NUM 1000 FAMILY

CNC - NUM DRIVE MAINTENANCE MANUAL

0101938979/0

Table of Contents

Part 1: CNC

Part 2: NUM DRIVE

Record of Revisions

DOCUMENT REVISIONS

Date	Revision	Reason for Revision
07 - 98	0	Document creation

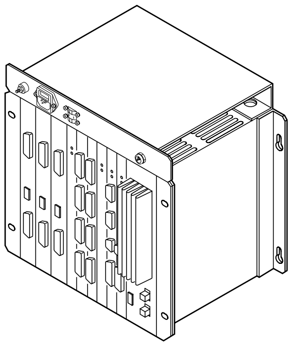
Part 1

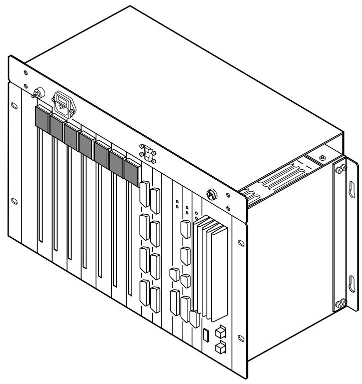
CNC

1 General

1.1 Main Rack

The main rack of NUM 1000 CNCs is available in two versions.





A yellow tag is affixed to each rack indicating the version and other very important information.

Identification Tag

This tag includes the following information (values given as illustration):

- Type : 1060M SI PCNC
- Affaire (Job number) : 12345600
- Ref. Client (User) : NUM SA
- Année (Year) : 1996

Serial/Part Number Tag

This tag includes the following information:

- No. de dossier (Part Number): 205202080
- No. de série (Serial Number): 70785

Affaire Number

Whenever you need to contact NUM for service or parts information, you will be asked for the 8-digit Affaire Number, used by NUM to keep track of all the systems sold throughout the world. All the pertinent information on 1060 systems is available from Num.

Model Number Breakdown

1060M SI PCNC

Identifies any special versions:	
	PC: A PC compatible computer is used as MMI
Identifies the series:	SI = Series I: 3 processors in rack
	SII = Series II: 2 processors in rack
	UCSII = Monoprocessor: 1 processor in rack
Identifies the version:	M = Milling
	T = Turning
	G = Grinding
	H = Gear hobbing
	HG = Gear hobbing and grinding

1.2 Differences Between Versions

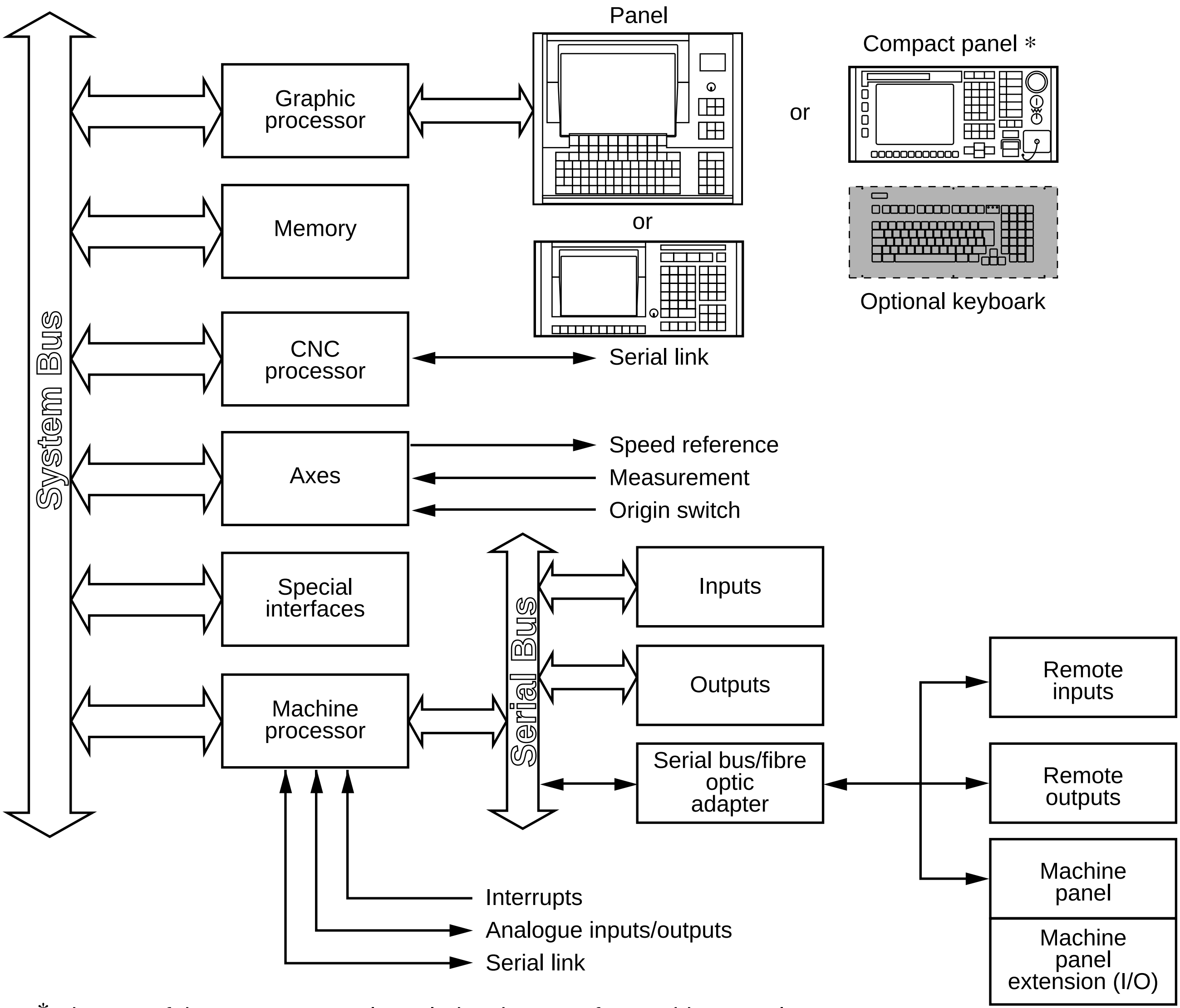
The entire family of NUM 1000 CNCs is based on Motorola MC68020 microprocessors and associated chipsets. The differences between series are a result of the number of processors in each series. The dialogue functionality (MMI) is identical on all systems, which differ only by the hardware.

The main rack assembly is available in two sizes: 19" and 12". Series I generally uses a 19" rack and Series II and UCSII a 12" rack, but this is not always the case. Always check the Affaire Number on the ID tag. The main components are briefly described below. For more detailed information on the sizes and conditions of use, refer to Installation Manuals 938816, 938938 and 938977.

Series I Systems

Series I systems include three processors:
- Graphic processor
- CNC processor
- Machine (PLC) processor.

The series I graphic processor can optionally be replaced by an Intel 486 PC processor.



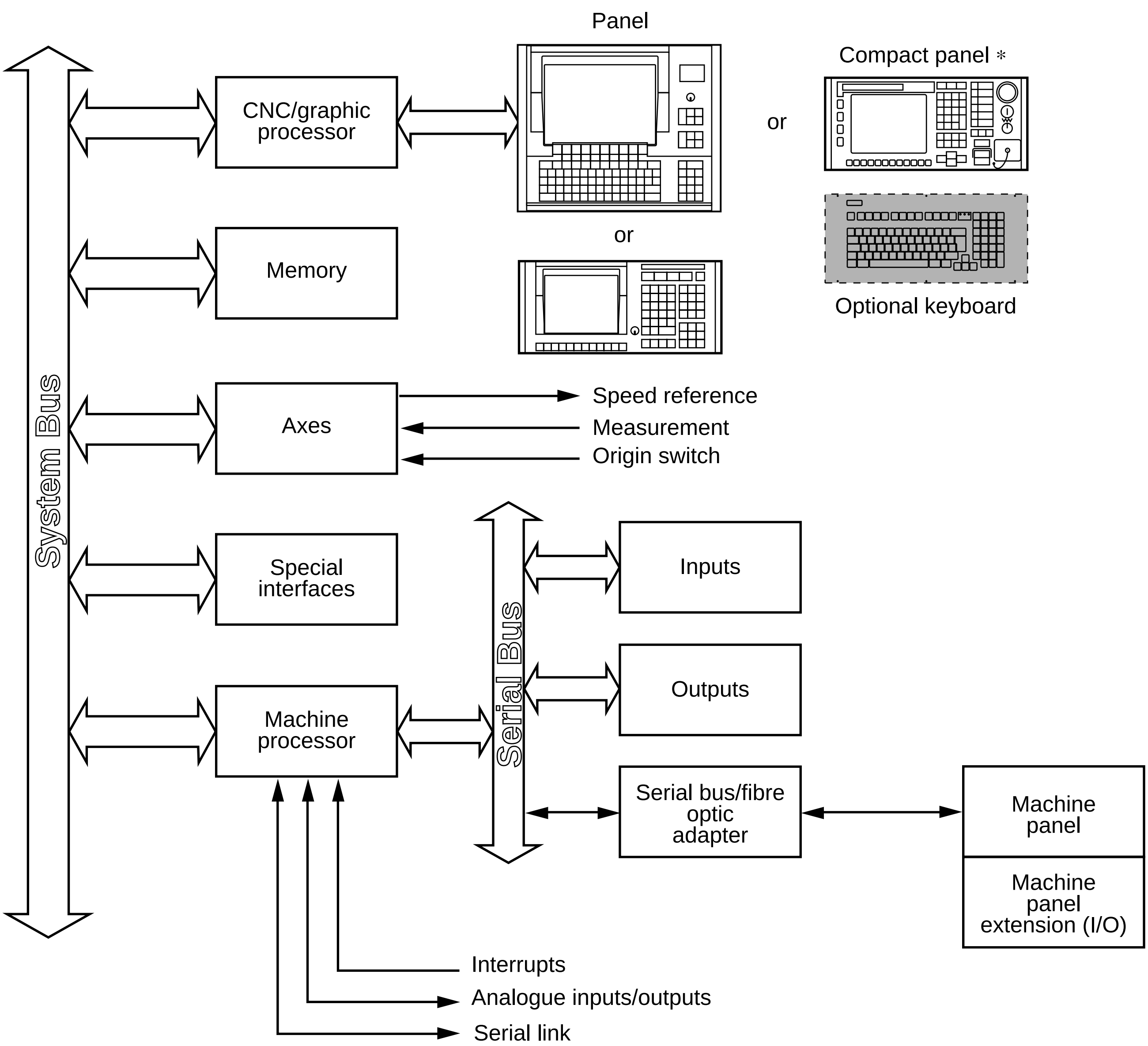
* The use of the compact panel precludes the use of a machine panel.

Series II Systems

Series II systems include two processors:

- CNC/graphic processor
- Machine (PLC) processor.

In a Series II system, all the processors are Motorola MC68020s.

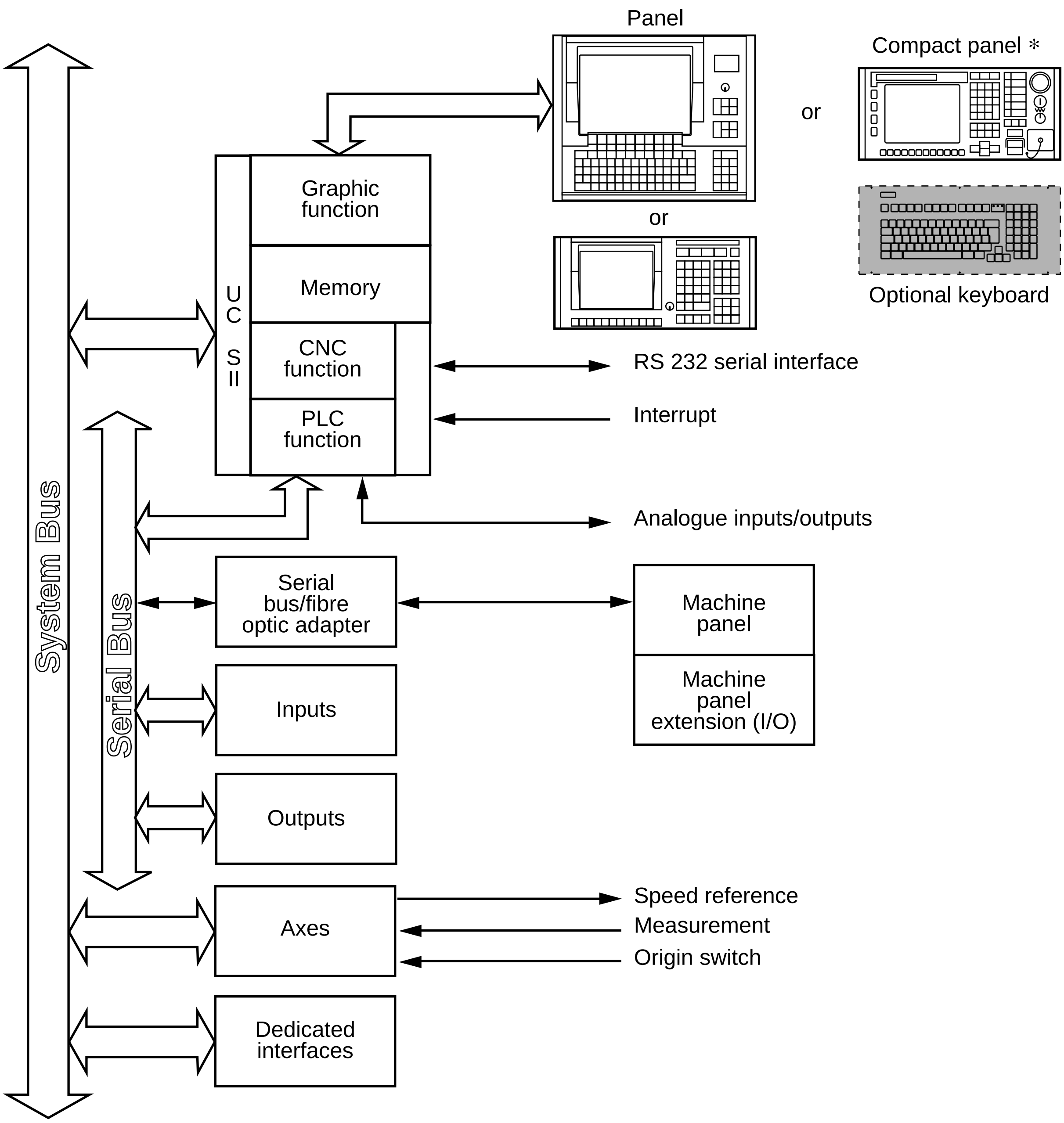


* The use of the compact panel precludes the use of a machine panel.

UCSII Systems

Such systems general include only one processor unless the PCNC option is present. In a standard system, the single processor performs all the functions:
- Graphic, CNC, PLC processor (Motorola MC68020).

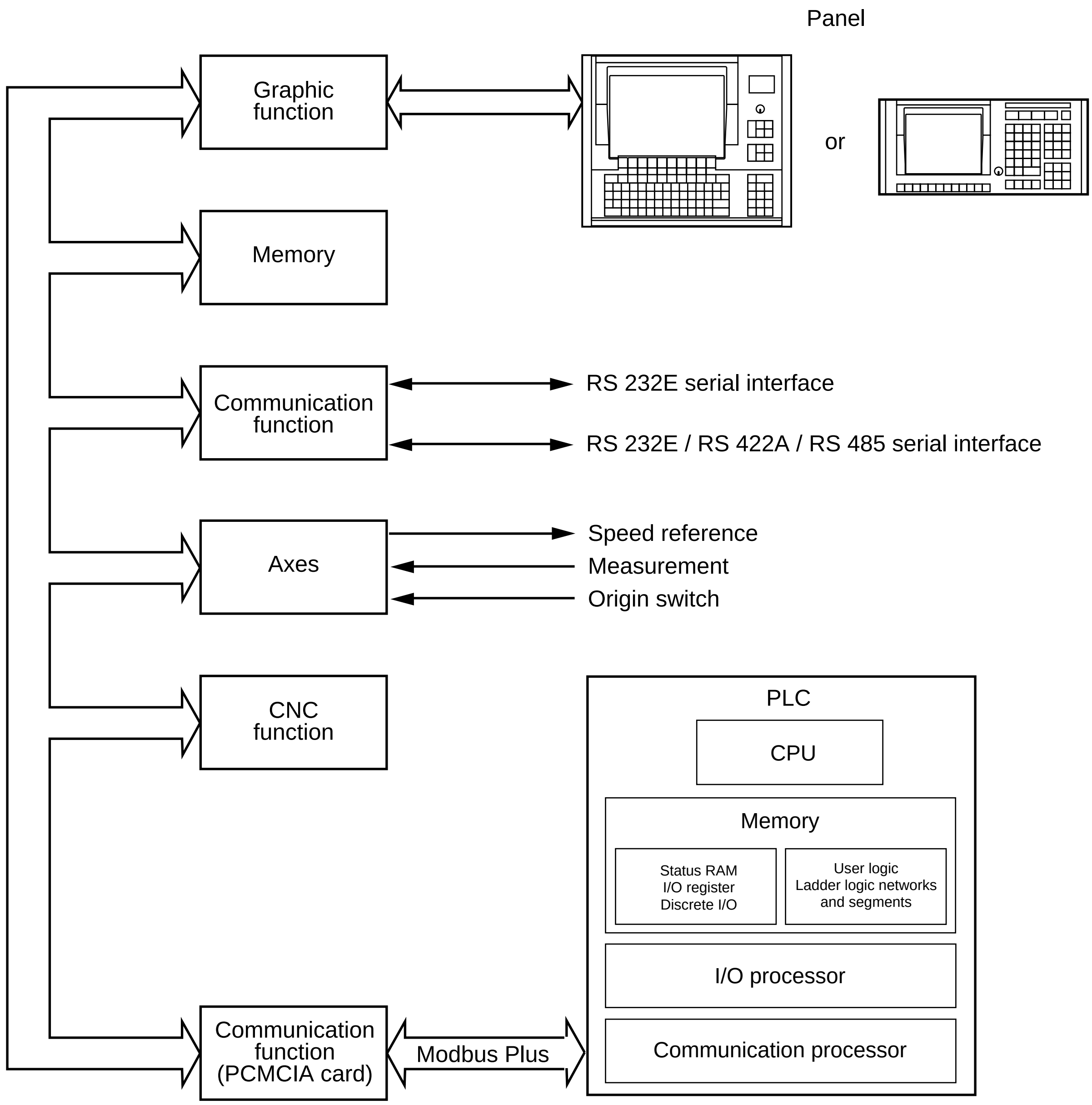
Such systems can optionally be equipped with an Intel 486 PC card. The tasks are then divided as follows:
- Graphic/keyboard processor : Intel 486 PC
- CNC/machine (PLC) processor : Motorola MC68020



* The use of the compact panel precludes the use of a machine panel.

1020/1040 Systems

The architecture of 1020/1040 systems is comparable to that of UCSII systems. The integrated PC functionality is not available on such systems. Unlike earlier 1020/1040 systems, they have a monolithic, not a modular, architecture.

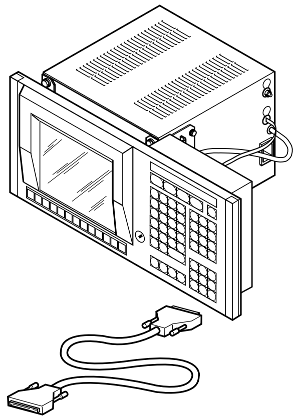


1.3 Panels

The panel includes a standard VGA CRT connected to the rear of the keyboard by a cable with a conventional Sub.D connector which is fully VGA compatible. The following panels are available for the 1000 family of CNCs:

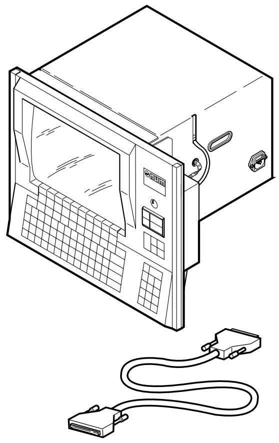
9" Monochrome (grey scale) or 10" Colour Panel

These two panels are the same size (483 x 220 mm) and are completely interchangeable. They have a 50-key keyboard providing all the controls necessary to control the machine.



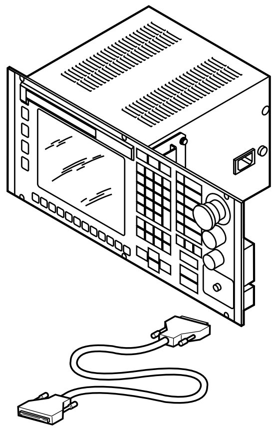
14" Colour Panel

This panel is functionally completely interchangeable with the 9" or 10" panel, but it is physically larger (483 x 399 mm). It has a complete QWERTY keyboard. Most of the new 14" panels include an ALT key for compatibility with PCNC systems. CAUTION: Panels which do not have an ALT key cannot be used with PCNCs.



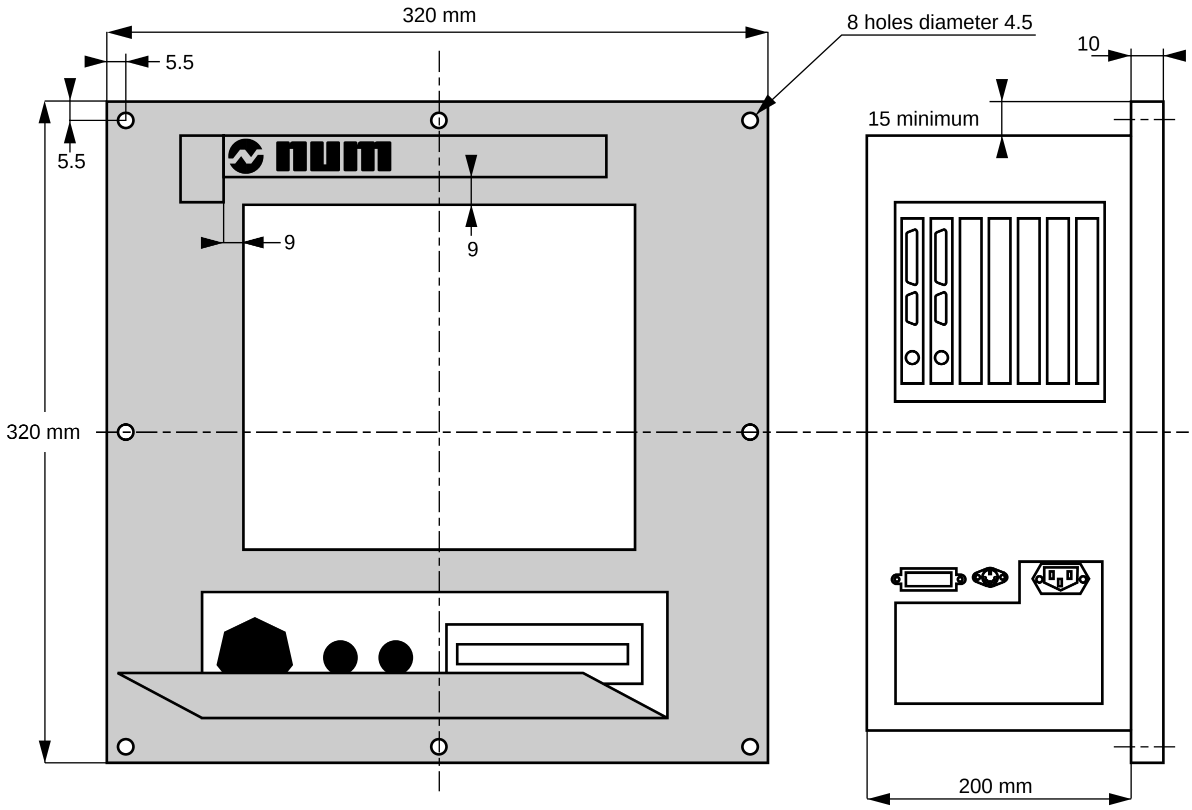
Compact Panel

The compact panel has a 483 x 220 mm 9" monochrome or 10" colour CRT with, in addition to the CNC keys, programmable keys for control of the machine. A PC type keyboard can be connected for settings or maintenance.



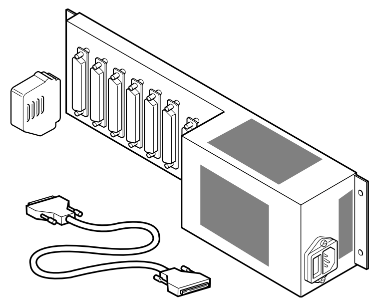
PC Panel

The PC panel is an industrial PC measuring 320 x 200 x 200 mm running DOS/Windows. It is connected to 1020/1040 systems via a conventional serial port or a high speed link requiring a special ISA card plus a PCMCIA card on the 1020/1040 system. The CNC is controlled via a special MMI application.



Multiplexer Module

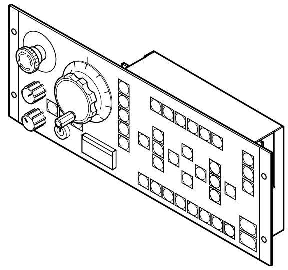
This module is not a panel as such, but is closely related to it. It is mounted at the rear of a panel or externally and is used to connect and gate two to four panels to a CNC or a panel to two to four CNCs.



1.4 Additional Components

Machine Panel

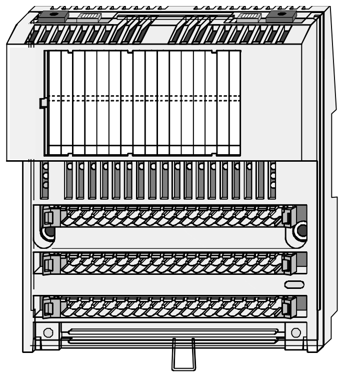
The machine panel is connectable via a fibre-optic ring. It includes the main machine control keys, programmable keys and handwheel, feed rate and spindle speed override and mode locking functionalities plus an emergency switch.



Extension Rack (NUM I/O)

This rack is actually a small (125 x 140 mm) input/output panel which is connected to the fibre-optic ring. It can be installed on 1060 and 1040 CNCs and is available in three versions:

- 16 inputs at 24 VDC
- 16 inputs at 24 VDC, 16 outputs at 24 VDC, 0.5 A
- 8 inputs at 24 VDC, 8 relay outputs at 2 A.

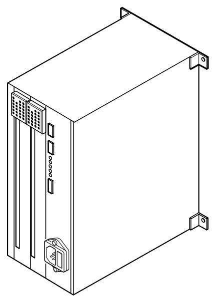


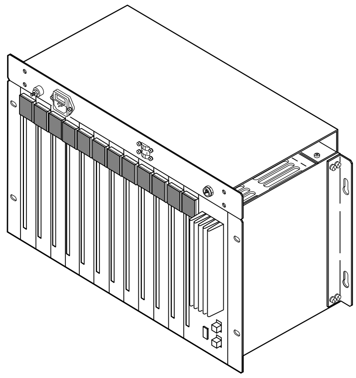
Additional Racks

The extension racks are connected to the fibre-optic ring and can be fitted with input/output cards. They can only be used with 1060 Series I type CNCS. Two versions are available:

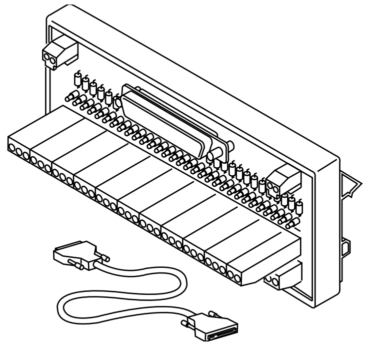
- Rack for a maximum of 2 cards (142 x 266 mm)
- Rack for a maximum of 12 cards (483 x 310.4 mm).

The maximum number of extension racks is limited to six per main rack. Each extension rack has its own power supply which is also used for the fibre-optic link.

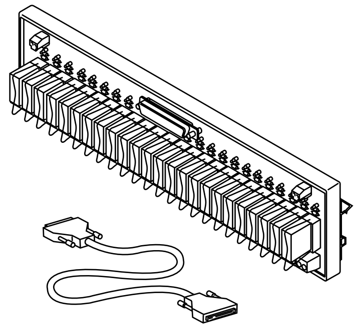




32-Input Interface Panel with Cable



24-Output Relay Panel with Cable



2 System Overview

The NUM 1060 CNC is of a modular design with a multislot main rack. The system consists of cards plugged into the rack, each of which performs a specific function (see below for detailed operation of the cards). The 1020/1040 CNCs are of a monolithic design with a motherboard into which are plugged daughterboards or optional cards (graphic, axis, memory). This section gives a general functional description to allow a better understanding of the role of each card.

2

The CNCs of the 1000 family make extensive use of RAM memory. Roughly 90% of all the data are stored in battery backed RAM memory. The remaining 10% are stored in EEPROM memory which is more permanent. The table below lists the types of data, type of memory and location.

Data	Storage type	Location
Part programmes	RAM	Memory card
Tool offsets	RAM	Memory card
External parameters	RAM	Memory card
User-defined macros	RAM	Memory card
PLC Ladder programmes	RAM	Memory card
PLC assembler programmes	RAM	Memory card
PLC C programmes	RAM	Memory card
PLC stored variables	RAM	Memory card
Axis calibration	RAM	Memory card
Machine parameters	EEPROM	Rack backplane
CNC customisation	EEPROM	Rack backplane
Executive software	EPROM	Memory card – daughterboard
Bootstrap BIOS	EPROM	On each processor card

Power up Sequence (PCNC Only)

When power is first applied to the system, the PC must boot up just like any other PC. The PC has an on-board hard drive which stores the OS/2 operating system and some special programmes to interface to the CNC through the system bus. First OS/2 boots, then it loads the interface programmes. Once these programmes are running, the normal 1060 boot sequence is started.

Each CNC processor starts independently from the others. They each perform the boot-up routines defined by the on-board BIOS chips. Once each processor is running, it requests the CPU to load its private operating system into its local RAM. Between 1 and 4 MB of RAM are allocated to the operating system of each processor.

Once all the cards have loaded their operating system, the CPU enables start-up of each processor in turn. Finally, when all the processors are running, the system finishes its boot-up sequence and the CNC is ready to run.

Power up Sequence (Conventional Version)

When power is applied to the system, each processor is started independently of the others. They each perform the boot-up routines defined by the on-board BIOS chips. Once each processor is running, it requests the CPU to load its private operating system into its local RAM. Between 1 and 4 MB of RAM are allocated to the operating system of each processor.

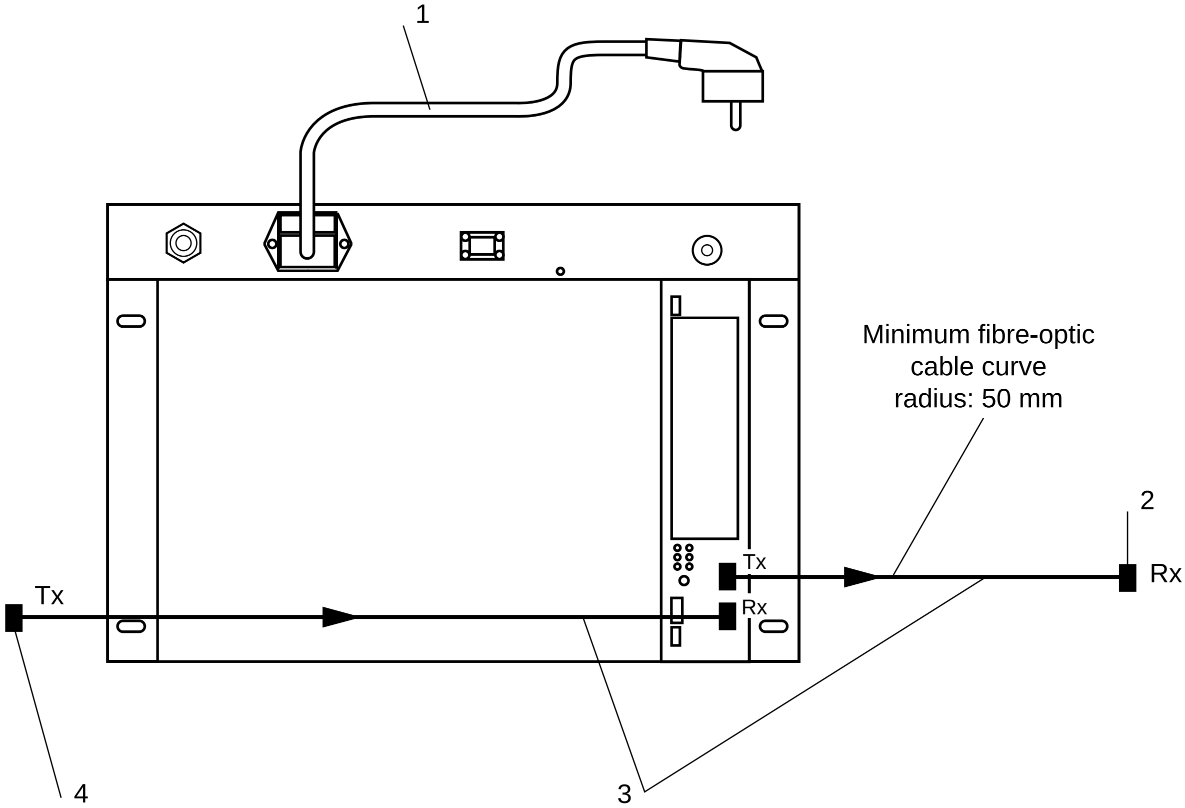
Once all the cards have loaded their operating system, the CPU enables start-up of each processor in turn. Finally, when all the processors are running, the system finishes its boot-up sequence and the CNC is ready to run.

3 Power Supplies

3.1 Rack Power Supply

The rack is powered by 220 VAC, 50/60 Hz. The power consumption depends on the number and types of cards in the rack. Theoretically, it is equal to the sum of the power consumptions of each card. The total consumption is used to calculate the required fuse ratings. For further information on this subject, refer to the Installation and Commissioning Manual 938816.

The power cable is connected to the receptacle located in the upper left-hand corner of the rack. There is a small fuse in the receptacle. If this fuse blows, the optional fans located in the top of the rack are stopped. If the fans are operating, the input voltage is probably normal, but it should nevertheless be checked. Use a small screwdriver to remove the fuse-holder from the receptacle.



1 - Power cable
2 - Receiver of following unit
3 - Fibre-optic cable
4 - Transmitter of previous unit

The power supply is available in two versions: 60 W and 130 W. The table below shows the main differences.

Power supply	60 W	130 W
Power consumption	90 W maximum	175 W maximum
+ 5 V	10 A	25 A
+ 15 V	250 mA	500 mA
- 15 V	250 mA	500 mA
+ 24 V (bus)	N/A	2 A
+ 24 V (external)	N/A	2 A

3.1.1 Voltage Level Indicators

The power supply card (see opposite) includes six LEDs, one for each output (voltage engraved on the LED) plus one PWR FAIL LED.

The voltage level LEDs are normally lit. If one or more LED is unlit, this could indicate a fault in the output or an excessive power draw by one of the other cards.

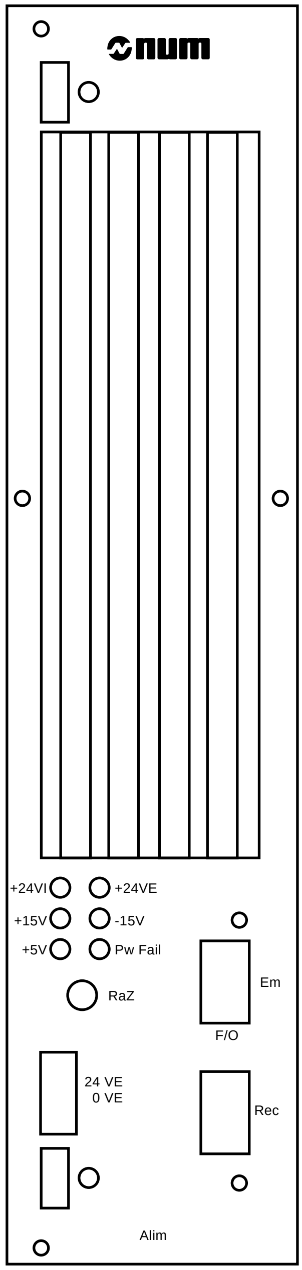
To correctly diagnose a problem, first power down the system. Then remove all the cards from the rack except the power supply card. Power up the system and check the voltage level LEDs. If they are all lit, the fault is probably on another card. However, if one of the LEDs remains unlit, the fault is in the power supply, which must be replaced (see below for the fibre-optic port switch settings).

3.1.2 PWR FAIL LED

This LED is lit in case of a fault in the input voltage. It remains lit until the internal capacitors fall to 0 V.

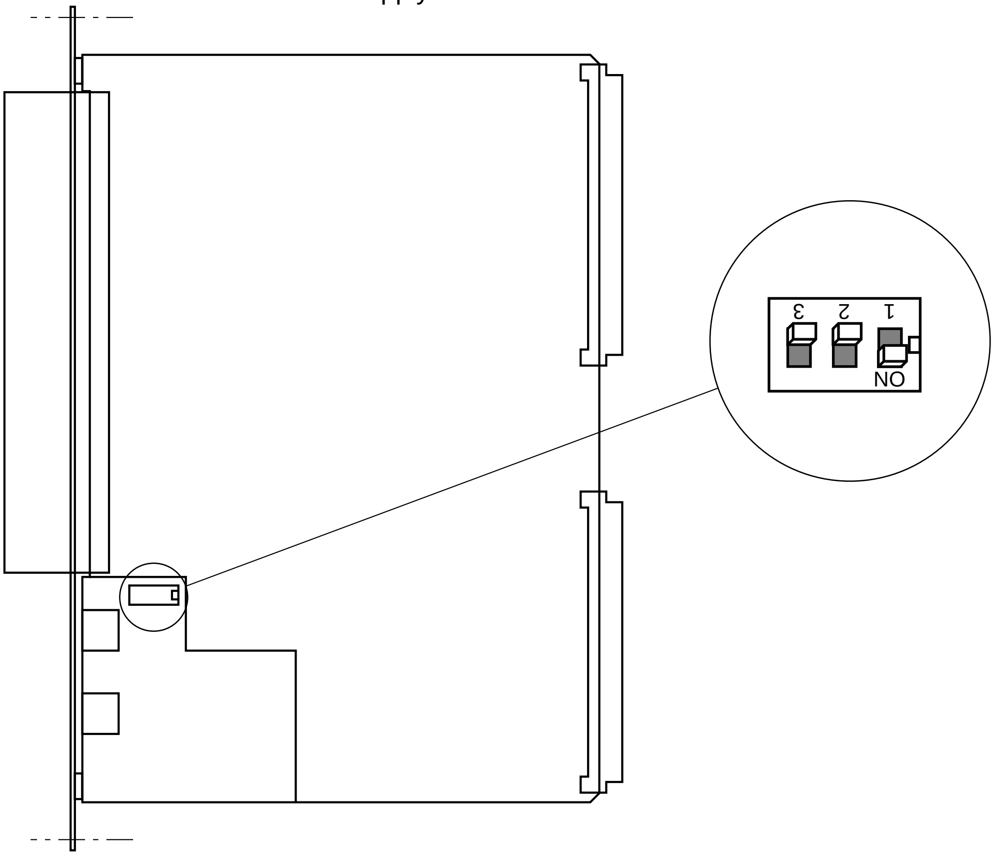
3.1.3 RaZ (Reset) Button

> ⚠ **CAUTION**
>
> Pressing this button causes an emergency stop, leading to complete rebooting of the system. It has the same effect as turning the system off and back on.



3.1.4 Fibre-Optic Ports

Some versions of the power supply include two fibre-optic ports on the front, used to communicate with other racks, remote input/output units or a machine panel. One port is the emitter port and the other is the receiver port.

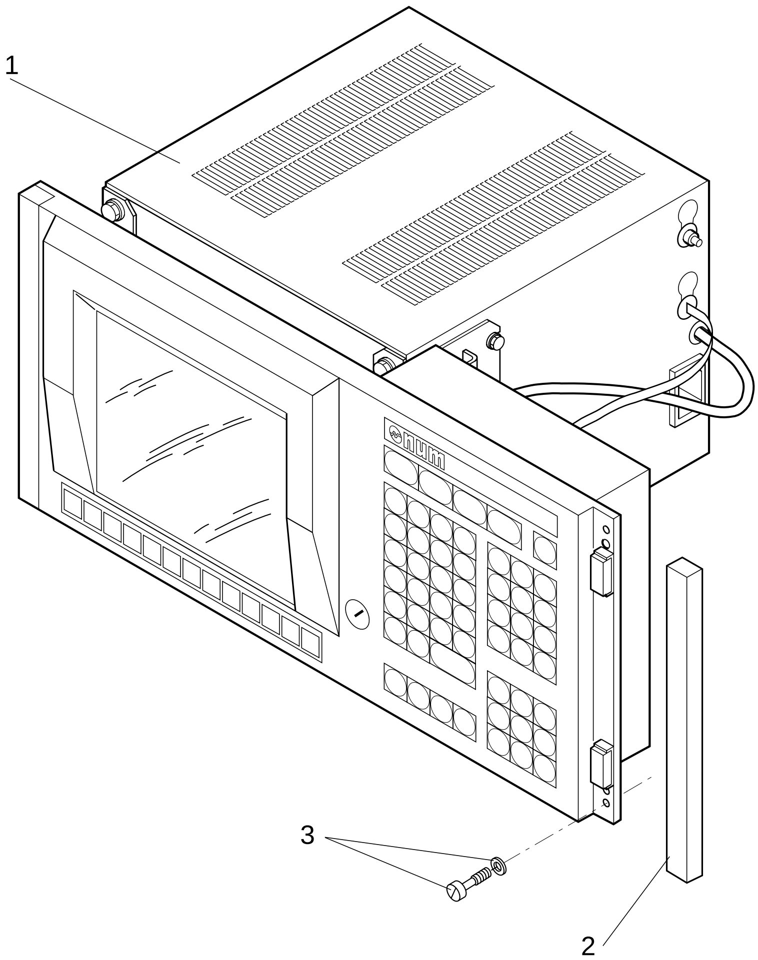


The diagram shows the location of the switches used to set the power on the fibre-optic ports. The settings are shown in the table below. They depend on the length of the fibre-optic cable. The wrong settings could lead to communication errors between the PLC and its inputs/outputs.

Fibre-optic cable length	Switch 3	Switch 2	Switch 1
L ≤ 15 m	ON	ON	OFF
15 m ≤ 30 m	ON	OFF	ON
L > 30 m	OFF	ON	ON

3.2 Panel Power Supply

The panel includes two separate parts, the CRT and the keyboard. The CRT has a built-in power supply connected to the 220 VAC, 50/60 Hz mains by a cable which plugs into the side.



1 - Panel
2 - Trim pane
3 - Panel attaching screw and washer (4)

The CRT includes a few fuses, but they are located inside the CRT housing.

> **⚠ CAUTION**
>
> It is not recommended to open the housing because of the very high voltage levels inside.

No Video – CRT Test

1. Power down the machine.
2. Unplug the video cable from the rear of the CRT.
3. Connect a standard PC VGA monitor to this connector.
4. Power up the system and check for video on the PC monitor.
5. If there is still no video, the CRT is probably not the cause of the trouble which should be investigated elsewhere. If there is now video, replace the CRT.

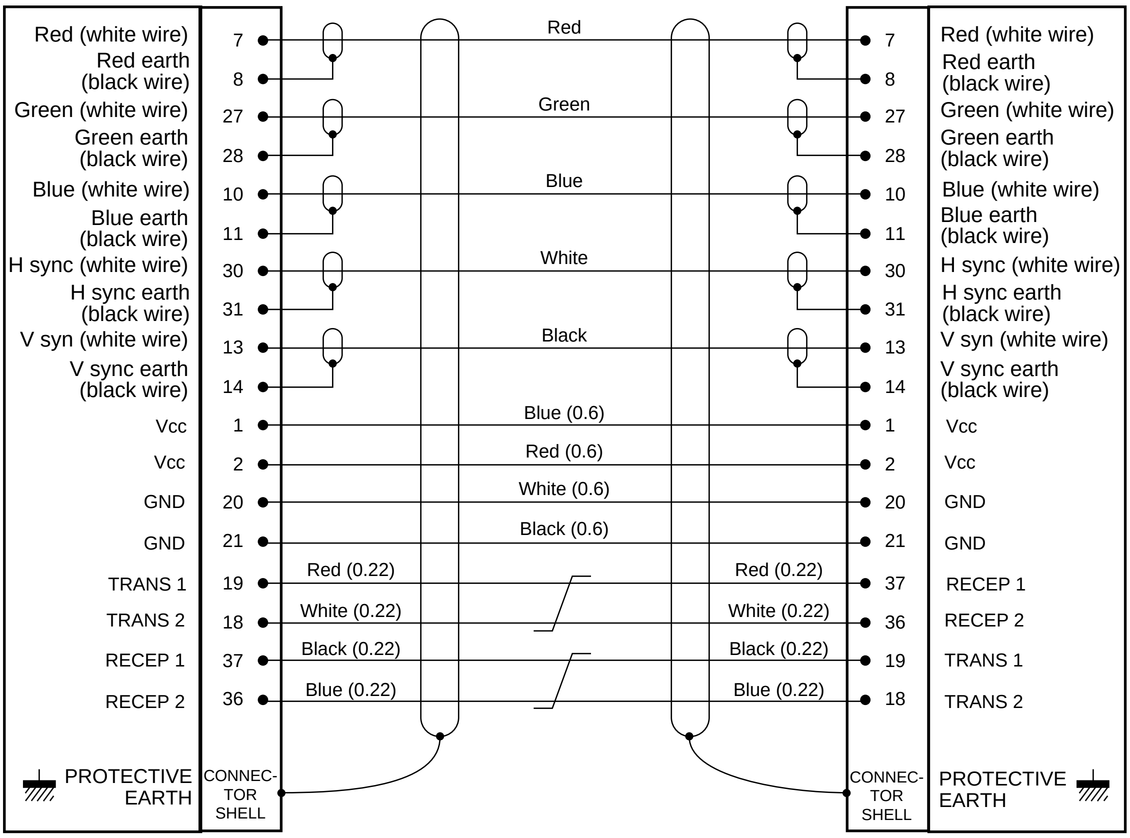
3.3 Keyboard Power Supply

The keyboard power is supplied by the graphic card. The panel is connected to the main rack by a single cable equipped at both ends with a 37-contact Sub.D connector. This cable is used for power supply, video and keyboard signal transfers between the panel and the graphic card.

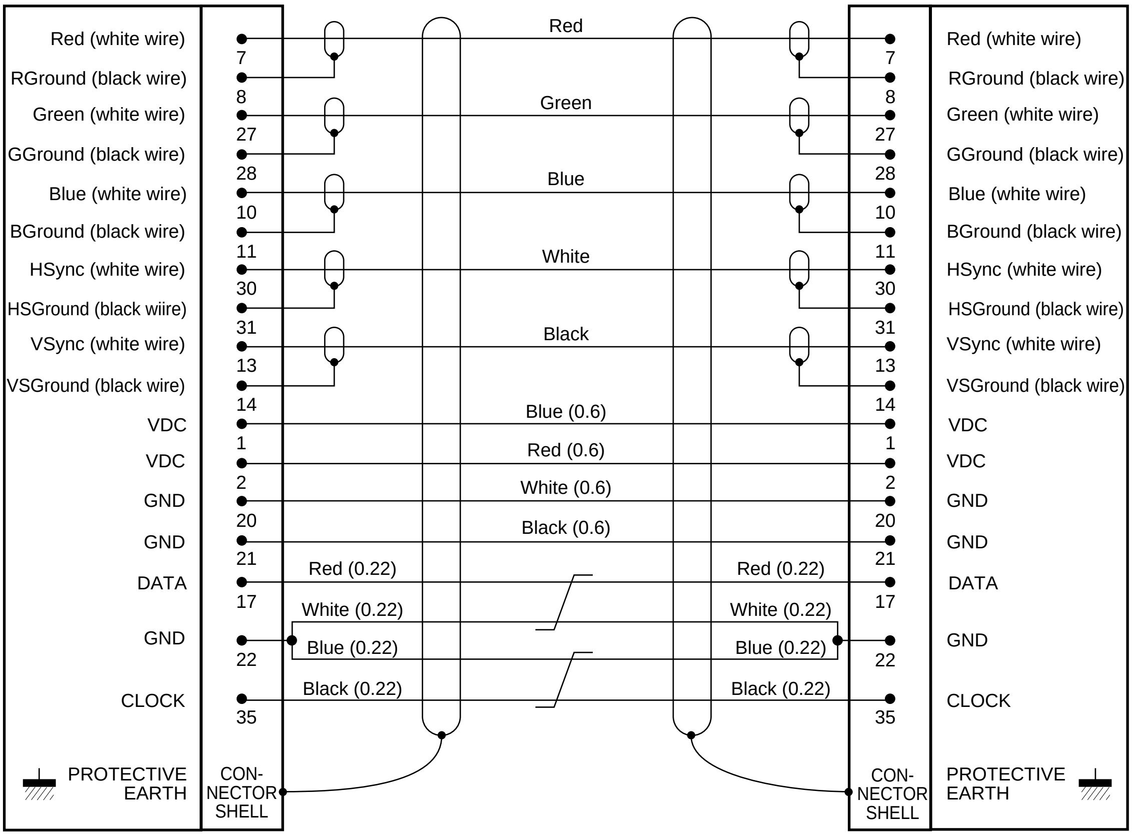
Keyboard Troubleshooting

1. If the keys on the keyboard are not functioning, power down the system.
2. Unplug the video cable from the graphic processor and the rear of the keyboard.
3. Test the continuity of each conductor in the cable, referring to the wiring diagram below and using an ohmmeter. Also make sure there are no connections between any conductor and the connector casings.
4. If a short to the casing or a cut wire is detected, remove the two connectors and correct the problem.
5. If the cable test is OK, replace the keyboard.
6. If both the cable and keyboard are OK, then replace the graphic card, referring to the corresponding section (this replacement is rather complicated).

Cable for standard graphic card (Motorola MC68020)



Cable for PCNC card (Intel 486)

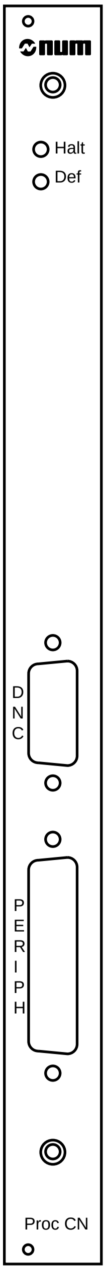


4 Processors

Depending on the type, the system is equipped with one or more processors. Chapter 1 explains how to determine the number of processors in a given system.

This section contains a detailed description of the cards, their functions, connectors, and diagnostic aids. It also explains how to replace the processors if necessary.

4.1 CNC Processor



CNC processors exist only on 1060 Series I CNCs. The main functions of this processor are to compute the machining paths and speeds, manage the part programmes and control the axes. This card can communicate with all axis cards, other processor cards and the memory card via the system bus.

The on-board processor is a Motorola MC68020. There is one BIOS EEPROM used for booting the system. This BIOS chip may have to be kept if the card is replaced. The BIOS chips are generally the same for all the processors in the system, but there are some exceptions. When replacing the card, make sure that the BIOS chip on the new card does not have a lower index than the one on the card replaced.

4.1.1 Version Identification

There are many different versions of the CNC processor cards. The part number changes in case of major modifications, such as the amount of available memory, but not for minor ones to a circuit, which may change only the version letter.

The main differences between cards generally concern the amount of memory. In case of doubt, check with the local NUM distributor that the card version is correct.

New cards are equipped with a small metal tag soldered near the top edge of the card. On this metal tag is a white paper sticker giving the serial number and part number of the card. On older cards, the sticker may be located on the card itself or on the edge connector at the rear of the card. **Ignore the number engraved on the card, which is not a part number!**

The sticker has numbers of the following types:
- 201775/C : Part number/version
- 12345/002 : Serial number/lot

As a general rule, a spare card can be used if it has exactly the same part number as the original card and an equal or higher version letter.

<u>CNC processor card types</u>

204201775	1 MB CNC processor card
204202771	4 MB CNC processor card
204203288	Referee CNC processor card
204203484	V2 CNC processor card

> ⚠ **CAUTION**
>
> Never replace a card by a card with a different part number or a lower version letter without first consulting NUM Technical Support.

4.1.2 LEDs

The front plate of this card includes two red LEDs, marked DEF and HALT. Under normal operating conditions, neither LED is lit, except during start-up, when they may come on briefly.

DEF LED

If the DEF LED is lit steady, the processor card is no longer operating. It may be a hardware or a software failure, but the most frequent cause is a problem with the software or memory. It is then necessary to reboot the system. This LED is sometimes lit during boot-up.

HALT LED

If the HALT LED is lit steady, the processor has stopped generally due to a fault on the card. However, this is not an absolute rule, and in some rare cases, the fault may be due to an outside cause.

Replace the card and reboot the system. If the system hangs on reboot or stops later with the same fault, reinstall the original card, which was not the cause of the failure, and look elsewhere for the cause.

4.1.3 Ports

There are two communication ports available on the front plate.

DNC Port (9 contacts)

This port is a TTL interface which can be assigned to different functions by the OEM by software settings. More details are given in the chapter on communications. A special adapter is available from NUM to configure this port differently, for instance as an RS232 or RS485 port.

Adapter	Part Number
TTL —> RS232	205201338
TTL —> RS485	205201339

PERIPH Port (25 contacts)

This port is an RS232 interface which can be assigned to different functions by the OEM by software settings. More details are given in the chapter on communications.

Pin	Signal
2	TD - Transmitted data
3	RD - Received data
4	RTS - Ready to send
5	CTS - Clear to send
7	GND - Signal earth
8	DCD - Data carrier detection
20	DTR - Data terminal ready
25	+ 12 V
Connector shell	Protective earth

4.1.4 Card Location

The actual slot where a given card is located depends on the system. The location of the cards in a 1060 SI system is illustrated below.

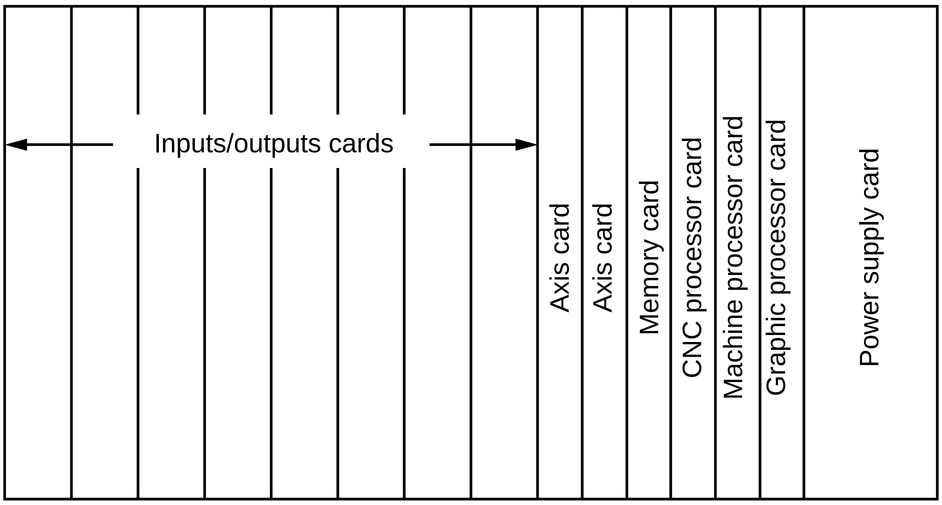


Figure 1: 1060 Series I in a 19" rack

The location of the cards in a 1060 SI PCNC system is illustrated below:

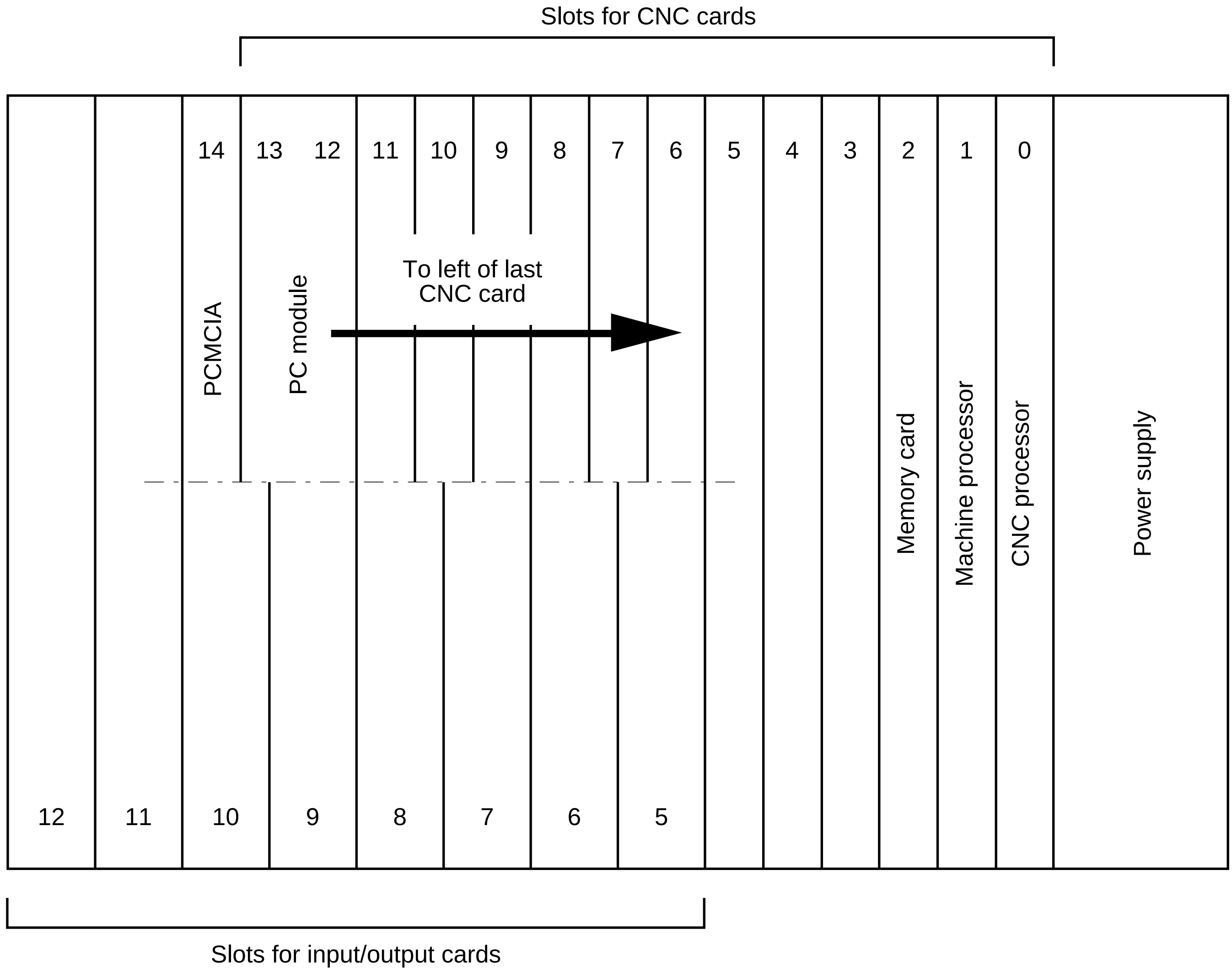


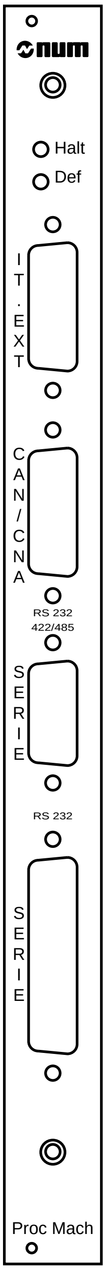
Figure 2: 1060 Series I PCNC in a 19" rack

4.1.5 Replacing the Card

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.
5. Make note of the direction of the notch on the BIOS chip.
6. If necessary, remove the BIOS EPROM from the original card with an IC removing tool.
7. If necessary, insert the original BIOS chip onto the socket on the replacement card, being very careful not to bends the leads on the chip and to insert it in the right direction.
8. Install the card in the rack and moderately tighten the attaching screws.
9. Reinstall all the connections removed above.
10. Power up the machine, then the CNC.

4.2 Machine (PLC) Processor



Machine processors are found on 1060 Series I and Series II systems. The main functions of this processor are to process the PLC programmes and control the discrete inputs and outputs. This card can communicate with all the other processor cards, the power supply (for the serial fibre-optic link) and the memory card via the system bus.

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<u>Machine processor card types</u>

204201935	1 MB machine processor card
204203035	4 MB machine processor card
204203123	4 MB machine processor card

⚠ CAUTION

Never replace a card by a card with a different part number or a lower version letter without first consulting NUM Technical Support.

4.2.2 LEDs

The front plate of this card includes two red LEDs, marked DEF and HALT. Under normal operating conditions, neither LED is lit, except during start-up, when they may come on briefly.

DEF LED

If the DEF LED is lit steady, the processor card is no longer operating. It may be a hardware or a software failure, but the most frequent cause is a problem with the software or memory. It is then necessary to reboot the system.

HALT LED

If the HALT LED is lit steady, the processor has stopped generally due to a fault on the card. However, the fault is not necessarily on the card.

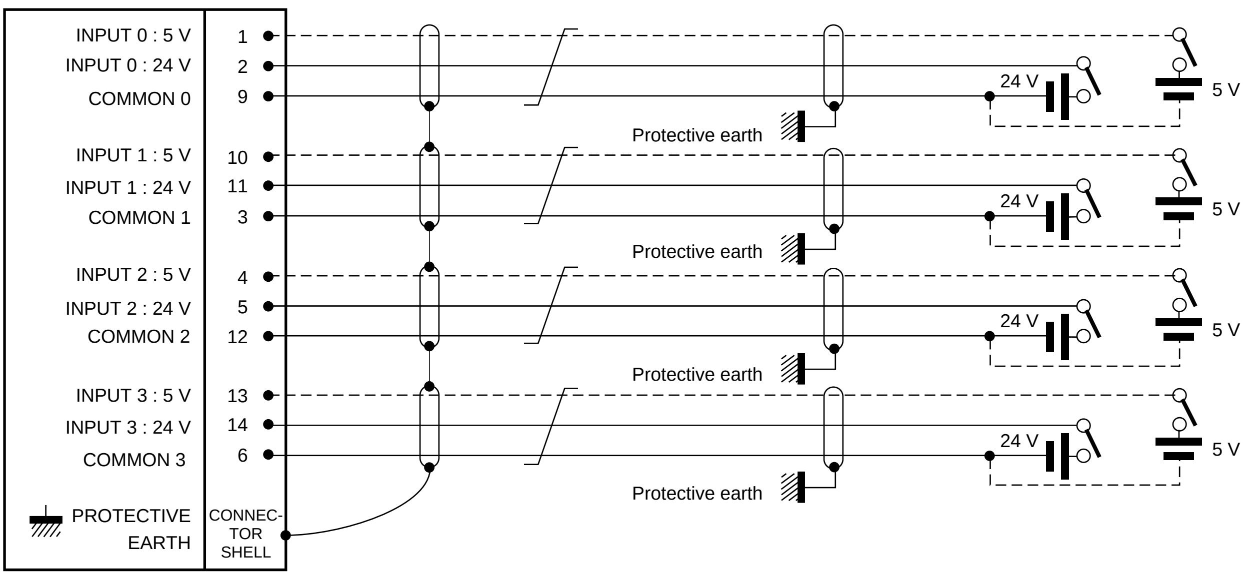
Replace the card and reboot the system. If the system hangs on reboot or stops later with the same fault, reinstall the original card, which was not the cause of the failure, and look elsewhere for the cause.

4.2.3 Ports

There are four ports available on the front plate, two dedicated to I/O and two to communications.

IT/EXT Port

This port has 15 contacts. It allows connection of discrete I/O devices such as sensors requiring the use of fast interrupts. The port has four fast interrupts which can be connected. It can be configured for 5 VDC or 24 VDC logic levels by wiring of the contacts.



CAN/CNA (ADC/DAC) Port

This port has 15 contacts. It allows connection of analogue I/O devices and a timer I/O (only on versions 204201935 and 204203035). For example, in configurations which do not include the NUM machine panel in a fibre-optic ring, the feed rate and spindle speed override potentiometers are wired to this connector as analogue signals.

I/O	Number and type	Voltage level
Analogue inputs	Four non-differential 8-bit inputs	0-10 V
Analogue outputs	Two 12-bit outputs	+10 V
External reference output	One	+10 V @ 100 mA
Timer	One input, one output	

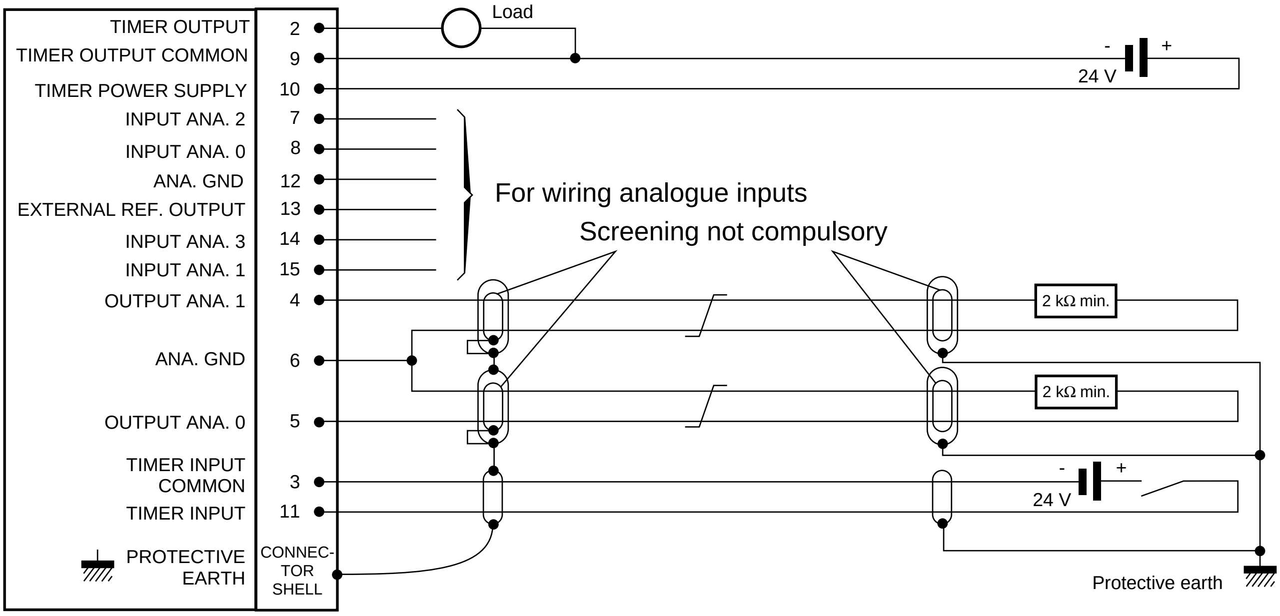


Figure 3: Processor 204203035 with timer input/output

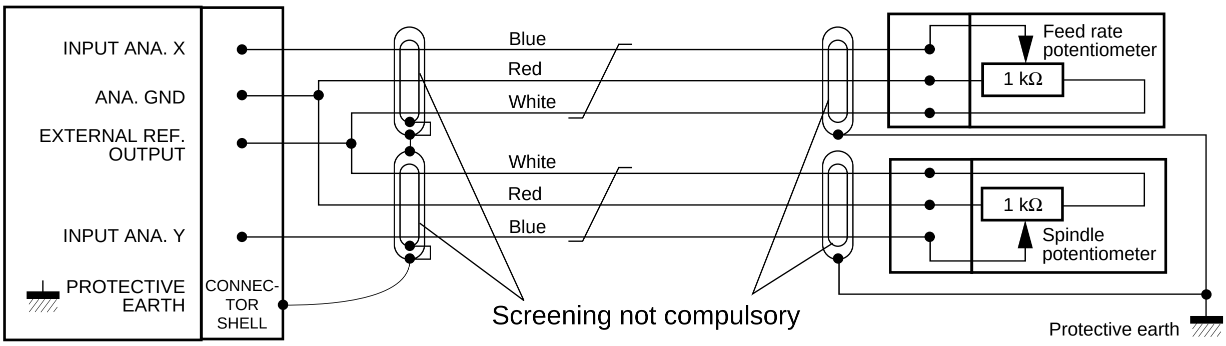


Figure 4: Typical analogue input wiring for feed rate and spindle speed override potentiometers

There are at least two different pin configurations for this port. The pinouts are shown in the tables below.

PROCESSOR 204203035	
Signal	Pin
Timer output	2
Timer output common	9
Timer power supply	10
Analogue input 2	7
Analogue input 0	8
Analogue earth	12
External reference output	13
Analogue input 3	14
Analogue input 1	15
Analogue earth	6
Analogue output 1	5
Time input common	3
Timer input	11
Not connected	1

PROCESSOR 204203123	
Signal	Pin
Not connected	2
Not connected	9
Not connected	10
Analogue input 2	7
Analogue input 0	8
Analogue earth	12
External reference output	13
Analogue input 3	14
Analogue input 1	15
Analogue earth	6
Analogue input 1	5
Not connected	3
Not connected	11
Not connected	1

SERIE Port (9 contacts)

There are two versions of this port, determined by the card part number. Older models provided only a TTL interface, whilst newer ones also support RS232 E, RS422 A and RS485 interfaces. The choice is made by wiring of the connector.

PROCESSOR 204203035	
Signal	Pin
TD TTL	2
RD TTL	4
RTS TTL	3
CTS TTL	6
DTR TTL	8
DCD TTL	7
DSR TTL	9
0 V	5
5 V	1

PROCESSOR 204203123	
Signal	Pin
TD	2
RD	3
RTS	7
CTS	8
0 V	5
T (A)+	9
T(B)-	4
R(A)+	6
R(B)-	1

There are two adapters available for the TTL compatible port, listed in the table below.

Adapter	Part Number
TTL —> RS232	205201338
TTL —> RS485	205201339

RS232 Port (25 contacts)

This port is an RS232 interface which can be assigned to different functions by the OEM by software settings. More details are given in the chapter on communications.

Pin	Signal
2	TD - Transmitted data
3	RD - Received data
4	RTS - Ready to send
5	CTS - Clear to send
7	GND - Signal earth
8	DCD - Data carrier detection
20	DTR - Data terminal ready
25	+ 12 V
Connector shell	Protective earth

4.2.4 Card Location

The actual slot where a given card is located depends on the system. The location of the cards in a 1060 SI system is illustrated below.

