SINUMERIK System 3

Configuring Instructions

SINUMERIK

Interface Description Part 2
E 8.87

SINUMERIK System 3

Interface Description Part 2

Configuring Instructions

Valid for SINUMERIK 3T / 3TT / 3M basic version 4B

Edition August 1987

Functions extending beyond the scope of this Description may be capable of operating on the controller. However, we accept no responsibility for such functions for new equipment or equipment which has been serviced.

Subject to change without prior notice.

SINUMERIK® Documentation

Key to editions

The editions listed below have been published prior to the current edition.

The column headed "Amendments" lists the amended sections/pages with reference to the preceding edition.

Edition	Order No.	Amendments
02.84	E80210-T11-X-A2-7600	New edition
05.85	E80210-T11-X-A3-7600	Revised edition
08.87	E80850-D27-X-A1-7600	Revised edition

Contents

Applicability

This description applies to

- SINUMERIK 3T/3TT lathe controls
- SINUMERIK 3M controls for drilling/ milling machines and machining centres.

Differences between the controls are marked accordingly.

Cross signals that are active at logic zero are marked with an asterisk * in front of their designation.

Capital letters are used for the signals described in impulse diagrams. Bold lines indicate genuine signals, light lines show symbolic paths.

Signal significance refers to the NC-PLC interface.

1. System configurations

1.1 Configuration: basic version 4B

Section 1.1

Section 1.2

Control type	Configuration	Rack assignment	Overview Standard systems T, M, TT	
T M	.5	.2		Power pack / PLC2 (N41)
		.1	Power pack / NC / PLC 6FC3...-OFA	Power pack / NC / PLC1 6FC3...-OFA
T M	.6	.2		Power pack / PLC2 (N41)
		.3	Power pack / PLC Power pack / NC / ⊠ 6FC3...-OHA	Power pack / PLC1 Power pack / NC / ⊠ 6FC3...-OHA
TT	.6	.2		Power pack / PLC2 (N41)
		.4	Power pack / PLC Power pack / NC1 / NC2 6FC373.-OFA	Power pack / Power pack / NC1 / NC2 6FC373.-OFA
T M	.7	.5	Power pack / PLC2 (N30) / PLC1 Power pack / NC1 / ⊠ 6FC3...-OJA	
TT	.7	.6	Power pack / PLC2 (N30) / PLC1 Power pack / NC1 / NC2 6FC373.-OJA	

SP03458.0

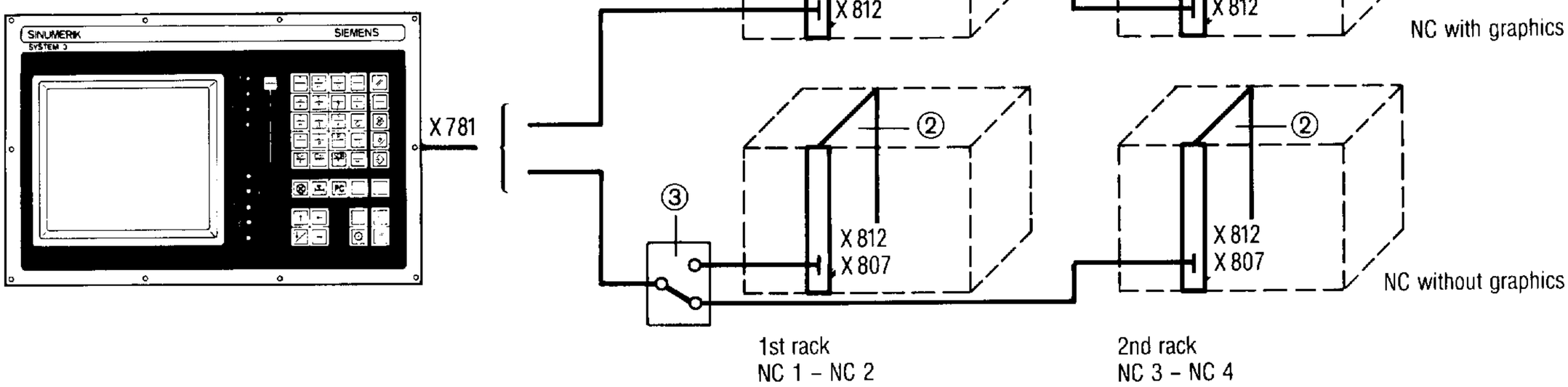
Overview
3FA Systems T/M/TT/MM/TM/MT

Control type	Configuration	Rack assignment	
	.6	.2	Power pack | PLC2 (N41) 6FC3871-OAA
		.7	Power pack | PLC 6FC871-OAA Power pack | PLC1 6FC3871-OAA
		.8	Power pack | NC1 | (NC2) 6FC3882-OFA 6FC3886-OFA Power pack | NC3 | (NC4) 6FC3882-OFA 6FC3886-OFA Power pack | NC1 | (NC2) 6FC3882-OFA 6FC3886-OFA
	.6	.2	Power pack | PLC2 (N41) 6FC3881-OFA 6FC3887-OFA
		.4	Power pack | PLC Power pack | NC1 | (NC2) 6FC3881-OFA 6FC3887-OFA Power pack | PLC1 Power pack | NC1 | (NC2) 6FC3881-OFA 6FC3887-OFA
		.8	Power pack | NC3 | (NC4) 6FC3882-OFA 6FC3886-OFA
	.7	.9	Power pack | PLC2 (N30) | PLC1 6FC3871-OBA
		.7	
		.8	Power pack | NC1 | (NC2) 6FC3882-OFA 6FC3886-OFA Power pack | NC3 | (NC4) 6FC3882-OFA 6FC3886-OFA
	.7	.6	Power pack | PLC2 (N30) | PLC1 Power pack | NC1 | (NC2) 6FC3881-OJA 6FC3887-OJA
		.8	Power pack | NC3 | (NC4) 6FC3882-OFA 6FC3886-OFA
	.8	.10	Power pack | PLC1 Power pack | NC | (PLC2) (N35) 6FC3881-OKA
	.9	.11	Power pack | PLC2 Power pack | NC | (PLC1) (N43) 6FC3881-OKA

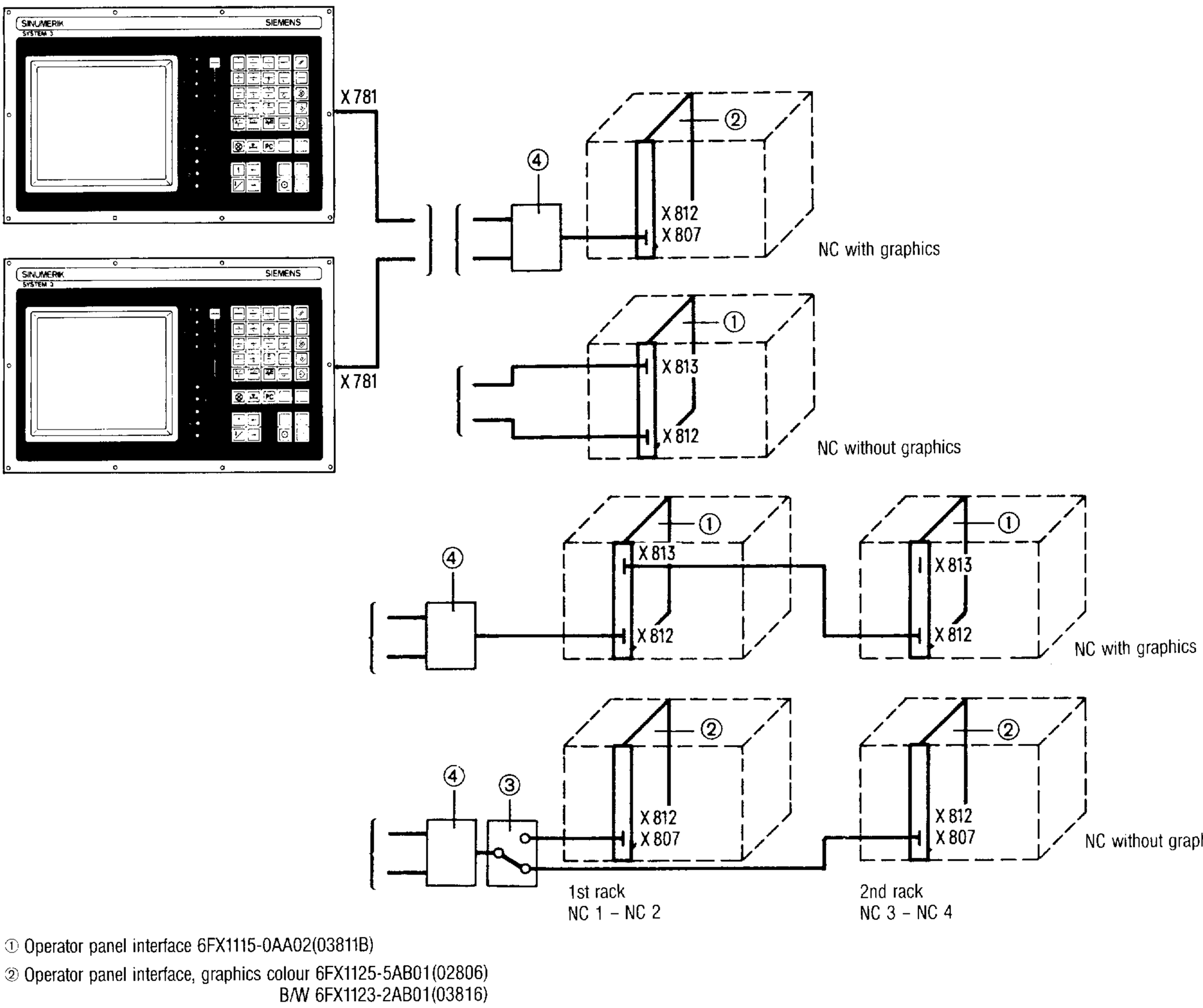
SP03459.0

1.1.1 Configurations: operator panel connection

2 NC racks - one operator panel



2 operator panels connected in parallel to one or two NC racks



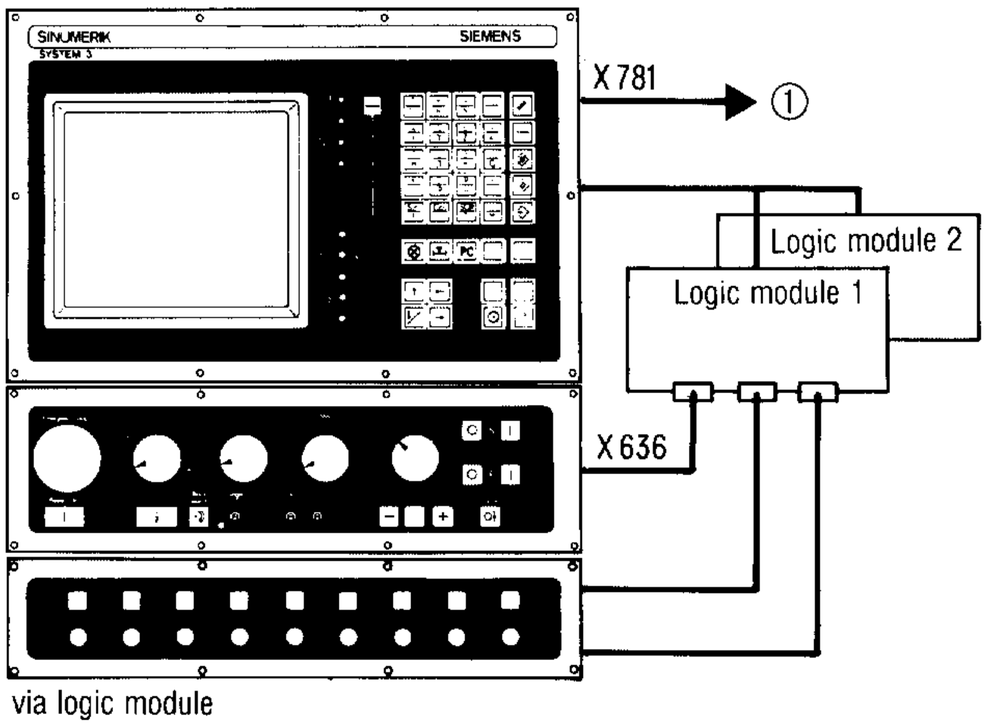
① Operator panel interface 6FX1115-0AA02(03811B)

② Operator panel interface, graphics colour 6FX1125-5AB01(02806)
B/W 6FX1123-2AB01(03816)

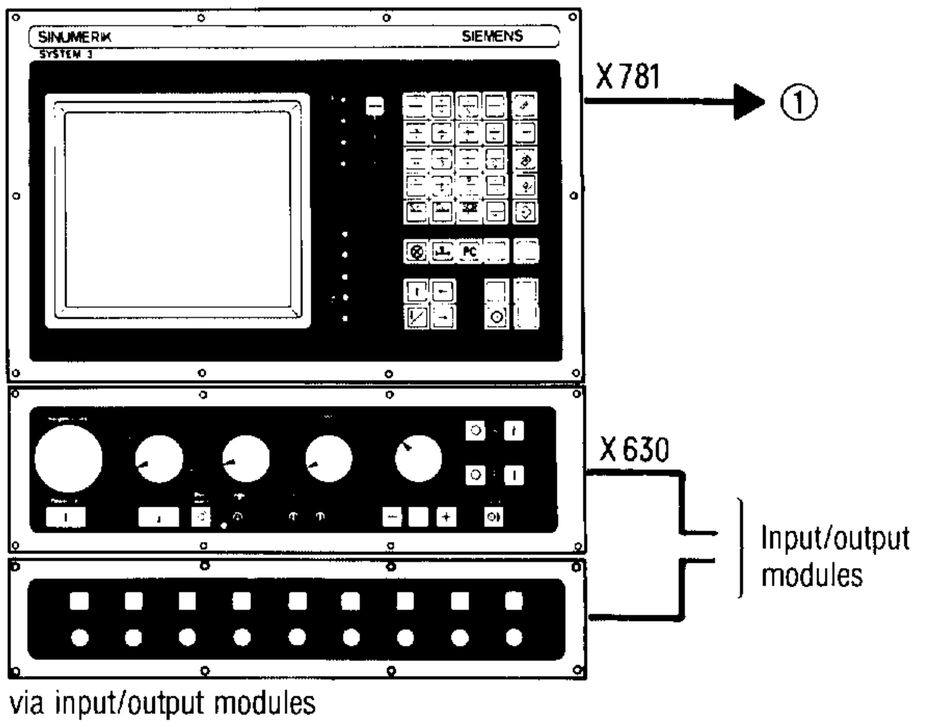
③ Operator panel switching unit B 06, B 10

④ Operator panel distributor B 09

1.1.2 Configuration: machine control panel connection



via logic module



via input/output modules

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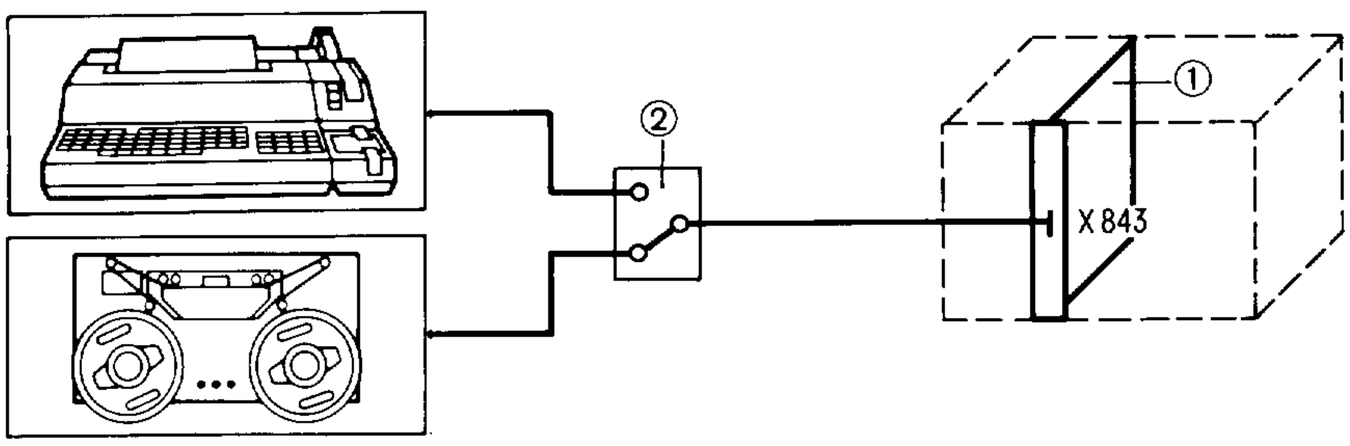
Connector assignment for logic modules:
see Section 2.3.5

① Operator panel interface

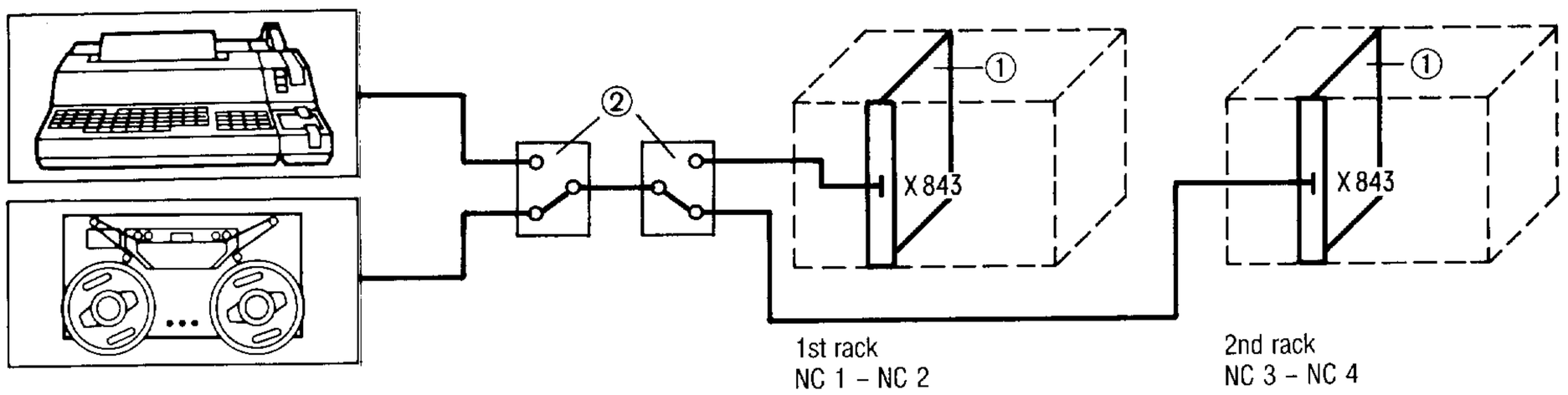
Siemens AG Order-No.: E80850-D27-X-A1-7600

1.1.3 Configurations: V.24 (RS232)/TTY interface

2 devices connected to one interface



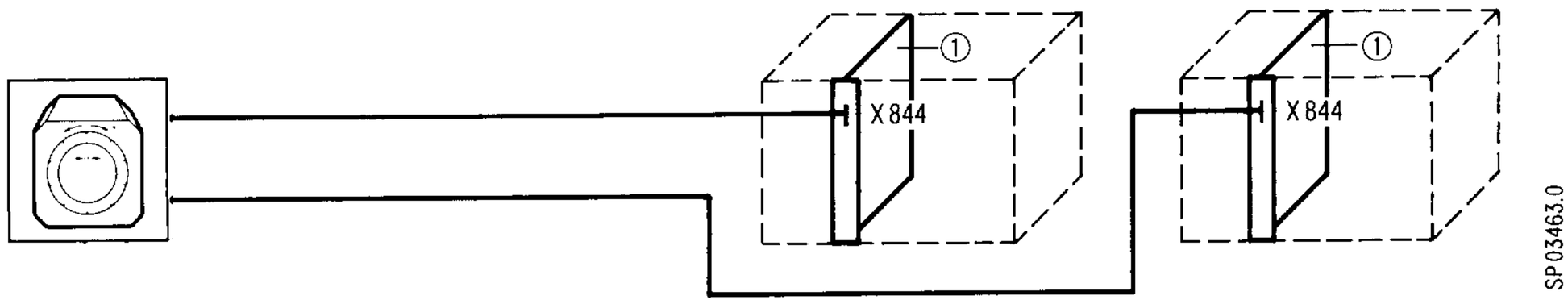
2 devices connected to 2 alternate interfaces



① PLC link module 6FX1122-2AA01 (03841)

② V.24/TTY switching unit B 07/B 06/B 08

1.1.4 Configurations: handwheel connection



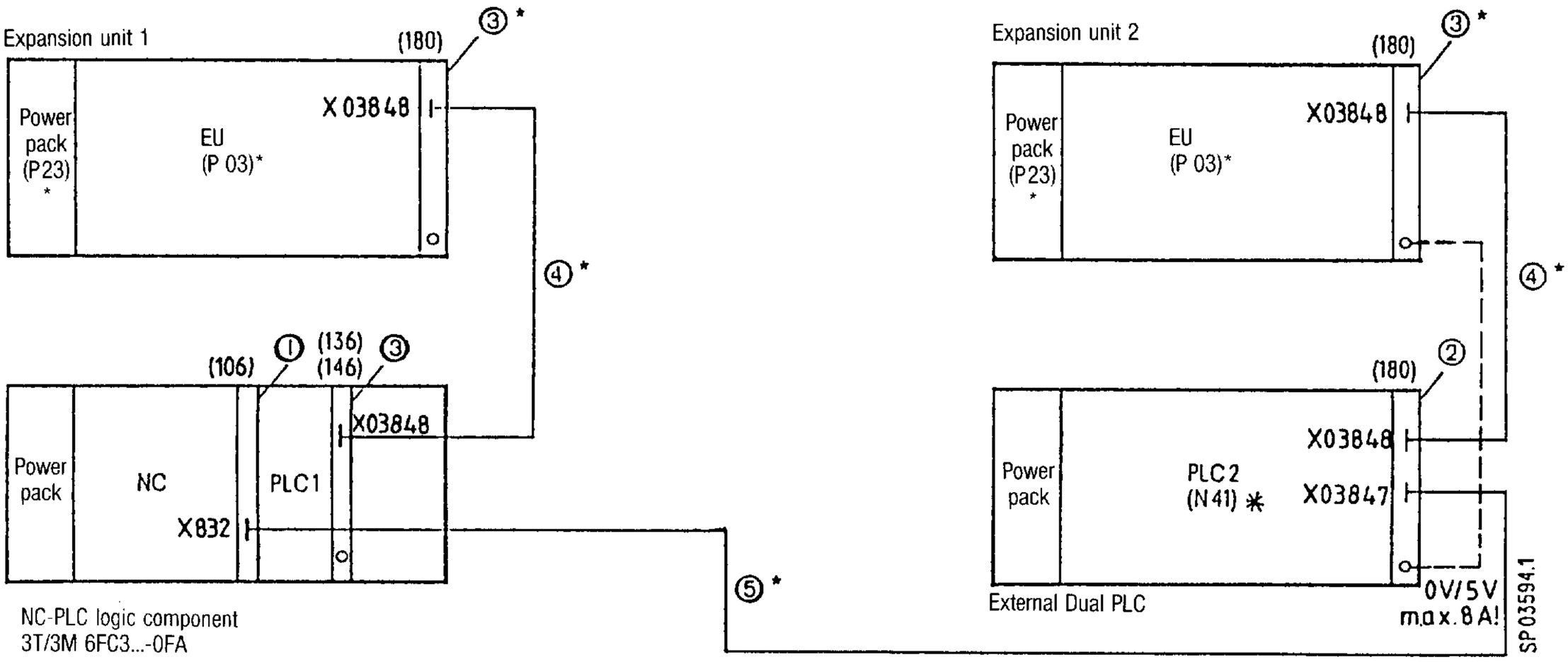
One handwheel can be connected to max. 2 NC's

① PLC link module 6FX1122-2AA01 (03841)

1st rack
NC 1 – NC 2

2nd rack
NC 3 – NC 4

1.1.5 Configuration: single-tier logic component



* Order separately if required as Option

① NC link module 6FX1122-1AA01 (03831)

② PLC/PLC link module 6FX1120-3BA01 (03845A)

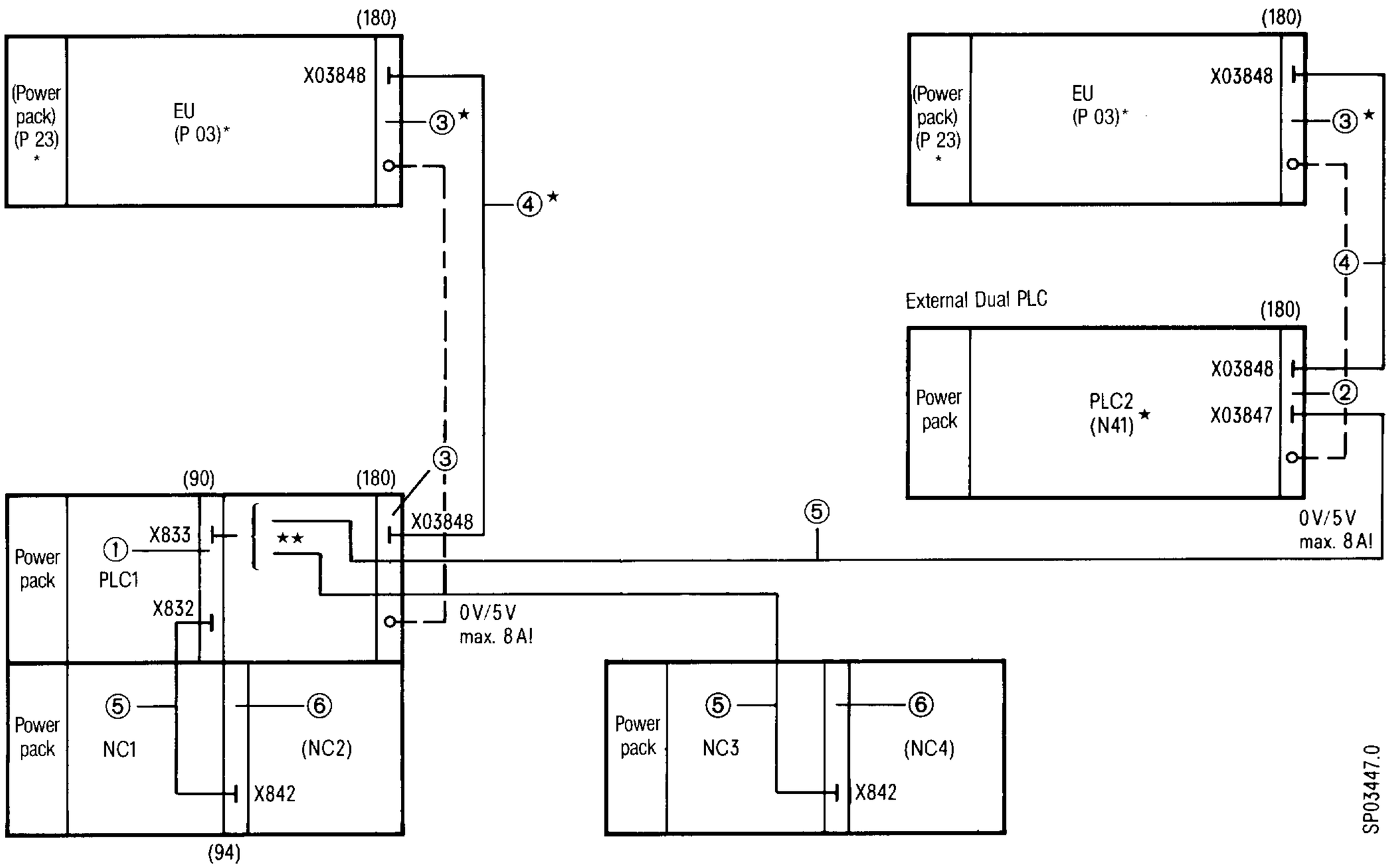
③ CC/EU interface 6FX1120-3BB01 (03845B) + (N87)

④ Cable 6FC9340-7Q

⑤ Cable 6FC9340-7HL (M.N.)

⑥ PLC link module 6FX1122-2AA02 (03842)

1.1.6 Configuration: two-tier logic component



(94)

NC-PLC logic component
6FC3...-0HA
6FC373.-0FA
6FC3881-0FA
6FC3887-0FA

Comprising single rack:

PLC logic component
6FC3871-0AA

NC logic component
6FC3882-0FA
6FC3886-0FA

NC logic component
6FC3882-0FA
6FC3886-0FA

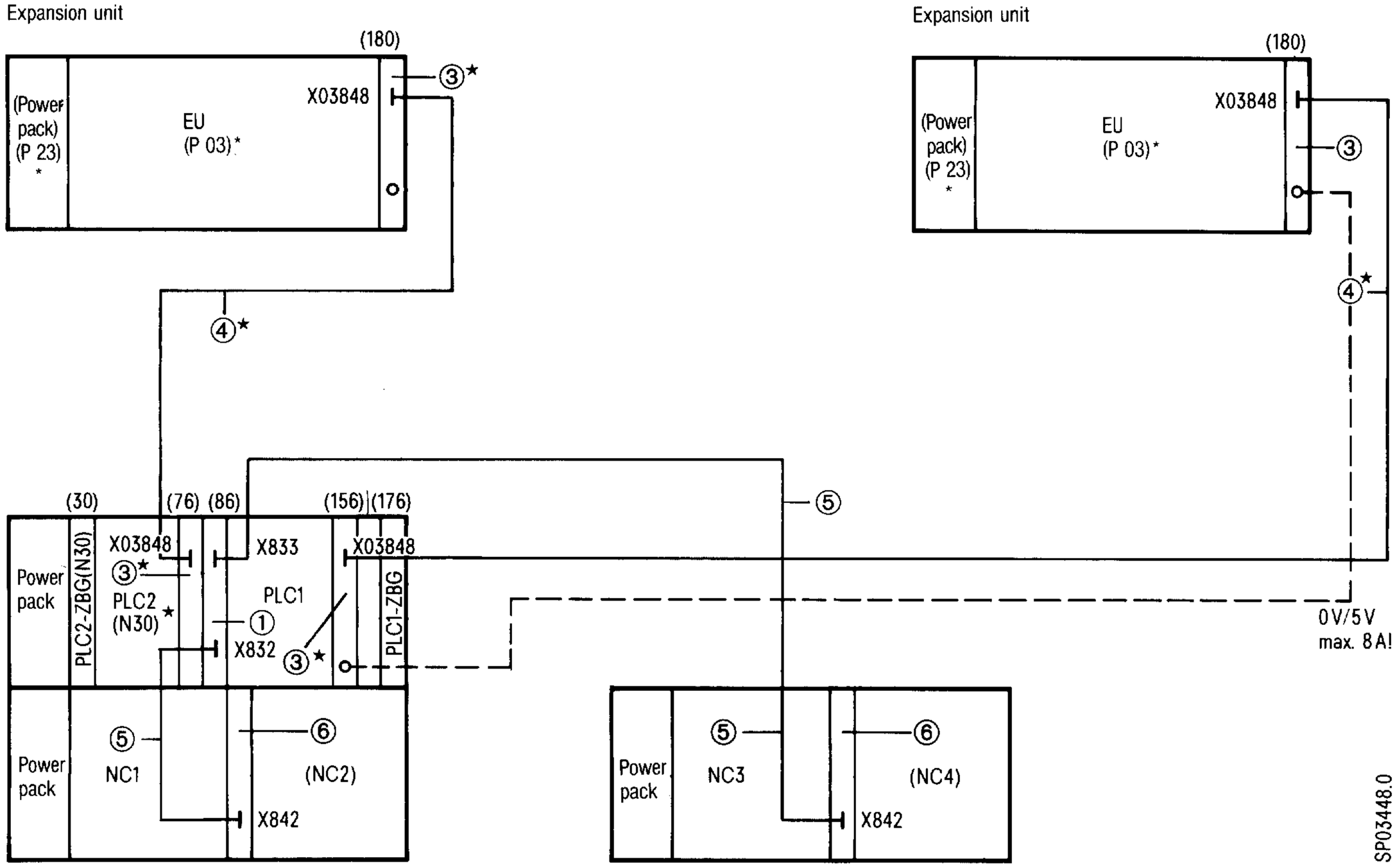
** No NC3, NC4 possible with Dual PLC

* Order separately if required as Option

① NC link module 6FX1122-1AA01 (03831)
② PLC/PLC link module 6FX1120-3BA01 (03845A)
③ CC/EU interface 6FX1120-3BB01 (03845B) + (N87)
④ Cable 6FC9340-7Q
⑤ Cable 6FC9340-7HL (M.N.)
⑥ PLC link module 6FX1122-2AA02 (03842)

(NX87)

1.1.7 Configuration: integrated Dual PLC



NC-PLC logic component
6FC3...-0JA
6FC373.-0JA
6FC3881-0JA
6FC3887-0JA

Comprising single rack:

PLC logic component
6FC3871-0BA

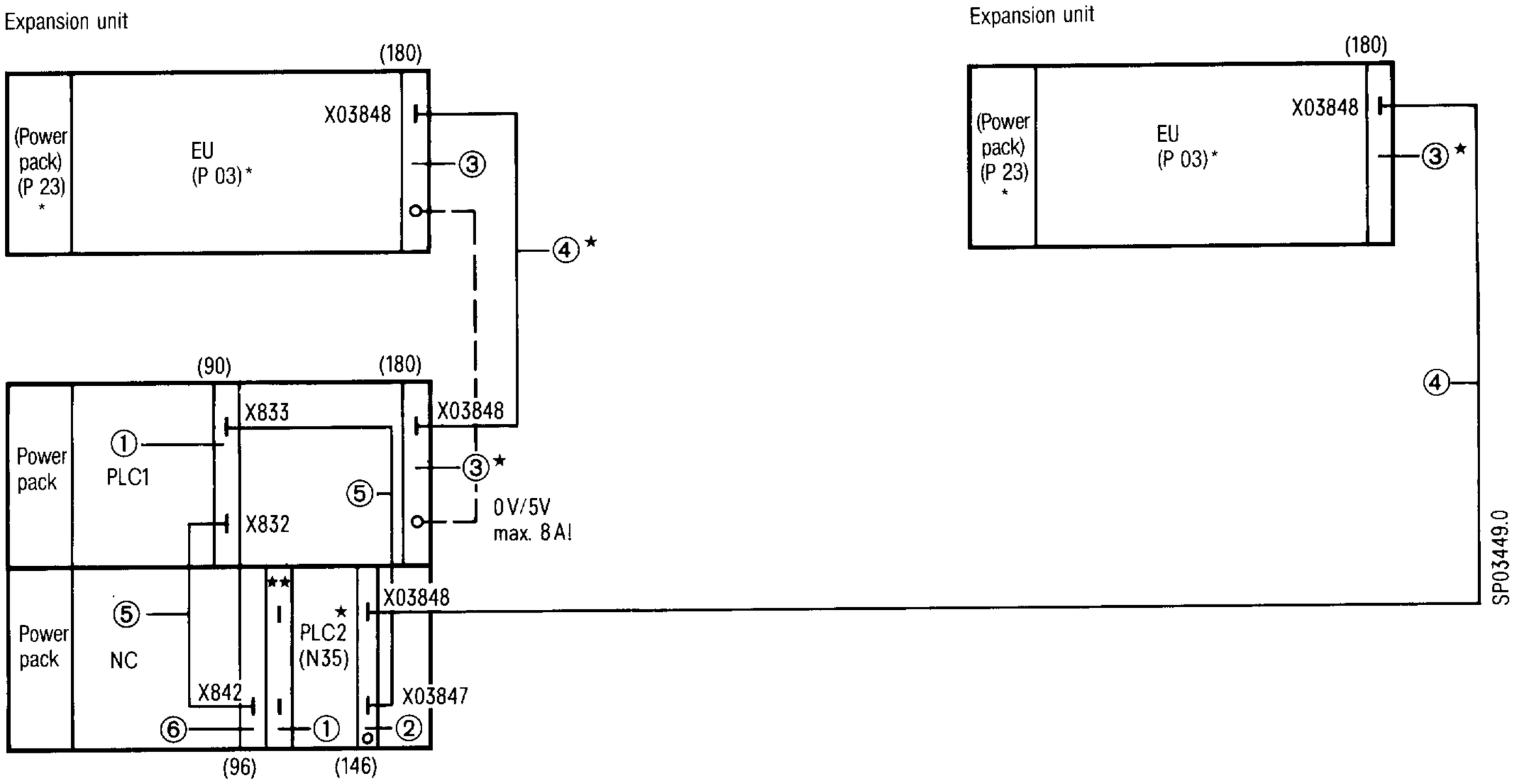
NC logic component
6FC3882-0FA
6FC3886-0FA

NC logic component
6FC3882-0FA
6FC3886-0FA

* Order separately if required as Option

① NC link module 6FX1122-1AA01 (03831)
② PLC/PLC link module 6FX1120-3BA01 (03845A)
③ CC/EU interface 6FX1120-3BB01 (03845B) + (N87)
④ Cable 6FC9340-7Q
⑤ Cable 6FC9340-7HL (M.N.)
⑥ PLC link module 6FX1122-2AA02 (03842)

1.1.8 Configuration: integrated Dual PLC (N35)



NC-PLC logic component
(6FC3881-0KA)

* Order separately if required as Option

** Not applicable with following preconditions
(see Service Handbook 6.1 Page P24R)

① NC link module 6FX1122-1AA01 (03831)

② PLC/PLC link module 6FX1120-3BA01 (03845A)

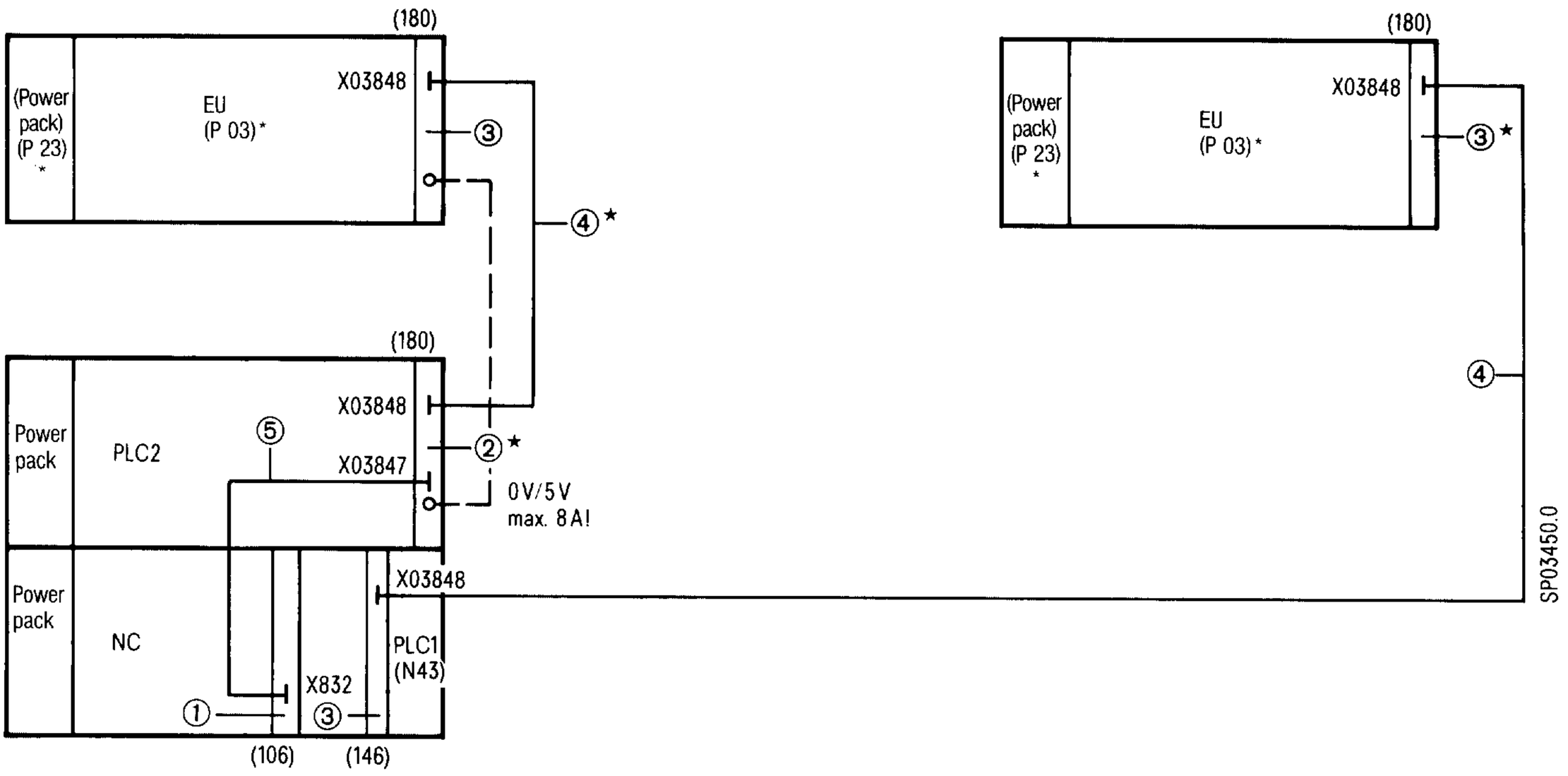
③ CC/EU interface 6FX1120-3BB01 (03845B) + (N87)

④ Cable 6FC9340-7Q

⑤ Cable 6FC9340-7HL (M.N.)

⑥ PLC link module 6FX1122-2AA02 (03842)

1.1.9 Configuration: integrated Dual PLC (N43)



NC-PLC logic component
(6FC3881-0KA)

* Order separately if required as Option

① NC link module 6FX1122-1AA01 (03831)

② PLC/PLC link module 6FX1120-3BA01 (03845A)

③ CC/EU interface 6FX1120-3BB01 (03845B) + (N87)

④ Cable 6FC9340-7Q

⑤ Cable 6FC9340-7HL (M.N.)

⑥ PLC link module 6FX1122-2AA02 (03842)

1.2 Rack assignment basic version 4B

Overview of principal modules

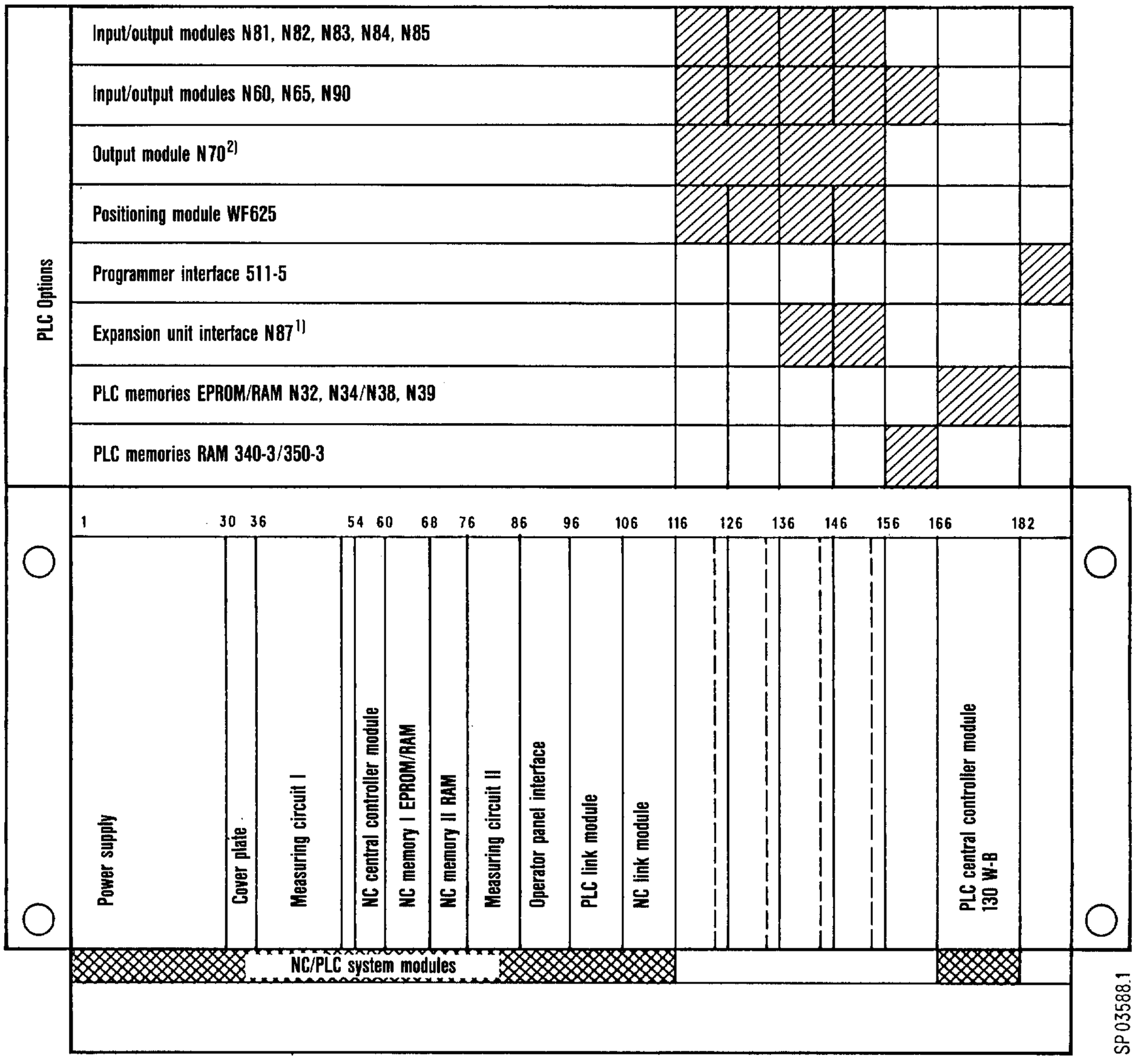
		Previous type designation	4A 5 MHz	4B 8 MHz
NC central controller module:				
6FX 1111-0AA01	NC-CPU	03161	x*	x**
6FX 1111-0AB02	NC-CPU	03162	x*	x**
* RE-START-	811.9011.00			
PROM'S	811.9012.00			
** RE-START-	817.7133.01			
PROM'S	817.7134.02			
NC memories:				
6FX 1120-2CA00	EPROM/RAM	–	–	x
6FX 1118-1AA02	EPROM	03202A	x	–
6FX 1190-1AE00	8K RAM	03260	x	–
6FX 1190-1AF00	16K RAM	03260	x	–
6FX 1190-1AG00	32K RAM	03260	x	–
Measuring circuits:				
6FX 1125-1AA01	4 actual values	03316	x	x
6FX 1123-7AA01	1 actual, 6 command values	03326	x	x
6FX 1111-1AA01	3 actual, 3 command values	03351	x	x
Operator panel interface:				
6FX 1115-0AA02	without graphics	03811B	x	x
6FX 1125-5AB01	*coulour graphics	03806	x	x
6FX 1123-2AB01	*monochrome graphics	03816	x	x
* Character EPROM for 4A/4B 548 817.7880.03				
Link module:				
6FX 1122-2AA02	PLC link	03841	x	–
6FX 1122-2AB02	PLC link	03842	–	x
6FX 1122-1AA01	NC link	03831	x	x
EPROM submodules:				
6FX 1123-6AE00		–	–	x
6FX 1126-0BB00		–	–	x
RAM submodules:				
6FX 1123-6A000		–	–	x
6FX 1126-0BL00		–	–	x
for NC memory 6FX 1120-2CA00				
PLC-CPU:				
130WB13		6ES 5921-3WB13	x	x
130WB12		6ES 5921-3WB12	x	x
Power packs:				
6EV 3054-0DC		External battery	x	x

x... Module can be used

–... Use not permitted

1.2.1 Rack assignment

Single rack 6FC3...-0FA



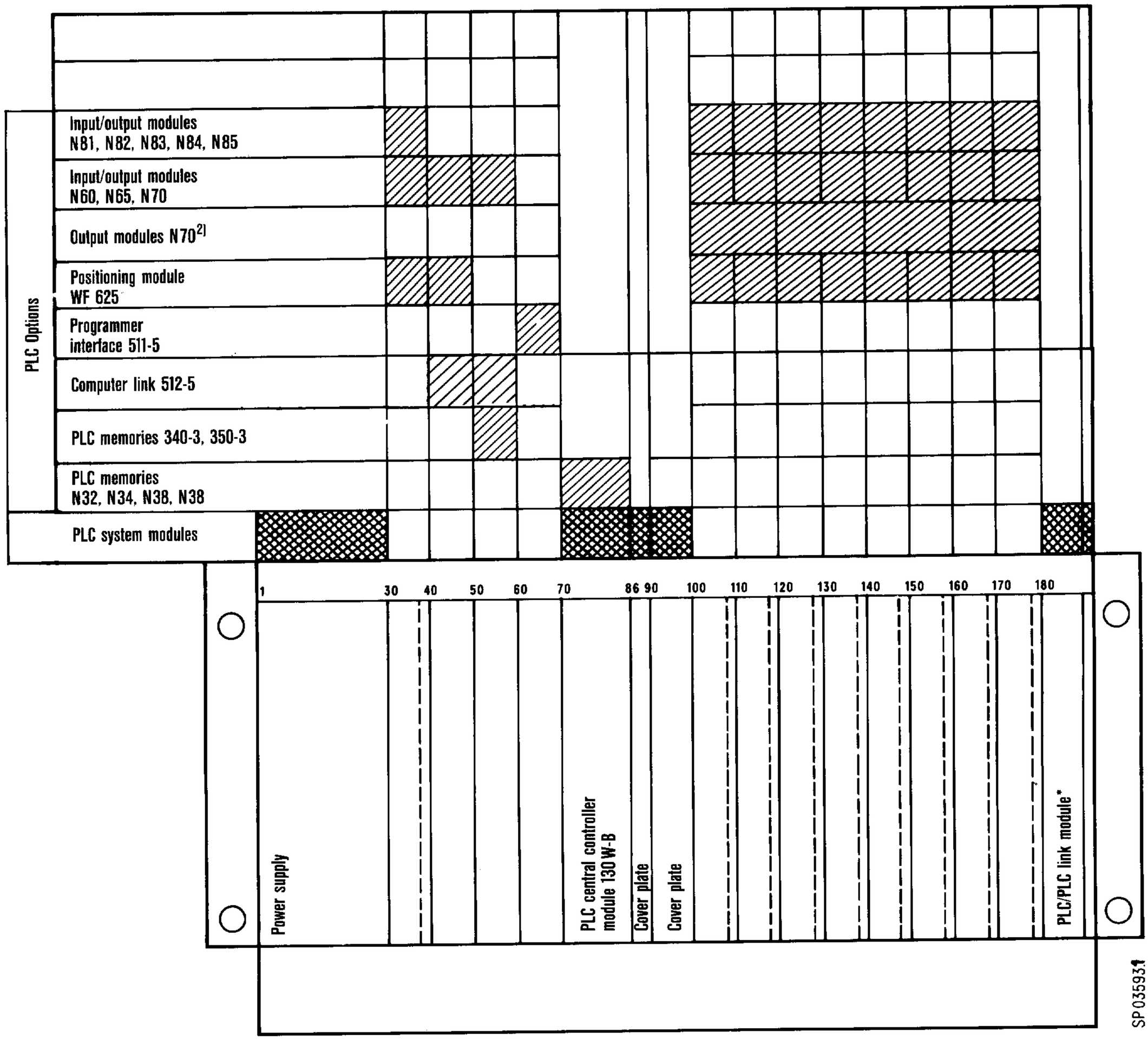
1] Without power transmission – no central power supply possible

2] Requires 2 slots

Siemens AG Order-No.: E80850-D27-X-A1-7600

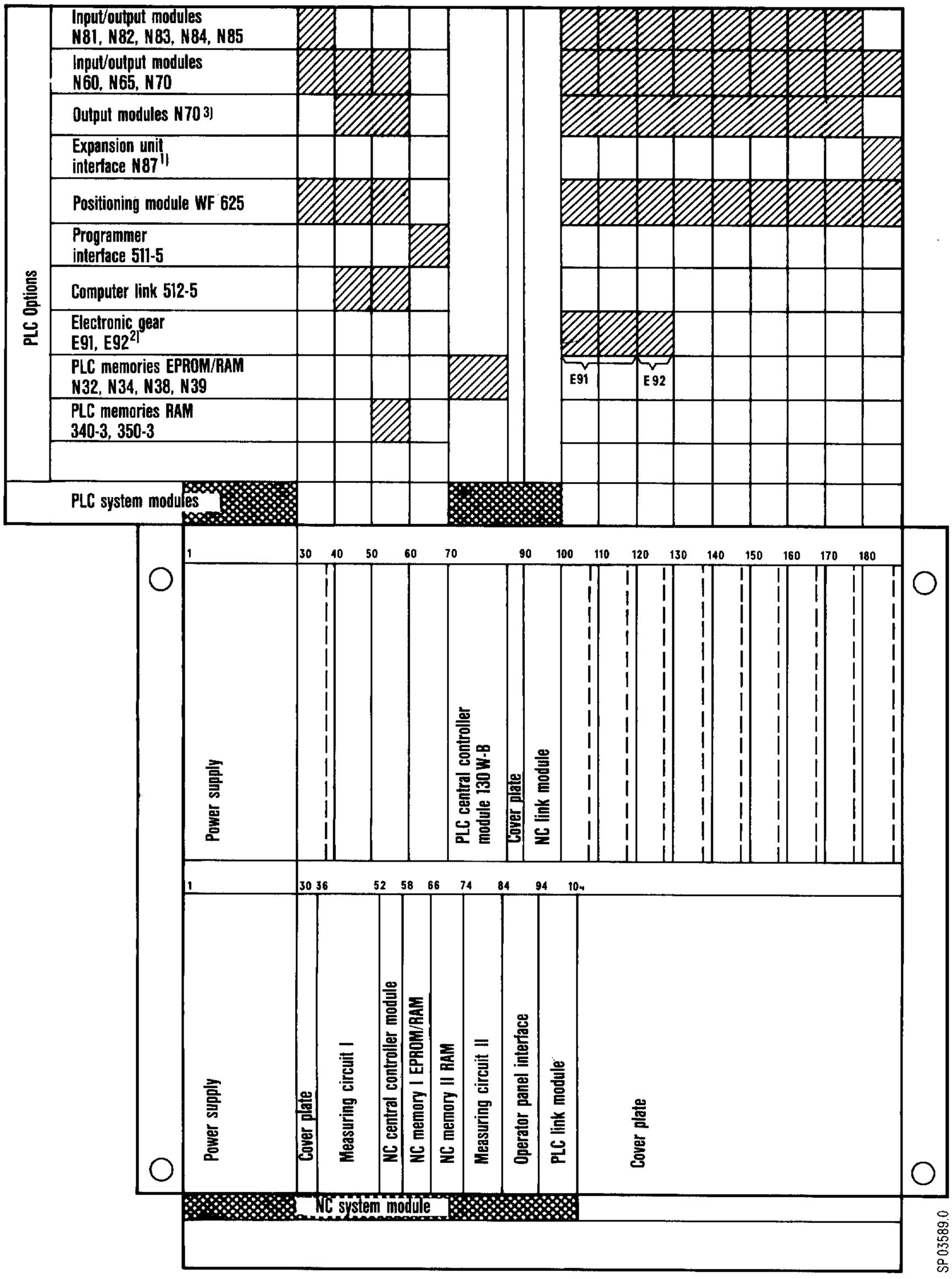
1.2.2 Rack assignment

External Dual PLC 6FC3871-0DA (N41)



1.2.3 Rack assignment

Two-tier rack 6FC3...-0HA with extended I/O area



1) With power transmission, central power supply max. 8A (current balance)

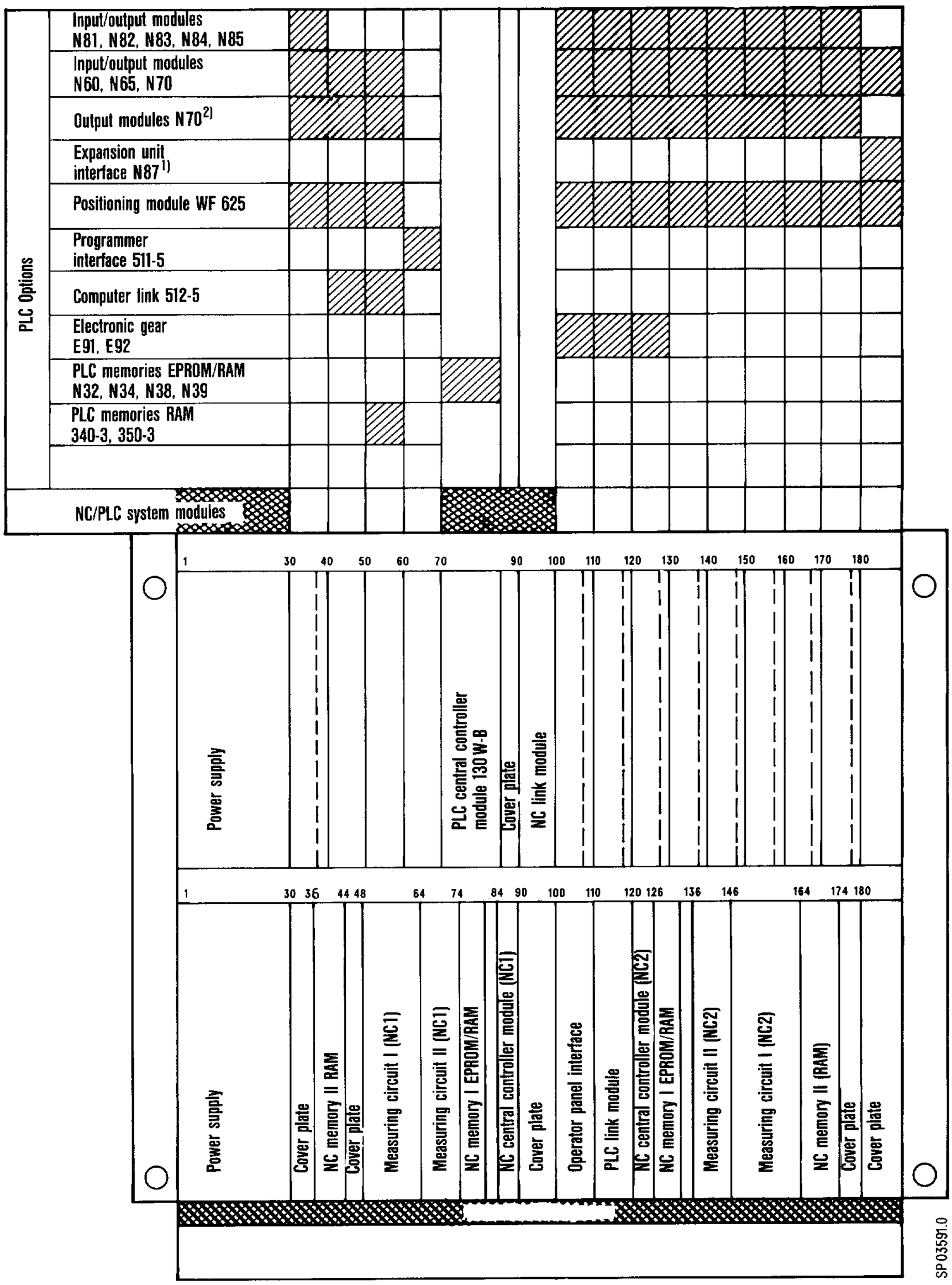
2) For 3M version only

3) Requires 2 slots

Siemens AG Order-No.: E80850-D27-X-A1-7600

1.2.4 Rack assignment

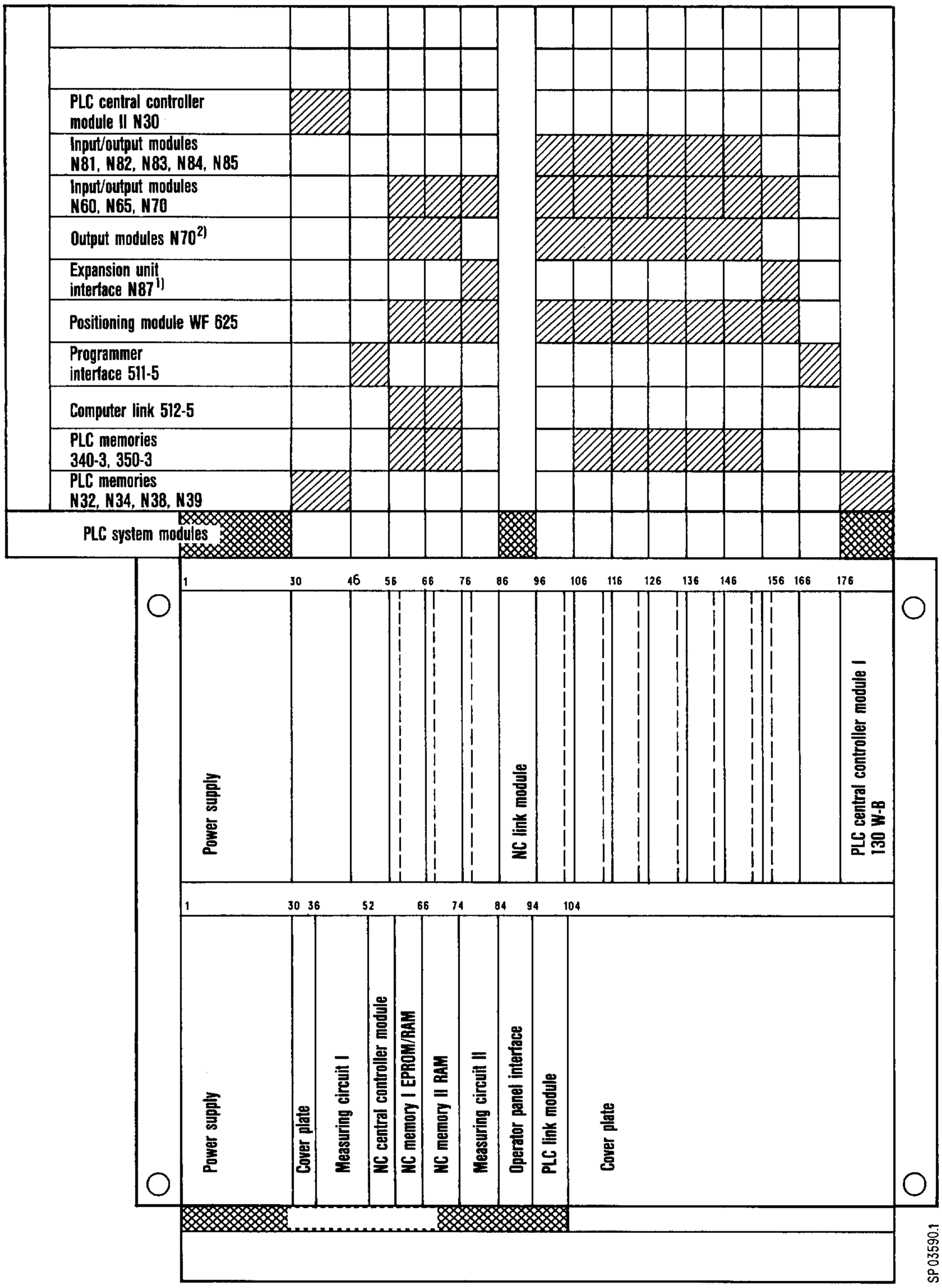
Two-tier rack 6FC373.-0FA
6FC3881-0FA with max. assignment of NC tier
6FC3887-0FA " " " " " "



1) With power transmission, central power supply max. 8 A (current balance)
2) Requires 2 slots

1.2.5 Rack assignment

Two-tier rack for Dual PLC 6FC3...-0JA

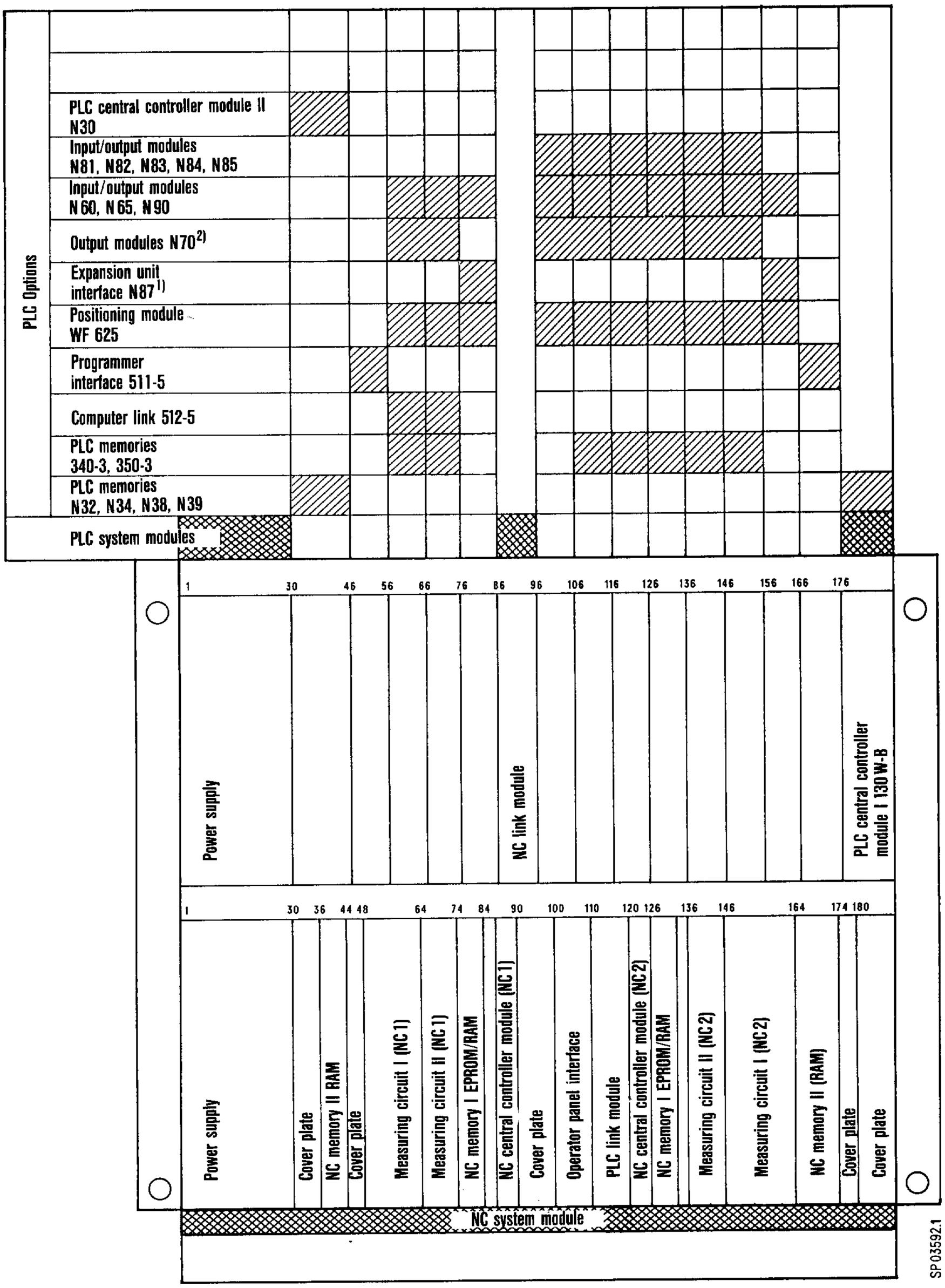


1) With power transmission, central power supply max. 8 A (current balance)

2) Requires 2 slots

1.2.6 Rack assignment

Two-tier rack for Dual PLC 6FC373.-0JA
6FC3881-0JA with max. assignment of NC tier
6FC3887-0JA " " " " " "

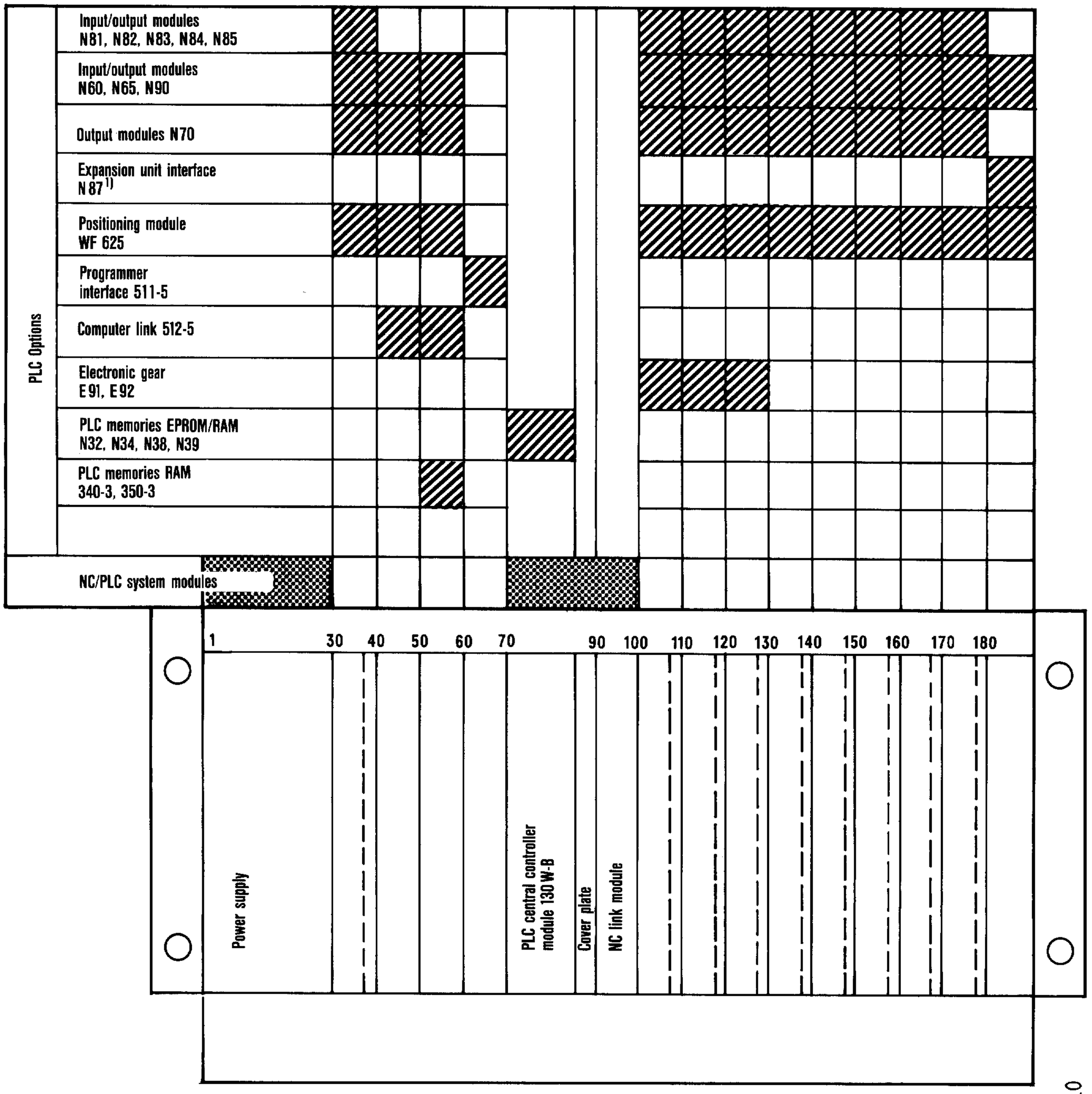


1) With power transmission, central power supply max. 8 A (current balance)

2) Requires 2 slots

1.2.7 Rack assignment

PLC rack 6FC3871-0AA

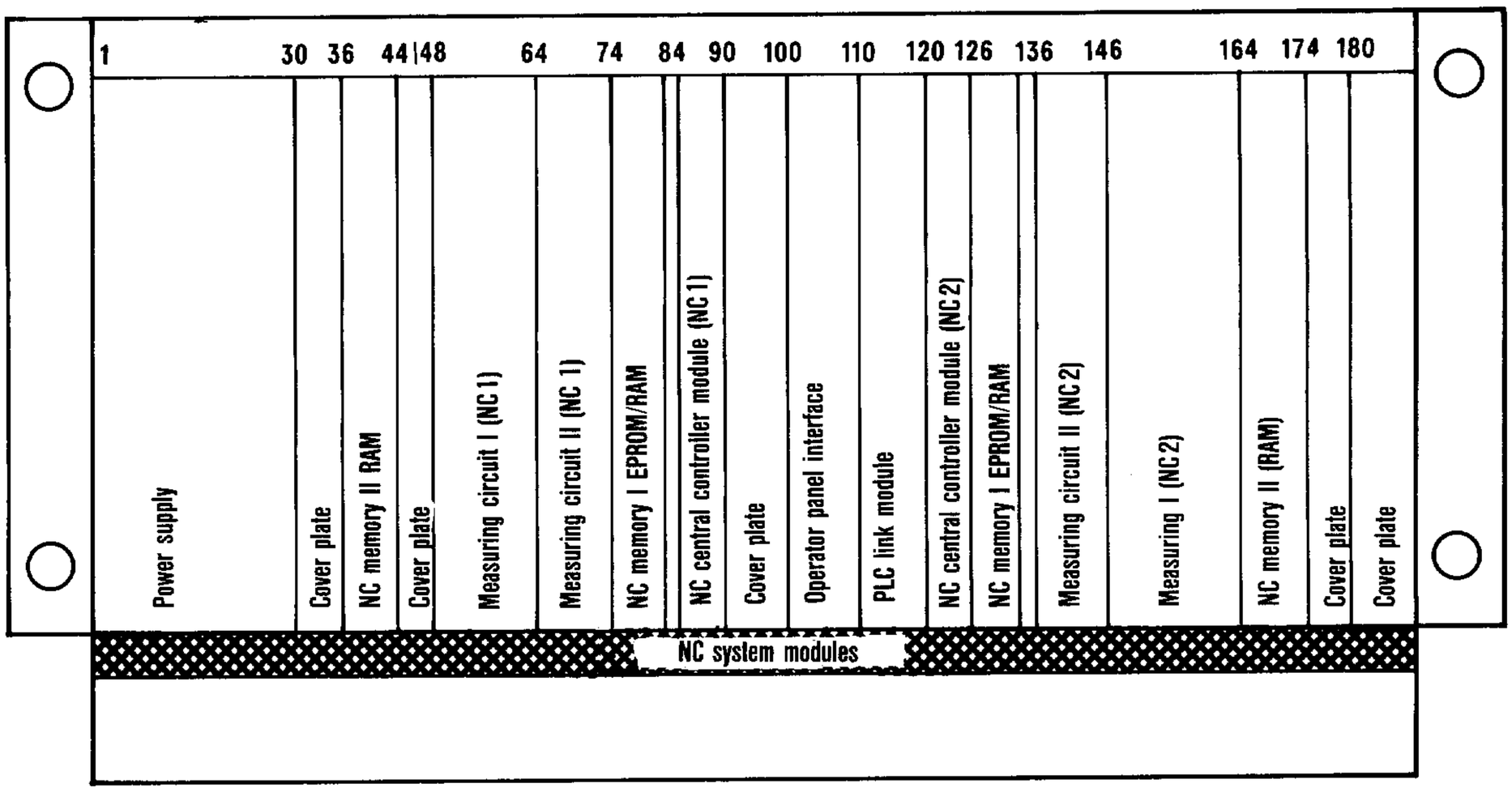


1) With power transmission – central power supply max. 8 A (current balance)

Siemens AG Order-No.: E80850-D27-X-A1-7600

1.2.8 Rack assignment

NC rack 6FC3882-0FA with max. assignment
6FC3886-0FA with max. assignment



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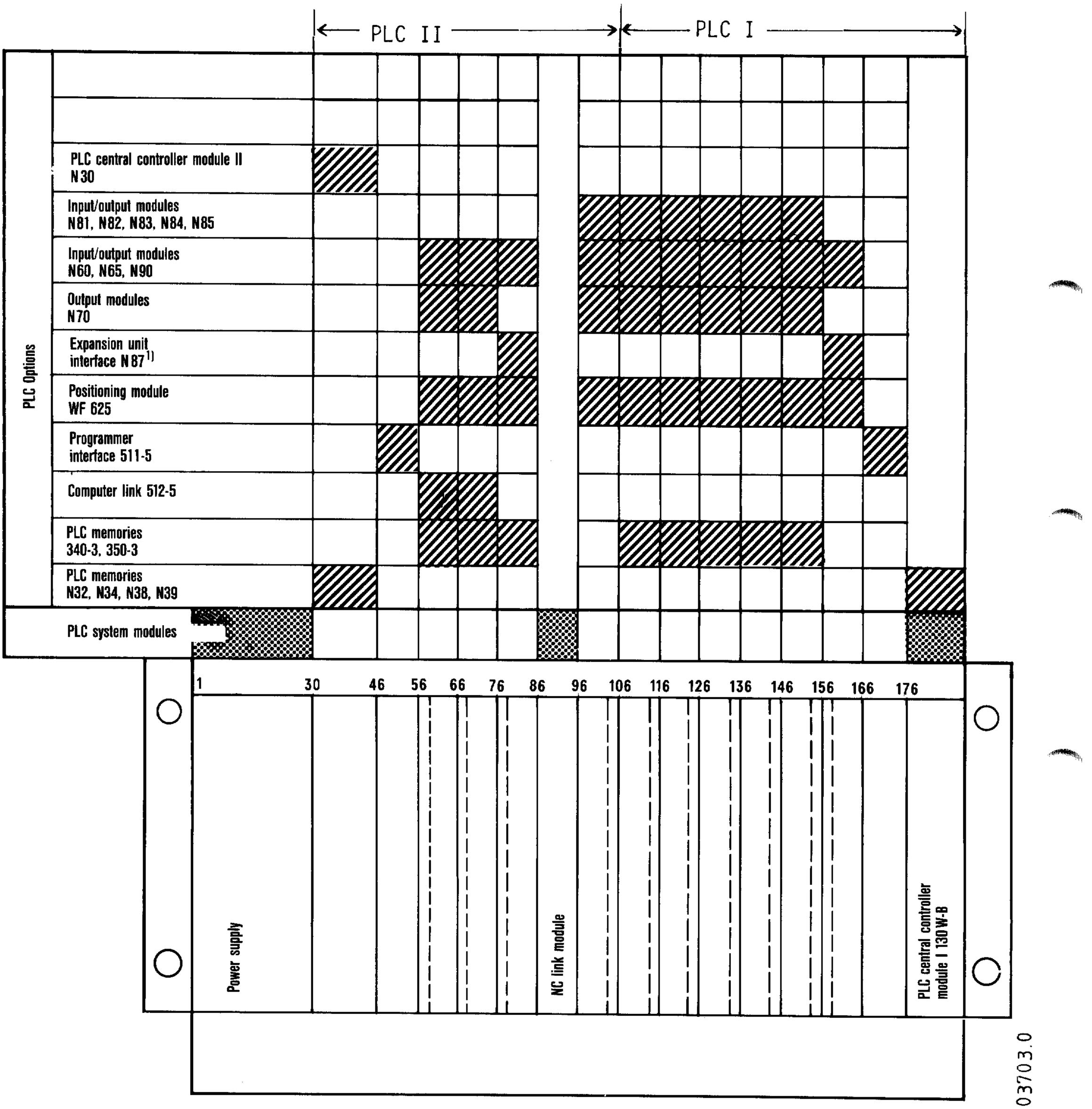
1.2.9 Rack assignment

Dual PLC 6FC3871-0BA

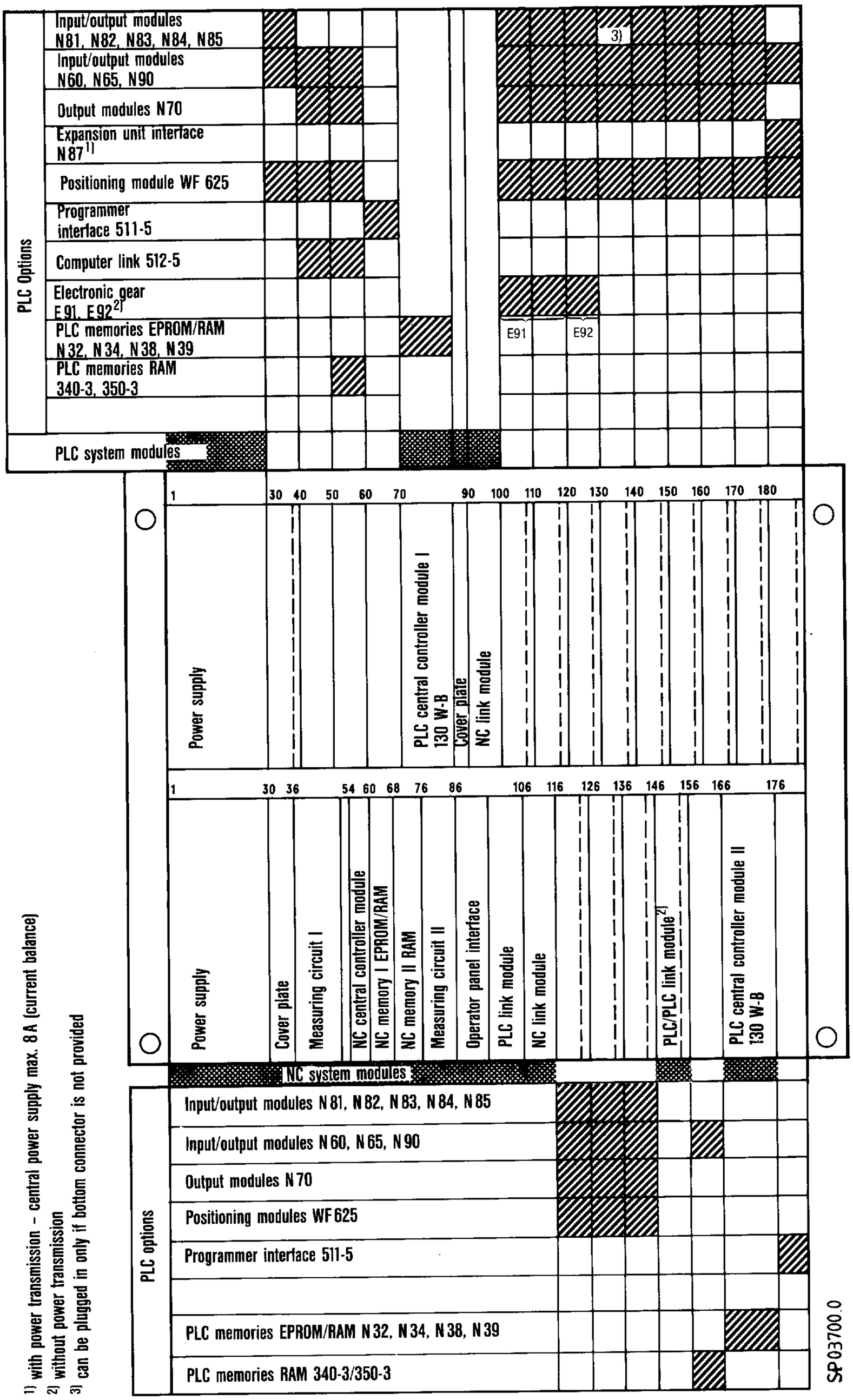


1) With power transmission – central power supply max. 8 A (current balance).
One central power pack permitted per tier.

Siemens AG Order-No.: E80850-D27-X-A1-7600

1.2.10 Rack assignment

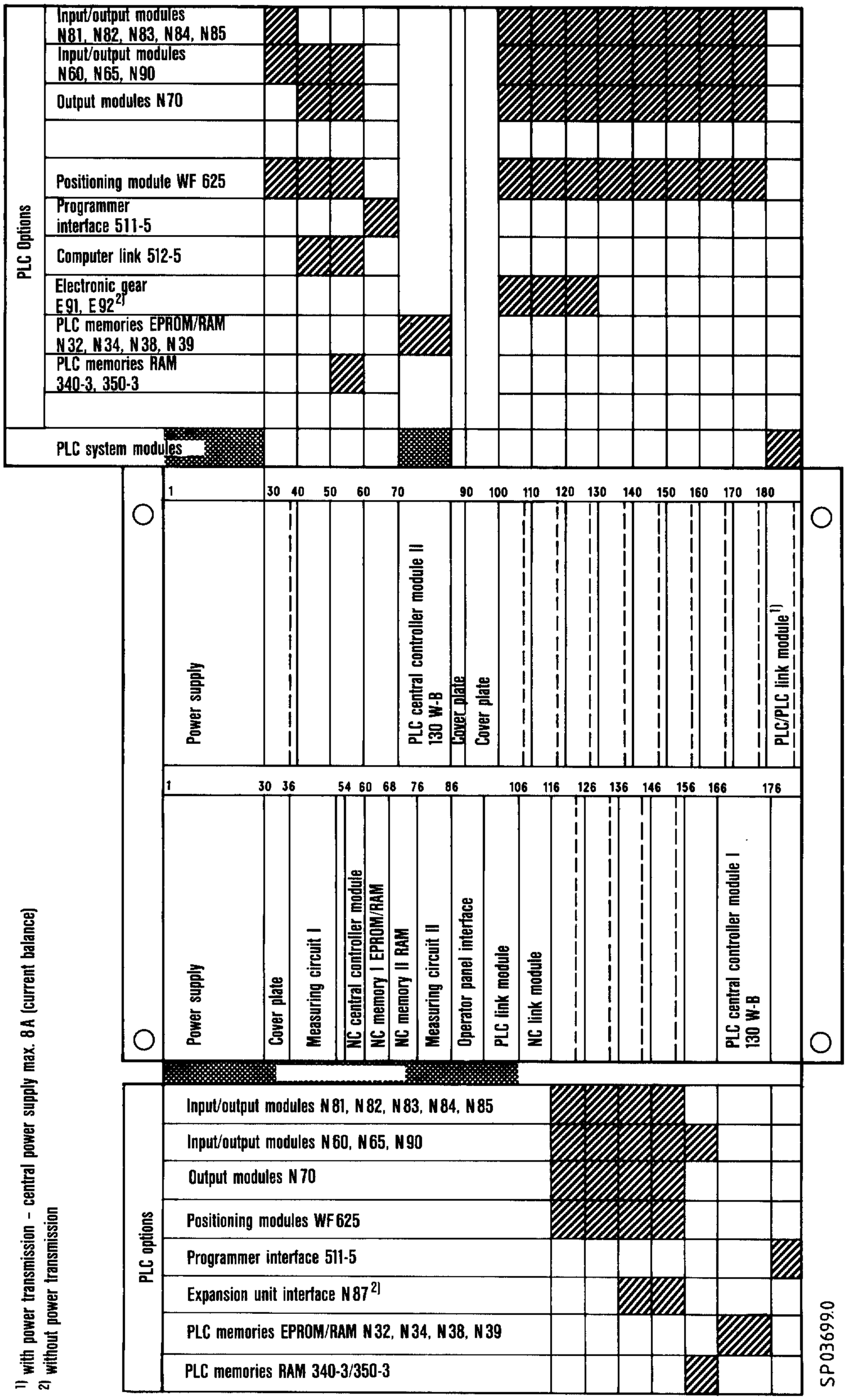
Two-tier rack 6FC3881-0KA with N35



1) with power transmission - central power supply max. 8 A (current balance)
2) without power transmission
3) can be plugged in only if bottom connector is not provided

1.2.11 Rack assignment

Two-tier rack 6FC3881-0KA with N43



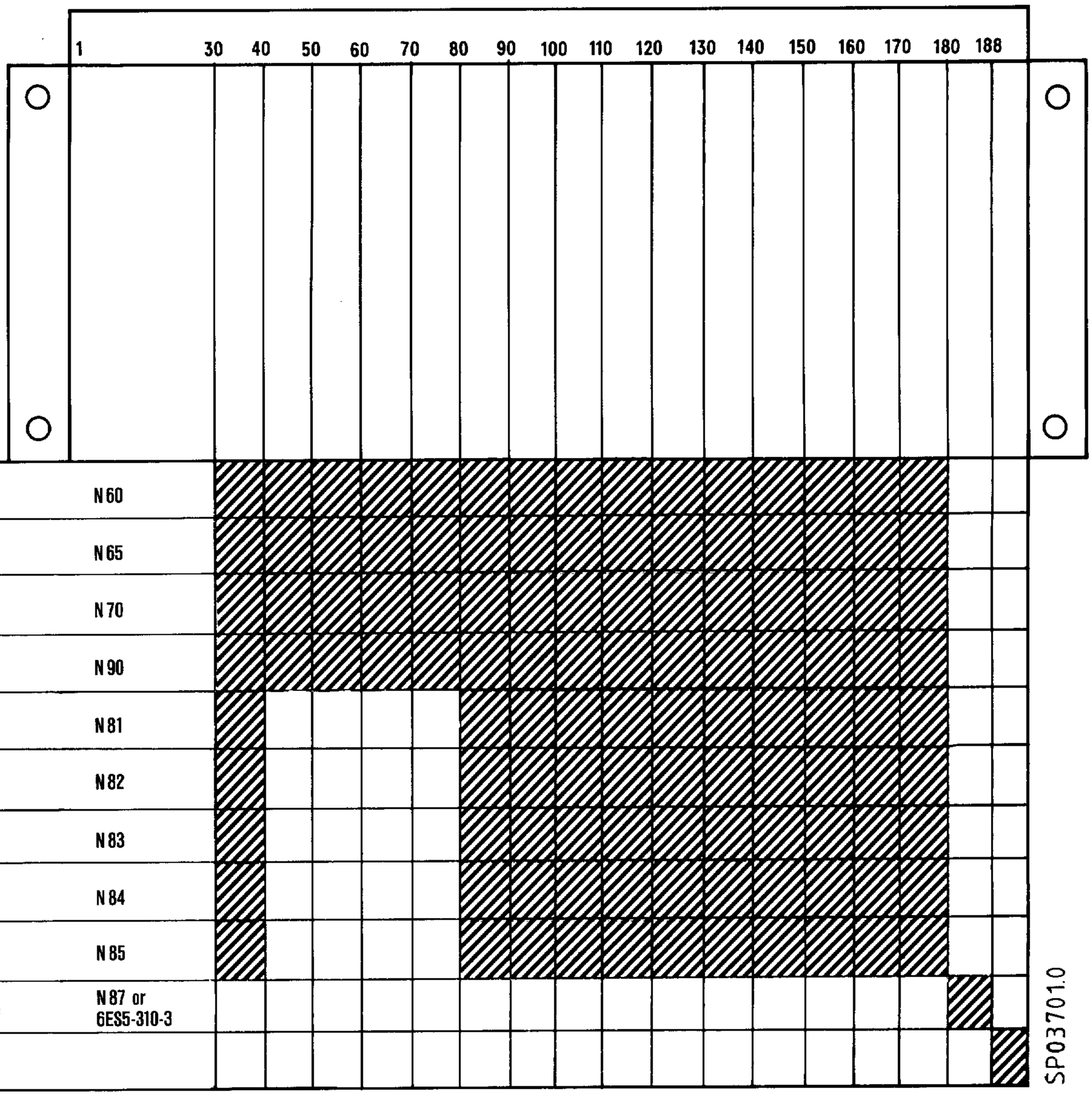
1) with power transmission – central power supply max. 8 A (current balance)
2) without power transmission

1.3 PLC expansion units

1.3.1 PLC expansion unit for 3T/3M/3TT

If the NC logic rack does not offer a sufficient number of slots for the required PLC peripherals, a PLC expansion unit may be connected by means of central controller/ expansion unit interfaces (CC/EU). This provides an additional 15 slots for input/output modules etc..

Rack assignment of PLC expansion unit 6FC 3981-4FD



1) requires 2 slots

The PLC expansion unit (P03) can be used without its own power pack (P23) on SINUMERIK 3 controls (see Section 1.1) provided that the overall power consumption of all the PLC modules in a single tier remains less than or equal to 25 A. The power consumption of all the modules in the expansion unit must not exceed 8 A.

In such cases, the expansion unit takes its power supply from link module N87, which can be used as a central controller interface or expansion unit interface depending on the jumpering configuration. The cable must have a cross-section of at least 6 mm^2. Max. cable length is 1 m.

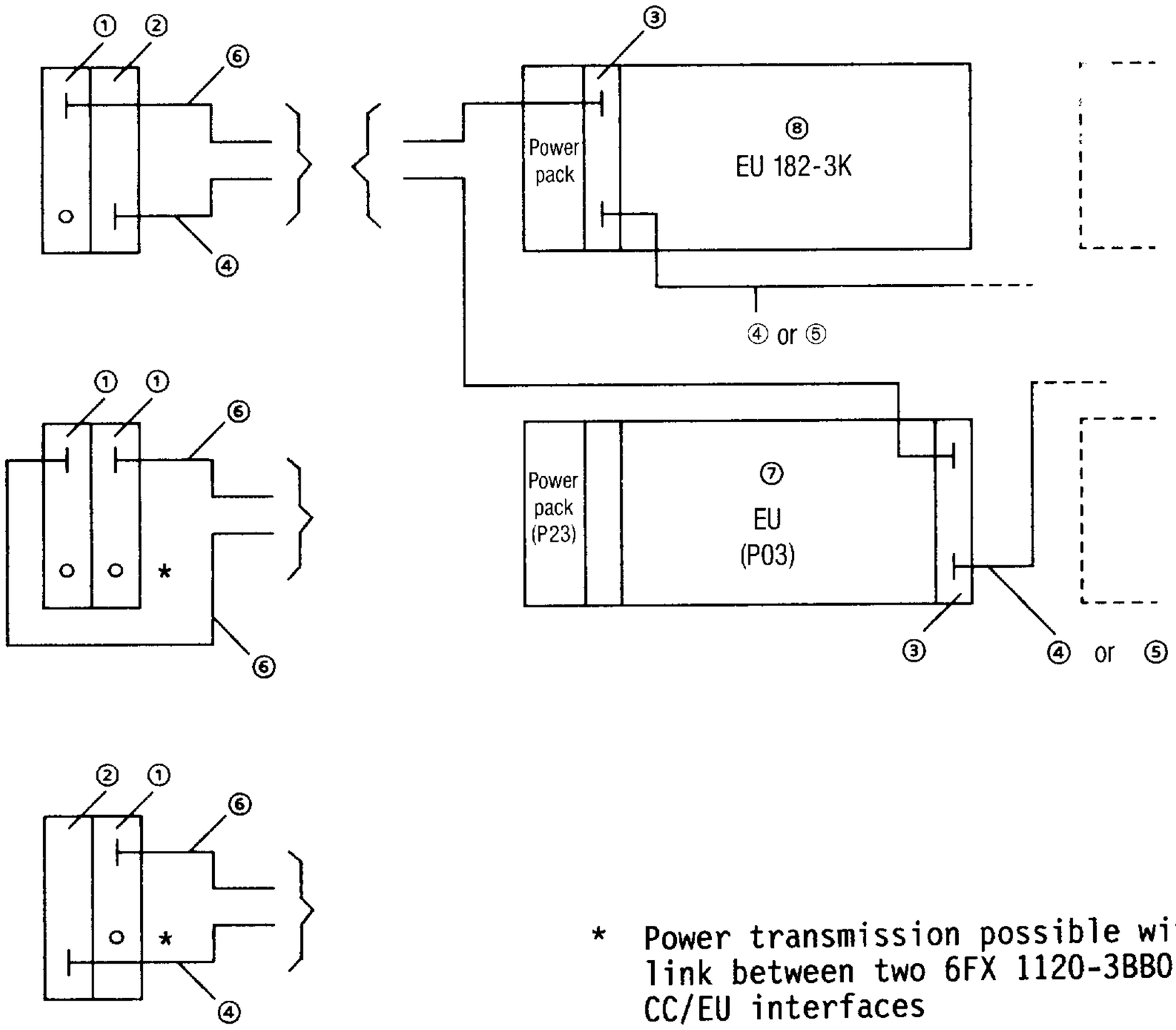
If this type of link with power supply is used (central connection), no power pack (P23) may be inserted in the PLC expansion unit (short-circuit risk).

Table for calculating current balance for PLC modules and their "internal current consumption at 5 V".

Programmer interface 511			1.6 A
PLC central controller 130 W-B	5.0 A		
Memory module 340 8K-RAM 16K-RAM	1.0 A 1.2 A		
NC link	1.6 A		1.6 A
Digital output N60	0.15 A	x 0.15 A=	
Digital output N65	0.3 A	x 0.3 A=	
Digital output N70	0.24 A	x 0.24 A=	
Digital input/output N90	0.27 A	x 0.27 A=	
Digital input/output N81	1.0 A	x 1.0 A=	
Digital input/output N82	0.5 A	x 0.5 A=	
Digital input N83	0.52 A	x 0.52 A=	
Digital output N84	0.25 A	x 0.25 A=	
Digital input/output N85	0.8 A	x 0.8 A=	
Positioning module WF 625	1.5 A	x 1.5 A=	
CC/EU interface N87	1.9 A		1.9 A

The methods of linking PLC expansion units in conjunction with the various NC and PLC rack configurations are shown in Section 1 (system configurations).

1.3.1.1 Connecting expansion units

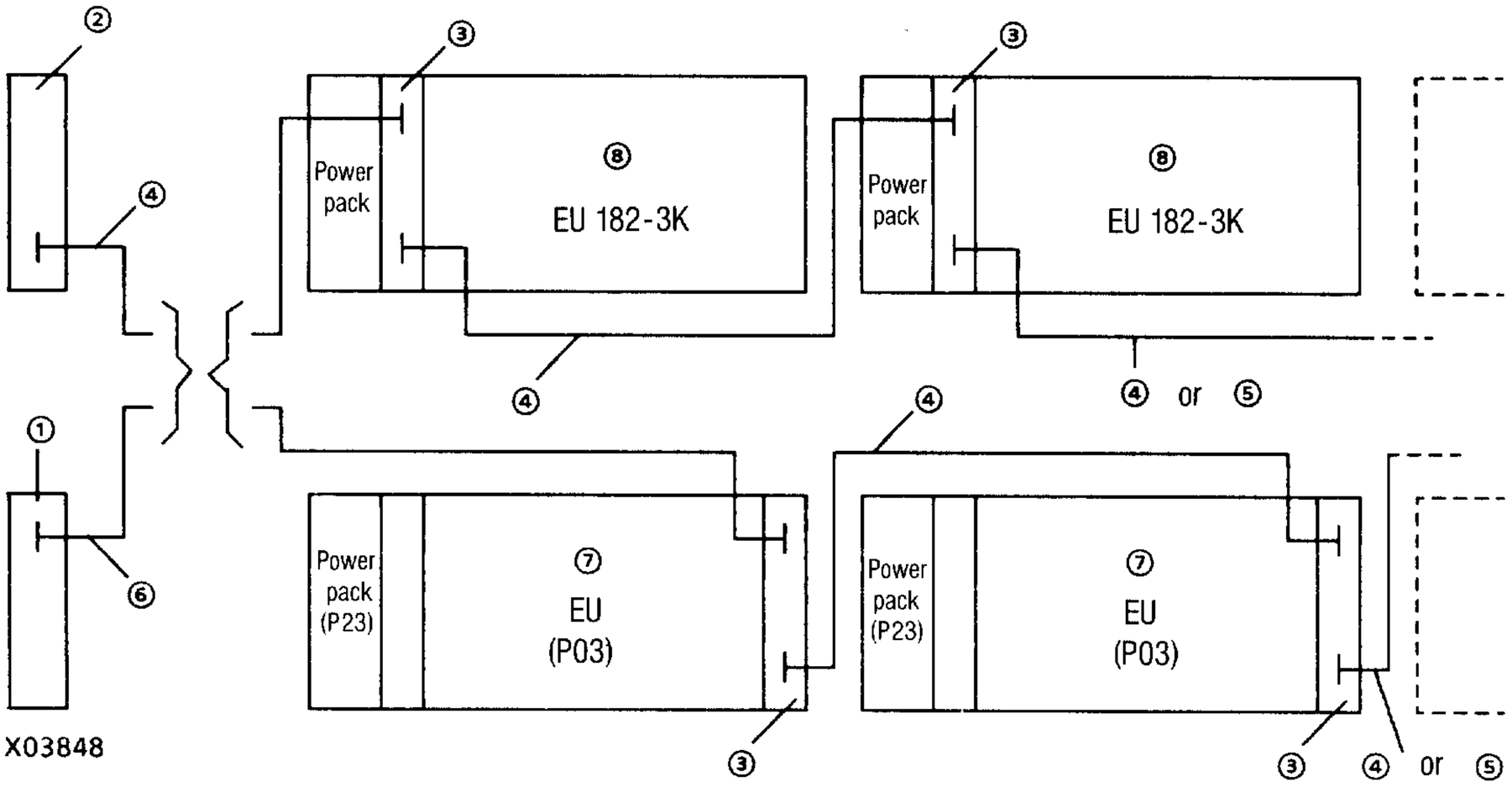


* Power transmission possible with link between two 6FX 1120-3BB01 CC/EU interfaces

① CC/EU interface 6FX 1120-3BB01 (03845B) + (N87)
② EU interface 6ES5 301-3
③ CC/EU interface 6ES5 310-3
④ Connecting cable 6ES5 721-0 ... 0
⑤ Terminal connector 6ES5 760-0AA11
⑥ Cable 6FC 9344-1X.
⑦ Expansion unit 6FC 3981-4FD
⑧ Expansion unit 6ES5 182-3KH61

1.3.1.2 Cascading expansion units

Expansion units can also be linked by means of modules CC/EU-IM 310-3 (central controller/expansion unit interface) and EU-IM 301-3 (expansion unit interface) or 6FX 1120-3BB01 (N87). Expansion units can be cascaded with module 6ES5 310-3 only.

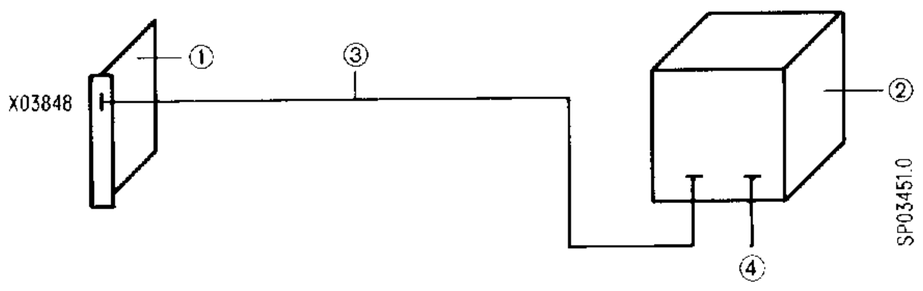


① CC/EU interface 6FX 1120-3BB01 (03845B) + (N87)
② EU interface 6ES5 301-3
③ CC/EU interface 6ES5 310-3
④ Connecting cable 6ES5 721-0 ... 0
⑤ Terminal connector 6ES5 760-0AA11
⑥ Cable 6FC 9344-1X.
⑦ Expansion unit 6FC 3981-4FD
⑧ Expansion unit 6ES5 182-3KH61

Siemens AG Order-No.: E80850-D27-X-A1-7600

1.3.2 Electronic terminator

The electronic terminator can be connected in place of a PLC expansion unit. It comprises an interface module and an input/output module.

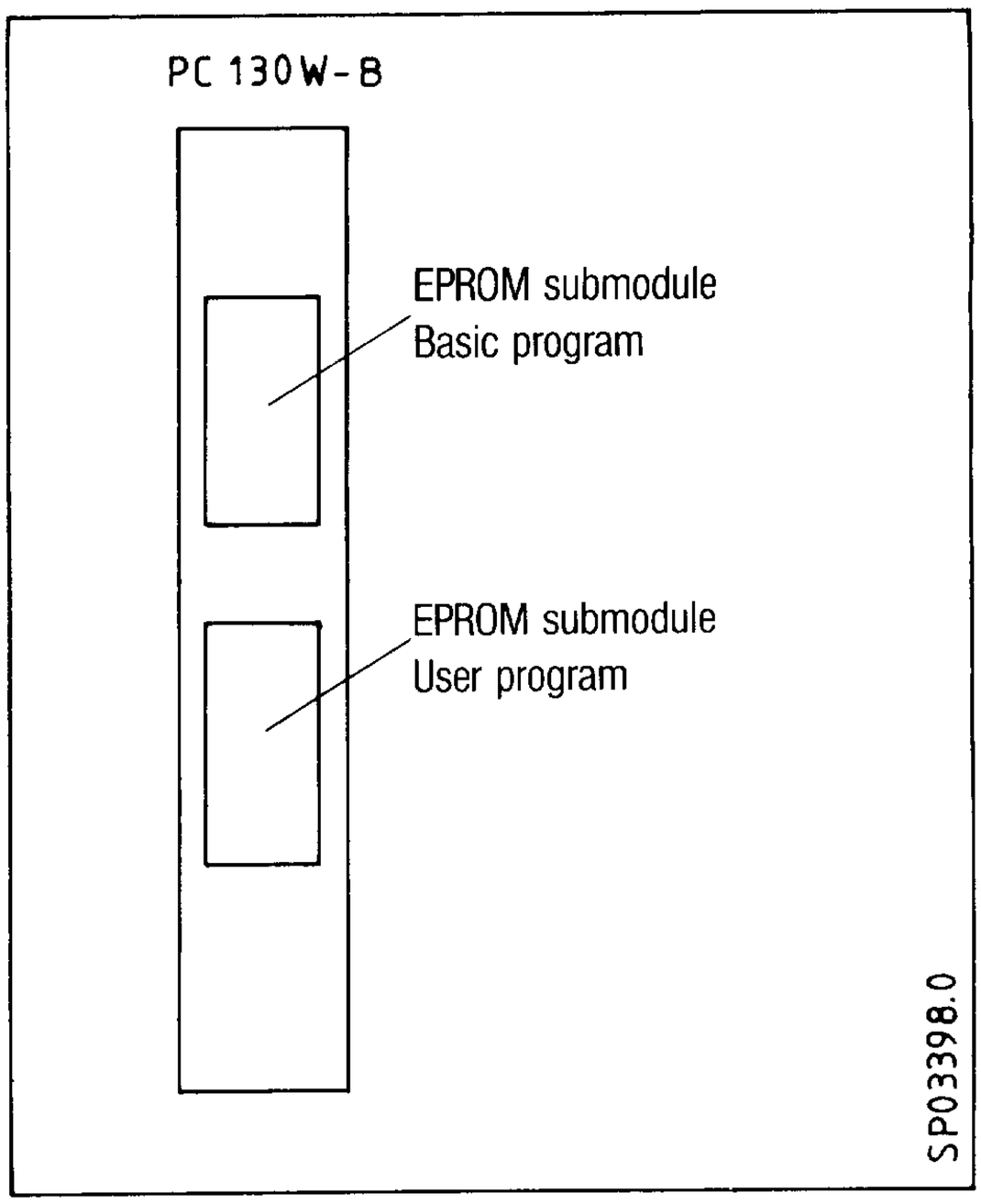


① CC/EU interface 6FX1120-3BB01(03845B), N87 can be connected from product version C onwards

② Electronic terminator 6ES5484-8AA11

③ Cable 6FC9344-1X

④ Terminal connector 6ES5760-0AA11



1.4 PLC interface control

The PLC interface control is the PLC 130W-B integrated interface control from the SIMATIC S5 automation system. The PLC central controller comprises a processor module with receptacles for 2 memory submodules (EPROM).

One memory submodule is supplied with the control (top receptacle in PLC central controller). This submodule contains the PLC basic program, which organizes the transfer of data between the NC and PLC (Section 4.3).

An additional memory submodule receptacle is provided (at the bottom) for the machine-specific user program. EPROM memory submodules N32/N34 (8/16 k words) can be inserted in this receptacle.

The PLC interface control also includes the following:

- System program memory for the system program (EPROM)
- System data memory for flags, counters, timers, process images of I/Os and other system data
- 2.9 k RAM, of which approx. 2 k are reserved for user-programmed functions or user-organized data.

The PLC matches the NC to the machine. It links the NC input and output signals to the machine signals using the STEP5 user-oriented programming language, thus permitting adaptation to various machine types by way of a program.

The SINUMERIK and PLC are linked by means of a common link RAM (a multi-port RAM), via which information is exchanged between the units. The link RAM comprises 2 k x 8 bits.

The interface control signals and the machine control panel signals in the interface are transferred in blocks in a 16 ms cycle, and the keyboard image in a 50 ms cycle, in all SINUMERIK operating modes.

2. Connection conditions

2.1 NC components

SINUMERIK System 3 controls comprise the following components:

- Logic component with integral PLC
- Operator panel component with keyboard and screen
- Machine control panel
- Handwheel
- Punched tape reader component

2.1.1 Cables and connectors

The individual components may be connected using the cable types prescribed in the cable and equipment overview only.

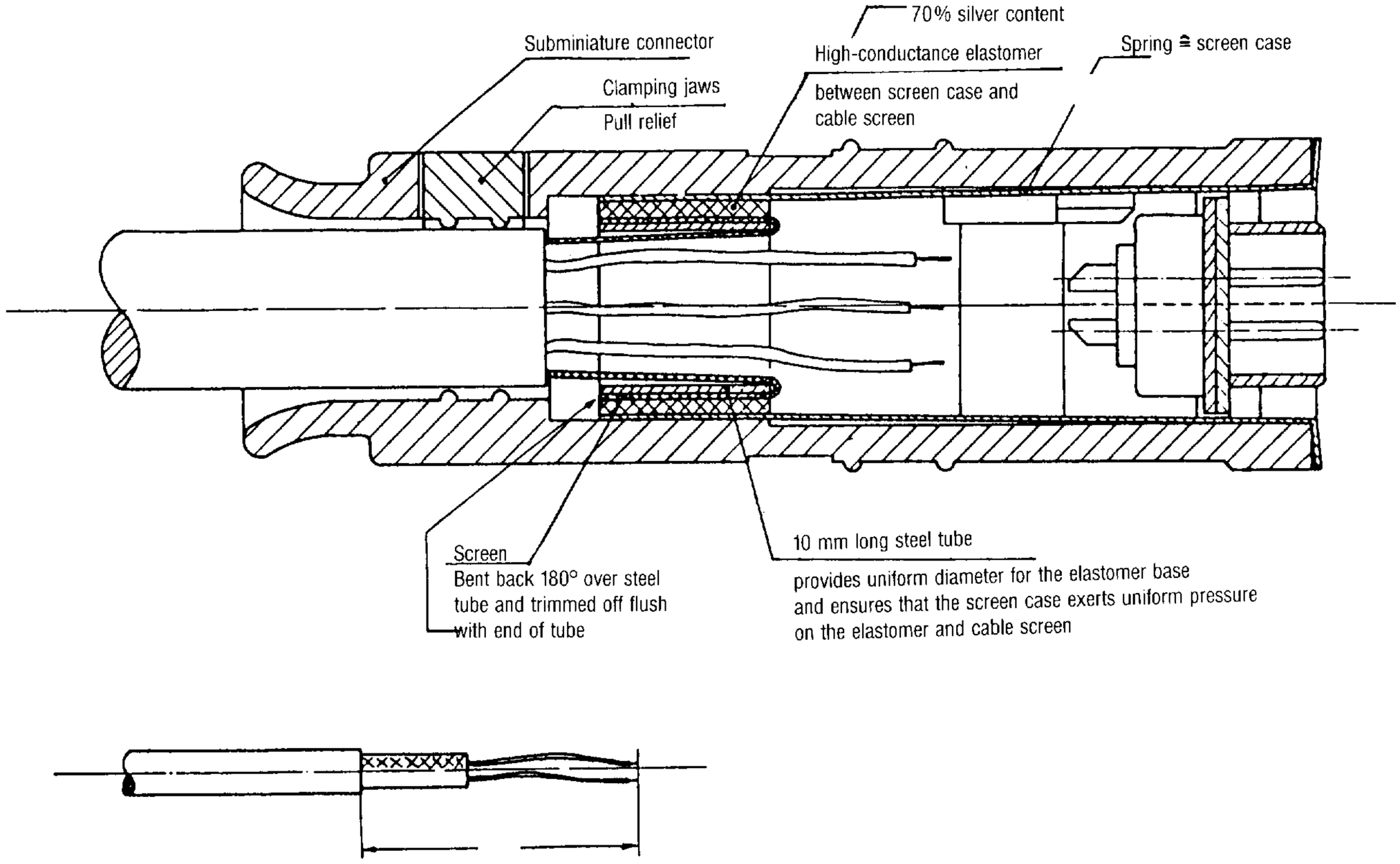
The cable and equipment overview and the accessories lists state the maximum permissible cable lengths.

The cable screen must be connected to the subminiature connector as shown in the assembly drawing. Protect the cables against mechanical damage e.g. by using cable ducts or sheet metal covers.

Penetration by oil, coolant or chips must be avoided.
Do not run low-voltage cables parallel to power cables. Cables not connected to the control must not be run through the control components.
Screw all connectors securely to the front plates of the modules.

