



ND-5000 ES
Model C Hardware
Maint. Manual
ND-830102.1 EN



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NOTE:

The numbering system for Norsk Data's documentation changed in September 1988. All numbers now start with an 8. The numbering structure is therefore ND-8xxxxx.xx xx. Example: ND-863018.3A EN. Existing manuals will receive a new number if and when they are updated or revised.

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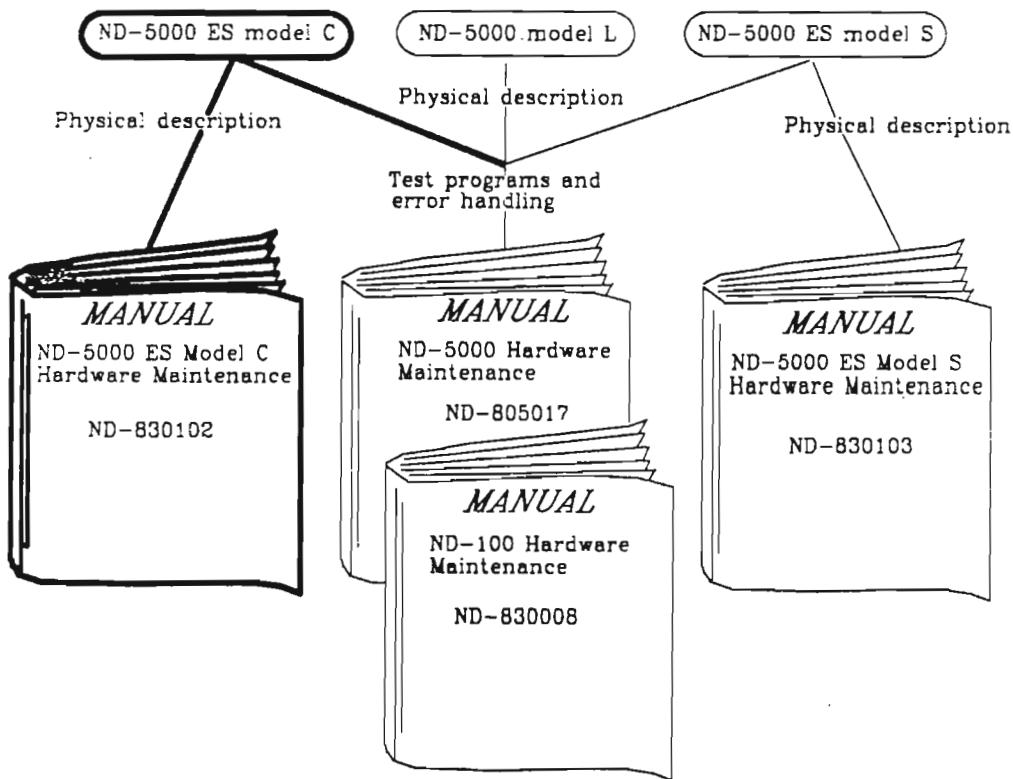
THE PRODUCT

The new ND-5000 ES Model C replaces the current ND-5000 Compacts. It covers the low/medium end of the ND-5000 systems and is meant to be used as general departmental systems and servers for installations that are not too large.

THE MANUAL

This manual covers the ND-5000 ES Model C. It is meant to be a helping hand for the service staff.

The manual is a physical description and does NOT cover the handling of system errors, test program descriptions etc., as these are described in other manuals. The illustration below shows which manual to use for the different tasks:



THE READER

The readers of this manual should be field service engineers and technical personnel directly involved in maintaining the ND-5000 ES Model C.

RELATED MANUALS

ND-100 Hardware Maintenance Manual	ND-830008
ND-5000 Hardware Maintenance	ND-805017
Test Program Description for ND-100	ND-830005
ND-5000 Hardware Description	ND-805020

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Chapter 1 INTRODUCTION

This chapter gives an introduction to the ND-5000 ES C models.

1.1 System description

The new ND-5000 ES Model C replaces the current ND-5000 Compact. It covers the low/medium end of the ND-5000 systems and is meant to be used as general departmental systems and servers for installations that are not too large.

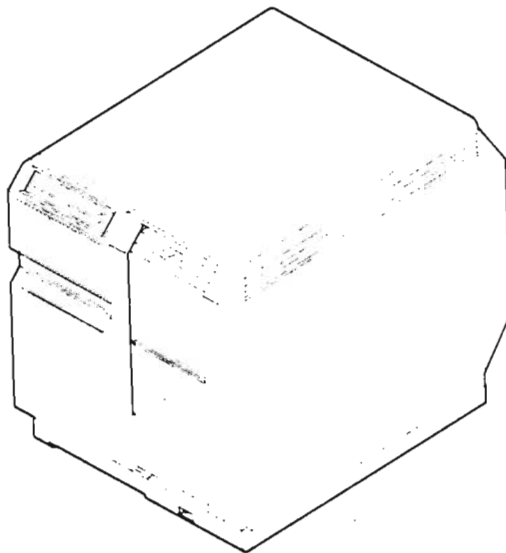
It has the same cabinet as the previous version, except for the front cover. The interior, however, is completely new. It consists of a large card crate, into which all cards and devices (including the new power supply, the fan unit, disks, floppy units and streamer units) can be plugged. The backwiring is located in the middle of the card crate, and cards and devices are plugged in from both the front and the rear sides.

The new ND-5000 ES Model C is available with all ND-5000 CPU versions, including ND-5800.

See the table on page 2 for an overview of the various systems available.

1.2 Models

This section contains an overview of the different models available.



SYSTEM	ND-5200	ND-5400	ND-5500	ND-5700	ND-5800
I/O PROCESSOR	ND-120	ND-120	ND-120	ND-120/CX	ND-120/CX
MEMORY (MB) SHARED+LOCAL	4 + 2	4 + 4	8 + 4	8 + 4	16 + 6
DISK SIZE (MB)	Model C1: 310 Model C2: 2x310 Model C3: 3x310 Model C4: 4x310 Model C5: 5x310				
BACKUP MEDIA	Streamer: 155 MB Options : ND Gigatape system HP magtape - 1600/6250 bpi, 125 ips				

Table 1. Model overview

1.3 Upgrading possibilities

Full upgrading is possible between the ND-5000 ES Model C systems:

- Upgrading between models, for example upgrading an ND-5200 Model C1 to an ND-5200 Model C5.
- Upgrading between systems, for example upgrading an ND-5200 to an ND-5700.

Note that extra memory boards are not included in the upgrading kits, and must therefore be ordered separately.

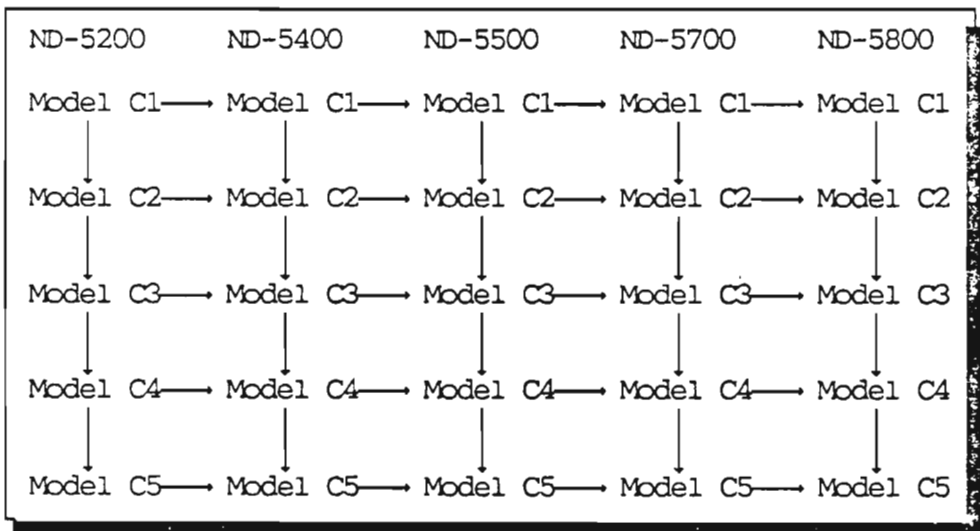


Table 2. Upgrading possibilities

Chapter 2 Physical description

This chapter describes the different parts of the hardware in the new ND-5000 ES Model C. This is a physical description, and will not cover functional descriptions of the different parts described in this chapter:

- Cabinet
- Panels
- Power switch
- Backwiring
- Fan tray
- Operator panel
- Card crate
- Plug-in modules

2.1 Cabinet

This section describes the cabinet, including the card crate, the power supply and the devices.

It is easy to replace defective devices and modules, as the parts that normally need service are plugged directly into the backwiring and the cabinet is practically free from internal cables.

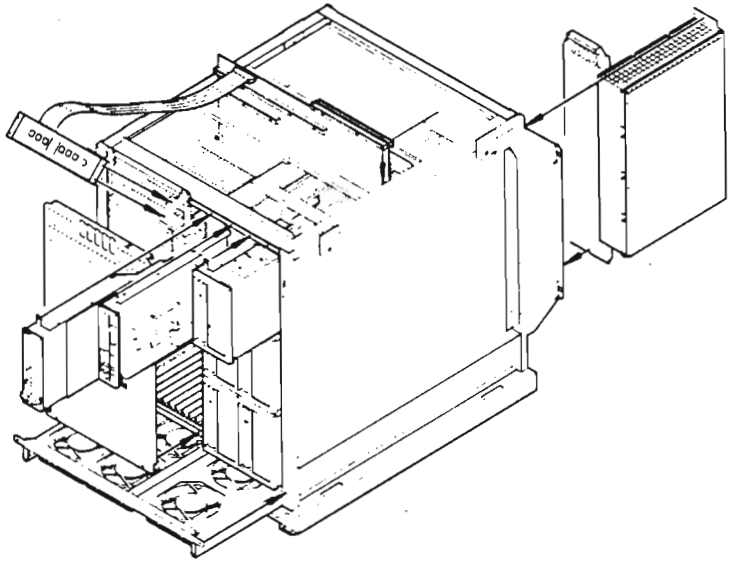


Figure 1. Cabinet

2.1.1 Panels

This section shows how to remove the panels.

Front panel

Remove the screw located at the top of the panel. Lift the panel slightly and pull it away.

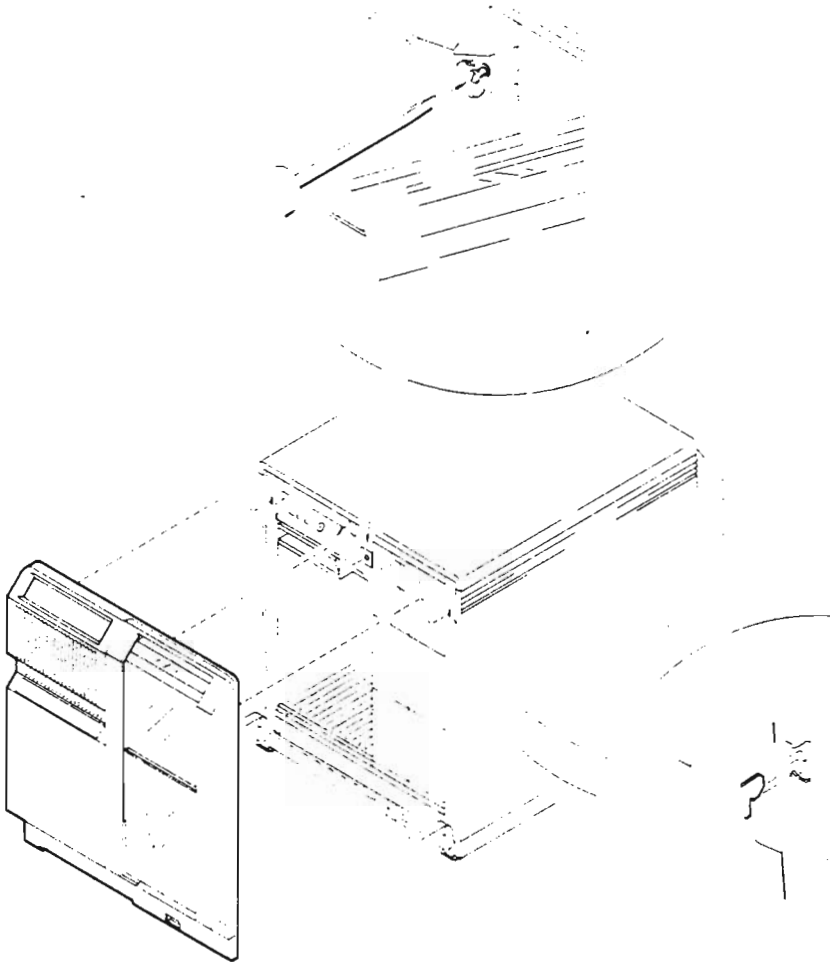


Figure 2. Front panel.

