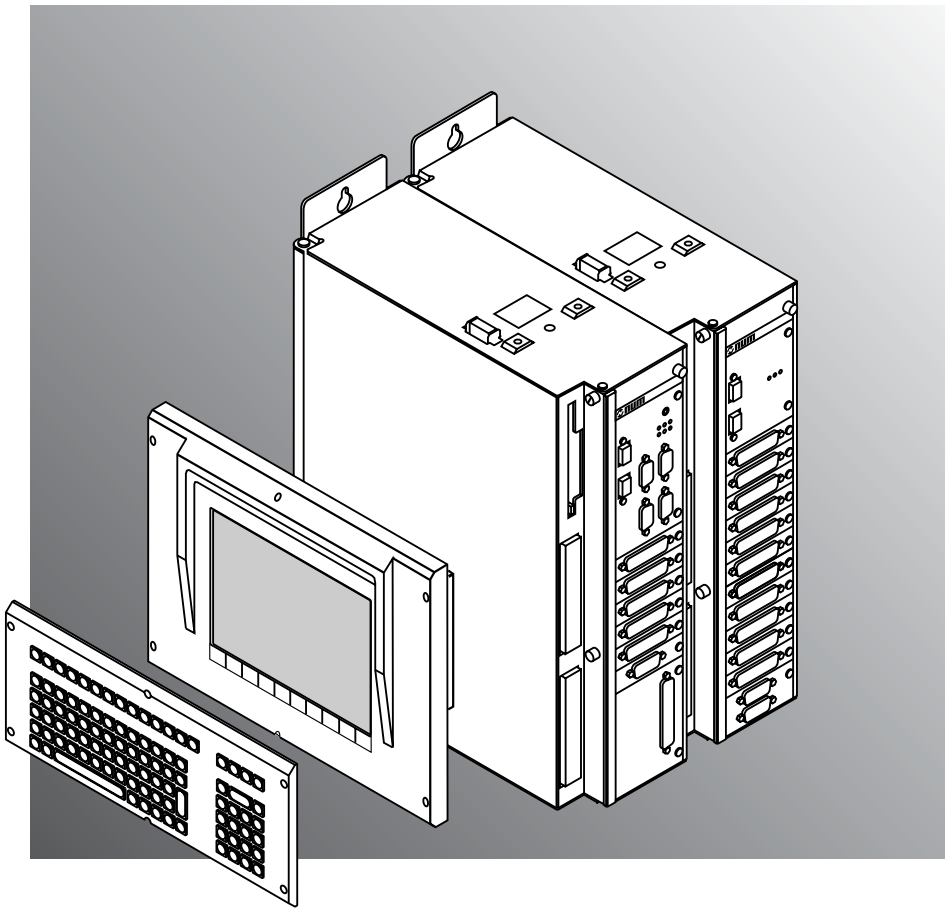
NUM Power 1020/ 1040/1060/1080 CNC

Installation and Commissioning Manual

0101208536/A



10/2001

Despite the care taken in the preparation of this document, NUM cannot guarantee the accuracy of the information it contains and cannot be held responsible for any errors therein, nor for any damage which might result from the use or application of the document.

The physical, technical and functional characteristics of the hardware and software products and the services described in this document are subject to modification and cannot under any circumstances be regarded as contractual.

The programming examples described in this manual are intended for guidance only. They must be specially adapted before they can be used in programs with an industrial application, according to the automated system used and the safety levels required.

Table of Contents

This executive summary includes only the level 1 and 2 titles. A complete table of contents is given at the beginning of each chapter.

Part One: INSTALLATION

Part Two: COMMISSIONING

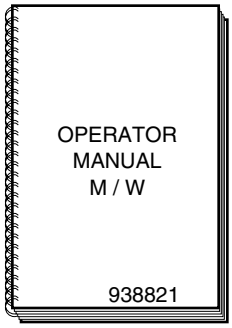
Record of Revisions

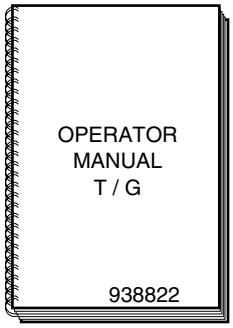
Date	Index	Description
10 - 2001	A	Document creation

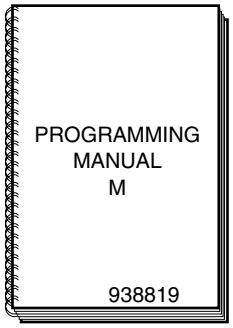
Document update - Upgrading of the Num Power 1020/1040/1060/1080 family

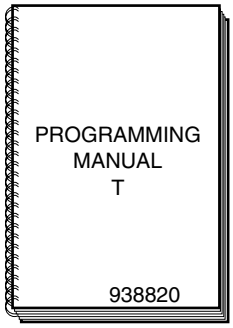
User Documents

These documents are designed for use of the CNC.



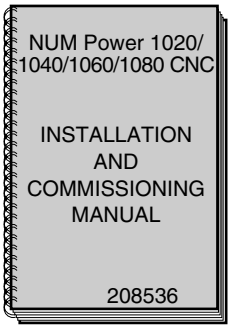


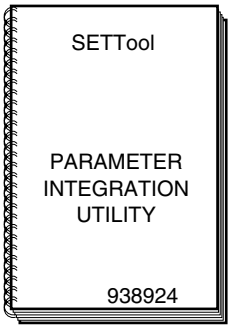


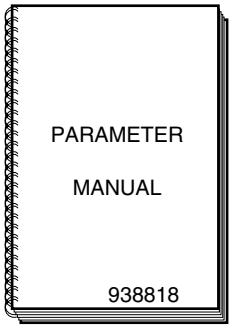


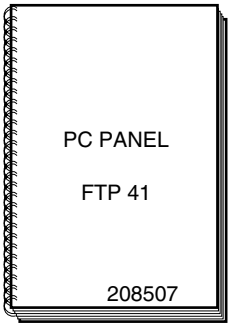
Integrator Documents

These documents are designed for setting up the CNC on a machine.









List of NUM Utilities

A series of utilities are available for integration and use of the systems.

These utilities may be included in the basic version or available as options.

Depending on the function performed by each utility, its use is described in the integration manual or operator manual, as appropriate.

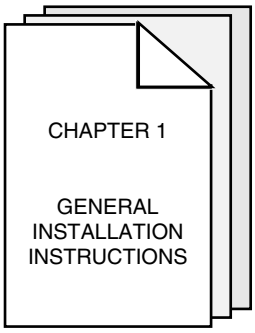
The table below lists the utilities and gives the references of the document describing them:

Utility	Name	Manual	Chapter
UT2	axis calibration	installation and commissioning manual (208536)	10
UT3	resident macros	operator manuals (938821 or 938822)	8
UT5	parameter integration	parameter manual (938818)	12
UT7	programme debugging	automatic control function programming manual - ladder language (938846)	16
UT12	option locking	operator manuals (938821 or 938822)	8
UT20	interaxis calibration	installation and commissioning manual (208536)	11
UT22	integration of axis parameters	SETTool manual (938924)	8

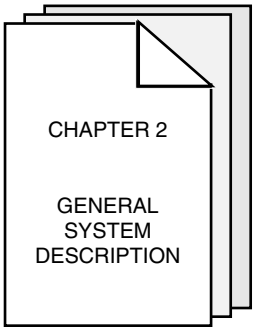
Installation and Commissioning Manual

This manual includes two parts:
- installation: physical integration of the numerical control with the machine and its environment,
- commissioning: adaptation of the CNC to the machine configuration.

Part One: Installation

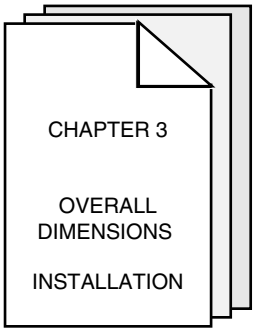


General requirements concerning the CNC environment:
- Applicable standards
- Power consumption
- Heat dissipation
- Electrical specifications
- Equipment colours.

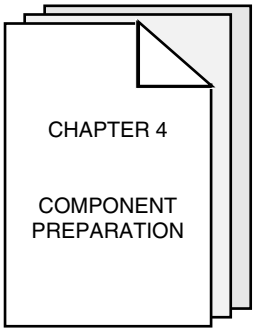


Detailed explanation of the various possible configurations.

Overview of the system architecture.



Data used for installation of the components:
- Detailed configuration
- Overall dimensions
- Mounting dimensions.



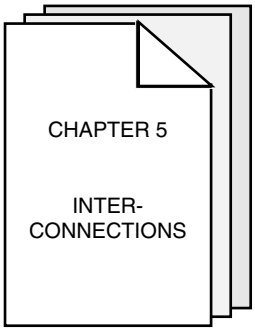
Preparing the CPU.

Preparing the compact panel.

Preparing the machine panel.

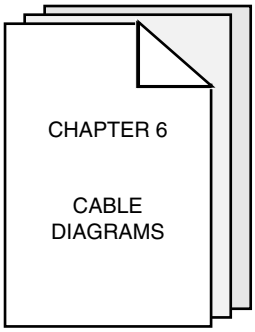
Replacing fuses.

Wiring the watchdog.



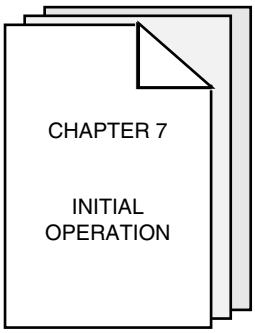
General interconnection diagram.

General data and connections:
- CPU
- Modax
- Compact panel
- CNC panels
- Machines panel
- NUM diskette drive.

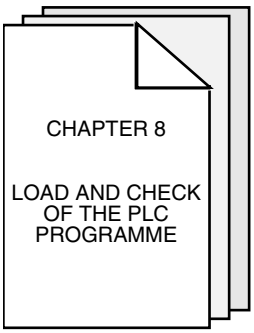


Wiring diagrams for the following cables:
- Communication
- Axes
- Analogue inputs/output and interrupt
- Inputs and outputs
- Power supply
- Video/panel.

Part Two: Commissioning



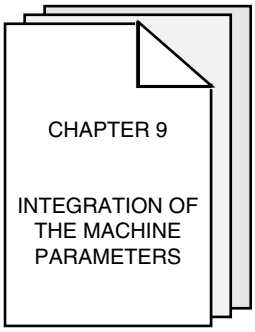
Initial operating procedure.



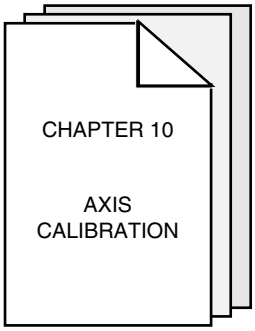
Reference to the PLC Function Programming Manual.

Checking instructions.

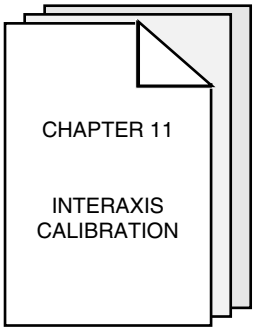
Supplements to PLC programming.



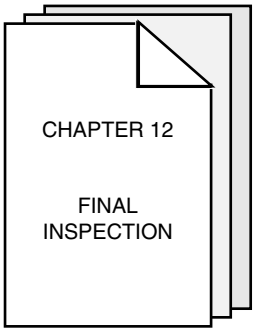
Reference to the Parameter Manual.



Correction of the axis position measurement read by the coupler according to the real position on the axis.



Correction of the offsets on a slave axis according to the position on a master axis.



Recommended inspection by machining of a reference part.

Use of the Installation and Commissioning Manual

Procedures

The manual includes procedures (in particular in Chapters 10 and 11).

The actions required are presented as follows:

Reset the system. ☞ Y —

On the right are indicated the keys to be pressed in two possible forms:

— Square keys: correspond to keys on the operator panel.

EXIT Rectangular keys: correspond to software keys located in the bottom part of the screen and actuated by function keys (F2-F11) located under the screen.

Dealers

The list of NUM dealers is given at the end of the manual.

Questionnaire

To help us improve the quality of our documentation, we request you return to us the questionnaire at the end of this manual.

Part One

INSTALLATION

1 General Installation Instructions

1.1 Operating Conditions

⚠ CAUTION

Do not unplug any subassemblies (cards, circuits) with the system live.

Do not use measuring instruments whose output voltage is > 5 VDC.

NUM equipment complies with the following standards:

	Reference standard	Level
Temperatures	IEC 1131	
Mechanical stresses	IEC1131	
Mains variation	IEC1131	
Mains brownouts	IEC1131	
Electrostatic discharge (ESD)	IEC 1000-4-2	Level 3
Electromagnetic field	IEC 1000-4-3	Level 3 (excluding video)
Fast electric transients	IEC 1000-4-4	Level 3
Electric shock	IEC 1000-4-5	Level 3
Electromagnetic emissions	EN 55022	

Operating temperature range: Minimum 5 °C, maximum 55 °C.

Cooling: See Sec. 1.3.

The systems must always be installed in power cabinets equipped with:
- efficient door seals,
- air filters or air/air exchangers,
- possibly, air conditioning.

1.2 System Power Consumption

The table below specifies the power consumption of each system component:

Component	Power consumption
NUM Power 1020/1040/1060/1080 CPU (24 VDC)	70 W
Modax (24 VDC)	45 W
CP30: QWERTY panels with 14" colour CRT (230 VAC)	100 W
50-key CRT panel (230 VAC)	
• CP20: Panel with 10" colour CRT	60 W
• MP20: Panel with 9" monochrome CRT	30 W
FS20: 10.4” LCD panel (24 VDC)	50W
Compact panel (230 VAC)	
• CP10: Panel with 10" colour CRT	60 W
• MP10: Panel with 9" monochrome CRT	30 W
FTP 41: PC panel	200 W
Multiplexer module (230 VAC)	25 W
MP01: Machine panel (24 VDC)	
• Panel alone	3.8 W
• 32-input/24-output extension	9.8 W
MP02: Machine panel (24 VDC)	
• Panel alone	5 W
• Panel and 10 outputs	40 W
Additional components (24 VDC)	
• 32-input interface terminal board	24 W
• 24-output relay terminal board	19.2 W
• Remote input/output module	5 W
• NUM diskette drive	3.5 W

The system power consumption is obtained by summing the power consumptions of the system components.

1.3 System Cooling

> ⚠ **CAUTION**
>
> The life cycle of electronic equipment is closely related to its operating temperature.
>
> Compliance with the following recommendations will ensure optimal product reliability.

Determining the Air Flow Rate

The heat to be dissipated is a maximum of 70 W for the CPU, 45 W for the Modax and 100 W for the panel.

The dissipation can be calculated more accurately by adding together the power consumptions of the individual components (see Sec. 1.2).

The cabinet and pendant must be designed such that the temperature difference between the ambient air of the components (CNC, CRT) and the ambient air in the shop is less than 10 °C or such that the average annual temperature of the ambient air of the components does not exceed 40 °C.

The air flow rate required for correct heat dissipation is Q = 0.4 x P

where:

Q = air flow rate (l/s)

P = heat to be dissipated.

Example

For a 50-key panel with 10" colour CRT in a pendant:

P = 60 W

Q = 0.4 x 60 = 24 l/s.

REMARK This calculation should be confirmed by temperature measurements.

Recommendations

Use efficient filters on the cabinet or pendant air intakes.

Do not allow the fans to blow air directly onto the equipment.

1.4 Interconnections

1.4.1 Frame Earth and Operational Earth

Definition of the concepts of frame earth and operational earth:
- frame earth: low impedance, low frequency path used in case of failure between the electric circuit and the earth,
- operational earth: low impedance path used for equipotentiality between electric circuits. The purpose of the operational earth is to attenuate all interference and spurious voltages that may exist between units over a very wide frequency band.

These two concepts do not always require different circuits.

The frame earth system is provided by interconnecting all metal parts (building structure, pipework, cable trays, equipment enclosures and equipment).

The operational earth is the physical connection point (earth rod, earthing mat, building earth) to which all the frame earths must be connected.

1.4.2 Signal Earth

A distinction is made between two types of electronic equipment:
- equipment operating at relatively low frequency (a few kHz to a few hundred kHz) and low signal level,
- equipment operating at high frequency (a few tens of MHz to a few hundred MHz) and high signal levels.

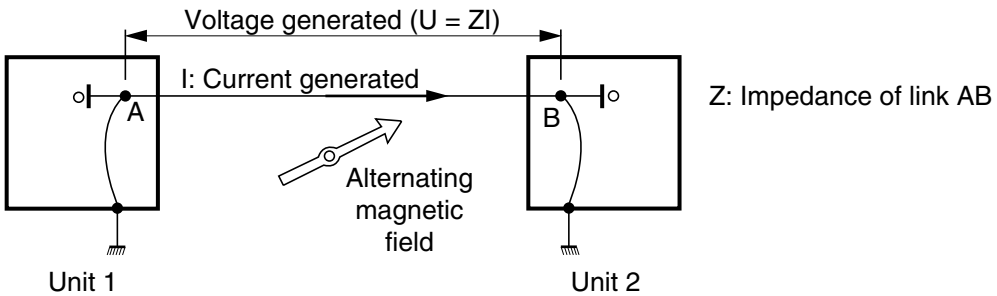
1.4.2.1 Equipment Operating at Relatively Low Frequency and Low Signal Levels

Such equipment mainly includes "analogue" systems sensitive to a few mV (or µV).

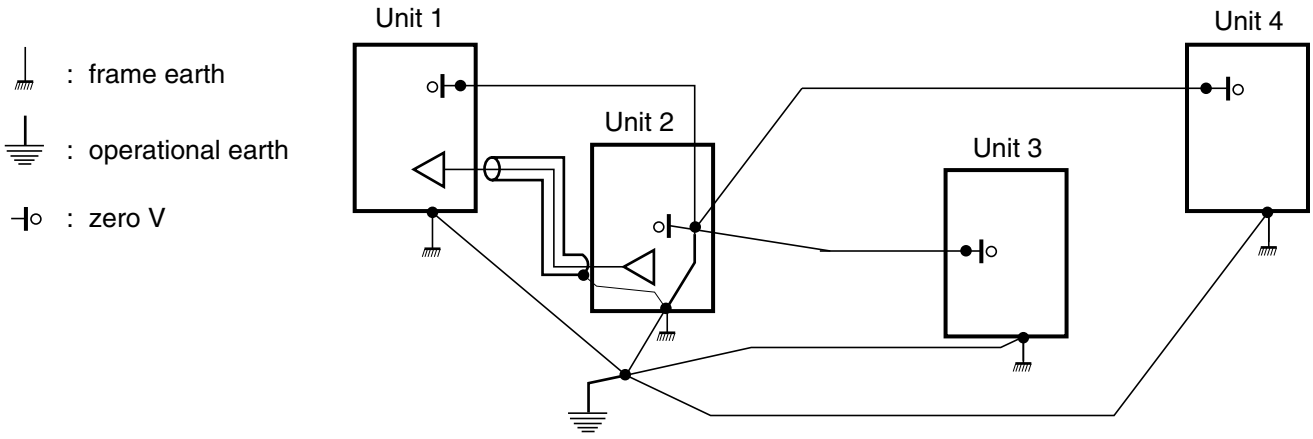
The most troublesome interference is generated by low or medium frequency electromagnetic fields captured mainly by the interconnections between units. High frequency interference is eliminated by the bandwidth of the circuits themselves or by low-pass filters.

Apply the following rules to attenuate interference:
- provide a wye connection for the signal earths and a wye connection for the frame earths with a single interconnection between the two earthing systems,
- when a sensitive wire must be protected against EMI by shielding, the shielding is considered a screen and is only earthed at one end so as not to create a loop with circulation of interference in the shielding.

Wrong: Loops between units due to interconnection of the earths and common wires



Right: Wye connection of frame earths and 0 V (signal earths)



1.4.2.2 Modern Equipment Operating at High Frequency and High Signal Levels

Such equipment includes modern "logic" equipment with electronic gates whose switching times are around 1 ns and whose signal levels are high (static switching margin from 400 mV to 1 V).

The most critical interference is electromagnetic interference at a frequency between 30 and 300 MHz.

Such interference originates in coil switching (relays, contactors, transformers, motors, transformer-supplied indicator lights, etc.), circuit breaker trip arcs, drive switching power supplies, HF systems located nearby, and electrostatic discharges generated by the operators, etc.

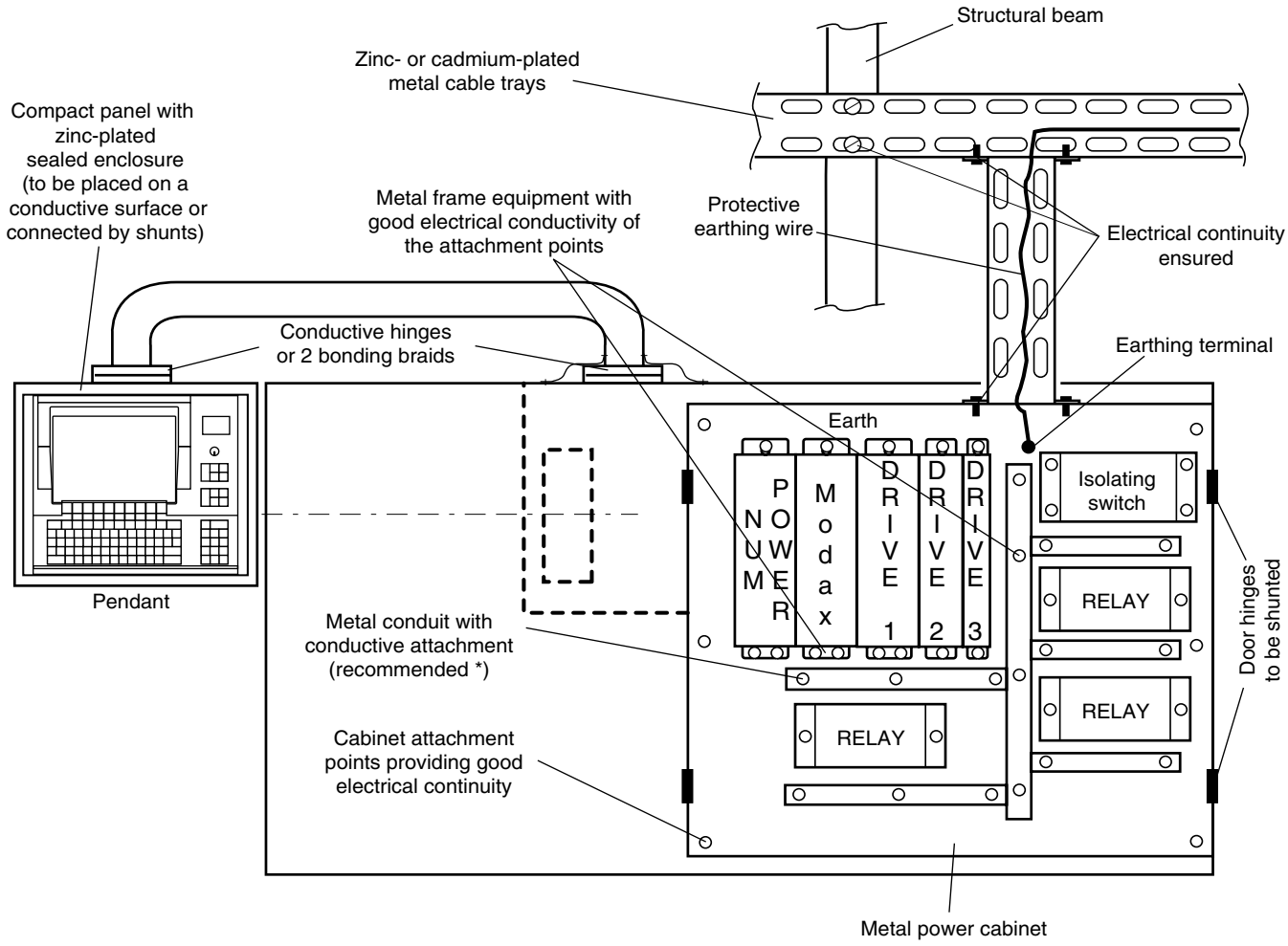
At such frequencies, the earths must be at the same potential. However, the impedance of an earthing wire becomes high at high frequencies (Z = Lw). For instance, for a 2.5 mm^2 wire 1 m long whose inductance is L = $1.4x10^{-6}$ H, the impedance, which is only 0.09 W at 10 kHz becomes 90 W at 10 MHz - and the earthing wires are not suitable for creating a good signal earth.

It is necessary to use a meshed system to decrease interference. This means interconnecting the units with one another by the largest possible number of the shortest possible links.

This is achieved best by using metal parts interconnected by many attachment points ensuring good electrical conduction (zinc- or cadmium-plated steel, stainless steel, removal of paint, use of claws on aluminium).

If electrical continuity is not correctly provided by the mechanical link, the link must be shunted by at least two short, wide bonding braids (length/width ratio ≤ 5 with length < 20 cm).

Example of Meshed System



Rear view of a lathe

* Plastic conduit, widely used, shall be systematically attached to metal rails or preferably directly to the cabinet.

In the units, the concepts of logical 0 V and protective earth coincide, i.e. the logical 0 V is connected in many points to the frame earth.

The shieldings of logical signal cables are earthed at both ends. This contributes to the mesh and in addition, the internal electronic circuitry and the enclosure are at the same potential.

To attenuate the loop effects thus created (the captured field depends on the loop area), the cables must be attached against the conduit or metal walls. This is called cabling with "reduction effect".

In the case of separate power supply for the logical inputs and outputs, the 0 V lines of these power supplies must be earthed and the wiring must be made with "reduction effect".

REMARK *Meshing the earths does not provide a protective system. The earthing terminals on the units must be connected to the general earth electrode of the building.*

1.4.3 Equipment Immunity

Equipment immunity to electromagnetic interference is guaranteed by:
- attenuating the interference generated by the sources,
- reducing the coupling between source and sink,
- increasing the immunity (hardening) of the equipment.

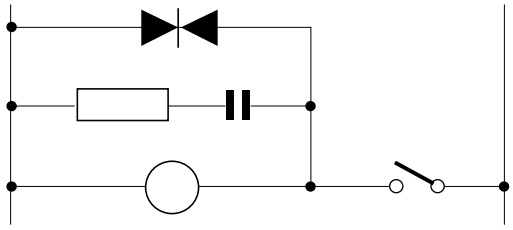
The three methods are complementary and should be applied together.

1.4.3.1 Attenuation at the Source (Interference Suppression)

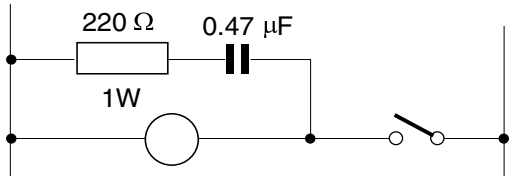
To limit the interference generated by components outside the system, make sure that:
- all the connections on terminal boards are securely attached,
- all the interference sources (relays, solenoid valves, motors, etc.) are provided with a suitable protection system.

Examples

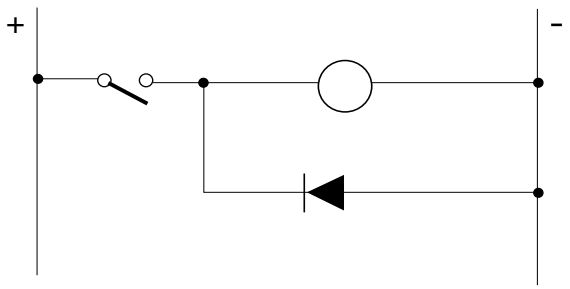
Low power AC contactor



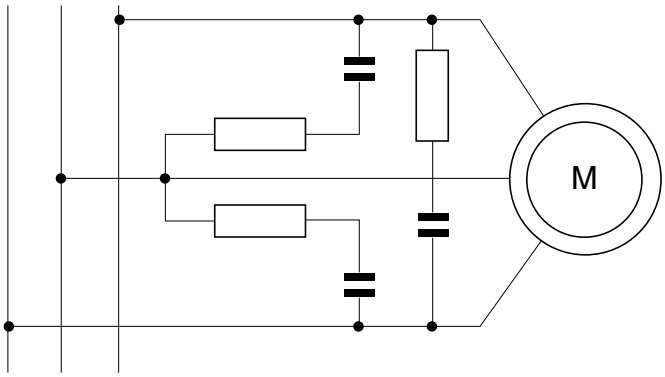
Medium and high power AC contactor



Low power DC contactor



Three-phase motor



1.4.3.2 Reduction of Couplings

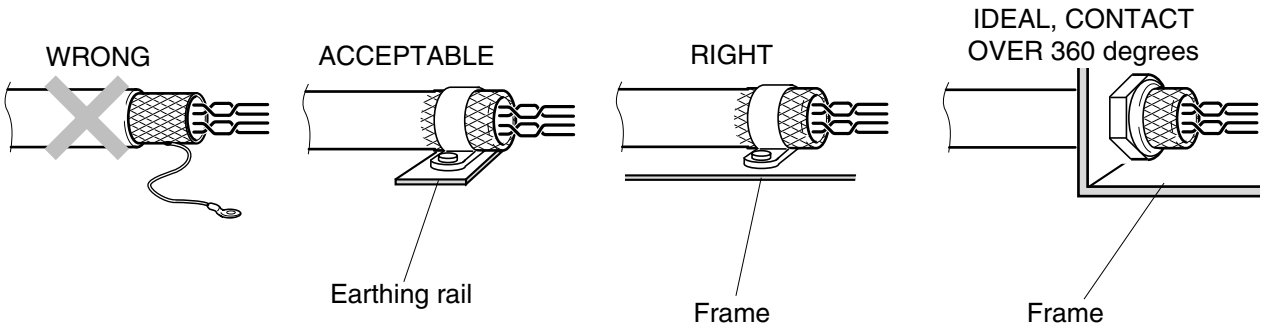
Provide a suitable earth meshing system (see Sec. 1.4.2.2) using metal parts with a conductive surface interconnected (bolted) together.

Wire with a reduction effect (low area loops):
- cables supplied against conduits and metal parts forming the frame earth,
- forward and backward travel of a signal in the same cable (twisted pair).

Earth the shielding of logic signal cables at both ends.

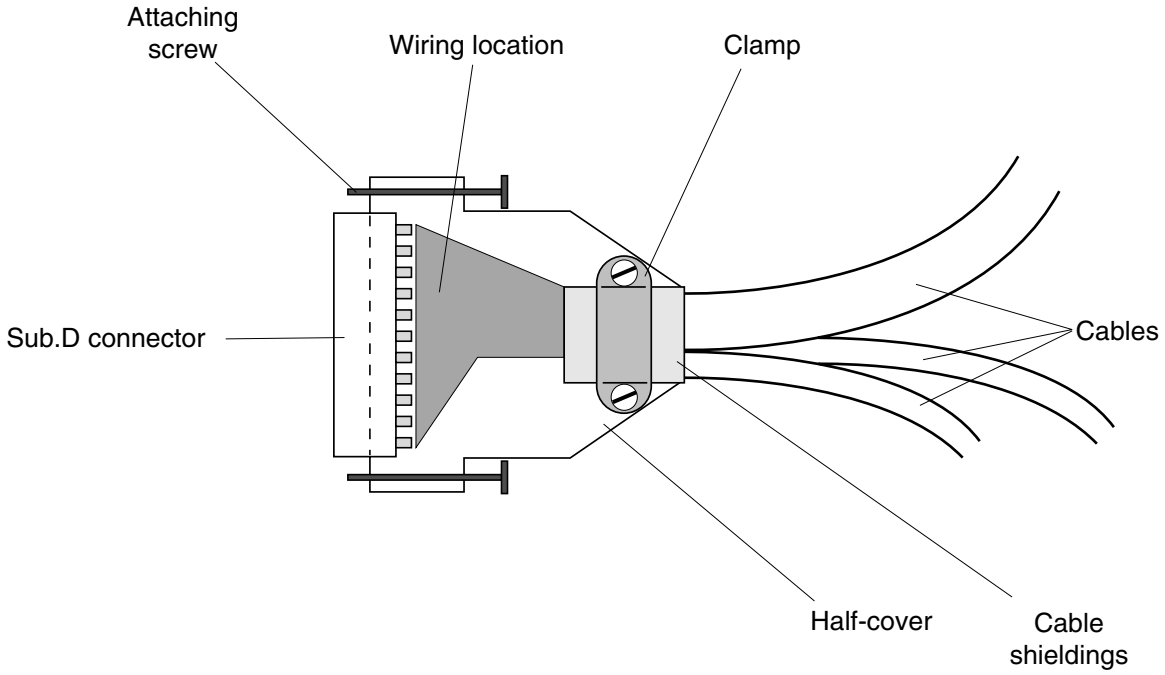
Earth the cable shielding over 360 degrees:
- with a conductive gland to penetrate through a bulkhead,
- by pinching the shielding in metal covers that are suitably earthed for connector plugs.

Connection of shielding to frame earth



Connection of cable shielding to the cover of a connector plug

Earth the cable shielding over 360 degrees by folding the shielding back onto the cable over a length of 1 cm and clamping it in the cover clamp.



Low level circuits must be separated from power circuits and circuits with interference:
- by physical separation of the cables (recommended minimum 30 cm),
- by routing in separate conduit or cable trays,
- by crossings at 90 degrees.

Analogue inputs (such as servo-drives) must be differential (common mode rejection).

Special case of servo-drive wiring

Servo-drives are low level (microvolt sensitivity), low frequency systems. It is therefore recommended to protect the link by a screen earthed only on the CNC side (see Sec. 1.4.2.1) and to provide double shielding on the cable earthed at both ends to serve for bonding.

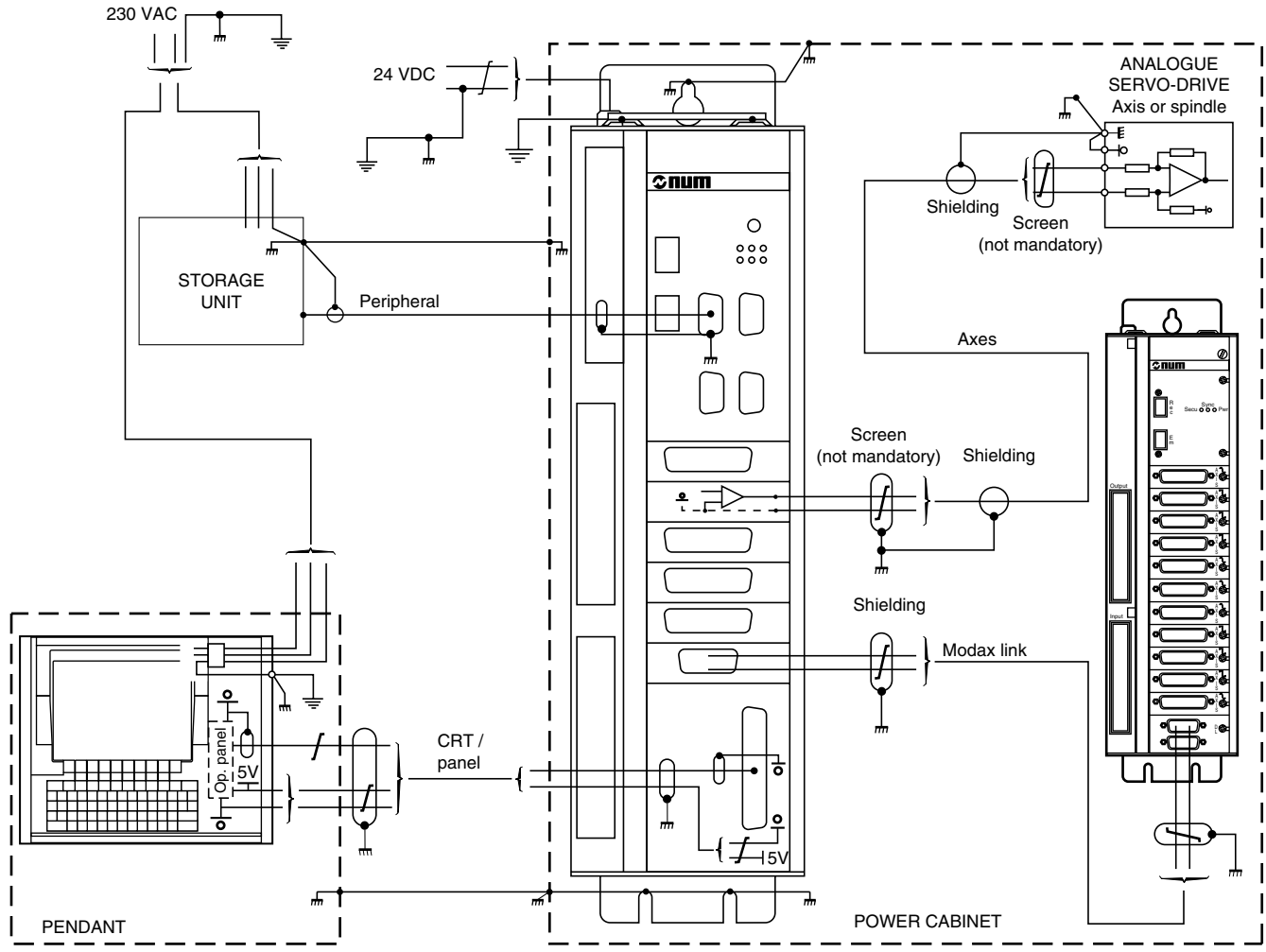
When these recommendations cannot be applied (unavailability of cable with double shielding, etc.), bonding must be given precedence by using a cable with single shielding earthed at both ends.

1.4.3.3 Equipment Hardening

Hardening is a feature integrated in the equipment design. Special care was taken with equipment immunity:
- multilayer cards with internal ground plane,
- stainless steel enclosure around the system and front panels in good contact with the enclosure so that the assembly forms an excellent Faraday cage,
- metal connector receptacles electrically connected to the front panels and provided with metal covers on which the shielding is earthed over 360 degrees,
- high level mains filtering on the power supply input,
- optoisolated binary inputs and outputs with physical separation from interference circuits.

All these measures give the equipment excellent immunity to electromagnetic interference.

1.4.4 Diagram of the 0 V, Frame Earth and Operational Earth



KEY

or Shielding not earthed at this end

or Shielding earthed at this end

Twisted wires

0 V

Frame earth

Operational earth

CAUTION

The 0 V lines of the 24 VDC power supplies must mandatorily be connected to the frame earth.

1.5 NUM Operator Panel Colours

The colours used for the NUM operator panels are from standard colour ranges:

Colour	Use	Standard
Dark grey	Background	RAL 7021
Medium grey	Keys	RAL 7036
Light grey	Keys	RAL 7032
Red	Side trim	PANTONE WARM RED C

1.6 Screen Saver

The CNC has a screen saver designed to extend the screen life. When it is activated by the PLC programme, the screen saver clears the screen after 5 minutes of no action on the keyboard. Pressing any key redisplays the previously active page.

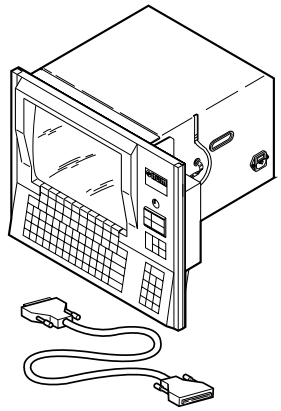
It is recommended to activate the screen saver by the PLC programme. This is done by setting the SC_SAVE bit (%W5.7).

2 General System Description

2.1 System Components

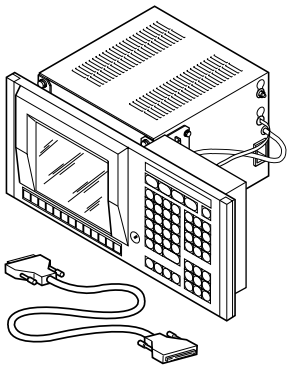
2.1.1 Operator Panels

2.1.1.1 14” Colour QWERTY Panel (CP30)



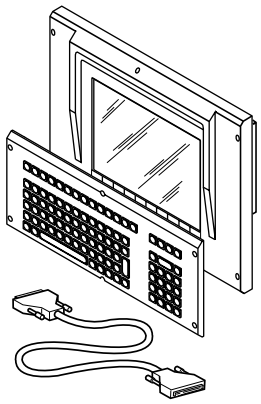
Subassemblies	Weight (kg)
Panel	16.5
Video cable	

2.1.1.2 10” Colour (CP20) and 9” Monochrome (MP20) 50-Key Panels



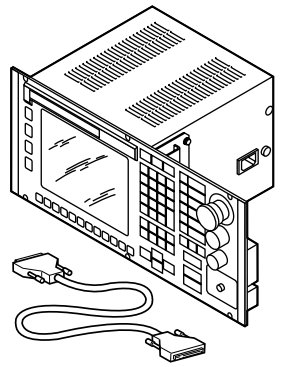
Subassemblies	Weight (kg)
Panel	10.7
Video cable	

2.1.1.3 Panel with LCD Display (FS20 Monitor and KBD30 Keyboard)



Subassemblies	Weight (kg)
Panel	5.9
Video cable	

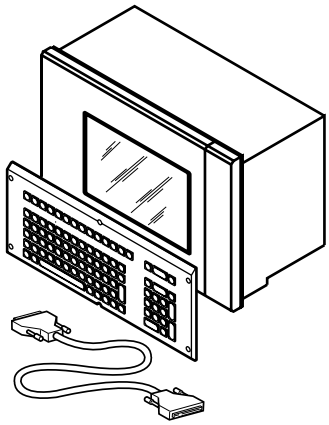
2.1.1.4 Compact Panels



10” Colour (CP10) and 9” Monochrome (MP10) Compact Panels

Subassemblies	Weight (kg)
Panel	11
Video cable	

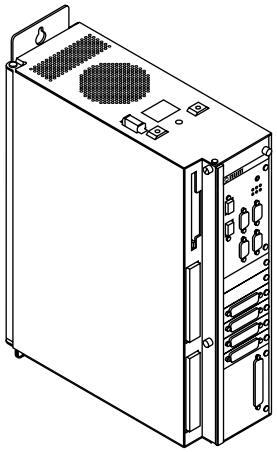
2.1.1.5 PC Panel



PC Panel (FTP41 Monitor and KBDPC Keyboard)

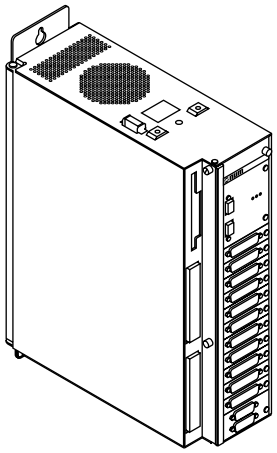
Subassemblies	Weight (kg)
Panel	10
Keyboard cable	

2.1.2 NUM Power 1020/1040/1060/1080 CPU



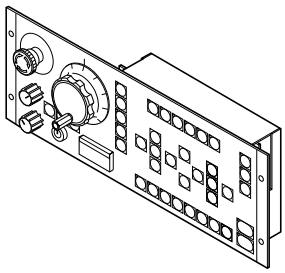
Weight: 6 kg

2.1.3 Modax



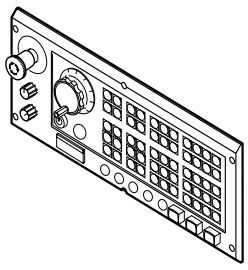
Weight: 6 kg

2.1.4 Machine Panels



Machine Panel (MP01)

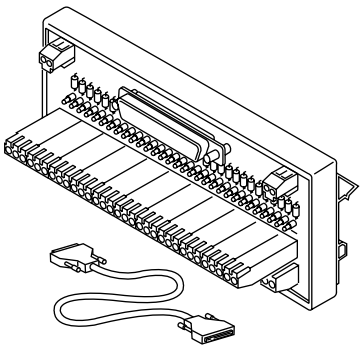
Subassemblies	Weight (kg)
Machine panel	2.200
Optical fibres	
Machine panel extension (optional)	0.300
Handwheel (optional)	0.600



Machine Panel (MP02)

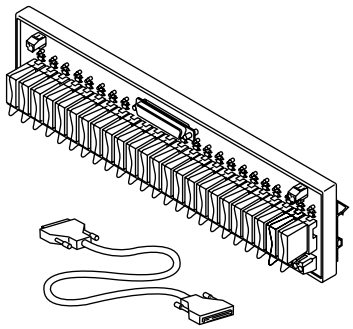
Subassemblies	Weight (kg)
Machine panel	1.5
Optical fibres	
Handwheel (optional)	0.250

2.1.5 Additional Components



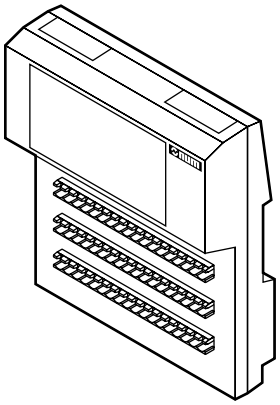
32-Input Interface Terminal Board

Subassemblies	Weight (kg)
Interface terminal board	0.300
Input/output card connecting cable	



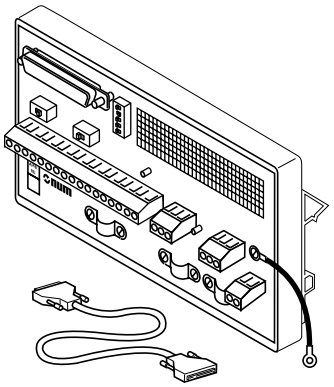
24-Output Relay Terminal Board

Subassemblies	Weight (kg)
Relay terminal board	1.050
Input/output card connecting cable	



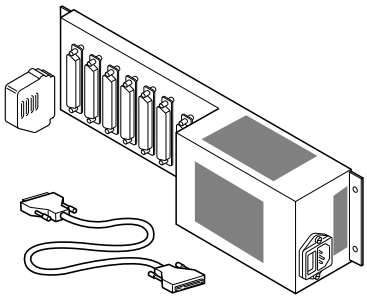
Remote Input/Output Modules

Subassemblies	Weight (kg)
Input/output module	
Fibre-optic cables	



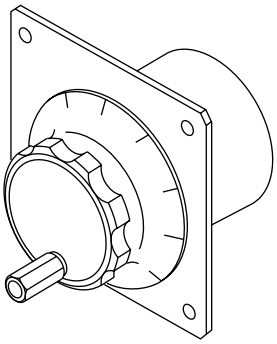
Axis Connection Terminal Board

Subassemblies	Weight (kg)
Axis connection terminal board	0.230
Axis interface connecting cable	



Multiplexer Module

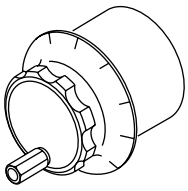
Subassemblies	Weight (kg)
Multiplexer module	1.580
Video cable and connector cap kit	



Handwheels

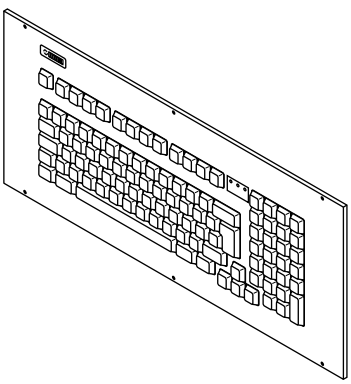
Handwheel Compatible with MP01 Machine Panel

Weight: 0.600 kg



Handwheel Compatible with MP02 Machine Panel

Weight: 0.250 kg

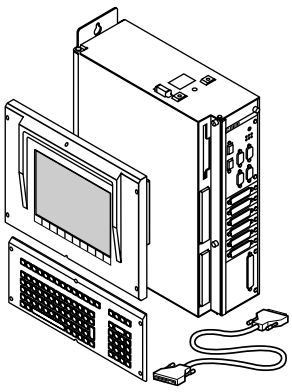


102-Key QWERTY Keyboard

This keyboard is available as an add-on option for the compact panel.

2.2 Typical NUM Power 1020/1040 Configuration

The basic configuration includes the following components:

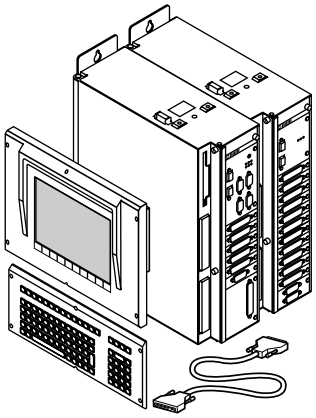


NUM Power 1020 or 1040 CPU
Panel* (QWERTY, 50-key, compact, LCD) + video cable
Machine panel (optional, cannot be used with compact panel)

* Only the compact panel can be used with the Power 1020 CNC.

2.3 Typical NUM Power 1060/1080 Configuration

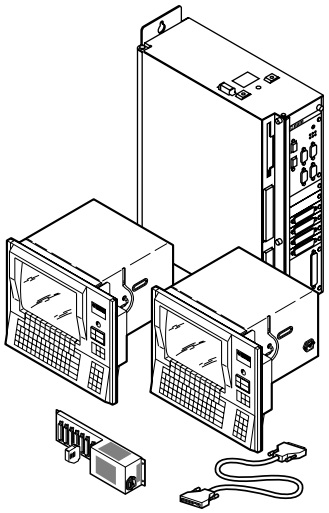
The basic configuration includes the following components:



NUM Power 1060 or 1080 CPU
Modax axis modules (number depending on configuration)
Panel (QWERTY, 50-key, compact, LCD) + video cable
Machine panel (optional, cannot be used with compact panel)

2.4 Multipanel Configuration (Power 1040/1060/1080)

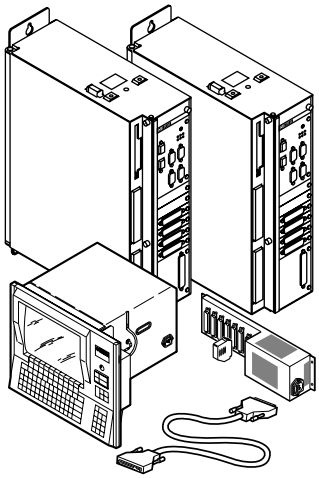
The multipanel configuration (one CNC/two to four panels) includes the following components:



Basic configuration (except compact panel and LCD panel)
Additional panels (QWERTY or 50-key)
Multiplexer modules + cables and caps

2.5 Multi-CNC Configuration (Power 1040/1060/1080)

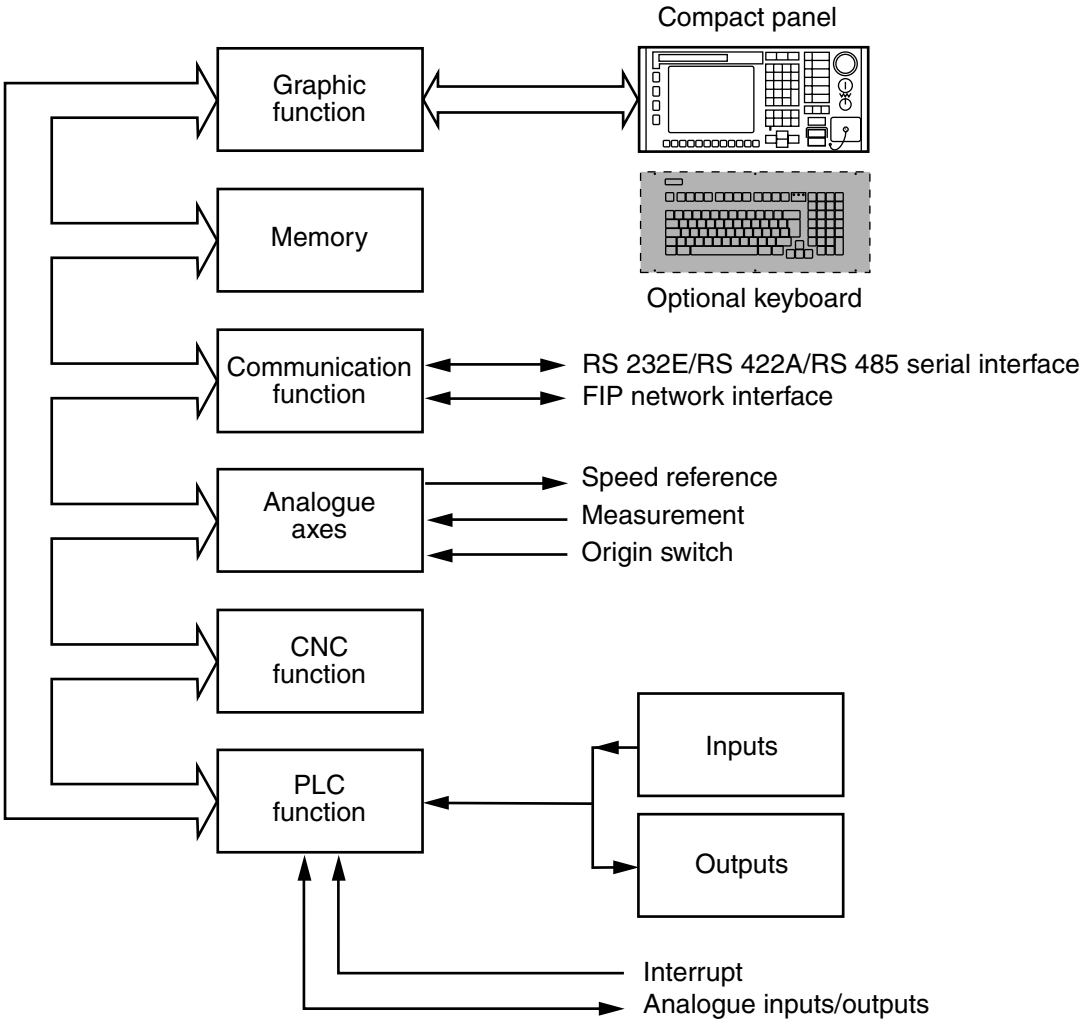
The multi-CNC configuration (one panel/two to four CNCs) includes the following components:



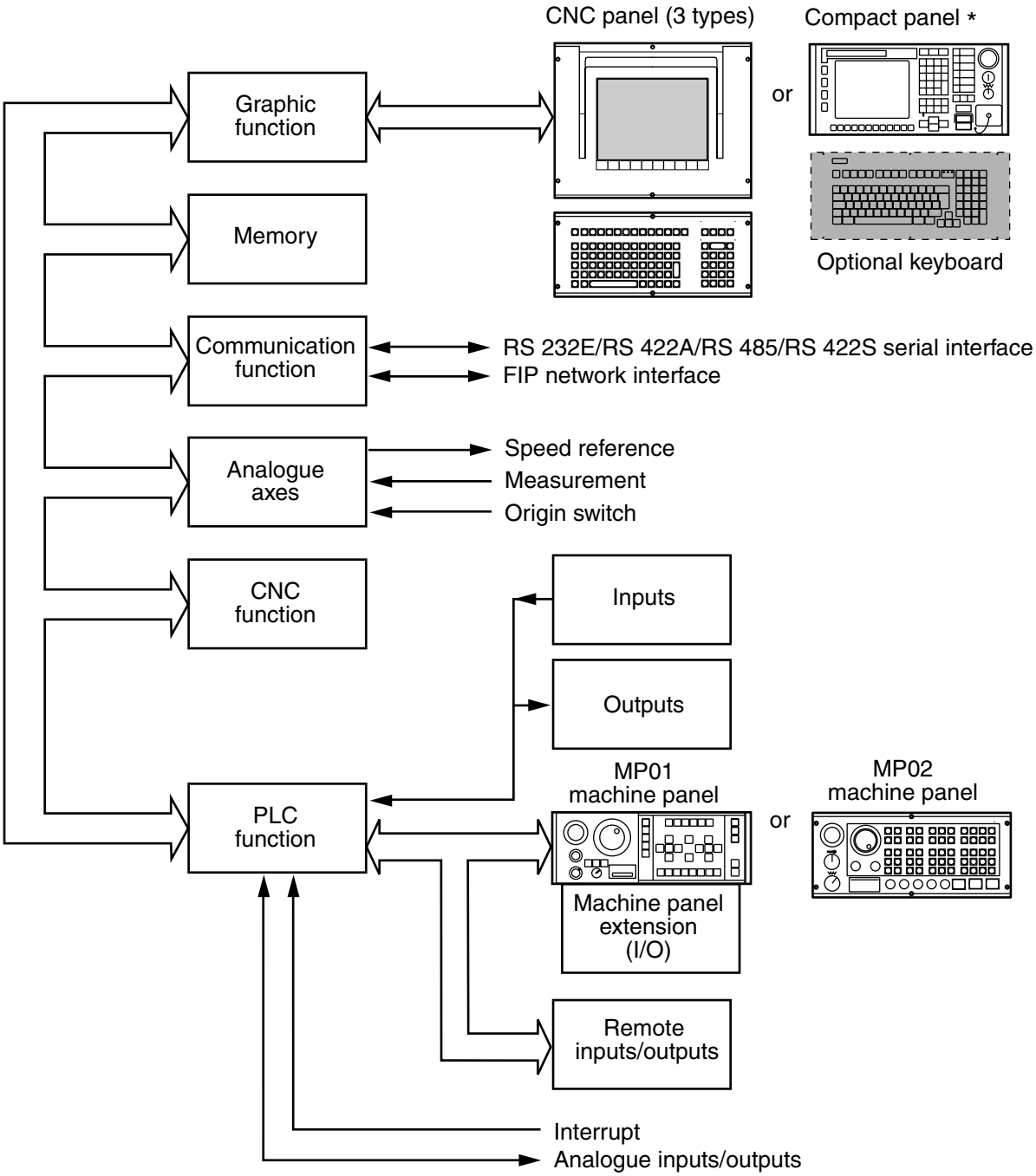
Basic configuration (except compact panel and LCD panel)
Additional CPUs
Multiplexer modules + cables and caps

2.6 System Architecture

2.6.1 NUM Power 1020 System with Compact Panel

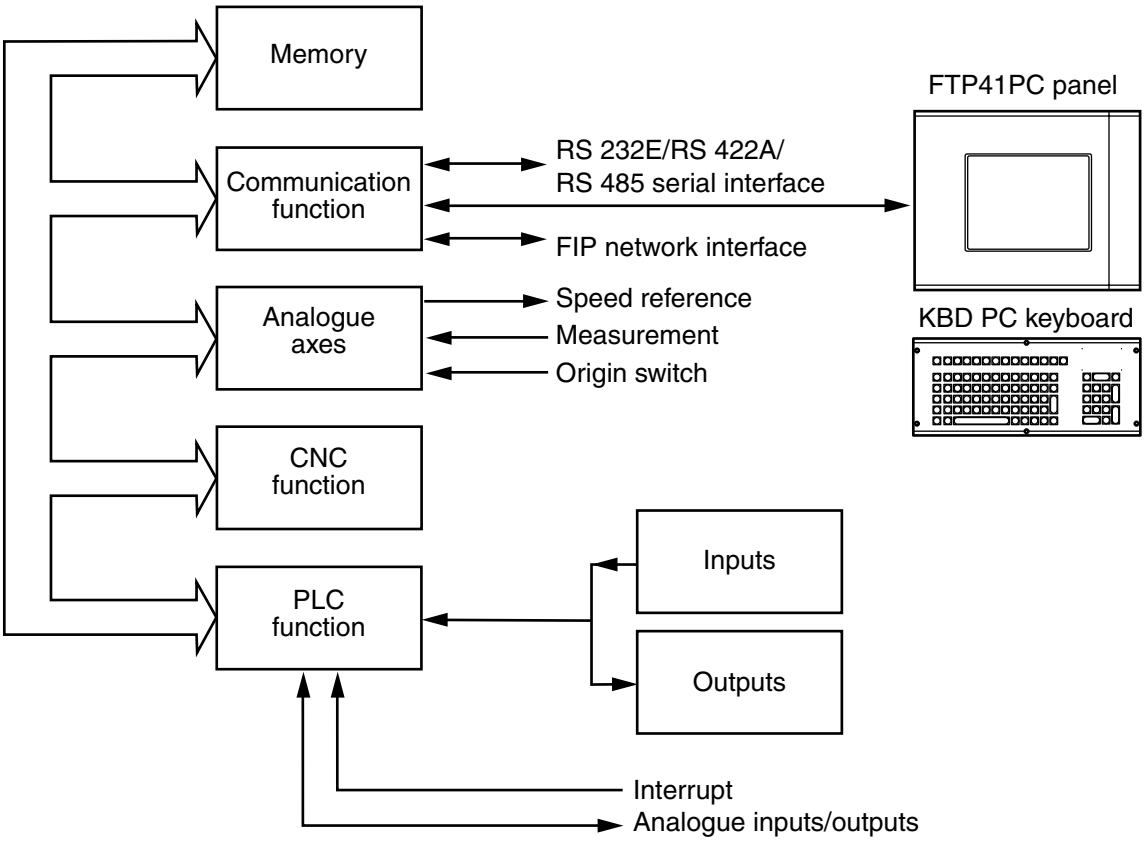


2.6.2 NUM Power 1040/1060/1080 System with CNC Panel or Compact Panel

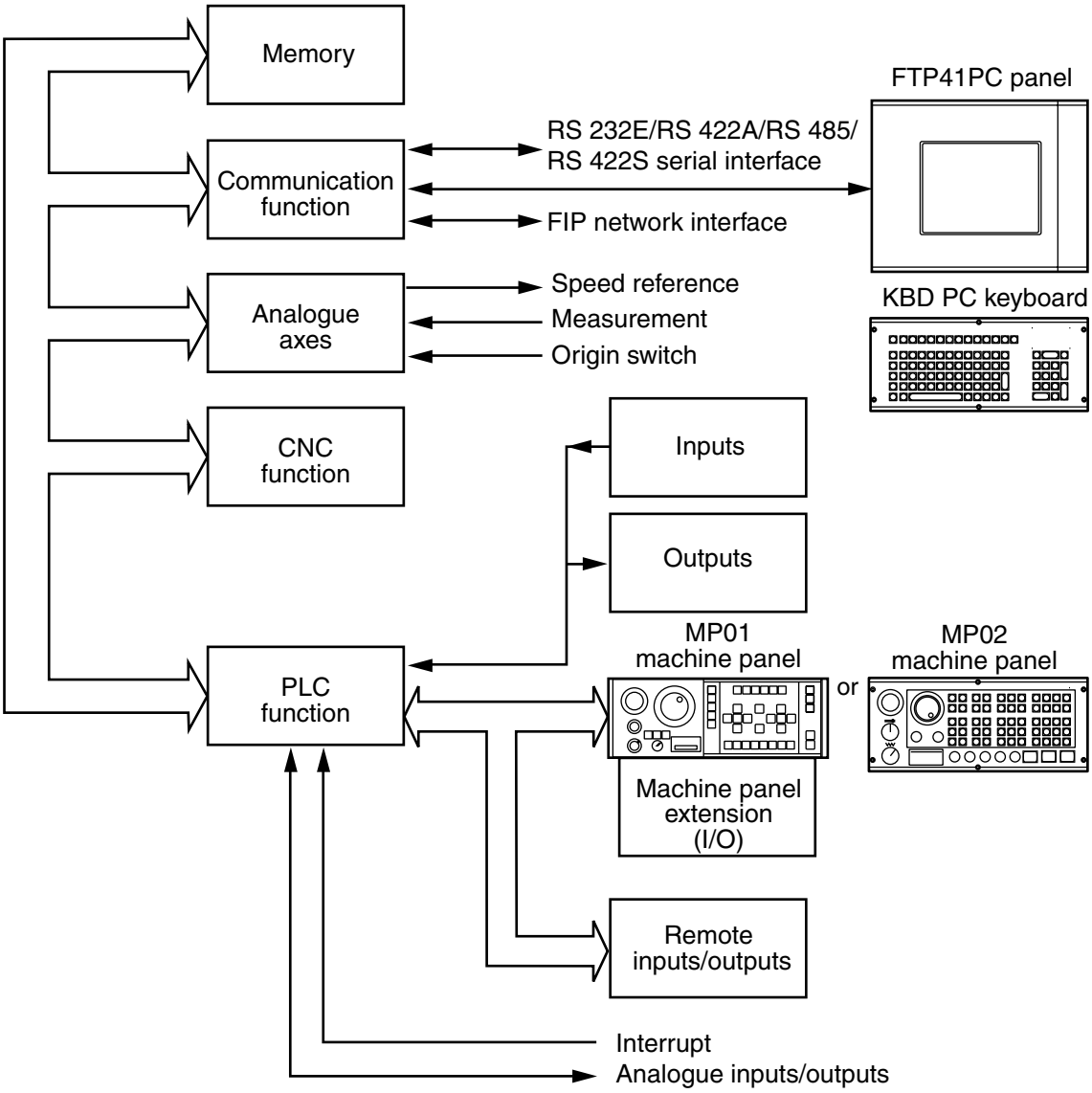


* The machine panel cannot be used with the compact panel.

2.6.3 NUM Power 1020 System with PC Panel



2.6.4 NUM Power 1040/1060/1080 System with PC Panel



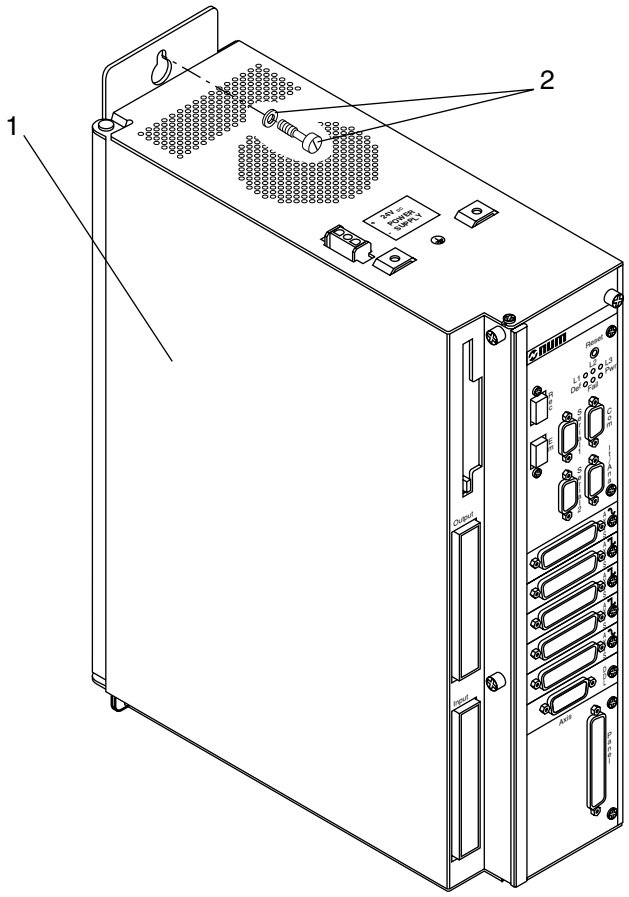
3 Overall Dimensions - Installation

3.1 NUM Power 1020/1040/1060/1080 CPU and Modax

CPU weight: 6 kg

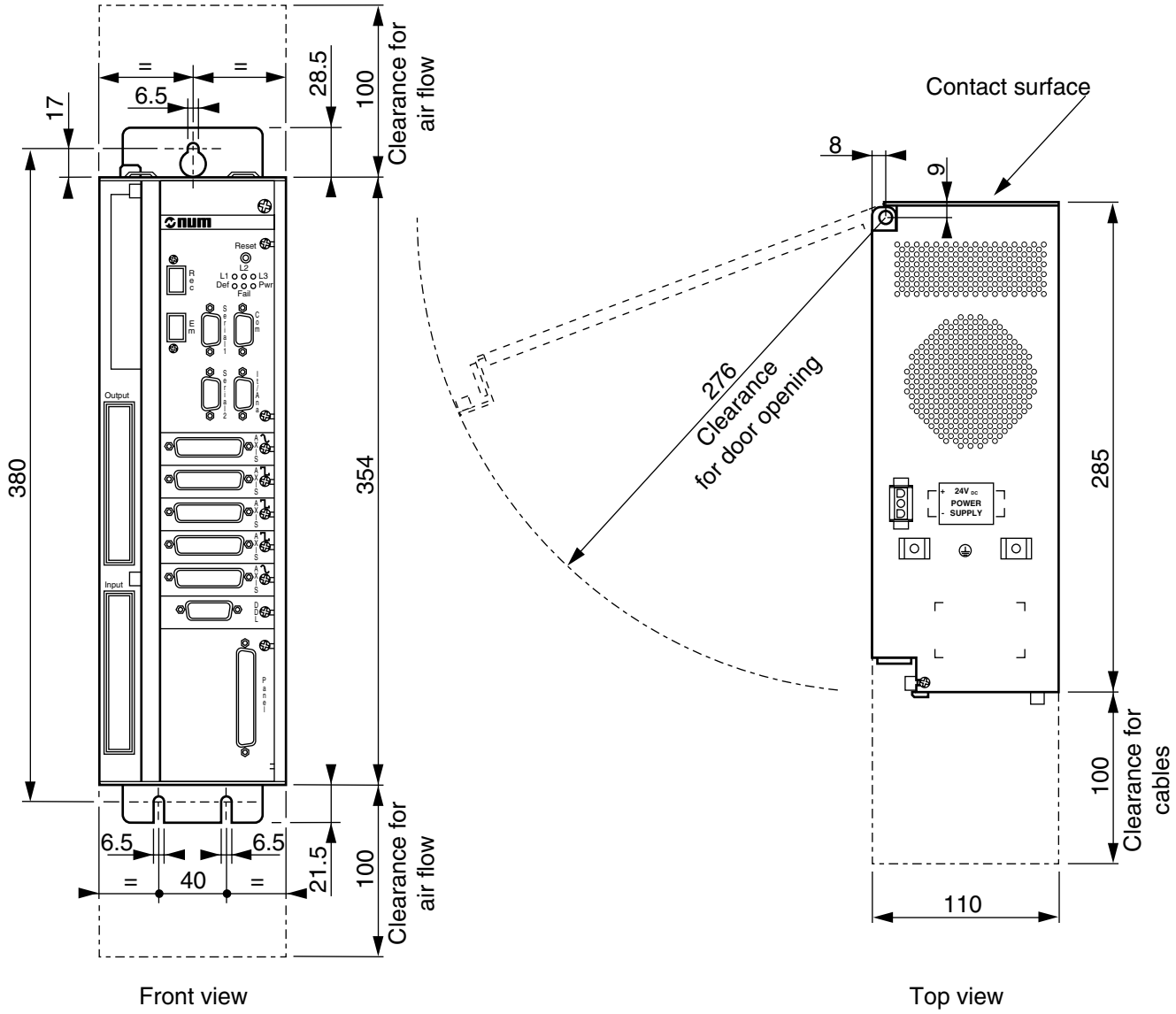
Modax weight: 6 kg

3.1.1 CPU and Modax Mounting Parts



1 - CPU or Modax
2 - Attaching screw and washer (3)

3.1.2 Overall Dimensions and Attachments of the CPU and one Modax



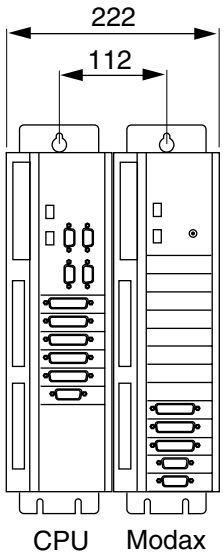
REMARK *It is not necessary to open the door except to add axis cards, modify the memory, replace the input/output fuses or adjust the transmit power of the fibre-optic line.*

CAUTION

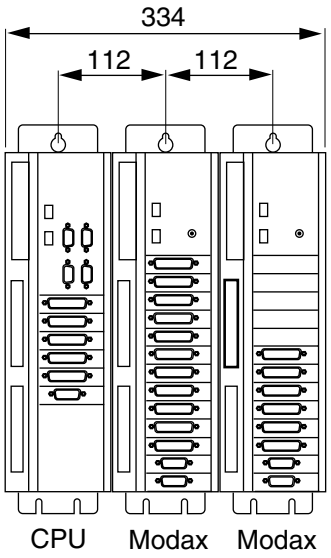
For correct ventilation, the CPU and the Modaxes must be installed vertically.

3.1.3 Overall Dimensions of the CPU and Modaxes for NUM Power 1060/1080 Systems

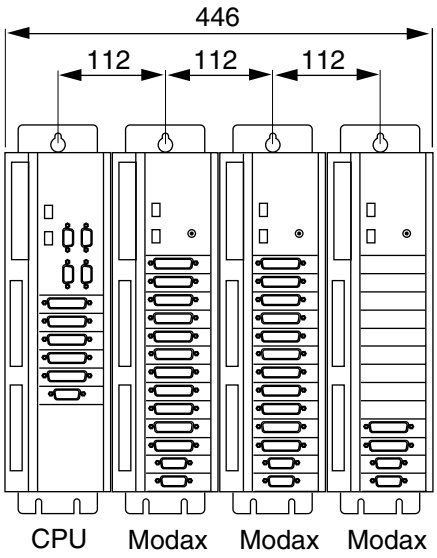
Overall dimensions for 1, 2 or 3 Modaxes added to the CPU.



