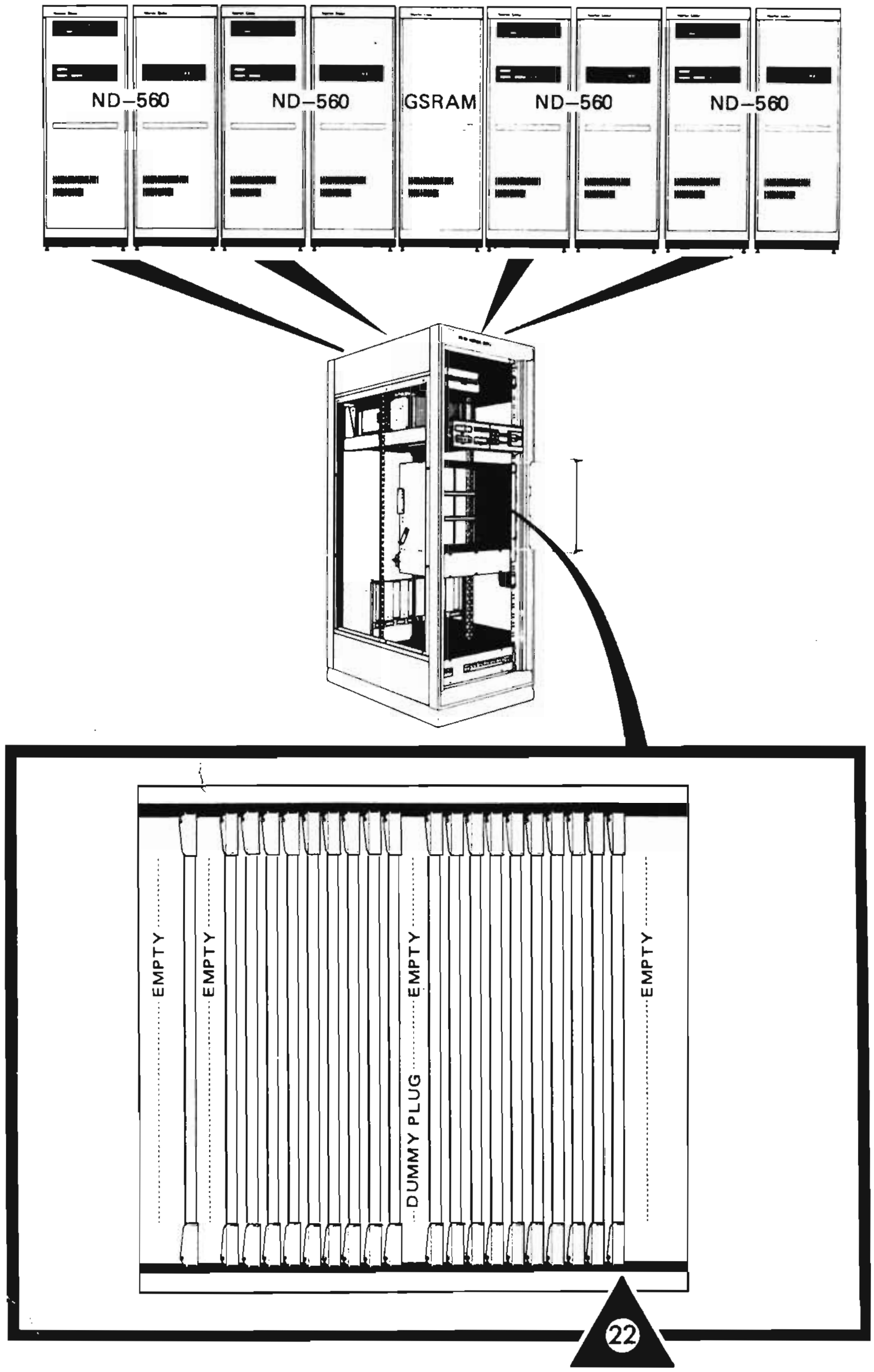

Figure 31. Location of the line printer controller card

BUILDING BLOCKS

On the Controller there are ident and interrupt control logics. In addition it contains address decoding and a data register. The control and status registers are connected to the line-printer interface. These registers use bits 10-15 in the control word which is sent from the ND-100. These lines are usually set by switches on the card, to define the intersection between computer and device.

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2.4.20 ND-312, FLOPPY DRIVE, 1.2 MBYTE, TOSHIBA

For detailed description, refer to the following manual(s):	
No.:	*Title:*
Vendor 71R111-883	*Maintenance Manual and Function Guide*

INTRODUCTION

The floppy disk drive consists of:

- Read/write and control electronics
- Drive mechanism
- Track positioning mechanism
- Read/write head

These components perform the following functions:

- Interpret and generate control signals
- Move read/write head to selected track
- Read and write data

The Head Positioning Actuator positions the read/write head to the desired track on the diskette. The Head Load Solenoid loads the read/write head against the diskette, and data may then be recorded or read from the diskette.

SPECIFICATIONS

Environmental limits

Ambient temperature: 4^0C to 47^0C

Relative humidity: 20% to 80%

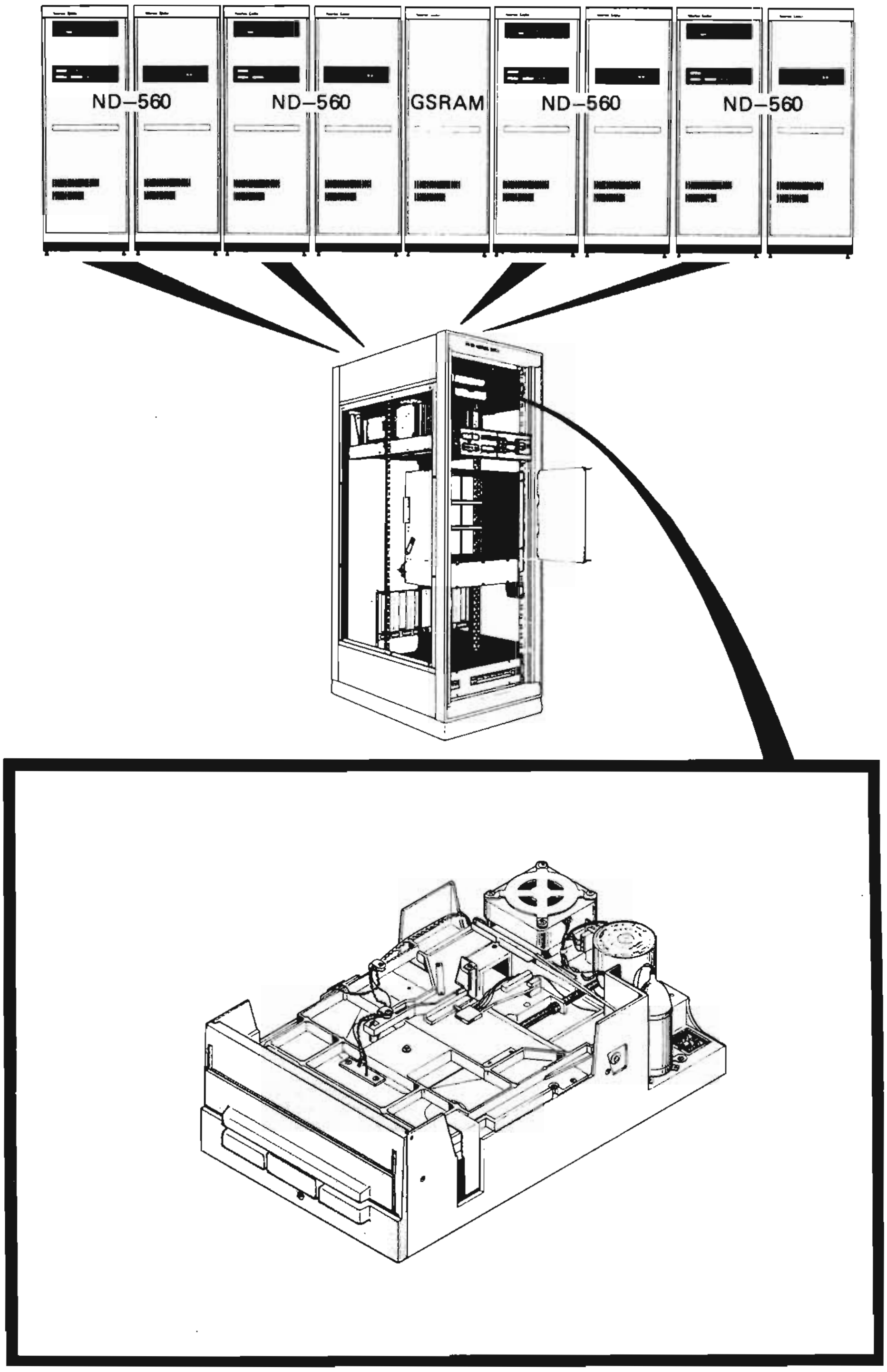

Figure 32. Location of the floppy drive

Data capacity	*Sectors/track*	*Bytes/sector*	*Kbytes/diskette*
IBM 3740 Format	*26*	*128*	*250*
ND Single dens.	*8*	*512*	*315*
IBM SYS 34	*26*	*256*	*998*
ND Double dens.	*8*	*1024*	*1261*

Table 7. Various formats for the TOSHIBA floppy drive

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2.4.21 ND-368. FLOPPY DRIVE HOUSING/POWER

INTRODUCTION

The floppy drive housing is designed to take two 8" drives. This ND-100 configuration, however, has only one floppy drive and a blind panel where the second drive would be located.

POWER DISTRIBUTION

The floppy disk housing contains an AC power distribution unit. The following connections are available:

- Input (3-pin plug).
- Fan (3-pin plug).
- Drive one (3-pin plug).
- Drive two (3-pin plug).
- Power supply. (3-pin plug).

In addition to these main power connections, there are three other plug distributions (6-pin plugs) to the control cards for the floppies.

POWER SUPPLY

The power one type DC-power to the floppy drive has the following specifications:

- 220, 230 and 240 volts inputs to be used depending on requirements. The line frequency is in the range of 47 to 63 Hz.
- +5, -5 and 24 volts DC outputs.

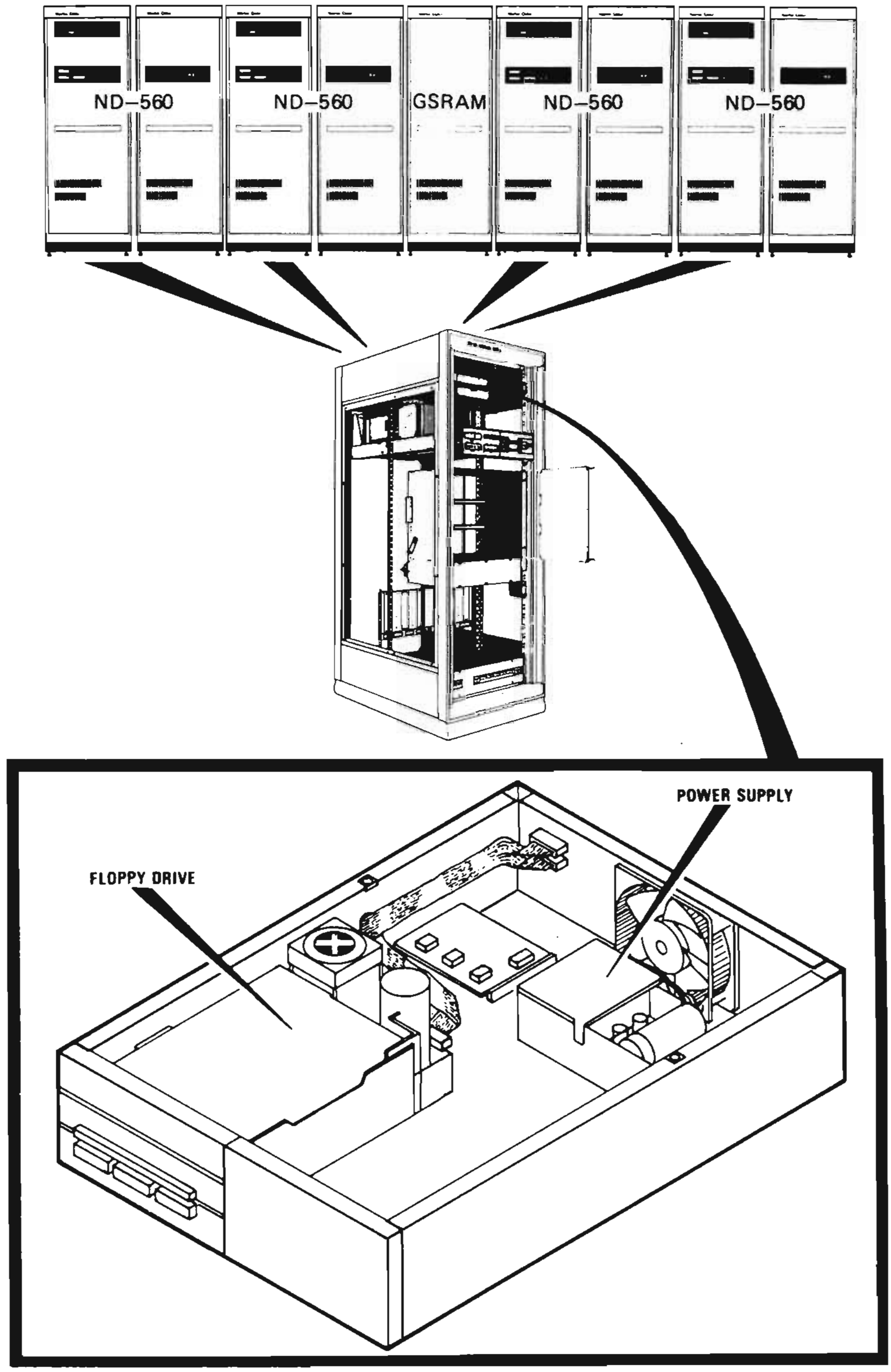

Figure 33. The floppy drive housing/power

2.4.22 ND-613, DISK DRIVE

For detailed description, refer to the following manual(s):	
No.:	*Title:*
Vendor	*M2321K/M2322K Micro-disk drives CE manual*

INTRODUCTION

The ND-613 disk drive unit contains non-removable disks in a sealed module. A rotary actuator using a closed-loop servo performs head positioning. The maximum unformatted storage capacity of this drive is 168 Mbytes. A standard SMD interface is used for the ND-613 unit. Fixed and variable sector length formats are internally selectable. Whitney-type technology Contact Start/Stop (CSS) heads and media are used.

MAGNETIC HEADS

Each head has an LSI-circuit on its arm to amplify the small signal, thereby reducing read errors by increasing the signal to noise ratio. There are two types of magnetic heads:

- Data head
- Servo head

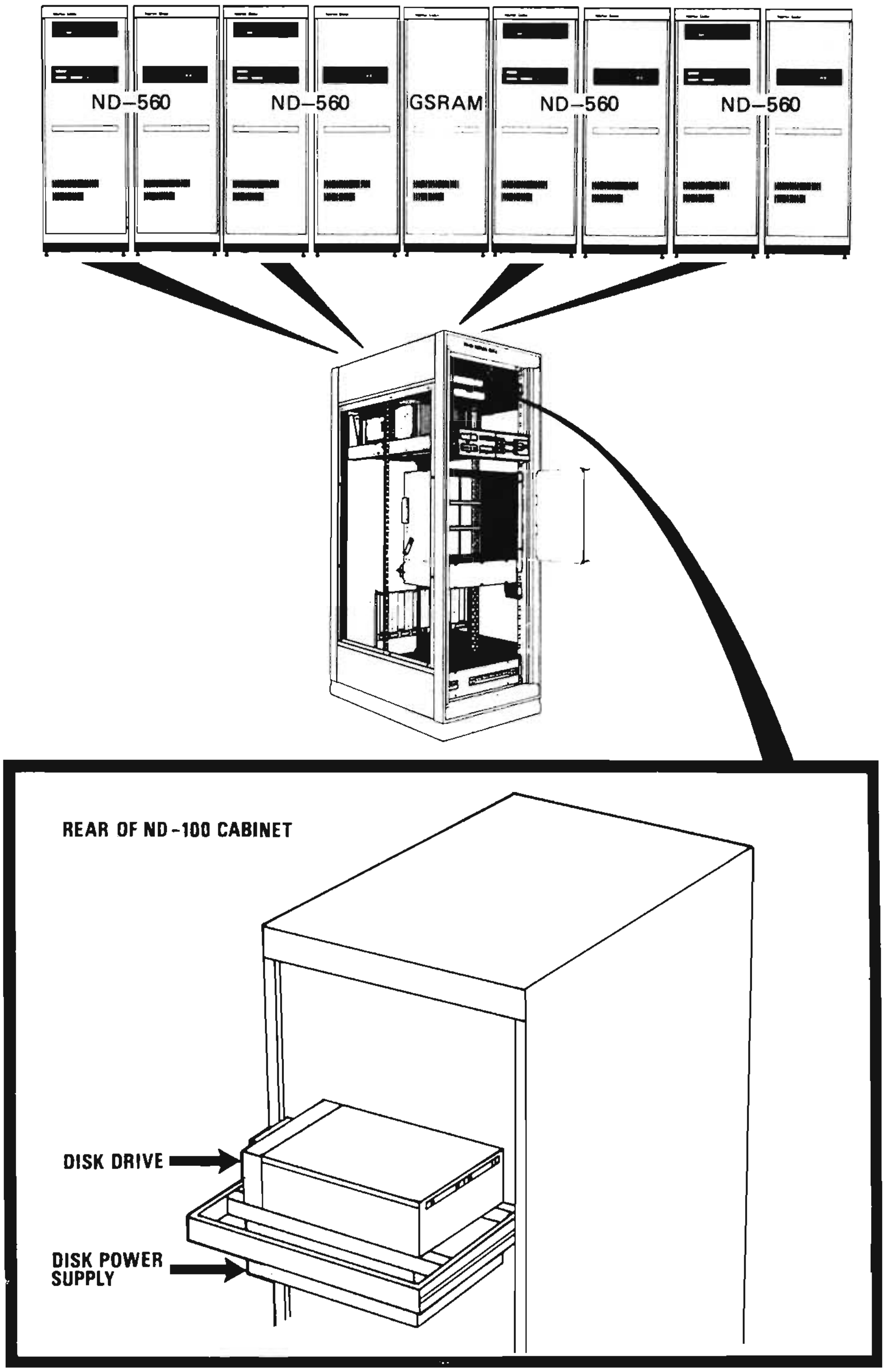

Figure 34. Location of the disk drive

Actuator

The actuator performs the following types of motion, which are controlled by servo feedback current from the servo head:

- Seek motion
  (The heads are moved to the specified cylinder while counting track-crossing signals.)

- On-cylinder motion
  (Heads follow the specified tracks.)

The servo head is located on the lower surface of the bottom disk, where servo information is pre-written at the factory. This information is used as a control signal for the actuator. It provides track-crossing signals during a seek operation, track-following signals during On-cylinder operations and timing signals such as index and servo clock.

Head motion

The heads are in contact with the disk surfaces during start and stop (CSS) at a fixed position called the landing zone. This zone is on the innermost area of the disk, separate from the recording zone. A spring force holds the actuator at this position. Once the disk attains the required rotation speed, an initial seek function occurs. The recording heads are released from the landing zone and moved to cylinder zero.

Air circulation

The contact start/stop (CSS) head used in this disk unit has a very low flying height (approximately 0.35 microm.). Due to this fact, head crashes can be caused by microscopic foreign particles. To keep the inside of the disk enclosure clean, it is completely sealed and clean air is supplied through two filters.

RECORDING MEDIA

The data recording media are aluminium disks approximately 210 mm in diameter and 2 mm thick. They are coated with a magnetic material. Up to six disks can be installed for a maximum storage capacity of 168.8 Mbytes.

Media defects

A media defect is defined as a repetitive read error that occurs on a properly adjusted drive within specific operating conditions. All drives will have a media defect list which will contain the following information:

- Cylinder address
- Head address
- Position (bytes from index)
- Length (bits)

Physical specifications

There are some critical physical conditions to be observed when using this type of data storage media. Here are some operating specifications:

- Temperature: 5^0C- 40^0C
- Vibration: Less than 0.26G (3-60Hz)

2.4.23 ND-881, MAIN POWER SUPPLY ESP 271, 150A/5V

For detailed description, refer to the following manual(s):

No.:	Title:
Vendor	Tecnical Manual - Switching Power Supply ESP 271

INTRODUCTION

The ESP 271 switching-type power supply has one voltage regulator with marginal voltage setting circuits, ON-OFF circuits and emergency stop circuits as well as power failure interrupt circuits. The marginal voltage setting circuits, activated by an external switch, cause the 5V output to shift by 5%. A remote switch turns the regulator on and off. Signals from an internal thermistor or an external switch can also turn off the regulator. The input power is sensed by a power-fail interrupt circuit. At the output of the power-fail interrupt circuit, a semi-conductor gives power OK when ON and power fail when OFF.

Connectors are located at the front and on the right side of the power supply.

SAFETY CONSIDERATIONS

1:1 insulation transformer

No attempt to service this regulator should be made unless safety precautions are taken. The preferable method is to use a one to one insulation transformer with a rating exceeding 1500VA. If an insulation transformer is not available, make sure that all instruments are floating off ground and keep track of live and neutral lines. In no case should there exist any possibility of touching grounded metal objects.

Note that the complete power supply is designed for use with a star type, (that is, live, neutral and ground) power configuration as well as open delta-type configurations.

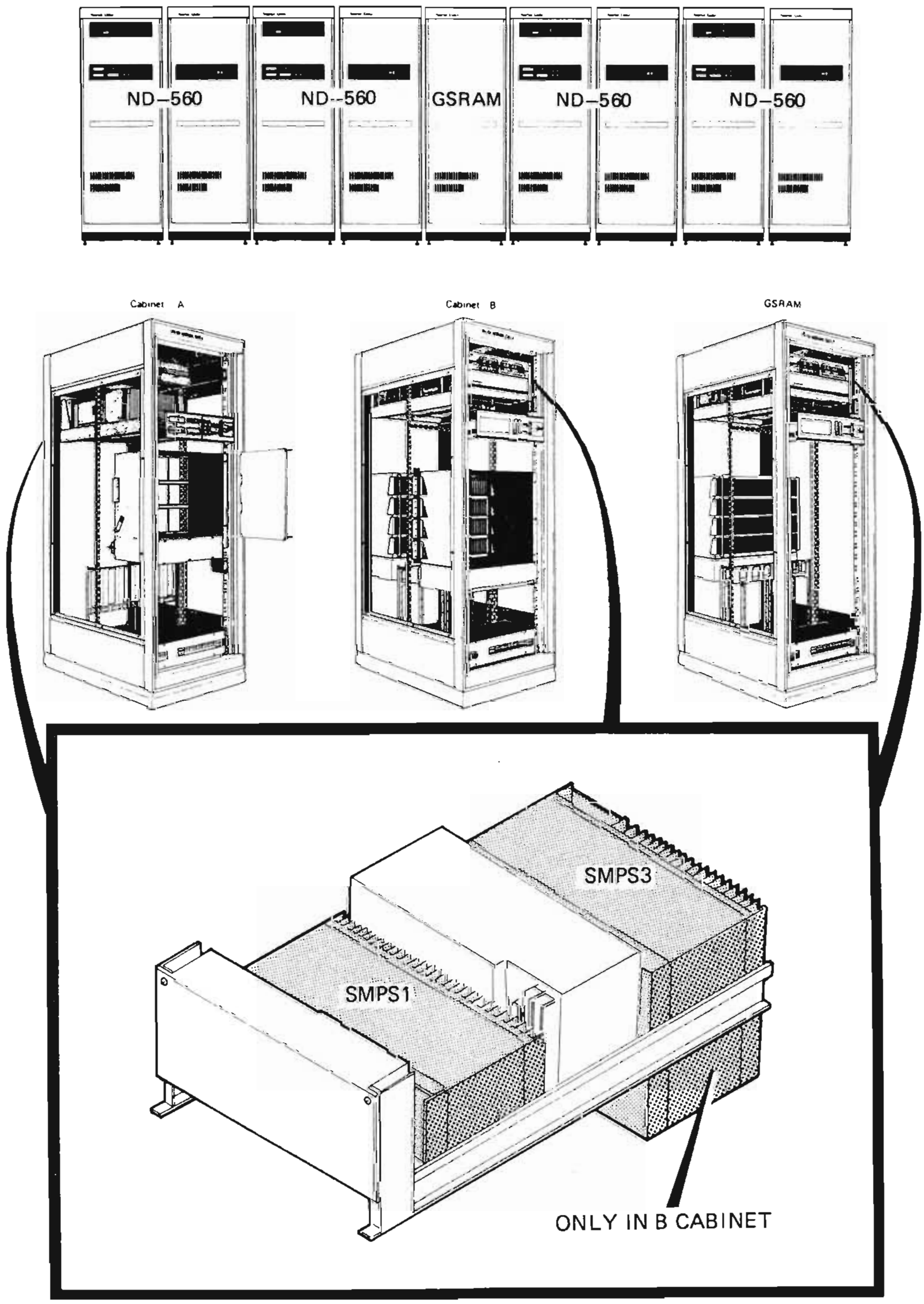

Figure 35. Location of the main power supply

SPECIFICATIONS

Input	- Input voltage, single phase 47-63Hz:	184-264V
5V/150A Output	- Output voltage factory adjusted:	5.00V
Output voltage with activated marginal switch	- Upper output voltage:	Vout +5% +-0,5
	- Lower output voltage:	Vout -5% +-0,5
	- Fine adjustment:	4.50-5.50V
	- Output current:	150A maximum
Power fail interrupt	- Power OK:	Output active low
	- Power fail:	Output deactivated
	- Input voltage limits:	184-264V
	- Factory adjusted:	184V
	- Input voltage dropout exceeding:	10ms
Remote ON-OFF	OFF at TTL high minimum 15mA	
Emergency stop	Closed relay contacts Heat sink temperature higher than 110^{0}C	
Temperature alarm	Heat sink temperature higher than 100^{0}C	

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2.4.24 ND-882, STANDBY POWER SUPPLY S 6005

For detailed description, refer to the following manual(s):	
No.:	*Title:*
Vendor	*Power Supply S 6005 Instruction Manual*

INTRODUCTION

The S 6005 power supply has two voltage regulators with marginal-voltage setting circuits as well as a rechargeable battery with a charging circuit.

The two regulators, supplying +5V at 25A maximum current load and +12V at 4A maximum current load respectively, are switching regulators of the buck type; that is, forward regulators with output voltages lower than the input voltage. The two regulators are equipped with marginal voltage setting circuits activated by externally mounted switches. When activated, the switches cause the 5V output to shift by 5% and the 12V output to shift by 10%.

Input voltage is normally derived from a rectifier and a filter. In case of short power interruptions, the regulators are supplied by the rechargeable battery.

SPECIFICATIONS

5V/25A Output	- Output voltage factory adjusted:	5.00V
Output voltage with activated marginal switch	- Upper output voltage:	5.25V +-0.025V
	- Lower output voltage:	4.75V +-0.025V
	- Fine adjust:	5.00V - 5.50V
	- Output current:	25A maximum
	- Regulation static for worst case combination of line and load charge:	1% maximum
	- Ripple, bandwidth 30MHz:	100mV ptp max.
	- Temperature coefficient, output voltage:	+-200 ppM max.
	- Overvoltage protection:	6.0V - 6.9V
	- Overcurrent protection:	28A - 35A
	- Short-circuit current:	< 13A

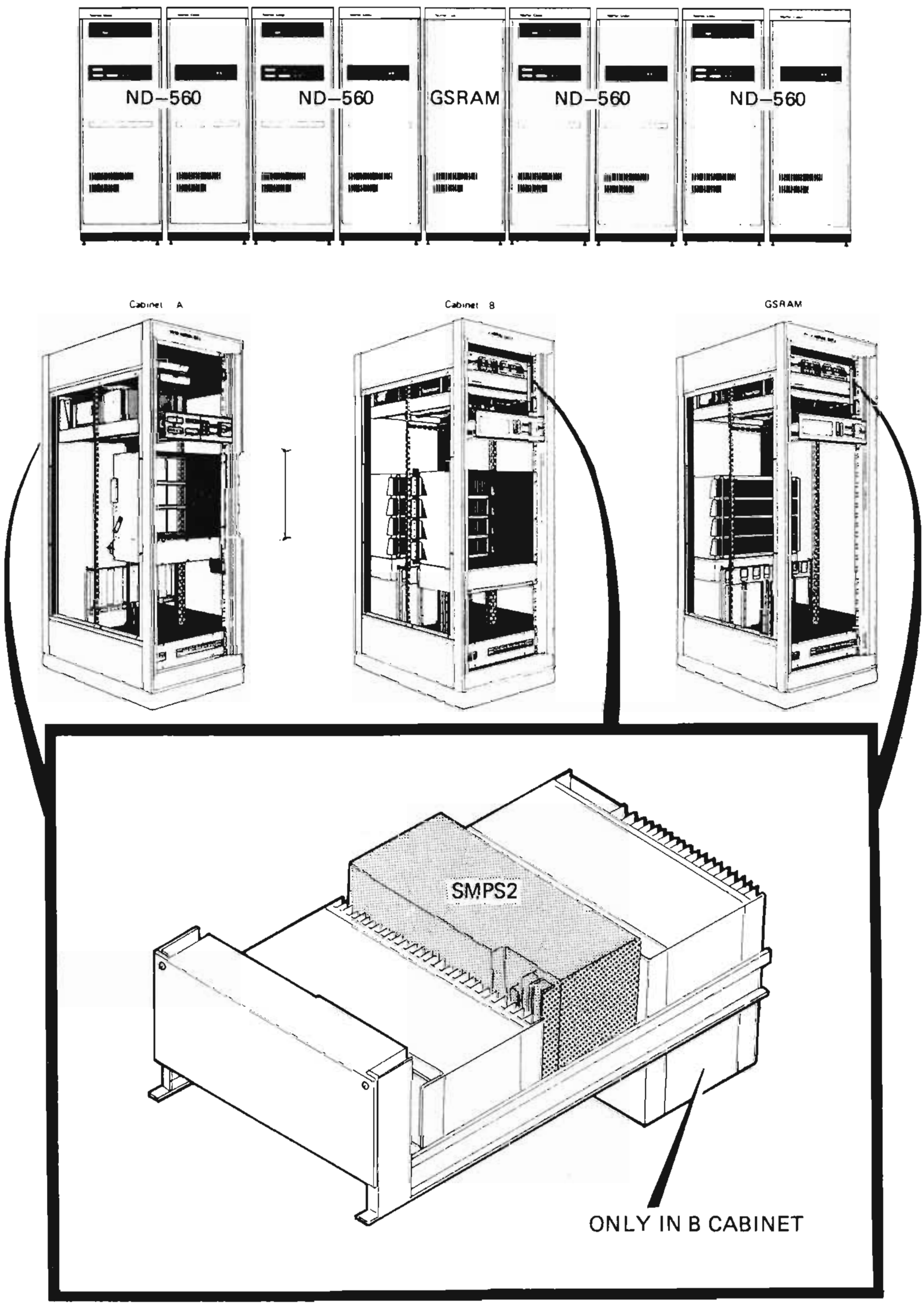

Figure 36. Location of the standby power supply

12V/4A Output	- Output voltage, factory adjusted:	12.00V
Output voltage with activated marginal switch	- Upper output voltage:	13.2V +-0.12V
	- Lower output voltage:	10.8V +-0.12V
	- Output current:	4A maximum
	Regulation static for worst case combination of line and load charge:	1%
	- Ripple, bandwidth 30MHz:	100mV ptp max.
	- Temperature coefficient, output voltage:	+-200ppM max.
	- Overvoltage protection:	13.5V - 15V
	- Overcurrent protection:	4.5A - 6.5A
	- Short-circuit current:	1.5A
5V/25A, 12V/4A	- Hold-up time, full load both outputs, fully charged battery	12 min. minimum
	- Battery charge up time	24 hours
Battery discharge indication	Approximately 10mA output current for activation of LED while battery is being discharged.	
Power fail indication	Phototransistor in photocoupler deactivated at loss of AC input. Load current 1.6 mA maximum.	
Overtemperature indication	Thermostat opens when ambient temperature exceeds 60^0C.	

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2.5 INDIVIDUAL UNITS IN CABINET B

2.5.1 ND-066, 27-POSITION CARD CRATE FOR ND-500

For detailed description, refer to the following manual(s):	
No.:	*Title:*
ND-30.014	*ND-500 Hardware Maintenance Manual*

The card crate is a 19" standard rack mount module. At the back of the crate there are four backplane cards for interconnection. The buses are named A,B,C and D bus.

Physical dimensions are:

- width: 440 mm
- height: 548 mm
- depth: 328 mm

The crate is mounted in the front of the cabinet.

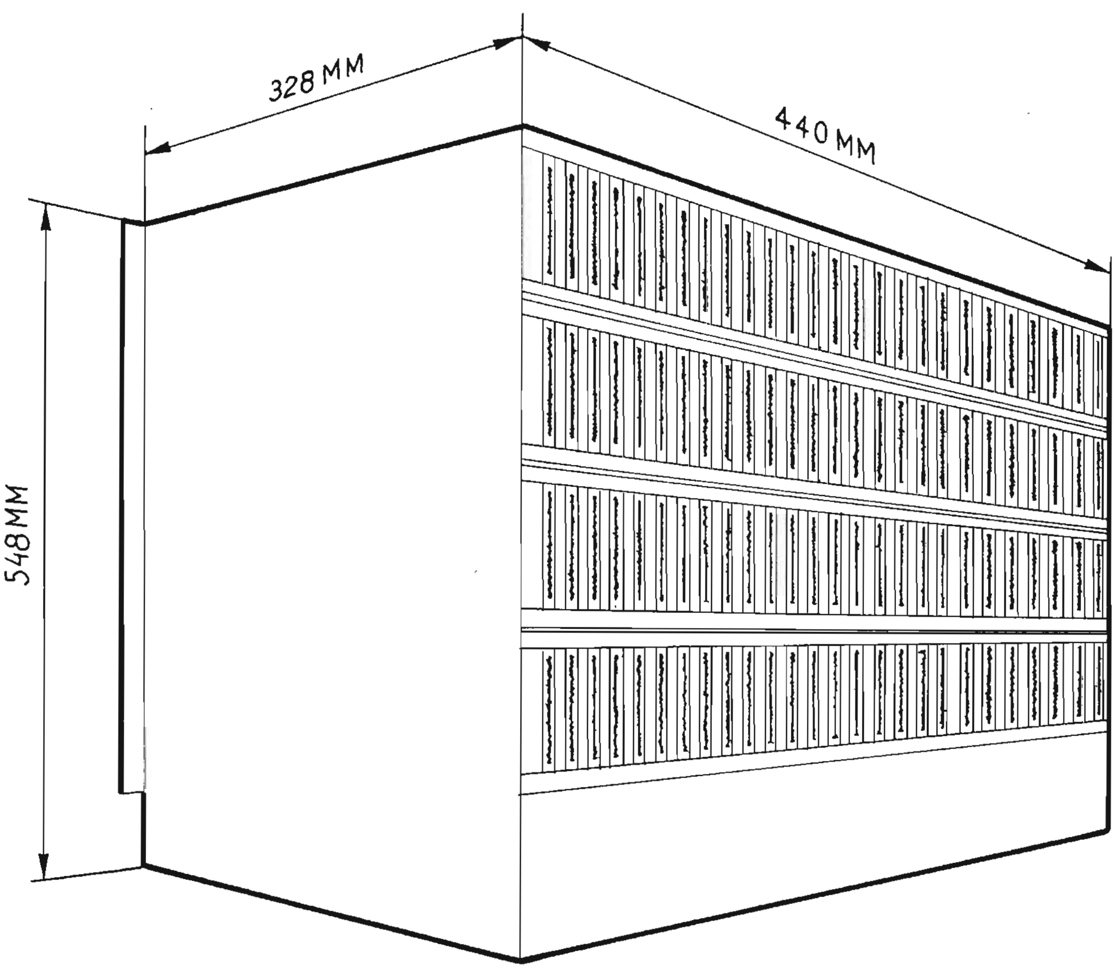

Figure 37. The 27-position card crate for ND-500

2.5.2 ND-061/ND-062, CACHE MEMORY SYSTEM FOR ND-500

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-05.011	*ND-500 Hardware Description*

The cache is a memory buffer located between the main memory and the CPU. The contents of the cache will at all times be a copy of the data most recently processed.

The idea behind cache is that recently used data will soon be needed again, and should therefore be readily available to the CPU in order to increase operating speed.

The ND-500 cache memory module (ND-062) consists of two identical cards, one for DATA and one for INSTRUCTIONS. If required, the system can be expanded by adding one or more ND-062 modules. The additional modules are used for data only.

Addressing is done with the virtual or logical addresses generated in the address arithmetic on the CPU slice cards. Since the cache system is not addressed by physical addresses, a separate cache directory module (ND-061) is needed. This module consists of two identical cards which control the DATA CACHE and INSTRUCTIONS CACHE respectively. See fig. 39, Block diagram of ND-500/1 cache system.

Each cache card, including the directory cards, has a high-speed static memory of 4 bytes x 4096 words.

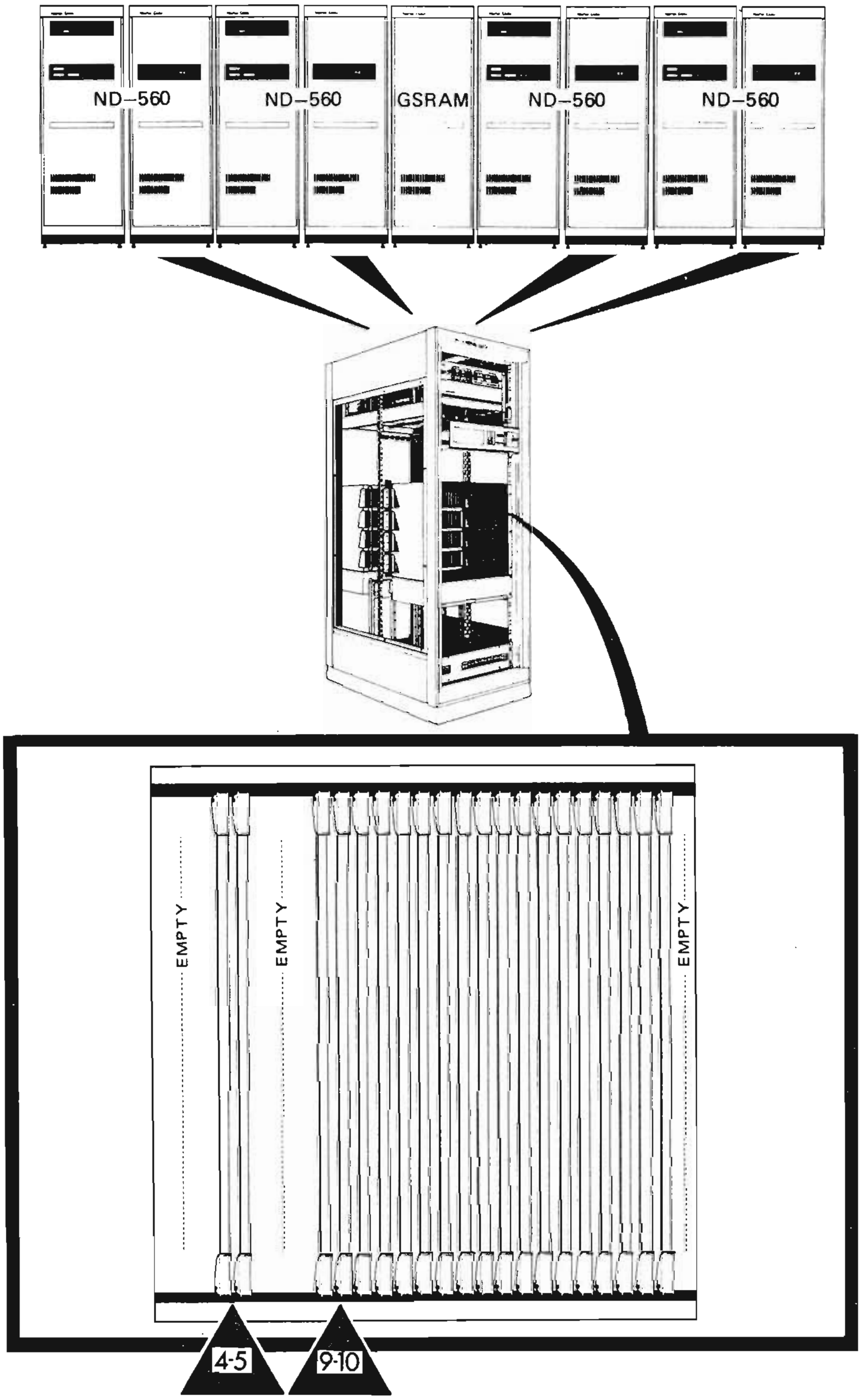

Figure 38. Location of the cache module

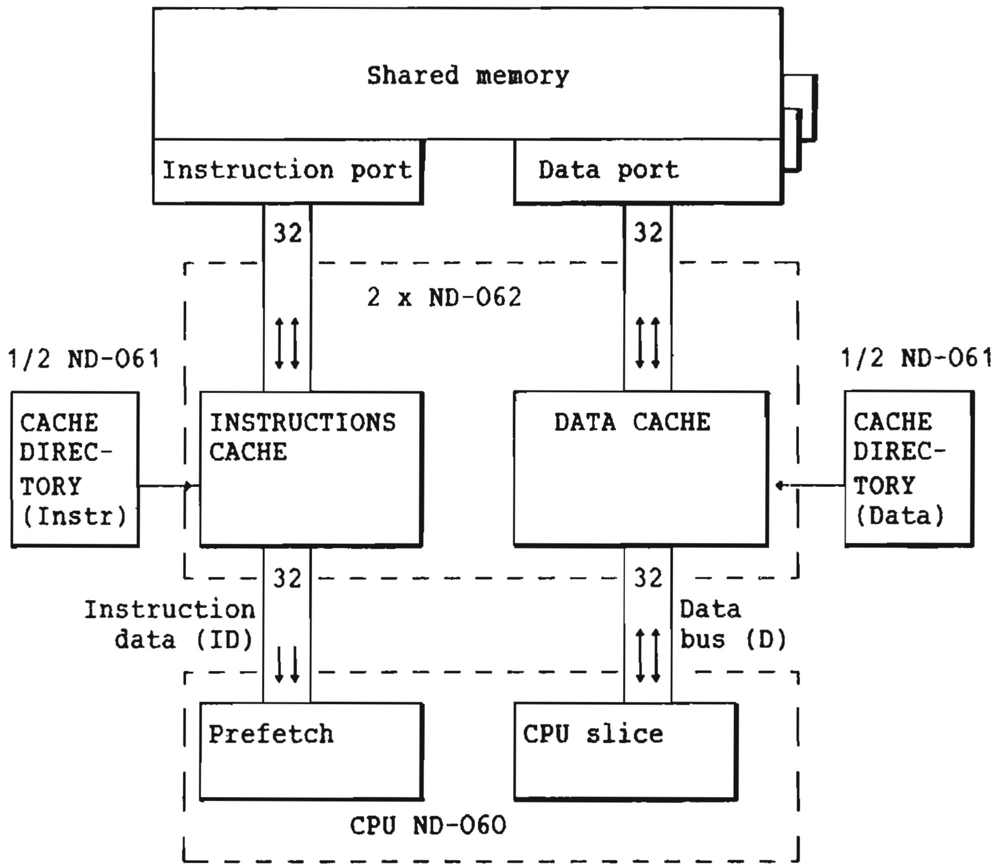

Figure 39. Block diagram of ND-500/1 cache system

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2.5.3 ND-063, MEMORY MANAGEMENT SYSTEM FOR ND-500 (2 CARDS)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-05.011	*ND-500 Hardware Description*

Instruction and data MMS

There are two, identical memory management systems in the ND-500, one for instructions and one for data.

The MMS maps the 32-bit logical byte address into a 25-bit physical byte address used when addressing main memory. The system acts as a protect mechanism for sections of memory that can be read-only, system data, etc.

The 4 gigabyte address space is divided into 32 segments, with a paging substructure for dynamic allocation of physical memory. Memory protection is performed on the segment level. The memory management system also extends the logical address range to 2^{40} bytes, by allowing each process (or user) to access a maximum of 256 domains, each of 4 gigabytes.

Logical to physical address

To convert the logical address to a physical address, a multi-level table look-up procedure is used. In order to speed up this procedure, a copy of the most recently used address conversions are kept in a separate buffer memory.

The access to cache memory for data or instructions and the access to the address translation buffer are done simultaneously. If the cache does not contain the desired address conversion, the multiple table look-up procedure is performed by the ND-500 microprogram.

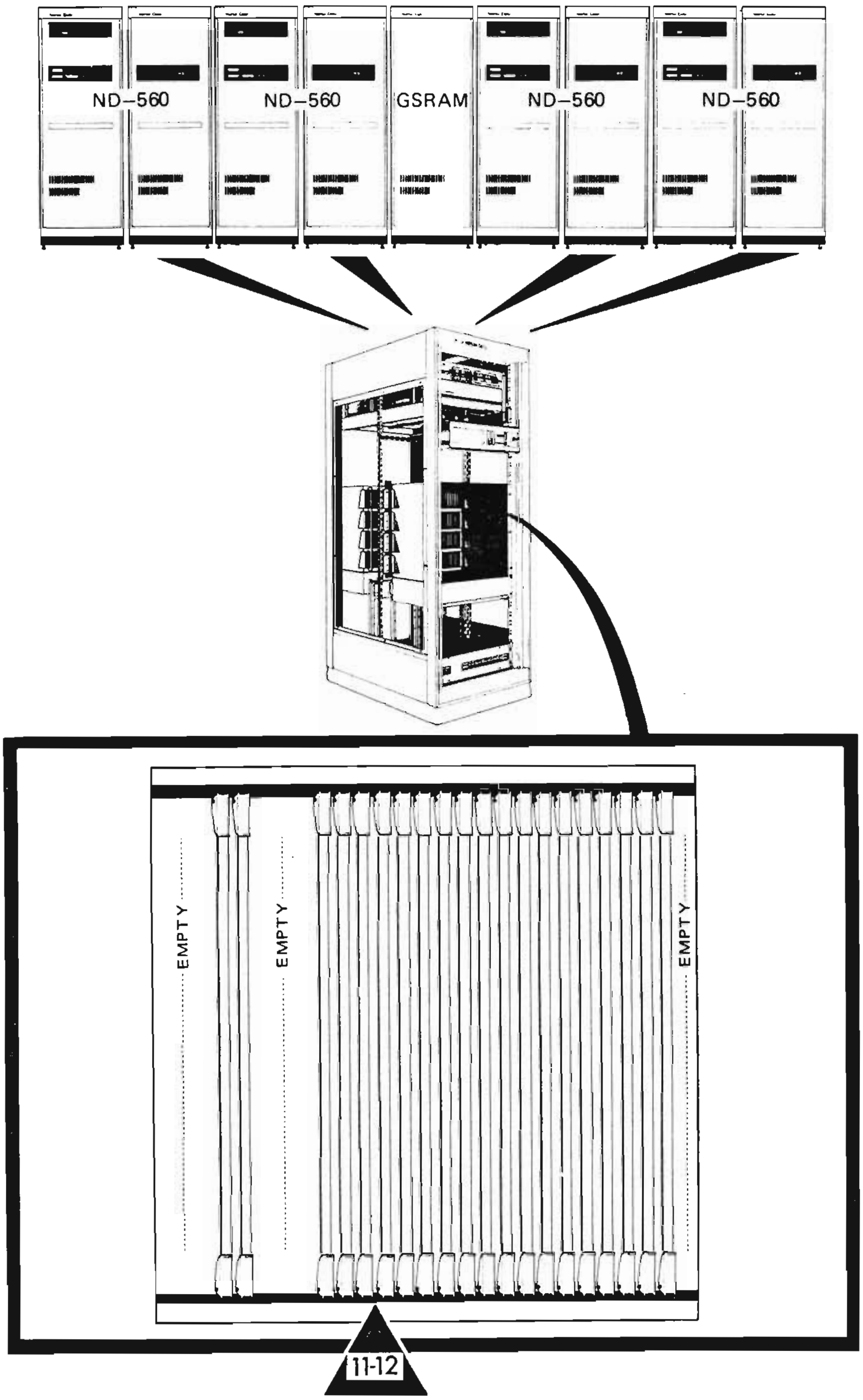

Figure 40. Location of the memory management modules

2.5.4 ND-060, CPU FOR ND-500 (14 CARDS)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-05.011	*ND-500 Hardware Description*

INTRODUCTION

The ND-500/1 CPU is a complex 32-bit CPU with 3 processors. These are the MAIN PROCESSOR, the OPERAND PROCESSOR and the INSTRUCTION PROCESSOR. The 32-bit ND-500/1 has extensive hardware for data manipulation, address calculation, data storage/retrieval, instruction decoding/execution control, instruction storage/retrieval, error detection (trapping), error tracing (debugging) and communication.

REGISTERS

The ND-500 CPU has a set of special purpose and general purpose registers accessible by the programmer as well as a "scratch-pad" register file accessible only by the microprogram.