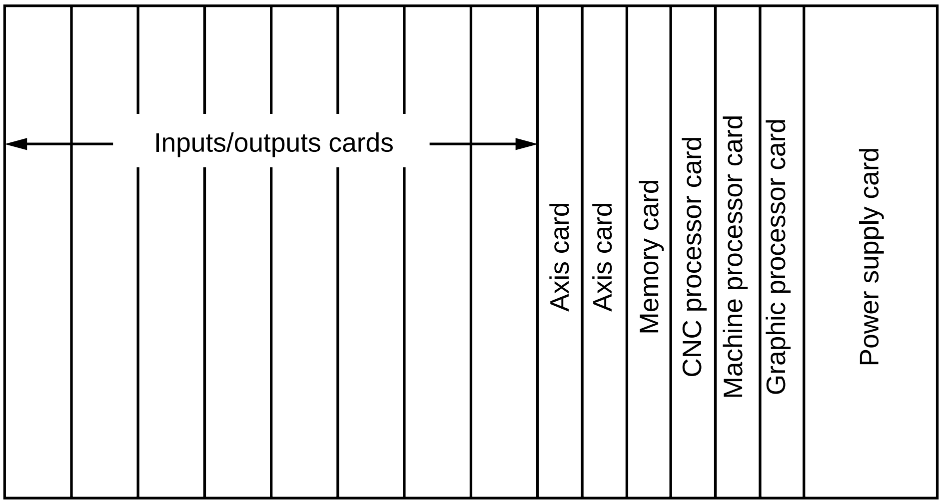


Figure 5: 1060 Series I in a 19" rack

The location of the cards in a 1060 SII system is illustrated below.

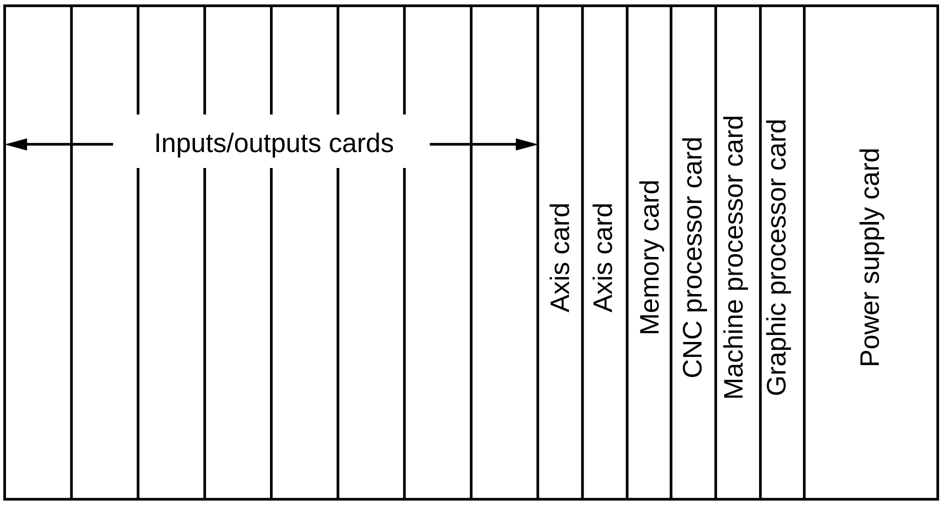


Figure 6: 1060 Series II in a 19" rack

The location of the cards in a 1060 SI PCNC system is illustrated below:

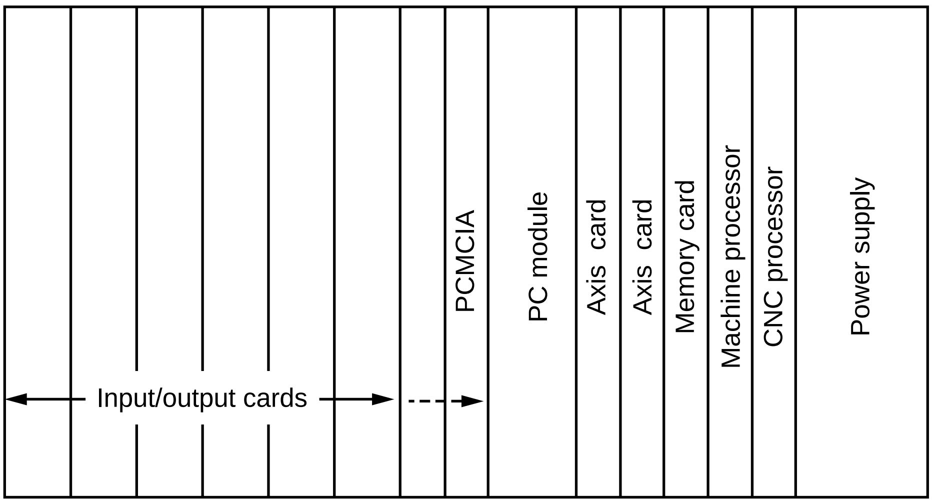


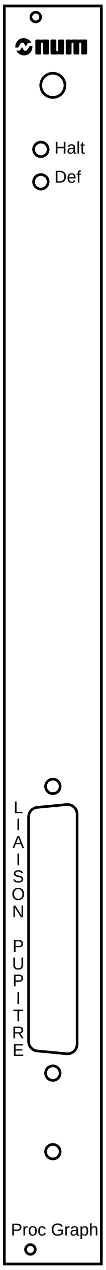
Figure 7: 1060 Series I PCNC in a 19" rack

4.2.5 Replacing the Card

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.
5. Make note of the direction of the notch on the BIOS chip.
6. If necessary, remove the BIOS EPROM from the original card with an IC removing tool.
7. If necessary, insert the original BIOS chip onto the socket on the replacement card, being very careful not to bends the leads on the chip and to insert it in the right direction.
8. Install the card in the rack and moderately tighten the attaching screws.
9. Reinstall all the connections removed above.
10. Power up the machine, then the CNC.

4.3 Graphic Processor



Graphic processors are found on 1060 Series I and Series II systems. The main functions depend on the system where it is installed. In a Series II CNC, it computes the machining paths and speeds, manages the part programmes and controls the axes. It also controls the keyboard and display, which is all it does in a 1060 Series I system. It can communicate with all the axis cards, the other processor cards and the memory card via the system bus.

The on-board processor is a Motorola MC68020. There is one BIOS EEPROM used for booting the system. This BIOS chip may have to be kept if the card is replaced. The BIOS chips are generally the same for all the processors in the system, but there are some exceptions. When replacing the card, make sure that the BIOS chip on the new card does not have a lower index than the one on the card replaced.

4.3.1 Version Identification

There are many different versions of graphic processor cards. The part number changes in case of major modifications, such as the amount of available memory, but not for minor ones to a circuit, which may change only the version letter.

The main differences between cards generally concern the amount of memory. In case of doubt, check with the local NUM distributor that the card version is correct.

New cards are equipped with a small metal tag soldered near the top edge of the card. On this metal tag is a white paper sticker giving the serial number and part number of the card. On older cards, the sticker may be located on the card itself or on the edge connector at the rear of the card. **Ignore the number engraved on the card, which is not a part number!**

The sticker has numbers of the following types:
- 203778/C : Part number/version
- 12345/002 : Serial number/lot

As a general rule, a spare card can be used if it has exactly the same part number as the original card and an equal or higher version letter.

Graphic processor card types

204202374	1 MB V2 graphic processor card
204202778	4 MB V2 graphic processor card
204203485	4 MB V3 graphic processor card

⚠ CAUTION

Never replace a card by a card with a different part number or a lower version letter without first consulting NUM Technical Support.

4.3.2 LEDs

The front plate of this card includes two red LEDs, marked DEF and HALT. Under normal operating conditions, neither LED is lit, except during start-up, when they may come on briefly.

DEF LED

If the DEF LED is lit steady, the processor card is no longer operating. It may be a hardware or a software failure, but the most frequent cause is a problem with the software or memory. It is then necessary to reboot the system.

Note: On the V3 graphic processor card (204203485), the Halt LED may flash at a very high rate and appear to be lit dimly. **This does not indicate a fault**, but corresponds to normal microprocessor operating modes.

HALT LED

If the HALT LED is lit steady, the processor has stopped generally due to a fault on the card. However, the fault is not necessarily on the card.

Replace the card and reboot the system. Do not forget to recover the BIOS EPROM from the original card. If the system hangs on reboot or stops later with the same fault, reinstall the original card, which was not the cause of the failure, and look elsewhere for the cause.

4.3.3 Daughterboards

Card 204203485 has two daughterboards which must not be moved. They are
- One 4 MB DRAM memory module
- One display control card (204202888).

These cards are almost always installed. If it should prove necessary to recover one of these cards on the card to be replaced, take all due precautions against electrostatic discharge and be careful to install the daughterboards gently on the new motherboard without forcing.

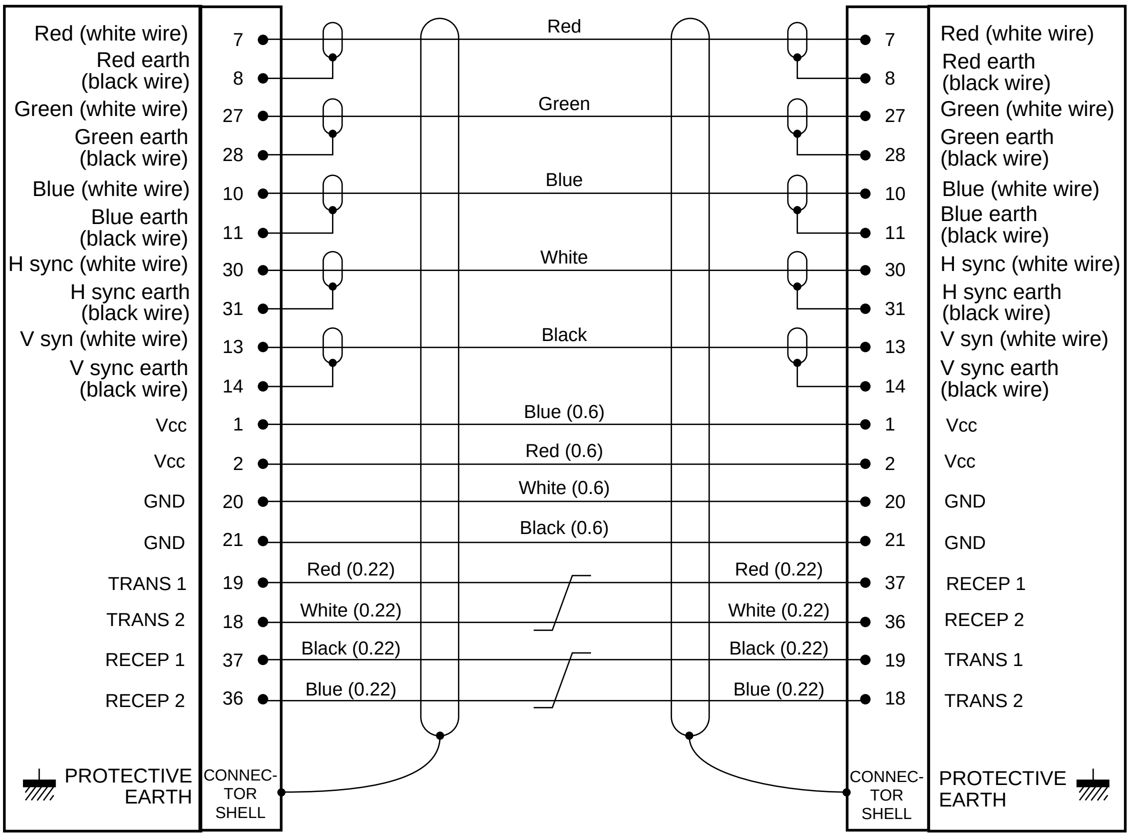
4

4.3.4 Ports

There is one port available on the front plate of this card.

LIAISON PUPITRE Port (37 contacts)

This is the connector to the panel. All the video signals to the CRT are sent out through this port and all the keyboard signals are input through it. This port is the only link between the panel and main rack.



4.3.5 Card Location

When this card is present, it is always located in slot 0.

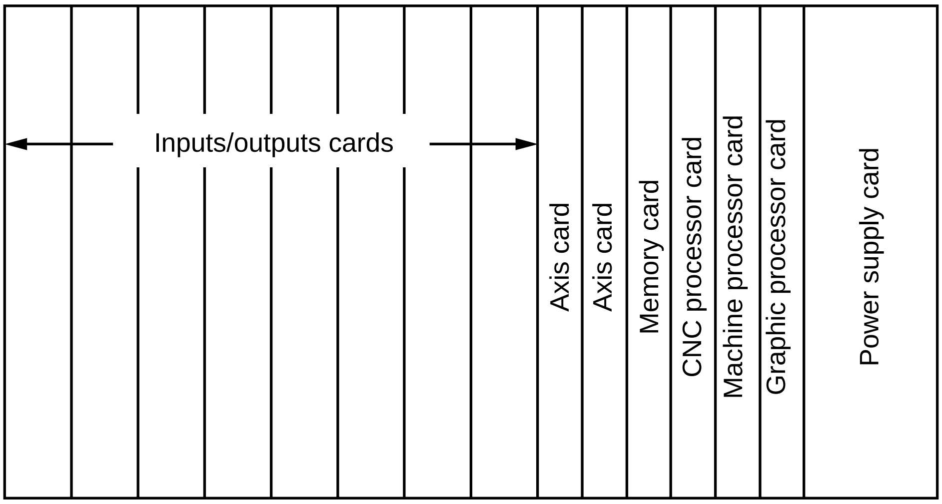


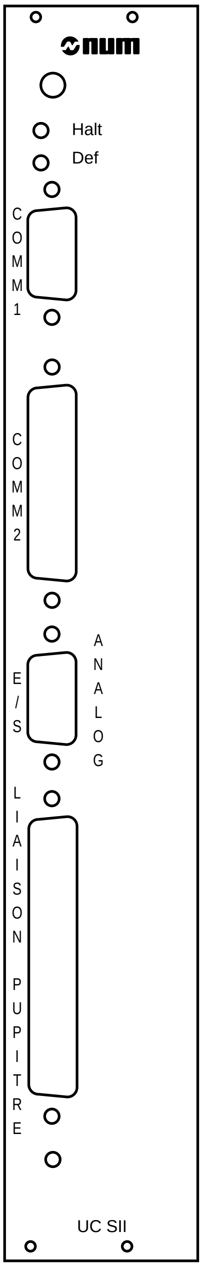
Figure 8: 1060 Series I in a 19" rack

4.3.6 Replacing the Card

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.
5. Make note of the direction of the notch on the BIOS chip.
6. If necessary, remove the BIOS EPROM from the original card with an IC removing tool.
7. If necessary, insert the original BIOS chip onto the socket on the replacement card, being very careful not to bends the leads on the chip and to insert it in the right direction.
8. Install the card in the rack and moderately tighten the attaching screws.
9. Reinstall all the connections removed above.
10. Power up the machine, then the CNC.

4.4 UCSII Monoprocessor



In the monoprocessor version of the 1060 CNC, the processor card is always located immediately to the left of the power supply. This Motorola MC68020 monoprocessor performs the CNC, PLC and graphic functions. When this processor is present, the system does not have a memory card. The executive firmware then resides on a daughterboard which plugs into this card. The memory includes several SRAM modules mounted in SIMM style instead of soldered RAM chips. The graphic function is performed by a daughterboard. This module also includes a battery to back up the memory in case of a power failure.

4.4.1 Version Identification

There are many different versions of UCSII processor cards. The part number changes in case of major modifications, such as the amount of available memory, but not for minor ones to a circuit, which may change only the version letter.

The main differences between cards generally concern the amount of memory. In case of doubt, check with the local NUM distributor that the card version is correct.

New cards are equipped with a small metal tag soldered near the top edge of the card. On this metal tag is a white paper sticker giving the serial number and part number of the card. On older cards, the sticker may be located on the card itself or on the edge connector at the rear of the card. **Ignore the number engraved on the card, which is not a part number!**

The sticker has numbers of the following types:
- 202886/C : Part number/version
- 12345/002 : Serial number/lot

UCSII processor card types (complete modules)
- 206202886 (128K/4MB module)
- 206203542 (512K/4MB module)

Daughterboards which can be installed
- 204203329 EPROM daughterboard
- 204202888 GSP daughterboard (graphic control)
- 204202897 1MB DRAM memory card
- 204202892 4 MB DRAM memory card
- 204202898 128 KB SRAM memory card
- 204202894 512 KB SRAM memory card
- 204203390 2 MB SRAM memory card.

As a general rule, a spare card can be used if it has exactly the same part number as the original card and an equal or higher version letter.

⚠ CAUTION

Never replace a card by a card with a different part number or a lower version letter without first consulting NUM Technical Support.

4.4.2 LEDs

The front plate of this card includes two red LEDs, marked DEF and HALT. Under normal operating conditions, neither LED is lit, except during start-up, when they may come on briefly.

DEF LED

If the DEF LED is lit steady, the processor card is no longer operating. It may be a hardware or a software failure, but the most frequent cause is a problem with the software or memory. It is then necessary to reboot the system.

HALT LED

If the HALT LED is lit steady, the processor has stopped generally due to a fault on the card. However, the fault is not necessarily on the card.

Replace the card and reboot the system. If the system hangs on reboot or stops later with the same fault, reinstall the original card, which was not the cause of the failure, and look elsewhere for the cause.

4.4.3 Ports

There are two communication ports, one analogue I/O port and one panel interface port, on the front plate of the card.

COMM1 Port (9 contacts)

This port is an RS232 interface which can be assigned to different functions by the OEM by software settings. More details are given in the chapter on communications.

Pin	Signal
1	DCD - Data carrier detection
2	RD - Received data
3	TD - Transmitted data
4	DTR - Data terminal ready
5	GND - Signal earth
6	DSR - Data set ready
7	RTS - Ready to send
8	CTS - Clear to send
9	Not connected
Connector shell	Protective earth

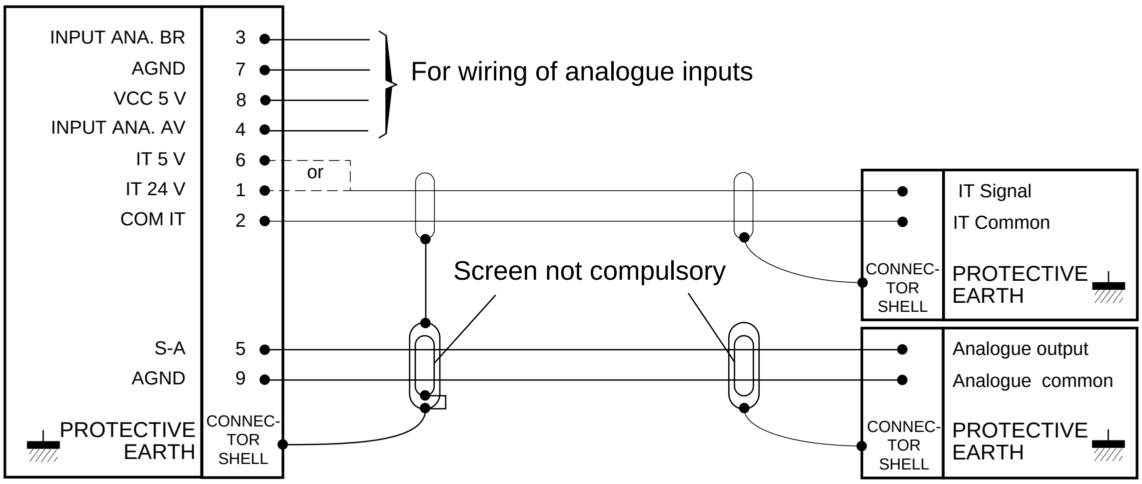
COMM2 Port (25 contacts)

This port is an RS232 interface which can be assigned to different functions by the OEM by software settings. More details are given in the chapter on communications.

Pin	Signal
2	TD - Transmitted data
3	RD - Received data
4	RTS - Ready to send
5	CTS - Clear to send
6	DSR - Data set ready
7	GND - Signal earth
8	DCD - Data carrier detection
20	DTR - Data terminal ready
Connector shell	Protective earth

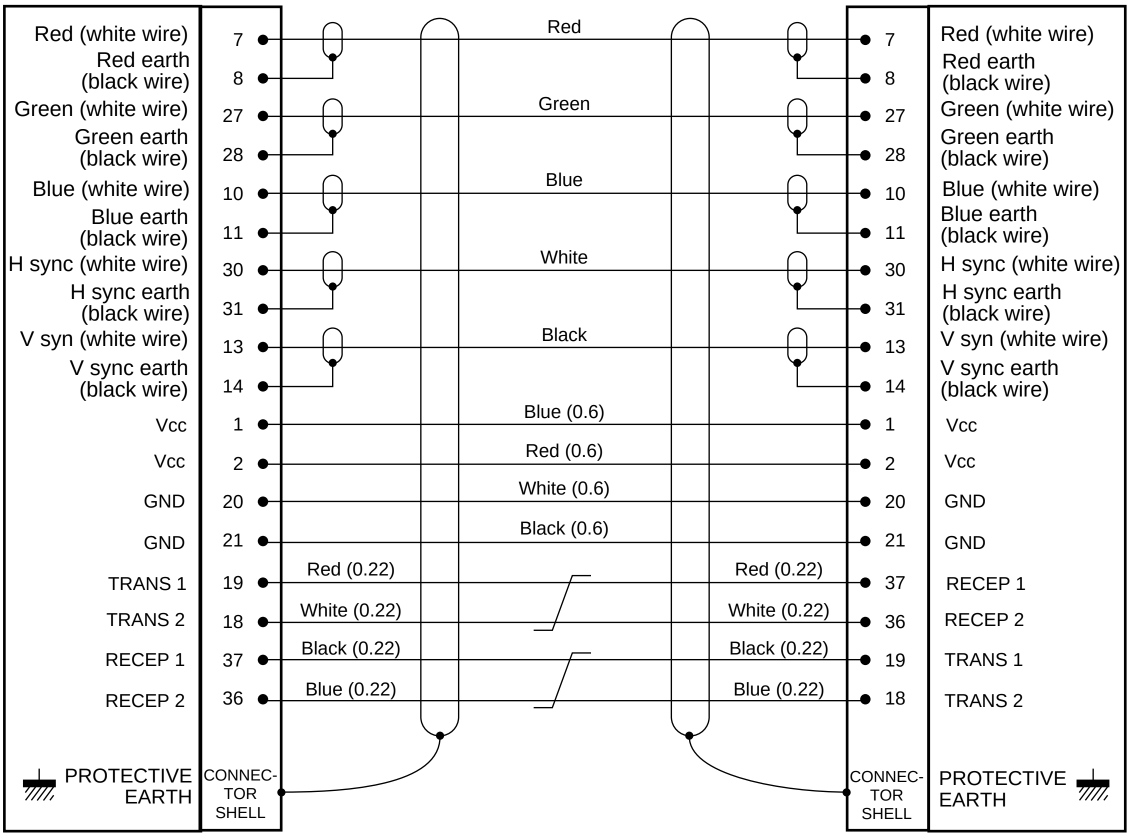
E/S ANALOG (Analogue I/O) Port

This port has two analogue inputs, one analogue output and one fast interrupt input. The wiring diagram is given below.



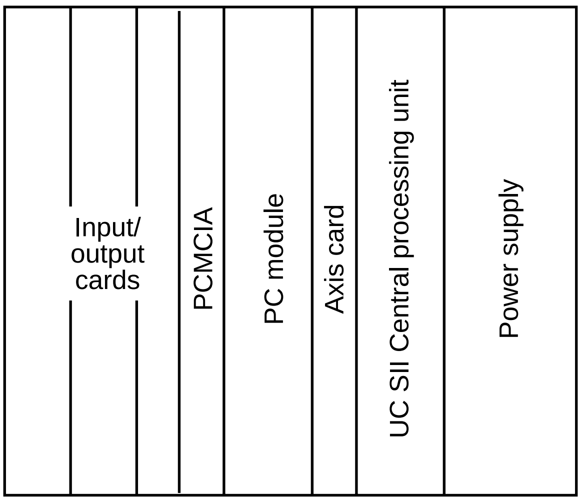
LIAISON PUPITRE Port (37 contacts)

This is the connector to the panel. The wiring diagram is given below.



4.4.4 Card Location

This cart is located immediately to the left of the power supply as shown in the diagram below.



4.4.5 Replacing the Card

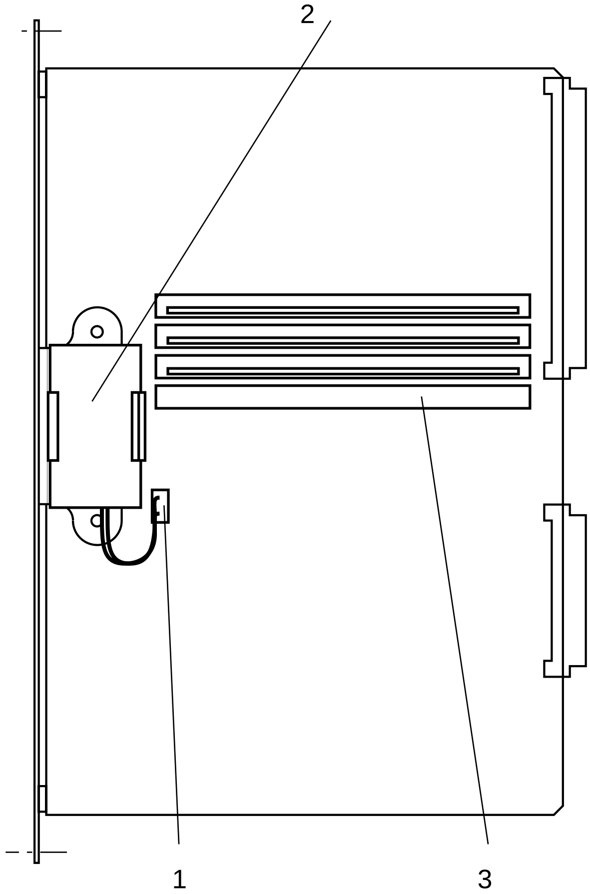
> **⚠ CAUTION**
>
> All the data stored in the RAM will be lost if the batteries are removed from the card. Make sure all the data have been backed up before attempting this procedure.

Before beginning, make sure a replacement card is available and make sure ALL the data have been backed up.

1. Back up all the software, referring to the relevant section.
2. Power down the CNC system and the machine.
3. Remove all the connections from the card.
4. Loosen the two card attaching screws, one at the top and one at the bottom.
5. Gently pull out the card to unplug it from the rack.
6. If the replacement card is not equipped with the EPROM daughterboard or the graphic daughterboard, recover them from the card replaced and install them on the new card, being very careful to correctly position the connectors. The memory cards are normally provided except for the SRAM2 card which is optional. Check that all the cards are present and are of the same type, especially the SRAMSys card, which can be of two different types, depending on the application (128KB or 512KB). If replacing a memory card, proceed with care and avoid electrostatic discharges.

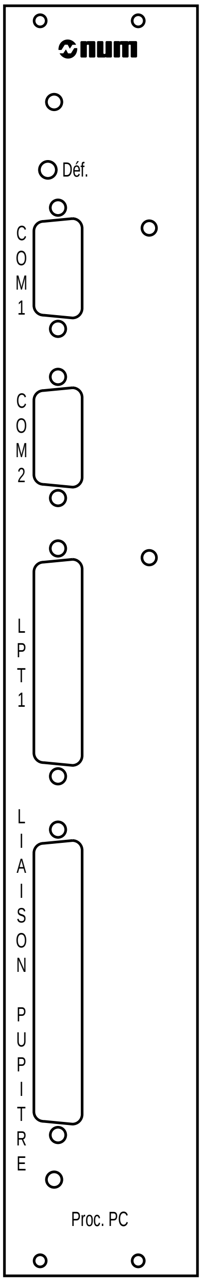
> **⚠ CAUTION**
>
> A memory module may be the cause of the card failure, so be very cautious about reusing them.

7. Make sure the battery cable is connected to the new card. This cable is normally not connected on replacement cards to avoid discharging the battery.
8. Install the card in the rack and moderately tighten the attaching screws.
9. Reinstall all the connections removed above.
10. Power up the machine, then the CNC.
11. Reload the software backed up in step 1.



1 - Battery connector
2 - Battery
3 - SRAM memory module location

4.5 PCNC Processor



The PCNC processor is available as an option for 1060 Series I and Series II UCSII systems. Its main function is to control the keyboard and display. It provides a very flexible man/machine interface (MMI) for the OEM. This card can communicate with all the other processor cards and the memory card via the system bus.

The on-board processor is either an Intel 486 SX or DX microprocessor. It is actually a self-contained personal computer on a card with all the functionalities of a desktop PC, including an IDE hard disk drive, 8 or 16 MB or RAM, an IDE diskette drive, two RS232 serial ports and one parallel port. The OS/2 operating system is installed on the hard disk.

4.5.1 Version Identification

Several different versions of the PC processor card are available from NUM. The part number changes in case of major modifications, such as the amount of available memory, but not for minor ones to a circuit, which may change only the version letter.

The main differences between cards generally concern the amount of memory, the type of processor (DX33, DX66, etc.), the capacity of the hard disk, the presence or absence of the Sub.D connector for the diskette drive and the PCMCIA option. In case of doubt, check with the local NUM distributor that the card version is correct.

PC cards are equipped with a small metal tag soldered near the top edge of the card. On this metal tag is a white paper sticker giving the serial number and part number of the card. On older cards, the sticker may be located on the card itself or on the edge connector at the rear of the card. **Ignore the number engraved on the card, which is not a part number!**

The sticker has numbers of the following types:
- 203115/C : Part number/version
- 12345/002 : Serial number/lot

Be very careful when noting down the references of this card. Each card has a number of references, one giving the size of the hard disk, another the RAM size, a number for the card itself, and another identifying the version as SX or DX.

As a general rule, a spare card can be used if it has exactly the same part number as the original card and an equal or higher version letter.

⚠ CAUTION

Never replace a card by a card with a different part number or a lower version letter without first consulting NUM Technical Support.

4.5.2 LEDs

The front plate of this card includes two red LEDs, marked DEF and HD. Under normal operating conditions, the DEF LED is never lit.

DEF LED

If the DEF LED is lit steady, the processor card is no longer operating. It may be a hardware or a software failure, but the most frequent cause is a problem with the software or memory. It is then necessary to reboot the system.

HD LED

The HD LED indicates hard drive activity. It lights when the hard drive is accessed for read or write of data. It only exists on newer versions of PC cards which use the Sub.D connector for connection of the diskette drive.

4.5.3 Ports

There are four ports available on the front plate of this card, including two RS232 ports, one parallel printer port and one panel interface port.

COM1/COM2 Ports (9 contacts)

These are industry-standard RS232 ports like those on every personal computer.

Pin	Signal
1	DCD - Data carrier detection
2	RD - Received data
3	TD - Transmitted data
4	DTR - Data terminal ready
5	GND - Signal earth
6	DSR - Data set ready
7	RTS - Ready to send
8	CTS - Clear to send
9	RI - Ring indicator

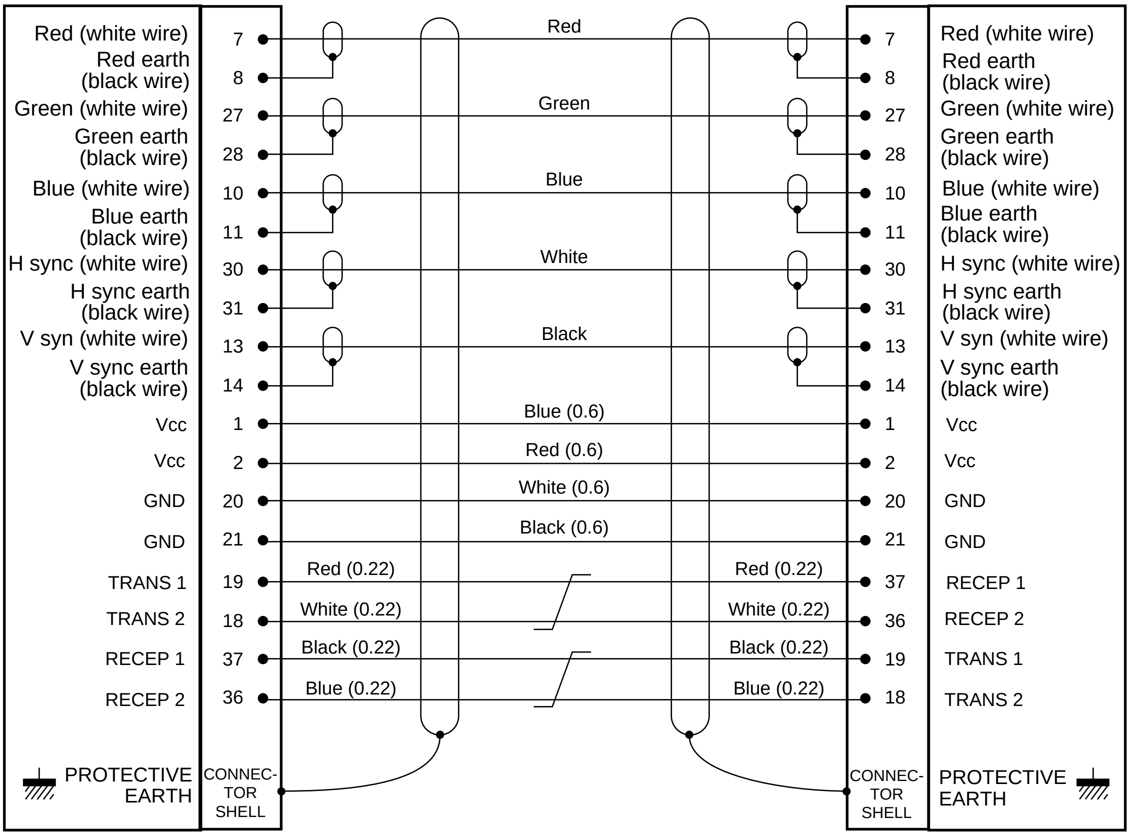
Parallel Printer Port (25 contacts)

This is an industry-standard parallel port like that on every personal computer. The "*" means active low signal.

Pin	Signal
1	Strobe*
2	Data bit 0
3	Data bit 1
4	Data bit 2
5	Data bit 3
6	Data bit 4
7	Data bit 5
8	Data bit 6
9	Data bit 7
10	Ack*
11	Busy
12	Paper out
13	Select
14	Auto line feed*
15	Error
16	Initialise printer*
17	Select in*
18	Earth
19	Earth
20	Earth
21	Earth
22	Earth
23	Earth
24	Earth
25	Earth

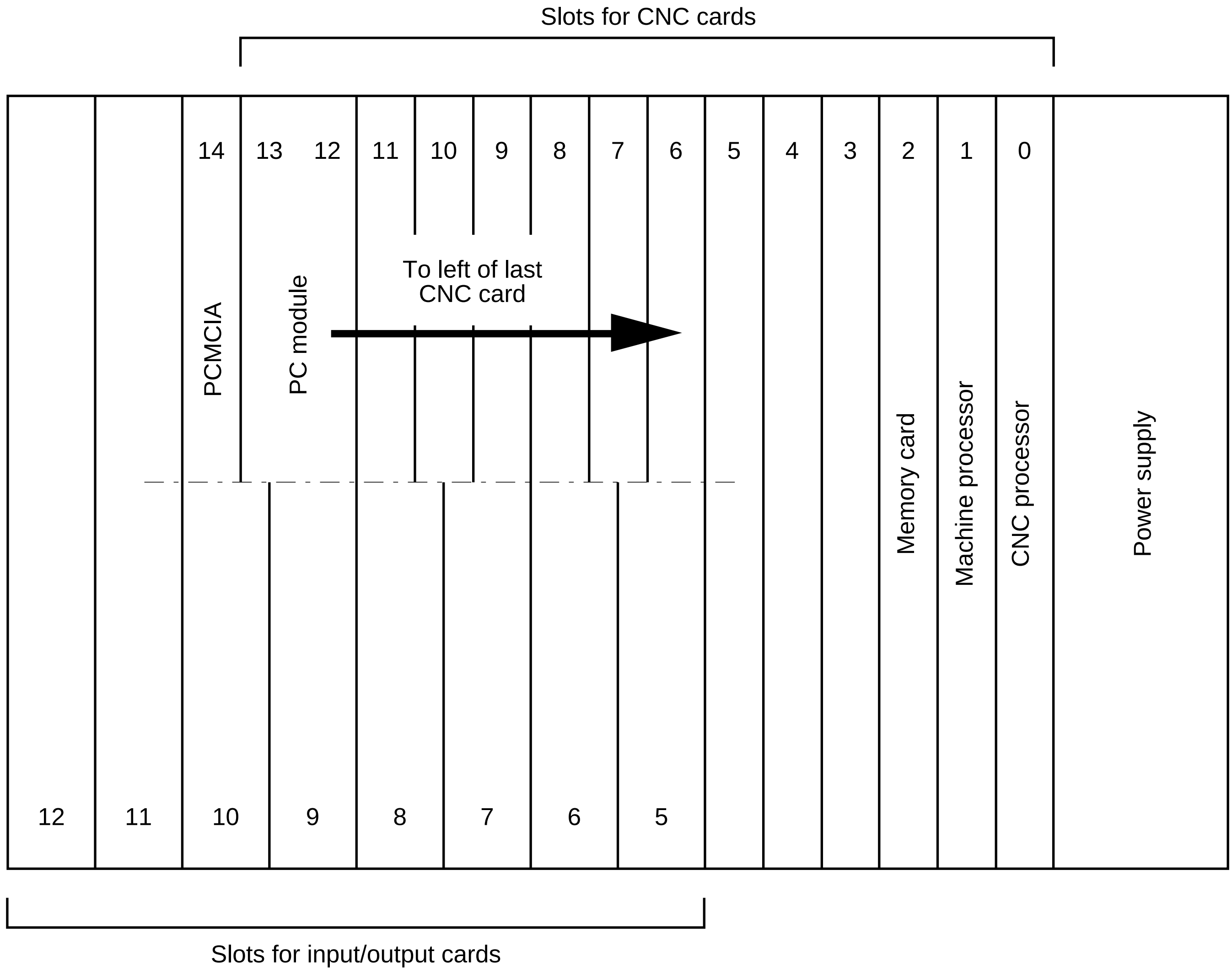
LIAISON PUPITRE Port (37 contacts)

This is the connector to the panel. All the video signals to the CRT are sent out through this port and all the keyboard signals are input through it. This port is the only link between the panel and main rack.



4.5.4 Card Location

When this card is present, it is always located immediately to the left of the memory cards and other processor cards in the main rack. The slot number therefore depends on the system configuration. There must be no free slots to the right of this card.



4.5.5 Pre-replacement Diagnostics

It is not easy to determine whether a failure is due to the hard drive or the card. In order for the CNC part to be able to boot up, the PC must already be booted up under OS/2. If the PC does not boot, the CNC cannot boot. Some of the most common problems encountered with the PC system are outlined below.

Symptom	Possible cause	Corrective action
PC starts to boot but hangs up during the process	Hard drive failure	Replace the hard drive
	Hard drive interface cable loose or cut	Check the ribbon cable connection from the board to the hard drive
	OS/2 swap file too large	Find and delete the swap file on the hard drive
	Hard drive corrupted	Reformat and restore the drive using the backup diskettes
PC refuse to boot	Hard drive failure	Replace the hard drive
	Hard drive interface cable loose or cut	Check the ribbon cable connection from the board to the hard drive
	Drive interface failure	Replace the PC card
PC boots completely but hangs when CNC starts to boot	Incorrect executive version in the CNC or incorrect gr_pc.exe file on the hard drive	Replace the executive or the gr_pc.exe file
PC responds slowly to keyboard input	Too many applications open	Close some application windows
PC locks up randomly after boot is complete	Application related errors when transferring data on the bus	Reboot the system and correct the application programmes

On machines equipped with a diskette drive, the PC alone can be booted from the O/2 utility disks or a DOS bootable diskette. Insert the first diskette in the drive and turn on the system. Follow the prompts until reboot is complete.

REMARK *If there are no backup diskettes, contact the machine builder or make a set from a similar machine, referring to the chapter on backups.*

When the machine has been booted from diskette, there are several ways of accessing the hard drive, which are outside the scope of this manual. Ask a knowledgeable technician who knows PCs to help with the diagnosis.

4.5.6 Replacing the Card Alone

Before beginning, make sure a replacement card is available and make sure all the software has been backed up. Refer to Chapter 13.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.

> ⚠ **CAUTION**
>
> There may be other cables connected to the card from inside the rack, so remove the card very carefully, without pulling hard.

5. If there are other cables inside the rack connected to the card, it is probably the diskette drive connection. Take careful note of the orientation of the connector on the card before removing it.
6. Place the card on a static control surface and disconnect the hard drive's ribbon cable from the card, not the drive.
7. Remove the hard drive from the card by removing the screws which hold the rubber mounts on the card. Do not disconnect the rubber mounts from the card unless access to the card screws is impossible.
8. Mount the original hard drive on the new PC card by proceeding strictly in reverse order.
9. Connect the hard drive ribbon cable to the card, making sure that the cable connector is firmly pushed onto the pins (this is a common source of trouble).
10. Reconnect the diskette drive cable coming from inside the rack if so equipped.
11. Install the card in the rack and moderately tighten the attaching screws.
12. Reinstall all the connections removed above.
13. Power up the machine, then the CNC.
14. It may be necessary to configure the CMOS RAM to match the hard drive with the new card. Refer to the section on PC CMOS configuration for more information.

4.5.7 Card and Hard Drive Replacement Procedure

Before beginning, make sure a replacement card is available with a working hard drive.

> ⚠ **CAUTION**
>
> The new card may not have the application programmes which were installed on the hard drive by the OEM. They will then have to be reinstalled. Refer to the section on software backup/restore procedures.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.

> ⚠ **CAUTION**
>
> There may be other cables connected to the card from inside the rack, so remove the card very carefully, without pulling hard.

5. If there are other cables inside the rack connected to the card, it is probably the diskette drive connection. Take careful note of the orientation of the connector on the card before removing it.
6. Reconnect the diskette drive cable coming from inside the rack if so equipped.
7. Install the card in the rack and moderately tighten the attaching screws.
8. Reinstall all the connections removed above.
9. Power up the machine, then the CNC.
10. It may be necessary to configure the CMOS RAM to match the hard drive with the new card. Refer to the section on PC CMOS configuration for more information.

4.5.8 CMOS RAM Configuration Access

The CMOS RAM is configured in the same way as on any personal computer. Only the command to access the utility is different.

> ⚠ **CAUTION**
>
> Changing the CMOS configuration data could result in loss of functionality of the hard drive, pointing devices, diskette drives, memory allocation, etc. Only trained technicians familiar with PC configurations should attempt these changes.

To access the CMOS configuration routine, depress the CTRL+ALT+S keys simultaneously while the PC is booting up from a power off state. Depress these keys at the end of the memory test and hold them depressed until the CMOS setup page appears.

The CMOS configuration utility is used to specify the type of hard drive, diskette drive, CRT, and keyboard and to set the date and time for the PC card. However, the only settings which should ever be adjusted are the hard drive settings and the time/date settings if required. In particular, the diskette drive should never be enabled from here. It is controlled via a software driver loaded in the config.sys file.

Since there are many types of hard drives currently available on the market, the settings for each drive are too numerous to list herein. To find out the settings required for a given hard disk, either call NUM technical support or the hard disk manufacturer. It is important to note that the CMOS RAM configuration does not allow custom drive settings, but only a choice among predefined values on a list for each parameter. This means that it may not be possible to exactly configure a given hard drive, if it does not match the available values.

A typical CMOS RAM setup screen is illustrated below. For instance, the hard disk size is set to 81 MB. It also contains other parameters such as time, date, memory size, diskette drives (none selected, which is correct), hard drives, video mode, keyboard, etc.

Page 2 shows the shadow RAMs, which are usually all disabled.

CMOS RAM configuration page

							Page 1
System Time	16:16:16						
System Date	Jan 15, 1996						
Diskette A	Not Installed						
Diskette B	Not Installed	**Cyl**	**Hd**	**Pre**	**LZ**	**Sec**	**Size**
Hard Disk 1	Type 2	977	10	-1	977	17	81
Hard Disk 2	Not Installed						
Base Memory	640KB						
Exteneded Memory	7168 KB						
Video Card	VGA/EGA						
Keyboard	Installed						
CPU Speed	Fast	**Numlock on at boot**	YES				

ESC	**F1**	**F2**	**F3**	**^v**	**+/-**	**PgUp/Dn**
Menu	**Help**	**Sys Info**	**ChipSet**	**Field**	**Value**	**Page**

**** VSLI VL82C486 Chip Set Feature Control **** **Page 2**

Shadow BIOS ROM:	Disabled	**640k - 1M Relocation:**	Disabled
Shadow Video ROM:	Disabled		
Shadow 16K at C4000h:	Disabled		
Shadow 16K at C8000h:	Disabled		
Shadow 16K at CC000h:	Disabled		
Shadow 16K at D0000h:	Disabled		
Shadow 16K at D4000h:	Disabled		
Shadow 16K at D8000h:	Disabled		
Shadow 16K at DC000h:	Disabled		
Shadow 32K at E0000h:	Disabled		
Shadow 32K at E8000h:	Disabled		

ESC	**F1**	**F2**	**F3**	**^v**	**+/-**	**PgUp/Dn**
Menu	**Help**	**Sys Info**	**ChipSet**	**Field**	**Value**	**Page**

Pressing the ESC key on page 1 or 2 of the CMS setup screens displays the following menu.

ESC - Continue with setup
F4 - Save values, exit setup and reboot
F5 - load default values for all pages
F6 - Abort setup without saving values

ESC	**F4**	**F5**	**F6**
Continue	**Save**	**Defaults**	**Abort**

To exit the CMOS configuration utility, follow the prompts on this menu or press ESC to return to the setup utility. Pressing F4 - Save and exit causes the system to reboot automatically.

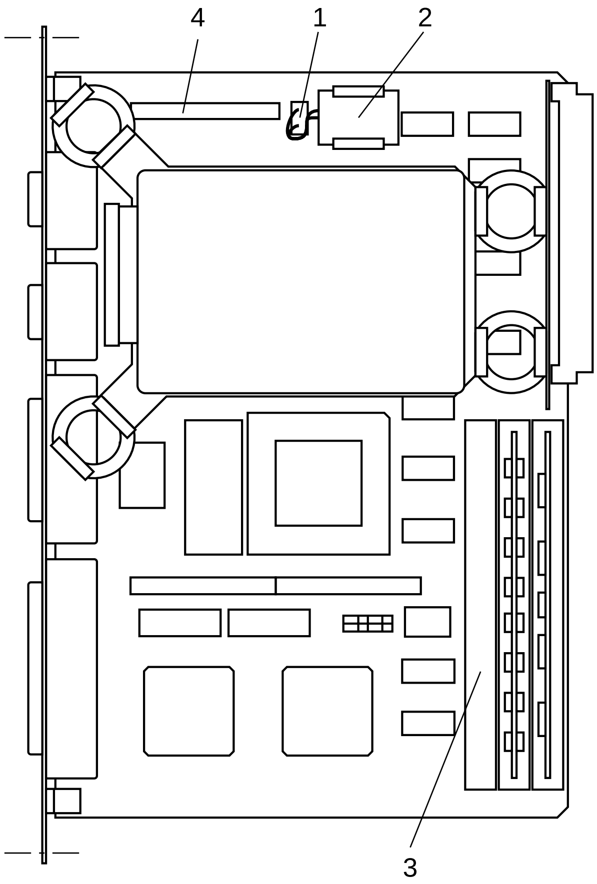
4.5.9 Replacing the Battery

> ⚠ **CAUTION**
>
> The battery must be replaced within 15 minutes or the data in the CMOS RAM will be lost. A special capacitor continues to supply the memory for that time.

1. Check and back up all the CMOS RAM data, then power down the CNC system and the machine.
2. Remove all the connections from the card.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.

> ⚠ **CAUTION**
>
> There may be other cables connected to the card from inside the rack, so remove the card very carefully, without pulling hard.

5. If there are other cables inside the rack connected to the card, it is probably the diskette drive connection. Take careful note of the orientation of the connector on the card before removing it.
6. Take careful note of the orientation of the battery connector, then disconnect the old battery and remove it from its housing.
7. Insert the new battery in its housing and connect it, making sure the connector is in the right direction.
8. Install the card in the rack and moderately tighten the attaching screws.
9. Reinstall all the connections removed above.
10. Power up the machine, then the CNC.
11. Check the CMOS RAM to see whether any data loss occurred. If so reset to the original values.



1 - Battery connector
2 - Battery
3 - Slot for DRAM memory module
4 - Edge connector for diskette drive (PC version 1 module only)

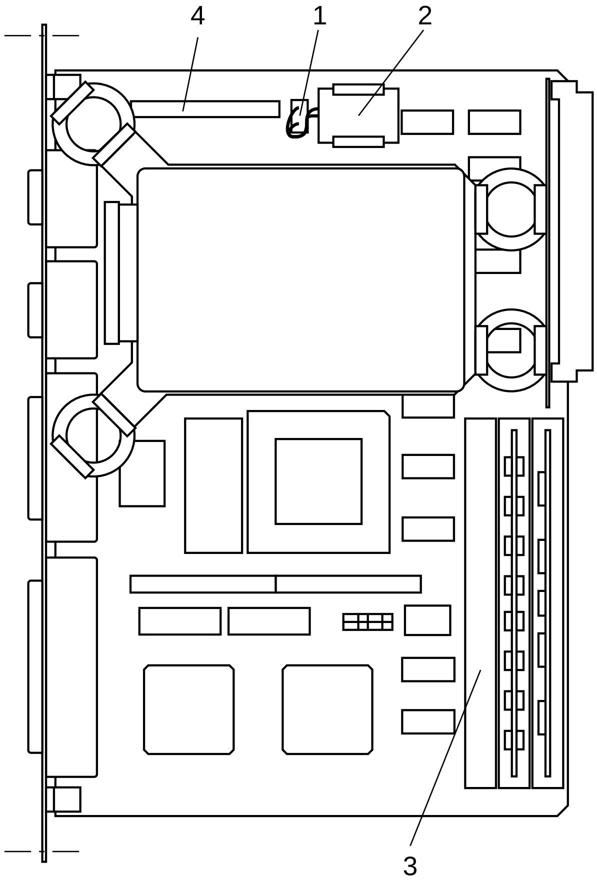
4.5.10 Adding or Removing a DRAM Memory Module

> **⚠ CAUTION**
>
> These modules are extremely sensitive to static electricity. Take all the normal precautions, such as wearing an antistatic wrist band, etc. before handling them.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.

> **⚠ CAUTION**
>
> There may be other cables connected to the card from inside the rack, so remove the card very carefully, without pulling hard.

5. If there are other cables inside the rack connected to the card, it is probably the diskette drive connection. Take careful note of the orientation of the connector on the card before removing it.
6. INSTALLATION: Push the module at a slant into the connector with the polarising notch on the left. Then tilt the model into upright position until it snaps into place.
7. REMOVAL: Carefully retract the two metal retaining clips on either side of the module and tilt the module downwards. When the module is clear of the clips, lift it out.
8. Install the card in the rack and moderately tighten the attaching screws.
9. Reinstall all the connections removed above.
10. Power up the machine, then the CNC.
11. Check the CMOS RAM to see whether any data loss occurred. If so reset to the original values.



1 - Battery connector
2 - Battery
3 - Slot for DRAM memory module
4 - Edge connector for diskette drive (PC version 1 module only)

4

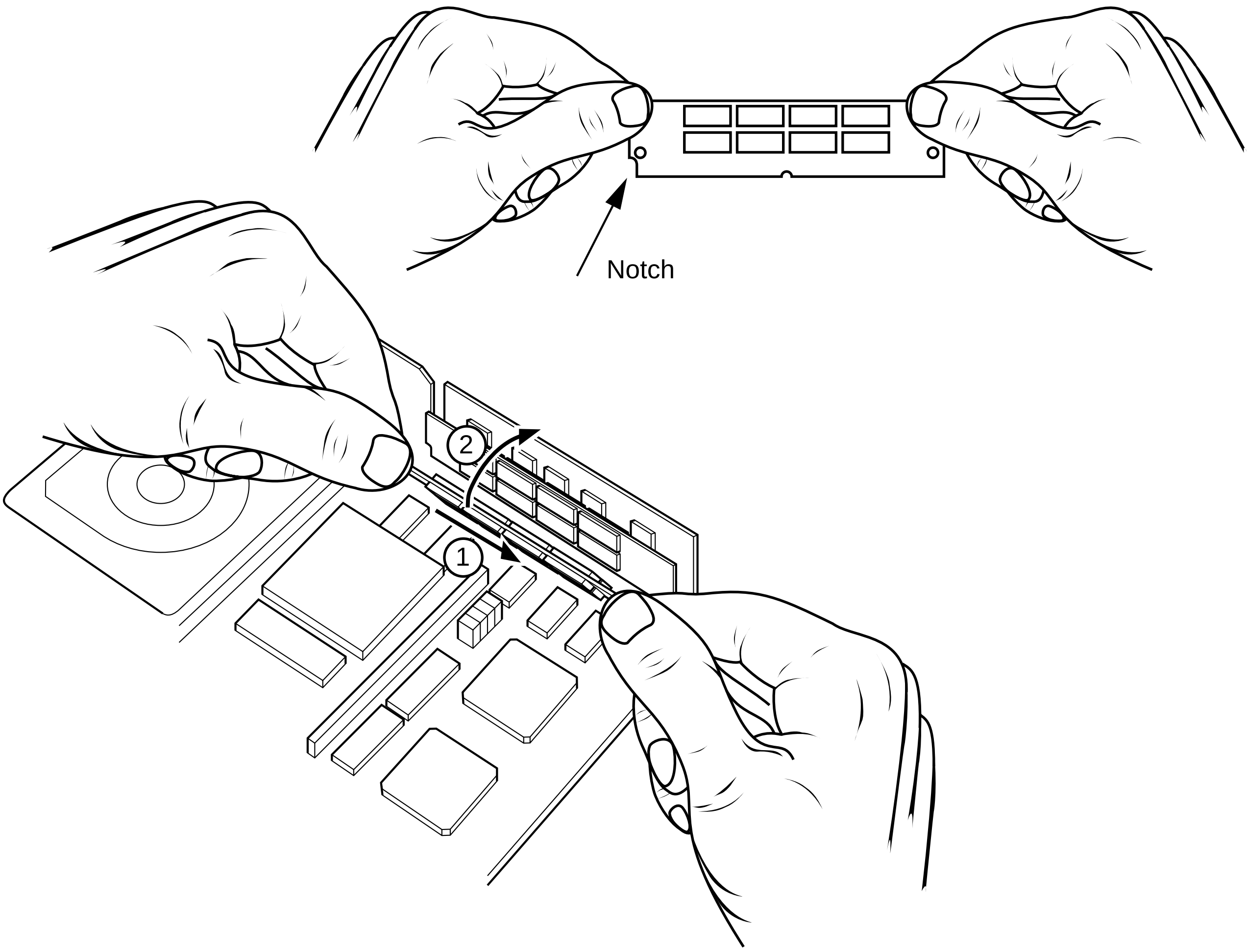
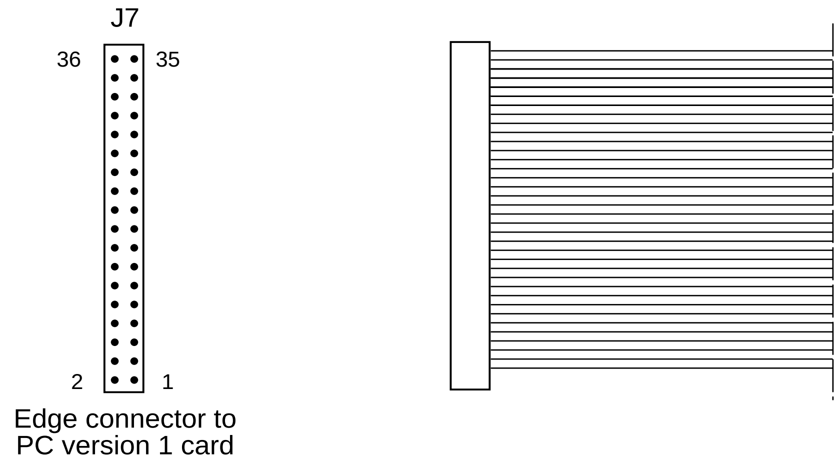


Figure 9: Installing DRAM memory modules on the PC processor

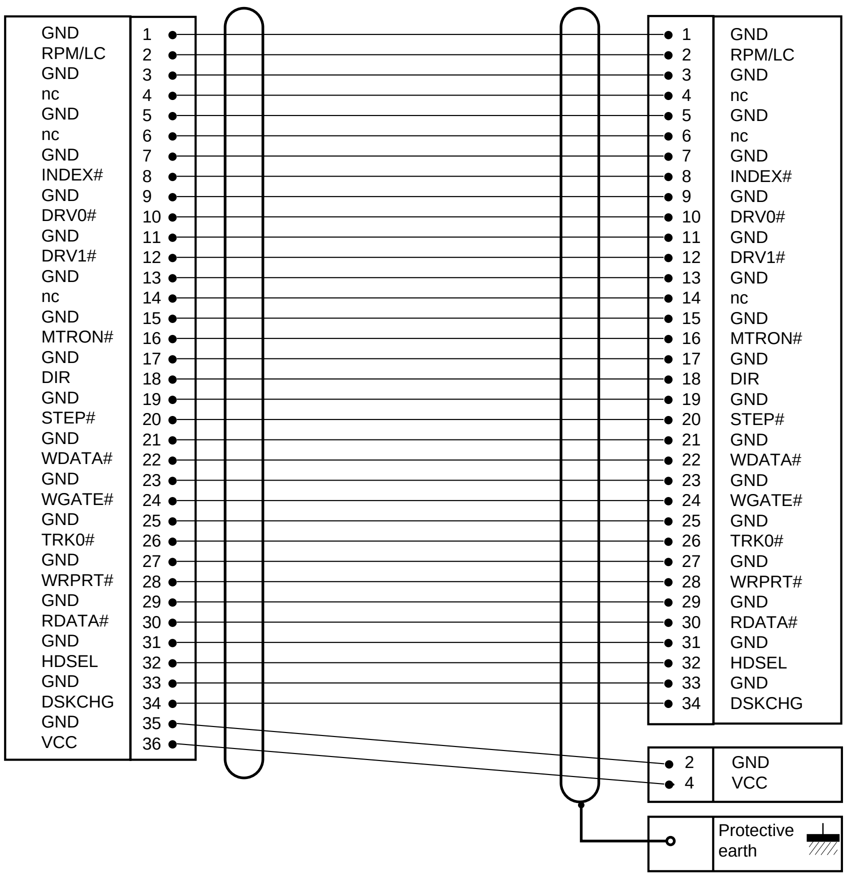
4.5.11 Diskette Drive

The diskette drive must be connected and enabled before being able to use it. There are currently two versions of the PC processor with different diskette drive connection schemes. On the older version, the drive is directly connected to the processor card by a dual-in line connector. The newer version has a sub.D connector on the front for connection of the drive.

Diskette Drive Connection on the Old Version of the Card

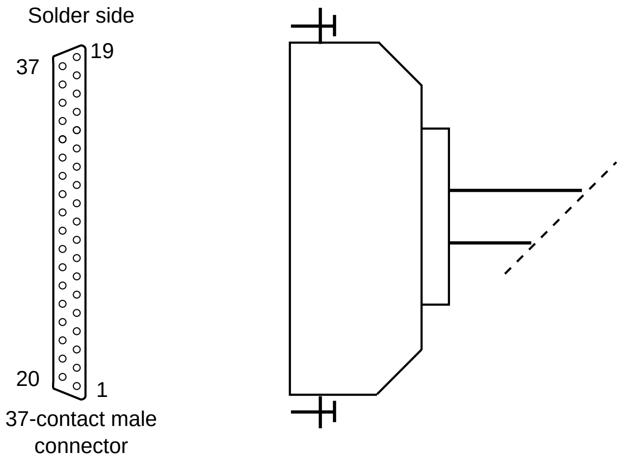


Wiring diagram for connection of a 3 1/2" diskette drive (type TEAC FD-235HF) to V1 PC module
Maximum length: 1 metre.

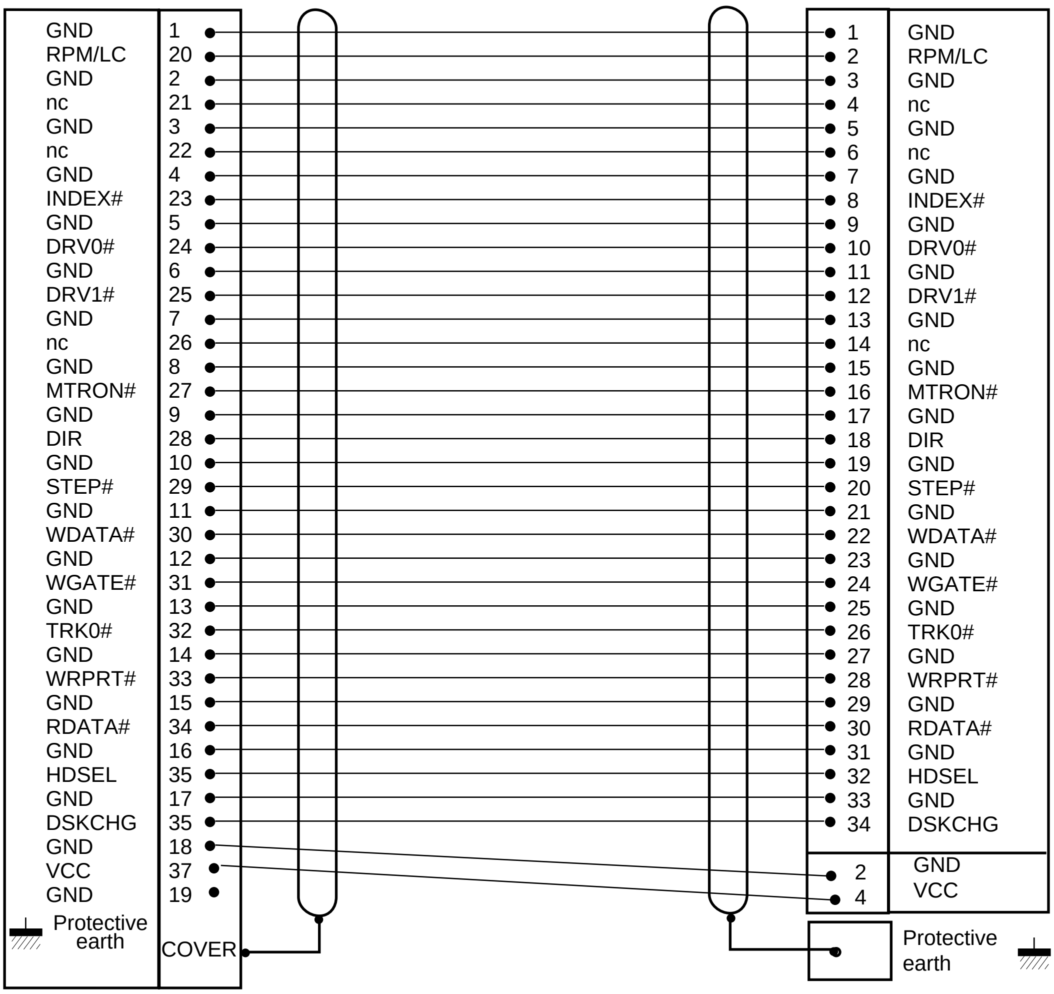


Diskette Drive Connection to Sub.D Connector

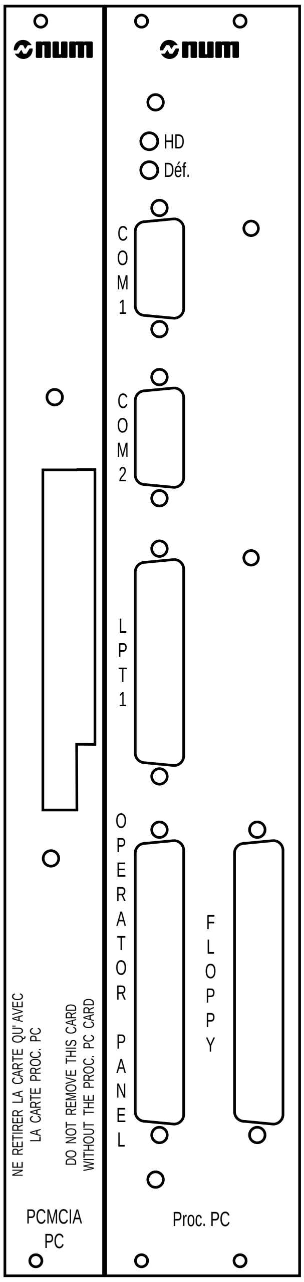
The pinout of the sub.D connector and drive is shown below.



Wiring diagram for connection of a 3 1/2" diskette drive (type TEAC FD-235HF) to V2 PC module
Maximum length: 1 metre.



In addition, the newer version can also come equipped with a PCMCIA slot. In this case, an additional card is attached to the PC card as shown below.



With this card combination, both cards must always be removed together, as they are interconnected by cables and screws.

CAUTION

Never attempt to remove one card without the other. They are attached together.

Enabling the Diskette Drive

The diskette drive is enabled by editing the config.sys file, which is located in the root directory on the hard drive. A typical config.sys file from a PC processor is shown below, with the line to be changed in boldface type. See Chapter 13 for information on how to edit this file.

Sample config.sys file:

```
REM IFS=C:\OS2\HPFS.IFS  /CACHE 64 /CRECL.4
PROTSHELL=C:\OS2\PMSHELL.EXE
SET USER_INI=C:\OS2\OS2.INI
SET SYSTEM_INI=C:\OS2\OS2SYS.INI
SET OS2_SHELL=C:\OS2\CMD.EXE
SET AUTOSTART=PROGRAMS.TASKLIST,FOLDERS,CONNECTIONS
SET RESTARTOBJECTS=STARTUPFOLDERSONLY
SET RUNWORKPLACE=C:\OS2\PMSHELL.EXE
SET COMSPEC=C:\OS2\CMD.EXE
LIBPATH= ;C:\OS2\DLL;C:\OS2\MDOS;C:\;C:\OS2\APPS\DLL;C:\OPENSHUT
SET PATH=C:\OS2;C:\OS2\SYSTEM;C:\OS2\MDOS\WINOS2;C:\OS2\INSTALL C:\;C:\OS2\MDOS;C:\OS2\APPS.
SET PATH=C:\OS2;C:\OS2\SYSTEM;C:\OS2\MDOS\WINOS2;C:\OS2\INSTALL C:\;C:\OS2\BITMAP;C:\OS2\MDOS;C:\
SET PROMPT=$I[$P]
SET HELP=C:\OS2\HELP;C:\OS2\HELP\TUTORIAL;C:\OPENSHUT
SET GLOSSARY=C:\OS2\HELP\GLOSS;
SET IPF_KEYS=SBCS
PRIORITY_DISK_IO=YES
FILES=20
DEVICE=C:\OS2\TESTCFG.SYS
DEVICE=C:\OS2\DOS.SYS
DEVICE=C:\OS2\PMDD.SYS
BUFFERS=30
IOPL=YES
DISKCACHE=1024,LW
MAXWAIT=3
MEMMAN=SWAP,PROTECT
SWAPPATH=C:\OS2\SYSTEM 2048 4096
BREAK=OFF
THREADS=256
PRINTMONBUFSIZE=134,134,134
COUNTRY=033,C:\OS2\SYSTEM\COUNTRY.SYS
SET KEYS=ON
REM SET DELDIR=C:\DELETE,512;
BASEDEV=OS2DASD.DMD
SET BOOKSHELF=C:\OS2\BOOK
PROTECTONLY=NO
SHELL=C:\OS2\MDOS\COMMAND.COM C:\OS2\MDOS
FCBS=16,8
RMSIZE=640
DEVICE=C:\OS2\MDOS\VEMM.SYS
DOS=LOW,NOUMB
DEVICE=C:\OS2\MDOS\VXMS.SYS /UMB
DEVICE=C:\OS2\MDOS\VDPMI.SYS
DEVICE=C:\OS2\MDOS\VDPX.SYS
REM DEVICE=C:\OS2\MDOS\VCDROM.SYS
DEVICE=C:\OS2\MDOS\VWIN.SYS
REM DEVICE=C:\OS2\PCMCIA.SYS
REM DEVICE=C:\OS2\MDOS\VPCMCIA.SYS
REM DEVICE=C:\OS2\MDOS\VMOUSE.SYS
REM DEVICE=C:\OS2\POINTDD.SYS
REM DEVICE=C:\OS2\MOUSE.SYS SERIAL=COM1
CODEPAGE=850,437
DEVINFO=KBD,US,C:\OS2\KEYBOARD.DCP
SET VIDEO_DEVICES=VIO_SVGA
DEVICE=C:\OS2\MDOS\VSVGA.SYS
REM BASEDEV=IBM1FLPY.ADD  <<------ *** Remove the 'REM' statement to enable the floppy drive. ***
BASEDEV=IBM1S506.ADD
BASEDEV=PRINT01.SYS
REM BASEDEV=OS2SCSI.DMD /Q
REM DEVICE=C:\OS2\OS2CDROM.DMD /Q
IFS=C:\OS2\CDFS.IFS /Q
REM BASEDEV=IBMINT13.I13
REM DEVICE=C:\OS2\APPS\SASYNCDA.SYS
DEVINFO=SCR,VGA,C:\OS2\VIOTBL.DCP
SET VIO_SVGA=DEVICE(BVHVGA,BVHSVGA)
DEVICE=C:\NUM\DRIVER\MEM_GLB.SYS
DEVICE=C:\OS2\MDOS\VMOUSE.SYS
DEVICE=C:\OS2\POINTDD.SYS
DEVICE=C:\OS2\MOUSE.SYS SERIAL=COM2
DEVICE=C:\OS2\COM.SYS
DEVICE=C:\OS2\MDOS\VCOM.SYS
```

4.6 1020/1040 Motherboard

This board is functionally very similar to the UCSII board. The difference resides in the absence of a rack. 1020 systems consist of a motherboard containing the customisation parameters usually stored in the rack, to which are connected axis cards and I/O cards. This Motorola MC68020 monoprocessor performs the CNC, PLC and graphic functions. The executive firmware resides on a daughterboard which plugs into this card. The memory includes several SRAM modules mounted in SIMM style instead of soldered RAM chips. The graphic function is performed by a daughterboard. This module also includes a battery to back up the memory in case of a power failure.

4.6.1 Version Identification

There are several different versions of 1020/1040 cards. The part number changes in case of major modifications, such as the amount of available memory, but not for minor ones to a circuit, which may change only the version letter.

The main differences between cards generally concern the amount of memory. In case of doubt, check with the local NUM distributor that the card version is correct.