Power 1060
or 1080



Power 1080

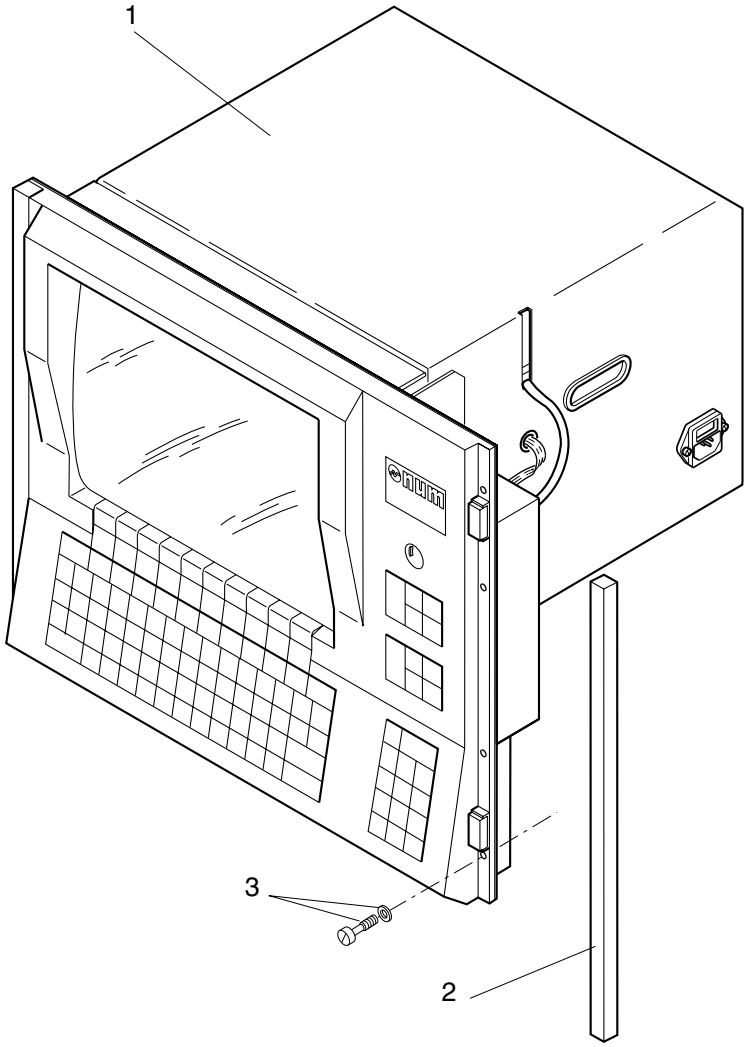


Power 1080

3.2 14" Colour QWERTY Panels (CP30)

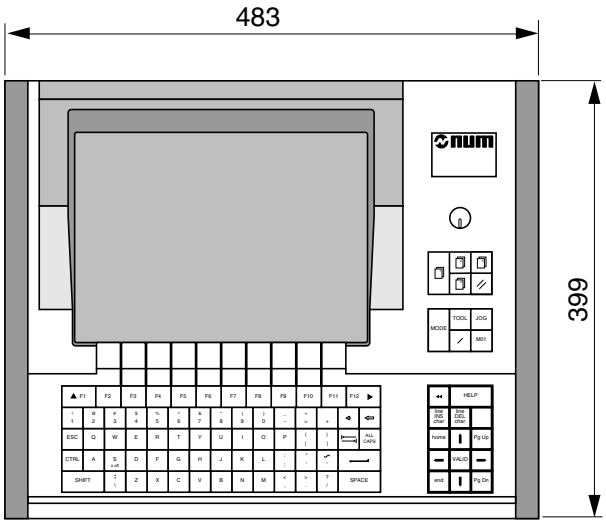
Weight: 16.5 kg.

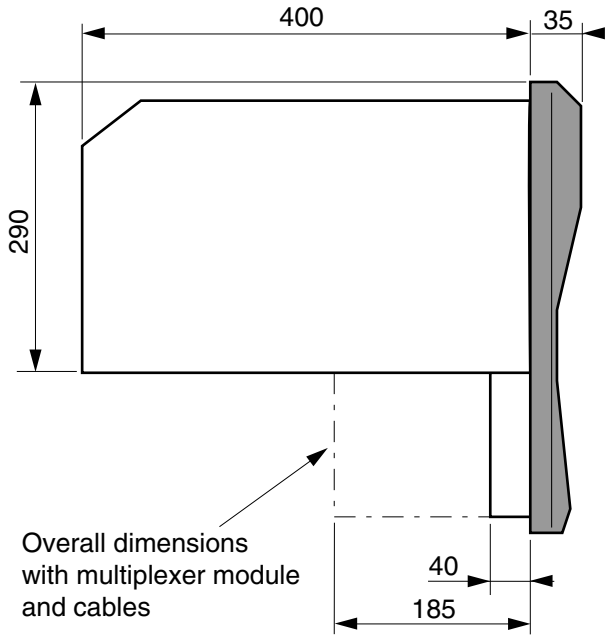
3.2.1 Panel Mounting Parts

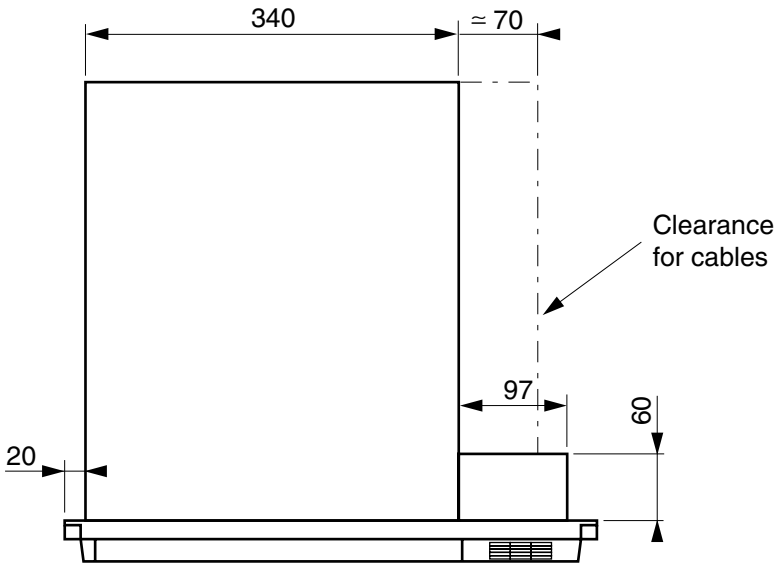


1 - Panel
2 - Edge trim
3 - Panel attaching screw and washer (8)

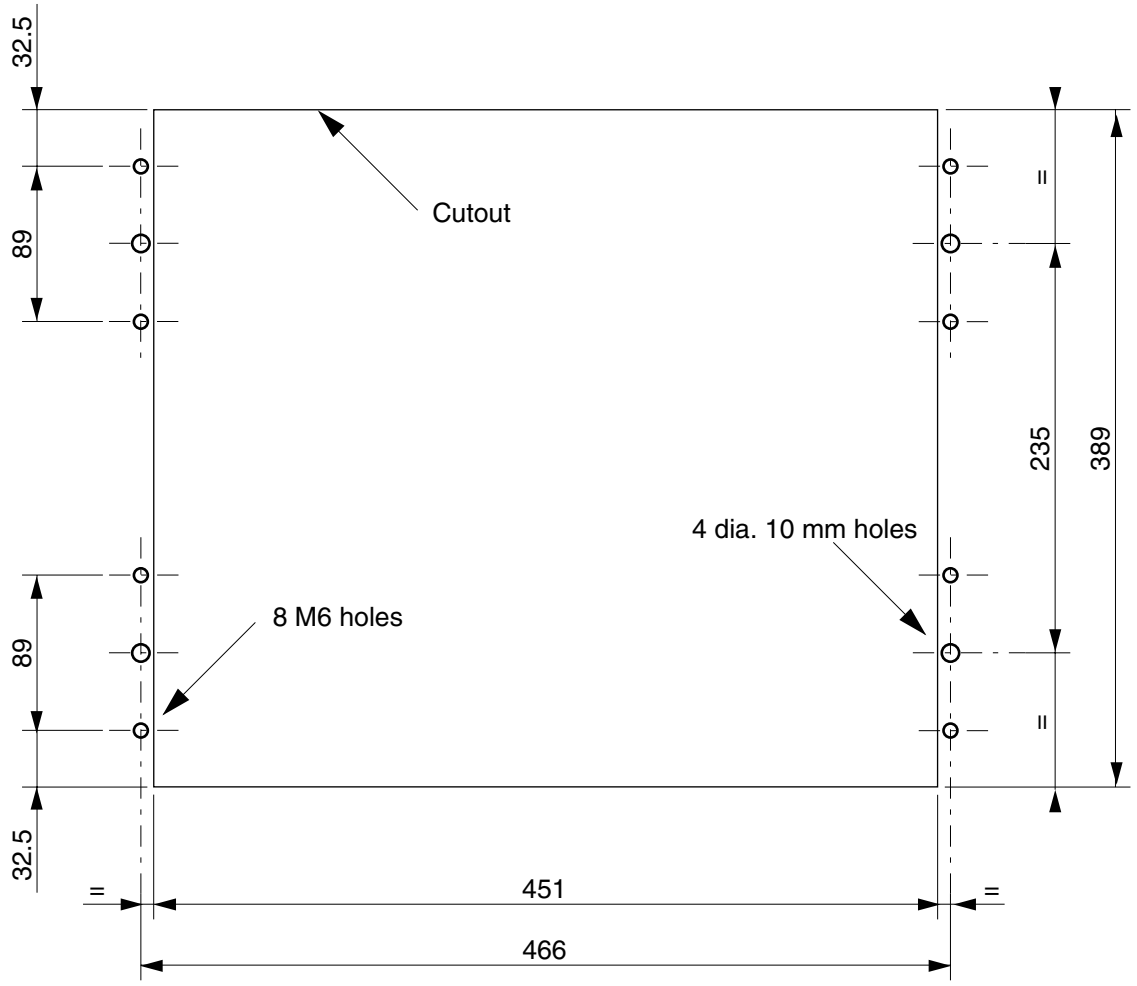
3.2.2 Overall Dimensions of the Panel







3.2.3 Cutouts for Panel Mounting



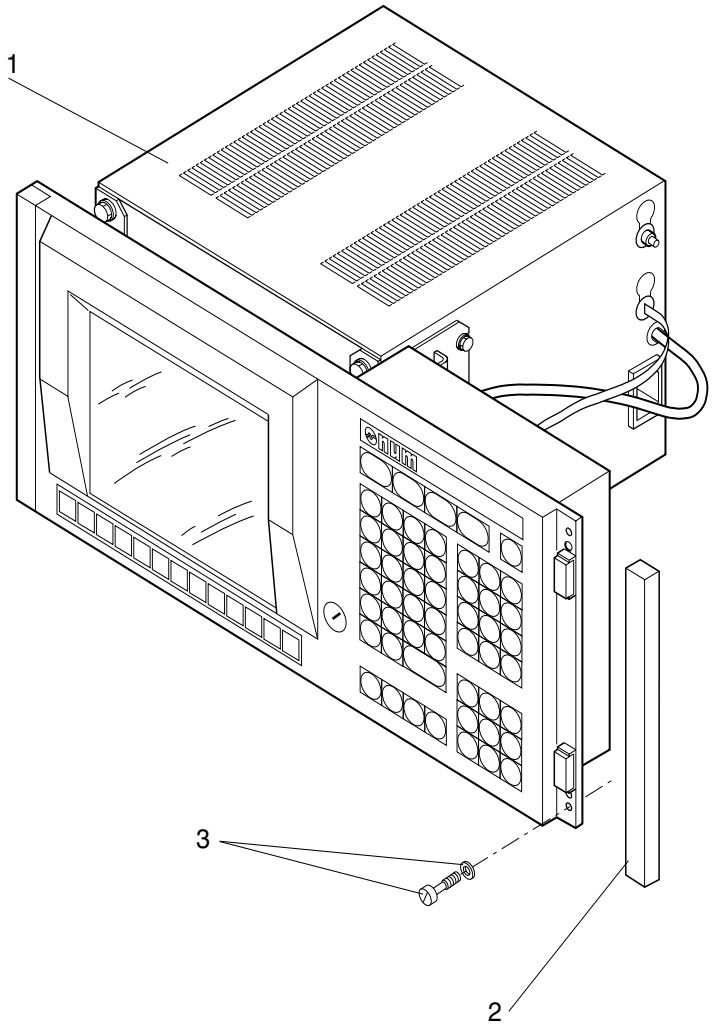
CAUTION

It is recommended to make sure that the enclosure supporting the panel provides IP65 insulation protection.

3.3 9” Monochrome (MP20) and 10” Colour (CP20) 50-Key Panels

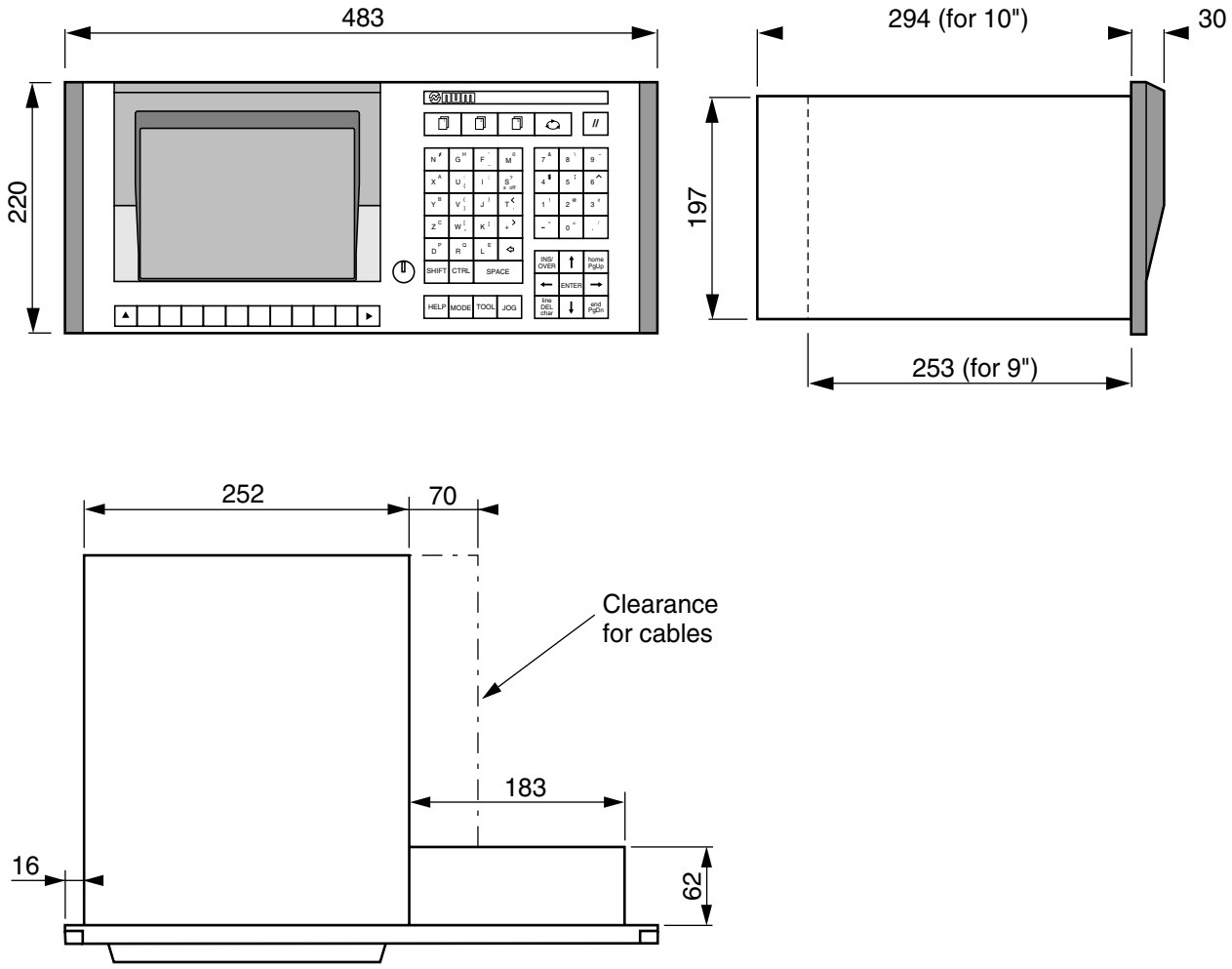
Weight: 10.7 kg.

3.3.1 Panel Mounting Parts

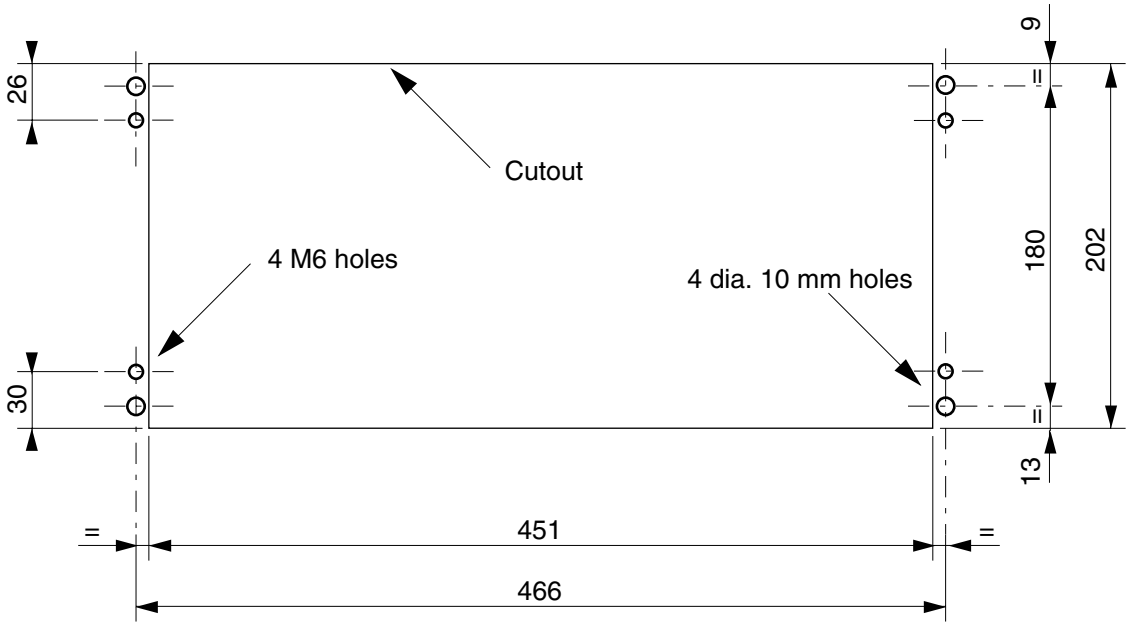


1 - Panel
2 - Edge trim
3 - Panel attaching screw and washer (4)

3.3.2 Overall Dimensions of the Panels



3.3.3 Cutouts for Panel Mounting



REMARK *The cutout dimensions are the same as for the compact panel. Only the attachment holes differ between the two types of panels.*

CAUTION

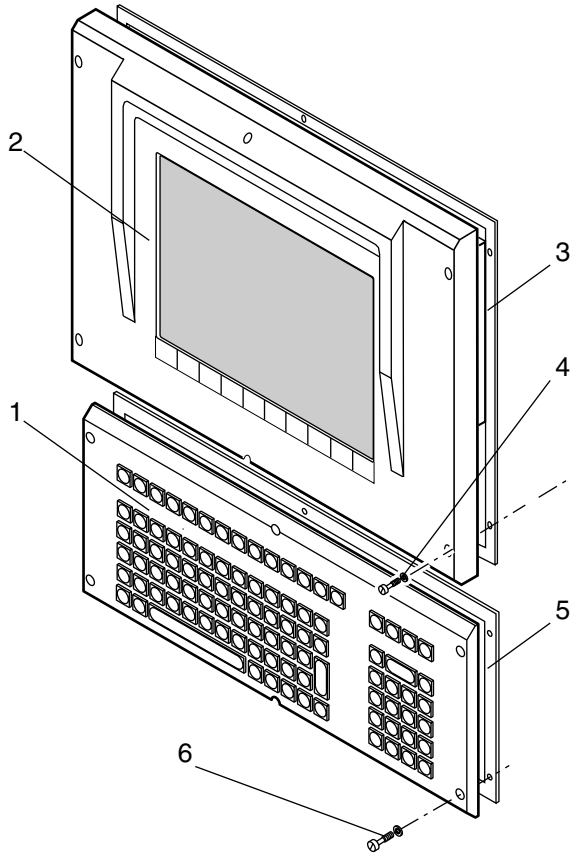
It is recommended to make sure that the enclosure supporting the panel provides IP65 insulation protection.

3.4 LCD Panel - Monitor (FS20) and Keyboard (KBD30)

Monitor weight: 4.2 kg

Keyboard weight: 1.7 kg

3.4.1 Panel Mounting Parts



1 - Keyboard KBD30
2 - Monitor FS20
3 - Monitor seal
4 - Monitor attaching screws and washers (6)
5 - Keyboard seal
6 - Keyboard attaching screws and washers (6)

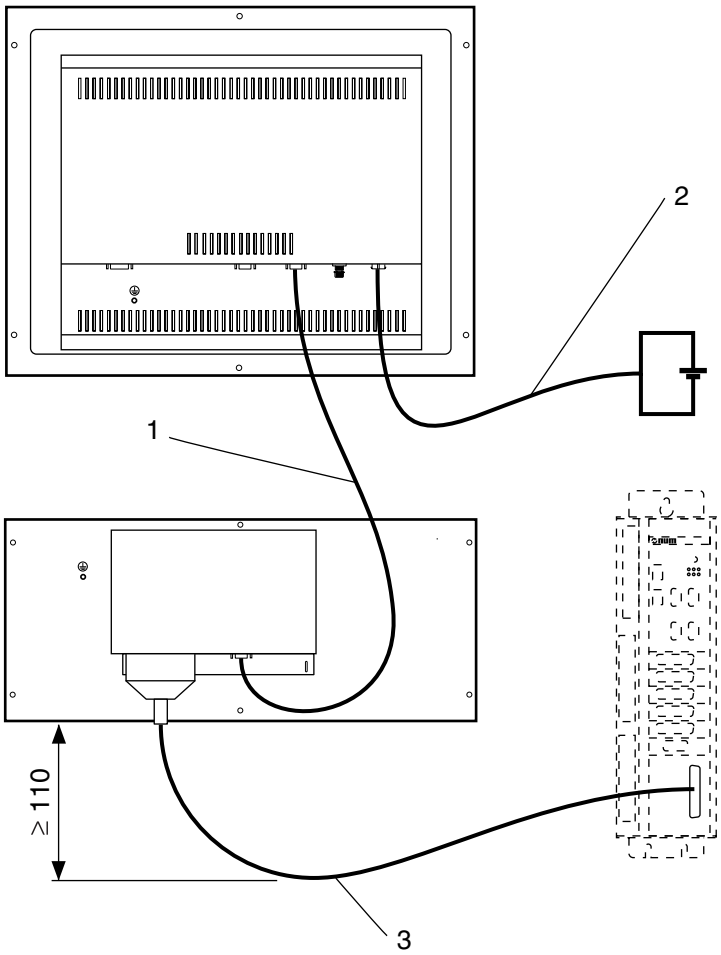
⚠ CAUTION

The liquid cristals contained in the LCD displays are a health hazard if spilled due to breakage of the display.
In case of contact with the eyes or mouth, rinse immediately with a large amount of water.
In case of contact with the skin or clothing, clean with alcohol then rinse with a large amount of water.

3.4.2 Panel Overall Dimensions

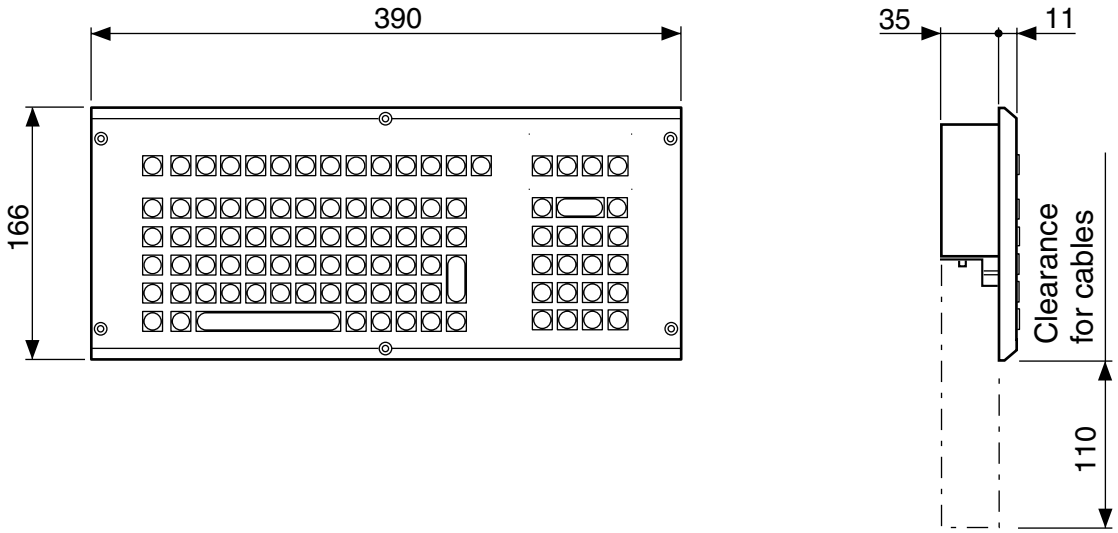
3.4.2.1 Keyboard/Monitor Assembly

The overall panel dimensions are determined from the keyboard/monitor assembly and the wiring constraints.

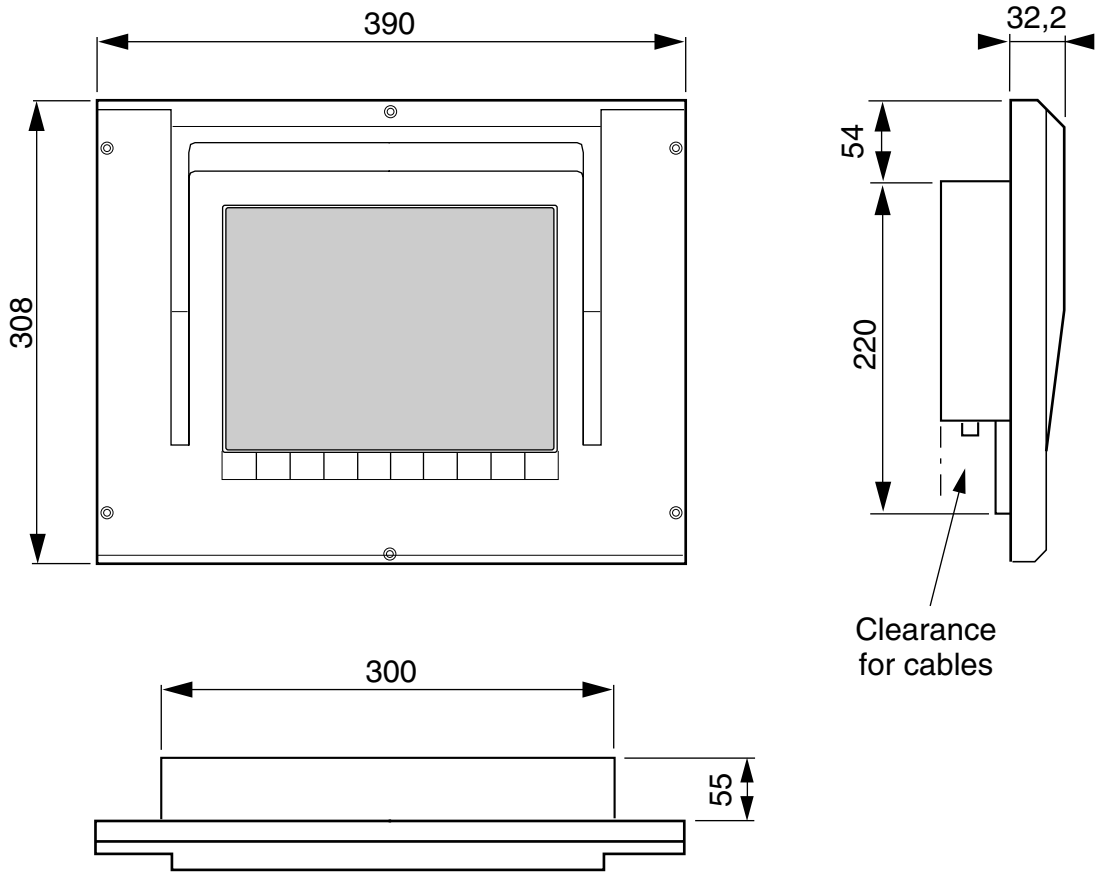


1 - Keyboard/monitor connecting cable: The cable is 2 m long, limiting the maximum distance between monitor and keyboard to around 1.5 m
2 - Power cable
3 - Video cable: Because of the minimum cable curve radius of 110 mm, a clearance of 110 mm must be provided under the keyboard.

3.4.2.2 Keyboard (KBD30)

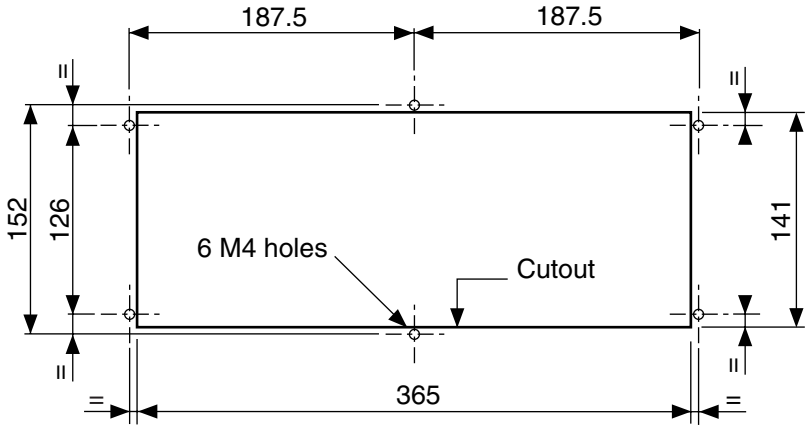


3.4.2.3 LCD Monitor (FS20)

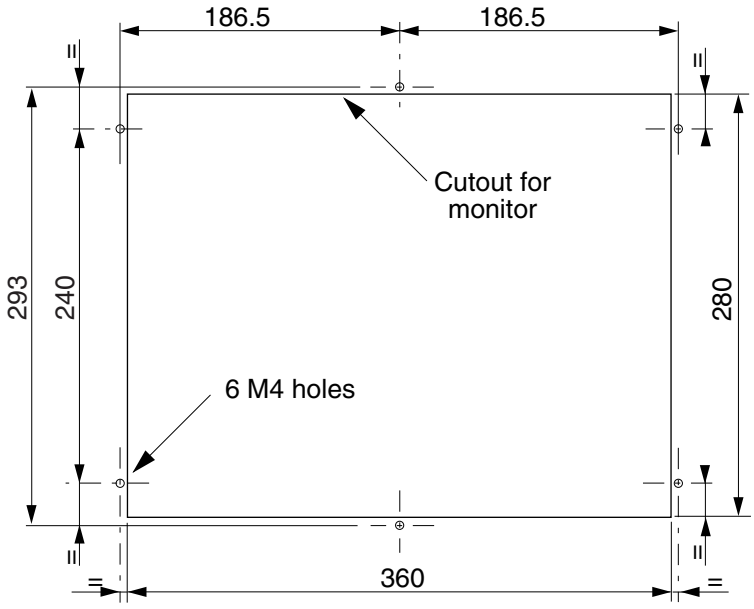


3.4.3 Cutouts for Panel Mounting

3.4.3.1 Keyboard (KBD30)



3.4.3.2 LCD Monitor (FS20)



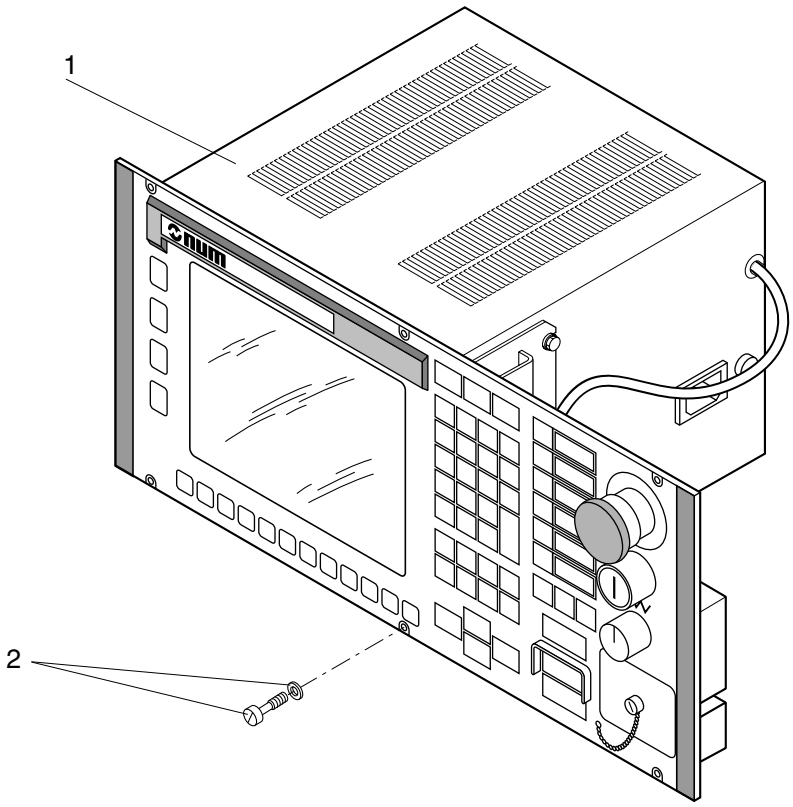
⚠ CAUTION

It is recommended to make sure that the enclosure supporting the keyboard and monitor provides IP65 insulation protection.

3.5 9” Monochrome (MP10) and 10” Colour (CP10) Compact Panel

Weight: 11 kg.

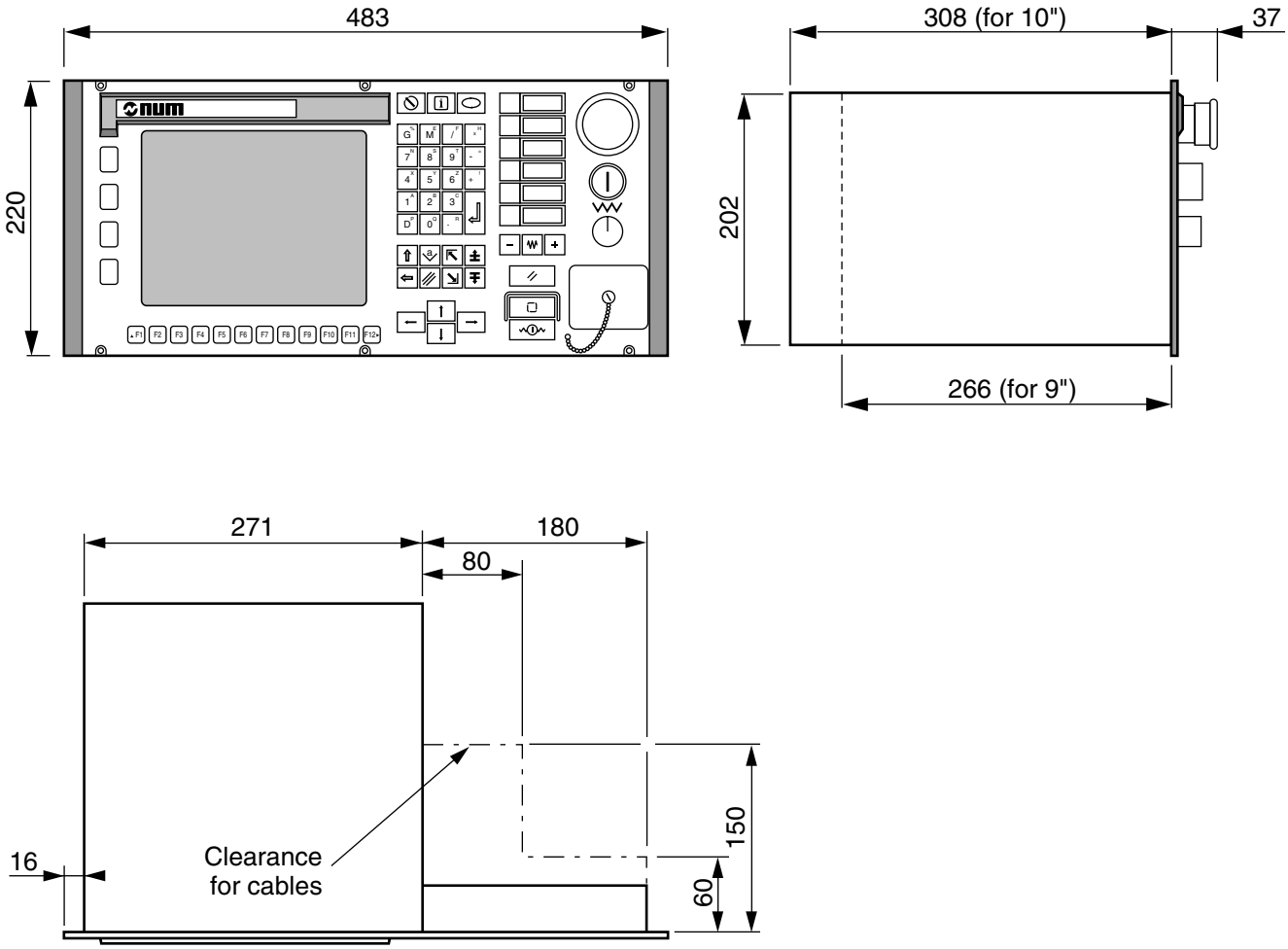
3.5.1 Panel Mounting Parts



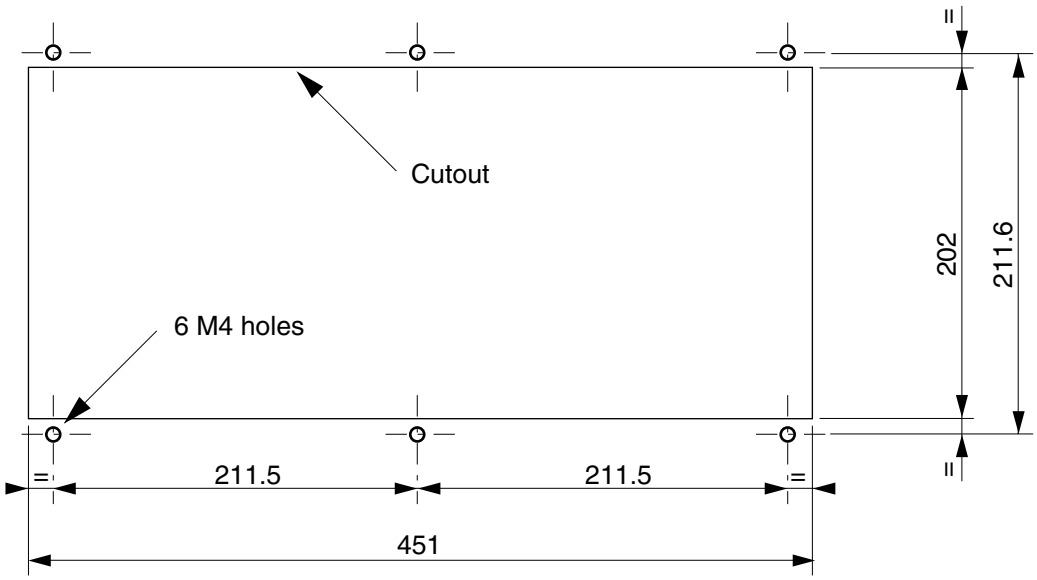
1 - Panel
2 - Panel attaching screw and washer (6)

> **CAUTION**
>
> The panel is not sealed unless the cover is installed over the front panel connectors.

3.5.2 Overall Dimensions of the Compact Panel



3.5.3 Cutouts for Compact Panel Mounting



REMARK *The cutout dimensions are the same as for the 50-key panels. Only the attachment holes differ between the two types of panels.*

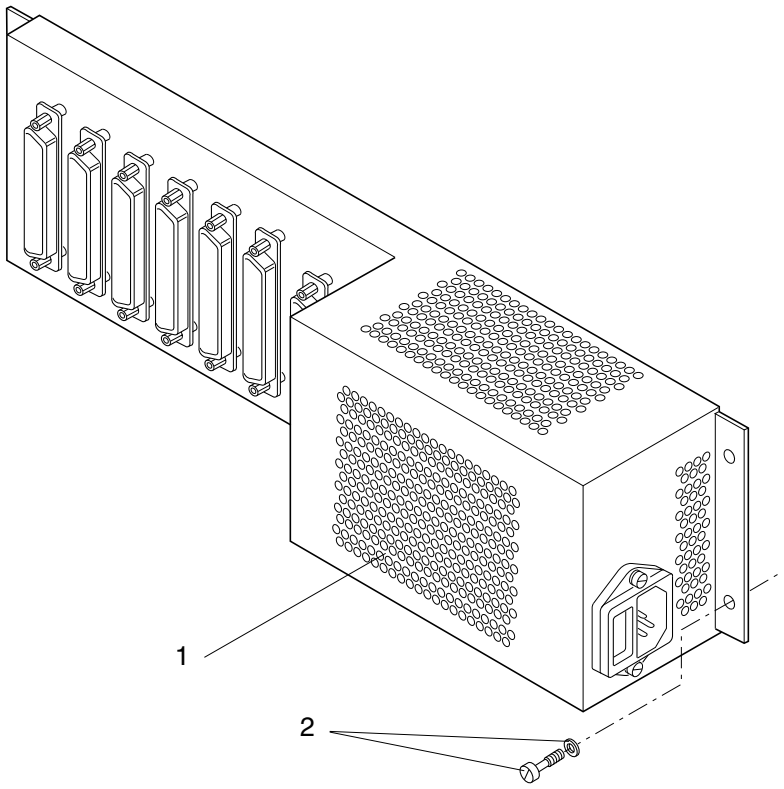
CAUTION

It is recommended to make sure that the enclosure supporting the panel provides IP65 insulation protection.

3.6 Multiplexer Module

Weight: 1.580 kg

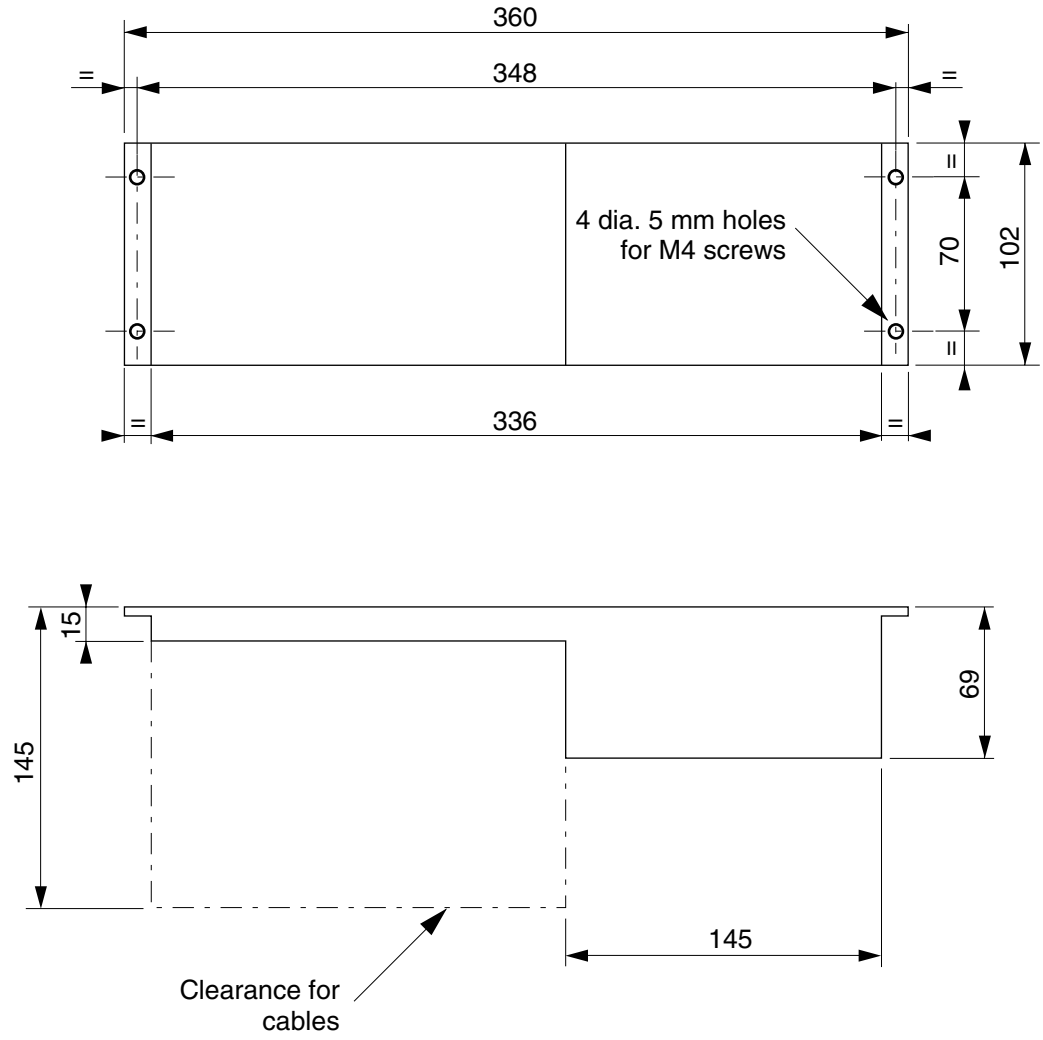
3.6.1 Multiplexer Panel Mounting Parts



1 - Multiplexer module
2 - Module attaching screws and washers (4)

REMARK *The multiplexer module must be kept away from the panels:*
- *In multi-CNC configuration, locate the multiplexer as far as possible from the panel (these two items are interconnected by a 50 cm cable),*
- *In multipanel configuration, locate the multiplexer modules at least 50 cm from each of the panels.*

3.6.2 Overall Dimensions and Mounting Dimensions of the Multiplexer Module

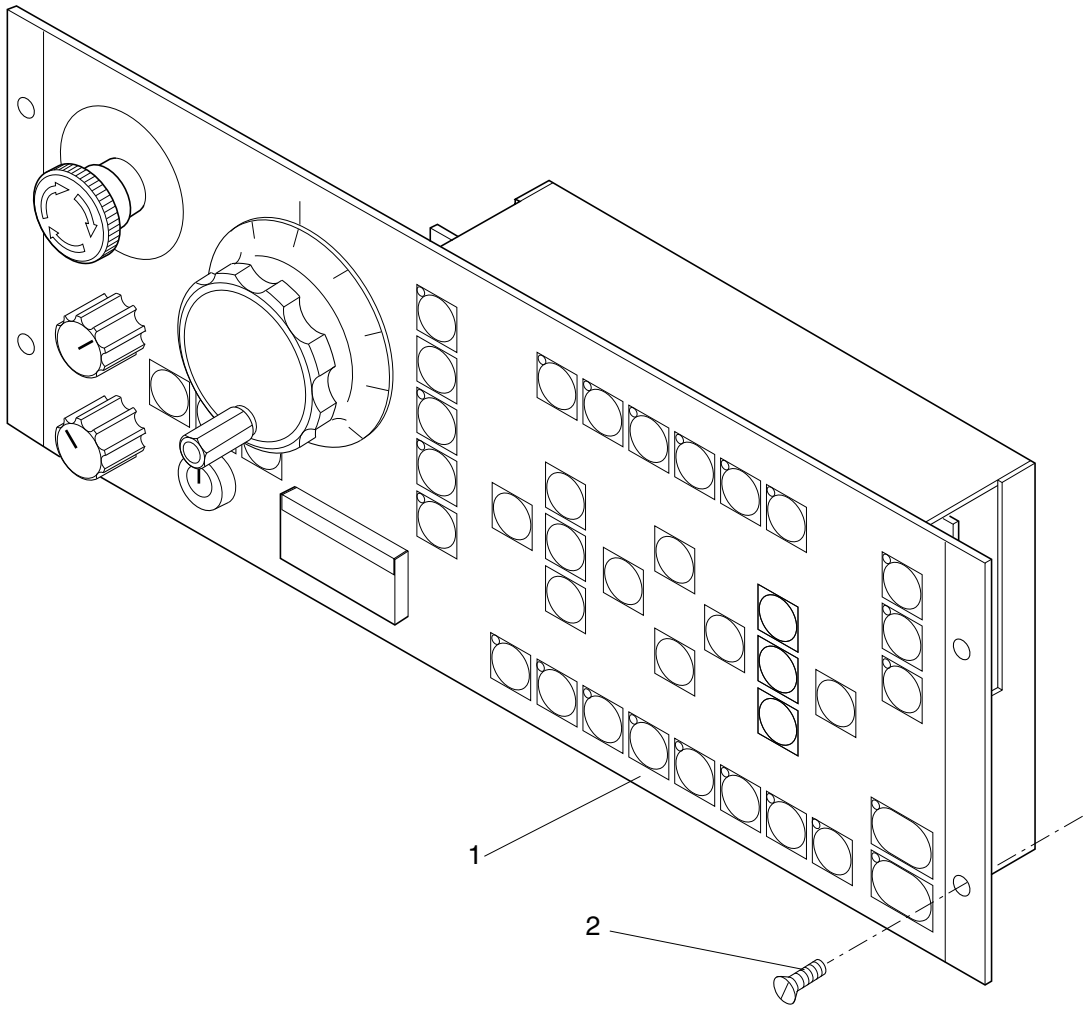


3.7 Machine Panels (MP01 and MP02)

3.7.1 MP01 Machine Panel

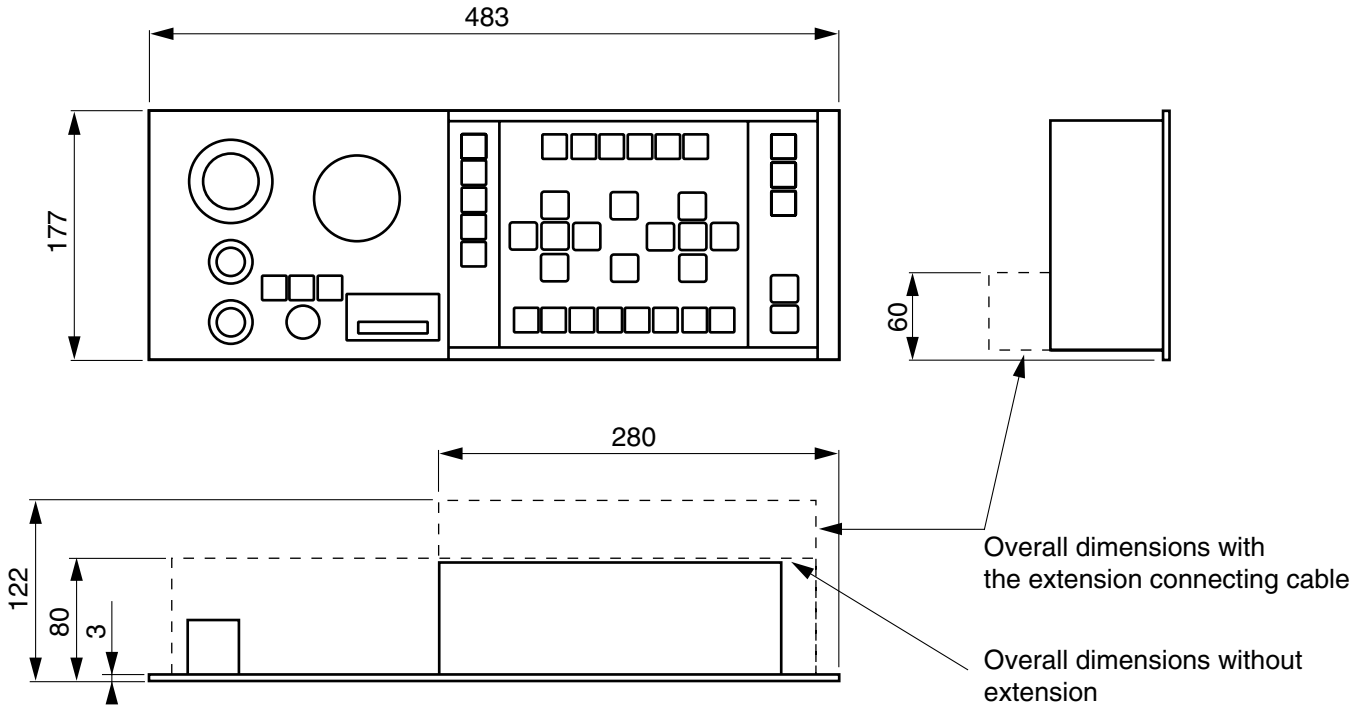
Weight: 2.200 kg unequipped (add 0.300 kg for the extension and 0.515 kg for the handwheel).

3.7.1.1 MP01 Machine Panel Mounting Parts

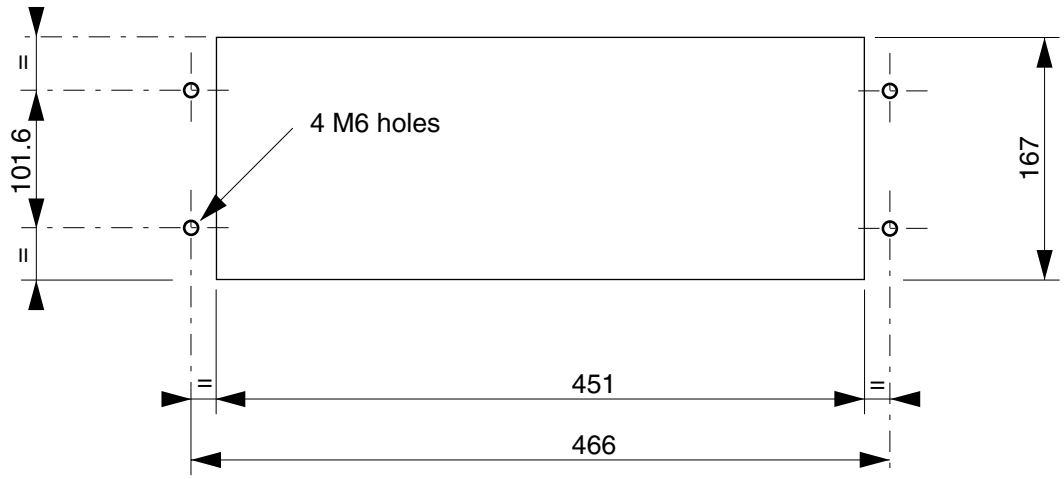


1 - Machine panel
2 - Machine panel attaching screw (4)

3.7.1.2 Overall Dimensions of MP01 Machine Panel



3.7.1.3 Cutouts for MP01 Machine Panel Mounting



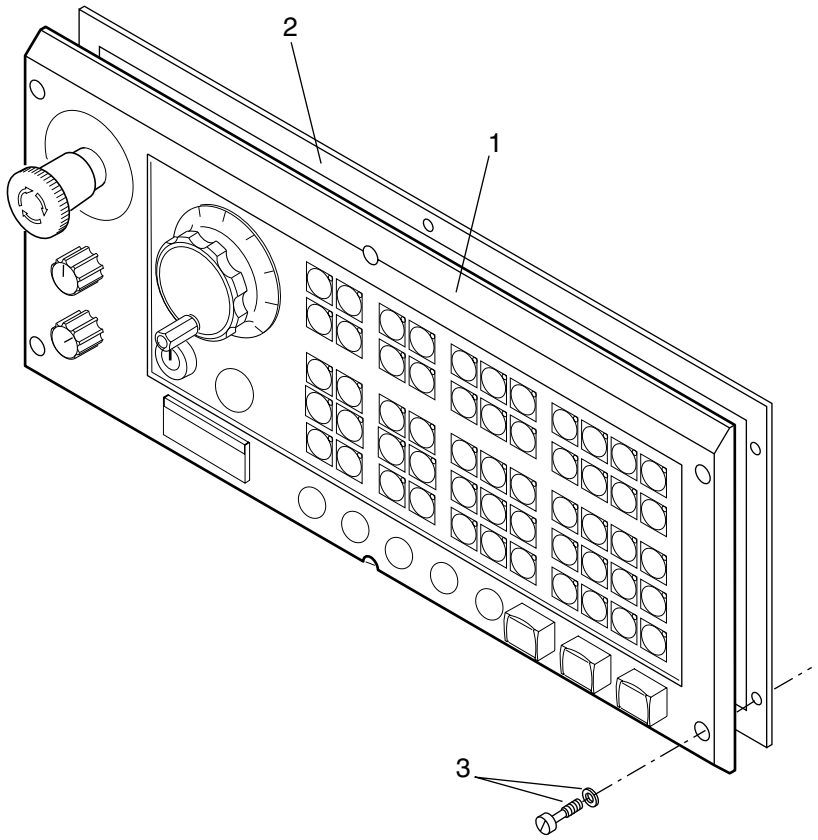
⚠ CAUTION

It is recommended to make sure that the enclosure supporting the panel provides IP65 insulation protection.

3.7.2 MP02 Machine Panel

Weight: 1.5 kg (depending on the configuration, add 0.250 kg for the handwheel)

3.7.2.1 MP02 Machine Panel Mounting Parts

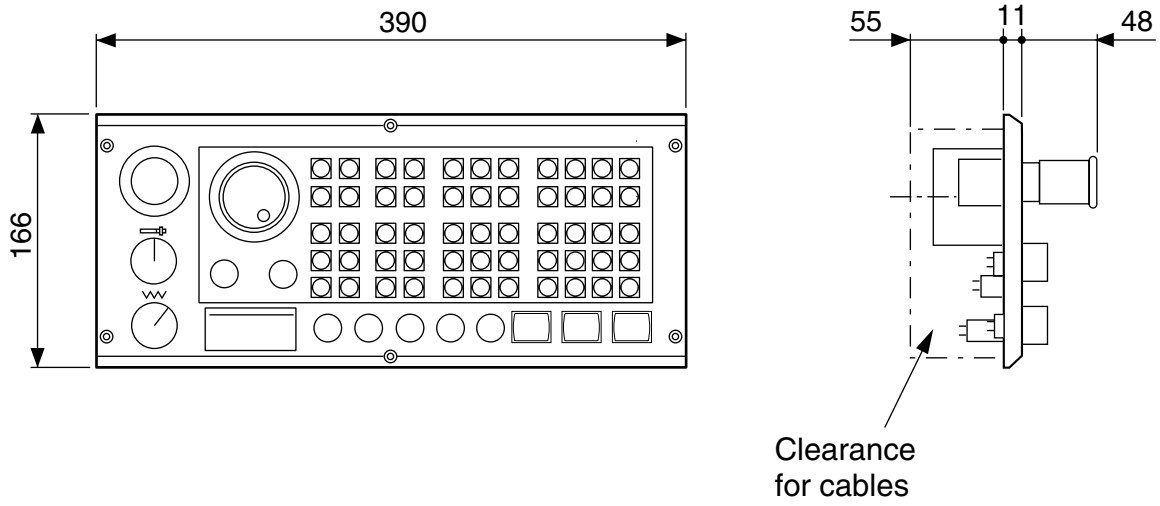


1 - Machine panel
2 - Seal
3 - Machine panel attaching screws and washers (6)

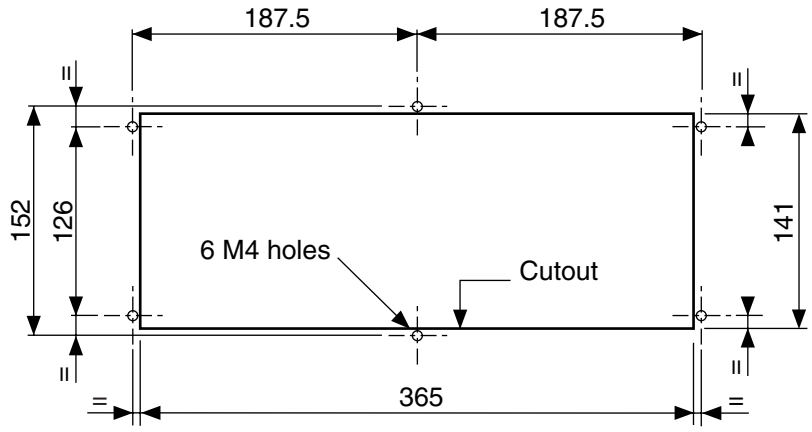
⚠ CAUTION

When installing the panel on its support, make sure the ribbon cable interfacing the keyboard and card and rewritable labels are not caught between the seal and panel support.

3.7.2.2 Overall Dimensions of MP02 Machine Panel



3.7.2.3 Cutouts for MP02 Machine Panel Mounting



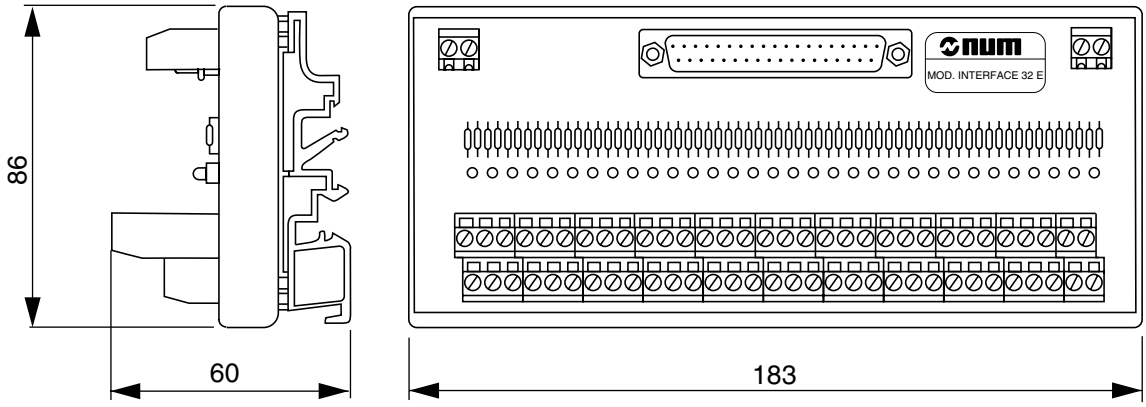
⚠ CAUTION

It is recommended to make sure that the enclosure supporting the panel provides IP65 insulation protection.

3.8 Additional Components

3.8.1 Mounting of the 32-Input Interface Panel

Weight: 0.300 kg.

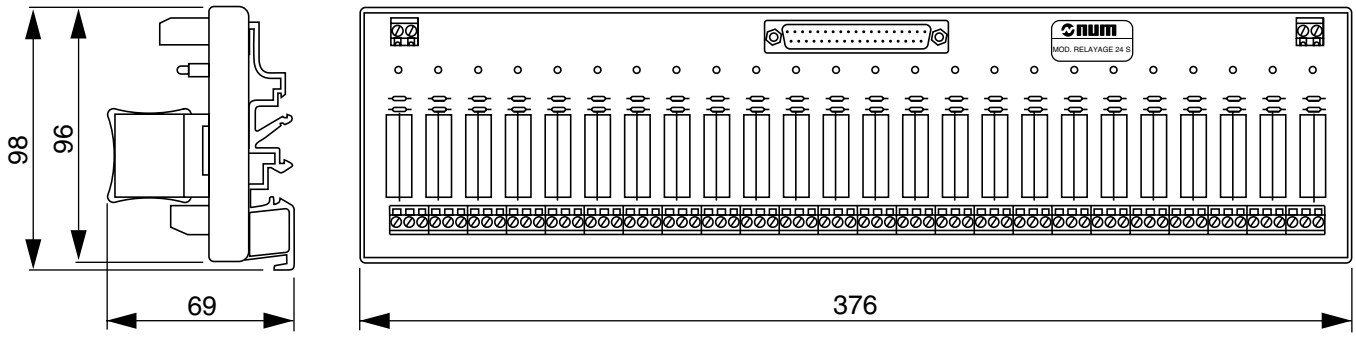


Mounted by snapping to extrusions complying with standards EN 50022 (or NF C 63-015) and EN 50035 (or NF C 63-018).

REMARK *Tighten the cable attaching screws in the terminals to a maximum torque of 0.4 Nm (IEC 947.1).*

3.8.2 Mounting of the 24-Output Relay Panel

Weight: 1.050 kg.

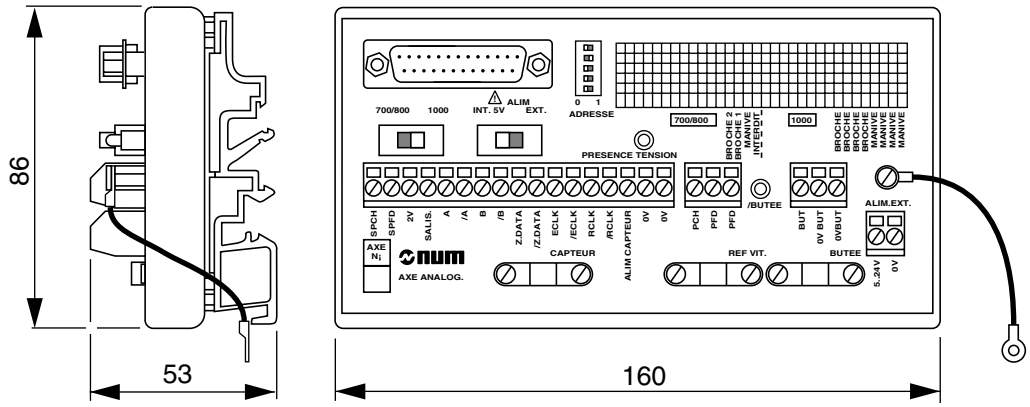


Mounted by snapping to extrusions complying with standards EN 50022 (or NF C 63-015) and EN 50035 (or NF C 63-018).

REMARK *Tighten the cable attaching screws in the terminals to a maximum torque of 0.4 Nm (IEC 947.1).*

3.8.3 Mounting of the Axis Interface Panel

Weight: 0.230 kg.



Mounted by snapping to extrusions complying with standards EN 50022 (or NF C 63-015) and EN 50035 (or NF C 63-018).

REMARK *Tighten the cable attaching screws in the terminals to a maximum torque of 0.4 Nm (IEC 947.1).*

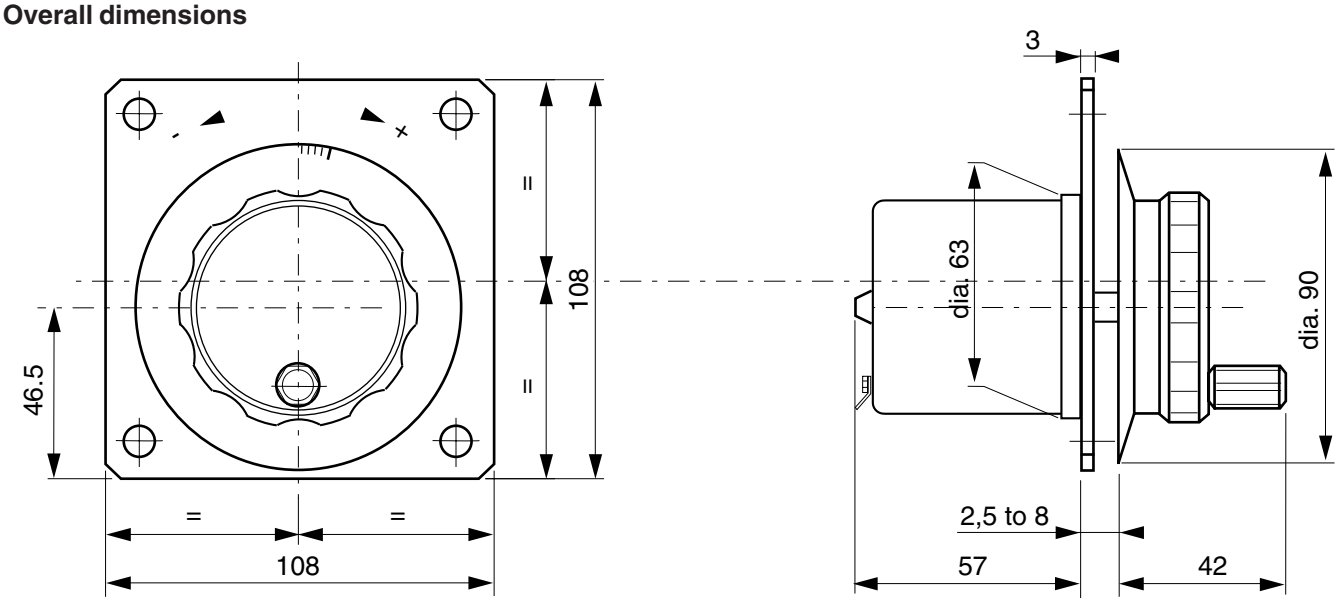
3.8.4 Remote Input/Output Modules

Refer to the remote input/output module manual.

3.8.5 Mounting of the Handwheel

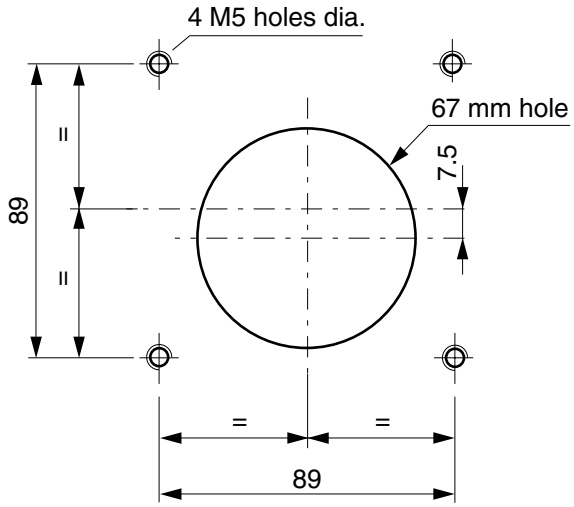
3.8.5.1 Handwheel Compatible with MP01 Machine Panel

Overall dimensions

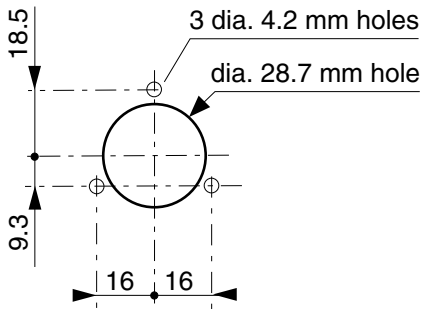


Cutouts

Handwheel attachment with plate

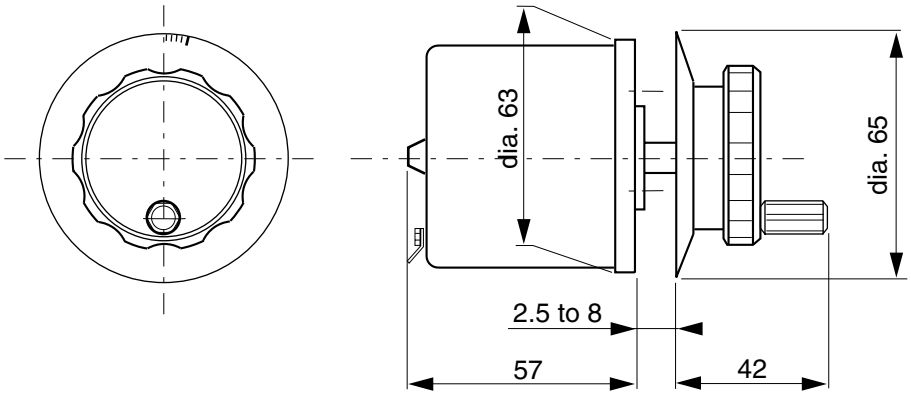


Handwheel attachment without plate

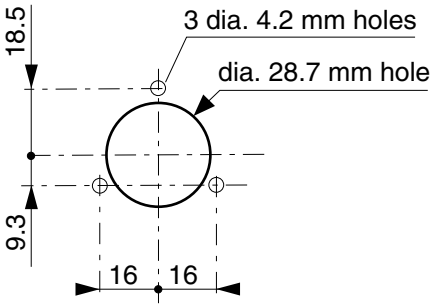


3.8.5.2 Handwheel Compatible with MP02 Machine Panel

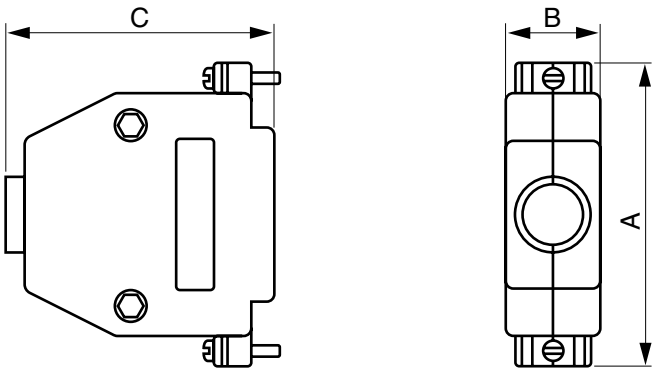
Overall dimensions



Cutout



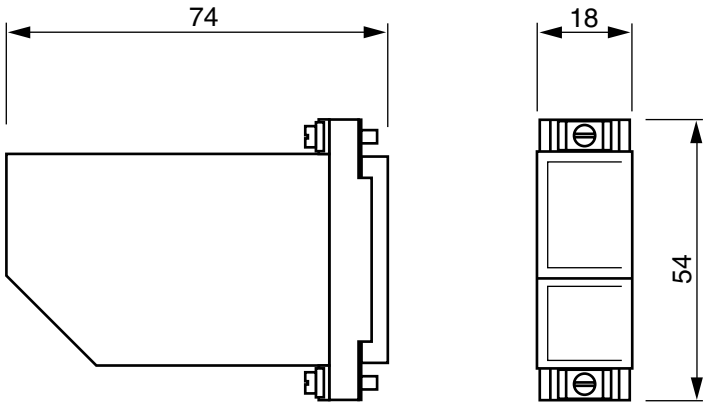
3.8.6 Overall Dimensions of the Sub.D Connector Covers (Cables)



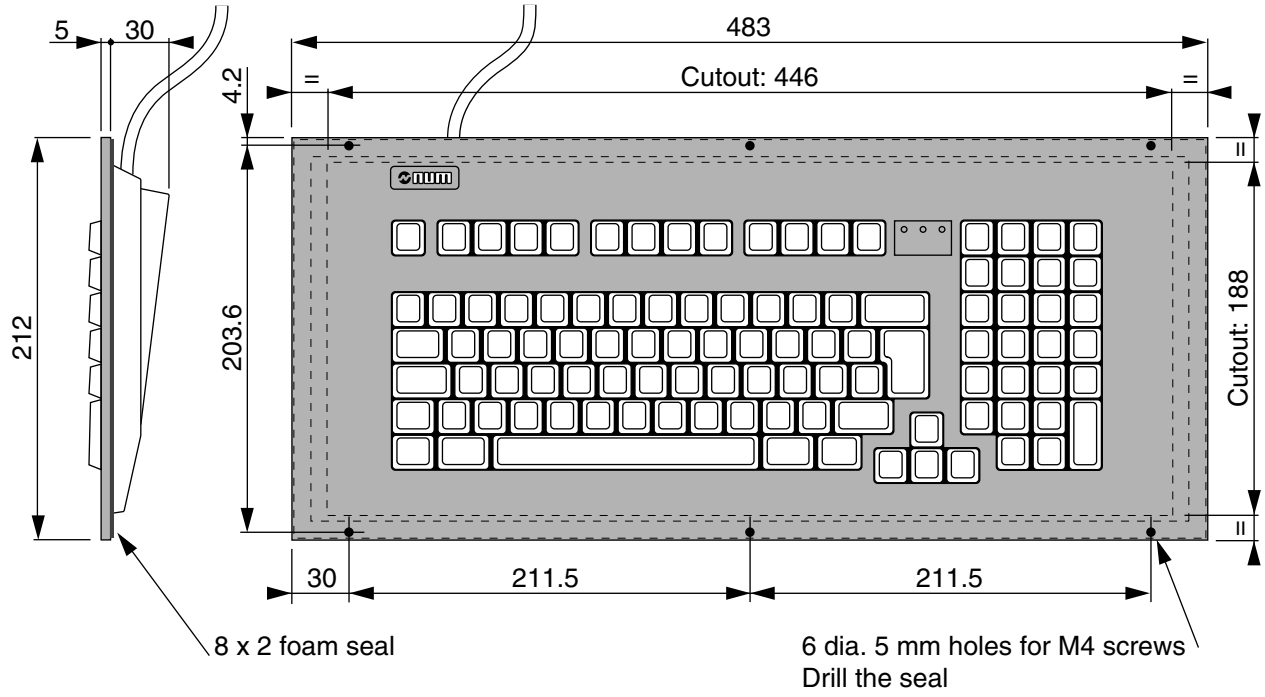
Number of contacts	A	B	C
9	31	16	41
15	53	16	38
25	53	16	45
37	70	24	51

REMARK *The dimensions given in the table are rounded off and correspond to the product line of a particular supplier. They could differ slightly for other suppliers.*

3.8.7 Overall Dimensions of the Axis Connector Covers



3.8.8 Mounting of the 102-Key QWERTY Keyboard



3.9 FTP41 PC Panel

Refer to the FTP 41 PC Panel Manual.