The user accessible registers are as follows:

- P-register (program counter register) 32 bits, holds the logical address
- L-register (link register) 32 bits, used for subroutine returns and linking
- B-register (base register) 32 bits, used for local addressing
- R-register (record-base register) 32 bits, also used for addressing records

The R1, R2, R3 and R4 General Purpose Registers are 32-bit registers used for index registers while addressing or as general purpose registers for data manipulations.

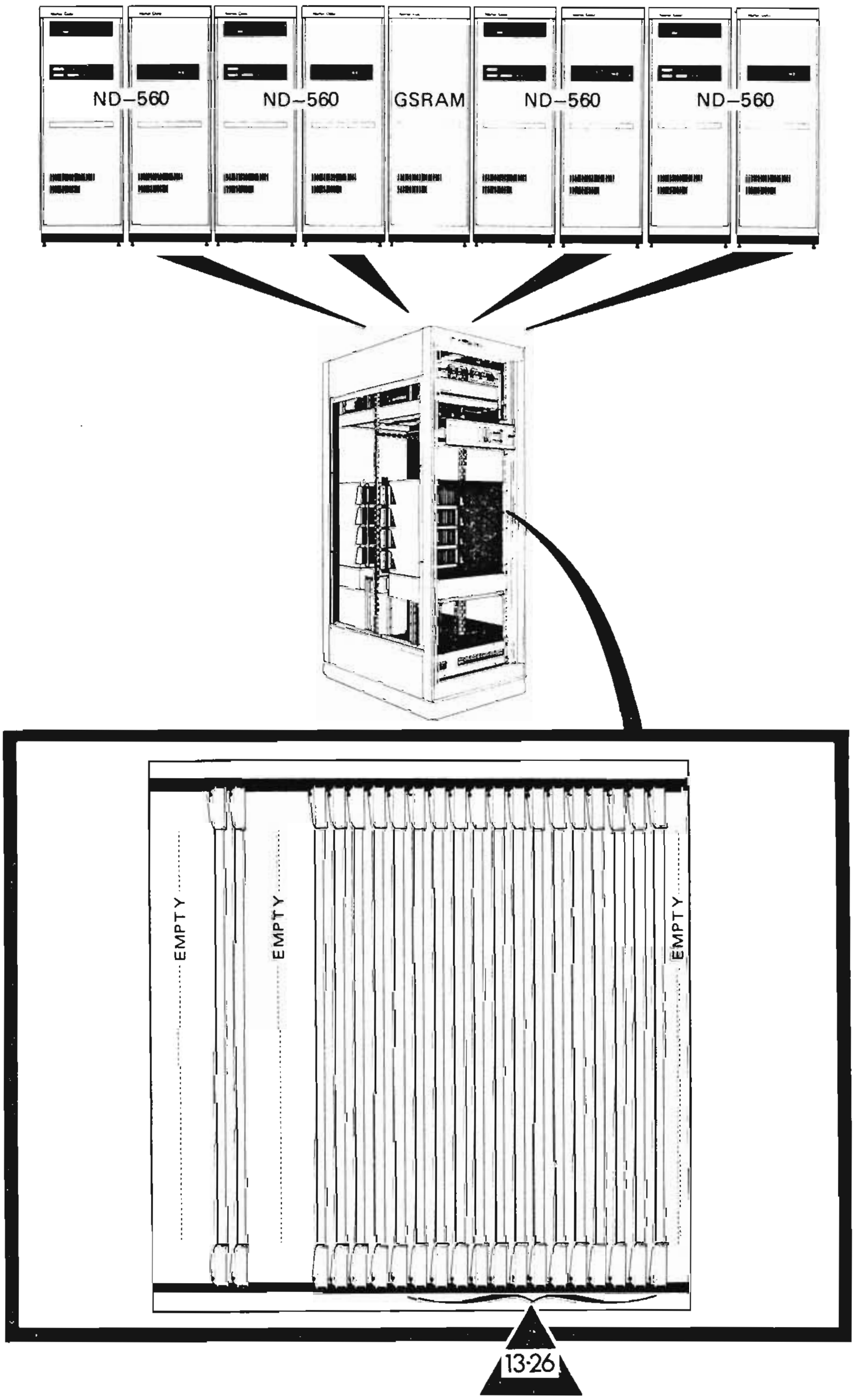

Figure 41. Location of the ND-500 CPU

The D1, D2, D3 and D4 Accumulators are 64-bit registers used for floating point arithmetic. These registers are addressed by the microprogram as eight 32-bit registers A1, A2, A3, A4, E1, E2, E3, E4.

In addition, there are the following special purpose registers:

- ST Status register (64 bits)
- OTE Own Trap Enable register (64 bits)
- CTE Child Trap Enable
- TEMM Trap Enable Modification Mask
- TOS "Top-Of-Stack" register (32 bits)
- LL Low Limit trap (32 bits)
- HL High Limit trap (32 bits)
- THA Trap Handler Address register (32 bits)

2.5.4.1 PREFETCH PROCESSOR

This processor handles the pre-decoding and assembling of machine level instructions in the pipeline, as well as initiating data fetch cycles for memory reference instructions.

The prefetch processor always keeps the instruction and data pipelines full, to ensure minimum idle time for the Instruction Processor and hence maximum execution speed.

2.5.4.2 TRAP SYSTEM

There is a set of conditions that can be specified in the Trap Register where the program in the ND-500 can be forced to branch to certain places in memory. These traps are conditions such as: overflow-on-branch (trace), always trap (to single step and trace a program) and others. There are a total of 33 traps that can be specified for program control at run-time.

2.5.4.3 CONTROL STORE

This memory unit contains the microcode for executing instructions at machine-code level. The control-store word is exceptionally wide and wraps the majority of instructions into only one microcycle.

The standard instruction set, as well as special routines for memory management, context switching and communication with the ND-100/CX supervisor, are implemented in approximately 72 Kbytes.

2.5.4.4 ARITHMETIC LOGIC UNIT

The Arithmetic Logic Unit (ALU) is the heart of the Main Processor, and performs specified operations on the data of specified registers.

2.5.4.5 FLOATING POINT HARDWARE

This is a set of specialized hardware controlled by the Main Processor in the ND-500. This unit will perform all floating point arithmetic as well as integer multiply, shift and divide, at hardware speeds.

This hardware contains accumulators for temporary storage of results and can be used effectively for combined operations, such as multiplication of many elements, etc.

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2.5.5 ND-386, SINGLE BANK CARD CRATE, MPM-5

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-10.005	*MPM-5 Bus Description*

The card crate positions are numbered from 0 to 26. The card crate is positioned at the back of the ND-500 cabinet and can be tilted out to get into the I/O connections at the back of the crate. The crate has four backplane buses called the A,B,C and D bus. The B,C and D buses have I/O connections. Physical dimensions:

- width: 440 mm
- height: 548 mm
- depth: 328 mm

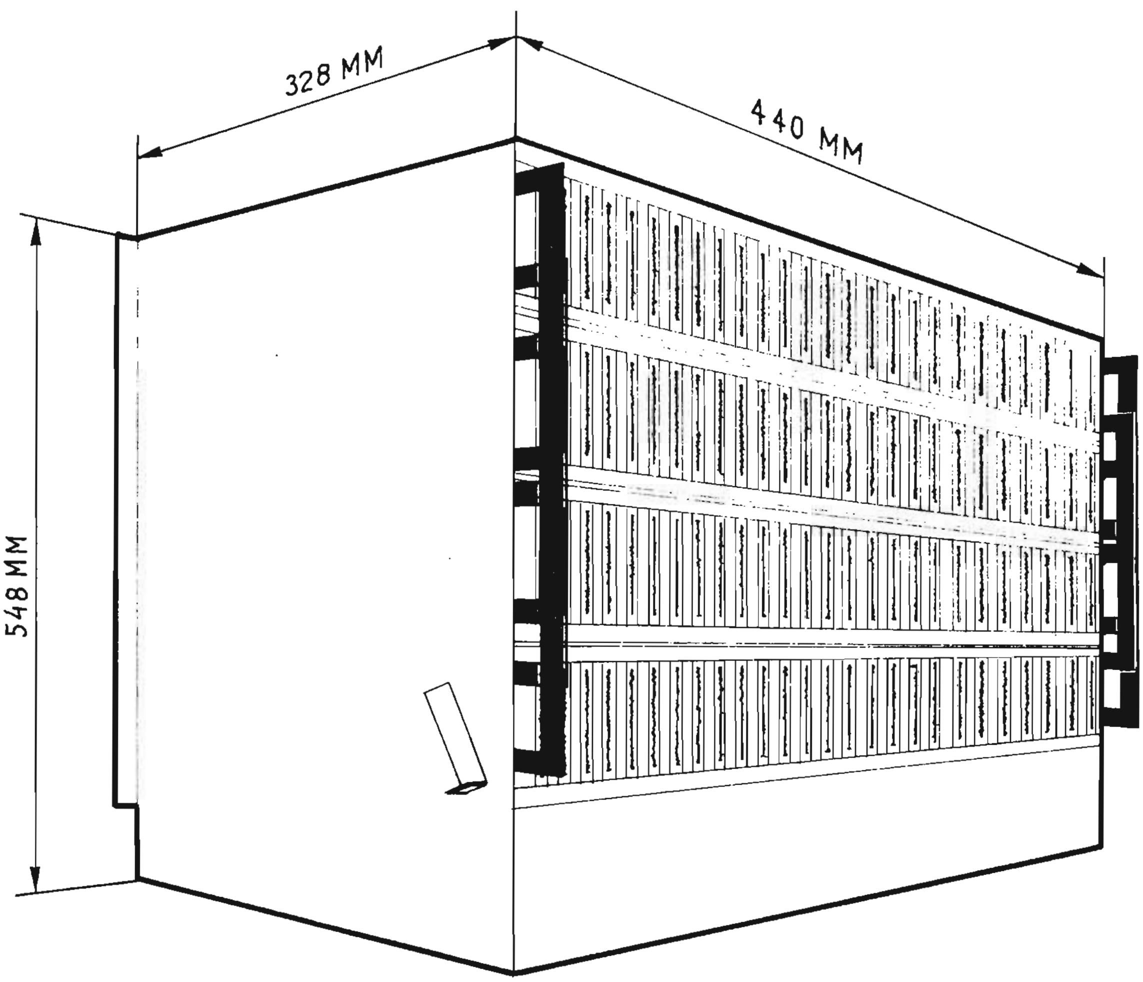

Figure 42. The single bank card crate for MPM-5

2.5.6 ND-381, CONTROL CARD, MULTIPORT MEMORY 5 (MPM-5)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-10.005	*MPM-5 Bus Descriptions*

Data bus

A 32-bit + 4 parity bits data bus exchanges data between the port and the dynamic RAM modules. The bus accepts 1,2,3 or 4 bytes to be written but reads the whole 32-bit width. The maintenance processor uses the data bus for setting limit/control parameters on the port and the memory modules and for reading status information.

Address bus

The 30-bit wide address bus addresses the memory word and four lines address the byte within the word. Parity on the address line is optional. The maintenance processor addresses the various registers on the ports or memory modules with the address bus.

There are 16 request lines in the MP-bus, one for each of the ports (max.15) in a bank and one internal on the controller module. When requesting, a GRANT signal is received.

Maintenance processor

The controller module always occupies the leftmost position in the MP-bus. In a 25-position bank, ports may be installed in the 15 positions nearest to the controller. Memory modules and line drivers may be installed in any of the 24 positions.

The controller module is divided into two sections which are described here as the maintenance processor and the bus controller. The maintenance processor MC 68000 on the controller module communicates with a printer terminal. The processor supports the port(s) and the memory module(s) with configuration parameters such as address limits and control information.

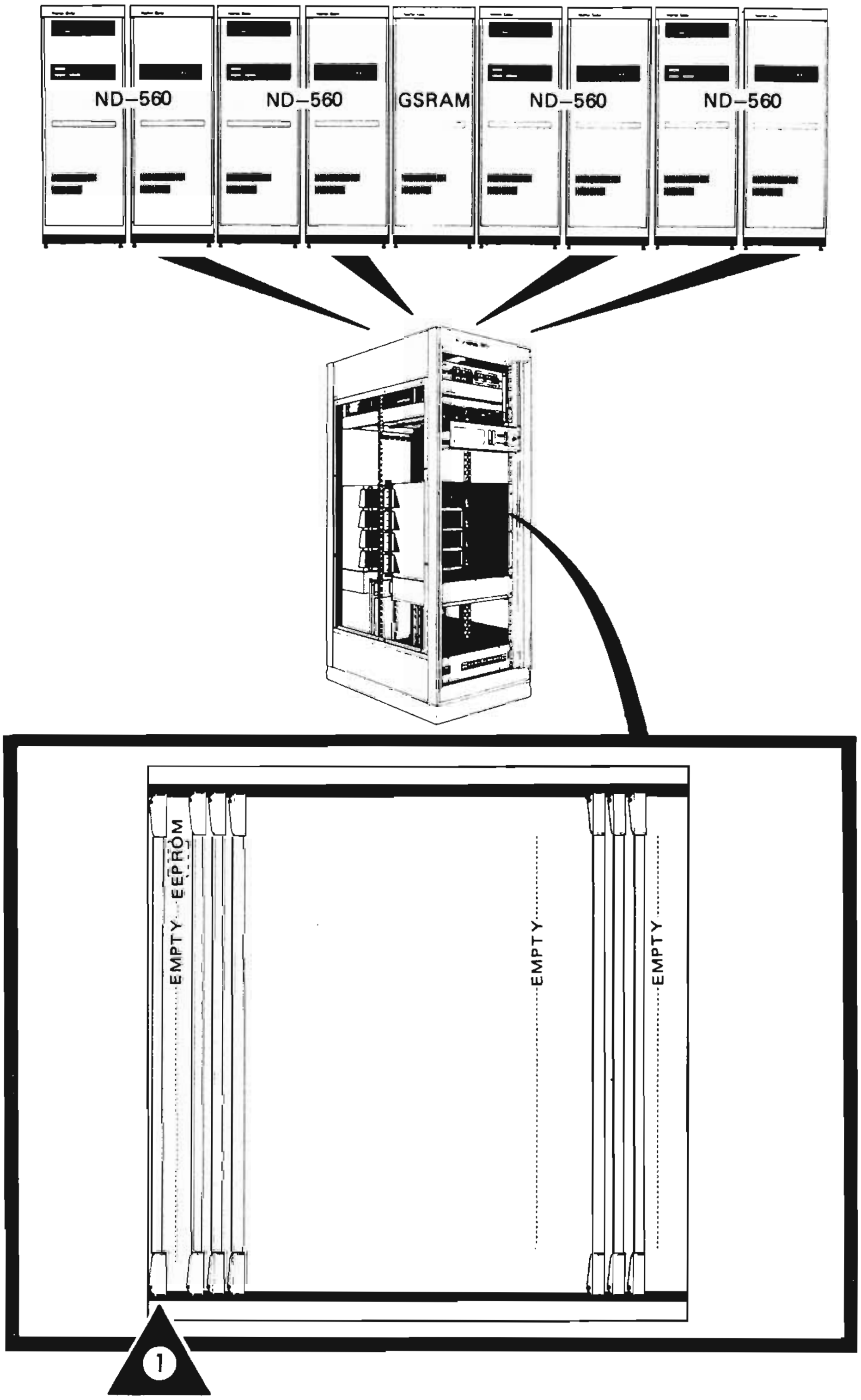

Figure 43. Location of the MPM-5 control card

Vital parameters and information are stored in an EEPROM in the backwiring. After a hard power failure, this EEPROM supplies ports and memory modules with vital parameters and information. The maintenance processor also continuously scans the memory to detect possible errors. Error messages appear on the printer terminal. Error messages may be sent to other CPUs or controllers via the octobus driver. In this way all error messages can be directed to one printer terminal.

Bus controller

The bus controller section allocates the address and the data buses to the ports according to the request signals received. The priority between the ports may be rotational or fixed (given by the position in the crate). The memory modules receive a syncronized refresh signal generated in the bus controller section.

2.5.7 ND-383, 16/32-BIT PORT CARD, MPM-5

For detailed description, refer to the following manual(s):	
No.:	*Title:*
ND-10.004	*MPM-5 Tecnical Description*

INTRODUCTION

The twin 16-bit port module serves as the communication link between a requesting source and the memory. The module accepts one address cable with up to 29 address bits (addressing 32-bit words) and two data cables of 16 bits + 2 parity bits each.

Lock signal

The LOCK signal prevents the bus arbiter from reallocation during two subsequent cycles. With this signal active, the port will have two memory cycles without any other source being able to change the memory content in between. This feature may be used for inter-processor signalling.

Correct setting of the lower, upper and base limit switches enables the port to see all or part of the local memory.

FEATURES

The modules contains:

- Address range registers (lower and upper)
- Base address register
- Interleave shift matrix
- Address range compare logic
- Write and read parity check

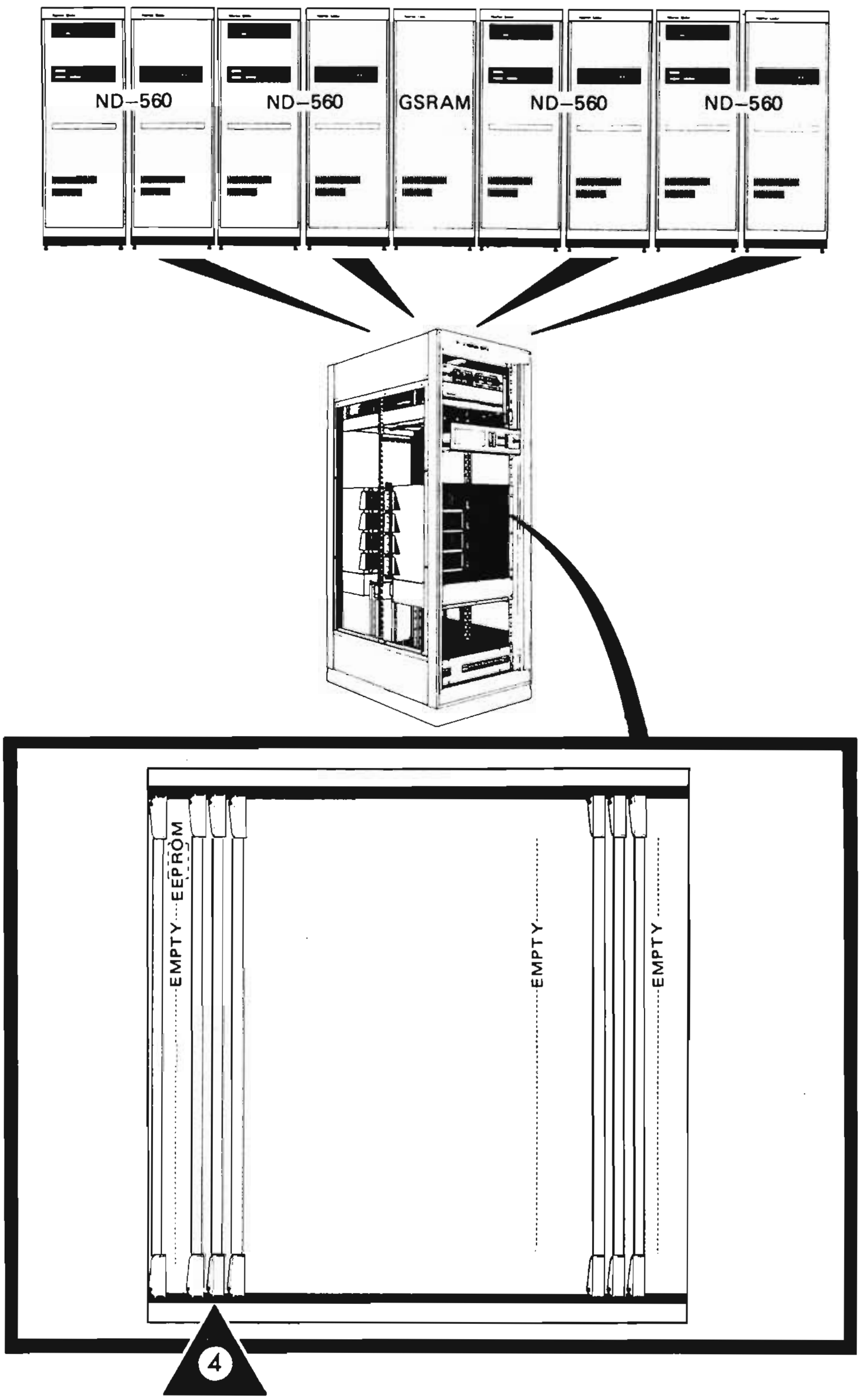

Figure 44. Location of the 16/32-bit port card for MPM-5

2.5.8 ND-382, 1 MB MEMORY CARD, MPM-5

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-10.004	*MPM-5 Tecnical Description*

The size of the memory modules is 1 Mbyte. The memory is organized as a 32-bit wide memory with 7 bits for error correction which corrects single errors and detects multiple errors. An EEPROM keeps a record of detected errors. For maintenance purposes, the error correction network may be disabled with a switch.

The first address plus the size of the module are displayed at the front. In case of a malfunction in the controller module or in the MP-bus during a power failure, the memory chips are refreshed locally on the module.

In the ND-560 configurations, the memory is regarded as a 2 x 16-bit memory. The ND-100 and any 16-bit source do a "read-modify-write" cycle internally on the module when accessing 16 bits in the memory.

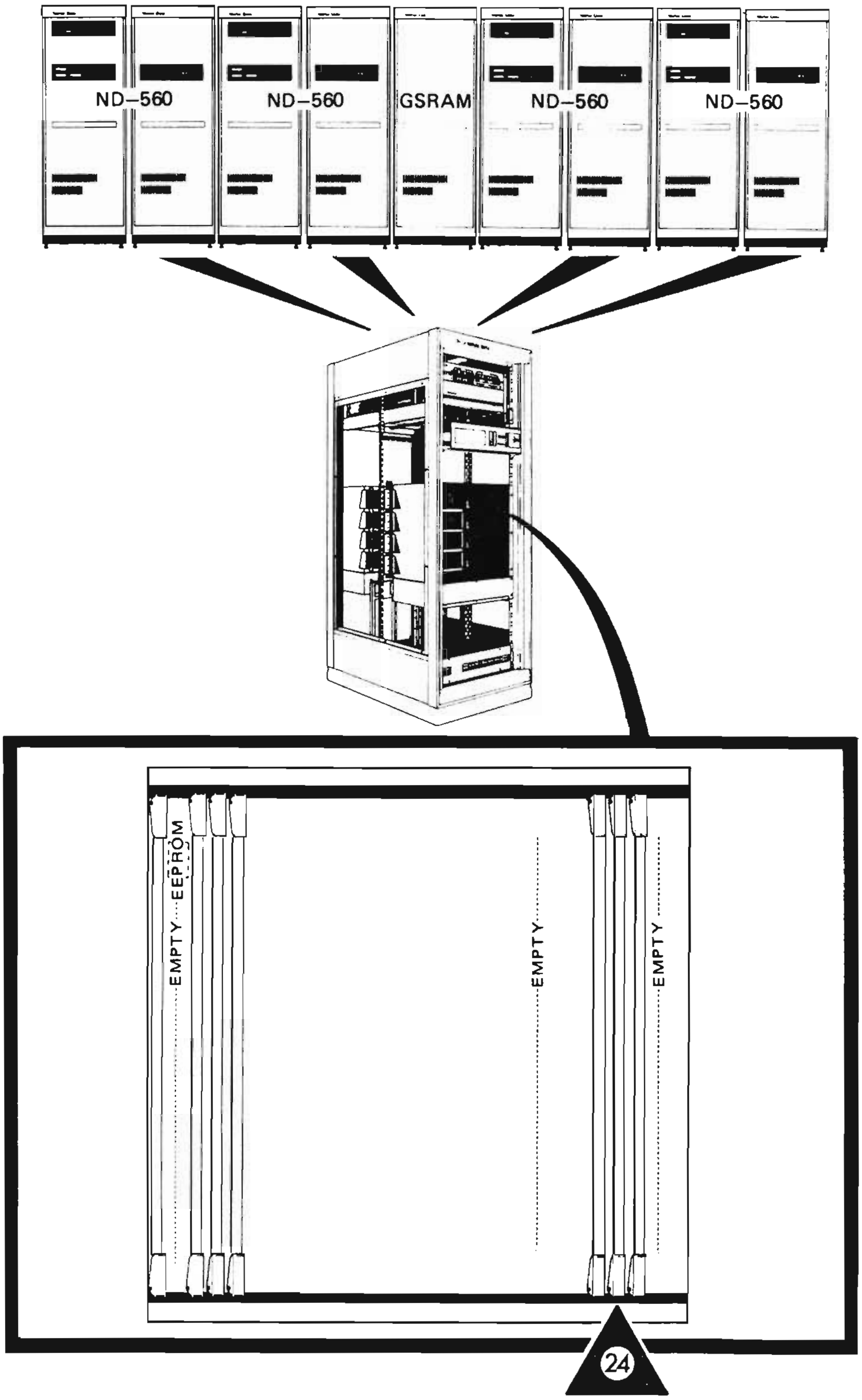

Figure 45. Location of the 1 Mb memory card

2.6 PERIPHERALS

2.6.1 ND-230E, PRINTER TERMINAL

For detailed description, refer to the following manual(s):

No.:	*Title:*
Vendor 2207425-9701	*OMNI 825 KSR Terminal*

INTRODUCTION

The ND-230 printer terminal can function as an interactive terminal or as an error-logging device.

It has a full alphanumeric, typewriter-like ASCII keyboard and can communicate serial, asynchronous data at rates from 110 to 600 baud.

FEATURES

- 75 characters per second optimized bi-directional printing
- 9X7 dot matrix character font
- 132 character positions per line
- full ASCII 128-character set
- standard typewriter-like full ASCII keyboard
- 3 to 15 inch adjustable wide carriage
- paper feed from rear or bottom
- paper/out and paper/jam indicator
- 6 or 8 lines per inch
- auto perforation skipover

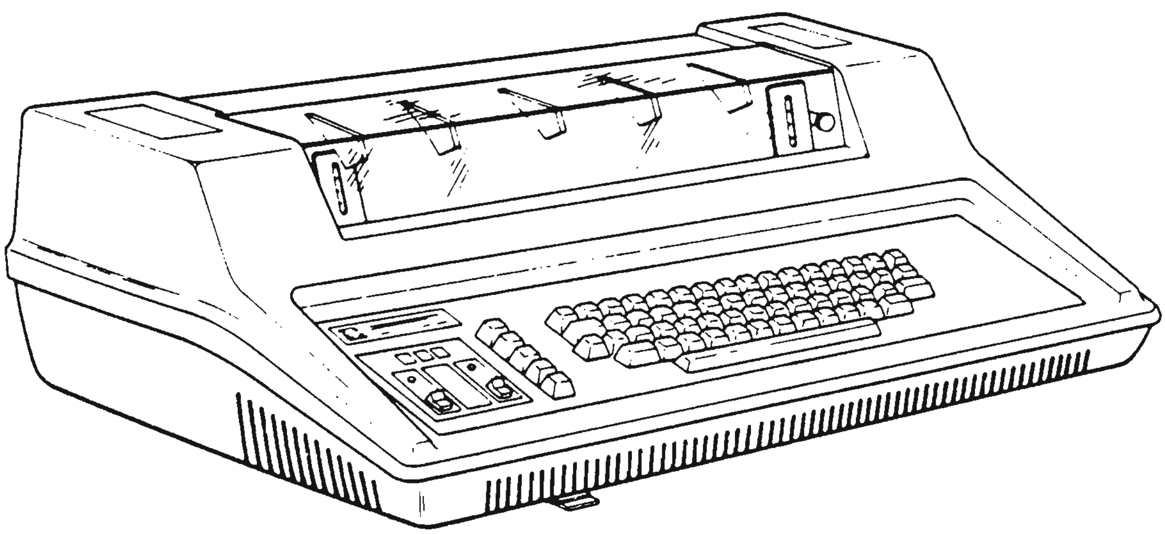

Figure 46. The ND-230E printer terminal

2.6.2 ND-242E, DISPLAY TERMINAL, TANDBERG, CURRENT LOOP/V.24

For detailed description, refer to the following manual(s):

No.:	*Title:*
Vendor Publ. 5223	*TDV 2200/9 S User's Guide*
Publ. 5384	*Specifications & Installation Guide*

INTRODUCTION

As shown in figure 47, there are two types of display terminals (TDV 2215) providing an
2 adjustable stand to accomodate people of different sizes. It may be swivelled and tilted to avoid interference from window and overhead lighting and the height may be adjusted to provide best possible viewing and sitting comfort. The keyboard is moveable and has a low profile enabling it to be used on a standard office desk. The large 15" diagonal screen is treated to reduce reflection and displays 25 lines of 80 characters in a 9x14 dot cell. By careful thermal engineering and low power consumption, a cooling fan is not required. The TDV 2215 operation is completely silent.

The TDV 2215 has non-volatile memory that the user can write to and erase (EAROM). Information stored in this memory stays there regardless of whether the power is on or off.

FEATURES

- The TDV 2215 can either be run in TDV 2115 compatible mode or extended mode in which additional features are available
- Insert, delete and erase functions
- Direct cursor addressing from host
- Cursor position report to host
- Local tab handling
- Local and remote printer control
- Optional one-page print buffer enabling printing to be done as a basic task

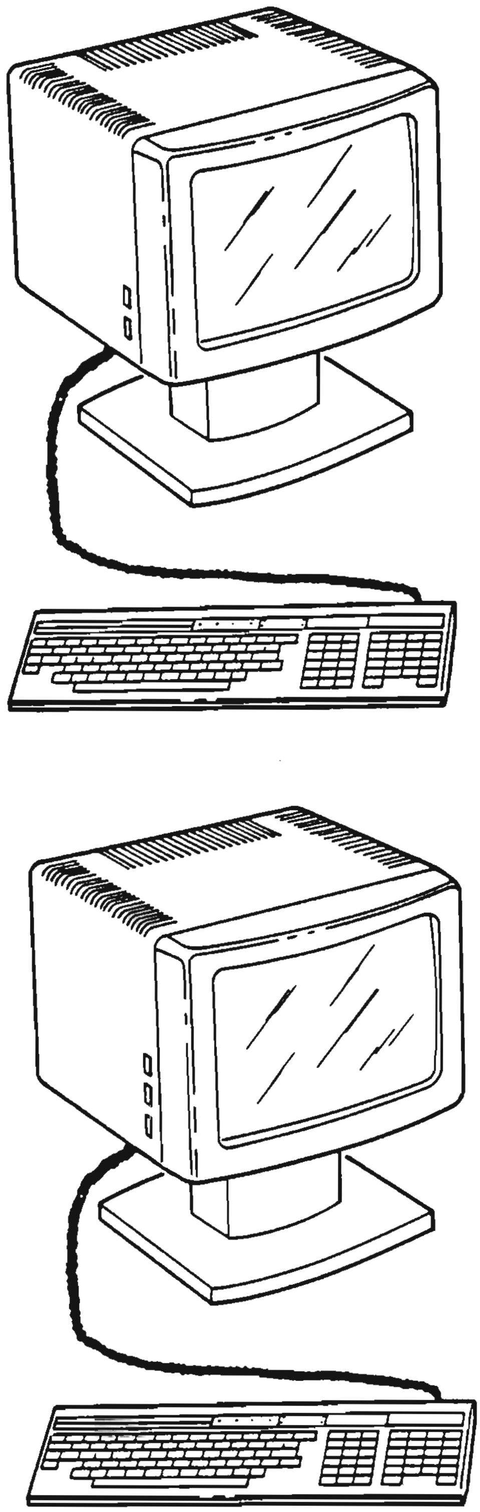

Figure 47. The ND-242E display terminal 2

PUSH-keys allow commonly used words or control strings to be transmitted by pushing a single key. The strings associated with PUSH-keys are stored in non-volatile memory and are not lost when power is turned off.

All switches reside in non-volatile memory ensuring that simple set-up is done using self-explanatory menus.

SPECIFICATIONS

Display Characteristics	
CRT	15" diagonal with bonded anti-reflex faceplate
Characters per line	80
Number of lines	25
Character matrix	7 x 9 dot characters in a 9 x 14 dot cell
Character set	Full uppercase and lowercase character sets are available in international, German, Swedish, Norwegian and Danish versions. All standard sets contain semigraphic characters for line drawing histograms, plotting and numeric subscript/superscript
Display modes	In addition to the TDV 2115 underline and attribute mode, the display mode can be controlled on a character-by-character basis
Refresh rate	50 Hz
Cursor	Underline blinking and steady block cursor are softswitch selectable
Control functions	
Cursor control	Cursor right Cursor left Cursor up Cursor down Cursor home Cursor position Request for cursor report
Scroll control	Scroll up Scroll down Soft or step scroll is selectable by soft-switch

Tab functions	Horizontal tab Backward horizontal tab Horizontal tab set Horizontal tab clear Clear all tabs
Editing function	Insert character Delete character Erase character Insert line Delete line Erase line (TDV 2115 mode) Erase in line Erase page (TDV 2115 mode) Erase in display
Soft-switch control	Set mode and reset mode
Push-key loading	16 PUSH-key strings can be loaded from the host These control functions allow a number of the soft-switches to be controlled remotely without affecting the setting the next time the power is switched on.
External controls	Both versions of the terminal contain an on/off control on the leftside of the unit. One version also has an intensity control allowing the user to adjust overall screen intensity. The other version also has controls to adjust the brightness of the display background. 2

2.6.3 ND-301, PAPER-TAPE READER

For detailed description, refer to the following manual(s):

No.:	*Title:*
Vendor 2540-M-500	*Paper-Tape Reader*

INTRODUCTION

The Comtec Digitronics Division Model 2540 Series Perforated Tape Reader is designed to read 5, 6, 7 or 8 level perforated tape in the forward or reverse direction at speeds up to 600 characters per second. The model 2540 combines a patented design read-head with integrated circuit channel amplifiers and results in a modern, accurate and reliable means for high-speed reading of perforated tape. The model 2540 converts information punched on tape into DC signal levels which are fully compatible with integrated circuit logic.

THE BASIC UNIT

The basic unit includes the read-head assembly which consists of an exciter lamp, collimating lens and the read-head with built-in discrete component preamplifiers for the sprocket channel and the data channels.

Its standard reading speed is 200, 300, 400 or 600 characters per second with a direct-drive capstan.

Type of tape

Paper, paper-mylar, aluminized mylar or solid mylar, 0.0025 to 0.005 inches thick, may be used with minor adjustment to pinch roller. Tapes with up to 40% transmissivity are acceptable without electrical adjustments.

Tape width

A three position, operator adjustable tape guide enables reading 11/16 to 1 inch (5 to 8 channel) tapes interchangeably. The tape guide is provided with a locking feature which prevents accidental moving of the guide. A slight realignment may be necessary when changing from 5 channel to 8 channel operation.

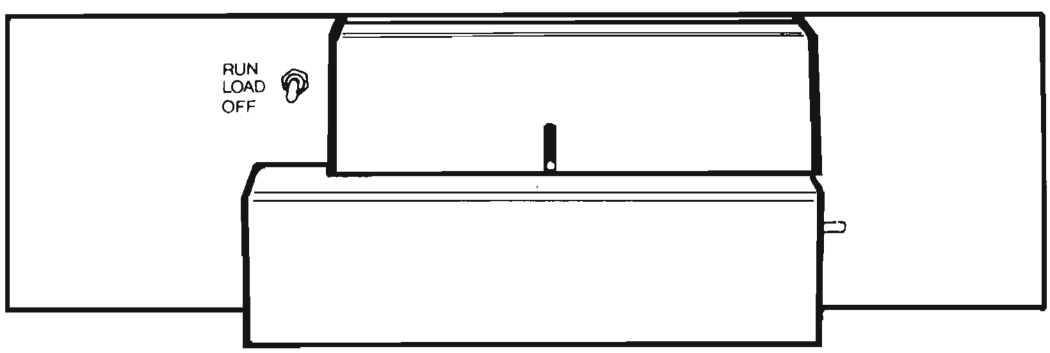

Figure 48. The paper-tape reader

Input tape form	Strip, reeled, fan-folded or loop with butt joints.
Tape perforations	According to EIA standards.
Tape loading	In -line.
Tape leader required	4 inches minimum.

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2.6.4 ND-303, PAPER-TAPE PUNCH, FACIT 4070

For detailed description, refer to the following manual(s):	
No.:	*Title:*
Vendor	*FACIT 4070 Tecnical description*

DESCRIPTION

The Facit 4070 is a compact, quiet-running tape punch operating at speeds up to 75 characters per second. It punches all types of standard tape for 5, 6, 7 or 8 tracks and is also available for punching 6-track typesetting tape.

The Facit 4070 tape punch consists of three main units. The punching and feeding unit, the tape supply and take-up unit and the control circuitry. The punching and feeding unit is easily exchangeable. It includes a stepper motor for feeding the tape by means of a capstan and a punching mechanism with solenoid-actuated punching pins. Only a few moving parts are used, reducing maintenance to a minimum. The punched tape may either be wound in the tape punch on the take-up flange or collected in a basket. Take-up direction is optional. For fan-folded tape handling, a special product - Facit 4017 - is available. All the electronics are built on a standard printed circuit board containing integrated circuits.

Control panel

A control panel is located on the top of the punch. This panel also contains voltage supply and tape-check pilot lamps. If the mains voltage supplied to the punch falls below a certain level, the current to the punching solenoids is automatically interrupted to eliminate punching errors. The amount of tape left on the supply flange is also checked and a lamp lights up when the tape is nearing the end.

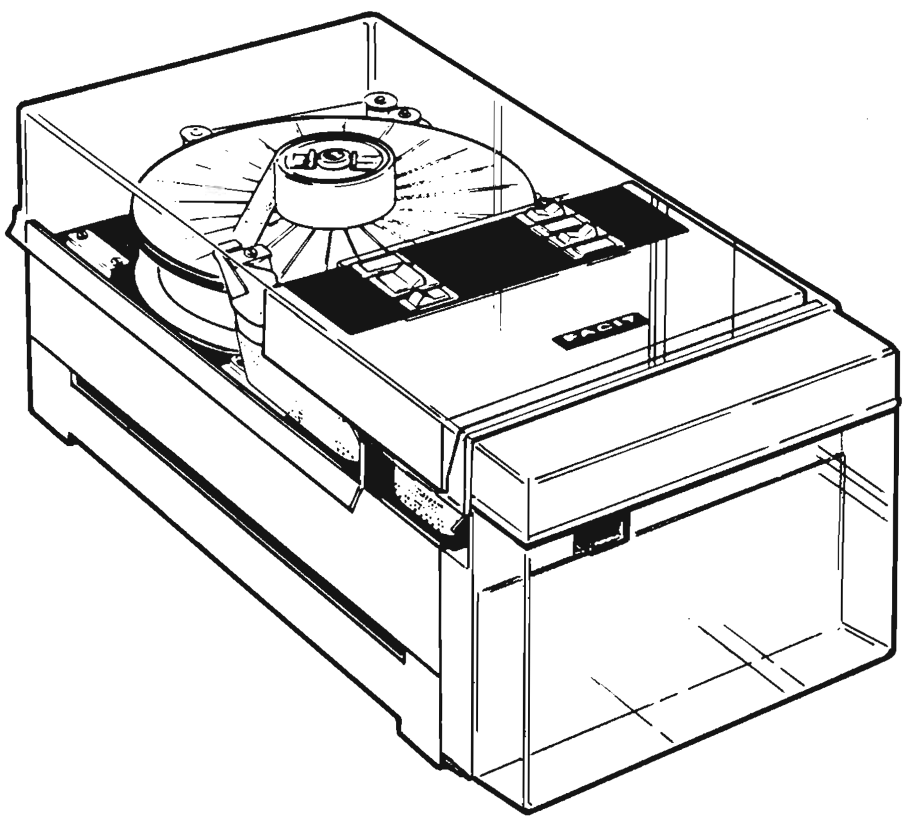


Figure 49. The paper-tape punch

Punching

Input data is gated to the punch in parallel with a punching signal. Punching speed is determined by the punching signal and can be varied between 0 and 75 characters per second. While punching is in progress, the punch emits a busy signal which also indicates that data has been received and stored in a buffer register in the tape punch.

Direction of tape feed is determined by a control signal to the punch. This also enables the tape to be moved backwards a number of steps permitting a correction, for example overpunching in manual routines.

The tape punch is fitted with a chad box in the front and a protective plastic cover at the top.

SPECIFICATIONS

Operation speed	Up to 75 characters per second
Tape feed	Asynchronous, externally controlled
Feed accuracy	Complies with ISO standards. Adjacent rows, 3%, 10 rows, 1%, 50 rows, 0.5%
Backspacing	Up to 10 steps
Punch hole	5-8 track ISO standard, 6-track
Configuration	Typesetting
Tape widths	5 track tape, 11/16 inch (17.5mm +/- 0.1mm) 8 track tape, 1 inch (25.4mm +/- 0.1mm). Alternatively 6 and 7 track, 7/8 inch (22.5mm +/- 0.1mm)
Thickness of tape	0.08-0.11 mm
Type of tape	ISO standardized paper tape. Paper/Mylar/Paper tape
Hub	50.8-52.4 mm cores (2") as standard. Other types on request.
Outer diameter of tape reel	Max. 203 mm (8")
Reel capacity	Approximately 300 meters corresponding to about 120,000 characters
Store	Built-in, stores one character (max. 9 bits)
Mark character	Customer selected. Usually an all hole delete character.
Noise level (cover on)	Idling nil 5 c/s punching one track 59 dBB 5 c/s punching all tracks 61 dBB 75 c/s punching one track 75 dBB 75 c/s punching all tracks 77 dBB

2.6.5 ND-432E, LINE PRINTER, 900 LPM

For detailed description, refer to the following manual(s):

No.:	*Title:*
Vendor 44684683	*Band Printer E-Series*

INTRODUCTION

The PB900 LPM line printer with controller electronics uses a metal band character font and a back impact printing process to produce printout one line at a time. The printer speed can vary according to the type of print band used. Actual speed is 900 LPM (Lines Per Minute). The printer may be operated from a 50 or 60 Hz power source. Voltage range is from 198 to 235 volts. The printer has a power protection arrangement.

PRINTING SPEED

The printing speed depends on the actual print band:

- 48 character band: 1130 LPM
- 64 character band: 900 LPM
- 96 character band: 660 LPM
- 128 character band: 500 LPM

ELECTRONICS

The band printer has a controller with compatible dataproduct interface. The controller consists of:

- Controller/Interface assembly
- Interface connector assembly
- Control panel assembly

The controller electronics is a microprocessor based printer interface. The 8085 microprocessor operates from a firmware PROM to load data, print and move paper. The executive routine determines if the printer is Ready and in On-Line mode. It will then enable the controller I/O interface TTL logic. This generates a demand signal to the data source. The data source then sets data on the interface bus and generates a data strobe.

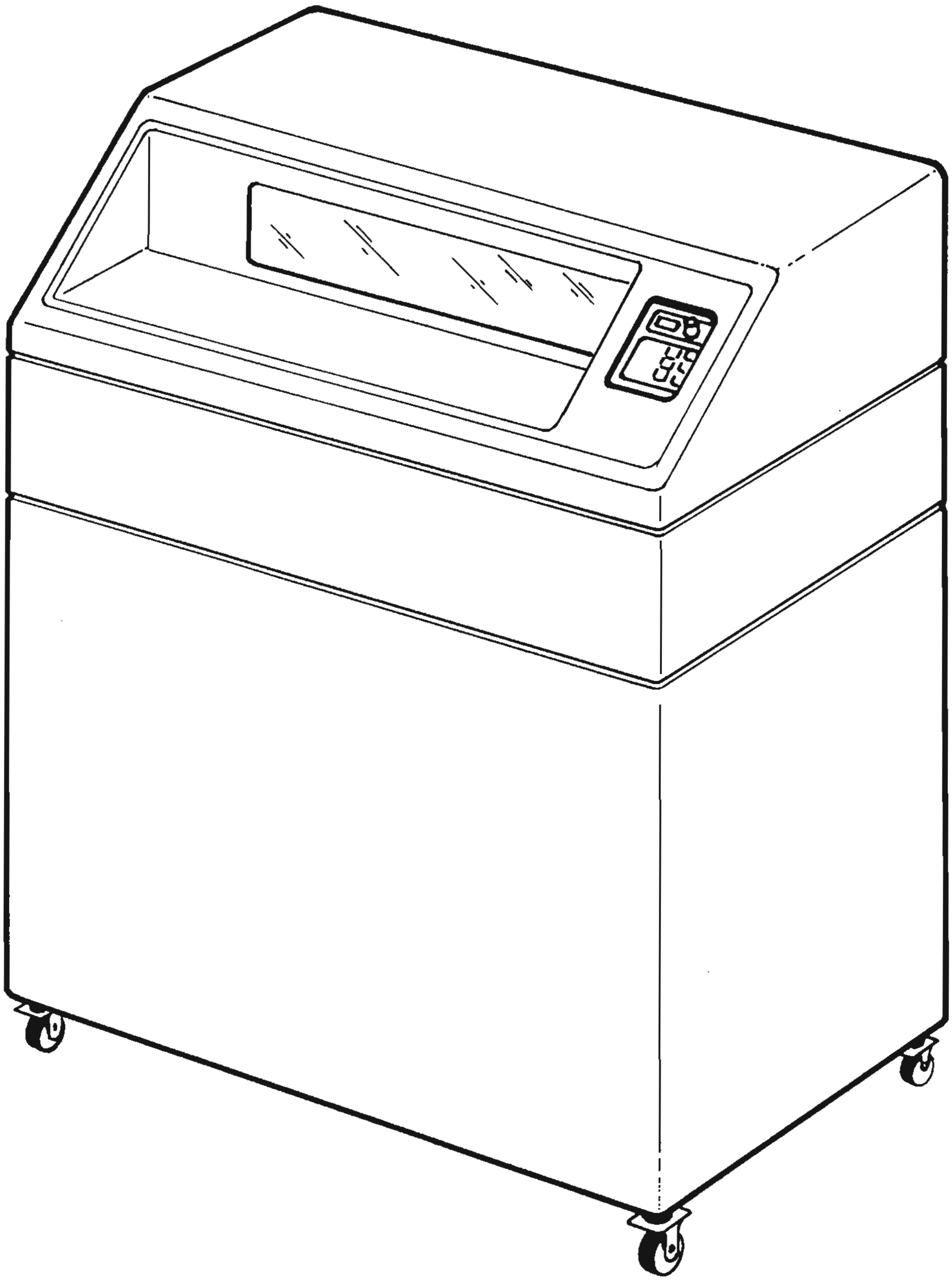


Figure 50. The line printer

The controller board incorporates a test printing feature as a standard means of testing both printing and mechanical motion systems.

Interface

Two types of interface connections exist:

- Long line controller interface with differential line drivers(19 lines). Drive capability 500 feet.

- Short line controller interface with 19 single ended interface lines in the printer interface connector. In addition, there are 4 interlocking control lines. The use of these lines depends on the interface to the computer system.

Print band

For each type of print band, a special PROM has to be selected. Selection is made with a switch on the print board.

Paper types

Paper width 4.00 to 16.75 in.

Paper length 8.00 to 14.00 in.

SPECIFICATIONS

Current:	Less than 5 A
Input power protection	Two poles of a 3 pole, dual purpose circuit breaker and on/off switch (located under the print gate) provides input power protection to the printer, and is rated as follows: - Full load = 15 A Rms - Trip = 19 A Rms
Operating temperature	50^0 to 95^0 F (10^0 to 35^0 C) - Operating 14^0 to 122^0 F (-10^0 to 50^0 C) - Storage
Relative humidity	20 to 80% Non Condensing - Operating 10 to 90% Non Condension - Storage

Sprocket drive holes	0.151 to 0.161 in (3.840 to 4.090 mm) diameter 0.247 to 0.253 in (6.270 to 6.430) mm from edge. 0.495 to 0.505 in (12.57 to 12.84) mm non-accumulative between hole centers
Maximum thickness of multipart forms	0.020 in (0.508 mm) maximum in the print area. 0.030 in (0.762 mm) maximum across crimp fastenings

NOTE

Refer to supplies section of CDC 44684668, Operator's Manual, for recommended forms

3 SOFTWARE CONFIGURATION AND DESCRIPTION

3.1 SOFTWARE OVERVIEW

This chapter contains brief descriptions of all the software supplied for the data processing subsystem. It includes the SINTRAN operating system, programming languages, word processing facilities and a variety of tools and utilities for use in developing applications.

Each software product is described briefly with its major features. A brief description of the relevant ND supplied manuals is also included.

3.2 SINTRAN OPERATING SYSTEM

3.2.1 SINTRAN III/VSX-500 (PRODUCT NUMBER: ND 10576)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-30.003	*SINTRAN III System Supervisor*
ND-60.051	*SINTRAN III Real Time Loader*
ND-60.125	*SINTRAN III Introduction*
ND-60.128	*SINTRAN III Reference Manual*
ND-60.132	*SINTRAN III Timesharing/Batch Guide*
ND-60.133	*SINTRAN III Real Time Guide*
ND-60.151	*SINTRAN III Utilities Manual*

INTRODUCTION

SINTRAN III is a family of general purpose, multimode, disk based operating systems.