- Side panels** Turn the two screws on the top of the side panels 1/2 turn counterclockwise and lift the panel away. See figure 3.
- Top panel** Remove the four screws holding the top panel and lift it away. See figure 3.
- Rear panel** Remove the four screws holding the rear panel and lift it away. See figure 3.

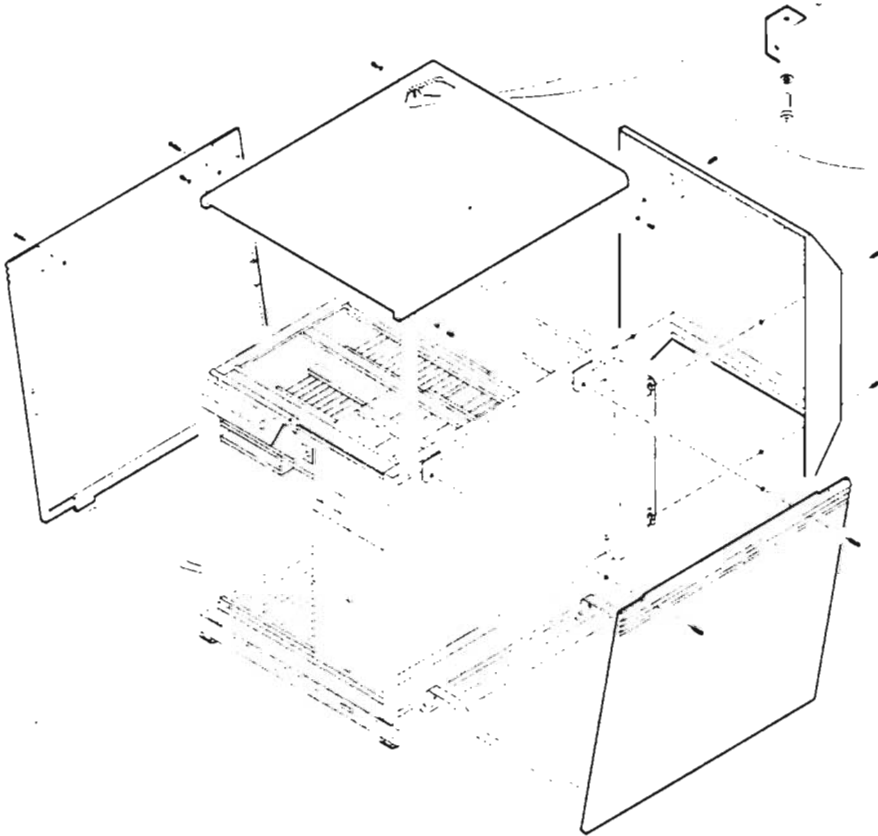


Figure 3. Panels

2.1.2 Fan tray

The cooling is based on the same principle as the previous ND-5000 Compact. The fans are located in a fan tray pluggable from the bottom of the front into the backwiring (see figure 4). The fans are the DC type, with an extra wire for indicating the rotation speed. The power for the fans is supplied by the DC 500 power supply, and the voltage is controlled by software and the ambient temperature. The input to the fan speed control comes from an NTC resistor which senses the room temperature. This sensor is mounted at the top of the backwiring, close to the air inlet.

NOTE

Note that you must turn the power off before removing or inserting the fan tray.

2.1.3 Operator panel

The operator panel and key switch are located at the top of the front (see figure 4). It is similar to the operator panels on previous ND computers, but the display has been removed. The information that earlier could be read from the display is still available, but you must connect a maintenance display to get it (see page 42). The operator panel is connected to the backwiring via a flat cable along the top of the cabinet.

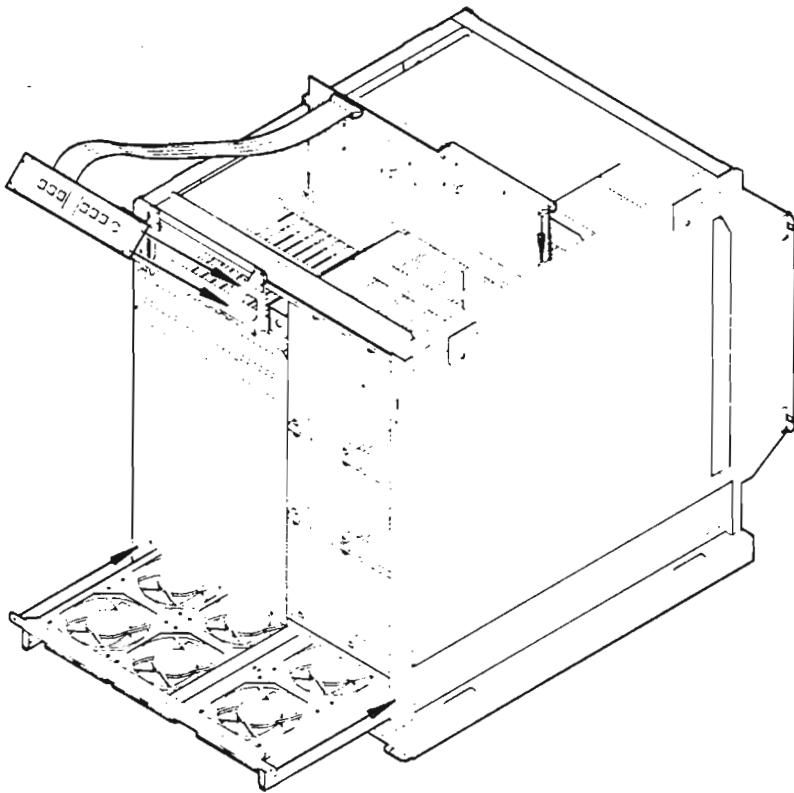


Figure 4. Fan tray and operator panel

2.1.4 Backwiring

The backwiring acts as the main connection between all internal modules. All cards and devices are plugged directly into the backwiring, including the power supply and the fan tray.

The backwiring also contains:

- Temperature sensor (regulating the fan speed)
- Connector for the operator panel
- An area where it is possible to measure the voltages
- Terminator/strap fields for the SCSI bus
- Switches for splitting the SCSI bus

The backwiring is prepared for taking care of the internal SCSI bus. This bus has been routed to all internal SCSI devices, and it ends up on the plugboard in position 14. Here the bus can be terminated, or one external single-ended SCSI device can be connected. This could, for example, be a magtape unit used for backup.

Normally all devices on the SCSI bus can be accessed from ND-100, but the strap/terminator fields and the split switches on the backwiring make it possible to split the SCSI bus. See the description in the section "SCSI bus" on page 14.

Two different versions of the backwiring are used:

- PCB number 5812 for early versions
- PCB number 5816 for later versions

The difference between these two backwirings is the possibility to split the bus with

straps/terminators and split switches. See the illustrations of the backwirings (figure 5 and figure 6) and the description in the section "The SCSI bus" on page 14.

Unused SCSI positions must be terminated by a dummy plug, part number 322774.

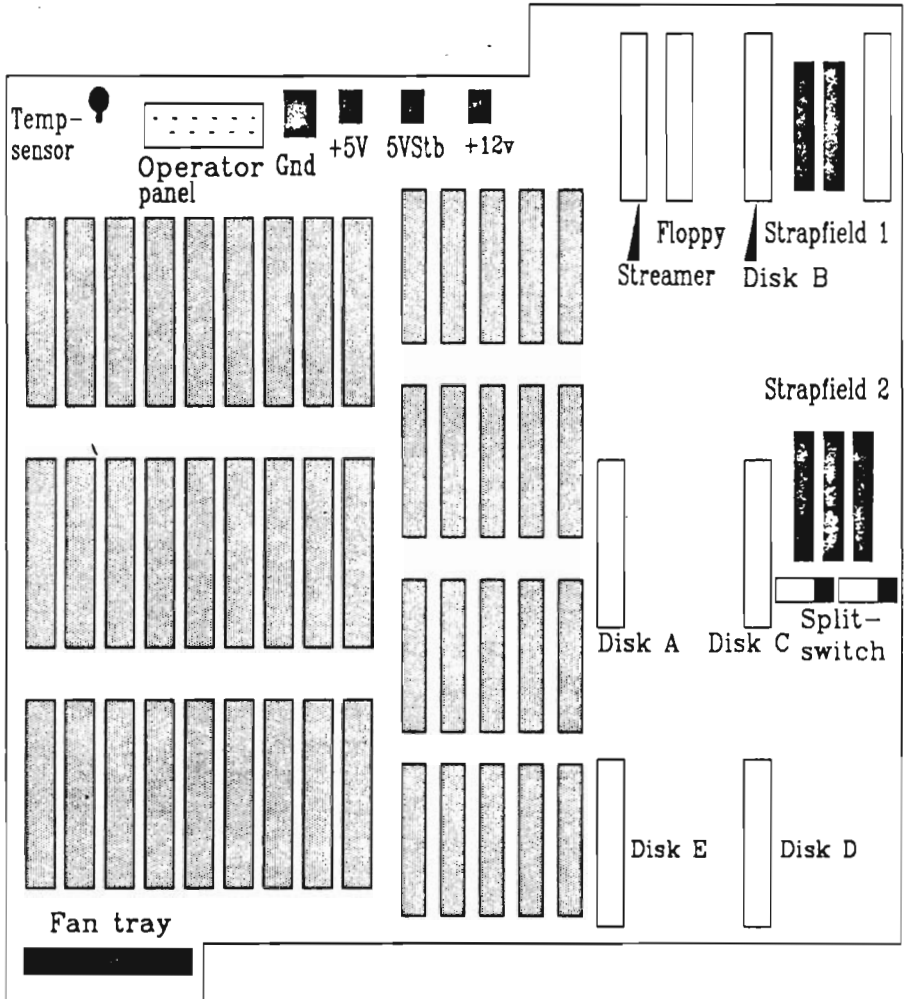


Figure 5. Backwiring (5812)