4 Component Preparation

4.1 Preparing the CPU and Modaxes

CPU

Operations that can be performed on the CPU:
- connecting or replacing the battery (see Sec. 4.1.1),
- adding axis cards (see Sec. 4.1.3),
- adding an SRAM memory module (see Sec. 4.1.4),
- adjusting the optical fibre transmit power (see Sec. 4.1.5),

The last three operations require opening the cover plate (see Sec. 4.1.2).

Modax

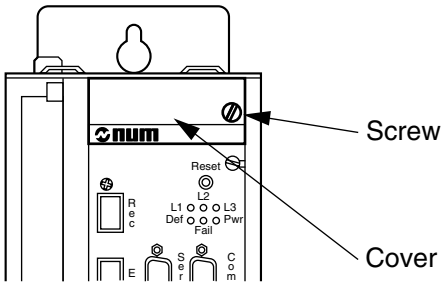
Operations that can be performed on a Modax:
- adding axis cards (see Sec. 4.1.3),
- adjusting the optical fibre transmit power (see Sec. 4.1.5),
- setting the Modax address (see Sec. 4.1.6).

The first two operations require opening the cover plate (see Sec. 4.1.2).

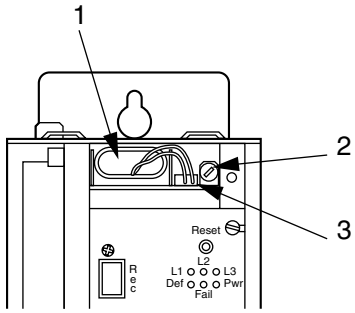
4.1.1 Connecting or Replacing the Battery

4.1.1.1 Opening the Fuse/Battery Cover

Remove the screw and take off the cover.



Location of the fuse and battery:



1 - Battery
2 - Fuse
3 - Battery connector

4.1.1.2 Connecting the Battery

Make sure battery (1) is connected (3).

If not:

Remove the battery from its housing, connect it, checking that the connector is in the right direction, and reinstall it in its housing.

4.1.1.3 Replacing the Battery

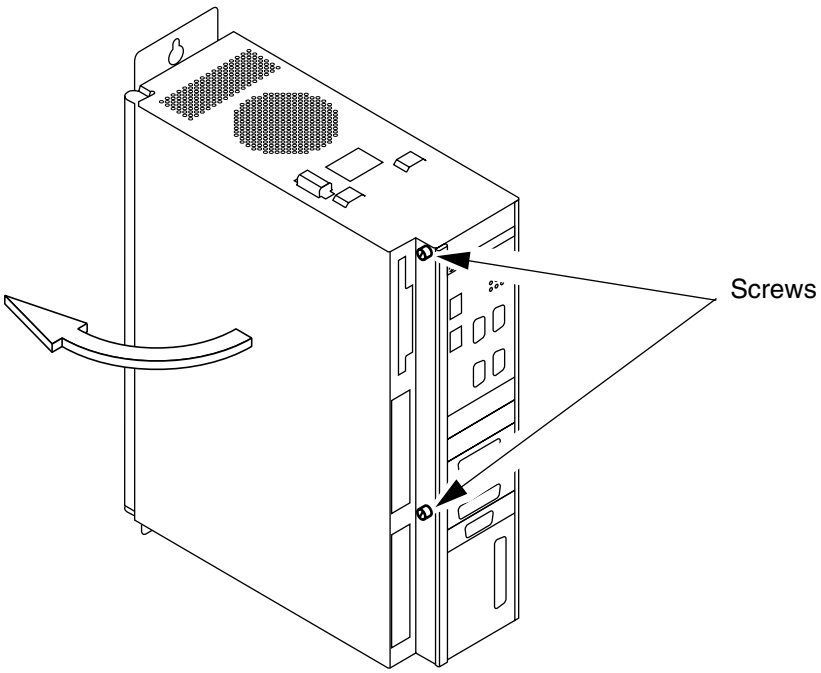
> **⚠ CAUTION**
>
> The battery must be replaced within 15 minutes or the data in the RAM may be lost. A special capacitor continues to supply the SRAM modules for that time.

Remove the battery from its housing and remove connector (3)

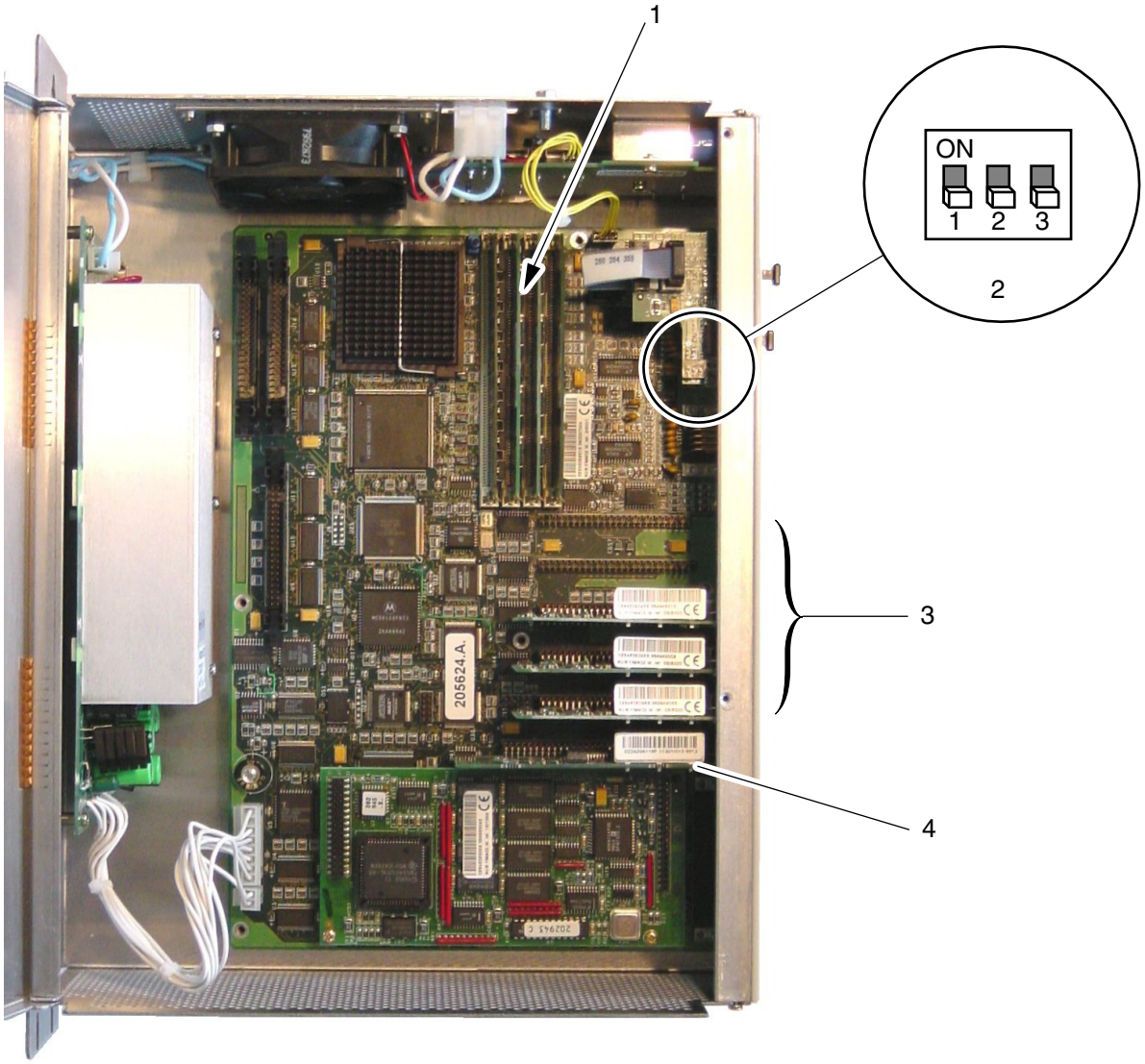
Connect the new battery, checking that the connector is in the right direction and place it in its housing.

4.1.2 Opening the Cover Plate

Remove the two screws and swing open the cover plate.

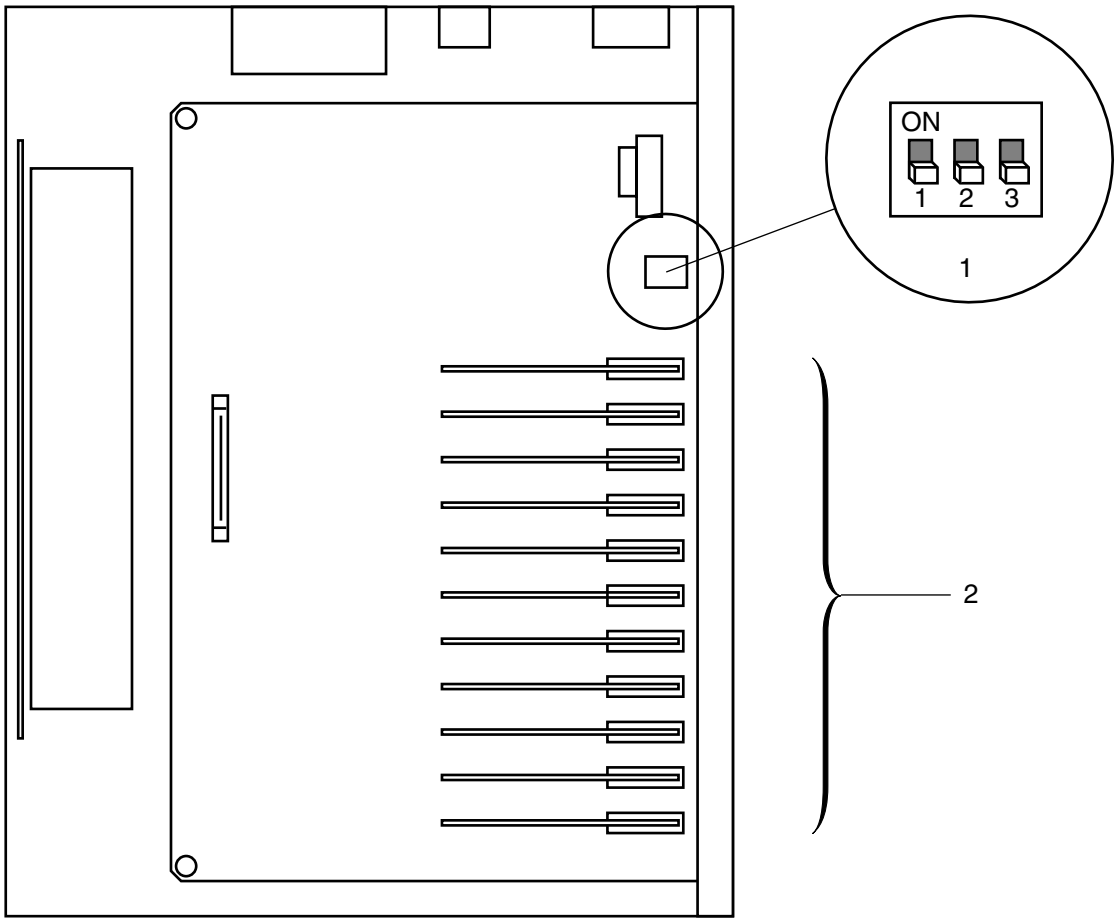


Location of the Items Concerned by Work Inside the CPU



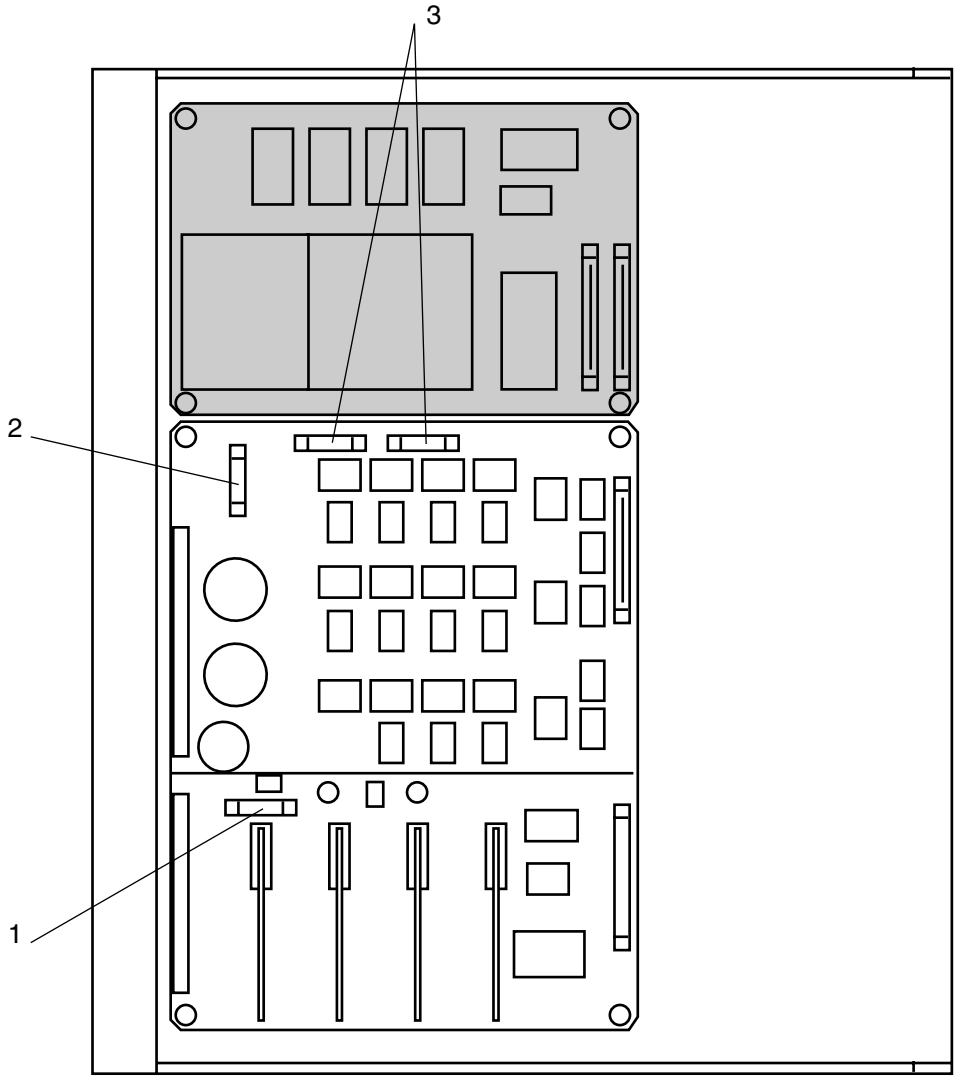
1 - Sockets for memory modules
2 - Optical fibre transmit power adjustment switches
3 - Axis cards
4 - CPU/Modax interface card

Location of the Items Concerned by Work Inside a Modax



1 - Optical fibre transmit power adjustment switches
2 - Axis cards

Location of Fuses Inside the Cover



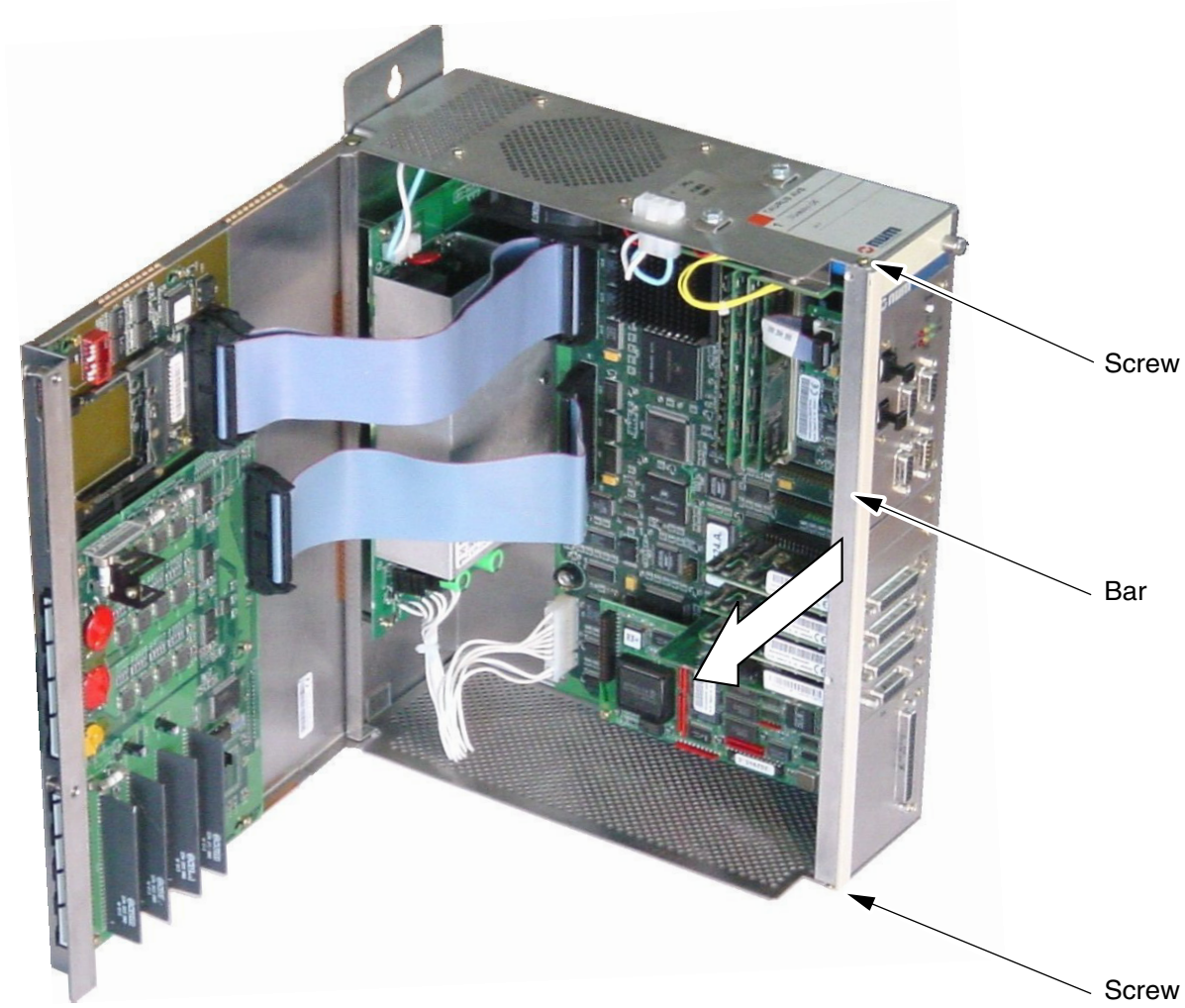
1 - Input power supply protective fuse
2 - Output power supply and overvoltage protective fuse
3 - Spare fuses

REMARK *The greyed part corresponding to the PCMCIA card drive is optional in the CPU and does not exist in the Modax. The input/output card is optional in the Modax.*

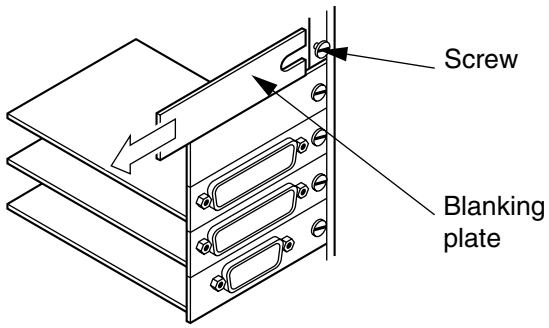
4.1.3 Adding Axis Cards

Refer to the layout diagram (see Sec. 4.1.2).

Remove the two screws and take off the card retaining bar.

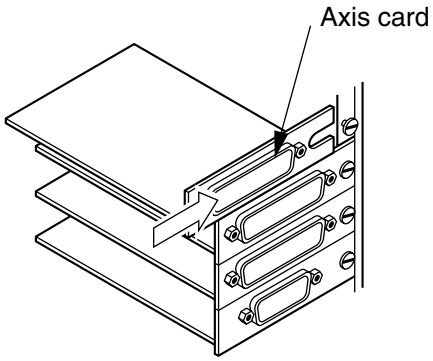


Remove the screw and remove the card slot blanking plate.



The axis cards are inserted from the bottom up.

Install the new card and tighten the screw.



⚠ CAUTION

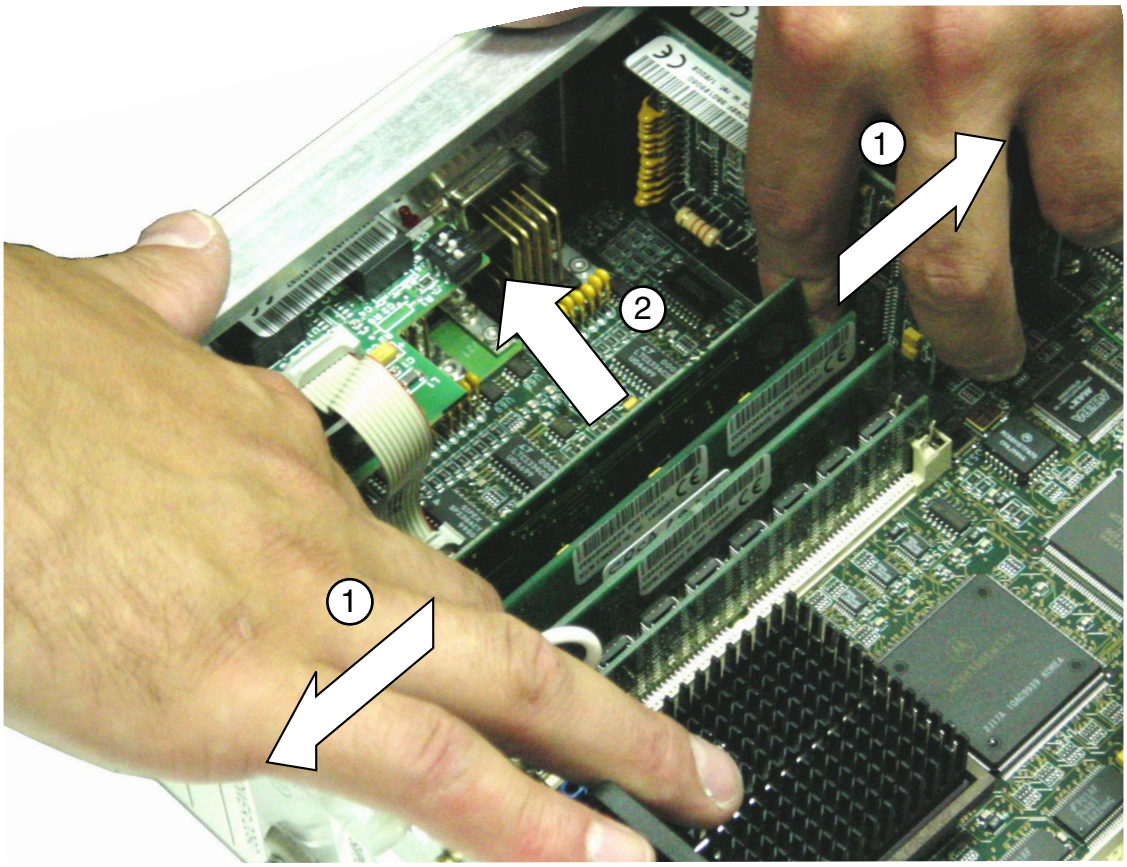
When inserting a new card, push it straight into the connector so as not to damage the connector pins.

Install the bar and tighten the screws.

4.1.4 Replacing a Memory Module

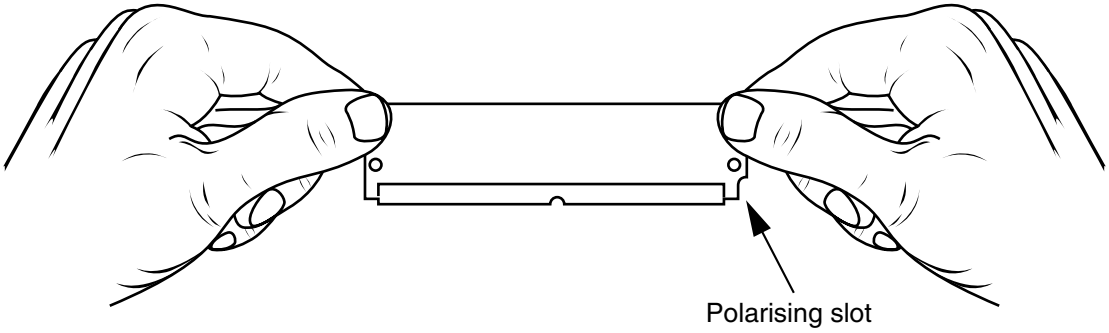
Refer to the layout diagram (see Sec. 4.1.2).

Remove the module to be replaced: pull on tabs (1), tilt and remove module (2).

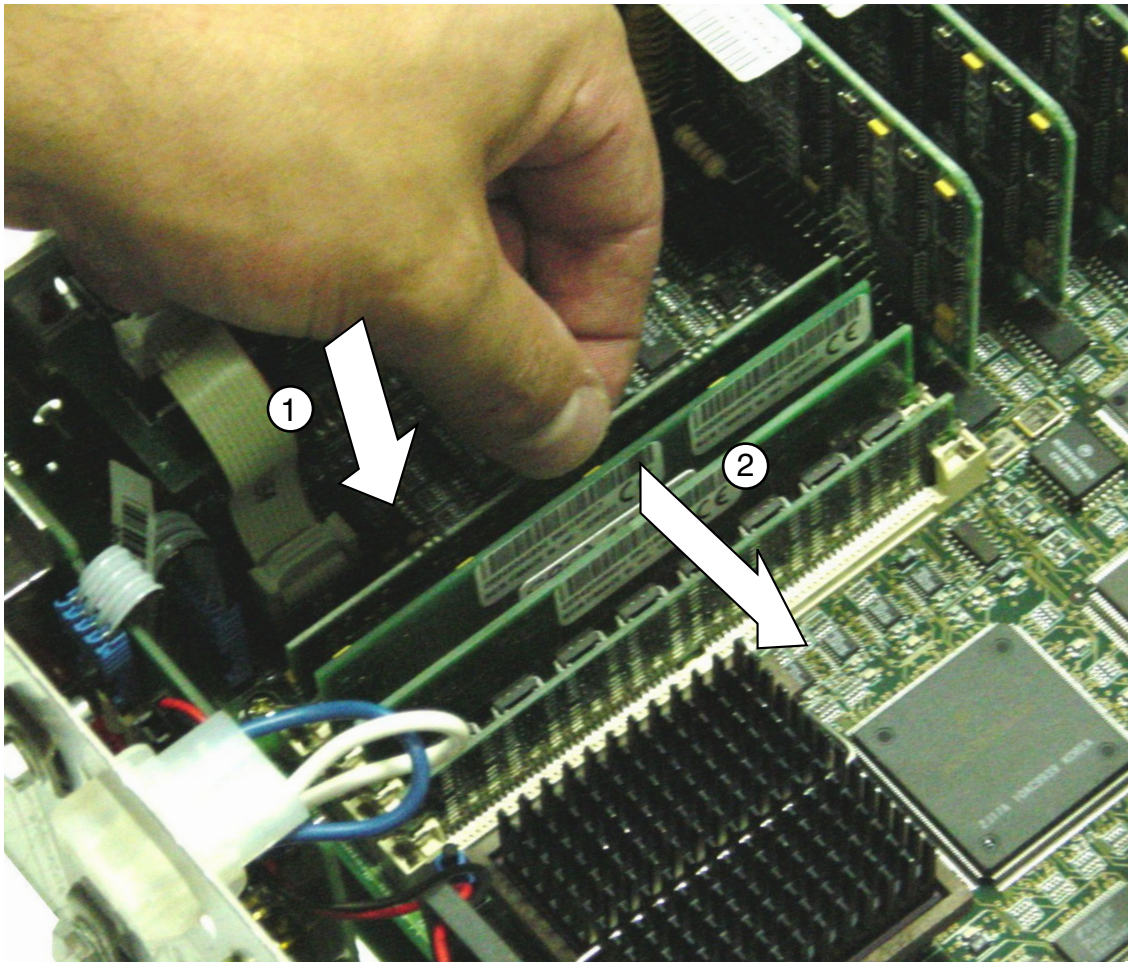


REMARK *If the module to be removed is not the last one, remove all the modules after it that prevent it from being tilted and keep them in the order removed.*

Position the new module in the socket with the polarising slot on the right.



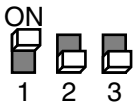
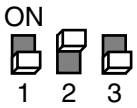
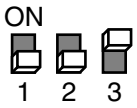
Position the module at a slant in connector (1) and swing it up to vertical position until it snaps into place (2).



Reinstall in their initial order any modules removed.

4.1.5 Adjusting the Optical Fibre Transmit Power

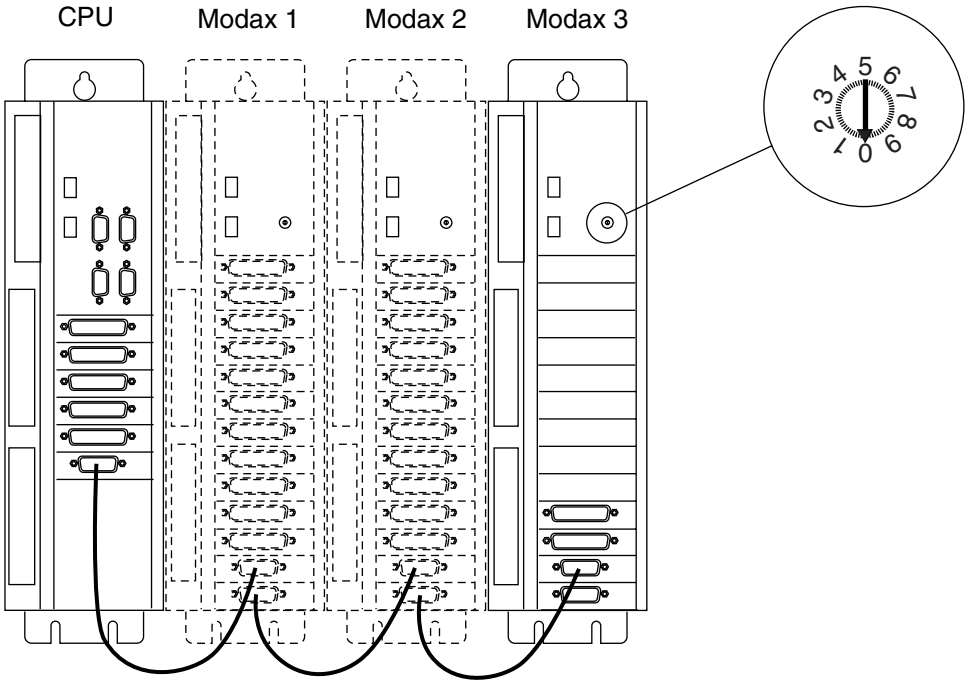
The adjustment is made on switches (see Sec. 4.1.2) according to the length of the optical fibre cable:

Optical fibre cable length	Switches setting
L < 15 m	
15 m < L < 30 m	
L > 30 m	

4.1.6 Setting the Address of a Modax

When one or more Modaxes are connected to the CPU, the last Modax must mandatory be assigned address 0. The other Modaxes can be assigned either address 1 or 2.

REMARK *Address 0 on the last Modax forces a line loopback, thereby avoiding a cap.*



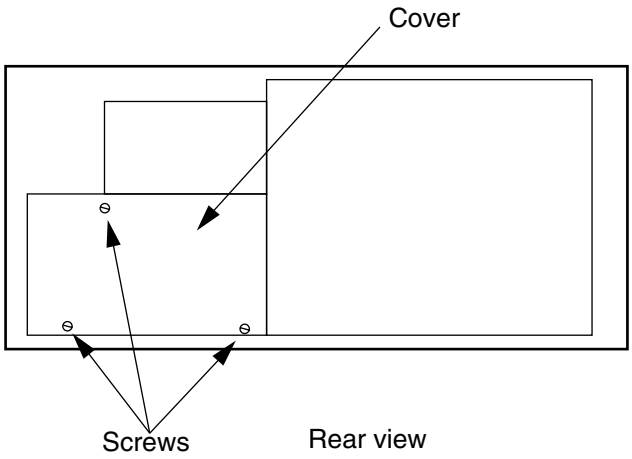
4.2 Preparing the Compact Panel (MP10 or CP10)

Operations that can be performed on the compact panel:
- Relocation of the DIN connector (see Sec. 4.2.2),
- Installation of the key customisation label (see Sec. 4.2.3).

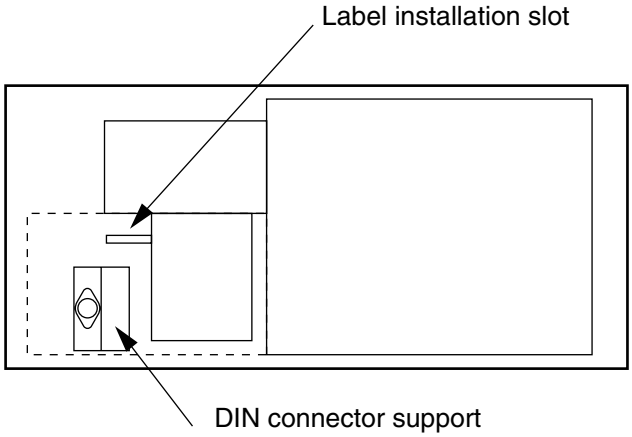
These operations require removing the rear cover (see Sec. 4.2.1).

4.2.1 Removing the Rear Cover

Remove the three screws and take off the cover.



Location of the items concerned by the operations:

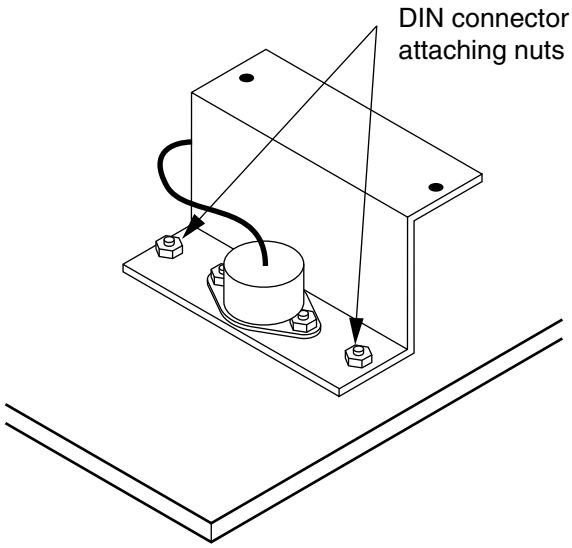


4.2.2 Relocating the Keyboard Connector

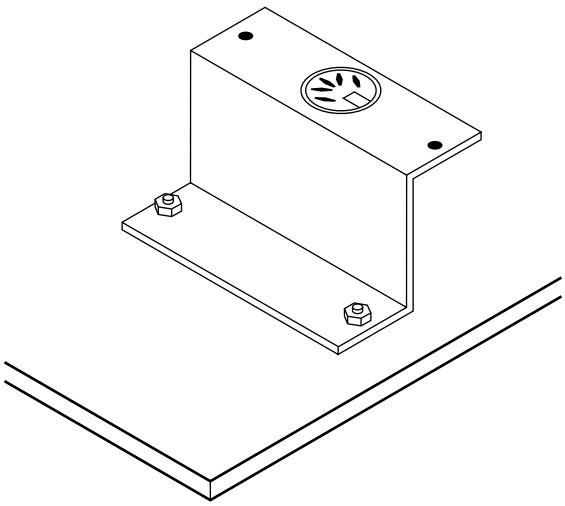
The compact panel is equipped with a keyboard connector (5-contact DIN connector) accessible on the front after removing the cover.

This location of the DIN connector corresponds to occasional use of a PC type keyboard (seal not ensured when the cover is removed).

For permanent connection of a PC type keyboard, the DIN connector can be moved to the back of the panel:



DIN connector located on the front



DIN connector relocated on the back of the panel

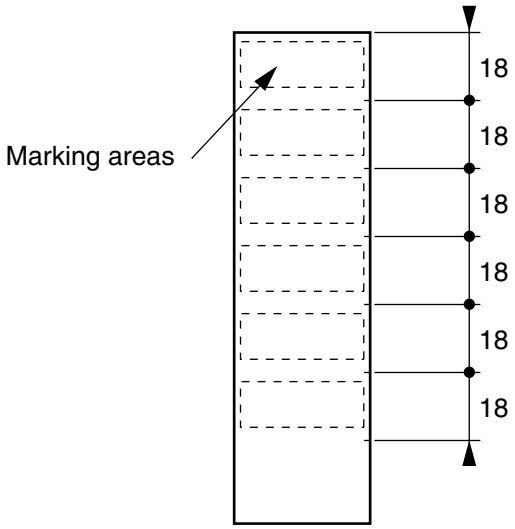
Unscrew the two DIN connector support attaching nuts.

Turn over the support and reinstall the nuts.

4.2.3 Installing the Key Customisation Label

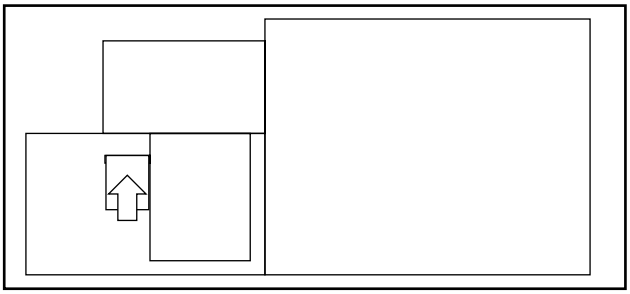
The compact panel has six cutomisable keys. The key assignments are identified by a label at the rear of the panel.

Customising the Label Supplied with the Compact Panel:



The label can be customised by transfers (Letraset type), Universe 54 font, pitch 12.

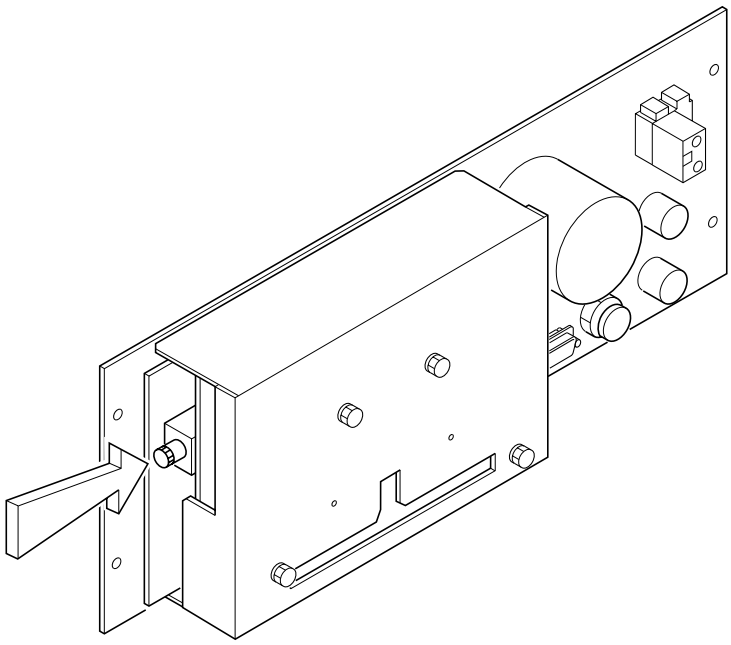
Installing the Label on the Rear of the Compact Panel:



4.3 Preparing a Machine Panel (MP01 or MP02)

4.3.1 Machine Panel (MP01)

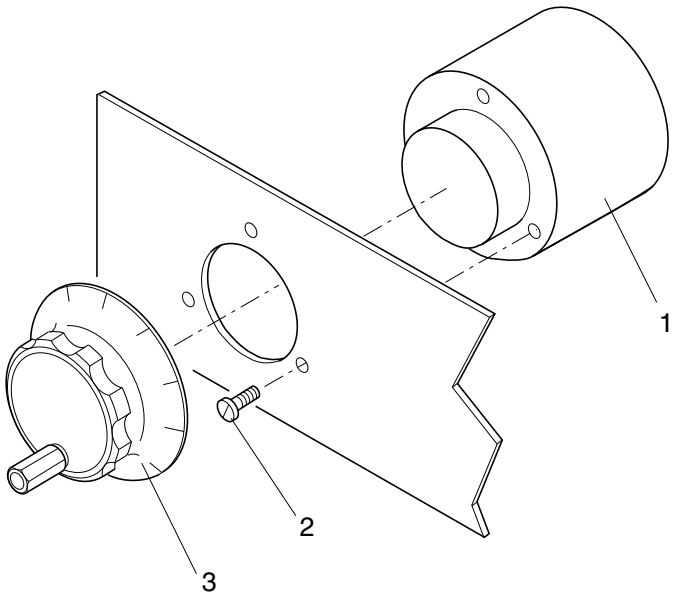
4.3.1.1 Assigning an Address to the Panel



Set the address on the thumbwheel: address 1 to 4, different for each panel.

4.3.1.2 Installing the Handwheel

The handwheel is installed on the machine panel without its bezel (remove the cap by cutting the plastic pins with cutting pliers):



1 - Handwheel body
2 - Attaching screw
3 - Bezel attached by screw

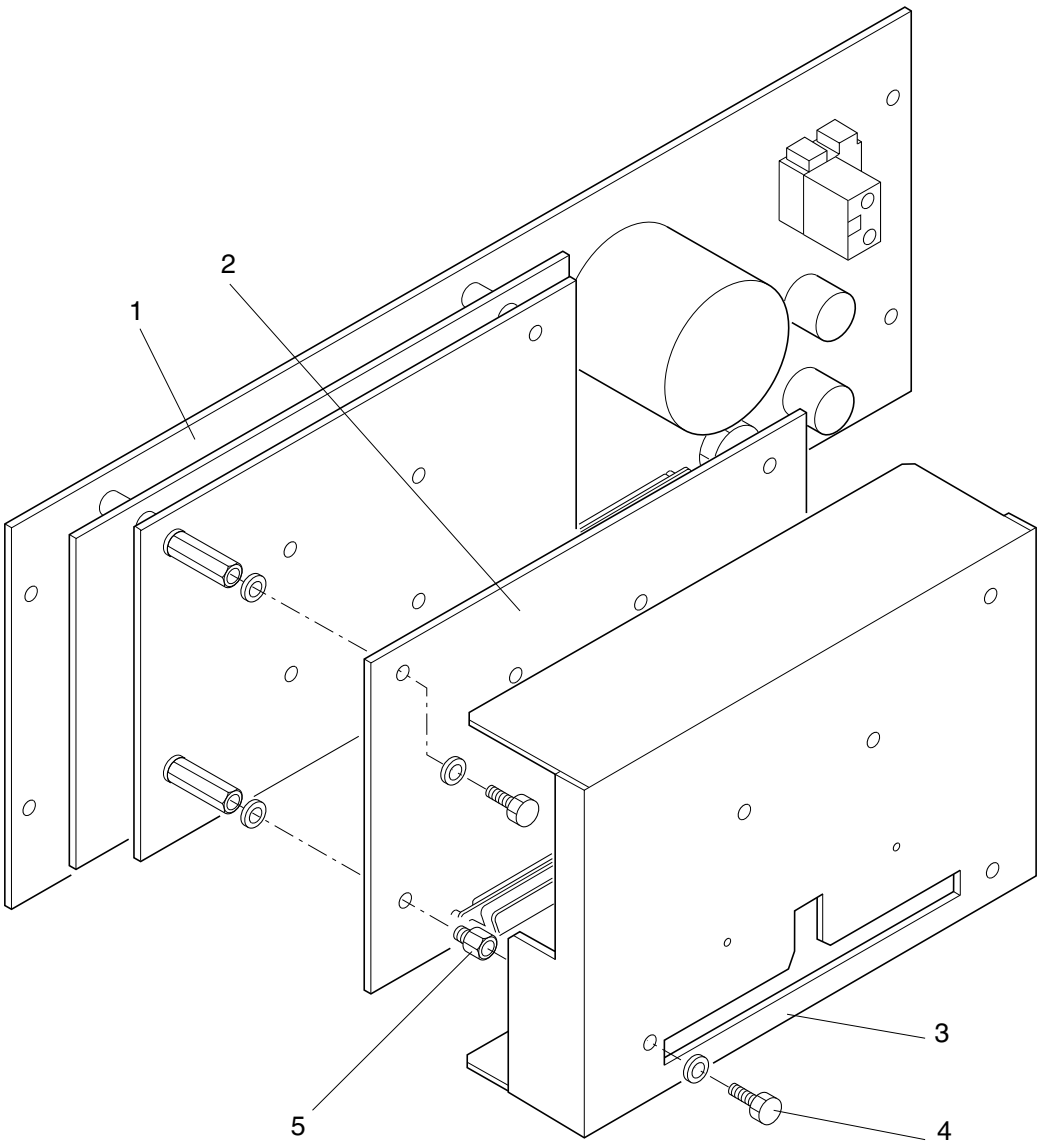
⚠ CAUTION

The handwheel could interfere with installation of the key labels.
It is therefore recommended to install the labels (see Sec. 4.3.1.5) before the handwheel.

4.3.1.3 Installing the Machine Panel Extension

The machine panel extension is installed at the rear of the machine panel.

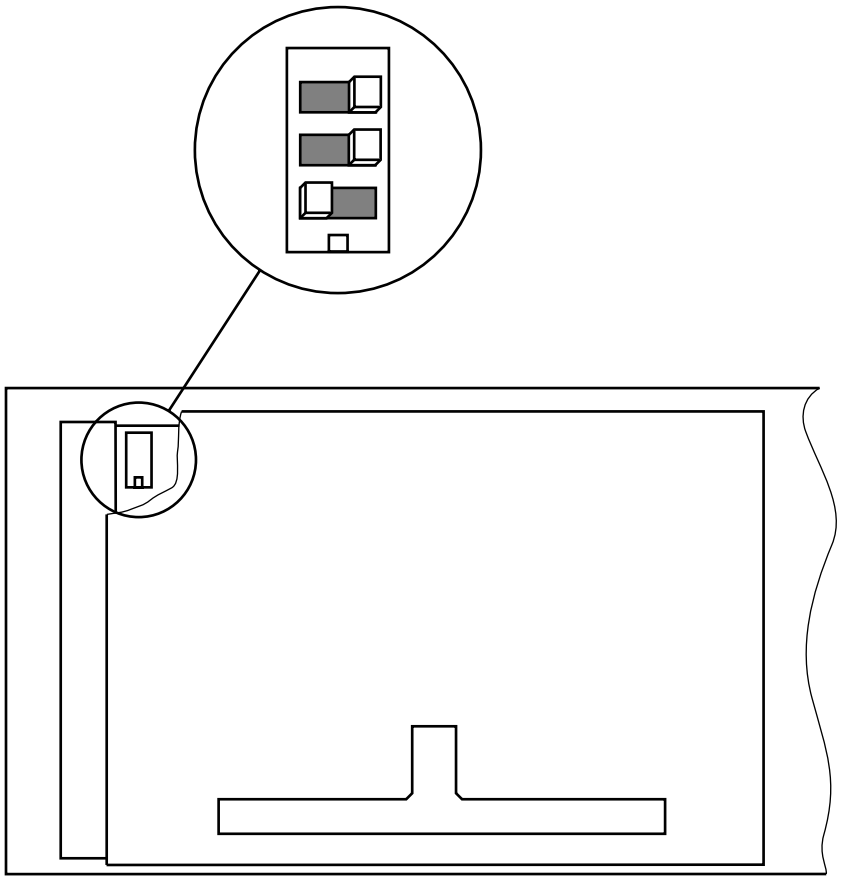
It requires removing the enclosure.

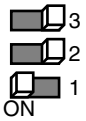
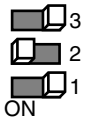


1 - Machine panel
2 - Machine panel extension
3 - Enclosure
4 - Screws (8)
5 - Spacers (5)

4.3.1.4 Setting the Optical Fibre Transmit Power

The setting is made on the rear of the machine panel according to the optical fibre cable length:



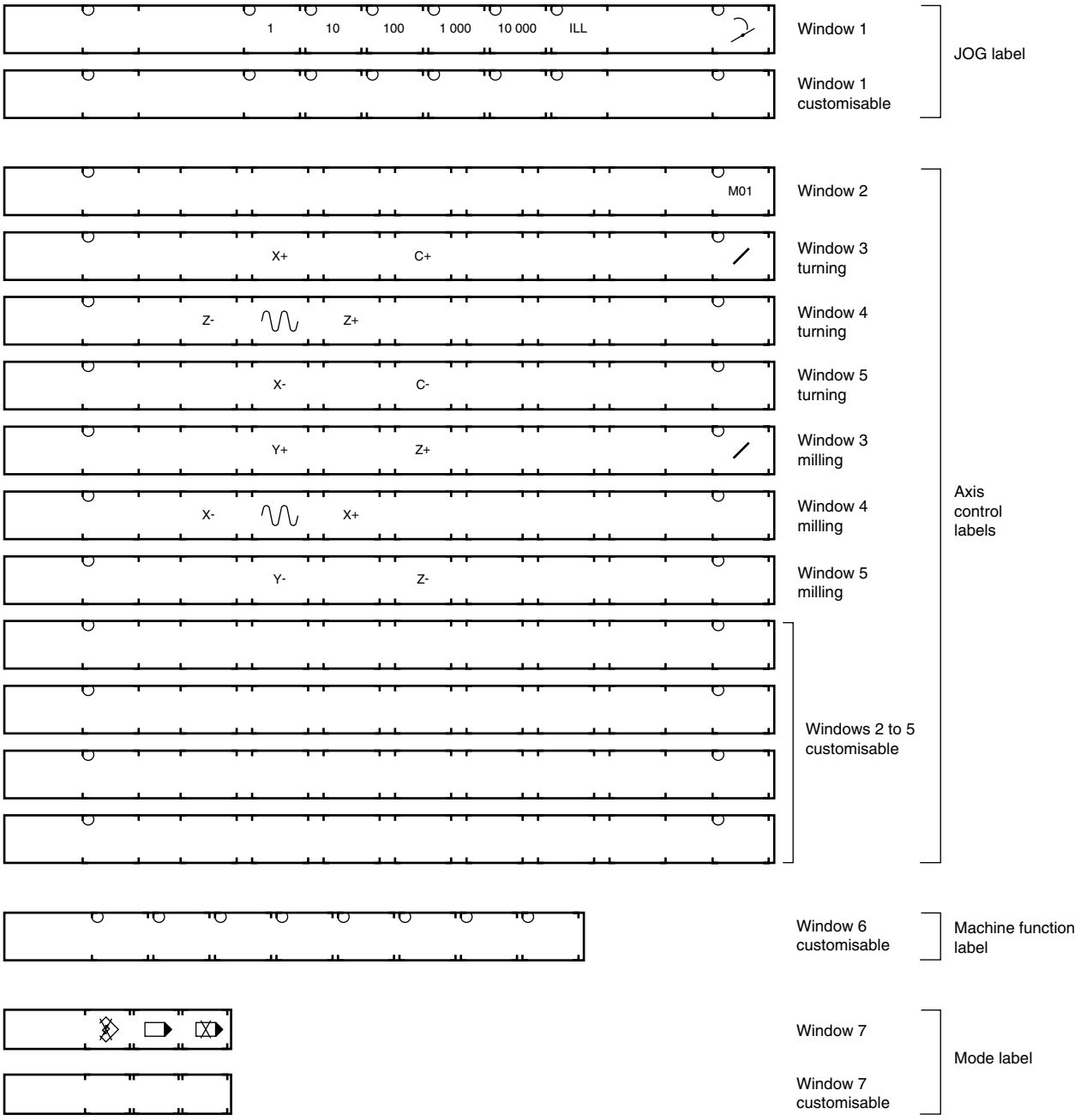
Optical fibre cable length	Switches settings
L < 15 m	
15 m < L < 30 m	
L > 30 m	

4.3.1.5 Installing the Key Labels

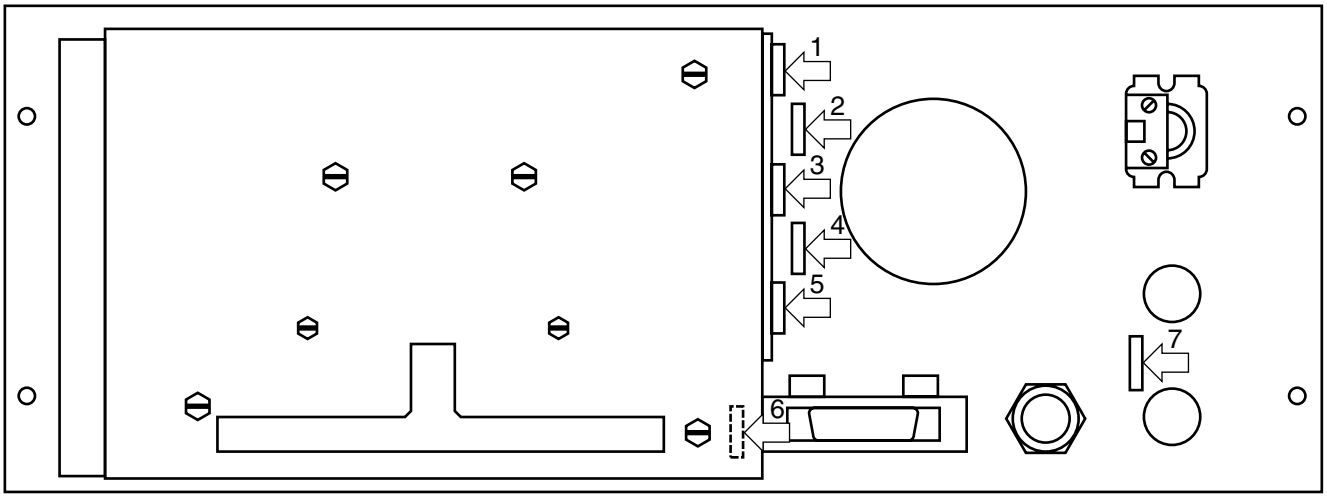
The keyj0n the machine panel are not engraved. Their assignment is specified by installing a set of labels in windows 1 to 7 at the rear of the machine panel.

These labels can be:
- the standard labels provided by NUM,
- labels customised for the user.

Set of Labels Supplied with the Machine Panel



Installing the Labels at the Rear of the Machine Panel:



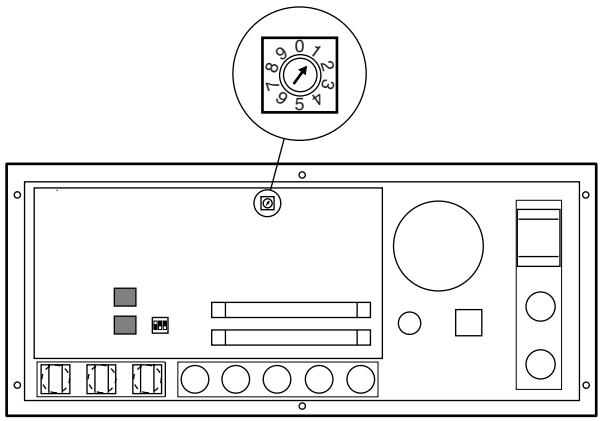
Customising the Labels

The labels can be customised by transfers (Letraset type), Universe 54 font pitch 12.

4.3.2 Machine Panel (MP02)

4.3.2.1 Assigning an Address to the Panel

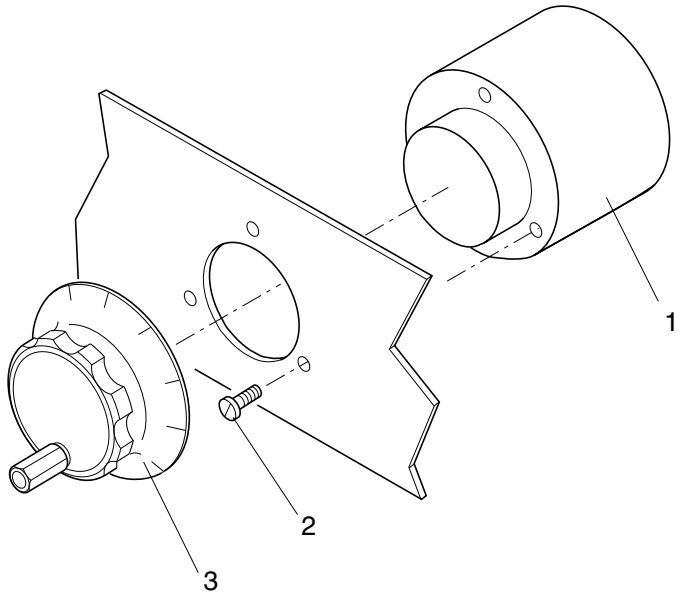
The card number (1 to 4) is set on the 10-position rotary switch at the rear of the panel.



Set the panel address on the switch.

4.3.2.2 Installing the Handwheel

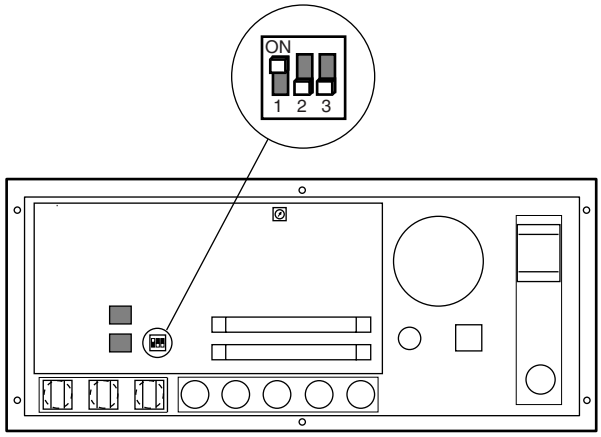
The handwheel is installed on the panel (remove the cap by cutting the plastic pins with pliers):

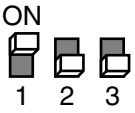
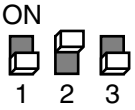


1 - Handwheel body
2 - Attaching screw
3 - Bezel attached by screw

4.3.2.3 Setting the Optical Fibre Transmit Power

The setting is made on the microswitches at the rear of the panel according to the optical fibre cable length.



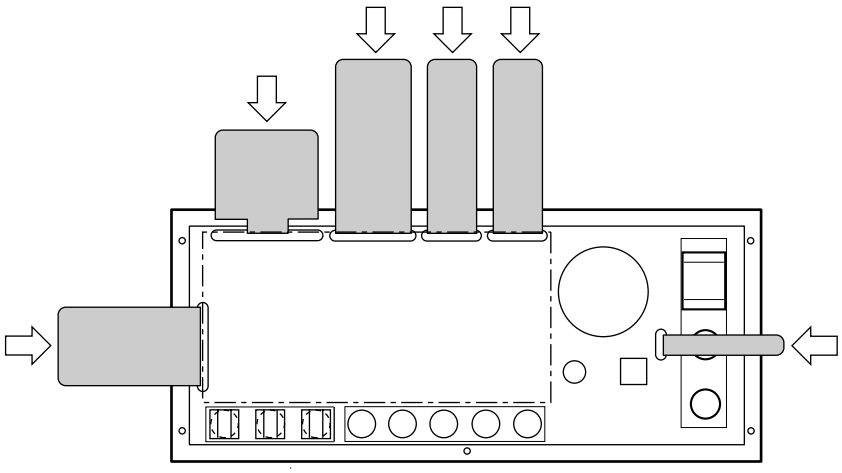
Optical fibre cable length	Switches settings
0.25 m < L < 15 m	
15 m < L < 25 m	
25 m < L < 40 m	

4.3.2.4 Installing the Key Customisation Strips

The panel includes five types of rewritable strips for customising the keys. The key assignments are made by installing a rewritable strip at the rear of the panel.

These strips can be:
- blank rewritable strips,
- printed rewritable strips.

Each strip can be customised using transfers (Letraset type, Univers 54 font, pitch 12).



REMARK The card is not shown in the above figure.

4.4 General Operations

4.4.1 Replacing Fuses

Accessible fuses:

Location	Characteristics
NUM Power CPU	Fast-blow 4 A, 5x20 glass fuses
CPU and Modax input/output card ⚠	Very fast-blow (FF) 10 A, 5x20 fuses - spare fuses are provided on the card **Use only very fast-blow (FF) fuses**
(CP20) 10" 50-key panel	Fast-blow 2 A, 250 V, 5x20 glass fuse
(FS20) monitor of the LCD panel	2.5 A, 250 V, 5x20 glass fuse
(CP10) 10" compact panel	Fast-blow 2 A, 250 V, 5x20 glass fuse
MP01 machine panel	Fast-blow 500 mA, 250 V, 5x20 glass fuse
MP02 machine panel	Slow-blow 500 mA, 250 V 5x20 glass fuse

4.4.1.1 NUM Power CPU Fuses

Refer to the layout diagram (see Sec. 4.1.1.1)

Unscrew the fuse-holder cover (quarter-turn fastener).

Replace the blown fuse.

Install and screw on the fuse-holder cover.

4.4.1.2 CPU and Modax Input/Output Card Fuses

Refer to the layout diagram showing the fuses inside the cover (see Sec. 4.1.2).

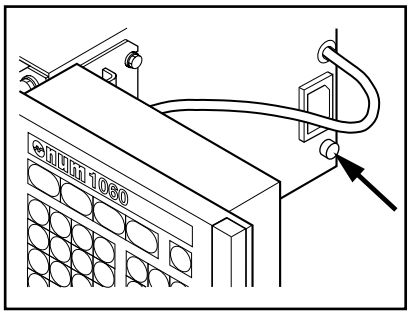
Replace the blown fuse (the card contains two spare fuses).

4.4.1.3 (CP20) 10" 50-Key Panel Fuse

Unscrew the fuse-holder cover (quarter-turn fastener).

Replace the blown fuse.

Install and screw on the fuse-holder cover.

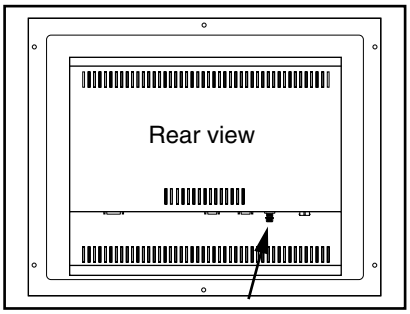


4.4.1.4 (FS20) LCD Panel Monitor Fuse

Unscrew the fuse-holder cover (quarter-turn).

Replace the blown fuse.

Install and screw on the fuse-holder cover.

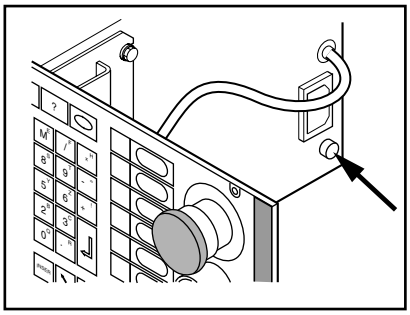


4.4.1.5 (CP10) 10" Compact Panel Fuse

Unscrew the fuse-holder cover (quarter-turn fastener).

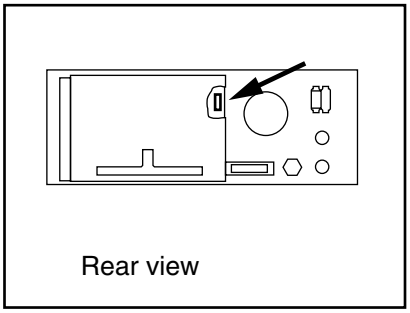
Replace the blown fuse.

Install and screw on the fuse-holder cover.



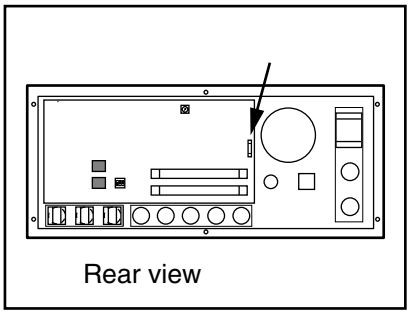
4.4.1.6 MP01 Machine Panel Fuse

Replace the blown fuse.



4.4.1.7 MP02 Machine Panel Fuse

Replace the blown fuse.



4.4.2 Wiring of the Watchdog, Safety Daisy Chain

The watchdog (WD) is the machine processor status signal. When WD = 0, the machine processor is faulty and the programmed safety devices are therefore triggered.

The watchdog output is set by PLC programming: WD is the first output (OUT.0) of the CPU or machine panel extension.

⚠ CAUTION

The CNC may continue to control the axes when WD = 0, which could cause problems (collisions, etc.).

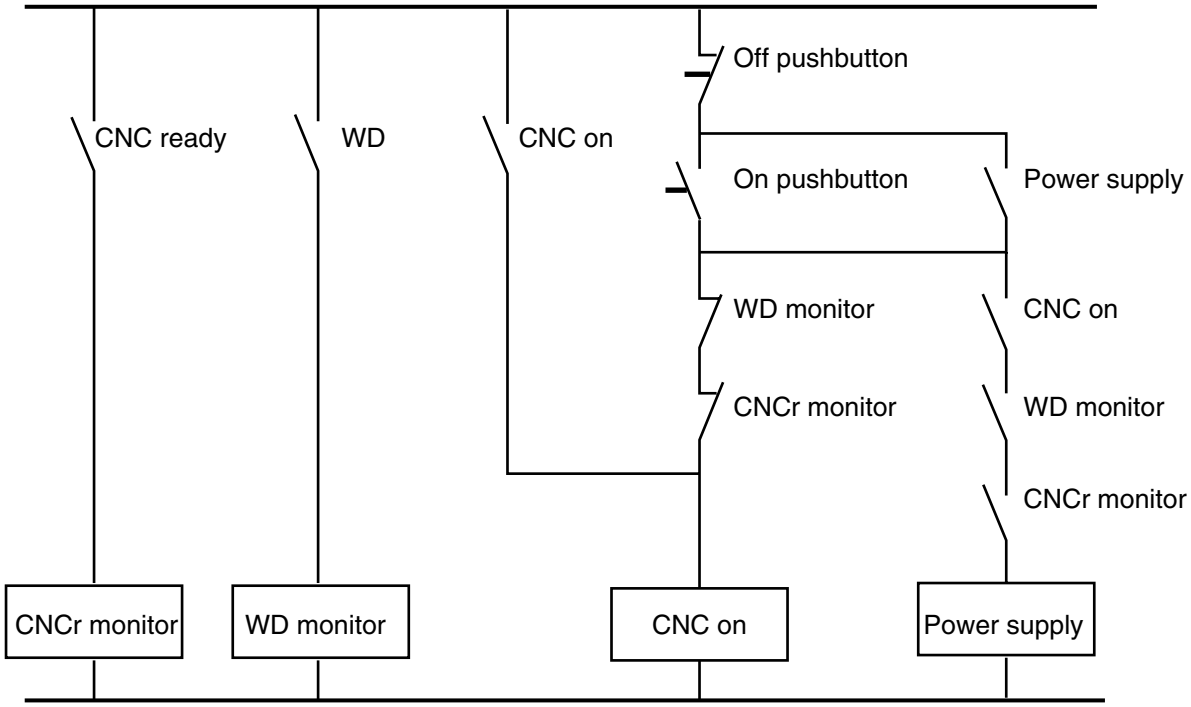
The WD output must therefore be wired in the safety chain so that when WD = 0, power supply to the axes is cut off.

The system should remain on, to allow troubleshooting and setting of certain logic inputs (which are not the only possible cause of failure).

To avoid undue movements, take all due precautions related to drop-out of the power contactor (loss of CNC ready signal, watchdog low, or emergency stop):

- Immediately brake the axes at maximum torque if this option is available on the drive, or the drives will be disabled,
- Immediately brake the motors driving unbalanced axes.

Recommended safety daisy chain:



CNCr: CNC ready

This diagram is used to check that the WD and CNCr relays are not operated at power on.

No timeout reused.

Powering up of the CNC is not enabled unless the watchdog and CNCr relay are deenergised.

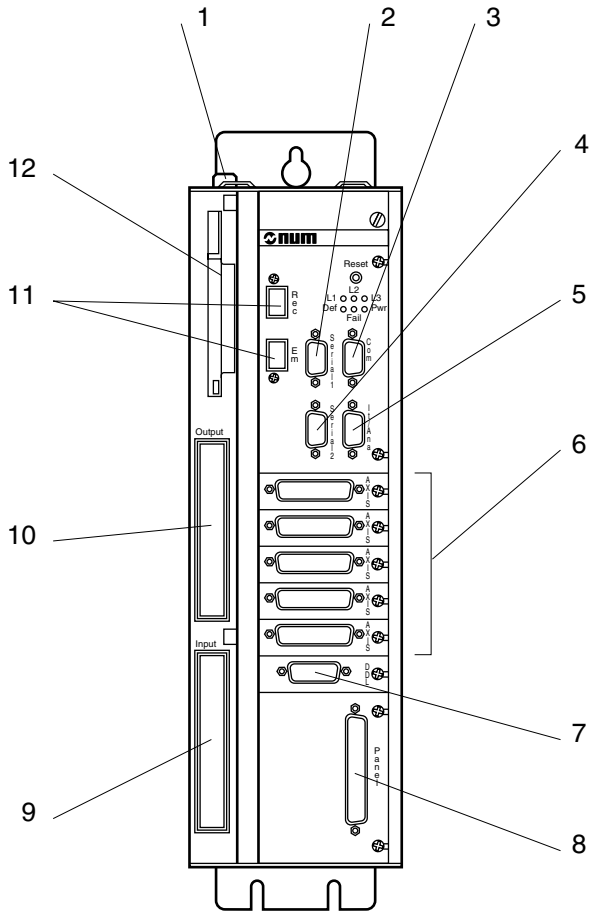
When the CNC is on, the PLC programme closes the CNCr relay.

Power application is determined by the presence of WD and CNCr.