Under SINTRAN III, the virtual memory, the multiprogramming and the resource sharing capabilities of the ND-500 series and the ND-100 series of computers are fully utilized.

SINTRAN III allows the concurrent execution of many different user and system programs in a multi-lingual environment. Depending upon available resources, up to 128 timesharing terminals may be supported simultaneously. The timesharing users are supported along with real-time process, local and remote batch tasks.

SINTRAN III is delivered in binary form on floppy disk ready for use, according to the actual hardware configuration and the customer's special software requirements. The user does not have to do any system generation.

FEATURES	- Simultaneous time-sharing, real-time, local and remote batch
	- Reentrant subsystems and real-time segments
	- On-line program development
	- Easy command language with parameter prompting and line editing facilities
Abbreviations	- All commands and programs may be referred to by any unique abbreviation
Security	- File management system with security and backup facilities
	- Exchangeable, self-contained disk volumes
	- Open architecture networking system (COSMOS)
	- Resource sharing - all peripherals available for all users both from terminals and programs
	- Output spooling
Usage reports	- Collection of accounting information and usage reports
	- Virtual storage system with dynamic memory allocation of up to 128 Mbytes
	- Physical memory for VSX-500 operating systems
	- Hardware controlled user/system protection.
	- Fast context switching
Power fail detecion	- Power fail detection and automatic restart
	- Full range of terminals, printers, disks, floppy disks, magnetic tape drives and a variety of special peripherals, such as paper-tape readers and punches.

PRODUCT DESCRIPTION

Operating Modes

The SINTRAN III system allows programs to be executed in three diferent modes, depending upon the application's requirements.

Real-time

Real-time processing is primarily used in applications where the data gathered during a physical process must be handled so rapidly that the results may influence the current process and/or the program needs more explicit control of resources, priorities, etc. The design philosophy of SINTRAN III has been, to a great extent, to support users in the implementation of real-time applications. The operating system takes full advantage of the advanced architecture of the ND-500 computers.

Programs may be scheduled for execution by any of the following:

- External events

- Program call

- Operator command

- Time of day, down to seconds

- After a certain period of time

Time-sharing

Time-sharing operation allows a number of users to communicate simultaneously with the computer. Through time-slicing, each user gets an equal share of processor time.

Time-sharing facilities may be used for on-line program development, information retrieval, computer aided instruction and other applications where the user needs to access the system directly.

On-line

On-line program development allows the individual programmer to edit a program, to compile it using the appropriate language compiler and to test directly without interfering with other users. In this way the time and cost of implementing an application system are reduced.

Batch

The SINTRAN III time-sharing users may also submit jobs from their terminals for batch processing. Real-time and time-sharing jobs will execute independently of any batch jobs. Batch operations under SINTRAN III include both multiple local batch streams and remote batch emulator packages.

File management system

The File Management System allows different types of mass storage devices such as disk and magnetic tapes, floppy disks and their types of peripheral units, to be handled in a uniform manner. Users may access files and peripheral units by using selected names, both from their terminals and from programs. This gives a high degree of device independence.

The File Management System also provides functions like on-line backup, retrieval of versions or old copies, and copying of file directories and individual files. Each file-directory, which may reside on a disk, contains a list of the users whose files are present in it, along with the file protection information assigned to the individual files. File directories may easily be entered and released and may be transported to, and used on, other installations.

HARDWARE REQUIREMENTS

The SINTRAN III operates on ND computers with a variety of peripherals and mass storage devices. The minimum hardware configuration required is:

- Disk with controller
- Floppy disk
- Printer terminal

3.2.2 SINTRAN III/VSE SPOOLING SYSTEM (PRODUCT NUMBER: ND 10049)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-30.003	*SINTRAN III System Supervisor*
ND-30.025	*COSMOS Operator Guide*
ND-60.128	*SINTRAN III Reference Manual*
ND-60.132	*SINTRAN III Timesharing/Batch Guide*

INTRODUCTION

In a multi-user system it is necessary to share common resources, like line printers and magnetic tapes, which are too expensive to be individually assigned. Even if each user has a hardcopy terminal, there are occasions when a large amount of printing is required. It is both inconvenient and expensive for the user to have to wait until a line printer is free. For this reason, the concept of "virtual" line printers is implemented in the ND File System.

When a user or a program writes data to the line printer, a disk file is assigned. Information is transferred in the same way as if a physical line printer had been assigned. Afterwards, the operating system automatically appends the disk file to a spooling queue; that is, the job is put at the end of the queue. The information will be printed on the physical line printer when its turn comes in the spooling queue and the file will again be available for use.

The user program performs faster as the data is "written" to a much faster device than the line printer. The printing capacity of the line printer also increases, since it will be running at full speed all the time instead of waiting for user programs to perform operations not connected with printing.

FEATURES

Same queue for several output devices

- In any one systemtheremay be several spooling queues and several output devices, such as line printers, which may be fed by the same queue.

Up to 250 line printer files

- The number of line printer files (that is, spooling files which are used when a user tries to write to the line printer) is determined by the ND file system and could be up to 250 files if necessary.
- Programs execute faster, not having to wait for the line printer to become available.
- Printing capacity increases since the line printer does not have to wait for user programs.
- Users can produce output to the line printer while long printing tasks are in progress.
- Users can submit their own disk files to be printed by the spooling system and even specify the number of copies.
- Output for different users is well separated by a one page header and a one page trailer which contain user name, date and the time the file was generated and printed. (This can be removed if necessary).

THE SPOOLING QUEUE

Files submitted to the spooling system are held in a queue and while there can be manipulated freely.

The queue will survive a system stop and restart.

Files can be moved within the queue

Files in the queue can be moved both backward and forward (the latter operation permitted only by user SYSTEM which controls the running of the computer installation).

User files and spooling files can be inserted and removed from the queue by their owners or by user SYSTEM.

User SYSTEM may "delete" spooling files so they are available for reuse. This involves losing the orginal contents.

The number of copies of a file to be printed can be set by command, either when submitting it to the queue (by command or by monitor call), or when it is in the queue (by command).

The contents of the queue can be listed by command.

PRINTING CONTROL

SPOOLING-FORM

Printing of files from the queue may be done selectively by defining a SPOOLING-FORM, to be compared with a USER TEXT associated with each file in the queue. The user text is defined when the file is added to the queue. The spooling form can be set by command by user SYSTEM.

Stop printing

It is possible for user SYSTEM to stop the printing of any file just before it is started. A user may also arrange for this to occur and for the user text to be printed out for the operator. This also allows messages to be sent, telling the operator to insert special forms (to be printed) in the printer.

When a file is being printed, it can be terminated, restarted and spooled forward or backward. Users can do this for their own files or user SYSTEM can do this for all files.

CONTROL OF THE SPOOLING SYSTEM

Start/stop spooling

User SYSTEM can start and stop spooling for any peripheral device quite independently of any other peripheral device.

The total number of disk pages used for spooling files can be varied by command within the limits of disk space available to user SYSTEM.

3.2.3 SINTRAN III VSE/VSX UTILITIES (PRODUCT NUMBER: ND 10628)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-30.003.06	*SINTRAN III System Supervisor*

INTRODUCTION

The ND 10628 consists of these stand-alone programs.

COP-VERIFY
FLOPPY-MON
FILSYS-INV
MCOPY-TANB
WINCH-TO-FLOPP, Not assigned.
FLOPP-TO-WINCH Not assigned.

COP-VERIFY

This program copies pages between mass storage devices.

FLOPPY-MON

The FLOPPY-MONITOR must be present on the diskette to load BPUN program into the computer when SINTRAN is not running.

FILSYS-INV

The File System Investigator can be used to check the consistency of a directory; that is, its structure is correct, files do not conflict, the bit file is correct, the number of pages used is correct and user and object entries are correct. The program reads from the disk only. It diagnoses errors but does not attempt to correct them.

MCOPY

MCOPY is a program for making a backup of disks on tape. It can be used to copy one or more directories from disk to tape or from tape to disk. It can also compare one or more directories on disk and tape. MCOPY runs under the test-program MONITOR (but it is not a test program).

3.2.4 ACCOUNTING SYSTEM FOR SINTRAN III (PRODUCT NUMBER: ND 10315)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-30.003.06	*SINTRAN III System Supervisor*
ND-60.125.04	*SINTRAN III Introduction*
ND-60.132.03	*SINTRAN III Timesharing/Batch Guide*

PURPOSE

This system provides facilities to account for the usage of some of the computer's resources. Depending on options chosen, it is possible to account for:

CPU time
- CPU time used by background users and RT programs.

Connect time
- Connect time for background users accessing an ND-500.

I/O transfers
- Block I/O transfers through the file system (1K pages written to, or read from, files on disk).

Pages printed
- Number of pages printed on printers to which output is spooled using the ND Spooling System.

FEATURES

Resources usage is logged on a disk file in records which contain a user name, a project name, a type identifier and accounting information according to record type. The user name is the standard SINTRAN III file-system user name. The project name is determined from the RT-program name in the case of RT-accounting records or from a project password typed in by the user at log-in time. RT-program names and project passwords are associated with the project name by means of records contained in files on disk. This provides a flexible means of creating and deleting projects. The project password is not echoed on log-in, so this functions like a tone password and provides security.

Tables containing accounting data are stored in a disk file and also temporarily in memory. The real-time program ACCRT is used to provide real-time accounting.

CONTROL OF ACCOUNTING

@INIT-ACCOUNTING

@START-ACCOUNTING
@STOP-ACCOUNTING

The control of the accounting system is limited to user SYSTEM who supervises the computer installation. The command @INIT-ACCOUNTING initialises and starts the accounting system, which can then be started and stopped by the commands @START-ACCOUNTING and @STOP-ACCOUNTING.

@START-RT-ACCOUNT
@STOP-RT-ACCOUNT

@LIST-RT-ACCOUNT

Once accounting has been started, accounting for individual RT programs can be enabled and disabled by the commands @START-RT-ACCOUNT and @STOP-RT-ACCOUNT. The current usage of CPU time by RT programs can be examined by the command @LIST-RT-ACCOUNT.

3.2.5 EXCEPTION HANDLING SYSTEM (PRODUCT NUMBER: ND 10511)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-60.136.04	*ND-500 Loader/Monitor*

INTRODUCTION

Exception

The term "exception" covers special situations and errors detected by software in addition to all defined hardware traps. An exception handler is a routine to be activated when an exception occurs to take appropriate actions for recovery. A set of standard routines for use with Fortran or Planc has been developed. These are available in a standard library, and will be linked automatically if the user so desires. For each error condition, the user may determine:

- The number of times each error message is to be printed.
- The number of times an error may occur before the program is abnormally terminated.
- Whether a user-supplied exception handler should be activated when an error is detected.

Traceback

- Whether a traceback of routine stack frames should be printed when the error occurs or when the program terminates (in case of traps, this includes a register dump).

Error statistics

- Whether a printout of error statistics should be obtained when the program terminates.

COMMANDS

EXCEPT	disable/enable handling of specified exception
EXCDEF	reset handling of exception to default
EXCTERM	define action to be taken upon program termination
PRITRAC	print traceback of routine instances (subroutines)
PRIMESS	print error message
GETMESS	return error text (Fortran)
PGETMESS	return error text (Planc)
RDEFVAL	read default exception handling parameter values
RCURVAL	read current exception handling

PRODUCT DESCRIPTION

Trap conditions

Trap conditions are special situations detected by hardware, possibly requiring special handling. Examples of such situations are division by zero, protect violation or illegal index. Some trap conditions may be completely ignored. Others require some form of handling, while still others are so serious that they are reported directly to the operating system. These

Ignorable, non-ignorable and fatal traps

three groups are labeled "ignorable", "non-"ignorable" and "fatal", respectively. Traps and exceptions will be handled in the ND-500, providing they are locally enabled. There are default settings for all traps. If no local handling has been specified, or the trap has been disabled, some of the traps may be handled as a system trap in the ND-100. The Monitor will handle the trap in a standard manner, depending on the type of trap. System traps may also be disabled, but the user's right to modify trap handling may be restricted.

3.2.6 JOB EXECUTION CONTROL (PRODUCT NUMBER: ND 10534)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-60.151	*SINTRAN III Utilities Manual*

INTRODUCTION

Batch/mode jobs

Skip steps

Job Execution Control (JEC) is a program which enables you to control execution of batch/mode jobs by means of a few simple control statements. JEC allows you to take various actions depending on the result of an executed program. JEC allows you to terminate a batch/mode job whenever you want to or to skip steps in the execution. Using batch/mode jobs, one batch/mode can start the execution of other batch/mode jobs, and the process may be repeated depending upon the result of previous steps.

FEATURES

- Determines whether a program or a SINTRAN file system command has completed execution without error.

- Tests the COMPLETION CODE from a SINTRAN file system command, a user written program, or other ND software (ie., compilers, sort-merge, libraries (Cobol/Fortran), file handler, etc.).

Software System Indication

- Tests the SOFTWARE SYSTEM INDICATION from a SINTRAN file system command, a user written program or other ND software.

Completion Code

- Sets the SOFTWARE SYSTEM INDICATION and the COMPLETION CODE with a user written program.

- Provides the ability to jump to labels defined in the command file (both forward and backward).

- Starts and/or terminates execution at any point.

Programming with loops

- Allows programming with loops.
- Analyzes data about the current state of the machine and uses it to decide whether a program should be started or not.
- Enables communication from the terminal with a program execution in a mode job.

PRODUCT DESCRIPTION

Reentrant subsystem

JEC contains a reentrant subsystem which is started each time a JEC command is executed within a batch/mode file. Together with the reentrant subsystem there is a JEC library. This library contains two routines which make it possible for a user-written program to read/write the JEC information on the system segment (COMPLETION-CODE and SSI-CODE). This makes it possible to control the execution of a batch/mode job from an application program.

3.3 MICROPROGRAM

The program resides in a RAM on the Control Store card of the ND-560/1 CPU (slot B-5-17). A backup is kept on the hard-disk in file "control-store:data" under user SYSTEM. The backup is transferred to the RAM upon power-up, on the commands "ND<cr>LOAD-CONTROL-STORE<cr>" or "ND<cr>VERSION<cr>".

3.3.1 ND-500 STANDARD MICRO PROGRAM (PRODUCT NUMBER: ND 10332)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-05.012.01	*ND-500 Micro Program Guide*

INTRODUCTION

Microinstructions in the ND-500 control the communication between different parts of the Central Processing Unit (CPU). These parts are:

ALU

- Arithmetic Logic Unit (ALU)
- External arithmetic (floating point or BCD arithmetic)
- Prefetch processor

Cache

- Cache and memory system
- Input and output system

Trap system

- Trap system
- Sequencer

The microprogram may be divided into four parts:

- Entry point part
- Part for macroinstructions requiring more than one microinstruction

- ND-100/ND-500 communication
- Trap handling

PRODUCT DESCRIPTION

Prefetch processor

A macroinstruction will need a number of microprogram instructions depending on the complexity of the instruction to be performed. The prefetch processor will execute a number of cycles for the same macroinstruction, depending on the number of operands involved in the operation.

The microprogram will use data fetched by the prefetch processor from a register or from the cache and memory system in ALU operations or it will use output from operations carried out by the external arithmetic. This involves syncronization with the prefetch processor, the cache and memory system and the external arithmetic.

3.4 PROGRAM LANGUAGES AND PROGRAM DEVELOPMENT TOOL

3.4.1 ND-500 FORTRAN (PRODUCT NUMBER: ND 10190)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-60.145	*ND FORTRAN Reference Manual*

INTRODUCTION

ANSI-77 (ANSI x 3.9 - 1978)

ND FORTRAN is a programming language based on the ANSI-77 standard (ANSI x 3.9 - 1978). The compiler generates very compact code for optimal utilization of the ND-500 computer. One version of the compiler is a cross compiler, meaning that it runs on an ND-100 and generates code to be run on an ND-500. The other version is an ND-500 native compiler. The language implemented is the full ANSI-77.

FEATURES

- Follows ANSI x 3.9 - 1978
- CHARACTER datatype for string manipulation
- Extended datatypes INTEGER*2,INTEGER*4, LOGICAL*2, LOGICAL*4,
- REAL*8, COMPLEX*8, COMPLEX*16
- IMPLICIT statement to set default datatypes
- IF-THEN-ELSEIF-ELSE-ENDIF statements to improve program structure and readability
- DO FOR-ENDDO/DO WHILE-ENDDO loop constructions to improve program structure
- Ability to place compilation options in the program source file by preceding the commands by a $

OPTIONS

The ND-500 FORTRAN compiler makes several other facilities available.

- A CROSS-REFERENCE command to list all names and labels, together with their datatypes and the statements which reference them. This list is provided for each program unit on a file and is followed by a summary of the global hierarchy of invocations.

- A HEADING-TEXT command to provide the user with a title on each page of the listing.

- A STANDARD-CHECK command to diagnose breaches of ANSI X3.9-1978.

- A $DEBUG-MODE command to generate tables for use by the symbolic debugger.

3.4.2 PLANC FOR ND-100/500 (PRODUCT NUMBER: ND 10309/10310)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-60.117	*PLANC Reference Manual*

INTRODUCTION

Used for system software

Programming Language for ND Computers (PLANC) is designed as a high-level systems programming language. It is a member of the ALGOL/PASCAL family of block structured languages. PLANC is used mainly for writing systems software such as operating systems and compilers and it has been defined in a machine-independent manner.

FEATURES

- Machine-independent system software
- Designed as high-level language for system software development
- Easy to develop systems
- Easy to maintain systems
- No restictions on new features
- Inline assembly code

SIMPLE DATA TYPES IN PLANC

Integer	- 8-bit, 16-bit and 32-bit possible lengths
Lengths. Real	- 32-bit, 48-bit and 64-bit possible lengths
Boolean	- 16-bit, 1-bit packed
Enumeration	- Enables a data element to take any value from an explicitly specified, ordered group
Pointer	- Address of simple or composite data element
Label	- Statement labels
Void	- Denotes absence of a data element in a routine declaration

DATA TYPES IN PLANC

Array	- A group of elements, all of the same data type.
Record	- A group of elements of various data types.
Set	- The usual mathematical notation, whose members may be integers or enumeration values.
Routine	- Allows declaration of a group of routines with similar structure or characteristics in the same way as for other data elements.

Some data types may be modified. For example, integers may have a value range declared or real numbers may have a number of digits precision-declared. Data elements of any data type can be "access modified". READ modification makes the data element read-only to protect parameters in routines which are to send values in or out of the routine.

TYPE specifications

For user-defined data types new data type must be spesified in terms of simple, composite, predefined or other newly defined data types. Operators available for a user-defined data type are either those available for the base type or new operators provided by user-supplied routines.

EXPRESSIONS

Expressions are made in the usual way, data elements (as operands), and operators. One unusual feature is that there is no assignment statement. PLANC has assignment operators. There can be one or more assignment operators in one expression, causing one or more values to be stored during expression evaluation.

Arithmetic operators

Arithmetic operators include +,-,*,/ and ** with their usual mathematical meanings. Further arithmetic operators are ABS (absolute value), MOD (the remainder in integer division), and SHIFT (left/right bit shift).

Logical operators

The logical operators include:

- NOT - logical complement (set negation)
- AND - logical and (set intersection)
- OR - inclusive or (set union)
- XOR - exclusive or (set difference)

The relational operators include:

- = equal to
- >< not equal
- > greater than
- >= greater than or equal to
- < less than
- <= less than or equal to
- IN set membership

SEQUENCE CONTROL STATEMENTS

PLANC has the following sequence control statements:

- GO specifies an unconditional change of sequence to a declared label.
- IF specifies a conditional change of sequence. There may be multiple ELSIF and an ELSE part within an IF statement.
- CASE is a multiple choice condition change of sequence.
- DO-ENDDO is a never-ending loop, especially useful for process control or real-time applications.
- FOR-ENDFOR are loops which cause repetitive execution of a group of statements; the number of times depends on the number of values listed within the FOR statement.
- WHILE allows repetitive execution of a DO-ENDDO or a FOR-ENDFOR loop until a particular condition is met.
- ASSERT causes a run-time error to occur if a specified condition is not true.

3.4.3 SUBSYSTEM PACKAGES I AND II (PRODUCT NUMBER: ND 10005 AND ND 10400)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-60.031.04	*QED User Manual*
ND-60.047.03	*NORD PL User's Guide*
ND-60.066.04	*ND Relocating Loader*
ND-60.096.01	*MAC Interactive Assembly and Debugging System ...*
ND-60.151.02	*SINTRAN III Utilities Manual*
ND-60.175	*File-Handler User's Manual*
ND-60.196.01	*BRF-LINKER User Manual*

INTRODUCTION

There are two packages of subsystems:

- Subsystem Package I (ND 10005), consisting of Subsystem Package II and some more subsystems
- Subsystem Package II (ND 10400)

NORD PROGRAMMING LANGUAGE (NPL)

The Nord Programming Language (NPL) is a machine oriented language included in Subsystem Packages I and II. It is a medium level language somewhere between a problem oriented language (high level language) and an assembly code. The syntax resembles that of ALGOL. However, the intention is to use it like an assembler since all the facilities of the computer can be reached:

- The complete assembler instruction set with all addressing modes
- All registers
- All available memory location

One of the main applications of NPL is system programming (operating systems, compilers), where efficiency as well as readability is needed.

In comparison to assembly code, it is easier to write programs in the NPL because error checking can be more extensive. Furthermore, the programs are easier to read.

When compared to high level languages NPL will give more optimal code (about the same as for assembly code) and the programmer is not dependent on fixed calling sequences or data structures.

QUICK EDITOR (QED)

Included in Subsystem Packages I and II, the Quick EDitor (QED) is a simple editing program that may be used on some ND data formats.

QED is a line oriented editor which means it is to be used on hardcopy terminals, such as the printer terminal, which cannot handle screen-oriented programs.

QED is mainly intended to be used as an editor when no other word processors are available or when data has to be changed during software loading of the computer.

The QED is capable of handling data formats produced by 7 bits NOTIS-WP and PED. This means all symbolic programs can be manipulated by QED (i.e., MAC, NPL and PASCAL).

QED has one-character commands to manipulate texts: read (R), edit (E), append (A), insert (I). QED operates through the file system in the same way as the other ND editors.

MACHINE ASSEMBLY CODE (MAC)

Included in Subsystem Package I & II, the Machine Assembly Code Interactive Assembly and Debugging system (MAC) is powerful and convenient. It can accept code in the MAC language, the symbolic assembly language and assemble the MAC code into binary machine code as is necessary for program execution. MAC can also examine and change a program, once the program has been assembled and loaded, and perform many other functions normally more closely associated with an interactive debugging system. Furthermore, MAC has a simple program editing capability. MAC was designed so that it can always be memory resident and can assemble programs directly into the memory. Consequently, MAC can be loaded and then continually used for all phases of the program construction process.

Simple program editing capability

MAC FILE (MACF)

Included in Subsystem Package I, this special version of MAC is designed to operate under SINTRAN III. From the user's point of view, there is no difference between MACF or MAC. When not in BRF output mode, the output goes to a 64k (maximum) random file called the image-file. This file is expanded during assembly as required by the program size, thus avoiding waste of mass storage space. All the commands in MAC which access memory are designed to access the image-file in MACF. For instance,)ZERO,)PRINT,)BPUN, etc. The main purpose of MACF is to allow the user to build systems anywhere in memory.

BRF output mode

Image-file

LOOK-FILE

Included in Subsystem I, look-file is a subsystem which enables a user to print data and browse through the data contained in a file. The contents of different files may also be compared. The data contained in a file may be output as bytes, words or ASCII characters. Bytes and words may be output as octal, decimal or hexadecimal values.

NORD RELOCATING LOADER (NRL)

Included in Subsystem I, the Nord Relocating Loader (NRL) is a subsystem which is able to convert the output from the language processors (compilers, assemblers) into executable programs running under SINTRAN III. The object files created by the language subsystems are in a relocatable format, known as BRF. The NRL relocates this

Changes output format — output and changes its format so that it can be loaded to actual addresses, the property of relocatability being lost in the process.

Symbol table — The NRL maintains a symbol table in which all intermodule references, symbols and labels appear together with their defined addresses. All of these are resolved by the NRL before execution of the program can proceed.

BRF-LINKER

Binary relocatable format — Included in Subsystem I. The BRF-linker is a subsystem which is able to convert the output from the language processors (compilers, assemblers) into executable programs running under SINTRAN III. The object files created by the language subsystems are in Binary Relocatable Format, known as BRF. The BRF-linker maintains a symbol table in which all intermodule references, symbols and labels appear together with their defined addresses. If the address of a symbol has not been defined

Symbol entry — before being used, the symbol entry in the table is marked as undefined. All symbols must be defined before the program can be executed.

FILE-HANDLER — Included in Subsystem I. The file-handler is a program for the retrieval and reformatting of data records from large files, generation of test files and production of reports or smaller extract files.

3.4.4 PED, PROGRAM EDITOR FOR ND-500 (PRODUCT NUMBER: ND 10532)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-60.121.04	*PED User's Guide*

INTRODUCTION

Fullscreen

The PED is a fullscreen, line based program editor incorporating extensive editing functions. Files are entered and edited from a video display terminal or from a teletype terminal. On terminals with cursor addressing, the editor will normally be run in page mode. In line mode, PED functions

QED

like an extended version of QED(Quick Editor). Files can be both program and data files. The editor will not be able to read NOTIS-WP 16-bit format and the reader is warned that none of the ND compilers will accept files in the 16-bit format. Files generated by PED are accepted by all ND compilers.

FEATURES

- Text may be added, modified, inserted, replaced or deleted by using the cursor movement controls and a few self-explanatory, easy-to-learn commands

- Available with English and Norwegian text

- Safe text buffer handling

- Parameters are used to set a number of editor variables.

On-line formatting

- On-line formatting

- Navigation keys

- Marking text areas

Manipulating

- Manipulating the marked text areas

- Line mode edit

- System error messages

- Menus to set up own document layout

Multiple level help

- Multiple level help
- National character sets
- Automatic file type control

3.4.5 SYMBOLIC DEBUGGER FOR ND-500/ND-100 (PRODUCT NUMBER: ND 10335/ND 10336)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-60.158	*Symbolic Debugger User's Guide*

INTRODUCTION

The ND Symbolic Debugger provides a powerful set of commands for controlling the execution of a program as well as inspecting and changing the state during the execution.

FEATURES

- One product for:
  - FORTRAN
  - COBOL
  - PLANC
  - PASCAL
  - Mixtures of the above
- Powerful set of commands
- No change to program code
- Separate address space
- Source program reference
- Symbolic names used
- Built-in assembler and disassembler

DESCRIPTION

The debugger may be used in conjunction with any executable code. Symbolic references are only possible for modules compiled in "DEBUG-MODE". The use of this mode is not mandatory for all modules of the program, nor does it alter the object code produced.

COMMANDS

Command input

When the debugger expects the operator to enter a command, it prints an asterisk (*). A command (along with possible arguments) must be typed on the same line as the asterisk. The debugger asks for any arguments which have been omitted. Several commands, separated by semicolons can be written on the same line. Command names may be abbreviated, and the standard SINTRAN editing characters are available when typing command input.

Macro facility

If a particular sequence of commands occurs often, these can be defined by the user as a single command by means of the macro facility. There is also a special feature aimed to assist debugging when an up-to-date listing is not available. This is a command which adjusts the line numbers in the debugger to correspond to those on the listing.

EXPRESSIONS

Command arguments representing numerical values and addresses may be entered as expressions. Such expressions may include constants (decimal, octal, hexadecimal, binary, real), simple identifiers in the user's program (module, routine, line, variable), simple arithmetic operators (+,-, SHIFT, *, /, **), pointer references, record component selections (dot notation), and array subscripts (single elements or subarrays).

CONTROLS

The debugger is a subsystem used to monitor the execution of another program. The user may specify what is to be executed and where execution is to be interrupted. When the user's program is not executing, control is returned to the debugger so that the state of the computation may be inspected.

Step-by-step execution

Breakpoint execution

The user may step through a program one source line or one routine call at a time. He may also permit the program to execute until it reaches a breakpoint, a particular place in the program specified by the user.

A breakpoint may be set at the beginning of a line of source code (entered as a line number or a label name), at the beginning of a routine (entered as the routine name), or immediately following the return from the present routine. A breakpoint may also be set at a particular program address. This is especially useful when suitable load maps are available for modules compiled without "DEBUG-MODE".

Conditional breakpoint

A conditional breakpoint may be specified by stating a legal range of values for a data element. If the value is set outside this range, execution will stop.

When stopped at a breakpoint, the current call hierarchy, may be examined starting with the current routine and ending with the main program.

The debugger will, if specified, maintain a log of routine calls or executed source-code lines. The log is dumped on request. In addition, it is possible to obtain a list of all unexecuted lines or routines to aid in evaluating a test case or in identifying areas of "dead" code.

A routine in the user's program may be executed directly without altering the breakpoint status. This ability to invoke routines is often useful for dumping or for initializing special data structures.

3.4.6 FOCUS FOR ND-500 (PRODUCT NUMBER: ND 10341)

For detailed description, refer to the following manual(s):	
No.:	*Title:*
ND-60.137.04	*FOCUS Screen Handling System Reference Manual*

INTRODUCTION

The FOCUS Screen Handling System consists of:

- FOCUS runtime library
- FOCUS screen definition system
- FOCUS auxiliary subroutines

Screen handling

FOCUS Screen Handling enables the user to define the format of screen forms interactively at display terminals with cursor control and to use these forms for the input and output of data to and from programs.

Create screen layouts

With FOCUS, it is possible to create and modify screen layouts interactively for data entry forms by typing in leading texts and data input field descriptions. Data input fields can be specified with various editing formats.

Display data records

Forms are stored on a disk file, and can be retrieved via user programs written in FORTRAN, BASIC or COBOL. The forms may be used for entering or displaying data records which are stored on user files or databases. Programs may also use the same forms as input media to update local data bases directly. Hardcopies of the layout of these forms can be produced on a line printer.

FEATURES

- Library is simple to use
- Screen handling operations using asynchronous display terminals with cursor control
- Built-in field editing and character-type checking
- Simple keystrokes alter field values by copying previous value, inserting or deleting characters
- Screen handling library routines for user programs
- Fields are referenced by field name
- Error-messages and HELP-information in desired national language
- Possibility of combining more than one form on the screen

PRODUCT DESCRIPTION

FOCUS consists of two modules:

- ND FORMS maintenance program.
- ND FORMS handling library.

ND FORMS maintenance program

The ND FORMS maintenance program is an interactive program for creating, modifying and testing screen form. During creation or modification, the user (programmer or data entry manager) establishes a screen form with leading texts and various data entry fields. The leading texts are protected and various fields are defined with fill characters for unused positions, editing formats and the number of characters. For security reasons when a form is modified and a new version made, the old version remains until it is explicity deleted by the user.

Edit codes define how fields are to be presented on the screen.

Some samples are:

- Right justified digits, no editing character
- Left justified digits, no editing characters
- Numeric string, left justified
- Alphabetic string, left justified
- Alphanumeric string, left justified

FOCUS library

Several forms may be stored on a source file. Each form has a unique name and may be retrieved by this name for modification. Both the screen layout and the field definitions may be printed for documentation purposes. The program can be used from different types of terminals to input screen layouts and commands without the user needing to specify terminal type. The FOCUS Runtime Library is a collection of subroutines to be used from a user program written in FORTRAN, BASIC or COBOL. There are routines to retrieve forms into the program, to display leading texts and fields (with or without data) on the screen and to read data as keyed-in by the operator. The program may operate dynamically on all fields or a subset of the fields in the form. In addition there are routines to write data into a field, to edit only one field at a time and to write messages on a specified line on the screen. Both reentrant and non-reentrant versions of the FOCUS Runtime Library exist. When many active programs are using the system, the reentrant version should be used.

3.4.7 ND-500 LINKAGE-LOADER (PRODUCT NUMBER: ND 10319)

For detailed description, refer to the following manual(s):	
No.:	*Title:*
ND-60.136.01	*ND-500 Loader/Monitor*

INTRODUCTION

Converts compiler output into instructions

The ND LINKAGE-LOADER (NLL) converts compiler output into executable instructions and data for processing by the ND-500. The compilers and language processors produce ND Relocatable Format (NRF) code. The Linkage-Loader converts NRF code into absolute instructions and data which it places on program and data segments on mass storage (disk). At execution time, the ND-500 monitor supervises the processing of the programs and data on such segments.

FEATURES

- Libraries may be automatically linked or loaded
- Several libraries may be loaded to the same segment
- Library segments may be reloaded without relinking connected programs
- References on a segment being loaded are linked to entry points on one or more preloaded segments
- Reentrant program segments
- Up to 30 program segments and 30 data segments
- Each segment may be up to 128 Mb. Total address space is 4 Gigabytes for programs and the same for data
- Common data (FORTRAN) may be placed on its own segment(s) and given special protection

- Editor function allows modules on an NRF file to be exchanged, added, removed, etc.
- Existing segments may be modified
- Loader maps may be printed out for all existing segments
- Can be forced to load a complete NRF file (even if the file is a library file)
- Can load only specified modules
- Can exchange modules on an already existing segment.

PRODUCT DESCRIPTION

Domain

The segments comprising a program are called a domain. Due to large address space available for each segment, most users would find one program and one data segment sufficient for running their program.

Some advantage, however, may be gained by splitting a system into several segments:

- Library segments may be used by many programs although present only once within the system. This reduces both memory and mass-storage requirements.
- Reentrant program segments reduce physical memory requirements.
- Individual segments may be protected in different ways. For example, a read-only data segment prevents important data from being destroyed in error.
- Common data may be placed on separate segment(s) and thus given special protection.

Program segment
Data segment
Link segment

The simplest process possible consists of one segment in one domain. A segment is built by NLL, on three separate files. One file contains the instructions - the program segment; another contains the data - the data segment; the third contains the names and values of all entry points and optional debug information - the link segment.

DESCRIPTION-FILE:DESC

The names of segments and domains for each user are found in a file under that user called DESCRIPTION-FILE:DESC. Each named object (segment or domain) has an entry in this file, containing all information needed by NLL and the monitor. For example, the domain entry - one for each domain - contains the name of the domain, a table of the segment files comprising the domain, information about the relationships to other domains, the size and the start address of the domain, and information relevant to the internal operation of the monitor.

Although all domains belonging to a user are described in one file, the same user can access NLL from several terminals simultaneously; NLL will resolve any conflicts. If attempts are made to modify the same domain from two terminals simultaneously, one of the users will get an error message.

Entry points

Information about intermodule references, entry points and symbol values is coded in the file that is output from the compilers. NRF procedure calls or references to global data are made through symbols; that is, alphanumeric labels assigned to an instruction or data item. These symbols are made by the language processor (often based on user assigned names in the source program) and referred to as "entry points".

At execution time, references are made to addresses rather than to symbols. The conversion from relocatable symbols to machine addresses is done by the loader. The loader maintains a table, called the loader table, where symbols are entered as they are encountered.

3.4.8 ND-500 MONITOR, MULTIUSER (PRODUCT NUMBER: ND 10333)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-05.009	*ND-500 Reference Manual*
ND-60.136	*ND-500 Loader/Monitor*

INTRODUCTION

The ND-500 Monitor is an extension to the multiuser SINTRAN III/VSE Operating System. It supervises the execution of programs running concurrently in the high-speed 32-bit ND-500.

The ND-500 Monitor's tasks are:

- Initialization and control of programs running in the ND-500.
- Allocation of physical memory to programs.
- Timesharing of user programs.
- Execution of input/output operations and other system functions requested by user programs.
- Control of communication between the ND-500 processor and the ND-100 auxiliary processor.

In addition, a number of system functions are incorporated:

- Initialization of the ND-500 down-load of control store.
- Initial memory allocation for the ND-500.

DESCRIPTION

Page-fault handling

Memory administration

The monitor consists of several programs. The page-fault handling and memory administration routine runs on the ND-500 processor. The others, for example the interactive command processor, run on the ND-100. The monitor itself is interactive and its commands fall into 4 main groups:

- Commands to execute programs
- Debugging commands
- Commands to measure and log performance
- System supervisor commands

A domain containing a program may be fetched into memory and the program started up. Execution may be halted and later restarted, if required.

Macro execution

Commands composed of other commands may be constructed using the macro facility. Logical statements may be included in order to terminate macro execution if an error stop occurs.

3.5 ADP SOFTWARE

3.5.1 USER ENVIRONMENT (PRODUCT NUMBER: ND 10518)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-60.179	*User Environment Reference Manual*

INTRODUCTION

Extensive use of menus

Restricted access

Data security

User Environment simplifies the use of the ND Operating System, by extensive use of menus. Menus may be tailored for each individual user, or user group, so that only relevant functions are available. Programs written by users can also be accessed via menus, together with the standard functions. User Environment greatly improves the security aspect of an ND computer system. Access to the system from individual terminals is restricted to specific users and to within specific time periods for that terminal. Still greater security may be obtained by restricting which functions are avilable to which users. Data security is controlled by allocating work areas to each user, containing only those files and documents which are needed. In addition, these work areas may be protected by a password.

FEATURES

- Menu system for easier use by inexperienced users

HELP

- HELP key provides assistance related to the situation the user was in when he/she requested help

- Limiting which functions are available reduces the possibility of confusion

Menu hierarchy	- Menu or menu hierarchy tailored to individual users
	- Good control of access via a system's terminals
	- Good control of functions accessible to each user
	- Good control of data area security
Password	- Personal user name protected by password
	- Work areas protected by password, distinct from personal user name
Document manager	- Document manager available for document administration using full screen editing
	- Full screen editor for editing menu forms
	- User programs easily accessed via menus

PRODUCT DESCRIPTION

User Environment provides a user interface to the operating system. It allows a much friendlier, small but relevant environment to be created for each user. It also improves system security with control over terminals, users and work areas, in a way which is far more comprehensive than was previously possible under SINTRAN III.

3.5.2 NOTIS-WP-II (PRODUCT NUMBER: ND 10079)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-63.002	*NOTIS-WP Reference Manual*
ND-63.007	*NOTIS-TF Reference Manual*
ND-63.009	*NOTIS-TF Macro Guide*
ND-99.006	*NOTIS-WP Reference Card*
ND-99.008	*NOTIS-WP Reference Card (FACIT)*

PRODUCT SUMMARY

Word processor

NOTIS-WP-II is a powerful and flexible full-screen word processor constructed to satisfy office users and others requiring a complete word processing family of products. It is simple to learn and use. NOTIS-WP's HELP function consists of a number of chapters, further divided into sections, giving the user easy access to complete on-line documentation whenever necessary. BEGINNER mode limits the functions available to novice users, and has corresponding HELP documentation. Users may set up their own document layouts by modifying standard menus.

Justification

Move, copy, delete

Documents may be entered, modified, printed and stored. Justification is automatic, either on word-wrap or when carriage return is pressed. Areas may also be manually justified. The documents themselves may be up to 256 characters wide and of any length. Text areas, which may be either lines of simple text or rectangular areas, may be moved, copied or deleted. Different parts of a document may use different margins and be justified in different manners. A text string may be searched for and a new string substituted if required. New text may be inserted within a line or between lines.

Sorting text

Graphic function

Text may be sorted and areas containing signed and unsigned numbers and arithmetic functions may be summed. Areas may be boxed; that is, have a box drawn around them. Graphic functions suitable for constructing tables and simple diagrams are also included.

FEATURES

- Online formatting
- Screen is identical to document
- BEGINNER and ADVANCED modes
- Multiple level HELP
- Menus to set up own document layout
- Single keystrokes for most functions
- Cut, paste and copying of text areas
- Document file includes margins, justification mode, etc.
- Areas for single-key functions which can be word, sentence, paragraph or explicitly marked fields.
- Automatic numbering and renumbering of chapter and section headings to any level
- Table of contents
- String search and substitute
- Justification: right, left, centre, stretch between margins
- Scroll and roll
- Documents may be up to 256 characters wide and of unlimited length
- Normal and decimal tabulation
- Arithmetic functions (+-*/%)
- Sorting
- Box graphics
- Discrete hyphen
- True underline
- Text formatter for heavy documents, such as manuals, large reports, etc.

KEYBOARD FUNCTIONS

Document layout	- Set borders - Set/reset tabs - Set/reset decimal tab - Set justification mode
Orientation in text	- Vertical/horizontal scroll - Move to end/start of line next/previous area next/previous tab - Cursor up, down, right, left, down, home
Justification of text	- Right adjust - Left adjust - Centre adjust - Justify - Stretch
Enter/edit text	- Expand, Insert - Underline, Hyphen - New paragraph, Insert line - Concatenate, Split line - Convert to lowercase/uppercase letters - Set/reset graphic mode
Select area	- Mark, Field, Paragraph - Sentence Word
Operate on area	- Copy, Move, Delete - Frame
Other	- Print, Help, Exit - Cancel - String search/substitute

DOCUMENT STORAGE

Documents are stored on the system's mass storage devices, which are both faster and more convenient than diskette storage.

16-character document name

Documents may be given any name up to 16 characters, chosen freely by the user. When a document is to be retrieved, the user may identify it by any non-ambiguous abbreviation. For example, if a document has been given the name "Annual-Report-82", then it can be retrieved by An-Rep-82, or even A-P-82. Each ND computer system has at least one diskette unit, so documents may also be copied to diskette.

Security

Each user has a password to provide security. Documents may be held secret by one user or they may be made available to either a selected list of users or to all users.

TEXT FORMATTER

When a document has been prepared by the NOTIS-WP editor, in most cases it is finished and may be printed on any ND printer. In some cases, further processing of the document is required.

The Text Formatter may create indexes, handle footnotes, references and standard documents and so on. It may be used to create individual letters to clients on the basis of information extracted from a data file.

Text Formatter features

- Index
- Footnotes
- Appendices
- Standard letter addressing
- References
- Standard document layouts:
  - memo
  - report
  - minutes
  - call for meeting
- User-designed layouts

The NOTIS-WP module may be run on the ND-100 and ND-500 computer systems under the SINTRAN III operating system, version G and later.

NOTIS-WP will run on any ND computer regardless the size of its physical memory. However, in order to keep response times within acceptable limits, 64 KB plus 24 KB for each simultaneous user should be allowed.

The amount of mass-storage space required will depend on the use of the system.

3.5.3 BACKUP SYSTEM (PRODUCT NUMBER: ND 10337)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-30.003	*SINTRAN III System Supervisor*
ND-60.151	*SINTRAN III Utilities Manual*

INTRODUCTION

The Backup System offers a variety of facilities for copying files between users to and from disk, diskette and magnetic tape. Files may be copied for archive storage, duplication and other purposes.

The backup may be performed interactively with mode files or in batch jobs. When using volume media (magnetic tape or diskettes), the Backup System will ask for the mounting and dismounting of backup media if more than one medium is used.

In a decentralized machine configuration, where the computers are connected through the COSMOS network system, backup on a specific computer may be performed from any machine in the network.

When using the Backup System interactively, the command HELP is available at all levels of dialogue to give descriptions of parameters for the command being used or information about the other commands.

FEATURES

- Backup can be performed interactively, using a mode file or in batch jobs
- Copying user's files
- Backup logging
- Selecting files by logical combinations of selection keys, e.g. files modified since last backup (incremental backup)
- Possibility of using a specific backup/copying function directly from a User Environment menu

- Possibility of calling the Backup System from programs
- ANSI defined format
- ANSI defined format with some SINTRAN III file system information
- Copying of selected files
- Copying of files with exact file name matching
- Interactive HELP facilities at all levels
- VOLUME create
- VOLUME list
- VOLUME delete files
- Simultanous backup/copy and file shrink

COMMAND SUMMARY

DESCRIBE-ALL-COMMANDS — This gives detailed descriptions of each command available and its options and parameters.

CREATE-VOLUME — This creates a <<VOLUME>> on magnetic tape or floppy disk. A VOLUME may contain files from many users. A file may extend over several volumes.

LIST-VOLUME — This lists the contents of a VOLUME on magnetic tape or floppy disk.

DELETE-VOLUME-FILES — This deletes all files on a VOLUME following and including a specified file.

RECREATE-FILES-AND-USERS — This copies several users of a directory in one command. This will not work between directories over the COSMOS network system.

COPY-USERS-FILES — The BACKUP-SYSTEM will create all the necessary file names and will copy one or more files from a user on one medium or machine to a user on the same or different medium or machine. Copying between machines presumes that the machines involved have COSMOS installed. For medium selection, there are options available in SERVICE-PROGRAM-CUF (see below) to assist with more complex copying requirements. User SYSTEM may access any user's files with the same access rights as the file owner, allowing files to be copied on behalf of the user. Using the COPY-USERS-FILES or MULTIUSER-COPY commands in the Incremental Backup Mode will also result in the contents of the fields FILE-ACCESS, LAST-DATE OPENED FOR READ, LAST-DATE OPENED FOR WRITE, CREATION-DATE and MAX-BYTE-POINTER being copied from the source file to the destination file.

SERVICE-PROGRAM-CUF

This may be used to select one of the various options relating to the COPY-USERS-FILES or MULTIUSER-COPY commands.

MODE-STANDARD-VOLUME,
MODE-BACKUP-SYSTEM-VOLUME,
MANUAL-STANDARD-VOLUME

These options are only significant for output to magnetic tape. The information on a VOLUME may be in the following formats:

- STANDARD-VOLUMES: similar to ANSI defined format

- BACKUP-SYSTEM-VOLUME: similar to ANSI defined format, plus some SINTRAN III file system information.

NOTE

A "VOLUME" may contain files written in a mixture of the STANDARD-VOLUME and the BACKUP-SYSTEM-VOLUME.

SET-VOLUME-ACCESS
SET-ALLOCATE-CREATE-DEFAULT
SET-SINGLE-SEARCH
RESET-SINGLE-SEARCH

The search begins from wherever the tape is positioned and no tape rewinds occur while in SINGLE-SEARCH mode. SINGLE-SEARCH makes it possible to copy a number of files with one pass through the tape.

MASTER-LOG-MODE
USER-COPY-LOG-MODE

Causes copy command information to be written into a LOG file.

SET-MATCHING-MODE

This command may be used to demand exact file name matching.

SHRINKING-MODE

By this command one may determine that the destination file should be shrunk according to actual size. However, database files and other contiguous files will not be shrunk.

DESTINATION-EXPANSION-MODE	User SYSTEM may set the Backup System in automatic expansion mode with this command so that the destination user space will be expanded, if necessary, to contain the destination files. When running the MULTIUSER-COPY command, the destination user will be created if it does not exist in advance.
COPY-MODE	This command may, for example, be used to set the ARCHIVE mode and thus delete the source files or their pages after copying.

3.6 COMMUNICATIONS

3.6.1 SHARED MEMORY X-MESSAGE (PRODUCT NUMBER: ND 10130)

For detailed description, refer to the following manual(s):

No.:	Title:
ND-60.134	SINTRAN III Communication Guide

INTRODUCTION

Many data processing applications require the division of a program system into separate, asynchronous processes or tasks that communicate with each other by sending messages.

This separation may be motivated by security considerations (separation of work area, definition of interface points), by hardware design (tasks may run on separate machines), by address space limitations or simplicity of program development.

The word "task" means a driver, a direct task, or a real-time (foreground or background) program. The X-message (XMSG) system allows tasks to send messages to each other, including handling of memory allocation, queueing and task synchronization.

A task can open PORTS through which it can send and receive messages. Data is normally transferred between tasks via message buffers within XMSG. The sending task first opens a port, then reserves an XMSG buffer, transfers data into that buffer and finally informs the receiving task's port that data awaits collection. The reservation and release of messages is done explicitly by the user.

FUNCTIONS

The functions are divided into two groups:

- User functions (of general interest)
- System functions for finding out what the message system is doing

XMSG functions are invoked via an XMSG monitor call with parameters being passed in the registers. The T-register indicates the particular function required with option bits set in its high order byte when required.

Completion status is returned in the T-register, positive (exact significance is dependent on the function) if successful, zero if the operation was not terminated, and negative indicating an error.

SERVICES

XMSG services are invoked by sending messages (using functions) to a defined standard task, called XROUT. It allows tasks to find each other initially by providing a port naming scheme.

3.6.2 PIOC BASIC SOFTWARE (PRODUCT NUMBER: ND 10493)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-60.161	*PIOC Software Guide*

INTRODUCTION

Real-time multiprogramming

Background program

The ND 10493 PIOC basic software includes the real-time multiprogramming operating system for PIOC (PIOCOS) and the PIOC monitor. The PIOC monitor runs in the ND-100 computer as a background program. The monitor has a debugger function, which allows breakpoints, inspection and modification of the PIOC memory from an ND-100 terminal. The software environment of PIOC may be viewed as a domain. All individual programs, including the PIOCOS, must be linked together to form this domain.

PRODUCT DESCRIPTION

Common memory

Loading, supervision and control

The PIOC and the ND-100 operate with a common memory. This memory must be allocated as a contiguous 64 k/256 kwords segment in SINTRAN III. The RT-loader or the FIXC command in SINTRAN III is used to define this contigiuous memory segment. The PIOC monitor in the ND-100 is responsible for the loading, supervision and control of the PIOC. A specific monitor call is available in SINTRAN III which is used by the PIOC monitor to communicate with the PIOC.