Assembly drawing: cable/subminiature connector

Dimension drawing

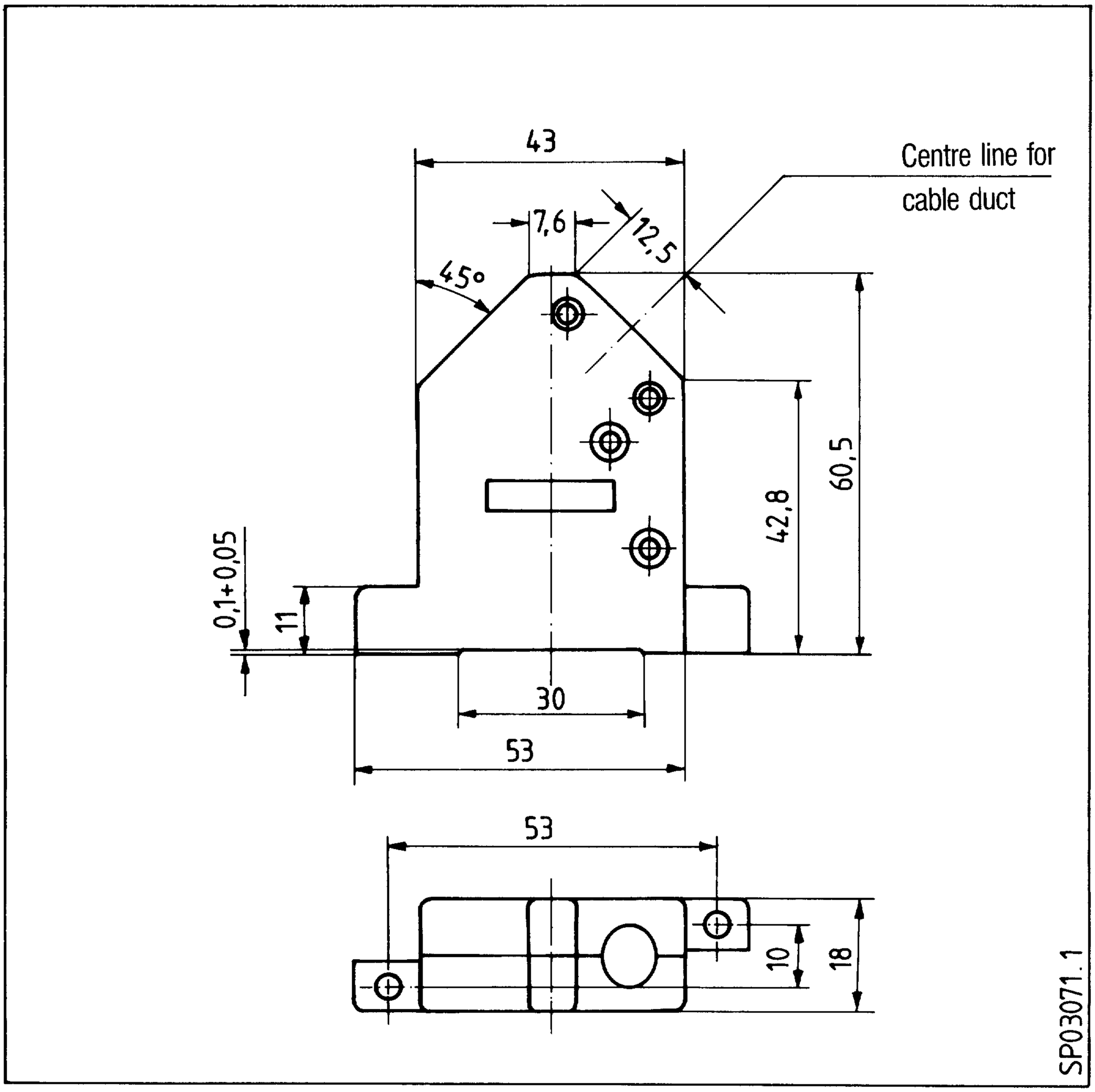


15-pole: 37 mm
25-pole: 37 mm
50-pole: 45 mm

70.0

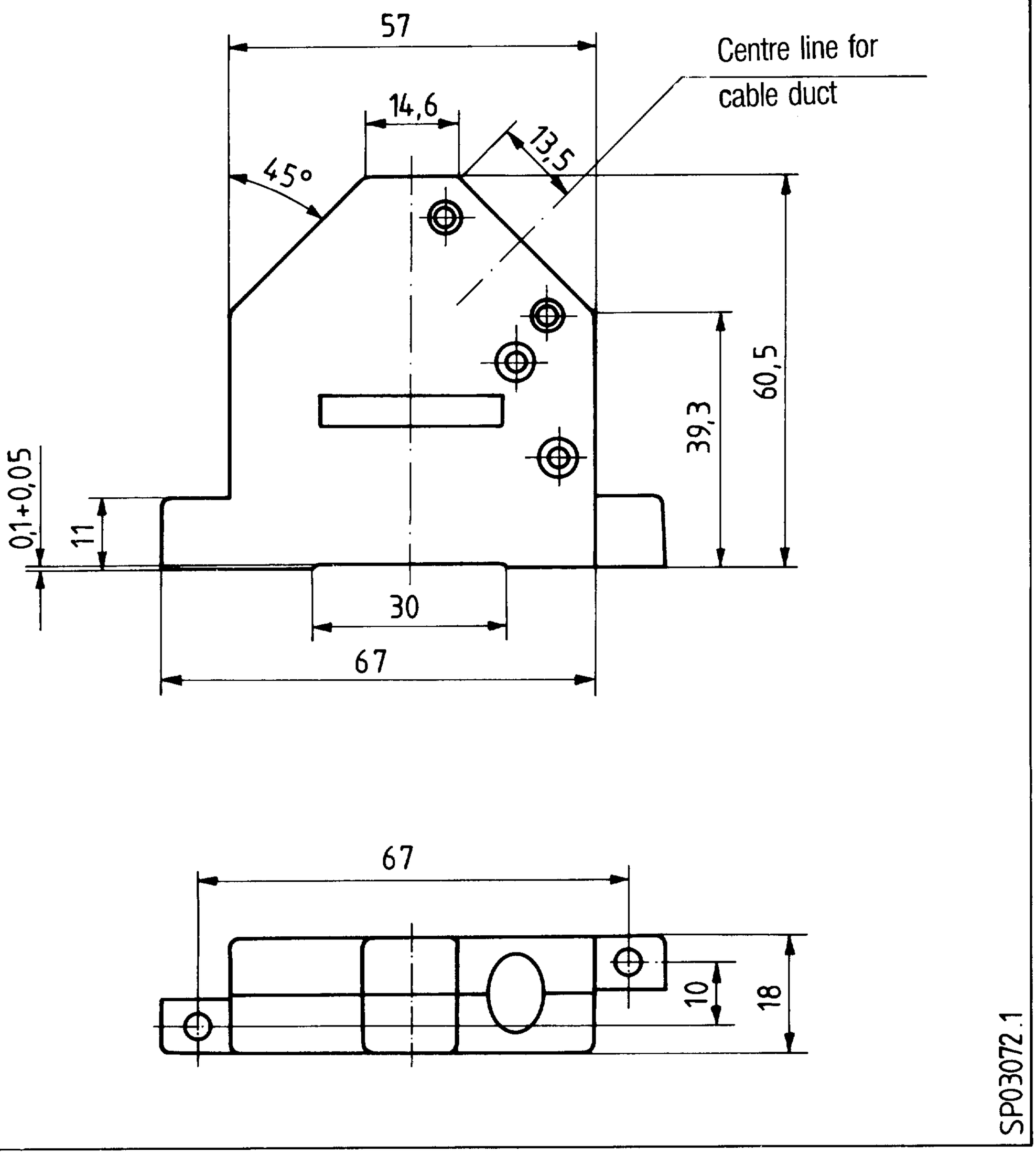
Subminiature connector (complete with housing): 15-pole socket MLFB 6FC9 341-1EC

Dimension drawing: Scale 1:1



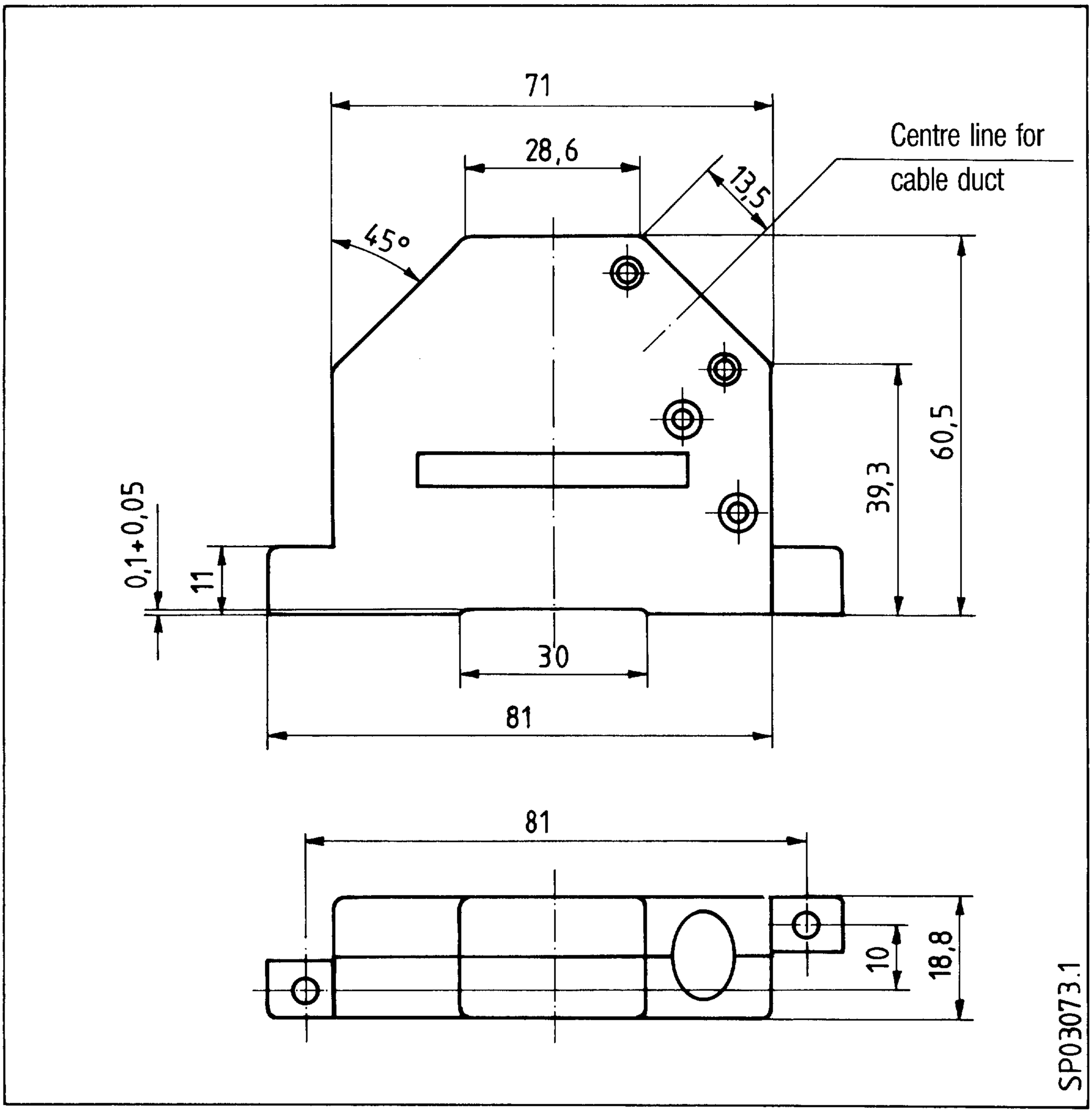
Subminiature connector (complete with housing): 25-pole socket
MLFB 6FC9 341-1ED

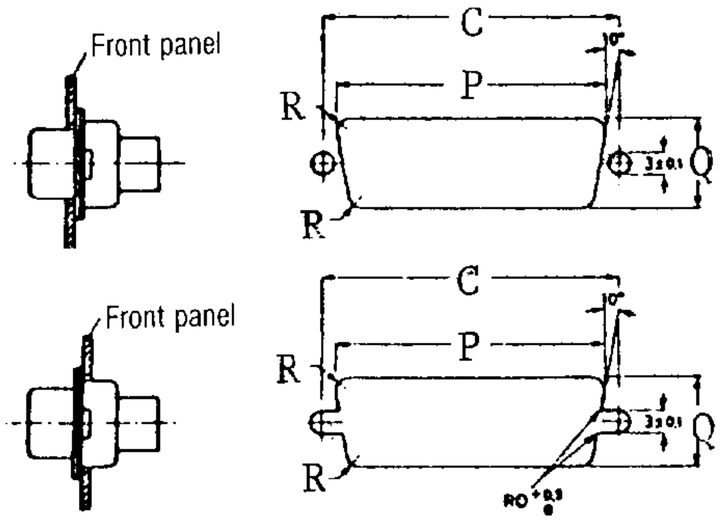
Dimension drawing: Scale 1:1



Subminiature connector (complete with housing): 50-pole socket MLFB 6FC9 341-1EE

Dimension drawing: Scale 1:1

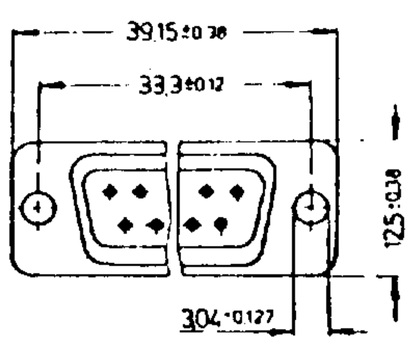




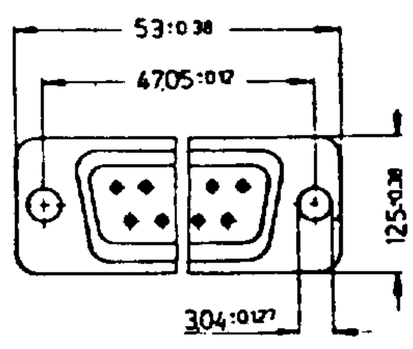
No. of pole	C(±0,2)	P(±0,2)	Q(±0,2)	R(±0,2)
15	33,3	28,8	11,4	3,4
25	47,0	42,5	11,4	3,4
50	61,1	56,3	14,1	3,4
15	33,3	30,5	12,3	2,1
25	47,0	44,3	12,3	2,1
50	61,1	58,3	15,3	2,1

SP03074.0

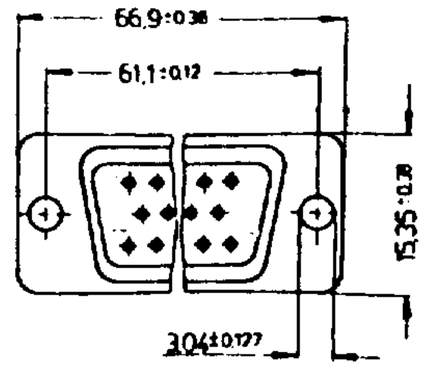
Socket-type connector
(same dimensions for pin-type connector)



15 poles



25 poles



50 poles

SP03075.0

2.1.2 Earth connection

The logic component rack is used for the reference potential and thus plays an important role as regards proper control operation.

The earth cable to the logic component rack must have a cross-section of at least 10 mm^2. Make the connection using an M5 insert nut (see dimension drawing). Other potential equalization cables can also be connected here in a star layout. The components must be connected to the logic component star point (M5 insert nut) by means of cables with a cross-section of at least 4 mm^2. The component connections are provided with cable screens for interference pulse discharge purposes.

2.1.3 Power supply conditions

The logic components including PLC and operator panel are designed for connection to a power supply of 24 V DC.

An additional power pack component has to be provided to obtain this power supply from the mains.

Built-in power supply data

	3T	3M	3T 4)	3M 4)	3TT
Supply voltage rated value	24 V DC	24 V DC	24 V DC	24 V DC	24 V DC
Input voltage range incl. ripple	20 to 30 V	20 to 30 V	20 to 30 V	20 to 30 V	20 to 30 V
Ripple	3.6 V_{SS}	3.6 V_{SS}	3.6 V_{SS}	3.6 V_{SS}	3.6 V_{SS}
Input capacitance	8100 /uF	8100 /uF	8100 /uF	8100 /uF	8100 /uF
Current consumption NC logic	1)	1)			
U_E = 20 V	I_E = 7.3 A	I_E = 7.7 A	I_E = 4.2 A	I_E = 4.7 A	I_E = 6.2 A
U_E = 24 V	I_E = 6.1 A	I_E = 6.4 A	I_E = 3.7 A	I_E = 3.9 A	I_E = 5.2 A
U_E = 30 V	I_E = 4.9 A	I_E = 5.2 A	I_E = 3.1 A	I_E = 3.4 A	I_E = 4.1 A
Current consumption 3) PLC logic					
U_E = 20 V	-	-	I_E = 3.3 A	I_E = 3.3 A	I_E = 3.3 A
U_E = 24 V	-	-	I_E = 2.9 A	I_E = 2.9 A	I_E = 2.9 A
U_E = 30 V	-	-	I_E = 2.3 A	I_E = 2.3 A	I_E = 2.3 A
Current consumption 2) Operator panel					
U_E = 20 V U_E = 24 V U_E = 30 V	$I_E \leq 2$ A	$I_E \leq 2$ A	$I_E \leq 2$ A	$I_E \leq 2$ A	$I_E \leq 2$ A

1) Current consumption of NC + PLC logic components without inputs/outputs of I/O modules
2) Without machine control panel, with screen
3) Current consumption of logic component without I/O modules
4) Logic component with extended I/O area

2.1.4 Power supply connection

2.1.4.1 Power supply connection logic component

The connection is made at the terminal strip on the front panel of the 24 V power pack 03 500 (NC).

Connection cross-section: 1.5 mm^2

24 V power supply for expansion unit (EU).

Connection cross-section: 1.5 mm^2

If multi-wire cables are used, all the wires must be connected, i.e. additional wires must be run in parallel.

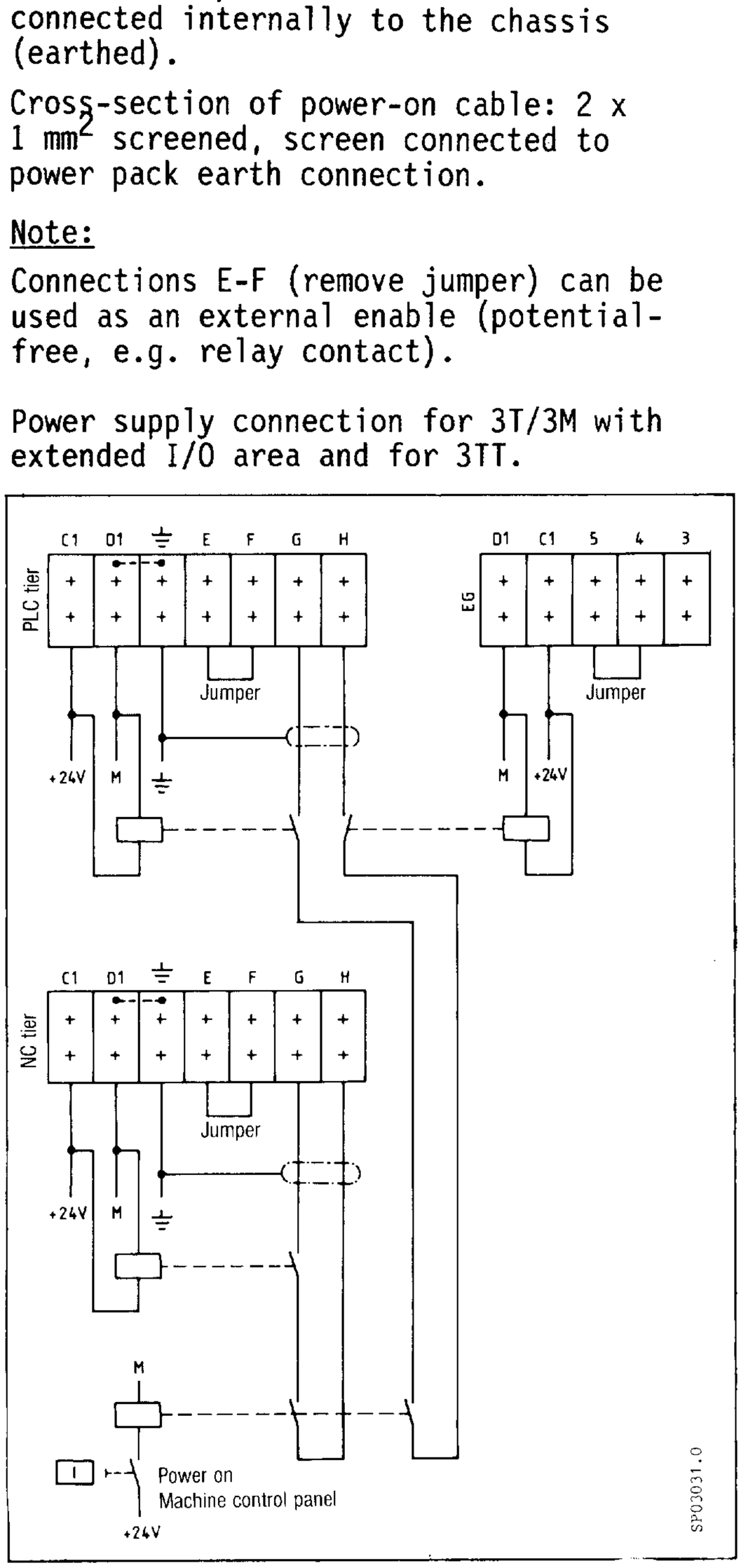
M-side NC input terminal D1 must be connected internally to the chassis (earthed).

Cross-section of power-on cable: 2 x 1 mm^2 screened, screen connected to power pack earth connection.

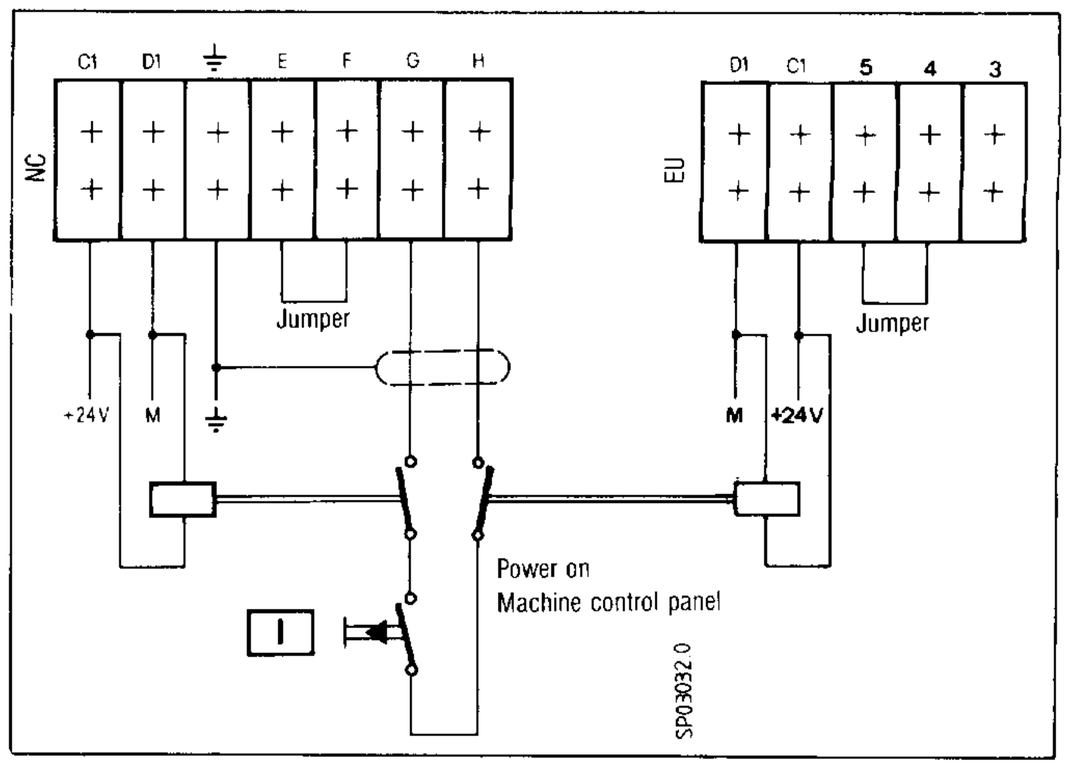
Note:

Connections E-F (remove jumper) can be used as an external enable (potential-free, e.g. relay contact).

Power supply connection for 3T/3M with extended I/O area and for 3TT.



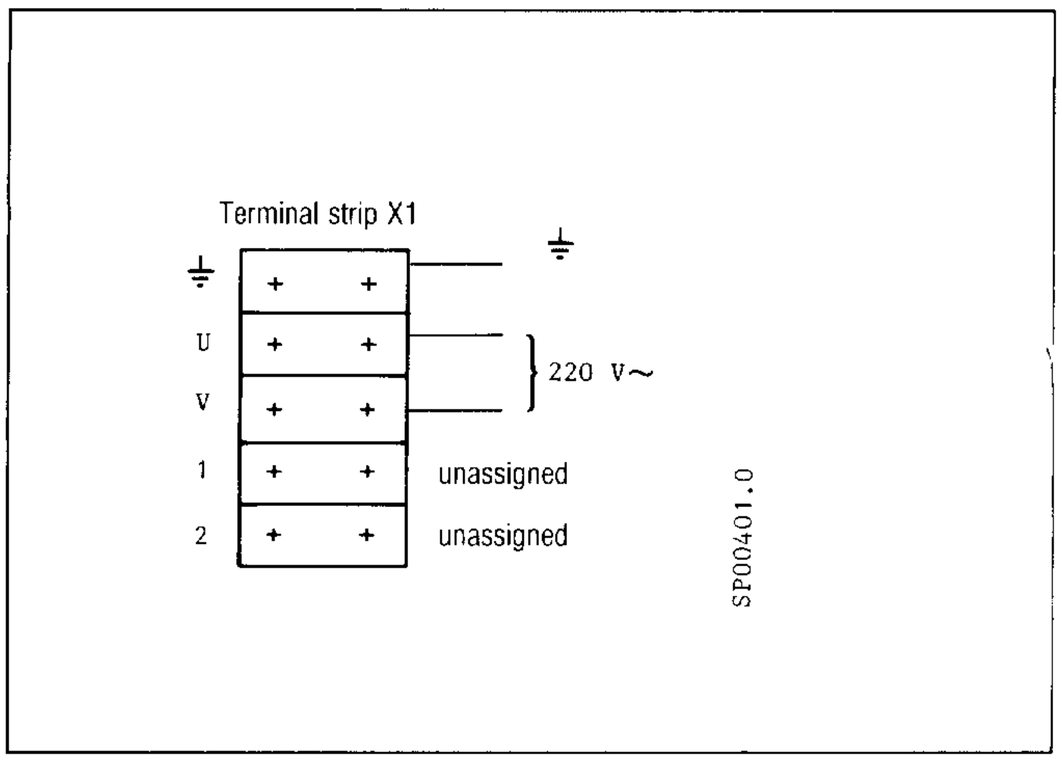
Power supply connection for 3T/3M



Power supply connection for logic component fan

Voltage:	220 V, 50/60 Hz
Connection cross-section:	1 mm^2
Power consumption:	100 W

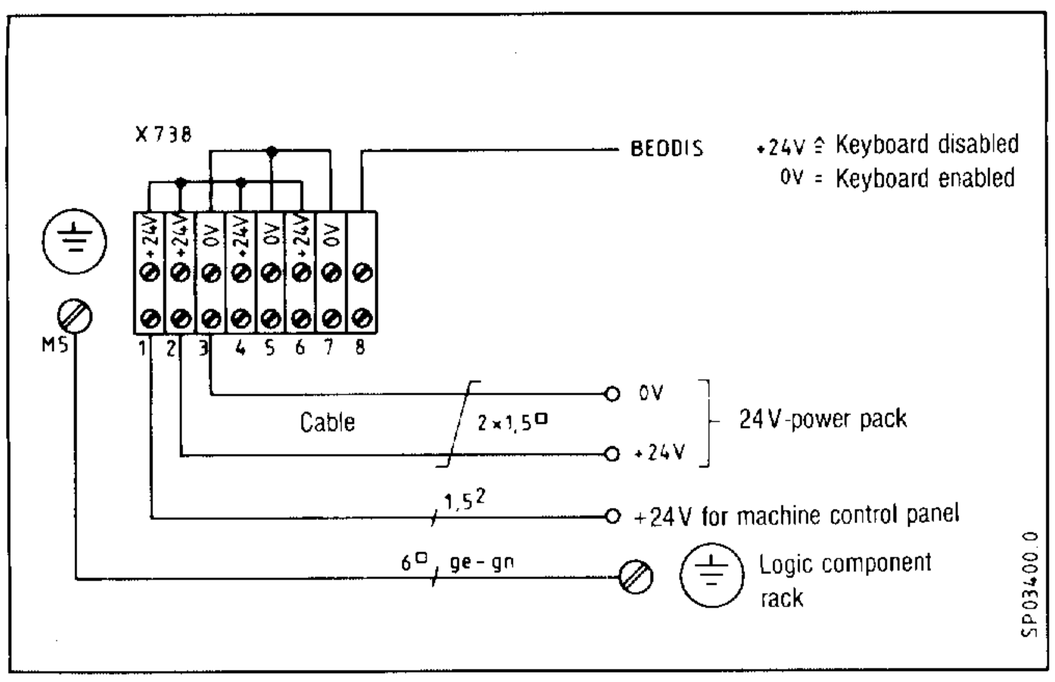
Note:
Terminal strip X2 on the right of the rack remains unused.



2.1.4.2 Power supply connection operator panel

Depending on the control version, the operator panel is connected to the logic component via various interface boards (03 371/03 780). The 24 V DC power supply is connected as follows:

Operator panel interface 03 731 (from 6/83 onwards)



Keyboard disable (BEDDIS) via terminal X738/8

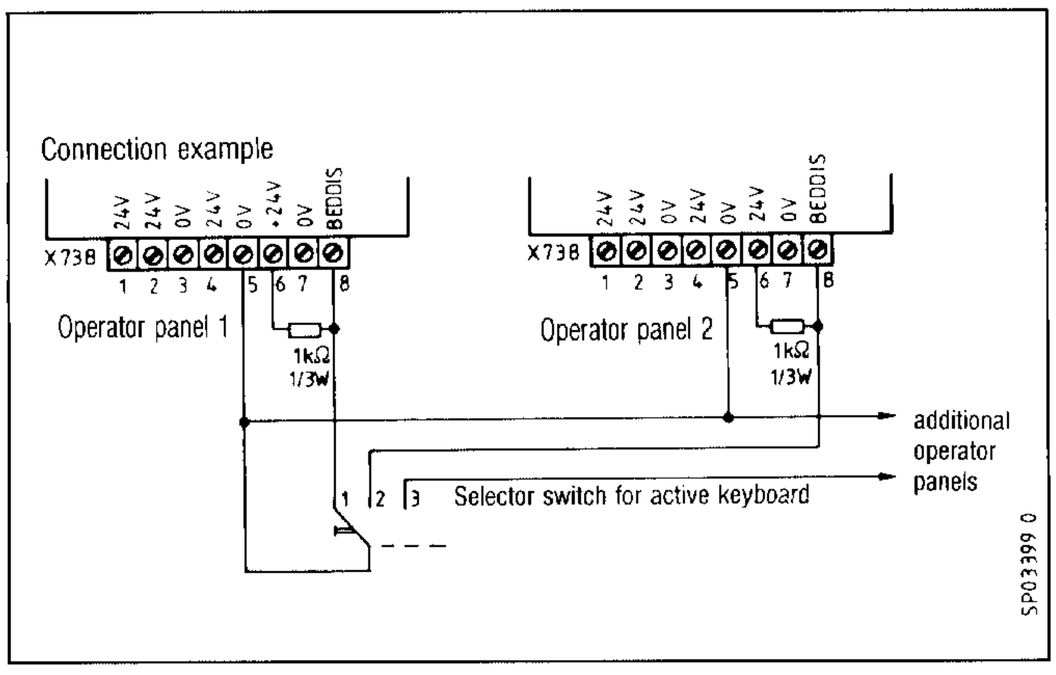
The keyboard of this operator panel is disabled by connecting a 24 V signal at this terminal. The screen remains active, however, and displays the current images of the connected NC logic module.

Connect a 0 V signal to this terminal to enable the operator panel keyboard.

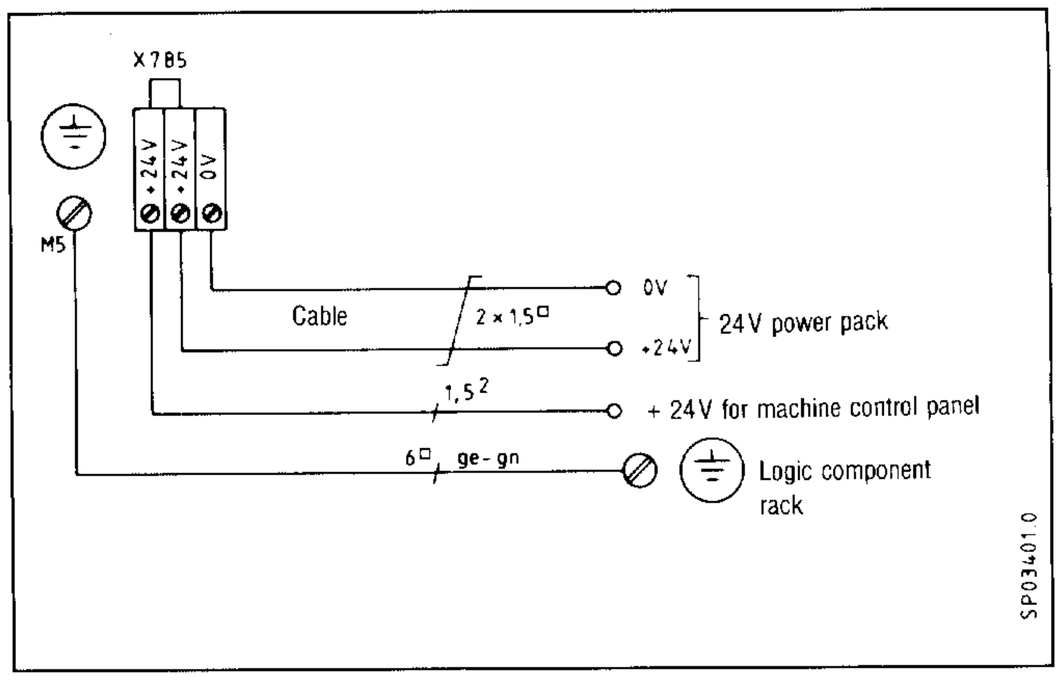
In cases where several operator panels (max. 7) are connected to a single NC, use of this signal allows one of the operator panels to be designated active (by operating a hardware selector switch) while retaining the displays in parallel on all the screens.

The keyboard is enabled without external switching since the circuit is referred to 0 V internally in the non-connected state.

Connection example



Operator panel interface 03 780 (up to 5/83)

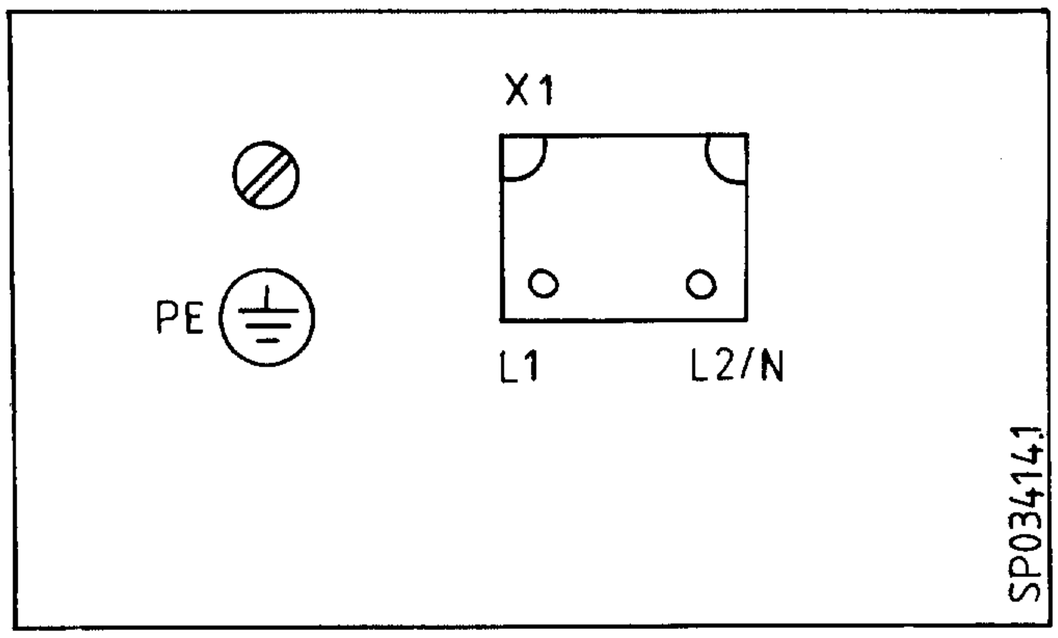


Power supply connection 9" monitor

With monochrome screens (9" green), power for the operator panel logic and the screen is taken from the 24 V DC supply.

Power supply connection 12" monitor

With the 12" screen, the operator panel logic is supplied with 24 V DC but the monitor itself requires an additional 220 V power supply. This is connected at terminals L1/L2 on the side of the monitor housing (see dimension drawing 11.3).



Colour monitor: 220 V 50/60 Hz ±10% 120 VA

Monochrome monitor (12"): 220 V +15%/-10% 50/60 Hz ±3% 70 W

2.1.4.3 Switch-on conditions for logic components

A specific switch-on sequence has to be observed when establishing links between the NC and PLC and between PLC's, each with an independent power supply.

The following rule applies:

All logic components (tiers) can be switched on simultaneously provided that the overall difference is not greater than 100 ms. If this is not possible, proceed as follows:

- switch on the expansion units (EU) first
- then switch on the logic components (tiers) without NC link modules (6FX1122-1AA01) (03831)
- finally, connect the logic component(s) with NC link module(s) (6FX1122-1AA01) (03831).

2.1.4.4 Battery buffer currents and time allowances for SINUMERIK System 3GA4

Buffer currents

The following table lists the maximum buffer currents of the modules used with System 3.

Module designation	MLFB No.	Memory capacity in K Byte	Max. buffer current in mA
Power pack	6EV3054	-	0.03
NC-CPU	6FX1111-0...	16	0.1
EPROM/RAM	6FX1120-2...	32	0.2
RAM module	6FX1126-0...	32	0.2
PLC-CPU	6ES5921-WB..	10	0.31
RAM module	6FX1123-6...	32	0.2
Memory expansion	6ES5340.....	32	1.0
Memory expansion	6ES5350.....	8	0.3

Buffer time allowances

The buffer time allowances of a SINUMERIK system depend on the buffer current values. The time allowance for one tier of a SINUMERIK rack is determined by the load exerted on the power pack by the modules listed under 1.

The capacity of a lithium battery with relatively low buffer currents is approx. 5200 mAh. The buffer time allowance per tier can be calculated according to the following formula:

$$d\ (\text{days}) = \frac{Q\ (\text{mAh})}{I\ \text{tot}\ (\text{mA}) \times 24\ (\text{h/days})}$$

d = time allowance in days
Q = battery capacity in mAh
I tot = total buffer current of modules per tier in mA

Note:

New batteries and batteries that have not been used for a long time (5 weeks) are coated with a passivation layer. This layer effectively increases the battery's internal resistance.
New batteries should therefore be subjected to a load of 30 - 50 Ohm for approx. 10 minutes before installation in the power pack, in order to wear down the passivation layer.
Batteries must not be activated after installation in the power pack as the passivation layer will be removed within a few days as a result of the power pack base load.

2.1.5 Preventive measures against magnetic interference affecting screen display

The screen image may oscillate if the monitor unit is exposed to electromagnetic fields. Generally speaking, equipment that generates magnetic fields (transformers, fans, electromagnetic switches, cables carrying alternating current) must be located at least 300 mm from the monitor unit.

2.1.6 Permissible climatic conditions and mechanical loads (Exact ambient conditions: VDE 0160 and DIN 40040)

Ambient temperature:
during operation
0°C to + 55°C
during storage and transportation
- 40°C to + 70°C

Max. permissible temperature fluctuation:
1.1 K/min

Humidity:
20 to 75 % rel. humidity, brief exposure to 95 % permitted

Concentration of aggressive gases and suspended matter:
MAK values* (maximum workplace concentration)

Mechanical loads:
brief exposure to max. 2.5 g vibration permitted

* (The MAK list is published by the Federal German Ministry of Labour and Social Affairs)

2.2 Input/output modules

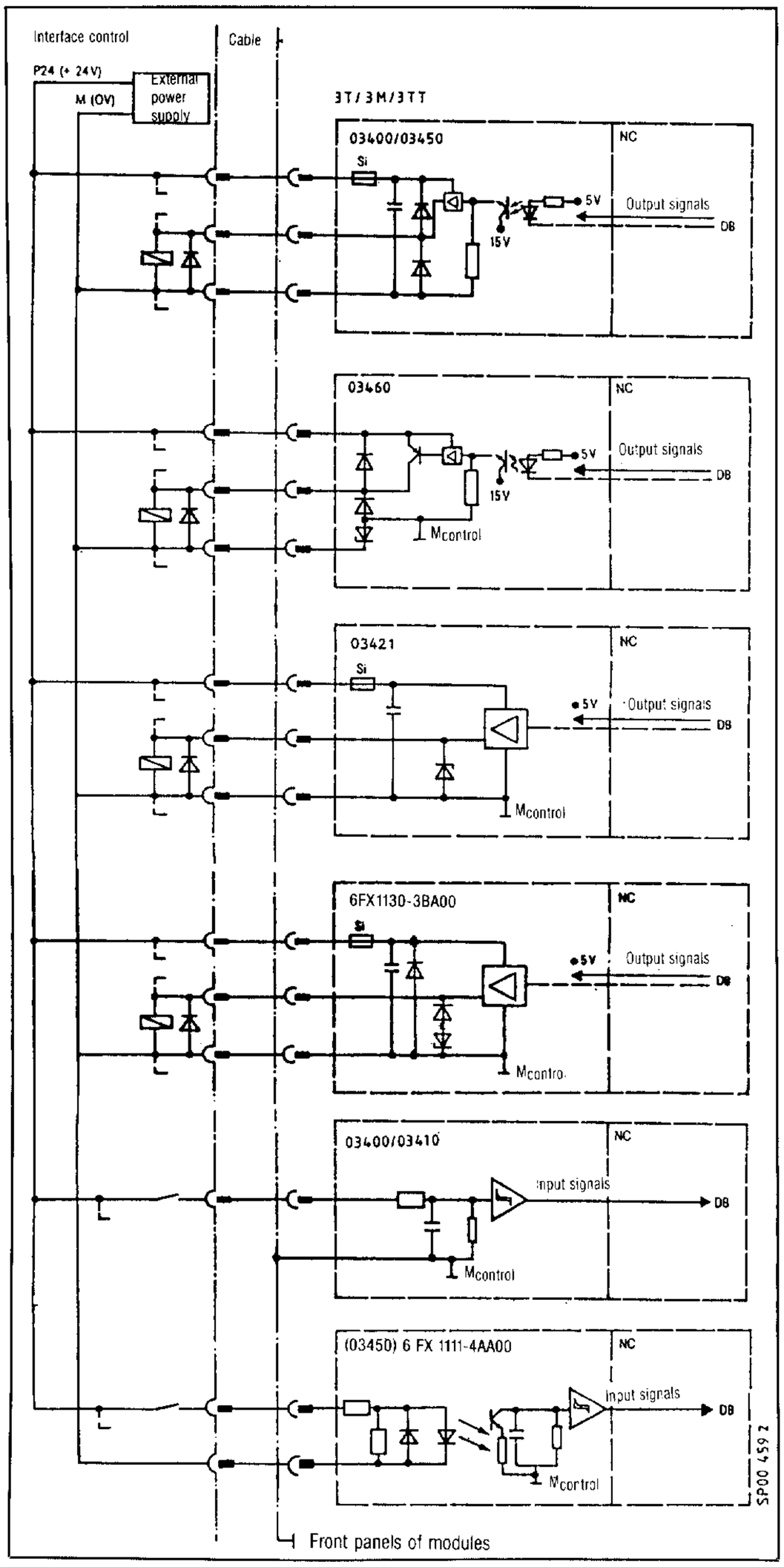
The input/output modules are specific to the SINUMERIK 3 System. They are all-purpose modules for use in the PLC or expansion units.

Separate power packs can be used for the input and output signals.

2.2.1 Overview of available SINUMERIK I/O modules

Module	Inputs	Outputs	Output current (rated value)
03400(N81)	48	24	100mA
03410(N83)	96	-	-
03421(N84)	-	48	50 mA
03450(N85)	32	32	100 mA
03460(N82)	-	16	2 A

2.2.2 Signal flow and cable connection



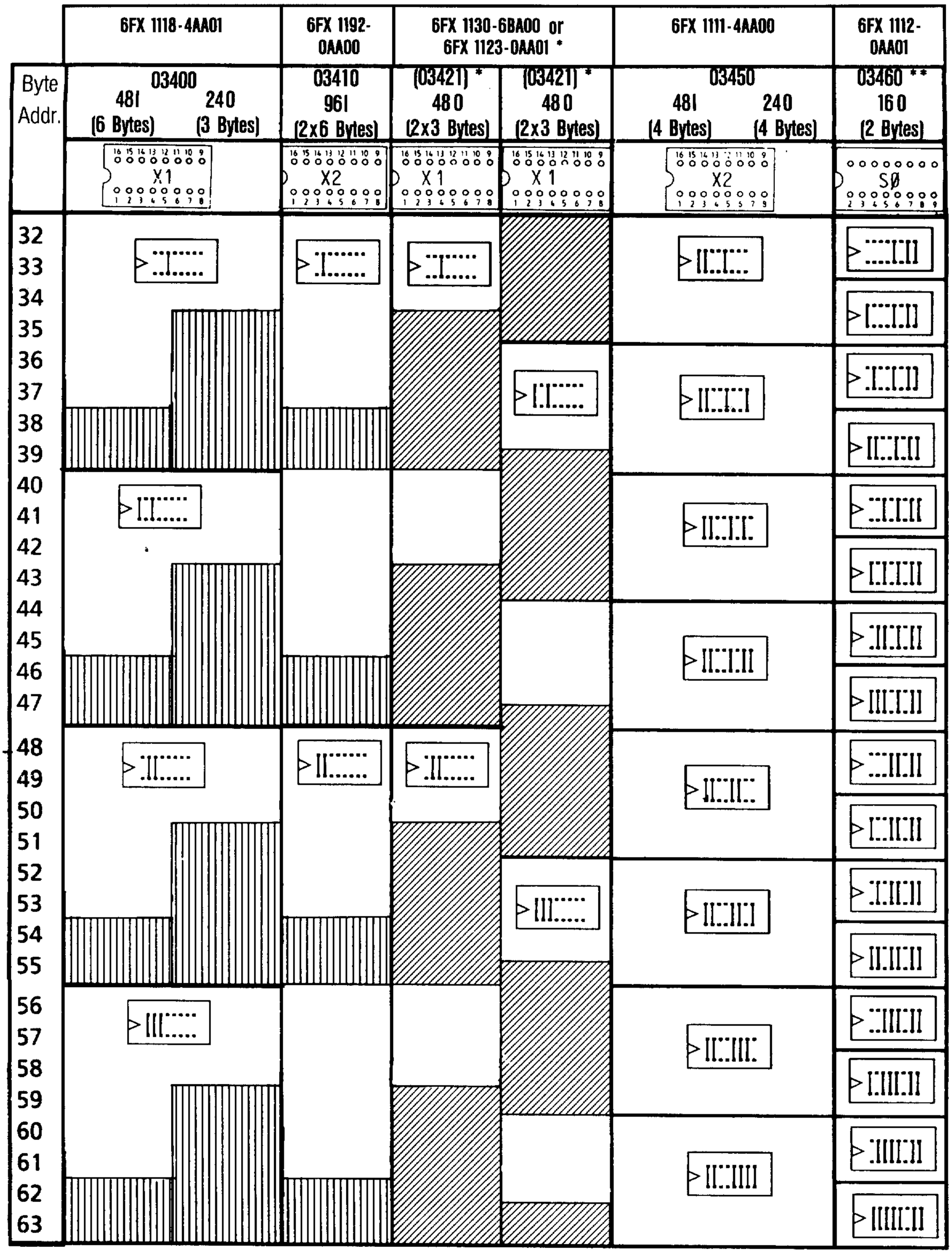
2.2.3 Addressing the I/O modules

Byte Addr.	6FX 1118-4AA01	6FX 1192-4AA00	6FX 1130-6BA00 or 6FX 1123-0AA01 *		6FX 1111-4AA00	6FX 1112-0AA01
	03400 *** 48I (6 Bytes) 24O (3 Bytes)	03410 96I (2x6 Bytes)	(03421) * 48O (2x3 Bytes)	(03421) * 48O (2x3 Bytes)	03450 48I (4 Bytes) 24O (4 Bytes)	03460 ** 16O (2 Bytes)
	X1	X2	X1	X1	X2	S0
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						

The modules can be plugged in the rack in any order.

** Jumper 8-11 deleted on modules with version AC

*** On module (03401A) socket X1 corresponds to socket S1, jumper 1-16/4, 2-15/5, 3-14/6, 4-13/7



Generally disabled addresses

Addresses may be occupied by other modules

Each module is allocated a number by means of a strap connection; this also determines the address range.

2.2.4 Electrical characteristics

	03400 /N81	03410 /N83	03421 N/84	03450 /N85	03460 /N82
No. of inputs Isolated	46 No	96 No		32 Yes	
Input voltage (rated value)	24V DC	24V DC		24V DC	
Input voltage - for "0" signal - for "1" signal	 -3V to +5V or open input +14V to +30V	 -3V to +5V or open input +14V to +30V		 -21V to +5V +15V to +30V	
Input current with "1" signal typ.	5.2 mA	5.2 mA		6.5 mA	
Delay time - for tpLH - for tpHL	 0.37...0.68 ms 0.70...1.45 ms	 0.37...0.68 ms 0.70...1.45 ms		 1.8 ms 2.2 ms	
Cable length	50 m	50 m		50 m	
No. of outputs Isolated	24 Yes		48 No	32 Yes	16 Yes
Power supply U_p - rated value - ripple U_{ss} max. - perm. range (incl. ripple)	 24V DC 3.6V 20V to 30V		 24V DC 3.6V 18V to 32V	 24V DC 3.6V 20V to 30V	 24V DC 3.6V 20V to 30V
Output current with "1" signal - rated value	 100 mA		 500 mA	 100 mA	 2 A
Short circuit protection	None		Electronic	None	Electronic
Inductive switch-off voltage limited to Switching power for lamps max.	 -0.7V --- 3)		 -0.7V 10 W	 -0.7V --- 3)	 -13V 10 W
Switching frequency with - resistive load max. - lamps max. - inductive load 1) max.	 100 Hz 11 Hz 2 Hz		 100 Hz 11 Hz 2 Hz	 100 Hz 11 Hz 2 Hz	 100 Hz 11 Hz 2 Hz
Overall load capacity 2) at 55°C	50 %		50 %	50 %	50 %
Signal level of outputs - with "0" signal max. - with "1" signal max.	 open output U_p -1.7V		 open output U_p -1.5V	 open output U_p -1.7V	 open output U_p -1.7V
Cable length max.	50 m		50 m	50 m	50 m
Insulation voltage External connections to housing - acc. to VDE 0160 - tested with	 125V DC 125V AC	 --- ---	 --- ---	 125V DC 125V AC	 125V DC 125V AC
Current consumption - internal (at 5 V) - internal (at 24 V) Space requirement (1SPS = 15.24 mm) Weight approx.	 0.6 A 0.15 A 1 2/3 SPS 0.4 kg	 0.52 A --- 1 2/3 SPS 0.4 kg	 0.25 A 0.12 A 1 2/3 SPS 0.3 kg	 0.8 A 0.12 A 1 2/3 SPS 0.4 kg	 0.5 A 0.34 A 1 2/3 SPS 0.6 kg

◤ Outputs only

1) At rated load. Higher values are permitted with lower loads.
2) Referred to the sum of the rated currents of all outputs.
3) Maximum starting current 350 mA.
With indicator lamp actuation: 12 V lamps with series resistance, or
24 V lamps with preheating

2.2.5 Connection layout of inputs/ outputs

Module 03400:

The inputs and outputs are connected separately at the pins of a 50-pole subminiature connector in each case.

Cable:
SINUMERIK standard cable 6FC9 340-2W.

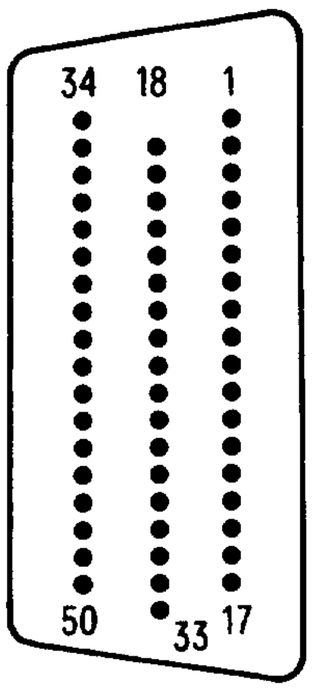
Input connector X402, IN

Byte	Connector pin Bit							
	7	6	5	4	3	2	1	0
0	8	7	6	5	4	3	2	1
1	16	15	14	13	12	11	10	9
2	25	24	23	22	21	20	19	18
3	33	32	31	30	29	28	27	26
4	41	40	39	38	37	36	35	34
5	49	48	47	46	45	44	43	42

Output connector X403, OUT

Byte	Connector pin Bit							
	7	6	5	4	3	2	1	0
0	16	15	14	13	12	11	10	9
1	25	24	23	22	21	20	19	18
2	33	32	31	30	29	28	27	26
P24 (+24V)			1	2	3			Inputs
Mext (0V)			34	35				Inputs

Connector X402, X403
IN, OUT



SP03076.0

Pin
View of module front panel

Module 03410:
---
48 inputs are connected at the pins of a 50-pole subminiature connector in each case.

Cable:
SINUMERIK standard cable 6FC9 340-2W.

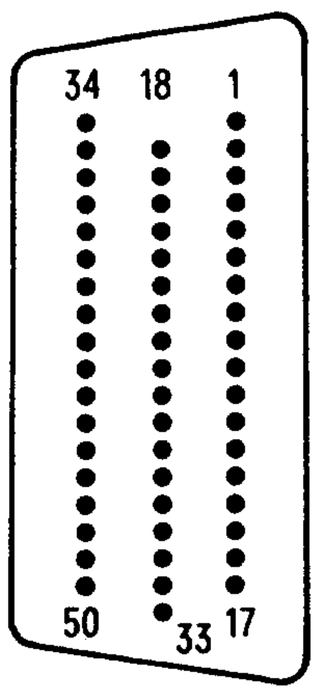
Input connector X412, IN

Byte	Connector pin Bit							
	7	6	5	4	3	2	1	0
0	8	7	6	5	4	3	2	1
1	16	15	14	13	12	11	10	9
2	25	24	23	22	21	20	19	18
3	33	32	31	30	29	28	27	26
4	41	40	39	38	37	36	35	34
5	49	48	47	46	45	44	43	42

Input connector X413, IN

Byte	Connector pin Bit							
	7	6	5	4	3	2	1	0
8	8	7	6	5	4	3	2	1
9	16	15	14	13	12	11	10	9
10	25	24	23	22	21	20	19	18
11	33	32	31	30	29	28	27	26
12	41	40	39	38	37	36	35	34
13	49	48	47	46	45	44	43	42

Connector X412, X413
IN



SP03076.0

Pin
View of module front panel

Module 03421:

24 outputs are connected at the pins of a 50-pole subminiature connector in each case.

Cable:
SINUMERIK standard cable 6FC9 340-2W.

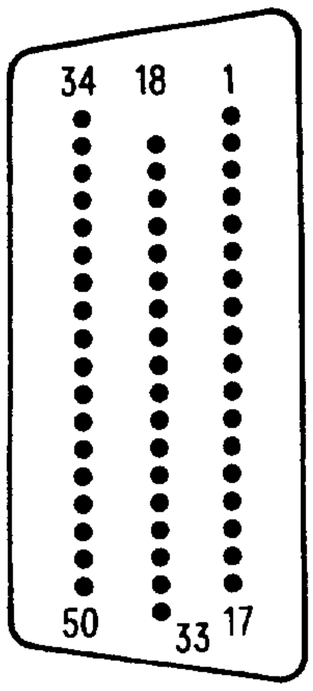
Output connector X423, OUT

Byte	Connector pin Bit							
	7	6	5	4	3	2	1	0
0	16	15	14	13	12	11	10	9
1	25	24	23	22	21	20	19	18
2	33	32	31	30	29	28	27	26

Output connector X424, OUT

Byte	Connector pin Bit							
	7	6	5	4	3	2	1	0
8	16	15	14	13	12	11	10	9
9	25	24	23	22	21	20	19	18
10	33	32	31	30	29	28	27	26

Connector X423, X424
OUT



Pin
View of module front panel

SP03076.0

Connector X422 with 03 421

Mext	(0V)	Input
P24	(+24V)	Input

Module 6FX 1130-6BA is the successor of 6FX 1123-0AA01 (03421).

Module 03450:

The inputs and outputs are connected separately at the pins of a 50-pole subminiature connector in each case.

Cable:
SINUMERIK standard cable 6FC9 340-2W.

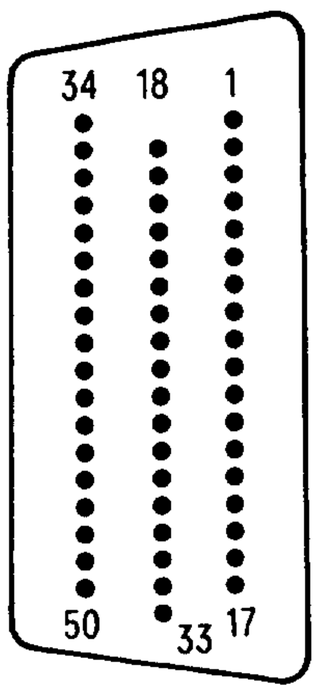
Input connector X454, IN

Byte	Connector pin Bit								MEXT (0V) on connector pin		
	7	6	5	4	3	2	1	0			
0	49	48	47	31	32	16	15	14	17	33	50
1	45	44	43	27	28	12	11	10	13	29	46
2	41	40	39	23	24	8	7	6	9	25	42
3	37	36	35	19	20	4	3	2	5	21	38

Output connector X453, OUT

Byte	Connector pin Bit								Connector pin Inputs			
	7	6	5	4	3	2	1	0	MEXT (0V)			P24 (+24V)
												1
0	49	48	47	31	32	16	15	14	17	33	50	18
1	45	44	43	27	28	12	11	10	13	29	46	34
2	41	40	39	23	24	8	7	6	9	25	42	
3	37	36	35	19	20	4	3	2	5	21	38	

Connector X454, X453
IN, OUT



Pin
View of module front panel

SP03076.0

Module 03460:

The connection is made at the pins of
a 50-pole subminiature connector.

Cable:
SINUMERIK standard cable 6FC9 340-2W.

Terminal strip X464

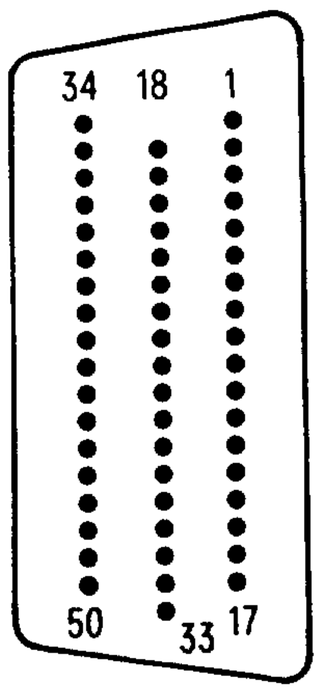
Mext	(0V)	Input
P24	(+24V)	Input

MEXT May also be connected at
connector pin (X463)
24V Connected at terminal strip X464

Output connector X463, OUT

Byte	Connector pin Bit 7		6		5		4		3		2		1		0		Connector pin Inputs MEXT (0V)
0	40	41	8	24	7	23	6	39	36	37	4	20	3	19	2	35	5 9 13 17 21 25
1	48	49	16	32	15	31	14	47	44	45	12	28	11	27	10	43	29 33 38 42 46 50

Connector X463
OUT



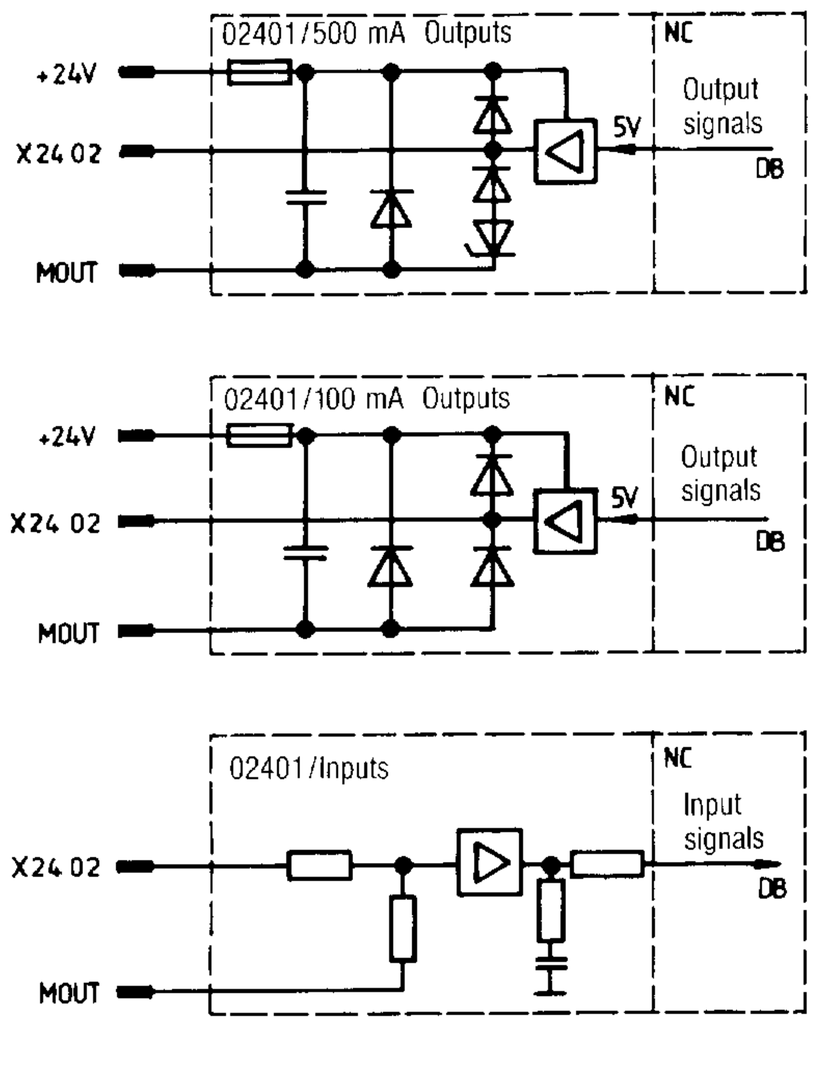
Pin
View of module front panel

2.3 Logic module

The standard machine control panel signals as well as an additional max. 96 inputs and 64 outputs can be connected with the logic module. These signals are transmitted via the operator panel bus to the NC and from there to the PLC.
A maximum of 2 logic modules can be connected to the operator panel.

When using the logic module, the max. length of the operator panel cable 6FC9 340-3W is restricted to 35 m.

2.3.1 Signal flow and cable connection for logic module



Mout/24 V supplied via X02 403 (also see 2.3.5).

2.3.2 Electrical characteristics of logic module

No. of inputs Isolated		64 No
Input voltage (rated value)		24V DC
Input voltage - for "0" signal - for "1" signal		-3V to +5V or open input +13V to +30V
Input current with "1" signal	typ.	6 mA
Delay time - for tpLH - for tpHL		 2.5...4.3 ms 2.5...4.3 ms
Cable length		50 m
No. of outputs Isolated		32 (8 + 24) No
Power supply U_p - rated value - ripple U_{ss} - perm. range (incl. ripple)	 max. 	 24V DC 3.6V 20V to 30V
Output current with "1" signal - rated value		 100 mA/0.5 A
Short circuit protection with 100 mA output with 0.5 A output		None Electronic
Inductive switch-off voltage limited to Switching power for lamps with 100 mA with 0.5 A	 max. max.	 - 11 V --- 3) 14 W
Switching frequency with - resistive load - lamps - inductive load 1)	 max. max. max.	 500 Hz 500 Hz 10 Hz
Overall load capacity 2) at 55°C		50 %
Signal level of outputs - with "0" signal - with "1" signal with 0.5 A output with 100 mA output	 max. max. max.	 open output U_p -1.1V U_p -1.7V
Cable length	max.	50 m
Insulation voltage External connections to housing - acc. to VDE 0160 - tested with		 --- ---
Current consumption - internal (at 5 V) - internal (at 24 V) Space requirement (1SPS = 15.24 mm) Weight	 approx.	 0.1 A 0.05 A 391x127x15 mm 0.4 kg

Outputs only

1) At rated load. Higher values are permitted with lower loads.
2) Referred to the sum of the rated currents of all outputs.
3) Maximum starting current 350 mA.
With indicator lamp actuation: 12 V lamps with series resistance, or
24 V lamps with preheating

1) 0.5 A output
2) 100 mA output

Example:

Output A 48.0 = Pin no. 3 of X02402
Input A 48.0 = Pin no. 3 of X02402

Terminal strip X02403

MOUT (0 V)	Input
+24 V	Input

Connector X02 404/X02 405

Pin 1 :	24 V
Pin 2 :	0 V

Input connector X02 406 is not required.

2.3.3 Connection layout of logic module

Module 02401

The connection is made for inputs at 2 connectors and for outputs at 1 connector.

Cable: see block diagram

2.3.4 Addressing

Module 02400:	6FX1124-6 AA00
---	6FX1124-6 AB00

Logic module 1	Logic module 2
Rotary switch 1: 2	Rotary switch 1: 0
Rotary switch 2: 1	Rotary switch 2: 0

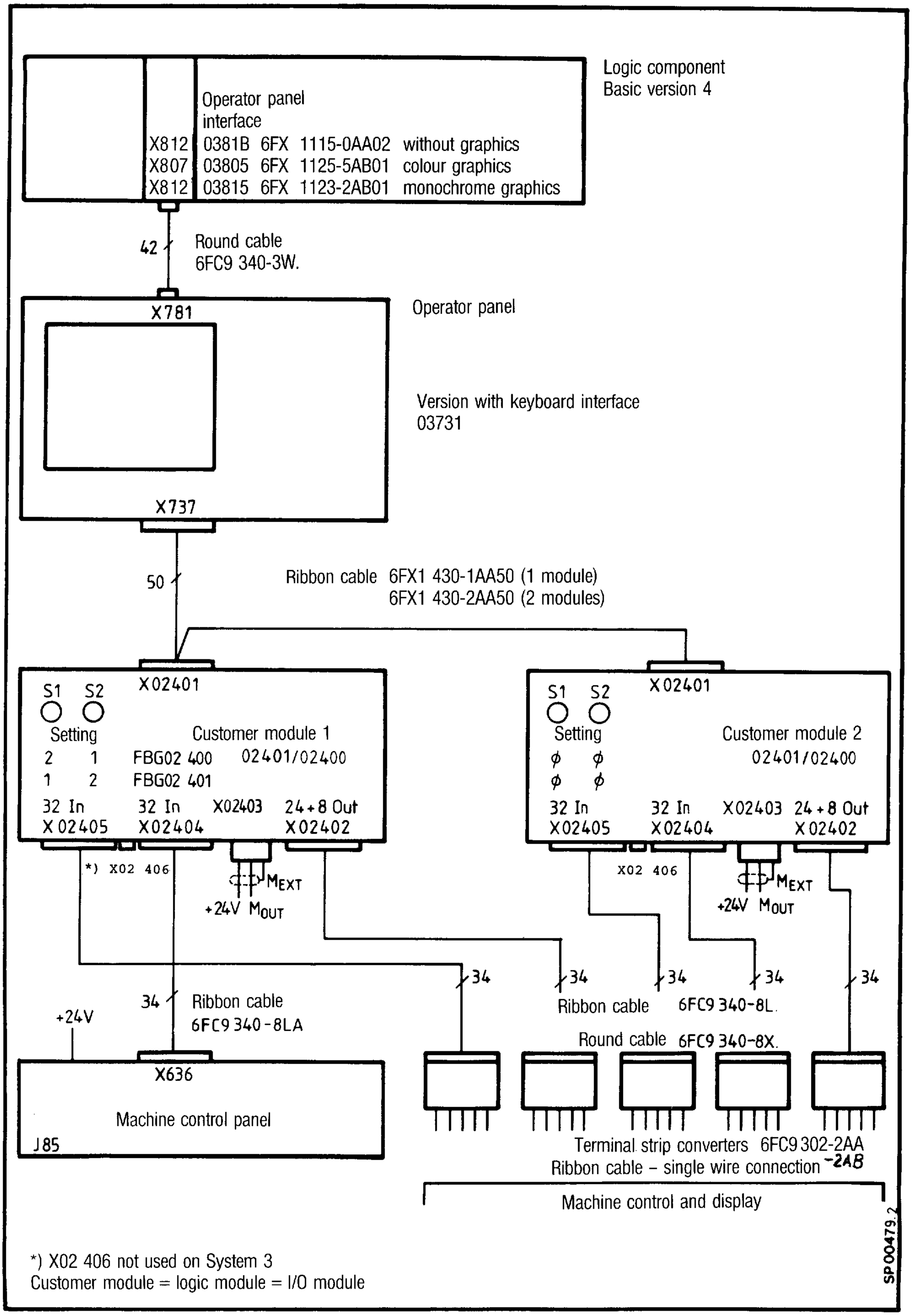
Module 02401:	6FX1124-6 AA01
---	6FX1124-6 AB01

Rotary switch 1: 1	Rotary switch 1: 0
Rotary switch 2: 2	Rotary switch 2: 0

Rotary switch 2 is not provided on logic module 6FX1124-6 AB01 (inputs only).

Input/output connector						Connector pin							
Logic module 1			Logic module 2			Bit no.							
X 02402	X 02404	X 02405	X 02402	X 02404	X 02405	7	6	5	4	3	2	1	0
Q 48 1)	I 48	I 52	Q 52 1)	I 56	I 60	10	9	8	7	6	5	4	3
Q 49 1)	I 49	I 53	Q 53 1)	I 57	I 61	18	17	16	15	14	13	12	11
Q 50 1)	I 50	I 54	Q 54 1)	I 58	I 62	26	25	24	23	22	21	20	19
Q 51 2)	I 51	I 55	Q 55 2)	I 59	I 63	34	33	32	31	30	29	28	27

2.3.5 Linking the logic module, schematic



3. Fixed blocks and variables in the PLC

3.1 Fixed blocks and variables, overview

a) Flags
Flag bytes 1 to 88 reserved for PLC/NC interface.
(If only NC1 is provided, the flag area for NC2 to NC4 may be used.)
Flag bytes 160 to 255 reserved for function blocks.

b) Inputs/outputs
Input/output bytes 64 to 127 reserved for interface.

Byte 64 - 73: NC1
Byte 74 - 83: NC2
Byte 84 - 93: NC3
Byte 94 - 103: NC4
Byte 104 - 127: PLCI/PLCII (Dual PLC)

c) Data blocks

DB 0 Address list
DB 1 to 149 occupied for standard function blocks
DB 5 For package 5 (date/time)
DB 8 Customer operator panel (5-bit gray-coded switch)
DB 9 PLC machine data
DB 10 Variables for function blocks
DB 11 Link area for function blocks
DB 12 I buffer for DNC
DB 13 Q buffer for DNC
DB 14 Status words for display programs
DB 15 Screen picture
DB 16 DB:P for ZO data NC to PLC (FB61)
DB 17 Intermediate memory, ZO data
DB 18 DB:P for ZO data NC to PLC (FB62) and parameters FB61, 63
DB 19 Status words for computer link
DB 20 Link area for NC1
DB 21 Data NC/PLC for NC1
DB 22 Link area for NC2
DB 23 Data NC/PLC for NC2
DB 24 Link area for NC3
DB 25 Data NC/PLC for NC3
DB 26 Link area for NC4
DB 27 Data NC/PLC for NC4
DB 29 Erase mask for blocks
DB 30 Basic texts for user program
DB 31 Texts for basic program
DB 32 Texts for package 1
DB 33 Texts for package 2
DB 34 Texts for package 3
DB 35 Texts for package 5
DB 36 Parameterization error texts for package 6 (display with FB4)
DB 37 Parameterization error texts for package 7 (display with FB4)
DB 38 Display status for colour monitor or Dual PLC
DB 39 Menu
DB 40 Assignments, operator messages
DB 41- 43 Assignments, operator message explanations
DB 44 Assignments, error messages
DB 45- 47 Assignments, error message explanations
DB 48 Format address list
DB 49 Assignment address list
DB 50 Texts, error location
DB 51 Texts, type 1
DB 52 Texts, type 2
DB 54 Texts for FB138 (diagnosis GRAPH-5 sequence chains)
DB 55 Content of DB5 filed on EPROM
DB 60- 69 Formats, assignments
DB 70- 89 Assignment magazine 1 or for ELG package 6
DB 90-109 Assignment magazine 2
DB 110-129 Assignment magazine 3
DB 130-149 Assignment magazine 4

d) Counters
Counter 0 for code conversion.

e) Timers
Timer 0 for PLC auxiliary signals.

f) Function blocks
FB0 to FB199 are reserved for standard FBs.

3.2 Flag assignment

Flag byte			
	0	FB parameterization (3.2.1)	For NC1 See following description for assignment
	1 – 3	Machine control panel signals (4.4.3)	
	4 – 6	Transfer flags for data transfer to NC (4.4.6)	
	7 – 9	Transfer flags for data transfer to PLC (4.4.5)	
	10 – 22	Signals, M decoding (3.2.2)	
	23 – 44		For NC2 (same as for NC1)
	45 – 66		For NC3 (same as for NC1)
	67 – 88		For NC4 (same as for NC1)
	89 – 159	Free for user	
	160 – 191	Error messages (3.2.3)	
	192 – 223	Operator messages (3.2.4)	
	224 – 227	Time/process alarms (3.2.5/3.2.6)	
	228 – 229	PLC signals (3.2.7)	
	230 – 237	Register for indexed commands (DOFW) (3.2.8)	
	238 – 239	PLC auxiliary signals (3.2.9)	
	240 – 255	Auxiliary flags for intermediate results (3.2.10)	

3.2.1 FB parameterization

Flag byte 0

7	6	5	4	3	2	1	0	Bit
				FB38	B-SP	PC-T	E-SP	

SP03415.1

E-SP Input disable for the STATUS program
This signal disables the writing of variables (I, Q, F, DW).

PC-T PLC key
If the "PLC key" machine datum is set, another key or PLC input can be used instead of the PLC key to select the PLC menu image. The user simply has to link the input to flag F0.1 (e.g. AI53.0, = F.01).

B-SP Operator panel disable for all NCs
This signal is set by logic module block FB8 from version C-2 onwards (if provided) if the operator panel disable applies to all NCs.

FB38 Function block FB38 available
Function block FB38 (user block) can be used in conjunction with logic modules to save signals in an additional buffer. "1" signal indicates to FB8 that FB38 is available (package 0 description: FB8).

Siemens AG Order-No.: E80850-D27-X-A1-7600

3.2.2 Output signals, M decoding

Byte Addr.				Bit Addr.							
NC1	NC2	NC3	NC4	0	1	2	3	4	5	6	7
M 10	32	54	76	M00	M01	M02	M03	M04	M05	M06	M07
11	33	55	77	M08	M09	M10	M11	M12	M13	M14	M15
12	34	56	78	M16	M17	M18	M19	M20	M21	M22	M23
13	35	57	79	M24	M25	M26	M27	M28	M29	M30	M31
14	36	58	80	M32	M33	M34	M35	M36	M37	M38	M39
15	37	59	81	M40	M41	M42	M43	M44	M45	M46	M47
16	38	60	82	M48	M49	M50	M51	M52	M53	M54	M55
17	39	61	83	M56	M57	M58	M59	M60	M61	M62	M63
18	40	62	84	M64	M65	M66	M67	M68	M69	M70	M71
19	41	63	85	M72	M73	M74	M75	M76	M77	M78	M79
20	42	64	86	M80	M81	M82	M83	M84	M85	M86	M87
21	43	65	87	M88	M89	M90	M91	M92	M93	M94	M95
22	44	66	88	M96	M97	M98	M99	res.	res.	res.	res.

SP00832.0

3.2.3 Assignment of flags for error messages

Byte Addr. \ Byte Addr.	0	1	2	3	4	5	6	7
M 160	F 0	F 1	F 2	F 3	F 4	F 5	F 6	F 7
161	F 8	F 9	F 10	F 11	F 12	F 13	F 14	F 15
162	F 16	F 17	F 18	F 19	F 20	F 21	F 22	F 23
163	F 24	F 25	F 26	F 27	F 28	F 29	F 30	F 31
164	F 32	F 33	F 34	F 35	F 36	F 37	F 38	F 39
165	F 40	F 41	F 42	F 43	F 44	F 45	F 46	F 47
166	F 48	F 49	F 50	F 51	F 52	F 53	F 54	F 55
167	F 56	F 57	F 58	F 59	F 60	F 61	F 62	F 63
168	F 64	F 65	F 66	F 67	F 68	F 69	F 70	F 71
169	F 72	F 73	F 74	F 75	F 76	F 77	F 78	F 79
170	F 80	F 81	F 82	F 83	F 84	F 85	F 86	F 87
171	F 88	F 89	F 90	F 91	F 92	F 93	F 94	F 95
172	F 96	F 97	F 98	F 99	F100	F101	F102	F103
173	F104	F105	F106	F107	F108	F109	F110	F111
174	F112	F113	F114	F115	F116	F117	F118	F119
175	F120	F121	F122	F123	F124	F125	F126	F127
176	F128	F129	F130	F131	F132	F133	F134	F135
177	F136	F137	F138	F139	F140	F141	F142	F143
178	F144	F145	F146	F147	F148	F149	F150	F151
179	F152	F153	F154	F155	F156	F157	F158	F159
180	F160	F161	F162	F163	F164	F165	F166	F167
181	F168	F169	F170	F171	F172	F173	F174	F175
182	F176	F177	F178	F179	F180	F181	F182	F183
183	F184	F185	F186	F187	F188	F189	F190	F191
184	F192	F193	F194	F195	F196	F197	F198	F199
185	F200	F201	F202	F203	F204	F205	F206	F207
186	F208	F209	F210	F211	F212	F213	F214	F215
187	F216	F217	F218	F219	F220	F221	F222	F223
188	F224	F225	F226	F227	F228	F229	F230	F231
189	F232	F233	F234	F235	F236	F237	F238	F239
190	F240	F241	F242	F243	F244	F245	F246	F247
191	F248	F249	F250	F251	F252	F253	F254	F255

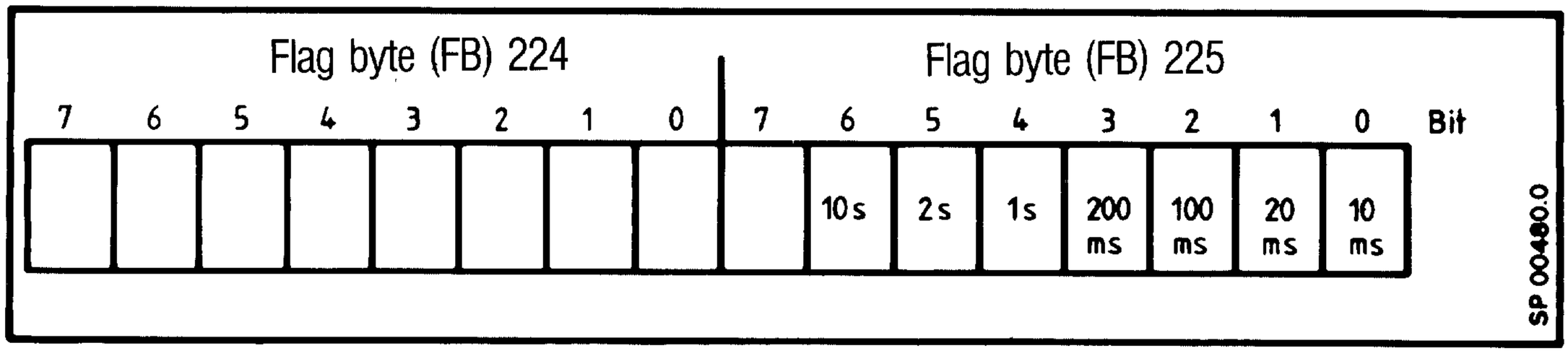
SP00833.0

3.2.4 Assignment of flags for operator messages

Byte Addr. \ Byte Addr.	0	1	2	3	4	5	6	7
M 192	B 0	B 1	B 2	B 3	B 4	B 5	B 6	B 7
193	B 8	B 9	B 10	B 11	B 12	B 13	B 14	B 15
194	B 16	B 17	B 18	B 19	B 20	B 21	B 22	B 23
195	B 24	B 25	B 26	B 27	B 28	B 29	B 30	B 31
196	B 32	B 33	B 34	B 35	B 36	B 37	B 38	B 39
197	B 40	B 41	B 42	B 43	B 44	B 45	B 46	B 47
198	B 48	B 49	B 50	B 51	B 52	B 53	B 54	B 55
199	B 56	B 57	B 58	B 59	B 60	B 61	B 62	B 63
200	B 64	B 65	B 66	B 67	B 68	B 69	B 70	B 71
201	B 72	B 73	B 74	B 75	B 76	B 77	B 78	B 79
202	B 80	B 81	B 82	B 83	B 84	B 85	B 86	B 87
203	B 88	B 89	B 90	B 91	B 92	B 93	B 94	B 95
204	B 96	B 97	B 98	B 99	B100	B101	B102	B103
205	B104	B105	B106	B107	B108	B109	B110	B111
206	B112	B113	B114	B115	B116	B117	B118	B119
207	B120	B121	B122	B123	B124	B125	B126	B127
208	B128	B129	B130	B131	B132	B133	B134	B135
209	B136	B137	B138	B139	B140	B141	B142	B143
210	B144	B145	B146	B147	B148	B149	B150	B151
211	B152	B153	B154	B155	B156	B157	B158	B159
212	B160	B161	B162	B163	B164	B165	B166	B167
213	B168	B169	B170	B171	B172	B173	B174	B175
214	B176	B177	B178	B179	B180	B181	B182	B183
215	B184	B185	B186	B187	B188	B189	B190	B191
216	B192	B193	B194	B195	B196	B197	B198	B199
217	B200	B201	B202	B203	B204	B205	B206	B207
218	B208	B209	B210	B211	B212	B213	B214	B215
219	B216	B217	B218	B219	B220	B221	B222	B223
220	B224	B225	B226	B227	B228	B229	B230	B231
221	B232	B233	B234	B235	B236	B237	B238	B239
222	B240	B241	B242	B243	B244	B245	B246	B247
223	B248	B249	B250	B251	B252	B253	B254	B255

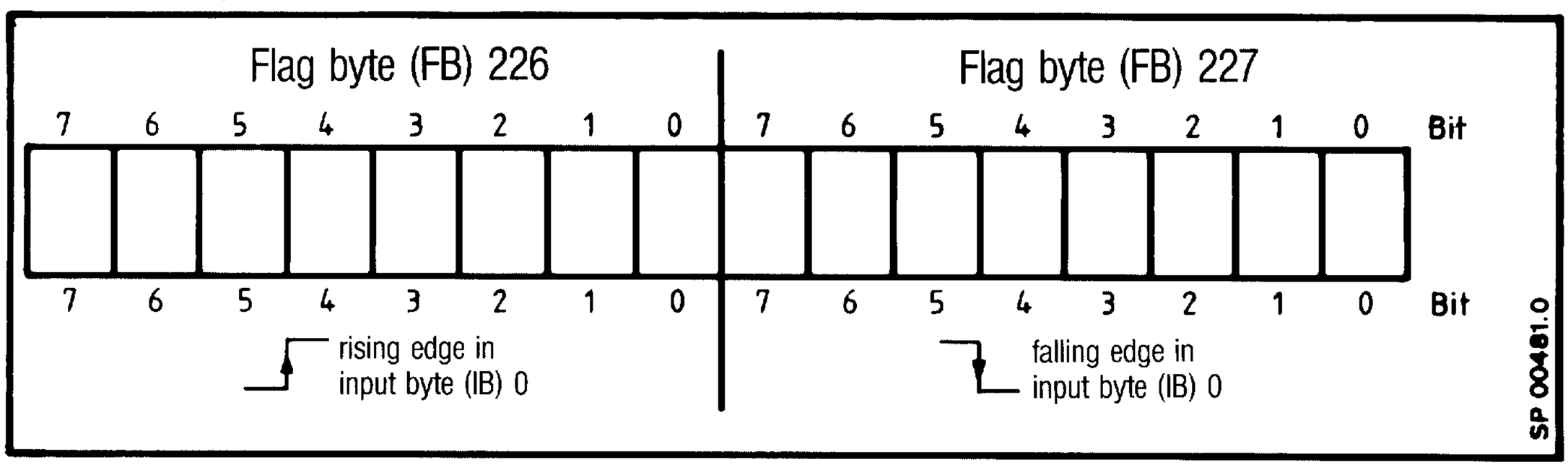
SP00834.0

3.2.5 Time alarms

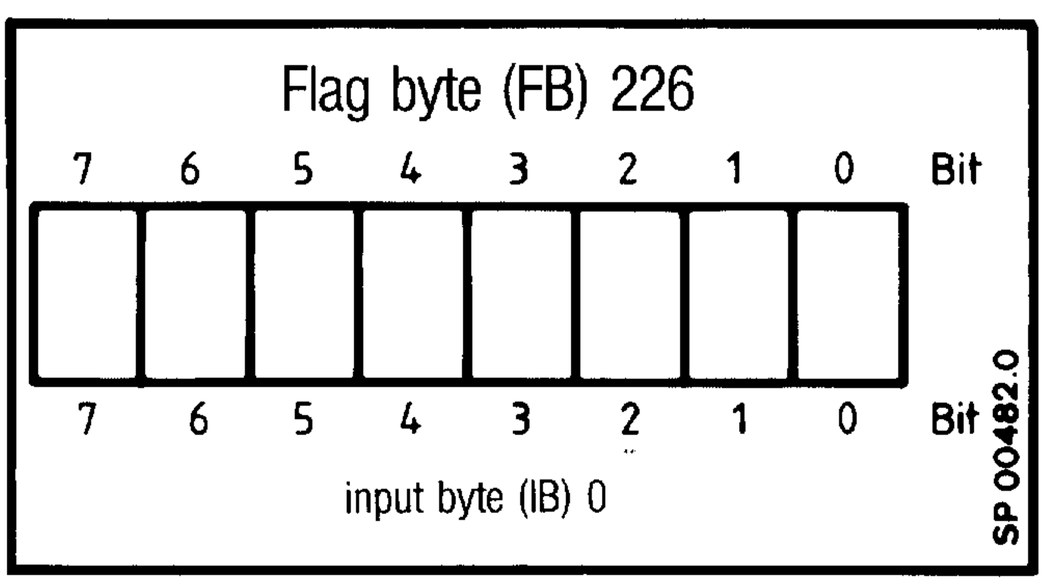


3.2.6 Process alarms

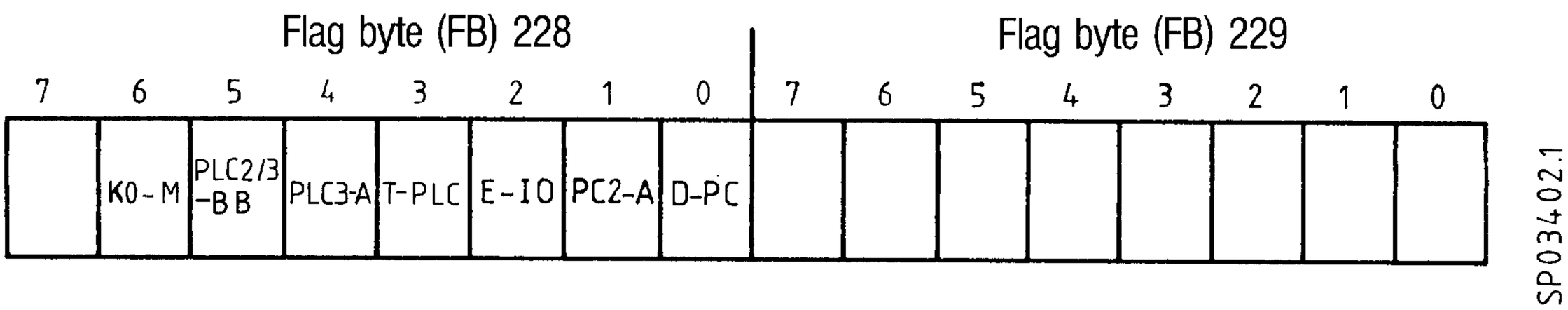
- Normal input module



- Group signal module
  6ES5 432 (N90)



3.2.7 PLC signals



DP-C Dual PLC available
"1" signal indicates a Dual PLC system, "0" signal indicates a Single PLC system. The user can differentiate between Single and Dual PLCs in his blocks by means of this signal.

PC2-A PLC2 active
On Dual PLCs, the user can differentiate between PLC1 and PLC2 by means of this signal.

"1" signal: PLC2 active
"0" signal: PLC1 active

E=IO Input is OK
The flag is set before calling FB17 (DEA:PRUF). If the input is not OK, the user has to reset the flag.

T-PLC Triple PLC available (from PLC1/PLC2 basic program version 03 onwards)
"1" signal indicates a Triple PLC system. The user can differentiate between Single, Dual and Triple PLCs in his blocks by means of this signal.

PLC3-A PLC3 active (from PLC1/PLC2 basic program version 03 onwards)
On Triple PLCs, the user can differentiate between PLC1, PLC2 and PLC3 by means of this signal.
"1" signal: PLC3 active

PLC2/
3-BB PLC2 or PLC3 ready (Triple PLC only)

"1" signal in PLC2: PLC3 ready

"1" signal in PLC3: PLC2 ready

KO-M Coordination flag for computer link

3.2.8 Register for indexed commands (DOFW)

Our standard function blocks use flag bytes FB230 to FB237 for the indexed command DOFW. This also applies to the user blocks.

3.2.9 PLC auxiliary signals

Output signals: Signal name:

M238	0	GST-T	GST-T	:	Reset state for time controlled program
	1	GST	GST	:	Reset state for program with cyclic processing
	2	FMA	FMA	:	Interrogate fault messages
	3	FMQ	FMQ	:	Acknowledge fault messages
	4	NST-T	NST-T	:	Restart for time controlled program
	5	NST	NST	:	Restart for program with cyclic processing
	6	BMA	BMA	:	Interrogate operator messages
	7	BMN	BMN	:	New output of operator messages
M239	0	ALPR	ALPR	:	Alarm controlled program called (process alarms)
	1	ZTPR	ZTPR	:	Time controlled program called (time alarms)
	2	DIN	DIN	:	New output of dialog information
	3				
	4	TB (0,5 s)	TB	:	Flash frequency 0.5 s
	5				
	6	Null			
	7	Eins			

SP03416.0

GST-T Reset state for time controlled program
This signal is used to set time controlled program sections to a defined reset state. Setting and resetting take place when the control starts up in OB20, OB21 and OB22. The user has to reset this signal (where used) in his program (in FB1 branch).

GST Reset state for program with cyclic processing
This signal is used to set cyclically processed program sections to a defined reset state. Setting and resetting take place when the control starts up in OB20, OB21 and OB22 as soon as the cycle (OB1) has been fully executed once.

FMA Interrogate error messages
This signal is generated in FB72 if the error message texts are displayed and the PAGE (forward paging) signal is given by the NC. If error messages are on the screen at this point, only the buffer memory is erased, so that additional error messages can be entered and displayed. If there is no error message on the screen, the FMA signal is output for one cycle and a re-interrogation of all the error messages is executed.

FMQ Acknowledge error messages
A "1" signal at the input of FB72 generates a pulse for one cycle period. If the error messages are displayed at the same time, the screen is cleared.

NST-T Restart for time controlled program
With this signal, data stored for retention (e.g. in data blocks) can be systematically reset after a restart. The NST-T signal is set by the basic program. The user has to reset this signal if it is used (in FB1 branch).

NST Restart for program with cyclic processing
With this signal, data stored for retention (e.g. in data blocks) can be systematically reset after a restart. The NST signal is deleted when a cycle has been fully executed.

BMA Interrogate operator messages
The BMA signal acts on the operator messages in the same ways as the FMA signal does on error messages.

BMN New output of operator messages
This signal is set when an operator message disappears, whereby any other relevant operator message is output. The screen is cleared if operator message texts are displayed.

ALPR Alarm controlled program called
The flag is set in OB2 before FB0 is called, and reset after returning from FB0. This bit can be used, for example, to suppress alarm enables during alarm processing. This is necessary in all cases where function blocks are called both cyclically and by alarm control.

ZTPR Time controlled program called
The flag is set in PB10 before FB1 is called and reset after returning from FB1.

DIN New output of dialog information
The entered block must set the DIN signal for one cycle on output of a message, so that input in the buffer memory and deletion of the entry are properly executed.

TB Flash frequency 0.5 Hz
Timer T0 is used to generate a time-slot pattern in the basic program from which the flash frequency is derived. The pulse/pause ratio is 1:1.

NULL Flags with defined "0" signal

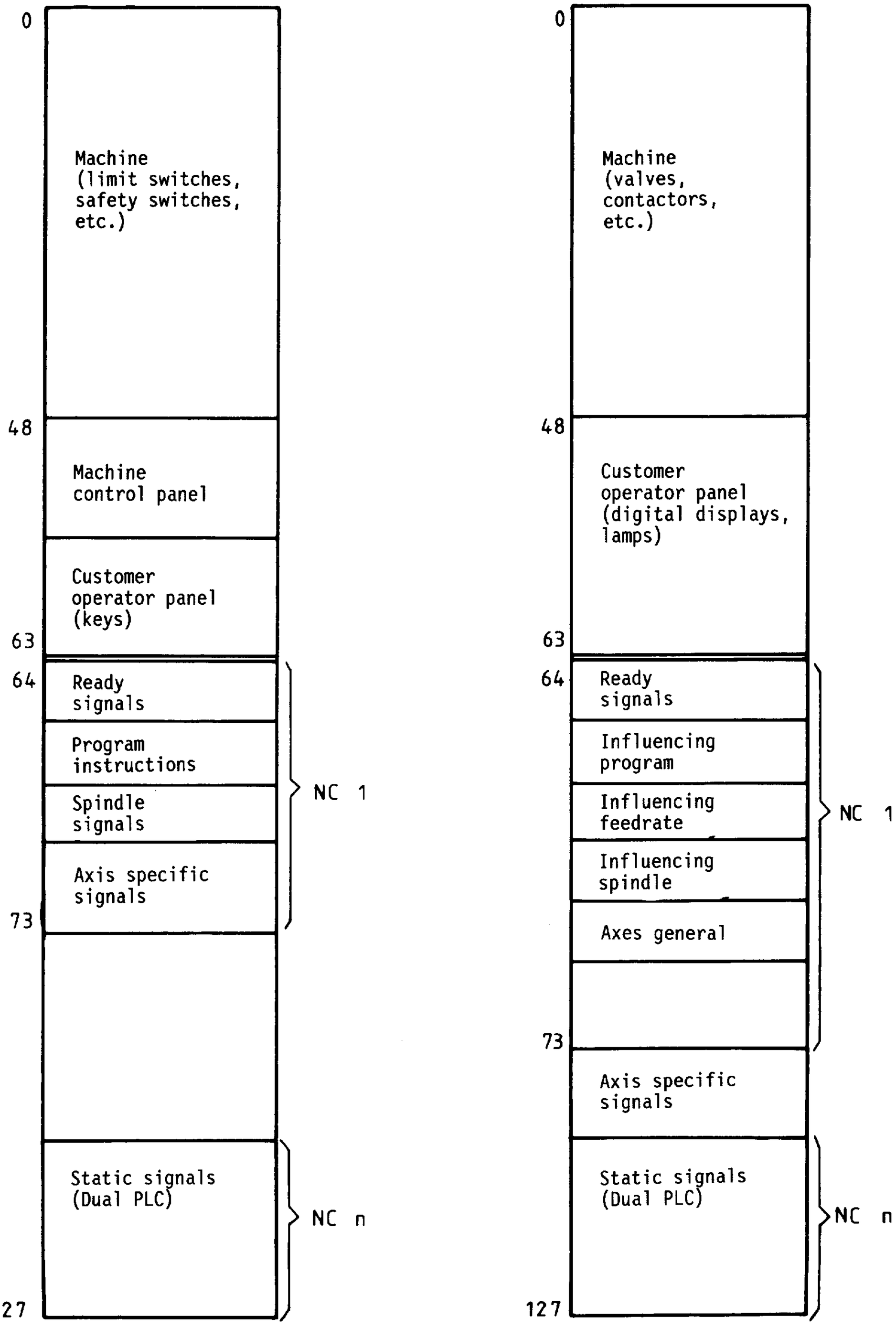
EINS Flags with defined "1" signal
These flags are used for switching FB parameters that are not required but have to assume a certain signal state, or for generating a defined logic operation result.

3.2.10 Auxiliary flags for intermediate results

Our standard function blocks use flag bytes FB240 to FB255 for storing the auxiliary signals generated in the function block. A loading routine at the start of the block loads the status words in the flag words and a save routine at the end of the block writes the flag words in the status words (data word in data block). In this way, these flag words can be used as often as required. The user can also utilize this facility in his blocks to save free flags.

3.3 Assignment of inputs/outputs

Assignment of the PLC input and output images.



3.4 Assignment of data blocks DBm

DW	DL DR	
0	Reserved for DODWO	
1 — 14		M, S, T, H auxiliary functions Section 4.4.4
15 — 63		Data transfer from NC to PLC Section 4.4.5
64 — 79	Reserved	
80 — 126		Data transfer from PLC to NC Section 4.4.6
127 — 144	Reserved	
145 — 167		Status words for FB
168 — 174	Reserved	

m = DB21 with NC1
DB23 with NC2
DB25 with NC3
DB27 with NC4

4. Description of NC/PLC interface

4.1 Reset signals

4.1.1 Meaning of reset signals

The abbreviations used in the signal tables for the reset functions have the following meanings:

PORESET
Mains reset (Power On Reset)

RESET
General reset: reset all unbuffered control units and memories except block number memory, actual value memory and machine data memory.

Occurs with:

- PORESET
- End of program
- Pressing "reset" key
- Moving operating mode switch
  MDI / MDA
  AUT / REF

CLPROAC
Reset PROGRAM ACTIVE signal and internal generation of feed hold with automatic operating mode AUT or MDA (CLear PROgram ACtive).

Occurs with:

- RESET
- Block executed and auxiliary functions output
- AUT or MDA and M00
- AUT or MDA and single block position reached
- Moving operating mode switch
  AUT / MDI - SE - TE
  MDA / JOG

4.1.2 Overview of effect of reset signals

PORESET = NC go home

No effect on the following functions filed in the memory: zero offset, tool offset, subroutines, machining program, additive zero offset, external zero offset.

RESET actuated by reset key, end of program or moving operating mode switch MDI/MDA or AUT/REF = General reset

The following are not reset:
- Actual value memory
- Block number memory

Otherwise same as PORESET.

The following are reset:
programmed path data valid for single blocks, reader active, intermediate memory, auxiliary functions, preparatory functions, automatic processing sequence, subroutine execution.

CLPROAC at end of single block,
at end of block M00,
when changing operating mode
AUT / MDI - SE - TE,
MDA / JOG
= Clear program active

The following are not reset:
actual value memory, block number memory, auxiliary and preparatory functions, position memory, intermediate memory; otherwise same as PORESET.

The following are reset:
automatic processing sequence.

4.2 Structure of NC/PLC interface

The NC and PLC are linked by way of the 2 K byte dual-port RAM (link RAM) in the PLC memory. This link configuration provides the NC system software with memory access to the link RAM only. The link RAM contains the entire NC/PLC interface for four NC controls (NC1...NC4).

The NC interface (DBn) includes the following signal areas:
- Data transfer NC to PLC
- Data transfer PLC to NC
- Image sectors and text buffers for PLC display images
- Standard keyboard image
- VDI input signals

- VDI output signals
- Auxiliary function output
- Machine control panel
- PLC machine data

DBn:n = DB20 with NC1; n = DB22 with NC2
n = DB24 with NC3; n = DB26 with NC4

The user interface is located in the following areas:

- Binary VDI signals in process image of inputs/outputs (starting at byte 64)
- Machine control panel (customer operator panel) in process image of inputs/outputs (I/O area, e.g. byte 48) or flag area
- Edit signals, auxiliary functions, NC/PLC data in data block (DBm: m = DB21 with NC1, m = DB23 with NC2, m = DB25 with NC3, m = DB27 with NC4)

The standard function blocks of the basic program execute the transfer of signals between the link RAM and user interface.

	GA3	GA4
NC interface	DB9	DBn
User interface	Flag area	DBm I/O area starting at byte 64

There are two methods of linking the machine control panels (compare Section 5.1).

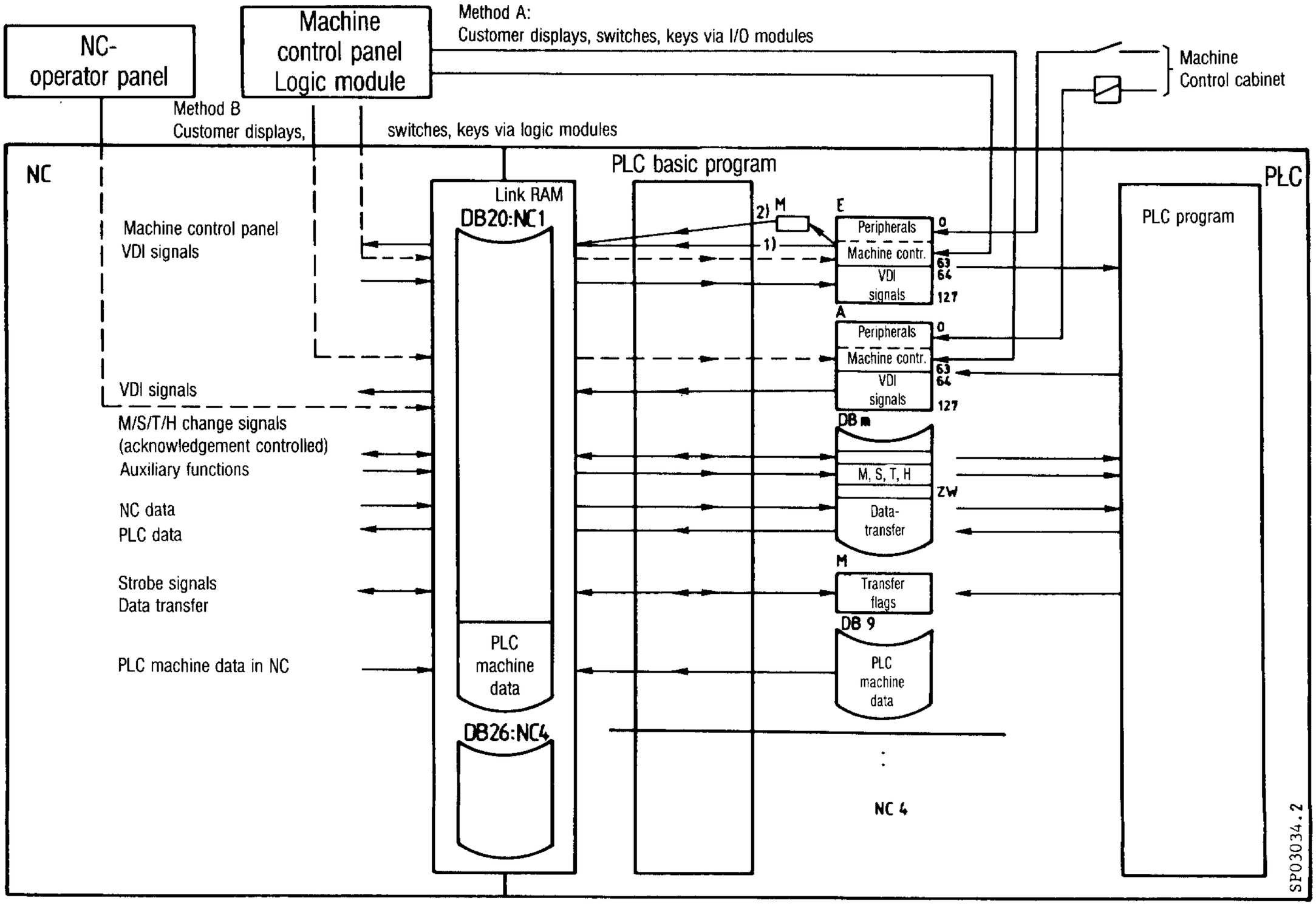
Method A:
Machine control panel via I/O module

Machine control panel signals can be transferred to the NC link RAM (compare Section 5.1) in two different ways:

1) Option 1:
Standard FB transfers machine control panel signals from the input image to the link RAM

2) Option 2:
Standard FB transfers machine control panel signals from the flag to the link RAM.
On this option, the user has to program the transfer of machine control panel signals from the input image to the flag area.

Method B:
Machine control panel via logic module



4.3 Structure of basic program

With System 3 basic versions 2 and 3, the user must load function modules FB12 (auxiliary functions), FB20 (M decoding), FB21 (S transfer), FB22 (data transfer) and all the other function modules in to the user memory. The parameters must also be defined in the memory.

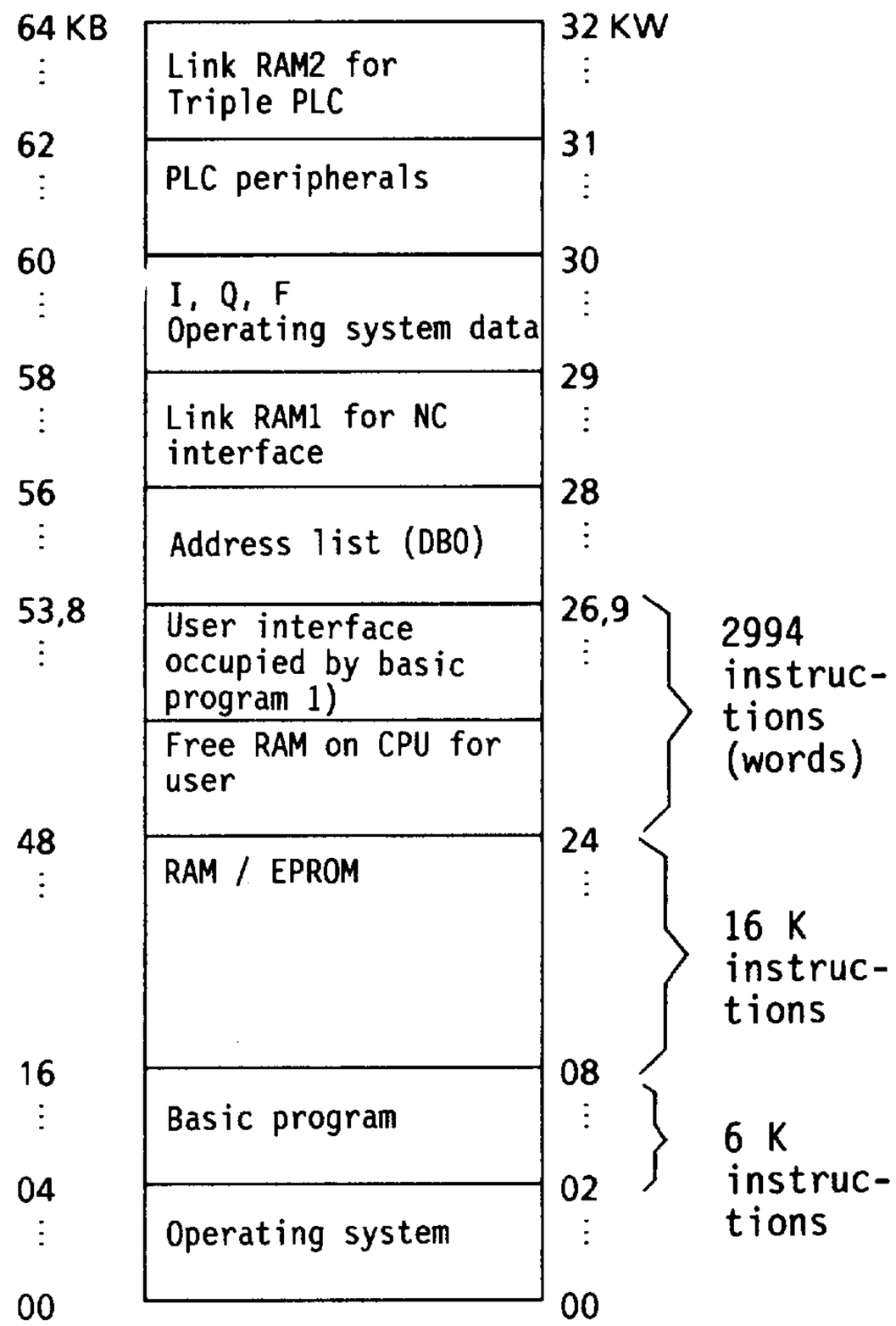
When basic version 4 (GA4) of the System 3 control leaves the factory, the basic program (OBs, FBs) is located in the top EPROM submodule of the 130W-B central controller. The user has to define the program parameters via the PLC machine data.

The basic programs for PLC 0, PLC 1 and PLC 2 are different.

The EPROMs are numbered as follows:

548817.5 0 .
- T_T_ Version
- ____ 1 receptacle D1, 2 receptacle D2
- _____ 0 PLC 0 (Single PLC), 2 PLC 1, 3 PLC 2

The basic program occupies 6 KW of memory capacity. This results in the following structure for the memory segmentation of PLC 130W-B:



1) The basic program occupies the following space in the various versions:

   1 NC: 950 words RAM (DB10, 14, 15, 21)
   2 NCs: 1130 words RAM (DB10, 14, 15, 21, 23)
   3 NCs: 1310 words RAM (DB10, 14, 15, 21, 23, 25)
   4 NCs: 1490 words RAM (DB10, 14, 15, 21, 23, 25,27)

The remaining RAM area on the CPU is available to the user program (for: DB9 machine data, standard packages 0 to 7, machine program etc.)

The basic program contains the start-up routine (OB20, 21, 22), the cyclically called program (OB0) and the alarm controlled programs (OB2, OB10).

The OB20, 21, 22 calls reset block FB10, which reloads the PLC machine data (or NC machine data area) in the link RAM data block DBn. Depending on the PLC machine data (number of NCs), data blocks are set up in the link RAM for the NC interface, and in the user RAM for the user interface. In addition, data block DB10 is set up for standard FB variables (FB9: EINR-DBK), FB11: EINR-DB). At the restart, the input image is reloaded, the "reset" and "restart" signals are output and the VDI interface pre-occupied.

After FB10, the OB20, 21, 22 calls FB2. The user should store a program in FB2, e.g. for creating data blocks or pre-occupying or deleting signals. Following FB2 execution, the PLC commences cyclic operation (OB0, OB1).

During cyclic PLC operation, organization block OB0 calls the function blocks (FB12, FB13: basic program, FB20, FB21, FB22) for implementing the auxiliary signals (flash frequency, "0" and "1" flags), M decoding, S transfer from the NC, auxiliary function output (M, S, T, H), data transfer in either direction between the NC and PLC, the STATUS display and the menu selection.

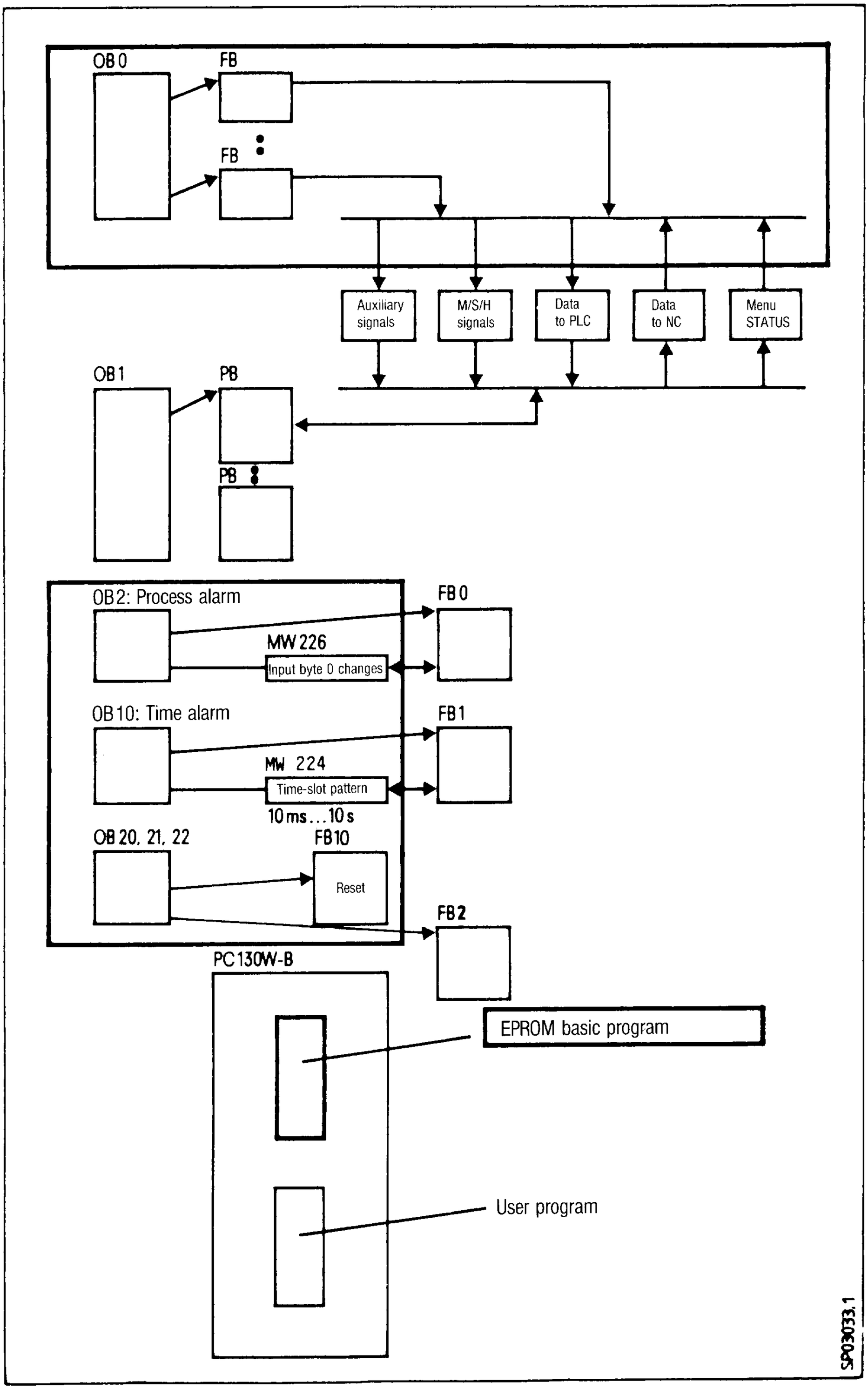
Alarm controlled programs are called by OB2 and OB10. The OB2 for process alarms saves flag areas FB230-237 and FB240-255, evaluates the signal changes in input byte 0, and files the rising edge in FB226 and the falling edge in FB227 (standard input module). Following this, function block FB0 is called. Subsequently, the flag areas are transferred back.

