Start-Up 08/2003 Edition

sinumerik

SINUMERIK 802C base line

SIEMENS

SIEMENS

SINUMERIK 802C base line

Start-Up

Technical Manual

Valid as from

Control system	*Software version*
SINUMERIK 802C base line	4

2003.08 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
2000.04	6FC5597-3AA20-0BP1	**A**
2002.01	6FC5597-3AA20-0BP2	**C**
2003.08	6FC5597-4AA21-0BP0	**C**

Trademarks

SIMATIC®, SIMATIC HMI®, SIMATIC NET®, SIMODRIVE®, SINUMERIK®, and SIMOTION® are registered trademarks of SIEMENS AG.

Other names in this publication might be trademarks whose use by a third party for his own purposes may violate the registered holder.

Exclusion of liability

We have checked that the contents of this document correspond to the hardware and software described. Nonetheless, differences might exist and we cannot therefore guarantee that they are completely identical. The information contained in this document is reviewed regularly and any necessary changes will be included in the next edition. We welcome suggestions for improvement.

Safety notices

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.

Contents

SINUMERIK 802C base line Control System 1

1.1 Components of the SINUMERIK 802C base line

What is SINUMERIK 802C base line?

The SINUMERIK 802C base line is a microprocessor-controlled numerical control system for economic machine tools with analog drives.

Hardware components

The SINUMERIK 802C base line is a compact CNC unit. It consists of the following areas (see figure 1-1):

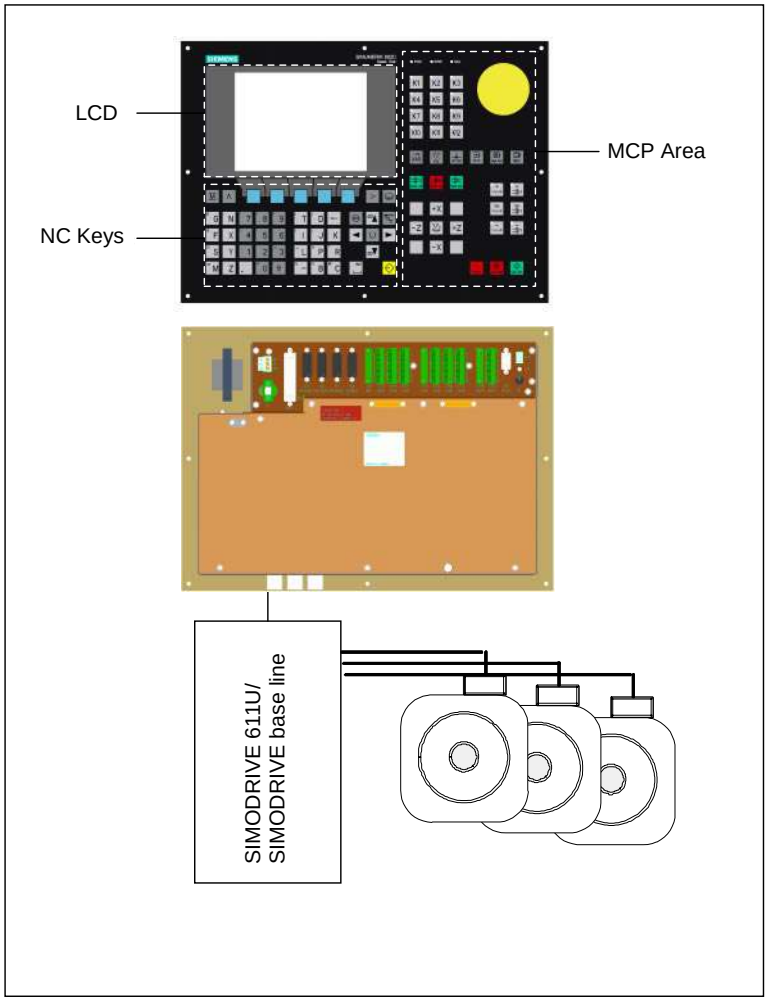


Fig. 1-1 Components of SINUMERIK 802C base line (turning variant)

Software components

The SINUMERIK 802C base line comprises the following software components, which can be ordered:

- System software on the permanent flash memory of the CNC
  - Boot software
    loads the remaining system software from the permanent memory into the user memory (DRAM) and starts the system.
  - MMC software (Man Machine Communication),
    implements all operating functions
  - NCK software (NC Kernel)
    implements all NC functions. This software controls an NC channel with a maximum of 3 movement axes and a spindle.
  - PLC software (Programmable Logic Control)
    executes the integrated PLC user program cyclically.
  - Integrated PLC user program
    intended to adjust the SINUMERIK 802C base line to the machine functions (see also Description of Functions “Integrated User Program for SINUMERIK 802C base line”).
- Toolbox
  - WinPCIN transfer program for a PC/PG (programming device) to transfer user data and programs
  - Text manager
  - Cycle kit for loading into the control system using WinPCIN
  - User program library
  - Technological machine data files
  - Programming tool
- Update diskettes
  - Update program with operator prompting system
  - 802C base line system software, packed, for loading and programming the SINUMERIK 802C base line via an update program.

User data

User data are:

- Machine data
- Setting data
- Tool data
- R parameters
- Zero offsets
- Compensation data
- Part programs
- Standard cycles

Data saving

Modified user data are saved for at least 50 h after power off or power failure. After then, they might get lost.

Warning

To avoid data loss, the operator must carry out data saving (see Section 4.1.4).

1.2 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		1.5		A
Power dissipation of CNC		35		W
Start-up current			4	A

Weight

Table 1–2 Weight

Component	Weight [g]
CNC	4500

Dimensions

Table 1–3 Component dimensions

Component	Dimensions LxWxD [mm]
CNC	420 x 300 x 83

Environmental operating conditions

Table 1–4 Environmental operating conditions

Parameter	
Temperature range	0...55 °C
Permissible relative humidity	5...95 % without condensation
Air pressure	700...1,060 hPa

The operating conditions comply with IEC 1131–2.
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	Transport: –40...70 °C Storage: -20 ... 55 °C
Permissible relative air humidity	5...95 % without condensation
Air pressure	700...1,060 hPa
Transport height	–1,000...3,000 m
Free fall in transport package	≤1,200 mm

Protective quality and degree of protection

Class of protection I to IEC 536.

No PE terminal required.

Foreign matter and water protection to IEC 529.

For CNC:IP 54 front IP 00 rear

Installing the Control System 2

2.1 Installing and Dismantling the SINUMERIK 802C base line

Warning

Do not install when the equipment is under power!

The modules contain electrostatically sensitive devices.
It must be ensured that persons without ESD protection never touch printed circuit boards or components when handling operator and machine control panels.

Approach

Due to the compactness, it is very convenient to install and dismantle the control system.

1. Fix the system in the machine control station.
2. Screw the system in place with 8 M4 x 16 assembled screws. The maximum allowed torque for the screws is 1.5 Nm.

Notice

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

Dismantling the control system

The control system is dismantled as described above in the reverse order.

Warning

Do not dismantle when the equipment is under power!

Mounting dimensions

The dimensions shown below are important for installing the control system:

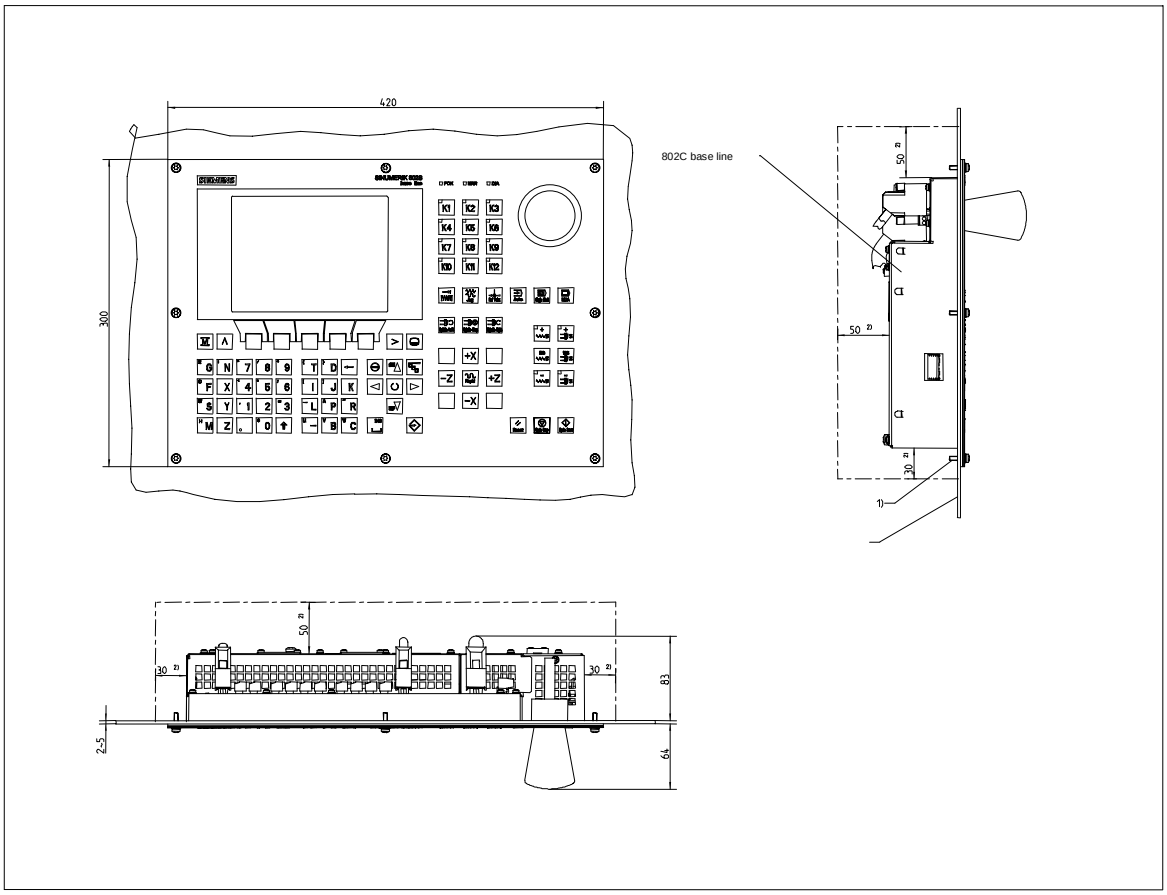
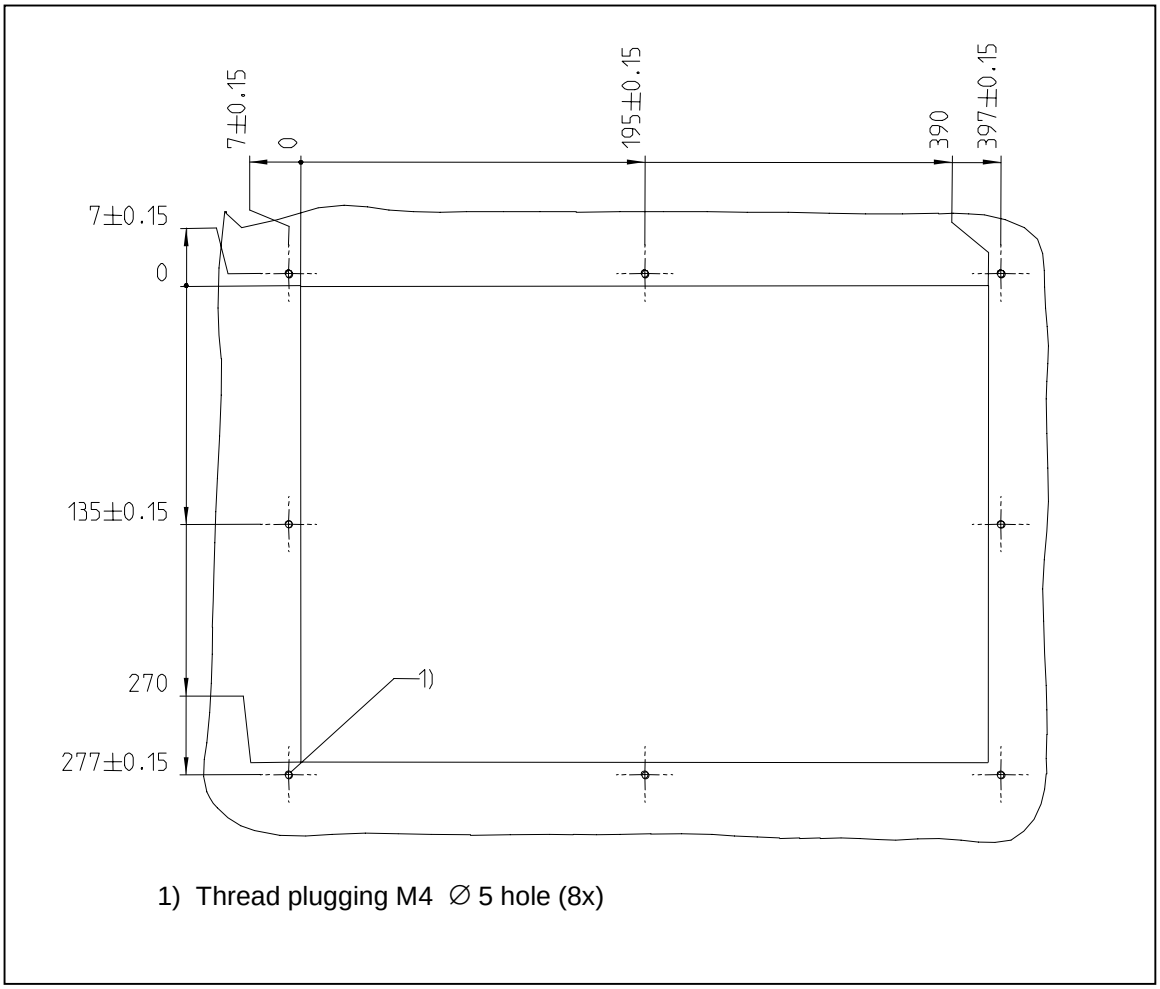


Fig. 2-1 Mounting dimensions for 802C base line



1) Thread plugging M4 ∅ 5 hole (8x)