Process communication

A subset of XMSG, the message system of SINTRAN III, is implemented in PIOCOS. Process communication and synchronization of their activities is performed through messages, which are transmitted and received over ports. Application programs are written in MC68-PLANC and/or assembly language. The relocatable code of these programs is linked together with PIOCOS by the ND Linkage-Loader (NLL), to form a domain. This domain is loaded in PIOC by the SINTRAN III PIOC monitor calls or by the PIOC monitor.

In addition to PIOC basic software, two other software products are available for PIOC, namely:

- MC68-PLANC compiler on the ND-100 generating MC 68000 code. Assembler codes may be inserted in the MC68-PLANC source language. This also includes the runtime system (ND 10491).

- ND Linkage-Loader for building PIOC memory image on the ND-100 file (segment) for loading into PIOC (ND 10319).

3.7 TEST PROGRAMS

3.7.1 MICRO TEST PROGRAM FOR ND-500 (PRODUCT NUMBER: ND 10331)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-30.013.02	*Test Micro Program Descriptions for ND-500*

INTRODUCTION

The micro test program package consists of these programs:

COMTE	ND-100/ND-500 combination test program
SLICE	ND-500 slice test program
MEMIC	ND-500 cache and memory test program
PREEF	ND-500 prefetch processor test program
ARITH	ND-500 external arithmetic test program
NOMAN	ND-500 no-memory-management test program
GMOFF	ND-500 memory-management-off test program
GMENT	ND-500 memory-management-on test program
TRAPT	ND-500 trap system test program
EXTRA	Extra ND-500 test program

PRODUCT DESCRIPTION

The micro test programs test the ND-500 by executing IOX-instructions. They do not use the interrupt system. The micro test programs work in two ways.

IOX-instructions

First, they test the communication interfaces (3022,5015) by executing IOX-instructions from the ND-100 (ND-500 is passive). This is how the ND-100/ND-500 communication is initially tested.

Small microprograms

Then they test the ND-500 by loading small micro- programs into the control store, starting them and checking the results. These microprograms are always loaded from the specified minimum control store address.

Utility microprograms

Relocatable

Utility microprograms, like dump programs, initialization programs, etc., are loaded into the uppermost part of the control store. The microprograms are relocatable.

The programs consist of sets of subroutines, each testing a small part of ND-500. There are two different kinds of subroutines:

Verification routines

- Verification routines that run tests, check results and report errors, if any.

Test routines

- Test routines, intended to run repeatedly and to be used together with oscilloscopes, logic probes, etc., to locate errors. As an input to these routines, there is a simulated Operator Register (OPR).

One-by-one-mode

Each program may run in one-by-one-mode (one routine runs over and over again) or in all-mode where all routines are run in sequence, one after another. This is intended for week-end runs, for instance. The programs may be started on Friday night and the results collected on Monday morning. The error messages are assumed to be self-explanatory.

3.7.2 TEST PROGRAMS FOR ND-100 (PRODUCT NUMBER: ND 10523)

For detailed description, refer to the following manual(s):

No.:	*Title:*
ND-30.005.02	*Test Program Description for ND-100, NORD-10/S...*

INTRODUCTION

The test programs cannot be executed when SINTRAN is running.

PRODUCT DESCRIPTION

The ND 10523 consists of the stand-alone programs listed in table 8. They are described more fully in DPS Book 2, section 4.7.

NAME	*EXPLANATION*	*TPD NO.*
100-ERROR	*Error correction test*	*Not assigned*
CACHE	*Hardware test for cache*	*104-A*
CONFIGURATION	*Check configuration*	*107-A*
DIMS	*Utility program 10 MB disk*	*Not assigned*
DISC-TEMA	*Utility program disks*	*113-A*
DSERV	*Utility for CDC disks*	*Not assigned*
ECCTEST	*Test ECC controller*	*Not assigned*
FL-LOOPS	*Debugging-loops floppy*	*Not assigned*
FLOPP-FORM	*Diskette formatting*	*109-A*
FLOPPY-FU	*Test interface, functions*	*Not assigned*
FLOPPY-RAN	*Random test floppy disk*	*111-A*
HDLC-MEGALINK	*HDLC and Megalink test program*	*Not assigned*
INSTRUCTION	*CPU test ND-100*	*102-A*
LP-TEST	*Line printer test program*	*117-A*
MEMORY	*Memory test program*	*106-A*
MOVER	*Memory test program*	*Not assigned*
MULTI	*Memory test program*	*Not assigned*
PAGING	*Paging test program*	*130-A*
PARAL-BYTE	*Tests interface ND-635*	*Not assigned*
PASCAN	*Pack verification 75/288 MB*	*Not assigned*
PFAIL	*Check power-fail restart*	*Not assigned*
RTC-12	*Test real-time clock*	*103-A*
SMALL-RAND	*Random test on 10 MB disk*	*Not assigned*
STC-RUNNER	*STC magnetic subsystem*	*Not assigned*
STC-TEST	*STC magnetic tape controller*	*Not assigned*
SUPER-RAND	*Random test for disks*	*Not assigned*
SYNC-MODEM	*Synchronous modem test*	*Not assigned*
TANDB-MAG	*Tandberg magnetic tape test*	*Not assigned*
TECOD	*Test 10 MB disk*	*Not assigned*
TERMINAL-ASYNC	*Terminal test program*	*108-A*
TET2200	*Test TDV 2200*	*Not assigned*
THREE-CHECK	*Test programmed interrupt*	*Not assigned*
TNCT	*Nordcom Colour Terminal*	*Not assigned*
UNIVERSAL-DMA	*Universal DMA test*	*Not assigned*
VERSATEST	*Versatec printer plotter*	*Not assigned*
WINCH-RAND-A	*Random test 5" and 8" disk*	*Not assigned*

Table 8. ND-100 test programs

3.7.3 TEST PROGRAMS FOR NORD 10/12 (PRODUCT NUMBER: ND 10522)

For detailed description, refer to the following manual(s):	
No.:	*Title:*
ND-30.005.02	*Test Program Description for ND-100, NORD-10/S...*

INTRODUCTION

The test programs can not be executed when SINTRAN is running.

PRODUCT DESCRIPTION

The ND 10522 consists of the stand-alone programs listed in table 9. They are described more fully in DPS Book 2, section 4.7.

NAME	*EXPLANATION*	*TPD NO.*
1158-SIMPL	*Test 1158 module*	*Not assigned*
BIG-RAND	*Random test for big disk*	*Not assigned*
CACHE	*Hardware test for cache*	*104-A*
CARDR	*Card reader test program*	*Not assigned*
CONFIGURATION	*Check configuration*	*107-A*
DIMS	*Utility program 10 MB disk*	*Not assigned*
DISC-TEMA	*Utility program disks*	*113-A*
DRUMS	*Drum maintenance system*	*Not assigned*
DSERV	*Utility for CDC disks*	*Not assigned*
ECCTEST	*Test ECC controller*	*Not assigned*
ERRCOR	*Error correction logic*	*Not assigned*
ES-PICT	*Evans and Sutherland picture*	*Not assigned*
EXTEN-ONE	*Instruction check*	*Not assigned*
FL-LOOPS	*Debugging-loops floppy*	*Not assigned*
FLOATING	*Floating instructions*	*Not assigned*
FLOPP-FORM	*Diskette formatting*	*109-A*
FLOPPY-FU	*Test interface, functions*	*Not assigned*
FLOPPY-RAN	*Random test floppy disk*	*111-A*
FOUR-CHECK	*Check internal interrupts*	*Not assigned*
HDLC-MEGALINK	*HDLC and Megalink test program*	*Not assigned*
HPMAG	*HP magnetic tape test*	*Not assigned*
INTER-T	*External interrupts NORD-10*	*Not assigned*
LP-TEST	*Line-printer test program*	*117-A*
MEMORY	*Memory test program*	*106-A*
MOVER	*Memory test program*	*Not assigned*
MULTI	*Memory test program*	*Not assigned*

- continued -

continued ...

NAME	EXPLANATION	TPD NO.
ONE-CHECK	Instruction check NORD-10	Not assigned
PAGING	Paging test program	105-A
PARAL-BYTE	Tests interface ND-635	Not assigned
PASCAN	Pack verification 75/288 MB	Not assigned
PFAIL-12	Test power fail on NORD-12	Not assigned
PFAIL	Check power fail restart	Not assigned
PROCES-PAN	Check process panel	Not assigned
RGCHK	Check register block	Not assigned
RTC-12	Test real-time clock	103-A
SMALL-RAND	Random test on 10 MB disk	Not assigned
SUPER-RAND	Random test for disks	Not assigned
SYNC-MODEM	Synchronous modem test	Not assigned
T-32B-FLOA	32-bit floating instructions	Not assigned
TANDB-MAG	Tandberg magnetic tape test	Not assigned
TCODR	Core and drum test	Not assigned
TECOD	Test 10 MB disk	Not assigned
TERMINAL-ASYNC	Terminal test program	108-A
TESTMONO	Monitor NORDCOM-74	Not assigned
TET2200	Test TDV 2200	Not assigned
THREE-CHECK	Test programmed interrupt	Not assigned
TNCT	Nordcom Colour Terminal	Not assigned
TREAL	Real-time clock 1024 card	Not assigned
TREPU	Tape reader and punch	Not assigned
TSTAD	Check big disk addresses	Not assigned
TWO-CHECK	Instruction check	Not assigned
UNIVERSAL-DMA	Universal DMA test	Not assigned
VERSATEST	Versatec printer plotter	Not assigned

Table 9. Test programs for NORD 10 and NORD 12

4 THEORY OF OPERATION

4.1 DATA PROCESSING SUBSYSTEM INPUTS AND OUTPUTS

General

A complete NEC CCIS site consists of several system parts that work together to perform the required tasks (see figure 51). The amount of equipment in each NEC CCIS site varies.

ND DPS

The ND Data Processing Subsystem performs most of the computing work on the site. Two or more CPUs work together on each site. Peripheral equipment connected to the site provides the operators and service personnel with the necessary tools to use and maintain the DPS. The peripheral equipment consists of terminals, printers, mass storage units and communication equipment.

AB switch

The AB switch connected to the ND DPS acts as a functional part of the ND DPS. It makes it possible for an operator to switch between two computers, with a single terminal. It is not delivered by ND, which is why it is drawn as a separate item. The AB switch is optional.

Database subsystem

The database subsystem is the main mass-storage unit within the NEC CCIS site. The database is for updating and storing the most recent information received by the NEC CCIS site. It is an advanced database system with data processing capabilities independent of the ND DPS. It has two disk drives and a magtape for backup. A disk for storing the operating system and system programs is also present in the DPS site.

Facit printers

The Facit printers are connected directly to the ND DPS. They are optional but, if included, provide the operators with additional printing services.

Communication equipment

The communication equipment is controlled from the ND DPS. The information flow can take two major paths: either to the display subsystem or to the digital network.

The communication equipment provides for the transmission and reception of informatiom from/to the surrounding digital networks outside the NEC CCIS site. Different network standards are implemented.

2

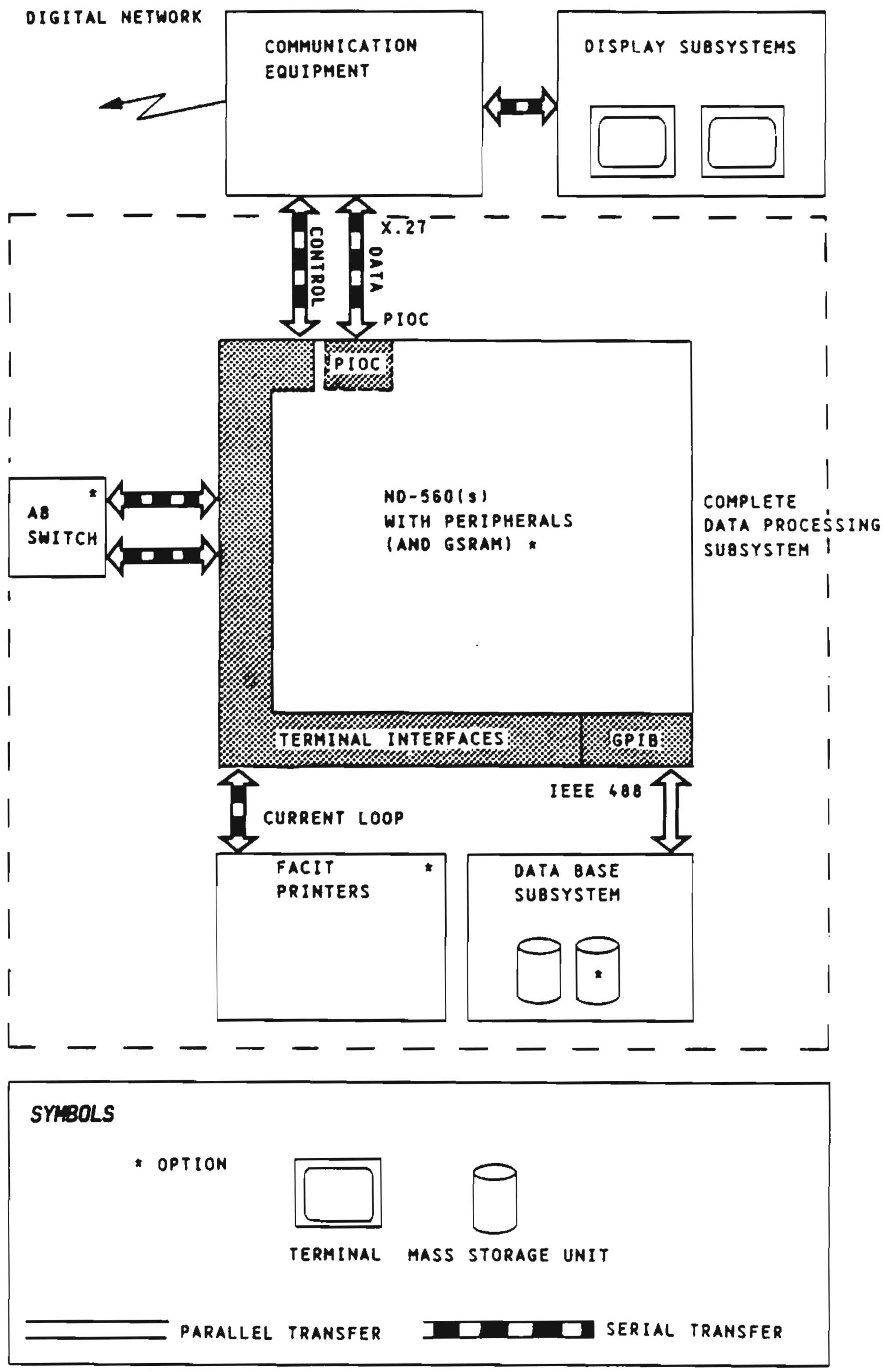


Figure 51. The NEC CCIS site

The display subsystems

The display subsystems are the main work stations for the operators on the site. They have advanced graphics/colour terminals with their own processing capabilities. This reduces the load on the ND DPS.

The display subsystems are used to present maps of military tactical situations together with typed information. They are also used for entering new information in an interactive, user-friendly manner.

4.2 MAIN SIGNAL PATHS IN THE DATA PROCESSING SUBSYSTEM (DPS)

4.2.1 STANDARD EQUIPMENT FOR ND-560 COMPUTER

The equipment in the tables 10 and 11 is defined as a minimum configuration and is included in all ND-560 computers.

Some ND-560 computers have more equipment. To find the total amount of equipment in a specific ND-560 computer, these entries must be added to those found in the tables in section 4.2.2.

ND SALES NO.	QTY	DESCRIPTION	
ND-032	1	Memory Management System (MMS)	
ND-033	1	Operator panel	
ND-034	1	Display panel	
ND-065	1	ND-100/ND-500 interface	
ND-082	1	ND-100/CX option	
ND-100	1	ND-100 CPU module	
ND-389	1	2 MB RAM memory	2
ND-230E	1	Printer terminal (console)	
ND-312	1	Floppy disk drive	
ND-362	1	Terminal interface	
ND-367	1	Floppy disk controller and formatter	
ND-559	1	Disk controller (2 CCAs)	
ND-613	1	Disk drive	
ND-640	1	MPM-5 line driver with octobus	
ND-855	1	GPIB controller	
ND-857	1	PIOC	

Table 10. Equipment list - ND-100 and peripherals

ND SALES NO.	QTY	DESCRIPTION
ND-060	1	ND-500/1 Basic CPU module (14 CCAs)
ND-061	1	Cache control module (2 CCAs)
ND-062	1	Cache memory (2 CCAs)
ND-063	1	Memory Management System (2 CCAs)
ND-381	1	MPM-5 Controller
ND-382	1	Local shared MPM-5 memory (1 MB)
ND-383	2	MPM-5 Port

Table 11. Equipment list - ND-500/1 CPU and local shared MPM-5 memory

4.2.2 ADDITIONAL CCAS AND PERIPHERALS PER DPS SITE

The equipment in the following tables is defined as optional and the options included vary from ND-560 computer to ND-560 computer.

To find the total amount of equipment in a specific ND-560 computer, the optional entries in these tables must be added to the tables in section 4.2.1.

ITEM/DPS SITE NO.	206	207	209	210	211	212	213	314	315	316	318	320	321	322	323	324	325	400M	400R
ND-242E Terminal	1		1	1	1	1	1	1		1	1	1	1	1		1	1	1	2
ND-303 Paper-tape punch	1		1	1	1	1	1												
ND-352 Paper-tape punch interface	1		1	1	1	1	1												
ND-362 Terminal interface	1		1	1	1	1	1												
ND-432E Line printer		1																1	
ND-655 Line printer controller		1																1	
ND-855 GPIB controller		1						1	1	1	1	1	1	1	1	1	1	1	1
ND-857 PIOC	1	4	1	1	1	1	3	2	3	2	2	1	1	1	2	1	1	2	1
ND-858 Adapter for NORD-10/S CCAs	1	1	1	1	1	1	1											1	
ND-382 Local shared MPM-5 memory		2							2						2			1	2

Table 12. Equipment list - ND-560 computer 1

ITEM / DPS SITE NO.	207	314	315	316	318	320	321	322	323	324	325	400M	400R
ND-242E Terminal	1		1						1				3
ND-301 Paper-tape reader		1		1	1	1	1	1		1	1		
ND-303 Paper-tape punch		1		1	1	1	1	1		1	1		
ND-351 Paper-tape reader interface		1		1	1	1	1	1		1	1		
ND-352 Paper-tape punch interface		1		1	1	1	1	1		1	1		
ND-432E Line printer	1		1						1				1
ND-655 Line printer controller	1		1						1				1
ND-855 GPIB Controller	1	1	1	1	1	1	1	1	1	1	1	1	1
ND-857 PIOC	4	2	3	2	2	1	1	1	2	1	1	2	1
ND-858 Adapter for NORD-10/S CCAs	1	1	1	1	1	1	1	1	1	1	1		1
ND-382 Local shared MPM-5 memory	2		2						2			1	2

Table 13. Equipment list - ND-560 computer 2

ITEM / DPS SITE NO.	207	315	323	400R
ND-242E Terminal				2
ND-301 Paper-tape reader		1	1	1
ND-303 Paper-tape punch		1	1	1
ND-351 Paper-tape reader interface		1	1	1
ND-352 Paper-tape punch interface		1	1	1
ND-432E Line printer	1			1
ND-655 Line printer controller	1			1
ND-855 GPIB controller	1	1	1	1
ND-857 PIOC	4			
ND-858 Adapter for NORD-10/S CCAs	1	1	1	2
ND-382 Local shared MPM-5 memory	2	2	2	2

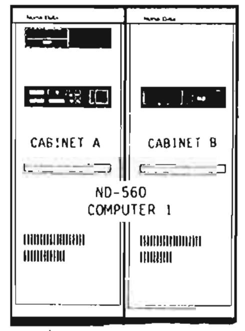
Table 14. Equipment list - ND-560 computer 3

ITEM / DPS SITE NO.	207	400R
ND-242E Terminal	2	2
ND-432E Line printer	1	
ND-529 Magnetic tape formatter	1	1
ND-536 Magnetic tape unit	2	2
ND-557 Magnetic tape controller	1	1
ND-655 Line printer controller	1	
ND-855 GPIB Controller	1	1
ND-857 PIOC	1	
ND-858 Adapter for NORD-10/S CCAs	1	
ND-382 Local shared MPM-5 memory	2	2

Table 15. Equipment list - ND-560 computer 4

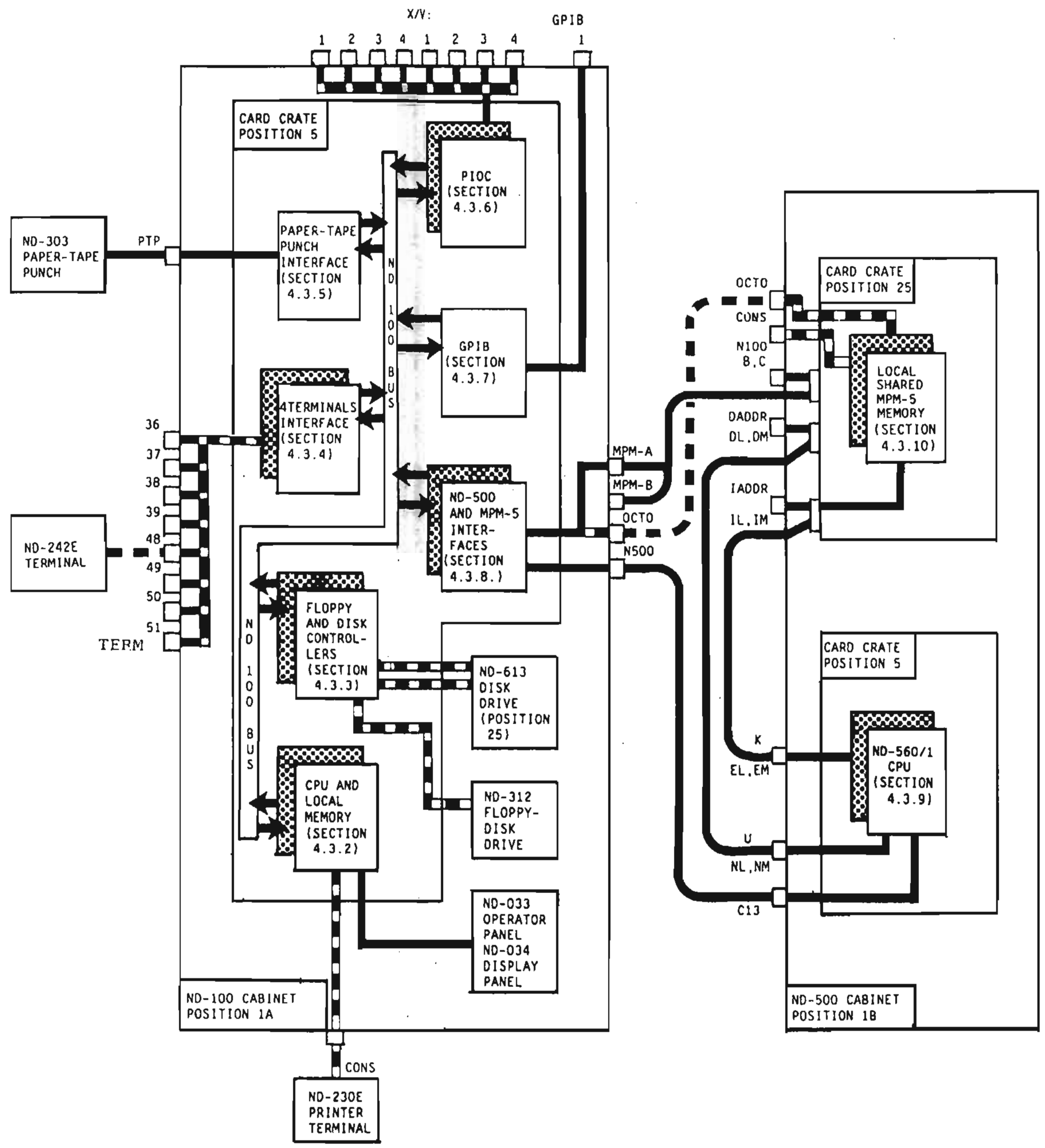
ITEM / DPS SITE NO.	207	314	315	316	318	320	321	322	323	324	325	400M	400R
ND-381 MPM-5 Controller	1	1	1	1	1	1	1	1	1	1	1	1	1
ND-382 MPM-5 Memory (1 MB)	2	1	2	1	1	1	1	1	2	1	1	2	2
ND-383 MPM-5 Port	8	4	6	4	4	4	4	4	6	4	4	4	8

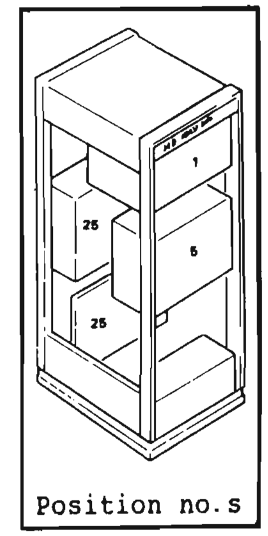
Table 16. Equipment list - Global shared MPM-5 memory



4.2.3 DPS SITE 206

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





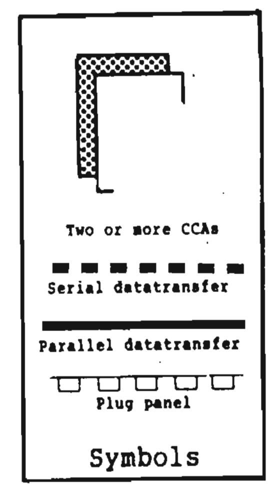
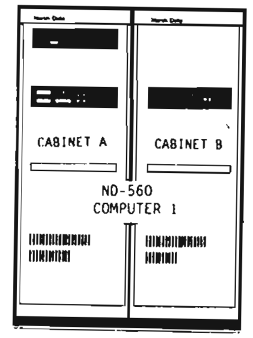


Figure 52. Site 206, main signal paths.

4.2.4 DPS SITE 207

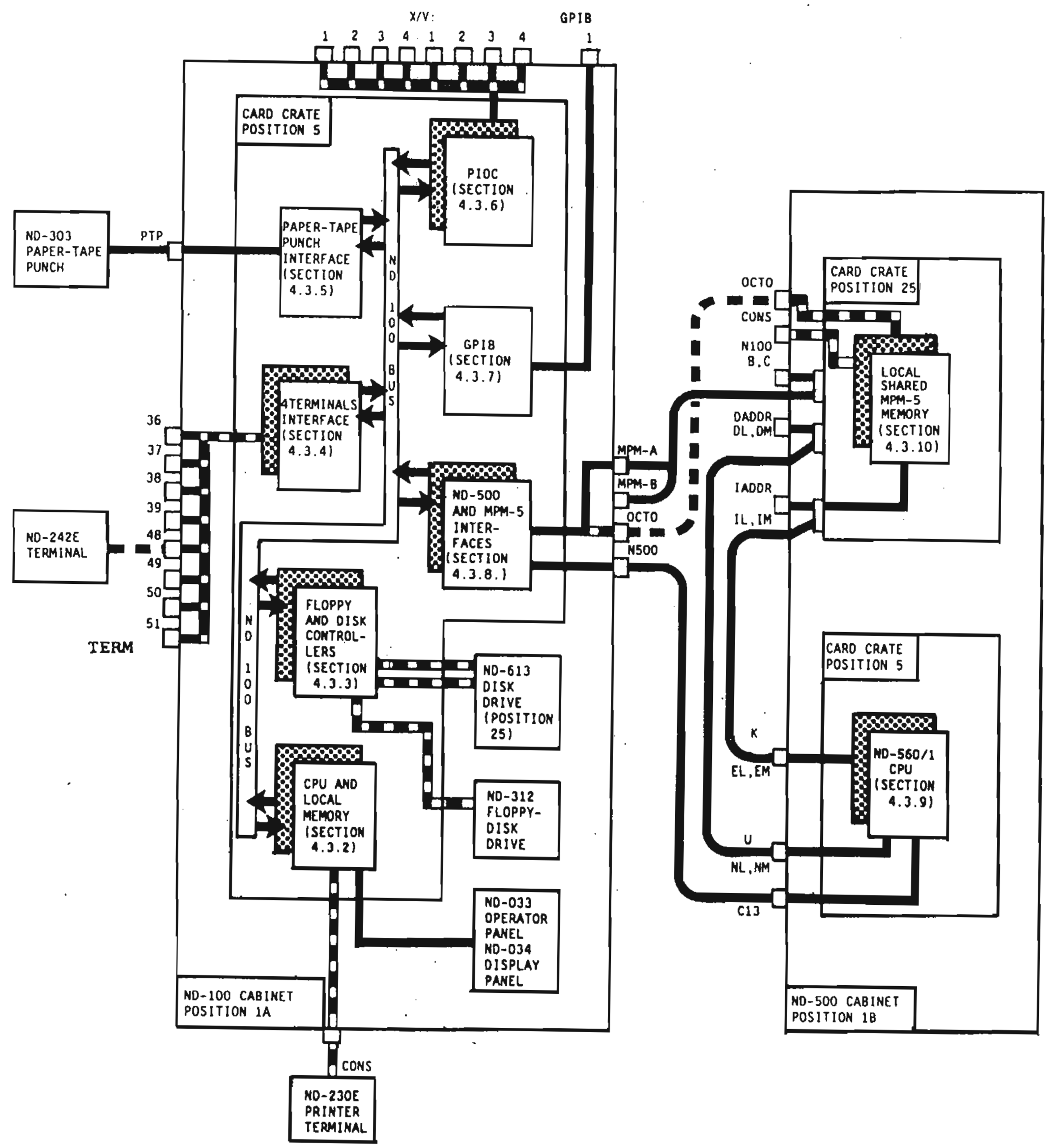
The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).

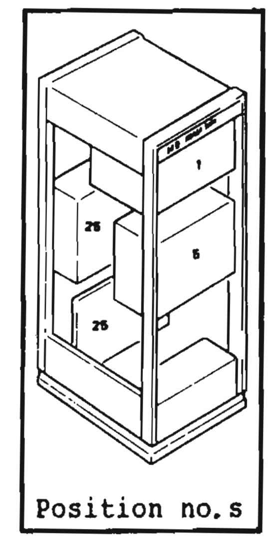
Figure 53. Site 207, main signal paths.



4.2.5 DPS SITE 209

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





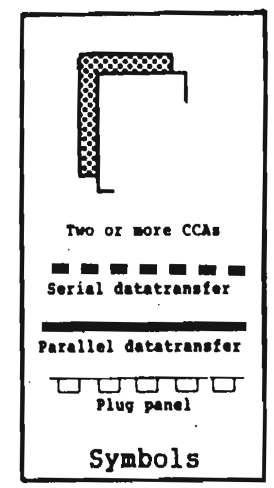
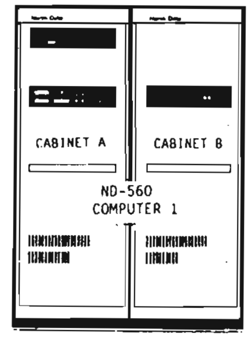
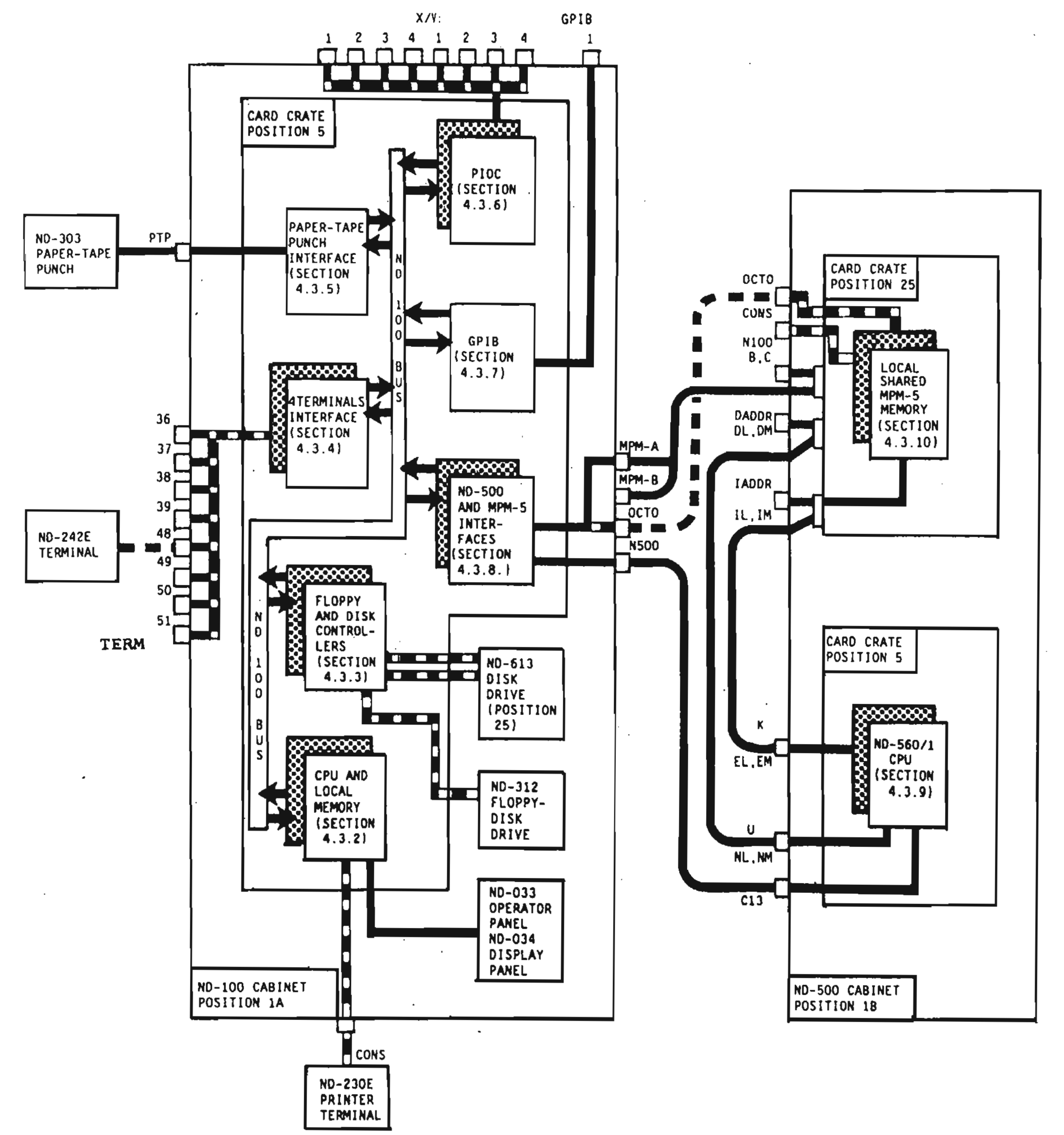


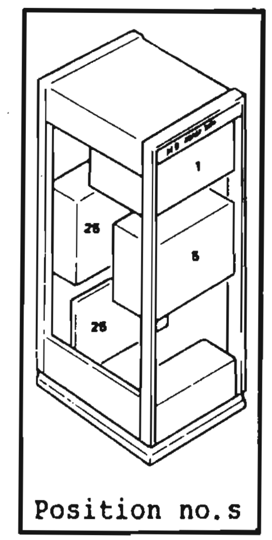
Figure 54. Site 209, main signal paths.



4.2.6 DPS SITE 210

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





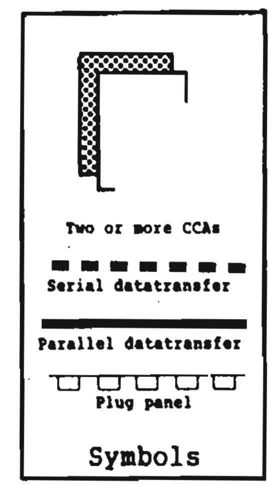
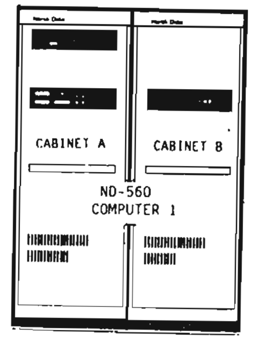
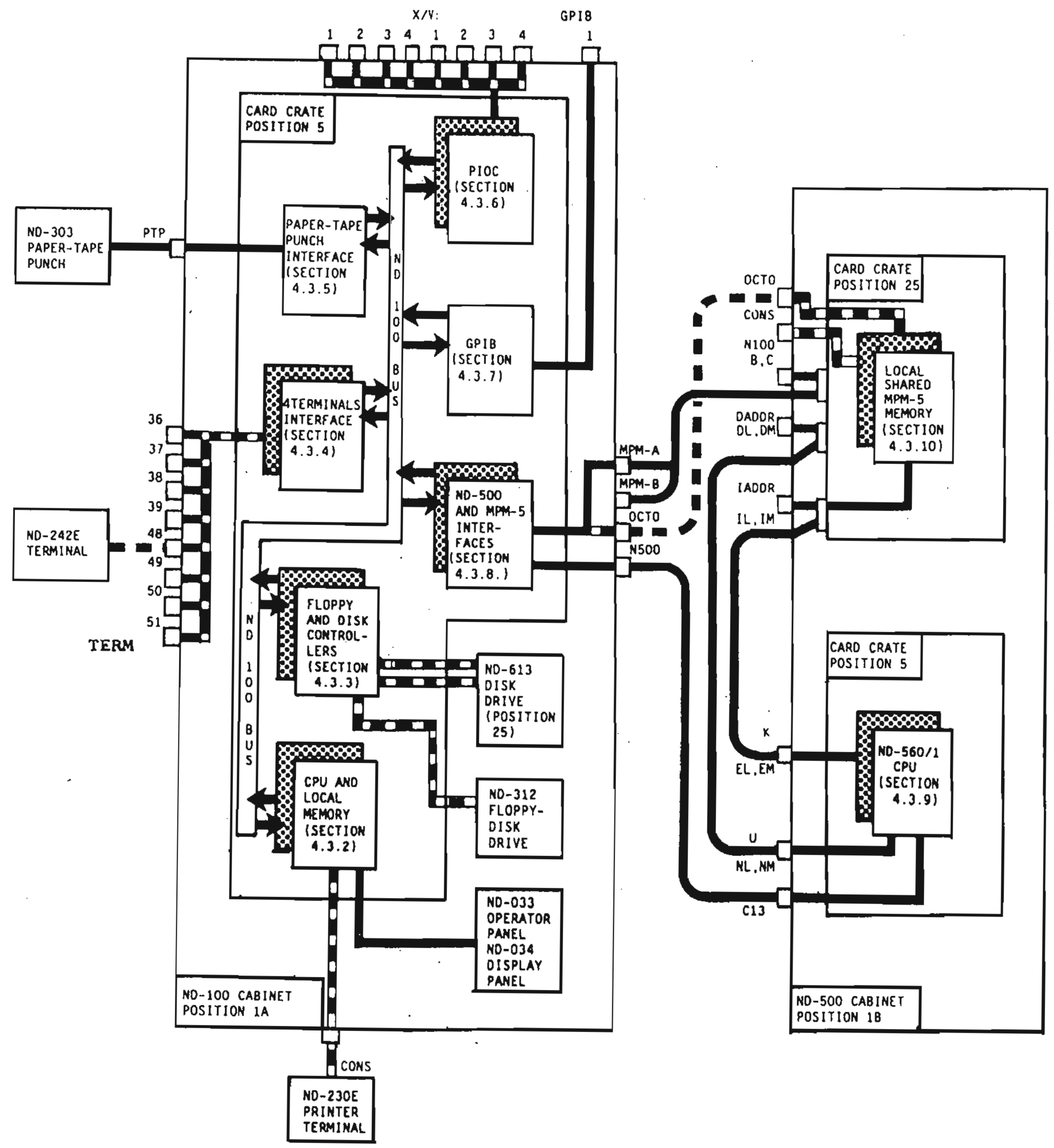


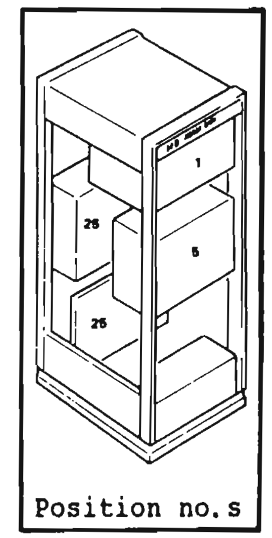
Figure 55. Site 210, main signal paths.



4.2.7 DPS SITE 211

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





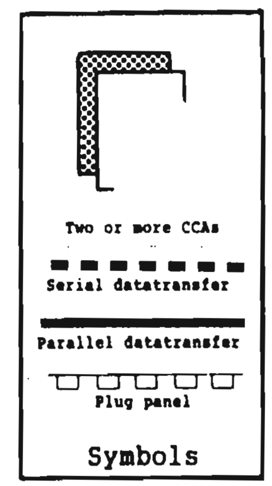
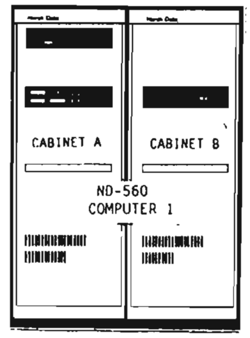
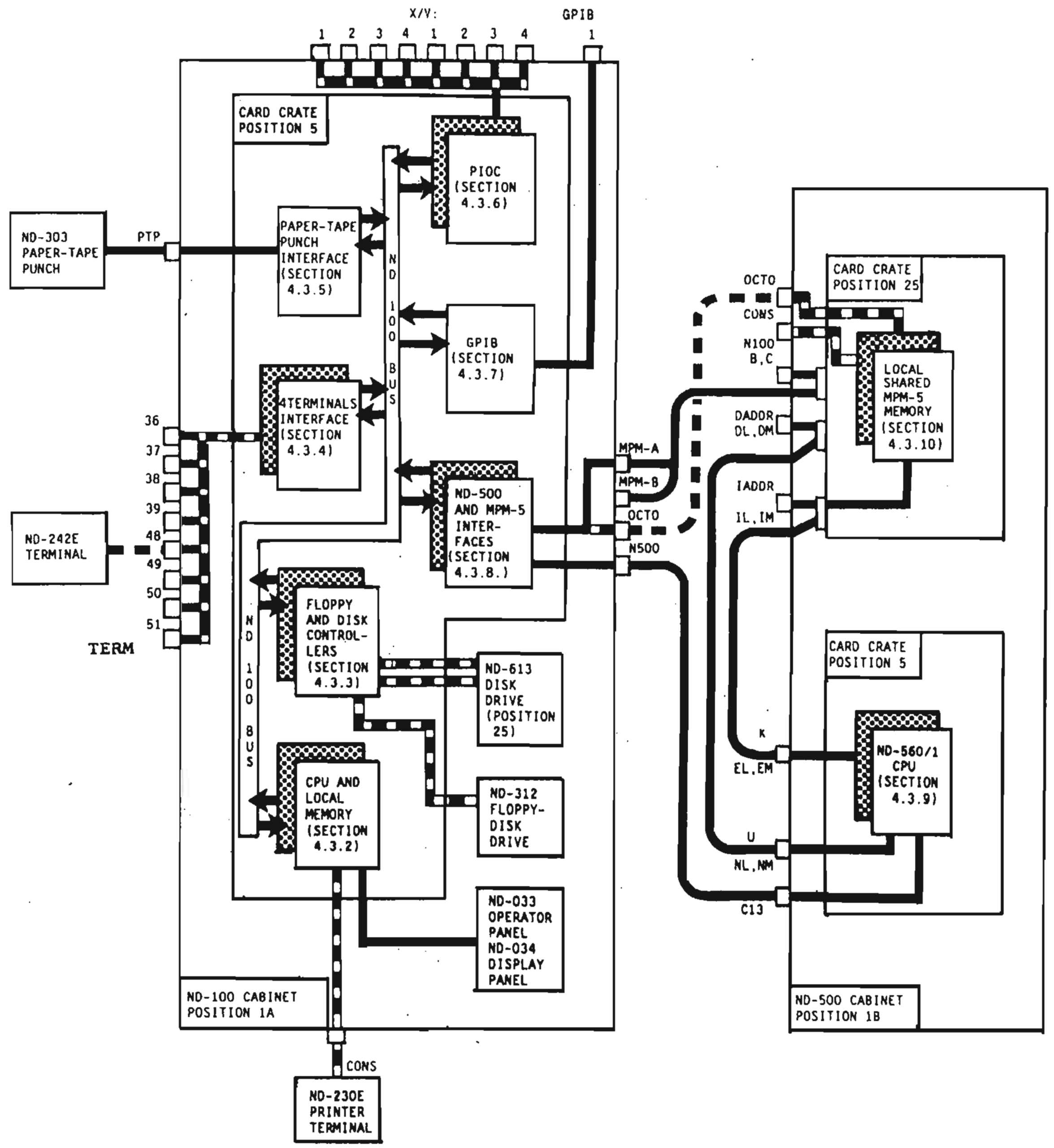


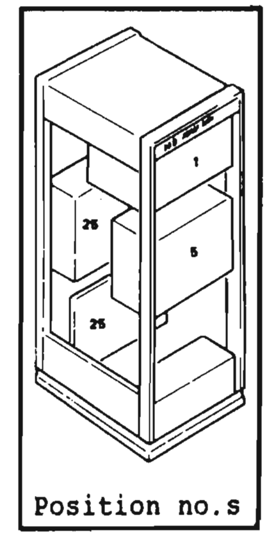
Figure 56. Site 211, main signal paths.



4.2.8 DPS SITE 212

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





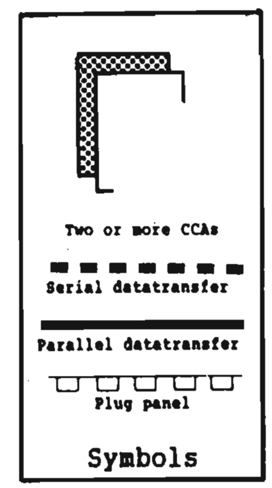
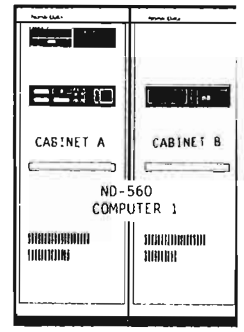
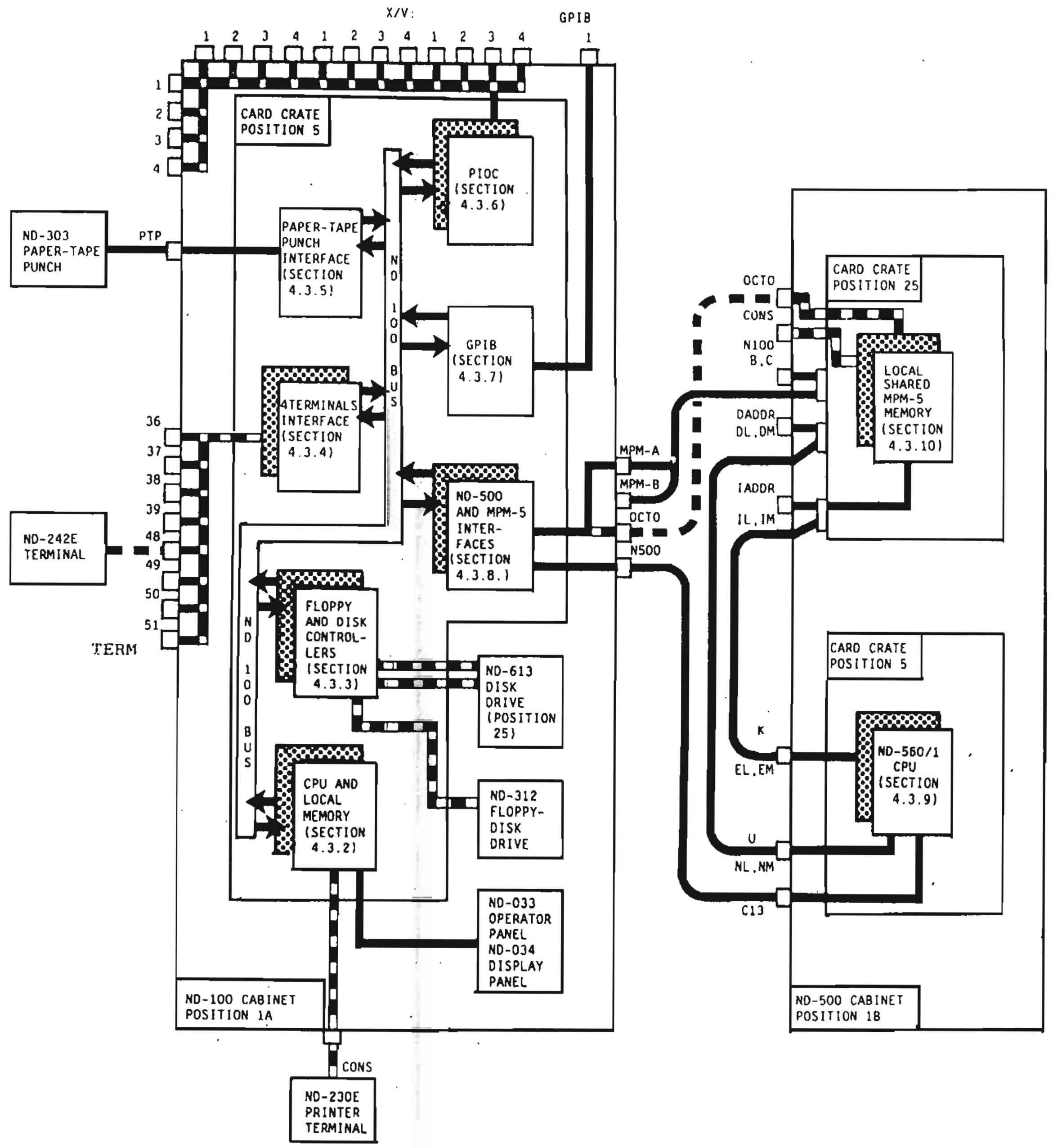


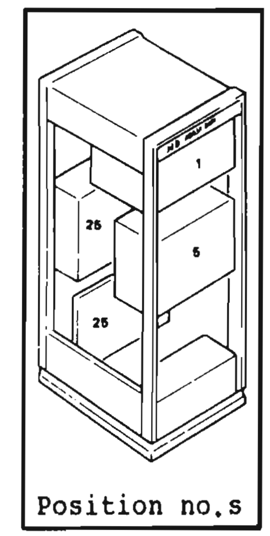
Figure 57. Site 212, main signal paths.