5 Interconnections

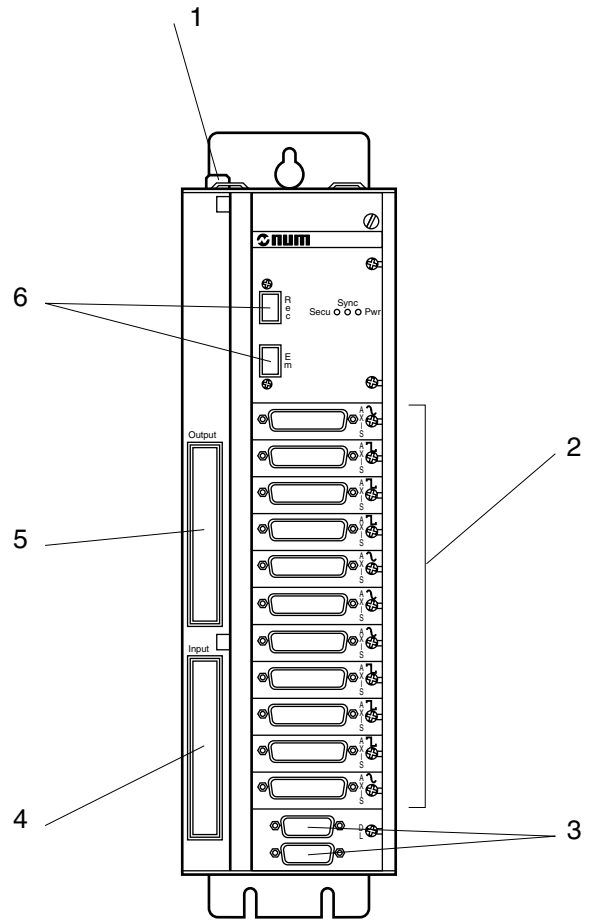
5.1 CNC/Peripheral Interconnections

5.1.1 Description of the NUM Power 1020/1040/1060/1080 CNC



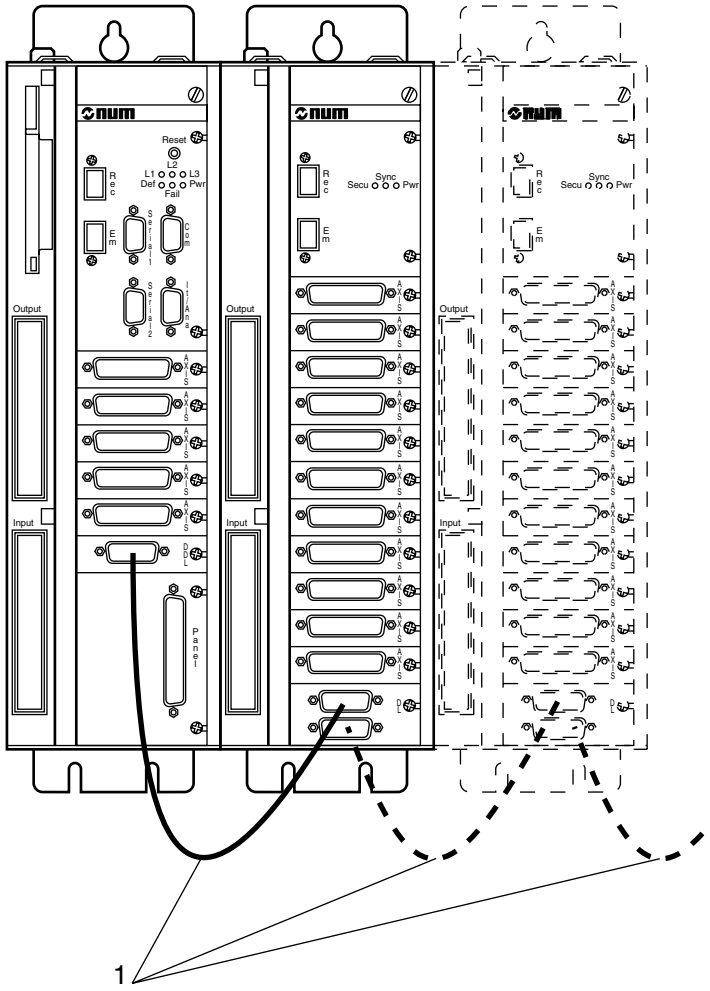
1 - Power supply connector
2 - "Serial 1" port
3 - "Com" serial port
4 - "Serial 2" port
5 - Interrupt/analogue I/O
6 - Analogue axes
7 - Modax interface port
8 - Panel video connector
or axis card in a CNC without Modax
9 - Inputs
10 - Outputs
11 - Fibre-optic transmitter/receiver
12 - PCMCIA port

5.1.2 Description of a Modax



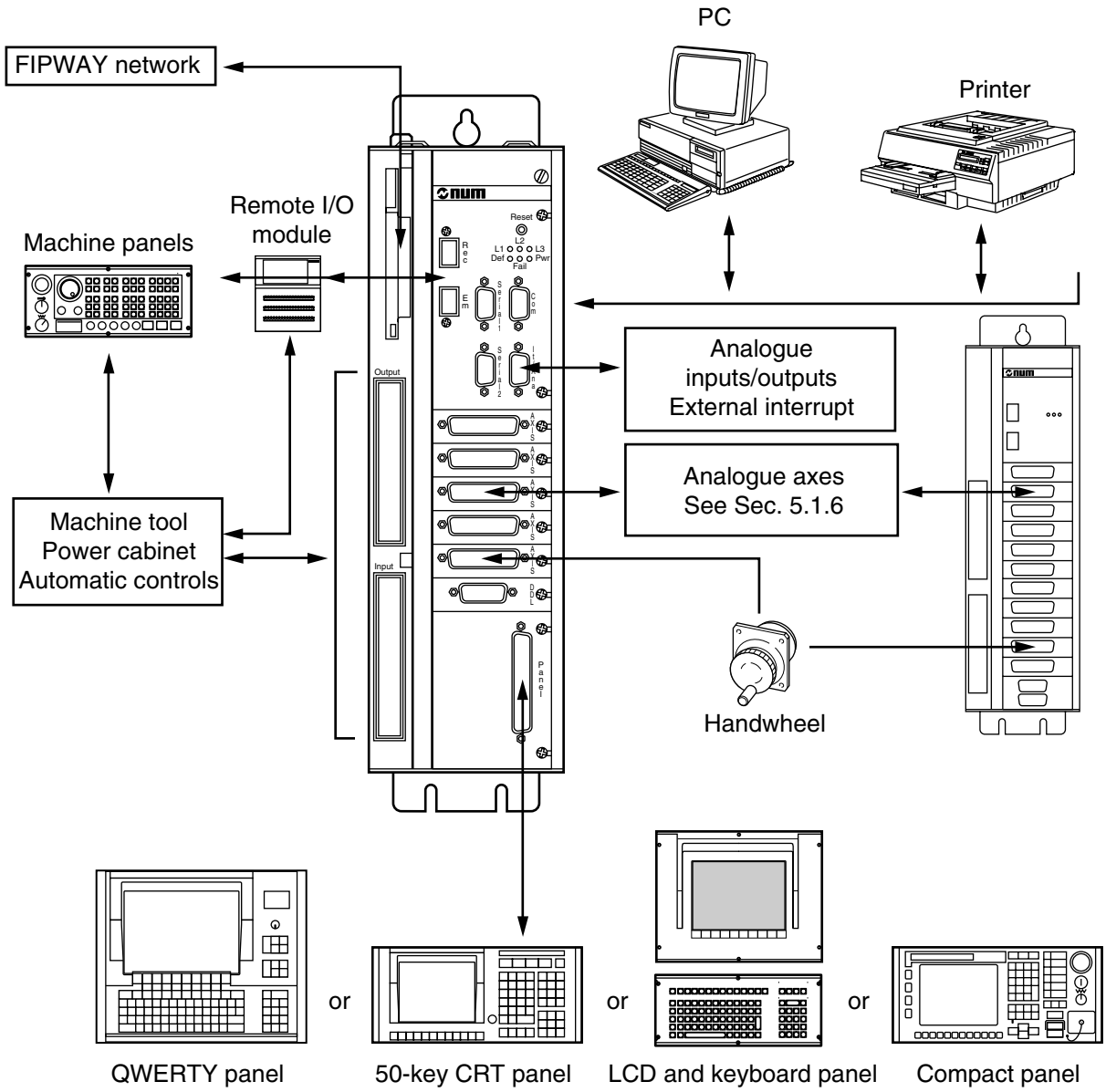
1 - Power supply connector
2 - Analogue axes
3 - CPU/Modax interface ports
4 - Inputs
5 - Outputs
6 - Optical fibre transmit/receive

5.1.3 CPU/Modax Wiring Diagram



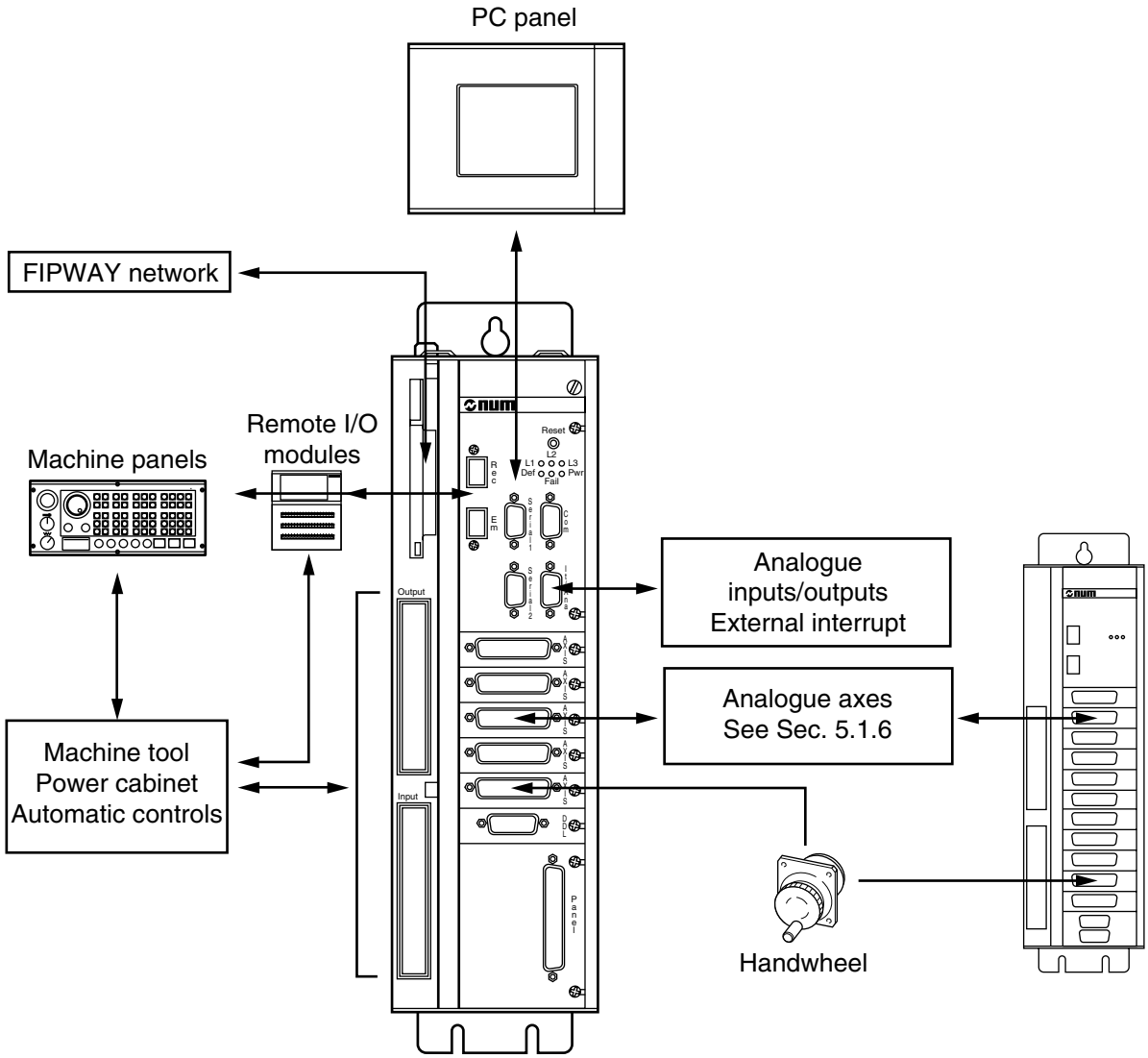
1 - CPU/Modax or Modax/Modax connection
(cable supplied, length 0.2 m - P/N: 260205352)

5.1.4 General Block Diagram of Connections with the CNC or Compact Panel

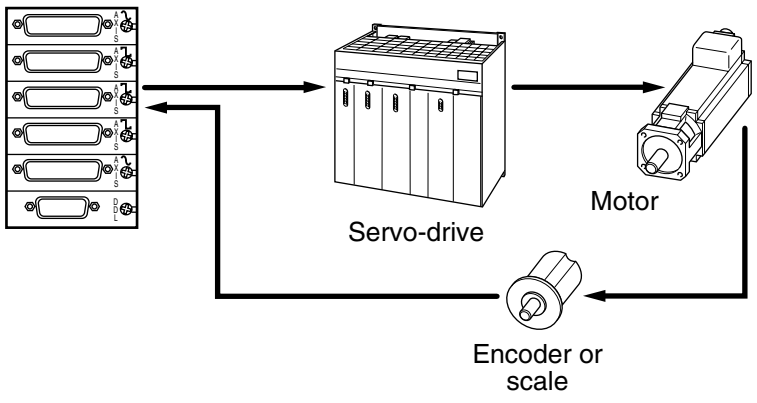


REMARK *A machine panel cannot be used with the compact panel.*

5.1.5 General Block Diagram of Connections with PC Panel



5.1.6 Axis Connection (on CPU or Modax)



5.2 NUM Power 1020/1040/1060/1080 CPU

A NUM power CNC includes a CPU and one to three optional Modaxes (axis and input/output extension modules). The table below gives the possible configurations depending on the type of CNC.

Communication function

The NUM Power CPU communicates with peripheral devices via the Com, Serial1 and Serial2 serial ports.

The table below gives the communication protocols used on the serial ports depending on the type of configuration:

Configuration	Serial ports	Protocols
Power 1020	Com	RS232E
	Serial 1	RS232, RS422 and RS485
Power 1040/1060/1080	Com	RS232E
	Serial 1	RS232, RS422 , RS485 and RS422 synchron
	Serial 2	RS232, RS422 and RS485

PLC function

The NUM Power CPU manages the machine environment via inputs and outputs:
- 32 inputs and 24 outputs with the 32-24 I/O card or 64 inputs and 48 outputs with the 64-48 I/O card,
- 32 inputs and 24 outputs or 64 inputs and 48 outputs per Modax fitted with an input/output card (see table above),
- remote inputs and outputs connected by a fibre-optic link.

The machine panel extension can manage an additional number of 32 inputs and 24 outputs.

An analogue I/O connector allows connection of the NUM Power to:
- two interrupt inputs,
- one analogue output,
- two analogue inputs.

CNC function

The NUM Power uses the CNC software to manage part programmes and machining data, compute paths and speeds and monitor axis movements.

Panel management function

The NUM Power CPU manages the VDU and keyboard.

Mass memory function

The NUM Power CPU stores the operating programmes in flash memory and the machine processor programmes and user files in RAM with backup.

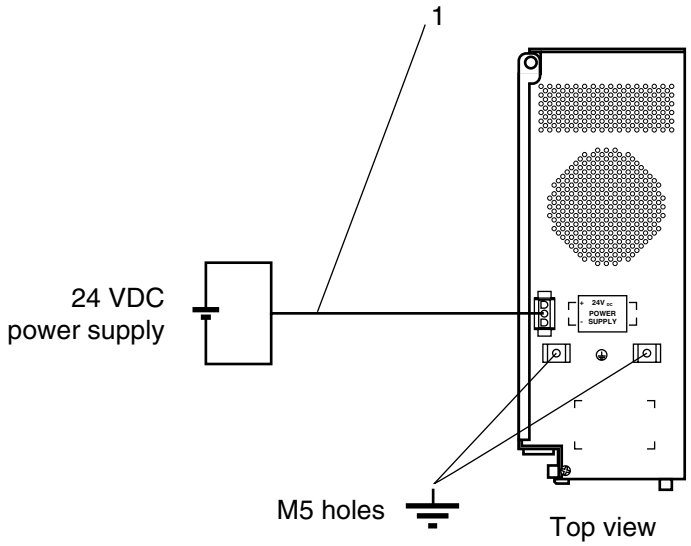
Backup of the files in RAM is ensured by a battery.

> ⚠ **CAUTION**
>
> The battery must mandatorily be replaced (see Sec. 4.1.1) after 5 years of use (connected).

REMARK *An alarm is programmed to draw the operator's attention at the end of the five-year period. This alarm is triggered on the CNC screen by setting of bit E_BAT (%R14.1) of the CNC/PLC exchange area.*

5.2.1 Power Supply (CPU and Modax)

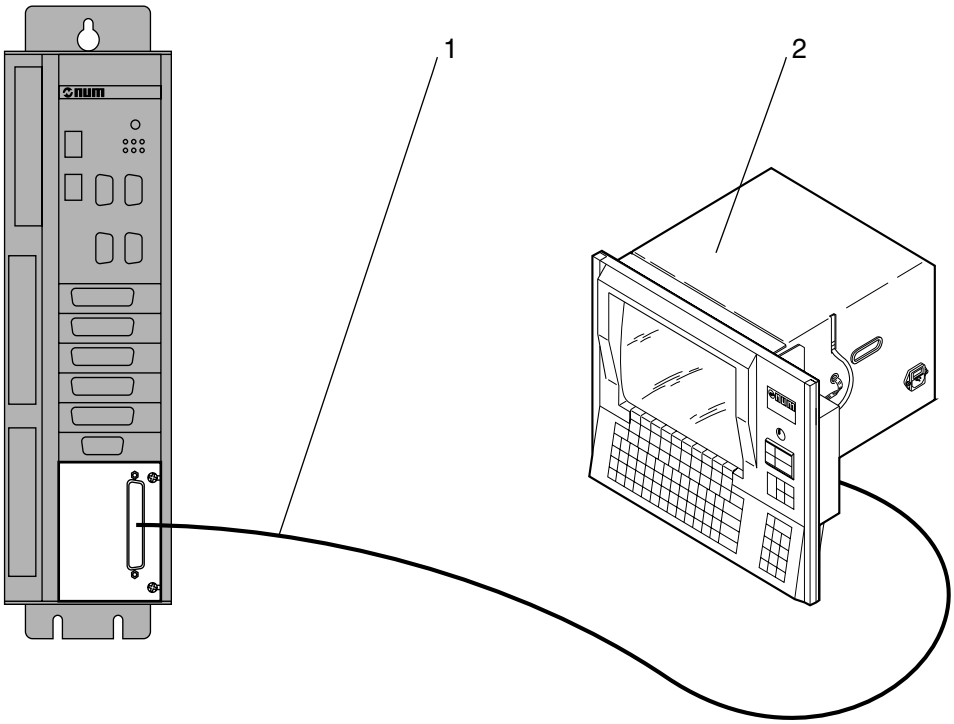
Power supply voltage	24 VDC nominal (20-30 VDC)
Maximum CPU power	70 W
Maximum Modax power	45 W



1 - Power cable (see Sec. 6.5.1)

5.2.2 Connection to the CNC or Compact Panels

5.2.2.1 Connection to the Panels in the Basic Configuration



1 - Video/panel cable (for lengths, see tables)
2 - Compact of CNC panel

The minimum video cable curve radius is 110 mm.

The video/panel cables are available in two versions:
- video interconnection kit (for wiring, see Sec. 6.6),
- video cable assembled.

Video interconnection kits:

Length	P/N	Length	P/N
5 m *	206203223	30 m	206203231
10 m *	206203225	40 m	206203233
15 m	206203227	to order	206203235
20 m	206203229		

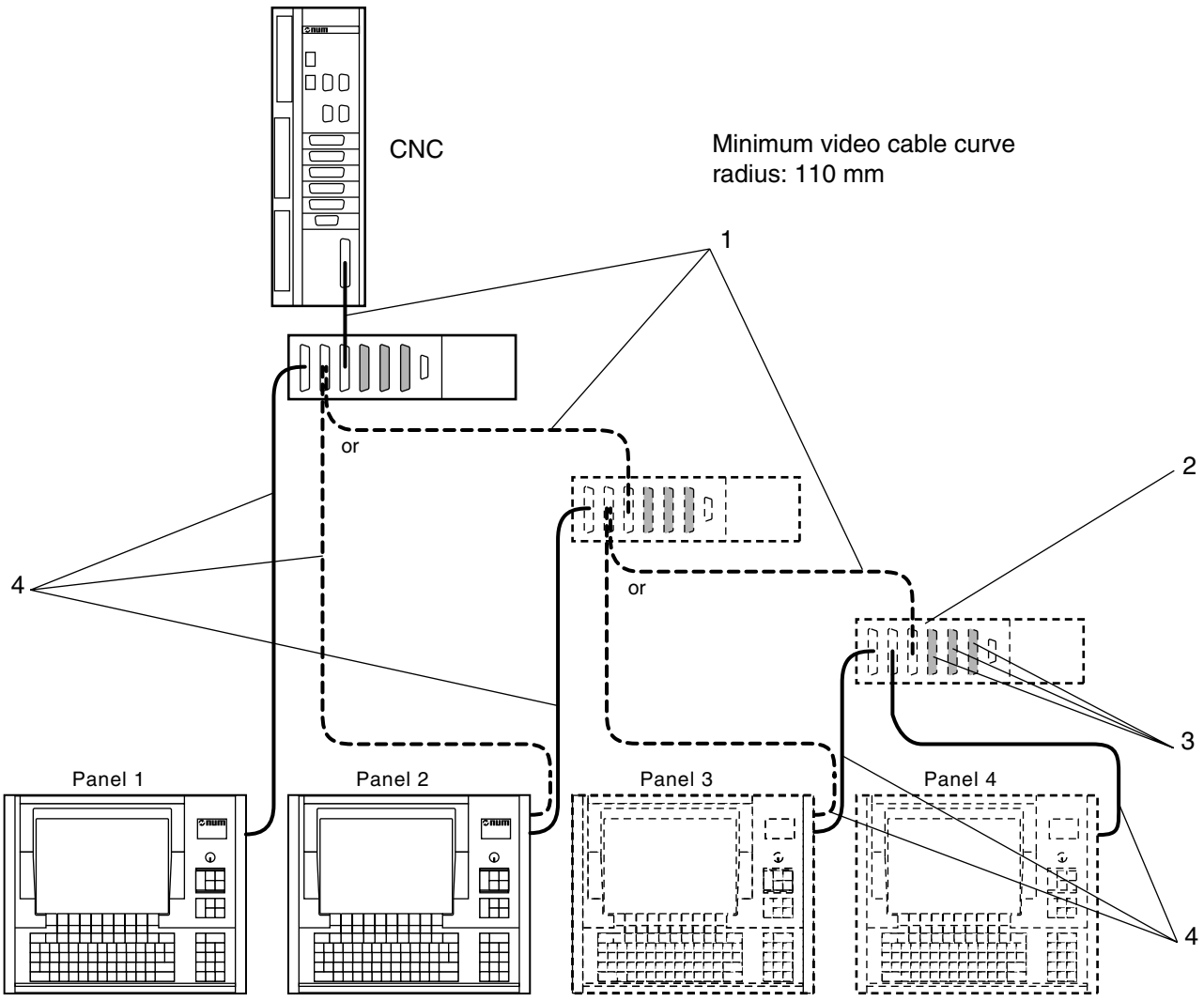
* Only the 5 and 10 m cables can be used to the compact panel.

Assembled video cables:

Length	P/N	Length	P/N
5 m	206202394	10 m	206202395

5.2.2.2 Multipanel Configuration (2 to 4 panels)

Differences with respect to the basic configuration

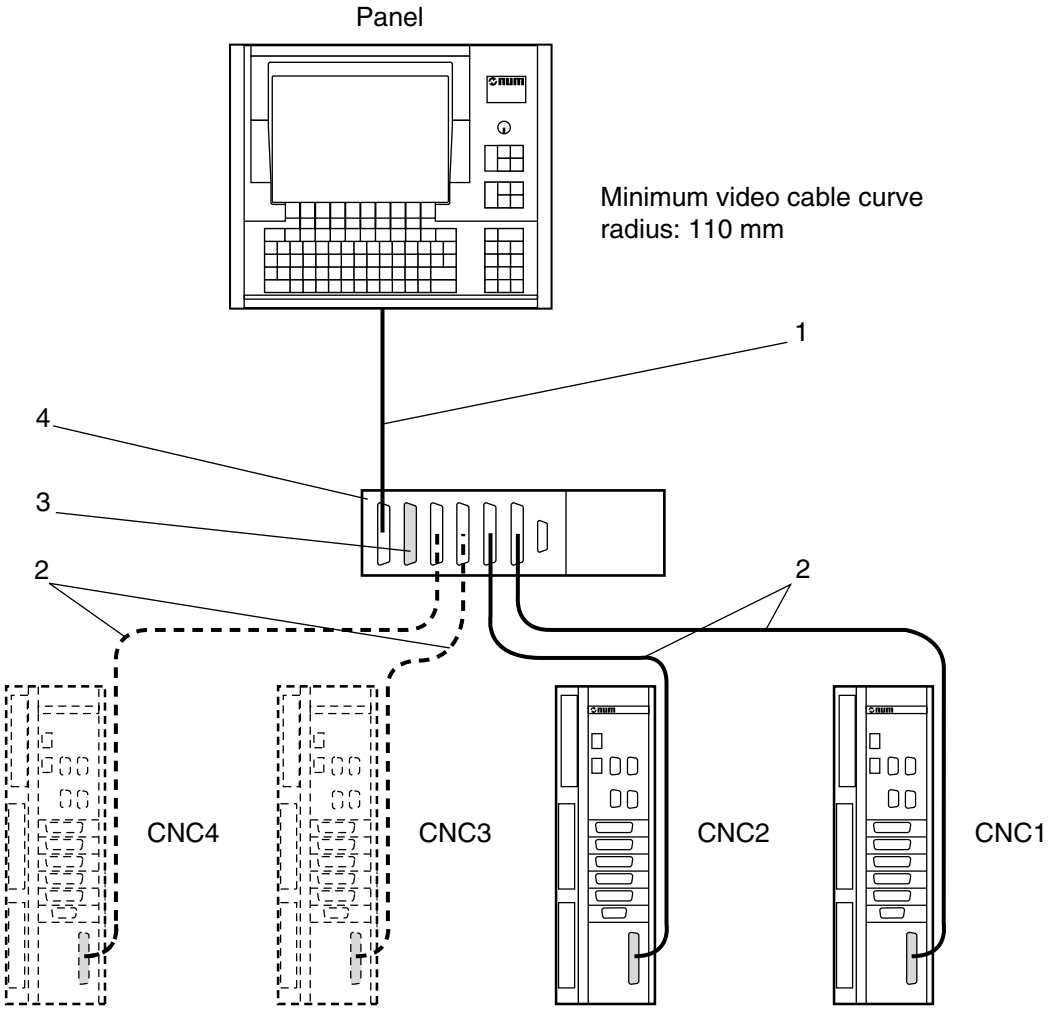


1 - 50 cm video cables: 1, 2 or 3 (P/N 206 202 620)
2 - Multiplexer modules: 1, 2 or 3
3 - Caps: 3 per multiplexer module on connectors CN1, CN2 and CN3
4 - Video cables: 2, 3 or 4 (see Sec. 5.2.2.1)

REMARK *This configuration is not possible with LCD or compact panels.*

5.2.2.3 Multi-CNC Configuration

Differences with respect to the basic configuration

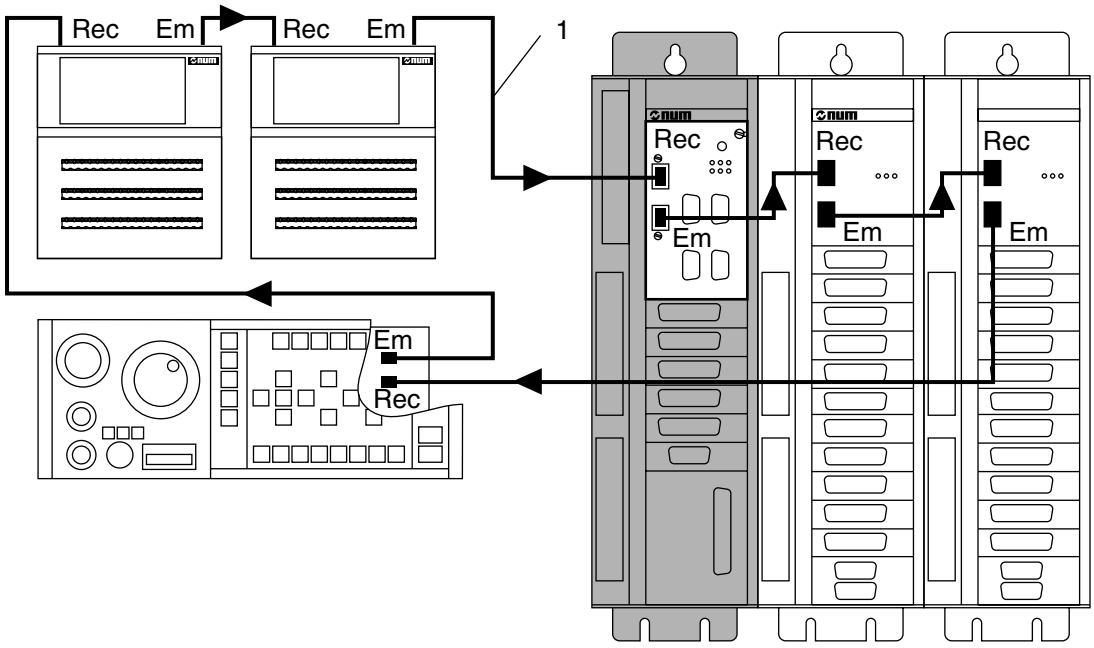


1 - 50 cm video cable (P/N 206 202 620)
2 - Video cables: 2, 3 or 4 (see Sec. 5.2.2.1)
3 - Caps on unused connectors: 1, 2 or 3
4 - Multiplexer module

REMARK *This configuration is not possible with LCD or compact panels.*

5.2.3 Fibre Optic Cable Connecting the CPU to the Modaxes, Machine Panels and remote Input/Output Modules

The CPU is connected to the Modaxes, machine panels and remote input/output modules by a fibre-optic ring as shown in the diagram below:



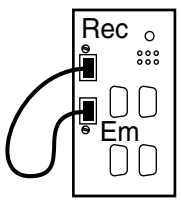
1 - Optical fibre

The minimum optical fibre cable curve radius is 50 mm.

The transmit power must be set according to the length of the optical fibre connecting the transmitter of an item to the receiver of the next item (see Sec. 4.1.5 for the CPU and Modaxes, Sec. 4.3.4 for the machine panels and the remote input/output module manual)

The machine panel address is set on a thumbwheel (see Sec. 4.3.1), and the remote input/output module address is set on switches (see the remote input/output module manual).

When the fibre-optic link is not used, connect the transmitter to the receiver by an optical fibre:



5.2.4 Analogue Inputs/Output and Interrupt

5.2.4.1 General

Analogue Inputs

Two inputs can be dedicated to connection of resistive potentiometers	
Typical potentiometer rating	10 kΩ
Resolution	0.025 percent full scale
Power supply	+ 10 V / 10 mA maximum

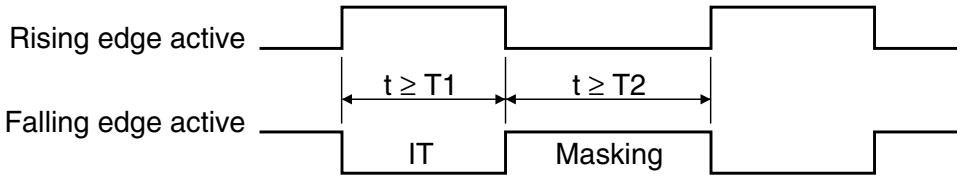
Analogue output

Output voltage	- 10 / + 10 V
Minimum load	2 kΩ
Resolution	305 µV

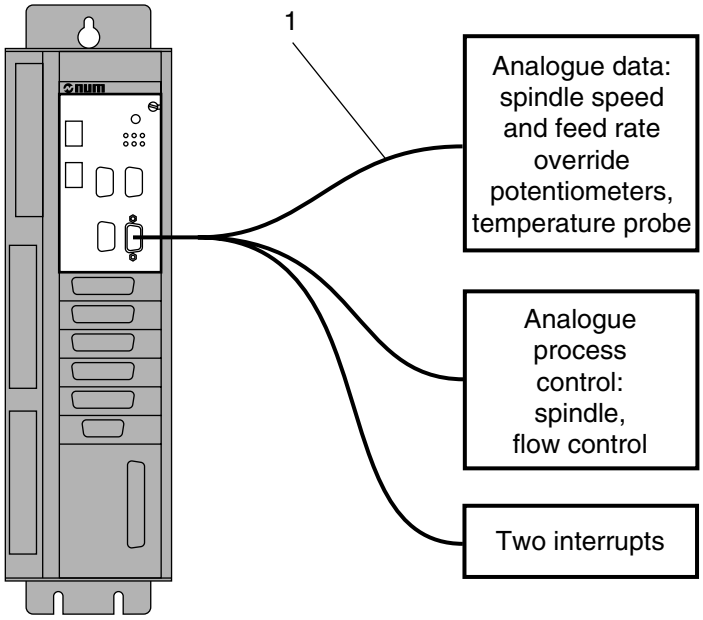
External Interrupt

Maximum current draw	20 mA
Minimum current required	10 mA
Input on 24 V	Logic "0" between 0 and 4.7 V Logic "1" between 18 and 27 V
IT time	Programmable: T1 = 0,5/250/500/2220/4440 µs
Masking between two ITs	Programmable: T2 = 1/500/1000/4000/8000 µs

Interrupt timing diagram:



5.2.4.2 Analogue/IT Link Connecting Diagram



1 - Analogue I/O - interrupt cable (see Sec. 6.3)

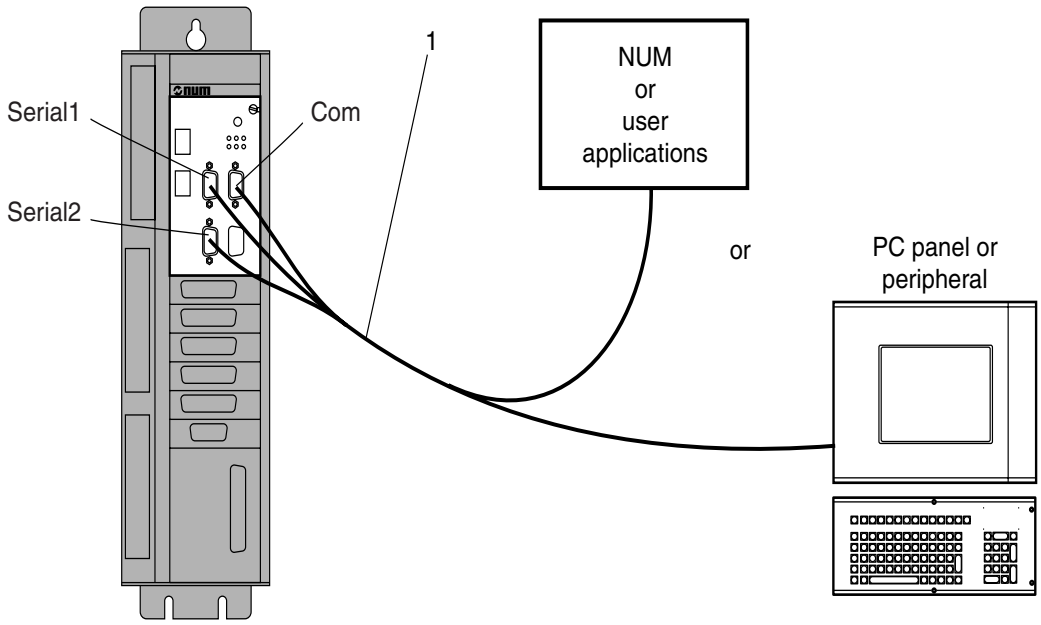
5.2.5 Communications

5.2.5.1 General

Serial line	RS 232E
Multistandard serial 1 line	RS232, RS 422A, RS 485 or RS 422 synchronous (Serial)
Multistandard serial 2 line	RS232, RS 422A or RS 485
Data rate	1200 bit/s to 115 kbit/s for standards RS 232, RS 232E, RS 422A and RS 485 2 Mbit/s for standard RS422 synchronous

The serial lines allow the CPU to exchange data with peripherals such as a PC, a diskette drive and/or a printer.

5.2.5.2 Serial Line Connection Diagram



1 - Serial interface cable
- RS 232E (see Sec. 6.1.1)
- RS 232 for NUM applications (PLCTool, etc., see Sec. 6.1.2)
- RS 422A (see Sec. 6.1.3)
- RS 485 (see Sec. 6.1.4)
- RS 422 synchronous (see Sec. 6.1.7, not available on 1020)

REMARK *The serial lines are to be configured using the serial line parameter setting utility (see the Operator Manual).*

⚠ CAUTION

The cable length must be consistent with the RS xxx standard concerned (length limited by data rate).
In synchronous mode, the real data rate is equal to twice the bit rate.

5.2.6 Analog Axes

5.2.6.1 General

Number of axes controlled	NUM Power 1020 or 1040: Maximum 6 NUM Power 1060: Maximum 8 NUM Power 1080: Maximum 31
Servo-drive analogue output	1 -10 V/+10 V 14-bit + sign output per axis
Switch contact	1 24 V input per axis (20 to 30 V including 5 % ripple)
Switch input impedance	2.15 kΩ (2 to 2.5 kΩ)
Switch input current	11 mA minimum

The axis interfaces allow the CNC to control the axes: control of the servo-drives and processing of the encoder data.

There are four types of axis measurements
- incremental measurement,
- absolute measurement by SSI link (synchronous serial interface),
- measurement by rule with encoded distance reference marks,
- combined measurement: absolute measurement by SSI link + incremental measurement.

Position Sensors Approved by NUM

Incremental sensors: ROD 428B (HEIDENHAIN, DG 60L (STEGMANN), ENH 2E7C55 (CODECHAMP) and C3158-05 (MCB).

Incremental rule with encoded distance reference marks: LS 706C + EXE 612 (HEIDENHAIN).

Single- and multiturn SSI absolute encoders: ROC 424 (Heidenhain), AG 66 and AG 661 (STEGMANN)

Combined encoders: ECN 1313 + IBV 610; EQN 1325 + IBV 650; ROC 412 + IBV 610 and RCN 619 (HEIDENHAIN).

Requirements Concerning Sensors and Their Power Supply

The installation of a sensor is subjected to several requirements:
- minimum sensor power supply voltage (see Sec. 5.2.6.2),
- maximum frequency above which the signals provided by the sensor are no longer counted with accuracy by the system (incremental channels, see Sec. 5.2.6.3),
- maximum available current for supply of the sensors (see Sec. 5.2.6.6).

These requirements determine:
- the minimum power cable size,
- the maximum cable lengths,
- the need or not for an external power supply.

In the case of incremental, SSI and semi-absolute combined encoders, the origin switch must be set after installation.

Consumption of the Axis Interface Module

The specific consumption of the axis interface module is:
- 14 mA maximum on the sensor power supply ("Power on" LED),
- 7 mA maximum on the switch power supply ("/SWITCH" LED)

5.2.6.2 Voltage Across the Sensor

When installing a position sensor, it is necessary to provide the minimum power supply voltage related to the type of sensor used.

5 VDC Sensors

When the NUM power supply is used, the voltage across the sensor is given by the equation:

$Vs = 4.95 - (0.45 + 36.8 \times 10^{-3} \times L/S) \times I$

where:
- Vs (in V) is the voltage across the sensor,
- L (in m) is the cable length (one way only),
- S (in mm^2) is the power conductor cross-sectional area,
- I (in A) is the current through the sensor.

The minimum wire size of the power supply conductors is calculated from the maximum current through the sensor, the minimum voltage across the sensor and the required wire length.

It is recommended not to use wires with a cross-sectional area above 2.624 mm^2. If a larger size is required, the use of an external power supply located near the sensor can reduce the required wire size.

Example of a 5 V ± 5 percent sensor, current rating 220 mA

The computed voltage (Vs) must not be less than 4.75 V.

The table below gives the calculation results obtained for different cable lengths using the NUM power supply:

Cable length	Minimum cross-sectional area	Voltage across the sensor
20 m	1.65 mm^2	4.753 V
30 m	2.624 mm^2	4.758 V

Above 30 m, the wire size required would be above 2.624 mm^2. In this case, use an external power supply whose characteristics provide a minimum voltage of 4.75 V across the sensor while preserving a reasonable wire size.

Sensors Requiring a Power Supply Voltage Above 5 VDC

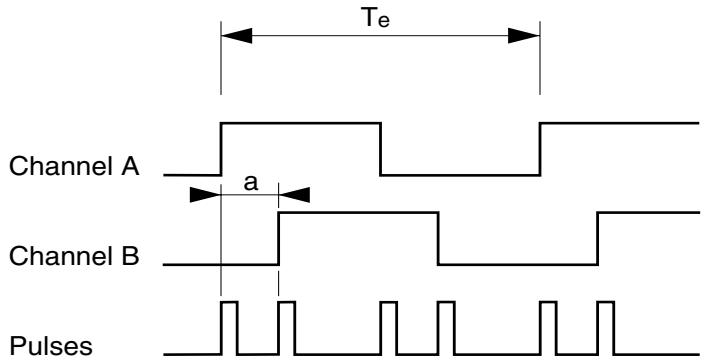
The use of an external power supply is mandatory.

Sensors with Sinusoidal Waveforms

Voltage: 1 Vpp

5.2.6.3 Maximum Incremental Sensor Channel Output Frequency (Incremental or Combined Sensors)

The diagram below shows the waveform of the signal on sensor channels A and B:



T_e : signal period on one of the channels

a : time between two edges

The sensor channel output frequency $f_e = 1 / T_e$

Extreme values allowing correct signal detection by the system:
- Maximum frequency: $f_{e\,max} = 1.8$ MHz
- Minimum time between two edges: $a_{min} = 138$ ns.

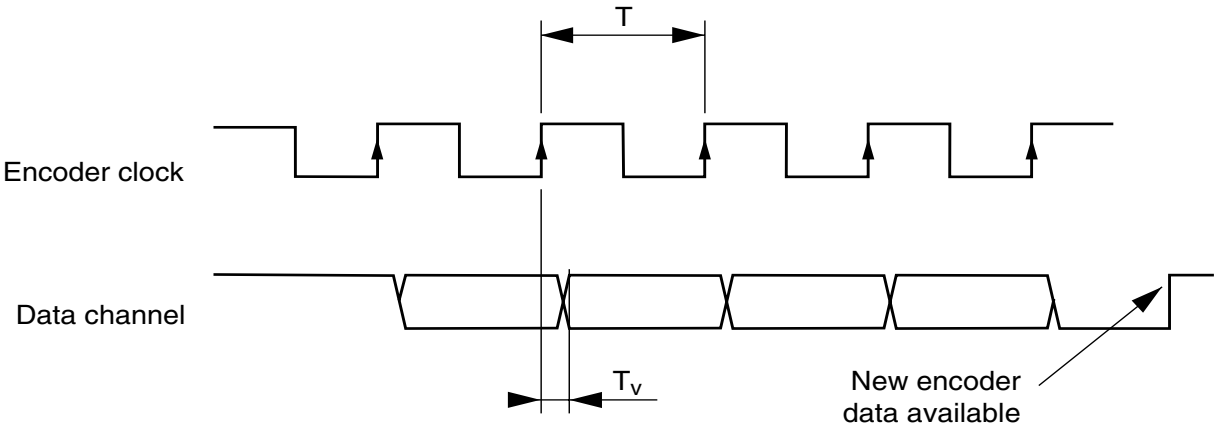
The minimum time between two edges allowing correct signal detection by the system depends on the length and type of cable used. The table below gives the results of tests conducted with [4 x (2 x 0.14 mm^2)] shielded cables connecting the sensor to the axis encoder card and using an external power supply:

Cable length	Minimum time between two edges
10 m	147 ns
20 m	156 ns
50 m	250 ns

5.2.6.4 Setting the Reference Signal (Rules with Encoded Distance Reference Marks)

The reference signal (Z pulse) must be set for an electrical angle of 90 degrees. This setting can be made on the EXE or IBV units.

5.2.6.5 Serial Timing Diagram (SSI)



f_{clock} = 1/T, minimum 125 kHz, maximum 2.5 MHz

Tv: Minimum 50 ns, maximum T

Synchronisation and data bits: Maximum 32

Status bits: Maximum 4

Parity bit: Maximum 1

REMARK *The synchronisation bits are leading 0's in the frame (not present on most encoders).*

Deending on the clock frequency and sensor cable length L, the clock output (RCLK) is connected to the clock input (ECLK) on the interface or the sensor:

Sensor clock frequency	Connection to interface	Connection to sensor
125 kHz	L < 320 m	L < 320 m
250 kHz	L < 160 m	L < 200 m
500 kHz	L < 50 m	L < 100 m
625 kHz	L < 40 m	L < 85 m
1000 kHz	L < 20 m	L < 75 m
1250 kHz	L < 15 m	L < 60 m
2000 kHz	----	L < 50 m
2500 kHz	----	L < 25 m

5.2.6.6 Maximum Available Current per Axis

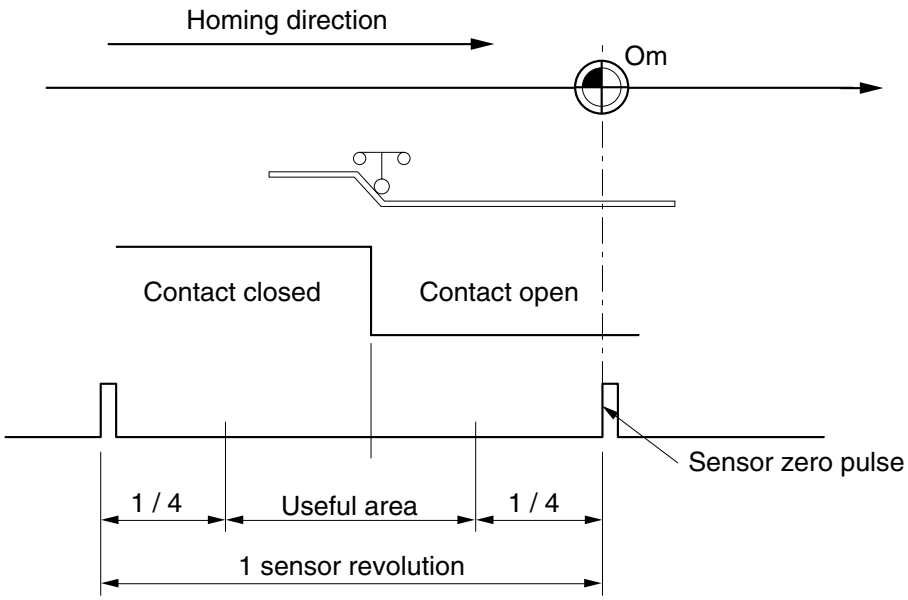
Each axis interface can supply a maximum of 350 mA.

The current draw of all the sensors connected cannot exceed 1.5 A.

Above these values, an external power supply should be used.

5.2.6.7 Setting the Origin Switch

Homing is carried out on the zero pulse following opening of the origin switch:

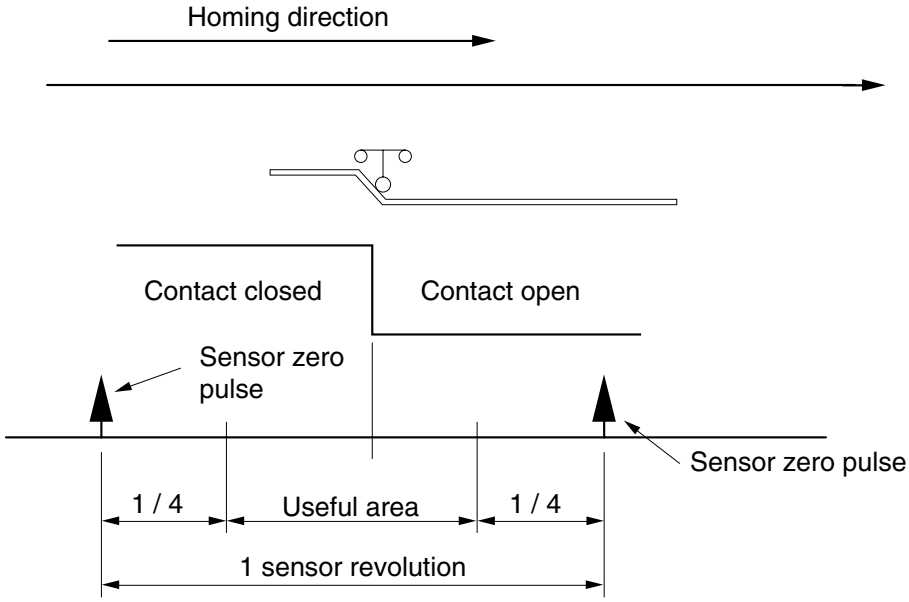


The switch must be set so that the contact opens between one-quarter and three-quarters of the distance separating two zero pulses. This is to avoid coincidence between switch operation and the zero pulse, which could cause a random shift by a distance equal to that separating two zero pulses.

The switch size should be such that the contact opens before detection of the sensor zero pulse and remains open until the axis stops after detection of the zero pulse.

5.2.6.8 Setting the Origin Switch (SSI or Combined Sensor with semiabsolute Measurement)

The axis travel exceeds the sensor measurement travel. Homing is carried out on opening of the origin switch. It is used to identify the sensor revolution on which the switch operates:



The electrical contact opening signal must be clean, without bounce.

The switch must be set so that the contact opens between one-quarter and three-quarters of the distance separating two zero pulses. This is to avoid coincidence between switch operation and the zero pulse, which could cause a random shift by a distance equal to that separating two zero pulses.

The switch size should be such that the contact opens before detection of the sensor zero pulse and remains open until the axis stops after detection of the open contact on the switch input.

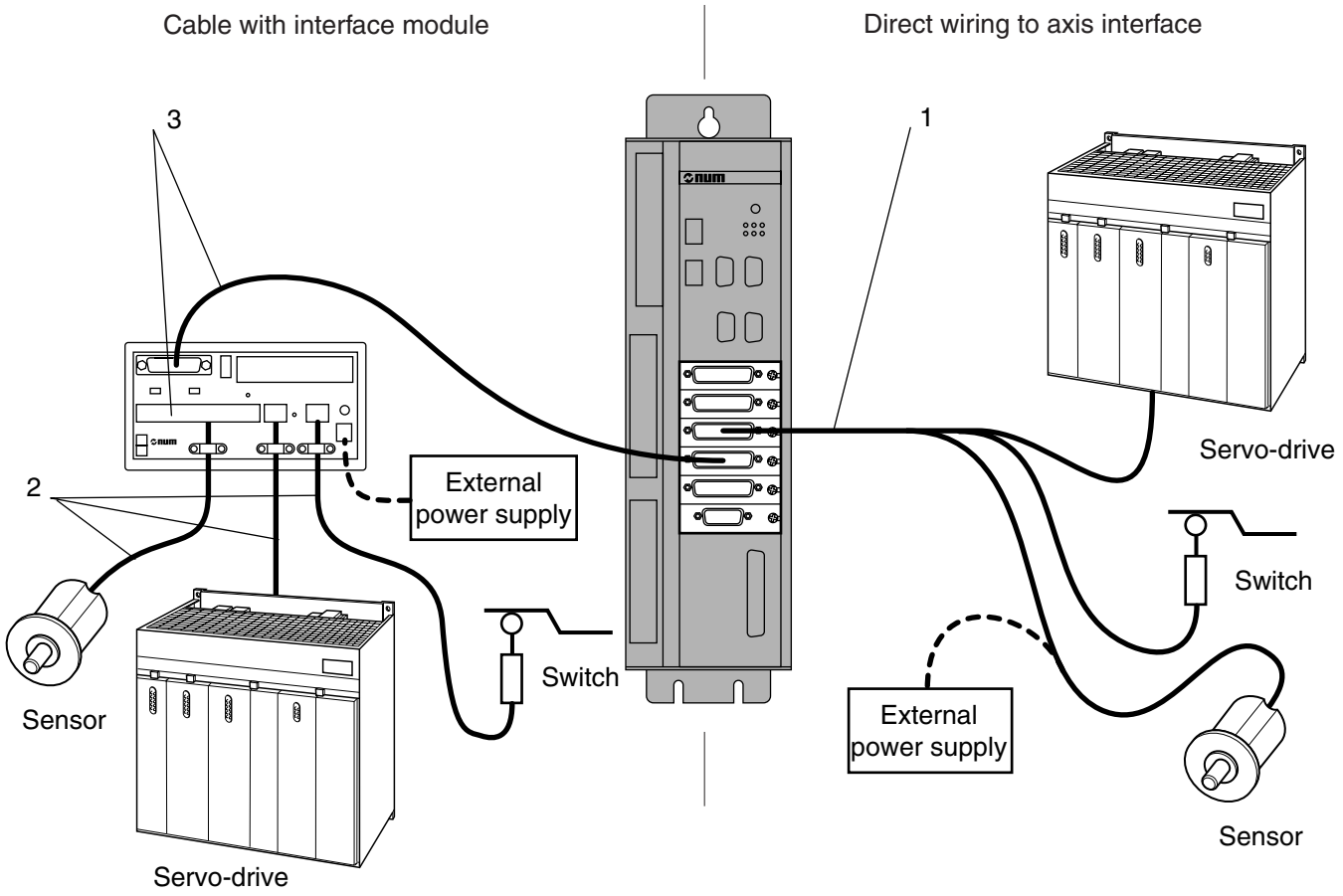
5.2.6.9 Homing of SSI or Combined Sensors with Absolute Measurement

The axis travel is less than the sensor measurement travel. Homing is made at any point of the axis travel at power on or after a reset of the CNC.

The axis connector switch input should not be wired.

REMARK The sensor zero pulse must be outside the axis travel.

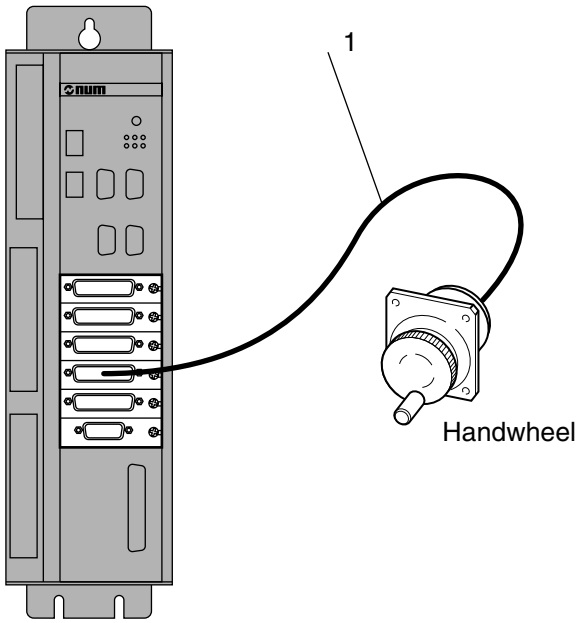
5.2.6.10 Axis Connection Diagram



1 - Axis cable (see table below, Direct wiring column)
2 - Axis cables (see table below, Wiring with interface module column)
3 - Axis interface module (P/N 263900000) and cable 1.5 m long (P/N 260900000)

Axis type	Power supply	Direct wiring (see Sec.)	Wiring with interface module (see Sec.)
Incremental	Supplied by the interface External	6.2.1.1 6.2.1.1 and 6.2.6	6.2.1.2 and 6.2.7 Same as above
SSI absolute measurement	Supplied by the interface External	6.2.2.1 6.2.2.1 and 6.2.6	6.2.2.2 and 6.2.7 Same as above
SSI semiabsolute measurement	Supplied by the interface External	6.2.3.1 6.2.3.1 and 6.2.6	6.2.3.2 and 6.2.7 Same as above
Combined: SSI + incremental Sinusoidal pulses	Supplied by the interface External	6.2.4.1 6.2.4.1 and 6.2.6	6.2.4.2 and 6.2.7 Same as above
Combined: SSI + incremental Square pulses	Supplied by the interface External	6.2.5.1 6.2.5.1 and 6.2.6	6.2.5.2 and 6.2.7 Same as above

5.2.6.11 Handwheel Connection Diagram



1 - Handwheel cable
- with nondifferential outputs (see Sec. 6.2.8)
- with differential outputs (see Sec. 6.2.9)

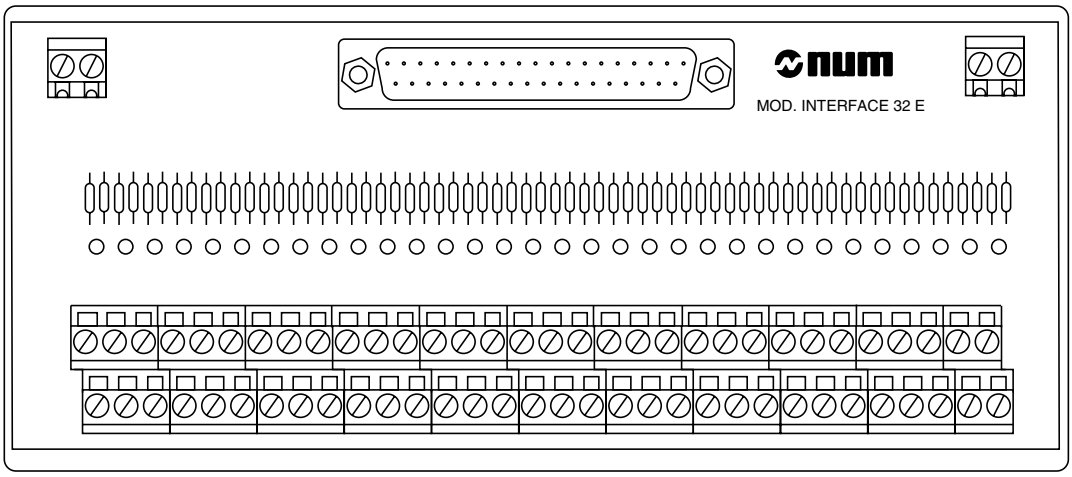
5.2.7 Discrete Inputs

The NUM Power CPU receives input signals via the front panel Input connector. There can be 32 inputs (32-24 I/O card) or 64 inputs (64-48 I/O card). The inputs can be wired via an interface module (see Sec. 5.2.7.2) or directly on the connector (see Sec. 5.2.7.4).

5.2.7.1 Input Characteristics

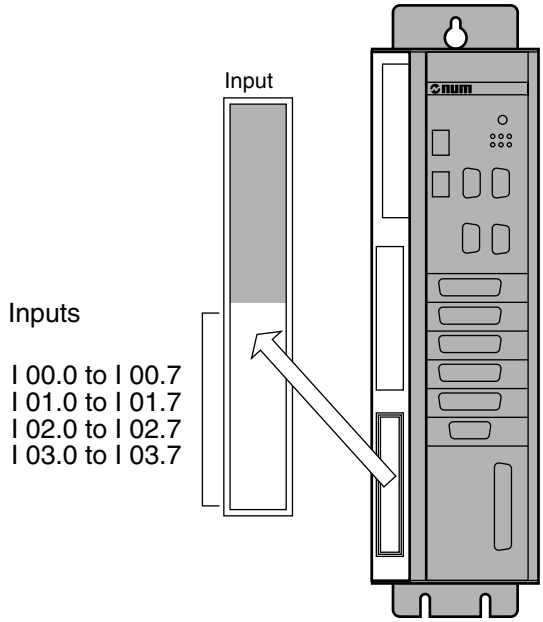
32-24 I/O card	32 inputs: I 00.0 to I 03.7
64-48 I/O card	64 inputs: I 00.0 to I 07.7

Input characteristics via the 32-input interface module

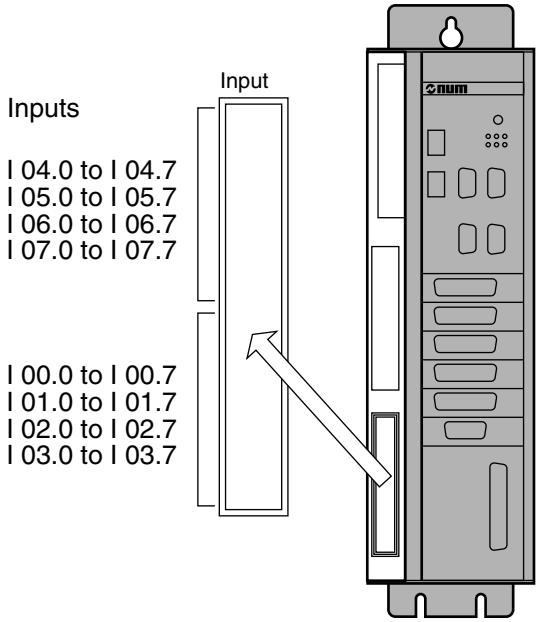


32 discrete inputs	Complying with IEC 1131 type 2
Power consumption	30 W maximum (all inputs switched)
Input ratings Nominal voltage Maximum current	 24 VDC 30 mA per input
Operating ranges	low level: 0 to 5 V high level: 11 to 30 V
Delay	5 ms ± 10 %
Wire size	0.2 to 2.5 mm^2 multistrand or 0.2 to 4 mm^2 single strand
Display	32 LEDs (LED lit: high level)

Characteristics of the inputs wired to the connector



With 32-24 I/O card

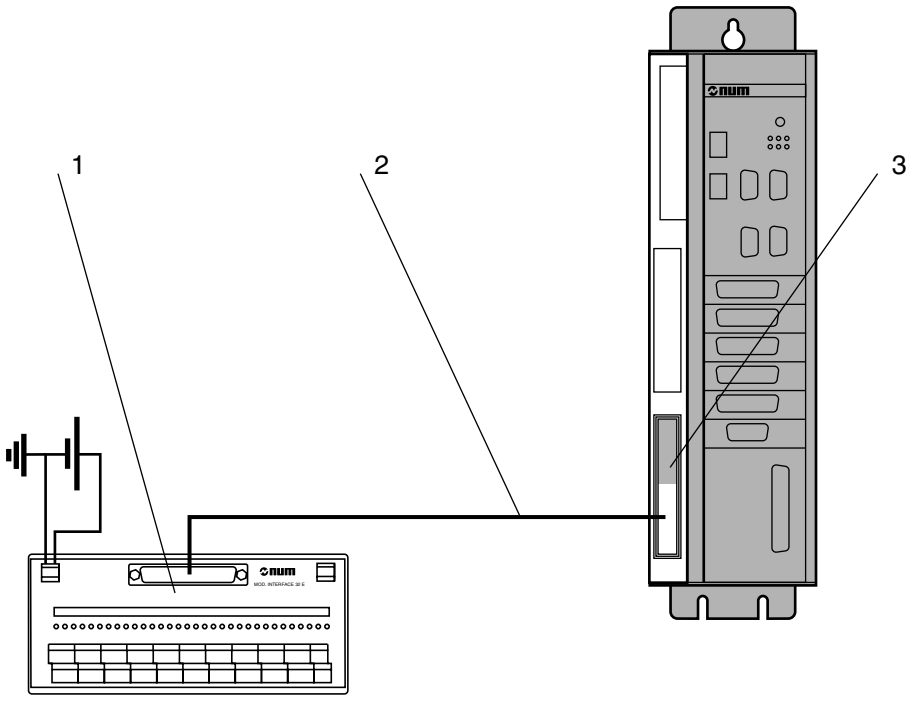


With 64-48 I/O card

Discrete inputs	Complying with IEC 1131 type 1
Input ratings	
Nominal voltage	24 VDC
Voltage limits	15-30 VDC
Maximum current	8 mA per input
Operating ranges	low level: 0-9 V (current < 2 mA) high level: 12-30 V (current > 4 mA)
Input impedance	4.7 kΩ
Reverse voltage withstand	30 VDC continuous
Response time	4.7 ms
Scanning time	2.6 ms
Sensor common	Positive power supply terminal
Logic	Positive (current sink)
Protection	Very-fast-blow 10A 5 x 20 glass fuse (FF) - the card includes spare fuses

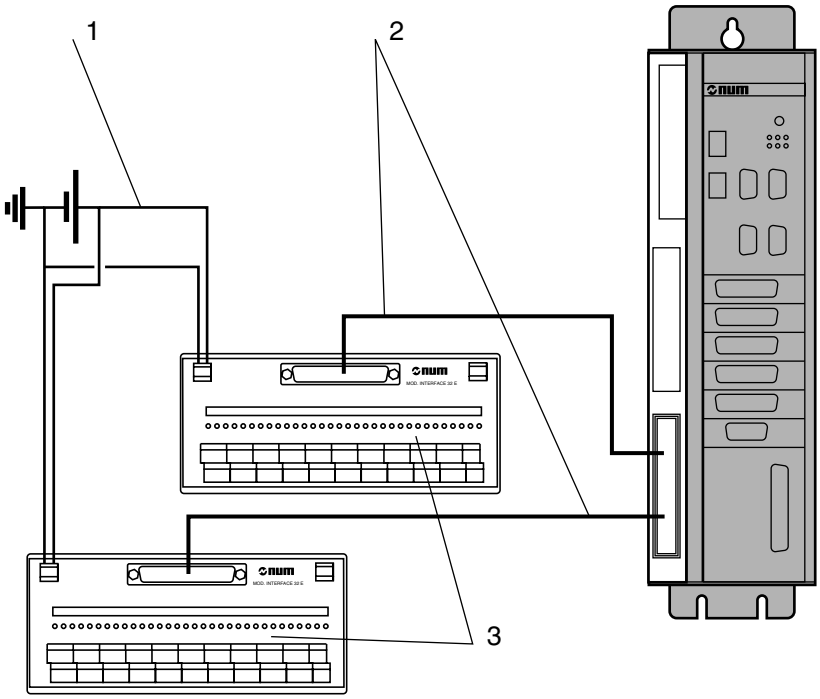
5.2.7.2 Connection Diagram for Inputs with Interface Panel

With 32-24 I/O Card



1 - 32-input interface module (P/N 263900001)
See Sec. 5.2.7.3: Interface Panel Connections and Customisation
2 - Card/Interface module connecting cable
- Length 1 m (P/N 263203077)
- Length 2 m (P/N 263203078)
- Length 5 m (P/N 263203611)
See Sec. 6.4.3: Installing the Input/Output Cables
3 - Leave the cover in place on the top part of the connector

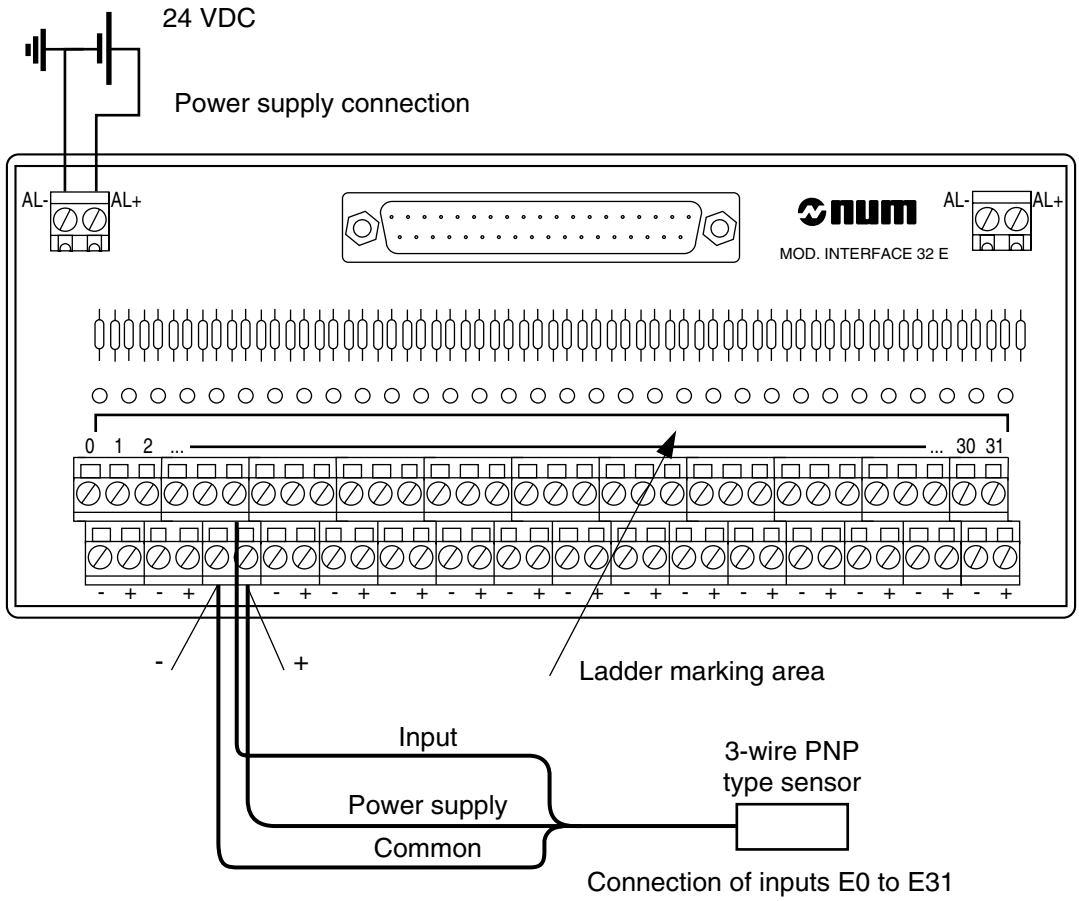
With 64-48 I/O Card



1 - Power supply common to the two interface panels
2 - Card/interface panel connecting cable
  - Length 1 m (P/N 263203077)
  - Length 2 m (P/N 263203078)
  - Length 5 m (P/N 263203611)

  See Sec. 6.4.3: Installing the Input/Output Cables
3 - 32-input interface panels (P/N 263900001)
  See Sec. 5.2.7.3: Interface Panel Connections and Customisation

5.2.7.3 Interface Panel Connections and Customisation



Input Connection

Three-wire sensors must be wired to one of the 32 inputs (E00 to E31) and to the power supply line (+) and common wire (-) closest to this input.

Two-wire sensors must be wired to one of the 32 inputs and to the power supply line (+) closest to this input.

All the power supply lines (+) are interconnected. All the common wires (-) are interconnected.

Power Supply Connection

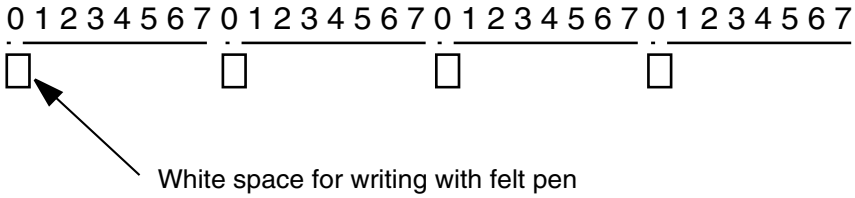
The interface panel must be connected to a 24 VDC power supply on terminals AL- and AL+ of one of the two power supply terminal blocks.

Customising the Interface Panels - Correspondence with Ladder Notation

An interface panel can be connected to the low part of the input connector (first 32 inputs) or the high part of the input connector (next 32 inputs, only with a 64-48 I/O card). The table below gives the correspondence between the marking of the interface board terminals and the connector inputs:

Input	E0 to E7	E8 to E15	E16 to E23	E24 to E31
High part: First 32 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
Low part: Next 32 inputs (64-48 I/O card)	I 04.0 to I 04.7	I 05.0 to I 05.7	I 06.0 to I 06.7	I 07.0 to I 07.7

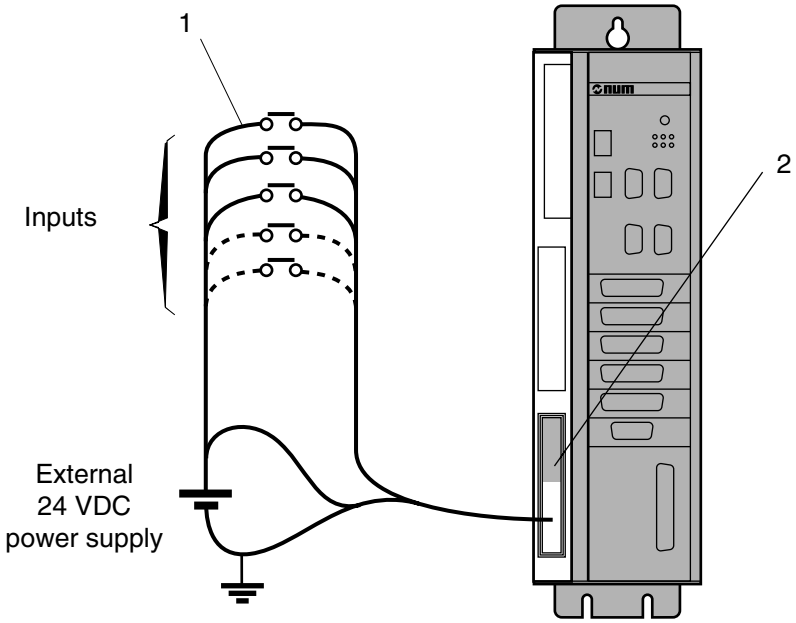
The interface panel includes a marking area for Ladder notation. Detail of the marking area:



The numbers to be written in the marking area are:
- 0, 1, 2 and 3 when the interface panel is connected to the low part of the input connector,
- 4, 5, 6 and 7 when the interface panel is connected to the high part of the input connector.

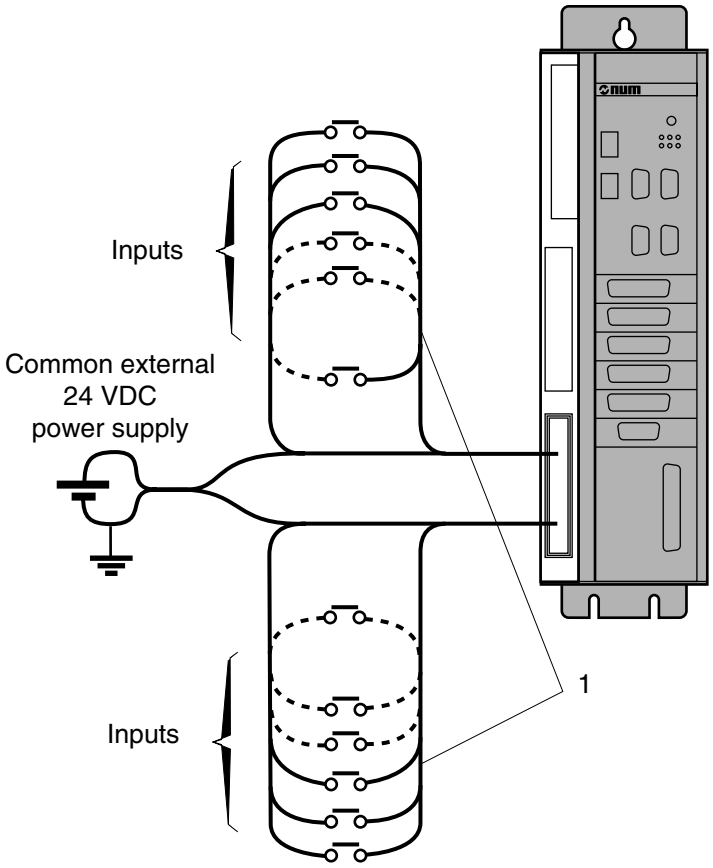
5.2.7.4 Connection Diagram for Inputs without Interface Panel

With 32-24 I/O Card



1 - 32-input cable (see Sec. 6.4.1)
2 - Leave the protection in place on the top part of the connector

With 64-48 I/O Card



1 - 32-input cable (see Sec. 6.4.1)

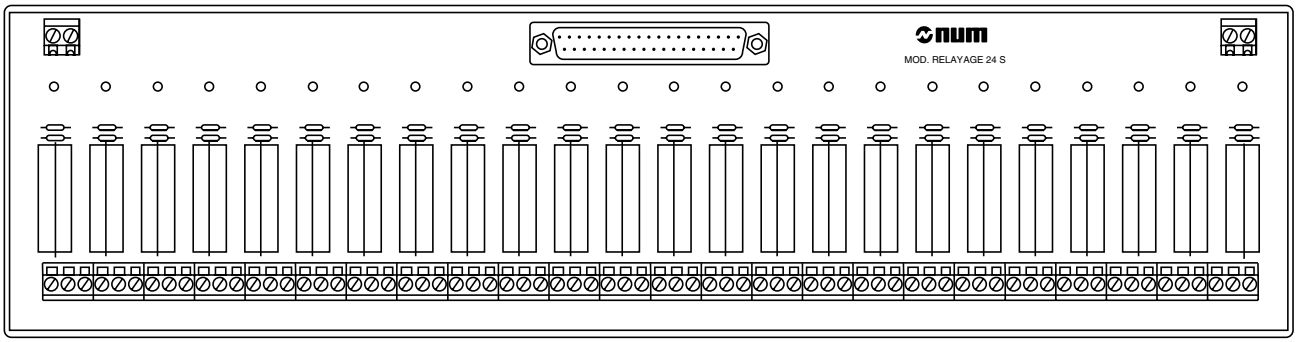
5.2.8 Outputs

The NUM Power CPU sends output signals via the front panel Output connector. There can be 24 outputs (32-24 I/O card) or 48 outputs (64-48 I/O card). The outputs can be wired via a relay module (see Sec. 5.2.8.2) or directly to the connector (see Sec. 5.2.8.4).

5.2.8.1 Output Characteristics

32-24 I/O card	24 outputs: O 00.0 to O 02.7
64-48 I/O card	48 outputs: O 00.0 to O 05.7

Characteristics of the Outputs Wired via the 24-Output Relay Module



24 relayed outputs	Outputs and complemented outputs
Power consumption	24 W maximum (all outputs switched)
Power supply current	1.1 A
Isolation voltage between inputs (Sub.D) and outputs	4 kV
Isolation with respect to the rail	2.5 kV
Wire size	0.2 to 2.5 mm^2 multistrand or 0.2 to 4 mm^2 single strand
Display	24 LEDs (LED lit: high level)

Relay Characteristics

Maximum output current	8 A
Thermal current	see derating curve
Operating voltages	24 or 48 VDC 24, 48, 110 or 230 VAC
Maximum voltages	250 VAC 125 VDC
Mechanical life	30,000,000 operations
Electrical endurance	See below
Response time at 20½C at nominal voltage	pick-up: 10 ms drop-out: 5 ms bounce: 10 ms

Relays qualified by NUM: Schrack RP418024 and Omron GR21-24V

Electrical Endurance versus Load

The numbers of operations are statistical values given only for reference.