Fig. 2-2 Mounting dimensions for 802C base line

2.2 Interfaces and cables

Position of the interfaces and elements

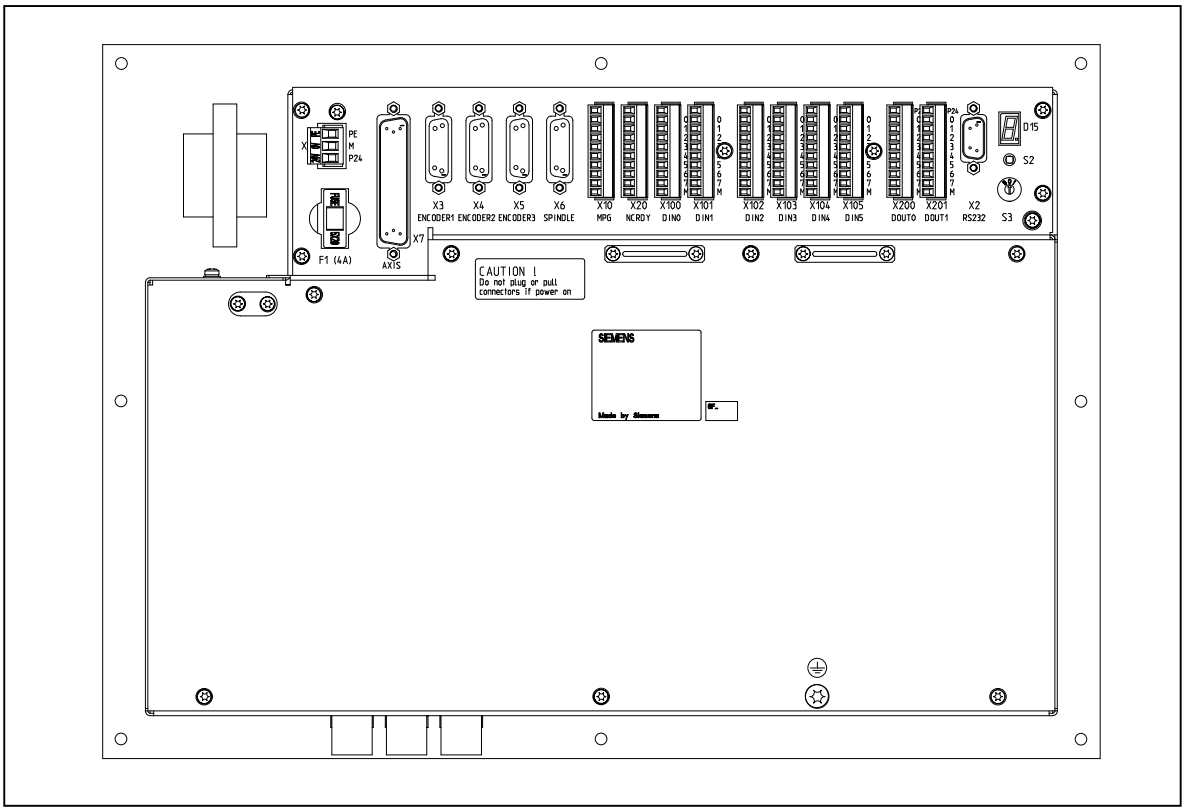


Fig. 2-3 Rear of CNC system

Interfaces

CNC

- X1 power supply terminals (DC24V)

  3-pin screw-type terminal block for connecting the 24 V load power supply
- X2 RS232 interface (V24)

  9-pin sub-D plug connector
- X3 to X5 measuring system interfaces (ENCODER)

  three 15-pin sub-D plug connectors for connecting incremental position encoders (RS422)
- X6 spindle interface (ENCODER)

  15-pin sub-D socket for connecting a spindle incremental position encoder(RS422)
- X7 drive interface (AXIS)

  50-pin sub-D socket connector for connecting the power sections for a maximum of four analog drives including spindle
- X10 handwheel interface (MPG)

  10-pin front connector for connecting the handwheels

- X20 digital inputs (DI)
  10-pin front connector for connecting the NC READY relay

DI/O

- X100 to X105
  10-pin front connector for connecting digital inputs
- X200 and X201
  10-pin front connector for connecting digital outputs

Operating elements Start-up switch S3

Fuse Fuse F1, externally designed to allow users for convenient replacement.

S2 and D15 These elements are provided only for debugging internally.

Connecting cables The components are wired up as shown in the Connection Diagram 2–4 and 2-5. For the cables required, please refer to the diagram below.

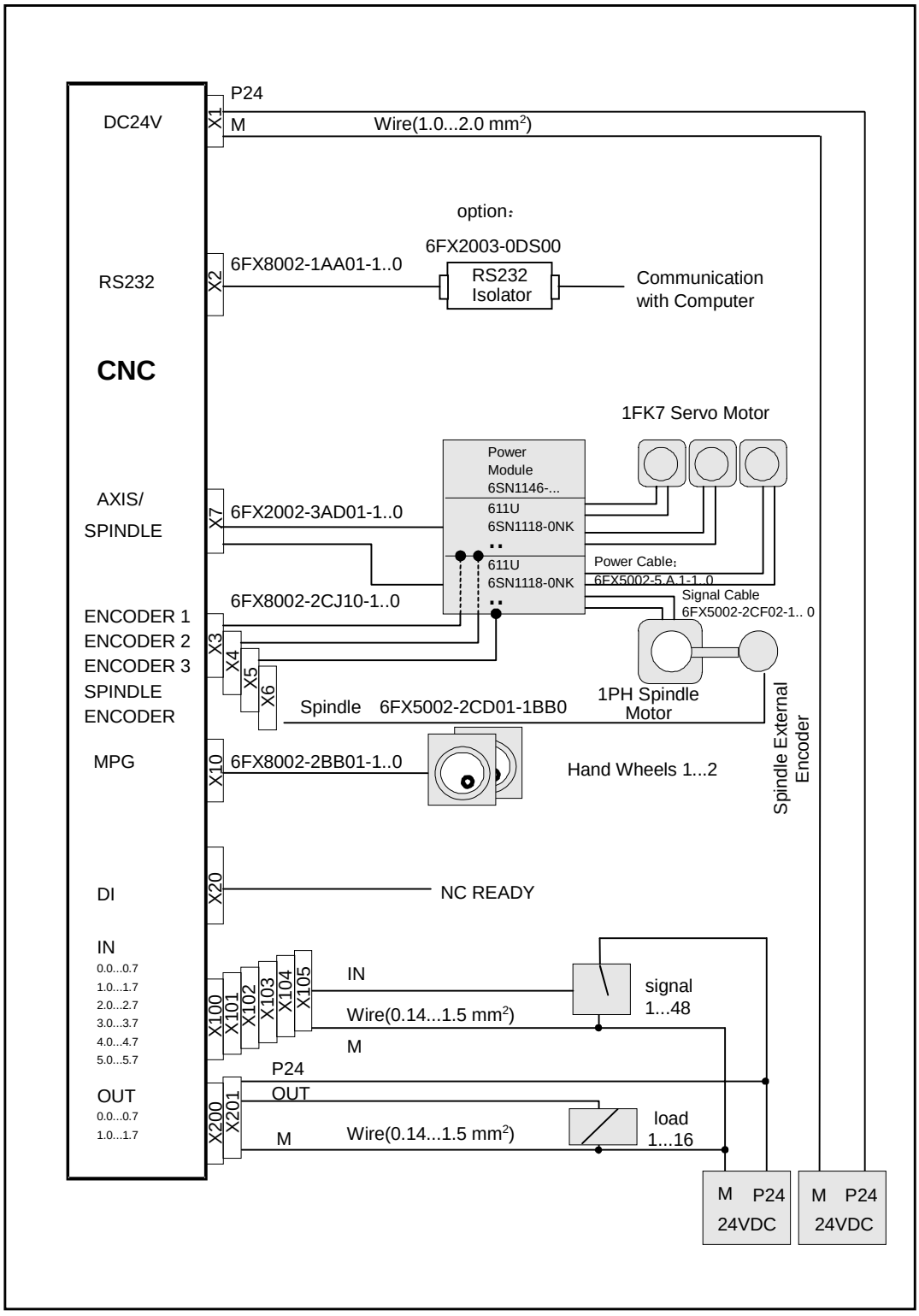


Fig. 2-4 Connection Diagram for SINUMERIK 802C base line with SIMODRIVE 611U

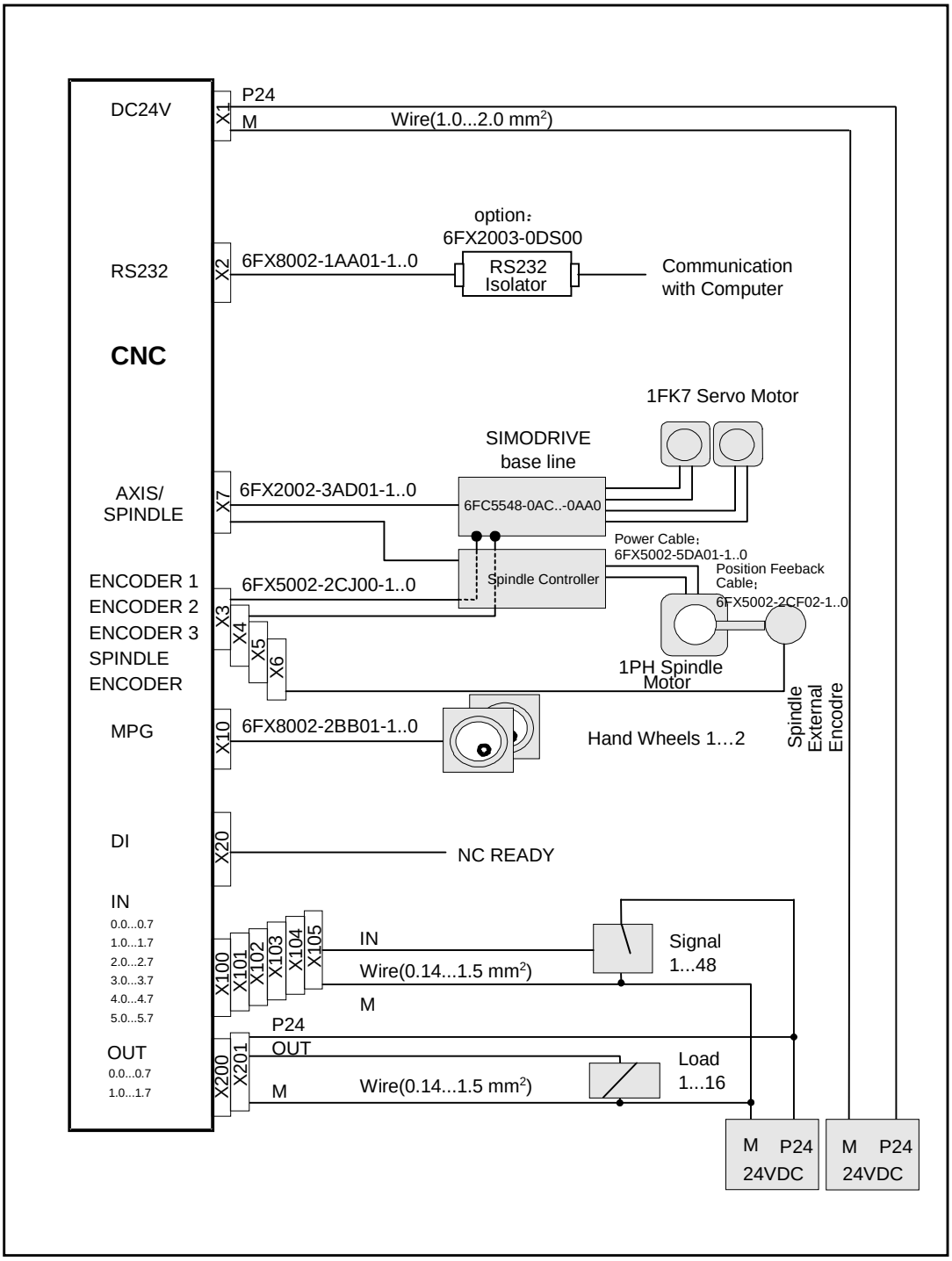


Fig. 2-5 Connection Diagram for SINUMERIK 802C base line with SIMODRIVE base line

2.3 Connecting the individual components

Connecting the components

Please note the following:

Notice

Use only shielded cable and make sure that the shield is connected to the metal or metal plated connector casing on the control side. For the purpose of isolating the analog setpoint signal from low-frequency interference, we recommend not to ground the shield on the drive side.

The preassembled cable offered as accessories provides optimum protection against interference.

General procedure:

Proceed as follows to connect the individual components:

1. Connect the cables to the components as shown in Fig. 2–4 or Fig. 2-5.
2. Fix the sub-D connector in place using the knurled screws.

2.3.1 Connecting the feed drives and the spindle (X7)

Pin assignments For connector on the CNC side

Feed drive interface

Connector designation: X7
AXIS 1–4

Connector type: 50-pin sub-D plug connector

Table 2-1 Pin assignments of connector X7

X7								
Pin	Signal	Type	Pin	Signal	Type	Pin	Signal	Type
1	AO1	AO	18	n.c.		34	AGND1	AO
2	AGND2	AO	19	n.c.		35	AO2	AO
3	AO3	AO	20	n.c.		36	AGND3	AO
4	AGND4	AO	21	n.c.		37	AO4	AO
5	n.c.		22	M	VO	38	n.c.	
6	n.c.		23	M	VO	39	n.c.	
7	n.c.		24	M	VO	40	n.c.	
8	n.c.		25	M	VO	41	n.c.	
9	n.c.		26	n.c.		42	n.c.	
10	n.c.		27	n.c.		43	n.c.	
11	n.c.		28	n.c.		44	n.c.	
12	n.c.		29	n.c.		45	n.c.	
13	n.c.		30	n.c.		46	n.c.	
14	SE1.1	K	31	n.c.		47	SE1.2	K
15	SE2.1	K	32	n.c.		48	SE2.2	K
16	SE3.1	K	33	n.c.		49	SE3.2	K
17	SE4.1	K				50	SE4.2	K

Signal names	**Description**
AOn	Analog Command Value
AGNDn	Analog Ground
SEn.1; SEn.2	Servo Enable Relay
M	Ground (not to be connected)
n = 1...4	Number of Axis

Signal Specification: +/-10V for Analog Outputs

Signal level RS422

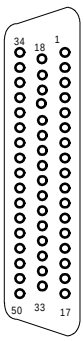
Signal type

VO	Signal output
K	Switching contact

Axis assignment

1	X axis
2	Y axis
3	Z axis
4	Spindle

Table 2–2 Cable assignment (for type 6FX2 002-3AD01)

CNC Side		**Cable**	**Drive Side**	
	PIN	**Core Color**	**Signal Name**	**PIN**
	14	black	1st axis	1.9
	47	brown		1.65
	34	red		1.14
	1	orange		1.56
	15	yellow	2nd axis	2.9
	48	green		2.65
	2	blue		2.14
	35	purple		2.56
	16	gray	3rd axis	3.9
	49	pink		3.65
	36	white/black		3.14
	3	white/brown		3.56
	17	white/red	Spindle	4.9
	50	white/orange		4.65
	4	white/yellow		4.14
	37	white/green		4.56

Drives with analog interface

Signals:

A voltage and an enable signal are output.

- AOn (SETPOINT)

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

- AGNDn (REFERENCE SIGNAL)

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

- SEn (SERVO ENABLE)

  Relay contact pair controlling the enable of the power section, e.g. of a SIMODRIVE drive unit controlled via a PLC program.

Signal parameters

The setpoint is output as an analog differential signal.

