Start-Up 11/2005 Edition

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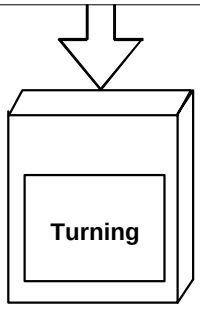
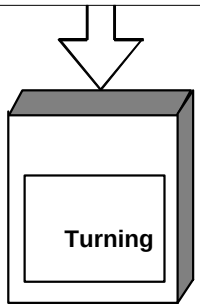
SINUMERIK 801

SINUMERIK 801 Document Structure

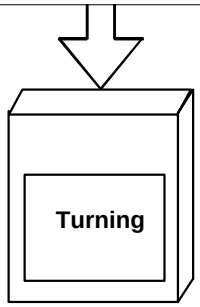
User Documentation: Operation and Programming



Technical Documentation: Start-Up



User Documentation: Diagnostics Guide



SIEMENS

SINUMERIK 801

Start-Up

Technical Manual

Valid for

Control system
SINUMERIK 801

11. 2005 Edition

SINUMERIK® Documentation

Key to editions

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

The column headed “Note” lists the amended sections, with reference to the previous edition.

Marking of edition in the “Note” column:

A ... ... New documentation.
B ... ... Unchanged reprint with new order number.
C ... ... Revised edition of new issue.

Edition	Order No.	Note
2005.11	A5E00702069	**A**

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This Manual contains notices intended to ensure your personal safety, as well as to protect products and connected equipment against damage. Safety notices are highlighted by a warning triangle and presented in the following categories depending on the degree of risk involved:

Danger

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury or in substantial property damage.

Warning

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury or in substantial property damage.

Caution

Used with safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.

Caution

Used without safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

Notice

Indicates important information relating to the product or highlights part of the documentation for special attention.

Qualified person

The unit may only be started up and operated by qualified person or persons. Qualified personnel as referred to in the safety notices provided in this document are those who are authorized to start up, earth and label units, systems and circuits in accordance with relevant safety standards.

Proper use

Please observe the following:

Warning

The unit may be used only for the applications described in the catalog or the technical description, and only in combination with the equipment, components and devices of other manufacturers as far as this is recommended or permitted by Siemens.

This product must be transported, stored and installed as intended, and maintained and operated with care to ensure that it functions correctly and safely.

Table of Contents

SINUMERIK 801 Control System 1

1.1 System Overview

General

The SINUMERIK 801 is a highly integrated, high-performance and economic numerical control system, which can be extensively applied to economic CNC turning machines. It can control 2 feed axes and 1 spindle. Control signals output to feed axes include digital pulse, direction and enable signals, control signals output to the spindle include analog voltage and enable. The SINUMERIK 801 can thus be used to control feed axes for stepper drives, and servo drives with digital pulse interfaces. Either servo spindle or variable frequency spindle can be controlled via the SINUMERIK 801. This documentation gives descriptions for configuring the SINUMERIK 801 with stepper drives/servo drives.

System components

The SINUMERIK 801 control system is a compact CNC unit. It consists of the following components:

- CNC

  A compact CNC with an integrated 6″ LCD, full NC keys and MCP area;
- Stepper drives and stepper motors
  1) Stepper drives STEPDRIVE C/C^{+};
  2) Five-phase hybrid stepper motors
- Cables
  1) Signal cables for connecting CNC to drives;
  2) Cables for connecting drives to motors;
  3) Signal cable for connecting spindle encoder to CNC;
  4) RS232 cable for connecting CNC to a PC;
  5) Signal cable for connecting CNC to an electronic handwheel.
- One spindle encoder
- One electronic handwheel
- Possible configurations by users: servo motors (with digital pulse interfaces) and servo motors.

SINUMERIK 801 system

Fig.1-1 SINUMERIK 801 system overview (CNC + stepper drives + stepper motors)

1.2 CNC Operator Panel

Layout of the CNC operator panel

The SINUMERIK 801 has a compact operator panel, which can be divided into three areas as: LCD, NC keys and MCP area.

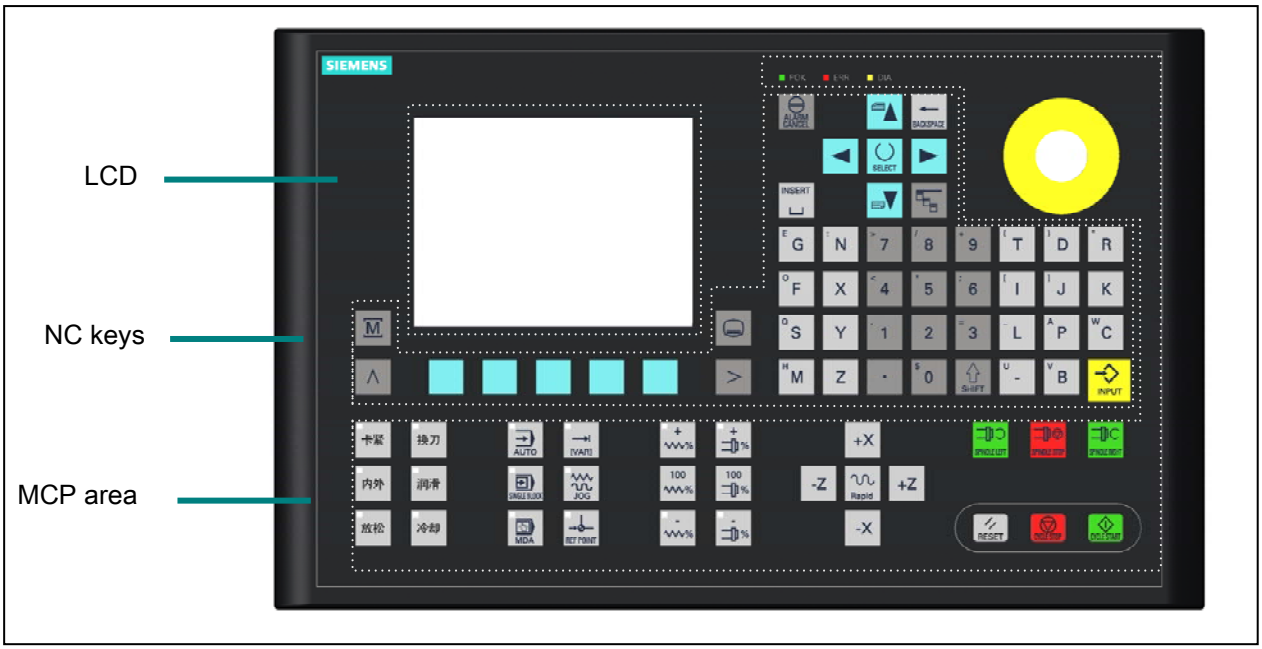


Fig. 1-2 Layout of the CNC operator panel (front view)

Key definition

NC keyboard area

M	Machine area key		Cursor UP (with shift: page up)
Λ	Recall key		Cursor DOWN (with shift: page down)
	Softkey		Cursor LEFT
	Area switchover key		Cursor RIGHT
>	ETC key	SELECT	Selection key/toggle key

Acknowledge alarm

Delete key (backspace)

SPACE (INSERT)

Vertical menu

ENTER / input key

Shift key

Numerical keys (with shift for alternative assignment)

Alphanumeric keys (with shift for alternative assignment)

Notice

See"Operation & Programming" for the use of NC keys.

MCP (Machine Control Panel) area

Chuck clamping (with LED)

Spindle override 100%

Chuck clamping internally / Chuck clamping externally (with LED)

Spindle override minus (with LED)

Chuck unclamping (with LED)

X axis, plus direction

Manual tool change (with LED)

X axis, minus direction

Manual lubrication (with LED)

Z axis, plus direction

Manual coolant (with LED)

Z axis, minus direction

AUTOMATIC (with LED)

RAPID TRAVERSE OVERLAY

SINGLE BLOCK (with LED)

SPINDLE START LEFT
Counterclockwise direction

MANUAL DATA (with LED)

SPINDLE STOP

Increment (with LED)

SPINDLE START RIGHT
Clockwise direction

JOG (with LED)

REFERENCE POINT (with LED)

Feedrate override plus (with LED)

Feedrate override 100%

Feedrate override minus (with LED)

Spindle override plus (with LED)

RESET

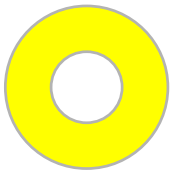
NC STOP

NC START

LED POK (Power OK), green

LED ERR (Error), red

LED DIA (Diagnostics), yellow



Emergency Stop button (option)

Notice

See Chapter 3 “Built-in PLC Application” for detailed definitions of User Keys, Traverse keys (+X, -X, +Z, -Z) and override keys.

1.3 Position of the Interfaces

General

Interfaces of the control system are positioned in the rear of the CNC system, see Fig. 1-3 below.

Interfaces

Interfaces of the SINUMERIK 801 control system are shown as below:

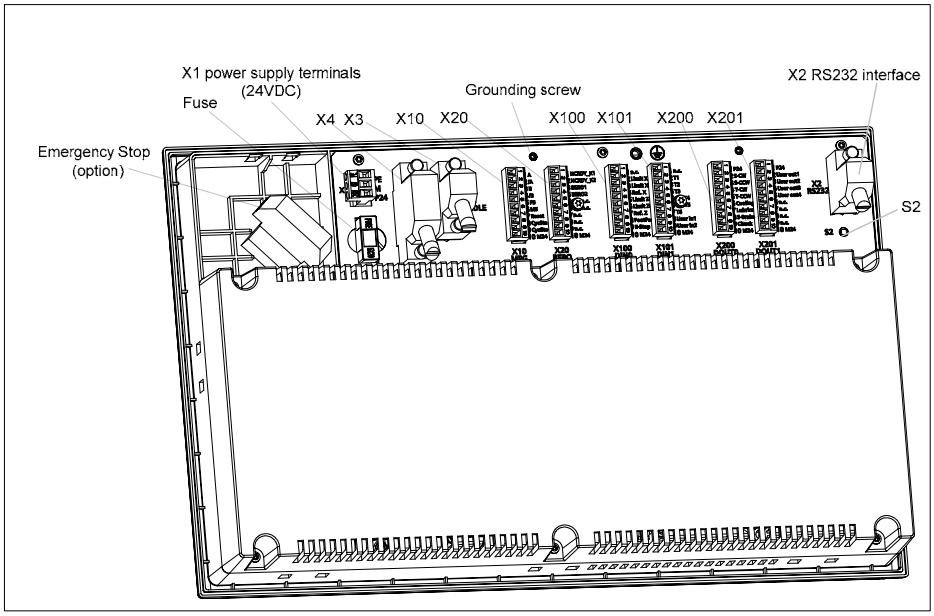


Fig. 1-3 Position of SINUMERIK 801 interfaces

Notice

See Section 2.3 “Interfaces and Cables” for detailed description of each interface.

1.4 Technical Data

Connected load

Table 1–1 Connected load

Parameter	Min.	Typ.	Max.	Unit
Supply voltage	20.4	24	28.8	V
Ripple			3.6	Vss
Current consumption from 24 V		2		A
Power dissipation of CNC		48		W
Start-up current			4	A

Note: The 24V DC voltage must be generated as a functional extra-low voltage with safe electrical isolation (to EN60204-1, Section 6.4, PELV).

Weight

Table 1–2 Weight

Component	Weight [g]
CNC	2120 circa

Dimensions

Table 1–3 Component dimensions

Component	Dimensions LxWxD [mm]
CNC	400 x 250 x 57.6

Environmental operating conditions

Table 1–4 Environmental operating conditions

Parameter	
Temperature range (horizontal mounting and convection)	0….55°C (for box) ; 0….45°C (for display surface)
Permissible relative humidity	5…95% without condensation
Air pressure	860 ... 1,060 hPa

The operating conditions refer to EN60204-1.
Installation in a housing (e.g. cubicle) is absolutely necessary for operation.

Transport and storage conditions

Table 1–5 Transport and storage conditions

Parameter	
Temperature range	-20 ... 60°C
Permissible relative air humidity	5 ... 95 % without condensation
Air pressure	700 ... 1,060hPa
Transport height	–1,000 ... 3,000m
Free fall in transport package	≤0.5m

Protection class

Class of protection I according to IEC 529

The control must be equipped with a grounding conductor terminal.

Protection against ingress of solid foreign bodies and water according to ICE 529:

For CNC system: Front: IP54 Rear: IP20

Installation and Start-Up 2

2.1 Cabinet, Power supply and Grounding

Requirements for cabinet

Machine tool builders need to pay attention to following requirements for a cabinet:

1) Furnish the cabinet with a cooling or ventilation device; When using an electric fan to cool the cabinet, mount a dust gauze at the air inlet of the cabinet;
2) Mount all cabinet components on an unpainted galvanized metal plate;
3) Protection class for cabinet: IP54;
4) Grounding as per China national standard *GB/T5226.1-2002/IEC60204-1 : 2000 Safety of machinery - Electrical equipment of machines – Part II: General requirements*;
5) In the case of poor field grounding, disconnect connections between PE and neutral (M24) of DC24V power supply and have CNC ungrounded;
6) When CNC is ungrounded, it's imperative to configure a RS232 terminal adapter (order number: 6FX2003-0DS00) for RS232 connector to protect the connector from being broken down;
7) When wiring up the cabinet, AC supply lines (e.g. 85VAC, 220VAC, 380VAC lines and the cable for connecting an inverter to spindle motor) shall be routed separately from the 24VDC and signal cables;
8) If an inverter is used as spindle drive unit for the machine tool, take adequate anti-interference measures to protect the cabinet from mains interference and radio interference, etc;
9) Connect an isolation transformer (i.e. control transformer 380VAC ->220VAC, JBK3-400VA) to the 24VDC power supply for the control system; Connect a separate isolation transformer to the 85VAC power supply for stepper drives (i.e. drive transformer 380VAC ->85VAC, JBK3 series); Do not connect the primary side of both transformers to the same phase of the 380VAC;
10) Have the control transformer ungrounded in the case of poor field grounding, however, it's required to connect the 220VAC power supply for either periphery (e.g. PC/PG) to the control transformer, see Fig. 2-1.

Control transformer

Use a separate control transformer in the cabinet to supply the 24VDC power supply for CNC when Siemens stepper drives are used. Cable connections with the control transformer are shown in Fig. 2-1.

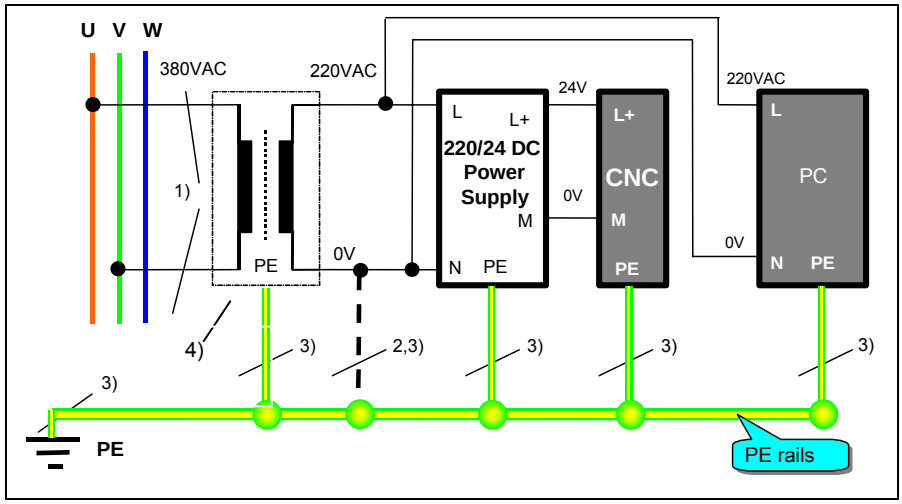


Fig. 2-1 Connecting the control transformer

Notes (for Fig. 2-1):

1) Two phases of U , V , W that are not used by the drive transformer;

2) Connections can not be made until PE rails are found well grounded.

3) In order to ensure a good grounding, the cross-sectional area of PE rails shall be not less than 6mm^2.

Notice

The control transformer will not be provided by Siemens. Customer may order it from other sources.

Drive transformer

Use a separate drive transformer in the cabinet to supply the 85VAC power supply for stepper drives. Connections with the drive transformer are shown in Fig. 2-2.

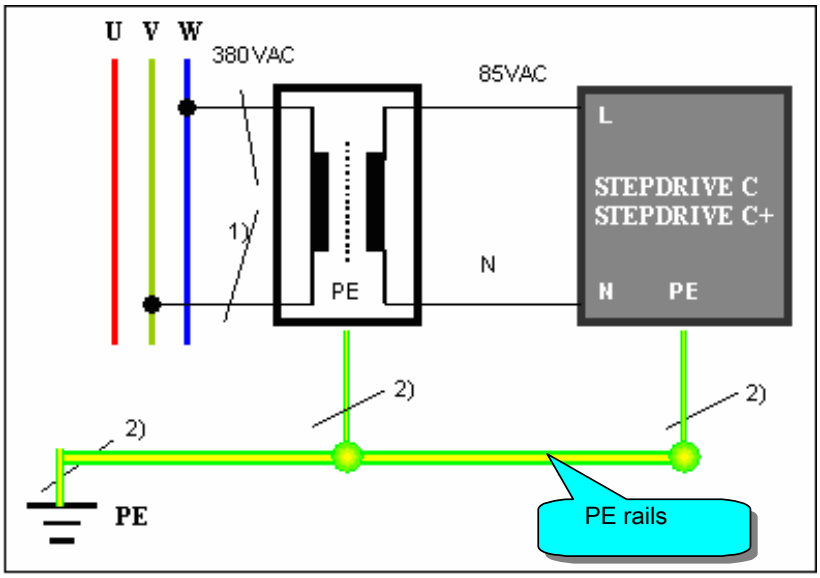


Fig. 2-2 Connecting the drive transformer

Notes (for Fig. 2-2):

1) Two phases of U，V，W that are not used by the control transformer;

2) In order to ensure a good grounding, the cross-sectional area of PE rails shall be not less than 6mm^2.

Notice

When AC servo drives are used, please connect cables as per requirements concerned.

24VDC power supply

The SINUMERIK 801 CNC is supplied by a 24V DC power supply, which enables the control system to run in order under the voltage range of 24V-15% ... +20%. The excellent quality of the DC power supply is critical for the stable operation of the control system. You're recommend to select Siemens 24VDC stabilized power supply (order number: 6EP1333-3BA00). If a DC power supply other than Siemens is used, please detect the output waveform generated when the power supply is switched off.

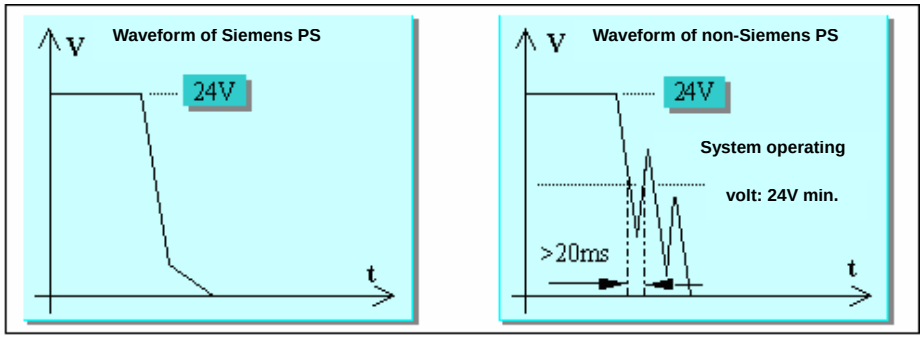


Fig. 2-3 The power supply waveform

If the waveform as shown in the upper right figure occurs, supply the SINUMERIK 801 in a way as indicated in the figure below and describe the system power-on sequences in the corresponding user guide for machine tools. Proper sequences are: switch on the mains for machine tools (to energize 24VDC power supply and drives) first, then supply the control system by pressing the button SA1; For switching off the control system, press SA2 first, then power off the mains for the machine tool.

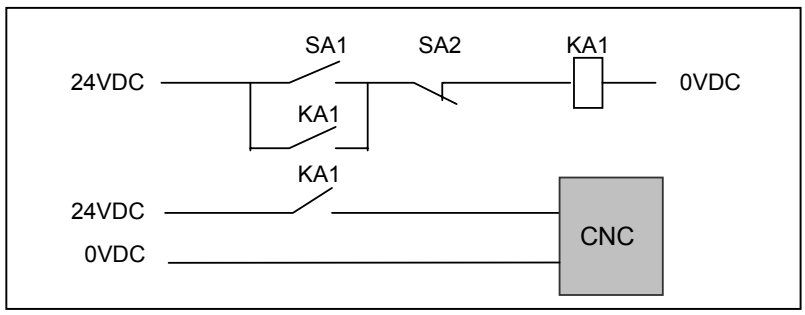


Fig. 2-4 Power on/off sequence of the power supply

Note:

1) All input signals must be level signals, i.e. level “0” (-3 ... 5VDC) and level “1” (11 ... 30VDC). Both suspended and high resistance signals are level “0”.

2.2 Installing and cabling

2.2.1 Installing the control system

Warning：

Never install or dismantle when the control system is under power!

General

As an integrated control system, the SINUMERIK 801 CNC can be installed in the machine control station directly. Stepper drives or servo drives are installed in the cabinet. The SINUMERIK 801 can be fixed in the station from the rear side of the CNC with 8 black plastic clips (each of them is equipped with one M4x16 fastening screw) specific for the control system. The maximum allowable torque for each screw is 1.5 Nm.

Notice

Prior to the installation, the machine control panel can be provided with an emergency stop button. If it is not required, the opening must be covered with a self-adhesive cover delivered together with the SINUMERIK 801.