AC voltage: resistive load (category AC1)

Voltage	Current	Number of operations
24 to 250 V	5 A	200 000
24 to 250 V	2 A	1 000 000

AC voltage, inductive load, 0.3 < power factor < 0.7 (category AC11)

Voltage	Current	Number of operations
24 to 250 V	2 A	500 000
24 to 250 V	1 A	2 000 000
24 to 250 V	0.4 A	5 000 000

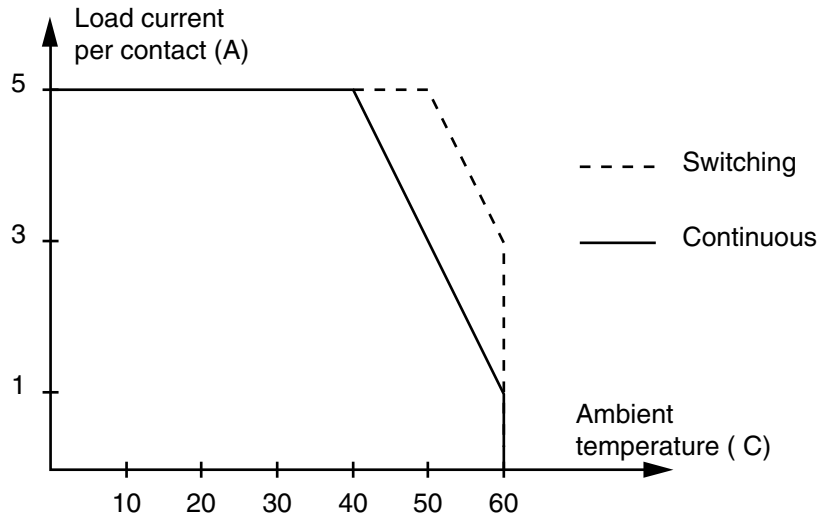
DC voltage, resistive load (category DC1)

Voltage	Current	Number of operations
24 V	1 A	1 000 000

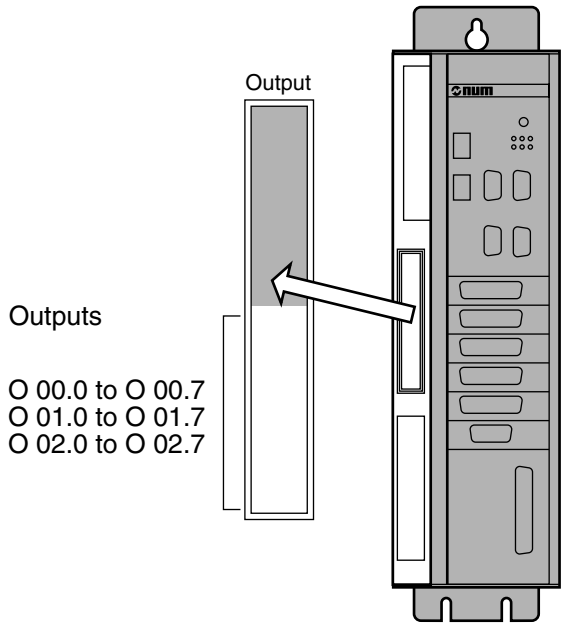
DC voltage, inductive load, L/R = 40 ms (category DC11)

Voltage	Current	Number of operations
24 V	1 A	250 000
48 V	0.4 A	250 000

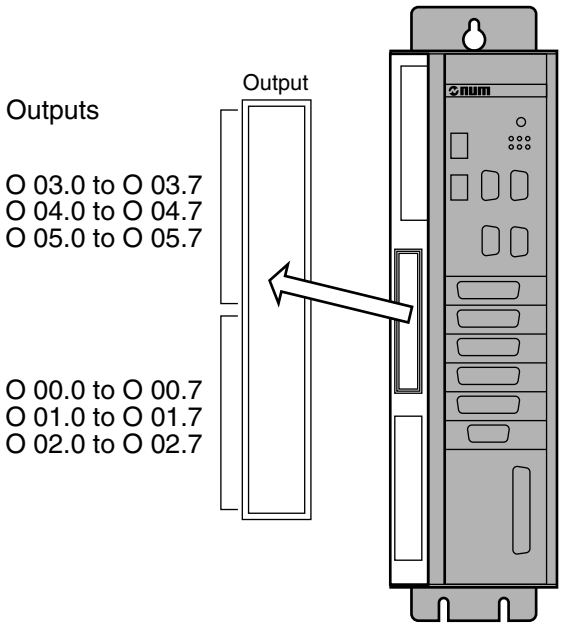
Derating Curve



Characteristics of the Outputs Wired to the Connector



With 32-24 I/O card

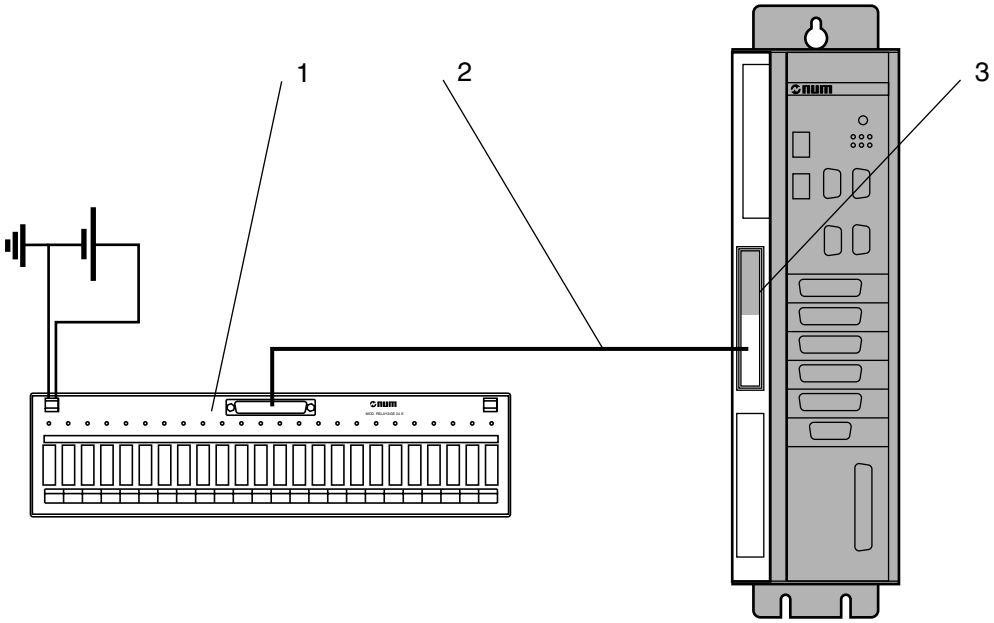


With 64-48 I/O card

Discrete outputs	Semiconductors
Output interface	
Nominal voltage	24 VDC (external power supply)
Voltage limits	15-30 VDC
Internal consumption	30 mA maximum
Output ratings	
Nominal voltage	24 VDC (external power supply)
Rated current	250 mA per output
Limit values	
Voltage	19.2-30 VDC
Current (at 55 °C maximum)	0.5 A maximum per output
Maximum current	10 A for all outputs (protection by fuse)
Switching frequency	
- On resistive load (12 W)	100 operations/s
- On inductive load (12 W)	1000 operations/h
- On filament lamp (1.2 W)	8 operations/s
Protection per output	Overload and short-circuit (thermal circuit-breaker)
Protection	Very-fast-blow 10 A 5 x 20 glass fuse (FF) - the card includes spare fuses

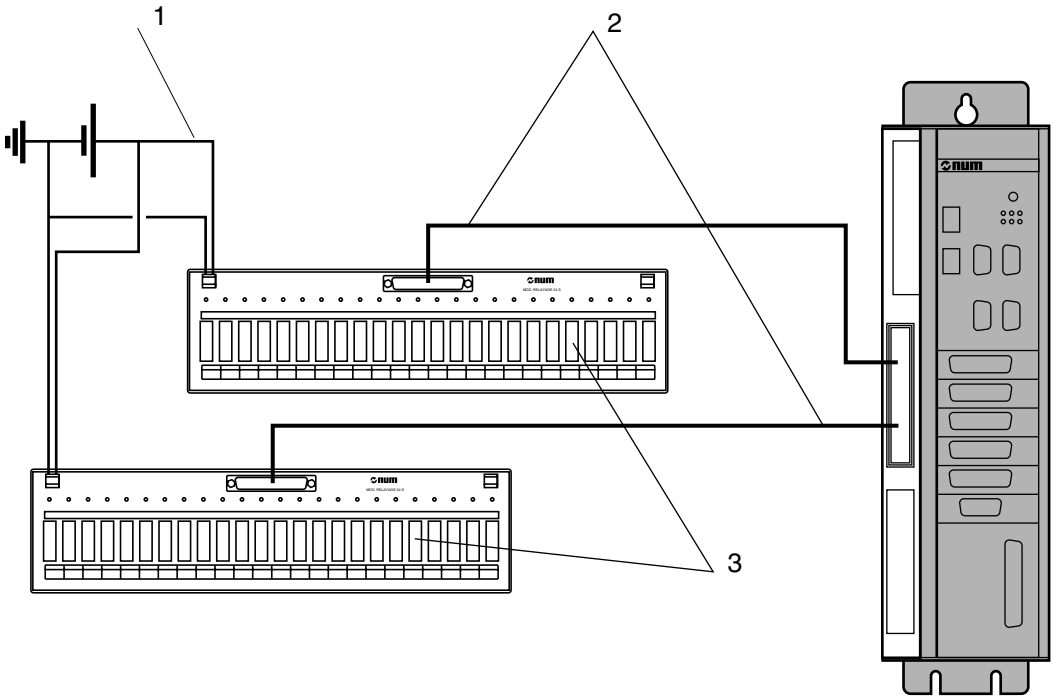
5.2.8.2 Connection Diagram for Outputs with Relay Panel

With 32-24 I/O Card



1 - 24-output relay panel (P/N 263900002)
See Sec. 5.2.8.3: Relay Panel Connections and Customisation
2 - Card/relay panel connecting cable:
- Length 1 m (P/N 263203079)
- Length 2 m (P/N 263203080)
- Length 5 m (P/N 263203612)
See Sec. 6.4.3: Installing the Input and Output Cables
3 - Leave the protection in place on the top part of the connector

With 64-48 I/O Card

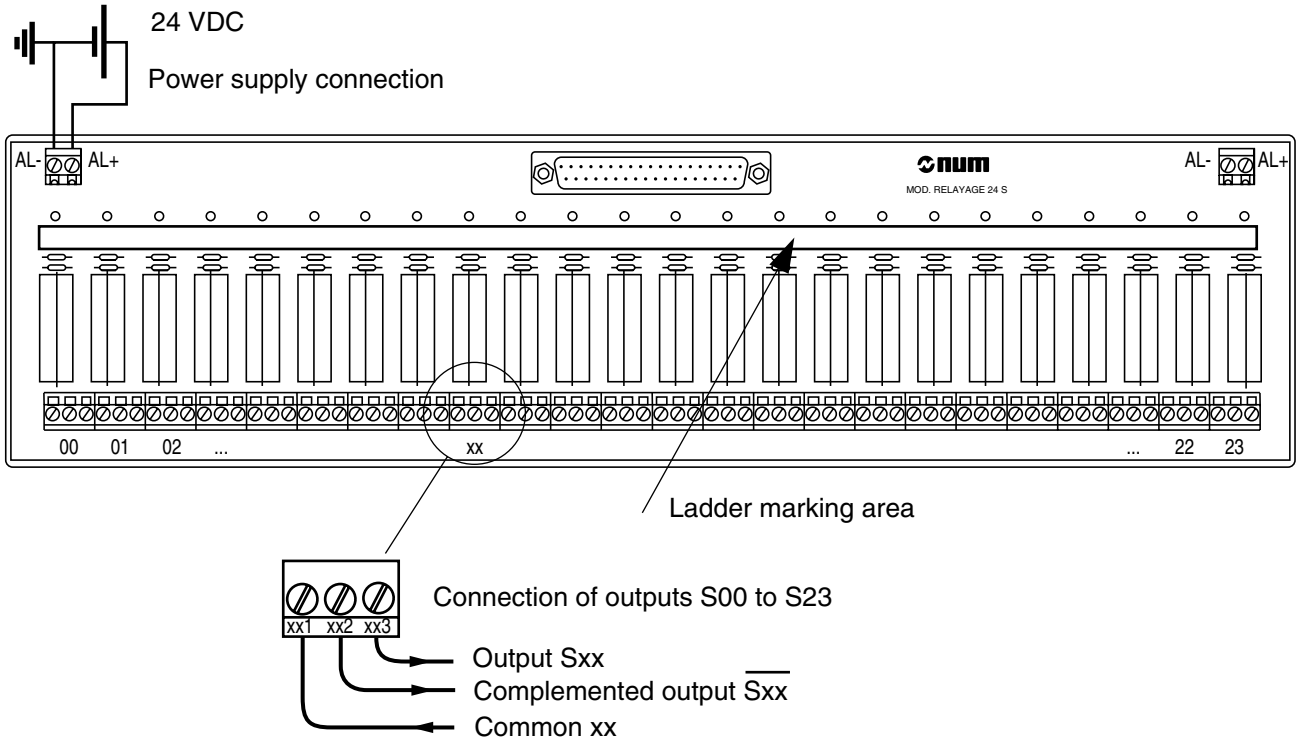


1 - Power supply common to the two relay panels
2 - Card/relay panel connecting cable:
- Length 1 m (P/N 263203079)
- Length 2 m (P/N 263203080)
- Length 5 m (P/N 263203612)

See Sec. 6.4.3: Installing the Input and Output Cables

3 - 24-output relay panels (P/N 263900002)
See Sec. 5.2.8.3: Relay Panel Connections and Customisation

5.2.8.3 Relay Panel Connections and Customisation



Output Connection

The 24 outputs S00 to S23 (and their complements) are available on the relay module output terminal board.

Power Supply Connection

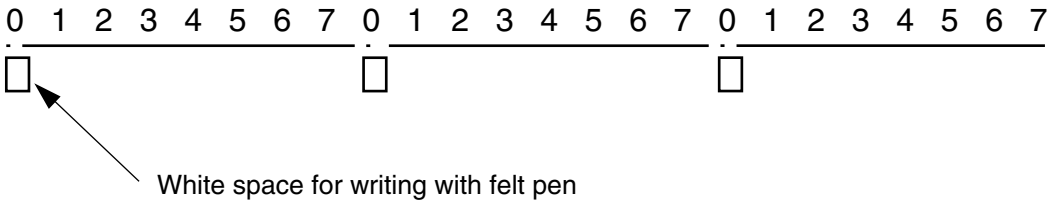
The relay module must be connected to a 24 VDC power supply on terminals AL- and AL+ of one of the two power supply terminal boards.

Customising the Relay Panels - Correspondence with Ladder Notation

A relay panel can be connected to the low part of the output connector (first 24 outputs) or the high part of the output connector (next 24 outputs, only with a 64-48 I/O card). The table below gives the correspondence between the marking of the relay board terminals and the connector outputs:

Output	S00 to S07	S08 to S15	S16 to S23
High part: First 24 outputs	O 00.0 to O 00.7	O 01.0 to O 01.7	O 02.0 to O 02.7
Low part: Next 24 outputs (64-48 I/O card)	O 03.0 to O 03.7	O 04.0 to O 04.7	O 05.0 to O 05.7

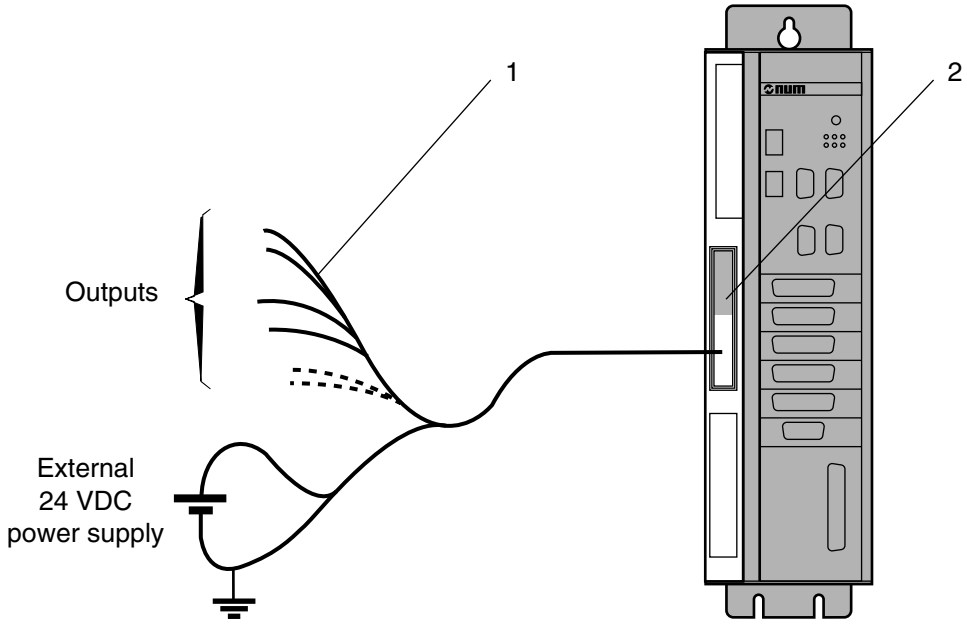
The relay panel includes a marking area for Ladder notation. Detail of the marking area:



The numbers to be written in the marking area are:
- 0, 1 and 2 when the relay panel is connected to the low part of the output connector,
- 3, 4 and 5 when the relay panel is connected to the high part of the output connector.

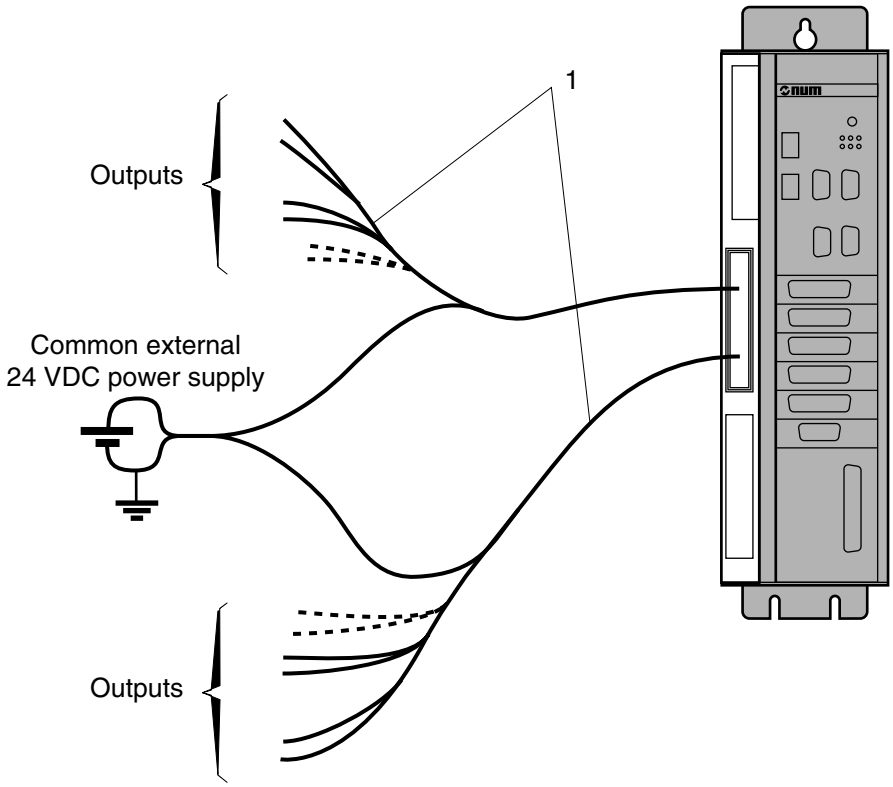
5.2.8.4 Connection Diagram for Outputs without Relay Panel

With 32-24 I/O Card



1 - 24-output cable (see Sec. 6.4.2)
2 - Leave the protection in place on the top part of the connector

With 64-48 I/O Card



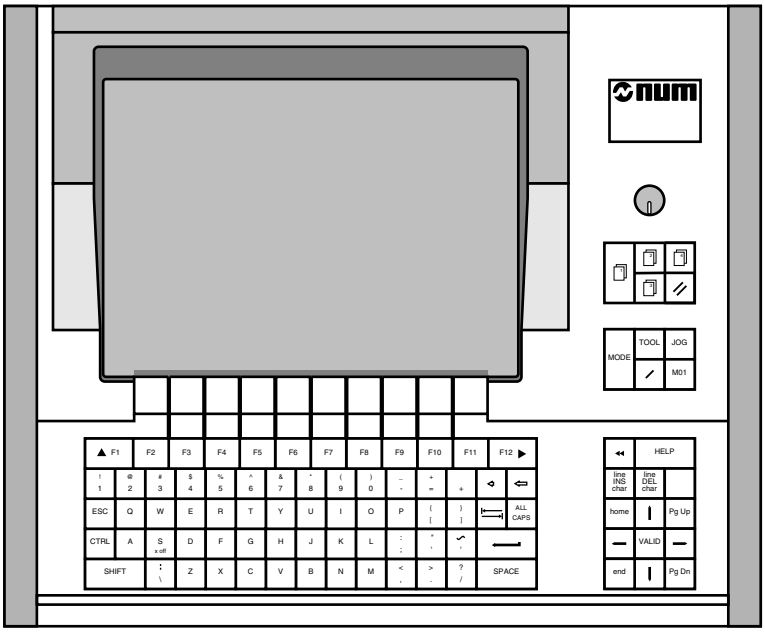
1 - 24-output cable (see Sec. 6.4.2)

5.3 CNC Panels

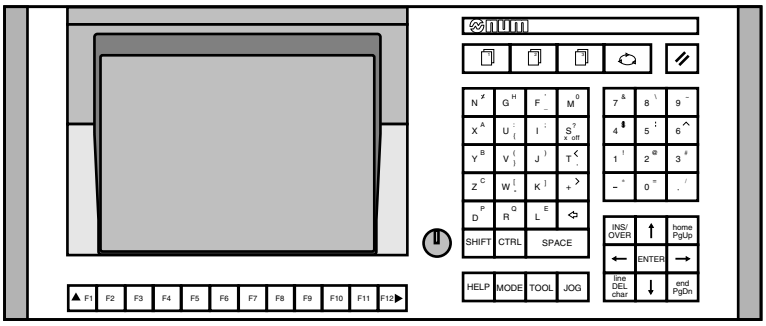
5.3.1 CNC Panels with CRT (CP30, CP20 and MP20)

5.3.1.1 General

QWERTY Panel



50-key panel

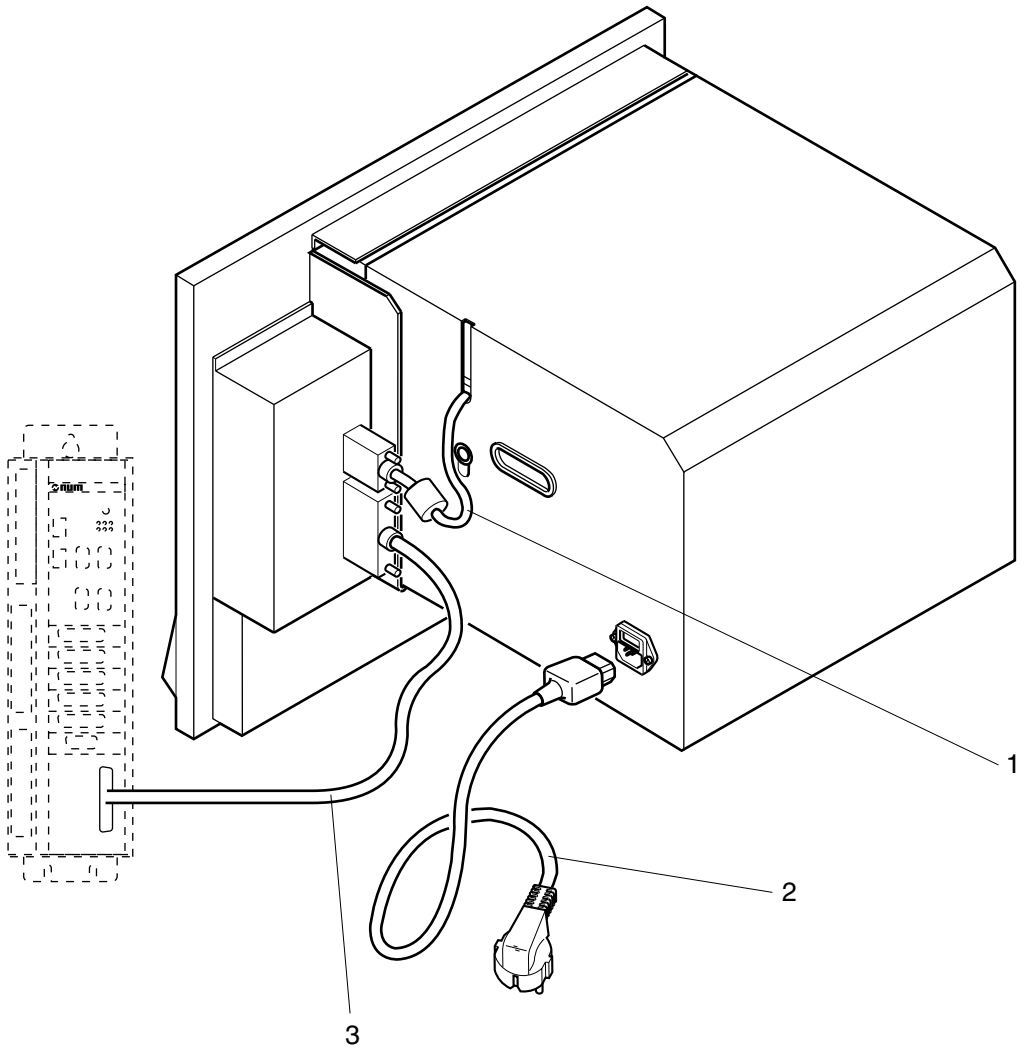


Panel type	Screen type	Maximum VDU power consumption
QWERTY panel	(CP30) 14" colour	100 W
50-key panel	(CP20) 10" colour	60 W
	(MP20) 9" monochrome	30 W
Power supply	230 VAC 50/60 Hz	

The panel provides the interface between the user and system:
- display on the VDU,
- user actions on the keyboard.

The panel communicates with the CNC processor card via a video cable.

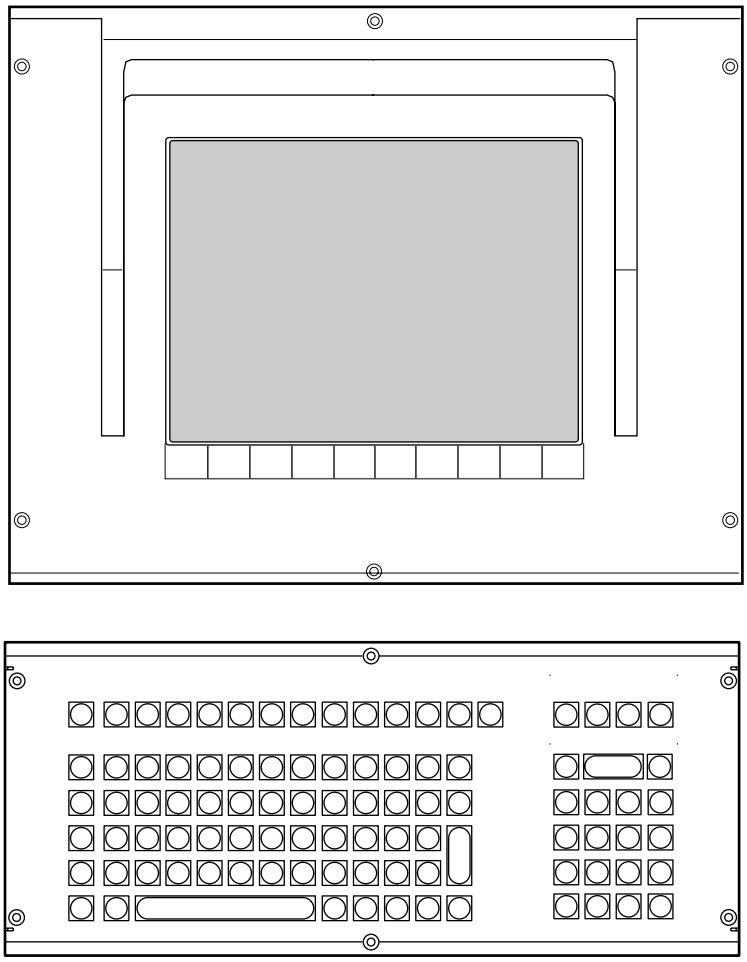
5.3.1.2 Panel Connection Diagram



1 - VDU video cable
2 - Power cable (see Sec. 6.5.2)
3 - Video cable

5.3.2 Panel with LCD Monitor and Keyboard (FS20 + KBD30)

5.3.2.1 General

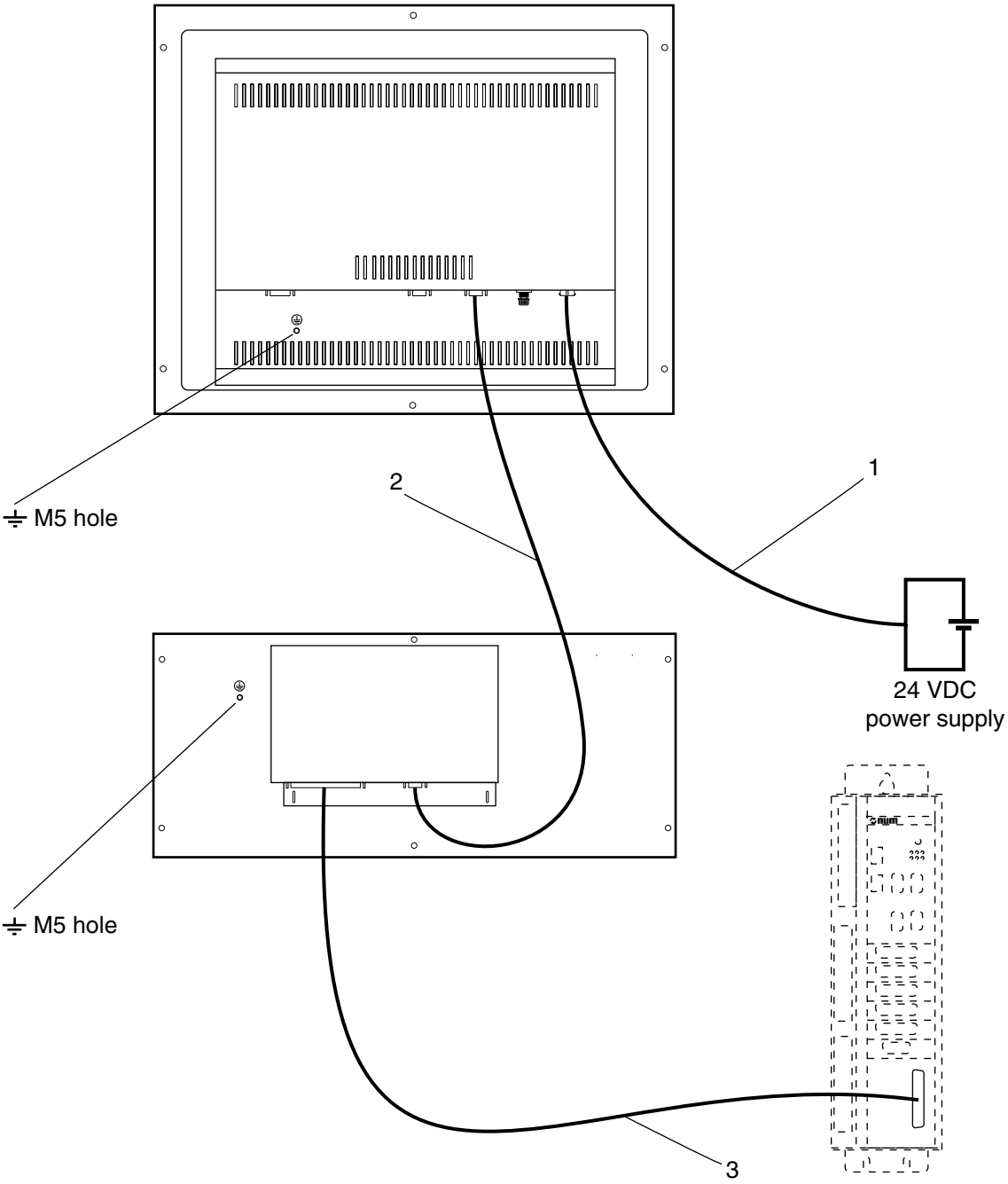


LCD panel	10.4” TFT monitor
Power supply	24 VDC
Maximum LCD power consumption	50 W

The panel provides the interface between the user and system:
- Output on LCD
- User input on keyboard.

The panel communicates with the CPU via a video cable.

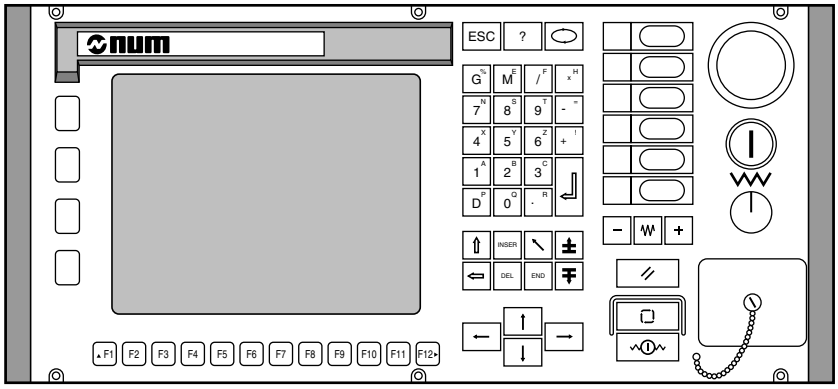
5.3.2.2 Panel Connection Diagram



1 - Power cable (see Sec. 6.5)
2 - 2 m LCD video cable (supplied)
3 - Standard video monitor cable (see Sec. 6.6)

5.4 Compact Panel

5.4.1 General



Compact panel	Screen type	Maximum VDU power consumption
	10" colour	60 W
	9" monochrome	30 W
Power supply	230 VAC 50/60 Hz	

The compact panel is the interface between the operator and the system.

The compact panel communicates with the CPU via a video cable.

The compact panel performs the following functions:
- display on VDU,
- access to the CNC menus,
- axis control,
- settings (homing, etc.),
- programme or MDI block execution (cycles, feed stop),
- special functions by programmable keys,
- machine power on,
- feed rate override by potentiometer,
- emergency stop,
- remote serial line (wiring optional).

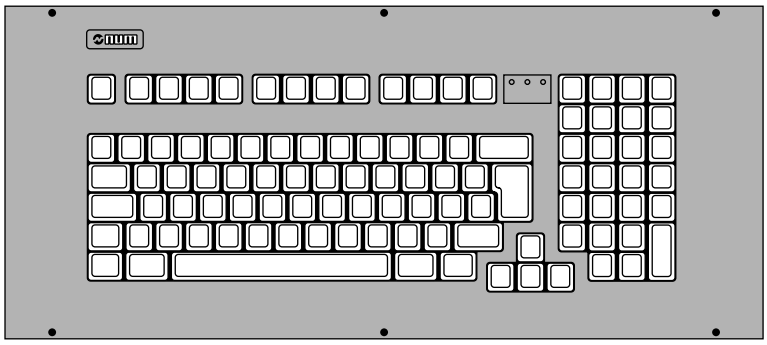
5.4.2 Connection of a 102-Key Keyboard

A standard 102-key PC keyboard can be connected to the front of the compact panel by removing the blanking plate (or to the rear if the DIN connector was moved to the rear, see Sec. 4.2.2), for instance to edit or create part programmes.

⚠ CAUTION

The keyboard should not be connected permanently to the front panel, because the seal is broken when the blanking plate is removed. For a permanent connection, move the connector to the rear of the panel.

5.4.2.1 102-Key QWERTY Keyboard



Keyboard type	US QWERTY, 102 keys
Seal	IP54 on the front, IP20 at the rear

5.4.2.2 Other Keyboards Connectable to the Compact Panel

To be connectable, the keyboard must have the following characteristics:
- US QWERTY, French AZERTY or German QWERTZ 102-key IBM PC/AT compatible keyboard
- Connection by male 5-contact DIN connector
- Maximum current draw 150 mA.

Keyboards tested by NUM

The following keyboards have been tested and found to operate correctly:
- Cherry RS3000, RS6000 and MY3000
- Tanguy AKB2000
- Mitsumi KPQ E99ZC-12.

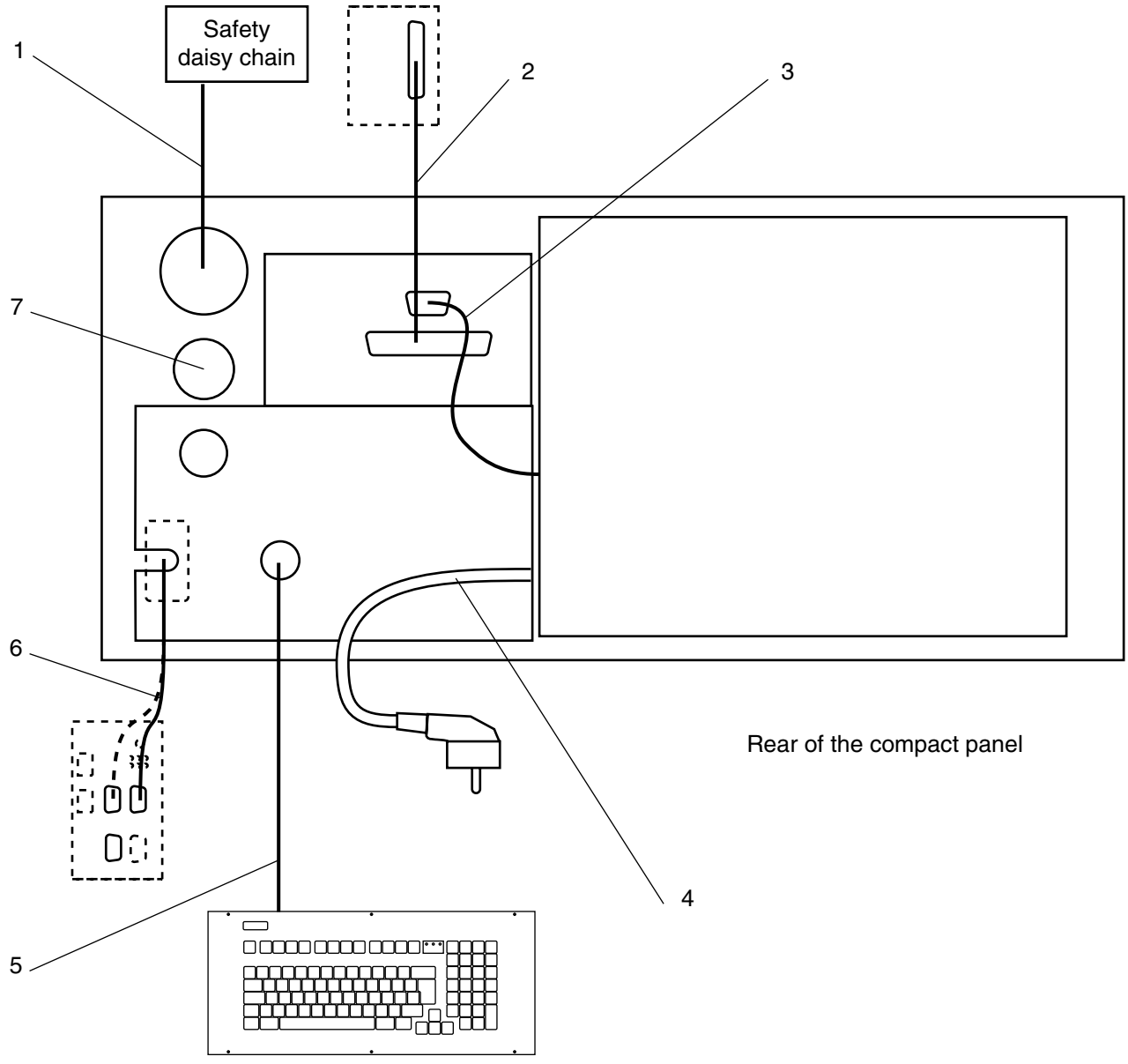
Compaq keyboards are unsuitable because they use different protocols.

5.4.2.3 Declaring the Keyboard

The keyboard connected must be declared by a key combination. The type is then stored. The US QWERTY keyboard is the default system keyboard.

Keyboard type	Key combination (digit to be entered from the numerical keypad)
US QWERTY	"Scroll lock" then "0"
French AZERTY	"Arrêt défilement" then "1"
German QWERTZ	"Roll" then "2"

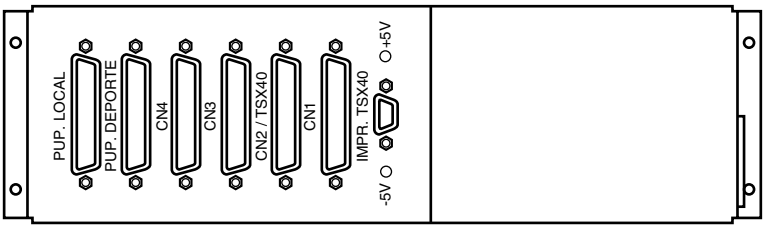
5.4.3 Compact Panel Connection Diagram



1 - Emergency stop wiring (Telemecanique P/N XB2-BS542)
2 - Video cable
3 - VDU video cable
4 - Power cable (see Sec. 6.5.2)
5 - Keyboard connection (on front or rear)
6 - Serial line relay cable:
  - RS 232E line (see Sec. 6.1.5.1)
  - RS 422A or 485 line (see Sec. 6.1.5.2)
7 - On/Off switch wiring (P/N ZB2-BW061)

5.5 Multiplexer Module

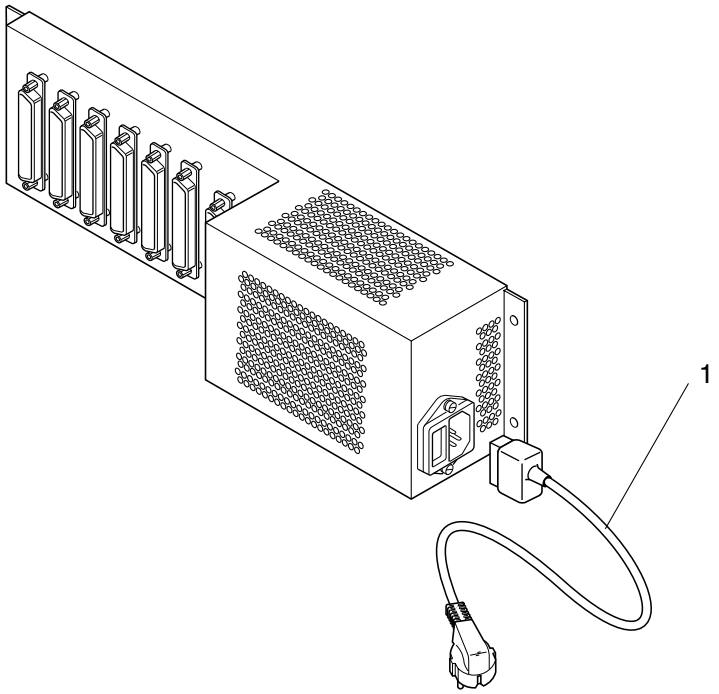
5.5.1 General



Power consumption	25 W
Location	Rear of the panel or external

The multiplexer module is used to associated two to four panels with a CNC (see Sec. 5.2.2.2) or two to four CNCs with a panel (see Sec. 5.2.2.3).

5.5.2 Module Connection Diagram

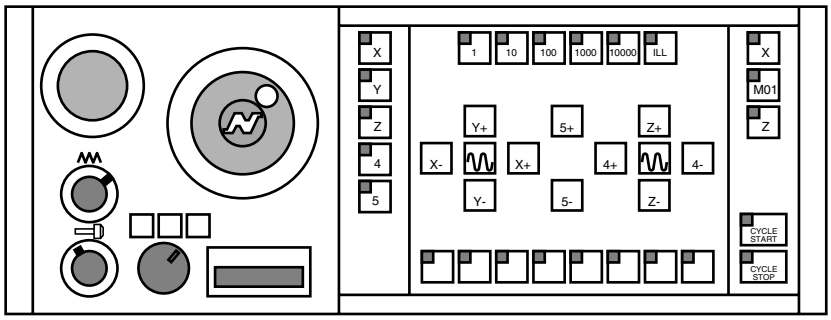


1 - Power cable (see Sec. 6.5.2).

5.6 Machine Panels (MP01 and MP02)

5.6.1 Machine Panel MP01

5.6.1.1 General



Power consumption	3.8 W maximum
Max. current rating	500 mA
Nominal voltage	24 VDC (external power supply)
Limit values	17 V minimum 30 V maximum

The machine panel provides the following functions:
- axis controls,
- machining (cycle start, cycle stop, axis recall, M01 and block skip enable),
- feed rate and spindle speed override by potentiometer,
- mode locking by key switch,
- emergency stop,
- remote serial line (wiring optional,)
- axis control by handwheel (optional).

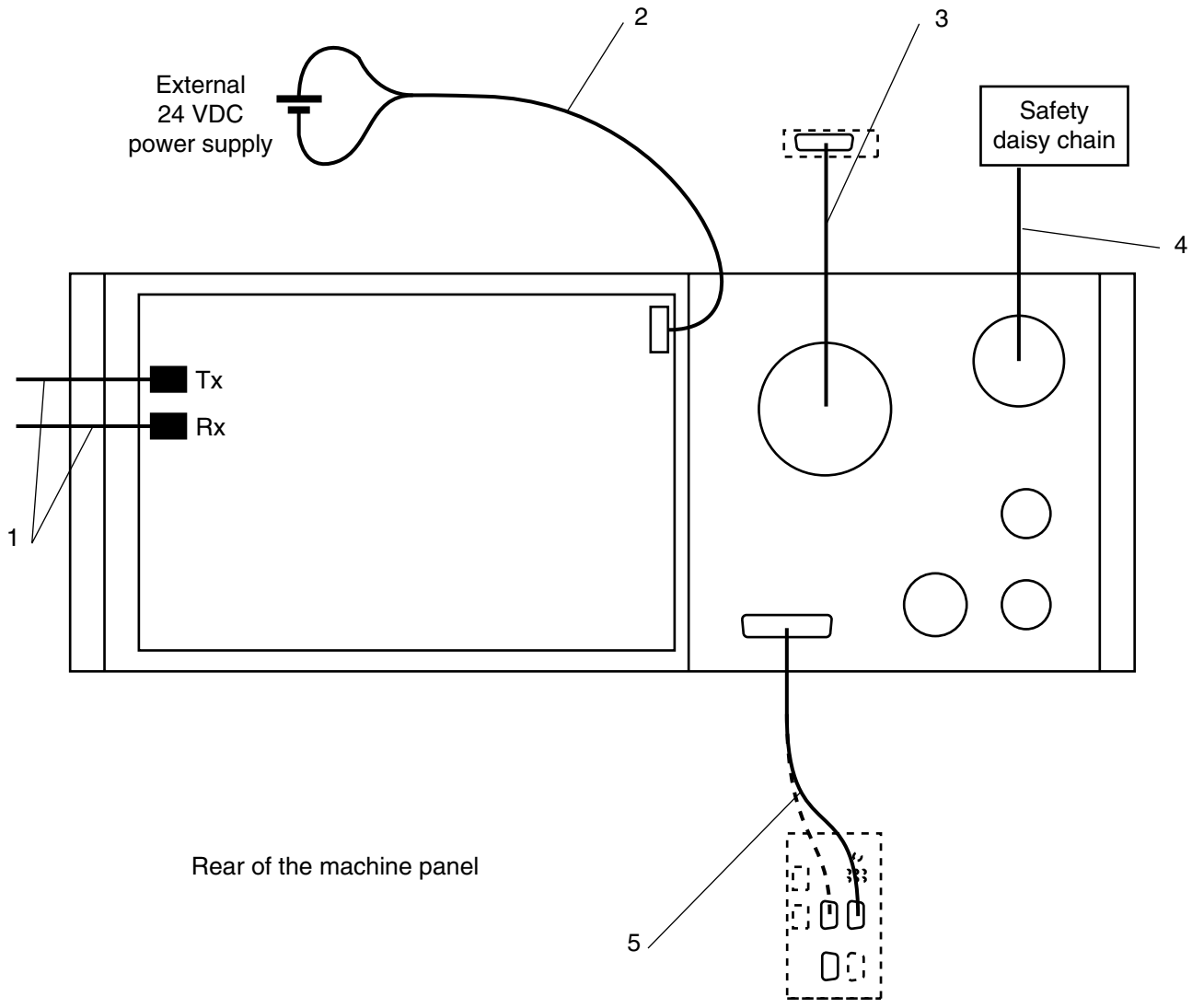
The machine panel can also provide special functions using unassigned keys and LEDs.

In addition, 32 inputs and 24 outputs can be added by using the machine panel extension card.

The machine panel is connected by a fibre optic line to the machine processor via the serial bus.

5.6.1.2 Machine Panel Connection Diagram

The diagram shows the connections at the rear of the panel.



1 - Optical fibre line to CPU
2 - Power cable (see Sec. 6.5.3)
3 - Handwheel cable
4 - Emergency stop wiring (P/N XB2-BS542)
5 - Relay wiring of a serial line:
  - RS 232E line (see Sec. 6.1.6.1)
  - RS 422A or 485 line (see Sec. 6.1.6.2)

5.6.1.3 Machine Panel Extension

General

Internal consumption	520 mA maximum
Location	at the rear of the machine panel
Nominal voltage	24 VDC (external power supply)
Limit values	15 VDC minimum 30 VDC maximum

Inputs

32 discrete inputs	
Current rating	12.8 mA per input
Operating range	low level: 0 to 5 V high level: 11 to 30 V
Input impedance	2060 Ω (low level) 1800-2060 Ω (high level)
Reverse voltage withstand	30 VDC continuous
Logic	positive (current sink)

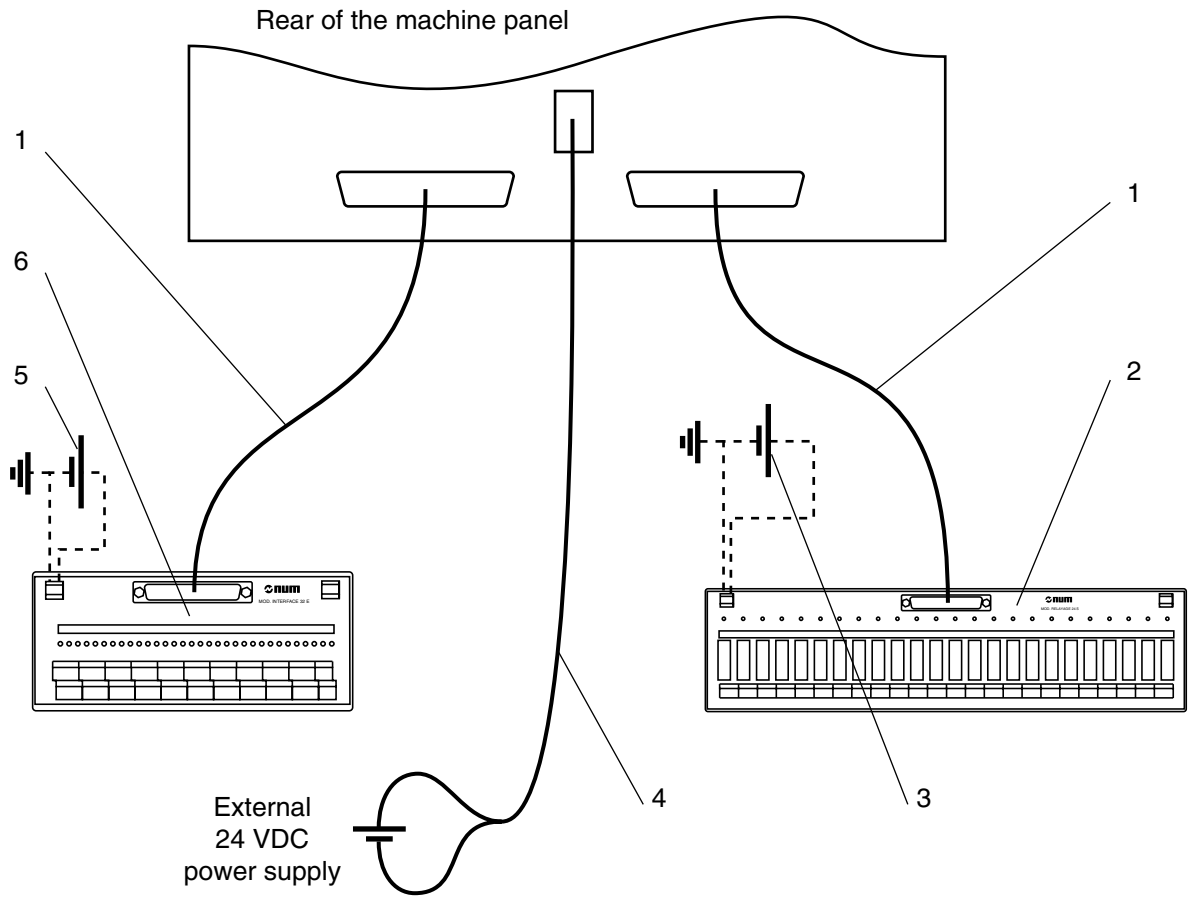
Outputs

24 open-collector discrete outputs	
Maximum current rating Limit value	200 mA per output 3 A per output for t < 10 µs
Protection	short-circuit inductive overvoltage
High level overshoot voltage	0.5 V maximum
Low level leakage current	0.3 mA maximum
Logic	positive (current source)

The machine panel extension is designed for logic data transfers between a second machine panel dedicated to the customer and the PLC application via the NUM machine panel.

The machine panel extension can:
- Communicate with the CPU via the NUM machine panel and optical fibre link
- Receive input signals from pushbuttons via the 32-input connector
- Send output signals to LEDs via the 24-output connector.

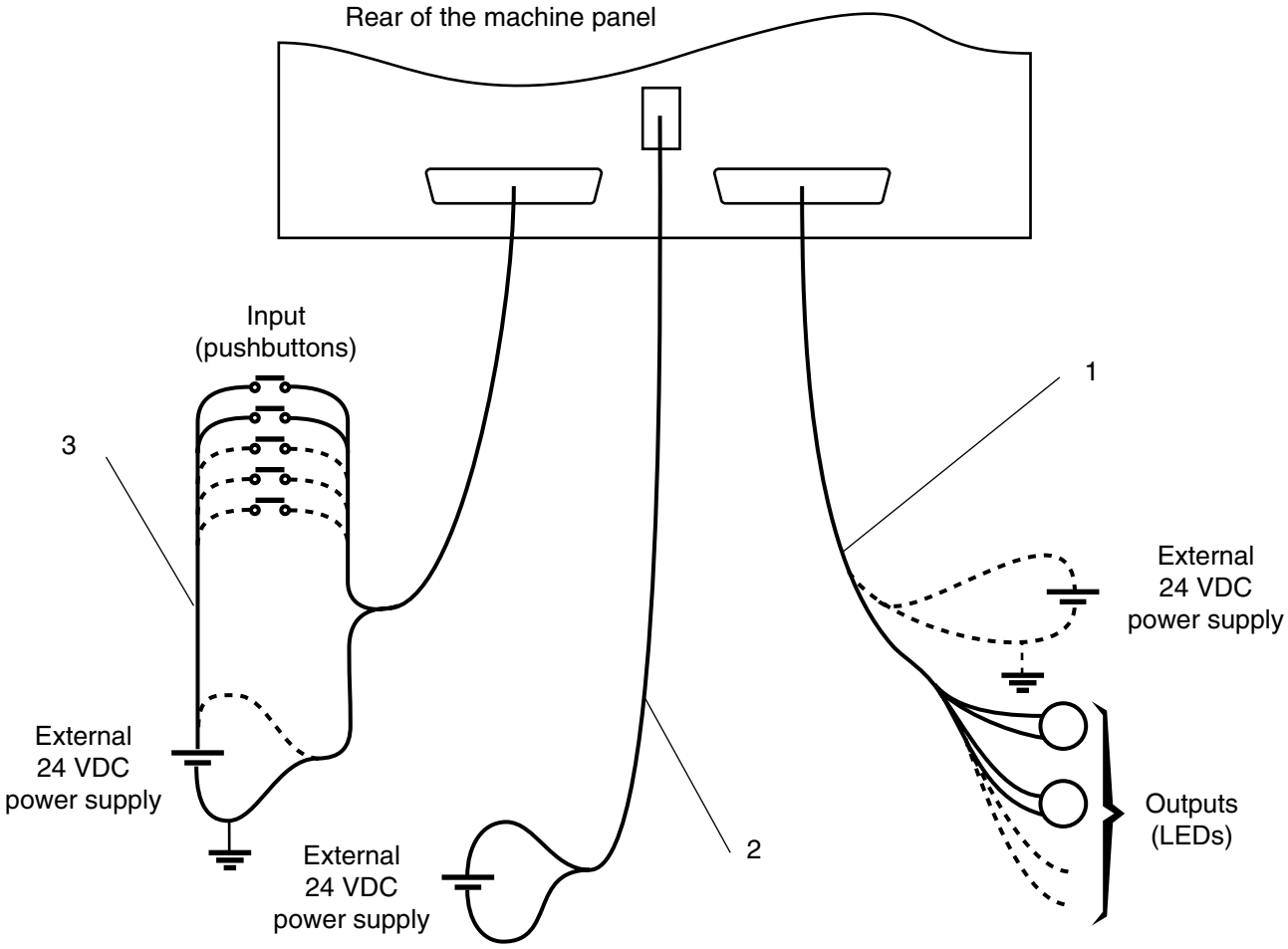
Connection Diagram of the Machine Panel Extension with Interface Panels



1 - Machine panel extension/relay panel connecting cable:
  - Length 1 m (P/N 263202928)
  - Length 2 m (P/N 263202929)
2 - 24-output relay panel (P/N 263900002, see Sec. 5.2.8.3: Relay Panel Connections and Customisation)
3 - Power supply via the relay panel (excludes power supply via the central connector or the interface panel
4 - Power cable (see Sec. 6.5.3: excludes power supply via the central connector or the interface panel
5 - Power supply via the interface panel (excludes power supply via the central connector or the relay panel)
6 - 32 input interface panel (P/N 263900001, see Sec. 5.2.7.3: Interface Panel Connections and Customisation).

REMARK *The power supply must be provided to the machine panel extension by one and only one of cables 3, 4 or 5.*

Connection Diagram of the Machine Panel Extension without Interface Panels

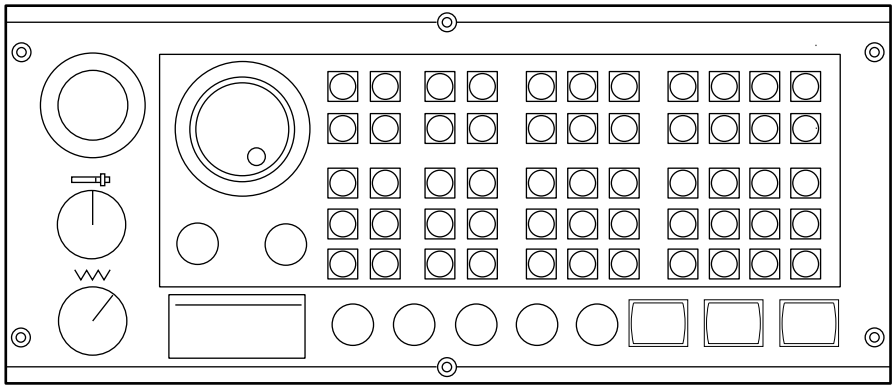


1 - 24-output cable with or without power supply (see Sec. 6.4.5)
2 - Power cable (only when the general power supply is not provided by one of the input or output cables: see Sec. 6.5.3)
3 - 32-input cable with or without general power supply (see Sec. 6.4.4)

REMARK *The power supply must be provided to the machine panel extension by one and only one of cables 1, 2 or 3.*

5.6.2 Machine Panel MP02

5.6.2.1 General



Nominal voltage	24 VDC (external power supply)
Limit values	19 V minimum 30 V maximum
Power consumption, outputs not used	5 W maximum
Power consumption, outputs used	40 W maximum

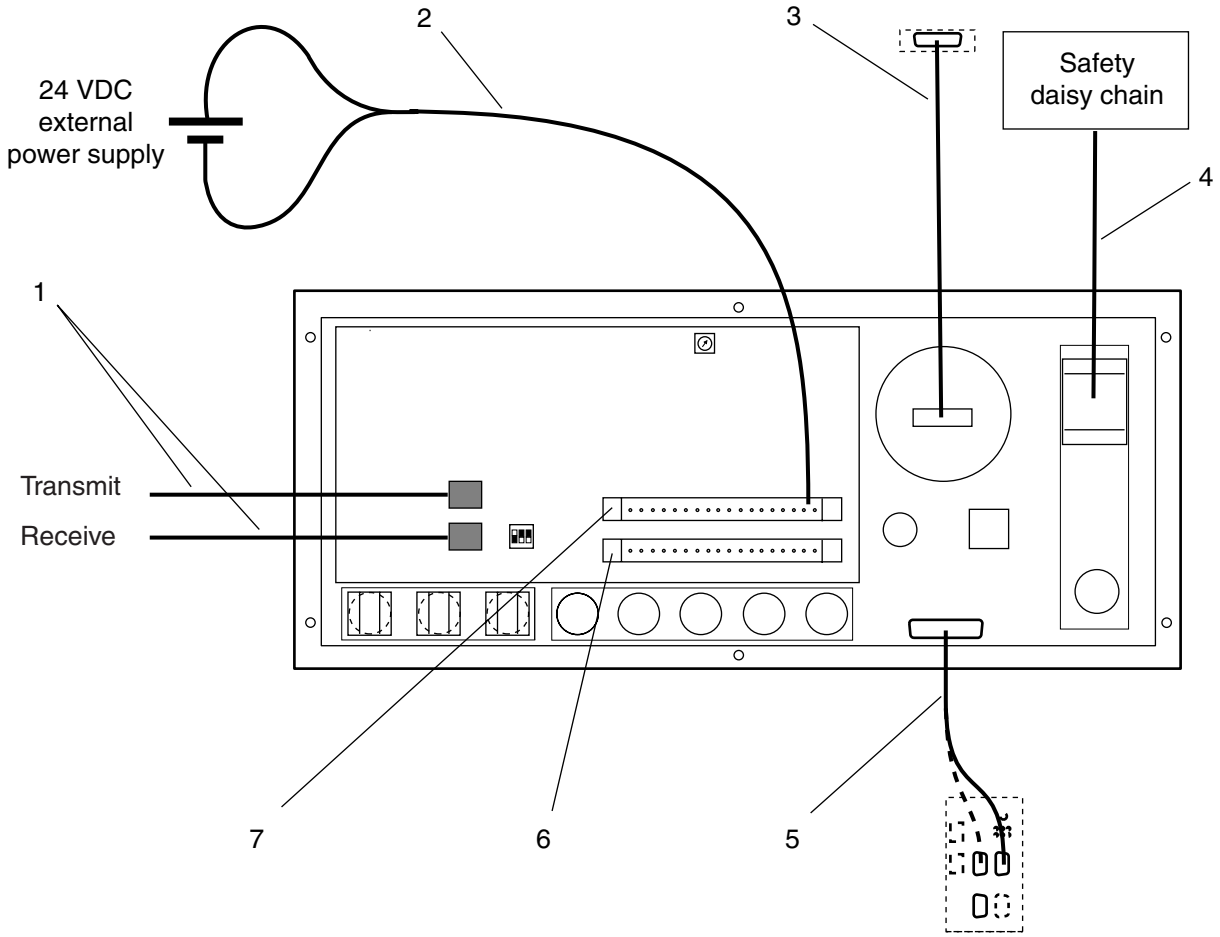
The machine panel provides the following functions:
- axis controls
- machining (cycle start, cycle stop, RESET, axis recall, M01 and block skip enable)
- feed rate and spindle speed override by potentiometer
- mode locking by key switch
- emergency stop
- remote serial line (wiring optional)
- axis control by handwheel (optional).

The machine panel can also provide special functions using five unassigned keys and LEDs.

Eight additional logic inputs and nine outputs can be added.

The machine panel is connected by a fibre optic line to the machine processor via the serial bus.

5.6.2.2 Machine Panel Connection Diagram



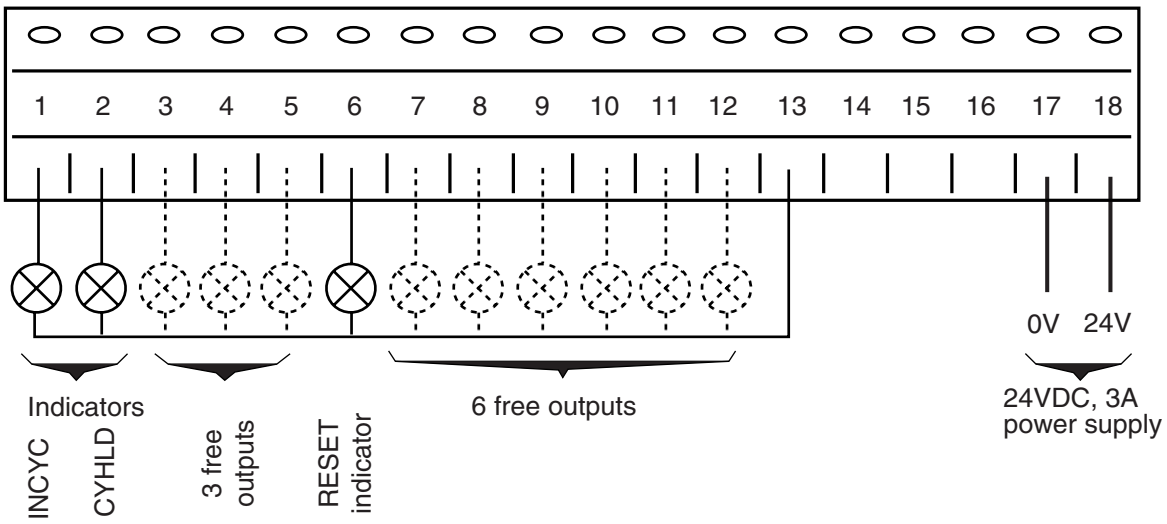
1 - Optical fibre line to CPU
2 - Power cable (see Sec. 5.6.2.3 for detail of output connector)
3 - Handwheel cable
4 - Emergency stop wiring (P/N ZB2-BE102)
5 - Relay wiring of a serial line:
- RS 232E line (see Sec. 6.1.6.1)
- RS 422A or 485 line (see Sec. 6.1.6.2)
6 - Input connector (see Sec. 5.6.2.3 for detail of connector)
7 - Output connector (see Sec. 5.6.2.3 for detail of connector)

5.6.2.3 Input/Output Connector Plug Wiring Diagram

Detail of Output Connector

12 logic outputs	
Organisation	1 group
Type	Semiconductor
Nominal operating voltage	24 VDC
Limit values	19.2 to 30 VDC maximum
Rated current	100 mA maximum per output
Outputs simultaneously active	100%
Protection	Short-circuit and permanent overloads (trip device)

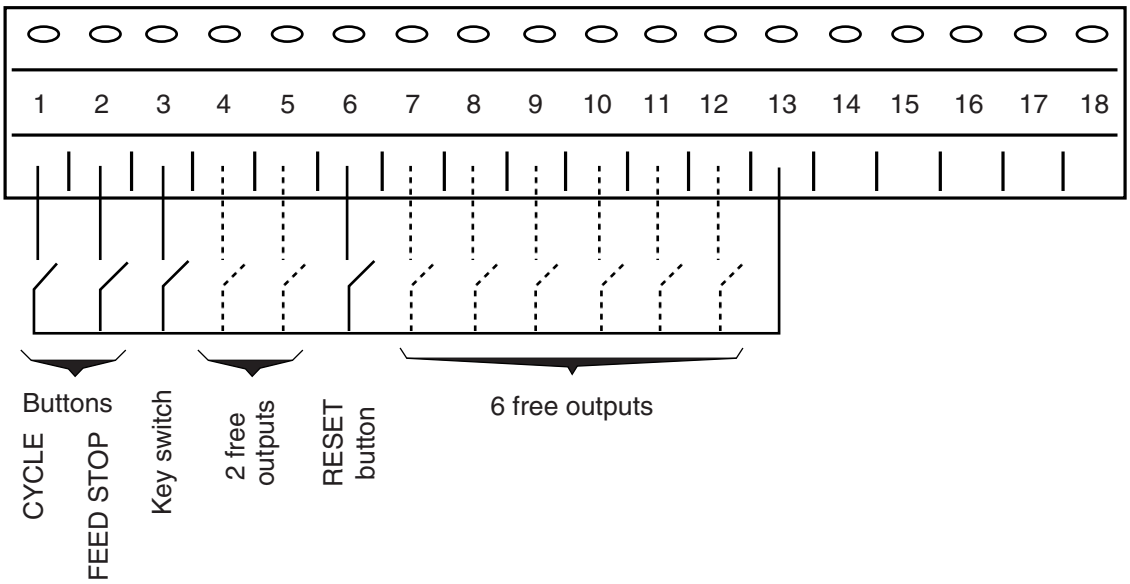
Description of the output connector:
- Outputs 1 to 12: 24 VDC, 100 mA (outputs 1, 2 and 6 assigned to the CYHLD, INCYC and RESET indicators)
- Outputs 13 to 16: Common wires (0V) for the outputs
- Output 17: Panel power supply 0V
- Output 18: Power supply +24V.



Detail of Input Connector

12 logic inputs	
Organisation	1 group
Nominal input voltage	24 VDC
Limit values	0 to 30 VDC maximum
Logic 0	0 to 5 VDC or I < 1.2 mA
Logic 1	11 to 30 VDC of I > 2.7 mA
Rated current	6 mA typical at 24 VDC
Filtering time	3 ms typical

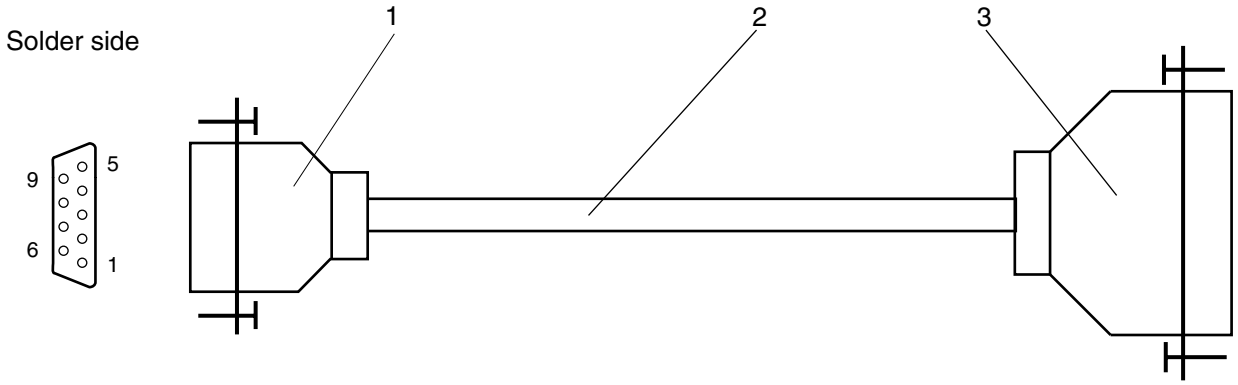
Description of input connector:
- Inputs 1 to 12: 24 VDC, 100 mA (inputs 1, 2 and 6 assigned to the CYCLE, FEED STOP and RESET buttons and input 3 to the key switch)
- Outputs 13 to 18: Common wires (+24 VDC) for the inputs



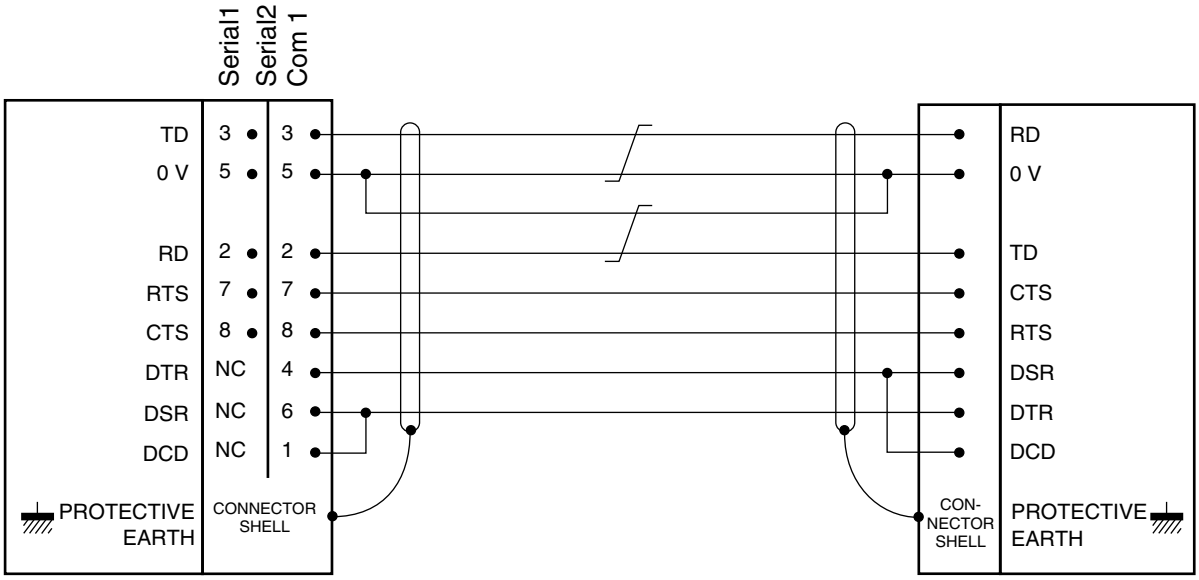
6 Cable Diagrams

6.1 Communication Cables

6.1.1 RS 232E Serial Interface Cable



1 - 9-contact male Sub.D connector on CPU side
2 - Shielded cable with 2 twisted pairs and 4 isolated conductors (minimum wire size 0.14 mm²)
3 - Connector plug depending on peripheral

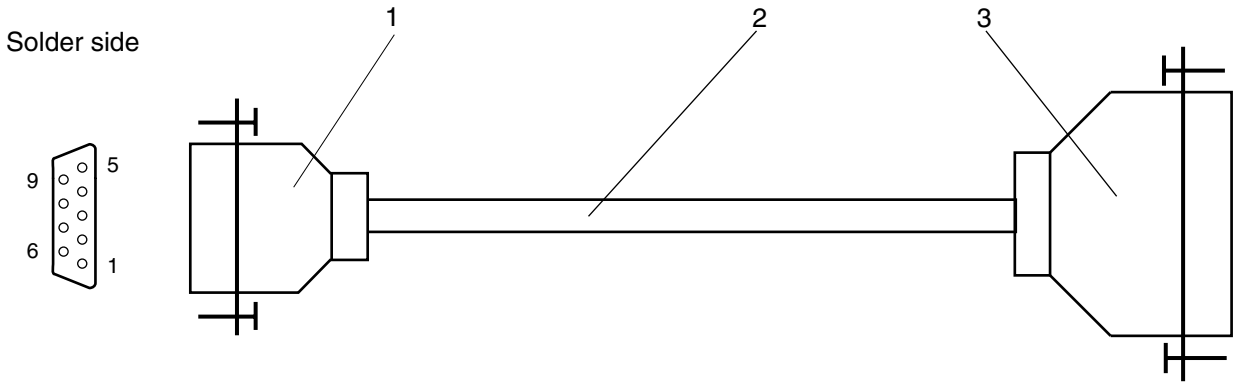


Pins 1, 4 and 6 are not wired for connection to one of connectors Serial1 or Serial2.