New cards are equipped with a small metal tag soldered near the top edge of the card. On this metal tag is a white paper sticker giving the serial number and part number of the card. On older cards, the sticker may be located on the card itself or on the edge connector at the rear of the card. **Ignore the number engraved on the card, which is not a part number!**

The sticker has numbers of the following types:
- 203310/C : Part number/version
- 12345/002 : Serial number/lot

1020/1040 processor card types (complete modules)
- 204203310

Daughterboards which can be installed
- 204203329 EPROM daughterboard
- 204202888 GSP daughterboard (graphic control)
- 204202897 1MB DRAM memory card
- 204202892 4 MB DRAM memory card
- 204202898 128 KB SRAM memory card
- 204202894 512 KB SRAM memory card
- 204203390 2 MB SRAM memory card.

As a general rule, a spare card can be used if it has exactly the same part number as the original card and an equal or higher version letter.

⚠ CAUTION

Never replace a card by a card with a different part number or a lower version letter without first consulting NUM Technical Support.

4.6.2 LEDs

The front plate of this card includes three LEDs marked PWR, FAIL and HALT. Under normal operating conditions, only the PWR LED is lit, except during start-up, when the other two may come on briefly.

PWR LED

This LED is lit when the card is powered up. Power supply is from a 24 V source connected to an internal power supply unit.

FAIL LED

If the FAIL LED is lit steady, the processor card is no longer operating. It may be a hardware or a software failure, but the most frequent cause is a problem with the software or memory. It is then necessary to reboot the system.

HALT LED

If the HALT LED is lit steady, the processor has stopped generally due to a fault on the card. However, the fault is not necessarily on the card.

Replace the card and reboot the system. If the system hangs on reboot or stops later with the same fault, reinstall the original card, which was not the cause of the failure, and look elsewhere for the cause.

L1, L2 and L3 LEDs

These three LEDs correspond to operational states of the card. Their on or off state does not give any information useful for diagnostic.

4.6.3 Ports

There are two communication ports, one analogue I/O and interrupt port and one panel interface port on the front plate of the card. There may also be optical ports if a fibre-optic link is provided.

COMM1 Port (9 contacts)

This port is an RS232 interface which can be assigned to different functions by the OEM by software settings. More details are given in the chapter on communications.

Pin	Signal
1	DCD - Data carrier detection
2	RD - Received data
3	TD - Transmitted data
4	DTR - Data terminal ready
5	GND - Signal earth
6	DSR - Data set ready
7	RTS - Ready to send
8	CTS - Clear to send
9	Not connected
Connector shell	Protective earth

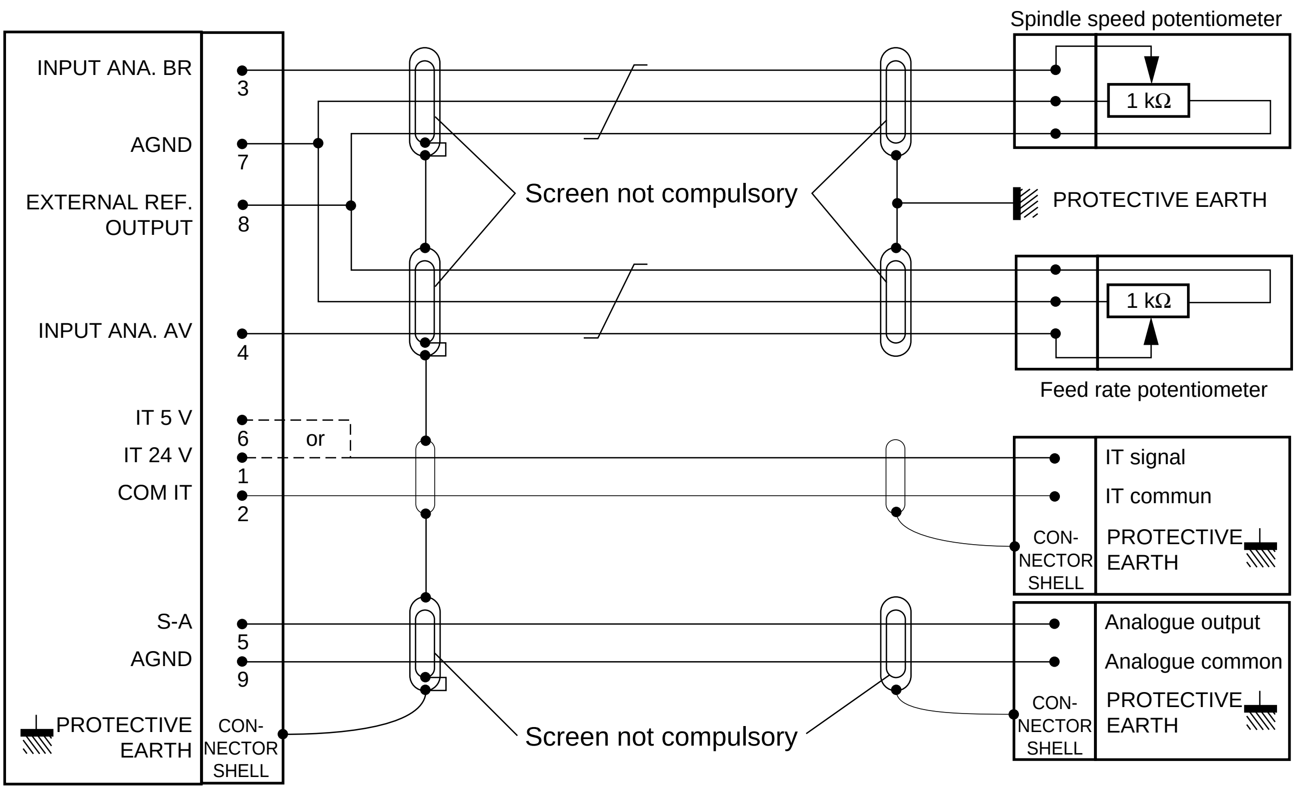
SERIAL Port (9 contacts)

This port is a multistandard RS232, RS422, RS485 interface which can be assigned to different functions by the OEM by software settings. More details are given in the chapter on communications.

Pin	Signal
1	R(B) - RS422-RS485 reception
2	RD - Received data
3	TD - Transmitted data
4	T(B) - RS422-RS485 transmission
5	GND - Signal earth
6	R(A) - RS422-RS485 reception
7	RTS - Ready to send
8	CTS - Clear to send
9	T(A) - RS422-RS485 transmission
Connector shell	Protective earth

E/S ANALOG (Analogue I/O) Port

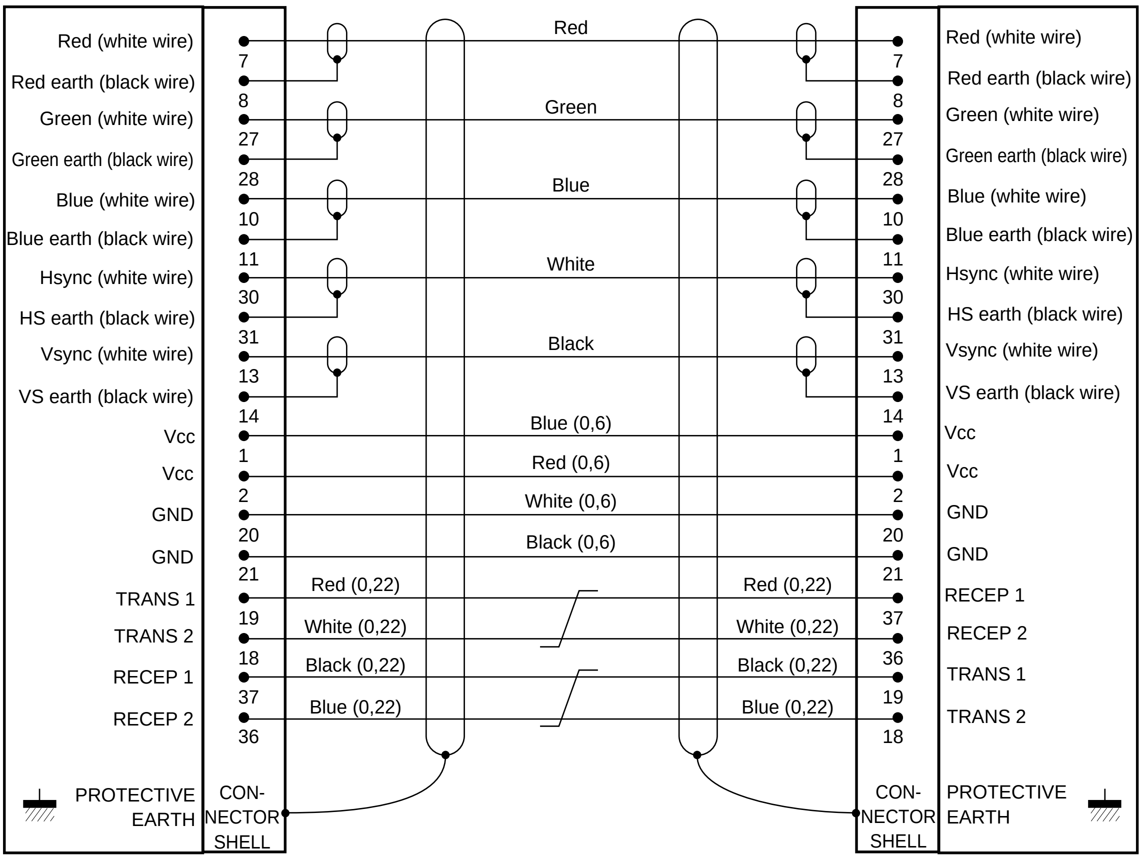
This port has two analogue inputs, one analogue output and one fast interrupt input. The wiring diagram is given below.



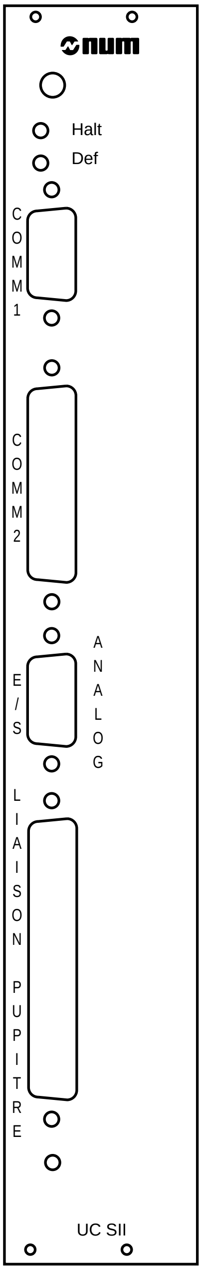
REMARK *If the interference level is low, the analogue output cable with double shielding can be replaced by a cable with single shielding connected at both ends to the protective earth.*

LIAISON PUPITRE Port (37 contacts)

This is the connector to the panel. The wiring diagram is given below.



4.6.4 Characteristics



Power consumption	11 W maximum
Location	CNC card slots 0 and 1

Serial Lines

2 RS232 serial lines	
Maximum input voltage	± 30 V
V_{0L} typical	- 9 V
V_{0H} typical	+ 9 V
Extreme loads	2000 pF, 5 kΩ (approximately 10 m of cable)
Data rate	9600, 19200 or 38400 bauds

Analogue Inputs

The inputs can be dedicated to connection of resistive potentiometers	
Typical potentiometer rating	1 kΩ
Resolution	0.4 percent full scale value

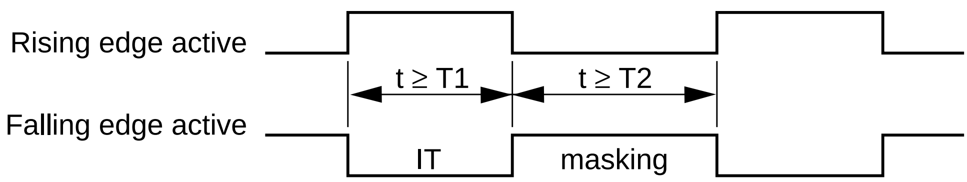
Analogue Output

Output voltage	- 10 / + 10 V
Minimum load	2 kΩ
Maximum error	20 mV (offset + accuracy)
Output amplifier	AD712 (Analog Device)

External Interrupt

Maximum current rating	20 mA
Minimum current required	10 mA
5 V input	Logic "0" between 0 and 1 V Logic "1" between 3.5 and 5.5 V
24 V input	Logic "0" between 0 and 4.7 V Logic "1" between 18 and 27 V
IT duration	Programmable: T1 = 0,5/250/500/2220/4440 µs
Masking between 2 ITs	Programmable: T2 = 1/500/1000/4000/8000 µs

Interrupt timing diagram:

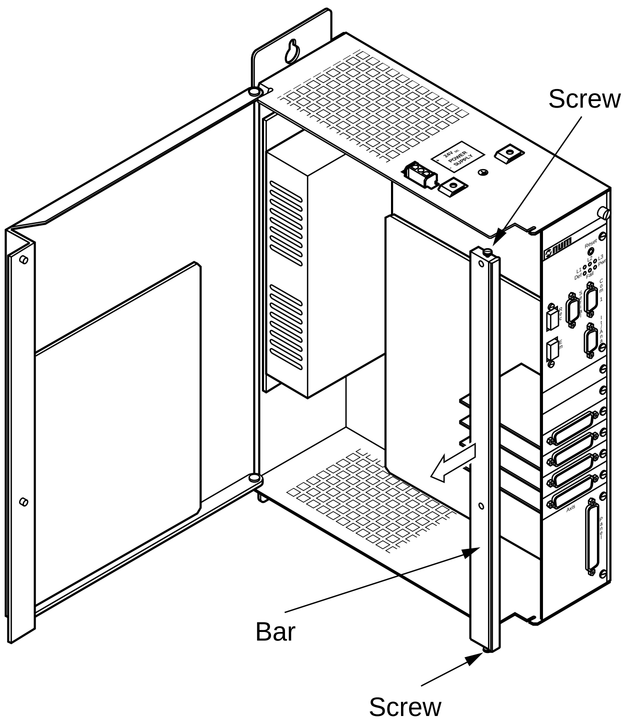


4.6.5 Replacing the Card

> **⚠ CAUTION**
>
> All the data stored in the RAM will be lost if the batteries are removed from the card. Make sure all the data have been backed up before attempting this procedure.

Before beginning, make sure a replacement card is available and make sure ALL the software has been backed up.

1. Back up all the software, referring to the relevant section.
2. Power down the CNC system and the machine.
3. Remove all the connections from the CNC.
4. Remove the CNC.
5. Open the cover, remove the two screws securing the card retaining rail and remove the rail.
6. Carefully remove the axis cards.
7. Disconnect the internal connecting cables (battery, I/O, power supply and fibre-optic link if any, being careful to note their location).
8. Loosen the three motherboard attaching screws and remove the motherboard.
9. If the replacement card is not equipped with the EPROM daughterboard or the graphic daughterboard, recover them from the old card and install them on the new card, being very careful to correctly position the connectors. The memory cards are normally provided except for the SRAM2 card which is optional. Check that the cards are present and are of the same type, especially the SRAMSys card, which can be of two different types, depending on the application (128KB or 512KB). If replacing a memory card, proceed with care and avoid electrostatic discharges.



> **⚠ CAUTION**
>
> A memory module may be the cause of the card failure, so be very cautious about reusing them.

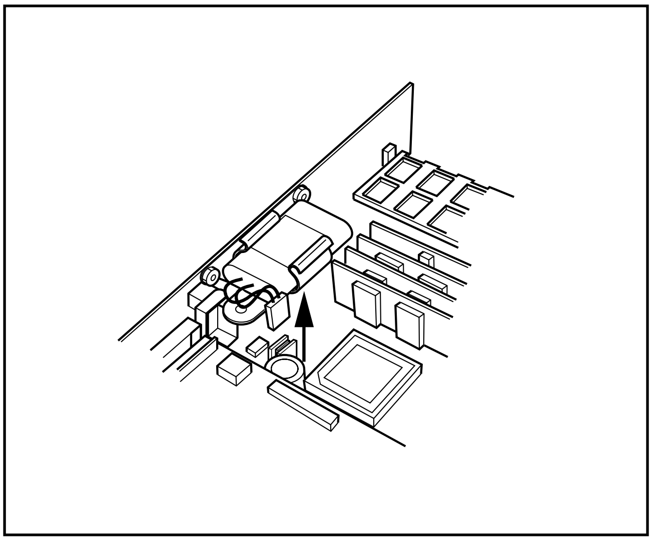
10. Proceed in reverse order for installation.
11. Power up the machine, then the CNC.
12. Reload the software backed up in step 1.

4.6.6 Replacing the Battery

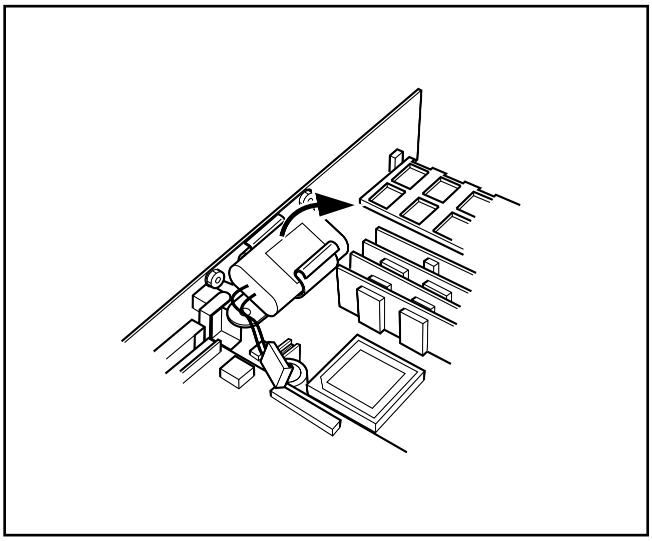
CAUTION

The battery must be replaced within 15 minutes or the data in the RAM will be lost.
A special capacitor continues to supply the SRAM modules for that time.

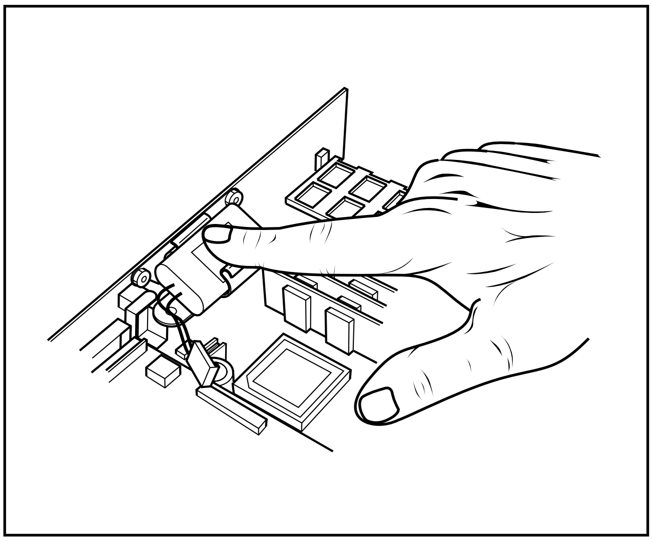
1 - Disconnect the battery



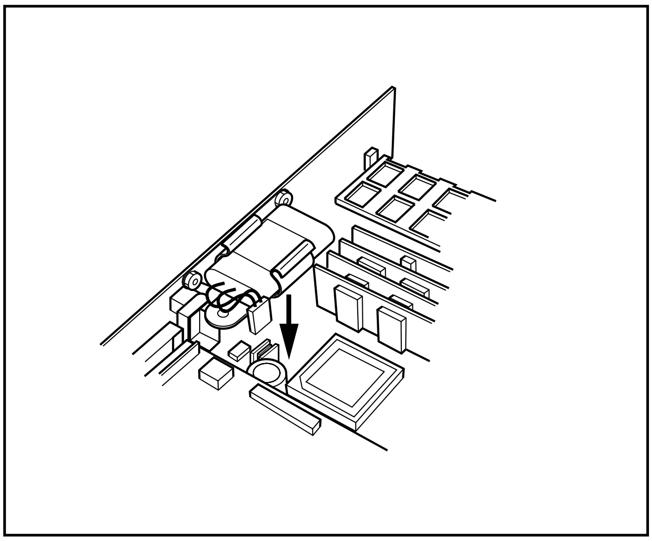
2 - Remove the old battery from its housing



3 - Snap the new battery into its housing



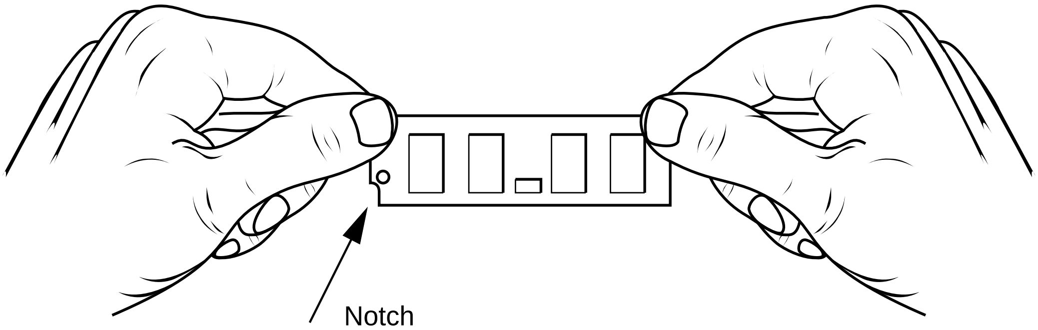
4 - Connect the battery, being careful that the connector is facing in the right direction

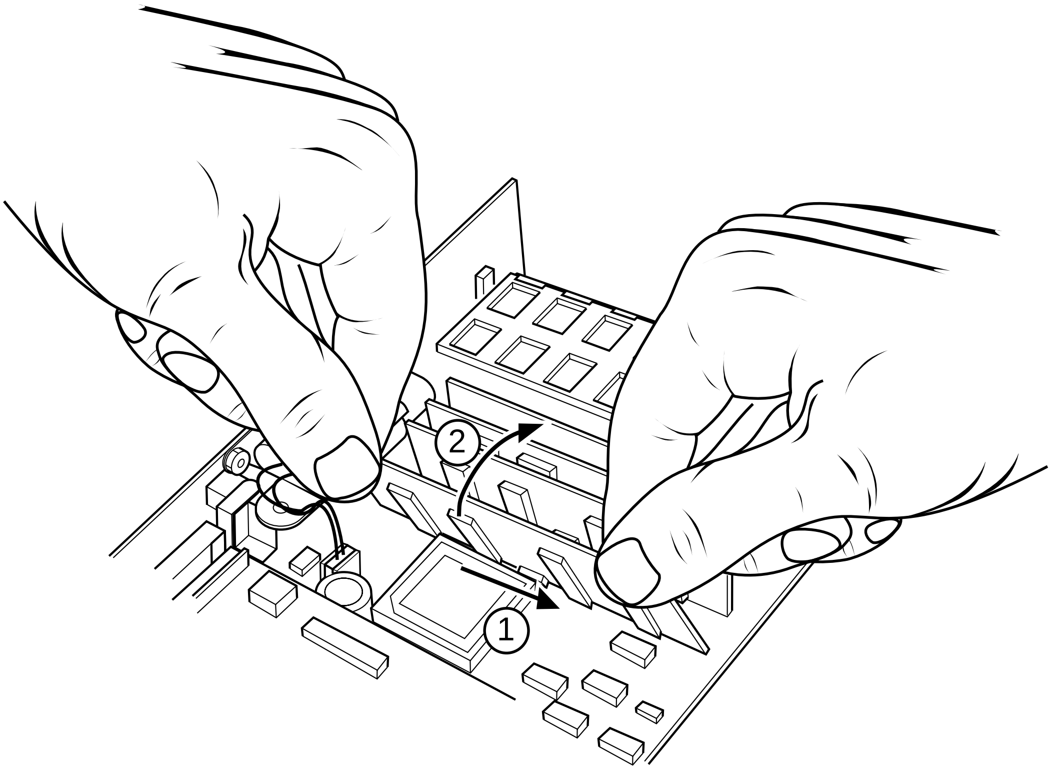


4.6.7 Adding an SRAM Module

1 - Push the module into the connector with the polarising notch on the left.

2 - Tilt the model into upright position until it snaps into place.



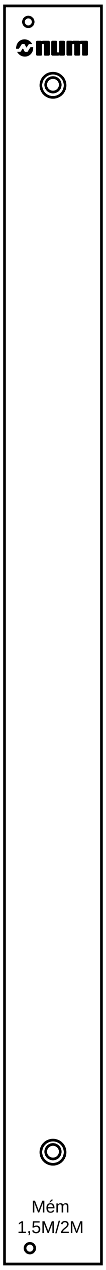


5 Memory

The memory card used depends on the type of system. Many different memory designs are available. Check the card or contact NUM for the card part number.

This section discusses the individual card functions, ports and diagnostic aids. It also includes instructions on how to replace a memory card if required.

5.1 Memory Card



The memory card is basically a passive card. It contains the following system data:

Data	Memory type	Location
Part programmes	RAM	Memory card
External parameters	RAM	Memory card
User-defined macros	RAM	Memory card
PLC Ladder programmes	RAM	Memory card
PLC assembler programmes	RAM	Memory card
PLC C programmes	RAM	Memory card
PLC variables	RAM	Memory card
Axis calibration points	RAM	Memory card

This card communicates with all the processor cards via the system bus. All the data on this card are backed up by battery except the executive firmware. The battery is soldered to the card so that the data are not lost when the card is removed.

5.1.1 Executive Firmware

The executive firmware is stored on a set of EPROMs (sometimes referred to as REPROMs in other NUM documents). On older versions, the EPROMs are directly plugged into sockets on the motherboard, whereas on newer versions, they are mounted on a daughterboard.

The executive firmware contributes to defining the basic personality of the CNC: milling, turning, grinding, etc. There are only a few different types of executive firmware, since the same programme performs all the functions. There are however many successive releases of the executives, called Indexes, identified by the letter following the part number.

EXECUTIVE FIRMWEAR PART NUMBERS			
Function	1060 SI	1060 SII	1060 UCSII
Milling, turning, grinding, general purpose	202852	203070	203375

The EPROM sockets are numbered U1, U2, U3, U4 or U1, V1, W1, etc. These numbers are etched on the card. Always note down the socket number on a chip before removing it to be able to reinstall it in the same socket. This is very important to prevent problems.

If the memory card is equipped with a daughterboard. The daughterboard may easily be removed if needed. Be very careful not to bend the leads when reinstalling it.

5.1.2 Batteries

⚠ CAUTION

All the data stored in the RAM will be lost if the batteries are removed from the card. Make sure all the data have been backed up before attempting this procedure.

The batteries are soldered in the lower right-hand corner of the memory card, near the bus connector. These batteries are under a constant charge whenever the rack is on. When the rack is turned off, the batteries supply the RAM chips to preserve the data they contain.

The batteries can be replaced, but only by a skilled technician with suitable tools. Replacement batteries can be obtained from NUM technical support.

5.1.3 Battery Jumpers

⚠ CAUTION

Removing these jumpers causes a total loss of all the data contained in the RAM.

The two small jumpers located near the batteries control charging and discharging. If the jumpers are removed, the batteries are not kept charged and will not be able to maintain the RAMs supplied.

One jumper controls charging and one controls the RAM socket. Their orientation is critical. The jumpers must be installed parallel to the bottom of the memory card. NEVER INSTALL THE JUMPERS PERPENDICULAR TO THE BOTTOM OF THE CARD.

These jumpers can be used to completely erase the memory. Other information on this subject is given in the section on the backup/restore procedure.

5.1.4 Replacing the Card

> ⚠ **CAUTION**
>
> Always back up the complete contents of the memory card before replacing the card. The following data are lost when replacing this card: part programmes, tool geometry offsets, tool wear offsets, DAT datum shifts, protected memory zones 1, 2 and 3, all PLC programmes and external parameters E8xxxx.

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Loosen the two card attaching screws, one at the top and one at the bottom.
3. Gently pull out the card to unplug it from the rack.
4. Perform one of the following operations on the card, depending on the version:
   a) If the old card is equipped with a daughterboard, carefully remove the daughterboard from the old card and place it on the new one.
   b) If the old card is not equipped with a daughterboard, carefully remove the EPROM chips from the old card and install them on the new one. Handle these chips very carefully, because the leads are very fragile.

> ⚠ **CAUTION**
>
> Use an approved IC extraction device and take all normal anti-static measures to prevent damage to the chips.

5. Make sure the battery jumpers are correctly installed on the new card.
6. Install the card in the rack and moderately tighten the attaching screws.
7. Power up the machine, then the CNC.
8. Restore all the data backed up by the procedures described in the relevant section of this manual.
9. Leave the CNC on for at least 24 hours to allow the batteries to charge fully.

6 Axis card

The CNCs of the 1000 family can be equipped with up to three different types of axis cards:
- Analogue axis card with incremental encoder capabilities
- Analogue axis card with SSI absolute and incremental encoder capabilities
- QVN (quad digital drive) axis card for DISC (Digital Integrated Servo Control) axes.

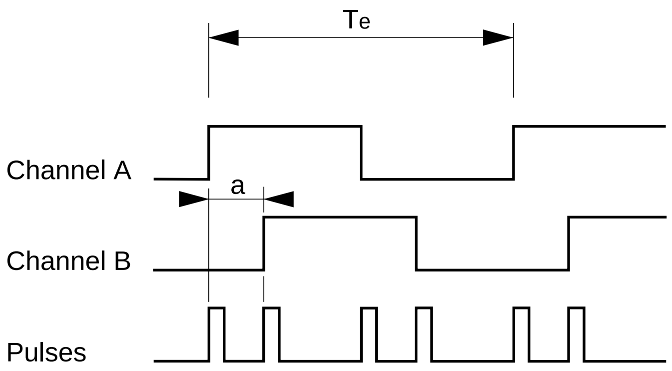
6.1 Encoder Feedback Theory

There are many different types of feedback devices available today, using several different types of connections and signals. The NUM 1060 CNCs accept both incremental and absolute encoder feedback.

6.1.1 Incremental Encoders

An incremental encoder normally has three output channels: A, B and Z (home pulse). These channels are normally electrically phase shifted by 90 degrees in relation to each other so that the device reading the pulse train can determine the direction of travel. For instance, movement is in the positive direction if A leads B or in the negative direction if B leads A. The timing diagram on the right shows the correct phase relationships for a BEI H25 encoder.

It should be noted that there are complementary (inverse) channels for each regular channel. These inverse channels are mainly used for error detection. On the NUM 1060, a software parameter setting is used to configure error detection if both A and A' or B and B' or Z and Z' go high at the same time, which should never occur when the system is operating correctly.



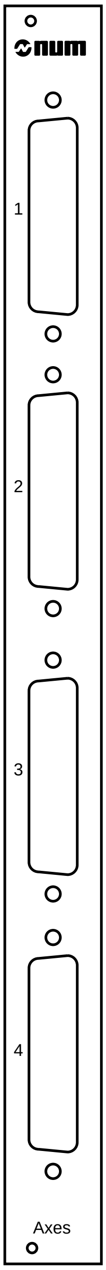
T_e: signal period of one of the channels
a: time between two edges

Figure 10

6.1.2 SSI Absolute Encoders

These encoders supply their information through a serial synchronous interface (SSI). The send the axis card a code which directly indicates the encoder's position. The code can be only 12, 16 or 24 bits, depending on the type of encoder. The code is not sent randomly, but in response to periodic polling of the axis card. However, because the interface is serial, data transmission takes longer, which can be penalising for high precision applications. Some machines are therefore equipped with combined SSI and incremental encoders. In such systems, the SSI encoder determines the slide position at power up and the incremental encoder supplies the position data when in motion. This gives the best of both worlds, the accuracy of the absolute encoder for position sensing and the speed of the incremental encoder.

6.2 Analogue Axis Card



This type of card can have two, three or four ports. However, the functionality is always the same, regardless of the number of ports.

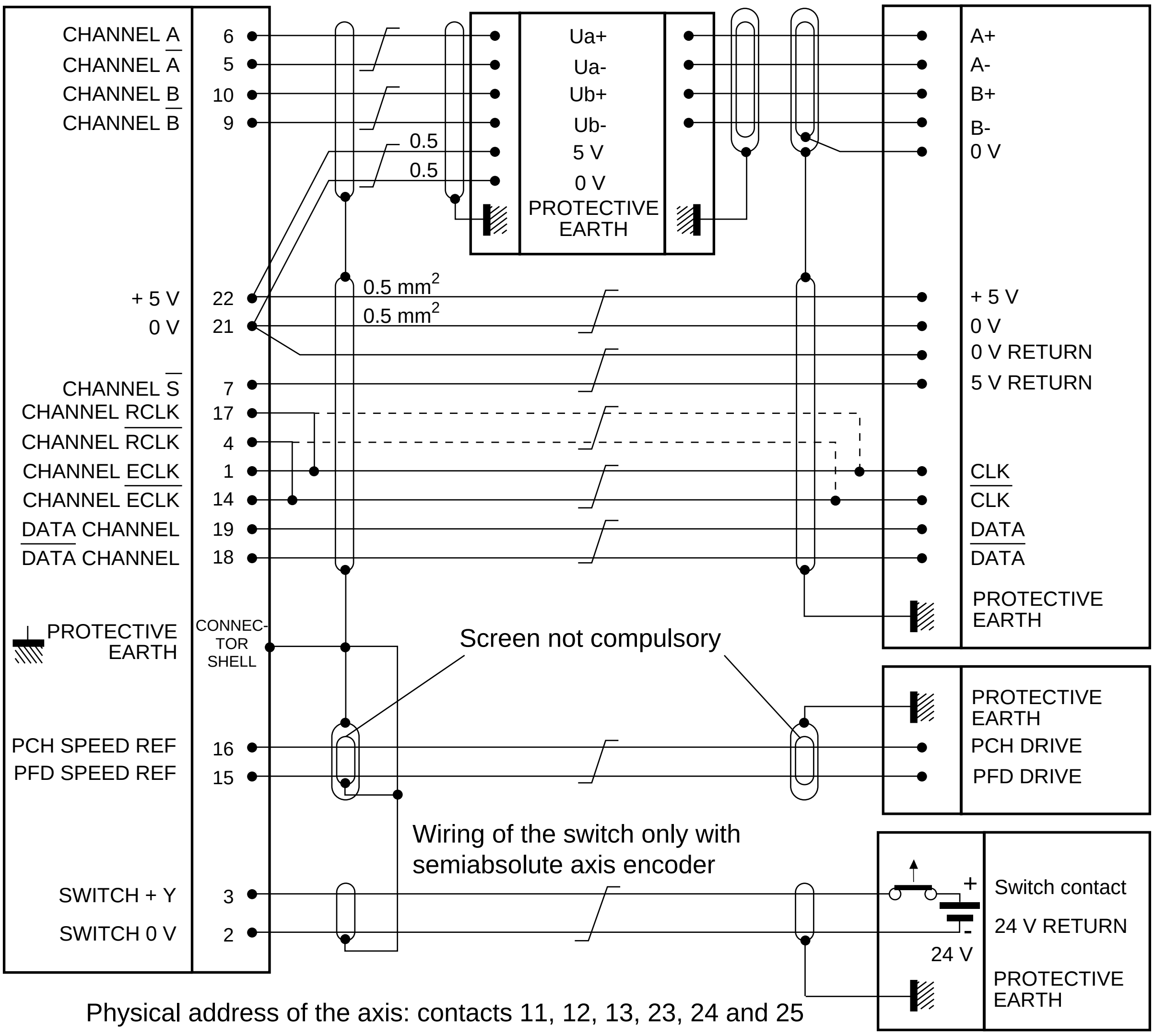
These cards communicate with all the processor cards of the system via the system bus. They use DSP (digital signal processing) technology for the axis control algorithms.

These cards allow connection of +5 VDC TTL line driver encoders, linear scales or handwheels. They can supply a $\pm$ 10 V command to the servo-drives or spindle motors. Each port allows connection of all the axis, feedback, addressing and homing signals. Wiring is described in detail in the following section.

These cards are not addressed. They can therefore be placed in any slot, provided it is to the left of the memory card and any QVN (Quadruple Variateur Numérique = Quadruple Digital Drive) cards present in the system and to the right of the first I/O or PC processor card.

The older versions of the axis card only supported incremental encoders, but the recent versions (series 2042030000) also support absolute encoders using the SSI protocol. It is necessary to check the card part number, because no external visual clues identify the type of card.

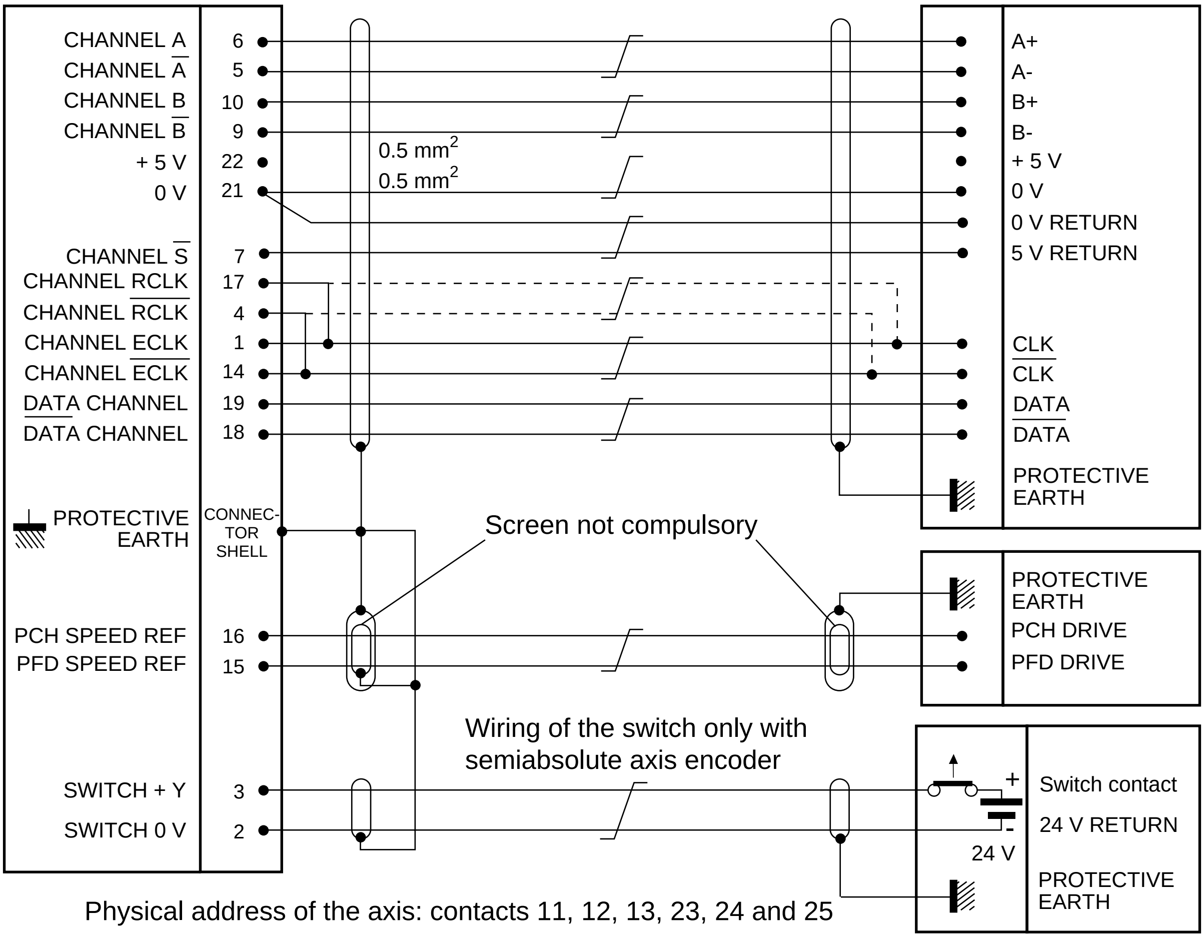
6.2.1 SSI Absolute + Incremental Axis Cable - Sinusoidal Pulses



Physical address of the axis: contacts 11, 12, 13, 23, 24 and 25

In the wiring diagram above, the card ports are connected to an encoder, a servo-drive input and a switch contact.

6.2.2 SSI Absolute + Incremental Axis Cable - Square Pulses



Physical address of the axis: contacts 11, 12, 13, 23, 24 and 25

In the wiring diagram above, the card ports are connected to an SSI encoder and an incremental encoder, a servo-drive input and a switch contact.

6.2.3 Axis Addressing

Since the analogue type axis cards are not addressed, the axis connected to a port is recognised by the wiring of the port connector. The connections labelled Addr1 to Addr16 on the wiring diagrams of the previous pages correspond to the pin weights in the address definitions. The table below shows all the possible combinations of jumpers and the associated axes.

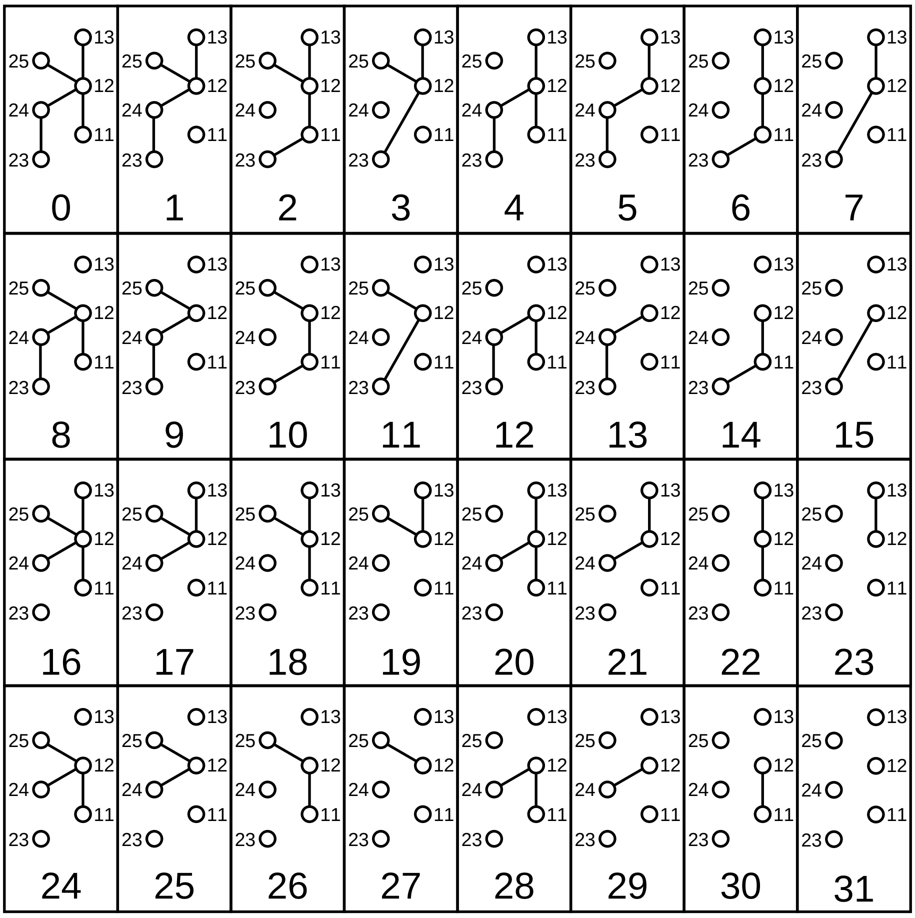


Figure 11: Analog axis address selections

Although all the addresses are listed in the previous table, the table does not show the customary axis assignment. For instance, the X axis is usually at address 0, the Y axis at address 1, etc.

The table opposite shows the address usually assigned to each axis. However, this table is given only for guidance, since each OEM can freely choose the address system best suited to his applications.

Both analogue and DISC axes can coexist in a system. In this case, the addressing is usually somewhat different for several reasons. Refer to the section on DISC addressing for further information.

AXIS NAME	ADDRESS
X	0
Y	1
Z	2
U	3
V	4
W	5
A	6
B	7
C	8
X1	9
Y1	10
Z1	11
U1	12
V1	13
W1	14
A1	15
B1	16
C1	17
	18
	19
	20
	21
	22
	23
Spindle 1	24
Spindle 2	25
Spindle 3	26
Spindle 4	27
Handwheel 1	28
Handwheel 2	29
Handwheel 3	30
Handwheel 4	31

6.2.4 Troubleshooting

Troubleshooting of analogue axis cards is relatively easy. Since the cards do not contain any data or programmes, no special precautions are required when replacing them.

Symptom	Possible Cause	Corrective actions
Axis shakes (oscillates)	Position loop (CNC) gain too high	Check the following error and adjust as required
	Speed loop (drive) gain too high	Check drive performance in open loop mode using a battery box and an oscilloscope. Adjust as required
	Poor encoder signals	Check the signals with an oscillo-scope. Check encoder wiring and shielding
	Poor motor speed control	Check motor speed feedback wires and feedback sensor (probably a tachometer or a resolver)
Axis drifts or gradually loses its position	Faulty encoder signals	Check encoder wiring and shielding
After power up, axis immediately runs at uncontrollable high speed	Encoder wiring error	Check for correct encoder phasing and that the wires are correctly connected
	Broken encoder wires	Check for broken encoder wires
	Speed command wiring error	Check speed command for correct phasing
Axis gives excessive error indication: ERROR 4x on CNC	Drive fault	Check for any type of drive fault which will cause the motor not to run
	Axis stuck or hard to move	Move the axis by hand to check it
	Axis speed too high or too low	Check the following error and adjust as required
	Axis performance is poor	Check drive and motor in open loop mode using a battery box and an oscilloscope

If unexplained errors are occurring and all the wiring checks above are OK, the problem could be in the axis port itself. Always begin by checking the wiring, which is small gauge and tends to break under repeated motions. If the wiring is OK, try to connect the cable to another port using the procedure given below.

Checking an Axis Port

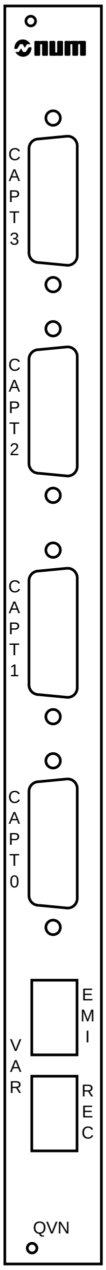
1. Power down the machine and the CNC.
2. Remove the cable from the suspected bad port.
3. Connect the cable to another analogue port. If there are no free ports, remove another cable from a good port and swap the two cables.
4. After reattaching the cables, power up the machine and the CNC. Test the axis where the problem was found. If the problem has disappeared, the port is probably faulty and the card should be replaced. However, if the problem persists on this axis, the original port is OK and the cause of the problem is elsewhere.

6.2.5 Replacing the Card

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.
5. Install the new card in the rack and moderately tighten the attaching screws.
6. Reinstall all the connections removed above.
7. Power up the machine, then the CNC.

6.3 QVN Axis Card



The QVN axis card is primarily used to control the DISC servo-amplifiers. It is installed in the rack just to the left of the memory card. It sends current commands to the servo-drives via the fibre-optic ring. Each servo-drive reads its respective current command and sends the appropriate power to the motor. As the motor turns, the special DISC encoders send speed and armature angle information back to the QVN card via the 26-contact axis port. The QVN card computes and controls the speed and current (torque) commands then issues new commands to the DISC servo-amplifiers via the fibre-optic ring.

There are four sub.D connectors and two fibre-optic ports on the front plate. The card is capable of controlling up to four DISC servo-amplifiers. The four axis ports are specially designed to receive special motor encoder signals from a DISC motor, but they can also be wired as traditional encoder ports and used for handwheels, spindle encoders or secondary feedback ports.

The two fibre-optic ports are for connecting the card in a fibre-optic ring, which can include up to four daisy-chained DISC amplifiers. One port is an emitter and the other a receiver.

6.3.1 Axis Port Connections

It is important to understand how the DISC encoder operates, to be able to understand and diagnose the signals. The DISC encoder has two output channels, one a traditional incremental encoder and the other an absolute channel.

The absolute channel is only absolute for one revolution. This channel is use to determine the current motor armature angle so that the motor can be commutated at the right time. That is the sole function of this channel.

The incremental channel serves two purposes. First, it supplies the speed information to the QVN card, and second, it can be used for position control if so configured by the OEM.

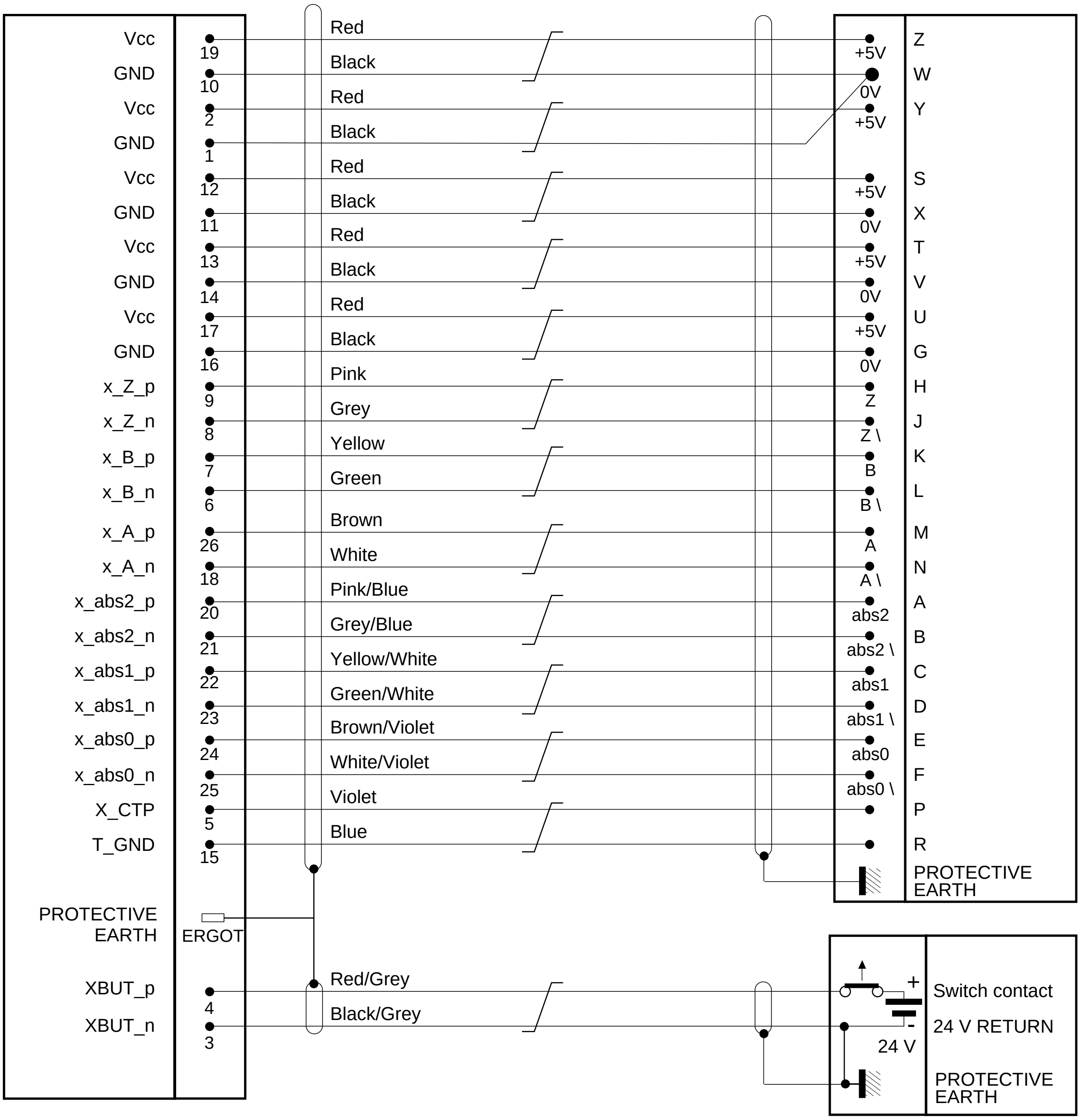


Figure 12: Typical wiring between a DISC encoder and QVN axis port

QVN axis port pinout	
Pin	Signal
1	Earth
2	Vcc + 5 V
3	Home switch common 0V
4	Home switch signal +24 VDC
5	X_CTP
6	x_B_n
7	x_B_p
8	x_Z_n
9	x_Z_p
10	Earth
11	Earth
12	Vcc + 5 V
13	Vcc + 5 V
14	Earth
15	T_GND
16	Earth
17	Vcc + 5 V
18	x_A_n
19	Vcc + 5 V
20	x_abs2_p
21	x_abs2_n
22	x_abs1_p
23	x_abs1_n
24	x_abs0_p
25	x_abs0_n
26	x_A_p

6.3.2 Axis Addressing

> ⚠ **CAUTION**
>
> QVN axis addressing is specific to both the slot and port. The cables cannot be swapped as on an analogue axis card.

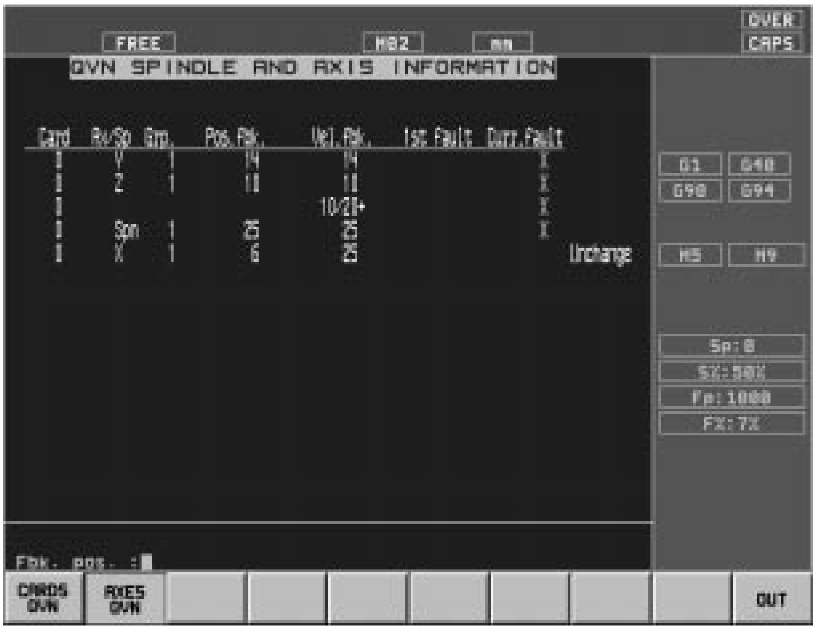
Unlike the analogue axis cards discussed above, these cards do not use jumpers to define the axis address. Instead, the axes are addressed by a machine parameter setting. The cards themselves do not have an address, but take that of the slot where they are located. It can therefore be complicated to change an axis address, which requires knowledge of the complete axis addressing scheme. Therefore, it is not covered herein. For more information on this subject, refer to Parameter Manual 938818.

6

6.3.3 Troubleshooting

There are two ways of troubleshooting the QVN card and DISC axes. The first method consists of checking for faults on the special QVN page displayed on the NUM panel screen. On one of the main screens, pressing key F9 (PLC I/O) displays a menu including option 4 - QVN CONTROLLED AXES. Choosing this option displays a screen similar to the one shown below.

On this screen, it is sufficient to select a Fbk. pos (feedback position), which is basically an axis address. For instance, if the fault appears to be on the X axis, enter the X axis feedback address (7 in the example) to display the second screen.



This screen is more detailed, listing all the possible faults on the axis selected. It includes two columns, labelled “1st flt” and “Curr. flt”. If the fault has disappeared, an asterisk is located opposite the fault in the “1st flt” column. If the fault still present, there is an asterisk in the “Curr. flt” column.

Depending on the nature and severity of the fault, it can be reset either by pressing the RESET key (key ..) on the front panel or by a power down/power up sequence. Relatively minor faults are acknowledged by the first method and more severe ones by the second.

The two softkeys labelled CARDS QDD and AXES QDD are used to display other screens.

CARDS QDD This key selects the screen below to help determine the status of the QVN cards themselves.

AXES QDD This key selects the first of the two screens shown above, labelled “QDD CONTROLLED AXIS INFORMATION”.

The first column lists the numbers of the QVN cards. Card 0 is the first card to the left of the memory cards, card 1 is to the left of card 0 and so forth.

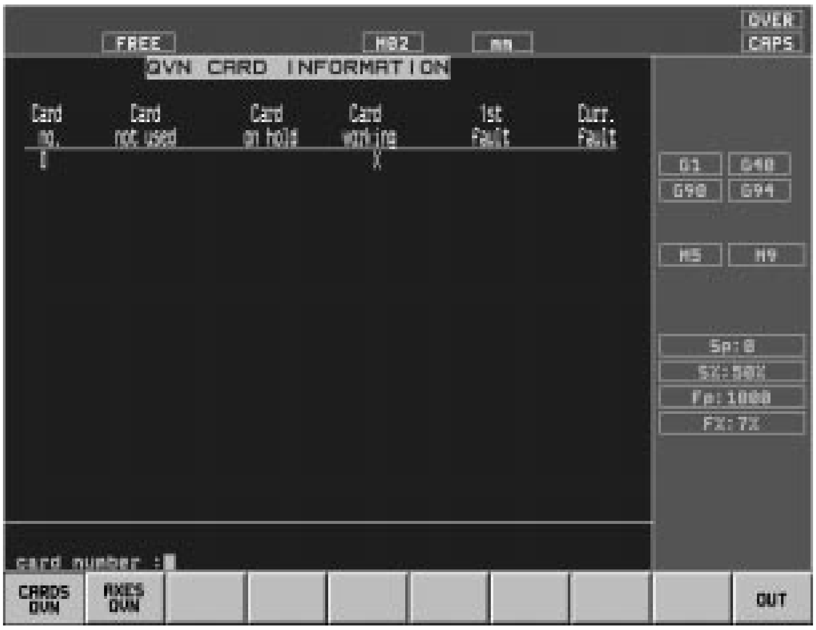
The second column indicates whether or not the card is used.

The third column indicates whether or not the card has been put on hold (servos stopped).

The fourth column indicates whether or not the card is operational.

The fifth column indicates whether a fault occurred then disappeared.

The sixth column shows if there is currently a fault on the card.



List of Possible Faults, Description and Probable Cause

FAULTS DETECTED BY THE POWER SUPPLY		
FAULT	DESCRIPTION	PROBABLE CAUSE
Undervoltage	The voltage level on the DC bus is below the minimum threshold	Mains voltage out of tolerance. Mains isolating switch open
Overvoltage	The voltage level on the DC bus is above the maximum threshold	Braking module faulty Mains voltage out of tolerance
Earth fault	The current is not balanced between the two branches of the DC bus	Earth leakage (motor phase, etc.)
Resistor temperature	The thermal switch of the braking resistor is open	Braking module faulty Resistor rating

FAULTS DETECTED BY THE CURRENT AMPLIFIERS		
FAULT	DESCRIPTION	PROBABLE CAUSE
Heat sink temperature	The thermal switch on the heat sink is open	RMS current > amplifier Ip
Power control (auxiliary power supply monitor)	Detection of an axis drive auxiliary power supply failure	
Short circuit	Short circuit between motor phases or on the DC bus	The fault might be internal or external ato the module. Check the motor power leads for shorts
Serial bus	Transmission error on the serial (fibre-optic) bus between the QVN card and a servo-drive	Fibre-optic ring not connected or open circuited SBCE drivers faulty
Overcurrent	Overcurrent detected in the axis drive	

FAULTS DETECTED BY THE QVN CARDS		
FAULT	DESCRIPTION	PROBABLE CAUSE
Complementarity	Faulty complementary signals on one of the encoder channels	Encoder failure Encoder wiring problems
Overspeed	Overspeed detected (the threshold is set at 1.8x the max speed specified by parameter P73)	Motor runaway Wrong speed setting in P73
Overcurrent (overtorque)	Current draw greater than $2^{0.5}$ / 3 times the peak current detected for too long (detection threshold = peak current x 2s)	Motor blocked Mechanical problem on the axis
Feedback loss	With sinusoidal feedback, the electrical angle supplied by the incremental channels for the rotor position is no longer consistent with the electrical angle supplied by the absolute channels (the fault detection threshold is between 5 and 35 electrical degrees)	Motor encoder fault Encoder cable fault
Drive runaway	The axis drive power transistor control is locked	

FAULTS DETECTED BY AN ENCODER		
FAULT	DESCRIPTION	PROBABLE CAUSE
Noisy signal	Encoder signal is weak or noisy	Encoder fault Cable fault Shielding problems
Absolute channel code	A code which is never used was detected on the absolute feedback channels from the motor	Encoder fault Encoder cable fault

FAULTS DETECTED BY A MOTOR		
FAULT	DESCRIPTION	PROBABLE CAUSE
Motor temperature	The internal thermal switch of the motor is open	RMS current in the motor > rated motor current Mechanical axis problem

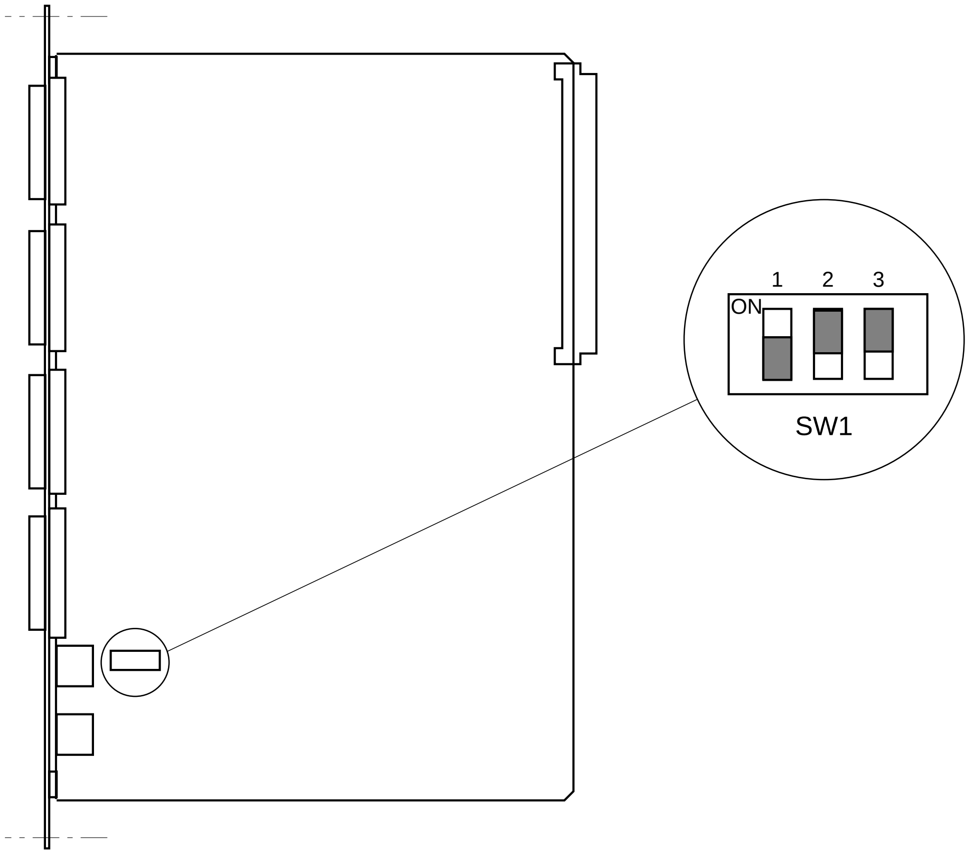
6.3.4 Replacing an Axis Card

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card. Be especially careful to identify the transmitter and receiver fibre-optic cables.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.
5. Set the DIP optical power switches on the new card exactly as they were the one on the old card (see Sec. 6.3.5).
6. Install the new card in the rack and moderately tighten the attaching screws.
7. Reconnect any cables removed from the axis ports. Be careful to place the fibre-optic cables in the same connectors as on the old card.
8. Power up the machine, then the CNC.

6.3.5 Fibre-Optic Power Settings

Fibre optics uses light instead of electricity to transmit information. To correctly calibrate the light intensity, it is necessary to set the optical power on the QVN card. This is done by setting a series of DIP switches located near the fibre-optic ports.



Distance	Switch 1	Switch 2	Switch 3
0.2, 1 m	ON	OFF	OFF
5, 10, 15 m	OFF	ON	OFF
20, 30 m	OFF	OFF	OFF

The distances are specified in metres because the cables supplied by NUM come only in the lengths specified in the table. If the cable used is a different length, chose the closest length from the table. The table settings are for plastic fibres, which are the kind used in NUM cables.

7 Input/Output Cards

Five different types of I/O cards are available from NUM. They are listed in the table below. These cards can be used in any combination. Some OEMs prefer to combine different cards, whilst others choose only one type.

Type	Inputs	Outputs	Connection
32 I	32 inputs @ 24 VDC	None	Terminal strip on the card edge
32 O	None	32 relay outputs	Terminal strip on the card edge
32 I/24 O	32 inputs @ 24 VDC	24 outputs @ 24 VDC	2 sub.D connectors on front plate
32 I/24 O	32 inputs @ 24 VDC	24 outputs @ 24 VDC	2 high density connectors
64 I/48 O	64 inputs @ 24 VDC	48 outputs @ 24 VDC	2 high density connectors

7.1 I/O Card Display and Troubleshooting

The state of each input or output can be displayed on the CNC. Before going into the display procedure, it is important to understand the structure of the I/O addresses.

Input and Output Addresses

%I r c xx . b

- b: The extension defines the bit number, from 0 to 7
- xx: Byte on the I/O card, range from 0 to 7
- c: I/O card slot number, range from 5 to B
- r: Rack number, range 0 to 7
- %I: Identifies whether it is an input or an output
  %I: input
  %Q: output.

The rack numbering is a little tricky because the logical addresses are not the same as the physical addresses. Always use the logical address, not the physical address, to display an input or output on the CRT or call it in a ladder programme.

Device	Logical rack address	Physical rack address with fibre-optic ring	Physical rack address without fibre-optic ring
Main rack	0	7	0
Extension racks	1-7	0-6	N/A
Machine panels	0	0- 3	N/A

7

Byte Determination

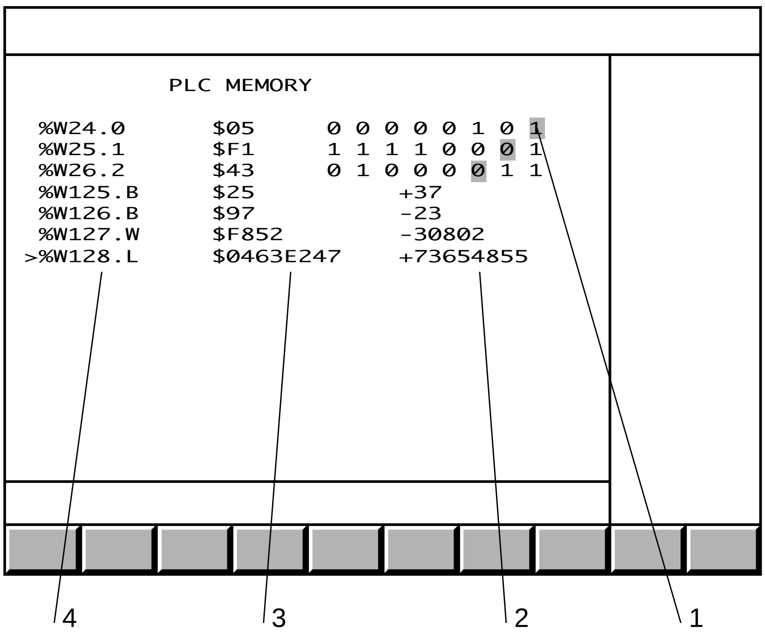
To determine byte number xx on an input or output card, it is necessary to know how many bytes there are on each card. This is given by the table below.

For instance, to obtain output 31 of the output card located in slot 9 of the main rack, the address would be %Q0903.7.

Input number	Output number	Byte Number
0-7	0-7	00
8-15	8-15	01
16-23	16-23	02
24-31	24-31	03
32-39	32-39	04
40-47	40-47	05
48-55	N/A	06
56-63	N/A	07

7.1.1 Input/Output Display

1. Press key F9 (PLC I/O) at the bottom of the screen.
2. Type 2 or use the cursor control keys to select option 2, PLC Memory, then press ENTER.
3. The PLC Memory screen is displayed. It contains a small prompt labelled “Address” in the lower left-hand corner for entry of an address. For instance, if you type %I0100.0 and press ENTER, the contents of the address specified are displayed.



1 - Values of bit variables highlighted in the corresponding bytes
2 - Decimal values of byte, word or long word variables
3 - Hexadecimal values of byte, word or long word variables
4 - Variables

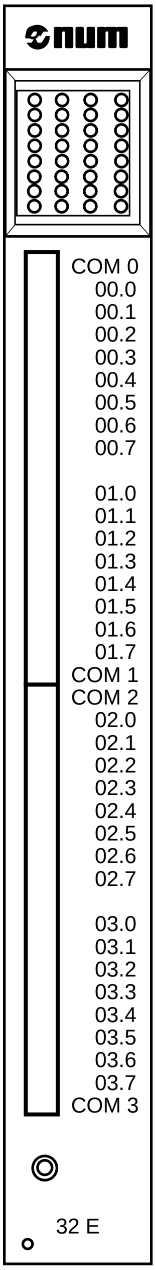
When displaying bit values, the contents of the address are always displayed as 8 bits.

Example: Entry of addresses %I0B00.0 and %Q0A01.4 and corresponding displays:

```
%I0B00.0      $01      0 0 0 0 0 0 0 1
%Q0A01.4      $10      0 0 0 1 0 0 0 0
```

In this example, bits 0 and 4 are requested. Both bits are highlighted (reverse video) on the screen.