Table 2–3 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 2–4 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

2.3.2 Connecting the measuring systems (X3 ... X6)

Pin assignment of the connector on the CNC side

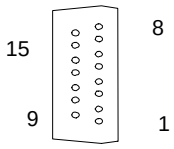
Measuring system interface (incremental encoder)

Connector designation: X3 ... X6
ENCODER

Connector type: 15-pin sub-D plug connector

Table 2–5 Pin assignment of the female connector X3 ... X6

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

Signal Specification: 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: 90º ± 30º

Current onsumption: 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

2.3.3 Configuration of the RS232 interface connection (X2)

Pin assignment of connector on the CNC side

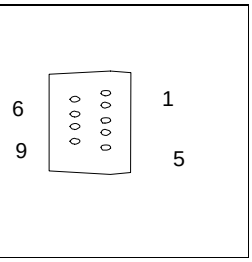
RS232 interface

Connector designation: X2
RS232

Connector type: 9-pin sub-D plug connector

Table 2–8 Pin assignment of connector X2

Pin	Name	Type	Pin	Name	Type
1			6	DSR	I
2	RxD	I	7	RTS	O
3	TxD	O	8	CTS	I
4	DTR	O	9		
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

Signal level

RS232

Signal type

I	Input
O	Output
VO	Voltage output

Cable for WinPCIN

Table 2–9 Cable for WinPCIN: Pin assignment of the Sub-D connector

9-Pin	Name	25-Pin
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	Name	9-Pin
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		

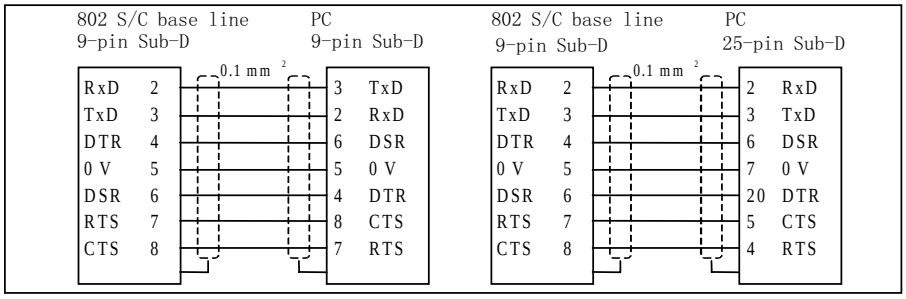


Fig. 2-5 Communication connector RS232(X2)

2.3.4 Connecting handwheels (X10)

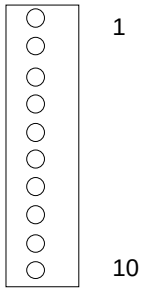
Pin assignment of connector on the CNC side

Handwheel interface

Connector designation: X10
MPG

Connector type: 10-pin mini–Combicon plug connector

Table 2–10 Pin assignment of connector X10

X10			
Pin	Name	Type	
1	A1	I	
2	A1_N	I	
3	B1	I	
4	B1_N	I	
5	P5_MS	VO	
6	M5_MS	VO	
7	A2	I	
8	A2_N	I	
9	B2	I	
10	B2_N	I	

Signal names

A1, A1_N	Track A, true and negated (handwheel 1)
B1, B1_N	Track B, true and negated (handwheel 1)
A2, A2_N	Track A, true and negated (handwheel 2)
B2, B2_N	Track B, true and negated (handwheel 2)
P5_MS	5.2 V supply voltage for handwheels
M	Supply ground

Signal level

RS422

Signal type

VO	Voltage output
I	Input (5 V signal)

Handwheels

Two electronic handwheels 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: 90º ± 30º

Supply: 5 V, max. 250 Ma

2.3.5 Connecting NCREADY (X20)

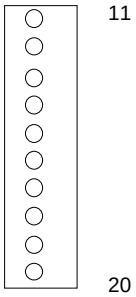
Pin assignment of connector on the CNC side

NCREADY interface

Connector designation: X20
DI

Connector type: 10-pin plug connector

Table 2–11 Pin assignment of connector X20

X20			
Pin	Signal	Type	
1	NCRDY_1	K	
2	NCRDY_2	K	
3	I0 / BERO1	Not defined	
4	I1 / BERO2	Not defined	
5	I2 / BERO3	Not defined	
6	I3 / BERO4	Not defined	
7	I4 / MEPU1	Not defined	
8	I5 / MEPU2	Not defined	
9	L-	VI	
10	L-	VI	

Signal description:

NCRDY_1…2	NC-READY-Contact, max. current is 2A at 150VDC or 125VAC)
I0 ... I6	Fast digital input 0 … 6
L-	Reference potential for digital input

Signal type

K	Switching contact

NC–READY output

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

Table 2–12 Electrical parameters of the NCREADYrelay contact

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

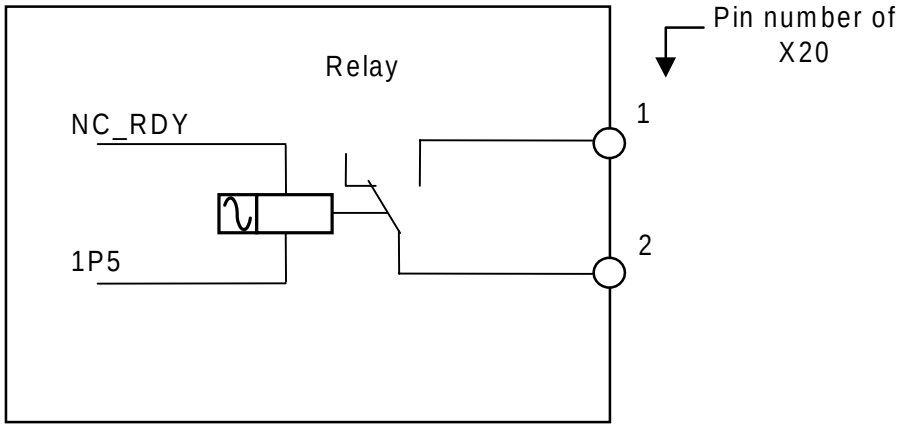


Fig. 2-5

The NCREADY is an internal relay of NC. 1 and 2 are the two contacts of this relay. It will open when NC is not ready, and close after NC is ready for operation.

2.3.6 Connecting the digital inputs (X100 ... X105)

Pin assignment for connector

Interface for the digital inputs

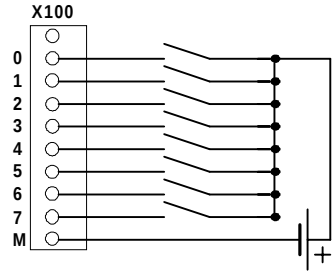
Connector designation: X100, X101, X102, X103, X104, X105
IN

Connector type: 10-pin plug connector

Table 2–13 Connector pin assignment

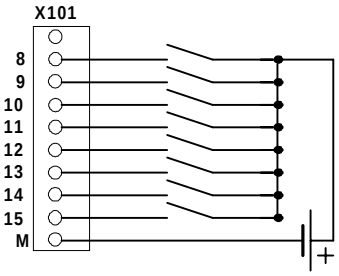
X100

Pin	Name	Type
1	n.c.	
2	DI0	DI
3	DI1	DI
4	DI2	DI
5	DI3	DI
6	DI4	DI
7	DI5	DI
8	DI6	DI
9	DI7	DI
10	M	VI



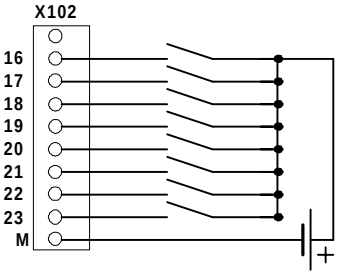
X101

Pin	Name	Type
1	n.c.	
2	DI8	DI
3	DI9	DI
4	DI10	DI
5	DI11	DI
6	DI12	DI
7	DI13	DI
8	DI14	DI
9	DI15	DI
10	M	VI

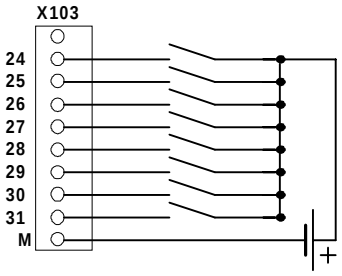


X102

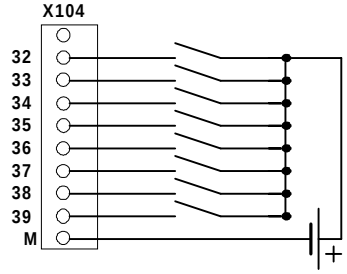
Pin	Name	Type
1	n.c.	
2	DI16	DI
3	DI17	DI
4	DI18	DI
5	DI19	DI
6	DI20	DI
7	DI21	DI
8	DI22	DI
9	DI23	DI
10	M	VI



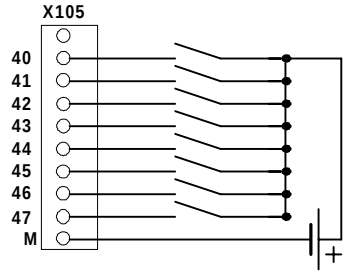
X103			
Pin	Name	Type	
1	n.c.		
2	DI24	DI	
3	DI25	DI	
4	DI26	DI	
5	DI27	DI	
6	DI28	DI	
7	DI29	DI	
8	DI30	DI	
9	DI31	DI	
10	M	VI	



X104			
Pin	Name	Type	
1	n.c.		
2	DI32	DI	
3	DI33	DI	
4	DI34	DI	
5	DI35	DI	
6	DI36	DI	
7	DI37	DI	
8	DI38	DI	
9	DI39	DI	
10	M	VI	



X105			
Pin	Name	Type	
1	n.c.		
2	DI40	DI	
3	DI41	DI	
4	DI42	DI	
5	DI43	DI	
6	DI44	DI	
7	DI45	DI	
8	DI46	DI	
9	DI47	DI	
10	M	VI	



Signal names

DI0...47 24 V digital inputs

Signal type

VI Voltage input
DI Input (24 V signal)

Table 2–14 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	

2.3.7 Connecting the digital outputs (X200, X201)

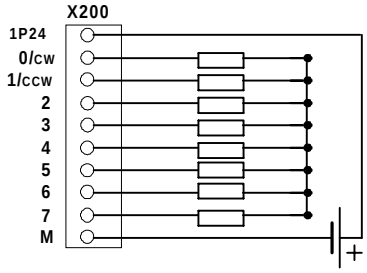
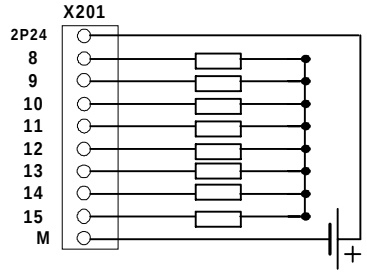
Connector pin assignment

Interface for digital outputs

Connector designation: X200, X201
OUT

Connector type: 10-pin plug connector

Table 2–15 Connector pin assignment

X200			
Pin	Name	Type	
1	1P24	VI	
2	DO0/CW	O	
3	DO1/CCW	O	
4	DO2	O	
5	DO3	O	
6	DO4	O	
7	DO5	O	
8	DO6	O	
9	DO7	O	
10	M	VI	
X201			
Pin	Name	Type	
1	2P24	VI	
2	DO8	O	
3	DO9	O	
4	DO10	O	
5	DO11	O	
6	DO12	O	
7	DO13	O	
8	DO14	O	
9	DO15	O	
10	M	VI	

Signal Description:

DO0 ... DO13 Digital output 0...13, Max. current 500mA.

DO0/ CW Digital output 0 / Unipolar Spindle CW Direction, Max. current 500mA.

DO1/ CCW Digital output 1 / Unipolar Spindle CCW Direction, Max. current 500mA.

1P24, M Power supply for the digital outputs 0...7

2P24, M Power supply for the digital outputs 8...15

Signal type

VI Voltage input

O Output (24 V signal)

Table 2–16 Electrical parameters of the digital outputs

Parameter	Value	Unit	Note
“1” signal, nominal voltage Voltage drop	24 max. 3	V V	
“1” signal, output current	0.5	A	Simultaneity factor 0.5 per 16 outputs
“0” signal, leakage current	max. 2	mA	

2.4 Power Supply for CNC (X1)

Screw-terminal block

The 24 V DC load power supply unit required for supplying CNC is connected to screw- type terminal block X1.

Characteristics of the load power supply

The 24 V DC voltage must be generated as a functional extra-low voltage with safe electrical Isolation (to IEC 204–1, Section 6.4, PELV).

Table 2–17 Electrical parameters of the load power supply

Parameter	Min.	Max.	Units	Conditions
Voltage range mean value	20.4	28.8	V	
Ripple		3.6	Vss	
Non-periodic overvoltage		35	V	500 ms cont. 50 s recovery
Rated current consumption		1.5	A	
Starting current		4	A	

Pin assignment on the CNC side

Table 2–18 Pin assignment of screw terminal block X1

Terminal		
1	PE	PE
2	M	Ground
3	P24	DC 24 V

2.5 LEDs and Other Elements on CNC

Error and status LEDs

There are three LEDs on the front panel of the CNC.

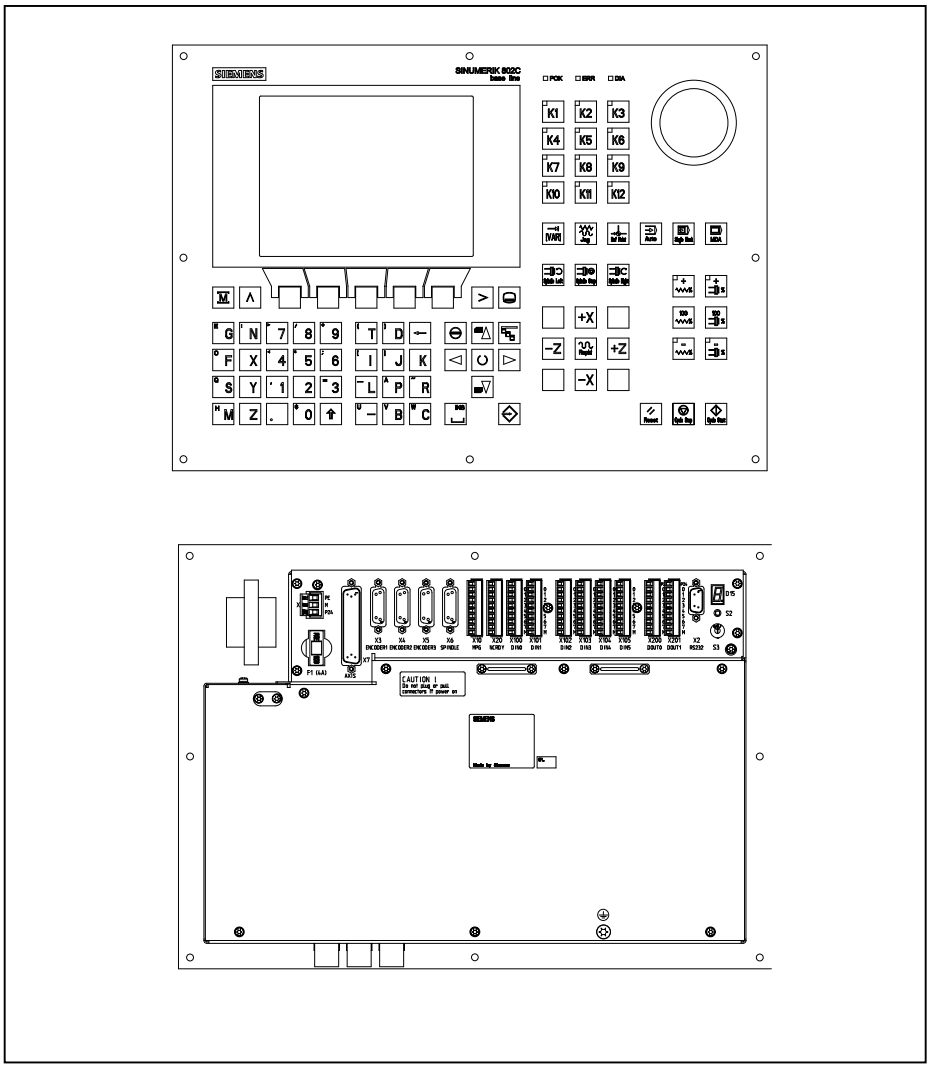


Fig. 2-6 Operator panel and user interfaces

ERR (red)

Group error

This LED indicates an error condition of the CNC.