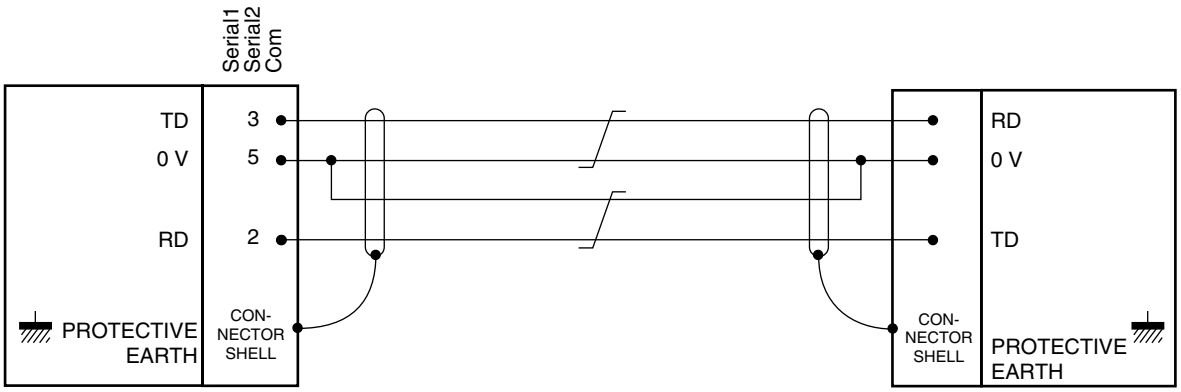
⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

6.1.2 RS 232 Serial Interface Cable for NUM Applications



1 - 9-contact male Sub.D connector on CPU side
2 - Shielded cable with 2 twisted pairs (minimum wire size 0.14 mm²)
3 - Connector plug depending on PC

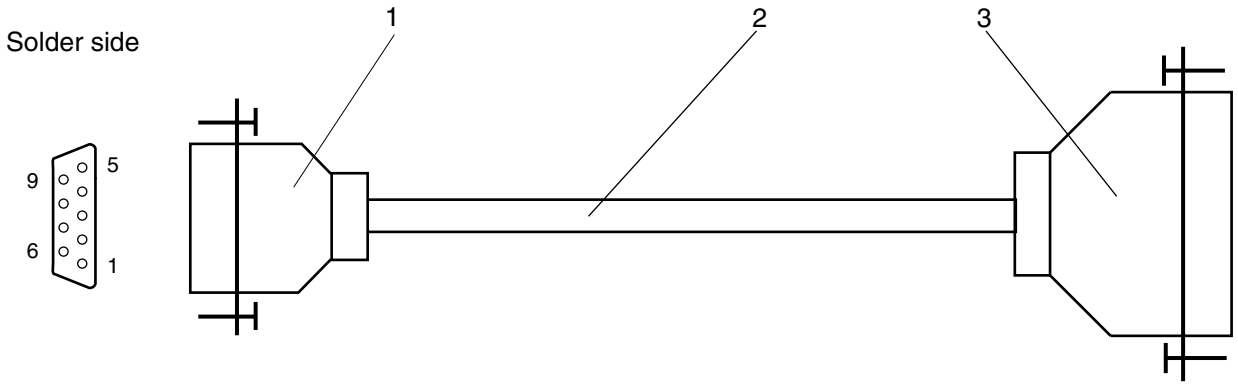


⚠ CAUTION

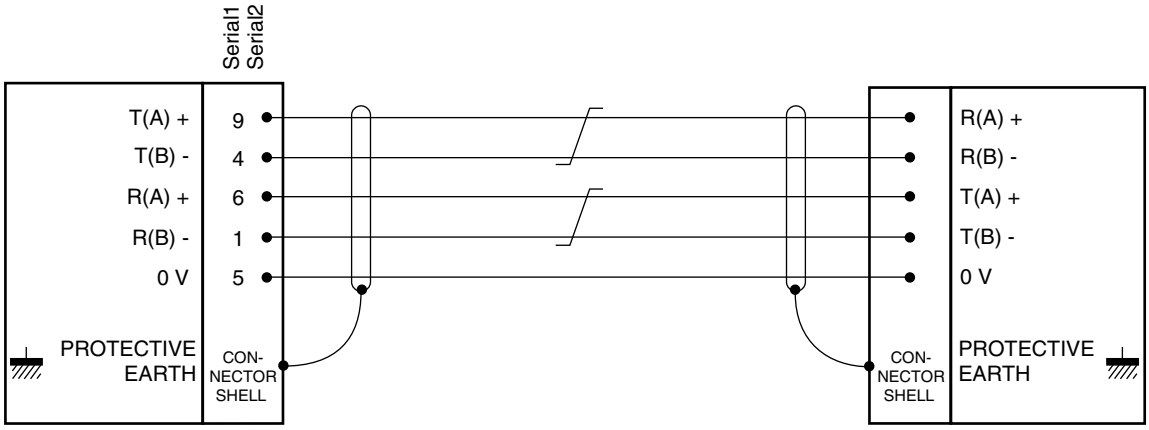
Use of this cable is mandatory for interfacing with NUM Applications (PLCTool, SETTool, etc.).

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

6.1.3 RS 422A Serial Interface Cable



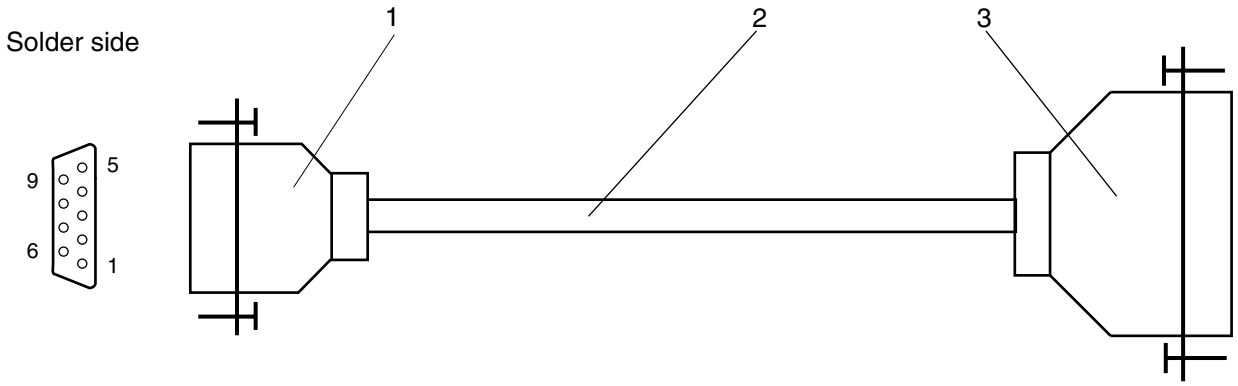
1 - 9-contact male Sub.D connector on CPU side
2 - Shielded cable with 2 twisted pairs and 1 isolated conductor (minimum wire size 0.14 mm²)
3 - Connector plug depending on peripheral



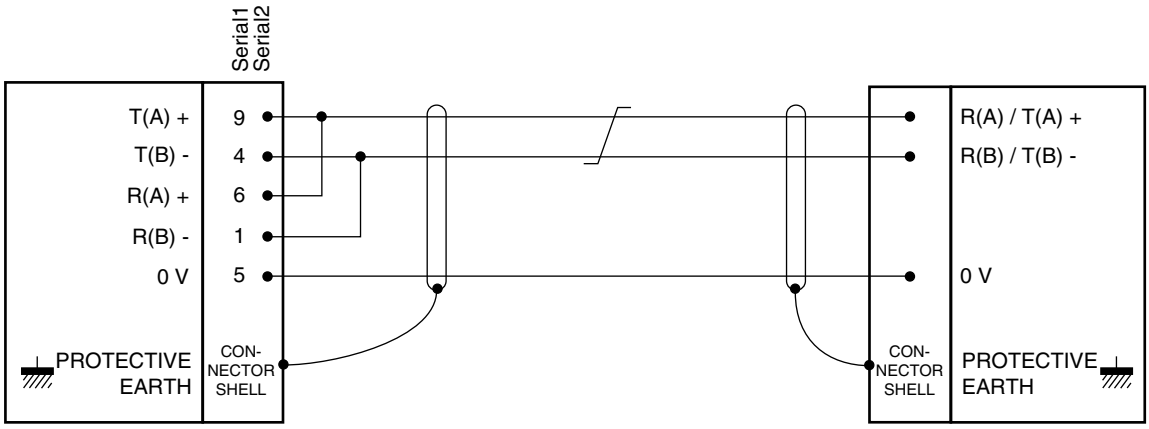
⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

6.1.4 RS 485 Serial Interface Cable



1 - 9-contact male Sub.D connector on CPU side
2 - Shielded cable with 1 twisted pair and 1 isolated conductor (minimum wire size 0.14 mm²)
3 - Connector plug depending on peripheral

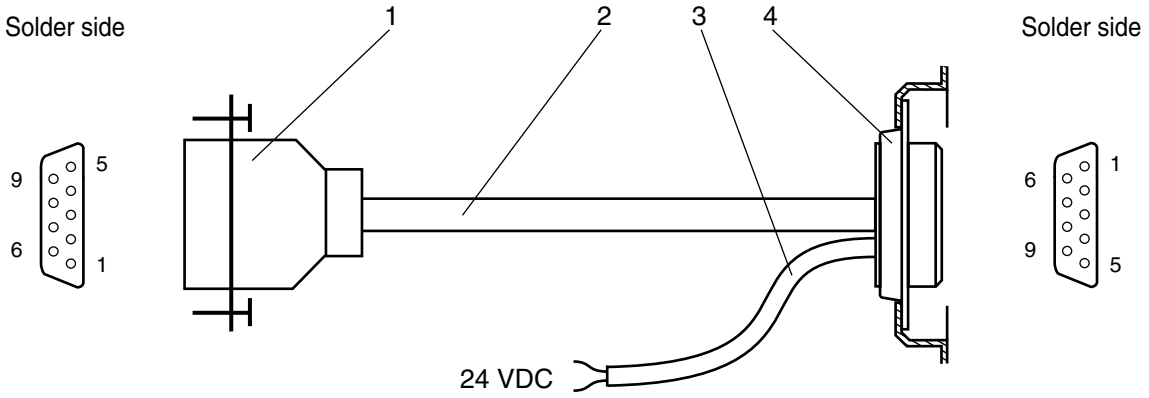


⚠ CAUTION

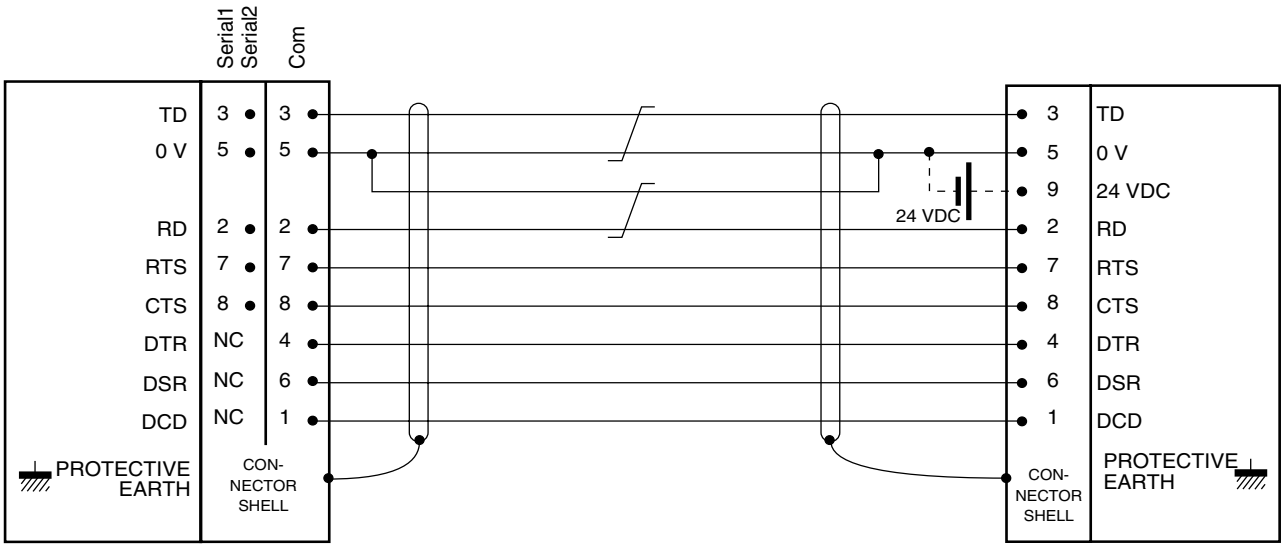
For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

6.1.5 Serial Line Relay Cable Connected to Compact Panel

6.1.5.1 RS 232E Line Relay Cable Connected to Compact Panel



1 - 9-contact male Sub.D connector on CPU side
2 - Shielded cable with 2 twisted pairs and 5 isolated conductors (minimum wire size 0.14 m^2)
3 - 2-wire cable (optional, for power supply of the NUM diskette drive)
4 - Remote 9-contact female Sub.D connector



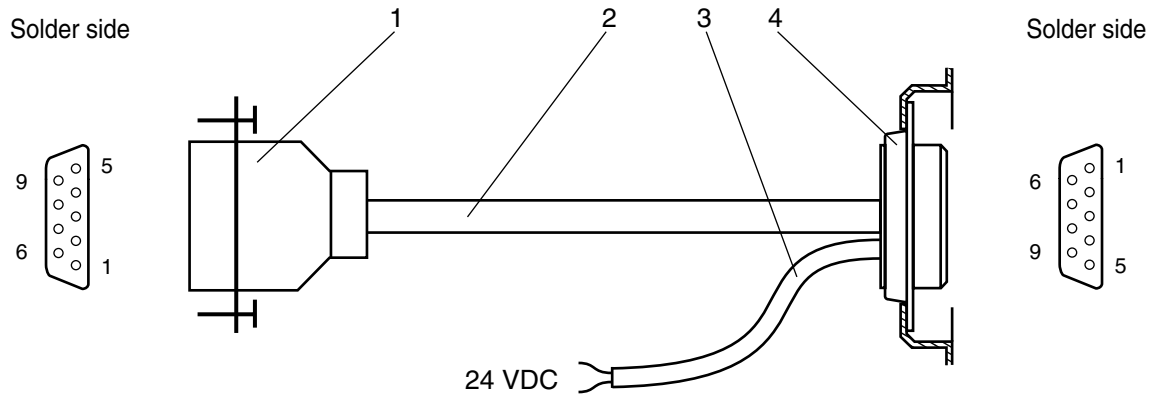
Pins 1, 4 and 6 are not wired for connection to one of connectors Serial1 or Serial2.

⚠ CAUTION

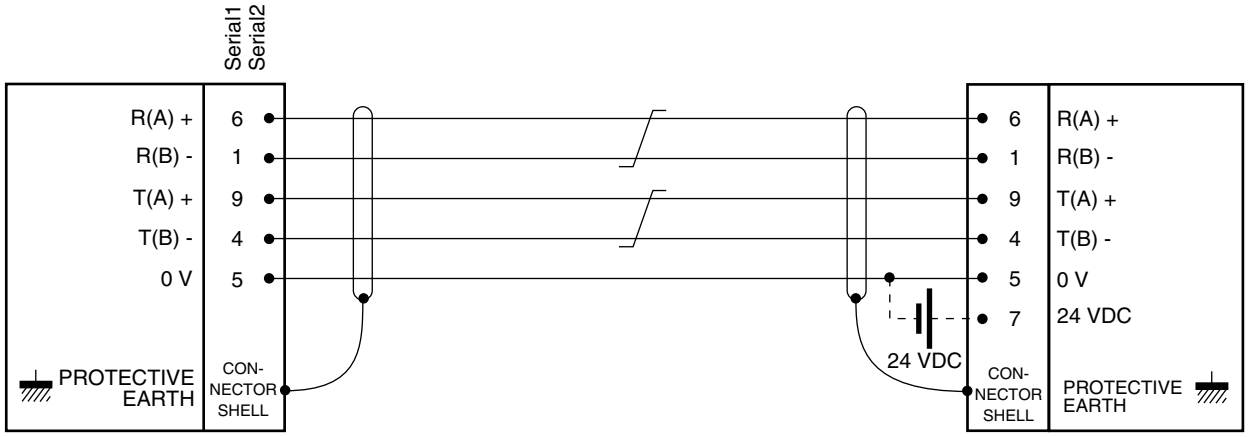
For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

If the 24 VDC cable is wired (for occasional connection of the NUM diskette drive), do not connect the peripheral for which contact 9 is used (e.g. signal RI of the PC standard).

6.1.5.2 RS 422A or RS 485 Line Relay Cable Connected to Compact Panel



1 - 9-contact male Sub.D connector on CPU side
2 - Shielded cable with 2 twisted pairs and 1 isolated conductor (minimum wire size 0.14 m^2)
3 - 2-wire cable (optional, for power supply of the NUM diskette drive)
4 - Remote 9-contact female Sub.D connector

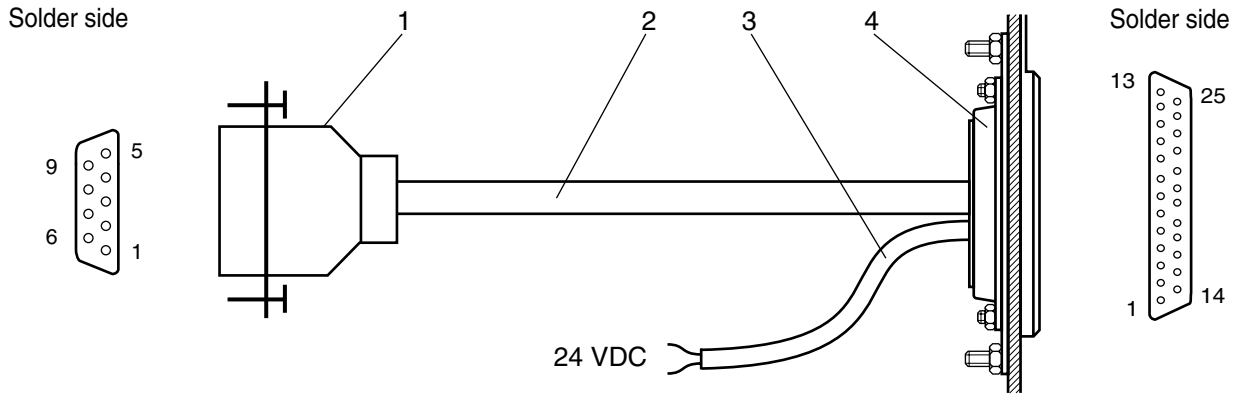


⚠ CAUTION

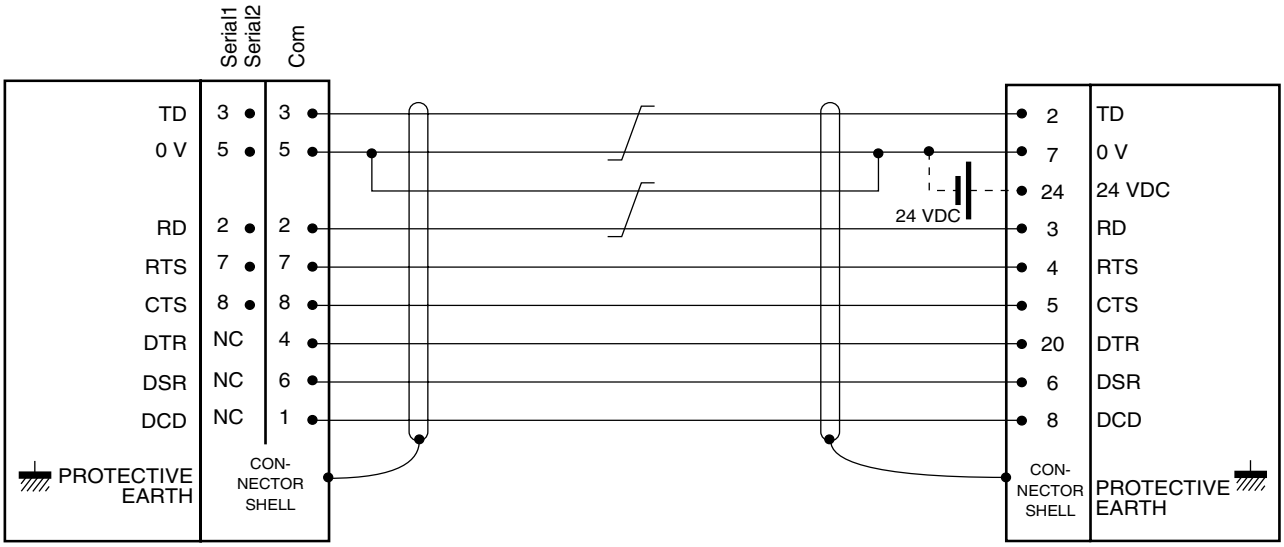
For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

6.1.6 Serial Line Relay Cable Connected to Machine Panel

6.1.6.1 RS 232E Line Relay Cable Connected to Machine Panel



1 - 9-contact male Sub.D connector on CPU side
2 - Shielded cable with 2 twisted pairs and 5 isolated conductors (minimum wire size 0.14 m^2)
3 - 2-wire cable (optional, for power supply of the NUM diskette drive)
4 - Remote 25-contact female Sub.D connector

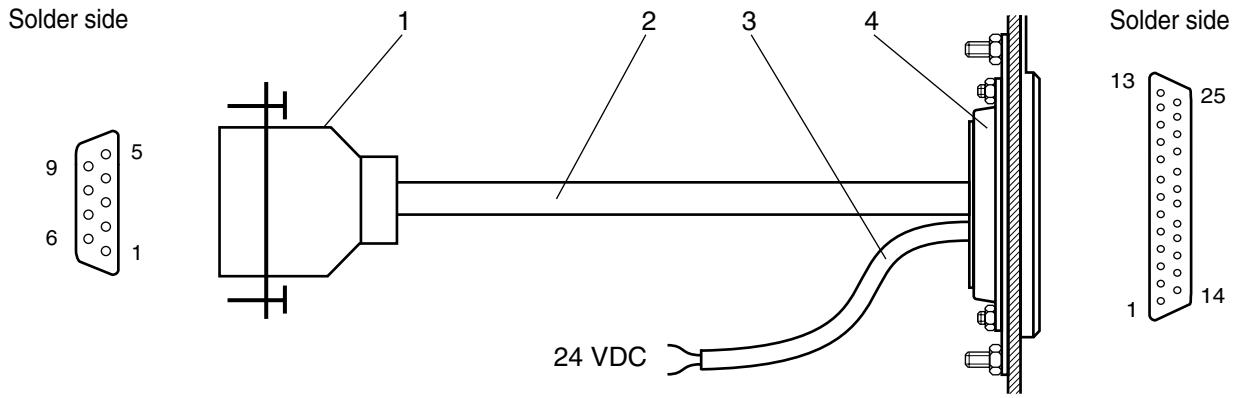


Pins 1, 4 and 6 are not wired for connection to one of connectors Serial1 or Serial2.

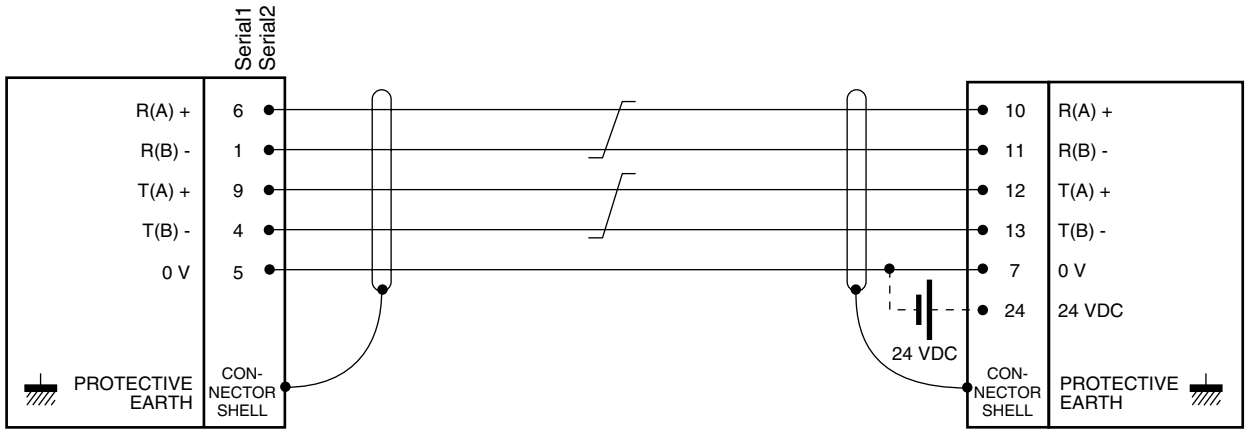
⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

6.1.6.2 RS 422A or RS 485 Line Relay Cable Connected to Machine Panel



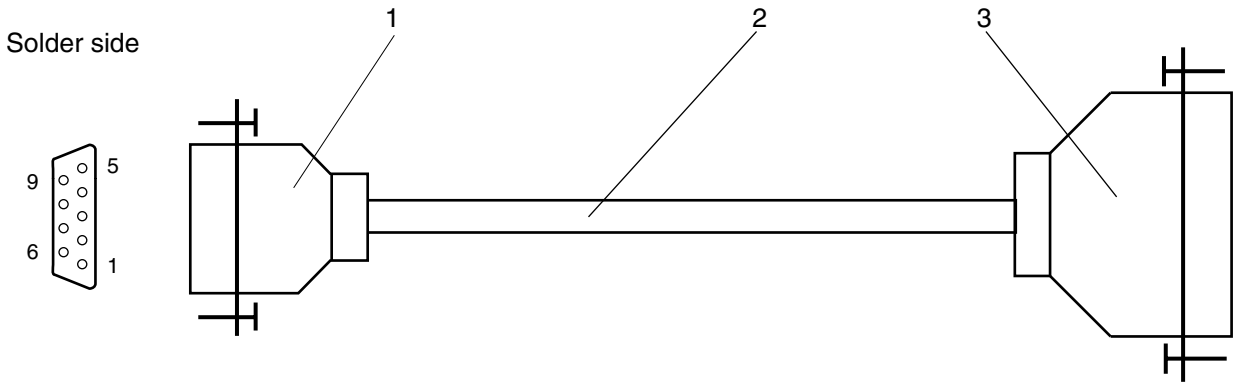
1 - 9-contact male Sub.D connector on CPU side
2 - Shielded cable with 2 twisted pairs and 1 isolated conductor (minimum wire size 0.14 m^2)
3 - 2-wire cable (optional, for power supply of the NUM diskette drive)
4 - Remote 25-contact female Sub.D connector



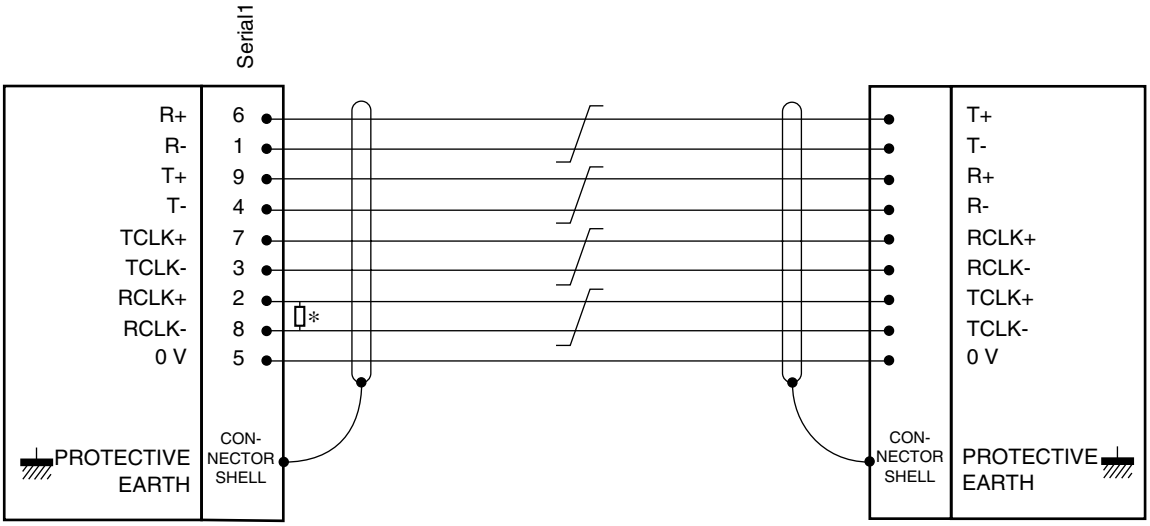
⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

6.1.7 RS 422 Synchronous Serial Interface Cable



1 - 9-contact male Sub.D connector on the CPU side
2 - Shielded cable with 4 twisted pairs and 1 isolated conductor (minimum cross-sectional area 0.22 mm², characteristic impedance of a twisted pair approx. 100 Ω)
3 - Connector depending on peripheral (metal or metal-plated cover)



* 100 to 120 Ω 1/4 W resistor to be soldered in the connector

⚠ CAUTION

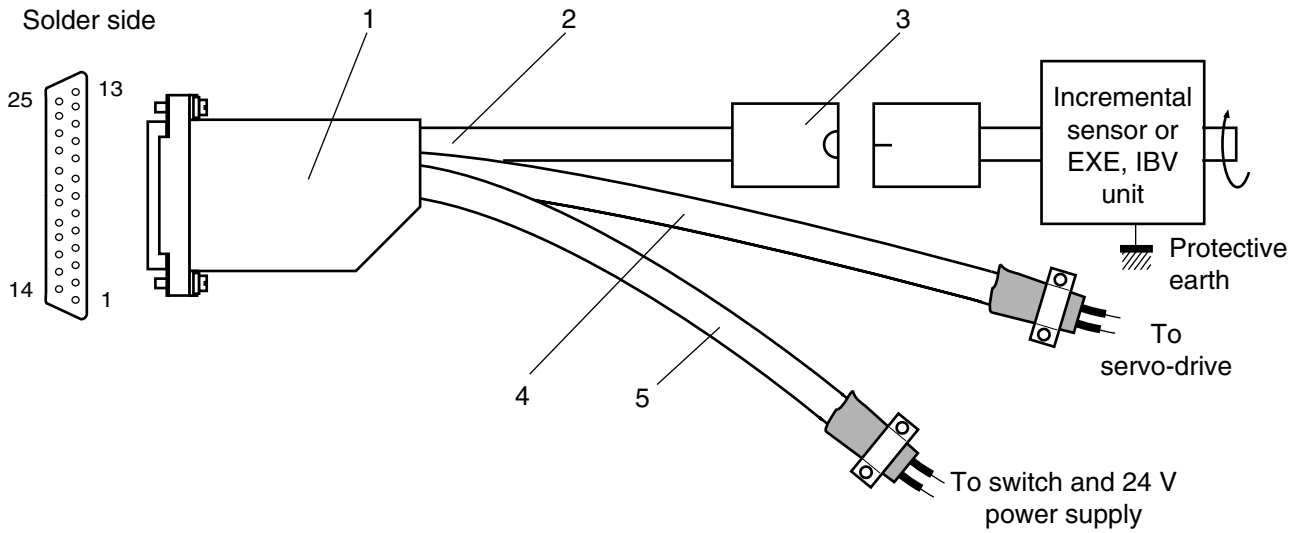
For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

Any additional wires must be connected to 0 V at both ends.

6.2 Axis Cables

6.2.1 Incremental Axis Encoder Cables

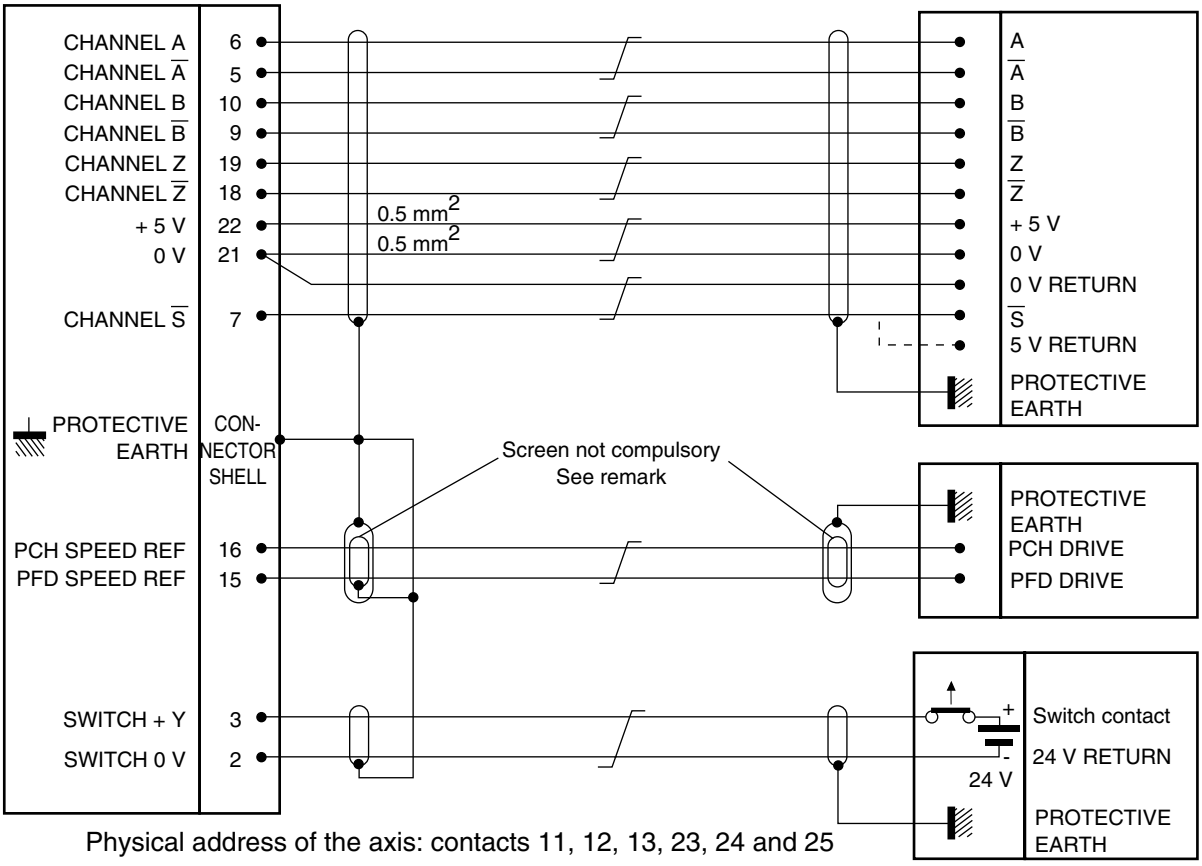
6.2.1.1 Incremental Axis Encoder Cable Connected to the Axis Interface, Power Supply Provided by the Interface



1 - 25-contact male Sub.D connector plug
2 - Shielded cable [4 x (2 x 0.14 mm^2) + 2 x 0.5 mm^2]
3 - Connector
4 - 1 twisted pair cable with double shielding (2 x 0.22 mm^2)
5 - 1 twisted pair shielded cable (2 x 0.22 mm^2)

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



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

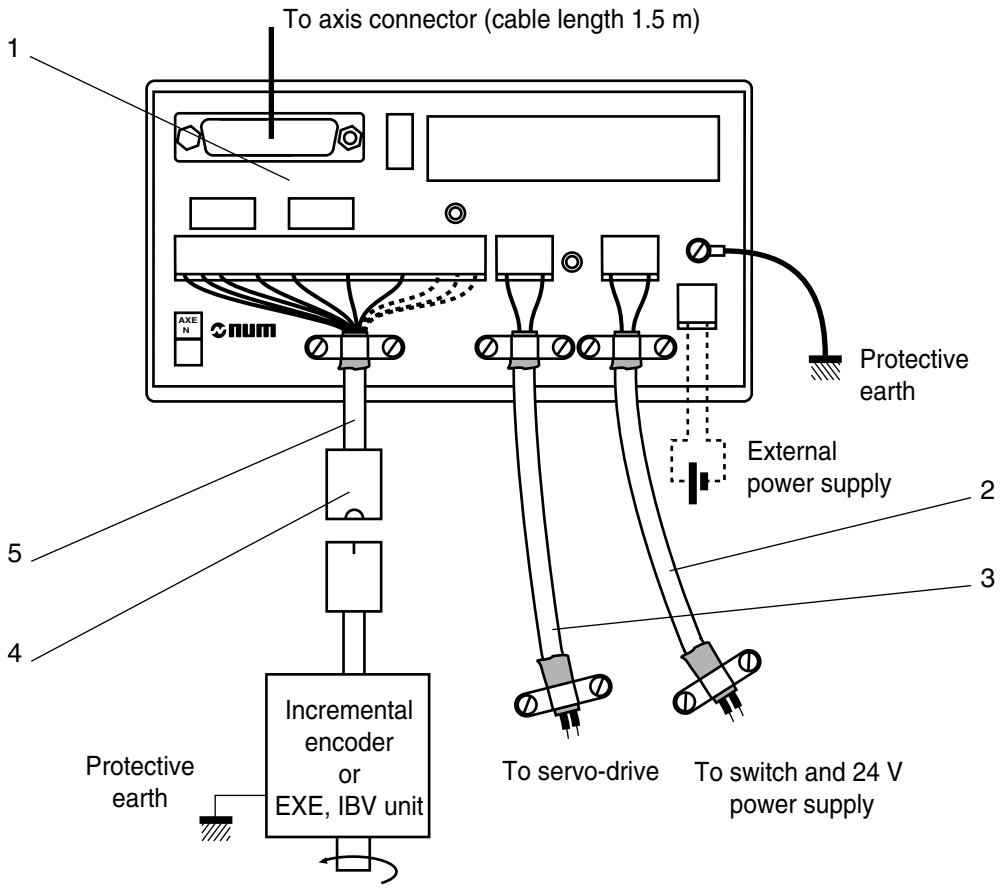
The physical address of the axis is obtained by the wiring of contacts 11, 12, 13, 23, 24 and 25 (see Sec. 6.2.10).

The wiring of channels A, B, $\overline{A}$, $\overline{B}$ and $\overline{S}$ allows detection of a wiring or encoder fault. This requires enabling the poor signal and/or encoder channel complementarity check (parameters P25 and P26 - refer to the Parameter Manual).

REMARKS *If the interference level is low, the cable with double shielding (servo-drive cable) can be replaced by a cable with single shielding connected at both ends to the protective earth.*

Contact $\overline{S}$ is present on sensors with poor signal errors. When the sensor does not include this signal, contact 7 on the CNC side must be connected to the sensor 5 V return.

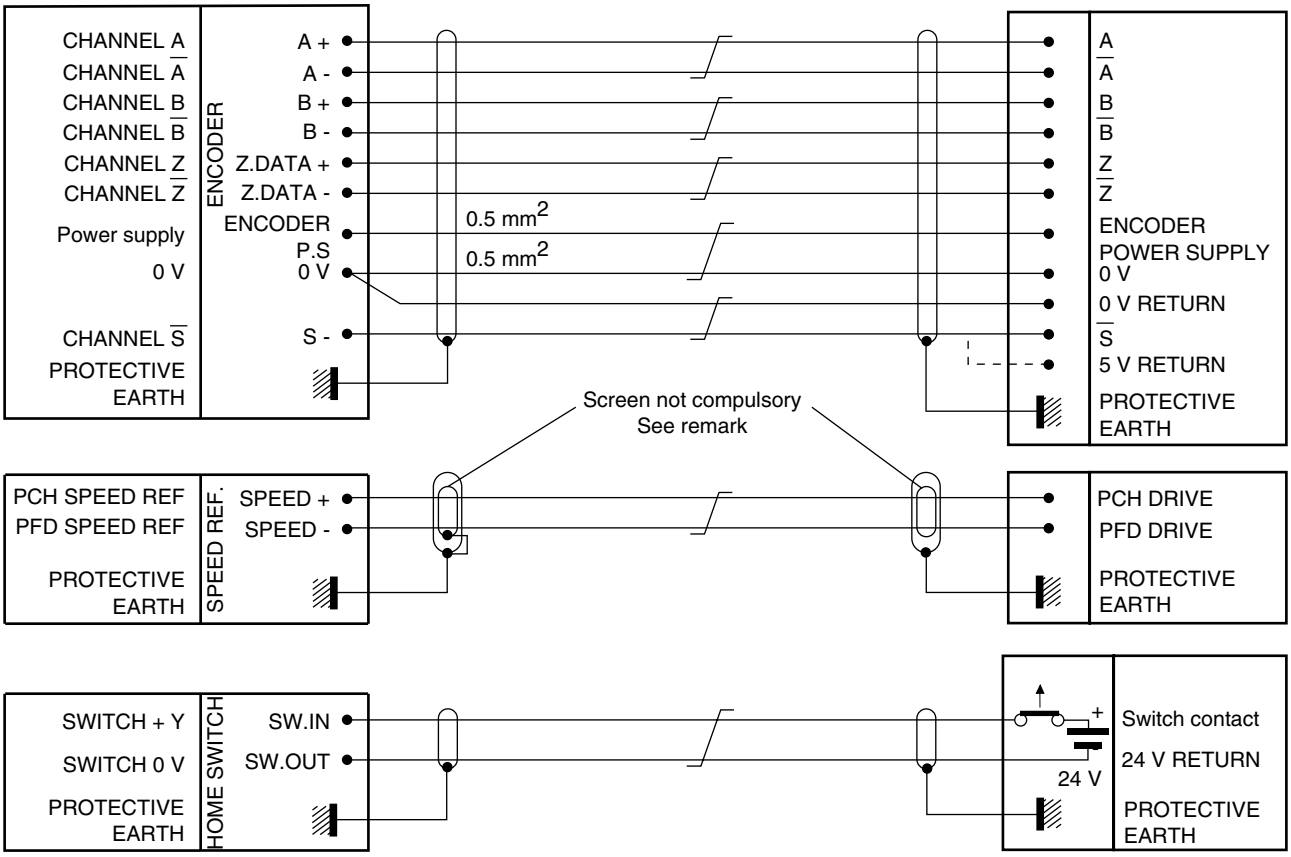
6.2.1.2 Incremental Axis Encoder Cable Connected to an Axis Interface Panel



1 - Axis interface panel
2 - 1 twisted pair shielded cable (2 x 0.22 mm²)
3 - 1 twisted pair cable with double shielding (2 x 0.22 mm²)
4 - Connector
5 - Shielded cable [4 x (2 x 0.14 mm²) + 2 x 0.5 mm²]

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



The physical address of the axis is set on switches (see Sec. 6.2.7).

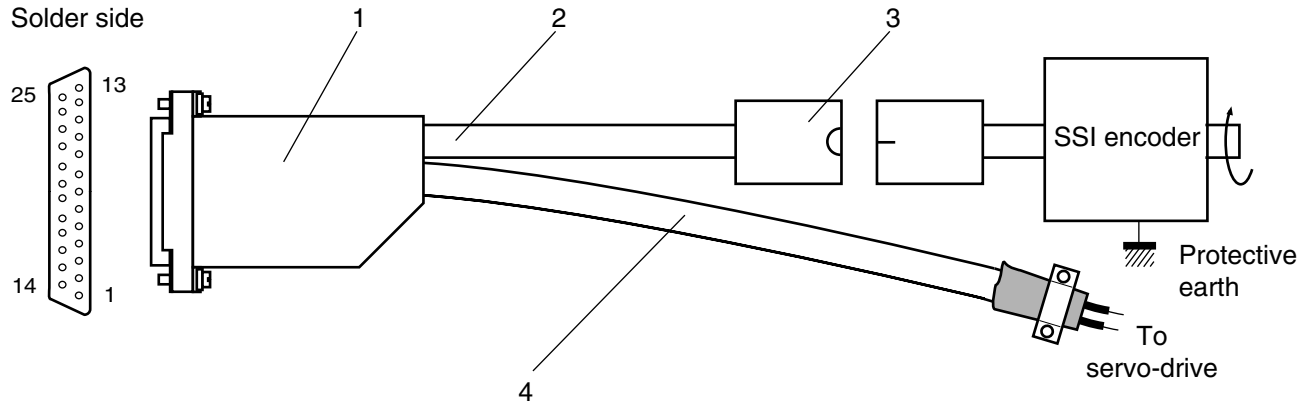
The wiring of channels A, B, $\overline{A}$, $\overline{B}$ and $\overline{S}$ allows detection of a wiring or encoder fault. This requires enabling the poor signal and/or encoder channel complementarity check (parameters P25 and P26 - refer to the Parameter Manual).

REMARKS *If the interference level is low, the cable with double shielding (servo-drive cable) can be replaced by a cable with single shielding connected at both ends to the protective earth.*

Contact S is present on sensors with poor signal errors. When the sensor does not include this signal, contact 7 on the CNC side must be connected to the sensor 5 V return (5V sensors only).

6.2.2 SSI Absolute Axis Encoder Cables

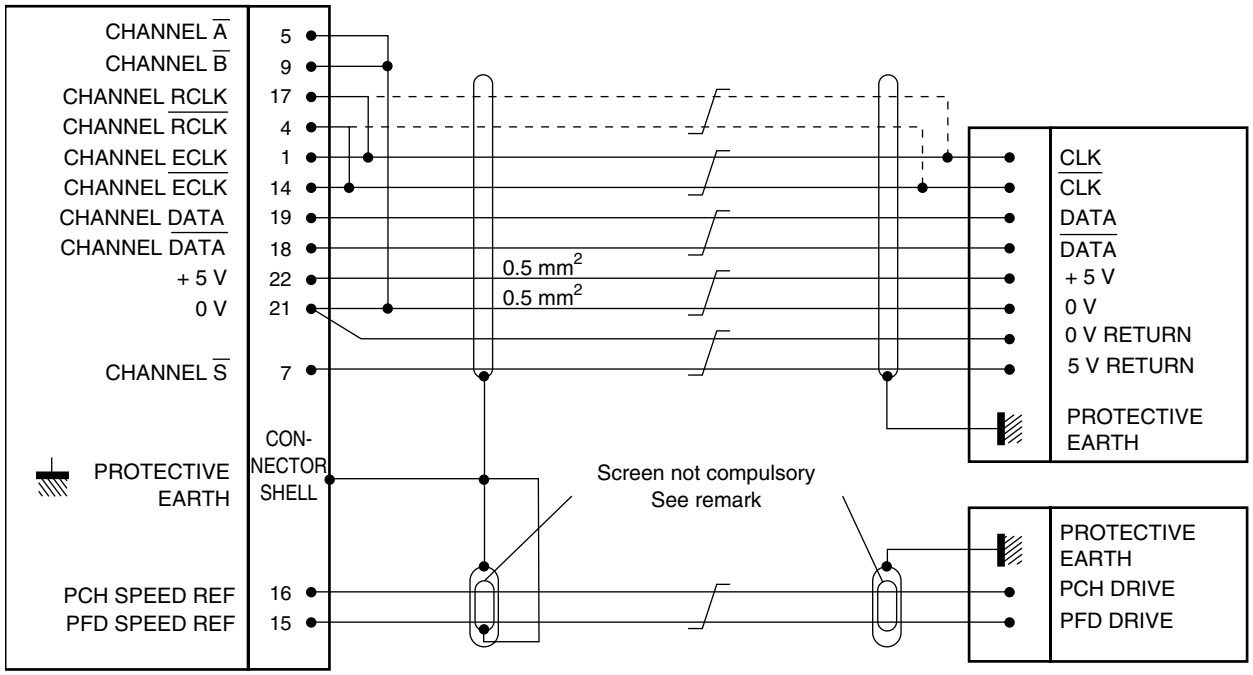
6.2.2.1 SSI Absolute Axis Encoder Cable Connected to the Axis Interface, Power Supply Provided by the Interface



1 - 25-contact male Sub.D connector plug
2 - Shielded cable [3 x (2 x 0.14 mm^2) + 2 x 0.5 mm^2]
or [4 x (2 x 0.14 mm^2) + 2 x 0.5 mm^2]
3 - Connector
4 - 1 twisted pair cable with double shielding (2 x 0.22 mm^2)

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



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

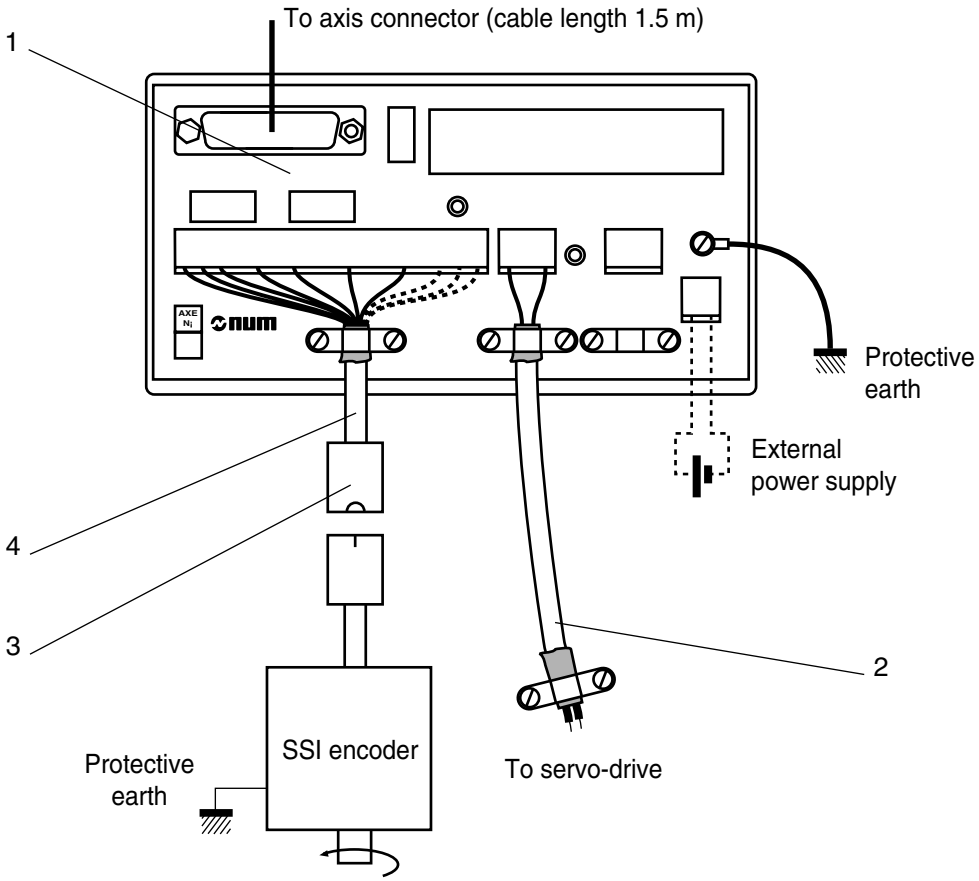
The physical address of the axis is obtained by the wiring of contacts 11, 12, 13, 23, 24 and 25 (see Sec. 6.2.10).

The wiring of channels $\overline{A}$, $\overline{B}$ and $\overline{S}$ allows detection of a wiring or encoder fault. This requires enabling the poor signal and/or encoder channel complementarity check (parameters P25 and P26 - refer to the Parameter Manual).

REMARKS *If the interference level is low, the cable with double shielding (servo-drive cable) can be replaced by a cable with single shielding connected at both ends to the protective earth.*

CRCLK is connected to ECLK either on the axis connector or on the encoder, depending on the frequency and the cable length (see Sec. 5.2.6.5).

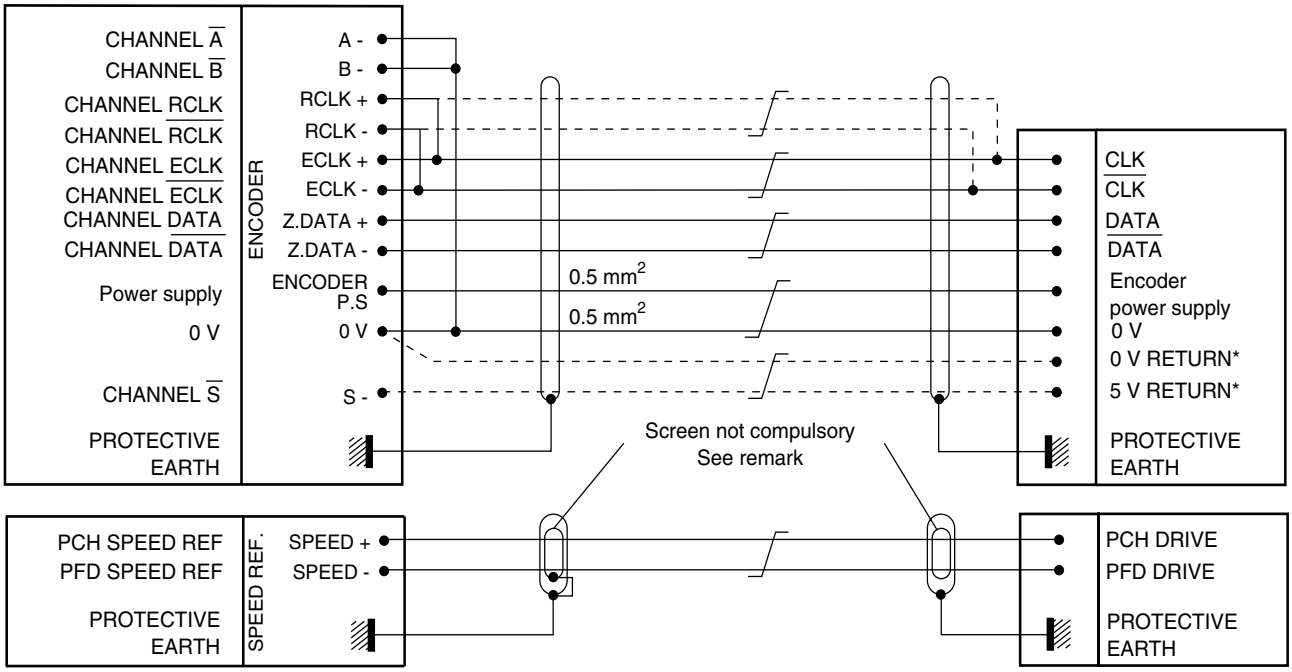
6.2.2.2 SSI Absolute Axis Encoder Cable Connected to an Axis Interface Module



1 - Axis interface module
2 - 1 twisted pair cable with double shielding (2 x 0.22 mm²)
3 - Connector
4 - Shielded cable [3 x (2 x 0.14 mm²) + 2 x 0.5 mm²]
or [4 x (2 x 0.14 mm²) + 2 x 0.5 mm²]

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



* 5V encoders only

The physical address of the axis is set on switches (see Sec. 6.2.7).

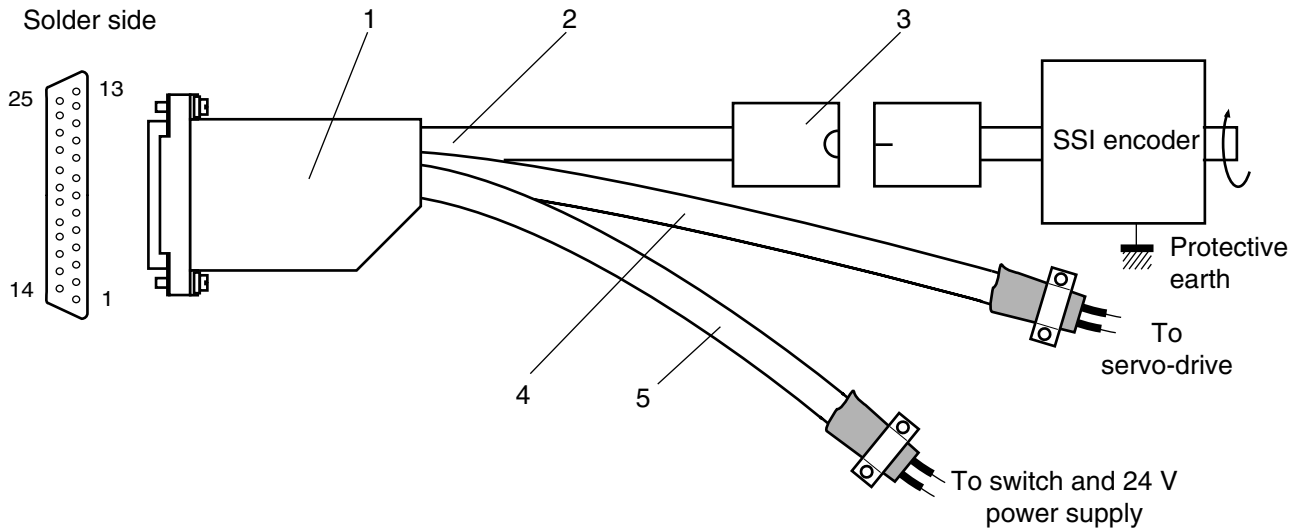
The wiring of channels $\overline{A}$, $\overline{B}$ and $\overline{S}$ allows detection of a wiring or encoder fault. This requires enabling the poor signal and/or encoder channel complementarity check (parameters P25 and P26 - refer to the Parameter Manual).

REMARKS *If the interference level is low, the cable with double shielding (servo-drive cable) can be replaced by a cable with single shielding connected at both ends to the protective earth.*

CRCLK is connected to ECLK either on the axis connector or on the encoder, depending on the frequency and the cable length (see Sec. 5.2.6.5).

6.2.3 SSI Semiabsolute Axis Encoders

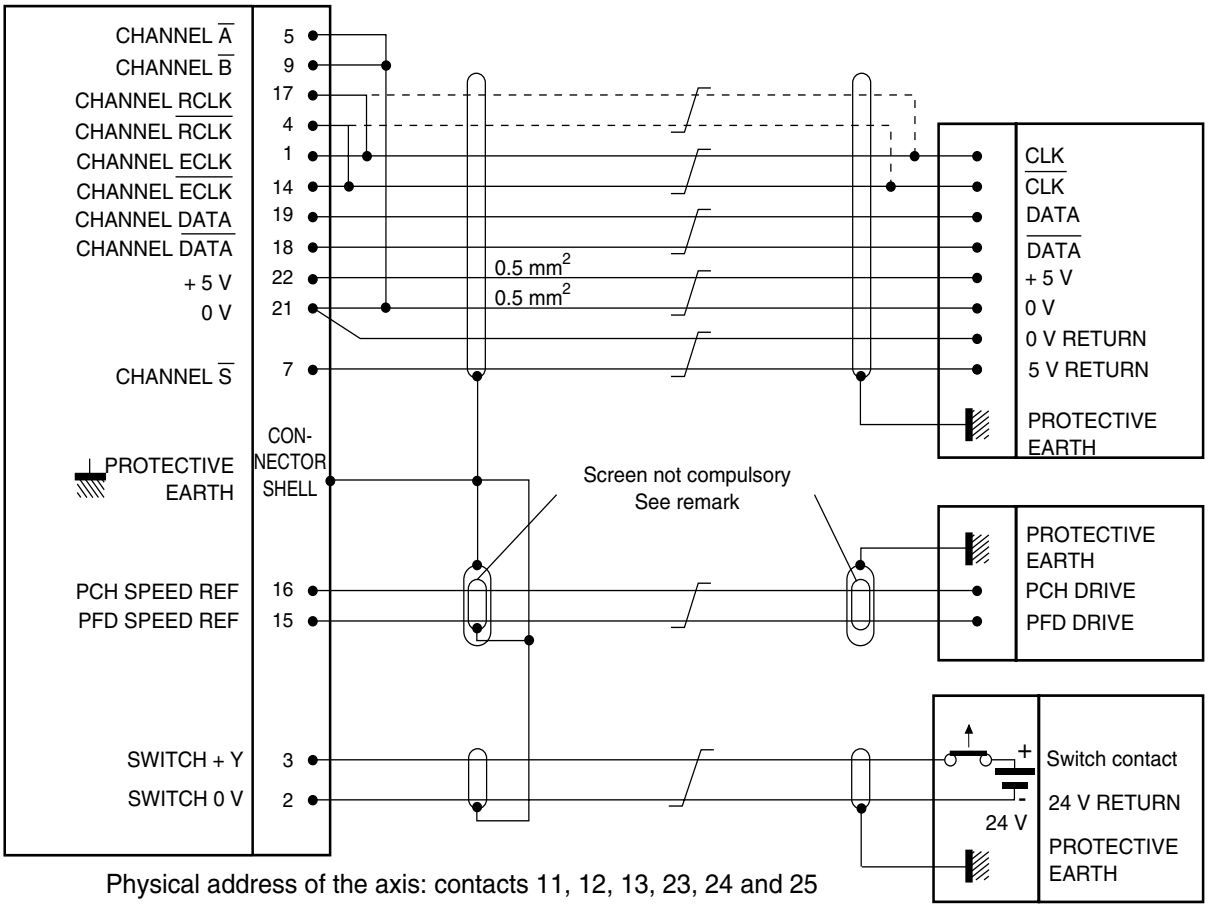
6.2.3.1 SSI Semiabsolute Axis Encoder Cable Connected to the Axis Interface, Power Supply Provided by the Interface



1 - 25-contact male Sub.D connector plug
2 - Shielded cable [3 x (2 x 0.14 mm^2) + 2 x 0.5 mm^2]
or [4 x (2 x 0.14 mm^2) + 2 x 0.5 mm^2]
3 - Connector
4 - 1 twisted pair cable with double shielding (2 x 0.22 mm^2)
5 - 1 twisted pair shielded cable (2 x 0.22 mm^2)

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



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

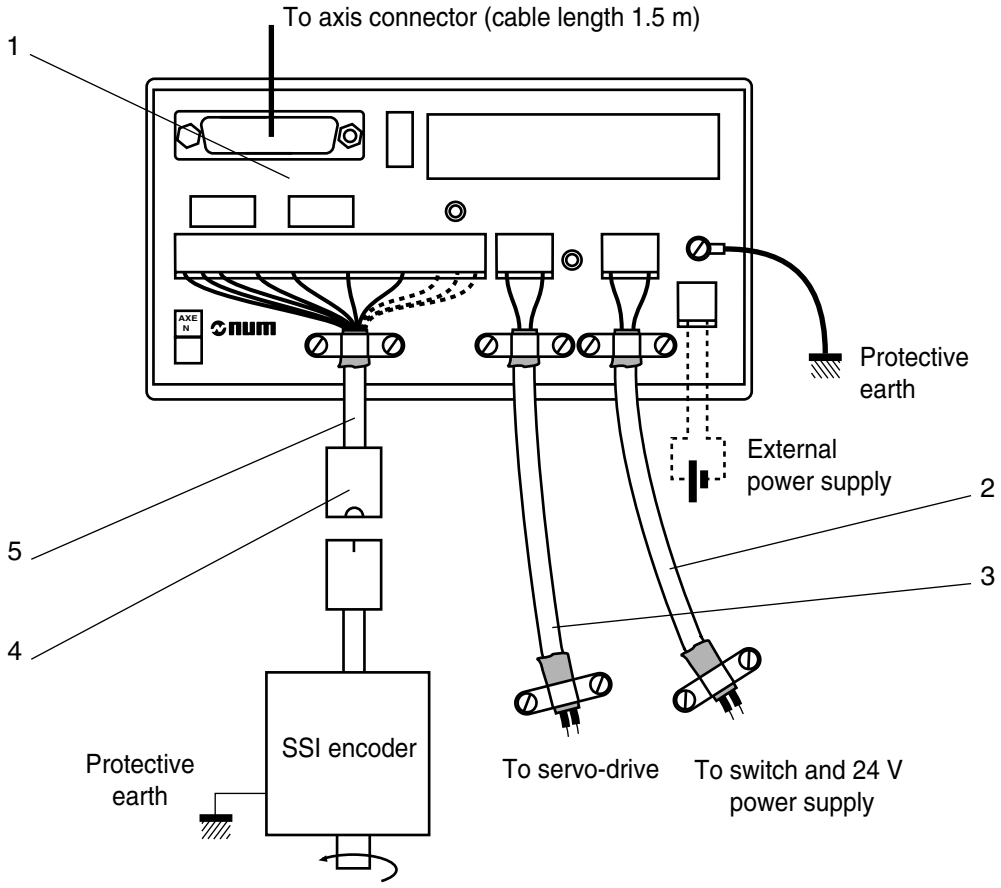
The physical address of the axis is obtained by the wiring of contacts 11, 12, 13, 23, 24 and 25 (see Sec. 6.2.10).

The wiring of channels $\overline{A}$, $\overline{B}$ and $\overline{S}$ allows detection of a wiring or encoder fault. This requires enabling the poor signal and/or encoder channel complementarity check (parameters P25 and P26 - refer to the Parameter Manual).

REMARKS *If the interference level is low, the cable with double shielding (servo-drive cable) can be replaced by a cable with single shielding connected at both ends to the protective earth.*

CRCLK is connected to ECLK either on the axis connector or on the encoder, depending on the frequency and the cable length (see Sec. 5.2.6.5).

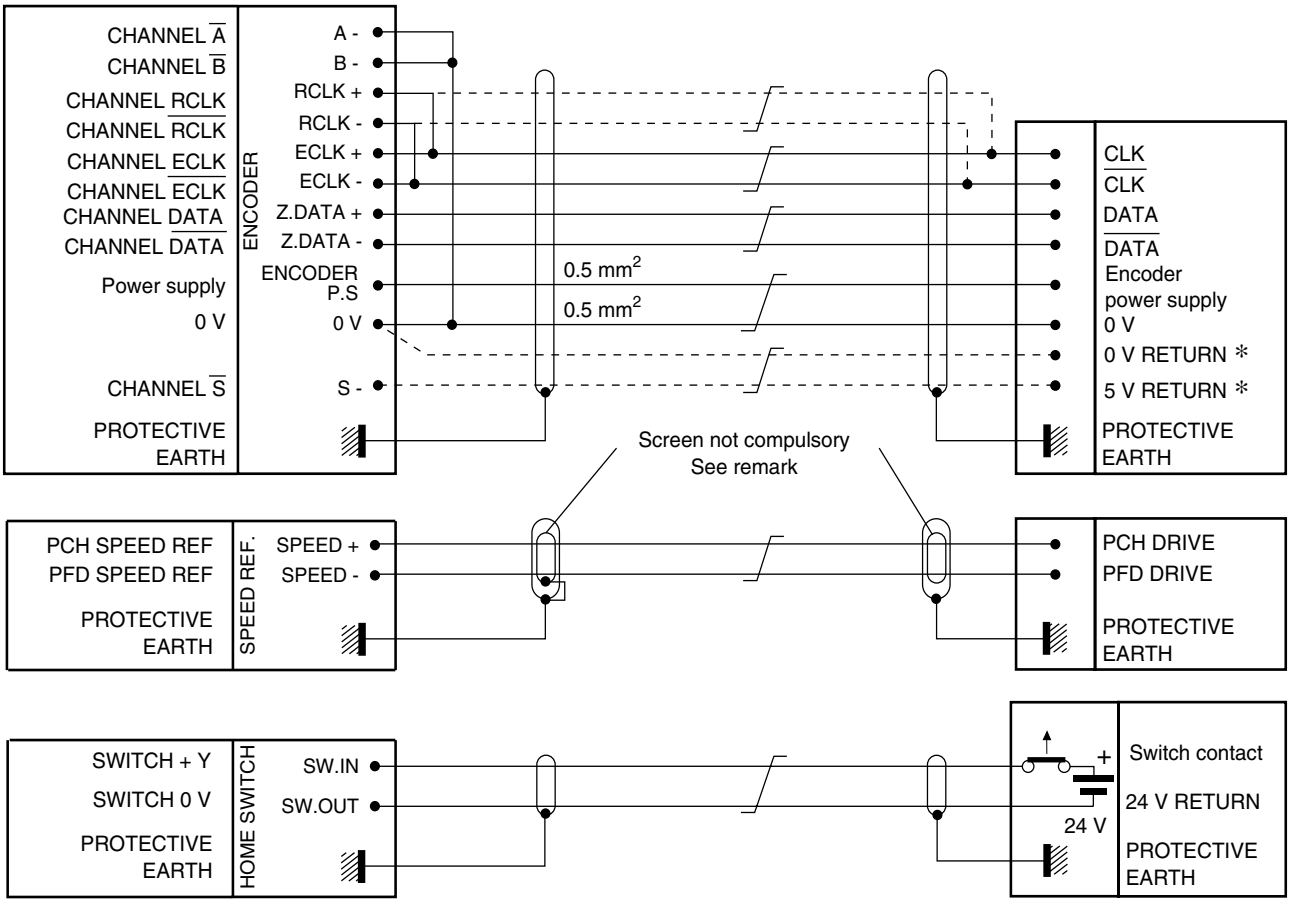
6.2.3.2 SSI Semiabsolute Axis Encoder Cable Connected to an Axis Interface Panel



1 - Axis interface panel
2 - 1 twisted pair shielded cable (2 x 0.22 mm²)
3 - 1 twisted pair cable with double shielding (2 x 0.22 mm²)
4 - Connector
5 - Shielded cable [3 x (2 x 0.14 mm²) + 2 x 0.5 mm²]
or [4 x (2 x 0.14 mm²) + 2 x 0.5 mm²]

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



* 5V encoders only

The physical address of the axis is set on switches (see Sec. 6.2.7).

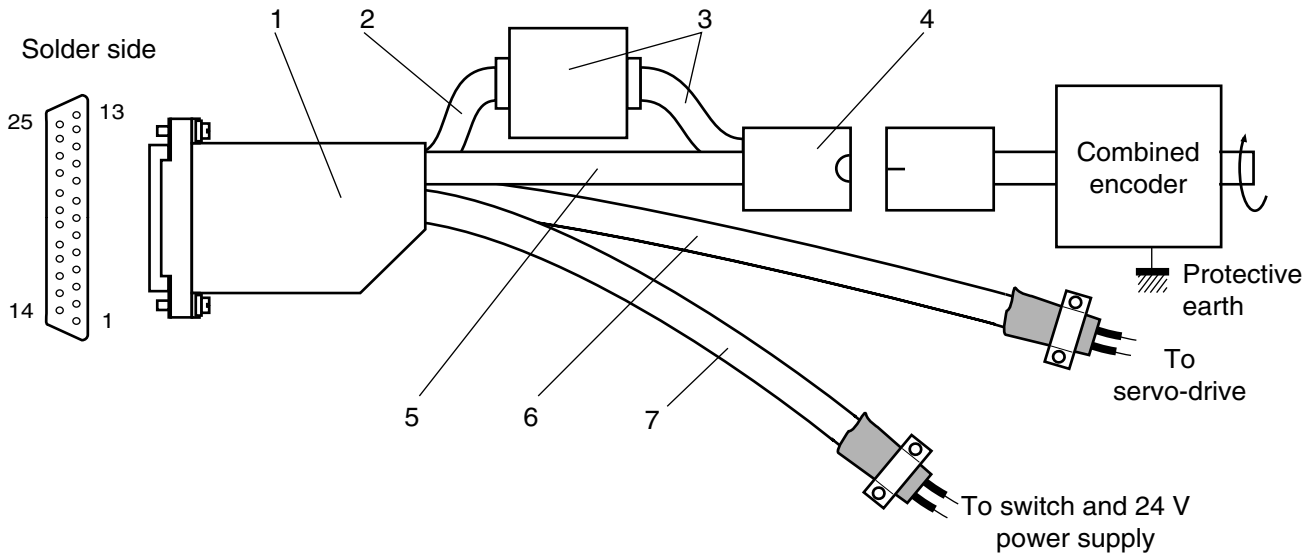
The wiring of channels $\overline{A}$, $\overline{B}$ and $\overline{S}$ allows detection of a wiring or encoder fault. This requires enabling the poor signal and/or encoder channel complementarity check (parameters P25 and P26 - refer to the Parameter Manual).

REMARKS *If the interference level is low, the cable with double shielding (servo-drive cable) can be replaced by a cable with single shielding connected at both ends to the protective earth.*

CRCLK is connected to ECLK either on the axis connector or on the encoder, depending on the frequency and the cable length (see Sec. 5.2.6.5).