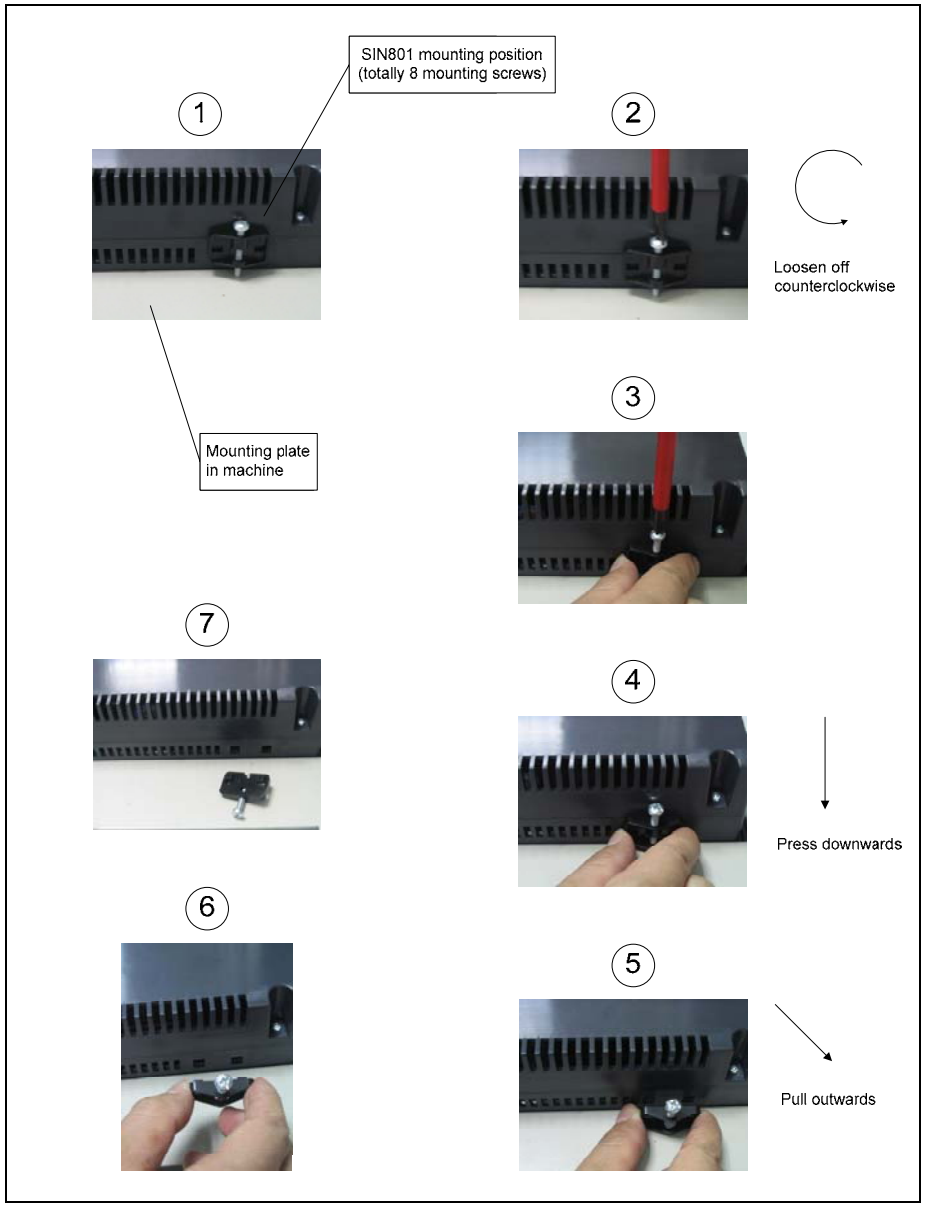


Fig.2-5 Schematic diagram for the dismounting of SINUMERIK 801 CNC

Notice

The control system is mounted as described above in the reverse order!

Mounting dimensions

See figures below for the mounting dimensions of SINUMERIK 801 CNC, STEPDRIVE C/C^{+} and step motors.

Notice

When AC servo drives, servo motors are used, please refer to installation instructions concerned for mounting dimensions.

Mounting Dimensions

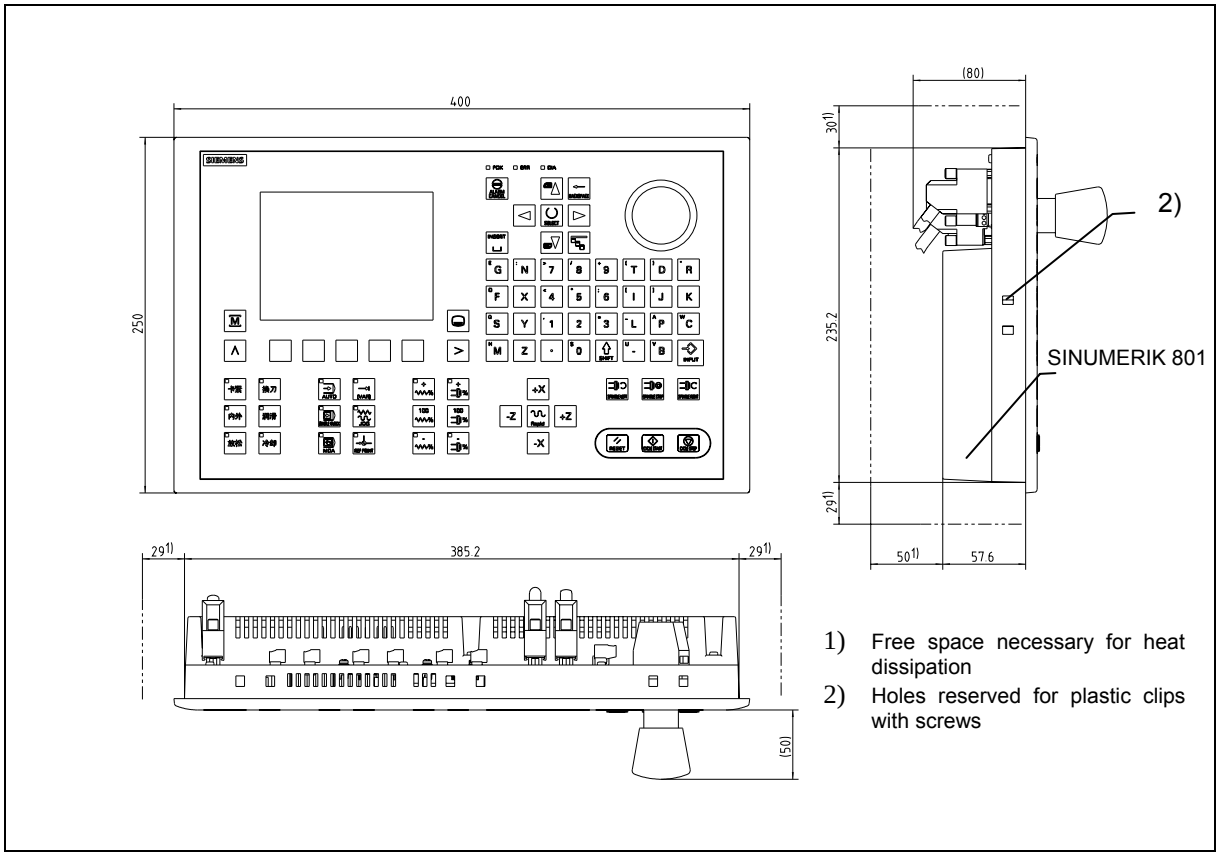


Fig. 2-6 CNC outline dimensions

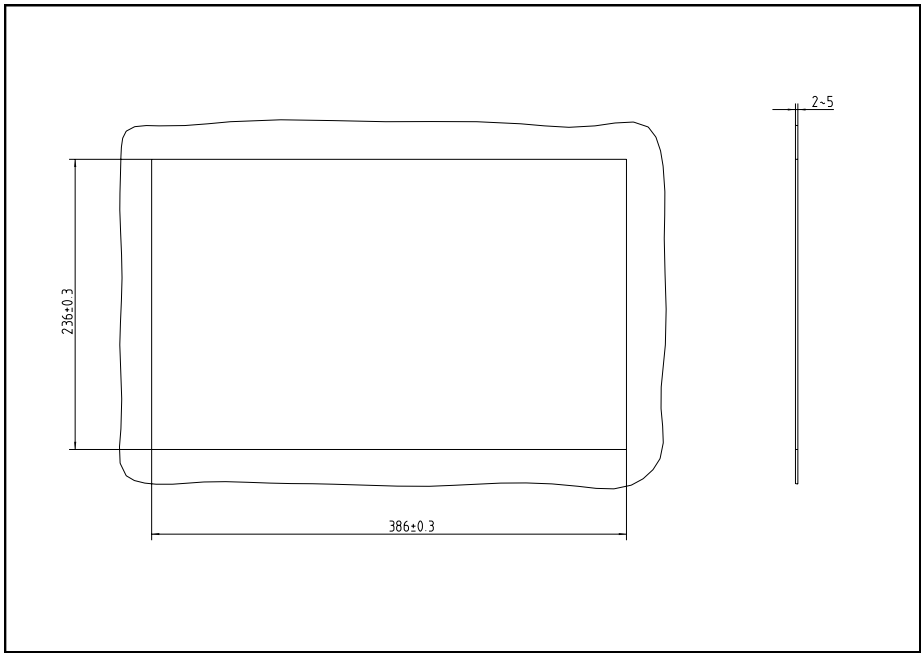


Fig. 2-7 Mounting hole dimensions

Step drives

To install the drive modules, proceed as follows (see vertical installation diagram shown in Fig. 2–8):

1. Screw in the upper fastening screws M5 with spring washer and spacer.
2. Hang the module into the clips of the upper fastening bracket.
3. Screw in the lower fastening screws and tighten all screws.

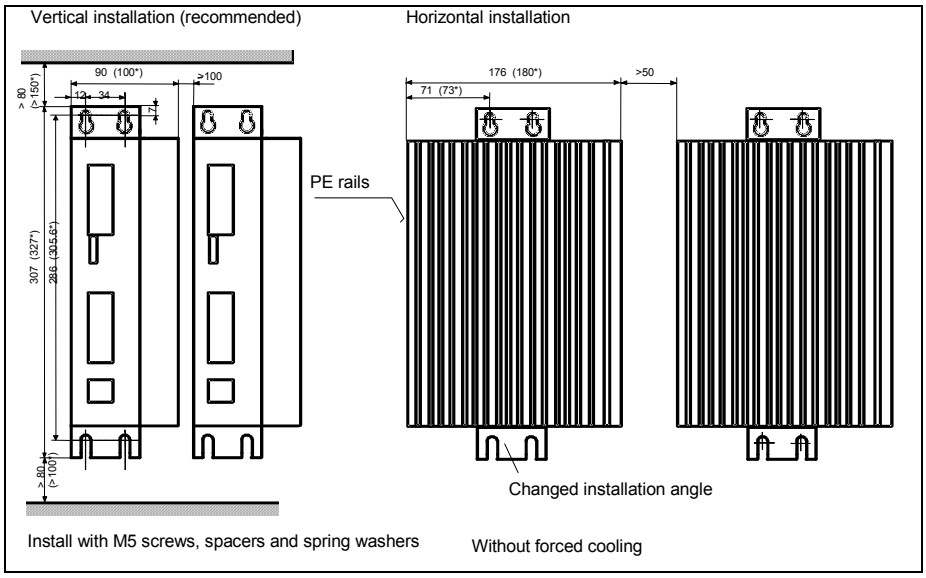


Fig. 2-8 Mounting dimensions for stepper drives

Notice

Bracketed dimensions as shown in the figure above are suitable for STEPDRIVE C+.

The modules should be installed such that a clearance of at least 10 cm is left above, below and between the modules (dimension “a”).

The drive modules, however, can be mounted directly side by side (a>10 mm) provided they are ventilated with an air stream greater than / equal to 1 m/s.

Do not install devices which are strongly heated during operation beneath the drive modules!

Step motors

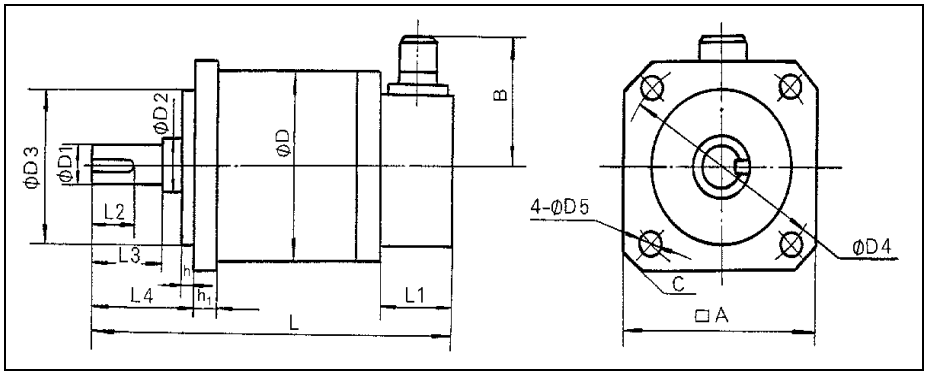


Fig. 2-9 Dimensions of the stepper motors (see Table 2-1)

Table 2-1 Outline dimensions of the stepper motors (see Fig. 2-9)

Model	Dimensions and tolerance																Key	Wt. (kg)
	D	D1	D2	D3	D4	D5	L	L_1	L_2	L_3	L_4	h	h1	A	B	C		
6FC5 548-0AB03-0AA0	92	9f6	10	60f7	107	6.6	162	34	14	20	26	3	7	93	62.5	R10	C3X14	3
6FC5 548-0AB06-0AA0	110	16f6	17	56f7	127	8.5	186.5	34	25	32	37	2	12.5	112	65.0	10X45°	C5X25	5.6
6FC5 548-0AB09-0AA0	110	16f6	17	56f7	127	8.5	216.5	34	25	32	37	2	12.5	112	65.0	10X45°	C5X25	7.2
6FC5 548-0AB12-0AA0	110	16f6	17	56f7	127	8.5	248.5	34	25	32	37	2	12.5	112	65.0	10X45°	C5X25	8.6
6FC5 548-0AB18-0AA0	130	16f6	17h7	100f7	155	10.5	239.0	34	32	36	43	3	15.0	132	90.0	10X45°	C5X25	13.0
6FC5 548-0AB25-0AA0	130	16f6	17h7	100f7	155	10.5	263.5	34	32	36	43	3	15.0	132	90.0	10X45°	C5X25	15.0

When installing the stepper motor, its radial load shall stay within the data range listed below:

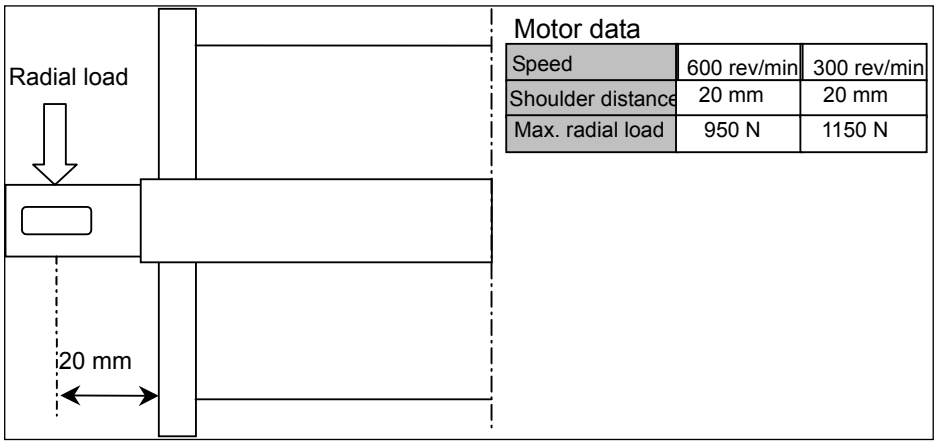


Fig. 2-10 Radial load of the stepper motor

Frequency – torque characteristics of the stepper motors

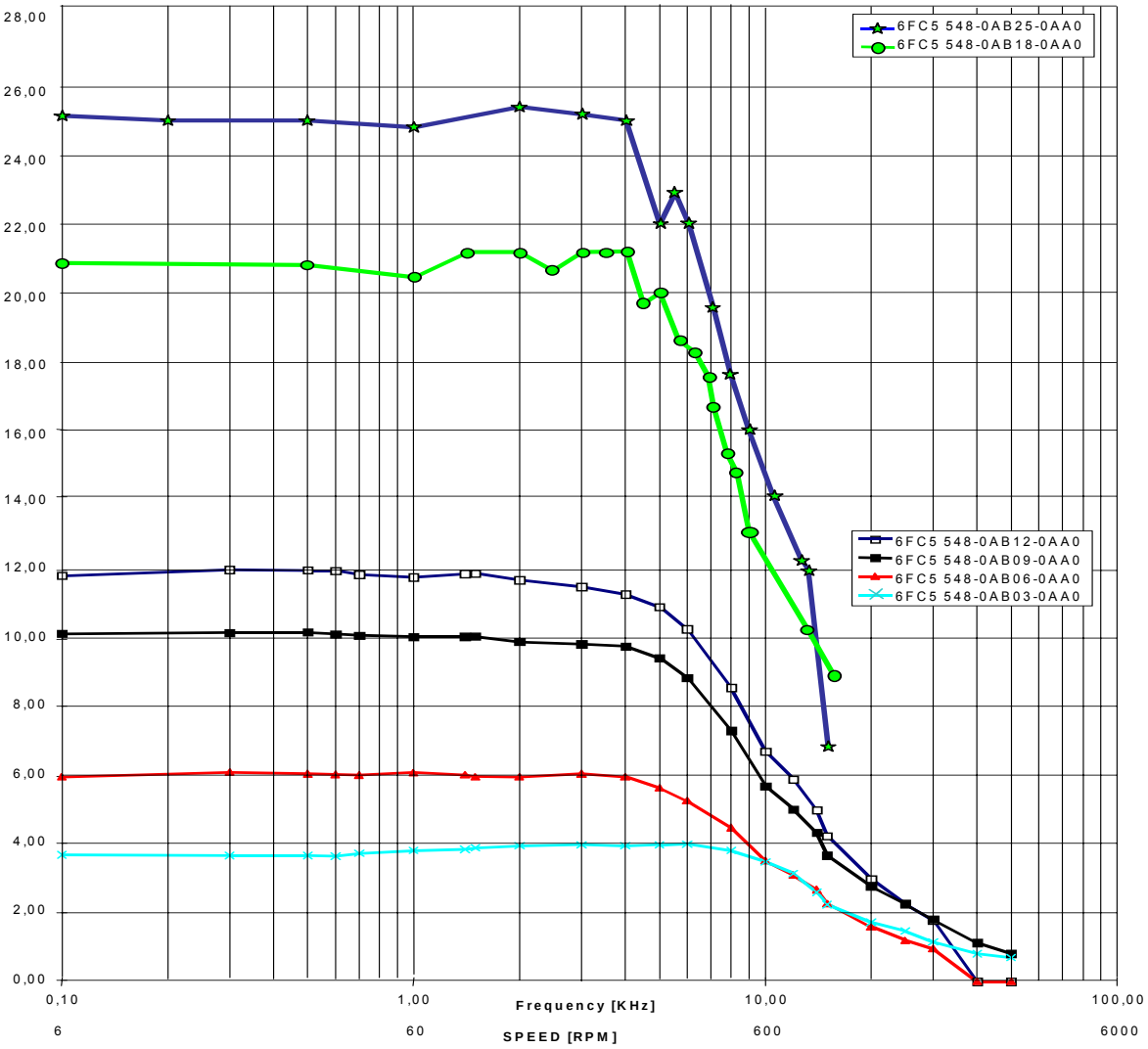


Fig. 2-11 Frequency – torque characteristics of the stepper motors

2.2.2 Cabling

2.2.2.1 Connecting with the stepper drives

Cable overview

Connect the STEPDRIVE C/C+ drive modules, the stepper motors and the SINUMERIK 801 control system as shown in the connection diagram 2-12. For the cables required, please refer to the diagram below.

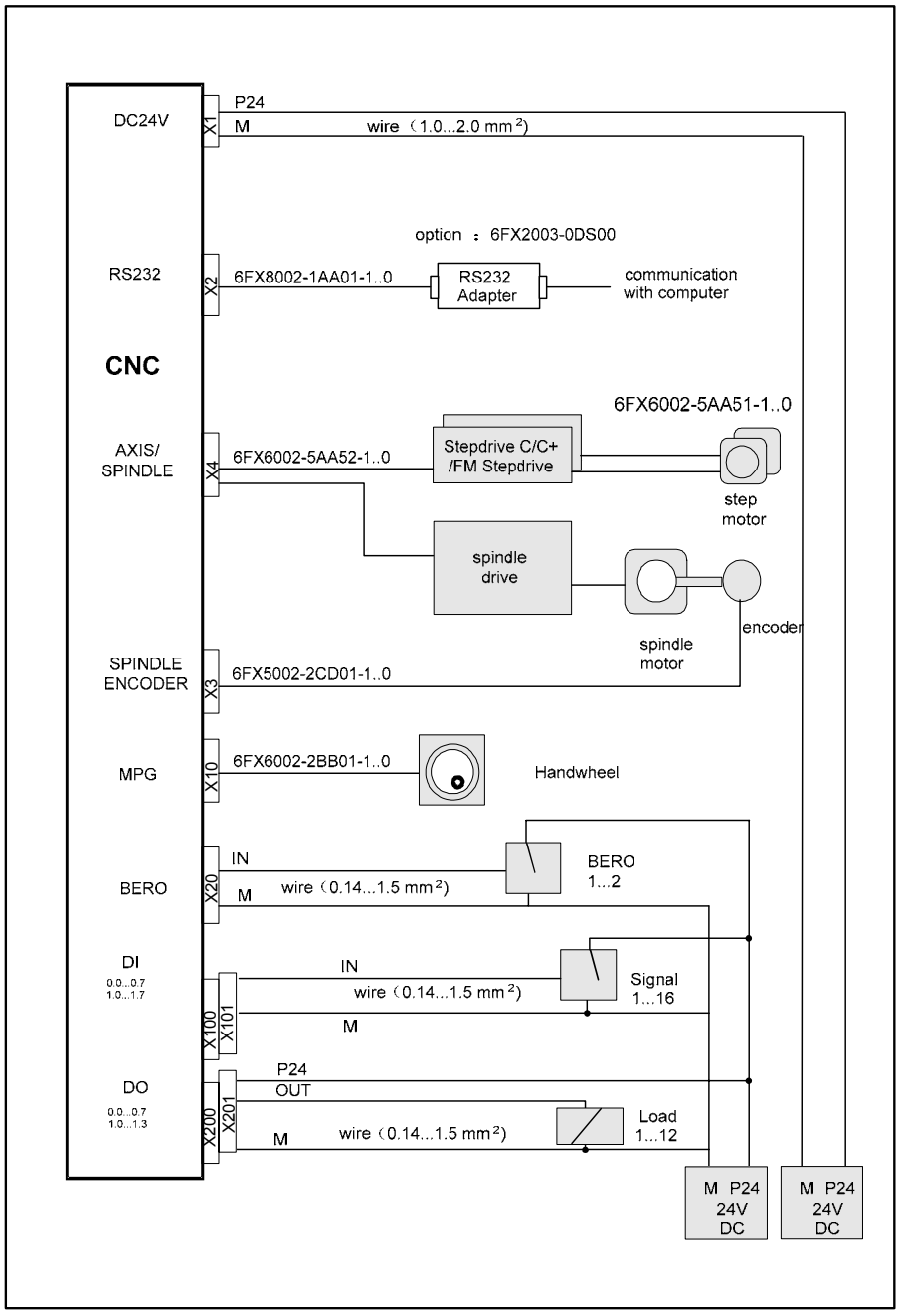


Fig. 2-12 Overview of cables

2.2.2.2 Connecting with the servo drives (example)

Notice

Adaptor, servo motor, servo drive and cable for connecting the adaptor to the servo drive are not included in the scope of supply of the SINUMERIK 801 control system.