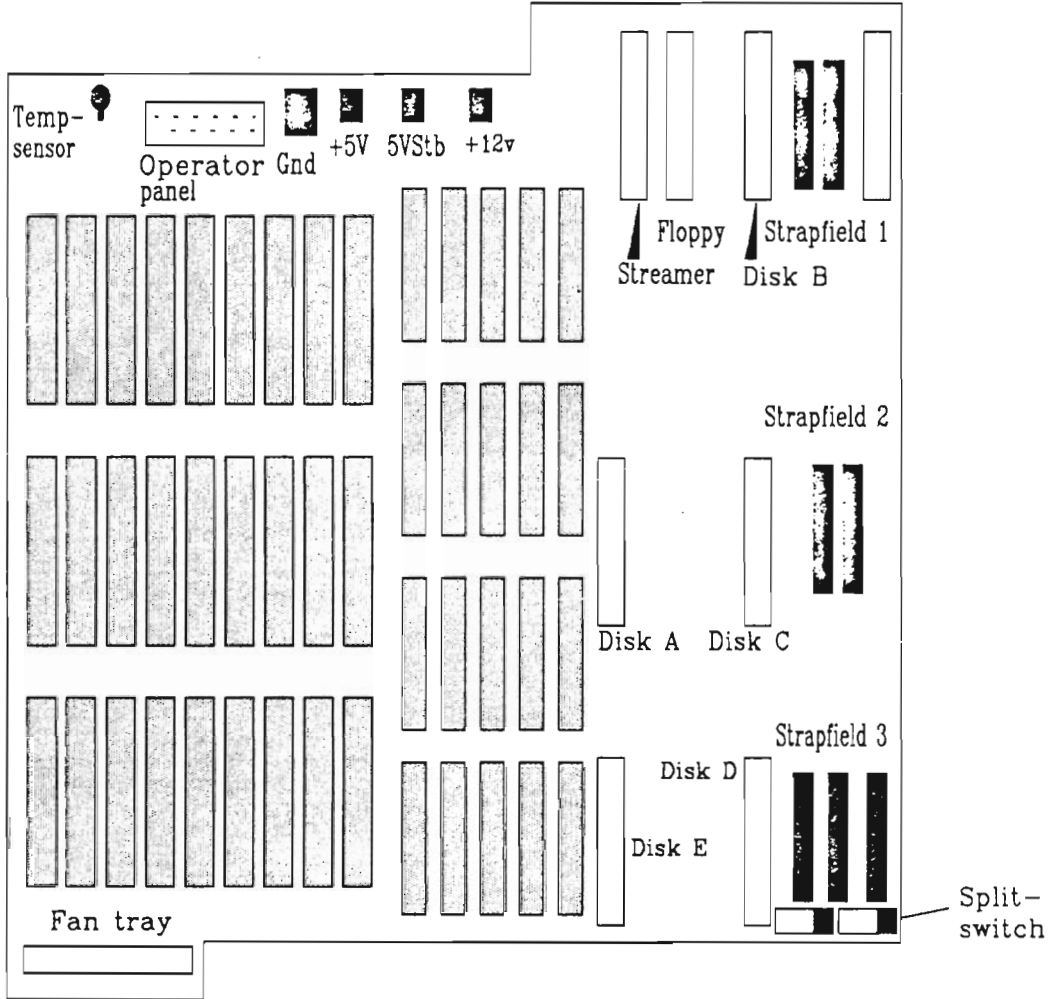


Figure 6. Backwiring (5816)

2.1.4.1 SCSI bus

The SCSI (Small Computer Systems Interface) standard is used for connecting mass storage devices to the computer. A maximum of eight units can be connected to one bus (including the ND-100 SCSI controller).

On the ND-5000 ES Model C, the backwiring takes care of the internal SCSI bus. This bus has been routed to all internal SCSI devices (streamer and disks), and it ends up on the plugboard in position 14 (see figures 7 and 8).

Here the bus can be terminated, or one external single-ended SCSI device can be connected. This could, for example, be a magtape unit used for backup.

To be able to separate the different SCSI units from each other, each unit connected to the SCSI bus must have its own SCSI identification number (ID number). These numbers are 0-7, and they are set by switches or straps on each device or board.

<u>ID number:</u>	<u>Device:</u>	<u>See page:</u>
0	Disk A (system disk)	31
*) 1	Streamer or ND Gigatape	32
2	Optional external SCSI device	
3 - 6	Free (Disk B-E)	31
7	ND-100 Floppy and SCSI controller	39

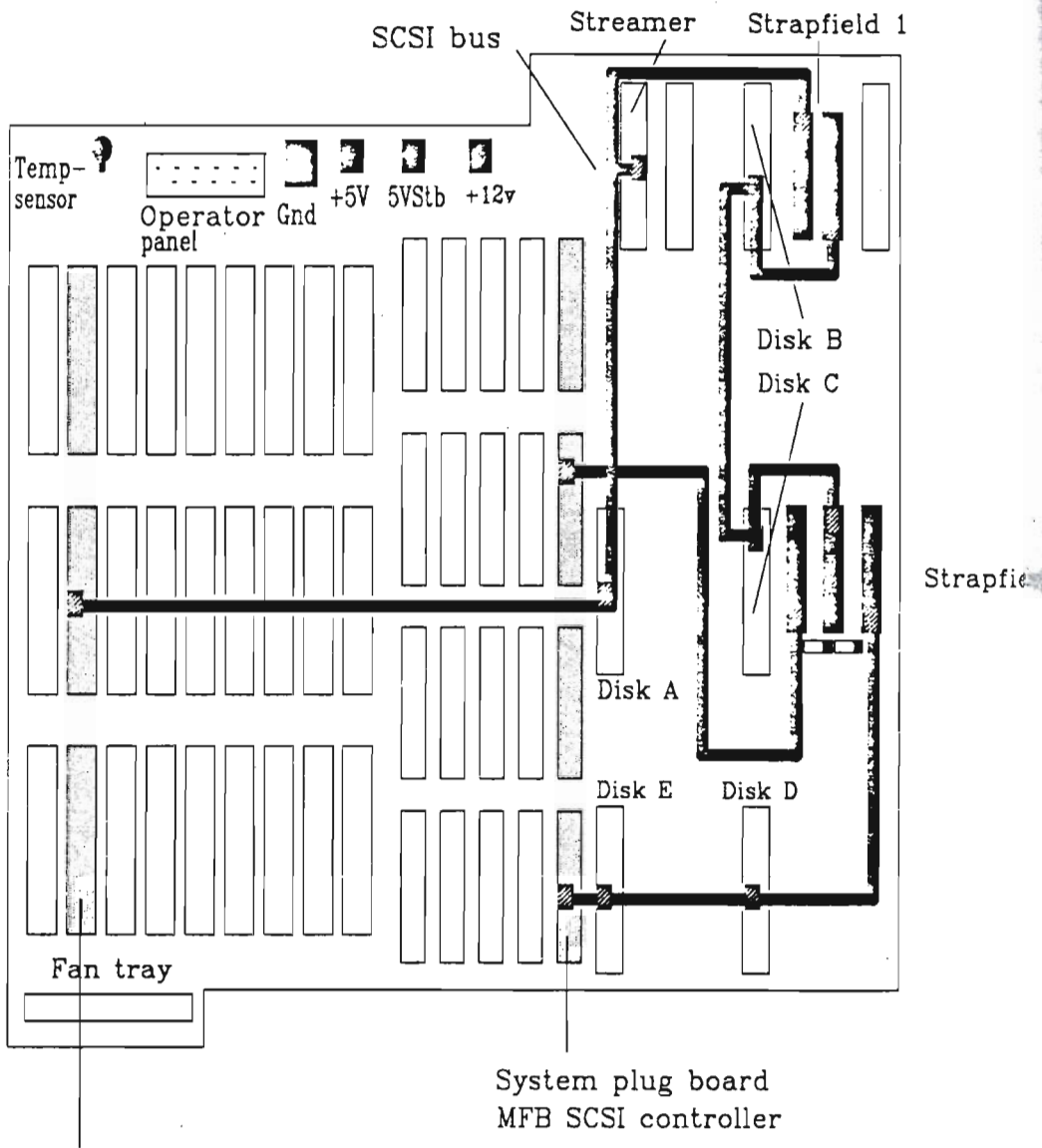
*) SCSI ID number 1 is reserved for the device used for system disk backup.

All devices on the SCSI bus are normally accessed from the ND-100, but there are several possible ways to split the access to the SCSI devices. This is done with strap fields and split switches in the backwiring (see figure 5 and figure 6) and a flat cable on the System plugboard - 5259 (see figure 22).

On the next pages we show three different examples of how to do this on both versions of the backwiring.

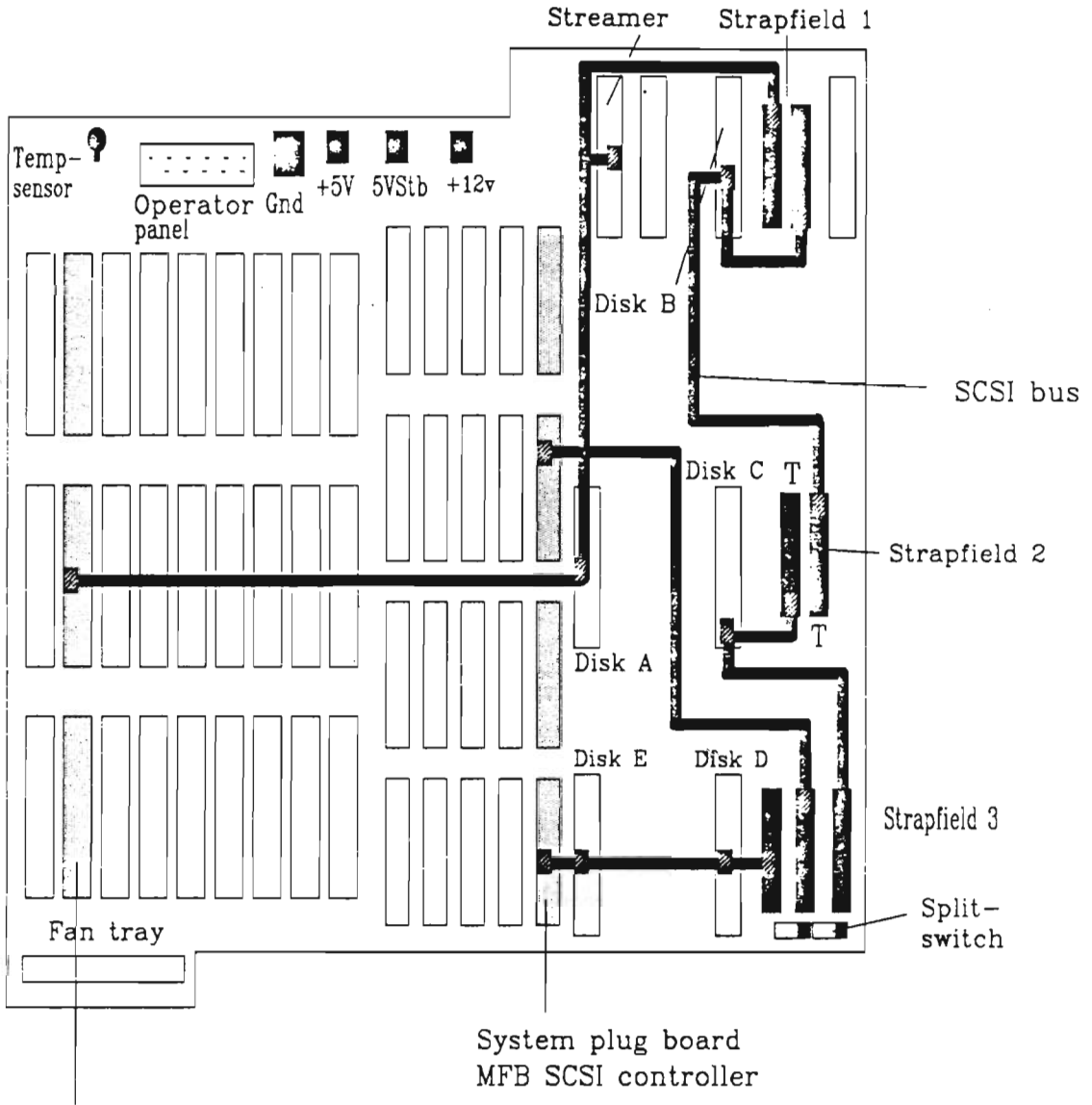
NOTE

Unused SCSI positions must be terminated by a dummy plug, part number 322774.