4.2.9 DPS SITE 213

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





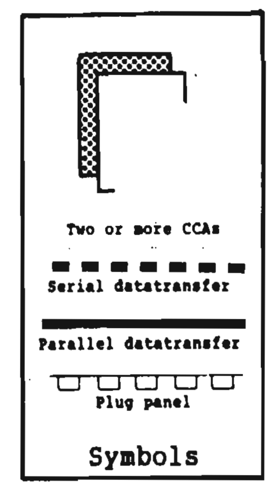
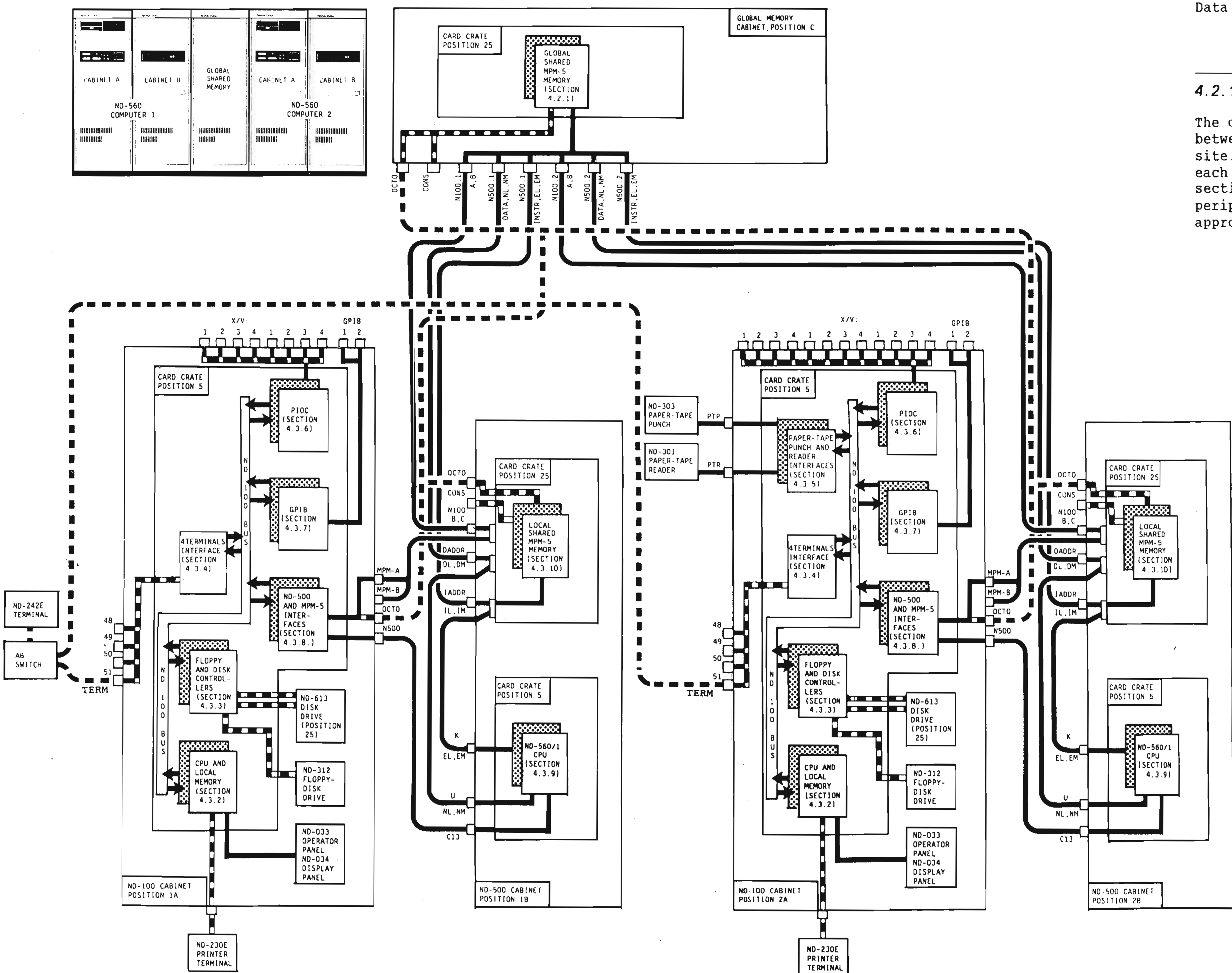
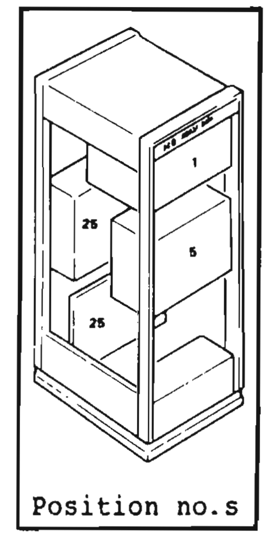


Figure 58. Site 213, main signal paths.

4.2.10 DPS SITE 314

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





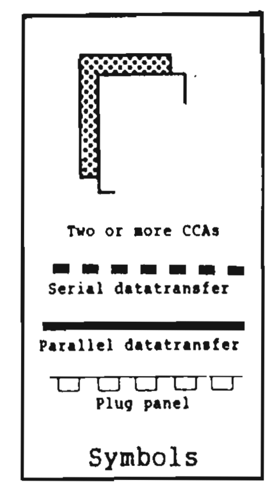
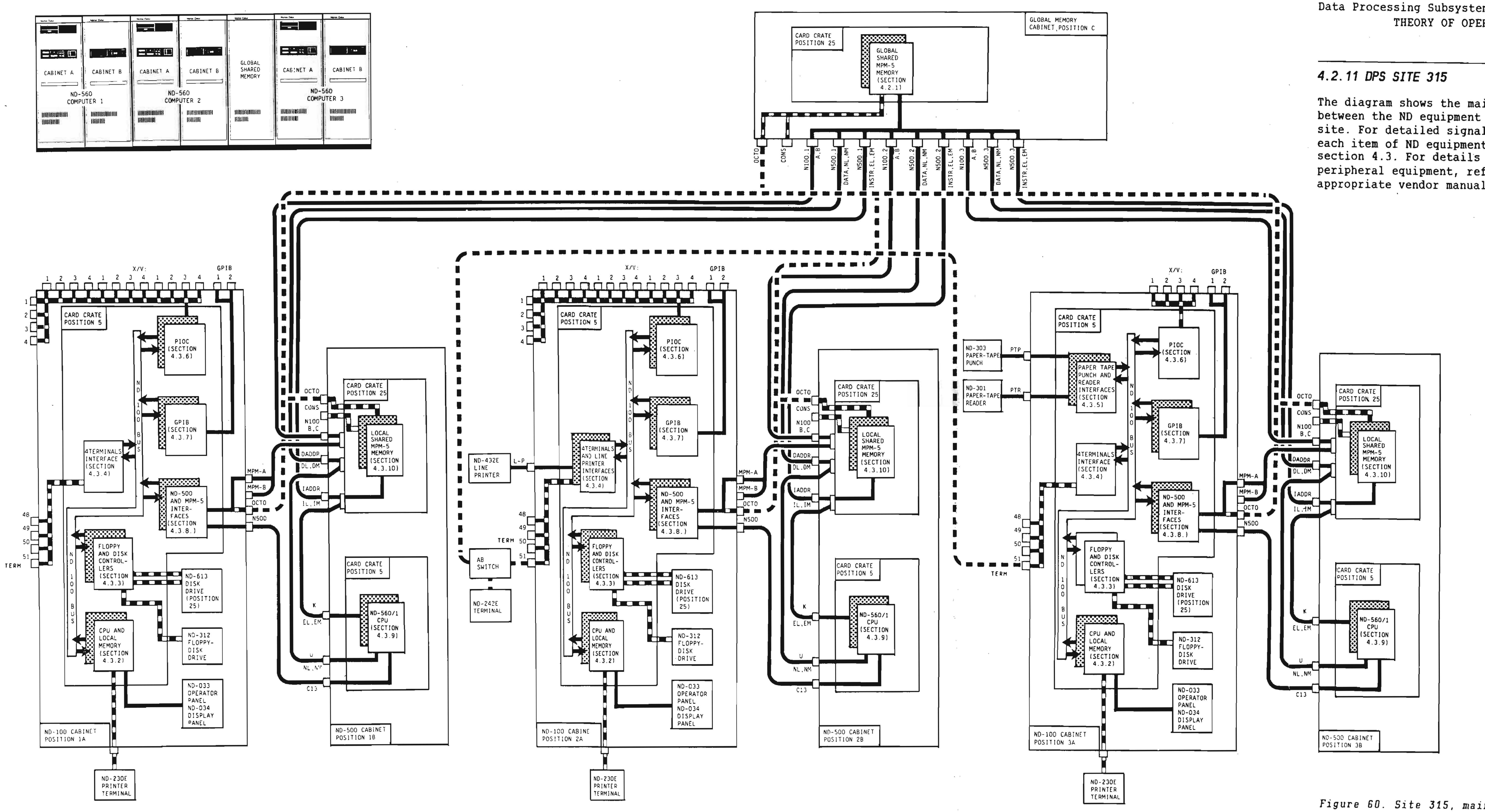
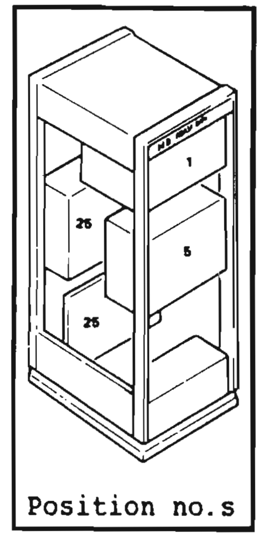


Figure 59. Site 314, main signal paths.

4.2.11 DPS SITE 315

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





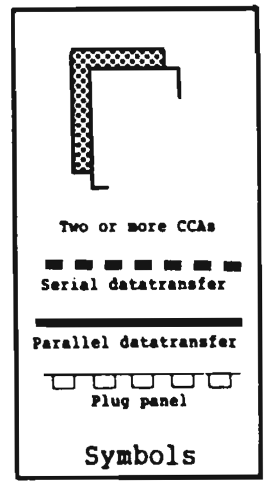
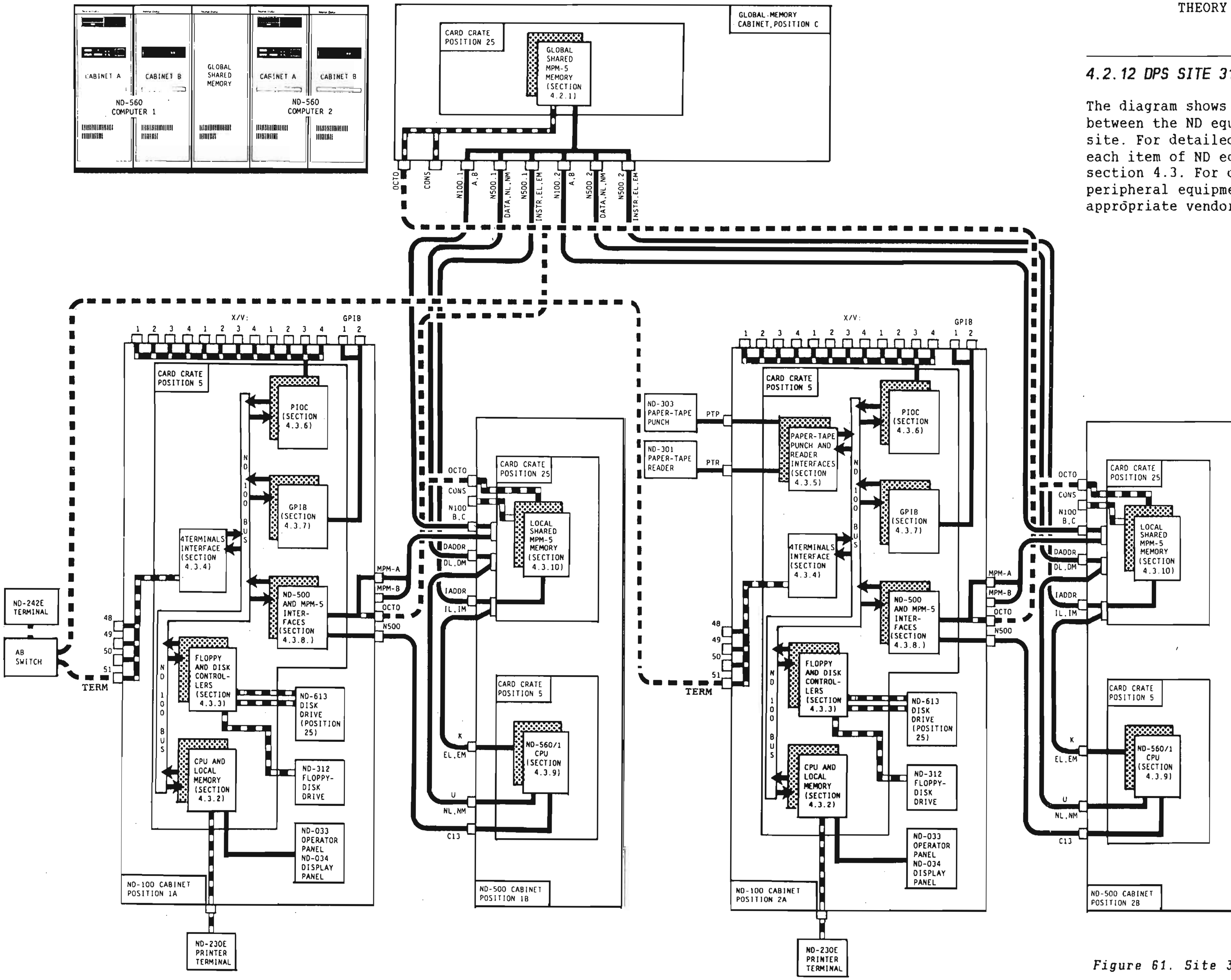
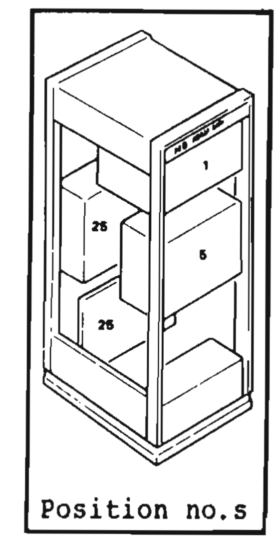


Figure 60. Site 315, main signal paths.

4.2.12 DPS SITE 316

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





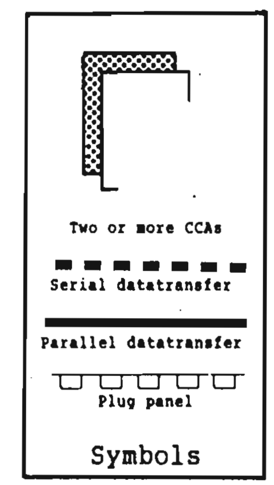
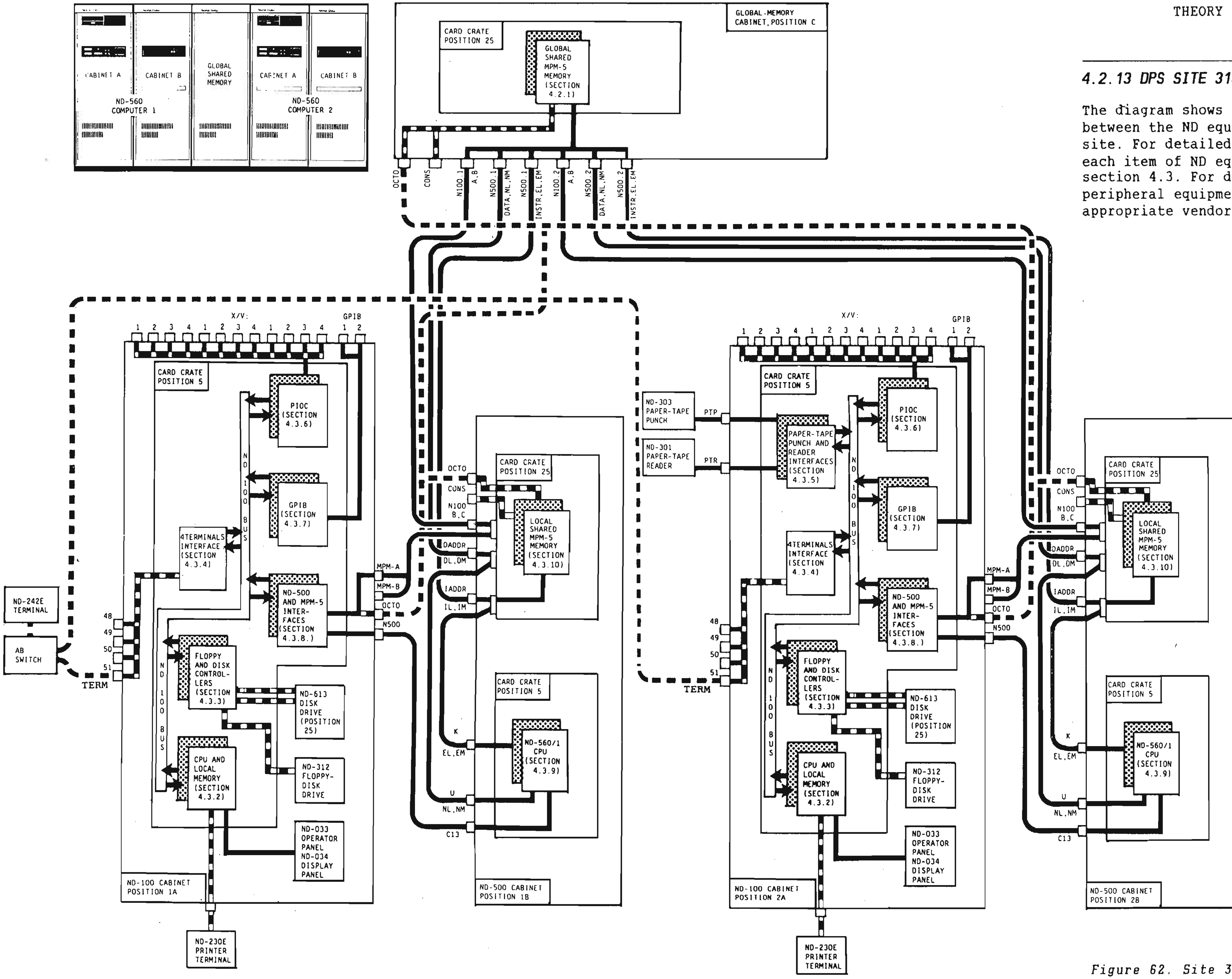
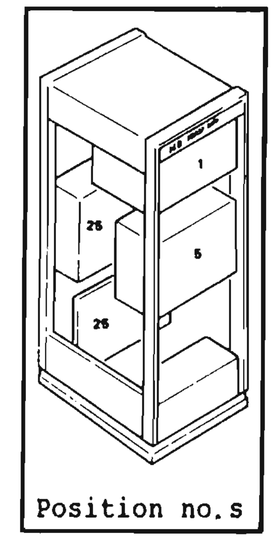


Figure 61. Site 316, main signal paths.

4.2.13 DPS SITE 318

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





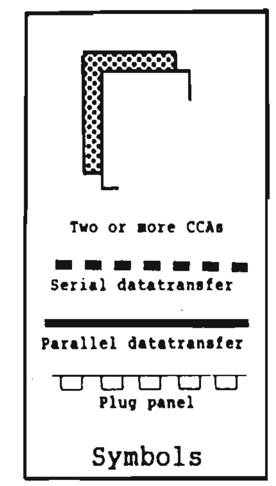
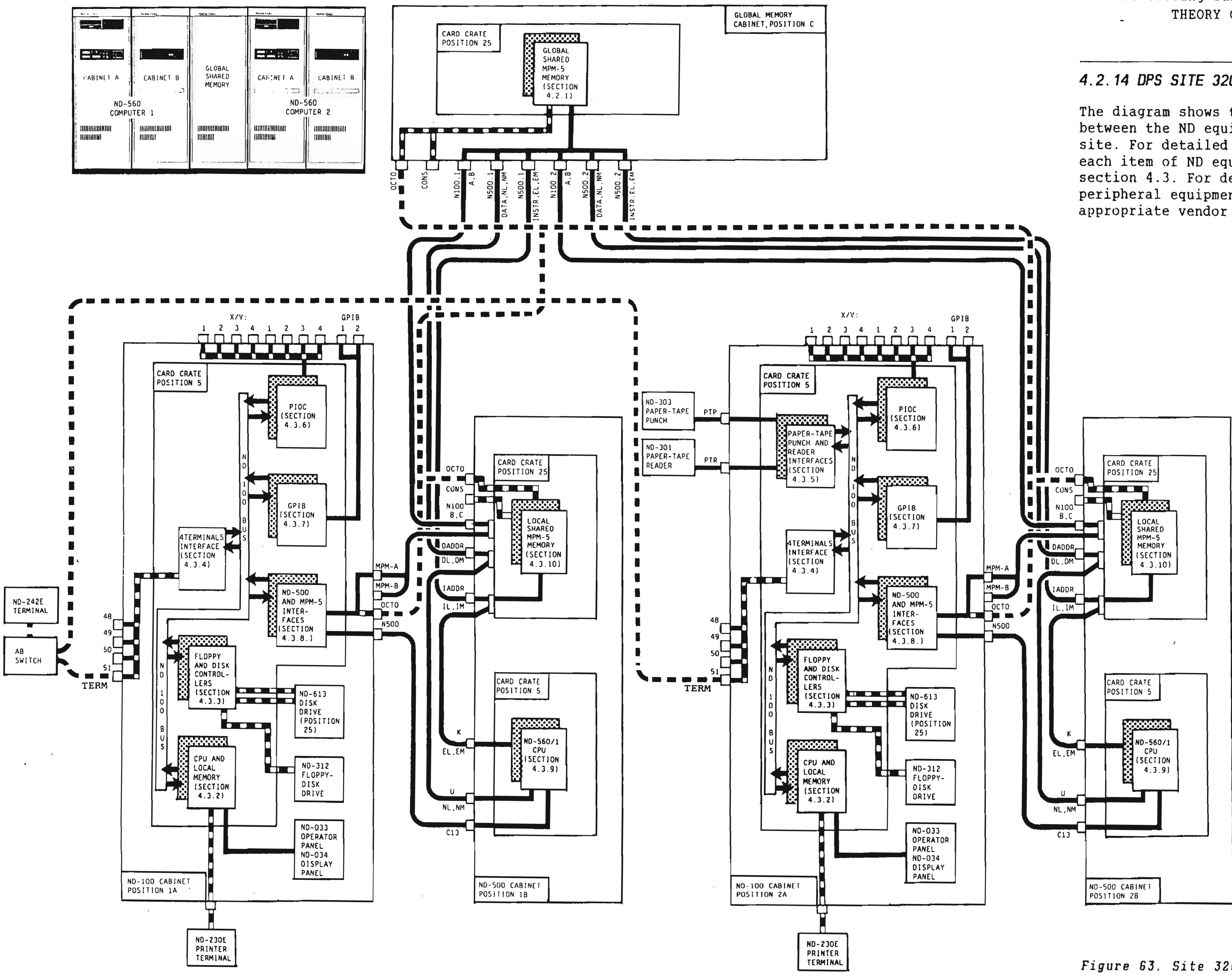
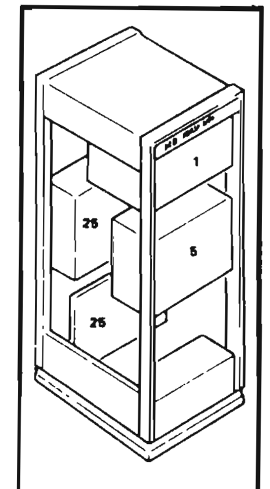


Figure 62. Site 318, main signal paths.

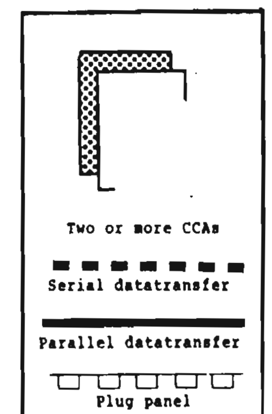
4.2.14 DPS SITE 320

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





Position no.s

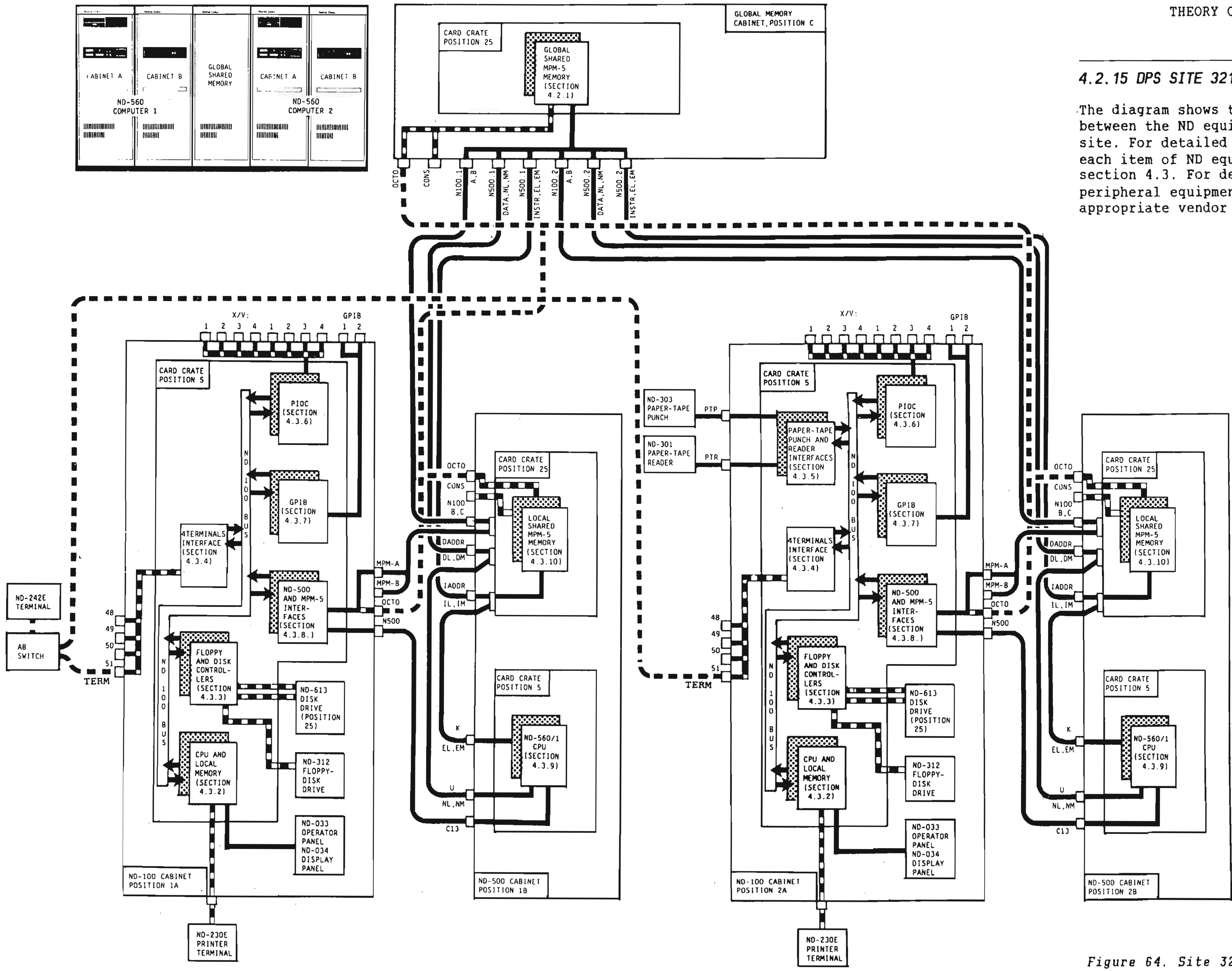


Symbols

Figure 63. Site 320, main signal paths.

4.2.15 DPS SITE 321

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).



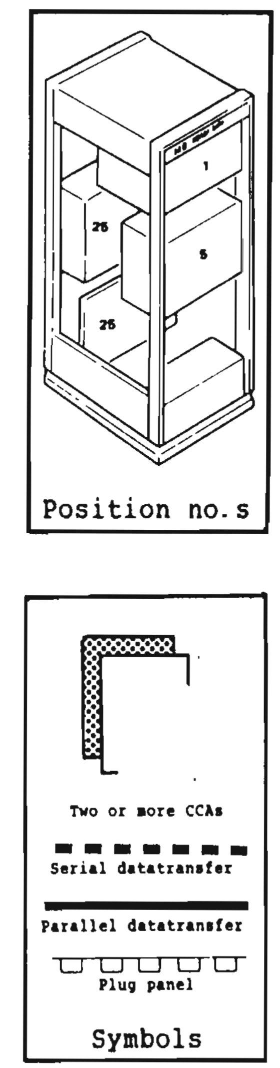
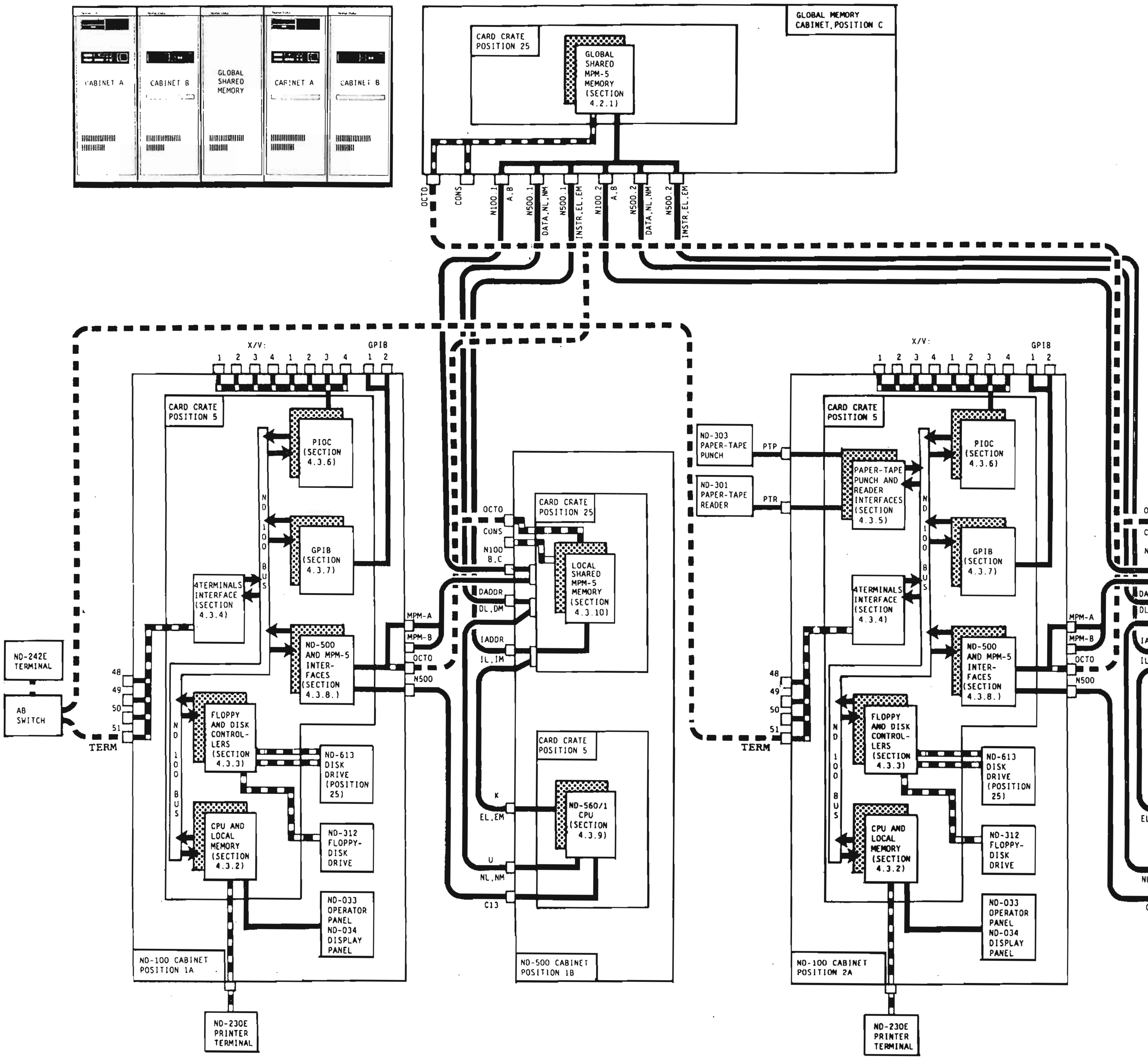


Figure 64. Site 321, main signal paths.

4.2.16 DPS SITE 322

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).



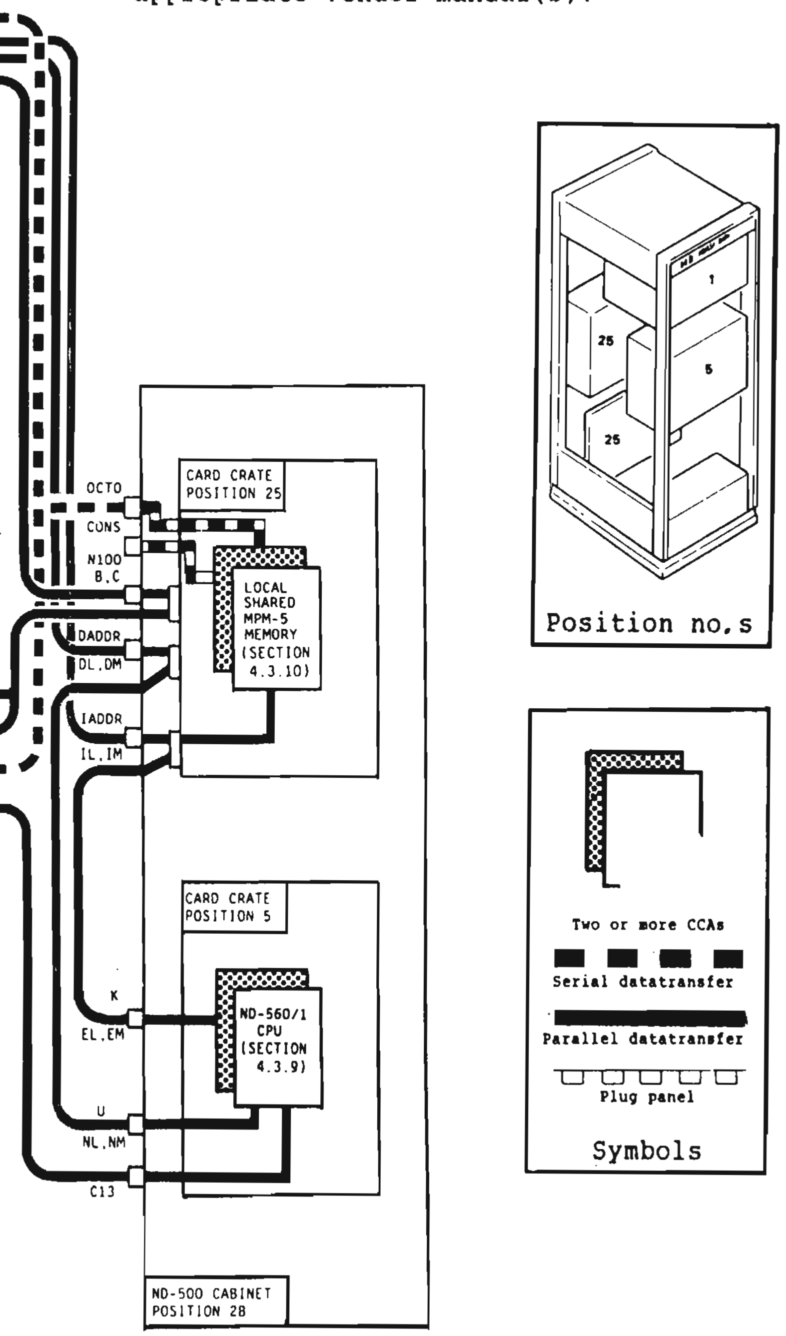
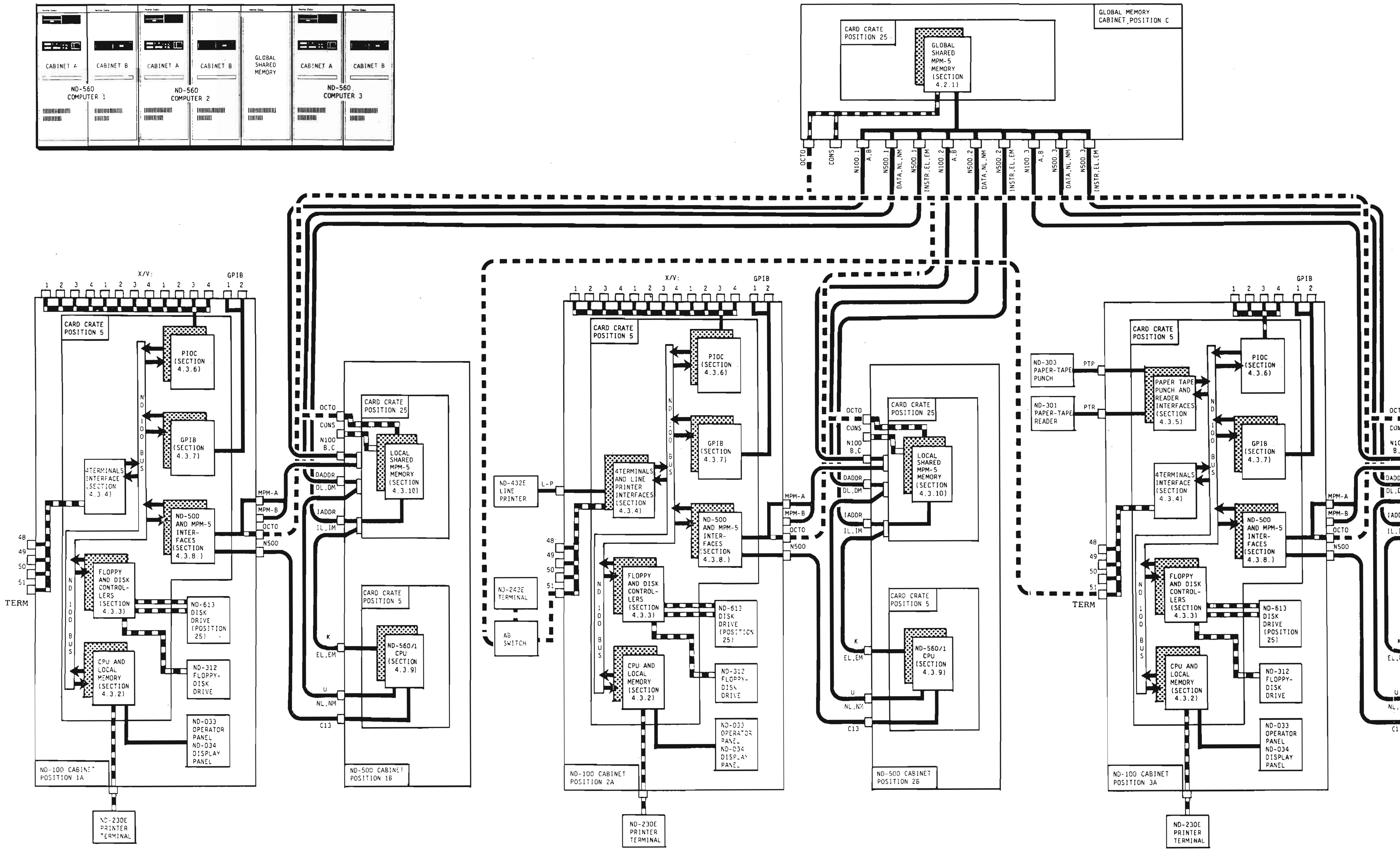


Figure 65. Site 322, main signal paths.

4.2.17 DPS SITE 323

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).



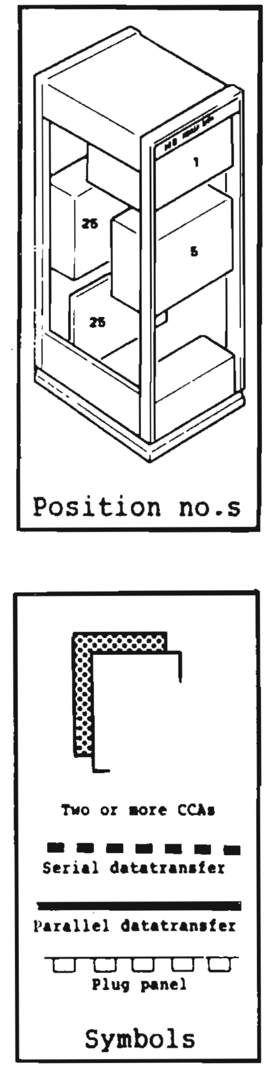
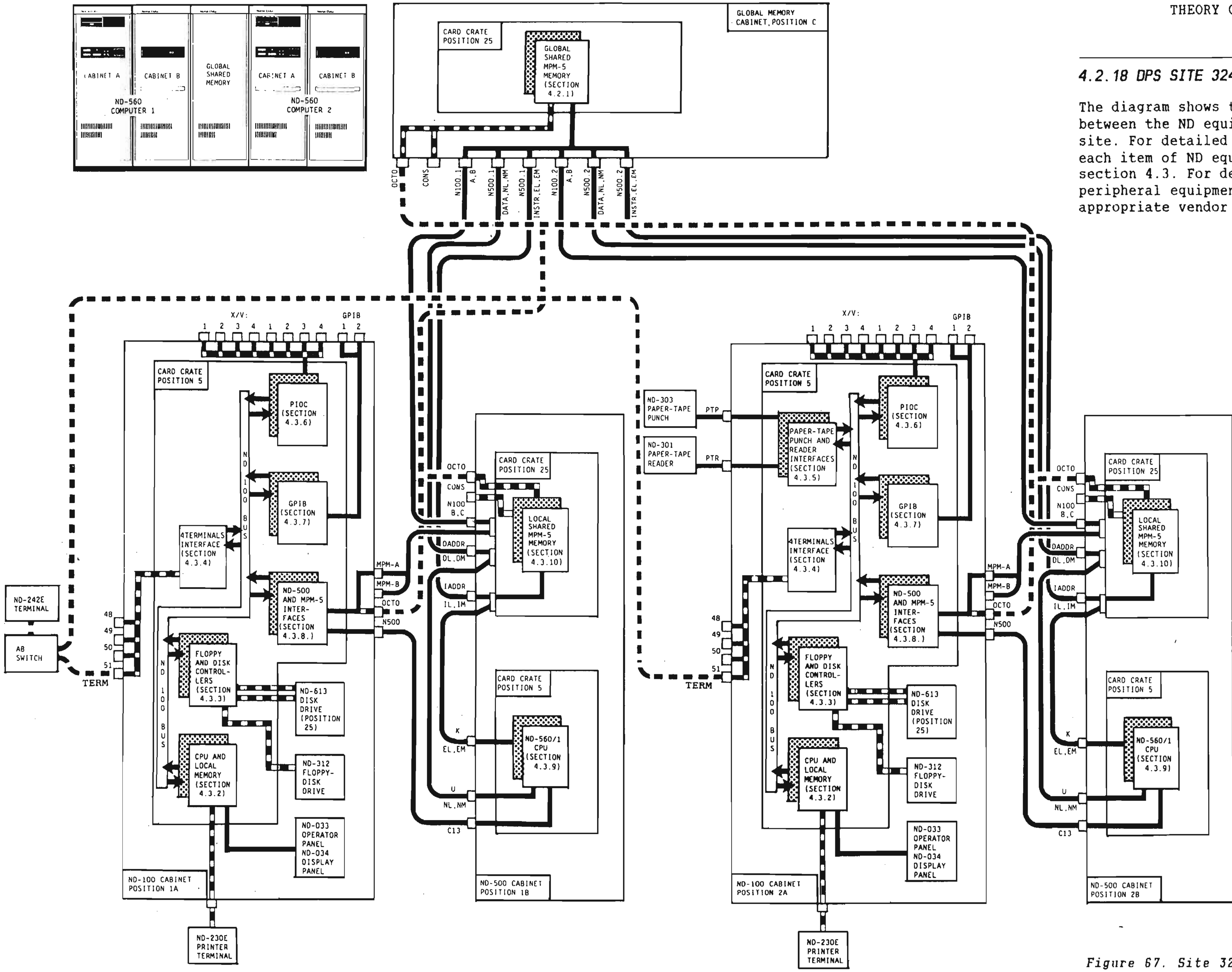
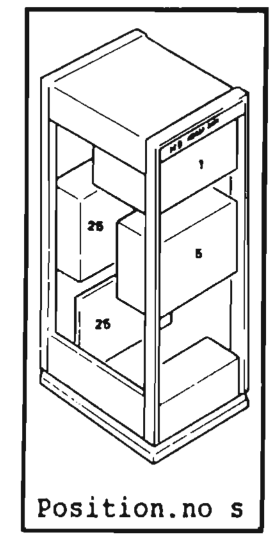


Figure 66. Site 323, main signal paths.