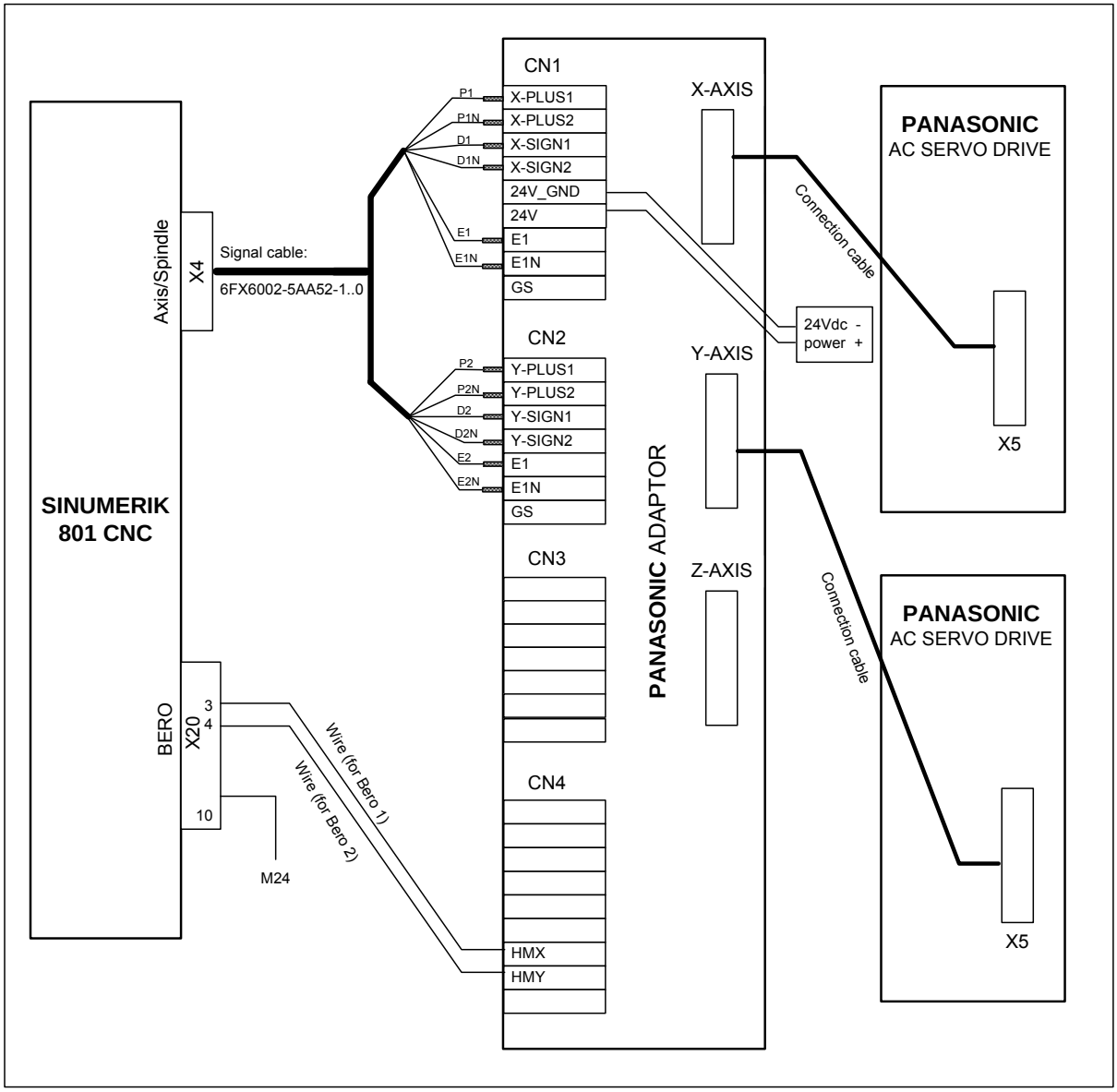


Fig. 2-13 Connecting with the servo drives (SINUMERIK 801+ Panasonic Adaptor + Panasonic Servo Drives)

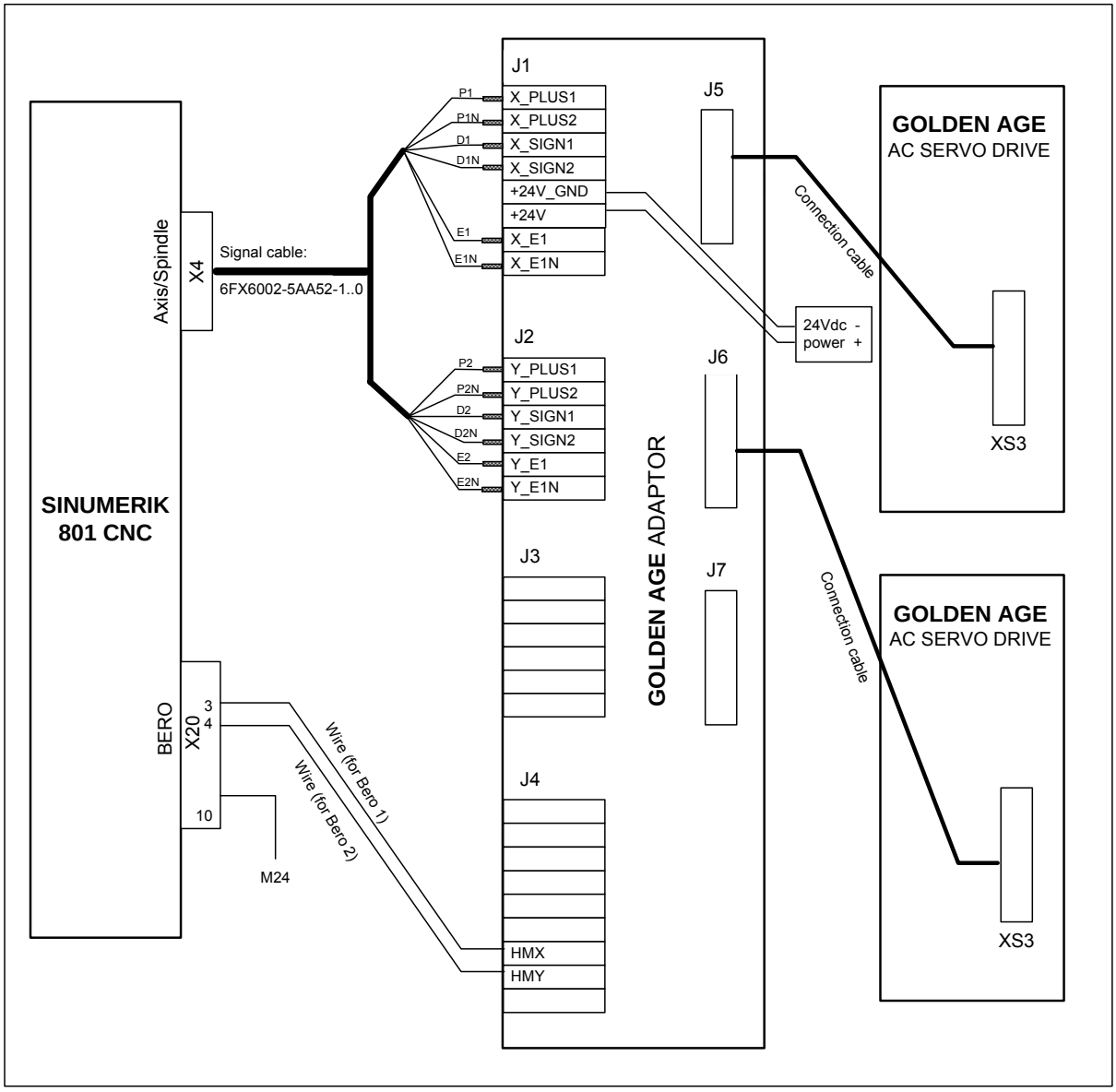


Fig. 2-14 Connecting with the servo drives (SINUMERIK 801+ Golden Age Adaptor + Golden Age Servo Drives)

2.3 Interfaces and Cables

Position of the interfaces

See Fig. 2-15 for interface positions.

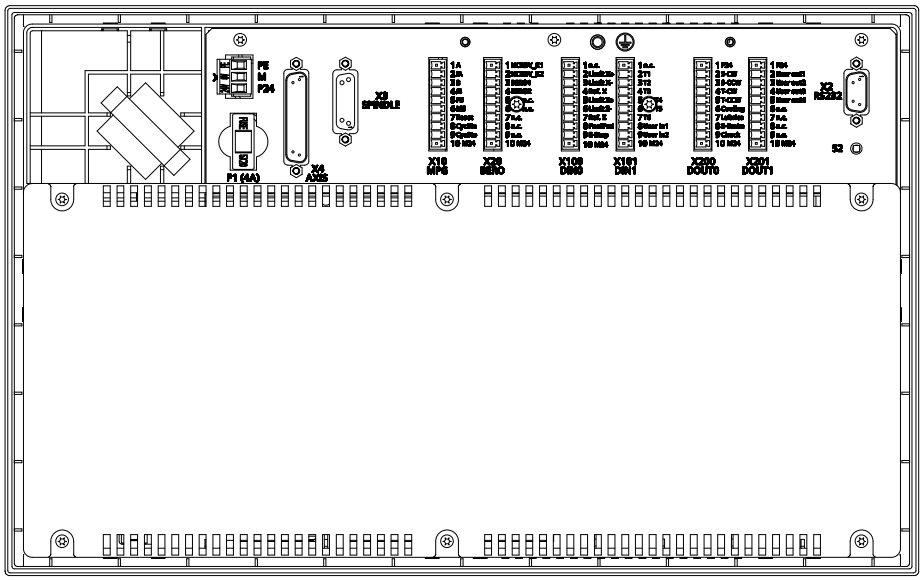


Fig. 2-15 Rear of CNC System

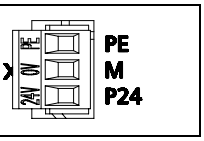
2.3.1 Power supply for CNC - X1

General

The 24V DC load power supply unit required for supplying CNC is connected to 3-pin screw-type terminal block.

Table 2-2 The load power supply for CNC (X1)

Terminal	Signal	Description
1	PE	Protective earth
2	M	0V
3	P24	DC24 V



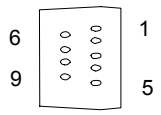
2.3.2 RS232 interface - X2 (RS232)

General

When external PC/PG is required to make data communication (WINPCIN) with the SINUMERIK 801, use RS232 plug connector (9 pin SUB-D).

Table 2-3 RS232 interface X2

Pin	Name	Type	Pin	Name	Type
1	n.c.		6	DSR	I
2	RxD	I	7	RTS	O
3	TxD	O	8	CTS	I
4	DTR	O	9	n.c.	
5	M	VO			



Signal description:

RxD	Receive Data
TxD	Transmit Data
RTS	Request to send
CTS	Clear to send
DTR	Data Terminal Ready
DSR	Data Set Ready
M	Ground (0V)

Signal level RS232

Signal type

I	Input
O	Output
VO	Voltage output

Cable for WinPCIN

Table 2-4 Cable for WinPCIN: Pin assignment of the Sub-D connector

9-Pin (801)	Name	25-Pin (PC)
1	Shield	1
2	RxD	2
3	TxD	3
4	DTR	6
5	M	7
6	DSR	20

7	RTS	5
8	CTS	4
9		

or

9-Pin (801)	Name	9-Pin (PC)
1	Shield	1
2	RxD	3
3	TxD	2
4	DTR	6
5	M	5
6	DSR	4
7	RTS	8
8	CTS	7
9		

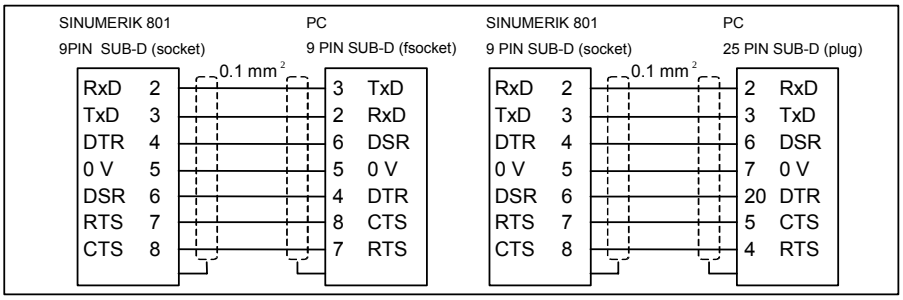


Fig. 2-16 Communication connector RS232(X2)

RS232 terminal adapter

When CNC stays ungrounded, a RS232 adapter must be used to protect RS232 connector from being broken down. The use and wiring method of the RS232 adapter is shown as below:

(1) The connecting diagram between the RS232 adapter and PC

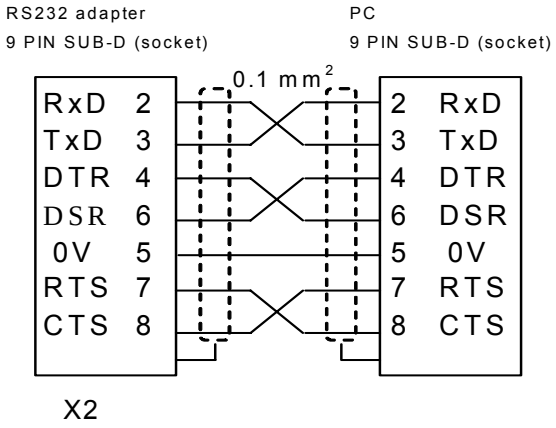


Fig. 2-17 Connecting diagram 1 (with 9 PIN SUB-D connector of PC Serial Port

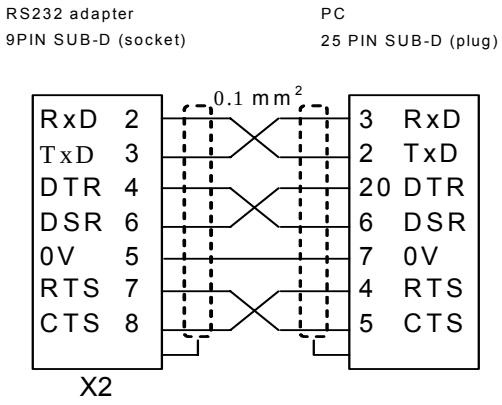


Fig. 2-18 Connecting diagram 2 (with 25PIN SUB-D connector of PC Serial Port)

(2) The connecting diagram between the RS232 adapter and SINUMERIK 801

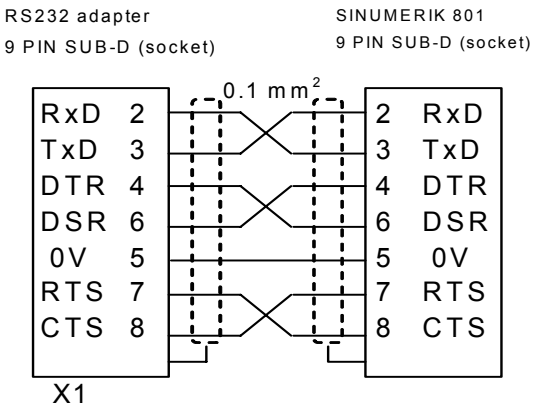


Fig.2-19 Connecting diagram 3 (with SINUMERIK 801)

Notes:

(1) X1 and X2 indicated in Fig. 2-17 ~ 2-19 refer to interfaces of RS232 adapter itself. In which, X1 is for connecting RM232 adapter and SINUMERIK 801, X2 is for connecting RS232 adapter and PC serial port.
(2) SIEMENS can provide the connecting cable (9PIN to 9PIN SUB-D), the order number (MLFB number): 6FX8002-1AA01-1..0.
(3) The maximum baudrate for RS232 adapter is 9600 and the maximum length of each connecting cable for PC and SINUMERIK 801 shall be no more than 15m.

Notice:

In order to ensure the common grounding between SINUMERIK 801 CNC and PC, use only shielded cable and make sure that the shield is connected to the metal or metal plated connector casing on both ends of the cable.

Connect and disconnect cables between CNC and PC under power-off conditions only;

We recommend you to use a RS232 terminal adapter (order number: 6FX2003-0DS00).

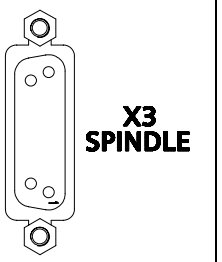
2.3.3 Spindle encoder interface – X3 (SPINDLE)

General

The spindle encoder interface (X3) of the SINUMERIK 801 is a 15-pin SUB-D socket connector.

Table 2-5 Spindle encoder interface X3

Pin	Signal	Type	Pin	Signal	Type
1	n.c.		9	M	VO
2	n.c.		10	Z	I
3	n.c.		11	Z_N	I
4	P5_MS	VO	12	B_N	I
5	n.c.		13	B	I
6	P5_MS	VO	14	A_N	I
7	M	VO	15	A	I
8	n.c.				



Signal	**Description**
A; A_N	Channel A
B; B_N	Channel B
Z; Z_N	Zero Reference Mark
P5_MS	+5,2V Supply Voltage
M	Ground

Signal level: RS422

Signal type

VO	Voltage output (supply)
I	5V input (5V signal)

Connectable encoder types

Incremental 5 V encoders can be connected directly.

Characteristics

The encoders must meet the following requirements:

Transmission method: Differential transmission with 5 V square-wave signals

Output signals: Track A as true and negated signal (U_{a1}, $\overline{U_{a1}}$)

Track B as true and negated signal (U_{a2}, $\overline{U_{a2}}$)

Zero signal N as true and negated signal (U_{a0}, $\overline{U_{a0}}$)

Max. output frequency: 1.5 MHz

Phase offset between tracks A and B: 90° ± 30°

Current consumption: max. 300 mA

Cable lengths

The maximum cable length depends on the specifications of the encoder power supply and on the transmission frequency.

To provide fault-free operation, make sure that the following values are not exceeded when using preassembled interconnecting cables from SIEMENS:

Table 2–6 Maximum cable lengths depending on the encoder power supply

Supply Voltage	Tolerance	Current Consumption	Max. Cable Length
5 V DC	4.75 V ... 5.25 V	≤ 300 mA	25 m
5 V DC	4.75 V ... 5.25 V	≤ 220 mA	35 m

Table 2–7 Maximum cable lengths depending on the transmission frequency

Encoder Type	Frequency	Max. Cable Length
incremental	1 MHz	10 m
	500 kHz	35 m

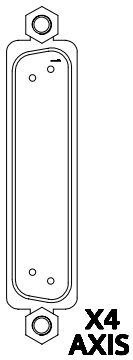
2.3.4 Feed drive interface - X4 (AXIS)

General

The feed drive interface X4 of the SINUMERIK 801 is a 25-pin SUB-D plug connector.

Table 2-8 Feed drive interface X4

Pin	Signal	Type	Pin	Signal	Type
1	PULS1	O	14	PULS1_N	O
2	DIR1	O	15	DIR1_N	O
3	ENABLE1	O	16	ENABLE1_N	O
4	PULS2	O	17	PULS2_N	O
5	DIR2		18	DIR2_N	O
6	ENABLE2	O	19	ENABLE2_N	O
7	n.c.		20	n.c.	
8	n.c.		21	n.c.	
9	n.c.		22	n.c.	
10	SE4_1	K	23	SE4_2	K
11	n.c.		24	n.c.	
12	AO4	AO	25	AGND4	AO
13	M				



Signal	Description
Stepper Interface	
PULS[1 … 2], PULS[1 … 2]_N	Stepper Clock
DIR[1 … 2], DIR[1 … 2]_N	Stepper Revolution Direction
EN[1 … 2], EN[1 … 2]_N	Stepper Enable
M	Ground (not to be connected when using differential signals)
Analog Spindle Interface	
AO4	Analog Command Value
AGND4	Analog Ground
SE4_1, SE4_2	Servo Enable Relay Contact
Signal level:	+/-10V for Analog Outputs RS422 for Stepper Signals

Signal type	
AO	Analog output
O	Output
K	Switch signal

Drives with analog interface

Signals:

A voltage and an enable signal are output.

- AO4 (SETPOINT)

Analog voltage signal in the range ± 10 V to output a speed setpoint

- AGND4 (REFERENCE SIGNAL)

Reference potential (analog ground) for the setpoint signal, internally connected to logic ground.

- SE4 (SERVO ENABLE)

Relay contact pair controlling the enable of the power section.

Signal parameters

The setpoint is output as an analog differential signal.

Table 2–9 Electrical parameters of the signal outputs for step-switching drives

Parameter	Min	Max	Unit
Voltage range	–10.5	10.5	V
Output current	–3	3	mA

Relay contact

Table 2–10 Electrical parameters of the relay contacts

Parameter	Max.	Unit
Switching voltage	50	V
Switching current	1	A
Switching power	30	VA

Cable length: max. 35 m

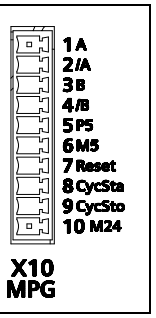
2.3.5 Handwheel & Extension Keys interface - X10 (MPG)

General

One handwheel can be connected externally via the handwheel & extension keys interface X10 (10-pin mini–Combicon plug connector) .