ND-100 Floppy and SCSI interface

Figure 7. SCSI bus on the backwiring PCB 5812

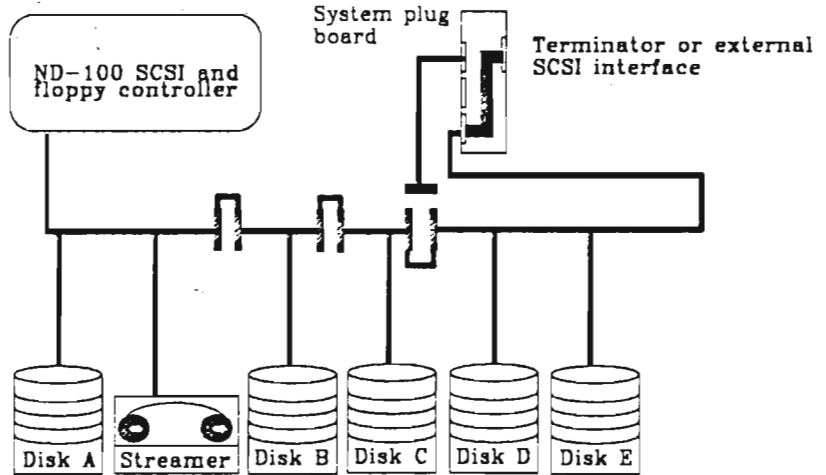


ND-100 Floppy and SCSI interface

Figure 8. SCSI bus on the backwiring PCB 5816

The ND-100 bus accesses all SCSI devices:

Backwiring PCB 5816



Backwiring PCB 5812

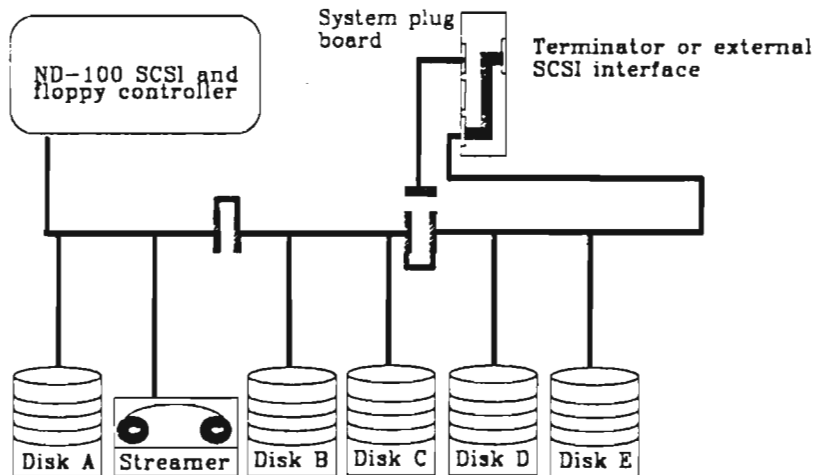


Figure 9. ND-100 accesses all SCSI devices

- The strap fields on the backwiring must be set as shown in the figures on the next page.
- The split switches on the backwiring must be set as shown in the figures on the next page.
- The flat cable on the System plugboard must be connected as shown on the figures on the next page.
- The SCSI plug on the System plugboard must be terminated, or an external SCSI device must be connected. Then the SCSI bus must be terminated on the external device.
- Empty SCSI positions must be equipped with dummy plugs, part number 322774

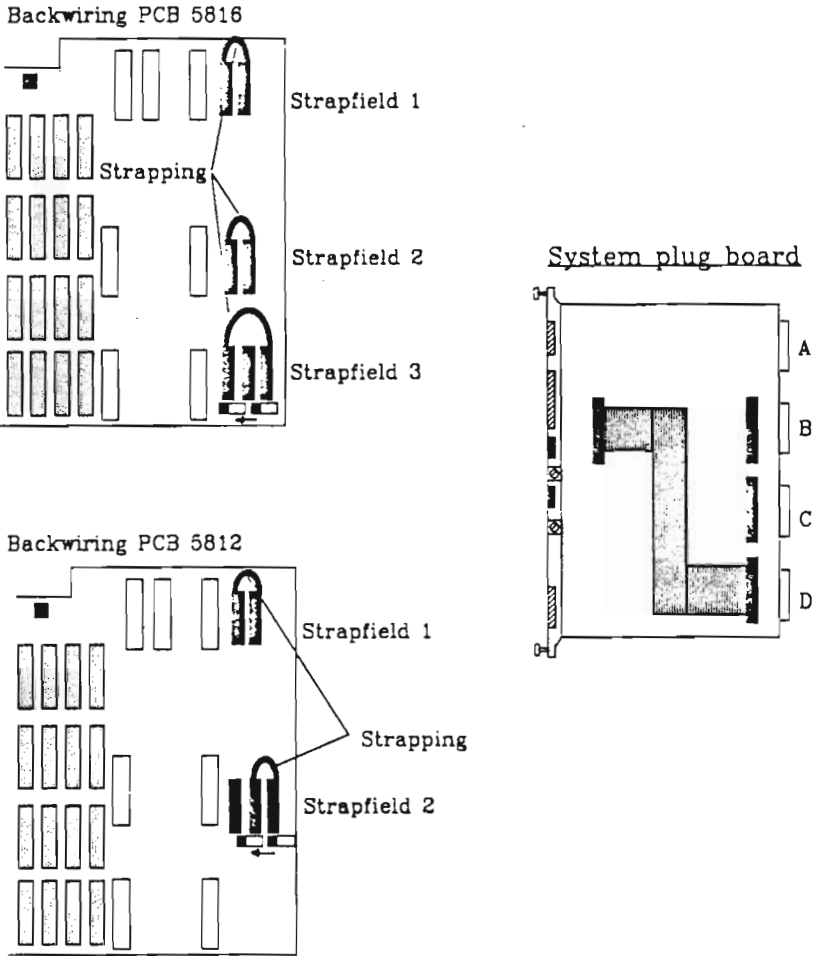
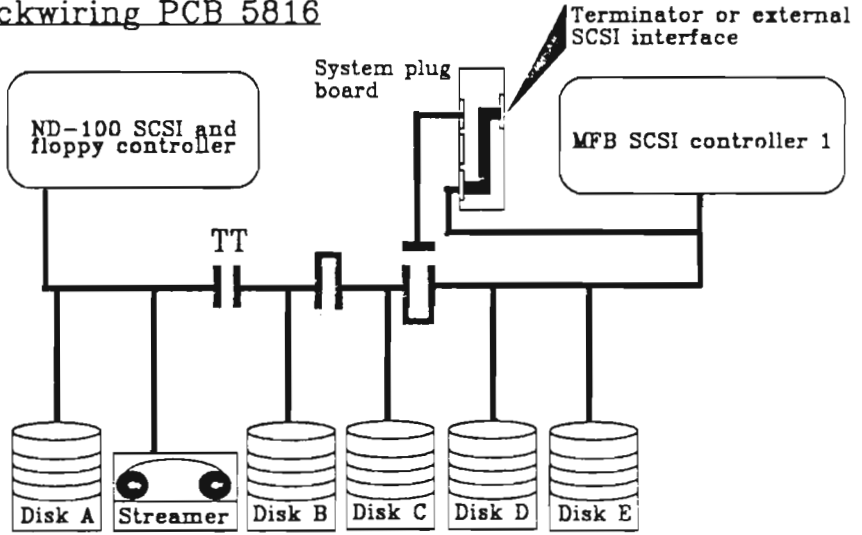


Figure 10. Strapping on the SCSI bus – normal configuration

ND-100 bus accesses the streamer and one disk, the MF bus accesses the rest of the SCSI devices:

Backwiring PCB 5816



Backwiring PCB 5812

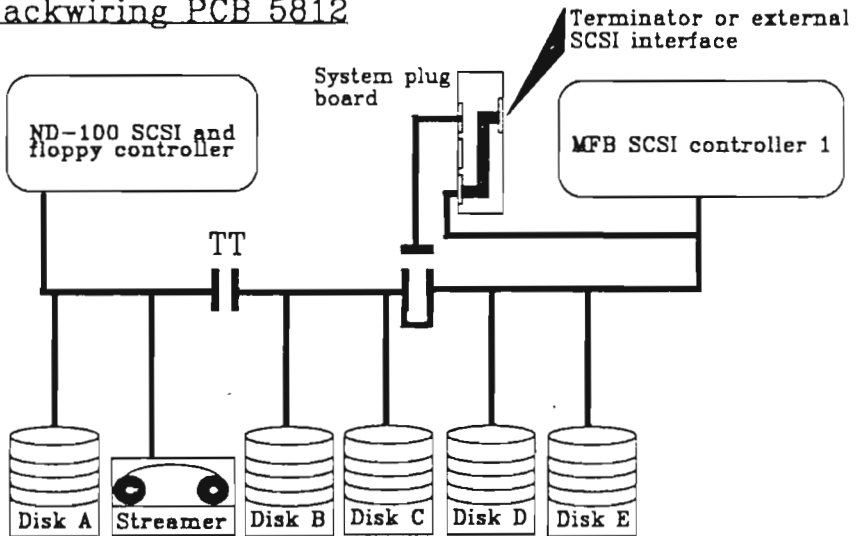
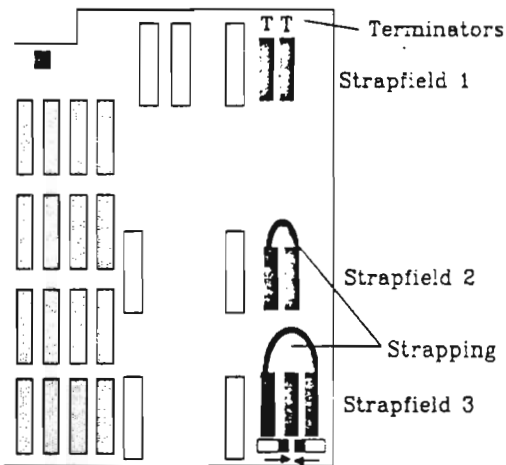


Figure 11. SCSI bus shared between two controllers

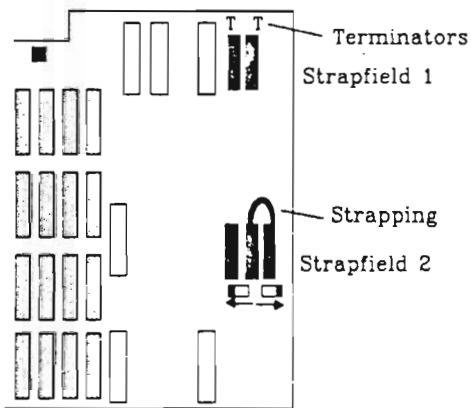
This can be done as described below:

- An MF bus SCSI controller card must be placed in MF bus position 8 in the card crate (positions 5, 6 or 7 may also be used, but then you must use an extra plugboard in the backwiring and a flat cable).
- The strap fields in the backwiring must be set as shown in the figure on the next page.
- The split switches in the backwiring must be as shown in the figure on the next page.
- The flat cable on the System plugboard must be connected as shown in the figure on the next page.
- The SCSI plug on the System plugboard must be terminated, or an external SCSI device must be connected. Then the SCSI bus must be terminated on the external device.
- Empty SCSI positions must be equipped with dummy plugs, part number 322774.