7.2 32-Input Card

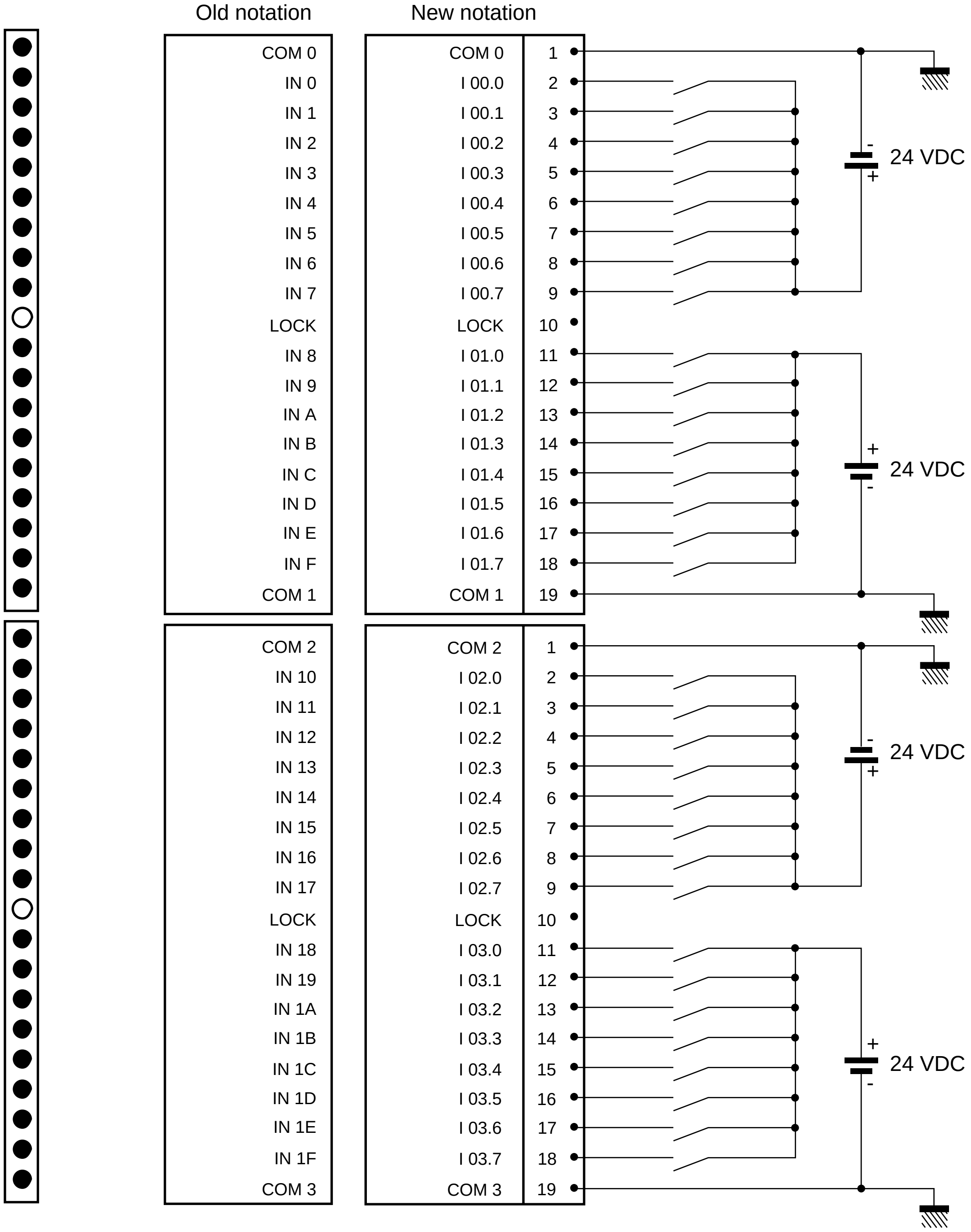


The 32-input card has two 16-contact screw terminal strips on the front plate. There are 32 LEDs at the top of the card which are lit when the corresponding inputs are high. These cards assume the address of the slot in which they are placed.

Nominal input voltage	+24 VDC
Maximum current rating	8 mA per input
Reverse voltage withstand capability	30 V continuous
Low input level (logic 0)	0-5 VDC (current < 1 mA)
High input level (logic 1)	13.2-30 V (current > 4 mA)
Logic	Positive

7.2.1 Input Wiring

The inputs are wired as shown below. They are grouped in four sets of 8 inputs. Each group has its own common connection.



Trelec 18-contact
connectors
+ locking system
and polarising pins

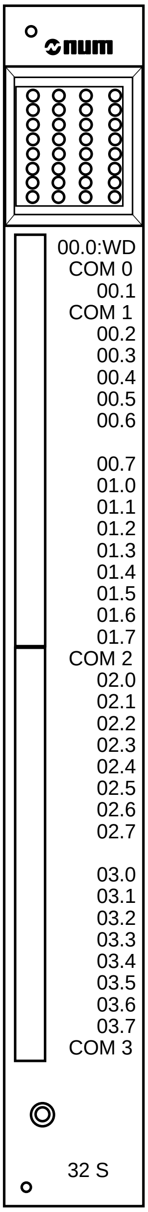
7.2.2 Replacing the Card

These cards do not include any components that can be replaced by the user. In case of a fault, replace the card.

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card. The terminal strips are ganged and attached by a single screw.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.
5. Install the card in the rack and moderately tighten the attaching screws.
6. Reinstall all the connections removed above.
7. Power up the machine, then the CNC.

7.3 32-Output Card



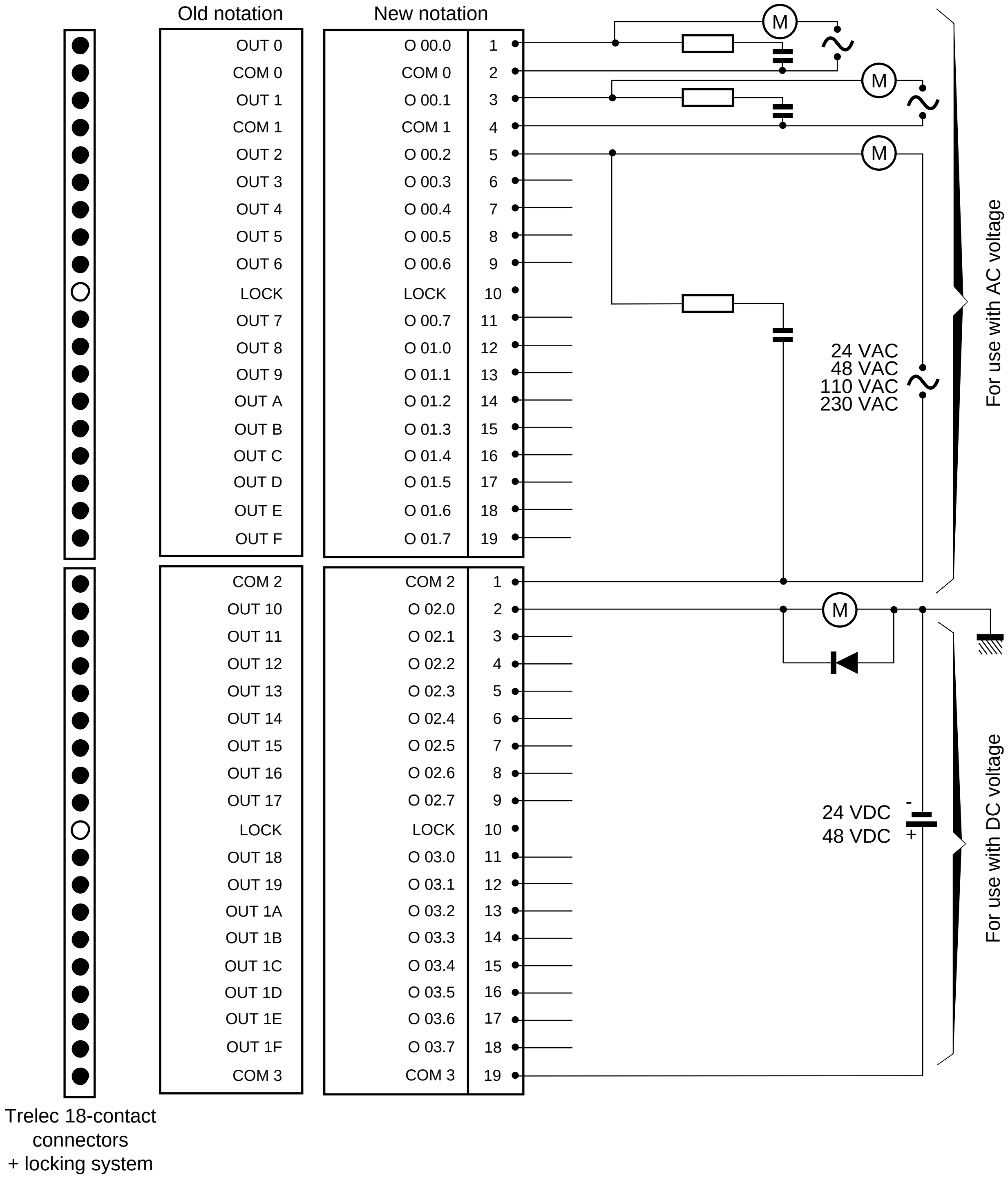
The 32-output card has two 16-contact screw terminal strips on the front plate. This card uses reed relays with fuse protection for the outputs. There are 32 LEDs at the top of the card which are lit when the corresponding outputs are high. These cards assume the address of the slot in which they are placed.

Operating voltages	24 VDC or 48 VDC 24 VAC to 230 VAC
Maximum current rating per output (refer to Installation and Commissioning Manual 938816 for more detailed information)	DC: 0.8 A at 24 VDC 0.5 A at 48 VDC AC: 0.8 A at 24 VAC 0.6 A at 48 VAC 0.5 A at 110 VAC 0.25 A at 230 VAC
Maximum current per group of 8 outputs	5 A
Fuses	Two: 250 V, 5 A
Suppression	None (provide an external diode or RC circuit)

7.3.1 Output Wiring

The outputs are wired as shown below. On the top connector, the first two outputs have their own separate common connections. The 14 other outputs use common COM2. The bottom connector with 16 contacts uses common COM3 for its supply voltages.

The wiring diagram shows DC and AC voltages on a single card. But in actual practice, the card could be wired for all DC or all AC or any other combination of the two.



7.3.2 Replacing the Card

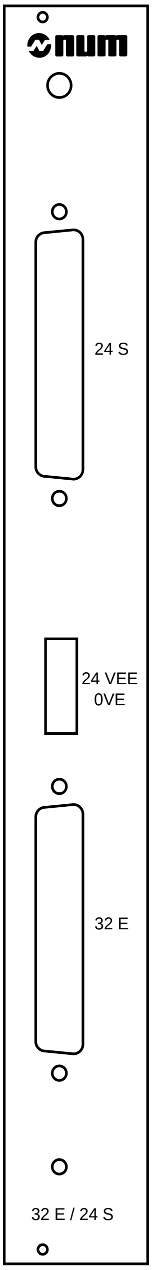
With the exception of the fuses, these cards do not include any components that can be replaced by the user. Always check the fuses first, before deciding the card is faulty. There are two fuses, one for each group of 16 outputs.

If after checking the fuses, the card is determined to be faulty, replace the complete card.

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card. The terminal strips are ganged and attached by a single screw.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.
5. Install the card in the rack and moderately tighten the attaching screws.
6. Reinstall all the connections removed above.
7. Power up the machine, then the CNC.

7.4 32-Input/24-Output Card (with Sub.D connectors)



Outputs

O 00.0 to O 00.7
O 01.0 to O 01.7
O 02.0 to O 02.7

Inputs

I 00.0 to I 00.7
I 01.0 to I 01.7
I 02.0 to I 02.7
I 03.0 to I 03.7

The 32-input/24-output card has two sub.D connectors on the front plate separated by a two-contact power supply connector, which can be used for connection of an external power supply. This type of card can be used with input and relayed output interface panels to allow external wiring of the inputs and outputs, or the inputs and outputs can be directly connected to the sub.D connectors. Like all input/output cards, these cards assume the address of the slot where they are located.

Inputs

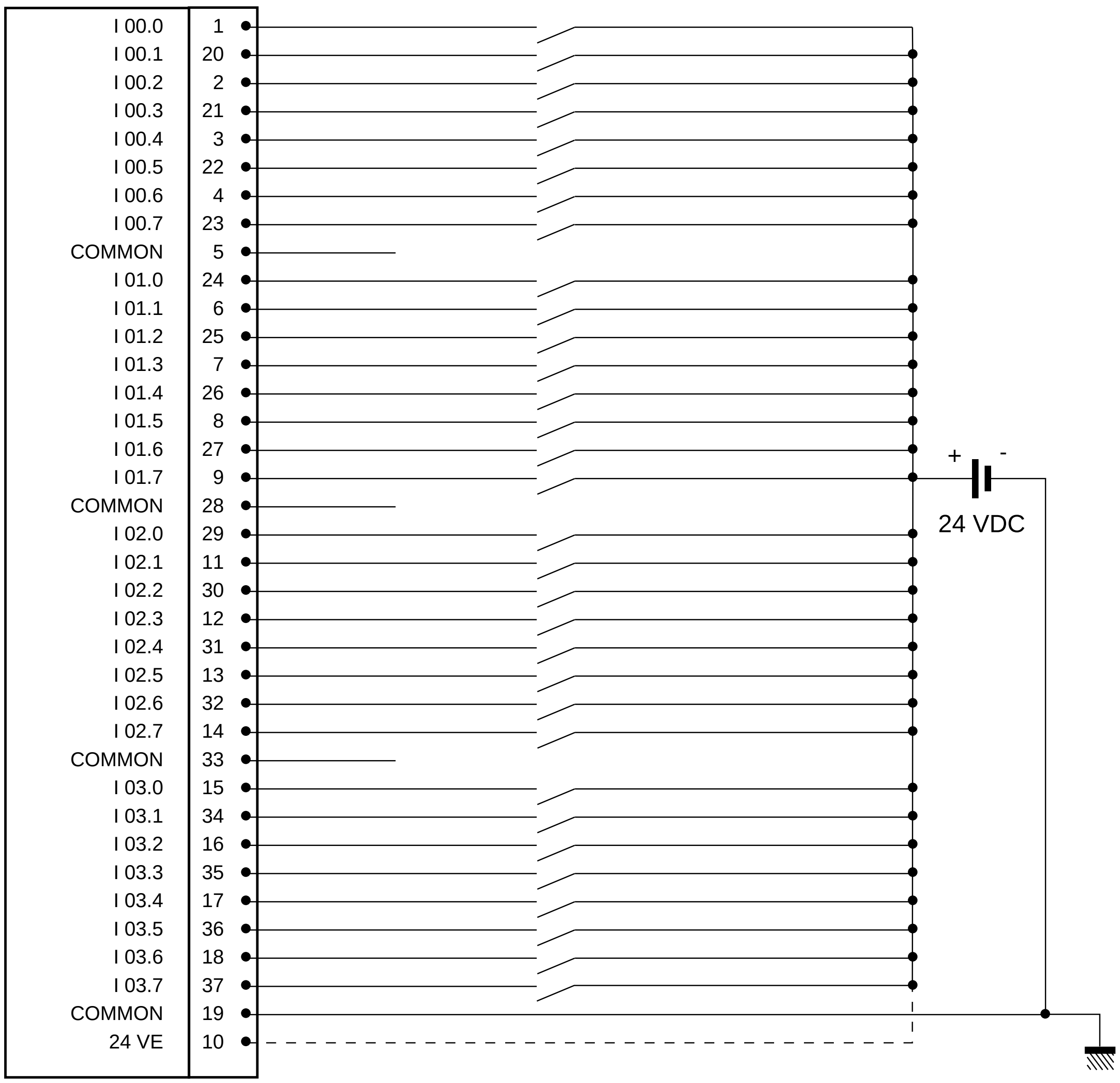
32 inputs	
Input voltage	15-30 VDC
Maximum current rating per input	30 mA
Low input level (logic 0)	0-5 VDC
High input level (logic 1)	11-30 VDC
Logic	Positive (sink)

Outputs

24 open-collector outputs	1 group of 16 and 1 group of 8
Output voltage	15-30 VDC (external power supply required)
Maximum current rating per output	30 mA to interface panel 250 mA to another load 3 A for t < 10 µs
Overload protection	Thermal with trip Clipping and discharge diode Reverse-biased parallel diode

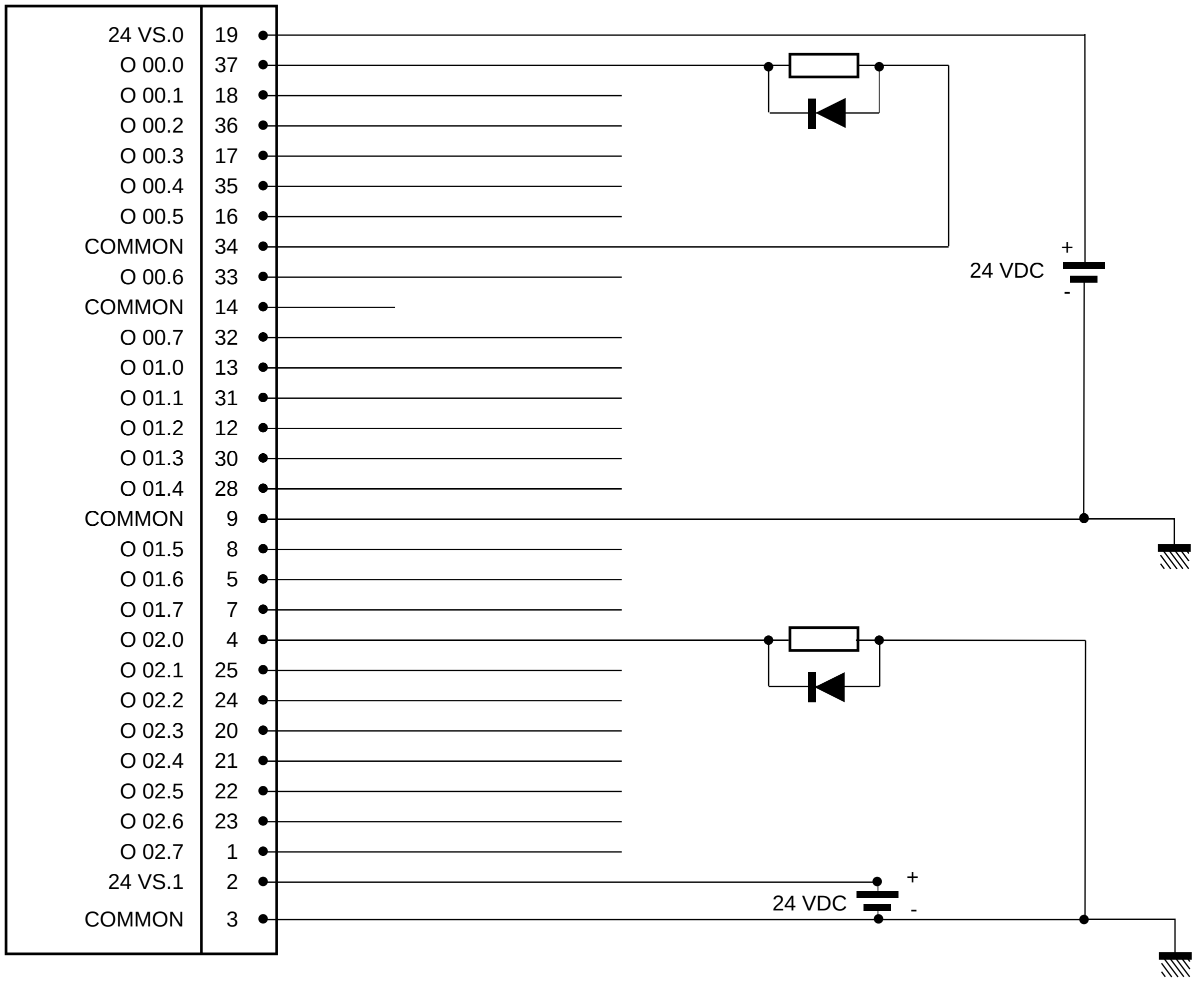
7.4.1 Input Wiring

The inputs are wired as shown below



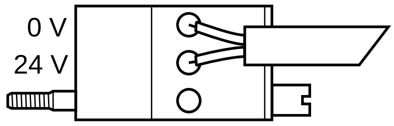
7.4.2 Output Wiring

The outputs are wired as shown below.



7.4.3 External Power Connector

The external power connector is wired as shown opposite. Connect an external power supply to this connector to supply the output levels and input commons.



7.4.4 Replacing the Card

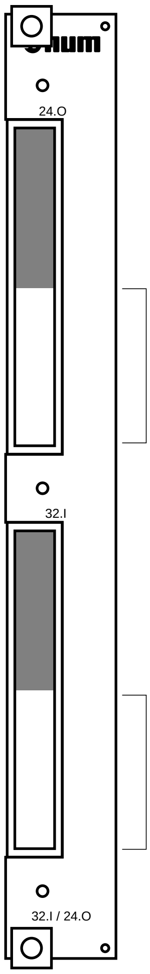
These cards do not include any components that can be replaced by the user. In case of a fault, replace the complete card.

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card. The terminal strips are ganged and attached by a single screw.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.
5. Install the card in the rack and moderately tighten the attaching screws.
6. Reinstall all the connections removed above.
7. Power up the machine, then the CNC.

7

7.5 32-24 I/O Card (with high density connectors)



The 32-24 I/O card includes two high density connectors on the front plate. This type of card must be used with input and relayed output interface panels to allow external wiring. Like all input/output cards, these cards assume the address of the slot where they are located.

The connections to the interface panels are made via cables supplied by NUM fitted with connectors at both ends and available in lengths of 1 m and 2 m. Since these cables are already terminated, the pinout is not given.

Refer to the sections on interface panels for more information on the connectors..

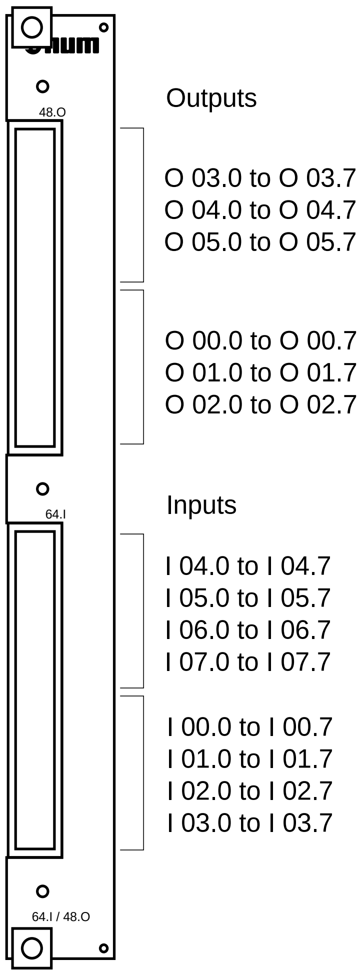
7.5.1 Replacing the Card

These cards do not include any components that can be replaced by the user. In case of a fault, replace the complete card.

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card. The terminal strips are ganged and attached by a single screw.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.
5. Install the card in the rack and moderately tighten the attaching screws.
6. Reinstall all the connections removed above.
7. Power up the machine, then the CNC.

7.6 64-48 I/O Card (with high density connectors)



The 64-48 I/O card includes two high density connectors on the front plate. This type of card must be used with input and relayed output interface panels to allow external wiring. Like all input/output cards, these cards assume the address of the slot where they are located.

The connections to the interface panels are made via cables supplied by NUM fitted with connectors at both ends and available in lengths of 1 m and 2 m. Since these cables are already terminated, the pinout is not given.

Refer to the sections on interface panels for more information on the connectors.

7.6.1 Replacing the Card

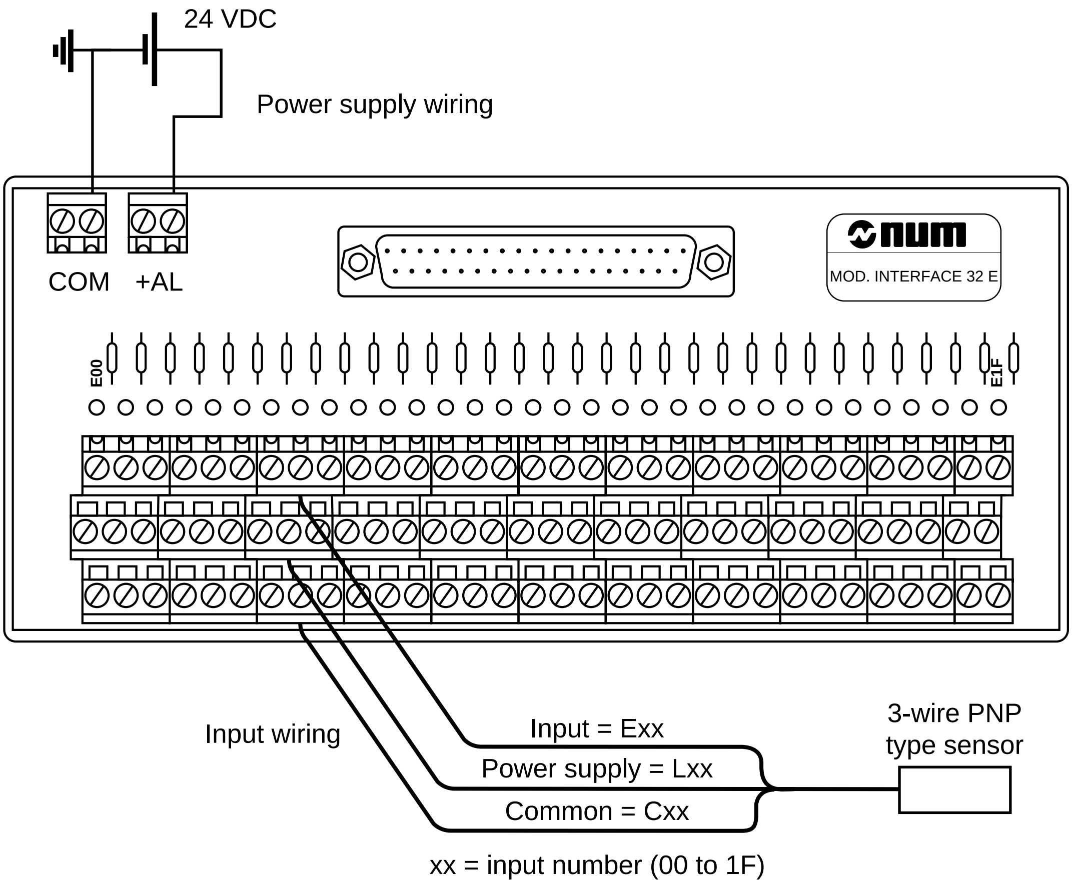
These cards do not include any components that can be replaced by the user. In case of a fault, replace the complete card.

Before beginning, make sure a replacement card is available.

1. Power down the CNC system and the machine.
2. Remove all the connections from the card. The terminal strips are ganged and attached by a single screw.
3. Loosen the two card attaching screws, one at the top and one at the bottom.
4. Gently pull out the card to unplug it from the rack.
5. Install the card in the rack and moderately tighten the attaching screws.
6. Reinstall all the connections removed above.
7. Power up the machine, then the CNC.

7.7 32-Input Interface Panel

The input interface panel facilitates field wiring of the machine. The panel is equipped with three rows of terminals. The first row contains the inputs, the second the +24 VDC bus and the third the 0V bus.

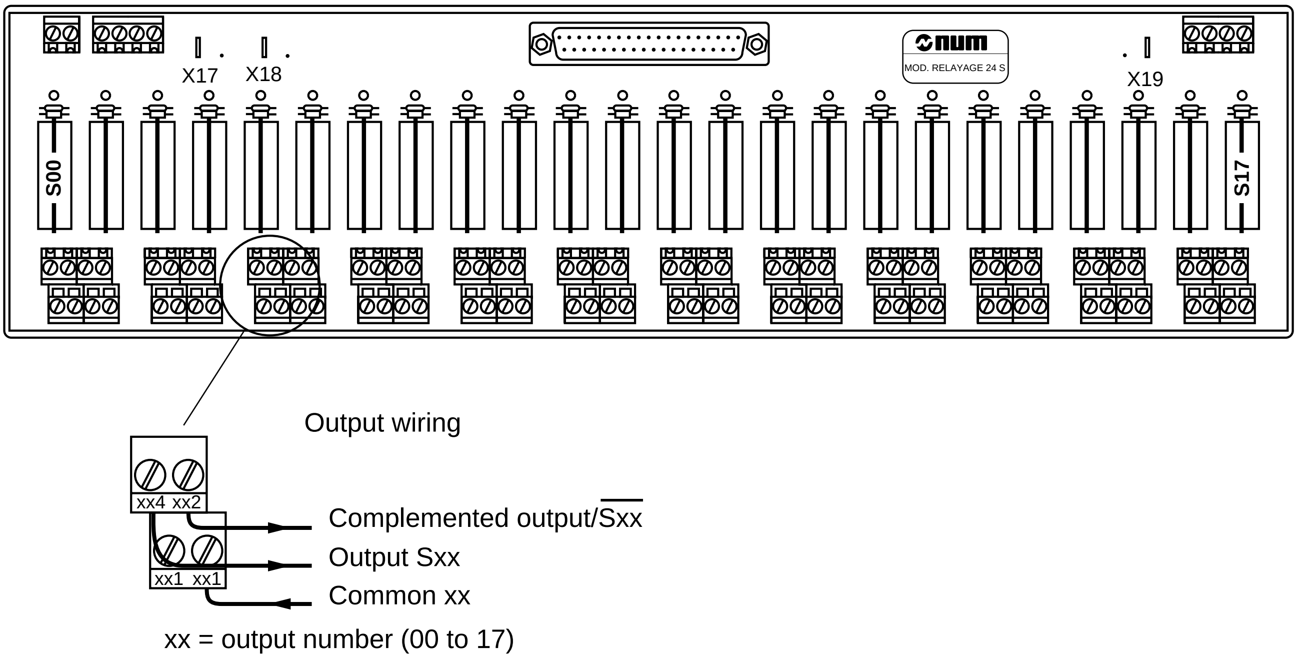


7.7.1 Replacing the Panel

No settings are required when replacing the interface panel. Refer to Installation and Commissioning Manual 938816 for further details.

7.8 24-Output Relay Panel

The output relay panel facilitates field wiring of the machine. The panel is equipped with two rows of terminals. The first row contains the direct and complemented outputs and the second the power supply for each output. This panel is equipped with relays which are switched by the output from the CNC. Each relay can have different voltages wired across its terminals. The relays are designed to be readily removable for replacement.



7.8.1 Replacing the Panel

When replacing a panel, there are three jumpers to be set: X17, X18 and X19, located near the top edge of the panel. Make sure the jumpers are in exactly the same location on the new panel. Refer to Installation and Commissioning Manual 938816 for further details.

8 IT/Serial Line Card

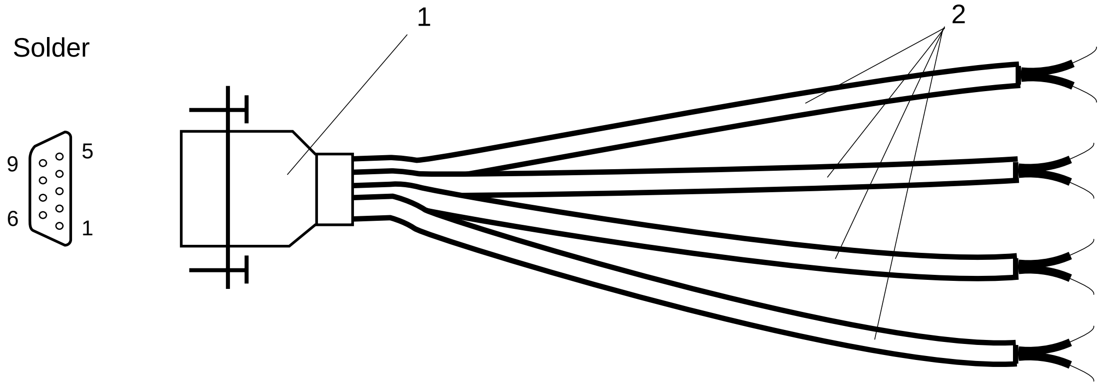
The IT/serial line card is connected to the system bus. It processes external interrupts (four 5 V or 24 V inputs) and four multiprotocol serial lines (RS232, RS422 and RS485). A maximum of two IT/serial line cards can be installed in a given system.

Note: This card must be installed just after the CNC cards to operate correctly.

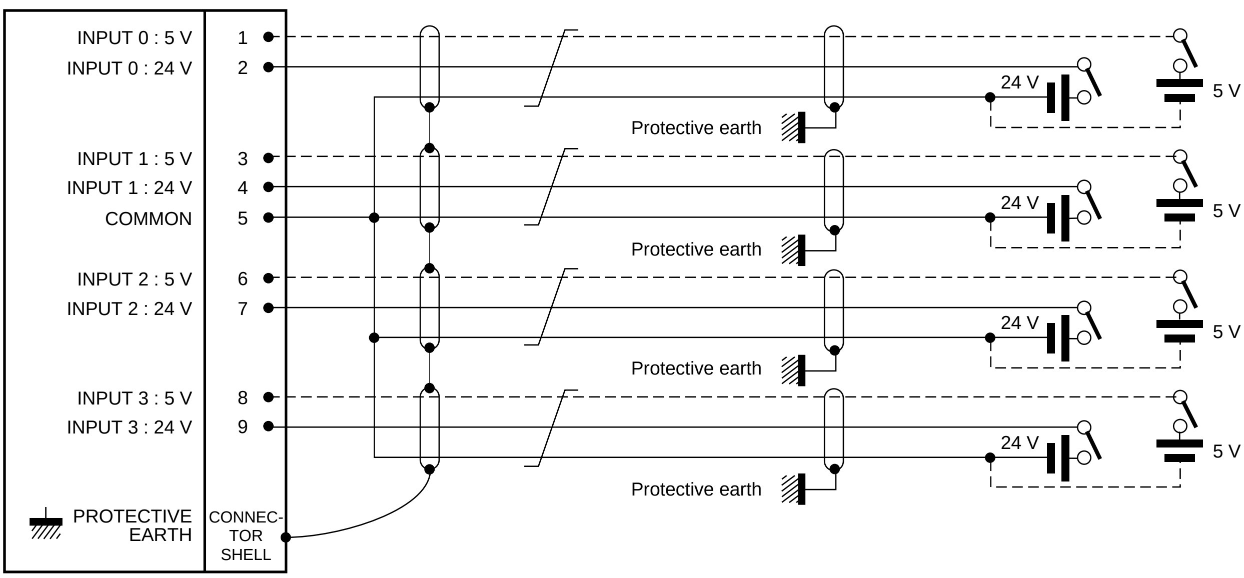
No special adjustments are required for replacing this card. However, the serial line settings may have to be adapted to the protocol used.

The card part number is 204203370. A simplified version which only processes interrupt inputs is also available. Its part number is 204202371.

The interrupt wiring is as follows



1 - 9-contact male Sub.D connector plug
2 - Four shielded twisted pair cables (cross-sectional area 0,22 mm^2)

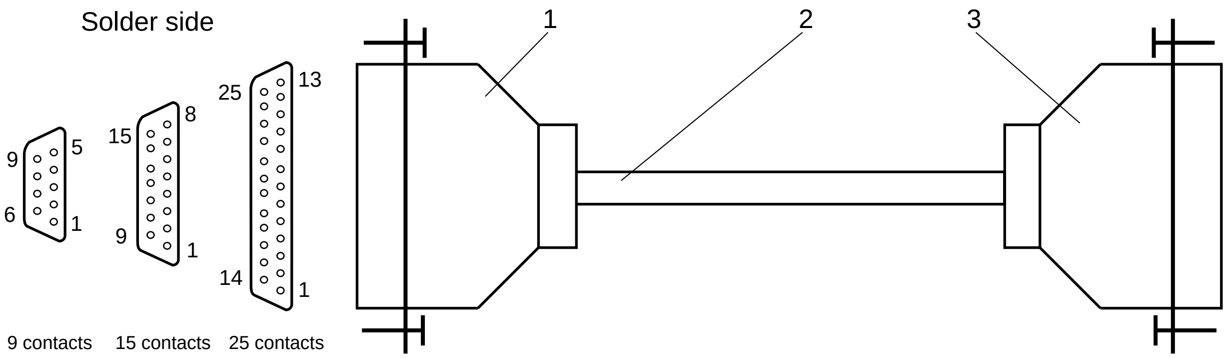


All the interrupt signals must be sent via shielded cables.

The serial interfaces are wired according to one of the following diagrams

<u>RS232 Serial Interface Cable</u>

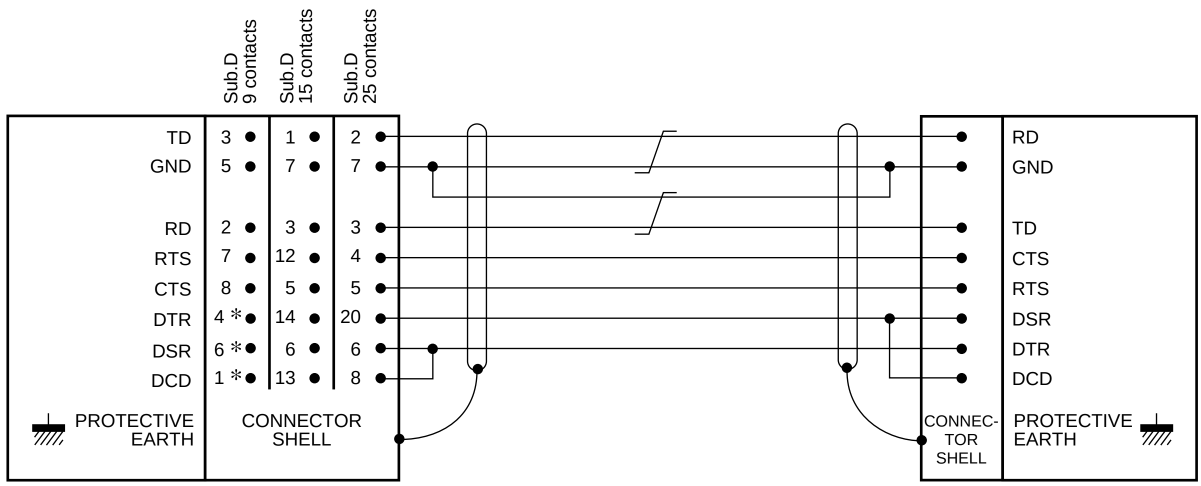
This cable can be adapted to suit the peripheral device by not wiring the signals that are not going to be used and by using an appropriate cinnector (see peripheral manual).



1 - Male Sub.D connector plug:
- 25 contacts on machine processor, CNC processor and UC SII CPU
- 15 contacts on IT/serial line card
- 9 contacts on the V2 machine processor, V2 CNC processor and UC SII CPU

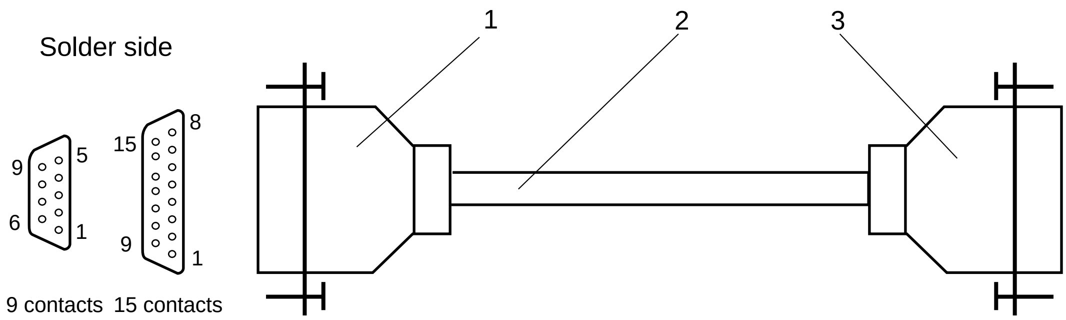
2 - Shielded cable depending on the peripheral device (2 twisted pairs and 4 conductors for complete connection, minimum size 0.2 mm[2])

3 - Connector plug depending on the peripheral device



* Contacts 1, 4 and 6 are not wired on 9-contact connectors of the V2 machine processor and V2 CNC processor.

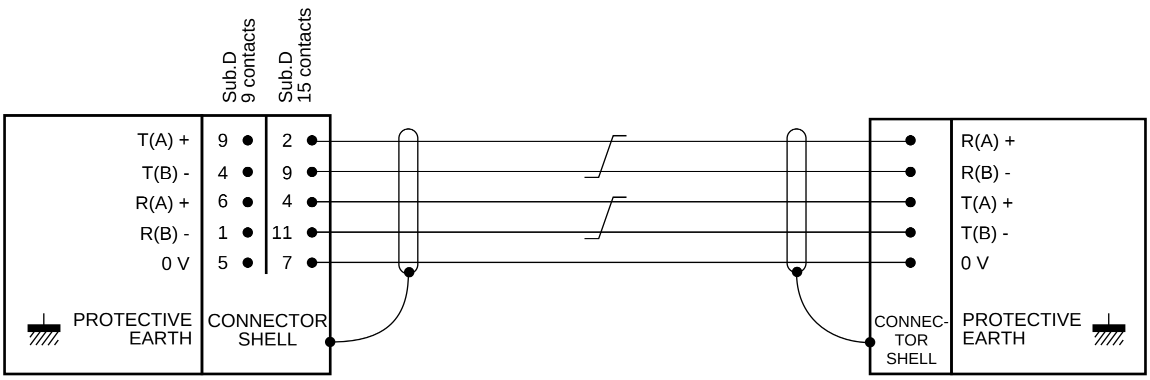
RS422 Serial Interface and High-Speed Cable



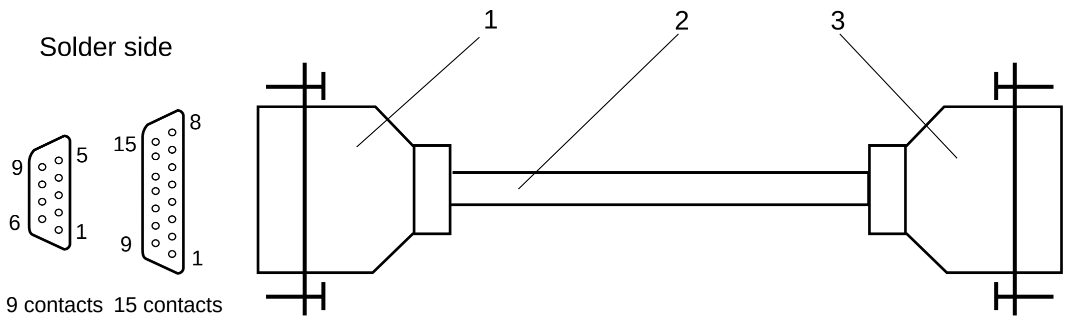
1 - Male Sub.D connector:
  - 15 contacts on IT/serial line card and high-speed line of V2 CNC processor
  - 9 contacts on the V2 machine processor and V2 CNC processor

2 - Shielding twisted 2-pairs and one isolated wire

3 - Sub.D connector plug depending on the application



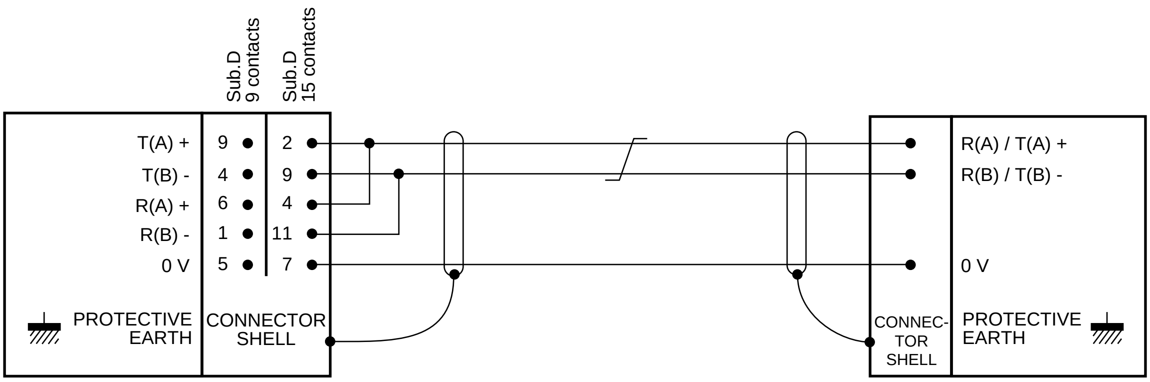
RS485 Serial Interface Cable



1 - Male Sub.D connector:
- 15 contacts on IT/serial line card
- 9 contacts on the V2 machine processor and V2 CNC processor

2 - Shielding twisted 2-pairs and one isolated wire

3 - Sub.D connector plug depending on the application



9 Analogue Input/Output Card

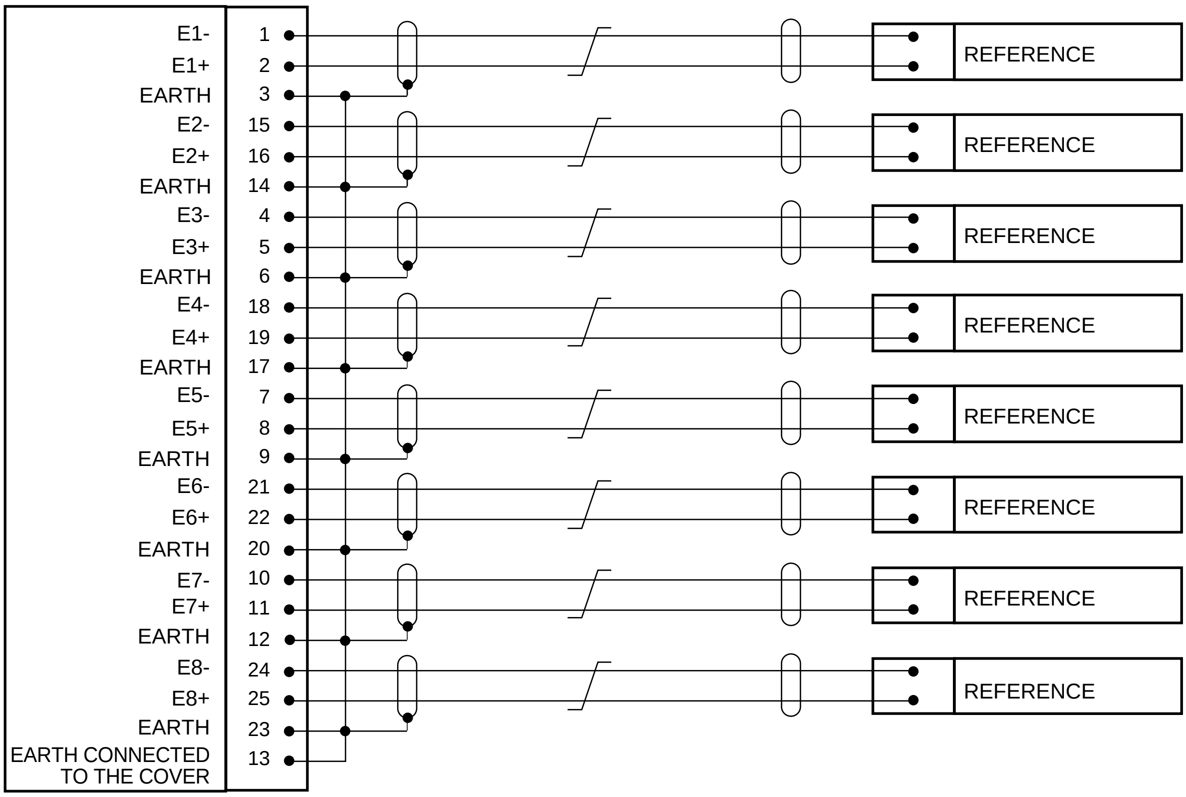
This card processes 8 analogue inputs and 8 analogue outputs at +/-10 V with a resolution of 12 bits. It can be configured by the machine processor application for:

- 8 inputs or 1 input (faster conversion)
- Gain of 1 or gain of 10 for each input.

No special adjustments are required for replacing this card. This card must be installed just after the CNC cards to operate correctly.

The card part number is 204202613.

The card must be connected using shielded cables. The cable wiring is shown in the diagram below:



10 Remote Input/Output Modules

10.1 Introduction

10.1.1 General

The remote input/output modules are designed to complete the line of input/output devices supplied by NUM. They are wired to the SBC fibre-optic bus to allow the inputs and outputs to be located as close as possible to the sensors and actuators.

The following types of modules are available:
- 24 VDC 16-input module
- 24 VDC 16-input/24 VDC 0.5 A 16-output module
- 8-input/2 A 8-output relay module, and
- 4-input/2-output analogue module.

These modules can be used with the following equipment:

CNC type	Limitation	Comments
NUM 1060 Series 1	Maximum 32 modules (*)	Maximum 4x4I/2O analogue modules
NUM PCNC 1060 Series 1	Maximum 32 modules (*)	Maximum 4x4I/2O analogue modules
NUM 1060 Series 2 (2-processor CPU)	Maximum 336 I/O (integrated I/O + remote I/O)	Maximum 2 machine panels in addition Maximum 2x4I/2O analogue modules in addition
NUM 1060 Seires 2 (UCSII CPU)	Maximum 336 I/O (integrated I/O + remote I/O)	Maximum 2 machine panels in addition 4I/2O analogue modules not allowed
NUM PCNC 1060 Series 2	Maximum 336 I/O (integrated I/O + remote I/O)	Maximum 2 machine panels in addition 4I/2O analogue modules not allowed
NUM 1050	Maximum 336 I/O (integrated I/O + remote I/O)	Maximum 2 machine panels in addition Maximum 2x4I/2O analogue modules in addition
NUM 1040	Maximum 256 I/O (integrated I/O + remote I/O)	Maximum 2 machine panels in addition Maximum 2x4I/2O analogue modules in addition

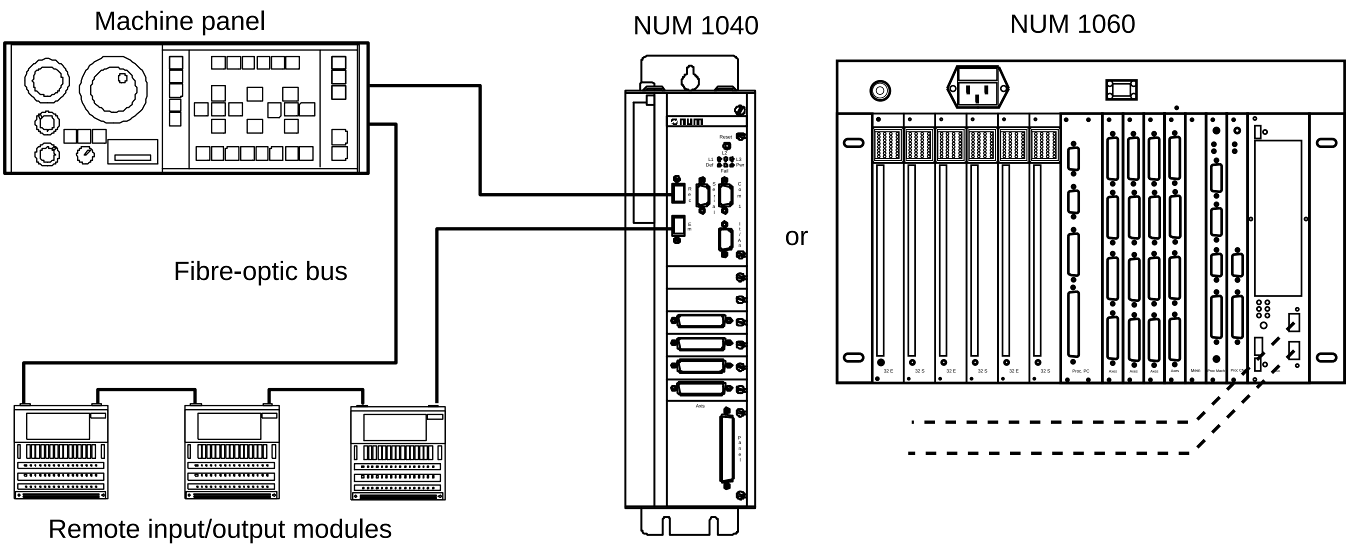
(*) With CNC software at index K and above (this number is limited to 16 for the CNC software at index J).

CAUTION

The use of the 4-input/2-output analogue modules requires CNC software at index MA or above.

10.1.2 Module Connection to the CNC

The modules are inserted in the fibre-optic ring of the PLC serial bus.

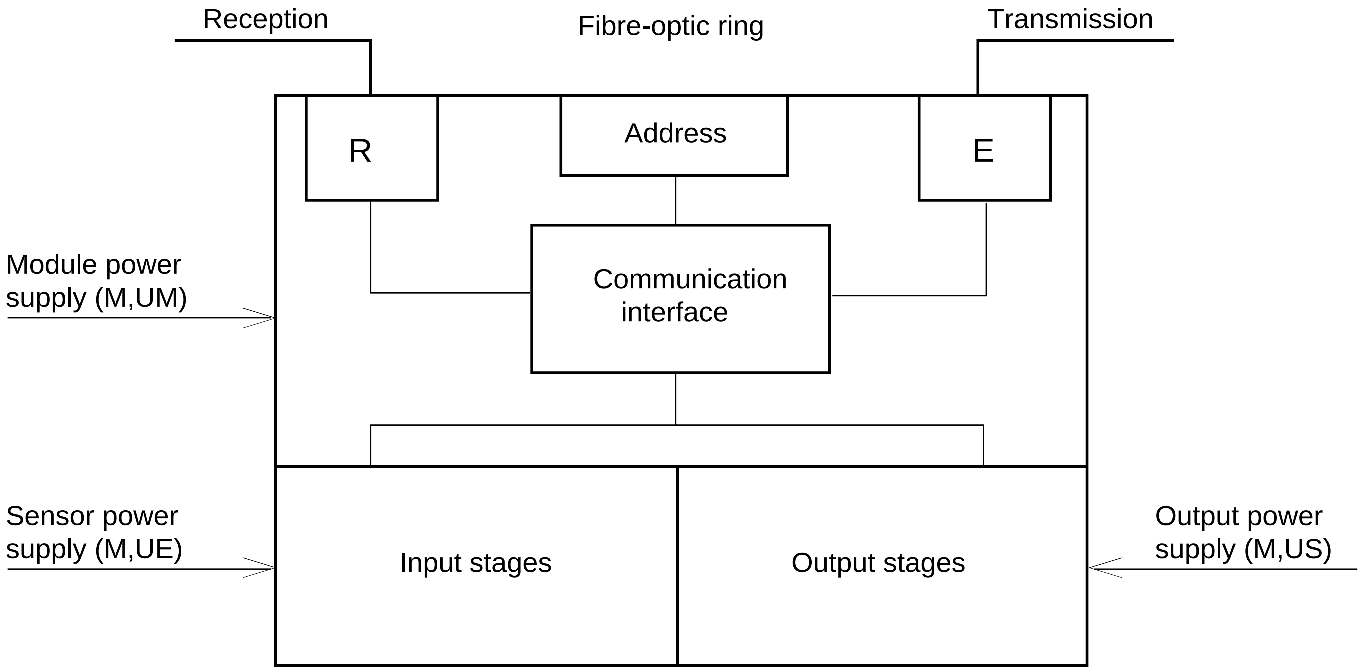


⚠ CAUTION
The maximum distance between two units is 40 metres.

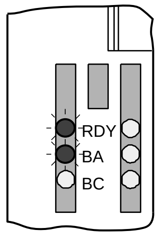
10.2 Diagnostics and Maintenance

10.2.1 Block Diagram of a Remote I/O Module

The internal structure of a remote I/O module can be schematically represented by the three functional subassemblies illustrated below.



LEDs



LED status during normal operation.

Communication LEDs

Green LED **RDY**: Ready
ON: Module ready for communication
OFF: Module faulty (initialisation impossible)

Green LED **BA**: Bus Activity
ON: The module is receiving frames
OFF: No frames

When the PLC is not in RUN mode, the BA LED is unlit.

Red LED **BC**: Bus Connection
ON: Fibre-optic cable cut or connection fault with the previous module
OFF: Connection OK

Faults can be classified in the following categories:
- Power supply faults
- Fault on the fibre-optic ring
- Address fault
- Input or output stage fault.

10.2.2 Power Supply Faults

To operate correctly, a remote I/O module requires presence of 24 VDC power supply for:
- The internal module logic (M,UM)
- The sensors wired to the inputs
- The output stages.

The presence of each of these power supplies is indicated by a green LED.

Failure of the power supply of a module causes a break in the fibre-optic ring, a watchdog timeout and sets the general link fault bit (DEFBUS %R97F.0).

Failure of the power supply of the sensors and/or the output stages is not detected or indicated by the PLC. It results in malfunctioning of the automatic control system, since the state of the inputs and/or outputs is no longer representative of reality.

REMARK *To enhance safety and availability of the automatic control system, it is recommended to wire these voltages to inputs that can be continuously monitored by the PLC programme.*

10.2.3 Fibre-Optic Ring Fault

A break in the fibre-optic ring causing a loss of data frames is immediately detected by the PLC, causes a watchdog timeout and sets the general link fault bit (DEFBUS %R97F.0).

The fibre-optic ring continuity fault can be located as follows:
- Search for the module on which the red BC LED is lit
- On this module, check that:
  - The reception fibre-optic cable (marked Rx) is correctly connected
  - The fibre-optic cable connecting it to the previous module is not damaged.
- On the previous module, check that:
  - It is correctly supplied
  - The transmission fibre-optic cable (marked Tx) is correctly connected
  - The output power setting switches are correctly set.

10.2.4 Address Fault

It is necessary to make sure that the addresses set on the remote I/O module effectively correspond to the addresses of the I/O variables used in the PLC programme.

When two I/O modules have the same address, the general link fault bit (DEFBUS %R97F.0) is set and a watchdog timeout occurs.

10.2.5 Input or Output Stage Fault

A fault on an input or output stage is not detected and results in malfunctioning of the automatic control system.

On the 16-input/16-output static I/O module, each shorted output is indicated by a red LED and a status word %Irc3C.W (1 bit per group of 8 outputs).

10.3 Replacement

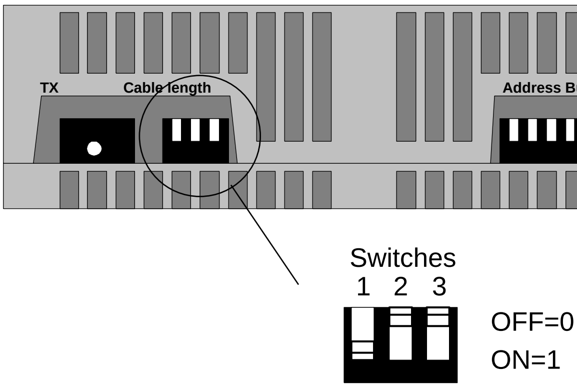
The replacement of these modules does not present any problems as they are software-configured. However, the fibre-optic cable power requires adjustment, and the address of the relevant module needs to be set by means of the "Cable length" and "Address bus" switch units which must be positionned as on the former module.

10.3.1 Setting the Output Power

The modules includes three switches used to set the output power according to the length of the fibre-optic cable.

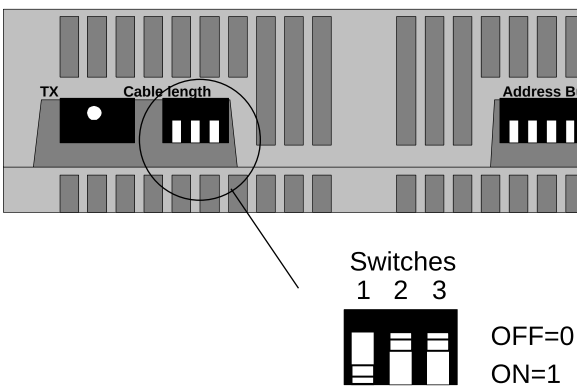
<u>Rear view:</u>

- 24 VDC 16-input module
- 24 VDC 16-input/24 VDC 0.5 A 16-output module
- 8-input/2 A 8-output relay module



<u>Rear view:</u>

- 4-input/2-output analogue module



Switch setting			Fibre-optic cable length (in metres)
Switch 1	Switch 2	Switch 3	
ON	OFF	OFF	0 < length < 15 m
OFF	ON	OFF	15 <= length < 30 m
OFF	OFF	ON	30 <= length <= 40 m

10.3.2 Programming

The remote discrete I/O modules must be used with CNC software at index J or above.

The remote analogue I/O modules must be used with CNC software at index MA or above.

10.3.2.1 Module Addressing

As is the case for the racks used in the PLC serial bus ring, it is necessary to define a geographical address for each remote I/O module used.

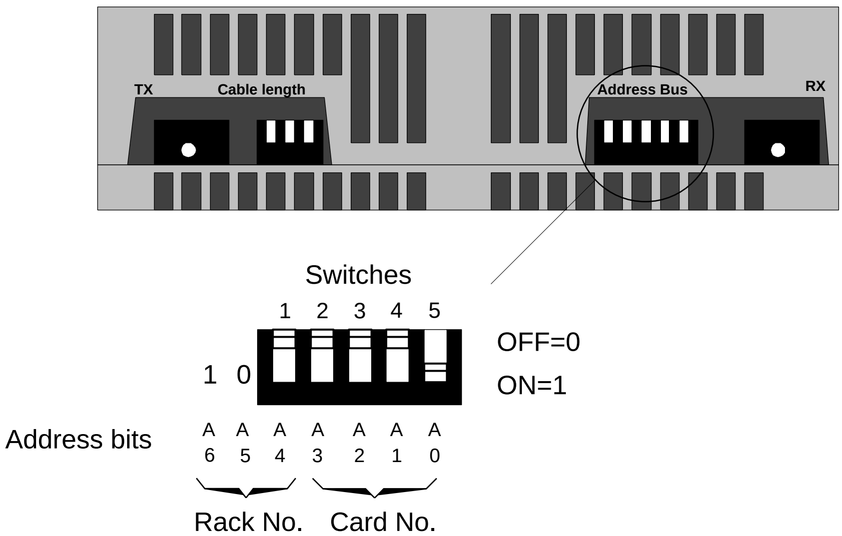
The module address is specified by assigning it a rack number and a card number. It is set on the 7 address bits, A0 to A6:
- A0 to A3: for the card number (0 to $F)
- A4 to A6: for the rack number (4 to 5).

Address bits A6 and A5 are internally set to high and low logic levels respectively. This means that the address field is limited to a maximum of 32 modules with a base address equal to $40. The first module has address $40 (rack 4, board 0) and the last has address $5F (rack 5, board F).

The module address is thus set on address bits A0 to A4 using the five address switches at the rear of the module.

Rear view:

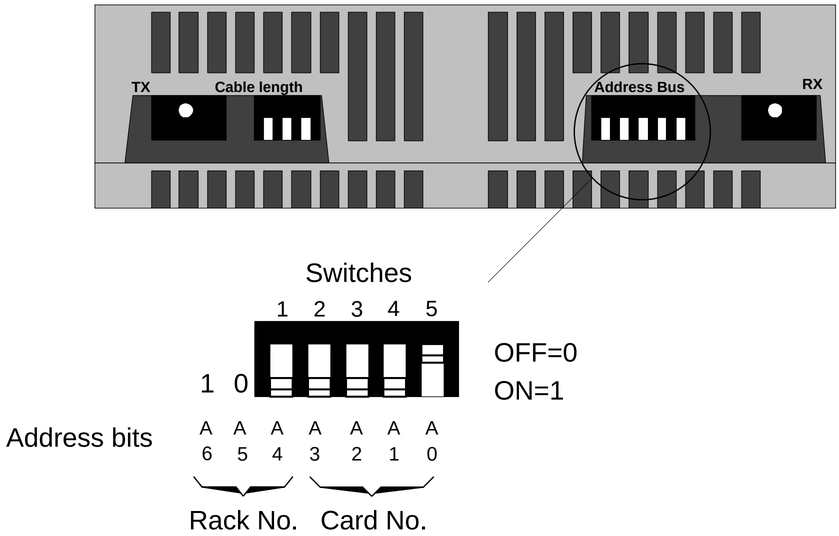
- 24 VDC 16-input module
- 24 VDC 16-input/24 VDC 0.5 A 16-output module
- 8-input/2 A 8-output relay module



In the example above, the module address is $41.

Rear view:

- 4-input/2-output analogue module



In the example above, the module address is $5E.

Module Address Table

Switches					Module address
Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	
OFF	OFF	OFF	OFF	OFF	$40
OFF	OFF	OFF	OFF	ON	$41
OFF	OFF	OFF	ON	OFF	$42
OFF	OFF	OFF	ON	ON	$43
OFF	OFF	ON	OFF	OFF	$44
OFF	OFF	ON	OFF	ON	$45
OFF	OFF	ON	ON	OFF	$46
OFF	OFF	ON	ON	ON	$47
OFF	ON	OFF	OFF	OFF	$48
OFF	ON	OFF	OFF	ON	$49
OFF	ON	OFF	ON	OFF	$4A
OFF	ON	OFF	ON	ON	$4B
OFF	ON	ON	OFF	OFF	$4C
OFF	ON	ON	OFF	ON	$4D
OFF	ON	ON	ON	OFF	$4E
OFF	ON	ON	ON	ON	$4F
ON	OFF	OFF	OFF	OFF	$50
ON	OFF	OFF	OFF	ON	$51
ON	OFF	OFF	ON	OFF	$52
ON	OFF	OFF	ON	ON	$53
ON	OFF	ON	OFF	OFF	$54
ON	OFF	ON	OFF	ON	$55
ON	OFF	ON	ON	OFF	$56
ON	OFF	ON	ON	ON	$57
ON	ON	OFF	OFF	OFF	$58
ON	ON	OFF	OFF	ON	$59
ON	ON	OFF	ON	OFF	$5A
ON	ON	OFF	ON	ON	$5B
ON	ON	ON	OFF	OFF	$5C
ON	ON	ON	OFF	ON	$5D
ON	ON	ON	ON	OFF	$5E
ON	ON	ON	ON	ON	$5F

11 Racks

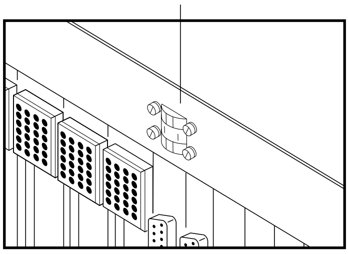
The main rack is not just a passive device. It includes some active components connected to the backplane bus. It is necessary to set the address of the main rack.

11.1 Rack Addressing

Racking numbering is a little tricky because the rack address differs according as the fibre-optic ring is present or absent.

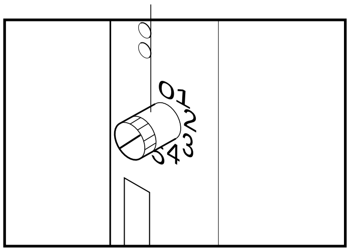
The table below shows the correct addressing. It should be noted that the logical addresses are not the same as the physical addresses. Always set the physical address, on the rack thumbwheel.

Thumwheel



Main racks and 12-slot extension racks

Thumwheel



2-slot extension rack

Device	Logical rack address	Physical rack address with fibre-optic ring	Physical rack address without fibre-optic ring
Main rack	0	7	0
Extension racks	1-7	0-6	N/A
Machine panels	0	0-3	N/A

11.2 EEPROM Chips

The EEPROM chip on the backplane contains the CNC customisation data, i.e. the settings of the machine parameters and the options selected by the OEM. This chip is not removable! Always back up the data it contains before replacing the rack.

CAUTION

The rack contains essential data. Do not replace the rack without checking with NUM technical support.

The data contained in the EEPROM can be partially recovered. The machine parameters can be backed up by a maintenance technician, but not the customisation data. It is therefore necessary to obtain a new customisation for the spare rack in order for the machine to operate correctly. Among these data are the Affaire Number, mentioned in Chapter 1. The other information concerns the maximum number of axes and spindles, as well as the basic and extra software options, the memory sizes, etc.

11.3 Temperature Sensor

There is a temperature sensor mounted in the fan housing just above the power supply. This sensor is designed to detect overheating of the power supply. It is normally wired to a PLC input and monitored by the PLC. It is a simple thermistor and can be checked by an ohmmeter if it seems faulty or is open. The sensor resistance increase with temperature until it looks like an open circuit to the PLC input.

11.4 Power Connections

The rack is powered by 220 VAC single phase. The power cable is connected to the receptacle located in the upper left-hand corner of the rack, which is fitted with a small fuse. If the fuse blows, the fans located in the top of the rack are stopped. In case of a problem, the power supply is probably not faulty if the fans are running, but the voltage should be checked. Use a small screwdriver to pry the fuse-holder out of the receptacle. Refer to Section 3.1 for further details on the power supply.

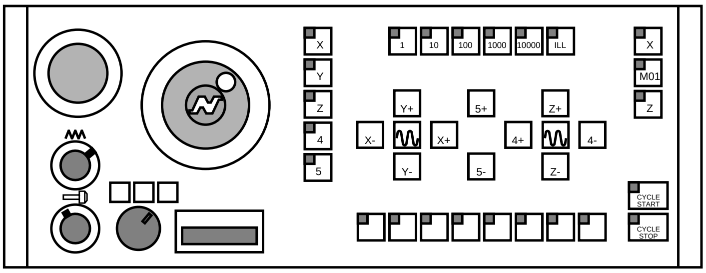
11.5 Replacing a Rack

Always check with NUM technical support before attempting to replace a rack. Also read Section 11.2, EEPROM Chips, and back up the machine parameters.

1. Power down the machine and the CNC system
2. Unplug all the cables from the cards in the rack and from the rack itself, marking each cable with the name of the connector it came from!
3. Unscrew the rack equipped with all its cards as a single unit.
4. Set the old rack next to the new rack on a workbench. Gently remove each card from the old rack and insert it in the new one, starting with the power supply on the right-hand side and working leftward. Always hold the cards by the edges and be careful not to touch the surface.
5. Install the new rack in the cabinet.
6. Reconnect all the cables disconnected in step 2. Use the marks made when disconnecting the cables to ensure that each cable is reconnected to the right connector. This is a very critical step!
7. Power up the CNC but do not attempt to take the system out of Emergency Stop.
8 Follow the procedure for checking or entering a new customisation and restore the machine parameters, referring to the appropriate sections.
9. Once the parameters have been loaded and customisation confirmed, the system is ready to operate.

12 Machine Panel

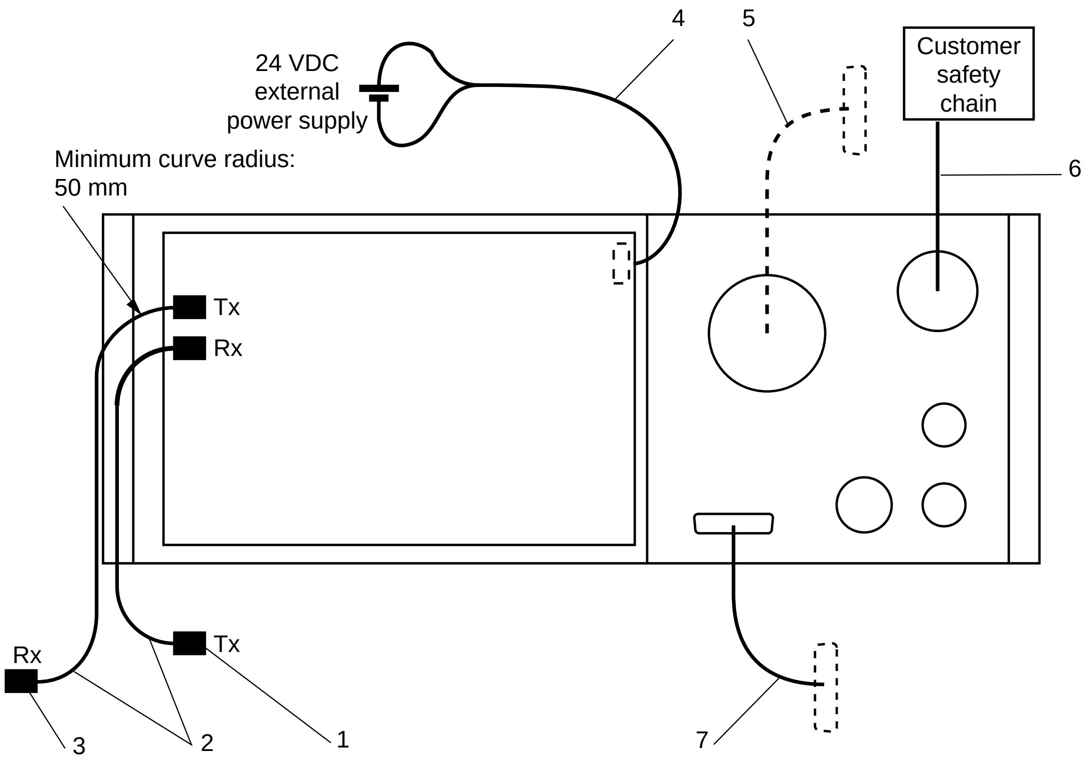
This chapter covers diagnosis and replacement of the machine panel with fibre-optic ring.