Table 2-11 Handwheel & extension keys interface X10

Pin	Signal	Type	Pin	Signal	Type
1	A	I	6	M5	VO
2	/A	I	7	Reset	DI
3	B	I	8	CycSta	DI
4	/B	I	9	CycSto	DI
5	P5	VO	10	M24	VI



Signal (handwheel)	Description
A	Channel A, true, handwheel
/A	Complement Channel A, negated, handwheel
B	Channel B, true, handwheel
/B	Complement Channel B, negated handwheel
P5	Power supply, 5.2V
M5	5.2 V supply ground for handwheel

Signal level (handwheel)

RS422

Signal type (handwheel)

VO	Voltage output
I	Input (5 V signal)

Handwheel

One electronic handwheel can be connected which must meet the following requirements:

Transmission method: 5 V square-wave (TTL level or RS422)

Signals: Track A as true and negated signal (U_{a1}, $\overline{U_{a1}}$)

Track B as true and negated signal (U_{a2}, $\overline{U_{a2}}$)

Max. output frequency: 500 kHz

Phase offset between tracks A and B: 90° ± 30°

Supply: 5 V, max. 250 mA

Reset	Reset key
CycSta	Cycle Start key
CycSto	Cycle Stop key
M24	24V supply ground

Signal level (extension keys) RS422

Signal type (extension keys)

VI	Voltage input
DI	Input (24V signal)

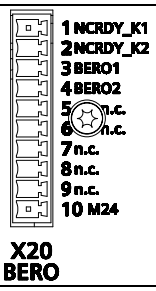
2.3.6 BERO input interface - X20 (BERO)

General

Two proximity switches (BERO) can be connected via a 10 pin Mini-Combicon plug connector X20.

Table 2-12 BERO input interface X20

Pin	Signal	Type	Pin	Signal	Type
1	NCRDY_K1	K	6	n.c.	
2	NCRDY_K2	K	7	n.c.	
3	BERO1	DI	8	n.c.	
4	BERO2	DI	9	n.c.	
5	n.c.		10	M24	VI



Signal	Description
NCRDY_K[1 … 2]	NC-READY-Relay-Contact, max. current is 2A at 150VDC or 125VAC)
BERO[1 … 2]	BERO-Input for axis 1 ... 2
M24	Reference potential for digital input

Signal type

K	Switching contact
DI	Digital input
VI	Voltage input

2 BERO inputs

These inputs are 24V PNP-switching. Switches or non-contact sensors, e.g. inductive proximity switches(BERO) can be connected.

They can be used as switches for reference points, for example:

BERO1 – X axis

BERO2 – Z axis

Table 2-13 Electrical parameters of the digital inputs

Parameter	Value	Unit	Note
“1” signal, voltage range	11 …30	V	
“1” signal, current consumption	6 …15	mA	
“0” signal, voltage range	-3 …5	V	Or input open
Signal delay 0→1	15	us	
Signal delay 1→0	150	us	

Notice

When AC servo drives are used, BERO can be input as zero mark signals. However, be careful that here BERO refers to 24V pulse input.

NC–READY output

Readiness in the form of a relay contact (NO); must be integrated into the EMERGENCY STOP circuit.

Table 2–14 Electrical parameters of the NCREADY relay contact

Parameter	Max.	Unit
DC switching voltage	50	V
Switching current	1	A
Switching power	30	VA

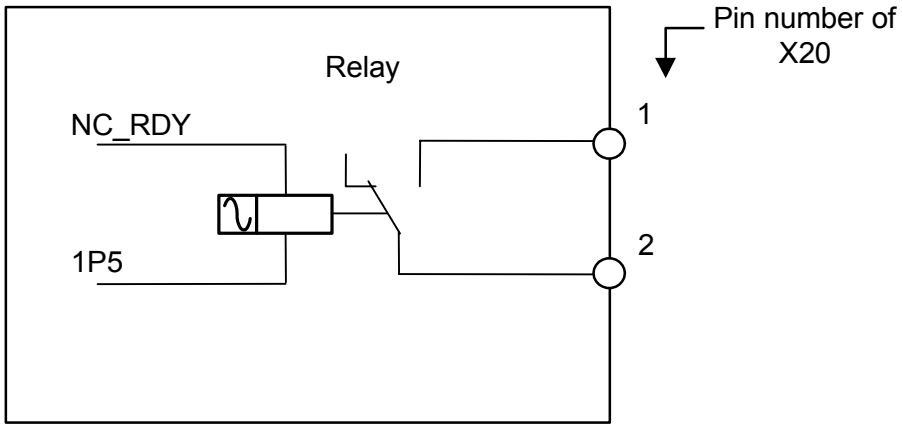


Fig. 2-20 NC-READY output

The NCREADY is an internal relay of NC. It will open when NC is not ready, and close after NC is ready for operation.

2.3.7 Digital inputs/outputs X100 (DIN0) ~ X101 (DIN1), X200 (DOUT0) ... X201 (DOUT1)

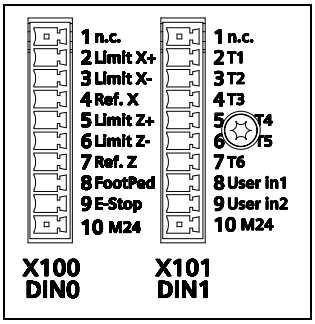
General

There are 16 digital inputs and 12 digital outputs in all. Connector designation: 10 pin Mini-Combicon plug connector.

Table 2-15 Pin assignment for connectors X100 ~ X101

Pin	Signal	X100 Signal type	Pin	Signal	X101 Signal type
1	n.c.		1	n.c.	
2	Limit X+	DI	2	T1	DI
3	Limit X-	DI	3	T2	DI
4	Ref. X	DI	4	T3	DI
5	Limit Z+	DI	5	T4	DI
6	Limit Z-	DI	6	T5	DI
7	Ref. Z	DI	7	T6	DI
8	FootPed	DI	8	User in1	DI
9	E-Stop	DI	9	User in2	DI
10	M24	VI	10	M24	VI

* In the list above, high signal level refers to 15 …30 VDC, current drain 2 … 15 mA and low level -3 … 5 VDC.



Signal type

VI	Voltage input
DI	Input (24 V signal)

Table 2–16 Electrical parameters of the digital inputs

Parameter	Value	Unit	Note
“1” signal, voltage range	15 ... 30	V	
“1” signal, current consumption	2 ... 15	mA	
“0” signal, voltage range	–3 ... 5	V	Or input open
Signal delay 0 → 1	0.5 ... 3	ms	
Signal delay 1 → 0	0.5 ... 3	ms	

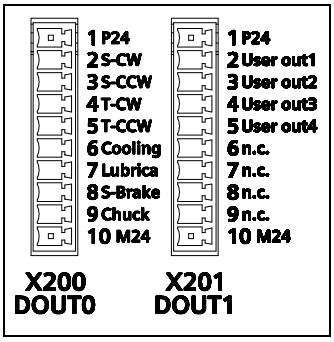
Notice

See Section 3.2 “ Input/Output Configuration” for definitions of X100 ... X101 input signals.

Table 2-17 Pin assignment for connectors X200 ~ X201

Pin	Signal	X200 Signal type	Pin	Signal	X201 Signal type
1	P24	VI	1	P24	VI
2	S-CW	DO	2	User out1	DO
3	S-CCW	DO	3	User out2	DO
4	T-CW	DO	4	User out3	DO
5	T-CCW	DO	5	User out4	DO
6	Cooling	DO	6	n.c.	
7	Lubric	DO	7	n.c.	
8	S-Brake	DO	8	n.c.	
9	Chuck	DO	9	n.c.	
10	M24	VI	10	M24	VI

* In this list, high signal level refers to the 24VDC, current leakage less than 2mA with a simultaneity factor of 0.5.



Signal type

VI	Voltage input
DO	Digital output (24 V signal)

Table 2–18 Electrical parameters of the digital outputs

Parameter	Value	Unit	Note
“1” signal, nominal voltage Voltage drop	24 max. 28.8	V V	
“1” signal, output current	0.5	A	Simultaneity factor 0.5 per 12 outputs
“0” signal, leakage current	max. 2	mA	

Notice

See Section 3.2 “Input/Output Configuration” for definitions of X200 ... X201 output signals.

Connections of digital inputs/outputs

For the connections of digital inputs/outputs, see Fig. 2-22 and 2-23 below.

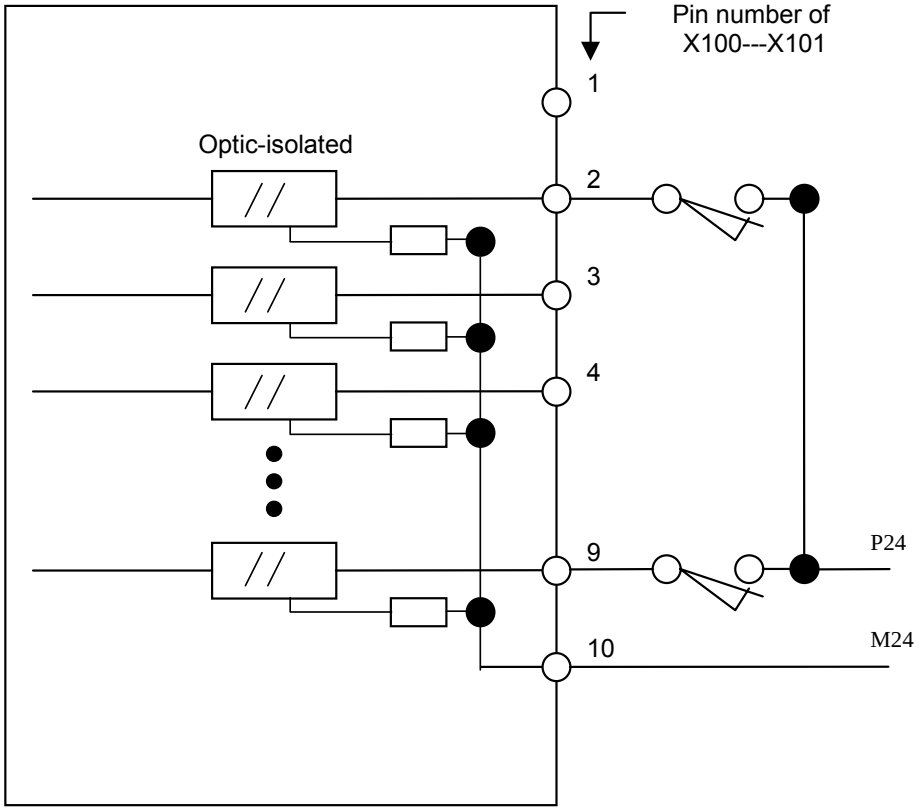


Fig. 2-21 Connection of digital inputs

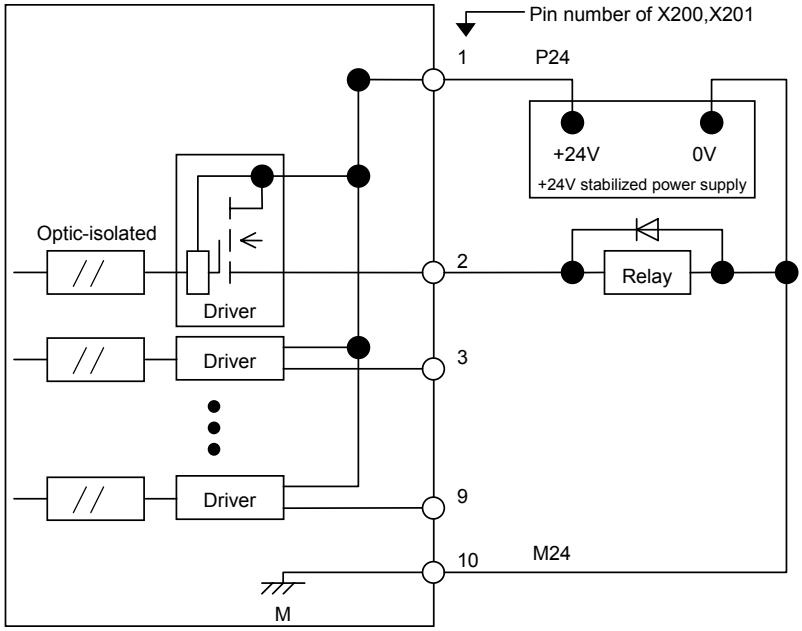


Fig. 2-22 Connection of digital outputs

2.3.8 Connecting cables for SINUMERIK 801

General

The connecting diagram of the setpoint cable between CNC and the drive is given in the figure below. The MLFB (order no.) of the said cable is 6FX6002-5AA52-1..0 with RS422 differential signals.

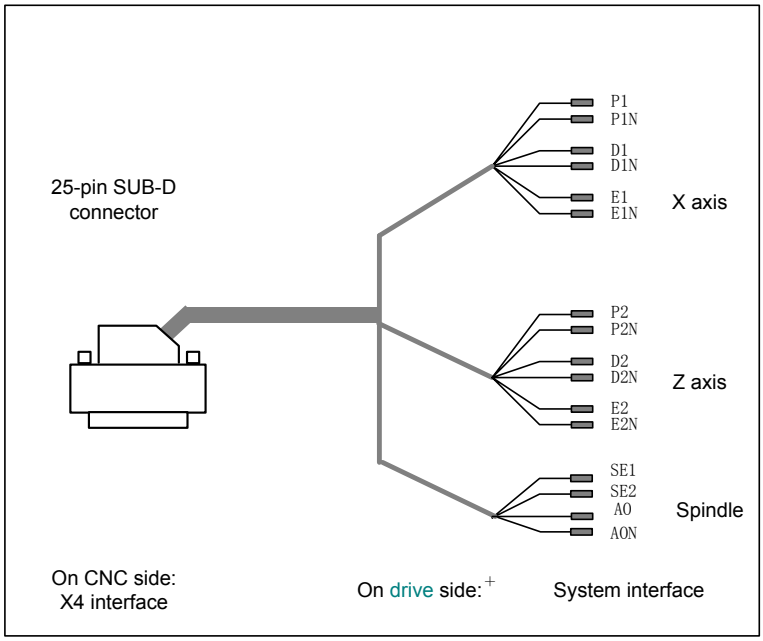


Fig. 2-23 Setpoint cable for SINUMERIK 801

2.4 Installing and Starting-Up the Drive Modules

2.4.1 Connecting the STEPDRIVE C/C+ drive modules

Cable overview

Connect the STEPDRIVE C/C+, the stepper motors and the SINUMERIK 801 control system as shown in Figure 2-24:

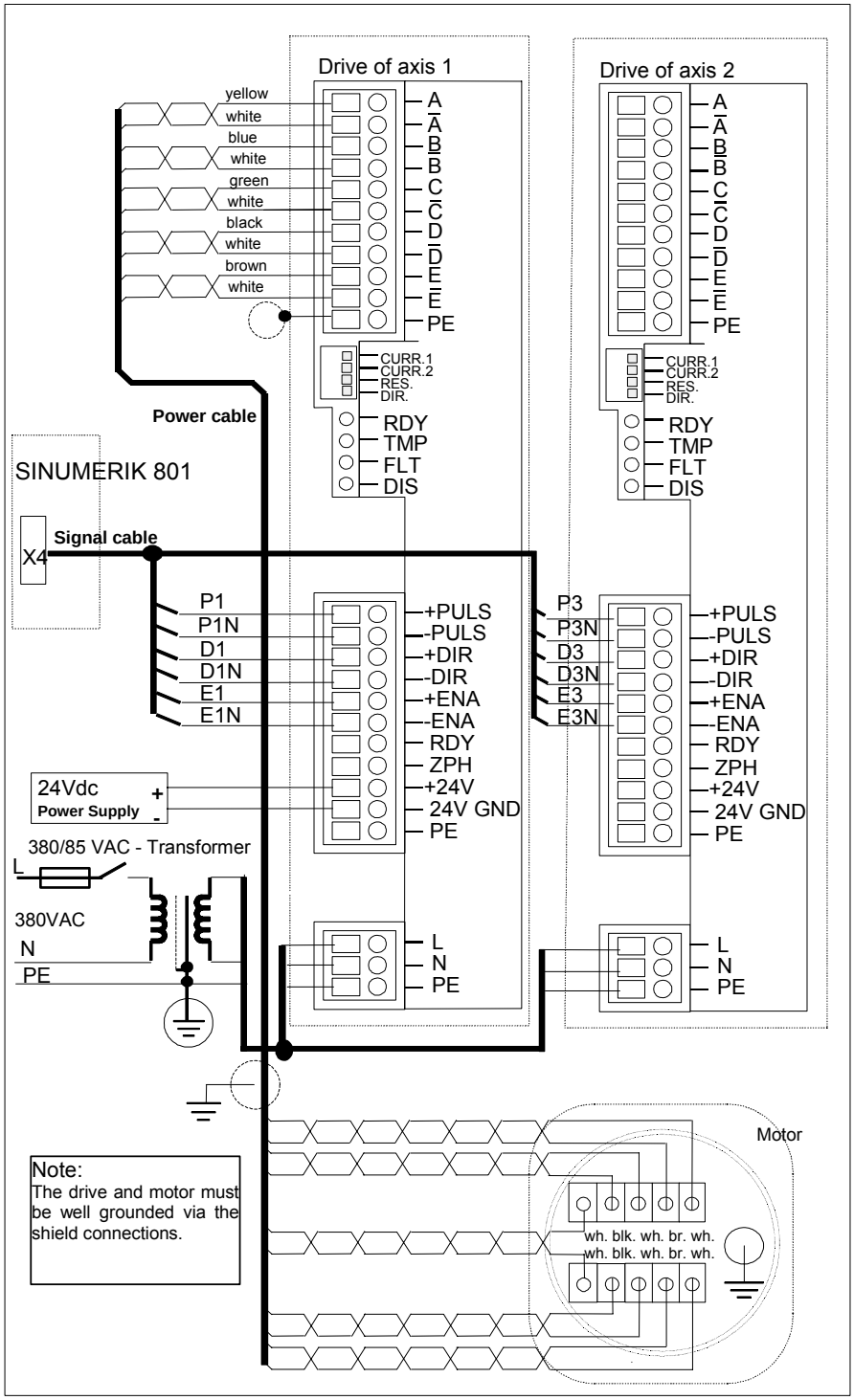


Fig. 2-24 Overview of cables

Warning

Prior to performing connection work, always first make sure that the supply voltage is switched off.

With the supply voltage switched off, hazardous voltages are present at the mains and motor connections. Under no circumstances may these connection be touched in the ON condition; otherwise, loss of life or severe personal injury could be the consequence.

Mains connection

- The device must be connected via an external fuse.

  Fuse: K6A for 1 axis

  K10A for max. 2 axes
- If the transformer possesses a shielded winding, this should be connected with low inductivity to PE.
- Ground the transformer on the secondary side.

Connecting the motor-end cables

- To connect the cables, remove the terminal box cover (3 screws).
- Use the cable with the order no. 6FX6 002–5AA51–1..0
- On the drive end, connect the cable shield to the housing such that an electrical connection is provided via the appropriate strain relief clamp and clamp the braided shield to PE.
- On the motor side, braid the shield, provided it with a cable shoe and clamp it to the grounding screw.

Pulse interface

- To connect the drive pulse interface to the SINUMERIK 801, use the preassembled cable, order no.6FX6 002–5AA52–1..0.
- On the drive side, connect the cable shield to the housing such that an electrical connection is provided via the appropriate strain relief clamp.

24V signal interface

- To evaluate the 24 V high–side signals “Zero Phase” (ZPH) and/or “Drive ready” (RDY) in the CNC, then connect a 24 V voltage (PELV) to the +24 V and 24 V GND terminals.

Driving system design

When a driving system for machine tools is configured with stepper drives, pay attention to following requirements:

1. Design the driving system according to the frequency – torque characteristics of the stepper motors (see Fig. 2-11: Frequency – torque characteristics of the stepper motors). The characteristic feature of the stepper motors depends on the frequency-torque characteristics. The motor will have a larger output torque while running at a low speed or a smaller one while at a high speed (and also a high power dissipation and

temperature boost during this period).

1) The resolution (displacement per step of the stepper motor) depends on mechanical data:

   Resolution = leadscrew pitch/steps per revolution × reduction ratio

2) Calculate the max. motor speed according to the max. axis speed, then the corresponding output torque of the stepper motor according to the frequency – torque characteristics:

   Motor speed = axis speed/leadscrew pitch/reduction ratio

2. Each axis must be configured with one BERO proximity switch (PNP normal open, viz. 24Vdc level output) for generating zero marks for reference point approach.

Notice

The quality of BERO proximity switches will have influences on the resolution of reference points. It's recommended to use high quality switches;

Make the clearance between end face of the proximity switch used for tesing and the object under test as short as possible.

Do not use conventional contact stroke switches as proximity switches for zero mark signals (because of the bigger signal jitters).

Reference point approach configuration

Since the stepper motors cannot generate zero marks required by the encoder, the SINUMERIK 801 can take two configurations for approaching reference points as: double-switch mode and single-switch mode.

Double-switch mode:

There is one reference cam in the axis and one BERO (inductive proximity switch) at the leadscrew (one pluse is generated per revolution of the leadscrew). Connect the reference cam to the inputs of DI (X100) (see Chapter 3:"Built-In PLC Application for detailed description) while BERO to connector X20 of the control system.

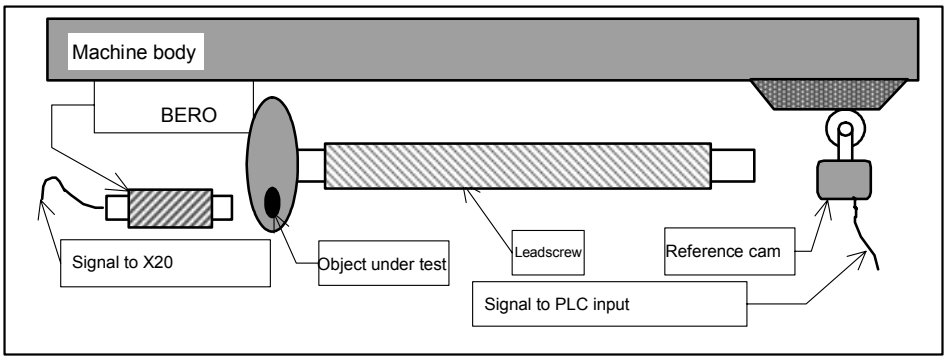


Fig. 2-25 Configuration 1 for reference point approaching: double-switch mode

This mode enables high speed search for the reference cam, then for BERO at a lower speed. With this mode, reference points can be approached rapidly and more precisely. In addition, BERO can also be used for monitoring revolutions.