6.2.4 Combined Axis Cables: SSI + Incremental, Sinusoidal Pulses

6.2.4.1 Combined Axis Cables: SSI + Incremental, Sinusoidal Pulses, Connected to the Axis Interface, Power Supply Provided by the Interface

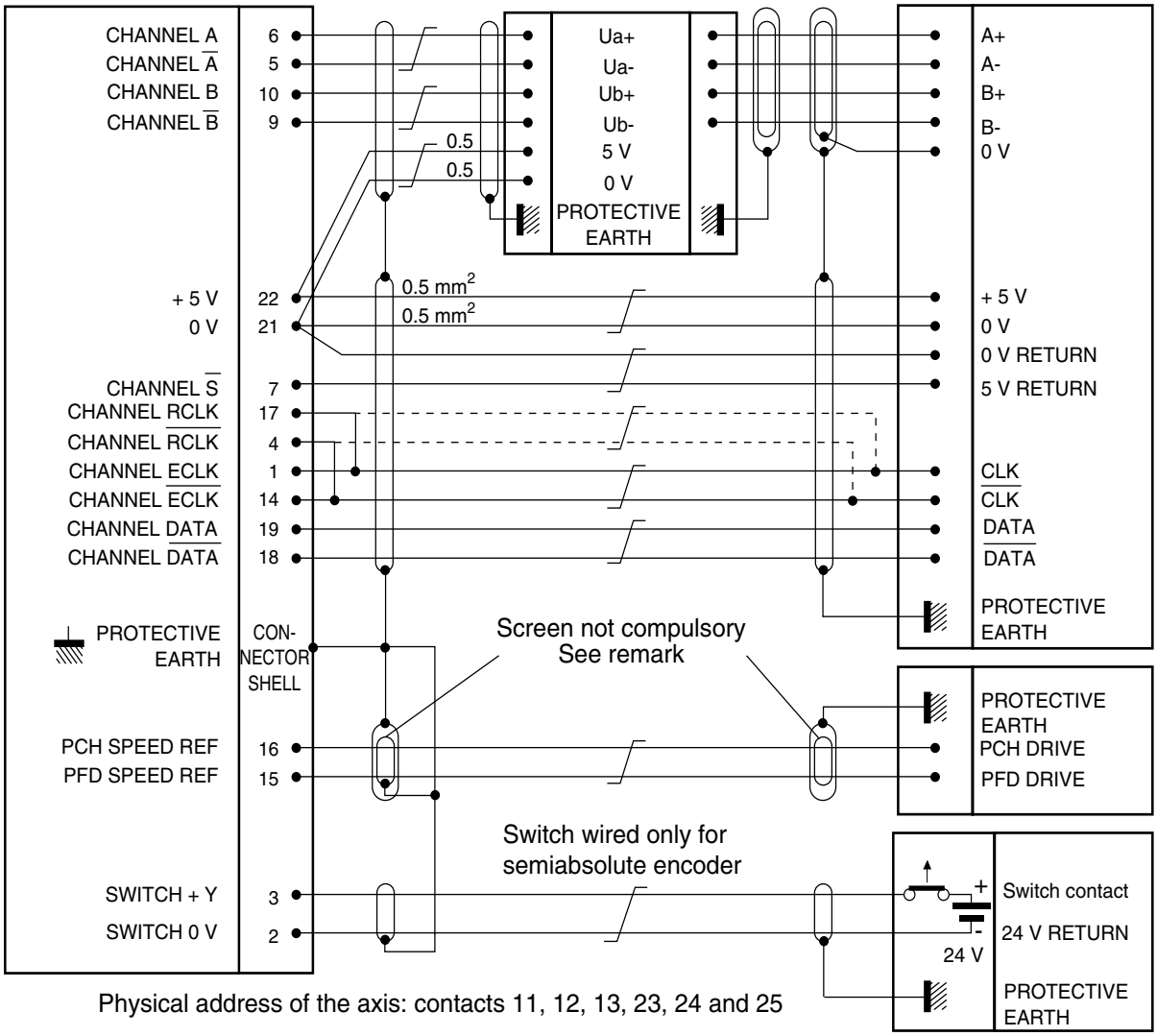


1 - 25-contact male Sub.D connector plug
2 - Shielded cable [2 x (2 x 0.14 mm^2) + 2 x 0.5 mm^2]
3 - Signal interpolation and shaping unit and associated cable
4 - Connector
5 - Shielded cable [3 x (2 x 0.14 mm^2) + 2 x 0.5 mm^2]
or [4 x (2 x 0.14 mm^2) + 2 x 0.5 mm^2]
6 - 1 twisted pair cable with double shielding (2 x 0.22 mm^2)
7 - 1 twisted pair shielded cable (2 x 0.22 mm^2)*

* The switch and cable (7) are used only with semiabsolute encoders

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



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

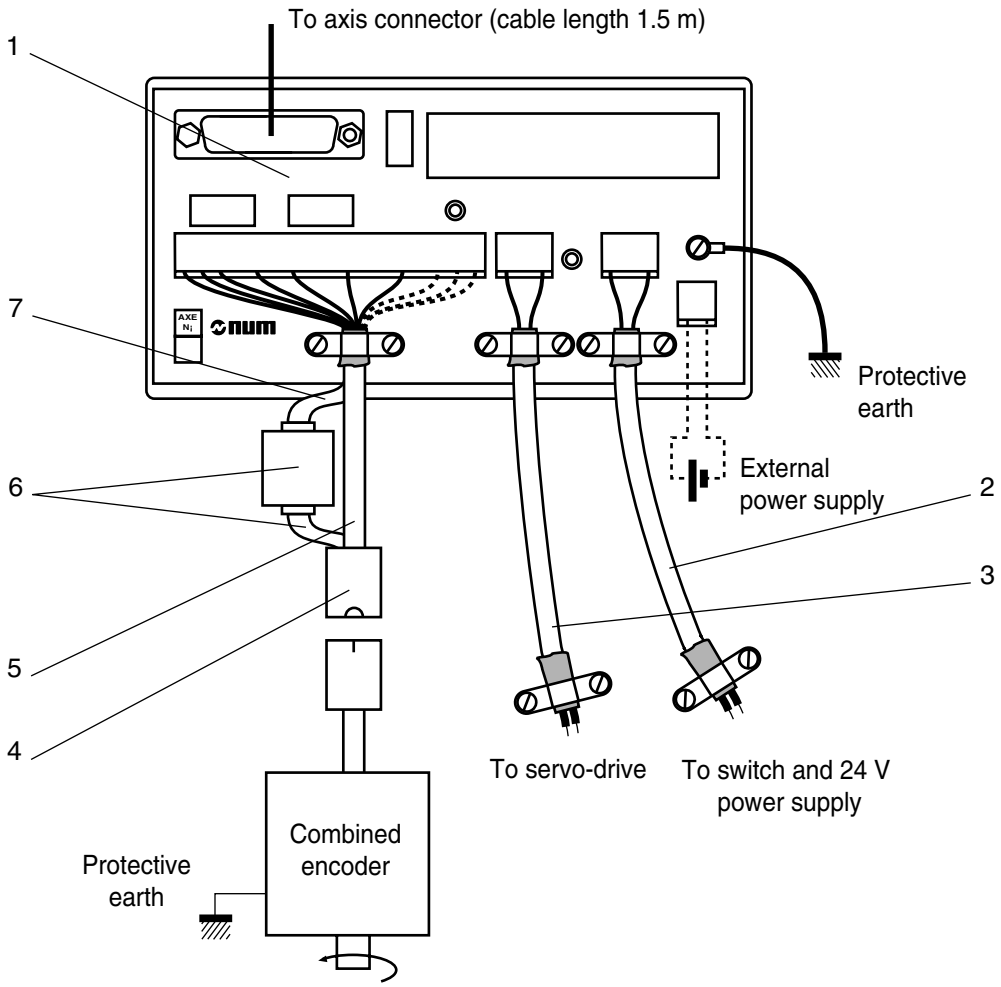
The physical address of the axis is obtained by the wiring of contacts 11, 12, 13, 23, 24 and 25 (see Sec. 6.2.10).

The wiring of channels A, B, $\overline{A}$, $\overline{B}$ and $\overline{S}$ allows detection of a wiring or encoder fault. This requires enabling the poor signal and/or encoder channel complementarity check (parameters P25 and P26 - refer to the Parameter Manual).

REMARKS *If the interference level is low, the cable with double shielding (servo-drive cable) can be replaced by a cable with single shielding connected at both ends to the protective earth.*

CRCLK is connected to ECLK either on the axis connector or on the encoder, depending on the frequency and the cable length (see Sec. 5.2.6.5).

6.2.4.2 Combined Axis Cables: SSI + Incremental, Sinusoidal Pulses, Connected to an Axis Interface Panel

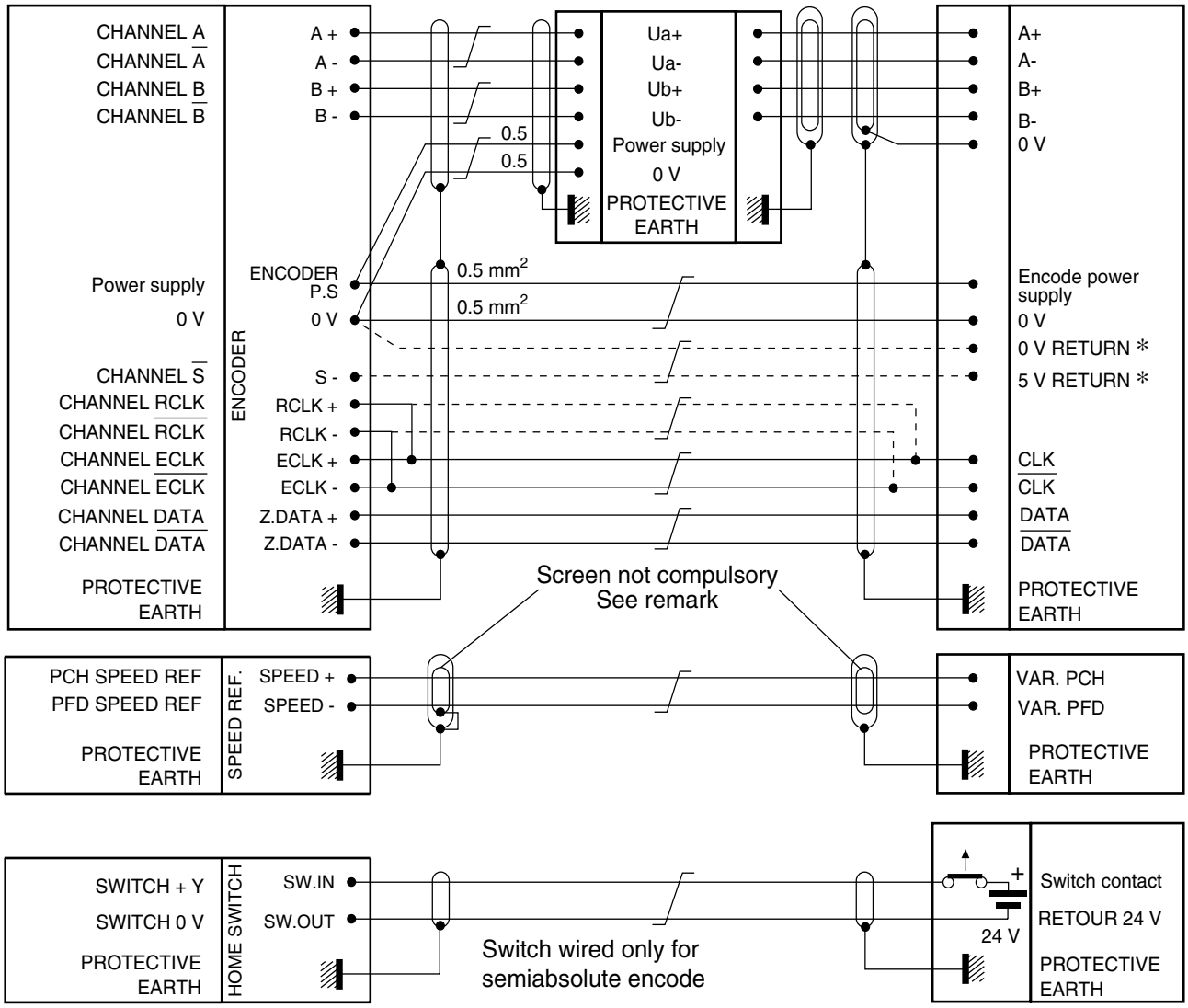


1 - Axis interface panel
2 - 1 twisted pair shielded cable (2 x 0.22 mm²)*
3 - 1 twisted pair cable with double shielding (2 x 0.22 mm²)
4 - Connector
5 - Shielded cable [3 x (2 x 0.14 mm²) + 2 x 0.5 mm²]
or [4 x (2 x 0.14 mm²) + 2 x 0.5 mm²]
6 - Signal interpolation and shaping unit and associated cable
7 - Shielded cable [2 x (2 x 0.14 mm²) + 2 x 0.5 mm²]

* The switch and cable (2) are used only with semiabsolute encoders

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



* 5V encoders only

The physical address of the axis is set on switches (see Sec. 6.2.7).

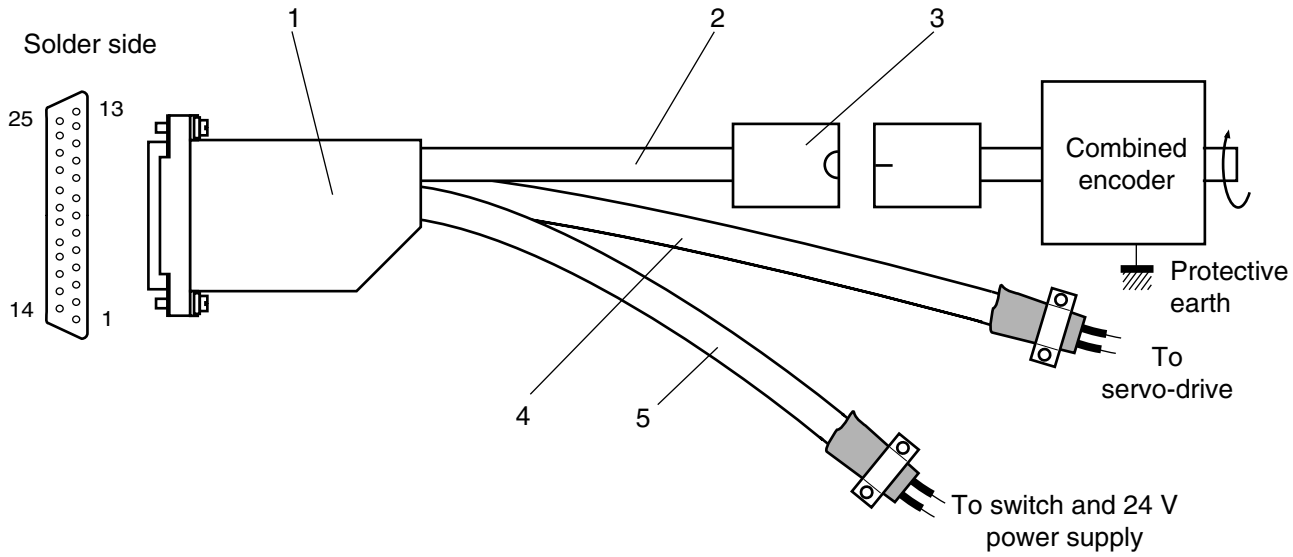
The wiring of channels A, B, $\overline{A}$, $\overline{B}$ and $\overline{S}$ allows detection of a wiring or encoder fault. This requires enabling the poor signal and/or encoder channel complementarity check (parameters P25 and P26 - refer to the Parameter Manual).

REMARKS *If the interference level is low, the cable with double shielding (servo-drive cable) can be replaced by a cable with single shielding connected at both ends to the protective earth.*

CRCLK is connected to ECLK either on the axis connector or on the encoder, depending on the frequency and the cable length (see Sec. 5.2.6.5).

6.2.5 Combined Axis Cables: SSI + Incremental, Square Pulses

6.2.5.1 Combined Axis Cables: SSI + Incremental, Square Pulses, Connected to the Axis Interface, Power Supply Provided by the Interface

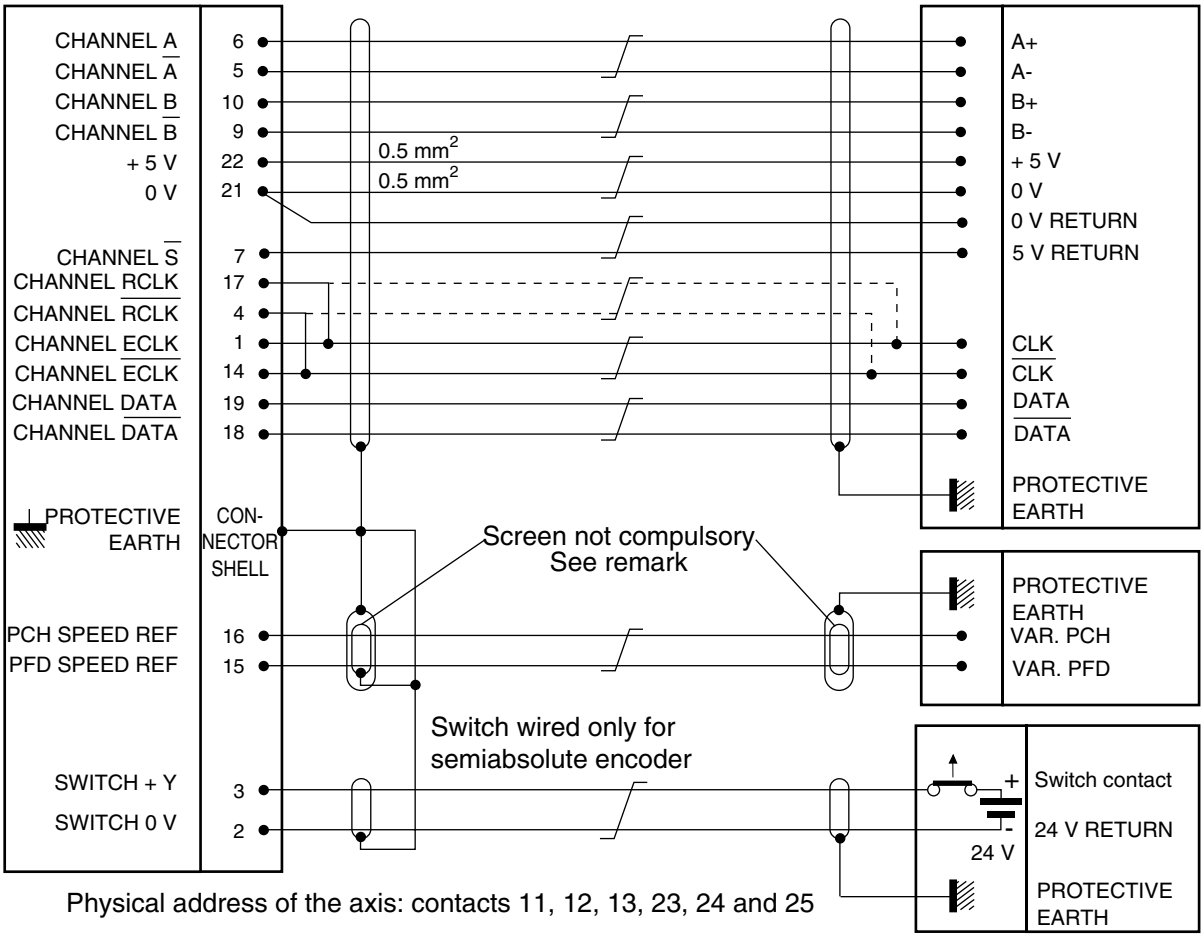


1 - 25-contact male Sub.D connector plug
2 - Shielded cable [5 x (2 x 0.14 mm^2) + 2 x 0.5 mm^2]
or [6 x (2 x 0.14 mm^2) + 2 x 0.5 mm^2]
3 - Connector
4 - 1 twisted pair cable with double shielding (2 x 0.22 mm^2)
5 - 1 twisted pair shielded cable (2 x 0.22 mm^2)*

* The switch and cable (5) are used only with semiabsolute encoders

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



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

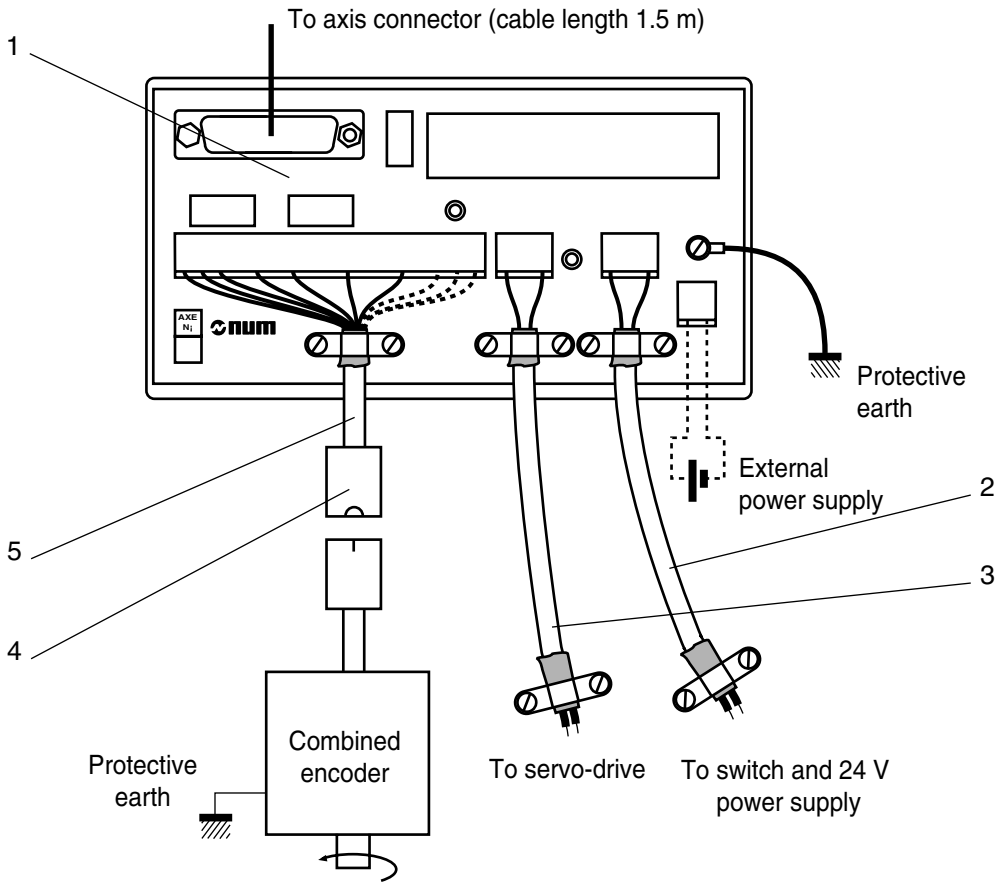
The physical address of the axis is obtained by the wiring of contacts 11, 12, 13, 23, 24 and 25 (see Sec. 6.2.10).

The wiring of channels A, B, $\overline{A}$, $\overline{B}$ and $\overline{S}$ allows detection of a wiring or encoder fault. This requires enabling the poor signal and/or encoder channel complementarity check (parameters P25 and P26 - refer to the Parameter Manual).

REMARKS *If the interference level is low, the cable with double shielding (servo-drive cable) can be replaced by a cable with single shielding connected at both ends to the protective earth.*

CRCLK is connected to ECLK either on the axis connector or on the encoder, depending on the frequency and the cable length (see Sec. 5.2.6.5).

6.2.5.2 Combined Axis Cables: SSI + Incremental, Square Pulses, Connected to an Axis Interface Panel

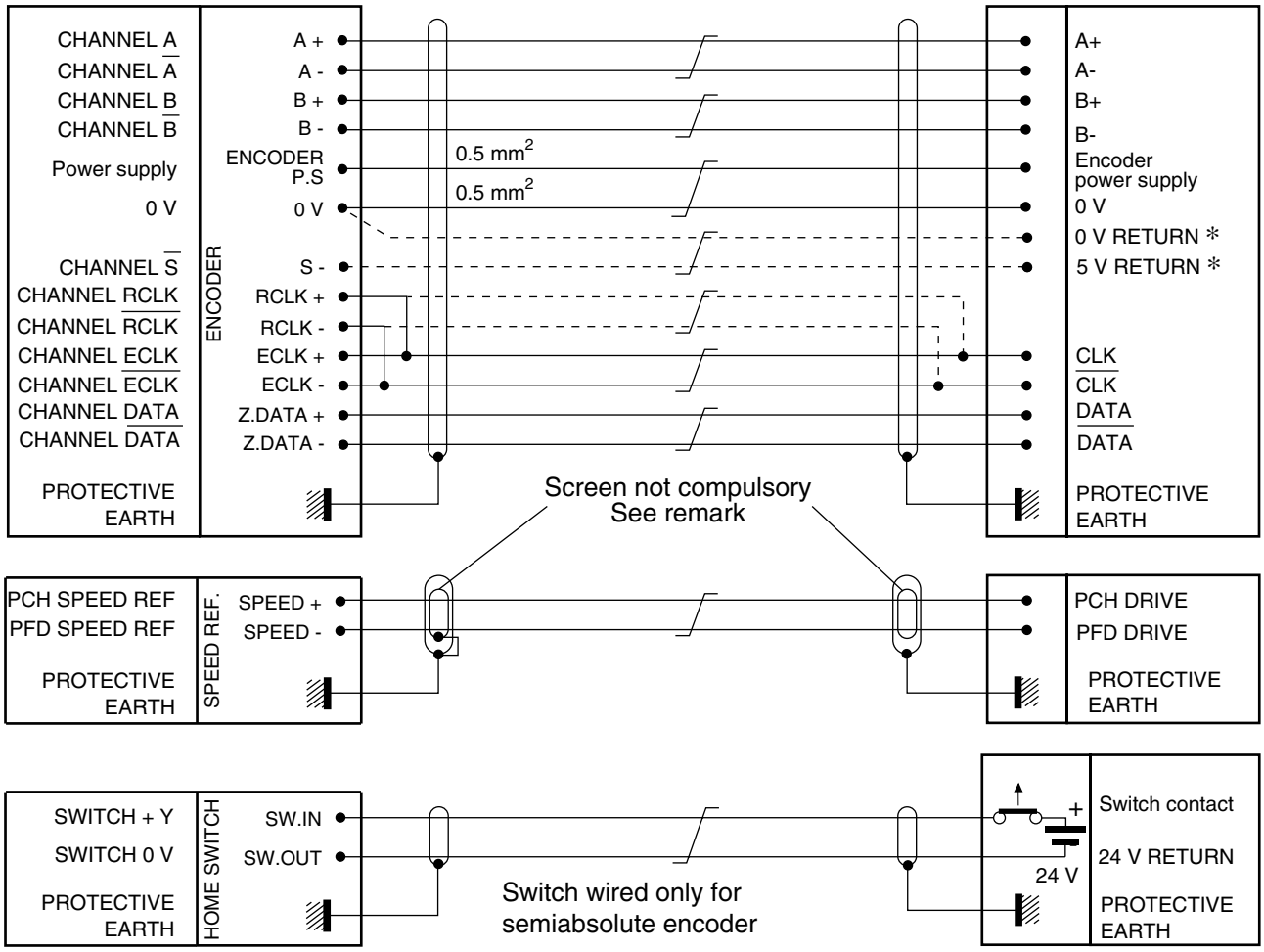


1 - Axis interface panel
2 - 1 twisted pair shielded cable (2 x 0.22 mm²)*
3 - 1 twisted pair cable with double shielding (2 x 0.22 mm²)
4 - Connector
5 - Shielded cable [5 x (2 x 0.14 mm²) + 2 x 0.5 mm²]
or [6 x (2 x 0.14 mm²) + 2 x 0.5 mm²]

* The switch and cable (2) are used only with semiabsolute encoders

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



* 5V encoders only

The physical address of the axis is set on switches (see Sec. 6.2.7).

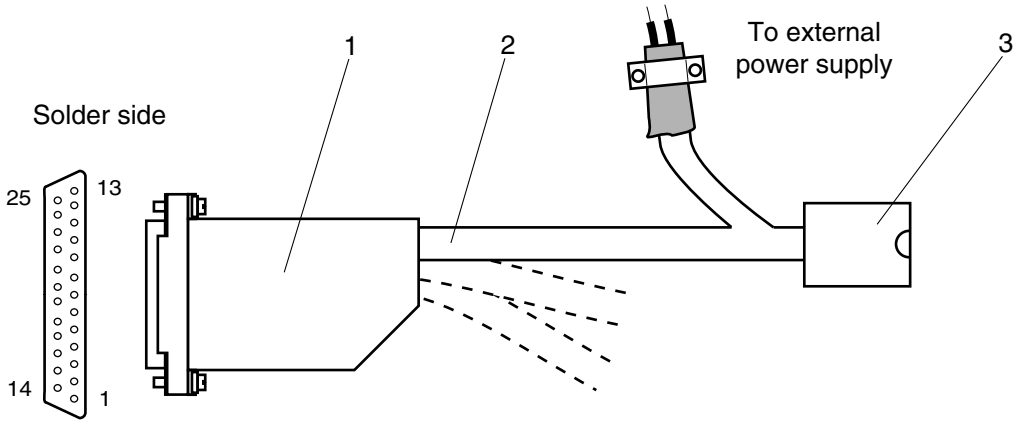
The wiring of channels A, B, $\overline{A}$, $\overline{B}$ and $\overline{S}$ allows detection of a wiring or encoder fault. This requires enabling the poor signal and/or encoder channel complementarity check (parameters P25 and P26 - refer to the Parameter Manual).

REMARKS *If the interference level is low, the cable with double shielding (servo-drive cable) can be replaced by a cable with single shielding connected at both ends to the protective earth.*

CRCLK is connected to ECLK either on the axis connector or on the encoder, depending on the frequency and the cable length (see Sec. 5.2.6.5).

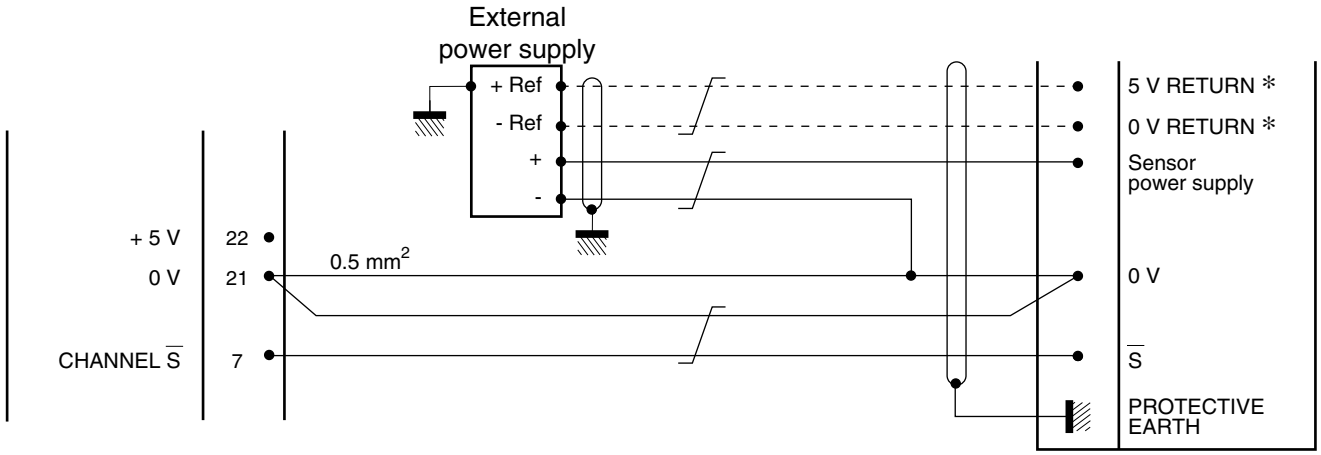
6.2.6 Axes With External Power Supply

When an external power supply is used (case of sensors > 5 V or 5 V sensors for which the axis interface cannot supply sufficient voltage because of the distance, for instance), the cables must be adapted to take this power supply into account. Only the differences from the cables for encoders supplied by the axis interface are described below.



1 - 25-contact male Sub.D connector plug
2 - Sensor cable
3 - Connector

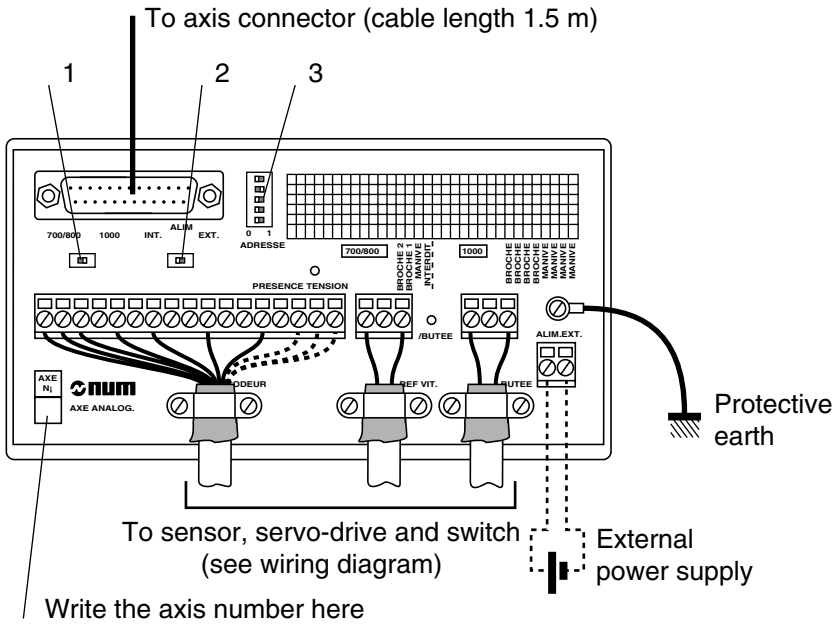
The following wiring is different from that of a sensor supplied by the axis interface:



* On 5 V encoders only.

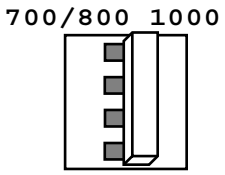
REMARK *This does not concern axes wired via an axis interface terminal board and requiring an external power supply (see axis wiring and Sec. 6.2.7).*

6.2.7 Settings on an Axis Interface Panel



Selecting the System (1)

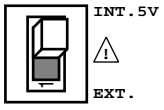
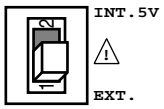
The NUM power 1020/1040/1060/1080 CNCs are part of the 1000 range. The switch must therefore be set as follows:



Selecting the Power Supply (2)

5 VDC Power Supply

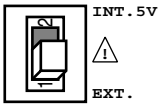
The choice of supplying a 5 VDC encoder by the axis interface or by an external power supply depends on the encoder current draw:

Encoder current draw	Power supply	Switch setting
< 250 mA	Internal	
> 250 mA	External (0.5 to 2.5 mm² wires)	

The selection of an internal or external power supply also depends on the distance to the encoder (see Sec. 5.2.6.2).

Power Supply Above 5 VDC

Since the axis interface cannot supply a voltage above 5 VDC, the supply must be external in this case (0.5 to 2.5 mm2 wires). The switch must therefore be set as follows:

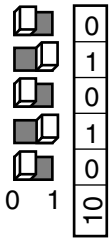


Setting the Physical Address of the Axis (3)

The physical address of the axis is set on 5 switches using the code given in the address table below:

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

For instance, the following switch setting corresponds to address 10:



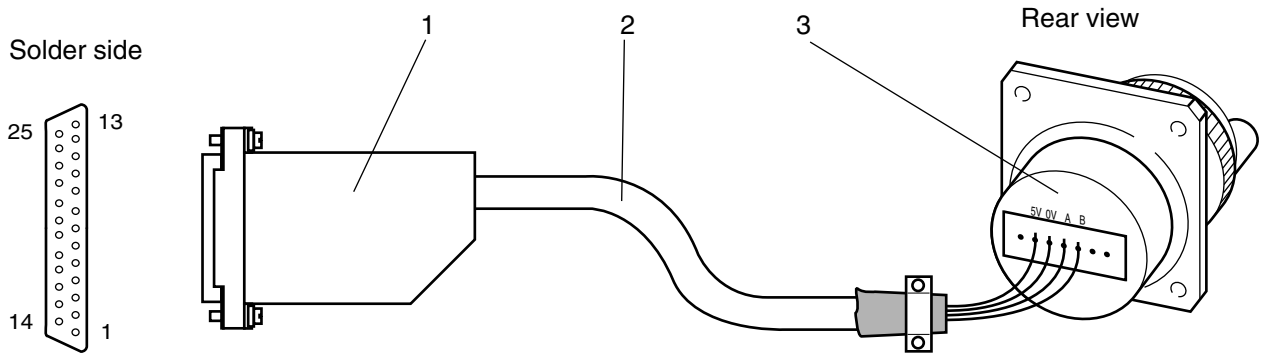
REMARKS *Two axes cannot have the same address. The system ignores axes with identical addresses.*

The addresses assigned to the PLC axes must be the highest addresses.

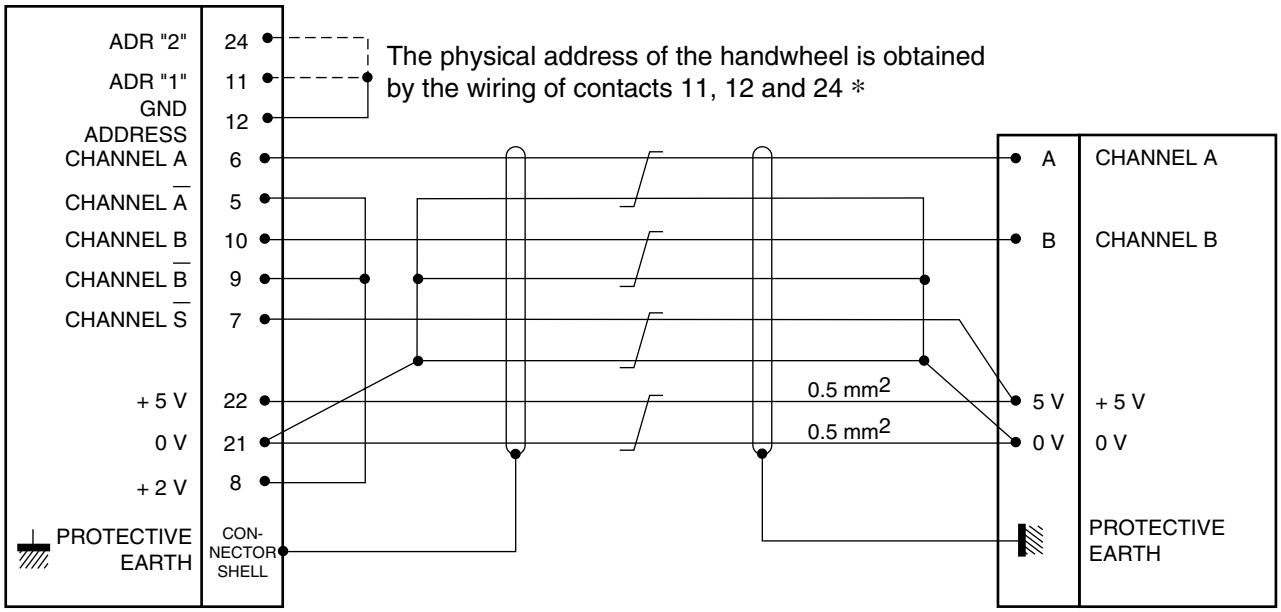
Physical addresses 24 to 27 are reserved for spindles 1 to 4.

Physical addresses 28 to 31 are reserved for handwheels 1 to 4.

6.2.8 Handwheels With Non-Differential Outputs



1 - 25-contact male Sub.D connector plug
2 - Shielded cable with three pairs twisted around one pair
[3 x (2 x 0.14 mm²) + (2 x 0.5 mm²)]
3 - Handwheel with non-differential outputs

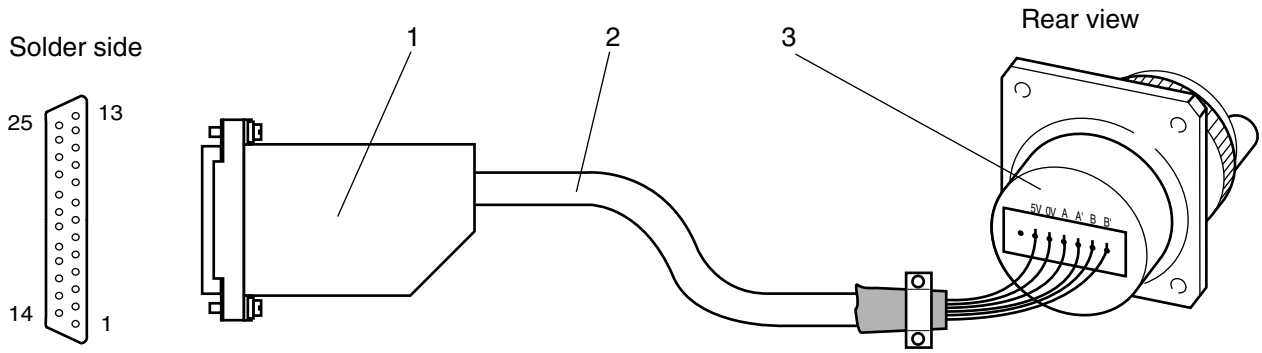


* See Sec. 6.2.10

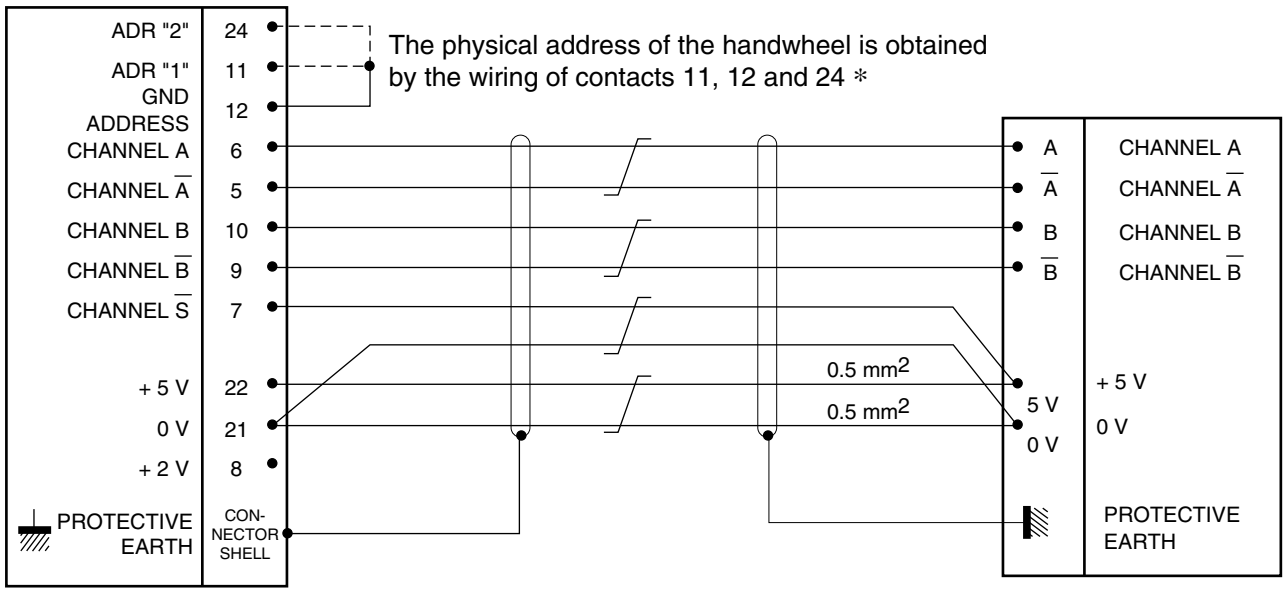
⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

6.2.9 Handwheels With Differential Outputs



1 - 25-contact male Sub.D connector plug
2 - Shielded cable with three pairs twisted around one pair [3 x (2 x 0.14 mm²) + (2 x 0.5 mm²)]
3 - Handwheel with differential outputs



* See Sec. 6.2.10

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.

6.2.10 Physical Addresses of the Axes

Each axis must be assigned an address in order to be recognised by the system.

The physical address of an axis is set by the wiring of contacts 11, 12, 13, 23, 24 and 25:

The physical address of an axis is the sum of the weights of the contacts not connected to contact 12: not connected = set.

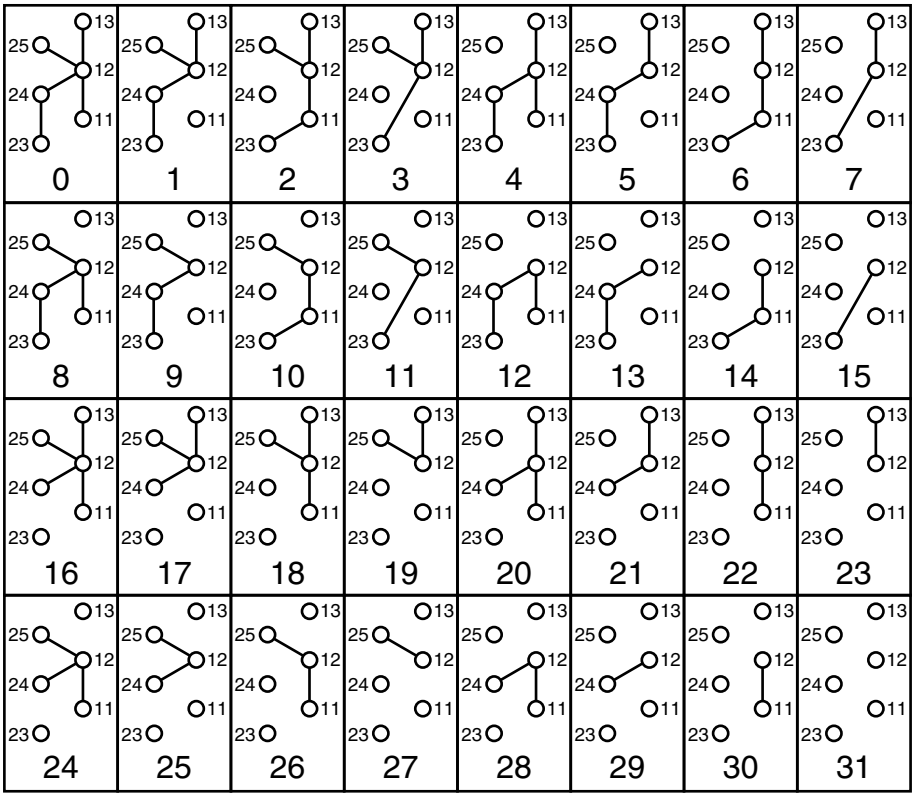
REMARKS *Two axes cannot have the same address. The system ignores axes with identical addresses.*

The addresses assigned to the PLC axes must be the highest addresses.

Physical addresses 24 to 27 are reserved for spindles 1 to 4.

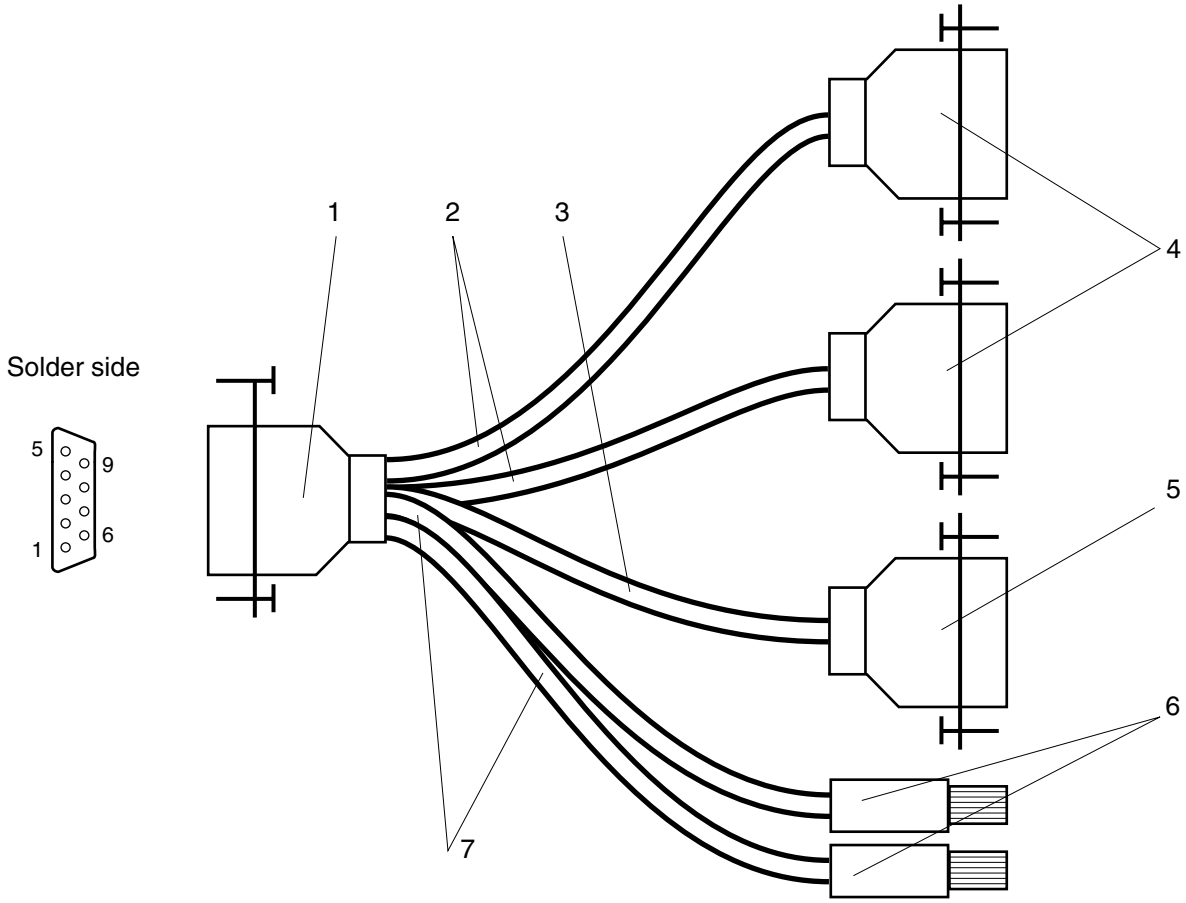
Physical addresses 28 to 31 are reserved for handwheels 1 to 4.

Axis Address Wiring



6.3 Analogue I/O and Interrupt Cable

6.3.1 Recommended Cable

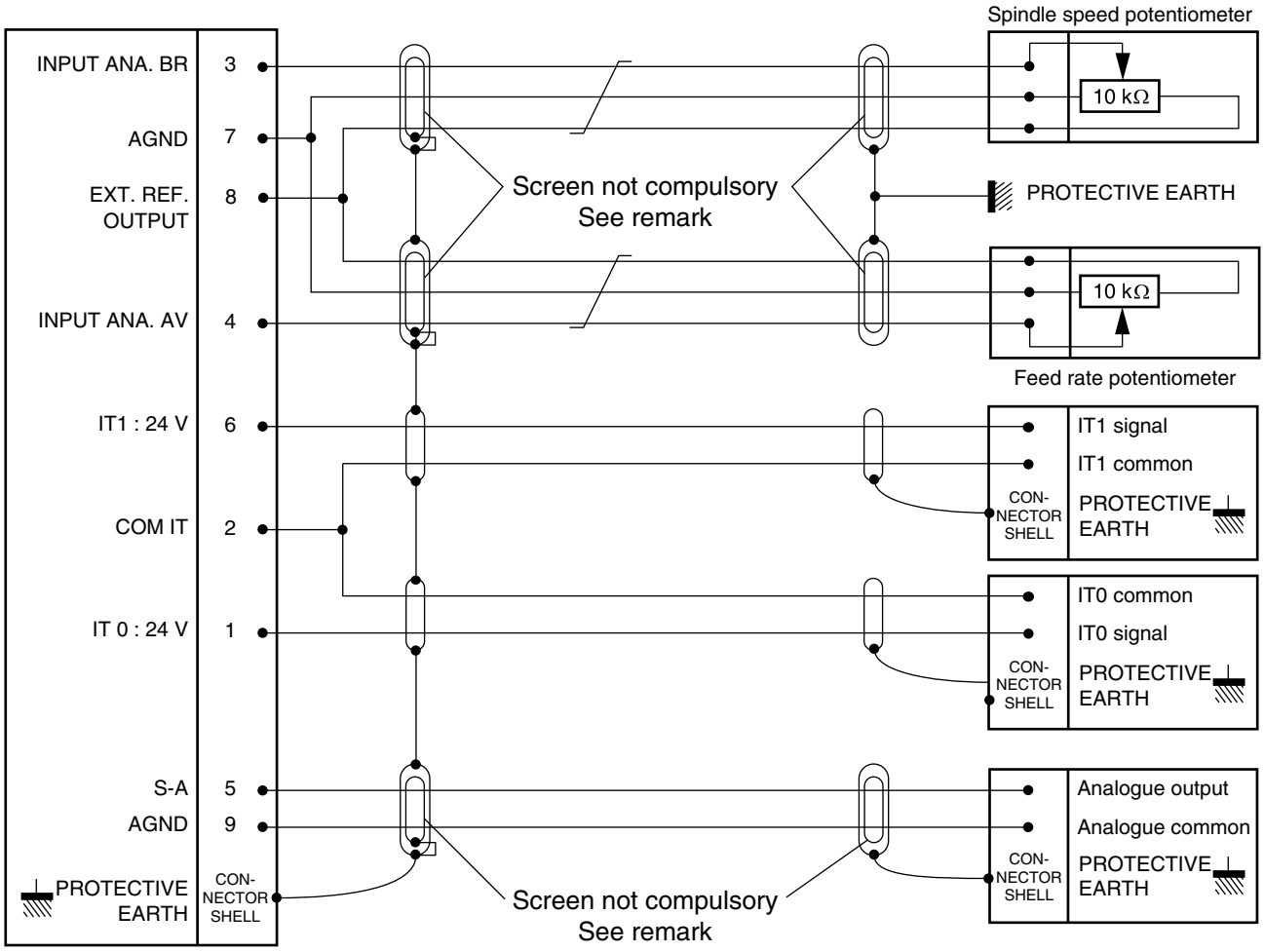


1 - 9-contact female Sub.D connector plug
2 - Shielded 2-wire (2 x 0.22 mm²) cable
3 - 1 pair cable with double shielding (2 x 0.22 mm²)
4 - Interrupt connector plugs
5 - Analogue output connector plug
6 - Spindle speed and feed rate override potentiometers (or other analogue inputs)
7 - 2 cables with 3 twisted pairs and double shielding (3 x 0.22 mm²)

When the Sub.D connector cannot accommodate two shielded cables (7), the wiring can be made using the alternate arrangement described in Sec. 6.3.2.

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed in accordance with the instructions of Section 1.4.3.2.



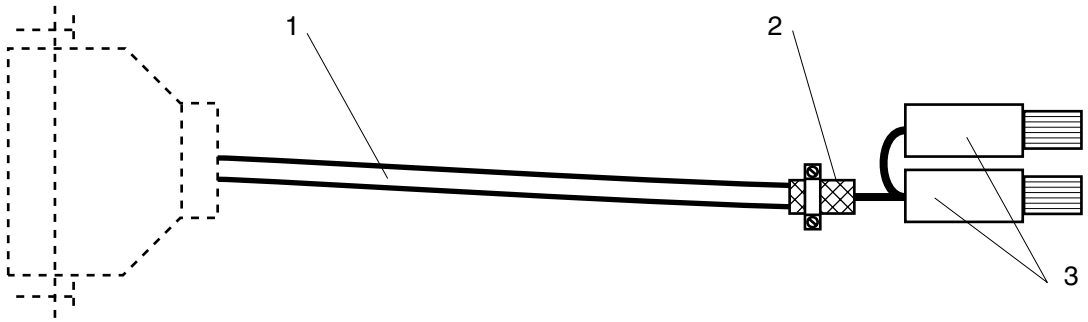
REMARK *If the interference level is low, the analogue output cable with double shielding can be replaced by a cable with single shielding connected at both ends to the protective earth.*

⚠ CAUTION

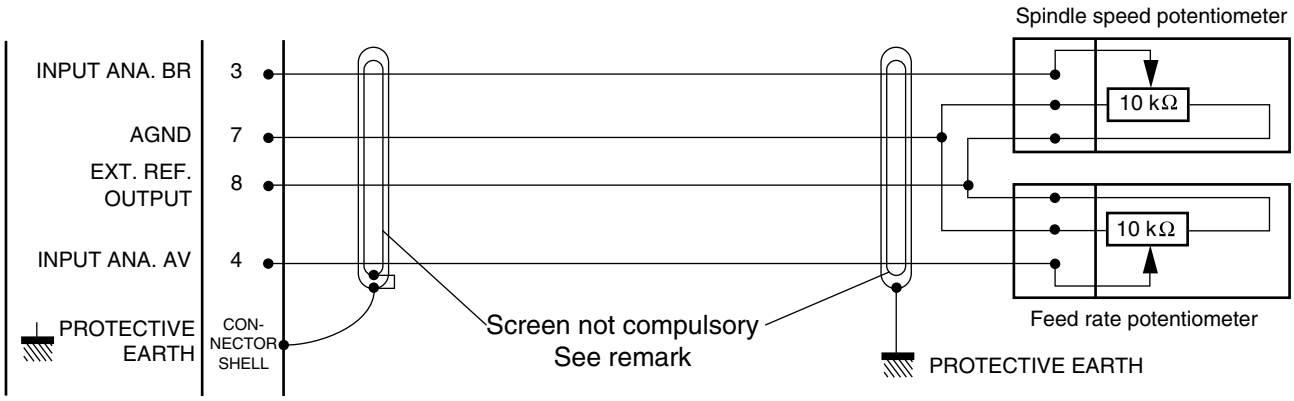
Contact 3 of the analogue I/O connector corresponds to address 0x10 of function anai.
Contact 4 of the analogue I/O connector corresponds to address 0x11 of function anai.

6.3.2 Alternate Wiring of the Analogue Inputs

When the Sub.D connector cannot accommodate two input cables, the wiring can be made with a single cable including both analogue inputs. This section describes only the differences in wiring.



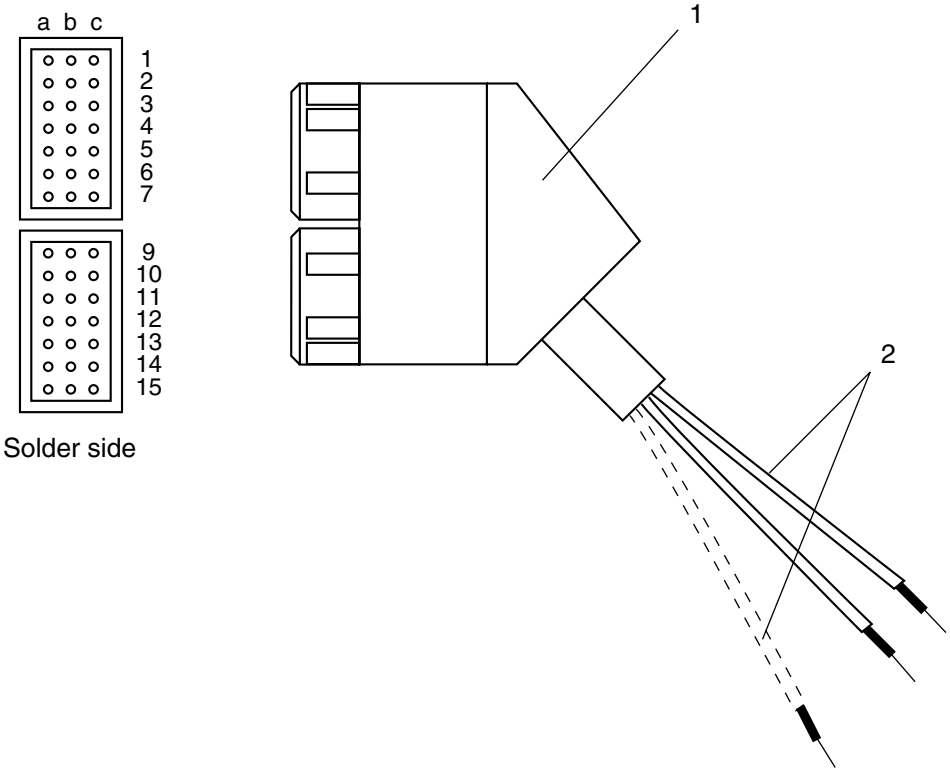
1 - 4-wire cable with double shielding (4 x 0.22 mm^2)
2 - Bonding braid connected to machine frame
3 - Spindle speed and feed rate override potentiometers



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.*

6.4 Input and Output Cables

6.4.1 32-Input Cables



1 - Connector (see Sec. 6.4.3 for cable customisation)
2 - Input and external power supply wires

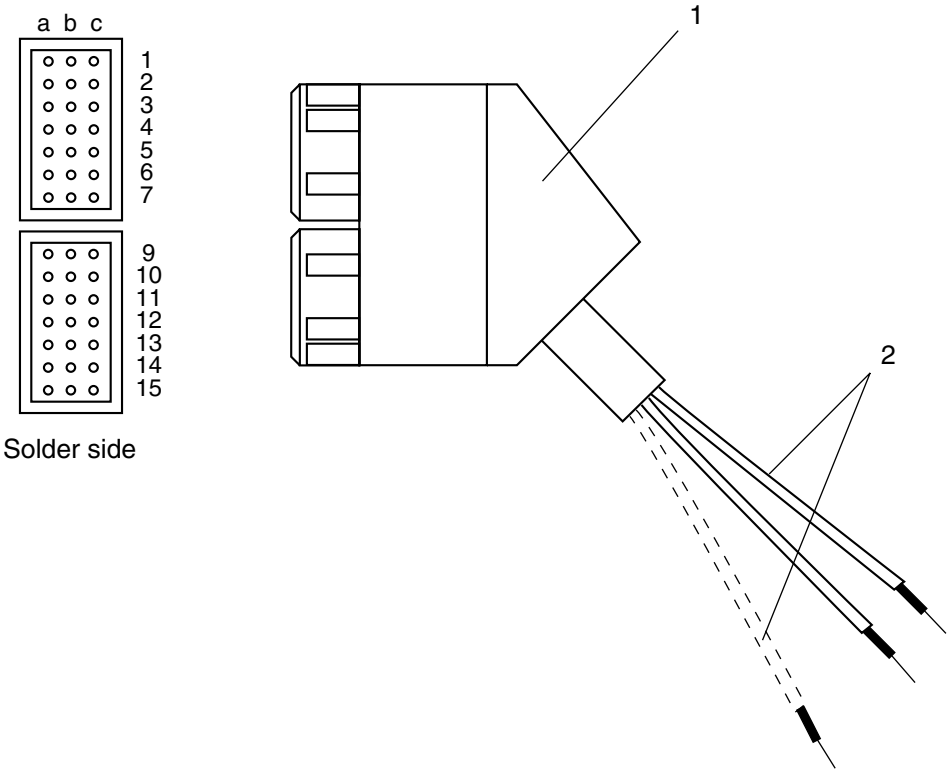
REMARK *Hole c7 is capped on the input cable connector.*

Low part	High part	Contact
P24VE	P24VE	a12
I 00.0	I 04.0	a1
I 00.1	I 04.1	c1
I 00.2	I 04.2	b1
I 00.3	I 04.3	c2
I 00.4	I 04.4	b2
I 00.5	I 04.5	c3
I 00.6	I 04.6	b3
I 00.7	I 04.7	c4
GND	GND	a2
I 01.0	I 05.0	b4
I 01.1	I 05.1	c5
I 01.2	I 05.2	b5
I 01.3	I 05.3	c6
I 01.4	I 05.4	b6
I 01.5	I 05.5	b7
I 01.6	I 05.6	a6
I 01.7	I 05.7	a7
GND	GND	a3
I 02.0	I 06.0	a9
I 02.1	I 06.1	c9
I 02.2	I 06.2	b9
I 02.3	I 06.3	c10
I 02.4	I 06.4	b10
I 02.5	I 06.5	c11
I 02.6	I 06.6	b11
I 02.7	I 06.7	c12
GND	GND	a4
I 03.0	I 07.0	b12
I 03.1	I 07.1	c13
I 03.2	I 07.2	b13
I 03.3	I 07.3	c14
I 03.4	I 07.4	b14
I 03.5	I 07.5	c15
I 03.6	I 07.6	b15
I 03.7	I 07.7	a15
GND	GND	a5

REMARK *All the commons are interconnected on the card.*

Wiring of 24 VDC to pin a12 is optional. It allows the PLC to detect the presence of 24 VDC by reading bit I013C.0 (bit = 1: 24 VDC present).

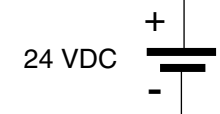
6.4.2 24-Output Cable



1 - Connector (see Sec. 6.4.3 for cable customisation)
2 - Output and external power supply wires

REMARK *Hole c15 is capped on the output cable connector.*

Low part	High part	Contact
P24VS	P24VS	a2
O 00.0	O 03.0	a1
O 00.1	O 03.1	c1
O 00.2	O 03.2	b1
O 00.3	O 03.3	c2
O 00.4	O 03.4	b2
O 00.5	O 03.5	c3
O 00.6	O 03.6	b3
O 00.7	O 03.7	c4
GND	GND	a9
P24VS	P24VS	a3
O 01.0	O 04.0	b4
O 01.1	O 04.1	c5
O 01.2	O 04.2	b5
O 01.3	O 04.3	c6
O 01.4	O 04.4	b6
O 01.5	O 04.5	c7
O 01.6	O 04.6	b7
O 01.7	O 04.7	a7
GND	GND	a10
P24VS	P24VS	a4
O 02.0	O 05.0	c9
O 02.1	O 05.1	b9
O 02.2	O 05.2	c10
O 02.3	O 05.3	b10
O 02.4	O 05.4	c11
O 02.5	O 05.5	b11
O 02.6	O 05.6	c12
O 02.7	O 05.7	b12
GND	GND	a11
GND	GND	a12
P24VS	P24VS	a5

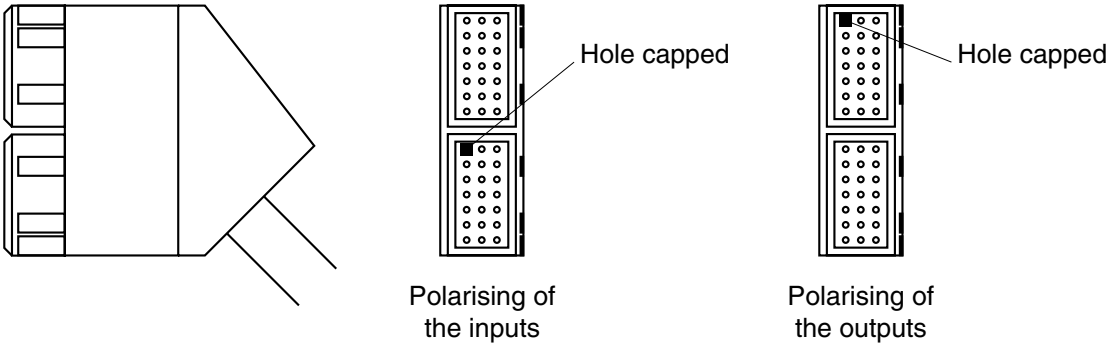


REMARK *All the common wires are interconnected on the card as are all the P24VS power supply wires.*

6.4.3 Installing the Input/Output Cables

6.4.3.1 Polarising the Input and Output Cables

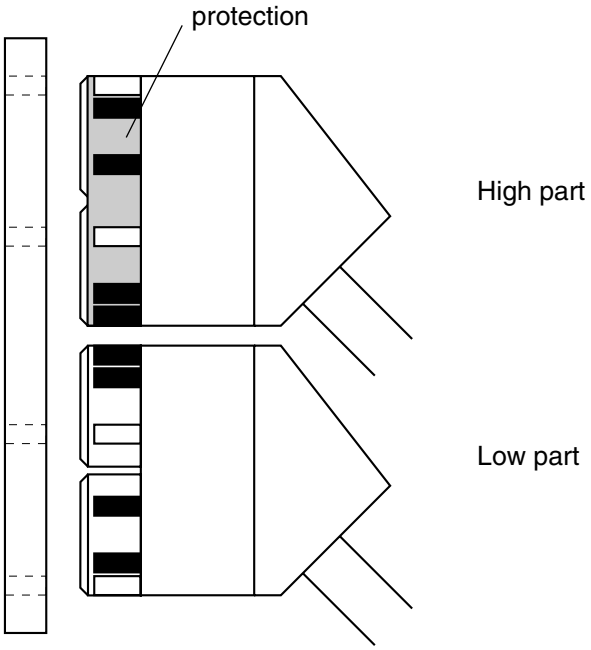
The input and output cables are differentiated:
- by marking with the words "ENTREES" (inputs) or "SORTIES" (outputs)
- by polarising:



The capped holes in the connector plugs correspond to a missing contact in the card connector receptacle.

6.4.3.2 Customising the Cables of the High or Low Part

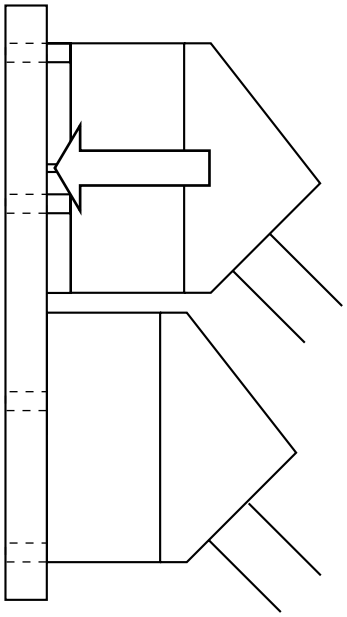
The cables must be customised according as they occupy the high or low part of the connector:



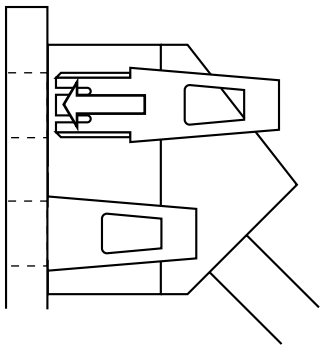
To customise the cables, break off the tabs shown in black.

6.4.3.3 Installing and Locking the Cables

Insert the connectors plugs in the receptacles taking the input/output polarising and top/bottom part into account:



Lock the connectors in place with the tabs provided, inserting them until they snap into place:



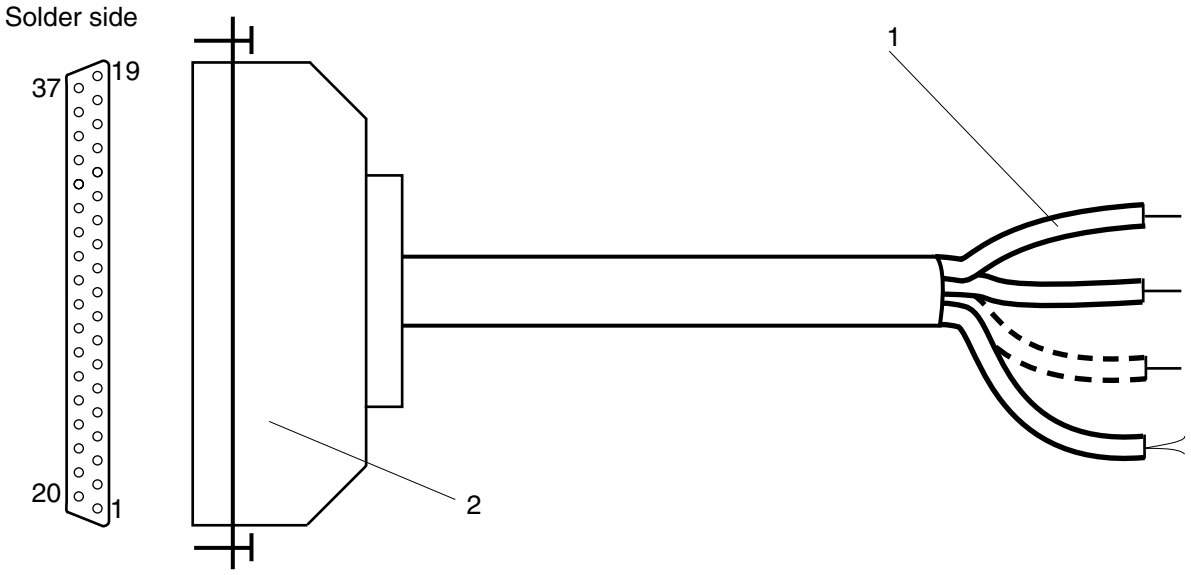
Removing a Connector

Slightly separate the two tabs and pull out the connector, taking care not to break the tabs.

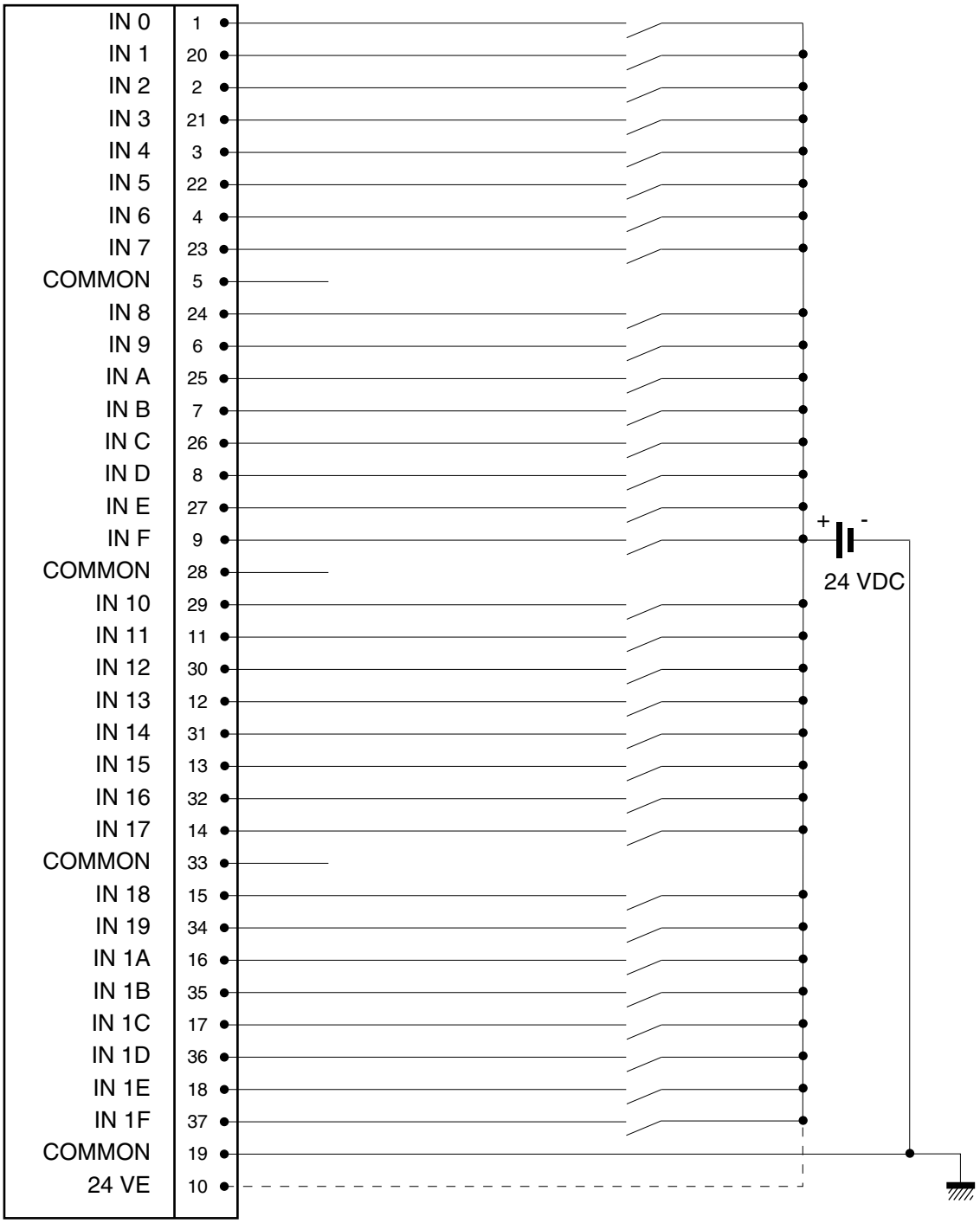
Reinstalling a Connector

Slightly separate the two tabs and push the connector home, taking care not to break the tabs.