4.2.18 DPS SITE 324

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





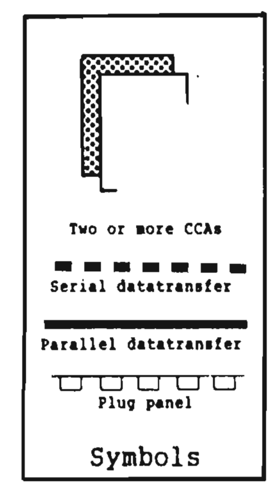
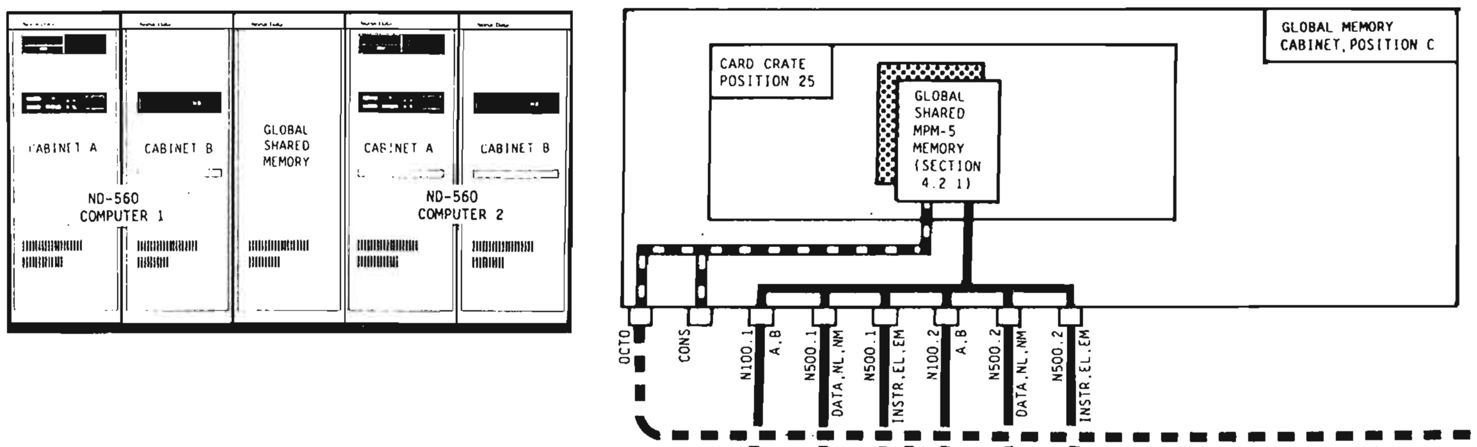
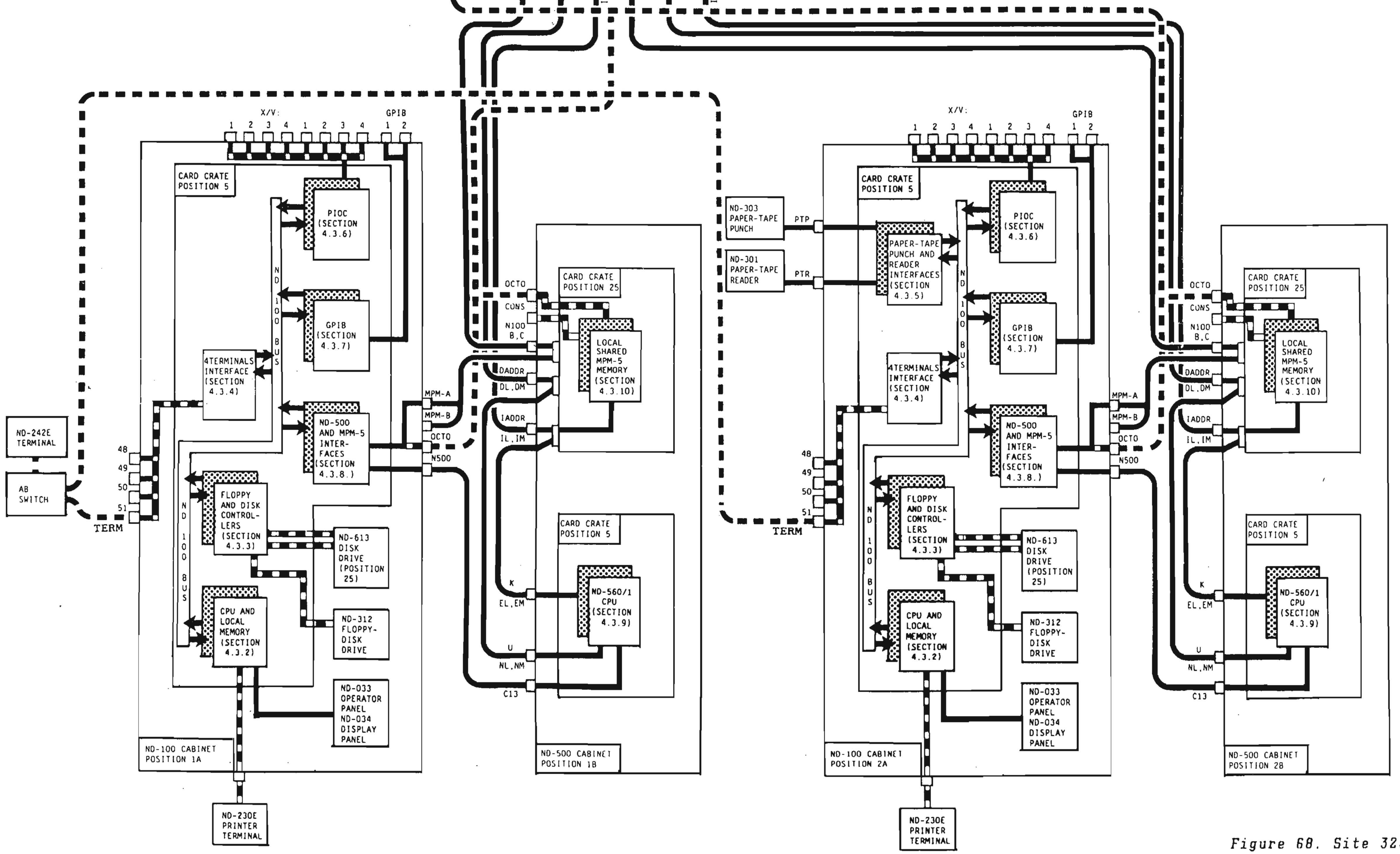


Figure 67. Site 324, main signal paths.

4.2.19 DPS SITE 325

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).





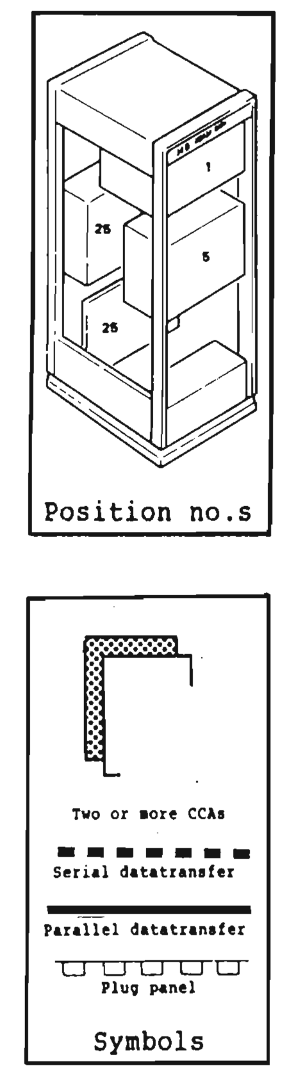


Figure 68. Site 325, main signal paths.

4.2.20 DPS SITE 400M

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).

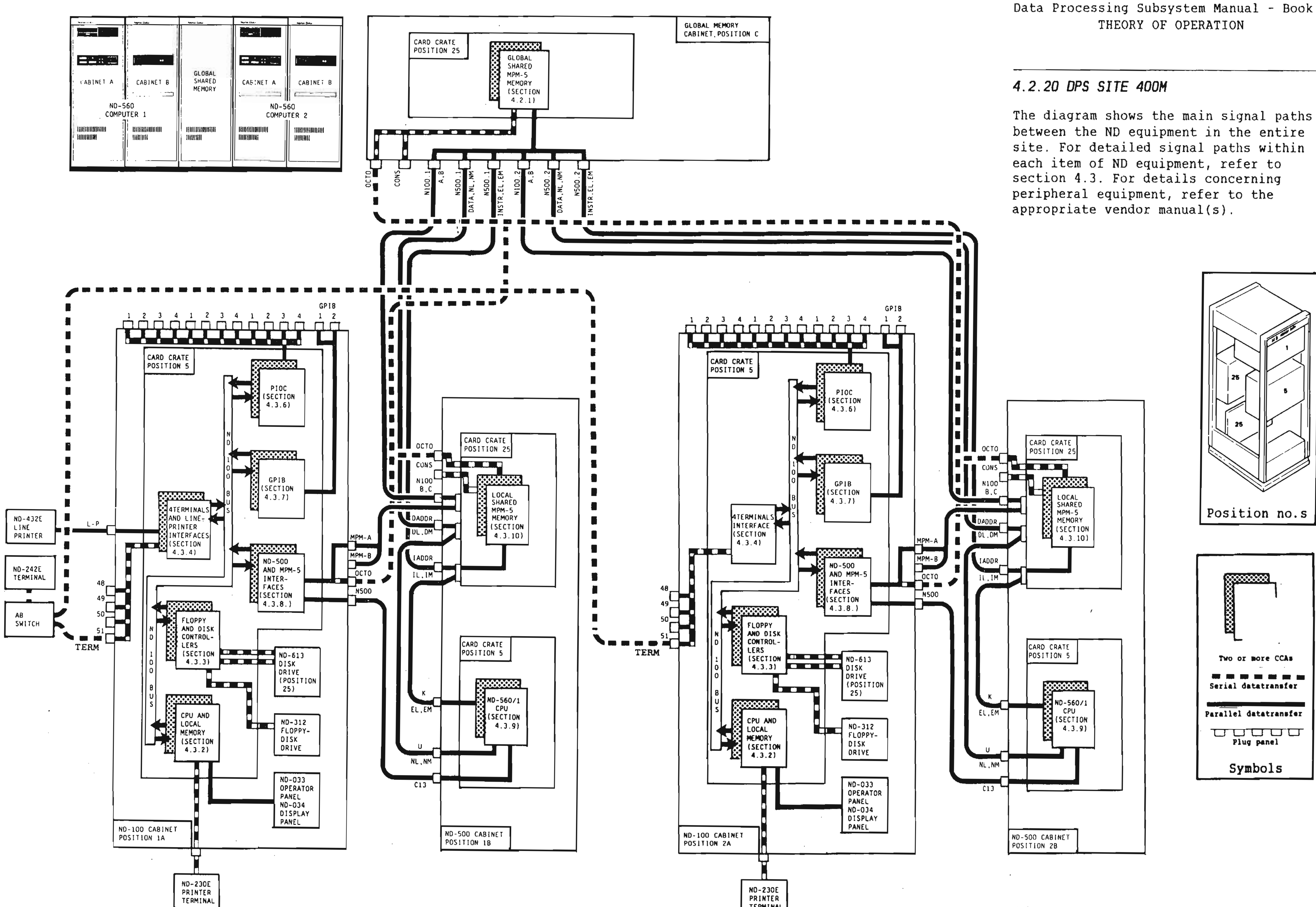


Figure 69. Site 400M, main signal paths.

4.2.21 DPS SITE 400R

The diagram shows the main signal paths between the ND equipment in the entire site. For detailed signal paths within each item of ND equipment, refer to section 4.3. For details concerning peripheral equipment, refer to the appropriate vendor manual(s).

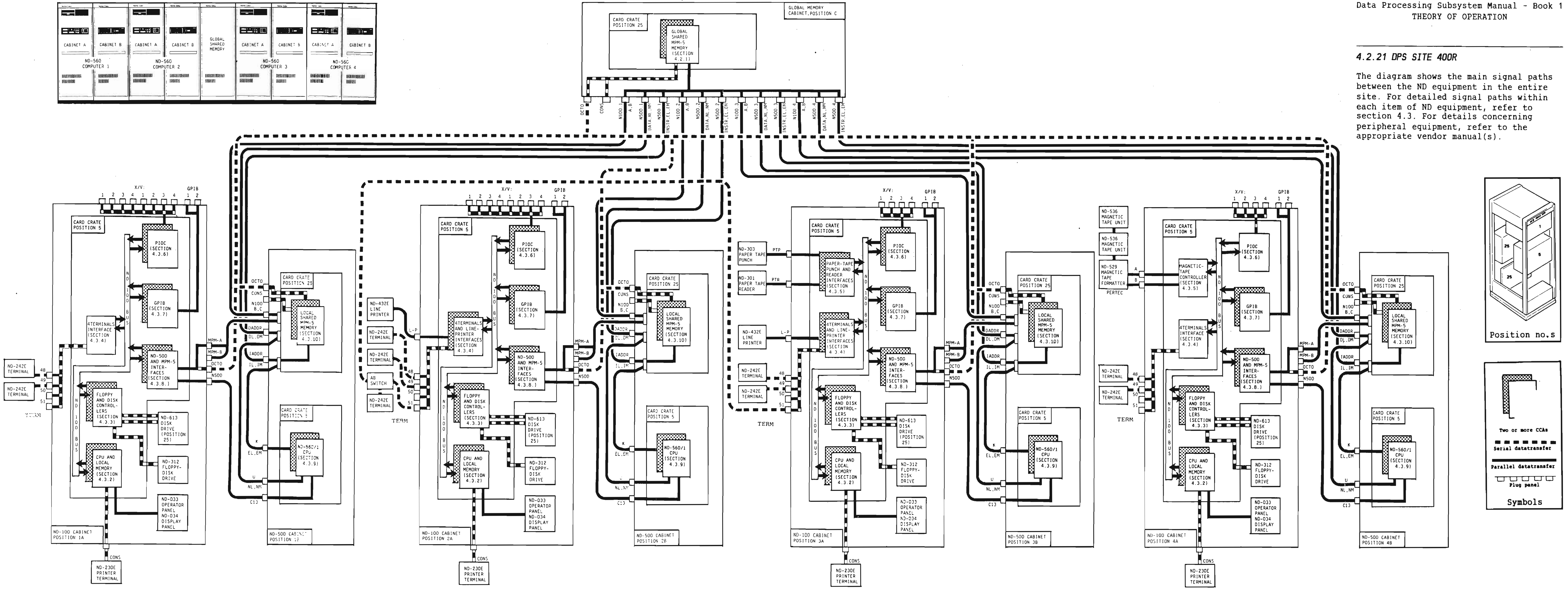


Figure 70. Site 400R, main signal paths.

4.3 DETAILED SIGNAL PATHS IN THE DATA PROCESSING SUBSYSTEM

4.3.1 GENERAL

The detailed signal paths in the Data Processing Subsystem (DPS) are shown in sections 4.3.2 - 4.3.11.

The ND-560 computer is presented first, followed by the Global Shared Multiport-5 (MPM-5) Memory.

Each Circuit Card Assembly (CCA) is drawn as a box. The slot position is indicated within the box. Optional CCAs and peripherals are marked with a "*". See section 4.2.1 for optional equipment included in the different DPS sites.

One arrow, indicating data transfer between a CCA and a plug panel, corresponds to one physical, internal cable. The marking on the plug panel is shown and also the marking on the other end of the external cable connected to the plug panel. See Chapter 4 in Book 3 for more information about physical cabling.

In the ND-100 crate (the A cabinets) there are three connectors:

- A and B - connection to peripherals via flat cables to plug panel
- C - connection to the common ND-100 bus implemented on a backwiring card.

In the ND-560 CPU card crate (cabinet B) there are four connectors called A, B, C and D. All connector signals are distributed to separate backwiring cards for interconnection between the CCAs.

Some A, B and C connectors are used for connection to ND-100 and multiport (MPM-5) memory via a plug panel.

In the multiport (MPM-5) memory crates (cabinets B and C) there are also 4 connectors called A, B, C and D. Again the connector signals are distributed to separate backwiring cards.

The A connector is used only for the common MPM-5 bus. The B, C and D connectors provide connection to the ND-100 and ND-560 computers.

The B and C connectors do not go directly to a plug panel for external connection but rather via an additional, internal plug panel behind the card crate.

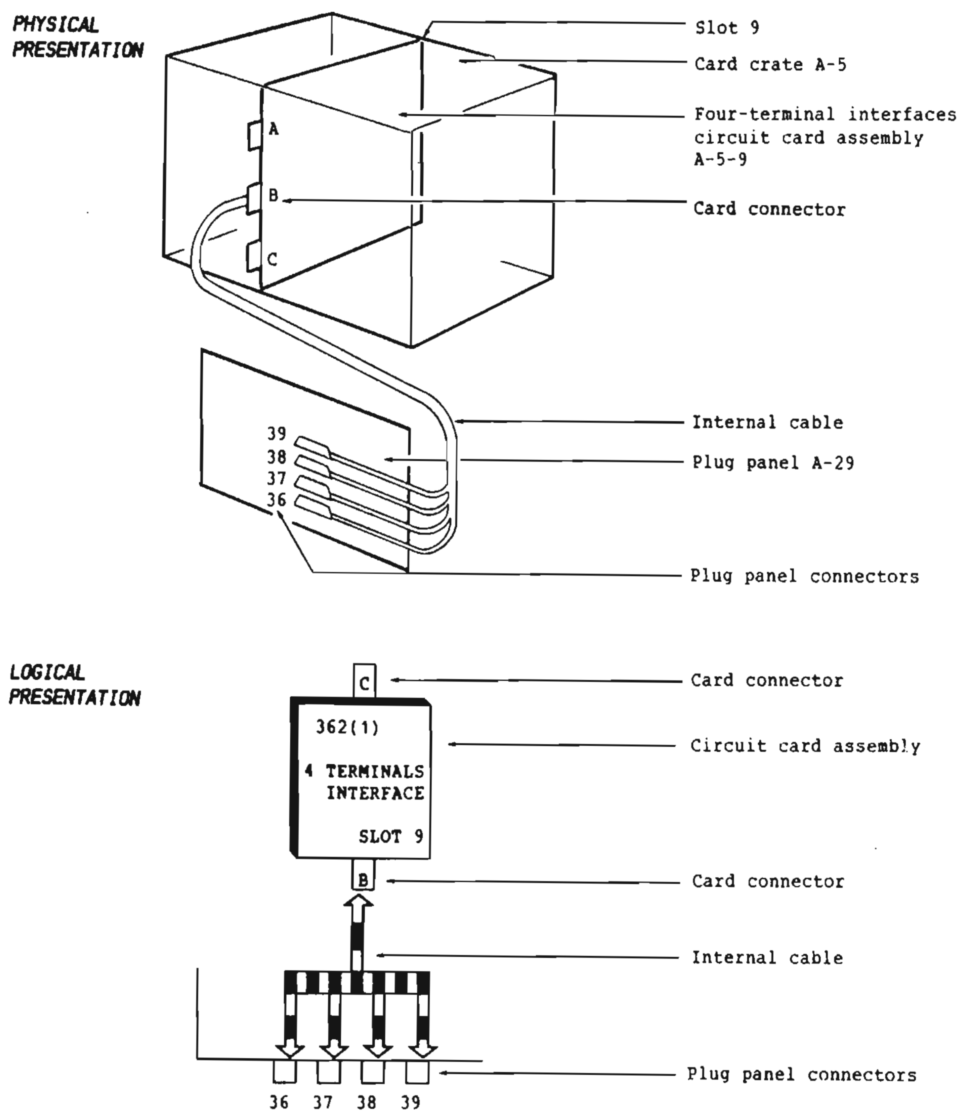


Figure 71. Logical presentation of equipment

4.3.2 ND-560 COMPUTER - ND-100 CPU AND LOCAL MEMORY

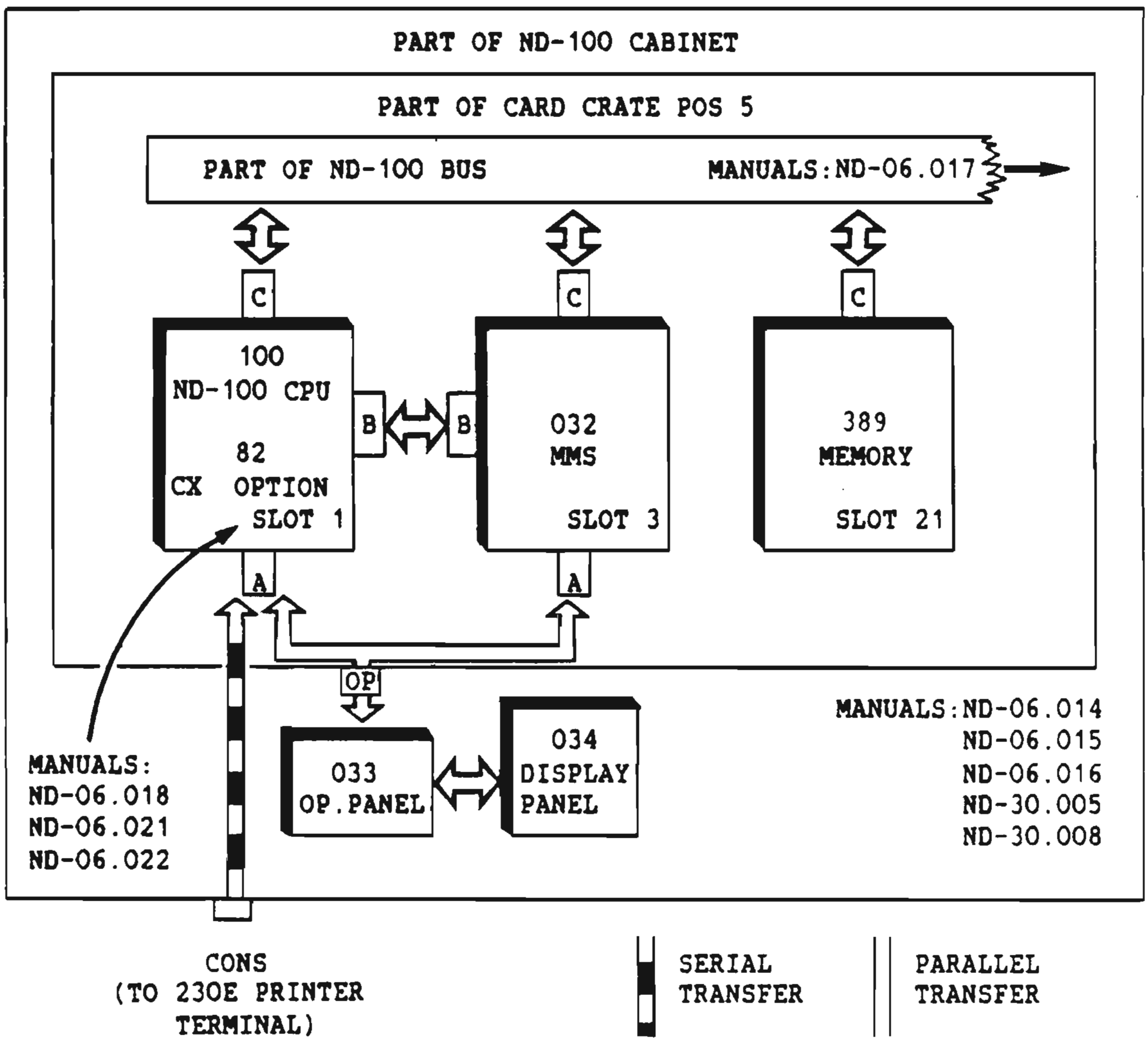


Figure 72. Logical drawing - ND-100 CPU and local memory

| 2

4.3.3 ND-560 COMPUTER - FLOPPY AND DISK CONTROLLERS

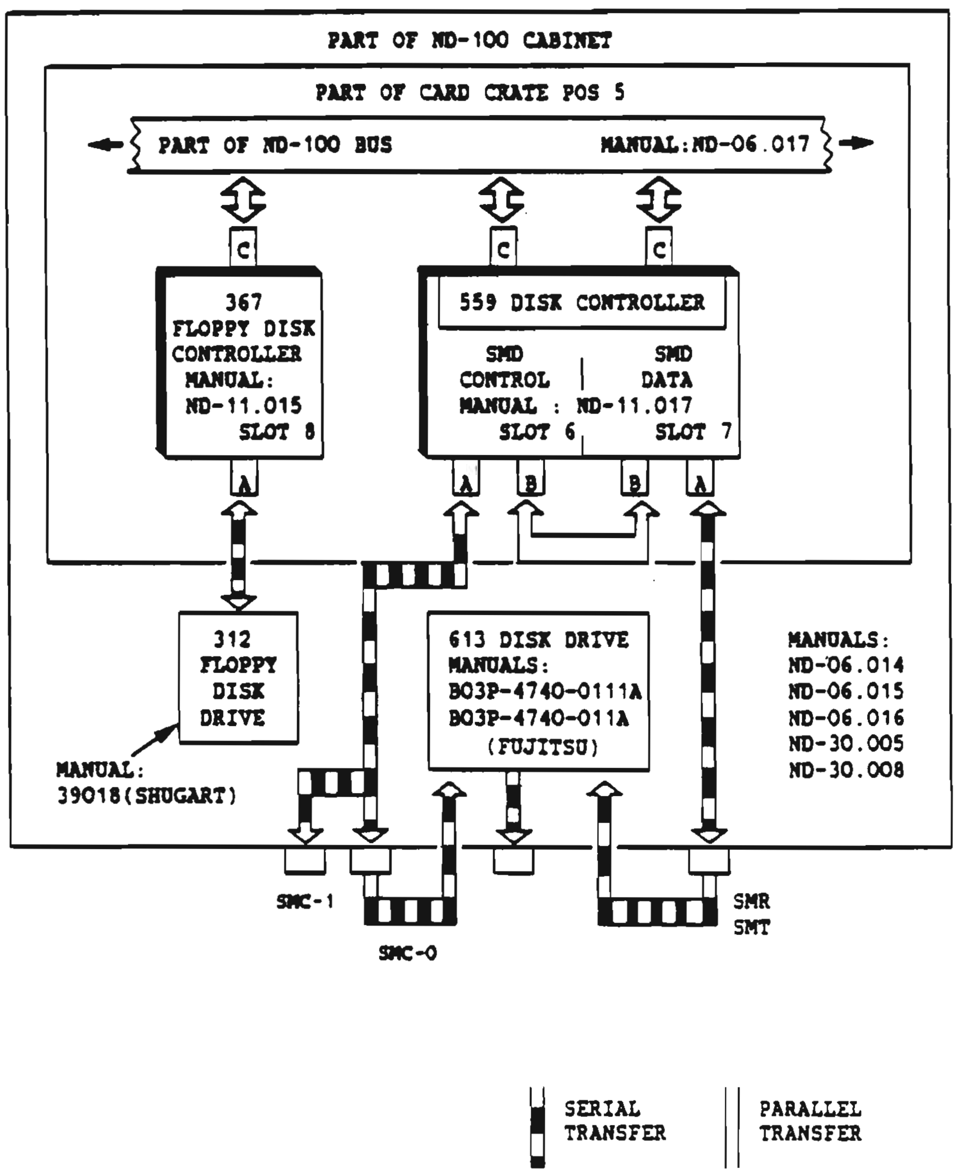


Figure 73. Logical drawing - floppy and disk controllers

4.3.4 ND-560 COMPUTER - FOUR-TERMINAL AND LINE PRINTER INTERFACES

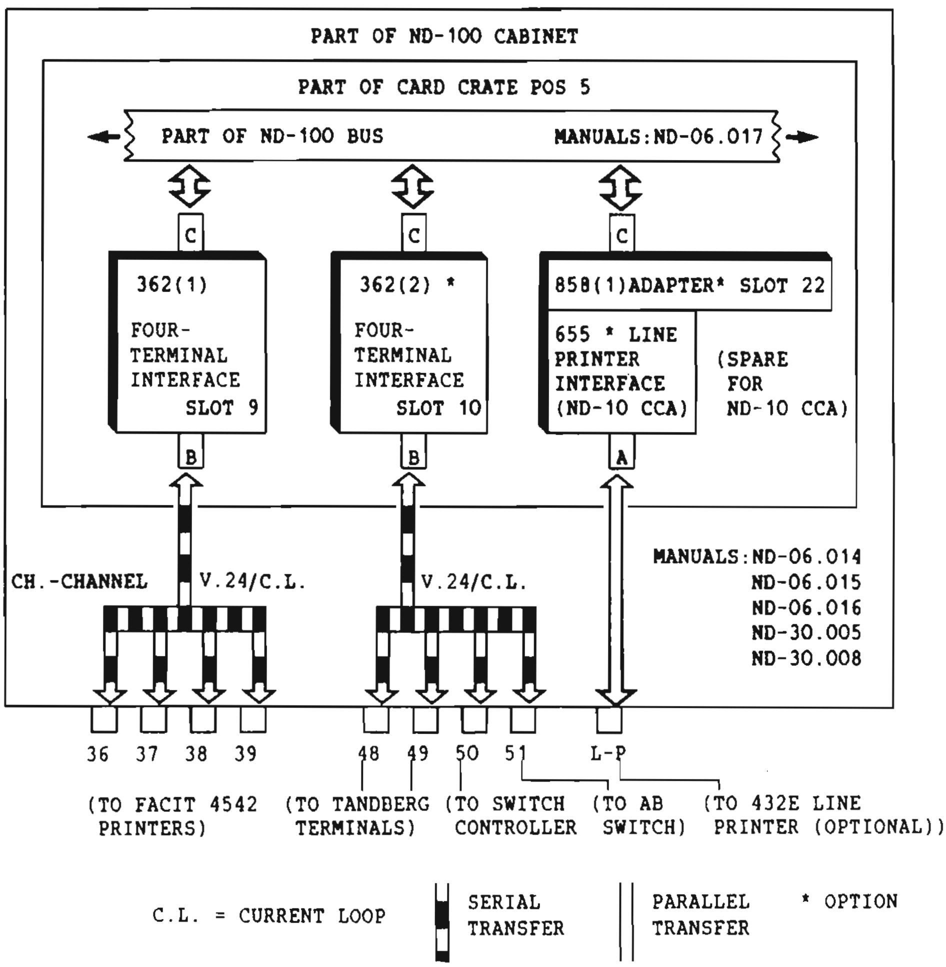


Figure 74. Logical drawing - four-terminal and line printer interfaces

4.3.5 ND-560 COMPUTER - MAGNETIC TAPE, TAPE READER AND TAPE PUNCH INTERFACES

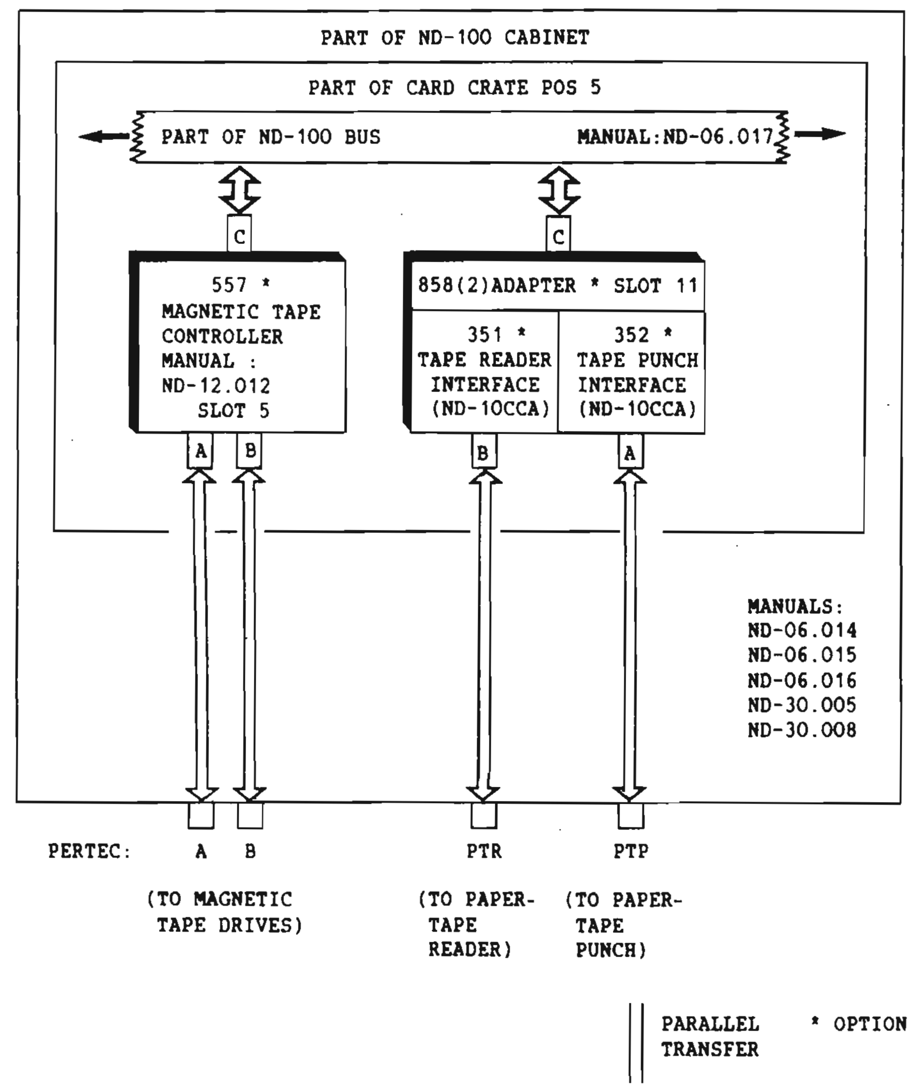


Figure 75. Logical drawing - Magnetic tape, tape reader and tape punch interfaces

4.3.6 ND-560 COMPUTER - PROGRAMMABLE I/O CONTROLLERS (PIOC)

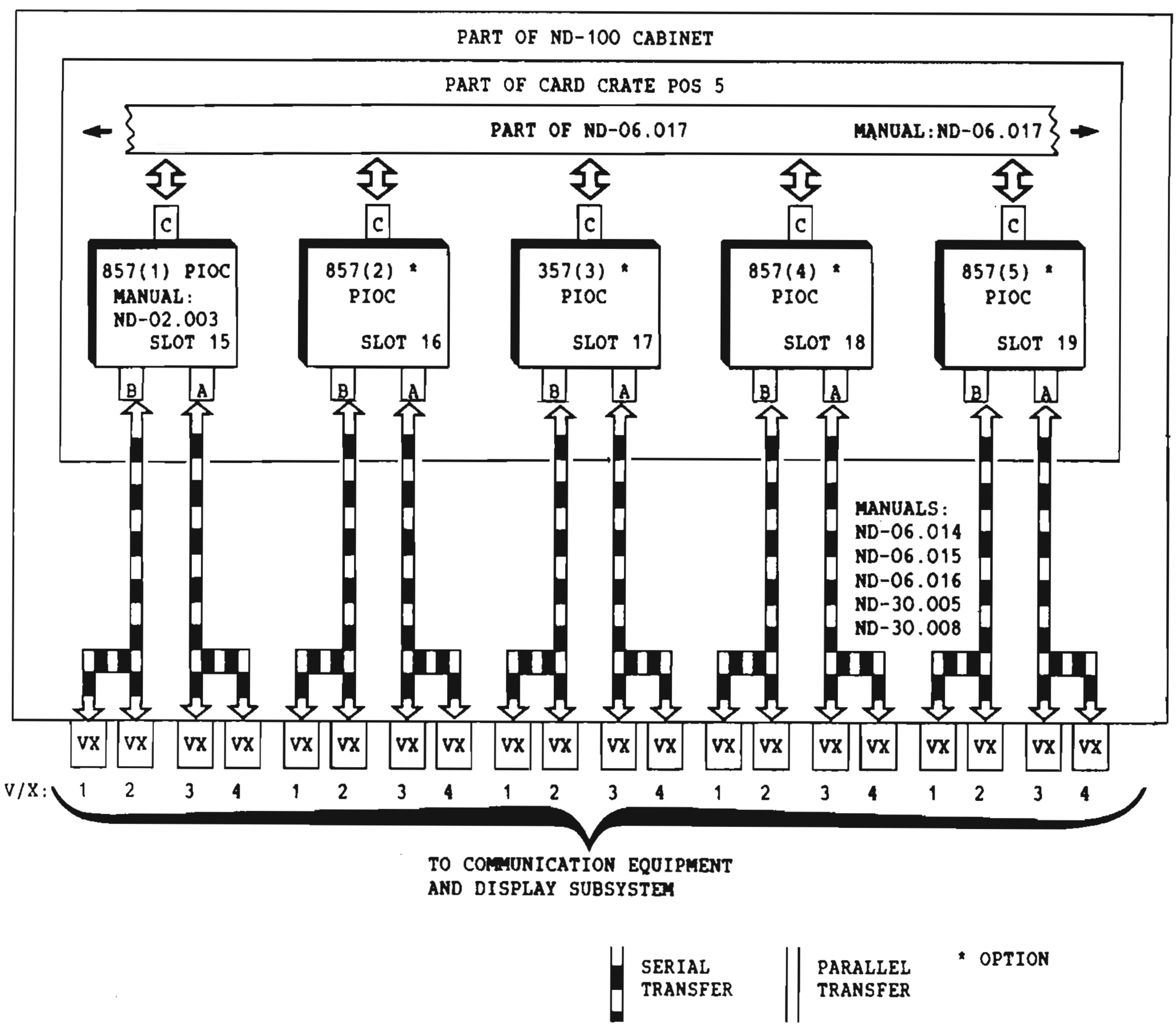


Figure 76. Logical drawing - Programmable I/O Controllers (PIOC)

4.3.7 ND-560 COMPUTER - GENERAL PURPOSE INTERFACE BUS (GPIB) CONTROLLERS

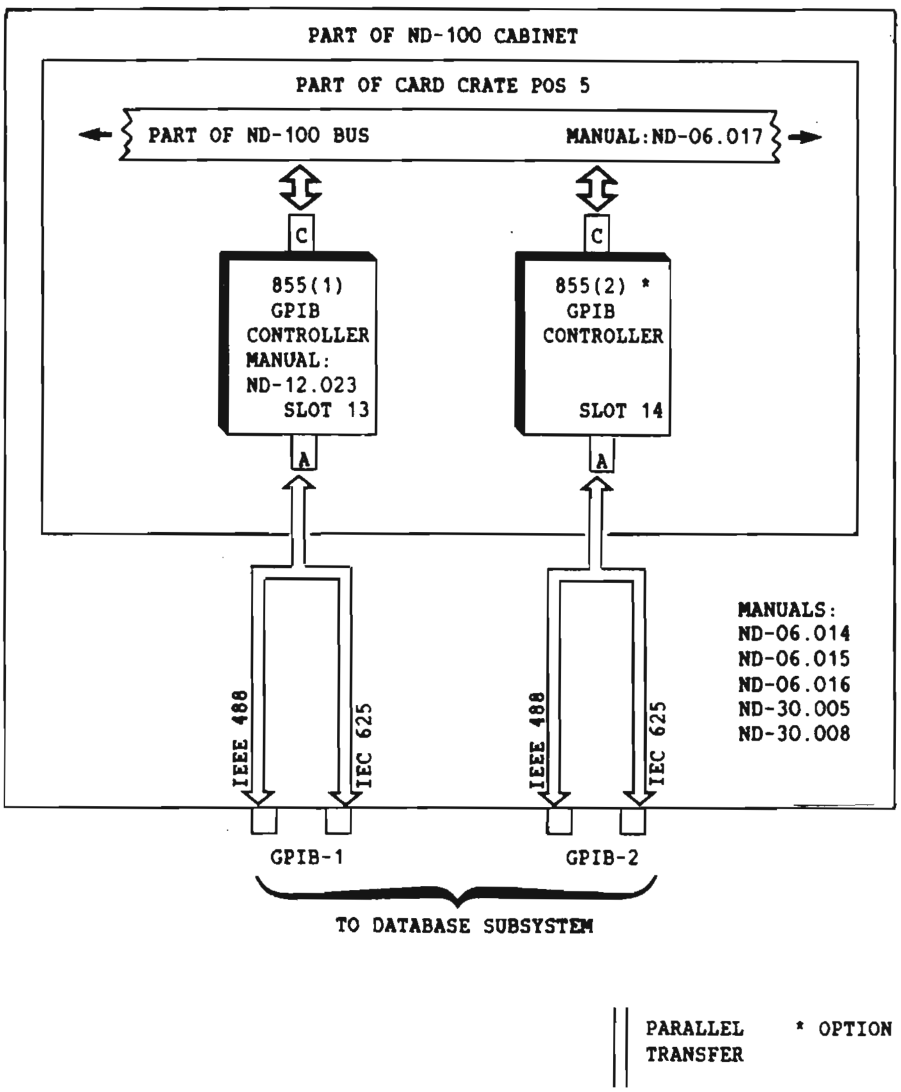


Figure 77. Logical drawing - General Purpose Interface Bus (GPIB) Controllers

4.3.8 ND-560 COMPUTER - ND-500 AND MULTIPORT-5 (MPM-5) INTERFACES

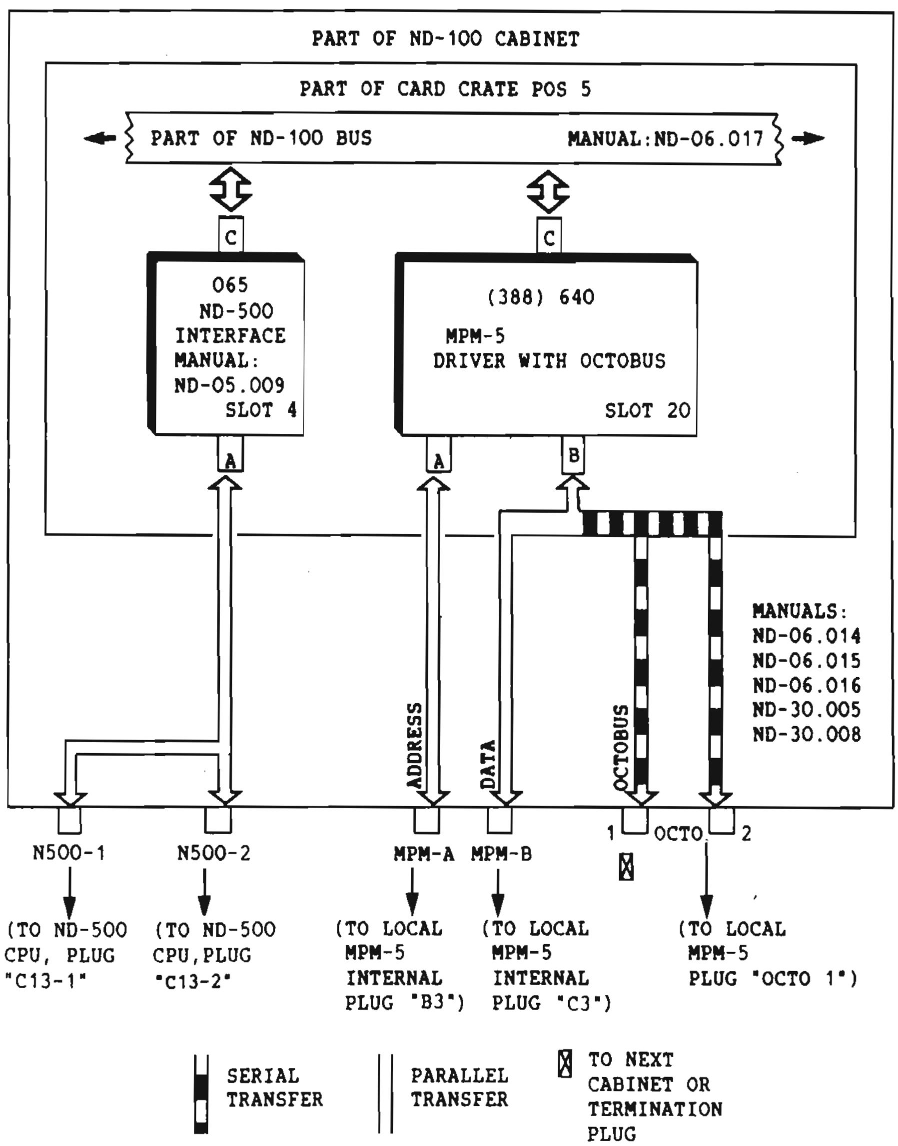


Figure 78. Logical drawing - ND-500 and Multiport-5 (MPM-5) interfaces

4.3.9 ND-560 COMPUTER - ND-560/1 CPU

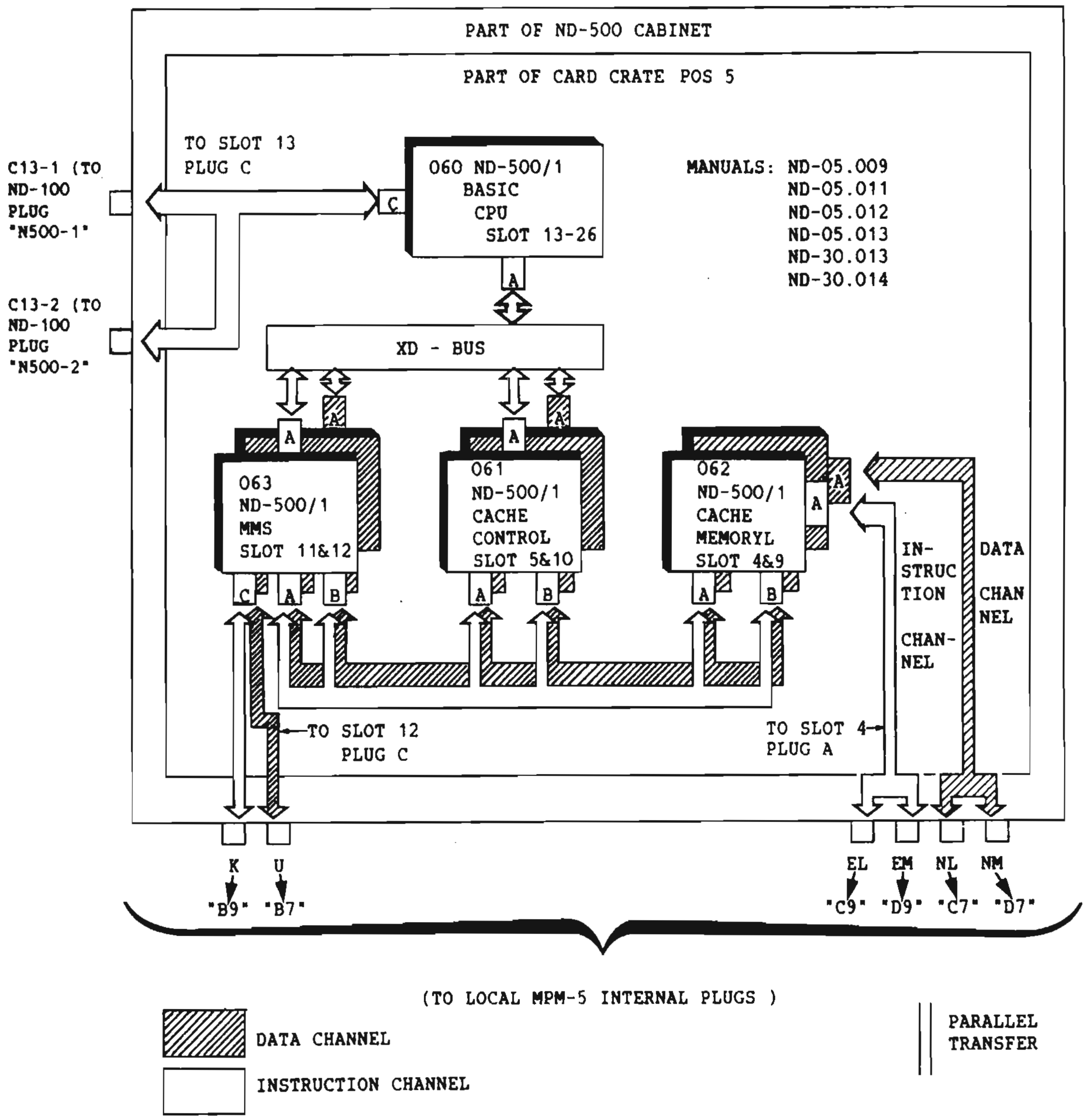


Figure 79. Logical drawing - ND-560/1 CPU

4.3.10 ND-560 COMPUTER - LOCAL SHARED MULTIPORT-5 (MPM-5) MEMORY

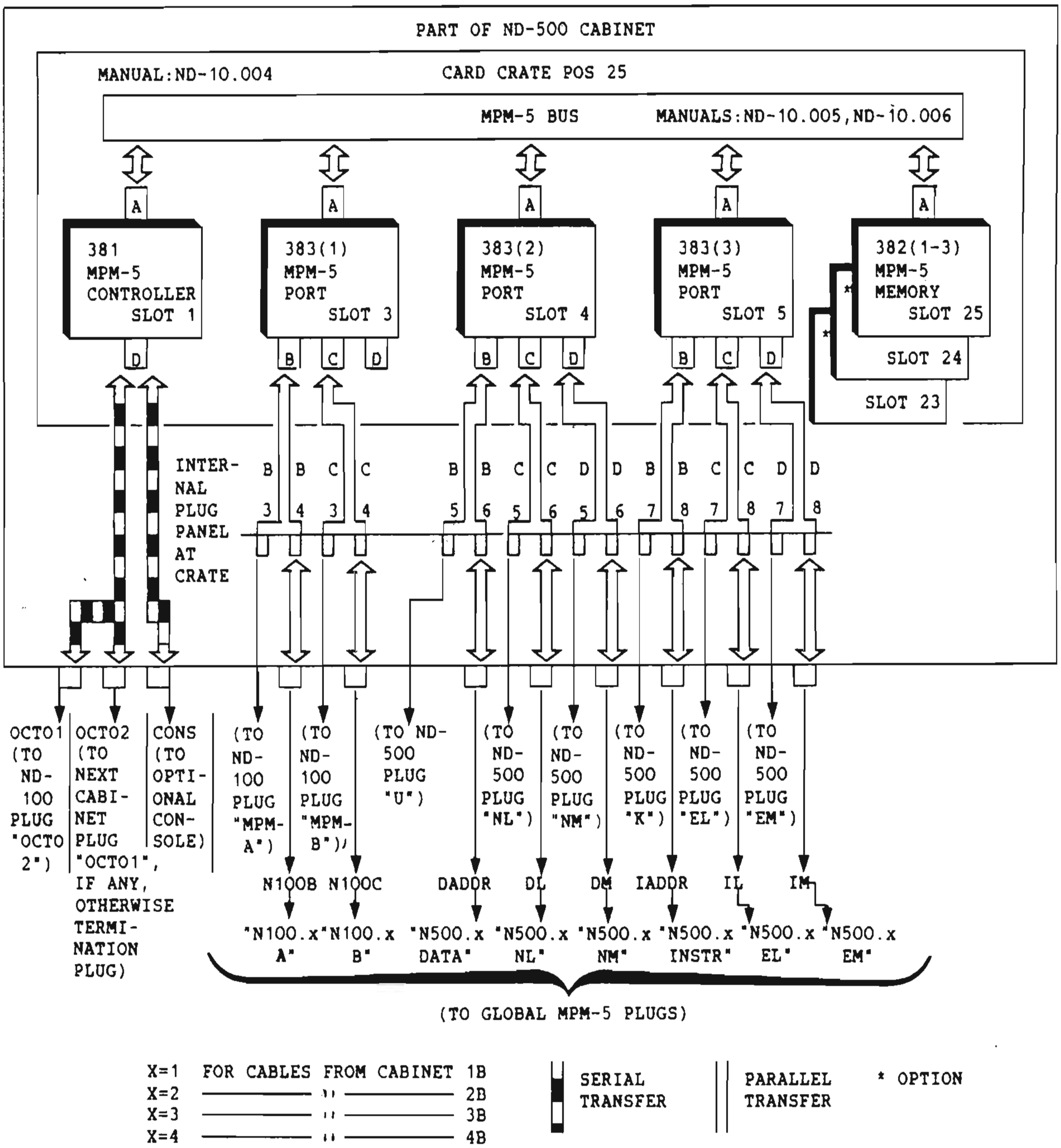


Figure 80. Logical drawing - Local shared Multiport-5 (MPM-5) memory

4.3.11 GLOBAL SHARED MULTIPORT-5 (MPM-5) MEMORY

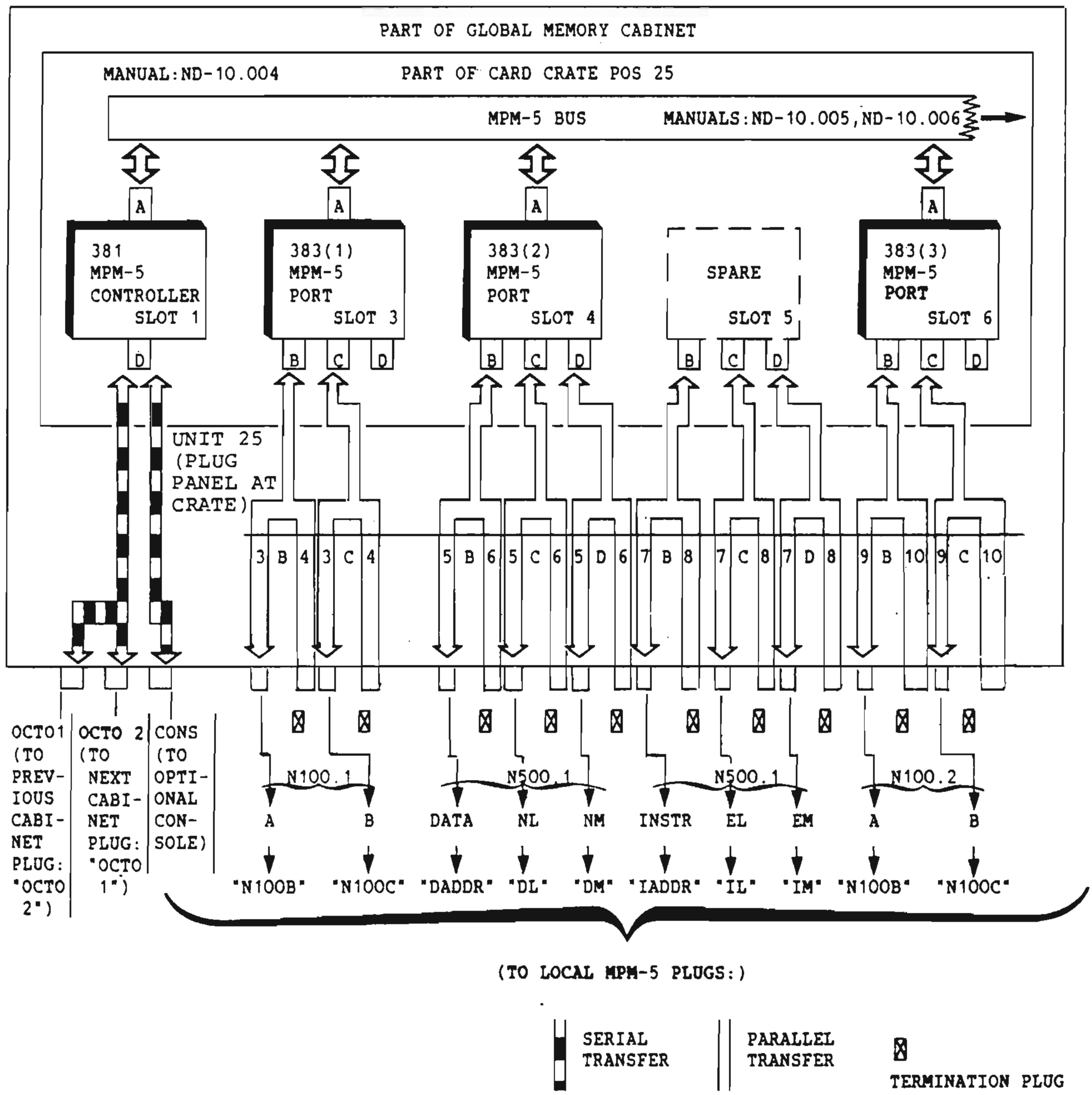


Figure 81. Logical drawing - Global shared Multiport-5 (MPM-5) memory (1 of 3)