Single-switch mode (without reference cam, MD34000=0) :

There is one BERO in the axis.

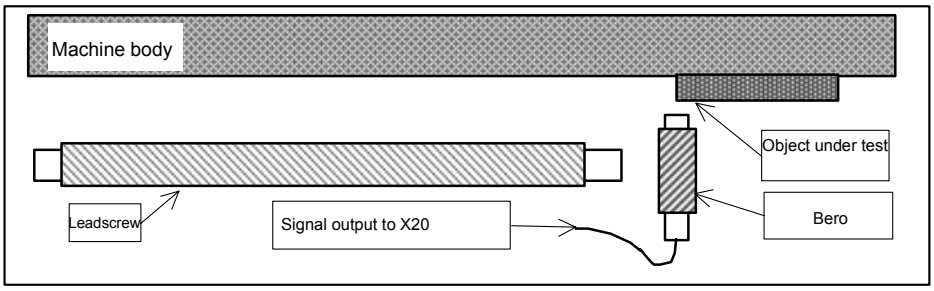


Fig. 2-26 Configuration 2 for reference point approaching: single-switch mode

With this mode, only one speed for referece point approaching can be set. Precision of reference point approach is relevant to the quality of BERO and the speed set for approaching reference points.

BERO sampling methods

No matter which configuration is taken, the control system can use two ways to sample BERO when approaching the reference point:

1) Sample the rising edge of BERO and take the effective level of the rising edge as the reference mark;

2) Move the axis onwards, record the distance traversed after this reference mark and sample the falling edge of BERO. After samping the falling edge, the control system will auto-calculate the middle point between both edges and use this point as the reference point for the axis.

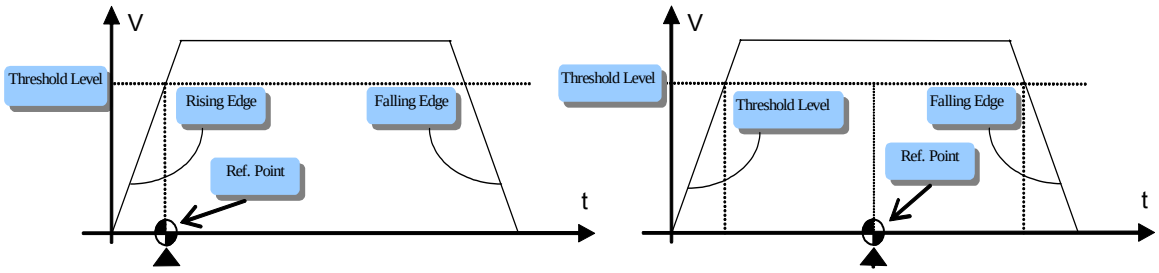


Fig. 2-27 BERO sampling methods

Mechanical installation of the proximity switches

Follow Fig. 2-28 & 2-29 to complete the mechanical installation of BERO under double-switch mode.

- When stepper motors is connected with a leadscrew directly:

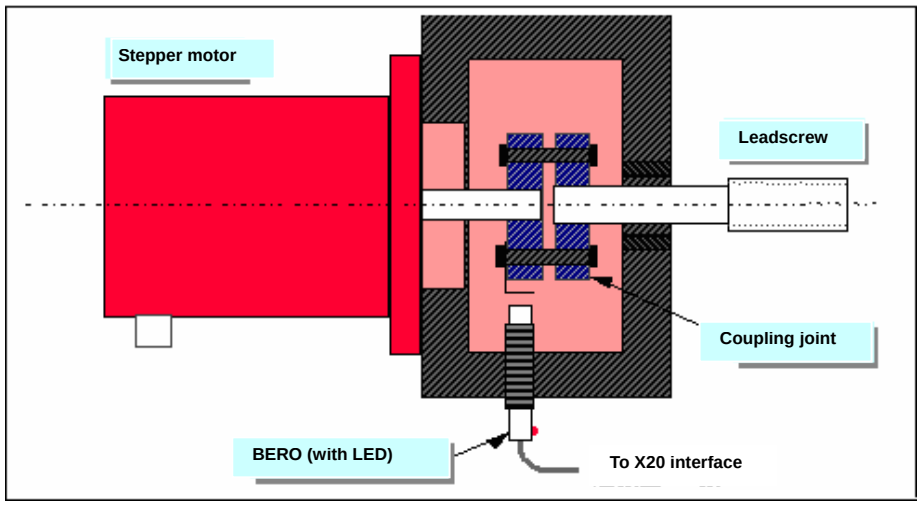


Fig.2-28 Installing the BERO – 1

- If there are reduction gears between the stepper motor and proximity switch

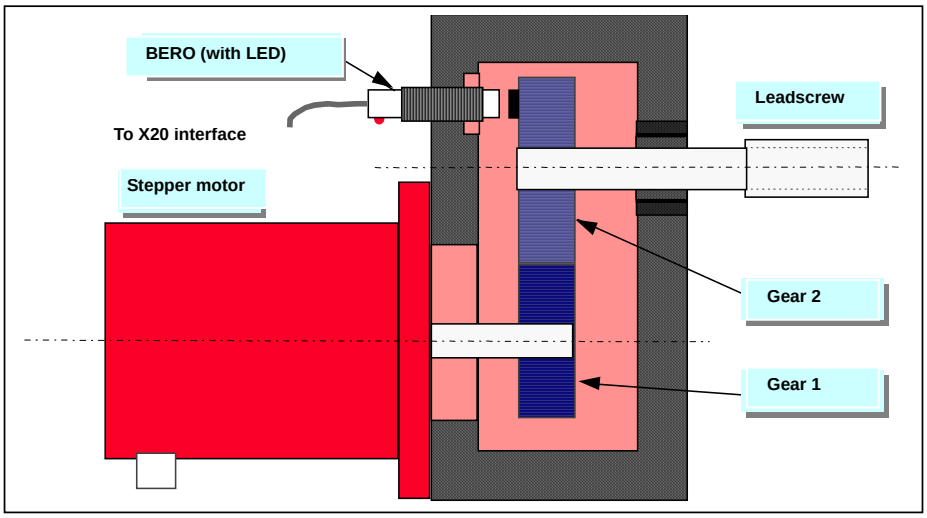
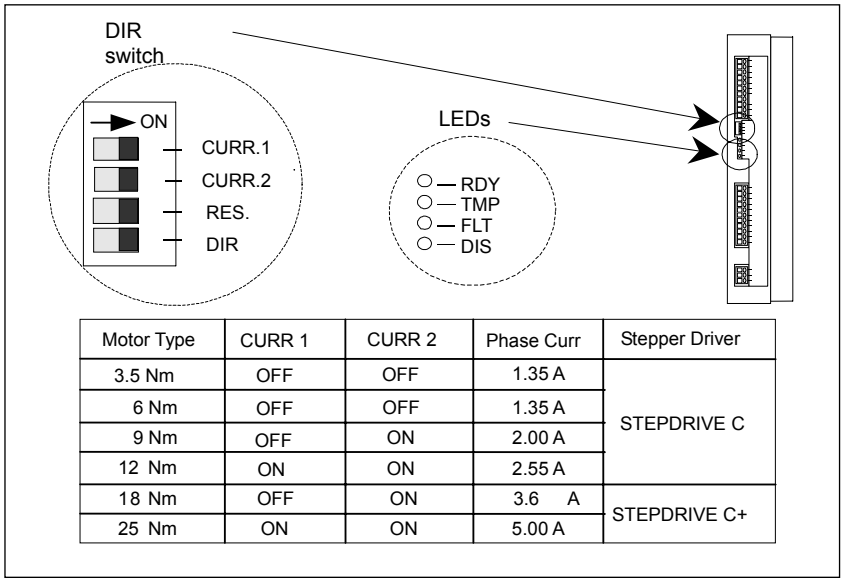


Fig. 2-29 Installing the BERO - 2

Drive current settings

Use stepper drives to actuate stepper motors of different torques. When starting up the drive system, set the drive current according to the torque of the motor used. See figure below for current settings:



Motor Type	CURR 1	CURR 2	Phase Curr	Stepper Driver
3.5 Nm	OFF	OFF	1.35 A	STEPDRIVE C
6 Nm	OFF	OFF	1.35 A	
9 Nm	OFF	ON	2.00 A	
12 Nm	ON	ON	2.55 A	
18 Nm	OFF	ON	3.6 A	STEPDRIVE C+
25 Nm	ON	ON	5.00 A	

Fig. 2-30 Drive current settings

Warning

If the current set is too large for the motor, the motor might be damaged due to overtemperature.

Start-up sequence

1. Connect the mains voltage and - if necessary - also the 24 V supply voltage.
2. Check the DIS LED.
3. Activate the ENABLE signal via the control system (power-up the control system).

The yellow DIS LED goes out and the green RDY LED is lit. The drive is ready, the motor is powered.
If the PULSE signal is provided by the control system with pulses, then motor will rotate in the direction of rotation specified by the DIR signal.

Notice

The DIR switch can be used to adapt the direction of rotation to the mechanics of the machine. Never actuate the switch when the drive is powered!

Table 2-19 LED alarms

LED			Meaning	Remedy
Name	**Color**			
RDY	green	the only LED that is lit	Drive ready	If the motor does not rotate, it can have the following causes: - No pulses are output by the control system. - Pulse frequency too high (motor is “out of step”) - Motor load too large or sluggish
DIS	yellow	the only LED that is lit	Drive ready; motor not powered	Activate ENABLE signal via CNC
FLT	red	is lit	There is one of the following errors: - Overvoltage or undervoltage - Short-circuit between the motor phases - Short-circuit between motor phase and ground	Measure 85 V operating voltage Check cable connections
TMP	red	is lit	Overtemperature in the drive	Drive defective; replace
all		No LED is lit	No operating voltage	Check cable connections

Selection of the drive transformer

Configure the stepper motors in different torques with a drive transformer (380VA C->85VAC) that has a suitable power.

Table 2-20 Reference table for power ratings of differnt transformers*

MLFB (Order No.) of Motor	No. of motor axes	Torque (Nm)	Power of transformer (KVA)
6FC5 548-0AB03-0AA0	1	3.5	0.3
6FC5 548-0AB06-0AA0	1	6	0.403
6FC5 548-0AB09-0AA0	1	9	0.612
6FC5 548-0AB012-0AA0	1	12	0.7
6FC5 548-0AB018-0AA0	1	18	1.368
6FC5 548-0AB025-0AA0	1	25	1.420

*Select the drive transformer based on this table and the simultaneity factor of the machine coordinates (coefficient recommended: 1.0).

2.4.2 Connecting the servo drive modules

Please refer to relevant technical instructions for the connection with servo drive.

Built-In PLC Application 3

Important !

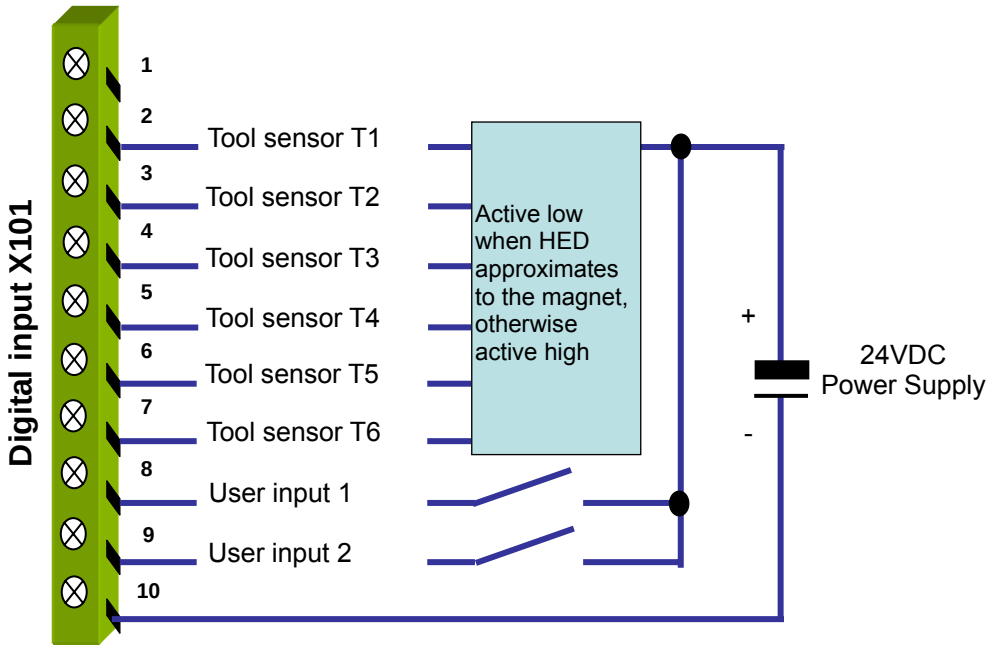
After the connection of individual components, the related functions in PLC application (emergency stop, hardware limit switch) must be commissioned **first**. Only after the afore-said safety functions are commissioned without error, you may start NC parameters.

3.1 Input/Output Configuration

Input signals description

Table 3-1 Input signals description

Description of Input Signals				
X100 DIN0				
Pin#	**Signal**	**Input #**	**Signal Description**	
1	n.c		Not defined	
2	Limit X+	I0.0	Hardware limit X+	(normally closed)
3	Limit X-	I0.1	Hardware limit X-	(normally closed)
4	Ref. X	I0.2	X reference cam	
5	Limit Z+	I0.3	Hardware limit Z+	(normally closed)
6	Limit Z-	I0.4	Hardware limit Z-	(normally closed)
7	Ref. Z	I0.5	Z reference cam	
8	FootPed	I0.6	Foot pedal	
9	E-Stop	I0.7	Emergency Stop key	(normally closed)
10	M24		24V ground	
X101 DIN1				
Pin#	**Signal**	**Input #**	**Signal Description**	
1	n.c.		Not defined	
2	T1	I1.0	Tool sensor T1	Active low when HED approximates to the magnet, otherwise active high (see below for wiring diagram)
3	T2	I1.1	Tool sensor T2	
4	T3	I1.2	Tool sensor T3	
5	T4	I1.3	Tool sensor T4	
6	T5	I1.4	Tool sensor T5	
7	T6	I1.5	Tool sensor T6	
8	User in1	I1.6	User input 1	
9	User in2	I1.7	User input 2	
10	M24		24V ground	



Output signals description

Table 3-2 Output signals description

Description of Output Signals			
X200 DOUT0			
Pin#	**Signal**	**Input #**	**Signal Description**
1	P24		24V power supply
2	S-CW	Q0.0	Direction and enable of unipolar spindle or contactor-controlled spindle (see MD30134 description)
3	S-CCW	Q0.1	Direction and enable of unipolar spindle or contactor-controlled spindle (see MD30134 description)
4	T-CW	Q0.2	Turret CW
5	T-CCW	Q0.3	Turret CCW
6	Cooling	Q0.4	Coolant control
7	Lubrica	Q0.5	Lubrication control
8	S-Brake	Q0.6	Spindle control
9	Chuck	Q0.7	Chuck clamping control
10	M24		24V ground
X201 DOUT1			
Pin#	**Signal**	**Input #**	**Signal Description**
1	P24		24V power supply

2	User out1	Q1.0	User output 1
3	User out2	Q1.1	User output 2
4	User out3	Q1.2	User output 3
5	User out4	Q1.3	User output 4
6	n.c.		Not defined
7	n.c.		Not defined
8	n.c.		Not defined
9	n.c.		Not defined
10	M24		24V ground

Note:

User inputs/outputs

a) User in1 (I1.6) = 0 ——>User out1(Q1.0)=0

User in1 (I1.6) = 1 ——>User out1(Q1.0)=1

b) User in2 (I1.7) = 0 ——>User out2(Q1.1)=0

User in2 (I1.7) = 1 ——>User out2(Q1.1)=1

c) The output values of User out3 and 4 are defined by M functions

	Use out3(Q1.3)	User out4(Q1.2)
M20	0	0
M21	0	1
M22	1	0
M23	1	1

3.2 Definition of User Keys

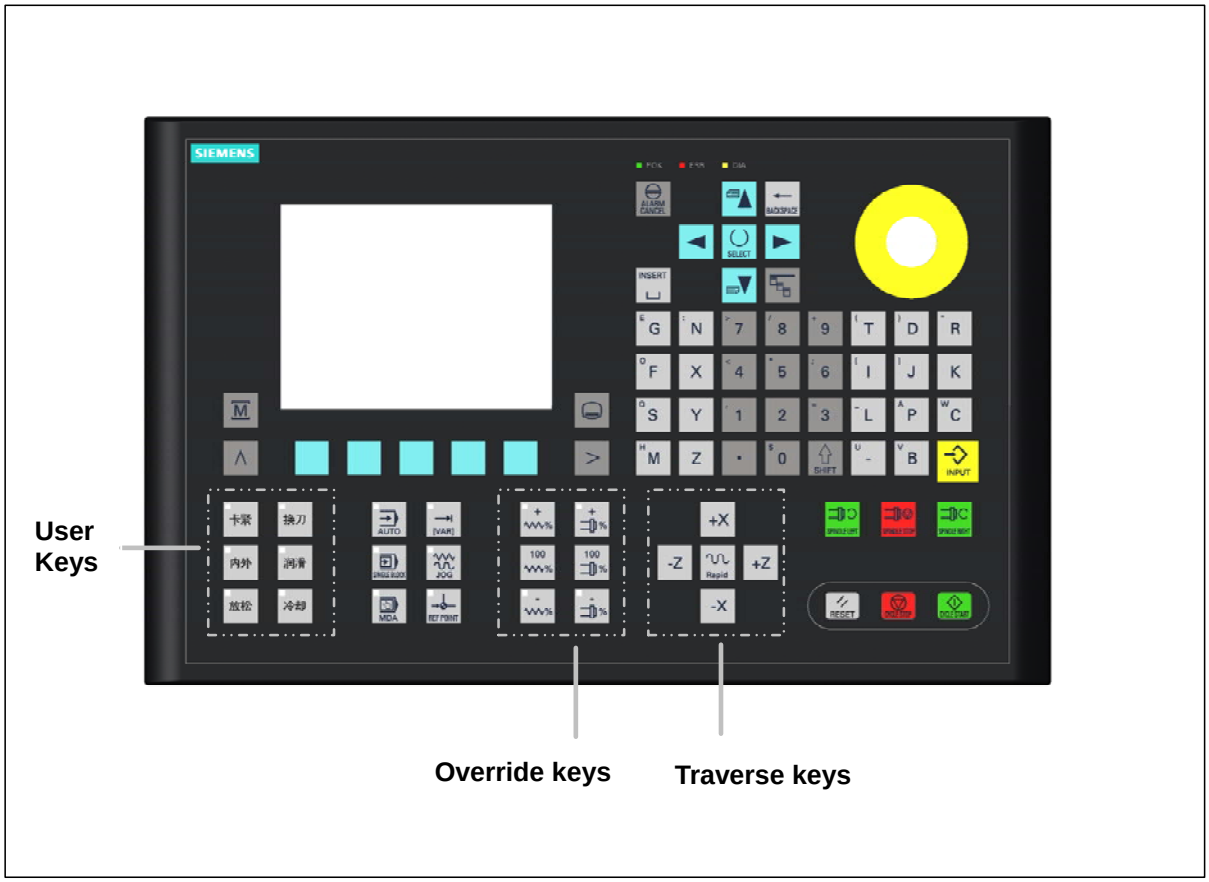


Fig. 3-1 User keys on MCP area

Definition of user keys

Table 3-3 Definition of user keys

Key	Description of User Keys
卡紧	Chuck clamping
内外	Chuck clamping internally/externally
放松	Chuck unclamping
换刀	Manual tool change
润滑	Manual lubrication start or stop
冷却	Manual coolant on or off
LED	**Description**
卡紧	Chuck clamped (LED lit)
内外	Chuck clamped internally (LED goes out) /externally (LED lit)
放松	Chuck unclamped (LED lit)
换刀	Tool changing (LED lit)
润滑	Lubricating (LED lit)
冷却	Cooling (LED lit)

Definiton of traverse keys

+X	X axis, plus direction
-X	X axis, minus direction
+Z	Z axis, plus direction
-Z	Z axis, minus direction
Rapid	RAPID TRAVERSE OVERLAY

Definition of override keys

1) Feedrate override plus key with LED

The feedrate override will be increased by a set increment when pressing the key once until reaching 120%;

LED is lit when the feedrate override is more than 100%, and flashes when it reaches 120%;

2) Feedrate override 100% key

Keep pressing this key for 1.5 seconds, the feedrate override will be changed into 100% directly.

3) Feedrate override minus key with LED

The feedrate override will be decreased by a set increment when pressing the key once until reaching 0%;

Keep pressing this key for 1.5 seconds, the feedrate override will be changed into 0% directly.

LED is lit when the feedrate override is between 0 ... 100%, and flashes when it's lowered to 0%;

4) Spindle speed override plus key with LED

The spindle override will be increased by a set increment when pressing the key once until reaching 120%;

LED is lit when the spindle override is more than 100%, and flashes when it reaches 120%;

5) Spindle override 100% key

Keep pressing this key for 1.5 seconds, the spindle override will be changed into 100% directly.

6) Spindle override minus key with LED

The spindle override will be decreased by a set increment when pressing the key once until reaching 50%;

Keep pressing this key for 1.5 seconds, the spindle override will be changed into 50% directly.

LED is lit when the spindle override is between 50 ... 100%, and flashes when it's lowered to 50%.

Notice

The feedrate override can be adjusted by settable incremens as: 0%, 1%, 2%, 4%, 6%, 8%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 75%, 80%, 85%, 90%, 95%, 100%, 105%, 110%, 115%, 120%.

The spindle override can be adjusted by settable increments as 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, 100%, 105%, 110%, 115%, 120%.