On no account may an alarm enable (AF) be programmed in FB0 or in any blocks called by FB0.

The OB10 for time alarms saves the same flag areas, sets the appropriate time-slot pattern in flag word FW224, calls function block FB1 and then transfers the flag areas back.

The user stores his program in the bottom EPROM submodule of the 130W-B central controller. The cyclic program is called in OB1 and the alarm controlled program in FB0 (process alarms) or FB1 (time alarms).

Structure of basic program



4.3.1 PLC machine data for basic program

The PLC machine data are used to parameterize blocks. There are PLC machine data for standard function blocks and user blocks.

PLC machine data can be filed in data block DB9 (user EPROM submodule) or in the NC machine data area (see Section 4.9.7).
When the control is switched on, the basic program's FB10 inquires whether DB9 is present in the PLC memory. If it is, DB9 is reloaded in to data blocks DBn of the link RAM. The complete PLC machine data for the NC must always be defined in DB9 (e.g. with one NC: DW0 to DW35; with two NCs: DW0 to DW69).
One of the following two situations applies if DB9 is not present:

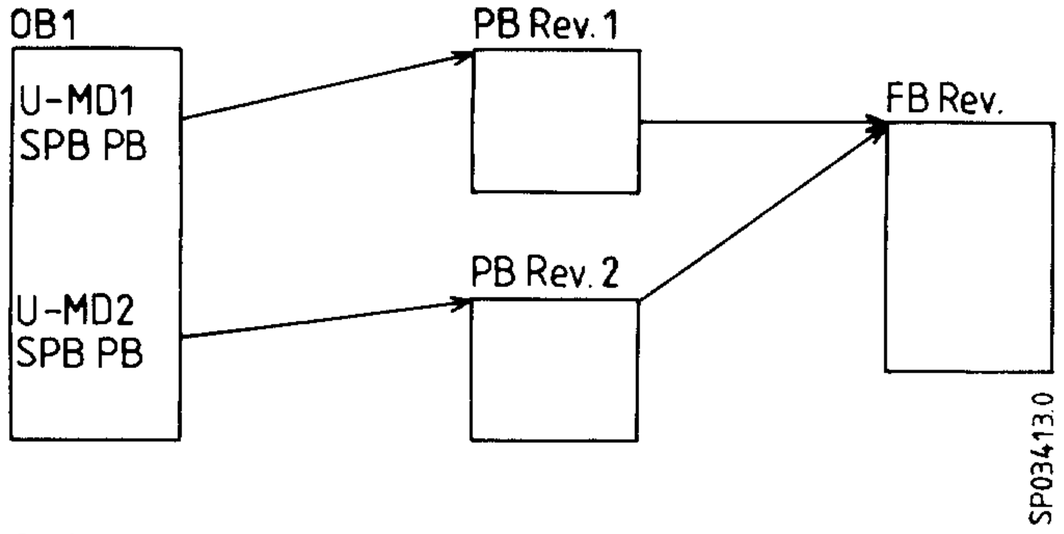
a) PLC machine data are stored in the NC and transferred from there to the link RAM
b) If no PLC machine data are present in the NC, the standard PLC machine data for the first NC are filed in DB20 of the link RAM.

The PLC machine data list commences with the common machine data for all four NCs (2 words). These are transferred to DB20 for NC1 only. The NC oriented PLC machine data areas (34 words per NC) follow after the common machine data. This area is divided into individual words for bits and BCD values, with one part reserved for the standard function blocks, e.g. basic program, and the other part for user blocks (see PLC machine data list).

During cyclic operation, the basic program function blocks are parameterized in the link RAM DBn in accordance with the PLC machine data.

Using his PLC machine data area and subject to certain restrictions, the user can process program blocks, function blocks or parts of a program, depending on the bits that have been set in the link RAM DBn. In addition, the user can also define machine-specific values using BCD values.

Example:
Consider the case of a user who builds machines with different turrets wanting to provide a common program for all the machines. The various turrets have different numbers of tool stations, e.g. turret 1 has 6 tool stations, turret 2 has 8 stations.
The program for each turret type (program block in this case) is called in the link RAM by means of an appropriate PLC machine data bit. The number of stations is preset in the program using BCD words.



OB1:

```
C    DB20      NC interface data block
L    DW101     Load user machine data bits
T    FW240     Store temporarily
A    F 241.0   Interrogate machine data
               bit 0
JC   PB100     Conditional call for turret
               1 program
     :
C    DB20      NC interface data block
L    DW101     Load user machine data bits
T    FW240     Store temporarily
A    F 241.1   Interrogate machine data
               bit 1
JC   PB101     Conditional call for turret
               2 program
     :
BE
```

PB 100:

```
L    DW121     Load user machine data words
               (BCD)
T    FW...     Evaluate BCD words
     :
     :
JU   FB200     Call generally valid turret
               FB
     :
BE
```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```
PB 101:

L   DW122   Load user machine data words
            (BCD)
T   FW...   Evaluate BCD words
    :
    :
JU  FB200   Call generally valid turret
            FB
    :
BE


FB200:
    :       Generally valid turret
    :       program
BE


DBn: n = 20 for NC1
         22 for NC2
         24 for NC3
         26 for NC4
```

4.3.2 PLC machine data description

4.3.2.1 Common PLC machine data

Number of NCs
The two machine data bits state the number of NCs for the basic program function blocks. The blocks then set up the interface data blocks and transfer the data. If DB9 is not present when the control is switched on, "00" is entered for 1 NC.

00 = 1 NC
01 = 2 NCs
10 = 3 NCs
11 = 4 NCs

Group signals
(1 = group signal module,
0 = normal module)
With a "0" signal, signal changes of alarm byte (input byte 0) are evaluated by OB2, the rising or falling edge is filed in FW226, and function block FB0 is called (rising edge in FB226, falling edge in FB227). With a "1" signal (group signal module), signal changes of alarm byte (input byte 0) are filed in FB226. In addition, flag areas FB230-FB237 and FB240-FB255 are saved before calling function block 0 and then reloaded afterwards.

On no account may an alarm enable (AF) be programmed in the FB0 or in any blocks called by the FB0. Refer to the description of group signal modules for further details.
If DB9 is not present when the control is switched on, the "group signals" bit is not set. This bit is not realized until basic program version 548 817.5....03.

Time alarms 10 ms, 20 ms, 100 ms, 200 ms, 1 s, 2 s, 10 s
With a "1" signal, OB10 transfers the appropriate time-slot pattern (10 ms - 10 s) to FW224 after the time has expired (10 ms = FB225 bit 0, 20 ms = FM225 bit 1, ...) and calls function block FB1. The user can interrogate the flag for the relevant time-slot pattern in FB1 and, with the flag set, e.g. branch off in to a program block (PB) in which his time controlled program is filed.
The OB10 saves flag areas FB230-FB237 and FB240-FB255 before calling FB1 and transfers them back afterwards. After calling FB1, the flag for the relevant time-slot pattern is cancelled.
If DB9 is not present when the control is switched on, no time alarm bits are set.
This bit is not realized until basic program version 548 817.5....03.

Machine control panel via logic module (1:1; 4-bit switch)
See Section 5.1
With a "1" signal and standard function block FB8 (TRAN-BED) present, the machine operator panel signals (machine control panel, customer keys, customer lamps) are transferred 1:1 (i.e. according to the Siemens standard machine control panel assignment (see Section 5.2) with the 4-bit switches: operating mode and feedrate/rapid traverse) in both directions between the logic module and the reserved I/O area (from input byte 48..., output byte 48... onwards) (version B).
The user has to load FB8 in his user memory. With basic program version 03 and 04, the user must call FB8 in OB1 first and use method 2 (machine control panel from flag) only.
From basic program version 05 onwards, the FB8 call is included in the basic program (OB0).

If DB9 is not present when the control is switched on, the bit is preset at "0".
This bit is not realized until basic program version 548 817.5....03.

Machine control panel via logic module (gray-coded 5-bit switches)
See Section 5.1
With a "1" signal, standard function block FB8 (TRAN-BED) and DB8 present, the machine operator panel signals (machine control panel, customer keys, customer lamps) are transferred, in accordance with a special machine control panel, with gray-coded 5-bit switches for operating mode and feedrate/rapid traverse override in both directions between the logic module and the reserved I/O area (from input byte 48..., output byte 48... onwards) (version B).
In the I/O area (input byte 48), the operating mode and feedrate/rapid traverse override switches are stored binary-coded (4 bit), as for the Siemens standard machine control panel (Section 5.2).

The user has to load FB8 and DB8 in his user memory. With basic program version 03 and 04, the user must call FB8 in OB1 first and use method 2 (machine control panel from flag) only. From basic program version 05 onwards, the FB8 call is included in the basic program (OB0).
If DB9 is not present when the control is switched on, the bit is preset at "0".
This bit is not realized until basic program version 548 817.5....03.

2. Logic modules

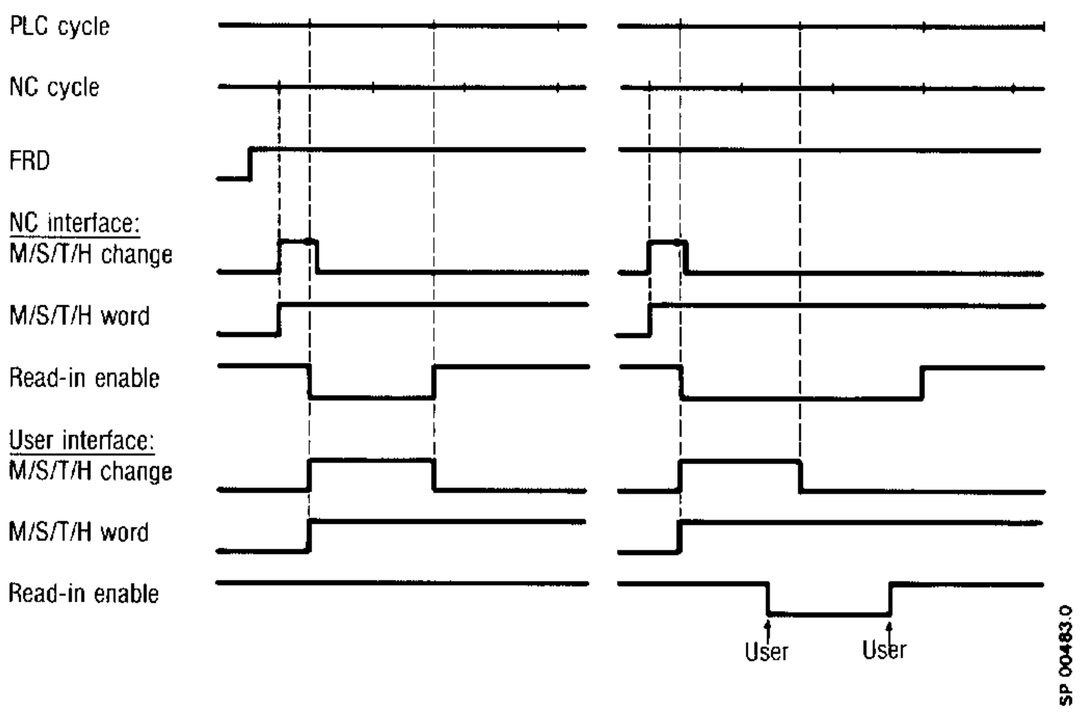
The bit is evaluated only with activated PLC machine data "Machine control panel via logic module 1:1" or "Machine control panel via logic module gray code".
With a 0 signal, the machine control panel signals are transferred for one logic module (input byte 48 - input byte 55, output byte 48 - output byte 51).
With a 1 signal, the signals for two logic modules are transferred. The bit is not realized until basic program version 548 817.5....03.

Menu for status program
With a 1 signal, the menu selection can be obtained by pressing the PLC key and then the status program called by pressing the "0" key. A 1 signal from FO.0 disables the input of variables. If the user wishes to select display programs via binary inputs, or to connect the inputs for external paging or cursor keys, the "menu for status program" bit has to be reset. The menu block (FB70) must be called up in the user program in this case.

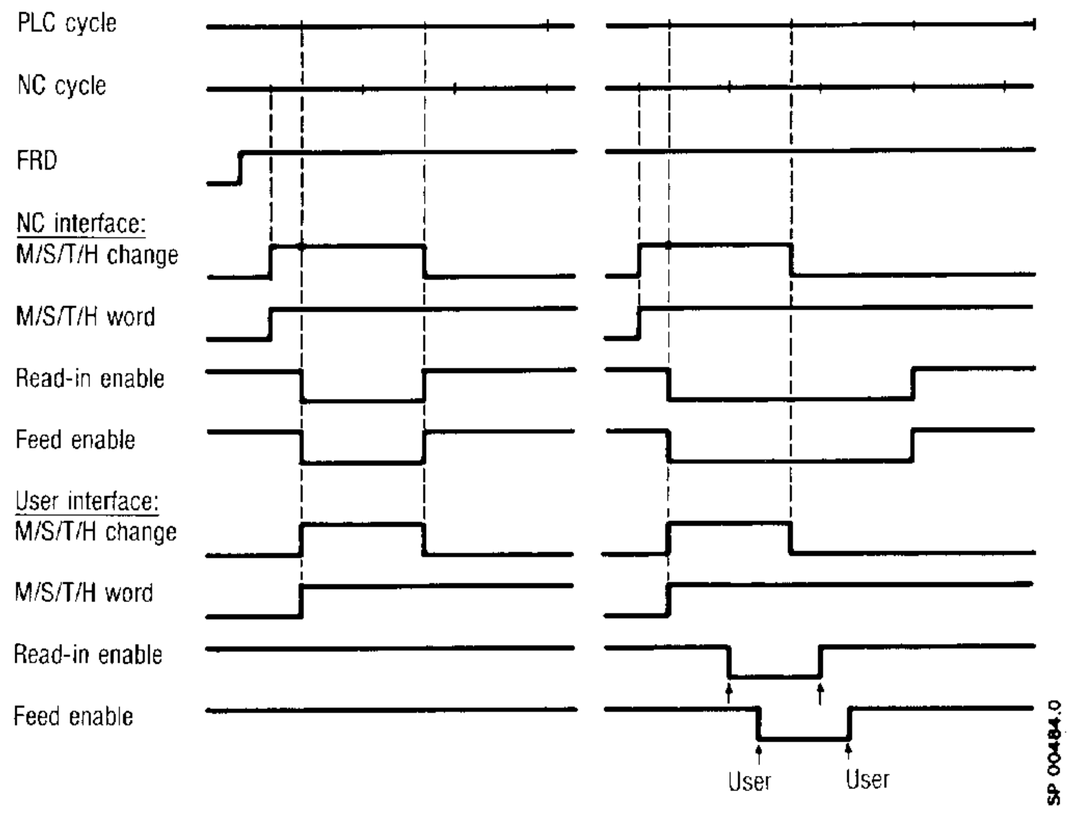
If DB9 is not present when the control is switched on, the bit is preset at "1".
This bit is not realized until basic program version 548 817.5....03.

M/S/T/H change signal extension

With a 0 signal, the auxiliary function output is as follows:
- PLC basic program recognizes change signal at NC interface
- PLC basic program cancels read-in enable at NC interface (precondition: FRD = 1, automatic operating mode)
- PLC basic program transfers word and change signal from NC interface to user interface and then acknowledges change signal at NC interface
- PLC basic program cancels change signal at user interface after one PLC cycle. Read-in enable passes to NC interface after one PLC cycle if read-in enable was not cancelled at user interface.



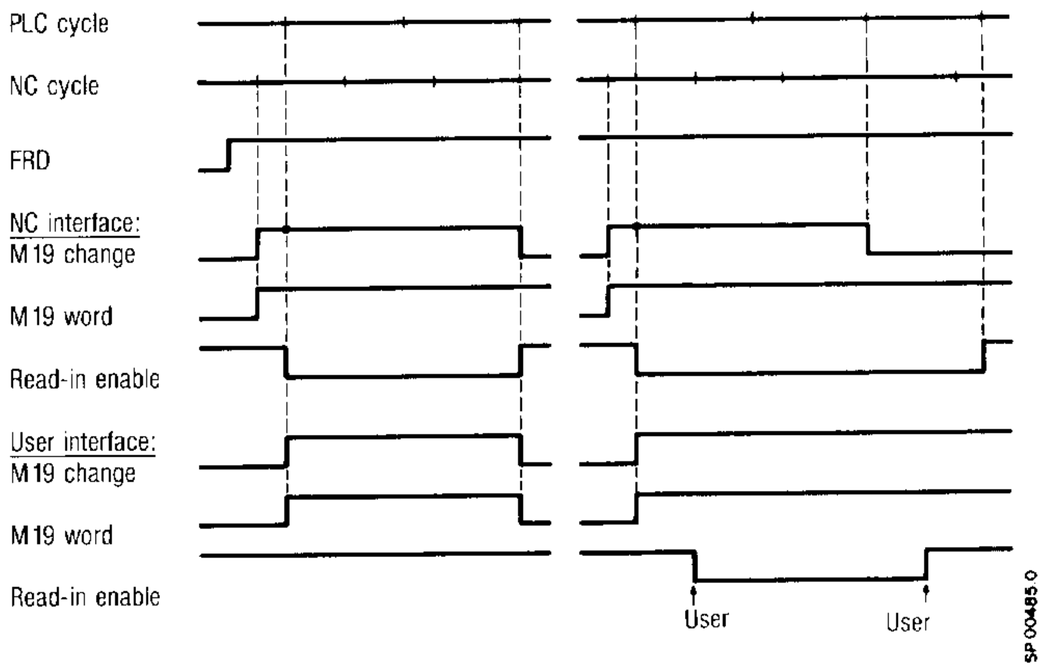
With a 1 signal, the auxiliary function output is as follows:
- PLC basic program recognizes change signal at NC interface
- PLC basic program cancels input and feed enable at NC interface (precondition: FRD = 1, automatic operating mode)
- PLC basic program transfers word and change signal from NC interface to user interface.
- PLC basic program cancels change signal at user and NC interface after one PLC cycle. Input/feed enable passes to NC interface after one PLC cycle if input/feed enable was not cancelled at user interface.



If DB9 is not present when the control is switched on, the bit is preset at "0".
This bit is not realized until basic program version 548 817.5....03.

M19 change signal extension

With a 1 signal, the sequence is as follows:
- PLC basic program recognizes M19 change signal at NC interface
- PLC basic program cancels read-in enable at NC interface (precondition: FRD = 1, automatic operating mode)
- PLC basic program transfers word and change signal from NC interface to user interface.
- PLC basic program acknowledges change signal at user and NC interface after two PLC cycles. Read-in enable passes to NC interface after two PLC cycles if read-in enable was not cancelled at user interface.



If DB9 is not present when the control is switched on, the bit is preset at "0".
This bit is not realized until basic program version 548 817.5....03.

T change signal acknowledgement by user

This machine datum permits the tool change procedure to be speeded up (via time controlled block FB1 where appropriate).
With a 1 signal, the T change signal given by the NC (DBn DL41 bit 5 = D41.13) at the NC interface is not acknowledged by the basic program. This applies to all operating modes. The user must evaluate the T word at the NC interface (DBn DR41 bit 0-3 BCD value 10^0, bit 4-7 BCD value 10^1; DL 42 bit 0-3 BCD value 10^2, bit 4-7 BCD value 10^3; with 3T: 10^2, 10^3 = T No., 10^0, 10^1 = compensation No.) in accordance with the T change signal. Before evaluating the T word, the user can cancel the read-in enable (DBn DR36 bit 6 = D36.6) or feed enable (DBn DL36 bit 2 = D36.10) at the user and NC interface to prevent additional NC blocks and axis movements being input and processed. The T change signal at the NC interface must not be acknowledged after cancelling the input or feed enable until at least 2 NC cycles (greater than 40 ms) have been executed, since the NC may not otherwise have recognized the input or feed disable due to asynchronous NC/PLC access.
The basic program does not transfer the T change and T word signals to the user interface (DBm DW1.6) where "T change signal acknowledgement by user" = 1. Similarly, the signals M02/M30 and FRD are not taken into account in conjunction with a T change.

Before the user resets the input or feed enable signals at NC interface DBn, they must be cancelled at the user interface (with NC1: Q65.5, Q66.7). The same applies to setting the signals. The T change must be recorded, the T word evaluated, the input and feed enable signals changed, and the T change signal acknowledged in one single block FBx. Otherwise, signal transfer between the NC and user interfaces will be uncoordinated through the basic program and special block (also better for program test purposes).
If DB9 is not present when the control is switched on, the bit is preset at "0".

This bit is not realized in this form until basic program version 548 817.5....04.

n = 20 with NC1 m = 21 with NC1
= 22 with NC2 m = 23 with NC2
= 24 with NC3 m = 25 with NC3
= 26 with NC4 m = 27 with NC4

NC interface = DBn;
user interface = input/output range from byte 64 or DBm onwards.

T change, acknowledgement by user

```
FB200:

NAME:T-AEND

     :AN   F 238.1 Reset position
     :JC   =ZYKL   Jump to cyclic program
     :L    KB0     Flag byte waiting time
     :T    FB101   Delete
     :BEC
ZYKL:C     DB20    NC interface: NC1
     :TBN  D 41.13 T change signal
     :A    F 100.0 Auxiliary flag T change
     :JC   =ZEIT
     :S    F 100.0 Auxiliary flag T change
     :R    Q 65.5  Input disable user
                   interface
     :R    Q 66.7  Feed disable user
                   interface
     :RU   D 36.6  Input disable NC
                   interface
     :RU   D 36.10 Feed disable NC
                   interface
     :L    DR41    BCD decade 10^0, 10^1
     :T    FB241   Intermediate storage
     :L    DL42    BCD decade 10^2, 10^3
     :T    FB240   Intermediate storage
     :C    DB21    User interface NC1
     :L    FW240   T word in user
                   interface
     :T    DW6     Load
     :JU   =ENDE
ZEIT:AN    F 100.0 Auxiliary flag T change
     :JC   =ENDE   No T change   end
     :L    FB101   Flag byte for 40 ms
                   waiting time
     :I    1
     :T    FB101
     :L    KB4     40 ms waiting time
     : =F          Expired
     :S    F 100.0 Auxiliary flag waiting
                   time
     :
     :
     :             User program:
     :             e.g. 1. Evaluate T word
     :                  2. User can jump
     :                     to end of block
     :                     until he has
     :                     completed
     :                     evaluation.
     :AN   F 100.1 Auxiliary flag waiting
                   time
     :JC   =ENDE
     :             40 ms waiting time
                   expired
     :C    DB20    NC interface: NC1
     :R    F 100.0 Auxiliary flag T change
     :R    F 100.1 Auxiliary flag waiting
                   time
     :S    Q 65.5  Read-in enable instruc-
     :             tion interface
     :S    Q 66.7  Feed enable instruc-
     :             tion interface
     :RU   D 41.13 Acknowledge T change at
     :             NC interface
     :SU   D 36.6  Read-in enable NC
     :             interface
     :SU   D 36.10 Feed enable NC
     :             interface
     :L    KB0     Flag byte waiting time
     :T    FB101   Delete
ENDE:BE
```

FB1 is called by the basic program every 10 ms.

```
MB1:

NAME:ZEIT-FB

     :JU FB200
NAME:T-AEND.
     :BE
```

Reset key inoperative when key lock on
With "0" and keyboard disable (in the display program), the reset key is ORed with the user interface reset signal and transferred to the NC interface. With "1" and keyboard disable, the reset key is disabled.
If DB9 is not present when the control is switched on, the bit is preset at "0". This bit is realized in basic program version 548 817.5....03.

Number: DB menu (binary coded)
If the byte is unequal to zero, the content is interpreted as a data block number for the menu image. The content of the data block is output by the basic program when the PLC key is pressed. If the byte is zero, the text from DB39 is displayed.

Application:
The menu data block can be stored in the user memory and activated in the language of the relevant country.

If DB9 is not present when the control is switched on, the bit is preset at "0".

This bit is realized in basic program version 548 817.5....06 (Single PLC), 548 817.5....01 (Dual PLC).

Key assignment 3G
With "1", the operator panel keys "." and "-", which are located elsewhere on the hardware of grinding control 3G, are reassigned to the 3T and 3M addresses for the PLC program (display). The NC continues to evaluate the hardware addresses.
If DB9 is not present when the control is switched on, the bit is preset at "0".
This bit is realized in basic program version 548 817.5....08 (Single PLC), 548 817.5....02 (Dual PLC).

PLC key
With "1", the user can operate a key other than than the PLC key or use a PLC input to select the PLC menu image. The input simply has to be linked to flag F0.1.

Example:
```
Q I53.0      new PLC key
= F 0.1
```

If DB9 is not present when the control is switched on, the bit is preset at "0".
This bit is realized in basic program version 548 817.5....08 (Single PLC), 548 817.5....02 (Dual PLC).

4.3.2.2 NC-oriented PLC machine data

M-dec, M storing signal
With M dec = 1, the M word is decoded and the relevant flag set on the NC in question on the basis of the M change signal (see flag assignment); it is cancelled with M storing signal = 0 after one PLC cycle (case 1) or not cancelled with M storing signal = 1 (case 2). If case 2 applies, the user must reset the M output signal himself.

If DB9 is not present when the control is switched on, the M-dec = 1 and M storing signal = 0 bits are set. Only case 1 is realized on basic program version 548 817.5....01 or 02.

Standard S transfer
With "1", the programmed spindle speed of the NC in question is returned to the same NC (via PLC detour). The S transfer cannot be disabled. If the user wishes to transfer the programmed spindle speed to a different NC or to disable the S transfer, he must call S transfer block FB21 in OB1 and parameterize it accordingly. If DB9 is not present when the control is switched on, the "standard S transfer = 1" bit is set.

Machine control panel via peripherals
With "1", FB22 DAT NC/PLC is called, mutual NC/PLC monitoring is activated, auxiliary functions are output, and the NC and PLC data are transferred. If the bit is not set, FB22 is not called and the NC indicates a PLC fault.
If DB9 is not present when the control is switched on, the "machine control panel via peripherals" bit is set to "1".
The "machine control panel via peripherals" bit is not provided from basic program version 548 817.5....03 onwards.

Machine control panel from input image (option 1)

With "1", the machine control panel signals are obtained direct from the peripherals starting with input byte 48 and transferred to the NC. The machine control panel signals must be preselected in input byte IB48 via an input/output or input module (version A) or via the logic module (version B).
If DB9 is not present when the control is switched on, the "Machine control panel from input image (option 1)" bit is set to "1".

Machine control panel from flag (option 2)

With "1", the machine control panel signals are obtained from the relevant NC flag area and transferred to the NC. The user must transfer the machine control panel signals stored in the I/O area via an input/output or input module (version A) or via the logic module (version B) from the I/O to the flag area.
If DB9 is not present when the control is switched on, the "Machine control panel from flag (option 2)" bit is preset at "0".

Machine data have been input (TE: N456 bit 7)

With "1", the bit states that all the PLC machine data have been input in the NC (NC machine data memory). This is necessary only in conjunction with PLC machine data in the NC.
If the PLC machine data are entered in the NC, no DB9 must be present in the PLC memory on the Single PLC or Dual PLC1. With "1", the PLC machine data are transferred to data blocks DBn of the link RAM (bits: N452 to N479; BCD values: N280 to N301. Caution: max. 4 decades, no prefixes allowed) by each NC (depending on the number of NCs).
PLC machine data may not be entered in the NC before NC software version C03 or D01 in conjunction with basic program version 548 817.5....08 (Single PLC), 548 817.5....01 (Dual PLC).

Machine data bits for computer linking

The transmission of messages from the PLC to the computer can be initiated by the following events (mask for RST T message frames - DBn, DW99) while a program is active:

SP EIN	Spindle on by operator
VS EIN	Feed on by operator
AUTO EIN	User switches to automatic after A: IR
OV = 0	Override position at machine control panel = 0
RESET	RESET by operator
A: IR	Automatic interrupted
SP:H	Spindle stop by operator
VS:H	Feed stop by operator
M00 M01	Programmed stop
M02 M03	Program end
PR:ST	Program start by operator

Computer link active

With computer link active = "1" and GSt (reset position), the computer link is activated if package 7 is loaded; i.e. the required DBs 12, 13, 17 and 19 are set up and pre-occupied. If this bit is deleted with the computer link active, all functions are stopped.
This bit is interrogated in DB60 only; i.e. when more than one NC is connected, this bit has to be set for NC1.

Number of connected magazines

The number of connected magazines is stored in hexadecimal code in DB20/DR99.4 ... 99.7. A maximum of 9 magazines can be connected.
These bits are interrogated in DB20 only; i.e. when more than one NC is connected, this bit has to be set NC1.

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PLC machine data for basic program, Single PLC and PLC1

ID No. in NC1	User DB DB9	Link-RAM DB20 DL	15	14	13	12	11	10	9	8	DR 7	6	5	4	3	2	1	0
N452,453	DW0	DW95		5)	4)	3)	2)	1)	Time alarms 10 s	2 s	1 s	200 ms	100 ms	20 ms	10 ms		Number of NC's	
N454,455	DW1	DW96	Number: DB menu (binary coded)									External Dual PLC	PLC key	Key assign-ment 36	Menu for status programs	8)	7)	6)

Standard FB's

Common machine data for all NC's

00 ≙ 1 NC
01 ≙ 2 NC's
10 ≙ 3 NC's
11 ≙ 4 NC's

1) Group signals
2) M/S/H change signal extension
3) M19 change signal extension
4) T change signal acknowledgement by user
5) Reset key inoperative when key lock on
6) Machine control panel via logic module (1:1)
7) Machine control panel via logic module (graycode)
8) 0 = 1 logic module
   1 = 2 logic modules

ID. No. in NC1...4	User DB DB9 NC1	NC2	NC3	NC4	DBn	DL 15	14	13	12	11	10	9	8	DR 7	6	5	4	3	2	1	0
N456,457	DW2	DW36	DW70	DW104	DW97	9)									N storing signal	MCP from flag (opt. 2)	MCP from I image (opt. 1)		MCP from peri-pherals	Standard S transfer	M-Dec
N458,459	DW3	DW37	DW71	DW105	DW98																10)
N460,461	DW4	DW38	DW72	DW106	DW99						SP EIN	VS EIN	Auto EIN	ON = 0	Reset	A:IR	SP:H	VS-H	M00 M01	M02 M30	PR: ST
N462,463	DW5	DW39	DW73	DW107	DW100									Number of magazines for computer link (with Dual PLC)							Computer link active Dual PLC
N464,465	DW6	DW40	DW74	DW108	DW101																
N478,479	DW13	DW47	DW81	DW115	DW108																
N280	DW14	DW48	DW82	DW116	DW109																
N281	DW15	DW49	DW83	DW117	DW110																
N282	DW16	DW50	DW84	DW118	DW111																
N283	DW17	DW51	DW85	DW119	DW112																
N284	DW18	DW52	DW86	DW120	DW113																
N285	DW19	DW53	DW87	DW121	DW114																
N286	DW20	DW54	DW88	DW122	DW115																
N287	DW21	DW55	DW89	DW123	DW116																
N288	DW22	DW56	DW90	DW124	DW117																
N289	DW23	DW57	DW91	DW125	DW118																
N290	DW24	DW58	DW92	DW126	DW119																
N291	DW25	DW59	DW93	DW127	DW120																
N292	DW26	DW60	DW94	DW128	DW121																
N301	DW35	DW69	DW103	DW137	DW130																

Standard FB's

User

Standard FB's

User

n = DB20 on NC1; DB24 on NC3
DB22 on NC2; DB26 on NC4

9) PLC MD have been input
(only with PLC machine data in the NC)

10) NC as electronic gear
(see Difference Description, Electronic Gear)

4.4 Overview of interface signals

4.4.1 PLC input signals from NC

Group	Byte address				Bit number							
	NC 1	NC 2	NC 3	NC 4	7	6	5	4	3	2	1	0
Ready signals (4.5.1)	I64	I74	I84	I94	Program active		NC Ready 2	NC Ready 1	V.24 (RS232) active			
	I65	I75	I85	I95			NC-alarm					
Program commands (4.5.2)	I66	I76	I86	I96	Probe deflected	Thread cutting G33 G63		Rapid traverse	v = constant G96 1)			
	I67	I77	I87	I97	Programmed stop M00	End prog. M03/M30						
Spindle (4.5.3)	I68	I78	I88	I98	Actual spindle rotation clockwise	Spindle speed limit	Spindle at speed	Spindle in position	Spindle stopped			Switched to T
Axis-specific signals (4.5.4)	I69	I79	I89	I99							Ref. point reached ①	Motion command ①
	I70	I80	I90	I100							Ref. point reached ②	Motion command ②
	I71	I81	I91	I101							Ref. point reached ③	Motion command ③
	I72	I82	I92	I102							Ref. point reached ④	Motion command ④
Program commands and spindle	I73	I83	I93	I102					Spindle speed at limit	G39 selected 5)	G38 selected 5)	G37 selected 5)

		3T/TT	3M	3T+C
①	1st axis	X	X	X
②	2nd axis	Z	Y	Z
③	3rd axis	-	Z	-
④	4th axis	-	4	C

1) Only 3T/TT
2) Only 3M
3) From C02 Mirror image Z possible (3M)
4) From C03
5) Only 4B from D01

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4.4.2 PLC output signals to NC

Group	Byte address				Bit number							
	NC 1	NC 2	NC 3	NC 4	7	6	5	4	3	2	1	0
Ready signals (4.6.1)	Q64	Q74	Q84	Q94	* Emergency off	Operator panel disable	Key lock	V.24 (RS232) disable	Cycle disable	Handwheel disable	Reset	Data start
Influencing the program (4.6.2)	Q65	Q75	Q85	Q95	NC start (ST)	Start enable (FRST)	Read-in enable		Cancel distance to go	Cancel remaining sub-routine passes		Pilot control on 5)
Influencing the feedrate (4.6.3)	Q66	Q76	Q86	Q96	Feed enable							Handwheel X 1)
Influencing the spindle (4.6.4)	Q67	Q77	Q87	Q97	Gear stages C	B	A	Spindle rotation clockwise com.	Spindle enable	New synchr. of spindle 4)	Follow-up oper. of spindle 4)	
Axis signals – general (4.6.5)	Q68	Q78	Q88	Q98	4th axis = main axis 2)	Mirror image 3) ③	②	①	Switchover to T 1)	Flying measurement	2nd software limit switch act.	Axis disable general
Axis-specific signals (4.6.6)	Q69	Q79	Q89	Q99		Follow-on operation ① 3)	Axis disable ① 3)	Decelerate (ref. point) ①	Feed enable ① 3)	Controller enable ①	Set reference dimension ① 5)	
	Q70	Q80	Q90	Q100		Follow-on operation ② 3)	Axis disable ② 3)	Decelerate (ref. point) ②	Feed enable ② 3)	Controller enable ②	Set reference dimension ② 5)	
	Q71	Q81	Q91	Q101		Follow-on operation ③ 3)	Axis disable ③ 3)	Decelerate (ref. point) ③	Feed enable ③ 3)	Controller enable ③	Set reference dimension ③ 5)	
	Q72	Q82	Q92	Q102		Follow-on operation ④ 3)	Axis disable ④ 3)	Decelerate (ref. point) ④	Feed enable ④ 3)	Controller enable ④	Set reference dimension ④ 5)	
Influencing the program	Q73	Q83	Q93	Q103	Coding Z0 5) B	A	Coding tool track 5) C	B	A	G39 selection 5)		

		3T/TT	3M	3T+C
①	1st axis	X	X	X
②	2nd axis	Z	Y	Z
③	3rd axis	–	Z	–
④	4th axis	–	4	C

1) Only 3T/TT
2) Only 3M
3) From C02 Mirror image Z possible (3M)
4) From C03
5) Only 4B from D01

4.4.3 Machine control panel signals to NC

Machine control panel signals 3T from PLC to NC

Flag	Bit number 7	6	5	4	3	2	1	0
F n.	Operating mode switch D 8	C 7	B 6	A 5	Feedrate/rapid traverse override switch D 4	C 3	B 2	A 1
F n+1.	Key switch 16	Dry run 15	Block delete 14	Single block 13	Block search 12	Spindle override switch C 11	B 10	A 9
F n+2.	Rapid traverse override active 25	Rapid traverse overlay 24	Direction keys X+ 23	X- 22	Z+ 21	Z- 20	19	18

n ≙ 1 on NC1
23 on NC2
45 on NC3
67 on NC4

Machine control panel signals 3M from PLC to NC

Flag	Bit number 7	6	5	4	3	2	1	0
F n.	Operating mode switch D 8	C 7	B 6	A 5	Feedrate/rapid traverse override switch D 4	C 3	B 2	A 1
F n+1.	Key switch 16	Dry run 15	Block delete 14	Single block 13	Block search 12	Spindle override switch C 11	B 10	A 9
F n+2.	Rapid traverse override active 25	Rapid traverse overlay 24	Direction keys + 23	- 22	Axis selector switch Code B 21	A 20	19	18

n ≙ 1 on NC1
23 on NC2
45 on NC3
67 on NC4

4.4.4 Auxiliary functions DBm

NC to PLC

	DL	DR	Designation
DW 0			Reserved for D0DW0
DW 1		M-AE | S-AE | T-AE | H-AE | M02/M30 | | VORL | FRD	Status word 1
DW 2		10^1 | 10^0	M word
DW 3			
DW 4	10^3 | 10^2	10^1 | 10^0	S word
DW 5			
DW 6	3T: 10^1 T no. 10^0 3M: 10^3 T no. 10^2	10^1 Offset no. 10^0 10^1 T no. 10^0	T word
DW 7			
DW 8	10^3 | 10^2	10^1 | 10^0	H word
DW 9			
DW10			
DW11			
DW12			
DW13			
DW14	10^3 | 10^2	10^1 | 10^0	S from source NC for destination NC 1)

m = DB21 on NC1
DB23 on NC2
DB25 on NC3
DB27 on NC4

1) see 4.7.2 "Types of spindle control"

4.4.5 Data transfer from NC to PLC
see Section 4.9

DBm

NC to PLC

			DL								DR								Designation
M n. 0		DW 15	QM TOAB	QM TOA		QM S-SP		QM S actual						QM RLES	QM IW-L	QM ZOEX	QM ZOP	QM ZOE	Status word 2
M n. 1	S actual read			QM SE-B	QM AI-V	QM NC-MB	QM NC-M			QM PRNR									Status word 3
M n. 2		DW 16	1:								2:								Tool offset additive (TOA) (4.9.2)
M n. 3		DW 17																	
M n. 4	S-SP	DW 18	0				0				0	0	0	0=+ 1=-	10^4				
M n. 5		DW 19	10^3				10^2				10^1				10^0				
M n. 6	TOA	DW 20	e.g. DP 1 1 1 0				10^{-1}				10^{-2}				10^{-3}				
M n. 7	TOAB	DW 21	1:								2:								Tool offset absolute (TOAB) (4.9.2)
M n+1.0	ZOE	DW 22	0				0				0	0	0	0=+ 1=-	10^3				
M n+1.1	ZOP	DW 23	10^2				10^1				10^0				e.g. DP 1 1 1 0				
M n+1.2	ZO EX	DW 24	10^{-1}				10^{-2}				10^{-3}				10^{-4}				
M n+1.3	Actual value read	DW 25	1:								2:								Adjustable zero offset G54... (ZO E) (4.9.3)
M n+1.4	R read	DW 26	0				0				0	0	0	0=+ 1=-	10^4				
M n+1.5		DW 27	10^3				10^2				10^1				10^0				
M n+1.6		DW 28	e.g. DP 1 1 1 0				10^{-1}				10^{-2}				10^{-3}				
M n+1.7		DW 29	1:								2:								Programmable additive zero offset G59 (ZO P) (4.9.3)
M n+2.0	PRNR	DW 30	0				0				0	0	0	0=+ 1=-	10^3				
M n+2.1		DW 31	10^2				10^1				10^0				e.g. DP 1 1 1 0				
M n+2.2		DW 32	10^{-1}				10^{-2}				10^{-3}				10^{-4}				
M n+2.3	NC-M	DW 33	1:								2:								External additive zero offset (additional compensation) (ZOEX) (4.9.3)
M n+2.4	NC-MB	DW 34	0				0				0	0	0	0=+ 1=-	10^4				
M n+2.5	AI-V	DW 35	10^3				10^2				10^1				10^0				
M n+2.6	SE-B	DW 36	z.B. DP 1 1 1 0				10^{-1}				10^{-2}				10^{-3}				
M n+2.7																			

n ≙ 7 on NC1
29 on NC2
51 on NC3
73 on NC4

1: ≙ 1st rel. address

2: ≙ 2nd rel. address
see Section 4.9

m ≙ DB21 on NC1
DB23 on NC2
DB25 on NC3
DB27 on NC4

DP = decimal point

NC to PLC

M n. 0	
M n. 1	S actual read
M n. 2	
M n. 3	
M n. 4	S-SP
M n. 5	
M n. 6	TOA
M n. 7	TOAB
M n+1.0	ZOE
M n+1.1	ZOP
M n+1.2	ZO EX
M n+1.3	Actual value read
M n+1.4	R read
M n+1.5	
M n+1.6	
M n+1.7	
M n+2.0	PRNR
M n+2.1	
M n+2.2	
M n+2.3	NC-M
M n+2.4	NC-MB
M n+2.5	AI-V
M n+2.6	SE-B
Mn+2.7	

DBm

	DL	DR	Designation
DW 37	1:	2: 0 0	Read actual values (IW read) (4.9.5)
DW 38	0 0	0 0 0 0=+ 1=- 10^4	
DW 39	10^3 10^2	10^1 10^0	
DW 40	DP 1 1 1 0 10^{-1}	10^{-2} 10^{-3}	
DW 41	1: Number 10^1 10^0	2: 0 Number 0	Read R parameters (R read) (4.9.6)
DW 42	0 0	0 0 0 0=+ 1=- 10^4	
DW 43	10^3 10^2	10^1 10^0	
DW 44	e.g. DP 1 1 1 0 10^{-1}	10^{-2} 10^{-3}	
DW 45	10^3 10^2	10^1 10^0	% program no. (PRNR)
DW 46	2: Number 10^2	1: Number 10^1 10^0	Read NC machine data (NC-M) (4.9.7)
DW 47	0 0	0 0 0 0=+ 1=- 10^8	
DW 48	10^7 10^6	10^5 10^4	
DW 49	10^3 10^2	10^1 10^0	
DW 50	1: Number Bit	2: Number 10^1 10^0	Read NC machine data bits (NC-MB) (4.9.7)
DW 51	0 0	0 0 0 0 Var. 0/1	
DW 52	0 0	0 10^2	Spindle command position (S-SP) (4.9.4)
DW 53	10^1 10^0	DP 1 1 1 0 10^{-1}	
DW 54			
DW 55			
DW 56	1:	2: 0 0	Actual axis value offset (A-IV)
DW 57	0 0	0 0 0 0=+ 1=- 10^4	
DW 58	10^3 10^2	10^1 10^0	
DW59	e.g. DP 1 1 1 0 10^{-1}	10^{-2} 10^{-3}	

n ≙ 7 on NC1
29 on NC2
51 on NC3
73 on NC4

1: ≙ 1st rel. address
2: ≙ 2nd rel. address
see Section 4.9

m ≙ DB21 on NC1
DB23 on NC2
DB25 on NC3
DB27 on NC4

DP = decimal point

NC to PLC

M n. 0	
M n. 1	S actual read
M n. 2	
M n. 3	
M n. 4	S-SP
M n. 5	
M n. 6	TOA
M n. 7	TOAB
M n+1.0	ZOE
M n+1.1	ZOP
M n+1.2	ZO EX
M n+1.3	Actual value read
M n+1.4	R read
M n+1.5	
M n+1.6	
M n+1.7	
M n+2.0	PRNR
M n+2.1	
M n+2.2	
M n+2.3	NC-M
M n+2.4	NC-MB
M n+2.5	AI-V
M n+2.6	SE-B
Mn+2.7	

DBm

	DL	DR	Designation
DW 60	0 0 0 0=+ 1=- | 0	0 | 0	Read actual spindle speed (S actual read)
DW 61	10^3 | 10^2	10^1 | 10^0	
DW 62	1: | Bit	2: 10^1 | 10^0	Read setting data bits (SE-B)
DW 63	0 | 0	0 | 0 0 0 Var 0/1	
DW 64			
DW 65			
DW 66			
DW 67			
DW 68			
DW 69			
DW 70			
DW 71			
DW 72			
DW 73			
DW 74			
DW 75			
DW 76			
DW 77			
DW 78			
DW 79			

n ≙ 7 on NC1
29 on NC2
51 on NC3
73 on NC4

1: ≙ 1st rel. address
2: ≙ 2nd rel. address
see Section 4.9

m ≙ DB21 on NC1
DB23 on NC2
DB25 on NC3
DB27 on NC4

DP = decimal point

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4.4.6 Data transfer from PLC to NC
see Section 4.9

NC to PLC

M m.0	S Ø
M m.1	S from NC
M m.2	S from PLC
M m.3	F-EX
M m.4	S-SP
M m.5	
M m.6	TOA
M m.7	TOAB
M m+1.0	ZOE
M m+1.1	ZOP
M m+1.2	ZOEX
M m+1.3	
M m+1.4	R load
M m+1.5	
M m+1.6	
M m+1.7	
M m+2.0	PRNR
M m+2.1	
M m+2.2	
M m+2.3	NC-M
M m+2.4	NC-MB
M m+2.5	AI-V
M m+2.6	SE-B
M m+2.7	

DBm

	DL								DR								Designation
DW 80	QM: TOAB	QM: TOA		QM: S-SP	QM: F-EX	QM: SPC	QM: SNC	QM: SØ				QM: RLAD		QM: ZOEX	QM: ZOP	QM: ZOE	Status word 4
DW 81		QM SE-B	QM AI-V	QM NC-MB	QM: NC-M			QM: PRNR									Status word 5
DW 82	0		0						0		0						Spindle speed from PLC (S from PLC) (4.9.4)
DW 83	10^3		10^2						10^1		10^0						
DW 84	0		0						0		10^4						Feedrate from PLC (F-EX) (4.9.4)
DW 85	10^3		10^2						10^1		10^0						
DW 86	1:								2:								Tool offset additive (TOA) (4.9.2)
DW 87	0		0						0	0	0	0=+ 1=-	10^4				
DW 88	10^3		10^2						10^1		10^0						
DW 89	e.g. DP 1 1 1 0		10^{-1}						10^{-2}		10^{-3}						
DW 90	1:								2:								Tool offset absolute (TOAB) (4.9.2)
DW 91	0		0						0	0	0	0=+ 1=-	10^3				
DW 92	10^2		10^1						10^0		e.g. DP 1 1 1 0						
DW 93	10^{-1}		10^{-2}						10^{-3}		10^{-4}						
DW 94	1:								2:								Adjustable zero offset (ZOE) (4.9.3)
DW 95	0		0						0	0	0	0=+ 1=-	10^4				
DW 96	10^3		10^2						10^1		10^0						
DW 97	e.g. DP 1 1 1 0		10^{-1}						10^{-2}		10^{-3}						
DW 98	1.								2:								Programmable additive zero offset G59 (ZOP) (4.9.3)
DW 99	0		0						0	0	0	0=+ 1=-	10^3				
DW 100	10^2		10^1						10^0		e.g. DP 1 1 1 0						
DW 101	10^{-1}		10^{-2}						10^{-3}		10^{-4}						

QM = acknowledgement flag

DP = decimal point

n ≙ 4 on NC1
26 on NC2
48 on NC3
70 on NC4

1: ≙ 1st rel. address
2: ≙ 2nd rel. address
see Section 4.9

m ≙ DB21 on NC1
DB23 on NC2
DB25 on NC3
DB27 on NC4

PLC to NC

DBm

			DL	DR	Designation
M m.0	S Ø				
M m.1	S from NC	DW 102	1:	2:	External additive zero offset (additional compensation) (ZOEX) (4.9.3)
		DW 103	0 | 0	0 | 0 | 0 | 0=+ 1=- | 10^4	
M m.2	S from PLC	DW 104	10^3 | 10^2	10^1 | 10^0	
M m.3	F-EX	DW 105	e.g. DP 1 | 1 | 1 | 0 | 10^{-1}	10^{-2} | 10^{-3}	
M m.4	S-SP	DW 106	1: Number 10^1 | 10^0	2: 0 | 0	Load R parameters (R load) (4.9.6)
M m.5		DW 107	0 | 0	0 | 0 | 0 | 0=+ 1=- | 10^4	
M m.6	TOA	DW 108	10^3 | 10^2	10^1 | 10^0	
M m.7	TOAB	DW 109	e.g. DP 1 | 1 | 1 | 0 | 10^{-1}	10^{-2} | 10^{-3}	
M m+1.0	ZOE	DW 110	10^3 | 10^2	10^1 | 10^0	% program no. (PRNR) (4.9.4)
M m+1.1	ZOP	DW 111	0 | 0	0 | 10^2	Spindle command position (S-SP) (4.9.4)
M m+1.2	ZOEX	DW 112	10^1 | 10^0	e.g. DP 1 | 1 | 1 | 0 | 10^{-1}	
M m+1.3		DW 113	2: Number | 10^2	1: Number 10^1 | 10^0	Write NC machine data (NC-M) (4.9.7)
M m+1.4	R load	DW 114	0 | 0	0 | 0 | 0 | 0=+ 1=- | 10^8	
M m+1.5		DW 115	10^7 | 10^6	10^5 | 10^4	
M m+1.6		DW 116	10^3 | 10^2	10^1 | 10^0	
M m+1.7		DW 117			
M m+2.0	PRNR	DW 118			
M m+2.1		DW 119	1:	2: 0 | 0	Actual axis value offset (A-IV)
M m+2.2		DW 120	0 | 0	0 | 0 | 0 | 0=+ 1=- | 10^4	
M m+2.3	NC-M	DW 121	10^3 | 10^2	10^1 | 10^0	
M m+2.4	NC-MB	DW 122	e.g. DP 1 | 1 | 1 | 0 | 10^{-1}	10^{-2} | 10^{-3}	
M m+2.5	AI-V	DW 123	1: Bit	2: 10^1 | 10^0	NC machine data bits (NC-MB)
M m+2.6	SE-B	DW 124	0 | 0	0 | 0 0 0 Var. 0/1	
M m+2.7					

n ≙ 4 on NC1
26 on NC2
48 on NC3
70 on NC4

1: ≙ 1st rel. address
2: ≙ 2nd rel. address
see Section 4.9

m ≙ DB21 on NC1
DB23 on NC2
DB25 on NC3
DB27 on NC4

DP = decimal point

NC to PLC

M m.0	S Ø
M m.1	S from NC
M m.2	S from PLC
M m.3	F-EX
M m.4	S-SP
M m.5	
M m.6	TOA
M m.7	TOAB
M m+1.0	ZOE
M m+1.1	ZOP
M m+1.2	ZOEX
M m+1.3	
M m+1.4	R load
M m+1.5	
M m+1.6	
M m+1.7	
M m+2.0	PRNR
M m+2.1	
M m+2.2	
M m+2.3	NC-M
M m+2.4	NC-MB
M m+2.5	AI-V
M m+2.6	SE-B
M m+2.7	

DBm

	DL	DR	Designation
DW 125	1: Bit	2: 10^1 10^0	Write setting data bits (SE-B)
DW 126	0 0	0 0 0 0 Var. 0/1	
DW 127			
DW 128			
DW 129			
DW 130			
DW 131			
DW 132			
DW 133			
DW 134			
DW 135			
DW 136			
DW 137			
DW 138			
DW 139			
DW 140			
DW 141			
DW 142			
DW 143			
DW 144			

n ≙ 7 on NC1
29 on NC2
51 on NC3
73 on NC4

1: ≙ 1st rel. address
2: ≙ 2nd rel. address
see Section 4.9

m ≙ DB21 on NC1
DB23 on NC2
DB25 on NC3
DB27 on NC4

DP = decimal point

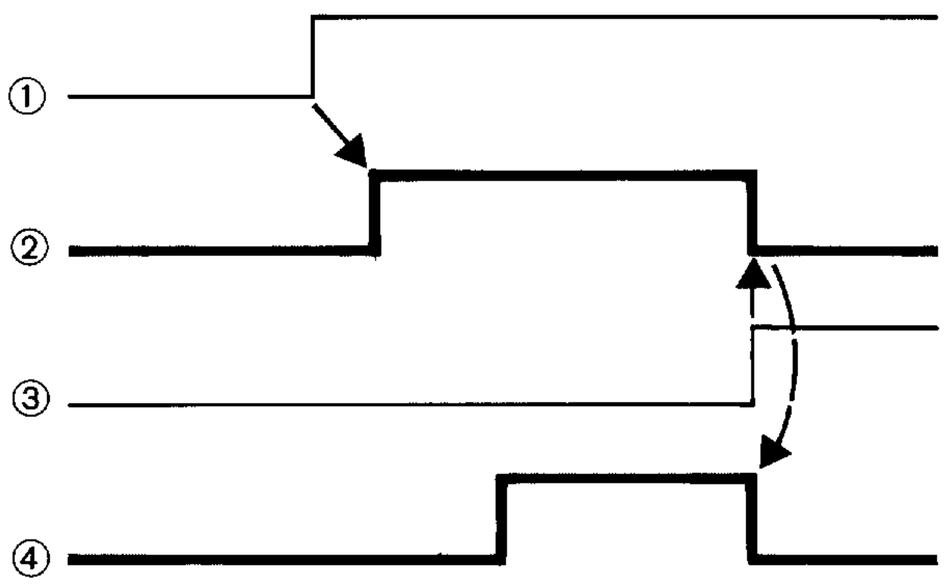
4.5 Description of PLC input signals from NC

4.5.1 Ready signals from NC to PLC

4.5.1.1 NC READY 1

1 Signal: After power on and reaching correct voltages

0 signal: Exceeding temperature limit 1 in SINUMERIK (warning message), with display on operator panel (alarm lamp and number)



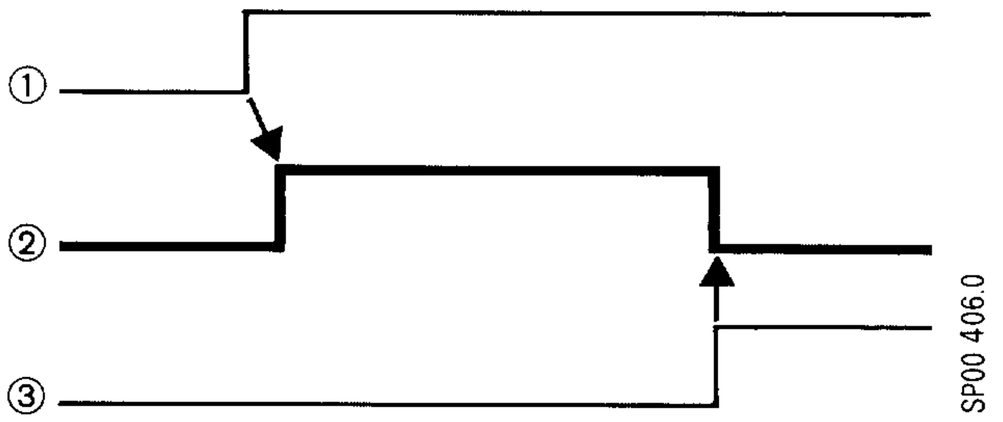
① Mains voltage
② NC READY 1
③ Warning message
④ READ-IN ENABLE

Note on application:
With the 0 signal, the interface control interrupts the program, for example, by preventing the input disable; i.e. the block being executed is completed.

4.5.1.2 NC READY 2

1 Signal: After power on and reaching correct voltages

0 signal: a) Exceeding temperature limit 2 in SINUMERIK (warning message)
b) Actuation of under-voltage monitor
c) Actuation of over-voltage monitor
d) Actuation of measuring circuit monitor



① Mains voltage
② NC READY 2
③ Fault message

Note on application:
Exceeding temperature limit 2 or actuation of the under-voltage or over-voltage monitors has the effect of switching off the control (incl. PLC) and therefore of deleting all the functions stored in the intermediate and main memories.

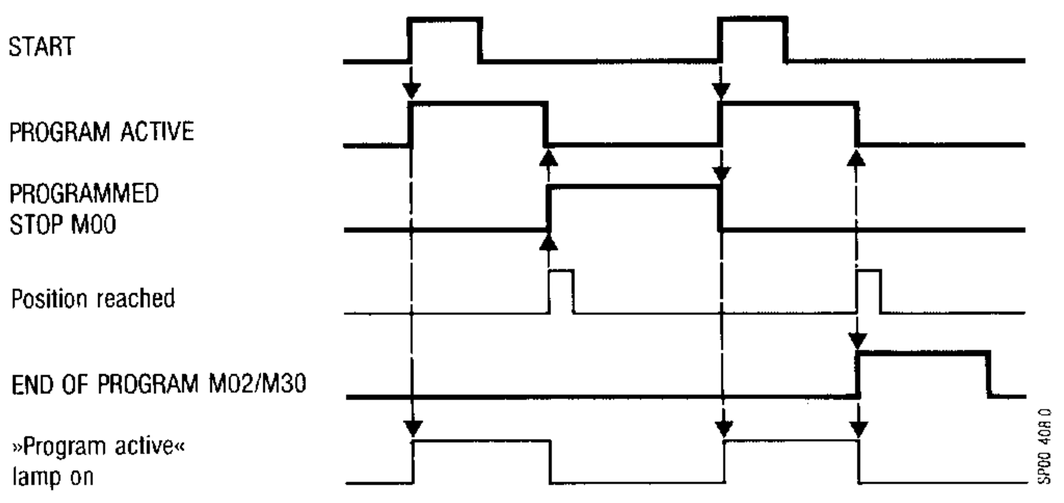
If the measuring circuit monitor trips, the feed drives and spindle drive are rapidly decelerated. The resulting alarms can be cleared by pressing the reset key. All the functions stored in the intermediate and main memories are deleted.

Note:
In addition to the NC READY 2 signal transmitted to the interface control, a similar signal also containing the computer monitoring function is transmitted to the NC/machine interface.

4.5.1.3 PROGRAM ACTIVE

With automatic operating modes AUT, MDA

1 signal: In automatic operating modes AUT and MDA, and NC start signal
0 signal: After RESET, block executed in single block, program stop, end of program, change of operating mode



4.5.1.4 V.24 (RS232) ACTIVE

1 signal: Data transfer active from or to control

0 signal: V.24 inactive

4.5.1.5 NC ALARM

1 signal: NC alarm active

0 signal: No NC alarm

4.5.1.6 SWITCHED TO 3T

1 signal: 3T with C axis switched to lathe operation

0 signal: 3T with C axis switched to milling machine operation

From software version D05 onwards, the signal is transmitted independent of the C axis:

1 signal: T version (lathe operation)

0 signal: M version (milling machine operation)

4.5.2 Program commands

4.5.2.1 RAPID TRAVERSE G00

With automatic operating modes AUT, MDA

1 signal: After data transfer of a block in which G00 has been programmed.

0 signal: a) After data transfer of a block in which another G function of the 1st G group has been programmed.
b) With RESET

With manual operating mode JOG

1 signal: With both the rapid traverse and direction keys pressed.

0 signal: a) Rapid traverse key released
b) Direction key released (rapid traverse key still pressed) and axis in position
c) With RESET

With operating mode approach reference point REF

1 signal: When direction key for movement towards reference point is pressed

0 signal: a) When reference point is reached
b) With RESET

Note on application:

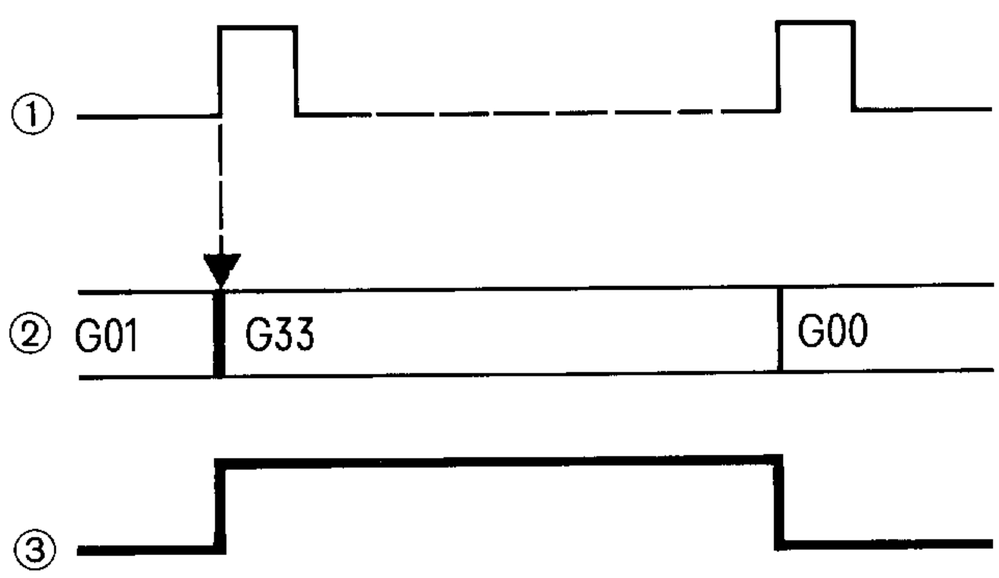
Engaging pumps

4.5.2.2 THREAD CUTTING G33/G63

With automatic operating modes AUT, MDA

1 signal: After data transfer of a block in which G33 or G63 has been programmed.

0 signal: a) After data transfer of a block in which another G function of the 1st G group has been programmed.
b) With RESET



① Data transfer to main memory
② Content of main memory
③ THREAD CUTTING G33/G63

Effect in SINUMERIK:

The following are inoperative:

With G33: a) Feedrate override switch
b) Feed hold ("feed enable" is not interpreted)
c) Spindle speed override switch
d) Individual block (stop at end of next block with G33 or G63)

With G63: Feedrate override switch

Note on application:
Feed hold can be achieved indirectly with G33 using Spindle OFF, in the form of a link between thread cutting and feed hold. In the case of G63, the spindle must be stopped in parallel with feed hold.

4.5.2.3 CONSTANT CUTTING SPEED G96

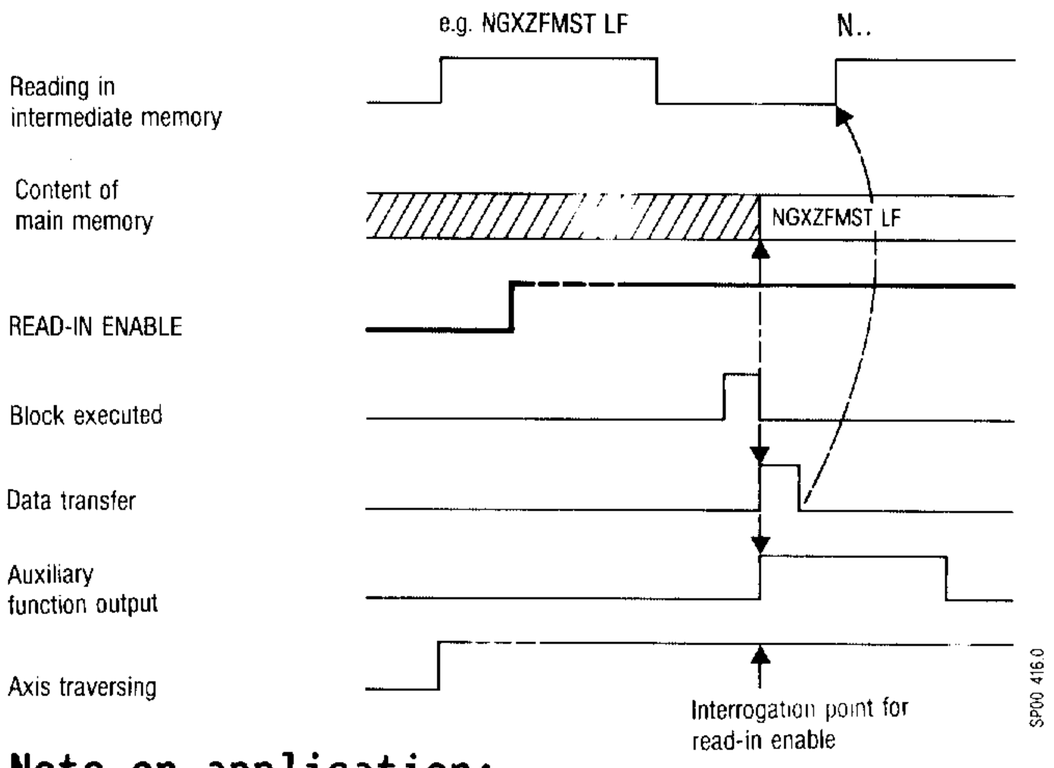
With automatic operating modes AUT, MDA

1 signal: After data transfer of a block in which G96 has been programmed.

0 signal: a) After cancelling by another G function in the same G group.
b) With RESET

4.5.2.4 PROGRAMMED STOP M00

1 signal: Block executed, auxiliary functions output, and M00 in main memory.
0 signal: a) With NC START
b) With RESET



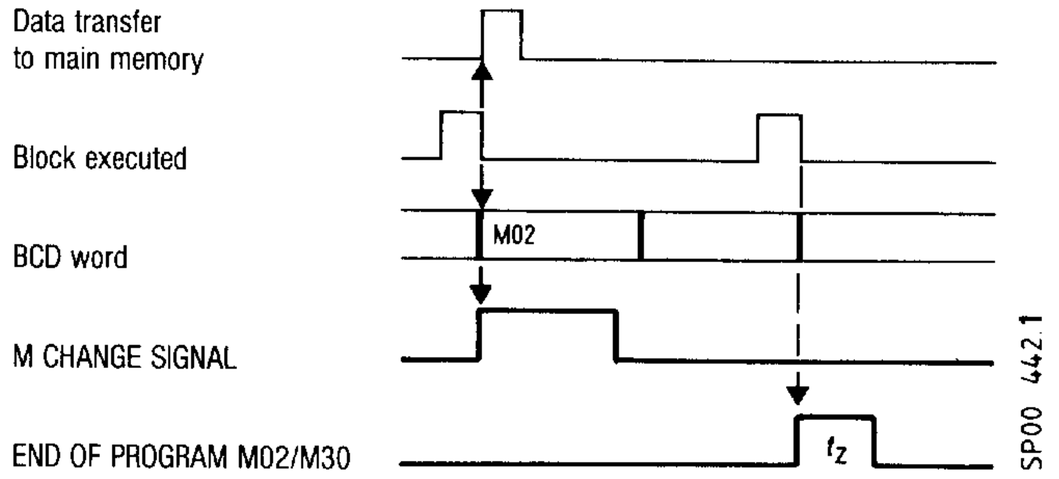
Note on application:
Stopping main spindle

4.5.2.5 END OF PROGRAM M02/M30

1 signal: a) Block executed, auxiliary functions output, and
- M02 in main memory
or
- M30 in main memory

b) With RESET

0 signal: After PLC acknowledgement (by PLC basic program after one PLC cycle)



Functions M02 and M30 are equivalent; M30 does not initiate reader rewind.

Note on application:

Clearing function memory, i.e. erasing the functions stored in the interface control.
Cannot be used directly for automatic function sequences in the interface such as bar feed, batch counting, or opening protective devices. The interface also has to use the BCD words M02 and M30 for these functions.

4.5.2.6 PROBE DEFLECTED

The condition of the probe can be interrogated to avoid the risk of probe breakage.

1 signal: Probe deflected

0 signal: Probe not deflected

4.5.3 Spindle signals

4.5.3.1 ACTUAL SPINDLE ROTATION CLOCKWISE

This signal is derived from the direction of the pulse transmitter.

1 signal: Actual rotation clockwise

0 signal: Actual rotation counter-clockwise

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4.5.3.2 SPINDLE SPEED LIMIT

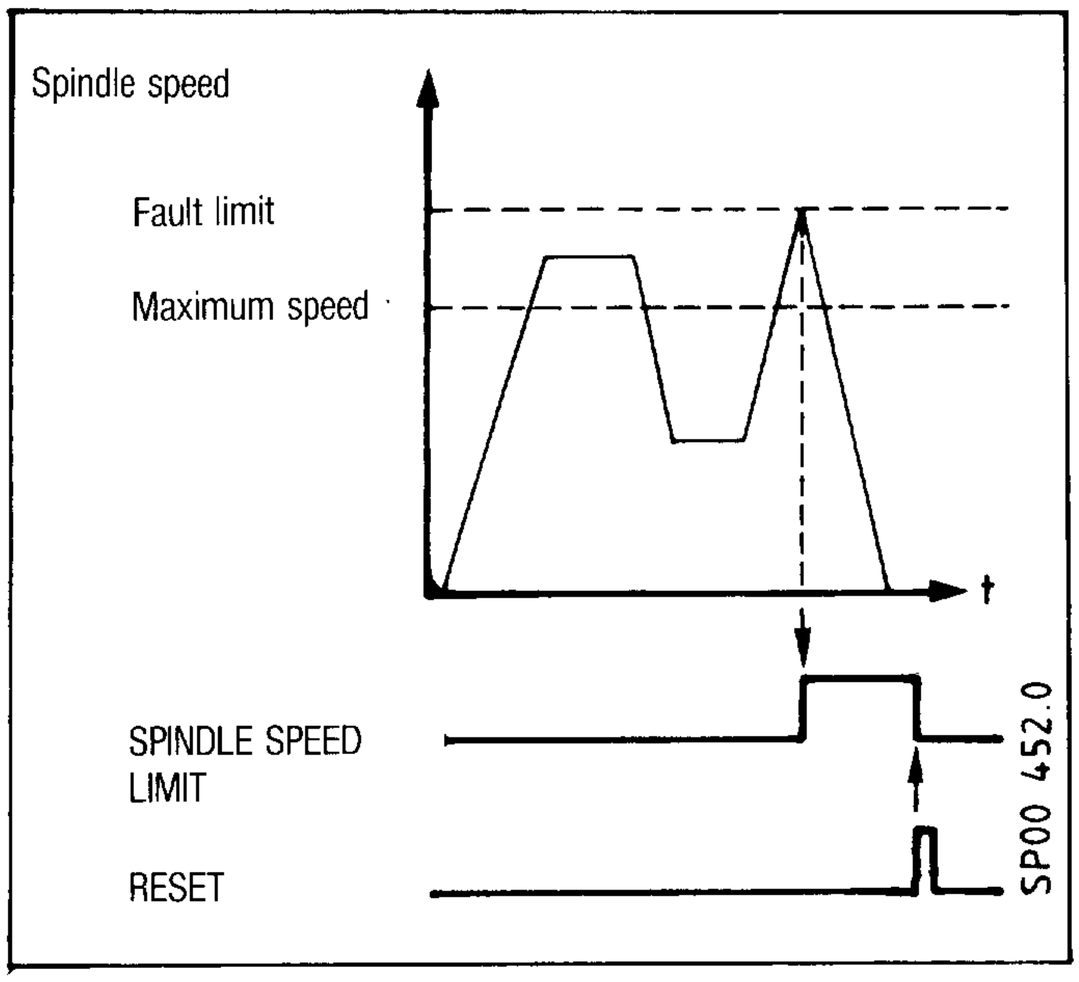
1 signal: Actual spindle speed has exceeded the tolerance window.

0 signal: Actual spindle speed within tolerance window.

The actual spindle speed is continuously monitored in comparison with the maximum speed limit plus a preset tolerance.

Maximum speed is:
- without G96: maximum gear stage speed
- with G96: the smaller of the two G96S.. limits and the maximum gear stage speed.

If actual spindle speed exceeds the tolerance limit, the spindle is stopped and the SPINDLE SPEED LIMIT signal and alarm 225 are set.



4.5.3.3 SPINDLE AT SPEED

1 signal: Actual spindle speed within command range (fault window)

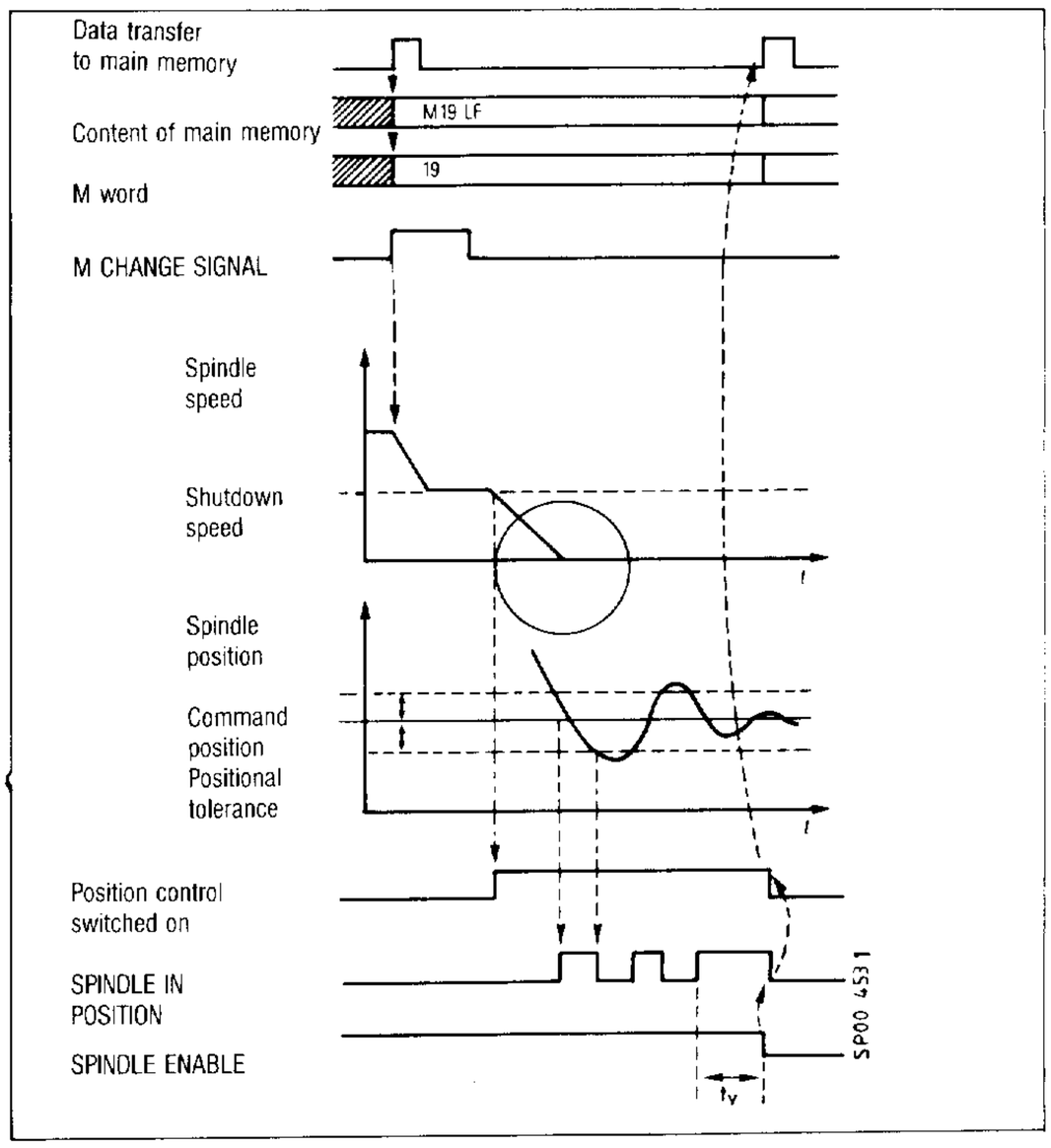
0 signal: Actual spindle speed outside command range

Note on application:
When the spindle has run up to the new command speed in accordance with the drive's ramp time constant (taking the selected gear stage into account), the message (actual spindle speed within command range) is transmitted to the PLC.

4.5.3.4 SPINDLE IN POSITION

1 signal: With spindle in position

0 signal: With spindle not in position
With spindle stop



The SPINDLE IN POSITION signal is transmitted with M19 in the position control range only if the actual position is within the position limit (NC machine datum). The signal is cancelled in the event of overshooting beyond this limit. This can occur if the spindle position or speed controller has been incorrectly optimized, and also in conjunction with close position limits. SPINDLE ENABLE must not be reset by the PLC until the spindle has returned to the proper position. In the event of pronounced overshooting, users are recommended not to remove SPINDLE ENABLE until after a delay, when the SPINDLE IN POSITION signal has been active uninterruptedly for time t_v.

4.5.3.5 SPINDLE STOPPED

1 signal: Actual spindle speed within standstill range

0 signal: Actual spindle speed outside standstill range

4.5.4 Axis-specific signals

4.5.4.1 REFERENCE POINT REACHED

1 signal: After reaching reference point and synchronizing the axis. Signal remains active until power supply switched off.

0 signal: Before synchronizing the axis.

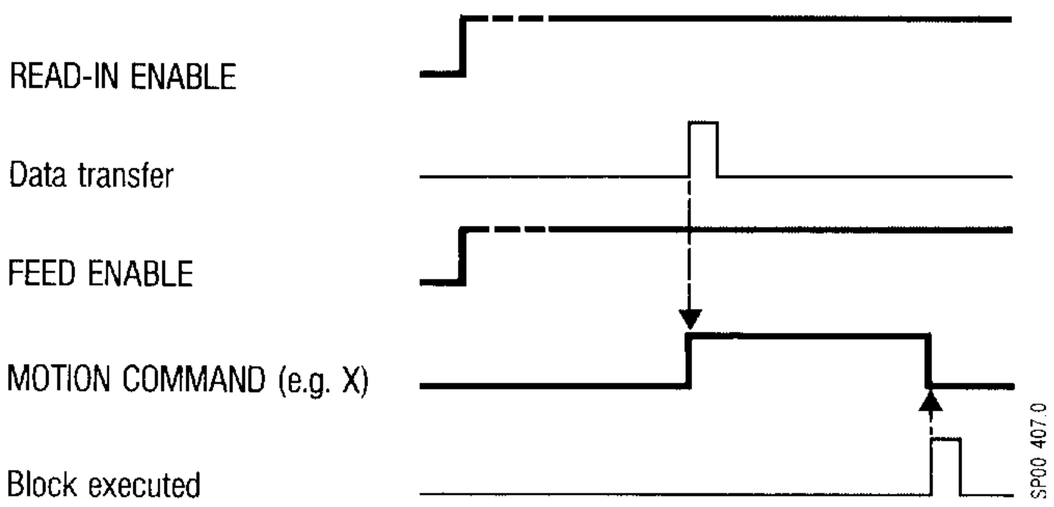
4.5.4.2 MOTION COMMAND

A single motion command for both directions is given for each axis.

With automatic operating modes AUT, MDA

1 signal: After data transfer to the main memory for one block; the block must contain at least one coordinate value

0 signal: a) When the block has been executed
b) With RESET
c) With axis disable active



With setting-up operating modes JOG, INC, REF

1 signal: Axis selected and/or direction key pressed. With REF, only after direction key for movement towards reference point is pressed.

0 signal: a) With manual/handwheel JOG if:
- direction key released and digital 0
- traverse using handwheel

b) With incremental feed, if traverse is complete and measuring circuit 0

c) With movement towards reference point, when the measuring point is reached and measuring circuit 0

d) Immediately with RESET

Note on application:
For machines with axis clamping, this function can be used to determined which clamps have to be released.

4.5.4.3 SPINDLE SPEED AT LIMIT

This signal is set in conjunction with spindle speed restriction by the NC.

1 signal: a) Programmed spindle speed greater than maximum speed of selected gear stage

b) Programmed spindle speed greater than absolute spindle speed limit (MD 370)

c) Programmed spindle speed greater than spindle speed limit stored under G92 S..

0 signal: Spindle speed not restricted by NC.

4.5.4.4 G37 selected

With automatic operating modes AUT, MDA

1 signal: After data transfer of a block in which G37 (TRANSMIT coordinate transformation) has been programmed.
0 signal: After data transfer of a block in which G36 (deselect coordinate transformation) has been programmed.

4.5.4.5 G38 selected

With automatic operating modes AUT, MDA

1 signal: After data transfer of a block in which G38 (DOUBLE TRANSMIT coordinate transformation) has been programmed.
0 signal: After data transfer of a block in which G36 (deselect coordinate transformation) has been programmed.

4.5.4.6 G39 selected

With operating modes AUT, MDA, JOG and INC

1 signal: Coordinate rotation G39 selected.
0 signal: Coordinate rotation G39 not selected.

4.6 Description of PLC output signals to NC

4.6.1 Ready signals from PLC to NC

4.6.1.1 *EMERGENCY OFF

1 signal: Operating status: no emergency off key actuated

0 signal: Emergency off status: one of the emergency off keys actuated

Note on application:

The 0 signal effects rapid deceleration of the feed drives and spindle drive at maximum braking current. The position control loop is opened and the NC goes into follow-up operation. Following this, only the actual position values are updated. After the EMERGENCY OFF status has been cancelled with RESET, the axes do not have to re-synchronized (no approach to reference points)

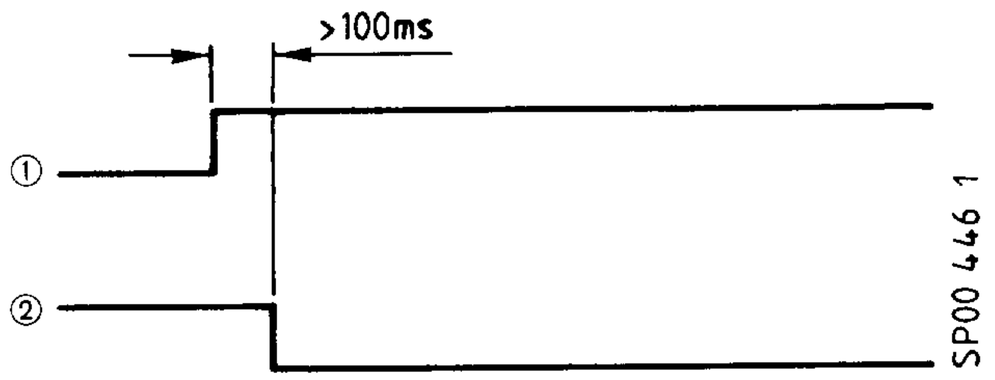
4.6.1.2 OPERATOR PANEL DISABLE

The operator panel disable signal permits controlled operation of several NC's with a single operator panel

1 signal: No inputs possible at operator panel (e.g. disabled by disable key switch).
0 signal: Inputs can be made at operator panel.

Switching operator panel between several controls

(e.g. from control 1 (NC1) to control 2 (NC2).)



① Operator panel disable (NC1)
② Operator panel disable (NC2)

From basic program version 548817.5....03 onwards, the time sequence of operator panel disable signals (greater than 100 ms) can be disregarded, since this function is realized in the basic program.

4.6.1.3 KEY LOCK

The key lock signal deactivates the NC keys. However, the key image is still updated.

1 signal: No inputs to NC possible at operator panel, e.g. with display program selected.
0 signal: Inputs to NC can be made at operator panel.

Note on application:

Key inputs can be made for the interface control with the 1 signal.
Key inputs are ignored by the NC. From basic program version 548817.5....03 onwards, the reset key function is transferred to the NC if the key lock is actuated. This can be prevented with the PLC machine datum "reset key inoperative with key lock".

Key image

The key image (TA) and key pulses (IM) are updated in data block DB14 approx. every 50 ms (plus PLC cycle time). The key pulses remain active for one PLC cycle.

DBn	DB14	
TA	IM	TA
DW31	DW22	DW16
DW32	DW23	DW17
DW33	DW24	DW18

n = 20 on NC1
22 on NC2
24 on NC3
26 on NC4

Bit 0															
7 %	6 Z	5 Y	4 X	3 K	2 J	1 I	0 D	G	T	S	F	R	L	9 N	8 /
				M	LF	P	4	↓	→	↑			NO	YES	
	PC	H				←									1)

Select NC image:
1 PLC cycle Set D24.11

1) Key switchover, LEDs
0 ≙ Digit
1 ≙ Address

SP0447.3

4.6.1.4 V.24 (RS232) DISABLE

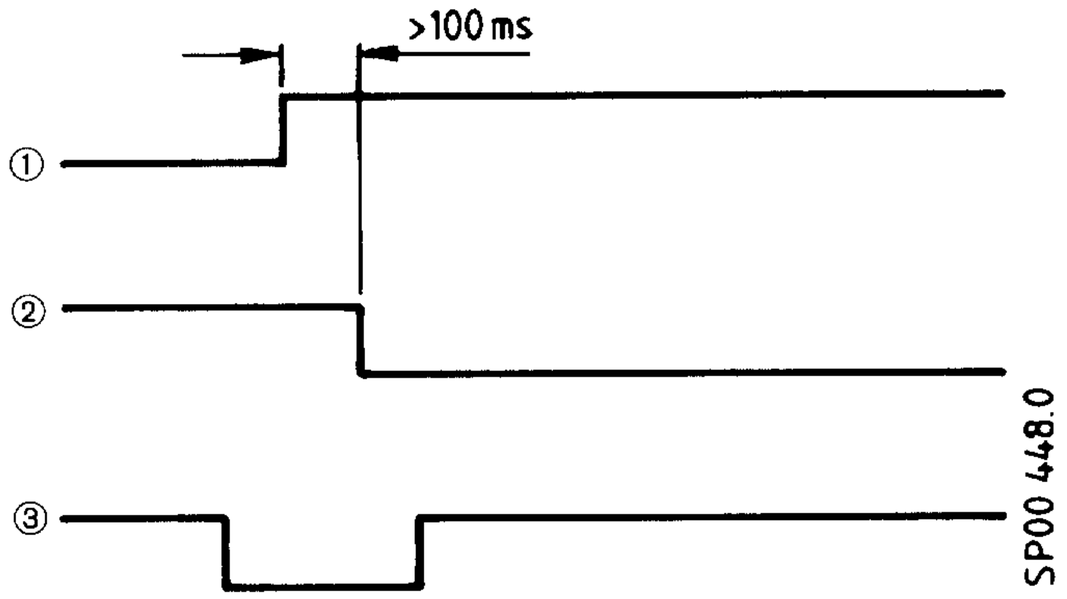
The V.24 disable signal permits the V.24 interface to be disabled by the interface control. This is necessary when switching the V.24 interface between several controls.

1 signal: V.24 interface disabled

0 signal: V.24 interface enabled

Switching V.24 interface between several controls

(e.g. from control 1 (NC1) to control 2 (NC2).)



① V.24 (RS232) DISABLE (NC1)
② V.24 (RS232) DISABLE (NC2)
③ V.24 (RS232) ACTIVE

4.6.1.5 CYCLE DISABLE

1 signal: All cycles (manufacturer's permanent subroutines: L80 to L99 and L900 to L999) are disabled from input, modification, display, and output.
R parameters updated in display only up to the R parameter display limit (machine datum 382).

When using the Options (cycles), it is essential that this signal is set to "1" after reading in the cycles.
For servicing purposes, a circuit should be included to cancel this cycle disable.

0 signal: Access permitted to cycles and all R parameters.

Note on application:

When the cycle disable is active (1 signal), the blocks listed below are not entered in the main memory, but processed at intermediate memory level in order to save block processing time:

1. Parameter definition and calculation, whereby R parameters outside the limit for R parameter display are modified (machine datum N382).
2. Jump instructions.
3. Blocks without information, e.g. N200 LF or N205 (COMMENTS) LF

4.6.1.6 HANDWHEEL DISABLE

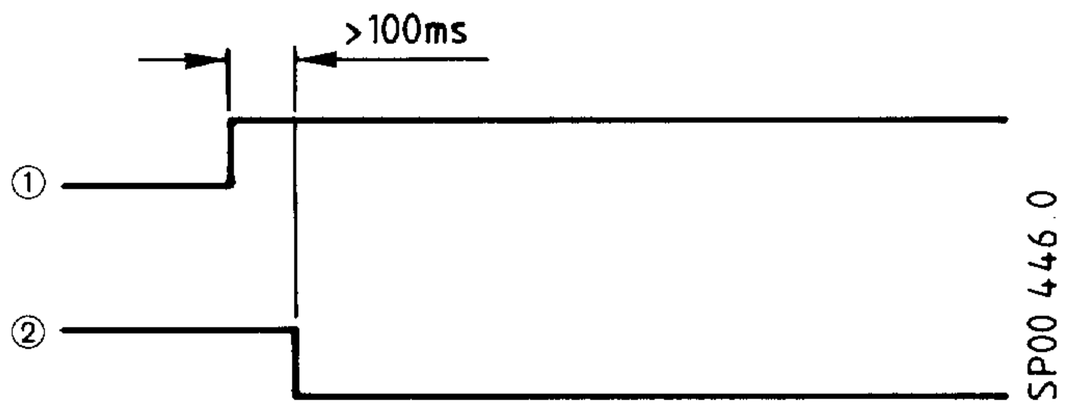
The handwheel disable signal permits the handwheel to be disabled by the interface control.
This is necessary when switching the handwheel between several controls.

1 signal: Handwheel disabled

0 signal: Handwheel enabled

Switching handwheel between several controls

(e.g. from control 1 (NC1) to control 2 (NC2).)



① Handwheel disable (NC1)
② Handwheel disable (NC2)

4.6.1.7 RESET

1 signal: Reset for control

0 signal: No reset

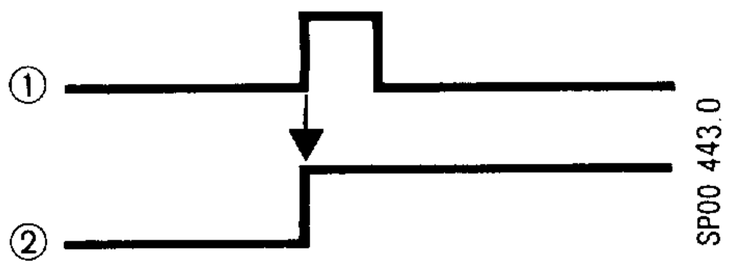
Note on application:

If the key lock is active, the reset function can be diverted via the interface control.

4.6.1.8 DATA START

1 signal: Start of data input or output

0 signal: Data start not actuated



① DATA START
② V.24 (RS232) ACTIVE

Note on application:

The data start signal must be active for at least 60 ms.

4.6.2 Influencing the program

4.6.2.1 START

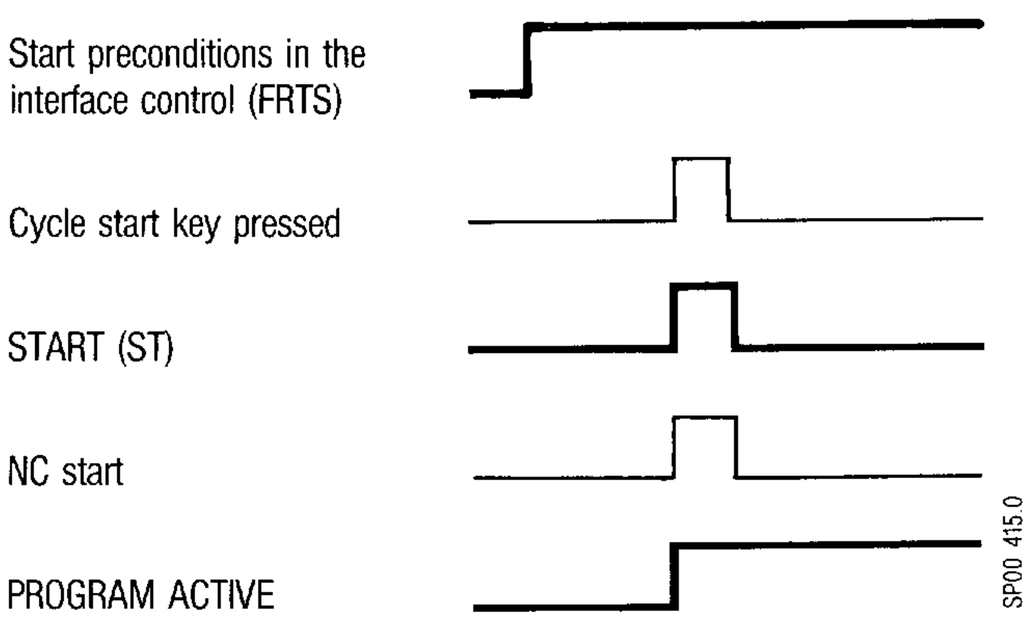
1 signal: Control cycle start key or start key actuated.

0 signal: No start key actuated.

4.6.2.2 START ENABLE

1 signal: Start preconditions of interface control (FRST) satisfied.

0 signal: Start preconditions of interface control (FRST) not satisfied.



The NC START signal is transmitted to the NC when the ST (Start NC) command is given with FRST active. The signal is suppressed if the "re-store" function was executed during interrupted automatic operation.

Effect in SINUMERIK:

With automatic operating modes AUT, MDA

With READ-IN ENABLE active, the NC START signal has the following effect:

a) Program start with the first block of the machining program stored in and called from the program memory.

b) After block search in the program memory: program start with the block that leads to the starting point (3T/3TT) of the preselected block.

c) Following a programmed stop M00: restart of automatic machining sequence

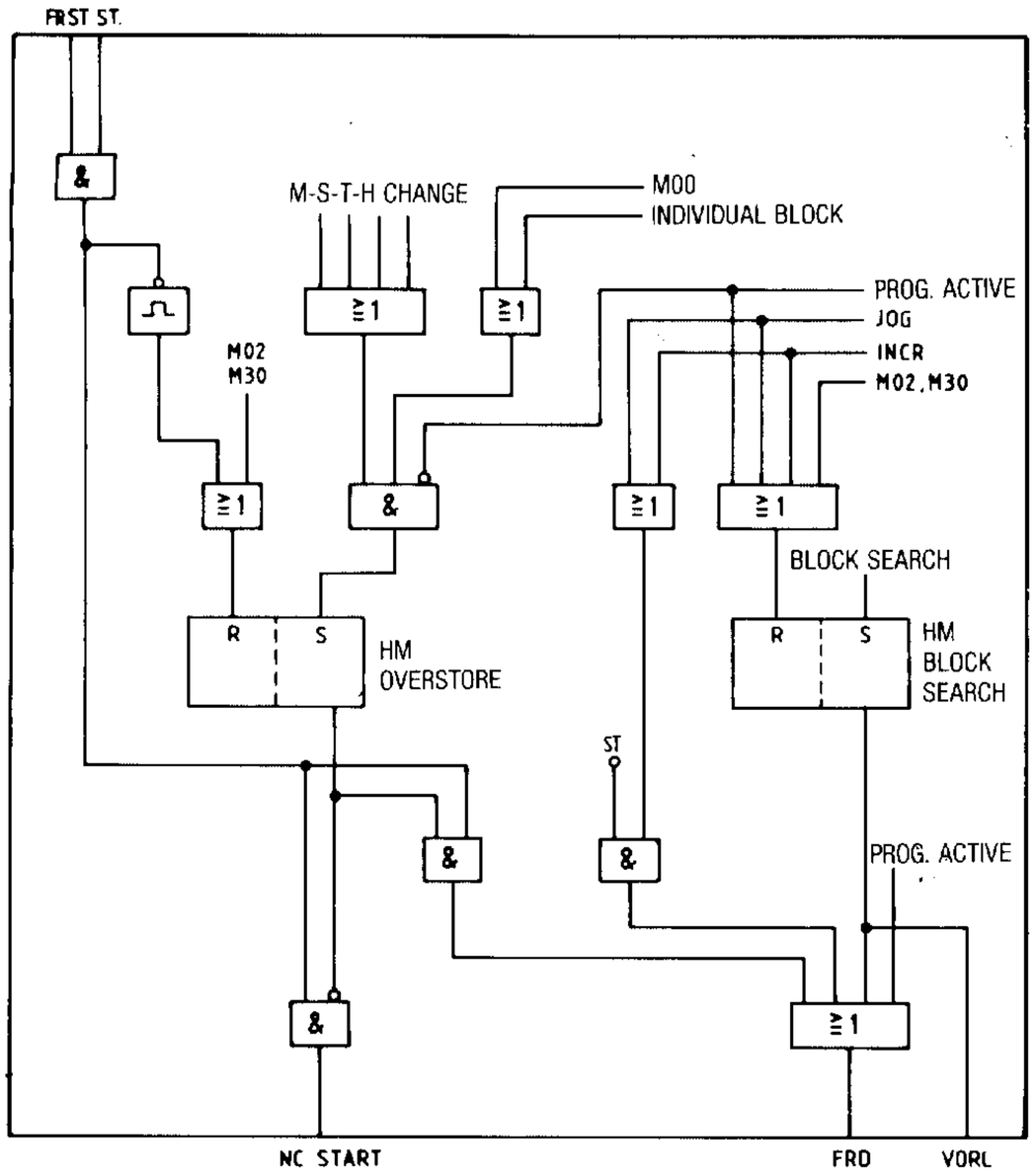
d) In AUT operating mode, single block after "block executed" and "auxiliary functions output": execution of the next block.

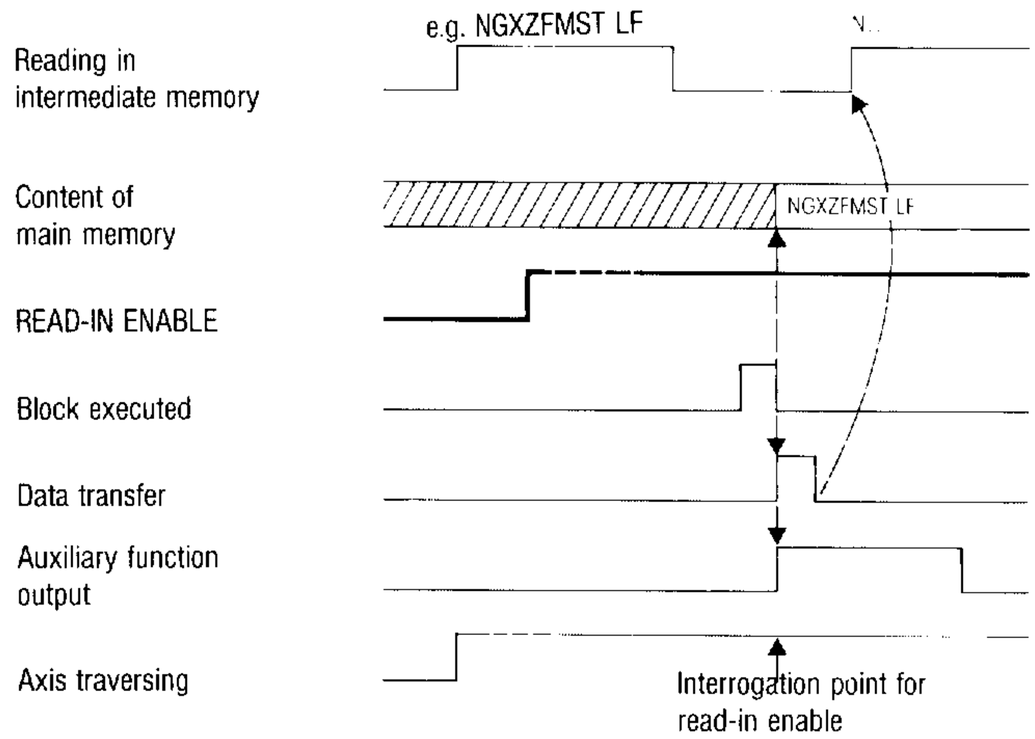
If no read-in enable signal is present when the NC START signal is given, no information is transferred to the main memory and no blocks are executed.

If the data enable input signal is given subsequently, the information is transferred to the main memory without a second NC START signal and processing begins.

The FRD (enable decoding) signal is output if:

- the NC program is active
- search is selected for the NC program
- an M, S, T or H function has been overstored and ST or FRST preselected during interrupted automatic operation, or
- ST or FRST were preselected for the JOG or INC operating modes.





Start precondition: reference point reached

A machine datum that monitors "reference point approaches" as a start precondition in the control can be used to inhibit the start of the automatic machining cycle.

4.6.2.3 READ-IN ENABLE

The READ-IN ENABLE signal is active in automatic operating modes AUT and MDA, and in setting-up modes JOG and INC.

With automatic operating modes AUT, MDA

1 signal: Permits transfer of data from intermediate memory to main memory
a) if "block executed" and the auxiliary functions of the preselected block have been output
b) if the next block has been input after NC START in conjunction with automatic operation, single block, or preceding M00.

0 signal: Disable data transfer from intermediate to main memory.

With setting-up operating modes JOG, INC

The input auxiliary functions are active after pressing the input key with READ-IN ENABLE active.

4.6.2.4 CANCEL DISTANCE TO GO

1/0 transition: Distance to go not cancelled

0/1 transition: Distance to go cancelled

With the 0/1 transition, the distance to go (difference between command and actual position) is cancelled for all axes. Following errors are always traversed. Active dwell blocks are interrupted. The "cancel distance to go" signal must be active for at least 60 ms.

Caution:

After "cancel distance to go", a program block with G90 in the cancelled axis has to follow.

4.6.2.5 CANCEL REMAINING SUBROUTINE PASSES

With automatic operating modes AUT, MDA

1 signal: Cancels remaining number of subroutine passes.

0 signal: Does not cancel remaining number of subroutine passes.

Note on application:

The remaining subroutine controlled passes can be cancelled via the interface control. This function can be used, for example, to synchronize the NC control with an externally reported machine position.

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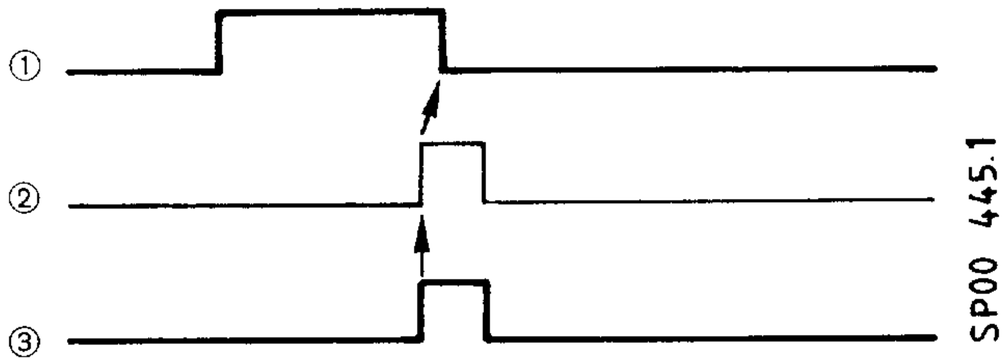
The subroutine pass that is currently being executed is completed as far as M17. The 0 signal must be active until the end of the subroutine.
Comply with the following programming method and interface signal sequence to cancel a specific subroutine.

Programming:

N5 ... LF
N10 L8099 LF
(Program section in which remaining subroutine passes are cancelled. PLC removes "cancel remaining subroutine passes" with M17.)

N11 G04 ... LF
(The dwell time must be set to 1.2 times the max. PLC cycle time.)

N12 @ 31 or L99 LF
(Clear intermediate memory)



① CHANCEL REMAINING SUBROUTINE PASSES
② Valid M17 decoded
③ M CHANGE SIGNAL

4.6.2.6 PILOT CONTROL

0 signal: Pilot control off

1 signal: Pilot control on

Following error of approx. 0 now results during traverse in the position control loop.
The pilot control has a differential quota that can be set between 0 and 7 for each axis with machine data 430-33, bits 0-2.

0 = No differential quota
7 = High differential quota

A high differential quota can result in pronounced overshooting of the command speed value.

Deceleration in the part command value channel can be set to between 0 and 7 for each axis with machine data 430-33, bits 3-5.

0 = No deceleration
7 = Maximum deceleration

This deceleration can be used to diminish overshooting of the command speed value.

The pilot control should be switched on and off only with the machine at a standstill (dwell time etc.).

4.6.3 Influencing the feedrate

4.6.3.1 FEED ENABLE

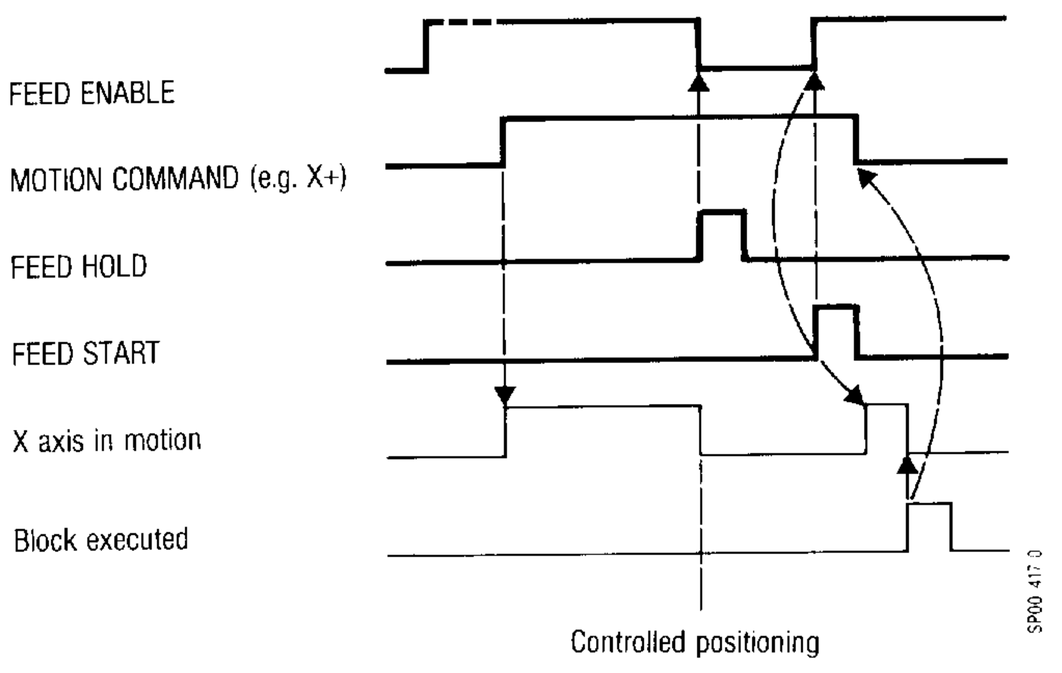
General feed enable

With automatic operating modes AUT and MDA, and setting-up operating modes JOG, INC and REF

1 signal: Effects feed enable for all axes.

0 signal: Effects feed hold for all axes, e.g. when a feed hold element is actuated.

Axes in motion are brought to a standstill along the contour.
The position control remains operative, i.e. the following error is reduced to zero.



FEED ENABLE (axis-specific)

The interface control issues a separate FEED ENABLE signal for each axis.

With automatic operating modes AUT, MDA

1 signal: Effects feed enable for the relevant axis. The axis-specific feed enable is also active for thread cutting (G33).

0 signal: Effects feed hold for all axes only if the feed enable is removed for an axis in motion. In such cases, the axis is brought to a standstill along the contour.
The position control remains operative, i.e. the following error is reduced to zero.
If the 0 signal is given in conjunction with thread cutting, the control generates alarm no. 523 (hold with thread cutting).

With all setting-up operating modes JOG, INC and REF

1 signal: Effects feed enable for the relevant axis.

0 signal: Effects feed hold for the relevant axis.

4.6.3.2 HANDWHEEL X/Z (3T/3TT)

This signal preselects the axis for movement with the handwheel in the JOG setting-up mode.

1 signal: X axis

0 signal: Z axis

4.6.3.3 FLYING MEASUREMENT

This signal activates the measuring procedure.

1 signal: Measuring procedure activated with 0/1 edge.

0 signal: Not active.

4.6.4 Influencing the spindle

4.6.4.1 GEAR STAGE CODING

A variable-speed gearbox connected to the output side of the DC motor provides a larger speed range at the spindle. S programming refers to the speed of the main spindle, and not to that of the DC motor. Therefore, the gear stages have to be taken into account when calculating command speed values.

Gear stages are programmed, for example, under address M, and selected by the machine control after decoding in the interface control.

Feedback is in coded form.

Gear stages	Input signals		
	A	B	C
1	0	0	0
2	1	0	0
3	0	1	0
4	1	1	0
5	0	0	1
6	1	0	1
7	0	1	1
8	1	1	1

The control takes the gear stages into account when determining the analog spindle speed so that the programmed speed is obtained at the main spindle.

Gear stage 1 is allocated to the low spindle speed range. Unavailable stages must not be offered to the NC in cases where there are less than 8 stages. The input signals are continuously interrogated by the NC, so that the speed changes immediately if the code is altered.

4.6.4.2 SPINDLE ROTATION CLOCKWISE COMMAND

1 signal: POSITIVE command voltage (rotation clockwise command = M03)
0 signal: NEGATIVE command voltage (rotation counter-clockwise command = M04)

Direct spindle control by NC:

With automatic operating modes AUT and MDA, and setting-up operating modes JOG and INC

This signal is active only in conjunction with external data input. It is interrogated starting with the first "external data input S" and then continuously and cyclically until RESET.

If an S value is entered by external data input during program execution, the programmed spindle data with a direct effect in the NC are blocked until the end of the program or RESET.

Note on application:

Spindle speeds and direction input by interface control during manual setting-up operation.

4.6.4.3 SPINDLE ENABLE

0 signal: Stops the spindle; deceleration is in accordance with the ramp characteristic.
Completion of M19 function, spindle in position.

1 signal: Effects main spindle drive enable with spindle rotation direction and spindle speed active.

Pulse length greater than/equal to 36 ms

Note on application:

As is the case with EMERGENCY OFF and a programmed S = 0, the spindle is brought to a standstill in accordance with the ramp characteristic when SPINDLE ENABLE is removed. When command speed 0 has been reached and after an adjustable delay (machine datum), 0 Volt (speed command contact opens) and controller disable are output.
When the SPEED ENABLE signal is given, the previous speed command value becomes effective and the spindle runs up to speed.

With M19, the position control is switched off when SPINDLE ENABLE is removed. Following positioning with M19 selected (message: SPINDLE IN POSITION), 0 Volt and controller disable are output and block change enabled in the active program (depending on machine datum TE 407, bit 5) without a delay when the SPINDLE ENABLE is removed.

4.6.4.4 NEW SYNCHRONIZATION OF SPINDLE

1 signal: The spindle is re-synchronized during the next rotation.

0 signal: Not active.

4.6.4.5 FOLLOW-UP OPERATION OF SPINDLE

1 signal: Deactivation of spindle monitor (alarm if maximum speed exceeded).

0 signal: Spindle monitor active.

4.6.5 Axis signals - general

4.6.5.1 4TH AXIS = MAIN AXIS (3M)

1 signal: 4th axis = main axis, parallel axis = supplementary axis

0 signal: 4th axis = supplementary axis, main axis remains main axis

Note on application:

The 4th axis can be designated the main axis with the SINUMERIK 3M control. Tool compensation is not taken into account on a supplementary axis.

A machine datum determines which axis operates in parallel with the 4th axis and which axis assumes the function of the main axis when this signal is active.

4.6.5.2 MIRROR IMAGE

a) On SINUMERIK 3T

1 signal: Mirror image in selected axes X and Z (all combinations possible)

X axis:

Mirror image of:
- programmed values
- arc direction of rotation (G02, G03)
- cutter radius compensation (G41, G42)
- tool length compensation
- tool tip position

No mirror image of:
- zero offset

Z axis:

Mirror image of:
- programmed values
- arc direction of rotation (G02, G03)
- cutter radius compensation (G41, G42)

No mirror image of:
- zero offset
- tool length compensation
- tool tip position

0 signal: Mirror image inoperative.

Note on application:

When a mirror image is provided in the X axis, it is always the axis that is reflected. This function can be used on lathes with 2 turrets on an X axis saddle. The workpiece is programmed as though the entire machining procedure were executed with the main turret. The distance between the reference points of turrets 1 and 2 is taken into account in the program by G59 X... (programmable zero offset) when the 2nd turret is selected.

When a mirror image is provided in the Z axis, it is always the workpiece that is reflected.

b) On SINUMERIK 3M

1 signal: Mirror image in selected main axes X, Y and Z (all combinations possible)

Main axes X, Y and Z:

Mirror image of:
- programmed values
- arc direction of rotation (G02, G03)
- cutter radius compensation (G41, G42)

No mirror image of:
- zero offset
- tool length compensation

0 signal: Mirror image inoperative.

Note on application:

When a mirror image is provided in main axes X, Y and Z, it is always the workpiece that is reflected.

4.6.5.3 2ND SOFTWARE LIMIT SWITCH X - ACTIVE

1 signal: Second software limit switch active for negative X direction.

0 signal: First software limit switch active.

Note on application:

With tailstock forward.

4.6.5.4 AXIS DISABLE GENERAL

1 signal: No speed command value issued to the axes (axes disabled). Position control loop remains closed.

0 signal: Normal status.

Note on application:

The disabled axes are held at command value = 0.

Example of application:

When commissioning or running a program sequence test. Axis movement is disabled.

4.6.5.5 SWITCHOVER TO 3T

1 signal: 3T with C axis switched over to lathe operation.

0 signal: 3T with C axis switched over to milling machine operation.

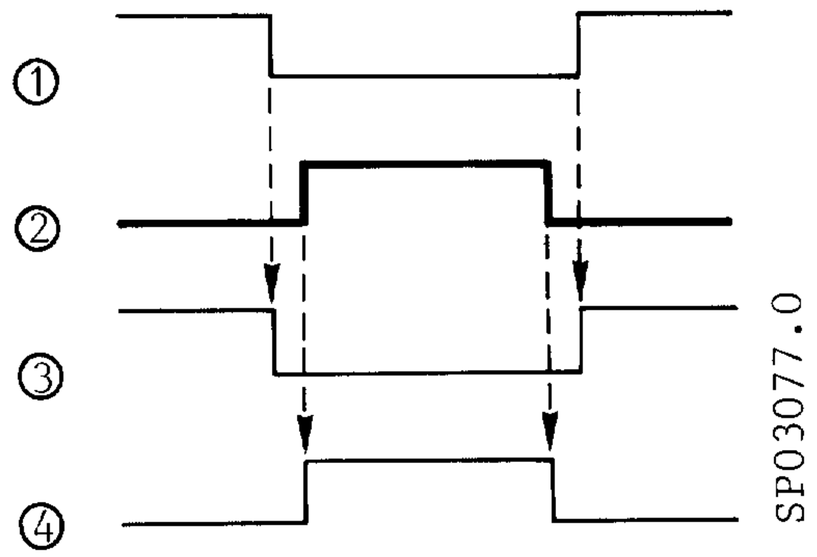
4.6.6 Axis-specific signals

4.6.6.1 FOLLOW-UP OPERATION

A separate FOLLOW-UP OPERATION signal is interpreted for each axis.

1 signal: NC position control loop open; drives can be operated via external speed command value.

0 signal: Normal status; NC position control loop closed.

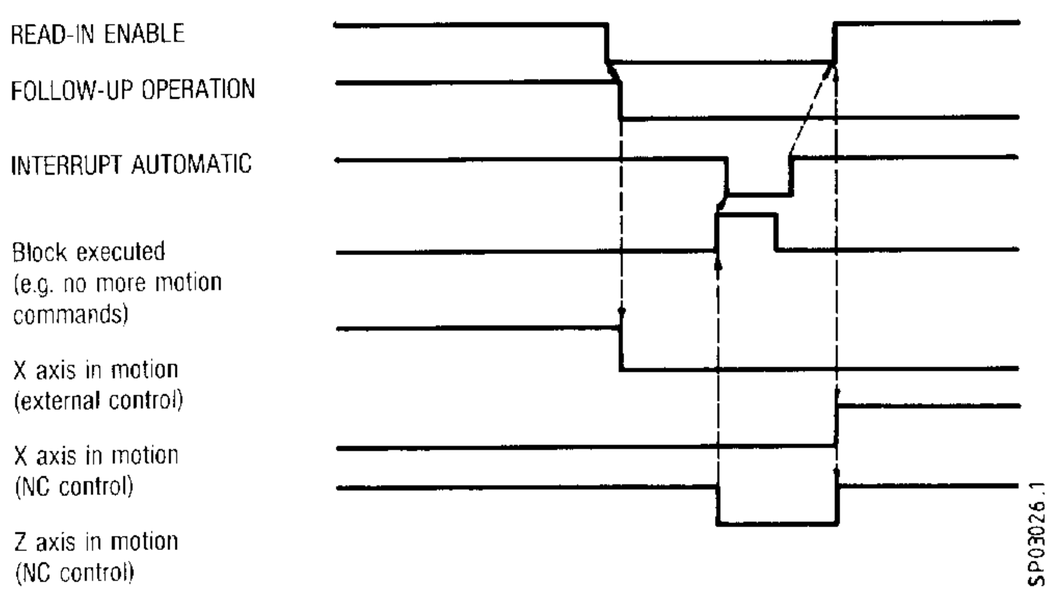


① MOTION COMMAND +X
② FOLLOW-UP OPERATION
③ X axis in motion (NC control)
④ X axis in motion (external control)

Note on application:

When follow-up operation is cancelled (0 signal), the axis does not have to be re-synchronized (no approach to reference point).
If the transmitter is switched off or the maximum pulse frequency exceeded by the measuring circuit, the axis has to be re-synchronized (approach reference point).
Axes must not be addressed by the active program in any automatic operating modes during follow-up operation (external axis control), otherwise the feed hold signal will be given.
Cancelling follow-up operation during an active program can lead to incorrect positioning in all automatic operating modes.
The following sequence must be complied with in all automatic operating modes:

- Remove read-in enable
- Cancel follow-up operation. During cancellation, no axes must be moved and there must be no active residual distance.
- When the block has been executed (no motion commands active), interrupt automatic operation without RESET to JOG. This synchronizes the actual value system. Give the READ-IN ENABLE after the automatic interrupt.
- All the axes can now be controlled by the NC. The axis that was previously controlled externally in the follow-up mode (X in this case) must now be programmed in the part program with <u>absolute dimensions</u> (G90).



The "*CONTROLLER DISABLE" signal is given briefly on axes in the follow-up mode when "FEED HOLD" is issued for an axis that is in motion. This can be avoided by removing the axis-specific "CONTROLLER DISABLE" signal together with the "FOLLOW-UP" signal at the same time.

4.6.6.2 <u>AXIS DISABLE</u>

1 signal: No speed command value issued to the relevant machine axis (axis disabled). Position control loop remains closed.

0 signal: Normal status.

<u>Note on application:</u>

The disabled axis does not receive any movement commands.

<u>Example of application:</u>

During commissioning, e.g. to plot the path of 2 axes only.

4.6.6.3 <u>*DECELERATION</u>

In the reference point approach mode REF, the control interprets a "*DECELERATION" limit switch signal for each axis. This signal permits the reference point to be approached at the appropriate speed, e.g. rapid traverse.

Both signal edges are effective:

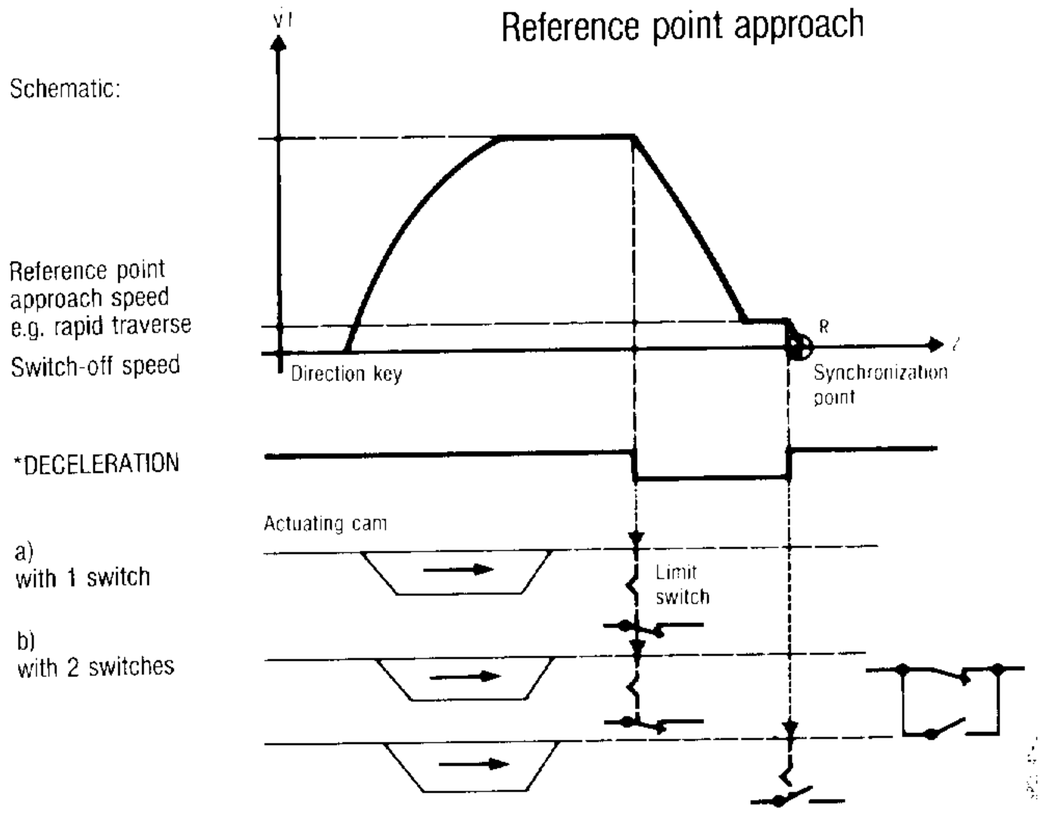
1/0 transition: Effects deceleration of the selected axis to the internally adjustable switch-off speed.

0/1 transition: Effects traverse to the zero mark of the measuring system plus 2 mm displacement.

<u>Note on application:</u>

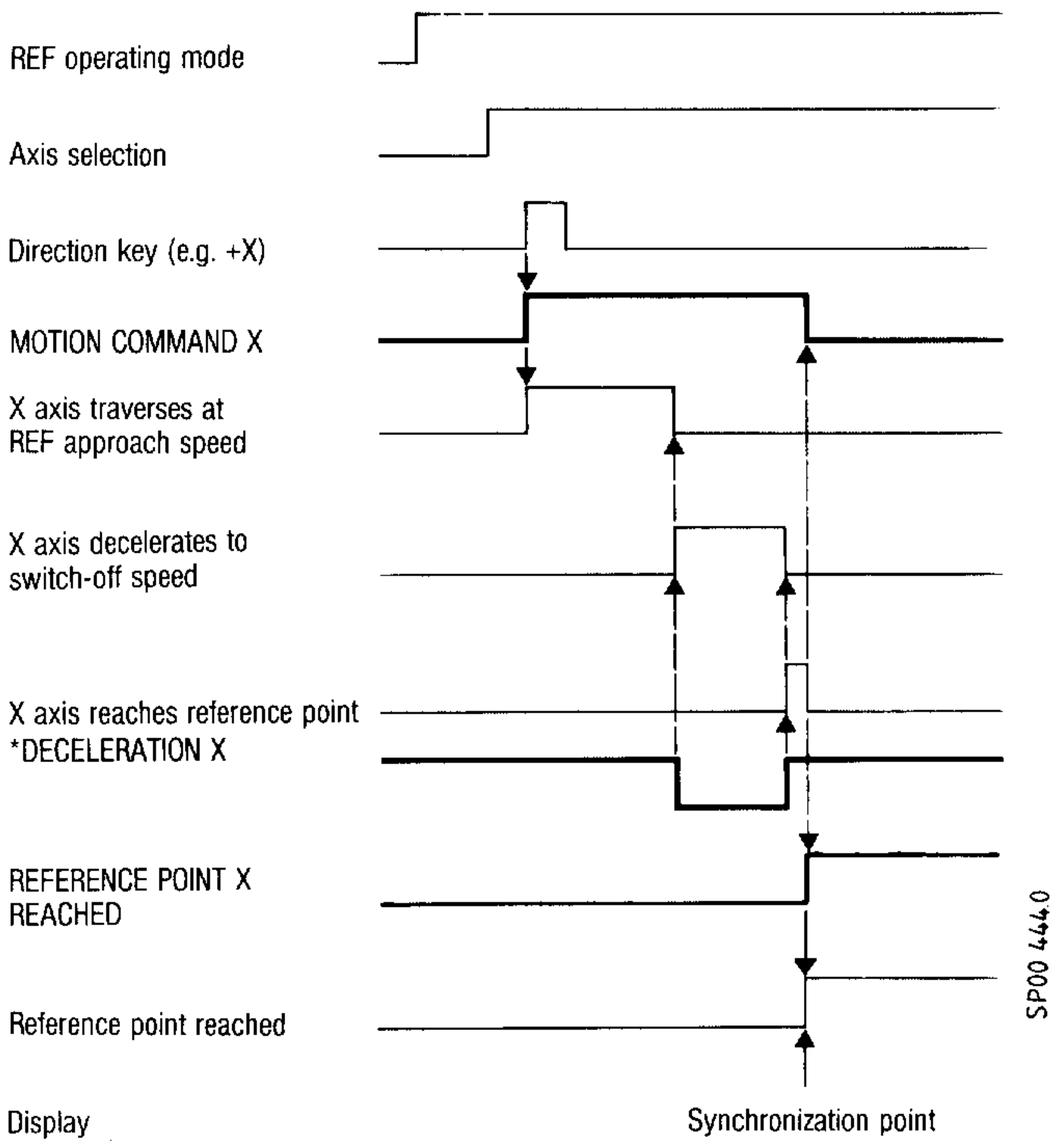
This function can be realized using a cam to actuate a normally closed contact.

If the available limit switch does not close quickly enough (see "Adjustments"), use two cams on different tracks.



The approach to the reference point is initiated by the appropriate direction key, with axis selection on the 3M control. At the 1/0 transition of the *DECELERATION signal, the axis drive is decelerated from the reference point approach speed to the switch-off speed. After the 0/1 transition, the axis traverses to the zero mark of the measuring system plus 2 mm.
The SINUMERIK screen display indicates when the reference point has been reached.

Reference point approach diagram



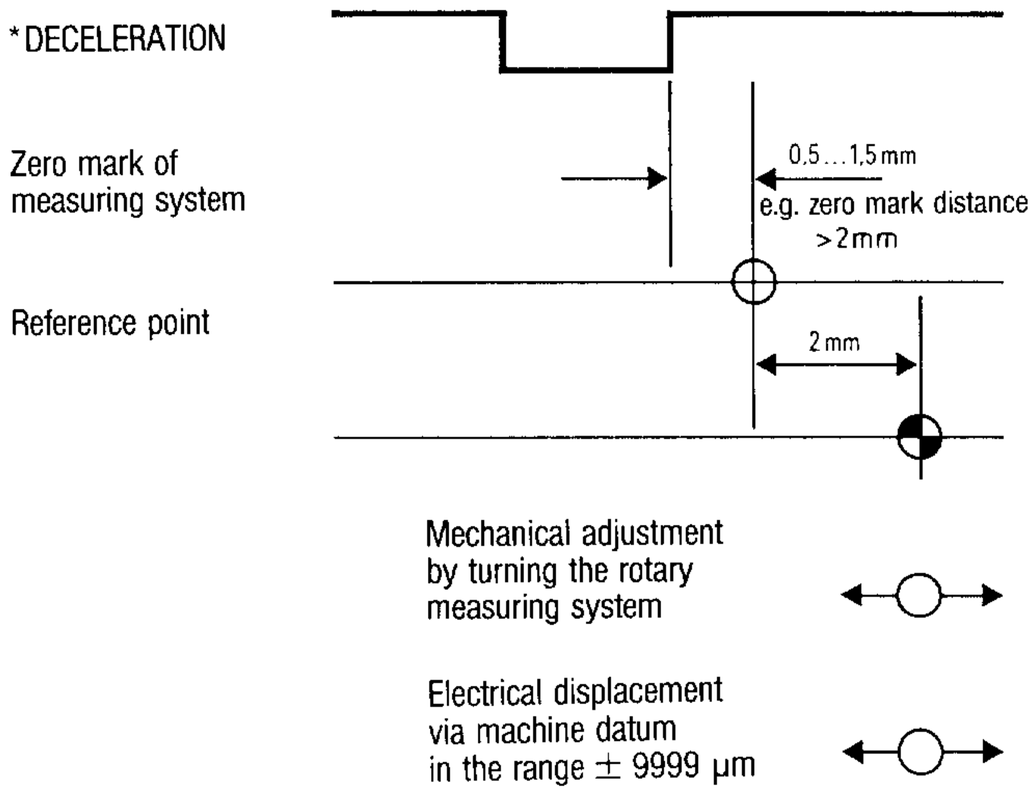
Note on application:

The cam must be long enough to ensure deceleration from the reference point approach speed to the switch-off speed.

The rear edge of the reference point cam should be located at a distance of 0.5 to 1.5 mm from the zero mark of the measuring system. With the internally adjustable switch-off speed, the reference point limit switch must operate within a reproducible range of 0.2 mm.

Determining the reference point

The reference point is determined by limit switches and the zero mark of the measuring system.



Note on application:

The measuring system need not necessarily be finely adjusted mechanically; electrical displacement using the machine data is also possible.

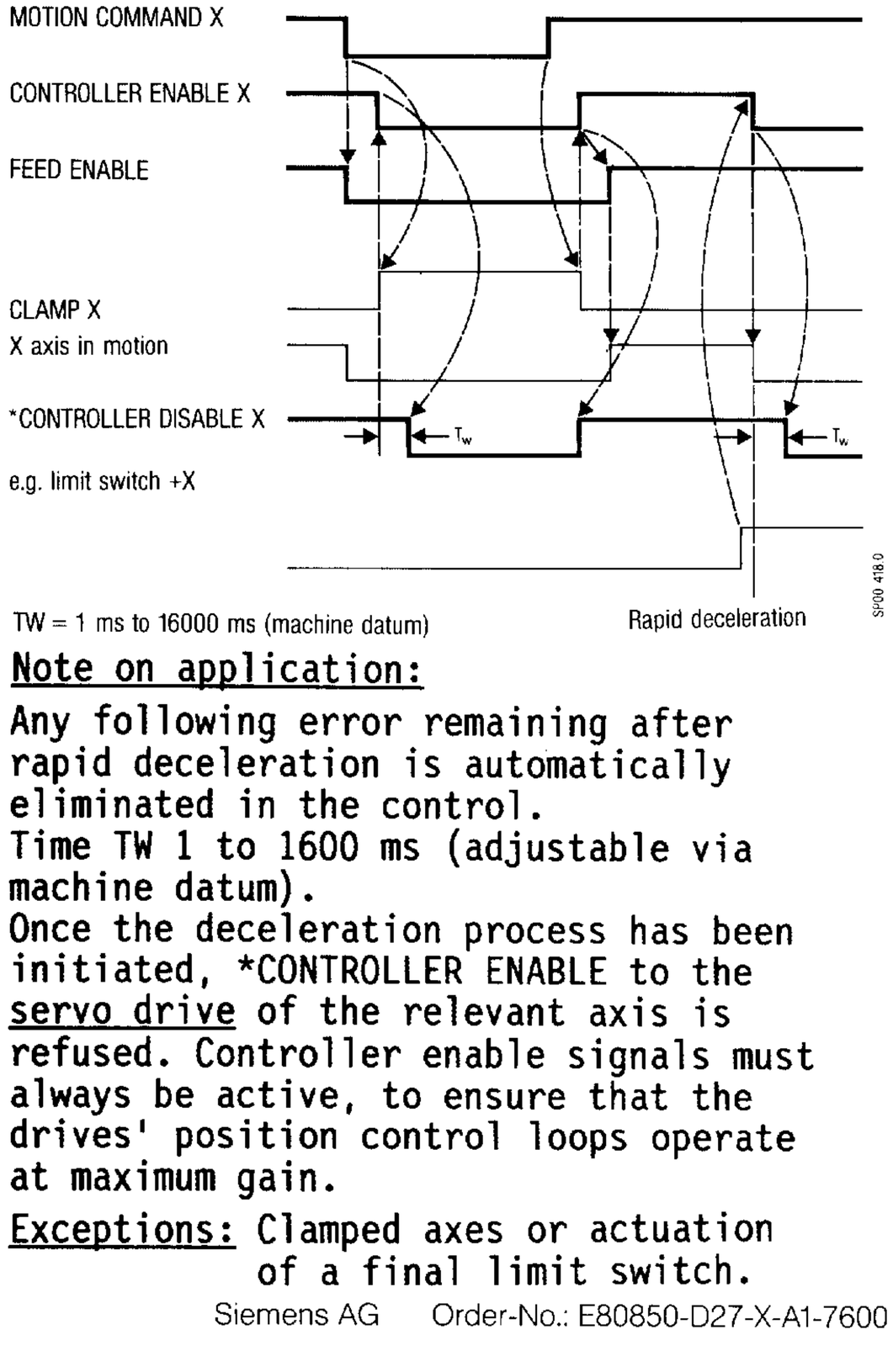
4.6.6.4 CONTROLLER ENABLE

A separate controller enable signal is interpreted for each axis.

1 signal: Closes the position control loop of the relevant axis.

0 signal: Effects rapid deceleration of axes in motion. In this case, the position control loop is opened and the drive brought to a standstill with maximum braking current.

In the AUT and MDA operating modes, all axes that are in motion are brought to a standstill. However, the axis that is still governed by the controller enable signal is decelerated only with digital speed = zero (following error eliminated by drive).



TW = 1 ms to 16000 ms (machine datum)

Rapid deceleration

Note on application:

Any following error remaining after rapid deceleration is automatically eliminated in the control.
Time TW 1 to 1600 ms (adjustable via machine datum).
Once the deceleration process has been initiated, *CONTROLLER ENABLE to the servo drive of the relevant axis is refused. Controller enable signals must always be active, to ensure that the drives' position control loops operate at maximum gain.

Exceptions: Clamped axes or actuation of a final limit switch.

4.6.6.5 SET REFERENCE DIMENSION

1 signal: Reference dimension set.

0 signal: Reference dimension not set.

Note on application:

The "set reference dimension" PLC signal reallocates the value from the reference dimension memory (MD 18x) to the actual value memory.
The PLC signal must be present for at least 20 ms to ensure that it is properly recognized. By shifting the actual value, the NC loses all reference to the actual absolute value.
After setting the reference dimension, the software limit switches are valid for the new actual value system.

Leadscrew error compensation is not permitted in such an axis. The "set reference dimension" PLC signal may be given for one axis only in each case.

Interlocks

The PLC signal is properly accepted only if:

- the reference point approach operating mode is selected
- the axis is exactly positioned
- no movement command is present.

If one of the interlock conditions is not complied with, alarm *8 (* = axis no. 1) is given.

4.6.6.6 CODING ZERO OFFSET GROUPS

Code A Code B	0 0	1 0	0 1
	Group 1	Group 2	Group 3
G54	Z01	Z05	Z09
G55	Z02	Z06	Z010
G56	Z03	Z07	Z011
G57	Z04	Z08	Z012

Note on application:

12 zero offsets can be selected with the 3T/M controls. The zero offsets are actuated via the PLC --> NC interface with functions G54 to G57 by stating the zero offset group.
The signals (code A/B) are static signals and processed block-by-block by the NC.
Changes to these signals and the selected zero offset group becomes effective 2 blocks later.

We suggest the following procedure to effect reliable and systematic changes to the zero offset groups:

Example:

```
N10 G40 X..... LF
N15 M.. ..... LF Select zero offset
                 groups 1 to 3 with an
                 M function

N20 L99 ..... LF Clear intermediate
                 memory

N25 G56 ..... LF Select zero offset
```

4.6.6.7 G39 SELECTION

Coordinate rotation can be selected with the NC at RESET status in the JOG and INC operating modes.

1 signal: G39 selection.

0 signal: No G39 selection.

4.6.6.8 CODING TOOL TRACK

TRACK	CODE C	CODE B	CODE A	MACHINE DATUM
1	0	0	0	317
2	0	0	1	318
3	0	1	0	319
4	0	1	1	320
5	1	0	0	321
6	1	0	1	322
7	1	1	0	323
8	1	1	1	324

Note on application:

Without MD 428, "tool track calculation" bit, the "coding tool track" function is available only in the G39 mode. @ 31 has to be programmed before each tool change.

Functional description:

The value in the tool tracks is included in the X axis as an additional zero offset. The offset is deselected when G53 is programmed. the active tool track is selected via interface signals.

Caution:

The selected tool track is always taken into account if MD 428, bit 0, is present. To deselect, e.g. for a program without tool tracks, a track with the value 0 must be selected.

4.7 Spindle control

4.7.1 General

With the SINUMERIK 3 system, the NC and PLC are jointly responsible for controlling spindle speed with reference to the machine parameters. The PLC contains the gear change logic and digital speed command function. The NC generates the analog command variable for the spindle drive loop. For this purpose, a ramp generator is provided in the NC for each gear stage.

The oriented spindle stop (M19) is controlled independently by the NC with reference to a machine datum. Spindle positioning can be effected in either direction of rotation and in all gear stages.

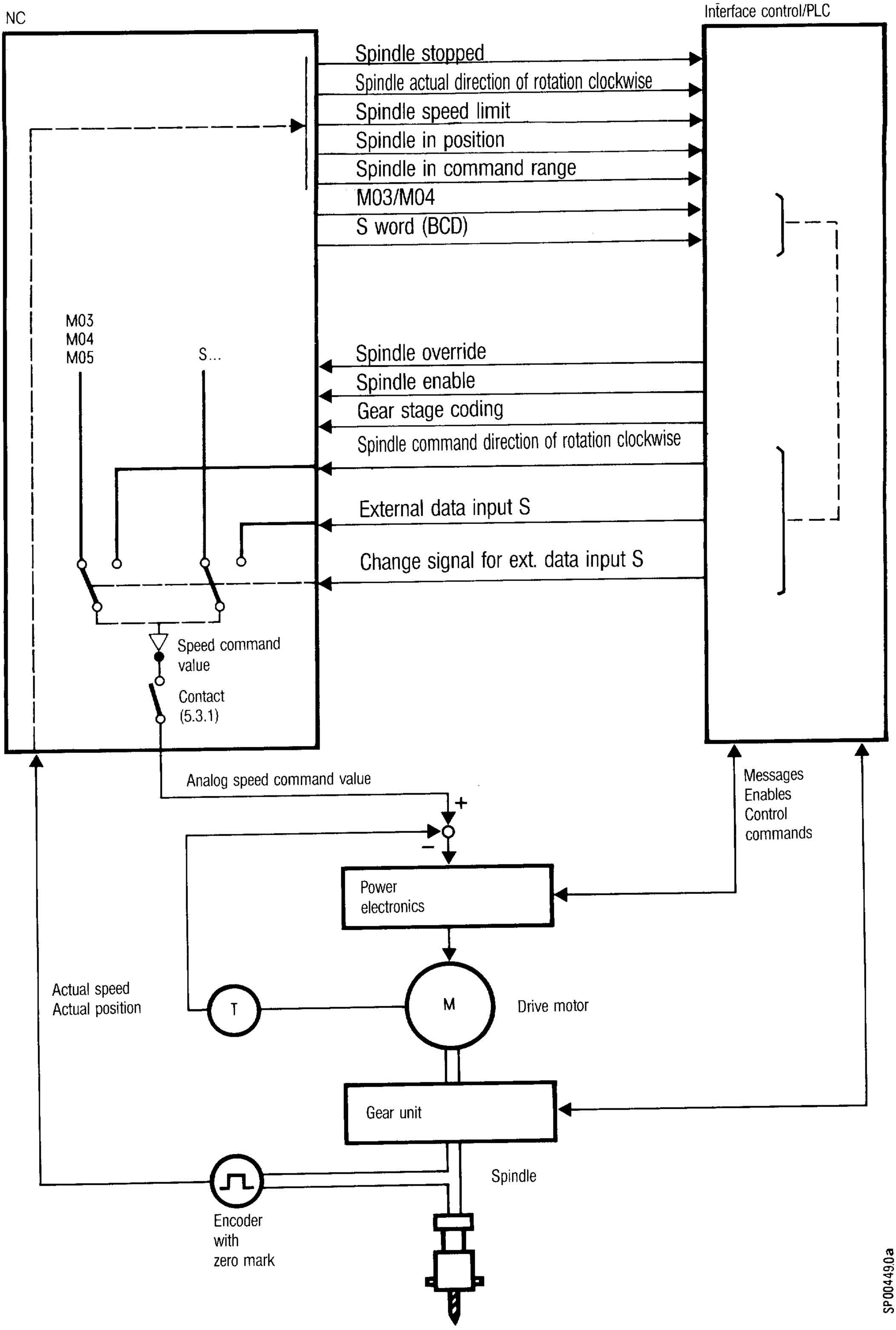
4.7.2 Types of spindle control

There are 2 types of spindle control with S analog:

a) Direct spindle control by NC

With internal interpretation of direction of spindle rotation M03, M04, M05 and programmed speed/ cutting speed S by the NC.
Even with direct spindle control by the NC, the speeds/cutting speeds and direction of spindle rotation can be overstored by the PLC.
Values obtained in this way remain active until RESET.

If S data are input by the PLC during program execution, the programmed data are suppressed until the end of the program (RESET). The "spindle rotation clockwise command" signal is interrogated by the PLC starting with the first S data input. It is then interrogated continuously and cyclically until RESET.


NC
Interface control/PLC
Spindle stopped
Spindle actual direction of rotation clockwise
Spindle speed limit
Spindle in position
Spindle in command range
M03/M04
S word (BCD)
M03
M04
M05
S...
Spindle override
Spindle enable
Gear stage coding
Spindle command direction of rotation clockwise
External data input S
Change signal for ext. data input S
Speed command value
Contact (5.3.1)
Analog speed command value
+
−
Messages
Enables
Control commands
Power electronics
Actual speed
Actual position
T
M
Drive motor
Gear unit
Spindle
Encoder with zero mark

SP00449.0a

b) Spindle control by PLC

If required, the PLC decodes the BCD data for spindle/cutting speed and direction of spindle rotation issued by the NC and then transfers them back to the NC.
Instead of the spindle data issued by the NC, PLC-specific data can be fed to the NC for special functions, e.g. oscillation for gear meshing or chip breaking.

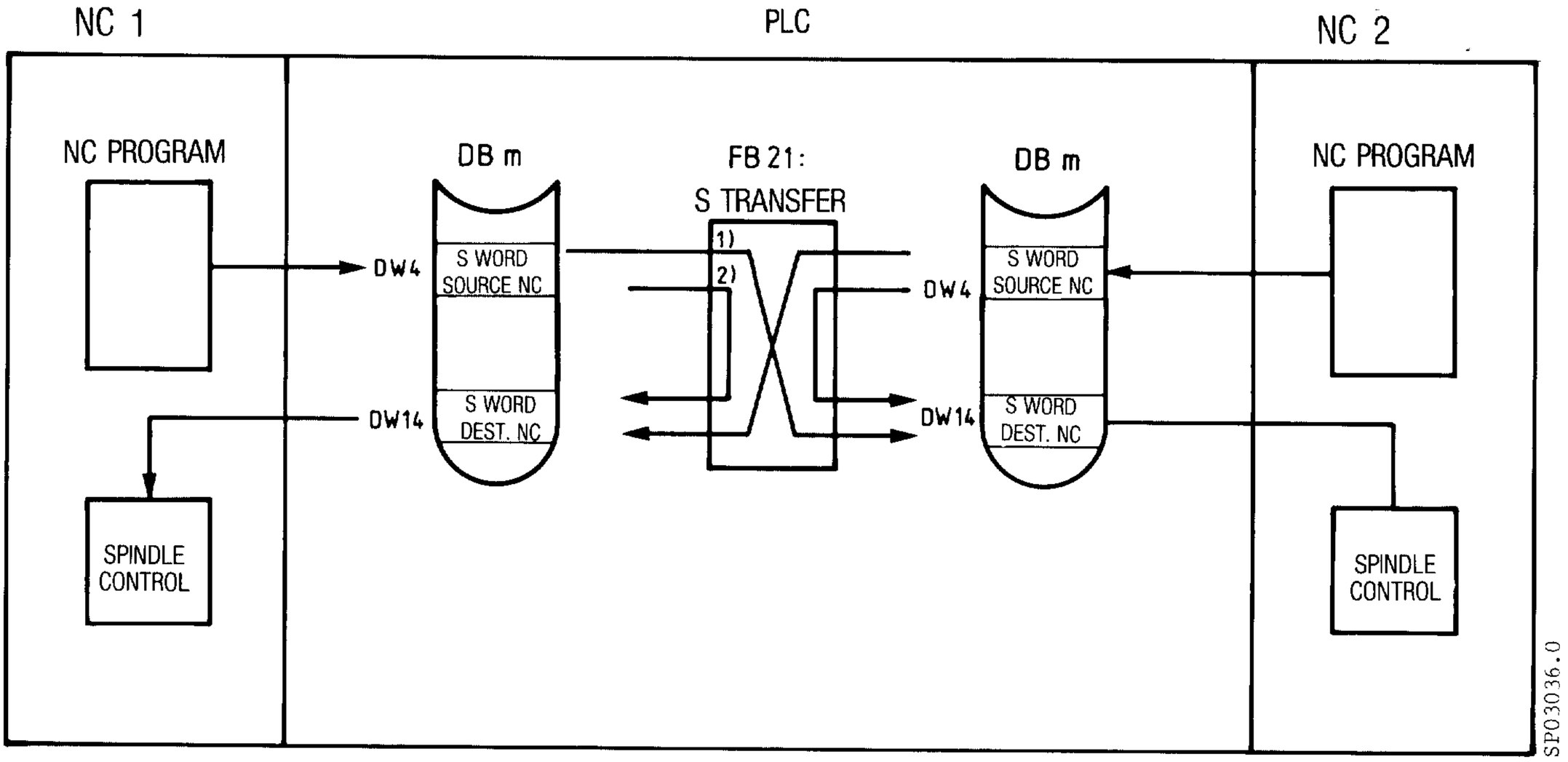
Internal interpretation of direction of spindle rotation M03, M04, M05 and programmed speed/cutting speed S by the NC is inoperative.

The "spindle rotation clockwise command" signal is interrogated continuously and cyclically.

The type of spindle control is determined by a machine datum.

c) Spindle control by PLC with SINUMERIK 3TT

With the SINUMERIK 3TT control, the spindle speed can be preset by up to 4 NC's. the NC that issues the programmed S word is designated the source NC (NCQ). The NC responsible for spindle control is designated the destination NC (NCZ).
FB21 (S transfer) effects transfer of the programmed spindle speed stored in the source NC (e.g. NC1) to the destination NC (e.g. NC1 or NC2 to NC4).



m = 21 on NC1
23 on NC2
25 on NC3
27 on NC4

1) NC source = 1
NC dest. = 2

2) NC source = 1
NC dest. = 1

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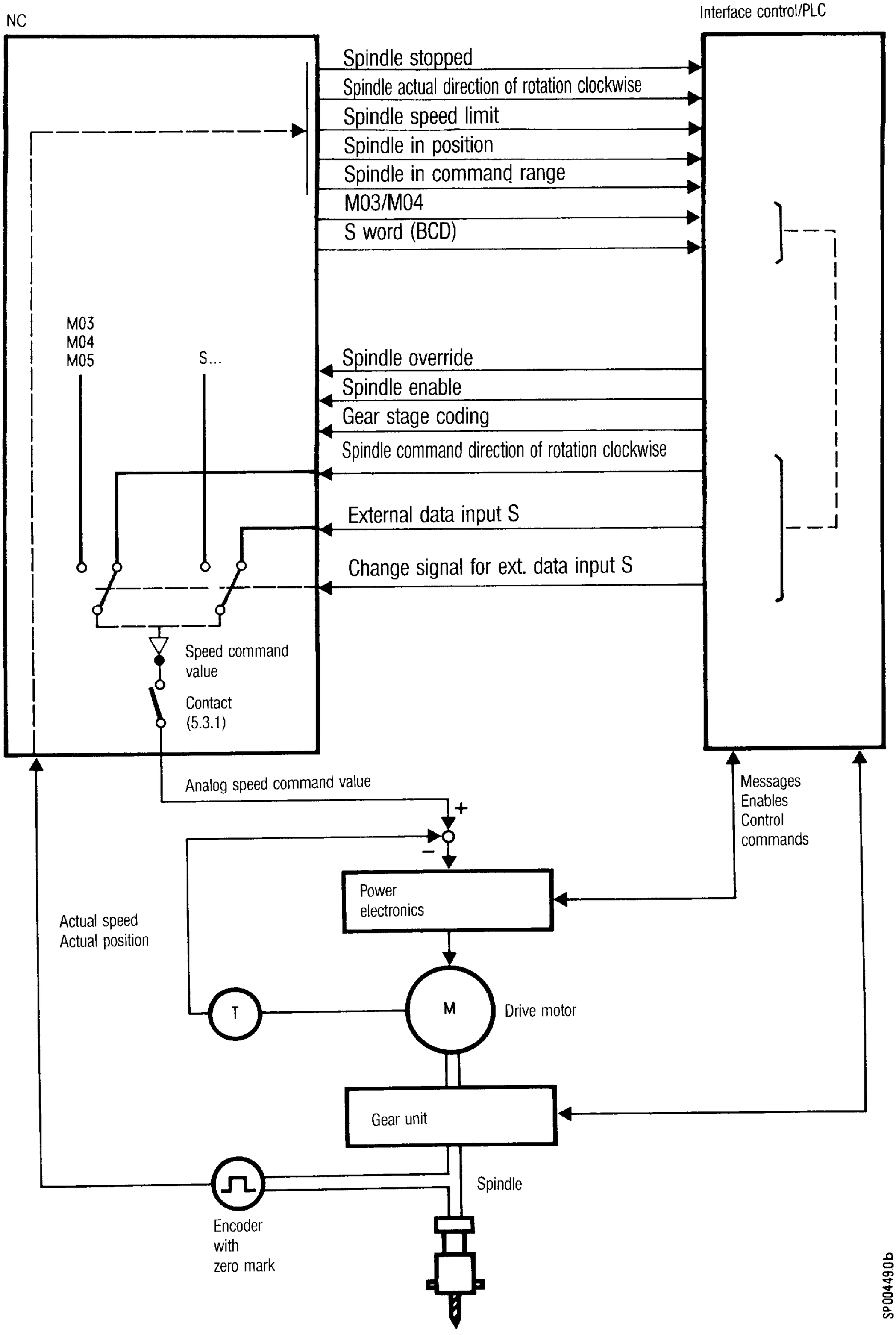
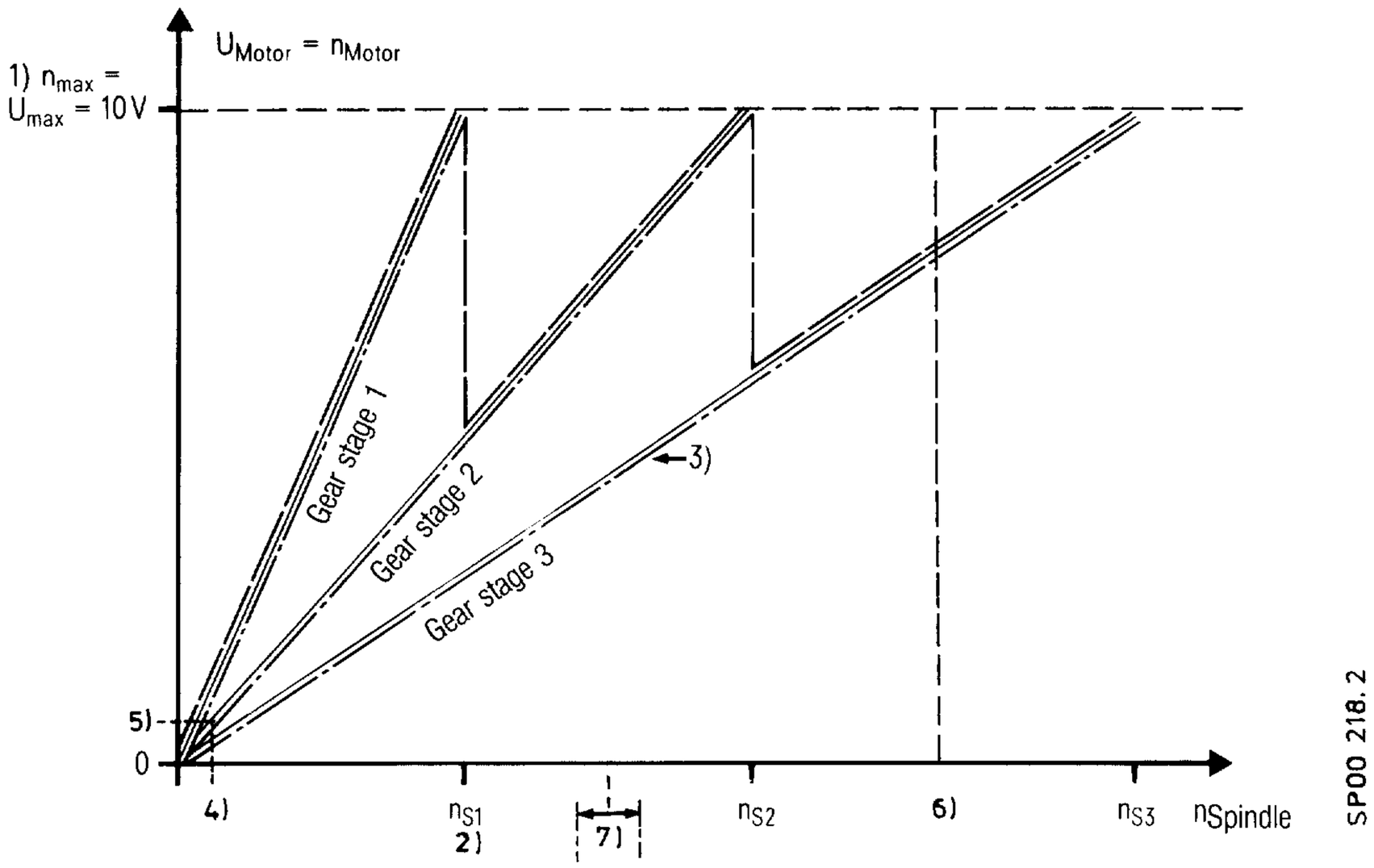

NC
Interface control/PLC
Spindle stopped
Spindle actual direction of rotation clockwise
Spindle speed limit
Spindle in position
Spindle in command range
M03/M04
S word (BCD)
M03
M04
M05
S...
Spindle override
Spindle enable
Gear stage coding
Spindle command direction of rotation clockwise
External data input S
Change signal for ext. data input S
Speed command value
Contact (5.3.1)
Analog speed command value
+
–
Messages
Enables
Control commands
Power electronics
Actual speed
Actual position
T
M
Drive motor
Gear unit
Spindle
Encoder with zero mark

SP004490b

Ramp characteristic

(Spindle speed graph)



The overall spindle speed range is achieved by utilizing different gear stages.

----- On milling machines, the gear stage is usually derived directly from the programmed S word (no switchover via M functions). There is no overlap between stages in this case (see graph).

-.-.- On lathes, gear changes are usually controlled by the M function. Here, the individual spindle speed stages overlap.

Re 1) 10 V equivalent to maximum motor speed (permanently stored value in NC).

Re 2) Maximum spindle speed values according to gear stage and 10 V for maximum motor speed.
Value range input as NC machine datum:
16 - 9999 rev/min or 1.6 - 999 rev/min, depending on machine datum.

Re 3) Ramp characteristic for spindle motor from n_o to n_{max}.

Taken into account at every change in speed, also with immediate stop and V constant (1 value per gear stage). Value range 0 to 2 min for 0 to n_{max}).

Re 4) Switch-off spindle speed; deceleration to this speed effected at M19 before the position control is switched on

Re 5) Minimum motor speed for true running. Generally speaking, speed is never reduced below this value. M19 is an exception: value as machine datum.

Re 6) Maximum spindle speed for V constant. Value stored in NC, can be altered via G92 S... at keyboard or by tape. If actual speed value exceeds the preselected limit value despite the command value restriction, a message is passed to the PLC.

Re 7) Command-actual value comparison of spindle speed. Spindle-specific command-actual comparison is implemented with reference to a tolerance window stored as an NC machine datum.

Note:

Maximum spindle speed is 9999 rev/min.

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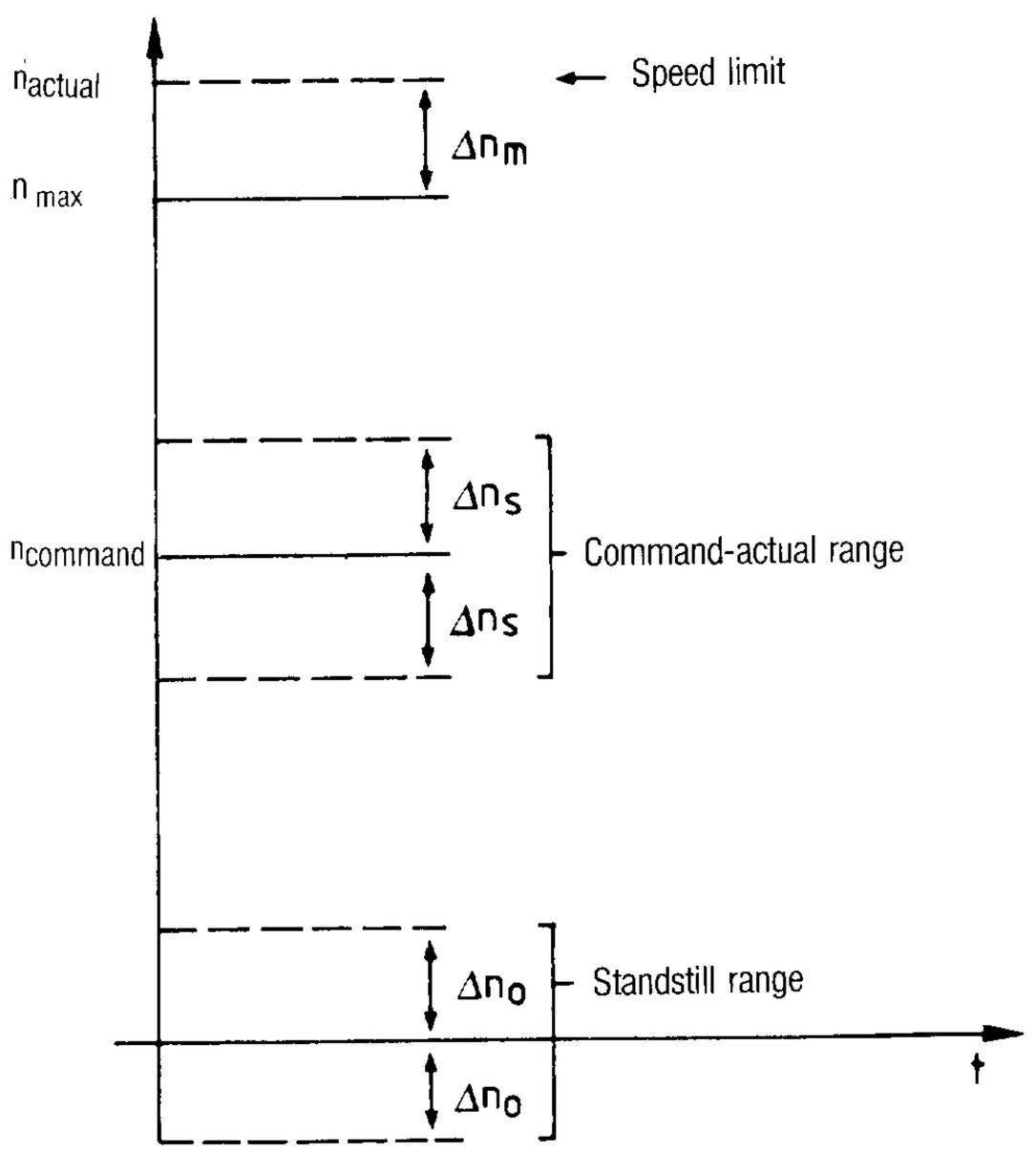
These values can be doubled using the "spindle actual value x2" machine datum and a 2:1 gear reduction for the spindle pulse transmitter.

4.7.3 Spindle monitoring

Monitoring of the actual speed is divided into three areas:

1) Standstill
2) Command-actual difference
3) Maximum speed

The three tolerances are input separately as percentages.



Standstill tolerance:

Percentage value of maximum current gear stage speed:
Machine datum TE 369 in 0.01 % steps; value range 0.01 to 1.25 %.

Command-actual tolerance:

Percentage value of programmed command speed:
Machine datum TE 367 in 1 % steps; value range 1 to 99 %.

Maximum tolerance:

Percentage value of maximum current gear stage speed n_{max} (see diagram):

Machine datum TE 368 in 1 % steps; value range 1 to 99 %; input of 100 % deselects monitoring function.
With V constant, the smaller of the SE datum or G92S ... values is interpreted with the % values of the TE368 machine datum (TE497, bit 4 = 1).

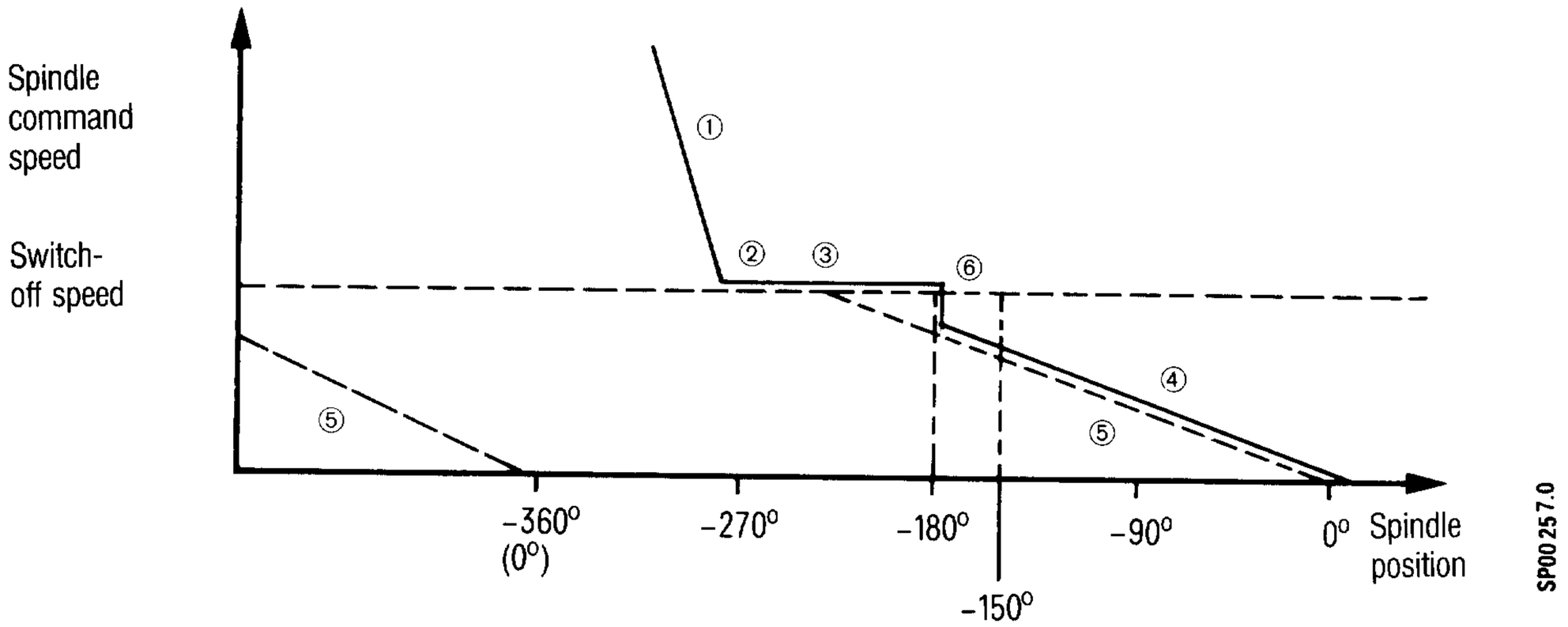
4.7.4 M19

4.7.4.1 Special features with M19

If M19 is not selected internally by the NC, it is treated in the same way as any other auxiliary function. The following sequence occurs (see graphs) if M19 is selected (spindle drive loop included in NC position control):

- Spindle decelerated to switch-off command speed according to ramp characteristic (1)
- Spindle continues to move at switch-off speed in the same direction of rotation (2)
- At point of intersection (3) between gain characteristic (5) and switch-off speed:
  position control switched on and movement to spindle stop position (4) (distance between reaching switch-off speed and stop position less than 1 ½ revolutions)
- Position held by position control
- SPINDLE IN POSITION message issued to PLC
- As soon as the PLC cancels the SPINDLE ENABLE (pulse greater than/equal to 32 ms), the NC switches off the position control, outputs command variable zero (speed command value contact opened), cancels the controller enable for the drive, and automatically continues with execution of the next block.
- Spindle positioning is not interrupted by reset if the machine datum has been set (TE 407, bit 6 = 1). If this machine datum has not been set (TE 407, bit 6 = 0), the spindle is decelerated according to the ramp characteristic; this means that the spindle does not reach the required position.

If the gain is set so low that the point of intersection between the gain characteristic and the switch-off speed is located more than 150° away from the command position, the approach continues at the same speed after the switch-off speed has been reached until 180° before the command position and then jumps to the positioning characteristic.



With M19 from a standstill, positioning is effected by the shortest path independent of the command direction of rotation.

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4.7.4.2 Function overview M19

<table>
<tr><td>S short circuit ON</td><td colspan="3">Machine datum "no M19 interrupt with reset" inoperative</td></tr>
<tr><td>Spindle position control ON</td><td colspan="3">M03 or M04 programmed or issue S word from PLC to NC and Spindle enable active and program M19</td></tr>
<tr><td></td><td colspan="2">M19 with axis motion</td><td>M19 without axis motion</td></tr>
<tr><td></td><td colspan="2">Execution of further NC blocks</td><td>Execution of further NC blocks only after spindle position control OFF (Spindle enable cancelled)</td></tr>
<tr><td>Spindle position control OFF
Spindle in position cancelled</td><td colspan="3">Reset or
M02/M30 or
Cancel spindle enable</td></tr>
<tr><td>S short circuit OFF</td><td colspan="3"></td></tr>
<tr><td>Spindle position control ON</td><td colspan="3">Issue spindle enable before acknowledgement from M19** and program M19</td></tr>
<tr><td></td><td colspan="2">M19 with axis motion</td><td>M19 without axis motion</td></tr>
<tr><td></td><td colspan="2">Execution of further NC blocks</td><td>Execution of further NC blocks only after spindle position control OFF (Spindle enable cancelled)</td></tr>
<tr><td></td><td>No M19 interrupt with reset</td><td>M19 interrupt with reset</td><td>No M19 interrupt with reset not permitted</td></tr>
<tr><td>Spindle position control OFF
Spindle in position cancelled</td><td>Cancel spindle enable</td><td colspan="2">Reset or
M02/M30 or
Cancel spindle enable</td></tr>
</table>

4.7.5 Special features of interface where V = constant

Similarly for V = constant, control of the spindle is executed exclusively by the NC in accordance with the actual turning diameter, but the NC still obtains the S speed command value from the PLC/NC interface. Where V = constant, therefore, the value is interpreted not as a rotational speed, but as a cutting speed. The gear stage is still determined by the PLC.
If a gear change is required while V = constant, it can be executed by the PLC. With the S speed command value 0, speed 0 is obtained even in conjunction with V = constant. The gear stage can then be changed. Subsequent running-up to the appropriate cutting speed is implemented with a new S input. Gear changes are not normally executed during machining.
If automatic operation is interrupted for setting-up when V = constant, the S speed command value continues to be interpreted as the cutting speed.

4.7.6 Special features with EMERGENCY OFF and switching on the system

As for normal stops, deceleration is according to the normal characteristic in the event of an EMERGENCY OFF. After command speed zero has been reached and the adjustable waiting time (machine datum) has elapsed, the 0 V (speed command value contact opened) and controller disable signals are given. (Other requirements such as deceleration without the normal characteristic or by means of armature short-circuiting must be implemented via appropriate external circuits).
The PLC speed command is deleted in the event of EMERGENCY OFF.

The SPEED CONTROLLER READY input signal is also significant for S analog. If this signal is not present when the power supply is connected, the S analog output is not activated. The NC does not close the speed command value contact and cancel the CONTROLLER DISABLE until the spindle is to be moved by M19 or an external command value input.
If the SPEED CONTROLLER READY signal is removed during machining, the NC reacts in the same way as for EMERGENCY OFF.

4.8 Auxiliary functions

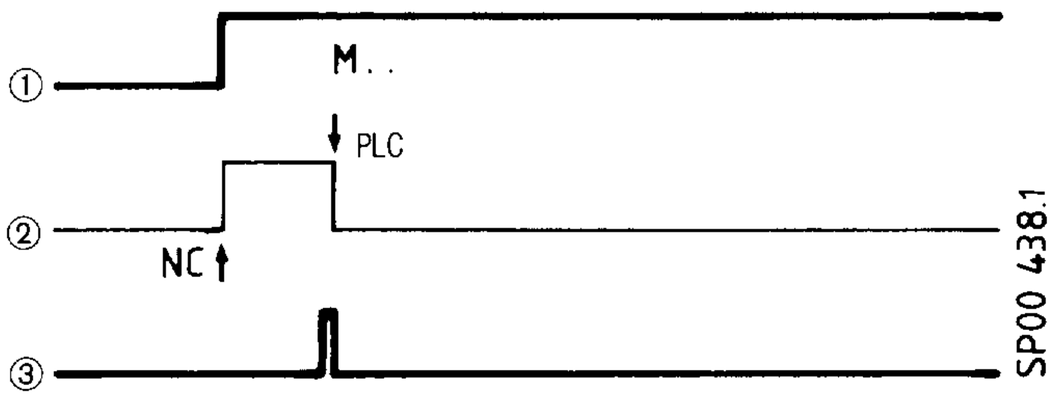
4.8.1 General

Switching and auxiliary functions M, S, T and H are output consecutively by acknowledgement control. The data are identified by their corresponding change signals. These signals are active for one PLC cycle in each case. If several functions are programmed in a single block, the output sequence is M, S, T, H, irrespective of the actual programming configuration in the block. Only one M function is permitted per block. After the interface control has received the signals (change signal and BCD output), the change signal is reset at the interface by the PLC basic program (acknowledgement). Following a delay of equal to/greater than 18 ms, the NC accepts the acknowledgement signal and outputs the next switching or auxiliary function.

The acknowledgement serves to coordinate data traffic between the NC and PLC; it must not be understood as confirmation that auxiliary functions have been implemented. If more than one cycle time is required to execute a command issued by an auxiliary function, the "data input disable" signal has to be given.

Depending on the machine data, switching and auxiliary functions can be output:

- before initiation of axis movement
- with initiation of axis movement.



① M word
② CHANGE SIGNAL
③ PLC acknowledgement

Three types of auxiliary function output can be selected via machine data during block search:

a) Auxiliary functions not stored and not output during block search

b) Input switching and auxiliary functions are output <u>immediately</u> with a change signal during block search

c) The NC stores the last switching and auxiliary function of each address internally during block search; the stored functions are then output consecutively in the sequence M, S, T, H with a change signal after NC start.

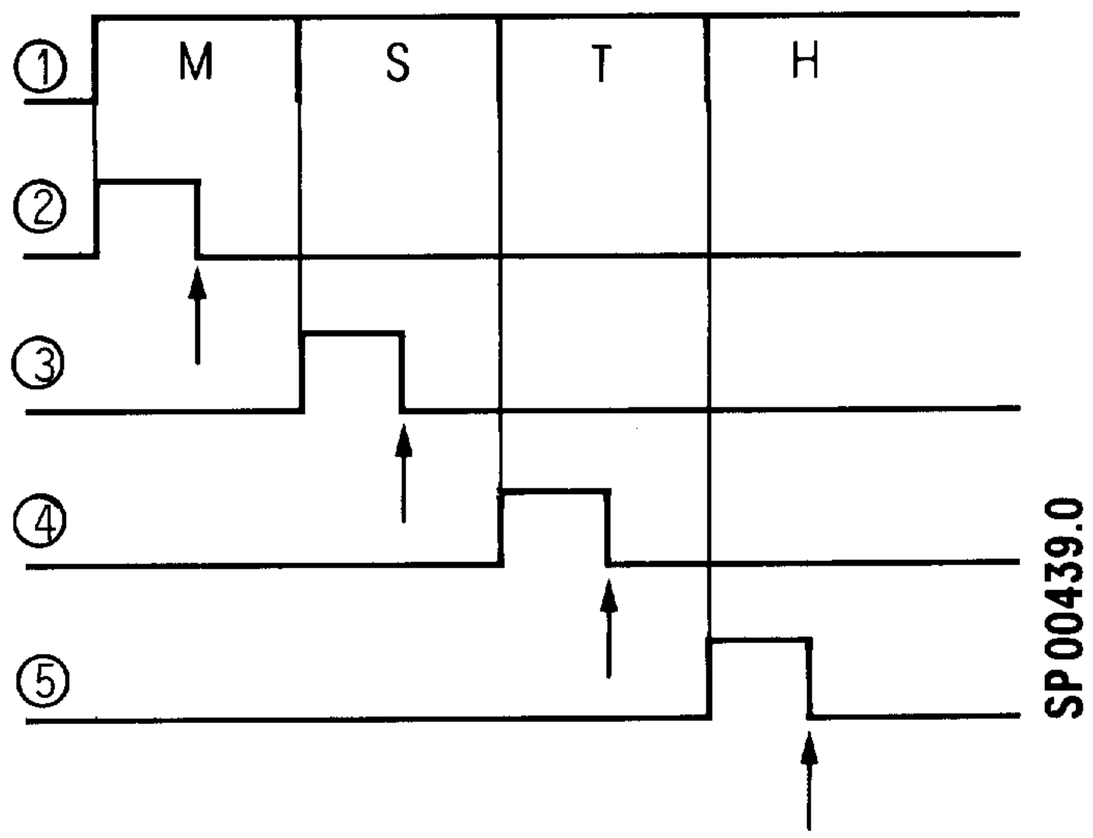
If the relevant machine data bit has not been set, the auxiliary functions can be stored manually (manual input) when the preselected block has been reached (search indicator).

4.8.2 <u>Switching and auxiliary functions M, S, T, H; output</u>

M 2	Decades with change signal
S 4	Decades with change signal
T 2 (4)	Decades with change signal
H 4	Decades with change signal

<u>Sequence</u>

a) Word, 2 (4) decades simultaneously
b) Change signal M, S, T, or H



① M-, S-, T, H WORD
② M CHANGE SIGNAL
③ S CHANGE SIGNAL
④ T CHANGE SIGNAL
⑤ H CHANGE SIGNAL

<u>M, S, T, H functions stored in the machining program</u>

(in automatic operating mode AUT or MDA)

Following data transfer of the BCD words to the main memory, the change signal is active for one PLC cycle. The BCD words are present until the next block with M, S, T, H functions occurs.

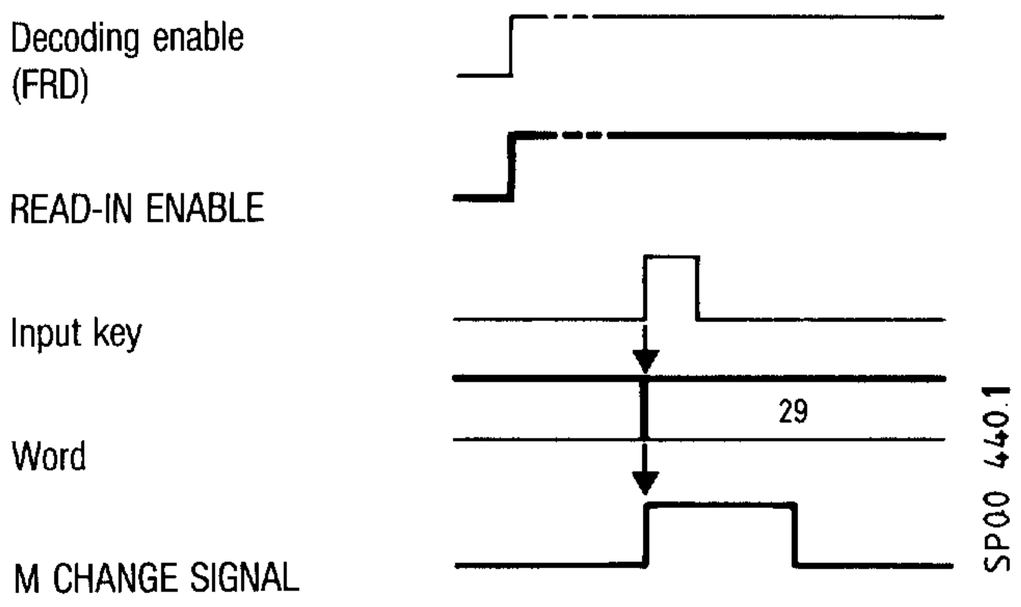
M, S, T, H functions are deleted with RESET.
Control-internal M commands (M00, M02, M03, M04, M05, M17, M19, M30) are contained in the BCD output complete with change signal.

<u>M, S, T, H functions input manually during feed hold</u>

(with AUT, MDA, JOG, INC)

The input word is active after pressing the input key in conjunction with read-in enable:

M, S, T, H functions are deleted with RESET.



Example: input of word M29

4.8.3 Switching and auxiliary functions M, S, T, H ; notes on functioning

Auxiliary function M

Control-internal M commands (M00, M02, M03, M04, M05, M17, M19, M30) are contained in the BCD output complete with change signal.

Note on application:
Control of miscellaneous functions, e.g. direction of spindle rotation, coolant, tool changes, gear stages.

Spindle speed S

The speed command value limit programmed under G92 S... is not output to the PLC.

Note on application:
Control of spindle speed.

Tool number T

Note on application:
Control of tool selection.

Tool changing:

During tool changes, program execution must be interrupted by refusing to issue the read-in enable signal. If axis movement is also to be suppressed, the feed enable signal must be refused as well.

4.9 Data transfer NC/PLC (see Sections 4.4.5/4.4.6)

4.9.1 General

Data can be transferred by two methods with System 3 GA4:

a) Data transfer with basic program:
   NC to PLC
   PLC to NC (one value per initiation)

b) Block-by-block data transfer:
   NC to PLC with FB61
   PLC to NC with FB62 (several values per initiation; see description of 0 package)

To transfer data from the NC to the PLC (Figure 1) with the basic program, the user must set the 1st and 2nd relative addresses and then the transfer flag (command) in the relevant data block DBm (user interface) once (with S F...). The basic program transfers the data type and datum read command to NC interface DBn with the relative addresses and transfer flag. When the NC has interpreted the command and type of data in NC interface DBn, it transfers the datum to this interface. The PLC recognizes this, stores the datum (BCD-coded) in the data words of the DBm, and then resets the transfer flag. Depending on the reset transfer flag, the user can now evaluate the datum in the DBm. The decimal point (hexadecimal input) in the data word is variable; it is preset in accordance with the NC data memory. The sign digit in the data word is always at the same location (Section 4.4.5).

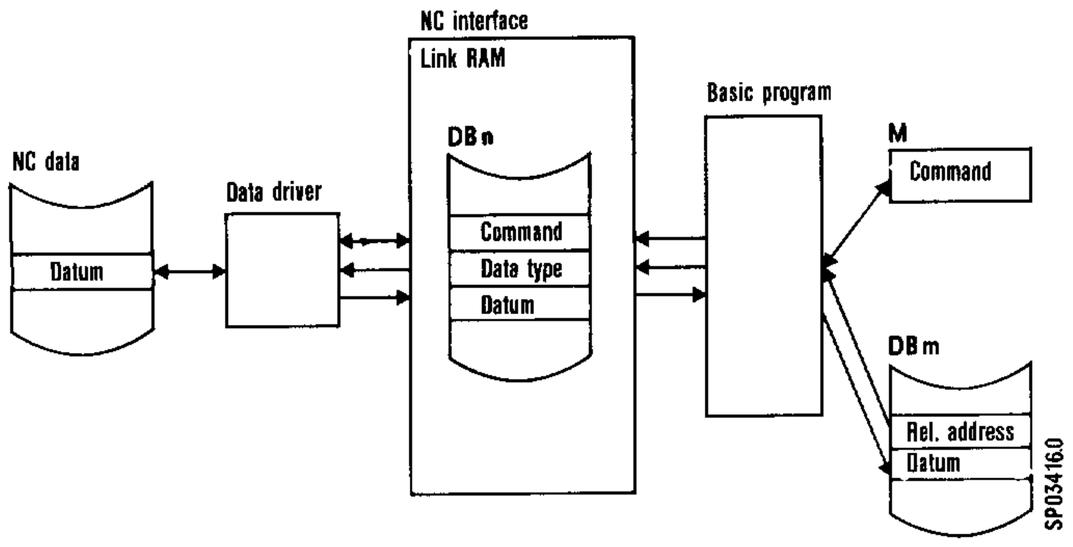


Figure 1: Data transfer with basic program: NC to PLC

Example 1:

Data transfer with basic program from NC to PLC (read R parameter).

Reading path increments for positioning module WF 625.

During execution of an NC program in the automatic operating mode, the PLC issues data input disable with an M function (e.g. M90). The R parameter previously loaded in the NC program is loaded in the DB200 VARIABLES data block (as the value 60). The input disable can now be removed and command F 248.7 given for transfer to positioning module WF 625. The procedure can be repeated when WF 625 has confirmed that the value in DB200 VARIABLES (60 path increments) has been traversed.

Note:
The R parameter value must be stated without a decimal point in DB200 VARIABLES.

NC program:

```
%100          LF
N1 R50 60     LF X axis: traverse 60/m
N2 M90        LF Input disable, effect
                 transfer
N3 R51 100 LF X axis: traverse 100/um
N4 M90        LF Input disable, effect
                 transfer
:
:
N400 M30      LF End of program
```

PLC program:

FB200:

```
      C DB21      Call user DB for NC1
      A F 8.4     Transfer flag: read R
                  parameter
      BEC
      AN F 21.2   F90 auxiliary flag
                  (M-Dec)
      JC=M001
      R Q 65.6    Input disable signal
      L KH5000    1st relative address = 50
                  2nd relative address = 00
      T DW 41     DW for 1st and 2nd
                  relative addresses
      S F 8.4     Transfer flag: read R
                  parameter
      S F 90.0    Auxiliary flag for edge
                  interpretation
      BEC
M001: A F 90.0    ------ " ------
      R F 90.0    Reset auxiliary flag
      JC=M001
      BEC
M002: L DW44      Edit R parameter for
      SRW 4       DB200 VARIABLES
                  (without decimal point)
      C DB200     Call VARIABLES data block
      T DW1       Store R parameter without
                  decimal point
      S Q 65.5    Give read-in enable
                  signal
      S F248.7    Start transfer to WF 625
      BE
```

To transfer data from the PLC to the NC with the basic program (Figure 2), the user must define the datum (BCD-coded) with decimal point (hexadecimal input) where appropriate, the 1st and 2nd relative addresses and then the transfer flag (command) in the relevant data block DBm (user interface) once (with S F...). The basic program transfers the BCD-coded datum, data type and datum load command to NC interface DBn with the relative addresses and transfer flag. When the NC has recognized the command, type of data and datum in NC interface DBn and loaded this information in its NC data memory the basic program resets the transfer flag at the user interface. Depending on the reset transfer flag, the user can now initiate another transfer. The decimal point in the datum can be preset according to the permissible value range in the data word. The sign digit in the data word is always at the same location (Section 4.4.6).

If several transfer flags are set for one data traffic direction (NC to PLC or PLC to NC), they are processed in an ascending flag bit and flag byte sequence (in each direction) (e.g. Fn.6=1, Fn.3=1, Fn+1.0=1; sequence Fn.3, Fn.6, Fn+1.0).

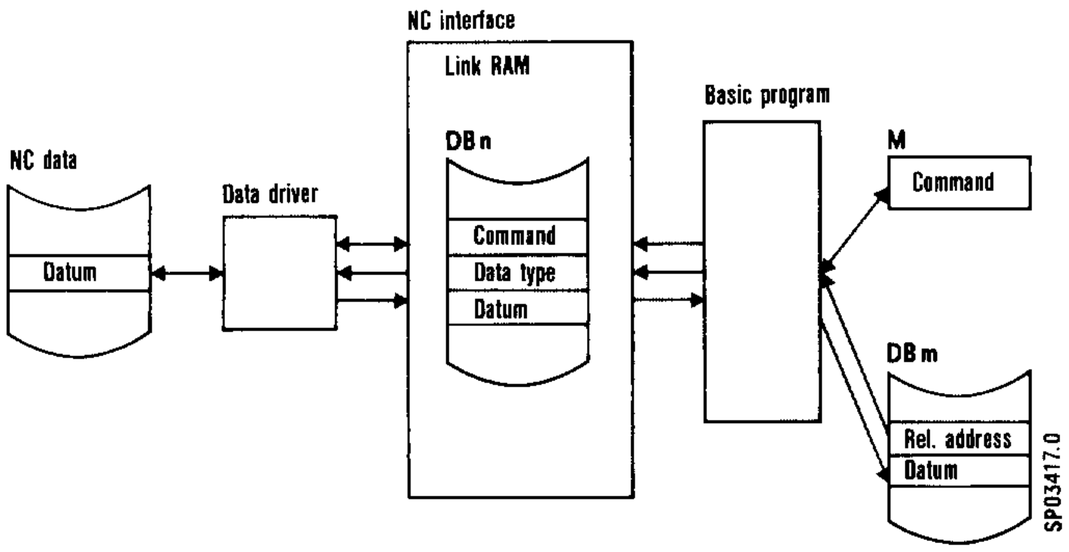


Figure 2: Data transfer with basic program: PLC to NC

Example 2:

Data transfer with basic program from PLC to NC (tool offset additive TOA).

The workpiece is measured with a measuring machine away from the machine area.

A deviation is identified on tool length X; this is to be transferred as an additive tool offset (TOA) from the PLC to the NC. The measuring machine feeds the PLC with the BCD value as input words and the initiation as an input signal.

PLC program:

```
PB100:
     A F 4.6    Transfer flag: additive
                tool offset
     BEC
     AN I 3.2   Input from measuring
                machine
     R F 90.1   Auxiliary flag for edge
                interpretation
     R F 90.2   Second auxiliary flag
     A I 3.0
     AN F 90.1
     S F 90.1   Auxiliary flag 1 PLC
                cycle = 1
    :
     ON F90.1
     O  F90.2
     BEC
     C DB21     Call user DB for NC1
     L KH0108   01 = tool length 1st axis
                08 = no. of tool offset
                     memory
     T DW86     Data word for 1st and 2nd
                relative addresses
     L IW4      Tool offset values from
                measuring machine
     T DW87     Store in data words
                (BCD-coded)
     L IW6
     T DW88
     L IW 8
     T DW89
     A F 239.7  "1" flag
     S F 4.6    Transfer flag for
                additive tool offset
     S F 90.2
    :
     BE
```

4.9.2 Tool offsets

Additive tool offset (TOA)

The value is added to the length in the internally selected tool offset memory (joint memory for additive and absolute tool offset).

Value range:

Variable decimal point position

Metric: ± 99999.999 mm
Imp. : ± 9999.9999 inches

1st relative address:

3T: 01 = Tool length 1st axis
    02 = Tool length 2nd axis

3M: 06 = Tool length
    07 = Tool radius

2nd relative address:

Number of tool offset memory

3T: 00 = Current number is valid *)
    01 = Select any number
    .
    .
    .
    32 = Select any number

3M: 00 = Current number is valid *)
01 = Select any number
.
.
.
64 = Select any number

*) A tool offset memory must be selected for reading or writing (number other than zero)

Absolute tool offset (TOAB)

Any tool offset memory can be overwritten.

Value range:

Variable decimal point position

Metric: ± 99999.999 mm
Imp. : ± 9999.9999 inches

1st relative address:

3T: 01 = Tool length 1st axis
02 = Tool length 2nd axis
07 = Tool length
08 = Tool radius
(Value range: 0 to 9)

3M: 06 = Tool length
07 = Tool radius

2nd relative address:

Number of tool offset memory

3T: 00 = Current number is valid *)
01 = Select any number
.
.
.
32 = Select any number

3M: 00 = Current number is valid *)
01 = Select any number
.
.
.
64 = Select any number

*) A tool offset memory must be selected for reading or writing (number other than zero)

4.9.3 Zero offsets

Adjustable zero offset G54-G57 (ZOE)

The value is transferred to the zero offset memory.

Value range:

Variable decimal point position

Metric: ± 99999.999 mm
Imp. : ± 9999.9999 inches

1st relative address: Axis number

3T: 01 = 1st axis
02 = 2nd axis

3M: 01 = 1st axis
02 = 2nd axis
03 = 3rd axis
04 = 4th axis

2nd relative address:

3T/3M: 01 = G54
02 = G55
03 = G56
04 = G57

Programmable additive zero offset G59 (ZOP)

The value is transferred to the zero offset memory for G59.

Value range:

Variable decimal point position

Metric: ± 99999.999 mm
Imp. : ± 9999.9999 inches

1st relative address: Axis number

3T: 01 = 1st axis
02 = 2nd axis
08 = Coordinate rotation angle

3M: 01 = 1st axis
02 = 2nd axis
03 = 3rd axis
04 = 4th axis
08 = Coordinate rotation angle

2nd relative address:

3T/3M: 01 = G59

External additive zero offset (ZOEX)

The value is stored in its own "external zero offset" memory and taken into account additively during block-by-block calculation of the tool offset.

The external additive zero offset can be changed or deleted only by altering the PLC input.

Value range:

For reading: Fixed decimal point position
For writing: Decimal point position can be shifted to left
Metric: ± 99999.999 mm
Imp. : ± 9999.9999 inches

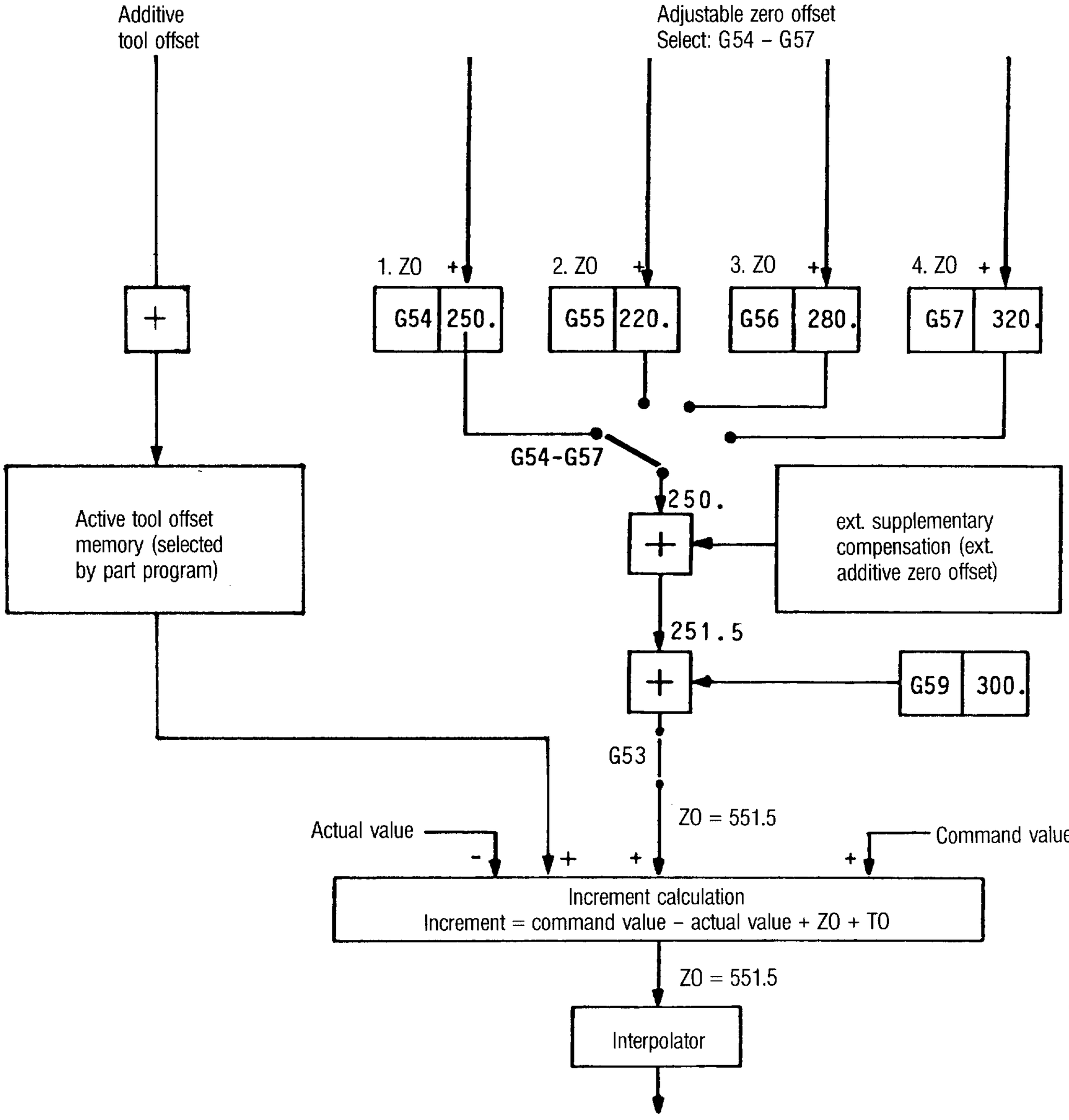
1st relative address: Axis number

3T: 01 = 1st axis
02 = 2nd axis

3M: 01 = 1st axis
02 = 2nd axis
03 = 3rd axis
04 = 4th axis

2nd relative address:

3T/3M: 01 = Select permanently with "01"



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4.9.4 S, F, % values

S word (4 decades)
(S from NC, S from PLC, S 0)

Value range: ± 9999 rpm

a) Direct spindle control by the NC:
The input S word suppresses the internally programmed S word until a RESET.
Starting with the first S input, the "spindle rotation clockwise command" signal is activated and cyclically interrogated.

b) Spindle control by the PLC:
The S value output by the NC is fed back via the PLC (S from NC). PLC-specific data can be fed to the NC (S from PLC, S 0) in place of the spindle data that it issued.

Setting the S0 transfer flag once transfers spindle speed = 0 to the NC (FB22).

The S value output by the NC (S from NC) can be re-established by setting the "S from NC" transfer flag once after a gear change (speed S from PLC).

The S word input via the PLC is deleted in the NC with RESET.

Read spindle speed from NC
(S actual read)

The spindle speed can be read by the PLC.

Value range: ± 9999 rpm

Spindle command position (S-SP)

Value range:

360.0° (fixed decimal point position)

The spindle command position can be transferred from the PLC to the NC for spindle positioning purposes.
Reading access is also permitted.

F word (4 decades) (F-EX)

Value range:

Metric: 99999 mm/min
Imp. : 99999 x 0.1 inch/min

In the JOG setting-up operating mode, a feedrate can be input for traverse using the direction keys. If this facility is used, the jog feedrate input via the machine datum is suppressed.
The F word input by the PLC is overwritten by the next F word read in the program or cancelled by RESET.

Call program number
(4 decades) (PRNR)

Value range: 99999

In addition to the facility for preselecting the number of the program to be executed at the NC operator keyboard, it can also be called up from the PLC.

4.9.5 Actual values (axes, spindle position) (read actual values)

Only reading access permitted.

Value range, axes:

Reading: Fixed decimal point position
Metric : ± 99999.999 mm
Imp. : ± 9999.9999 inches

Value range, spindle position:

359.9° (fixed decimal point position)

1st relative address:

3T: 01 = 1st axis
02 = 2nd axis
05 = Spindle position

3M: 01 = 1st axis
02 = 2nd axis
03 = 3rd axis
04 = 4th axis
05 = Spindle position

2nd relative address:

3T/3M: 00 = Occupied permanently with "0"

4.9.6 Calculation parameters (R parameters) (read R, load R)

The value can be written in any R parameter.
If the cycle disable signal is active, the PLC can write or read R parameters as far as the adjustable limit (TE 382).

Value range:

Variable decimal point position

Metric : ± 99999.999 mm
Imp. : ± 9999.9999 inches

1st relative address:

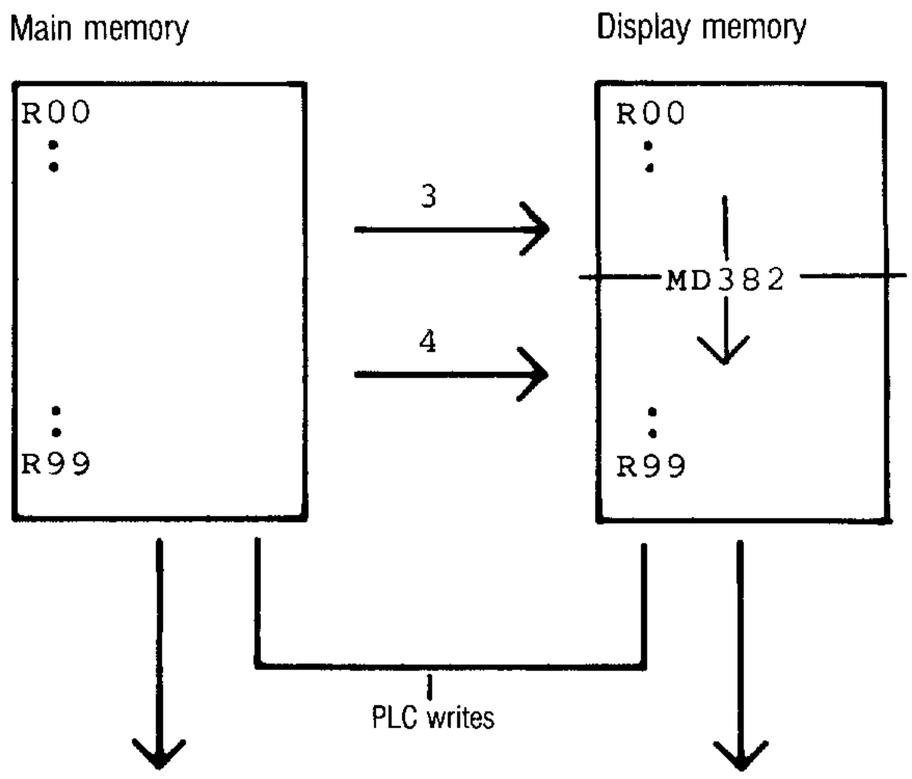
3T/3M: 00-99 = R parameter number (decades 10^0, 10^1)

2nd relative address:

3T/3M: 00 = Occupied permanently with "0"

R parameter assignment

System 3/GA4, GA4B



PLC reads with software version D02 (System GA4B) C08 (System GA4) from software version D03 (System GA4B) C09 (System GA4) if MD 428, bit 2 = 1

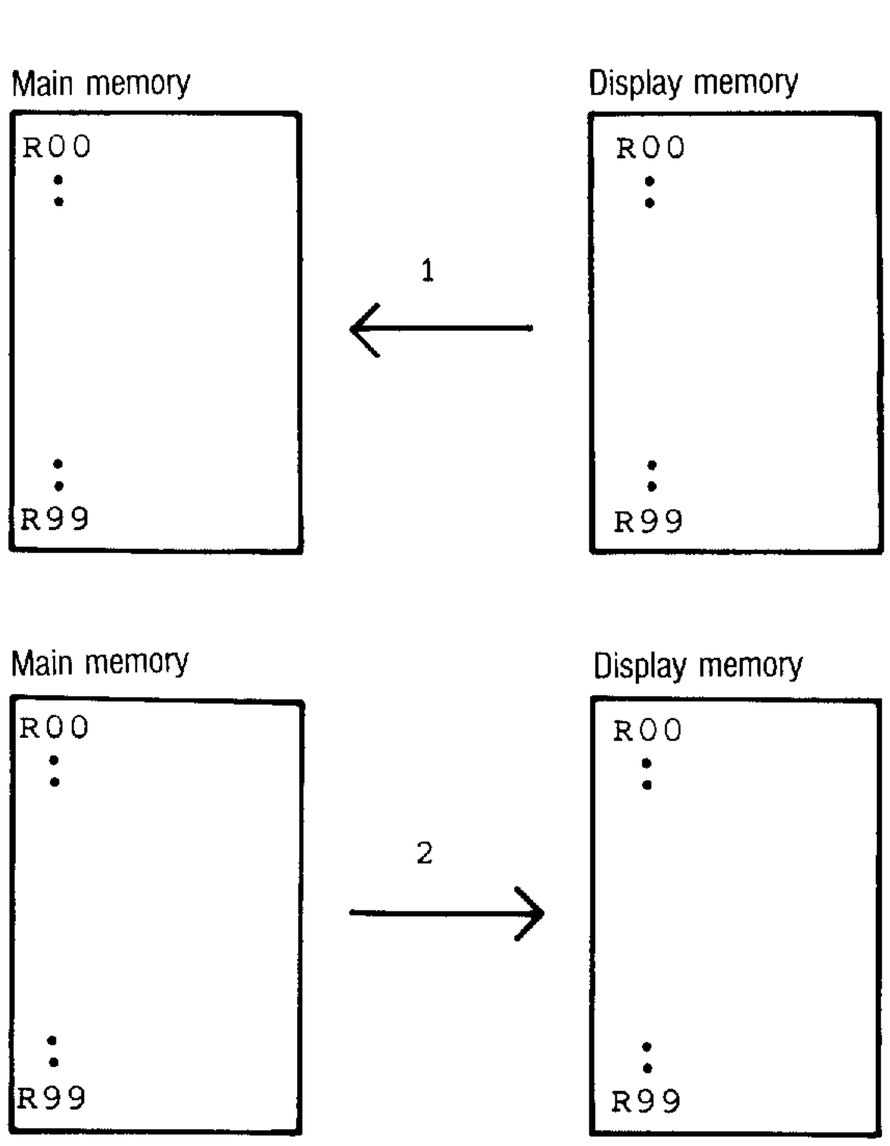
PLC reads up to software version D01 (System GA4B) C07 (System GA4) from software version D03 (System GA4B) C09 (System GA4) if MD 428, bit 2 = 0

1. With NC start, the display memory (ANZ) is transferred to the main memory (ARB)

2. During program execution without "cycle disable", the amended R parameters are transferred to the work memory and to the display memory.

3. During program execution with "cycle disable", the amended R parameters are transferred to the work memory and to the display memory up to the R parameter display limit (machine datum 382).

4. Altered R parameters in the main memory can also be transferred to the display memory beyond the R parameter display limit (machine datum 382) if G functions or auxiliary functions are programmed in calculation blocks.



4.9.7 Machine data, machine data bits (NC-M, NC-MB)

Reading access permitted to machine data (N100 - N393) and to machine data bits (N400 - N479).

With feed hold, the following machine data can be written by the PLC:

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3T/3TT	3M	Meaning
N120 N121	N120 N121 N122 N123	Acceleration
N150 N151	N150 N151 N152 N153	KV factor
N160 N161	N160 N161 N162 N163	Traversing range limitation positive
N170 N171	N170 N171 N172 N173	Traversing range limitation negative
N180 N181	N180 N181 N182 N183	Reference point value
N329	N329	Turret radius C2
N370	N370	Max. spindle speed
N378	N378	Switch-off spindle speed for M19
N379	N379	Gain factor for M19
N380	N380	Position limit for M19
N386 up to N393	N386 up to N393	Acceler. time const. for gear unit
N403 Bit 3 Bit 4 Bit 6	N403 Bit 3 Bit 4 Bit 6	1st axis Multiply part actual value by 2 Divide part actual value by 2 Multiply part actual value by 10
N404 Bit 3 Bit 4 Bit 6	N404 Bit 3 Bit 4 Bit 6	2nd axis Multiply part actual value by 2 Divide part actual value by 2 Multiply part actual value by 10
	N405 Bit 3 Bit 4 Bit 6	3rd axis Multiply part actual value by 2 Divide part actual value by 2 Multiply part actual value by 10
	N406 Bit 3 Bit 4 Bit 6	4th axis Multiply part actual value by 2 Divide part actual value by 2 Multiply part actual value by 10
N407 Bit 0 Bit 1	N407 Bit 0 Bit 1	Spindle Actual value x 2 Actual value sign change
N409 Bit 5	N409 Bit 5	Feedrate not contour related
N411	N411	Device coding/baud
N412	N412	Device coding/baud

1st relative address:

00-99 = Machine data nos.
(decades 10^0, 10^1)

2nd relative address:

01-04 = Machine data nos.
(decade 10^2)

Machine data bits:

Value range: 0 or 1

1st relative address:

00-07 = Bit nos. 1 to 7

2nd relative address:

00-79 = Machine data nos.
(N4.. ; decades 10^0, 10^1)

4.9.8 Axis actual value offset (AI-V)

The actual value display of a rotary axis in the follow-up mode can be synchronized with the actual position of the rotary table. This function serves as a substitute for the "reference point approach" function. The PLC can input an axis actual value offset in the NC. The value of the actual value display minus the axis actual value offset gives the new actual value for the display.
Reading access is also permitted to the axis actual value offset.

Value range:

For reading: Fixed decimal point position
For writing: Decimal point position can be shifted to left
Metric: ± 99999.999 mm
Imp. : ± 9999.9999 inches

1st relative address:

3T: 01 = 1st axis
02 = 2nd axis

3M: 01 = 1st axis
02 = 2nd axis
03 = 3rd axis
04 = 4th axis

2nd relative address:

3T/3M: 00 = Occupied permanently with "0"

4.9.9 Setting data bits (SE-B)

Reading access to setting data bits (25, 26).
Writing access permitted to setting datum 26, bits 0-2.

Value range: 0 or 1

1st relative address:

3T/3M: 01 = Bit 0
02 = Bit 2
.
.
.
07 = Bit 7

2nd relative address:

3T/3M: 25 = Byte address 25
26 = Byte address 26

AXIS-SPECIFIC VALUES

ID No.	Designation			Maximum input value	Input unit	Unit (metric)
10*	Stop tolerance range 1			32 000	MS	µm
11*	Clamping tolerance			32 000	MS	µm
12*	Acceleration			5 000	IS	0,01 m/s**2
13*	Max. feedrate			15 000	IS	mm/min
14*	Command value limit			3) 2 048	--	2) V E L O
15*	KV factor			10 000	MS	0,01 s**-1
16*	Software limit switch +			+/- 99 999 999	MS	µm
17*	Software limit switch –			+/- 99 999 999	MS	µm
18*	Reference point value			+/- 99 999 999	MS	µm
19*	Backlash compensation			+/- 255	MS	µm
20*	Tool reference value			+/- 99 999 999	IS	µm
21*	Reference point shift			+/- 9 999	MS	µm
22*	Mult gain			32 000	MS	1) CX [1/mm/min]
23*	Drift compensation			3) +/- 500	--	2) V E L O
24*	Stop tolerance range 2			32 000	MS	µm
25*	Compensation value for leadscrew pitch error			99	MS	µm
26*	Reference pointer for leadscrew pitch error compensation			1023	--	---
27*	Distance between leadscrew pitch error compensation points			32 000	MS	10 µm

PLC VALUES

ID-No.	Designation			Maximum input value	Input unit	Unit (metric)
280						
281						
282						
283						
284						
285						
286						
287						
288						
289						
290						
291						
292						
293						
294						
295						
296						
297						
298						
299						
300						
301						
302						
303						
304						
305						
306						
307						
308						
309						

NC VALUES

ID-No.	Designation			Maximum input value	Input unit	Unit (metric)
310	Min. limit input background memory			100	--	---
311	Max. limit input background memory			100	--	---
312						
313						
314						
315						
316						
317	Distance tool track 1 – Z axis			+/- 9 999 999	IS	ym
318	Distance tool track 2 – Z axis			+/- 9 999 999	IS	ym
319	Distance tool track 3 – Z axis			+/- 9 999 999	IS	ym
320	Distance tool track 4 – Z axis			+/- 9 999 999	IS	ym
321	Distance tool track 5 – Z axis			+/- 9 999 999	IS	ym
322	Distance tool track 6 – Z axis			+/- 9 999 999	IS	ym
323	Distance tool track 7 – Z axis			+/- 9 999 999	IS	ym
324	Distance tool track 8 – Z axis			+/- 9 999 999	IS	ym
325	Oblique angle coordinate rotation			9 000 000	--	10**-5 grd
326	Distance machine origin – transf. centre			9 999 999	IS	ym
327	Distance fict. origin – transf. centre			9 999 999	IS	ym
328	Revolver radius tool changer			9 999 999	IS	ym
329	Revolver radius C2 – axis			9 999 999	IS	ym
330	Feedrate override – 2nd switch pos.			130	--	%
331	Feedrate override – 3rd switch pos.			130	--	%
332	Feedrate override – 4th switch pos.			130	--	%
333	Feedrate override – 5th switch pos.			130	--	%
334	Feedrate override – 6th switch pos.			130	--	%
335	Feedrate override – 7th switch pos.			130	--	%
336	Feedrate override – 8th switch pos.			130	--	%
337	Feedrate override – 9th switch pos.			130	--	%
338	Feedrate override – 10th switch pos.			130	--	%
339	Feedrate override – 11th switch pos.			130	--	%
340	Feedrate override – 12th switch pos.			130	--	%
341	Feedrate override – 13th switch pos.			130	--	%
342	Feedrate override – 14th switch pos.			130	--	%
343	Feedrate override – 15th switch pos.			130	--	%
344	Feedrate override – 16th switch pos.			130	--	%

NC VALUES

ID-No.	Designation			Maximum input value	Input unit	Unit (metric)
345	Prelimit switch			99 999 999	MS	µm
346	Speed after prelimit switch			15 000	IS	mm/min
347	Reducing speed with G62			15 000	IS	mm/min
348	Speed with Jog – measuring			15 000	IS	mm/min
349	Switch-off speed – rotary axis			15 000	IS	mm/min
350	Switch-off speed			15 000	IS	mm/min
351	Threshold speed for contour monitoring			15 000	IS	mm/min
352	Tolerance band for contour monitoring			32 000	MS	µm
353	Delay time position monitoring			16 000	--	ms
354	Command speed limit		3)	3 000	--	2) VELO
355	Arc endpoint monitoring			32 000	IS	µm
356	Threshold for skipping comp. blocks			32 000	IS	µm
357	Spindle – drift		+/-	500	--	VELO
358	Dynamic smoothing exponent			5	--	---
359	Max. speed for gear stage 1			9 999	--	1/min
360	Max. speed for gear stage 2			9 999	--	1/min
361	Max. speed for gear stage 3			9 999	--	1/min
362	Max. speed for gear stage 4			9 999	--	1/min
363	Max. speed for gear stage 5			9 999	--	1/min
364	Max. speed for gear stage 6			9 999	--	1/min
365	Max. speed for gear stage 7			9 999	--	1/min
366	Max. speed for gear stage 8			9 999	--	1/min
367	Spindle speed tolerance			99	--	%
368	Max. spindle speed tolerance			99 [100]	--	
369	Standstill speed tolerance			125	--	0,01 %
370	Maximum spindle speed			9 999	--	1/min
371	Jog feed			10 000	IS	mm/min
372	Manual rapid traverse			15 000	IS	mm/min
373	Ref. point approach speed			15 000	IS	mm/min
374	Incremental feedrate			15 000	IS	mm/min
375	Dry run feedrate			15 000	IS	mm/min
376	Delay for spindle enable			16 000	--	ms
377	Minimum spindle speed (motor)			8 192	--	VELO
378	Spindle switch-off speed for M19			9 999	--	1/min
379	Gain factor for M19			10 000	--	1/min/360

NC VALUES

ID-No.	Designation	Maximum input value	Input unit	Unit (metric)
380	Position limit for M19	1 000	-	1/11 grd
381	Software release	32 000	-	-
382	Ref. point display limit (FCL)	100	-	-
383	Increase scanning time	32 000	-	1/2 MS
384				
385	2nd software limit switch X axis	+/- 99 999 999	MS	UM
386	Acceler. time const. for gear stage 1	32 000	-	4 MS
387	Acceler. time const. for gear stage 2	32 000	-	4 MS
388	Acceler. time const. for gear stage 3	32 000	-	4 MS
389	Acceler. time const. for gear stage 4	32 000	-	4 MS
390	Acceler. time const. for gear stage 5	32 000	-	4 MS
391	Acceler. time const. for gear stage 6	32 000	-	4 MS
392	Acceler. time const. for gear stage 7	32 000	-	4 MS
393	Acceler. time const. for gear stage 8	32 000	-	4 MS
394				
395				
396				
397				
398				
399				

MS = UNITS IN MEASURING SYSTEM
IS = UNITS IN INPUT SYSTEM
FCL = FIXED CYCLE LOCKED

1) $CX = \frac{3 * 10^{**7}}{Vmax\ [mm/min]} * \frac{Umax\ [V]}{10\ [V]}$

2) $+/- 1\ VELO = \frac{+/- 10\ V}{3)\ 2048}$

3) With 12-bit DAC: value x 4 with 14-bit DAC

Machine data bits

ID	Remarks	7	6	5	4	3	2	1	0
400						Name of radius of chamfer			=1=
401						Name of angle (type)			=1=
402						Name of 4th axis 3M only			=1=
403	1st axis	Omit axis as start inhibit	Mulitply part actual value by 10	Rotary axis	Divide part actual value by 2	Mulitply part actual value by 2	Sign change for part actual value	Sign change for speed command value	Approach ref. point in minus direction
404	2nd axis	- " -	- " -	- " -	- " -	- " -	- " -	- " -	- " -
405	3rd axis (3M only)	- " -	- " -	- " -	- " -	- " -	- " -	- " -	- " -
406	4th axis (3M only)		- " -	- " -	- " -	- " -	- " -	- " -	- " -
407	Spindle (bit 0-6)	NC start without ref. point enable				Speed in 0.1 rpm	Pulse coder available	Sign change for actual value	Actual value x2
408		No deceleration at limit switch	G70 actual reset position	Measuring system units =4=		Short circuit for S input data	Auxiliary functions output before travel	Auxiliary functions output during search =7=	
409		Machine data have been input		Feedrate not contour-related			Dia. prog. X axis with G90		Interrogate length comp. also for non-prog. axis
410	Key switch operative for:	Data start with MDI auto	Z0 data	T0 data absolute input	T0 data additive input	Part program edit	Dry run feed	Search indicator	Overstore
411	V.24 input device	Device coding =5=					Baud rate		=6=
412	V.24 output device	Device coding =5=					Baud rate		=6=
413	@ :	EIA code for @							
414		DC control sign without parity V.24					Common reset for NC ready	Name of main axis allocated to 4th axis	=3=
415		C R C				Teach in/ play back		Thread cutting and revolutional feedrate	
416		End of block: CR LF	3T: display actual dia. of X axis		@ 2 9		NC alarm texts	cycles	V.24
417		User module			Decelerate to feed-rate of next block	Spindle override active for thread cutting	Wear input in dia. (X axis)	KV factor measured	14-bit D-A converter
418									
419									

Machine data bits

ID	Remarks	7	6	5	4	3	2	1	0
420	1st axis	Rotary axis modulo 1 rev		Leadscrew pitch error comp. depends on dir.	Switch off hard-ware monitoring	Actual value display modulo 360 deg	Rotary axis modulo 256 rev	Round off 1 deg.	Round off 0.5 deg.
421	2nd axis	- " -		- " -	- " -	- " -	- " -	- " -	- " -
422	3rd axis (3M only)	- " -		- " -	- " -	- " -	- " -	- " -	- " -
423	4th axis (3M only)	- " -		- " -	- " -	- " -	- " -	- " -	- " -
424						Tool sign via G43/G44			Common actual value display
425					No display of SINUMERIK System 3	Program output without trailer	Operation with Dual PLC	Operation without meas. circuit modules	Operation possible without operator panel
426		Block search without path calculation	Pilot control	No output of M17					Signal charge axis in position
427		Dia. prog. and no. X axis inoperative with 3M			Feedrate contour-related at inner arc only				Spindle speed from el. gear
428		Reduced servo scanning time	No external Z0 disable with G53		No max. gear stage speed monitoring	Positioning exact 2 for change G64 → G00	Read R parameter from main memory	M19 always with switch-off speed	Tool track calculation
429			Work.in ext. Z0 in autom. tool evaluation axis value + Z0	Do not delete N displacement at Power On				Clock through current alarms	Page backwards without stop
430	1st axis		Leadscrew pitch error comp. value in 0.5 µm	Time constant in command value channel with pilot control			Differential quota in command value channel with pilot control		
431	2nd axis		- " -		- " -			- " -	
432	3rd axis (3M only)		- " -		- " -			- " -	
433	4th axis (3M only)		- " -		- " -			- " -	
434									
435									
436									
437									
438									

Machine data bits

ID	Remarks	7	6	5	4	3	2	1	0
440		Colour graphics	Monochrome graphics		Simulation with aux. function output				
441									
442		Colour display range 2			=B=	Colour display range 1			=B=
443		Colour display range 4			=B=	Colour display range 3			=B=
444		Colour display range 6			=B=	Colour display range 5			=B=
445		Colour display range 8			=B=	Colour display range 7			=B=
446							Type of representation Plane XY		=10=
447							Type of representation Plane ZX		=11=
448							Type of representation Plane YZ		=12=
449									

PLC-machine data bits

ID	Remarks	7	6	5	4	3	2	1	0
450									
451									
452									
453									
454									
455									
456									
457									
458									
459									
460									
461									
462									
463									
464									
465									
466									
467									
468									
469									

PLC-machine data bits

ID	Remarks	7	6	5	4	3	2	1	0
470									
471									
472									
473									
474									
475									
476									
477									
478									
479									

Leadscrew pitch error compensation bits

ID	Remarks	7	6	5	4	3	2	1	0
500		Compensation flag 3 =9=		Compensation flag 2 =9=		Compensation flag 1 =9=		Compensation flag 0 =9=	
501		Compensation flag 7 =9=		Compensation flag 6 =9=		Compensation flag 5 =9=		Compensation flag 4 =9=	
502		Compensation flag 11 =9=		Compensation flag 10 =9=		Compensation flag 9 =9=		Compensation flag 8 =9=	
503		Compensation flag 15 =9=		Compensation flag 14 =9=		Compensation flag 13 =9=		Compensation flag 12 =9=	
504		Compensation flag 19 =9=		Compensation flag 18 =9=		Compensation flag 17 =9=		Compensation flag 16 =9=	
505		Compensation flag 23 =9=		Compensation flag 22 =9=		Compensation flag 21 =9=		Compensation flag 20 =9=	
506		Compensation flag 27 =9=		Compensation flag 26 =9=		Compensation flag 25 =9=		Compensation flag 24 =9=	
507		Compensation flag 31 =9=		Compensation flag 30 =9=		Compensation flag 29 =9=		Compensation flag 28 =9=	
...									
...									
...									
...									
...									
...									
...		Compensation flag 1007		Compensation flag 1006		Compensation flag 1005		Compensation flag 1004	
751		Compensation flag 1011 =9=		Compensation flag 1010 =9=		Compensation flag 1009 =9=		Compensation flag 1008 =9=	
752		Compensation flag 1015 =9=		Compensation flag 1014 =9=		Compensation flag 1013 =9=		Compensation flag 1012 =9=	
753		Compensation flag 1019 =9=		Compensation flag 1018 =9=		Compensation flag 1017 =9=		Compensation flag 1016 =9=	
754		Compensation flag 1023 =9=		Compensation flag 1022 =9=		Compensation flag 1021 =9=		Compensation flag 1020 =9=	
755		=9=		=9=		=9=		=9=	

Setting data NUMBER 25

Bit No.	Bit = 0	Bit = 1
07		
06		
05	Punch out ISO code	Punch out EIA code
04		
03	Program start with %	Program start with LF
02	Punched tape block parity OFF	Punched tape block parity ON
01	Operator guidance OFF	Operator guidance ON
0	Display actual value system of machine	Display actual value system of workpiece

Setting data NUMBER 26

Bit No.	Bit = 0	Bit = 1
07		
06		
05		
04		
03		
02	Handwheel pulse value Increment per division 0	Handwheel pulse value Increment per division 100
01	Handwheel pulse value Increment per division 0	Handwheel pulse value Increment per division 10
0	Handwheel pulse value Increment per division 0	Handwheel pulse value Increment per division 1

Setting data 25, bit 3

Bit 3 = 1, program start with LF

In the Data In operating mode, a part program is read in the part program memory starting with the first LF. This part program is filed under % 0 in the part program memory.

Bit 3 = 0, program start with %

In the Data In operating mode, a part program is read in the part program memory starting with % and filed under the appropriate part program number.

4.9.10 Incremental path from PLC

The PLC can define an axial incremental path and the corresponding feedrate for the NC via "feedrate for path from PLC".

General functional description:

- Axis can be selected
- Incremental path
- Only one axis at a time, not several axes simultaneously
- Valid for axes X, Z on 3T; X, Y, Z, 4 on 3M; X, Z, Y, C on 3T+C
- Active in operating modes MDA, JOG, INC, AUTO
- Feedrate override active
- When traversing the PLC path, the motion lamp comes on and motion command is active
- Incremental residual distance is displayed on screen
- Function start by strobe 25

Interlocks for strobe channel 25:

- Only in operating modes MDA, JOG, INC and AUTO
- Not during traversing of:
  a preset displacement, an incremental displacement (operating mode INC) or a manual displacement (operating mode JOG and traverse key pressed)

Functional description in AUTO operating mode:

"PROGRAM ACTIVE" signal = 0

Strobe 25 effects immediate traversing of the path at the feedrate previously set via "feedrate for path from PLC" strobe 26.

"PROGRAM ACTIVE" signal = 1

- Remove read-in enable
- Wait until active block is executed
- Issue strobe 25

The path is traversed immediately when the strobe is issued; the read-in enable must be given again during or after traversing so that program execution can continue

At this point, the axis controlled by the PLC is at a different position than that defined by the NC program. This positioning error is compensated as soon as the PLC controlled axis is reprogrammed.

Functional description in JOG and INC operating modes:

Strobe 25 effects immediate traversing of the path at the feedrate previously set via "feedrate for path from PLC" strobe 26. This interrupts traversing with the handwheel where applicable. During the displacement, manual motion commands (handwheel or traverse key) are disregarded.

Functional description in MDA operating mode:

See AUTO operating mode.

This value cannot be written via the basic program, but only via FB62 (package 0) (PLC to NC only).

Coding/type = 25

Value ranges:

Decimal point position can be shifted to left.

Metric: ± 99999.999 mm
Imp. : ± 9999.9999 inches

1st relative address:

3T: 01 = 1st axis
    02 = 2nd axis

3M: 01 = 1st axis
    02 = 2nd axis
    03 = 3rd axis
    04 = 4th axis

2nd relative address:

3T/3M: 00 = Occupied permanently with "0"

4.9.11 Feedrate for path from PLC

This value cannot be written via the basic program, but only via FB62 (package 0) (PLC to NC only).

Coding/type = 26

Value ranges:

Decimal point position can be shifted to left.

Metric: 99999 mm/min
Imp. : 99999 x 0.1 inches/min

1st/2nd relative address:

3T/3M: 00 = Occupied permanently with "0"

4.9.12 Reading NC alarms

NC alarms cannot be read via the basic program, but only via FB61 (package 0) (NC to PLC only).

Coding/type = 27

Value range:

1 to 718

1st relative address:

3T/3M: 01 = 1st NC alarm
. .
. .
. .
10 = 10th NC alarm

2nd relative address:

3T/3M: 00 = Occupied permanently with "0"

4.9.13 M19 from PLC

The PLC can preset an M19 function for the NC.

Preconditions:

- The "oriented spindle stop" option must be available
- Operating mode MDA, JOG, INC or AUT must be selected

The M19 function preset by the PLC has the same effect as the M19 function activated by the NC part program.

No writing must take place in strobe channel 30 while executing the following functions:
- M19 function from PLC
- M19 function from part program
- Incremental path from PLC
- Incremental path in INC operating mode
- Traverse keys pressed in JOG operating mode

Functional description in AUT and MDA operating modes

The following must be observed while the program is active:

- Read-in enable must be removed
- Wait until active block has been executed
- Strobe 30 must be issued: execution of M19 from PLC
- Read-in enable must be reinstated

If no program is active:

- "M19 from PLC" immediately effects an M19 function

Functional description in JOG and INC operating modes

"M19 from PLC" immediately effects the M19 function. While M19 is active and the "M19 with axis movement" option is set, manual motion commands are interpreted (traverse keys pressed).

M19 from PLC cannot be written via the basic program, but only via FB62 (package 0) (PLC to NC only).

Coding/type = 30

Value range:

360.0 fixed decimal point position

1st/2nd relative address:

3T/3M: 00 = Occupied permanently with "0"

4.9.14 Incremental spindle positioning from PLC

General functional description:
The PLC can assign the NC an incremental angle of rotation for the spindle together with the corresponding positioning speed via strobe channels 31 and 32.

The final spindle position is calculated from the absolute start position and the preset incremental angle of rotation.

Start position = command position of last positioning process completed with "spindle stop".
The start position is not necessarily the same as the spindle's actual position (when ending a positioning process with "spindle stop", the spindle may not be exactly at the command position, but may drift). Deviation of the actual spindle position from the start position is properly recognized and included in the calculation up to a value of 180 degrees (see examples 2, 3 and 4).

- Incremental angle of rotation via strobe channel 31 (an input of 400 degrees means that rotation will continue through 400 degrees from the start position in the M03 direction of rotation).

- Positioning speed adjustable via separate strobe channel 32.

- Active in operating modes: MDA, JOG, INC and AUTO.

- Function start via strobe 31 signal.

- Function ended via "spindle stop" signal (same as M19).

- Spindle override inoperative.

- The spindle is subject to position control during the entire positioning process.
  (Scanning time in normal circumstances = 16 ms on 3T, 18 ms on 3M).
  The following machine data are used (can be written by PLC):

MD 379	KV factor for spindle position control
MD 386-393	Acceleration time constant for gear stage
MD 380	Position limit for "spindle in position" signal

- The "no M19 interruption with reset" and "M19 with axis movement" machine data do not affect this function.

- No "paths from PLC" can be traversed while the "incremental spindle positioning from PLC" function is active.

Functional description in AUT and MDA operating modes

- If no program is active, strobe 31 immediately initiates positioning at the speed previously programmed via strobe 32.

- The following must be observed while the program is active:
  - Read-in enable must be removed
  - Wait until active block has been executed
  - Strobe 31 must be issued
  - Positioning procedure ended by "spindle stop"
  - Read-in enable must be reinstated

Functional description in JOG and INC operating modes

Strobe 31 immediately initiates positioning at the speed previously programmed via strobe 32. This interrupts traversing with the handwheel where applicable. During positioning, manual motion commands (handwheel or traverse keys) are disregarded.

Examples:

Example 1:

+ 410° = Incremental angle of rotation programmed via strobe 31

45° = Command position of a previous "M19 S45" completed with "spindle stop" = actual position of spindle at initiation of function by strobe 31

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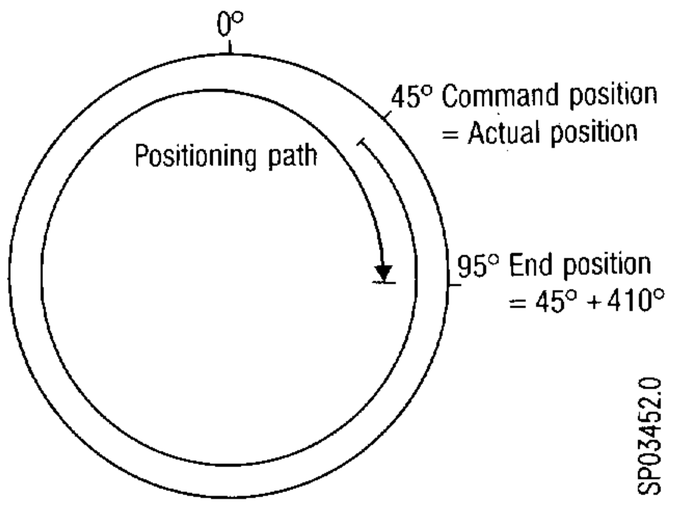
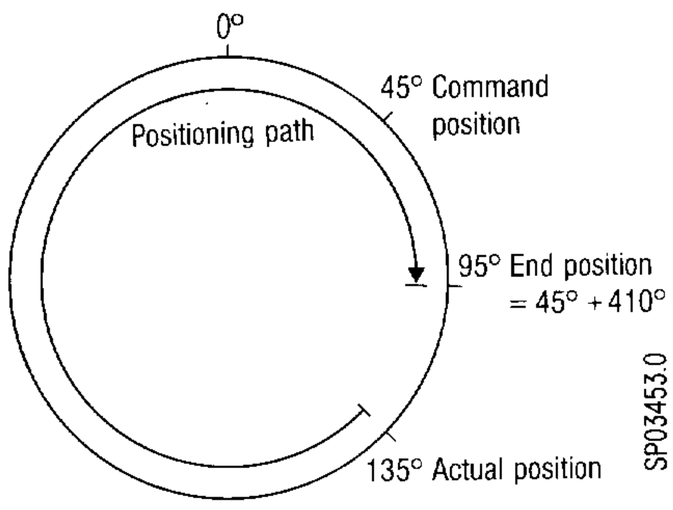


Example 2:

+ 410^{o} = Incremental angle of rotation programmed via strobe 31

45^{o} = Command position of a previous positioning process completed with "spindle stop"

135^{o} = Actual position of spindle at initiation of function by strobe 31

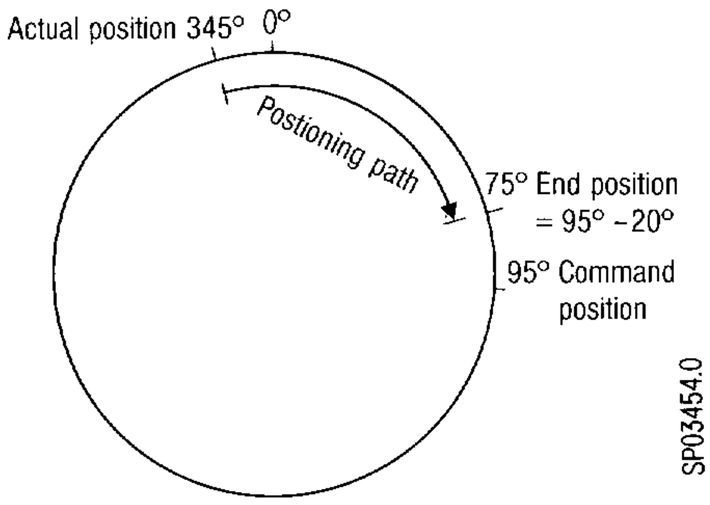


Example 3:

- 20^{o} = Incremental angle of rotation programmed via strobe 31

95^{o} = Command position of a previous positioning process completed with "spindle stop"

345^{o} = Actual position of spindle at initiation of function by strobe 31



Caution:

Even though the programmed incremental angle of rotation has a negative sign (= direction of rotation M04), the spindle rotates in the opposite direction (same as M03).

Reason:

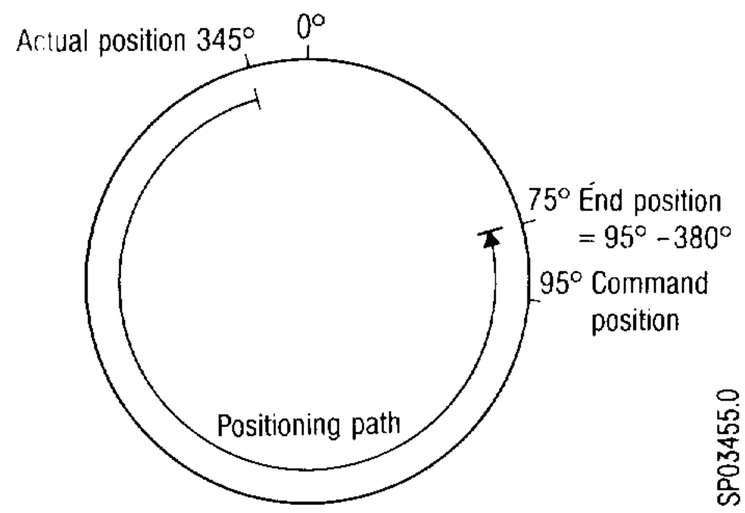
Since the end of the last positioning process, the spindle has already drifted past the new command position.

Example 4:

- 380^{o} = Incremental angle of rotation programmed via strobe 31

95^{o} = Command position of a previous positioning process completed with "spindle stop"

345^{o} = Actual position of spindle at initiation of function by strobe 31



Interlocks for strobe channel 31:

- Only in operating modes MDA, JOG, INC and AUT
- The spindle must be synchronized, i.e. it must have made at least one complete revolution since Power On
- The spindle must be at a standstill (spindle command speed = 0)
- No "paths from PLC" active
- No M19 active
- No manual movement of axes
- The following MD bits must be set:

  "Oriented spindle stop"
  "Analog spindle speed"
  "Incremental spindle positioning from PLC"

Incremental spindle positioning from PLC cannot be written via the basic program, but only via FB62 (package 0) (PLC to NC only).

Coding/type = 32

Value range:

± 999.9 degrees (fixed decimal point position)

1st/2nd relative address:

3T/3M: 00 = Occupied permanently with "0"

The arithmetic sign designates the direction of rotation (+ as for M03, - as for M04).

4.9.15 Speed for spindle positioning from PLC

The positioning speed needs to be programmed only once after POWER-ON-RESET.

This value cannot be written via the basic program, but only via FB62 (package 0) (PLC to NC only).

Coding/type = 32

Value range:

9999 rpm

1st/2nd relative address:

3T/3M: 00 = Occupied permanently with "0"

5. Machine control panel

5.1 General

The machine control panel must have a 24 V power supply.

There are two alternative ways of connecting the machine control panel.

1. Version 1

Connection via an input module or input/output module with standard addressing to input byte 48 or another input byte (IB2 where possible).
The machine control panel is connected directly to input connector IN of the selected function module by means of a standard input/output cable.

The 18 unassigned bits on the input function module can be occupied by connecting additional machine operating signals at the solder tags of machine control panel link module 03630. The solder tag numbers and the numbers in the data bit lists on the following two pages refer to the pin numbers.

2. Version B

Connection via a logic module. As well as the machine control panel signals, additional input/output signals can be transferred to the machine control panel with a logic module. Up to 2 logic modules can be connected. Input/output assignment is fixed.

There are two methods of transferring machine control panel signals to the NC link area:

Method 1:
Machine control panel signals transferred by FB22 from input bytes IB48 to IB50 without modification to the NC link area.

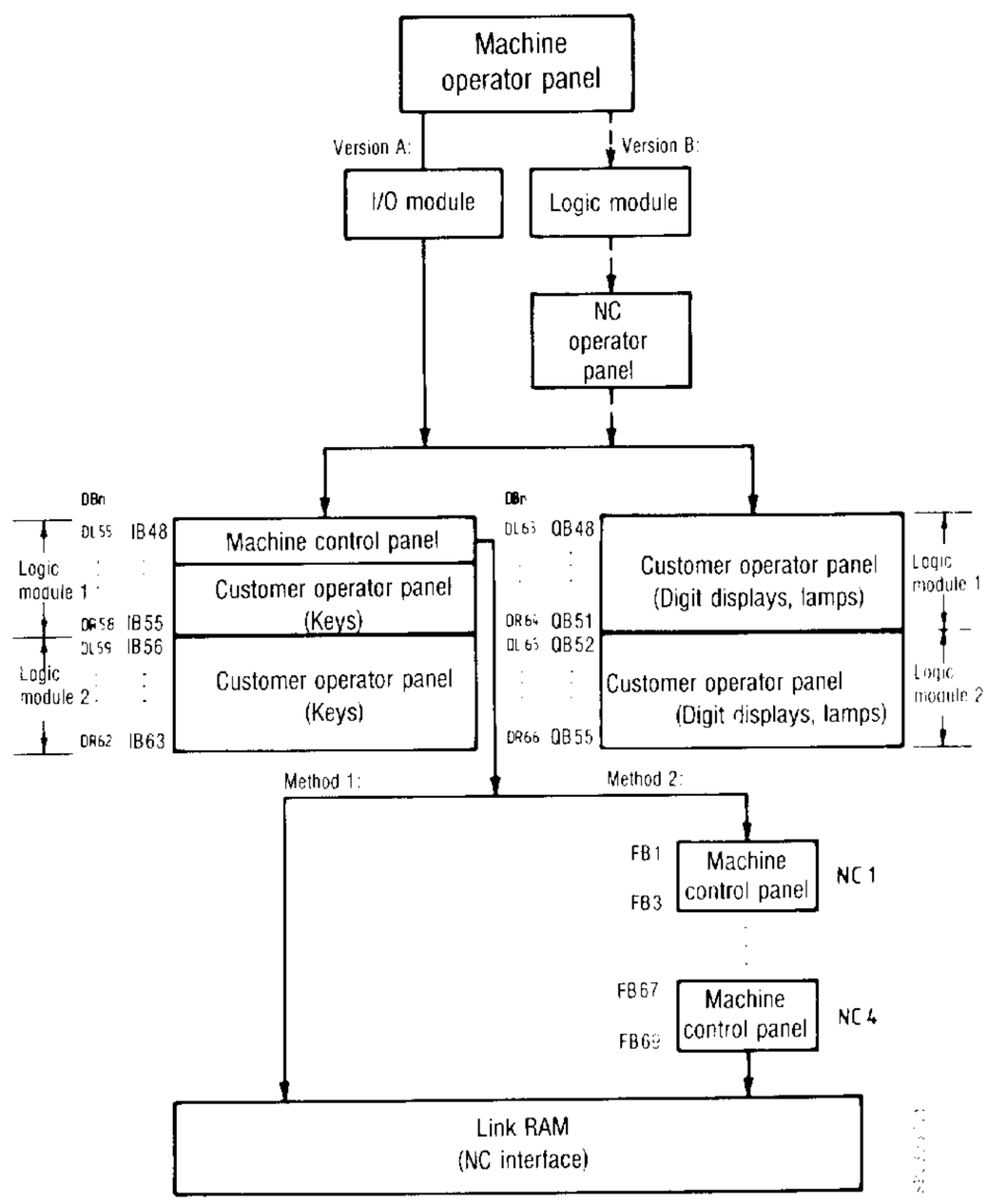
Method 2:
If an input byte other than IB48 is addressed, the PLC user program must transfer the machine control panel signals to the appropriate flag areas (see "Machine control panel signals to NC"). FB22 transfers the signals from there to the NC link area. IB0 is reserved for alarm inputs and must not be used for machine control panel signals.

Individual components of machine control panel

The machine control panel operates at 24 V.
It does not contain any electric circuits. Operator control signals are directed straight to the inputs of the input/output module.

The machine control panel can also be constructed from individual components and wired up accordingly. In this case, the selector switches coded with a diode matrix can be installed as a single component complete with diode board.

Refer to Section 9 for the circuit diagram and mechanical design of these coded selector switches.



5.2 Overview of machine control panel signals

Connecting 3T/3TT machine control panel to the PLC via an input/output module

PLC inputs Byte addr.	Bit number 7	6	5	4	3	2	1	0	
e.g. 48	Operating mode switch D 8	C 7	B 6	A 5	Feedrate/rapid traverse override switch D 4	C 3	B 2	A 1	
49	Key switch 16	Dry run 15	Skip block 14	Single block 13	Block search 12	Spindle speed override switch C 11	B 10	A 9	*)
50	Rapid traverse override active 25	Rapid traverse overlay 24	Direction keys X+ 23	X– 22	Z+ B 21	Z– 20	X 19	X 18	
51	* Spindle OFF 33	Spindle ON 32	* Feed HOLD 31	Feed Start 30	Handwheel X 29	Cycle Start 28	unassigned 27	unassigned 26	
52	unassigned 41	unassigned 40	unassigned 39	unassigned 38	unassigned 37	unassigned 36	unassigned 35	unassigned 34	**)
53	unassigned 49	unassigned 48	unassigned 47	unassigned 46	unassigned 45	unassigned 44	unassigned 43	unassigned 42	

SP03465.0

Pin 17 not available

Pin No. (X630)

Pins 18 and 19 not connected to machine control panel; can be used as customer keys

*) FB22 (DAT NC/PLC) transfers signals to link RAM if »machine control panel from I image (method 1)« has been set in DB9

**) Freely assignable to customer keys

Siemens AG Order-No.: E80850-D27-X-A1-7600

Connecting 3M machine control panel to the PLC via an input/output module

PLC inputs Byte addr.	Bit number 7	6	5	4	3	2	1	0
e.g. 48	Operating mode switch D 8	C 7	B 6	A 5	Feedrate/rapid traverse override switch D 4	C 3	B 2	A 1
49	Key switch 16	Dry run 15	Skip block 14	Single block 13	Block search 12	Spindle speed override switch C 11	B 10	A 9
50	Rapid traverse override active 25	Rapid traverse overlay 24	Direction keys + 23	− 22	Axis selector switch Code B 21	A 20	19	18
51	* Spindle OFF 33	Spindle ON 32	* Feed HOLD 31	Feed Start 30	unassigned 29	Cycle Start 28	unassigned 27	unassigned 26
52	unassigned 41	unassigned 40	unassigned 39	unassigned 38	unassigned 37	unassigned 36	unassigned 35	unassigned 34
53	unassigned 49	unassigned 48	unassigned 47	unassigned 46	unassigned 45	unassigned 44	unassigned 43	unassigned 42

*) **)

SP03466.0

Pin 17 not available

Pins 18 and 19 not connected to machine control panel; can be used as customer keys

*) FB22 (DAT NC/PLC) transfers signals to link RAM if »machine control panel from I image (method 1)« has been set in DB9

**) Freely assignable to customer keys

Pin No. (X636)

Connecting 3M machine control panel to the PLC via a logic module

PLC inputs Byte addr.	Bit number 7	6	5	4	3	2	1	0
E 48	Operating mode switch D 10	C 9	B 8	A 7	Feedrate/rapid traverse override switch D 6	C 5	B 4	A 3
49	Key switch 18	Dry run 17	Skip block 16	Single block 15	Block search 14	Spindle speed override switch C 13	B 12	A 11
50	Rapid traverse override active 26	Rapid traverse overlay 25	Direction keys + 24	− 23	Axis selector switch Code B 22	A 21	20	19
51	* Spindle OFF 34	Spindle ON 33	* Feed HOLD 32	Feed Start 31	unassigned 30	Cycle Start 29	28	27

SP03467.0

Pin No. (X636)

Connecting 3T machine control panel to the PLC via a logic module

PLC inputs Byte addr.	Bit number 7	6	5	4	3	2	1	0
E 48	Operating mode switch D 10	C 9	B 8	A 7	Feedrate/rapid traverse override switch D 6	C 5	B 4	A 3
E 49	Key switch 18	Dry run 17	Skip block 16	Single block 15	Block search 14	Spindle speed override switch C 13	B 12	A 11
E 50	Rapid traverse override active 26	Rapid traverse overlay 25	Direction keys X+ 24	X- 23	Z+ 22	Z- 21	20	19
E 51	* Spindle OFF 34	Spindle ON 33	* Feed HOLD 32	Feed Start 31	Handwheel X 30	Cycle Start 29	28	27

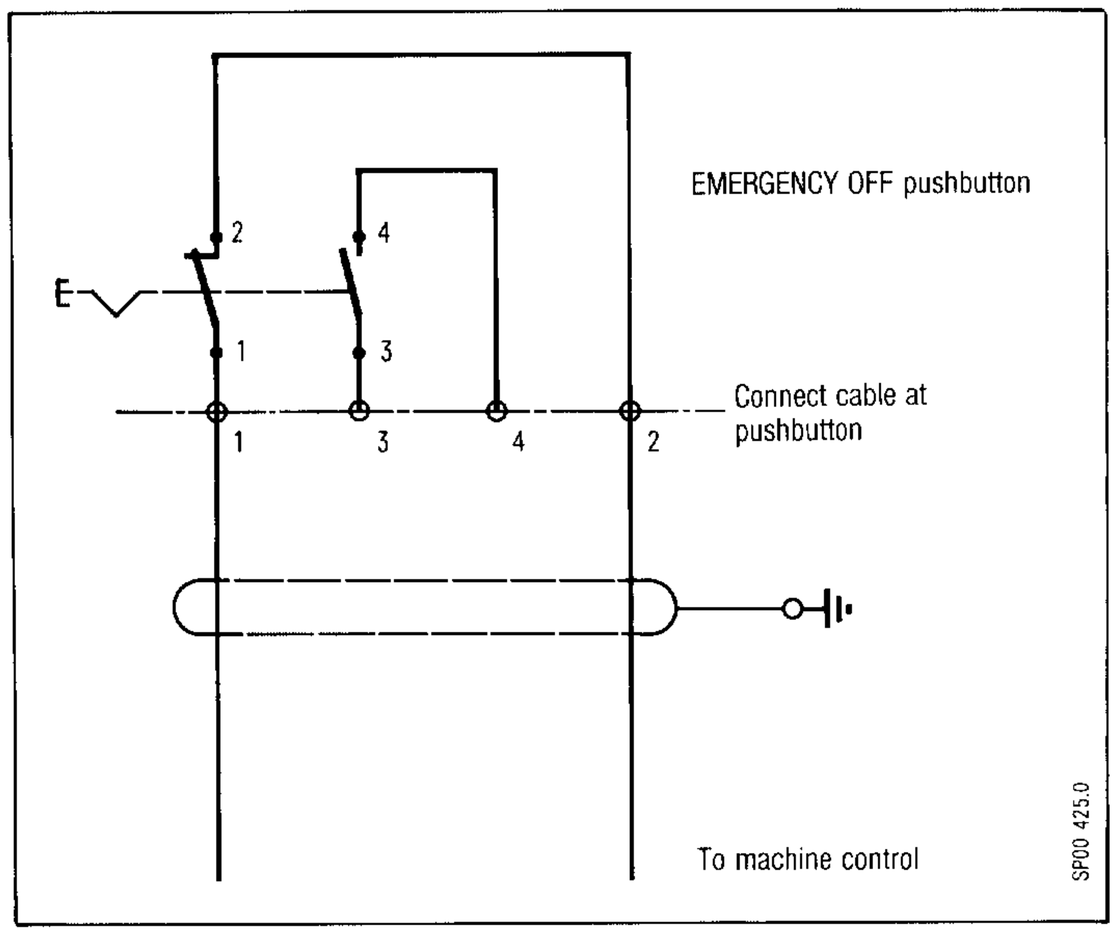
SP 03468.0

Pin No. (X636)

Link module for connecting additional machine operator controls

Module 03636

Additional machine signals (pins 26 to 49) can be fed in via terminal strip X638.



5.3 Description of machine control panel signals

5.3.1 EMERGENCY OFF

- Separate cable, 4 (2) signals -

EMERGENCY OFF PUSHBUTTON (mushroom head pushbutton with twist release), max. switching voltage 220 V.

Connection via screened cable direct to EMERGENCY OFF PUSHBUTTON.
Screen connected at one end only, in machine control.

Note on application:

Effective in EMERGENCY OFF circuitry of machine.

Siemens AG Order-No.: E80850-D27-X-A1-7600

5.3.2 NC ON

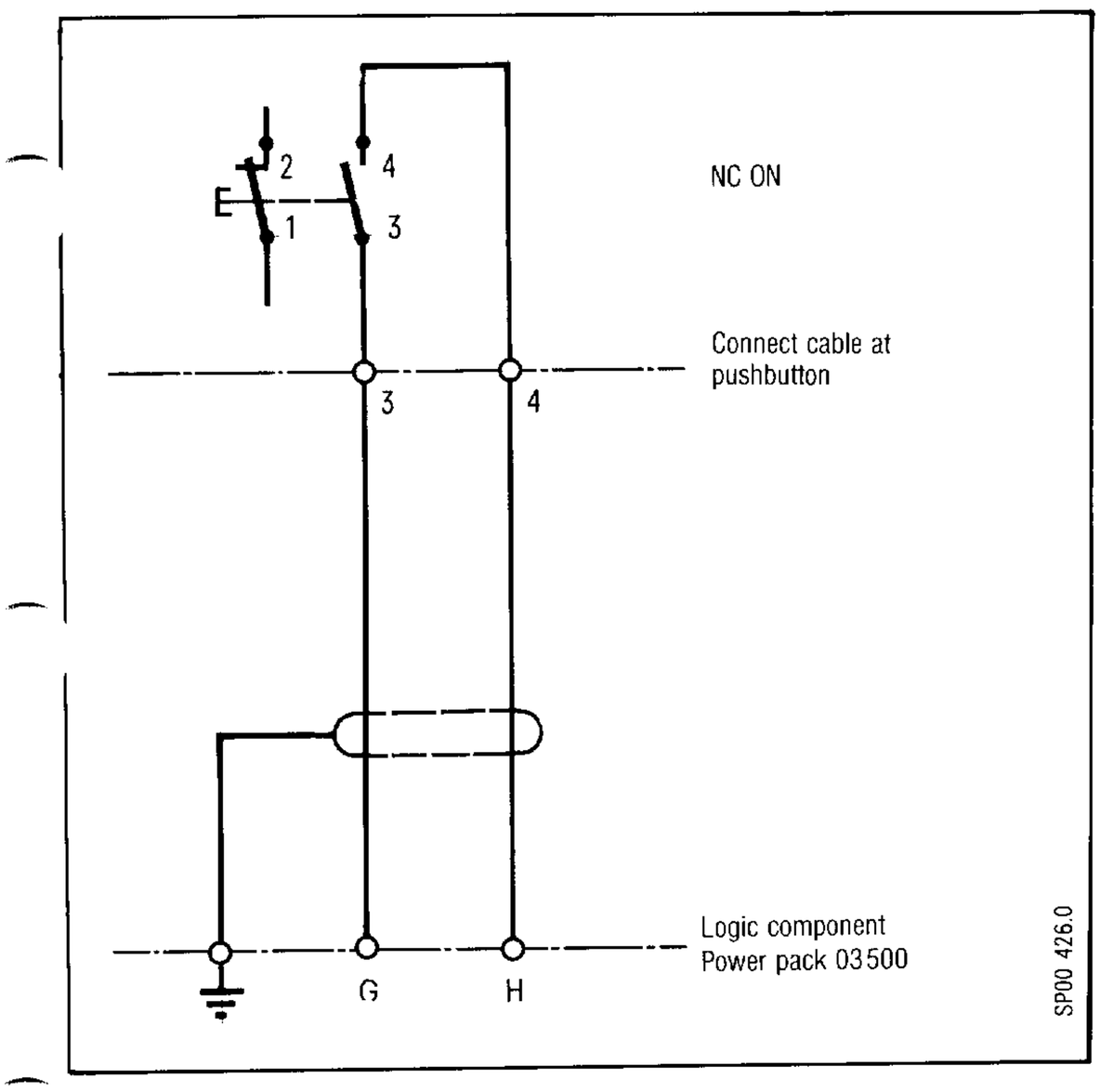
- Separate cable, 2 signals -

POWER ON PUSHBUTTON
Switching voltage 24 V DC.

Connection via screened cable directly at pushbutton.
Screen connected at one end only, to NC logic component.

Note on application:

Switches on NC logic component when 24 V DC power supply is connected.



5.3.3 OPERATING MODE SWITCH

16-position coded selector switch
Overlapping contact arrangement

This switch is used to select the various operating modes.

Code Table

Position	Connection	Symbol	Code D C B A
1	1		0 0 0 1
2	3		
3 > a)	5		0 0 1 1
4	7		
5 > b)	9		0 0 1 0
6	11		1 0 1 0
7	13	1	1 0 1 1
8	15	10	1 0 0 1
9	17	100	1 0 0 0
10	19	1000	1 1 0 0
11	21	10000	1 1 0 1
12	23		0 1 0 1
13 > b)	25		0 1 0 0
14	27		0 1 1 0
15 > a)	29		
16	31		1 1 1 0

c)

a) Overall erasure of increment memory
b) Erasure of increment memory when switching from ↔
c) Non-erasable areas

5.3.4 SPINDLE SPEED OVERRIDE SWITCH

8-position coded selector switch
Overlapping contact arrangement

This switch enables the spindle speed to be altered in steps between 50 % and 120 %.

In conjunction with revolutional feedrates and constant cutting speeds, the feed drives are adjusted automatically when the spindle speed is altered with this switch.
The switch is inoperative with thread cutting.

Code Table

Position	Connection	Symbol S ↻ %	Code C B A
1	1	50	1 1 1
2	3	60	1 1 0
3	5	70	0 1 0
4	7	80	0 1 1
5	9	90	0 0 1
6	11	100	0 0 0
7	13	110	1 0 0
8	15	120	1 0 1

5.3.5 FEEDRATE OVERRIDE SWITCH

16-position coded selector switch
Overlapping contact arrangement

This switch enables the feedrate to be altered in steps between 0 % and 120 %. With the "rapid traverse override active" switch operated, the rapid traverse rate can be altered in steps between 0 % and 100 %.
The switch is inoperative with thread cutting.

Code Table

Position	Connection	Symbol F ⇝ %	Code D C B A
1	1	0	0 0 0 0
2	3	1	0 0 0 1
3	5	2	0 0 1 1
4	7	4	0 0 1 0
5	9	6	0 1 1 0
6	11	8	0 1 1 1
7	13	10	0 1 0 1
8	15	20	0 1 0 0
9	17	40	1 1 0 0
10	19	60	1 1 0 1
11	21	70	1 1 1 1
12	23	80	1 1 1 0
13	25	90	1 0 1 0
14	27	100	1 0 1 1
15	29	110	1 0 0 1
16	31	120	1 0 0 0

5.3.6 AXIS SELECTOR SWITCH (3M)

4-position coded selector switch
Overlapping contact arrangement

This switch is used to preselect the axis to be traversed in setting-up operating modes JOG, INC and REF. Traverse is initiated with the + or - direction key.

Code Table

Position	Connection	Symbol	Code B A
1	1	X	0 0
2	3	Y	0 1
3	5	Z	1 0
4	7	4	1 1

5.3.7 DIRECTION KEYS (3T)

1 normally-open contact per key

The direction keys are used to determine the axis and direction of traverse, and to initiate axis traverse, in setting-up operating modes JOG, INC and REF.

5.3.8 DIRECTION KEYS PLUS, MINUS (3M)

1 normally-open contact per key

The direction keys are used to traverse the axis preselected at the axis selector switch.

5.3.9 RAPID TRAVERSE OVERLAY

1 normally-open contact per key

The rapid traverse rate is selected when this key is operated during traverse with the direction keys in setting-up operating modes JOG, INC and REF.

5.3.10 HANDWHEEL ACTIVE IN X AXIS (3T/3TT)

Rocker switch, 1 normally-open contact

This switch is used to preselect the axis to be traversed with the handwheel in setting-up operating mode JOG.

1 signal: X axis
0 signal: Z axis

The axis is preselected with the axis selector switch on the 3M System.

5.3.11 RAPID TRAVERSE OVERRIDE ACTIVE

Rocker switch, 1 normally-open contact

This signal enables the feedrate override switch to be used also for rapid traverse between 0 % and 100 %. The 0 % position of the feedrate override switch is always operative, also for rapid traverse, even without the rapid traverse override active signal.

5.3.12 DRY RUN

Rocker switch, 1 normally-open contact

This signal is provided for testing the workpiece program. When it is active, traverse takes place at a dry run feedrate set by machine data instead of at the programmed feedrate. This feedrate also replaces the revolutional feedrate and the feedrate for thread cutting.

5.3.13 SKIP BLOCK

Rocker switch, 1 normally-open contact

When this signal is active, blocks marked "/" in the workpiece program are skipped. If there is a series of skippable blocks (measuring loop), the signal must be active before the first "/" block is read, otherwise the entire measuring loop will be executed for safety reasons.

5.3.14 INDIVIDUAL BLOCK

Rocker switch, 1 normally-open contact

When this signal is active, the program is executed in individual blocks in the AUT operating mode.

5.3.15 SEARCH

Pushbutton, 1 normally-open contact

This signal selects the search routine to re-enter the program at a predetermined point.

5.3.16 KEY SWITCH

Key switch, 1 normally-open contact

0 signal: Key removed

This signal permits data input in the program memory, editing, and tool offset and zero offset data inputs.

5.3.17 SPINDLE OFF
SPINDLE ON

OFF: Pushbutton, 1 normally-closed contact
ON: Pushbutton, 1 normally-open contact

The spindle OFF and spindle ON pushbutton signals are combined in the PLC in a logic operation and, in conjunction with machine parameters, generate the spindle enable signal.

Additional external spindle OFF/ON operator controls can be included in this logic operation.

5.3.18 FEED HOLD
FEED START

HOLD: Pushbutton, 1 normally-closed contact
START: Pushbutton, 1 normally-open contact

The feed HOLD and feed START pushbutton signals are combined in the PLC in a logic operation and, in conjunction with machine parameters, generate the feed enable signal.

Additional external feed HOLD/START operator controls can be included in this logic operation.

5.3.19 CYCLE START

Pushbutton, 1 normally-open contact

The CYCLE START pushbutton signal generates the NC Start signal in the PLC if the machine is ready for operation. NC Start initiates program execution in automatic operating modes AUT and MDA.

Additional external start keys can be included in this logic operation with parallel effect.

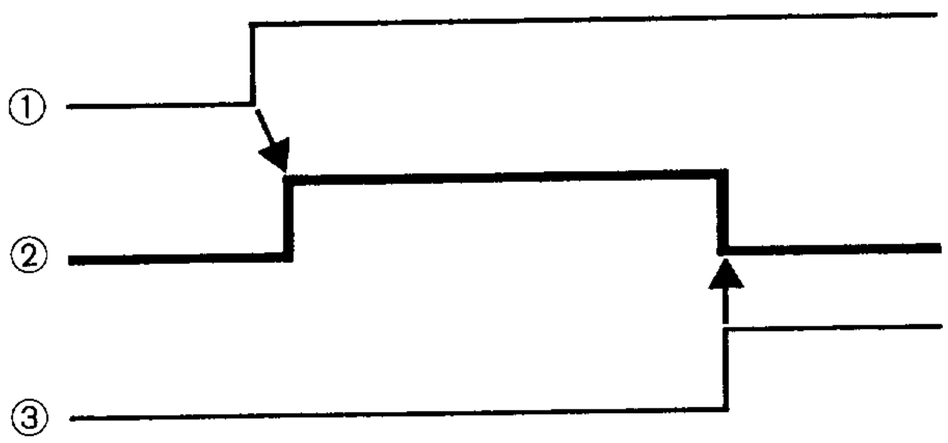
6. Description of NC-machine signals

6.1 Ready signals

6.1.1 NC READY 2

1 signal: After power on and reaching correct voltages

0 signal:
a) Exceeding temperature limit 2 in SINUMERIK (fault message)
b) Actuation of under-voltage monitor
c) Actuation of over-voltage monitor
d) Actuation of measuring circuit monitor
e) Actuation of computer monitor



① Mains voltage
② NC READY 2
③ Fault message

Note on application:
Exceeding temperature limit 2 or actuation of the under-voltage or over-voltage monitors has the effect of switching off the control and therefore of deleting all the functions stored in the intermediate and main memories.

Another Power On is required before the control is operational again. If the measuring circuit monitor trips, the feed and spindle drives are rapidly decelerated with S analog. The resulting alarms can be cleared with RESET. All the functions stored in the intermediate and main memories are deleted.

Note:

The NC READY 2 output signal, which also contains the computer monitoring function, is output in the command value cable by the measuring circuit module via a relay contact. This signal must be used for immediate interruption of all NC controlled movements (signal interpretation via relays and contactors, fault = 0 signal).

NC ready 2 relay output rating
30 V/0.4 A, max. resistive load 10 VA.

In addition to the NC READY 2 signal transmitted at the NC-machine interface, a similar signal without the computer monitoring function is transmitted at the interface to the PLC.

6.1.2 SPEED CONTROLLER READY

The input signal applies to all axes and the spindle with S analog for monitoring the drive controllers.

The input signal is transmitted via the 1st command value cable and received by measuring circuit module 03320.

1 signal: Speed controller ready

0 signal: Effects rapid deceleration of all drives; alarm no. 222 is given

If the SPEED CONTROLLER READY signal is not used, the corresponding input must be permanently wired to 24 V.

6.2 Feed drives

6.2.1 SPEED COMMAND VALUE

Polarity of speed command value:

POSITIVE voltage
effects traverse in direction of increasing coordinate values PLUS

NEGATIVE voltage
effects traverse in direction of decreasing coordinate values MINUS

The speed command value is a pure DC voltage. Additional circuitry is not normally required.

Note:

The speed command value is switched to 0 Volt if the computer monitor trips.

6.2.2 *CONTROLLER DISABLE

The axis-dependent controller enable signals from the interface control are logically processed in the control and output to the servo units.

0 signal: Thyristor pulses disabled
1 signal: Thyristor pulses enabled

Note:

*Controller disable is not removed if the computer monitor trips.

On machines without mechanical axis clamping, the controller enables must normally be present at all times, except when approaching a final limit switch.

On machines with mechanical axis clamping, the controller enable signal is refused for axes as long as they are clamped.

EMERGENCY OFF, no NC READY 2, no SPEED CONTROLLER READY (optional) or actuation of the measuring circuit monitor of the corresponding axis effect immediate feed drive stoppage with max. braking current. Axes not affected by the measuring circuit monitor actuation are braked as normal. All 0 signals to the servo units of the corresponding axis become active 1 ms to 16000 ms after actuation of the braking procedure. The axes cannot be traversed until the EMERGENCY OFF situation is cleared.

Refusal to issue the controller enable during traverse with the corresponding axis is also interpreted as EMERGENCY OFF and effects immediate stoppage of the feed drive of the corresponding axis. These drives are brought to a standstill with the max. braking current; all other drives are braked as normal.
The 0 signal to the servo units of the corresponding axis becomes active 1 ms to 32767 ms after actuation of the braking procedure.
All other axes can be traversed again after the braking procedure.

The braking distance and following error are recorded in the control in such a way that the actual value memory contains the correct machine position after the braking procedure. The axes do not have to be re-synchronized (no reference point approach necessary).

6.3 Main spindle drives

6.3.1 SPEED COMMAND VALUE

The main spindle direction of rotation is controlled by the NC via program functions M03 and M04.
In the case of spindle control by the PLC, the "spindle rotation clockwise command" is used.

The speed command value is a pure DC voltage.
Additional circuitry is not normally required.

The following polarity assignment is recommended for the command value voltage:

POSITIVE voltage: clockwise rotation M03
NEGATIVE voltage: counter-clockwise rotation M04

6.3.2 *CONTROLLER DISABLE

The 0 signal is given in the following circumstances:

Thyristor pulse disable
Refusal of spindle enable
Programmed spindle stop M05
EMERGENCY OFF
Actuation of measuring circuit monitor
S = 0

Following output of a command value voltage equivalent to speed = 0 and expiry of a delay, adjustable from 1 ms to 32767 ms.
A command value voltage of 0 V is output at the same time.

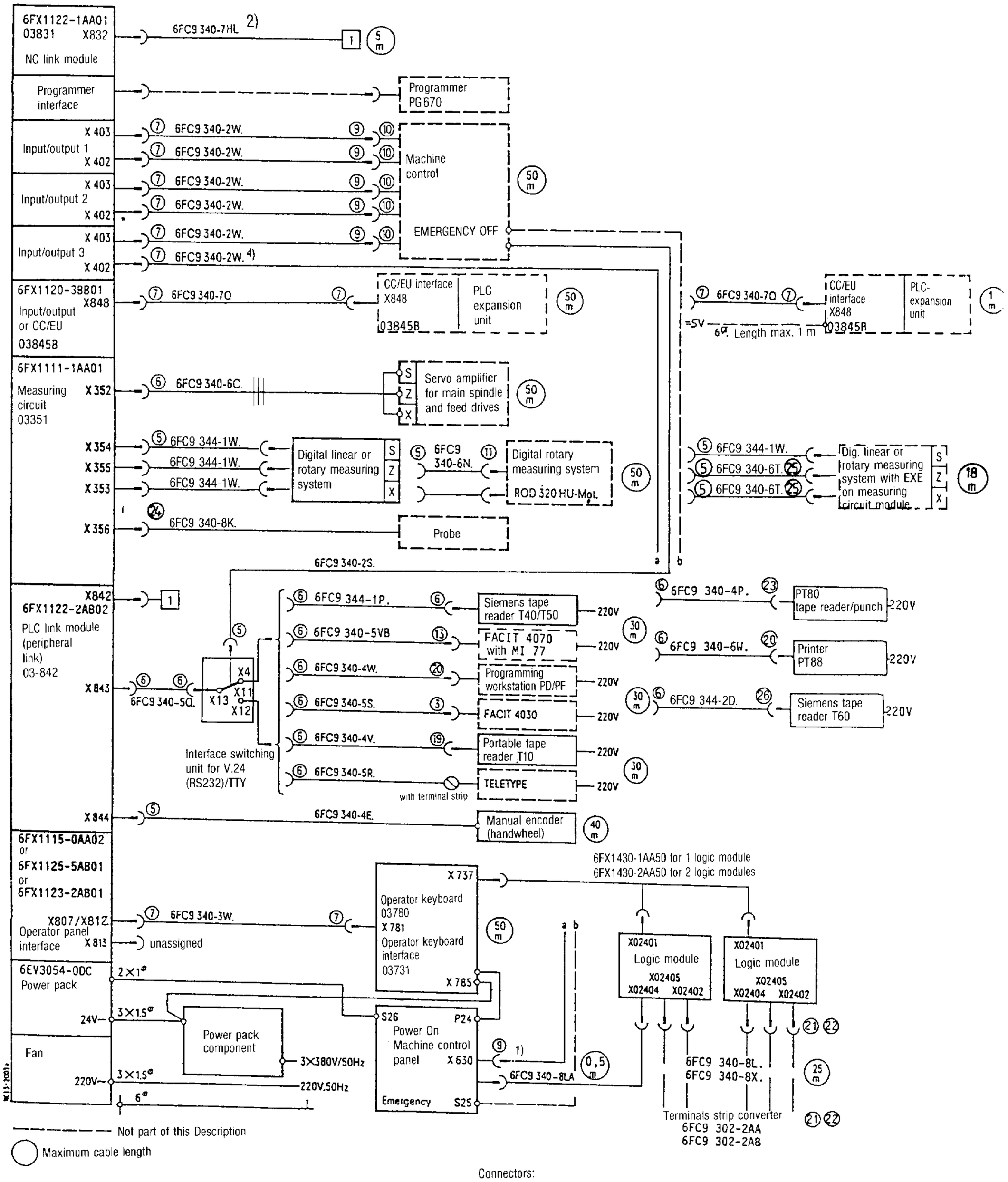
The 1 signal is given in the following circumstances:

Thyristor pulse enable
Main spindle drive enable

7. Cable and equipment overview

7.1 SINUMERIK 3T

7.1.1 SINUMERIK 3T



Not part of this Description

Maximum cable length

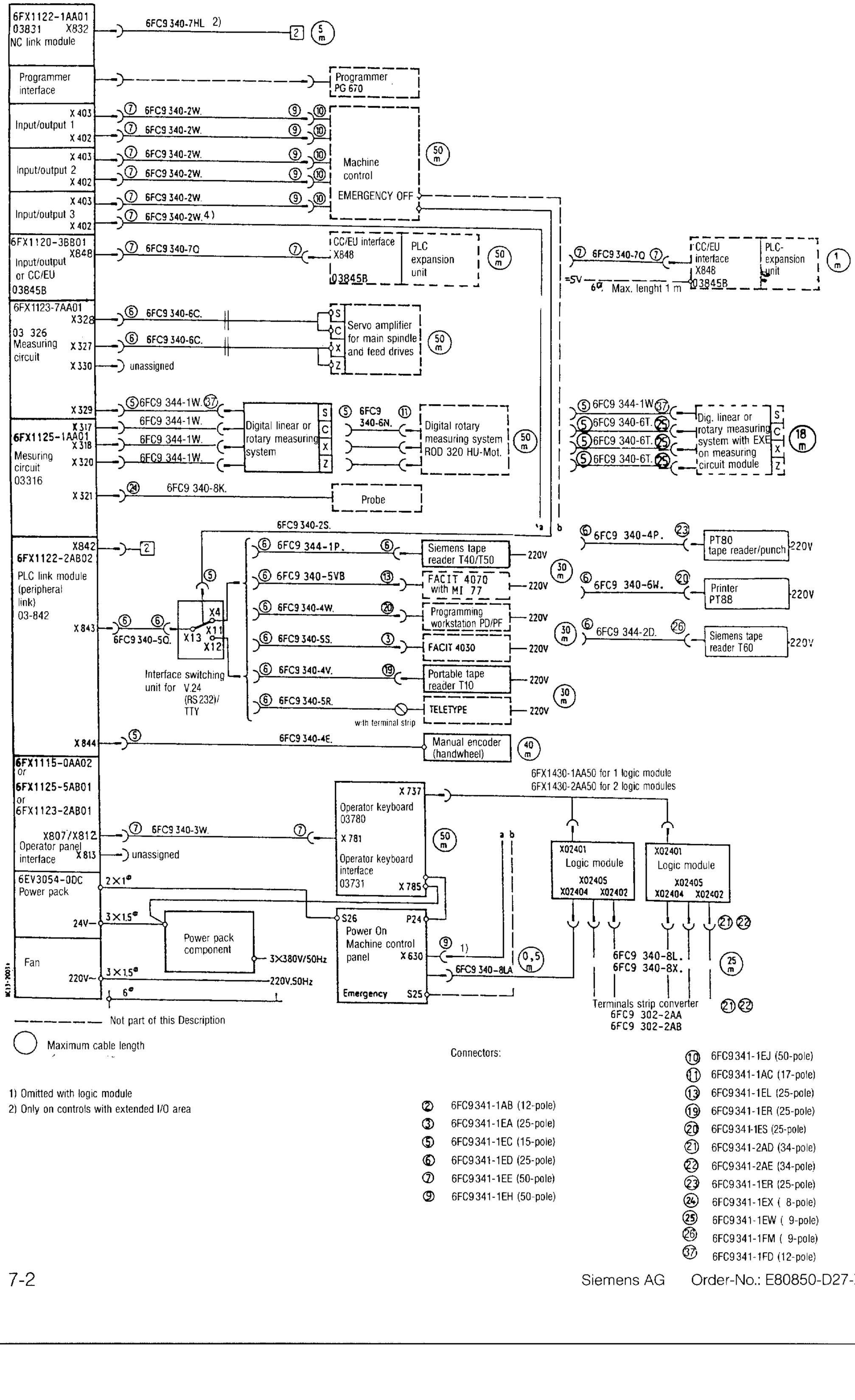
1) Omitted with logic module

2) Only on controls with extended I/O area

Connectors:

②	6FC9341-1AB (12-pole)	⑩	6FC9341-1EJ (50-pole)	㉓	6FC9341-1ER (25-pole)
③	6FC9341-1EA (25-pole)	⑪	6FC9341-1AC (17-pole)	㉔	6FC9341-1EX (8-pole)
⑤	6FC9341-1EC (15-pole)	⑬	6FC9341-1EL (25-pole)	㉕	6FC9341-1EW (9-pole)
⑥	6FC9341-1ED (25-pole)	⑲	6FC9341-1ER (25-pole)	㉖	6FC9341-1FM (9-pole)
⑦	6FC9341-1EE (50-pole)	㉑	6FC9341-2AD (34-pole)	㊲	6FC9341-1FD (12-pole)
⑨	6FC9341-1EH (50-pole)	㉒	6FC9341-2AE (34-pole)		

7.1.2 SINUMERIK 3T with C axis



1) Omitted with logic module

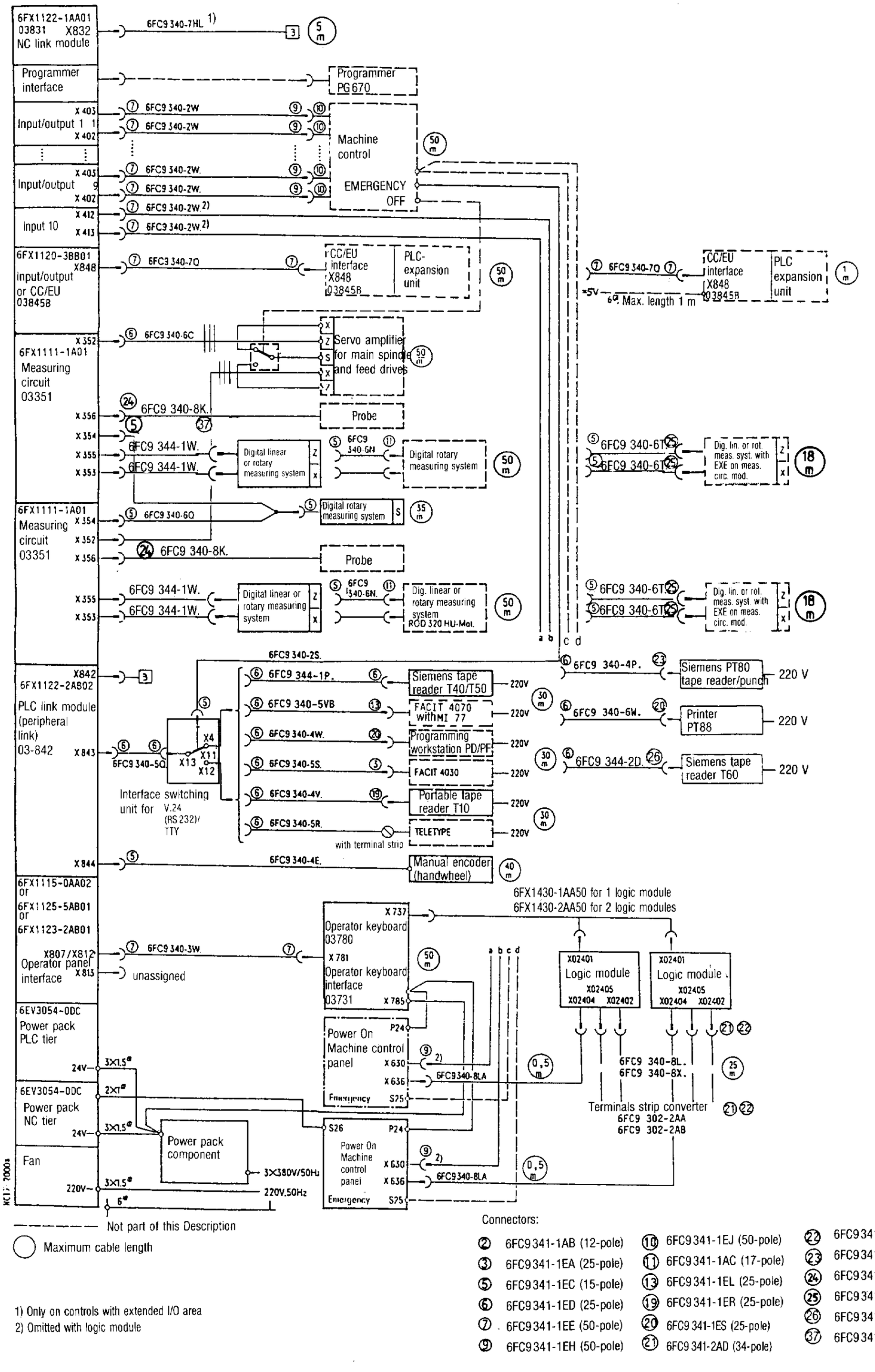
2) Only on controls with extended I/O area

Connectors:

② 6FC9341-1AB (12-pole)
③ 6FC9341-1EA (25-pole)
⑤ 6FC9341-1EC (15-pole)
⑥ 6FC9341-1ED (25-pole)
⑦ 6FC9341-1EE (50-pole)
⑨ 6FC9341-1EH (50-pole)
⑩ 6FC9341-1EJ (50-pole)
⑪ 6FC9341-1AC (17-pole)
⑬ 6FC9341-1EL (25-pole)
⑲ 6FC9341-1ER (25-pole)
⑳ 6FC9341-1ES (25-pole)
㉑ 6FC9341-2AD (34-pole)
㉒ 6FC9341-2AE (34-pole)
㉓ 6FC9341-1ER (25-pole)
㉔ 6FC9341-1EX (8-pole)
㉕ 6FC9341-1EW (9-pole)
㉖ 6FC9341-1FM (9-pole)
㊲ 6FC9341-1FD (12-pole)

7.2 SINUMERIK 3TT

7.2.1 Use with single spindle machines

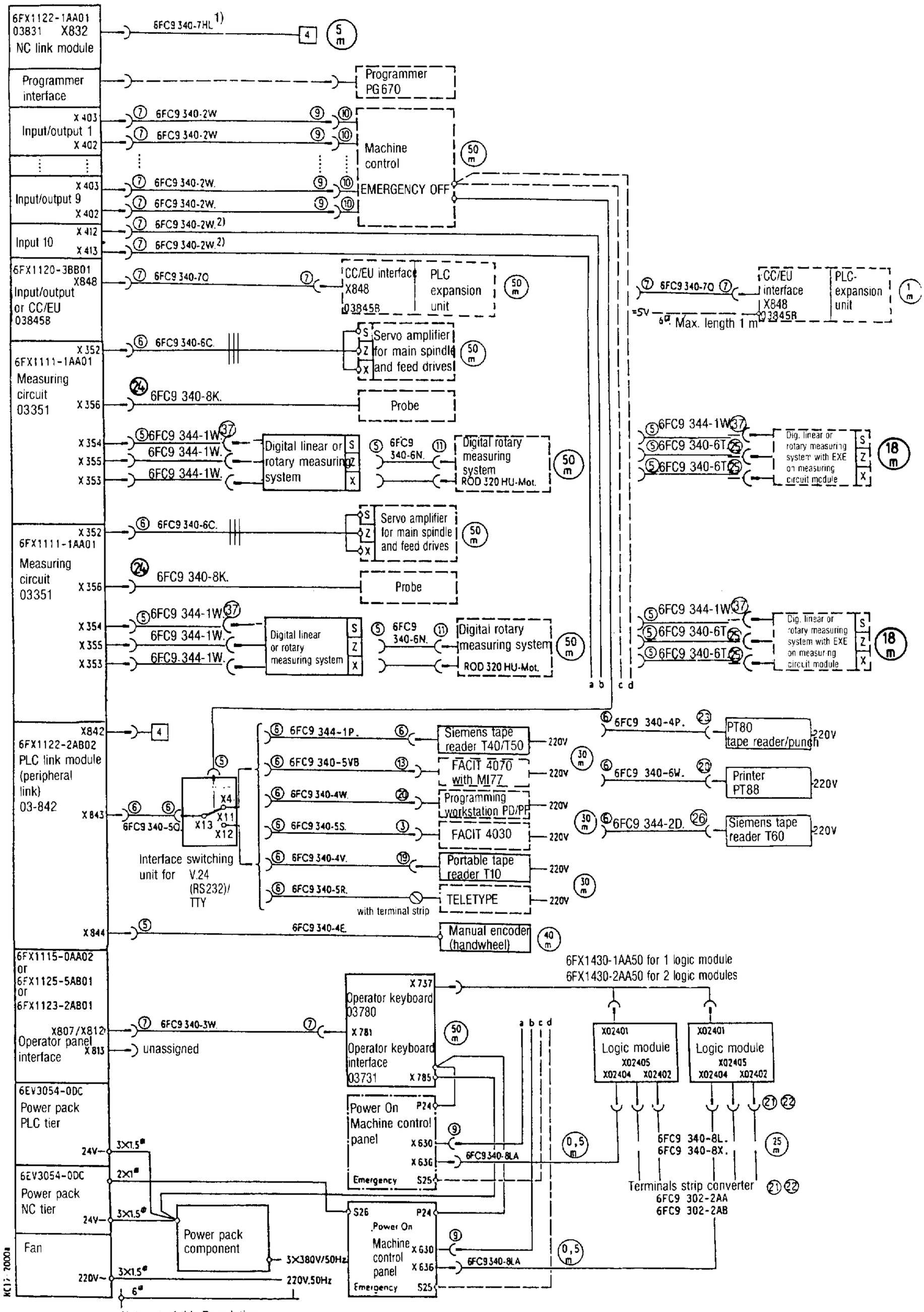


1) Only on controls with extended I/O area
2) Omitted with logic module

Connectors:

②	6FC9341-1AB (12-pole)	⑩	6FC9341-1EJ (50-pole)	㉒	6FC9341-2AE (34-pole)
③	6FC9341-1EA (25-pole)	⑪	6FC9341-1AC (17-pole)	㉓	6FC9341-1ER (25-pole)
⑤	6FC9341-1EC (15-pole)	⑬	6FC9341-1EL (25-pole)	㉔	6FC9341-1EX (8-pole)
⑥	6FC9341-1ED (25-pole)	⑲	6FC9341-1ER (25-pole)	㉕	6FC9341-1EW (9-pole)
⑦	6FC9341-1EE (50-pole)	⑳	6FC9341-1ES (25-pole)	㉖	6FC9341-1FM (9-pole)
⑨	6FC9341-1EH (50-pole)	㉑	6FC9341-2AD (34-pole)	㊲	6FC9341-1FD (12-pole)

7.2.2 Use with double spindle machines



——————— Not part of this Description

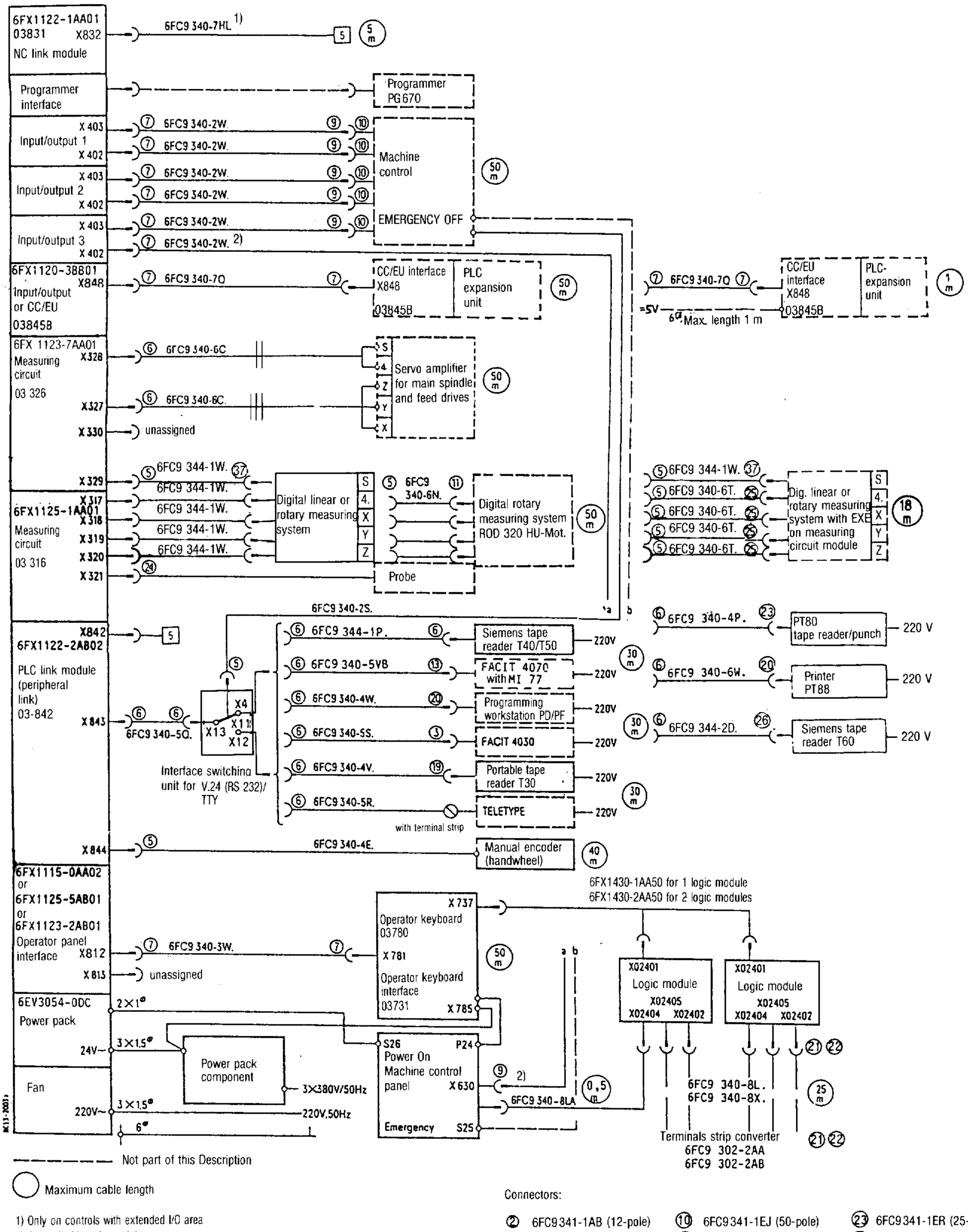
◯ Maximum cable length

1) Only on controls with extended I/O area
2) Omitted with logic module

Connectors:

② 6FC9341-1AB (12-pole)
③ 6FC9341-1EA (25-pole)
⑤ 6FC9341-1EC (15-pole)
⑥ 6FC9341-1ED (25-pole)
⑦ 6FC9341-1EE (50-pole)
⑨ 6FC9341-1EH (50-pole)
⑩ 6FC9341-1EJ (50-pole)
⑪ 6FC9341-1AC (17-pole)
⑬ 6FC9341-1EL (25-pole)
⑲ 6FC9341-1ER (25-pole)
⑳ 6FC0341-1ES (25-pole)
㉑ 6FC9341-2AD (34-pole)
㉒ 6FC9341-2AE (34-pole)
㉓ 6FC9341-1ER (25-pole)
㉔ 6FC9341-1EX (8-pole)
㉕ 6FC9341-1EW (9-pole)
㉖ 6FC9341-1FM (9-pole)
㊲ 6FC9341-1FD (12-pole)

7.3 SINUMERIK 3M



Not part of this Description

Maximum cable length

1) Only on controls with extended I/O area
2) Omitted with logic module

Connectors:

- ② 6FC9341-1AB (12-pole)
- ③ 6FC9341-1EA (25-pole)
- ⑤ 6FC9341-1EC (15-pole)