12.1 Connections

The machine panel is powered by 24 VDC. It communicates with the CNC via a serial fibre-optic field bus. On the diagram the fibre-optic cables are marked Tx for transmit and Rx for receive. If a handwheel is present, it is hardwired to an analogue or QVN axis port. The E-STOP (emergency stop) button is hardwired to the machine E-STOP circuit and the sub.D connector to one of the CNC’s communication ports.

All the output signals are sent back to the CNC via the fibre-optic ring except those from the handwheel, E-STOP button and sub.D connector.



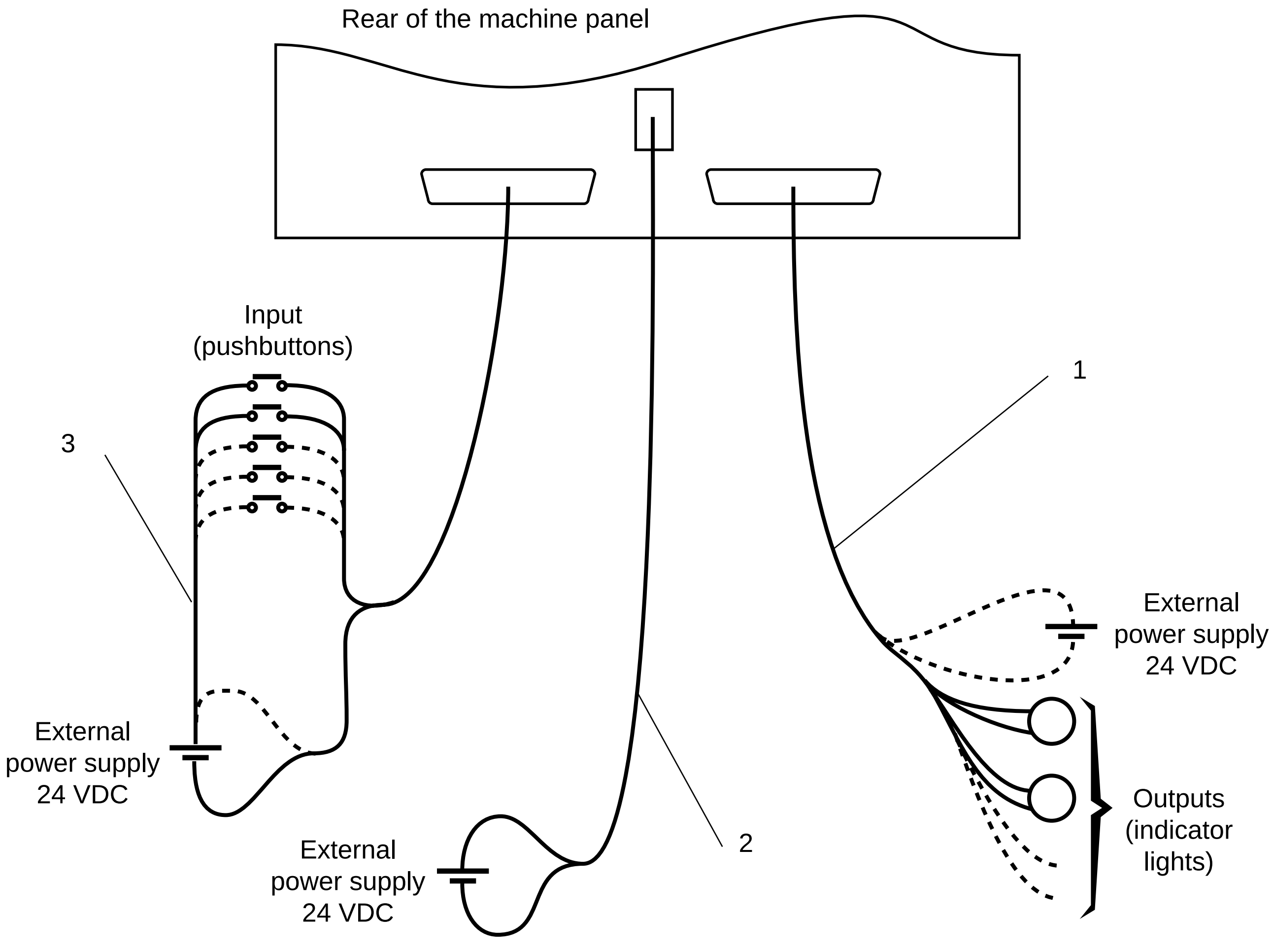
11 - Transmitter of the previous unit
2 - Fibre-optic cable
3 - Receiver of the next unit
4 - Power supply cable
5 - Handwheel cable
6 - Emergency stop cable (P/N XB2-BS542)
7 - Relay cable of a serial line:
  - RS 232
  - RS 422 or 485

Figure 13: Rear view of the machine panel

12.1.1 Machine Panel Extension

Certain machine panels are fitted with an extension at the rear giving access to 32 inputs and 24 outputs. These inputs and outputs can be used to connect additional pushbuttons and indicator lights to the operator panel.

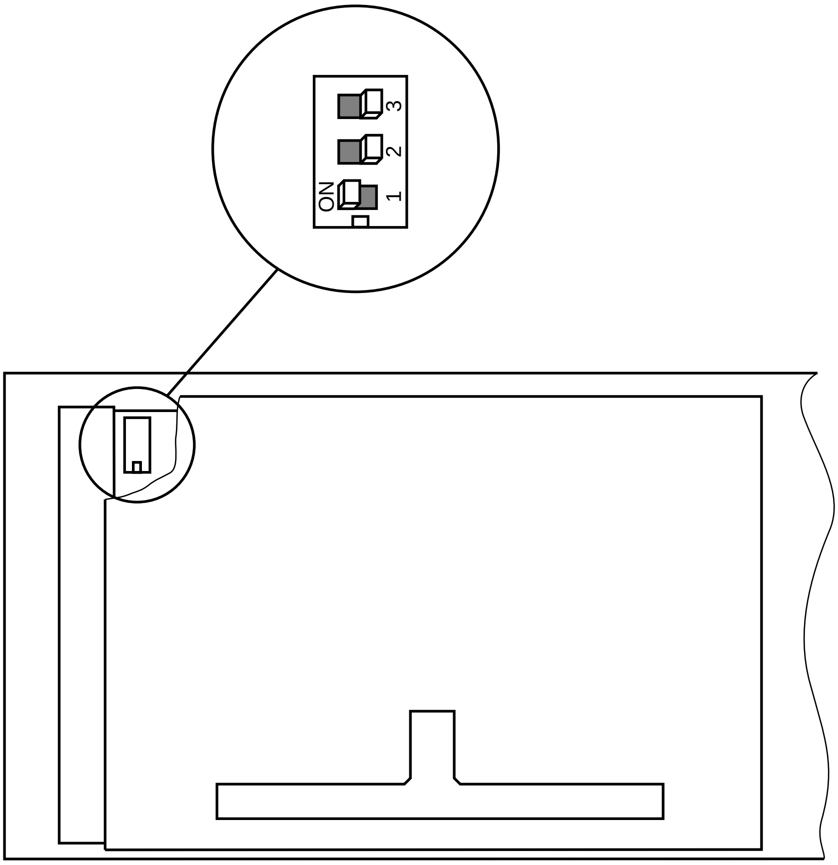
The extension includes additional connections which it is necessary to be aware of. The inputs and outputs are connected in the same way as on the 32-input/24-output panel with sub.D connector. Refer to the wiring diagram of this connector.



1 - 24-output cable with or without power supply
2 - Power cable (only when the general power supply is not provided by the input or output cable
3 - 32-input cable with or without general power supply

12.2 Fibre-Optic Power Settings

The machine panel fibre-optic ring transmit power must be set according to the cable length.



Fibre-optic cable length	Switch 3	Switch 2	Switch 1
L ≤ 15 m	ON	OFF	OFF
15 m ≤ 30 m	OFF	ON	OFF
L > 30 m	OFF	OFF	ON

12.3 Address Settings

Up to four machine panels can be connected to each fibre-optic ring. The address of each panel must be set on the thumbwheel located next to the optical power switches. The thumbwheel has ten possible settings numbered from 0 to 9, but the only legal settings are 0 to 3. For instance, if there is only one machine panel, its address must be set to 0. If there are two panels, the addresses must be 0 and 1 and so forth up to a total of four panels.

12.4 Troubleshooting

There is very little troubleshooting to be done on a machine panel. If a panel is thought to be faulty, proceed as shown in the table below.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
An LED or pushbutton is inoperative	Function inhibited by the PLC	Check the PLC variables; refer to I/O troubleshooting
	Pushbutton or LED defective	Replace the machine panel
No LEDs or pushbuttons are operative	Loss of 24 VDC input power	Check the 24 VDC input to the panel
	Loss of fibre-optic signals	Broken fibre-optic cable, incorrect power settings or defective panel
	Wrong address	Check the address set on the panel

12.5 Replacing a Machine Panel

Proceed as follows to replace the machine panel.

1. Power down the machine and the CNC.
2. Disconnect all the cables from the rear of the machine panel. Carefully note down on each fibre-optic cable the port to which it is connected (sometimes the cables are not marked by the OEM).

REMARK *The 24 VDC wires are connected to a special type of terminal rail, without screws. The wires are inserted in holes with special clamping mechanisms. To release a clamp, insert a small screwdriver in the slot directly above where the wire enters the terminal.*

3. Remove the four panel attaching screws and remove the panel.
4. Set the removed panel on a workbench next to the replacement panel and check that the power settings on the two panels are the same.
5. Install the new panel and screw down the attaching screws.
6. Reconnect all the wires and fibre-optic cables, being careful to connect them correctly, especially the fibre-optic cables, which it is very easy to connect to the wrong port.
7. Power up the machine, then the CNC. Test the new machine panel.

13 Software

This chapter is devoted to the operation, backup/restore functions and diagnostic tools available to the maintenance personnel through NUM software and the MMI.

13.1 Selecting the CNC Serial Port

Before beginning communications, it is necessary to check that the serial line parameters are correctly set for the backup and restore functions. There are many ways of configuring the serial ports on the NUM 1060 CNCs. The OEM has a choice of several possible types of connection and configuration schemes. Since the number of possible combinations is large, this manual covers only the most common cases. For other cases, contact NUM customer support or the OEM for assistance.

The table below shows the recommended primary and secondary port choices for each of the three CNC types. If the primary port is available, select it. Otherwise, choose the secondary port.

PREFERRED SERIAL PORT CHOICES *and line (port) numbers*			
PORT	1060 UCSII	1060 SII	1060 SI
COMM1	**Primary** (line 0)		
COMM2	Secondary (line 1)		
SERIE		(line 0)	(line 0)
RS232C		**Primary** (line 1)	Secondary (line 1)
DNC			(line 2)
Periph			**Primary** (line 3)

13.1.1 Configuring the Serial Ports

Each port is configured from the operator panel. Proceed as follows to access the configuration page:

1. Press softkey F11 (UTIL)
2. Select option 1, Serial Line Parameters, then press ENTER.

The SERIAL LINE PARAMETERS page is displayed.

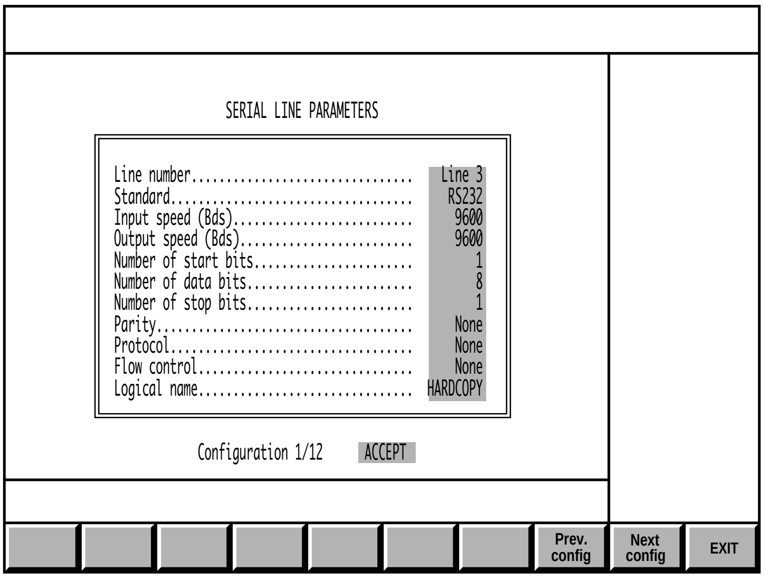


Figure 14: Serial Line Parameters page

Each port can have multiple configurations. This aim is to allow different devices to be connected to the same port, simply by changing the software configuration. There are a maximum of 12 different configurations for each port. The 12 parameters listed below must be set for each configuration. The possible choices are displayed in the softkeys at the bottom of the screen.

Line Number	Number of the line (port) to be configured. Use the **Prev Line** and **Next Line** keys to change the setting of this field.
Standard	Communication standard to be used on the port. Select **RS232**, **RS485** or **RS422** by pressing the appropriate softkey
Input Speed (Bds)	Reception speed in bauds: **600**, **1200**, **2400**, **4800**, **9600**, **19200** or **38400**
Output Speed (Bds)	Transmission speed in bauds: **600**, **1200**, **2400**, **4800**, **9600**, **19200** or **38400**
Number of start bits	**0** or **1**
Number of data bits	**5**, **6**, **7** or **8**
Number of stop bits	**0**, **1**, **1.5** or **2**
Parity	**None**, **Even** or **Odd**
Protocol	**None**, **DNC1**, **Kermit** or **CMP**
Flow Control	**None**, **RTS/CTS** or **Xon/Xoff**
Logical Name	**Hardcopy**, **Mess $5**, **Mess $6** or **Other Name**. The Other Name softkey allows entry of a user-defined name. A name like Tape or Punch or PC could be appropriate, to facilitate recognition of the port function
Configuration x/12	**Accept** to confirm the settings or **Reject** to abort the process.

After setting a configuration, exit from the pages by F11 (EXIT).

13.1.2 Configuring the Port for the NUMCOM Software

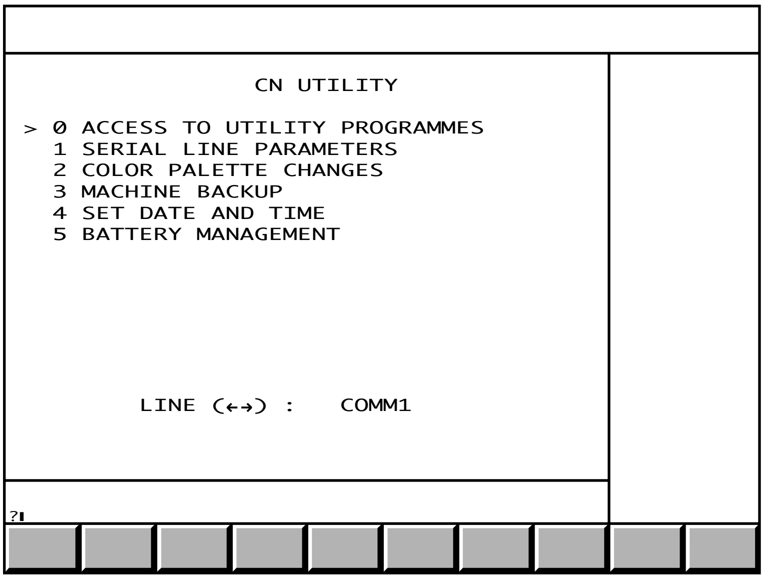
NUMCOM is a public domain programme relatively widespread among NUM CNC users. It runs under DOS. It is used to upload and download files via a serial interface. Other applications, such as NUMPC, are available from the NUM network.

In order for NUMCOM to operate correctly, set the port as follows:

Line Number	Free choice; see Sec. 13.1.
Standard	RS232
Input Speed (Bds)	9600
Output Speed (Bds)	9600
Number of start bits	1
Number of data bits	8
Number of stop bits	1
Parity	None
Protocol	None
Flow Control	RTS/CTS
Logical Name	Free choice, but COMM1 is recommended
Configuration x/12	Accept

13.1.3 Selecting an Existing Configuration

Before data upload from or download to the CNC, select a port using the left or right arrow keys. Refer to the screen below:



This message appears on each upload/download page, to allow selection of a configuration before beginning.

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13.2 CNC Software Backup Methods

Several software packages are available for editing, backing up and restoring system files. The table below shows the possibilities available for each type of file.

Backup/Restore and Editing Method						
File type	NUMCOM		PLCTool		Terminal emulation software	
	Backup/ restore	Edit	Backup/ restore	Edit	Backup/ restore	Edit
PLC	X	X	X	X	X	X
Parameters	X		X	X	X	
Axis calibration	X	X	X	X	X	X
Interaxis calibration	X					
Part programmes						
Protected memory areas	X					
Tool offsets	X	X			X	X
Options	X					

NUMCOM NUMCOM is a DOS-based software package which runs on any personal computer. It can be used to backup and restore all the CNC files, some in binary format and others as ASCII text files. However, it does not include an editor. ASCII files can be edited using a simple text editor, but not binary files.

PLCTool PLCTool is a Windows-based software package that runs on any personal computer which has Windows 3.1 or above. It is the package used by OEMs to create PLC software. Although primarily intended for design of the system, it also supports many other file types including part programmes stored in the CNC. It includes full editing capability for all file types supported.

Terminal Emulation Software This is any off-the-shelf communication software. Both PROCOMM and CROSSTALK are known to function correctly. These packages can only be used to transfer ASCII type files, but not binary files.

The following table indicates the format of the files to be transferred:

File format			
File type	NUMCOM	PLCTool	Terminal emulation software
PLC	Binary	Binary	
Parameters	ASCII or binary	ASCII	ASCII
Axis calibration	ASCII or binary	ASCII	ASCII
Interaxis calibration	ASCII or binary		
Part programmes	ASCII or binary	ASCII	ASCII
Protected memory areas	Binary		
Tool offsets	ASCII or binary		ASCII
Options	Binary		

As can be seen from the above two tables, only the NUMCOM software can be used to back up and restore all file types. Below, only this package is therefore discussed. The use of PLCTool is described in manual 938359. For terminal emulation software, refer to the manufacturer's manual.

13.3 NUMCOM

13.3.1 Communication Cable

25-contact male sub.D CNC connector		9-contact female sub.D PC connector	
Shielding	1	Not connected	
TD	2	2	RD
RD	3	3	TD
RTS	4	8	CTS
CTS	5	7	RTS
DSR	6	Not connected	
Earth	7	5	Earth
Not connected		1,4,6,9	Connected together
Connected together	8,25	Not connected	

The NUMCOM communication cable can also be used with PLCTool and other communication packages such as PROCOMM and CROSSTALK.

13.4 Part Programme (Zone 0) Backup/Restore

Part programmes are generally stored in zone 0, called the working memory. It is probably the main part programme storage area. The operator can access the part programmes stored here to edit or delete them. The part programmes in zone 0 can be backed up in ASCII or binary format, but ASCII is recommended.

13.4.1 Backup (Upload) One or All Programme(s)

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2	Select RECEIVE ASCII FILE		
3		Press MODE key twice	
4		Press UNLOAD F5	
5		Select the correct line configuration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
6		Select menu option 2 and press ENTER	
7		Press ENTER again	Green In Cycle lamp lights
8		Type %% and press ENTER to backup all the files in zone 0 OR Type %xxxx and press ENTER to back up a single file (where xxxx is the programme number)	Files being sent on CNC and files being received on PC
9		Transfer automatically stops when finished	Green In Cycle lamp goes out
10	File automatically closes when reception is complete. The disk filename is the name of the first programme sent		List of files on PC

13.4.2 Restore (Download) One or All Programmes

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2	Select SEND ASCII FILE		
3		Press MODE key twice	
4		Select the correct line configuration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
5		Press LOAD F4	
6		Select menu option 0 and press ENTER	
7		Press ENTER again	Green In Cycle lamp lights
8	Select the file to be sent		The files sent by the PC are loaded in the CNC
9	Transfer automatically stops when finished		Green In Cycle lamp goes out

13.5 Part Programme Backup/Restore in Zone 1, 2 or 3

The memory of CNCs of the 1000 family is divided into four zones. As was seen in section 13.4, zone 0 is the working memory where programmes can be edited and deleted at will. Zones 1, 2 and 3 are special protected memory areas where the OEM and NUM may have stored critical machine macros or canned cycles. Programmes stored in these zones may be protected by password to prevent them from being deleted or edited, thereby offering some security to the OEM.

Programmes can only be stored in binary format in zones 1, 2 and 3. To back them up in ASCII format, they must be transferred to zone 0 and backed up using the zone 0 techniques described in Sec. 13.4. Refer to the chapter on Utility 3, Resident Macros, for more information on these special memory zones.

13.5.1 Backup (Upload) a Protected Memory Zone

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2		Press UTIL F11	Operator Utility Menu
3		Select the correct line configu-ration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
4		Select menu option 0 and press ENTER	Maintenance Utility Menu
5		Select menu option 3 and press ENTER	Resident Macros Menu
6		Select menu option 5 and press ENTER	Zone selection menu
7		Select menu option 1, 2 or 3 and press ENTER	(&x%[%/*/..]) &x%_ This is a prompt, where x=zone number. The CNC is waiting for you to finish the command with either a % to send all the program-mes encoded with this affaire number, "*" to send all programmes without encoding or a programme number.
8	Select RECEIVE BINARY FILE		List of files in current directory
9	Press F3 to cancel automatic file closing		
10		Press %, * or xxxx and ENTER to start sending	UNLOAD ? (Y,N)
11		Press Y and ENTER	UNLOADING IN PROGRESS on PC

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Step	On the PC	On the CNC	You can see
12	When file transfer is complete, the number of bytes displayed on the PC stops increasing. Press ESC to close the file. Then enter a file name.		
13		To verify the data, press Y and ENTER; otherwise press N and ENTER	VERIFY ? (Y,N)
14	If you answered Y to VERIFY, select SEND BINARY FILE.		
15	Select the file to verify and press ENTER		VERSION: xx IDENTIFICATION: xxxx AFFAIRE No.: xxxxxxxxx BACKUP OK!
16		Press EXIT F11	Resident macros menu
17		Press CTRL+S	Exit from utilities

13.5.2 Restore (Download) a Protected Memory Area

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2		Press UTIL F11	Operator Utility Menu
3		Select the correct line configu-ration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
4		Select menu option 0 and press ENTER	Maintenance Utility Menu
5		Select menu option 3 and press ENTER	Resident Macros Menu
6		Select menu option 4 and press ENTER	LOAD ? (Y,N)
7		Press Y and ENTER	
8	Select SEND BINARY FILE		List of available files
9	Select the file to send and press ENTER		
10	When loading is finished, the file closes		BACKUP LOADED on the CNC
11		Press EXIT F11	Resident macros menu
12		Press CTRL+S	Exit from utilities

13.6 Tool Offset Backup/Restore

Tool offsets are stored in the RAM memory and can be backed up via the serial interface. The files are in ASCII format.

13.6.1 Backup Tool Offsets

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2	Select RECEIVE ASCII FILE		
3		Press MODE key twice	
4		Press UNLOAD F5	
5		Select the correct line configuration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
6		Select menu option 1 and press ENTER	
7		Press ENTER again	Green In Cycle lamp comes on
8		Transfer automatically stops when finished	Green In Cycle lamp goes out
9	File automatically closes when reception is complete. Enter a filename.		

13.6.2 Restore (Download) Tool Offsets

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2	Select SEND ASCII FILE		
3		Press MODE key twice	
4		Select the correct line configuration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
5		Press LOAD F4	
6		Select menu option 1 and press ENTER	
7		Press ENTER again	Green In Cycle lamp comes on
8	Select the file to be sent		The files sent by the PC are loaded in the CNC
9	Transfer automatically stops when finished		Green In Cycle lamp goes out

13.7 Parameter File Backup/Restore

The parameter files are stored in EEPROM and do not need to be backed up often. They should be backed up only after changes have been made for maintenance purposes. These files can be in binary or ASCII format, but ASCII format is recommended.

13.7.1 Backup (Upload) Parameters

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2		Press UTIL F11	Operator Utility Menu
3		Select the correct line configuration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
4		Select menu option 0 and press ENTER	Maintenance Utility menu
5		Select menu option 5 and press ENTER	Machine Setup Data menu
6		Select menu option 3 and press ENTER	
7.	Select RECEIVE ASCII FILE		List of files in current directory
8		Press Y and ENTER	READY?
9		Press ENTER	%xxxxxxx
10	When file transfer is complete, the PC closes the file and assigns it the affaire number as filename		On the PC, the data being transferred
11		Press EXIT F11	Resident macros menu
12		Press CTRL+S	Exit from utilities

13.7.2 Restore (Download) Parameters

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2		Press UTIL F11	Operator Utility Menu
3		Select the correct line configuration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
4		Select menu option 0 and press ENTER	Maintenance Utility menu
5		Select menu option 5 and press ENTER	Machine Setup Data menu
6		Select menu option 2 and press ENTER	READY ?
7		Press Y and ENTER	
8	Select SEND ASCII FILE		List of available files
9	Select the file to send and press ENTER		
10	When loading is finished, the file closes		Machine Setup Data menu
11		Press EXIT F11	Machine Setup Data menu
12		Press CTRL+S	Exit from utilities

13.8 PLC File Backup/Restore

The PLC files are stored in RAM memory and should be backed up only after changes have been made for maintenance purposes. These files must be in binary format.

13.8.1 Backup (Upload) PLC Files

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2		Press UTIL F11	Operator Utility Menu
3		Select the correct line configu-ration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
4		Select menu option 0 and press ENTER	Maintenance Utility menu
5		Select menu option 7 and press ENTER	PLC Utility menu
6		Press S and ENTER	Load/unload utility menu
7	Select RECEIVE BINARY FILE		List of files in current directory
8	Press F3 to cancel automatic file closing		
9		Press U and ENTER	
10		Press Y and ENTER	READY?
11		Press ENTER	
12	When file transfer is complete, press ESC to close the file then enter a filename		The number of bytes received stops being incremented when transfer is complete
13		Press EXIT F11	Resident macros menu
14		Press CTRL+S	Exit from utilities

13.8.2 Restore (Download) PLC files

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2		Press UTIL F11	Operator Utility Menu
3		Select the correct line configu-ration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
4		Select menu option 0 and press ENTER	Maintenance Utility menu
5		Select menu option 7 and press ENTER	PLC Utility menu
6		Press S and ENTER	Load/Unload utility menu
7		Press L and ENTER	
8		Press Y and ENTER	READY?
9	Select SEND ASCII FILE		List of available files
10	Select the file to send and press ENTER		
11	When loading is finished, the file closes		Load/Unload utility menu
12		Press EXIT F11	Machine Setup Data menu
13		Press CTRL+S	Exit from utilities

13

13.9 Axis Calibration File Backup/Restore

The axis calibration files are stored in RAM memory and do not normally need to be backed up often. The axis calibration files should be backed up only after changes have been made for maintenance purposes. These files may be in binary or ASCII format, but ASCII format is recommended.

13.9.1 Backup (Upload) Calibration Data

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2		Press UTIL F11	Operator Utility Menu
3		Select the correct line configuration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
4		Select menu option 0 and press ENTER	Maintenance Utility menu
5		Select menu option 2 and press ENTER	Axis Calibration Data menu
6		Select menu option 2 and press ENTER	READY (Y/N)?
7	Select RECEIVE BINARY FILE	List of files in current directory	
8		Press Y and ENTER	%xxxxxxx
9		Press ENTER	
10	When file transfer is complete, the PC closes the file and assigns it the affaire number as filename		The data being transferred, on the PC
11		Press EXIT F11	Axis Calibration Data menu
12		Press CTRL+S	Exit from utilities

13.9.2 Restore (Download) Calibration Data

Before anything else, connect the communication cable, boot the PC and make sure the CNC is operating.

Step	On the PC	On the CNC	You can see
1	Run the NUMCOM software		
2		Press UTIL F11	Operator Utility Menu
3		Select the correct line configuration with the left or right arrow keys (see Sec. 13.1)	The line name changes at the bottom of the screen
4		Select menu option 0 and press ENTER	Maintenance Utility menu
5		Select menu option 2 and press ENTER	Axis Calibration Data menu
6		Select menu option 1 and press ENTER	READY?
7		Press Y and ENTER	
8	Select SEND BINARY FILE		List of available files
9	Select the file to send and press ENTER		
10	When loading is finished, the file closes		Axis Calibration Data menu
11		Press EXIT F11	Machine Setup Data menu
12		Press CTRL+S	Exit from utilities

14 PLC Diagnostics

In NUM 1060 CNCs, the PLC is an integral part of the system. It controls the auxiliary functions of the machine other than the feedback systems. For instance, when an axis reaches its travel limit switch, the PLC must stop axis movement by the CNC. Similarly, when the operator presses a button on the panel, e.g. Cycle Start, the PLC must order the CNC to start the cycle. Transfers between the PLC and CNC are therefore essential. Such transfers take place via the Exchange Area, which contains a predefined set of variables in the form of bits, bytes and words which the CNC or PLC can read and/or write to communicate with each other.

This chapter describes the variables that are critical to operation of the machine. There are many other variables, not covered herein. Refer to manual 938846, PLC Programming in Ladder Language, for a complete listing of the exchange area addresses.

14.1 Global Addresses CNC —> PLC

Variable	Mnemonic	Description
%R0.W	CARCLAV	Receives the characters entered from the keyboard at a rate of %TS5, i.e.onecharacter every 5 RTCs.
%R2.7	E_M01	Optional programme stop enabled Image of field M01 of the NC status window. Indicates inclusion of optional programme stops in a part programme. The state of this bit can be changed bypressing the M01 key on the panel or reading C_M01 =1.
%R2.6	E_SLASH	Block skip enabled Image of the / field of the NC status window. Indicates inclusion of block skips in a part programme. The state of the bit can be changed by pressing the / key on the panel or reading C_SLASH =1.
%R2.5	E_INTERV	Intervention state After a cycle stop, the switch to INTERV occurs the first time the AXIS RECALL key on the machine panel is pressed. Set by read of C_RAX = 1 by the NC. Reset by read of C_RAX = 0 by the NC.
%R2.4	S_RECUL	Backward/forward movement on path Set for backward or forward CNC movement. Reset to cancel this state.
%R2.1	E_NMAUTO	N/M AUTO functionality Set to indicate that the N/M functionality (2/3, 3/5, etc.) is enabled.
%R3.7	E_OPER	Programme stop Indicates a programme stop caused by M00 or enabled M01. Set by M00 or M01. Reset by the CYCLE key on the machine panel (C_CYCLE = 1)
%R3.6	E_DEFCN	CNC fault Image of the NC?? field in the CNC status window. Indicates a machine error or a part programme error. The machine error number is contained in ERRMACH. Set by occurrence of a machine error (E30-E33, E36, E40-E71) or a part programming error. Reset by the RAZ key on the panel, C RAZ = 1.
%R3.4	E DGURG	General emergency retract Indicates execution of an emergency retract programme. Set by read of C_DGURG = 1 by the NC if the emergency retraction programme is enabled. Reset by detection of M00 or M02.
%R3.3	E_RAX	General axis recall In CYHLD mode and at the end of SEARCH, indicates axis recall is enabled. Set by read of C_RAX = 1 by the NC. Reset by read of C_RAX = 0 by the NC.

Variable	Mnémonique	Description
%R3.2	E_CYCLE	Cycle in progress Set by the CYCLE key on the machine panel (C CYCLE = 1). Reset by the RAZ key on the panel, C_RAZ = 1 or at the end of execution of the programme (M02).
%R3.1	E_ARUS	Cycle stop Indicates the CYHLD state of the system (programme stopped during execution and enabling of axis jogs). Set by the CYHLD key on the machine panel (C_ARUS = 1). Reset by the CYCLE key on the machine panel (C_CYCLE = 0).
%R3.0	E_RAZ	CNC reset in progress Pulse bit with a duration of 100 ms indicating a system reset. While this pulse is high, data from the automatic control function are ignored. Set by the RAZ key on the panel, a reset request from the automatic control function (C_RAZ = 1), at the end of execution of a part programme (M02) or when the NC is turned on. This variable is reset after 100 ms
%R5.7	E_TRANSP	Transparent mode Gives access by the machine processor to the CNC operator panel for display of data (data tables, etc.). Machining may be in progress. Set by enabling the TRANSPARENT MODE screen page. Reset by clearing the TRANSPARENT MODE screen page.
%R5.5	E_PPP	Dripfeed mode ready Indicates that the NC is ready to operate in drip feed mode or that the machining ordered by the automatic control function will be carried out in drip feed mode. In the second case PROGDEM must be initialised with -2 (0xFFFE). Set after CHOICE OF CURRENT PROGRAM and keyboard entry of PPR or PPL followed by ENTER. Reset after CHOICE OF CURRENT PROGRAM and keyboard entry of -PPR or -PPL followed by ENTER.
%R5. 1	E_PROG	Active programme Indicates that a part programme is being executed in AUTO, SINGLE, MDI or DRYRUN mode. Set by the first action on the CYCLE key on the machine panel (C_CYCLE =1). Reset by detection of M00 (programme stop), M01 (optional stop), M02 (end of programme); the reset key on the operator panel, variable C_RAZ = 1 and at power on.
%R5.0	E_CNPRET	CNC ready Indicates that power can be applied to the machine. Set at power on and by the RAZ key on the operator panel, variable C_RAZ =1. Reset by detection of an excessive following error on an axis, poor signal or encoder complementary channel fault detected on an axis.
%R6.7 to %R6.0	AXMVT31 to AXMVT24	axis 31 in motion to axis 24 in motion Indicates axes 24 to 31 in motion during execution of a block in a part programme or in MDI mode. Set at the start of execution of the block. Reset at the end of execution of the block if it includes M00 or M01, at the rnd of execution of the block in MDI mode, before carrying out axis clamping, by the RAZ key on the operator panel, variable C_RAZ = 1.

Variable	Mnemonic	Description
%R7.7 to %R7.0	AXMVT23 to AXMVT16	axis 23 in motion to axis 16 in motion Indicates axes 16 to 23 in motion during execution of a block in a part programme or in MDI mode. Set at the start of execution of the block. Reset at the end of execution of the block if it includes M00 or M01, at the end of execution of the block in MDI mode, before carrying out axis clamping. by the RAZ key on the operator panel, variable C_RAZ = 1.
%R8.7 to %R8.0	AXMVT15 to AXMVT8	axis 15 in motion to axis 8 in motion Indicates axes 8 to 15 in motion during execution of a block in a part programme or in MDI mode. Set at the start of execution of the block. Reset at the end of execution of the block if it includes M00 or M01, at the end of execution of the block in MDI mode, before carrying out axis clamping. by the RAZ key on the operator panel, variable C_RAZ = 1.
%R9.7 to %R9.0	AXMVT7 to AXMVT0	axis 7 in motion to axis 0 in motion Indicates axes 0 to 7 in motion during execution of a block in a part programme or in MDI mode. Set at the start of execution of the block. Reset at the end of execution of the block if it includes M00 or M01, at the end of execution of the block in MDI mode, before carrying out axis clamping, by the RAZ key on the operator panel, variable C_RAZ = 1.
%RA.7 to %RA.0	AXINI31 to AXINI24	axis 31 initialised to axis 24 initialised Indicates the axes on which origin setting is completed. Reset when origin setting is completed on the corresponding axis. Set by a system restart (origin setting not completed).
%RB.7 to %RB.0	AXINI23 to AXINI16	axis 23 initialised to axis 16 initialised Indicates the axes on which origin setting is completed. Reset when origin setting is completed on the corresponding axis. Set by a system restart (origin setting not completed).
%RC.7 to %RC.0	AXINI15 to AXINI8	axis 15 initialised to axis 8 initialised Indicates the axes on which origin setting is completed. Reset when origin setting is completed on the corresponding axis. Set by a system restart (origin setting not completed).
%RD.7 to %RD.0	AXINI7 to AXINI0	axis 7 initialised to axis 0 initialised Indicates the axes on which origin setting is completed. Reset when origin setting is completed on the corresponding axis. Set by a system restart (origin setting not completed).

Variable	Mnemonic	Description
R11.0	E10000	
R11.1	E10001	
R11.2	E10002	
R11.3	E10003	
R11.4	E10004	
R11.5	E10005	
R11.6	E10006	
R11.7	E10007	
R10.0	E10008	
R10.1	E10009	
R10.2	E10010	
R10.3	E10011	
R10.4	E10012	
R10.5	E10013	
R10.6	E10014	
R10.7	E10015	
RF.0	E10016	
RF.1	E10017	
RF.2	E10018	
RF.3	E10019	
RF.4	E10020	
RF.5	E10021	
RF.6	E10022	
RF.7	E10023	
RE.0	E10024	
RE.1	E10025	
RE.2	E10026	
RE.3	E10027	
RE.4	E10028	
RE.5	E10029	
RE.6	E10030	
RE.7	E10031	
%R13.3	POSBR4	Spindle 4 in position For a spindle indexing or synchronisation request, indicates that spindle 4 is in position or synchronised. Set when the required position is reached. Reset after leaving the required position, by oscillations and by cancellation of function M19.
%R13.2	POSBR3	Spindle 3 in position For a spindle indexing or synchronisation request, indicates that spindle 3 is in position or synchronised. Set when the required position is reached. Reset after leaving the required position, by oscillations and by cancellation of function M19.

Variable	Mnemonic	Description
%R13.1	POSBR2	Spindle 2 in position For a spindle indexing or synchronisation request, indicates that spindle 2 is in position or synchronised. Set when the required position is reached. Reset after leaving the required position, by oscillations and by cancellation of function M19.
%R13.0	POSBR1	Spindle 1 in position For a spindle indexing or synchronisation request, indicates that spindle 1 is in position or synchronised. Set when the required position is reached. Reset after leaving the required position, by oscillations and by cancellation of function M19.
%R15.B	E_INCJOG	Current jog increment The value of this variable is the image of the current jog increment: 0x0A Manual movement by 10^{-6} inches 0x09 Manual movement by 10^{-2} µm or 10^{-5} inches 0x00 Manual movement by 10^{-1} µm or 10^{-4} inches 0x01 Manual movement by 1 µm or 10^{-3} inches 0x02 Manual movement by 10 µm or 10^{-2} inches 0x03 Manual movement by 100 µm or 10^{-1} inches 0x04 Manual movement by 1000 µm or 1 inch 0x05 Manual movement by 10000 µm or 1 inch 0x06 Continuous jog 0x08 Movement by handwheel The increment is in µm or inches depending on the value of variable C_UNIT.
%R16.B	MODCOUR	Current Mode The value of the variable is the image of the current NC mode: 0x00 Auto mode AUTO 0x01 Single step mode SINGLE 0x02 Manual data input mode MDI 0x03 Dryrun mode DRYRUN 0x04 Sequence number search mode SEARCH 0x05 Edit mode EDIT 0x06 Test mode TEST 0x07 Manual mode MANUAL 0x08 Home mode HOME 0x09 Origin shift mode SHIFT 0x0A Tool setting mode TL SET 0x0B No mode active 0x0D Load mode LOAD 0x0F Unload mode UNLOAD
%R14.0	SC_USED	Screen enabled in PCNC configuration Variable set to indicate that the screen is used by a user application (transparent mode inhibited). Variable reset to indicate that the screen is used by the NUM CNC application(transparent mode possible).

Variable	Mnemonic	Description
%R17.B	PGVISU	Displayed Page Number This variable is the image of the page displayed on the NC screen: 0x01 DIR. directory page 0x03 PROG. programme page 0x04 INFO information page 0x05 L/@ programme variable page 0x06 AXIS current point page 0x07 TOOLS tool correction page 0x08 PROCAM graphic programming page 0x19 Load page during machining 0x1A Unload page during machining 0x09 I/O input/output page 0x0A UTIL utility page 0x15 SHIFT shift page 0x17 Edit mode page 0x0E Load mode page 0x11 Unload mode page
%R18.B	ERRMACH	Machine Error Number This variable contains the machine error number detected by the system (errors 30, 32, 33, 36 and 40-71) as a decimal code. *REMARK: Refer to the OPERATOR MANUAL for the list of machine errors.*
%R19.B	ID_KB_CN	Operator panel or CNC active identifier In a multipanel configuration, gives the number of the active panel (0 to 7). In a multi-CNC configuration, gives the number of the active CNC (0 to 4).
%R1A.W	PROGCOUR	Active Programme Number This variable contains the number of the active programme. The value 0XFFFF (-1) indicates there is no active programme. The value 0xFFFE (-2) indicates selection of the drip feed mode.
%R1C.W	VITBR 1	Spindle 1 Speed Reference Contains the hexadecimal code of the spindle 1 servo-drive reference in the programmed speed range. The absence of functions M3 and M4 in the part programme forces the variable to zero.
%R1E.W	VITBR2	Spindle 2 Speed Reference Contains the hexadecimal code of the spindle 2 servo-drive reference in the programmed speed range. The absence of functions M3 and M4 in the part programme forces the variable to zero.
%R20.W	VITBR3	Spindle 3 Speed Reference Contains the hexadecimal code of the spindle 3 servo-drive reference in the programmed speed range. The absence of functions M3 and M4 in the part programme forces the variable to zero.
%R22.W	ViTBR4	Spindle 4 Speed Reference Contains the hexadecimal code of the spindle 4 servo-drive reference in the programmed speed range. The absence of functions M3 and M4 in the part programme forces the variable to zero.

14.2 Global Addresses PLC —> CNC

Variable	Mnemonic	Description
%W2.1	C_NMAUTO	N/M AUTO functionality Set to enable the AUTO N/M (2/3, 3/5, etc.) functionality. This command is operative when command C_CYCLE goes low.
%W2.0	KB_INIT	Keyboard initialisation Set to enable identification of the configuration of keyboards and interconnected CNCs. Identification must be carried out whenever the configuration is modified. After identification, keyboard 1 is assigned to CNC 1.
%W3.7	C_M01	Optional stop (M01) enabled A pulse forces a change of state to enable or inhibit optional stop depending on the previous state.
%W3.6	C_SLASH	Block skip enabled A pulse forces a change of state to enable or inhibit block skip depending on the previous state.
%W3.5	C_RAZER	Reset machine error.
%W3.4	C_DGURG	Emergency retract request This request is taken into account in the AUTO, SINGLE and DRYRUN modes. The current block is interrupted and the system branches to the last emergency retract programme declared in the part programme by function G75. if no emergency retract programme was defined, this command is processed in the same way as C_ARUS.
%W3.3	C_RAX	Axis recall selection This request is taken into account when E_ARUS = 1 and all the axis jogs are released. It is a bistable type command. The first pulse sets E_INTERV and enables the axis jogs in both directions. If at least one axis has been moved in INTERV mode, a second pulse sets E_RAX and enables a single direction of movement of the axis jogs to return the slides to the initial position.
%W3.2	C_CYCLE	CYCLE START pulse Allows execution of the AUTO, SINGLE, MDI, DRYRUN, SEARCH, TEST LOAD and UNLOAD modes. A pulse command must be used for C_CYCLE to prevent resumption of machining after detection of M02 or a reset in the AUTO and DRYRUN modes.
%W3.1	C_ARUS	Machining stop request This request is taken into account in the AUTO, SINGLE, MDI, DRYRUN and incremental JOG modes. The first pulse stops machining . Machining is restarted by action on CYCLE.
%W3.0	C_RAZ	Reset request Taken into account if there is no movement on the axes.
%W4.7	VREDUIT	Causes a switch to low speed Set to force the low speeds of movement set in words N3 and N4 of parameter P31 (see Parameter Manual).
%W4.6	INIBUTIL	Utility inhibit Set to inhibit access to the utilities. Reset to enable access to the utilities.

Variable	Mnemonic	Description
%W4.5	C_UNIT	Display units (metric system or inches) Set to enable dimension entry and display in inches. Reset to enable dimension entry and display in the metric system.
%W4.4	PRESPUIS	Motor power on. This variable is reset to indicate a synchronised axis motor power failure to the NC (after a synchronisation error). It is set to indicate power return and axis synchronisation enable to the NC.
%W4.3	NARFIB	No stop at end of block Enables execution of a CYCLE in the AUTO, SINGLE, MDI, DRYRUN modes and enables block sequencing in the AUTO and DRYRUN modes. Reset of this variable causes the cycle to stop at the end of execution of the current block.
%W4.2	VITMAN2	Selection of rapid feed rates in manual modes 1 and 2
%W4.1	VITMAN1	Enable selection of rapid feed rates in the JOG and HOME modes or setting the handwheel increment multiplier. The feed rates are modulated by the feed rate potentiometer. VITMAN1 (Parameter P31) / VITMAN2 / FEED RATE / INCREMENT HANDWHEEL 0 / 0 Normal / JOG / IU x 1 0 / 1 / Slow JOG / IU x 100 1 / 0 / Fast JOG / IU x 10 1 / 1 / Fast JOG / IU x 10 Where IU = internal system unit set by a machine parameter.
%W4.0	AUTAV	Feed authorised on all the axis groups Enables movements in all the modes with movement. STOP in the CNC status window indicates that this operand is reset.
%W5.7	SC_SAVE	CNC screen saver Set to enable the CNC screen saver after five minutes of keyboard inactivity. Reset to inhibit the screen saver and immediately reactivate the screen
%W5.6	SK_DISPL	Softkey bar window display Set to inhibit display of the softkey bar window. Reset to enable display of the softkey bar window. *REMARK: Inhibiting the display does not inhibit use of the softkeys.*
%W5.5	INIBCLAV	Keyboard inhibit Set to inhibit the alphanumeric QWERTY keyboard and function keys for the basic softkeys which are then no longer processed by the CNC. The key codes are however transmitted to the automatic control function by CARCLAV
%W5.4	IMPULS	Operator panel pulse inputs Disable the RAZ, ARUS, CYCLE, M01, / keys and the TCOMP softkey. Set to disable the keys on the CNC operator panel and enable selection by the automatic control function.
%W5.3	CORDYN	Wear offset load enable Set to enable load of the tool wear offsets by the automatic control function and disable load from the operator panel.
%W5.2	JOGPUP	JOG selection from the operator panel Set to disable selection of the jog type by the CNC operator panel and enable selection by the automatic control function.

Variable	Mnemonic	Description
%W5.1	MODPUP	Operator panel mode selection Set to disable mode selection by the CNC operator panel and enable mode selection by the automatic control function.
%W5.0	PUPABS	CNC panel absent Set to declare the CNC panel absent. All the CNC operator panel functions are disabled and can be simulated by the automatic control function.
%W6.7 to %W6.0	JOGPOS31 to JOGPOS24	Positive JOG on axis No. 31 to Positive JOG on axis No. 24
%W7.7 to %W7.0	JOGPOS23 to JOG POS16	Positive JOG on axis No. 23 to Positive JOG on axis No. 16
%W8.7 to %W8.0	JOG POS15 to JOGPOS8	Positive JOG on axis No. 15 to Positive JOG on axis No. 8
%W9.7 to %W9.0	JOGPOS7 to JOGPOS0	Positive JOG on axis No. 7 to Positive JOG on axis No. 0
%WA.7 to %WA.0	JOGNEG31 to JOGNEG24	Negative JOG on axis No. 31 to Negative JOG on axis No. 24
%WB.7 to %WB.0	JOGNEG23 to JOGNEG16	Negative JOG on axis No. 23 to Negative JOG on axis No. 16
%WC.7 to %WC.0	JOGNEG15 to JOGNEG8	Negative JOG on axis No. 15 to Negative JOG on axis No. 8
%WD.7 to %WD.0	JOGNEG7 to JOGNEG0	Negative JOG on axis No. 7 to Negative JOG on axis No. 0
W11.0	E20000	
W11.1	E20001	
W11.2	E20002	
W11.3	E20003	
W11.4	E20004	
W11.5	E20005	
W11.6	E20006	
W11.7	E20007	
W10.0	E20008	
W10.1	E20009	
W10.2	E20010	
W10.3	E20011	
W10.4	E20012	
W10.5	E20013	
W10.6	E20014	

Variable	Mnemonic	Description
W10.7	E20015	
WF.0	E20016	
WF.1	E20017	
WF.2	E20018	
WF.3	E20019	
WF.4	E20020	
WF.5	E20021	
WF.6	E20022	
WF.7	E20023	
WE.0	E20024	
WE.1	E20025	
WE.2	E20026	
WE.3	E20027	
WE.4	E20028	
WE.5	E20029	
WE.6	E20030	
WE.7	E20031	
%W13.B	C_INCJOG	JOG increment command. The variable value corresponds to the jog increment requested: 0x0A Manual movement by 10^{-6} inches 0x09 Manual movement by 10^{-2} µm or 10^{-5} inches 0x00 Manual movement by 10^{-1} µm or 10^{-4} inches 0x01 Manual movement by 1 µm or 10^{-3} inches 0x02 Manual movement by 10 µm or 10^{-2} inches 0x03 Manual movement by 100 µm or 10^{-1} inches 0x04 Manual movement by 1000 µm or 1 inch 0x05 Manual movement by 10000 µm or 1 inch 0x06 Continuous jog 0x08 Manual movement by handwheel The jog increment is in µm or inches depending on the value of variable C_UNIT.
%W14.B	MODEDEM	Mode Requested The value of the variable corresponds to the CNC mode requested: 0x00 Auto mode AUTO 0x01 Single step mode SINGLE 0x02 Manual data input mode MDI 0x03 Dryrun mode DRYRUN 0x04 Sequence number search mode SEARCH 0x05 Edit mode EDIT 0x06 Test mode TEST 0x07 Manual mode MANUAL 0x08 Home mode HOME 0x09 Origin shift mode SHIFT 0x0A Tool setting mode TL SET 0x0B No mode active 0x0D Load mode LOAD 0x0F Unload mode UNLOAD

Variable	Mnemonic	Description
%W15.B	MSG1	Message number to be displayed on line 1 The message is displayed on line 1 of the Error Message page. A message with that number must be included in part programme %9999.9.
%W16.B	MSG2	Message number to be displayed on line 2 The message is displayed on line 2 of the Error Message page. A message with that number must be included in part programme %9999.9.
%W17.B	SELECGR	Axis Group Selection Assigns all the data relative to one axis group (part programme, programme variable, etc.) for display. The data entered from the CNC keyboard in MDI mode is assigned to the axis group selected. 0 Selection of axis group 1 1 Selection of axis group 2 2 Selection of axis group 3 3 Selection of axis group 4 4 Selection of axis group 5 5 Selection of axis group 6 6 Selection of axis group 7 7 Selection of axis group 8 *REMARK: Used only for axis multigroup machine-tools.*
%W18.W	PROGDEM	Requested Programme Number Used to load the requested programme number as active programme or request machining in drip feed mode. The programme number or drip feed machining request is read by the system on the rising edge of the reset flag C_RAZ = 1. 0 No programme number requested by the automatic control function. 1 to 0x270F (9999) Programme number specified by the automatic control function. -2 (0xFFFE) Machining in drip feed mode requested by the automatic control function. *REMARK: The programme requested must be present in the CNC memory to be installed as the active programme. If it is not present, the system cancels the old active programme and the message <NO ACTIVE PROGRAM> is displayed on the current programme page.*
%W1A.B	AFMAN1	Handwheel 1 Assignment Contains the physical address of the axis to be moved. Refer to the Installation and Commissioning Manual for assignment of the physical axis addresses.
%W1B.B	AFMAN2	Handwheel 2 Assignment Contains the physical address of the axis to be moved. Refer to the Installation and Commissioning Manual for assignment of the physical axis addresses.
%W1C.B	AFMAN3	Handwheel 3 Assignment Contains the physical address of the axis to be moved. Refer to the Installation and Commissioning Manual for assignment of the physical axis addresses.

Variable	Mnemonic	Description
%W1D.B	AFMAN4	Handwheel 4 Assignment Contains the physical address of the axis to be moved. Refer to the Installation and Commissioning Manual for assignment of the physical axis addresses.
%W1E.B	POTBR1	Spindle 1 Potentiometer A hexadecimal value corresponding to the Analogue to Digital input. Hexadecimal Analogue to Digital input Spindle speed override code (anai(…) function) percentage. 0x0 - 0 volts - 50% 0xFF - 10 volts - 100%
%W1F.B	POTBR2	Spindle 2 Potentiometer Same as POTBR1 for spindle 2.
%W20.B	POTBR3	Spindle 3 Potentiometer Same as POTBR1 for spindle 3.
%W21.B	POTBR4	Spindle 4 Potentiometer Same as POTBR1 for spindle 4.
%W22.3	STOPBR4	Spindle 4 stop requested by the PLC function Latched command. The spindle remains stopped as long as this bit remains set. When the bit is reset, the spindle can begin rotating again.
%W22.2	STOPBR3	Spindle 3 stop requested by the PLC function Latched command. The spindle remains stopped as long as this bit remains set. When the bit is reset, the spindle can begin rotating again.
%W22.1	STOPBR2	Spindle 2 stop requested by the PLC function Latched command. The spindle remains stopped as long as this bit remains set. When the bit is reset, the spindle can begin rotating again.
%W22.0	STOPBR1	Spindle 1 stop requested by the PLC function Latched command. The spindle remains stopped as long as this bit remains set. When the bit is reset, the spindle can begin rotating again.
%W23.3	COMBR4	Spindle 4 control Set to enable spindle control by the automatic control function. The setting is transmitted to the axis card by C_VITBR4.
%W23.2	COMBR3	Spindle 3 control Set to enable spindle control by the automatic control function. The setting is transmitted to the axis card by C_VITBR3.
%W23.1	COM8R2	Spindle 2 control Set to enable spindle control by the automatic control function. The setting is transmitted to the axis card by C_VITBR2.
%W23.0	COMBR1	Spindle 1 control Set to enable spindle control by the automatic control function. The setting is transmitted to the axis card by C_VITBR1.
%W24.W	C_VITBR1	Spindle 1 Speed Setting Used to send the spindle servo-drive reference in binary code on 14 bits plus sign. Bit 15 of C_VITBR1 gives the sign of the setting.
%W26.W	C_VIT8R2	Spindle 2 Speed Setting Used to send the spindle servo-drive reference in binary code on 14 bits plus sign. Bit 15 of C_VITBR2 gives the sign of the setting.

Variable	Mnemonic	Description
%W28.W	C_VITBR3	Spindle 3 Speed Setting Used to send the spindle servo-drive reference in binary code on 14 bits plus sign. Bit 15 of C_VITBR3 gives the sign of the setting.
%W2A.W	C_VITBR4	Spindle 4 Speed Setting Used to send the spindle servo-drive reference in binary code on 14 bits plus sign. Bit 15 of C_VIT8R4 gives the sign of the setting.
%W2C.1	NJGMANIV	Inhibits handwheel selection. Inhibits the HAND softkey in the jog key bar. Set to inhibit the key. Reset to enable the key.
%W2C.0	NJG0001	Inhibits selection of the 0.001 mm increment. Inhibits the .001 softkey in the jog key bar. Set to inhibit the key. Reset to enable the key.
%W2D.7	NJG001	Inhibits selection of the 0.01 mm increment. Inhibits the .01 softkey in the jog key bar. Set to inhibit the key. Reset to enable the key.
%W2D.6	NJG01	Inhibits selection of the 0.1 mm increment. Inhibits the .1 softkey in the jog key bar. Set to inhibit the key. Reset to enable the key.
%W2D.5	NJG1	Inhibits selection of the 1 mm increment. Inhibits the 1 softkey in the jog key bar. Set to inhibit the key. Reset to enable the key.
%W2D.4	NJG10	Inhibits selection of the 10 mm increment. Inhibits the 10 softkey in the jog key bar. Set to inhibit the key. Reset to enable the key.
%W2D.3	NJG100	Inhibits selection of the 100 mm increment. Inhibits the 100 softkey in the jog key bar. Set to inhibit the key. Reset to enable the key.
%W2D.2	NJG1000	Inhibits selection of the 1000 mm increment. Inhibits the 1000 softkey in the jog key bar. Set to inhibit the key. Reset to enable the key.
%W2D.1	NJG10000	Inhibits selection of the 10000 mm increment. Inhibits the 10000 softkey in the jog key bar. Set to inhibit the key. Reset to enable the key.
%W2D.0	NJGILLIM	Inhibits continuous jog selection. Inhibits the FREE softkey in the jog key bar. Set to inhibit the key. Reset to enable the key.
%W30.7	I_POM	Inhibits selection of the homing mode. Inhibits the HOME softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W30.6	I_PREF	Inhibits selection of origin shift mode. Inhibits the SHIFT softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W30.5	I_REGOUT	Inhibits selection of automatic tool setting mode. Inhibits the TLSET softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.

Variable	Mnemonic	Description
%W30.2	I_CHARG	Inhibits selection of the load mode. Inhibits the LOAD softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W30.0	I_DCHG	Inhibits selection of the unload mode. Inhibits the UNLOAD softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W31.7	I_CONT	Inhibits selection of the automatic mode. Inhibits the AUTO softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W31.6	I_SEQ	Inhibits selection of the single step mode. Inhibits the SINGLE softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W31.5	I_IMD	Inhibits selection of the manual data input mode. Inhibits the MDI softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W31.4	I_RAPID	Inhibits selection of the dryrun mode. Inhibits the DRYRUN softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W31.3	I_RNS	Inhibits selection of the sequence number search mode. Inhibits the SEARCH softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W31.2	I_MODIF	Inhibits selection of the edit mode. Inhibits the EDIT softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W31.1	I_TEST	Inhibits selection of the test mode. Inhibits the TEST softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W31.0	I_JOG	Inhibits selection of the manual mode. Inhibits the MANUAL softkey in the mode key bar. Set to inhibit the key. Reset to enable the key.
%W34.7 to %W34.0	DISC_TRQ31 to DISC_TRQ24	Torque enabled on QVN axis No. 31 to Torque enabled on QVN axis No. 24 Set to enable torque, reset to inhibit torque
%W35.7 to %W35.0	DISC_TRQ23 to DISC_TRQ16	Torque enabled on QVN axis No. 23 to Torque enabled on QVN axis No. 16 Set to enable torque, reset to inhibit torque
%W36.7 to %W36.0	DISC_TRQ15 to DISC_TRQ8	Torque enabled on QVN axis No. 15 to Torque enabled on QDD axis No. 8 Set to enable torque, reset to inhibit torque
%W37.7 to %W37.0	DISC_TRQ7 to DISC_TRQ0	Torque enabled on QDD axis No. 7 to Torque enabled on QDD axis No. 0 Set to enable torque, reset to inhibit torque

Variable	Mnemonic	Description
%W38.0	DISC_SDP	Speed reference enable for QVN axes Set to enable normal operation of QVN axes. Reset to cancel the speed reference immediately on the QVN axes to enable braking at maximum torque. If the speed references are inhibited, they are forced low. At power on, the speed references are inhibited. In the case of detection of a CNC error causing E_CNPRET to go low, the speed reference is forced low for the QVN axes. Cancellation of the error by a reset again allows the automatic control function to enable or inhibit the speed references. R*EMARK: It is recommended to inhibit DISC_SDP on an emergency stop and to activate a feed stop so as not to generate an excessive following erro*r.
%W39.2	INITPOS	Automatic recall after maintenance. Set to enable recall. Reset to cancel recall.
%W39.1	FORWARD	Forward movement requested on path. Set to enable the request. Reset to inhibit the request
%W39.0	BACKWARD	Backward movement requested on path. Set to enable the request. Reset to inhibit the request.

14.3 CNC —> PLC Axis Group Addresses

REMARK *The inputs from the axis groups are contained in eight 128-byte blocks. These are variables %Rg00 to %Rg7F where g equals 1 to 8 for groups 1 to 8.*

Variable	Mnemonic	Description
%Rg01.6	E_DEF1 to E-DEF8	Fault on group g Indicates a programming error or the absence of a part programme on the group. Set to indicate that the group is faulty.
%Rg01.5	NO_POS1 to NO_POS8	Axis on wait for positioning When accurate positioning is required by programming (functions G09, M00, M02 or M10) in MDI or JOG mode whenever movement is stopped, signal NO_POSg is transmitted while the axis is on wait for positioning. Set to indicate that the axis is on wait for positioning.
%Rg01.4	E_DGURG1 to E_DGURG8	Emergency retraction in progress on group g Indicates execution of an emergency retraction programme. Set after read of C_DGURGg = 1 by the CNC if the emergency retraction programme is enabled. Reset by detection of M00 or M02.
%Rg01.2	E_CYCL1 to E_CYCL8	Cycle in progress on group g Indicates that the group is executing a part programme block. Reset: the CNC is waiting for flag C_CYCLEg = 1 to execute the part programme or the next block. Set: indicates that a block is being executed.
%Rg01.0	E_RAZ1 to E_RAZ8	Reset in progress on group g Pulse bit with a duration of 100 ms that indicates a reset on the group. While this pulse is set, the data from the automatic control function are ignored. Set by the RAZ key on the operator panel, by a reset request from the automatic control function C_RAZg = 1, at the end of execution of a part programme (M02) or at CNC power on. This variable is reset after 100 ms
%Rg02.B	NUMCYC1 to NUMCYC8	Current machining cycle number on group g Used to read the machining cycle subroutine number from %10000 to %10255 (0 for %10000 to 0xFF for %10255).
%Rg03.1	FILET1 to FILET8	Thread cutting on group g Indicates execution of a thread cutting cycle: G31 (thread chasing), G33 (thread cutting), G38 (sequenced thread cutting) or G84 (rigid tapping). Set by execution of function G31, G33, G38 or G84. Reset by cancellation of the function
%Rg03.0	RAPID1 to RAPID8	Rapid positioning (G00) on group g Indicates execution of G0 in the current block of the part programme. Set by execution of function G0. Reset by cancellation of function G0.

Variable	Mnemonic	Description
%Rg04.W	MSSCR1 to MSSCR8	Encoded M function without response from group g This variable is used to read on-the-fly encoded M functions without report from M200 to M899 (e.g. M210 sends MSSCRg == 210 to the automatic control function). These functions are considered pre-move and modal by the system. The part programme is continued without waiting for an acknowledgement. Used in part programmes, they are accessible for read by the automatic control function and must be decoded in the user programme. Only one modal encoded M function can be included in a part programme block. One modal and one non-modal encoded M function can be included in the same part programme block. M functions must always be decoded by sequential task TS0.
%Rg06.W	POTAVC1 to PCTAVC8	Feed rate override percentage on group g Contains the ADC input from 0 to 10 volts corresponding on the CNC to a feed feed rate override percentage between 0 and 120 percent.
%Rg1E.W	MCODCR1 to MCODCR8	Encoded M function with response received from group g This variable is used to read the encoded M functions with report up to M199 (e.g. M92 sends %MCODCRg == 92 to the automatic control function). These functions are considered post-move and non-modal by the system. The automatic control function determines whether or not they are modal. Used in part programmes, they are accessible for read by the automatic control function and must be decoded in the user programme. Only one non-modal encoded M function can be included in a part programme block. One modal and one non-modal encoded M function can be included in the same part programme block. M functions must always be decoded by sequential task TS0.
%Rg20.7	M999_1 to M999_8	Masking by programming of M997, M998
%Rg20.6	M998_1 to M998_8	Unmasking by programming of M999, M997
%Rg20.5	M997_1 to M997_8	Forced block sequencing
%Rg20.3	M49_1 to M49_8	Force 100% feed rate and spindle speed override
%Rg20.2	M48_1 to M48_8	Re-enable feed rate and spindle speed override
%Rg20.1	M11_1 to M11_8	Axis unclamp
%Rg20.0	M10_1 to M10_8	Axis clamp

Variable	Mnemonic	Description
%Rg21.7	M12_1 to M12_8	Programme stop
%Rg21.5	M45_1 to M45_8	Select spindle 6 speed range
%Rg21.4	M44_1 to M44_8	Select spindle 5 speed range
%Rg21.3	M43_1 to M43_8	Select spindle 4 speed range
%Rg21.2	M42_1 to M42_8	Select spindle 3 speed range
%Rg21.1	M41_1 to M41_8	Select spindle 2 speed range
%Rg21.0	M40_1 to M40 8	Select spindle 1 speed range
%Rg22.7	M19_1 to M19 8	Spindle indexed stop
%Rg22.6	M09_1 to M09_8	Coolant off
%Rg22.5	M08_1 to M08_8	Coolant 1
%Rg22.4	M07_1 to M07_8	Coolant 2
%Rg22.3	M06_1 to M06_8	Tool change
%Rg22.2	M05_1 to M05_8	Spindle stop
%Rg22.1	M04_1 to M04_8	Spindle CCW rotation
%Rg22.0	M03_1 to M03_8	Spindle CW rotation

Variable	Mnemonic	Description
%RG23.7	M61_1 to M61_8	Disable current spindle in a group
%Rg23.2	M02_1 to M02_8	End of part programme
%Rg23.1	M01_1 to M01_8	Optional stop
%Rg23.0	M00_1 to M00_8	Programme stop
%Rg24.3	M63_1 to M63_8	Spindle reference applied to spindle 4
%Rg24.2	M62_1 to M62_8	Spindle reference applied to spindle 3
%Rg24.1	M65_1 to M65_8	Spindle reference applied to spindle 2
%Rg24.0	M64_1 to M64_8	Spindle reference applied to spindle 1
%Rg25.3	M69_1 to M69_8	Spindle 4 measurement enabled
%Rg25.2	M68_1 to M68_8	Spindle 3 measurement enabled
%Rg25.1	M67_1 to M67_8	Spindle 2 measurement enabled
%Rg25.0	M66_1 to M66_8	Spindle 1 measurement enabled
%Rg7C.L	OUTIL1 to OUTIL8	Tool number requested by group g Contains the tool numbers (decimal values from 0 to 65535). T functions are considered as pre-move and modal by the system, which does not wait for a response.

14.4 PLC —> CNC Axis Group Addresses

REMARKS *The outputs to the axis groups are contained in eight 128-byte blocks. These are in variables %Wg00 to %Wg7F where g equals 1 to 8 for groups 1 to 8.*

Variables C_MODE1 to C_MODE8, C_CYCLE1 to C_CYCLE8, C_RAZ1 to C_RAZ8 and C_DGURG1 to C_DGURG8 are enabled only for PLC axes

Variable	Mnemonic	Description
%Wg00.7	C_MODE1 to C_MODE8	Activates AUTO or SINGLE mode on PLC axis groups g Reset: AUTO mode enabled on the next block. Set: SINGLE mode enabled for the current block. This flag is meaningful only if the group is valid
%Wg00.6	C_FAST1 to C_FAST8	Latched high speed command during a cycle This command is used during a cycle (C_CYCLEg = 1). Set to enable movement at the highest possible speed. Reset to enable movement at the work rate.
%Wg00.5	CRM1 to CRM8	M function response for group g Reset: places the system on wait without processing the next functions in the block being executed. Set: enables processing to continue.
%Wg00.4	APPSS1 to APPSS8	Subroutine call for group g During execution of a part programme, APPSS is set for a branch to subroutine %9999.g (where g is the group number). Latching of the bit or a new subroutine call is ignored during execution of the subroutine. No response is sent by the system during execution of the subroutine. The subroutine should send the machine processor a response to cancel the bit (M function, external parameter, etc.). If only one CNC axis group is declared, programme %9999 is called (i.e. %9999.0).
%Wg00.3	ARBUT1 to ARBUT8	Block interrupt on group g Set to stop movement on the axis group, then go to the next block or jump to another block. Function G10 associated with its arguments must be present in the part programme.
%Wg00.2	VALID1 to VALID8	Group g enable Set to enable use of the axis group. Enabling or inhibiting are effective only after a reset or M02.
%Wg00.1	C_FMEXT1 to C_FMEXT8	End of external movement control on group g Reset to inhibit cancellation of CYCLE in SINGLE and MDI modes or sequencing to the next block in AUTO and DRYRUN modes. Set to allow normal execution of the mode. This variable is tested at the end of execution of each block.
%Wg00.0	C_AUTAV1 to C_AUTAV8	Feed authorisation on group g This variable is active if general feed authorisation bit AUTAV = 1. Reset to stop movement on the axis group in all modes with movements. Movement is resumed when C_AUTAVg = 1.

Variable	Mnemonic	Description
%Wg01.4	C DGURG1 to C_DGURG8	Emergency retraction request for group g This request is accepted in AUTO and SINGLE modes. The current block is interrupted and the system branches to the last emergency retraction programme declared in the part programme by function G75. If no emergency retraction programme is specified, this signal is processed in the same way as C_ARUS.
%Wg01.2	C_CYCLE1 to C_CYCLE8	Cycle start request on PLC axis group g Allows execution of the AUTO and SINGLE modes for the PLC axis groups. A pulse command must be used for C_CYCLEg to prevent resumption of machining after detection of M02 or a reset in the AUTO mode. This flag is ignored unless the group is valid.
%Wg01.0	C_RAZ1 to C_RAZ8	Reset request on PLC axis group g Taken into account if there is no movement on the axes. It is during a reset on a group that flag VALIDg is taken into account and the presence of the part programme assigned to the PLC group is detected.
%Wg02.B	POTAV1 to POTAV8	Feed Rate Potentiometer for Group g Hexadecimal code corresponding to the ADC input value. Hexadecimal ADC input feed rate override code (function anai(.)) percentage 0x0 = 0 volts = 0% 0xFF = 10 volts = 120%

14.5 Standard Internal Variables

There are other internal variables in bit, byte, word or long word format. Saved variables begin with %M and variables not saved after power down with %V. These two types of variables are otherwise equivalent.

Memory access differs according as the variable is in bit, byte, word or long word format. The extension defines the variable format.

Internal Variables

%V xxxx . b

b — The extension defines the format:

.0 to .7 Bit number from 0 to 7
.B Signed integer on 8 bits (byte)
.W Signed integer on 16 bits (word)
.L Signed integer on 32 bits (long word)
.& Internal address format (refer to PLC Ladder Programming manual 938846 for more information).
.[ ] Indexed address mode (refer to PLC Ladder Programming manual 938846 for more information)

xxxx — Logical number of the variable. The range is:
- %V0 to %V7FFF (32 KB)
- %V7FFF (32 KB).