Backwiring PCB 5816



Backwiring PCB 5812



System plug board

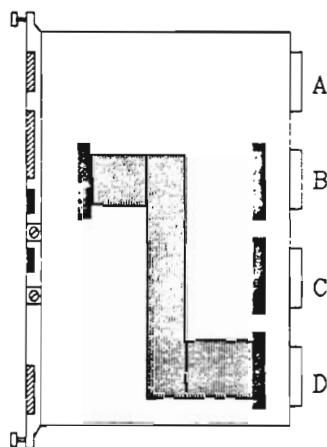


Figure 12. Strapping on the SCSI bus - extended configuration I

The SCSI devices split between three controllers (one ND-100 SCSI controller and two MF bus SCSI controllers):

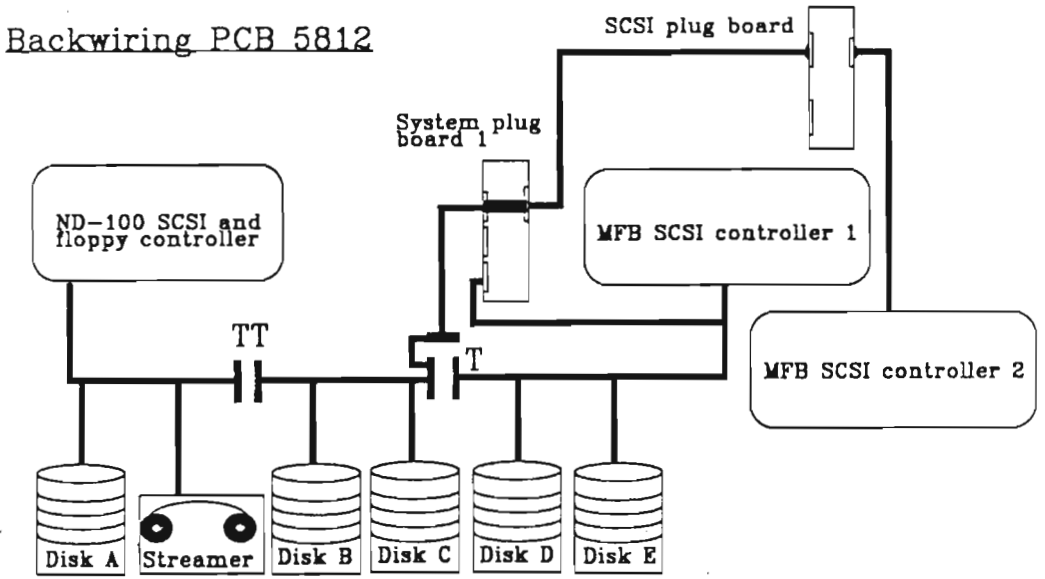
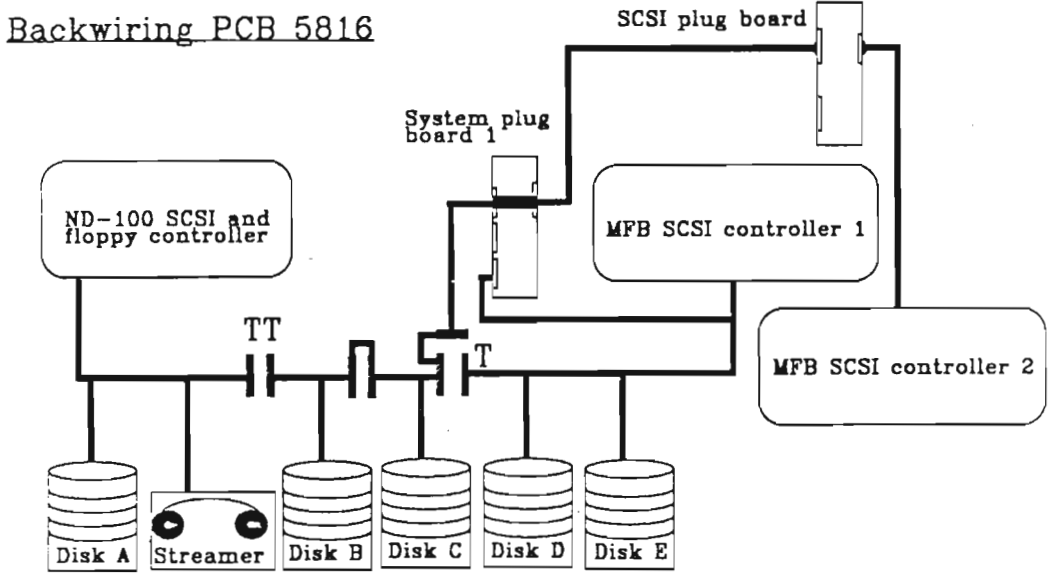


Figure 13. SCSI bus shared between three controllers

This can be done as described below:

- An MF bus SCSI controller (MF bus SCSI controller I) must be placed in MF bus position 8 in the card crate (positions 5, 6 or 7 may also be used, but then you must use an extra plugboard in the backwiring and a flat cable).
- Another single-ended MF bus SCSI controller (MF bus SCSI controller II) must be placed in MF bus positions 5, 6 or 7, and a SCSI plugboard must be placed in the same position from the rear side.
- The strap fields on the backwiring must be set as shown in the figure on the next page.
- The split switches on the backwiring must be as shown in the figure on the next page.
- The flat cable on the System plugboard must be connected as shown in the figure on the next page.
- A cable must be connected between the two plugboards.
- Empty SCSI positions must be equipped with dummy plugs, part number 322774.

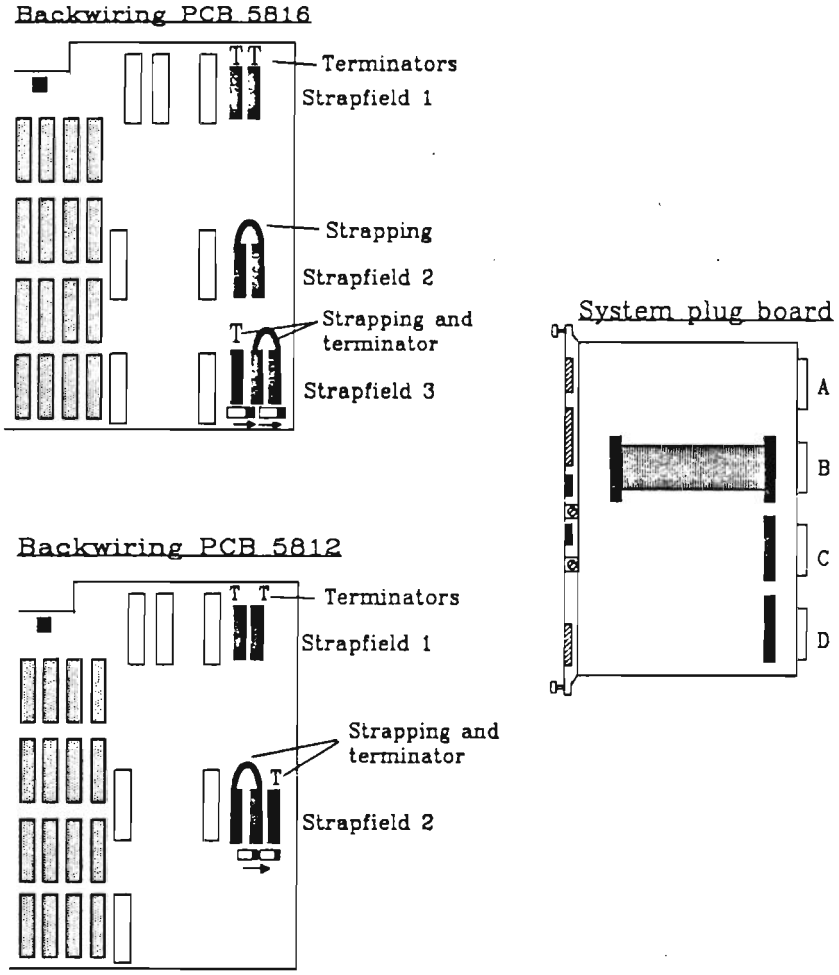


Figure 14. Strapping on the SCSI bus – extended configuration II

2.1.5 Card crate

The card crate has the following layout:

In the front:

- Nine positions for ND-100 cards
- Five positions for MF bus cards
- Place for streamer unit, floppy unit and up to five disk units

Free ND-100 positions do not need dummy plugs. Empty positions for mass storage devices must be terminated by special plugs.

At the rear:

- Slots for plugboards
- Four positions for the ND-5000 CPU
- Place for the power supply

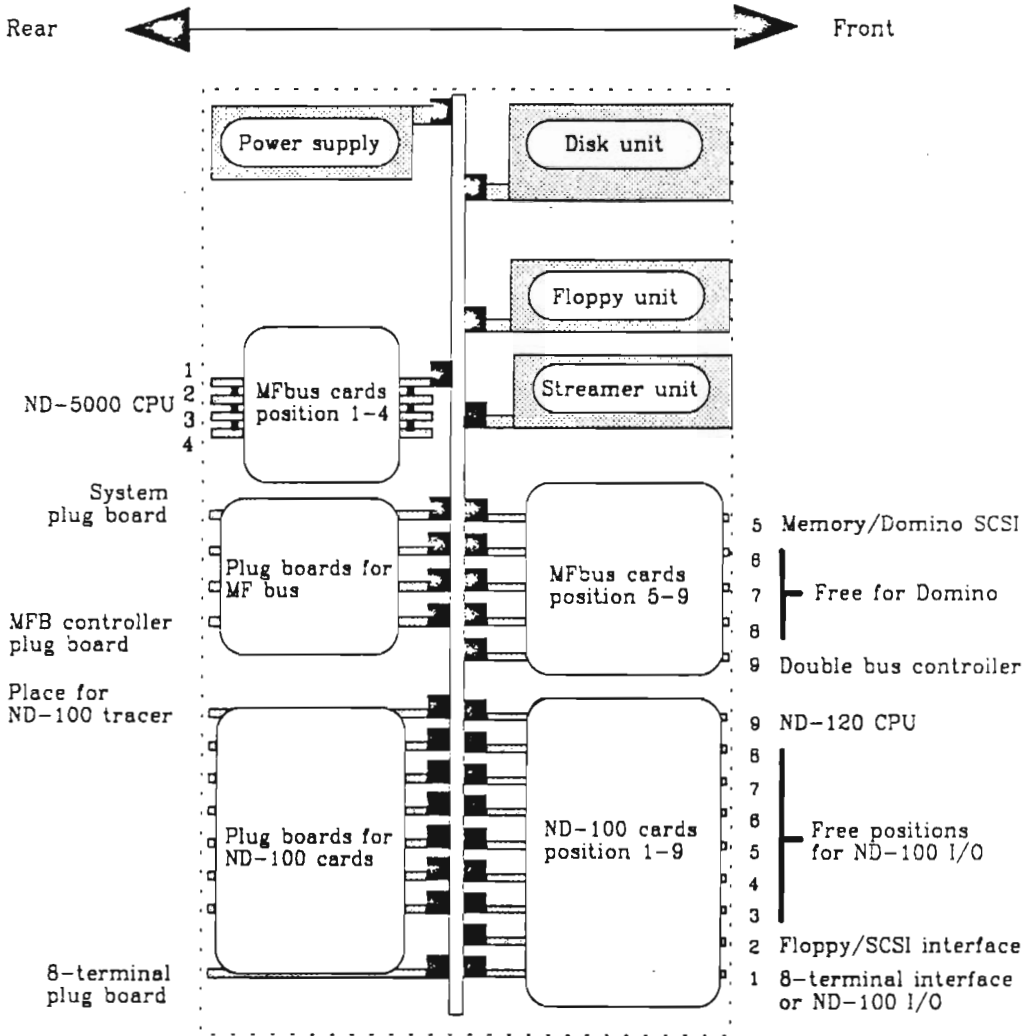


Figure 15. Card crate

2.1.6 Mass storage devices

This section describes the mass storage devices:

- Floppy drive
- Streamer
- Disk drive
- Gigatape

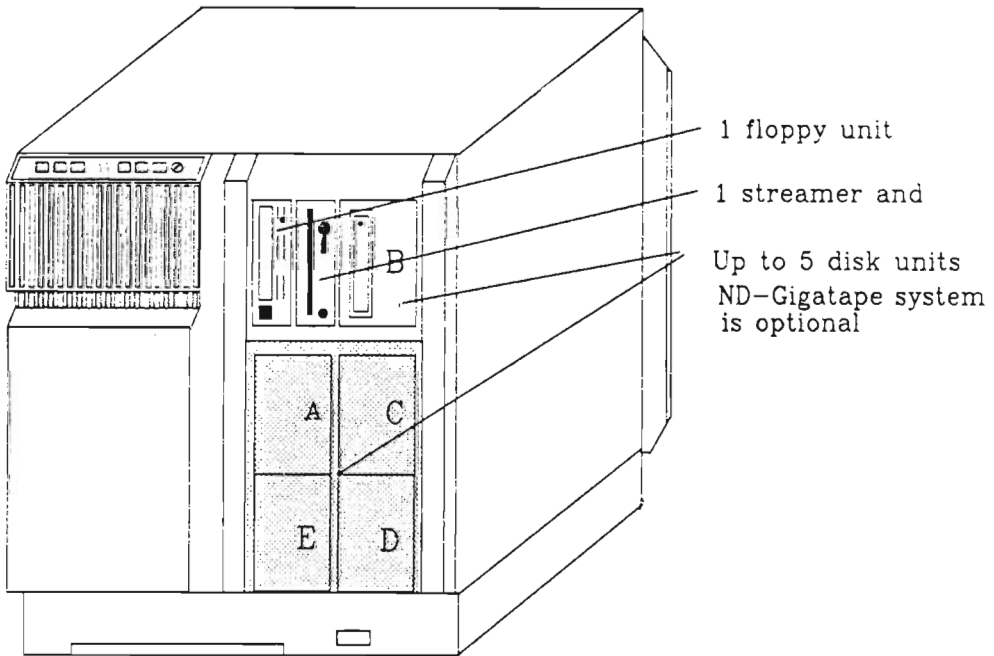


Figure 16. Mass storage devices

2.1.6.1 Floppy drive

The 5 1/4" floppy drive is the plug-in type, located at the top of the front (see figure 16). The drive is mounted on a board, and is therefore very easy to replace: Turn off the power, remove the two screws holding the floppy drive and pull it out.

NOTE

Turn the key switch on the operator panel to OFF and turn the power off before removing the floppy drive.

When replacing the floppy unit, remember to check that the switchsetting on the new unit is set to the correct value (see the figure below).

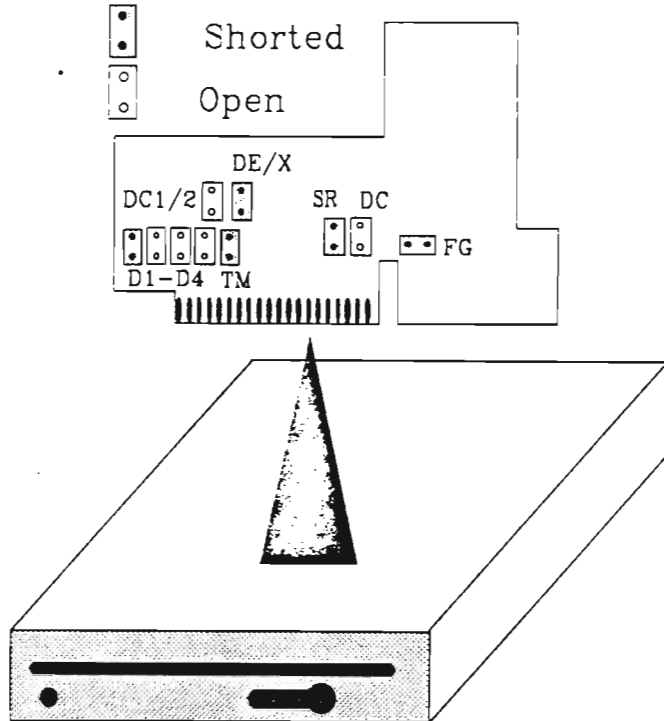


Figure 17. Switchsetting on the floppy unit

2.1.6.2 Disk unit(s)

Up to five disk units can be mounted in the cabinet (see figure 16), depending on the model. Each drive is mounted on a board, and they are therefore easy to replace:

Turn off the power, remove the two screws holding the disk and pull it out.

NOTE

Turn the key switch on the operator panel to OFF and turn the power off before removing the disk unit.

When replacing a disk unit, you must check that the switchsetting on the new unit is correct (see the figure below).

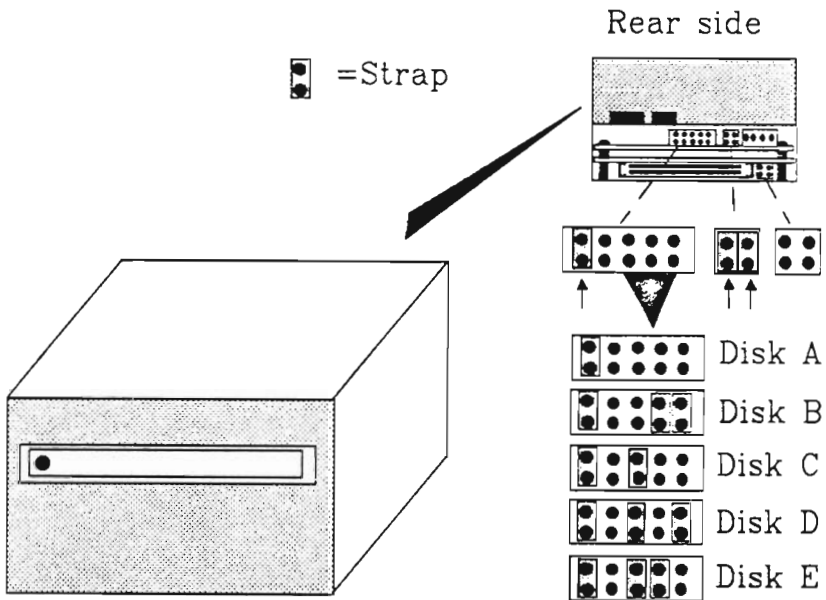


Figure 18. Switchsetting on the disk unit

2.1.6.3 Streamer drive

The 5 1/4" streamer drive is the plug-in type, located at the top of the front (see figure 16). The drive is mounted on a board, and is therefore very easy to replace:
Turn off the power, remove the two screws holding the streamer and pull it out.

NOTE

Turn the key switch on the operator panel to OFF and turn the power off before removing the streamer.

When replacing a streamer unit, you must check that the switchsetting on the new unit is correct (see the figure below).

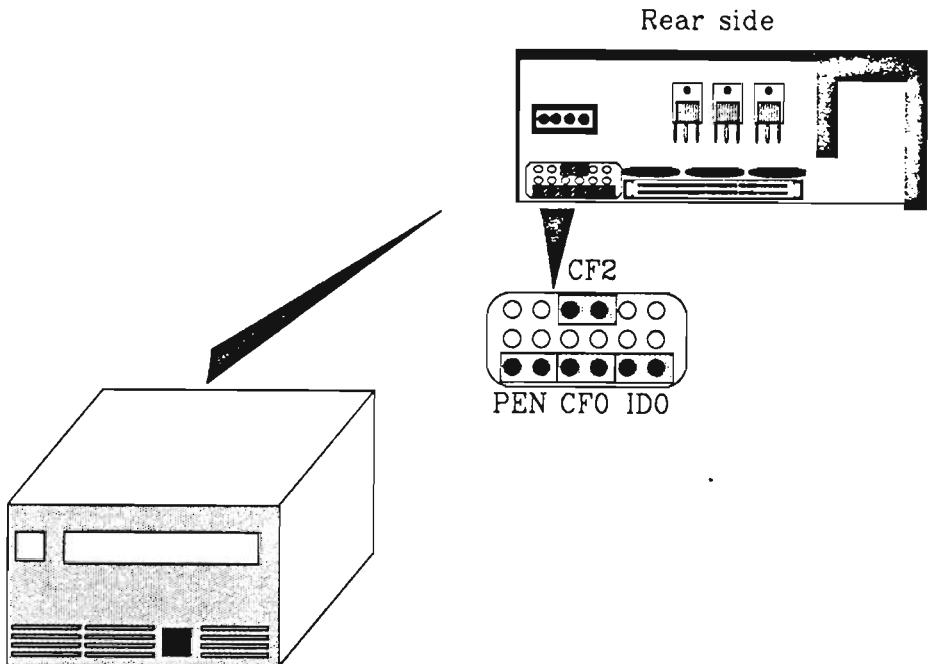


Figure 19. Switchsetting on the streamer

2.1.6.4 ND Gigabyte System

This is an optional tape system that uses 8 mm cartridge tapes and can store up to 2.2 Gbytes of data on one cartridge. The tape system uses a standard SCSI interface, and the drive is 5 1/4" high. When installed on models C1-C4, it is located in the upper right corner where disk B is normally located (see figure 16). When installed on model C5, it is mounted in a separate box.

The drive is mounted on a board and is therefore very easy to replace:

Turn off the power, remove the two screws holding the board and pull it out.

When replacing a unit, you must check that the switchsetting on the new unit is correct (see the figure below).