POK (green)

Power OK

The power supply is ready.

DIA (yellow)

Diagnostics

This LED indicates various diagnosis states. Under normal operating conditions, this LED flashes 1:1.

Start-up switch (S3) This rotary switch is intended to assist start-up.

Position 0: Normal operation

Positions 1–4: Start-up

cf. also Section 4.2, Table 4–2

Fuse (F1) This design allows users to replace the fuse very conveniently when the fuse is broken.

S2 and D15 They are provided only for debugging internally.

Grounding Screw In order to ensure the system functions correctly and safely, the CNC must be grounded through the grounding screw ⏚ on the rear side of CNC.

Installing the Drives 3

References

Manufacturer documentation of the drives

Start-Up 4

4.1 General

Start–up requirements

- The following is required:
  - User Manual: Operation and Programming, SINUMERIK 802C base line
  - PC/PG (programming device) only for data saving and series start–up
  - Toolbox on CD. The CD is either supplied with the control system or can be ordered separately.

    Contents
    - WINPCIN for data transfer via the V24 interface from/to external PC/PG
    - Cycle pack Turning and Milling
- The mechanical and electrical installation of the equipment must be completed.

Notice

For installation refer to the installation notes provided in the section 2.

- The control system with its components has powered up without errors.

Start–up sequence

The SINUMERIK 802C base line can be strated up as follows:

1. Check whether the ENC has powered up.
2. PLC start-up
3. Technology setting
4. Set general machine data.
5. Set axis/machine–specific machine data.
   - Match encoder with spindle
   - Match setpoint with spindle
6. Dry run for axes and spindle(s)
7. Drive optimization
8. Complete start-up, data saving

4.1.1 Access levels

Protection levels

The SINUMERIK 802C base line provides a protection level concept for enabling data areas. The protection levels range from 0 to 7 whereby 0 is the highest and 7 the lowest level.

The control system comes with default passwords for protection levels 2 and 3. If necessary these passwords can be changed by the appropriate authorized person.

Table 4–1 Protection level concept

Protection Level	Disabled via	Data Area
0		Siemens, reserved
1		Siemens, reserved
2	Password: EVENING (default)	Machine manufacturer
3	Password: CUSTOMER (default)	Authorized operator, setter
4	No password or user IS from PLC → NCK	Authorized operator, setter
5	User IS from PLC → NCK	
6	User IS from PLC → NCK	
7	User IS from PLC → NCK	

Protection levels 2 ... 3

The protection levels 2 and 3 require a password. The passwords can be changed after activation. For example, if the passwords are no longer known, the control system must be reinitialized (booting in Start–Up Switch position 1). This will reset all passwords to the default settings for this software version.

If the password is deleted, protection level 4 is applicable.

The password remains set until it is reset using the Delete password softkey; POWER ON will not reset the password.

Protection levels 4 ... 7

Protection level 4 is automatically set when no password is entered. If required, the protection levels 4 ... 7 can be set from the user program via the user interface.

See Section 6.1.1 “Display Machine Data”.

How to set the access levels is described in the User’s Guide “Operation and Programming”.

4.1.2 Structure of machine data (MD) and setting data (SD)

Number and name

Machine data (MD) and setting data (SD) are differed either by numbers or names. Both the number and the name are displayed on the screen.

Parameters:

- Activation
- Protection level
- Unit
- Standard value
- Range of values

Activation

The activation levels are listed according to their priority. Any data changes come into effect after:

- POWER ON (po) switching on/off the SINUMERIK 802C base line
- NEW_CONF (cf)
  - Activate MD softkey on the operator panel
  - RESET key on the operator panel
  - Modifications at the block limits are possible while the program is running.
- RESET (re) RESET key on the operator panel or M2/M30 at the end of the program
- IMMEDIATELY (im) after entering a value

Protection level

To display machine data, protection level 4 (or higher) must be activated.

Start–up or machine data input generally requires protection level 2 or higher (password “EVENING”).

Unit

Depending on the MD SCALING_SYSTEM_IS_METRIC, the physical units of the MD are set as follows:

MD10240 = 1	MD10240 = 0
Mm	in
mm/min	in/min
m/s^2	in/s^2
m/s^3	in/s^3
mm/rev	in/rev

If no physical units are applicable to the MD, the field contains a “–”.

Notice

The default setting of the machine data is
MD10240 SCALING_SYSTEM_IS_METRIC = 1 (metric).

Default data

This is the default value for the machine or setting data.

Range of values (minimum and maximum values)

... specifies the input limits. If no range of values is specified, then the input limits are defined by the data type, and the field is marked with “***“.

4.1.3 Handling of machine data

Handling methods

- Display
- Input via keys and V24 interface
- Making backup copies and reading in/reading out data via the V24 interface

  These back-up copies contain

  — machine data

  — line check sums and

  — machine data numbers.

Aborting when loading MD

If incorrect machine data files are read into the control system, an alarm is output.

At the end of reading, an alarm with the number of errors is displayed.

4.1.4 Data saving

Internal data saving

The data in the memory backed up for a limited period can be saved internally in the

permanent memory of the control system.

An internal data backup should be carried out if the control system has been switched off for more than 50 hours (at least 10 min/day with controller ON).

It is recommended to carry out internal data saving whenever important data changes have been made.

Notice

During the internal data backup, a memory copy of the memory backed up for a limited time is made and stored in the permanent memory. Selective data backup (e.g. only the machine data and not the part programs) is not possible.

Saving data internally:

Use the ETC key to extend the menu in the Diagnosis/Start–up menu and press the Save data softkey.

Loading data from an internal data backup:

Boot the control system using the start–up switch, position 3

If the data in the backed–up memory area is lost, on POWER ON the data saved in the permanent memory area are automatically reloaded into the memory.

Notice

The note “4062 Data backup copy has been loaded” appears.

External data saving

In addition to the internal data backup, the user data of the control system can and must also be saved externally.

External data saving requires a PC/PG (programming device) with V24 interface and the WinPCIN tool (included in the tool box).

External data saving should be performed whenever substantial changes in the data have been made, as well as always at the end of start–up.

External data backup variants:

Saving data externally:

1. The data record is read out completely, creating the series start-up file. This is intended for series start-up or to restore the control system status after replacing hardware components or after data loss.
2. Files are read in or read out by areas. The following user data can be selected as individual files:

   Data

   — Machine data
   — Setting data
   — Tool data
   — R parameters
   — Zero offset
   — Compensation data (LEC)

   Part programs

   Standard cycles

Saving data externally:

Use the Services/Data outp. menu to transfer the following user data as individual files to an external PC via the V24 interface.

Loading data from an external data backup into the control system:

Press the Start data inp. softkey in the Services menu.

4.2 Turning on and booting the control system

Procedure

- Inspect the system visually for:
  - proper mechanical installation with tight electrical connections
  - supply voltages
  - connections for shielding and grounding.
- Turn on the control system.

Notice

Providing memory and start–up switch S3 are set correctly (see Fig.2–6), the control system boots.

Start–up switch S3 (hardware)

The CNC is provided with a start–up switch to assist start–up of the control system.

This switch can be actuated using a screw driver.

Table 4–2 Start–up switch settings

Position	Meaning
0	Normal power-up
1	Power-up with default machine data (user data determined by the software version)
2	System software update
3	Power-up with saved data
4	PLC stop
5	Reserve
6	Assigned
7	Assigned

The switch position comes into effect with next power-up and is displayed on the screen when the control system powers up.

Start–up switch (software)

In addition to the hardware start–up switch, the following functions can also be carried out in the Diagnosis/Start–up/Start–up switch menu:

- Normal boot (Start–up switch position 0)
- Boot with default machine data (Start–up switch position 1)
- Boot with saved data (Start–up switch position 3)

These power-up functions have a higher priority than the hardware start-up switch.

Booting the control system

When the control system is turned on for the first time, an initial state of the control system is established automatically. All memory areas are initialized and are loaded with previously stored default data.

The PLC area of retentive bit memories is explicitly erased.

The control system changes to the JOG/Ref.point approach mode and the yellow LED DIAG flashes (see Fig. 2–6).

This initial state is the precondition for error–free start–up of the control system.

When the control system is already turned on, start–up is also possible in the Diagnosis menu (see User Manual).

Normal booting (Start-up switch position 0)

Result	
User data exist, no boot error	Control system changes to JOG/Ref.point approach mode, yellow LED DIAG (see Fig. 4–1) flashes.
Data in user memory faulty	Backed–up user data are loaded from the permanent memory into the user memory (as in start–up switch position 3). If no valid user data are in the permanent memory, the default data are loaded (as in start–up switch position 1). Any deviations from normal booting are displayed on the screen.

Booting with default machine data (Start–up switch position 1)

Result
The user memory area not loaded with default data is erased, and the default machine data are loaded from the permanent memory into the user memory.

Booting with saved data (Start–up switch position 3)

Result
The user data backed–up on the permanent memory are loaded into the user memory.

Contrast control See User's Guide "Operation and Programming"

4.2.1 Boot messages

Displays on the screen

When the control system is booting, test patterns or boot information are displayed on the screen as progress displays.

After the control system has booted without errors, it changes to the JOG/Ref.point approach mode, and the yellow DIAG LED (see Fig. 4–1) flashes.

Boot errors

Boot errors are displayed either on the screen or via the LED (see Fig. 4–1 in the following).

The ERR flashes, and the DIAG LED does not flash.

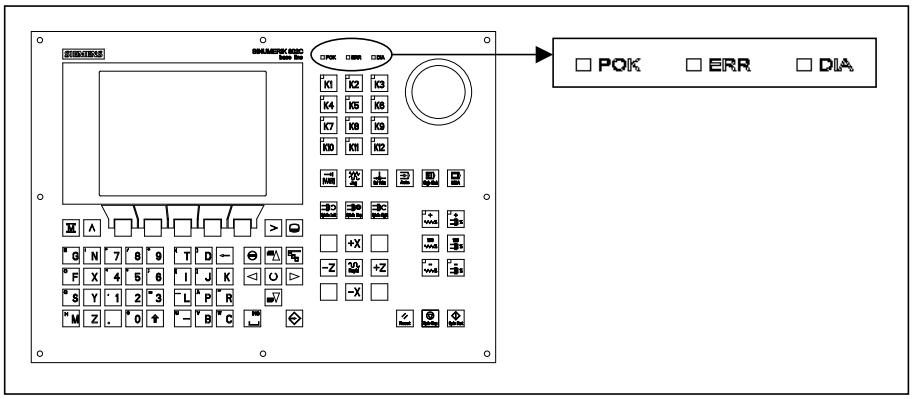


Fig. 4-1 LED

Table 4–3 Boot errors

Error Message	Remedial Action
ERROR EXCEPTION	1. Switch off the control system and back on again (POWER ON). 2. Inform the hotline if necessary. 3. Carry out a software update. 4. Replace the hardware components.
ERROR DRAM	
ERROR BOOT	
ERROR NO BOOT2	
ERROR NO SYSTEM	
ERROR LOAD NC NO SYSTEM–LOADER	
ERROR LOAD NC CHECKSUM–ERROR	
ERROR LOAD NC DECOMPRESS– ERROR	
ERROR LOAD NC INTERNAL–ERROR 1	

4.3 Starting up the PLC

General

The PLC is a store-programmable logic controller for simple machines. It has no hardware of its own and is used as a software PLC in the SINUMERIK 802C base line control system.

The task of the PLC is to control machine-related functional sequences.

The PLC executes the user program cyclically. A PLC cycle is always executed in the same sequence of order.

- Update process image (inputs, outputs, user interface, timers)
- Process communication requests (Operator Panel, PLC 802 Programming Tool)
- Execute user program
- Evaluate alarms
- Output process image (outputs, user interface)

The PLC executes the user program cyclically, starting from the first up to the final operation. Access from user program is only carried out via the process image and not directly to the hardware inputs or outputs. The hardware inputs and outputs are updated by the PLC at the beginning and at the end of program execution. The signals are thus stable over a PLC cycle.

The user program can be created by means of the PLC 802 Programming Tool using the programming language S7-200 in conjunction with ladder diagrams (LAD). A ladder diagram is a graphical programming language to represent electrical circuit diagrams.

This Documentation describes the program structure and the instruction set of the PLC in detail.

4.3.1 Commissioning of the PLC

The SINUMERIK 802C base line comes to the user with a simulation program included.

The SAMPLE user program is stored in the permanent memory. This sample program and the documentation are included in the SINUMERIK 802SC base line Toolbox component “PLC802SC base line Library”.

The simulation program is intended for the first function test of the control system after assembling the control.

Internal simulation program

The simulation program is an integral part of the 802C base line system software. It allows operation of the control system even without connection to input and output terminals. The user program processes all firmly defined keys and the default setting of the axis keyboard (default).

Axes and spindle are switched to simulation mode. No real axis movement is carried out. The Axis/Spindle Disable user signal is set for each axis. For this reason, the movements of both axes and spindle are simulated virtually. The user can use this program to test the interrelation of the components integrated in CNC.

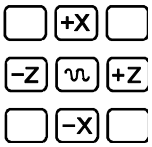
Approach

- Set MD20700 to zero.
- Use the Diagnosis/StartUp switch/PLC softkey to select Simulation.
  You can check the current setting via Diagnosis/Service display/Version /PLC application.
- Select the desired key and check your setting by pressing the key.

Supported keys

- Mode selection

- Axis keys



- NC keys

Notice

The Increment key is only active in the JOG mode. The toggle function can be used to set increments in the range between 1,10,100, or 1000. Check the response by pressing the axis direction keys.

Reference Point is not supported.

Standard user program

The control system comes with an universal program, the customer can choose the technology mode (Turning or Milling) with PLC user machine data.

4.3.2 Start-up modes of the PLC

The PLC can activate its start-up modes from two places.