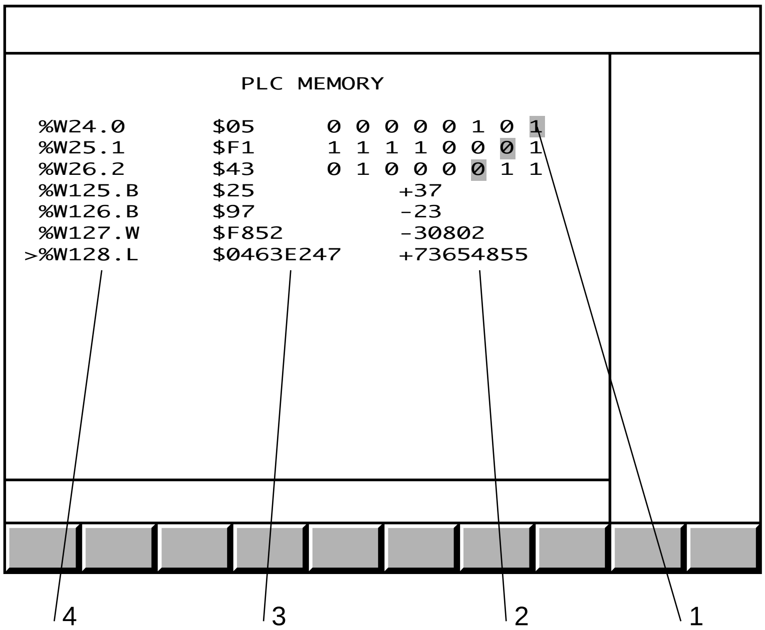
%V — The letter determines whether or not the variable is saved:
- %V denotes a non-saved variable
- %M denotes a saved variable.

14.6 Displaying the PLC Variables

14.6.1 Displaying PLC Internal or I/O Variables

It is very easy to display a PLC internal or input/output variable (see Chapter 7 for more information on inputs and outputs). Proceed as follows:

1. Press the PLC I/O softkey (F9) below the screen
2. Type 2 or use the cursors to select option 2, PLC MEMORY, then press ENTER
3. The PLC Memory screen is displayed. It contains a small prompt labelled "Address" in the lower left-hand corner for entry of an address. For instance, if you type %I0100.0 and press ENTER, the contents of the requested address are displayed.



1 - Values of bit variables highlighted in the corresponding bytes
2 - Decimal values of byte, word or long word variables
3 - Hexadecimal values of byte, word or long word variables
4 - Variables

For display of bit values, the contents of the address are always displayed as 8 bits.

Example: Entry of addresses %I0B00.0 and %Q0A01.4 and corresponding displays:

%I0B00.0 $01 0 0 0 0 0 0 0 1
%Q0A01.4 $10 0 0 0 $\boxed{1}$ 0 0 0 $\boxed{0}$

In this example, bits 0 and 4 are requested. Both bits are highlighted (inverse video) on the screen.

For display of variables in byte, word or long word format, both the hexadecimal and decimal values are displayed. Hexadecimal values are preceded by $ and decimal values by + or -.

Entering Multiple Addresses

To enter more than one address at a time, simply leave a space between entries as shown below:

```
ADDRESS %M100.W %V2A.B %I600.7
```

Adding Addresses to the Display

To add addresses to those already displayed, press the PAGE DOWN key to display the ADDRESS prompt, then enter + followed by the additional addresses:

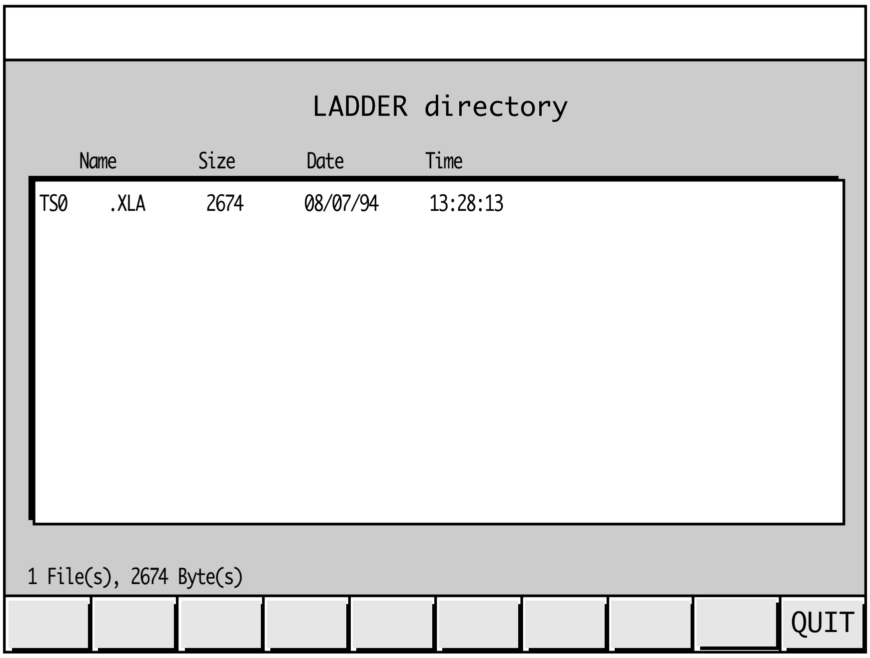
```
ADDRESS +%Q703.4 %R3.0 %W100.0
```

Deleting an Address from the Display

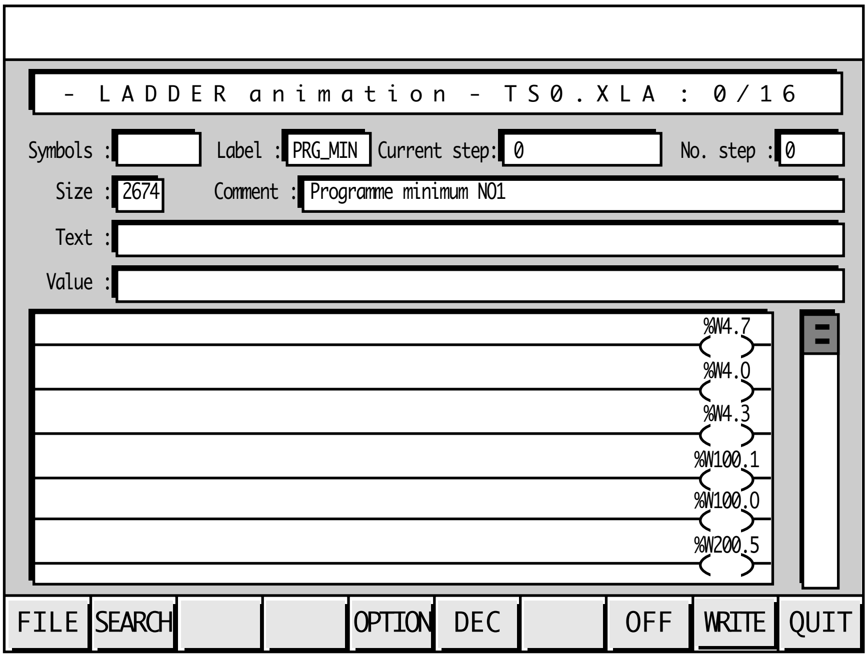
Select the address to be deleted with the cursor keys, then press the minus sign "-" and ENTER. The address is cleared.

14.6.2 Displaying the Ladder Programme

Proceed as follows to display the Ladder programme:
1. Press the PLC I/O softkey (F9)
2. Type 5 or use the cursors to select option 5, PLC ANIMATION, then press ENTER
3. The Ladder Directory screen is displayed. Use the cursor keys to select the module to be displayed and press ENTER.



4. The Ladder animation screen is displayed.



The contacts or rungs which are RED (colour screen) or LIGHT GREY (monochrome screen) are in HIGH or TRUE state. Contacts or rungs which are BLACK are in LOW or FALSE state.

14.7 Utility 7 - Ladder Programming

A ladder utility is available to assist the maintenance staff in diagnosing a PLC-related problem. It is utility 7, accessed by the following procedure:

Accessing Utility 7

Step	On the CNC	You can see
1	Press UTIL softkey F11	Operator Utility Menu
2	Select menu option 0 and press ENTER	Maintenance Utility menu
3	Select menu option 7 and press ENTER	PLC Utility menu

Exiting Utility 7

Step	On the CNC	You can see
1	Press EXIT softkey F11	PLC Utility menu
2	Press CTRL + S	Normal CNC screen

When the ladder utility opens, the following screen is displayed:

```
      PLC APPLICATION MANAGEMENT

- PLC OPERATION
- Monitor and %TS time profile
- File management
- I/O configuration
- Software backup
- Animation

-- enter a command (Exit X OFF) --

../..                                  EXIT
```

⚠ CAUTION

It is possible to delete the entire contents of the PLC by accessing File Management then using the function Delete a file or Format the volume. Exercise extreme caution when working in this menu!

The above menu gives access to the functions listed by pressing the first letter of the function name. For instance, press P to access PLC OPERATION. All the submenus are accessed in the same way. Always use the first letter of the commands available on the screen.

14.7.1 PLC Operation

Selecting PLC Operation from the main menu of utility 7 displays the following screen. The PLC status field indicates whether the PLC is running or stopped. Any PLC errors are reported on the next line. The list of errors is given below.

```
      PLC OPERATION
PLC status: RUNNING
(No error)
TF Activity:
(0-7)   0   0   0   0   0   0   0   0
(8-15)  0   0   0   0   0   0   0   0
TH Activity:
(0-7)   0   0   0   0   0   0   0   0
(8-15)  0   0   0   0   0   0   0   0

Reset saved variables

../..                                  EXIT
```

PLC RUN Status Messages

Messag	Comment
No error	PLC operating correctly
Bad I/O bus configuration	**Cause** Unidentified card present Card missing Discrepancy between programmed configuration and real configuration Watchdog programming error **Corrective action** Check the input/output configuration (see Sec. 18.2.5 of Manual 938846). Check the state of %R97F.B (see Sec. 3.8.5 of Manual 938846). Check %INI in the user programme (card and watchdog configuration variables)
Erroneous I/O bus behaviour	**Cause** Link error on the bus **Corrective action** Check the state of bus signal %Rrc39.B (see Sec. 3.7.3) Check the continuity of the fibre-optic ring Contact NUM Customer Support

PLC HALTED Status Messages

Message	Comment
Internal monitor fault	**Cause** Serious internal error **Corrective action** Contact NUM Customer Support
Application time limit overrun	**Cause** RTC overrun (endless loop in a programme) **Corrective action** Correct the user programme
Unknown PLC error	**Cause** Serious internal error **Corrective action** Contact NUM Customer Support
Bad I/O bus configuration	**Cause** Unidentified card present Card missing Discrepancy between programmed configuration and real configuration Watchdog programming error **Corrective action** Check the input/output configuration (see Sec. 18.2.5 of Manual 938846). Check the state of %R97F.B (see Sec. 3.8.5 of Manual 938846). Check %INI in the user programme (card and watchdog configuration variables)
Erroneous I/O bus behaviour	**Cause** Link error on the bus **Corrective action** Check the state of bus signal %Rrc39.B (see Sec. 3.7.3) Check the continuity of the fibre-optic ring Contact NUM Customer Support
Too many boards in I/O bus	**Cause** Too many inputs and outputs for the system **Corrective action** Decrease the number of input and output cards to remain within authorised limits

Background Task Activity

The activity of the background tasks is displayed by 16 counters associated with tasks %TF0 to %TF15.

Whenever a background task has been totally or partially processed during an RTC cycle, the task counter is incremented by 1. This function is used to display tasks that are dormant, executing, the number of RTC cycles required for execution of a task, etc.

Hardware Task Activity

The activity of the hardware tasks is displayed by 16 counters associated with tasks %TH0 to %TH15. Whenever a hardware task has been processed, the task counter is incremented by 1.

CPU Commands

The commands GO, STOP and INIT are used to control the PLC during user programme debugging.

Operation	Command	Comment
Dtart the PLC	Type G for Go	Watchdog set User programme runs
Stop the PLC	Type S for Stop	Watchdog reset User programme stops The HALTED status is displayed on the screen page
System initialisation	Type I for INIT	Requires stopping the PLC - Clears all errors - Initialises the inputs/outputs

14.7.2 Monitor and %TS Time Profile

Selecting Monitor and %TS Time Profile displays the following screen:

```
MONITOR AND %TS TIME PROFILE

Monitor Average: 0%  Max: 0%  Application time limit overrun: 0
TS0:    Average: 0%  Max: 0%
TS1:    Average: 0%  Max: 0%
Monitor Average: 0%  Max: 0%  Application time limit overrun: 0
TS0:    Average: 0%  Max: 0%
TS2:    Average: 0%  Max: 0%
Monitor Average: 0%  Max: 0%  Application time limit overrun: 0
TS0:    Average: 0%  Max: 0%
TS3:    Average: 0%  Max: 0%
Monitor Average: 0%  Max: 0%  Application time limit overrun: 0
TS0:    Average: 0%  Max: 0%
TS4:    Average: 0%  Max: 0%
Monitor Average: 0%  Max: 0%  Application time limit overrun: 0
TS0:    Average: 0%  Max: 0%
TS5:    Average: 0%  Max: 0%
                              Commands: Valid / Reset Max

../..                                                  EXIT
```

This function displays the percentage of time occupied by the monitor and the %TS tasks each PLC cycle.

It shows:
- The average time occupied by the monitor each cycle and the maximum time occupied by the monitor
- The average time occupied by each %TS task
- The maximum time occupied by each %TS task and the application time overruns each cycle.

The percentage is calculated with reference to the time allocated to the monitor and user programme, i.e.:
- 18 ms for Series I and Series II processors
- Value in ms set in P99 for UCSII processors.

Commands

Three commands are available:

"V"	Validate (enable) time monitoring
"I"	Inhibit time monitoring
"R"	Reset the times.

14.7.3 PLC File Management

Selecting File Management displays the following screen:

```
     PLC FILES MANAGEMENT


Inhibition of the PLCTOOL link
Application directory
File delete
Format the volume

  PLC: 12040 used/17884 free
-- Enter a command (Exit F11) --

../..                                         EXIT
```

CAUTION

It is possible to delete the entire contents of the PLC by accessing File Management then using the function Delete a file or Format the volume. Exercise extreme caution when working in this menu!

<u>Commands</u>

Four commands are available:

"I"/"V"	Validate or invalidate the port configured exclusively for PLCTools
"A"	Select the application directories. There are three directories: LADDER, C CODE and USER FILES
"D"	Delete a PLC file
"F"	Format the volume, which deletes all the PLC files from the memory.

14.7.4 I/O Configuration

Selecting I/O Configuration displays the following screen:

```
          I/O CONFIGURATION

Racks              Slots

0 (P8)        C B x 9 x 7 6 5 x x x 1 0
3 (E12)       C B A 9 x x x x x 3 2 1 0
4 (E12)       x x x x x x x x x 3 2 1 0

-- Commands <R#> or <C##> or <F11> --

../..                                    EXIT
```

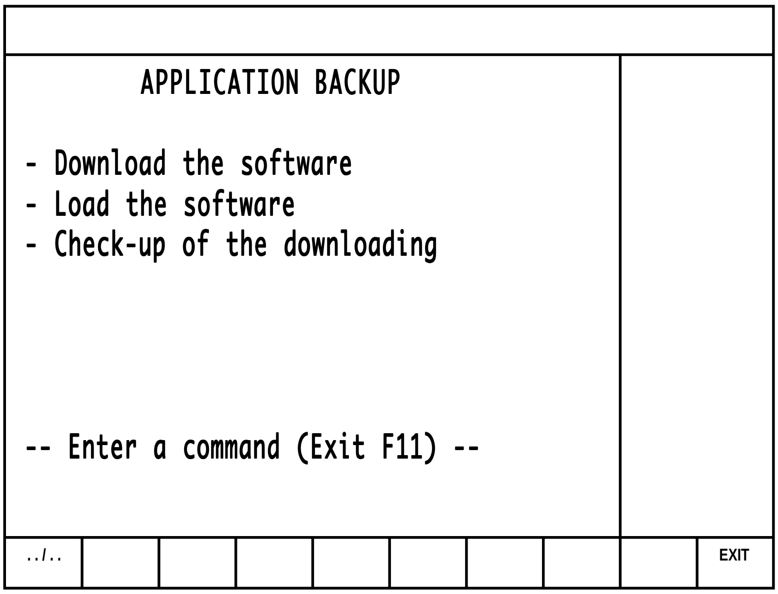
This screen shows the racks and the slots fitted with cards. Slots marked x are not fitted with cards. The slots with numbers or letters are equipped with cards.

<u>Commands</u>

"R"	This command followed by a rack number from 0 to 7 shows information on the rack selected
"C"	This command followed by a two-digit slot number flashes a message indicating the type of I/O card currently plugged into the slot.

14.7.5 Software Backup

Selecting Software Backup displays the following screen:



The UNLOAD, LOAD and VERIFY functions are discussed in an earlier section. Refer to Section 13.8 for more information.

15 Machine Parameters

NOTICE

The information presented below is in condensed format. For more detailed information, please refer to the Parameter Manual 938818.

15.1 List of Parameters

Parameter	Category	Description
P0	Axis declaration	Displayed axes
P1	Axis declaration	Modulo and limited excursion rotary axes
P2	Axis declaration	Measured axes
P3	Axis declaration	Servo-controlled and interpolated axes
P4	Axis declaration	Axes programmed by diameter Internal system measurement
P5	Axis declaration	Axis group machine configuration Lathe or milling machine groups Front/Rear turrets
P6	Spindles	Number of controlled spindles Spindle type Spindle assignments to axis groups
P7	Miscellaneous	Initialisation in inches or metric units Direction of automatic spindle search Transmission of T and M functions to the machine processor in SEARCH and TEST modes Forcing of T functions Interaxis calibration table enable Initialisation in G94 or G95 Forcing of manual mode Homing selection Subroutine call on reset Feed stop with rigid tapping Speed variation with gradual acceleration
P8	Axis declaration	Axes with clamps
P9	Axis declaration	Axis assignment to groups
P10	Measurements	Axis measurement direction
P11	Measurements	Axis measurement conversion coefficient
P12	Measurements	Direction of handwheel measurement
P13	Measurements	Handwheel measurement conversion coefficient
P14	Axis declaration	Handwheels
P15	Axis travel	Direction of homing Switch status test
P16	Axis travel	Reference switch position in machine dimensions
P17	Axis travel	Axis travel limit
P18	Axis travel	Reversal error compensation
P19	Servo-control	Very high speed machining
P20	Servo-control	Direction of axis speed reference
P21	Servo-control	Servo-system loop gain coefficient
P22	Servo-control	In-position window
P23	Servo-control	Maximum following error
P24	Servo-control	Synchronised axis control

Parameter	Category	Description
P25	Measurements	Poor signal and encoder channel complementarity check declaration
P26	Measurements	Poor signal and encoder channel complementarity check
P27	Axis declaration	Duplicated axis coupling definition
P28	Axis declaration	Synchronised axis coupling enable
P30	Servo-control	Maximum axis traverse rates
P31	Servo-control	JOG speed and reduced speed
P32	Servo-control	Maximum permissible acceleration
P33	Servo-control	Approach speed
P34	Measurement	Definition of measurement sensor type and parameters
P35	Miscellaneous	Subroutine call by M function
P36	Measurement	Measurement sensor graduation and number of graduations
P37	Communication	Character format in DNC1
P38	Communication	Translation of special DNC1 characters
P39	Communication	DNC1 timeouts
P40	Spindles	Spindle measurement conversion
P41	Spindles	Spindle reference reversal
P42	Spindles	Spindle origins
P43	Spindles	Maximum spindle speed
P44	Spindles	Indexing in-position window
P45	Spindles	Spindle servo-system gain
P46	Spindles	Spindle 1 speed range
P47	Spindles	Spindle 2 speed range
P48	Spindles	Spindle 3 speed range
P49	Spindles	Spindle 4 speed range
P50	Miscellaneous	Sampling period (CNC and QVN)
P51	Miscellaneous	Minimum block execution time
P52	Servo-control	Servo-system error tolerated on circles
P55	Servo-control	Speed anticipation coefficient, number of terms used to calculate the filtered reference for very high speed machining
P56	Servo-control	Servo-loop time constant
P57	Servo-control	Dynamic movement control
P58	Miscellaneous	Interaxis calibration table reservation Programme stack size
P59	Miscellaneous	Graphic, display and print configurations
P62	Spindles	Spindle acceleration Minimum spindle reference in hole bottom
P63	Spindles	Cycle axis integration time constant Cycle axis position anticipation time constant Spindle zero crossing anticipation time constant
P64	Axis declaration	Carried or carrier axes
P65	Axis declaration	Axes with quantified movements

Parameter	Category	Description
P70	QVN	Mapping by cards
P71	QVN	Axes controlled by QVN
P72	QVN	Direction of motor rotation
P73	QVN	Maximum motor speed
P74	QVN	Proportional action coefficient of the speed servo-loop corrector
P75	QVN	Integral action coefficient of the speed servo-loop corrector
P80	Miscellaneous	Xoff character choice
P84	Communication	File upload timeout
P95	Miscellaneous	Part programme memory segment size
P96	Miscellaneous	Type of machine for PROCAM Language selection
P97	Axis declaration	Number of axis groups in the system
P98	Miscellaneous	Integrated machine processor programming language selection
P99	Miscellaneous	Maximum time allocated to the PLC application
P100	Communication	MAPWAY/ETHWAY network and station number
P110	Communication	UNI-TELWAY master settings
P111	Communication	UNI-TELWAY slave settings
P112	Communication	Settings of the line assigned to PLCTOOL

15.2 Utility 5 - Machine Setup Data

Utility 5 gives access to the machine parameters for editing, backup/restore and display.

Accessing Utility 5

Step	On the CNC	You can see
1	Press UTIL softkey F11	Operator Utility Menu
2	Select menu option 0 and press ENTER	Maintenance Utility menu
3	Select menu option 5 and press ENTER	Machine Setup Data utility menu

Exiting Utility 5

Step	On the CNC	You can see
1	Press EXIT softkey F11	Machine Setup Data utility menu
2	Press CTRL + S	Normal CNC screen

```
           MACHINE SETUP DATA

>0 DISPLAY
 1 CHANGE
 2 LOAD
 3 UNLOAD
 4 CHECK


?▮
../..                                          EXIT
```

To select a function, type the corresponding number. For instance, type 1 to edit the parameters.

Moving from Parameter to Parameter

Use one of the following commands to move from one parameter to another:

"PgDn"	Next parameter
"Pxx"	Parameter number

Moving up and down N words within a Parameter

Down arrow	Move down
"Nxx"	Word number

Editing a Word

1. Place the cursor on the word to be edited (sign > opposite the word)
2. Type #
3. Press ENTER
4. The line is displayed in the command line at the bottom of the screen
5. Enter the new value and confirm by pressing ENTER.

15.3 Often Accessed Machine Parameters

15.3.1 P16 Home Switch Position in Machine Dimensions

Description

Used to set the measurement origin (ORPOM) of an axis inside or outside the travel limits.

Principle

The word number gives the physical address of the axis.

Physical axis @	List of words	Switch position in internal measurement unit
@0	Word N0	
@1	Word N1	
@2	Word N2	
‘ ‘		
‘ ‘		
@31	Word N31	

The values are expressed in the internal measurement unit: mm/100, µm, µm/10 or µm/100 for linear axes (see Sec. 4.8 of manual 938818) and deg/10000 for rotary axes.

To determine the sign of ORPOM, go to the desired measurement origin OM and set the initialisation point.

Each word contains the position of the home switch on the corresponding axis in machine dimensions. The sign is determined by the direction from the measurement origin OM to the datum switch, taking into account the normalised axis direction.

UNI-TE request (see UNI-TE Protocol User’s Manual).

The measurement origin on an axis can be modified by a UNI-TE request. A reset (CNC reset) resets the CNC to the state specified by P16.

15.3.2 P18 Reversal Error

Description

Used to correct positioning errors due to backlash.

Principle

The word number gives the physical address of the axis.

Physical axis @	List of words
@0	Word N0
@1	Word N1
@2	Word N2
‘ ‘	
‘ ‘	
@31	Word N31

The values are expressed in the internal measurement unit: mm/100, µm, µm/10 or µm/100 for linear axes (see Sec. 4.8 of manual 938818) and deg/10000 for rotary axes.

The absolute value contained in a word gives the maximum backlash on the corresponding axis. The sign gives the direction of movement to which backlash correction applies and the sign of the correction.

Value > 0: Positive correction applied when the axis moves in the positive direction.

Value < 0: Negative correction applied when the axis moves in the negative direction.

UNI-TE request (see UNI-TE Protocol User’s Manual)

The backlash error compensation can be modified by a UNI-TE request. A reset (CNC reset) resets the CNC to the state specified by P18.

15.3.3 P42 Spindle Origins

Description

Used to define the spindle origin positions.

Principle

This parameter includes four decimal values defining the origin positions of spindles 1 to 4.

Spindle 1	Word N0
Spindle 2	Word N1
Spindle 3	Word N2
Spindle 4	Word N3

The values are expressed in the internal measurement units (see Sec. 8.5 of manual 938818).

The spindle origin setting is effective on the first encoder marker pulse encountered during the first revolution:
- if P42 = 0 -> Spindle measurement = 0 on first marker pulse,
- if P42 = x -> Spindle measurement = x on first marker pulse.

UNI-TE request (see UNI-TE Protocol User’s Manual)

The spindle origins can be modified by a UNI-TE request. A reset (CNC reset) resets the CNC to the state specified by P42.

16 PCNC

Some versions of the NUM 1060 come equipped with an integral PC (Personal Computer) built into the rack. There are some special maintenance issues which should be considered for a PCNC version.

The most important item to consider for maintenance is that of hard drive backup and restore functions. Since the system has a built in hard drive, it is very important that the contents of this disk be backed up. In the event that a hard drive does fail, you must be able to replace the drive and reload the software quickly to get the machine back up. This chapter is devoted to the configuration of the PC.

16.1 Using in the PC

The first thing you must learn is to do is to navigate around the PC. There are numerous keystroke and mouse commands which you will need to know to be proficient at this. This section describes those functions.

16.1.1 Switching between the PC and CNC

From CNC to PC Display

Pressing ALT+F9 on the keyboard displays a screen similar to the one on the right.

From PC to CNC Display

1. Locate the minimised window icon and open it by double clicking it with the mouse.
2. Locate the NUM Symbol icon within this window and double click it with the mouse.

16.1.2 OS/2 Keyboard and Mouse Command Summary

Keyboard	The following tables list some of the most common tasks you can do, using either the keyboard or a mouse. The plus (+) sign between key names means to press and hold down the keys in the order shown and release them together.
Mouse	When a column is left blank under the Mouse heading, it means that there is no equivalent mouse function. The keyboard must be used.

The following terms are used to describe actions taken with a mouse.

Click	Press and release a mouse button. Instructions explain whether you should click mouse button 1 or 2.
Double-Click	Press and release mouse button 1 twice in quick succession.
Drag	Move an object across the computer screen with a mouse.
Open	Point to an ojbect and double click. Instructions explain which object to point to.
Point	Move the mouse pointer.
Select	Point to an object and click mouse button 1. Instructions explain which object to point to.

System Tasks

Task	Keys	Mouse
Help	F1	Select the word Help
Restart the system	Ctrl+Alt+Del	
Switch to the next window.	Alt+Tab	Select the window
Switch to the next window or full screen session	Alt+ESC	Press both mouse buttons at the same time; then open window
Display the Window List	Ctrl+ESC	Point to an empty area on the desktop then click both mouse buttons at the same time.

Object Tasks

Task	Keys	Mouse
Move among objects	Arrow keys	Point to the object
Select an object	Use the arrow keys to move among the objects. Press the spacebar to select an object	Select the object
Select more than one object	Shift+F8 to begin Add mode. Use the arrow keys to move among objects. Press the Spacebar to make each selection. Repeat as needed. Press Shift+F8 again to end Add.	Press and hold the Ctrl key. Select an object. Repeat as needed. Release the Ctrl key when done
Select all objects	Press Ctrl+/	Press and hold mouse button 1; then drag the pointer over every object
Deselect all objects	Press Ctrl+\	Select an empty area on the desktop
Open an object	Select it; then press Enter	Point to the object then Double-Click
Delete an object	Select it; then press Shift+F10. Select Delete from the pop-up menu.	Point to the object then press and hold down mouse button 2. Drag the object to the Shredder object. Release mouse button 2
Print an object	Select it; then press Shift+F10. Select Print from the pop-up menu	Point to the object then press and hold down mouse button 2. Drag the object to the Printer object. Release mouse button 2
Move an object	Select it; then press Shift+F10. Select Move from the pop-up menu	Point to the object then press and hold down mouse button 2. Drag the object to another folder object. Release mouse button 2

Task	Keys	Mouse
Copy an object	Select it; then press Shift+F10. Select Copy from the pop-up menu	Press and hold down the Ctrl key; then point to the object. Press and hold down mouse button 2. Drag the object to where you want a copy to appear. Release mouse button 2; then release the Ctrl key.
Rename an object	Select it; then press Shift+F10 Press ->; then press Enter. Select the General tab. Select the Title field; then edit the name	Press and hold down the Alt key; select the name (title). Release the Alt key. Edit the name. Select an area away from the name.
Display the pop-up menu for the desktop folder	Press Alt+Shift+Tab then press Ctrl+\; then press Shift+F10	Point to an empty area of the desk top folder then click mouse button 2
Display the pop-up menu for an object	Select it; then press Shift+F10	Point to the object; then click mouse button 2
Select the first choice in a pop-up menu	Home	Select the choice
Select the last choice in a pop-up menu	End	Select the choice
Select a choice using the under-lined letter	Type the underlined letter	
Get Help	Select an object; then press F1	Point to the object then click mouse button 2. Select Help
Move between the object and the Help window	Press Alt+F6	Select the window or object

Window Tasks

Task	Keys	Mouse
Get Help	F1	Select the word Help; then select the type of help you want
Display the pop-up menu	Alt+Spacebar	Point to the title bar menu for a window icon; then click mouse button 2
Move a window	Alt+F7; then use the arrow keys	Point to the title bar icon; then press and hold down mouse button 2. Drag the window to a new location. Release mouse button 2
Size a window	Alt+F8; then use the arrow keys	Point to the border; then press and hold down mouse button 2. Drag the border of the window in any direc-tion. Release mouse button 2

Task	Keys	Mouse
Set a default size for a window	Press Alt; then press S. Use the up, down, left, or right cursor keys to adjust two of the borders; then press Enter. Note: If you press the mnemonic key for Hide, Minimise, or Maximise, instead of the S key for Size, the selected choice will become the default size of the window.	Press and hold the Shift key; then point to a corner of the window border. Press and hold mouse button 1; then drag the border to the desired size. Release mouse button; then release the Shift key
Minimise a window	Alt+F9	Select the Minimise button
Hide a window	Alt+F11	Select the Hide button
Maximise a window	Alt+F10	Select the Maximise button
Close a window	Alt+F4	Double-click on the title bar icon
Move up through the contents of a window, one page at a time	Page Up or PgUp	Select the area above the slider box on the scroll bar
Move down through the contents of a window, one page at a time	Page Down or PgDn	Select the area below the slider box on the scroll bar
Move to and from the menu bar	F10	Select the menu bar or the window

Notebook Tasks

Task	Keys	Mouse
Get Help	F1	Select the Help pushbutton
Move to the next page	Alt+Page down	Select a notebook tab
Move to the previous page	Alt+Page up	Select a notebook tab
Move the cursor from the notebook page to a tab	Alt+Up Arrow	Select a notebook tab
Move the cursor from a tab to the notebook page	Alt+Down Arrow	Select the notebook page
Move to the next field	Tab	Select the field
Move to the next item within a field	Up, Down, Left, or Right Arrow	Select the item
Select an item in a single selection field	Enter	Select the item
Select an item in a multiple selection field.	Spacebar	Select the button or box next to the item

Help Window Tasks

Task	Keys	Mouse
Switch between a help window and the object or window for which help was displayed	Alt+F6	Select the window
Display General help	F2	Select Help; then select General help
Display Keys help	F9	Select Help; then select Keys help
Display Help index	F11 or Shift+F1	Select Help; then select Help index
Display Using help	Shift+F10	Select Help; then select Using help
Display help for a highlighted word or phrase	Use Tab to move the cursor to the highlighted word or phrase; then press Enter	Double-Click on the highlighted word or phrase
Display the previous help window	Esc	Select the Previous push button
Search for a word or phrase	Ctrl+S	Select Services; then select Search

Master Help Index Tasks

Task	Keys	Mouse
Open the Master Help index	Enter	Double-Click on the Master Help Index
Move through the topics, one fine at a time	Up or Down cursor keys	Select the topic
Move down through the topics, one page at a time.	Page Down or PgDn	Select the area below the slider box on the scroll bar
Move up through the topics, one page at a time	Page Up or PgUp	Select the area above the slider box on the scroll bar
Move to the topics beginning with a letter	Type the letter of the alphabet	Select the letter of the alphabet
Switch between an entry and the Master Help Index	Alt+F6	Select the window
Display related information	Use Tab to move the cursor to the entry listed under related information; then press Enter	Double-click on an entry listed under related information
Return to the Previous help window	Esc	Select the Previous push button

16.2 OS/2 Window Session

During system maintenance, it may be necessary to open an OS/2 session to check the directories on the hard disk or manipulate files. Access to this mode is from the Desktop.

Procedure

1. Find and double-click the OS/2 system icon on the desktop.
2. Locate the OS/2 Window Session icon in the OS/2 System window, and double-click it.
3. This opens an OS/2 windowed session. This session allows DOS-like commands, such as choose directory (CD), make directory (MD), copy file (COPY), etc. To leave this session, type EXIT and press ENTER.

From this session you can browse the hard drive to determine if all is well with OS/2 and the special NUM files stored on the hard drive. See Section 16.3.

16.3 Hard Drive Directory Structure

Strict compliance with the structure of certain directories containing files dedicated to the NUM application is required. The files listed below must be located in the specified directories.

C:\NUM\DRIVER\MEM_GLB.SYS

C:\NUM\GRAPHIC\CODES.NUM
\GPCCODES.NUM
\GR_PC.EXE
\NUM12x18.DLL
\NUM12x36.DLL
\NUM16x12.DLL
\NUM16x24.DLL
\NUM24x56.DLL
\NUM6x18.DLL
\NUM8x12.DLL
\NUM9x12.DLL

C:\OS2\DLL\NUMHOOKS.DLL

16.3.1 Software Versions

The files in these directories exist in several versions, depending on the software installed on the CNC. Since not all the versions are mutually compatible, it is not recommended to replace files by other files which have a different index. In case of doubt, check with your local NUM agent, specifying the version of software on your CNC.

16.4 Making Utility Diskettes

In order to backup and restore the system hard drive, it is necessary to make a set of utility diskettes. These diskettes are created from the OS/2 Desktop:

- Find and double-click the OS/2 System icon on the desktop
- In the window that opens, select and double-click the SYSTEM SETUP icon
- Find and double-click the UTILITY DISK icon and follow the instructions on the screen.

16.5 Hard Drive Backup/Restore

In order to make hard drive backup diskettes you must be in a pure OS/2 session with no NUM files running. In order to accomplish this, use the utility diskettes made in section 16.4.

16.5.1 Backup Procedure

1. Power down the CNC completely.
2. Insert utility diskette 1 into the floppy drive and power on the CNC.
3. You will be prompted for loading each diskette in order.
4. After OS/2 has finished booting, the machine will be inoperable, but you can run the PC.
5. Insert utility diskette 3 into the floppy drive.
6. Type "Backup C: A: /S" then press ENTER.
7. You will be prompted to insert as many as thirty-five (35) diskettes during this process. So be prepared and have enough diskettes on hand.
8. When you are prompted that the backup is completed, remove the last diskette from the floppy drive, and power down the CNC.
9. Power up the CNC after 1 to 2 minutes.
10. Hard drive backup is completed.

16.5.2 Restore Procedure

1. Power down the CNC completely.
2. Insert utility diskette 1 into the floppy drive and power on the CNC.
3. You will be prompted for loading each diskette in order.
4. After OS/2 has finished booting, the machine will be inoperable, but you can run the PC.
5. Insert utility diskette 3 into the floppy drive.
6. Type "Restore A: C: /S" then press ENTER.
7. You will be prompted to insert as many as thirty-five (35) diskettes during this process.
8. When you are prompted that the restore is completed, remove the last diskette from the floppy drive, and power down the CNC.
9. Power up the CNC after 1 to 2 minutes.
10. Hard drive restoration is completed.

REMARK *There are other backup methods that are easier to use, but they require available of a special device, such as tape streamer or a removable hard disk. A method based on the Iomega Zip drive has been tested. For more information, ask your local NUM dealer.*

16.6 OS/2 Text Editor

OS/2 has a built-in text editor which is accessed via an OS/2 session.

Procedure

1. Find and double-click the OS/2 system icon on the desktop.
2. Locate the OS/2 Window Session icon in the OS/2 System window, and double-click it.
3. This opens an OS/2 windowed session. This session allows DOS-like commands, such as choose directory (CD), make directory (MD), copy file (COPY), etc. To leave this session, type EXIT and press ENTER.
4. Type "ED flename.ext" and press ENTER. The editor starts and the file opens.
5. To exit the editor, double click on the upper left-hand corner of the window and you will be prompted to save your file etc.
6. To leave this session type EXIT at the prompt and press ENTER.

From this editor you can edit the PC's CONFIG.SYS or AUTOEXEC.BAT files.

16.7 Mouse Enabling

In order to enable or disable the mouse, you will have to access the system setup window. The procedure is outlined below.

Procedure

1. Find and double-click the OS/2 system icon on the desktop.
2. Locate the SYSTEM SETUP icon in the OS/2 System window, and double-click it.
3. The System Setup window opens.
4. Locate the CONFIGURE PREINSTALLED SYSTEM ICON and double-click it.
5. Click the MOUSE selection and press the OK button.
6. Select the type of mouse which you have. Typically two-button mice use "SERIAL POINTING DEVICE" while three-button mice use "LOGITECH M SERIES". But you might have to experiment to find the right selection.
7. Click the OK button when your selections are made, and the CNC will tell you that you will have to reboot to activate the new configuration.
8. Close all windows on the PC, and return to the CNC.
9. Power down the CNC.
10. After 1 to 2 minutes, power up the CNC and the new mouse configuration will be active.

16

16.8 Default System Files

16.8.1 CONFIG.SYS

```
REM IFS=C:\OS2\HPFS.IFS  /CACHE:64 /CRECL:4
PROTSHELL=C:\OS2\PMSHELL.EXE
SET USER_INI=C:\OS2\OS2.INI
SET SYSTEM_INI=C:\OS2\OS2SYS.INI
SET OS2_SHELL=C:\OS2\CMD.EXE
SET AUTOSTART=PROGRAMS,TASKLIST,FOLDERS,CONNECTIONS
SET RESTARTOBJECTS=STARTUPFOLDERSONLY
SET RUNWORKPLACE=C:\OS2\PMSHELL.EXE
SET COMSPEC=C:\OS2\CMD.EXE
LIBPATH=.;C:\OS2\DLL;C:\OS2\MDOS;C:\;C:\OS2\APPS\DLL;C:\OPENSHUT
SET PATH=C:\OS2;C:\OS2\SYSTEM;C:\OS2\MDOS\WINOS2;C:\OS2\INSTALL;C:\;C:\OS2\MDOS;C:\OS2\APPS;
SET
DPATH=C:\OS2;C:\OS2\SYSTEM;C:\OS2\MDOS\WINOS2;C:\OS2\INSTALL;C:\;C:\OS2\BITMAP;C:\OS2\MDOS;C:\OS2\APPS;
SET PROMPT=$I[$P]
SET HELP=C:\OS2\HELP;C:\OS2\HELP\TUTORIAL;C:\OPENSHUT
SET GLOSSARY=C:\OS2\HELP\GLOSS;
SET IPF_KEYS=SBCS
PRIORITY_DISK_IO=YES
FILES=20
DEVICE=C:\OS2\TESTCFG.SYS
DEVICE=C:\OS2\DOS.SYS
DEVICE=C:\OS2\PMDD.SYS
BUFFERS=30
IOPL=YES
DISKCACHE=1024,LW
MAXWAIT=3
MEMMAN=SWAP,PROTECT
SWAPPATH=C:\OS2\SYSTEM 2048 4096
BREAK=OFF
THREADS=256
PRINTMONBUFSIZE=134,134,134
COUNTRY=033,C:\OS2\SYSTEM\COUNTRY.SYS
SET KEYS=ON
REM SET DELDIR=C:\DELETE,512;
BASEDEV=OS2DASD.DMD
SET BOOKSHELF=C:\OS2\BOOK
PROTECTONLY=NO
SHELL=C:\OS2\MDOS\COMMAND.COM C:\OS2\MDOS
FCBS=16,8
RMSIZE=640
DEVICE=C:\OS2\MDOS\VEMM.SYS
DOS=LOW,NOUMB
DEVICE=C:\OS2\MDOS\VXMS.SYS /UMB
DEVICE=C:\OS2\MDOS\VDPMI.SYS
DEVICE=C:\OS2\MDOS\VDPX.SYS
REM DEVICE=C:\OS2\MDOS\VCDROM.SYS
DEVICE=C:\OS2\MDOS\VWIN.SYS
REM DEVICE=C:\OS2\PCMCIA.SYS
REM DEVICE=C:\OS2\MDOS\VPCMCIA.SYS
REM DEVICE=C:\OS2\MDOS\VMOUSE.SYS
REM DEVICE=C:\OS2\POINTDD.SYS
REM DEVICE=C:\OS2\MOUSE.SYS SERIAL=COM1
CODEPAGE=850,437
DEVINFO=KBD,US,C:\OS2\KEYBOARD.DCP
SET VIDEO_DEVICES=VIO_SVGA
DEVICE=C:\OS2\MDOS\VSVGA.SYS
BASEDEV=IBM1FLPY.ADD
BASEDEV=IBM1S506.ADD
BASEDEV=PRINT01.SYS
REM BASEDEV=OS2SCSI.DMD /Q
```

mtb-1000/0

```
REM DEVICE=C:\OS2\OS2CDROM.DMD /Q
IFS=C:\OS2\CDFS.IFS /Q
REM BASEDEV=IBMINT13.I13
REM DEVICE=C:\OS2\APPS\SASYNCDA.SYS
DEVINFO=SCR,VGA,C:\OS2\VIOTBL.DCP
SET VIO_SVGA=DEVICE(BVHVGA,BVHSVGA)
DEVICE=C:\NUM\DRIVER\MEM_GLB.SYS
DEVICE=C:\OS2\MDOS\VMOUSE.SYS
DEVICE=C:\OS2\POINTDD.SYS
DEVICE=C:\OS2\MOUSE.SYS SERIAL=COM2
DEVICE=C:\OS2\COM.SYS
DEVICE=C:\OS2\MDOS\VCOM.SYS
```

16.8.2 AUTOEXEC.BAT

```
@ECHO OFF
ECHO.
PROMPT $i$p$g
REM SET DELDIR=C:\DELETE,512;
PATH C:\OS2;C:\OS2\MDOS;C:\OS2\MDOS\WINOS2;C:\;
LOADHIGH APPEND C:\OS2;C:\OS2\SYSTEM
SET TMP=C:\
REM LOADHIGH DOSKEY FINDFILE=DIR /A /S /B $*
REM DOSKEY EDIT=QBASIC/EDITOR $*
REM SET DIRCMD=/A
SET TEMP=C:\OS2\MDOS\WINOS2\TEMP
```

17 Option Grid Settings

Another very important topic is that of the option settings. If it ever becomes necessary to change a rack or add an option, you will need the procedures in this section.

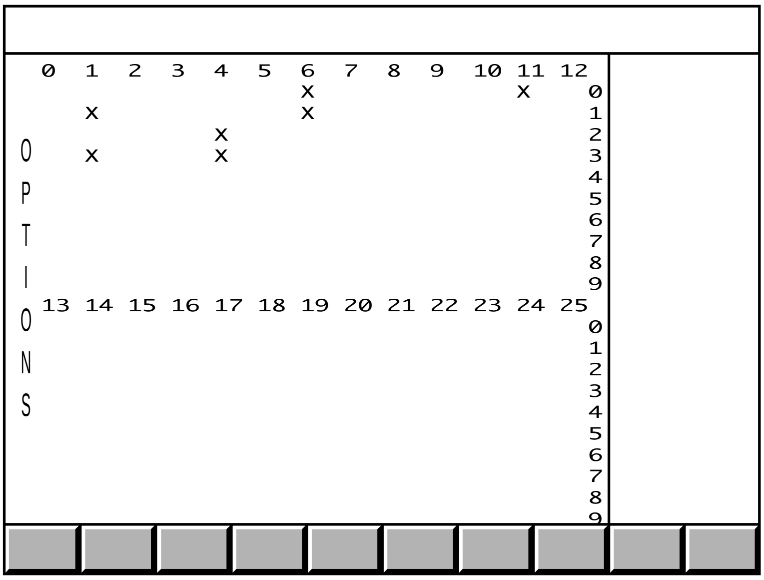
17.1 Viewing the Options

Proceed as follows to access the option information:

1. Press the PLC I/O key (F10).
2. Type 8 and press ENTER.
3. The screen shown on the right is displayed.

Each option present in the CNC is denoted by the presence of an 'X'. The option numbers are shown along the top and down the right side.

For example: Option number 95 is circled on the screen.



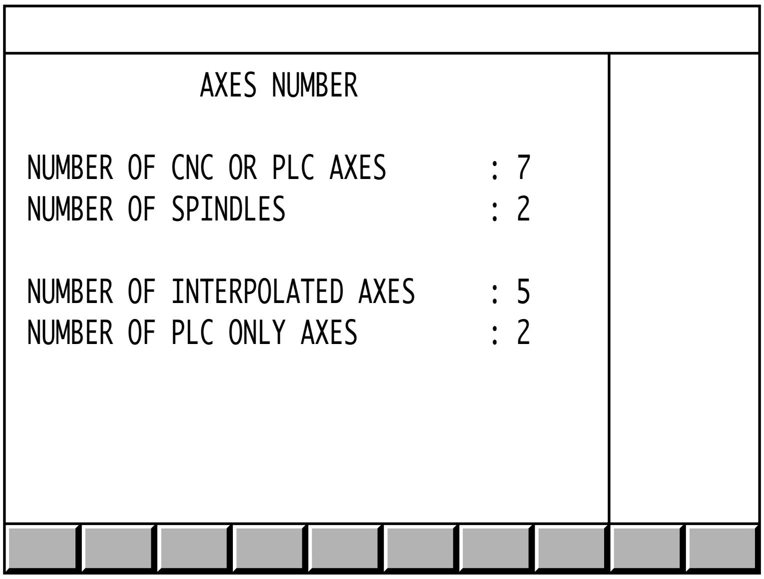
17.1.1 Number of Axes

This screen shows how many CNC or PLC axes and measured spindles are enabled in the CNC.

It also shows the maximum number of interpolated axes, and which axes are designated for PLC group usage only.

Proceed as follows to access this information:

1. Press the PLC I/O key (F10).
2. Type 8 and press ENTER.
3. Press PAGE DOWN once.
4. The page showing the number of axes is displayed.



17.1.2 Memory Sizes

This screen shows the memory size available for part programme storage (Zones 0, 1, 2 and 3 together) and PLC code storage.

Proceed as follows to access this information:

1. Press the PLC I/O key (F10).
2. Type 8 and press ENTER.
3. Press PAGE DOWN twice.
4. The MEMORY SIZES page is displayed.

```
        MEMORY SIZES


PART PROGRAM STORAGE        : 1024

PLC PROGRAM STORAGE         : 256

TAILLE ZONE MMI             : 800
```

17.1.3 Option Setting History

This screen shows when the CNC was first and last configured and by whom.

Proceed as follows to access this information:

1. Press the PLC I/O key (F10).
2. Type 8 and press ENTER.
3. Press PAGE DOWN three times.
4. The HISTORY screen is displayed.

```
             HISTORY


    FACTORY OUT    :
26 / 2 / 92  15:20:65   CABE-EF

    LAST MODIFIED ON :
8 / 6 / 94  10:37:23   D2R2
```

17.1.4 System Bus Hardware Configuration

This screen shows the type of cards and the respective part numbers for all the cards plugged into the CNC bus. The cards are displayed in the same order as in the rack.

Proceed as follows to access this information:

1. Press the PLC I/O key (F10).
2. Type "8" and press ENTER.
3. Press PAGE DOWN four times.
4. The System Bus configuration screen is displayed.

SYSTEM BUS HARDWARE CONFIGURATION

Address	Designation	File number	Vers	Ident.
	Unknown card	000 000 000	8	$0007F8
0	4M V2 graphic processor	204 202 778	0	$005340
1	1M PLC	204 201 935	0	$004B00
2	V2 1,7M memory	204 202 301	0	$008D80
3	4 V1 14b encoder axes	204 201 982	0	$000E00
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				

.../...

17.1.5 PLC Bus Hardware Configuration

This screen shows the type of cards and the respective part numbers for all the cards plugged into the PLC bus. The cards are displayed in the same order as in the rack.

Proceed as follows to access this information:

1. Press the PLC I/O key (F10).
2. Type "8" and press ENTER.
3. Press PAGE DOWN five times.
4. The PLC bus configuration screen is displayed.

PLC BUS CONFIGURATION (RACK 0)

Address	Designation	File number	Vers.	Ident.
0	Main serial bus	204 201 857	0	$000000
0	130W power supply with optic F.	204 201 950	0	$000000
1				
2				
3				
4				
5	32 inputs board	204 201 926	0	$000A00
6	32 relayed outputs board	204 201 746	0	$000100
7				
8				
9				
10				
11				
12				
13				

17.2 Setting the Options

The options are set using utility 12. Proceed as follows to access this utility.

Accessing Utility 12

Step	On the CNC	You can see
1	Press UTIL softkey F11	Operator Utility Menu
2	Select menu option 0 and press ENTER	Maintenance Utility menu
3	Select menu option 12 and press ENTER	Options locking menu

Exiting Utility 12

Step	On the CNC	You can see
1	Press EXIT softkey F11	Options locking menu
2	Press CTRL+S	Normal CNC screen

17.2.1 Option Data

During the machine's lifetime, the user may need extra functions corresponding to a different customisation. The option data are printed on a piece of paper supplied by NUM. A typical listing is shown below.

Example of customisation grid

```
  JOB REFERENCE              : XXXXX 88
  EEPROM SOFTWARE #          : SIMU EEP
  CNC SOFTWARE #             : 282686C1
  USER PLC SOFTWARE #        :
  PARAMETER TABLE            : F8

  OPTIONS PRESENT:
COMM.       DEV.
61258       11
61371       13
61581       42
61511       47
             60
             110

NUMBER OF CNC OR PLC AXES    : 7
NUMBER OF SPINDLES           : 2
NUMBER OF INTERPOLATED AXES  : 5
NUMBER OF PLC ONLY AXES      : 1
PART PROGRAM STORAGE         : 768
PLC PROGRAM STORAGE          : 256

  GRID:
140000 210000 0 20000 0 0 0 0

  KEY: 13846C75
DATE: 18 5 92  TIME: 9 15 8
IDENTIFICATION: CABE-EF

  RESUME:
XXXXXX 00 / 140000 210000 0 20000 0 0 0 0
7 2 5 2/128 64 / CABE-EF / 138467C5
```

17.2.2 Settings

When utility 12 opens, the following menu is displayed:

```
0 JOB REFERENCE
1 AXES NUMBER
2 MEMORY SIZES
3 OPTIONS LIST
4 DATE
5 LOCKING
6 EDITION
```


To select a menu option, press the number followed by ENTER. Inside each menu there are more data to be entered. All the data should be taken from the printed option list given to you by NUM.

On each of the submenus you will see prompts on the bottom left-hand comer of the CRT. These prompts are used for entering the settings.

Example: AXIS NUMBER submenu:

```
             AXES NUMBER
 NUMBER OF CNC OR PLC AXES:        7
 NUMBER OF SPINDLES:               1
 NUMBER OF INTERPOLATED AXES:      5
 NUMBER OF PLC ONLY AXES:          0

(A, B, IS, XA)
```

Use the prompt along the bottom as follows:

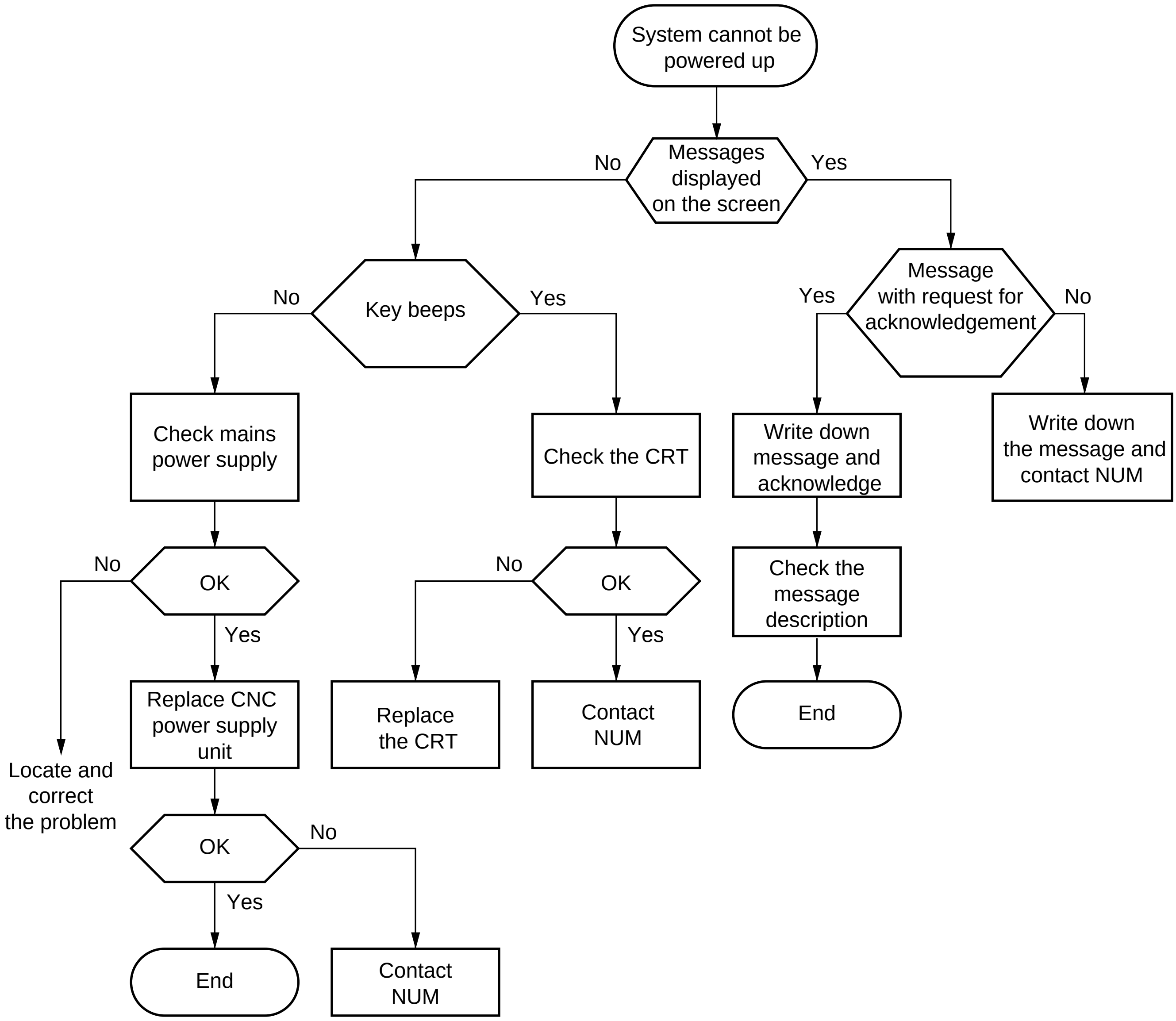
- A 7 ENTER Changes NUMBER OF CNC OR PLC AXES
- B 1 ENTER Changes NUMBER OF SPINDLES
- IS 5 ENTER Changes NUMBER OF INTERPOLATED AXES
- XA 0 ENTER Changes NUMBER OF PLC ONLY AXES

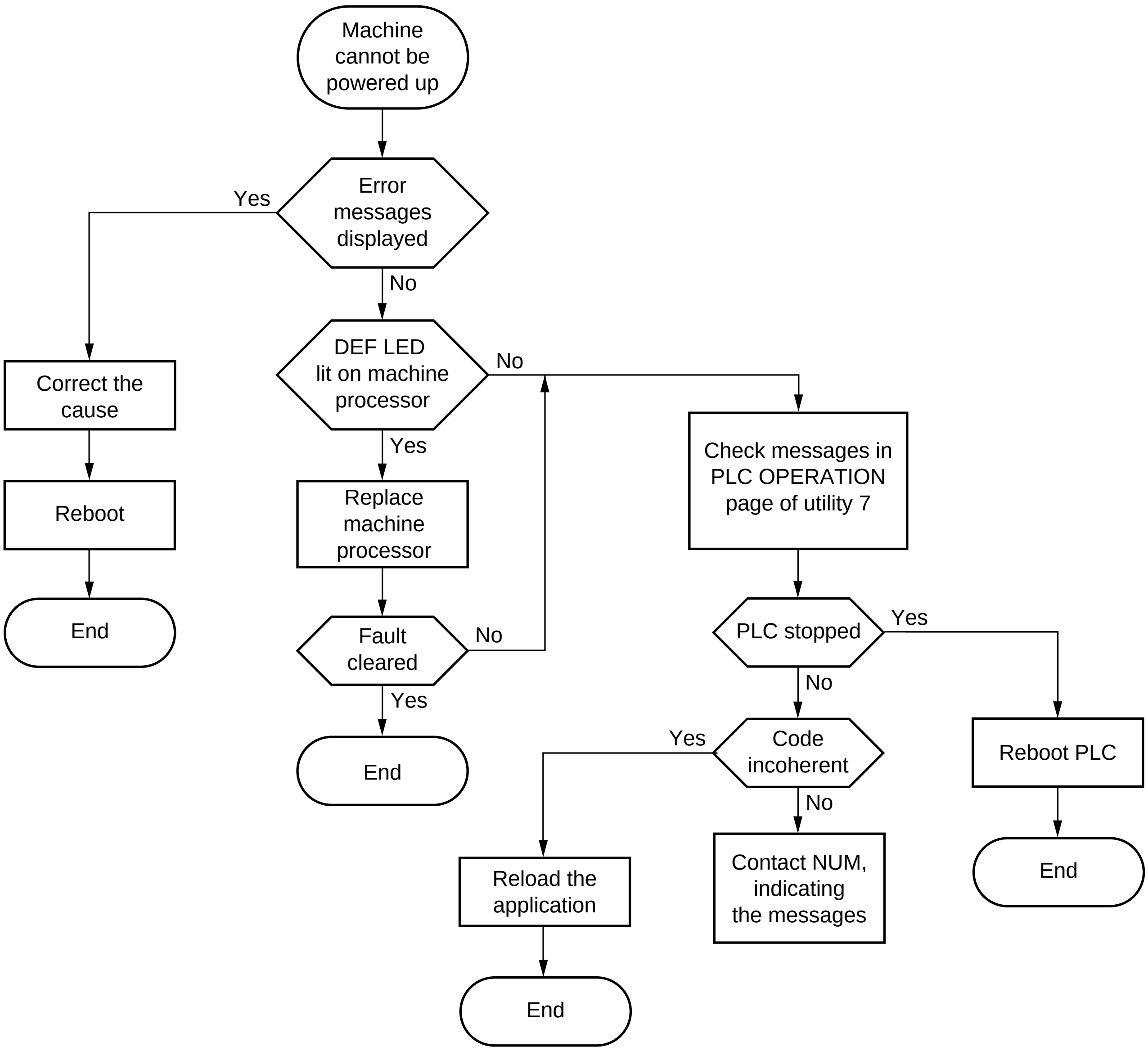
Once you have entered all the data on all the submenus, you can finally select the most important menu option, number 5. This menu option will lock the current setting into the control and erase the old ones. When locking is completed you can connect a printer and print out the current grid using menu item 6, EDITION. But this is usually not required since you already have a piece of paper with the options on it.

17.2.3 PERSOTool

The options can also be loaded using the PERSOTool software. The procedure for this is given in Manual 938973, pages 9-14.

18 Main Diagnostics




Machine cannot be powered up
Error messages displayed
Yes
No
Correct the cause
Reboot
End
DEF LED lit on machine processor
No
Yes
Replace machine processor
Fault cleared
No
Yes
End
Check messages in PLC OPERATION page of utility 7
PLC stopped
Yes
No
Reboot PLC
End
Code incoherent
Yes
No
Reload the application
End
Contact NUM, indicating the messages

19 Initial Messages

A number of information and error messages may appear while the system is booting up. These messages need to be acknowledged. They are listed below with their meaning and possible cause

PARAM TABLE INDEX ERROR	The table of machine parameters doesn't match the CNC software index May appear after a software upgrade	Information message followed by an acknowledgement request to allow parameter update.
REINIT TAB (Y)	Follows the above message to request acknowledgement	Answer Y
EEPROM BACKED UP?	Follows the above messages. The upgrade involves editing of the parameters, so it is necessary first to back them up	Answer Y if a backup copy exists
WRITING IN EEPROM	Information message, indicating that the parameters are being updated	Nothing to do
TOO MANY AXES OR SPINDLES	The number of slave axes or spindles declared in the machine parameters exceeds the maximum number authorised in the configuration	Acknowledge the message, then correct the machine parameters (P2, P3 and/or P6) and reboot the system. Programme control of the machine is inhibited as long as this message appears at power up
WRONG NUMBER OF PLC AXES	The configuration specifies a minimum number of PLC axes that does not exist	Acknowledge the message, validate the required number of PLC axes and reboot the system. Programme control of the machine is inhibited as long as this message appears at initialisation
OPTIONS NOT VALID	Error in the options grid	Reload a correct customisation with the PERSOTool utility if possible. Otherwise, contact NUM Customer Support
MEAS. OFFSET SPACE FULL	The area dedicated to measurement offsets is full	Edit the measurement offset tables (utility 2) to delete the excess data
CUSTOMISATION NOT FINAL	System not configured	Operation is possible, but the configuration is necessary to be able to benefit from the warranty. Contact NUM Customer Support
SYSTEM NOT COVERED BY WARRANTY	Continuation of the above message	Contact NUM Customer Support
CONTINUE	Request for acknowledgement	Answer Y
BOOTING SYSTEM-CNC	Initialisation in progress	Momentary information message. If this message remains displayed, contact NUM Customer Support

MACHINE PARAM ERROR	Error in a machine parameter	Acknowledge the message and check the machine parameters (size, contents)
ACKNOWLEDGE (Y/N)	Request for acknowledgement	Answer Y after reading the above messages
CKS ERROR IN PARAM TABLE	Checksum error in the machine parameter table	Reload the parameters. If the message remains displayed, contact NUM Customer Support
END OF CNC TESTS	Information message; the start-up tests are finished	This message should only be displayed momentarily. If it remains displayed, there is a hardware problem. Contact NUM Customer Support
SAMPLING PERIOD TOO SMALL	The sampling period defined by P50 is too short for the number of axes declared	Set P50 as a minimum to the value indicated by the next message
IT MUST BE AT LEAST	Continuation of previous message	Set word N1 of P50 to a value higher than the one specified
MISSING AXIS	At least one of the axes declared in P2 was not detected as connected to the axis cards	Check the axis ports, and check that P2 matches the machine configuration
SAMPLING PERIOD MUST BE A MULTIPLE OF PERIOD QVN AND EQUAL AT LEAST AT 2 ms FOR AXIS QVN	The sampling period for DISC axes must be a multiple of the sampling period of the QVN axis cards (P50 N)	Set words N0 and N1 of P50 so that N0 is a multiple of N1 and greater than 2 ms
WARNING : SAMPLING PERIOD IS NOT A MULTIPLE OF 2 ms	On certain 1020/1040 and UCSII systems, the sampling period must be a multiple of 2 ms	Set word N0 of P50 to an integer multiple of 2000
TRANSMISSION ERROR MESURE DURING POM AXIS	On an absolute measurement system (SSI), a transmission error occurred during homing	Check the SSI encoder wiring. The problem may also be due to the encoder itself or the axis card
NO TRANSMISSION MESURE DURING POM AXIS	On an absolute measurement system (SSI), no data were transmitted during homing	Check the encoder wiring. The problem may also be due to the encoder
SSI / MIXT or REFERENCE MARK SENSOR REFUSAL: CONNECTING AXIS ACCES CONFLICT Refer to P34	Incompatible encoder type declared in parameter P34 (absolute encoder for an axis card which does not support them)	Make sure the axis cards support the type of encoder connected. Check parameter P34
SAMPLING PERIOD QVN MUST BE BETWEEN 0.4 ms and 1ms BY STEP OF 0.05 ms	On DISC systems, the QVN card refresh rate must be between 0.4 and 1 ms	Set word N1 of P50

20 Card Part Numbers

Power Supply Cards

130 W power supply	206202724
60 W power supply with fibre-optic link	282900003
60 W power supply without fibre-optic link	206202725

Graphic Processors

1 MB V2 graphic processor	204202374
4 MB V2 graphic processor	204202778
4 MB V3 graphic processor	204203485

Machine Processors

1 MB V1 machine processor	204201935
4 MB V1 machine processor	204203035
4 MB V2 machine processor	204203123

CNC Processors

1 MB CNC processor	204201775
4 MB CNC processor	204202771
4 MB arbiter CNC processor	204203288

UCSII Modules

UCS II module	206202886
UCSII module	206203542

PCNC Modules

80 MB V1 PCNC module	206203115
170 MB V1 PCNC module	206203489
270 MB V2 PCNC module	206203502
500 MB V2 PCNC module	206203950

Memory Cards

2 MB 512 RAM memory	204202247
2 MB 768 RAM memory	204202248
2 MB 1.7 RAM memory	204202249
2-4 MB 512 V2 memory	204202229
2-4 MB 768 V2 memory	204202300
2-4 MB 1.7 V2 memory	204202301

Axis Cards

	4x16-bit V1 axis card	204202277
	4x14-bit V1 axis card	204201982
	3x14-bit V1 axis card	204202278
	2x14-bit V1 axis card	204202279
	4x16-bit V2 axis card	204202668
	4x14-bit V2 axis card	204202222
	3x14-bit V2 axis card	204202669
	2x14-bit V2 axis card	204202670
	4x16-bit abs axis card	204203002
	4x14-bit abs axis card	204203000
	3x14-bit abs axis card	204203000
	QVN axis card	204202069

Input/Output Cards

	32 relayed outputs	204201746
	32 inputs 24 VDC	204201926
	32I/24O	204202385
	64I/48O	204202956
	32I/24O	204203167

Miscellaneous Cards

	IT/serial lines	204202370
	Interrupt	204202371
	Analogue inputs/outputs	204202613

1020/1040 Motherboards

	1020/1040 motherboard	204203310

Memory Banks

	4 MB DRAM	204202892
	512 KB SRAM	204202894
	2 MB SRAM	204203390

Appendix A - List of Errors

A

A.1 Miscellaneous and Machine Errors

Error No.	Description
N1	Unknown character/Axis not recognised by the system Too many digits after a function Plus or Minus sign not allowed by a function Wrongly formatted symbolic variable i.e.: F[SPEED] with [SPEED] = 123456
N2	Unknown G Function
N3	Attribute of a G code wrongly positioned
N4	Structured Programming Option disabled
N5	Geometric Programming Option not enabled
N8	Tool corrector number too high
N9	Too many consecutive non working blocks
N17	Missing close bracket
N20	M02 missing
N21	Incoherent definition of the billet in 3D
N25	Unknown sub-programme or sequence number
N26	Sub-programme nesting too deep - 4 maximum
N27	Tool Radius Correction: / in m/c reference mode G52 / In tapered threading
N28	Syntax error in CCSPD or working radius definition G96 Must Be Followed By S G97 Must Be Followed By S Starting Radius undefined X or U are not programmed in this block nor in a previous one
N29	Error in the spindle speed With auto Range Selection, S word not in any range Without auto Range Selection, S not available in the programmed range No programmed Range in CCSPD / No Suitable Range For S in G97
N30	Reader unconnected or faulty. Line fault in DNC or Plotter
N32	Axis referencing error
N33	All axis groups waiting for synchronisation
N34	Minimum radius for interpolation reached - G21
N35	Searched for sequence number not found
N36	Part programme memory full
N37	Maximum feed exceeded in thread chasing
N38	Control of a spindle already affected to another group
N39	Axis synchronisation fault
N40	Excessive following error on axis 0
N41	Excessive following error on axis 1
N42	Excessive following error on axis 2
N43	Excessive following error on axis 3
N44	Excessive following error on axis 4
N45	Excessive following error on axis 5
N46	Excessive following error on axis 6

Error No.	Description
N47	Excessive following error on axis 7
N48	Excessive following error on axis 8
N49	Excessive following error on axis 9
N50	Excessive following error on axis 10
N51	Excessive following error on axis 11
N52	Excessive following error on axis 12
N53	Excessive following error on axis 13
N54	Excessive following error on axis 14
N55	Excessive following error on axis 15
N56	Excessive following error on axis 16
N57	Excessive following error on axis 17
N58	Excessive following error on axis 18
N59	Excessive following error on axis 19
N60	Excessive following error on axis 20
N61	Excessive following error on axis 21
N62	Excessive following error on axis 22
N63	Excessive following error on axis 23
N64	Excessive following error on axis 24
N65	Excessive following error on axis 25
N66	Excessive following error on axis 26
N67	Excessive following error on axis 27
N68	Excessive following error on axis 28
N69	Excessive following error on axis 29
N70	Excessive following error on axis 30
N71	Excessive following error on axis 31
N72	Incomplete data, relative to the previous block
N75	G20 to G21 or G22 transition: last block in G20 incomplete: programmed in PGP or with tool tip correction or with X<0 first block in G21 without X and Y or in G22 without Y and Z G21 or G22 to G20 transition: last block in G21 or G22 incomplete or first block in G20 with tool tip correction in G21 or G22, the starting radius is either negative or zero
N76	In G21: turning or milling fixed cycles are not allowed
N77	Tool type not compatible with the operation
N78	Syntax error in synchronising axis groups G78P:4 digits max, the decimal part being < the number of axis groups G78Q:4 digits max in ascending order M00, M01 or M02 not allowed with G78P

A.2 Parametric Programming Errors

Error No.	Description
N91	Unknown parameter or variable An unsigned function assigned a negative parameter?
N92	Error in assignment to a parameter or variable. the parameter value exceeds the limit for the assigned function
N93	Error in the definition of a parameter or in the expression of a test: L function not followed by one of the relational symbols =, <, >, &, ! appending with +,-,*,/, to a prohibited function
N94	Impossible operation: / square root of a negative number or division by zero?
N95	Trying to write to a read-only parameter
N96	Preceding block “look ahead”, conflicts with external parameter access L100 ... programmed in definition of a profile of a G64
N97	Demands of a parameter in G76 not possible: Equals symbol missing after the parameter number Less than 10 characters reserved to write in the value
N98	Writing out of an axis group with a dynamic operator already used by another group

A.3 Profile Geometry Programming (PGP) Errors

Error No.	Description
N101	PGP: insufficient data in the programming of a circle. Circle programmed on two parallel axes
N102	PGP: when programming a line by angle and one co-ordinate, the missing co-ordinate cannot be calculated
N106	In G2 G3 3rd axis programmed without helical option
N107	PGP: if circle programmed by its radius and end point, the end point is more than twice the radius away If circle programmed by its end point and centre, the trajectory misses the end point Circle programming on two parallel axes (with I,J,K / see error 101)
N110	PGP: syntax error in the first of 2 blocks
N 111	PGP: syntax error in the second block
N112	PGP: line-line intersection in which: first block start and second block end points coincide or angle of first line = angle of second Line
N113	PGP: the values programmed in the two blocks do not allow the line intersection or the tangent point to be calculated
N 114	PGP: intersection or tangent point not defined by ET+, ET-, ES+ or ES-
N121	PGP: syntax error in last of 3 blocks.
N122	PGP: the first two blocks are non-secant lines.
N123	PGP: data in the 3 blocks doesn’t allow the tangent points to be calculated
N124	PGP: second-third block tangent point not defined by ET+ or ET
N130	No axis movement in 1 of the 2 blocks connected by a fillet or chamfer

Error No.	Description
N131	M0, M1 or M2 is not allowed in a block with a fillet or chamfer Programme sequence deficient end point, cannot be calculated
N135	A chamfer can only be ebtween 2 lines
N136	More than 2 non movement blocks between 2 elements whose intersection point or tangency is to be calculated
N137	Change of interpolation plane even though the block is not valid

A.4 Miscellaneous errors

Error No.	Description
N138	Change of interpolation plane must be in G40
N139	Two parallel axes programmed in the same block must be in G52 or G0
N140	Programming error in radius correction: too many non-compensated blocks between 2 compensating ones the following functions are forbidden in G41, G42:M0,M1,M2, access to external parameters and write access to E8xxxx or L100 series parameters
N141	Parallel carried axes: programming a circle whose start point was programmed with one axis and whose end point with its associated parallel axis
N143	G73/G74 is not allowed in radius correction mode
N144	Quantified axis displacement is different from the increment
N145	G29: abs. value (P*P + Q*Q + R*R) > 1 mm (normal vector is not unit vector)
N146	G29: correction in space - at least one dimension P,Q or R missing - at least one dimension X/U Y/V or Z/W missing
N147	Syntax error in G43
N148	Number of interpolated axes bigger than the maximum allowed
N149	Tool radius too large in relation to the programmed trajectory

A.5 Axis Overtravel Errors

Error No.	Description
N150	X axis out of limits
N151	Y axis out of limits
N152	Z axis out of limits
N153	U axis out of limits
N154	V axis out of limits
N155	W axis out of limits
N156	A axis out of limits
N157	B axis out of limits
N158	C axis out of limits
N159	Move demanded on an unhomed axis

A.6 Structured Programming Errors

Error No.	Description
N190	Too many nested jumps or loops
N191	Syntax error in structured programming: structured programming in MDI is not allowed the index of a FOR loop must be: L variable or symbol or an E80000, E81000, or E82000 parameter syntax error with PUSH or PULL DO missing following a WHILE IF ,THEN , ELSE programming in MDI
N192	Unknown key word, in this program context
N193	Structural error
N195	Stack overflow Number of defined constants exceeds the reservation
N196	Error in the table-index declaration
N197	Use of an undeclared symbol
N198	Syntax error in declaring the symbol for a variable
N199	Syntax error in declaring a variable

A.7 Axis Faults

Error No.	Description
N210	Axis 0 encoder signal fault
N211	Axis 1 encoder signal fault
N212	Axis 2 encoder signal fault
N213	Axis 3 encoder signal fault
N214	Axis 4 encoder signal fault
N215	Axis 5 encoder signal fault
N216	Axis 6 encoder signal fault
N217	Axis 7 encoder signal fault
N218	Axis 8 encoder signal fault
N219	Axis 9 encoder signal fault
N220	Axis 10 encoder signal fault
N221	Axis 11 encoder signal fault
N222	Axis 12 encoder signal fault
N223	Axis 13 encoder signal fault
N224	Axis 14 encoder signal fault
N225	Axis 15 encoder signal fault
N226	Axis 16 encoder signal fault
N227	Axis 17 encoder signal fault
N228	Axis 18 encoder signal fault
N229	Axis 19 encoder signal fault
N230	Axis 20 encoder signal fault
N231	Axis 21 encoder signal fault
N232	Axis 22 encoder signal fault
N233	Axis 23 encoder signal fault
N234	Axis 24 encoder signal fault

Error No.	Description
N235	Axis 25 encoder signal fault
N236	Axis 26 encoder signal fault
N237	Axis 27 encoder signal fault
N238	Axis 28 encoder signal fault
N239	Axis 29 encoder signal fault
N240	Axis 30 encoder signal fault
N241	Axis 31 encoder signal fault
N245	Error in digital servo-control

A.8 Errors in Pocket Cycles

Error No.	Description
N260	Executive memory busy
N261	Program number too high
N262	NU number not amongst those authorised
N263	TEST or GRAPHIC mode obligatory after initial load or modification
N264	No dimension programmed in the profiling plane
N265	First positioning block missing - The profile definition must start with G0 or G1
N266	Insufficient memory
N267	Invalid character in pocket syntax
N268	Incomplete pocket block or containing unauthorised data
N269	Incomplete profiling block
N270	Pocket definition partially or totally missing
N271	Tool orientation not perpendicular in relation to profiling plane
N272	Real tool incompatible with pocket’s machining data
N273	Change of profiling plane between pocket definition and execution
N274	Two pocket definitions overlapped
N275	NU0 programmed with G59
N276	Zero pocket depth
N277	Incomplete start or end point coordinates in pocket definition
N278	Spindle rotation inconsistent with that requested in pocket definition
N279	G Function unauthorised in pocket programming block
N280	First profiling block incomplete
N281	Profile inconsistency
N282	Incorrect pocket parameter
N283	Outer profile must exist and be unique
N284	Error in profile definition
N285	Too many profiles
N286	Tool pass too great relative to the tool dia.
N287	Tool pass too shallow in relation to the dimensions
N288	Finishing OP start point at a re-entrant angle or an area not yet roughed: change the entry point
N289	Tool diameter too big
N290	Pocket: Internal error
N291	Finishing stars point outside the profile
N292	Double positioning at start of profile

Part 2

NUM DRIVE

21 Axis Motors

21.1 General

NUM DRIVE axis motors are brushless motors.