3.3 PLC Machine Data

Definition of MD14512

Table 3-4 MD14512

MD14512 Machine data	USER_DATA_HEX PLC machine data - Hex							
INDEX	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
[0]	Reserved							
[1]	Reserved							
[2]	Reserved							
[3]	Reserved							
[4]	PLC application configuration Toolholder control inactive					Clamp & unclamp inactive	Lubrication inactive	
[5]	Reserved							
[6]	Technology Setting 	Z axis rotation monitoring active		X axis rotation monitoring active		Spindle brake active		Auto lubrication once when power on
[7]	Reserved							

Notes:

1) If you don't want to use PLC to activate toolholder control, clamp/umclamp or lubrication functions, set MD14512 [4] to proper bit to deactivate corresponding function.

2) You may set MD14512[6] to desired bit to activate corresponding function.

Caution

PLC machine data reserved by the control system must not be changed!

Definition of MD14510

Table 3-5 MD14510

MD14510 Machine Data	PLC Machine Date—Integer
Index	
14510[0]	Reserved
14510[1]	Reserved

14510[2]	Definition: Interval of track lubrication Unit: 1 minute Range: 5 ~ 300 minutes
14510[3]	Definition: Duration of lubrication Unit: 0.1 second Range: 10 ~ 200 (1 ~ 20 seconds)
14510[4]	Definition: Number of positions on the turret Unit: - Range: 4 or 6
14510[5]	Definition: Monitor time (turret change abort if destination tool not found within specified time) Unit: 0.1second Range: 30 ~ 200 (3 ~ 20 seconds)
14510[6]	Definition: Turret clamping time Unit: 0.1 second Range: 5 ~ 30 (0.5 ~ 3 seconds)
14510[7]	Definition: Braking time of external brake mechanism of a contactor controlled spindle Unit: 0.1 second Range: 5 ~ 200 (0.5 ~ 20 seconds)

3.4 Fixed PLC Alarms

Definition of fixed PLC alarms

Table 3-6 Definition of fixed PLC alarms

Alarm #	Alarm Description
700008	Turret # wrongly defined, MD14510[4] (4/6)
700009	Turret clamping time undefined, check MD14510[6]
700010	Turret monitoring time undefined, check MD14510[5]
700011	Spindle brake time out range, check MD14510[7]
700021	Spindle/feed axis start impossible while unclamped
700022	Unclamping impossible while spindle run or NC start enabled in AUTO or MDA mode
700023	Programmed tool #. > Max. turret on turret#
700024	Tool not found, monitoring time up
700025	No position signals from turret
700027	Approach ref. point again after rot. monitoring

Setting Up 4

4.1 Setting Up NC Parameters

System configuration

The system configuration for SINUMERIK 801 is a turning variant, i.e.: X axis is set as the 1st axis, Z axis the 2nd and spindle the 3rd. Technology settings are also for turning machining.

Notice

NC parameters can not be changed unless the Machine Manufacturer password (“Evening”) has been input.

Parameterization

Parameter settings for SINUMERIK 801 are given in following tables. In which, IPR refers to pulses per motor revolution, RPM revolutions per minute and I the number of pulses.

SINUMERIK 801 :

MD	Designation	Unit	Axis	Input value	Description
30130	CTRLOUT_TYPE	-	X , Z	2	Output type of setpoint (setpoint branch): the setpoint signals are output to connector X4
30240	ENC_TYPE	-	X , Z	3	Type of actual value acquisition (actual position value) (encoder no.): 3: Encoder for stepper motor
34200	ENC_REF_MODE	-	X , Z	2* or 4*	Type of position measuring system: 2: BERO 4: Bero with two edges
34210	ENC_REF_STATE	-	X , Z	0 or 1	Reference state 0: Function “Record reference point” inactive 1: Function “Record reference point” activated

* 2: single-edge evaluation, for locking the reference point in the rising edge of the proximity switch; 4: double-edge evaluation, for locking the referece point in the intermediate point between rising and falling eges.

Notice

Even if the function “record reference point” has been activated, reference point must be approached again under following circustances, otherwise collision might be resulted!

1. After system power up with saved data

a) After machine operator selects on the operator panel to “power up with saved data” (corresponding alarm# 004062).

b) System will be powered up automatically with saved data after it has been dead for a long period and battery for internal data savings run out of power. (corresponding alarm# 004065)

2. After system power-off, the actual position of the axis concerned has been moved out of maintenance or other reasons.

Parameterization for stepper motors:

MD	Designation	Unit	Axis	Input value	Description
31020	ENC_RESOL	IPR	X, Z	1000	Encoder markings per revolution (encoder no.)
31400	STEP_RESOL	IPR	X, Z	1000	Steps per stepping motor revolution

Mechanical parameters for the driving system:

MD	Designation	Unit	Axis	Input value	Description
31030	LEADSCREW_ PITCH	mm	X, Z	5	Pitch of leadscrew
31050	DRIVE_AX_RATIO _DENUM[0 ... 5]	-	X, Z	40	Denominator load gearbox (control parameter No.)
31060	DRIVE_AX_RATIO _NUMERA[0 … 5]	-	X, Z	50	Numerator load gearbox (control parameter set No.)

Note:

After determining the mechanical parameters, set the axis speed. For stepper motors, the motor speed shall be determined according to its frequency-torque characteristics: motor speed = axis speed/leadscrew pitch/reduction ratio.

MD	Designation	Unit	Axis	Example value	Description
32000	MAX_ AX_VELO	mm/Min	X , Z	4800	Maximum axis velocity
32010	JOG_ VELO_ RAPID	mm/Min	X , Z	4800	Rapid traverse in JOG mode
32020	JOG_ VELO	mm/Min	X , Z	3000	JOG axis velocity
32260	RATED_VELO	RPM	X , Z	1200	Rated motor speed (setpoint branch)
36200	AX_VELO_LIMIT	mm/Min	X , Z	5280	Threshold value for velocity monitoring

After the above parameters have been set, SINUMERIK 801 will automatically determine the frequency when being powered on: 20rev./sec.×1000 pulses/rev. = 20000pulses/sec., and MD31350 is set as follows:

MD	Designation	Unit	Axis	Example value	Description
31350	FREQ_STEP_LIMIT	Hz	X , Z	20000	Stepping rate at maximum velocity

Setting the encoder limit frequency according to MD31350:

MD	Designation	Unit	Axis	Example value	Description
36300	ENC_FREQ_LIMIT	Hz	X , Z	22000	Encoder limit frequency

Note:

The max. output frequency of SINUMERIK 801 can reach 500000Hz.

4.2 Starting Up the Dynamic Characteristic of the Axes

General

For SINUMERIK 801, the dynamic characteristic of the axes can be started-up through machine data settings.

SINUMERIK 801

Test the dynamic characteristic of the axes in JOG mode, set the max. velocity of each axis and select suitable acceleration curves.

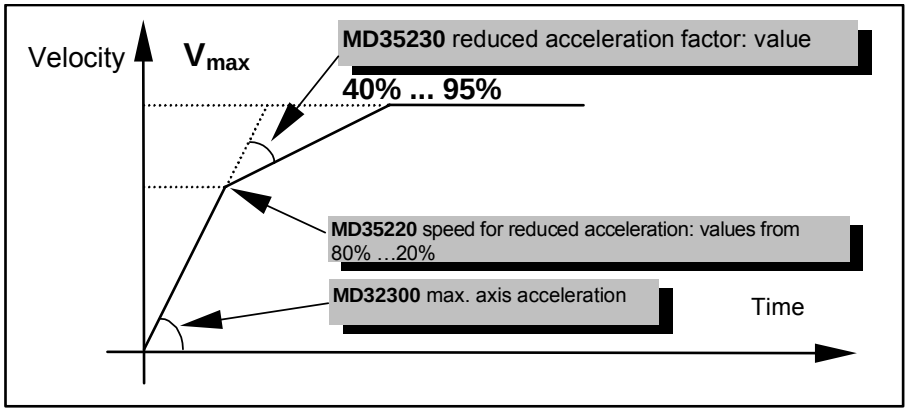


Table 4-1 Parameterization

MD	Designation	Unit	Axis	Input value	Description
35220	ACCEL_REDUCTION_SPEED_POINT	-	X , Z	1 ... 0	Speed for reduced acceleration: max. speed * percent, values valid from 0.8 ... 0.2.
35230	ACCEL_REDUCTION_FACTOR	-	X , Z	0 ... 1	Factor of reduced acceleration: max. acceleration * percent, values valid from 0.4 ... 0.95.
32300	MAX_AX_ACCEL	m/s^2	X , Z	1	The max. axis acceleration (default value)

4.3 Starting Up Reference Points

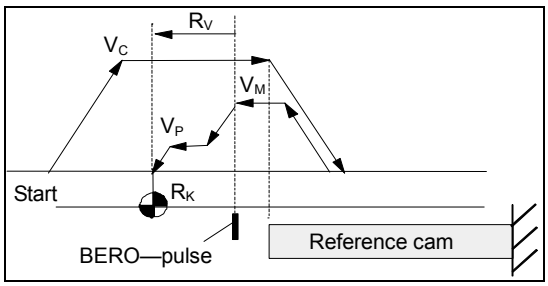
General

Many functions of the SINUMERIK 801are built on reference points, e.g., AUTO and MDA modes can only be activated after the machine has approached the reference points; the backlash compensation and leadscrew error compensation can not be enabled until reference points have been approached. Therefore, reference points shall first be approached prior to the normal operation of the control system.

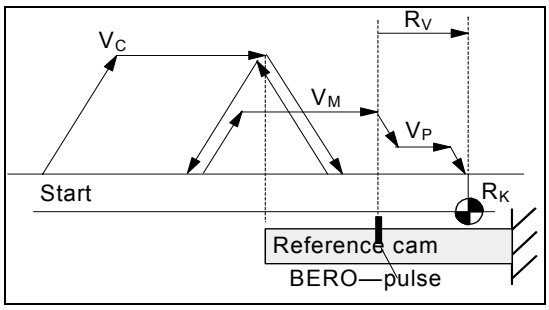
With Reference Cam

BERO pulse refers to proximity switch signals. The BERO pulse can be

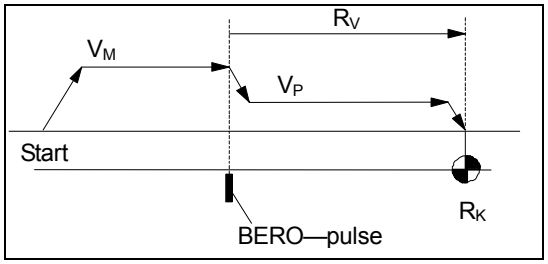
1) **before reference cam:**
MD34050: REFP_SEARCH_MARKER_REVERS=0, search for BERO pulse in a direction reversal to the reference cam.



2) **after reference cam:**
MD34050: REFP_SEARCH_MARKER_REVERS=1, search for BERO pulse in the same direction as the reference cam.



Without reference cam



Notes:

V_C – Reference point approach velocity

MD34020 : REFP_VELO_SEARCH_CAM

V_M – Creep speed

MD34040 : REFP_VELO_SEARCH_MARKER

V_P – Reference point positioning velocity

MD34070 : REFP_VELO_POS

R_V - Reference point distance/target point for distance–coded system

MD34080 : REFP_MOVE_DIST

R_K – Reference point value/irrelevant to distance-coded system

MD34100 : REFP_SET_POS[0]

Parameterization

MD	Designation	Unit	Axis	Example value	Description
34000	REFP_CAM_ IS_ACTIVE	-	X, Z	1	Axis with reference point cam
34010	REFP_CAM_ DIR_IS_ MINUS	-	X, Z	0/1	Approach reference point in: 0- plus direction; 1- minus direction
34020	REFP_VELO_ SEARCH_ CAM	mm/Min	X, Z	2000	Reference point approach velocity
34040	REFP_VELO_ SEARCH_ MARKER	mm/Min	X, Z	300	Creep speed (encoder no.)
34050	REFP_SEAR CH_MARKER _REVERSE	-	X, Z	0/1	BERO pulse is: 0-ouside BERO; 1-inside BERO
34060	REFP_MAX_ MARKER_ DIST	mm	X, Z	200	Maximum distance to reference mark. Max. distance to 2 reference marks for distance–coded measuring systems.
34070	REFP_VELO_ POS	mm/Min	X, Z	200	Reference point positioning velocity
34080	REFP_MOVE	mm	X, Z	-2	Reference point distance/target

	_DIST				point for distance-coded system (with direction)
34100	REFP_SET_ POS	mm	X, Z	29.4	Reference point value/irrelevant to distance-coded system

4.4 Software Limit Switch and Backlash Compensation

Software limit switch settings

Set the software limit switche after starting up the reference point approach function and determining the referece point positions:

MD	Designation	Unit	Axis	Example value	Description
36100	POS_LIMIT_MINUS	mm	X, Z	-1	1st software limit switch minus
36110	POS_LIMIT_PLUS	mm	X, Z	200	1st software limit switch plus

Backlash compensation

Test the backlash and make backlash compensations:

MD	Designation	Unit	Axis	Example value	Description
32450	BACKLASH	mm	X, Z	0.024	Backlash

4.5 Rotation Monitoring

Rotation monitoring

If the double switch mode is used for reference point approaching, (see Section 4.3 “Starting Up Reference Points”), monitor the output pulse of the stepper motors with BERO pulse generated with each rotation of the leadscrew.

MD	Designation	Unit	Axis	Example value	Description
31100	BERO_CYCLE	IPR	X , Z	1250	Steps for monitoring rotation
31110	BERO_EDGE_ TOL	I	X , Z	500	Step tolerance for monitoring rotation

Notes:

The step tolerance of the stepper motors shall include positional difference between both edges of BERO and follow-up error resulted at the maximum traversing speed. The interrelations are given as below:

Steps for monitoring rotation = steps per revolution of the step motor/reduction ratio

Steps corresponding to follow-up error = steps × follow-up error at the max. speed/pitch of leadscrew

4.6 Leadscrew Error Compensation

General

When starting up a machine tool, you may make leadscrew error compensations to enhance the machining precision. Herein below gives an example to show you how to make a leadscrew error compensation.

A maximum of 64 compensation intermediate points can be set for each axis of the SINUMERIK 801. Machine tool builders may set desired number of compensation intermediate points based on actual needs.

Example

Set the Z axis as the compensation axis, the starting compensation point as 100mm(absolute coordinate) , clearance for compensation 100mm and end point for compensation 1200mm (absolute coordinate).

1st step: Determine the number of compensation intermediate points
Example:

Number of compensation intermediate points: 13

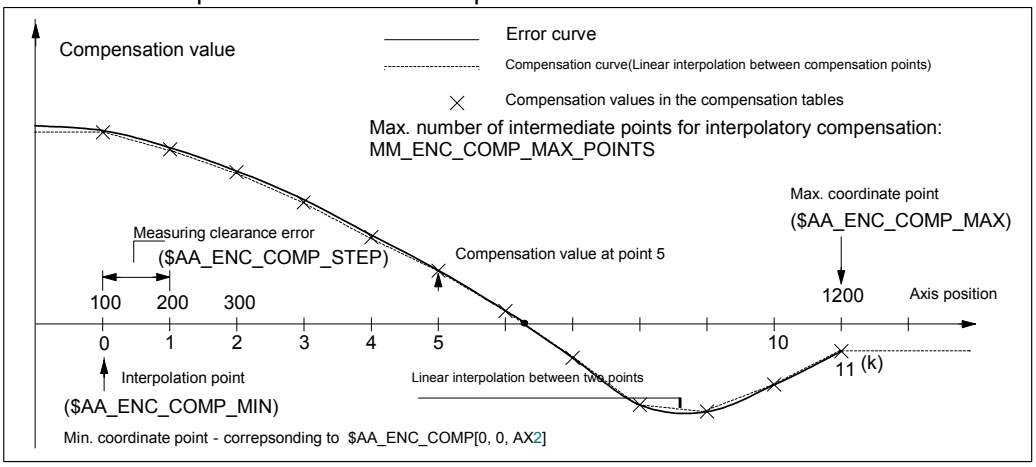


Table 4-1 Compensation principle

Caution

After setting up this MD, the control system will reassign the memory when next power-up and user data including part program, fixed cycles and tool parameter will be cleared. So, prior to this data setting, unload user data into a PC.

2nd step: Transfer the leadscrew error compensation file into the computer using the WINPCIN tool integreated into the control sytem. You may enter compensation values with following two methods:

1st method:

1) Load the leadscrew pitch error compensation array into the computer via SINUMERIK 801;
2) Edit this file on computer and write the error values measured into corresponding positions in the array;
3) Transfer the file into SINUMERIK 801 from the computer.

2nd method:

1) Transfer this compesation array into the computer via SINUMERIK 801;

2) Edit this file on computer and change the file header into a machining program, then transfer to SINUMERIK 801;

3) Use the Edit function of the SINUMERIK 801 to input compensation values on the operator panel directly;

4) Start running this program (and compensation values will be input into the control system)

1ST Method	2nd Method	Remarks
%_N_COMPLETE_EEC_INI	%_N_BUCHANG_MPF ; $PATH=/_N_MPF_DIR	File header
$AA_ENC_COMP [0 , 0 , AX2]= 0.0	$AA_ENC_COMP[0 , 0 , AX2]= 0.0	
$AA_ENC_COMP [0 , 1 , AX2]= 0.020	$AA_ENC_COMP[0 , 1 , AX2]= 0.020	
$AA_ENC_COMP [0 , 2 , AX2]= 0.015	$AA_ENC_COMP[0 , 2 , AX2]= 0.015	
$AA_ENC_COMP [0 , 3 , AX2]= 0.014	$AA_ENC_COMP[0 , 3 , AX2]= 0.014	
$AA_ENC_COMP [0 , 4 , AX2]= 0.011	$AA_ENC_COMP[0 , 4 , AX2]= 0.011	Corresponding min. position
$AA_ENC_COMP [0 , 5 , AX2]= 0.009	$AA_ENC_COMP[0 , 5 , AX2]= 0.009	
$AA_ENC_COMP [0 , 6 , AX2]= 0.004	$AA_ENC_COMP[0 , 6 , AX2]= 0.004	Compensation value array
$AA_ENC_COMP [0 , 7 , AX2]=-0.010	$AA_ENC_COMP[0 , 7 , AX2]=-0.010	
$AA_ENC_COMP [0 , 8 , AX2]=-0.013	$AA_ENC_COMP[0 , 8 , AX2]=-0.013	Corresponding max. position
$AA_ENC_COMP [0 , 9 , AX2]=-0.015	$AA_ENC_COMP[0 , 9 , AX2]=-0.015	
$AA_ENC_COMP [0 , 10 , AX2]=-0.009	$AA_ENC_COMP[0 , 10 , AX2]=-0.009	
$AA_ENC_COMP [0 , 11 , AX2]=-0.004	$AA_ENC_COMP[0 , 11 , AX2]=-0.004	
...	...	
$AA_ENC_COMP [0 , 63 , AX2]	$AA_ENC_COMP[0 , 63 , AX2]	
$AA_ENC_COMP_STEP [0 , AX2]=100.0	$AA_ENC_COMP_STEP[0 , AX2]=100.0	Measuring clearance (mm)
$AA_ENC_COMP_MIN [0 , AX2] =100.0	$AA_ENC_COMP_MIN[0 , AX2] =100.0	Min. position (abs.)
$AA_ENC_COMP_MAX [0 , AX2] =1200.0	$AA_ENC_COMP_MAX[0 , AX2] =1200.0	Max. position (abs.)
$AA_ENC_COMP_IS_MO	$AA_ENC_COMP_IS_MODULO[0 ,	(for rotating axis)

DULO [0 , AX2]=0	AX2]=0	
M17	M02	End of the file

3rd step : Enable the leadscrew error compensation function through set MD

MD	Designation	Unit	Axis	Example value	Description
32700	ENC_COMP_ENABLE	-	X , Z	0	Compensation inactive
				1	Compensation active

Notice

When MD32700=1, the internal compensation value file in SINUMERIK 801 goes into the write protection automatically. To change a compensation value , first amend the compensation file and set MD32700=0 for entering the desired value into SINUMERIK 801. Finally, reset MD32700=1.

4th step: Power on the system again.

Notice

The leadscrew error compensation will not be enabled until reference points have been approached.

4.7 Starting Up the Spindle

General

Spindle can come in two types: contactor-controlled spindle and analog spindle. For analog spindle, through setting up the spindle, the machine tool can have various functions such as thread machining, constant cutting speed, programming spindle speed limit, etc.

Parameterization

If an AC motor and inverter or a servo spindle is used, when machining a thread or programming it based on the feedrate per revolution, set

MD30130 = 1.

MD	Designation	Unit	Axis	Input value	Description
30130	CTRLOUT_TYPE	-	Spindle	0	No analog output
30130	CTRLOUT_TYPE	-	Spindle	1	±10VDC analog output

Set the machine spindle outputs as unipolar/bipolar setpoint output.

MD	Designation	Unit	Axis	Input value	Description
30134	IS_UNIPOLAR_OUTPUT	-	Spindle	0	Setpoint output is bipolar
30134	IS_UNIPOLAR_OUTPUT	-	Spindle	1*	Setpoint output is unipolar
30134	IS_UNIPOLAR_OUTPUT	-	Spindle	2*	Setpoint output is unipolar，Q0.0 and Q0.1 can not be recalled by PLC;

* When MD30134 =1: Q0.0 = Servo enable;

Q0.1 = Spindle CCW

MD30134 =2: Q0.0 = Sevo enable, spindle CW;

Q0.1 = Servo enable, spindle CCW

If the spindle has no encoder feedback, set MD30200 = 0.