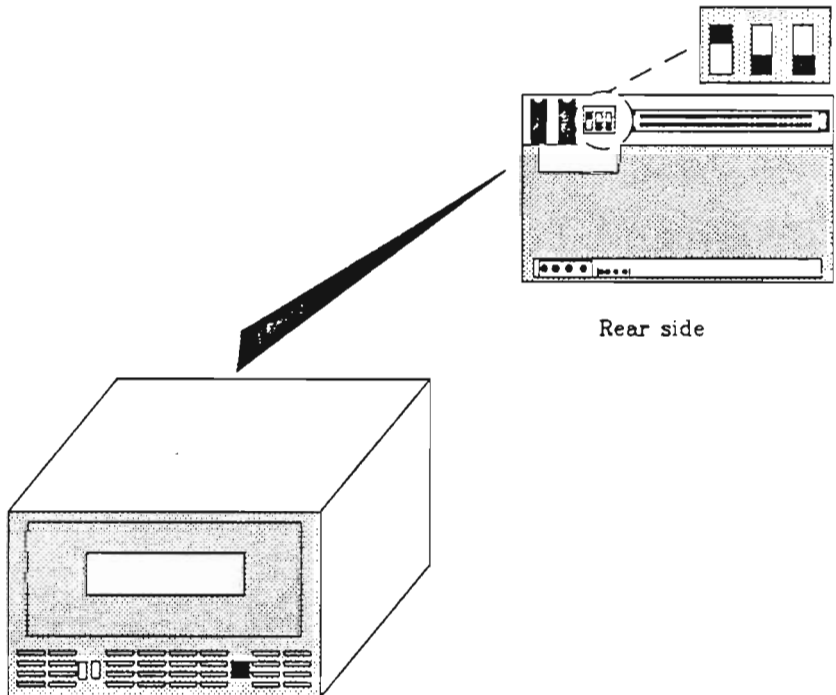


Figure 20. Switchsetting on the gigatape

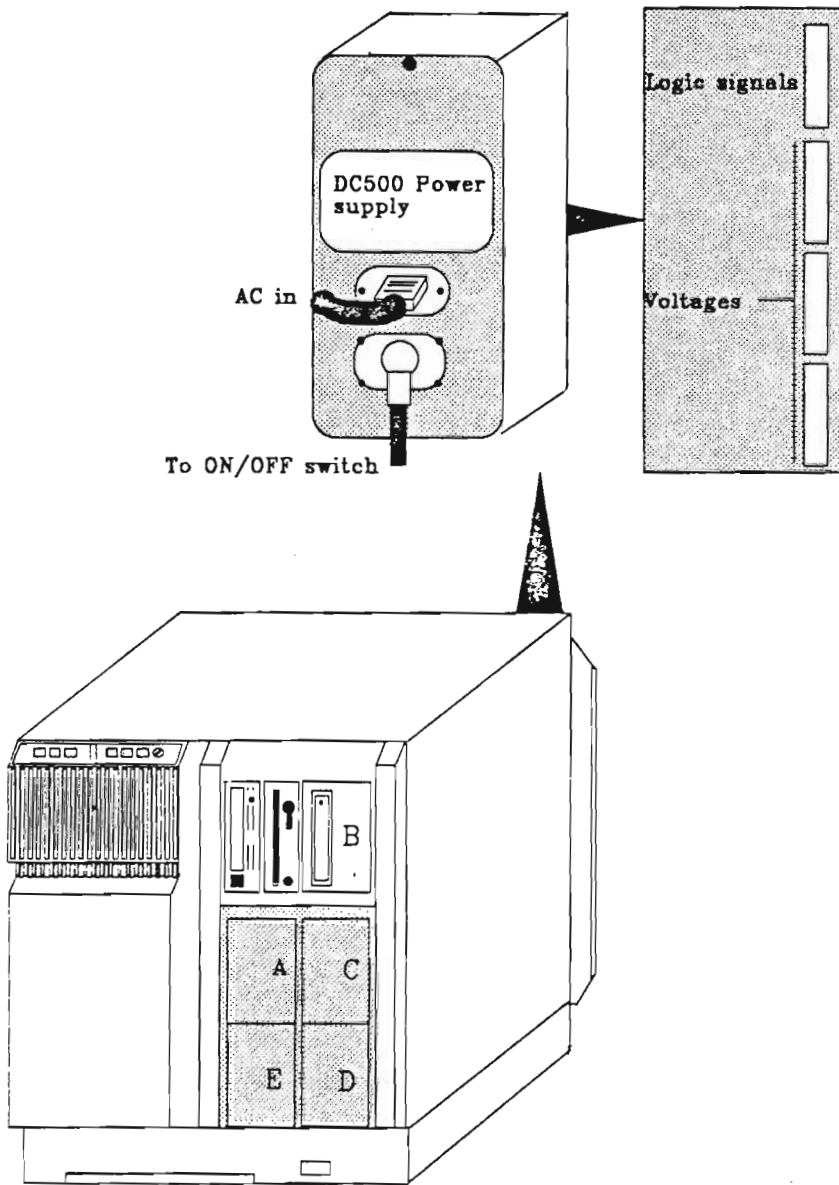


Figure 21. Power supply

2.1.8 Boards

This section describes new boards that are unique to the ND-5000 ES Model C, controllers or plugboards. Other ND-100 cards and cards in the MF bus are not described here, since they are described in other manuals.

Plugboards are plugged into the backwiring from the rear of the cabinet, and this means the computer is almost cable-free.

Some of the plugboards are delivered with every system, while others are optional depending on the model and configuration.

The purpose of this brief description is to show the plugs and switches on the boards.

System plugboard (5259)

This board is used to connect the following devices:

- Maintenance display
- External SCSI device
- ND-5000 CPU console
- ND-100 console
- TELEFIX modem

The plugboard also contains switches for baud rates for the consoles and a switch for enabling/disabling TELEFIX. It is delivered with every system and is placed in the leftmost position in the backwiring, seen from the rear side.

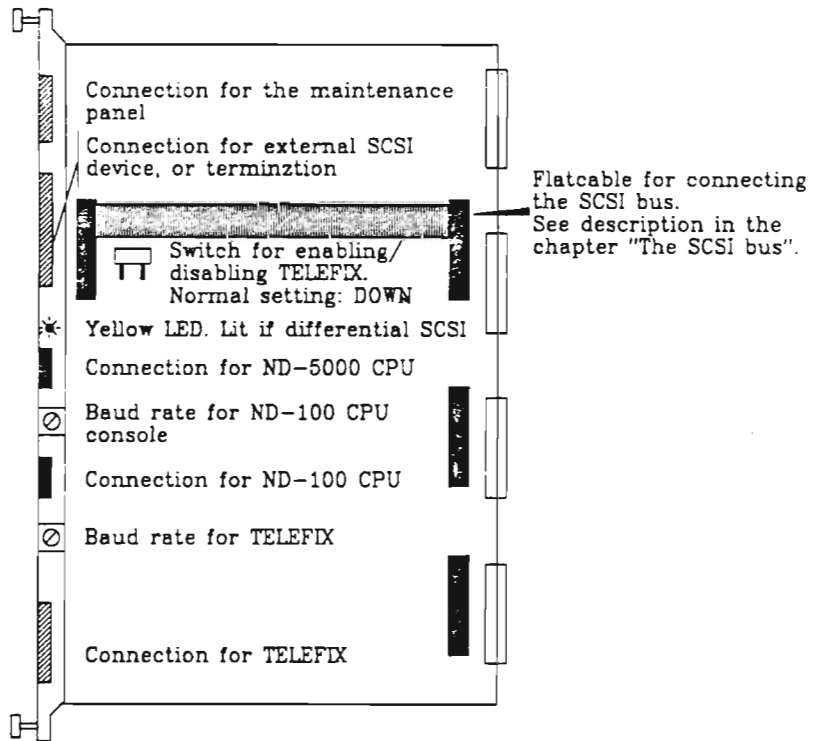


Figure 22. System plugboard (5259)

MFB controller plugboard (5234)

This board is used for the following connections:

- OCTO 1 and OCTO 2
- Power-fail interrupt (not used)
- MFB console (RS232 and current loop)

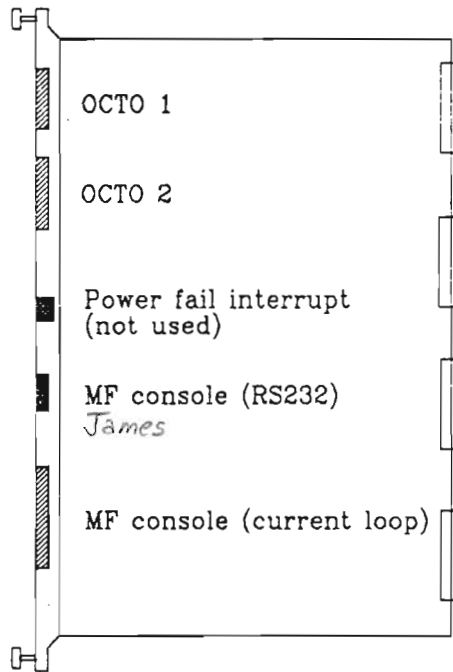


Figure 23. MFB controller plugboard (5234)

ND-100 Floppy and SCSI controller (3201)

This board contains both the old floppy controller circuitry and the SCSI adapter to the ND-100. You can install up to four SCSI adaptors in one ND-100.

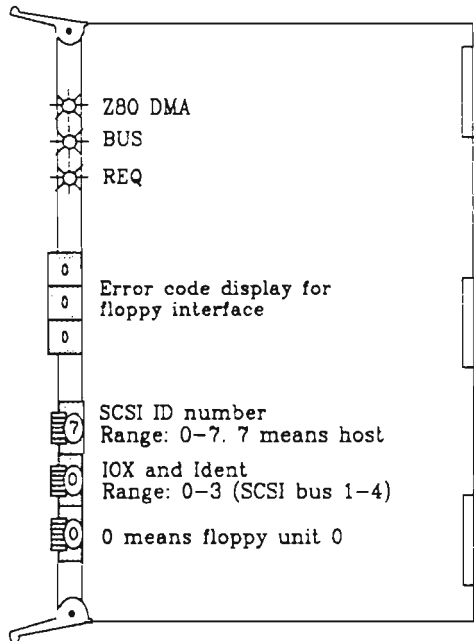


Figure 24. ND-100 floppy and SCSI controller (3201)

8-terminal plugboards

There are two different types of plugboards for the 8-terminal interface:

- PCB 5261 (8-terminal plugboard) is plugged into the backwiring from the rear side, normally in position 1. Because of the size of the plugboard, it is not possible to plug other plugboards into position 2. Up to eight terminals can be connected to this plugboard.

This board is normally used when eight or less terminals are connected.

- PCB 5262 (Plugboard for external panel) is plugged into the backwiring from the rear side in one of the free I/O-positions. This plugboard is connected to an external plug panel (PCB 1701) via two cables (see figure 25). PCB 1701 is mounted in a frame on a wall in the data room. Up to eight terminals can be connected to PCB 1701, and each frame can take up to eight external plug panels.

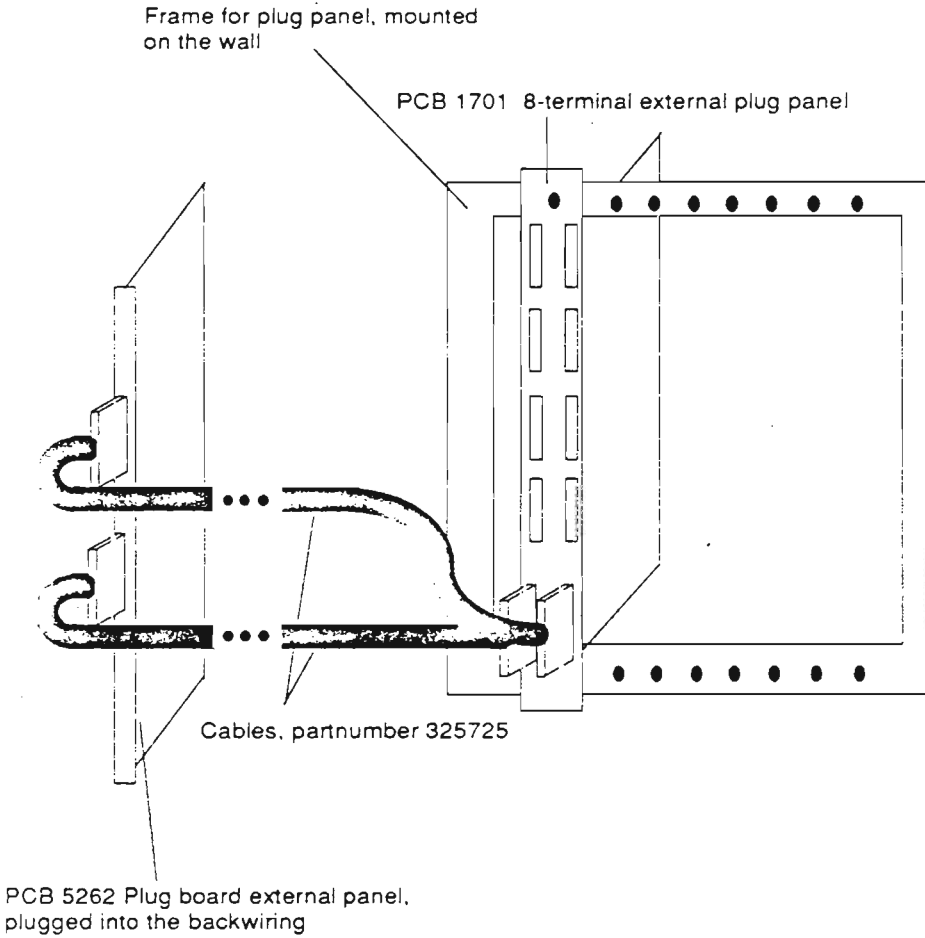


Figure 25. External plug panel (1701)

Chapter 3 Maintenance display

Since there is no display on the operator panel of the ND-5000 ES Model C, you must use an external maintenance display. It is similar to the display part of the first ND-100 operator panels, but there is no OPCOM button (see the figure on page 43).