These motors have samarium cobalt magnets. They feature a high power-to-weight ratio, a high dynamic speed range and a compact size. They can withstand a high applied overtorque without becoming demagnetised.

Several lines of motors are available:
- BMS brushless servo-motors with or without brake (delivered until the end of 1993)
- BMH brushless servo-motors with or without brake (available since September 1993)
- BMG high-inertia brushless servo-motors without brake (available since April 1995)
- BML compact brushless servo-motors without brake (available since November 1994)

These motors can be used with several different types of NUM DRIVE servo-drives with sinusoidal and flux vector control.

21.2 Characteristics and Performance

The detailed mechanical characteristics of the axis motors (overall dimensions, shaft loads) are given in NUM DRIVE Catalogue en-938919/3, Chapter 1.

For interfacing the motors and associated servo-drives, refer to the installation and maintenance manuals for the servo-drives:

UAC	Manual	738F003/C
MNDA	Manual	738F006/E
MDLA	Manual	738F008/C

Characteristics

General Characteristics

- General characteristics as per IEC 34.1
- Sm Co magnets on the rotor periphery
- Torque range: 0.4-100 Nm at 1500-8000 rpm
- Protection class: IP65 as per IEC 529
- Shaft end protection IP54 as per IEC 529
- Power outputs by terminal box or connector
- Sensor outputs by connector
- Optional 24 VDC brake
- Thermal protection by thermal switch
- Winding insulation class: H (180 degrees) as per VDE 0530 (BMH055 class F)
- Out-of-round, concentricity, perpendicularity between flange and shaft as per DIN 42955 R
- End plate as per IEC 72.2
- Shaft end and key as per IEC 72.1
- Authorised mounting positions: IMB5 - IMV1 - IMV3 as per DIN 42950
- Balancing: classe S as per ISO 2373
- Ambient operating temperature rage 0-40°C

See NUM DRIVE Catalogue, page 1-5 for the characteristics of motor BMH055.

Identification

Typical: reference

BMH 142 2 N 1 R A 2 L

BMH series axis motor

Size

Length

Speed

Power output
1: on terminal box (standard)
5: on connector

Sensor
R: resolver with 3 pole pairs (standard)
U:resolver with 1 pole pair
T: resolver with encoder fitting
D: digital sensor (for DISC)

Brake
A: no brake (standard)
F: brake

Connector (s)
2: frontward (standard)
1: rearward

Shaft end
L: smooth (standard)
C: keyed

Note: Connectors must be ordered separately. See NUM DRIVE Catalogue, Chapter 3.

Detailed Characteristics

Detailed Characteristics

Pos.	BMH... Motor	Nominal torque at low speed (100K) Cn (1) [Nm]	Nominal speed ω n [rpm]	Rotor inertia without brake [g.m²]	Rotor inertia with brake [g.m²]	Optional brake Torque [Nm]	Optional brake Current [A]	Motor weight without brake [kg]	Motor weight with brake [kg]	Thermal time constant T th [min]	Rated rms current (100K) In [Arms]	Power to nominal torque and speed Wdim (100K) [kW]
1	055 2 S	**0.4**	**8000**	0.024	0.025	1		1.4		20	1.1	0.25
2	075 1 N	**1.3**	**3000**	0.08	0.12	2.5	0.5	3.5	3.85	20	2.2	0.41
3	075 1 V	**1.3**	**6000**	0.08	0.12	2.5	0.5	3.5	3.85	20	3	0.82
4	075 2 N	**2.3**	**3000**	0.12	0.16	2.5	0.5	4.3	4.65	23	2.7	0.72
5	075 2 V	**2.3**	**6000**	0.12	0.16	2.5	0.5	4.3	4.65	23	3.5	1.45
6	075 4 N	**4**	**3000**	0.21	0.25	5	0.5	6	6.35	26	3.5	1.26
7	095 2 N	**4.3**	**3000**	0.30	0.41	5	0.7	6.7	7.5	26	3.5	1.35
8	095 2 V	**4.3**	**6000**	0.30	0.41	5	0.7	6.7	7.5	26	5.9	2.70
9	095 3 N	**6**	**3000**	0.41	0.52	5	0.7	8	8.8	29	5.2	1.88
10	095 3 V	**6**	**6000**	0.41	0.52	5	0.7	8	8.8	29	10.3	3.77
11	095 5 N	**9.2**	**3000**	0.64	0.75	11	0.7	10.5	11.3	33	5.8	2.89
12	115 2 N	**7.4**	**3000**	0.70	1.07	12	0.8	9.6	10.9	29	5.5	2.32
13	115 2 V	**7.4**	**6000**	0.70	1.07	12	0.8	9.6	10.9	29	10.5	4.65
14	115 3 K	**10.5**	**2000**	0.97	1.34	12	0.8	11.7	13	33	5.3	2.20
15	115 3 N	**10.5**	**3000**	0.97	1.34	12	0.8	11.7	13	33	9.2	3.30
16	115 3 V	**10.5**	**6000**	0.97	1.34	12	0.8	11.7	13	33	12.6	6.60
17	115 4 K	**13.3**	**2000**	1.25	1.62	12	0.8	13.8	15.1	36	6.2	2.79
18	115 4 N	**13.3**	**3000**	1.25	1.62	12	0.8	13.8	15.1	36	10.1	4.18
19	115 4 V	**13.3**	**6000**	1.25	1.62	12	0.8	13.8	15.1	36	17.6	8.36
20	115 6 N	**18.7**	**3000**	1.80	2.17	22	0.8	17.9	19.2	41	12	5.87
21	142 2 K	**12**	**2000**	1.59	2.54	20	1	17.2	19.4	30	6	2.51
22	142 2 N	**12**	**3000**	1.59	2.54	20	1	17.2	19.4	30	10.4	3.77
23	142 2 R	**12**	**4250**	1.59	2.54	20	1	17.2	19.4	30	11.5	5.34
24	142 3 K	**17**	**2000**	2.19	3.14	20	1	20.1	22.3	34	9.5	3.56
25	142 3 N	**17**	**3000**	2.19	3.14	20	1	20.1	22.3	34	11.7	5.34
26	142 3 R	**17**	**4250**	2.19	3.14	20	1	20.1	22.3	34	16.9	7.57
27	142 4 K	**22**	**2000**	2.79	3.74	20	1	23	25.2	37	10.4	4.61
28	142 4 N	**22**	**3000**	2.79	3.74	20	1	23	25.2	37	15.6	6.91
29	142 4 R	**22**	**4250**	2.79	3.74	20	1	23	25.2	37	20.8	9.79
30	142 7 N	**35**	**3000**	4.29	5.24	40	1	31.7	33.9	42	24.2	11
31	190 2 K	**25**	**2000**	5.14	8.25	40	1.5	32.1	36.2	38	16.6	5.24
32	190 2 N	**25**	**3000**	5.14	8.25	40	1.5	32.1	36.2	38	19.9	7.85
33	190 2 R	**25**	**4250**	5.14	8.25	40	1.5	32.1	36.2	38	29.2	11.1
34	190 3 K	**36**	**2000**	7.10	10.2	40	1.5	37.3	41.4	43	19.7	7.54
35	190 3 N	**36**	**3000**	7.10	10.2	40	1.5	37.3	41.4	43	27.8	11.3
36	190 4 K	**48**	**2000**	9.04	12.1	40	1.5	42.4	46.5	48	20.6	9.63
37	190 4 N	**48**	**3000**	9.04	12.1	40	1.5	42.4	46.5	48	30.3	14.5
38	190 5 H	**56**	**1500**	11	14.1	80	1.5	47.6	51.7	52	20	8.79
39	190 5 L	**56**	**2500**	11	14.1	80	1.5	47.6	51.7	52	31.4	14.7
40	190 7 K	**75**	**2000**	14.90	18	80	1.5	58	62.1	59	27.9	15.7
41	190 A K	**100**	**2000**	20.75	23.8	80	1.5	73.9	78	74	44	21

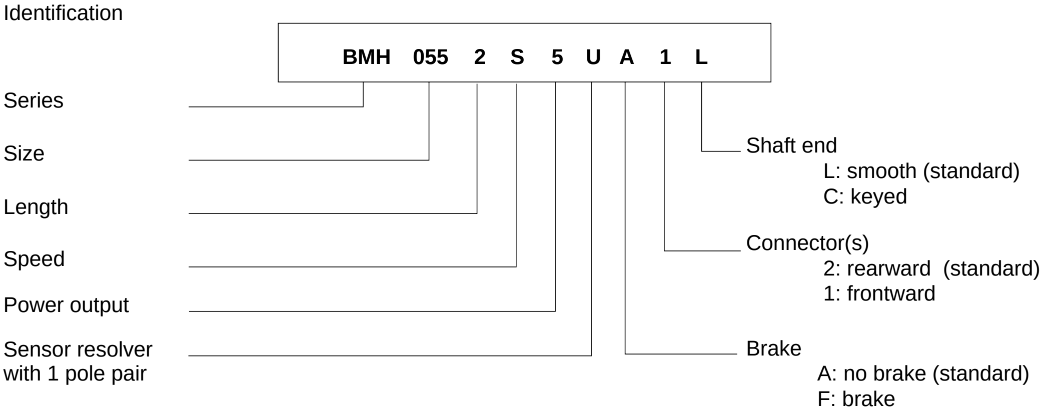
(1) To obtain the low speed torque corresponding to a 60 K temperature rise, apply a coefficient of 0.77.
For motor/servo-drive associations, refer to the chapter on the servo-drive concerned.

BMH055 Axis Motors

BMH055 Motor Characteristics Compared with Other BMH Motors

- Winding insulation class: F (155°C) as per VDE 0530
- Out-of-round, concentricity, perpendicularity between flange and shaft as per DIN 42955 R
- Resolver with 1 pole pair
- Control and power connections by special connectors (see Chapter 3)
- Not configured for encoder
- DISC version not available
- Requires a resolver interface (see the chapter on the associated servo-drive).

Identification



Sensors

The standard motor is equipped with a resolver with 3 pole pairs (resolver with 1 pole pair optional). This provides several functions:

- It gives the angular position of the rotor to allow static switching.
- It measures the rotor speed via the associated servo-drive.
  This information is used by the speed governor.
- It can also provide incremental position outputs for the position controller (encoder simulation output). For further details on this function, see the chapter on the associated servo-drive.
- Connections are always made using a connector.

Note: **For a DISC application, the resolver is replaced by a digital sensor that supports all the above functions.**

Caracteristics

General Characteristics

- General characteristics as per IEC 34.1
- Sm Co magnets on the rotor periphery
- Torque range: 1.3-36 Nm at 2000-3000 rpm
- Protection class: IP65 as per IEC 529
- IP54 shaft end
- Power outputs by terminal box or connector
- Sensor outputs by connector
- Optional 24 VDC brake
- The terminal protection by thermal switch
- Winding insulation class: H (180 degrees) as per VDE 0530
- Out-of-round, concentricity, perpendicularity between flange and shaft as per DIN 42955 R
- End plate as per IEC 72.2
- Shaft end and key as per IEC 72.1
- Authorised mounting positions: IMB5 - IMV1 - IMV3 as per DIN 42950
- Balancing: classe S as per ISO 2373
- Ambient operating temperature rage 0-40°C
- *No parking brake possible*

Identification

Typical reference

BMG 142 2 N 1 R A 2 L

BMG series axis motor

Size

Length

Speed

Power output
1: on terminal box (standard)
5: on connector

Sensor
R: resolver with 3 pole pairs (standard)
U:resolver with 1 pole pair
T: resolver with encoder fitting
D: digital sensor (for DISC)

No brake (unavailable)

Connector (s)
2: rearward (standard)
1: frontward

Shaft end
L: smooth (standard)
C: keyed

Note: Connectors must be ordered separately. See NUM DRIVE Catalogue, Chapter 3.

Detailed Characteristics

Detailed Characteristics

Pos.	BMG ... Motor	Nominal torque at low speed (100K) Cn (1) [Nm]	Nominal speed ωn [rpm]	Rotor inertia [g.m²]	Motor weight [kg]	Thermal time constant T therm [min]	Rated rms current (100K) In [Arms]	Power to nominal torque and speed Wdim (100K) [kW]
1	075 1 N	**1.3**	**3000**	0.254	4	20	2.2	0.41
2	075 2 N	**2.3**	**3000**	0.304	4.8	23	2.7	0.72
3	095 2 N	**4.3**	**3000**	0.86	7.6	26	3.5	1.35
4	095 3 N	**6**	**3000**	0.97	8.9	29	5.2	1.88
5	115 2 N	**7.4**	**3000**	2.45	11.2	29	5.5	2.32
6	115 3 N	**10.5**	**3000**	2.73	13.3	33	9.2	3.30
7	142 2 N	**12**	**3000**	6.7	20.4	30	10.4	3.77
8	142 3 N	**17**	**3000**	7.3	23.3	34	11.7	5.34
9	142 4 K	**22**	**2000**	7.9	26.2	37	10.4	4.61
10	142 7 N	**35**	**3000**	9.7	34.9	42	24.2	11
11	190 2 K	**25**	**2000**	20.9	38.1	38	16.6	5.24
12	190 3 N	**36**	**3000**	22.9	43.3	43	27.8	11.3

(1) To obtain the low speed torque corresponding to a 60 K temperature rise, apply a coefficient of 0.77.
For motor/servo-drive associations, refer to the chapter on the servo-drive concerned.

21.3 Sensors

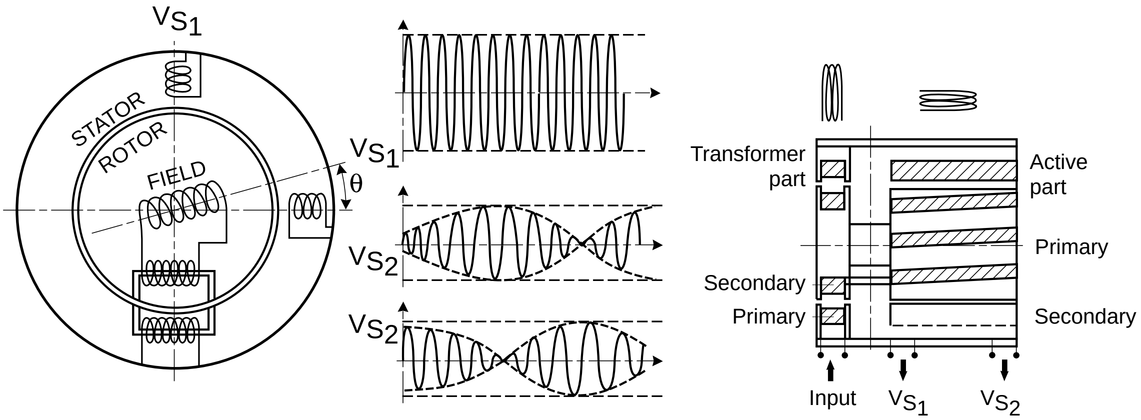
The motors are equipped with an internal sensor measuring the rotor angle.

Different types of sensors can be used:

1. 6-pole resolver   Sensor code R
2. 2-pole resolver   Sensor code U
3. DISC encoder   Sensor code D

This section describes a motor equipped with a resolver. For the DISC encoder, refer to the DISC manuals.

Technology and Principle



$V_S = U \sin \omega t$

$V_{S1} = KU \sin \theta \sin \omega t$

$V_{S2} = KU \cos \theta \sin \omega t$

The resolver is mounted directly on the motor shaft (hollow shaft) to minimise space, and enhance integration.

It does not include any switches. It is therefore highly reliable and requires no maintenance.

It operates according to the principle of magnetic induction. It has two parts:

- Transformer T1 whose primary is wired to the stator and whose secondary is wired to the rotor, supplied by a 10 kHz carrier frequency
- Transformer T2, whose primary, called field winding, integrated in the rotor, is supplied from the secondary of transformer T1 (10 kHz carrier). This field winding, which rotates with the rotor, generates a rotating field which induces a variable signal in the two secondaries, called armature windings, placed in the stator.

The two secondaries of T2 (armature) are situated 90 degrees apart such that the rotor angle can be determined by combining their outputs. The accuracy is ± 6 electrical arc minutes.

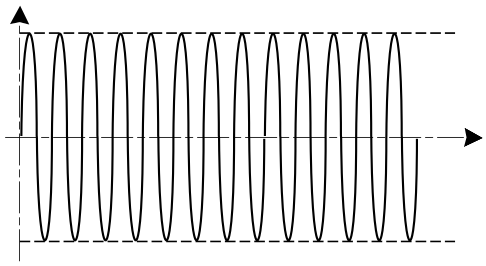
When processed, the position signal can be used by the servo-drive to perform the following functions:
- Static commutation (selsyn operation)
- Generation of the speed signal (speed loop)
- General of a digital position signal (position loop).

Signals measured at the servo-drive input (the terminals vary according to the servo-drive used; see the section on servo-drives).

Carrier (9750 Hz, 10 V peak)

Terminals A and B of the motor connector

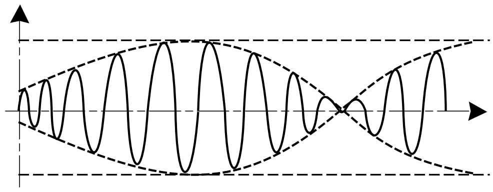
Green and black wires



Cosinusoidal signal

Terminals C and D of the motor connector

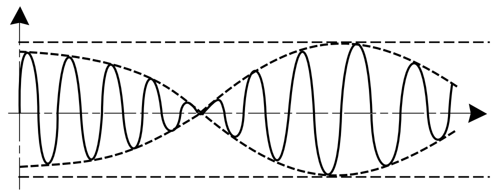
White and black wires



Sinusoidal signal

Terminals E and F of the motor connector

Red and black wires



NUM DRIVE servo-drives monitor the presence of the resolver signals (open circuit, pole reversal, etc.).

Alarms (differing according to the servo-drive used) indicate the presence of a resolver connection fault.

If a resolver alarm is present, but the servo-drive input signals are correct, the presence of the internal sinusoidal and cosinusoidal signals can be checked using the PC communication tool with the servo-drive (PC Set Link for UAC and MNDA, and DPM for MDLA).

These tools can also be used to check that the reading on the e-gain (resolver gain) test point is between 0 and 255.

Readings close to 0 (input signals too high) or 255 (signals too low) generate a resolver alarm.

A faulty resolver can easily be replaced by an electromechanical technician.

Part number of 6-pole resolver: RESOLVER N303 410256303

Part number of 2-pole resolver: RESOLVER N301 410252301

When installing the new resolver, it is very important to set the resolver at exactly the right angle or there is a risk of motor runaway or loss of torque.

A setting procedure is described in the Installation and Maintenance Manuals for the associated servo-drives.

Manual 738E003/C for UAC

Manual 738E006/E for MNDA

Manual 738E008/C for MDLA

This procedure, although simple, requires use of the SPM or MPM communication software, a PC and a digital multimeter.

After replacement of the motor, the resolver or its wire, always repeat the automatic calibration procedure with PC Set Link (SPM software packages).

21.4 Thermal Probes

The motor temperature is monitored by a thermal switch mounted on the motor frame. If it fails, this thermal switch is very easy to replace. It is located inside the motor terminal box.

For motor:

BMS	: TERMF11160C	410211160	(160 °C)
BMH/BMG	: TERMF1150C	410211150	(150 °C)
BMH DISC	: TERMF190C	410211090	(90 °C)

21.5 Maintenance

NUM DRIVE brushless motors have life-lubricated bearings and require no maintenance.

If repeated Overcurrent alarms are detected by the servo-drive, check the winding impedance and insulation from the protective earth.

21.5.1 Checking Motor Insulation

The insulation resistance must be measured by a special insulation tester (e.g. Megger) which can output 1000 VDC.

Disconnect the motor cables. Earth the thermal switch and the brake if any.

Interconnect the three phases of the motor. Then apply the test voltage to the windings and earth.

The insulation resistance must be > 2 MΩ

If the measured value is lower, check for moisture inside the motor power connections, before deciding that the windings are faulty.

21.5.2 Measuring the Winding Impedance

The motor winding impedance is generally very low (a few tenths of an ohm to a few ohms, depending on the motor). It is therefore difficult to measure with a conventional multimeter.

21.6 Technical Characteristics of Brushless Motors

(Table headings on following pages)

Cnom : Nominal torque (Nm)

wnom : Nominal speed (rpm)

Wdim : Power at nominal torque and speed Wdim = Cnom x wnom x 2P/60

Inom : Rated current (at nominal torque) (Arms)

Kt : Torque constant = Cnom/Inom (Nm/A)

Ef : Electromotive force of a winding (V/1000 rpm)

Jr : Motor inertia (g.m^2)

Ke : Speed constant = Ef/w(V.s)

P = Cw = **Kt.If.w**
If: Current in a winding = phase current (wye coupling)
Ef: Voltage in a winding
U: Voltage between phases = Vf.$\sqrt{3}$ (wye coupling)

P = U.If.cos∅.$\sqrt{3}$ = Ef.$\sqrt{3}$.If.$\sqrt{3}$ = 3.Ef.If **= 3.Ke.w.If** (neglecting the power factor)
Therefore **Ke = Kt / 3**

Rf : Winding resistance (mohm) (value at 20°C)

Lf : Winding inductance (mH)

Te : Electrical time constant (ms) = Lf/Rf

Tm : Mechanical time constant (ms)

Tth : Thermal time constant (min)

21.7 Technical Characteristics of BMS Motors

TYPE BMS	Cnom	wnom	Wdim	Inom	Kt	Ef	Jr	Ke	Rf	Lf	Te	Tm	Tth
	(Nm)	(rpm)	(kW)	(Arms)	(mN/A)	(V) /1000 rpm	(g.m^2)	(V.s)	(mOhm) at 20 °C	(mH)	(ms)	(ms)	(min)
BMS 75 1 18125	1.3	3000	0.41	2.2	0.59	20.13	0.07	0.20	5126.45	18.43	3.60	3.16	20
BMS 75 1 1891	1.3	6000	0.82	3	0.43	14.65	0.07	0.14	2716.94	9.77	3.60	3.14	20
BMS 75 2 1891	2.3	3000	0.72	2.7	0.85	29.30	0.12	0.28	3898.21	17.94	4.60	1.96	23
BMS 75 2 1870	2.3	6000	1.45	3.5	0.66	22.54	0.12	0.22	2306.63	10.62	4.60	1.96	23
BMS 75 4 1861	4	3000	1.26	3.5	1.14	39.38	0.21	0.38	2815.88	15.42	5.48	1.38	26
BMS 75 4 1840	4	6000	2.51	5.3	0.75	25.76	0.21	0.25	1210.80	6.63	5.48	1.37	26
BMS 95 2 18102	4.3	3000	1.35	3.5	1.23	42.26	0.30	0.41	3059.51	23.29	7.61	1.85	20
BMS 95 2 1860	4.3	6000	2.70	5.9	0.73	24.86	0.30	0.24	1058.66	8.06	7.61	1.84	20
BMS 95 3 1863	6	3000	1.88	5.2	1.15	39.14	0.41	0.38	1489.32	12.85	8.63	1.42	23
BMS 95 3 1832	6	6000	3.77	10.3	0.58	19.88	0.41	0.19	384.24	3.32	8.64	1.42	23
BMS 95 5 1860	9.2	2000	1.93	5	1.84	62.16	0.64	0.61	1935.01	18.85	9.74	1.13	26
BMS 95 5 1852	9.2	3000	2.89	5.8	1.59	53.87	0.64	0.53	1453.40	14.16	9.74	1.14	26
BMS 95 5 1826	9.2	6000	5.78	11.6	0.79	26.94	0.64	0.26	363.35	3.54	9.74	1.14	26
BMS 115 2 1886	7.4	3000	2.32	5.5	1.35	46.00	0.70	0.45	1609.45	17.09	10.62	1.91	29
BMS 115 2 1845	7.4	6000	4.65	10.5	0.70	24.07	0.70	0.23	440.66	4.68	10.62	1.90	29
BMS 115 3 1884	10.5	2000	2.20	5.3	1.98	67.41	1.00	0.66	1918.45	23.41	12.20	1.50	33
BMS 115 3 1848	10.5	3000	3.30	9.2	1.14	38.52	1.00	0.38	626.43	7.65	12.21	1.49	33
BMS 115 3 1835	10.5	6000	6.60	12.6	0.83	28.09	1.00	0.28	333.06	4.06	12.19	1.49	33
BMS 115 4 1868	13.3	2000	2.79	6.2	2.15	72.76	1.30	0.72	1507.54	19.99	13.26	1.31	36
BMS 115 4 1842	13.3	3000	4.18	10.1	1.32	44.94	1.30	0.44	575.11	7.63	13.27	1.32	36
BMS 115 4 1824	13.3	6000	8.36	17.6	0.76	25.68	1.30	0.25	187.79	2.49	13.26	1.32	36
BMS 115 6 1842	18.7	2000	3.92	9.4	1.99	67.41	1.80	0.66	766.47	11.18	14.59	1.08	41
BMS 115 6 1833	18.7	3000	5.87	12	1.56	52.97	1.80	0.52	473.18	6.90	14.58	1.08	41
BMS 115 6 1818	18.7	6000	11.75	21.9	0.85	28.89	1.80	0.28	140.78	2.05	14.56	1.08	41
BMS 142 2 3654	12	2000	2.51	6	2.00	69.88	1.60	0.67	1855.20	21.97	11.84	2.22	30
BMS 142 2 3631	12	3000	3.77	10.4	1.15	40.11	1.60	0.38	611.40	7.24	11.84	2.21	30
BMS 142 2 3628	12	4250	5.34	11.5	1.04	36.23	1.60	0.35	498.79	5.91	11.85	2.21	30

TYPE BMS	Cnom	wnom	Wdim	Inom	Kt	Ef	Jr	Ke	Rf	Lf	Te	Tm	Tth
	(Nm)	(rpm)	(kW)	(Arms)	(mN/A)	(V) *\/1000 rpm*	(g.m^2)	(V.s)	(mOhm) *at 20 °C*	(mH)	(ms)	(ms)	(min)
BMS 142 2 3618	12	6000	7.54	17.9	0.67	23.29	1.60	0.22	206.13	2.44	11.84	2.21	30
BMS 142 3 3632	17	2000	3.56	9.5	1.79	62.14	2.20	0.60	798.29	10.94	13.70	1.65	34
BMS 142 3 3626	17	3000	5.34	11.7	1.45	50.49	2.20	0.48	526.99	7.22	13.70	1.65	34
BMS 142 3 3618	17	4250	7.57	16.9	1.01	34.96	2.20	0.34	252.58	3.46	13.70	1.65	34
BMS 142 3 3615	17	6000	10.68	20.3	0.84	29.13	2.20	0.28	175.40	2.40	13.68	1.66	34
BMS 142 4 3628	22	2000	4.61	10.4	2.12	72.49	2.80	0.71	723.58	10.85	14.99	1.38	37
BMS 142 4 3619	22	3000	6.91	15.6	1.41	49.19	2.80	0.47	333.18	5.00	15.01	1.41	37
BMS 142 4 3614	22	4250	9.79	20.8	1.06	36.25	2.80	0.35	180.90	2.71	14.98	1.38	37
BMS 142 4 3610	22	6000	13.82	29.1	0.76	25.89	2.80	0.25	92.29	1.38	14.95	1.38	37
BMS 142 7 3624	35	1500	5.50	11.1	3.15	108.74	4.30	1.05	779.34	13.42	17.22	1.02	42
BMS 142 7 3616	35	2000	7.33	16.6	2.11	72.50	4.30	0.70	346.37	5.96	17.21	1.02	42
BMS 142 7 3611	35	3000	11.00	24.2	1.45	49.84	4.30	0.48	163.72	2.82	17.22	1.02	42
BMS 142 7 369	35	4250	15.58	29.6	1.18	40.78	4.30	0.39	109.60	1.89	17.24	1.02	42
BMS 190 2 3630	25	2000	5.24	16.6	1.51	52.11	5.10	0.50	375.78	8.10	21.56	2.56	38
BMS 190 2 3625	25	3000	7.85	19.9	1.26	43.43	5.10	0.42	260.96	5.62	21.54	2.55	38
BMS 190 2 3617	25	4250	11.13	29.9	0.84	29.53	5.10	0.28	120.67	2.60	21.55	2.61	38
BMS 190 3 3628	36	1500	5.65	16.9	2.13	72.97	7.10	0.71	389.75	9.37	24.04	1.86	43
BMS 190 3 3624	36	2000	7.54	19.7	1.83	62.54	7.10	0.61	286.35	6.88	24.03	1.86	43
BMS 190 3 3617	36	3000	11.31	27.8	1.29	44.30	7.10	0.43	143.67	3.45	24.01	1.86	43
BMS 190 4 3626	48	1500	7.54	17.5	2.74	89.96	9.00	0.91	389.77	10.07	25.84	1.49	48
BMS 190 4 3622	48	2000	10.05	20.6	2.33	76.12	9.00	0.78	279.07	7.21	25.84	1.48	48
BMS 190 4 3615	48	3000	15.08	30.3	1.58	51.90	9.00	0.53	129.73	3.35	25.82	1.49	48
BMS 190 5 3622	56	1500	8.80	20	2.80	95.68	11.00	0.93	317.59	8.64	27.20	1.37	52
BMS 190 5 3616	56	2000	11.73	27.5	2.04	69.58	11.00	0.68	167.98	4.57	27.21	1.37	52
BMS 190 5 3614	56	2500	14.66	31.4	1.78	60.89	11.00	0.59	128.61	3.50	27.21	1.36	52
BMS 190 7 3620	75	1400	11.00	20.9	3.59	121.66	15.00	1.20	326.10	9.51	29.16	1.17	61
BMS 190 7 3615	75	2000	15.71	27.9	2.69	91.25	15.00	0.90	183.43	5.35	29.17	1.17	61
BMS 190 A 369	100	2000	20.94	44	2.27	78.30	21.00	0.76	79.39	2.63	33.13	0.98	65

21.8 Technical Characteristics of BMH Motors

TYPE BMH	Cnom (Nm)	wnom (rpm)	Wdim (kW)	Inom (Arms)	Kt (mN/A)	Ef (V) /1000 rpm	Jr (g.m²)	Ke (V.s)	Rf (mOhm) at 20 °C	Lf (mH)	Te (ms)	Tm (ms)	Tth (min)
BMH 75 1 N	1.3	3000	0.41	2.2	0.59	20.13	0.07	0.20	5126.45	18.43	3.60	3.16	20
BMH 75 1 V	1.3	6000	0.82	3	0.43	14.65	0.07	0.14	2716.94	9.77	3.60	3.14	20
BMH 75 2 N	2.3	3000	0.72	2.7	0.85	29.30	0.12	0.28	3898.21	17.94	4.60	1.96	23
BMH 75 2 V	2.3	6000	1.45	3.5	0.66	22.54	0.12	0.22	2306.63	10.62	4.60	1.96	23
BMH 75 4 N	4	3000	1.26	3.5	1.14	39.38	0.21	0.38	2815.88	15.42	5.48	1.38	26
BMH 95 2 N	4.3	3000	1.35	3.5	1.23	42.26	0.30	0.41	3059.51	23.29	7.61	1.85	20
BMH 95 2 V	4.3	6000	2.70	5.9	0.73	24.86	0.30	0.24	1058.66	8.06	7.61	1.84	20
BMH 95 3 N	6	3000	1.88	5.2	1.15	39.14	0.41	0.38	1489.32	12.85	8.63	1.42	23
BMH 95 3 V	6	6000	3.77	10.3	0.58	19.88	0.41	0.19	384.24	3.32	8.64	1.42	23
BMH 95 5 N	9.2	3000	2.89	5.8	1.59	53.87	0.64	0.53	1453.40	14.16	9.74	1.14	26
BMH 115 2 N	7.4	3000	2.32	5.5	1.35	46.00	0.70	0.45	1609.45	17.09	10.62	1.91	29
BMH 115 2 V	7.4	6000	4.65	10.5	0.70	24.07	0.70	0.23	440.66	4.68	10.62	1.90	29
BMH 115 3 K	10.5	2000	2.20	5.3	1.98	67.41	1.00	0.66	1918.45	23.41	12.20	1.50	33
BMH 115 3 N	10.5	3000	3.30	9.2	1.14	38.52	1.00	0.38	626.43	7.65	12.21	1.49	33
BMH 115 3 V	10.5	6000	6.60	12.6	0.83	28.09	1.00	0.28	333.06	4.06	12.19	1.49	33
BMH 115 4 K	13.3	2000	2.79	6.2	2.15	72.76	1.30	0.72	1507.54	19.99	13.26	1.31	36
BMH 115 4 N	13.3	3000	4.18	10.1	1.32	44.94	1.30	0.44	575.11	7.63	13.27	1.32	36
BMH 115 4 V	13.3	6000	8.36	17.6	0.76	25.68	1.30	0.25	187.79	2.49	13.26	1.32	36
BMH 115 6 N	18.7	3000	5.87	12	1.56	52.97	1.80	0.52	473.18	6.90	14.58	1.08	41
BMH 142 2 K	12	2000	2.51	6	2.00	69.88	1.60	0.67	1855.20	21.97	11.84	2.22	30
BMH 142 2 N	12	3000	3.77	10.4	1.15	40.11	1.60	0.38	611.40	7.24	11.84	2.21	30
BMH 142 2 R	12	4250	5.34	11.5	1.04	36.23	1.60	0.35	498.79	5.91	11.85	2.21	30
BMH 142 3 K	17	2000	3.56	9.5	1.79	62.14	2.20	0.60	798.29	10.94	13.70	1.65	34
BMH 142 3 N	17	3000	5.34	11.7	1.45	50.49	2.20	0.48	526.99	7.22	13.70	1.65	34
BMH 142 3 R	17	4250	7.57	16.9	1.01	34.96	2.20	0.34	252.58	3.46	13.70	1.65	34
BMH 142 4 K	22	2000	4.61	10.4	2.12	72.49	2.80	0.71	723.58	10.85	14.99	1.38	37
BMH 142 4 N	22	3000	6.91	15.6	1.41	49.19	2.80	0.47	333.18	5.00	15.01	1.41	37

TYPE BMH	Cnom (Nm)	wnom (rpm)	Wdim (kW)	Inom (Arms)	Kt (mN/A)	Ef (V) /1000 rpm	Jr (g.m²)	Ke (V.s)	Rf (mOhm) at 20 °C	Lf (mH)	Te (ms)	Tm (ms)	Tth (min)
BMH 142 4 R	22	4250	9.79	20.8	1.06	36.25	2.80	0.35	180.90	2.71	14.98	1.38	37
BMH 142 7 N	35	3000	11.00	24.2	1.45	49.84	4.30	0.48	163.72	2.82	17.22	1.02	42
BMH 190 2 K	25	2000	5.24	16.6	1.51	52.11	5.10	0.50	375.78	8.10	21.56	2.56	38
BMH 190 2 N	25	3000	7.85	19.9	1.26	43.43	5.10	0.42	260.96	5.62	21.54	2.55	38
BMH 190 2 R	25	4250	11.13	29.9	0.84	29.53	5.10	0.28	120.67	2.60	21.55	2.61	38
BMH 190 3 K	36	2000	7.54	19.7	1.83	62.54	7.10	0.61	286.35	6.88	24.03	1.86	43
BMH 190 3 N	36	3000	11.31	27.8	1.29	44.30	7.10	0.43	143.67	3.45	24.01	1.86	43
BMH 190 4 K	48	2000	10.05	20.6	2.33	76.12	9.00	0.78	279.07	7.21	25.84	1.48	48
BMH 190 4 N	48	3000	15.08	30.3	1.58	51.90	9.00	0.53	129.73	3.35	25.82	1.49	48
BMH 190 5 H	56	1500	8.80	20	2.8	95.68	11.00	0.93	317.59	8.64	27.20	1.37	52
BMH 190 5 L	56	2500	14.66	31.4	1.78	60.89	11.00	0.59	128.61	3.50	27.21	1.36	52
BMH 190 7 K	75	2000	15.71	27.9	2.69	91.25	15.00	0.90	183.43	5.35	29.17	1.17	61
BMH 190 A K	100	2000	20.94	44	2.27	78.30	21.00	0.76	79.39	2.63	33.13	0.98	65

22 Spindle Motors

22.1 General

The spindle motors of the NUM DRIVE line are induction motors.

They are asynchronous squirrel cage motors equipped with a speed measurement sensor to control motor slip very accurately.

Several lines of motors are available:
- Series IM and HM spindle motors
- Series AMS spindle motors (this more recent line of motors is gradually replacing the IM line)
- AM132 liquid-cooled spindle motors
- MotorSpindle motor-driven spindles
  This motor technology achieves optimum spindle motor integration in the machine and simplifies the mechanical parts to the utmost.
  - Hollow rotor
  - Liquid-cooled stator
  - High-resolution sensor + cog wheel.

These motors are used in conjunction with UAC and MDLS flux vector control and sinusoidal control servo-drives.

22.2 Characteristics and Performance

The detailed mechanical characteristics of the spindle motors (overall dimensions, shaft loads) are given in NUM DRIVE Catalogue en-938919/3, Chapter 2.

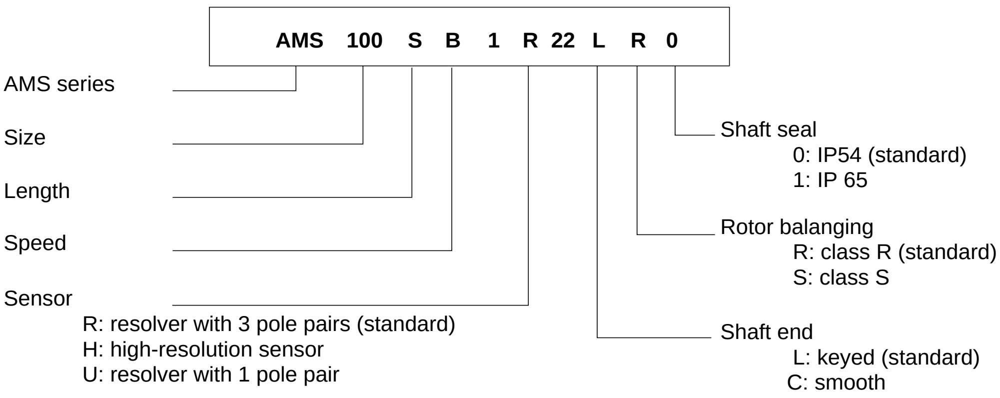
For interfacing the motors and associated servo-drives, refer to the installation and maintenance manuals for the servo-drives:

UAC Manual 738F003/C

Identification

AMS Motor Identification

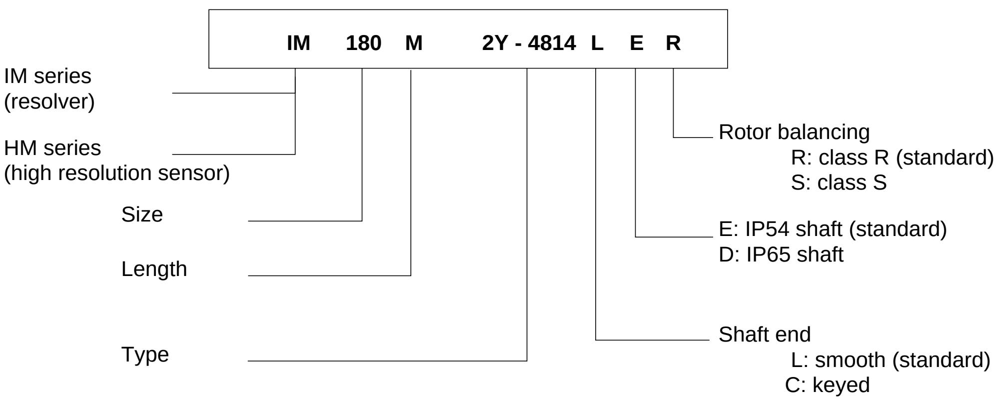
Typical reference



Note: The connectors must be ordered separately. See NUM DRIVE Catalogue, Chapter 3.

IM Motor Identification

Typical reference



Note: The connectors must be ordered separately. See NUM DRIVE Catalogue, Chapter 3.

Technical Characteristics

Technical Characteristics

- General characteristics as per IEC 34.1
- Protection class: IP 65 as per IEC 529
- Shaft end: IP54
- Termal protection by thermal switch
- Winding insulation class: H (180°)
- Out-of-round, concentricity, perpendicularity between flange and shaft as per DIN 42955 R
- Mounting: flange (or foot) with smooth holes as per IEC 72-2
- Shaft end and key as per IEC 72-1
- Authorised mounting positions: IMB5 - IMV1 - IMV3 as per DIN 42950
- Balancing as per ISO 2373: class R standard - class S optional
- Ambient operating temperature range: 0-40°C

AMS **motors**	Power S1 [kW]	Weight [kg]	Inertia [kg.m²]	Thermal time constant [min]	Three-phase fan [V]	[A]
AM 100 S	3.7	37	0.009	32		
AMS 100 M	5.5	4.9	0.014	35	380	0.11
AMS 100 G	9	71	0.023	38		
AMS 132 S	15	105	0.055	45		
AMS 132 M	19.5	131	0.075	50	380	0.20
AMS 132 L	22	183	0.113	55		
AMS 160 M	36	215	0.25	57		
AMS 160 L	36	290	0.37	61	380	0.3

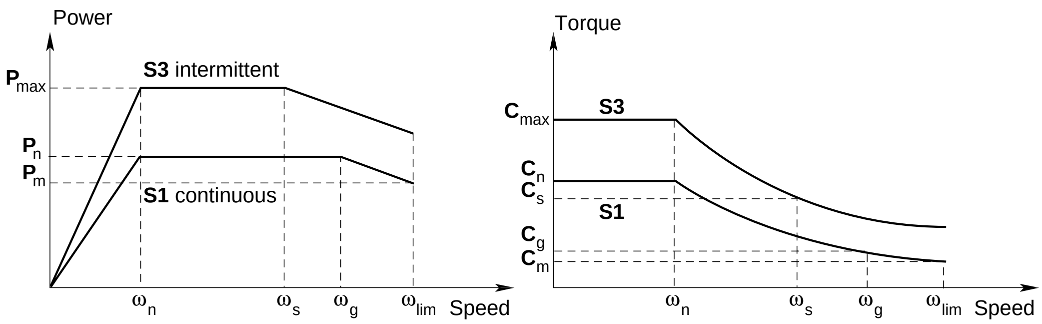
IM - HM motors	Power S1 [kW]	Weight [kg]	Inertia [kg.m²]	Thermal time constant [min]	Three-phase fan [V]	[A]
IM 180 M	55	415	0.57	63	220	0.78

Noise level dB [A]
as per ISO 1680 - Second session, 1986.

Motor	Noise level dB [A]
AMS 100	70
AMS 132	68
AMS 160	—
IM 180	71

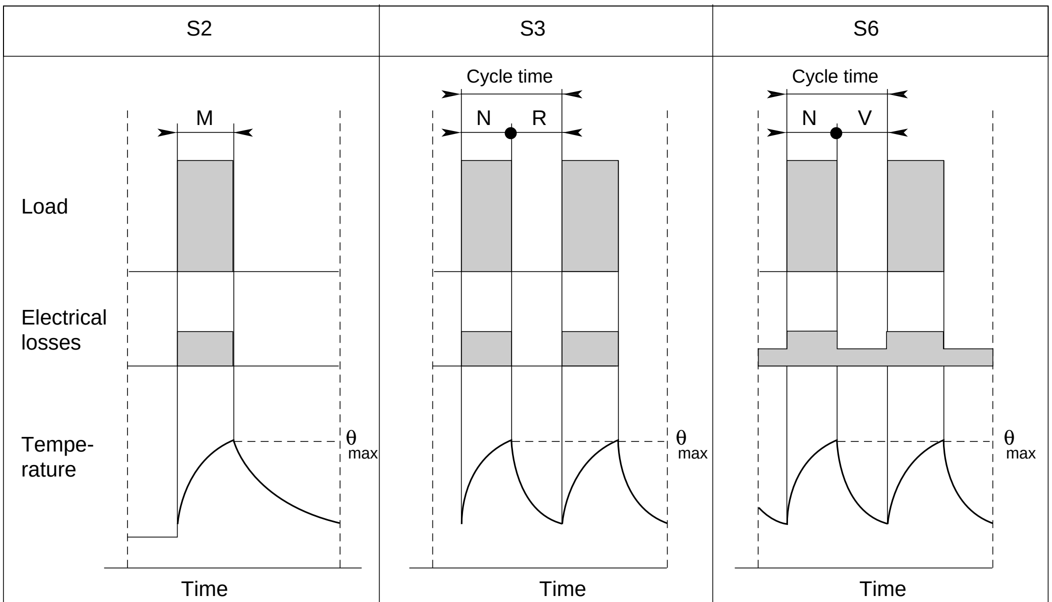
Motor/Servo-Drive Associations

Power-Speed and Torque-Speed Curves for AMS and IM Motors



P$_n$ = Continuous power [kW]
P$_{max}$ = Overload power [kW]
P$_m$ = Power at max. speed [kW]
ω_n = Base speed [rpm]
C$_n$ = Constant torque between ω=0 and ω_n [Nm]
C$_{max}$ = Overload torque between ω=0 and ω_n [Nm]
ω_s = Maximum speed for operation at constant power at **S3** [rpm]
ω_g = Maximum speed for operation at constant power at **S1** [rpm]
C$_g$ = Torque corresponding to speed ω_g [Nm]
C$_s$ = Torque corresponding to speed ω_s in overload state **S3** [Nm]
ω_{lim} = Max. speed [rpm]
C$_m$ = Torque at max. speed [Nm]
I$_{cont}$ = Motor continuous current rating [Arms]
I$_{ms}$ = Motor overload current [Arms]

Duty Cycles



S2	S3	S6
–	$f_m = \frac{N}{N+R}$ x100 (%)	$f_m = \frac{N}{N+V}$ x100 (%)

N = Operation at P_{max}
R = Idle
V = Off-load operation
f$_m$**=** Duty cycle

Motor/Servo-Drive Associations

Association with AMS 100 Spindle Motors

Motor	3UAC Servo-drive	CONTINUOUS OPERATION S1									OVERLOAD						
		Pn	ωn	Cn	ωg	Cg	Pm	ωlim	Cm	Icont	Pmax	Cmax	Cs	Ims	S2	S3	S6
		kW	rpm	Nm	rpm	Nm	kW	rpm	Nm	Arms	kW	Nm	Nm	Arms	min	% 10 min	% 10 min
AMS 100S B	M5030I 51	**2.2**	150	14	6500	3	2.2	**6500**	3	14	3.7	24	5.5	21	12	40	30
AMS 100S B	L5050I 51	**3.7**	150	24	6500	5.5	3.7	**6500**	5.5	21	5.5	35	8	30	12	40	30
AMS 100M B	L5050I 51	**5.5**	1500	35	6500	8	5.5	**6500**	8	26	7.5	47	11	35	12	40	30
AMS 100G B	L5075I 51	**9**	1500	57	6500	13	9	**6500**	13	39	12.5	80	18	52	12	40	30
AMS 100S D	M5030I 51	**2.2**	1500	14	6500	3	1.1	**12000**	1	14	3.7	24	5.5	21	12	40	30
AMS 100S D	L5050I 51	**3.7**	1500	24	6500	5.5	1.8	**12000**	1.4	21	5.5	35	8	30	12	40	30
AMS 100M D	L5050I 51	**5.5**	1500	35	6500	8	2.8	**12000**	2.2	26	7.5	47	11	35	12	40	30
AMS 100G D	L5075I 51	**9**	1500	57	8200	10.5	6.2	**12000**	5	39	12.5	80	15	52	12	40	30

For AMS 100 motor, ωs= ωg

Motor/Servo-Drive Associations

Association with AMS 132 Spindle Motors

	Motor	3UAC... Servo-drive	CONTINUOUS OPERATION S1									OVERLOAD						
			Pn	ωn	Cn	ωg	Cg	Pm	ωlim	Cm	Icont	Pmax	Cmax	ωs	Ims	S2	S3	S6
			kW	rpm	Nm	rpm	Nm	kW	rpm	Nm	Arms	kW	Nm	rpm	Arms	min	% 10 min	% 10 min
1	AMS 132 S A	L5050I 51	**5**	750	64	6000	8	2.8	**7000**	4	26	7.5	95	5000	35	30	45	37
2	AMS 132 S C	L5075I 51	**10**	1500	64	6000	16	8	**7000**	11	39	14	89	5000	52	30	45	37
3	AMS 132 S E	G50100I 51	**15**	1750	82	4000	36	10	**7000**	13.5	52	23	110	3300	70	14	35	30
4	AMS 132 M A	L5075I 51	**7.5**	750	95	6000	12	5.7	**7000**	8	39	10	127	5000	52	30	45	37
5	AMS 132 M C	G50100I 51	**15**	1500	95	6000	24	12.5	**7000**	17	52	21	134	5000	70	30	45	37
6	AMS 132 M E	G50150I 51	**19.5**	1850	100	5500	34	19	**7000**	26	75	35	149	4500	105	14	35	30
7	AMS 132 L A	G50100I 51	**11**	750	140	6000	17	9	**7000**	12.5	52	15	191	5000	70	30	45	37
8	AMS 132 LE	G50150I 51	**22**	1250	168	4200	50	15	**7000**	20	75	36	229	3300	105	14	35	30
								AMS 132 high speed										
1a	AMS 132 S F	L5050I 51	**5**	750	64	6000	8	2	**10000**	2	26	7.5	95	5000	35	30	45	37
2a	AMS 132 S G	L5075I 51	**10**	1500	64	6000	16	6	**10000**	6	39	14	89	5000	52	30	45	37
3a	AMS 132 S H	G50100I 51	**15**	1750	82	4000	36	7.5	**10000**	7	52	23	110	3300	70	14	35	30
4a	AMS 132 M F	L5075I 51	**7.5**	750	95	6000	12	4	**10000**	4	39	10	127	5000	52	30	45	37
5a	AMS 132 M G	G50100I 51	**15**	1500	95	6000	24	9	**10000**	8	52	21	134	5000	70	30	45	37
6a	AMS 132 M H	G50150I 51	**19.5**	1850	100	5500	34	13.5	**10000**	13	75	35	149	4500	105	14	35	30
7a	AMS 132 L F	G50100I 51	**11**	750	140	6000	17	7	**9000**	7.5	52	15	191	5000	70	30	45	37
8a	AMS 132 LI	L5075I51	**12.5**	815	146	2300	52	3	**9000**	3	39	16.8	202	2000	52	14	35	30
9a	AMS 132 L H	G50150I 51	**22**	1250	168	4200	50	12	**9000**	13	75	36	229	3000	105	14	35	30

Note: Pos 3 and 3a : Puissance 17 kW 2000 rpm en S2 / 45 min
6 and 6a 24 2250 rpm en S2 / 35 min
8 and 8a 26 1500 rpm en S2 / 60 min

See NUM DRIVE Catalogue, power versus speed curve

The performance figures are given for a temperature of 40 °C with the motor thermally stabilised

Motor/Servo-Drive Associations

Association with AMS 160 Spindle Motors

Pos.	MOTOR Type AMS 160	MOTOR Connection	UAC servo-drive	CONTINUOUS OPERATION S1 Pn kW	ωn ÷ ωg rpm		wlim rpm	Pm kW	Cm Nm	Icont Arms	OVERLOAD Pmax kW	Cmax Nm	ωs rpm	Ims Arms	S2 min	S3 % 10 min	S6 % 10 min
1	MA1 (1)	Y*	50100I51	18	650	1300	8500	2.7	264	52	24.2	355	1300	70	18	40	35
		Δ*			1300	2600		5.4	132		24.2	178	2400				
2	MB1	Y*	50150I51	26	1200	2400		7.3	208	75	36.4	290	2400	105	18	40	35
		Δ*			2400	4800		14.5	104		36.4	145	4500				
3	MC1 (1)	Δ*	50200I51	36	1700	2800		10	202	100	47	300	2600	140	18	40	35
4	LA1	Y*	50100I51	18	500	1000	6500	2.8	344	52	24.2	463	1000	70	18	40	35
		Δ*			1000	2000		5.6	172		24.2	231	1850				
5	LB1	Y*	50150I51	26	950	1900		7.6	260	75	36.4	364	1900	105	18	40	35
		Δ*			1900	3800		15.2	130		36.4	182	3550				
6	LC1 (1)	Δ	50200I51	36	1050	2000	6500	11.6	328	100	48	437	1800	140	18	40	35

*** With change of the electrical speed (the associated motor must have a G14 or G15 relay card).**
The performance figures are given for an ambient temperature of 40°C with the motor thermally stabilised.

Motor/Servo-Drive Associations

Associations with AMS 180 Spindle Motors

MOTOR		3UAC Servo-drive	CONTINUOUS OPERATION S1									OVERLOAD						
			Pn	ωn	Cn	ωg	Cg	Pm	ωlim	Cm	Icont	Pmax	Cmax	ωs	Ims	S2	S3	S6
Type	Connec-tion		kW	rpm	Nm	rpm	Nm	kW	rpm	Nm	Arms	kW	Nm	rpm	Arms	min	% 10 min	% 10 min
IM 180 M 2Y-4814	Y*	G50150I 51	**26**	500	500	1000	250	3.7	**7000**	5	75	36.4	700	350	105	18	40	35
	Δ*		**26**	1000	250	2000	125	7.4	**7000**	10	75	36.4	350	189	105			
IM 180 M 2Y-4814	Δ*	G50200I 51	**36**	950	362	1900	181	9.8	**7000**	13.3	100	50.4	506	253	140	18	40	35
	ΔΔ*		**26**	1900	181	3800	90	19.6	**7000**	26.6	100	50.4	253	135	140			
IM 180 M 2Y-4814	YY	X50300I 51	**55**	1050	500	2100	250	16.5	**7000**	22.5	145	76	690	372	200	18	40	35

*** Change of electrical connection (the associated servo-drive must have a relay card).**

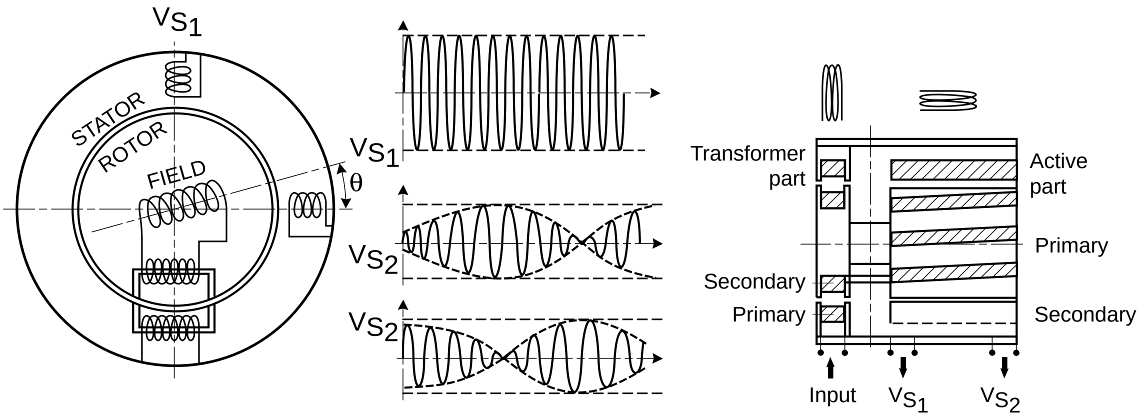
22.3 Sensors

The motors are equipped with an internal sensor measuring the rotor speed.

Different types of sensors can be used:
1. 6-pole resolver — Sensor code R
2. 2-pole resolver — Sensor code U
3. High-resolution sensors — Sensor code H

22.3.1 Resolver

Technology and Principle



$V_S = U \sin \omega t$

$V_{S_1} = KU \sin \theta \sin \omega t$

$V_{S_2} = KU \cos \theta \sin \omega t$

The resolver is mounted directly on the motor shaft (hollow shaft) to minimise space, and enhance integration.

It does not include any switches. It is therefore highly reliable and requires no maintenance.

It operates according to the principle of magnetic induction. It has two parts:
- Transformer T1 whose primary is wired to the stator and whose secondary is wired to the rotor, supplied by a 10 kHz carrier frequency
- Transformer T2, whose primary, called field winding, integrated in the rotor, is supplied from the secondary of transformer T1 (10 kHz carrier). This field winding, which rotates with the rotor, generates a rotating field which induces a variable signal in the two secondaries, called armature windings, placed in the stator.

The two secondaries of T2 (armature) are situated 90 degrees apart such that the rotor angle can be determined by combining their outputs. The accuracy is ± 6 electrical arc minutes.

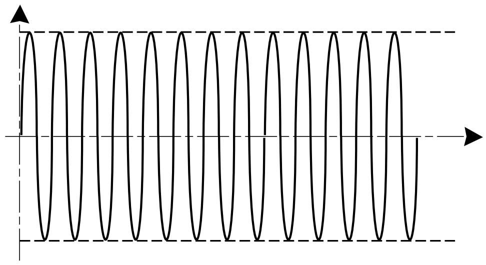
When processed, the position signal can be used by the servo-drive to perform the following functions:
- Static commutation (selsyn operation)
- Generation of the speed signal (speed loop)
- General of a digital position signal (position loop).

Signals measured at the servo-drive input (the terminals vary according to the servo-drive used; see the section on servo-drives).

Carrier (9750 Hz, 10 V peak)

Terminals A and B of the motor connector

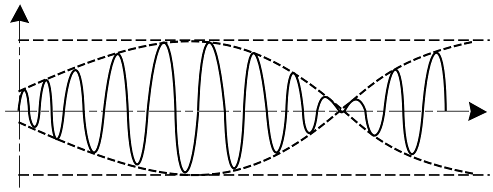
Green and black wires



Cosinusoidal signal

Terminals C and D of the motor connector

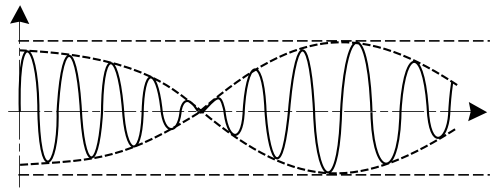
White and black wires



Sinusoidal signal

Terminals E and F of the motor connector

Red and black wires



NUM DRIVE servo-drives monitor the presence of the resolver signals (open circuit, pole reversal, etc.).

Alarms (differing according to the servo-drive used) indicate the presence of a resolver connection fault.

If a resolver alarm is present, but the servo-drive input signals are correct, the presence of the internal sinusoidal and cosinusoidal signals can be checked using the PC communication tool with the servo-drive (PC Set Link for UAC and CPM for MDLS).

These tools can also be used to check that the reading on the e-gain (resolver gain) test point is between 0 and 255.

Readings close to 0 (input signals too high) or 255 (signals too low) generate a resolver alarm.

A faulty resolver can easily be replaced by an electromechanical technician.

Part number of 6-pole resolver: RESOLVER N303 410256303

Part number of 2-pole resolver: RESOLVER N301 410252301

Contrary to brushless axis motors, angular setting of the stator is not required when installing a new resolver.

However, it must be checked that connection of the sinusoidal and cosinusoidal signals complies with the diagram.

After replacement of the motor, the resolver or its wire, always repeat the automatic calibration procedure with PC Set Link (SPM software packages) on software packages UAC S3.82 or S3.90.

22.3.2 High Resolution Sensor

For spindles used for the C axis function, the motors are equipped with a high resolution sensor consisting of a cog wheel (256 or 512 teeth) and a magnetoresistive sensor.

The sensor consists of a magnet and a Wheatstone bridge supplied with +5 V and including two fixed resistors and two magnetoresistors. When the cog wheel passes in front of the sensor, the resistance of the magnetoresistors varies, generating a sinusoidal waveform across the bridge (256 or 512 sinusoidal cycles per revolution).

The sinusoidal waveform is then divided again by the servo-drive software, which may increase the encoder resolution up to 1,000,000 pulses per motor revolution at very low speeds.

One of two types of sensors and cog wheels is used, depending on the motor.

AMS and HM motors
- Sensor without zero pulse 62AF
- Single cog wheel with 256 teeth.

The high resolution sensor signals are processed by a daughterboard located on the servo-drive control card: ACQ card for UAC or EF06B960327 P/N 418960237 for MDLS.

Card part numbers: 2UACCAXIS411, P/N 418401411.

The procedure for checking and adjusting this sensor is described in the UAC Commissioning Manual 738E003/C (pages 75 and 76).

Replacement of a sensor on a motor must always be carried out by a NUM technician.

MS, MSA MotorSpindle
- Sensor with zero pulse 63AB
- Double cog wheel with 512 teeth

The sensor signals are processed by card 2UACHR411, P/N 418411411 located on the servo-drive control card.

In addition to processing the sensor signals, this card supports an encoder simulation function which provides incremental signals (RS422) used for position measurement by the CNC.
- Low resolution output (1024 pulses per revolution) used for spindle measurement
- High resolution output (default 65535 pulses per revolution) used for C axis measurement.

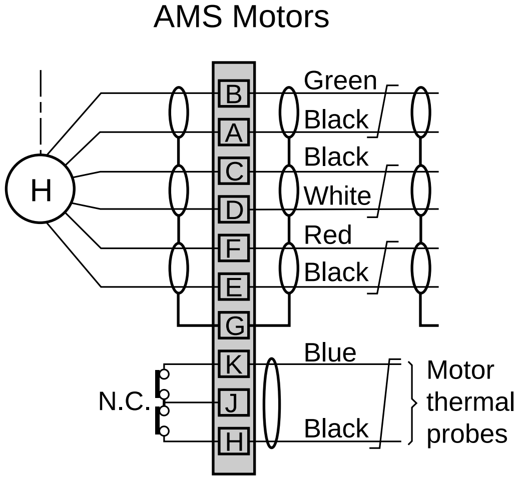
The procedure for checking and adjusting this sensor is described in the UAC Commissioning Manual 738E003/C (pages 77-79) or MDLS Commissioning Manual 738013/A (pages 78-80).

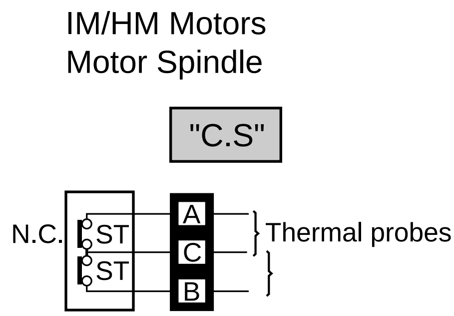
Replacement of a sensor on a motor must always be carried out by a NUM technician.

Incorrect adjustment of the motor sensor signals can trigger alarms RSL fixed (UAC) or 09 (MDLS) if the signals are too low or EXP flashing (UAC) or 25 (MDLS) if the signals are too high.

22.4 Thermal Probes

The motor temperature is monitored by two thermal switches wired in series in the windings. In case of failure of these probes, they cannot be replaced. However, it is possible to bypass a failed probe by changing the external wiring (see wiring diagrams in Commissioning Manuals).





22.5 Maintenance

NUM DRIVE spindle motors are asynchronous squirrel cage motors with life-lubricated bearings. They do not require any maintenance.

If repeated overcurrent alarms are detected by the servo-drive, check the winding impedance and insulation resistance from the protective earth.

22.5.1 Checking Motor Insulation Resistance

The insulation resistance must be measured by a special insulation tester (e.g. Megger) which can output 1000 VDC.

Disconnect the motor cables. Earth the thermal switch and the brake if any.

Interconnect the three phases of the motor. Then apply the test voltage to the windings and earth.

The insulation resistance must be > 2 MΩ

If the measured value is lower, check for moisture inside the motor power connections, before deciding that the windings are faulty.

22.5.2 Measuring the Winding Impedance

The motor winding impedance is generally very low (a few tenths of an ohm to a few ohms, depending on the motor). It is therefore difficult to measure with a conventional multimeter.

The most accurate methods for measuring low resistance require the use of a Wheatstone bridge or, for indirect measurement, consist of applying a constant current to the winding and measuring the voltage (R = V/I).