MD	Designation	Unit	Axis	Input value	Description
30200	NUM_ENCS	-	Spindle	0	Spindle without encoder

When producing a thread, configure the spindle with an encoder:

MD	Designation	Unit	Axis	Input value	Description
30240	ENC_TYPE	-	Spindle	2	Spindle with measuring system

Set spindle MDs as listed below:

MD	Designation	Unit	Axis	Input value	Description
31020	ENC_RESOL	IPR	Spindle	1024	Encoder markings per revolution (encoder no.)
32260	RATED_VELO	RPM	Spindle	3000	Rated motor speed (setpoint branch)
36200	AX_VELO_ LIMIT[0 ... 5]	RPM	Spindle	3300	Threshold value for velocity monitoring

Determine the encoder limit frequency:

Spindle speed3000 rev/min = 50rev/s;

Encoder limit frequency 50 rev/s×1024 pulses/rev = 51200 pulses/s

Fill in weighted machine data:

MD	Designation	Unit	Axis	Input value	Description
36300	MA_ ENC_ FREQ_ LIMIT	Hz	Spindle	55000	Encoder limit frequency

For anolog spindle with gear changes:

MD	Designation	Unit	Axis	Input value	Description
35010	GEAR_STEP_ CHANGE_ ENABLE	-	Spindle	1	Gear change possible. Spindle has several gear steps
35110	GEAR_STEP_ MAX_VELO[0 , 1 ... 5]	RPM	Spindle	Speed [i]	Maximum speed for gear change(gear stage no.): 0 ... 5
35130	GEAR_STEP_ MAX_VELOLIMI T[0 , 1 ... 5]	RPM	Spindle	Speed [i]	Maximum speed of gear stag(gear stage no.): 0 ... 5
36200	AX_VELO_ LIMIT[0 ,1 ... 5]	RPM	Spindle	Speed [i]	Threshold value for velocity monitoring (control parameter set no.): 0 ... 5
31050	DRIVE_AX_ RATIO_ DENUM[0 , 1 ...	-	Spindle	Denominator [i]	Denominator load gearbox (control parameter

	5]				no.): 0 ... 5
31060	DRIVE_AX_ RATIO_ NUMERA[0 ,1 ... 5]	-	Spindle	Numerator [i]	Numerator load gearbox (control parameter set no.): 0 ... 5

Notice

A maxium of 5 spindle gear stages can be provided. Assigning the same parameters to the index [0] and [1] makes gear changes (i=1 ... 5) active only by setting corresponding interface signals via PLC application.

Programming notice

Pay attention to the following instructions when programming machining programs:

1) When mm/Min is used as the unit of measurement for the feedrate F, activate G94; Programming example: N10 G94 G01 Z100 F100
2) When mm/Rev is used as the unit of measurement for the feedrate F, activate G95; mm/Rev. Programming example: N10 G95 G01 Z100 F1
3) For contactor-controlled spindle, when producing a thread with G33, program spindle speed S within the actual spindle speed range;
4) When programming a thread cutting, program thread run-in and run-out paths;
5) The result of a thread lead value multiplied by spindle speed shall be less than the maximum setpoint speed of Z axis.

Programming example

```
N10 G91 G94 F100 S350 M4      ;  actual spindle speed 350
N20 G01 Z-0.5                 ;  thread run-in
N30 G33 Z-100 K2 SF=0         ;  K - thread lead; SF ;SF – Infeed angle for
                                 thread cutting
N40 G01 Z-0.5                 ;  thread run-out
N50 X50
```

Services, Diagnosis and Data Saving 5

5.1 Services

Functionality

You can use the RS232 interface of the CNC to output data to an external data storage medium or to read in them from there. RS232 interface parameters have been fixed by the control system and cannot be changed.

File types

Files including various data, programs and parameters can be read in/out of RS232 interface with specified access authorization.

File type has been fixed as : RS232 text Baudrate: 9600

RS232 text file screen is shown as below:

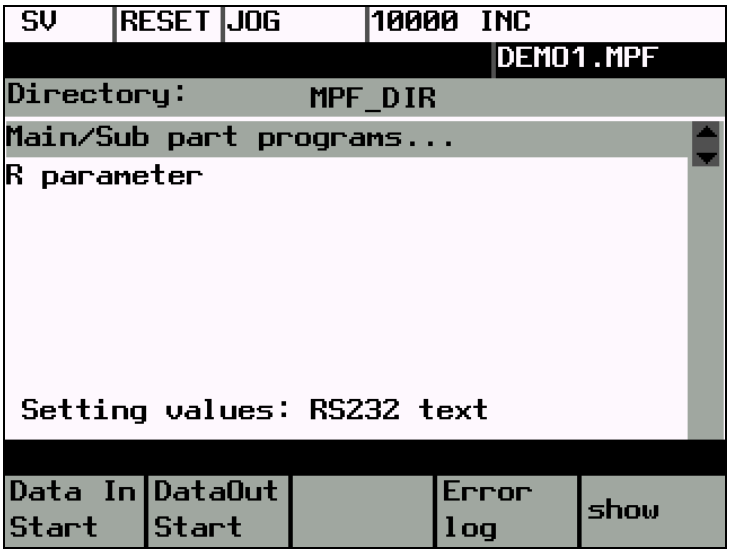


Fig. 5-1 RS232 text file screen

For machine tool builders, after the password assigned to them is entered, following screen appears:

Fig. 5-2 RS232 text file screen (after entering machine tool manufacturer-specific password)

In this screen, pressing softkey “show” can display “Main/Sub part programs…” or “Data…” and therefore execute corresponding data transfers.

Communication tool

The RS232 communication tool WinPCIN shall be loaded onto the PC (you may download corresponding tool on website at www.ad.siemens.com.cn/download/) and baudrate be set as 9600. For detailed information about baudrate setting and softeware tool version, see Fig. 5-3 and 5-4 below.

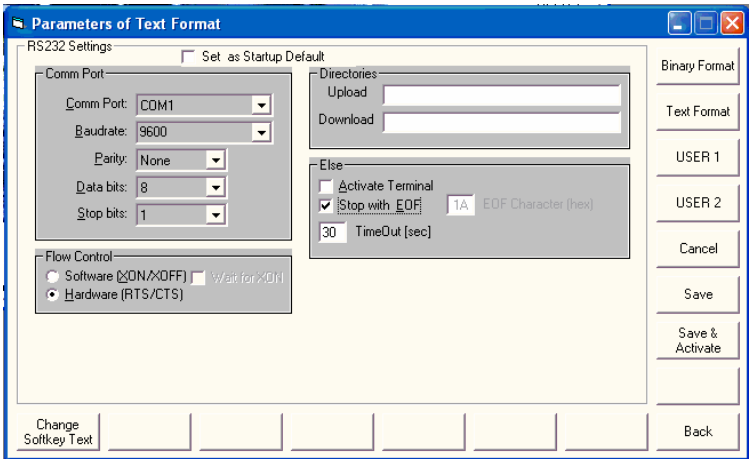


Fig. 5-3

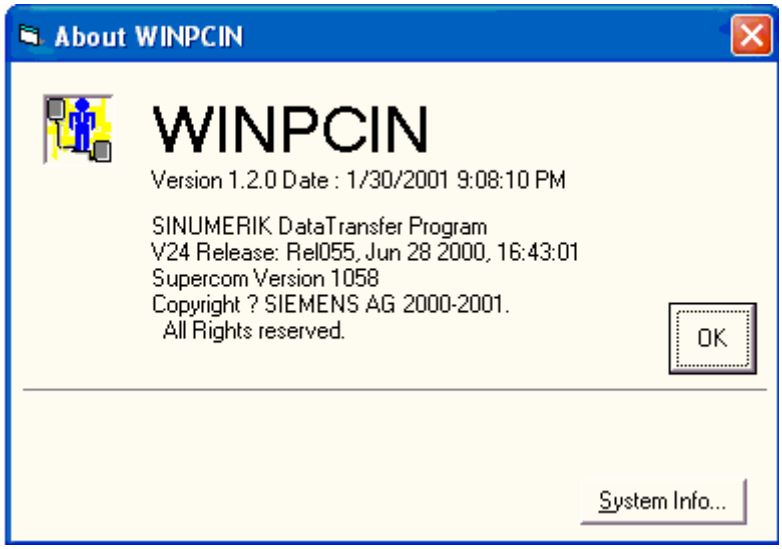

About WINPCIN
WINPCIN
Version 1.2.0 Date : 1/30/2001 9:08:10 PM
SINUMERIK DataTransfer Program
V24 Release: Rel055, Jun 28 2000, 16:43:01
Supercom Version 1058
Copyright ? SIEMENS AG 2000-2001.
All Rights reserved.
OK
System Info...

Fig.5-4

5.2 Diagnosis

Functionality

In the “Diagnosis” operating area, machine manufactuere may optimize the drives with an oscillograph function.

Selecting the Diagnosis softkey will open the Diagnosis main screen.

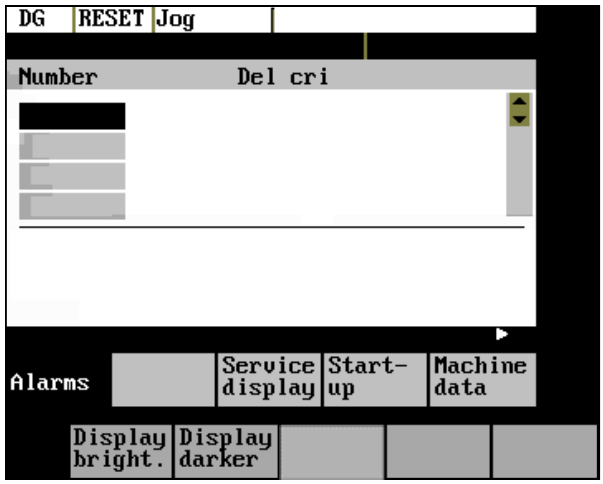


Fig.5-5 Diagnosis main screen

Selecting the “Service display” from the screen above to branch to another softkey level.

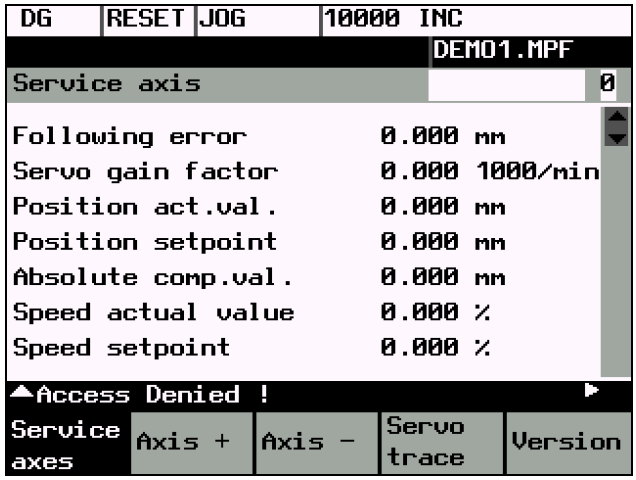


Fig. 5-6

Notice

Machine manufacturer may select the “Servo trace” softkey on the screen of Fig. 5-6 to branch to the corresponding “Servo trace” main screen. However, before entering this main screen, machine manufacturer password must first be input. Otherwise, system will prompt “Access Denied!”

To optimize the drives, an oscillograph function is provided for graphical representation of the velocity setpoint. The velocity setpoint corresponds to the ± 10V interface.

The start of recording can be linked with various criteria which permit recording in parallel to internal conditions of the control system. The setting needed for this option must be carried out in the “Select Signal” function.

The following functions can be used to analyze the result:

- Change scaling of abscissa and ordinate,
- Measure value by means of a horizontal or vertical marker,
- Measure the abscissa and ordinate values as a difference between two marker positions.

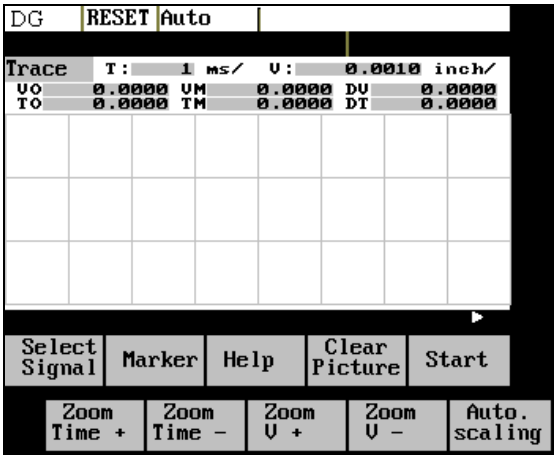


Fig. 5–7 The “Servo Trace” main screen

The heading of the diagram contains the current graduation of abscissa and ordinate, the current measured positions and the difference values of the markers.

The displayed diagram can be moved within the visible screen area by means of the cursor keys.

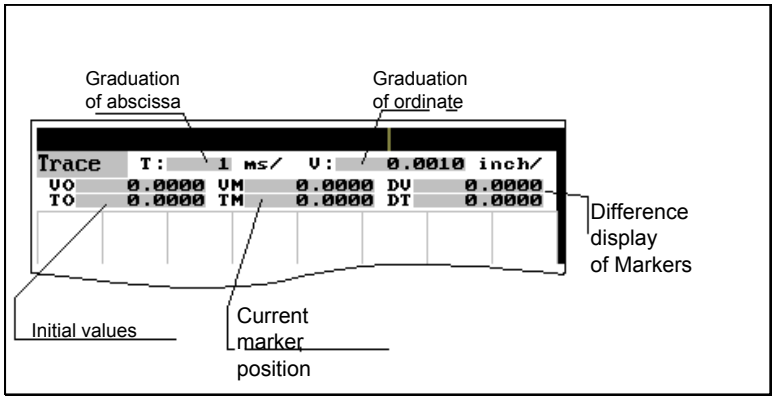


Fig. 5-8 Meaning of the fields

Press the softkey “Select Signal” to select the axis to be measured, the measuring time, threshold value, pre-trigger/post-trigger time and trigger conditions. The signal settings are fixed.

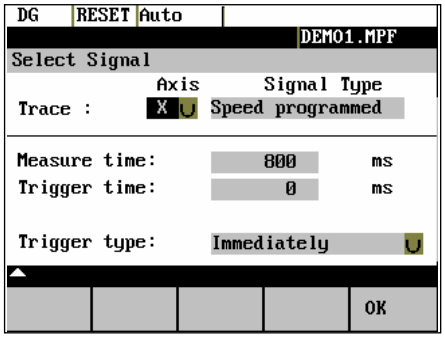


Fig. 5–9 Signal selection

- Selecting the axis: The axis is selected in the Axis toggle field.
- Signal type:
  Velocity setpoint
  Actual position value of measuring system 1
  Following error
- Determining the measuring time: The measuring time is entered in ms directly in the “Measuring Time” input field.
- Determining trigger time to or after

With input values < 0, recording starts by the set time prior to the trigger event, and with values > 0 accordingly after the trigger event, whereby the following conditions must be observed:
Trigger time + measuring time ≥ 0.

- Selecting the trigger condition: Position the cursor on the Trigger Condition field and select the condition using the toggle key.

— No trigger, i.e. the measuring starts immediately after pressing the Start softkey.

— Negative edge.

— Exact stop fine reached.

— Exact stop coarse reached.

- Determining the trigger threshold: The threshold is entered directly in the Threshold input field. It acts only for the trigger conditions “Positive edge” and “Negative edge”.

Press “Marker” key to branch to another softkey level, in which the horizontal or vertical marker can be switched on or off. The markers are displayed in the status bar.

The markers are moved in steps of one increment by means of the cursor keys. Larger step widths can be set in the input fields. The value specifies the number of raster units per <SHIFT> + cursor movement by which the marker is to be moved.

If a marker reaches the margin of the diagram, the next raster in horizontal or vertical direction is automatically pulled down.

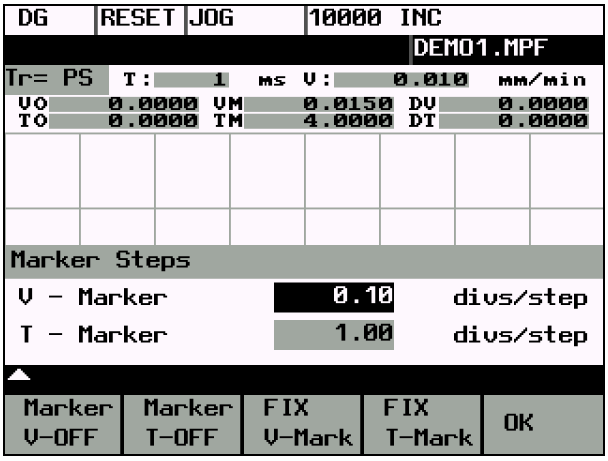


Fig. 5–10 Setting the markers

The markers can also be used to determine the differences in the horizontal or vertical direction. To this aim, position the marker on the start point and press either the Fix H - Mark. or the Fix T- Mark. softkey. The difference between the start point and the current marker position is now displayed in the status bar. The softkey labeling changes to “Free H - Mark” or “Free T - Mark”.

Pressing the Help key softkey calls explanations with regard to the displayed values on the screen.

Pressing the Start softkey starts recording. The softkey labeling changes to Stop. The note “Recording active” is displayed.

When the measuring time is elapsed, the softkey labeling changes to Start.

Pressing the Stop softkey aborts the current measuring. The softkey labeling changes to Start.

Pressing “Zoom Time +”/”Zoom Time - ” enables the scaling changes in the following steps:

1, 2, 5, 10, 20, 50, 100, 200, 500, 1,000 ms/div.

Pressing “Zoom V +”/”Zoom V -” enables the horizontal scaling changes in the following steps:

0.01, 0.05, 0.1, 0.5, 1, 5, 10, 50, 100, 500, 1,000, 5,000 unit/ div

Pressing the Auto Scaling key calculates the vertical scaling from the peak values.

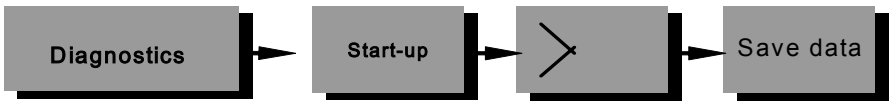
5.3 Data Saving

5.3.1 Internal Data Saving

Data saving

After all MD has been started up, the password must be closed so as to save data and call the data again rapidly next time.

Operating sequence:



Save machine data, set data, machining data, leadscrw error compensation data, etc. in the permanent memory. Recall them again via Start-up switch position 3 or by selecting menu “Power-up with saved data”.

Notice

If the fuction “record reference point” has been executed (with MD34210), **do** approach reference point again after system power up with saved data!

5.3.2 External Data Saving

Purpose

In case of any product fault and subsequent maintenance, the machine tool builder / end user is requested to fill in the Warranty Card – SINUMERIK 801 delivered in the package so that the setting data can be recovered immediately by Siemens after product has been replaced or maintained. Hereinbelow is relevant data sheet described in the Warranty Card.

1. Machine Data

Data	Definition	Unit	OEM Value		
			X-axis	Z-axis	Spin.
Setting value:					
30134	Setpoint output is unipolar	-			
30600	Fixed-value positions of axis with G75 (position no.)	mm			
31020	Encoder markings per revolution (encoder no.)	IPR			
31030	Pitch of leadscrew	mm			
31050 [0]	Denominator load gearbox (control parameter No.)[0]	-			
31050 [1]	Denominator load gearbox (control parameter No.)[1]	-			
31060	Numerator load gearbox (control	-			

Data	Definition	Unit	OEM Value		
			X-axis	Z-axis	Spin.
[0]	parameter set No.)[0]				
31060 [1]	Numerator load gearbox (control parameter set No.)[1]	-			
31100	Steps for monitoring rotation	IPR			
31110	Step tolerance for monitoring rotation	I			
31350	Stepping rate at maximum velocity	Hz			
31400	Steps per stepping motor revolution	IPR			
32000	Maximum axis velocity	mm/Min rpm			
32010	Rapid traverse in jog mode	mm/Min rpm			
32020	Jog axis velocity	mm/Min rpm			
32100	Traversing direction (not control direction)	-			
32110	Sign actual value (control direction)	-			
32200 [0]	Servo gain factor (control parameter set no.)	1000/min			
32200 [1]	Servo gain factor (control parameter set no.)	1000/min			
32260	Rated motor speed (setpoint branch)	rpm			
32300	Axis acceleration	m/s^2			
32450	Backlash	mm			
32700 *	Interpolatory compensation (encoder no.)	-			
34000	Axis with reference point cam	-			
34010	Approach reference point in minus direction	-			
34020	Reference point approach velocity	mm/Min			
34040	Creep speed (encoder no.)	mm/Min			
34060	Maximum distance to reference mark	mm/Min			
34070	Reference point positioning velocity	mm/Min			
34080	Reference point distance				
34100	Reference point value/irrelevant for distance-coded system	mm			
35110	Maximum speed for gear change	rpm			

Data	Definition	Unit	OEM Value		
			X-axis	Z-axis	Spin.
[1]	[1]				
35130 [1]	Maximum speed of gear change [1]	rpm			
35150	Spindle speed tolerance	-			
36100	1st software limit switch minus	mm			
36110	1st software limit switch plus	mm			
36200 [0]	Threshold value for velocity monitoring [0]	mm/Min rpm			
36200 [1]	Threshold value for velocity monitoring [1]	mm/Min rpm			
36300	Encoder limit frequency	Hz			
Other machine data (if necessary)					

32700* note: If interpolatory compensation is used, please fill in the parameters into the following table.

X-axis	Z-axis
$AA_ENC_COMP[0,0,AX1]=	$AA_ENC_COMP[0,0,AX2]=
$AA_ENC_COMP[0,1,AX1]=	$AA_ENC_COMP[0,1,AX2]=
$AA_ENC_COMP[0,2,AX1]=	$AA_ENC_COMP[0,2,AX2]=
$AA_ENC_COMP[0,3,AX1]=	$AA_ENC_COMP[0,3,AX2]=
$AA_ENC_COMP[0,4,AX1]=	$AA_ENC_COMP[0,4,AX2]=
$AA_ENC_COMP[0,5,AX1]=	$AA_ENC_COMP[0,5,AX2]=
$AA_ENC_COMP[0,6,AX1]=	$AA_ENC_COMP[0,6,AX2]=
$AA_ENC_COMP[0,7,AX1]=	$AA_ENC_COMP[0,7,AX2]=
$AA_ENC_COMP[0,8,AX1]=	$AA_ENC_COMP[0,8,AX2]=
$AA_ENC_COMP[0,9,AX1]=	$AA_ENC_COMP[0,9,AX2]=
$AA_ENC_COMP[0,10,AX1]=	$AA_ENC_COMP[0,10,AX2]=
$AA_ENC_COMP[0,11,AX1]=	$AA_ENC_COMP[0,11,AX2]=
$AA_ENC_COMP[0,12,AX1]=	$AA_ENC_COMP[0,12,AX2]=
$AA_ENC_COMP[0,13,AX1]=	$AA_ENC_COMP[0,13,AX2]=
$AA_ENC_COMP[0,14,AX1]=	$AA_ENC_COMP[0,14,AX2]=
$AA_ENC_COMP[0,15,AX1]=	$AA_ENC_COMP[0,15,AX2]=
$AA_ENC_COMP_STEP[0,AX1]=	$AA_ENC_COMP_STEP[0,AX2]=
$AA_ENC_COMP_MIN[0,AX1]=	$AA_ENC_COMP_MIN[0,AX2]=
$AA_ENC_COMP_MAX[0,AX1]=	$AA_ENC_COMP_MAX[0,AX2]=

2．PLC Parameter

MD14512	**PLC data (Binary)**								**MD 14510**	**PLC data (integer)**
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
14512[4]									14510[2]	
14512[6]									14510[3]	
									14510[4]	
									14510[5]	
									14510[6]	
									14510[7]	

5.3.3 Important Notice

Important

Pay attention to following notices prior to the delivery of machine tools by machine manufacturers:

1) Password

Some functions of the the control system are protected by password. The control system has preset one password (“Evening”) for machine manufacturers. If no password is entered by the machine manufacturer, only tool offset, tool wear, zero offset, R parameter and part program edit can be changed. If the password is entered, still machine data modification, data transfer and servo trace functions will be made possible.