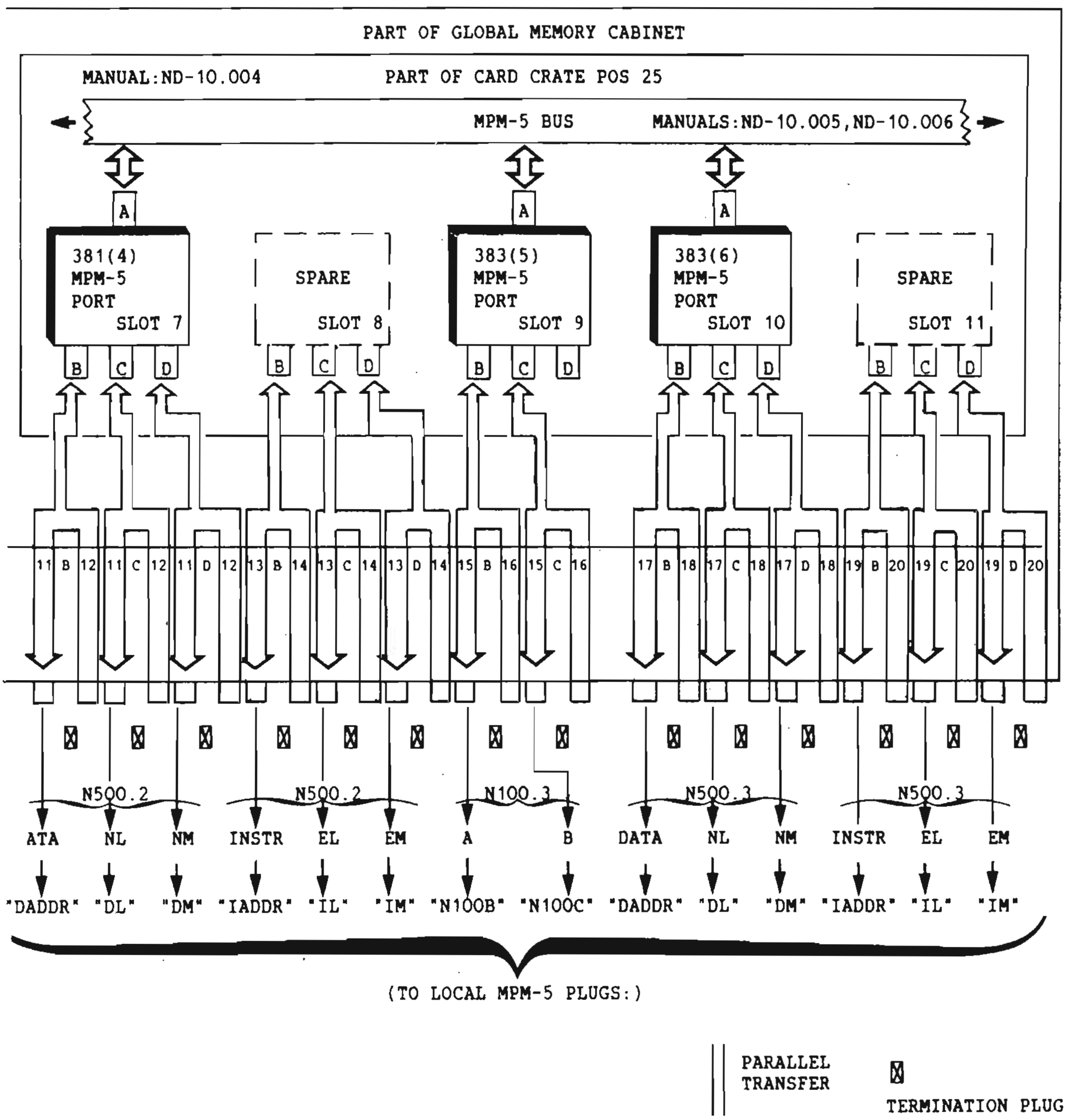


Figure 82. Logical drawing - Global shared Multiport-5 (MPM-5) memory (2 of 3)

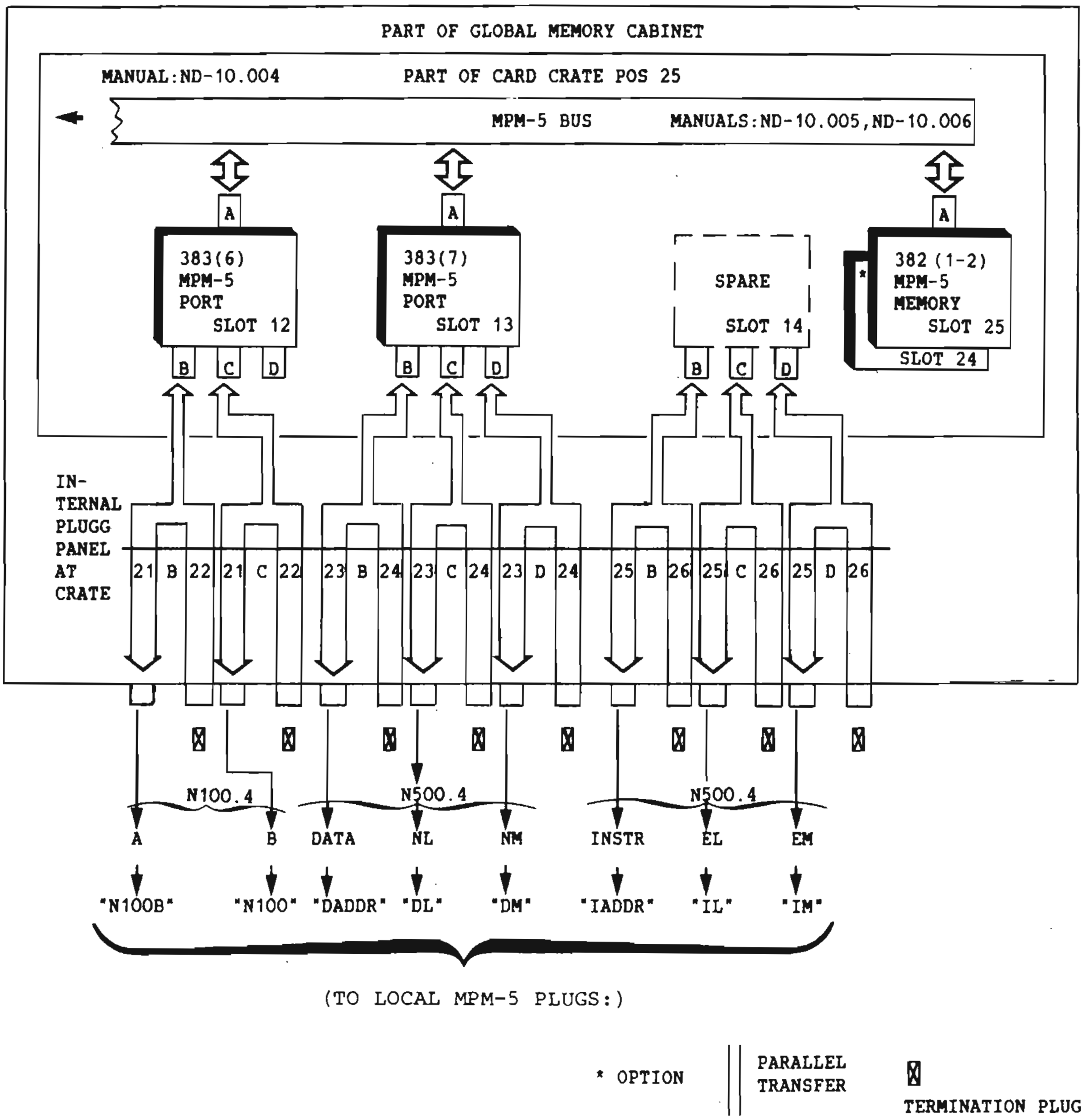


Figure 83. Logical drawing - Global shared Multiport-5 (MPM-5) memory (3 of 3)

4.4 POWER SUPPLY SYSTEM

4.4.1 GENERAL

Scope

The presentation of the power supply system is done by first describing all the different units which are a part of the entire power system. The last part of the section describes the special features (cabling) valid for the DPS sites.

The power supplies in the peripheral equipment are not covered by this section. These power supplies are an integrated part of that equipment and are covered by separate vendor manuals.

Power panel

Input power coming into a cabinet is distributed via a power panel on separate lines, protected by circuit breakers.

Multi Power system

All the ND-560 computers and the Global Shared Multiport-5 Memory (MPM-5) cabinets contain a Multi Power system.

The Multi Power system consists of a power control panel and up to four power supplies. The number of power supplies depends on the cabinet type.

The Multi Power system is designed to work with input power within the following limits:

- Voltage 184-264V AC
- Frequency 47-65 Hz

Power control panel

The power control panel is capable of controlling the power supplies and sending an early warning to the CPUs in the case of malfunction.

Main/standby supplies

The power supply types are a mixture of main and standby power supplies.

Cabinet type	*Number of power supplies*	
	Main	*Standby*
ND-100 A	*1*	*1*
ND-500 B	*3*	*1*
GSRAM C	*2*	*1*

Table 17. The number of Multi Power supplies

The power control panel and up to three power supplies are mounted in a special frame. The fourth power supply is mounted separately in the cabinet. Table 17 shows how many power supplies are present in the various cabinets.

Floppy/disk power

The ND-100 cabinet containing the floppy-disk drive and the disk drive, has separate power supplies for these units. They are independent of the Multi Power system. That means these power supplies do not exchange control signals with other units in the cabinet.

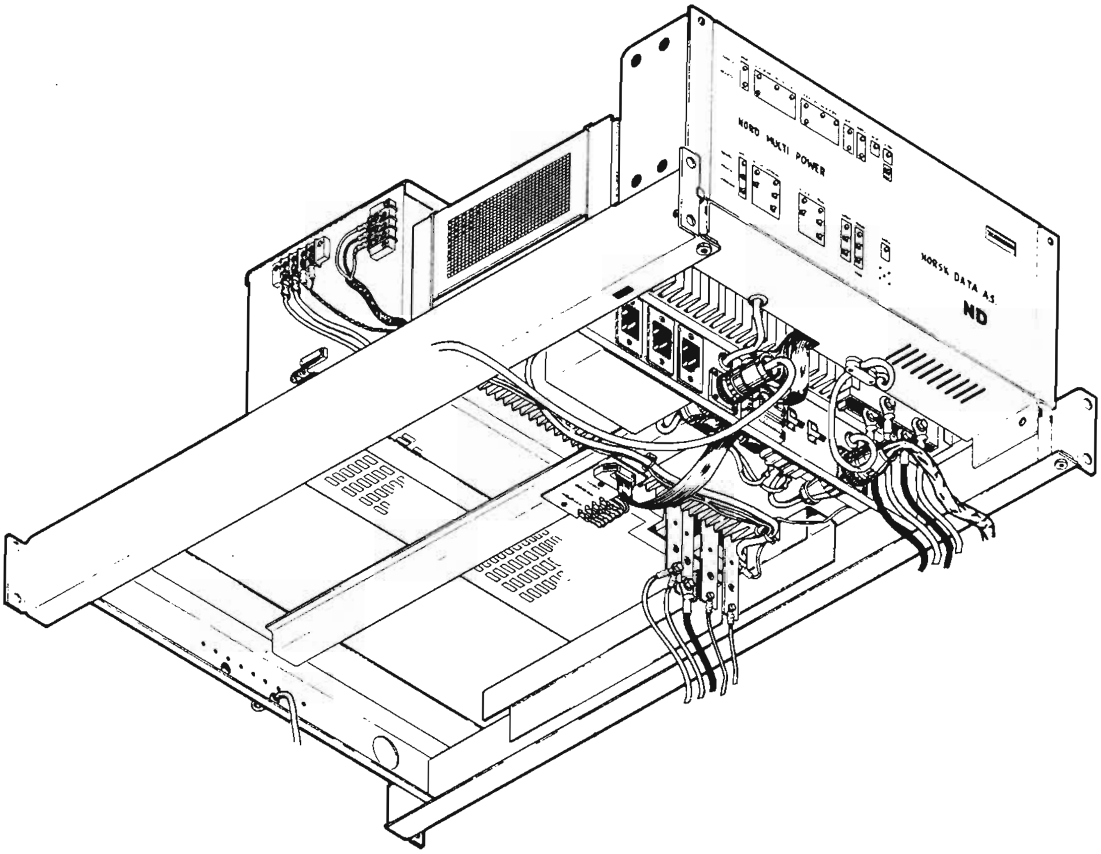


Figure 84. The Multi Power system

4.4.2 POWER PANEL

Function

The main function of the power panel is to distribute input power in separate lines to the different units in the cabinet, the Multi Power Supply system and fans. If the cabinet is an ND-100, power is also supplied to the separate power supplies for the floppy disk drive and the disk drive.

Circuit breakers

All separate lines are equipped with automatic circuit breakers located within the power panel.

Functional description

The functional description of the power panel is based on the block diagrams in figure 86 and 87.

Input circuit breakers

S8 and S9 are the input circuit breakers in the cabinet.

Input filter

The input filter provides filtering of the input power. It provides suppression of voltage spikes (transients) and noise coming into/going out off the cabinet.

Keyswitch influence

The outlets P8 - P10 and P13 - P15 are controlled by the keyswitch on the operator panel (located at the front of the cabinet).

When the key is in the "ON" or "LOCK" position, the power control panel delivers 12V DC to relays D1 and D3, such that power is supplied through the lines.

If the key is turned to the "OFF" position, the power control panel is deactivated, turning off the supply of 12V DC.

The floppy drive (in the ND-100 cabinet) is the only active power consumer in this case.

Service outlet

The service outlet, P16, is used to provide power to additional, external equipment when maintaining the equipment.

Control current

Circuit breaker S7 is used to generate a control signal to the power control panel. The fans are connected to this line. If S7 "blows" the fans stop working and the signal "FAN FAILURE" is grounded. This is an error condition interpreted by the power control panel as a fan failure.

The inlet P12 and the outlets P13 - P15 are used to make a sequential ("one by one") power-up of the cabinets in the DPS site.

Master/slave(s)

This is called a master/slave configuration. The master is the ND-100 cabinet controlling the other slave cabinet(s).

Time delay

The slaves are powered-up after a time delay by the master. The delay is defined by a delay relay in each slave cabinet. The time delay is adjustable.

Refer to figure 87 for a master/slave configuration.

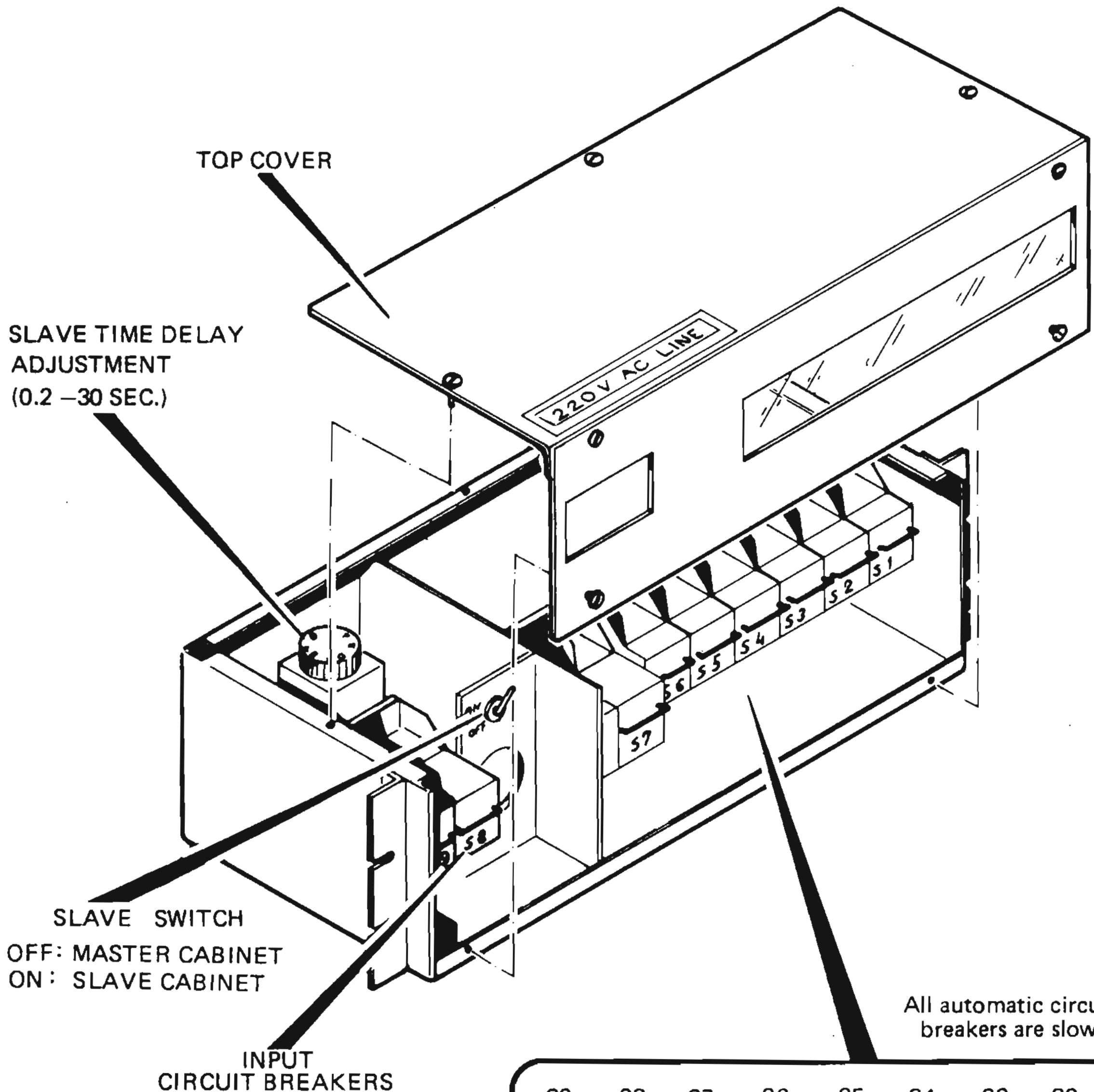
In the master cabinet, the delay switch must be set to the "OFF" position. The reason is that there is no control current coming in that can power-up this cabinet.

When the key on the operator panel is turned to "ON" or "STANDBY", a control signal to the power control panel is grounded (activated). This turns the Multi Power system in the master cabinet on and 12V DC is presented on relay D3.

This enables control current to be sent to the slave cabinet. After a delay in the slave's delay relay, the control signal to the slave's operator panel is grounded and the slave cabinet is also powered-up. Note that there are only DC control signals and current internally in the cabinet.

Galvanic isolation

The 230V AC control current provides galvanic isolation between the cabinets in the site.



S9	S8	S7	S6	S5	S4	S3	S2	S1
25A	2A	4A	4A	4A	10A	10A	10A	10A

Figure 85. The power panel

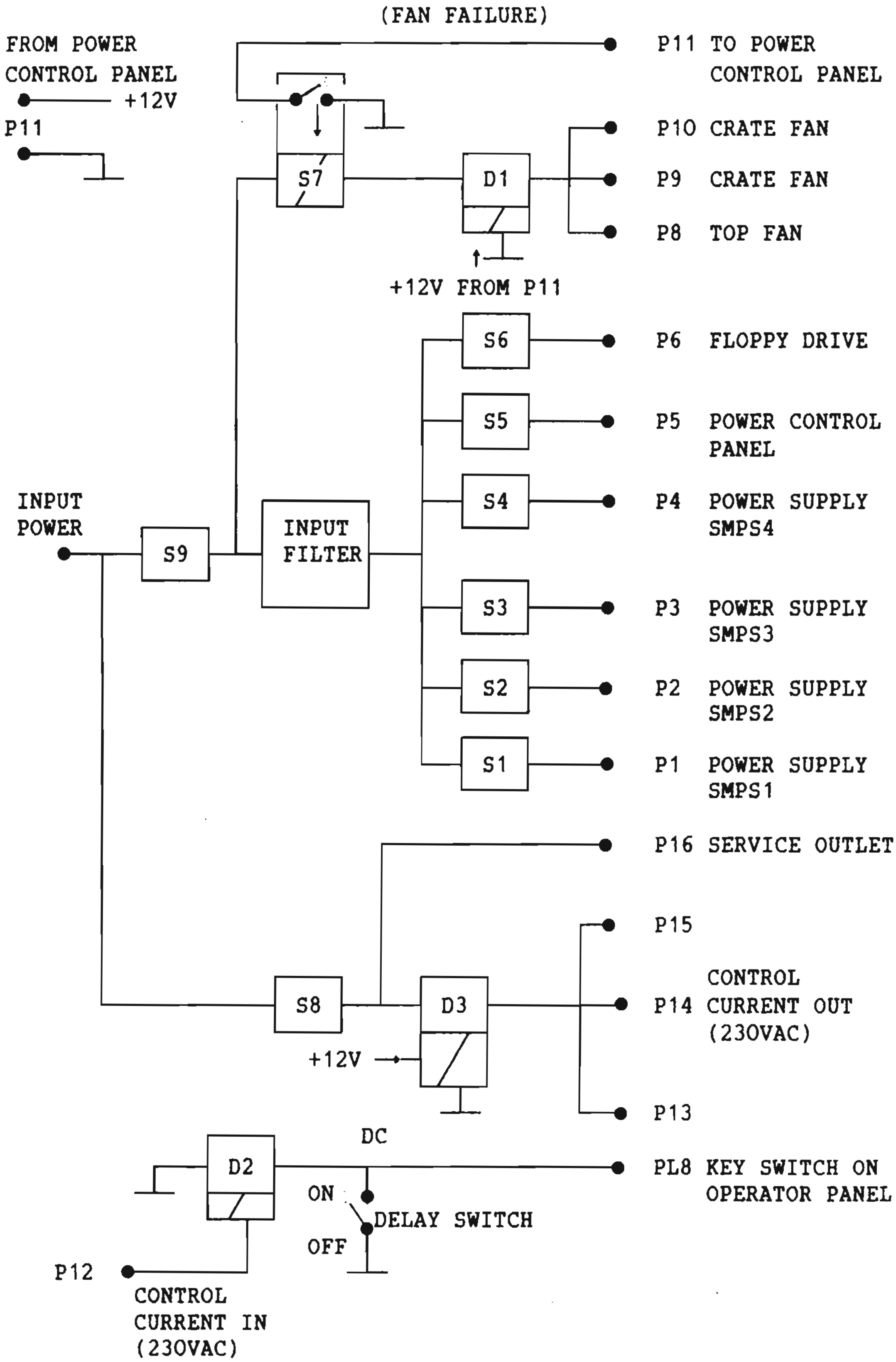


Figure 86. The power panel

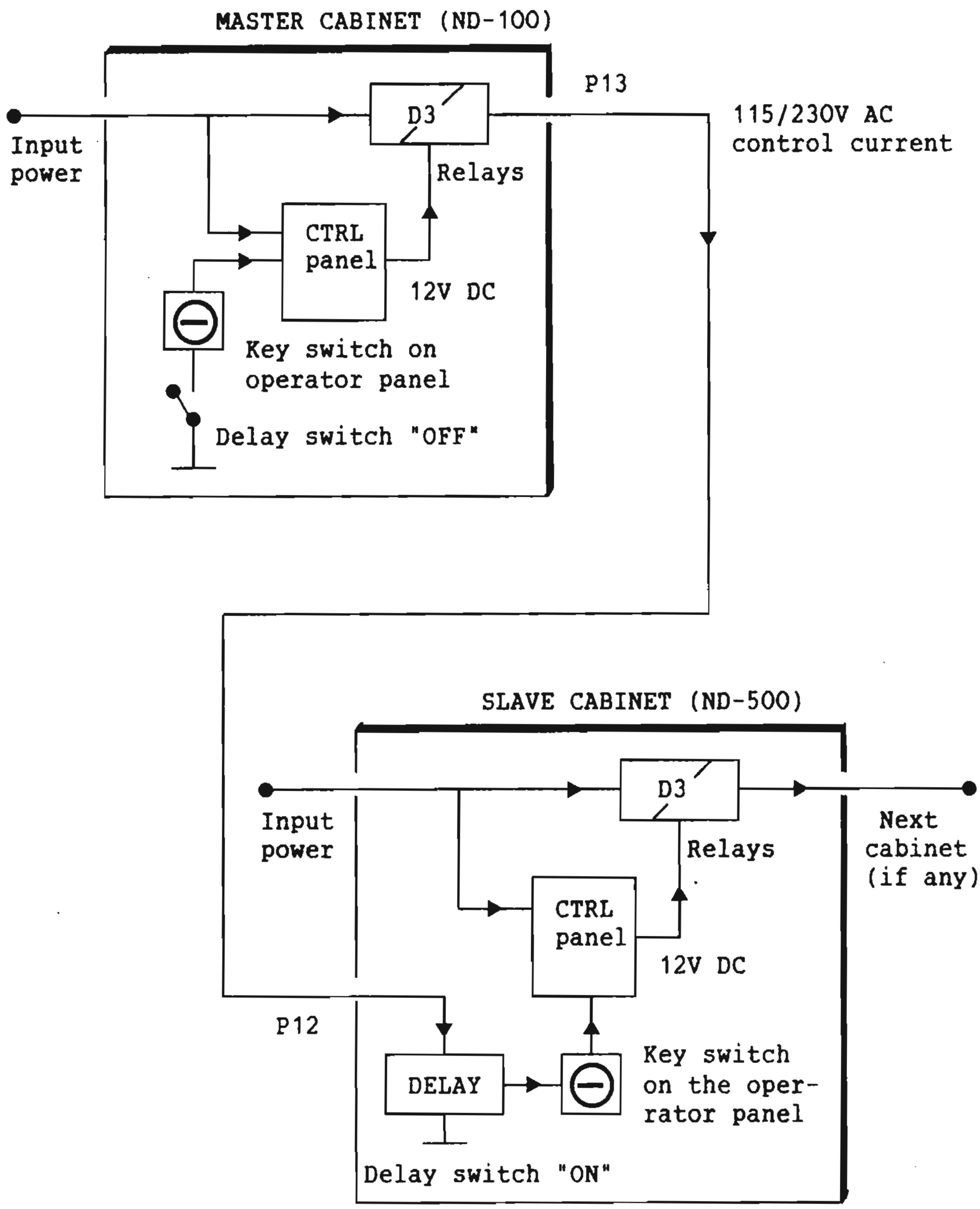


Figure 87. Master/slave configuration

4.4.3 POWER CONTROL PANEL

Function

The main functions of the power control panel are to control and monitor the power supplies in the Multi Power system and provide information and control for service personnel.

The last function is perfomed via status indicators and operator controls at the front of the power control panel.

There are two different power control panels used in the DPS sites, each having the same capabilities.

The two types are: EMP 325 manufactured by EMI, and PE 1018 manufactured by Philips.

Configurations

The power control panel can, in general, control up to four power supplies. In the DPS sites, the number of power supplies connected to this panel, varies from 2 to 4 (see section 4.4.1).

The power supplies are Switch Mode Power Supplies (SMPS). The power supplies are called SMPS1, SMPS2, SMPS3 and SMPS4. Sometimes the SMPS2 and SMPS3 are also called Standby 2 and Standby 3.

Main and standby

There are more control signals to SMPS2 and SMPS3 than to the other power supplies. This is because they are capable of being standby supplies. A standby supply delivers both 5V and 12V DC.

The SMPS1 and SMPS4 are capable only of being main supplies, delivering 5V DC.

SMPS2 is always connected as a standby power supply in the DPS site. All the other supplies act as main supplies.

Plug panel

The power supplies receive input power via a plug panel located below the power control panel.

There is also a switch to disable the battery of the standby power supply (SMPS2). This is the only way to disable the battery backup.

During power failure, the battery is the only supplying part of the Multi Power system.

The battery must be disabled when input power to the computer is switched off for long intervals (more than about 12 minutes) to prevent damage to the battery.

Signal cables

Flat cables connected via the same plug panel transfer control signals between the power control panel and the power supplies.

A round cable transfers control signals between the power control panel and the power panel, the card crates and the other cabinets.

Functional description

The following functional description is based on figure 89.

Key-switch

When input power is present at the power control panel and the key-switch at the operator panel is in the "ON" or "LOCK" position (see section 4.4.2), the Multi Power system is on.

A time-meter located on the power control panel records when the system is operating.

"Voltage present" LEDs

The green indicators light, indicating presence of the different voltages in the power supplies. The number of indicators that light depends on the cabinet type (see section 4.4.1).

A green indicator that NEVER LIGHTS is the "12V" of SMPS3 because this power supply is not used as a standby supply for any cabinet.

The indicator marked "LOCAL" is for the 12V DC supplied by the power control panel.

The power control panel senses the output voltage from each power supply in order to perform this task.

Voltage error	The output voltages are also controlled by the power control panel so that they are not too high or low. Voltage error causes a red indicator on the power control panel to light. There is one red indicator for each voltage (this corresponds to the green indicators). Too high/low voltage means about 10% deviation from the nominal value.
Power interrupt	If input power to a power supply fails, this is also reported to the power control panel via a control signal.
Switching off (on/off)	Each power supply, except for SMPS2, may be turned off by separate switches located on the power control panel. This is done by activating a separate control signal to the power supply.
Over temperature	If too high a temperature is detected by a power supply, this is reported to the power control panel via separate control signals. If the temperature exceeds 70 degrees C in the power control panel, this is also detected as a failure.
Fan failure	A control signal from the power panel, indicates whether the fan is working or not.
External power fail	The signal External Power Fail is used to tell the power control panel about a malfunction in the Multi Power system in another cabinet.
Error handling	Errors detected by or reported to the power control panel lead to the power control panel turning off all the power supplies in the cabinet. The only exceptions to this are 12V DC supplied by the power control panel, and the battery backup (SMPS2).
Reset switch	An acoustic alarm sounds during power failure. It has to reset separately, when the reason for the error first is removed. A reset switch is used for this purpose.

Power failure

A warning is sent to the CPU in the card crate. This consists of sending the signal "POWER FAIL" to the ND-100 or ND-500 CPU. The Multiport-5 system has its own power failure detection mechanism.

Battery indicators

The indicator "BATT" for SMPS2 lights during power failure indicating that the battery backup is OK.

Marginal switches

Marginal switches are located at the front of the power control panel. They are used to regulate the output voltage from the power supplies $\pm$ 5% of the nominal value.

They are a useful tool during fault finding (corrective maintenance) to examine whether there are electronic components that are sensitive to small voltage variations in the DC power supplied.

The marginal variations of the voltage also show that communication between the power supply and the power control panel is good and that voltage regulators in the power supply can be manipulated.

Switch setting

Each power supply has its own switch setting on the back of the power supply.

These must be set in accordance with the alarm functions that are present in the power supply.

All alarm functions that are used from a power supply, require that the corresponding switch is set to the "OFF" position (called "OPEN" in EMI EMP 325).

Alarm functions that not are present, or are disabled in the power supply, require that the corresponding switch is set to the "ON" position (called "CLOSED" in EMI EMP 325).

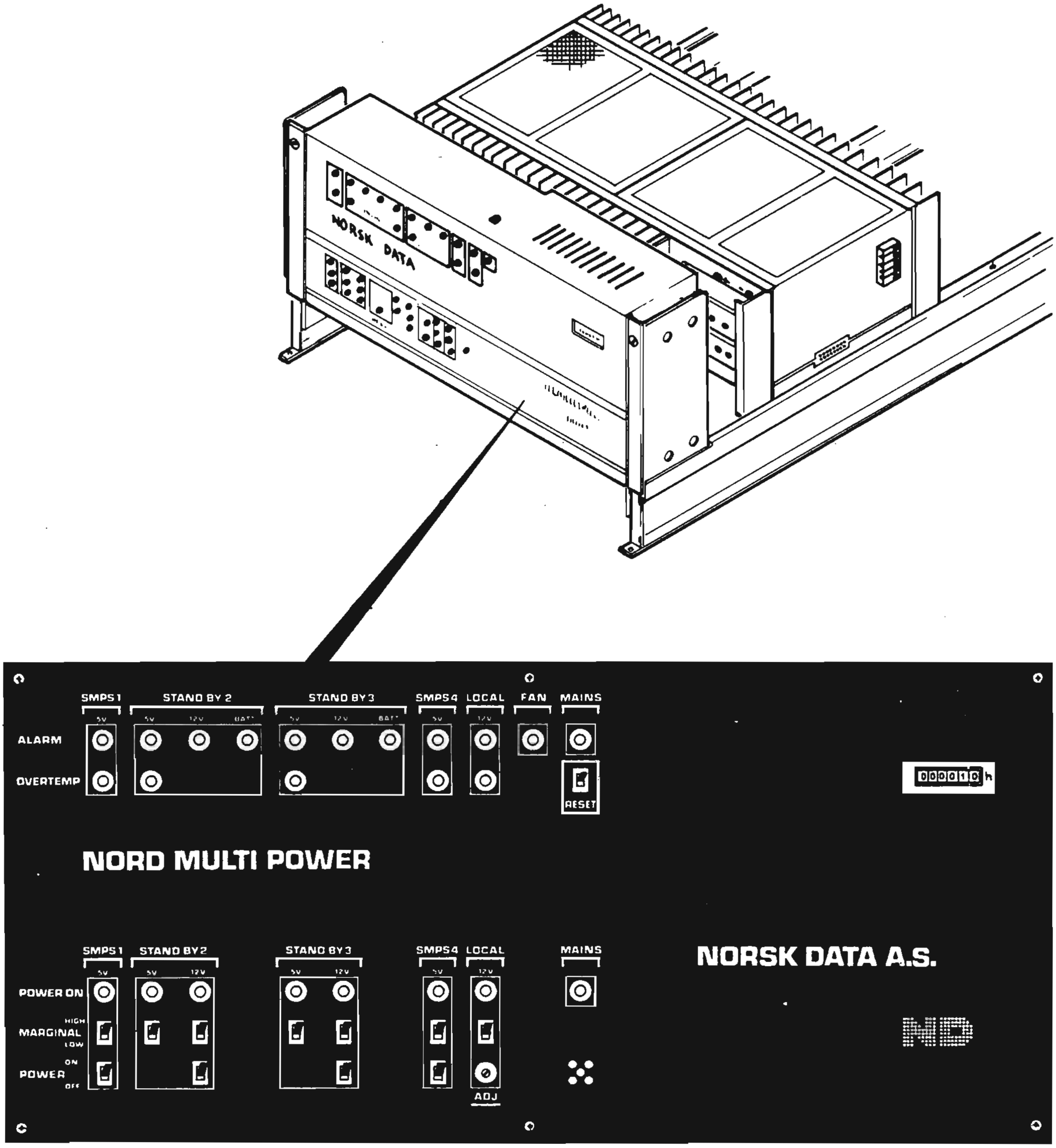


Figure 88. The Philips power control panel

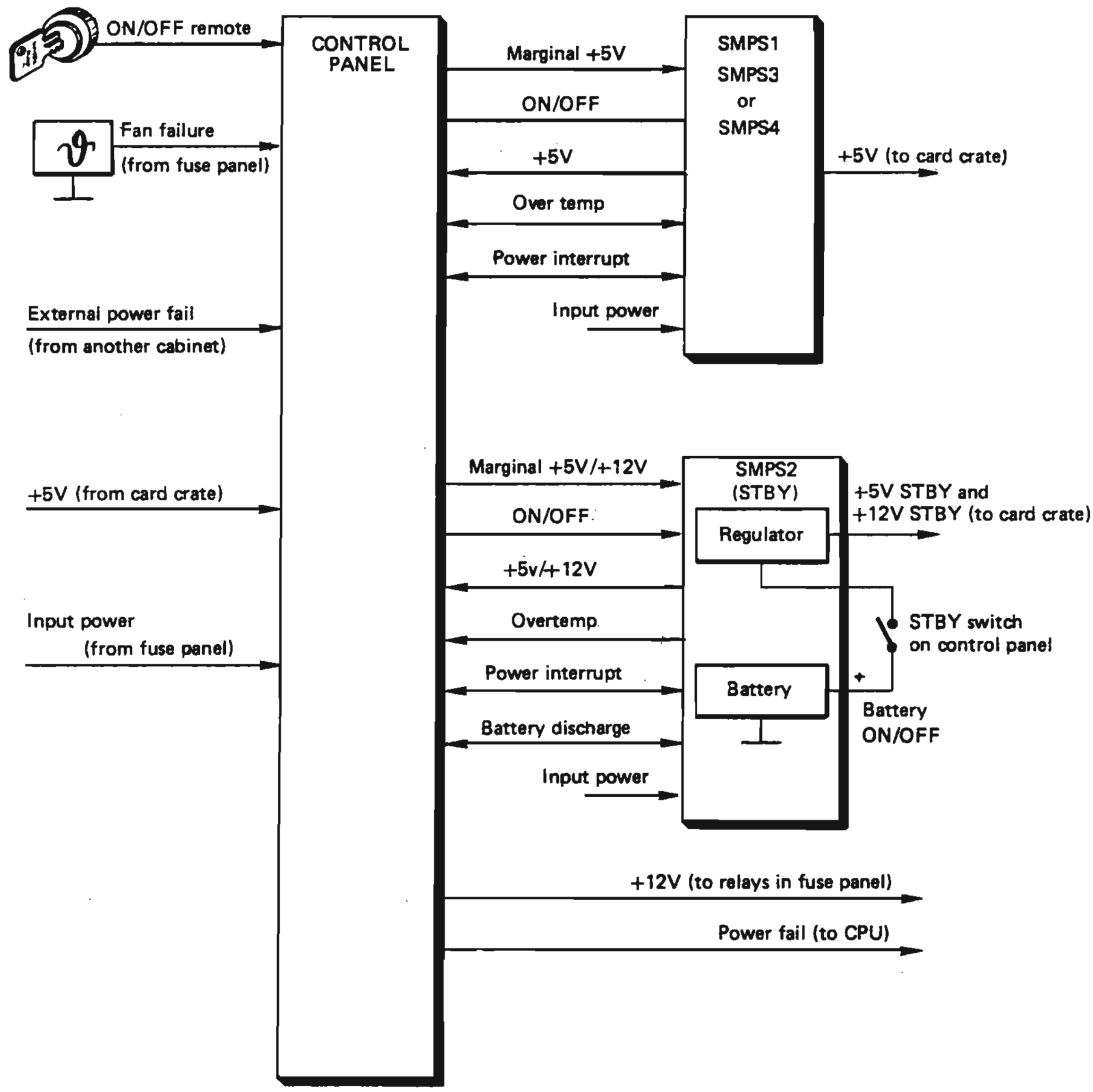


Figure 89. Multi power interface signals

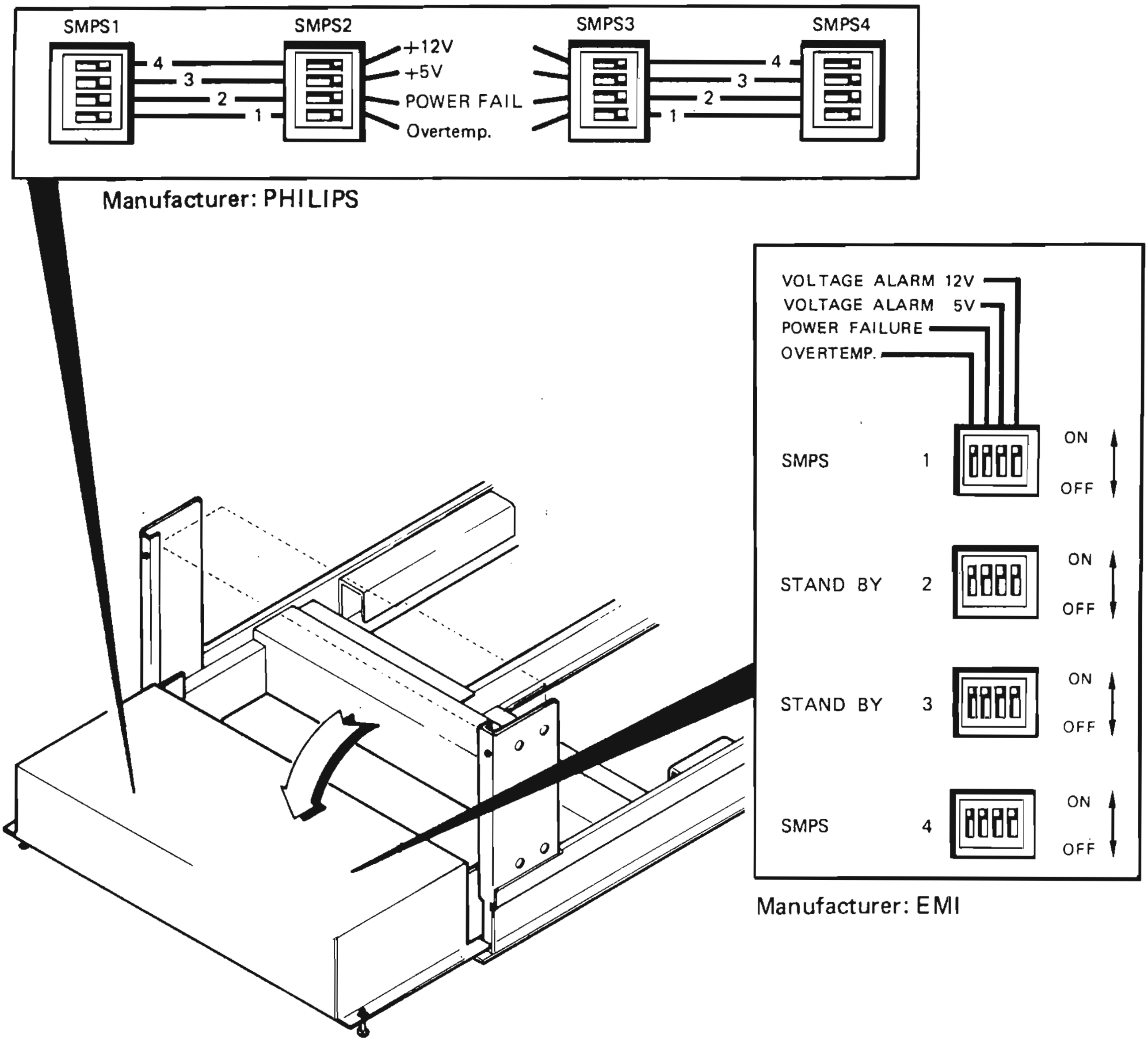


Figure 90. Switch setting on the power control panel

Pin no.	Signal	Function	Colour
1	+12V DC	Controls relays D1 and D3 in the power panel.	Green
2	0V DC	Return for pin 1.	Black
6	GND	Logic low, 0V DC from card crate to control panel.	Black
7	+5V DC	Logic high from card crate.	Violet
8	MEMORY $INHIBIT_0$	Logical signal to card crate. Intended to be used for preventing interfaces from accessing memory. NOT USED.	Grey
9	POWER $FAIL_0$	Logical signal to card crates in ND-100 and ND-500. Notifies the CPU of power failure.	White
10	GND	Connected to pin 6.	Black
11	REMOTE ON_0	Logical signal from key switch on the operator panel. Turns the power system on/off.	Yellow
12	EXTERNAL POWER $FAIL_0$	Logical signal that notifies the power control panel of power failure in an external cabinet.	Brown
13	GND	Return for pin 14.	Black
14	FAN $FAILURE_0$	Signal from fuse S7 in the power panel. Notifies the power control panel of fan failure.	Orange

Signals to the card crates go through the terminal strip located on the back of the card crate.