6.4.4 Machine Panel Extension 32-Input Cable (with or without External Power Supply)



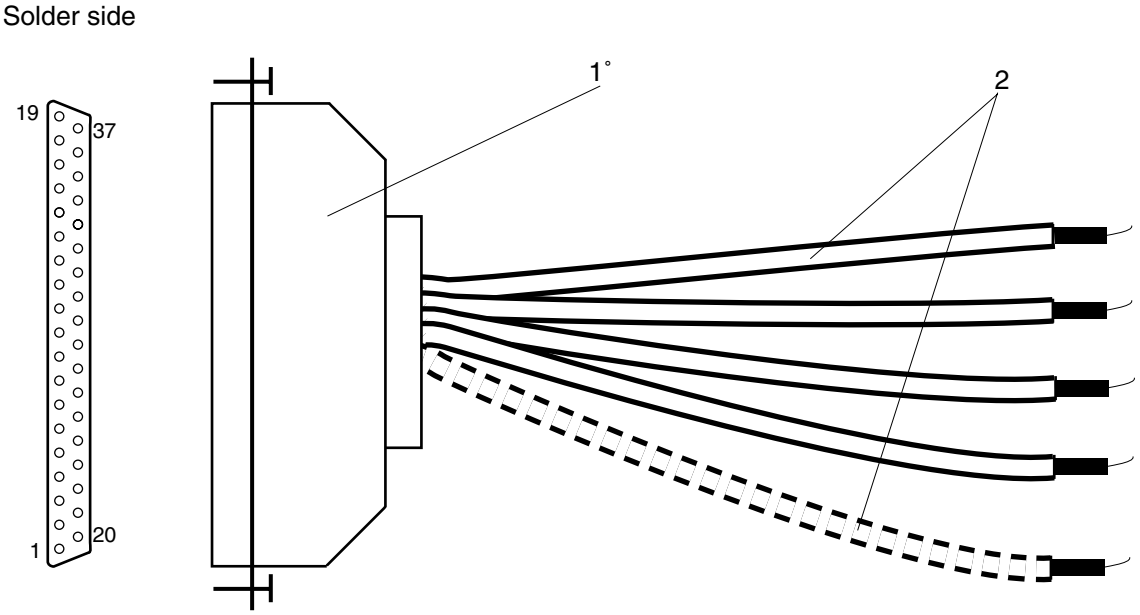
1 - Input (and external power supply) wires
2 - 37-contact male Sub.D connector plug



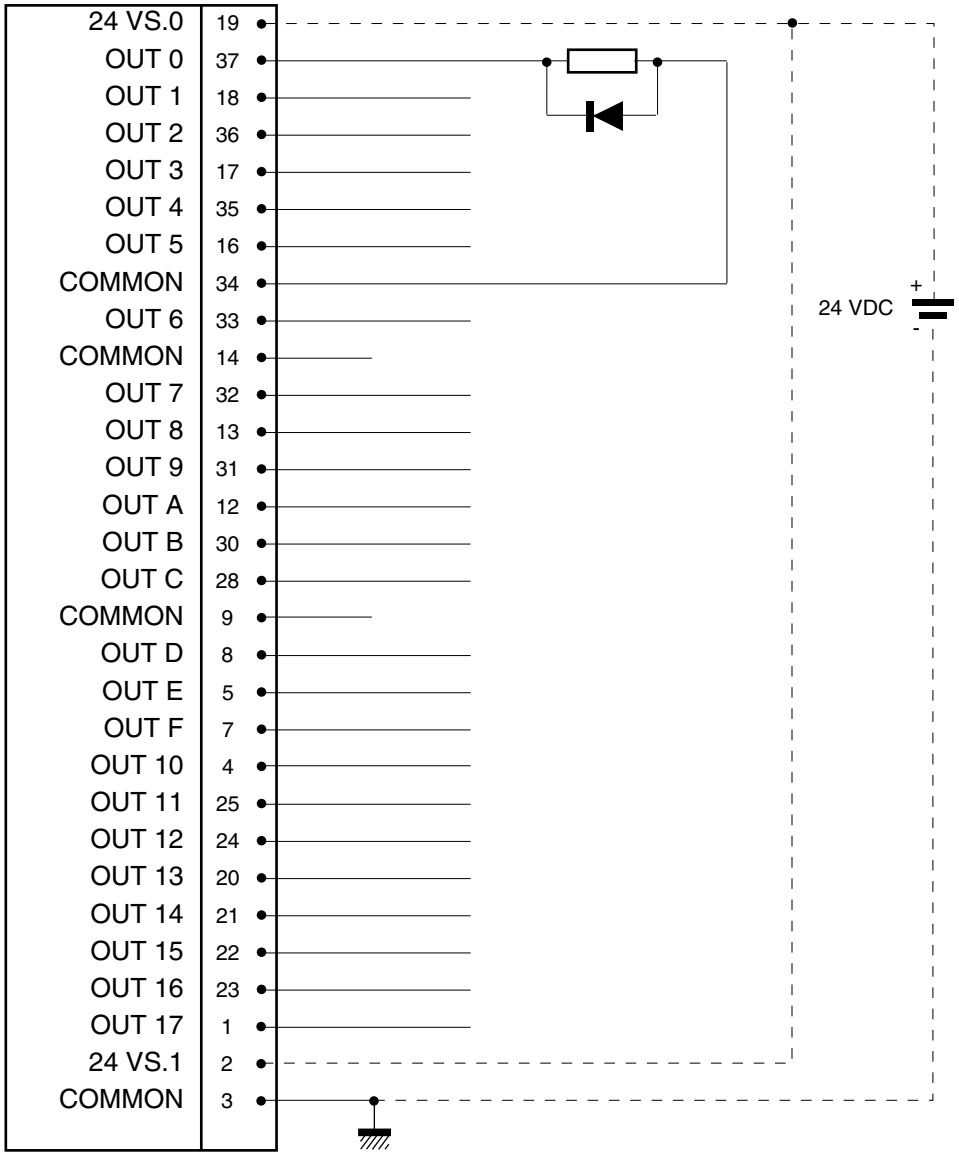
REMARKS *Contact 10 is not connected unless the 32-input cable provides the general power supply for the machine panel extension.*

All the commons are interconnected inside the machine panel extension.

6.4.5 Machine Panel Extension 24-Output Cable (with or without External Power Supply)



1 - 37-contact female Sub.D connector plug
2 - Output and external power supply wires



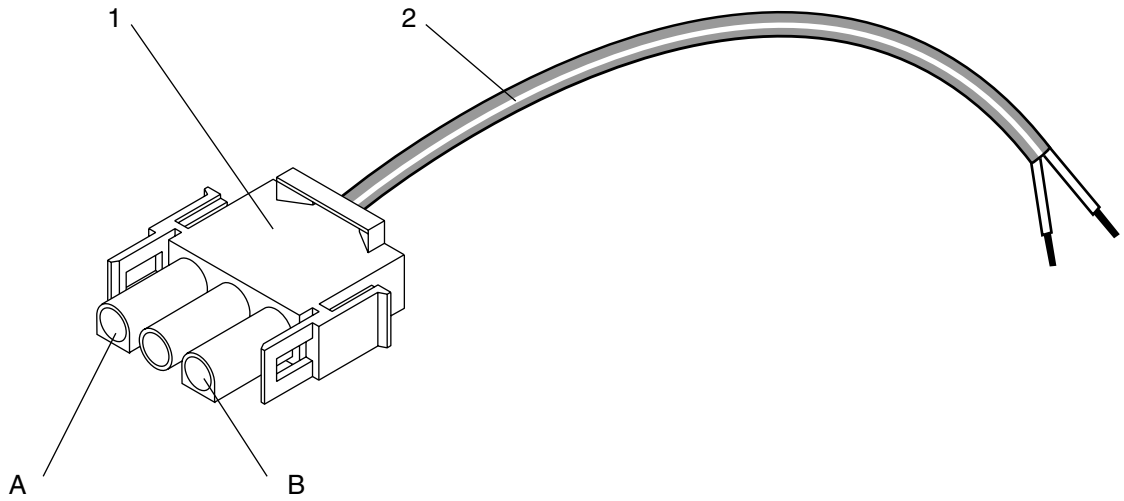
REMARKS *The power supply is not connected unless the 24-output cable provides the general power supply for the inputs (or the machine panel extension).*

In this case the 24 VDC can be connected to one of contacts 2 or 19.

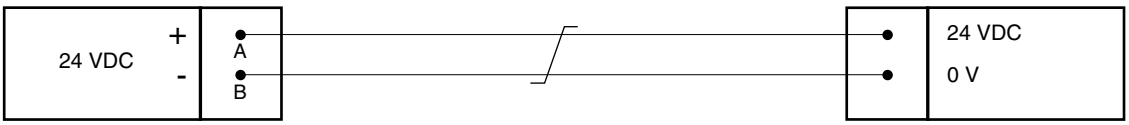
All the commons are interconnected on the machine panel extension.

6.5 Power Cables

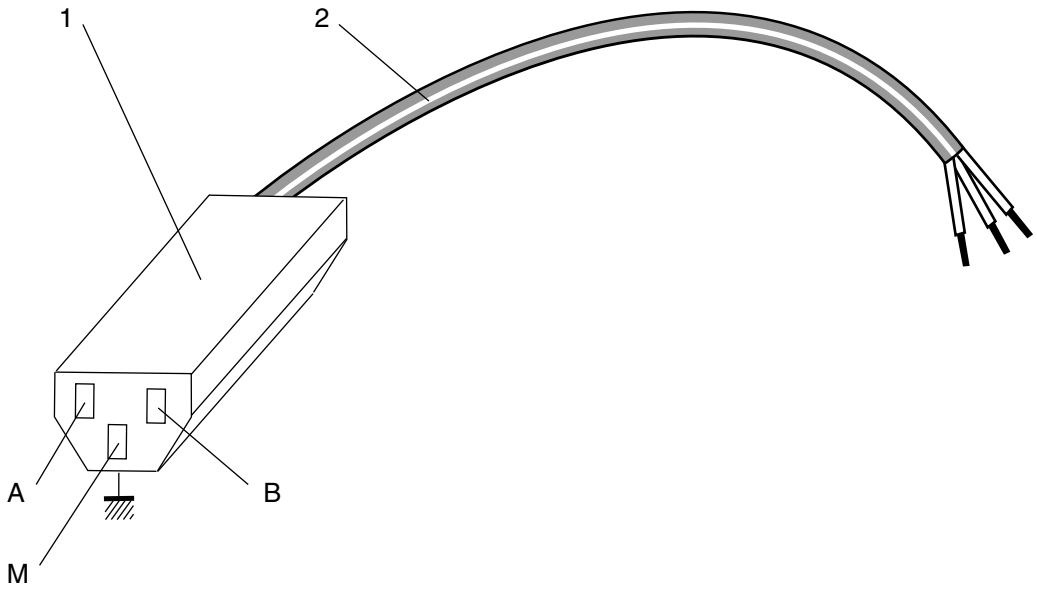
6.5.1 CPU, Modax and LCD Panel Monitor (FS20) Power Cable



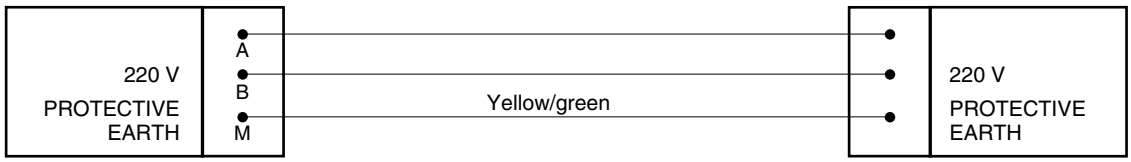
1 - 3-contact connector equipped with 2 male crimped contacts (A and B)
2 - Twisted 2-wire cable (2 x 1 mm²)



6.5.2 Mains Power Cable



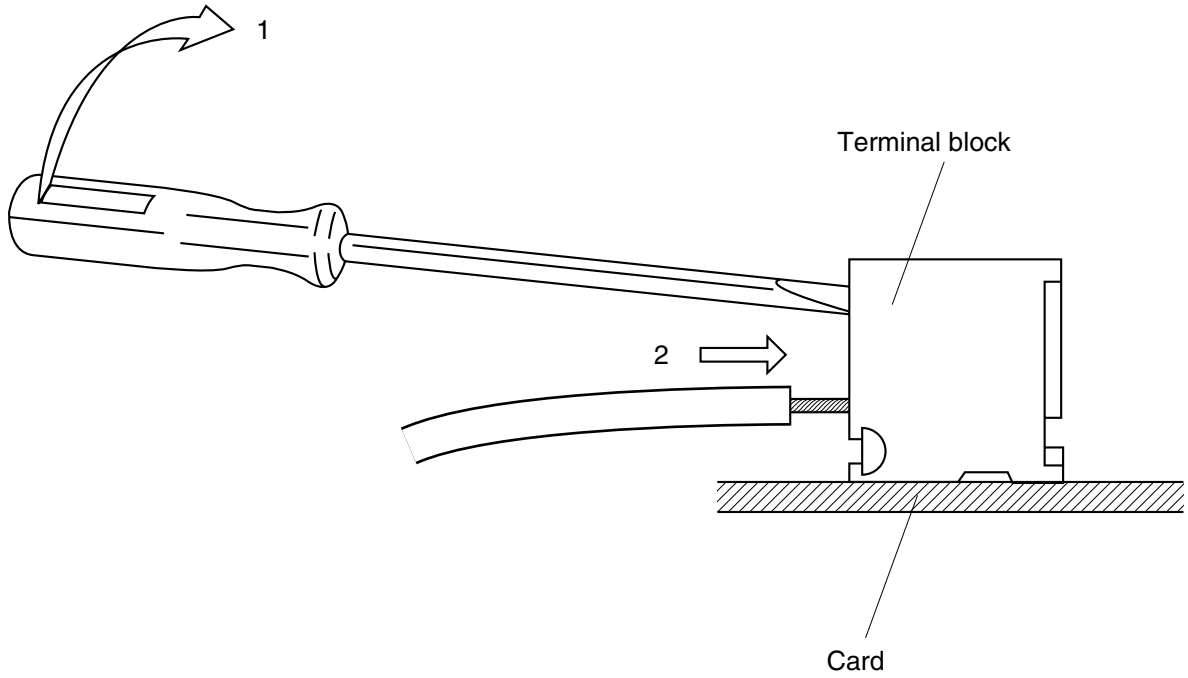
1 - Female mains power connector
2 - 3-wire cable (3 x 1.3 mm^2)



REMARK *The yellow/green conductor of the mains power cable is the protective earth. It is not compulsory to earth the additional earthing terminal, but this has the advantage of keeping the frame earthed even when the mains power cable is unplugged.*

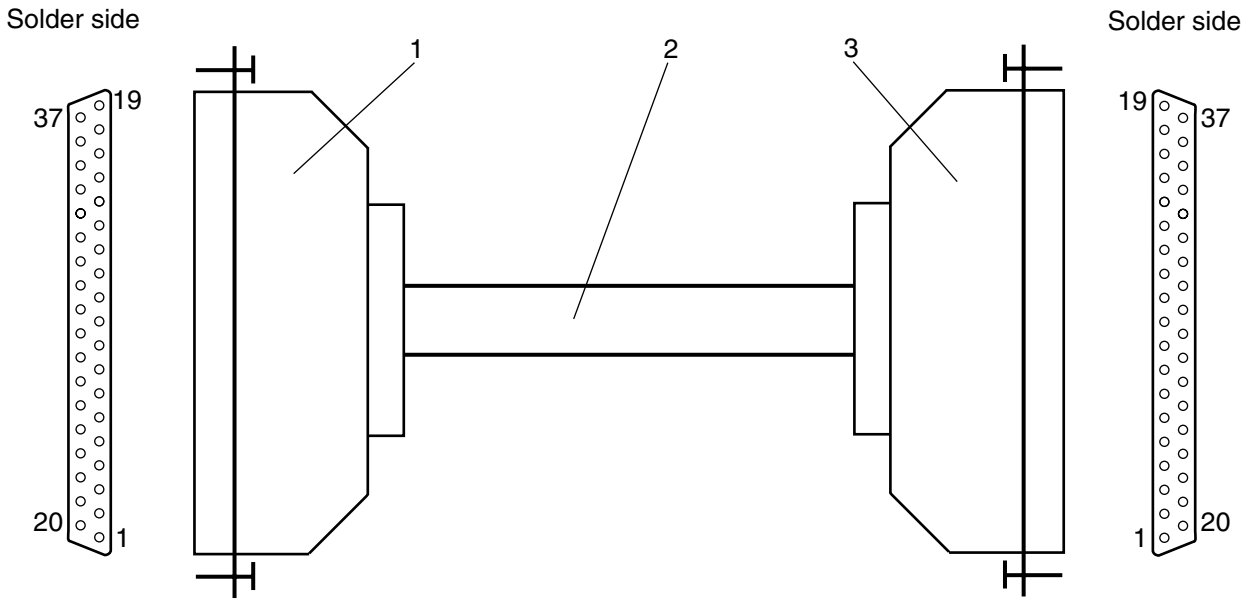
6.5.3 Machine Panel and Extension Power Cable

Wiring the two wires of the power supply cable:

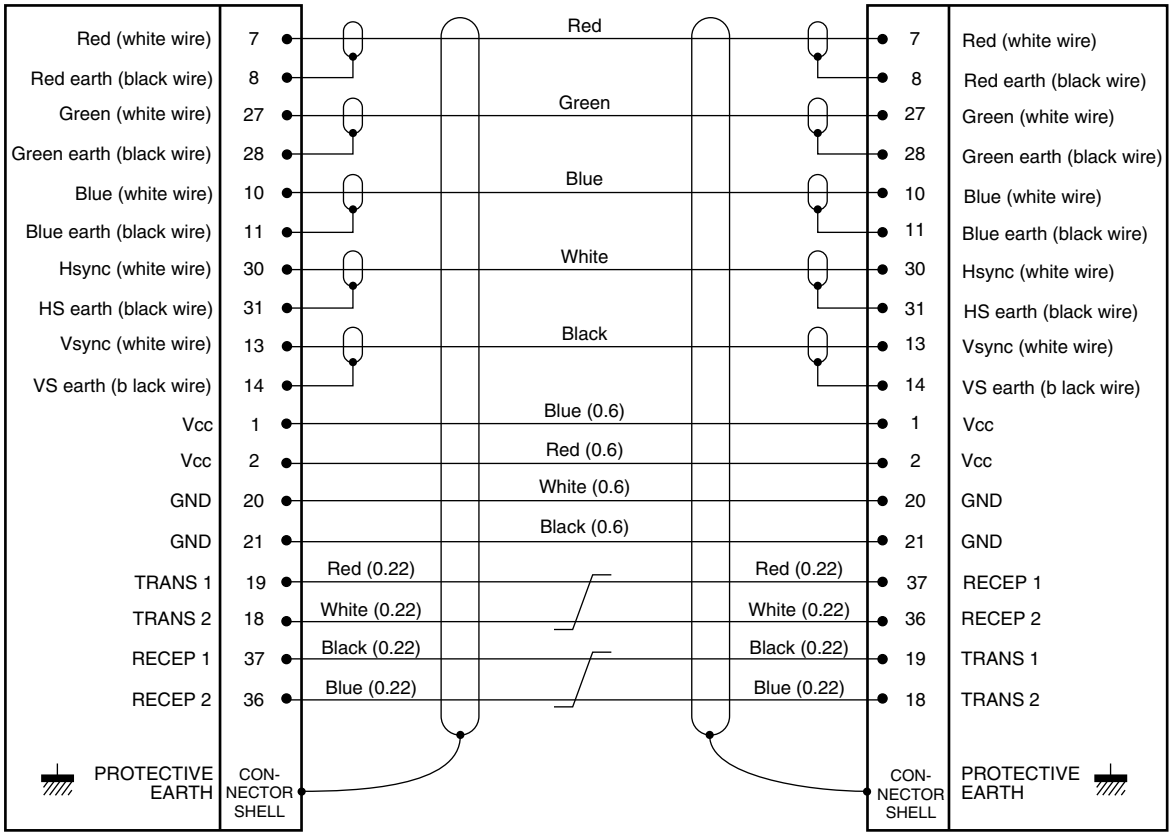


Wiring instructions:
- open the terminal by turning the screwdriver (1),
- insert the wire (2),
- remove the screwdriver to clamp the wire.

6.6 Video/Panel Cable



1 - 37-contact male Sub.D connector
2 - Video cable
3 - 37-contact female Sub.D connector



Wiring instructions:
- Clamp the cable to a half-cover
- Solder the wires to the contacts opposite the half-cover
- Clamp the other side of the cable to the other half-cover
- Solder the wires to the contacts on the side opposite the half-cover.

⚠ CAUTION

For correct interference suppression in the system, the cable shielding must be earthed (over 360 degrees) in accordance with the instructions of Section 1.4.3.2.

The two clamps must be used to clamp the cable to the cover.

Part Two

COMMISSIONING

7 General - Commissioning

Initial Conditions

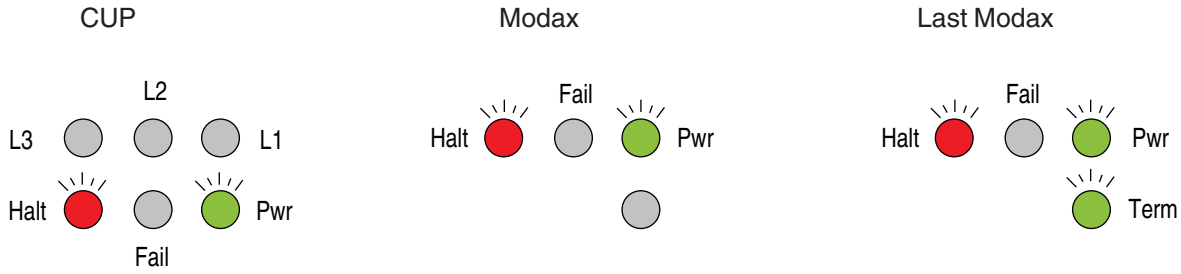
- Power components turned off.
- CPU supplied with 24 VDC.
- Mains voltage 230 VAC.

Actions

Turn on the general power supply.

Turn on the CNC (a reset is automatically executed).

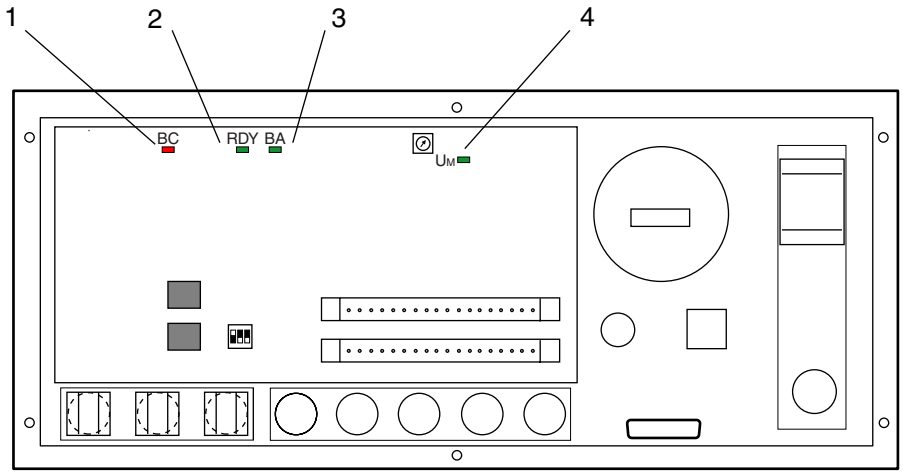
Power-on LEDs



When powering up is complete, if an axis is connected, it must be recognised and the Halt LED must go out. Only the Pwr LEDs and the Term LED for the last Modax remain lit.

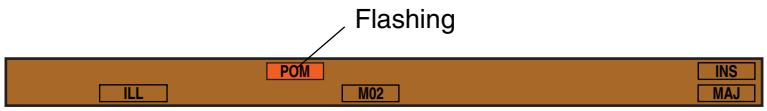
LEDs at the Rear of Machine Panel MP02

There are four LEDs at the rear of machine panel MP02 to indicate the operational state:



1 - Red BC LED: lit for bad connection with the preceding module
2 - Green RDY LED: lit when the machine panel is correctly initialised by the PLC
3 - Green BA LED: lit for correct access to machine panel MP02 by the PLC
4 - Green U_M LED: lit when the power supply input is present.

The current point page and the following status window are displayed on the main display page:



The Fail LED comes on for a software error.

All the display pages must be accessible from the operator panel.

Problems

In the event of a malfunction:

Reset the system (press the "Reset" button on the CPU).

8 Load and Check of the PLC Programme

8.1 Load Procedures

The Ladder language is used to programme the automatic control function (see Automatic Control Function Programming Manual in Ladder Language).

Programming and programme loading are carried out with PLCTOOL running on a PC or compatible.

The programme coherence and consistency with the system configuration is checked using CNC utility 7 (UT7).

8.2 Checking the PLC Programme: Test of the Safety Systems

The safety systems and PLC programme are checked off load before turning on the power components.

8.3 PLC Programming Supplements

The information below supplements the Automatic Control Function Programming Manual in Ladder Language to describe the specific features of digital servo-drives :

- Modax module
- MP02 machine panel

8.3.1 Modax

Input/output card identifiers

Card type	Identifier
64/48 card	%Irc3E.W=55FF
32/24 card	%Irc3E.W=56FF

Modax input/output addresses

Modax address	Card address %Qrc00.0	Card address %Irc00.0
0	%Q1000.0 to %Q1005.7	%I1000.0 to %I1007.7
1	%Q1100.0 to %Q1105.7	%I1100.0 to %I1107.7
2	%Q1200.0 to %Q1205.7	%I1200.0 to %I1207.7

8.3.2 MP02 Machine Panel

Image of Panel Components in the Exchange Area

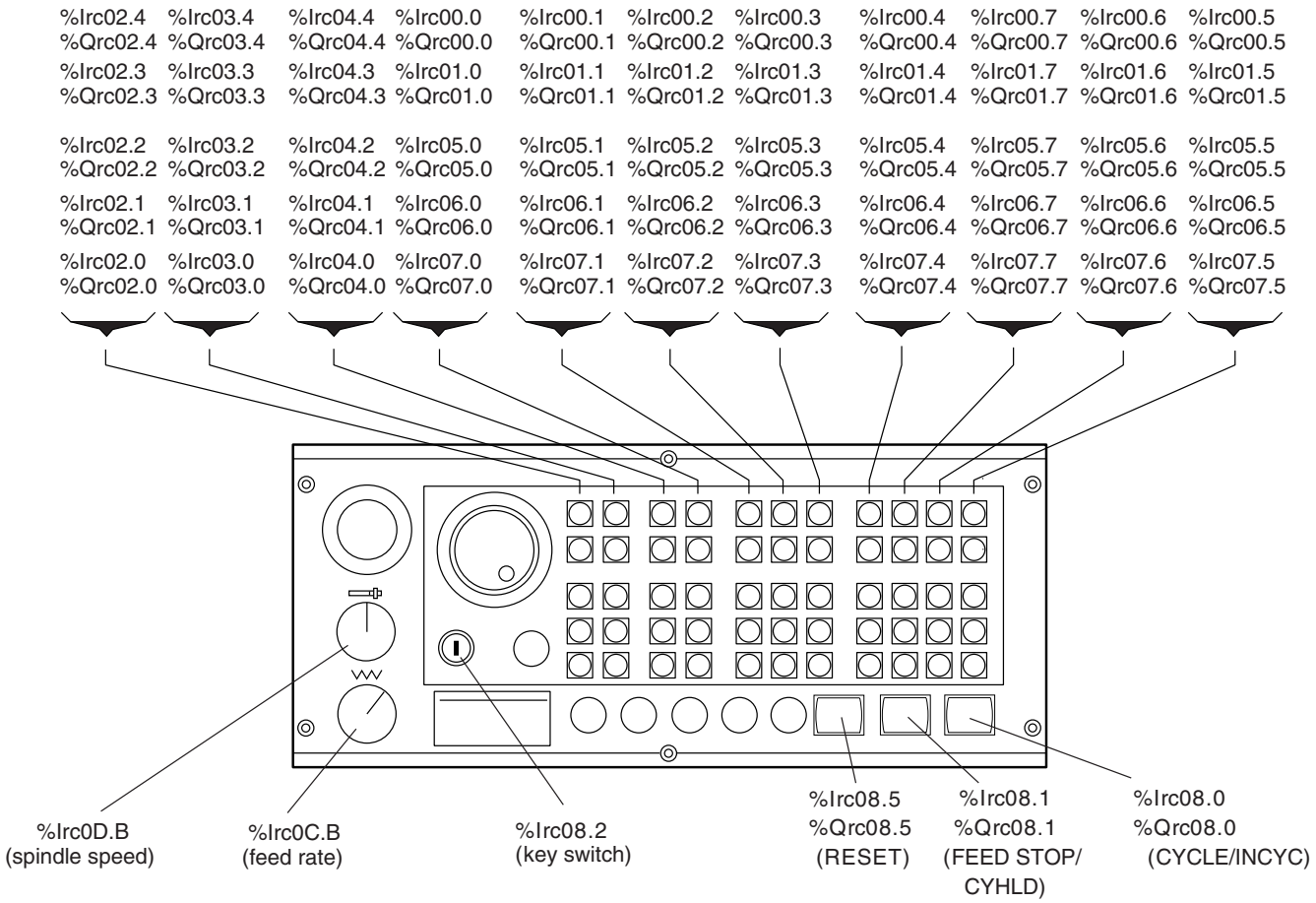
Input/output card identifier

Card type	Identifier
IMP02	%Irc3E.W = 0x53FF

Variable equivalence with inputs/outputs

Variables	Input/output type	
%Irc00.0 to %Irc07.7	Inputs 0-54	Keyboard key images
%Qrc00.0 to %Qrc07.7	Outputs 0-54	Keyboard key LED images
%Irc08.0 and %Qrc08.0	Input and output 0	Image of CYCLE button and INCYC indicator
%Irc08.1 and %Qrc08.1	Input and output 1	Image of FEED STOP button and CYHLD indicator
%Irc08.2	Input 2	Key switch image
%Irc08.5 and %Qrc08.5	Input and output 5	Image of button and RESET indicator
%Irc08.3 and %Irc08.4 %Irc08.6 to %Irc09.3	Inputs 3-4 Inputs 6-11	Image of free user inputs
%Qrc08.2 to %Qrc08.4 %Qrc08.6 to %Qrc09.3	Outputs 2-4 Outputs 6-11	Image of free user outputs
%Irc0C.B and %Irc0D.B	Analogue inputs	Image of feed rate and spindle speed override potentiometers

Representation of Panel Image



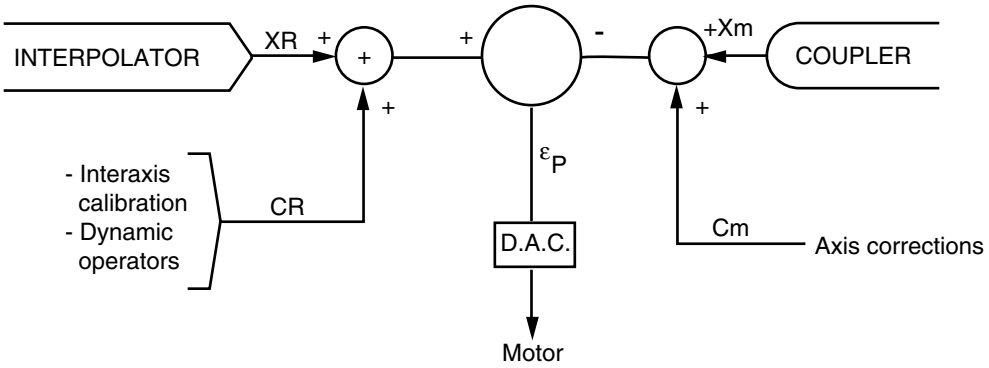
9 Integration of the Machine Parameters

The machine parameters are integrated using the SETTool utility (see SETTool Manual).

10 Axis Calibration (by UT2)

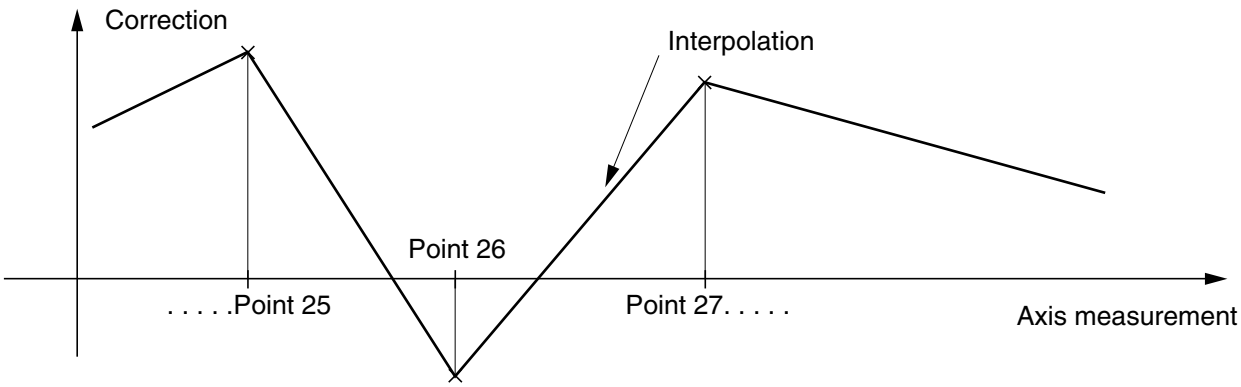
10.1 General

Axis calibration allows the system to add a correction depending on the real axis position to the measurement made by the coupler.



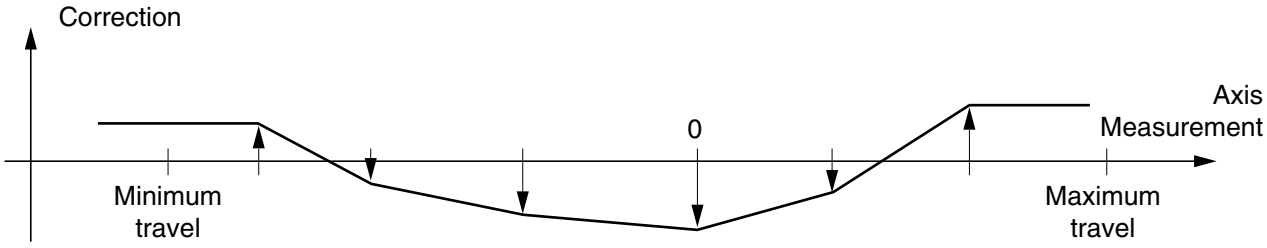
Axis calibration is carried out on both linear and rotary axes.

The corrections are entered for a limited number of points per axis. The system computes the corrections between two points by linear interpolation.

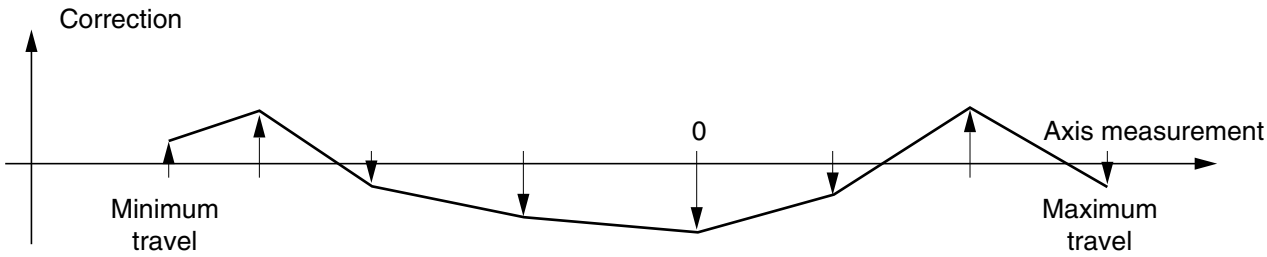


It is recommended to correct the measurements of the minimum and maximum travel points (defined by machine parameter P17). Otherwise, the value of the last correction is applied to these points:

Minimum and maximum travel points not corrected



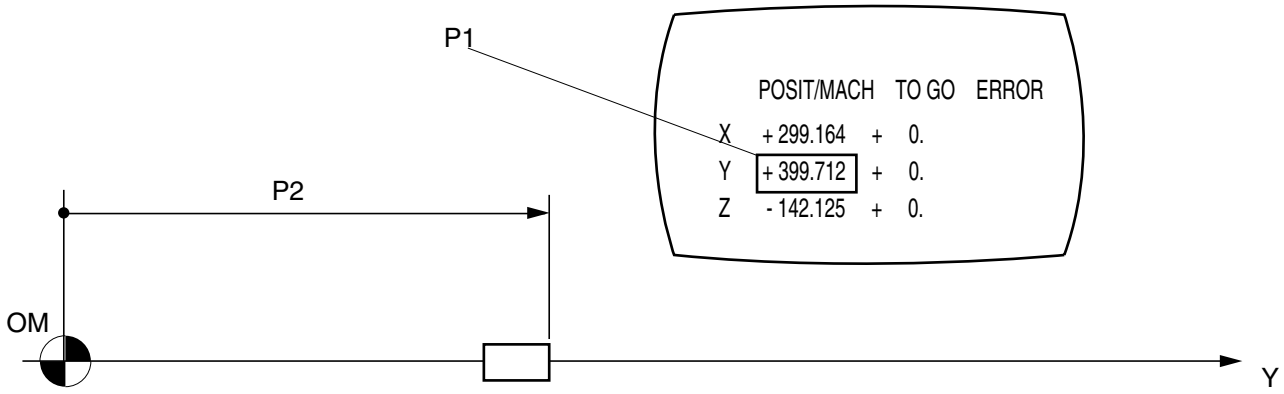
Minimum and maximum travel points corrected



A maximum number of approximately 2600 points can be corrected for all the axes combined. There are no restrictions on how the points are distributed on the axes.

10.2 Record of Corrections to Be Made

The real axis position is taken for a series of points to determine the corrections required:



The corrections are in the internal system units (IU).

Axis number: Unit:

Measured position (P1)							
Real position (P2)							
Correction (P2 - P1)							

The measured values and corresponding corrections are recorded in the correction tables (see 10.3.1).

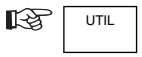
REMARKS *A correction table must have at least three points.*

The correction range is between -32768 and 32767 units.

For a rotary axis, the corrections must be identical for the 0 and 360 degree points.

10.3 Operations on Axis Measurement Correction Tables

Select the CN UTILITY menu.



Display of the "CN UTILITY" menu.

Select the "UTILITIES PRESENT" menu.

Display of the "UTILITIES PRESENT" menu.

Select the axis calibration utility.

Display of the menu:

```
      AXIS CABLIBRATION VALUES

>0 DISPLAY - CHANGE
 1 LOAD
 2 UNLOAD
 3 VERIFY
```

Select the operation to be performed:

- enter a measurement correction table (see 10.3.1),
- load a measurement correction table (see 10.3.4),
- save a measurement correction table (see 10.3.2),
- check the measurement correction table (see 10.3.3),
- exit from the utility, confirming the data modified (see 10.3.5).

10.3.1 Entering the Measurement Correction Table

Initial Conditions

Record made of required corrections (see 10.2).

"AXIS CALIBRATION VALUES" menu displayed.

Actions

Choose "DISPLAY - CHANGE"	☞) 0 ⟵

Display of the question:

```
AXIS ?
```

Enter the number of the axis to be corrected (corresponds to the axis position in machine parameter P9).	☞ ⟵

Display of the measurement correction table for the axis considered, e.g.:

```
   AXIS CALIBRATION  AXIS: 2

>M-   10000   C-       3
 M-    9000   C+       6
 M-    8000   C-       9
 ...
```

Interpretation of the measurement correction table:
- the header gives the axis number selected,
- the next number, "M", is the measurement of the point (in internal units),
- the following number, "C", is the correction to be made (in internal units).

The table is in increasing order of measurements.

When the table is empty, only the header is displayed.

Modifying or Adding a Correction

The corrections can be entered in any order.

Enter the correction: "M±[measurement] C±[correction]".	☞ ⟵

Modification of the correction line concerned or display of the new line.

Deleting a Correction

Select the correction to be deleted.	☞ ↓
Delete the correction.	☞ _ - ⟵

Return to the "AXIS CALIBRATION VALUES" menu (to enter the corrections for another axis)

Exit from the measurement correction table.	☞ EXIT

Return to the "AXIS CALIBRATION VALUES" menu.

10.3.2 Saving the Measurement Correction Table

Initial conditions

Peripheral device (PC + communication tool, diskette drive or tape reader/punch) connected and ready to receive data.

"AXIS CALIBRATION VALUES" menu displayed.

Actions

Select "UNLOAD". ☞ [@ 2] [⟵]

Display of the question:

```
READY  (Y/N)?
```

Initiate the save. ☞ [Y] [⟵]

Display of :

```
%[CNC job reference]
```

Keep the job reference	Change the job reference
Possibly add a comment	Enter another job reference (possibly with comment)

Reinitiate the save. ☞ [⟵]

The correction tables are saved then the following message is displayed:

```
UPLOADING COMPLETE!
```

Acknowledge the message. ☞ [EXIT]

Structure of the data transmitted

The data saved are in the following format:

```
%00084001 ;0A
AXIS:  0;08
M-   10000   C-       3;17
M-    9000   C-      10;17
...
AXIS:  1;08
M-   10000   C+      25;17
M-    9000   C-       5;17
...
!!
```

Interpretation of the data transmitted:
- the first line gives the CNC job reference (which may be followed by a comment, e.g.:."%00084001 28 June 1995"),
- each of the axes (AXIS: [No.]= is followed by the corrections assigned to it,
- the number after "M" is the measurement of the point (in internal units),
- the number after "C" is the correction of the point (in internal units),
- the two digits after ";" on each line are the hexadecimal number of characters in the line.

10.3.3 Checking the Measurement Correction Table

The measurement correction table can be checked to make sure that it was saved or loaded correctly.

Initial Conditions

Peripheral (PC + communication tool, diskette drive or tape reader/punch) connected and ready to transmit the table to be checked.

"AXIS CALIBRATION VALUES" menu displayed.

Actions

Choose "VERIFY". ☞ [#3] [⟵]

Display of the question:

```
READY  (Y/N)?
```

Initiate the check. ☞ [Y] [⟵]

Initiate transmission by the peripheral.

The measurement correction table is checked followed by display of the message:

```
OK!
```

Acknowledge the message. ☞ [EXIT]

Possible Problems

The job reference is different from the CNC job reference

Loading stops and the incorrect job reference is displayed.

Enter the correct job reference. ☞ [⟵]

The check is then resumed and continues normally.

The data saved do not correspond to the correction table

Display of the message:

```
ERROR
```

Acknowledge the message. ☞ [EXIT]

Resume save (see 10.3.2) or load (see 10.3.4).

The changes made to the measurement correction table were not confirmed before the check

Display of the message:

```
WARNING - CHANGES MAY BE LOST
 (EXIT TO SAVE)
```

Acknowledge the message.	☞ EXIT
Confirm the modifications (see 10.3.5).	
Resume the check.	

10.3.4 Loading a Measurement Correction Table

The measurement correction tables to be loaded can have two possible origins:
- table saved earlier,
- table entered on a peripheral device (complying with the structure shown in 10.3.2; the spaces before the numerical data can be omitted and the two digits after the ";" on each line are the number of characters in the line).

Initial Conditions

Peripheral device (PC + communication tool, diskette drive or tape reader/punch) connected and ready to transmit data.

"AXIS CALIBRATION VALUES" menu displayed.

Actions

Choose "LOAD".	☞ ! 1 ⟵

Display of the question:

```
READY  (Y/N)?
```

Initiate the load.	☞ Y ⟵
Initiate transmission by the peripheral.	

Load of the correction table.

Possible Problems

The job reference is different from the CNC job reference

Loading stops and the incorrect job reference is displayed.

Enter the correct job reference.	☞ ⟵

Loading is then resumed and continues normally.

10.3.5 Exit from the Utility Confirming the Changes Made

Exit from the utility. ☞ CTRL + S X OFF

Changes were made

Display of the message:

```
WRITING IN PROGRESS
```

After confirmation, display of the message:

```
WARNING ! LOADING REQUIRES TO STOP
          MACHINE CONTROL OK?  (Y/N) :
```

It is necessary to reset the system to take the changes made into account. ☞ Y ⏎

Reset the system.

No changes

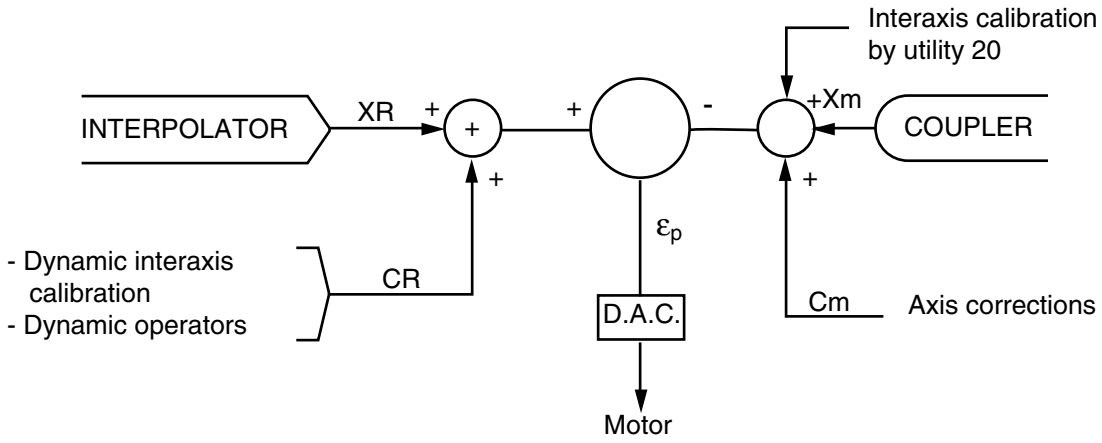
Return to the menu "UTILITIES PRESENT".

11 Interaxis Calibration

11.1 General Description of Interaxis Calibration

11.1.1 General

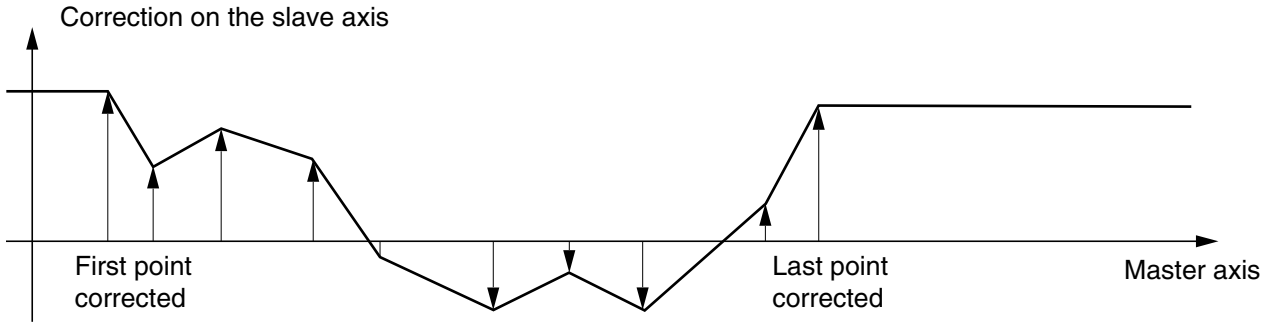
Interaxis calibration allows the system to add to the reference of a slave axis (reference created by the interpolators) an offset which depends on the reference of a master axis.



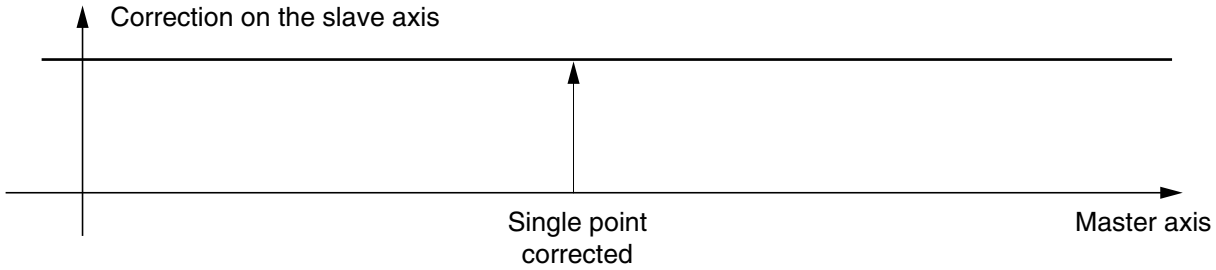
The corrections concern both linear and rotary axes.

They are entered for a limited number of points per axis. The system computes the corrections between two points by linear interpolation.

Beyond the end points, the corrections are constant.



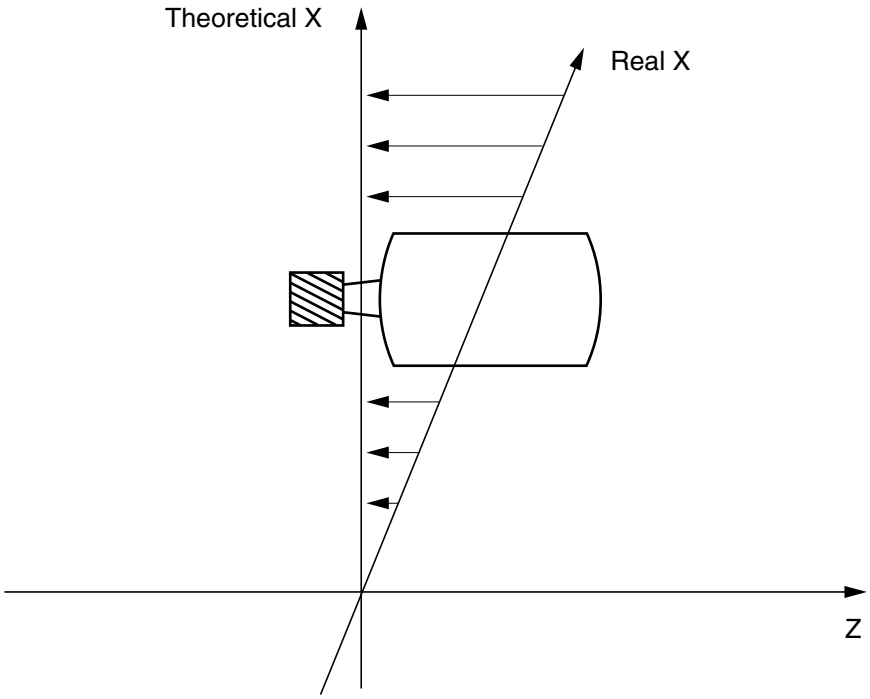
Special case: Correction in a single point



11.1.2 Examples of Interaxis Calibration

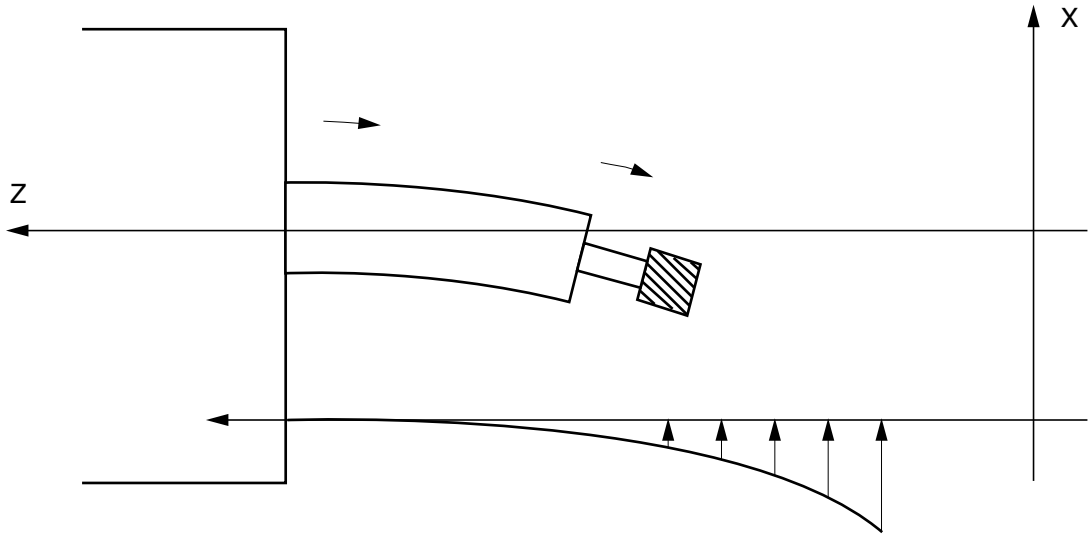
REMARK The deformations are exaggerated for clarity in the examples below.

Correction of a perpendicular alignment fault



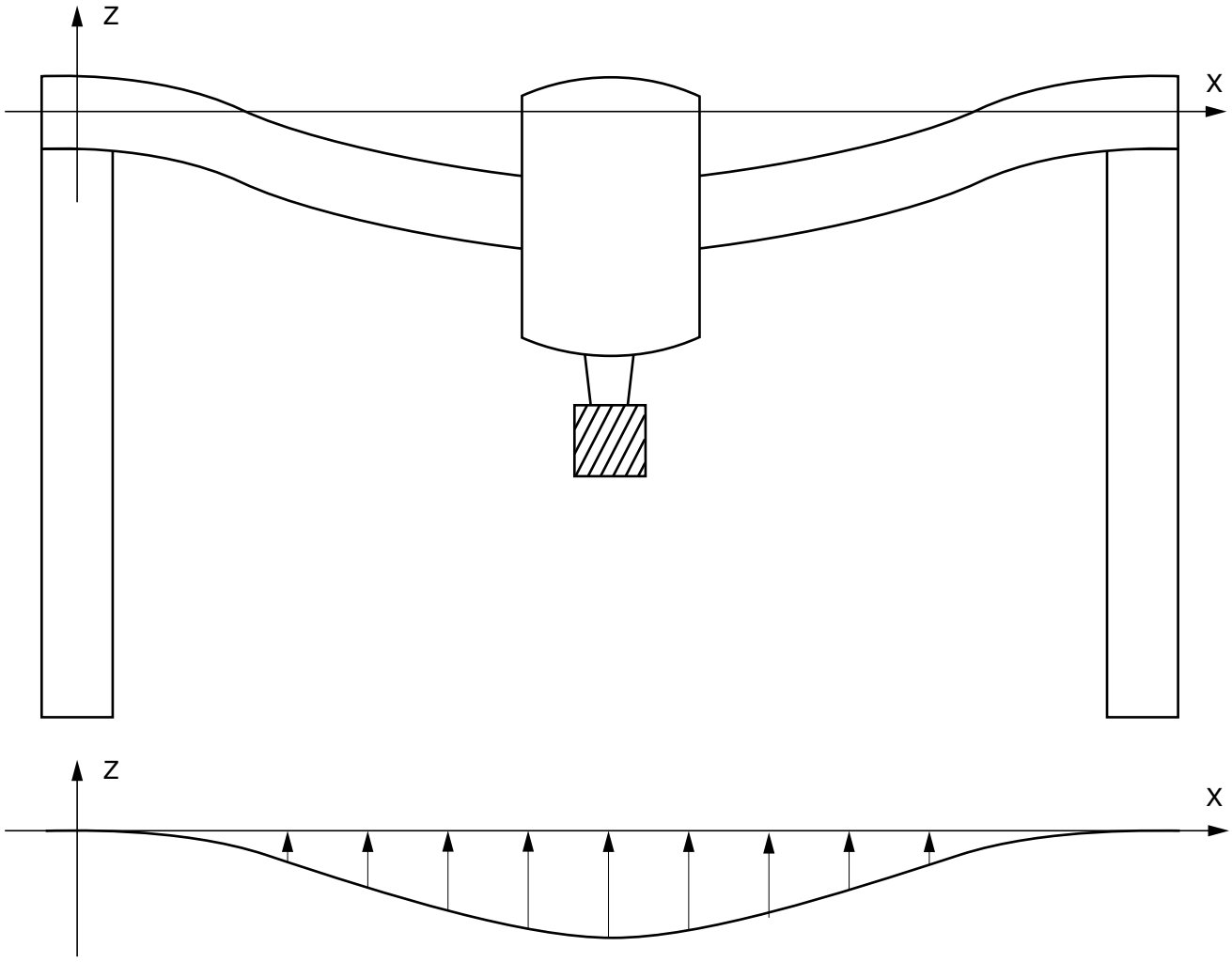
Z corrected according to the position on the X axis.

Correction of bending of a boring bar



X corrected according to extension of the boring bar.

Correction of sag of the cross member of a gantry machine



Sag in Z corrected according to the position on the X axis.

Expansion take-up on an axis

An axis can be self-corrected (only with dynamic calibration, master axis same as slave axis) to cater for thermal expansion.

The correction tables can be written by the PLC programme according to the measured temperatures then used by the system.

The use of these corrections may prove difficult because of the thermal inertia of the machines.

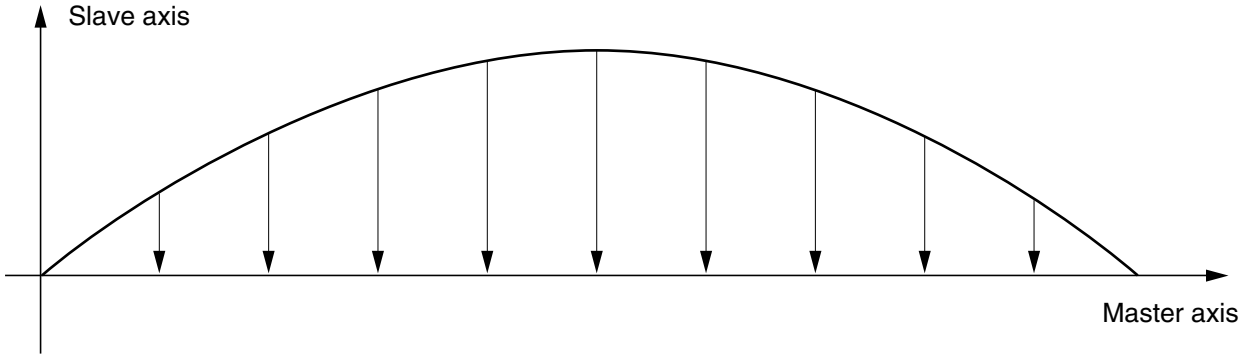
11.1.3 Tools Used for Interaxis Calibration

Two tools can be used for interaxis calibration:
- calibration by utility 20 (see 11.2) to make unvariable corrections to take into account deformations of the machine,
- dynamic calibration by parameters E81xxx and E82xxx (see 11.3) that can be modified at any time (by the part programme). These corrections are suited to variables that change over time such as thermal expansion.

The effects of interaxis calibration by utility 20 and of dynamic calibration are added together, which is why it is not recommended to use both methods together.

11.1.4 Measurement of the Corrections on the Axes

The corrections to be made to the slave axis are measured for a series of reference positions on the master axis.



The corrections are made in the internal system unit (IU).

Master axis No.: Slave axis No.:

Master axis position Unit:							
Slave axis correction Unit:							

The values measured are recorded in the correction tables (see 11.2.1 and 11.3.3).

REMARKS: For interaxis calibration by utility 20, the maximum corrections are ± 9999 units.

For dynamic interaxis calibration, the maximum difference between two consecutive corrections is ± 65,000 units.

11.2 Interaxis Calibration by Utility 20

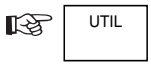
A slave axis can have only one master axis.

A master axis can have several slave axes.

An axis cannot be its own master axis (contrary to dynamic calibration).

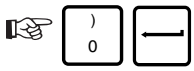
Actions

Select the "CN UTILITY" menu.



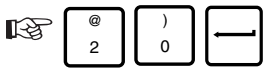
Display of the "CN UTILITY" menu.

Select the "UTILITIES PRESENT" menu.



Display of the "UTILITIES PRESENT" menu.

Select the interaxis calibration utility.



Display of the menu:

```
      INTER-AXIS CALIBRATION VALUES

>0 DISPLAY- CHANGE
 1 LOAD
 2 UNLOAD
 3 VERIFY
```

Select the operation to be performed:

- enter a measurement correction table (see 11.2.1),
- load a measurement correction table (see 11.2.4),
- save a measurement correction table (see 11.2.2),
- check the measurement correction table (see 11.2.3),
- exit from the utility, confirming the data modified (see 11.2.5).

11.2.1 Entering the Measurement Correction Table for an Axis

Initial Conditions

Record made of required corrections (see 11.1.4).

"INTER-AXIS CALIBRATION VALUES" menu displayed.

Actions

Choose "DISPLAY - CHANGE"	☞) 0 ⟵

Display of the question:

```
AXIS  (SLAVE  [,MASTER ]) ?
```

Enter “Slave axis no.[, Master axis no.]” (machine axis numbers set in machine parameter P9).	☞ ⟵

REMARK *If the master/slave axis pair already exists, it is sufficient to enter the slave axis number.*

Display of the measurement correction table for the axis considered, e.g.:

```
   SLAVE AXIS: 0, MASTER AXIS: 2

>M-   10000   C-       1
 M-    9000   C+       1
 M-    8000   C+       4
 ...
```

Interpretation of the measurement correction table:
- the header gives the slave axis number followed by the master axis number,
- the number after M is a measured point on the master axis (in internal units),
- the number after C is the correction made to the slave axis (in internal units).

The table is in increasing order of measurements.

When the table is empty, only the header is displayed.

Modifying or Adding a Correction

The corrections can be entered in any order.

Enter the correction: "M±[measurement] C±[correction]".	☞ ⟵

Modification of the correction line concerned or display of the new line.

Deleting a Correction

Select the correction to be deleted.	☞ ↓
Delete the correction.	☞ − . ⟵

Return to the "INTER-AXIS CALIBRATION VALUES" menu (to enter the corrections for another axis)

Exit from the measurement correction table for axis pair.	☞ EXIT

Return to the "INTER-AXIS CALIBRATION VALUES" menu.

11.2.2 Saving the Measurement Correction Table

Initial conditions

Peripheral device (PC + communication tool, diskette drive or tape reader/punch) connected and ready to receive data.

"INTER-AXIS CALIBRATION VALUES" menu displayed.

Actions

Select "UNLOAD". 

Display of the question:

```
READY  (Y/N)?
```

Initiate the save. 

Display of :

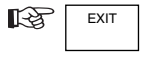
```
%[CNC job reference]
```

Keep the job reference	Change the job reference
Possibly add a comment	Enter another job reference (possibly with comment)

Reinitiate the save. 

The correction tables are saved then the following message is displayed:

```
UPLOADING COMPLETE!
```

Acknowledge the message. 

Structure of the data transmitted

The data saved are in the following format:

```
%00084001 ;0A
AXIS:  0, 1;0B
M-   10000   C-       2;17
M-    9000   C+       1;17
...
AXIS:  2, 1;0B
M-   10000   C+       8;17
M-    9000   C+       5;17
...
!!
```

Interpretation of the data transmitted:
- the first line gives the CNC job reference (which may be followed by a comment, e.g.:. "`%00084001 6 September 2001-10-17`),
- each of the axis pairs (AXIS: [slave], [master]) is followed by the corrections assigned to it,
- the number after "M" is a measured point on the master axis (in internal units),
- the number after "C" is the correction made to the slave axis (in internal units),
- the two digits after ";" on each line are the hexadecimal number of characters in the line.

11.2.3 Checking the Measurement Correction Table

The measurement correction table can be checked to make sure that it was saved or loaded correctly.

Initial Conditions

Peripheral (PC + communication tool, diskette drive or tape reader/punch) connected and ready to transmit the table to be checked.

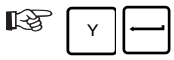
"INTER-AXIS CALIBRATION VALUES" menu displayed.

Actions

Choose "CHECK". 

Display of the question:

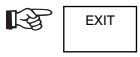
```
READY  (Y/N)?
```

Initiate the check. 

Initiate transmission by the peripheral.

The measurement correction table is checked followed by display of the message:

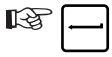
```
OK
```

Acknowledge the message. 

Possible Problems

The job reference is different from the CNC job reference

Loading stops and the incorrect job reference is displayed.

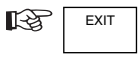
Enter the correct job reference. 

The check is then resumed and continues normally.

The data saved do not correspond to the correction table

Display of the message:

```
INCORRECT TAPE
```

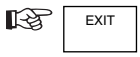
Acknowledge the message. 

Resume save (see 11.2.2) or load (see 11.2.4).

The changes made to the measurement correction table were not confirmed before the check

Display of the message:

```
WARNING - CHANGES MAY BE LOST
          (EXIT TO SAVE)
```

Acknowledge the message. 

Confirm the modifications (see 11.2.5).

Resume the check.

11.2.4 Loading a Measurement Correction Table

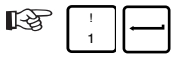
The measurement correction tables to be loaded can have two possible origins:
- table saved earlier,
- table entered on a peripheral device (complying with the structure shown in 11.2.2; the spaces before the numerical data can be omitted and the two digits after the ";" on each line are the number of characters in the line).

Initial Conditions

Peripheral device (PC + communication tool, diskette drive or tape reader/punch) connected and ready to transmit data.

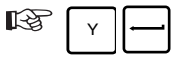
"AXIS CALIBRATION VALUES" menu displayed.

Actions

Choose "LOAD". 

Display of the question:

```
READY  (Y/N)?
```

Initiate the load. 

Initiate transmission by the peripheral.

Read of the correction table.

Possible Problems

The job reference is different from the CNC job reference

Loading stops and the incorrect job reference is displayed.

Enter the correct job reference. 

Loading is then resumed and continues normally.

11.2.5 Exit from the Utility Confirming the Changes Made

Exit from the utility. ☞ CTRL + S X OFF

Changes were made

Display of the message:

```
WRITING IN PROGRESS
```

After confirmation, display of the message:

```
WARNING ! LOADING REQUIRES TO STOP
          MACHINE CONTROL OK?  (Y/N) :
```

It is necessary to reset the system to take the changes made into account. ☞ Y ⟵

Reset the system.

No changes

Return to the menu "UTILITIES PRESENT".

11.3 Dynamic Interaxis Calibration

The possibility of writing correction tables from a part programme depends on the setting of machine parameter P7 (see the parameter manual):
- P7 word 0 bit 5 = 0: write by part programme enabled,
- P7 word 0 bit 5 = 1: write by part programme inhibited.

11.3.1 Addresses of the Correction Parameters

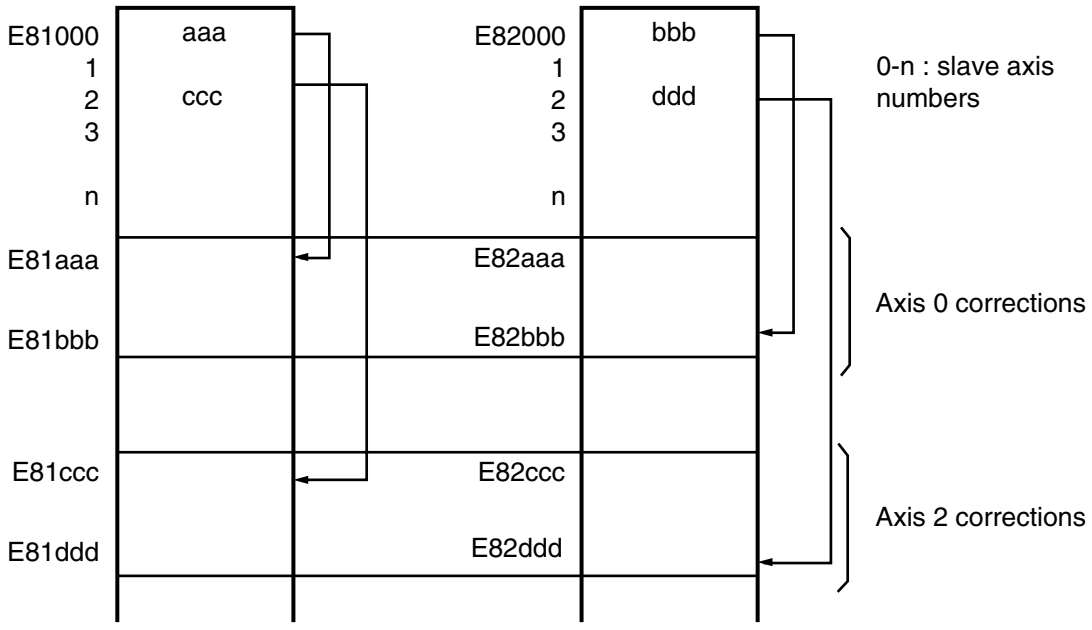
The corrections are made using parameters E81xxx, E82xxx and E940xx:
- parameters E81xxx address the master axis reference positions,
- parameters E82xxx address the corresponding corrections on the slave axes,
- parameters E940xx assign a master axis to a slave axis.

The current slave axis correction is accessible in read-only parameters E950xx.

11.3.2 Correction Tables

The size of the correction tables (number of parameters E81xxx and parameters E82xxx) is defined by machine parameter P58, word 0 (See Parameters Manual). The maximum size of the correction tables is 1000 parameters E81xxx and 1000 parameters E82xxx.

The correction tables can be schematically represented as follows:



The first 32 parameters E81xxx and E82xxx are each assigned to the axis with the same number: E8100**3** and E8200**3** are assigned to axis 3. They define the limits of the correction table assigned to the axis.

The following parameters included in the table of corrections assigned to an axis define:
- the reference position on the master axis (parameters E81xxx),
- the corresponding correction applied to the slave axis (parameters E82xxx).

The reference positions and slave axis corrections are signed values in internal system units.

A master axis is assigned to a slave axis by E940xx = yy where:
- xx is the slave axis number,
- yy is the corresponding master axis number.

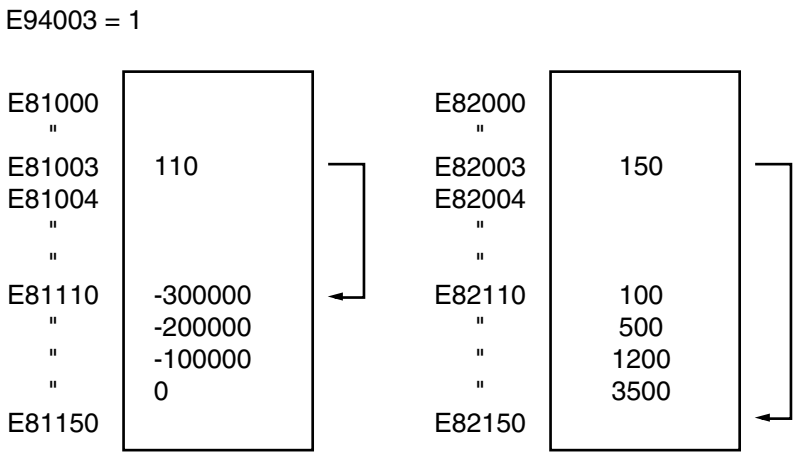
E940xx = -1 means that no master axis is assigned to slave axis xx.

Specifically

For a corrected axis, the reference positions on the master axis must be defined in increasing order.

Any unused location in the correction table can be used as extra E80xxx parameters (local data written and read by the CNC).

Example



E9400**3** = 1 means that master axis 1 is assigned to slave axis 3.

E8100**3** = 110 and E8200**3** = 150 mean that the parameters defining the corrections of axis 3 are between E81110 and E81150 for the reference positions on master axis 1 and between E82110 and E82150 for the corresponding corrections made to slave axis 3.

E81110 = -300000 and E82110 = 100 means that the first reference position on master axis 1 is located at -300000 IU (i.e. -300 mm if the internal system unit is micrometres) and that the corresponding correction on slave axis 3 is 100 IU (i.e. 100 µm if the internal system unit is micrometres).

11.3.3 Writing and Enabling the Correction Tables

Parameters E81xxx, E82xxx and E940xx can be written by the part programme.

11.3.3.1 Conditions for Writing Parameters E81xxx and E82xxx

All E940xx parameters are equal to -1

This means that no correction table is enabled.

All E81xxx and E82xxx parameters can be modified without restriction.

At least one E940xx parameter is different from -1

This means that there is at least one master axis. All the master axes must be reset (by setting parameters E940xx to -1).

> ⚠ **CAUTION**
>
> As long as there is a master axis, do not modify:
> - the parameters defining the limits of the correction tables
> - the parameters defining the reference positions and the corrections.

11.3.3.2 Conditions for Writing Parameters E940xx

To change the master axis, it is first necessary to disable the correction linkage (parameter = -1). For instance, the following steps are necessary to change from master axis 3 to master axis 1 for slave axis 2:
- E94002 = -1,
- E94002 = 1.

An axis can be slaved to its own reference, e.g. E94002 = 2.

A consistency test is made on the correction table when writing a parameter E940xx (table limits, master axis reference points listed by increasing order). When an inconsistency is detected, the parameter setting is rejected and error 95 is generated.

11.3.3.3 Procedure for Writing and Enabling the Correction Tables

The logical order for writing parameters E81xxx, E82xxx and E940xx is as follows:
- cancel enabling of all the correction tables: E940xx = -1,
- write the correction tables by modifying parameters E81xxx and E82xxx,
- assign master axes to the slave axes: E940xx=yy.

12 Final Inspection

A final inspection is made by machining a reference part (e.g. NASA part) to check that the CNC has been correctly configured for the machine (in particular by making the corrections on the axes).

NUM Power 1020/1040/1060/1080
INSTALLATION AND COMMISSIONING MANUAL
en-208536/A

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