- ⑥ 6FC9341-1ED (25-pole)
- ⑦ 6FC9341-1EE (50-pole)
- ⑨ 6FC9341-1EH (50-pole)
- ⑩ 6FC9341-1EJ (50-pole)
- ⑪ 6FC9341-1AC (17-pole)
- ⑬ 6FC9341-1EL (25-pole)
- ⑲ 6FC9341-1ER (25-pole)
- ⑳ 6FC0341-1ES (25-pole)
- ㉑ 6FC9341-2AD (34-pole)
- ㉒ 6FC9341-2AE (34-pole)
- ㉓ 6FC9341-1ER (25-pole)
- ㉔ 6FC9341-1EX (8-pole)
- ㉕ 6FC9341-1EW (9-pole)
- ㉖ 6FC9341-1FM (9-pole)
- ㊲ 6FC9341-1FD (12-pole)

7.4 Accessories - cables

Required accessories	Max. poss. length	Order number	Length
Cables, complete			
Cable to operator panel switching unit B06/B07		6FC9 340-2SB 6FC9 340-2SC	5 m 10 m
To 1 handwheel	25 m	6FC9 340-4EB 6FC9 340-4EC	5 m 10 m
To Siemens tape readers T40 and T50	30 m	6FC9 344-1PB 6FC9 344-1PC	5 m 10 m
To portable tape reader T60		6FC9 344-2DB 6FC9 344-2DC	5 m 10 m
To portable tape reader T60 and printer PT88		6FC9 340-4VB 6FC9 340-4VC	5 m 10 m
To RS 422 remote adapter	5 m	6FC9 340-5QB	5 m
To Siemens PT80	30 m	6FC9 340-4PB 6FC9 340-4PC	5 m 10 m
To Teletype	30 m	6FC9 340-5RB 6FC9 340-5RC	5 m 10 m
To FACIT 4030	30 m	6FC9 340-5SB	5 m
To FACIT 4070 with MI77	30 m	6FC9 340-5VB	5 m
For serial data transfer V.24 (RS232)/20mA, crossed	30 m	6FC9 340-6UB 6FC9 340-6UC 6FC9 340-6UF	5 m 10 m 25 m
For serial data transfer 20 mA, uncrossed	200 m	6FC9 340-6VG	50 m
To operator panel	50 m	6FC9 340-3WB 6FC9 340-3WC	5 m 10m
To servo amplifiers, feed drives and main spindle drive	50 m	6FC9 340-6CB 6FC9 340-6CC	5 m 10 m
To rotary position encoders (6FC9 320-3K.) and main spindle encoder (6FC9 320-3KB; 6FC9 320-3H.)	50 m	6FC9 344-1WB 6FC9 344-1WC 6FC9 344-1WE 6FC9 344-1WF	5 m 10 m 18 m 25 m
To rotary position encoders and main spindle encoder	50 m	6FC9 340-6KB 6FC9 340-6KC 6FC9 340-6KE 6FC9 340-6KF	5 m 10 m 18 m 25 m
To incremental rotary position encoder ROD 320	50 m	6FC9 340-6NB 6FC9 340-6NC 6FC9 340-6NE 6FC9 340-6NF	5 m 10 m 18 m 25 m

Required accessories	Max. poss. length	Order number	Length
Between PLC input/output modules N81 to N85 and interface control	50 m	6FC9 340-6WB 6FC9 340-6WC 6FC9 340-6WE 6FC9 340-6WF	5 m 10 m 18 m 25 m
To PLC	3 m	6FC9 340-7HL 6FC9 340-7HM 6FC9 340-7HN	1 m 2 m 3 m
To PLC expansion unit	50 m	6FC9 340-7QL 6FC9 340-7QM 6FC9 340-7QN 6FC9 340-7QB	1 m 2 m 3 m 5 m
To PD programming workstation	30 m	6FC9 340-4WB 6FC9 340-4WC	5 m 10 m
To main spindle encoder for 3TT single spindle machines	35 m	6FC9 340-6QB 6FC9 340-6QC 6FC9 340-6QE 6FC9 340-6QF	5 m 10 m 18 m 25 m
Ribbon cable for connection between NC operator keyboard and one logic module and two logic modules	0.5 m	 6FX1430-1AA50 6FX1430-2AA50	 0.5 m 0.5 m
Ribbon cable for connection between logic module and standard machine control panel J85	0.5 m	6FC9 340-8LA	0.5 m
Connecting cable between logic module and terminal strip converter		6FC9 302-8AA	0.5 m
Ribbon cable	2 m	6FC9 340-8LA 6FC9 340-8LL 6FC9 340-8LM	0.5 m 1 m 2 m
Round cable	25 m	6FC9 340-8XB 6FC9 340-8XC 6FC9 340-8XE 6FC9 340-8XF	5 m 10 m 18 m 25 m
Cable for integrated pulse shaper electronics	20 m	6FC9 340-6TB 6FC9 340-6TC 6FC9 340-6TD	5 m 10 m 17 m
Cable for probe connection	35 m	6FC9 340-8KM 6FC9 340-8KB 6FC9 340-8KC 6FC9 340-8KD 6FC9 340-8KE 6FC9 340-8KF	2 m 5 m 10 m 15 m 18 m 25 m

Order number Cable	Dimensions	External diameter	Min. bending radius once	repeated
6FC9 343-0AN	3 x 2 x 0.18	6.0 mm	60 mm	124 mm
6FC9 343-0AA	8 x 2 x 0.18	8.2 mm	82 mm	170 mm
6FC9 343-0AB	10 x 2 x 0.18	9.4 mm	94 mm	194 mm
6FC9 343-0AC	13 x 2 x 0.18	10.2 mm	102 mm	210 mm
6FC9 343-0AD	21 x 2 x 0.18	12.0 mm	120 mm	246 mm
6FC9 343-0AK	23 x 2 x 0.09	8.2 mm	82 mm	170 mm
	25 x 2 x 0.09			
6FC9 343-0AE	50 x 1 x 0.22	11.8 mm	118 mm	244 mm
6FC9 343-0AL	12 x 2 x 0.14	12.3 mm	123 mm	252 mm
6FC9 343-0AF	4 x 2 x 0.38 + 4 x 0.5	9.8 mm	98 mm	200 mm
6FC9 343-0AM	3 x 2 x 0.14 + 2 x 0.5	8.2 mm	82 mm	170 mm

7.5 Accessories - connectors

Required accessories	Order number
Connectors	
12-pole male connector	6FC9 341-1AB
12-pole female connector	6FC9 341-1FD
25-pole subminiature male connector	6FC9 341-1EA
15-pole subminiature female connector (complete with housing)	6FC9 341-1EC
25-pole subminiature female connector (complete with housing)	6FC9 341-1ED
50-pole subminiature female connector (complete with housing)	6FC9 341-1EE
50-pole subminiature male connector (complete with housing)	6FC9 341-1EH
50-pole subminiature female connector (mating connector, solder connection)	6FC9 341-1EJ
17-pole female connector	6FC9 341-1AC
50-pole female connector (complete with housing and sliding locking device)	6FC9 341-1EN
50-pole subminiature male connector insert with solder connection	6FC9 341-1EQ
25-pole male connector	6FC9 341-1EL
25-pole female cable connector	6FC9 341-1ER
25-pole male cable connector	6FC9 341-1ES
34-pole connector for logic module or terminal strip converter for ribbon or round cable for ribbon cable	 6FC9 341-2AD 6FC9 341-2AE
9-pole female connector	6FC9 341-1FM
34-pole ribbon cable (order in metres)	6FC9 343-0BA
Round cable (21 x 2 x 0.18) (order in meters)	6FC9 343-0AD
Crimping pliers	6FC9 307-1AA
Ejector	6FC9 307-1AB

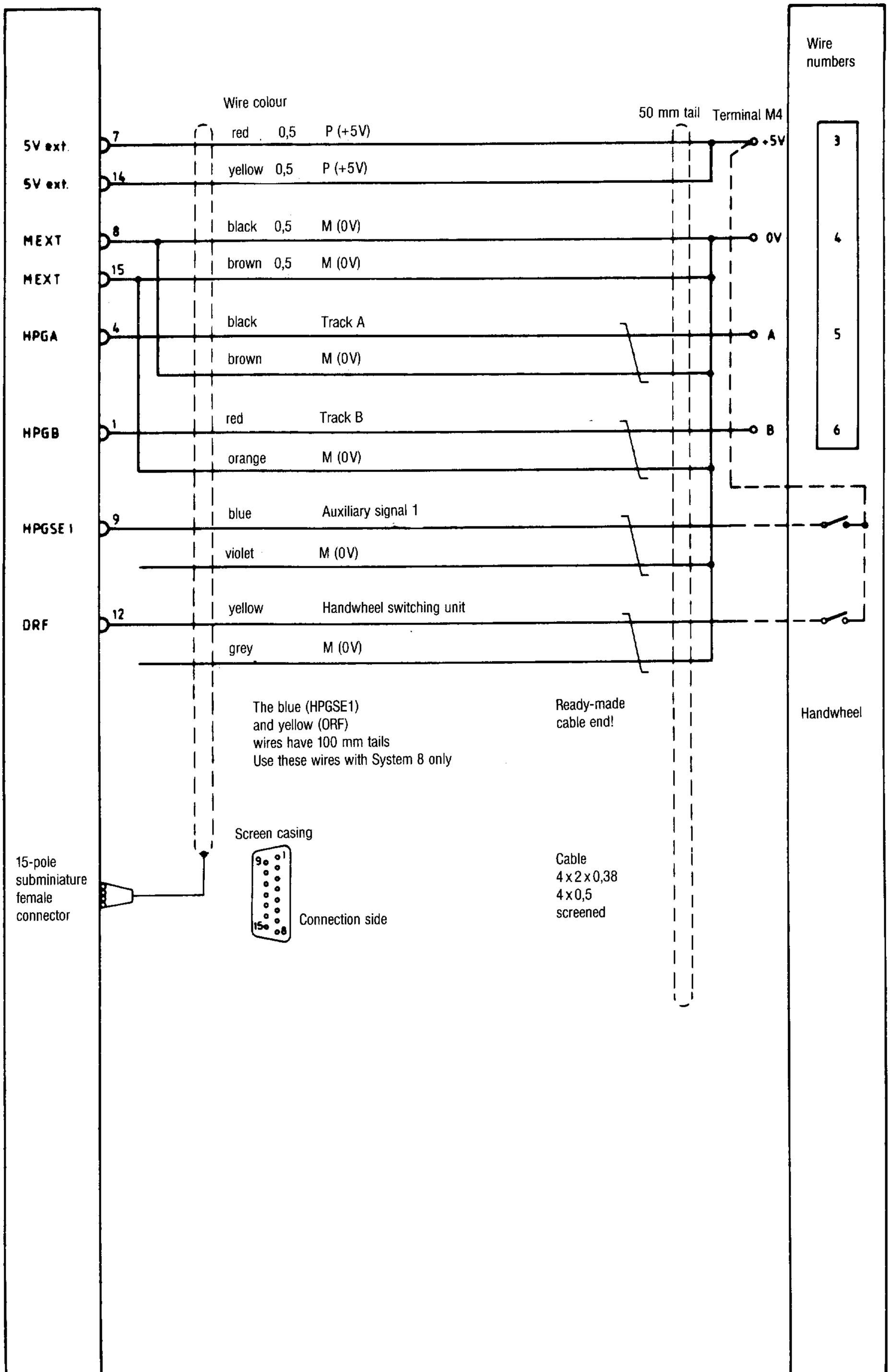
7.6 Accessories - equipment

Required accessories	Order number
Equipment	
Encoder, 1024 pulses/rev for spindle[1)3)]	6FC9 320-3KB
Handwheel	6FC9 320-5DA
Incremental rotary position encoder[1)] 2000 pulses/rev 2500 pulses/rev 5000 pulses/rev 9000 / 1024 pulses/rev[2)] (C axis / spindle)	 6FC9 320-3KK 6FC9 320-3KN 6FC9 320-3KS 6FC9 320-1EA
Clamping jaws	6FC9 320-4GA
Spring coupling, 6/6 mm	6FC9 320-4GB
Power pack component primary 3 x 380 V/415 V, 50 Hz/60 Hz secondary +24 V DC, 20 A or 40 A Power pack component 20 A Power pack component 40 A	 6FC9 304-0AC 6FC9 304-0AD
Logic module without mounting plate Logic module with mounting plate 64 inputs, 24 V DC 24 outputs, 24 V DC, 0.5 A, short-circuit-proof 8 outputs, 24 V DC, 100 mA, not short-circuit-proof	6FC9 331-0GA 6FC9 331-0GB
Logic module without mounting plate Logic module with mounting plate 64 inputs, 24 V DC	6FC9 331-0FA 6FC9 331-0FB
Terminal strip converter, 34-pole, without LED display	6FC9 302-2AA
Terminal strip converter, 34-pole, with LED display	6FC9 302-2AB

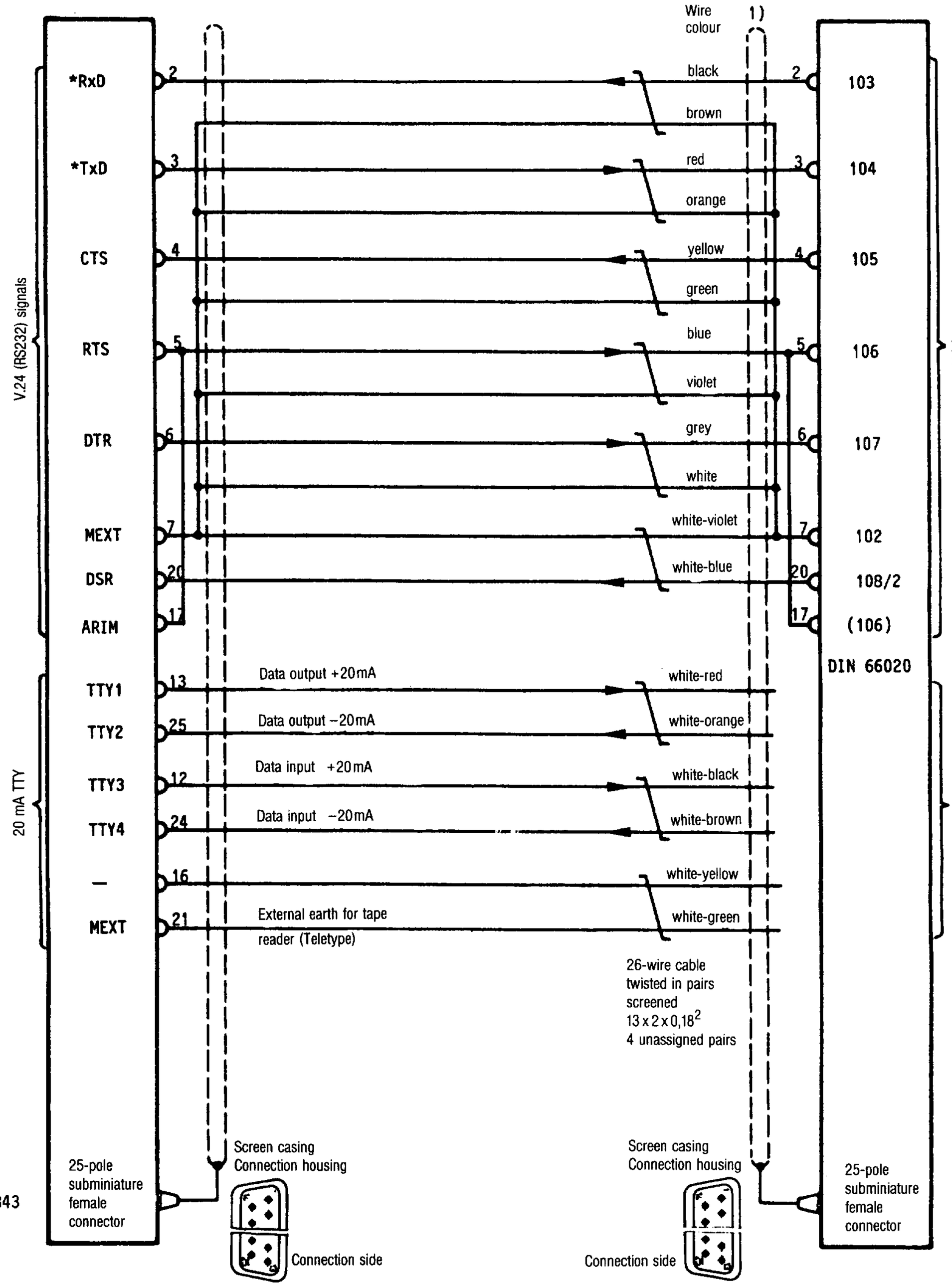
1) Without spring coupling, without clamping jaws
2) With 6/6 mm spring coupling and 3 clamping jaws
3) 3 clamping jaws and 1 6/6 mm spring coupling are required per encoder

8. Cable diagrams for SINUMERIK 3T/3TT/3M

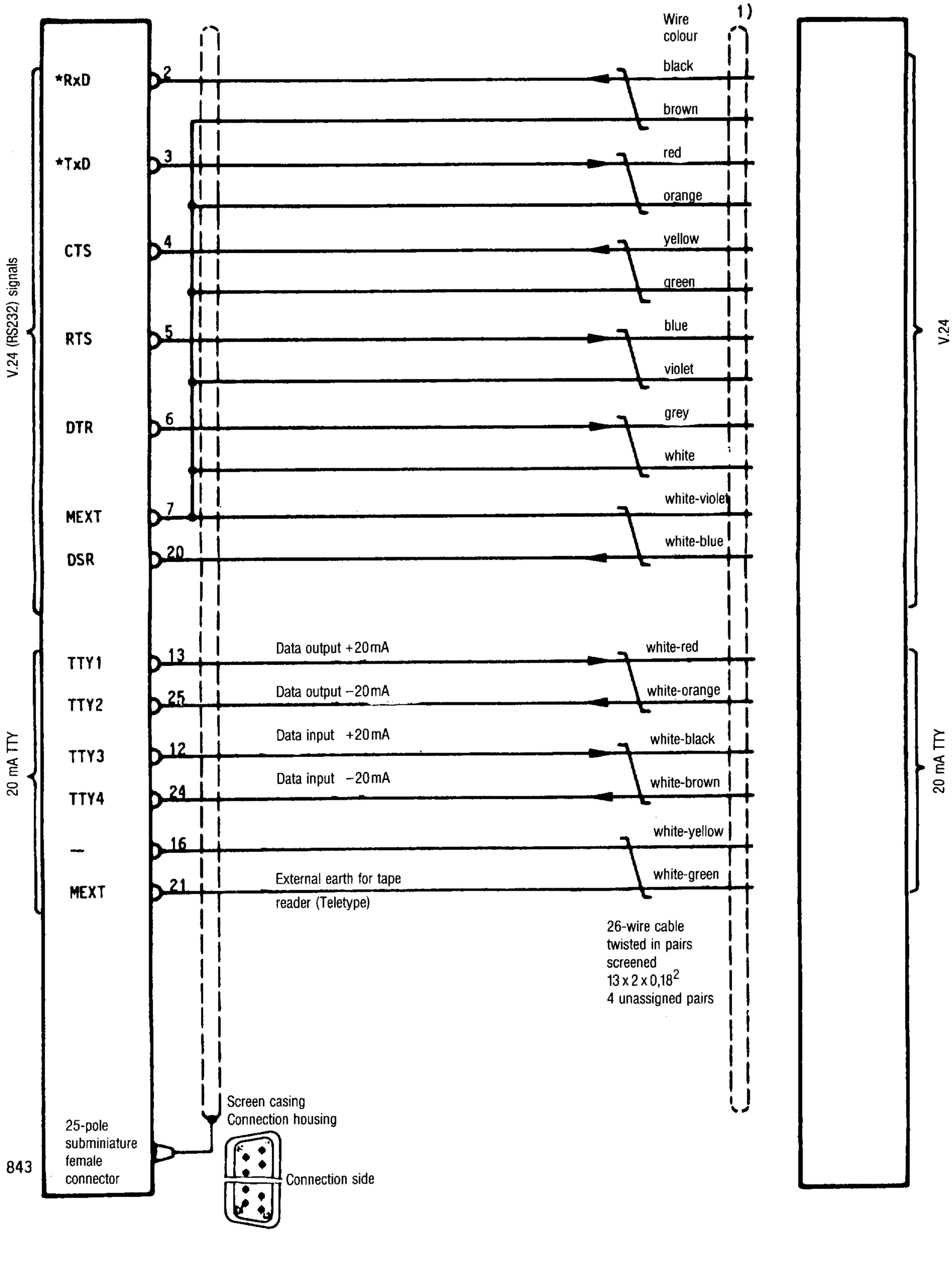
Cable name: Handwheel Module: 03 840
Order No.: 6FC9 340-4E. SINUMERIK 3T, 3TT, 3M



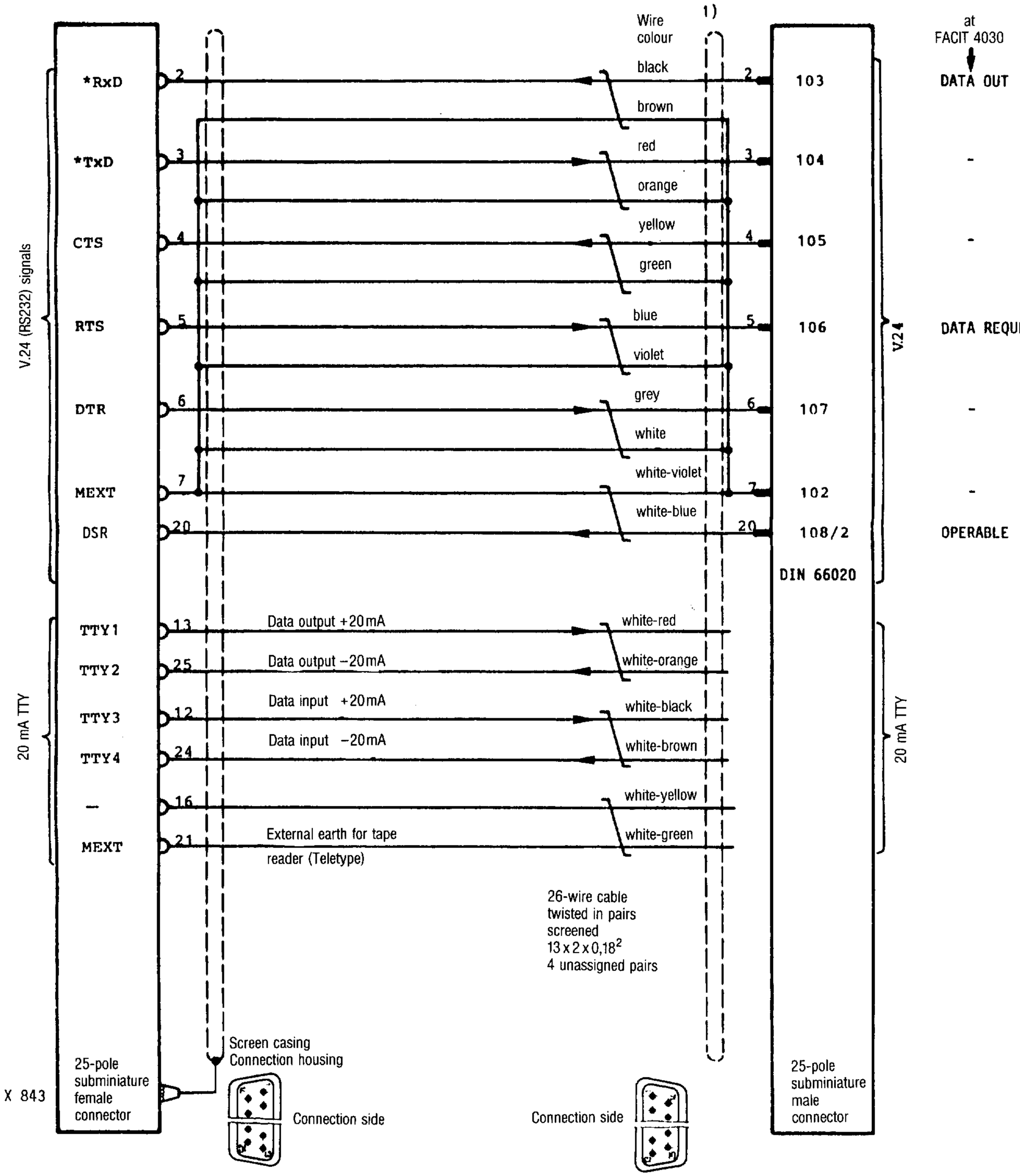
Cable name: Serial data transfer (V.24 (RS232))
Order No.: 6FC9 340-5Q.
Module: 03 840
SINUMERIK 3T, 3TT, 3M



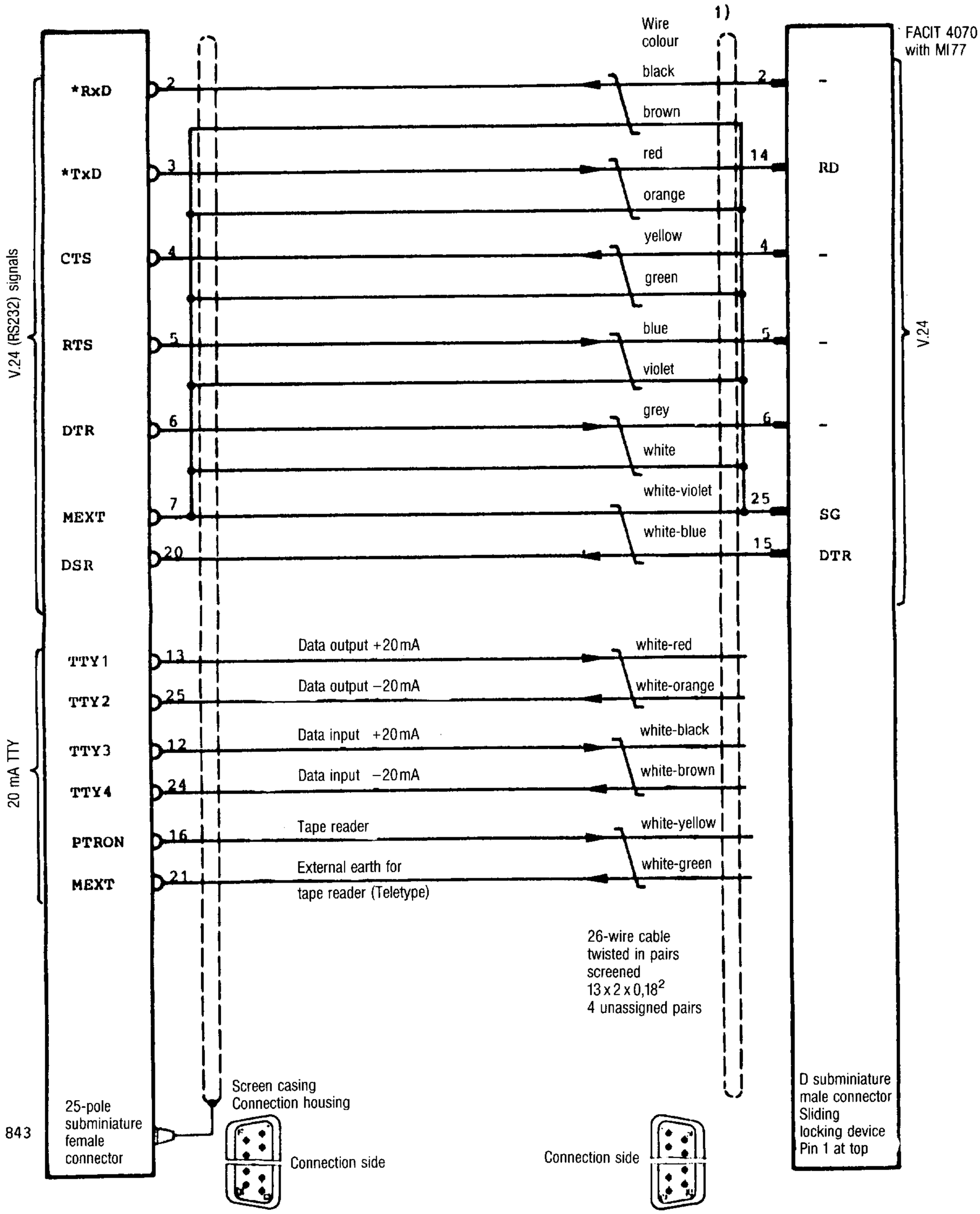
Cable name: Serial data transfer (V.24 (RS232), 20mA TTY)
Order No.: 6FC9 340-5R.
Module: 03 840
SINUMERIK 3T, 3TT, 3M



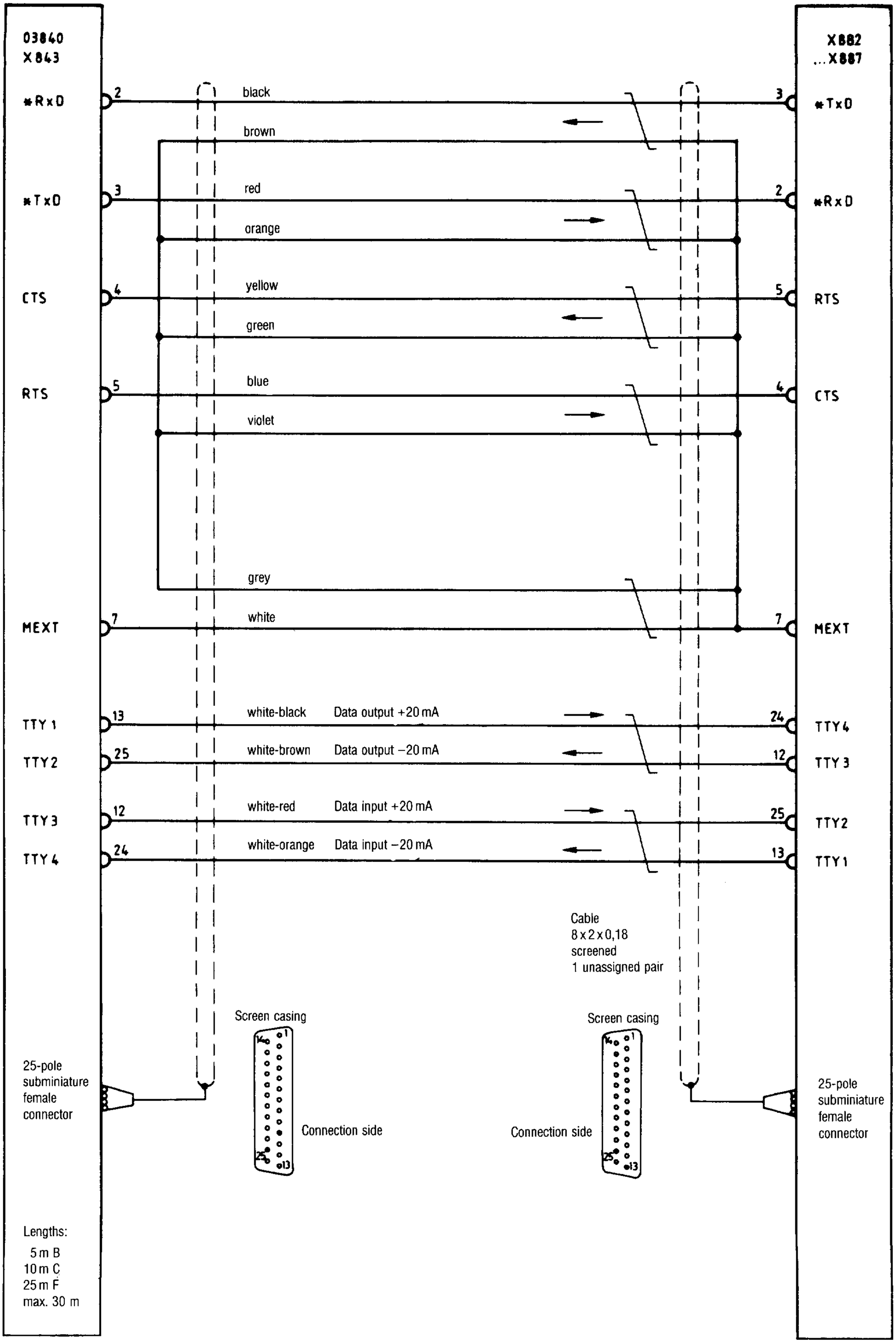
Cable name: Serial data transfer
Order No.: 6FC9 340-5S.
Module: 03 840
SINUMERIK 3T, 3TT, 3M



Cable name: Serial data transfer
Order No.: 6FC9 340-5VB
Module: 03 840
SINUMERIK 3T, 3TT, 3M



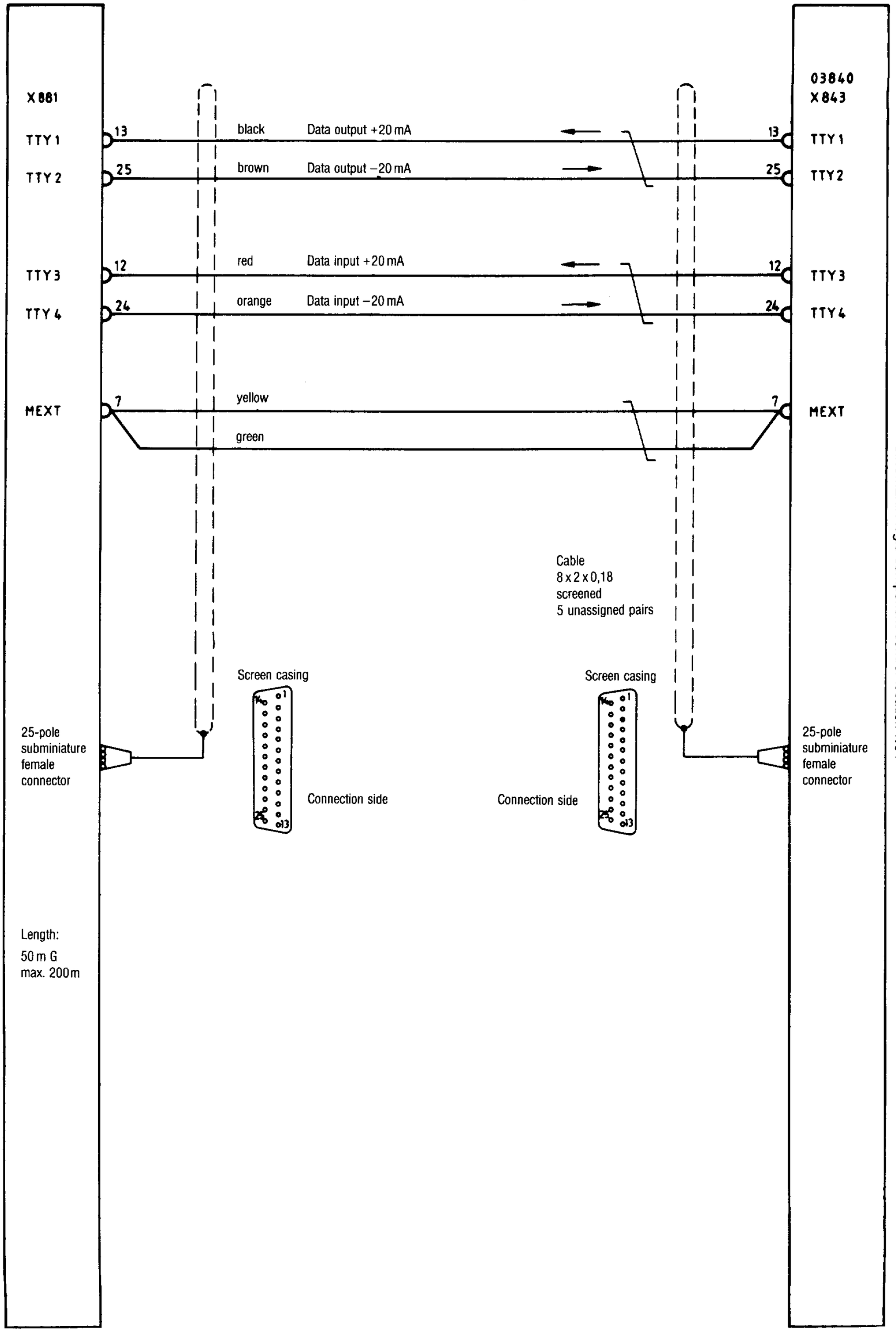
Cable name: Serial data transfer Module: 03 840
Order No.: 6FC9 340-6U. SINUMERIK: 3



Siemens AG Order-No.: E80850-D27-X-A1-7600

Cable name: Data transfer 20 mA
Order No.: 6FC9 340-6V.

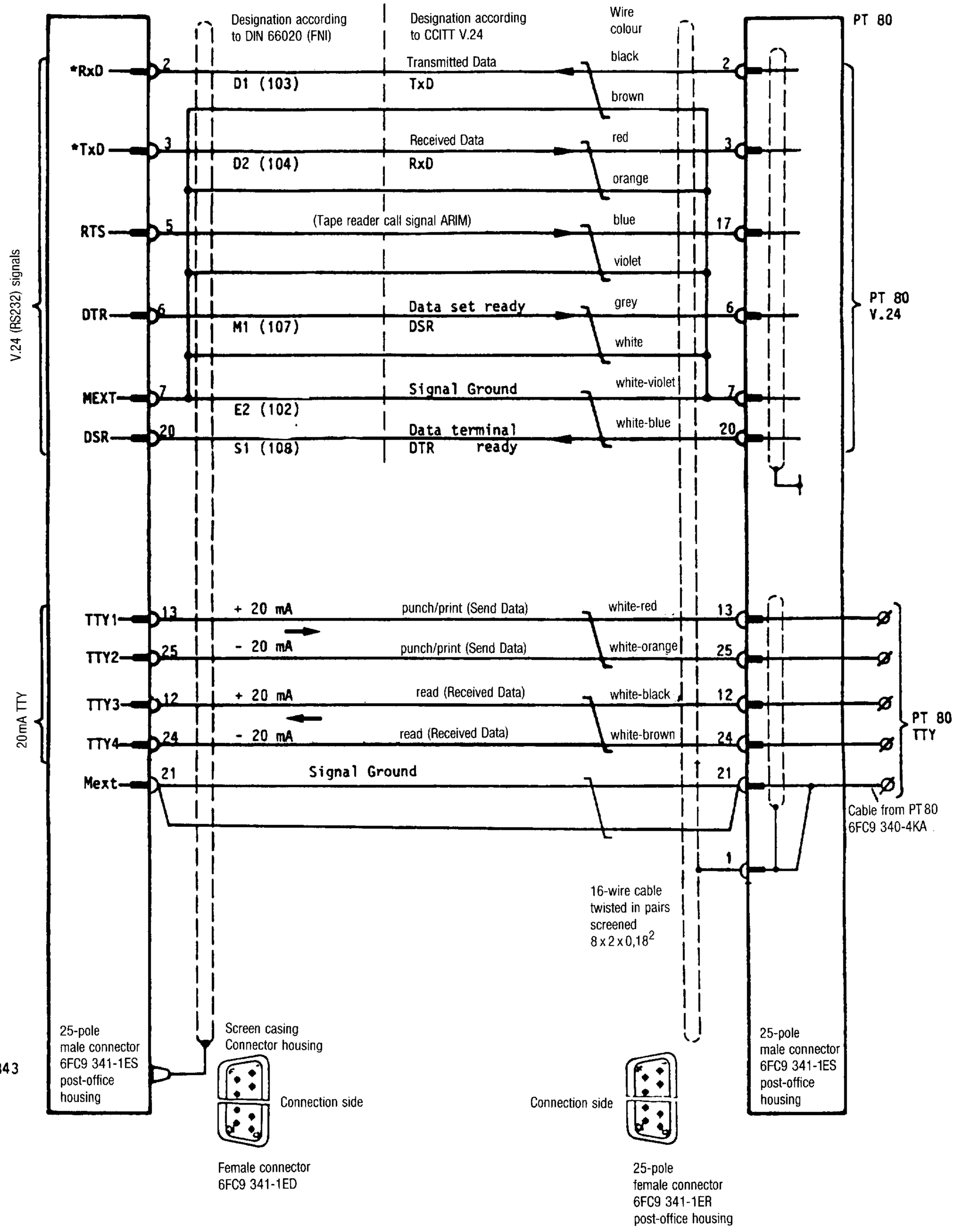
Module: 03 840
SINUMERIK: 3



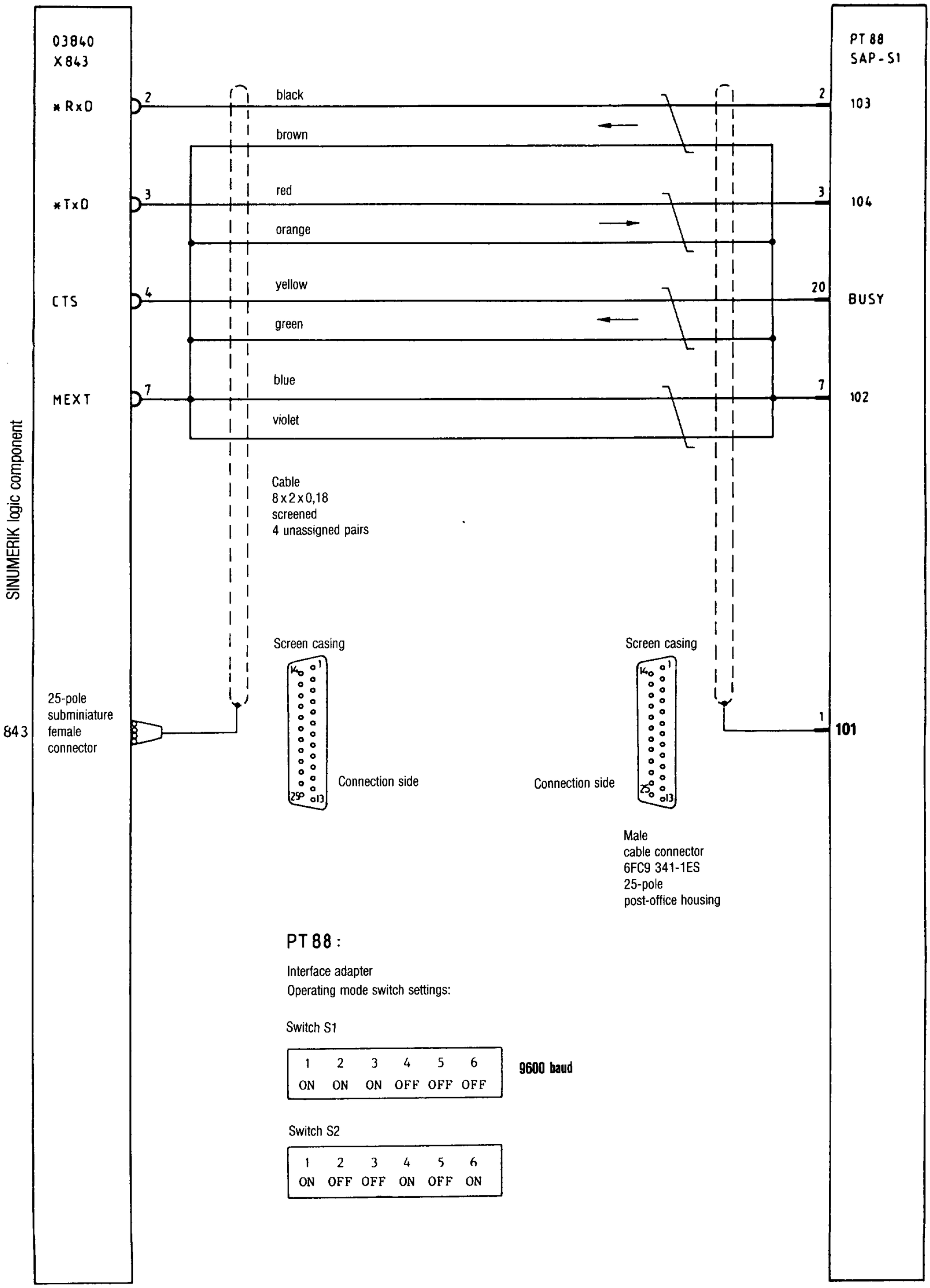
Universal interface switching unit B08

SINUMERIK logic component control location NC1

Cable name: Data transfer (V.24 (RS232), 20 mA TTY)
Order No.: 6FC9 340-4P.
Module: 03 840
SINUMERIK 3T, 3TT, 3M



Cable name: Serial data transfer
Order No.: 6FC9 340-6W.
Module: 03 840
SINUMERIK 3T, 3TT, 3M



PT 88 :

Interface adapter
Operating mode switch settings:

Switch S1

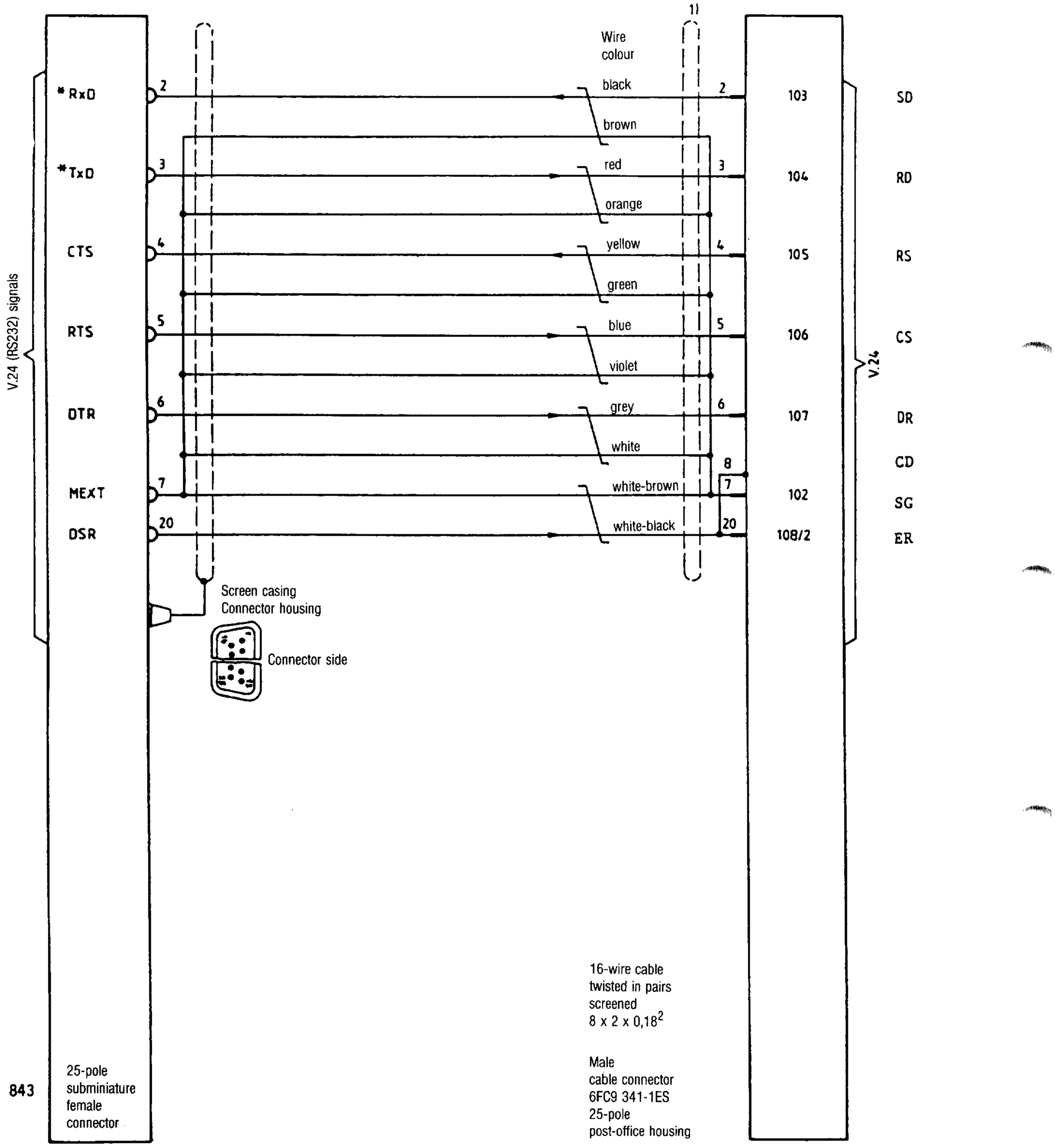
1	2	3	4	5	6	
ON	ON	ON	OFF	OFF	OFF	**9600 baud**

Switch S2

1	2	3	4	5	6
ON	OFF	OFF	ON	OFF	ON

Cable name: Serial data transfer
Order No.: 6FC9 340-4W.
Module: 03 840
SINUMERIK 3T, 3TT, 3M

PD programming workstation
PF programming workstation



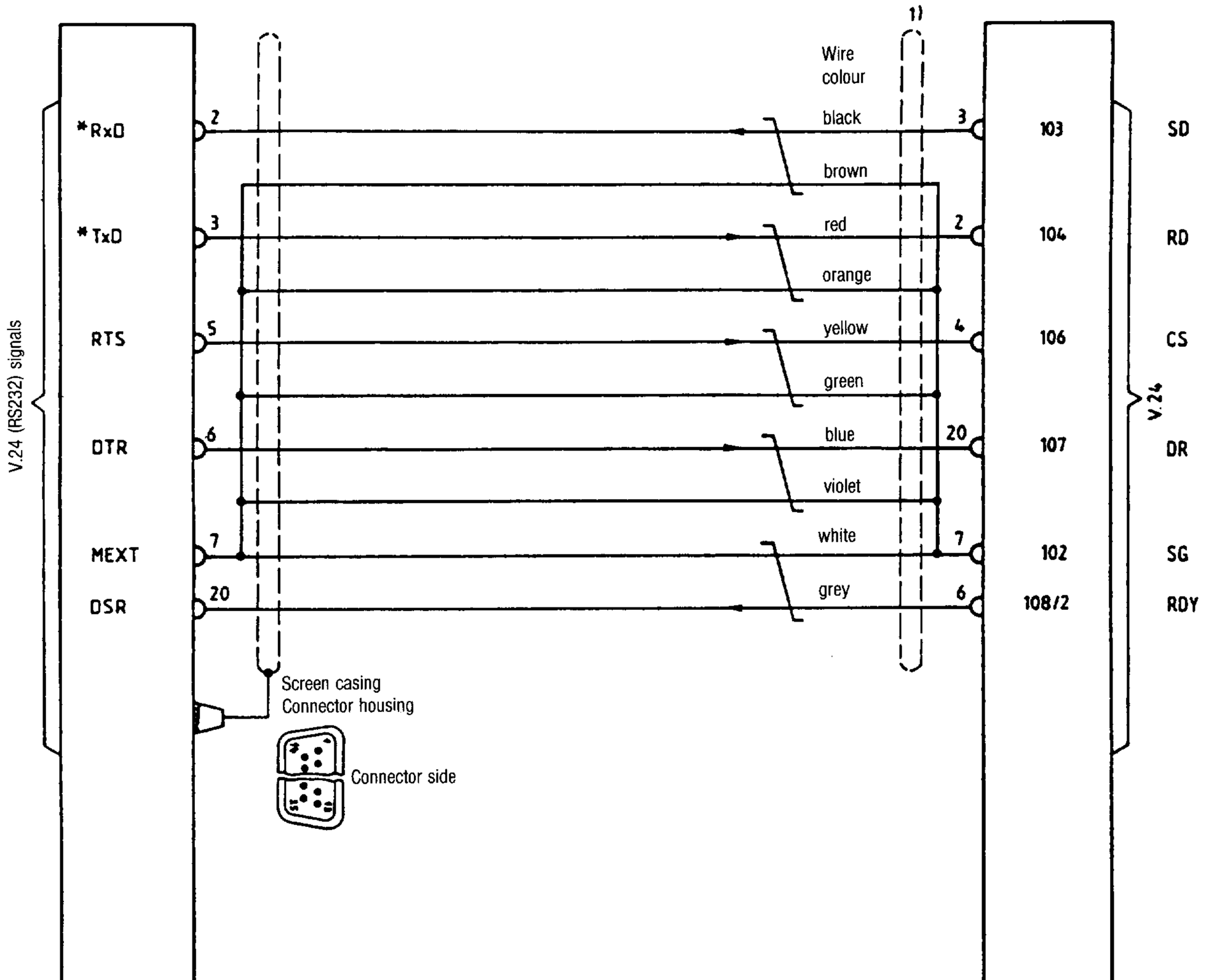
X 843

25-pole
subminiature
female
connector

16-wire cable
twisted in pairs
screened
$8 \times 2 \times 0{,}18^2$

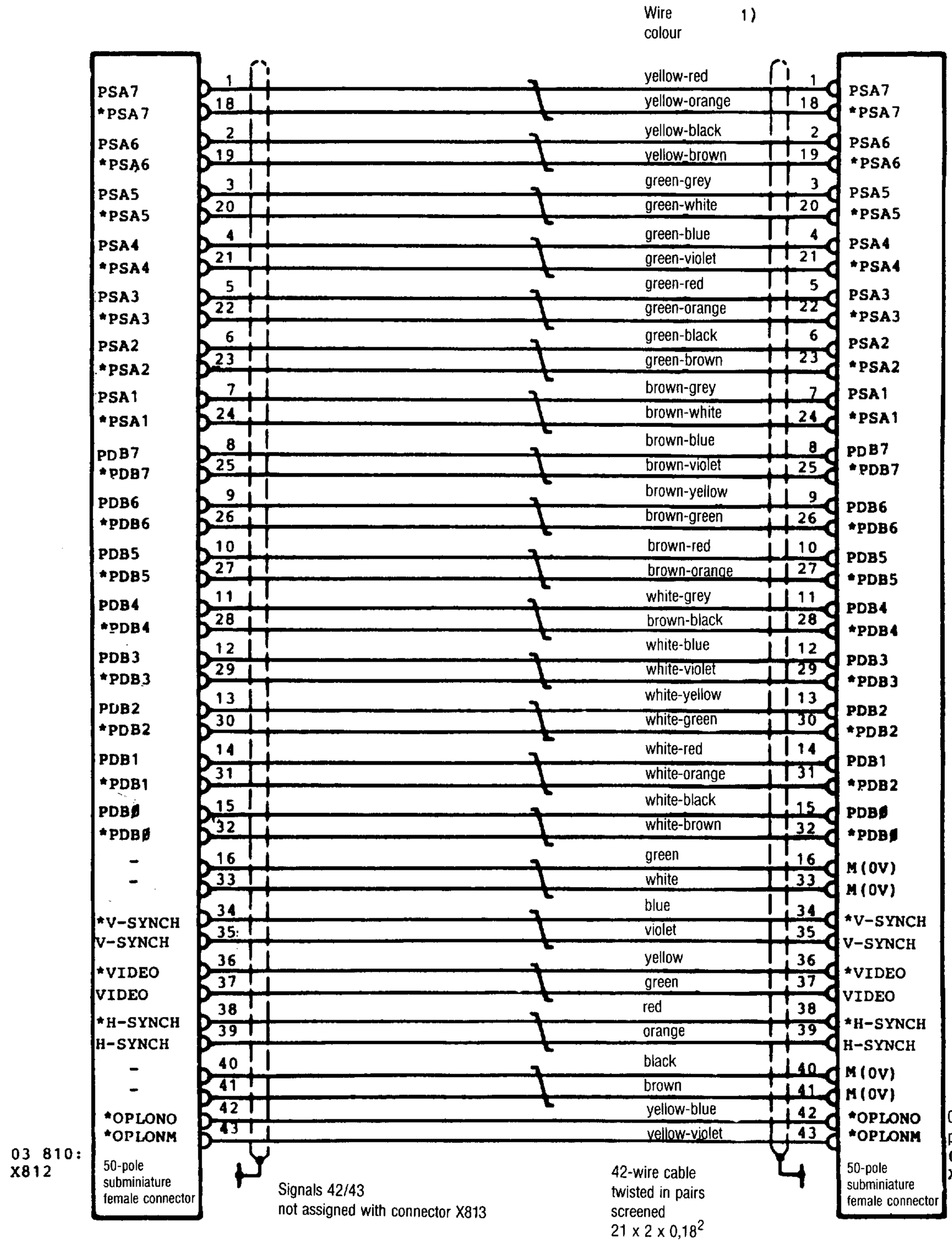
Male
cable connector
6FC9 341-1ES
25-pole
post-office housing

Cable name: Serial data transfer
Order No.: 6FC9 340-4V.
Module: 03 840
SINUMERIK 3T, 3TT, 3M

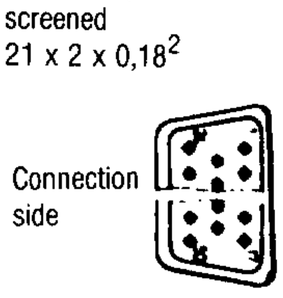


X 843	25-pole subminiature female connector	16-wire cable twisted in pairs screened $8 \times 2 \times 0{,}18^2$ 25-pole female cable connector 6FC9 341-1ER post-office housing with bolt (nut)

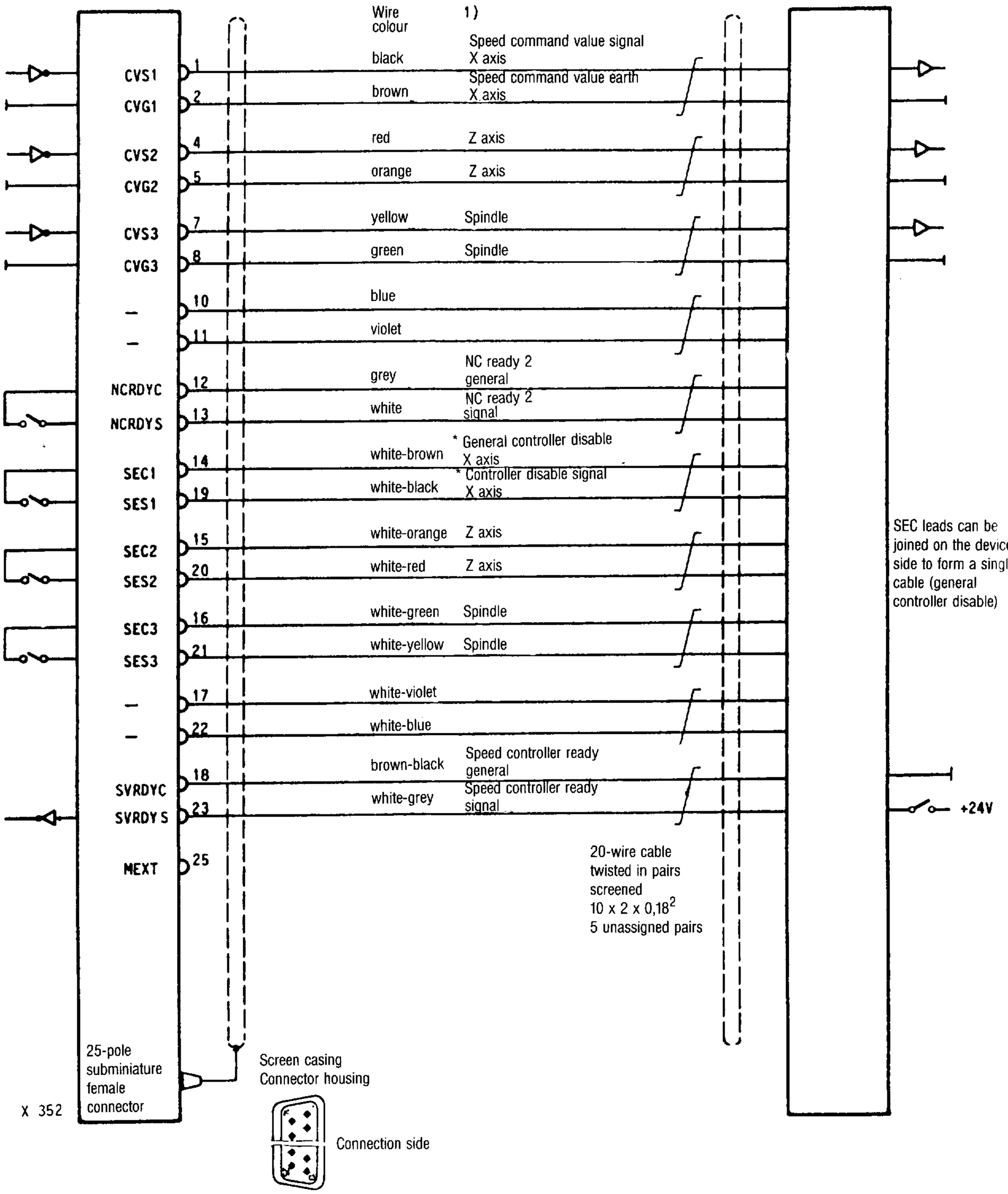
Cable name: Operator panel
Order No.: 6FC9 340-3W.
Module: 03 810, 03 780
SINUMERIK 3T, 3TT, 3M



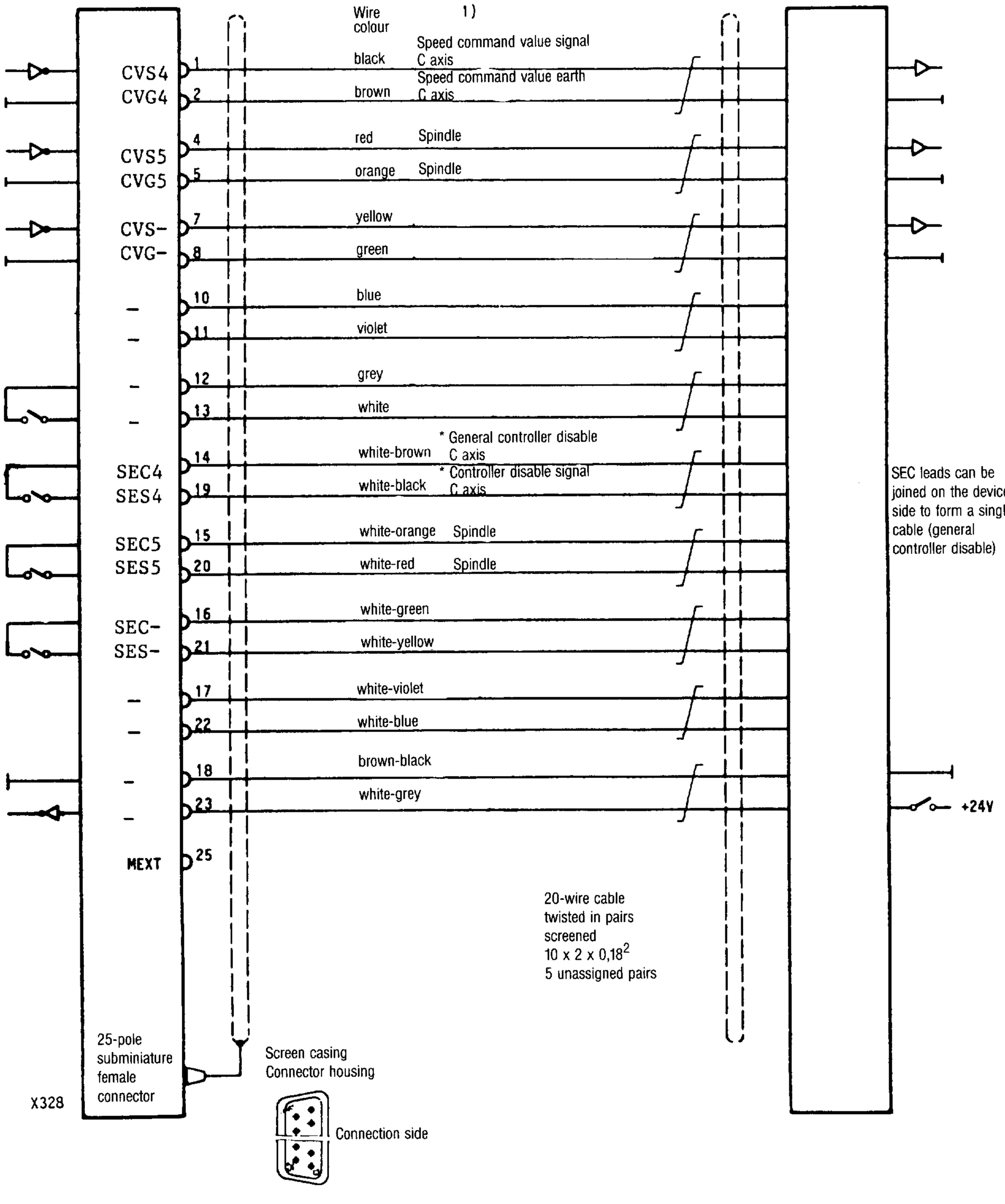

Connection side


Connection side

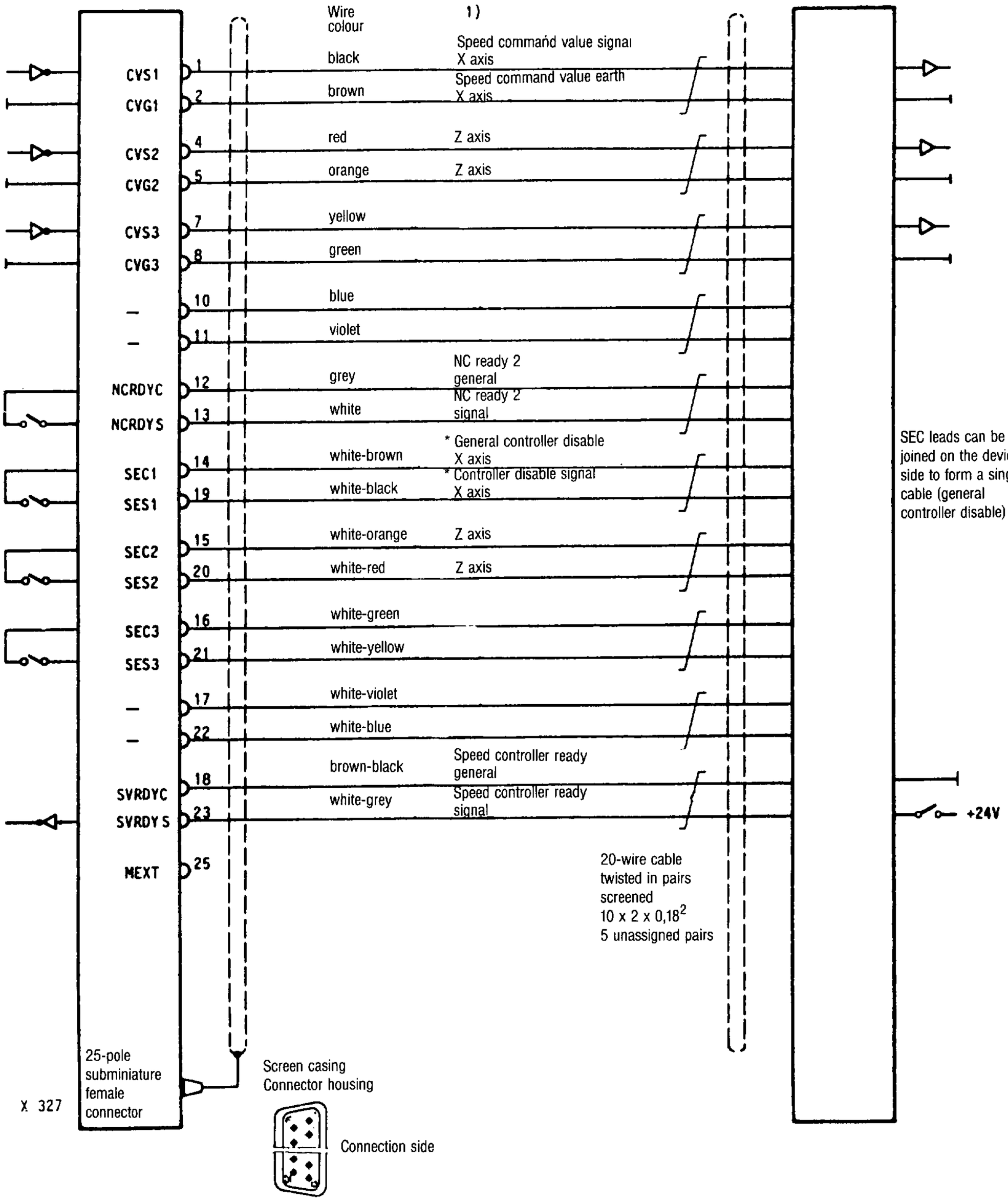
Cable name: Feed drives/main spindle drives
Order No.: 6FC9 340-6C.
Module: 03 350
SINUMERIK 3T, 3TT



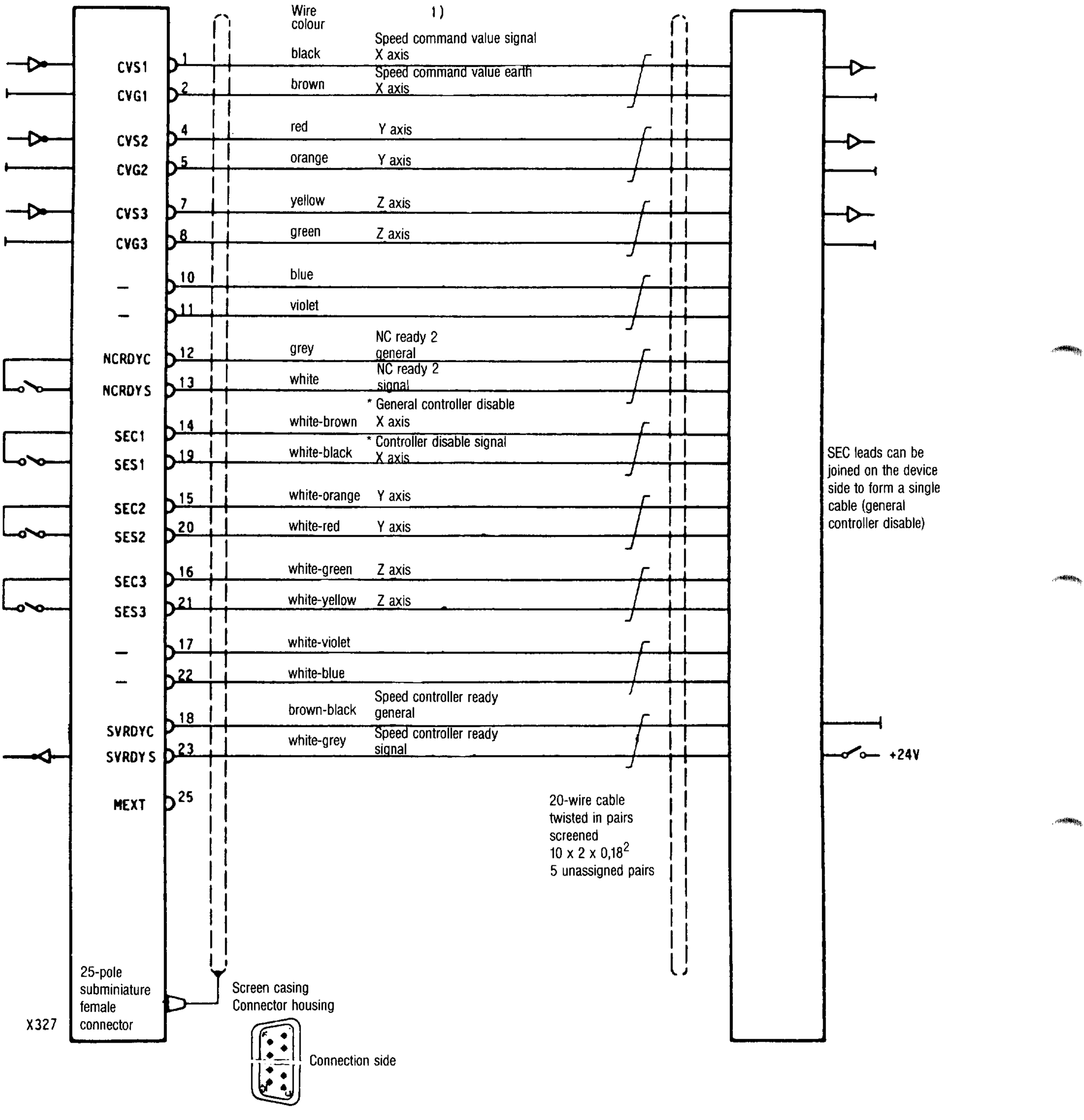
Cable name: Feed drives/C axis/main spindle drive
Order No.: 6FC9 340-6C.
Module: 03 325
SINUMERIK 3T, 3TT with C axis



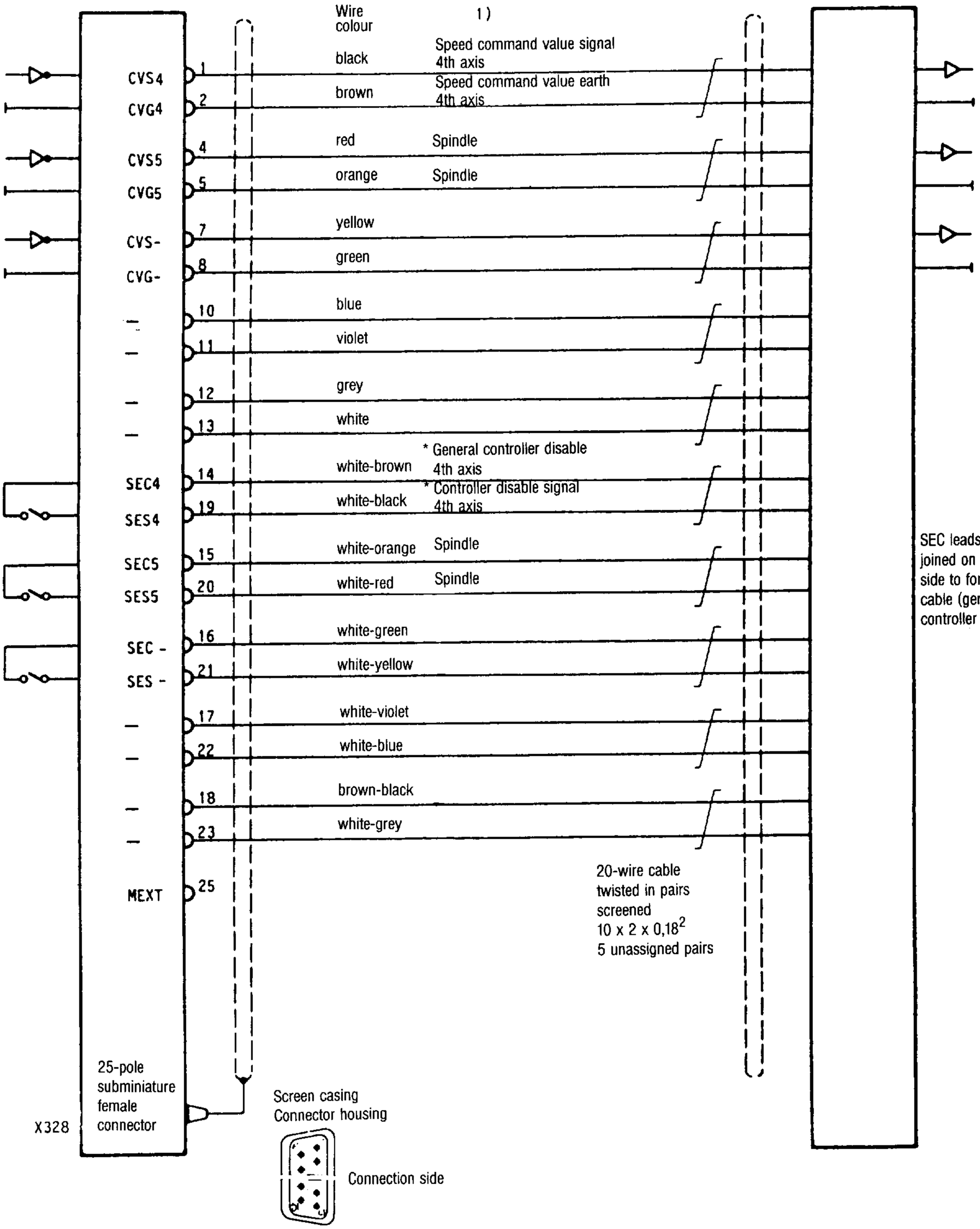
Cable name: Feed drives, X and Z axes
Order No.: 6FC9 340-6C.
Module: 03 325
SINUMERIK 3T, 3TT with C axis



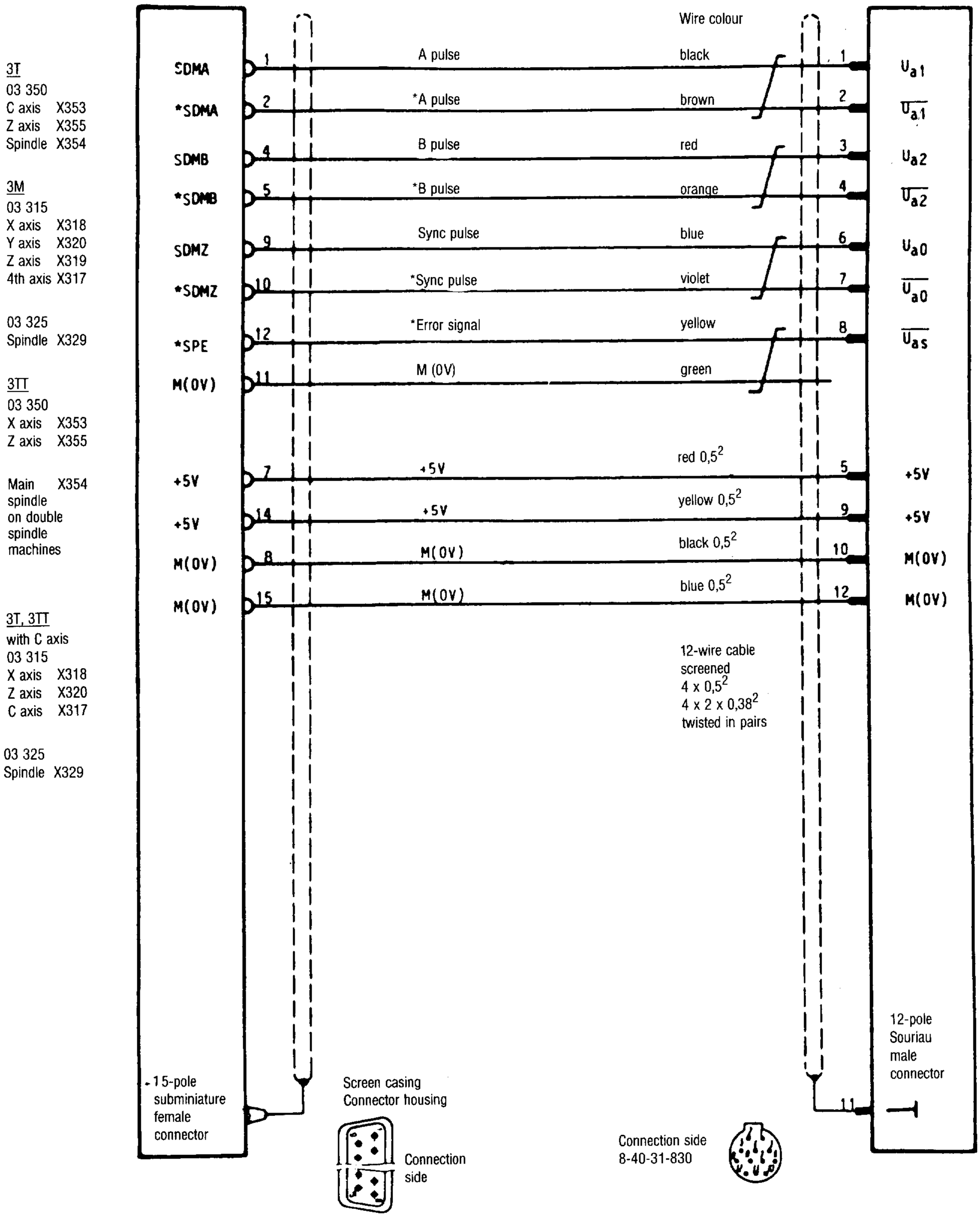
Cable name: Feed drives, X, Y and Z axes
Order No.: 6FC9 340-6C.
Module: 03 325
SINUMERIK 3M



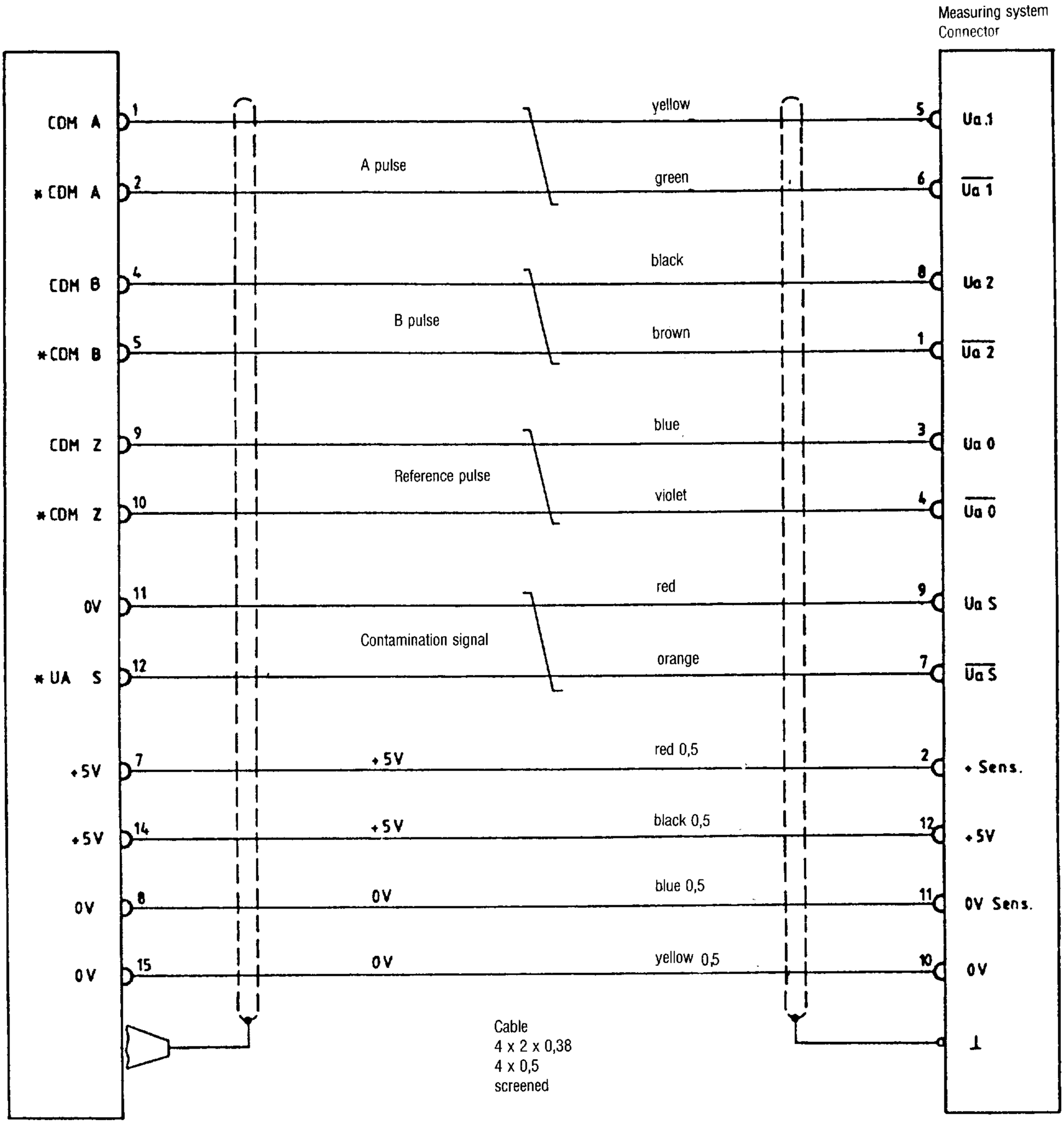
Cable name: Feed drives/4th axis/main spindle drive
Order No.: 6FC9 340-6C.
Module: 03 325
SINUMERIK 3M

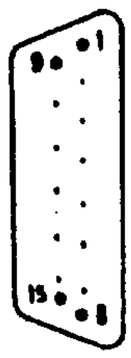


Cable name: Main spindle encoder/digital linear or rotary measuring system
Order No.: 6FC9 340-6K.
Suitable for encoders 6FC9 320-1DA. and 6FC9 320-3C. as well as for
EXE 601 S and 605 S
Module: 03 315, 03 325, 03 350
SINUMERIK 3T, 3TT, 3M



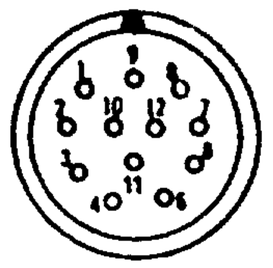
Cable name: Digital rotary measuring system
Order No.: 6FC9 344-1W.
Suitable for encoders 6FC9 320-3K. and 6FC9 320-3H.
SINUMERIK 3T, 3TT, 3M
Module location: 03 315, 03 325, 03 350
Module connector: Encoder



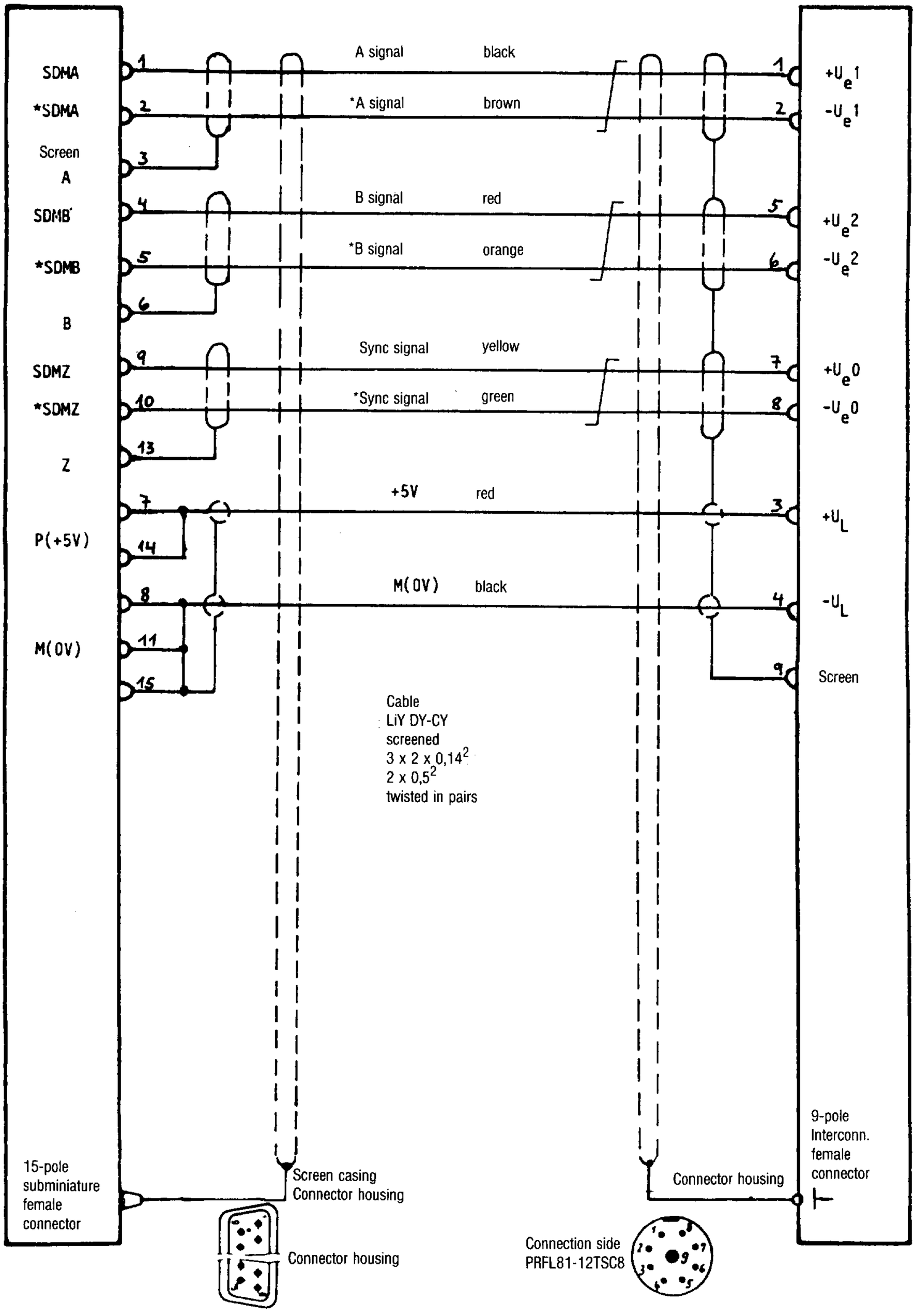


Position: 1 at top
15-pole D subminiature
female connector
Connection side
SINUMERIK housing
6FC9 341-1EC

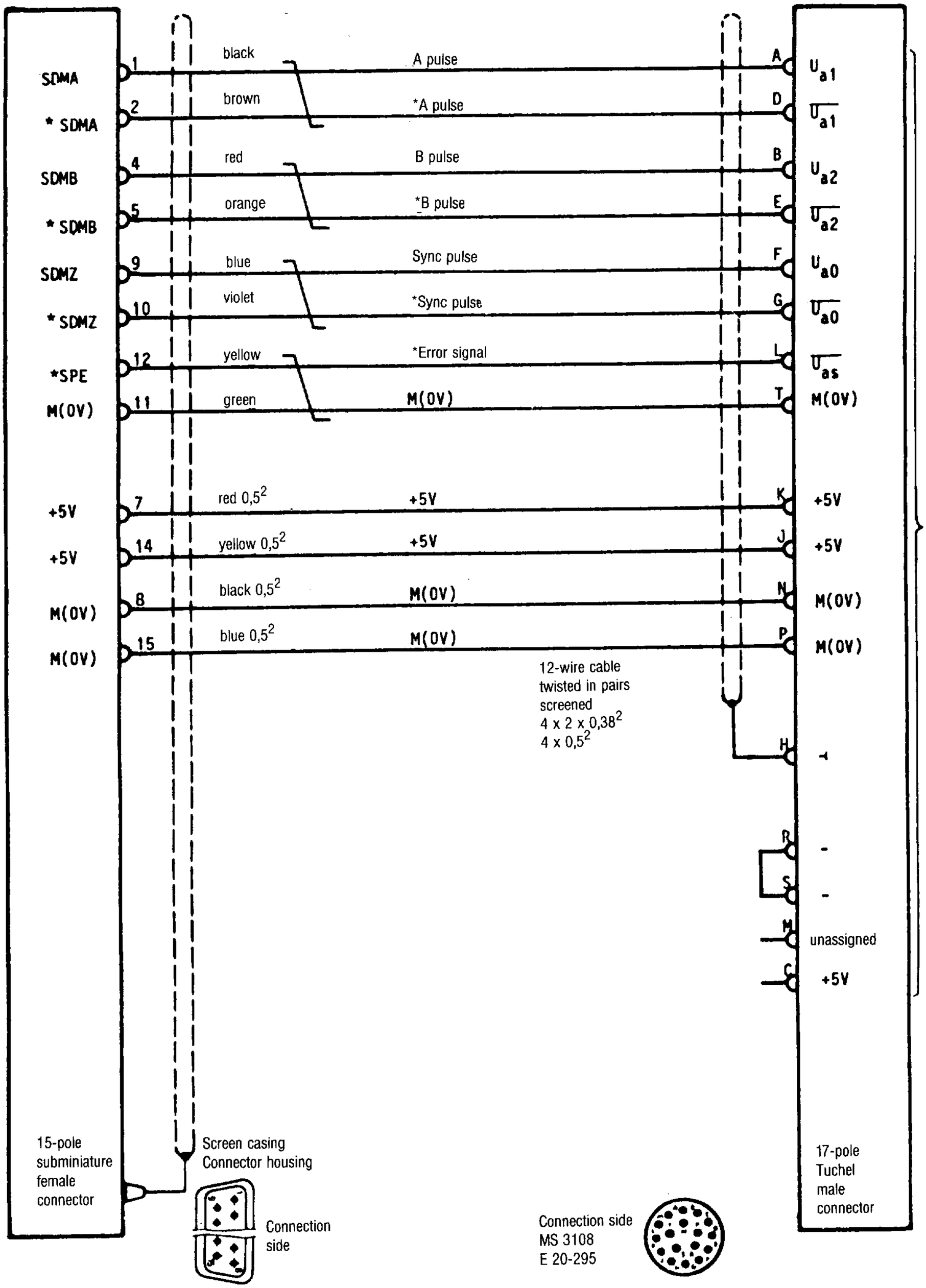
12-pole round
female connector
Connection side
SIEMENS
6FC9 341-1FD



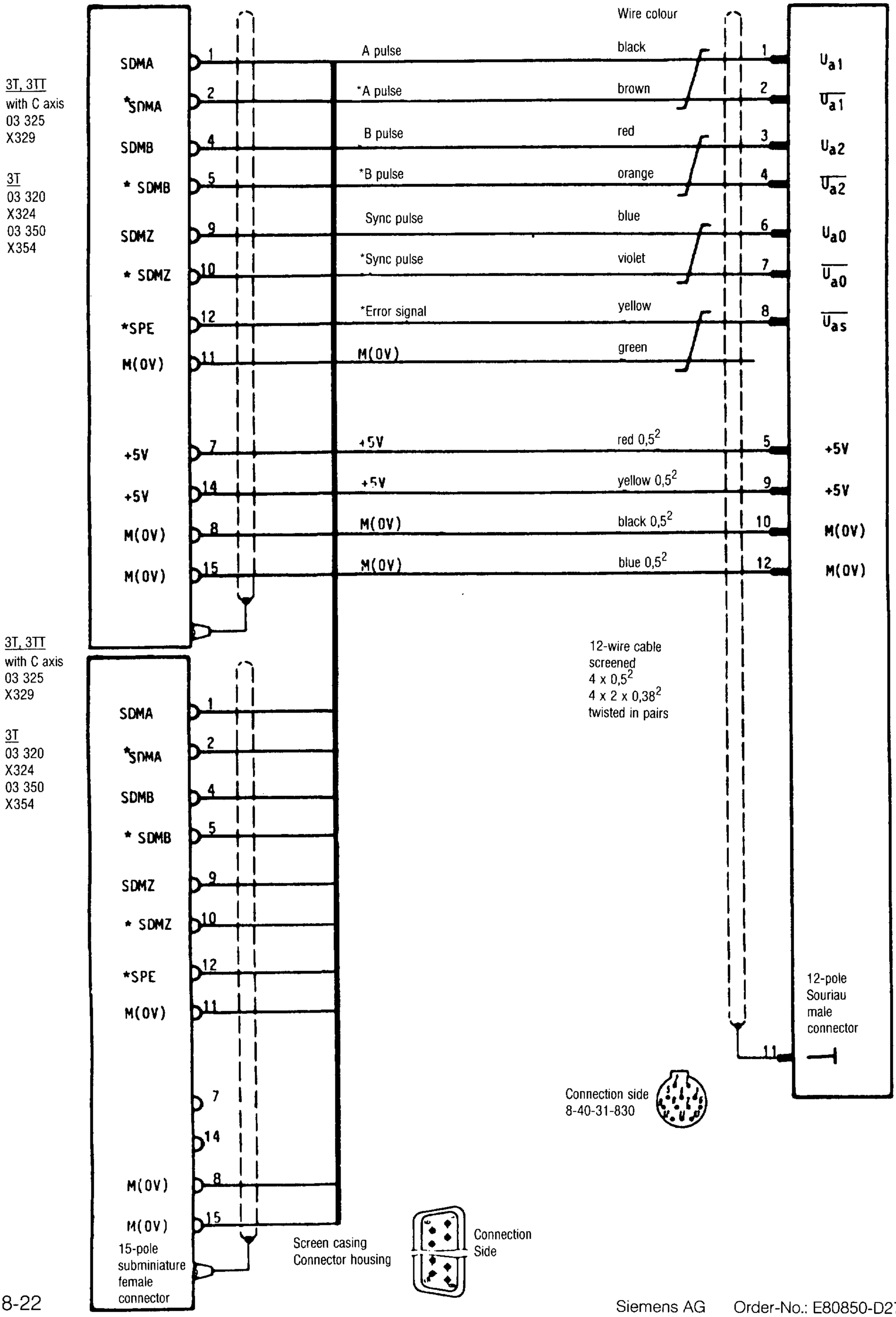
Cable name: Integrated EXE
Order No.: 6FC9 340-6T.
Module: 03 315, 03 325, 03 350
SINUMERIK 3T, 3TT, 3M



Cable name: Digital rotary measuring system ROD 320
Order No.: 6FC9 340-6N.
Module: 03 310, 03 315, 03 320, 03 325, 03 350
SINUMERIK 3T, 3TT, 3M

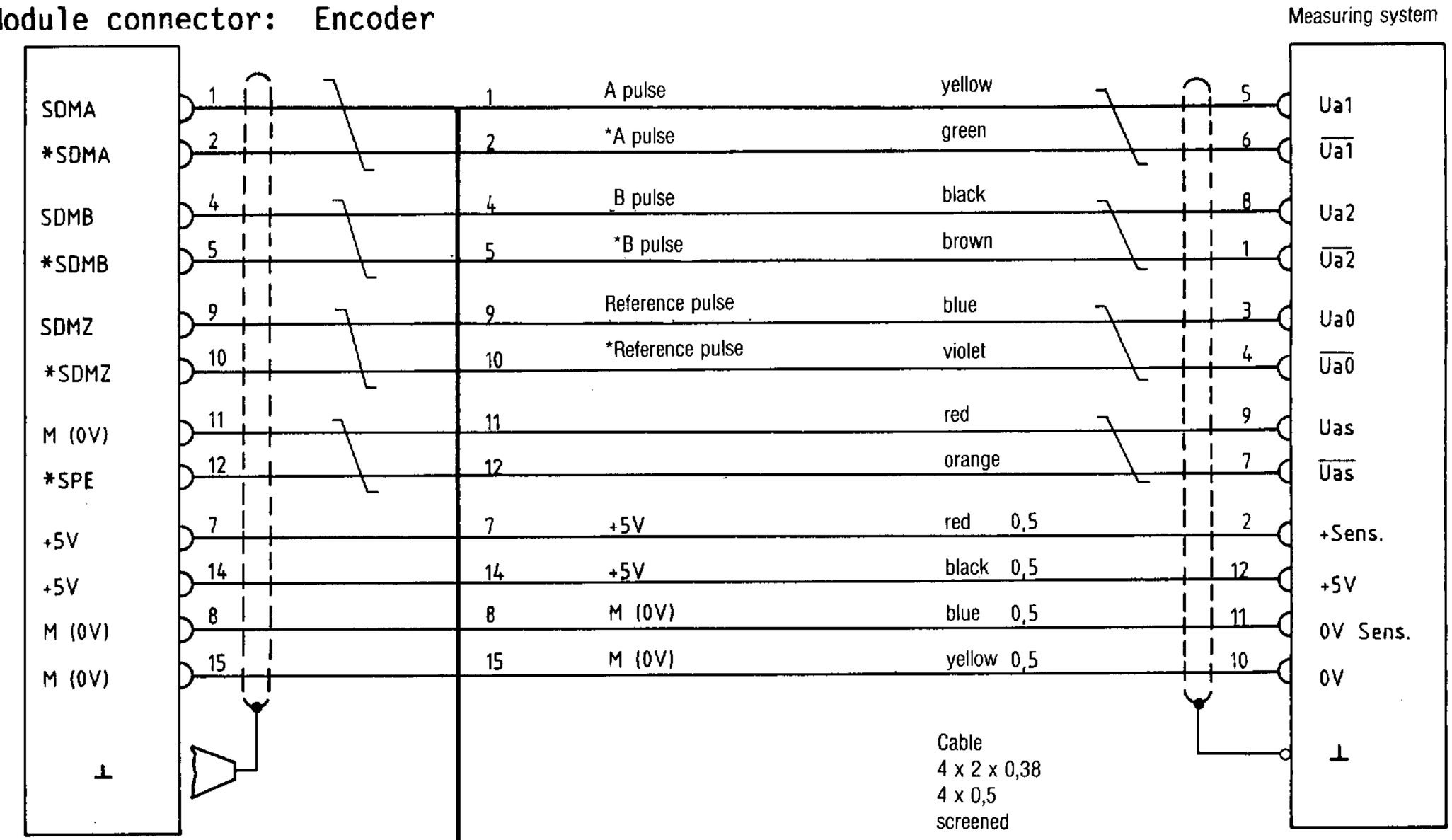


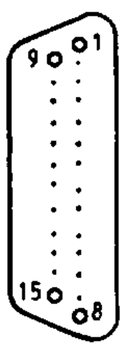
Cable name: Main spindle encoder
Order No.: 6FC9 340-6Q.
Suitable for encoders 6FC9 320-1DA and 6FC9 320-3C.
Module: 03 310, 03 320, 03 350
SINUMERIK 3TT single spindle machines



Siemens AG Order-No.: E80850-D27-X-A1-7600

Cable name: Digital rotary measuring system for main spindle, 3TT single spindle machines (new version)
Order No.: 6FC9 344-2S.
SINUMERIK 3TT, NC1
Module location:
Module connector: Encoder

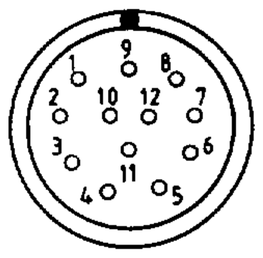


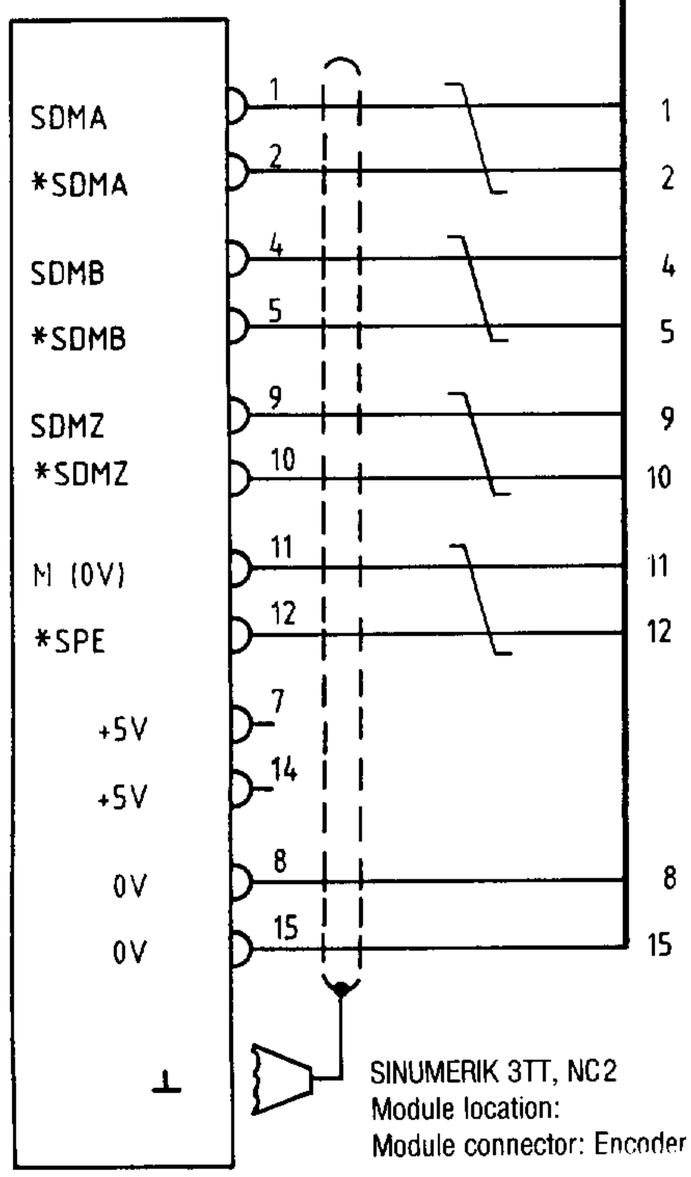


Position: 1 at top
15-pole D subminiature
female connector
Connection side
SINUMERIK housing
6FC9 341-1EC
Designation: NC1

Length 1 m

12-pole round
female connector
Connection side
SIEMENS
6FC9 341-1FD

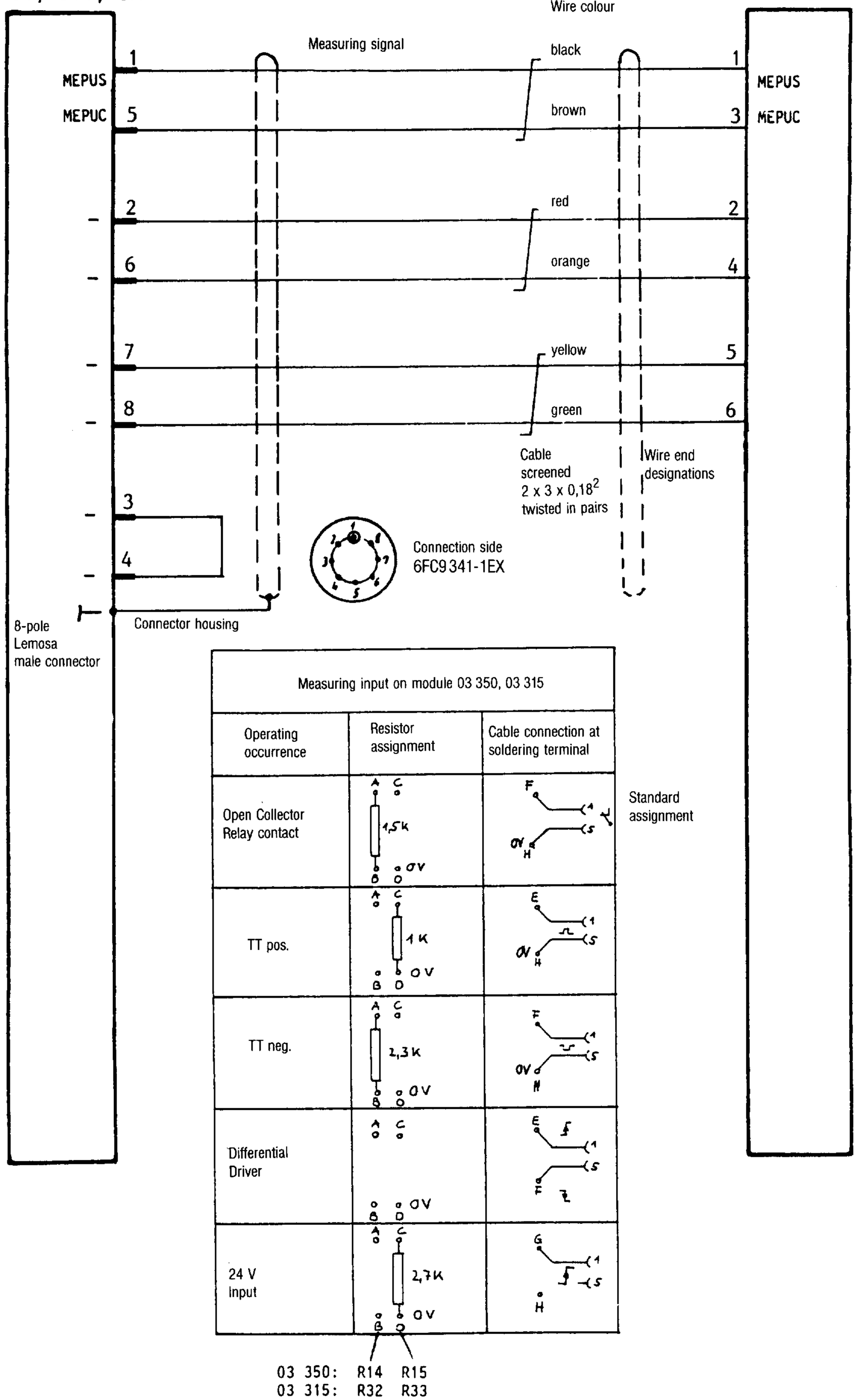




Position: 1 at top
15-pole D subminiature
female connector
Connection side
SINUMERIK housing
6FC9 341-1EC
Designation: NC2

SINUMERIK 3TT, NC2
Module location:
Module connector: Encoder

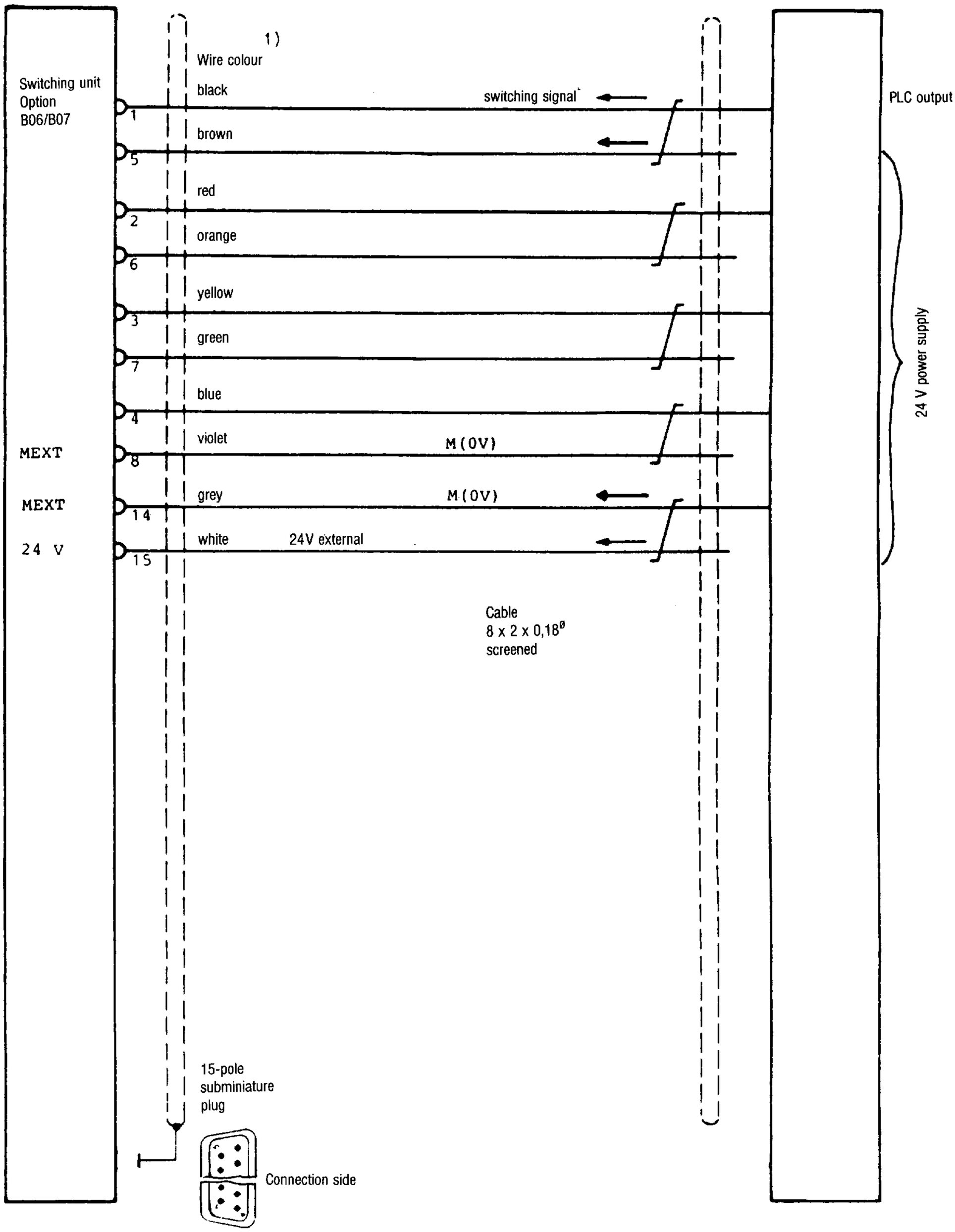
Cable name: Measuring
Order No.: 6FC9 340-8K.
Module: 03 315, 03 350
SINUMERIK 3T, 3TT, 3M



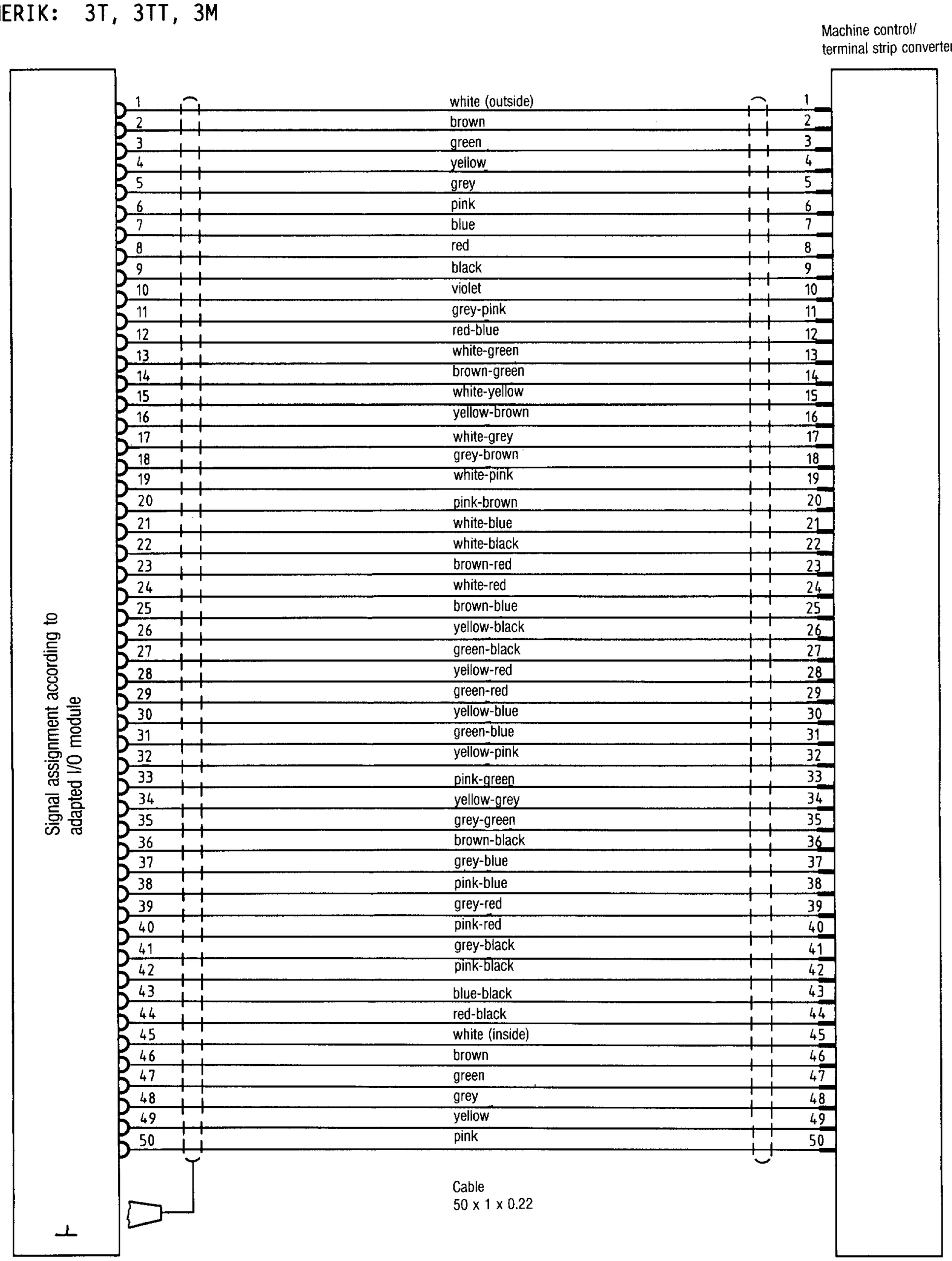
3T, 3TT
03 350
Sensor X356

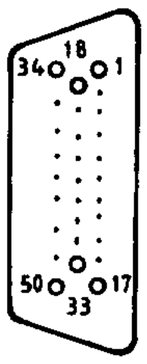
3M
3T, 3TT
with C axis
03 315
Sensor X321

Cable name: Operator panel switching unit
Order No.: 6FC9 340-2S.
Module: 03 820



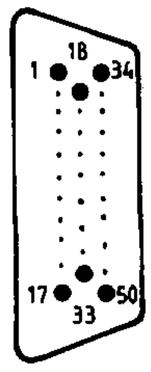
Cable name: Machine control Module location: C3630,034.....
Order No.: 6FC9 340-2W. Module connector:
SINUMERIK: 3T, 3TT, 3M



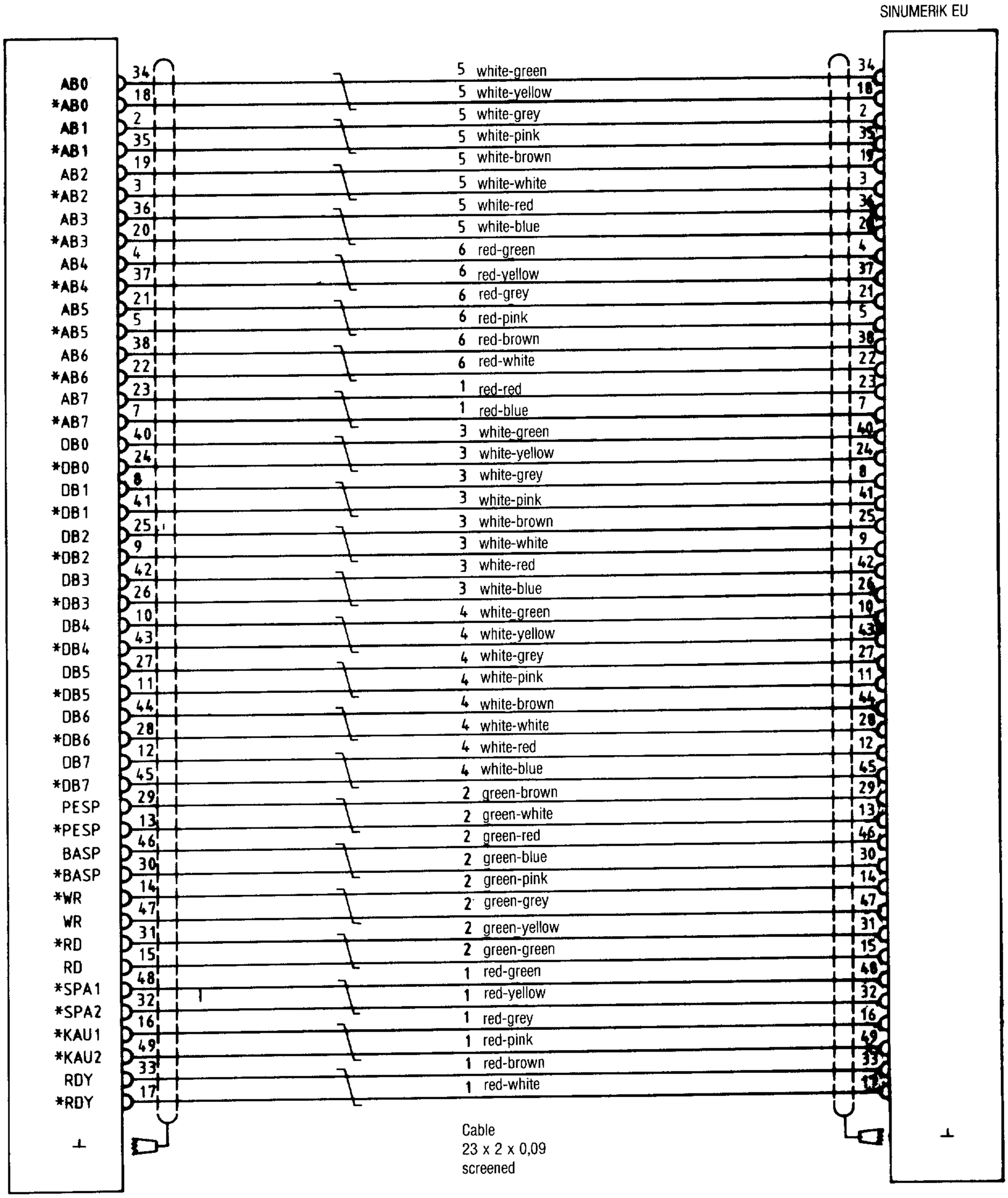


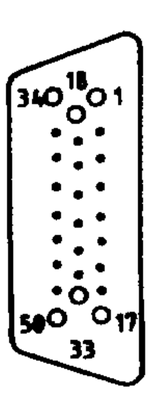
Position: 1 at top
50-pole D subminiature
female connector
Connection side
SINUMERIK housing
6FC9 341-1EE

Position: 1 at top
50-pole D subminiature
male connector
Connection side
SINUMERIK housing
6FC9 341-1EH

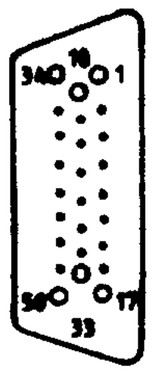


Cable name: SINUMERIK - EU link
Order No.: 6FC9 340-7Q.
SINUMERIK
Module location:
Module connector:

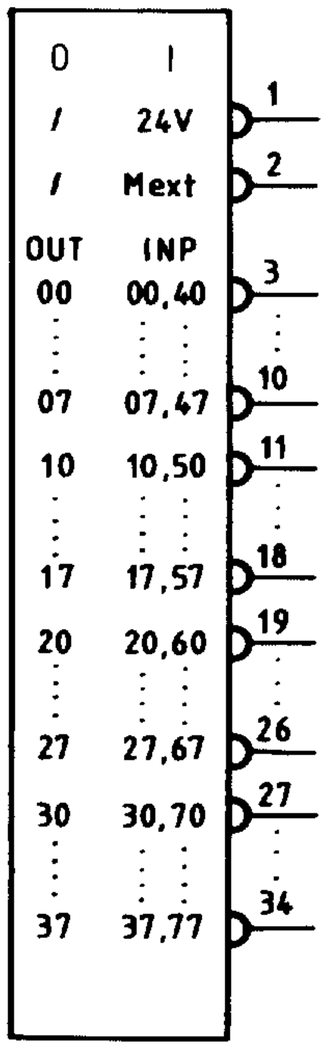


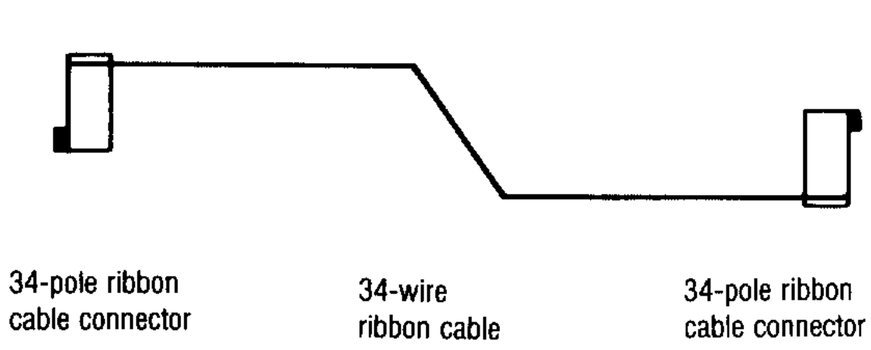


Position: 1 at top
50-pole D subminiature
female connector
Connection side
SINUMERIK housing
6FC9 341-1EE

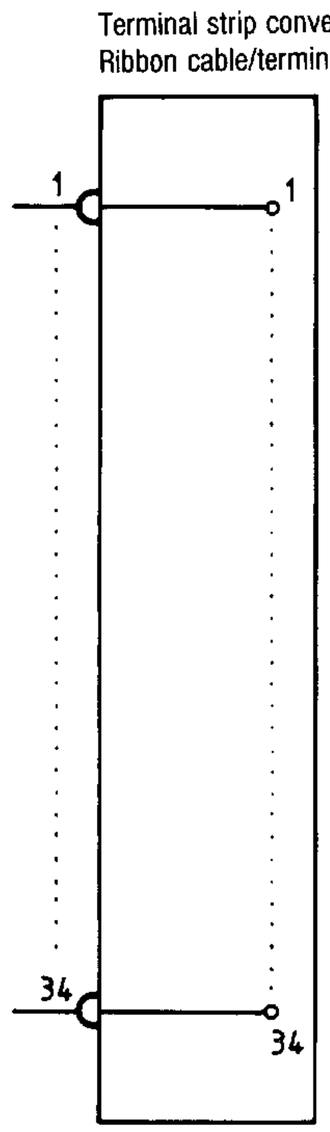


Cable name: Terminal strip converter for I/O module
Ribbon cable
Order No.: 6FC9 340-8L.
SINUMERIK
I/O module: 6FC9 331-0F./0G.
Connector: X02 402, 404, 405

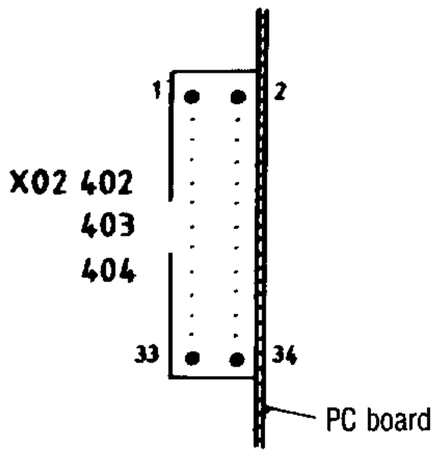




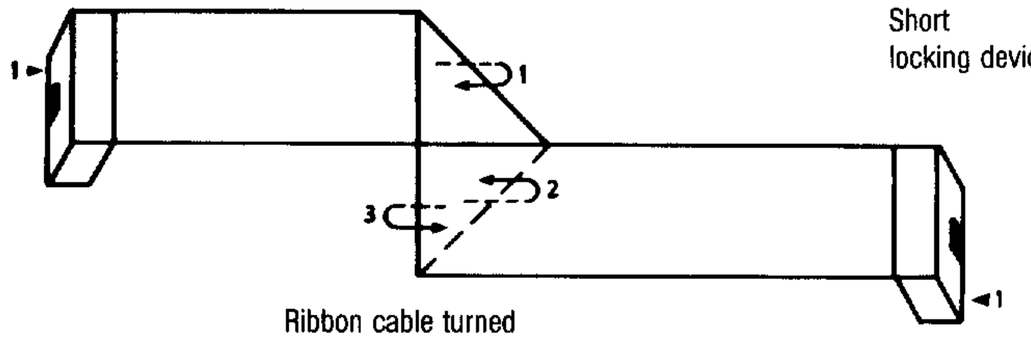
Side view



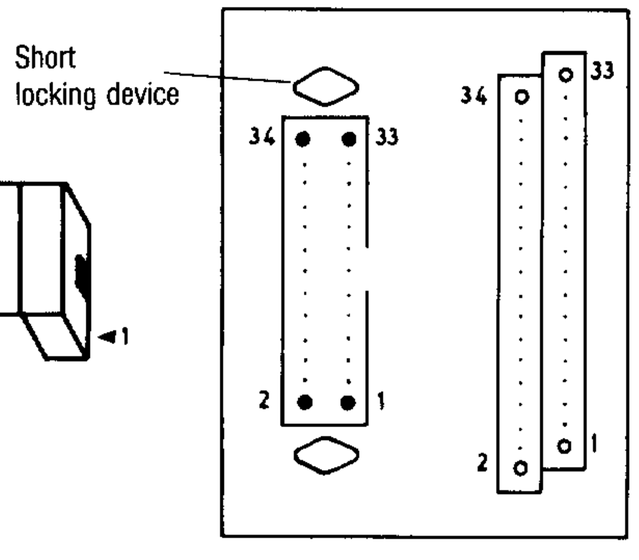
Installation layout
Top view



Connection side



Ribbon cable turned through 180°

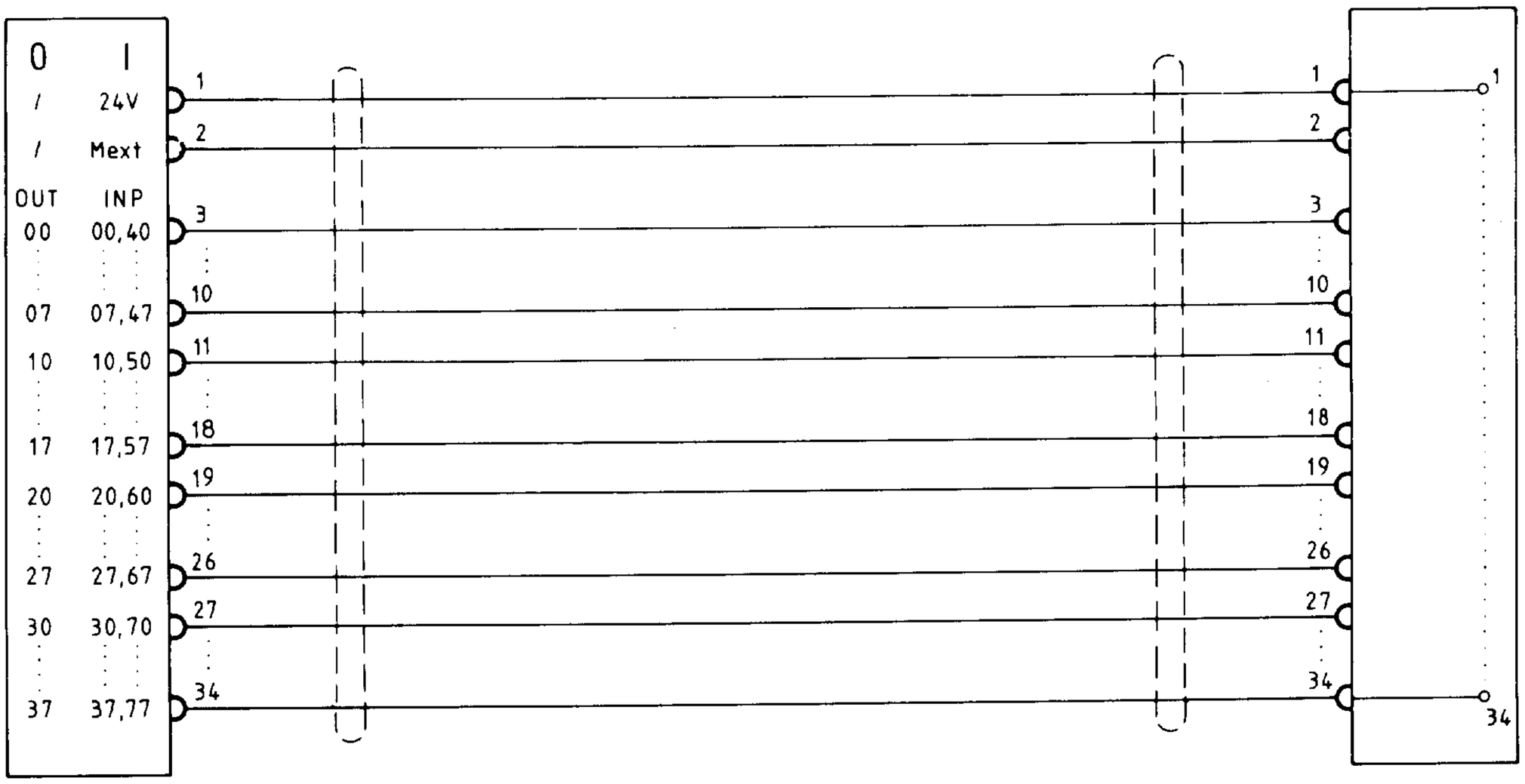


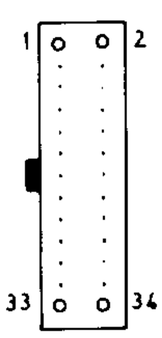
Terminal strip converter FLKM 34
34-pole ribbon cable
Connection side
6FC9 302-2AA

Input/output connector Logic module 1			Logic module 2			Connector pin Bit							
X02402	X02404	X02405	X02402	X02404	X02405	7	6	5	4	3	2	1	0
Q 48	I 48	I 52	Q 52	I 56	I 60	10	9	8	7	6	5	4	3
Q 49	I 49	I 53	Q 53	I 57	I 61	18	17	16	15	14	13	12	11
Q 50	I 50	I 54	Q 54	I 58	I 62	26	25	24	23	22	21	20	19
Q 51	I 51	I 55	Q 55	I 59	I 63	34	33	32	31	30	29	28	27

Siemens AG Order-No.: E80850-D27-X-A1-7600

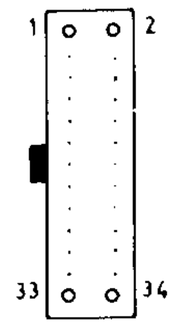
Cable name: Terminal strip converter for I/O module
Round cable
Order No.: 6FC9 340-8X.
SINUMERIK
I/O module: 6FC9 331-0F./0G.
Connector: X02 402, 404, 405





Honda
MFC 34 LH/HF
34-pole female connector
Crimp contacts
Connection side
6FC 341-2AD

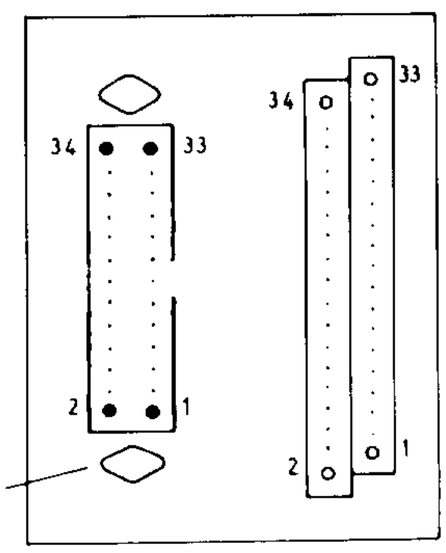
Cable
21 x 2 x 0,18
(screened)
4 unassigned pairs



Honda
MFC 34 LH/HF
34-pole female connector
Crimp contacts
Connection side
6FC9 341-2AD

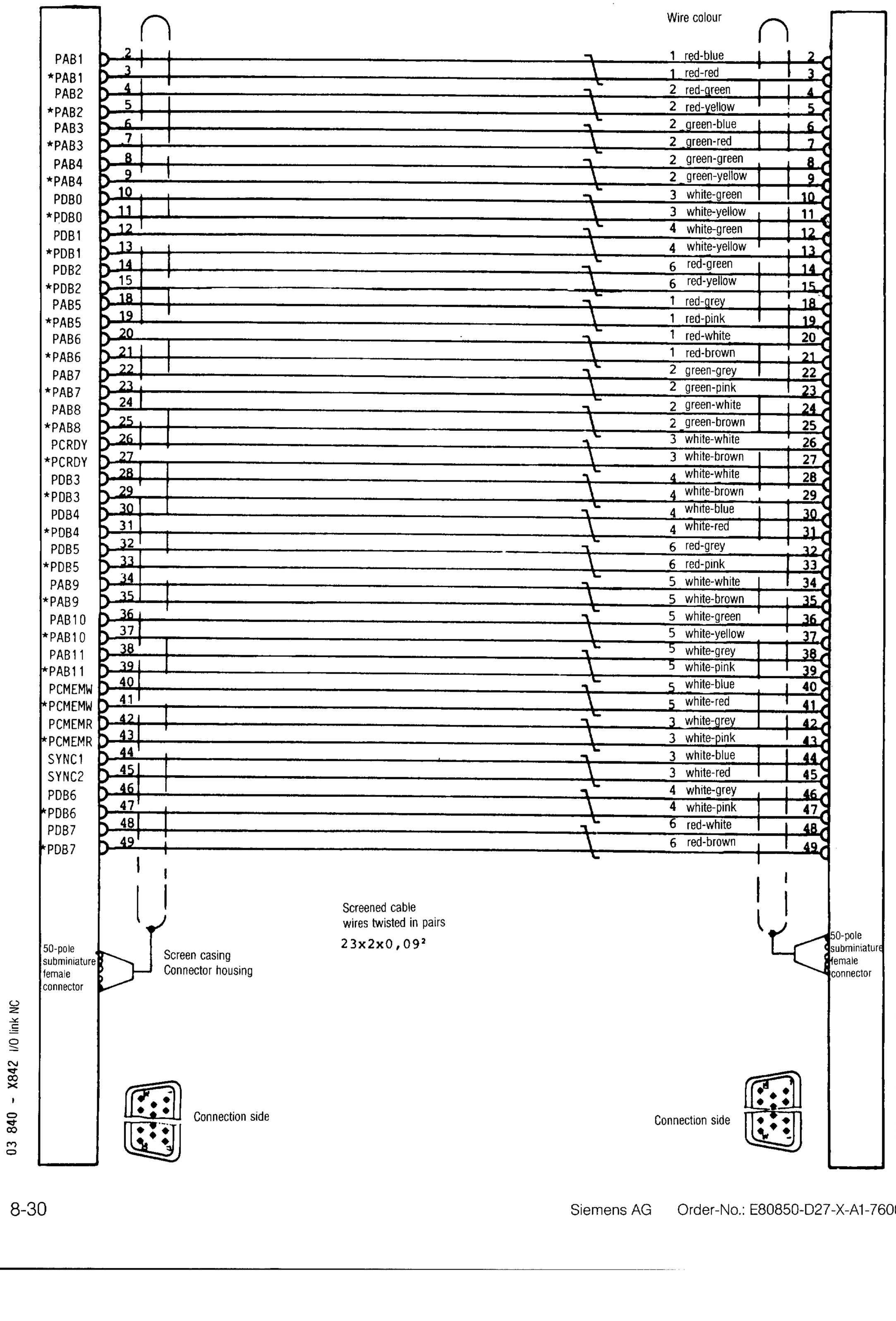
Wire colour			
1 black	11 white-black	21 brown-red	31 green-red
2 brown	12 white-brown	22 brown-orange	32 green-orange
3 red	13 white-red	23 brown-yellow	33 green-blue
4 orange	14 white-orange	24 brown-green	34 green-violet
5 yellow	15 white-yellow	25 brown-blue	
6 green	16 white-green	26 brown-violet	
7 blue	17 white-blue	27 brown-grey	
8 violet	18 white-violet	28 brown-white	
9 grey	19 white-grey	29 green-black	
10 white	20 brown-black	30 green-brown	

Terminal strip
converter FLKM 34
34-pole ribbon cable
Connection side
6FC9 302-2AA



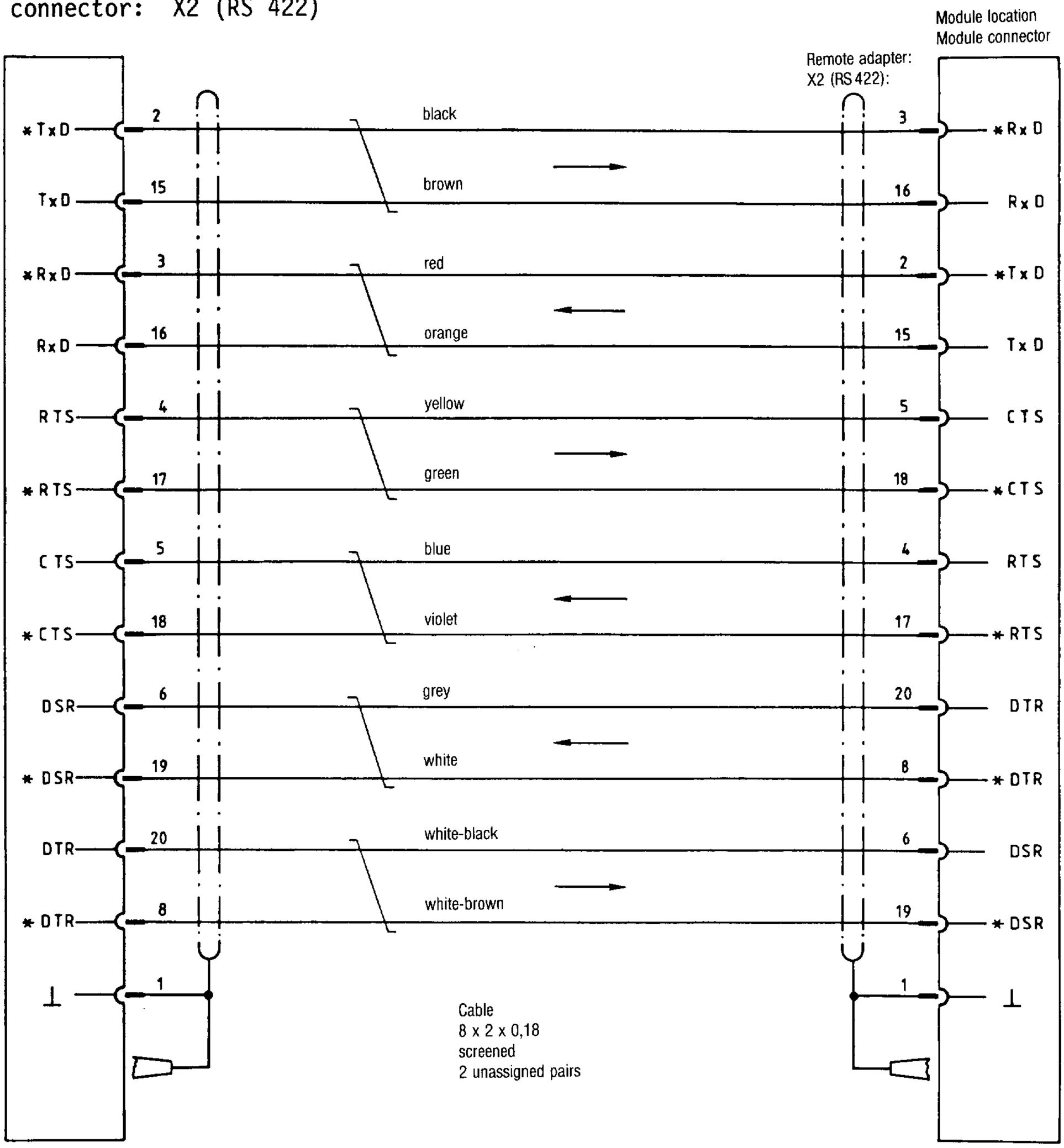
Input/output connector						Connector pin							
Logic module 1			Logic module 2			Bit							
X02402	X02404	X02405	X02402	X02404	X02405	7	6	5	4	3	2	1	0
Q 48	I 48	I 52	Q 52	I 56	I 60	10	9	8	7	6	5	4	3
Q 49	I 49	I 53	Q 53	I 57	I 61	18	17	16	15	14	13	12	11
Q 50	I 50	I 54	Q 54	I 58	I 62	26	25	24	23	22	21	20	19
Q 51	I 51	I 55	Q 55	I 59	I 63	34	33	32	31	30	29	28	27

Cable name: PLC with link memory interface
Order No.: 6FC9 340-7H.
Module: 03 840
SINUMERIK 3T, 3TT, 3M

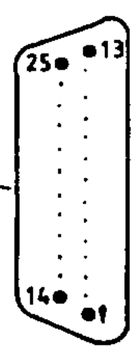


Siemens AG Order-No.: E80850-D27-X-A1-7600

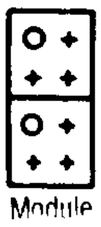
Cable name: Remote adapter for data transfer (RS 422)
Order No.: 6FC9 344-1S
SINUMERIK: System 3 and 8
Module location: Remote adapter
Module connector: X2 (RS 422)



Position: 1 at bottom
25-pole D subminiature
male connector
Connection side
SINUMERIK housing
6FC9 341-2AB

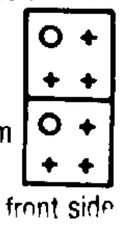


Connector code



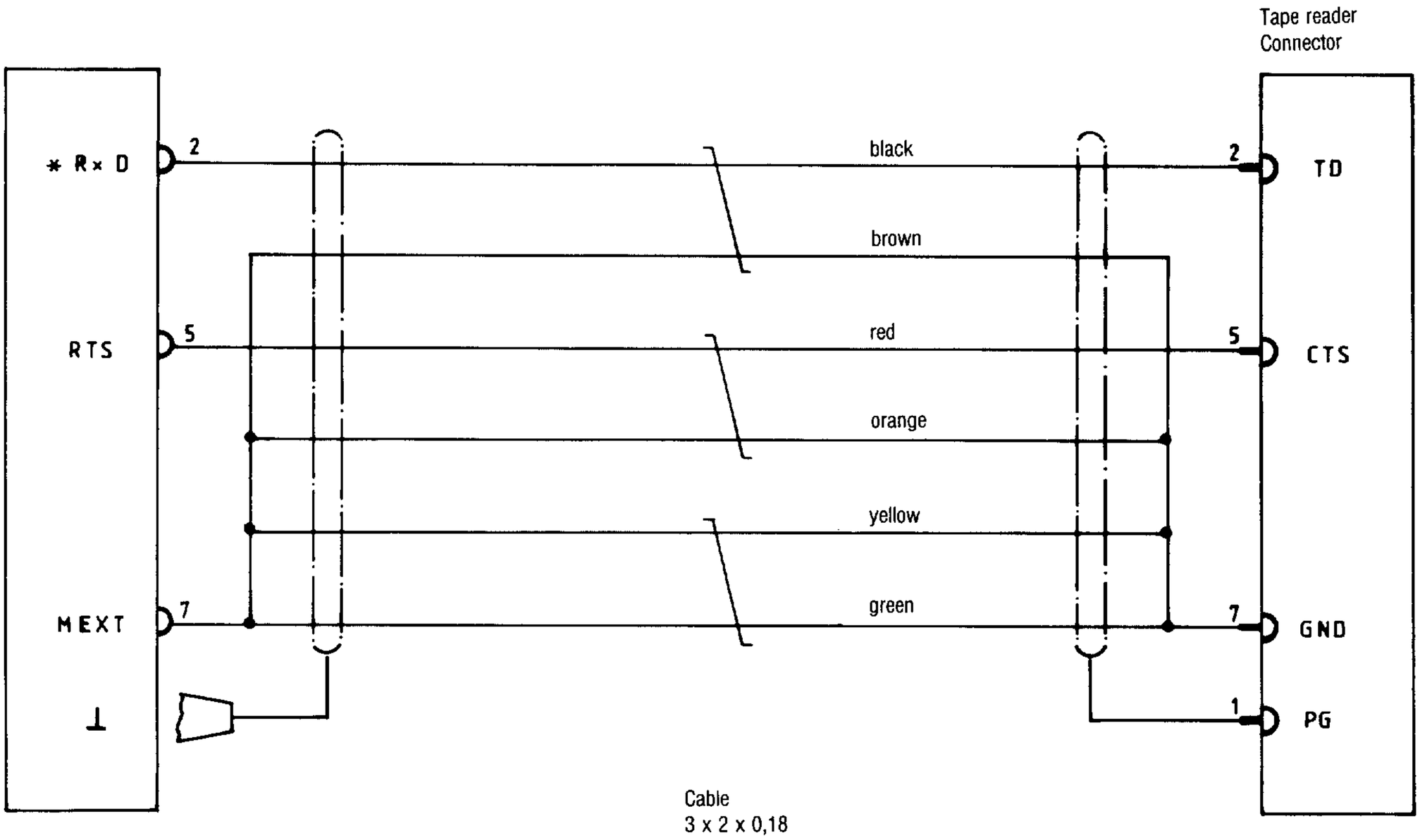
Module front side

Connector code

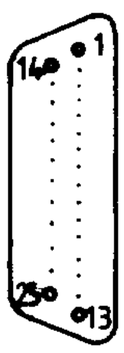


Module front side

Cable name: SINUMERIK tape readers T40 and T50
Order No.: 6FC9 344-1P.
SINUMERIK: System 3 and 8
Module location:
Module connector:



Cable
3 x 2 x 0,18
screened

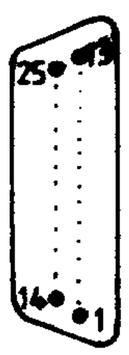


Position: 1 at top
25-pole D subminiature
female connector
Connection side
SINUMERIK housing
6FC9 341-1ED

Designation: NC

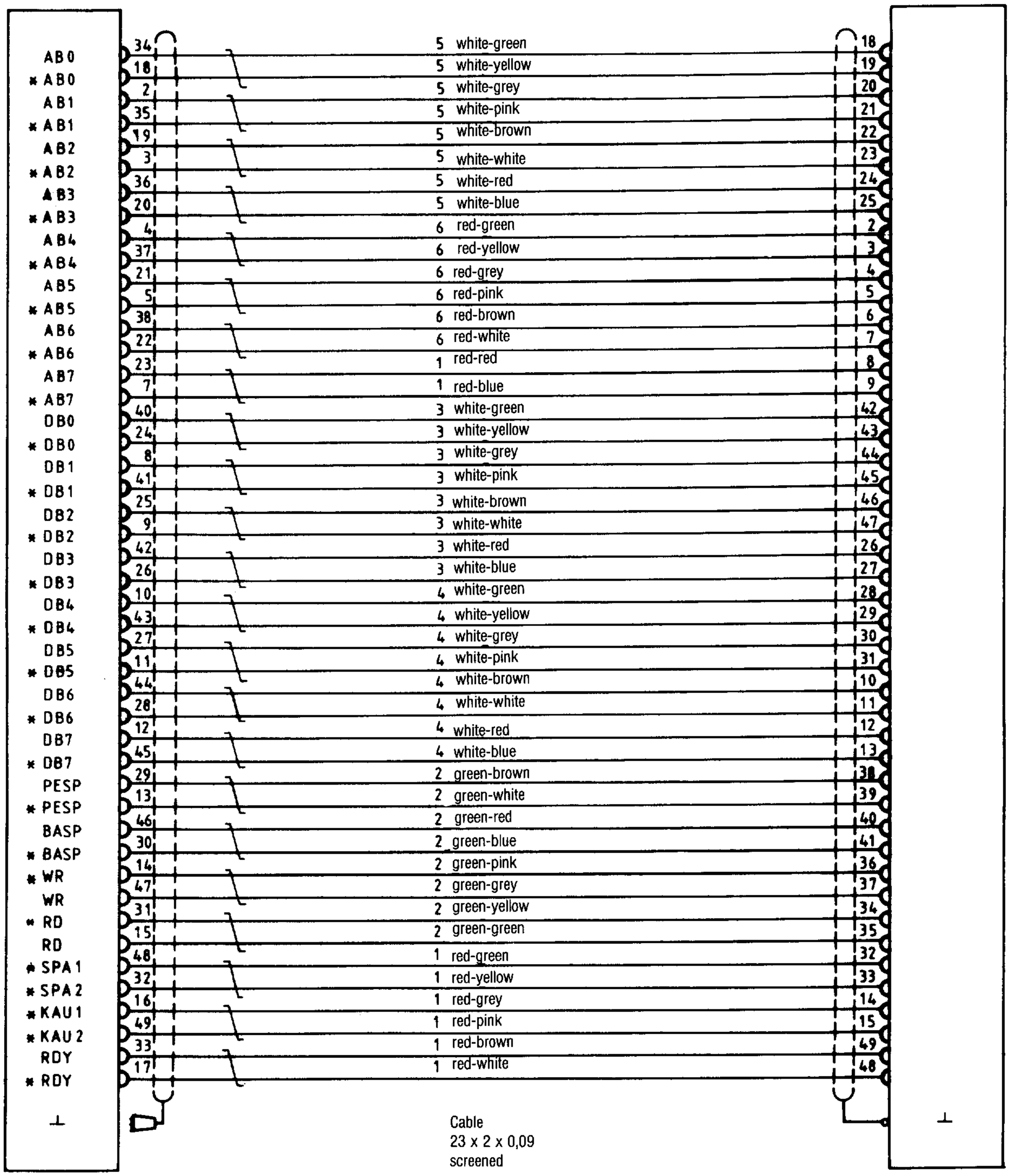
Position: 1 at bottom
25-pole D subminiature
male connector
Connection side
Housing with sliding
locking device
6FC9 341-2AA

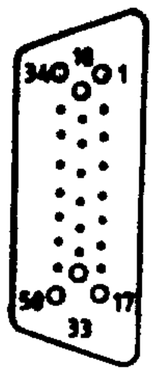
Designation: PTR



Cable name: SIMATIC S5 - EU link
Order No.: 6FC9 344-1X.
SINUMERIK
Module location:
Module connector:

SIMATIC S5
6ES5310-3AB
6ES5484-8AA



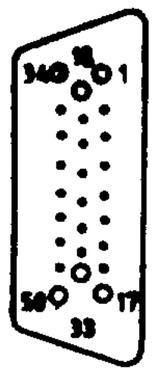


Position: 1 at top
50-pole D subminiature
female connector
Connection side
SINUMERIK housing
6FC9 341-1EE

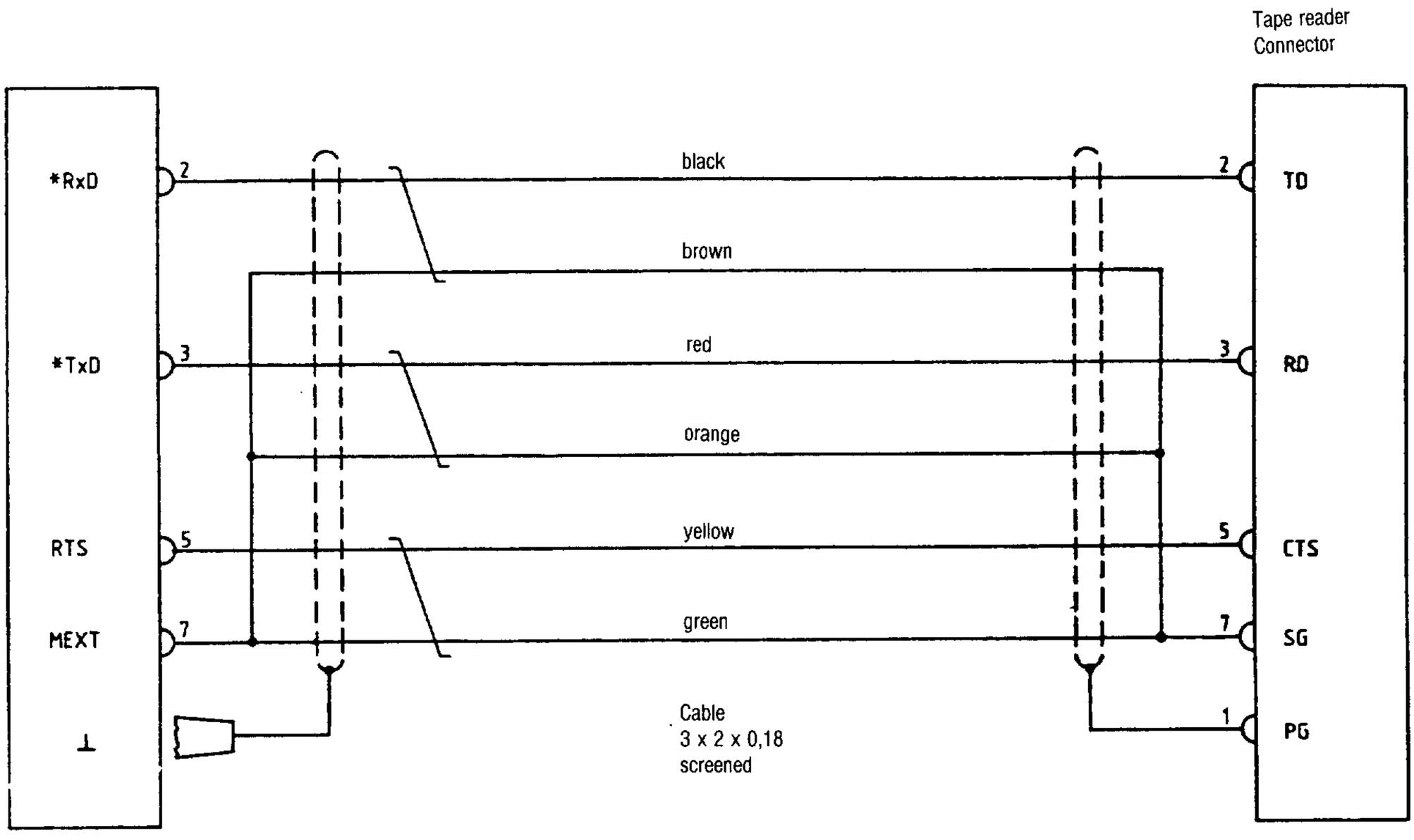
Designation: NC

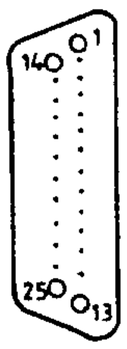
Position: 1 at top
50-pole D subminiature
female connector
Connection side
Housing with sliding
locking device
6FC9 341-1EN

Designation: S5-EG



Cable name: SINUMERIK tape reader T60
Order No.: 6FC9 344-2D.
SINUMERIK
Module location:
Module connector:



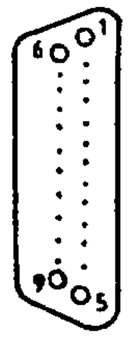


Position: 1 at top
25-pole D subminiature
female connector
Connection side
SINUMERIK housing
6FC9 341-1ED

Designation: NC

Position: 1 at top
9-pole D subminiature
female connector
Connection side
Housing with sliding
locking device
6FC9 341-1FM

Designation: PTR

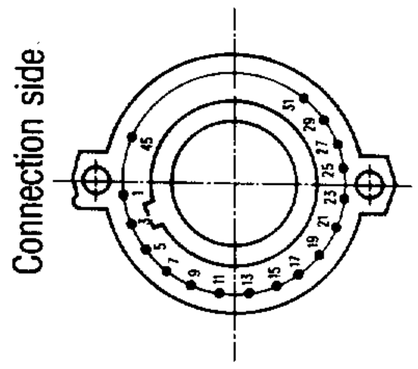


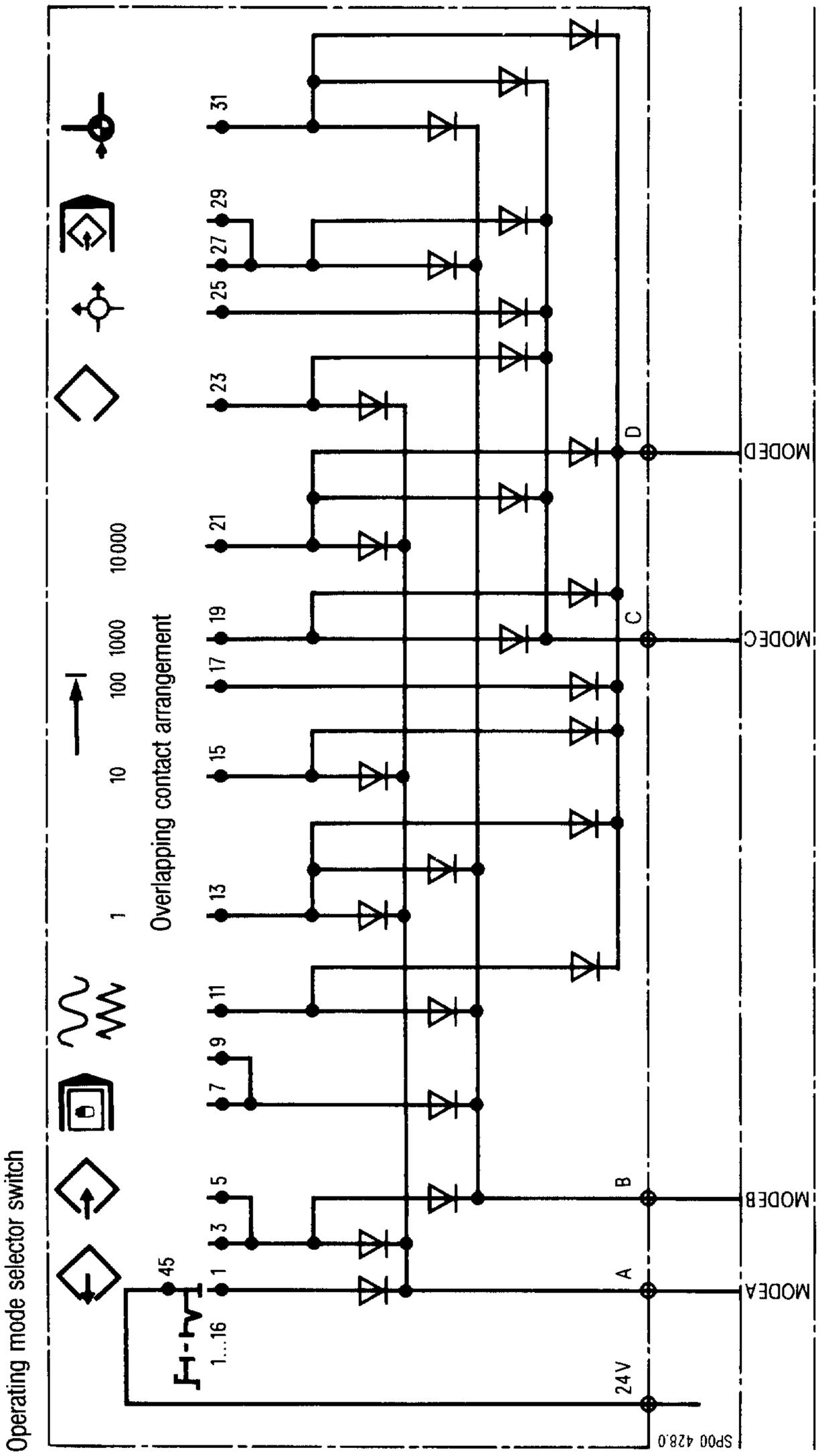
9. External machine control panel

Construction from individual components

The machine control panel can be supplied as a single unit or constructed from individual components by the customer.
The coded selector switches can be used for this version as individual components complete with diode board.

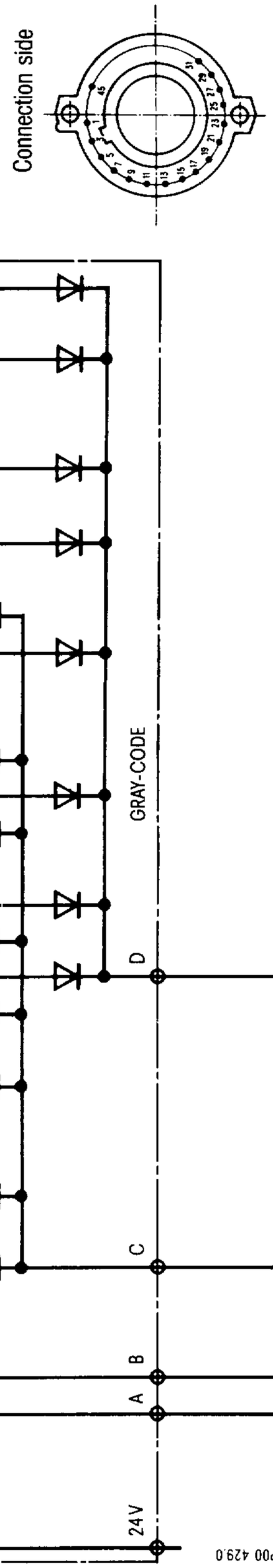
External machine control panel
comprising individual components
6FC9 301-0EB



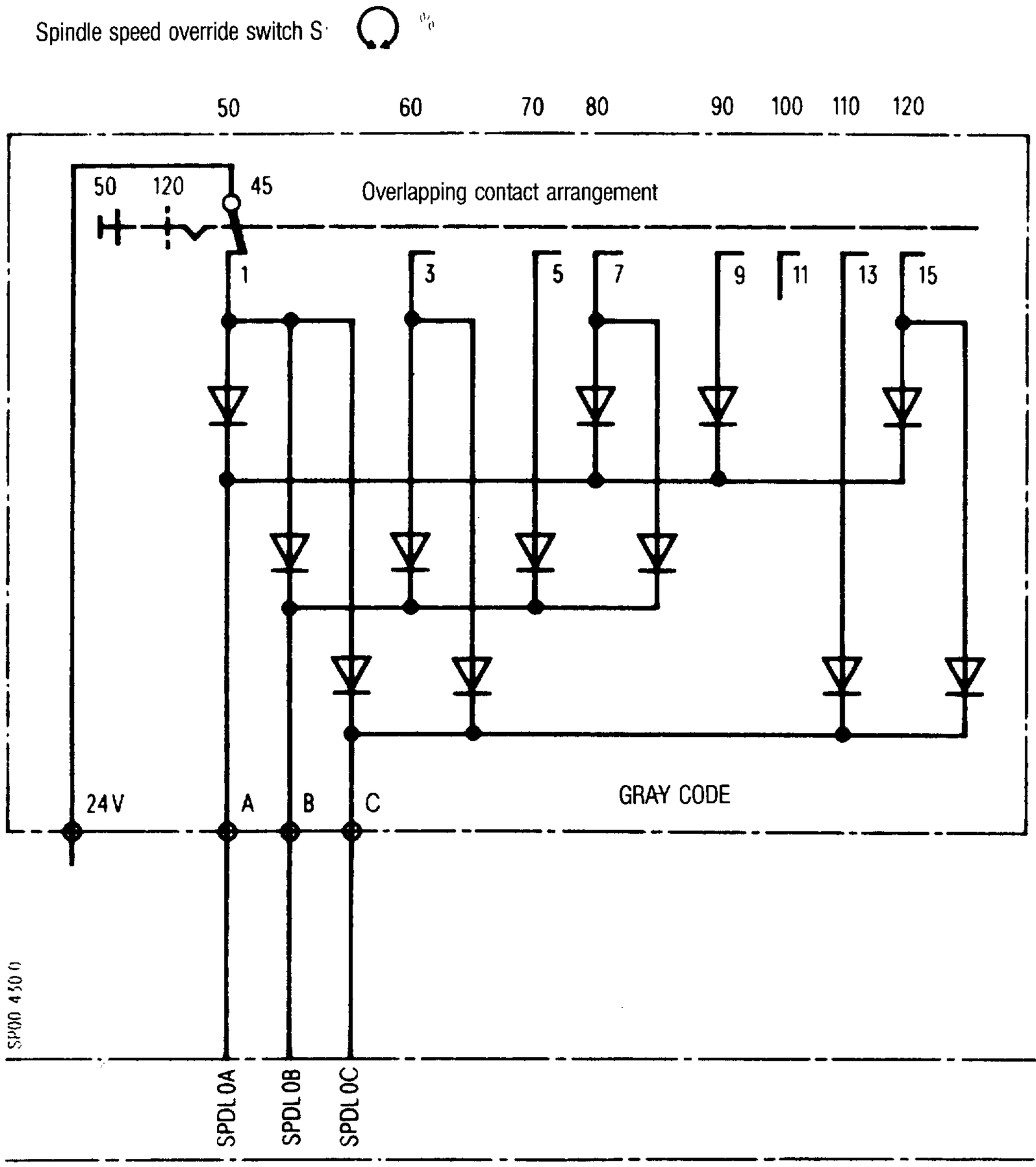


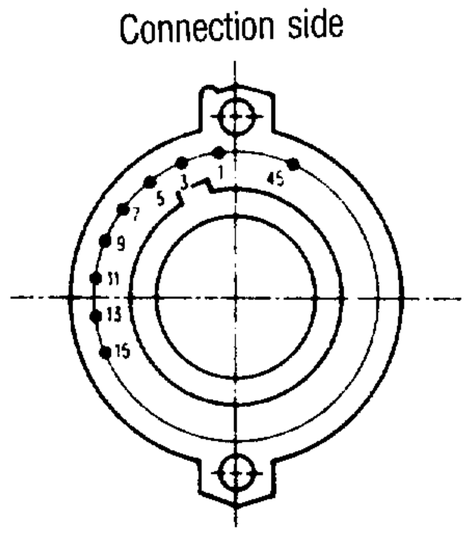
Siemens AG Order-No.: E80850-D27-X-A1-7600

External machine control panel
comprising individual components
6FC9 130-0AC00



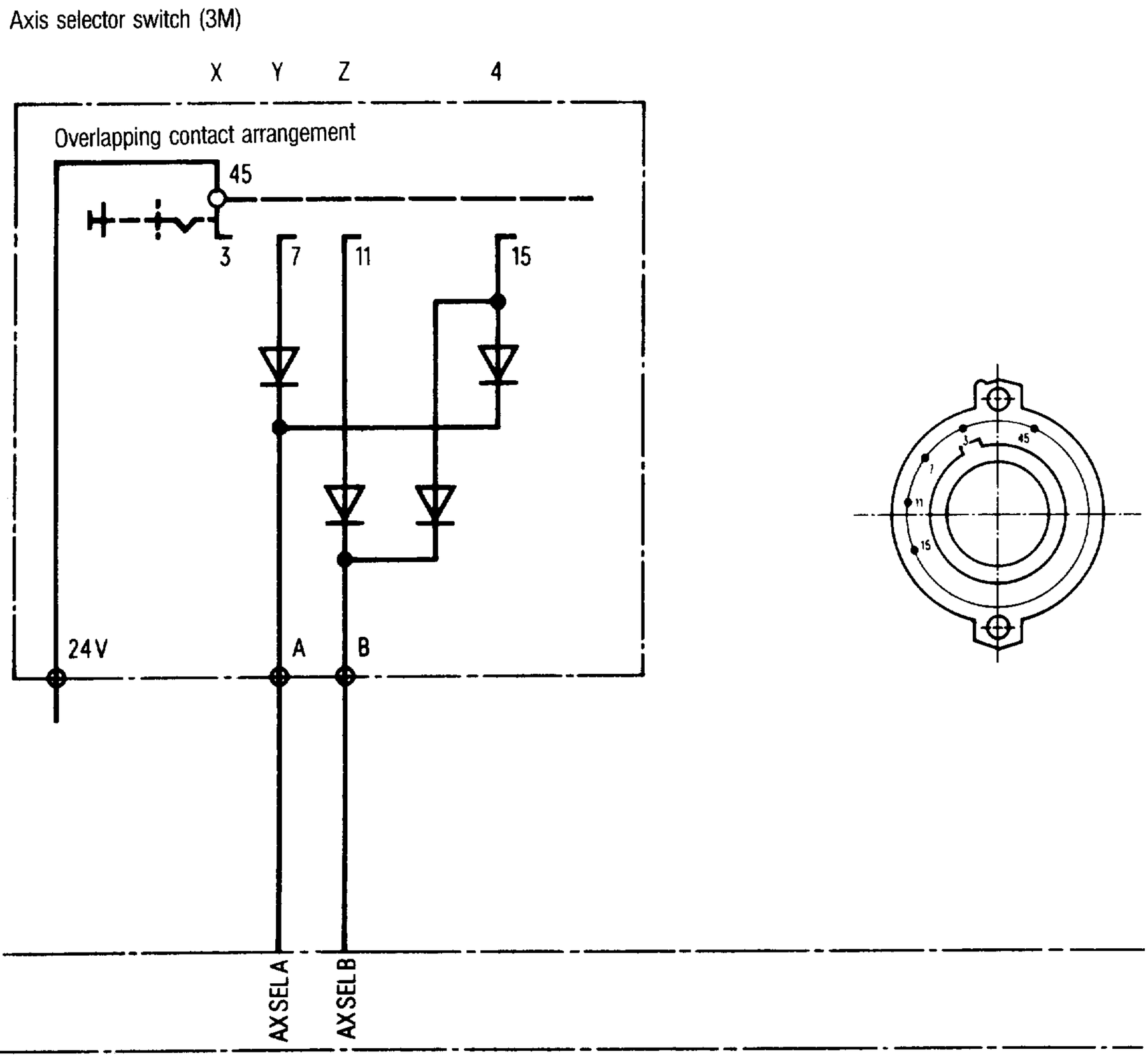
External machine control panel
comprising individual components
6FC9 301-0EA





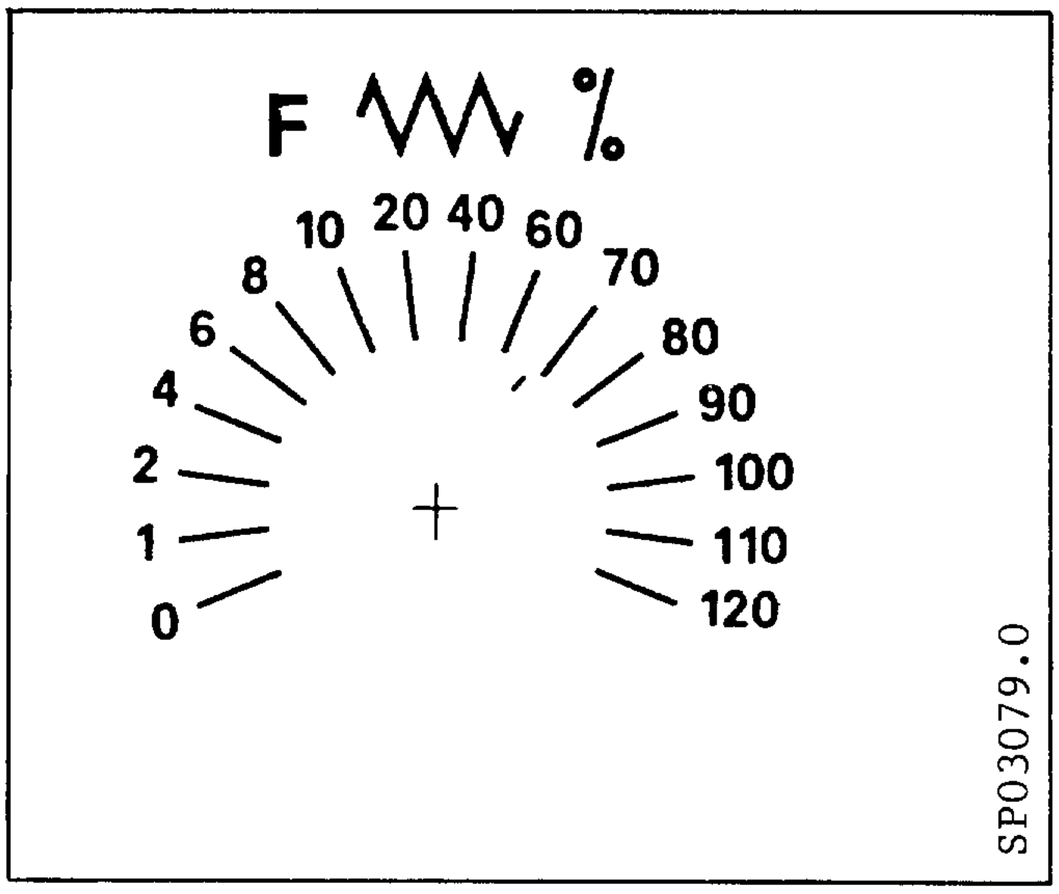
Siemens AG Order-No.: E80850-D27-X-A1-7600

External machine control panel comprising individual components 6FC9 130-0AB

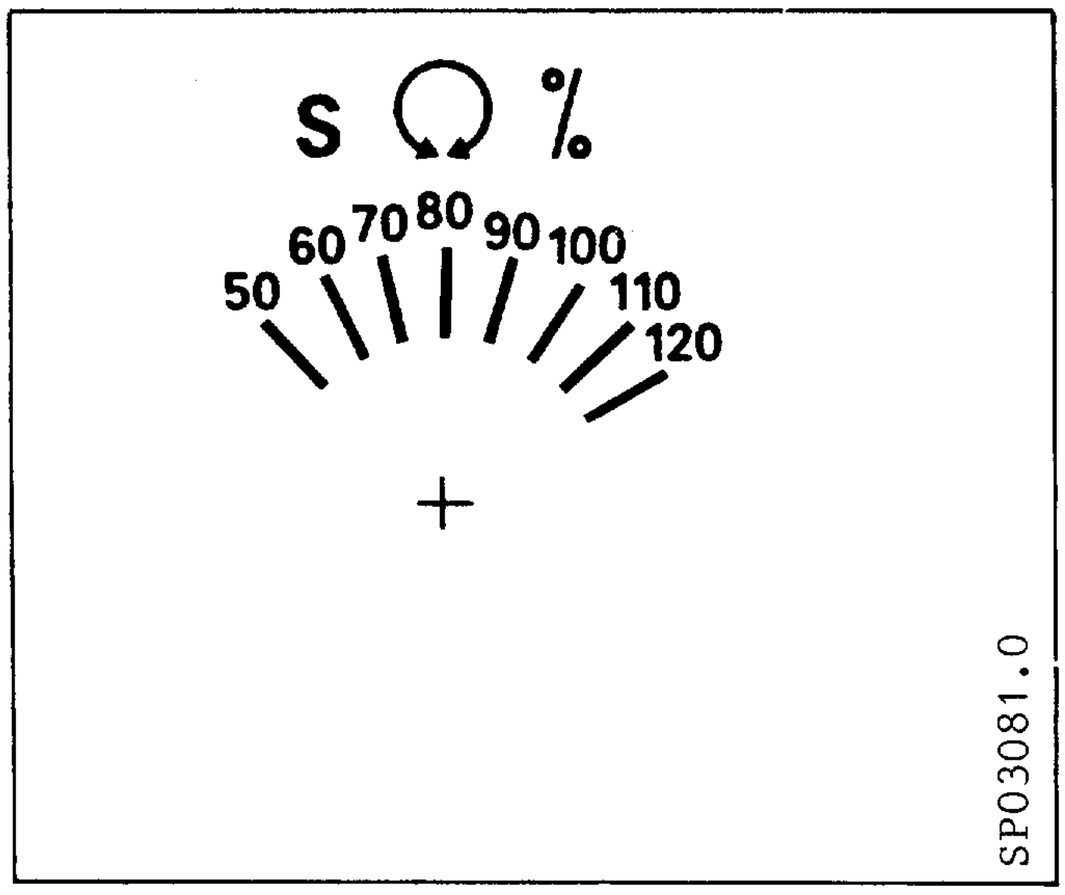


Selector switch markings

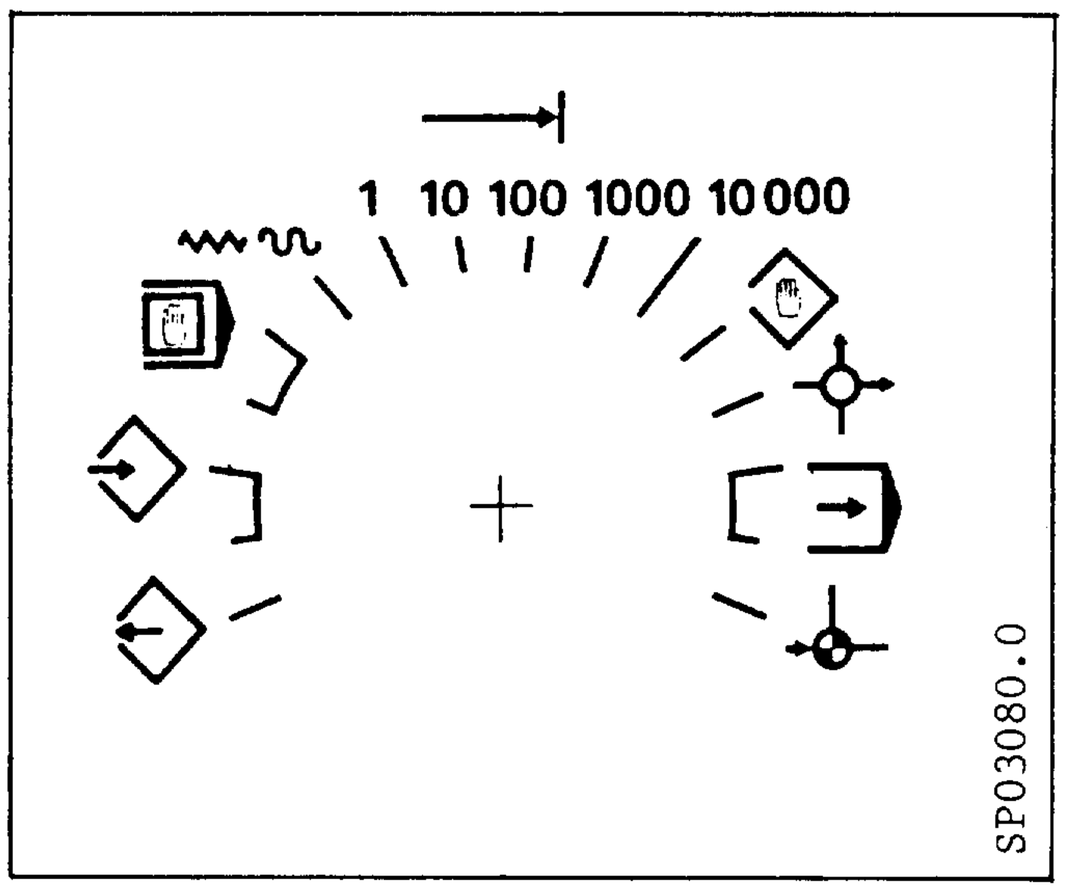
Feedrate override switch
15° notches



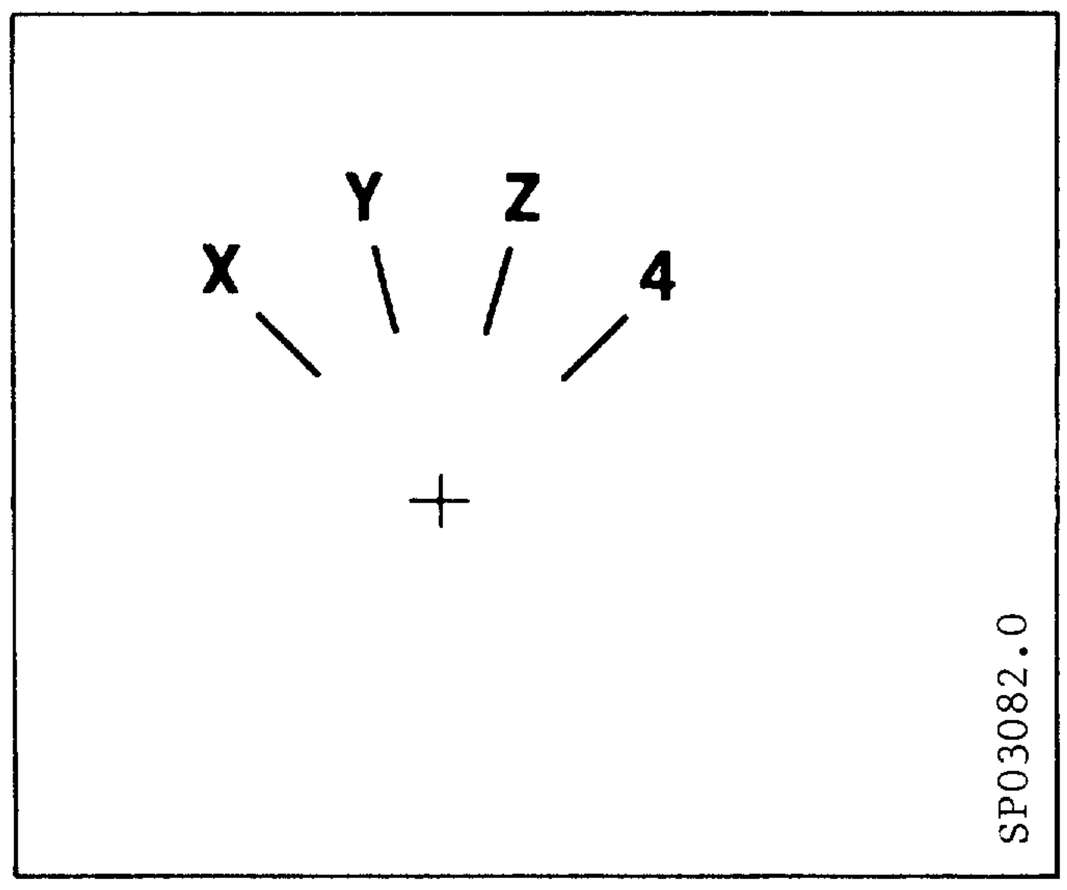
Spindle speed override switch on machine
control panel
15° notches



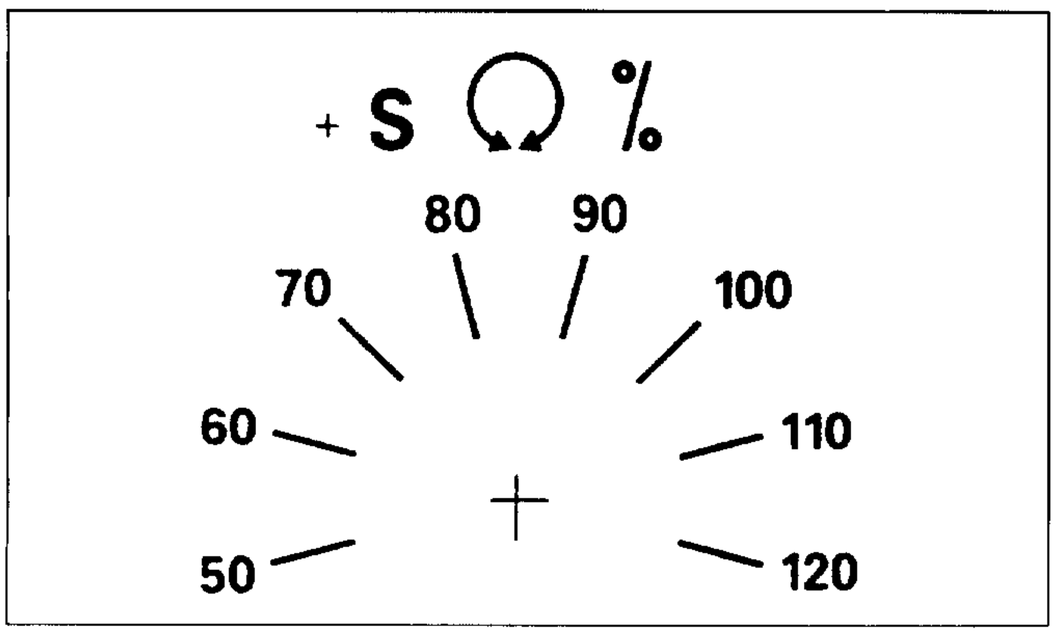
Operating mode switch
15° notches



Axis selector switch 3M
30° notches

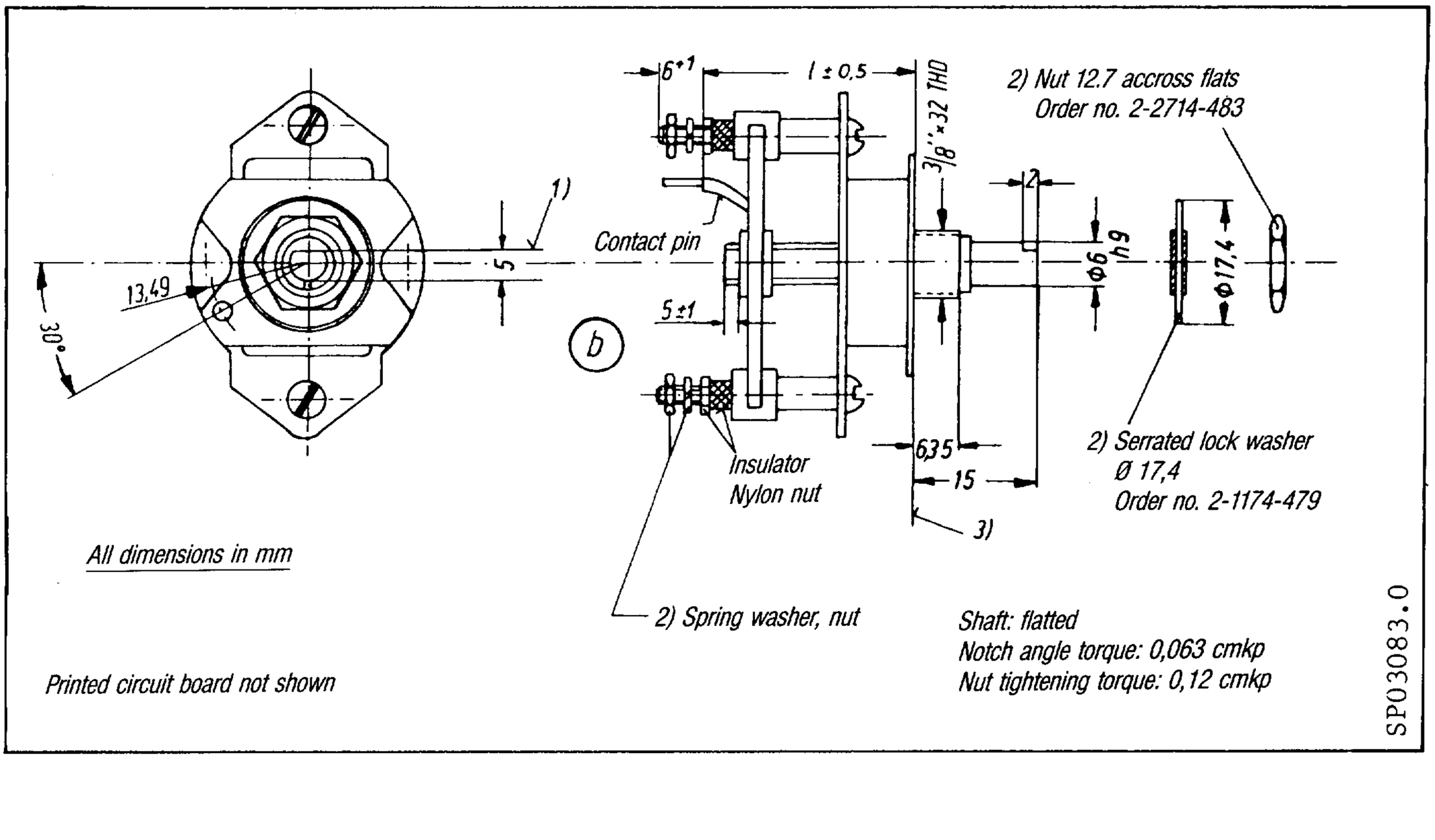


Spindle speed override switch on machine
control panel
30° notches



Siemens AG Order-No.: E80850-D27-X-A1-7600

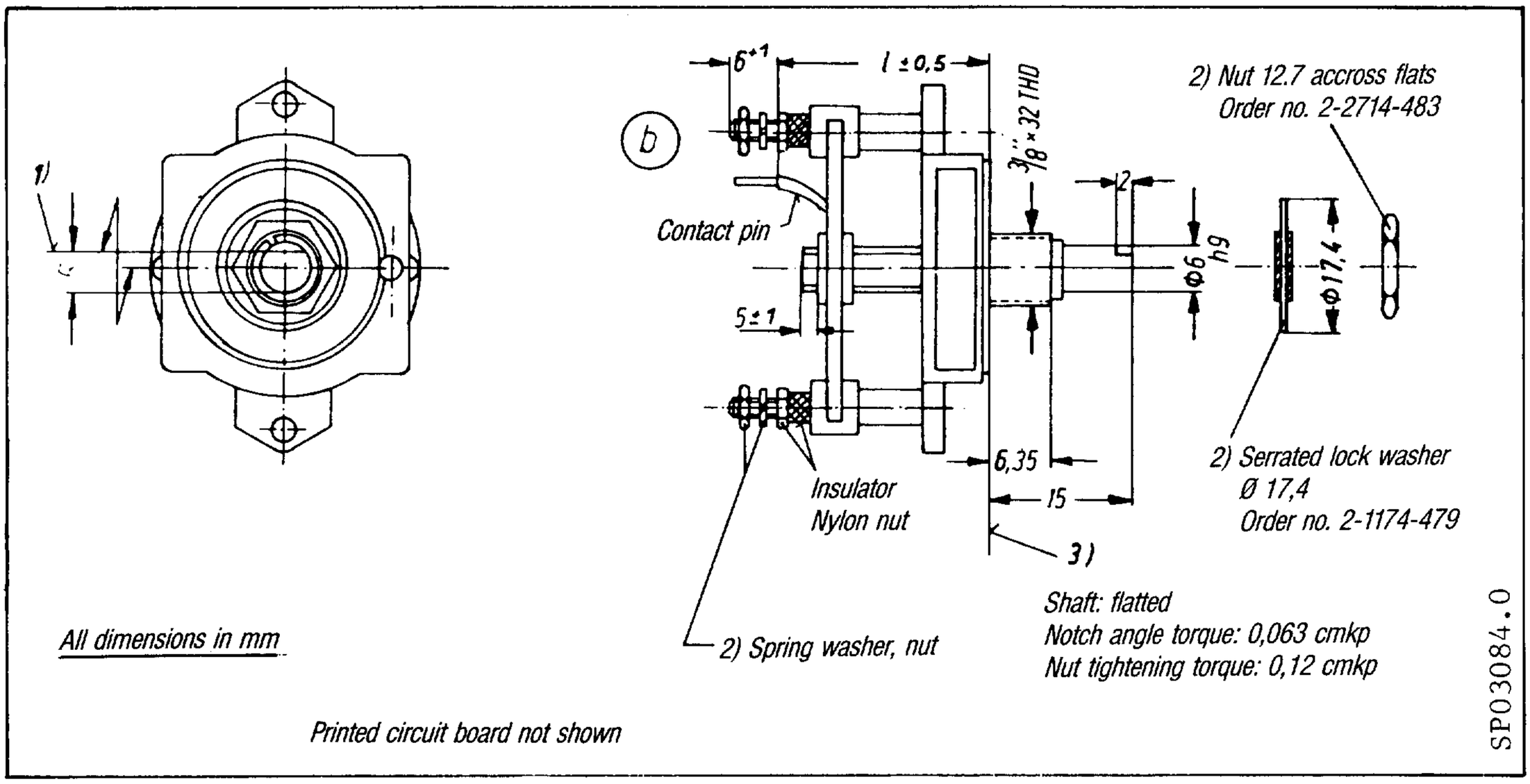
Dimension drawing of 30° selector switch without diode boards



	Axis selector switch 3M
End positions	3 and 15
Notch angle	30°
Dimension 1	21

All switches with overlapping contact arrangement

Dimension drawing of 15° selector switch without diode board



All dimensions in mm

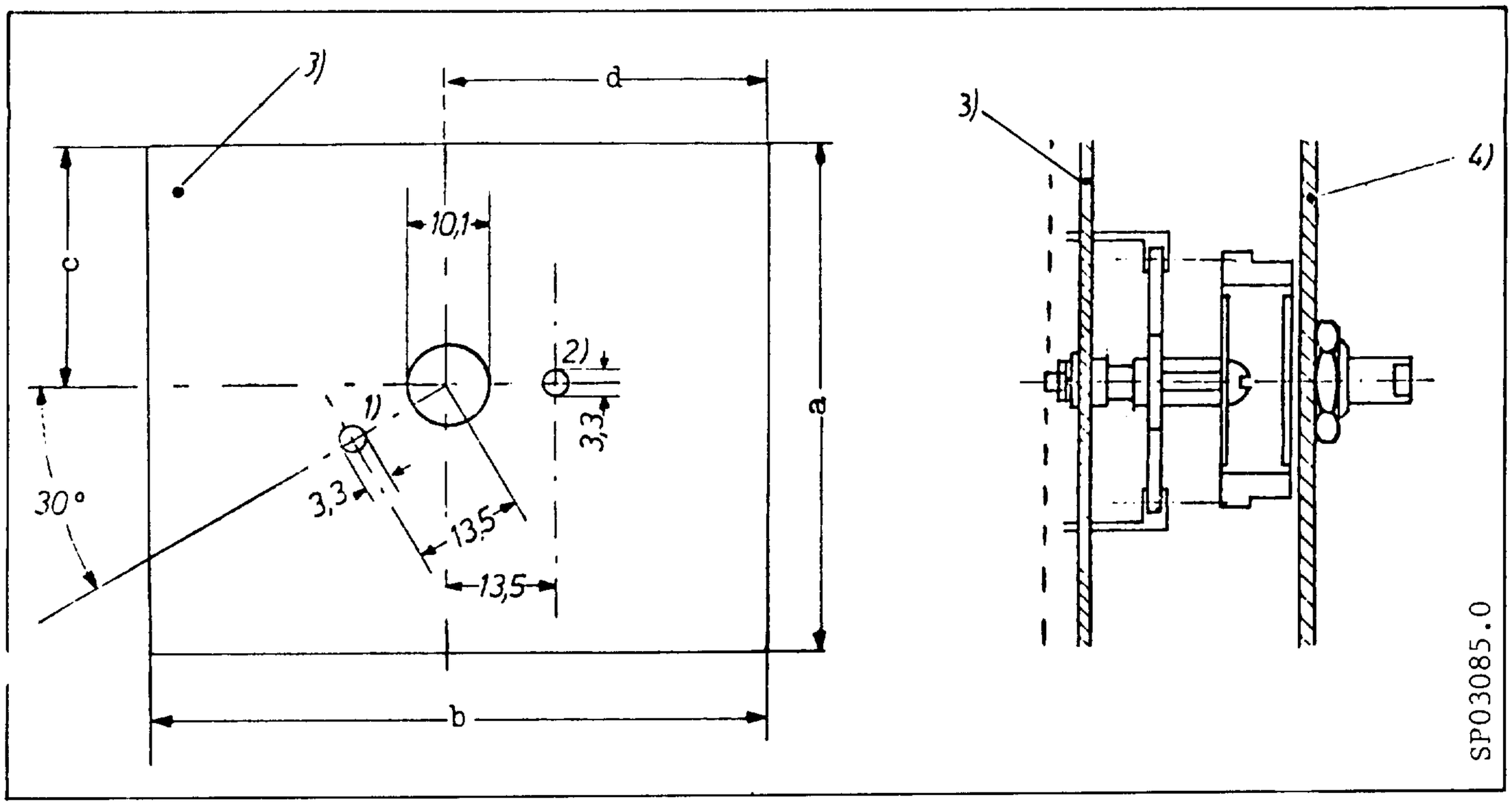
Printed circuit board not shown

	Feedrate override/ operating mode switch	Spindle speed override switch
End positions	1 and 31	1 and 15
Notch angle	15°	15°
Dimension 1	21	21

All switches with overlapping contact arrangement

Siemens AG Order-No.: E80850-D27-X-A1-7600

Dimension drawing of selector switches with diode board



1) Hole for locking element
30^{o}-notch switch

2) Hole for locking element
15^{o}-notch switch

3) Printed circuit board with diodes.
The switch is delivered complete
with the printed circuit board.

4) Front panel

Printed circuit board dimensions

Dimensions in mm	a	b	c	d
Operating mode switch	65	80	32	42
Axis selector switch (3M)	51	71	25	41
Feedrate override switch	65	80	32	42
Spindle speed override switch	65	80	32	42

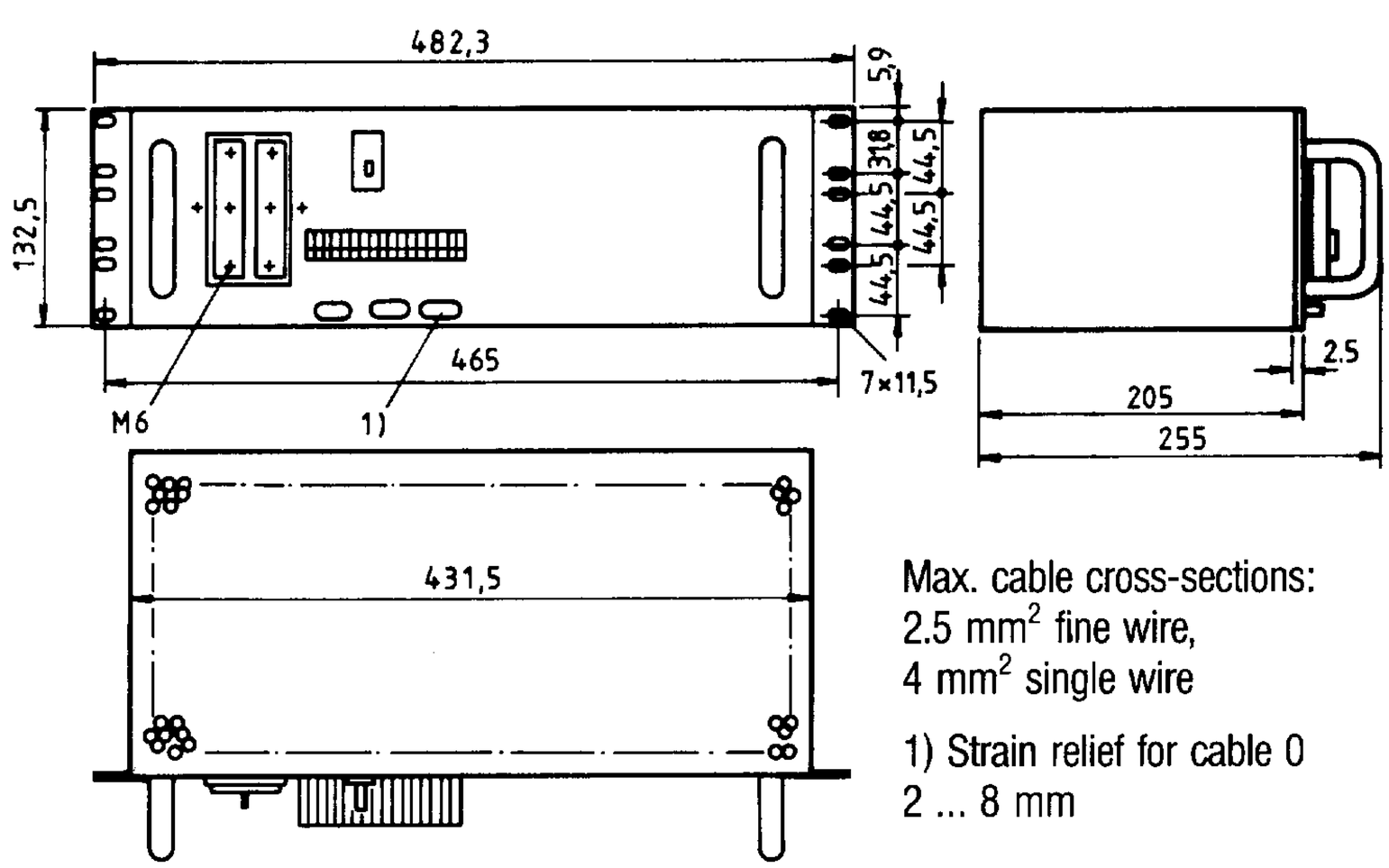
10. External equipment

10.1 Power pack component

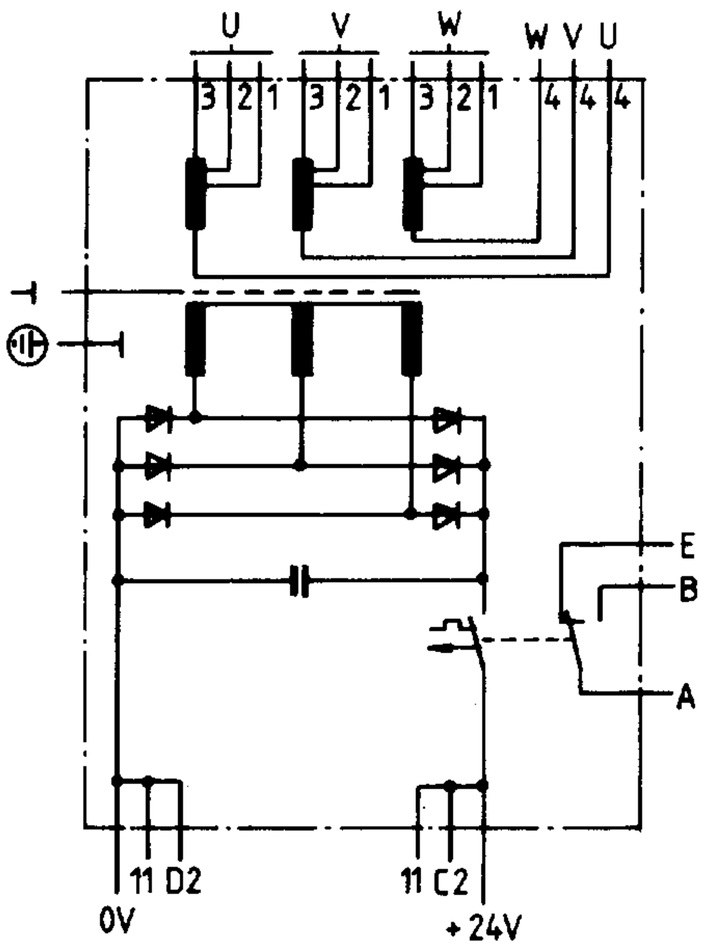
Type: 6EV1 352-5BK00 - 20 A
Order no.: 6FC9 304-0AC
Type: 6EV1 362-5BK00 - 40 A
Order no.: 6FC9 304-0AD

On this modified version, the star point has been opened and connected to terminals, to permit 3-phase connection to the Δ-voltages 220 V, 240 V, 254 V.

Dimension drawing



Circuit diagram

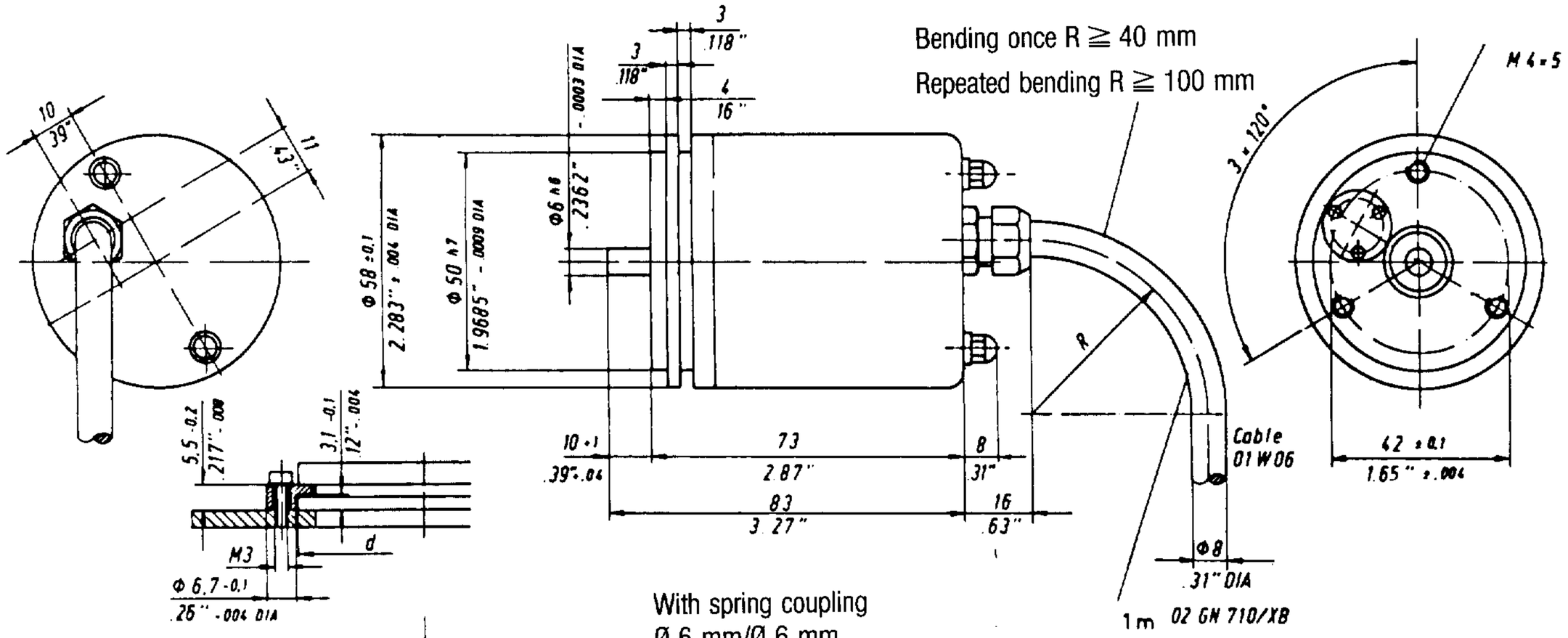


Connection	Terminal	Terminal jumper
220 V Δ	U1,V1,W1	U1-W4, V1-U4, W1-V4
240 V Δ	U2,V2,W2	U2-W4, V2-U4, W2-V4
254 V Δ	U3,V3,W3	U3-W4, V3-U4, W3-V4
380 V Y	U1,V1,W1	U4-V4-W4
415 V Y	U2,V2,W2	U4-V4-W4
440 V Y	U3,V3,W3	U4-V4-W4

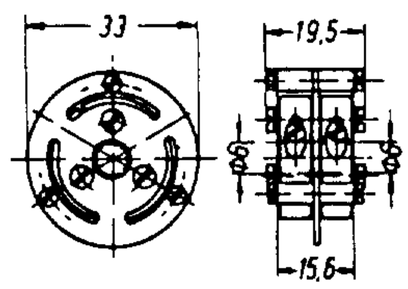
10.2 Incremental encoders

10.2.1 Rotary encoders

- Rotary encoder 6FC9 320-3C



With spring coupling
Ø 6 mm/Ø 6 mm
V23422-A008



Dimensions in mm

Cable length 1 m
with 12-pole connector

Souriau 8-40-30-008 +
8-40-31-570 (female)

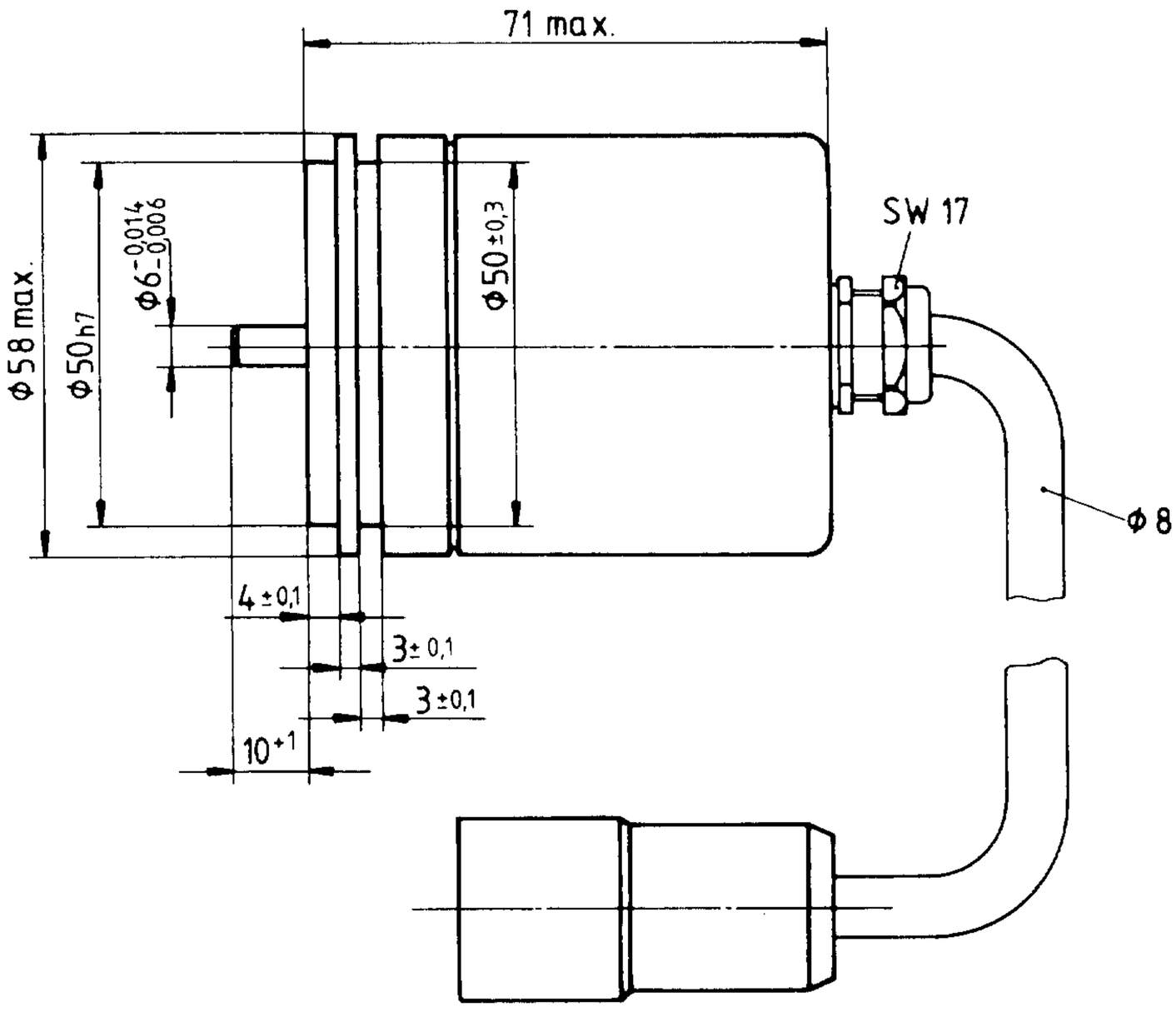
Mating connector:

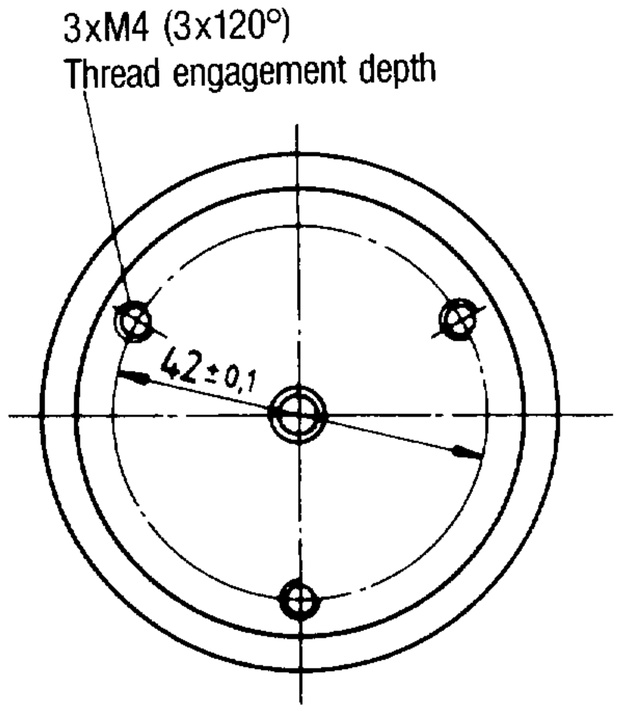
Souriau 8-40-30-008 +
8-40-31-830 (male)

(not included in delivery specification)

Degree of protection: IP 54 acc. to DIN 40050

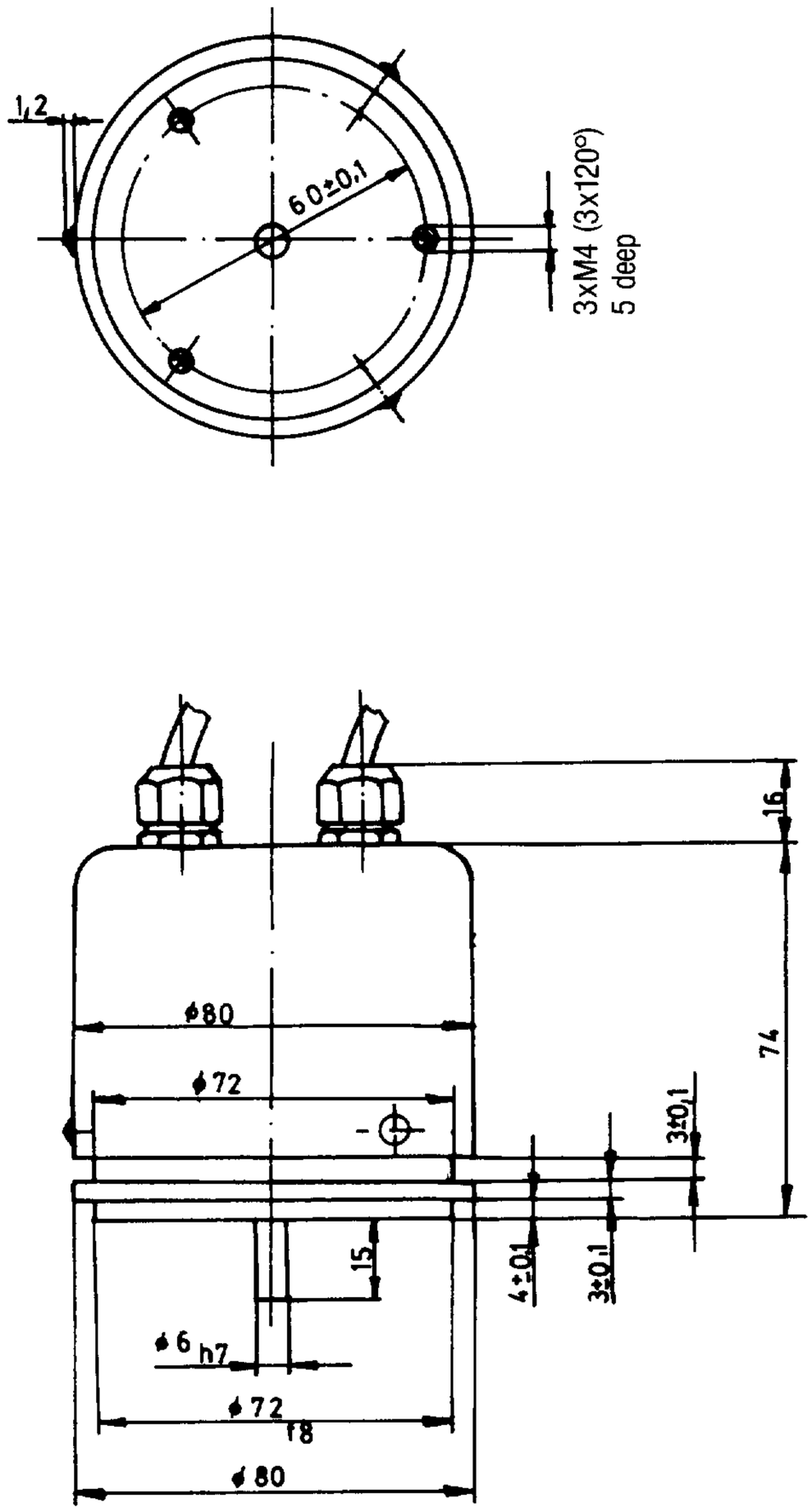
- Rotary encoder 6FC9 320-3K from 6.86 onwards





10.2.2 Combined rotary encoder for spindle and C axis

6FC9 320-1EA



Cable length 1 m with 12-pole Souriau connector. The cable ends are marked with the corresponding pulse numbers.

10.2.2.1 Table for input and output resolution

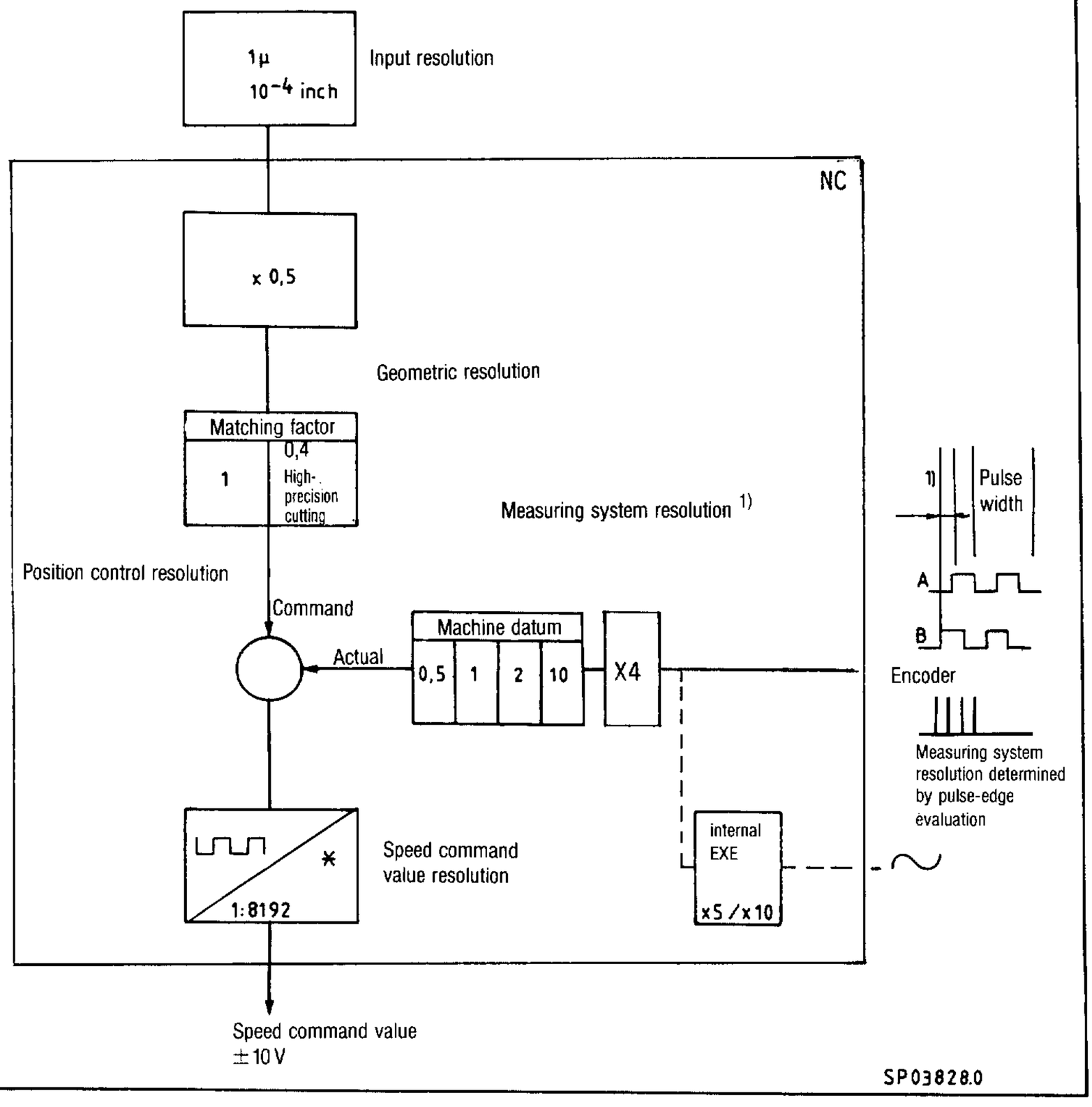
Input resolution / Geometric resolution = 0.5. input resolution	V-max theoret. 1) 3T	V-max theoret. 1) 3T+C 3M	Position control resolution	Actual value resolution: Software factor mach. dat.	Measuring system resolution x4: Pulse edge spacing [µ]	Measuring system resolution x4: Pulse width track A/B [µ]	Examples Vmax at encoder freque 100 kHz [m/min]	Examples Vmax at encoder freque 125 kHz [m/min]	Position feedback encoder: Lenear measuring System: Grid constant in (µ) with EXE x1	EXE x5	EXE x10	EXE x25	Incremental shaft encoder: Leadscrew pitch / pinion rotation in (mm/rev) with encoder resolution: without EXE: 2000 p/rev	without EXE: 2500 p/rev	without EXE: 5000 p/rev	with 5x EXE: 2000 p/rev	with 5x EXE: 2500 p/rev	with 5x EXE: 5000 p/rev
	[m/min]	[m/min]		0.5	0.25	1	6	7.5			10		2		5	10		
	61.4	54.6	0.5µ	1	0.5	2	12	15		10	20		4	5	10	20		
				2	1	4	24	30		20	40	100	8	10	20			
				5	2.5	10	60	72	10		100		20			100		
				10	5	20	120	150	20	100	200				100			
				20	10	40	240	300						100				
	[m/min]	[m/min]		0.5	0.1	0.4	2.4	3				10			2	4	5	10
1µ	24.6	21.9	0.2µ 2)	1	0.2	0.8	4.8	6				20		2	4	8	10	20
				2	0.4	1.6	9.6	12				40		4	8		20	
				5	1	4	24	30				100	8	10	20			100
				10	2	8	48	60						20			100	
				20	4	16	96	120										
$1 \cdot 10^{-4}$ inch	$[10^3 \frac{\text{inch}}{\text{min}}]$	$[10^3 \frac{\text{inch}}{\text{min}}]$			$[10^{-4}/\text{inch}]$	$[10^{-4}/\text{inch}]$	$[10^3 \frac{\text{inch}}{\text{min}}]$	$[10^3 \frac{\text{inch}}{\text{min}}]$					(inch/rev)	(inch/rev)	(inch/rev)	(inch/rev)	(inch/rev)	(inch/rev)
	2.4 (61.4)	2.1 (54.6)	$0.5 \cdot 10^{-4}$ inch	0.5	0.25	1	0.6 (15)	0.75 (19)					0.2 (5,08)	0.25 (6,35)	0.5 (12,7)	1 (25,4)		
				1	0.5	2	1.2 (30)	1.5 (38)					0.4 (10,6)	0.5 (12,7)	1 (25,4)			5 (127)
				2	1	4	2.4 (60)	3 (76)					0.8 (21,2)	1 (25,4)		4 (106)	5 (127)	
	6.14 (156)	5.4 (138)		5	2.5	10	6 (150)	7.5 (190)							5 (127)			
				10	5	20	12 (350)	15 (380)					4 (106)	5 (127)				
				20	10	40	24 (600)	30 (760)										

Encoder selection:

$$\text{Encoder pulse number} = \frac{\text{Leadscrew pitch (mm)}}{[\text{measuring system resolution (mm)} \cdot 4]}$$

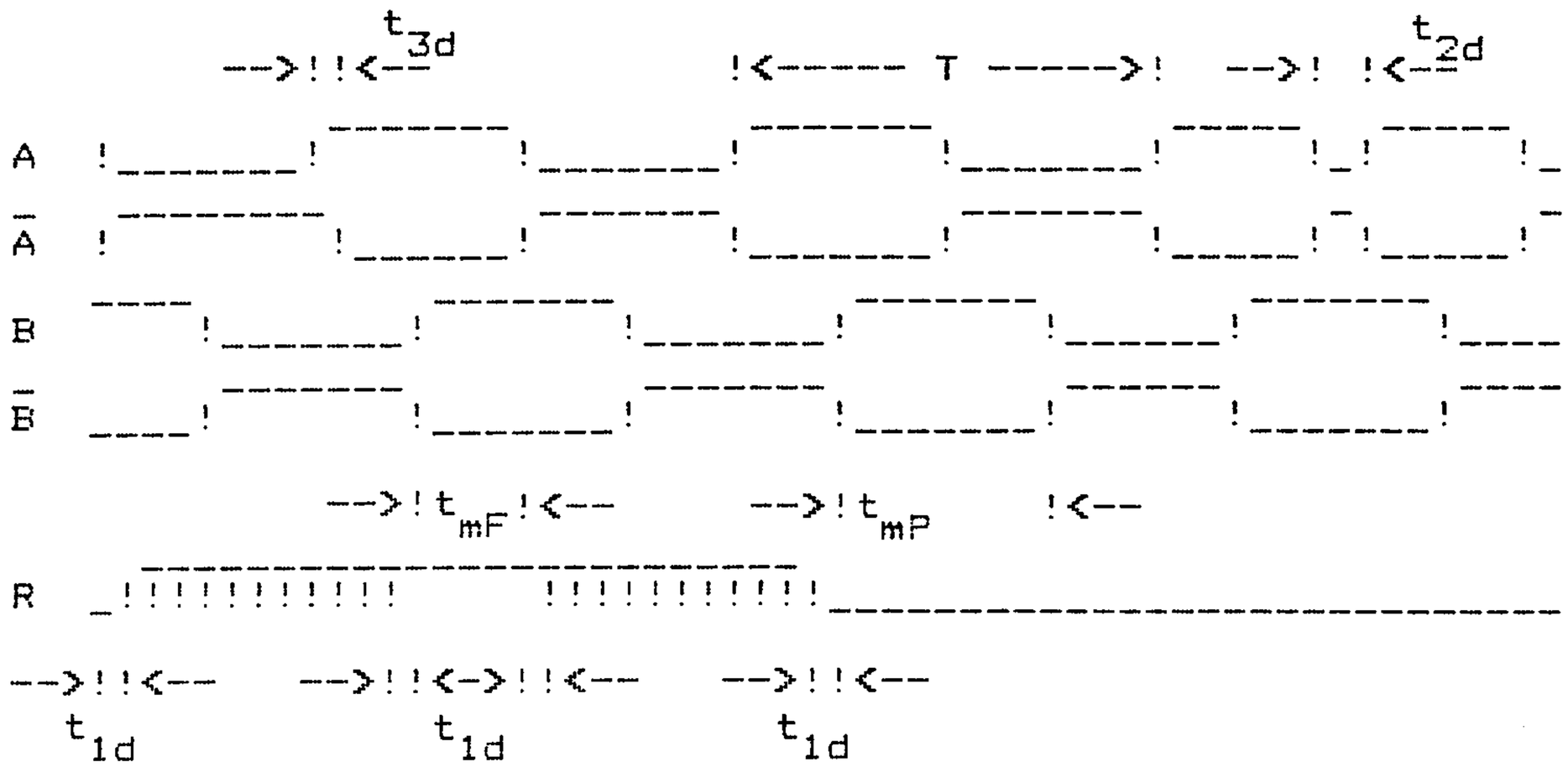
1) Vmax depends on encoder and measuring circuit (measuring circuit 500 kHz, EXE external ≤ 50 kHz, EXE external 5x 25 kHz, EXE internal 10x 12 kHz)
2) Option E44 (high-precision cutting)

Definitions



Data sheet for interface, measuring circuit, actual value, digital

Connector no.					
Signal type (DIN...)				Diff.-Tr.	
Encoder power supply					
- Short-circuit protection				No	
		DES.	MIN.	TYPE MAX.	UNIT
Encoder power supply					
- Voltage			+4.75	+5.0 +5.25	V
- Ripple				100	mVss
- Current per encoder				300	mA
Input voltage					
- Positive (TTL)			-	-	V
- Negative (TTL)			-	-	V
- Difference			1.0	10	V
- Perm. common-mode range			-2.0	+5.0	V
Input current					
- Current "H"			-	- 10	mA
- Current "L"			-	- 10	mA
Inputs					
- Frequency with 90°el A-B		1/T		500	kHz
- Pulse width		t_{mP}	1.0		us
- Edge steepness			5.0	-	V/us
- Edge spacing		t_{mF}	0.5		us
- Edge spacing ref. signal		t_{1d}	-	0.2	us
- Edge spacing (change)		t_{2d}	0.5		us
- Edge skew		t_{3d}		-	us
- Interference immunity (DIN 57847)				3	kV
Interference signal - width				-	us
Interference energy				-	uWs
Length of lead to encoder when using SINUMERIK cables				50	m



Data sheet for interface, actual value with EXE

Connector no.				
Signal type (DIN...)			Sinusoidal current	
Encoder power supply				
- Short-circuit protection			No	
	DES.	MIN.	TYPE	MAX.	UNIT
Encoder power supply					
- Voltage		+4.75	+5.0	+5.25	V
- Ripple				100	mVss
- Current per encoder				300	mA
Input voltage					
- Tracks A and B		0.007		0.016	mA
- Ref. mark		0.002		0.009	mA
- Direct component				6.5	%
- Amplitude difference				20	%
Inputs					
- Frequency with 90^{o} el A-B				25(12)	kHz
- Phase displacement A to B		80	90	100	^{o}el
- Phase displacement ref. mark to A		45	135	405	^{o}el
- Interference immunity (DIN 57847)				3	kV
Length of lead to encoder when using SINUMERIK cables				20	m

Input schematic

Resolution
Max. 0.0001° (0.36") with 36,000 segments, 25x interpolation and 4x evaluation

Power supply
+ 5 V

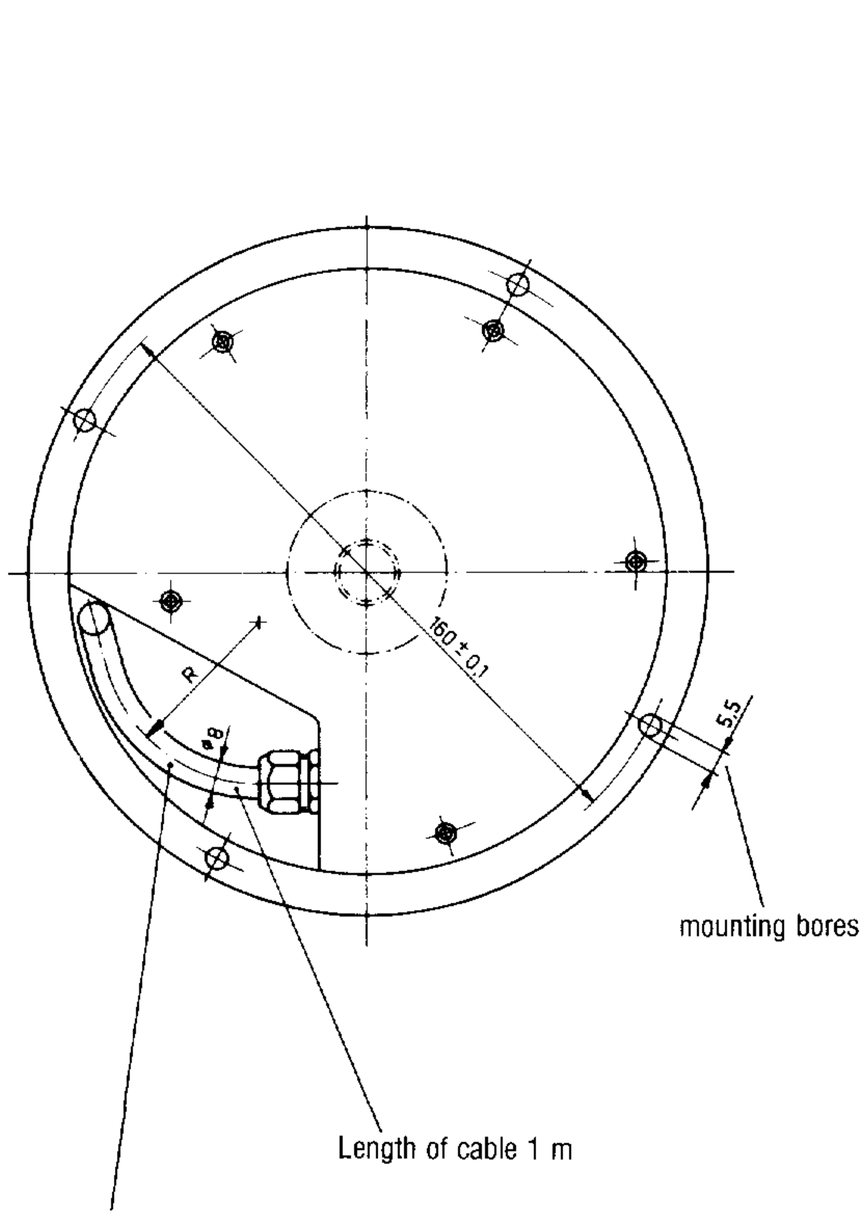
Output signals
Sinusoidal

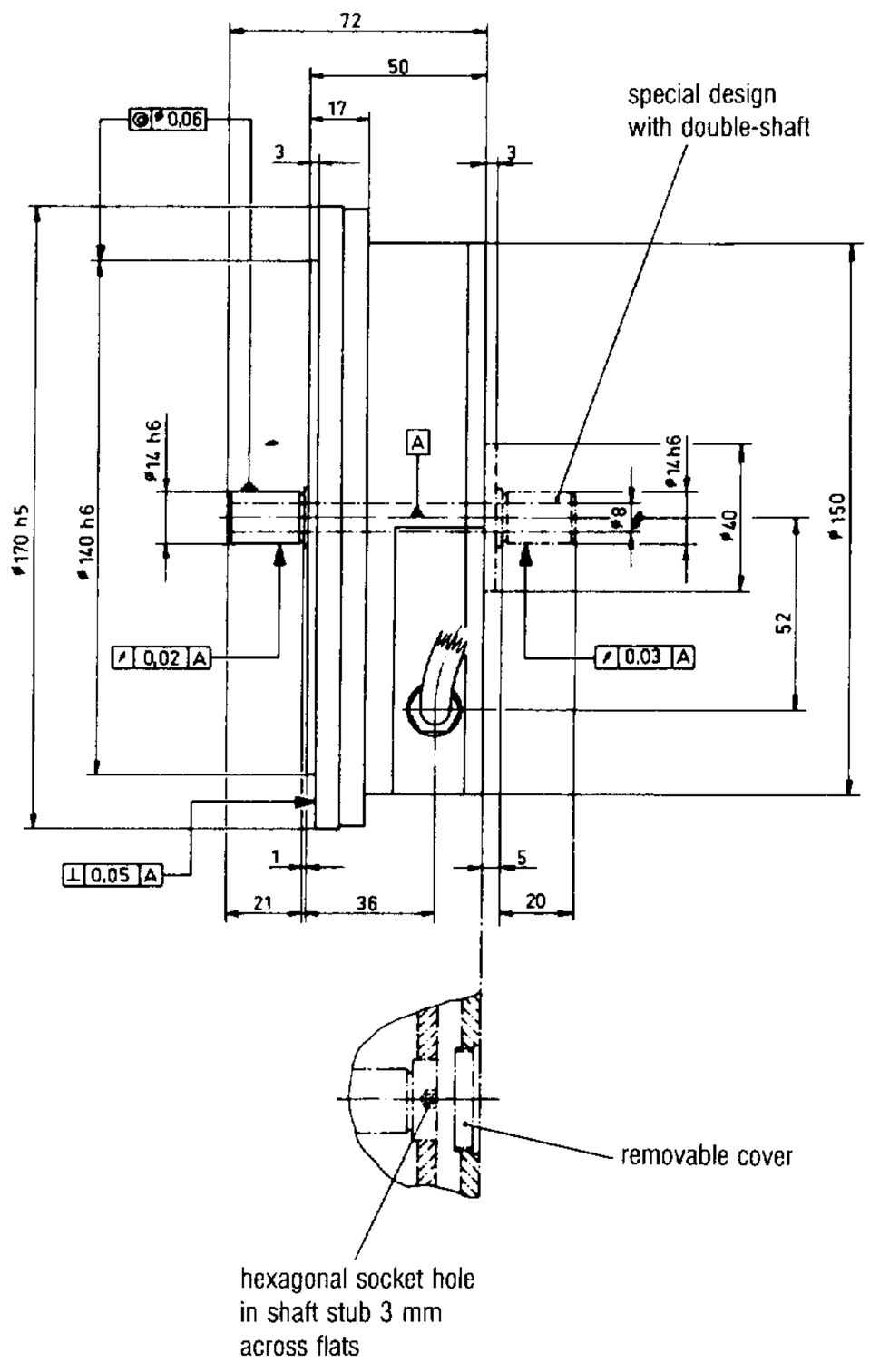
Reference signal
Standard

Pulse shaper electronics
External (see >Counter< or >EXE<)

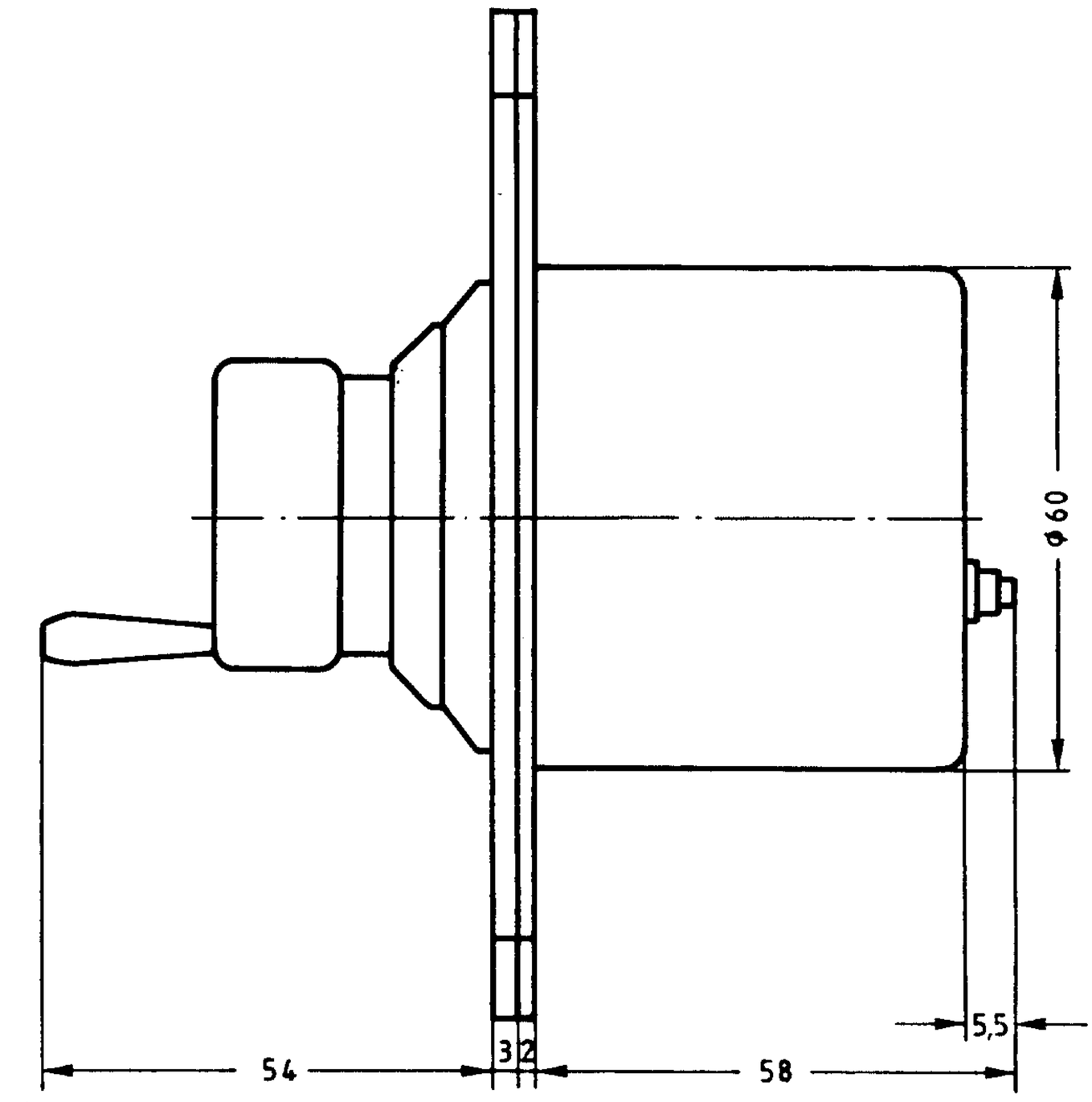
Mechanical design
Flat construction, high shaft load, straight-through shaft on request, radial or axial cable outlet

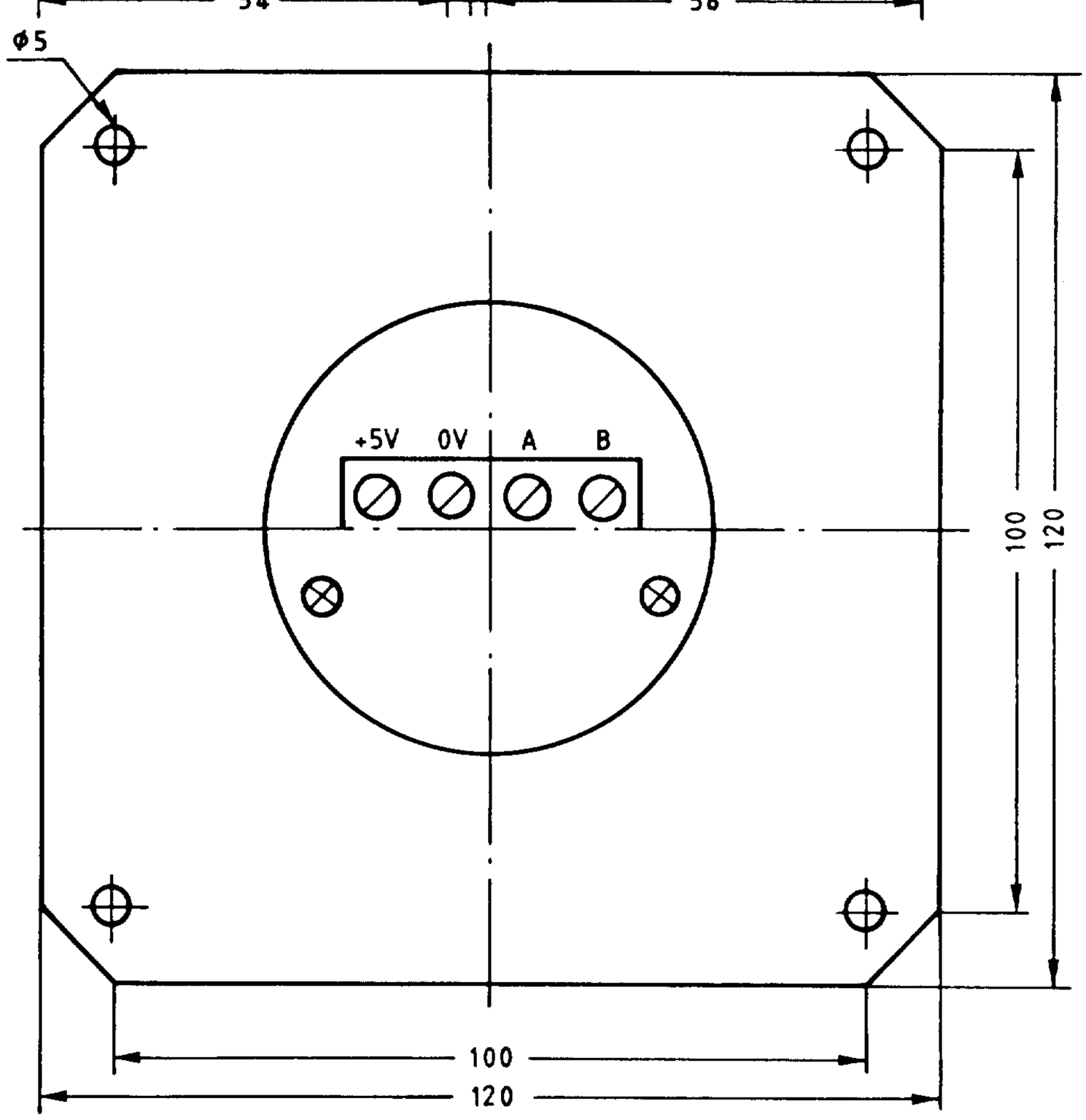
High precision





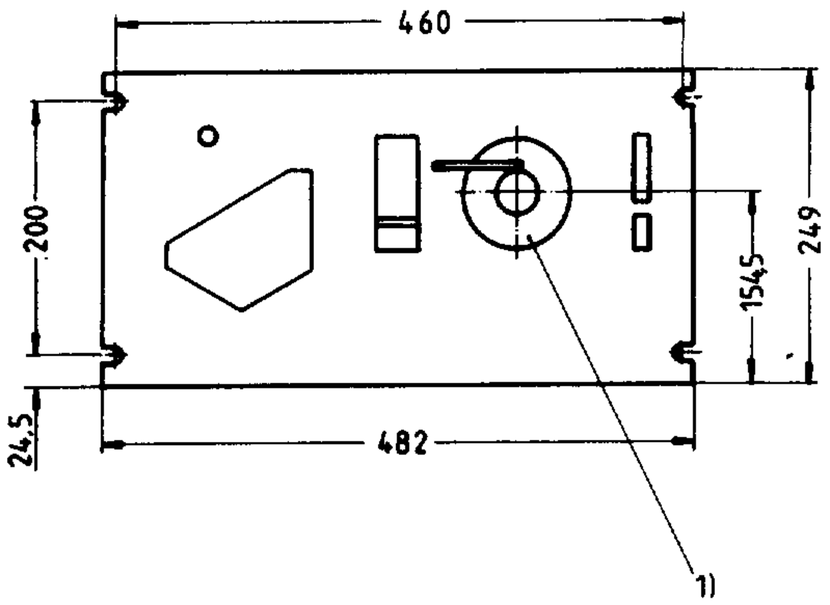
10.3 Handwheel Dimensions in mm

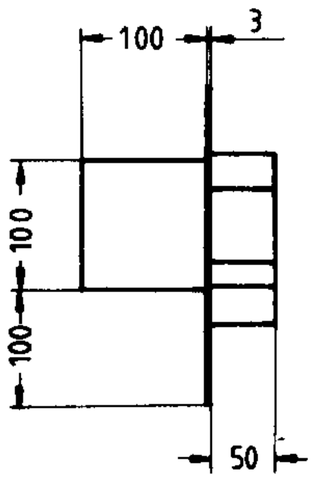


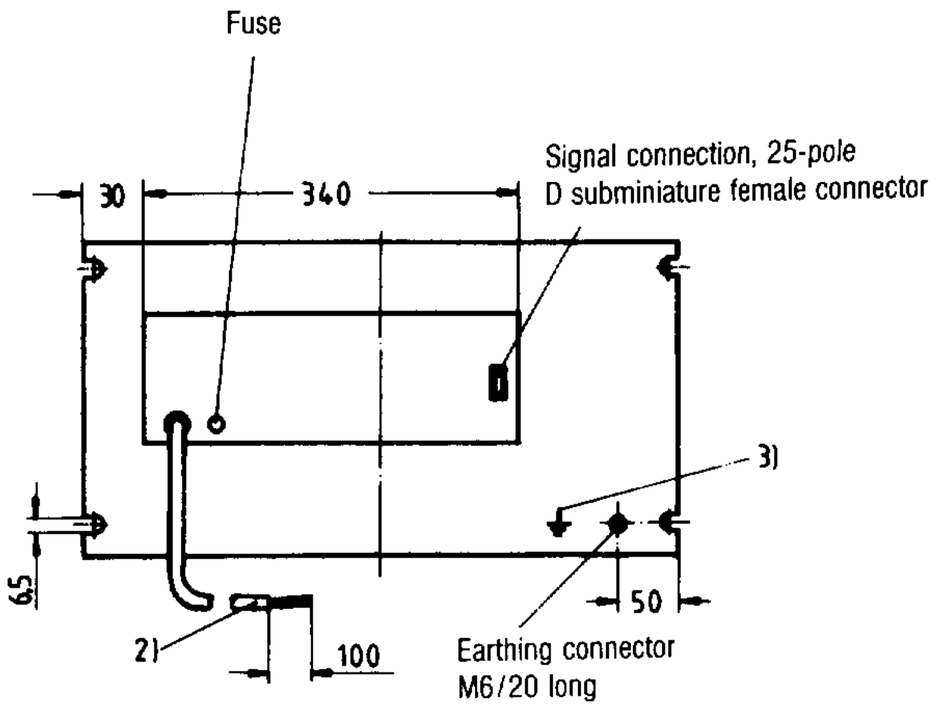


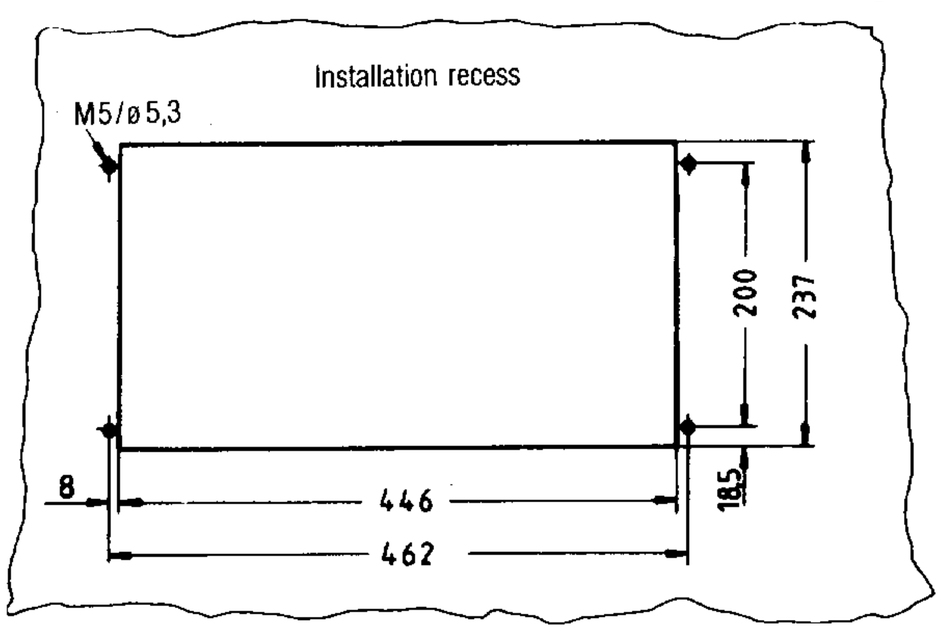
10.4 Tape reader

10.4.1 Tape reader with draw-in reel T40







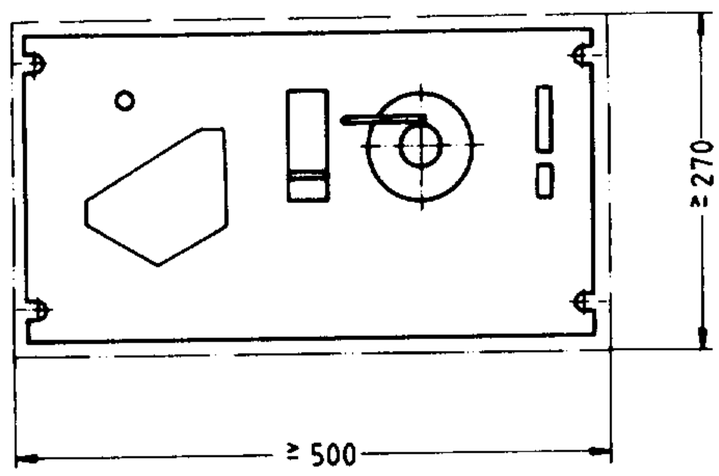


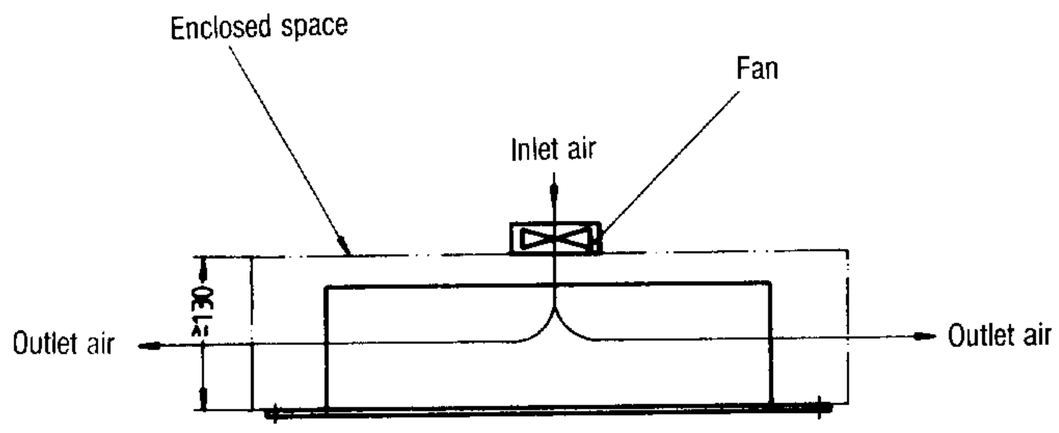
1) Rubber ring for endless loop included

2) Mains cable 1.5 m long, free wires with end ferrules

3) Earth symbol DIN 30600 acc. to DIN 40011 Suppl. 8

Recommended configuration





Installation

a) For enclosed installation without additional ventilation: required volume of enclosed space 0.6 m^3

b) For enclosed installation with internal air turbulence (additional fan): required volume of enclosed space 0.3 m^3

c) With through ventilation:
Required airflow ≥ 65 m^3/h
The intake air must be clean

Temperature in enclosed space ≤ + 55°C

Max. power loss 30 Watt

Max. intake air and ambient temperature during operation + 55°C

Ambient storage temperature - 40 to + 70°C

Max. temperature fluctuation 1.1 K/min

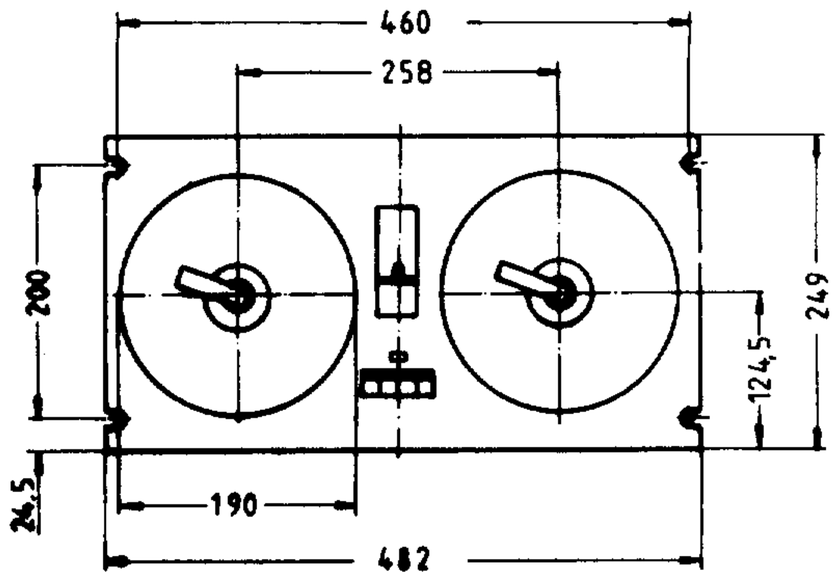
Permissible humidity: class F according to DIN 40040

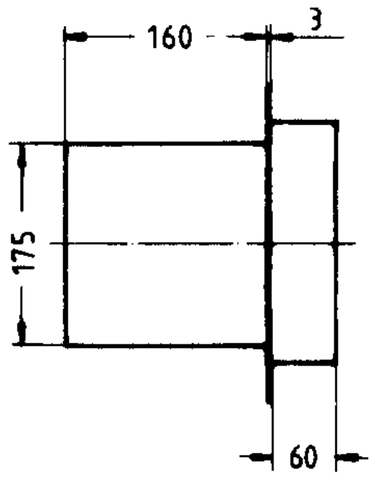
The intake air must be free of aggressive gases

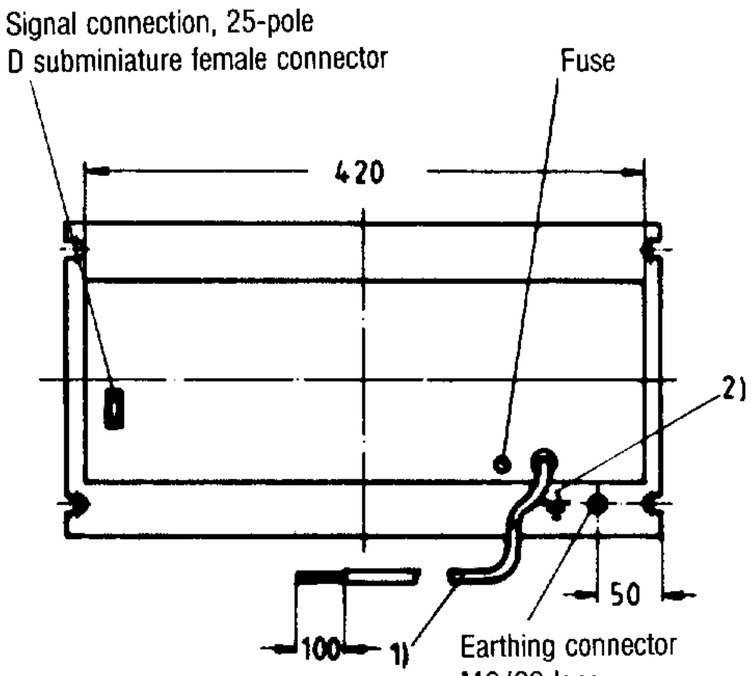
Degree of protection: IP00 according to DIN 40050

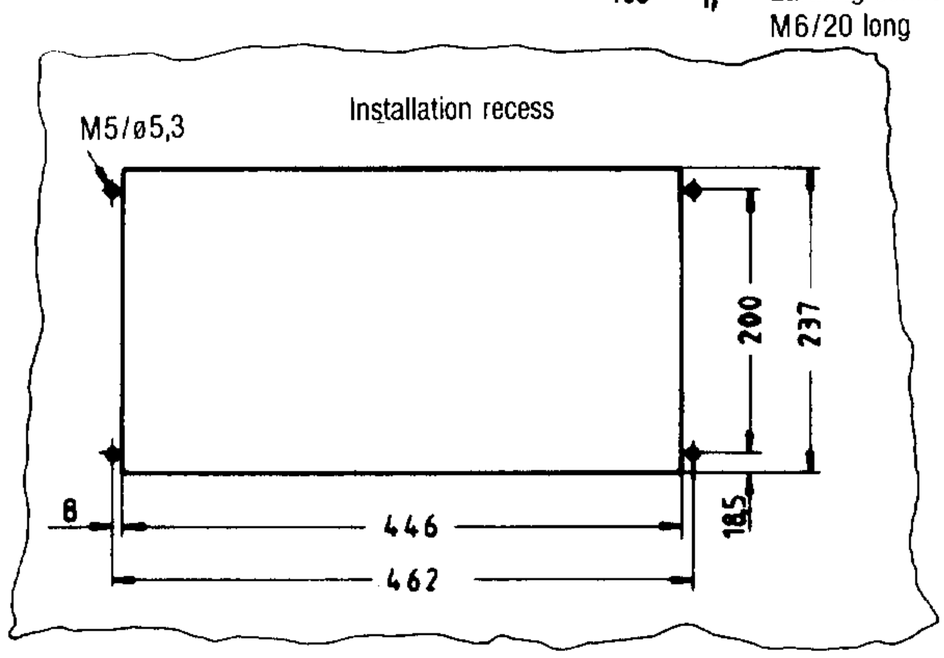
Vibration resistance: severity 12 according to SN 29010

10.4.2 Tape reader with winder T50





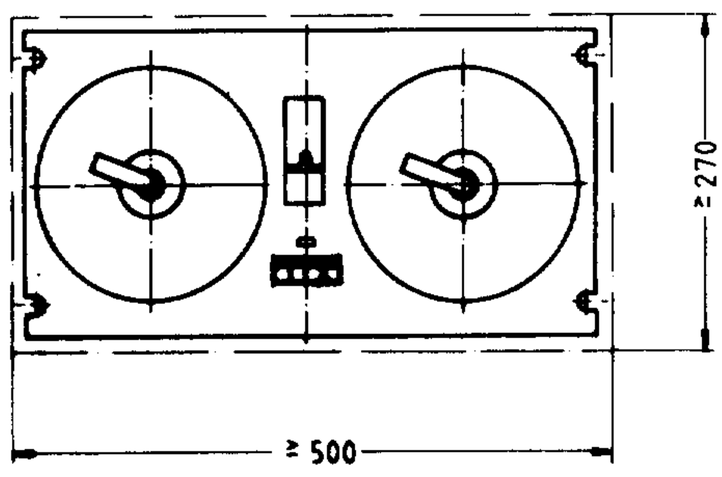


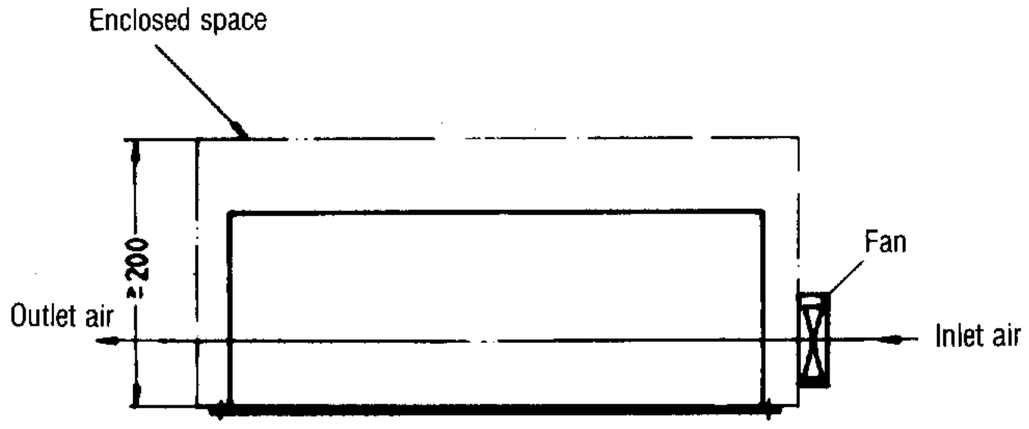


1) Mains cable 1.5 m long, free wires with end ferrules

2) Earth symbol DIN 30600 acc. to DIN 40011 Suppl. 8

Recommended configuration





Installation

a) For enclosed installation without additional ventilation: required volume of enclosed space 2.2 m^3

b) For enclosed installation with internal air turbulence (additional fan): required volume of enclosed space 1.1 m^3

c) With through ventilation:
Required airflow ≥ 65 m^3/h
The intake air must be clean

Temperature in enclosed space ≤ + 55°C

Max. power loss 110 Watt

Max. intake air and ambient temperature during operation + 55°C

Ambient storage temperature - 40 to + 70°C

Max. temperature fluctuation 1.1 K/min

Permissible humidity: class F according to DIN 40040

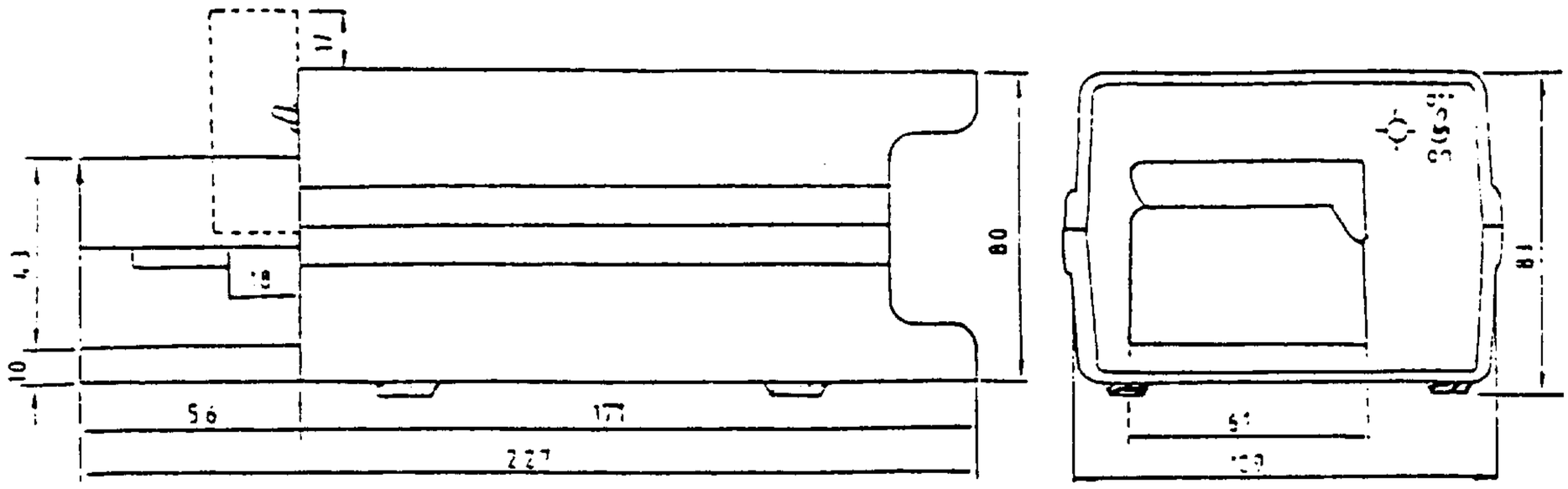
The intake air must be free of aggressive gases

Degree of protection: IP00 according to DIN 40050

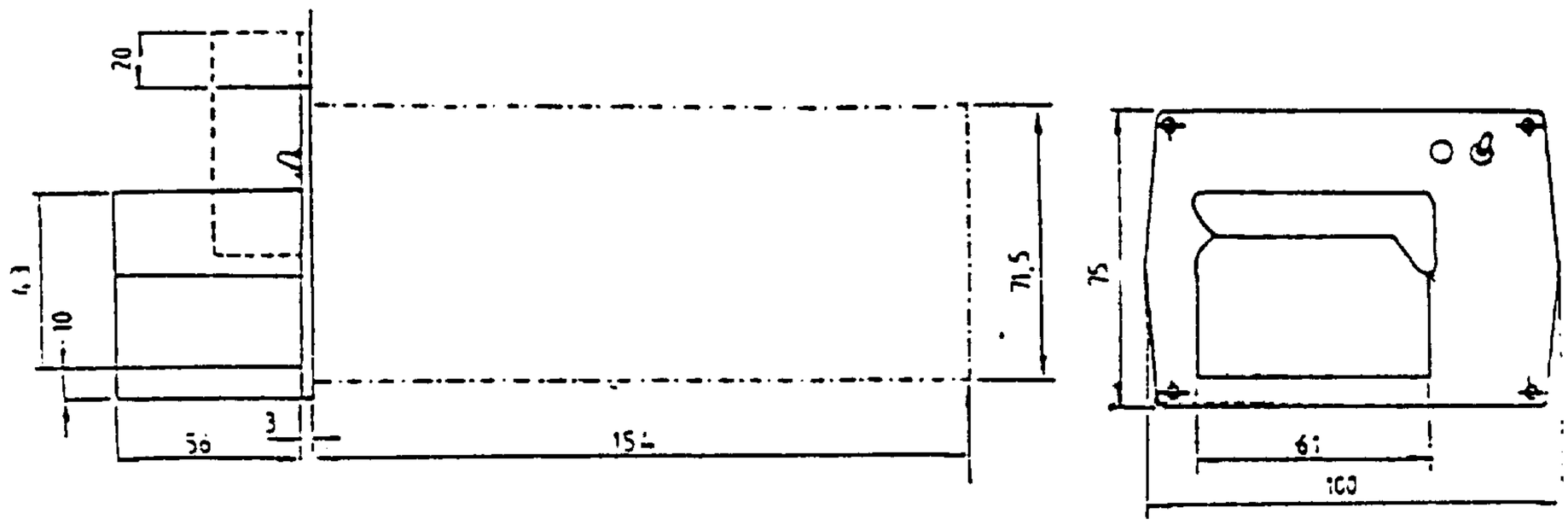
Vibration resistance: severity 12 according to SN 29010

Siemens AG Order-No.: E80850-D27-X-A1-7600

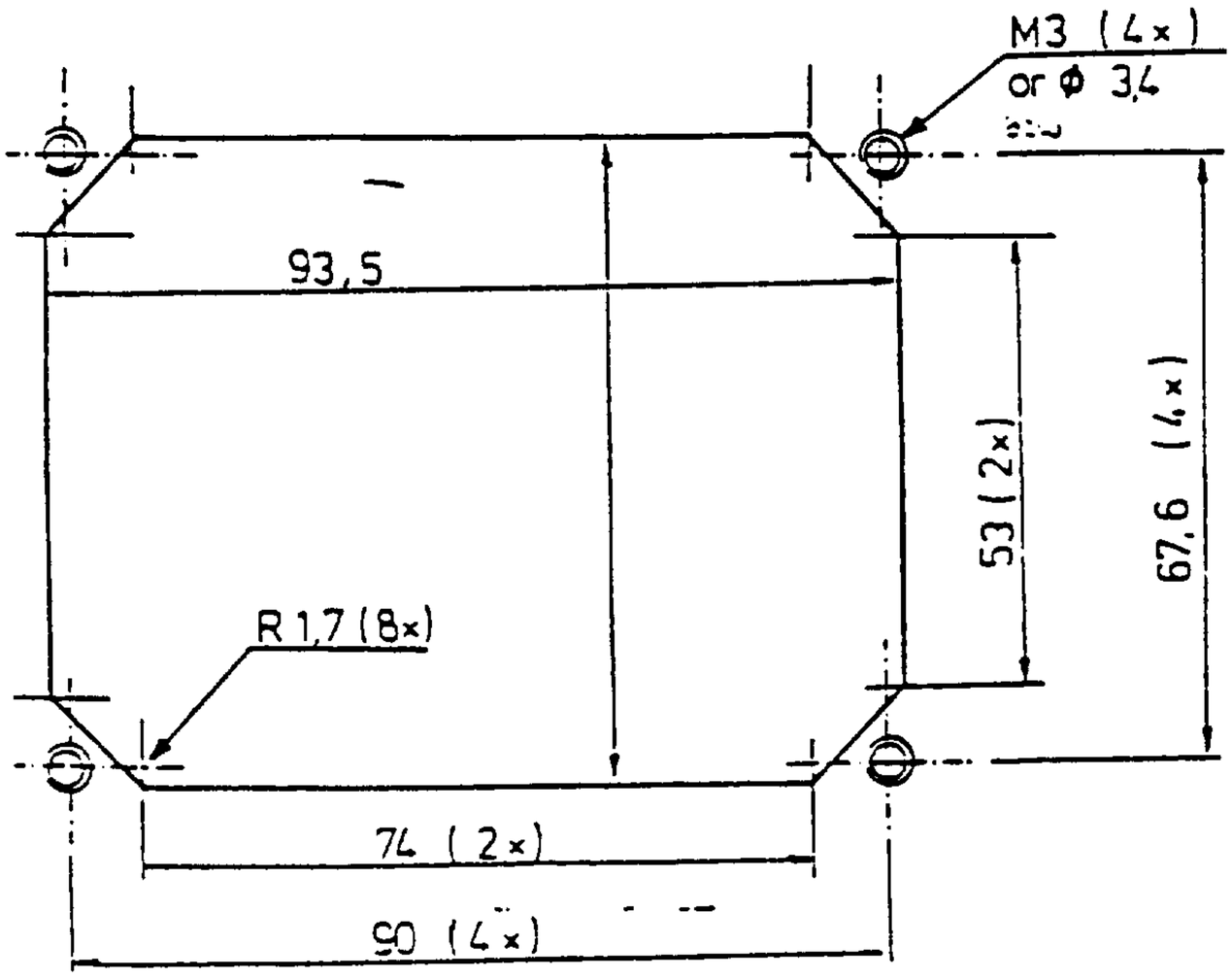
10.4.3 Portable tape reader without winder, reader T60



Portable version



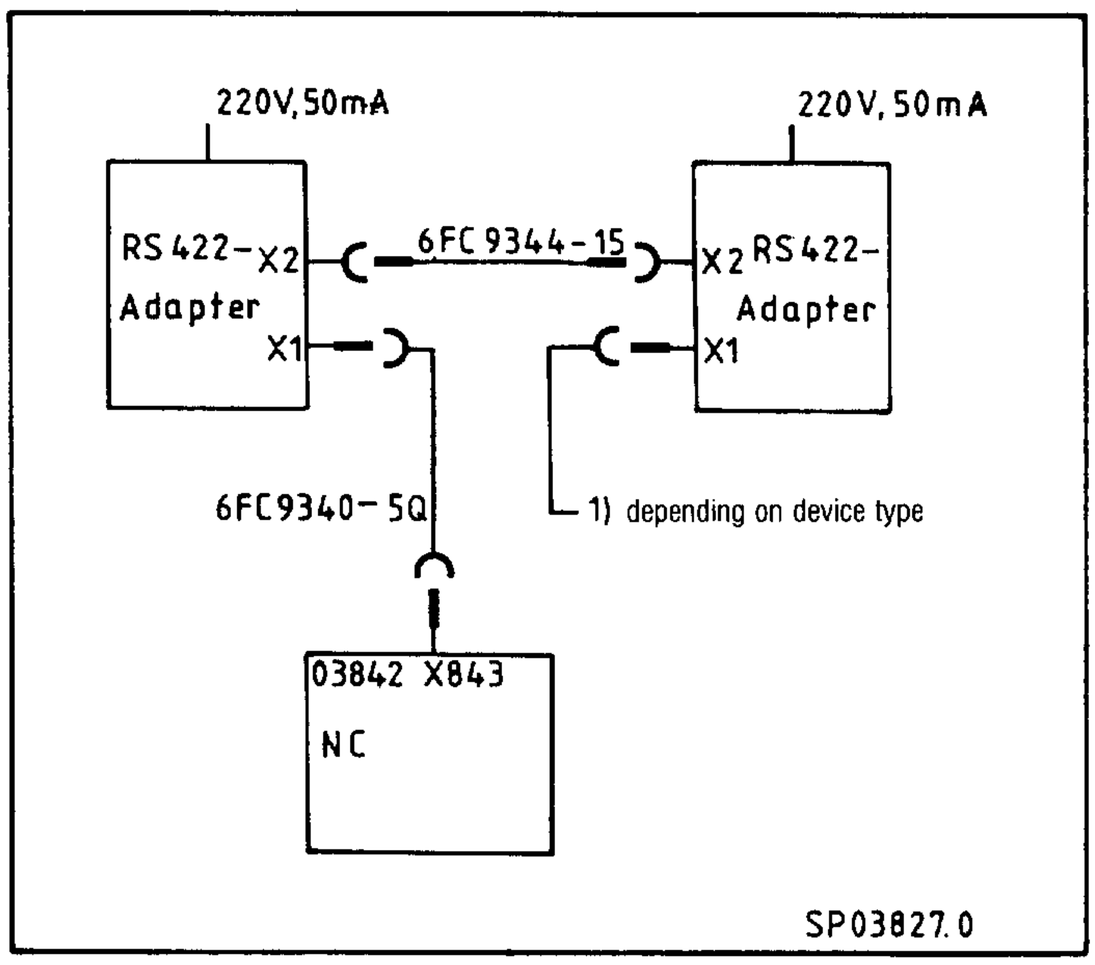
Built-in version, with housing removed



Installation recess for T60

10.5 RS422 remote adapter

As far as signal functions are concerned, the RS422 interface is identical to the V.24 (RS232) interface. Instead of the V.24 controller, however, signals are transferred via two-wire cables by means of a differential driver and differential receiver.
The RS422 interface combines the advantages of a V.24 (RS232) interface (modem capability with control signals) with those of a 20 mA interface (long transmission links).

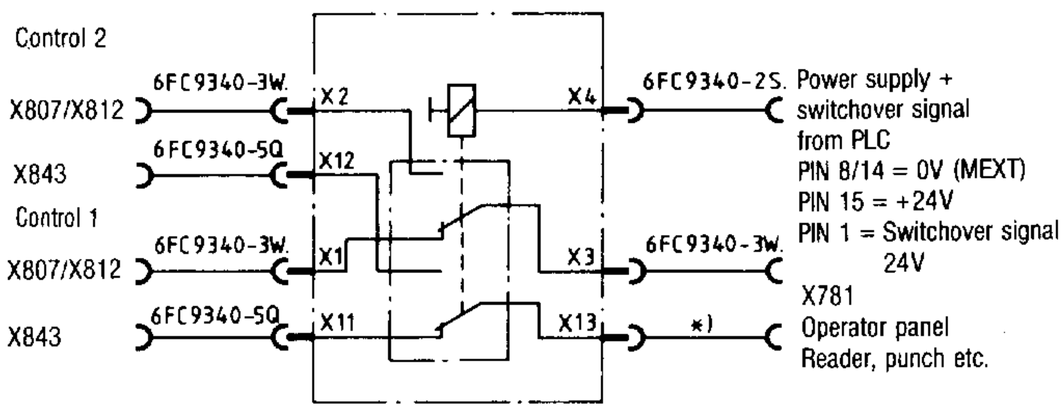


Siemens AG Order-No.: E80850-D27-X-A1-7600

10.6 Operator panel switching unit Option B06

This switching unit includes a module with relay switchover contacts for the operator panel and serial standard interface (V.24 or 20 mA) signals. (See dimension drawing in Section 11.6 for dimensions and connection assignment.)

10.6.1 Connection of switching unit



Power consumption 24V 800mA max.
Switchover signal 24V 32mA

*) Connecting cable acc. to device:
6FC9340-5Q. Siemens reader, reader/punch PT80
-5S. FACIT 4030
-5R. TELETYPE
-5V. FACIT 4070 with MI77

Power consumption 24 V, 800 mA max.
Switchover signal 24 V, 32 mA

Connecting cable according to device:

6FC9 340-5Q. Siemens reader, reader/punch PT80
6FC9 340-5S. FACIT 4030
6FC9 340-5R. TELETYPE
6FC9 340-5V. FACIT 4070 with MI77

10.6.2 Functional description of switching unit

The switching unit is used to connect a single operator panel to two System 3 controls if required. As well as the operator panel, the V.24 (RS232) interface is also switched over.

The switchover functions only in conjunction with the "operator panel disable" interface signals (Section 4.6.1.2).

Preferably use a rocker switch to perform the switching functions:

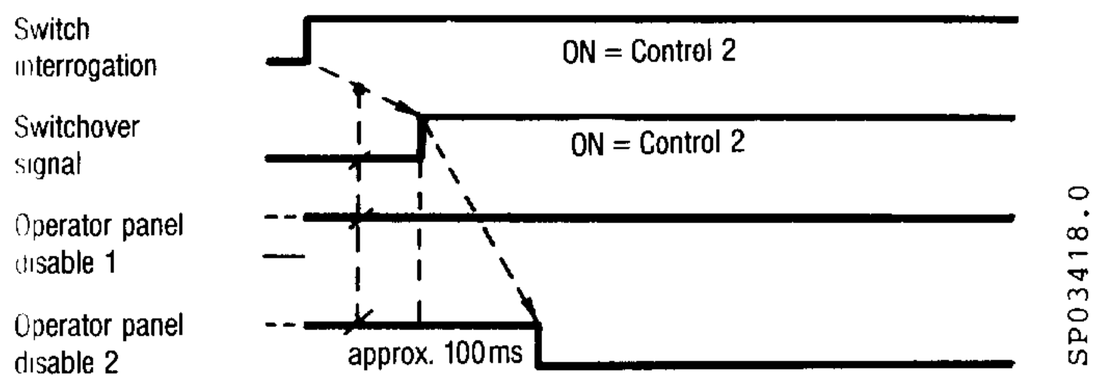
OFF position = Control 1
Switchover signal = 0

ON position = Control 2
Switchover signal = 24 V

Procedure:

Switching on the system

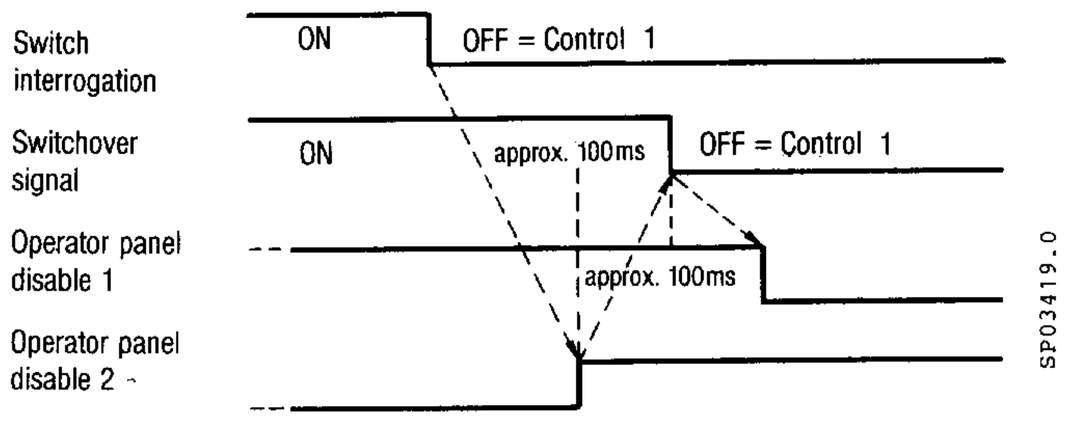
According to the switch position, the switchover signal is activated by the PLC and the operator panel disable of the linked control cancelled after a delay.
The operator panel disable signal for the unconnected control must be given immediately.



SP03405.0

Switchover during operation

At the time of switchover, the "operator panel disable" signal must be active in both controls. Thereafter, the operator panel disable signal is cancelled with a delay for the additionally linked control.



The machine control panel must be active for both controls.

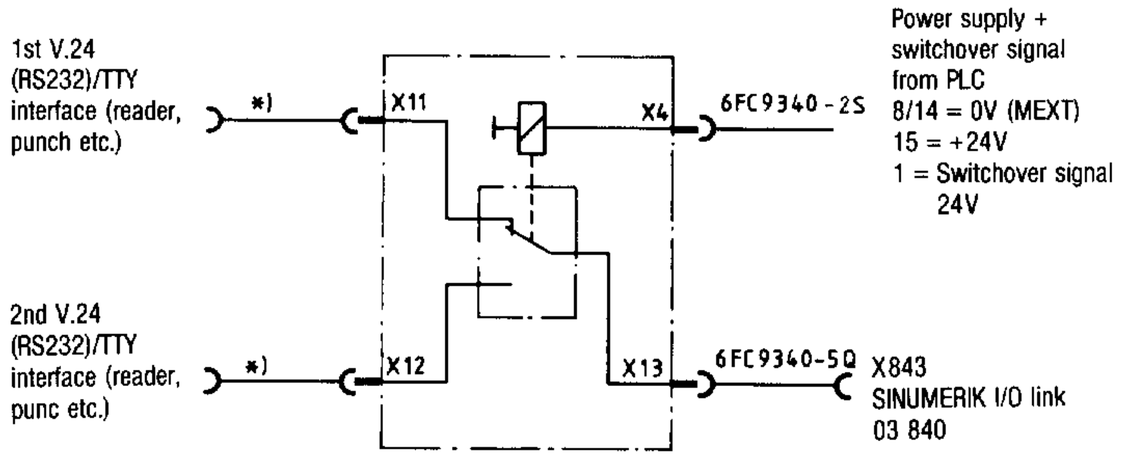
While the control disconnected from the operator panel is executing a program, for example (the program can be influenced via the machine control panel), setting up, editing, program inputs and outputs via the V.24 (RS232) interface or program execution can be carried out at the operator panel (connected to the other control).

If the operator panel disable signal is given for both controls, the complete display for the additionally linked control is active, but no inputs can be made.

10.7 V.24 (RS232)/TTY switching unit Option B07

This switching unit includes a module with relay switchover contacts for the serial standard interface (V.24 or 20 mA) signals.
See dimension drawing in Section 11.7 for dimensions and connection assignment.

10.7.1 Connection of switching unit



Power consumption 24V 160mA
Switchover signal 24V 14mA

*) Connecting cable acc. to device:
6FC9340-5Q. Siemens reader, reader/punch PT80
-5S. FACIT 4030
-5R. TELETYPE
-5V. FACIT 4070 with MI77

10.7.2 Functional description of switching unit

Procedures are basically the same as described at 10.6.2. Instead of the "operator panel disable" signal, the "V.24 disable" signal is used for switching over the V.24/20 mA interface.

10.8 Universal interface switching unit - Option B08

This switching unit includes a module with relay switchover contacts and connectors for the serial universal interface (V.24 or 20 mA/TTY) signals.

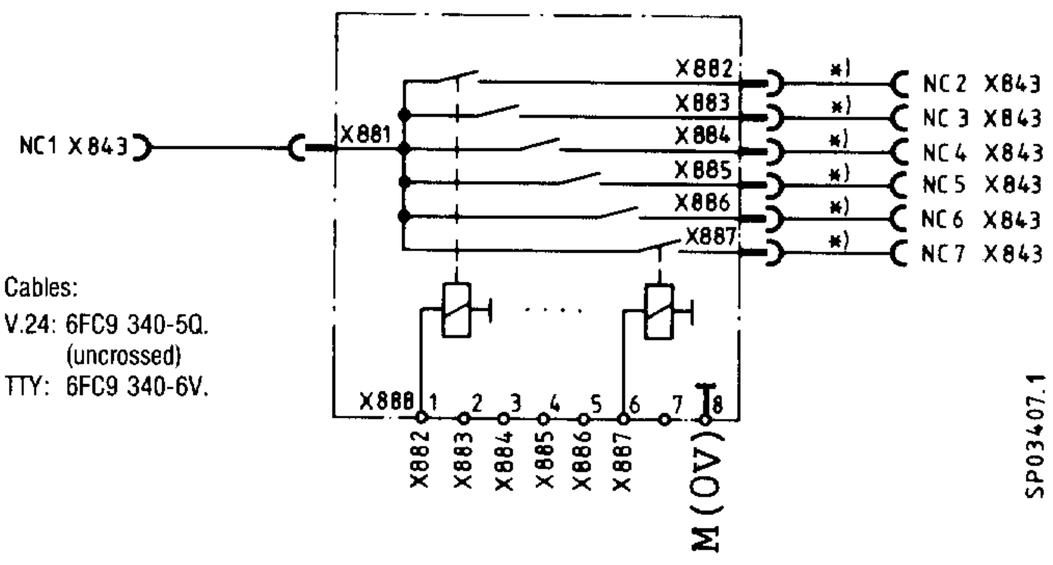
The serial universal interface of one NC (X843) is connected with connector X03 881 using cable 6FC9 340-5Q. (V.24, uncrossed) or 6FC9 340-6V. (20 mA/TTY). Up to 6 additional NCs can be connected at output connectors X03 882 to X03 887 using cable 6FC9 340-6U. (V.24, crossed).

Depending on the data device, various data input/output devices can also be connected using the appropriate connecting cable for the V.24 or 20 mA interface.

One of the six outputs X03 882 to X03 887 of X03 888 is selected via switchover terminals X882 to X887 and connected to input socket X03 881. This permits serial data transfer between the two connected devices, e.g. NC - NC, NC data input - output device.

Example of application:
Transfer of NC programs between several training NCs and a single control NC on NC training courses.

10.8.1 Connection of switching unit



SP03406.0

Cables:
V.24: 6FC9 340-5Q. (uncrossed)
TTY: 6FC9 340-6V.

SP03407.1

Switchover signals X882 ... X887
24 V/180 mA per channel

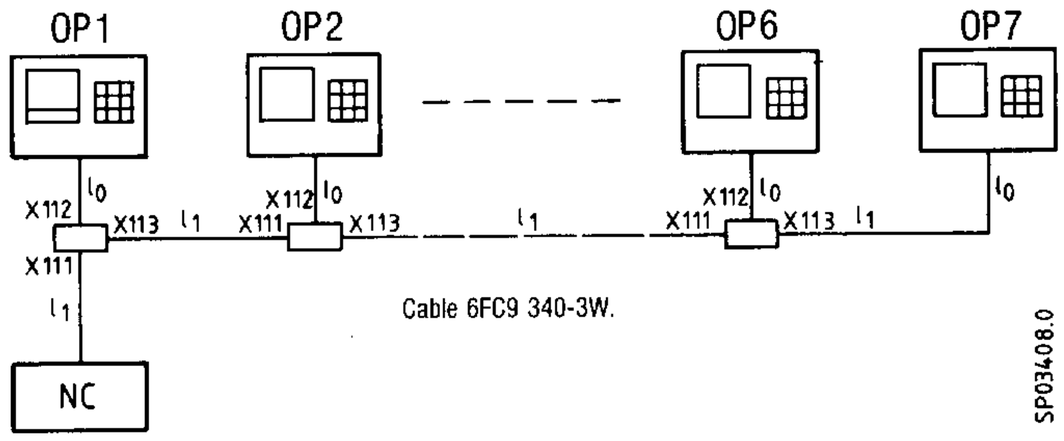
* Connecting cable according to device:

6FC9 340-6U SINUMERIK System 3 (crossed)
-5Q. Siemens reader, reader/punch PT80
-5S. FACIT 4030
-5R. TELETYPE
-5V. FACIT 4070 with MI77
-4W. Programming workstation PP/PG/PF

10.9 Operator panel distributor B09

This device divides the signals of the operator panel interfaces (03 805, 03 810, 03 815) between 2 outputs X112 and X113, so that 2 operator panels can be connected in parallel to a single NC logic component. The video signals are amplified by line transmitters for decoupling. The keyboard signals are transmitted in parallel to the two outputs without amplification.
By connecting several B09 operator panel distributors in series, up to 7 operator panels can be linked to a single NC logic component (application: NC training).
If several operator panels are connected using B09 operator panel distributors, a hardware switch must be provided to ensure that only one operator panel is active at a time. All the other keyboards must be disabled via the BEDDIS signal inputs (X738/8 on 03 731) to prevent possible overloading of the line transmitters (see Section 2.1.4.2). The NC logic unit monitors the connected operator panels via cable 6FC9 340-3W.. In conjunction with the B09 operator panel distributor, only the operator panel connected at connector X112 is monitored (control workstation).

If more than 3 operator panels (up to 7) are connected using operator panel distributors, the following conditions apply as regards cable lengths:



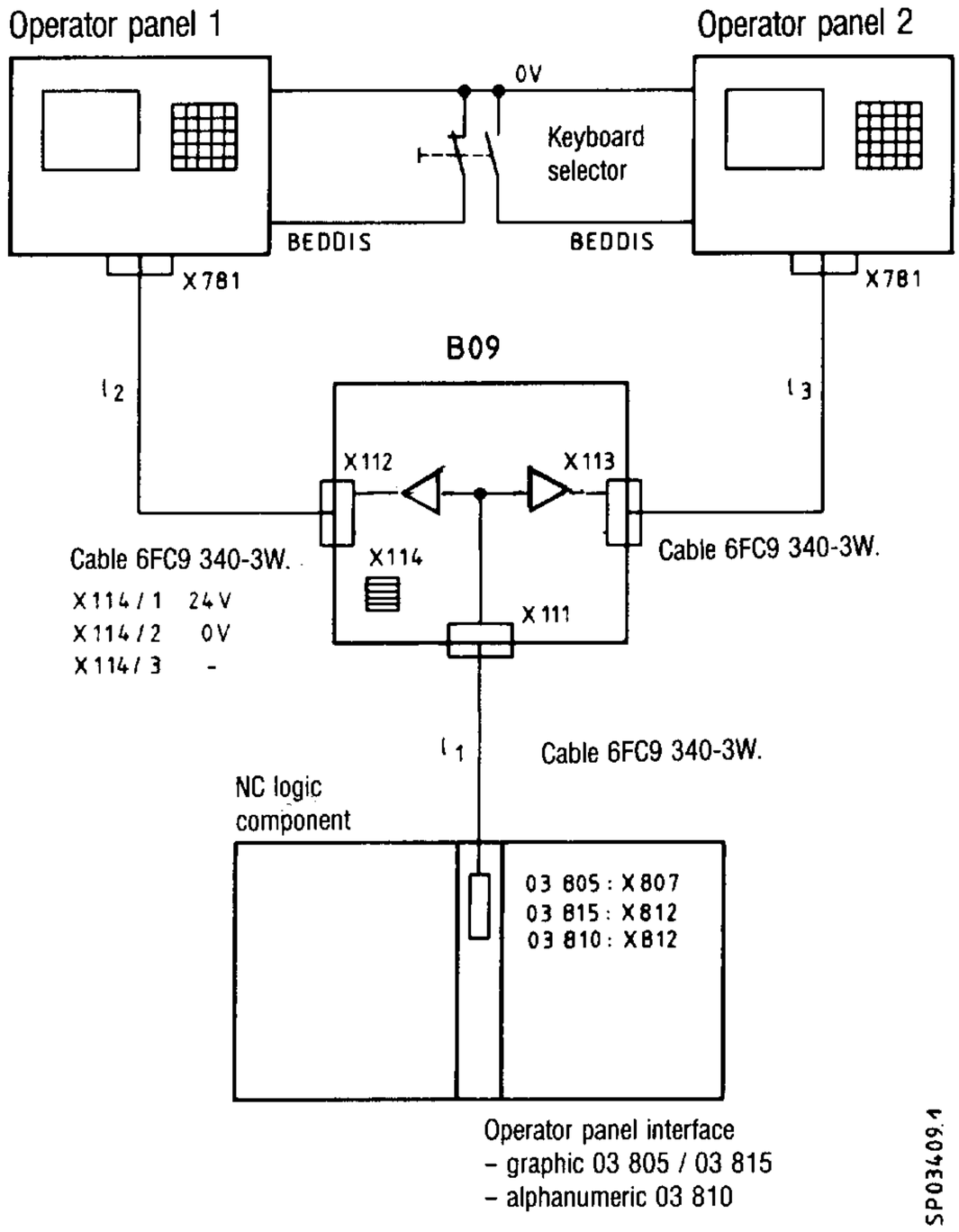
SP03408.0

Install the operator panel distributor as near as possible to the corresponding operator panel, l0 less than/equal to 0.5 m.
Individual lengths between operator panel distributors, l1 max. 15 m. Total length from the logic component to the most remote operator panel max. 50 m.
The RC terminator combinations R3/C4 must be pulled out of the sockets on operator panel modules 03 371, except for operator panel 7.
No logic module is connected.

If the operator panel distributors cannot be located in the immediate vicinity of the corresponding operator panels, max. total cable lengths a are restricted as follows:

Up to	3	operator panels 50 m
"	4	" " 27 m
"	5	" " 20 m
"	6	" " 18 m
"	7	" " 10 m

10.9.1 Connection of operator panel distributor B09 (6FX1 120-1BA0*)



SP03409.1

Cable lengths for 2 operator panels

Without logic module
l = l1 + l2 less than/equal to 50 m
l = l1 + l3 less than/equal to 50 m

With logic module
l = l1 + l2 less than/equal to 46 m
l = l1 + l3 less than/equal to 46 m

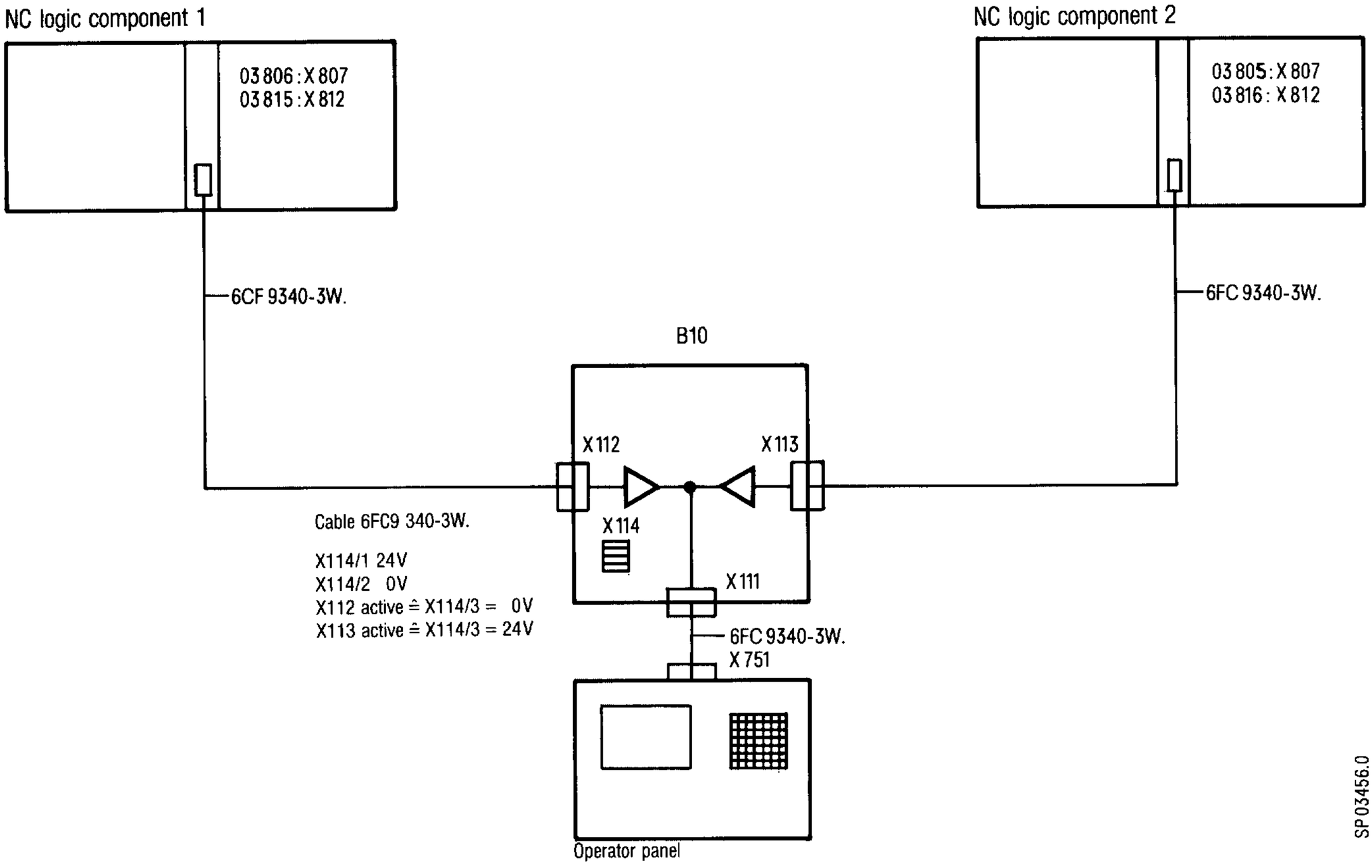
Any cable part-lengths l1, l2, l3 are permitted.

The max. total cable length l between the logic component and the most remote operator panel must not exceed 50 or 46 m, as appropriate.

10.10 Operator panel distributor B10

On the B10 operator panel distributor, the input and output drivers are equipped differently than on the B09 version. The B10 operator panel distributor thus permits connection of one operator panel to 2 NC racks with graphics. The operator panel is assigned via the PLC.

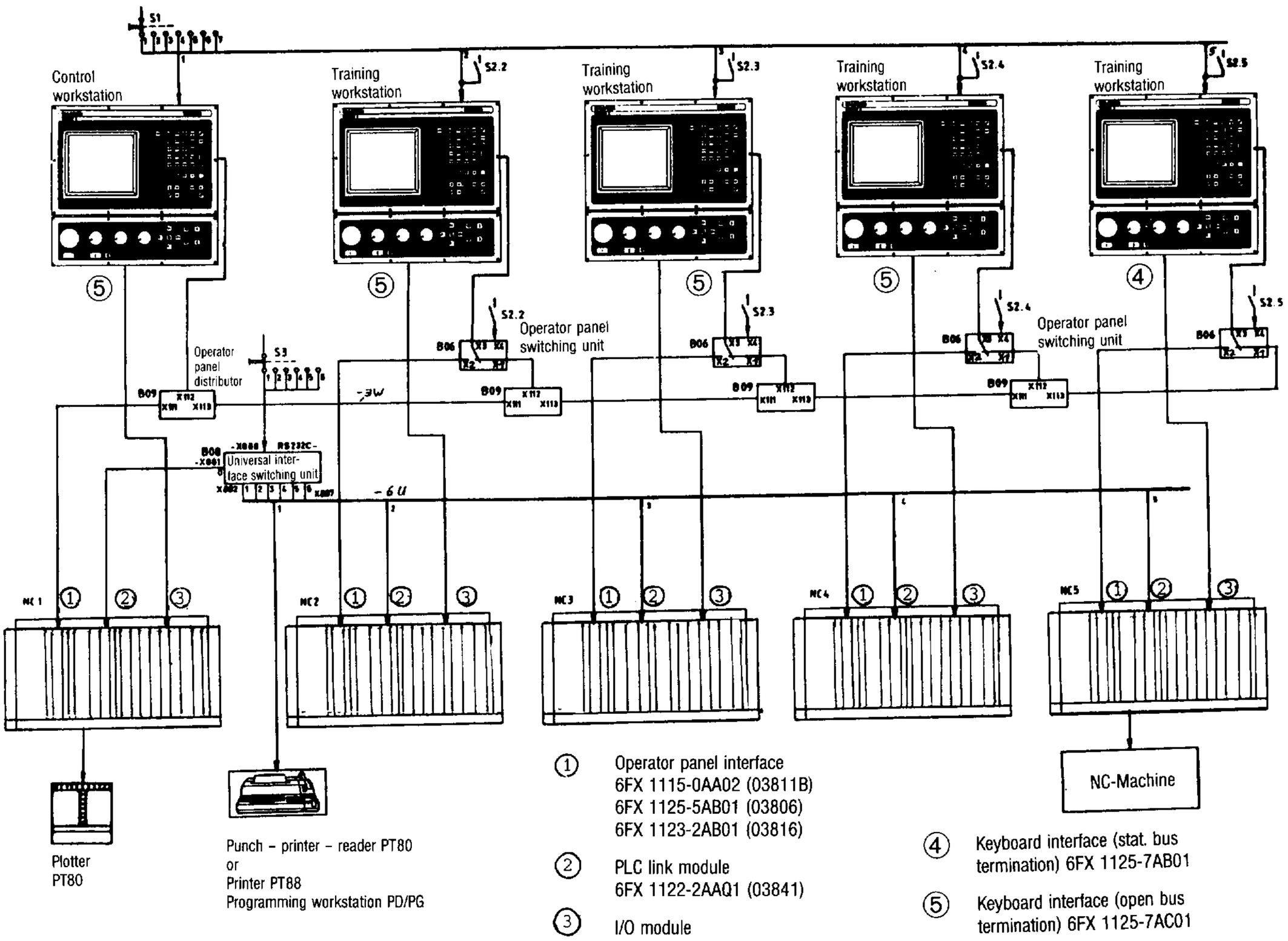
10.10.1 Connection of operator panel distributor B10
6FX1 120-1BB0*)



SP 03456.0

See Section 10.9.1 for cable lengths

10.11 Example of using B06, B08 and B09 in NC training centres

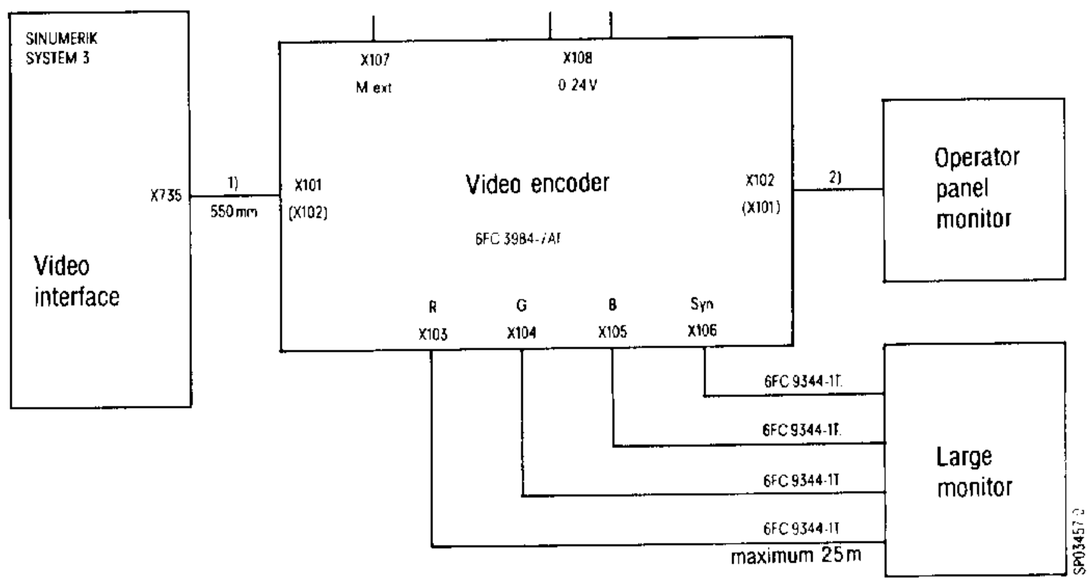


10.12 Video encoder

A large monitor can be connected to System 3 using the video encoder.

The encoder is connected to the video interface using the cable provided. The NC screen is connected to the encoder with the standard NC cable.
If the cable is too short to cover the distance between the NC screen and the encoder, the cable ties in the control have to be opened.
Alternatively, a ribbon cable can be obtained and installed instead of the cable provided. The old cable can remain wired up.
The maximum cable length between the NC screen and the video interface must not exceed 1 m since the ribbon cables are not screened.
The power supply to the encoder is delivered by a ribbon cable; no separate supply is required. Since commercially available RGB monitors do not provide satisfactory images, use special monitor 6DS3 401-8BH.

10.12.1 Connection of video encoder



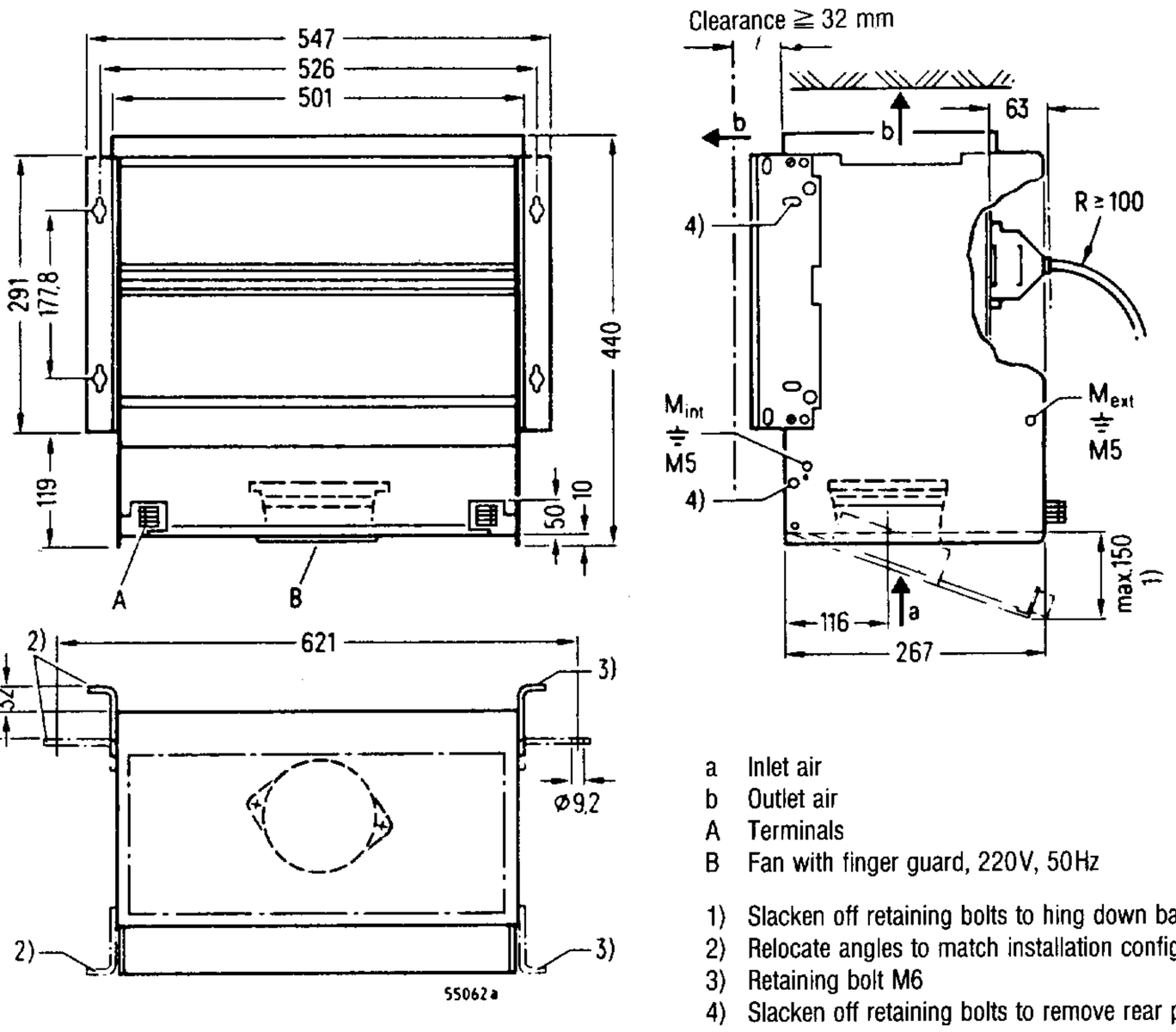
1) Included in delivery specification of encoder
2) If required (6FX1450-0DA37) 370 mm

11. Dimension drawings

11.1 Dimension drawing: single-tier rack

Single-tier rack as NC/PLC logic component, PLC rack and PLC expansion unit
6FC3 ...-0FA
6FC3 ...-0BA
6FC3 ...-0AA

Dimensions in mm

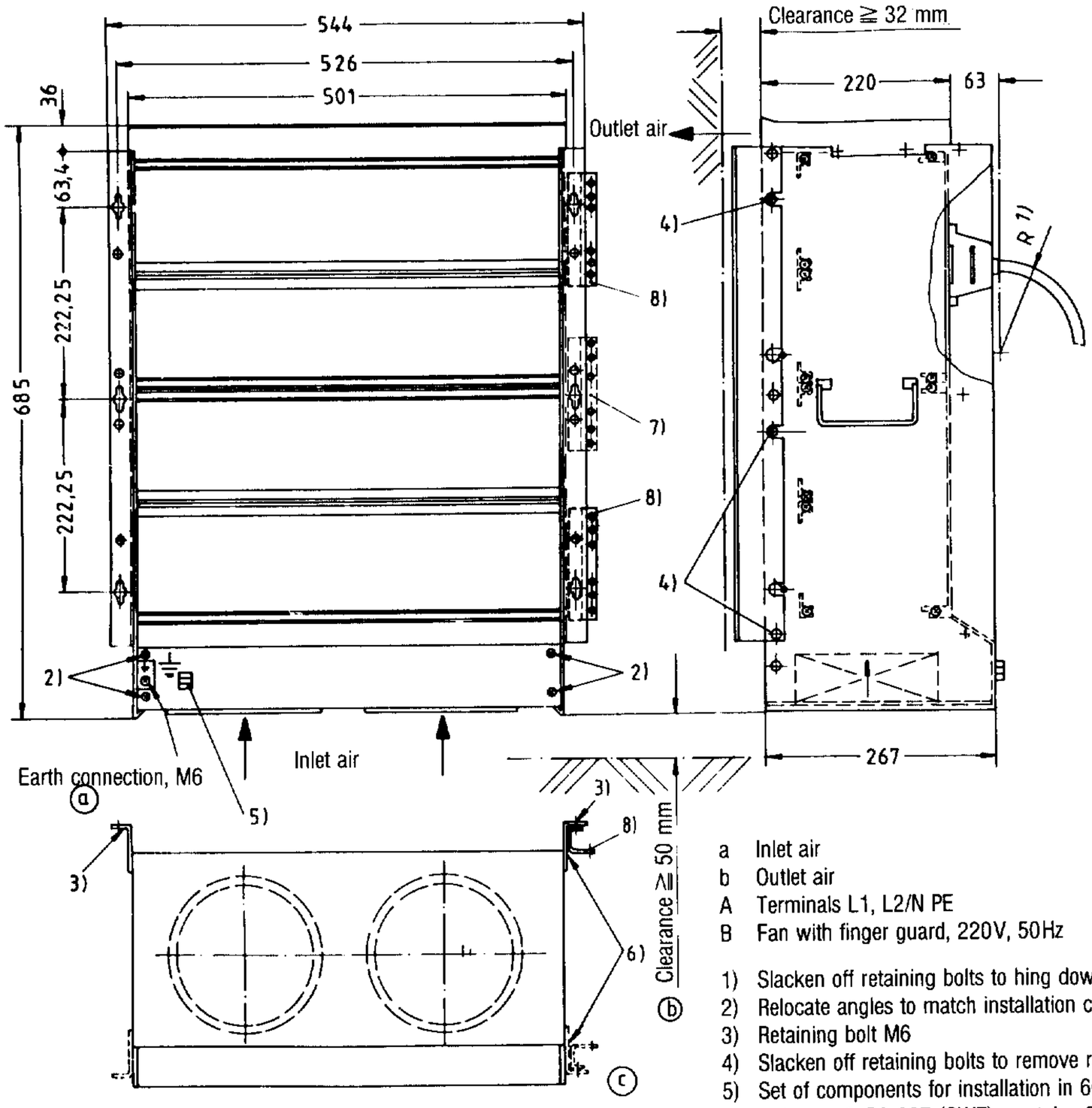


a Inlet air
b Outlet air
A Terminals
B Fan with finger guard, 220V, 50Hz

1) Slacken off retaining bolts to hing down base plate
2) Relocate angles to match installation configuration
3) Retaining bolt M6
4) Slacken off retaining bolts to remove rear panel

Dimension drawing: two-tier rack

Two-tier rack as NC/PLC logic component
for controls with extended I/O area and
integrated Dual PLC
6FC3 ...-0HA
6FC3 ...-0JA
6FC3 ...-0KA



Dimensions in mm

a Inlet air
b Outlet air
A Terminals L1, L2/N PE
B Fan with finger guard, 220V, 50Hz

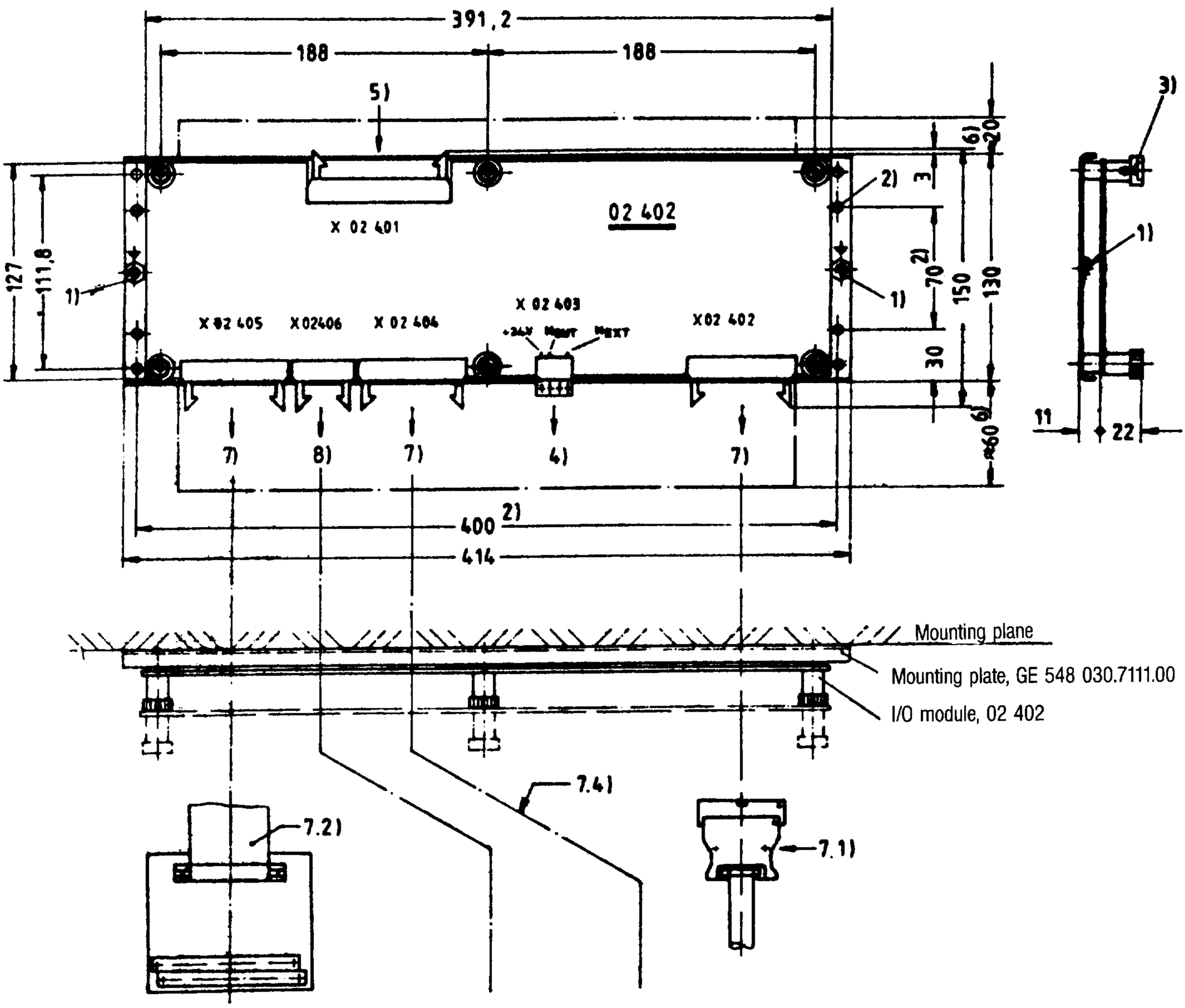
1) Slacken off retaining bolts to hing down base plate
2) Relocate angles to match installation configuration
3) Retaining bolt M6
4) Slacken off retaining bolts to remove rear panel
5) Set of components for installation in 600 mm 8MF standard cabinet order no. 6xB9 807 (GWE), contains 2 angles
6) Same as 5), if required

Siemens AG Order-No.: E80850-D27-X-A1-7600

11.2 Dimension drawing: logic module

Logic module for 64 inputs/32 outputs
and logic module for 64 inputs

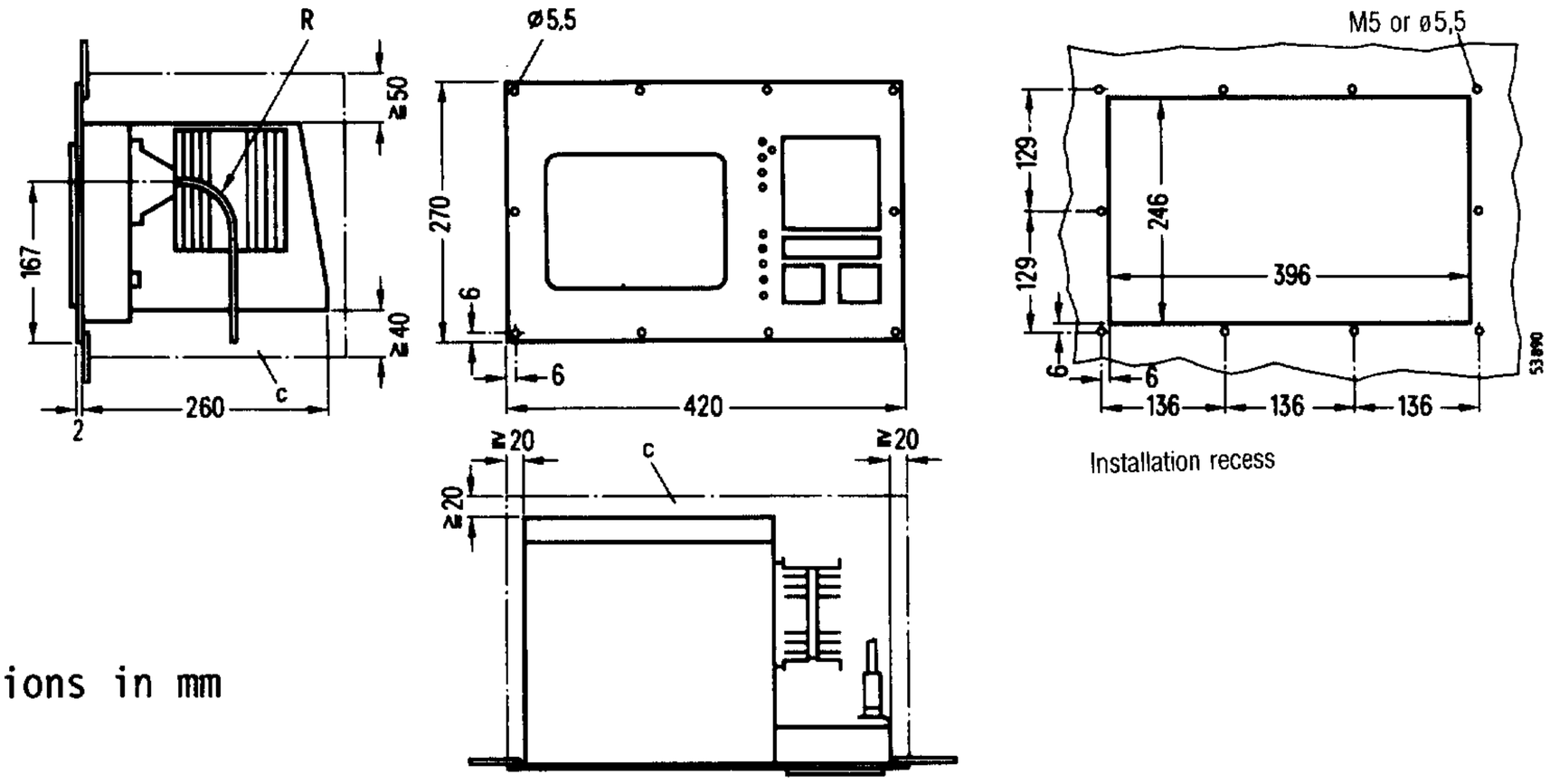
Dimensions in mm



1) Earth connection M5
2) Retaining hole for M4 bolt
3) Threaded hole for M4 bolt
4) X02403: +24V, M_{out} and M_{ext} connection, with plug-in terminal max. 1.5 mm²
5) X02401: 50-pole ribbon cable
   With 1x X02401: 6FX1 430-1AA50
   With 2x X02401: 6FX1 430-2AA50
6) Space requirement for connector
7) X02402, X02404, X02405: connect with 34-pole ribbon cable 6FC9 340-8L.
   with 34-pole round cable 6FC9 340-8X.
8) X02406 not for use with System 3!

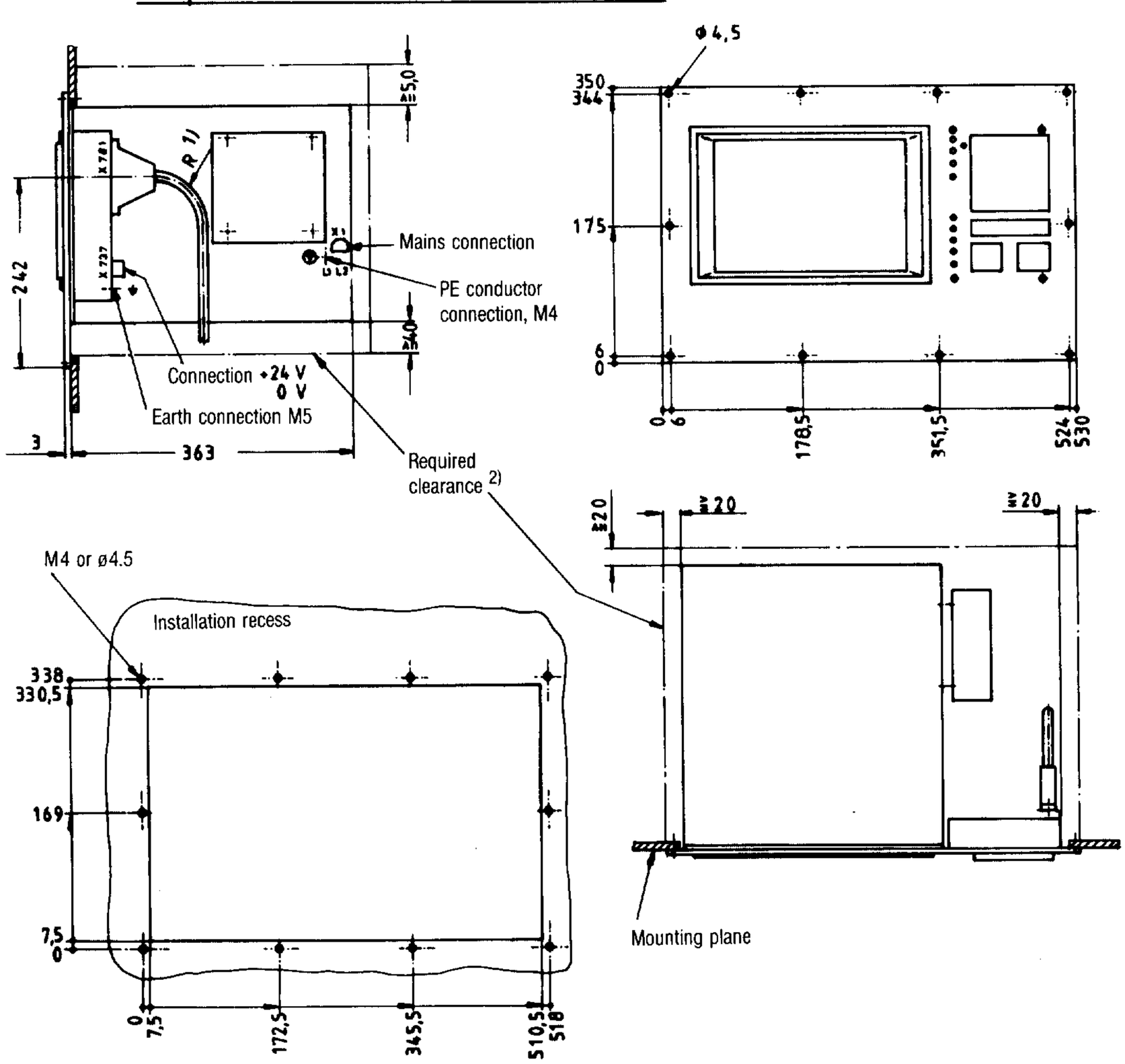
11.3 Dimension drawings: operator panel components

11.3.1 Dimension drawing: operator panel component with 9" monochrome screen



11.3.2 Dimension drawing: operator panel component with 12" monochrome screen

11.3.3 Dimension drawing: operator panel component with 12" colour screen



Dimensions in mm

2) Installation:

a) For enclosed installation without additional ventilation: required cabinet surface area ≧ 2.6 m^2

b) For enclosed installation with internal air turbulence (additional fan): required cabinet surface area ≧ 1.3 m^2

c) With through ventilation: required airflow ≧ 40 m^3/h. The intake air must be clean.

1) In accordance with cable type: R ≧ 100 with SIEMENS cable

Temperature at front ≦ +45°C

Temperature in enclosed space ≦ +55°C

Max. temperature fluctuation 1.1 K/min

Permissible humidity: class F acc. to DIN 40040

The intake air must be free of aggressive gases

Degree of protection acc. to DIN 40050:

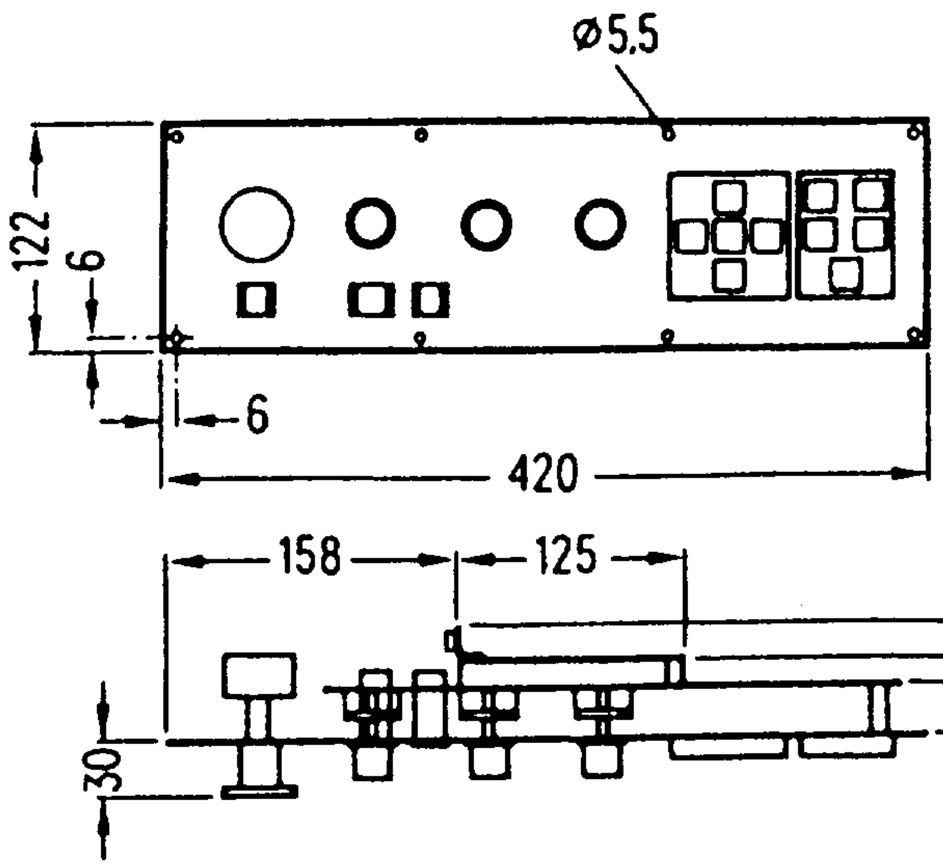
Front IP54

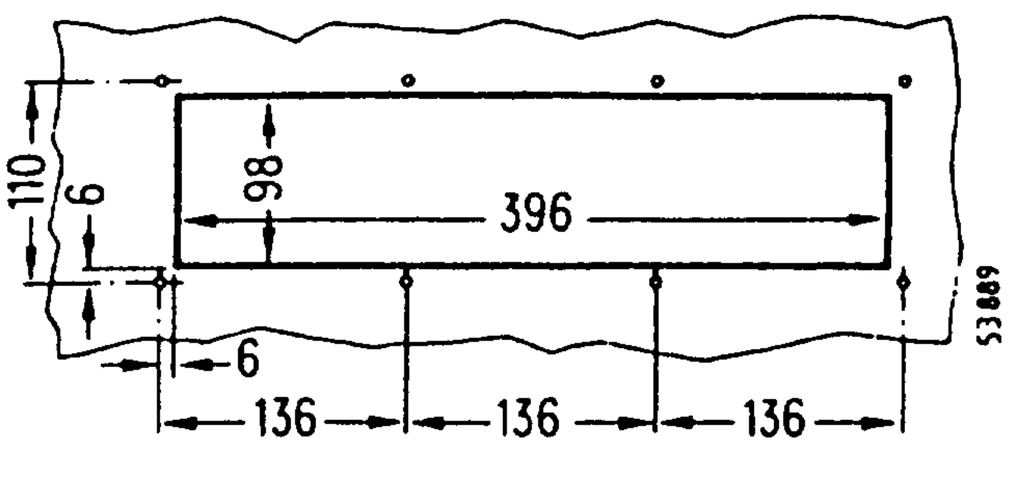
Rear IP0
Max. power loss 30 Watt

11.4 Dimension drawing: machine control panel

Machine control panel 3T/3TT

Dimensions in mm

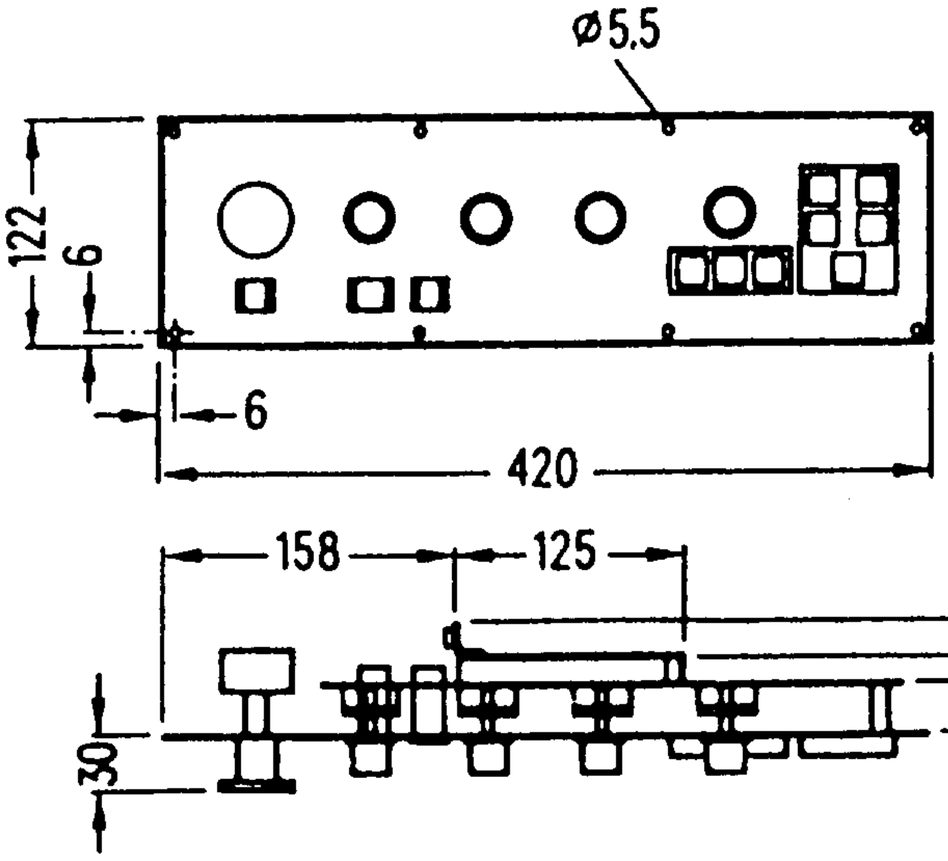


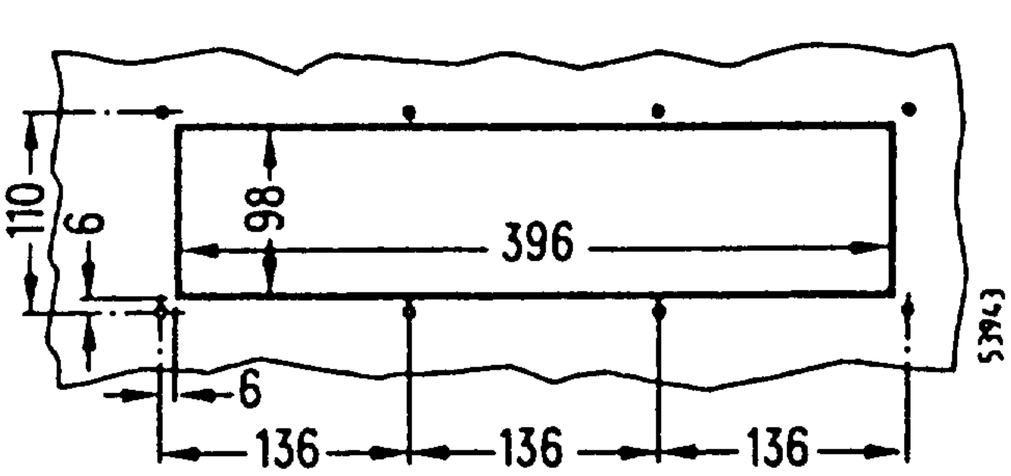


Installation recess

Machine control panel 3M

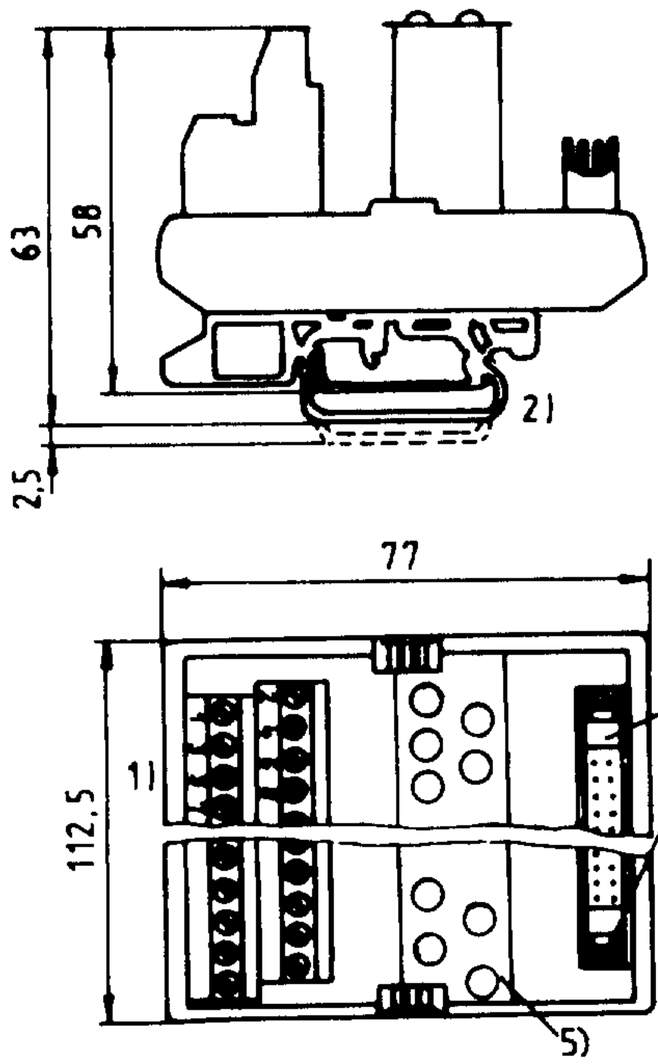
Dimensions in mm





Installation recess

11.5 34-pole terminal strip converter
without LED displays 6FC9 302-2AA
with LED displays 6FC9 302-2AB



1) Connection data

single-wire	fine-wire	AWG	I	U
4	2,5	12	1A	60V

2) Module with universal foot for mounting on all commercially available DIN-EN support rails

3) Connect to logic module with
34-pole ribbon cable 6FC9 340-8L.
34-pole round cable 6FC9 340-8X.

4) Secure connectors with the locking catches provide
short catch for ribbon cable 6FC9 340-8L.
long catch for round cable 6FC9 340-8X.

5) LED display block with version 6FC9 302-2AB only.

SP034691

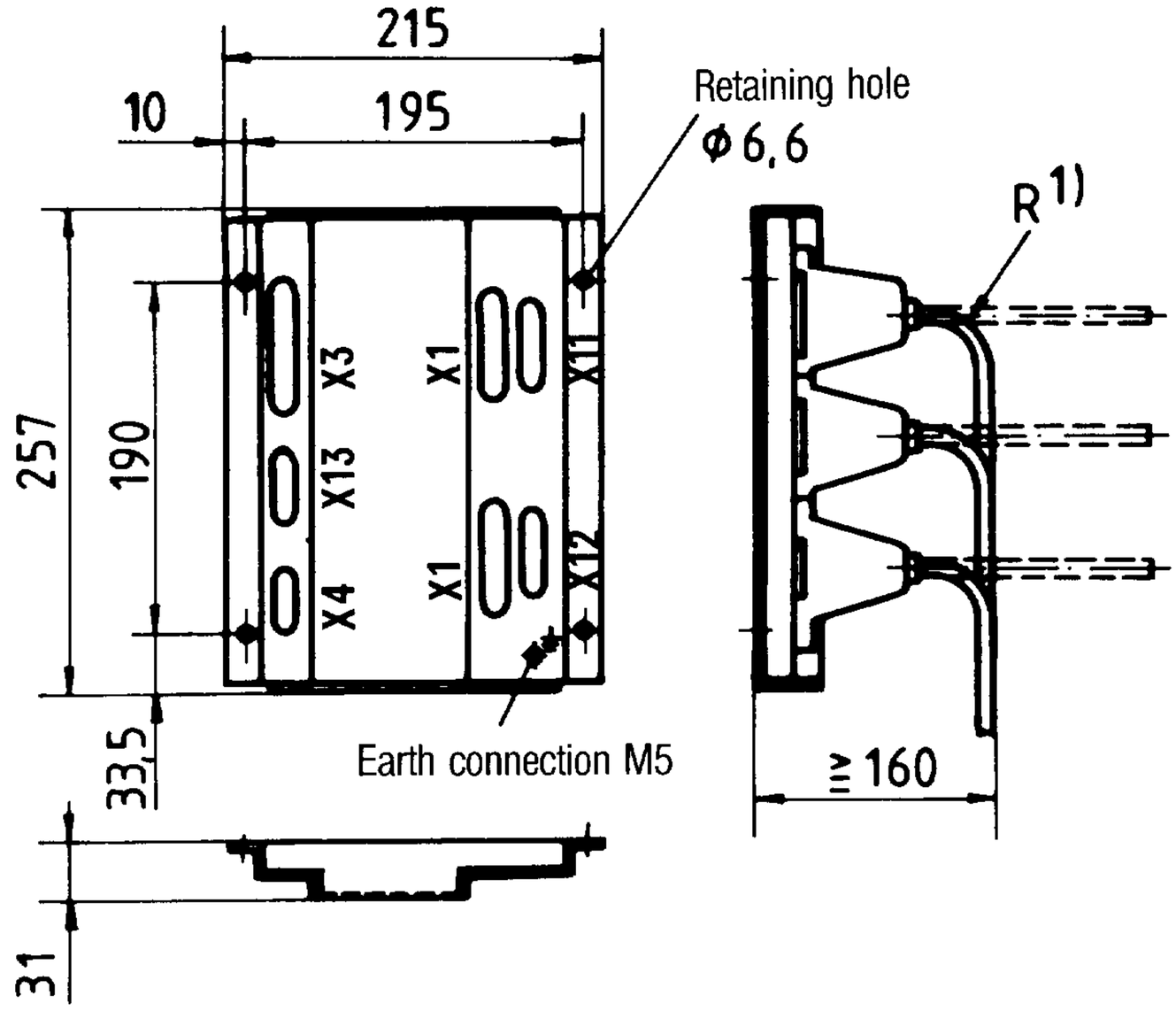
Siemens AG Order-No.: E80850-D27-X-A1-7600

11.6 Dimension drawing: switching unit Option B06

Switching unit for operator panel and V.24 (RS232)/TTY signals

Switching unit
External views

Dimensions in mm



1) In accordance with cable type:
   R ≧ 100 with SIEMENS cable

2) Ambient temperature ≦ +55°C
   Max. temperature fluctuation 1.1 K/min

   Permissible humidity: class F acc. to DIN 40040

   The ambient air must be free of aggressive gases

   Degree of protection IP0 acc. to DIN 40050

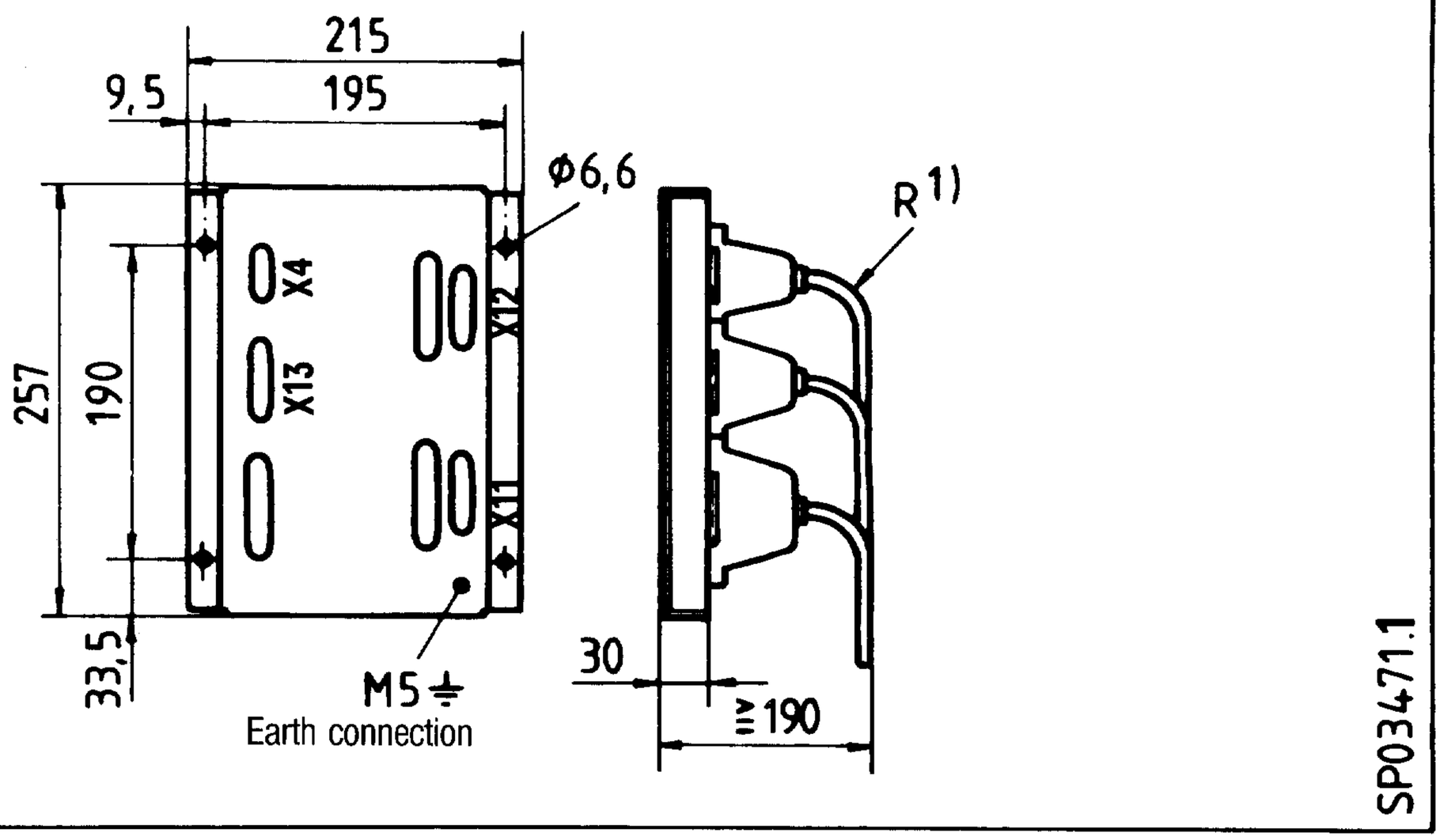
SP03470.1

11.7 Dimension drawing: switching unit Option B07

Switching unit for V.24 (RS232)/TTY signals

External views

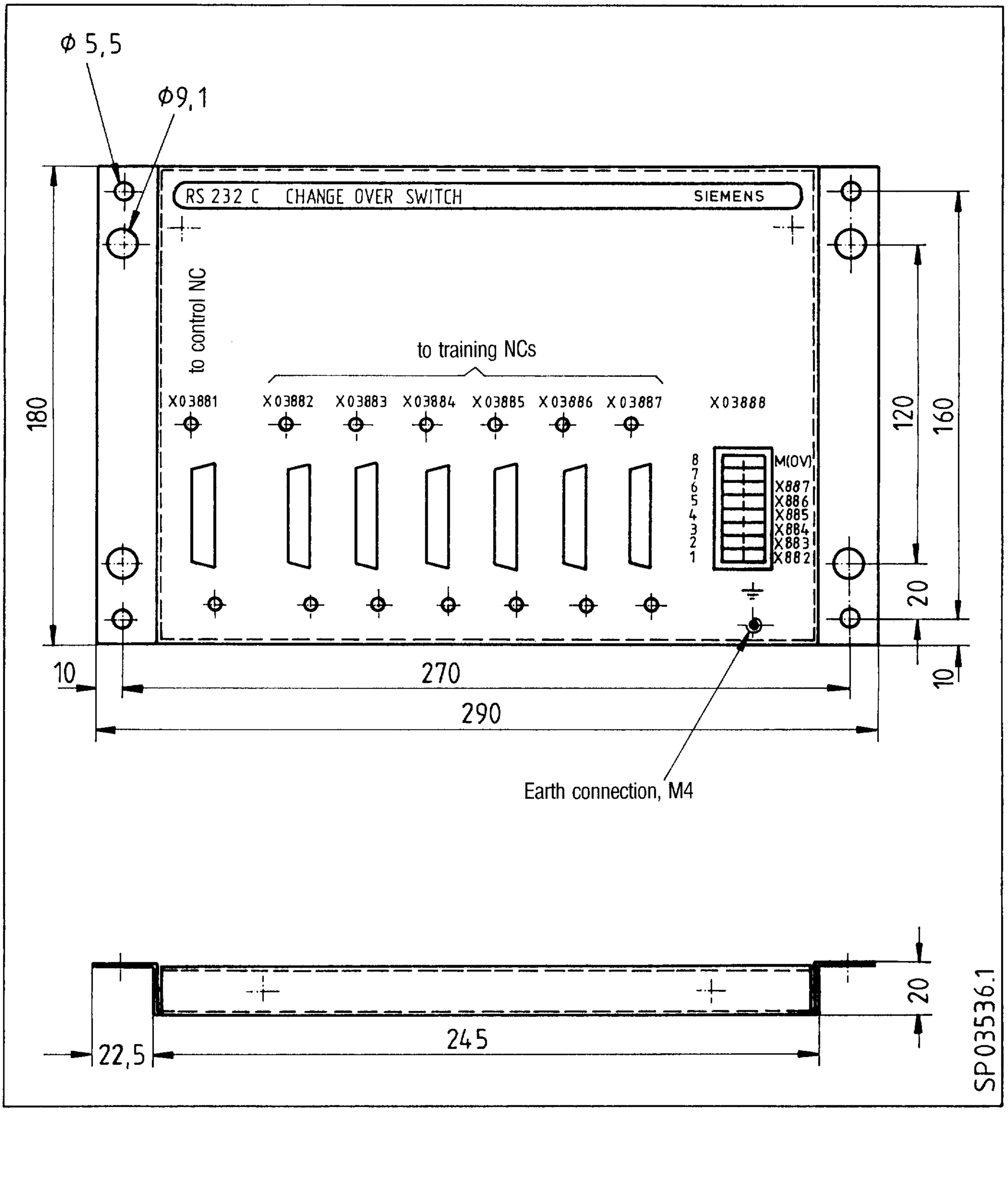
Dimensions in mm



11.8 Dimension drawing: switching unit Option B08

External views

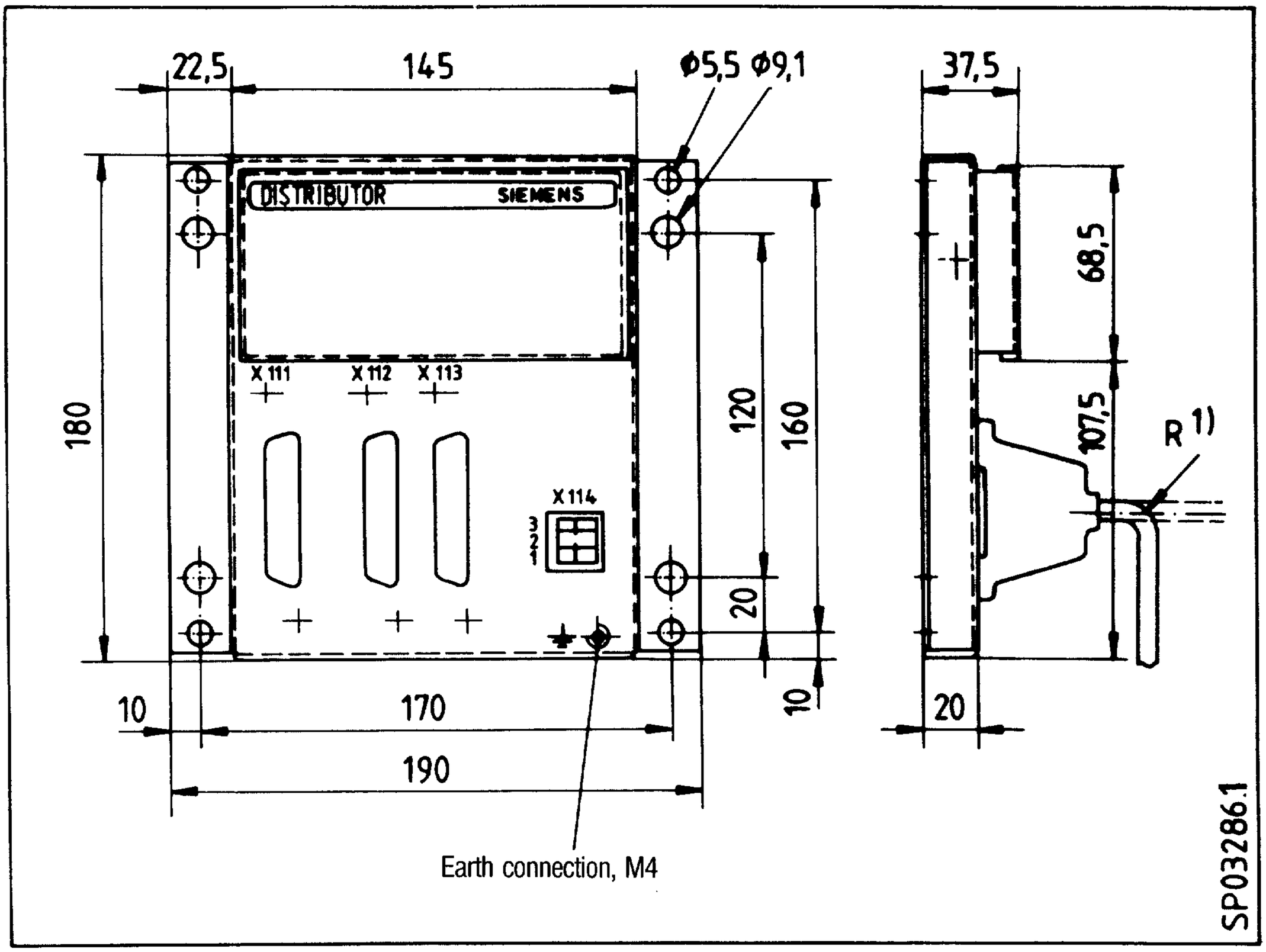
Dimensions in mm



11.9 Dimension drawing: operator panel distributor Option B09, B10

External views

Dimensions in mm



Connection assignment: operator panel distributor B09

X111 NC operator panel interface 03-805, 03-810, 03-815 (x 807 or x 812)

X112 Operator panel 1

X113 Operator panel 2 or additional operator panel distributors

X114 Power supply
Pin 1: 24 V
Pin 2: 0 V
Pin 3: --

1) In accordance with cable type:
$R \geq 100$ with SIEMENS cable

2) Ambient temperature 55°C

Max. temperature fluctuation 1.1 K/min

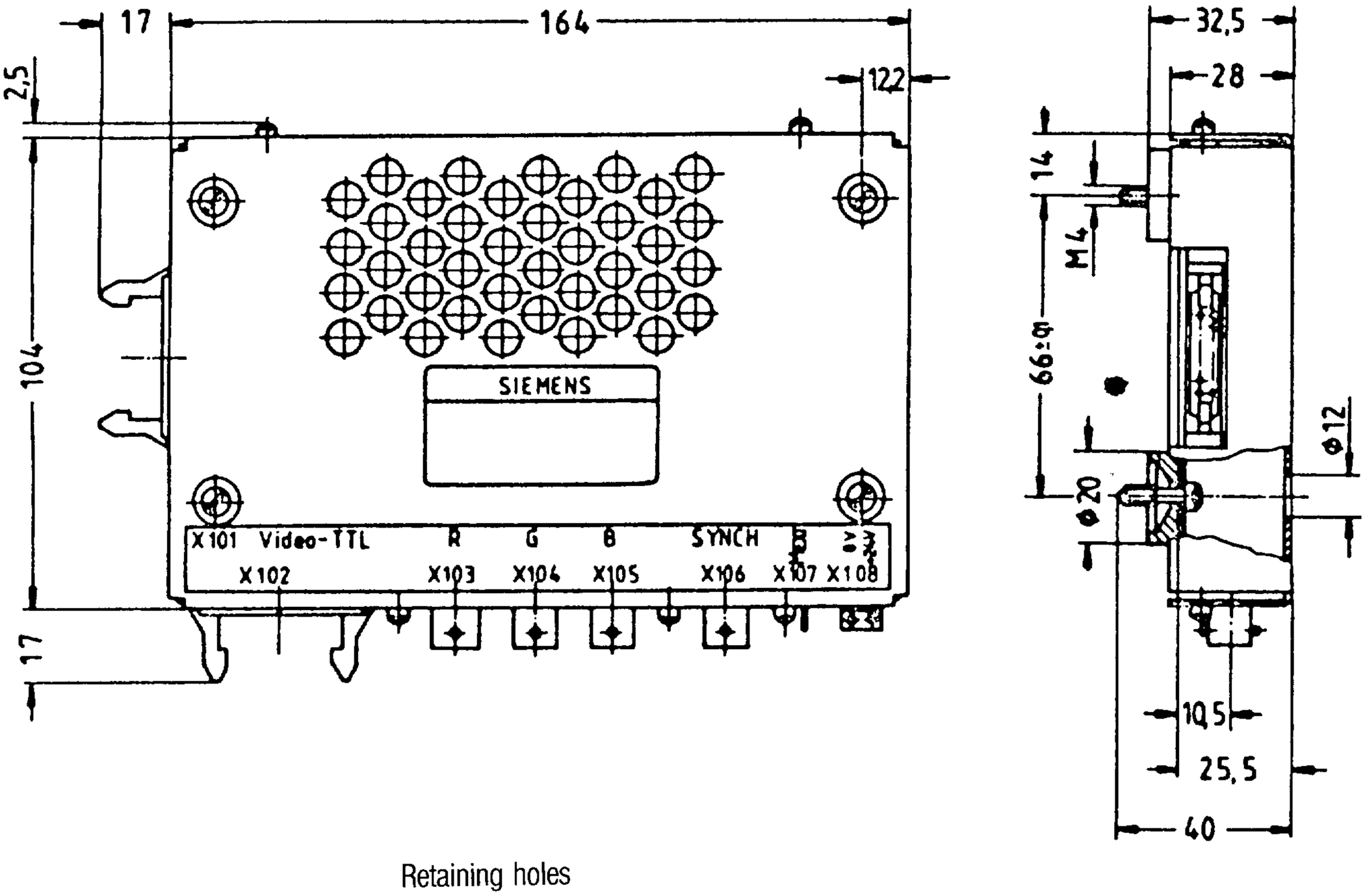
Permissible humidity: class F according to DIN 40040

The ambient air must be free of aggressive gases

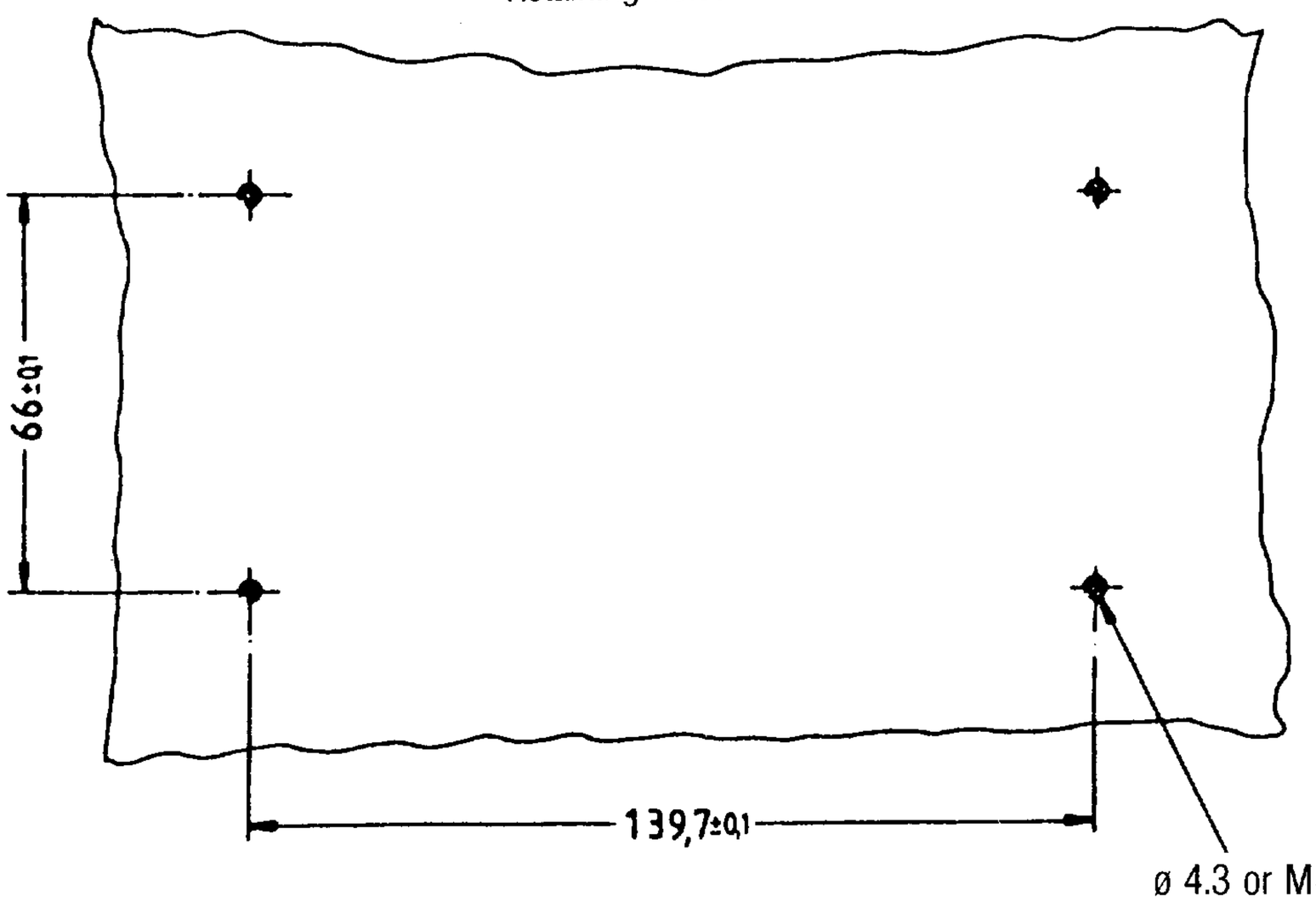
Degree of protection IP0 according to DIN 40050

Siemens AG Order-No.: E80850-D27-X-A1-7600

11.10 Video encoder



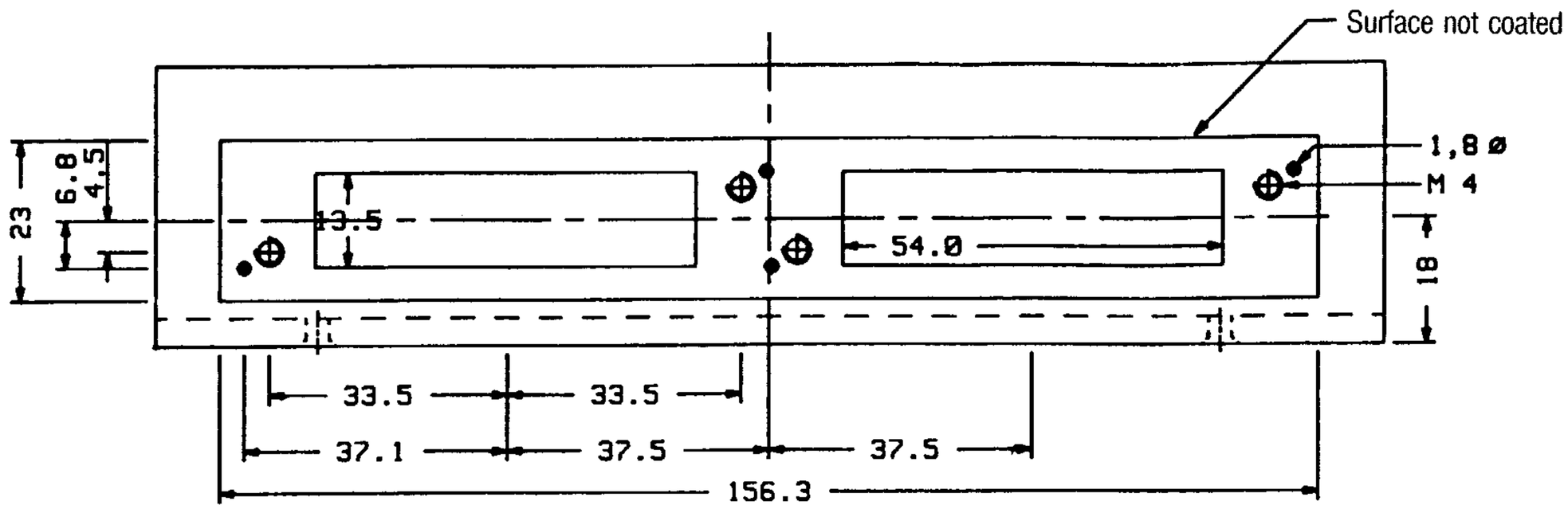
Retaining holes

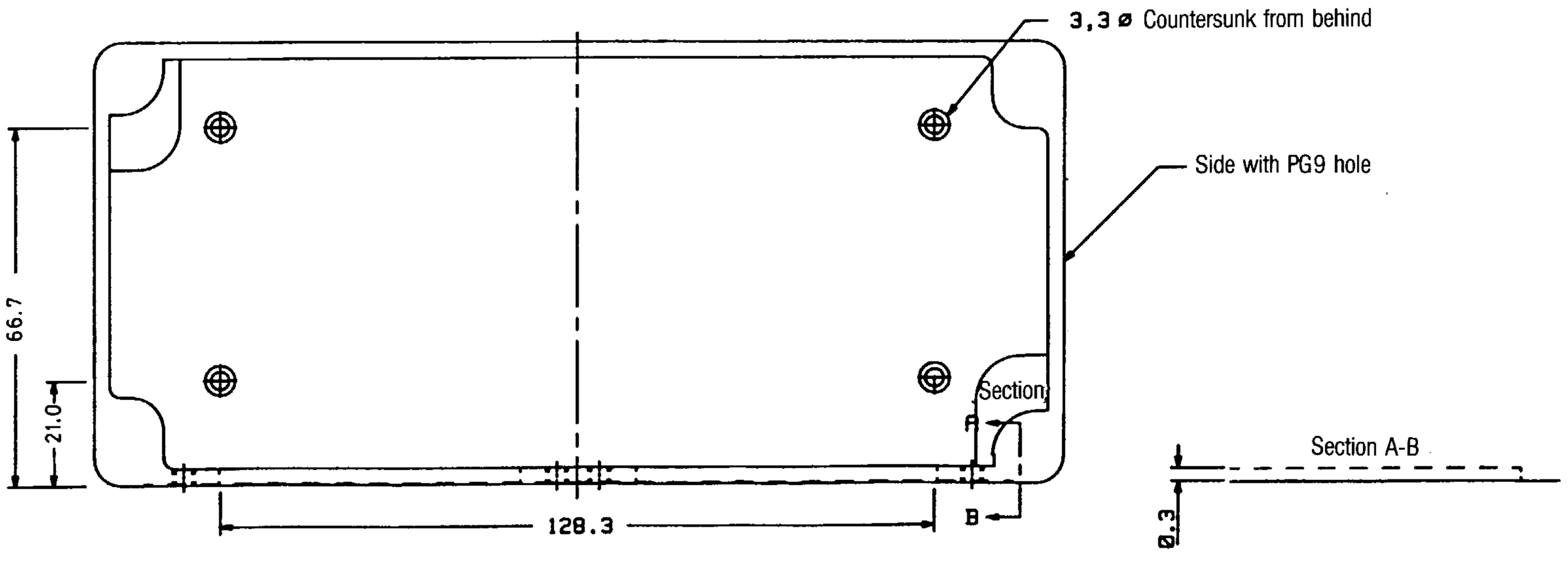


ø 4.3 or M4

RS 422 remote adapter

All holes are dimensioned symmetrically in relation to the recess.





11.11 Dimension drawing: RS422 remote adapter

G33928-T2806-C-002-A3-0006

12. Dual PLC

12.1 Preconditions

Software preconditions

- Software version ≥ C03 of NC for System 3 GA4A

- Software version ≥ D01 of NC for System 3 GA4B

  If display programs are used, comply with the following Dual PLC display program versions:

  for PLC1: 6FC9 371-2FB01
  (or more recent version)
  for PLC2: 6FC9 371-2FC01
  (or more recent version)

12.2 Hardware configuration and link concept

The hardware configuration of System 3 GA4 with Dual PLC is as illustrated in Section 1.1.
The two PLCs can be arranged as follows:

a) Two 130 WB central controller modules located in one rack (Section 1.1.7)
PLC1 central controller module at slot 176
PLC2 central controller module at slot 30
Link RAM 6FX1122-1AA01 (03 831) connected at slot 86
Communication between PLC1 and PLC2 and with the individual NCs takes place via the Link RAM (Fig. 1).
Each PLC has its own S5 bus for communicating with its I/O modules.
PLC1 bus covers slots 106 to 176, PLC2 bus covers slots 30 to 96. See Section 1.2.3 for assignment of the modules in the rack.

b) One central controller module in each case located in two separate racks (external Dual PLC). Sections 1.1.5 and 1.1.6 show the different configurations and Sections 1.2.2 and 1.2.4 the corresponding assignment of the modules in the racks.
Communication between PLC1 and PLC2 and with the individual NCs takes place via Link RAM 6FX1122-1AA01 (03 831) (Fig. 1).
Additional PLC link module 6FX1120-3AB00 (03 845) connects the Link RAM area to the external PLC2.
With this Dual PLC configuration, the user has to set the "external Dual PLC" PLC1 machine data bit so that PLC1 and PLC2 commence cyclic operation simultaneously.

Note

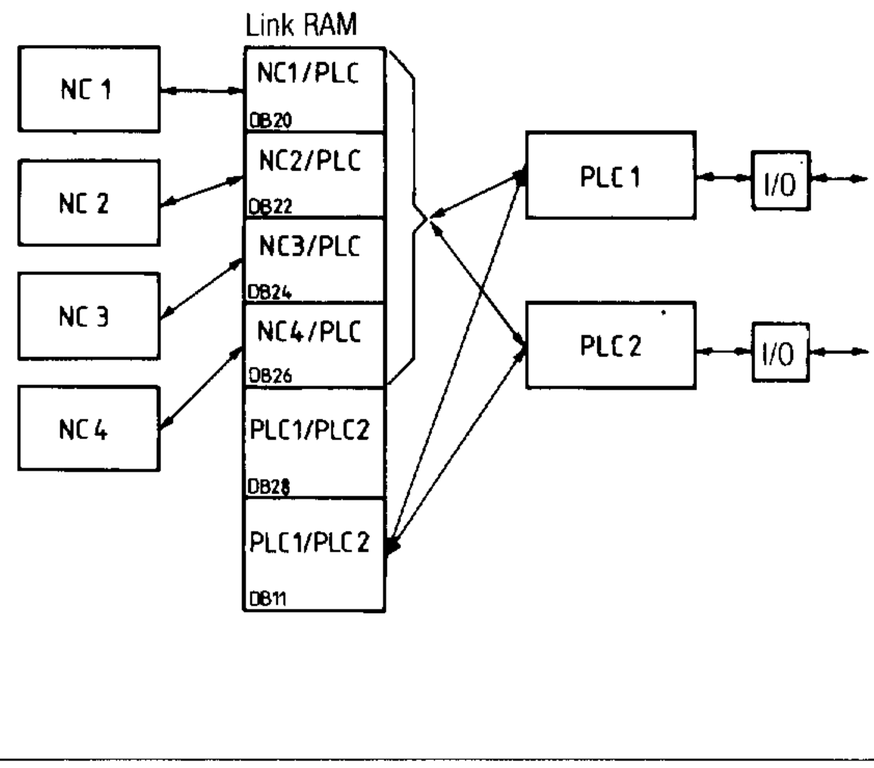
The stated versions or more recent ones may be used. The Link RAM module must be jumpered in accordance with the list.

PLC program divisions:
- PLC1 Machine program
- PLC2 Display programs, tool management and supplementary programs (Fig. 2).

On an installation with only 2 NCs, for example, the Link RAM1 data blocks DB24 (DW0....DW130) for the internal NC3/PLC interface and DB26 (DW0....DW130) for the internal NC4/PLC interface are not used in the cyclic mode.

In such cases, these data blocks can be assigned by the user, e.g. for additional data exchange between PLC1 and PLC2. At each new start (power supply on, hardware reset), the basic program erases these data blocks and effects preliminary allocation of a number of data words.

Link concept for SINUMERIK 3GA4 with Dual PLC



12.3 PLC machine data

There are 3 possibilities for PLC1:

- DB9 not available; basic program generates the standard PLC machine data for the 1st NC in the Link RAM (DB20).

- DB 9 available; basic program transfers DB9 machine data to the Link RAM.
  The complete PLC machine data range for the NC must always be included in DB9 (e.g. for one NC: DW0...DW35; for two NCs: DW0....DW69).

- PLC machine data in NC machine data memory; NC transfers PLC machine data to the Link RAM when starting up.

Note

With the external Dual PLC configuration, the user has to set the "external Dual PLC" PLC1 machine data bit.

On the PLC2, one DB9 must always be preset with only one data word (DW0) (bit 0,1: number of NCs).

Starting up is coordinated between PLC1 and PLC2.
In the start-up routine (FB10), the flags F 228.0, F 228.3 and F 228.4 are defined and set or reset in PLC1 and PLC2.

PLC machine data for PLC 2

User DB	Link RAM	DL								DR							
DB 9	DB 20	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DW 0	DW 93														T-PLC	Number of NCs	

Number of NCs 00 = 1 NC
01 = 2 NCs
10 = 3 NCs
11 = 4 NCs

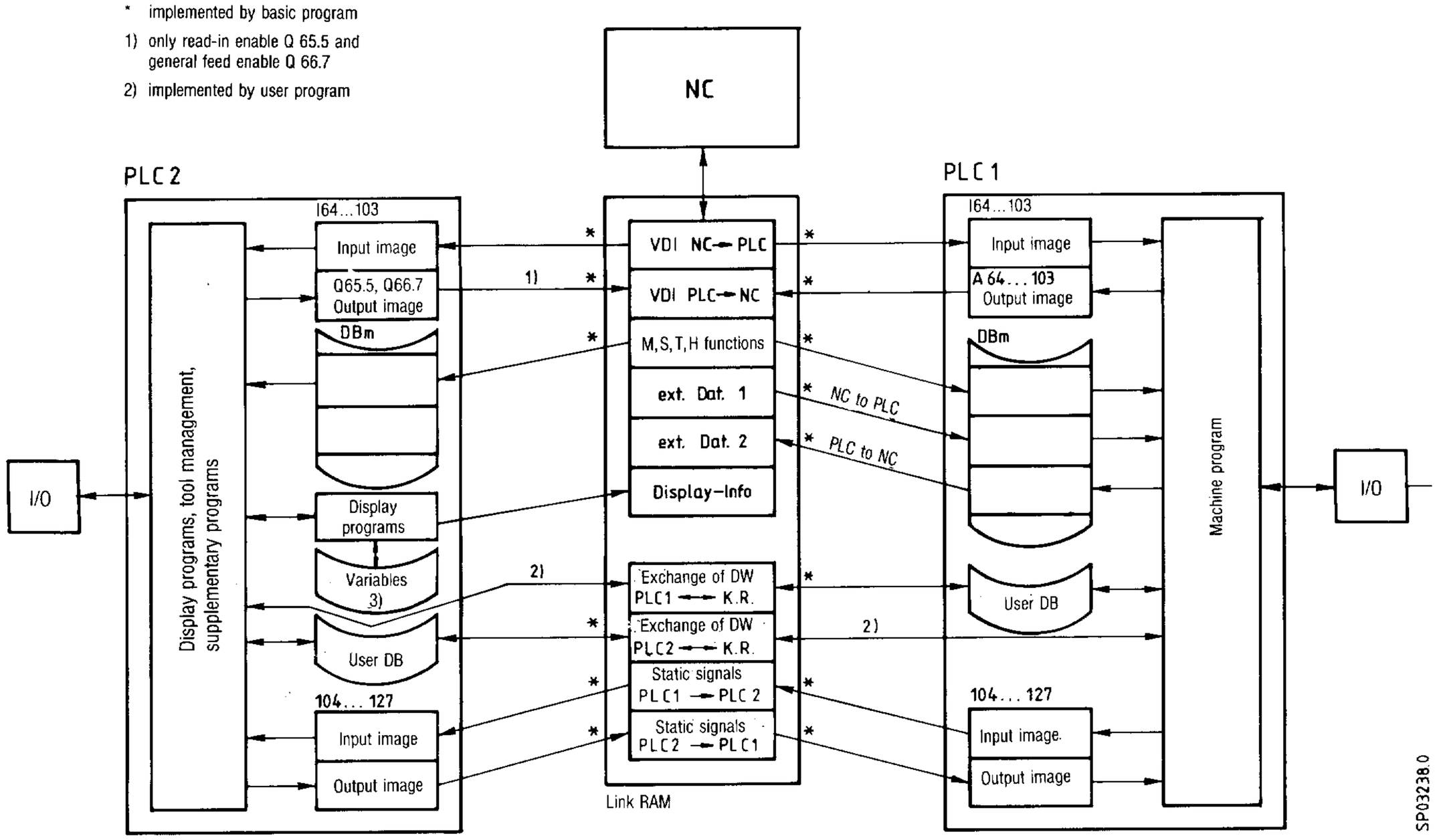
T-PLC Triple PLC available
"1" signal indicates a Triple PLC system

12.4 Exchange of VDI signals

* implemented by basic program

1) only read-in enable Q 65.5 and general feed enable Q 66.7

2) implemented by user program



Signal exchange between NC/PLC and PLC1/PLC2

12.4.1 NC to PLC signals

NC to PLC signals are available to the user in the input images of PLC1 and PLC2 (Fig. 2).

12.4.2 PLC to NC signals

PLC to NC signals can be preset by PLC1 only.

The VDI signals that affect program processing ("read-in enable" and "general feed enable") can also be preset by PLC2. They are combined and transferred to the appropriate NC by the basic program. A "read-in enable" or "general feed enable" in the relevant NC is effected only if the enable signal is present in PLC1 and PLC2 (Fig. 2).

12.5 Auxiliary functions (M, S, T, H)

The auxiliary functions are available to the user in PLC1 and PLC2 for $\geq$ 1 PLC cycle (Fig. 2).

12.6 External data transfer NC <-> PLC

Data transfer to PLC1 follows the same routine as before for the user. In addition, the standard blocks FB61 and 62 that have been modified for the Dual PLC are provided in the PLC1 basic program for block transfer. There is no data transfer from the basic program in PLC2 (DB21, 23 .... DW15 to DW144). The user can implement data transfer in PLC2 by means of FB61, 62. The user can copy blocks FB61, 62 from the PLC1 basic program into the PLC2 user EPROM submodule and call them there in OB1.

12.7 Machine control panel

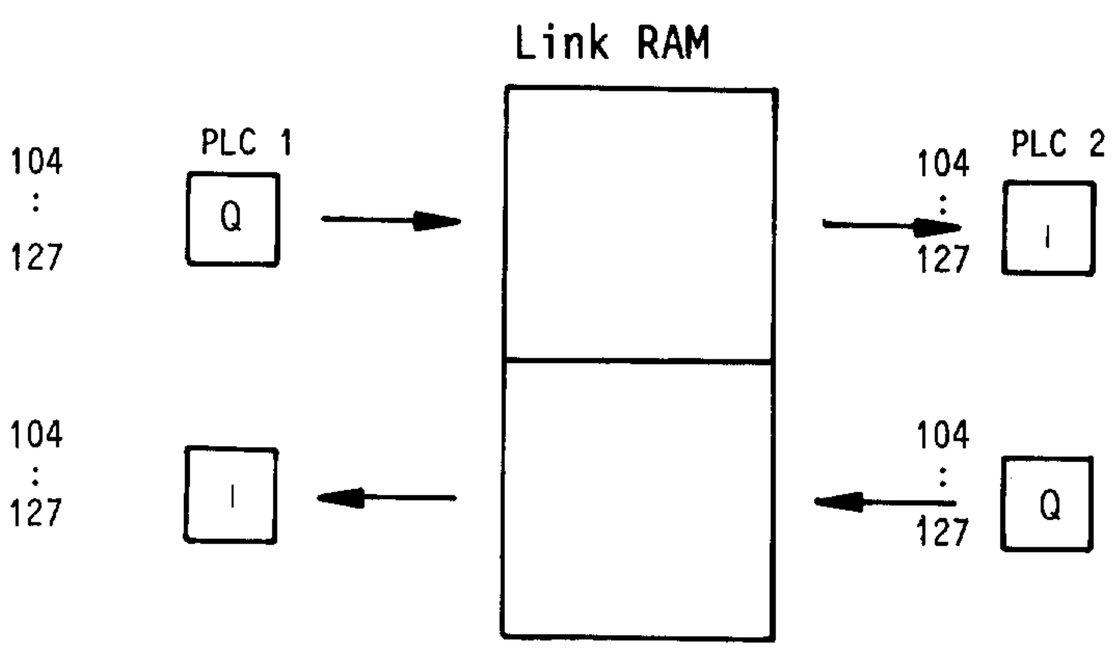
Machine control panel signals can be carried via PLC1 only.

12.8 Data exchange between PLC1 and PLC2

12.8.1 Exchange of static signals (Fig. 2)

The following are exchanged cyclically between PLC1 and PLC2:

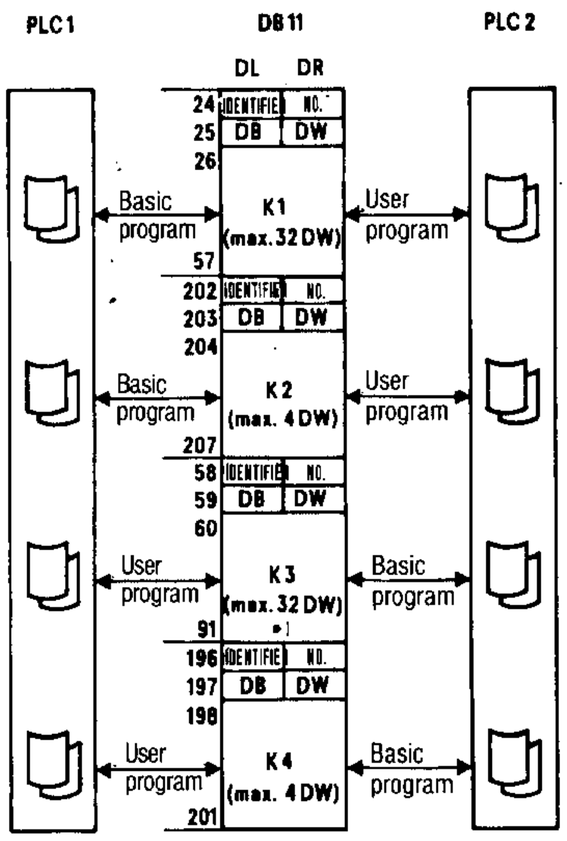
- PLC1 output bytes 104 to 127 to PLC2 input bytes 104 to 127
- PLC2 output bytes 104 to 127 to PLC1 input bytes 104 to 127



12.8.2 Exchange of data words between PLC1 and PLC2

The basic program enables the user to exchange data words between PLC1 and PLC2 and the Link RAM in PLC1 (Fig. 3).

Exchange of data words between PLC1, PLC2 and PLC3



Channels 1 and 3 with max. 32 data words with Dual PLC basic program version 03 and above only

SP04031.1

The user can determine the following transmission criteria:

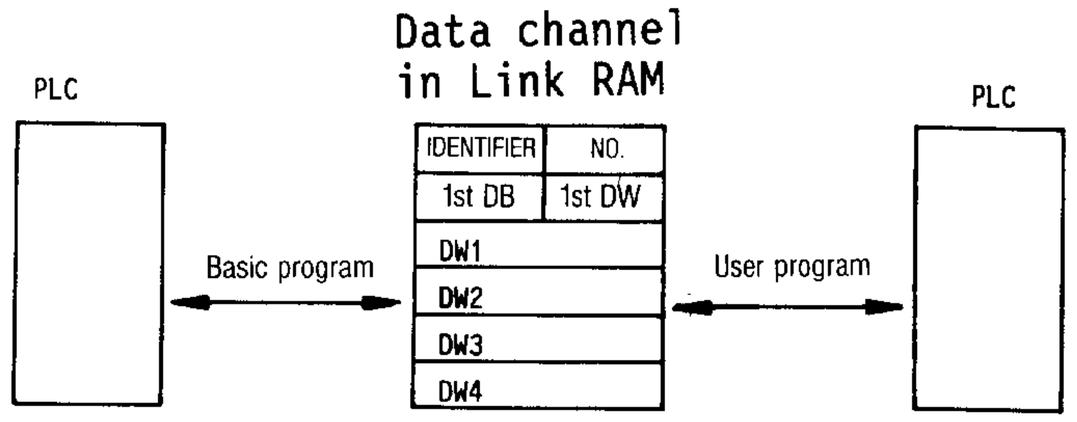
- Transmission direction:
  Write: data words from Link RAM ---> PLC
  Read : data words from PLC ---> Link RAM

- Transmission mode:
  Parallel: data words in several DBs
  Serial : data words in one DB

- Number of data words to be transmitted

The interface to the user comprises 80 data words in DB11. These have to be evaluated or supplied by the user. Four data channels are provided:

Principle (example for one data channel):



Reading data words:
(Data direction PLC ---> Link RAM)

Reading data words means transferring data words filed in one of the two PLCs from the basic program to the relevant Link RAM. They can then be processed further by the user program.
The user enters the DB and DW numbers and the number of words to be read in the interface and then adds the identifiers for parallel/serial, reading and the strobe bit. The error bit and "data available" bit have to be erased. When the data words have been read, the strobe bit is deleted, the error bit is not set and the "data available" bit is set.

If the user DBs are not available or have not been set up long enough in the "parallel reading" transmission mode, the basic program sets the error bit. The number of the unavailable data word is given in DW1 (see above) (DL1: DB No., DR1: DW No.).

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Writing data words:
(Data direction Link RAM ---> PLC)

Writing data words means transferring data words filed in the Link RAM from the basic program to the relevant PLC. The user enters the DB and DW numbers and the number of data words to be written in the interface and then adds the identifiers for parallel/serial, writing and the strobe bit. All other bits have to be erased. Successful transfer has taken place if the strobe bit has been deleted and the error bit has not been set.

The basic program checks whether the user DBs are available and have been set up long enough.
If this is not the case, the error bit is set.

a) Data exchange between PLC1 and PLC2

With Dual PLC basic program version 01 and above, 4 data words in each case can be exchanged between PLC1 and PLC2 via the following channels:

C2 Data exchange PLC1 <--> Link RAM1

DB11	DL202	Identifier
	DR202	Number
	DL203	1. DB
	DR203	1. DW
	DW204-207	max. 4 DW

C4 Data exchange PLC2 <--> Link RAM1

DB11	DL196	Identifier
	DR196	Number
	DL197	1. DB
	DR197	1. DW
	DW198-201	max. 4 DW

In addition, with Dual PLC basic program version 03 and above, 32 data words in each case can be exchanged between PLC1 and PLC2 via the following channels:

C1 Data exchange PLC1 <--> Link RAM1

DB11	DL24	Identifier
	DR24	Number
	DL25	1. DB
	DR25	1. DW
	DW26-57	max. 32 DW

C3 Data exchange PLC2 <--> Link RAM1

DB11	DL58	Identifier
	DR58	Number
	DL59	1. DB
	DR59	1. DW
	DW60-91	max. 32 DW

Structure of a data channel:

DL	DR
IDENT.	NO.
1. DB	1. DW
DW1	
:	
:	
DW32	

IDENT. Identifiers:

7	6	5	4	3	2	1	0
S	S/L	F	P/R	VOR			

S Strobe bit
The user sets the bit after he has provided the rest of the interface (1st DB, 1st DW and, for writing, DW1-DW32). After the job has been processed, the basic program erases the strobe bit.

S/L Read/write
"0" signal = Write
"1" signal = Read

Link RAM --> PLC
PLC --> Link RAM

F Error
"1" signal: Number > 32 or < 1 DW
or a parameterized
is not available.

P/R Parallel/serial
"0" signal = Parallel
"1" signal = Serial

VOR Data available
"1" signal = Data are available
(READING only)

NO. Number of data words (1-4/32) for reading/writing

1.DB Number of the first data block

1.DW Number of the first data word

DW1-DW32 1st to 32nd word

Examples

1. The PLC1 user program instigates the transfer of 4 data words from PLC2 to the Link RAM (channel 4). The data words are stored in parallel in PLC2, starting in DB160, DW12. The user has to call the following program in the PLC1:

```
    : C    DB11
    : L    DL196
    : T    FB255
    : A    F 255.7  Strobe
    : BEC
    : A    F 255.3  Data available
    : JC   =LES
    : L    KY160,12
    : T    DW197
    : L    KHC004   Strobe/read, No.=4
    : T    DW196
    : BEU
LES : L KB0
    : T DL196
    : A F 255.5     Error(s)
    : JC   =FEHL
OK  :                Reading data words
    :                from channel 4 (Link
    :                RAM) into PLC1 memory
    : BEU
FEHL: L    KB0      Reaction to error(s)
    : T    DL196
    :
    : BE
```

2. The PLC2 user program instigates the transfer of 2 data words filed by the user in the Link RAM (channel 2) to the PLC1 data blocks. The data words are stored in series in PLC1, starting in DB70, DW11. The user has to call the following program in the PLC2:

```
    : C    DB11
    : L    DL202
    : T    FB255
    : O    F 255.7  Strobe
    : O    F 255.3  Data available
    : BEC
    : A    F 255.5  Error(s)?
    : JC   =FEHL
    : L    KY070,11
    : T    DW203
    : L    KH1234   Word 1
    : T    DW204
    : L    KH5678   Word 2
    : T    DW205
    : L    KH9002   Strobe/serial, No.=2
    : T    DW202
    : BEU
FEHL: L    KB0      Reaction to error(s)
    : T    DL202
    :
    :
    : BE
```

3. The PLC1 user program instigates the transfer of 32 data words from PLC2 to the Link RAM (channel 3). The data words are stored in parallel in PLC2, starting in DB40, DW0. The user has to call the following program in the PLC1:

```
    : C    DB11
    : L    DL58
    : T    FB255
    : A    F 255.7  Strobe bit = 1?
    : BEC
    : A    F 255.3  Data available
    : JC   =LES
    : L    KY 40,0  1.DB, 1.DW
    : T    DW59
    : L    KHC020   No. = 32
    : T    DW58
    : BEU
LES : L KB0
    : T DL58
    : A F 255.5     Error(s)
    : JC   =FEHL
OK  :                Reading data words
    :                from channel 3 (Link
    :                RAM) into PLC1 memory
    : BEU
FEHL: L    KB0      Reaction to error(s)
    : T    DL58
    :
    : BE
```

12.9 Display programs

If display programs are used, comply with the following Dual PLC display program versions:

for PLC1: 6FC9 371-2FB01
(or more recent version)

for PLC2: 6FC9 371-2FC01
(or more recent version)

12.9.1 STATUS display

The FBs for STATUS are filed in both PLC basic programs.
Selection is via the menu: menu No. 0 for STATUS PLC1 and menu No. 1 for STATUS PLC2. The numbers are preset.

12.9.2 Fault and operator messages, step display and dialog information

The messages are recorded in one or both PLCs. In the case of fault and operator messages, the inquiry FB may be in PLC1 and PLC2. In the case of dialog information, the buffer memory entry may be in PLC1 and PLC2.
In the case of the step display, the buffer memory entry may be in PLC1 and PLC2, but not at the same time.
The display FB and the fault texts in the DBs of the individual display programs must be in the PLC2.

12.9.3 Menu, header line, data I/O, DB display

These display programs must always be filed in PLC2. Menu No. 0 for STATUS PLC1, and menu No. 1 for STATUS PLC2 have to be reserved for the menu FB. The DB39 menu has to be preset as appropriate. In the case of data I/O, a data word is determined for each display program No. (display) in DB38 according to the location of the variables (PLC1 or PLC2).

12.10 Notes on starting up

12.10.1 Switch-on sequence

Since the start-up of PLC1, PLC2 and NC is mutually coordinated, a specific switch-on sequence has to be observed: The non-intelligent units (EU) must always be switched on first. The units (tiers) without a Link RAM are switched on next. The final unit to be switched on is the one with the Link RAM(s). All units (tiers) can be switched on simultaneously provided that the overall difference is not greater than 100 ms. The following switch-on sequences apply to hardware configurations according to Section 1.1:

External Dual PLC (Section 1.1.5)

1. EU
2. PLC2
3. NC, PLC1

External Dual PLC (Section 1.1.6)

1. EU
2. PLC2, NC
3. PLC1

Dual PLC in one rack (Section 1.1.7)

1. EU
2. NC
3. PLC1 and PLC2 (Dual PLC)

12.10.2 Overall reset

On the external Dual PLC version, overall reset of the PLC2 functions only if the PLC1 does not switch to stop when started up (power supply on, hardware reset).

12.10.3 NC cancel functions

To carry out NC cancel functions the reset keys have to be pressed, first on the PLC and then on the NC power pack, otherwise the PLC switches to stop and the NC remains in the PLC fault loop. If only one reset key is pressed or PLC1 or PLC2 remains in the stop mode, the NC cancel function is not carried out.
The power supply can be switched on and off as an alternative to operating the reset buttons.

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Suggestions

Corrections

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