Table 4–4 Start-up modes

Start-Up Switch	Operator Panel Start Up Menu	PLC Program Selection	Program Status	Retentive Data (Backed-Up)	MD for the PLC in the User Interface
	CNC start-up *				
Normal power-up Position 0	Normal power-up	User program	Run	Unchanged	Accept active PLC MD
Power-up with default values Position 1	Power-up with default values	User program	Run	Deleted	Standard PLC MD
Power-up with saved data Position 3	Power-up with saved data	User program	Run	Saved data	Saved PLC MD
PLC Stop after POWER ON Position 4		Unchanged	Stop	Unchanged	Accept active PLC MD
	PLC start up **				
	Restart	User program	Run	Unchanged	Accept active PLC MD
	Restart and debug mode	User program	Stop	Unchanged	Accept active PLC MD
	Restart with simulation	Simulation program	Run	Unchanged	Accept active PLC MD
	Overall reset	User program	Run	Deleted	Accept active PLC MD
	Overall reset and debug mode	User program	Stop	Deleted	Accept active PLC MD

* Diagnosis/Start up / Start up switch / CNC softkey

** Diagnosis/Start up / Start up switch / PLC softkey

The start-up switch PLC Stop can be activated either during operation or power-up.

The debug mode (see “Operation and Programming”, Chapter 7) causes the PLC to remain in PLC Stop after the control system has powered up. All power-up modes that have been set either via softkeys or via hardware start-up switches will only come into effect after the next power-up of the control system. The hardware start-up switch “PLC STOP” (position 4) is active immediately. The priority of the power-up modes activated via the softkeys on the operator panel is higher than that of the hardware start-up switches.

Example:

- Hardware start-up switch position 3
- Restart from operator panel

⇨ Restart is active from next power-up of the control system

The Run mode activates the cyclic mode.

In the Stop mode, the following actions are initiated:

- All hardware outputs are disabled.
- The NC Ready relay is inactive.
- No cyclic operation (active user program is not executed)
- Process image is no longer updated (“frozen”)
- Emergency Stop active

The user can also use the PLC 802 Programming Tool to start the Stop or Run modes.

A corrected or new project can only be loaded into the control system in the Stop mode. The user program comes only into effect with next power-up or when the Run mode is active.

4.3.3 PLC alarms

The control system displays a maximum of 8 PLC alarms (system alarms or user alarms).

The PLC manages the alarm information per PLC cycle. It stores or deletes the alarms in the alarm list according to their occurrence. The first alarm in the list is generally the alarm last occurred.

If more than 8 alarms occur, the first seven alarms occured are displayed, and the last one with the highest cancel priority is displayed.

Alarm response and cancel criterion

Furthermore, the PLC manages the alarm responses. The alarm responses are always active, irrespective of the number of active alarms. Depending on the type of the alarm response, the PLC triggers an appropriate response.

Each alarm requires a cancel criterion to be defined. The PLC uses the SELF-CLEARING criterion as default criterion.

Cancel criteria are:

- POWERONCLEAR: The alarm is canceled by switching off/switching on the control system.
- CANCELCLEAR: The alarm is canceled by pressing the Cancel key or the Reset key (analogously to CNC alarms).
- SELF-CLEARING: The alarm is cleared because the cause resulting in the alarm has been eliminated or does not exist any longer.

Desired alarm responses are defined for each alarm in the PLC. By default, the PLC uses the SHOWALARM response (bit0 - bit5 = 0).

Possible alarm responses are:

- PLC Stop : The user program is no longer executed, the NC Ready relay drops out, and the hardware outputs are disabled (OUTDS).
- EMERGENCY STOP: The PLC provides the EMERGENCY STOP signal to the CNC in the user interface after the user program has been executed.

- Feed disable: The PLC provides the Feed Disable signal to the CNC in the user interface after the user program has been executed.
- Read-in disable: The CNC provides the Read-in Disable signal to the CNC in the user interface after the user program has been executed.
- NC Start inhibited: The PLC provides the NC Start Inhibited signal to the CNC after the user program has been executed.
- SHOWALARM: This alarm has no alarm response (bit0 - bit5 =0).

Priority of cancel conditions

The cancel conditions have the following priority:

- POWER ON CLEAR - system alarms (highest priority)
- CANCEL CLEAR - system alarms
- SELF-CLEARING - system alarms
- POWER-ON CLEAR - user alarms
- CANCEL CLEAR - user alarms
- SELF-CLEARING - user alarm (lowest priority)

System alarms

see Diagnostics Guide

User alarms

The user interface “1600xxxx” provides the user with two sub-ranges for setting a user alarm.

- Sub-range 0: 4 x 8 bits to set user alarms (0 -> 1 edge)
  Byte 0 : Bit0 => 1st user alarm ‘’ 700000 ‘’
  Byte 3 : Bit7 => 32nd user alarm ‘’ 700031 ’’
- Sub-range 1: User alarm variables

The respective bit (sub-range 0) with a 0/1 edge change will activate a new user alarm.
Sub-range 1 is intended for additional user information.

Sub-range 2 can be used to analyze the active alarm responses.

Sub-range 1 can only be read or written as a double word. Sub-range 2 can only be read.

You can delete self-clearing alarms by resetting the respective bit in the variable range ‘’1600xxxx’’ in sub-range 0 (1 -> 0 edge).

The remaining user alarms are cleared by the PLC after detecting the respective cancel condition. If the alarm is still present, the alarm occurs again.

User alarm activation

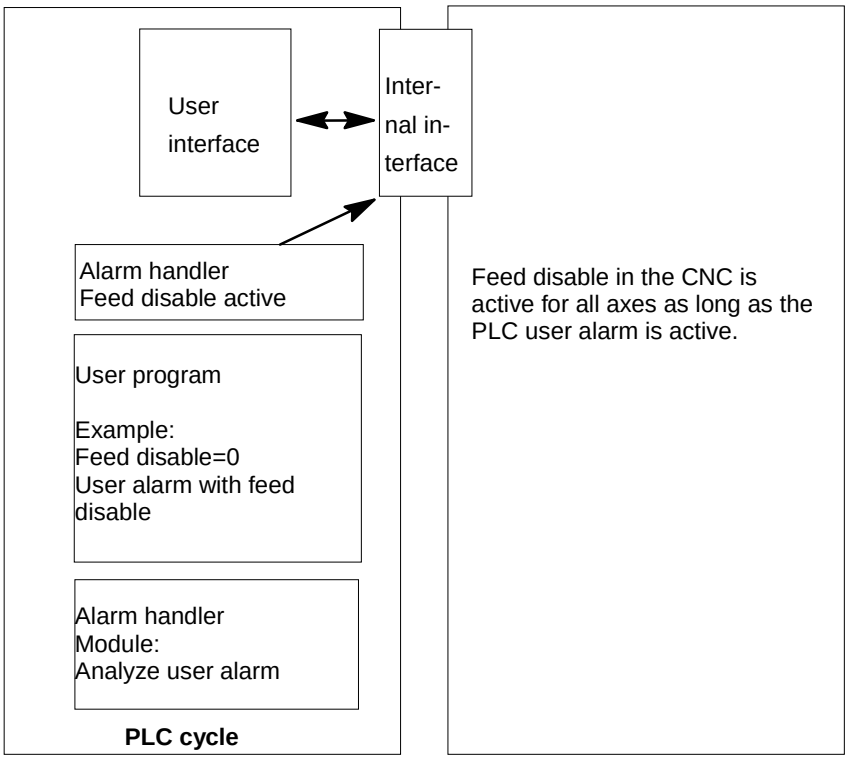


Fig. 4-2 User alarm with Feed Disable alarm response

Configuring user alarms

Each alarm is assigned a configuration byte. The user alarms can be configured by the user in machine data 14516_MN_USER_DATA_PLC_ALARM.

Default setting MD 14516: 0 => SHOW ALARM/SELF-CLEARING user alarm

Configuration byte structure:

- Bit0 - bit5 : Alarm responses
- Bit6 - bit7 : Cancel criterion

Alarm responses:	Bit0 - bit 5 = 0:	Showalarm (default)
	Bit0 = 1:	NC Start inhibited
	Bit1 = 1:	Read-in disable
	Bit2 = 1:	Feed disable for all axes
	Bit3 = 1:	EMERGENCY STOP
	Bit4 = 1:	PLC Stop
	Bit5 =	Reserved
Cancel criteria:	Bit6 + bit7 = 0:	SELF-CLEARING alarm (default)
	Bit6 = 1 :	CANCELCLEAR alarm
	Bit7 = 1 :	POWERONCLEAR alarm

Alarm texts

The user has two possibilities to define his own alarms.

- using the “Edit PLC txt” softkey (See “Operation and Programming”, Chapter 7)

- using the “Text Manager” in Toolbox CD
  The procedure is described in the Toolbox readme file.
  Alarm texts are structured as follows:
  Alarm number Flag 1 Flag2 Text

Notice

The text must be put in inverted commas (‘’ ‘’)!

Adhere to the given text structure.

Table 4–5 Example

Alarm Number	Flag 1	Flag 2	Text
700000	0	0	“User alarm 1”

```
700000 0 0 “ ’’   // 1st user alarm, text is assigned by the user
700001 0 0 “ ’’   // 2nd user alarm, text is assigned by the user
700002 0 0 “ ’’   // 3rd user alarm, text is assigned by the user
700003 0 0 “ ’’   // 4th user alarm, text is assigned by the user
700004 0 0 “ ’’   // 5th user alarm, text is assigned by the user
700005 0 0 “ ’’   // 6th user alarm, text is assigned by the user
...
700031 0 0 “ ’’   // 32nd user alarm, the text is assigned by the user
```

Number

The alarm text must be here

Comment line (does not appear in the dialog window of the Operator Panel)

If no user alarm text is assigned by the user, the operator panel will display only the alarm number.

The % character in the alarm text is the code for the additional variable. The variable type is the representation type of the variable.

The following variable types are possible:

- %D ... Integer decimal number
- % I ... Integer decimal number
- %U ... Unsigned decimal number
- %O ... Integer octal number
- %X ... Integer hexadecimal number
- %B ... Binary representation of 32-bit value
- % F... 4 byte floating point number

User alarm text examples

- 700000 “ ’’ // Only user alarm number
- 700001 “ Hardware limit switch X + axis
- 700002 “ %D ’’ // Only variable as an integer decimal number
- 700003 “ Alarm number with fixed alarm text and variable %X ’’
- 700004 “ %U Alarm number with variable and fixed alarm text ’’
- 700005 “ Rotation monitoring of axis active : %U ’’

  Operator panel display: 700005 Rotation monitoring of axis active : 1

  or 700005 Rotation monitoring of axis active : 3

4.3.4 Machine control panel area layout

The machine control panel area in the standard version has been configured for economic turning machines (2 axes and one spindle).

The user can use the keys K1 – K12 and the associated LEDs (the same applies to keys K1 ... K12) for his own purposes.

The keys K22-K30 should be used as axis keys (see sample program SAMPLE). The programmer can assign the axis keys depending on his particular machine type.

The keys K31-K36 are used as axis override and spindle override buttons.

Notice

When delivery, the SINUMERIK 802SC base line is provided with inserted stripes (10 provided, 3 of them are inserted as standard for turning technology), which consist of all the combinations for both turning and milling technologies.

It is also possible for the user to customize keys K1…K12. The method in details is explained in Toolbox.

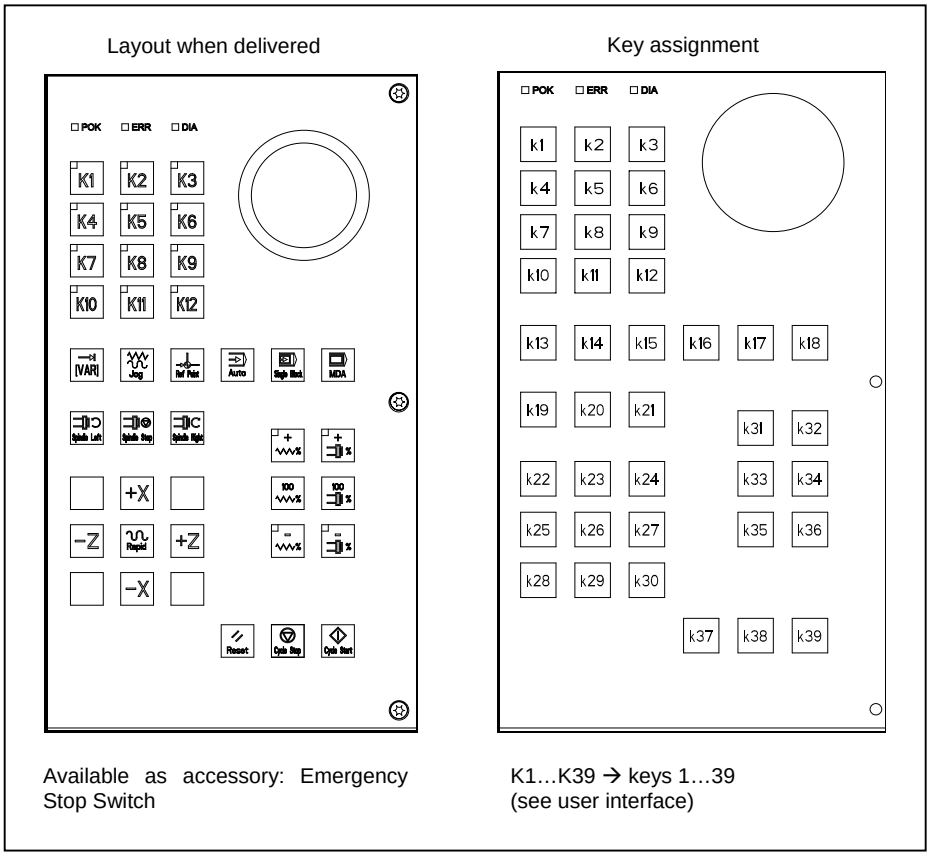


Fig. 4-3 Layout of machine control panel area

Fig. 4-4 Examples for the assignment of the axis keyboard

4.3.5 PLC programming

The PLC user program is created using the PLC 802 Programming Tool.

The Documentation “S7-200 Automation System, System Manual’’ describes how this tool is operated for S7-200. The PLC 802 Programming Tool is to be understood as a subset of this Documentation.

Compared with the S7-200 MicroWin basic system, please note the following:

- The PLC 802 Programming Tool is delievered in the English language version.
- The user program can only be programmed using ladder diagram.
- Only a subset of the S7-200 programming language is supported.
- The compilation of the user program is carried out either offline on a programming device (PG)PC or semi-automatically when downloading into the control system.
- The project can be loaded into the control system (download).
- It is also possible to load the project from the control system (upload).
- Direct data addressing is not possible; therefore, no programming errors will result during the operation.
- The data/process information must be managed by the user in accordance with the particular type.

Example:

Information	1	T value	DWord memory size	(32-bit)
Information	2	Override	Byte memory size	(8-bit)

User data

Byte 0	DWord (Information 1)
Byte 4	Byte (Information 2)

The user is not allowed to access both of these data at the same time; otherwise, the relevant data access rules must be observed.

Furthermore, the data direction in the memory model (alignment) and the data type must be observed for all data.