Table 18. Control signals in round cable (connector PL8)

Pin no.	*Signal*	*Function*
1	$OVERTEMP_0$	*Notifies the control panel if the temperature in the power supply is too high.*
2	*COMMON*	*Return for signals on pins 1 and 3.*
3	*0V DC*	*Return for +5V DC from power supply.*
4	OFF_0	*Turns the power on/off.*
5	*COM MARG* $12V_0$	*Common conductor for pins 10 and 14.*
6	*POWER* $FAIL_0$	*This signal informs the power control panel of input power failure.*
8	———	*Return for pin 6.*
9	*COM MARG* $5V_0$	*Common conductor for pins 12 and 16.*
10	*- MARG* $12V_0$	*Instructs the power supply to decrease the 12V DC by 5%. The signal is only used on SMPS2.*
11	*0V DC*	*Return for +12V DC from power supply.*
12	*+ MARG* $5V_0$	*Instructs the power supply to increase the 5V DC by 5%.*
13	*+12V DC*	*+12V DC from the power supply to the panel for monitoring the voltage. This is used only on SMPS2.*
14	*+ MARG* $12V_0$	*Instructs the power supply to increase the 12V DC by 5%. The signal is used only on SMPS2.*
15	*+5V DC*	*+5V DC from the power supply to the panel for monitoring the voltage.*
16	*- MARG* $5V_0$	*Instructs the power supply to decrease the 5V DC by 5%.*

Table 19. Signals in flat cable connectors 1-3 and 5

Pin no.	*Signal*	*Function*
6	———	*Return for pin 7.*
7	*BATT2* 1	*Signal to power control panel. It is high if the standby battery of SMPS2 delivers standby power.*
10		*Return for pin 11. Not used.*
11	*BATT3* 1	*Same as for pin 7 (SMPS3). Not used.*

Table 20. Signals in flat cable connectors 4-5

4.4.4 MAIN POWER SUPPLY

Function	The function of the main power supply is to supply the CCAs in a card crate with power.
Capabilities	The main power supply orginates from two manufacturers. It is either an ESP 271 produced by EMI, or a P-6010 produced by Tore Seem.
	It can deliver a maximum of 5V/150A. The power is fed to a separate power bar in the backwiring of the card crate.
SMPS theory	The power supply is a Switch Mode Power Supply (SMPS). A SMPS has, in general, less power dissipation than conventional power supplies.
	The next paragraphs describe how a SMPS functions in general. The interface signals that are sent between the SMPS and the power control panel were explained in section 4.4.3.
Input filter	The input filter provides protection of the power supply against voltage transients on input power. It also protects noise from being sent out on the mains lines from the power supply ("radio interference").
Voltage sensing	The voltage sensor is used for monitoring the incoming voltage. If the voltage fails (too low or high voltage) the power supply is turned off and the power control panel is notified.
Soft start	When the power supply is turned on, a "soft start" circuit prevents voltage transients both on input AC power and output DC power. This is done by controlling the AC input.
Transformer/rectifier	The transformer and rectifier circuit provides the necessary transformation from AC voltage to a lower DC voltage. A capacitor placed after this circuit functions like an energy buffer for the regulation circuits.

Switching circuit

The switching circuit regulates the output voltage of the power supply. The switching circuit charges the output capacitor with current from the filtering capacitor. By operating as a switching circuit, either conducting completely or not at all, the power loss is low.

Pulse width regulator

The pulse width regulator enables the controlling circuit to manipulate the switching circuit. A reference oscillator (frequency approx. 22 kHz) is used to start each charging period by turning the switching circuit on. A comparator senses when the output capacitor is charged to nominal voltage, and turns the switching circuit off. In this way, the pulse width (duty cycle) is a function of the load applied to the power supply.

Output protection

The output protection circuit protects the load from over-voltage and the power supply from being short-circuited.

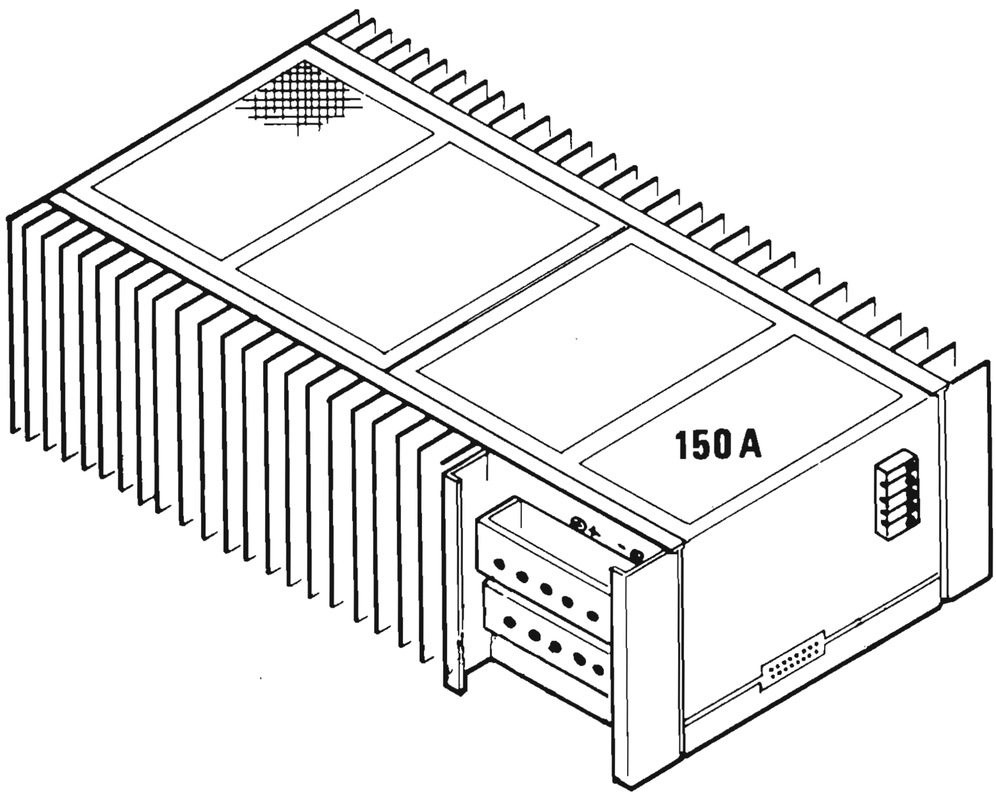


Figure 91. Main power supply

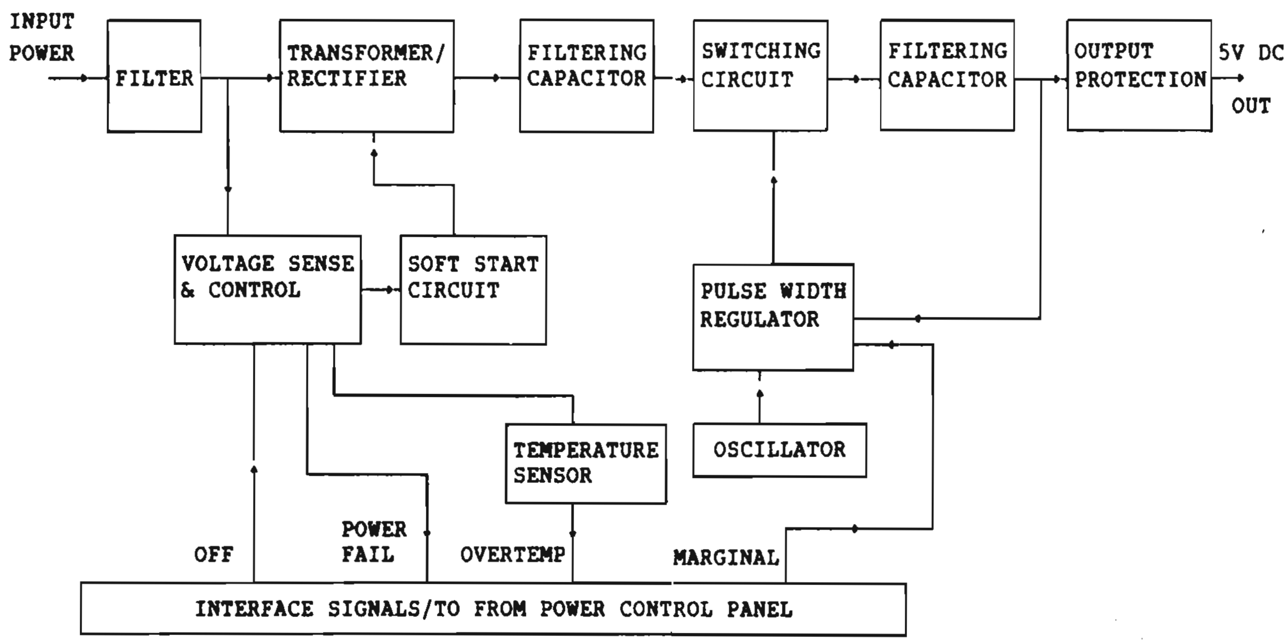


Figure 92. SMPS block diagram

4.4.5 STANDBY POWER SUPPLY

Function

There are four types of standby power supplies. They are: Philips PE 1759, Seem S 6005, Seem S 6007 and Seem 6011.

The purpose of the power supply is to supply the CCAs in a card crate with standby power.

During power failure a separate battery backs up the 5V STBY for at least 12 minutes.

Capabilities

Both the main and the standby power supplies deliver output current at the same time. The difference is that the standby power supply delivers 5V STBY to a separate conductor in the backwiring of the card crate.

The functional parts of a CCA which use the standby supply vary from design to design.

Most of the standby supply is used to refresh the memory and vital parts of the CPUs (5V STBY). The separate 12V supply is not used by any of the CCAs in the card crates today. They are mainly present to supply a customer's self-designed CCAs.

The battery in the standby power supply is a nickel-cadmium type.

Output voltage	Output current	Battery charge current	Battery capacity
5V DC	25A	70mA	1.8AH
12V DC	4A	300mA	4.0AH

Table 21. Specifications for standby power supplies

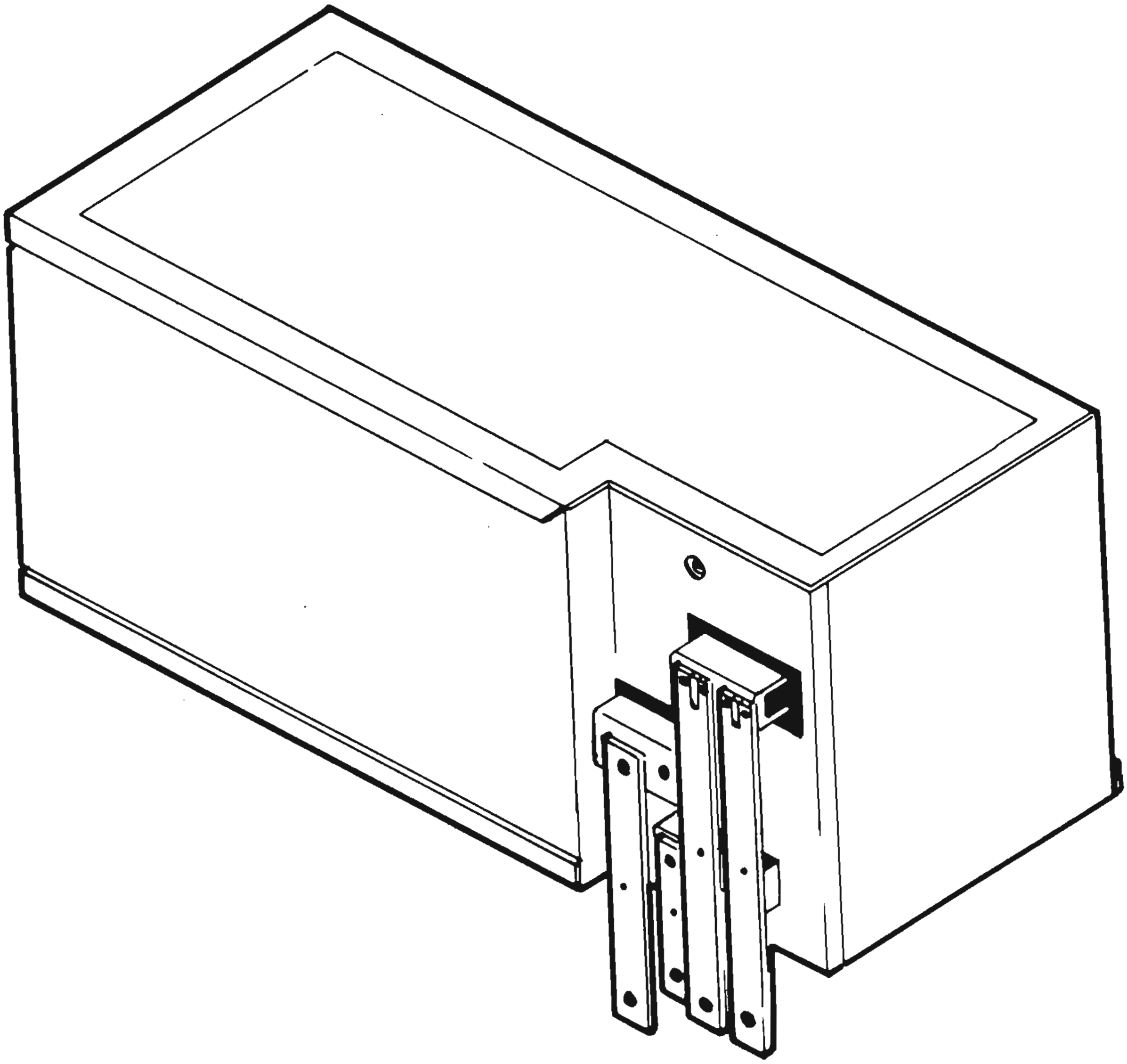


Figure 93. The standby power supply

Theory of operation

The standby is also a Switch Mode Power Supply (SMPS). A brief introduction to this concept is given in section 4.4.4.

The interface signals between the power control panel and the power supplies are explained in section 4.4.3.

Figure 94 shows the special features of the standby power supply.

Battery

The standby battery is charged during normal operation of the power supply. When input power fails, the battery immediately supplies the regulators in the power supply.

The standby battery switch provides the possibility of disabling the battery backup. This switch is located at the plug panel under the power control panel (STBY 2).

Regulators

Since there are two separate load outputs, there are also two regulators.

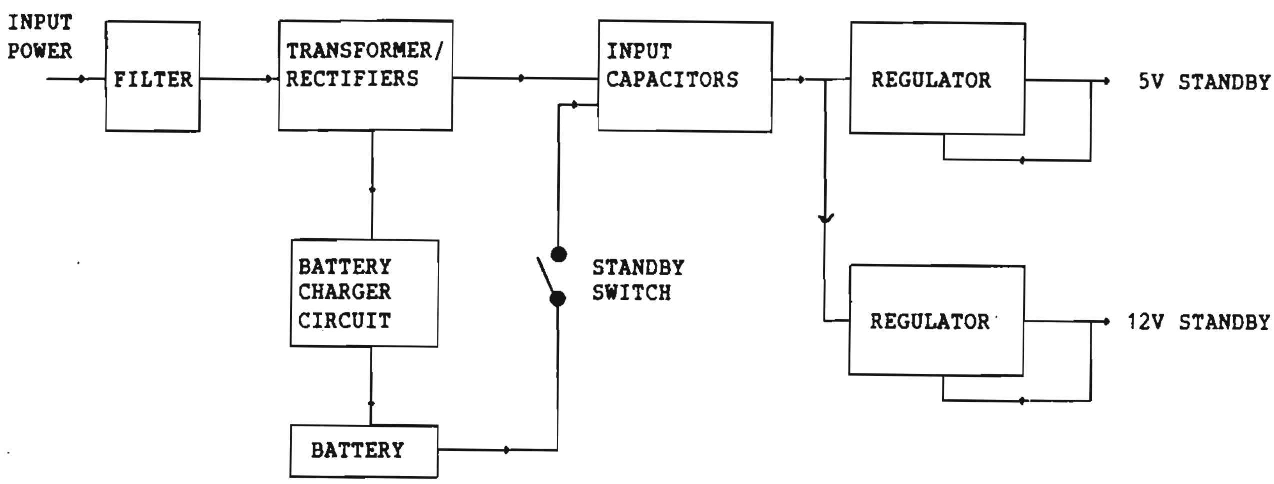


Figure 94. Block diagram of standby battery

4.4.6 FLOPPY POWER SUPPLY

Function

The main function of the floppy power supply is to supply the floppy drive located at the top of the ND-100 cabinet.

The floppy power supply is type CP 384, manufactured by Power One.

Voltage/current

The voltages and current supplied by the unit are:

Voltage	*Current*
5V DC	*8.0A*
-5V DC	*0.3A*
24V DC	*2.0A*

Table 22. Specifications for floppy power supply

The floppy disk drive requires 220V AC input to supply the spindle motor.

The DC-voltages are used to supply the logic CCAs and the stepper motor.

In addition to the power supply there are some other components.

Switch/fuse

A separate ON/OFF switch is placed on the outside of the floppy disk housing.

Input filter

An input filter is placed on the inside of the floppy disk housing.

AC/DC distribution

A separate CCA provides the necessary power distribution from the power supply to the fan and floppy disk power. It is used as an interconnection board.

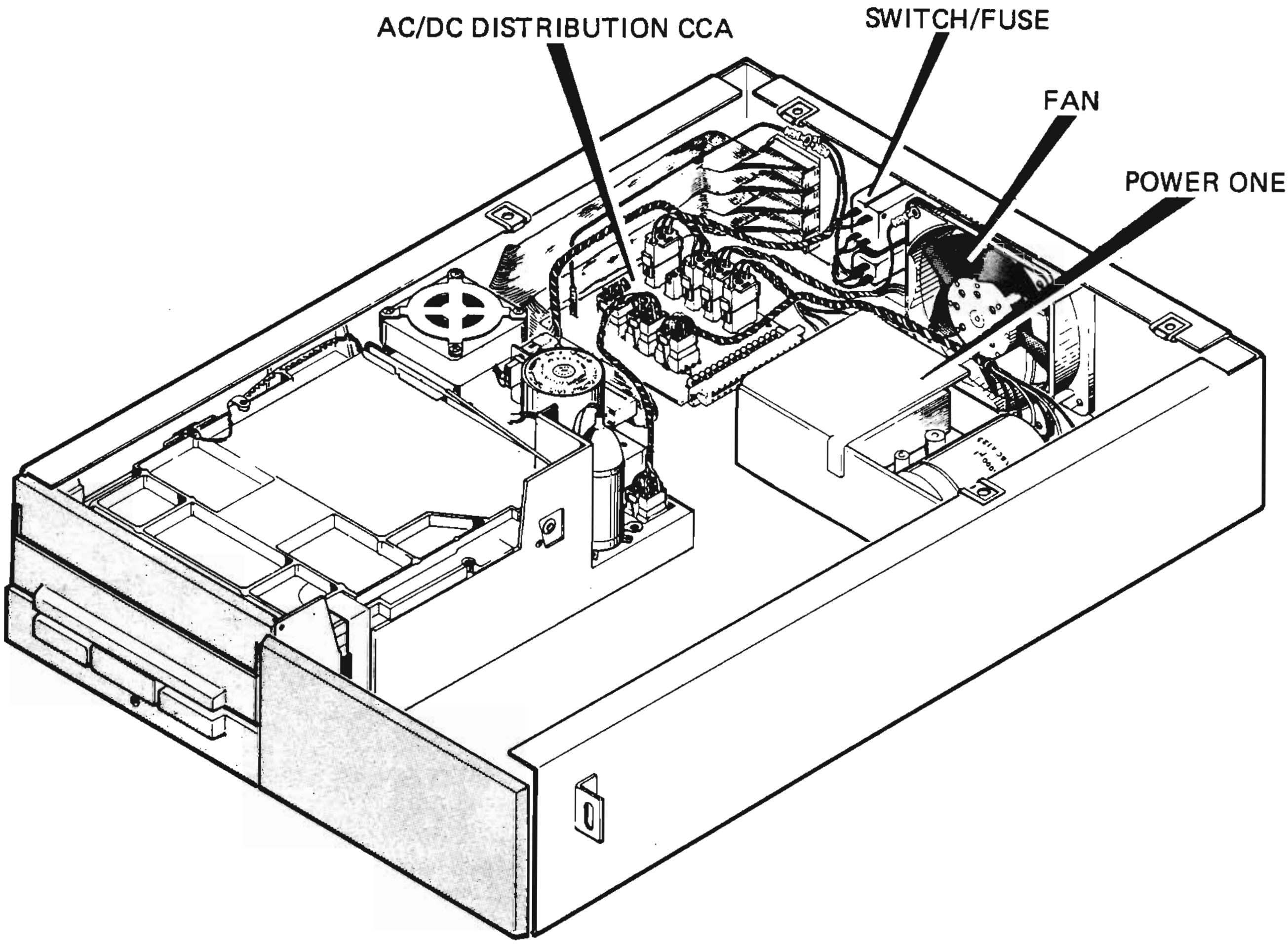


Figure 95. Floppy power supply

4.4.7 DISK POWER SUPPLY

Function

The disk power supply is located below the disk drive in the rear of cabinet A (ND-100). It is independent of the Multi Power system.

It is equipped with a separate on/off switch and a fuse.

Power consumers

The main power consuming units in the disk power supply are:

- logic circuits
- drive motor and head positioning system
- internal fan

Voltages

The disk drive uses only DC-voltages: ±24 and ±5V DC.

There are no interface signals between the disk drive and the disk power supply. Inside the disk drive the power is split up into more voltages and lines.

Power-up/power-down

During power-up, the disk drive performs a self-test. If this is successful, the drive motor rotates and the disk heads are positioned on track 0 (the outermost track).

If the power supply is removed, the drive motor stops and the heads are unloaded from the disk.

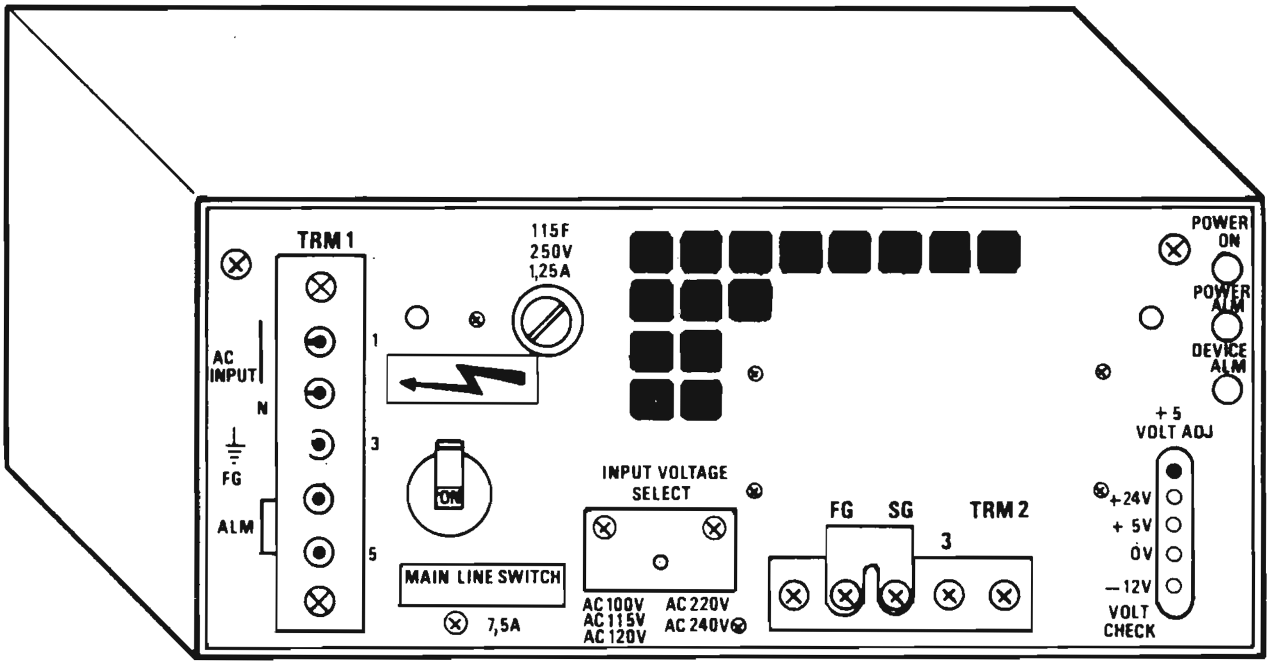


Figure 96. The disk power supply

4.4.8 POWER DISTRIBUTION (AC/DC) IN THE ND-560 COMPUTER

Figures 97 and 98 illustrate the AC and DC distribution within a ND-560 computer and a Global Shared Multiport-5 (MPM-5) cabinet.

The AC and DC distribution shown is identical for the different cabinet types (ND-100, ND-500 and Global MPM-5 cabinets).

The reference number on the diagrams refers to the marking on the power panel (Pxx). See section 4.4.2 for more details about the power panel.

Each of the cabinets has a standby power supply.

In the ND-500 cabinet, 2 main power supplies are used to supply the ND-560 CPU card crate. The backwiring of the card crate is divided into two independent parts for power supply connection.

The standby power supply is shared between the two card crates in the ND-500 cabinet. The local shared MPM-5 card crate has a separate main power supply.

In the Global Shared MPM-5 cabinet there are also two main power supplies connected to the card crate. The power supplies are connected in parallel, supplying each side of the power bar in the backwiring.

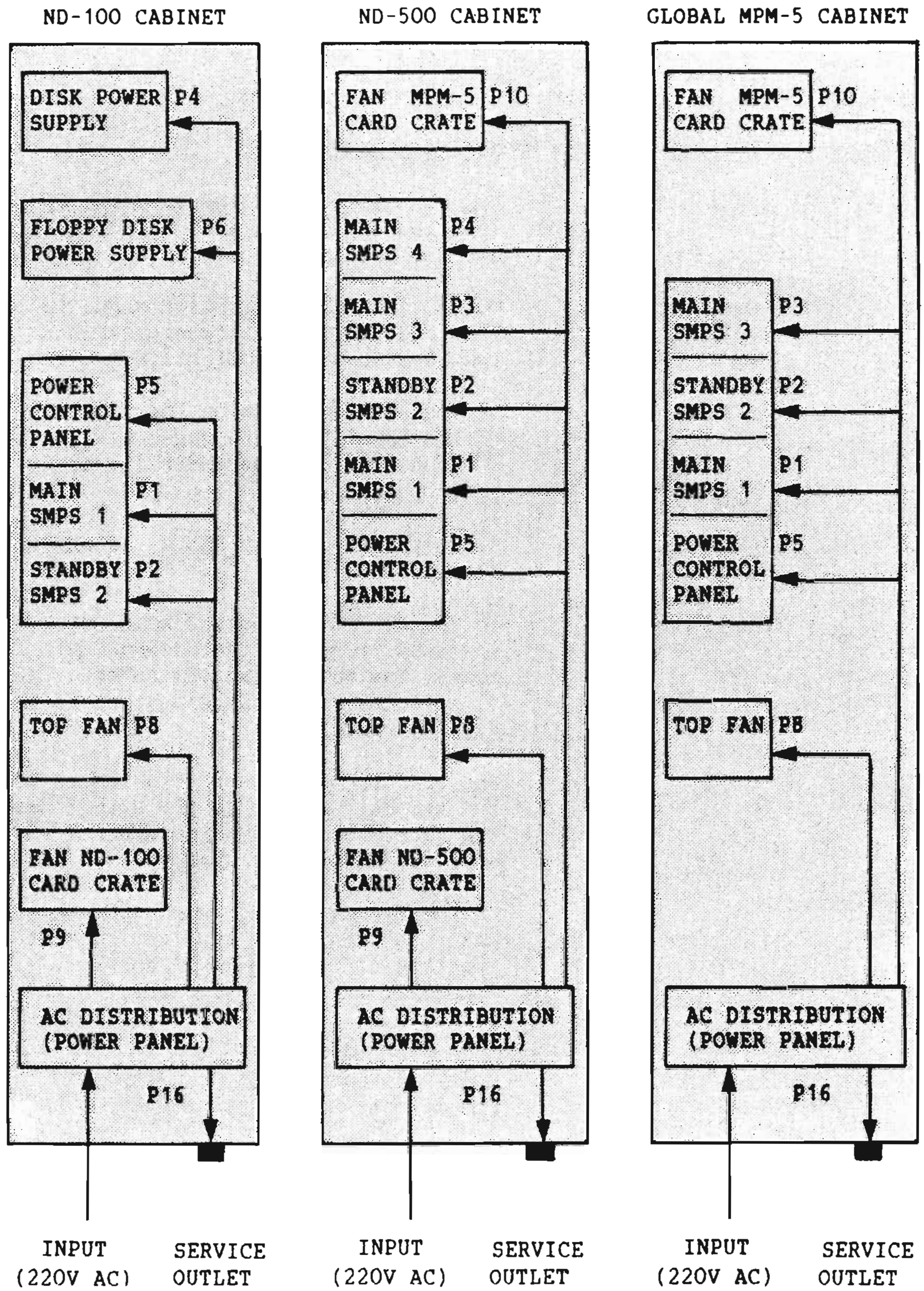


Figure 97. Power Distribution (AC)

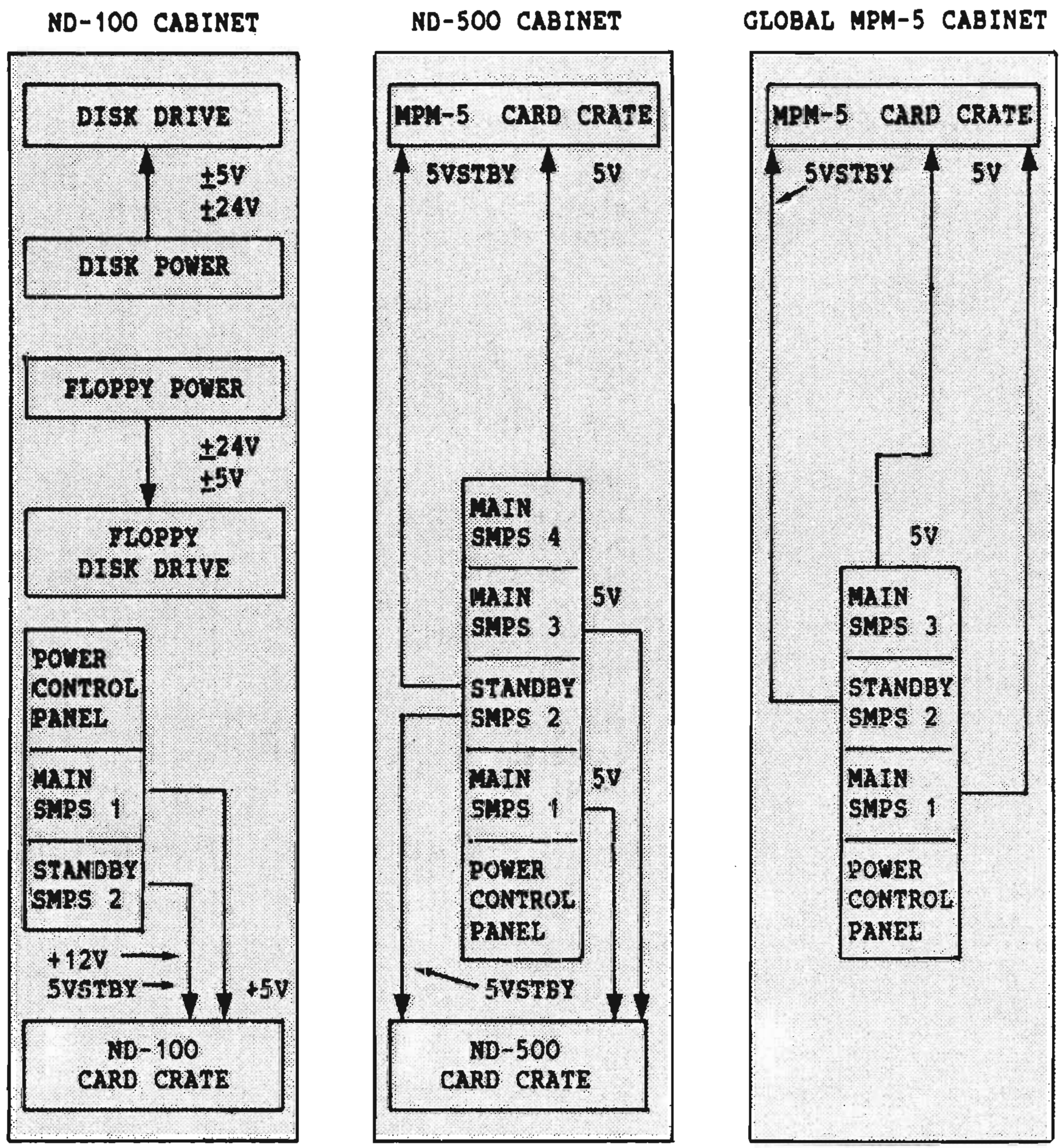


Figure 98. Power Distribution (DC)

4.4.9 POWER CONTROL SIGNALS IN THE ND-560 COMPUTER

Figure 99 illustrates the flow of control signals between an ND-560 computer and a Global Shared Multiport-5 (MPM-5) cabinet.

The ND-500 cabinet is connected as a slave cabinet to the ND-100, which is the master. This is done by the AC control current going out of plug P15 on the power panel of ND-100 and coming in on P12 in the ND-500 cabinet.

This interconnection provides automatic turning on of the power supply. The ND-500 powers-up after a timedelay in relation to the ND-100 cabinet. The ND-100 cabinets on a DPS site are always connected as Master cabinets. Refer to section 4.4.2 for greater detail.

The power-up delay is different for the different ND-500 configurations on each site:

- ND-500, position 1B : 5 seconds
- ND-500, position 2B : 10 seconds
- ND-500, position 3B : 15 seconds
- ND-500, position 4B : 20 seconds

The power-fail wiring is done in a way such that a power failure detected by the Global MPM-5 cabinet causes power-fail handling in <u>all</u> ND-560 computers in the site.

The power-fail wiring in the ND-560 computer is done in a way such that a power failure detected by the ND-100 cabinet also causes power-fail handling in the ND-500 cabinet (via the master/slave configuration). A power failure detected by the ND-500 cabinet also causes power-fail handling in the ND-100 cabinet (via the power-fail signal).

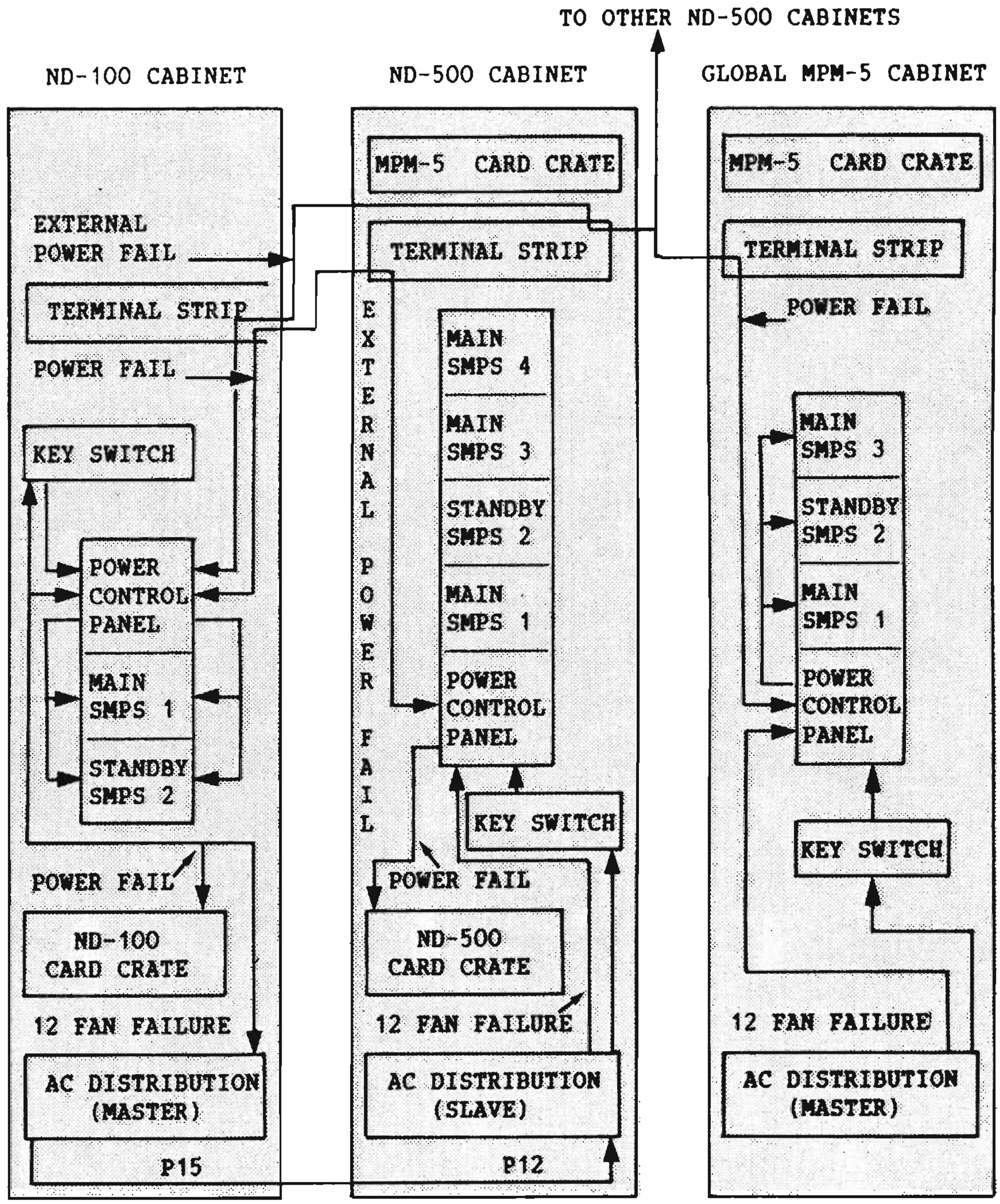


Figure 99. Control signals (AC/DC)

VENDOR	DOCUMENTATION REFERENCE NUMBER	DOCUMENTATION TITLE
ND	ND-02.003	PIOC Hardware Reference Manual - ND-857
ND	ND-05.009	ND-500 Reference Manual
ND	ND-05.011	ND-500 Hardware Description
ND	ND-05.012	ND-500 Microprogram Guide
ND	ND-05.013	ND-500 Array Processing Functions
ND	ND-06.012	NORD-10/S Input/Output System
ND	ND-06.014	ND-100 Reference Manual
ND	ND-06.015	ND-100 Functional Description
ND	ND-06.016	ND-100 Input/Output System
ND	ND-06.017	ND-100 Bus Description
ND	ND-06.018	ND-100 Microprogramming Description
ND	ND-06.021/ND-99.005	ND-100 Instant Instruction Codes (Ref. Card)
ND	ND-06.022/ND-99.016	ND-100 OPCOM Instruction Survey (Ref. Card)
ND	ND-10.004	MPM-5 Technical Description
ND	ND-10.005	MPM-5 Bus Description
ND	ND-10.006	MPM Channel Specifications
ND	ND-11.015	Floppy Disk Controller - 3027
ND	ND-11.017	ECC Disk Controller/ND-100
ND	ND-12.012	Interface to Pertec Magnetic Tape W/Formatter
ND	ND-12.023	GPIB User Guide
ND	ND-13.014	Site Preparation and Installation Manual
ND	ND-30.003	SINTRAN III System Supervisor
ND	ND-30.005	NORD-100/10S Test Program Description
ND	ND-30.008	ND-100 Hardware Maintenance Manual
ND	ND-30.013	Test Micro Program Descriptions for ND-500
ND	ND-30.014	ND-500 Hardware Maintenance Manual
ND	ND-30.018	Test Program Description ND-500
ND	ND-30.025	COSMOS Operator Guide
ND	ND-40.004	Documentation Catalogue
ND	ND-60.031	QED User Manual
ND	ND-60.047	NORD PL User's Guide
ND	ND-60.051	SINTRAN III Real Time Loader
ND	ND-60.066	ND Relocating Loader
ND	ND-60.096	MAC Interactive Assembly and Debugging System
ND	ND-60.117	PLANC Reference Manual
ND	ND-60.121	PED User's Guide
ND	ND-60.125	SINTRAN III Introduction
ND	ND-60.128	SINTRAN III Reference Manual
ND	ND-60.132	SINTRAN III Timesharing/Batch Guide
ND	ND-60.133	SINTRAN III Real Time Guide
ND	ND-60.134	SINTRAN III Communication Guide

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VENDOR	DOCUMENTATION REFERENCE NUMBER	DOCUMENTATION TITLE
ND	ND-60.136	ND-500 Loader/Monitor
ND	ND-60.137	FOCUS Screen Handling System Reference Manual
ND	ND-60.145	ND FORTRAN Reference Manual
ND	ND-60.151	SINTRAN III Utilities Manual
ND	ND-60.158	Symbolic Debugger Users's Guide
ND	ND-60.161	PIOC Software Guide
ND	ND-60.163	COSMOS User Guide
ND	ND-60.174/ND-99.020	SINTRAN III Quick Reference Card
ND	ND-60.179	User Environment Reference Manual
ND	ND-60.196	BRF-Linker User Manual
ND	ND-63.002	NOTIS-WP Reference Manual
ND	ND-63.007	NOTIS-TF Reference Manual
ND	ND-63.009	NOTIS-TF Macro Guide
ND	ND-63.015/ND-99.006	NOTIS-WP Reference Card
ND	ND-63.018	NOTIS-WP User Guide
ND	ND-99.001	COSMOS User Card
CDC	44684668	CDC Band Printer E-series, Operator's Manual
CDC	44684683	CDC Band Printer E-series, Hardware Ref./ Maintenance Manual, Vol. 1
CDC	44684643	CDC Band Printer E-series, Hardware Ref./ Maintenance Manual, Vol. 2
CDC	44684481	CDC Band Printer E-series, Parts Manual
CDC	44684652	CDC Band Printer E-series, Controller Manual
CDC	95390100	CE Manual, Logic Symbology Handbook
DIGITRONICS	2540-M-500	Perforated Tape Reader-Oper. & Maint. Manual
EMI		Technical Manual - Multipower EMP 325
EMI		Technical Man.-Switching Power Supply ESP 271
FACIT		FACIT 4070 Technical Description
FUJITSU	B03P-4740-0111A	M2321K/M2322 Micro-Disk Drives Hardware Reference/Maintenance Manual
PERTEC	104931	Pertec Operating and Service Manual
PHILIPS	4031 116 27820	Control Panel PE 1018
PHILIPS	4031 116 38670	Switched Mode Power Supply PE 1759
SEEM		Power Supply S 6005 Instruction Manual
SEEM		Power Supply S 6007 Instruction Manual
TANDBERG	961328	TDV 2215 Hardware Manual
TANDBERG	Publ. xxxx	TDV 2215 Specifications & Installation Guide
TANDBERG	961328	TDV 2215 Owner's Manual
TANDBERG	Publ. 5415	TDV 2215 Reference Card
TI	2207425-9701	OMNI 825 KSR Terminal, Operator's Manual and System Manual
TOSHIBA	71R111-883	Maintenance Manual and Function Guide

APPENDIX B: ABBREVIATIONS

µ	10^{-6}
µ4	Microseconds
A	Ampere
ABS	Absolute value
AC	Alternating Current
ADP	Administrative Data Processing
AH	Ampere * Hour
ALD	Automatic Load Descriptor
ALGOL	ALGOrithmic Language
ALU	Arithmetic Logic Unit
ANSI	American National Standards Institute
APT	Alternative Page Table
ASCII	American National Standard Code for Information Exchange
Async	Asynchronous
ATP	Acceptance Test Procedure
BCD	Binary Coded Decimal
BISYNC	Binary Synchronous Communications (Protocol)
BMPM	Big Multiport Memory
BMR	Bit Mask Register
bpi	Bits per inch
BPUN	Binary Punched (Program format; machine code)
BRF	Binary Relocatable Format
CCA	Circuit Card Assembly
CDC	Control Data Corporation
CE	Customer Engineer
CI	Communication Interface
C.L.	Current Loop
cm	Centimeter
CNTR.	Control
Comp.	Compare
Contr.	Controller
Cpi	Characters per inch
Cps	Characters per second
CPU	Central Processing Unit
CR	Carriage Return
CRC	Cyclic Redundancy Check
CRT	Cathode Ray Tube
CSS	Contact Start/Stop
CTE	Child Trap Enable
CTRL	Control
CX	Commercial eXtended (ND-100 CPU)
Cyl.	Cylinder
DADDR	Plug, Data Address
dBB	deciBel weighed by B-scale
DC	Direct Current
DD	Double Density floppy
DESC	Descriptor Addressing
Dev.	Device
DEVNO	Device Number
DIP	Dual In-line Package
DL	Plug, Data Least (significant 16 bits)
DM	Plug, Data Most (significant 16 bits)
DMA	Direct Memory Access
DMACT	Direct Memory Access Active
DPS	Data Processing Subsystem

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DS	Double Sided floppy
DSCFA	Data Memory Management System Scratch File Address, XD register
DSCRF	Data Memory Management System Scratch File, XD register
DTSB	Data TSB, XD register
EAROM	Electrically Alterable Read Only Memory
ECC	Error Correction Control
EEPROMS	Electrically Enable Programmable Read On Memories
EIA	Electronic Industries Association
EL	Plug, Instruction Least (significant 16 bits) - Cabinet C
EM	Plug, Instruction Most (significant 16 bits) - Cabinet C
EMI	Elektro Mekanisk Industri
ENAB	Enable
EP	External Power Fail
Err.	Error
FAT	Factory Acceptance Test
FIFO	First In, First Out
Form.	Format
Frmtr.	Formatter
FT	Formatted Transport (magtape)
GPIB	General Purpose Interface Bus Card
GSRAM	Global Shared Random Access Memory
HDLC	High level Data Link Control
HL	High Limit trap
HW	Hardware
HZ	Herz
IADDR	Plug, Instruction Address
IC	Integrated Circuit
IDM	Information Database Management
IEEE	Institute of Electrical and Electronics Engineers
IF	Interface
IL	Plug, Instruction Least (significant 16 bits) - Cabinet B
IM	Plug, Instruction Most (significant 16 bits) - Cabinet B
in	Inch(es)
Instr.	Instruction
IOX	Input Output transfer instruction
ips	Inches per second
ISCFA	Instruction Scratch File Address, XD register
ISCRF	Instruction Scratch File, XD register
ITSB	Instruction Transfer Speedup Buffer
J	Plug
JEC	Job Execution Control
JMPCAR	JuMP to address in Computed Address Register
JSR	Jump Save Return
K	1024 (ex. Kbytes)
Kb	1024 bytes
Kbits	1024 bits
Kbytes	1024 bytes
KHz	Kilo Hertz
KIPS	Kilo Instructions Per Second
Kw	1024 words
LED	Light Emitting Diode

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LEV	Level
LL	Low Limit trap
LLR	Lower Limit Register
lpi	Lines per inch
LPM	Lines Per Minute
LRU	Lowest Repairable Unit
LSI	Large Scale Integration
LSRAM	Local Shared Random Access Memory
m	10^{-3}
M	1024^2 (ex. Mbytes)
mA	Milliampere
MAC	MAchine Code
MACM	MAchine Code File
MACM	MAchine Code - Modified
Magtape	Magnetic Tape
MAR	Memory Address Register
max.	Maximum
Mb	1024 x 1024 bytes (RAMS) or 1 million bytes (disks)
MCL	Master CLear
MI	Memory Inhibit
min.	Minimum
mm	Millimeter
MMS	Memory Management System
MOD	(Remainder in integer division)
MOPC	Microprogrammed OPerator's Communication
MOS	Metal Oxide Semiconductor
MP-bus	Multiport-bus
MPM	Multiport Memory
MPMA	Multiport Memory, A plug
ms	Milliseconds
MSI	Medium Scale Integration
MT	Magtape
n	10^{-9}
ND	Norsk Data
NEC CCIS	North European Command - Command Control and Information System
NIC	Not In Cache
NL	Plug, Data Least (significant 16 bits)
NLL	Norsk Data Linkage Loader
NM	Plug, Data Most (significant 16 bits)
No.	Number
NPL	NORD Programming Language
NRF	Norsk Data Relocatable Format
NRZ	Non Return to Zero
NRZI	Non Return to Zero Inverted
ns	Nanoseconds
OAT	On site Acceptance Test
OET	Own trap enable register
OPCOM	Operator COMmunication
OPR	Operator Register
par.	Parity
PB	Print Board

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PCB	Printed Card Board
PCBA	Printed Card Board Assembly
PCR	Paging Control Register
PD Clock	Data Clock
PE	Phase Encoded
PF	Power Failure
PGU	Page Used
PID	Priority Interrupt Detect
PIE	Priority Interrupt Enable
PIOC	Programmable Input/Output Controller Card
PLANC	Programming Language for Norsk Data Computers
PROM	Programmable Read Only Memory
PTP	Paper-Tape Punch
PTR	Paper-Tape Reader
QED	Quick EDitor
RAM	Random Access Memory
REMOK	Remote OK
RFT	Ready For Transfer
RG	Read Gate
ROM	Read Only Memory
RS-232-C	EIA standard for character-oriented communication
RT	Real Time
RTC	Real-Time Clock
SD	Single Density floppy
SDLC	Synchronous Data Link Control
sec	Seconds
SMC	Storage Module drive Control
SMD	Storage Module Drive
SMPS	Switch Mode Power Supply
SMR	Storage Module drive Receiver
SMT	Storage Module drive Transmitter
SS	Single Sided floppy
ST	Status register
STBY	Standby (power supply)
SYC	System Controller
TE	Trap Enable register
TEMM	Trap Enable Modification Mask
TH	THumbwheel
THA	Trap Handler Address register (32 bits)
TI	Texas Instruments
TLA	Top Level Assembly
TOS	"Top-Of-Stack" register
TPD	Test Program Description
TSB	Transfer Speedup Buffer
ULR	Upper Limit register
V	Volt
VAC	Volt Alternating Current
VDU	Visual Display Unit
VS	Virtual Storage
W	Watt
WA	Word Address
WG	Write Gate

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WIP	Written In Page
WP	Word Processor
XD	External Data (bus)
XMSG	X-MeSsaGe
XOR	eXclusive OR
XROUT	X-Routing of messages

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