5-4

The password input by the machine manufacturer before system power-off will be cancelled by the control system after control power-off. Next time after power-on again, the password shall be input again by the machine manufacturer when necessary. Change of password by the machine manufacturer is allowed.

2) Data backup

Be sure to make data backup after the machine has been started up and ready for delivery. Data backup includes internal data saving and external data saving. With external data saving, machine data, leadscrew error compensation data, tool data can be loaded into a PC.

Accessories 6

General

For the more convenient use of SINUMERIK 801, some accessories are also delivered together with the control system such as fuse, emergency stop cover, etc.

Fuse

SINUMERIK 801 uses glass-tube fuse made by WICKMANN company, its model and specification are : 5x20mm, No.196, 4A, 250V.

If the fuse is broken, please first find out the cause, eliminate the trouble and then replace it with delivered spare fuse.

Cover for Emergency Stop Button

The delivered control system has a reserved mounting hole for emergency stop button. If customer does not intend to use this button, he may attach the delivered cover for emergency stop button to the hole after the protective film on the cover has been removed so as to make the operator more presentable.

When mounting the cover, please first detach the adhesive film on the surface of the cover, then direct the cover to the center of the hole and attach it to the hole.

Technical Appendix 7

7.1 List of Machine Data

Data type	BOOLEAN	Machine data bit (1 or 0)
	BYTE	Integer values (from – 128 to 127)
	DOUBLE	Real and integer values (from ± 2.23 x 10^{-308} to ± 1.79 x 10^{308})
	DWORD	Integer values (from – 2.147 x 10^{9} to 2.147 x 10^{9})
	STRING	Character string (max. 16 characters) consisting of upper–case letters with digits and underscore
	UNSIGNED WORD	Integer values (from 0 to 65535)
	SIGNED WORD	Integer values (from – 32768 to 32767)
	UNSIGNED DWORD	Integer values (from 0 to 4294967295)
	SIGNED DWORD	Integer values (from – 2147483648 to 2147483647)
	WORD	Hex values (from 0000 to FFFF)
	DWORD	Hex values (from 00000000 to FFFFFFFF)
	FLOAT DWORD	Real values (from ±1.18 x 10^{-38} to ± 3.4 x 10^{38})

Activation conditions

PO(Power On)	Data active when system power on;
RE(Reset)	Data active whey system is reset
CF(Configuration)	Active when “Data Active” soft menu is enabled;
IM(Immediate)	Immediately active

Data format

Number	MD Name			Reference
Unit	Name, Miscellaneous		Activated	
HW / function	Standard value	Minimum value	Maximum value	Data type

General machine data

10240	SCALING_SYSTEM_IS_METRIC			
–	Basic system metric		POWER ON	
_always	1	***	***	BOOLEAN

14510	USER_DATA_INT [n]			
kB	User data (INT) 0 ... 31		POWER ON	
–	–	0	–	DWORD

14512	USER_DATA_BIN [n]			
kB	User data (Binary) 0 ... 31		POWER ON	
–	0	0	0xFF	DWORD

Axis-specific machine data

30130	CTRLOUT_TYPE			
–	Output type of setpoint (setpoint branch): 0		POWER ON	
_always	0	0	2	BYTE

30134	IS_UNIPOLAR_OUTPUT[0]			
–	Setpoint output is unipolar : 0		POWER ON	
_always	0	0	2	BYTE

30200	NUM_ENCS			
–	Number of encoders (spindle with or without encoder)		RESTART	
	1	0	1	BYTE

30240	ENC_TYPE			
–	Type of actual value acquisition (actual position value) (encoder no.) 0: Simulation 2: Square–wave generator, standard encoder (pulse multiplication) 3: Encoder for stepper motor		POWER ON	
_always	0, 0	0	4	BYTE

30350	SIMU_AX_VDI_OUTPUT			
–	Output of axis signals with simulation axes		POWER ON	
_always	0	***	***	BOOLEAN

30600	FIX_POINT_POS			

mm, degrees	Fixed–value positions of axis with G75 (position no.)		POWER ON	
_always	0.0	–	–	DOUBLE

31000	**ENC_IS_LINEAR**			
–	Direct measuring system (linear scale) (encoder no.)		POWER ON	
_always	0	***	***	BOOLEAN

31010	**ENC_GRID_POINT_DIST**			
mm	Division period for linear scales (encoder no.)		POWER ON	
_always	0.01	0.0	plus	DOUBLE

31020	**ENC_RESOL**			
–	Encoder markings per revolution (encoder no.)		POWER ON	
_always	2048	0.0	plus	DWORD

31030	**LEADSCREW_PITCH**			
mm	Pitch of leadscrew		POWER ON	
_always	10.0	0.0	plus	DOUBLE

31040	**ENC_IS_DIRECT**			
–	Encoder mounted directly to the machine (encoder no:)		POWER ON	
_always	0	***	***	BOOLEAN

31050	**DRIVE_AX_RATIO_DENOM**			
–	Denominator load gearbox (control parameter no.): 0 ... 5		POWER ON	
_always	1, 1, 1, 1, 1, 1	1	2147000000	DWORD

31060	**DRIVE_AX_RATIO_NUMERA**			
–	Numerator load gearbox (control parameter set no.): 0 ... 5		POWER ON	
_always	1, 1, 1, 1, 1, 1	1	2147000000	DWORD

31070	**DRIVE_ENC_RATIO_DENOM**			
–	Denominator resolver gearbox (encoder no.)		POWER ON	
_always	1	1	2147000000	DWORD

31080	**DRIVE_ENC_RATIO_NUMERA**			
–	Numerator resolver gearbox (encoder no.)		POWER ON	
_always	1	1	2147000000	DWORD

31090	**JOG_INCR_WEIGHT**			
mm, degrees	Evaluation of an increment with INC/handwheel		RESET	

31100	**BERO_CYCLE**			
–	Steps for monitoring rotation		POWER ON	
	2000	10	10000000	DWORD

31110	**BERO_EDGE_TOL**			
–	Step tolerance for monitoring rotation		POWER ON	
	50	10	10000000	DWORD

31350	**FREQ_STEP_LIMIT**			
–	Stepping rate at maximum velocity		NEW CONF	
Hz	250000	0.1	4000000	DOUBLE

31400	**STEP_RESOL**			
–	Steps per stepper motor revolution		POWER ON	
	1000	0	plus	DWORD

31500	**AXIS_NUMBER_FOR_MONITORING**			
–	Display setpoint of this axis for servicing		POWER ON	
	0	0	4	DWORD

32000	**MAX_AX_VELO**			
mm/min, rev/min	Maximum axis velocity		NEW CONF	
_always	10000.	0.0	plus	DOUBLE

32010	**JOG_VELO_RAPID**			
mm/min, rev/min	Rapid treverse in jog mode		RESET	
_always	10000.	0.0	plus	DOUBLE

32020	**JOG_VELO**			
mm/min, rev/min	Jog axis velocity		RESET	
_always	2000.	0.0	plus	DOUBLE

32070	**CORR_VELO**			
%	Axis velocity for handwheel override, ext. ZO, cont. dressing, distance control		RESET	
_always	50	0.0	plus	DWORD

32100	**AX_MOTION_DIR**			
–	Traversing direction (not control direction)		POWER ON	
_always	1	–1	1	DWORD

32110	**ENC_FEEDBACK_POL**			
–	Sign actual value (control direction) (encoder no.)		POWER ON	
_always	1	–1	1	DWORD

32200	**POSCTRL_GAIN**			
1000/min	Servo gain factor (control parameter set no.): 0 ... 5		NEW CONF	
_always	(2,5; 2,5; 2,5; 1), ...	0.0	plus	DOUBLE

32260	**RATED_VELO**			
rev/min	Rated motor speed (setpoint branch): 0		NEW CONF	
_always	3000	0.0	plus	DOUBLE

32300	MAX_AX_ACCEL			
mm/s^2, rev/s^2	Axis acceleration		NEW CONF	
_always	1	0	***	DOUBLE

32420	JOG_AND_POS_JERK_ENABLE			
-	Enable axial jerk limitation		NEW CONF	
_always	0	***	***	BOOLEAN

32430	JOG_AND_POS_,AX_JERK			
-	Axial jerk		NEW CONF	
_always	1000 (mm/s^3) 2777,77 (degrees/s^3)	10^{-9}	***	DOUBLE

32450	BACKLASH			
mm	Backlash		NEW CONF	
_always	0.000	*	*	DOUBLE

32700	ENC_COMP_ENABLE			
–	Interpolatory compensation (encoder no.): 0,1		POWER ON	
_always	0	***	***	BOOLEAN

32900	DYN_MATCH_ENABLE			
–	Dynamic response adaptation		NEW_CONF	
	0	0	1	BYTE

32910	DYN_MATCH_TIME			
–	Time constant of dynamic adaption (control parameter set no): 0 ... 5		NEW_CONF	
	0	0.0	plus	DOUBLE

32920	AC_FILTER_TIME			
s	Smoothing factor time constant for adaptive control		POWER ON	
_always	0.0	0.0	plus	DOUBLE

33050	LUBRICATION_DIST			
mm, deg.	Traversing distance for lubrication from PLC		NEW CONF	
_always	100000000	0.0	plus	DOUBLE

34000	REFP_CAM_IS_ACTIVE			
–	Axis with reference point cam		RESET	
_always	1	***	***	BOOLEAN

34010	REFP_CAM_DIR_IS_MINUS			
–	Approach reference point in minus direction		RESET	
_always	0	***	***	BOOLEAN

34020	REFP_VELO_SEARCH_CAM			
mm/min, rev/min	Reference point approach velocity		RESET	

_always	5000.0	0.0	plus	DOUBLE

34030	**REFP_MAX_CAM_DIST**			
mm, deg.	Maximum distance to reference cam		RESET	
_always	10000.0	0.0	plus	DOUBLE

34040	**REFP_VELO_SEARCH_MARKER**			
mm/min, rev/min	Creep speed (encoder no.)		RESET	
_always	300.0	0.0	plus	DOUBLE

34050	**REFP_SEARCH_MARKER_REVERSE**			
–	Direction reversal to reference cams (encoder no.)		RESET	
_always	0	***	***	BOOLEAN

34060	**REFP_MAX_MARKER_DIST**			
mm, deg.	Maximum distance to reference mark. Max. distance to 2 reference marks for distance–coded measuring systems.		RESET	
_always	20.0	0.0	plus	DOUBLE

34070	**REFP_VELO_POS**			
mm/min, rev/min	Reference point positioning velocity		RESET	
_always	1000.0	0.0	plus	DOUBLE

34080	**REFP_MOVE_DIST**			
mm, deg.	Reference point distance/target point for distance–coded system		RESET	
_always	–2.0	–	–	DOUBLE

34090	**REFP_MOVE_DIST_CORR**			
mm, deg.	Reference point offset/absolute offset distance–coded		POWER ON	
_always	0.0	–	–	DOUBLE

34092	**REFP_CAM_SHIFT**			
mm, deg.	Electr. cam offset of incremental measuring systems with equidistant zero marks		RESET	
_always	0.0	0.0	plus	DOUBLE

34100	**REFP_SET_POS**			
mm, deg.	Reference point value/irrelevant for distance–coded system: 0 ... 3		RESET	
_always	0., 0., 0., 0.	–	–	DOUBLE

34110	**REFP_CYCLE_NR**			
–	Sequence of axes in channel–specific referencing –1: No obligatory reference point for NC Start 0: No channel–specific reference–point approach 1–15: Sequence in channel–specific reference point approach		RESET	

_always	1	–1	31	DWORD

34200	**ENC_REFP_MODE**			
–	Type of position measuring system 0: No ref. point appr.; if an absolute encoder exists: REFP_SET_POS accepted 1: Zero pulse (on encoder track)		POWER ON	
_always	1	0	6	BYTE

34210	**ENC_REFP_STATE**			
–	0: Function “record reference point” inactive. Reference point must be approached again next time when normal system power-up. 1: Fucntion “record refrence point” activated. After reference point has been approached, this machine data is changed to 2 automatically. If the reference point has been saved before power-off, next time when power up, system will record position and reference point of that axis saved, so no reference point approach is required.		POWER ON	
_always	0	1	2	DWORD

35010	**GEAR_STEP_CHANGE_ENABLE**			
–	Gear change possible. Spindle has several gear steps		POWER ON	
_always	0	***	***	BOOLEAN

35040	**SPIND_ACTIVE_AFTER_RESET**			
–	Own spindle reset		POWER ON	
_always	0	***	***	BOOLEAN

35100	**SPIND_VELO_LIMIT**			
rev/min	Maximum spindle speed		POWER ON	
_always	10000	0.0	plus	DOUBLE

35110	**GEAR_STEP_MAX_VELO**			
rev/min	Maximum speed for gear change (gear stage no.): 0..5		NEW CONF	
_always	500, 500, 1000, 2000, 4000, 8000	0.0	plus	DOUBLE

35120	**GEAR_STEP_MIN_VELO**			
rev/min	Minimum speed for gear change (gear stage no.): 0..5		NEW CONF	
_always	50, 50, 400, 800, 1500, 3000	0.0	plus	DOUBLE

35130	**GEAR_STEP_MAX_VELO_LIMIT**			
rev/min	Maximum speed of gear stage (gear stage no.): 0 ... 5		NEW CONF	
_always	500, 500, 1000, 2000, 4000, 8000	0.0	plus	DOUBLE

35140	**GEAR_STEP_MIN_VELO_LIMIT**			
rev/min	Minimum speed of gearsetp (gear stage no.): 0 ... 5		NEW CONF	

_always	5, 5,10, 20, 40, 80	0.0	plus	DOUBLE

35150	**SPIND_DES_VELO_TOL**			
Factor	Spindle speed tolerance		RESET	
_always	0.1	0.0	1.0	DOUBLE

35160	**SPIND_EXTERN_VELO_LIMIT**			
rev/min	Spindle speed limitation from PLC		NEW CONF	
_always	1000	0.0	plus	DOUBLE

35200	**GEAR_STEP_SPEEDCTRL_ACCEL**			
rev/s^2	Acceleration in speed control mode [gear stage no.]: 0 ... 5		NEW CONF	
_always	30, 30, 25, 20, 15, 10	2	***	DOUBLE

35210	**GEAR_STEP_POSCTRL_ACCEL**			
rev/s^2	Acceleration in position control mode (gear stage no.): 1 ... 5		NEW CONF	
_always	30, 30, 25, 20, 15, 10	2	***	DOUBLE

35220	**ACCEL_REDUCTION_SPEED_POINT**			
Factor	Speed for reduced acceleration		RESET	
_always	1.0	0.0	1.0	DOUBLE

35230	**ACCEL_REDUCTION_FACTOR**			
Factor	Reduced acceleration		RESET	
_always	0.0	0.0	0.95	DOUBLE

35240	**ACCEL_TYPE_DRIVE**			
–	Type of acceleration		RESET	
	0	0	1	BOOLEAN

35300	**SPIND_POSCTRL_VELO**			
rev/min	Position control switch–on speed		NEW CONF	
_always	500	0.0	plus	DOUBLE

35350	**SPIND_POSITIONING_DIR**			
–	Direction of rotation when positioning		RESET	
_always	3	3	4	BYTE

35400	**SPIND_OSCILL_DES_VELO**			
rev/min	Reciprocation speed		NEW CONF	
_always	500	0.0	plus	DOUBLE

35410	**SPIND_OSCILL_ACCEL**			
rev/s^2	Acceleration during reciprocating		NEW CONF	
_always	16	2	***	DOUBLE

35430	**SPIND_OSCILL_START_DIR**			
-	Starting direction during reciprocation 0-2: As last direction of rotation (zero-speed		RESET	

	M3) 3: M3 direction 4: M4 direction			
_always	0	0	4	BYTE

35440	**SPIND_OSCILL_TIME_CW**			
s	Reciprocation time for M3 direction		NEW CONF	
_always	1.0	0.0	plus	DOUBLE

35450	**SPIND_OSCILL_TIME_CCW**			
s	Reciprocation time for M4 direction		NEW CONF	
_always	0.5	0.0	plus	DOUBLE

35500	**SPIND_ON_SPEED_AT_IPO_START**			
-	Feed enable for spindle in setp. Range		RESET	
_always	1	0	2	BYTE

35510	**SPIND_STOPPED_AT_IPO_START**			
–	Feedrate enable for spindle stopped		RESET	
_always	0	***	***	BOOLEAN

36000	**STOP_LIMIT_COARSE**			
mm, deg.	Exact positioning coarse		NEW CONF	
_always	0.04	0.0	plus	DOUBLE

36010	**STOP_LIMIT_FINE**			
mm, deg.	Exact positioning fine		NEW CONF	
_always	0.01	0.0	plus	DOUBLE

36020	**POSITIONING_TIME**			
s	Delay exact positioning fine		NEW CONF	
_always	1.0	0.0	plus	DOUBLE

36030	**STANDSTILL_POS_TOL**			
mm, deg.	Zero–speed tolerance		NEW CONF	
	0.2	0.0	plus	DOUBLE

36040	**STANDSTILL_DELAY_TIME**			
s	Delay zero–speed monitoring		NEW CONF	
_always	0.4	0.0	plus	DOUBLE

36050	**CLAMP_POS_TOL**			
mm, deg.	Clamping tolerance		NEW CONF	
_always	0.5	0.0	plus	DOUBLE

36060	**STANDSTILL_VELO_TOL**			
mm/min,	Maximum velocity/speed “axis/spindle stopped”		NEW CONF	

rev/min				
_always	5 (0.014)	0.0	plus	DOUBLE

36100	**POS_LIMIT_MINUS**			
mm, deg.	1st software limit switch minus		RESET	
_always	–100000000	–	–	DOUBLE

36110	**POS_LIMIT_PLUS**			
mm, deg.	1st software limit switch plus		RESET	
_always	100000000	–	–	DOUBLE

36120	**POS_LIMIT_MINUS2**			
mm, deg.	2nd software limit switch minus		RESET	
_always	–100000000	–	–	DOUBLE

36130	**POS_LIMIT_PLUS2**			
mm, deg.	2nd software limit switch plus		RESET	
_always	100000000	–	–	DOUBLE

36200	**AX_VELO_LIMIT**			
mm/min, rev/min	Threshold value for velocity monitoring (control parameter set no.): 0 ... 5		NEW CONF	
_always	11500., 11500., 11500., 11500., ...	0.0	plus	DOUBLE

36300	**ENC_FREQ_LIMIT**			
Hz	Encoder limit frequency		POWER ON	
_always	300000	0	plus	DOUBLE

36302	**ENC_FREQ_LIMIT_LOW**			
%	Encoder limit frequency at which encoder is switched on again. (Hysteresis)		NEW CONF	
_always	99.9	0	100	DOUBLE

36310	**ENC_ZERO_MONITORING**			
–	Zero mark monitoring (encoder no.): 0,1 0: Zero mark monitoring off, encoder HW monitoring on 1–99, >100: Number of recognized zero mark errors during monitoring 100: Zero mark monitoring off, encoder HW monitoring off		NEW CONF	
_always	0, 0	0.0	plus	DWORD

36400	**CONTOUR_TOL**			
mm, deg.	Contour monitoring tolerance band		NEW CONF	
_always	1.0	***	***	DOUBLE

36500	**ENC_CHANGE_TOL**			

mm, deg	Portion of distance for backlash working		NEW CONF	
_always	0,1	0.0	plus	DOUBLE

36610	**AX_EMERGENCY_STOP_TIME**			
s	Duration of the deceleration ramp for error states		NEW CONF	
_always	0.05	0.0	plus	DOUBLE

36620	**SERVO_DISABLE_DELAY_TIME**			
s	Cutout delay servo enable		NEW CONF	
_always	0.1	0.0	plus	DOUBLE

36700	**DRIFT_ENABLE**			
–	Automatic drift compensation		NEW CONF	
_always	0	***	***	BOOLEAN

36710	**DRIFT_LIMIT**			
%	Drift limit value for automatic drift compensation		NEW CONF	
_always	1.000	0.0	plus	DOUBLE

36720	**DRIFT_VALUE**			
%	Drift basic value		NEW CONF	
_always	0.0			DOUBLE

38000	**MM_ENC_COMP_MAX_POINTS**			
–	Number of intermediate points for interpolatory compensation (SRAM)		POWER ON	
_always	0, 0	0	5000	DWORD

Setting data

41110	**JOG_SET_VELO**			
mm/min	Axis speed for JOG		Immediately	
_always	0.0	0.0	plus	DOUBLE

41200	**JOG_SPIND_SET_VELO**			
rev/min	Speed for spindle JOG mode		Immediately	
_always	0.0	0.0	plus	DOUBLE

43210	**SPIND_MIN_VELO_G25**			
rev/min	Progr. spindle speed limitation G25		Immediately	
_always	0.0	0.0	plus	DOUBLE

43220	**SPIND_MAX_VELO_G26**			
rev/min	Progr. spindle speed limitation G26		Immediately	
_always	1000	0.0	plus	DOUBLE

43230	**SPIND_MAX_VELO_LIMS**			
rev/min	Spindle speed limitation with G96		Immediately	

_always	100	0.0	plus	DOUBLE

52011	**STOP_CUTCOM_STORE**			
	Alarm response for TRC and feedforward stop		Immediately	
–	1	0	1	BOOLEAN

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For Publication/Manual:

SINUMERIK 801
Start-Up

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Techncial Manual
Order No: A5E00702069
Edition: 2005.11

Should you come across any printing errors when reading this publication, please notify us on this sheet.
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Suggestions and/or corrections

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