22.6 Electrical Characteristics of the Spindle Motors Described in the Catalogue

Motor type	ST for S3.82	Notes	Connec-tion	Rated I moyot	I module	Id start of defluxing			Resist. at 20°C	sigma * Is	Acceleration time - sec. (rpm)		
				- A -	- A -	- rpm -	- A -	- V - Vca	- mΩ -	- mH -	0 - ω 1	0 - ω 2	0 - ω max
AMS 100SB1	1142BU		Y	14	30	2620	14	2.439	433	3.78	0.08(2200)	0.36(6200)	0.4(6500)
AMS 100SD1	11427U		Y	14	30	2620	14	2.439	433	3.78	0.08(2200)	0.36(6200)	2.7(12000)
AMS 100SB1	11424U		Y	21	50	2290	16	1.394	433	3.78			0.4(6500)
AMS 100SD1			Y										
AMS 100MB1	11341U		Y	26	50	2280	22	1.916	228	2.07	0.04(1500)	0.2(5000)	0.34(6500)
AMS 100MD1	11340U		Y	26	50	2280	22	1.916	228	2.07	0.04(1500)	0.2(5000)	2.1(12000)
AMS 100GB1	11334U		Y										
AMS 100GD1	11333U		Y										
AMS 132SA1	11418U		Y	26	50	1280	22	1.916	198	3.42	0.06(1000)	0.09(5000)	2.5(7000)
AMS 132SC1	11419U		Y	39	75	2080	31	2.7	88	1.52	0.13(2000)	0.72(6000)	1.06(7000)
AMS 132SE1	11412U		Δ	52	100	2340	35	1.52		1.138	0.11(2000)	0.52(6000)	1.24(7000)
AMS 132SF1	11402U		Y	26	50	1280	22	1.916	198	3.42	0.06(1000)	0.49(4000)	4(8000)
AMS 132SG1	11403U		Y	39	75	2080	31	2.7	88	1.52	0.1(1500)	0.72(6000)	1.6(8000)
AMS 132SH1	11413U		Δ	52	100	2340	35	1.52		1.138	0.11(2000)	0.52(6000)	2.6(10000)
AMS 132MA1	11420U		Y	39	75	1440	38	3.31	98	1.609	0.06(1000)	1(6000)	1.56(7000)
AMS 132MC1	11421U		Y	52	100	1950	51	2.22	55	0.905	0.1(1500)	0.72(6000)	1.02(7000)
AMS 132ME1	11408U		Δ	75	150	2650	62	2.69	98	0.0005	0.12(2000)	0.5(6000)	0.67(7000)
AMS 132MF1	11404U		Y	39	75	1440	38	3.31	98	1.609	0.06(1000)	1(6000)	2.45(8000)
AMS 132MG1	11405U		Y	52	100	1950	51	2.22	55	0.905	0.1(1500)	0.72(6000)	1.46(8000)
AMS 132MH1	11409U		Δ	75	150	2650	62	2.69	98	0.0005	0.12(2000)	1.2(9000)	1.6(10000)
AMS 132LA1	11422U		Y	52	100	1310	42	1.83	69	1.33	0.07(1000)	1.4(6000)	1.8(7000)
AMS 132LE1	11410U		Y	75	150	1710	60	2.61	38.5	0.0007	0.05(1000)	0.75(6000)	1.1(7000)
AMS 132LI1	11442U		Y	39	75	860	29	2.52	156	2.79	0.06(1000)	0.38(3000)	11(9000)
AMS 132LF1	11406U		Y	52	100	1310	42	1.83	69	1.33	0.07(1000)	1.14(6000)	2.8(8000)
AMS 132LH1	11411U		Y	75	150	1710	60	2.61	38.5	0.0007	0.05(1000)	0.75(6000)	2.5(9000)
AMW 132LC1	11446U	Low range	Y	88	150	1610	70	3.048	64		0.06(1000)	0.5(5000)	1.3(7000)
AMW 132LC1	11446U	High range	Δ			3465	90	3.91			0.12(1000)	0.5(5000)	0.8(7000)
AMS 160MA1	11452U	Low range	Y	52	100	700	38	1.65	130	3.4	0.06(750)	7.4(6000)	26(8500)
AMS 160MA1	11452U	High range	Δ			1505	45	1.96			0.1(750)	2.4(6000)	7(8500)
AMS 160MB1	11453U	Low range	Y	75	150	1270	56	2.43	49	1.25	0.08(1000)	2.5(6000)	8.2(8500)
AMS 160MB1	11453U	High range	Δ			2475	76	3.30			0.15(1000)	1.48(6000)	3.1(8500)
AMS 160MC1	11454U		Δ	100	200	1700	71	1.55	87	0.738	0.12(1500)	2.1(7000)	3.8(8500)
AMS 160LA1	11455U	Low range	Y	52	100	500	35	1.52	144	4.3	0.04(500)	8(5000)	19.6(6500)
AMS 160LA1	11455U	High range	Δ		100	1090	46	2			0.08(500)	2.5(5000)	5.4(6500)
AMS 160LB1	11456U	Low range	Y	75	150	990	53	2.31	52	1.5	0.05(500)	2.45(5000)	5.5(6500)
AMS 160LB1	11456U	High range	Δ		150	1915	75	3.27			0.085(500)	1.45(5000)	2.45(6500)
AMS 160LC1	11457U		Δ	100	200	1105	70	1.52	110	1.12	0.08(1000)	1.75(5000)	4(6500)
AMS 180LB1	11379U		Δ	169	300	1650	133		36.5	0.328			0.85(5000)

22

23 UAC Line

23.1 General

UAC servo-drives are multiaxis drives provided in a prewired cooled rack.

The power supply is connected directly to the 380 VAC mains.

Braking can be resistive or regenerative.

The associated servo-drives are fully digital. They can control axis motors or spindle motors, which is why they are named UAC for Universal AC Controller (they are differentiated by software). This makes maintenance much easier.

These servo-drives brake the associated motor until it comes to a full stop, even in case of an unexpected mains failure.

Flux vector control makes speed and torque control very accurate.

Many options are available:
- Relay cards for remote I/O
- Multiposition indexing cards
- Analogue output cards
- Encoder simulation
- Antipitch control (electronic backlash compensation).

The servo-drives are set up and customised from a PC using the PC Set Link software common to all the servo-drives in the line.

23.2 Rack

1MAIF UAC 4M 1M

Power supply size: M, L, G, X

Servo-drives: Number and size: M, L, G, X

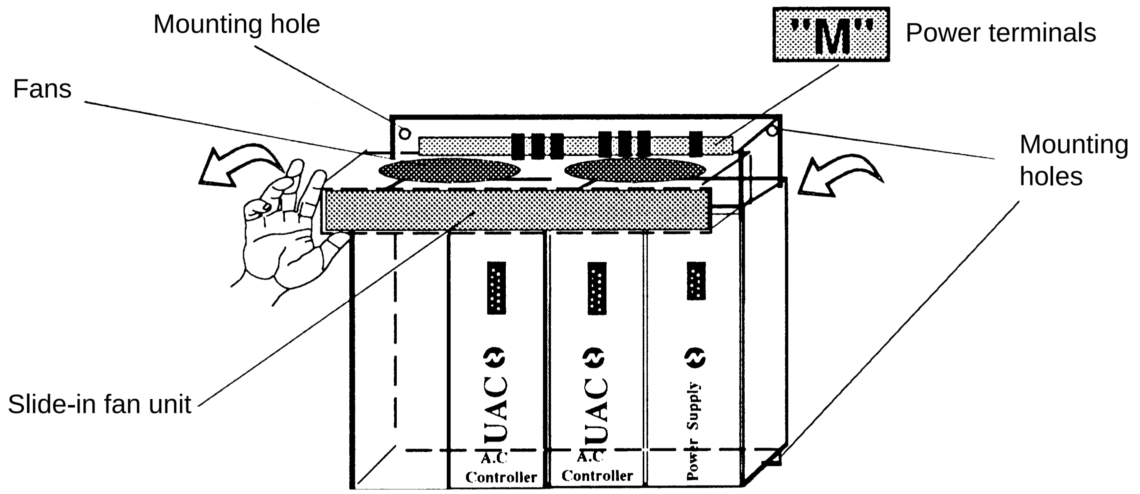
The rack contains one or more axis, spindle and/or MotorSpindle servo-drives plus a Power Supply or Regenerative Power Supply module always located in the rightmost slot of the rack.

A slide-in unit containing the fans* is located in the top of the rack.

Pulling out the slide-in unit gives access to the M power terminals.

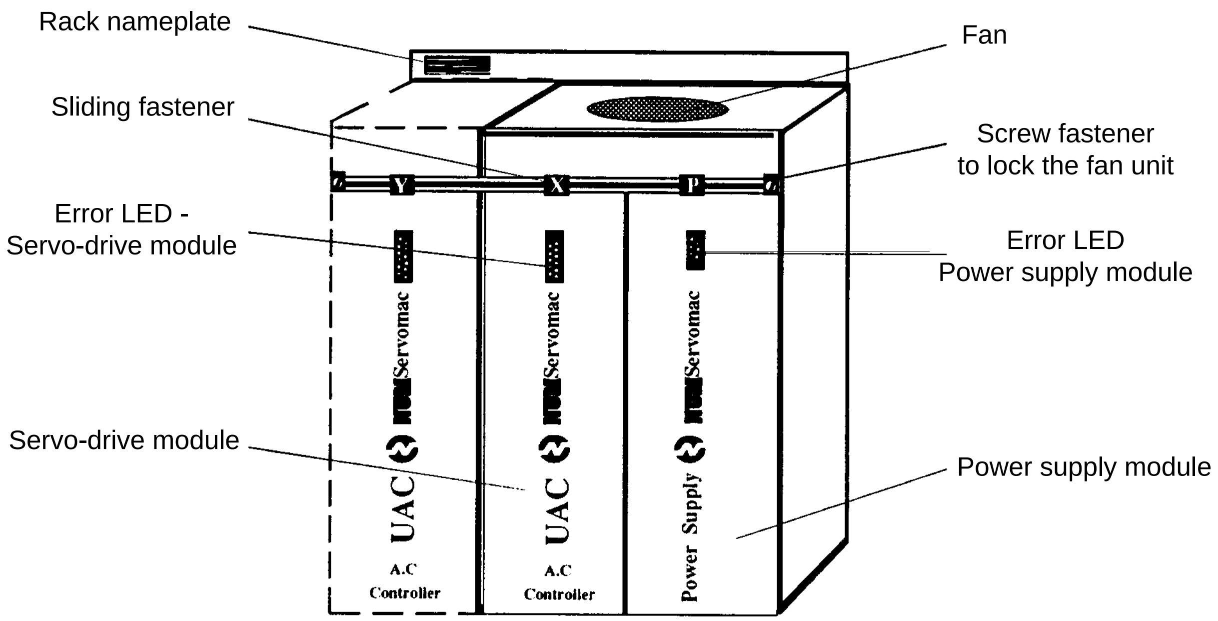
The servo-drive and power supply interconnections are already completed inside the rack.

* Rack width:
- Less than 380 mm: 1 fan
- Between 380 mm and 569 mm: 2 fans
- Above 570 mm: 3 fans.



23.2.1 Rack Identification

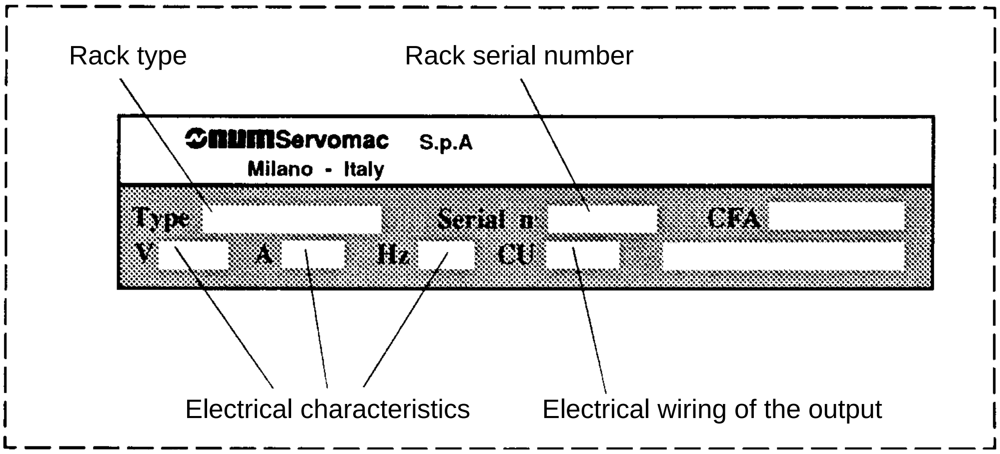
Main rack components



IMPORTANT

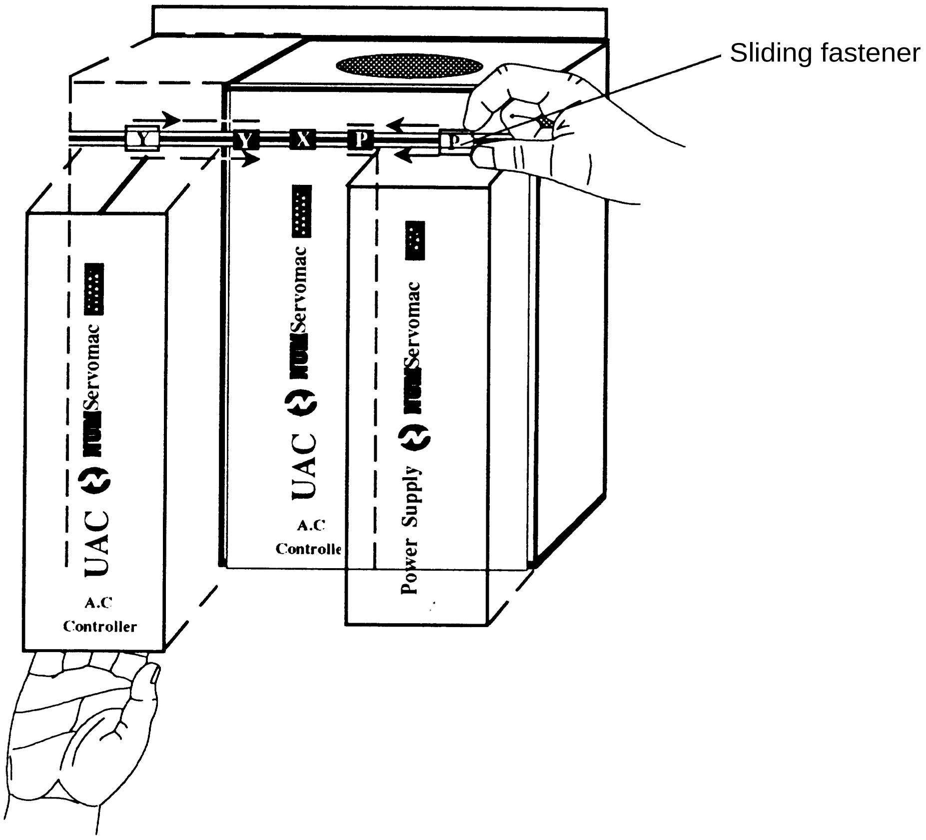
The letter **P**	denotes a Power Supply.
The letters **X/Y/Z**	denote an axis motor servo-drive
The letter **S**	denotes a spindle motor servo-drive
The letters **X1** and **X2**	denote a drive with backlash compensation.

Rack nameplate



23.2.2 Module Extraction from Rack

Servo-drive and Power Supply Module Extraction from Rack



⚠ **IMPORTANT**

So as not to endanger the safety of maintenance staff, **make sure the system has been powered down for at least 5 minutes before proceeding to module insertion or extraction, to allow complete discharge of the high voltage capacitors.**

Move the sliding fastener corresponding to the servo-drive or power supply module to be extracted and pull out the module as shown.

Be careful when reinserting the module and make sure the quick-lock connectors are correctly positioned in the rack.

Reposition the sliding fastener on the module.

23.3 Power Connections

See UAC Manual 738E003/C:
- Chapter 2: pages 21-26 and page 32
- Chapter 5: pages 96 et seq.

24 PWS Power Supply Modules

24.1 Resistive Braking Power Supply Module

24.1.1 Technical Characteristics

24.1.1.1 Power Supply Module

Technical Characteristics

Power Supply		Unit	**3PWS30M**	**3PWS75L**	**3PWS150G**	**3PWS300XRE***
Power supply consumption		kW	12	30	60	130
No-load dissipation		W	20	20	20	20
Maximum dissipation		W	70	165	280	630
External braking resistor	Continuous power Peak power	kW kW	1.2 30	1.8 30	3 60	External resistor External resistor
AC input voltage		V	380 V +10% -15% 50/60 Hz			
DC voltage on intermediate bus		V	535 VDC for 380 VC			
Forced cooling			Flow rate: 2m/sec			
Protection class			IP 10			
Operating temperature range		°C	0°C to +40°C			
Storage temperature range		°C	-25°C to +70°C			
Relative humidity			max 90%			
Module dimensions		mm	62x348x353	105x348x353	190x348x353	190x581x353
Weight		Kg	7.7	15.5	26.7	31

The power supply module converts the 380 VAC 50/60 Hz mains input to the DC level required for supply of the servo-drives. All the interconnections are made via the plug-in connectors located in the back of the module.

The power supply module does not require any wiring by the installer. The LEDs on the front of the module facilitate diagnostic in case of a fault on the power supply.

* This power supply module is available only with external braking resistors.

24.1.1.2 Power Supply Modules with External Braking Resistor

If required by the machine cycle, the PWS module may be equipped with one or more external braking resistors to increase the recoverable continuous power or externalise the heat source outside the rack. For the technical characteristics of modules 3PWS30MRE, 3PWS75LRE, 3PWS150GRE and 3PWS300XRE, refer to the above table, except for the data concerning the internal resistor and the weight (for the weight, see the table below).

A single set of one or more resistors is connected to module 3PWS30MRE; two sets of one or more resistors are connected to modules 3PWS75LRE, 3PWS150GRE and 3PWS300XRE. The external braking resistors are available in two continuous power ratings: 1.3 kW (code KFIG1) and 2.6 kW (code KFIG2). Each braking resistor has a rating of 13.5 ohms. The resistor can be connected in series/parallel to increase the power dissipation capability, provided the resistance of each set is **never below 13.5 ohms** for 3PWS30MRE/75LRE/150GRE or **6.5 ohms** for 3PWS300XRE (for 3PWS300XRE from revision 1012A up). **It is essential to comply with this requirement so as not to damage the PWS.**

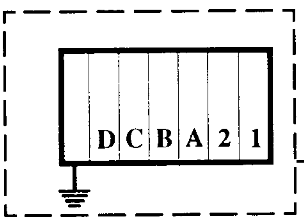
Power supply module with external braking resistor	Unit	**3PWS30MRE**	**3PWS75LRE**	**3PWS150GRE**	**3PWS300XRE**
Weight	kg	6.6	12.2	20.1	31

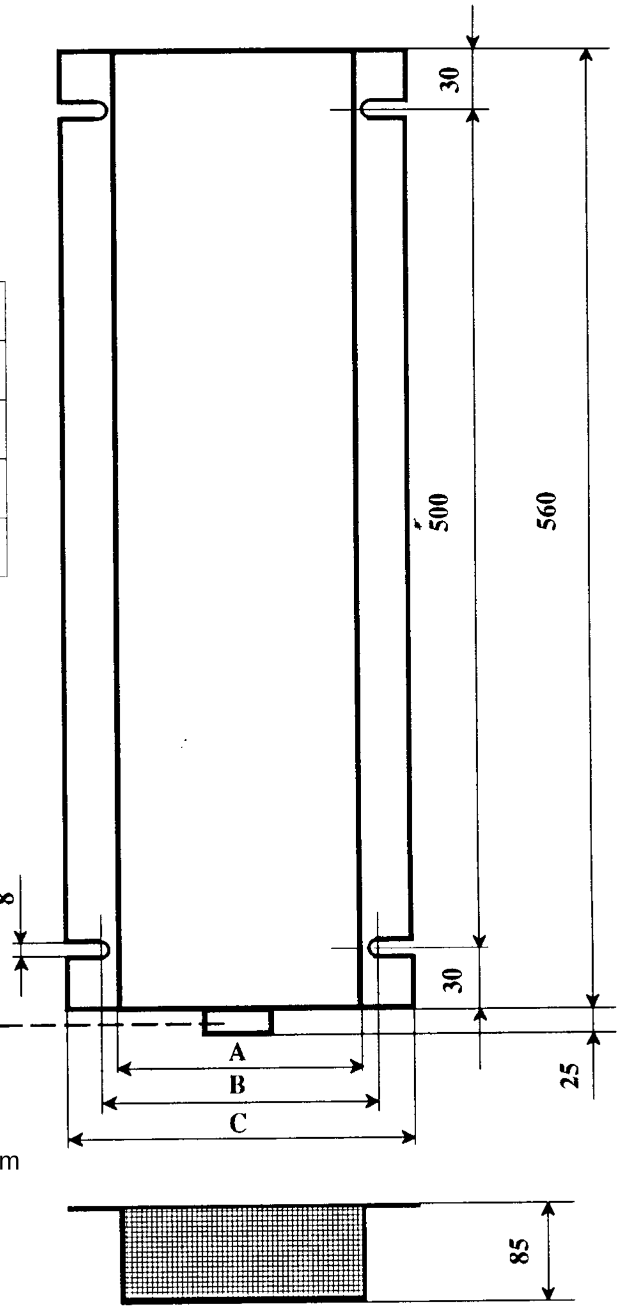
24.1.1.3 External Braking Resistors - Overall Dimensions and Mounting

Rating 1.3 kW - 13.5 Ω (code KFIG1)
Rating 2.6 kW - 13.5 Ω (code KFIG2)

	KFIG1	KFIG2
A (mm)	125	240
B (mm)	145	260
C (mm)	180	295
Weight	3.8	6.6

Terminal block





Tol. ± 2 mm

> **⚠ CAUTION**
>
> If the duty cycle used includes a large number of accelerations and decelerations, the resistor case may reach high temperatures. In this case, install it out of reach.
>
> For correct heat dissipation, the resistor must always be mounted vertically with the terminal block at the bottom as shown in the figure.

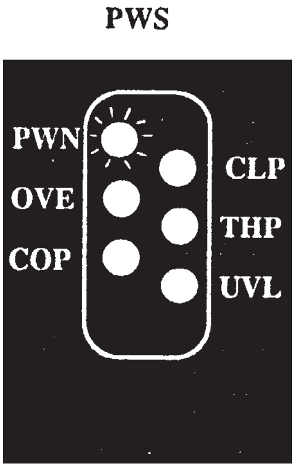
24.1.2 Maintenance

24.1.2.1 Alarms

PWS alarms are exclusively hardware and are not stored after a power failure, contrary to UAC alarms.

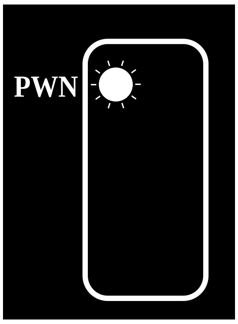
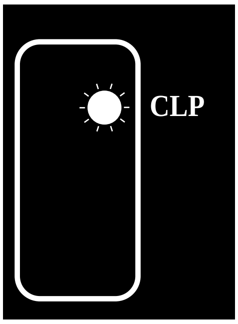
A PWS fault cuts off power to all the UAC servo-drives in the rack.

PWS Power Supply Module - Status and Alarm LEDs

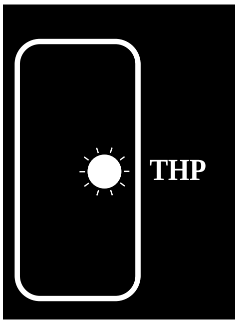
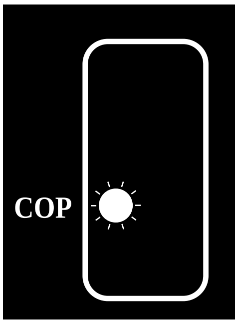
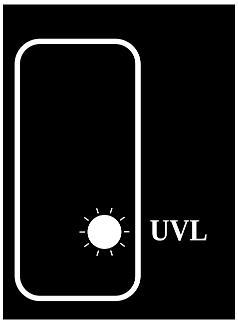


STATUS	**PWN**	**Green LED**	Module power on
	CLP	**Yellow LED**	Braking resistor inserted
ALARM	**OVE**	**Red LED**	Internal power supply overvoltage
	THP	**Red LED**	PWS heat sink overheating COP
	COP	**Red LED**	Braking resistor overload
	UVL	**Red LED**	Undervoltage on mains

PWS Power Supply Module - Status LEDs

	The green PWN LED is lit when the module is powered.
	The yellow LED is lit when the motor is being braked and power is being dissipated by the braking resistor.

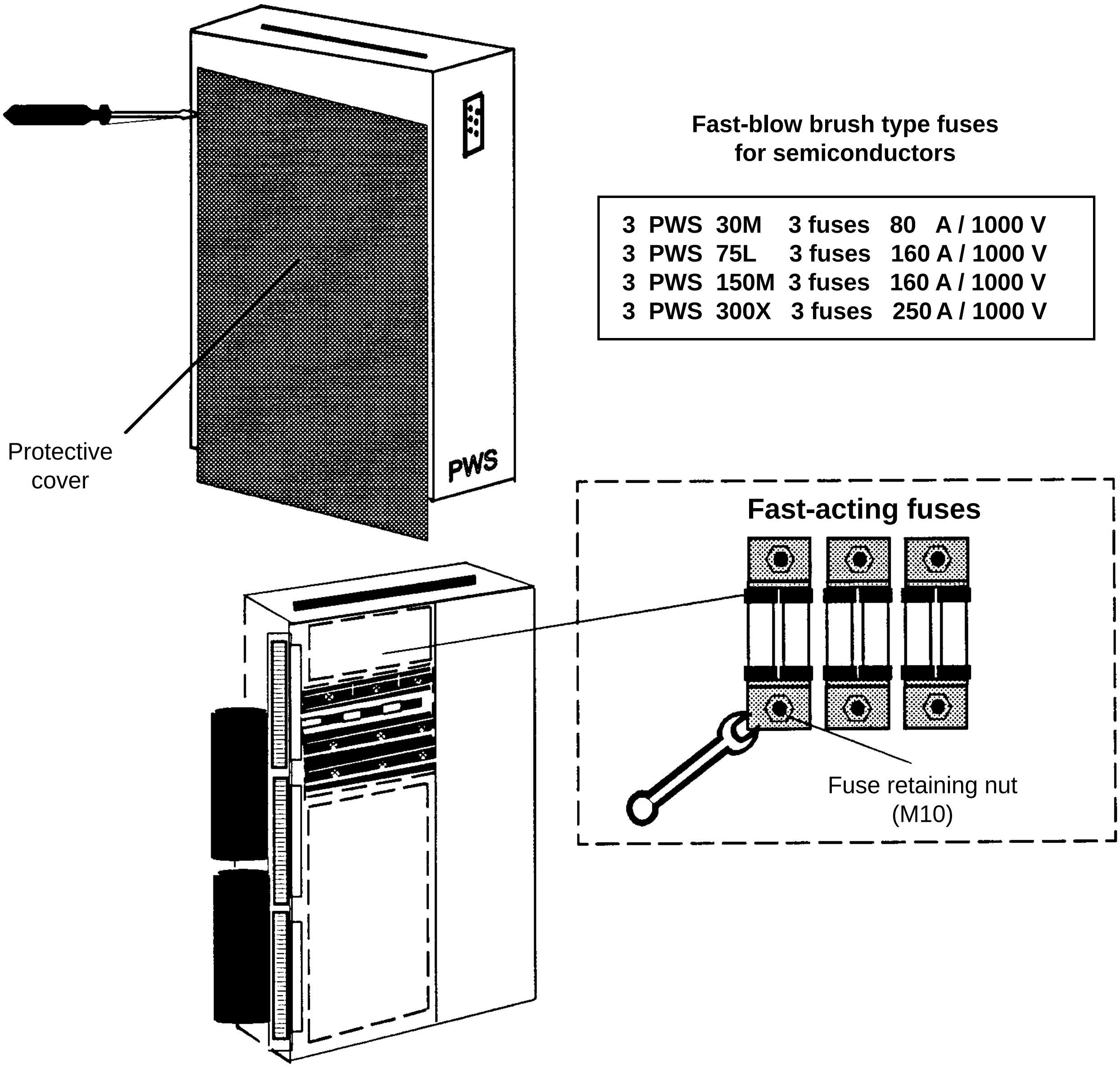
PWS Power Supply Module - Alarm LEDs

	Cause	Corrective action
	**A** During braking, the braking resistor was not able to absorb all the power generated by the motor **B** The braking resistor circuit is faulty	**A** Pheck for correct dimensioning of PWS/UAC in terms of maximum power **B** Replace the module. **C** Replace the resistor if it is external
	**A** The rack fan is not running **B** The temperature inside the rack is too high (> 45°C)	**A** Check that the fan slide-in unit is correctly engaged (see Sec. 23.2, Rack) **B** Check with the machine manufacturer for correct heat exchange
	The duty cycle is characterised by very frequent accelerations/decelerations The resistor has heated to above 250°C	Use a less strenuous duty cycle by increasing the time between decelerations
	**A** The mains voltage is below 300 VAC **B** Open circuit in one of the three phase wires	**A** Check the mains voltage **B** Check for presence of the three phases and the fuses inside the module

Note: In case of a mains power failure, the voltage reaches the UVL protection trigger threshold while the capacitors are discharging. Before reconnecting the mains, always make sure all the LEDs on the module are unlit (max. 30 sec.).

24.1.2.2 Fuses

The PWS modules are equipped internally with input protection fuses.



3	PWS	30M	3 fuses	80 A / 1000 V
3	PWS	75L	3 fuses	160 A / 1000 V
3	PWS	150M	3 fuses	160 A / 1000 V
3	PWS	300X	3 fuses	250 A / 1000 V

24

24.2 Regenerative Power Supply Module

24.2.1 Technical Characteristics

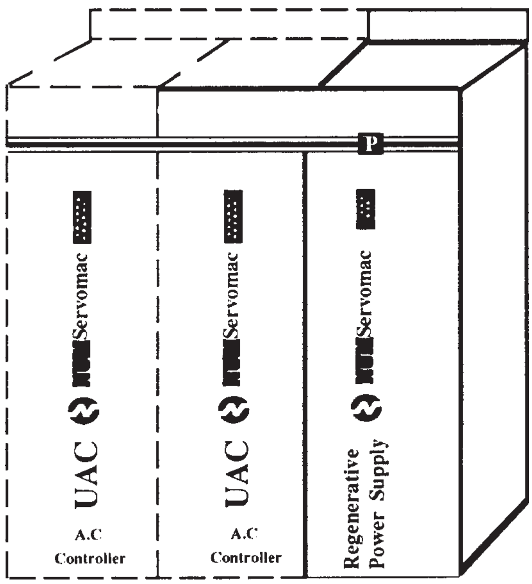
24.2.1.1 Regenerative Power Supply Module

The regenerative power supply module directly recovers mains power during braking of the motor.

The external braking resistor (code KFIG1) is used only in case of a mains power failure occurring during braking.

Technical Characteristics

Regenerative Power Supply Modules	Unit	**3PWS75LRR**	**3PWS150GRR**
Power consumption	kW	30	60
AC input voltage	V	380 V +10%-15% 50/60 Hz	
DC voltage on intermediate bus	V	535 VDC for 380 VC	
Forced cooling		Flow rate: 2m/sec	
Protection class		IP 10	
Operating temperature range	°C	0°C to +40°C	
Storage temperature range	°C	-25°C to +70°C	
Relative humidity		max 90%	
Module dimensions	mm	105x348x353	190x348x353
Weight	Kg	11.5	17



24.2.2 Configuration

The regenerative power supply is mounted in a UAC rack.

Racks with PWS75

The rack is the same regardless of whether a normal or a regenerative power supply is used (see UAC installation manual, pages 23 and 25).

Racks with PWS150

Different rack types are used for normal and regenerative power supplies.

The regenerative power supply must always be used with the following external components:
- A three-phase choke coil (RL75 or RL150) applying an inductive load to the power supply and limiting the AC ripple current
- A capacitive filter HPPM166 (3x16.6 µF, 440 V) decreasing the noise generated by the power supply
- An external braking resistor KFIG1 (13.5 ohms, 1300 W), not used during normal operation but providing the following functions:
  - . A soft start of the power supply by limiting the load in the wires at start-up
  - . Braking in case of a mains power failure
- Fuses: unlike the normal power supply, the fuses are not integrated and must be installed by the customer.

Fuses to be used (see Marketing Note of 22 June 1993):
- 3PWS75LRR: Brush 63 AFE or equivalent Protistors
  Nominal voltage = 660 Vrms, I^2t at 660 Vrms = 700 A^2.s in 3 ms
- 3PWS150GRR: Brush 140 AFE or equivalent Protistors
  Nominal voltage = 660 Vrms, I^2t at 660 Vrms = 1500 A^2.s in 3 ms

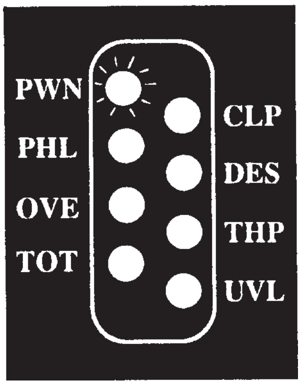
24

24.2.3 Maintenance

24.2.3.1 Alarms

Regenerative PWS Module - Status and Alarm LEDs

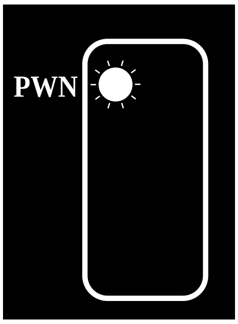
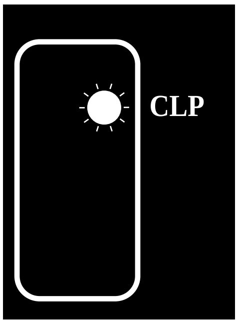
Regenerative PWS LEDs



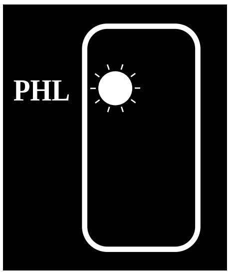
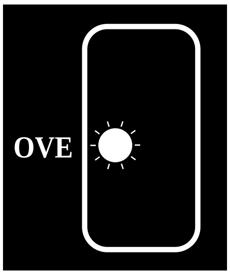
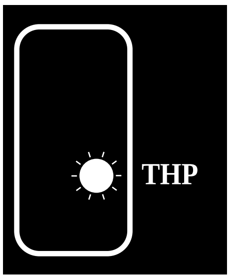
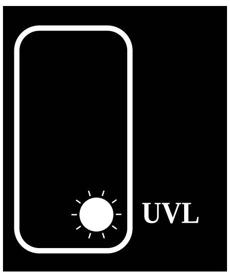
Status	**PWN**	**Green LED**	Module powered
	CLP	**Yellow LED**	Module regenerating
	PHL (sw)	**Red LED**	Mains voltage < Un - 20% or open circuit on a phase
	DES (hw)	**Red LED**	Current spike in a transistor
	OVE (sw)	**Red LED**	Internal overvoltage in power supply module
	THP (hw)	**Red LED**	Heat sink overheating
	TOT (SW	**Red LED**	Not active
	UVL (sw)	**Red LED**	Mains voltage < Un - 20%
	OVE+TOT (hw)	**Red LED**	Internal overvoltage in power supply module
	TOT+UVL (hw)	**Red LED**	Overcurrent
	PHL+OVE (sw)	**Red LED**	Mains voltage > Un + 20%
	PHL+TOT (sw)	**Red LED**	Incorrect synchro connection
	PHL+UVL (sw)	**Red LED**	EPROM fault

sw = software alarms
hw = hardware alarms

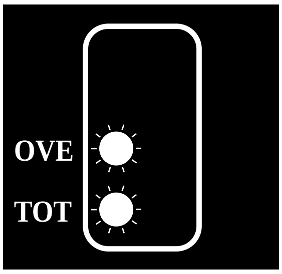
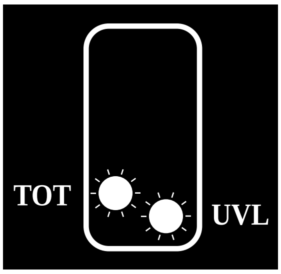
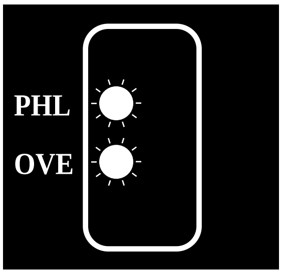
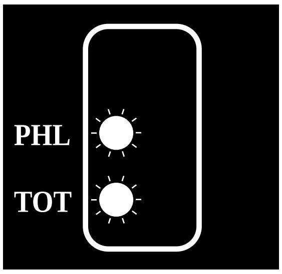
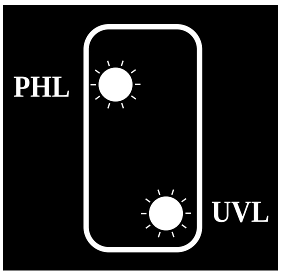
PWS Power Supply Module - Status LEDs

	The green PWN LED is lit when the module is powered.
	The yellow LED is lit when the motor is being braked and the power is being regenerated from the mains.

Regenerative PWS Module - Alarm LEDs

LED	Cause	Corrective action
	Open circuit on a phase or mains voltage < Un - 20%	Check the mains voltage
	**A** Selsyn connection error (terminals 9T/10S/11R of rack terminal block M)	**A** Check the power wiring
	B Interference on mains due to brownouts occurring in rapid succession	**B** Check the mains
	**A** The module was not able to regenerate all the motor power during braking	**A** Check for correct dimensioning of the regenerative PWS/UAC in terms of maximum power
	B Regeneration circuit failure	**B** Replace the regenerative PWS module
	**A** The rack fan is not running	**A** Check that the fan slide-in unit is correctly engaged (see Sec. 23.2, Rack)
	B The temperature inside the rack is too high	**B** Check with the machine manufacturer for correct heat exchange
	**A** The mains voltage is below 320 VAC	**A** Check the mains voltage

Note: In case of a mains power failure, the voltage reaches the UVL protection trigger threshold while the capacitors are discharging. Before reconnecting the mains, always make sure all the LEDs on the module are unlit (max. 30 sec.).

	Cause	Corrective action
	**A** The module was not able to regenerate all the motor power during braking **B** Regeneration circuit failure	**A** Check for correct dimensioning of the regenerative PWS/UAC in terms of maximum power **B** Replace the regenerative PWS module
	**A** Selsyn connection error (terminals 9T/10S/11R of rack terminal block M) **B** The module was not able to supply all the current required by the motor power during an acceleration	**A** Check the power wiring **B** Check for correct dimensioning of the regenerative PWS/UAC in terms of maximum power
	The mains voltage is above Un + 20%	Check the mains voltage
	One of the selsyn not connected (terminals 9T/10S/11R of rack terminal block M)	Check the power wiring
	Software error	Replace the module

24.2.3.2 Brownouts

The regenerative system is disconnected when brownouts occur on the mains, then reconnected when power is restored.

If the brownout lasts more than three cycles, the system stops and a fault is indicated.

25 UAC Servo-Drives

25.1 Technical Characteristics

UAC servo-drives (Universal AC Controllers) use the same hardware to control brushless axis motors and asynchronous spindle motors.

Only two memory modules (one REPROM containing the software and one RAM or EEPROM containing the parameters) customise a servo-drive as axis or spindle servo-drive.

Technical Characteristics

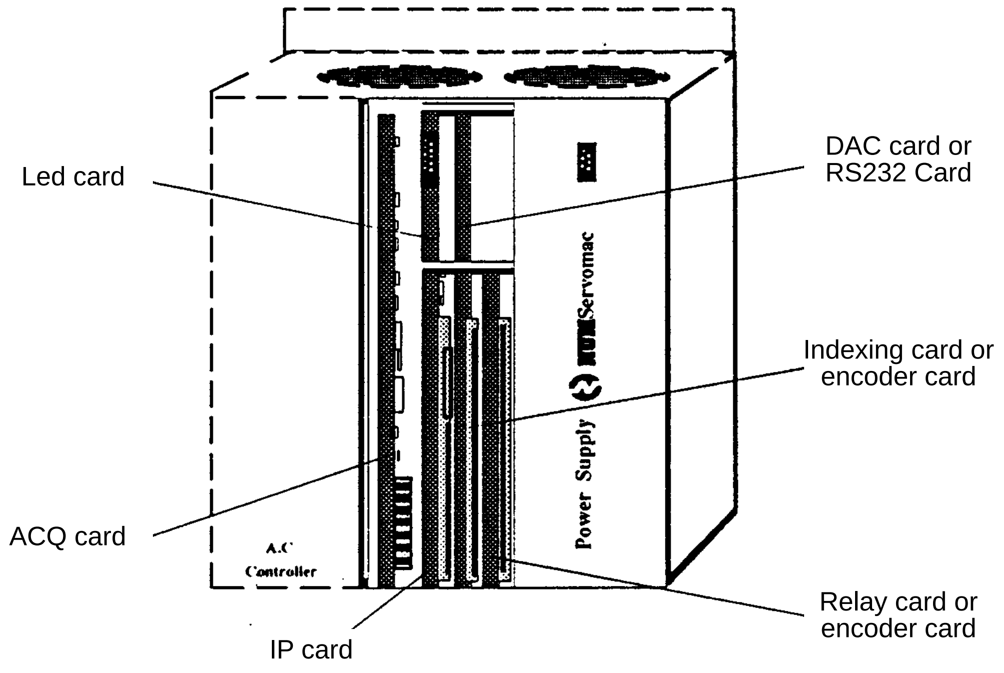
UAC servo-drive	Unit	**3UACM5030I**	**3UACL5050I**	**3UACL5075I**	**3UACG50100II**	**3UACG50150I**	**3UACX50200I**	**3UACX50300I**
Rated current (rms)	A	14	24	35	47	70	94	141
Maximum current (rms)	A	21	35	53	70	106	141	212
No-load dissipation	W	30	30	30	30	30	30	30
Dissipation at nominal load	W	215	280	350	450	680	900	1360
Control technique		Fully digital with flux vector control						
Logic input signals	V	+ 15/24 V DC						
Command reference	V	Analogue +/- 10 VDC						
Auxiliary voltages	V	+ 24 VDC 0.4 A – + 10 / – 10 VDC 7mA						
Protection class		IP 10						
Operating temperature range	°C	0°C to +40°C						
Storage temperature range	°C	-25°C to +70°C						
Relative humidity		max 90 %						
Module dimensions	mm	62x348x353	105x348x353	105x348x353	190x348x353	190x348x353	190x581x353	190x581x353
Weight	Kg	6.5	10	10	20	20	33	33

25.2 Hardware Implementation

The servo-drive includes:

- A power module containing:
  . The IGBT power stage with short-circuit, overvoltage, overcurrent and overheating protection
  . A power transistor driver card
  . An auxiliary power supply card.

  In case of failure of any of these items, it is necessary to replace the complete power module.
- Three basic plug-in cards.
  The front panel of the servo-drive is removable by removing the four attaching screws.
  A failed card can be replaced individually. In this case, it is not necessary to replace the complete servo-drive.
- A number of optional cards: RS232, DAC, Indexing, Relay, Encoder Simulation, Backlash Compensation, etc.



CAUTION

Always power down the module before removing cards.

25.2.1 ACQ Card

The ACQ card is in the leftmost position in the module. It contains two microprocessors, the resolver signal acquisition circuits, the REPROM containing the software and RAM (or EEPROM) containing the customisation parameter file called Technical Specification (ST).

The following information is noted on the RAM*:
- The type of motor for which it is configured
- The ST number (name of the parameter file)
- The maximum current rating of the module, which must be equal to that mentioned on the setting card (CT350) of the IP card.

When replacing the ACQ card, recover the memories from the failed card and install them on the new card.

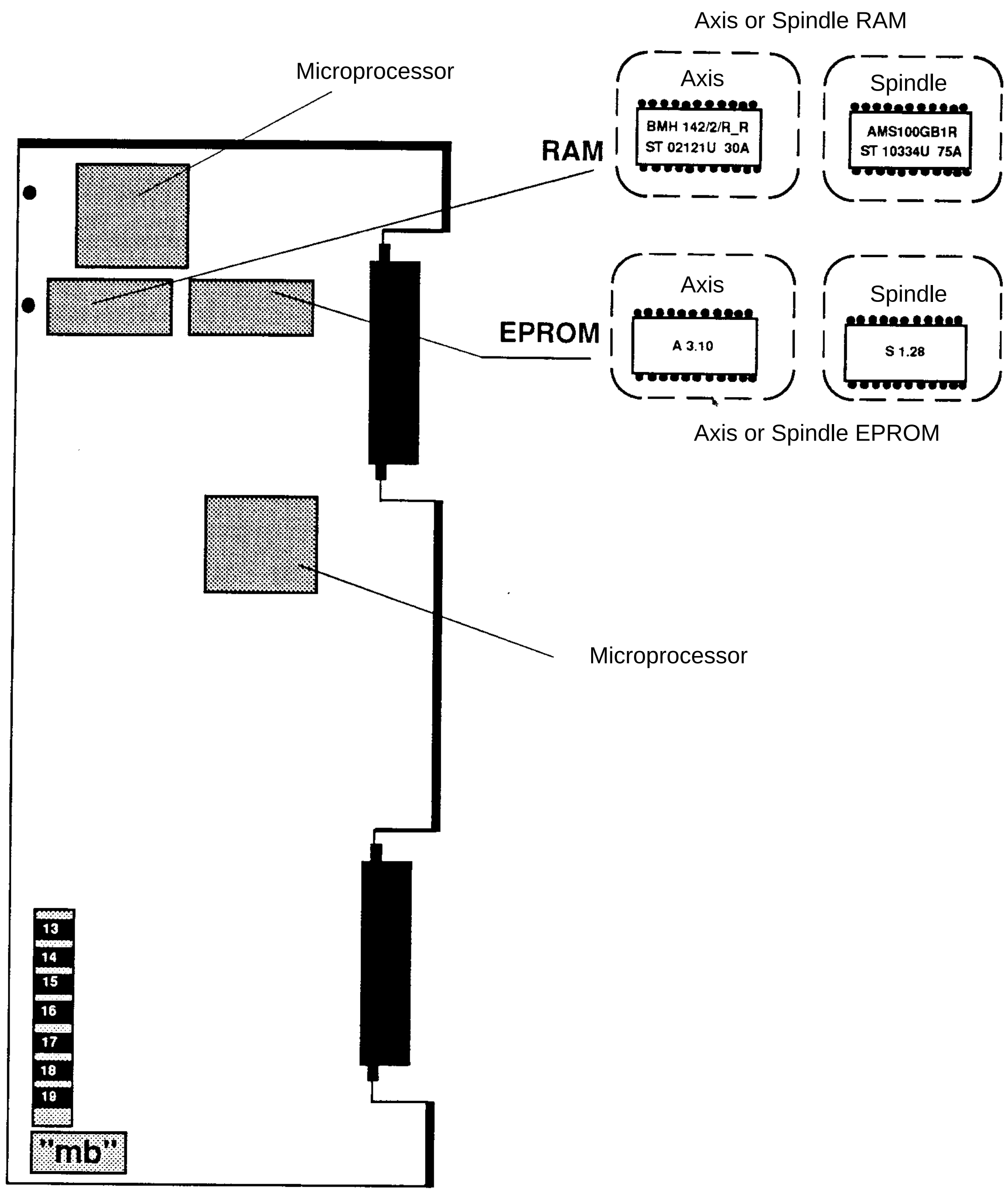
In case of a problem with the memories, the NUM spare parts department will need to know the information noted on the memories (software version on the REPROM, ST on the RAM).

* Note: The lithium battery (inside the RAM) life does not exceed 3 years for modules in stock.

The battery cannot be recharged, but it is disconnected when the UAC module is powered by the mains.

When the battery is flat, an alarm is indicated on the servo-drive (OVS LED flashing).

To solve this problem, NUM recently replaced the RAMs by EEPROMs.



The shielded cables from the sensor are connected to connector **mb** of the ACQ card.

25.2.1.1 Replacing the RAM

If you have a backup copy of the parameter file and the PC Set Link (SPM) software tool, it is recommended to restore the file by the SPM pLoad command.

If not, specify the ST number to NUM who will configure the memory before shipping it out.

> **CAUTION**
>
> The file created by NUM is the standard file for a given motor/servo-drive association. The OEM may have modified some parameters to adapt them to the machine or to optimise the feedback. These new parameter settings are not included in NUM's supply.

- Replacing with a RAM of the same type
  Reference ARA002C08J02JT P/N 410728025
- eplacing with an EEPROM
  Reference XICORX2816CP20 P/N 410728016

This operation also requires replacing the UAC servo-drive software (see equivalence table)

Software description	Software for RAM	Software for RAM and EEPROM
2.5 kHz axis	A 3.10	A 3.21
5 kHz axis	A 4.02	A 4.10
2.5 kHz resolver spindle	A 1.28	S 1.31
5 kHz cog wheel resolver spindle	A 3.00	S 3.10
5 kHz resolver spindle	S 3.82	S 3.90

For equivalent software, the ST number is the same for an EEPROM and a RAM. To be able to communicate with a PC, SPM Release 2.20 is required as a minimum.

25.2.1.2 Different Types of ACQ Cards

- Basic 2.5 kHz ACQ card:
  Reference 2UACLACQF356 P/N 418200356
- 2.5 kHz ACQ card with options:
  Reference 2UACLACQF356P P/N 418220356

Various optional daughterboards can be provided for this card:

- Master or slave backlash compensation (axes), option:
  Reference 2UACANT385 P/N 418400385
- High resolution sensor processor (spindle): 2UACCAXIS411
- High resolution sensor + encoder simulator (spindle): 2UACHR411
- 5 kHz ACQ card
  Reference 2UACLACQF356 P/N 418250356

  By comparison with the above cards, this card increases the PWM system frequency from 2.5 kHz to 5 kHz. This modification decreases the heat and noise generated by the motor. It is mainly used with asynchronous spindle motors.
  This card can also be fitted with the above optional daughterboards.
  If used, the UAC module reference becomes 3UACx50xx151

25.2.1.3 Compatibility of ACQ Cards with Software Versions

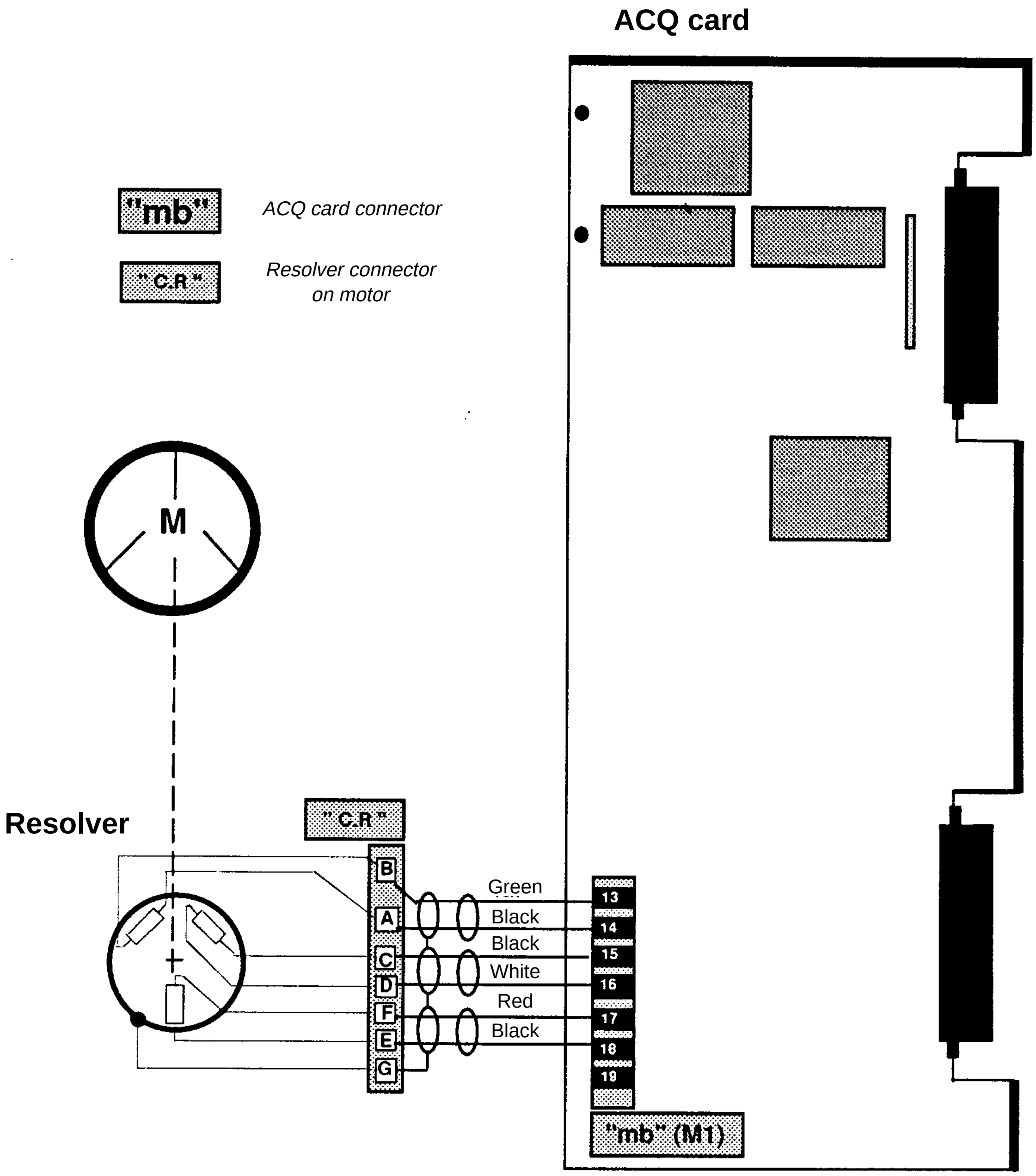
Compatibilities between ACQ Cards and UAC Software Versions

ACQ Cards			SOFTWARE							
Type	**NUM SpA reference**	**NUM Part No.**	**A 3.10 and <**	**A 4.02**	**S 1.28 and <**	**S 2.52**	**S 2.00 to S 2.06**	**S 2.08**	**S 3.82**	**S 3.00**
2.5 kHz Standard	2UACLACQF356	418 200 356	Yes	Rel 3.0 and above	Yes	Yes	Rel 3.0 and above	No	Rel 3.0 and above	Rel 3.0 and above
2.5 kHz Options	2UACLACQF356P	418 220 356	Yes	Rel 3.0 and above	Yes	Yes	Rel 3.0 and above	No	Rel 3.0 and above	Rel 3.0 and above
5 kHz	2UACLACQF356V	418 250 356	No	Yes	No	No	No	Yes	Yes	Yes

Compatibilities between ACQ Cards and UAC Options

ACQ Cards			OPTIONS		
Type	**NUM SpA reference**	**NUM Part No.**	**Backlash compen-sation**	**C Axis**	**High resolution**
2.5 kHz Standard	2UACLACQF356	418 200 356	No	No	No
2.5 kHz Options	2UACLACQF356P	418 220 356	Yes	Yes	Yes
5 kHz	2UACLACQF356V	418 250 356	Yes	Yes	Yes

25.2.1.4 Connector mb (ACQ card)



The cable supplied by NUM (RSC AWG 22x8) connects the resolver to the connector mb.

Refer to the CAT wiring diagram for connection of the shielding.

To prevent interference in the signal due to the resolver, make sure when installing the cables in the cabinet to keep the resolver cable and power cables at least 300 mm apart.

25

25.2.2 IP1 Card

Reference: 2UACLIPF349 P/N 418201349

(UAC Manual 783E003/C, page 19)

Connections (see UAC manual, pages 34, 35, 36).

25.2.3 AL1 LED Card

Référence: 2UACLF353 P/N 418200353

The AL1 card is located at the top of the module, to the right of the ACQ card.

It includes the UAC servo-drive status and alarm LEDs (see Maintenance below) as well as the regulators for the auxiliary outputs (+5 V, +15 V, -15 V, +24 V).

25.2.4 Optional Cards

Optional cards can be placed to the right of the IP card (bottom) and the LED card (top).

Two slots (for UAC 5030) or four slots (for other modules) are available for optional cards.

There are no predefined slots for the optional cards.

The following optional cards are available:

- Standard relay card: 2UACG14 P/N 418414386
- Relay + current limiting card: 2UACG15 P/N 418415386
- Indexing card: 2UACPOS1 P/N 418400386
- Encoder card: 2UACENC387x
  x specifies the card resolution:
  x = A: 768 pulses per revolution P/N 418401387
  = B: 3072 pulses per revolution P/N 418400387 (standard)
  = C: 12,288 pulses per revolution P/N 418402387
  = D: 49,152 pulses per revolution P/N 418403387

These cards are described in detail in the UAC Installation and Maintenance Manual 738E003/C, pages 38-51.

They are not detailed further herein.

However, two optional cards are required for maintenance of the UAC servo-drives.

25.2.4.1 RS232 Serial Interface Card

Reference: 2AUC232 P/N 418400372

This card interfaces the UAC servo-drive with a PC.

It also allows connection of the PC Set Link servo-drive setup software (SPM software) running under DOS.

This software is described in detail in the PC Set Link Manual 738E0.

The SPM software is used to set up the servo-drive and optimise the customisation parameters (ST): servo-drive configuration, optimisation of the speed loop, adaptation of the options.

It is also used to control the motor from the PC and provides an internal oscilloscope function.

This software is essential for setup and can also be useful for maintenance.

The SPM Info command displays the servo-drive alarm history.

A table in the parameter memory can contain up to 128 servo-drive alarms. This table indicates the type of alarm as well as the date and time of occurrence (time-date function available only with a RAM but not with an EEPROM).

25.2.4.2 DAC Card (analogue outputs)

Reference: 2UACDAC1374 P/N 418400374

The DAC card converts internal digital quantities to analogue signals available for display on Test Points (TP) and the terminals of md. Maximum output current 6 mA.

Each card can display two quantities.

The signed value (+ or -) and absolute value are available for each quantity. Two DAC cards can be used together (if two free slots are available). When two DAC cards are used together, the address dipswitches must be set as follows:

Switch setting (S1)	DAC card 1	DAC card 2
1	OFF	ON
2	OFF	OFF
3	OFF	OFF

Use PC Set Link to select the parameters to be displayed. The following default quantities are selected in the servo-drive as delivered:

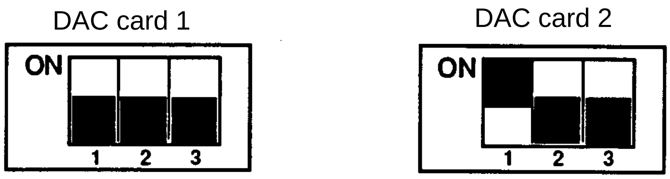
Spindle	TP1: Veldb (speed)	0.444 V = 1000 rpm
	TP2: Load	5 V = nominal load
Axis	TP1: Velfil (speed)	1.33 V = 1000 rpm for kvelf = 32
	TP2: Iq (torque current)	3.93 V = maximum module current

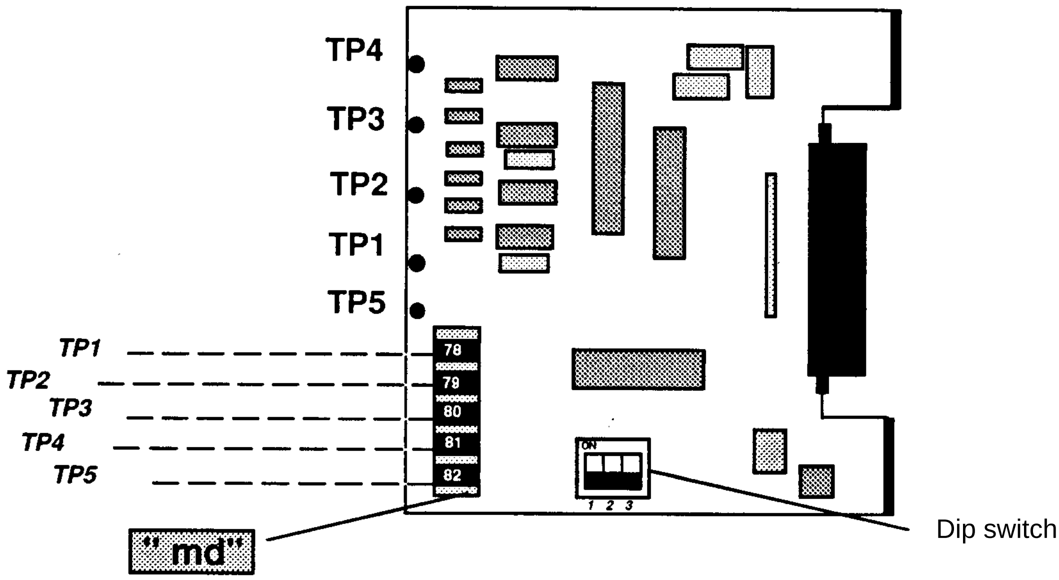
The table below shows the terminal and test point numbers where the quantities are available.

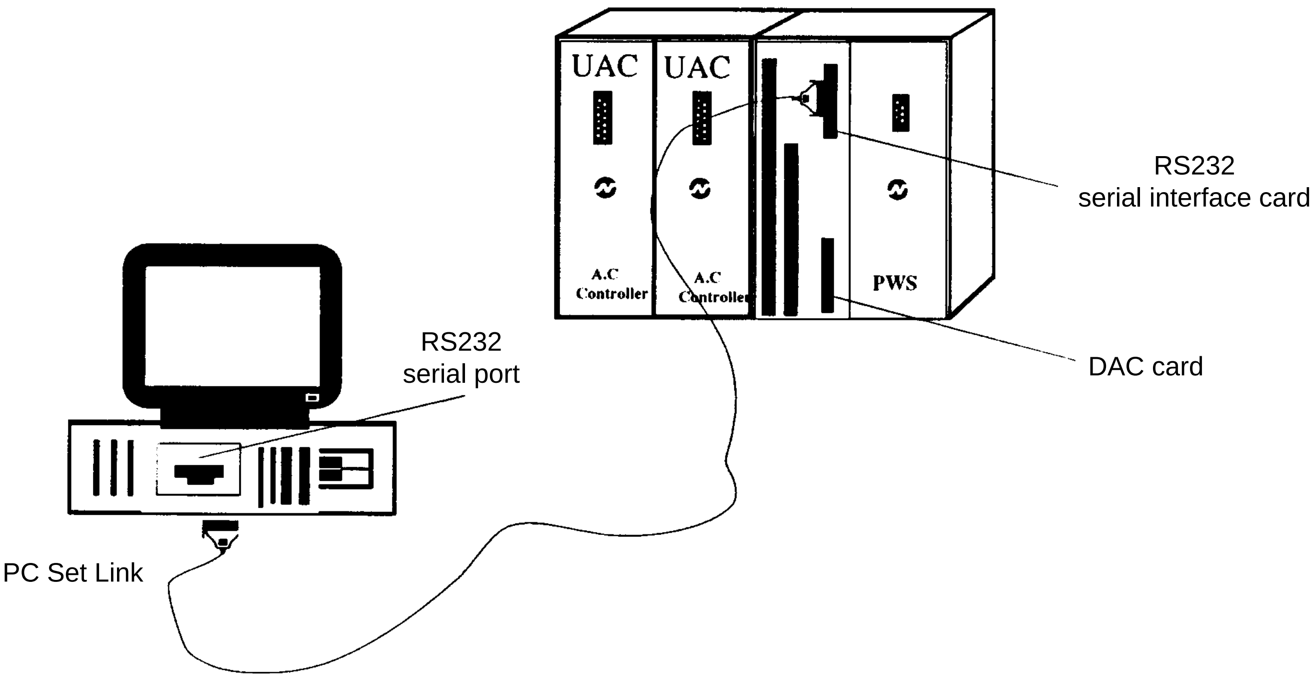
	PC Set Link software test point	DAC hardware test point	DAC card output terminal	Signal type
DAC card 1	TP 1	TP1	78	0 / +10 V
		TP2	79	–10 / +10 V
	TP 2	TP 3	80	–10 / +10 V
		TP 4	81	0 / +10 V
		TP 5	82	GND
DAC card 2	TP 3	TP 1	78	0 / +10 V
		TP 2	79	–10 / +10 V
	TP 4	TP 3	80	–10 / +10 V
		TP 4	81	0 / +10 V
		TP 5	82	GND

DAC Card (Test Point Selection with PC Set Link)

DAC Card address dipswitch







With the SPM software, you can modify the assignments of the test points measured on the cards.

The quantities selected can be displayed on the DAC card, on the internal oscilloscope of SPM and dynamically on the SPM software (command dtEp).

The standard quantities (current, axis speed, power and spindle speed) are used to check the behaviour of an axis.

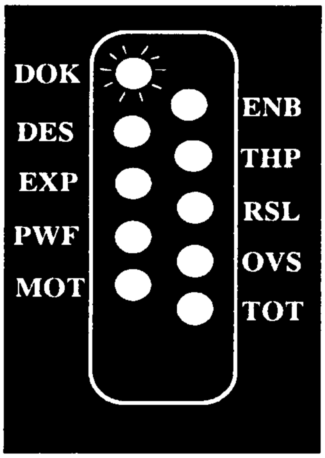
However, other quantities can be selected during maintenance to check the resolver (e-cos-r, e-sin-r, e-gain) or its angular setting (Vd) (see the section on axis motors for the setting procedure).

Most of the other quantities that can be tested are for use by NUM S.A. for servo-drive design.

25.3 Maintenance - Alarms

> **⚠ CAUTION**
>
> The alarm LEDs can be lit in two ways:
>
> LED lit steady —> hardware alarm
>
> LED flashing —> software alarm

UAC



Status	**DOK** **ENB**	**Green LED** **Yellow LED**	Servo-drive OK, no error Servo-drive enabled
Hardware alarm, LED lit steady	**DES** **THP** **EXP** **RSL** **PWF** **OVS** **MOT** **TOT**	**Red LED** **Red LED** **Red LED** **Red LED** **Red LED** **Red LED** **Red LED** **Red LED**	Current spike in a transistor Heat sink overheating External protection triggered Connection to resolver cut or incorrect Current leakage to earth Motor overspeed Motor overheating I^2t Transistor overheating

Software alarm, LED flashing	**RSL** **TOT** **THP**	**Red LED** **Red LED** **Red LED**	RAM battery flat RAM parameters incompatible Remote KO (only for servo-drive with backlash compensation)

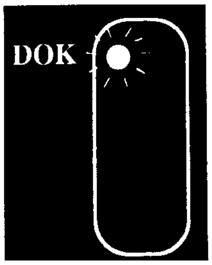
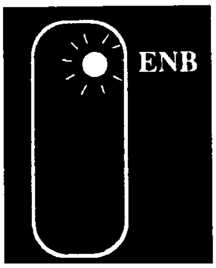
25.3.1 Clearing Stored Alarms

When an fault triggering an alarm occurs:
- The green DOK (drive OK) and yellow ENB (drive enabled) LEDs go out
- The DOK contact on terminals 1 and 2 of connector ma on the IP card opens
- The alarm LED comes on
- The alarm is stored
- The motor stops by inertia.

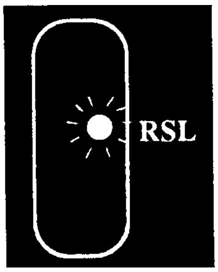
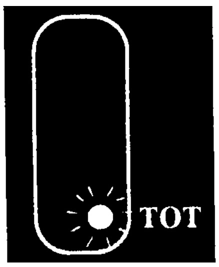
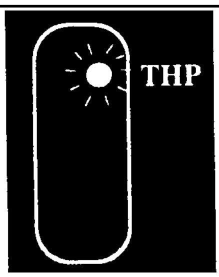
To start operation, proceed as follows:
- Power down and wait for around 30 seconds
- Power up (the DOK and alarm LED concerned are lit)
- Check the type of alarm stored
- Correct the problem
- Clear the alarm by enabling then disabling the servo-drive. (The alarm can also be cleared by applying power to and removing it from terminal 20 of the IP card).

If the alarm disappears and DOK remains lit, the drive is OK. Otherwise, the alarm persists.

25.3.2 UAC Module - Status LEDs

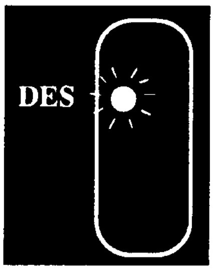
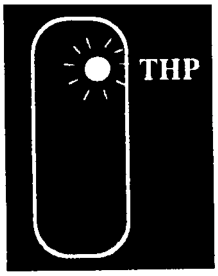
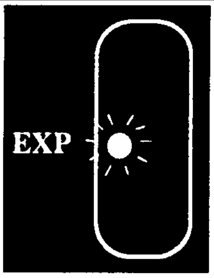
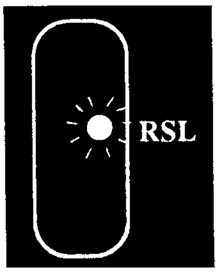
	The green DOK LED is lit when the module is operating correctly. It goes out when one of the alarm LEDs comes on.
	The yellow ENB LED is lit when the servo-drive is enabled and current is flowing through the motor.

25.3.3 UAC Module - Software Alarm Indications

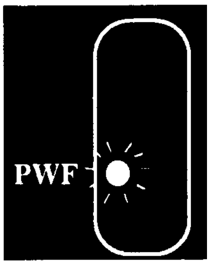
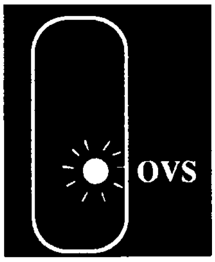
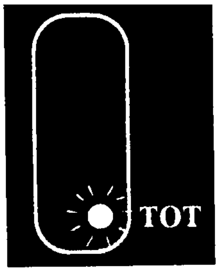
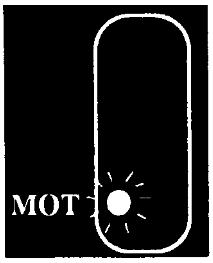
	Cause	Corrective action
	RAM battery flat	Replace the RAM and reload the parameters with PC Set Link
	Incorrect parameters with incompatible format loaded. e.g. axis parameters loaded in a spindle servo-drive	Reload the correct parameters with PC Set Link
	Operational problems on the other module operating with backlash compensation Communication problems between master and slave cards	Check the alarms on the other backlash compensation module Check the link between the master and slave cards

If one of the above LEDs starts flashing, replace the ACQ card to solve the problem.

25.3.4 UAC Module - Hardware Alarm Indications

	Cause	Corrective action
	Power wiring error, e.g. incorrect wiring of electrical gear change Error on power (motor or servo-drive)	- Check the wiring - Check the motor insulation and winding impedance - Replace the power module
	**A** The rack fan is not running **B** The temperature inside the rack is too high (> 45°C)	**A** Check that the fan slide-in unit is correctly engaged (see Sec. 23.2, Rack) **B** Check with the machine manufacturer for correct heat exchange
	No 24 V across terminals 21 and 6 of IP card connector ma	Check the wiring
	Short circuit between resolver cables Leakage to earth Connections reversed	Check the wiring between the resolver and ACQ card

25

	Cause	Corrective action
	Leakage to earth from a power cable	Check the wiring of the power part (terminal M/motor)
	Maximum speed set is higher than that specified	Check the speed setting on potentiometer S1 or S2 of the setting card on the IP card
	**A** Wiring error between motor and servo-drive **B** Motor seizure.	**A** Check the wiring **B** Check the mechanical parts
	The motor has been running too long in overload	Check the duty cycle