Connection

Connect the display to the upper socket in the system plugboard (5259), which is located in the leftmost position in the backwiring, seen from the back.

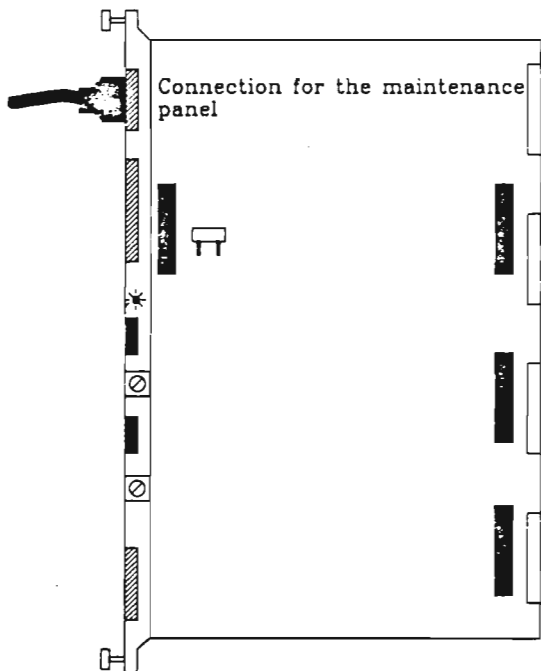


Figure 26. Connecting the maintenance display

3.1 Function

The maintenance display has four main parts:

1. The FUNCTION field
2. The ADDRESS field
3. The DATA field
4. The OPCOM indicator

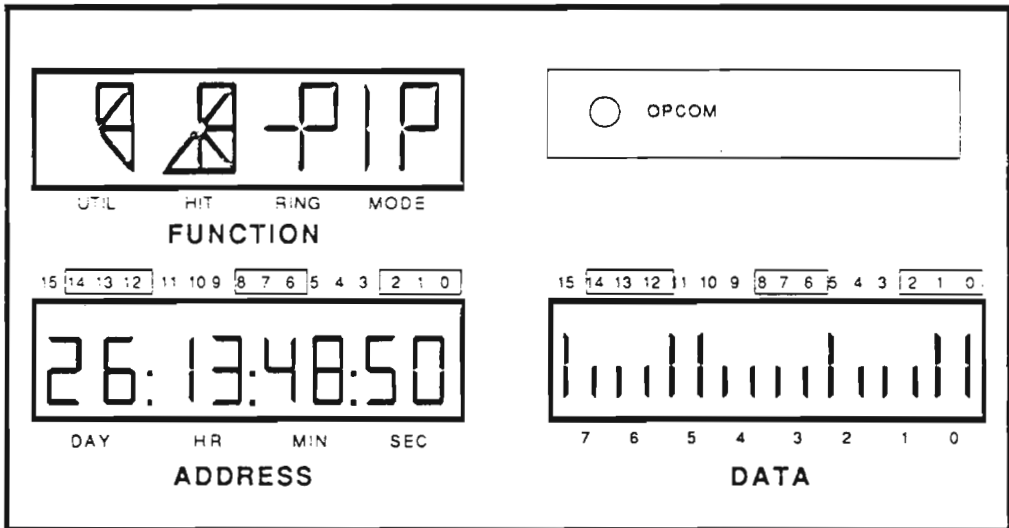


Figure 27. Maintenance-display

3.1.1 Normal display operation

In normal conditions, the different parts of the display operate as described in this section.

The FUNCTION field:

The four parts of the FUNTION field show the following:

UTILity

The UTIL part shows the utility of the ND-120 CPU. The more the ND-120 is utilized (that is, the less time spent on program level 0), the more segments are lit.



No activity 100 % Utility

Cache HIT

The HIT part shows the hit rate in cache memory. The more hit in cache, the more segments are lit.



No cache hits 100 % cache hit

Protect RING

If the paging system is on, the RING part shows which of the four protection rings the computer is running on.



Paging off Ring 0 Ring 1 Ring 2 Ring 3

Interrupt/paging**MODE**

The MODE part shows whether the interrupt system and/or the paging system is turned on.



Both the Interrupt and
paging systems are on.

Only the interrupt sys-
tem is on.

**The ADDRESS
field**

The ADDRESS field displays the DAY, HouR, MINute and SECond taken from the system clock. (See figure 27 on page 43.)

The DATA field

The DATA field shows the active program level in the computer. A "one" is set in one of the positions 0-15, corresponding to the active level. The display has afterglow, so it is possible to see a single instruction on a program level. (See figure 27 on page 43.)

**The OPCOM
indicator**

As the name indicates, the OPCOM indicator is lit when the computer is in OPCOM mode.

3.1.2 OPCOM commands using display

Some of the commands available in OPCOM use the display. A summary of how they affect the display is given here. For a complete explanation of OPCOM etc., see the manual ND-110 & ND-120 Functional Description (ND-806030).

Why use the display?

Much of the same information is shown on both the console and the display. But the display remains in the same mode afterwards, and is continuously updated. Therefore you can set up the display to examine for example register or memory address, leave OPCOM, start a program, and still see what happens in that register or address.

Memory examine

Display

When you examine memory, the display respond like this:

FUNCTION field: examine mode

PEXM =Physical address examine

PT 0 - PT17 =Logical address, mapped via page table 0 - 178.

ADDRESS field: Memory address.

DATA field: Contents of current address.

Examine mode First, set the memory examine mode. If you want to use physical addresses, give the OPCOM command:

#E↓

If you want to use logical addresses, specify the number of the desired page table (0 - 178) before the "E".

Example:

#2E↓

Subsequent addresses will be mapped through page table 2.

Memory examine To examine a location in memory, type the address followed by a /. The display remains in this mode until you give a new display command.

Example:

#E↓
#12345/ 54321

The contents of physical address 123458 is now 543218. This is shown on both the console and the display. If it is changed by a running program, the new contents will be shown on the display.

Register examine

In register examine mode, the display shows:

FUNCTION field: Name (and program level if specified) of the register.

ADDRESS field: Current Program Counter (PC). Updated continuously.

DATA field: Contents of register. Updated continuously.

Working registers

To examine one of the working registers, type:

#xxRy/

xx = Program level (0 - 178). Default is program level 0.

Ry = Working register name R0 - R7.

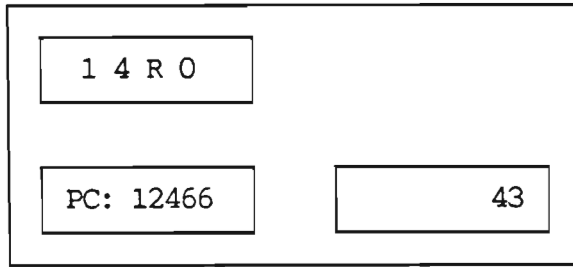
Corresponding to register-file working registers STS, D, P, B, L, A, T, and X respectively.

(These names can also be used directly, but STS must be abbreviated to S.)

Example:

#14R0/ 000043

The contents of R0 (STS register) on program level 14 is now 43. This is shown on both the console and the display. If it is changed by a running program, the new contents will be shown on the display. In addition, the display shows the current program counter (also updated continuously) and the name and level for the register.



Internal registers

To examine one of the internal registers, type:

#Iy/

y = internal register number:

0 = PANS	1 = STS	2 = OPR
3 = PSR	4 = PVL	5 = IIC
6 = PID	7 = PIE	10 = CSR
11 = ACTL	12 = ALD	13 = PES
14 = PCR	15 = PEA	

Example:

#I7/

This input on the console will show the contents of the PIE-register on the console and the display. Changes will only be seen on the display.

Userregister

The user register is used by some diagnostic and utility programs to hold current status information. To examine this register, type

#U/

Reset to normal operation

OPCOM input	The command <u>#ACT/</u> resets the display to the normal operating mode, which is described beginning on page 44.
Master Clear	The display is also reset to normal operation by a Master Clear to the ND-100.

Define display format

OPCOM input	<u>#uuzzzyxF↓</u> This command sets the format for the display of data. If the parameters uuzzzyx are omitted, the default is octal format.
-------------	--

Parameter explanation

x : Number representation code.

x = 0 Displayed data is in octal format.
 zz has no effect.

x = 1 Displayed data is in unary format,
 i.e. four of the bits in the displayed
 data are used to light one out of 16
 indicators.

x = 2 Displayed data is in binary format.
 zz has no effect.

y : "Stretch" code (afterglow).

y = 0 No stretching

y = 1 Zeros are stretched

y = 2 Ones are stretched

y = 3 Zeros and ones are stretched

zz : Lower start bit for unary display.

zz = 0-248 Position of lowest bit
to be represented in unary format.

uu : Display processor maintenance codes.

uu = 1 Display year and month in the
ADDRESS field

uu = 2 Inhibit message

uu = 4 Initialize panel processor

uu = 108 Abort message

(See "ND-110 & ND-120 Functional Description"
for details on displaying messages on the
display.)

Example

#1421F↓

After this command is given in OPCOM, bits 148-
178 are shown in unary format with afterglow on
ones.

 Appendix A Part numbers

This appendix contains the part numbers for some of the parts in the ND-5000 ES C models.

Part	Part number
DC 500 power supply	512030
Disk drive 310 Mb SCSI 5.25 "	323355
Double Bus controller (5464)	324244
Dummy plug for empty SCSI positions	322774
External SCSI cable	325725
Fan unit	323354
Floppy drive 1.2 Mb 5.25 "	323357
Frame for external plug panel	509507
MOS Memory 4 Mb (5462)	350160
ND-120 CPU, 2 Mb (3202)	350112
ND-120 CPU, 4 Mb (3202)	350110
ND-120 CPU, 6 Mb (3202)	350108
ND-5200 Basic CPU type I	320001
ND-5400	Basic CPU type II
ND-5500	
ND-5700	
ND-5800 Basic CPU type III	320003
Operator panel	323235
PCB 1701 8 terminal external plug panel	350231
PCB 5234 MFB console/Octobus plugboard	324194
PCB 5259 System plugboard	350309
PCB 5261 8 terminal plugboard	350311
PCB 5262 Plugboard external panel	350312
PCB 5812 Backwiring	324812
SCSI and floppy disk interface (3201)	350001
SCSI bus terminator (backwiring) (1880)	324148
SCSI bus terminator (plugboard)	517692
Streamer 155 Mb 5.25 "	323356
PCB 5257 Tracer converter	350307

+12 volts	34
+5 Volts	34
+5 Volts standby	34
Air inlet	8
Back panel	7
Backwiring	10
Cooling	8
Currents	34
DC500	34
DC501	34
Display	8
Dummy plug	10
External single-ended SCSI device	10
Fan speed	34
Fan speed control	8
Fans	8
Front panel	6
Internal SCSI bus	10
Internal SCSI devices	14
Key switch	8
ND-100 console	37
ND-5000 CPU console	37
NTC resistor	8

Physical description	4
Side panels	7
Split switch	10
Splitting the SCSI bus	10
Standby power	34
Strap fields	10
System plugboard	19
TELEFIX connection	37
Temperature sensor	10
Terminator fields	10
Top panel	7
Upgrading	3
Voltages	34