Example:

Flag bit	MB0.1,MB3.5
Flag byte	MB0,MB1,MB2
Flag word	MW0,MW2,MW4 MW3, MW5 ... are not permissible
Flag double-word	MD0,MD4,MD8 MD1,MD2,MD3, MD5 ... are not permissible

Table 4–6 PLC data types permitted in the control system

Data Type	Size	Address Alignment	Range for Logic Operations	Range for Arithmetical Operations
BOOL	1 bit	1	0, 1	-
BYTE	1 byte	1	00 ... FF	0 ... +255
WORD	2 bytes	2	0000 ... FFFF	-32 768 ... + 32 767
DWORD (Double Word)	4 bytes	4	0000 0000 ... FFFF FFFF	-2 147 483 648 ... +2 147 483 647
REAL	4 bytes	4	-	$+/-10^{-37}$... $+/-10^{38}$

PLC project

In any case, the PLC 802 Programming tool manages one project (logic operations, symbols and comments). The download function is intended to store all important information of a project in a control system.

The control system is able to store max. 4,000 instructions and 1,000 symbols. The required PLC memory is influenced by the following components:

- Number of instructions
- Number and length of the symbol names
- Number and length of the comments

S7-200

A ladder diagram is a graphical programming language similar to electric circuit diagrams.

ladder diagram

When creating a program using the ladder diagram form, then you will work with graphical components to create the networks of your logics. To create your program, you can use the following elements:

- Contacts constitute a switch through which the current can flow. Current, however, will only flow through a normally open contact if the contact is closed (logical value 1). Current will flow through a normally closed contact or a negated contact (NOT) if the contact is open (logical value 0).
- Coils constitute a relay or an output which is updated by the signal flow.
- Boxes constitute a function (e.g. a timer, counter or arithmetic operation) which is carried out at the moment when the signal flow reaches the box.

A network consists of the elements mentioned above, forming a closed circuit. The current flows from the left conductor bar (in the ladder diagram symbolized by a vertical line at the left window) through the closed contacts, enabling coils or boxes.

Overview of commands

Table 4–7 Operand identifers

Operand ID	Description	Range
V	Data	V0.0 to V79999999.7 (see Table 4-8)
T	Timers	T0 to T15
C	Counters	C0 to C31
I	Map of digital inputs	I0.0 to I7.7
Q	Map of digital outputs	Q0.0 to Q7.7
M	Flags	M0.0 to M127.7
SM	Special flags	SM0.0 to SM 0.6 (see Table 4-10)
AC	ACCU	AC0 ... AC3

Table 4–8 Generating the addresses for the V range (see user interface)

Type Code (DB No.)	Range No. (Channel/ Axis No.)	Subrange	Offset	Addressing
00 (00-79)	00 (00-99)	0 (0-9)	000 (000-999)	symbolic (8-digit)

Table 4–9 802C base line ranges of operands

Accessed by:	Memory Type	SINUMERIK 802C base line
Bit (Byte.bit)	V	14000000.0-79999999.7
	I	0.0 - 7.7
	Q	0.0 - 7.7
	M	0.0 - 127.7
	SM	0.0 – 0.6
	T	0 – 15
	C	0 - 31
	L	0.0 - 59.7
Byte	VB	14000000-79999999
	IB	0 - 7
	QB	0 - 7
	MB	0 - 127
	SMB	0
	LB	0 - 59
	AC	0 - 3
Word	VW	14000000-79999998
	IW	0 – 6
	QW	0 – 6
	MW	0 - 126
	T	0 - 15
	C	0 – 31
	LW	0 - 58
	AC	0 - 3
Double Word	VD	14000000-79999994
	ID	0 – 4
	QD	0 – 4
	MD	0 – 124
	LD	0 - 56
	AC	0 – 3

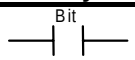
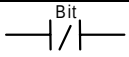
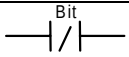
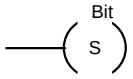
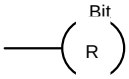
Table 4–10 Special Flag SM Bit Definition

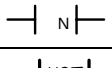
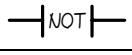
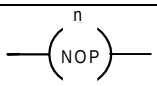
SM Bits	Description
SM 0.0	Flags with defined ONE signal
SM 0.1	Initial position: first PLC cycle ‘1’, following cycles ‘0’
SM 0.2	Buffered data lost - applicable only to the first PLC cycle (‘0’ data o.k., ‘1’ - data lost)
SM 0.3	POWER ON: first PLC cycle ‘1’, following cycles ‘0’
SM 0.4	60 s cycle (alternating ‘0’ for 30 s, then ‘1’ for 30 s)
SM 0.5	1 s cycle (alternating ‘0’ for 0.5 s, then ‘1’ for 0.5 s)
SM 0.6	PLC cycle (alternating, one “0” cycle, then one “1” cycle)

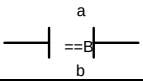
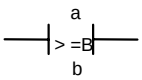
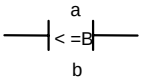
4.3.6 Instruction set

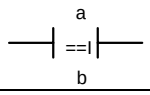
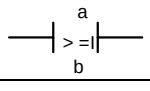
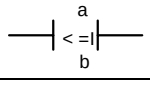
A detailed description of the instructions is to be found in the help system of the PLC 802 Programming Tool (Help > Contents and Index, “SIMATIC LAD Instructions”) and in the Documentation “S7-200 Automation System, CPU22x System Manual.

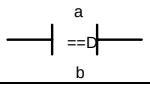
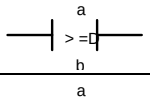
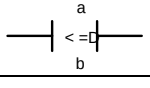
Table 4–11 Instruction set

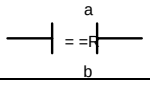
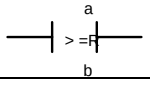
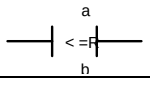
BASIC BOOLEAN INSTRUCTIONS			
Instruction		**Ladder Symbol**	**Valid Operands**
Load And Or	normal open n=1 close n=0 open		V, I, Q, M, SM, T, C, L
Load Not And Not Or Not	normal close n=0 close n=1 open		V, I, Q, M, SM, T, C, L
Output	prior 0, n=0 prior 1, n=1		V, I, Q, M,T, C, L
Set (1 Bit)	prior 0, not set prior 1 or ↑		V, I, Q, M, T, C, L
Reset (1 Bit)	prior 0, no reset prior 1 or ↑		V, I, Q, M, T, C, L

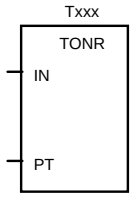
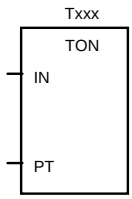
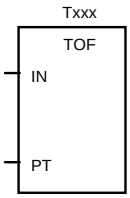
OTHER BOOLEAN INSTRUCTIONS			
Instruction		**Ladder Symbol**	**Valid Operands**
Edge Up	prior ↑ close (1 PLC cycle)		
Edge Down	prior ↓ close (1 PLC cycle)		
Logical Not	prior 0, later 1 prior 1, later 0		
No operation			n = 0 ... 255

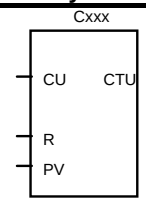
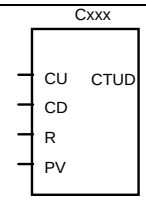
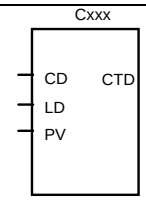
BYTE COMPARES (Unsigned)			
Instruction		**Ladder Symbol**	**Valid Operands**
Load Byte = **And Byte =** **Or Byte =**	a = b close a ≠ b open		a: VB, IB, QB, MB, SMB, AC, Constant, LB b: VB, IB, QB, MB, SMB, AC, Constant, LB
Load Byte **And Byte** **Or Byte**	a ≥ b close a < b open		
Load Byte **And Byte** **Or Byte**	a ≤ b close a > b open		

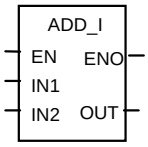
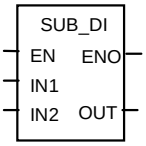
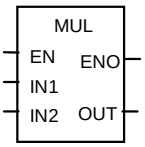
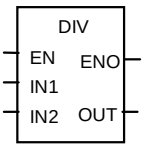
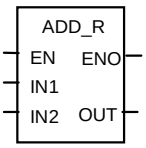
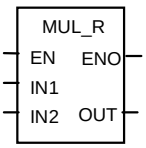
WORD COMPARES (Signed)			
Instruction		**Ladder Symbol**	**Valid Operands**
Load Word = And Word = Or Word =	a = b close a ≠ b open		a: VW, T, C, IW, QW, MW, AC, Constant, LW b: VW, T, C, IW, QW, MW, AC, Constant, LW
Load Word And Word Or Word	a ≥ b close a < b open		
Load Word And Word Or Word	a ≤ b close a > b open		

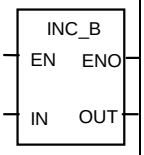
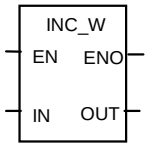
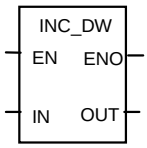
DOUBLE WORD COMPARES (Signed)			
Instruction		**Ladder Symbol**	**Valid Operands**
Load DWord = And DWord = Or DWord =	a = b close a ≠ b open		a: VD, ID, QD, MD, AC, Constant, LD b: VD, ID, QD, MD, AC, Constant, LD
Load DWord And DWord Or DWord	a ≥ b close a < b open		
Load DWord And DWord Or DWord	a ≤ b close a > b open		

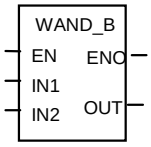
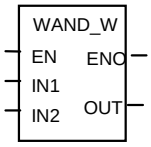
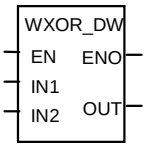
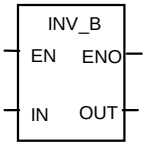
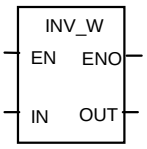
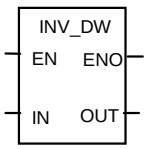
REAL WORD COMPARES (Signed)			
Instruction		**Ladder Symbol**	**Valid Operands**
Load RWord = And RWord = Or RWord =	a = b close a ≠ b open		a: VD, ID, QD, MD, AC, Constant, LD b: VD, ID, QD, MD, AC, Constant, LD
Load RWord And RWord Or RWord	a ≥ b close a < b open		
Load RWord And RWord Or RWord	a ≤ b close a > b open		

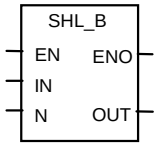
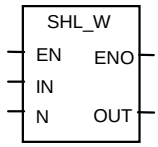
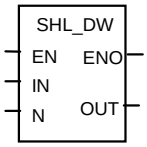
TIMER			
Instruction		**Ladder Symbol**	**Valid Operands**
TimervRetentive On Delay	EN=1, Start EN=0, Stop If T_{Value} ≥ PT, T_{bit}=1		Enable: (IN) S0 Txxx: T0 - T15 Preset: (PT) VW, T, C, IW, QW, MW, AC, Constant 100 ms T0 - T15
Timer On Delay	EN=1, Start EN=0, Stop If T_{Value} ≥ PT, T_{bit}=1		Enable: (IN) S0 Txxx: T0 - T15 Preset: (PT) VW, T, C, IW, QW, MW, AC, Constant 100 ms T0 - T15
Timer Of Delay	If T_{Value} < PT, T_{bit}=1		Enable: (IN) S0 Txxx: T0 - T15 Preset: (PT) VW, T, C, IW, QW, MW, AC, Constant 100 ms T0 - T15

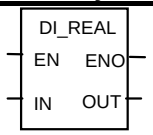
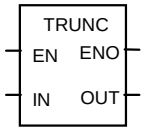
COUNTER			
Instruction		**Ladder Symbol**	**Valid Operands**
Count Up	CU ½, Value+1 R=1, Reset If C_{Value} ≥ PV, C_{bit}=1		Cnt Up: (CU) S1 Reset: (R) S0 Cxxx: C0 - 31 Preset: (PV) VW, T, C, IW, QW, MW, AC, Constant, LW
Count Up/Down	CU ½, Value+1 CD ½, Value-1 R=1, Reset If C_{Value} ≥ PV, C_{bit}=1		Cnt Up: (CU) S2 Cnt Dn: (CD) S1 Reset: (R) S0 Cxxx: C0 - 31 Preset: (PV) VW, T, C, IW, QW, MW, AC, Constant, LW
Count Down	If C_{Value} = 0, C_{bit}=1		Cnt Down: (CD) S2 Reset: (R) S0 Cxxx: C0 - 31 Preset: (PV) VW, T, C, IW, QW, MW, AC, Constant, LW

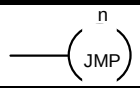
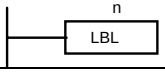
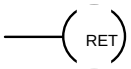
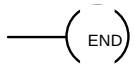
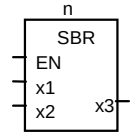
MATH OPERATIONS			
Instruction		**Ladder Symbol**	**Valid Operands**
Word Add Word Subtract	If EN = 1, b = a + b b = b - a		Enable: EN In: VW, T, C, IW, QW, MW, AC, Constant, LW Out: VW, T, C, IW, QW, MW, AC, LW
DWord Add DWord Subtract	If EN = 1, b = a + b b = b - a		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD
Multiply	If EN = 1, b = a x b		Enable: EN In: VW, T, C, IW, QW, MW, AC, Constant, LW Out: VD, ID, QD, MD, AC, LD
Divide	If EN = 1, b = a b Out: 16 bit remainder Out+2: 16 bit quotient		Enable: EN In: VW, T, C, IW, QW, MW, AC, Constant, LW Out: VD, ID, QD, MD, LD
Add Subtract Real Numbers	If EN = 1, b = a + b b = b - a		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD
Multiply Divide Real Numbers	If EN = 1, b = a x b b = a b		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD

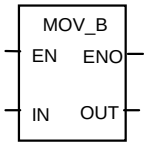
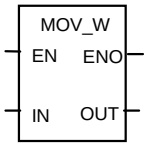
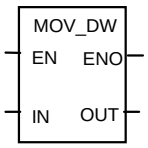
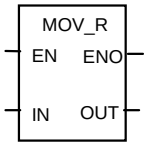
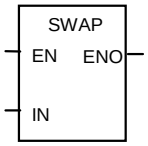
INCREMENT, DECREMENT			
Instruction		**Ladder Symbol**	**Valid Operands**
Increment Decrement Byte	If EN = 1, a = a + 1 a = a - 1		Enable: EN In: VB, IB, QB, MB, AC, Constant LB Out: VB, IB, QB, MB, AC, LB
Increment Decrement Word	If EN = 1, a = a + 1 a = a - 1 a = /a		Enable: EN In: VW, T, C, IW, QW, MW, AC, Constant, LW Out: VW, T, C, IW, QW, MW, AC, LW
Increment Decrement.	If EN = 1, a = a + 1 a = a - 1		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD

LOGIC OPERATIONS			
Instruction		**Ladder Symbol**	**Valid Operands**
Byte AND Byte OR Byte XOR	If EN = 1, b = a AND b b = a OR b b = a XOR b		Enable: EN In: VB, IB, QB, MB, AC, Constant, LB Out: VB, IB, QB, MB, AC, LB
Word AND Word OR Word XOR	If EN = 1, b = a AND b b = a OR b b = a XOR b		Enable: EN In: VW, T, C, IW, QW, MW, AC, Constant, LW Out: VW, T, C, IW, QW, MW, AC, LW
DWord AND DWord OR DWord XOR	If EN = 1, b = a AND b b = a OR b b = a XOR b		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD
Invert Byte	If EN = 1, a = /a		Enable: EN In: VB, IB, QB, MB, AC, Constant, LB Out: VB, IB, QB, MB, AC, LB
Invert Word	If EN = 1, a = /a		Enable: EN In: VW, T, C, IW, QW, MW, AC, Constant, LW Out: VW, T, C, IW, QW, MW, AC, LW
Invert DWord	If EN = 1, a = /a		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD

SHIFT AND ROTATE OPERATIONS			
Instruction		**Ladder Symbol**	**Valid Operands**
Shift Right Shift Left	If EN = 1, a = a SR c bits a = a SL c bits		Enable: EN In: VB, IB, QB, MB, AC, Constant, LB Out: VB, IB, QB, MB, AC Count: VB, IB, QB, MB, AC, Constant, LB
Shift Right Shift Left	If EN = 1, a = a SR c bits a = a SL c bits		Enable: EN In: VW, T, C, IW, QW, MW, AC, Constant, LW Out: VW, T, C, IW, QW, MW, AC, LW Count: VB, IB, QB, MB, AC, Constant, LB
DWord Shift R DWord Shift L	If EN = 1, a = a SR c bits a = a SL c bits		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD Count: VB, IB, QB, MB, AC, Constant, LB

CONVERSION OPERATIONS			
Instruction		**Ladder Symbol**	**Valid Operands**
Convert Double Word Integer to a Real	If EN = 1, convert the double word integer i to a real number o.		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD
Convert a Real to a Double Word Integer	If EN = 1, convert the real number i to a double word integer o.		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD

Instruction		**Ladder Symbol**	**Valid Operands**
Jump to Label	If EN = 1, go to label n.		Enable: EN Label: WORD: 0-127
Label	Label marker for the jump.		Label: WORD: 0-127
Conditional Return from Subroutine	If EN = 1, exit the subroutine.		Enable: EN
Conditional End	If EN = 1, END terminates the main scan.		Enable: EN
Subroutine	If EN ↑, go to subroutine n.	 (x... optional parameters)	Label: Constant : 0-63

MOVE, FILL AND FIND OPERATIONS			
Instruction		**Ladder Symbol**	**Valid Operands**
Move Byte	If EN = 1, copy i to o.		Enable: EN In: VB, IB, QB, MB, AC, Constant, LB Out: VB, IB, QB, MB, AC, LB
Move Word	If EN = 1, copy i to o.		Enable: EN In: VW, T, C, IW, QW, MW, AC, Constant, LW Out: VW, T, C, IW, QW, MW, AC, LW
Move DWord	If EN = 1, copy i to o.		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD
Move Real	If EN = 1, copy i to o.		Enable: EN In: VD, ID, QD, MD, AC, Constant, LD Out: VD, ID, QD, MD, AC, LD
Swap Bytes	If EN = 1, exchange MSB and LSB of w.		Enable: EN In: VW, IW, QW, MW, T, C, AC, LW

4.3.7 Program organization

Each programmer should divide the user program into several closed program sections (subroutines). The S7-200 programming language allows the user to create structured user programs. There are two program types - main programs and subroutines. Eight program levels are possible.

A PLC cycle can be a multiple of the control-internal interpolation cycle (IPO cycle). The machine manufacturer must set the PLC cycle according to his/her own requirements (see machine data “PLC_IPO_TIME_RATIO”). The ratio IPO/ PLC of 1:1 is the fastest possible cyclic processing.

Example: The programmer programs a sequence control in the main program using his own defined cycle counter. The sequence control defines all cyclic signals in the subroutine (UP0); UP1/UP2 is called every two cycles, and UP 3 controls all signals in steps of three cycles.

4.3.8 Data organization

The data can be divided into three areas:

- non-retentive data
- retentive data
- machine data for the PLC (All these machine data are active after POWER ON.)

Most data, such as process map, timers and counters, are non-retentive data and deleted with each power-up.

The user has a certain area available for the retentive data (data range 14000000 -140000xx). All data that are wished to remain their validity even after POWER ON can be stored in this area.

The user can use the PLC MD (see user interface) to load his program with default data or to parameterize various program sections.

4.3.9 Interface to the control system

This interface can be selected on the operator panel using the softkeys Diagnosis \ Start-up \ STEP7 connect.

The V24 interface remains active even after restart or normal power-up. The connection (STEP7 connect active) to the control system can be checked in the PLC 802 Programming Tool menu “PLC/Information”. If the interface is active, e.g. the active PLC mode (Run/Stop) is displayed in this window.

4.3.10 Testing and monitoring the user program

The user program can be analyzed or checked for errors using the following methods:

- PLC Status menu (OP)
- Status list menu (OP)
- PLC 802 Programming Tool (see Help menu > Contents and Index, “Debugging” or documentation “S7-200 Automation System”, Section “Testing and Monitoring Your Program”)

4.4 PLC applications “Download/Upload/Copy/Compare”

The user can save or copy PLC applications in the control system or overwrite them by another PLC project.

This is possible using the

- Programming Tool 802
- WinPCIN (binary file)

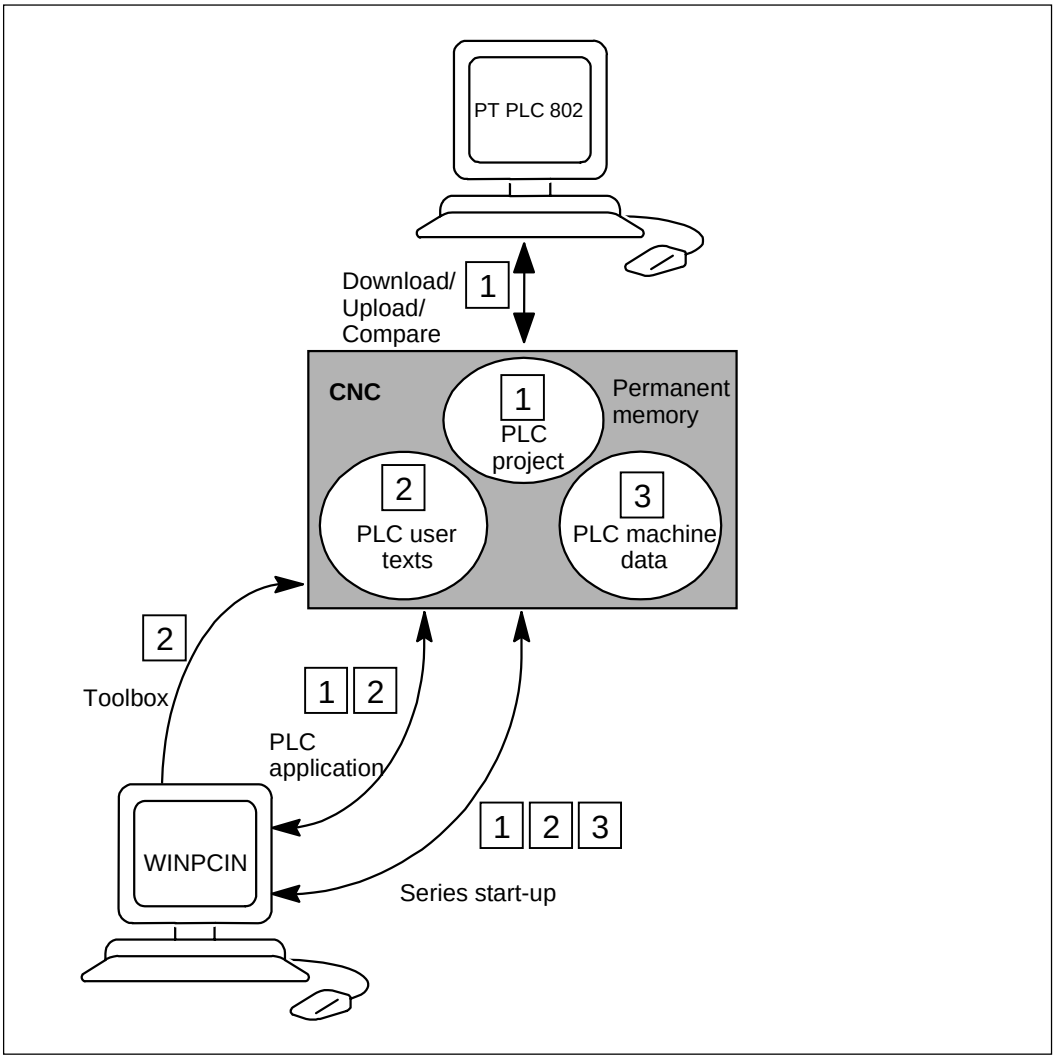


Fig. 4–5 PLC applications in the control system

Download

This function is used to write the transferred data to the permanent memory (load memory) of the control system.

- Download the PLC project using the PLC 802 Programming Tool (Step 7 connect on)
- Series start-up using the WinPCIN tool (PLC MD, PLC project and user alarm texts) Data In

The loaded PLC user program is transferred from the permanent memory to the user memory when the control is booted next time; it will be active from this moment.

Upload

The PLC applications can be saved using the PLC 802 Programming Tool or the tool WINPCIN.

- Upload PLC project using the PLC 802 Programming Tool (Step 7 connect on)

  Read out the project from the control system to reconstruct the current project in the PLC 802 Programming Tool.
- Series start-up “Start-up Data” using the tool WINPCIN (PLC MD, PLC Project and user alarm texts) Data Out
- Read out PLC applications using the Tool WINPCIN (PLC Project information and user alarm texts) Data Out

Compare

The project in the PLC 802 Programming Tool is compared with the project contained in the permanent memory (load memory) of the CNC.

Versions display

Calling via the softkey Diagnosis / Service Display / Version(PROJECT)

The transmitted project including user program, which is active in the PLC after the control system has powered up.

The programmer can use the first comment line in the program title of the PLC 802 Programming Tool for his own additional information in the version display (see “View Properties“).

4.5 User Interface

This interface includes all signals between CNC/PLC and HMI/PLC. In addition, the PLC decodes the auxiliary function commands for straightforward further processing in the user program.

4.6 Technology Setting

Overview

The SINUMERIK 802C base line is supplied with the default machine data as a control system for turning machines (2 axes, 1 spindle). If you wish to set another technology (e.g. milling), the relevant machine data file must be loaded from the tool box into the control system.

The file with the technology machine data must be loaded after the control system has booted successfully, but prior to commissioning.

Sequence of operations

To change the technology setting, proceed as follows:

- Make a V24 link between PG/PC and the control system.
- Turn on the control system and wait until it has booted without errors.
- Press the Start data inp. softkey in the Services menu (use the V24 default interface settings).
- Select the technology machine data file techmill.ini (included in the toolbox) required for milling and transfer it to the PG/PC using WinPCIN.
- After the file has been transferred correctly, carry out POWER ON.
- The SINUMERIK 802C base line is now preset to the desired technology.

  Example: techmill. ini
  Default: 3 axes (X, Y and Z), 1 spindle, no transversal axis, G17 etc.

If you wish to reconfigure a SINUMERIK 802C base line control system to turning, carry out POWER ON with the default machine data (start-up switch position 1).

Notice

All memory areas are initialized or loaded with stored default values (machine data).

The basic configuration of the SINUMERIK 802C must be carried out during the commissioning prior to the general configuration (MD input).

This need not to be done when series start-up is carried out. The configured machine data are contained in the series start-up file.

4.7 Commissioning

Initializing the control system

- Turn on the control system.
- The SINUMERIK 802C base line will load the standard machine data automatically.

4.7.1 Entering the general machine data

Overview

To make your work easier, the most important machine data of the individual subranges are listed. If more detailed information is required, the user is referred to the relevant chapters/sections of this manual. The machine data and interface signals are described in detail in the descriptions of functions to which reference is made in the relevant lists.

Notice

The general machine data are selected such (default values) that only a few machine data parameters have to be modified.

Entering the machine data (MD)

Before the machine data can be entered, the password for protection level 2 or 3 must be entered.

The following machine data ranges must be selected and modified (if necessary) using the appropriate softkeys:

- General machine data
- Axis machine data
- Other machine data
- Display machine data

Once entered, these data are immediately written to the data memory.

The machine data are activated depending on the Activation setting of the appropriate machine data, Section 4.1.2.

Notice

Since these data are only stored in the memory backed up for a limited period of time, a data backup is necessary (see Section 4.1.4).

Machine data

The following machine data list contains all general and other machine data and setting data, which can be changed if necessary.

Number	Description	Default Value
10074	Division ratio of the PLC task factor for main run	2
11100	Number of auxiliary function groups	1
11200	Standard machine data loaded on next Power On	O_H
11210	MD backup of changed MD only	0FH
11310	Threshold for direction change of handwheel	2
11320	Handwheel pulses per detent position (handwheel number): 0...1	1
20210	Maximum angle for compensation blocks with TRC	100
20700	NC–Start disable without reference point	1
21000	Circle end point monitoring constant	0.01
22000	Auxiliary function group (aux. fct. no. in channel): 0...49	1
22010	Auxiliary function type (aux. fct. no. in channel): 0...49	“”
22030	Auxiliary function value (aux. fct. no. in channel): 0...49	0
22550	New tool compensation for M function	0

Setting data

Number	Explanation	DefaultValue
41110	Jog feedrate	0
41200	Spindle speed	0
42000	Start angle	0
42100	Dry run feedrate	5000

4.7.2 Starting up the axes

Overview

The SINUMERIK 802C base line has up to three servo motor feedrate axes (X, Y and Z). The servo motor drive signals are output at connector **X7** for the:

- X axis (SW1, BS1, RF1.1, RF1.2)
- Y axis (SW2, BS2, RF2.2, RF2.2)
- Z axis (SW3, BS3, RF3.1, RF3.2)
- Spindle (SW4, RF4.1, RF4.2)

Simulation/servo motor drive

Setpoint output and pulse feedback can be switched between simulation and drive operation using the axis MD 30130_CRTLOUT_TYPE and 30240_ENC_TYPE.

Table 4–12

MD	Simulation	Normal Operation
30130	Value = 0 To test the axis, the actual value is fed back internally as an actual value. No setpoint output at connector X7.	Value = 1 The setpoint signals for stepper motor operation are output at connector X7. Real axis traversal is possible using a servo motor.
30240	Value = 0	Value = 2 Internal pulse feedback from setpoint output to actual value input “ON”

Machine data for axes and spindle

Number	Explanation	Default Value
30130	Output type of setpoint (setpoint branch):	0
30200	Number of encoders	1
30240	Type of actual value acquisition (actual position value) (encoder no.) 0: Simulation 2: Square–wave generator, standard encoder (pulse multiplication)	0
30350	Output of axis signals with simulation axes	0
31020	Encoder markings per revolution (encoder no.)	2048
31030	Pitch of leadscrew	10
31040	Encoder mounted directly to the machine (encoder no:)	0
31050	Denominator load gearbox (control parameter no.): 0...5	1
31060	Numerator load gearbox (control parameter set no.): 0...5	1
31070	Denominator resolver gearbox (encoder no.)	1
31080	Numerator resolver gearbox (encoder no.)	1
32100	Traversing direction (not control direction)	1
32110	Sign actual value (control direction) (encoder no.)	1
32200	Servo gain factor (control parameter set no.): 0...5	1
32250	Rated output voltage	80
32260	Rated motor speed (setpoint branch): 0	3000

Number	Explanation	Default Value
32700	Interpolatory compensation (encoder no.): 0,1	0
33050	Traversing distance for lubrication from PLC	100 000 000
35010	Gear change possible. Spindle has several gear steps	0
35040	Own spindle reset	0
35100	Maximum spindle speed	10000
35110	Maximum speed for gear change (gear stage no.): 0..5	500,...
35120	Minimum speed for gear change (gear stage no.): 0..5	50,...
35130	Maximum speed of gear stage (gear stage no.): 0...5	500,...
35140	Minimum speed of gearstage (gear stage no.): 0...5	5,...
35150	Spindle speed tolerance	0.1
35160	Spindle speed limitation from PLC	1000
35220	Speed for reduced acceleration	1.0
35230	Reduced acceleration	0.0
35300	Position control switch–on speed	500
35350	Direction of rotation when positioning	3
35400	Reciprocation speed	500
35410	Acceleration during reciprocating	16
35430	Starting direction during reciprocation	0
35440	Reciprocation time for M3 direction	1
35450	Reciprocation time for M4 direction	0,5
35510	Feedrate enable for spindle stopped	0
36000 (only SPOS)	Exact positioning coarse	0.04
36010 (only SPOS)	Exact positioning fine	0.01
36020 (only SPOS)	Delay exact positioning fine	1
36030 (only SPOS)	Zero–speed tolerance	0.2
36040 (only SPOS)	Delay zero–speed monitoring	0.4
36050 (only SPOS)	Clamping tolerance	0.5
36060 (only SPOS)	Maximum velocity/speed ”axis/spindle stopped”	5 (axis); 0.0138 (spindle)
36200	Threshold value for velocity monitoring (control parameter set no.): 0...5	11500 (axis); 31,94 (spindle)
36300	Encoder limit frequency	300000
36302	Encoder limit frequency at which encoder is switched on again. (Hysteresis)	99.9

Number	Explanation	Default Value
36310	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	0
36400	Contour Tol	1
36610	Duration of the deceleration ramp for error states	0.05
36620	Cutout delay servo enable	0.1
36700	Automatic drift compensation	0
36710	Drift limit value for automatic drift compensation	1
36720	Drift basic value	0

Matching encoder to axis/spindle

Machine data for encoder adjustment

Number	Description	Spindle	
31040	Encoder mounted directly to the machine (encoder no.)	0	1
31020	Encoder markings per revolution (encoder no.)	Incr. /rev.	Incr. /rev.
31080	Numerator resolver gearbox (encoder no.)	Motor revs	Load rev.
31070	Denominator resolver gearbox (encoder no.)	Enc. revs	Enc. revs
31060	Numerator load gearbox (control parameter set no.): 0...5	Motor revs	Motor revs
31050	Denominator load gearbox (control parameter no.): 0...5	Load revs	Load revs

Example 1 for encoder matching:

Spindle with rotary encoder (500 pulses) mounted directly on the motor. The internal multiplication factor is 4. The internal computational resolution amounts to 1,000 increments per degree.

$$\text{Internal resolution} = \frac{360 \text{ degrees}}{\text{MD } 31020 \times 4} \times \frac{\text{MD } 31080}{\text{MD } 31070} \times 1000$$

$$\text{Internal resolution} = \frac{360 \times 1 \times 1000}{500 \times 4 \times 1} = 180$$

One encoder increment corresponds to 180 internal increments. One encoder increment corresponds to 0.18 degrees (minimum positioning step).

Example 2 for encoder matching:

Spindle with rotary encoder on motor (2,048 pulses), internal multiplication = 4, 2 speed stages exist:

Gear stage 1: Motor/spindle = 2.5/1
Gear stage 2: Motor/spindle = 1/1

Gear stage 1

$$\text{Internal resolution} = \frac{360\ \text{degrees}}{\text{MD 31020} \times 4} \times \frac{\text{MD 31080}}{\text{MD 31070}} \times \frac{\text{MD 31050}}{\text{MD 31060}} \times 1000\text{incr/deg}$$

$$\text{Internal resolution} = \frac{360}{4 \times 2048} \times \frac{1}{1} \times \frac{1}{2.5} \times 1000\text{pulses/deg} = 17.5781$$

One encoder increment corresponds to 17.5781 internal increments. One encoder increment corresponds to 0.0175781 degrees (minimum positioning step).

Gear stage 2

$$\text{Internal resolution} = \frac{360\ \text{degrees}}{\text{MD 31020} \times 4} \times \frac{\text{MD 31080}}{\text{MD 31070}} \times \frac{\text{MD 31050}}{\text{MD 31060}} \times 1000\text{incr/deg}$$

$$\text{Internal resolution} = \frac{360}{4 \times 2048} \times \frac{1}{1} \times \frac{1}{1} \times 1000\text{pulses/deg} = 43.945$$

One encoder increment corresponds to 43.945 internal increments. One encoder increment corresponds to 0.043945 degrees (minimum positioning step).

Machine data default settings for analog motor axes

The machine data list below contains the default machine data with their recommended settings with the analog motor axes connected.

After they have been set, the axis are ready to be traversed, as far as the machine data are concerned, and only fine settings have to be done.

Number	Description	Default Value	Setting or Remark
30130	Output type of setpoint (setpoint branch): 0	0	1
30240	Type of actual value acquisition (actual position value) (encoder no.) 0: Simulation 2: Encoder external	0	2
31020	Encoder markings per revolution (encoder no.)	2048	Steps per encoder revolution
31030	Pitch of leadscrew	10	Leadscrew pitch
31050	Denominator load gearbox (control parameter no.): 0...5	1	Load gear transmission ratios
31060	Nominator load gearbox (control parameter no.) 0...5	1	Load gear transmission ratios (MD31080:MD 31050)
31070	Denominator resolver gearbox (control parameter no.): 0...5	1	Load gear transmission ratios

Number	Description	Default Value	Setting or Remark
31080	Nominator resolver gearbox (control parameter no.): 0...5	1	Load gear transmission ratios (MD31080:MD 31050)
32000	Maximum axis velocity	10000	30,000 (max. axis velocity)
32100	Traversing direction (not control direction)	0	Reversal of direction of movement
32110	Sign actual value (control direction) (encoder no.)	0	Measuring system reversal
32200	Servo gain factor (control parameter set no.): 0...5	1,0	1.0 (position controller gain)
32250	Rated output voltage	80%	The speed defined in MD32260 is reached at the setpoint of 8 V
32260	Rated motor speed (setpoint branch): 0	3000	Motor speed
34070	Reference point positioning velocity	300	Positioning velocity when referencing
34200	Type of position measuring system 1: Zero pulse (on encoder track)	1	Zero pulse
36200	Threshold value for velocity monitoring (control parameter set no.): 0...5	11500	Threshold monitoring for velocity monitoring in the axis
		31,94	Threshold value for speed monitoring in the spindle

To solve monitoring problems, the following machine data must be set.

Number	Description	Default Value	Setting or Remark
36000	Exact positioning coarse	0.04	Exact stop coarse
36010	Exact positioning fine	0.01	Exact stop fine
36020	Delay exact positioning fine	1.0	Positioning dealy time
36060	Maximum velocity/speed “axis/spindle stopped”	5.0	Threshold velocity for “Axis at standstill”
		0.013889	Threshold velocity for “Spindle at standstill”

Parameterization example

Encoder: 2500 [10,000 pulses per motor revolution]

Load gear: 1:1

Leadscrew pitch: 10 mm

Motor speed: 1,200 rpm

MD 30130 =1

MD 30240 =2

MD 31020 =2500

MD 32250 =80%

MD 32260 =1,200 rpm

MD 32000 =12,000 mm/min

The hardware of the drive must be set such that it will reach exactly 1,200 rpm at 8 V.

Servo gain

The servo gain default setting is K_v=1 (corresponds to 1mm following error at a velocity of 1m/min).

The servo gain can or has to be adapted according to the particular mechanical conditions. Too high gain will result in vibrations, too low gain in a too high following error. It is imerative that the drive observes the set speed characteristic (MD32250, MD32260). In addition, the continuous characteristic of the speed when passing zero is also imperative.

Service display of the axis behavior

Servo Trace

To provide axis service, the Servo Trace function is integrated in the Diagnosis menu, which can be used for graphical representation of the axis setpoint speed.

The Trace function is selected in the Diagnosis/Service display/Servo Trace operating area (cf. User Manual “Operation..”).

Dynamic adaptation for thread G331/G332

Function

The dynamic response of spindle and involved axis for the function G331/G332-thread interpolation - can be adapted to the “slower” control loop. Usually, this concerns the Z axis, which is adapted to the more inert response of the spindle.

If an exact adjustment is carried out, it is possible to sacrifice of a compensating chuck for tapping. At least, higher spindle speeds/smaller compensation paths can be achieved.

Activation

The values for the adaptation are entered in MD 32910 DYN_MATCH_TIME [n], usually for the axis. The adaptation is only possible if MD 32900 DYN_MATCH_ENABLE =1 has been set for the axis/spindle.

With active function G331/G332, parameter block n (0...5) of the axis of MD 32910 becomes automatically active, which acts corresponding to the gear stage for the spindle. The gear stage is dependent on the spindle speed with M40 or is directly set by M41...M45 (see also Section 4.5.3 Start-up of the spindle).

Number	Explanation	Default Value
32900	Dynamic response adaptation	0
32910	Time constant of dynamic adaption (control parameter set no): 0...5	0.0

Determination of value

The dynamic value of the spindle is stored for each individual stage in MD 32200 POSCTRL_GAIN[n] as closed-loop gain. An adaptation of the axis to these values must be made in MD 32910 DYN_MATCH_TIME [n] in accordance with the following instruction:

$$\text{MD 32910 DYN\_MATCH\_TIME[n]} = \frac{1}{\text{Kv[n] Spindle}} - \frac{1}{\text{Kv[n] axis}}$$

The entry to be made in MD 32910 requires the time unit s. The values of MD 32200 POSCTRL_GAIN[n] for spindle and axis must be converted accordingly:

$$K_v[n]_{spindle} = \text{POSCTRL\_GAIN[n]}_{spindle} \frac{1000}{60}$$

$$K_v[n]_{axis} = \text{POSCTRL\_GAIN[n]}_{axis} \frac{1000}{60}$$

When using further gear stages with G331/G332, the adaptation must also be carried out in these parameter blocks.

Example for adaptation of the dynamic response of the Z axis/spindle:
1st gear stage -> parameter block[1],
for spindle-K_v MD 32200 POSCTRL_GAIN[1] = 0.5 is entered,
for axis Z-K_v MD 32200 POSCTRL_GAIN[1] = 2.5 is entered.,
The searched entry for the Z axis in

$$\text{MD 32910 DYN\_MATCH\_TIME[1]} = \frac{1}{\text{Kv[1]Spindle}} - \frac{1}{\text{Kv[1] z}}$$

$$\text{MD 32910 DYN\_MATCH\_TIME[1]} = \left(\frac{1}{0.5} - \frac{1}{2.5}\right) \times \frac{60}{1000} = 0.0960\text{s}$$

If necessary, for fine adaptation, in practice a more exact value must be determined.

When traversing axis (e.g. Z axis) and spindle, the exact value for POSCTRL_ GAIN is displayed on the service display.
MD 32900 DYN_MATCH_ENABLE must be set to = 1.
Example: service display for Z axis with POSCTRL_GAIN : 2.437 in 1,000/min
Exact calculation:

$$\text{MD 32910 DYN\_MATCH\_TIME[1]} = \left(\frac{1}{0.5} - \frac{1}{2.437}\right) \times \frac{60}{1000} = 0.0954\text{s}$$

In practice, this value can be optimized. To this aim, the thread is first tested with compensating chuck and the calculated values. Then the values should be modified sensitively such that the difference path in the compensating chuck approximates to zero.
Now, the POSCTRL_GAIN values displayed on the service display for axis and spindle should be identical.

Notice

If MD 32900 DYN_MATCH_ENABLE has been set to “1” for the drilling axis, it should also be set to “1” for all interpolating axes. This increases the traversing accuracy along the contour. However, the entries for these axes in MD 32910 DYN_MATCH_TIME [n] must be left at the value “0”.

Backlash compensation

Overview

The falsification of axis travel due to mechanical backlash can be compensated (cf. Technical Manual “Description of Functions”).

Function

The axis-specific actual value is corrected by the backlash compensation value (MD32450 BACKLASH) with each change of the traversing direction.

Activation

The backlash compensation is active in all operating modes only after referencing.

Leadscrew error compensation (LEC)

Overview

The compensation values are determined by means of the measured error curve and entered in the control system using special system variables during start–up. The compensation tables (cf. Technical Manual “Description of Functions”) must be created in the form of NC programs.

Function

The leadscrew error compensation (LEC) changes the axis–specific actual position by the associated compensation value.

If the compensation values are too high, an alarm message can be output (e.g. contour monitoring, speed setpoint limitation).

Activation

The LEC is only activated in all operating modes if the following requirements are met:

The number of compensation intermediate points must be defined. They are only active after Power ON (MD: MM_ENC_MAX_POINTS).

Caution

Changing the MD: MM_CEC_MAX_POINTS[t] or MM_ENC_COMP_MAX _POINTS automatically reorganizes the NC user memory when the control system is booting. All user data stored in the user memory (e.g. drive and MMC machine data, tool offsets, part programs, compensation tables etc.) are deleted.

- Enter the compensation value for the intermediate point N in the compensation value table (ENC_COMP_[0,N,Axi]).
- Select the distance between the individual intermediate points (ENC_COMP_STEP [0,Axi]).
- Select the start position (ENC_COMP_MIN [0,Axi]).
- Define the end position (ENC_COMP_MAX [0,Axi]).
- In the NC, set MD: ENC_COMP_ENABLE(0)=0. This is the only way to load the compensation table.

The compensation values for the machine axes are entered into the NC memory by means of a part program (see also example in the Manual “Description of Functions”)

Approach the reference points in the axes. Then start the NC program with the leadscrew error compensation table. The reference points must then be approached once more to set the LEC active. The LEC function is activated by setting the MD: ENC_COMP_ENABLE(0)=1 for each machine axis.

Another possibility to create the LEC compensation table is by reading out the LEC file from the NC via the V24 interface.

MD: MM_ENC_MAX_POINTS must be set depending on the number of axes to be compensated. Select Service using the softkey, put the cursor to Data, and press the Show softkey. Then select “Leadscrew Error” using the cursor and press the Data Out softkey.

Enter compensation values, intermediate point distance, start and end position in the received file _N_COMPLETE_EEC by means of the editor (e.g. in the WINPCIN/OUT program). Then re-read the edited file into the control system.

Approach the reference point in the axes and set MD: ENC_COMP_ ENABLE (0)=1. The LEC is thus activated.

4.7.3 Starting up the spindle

Overview

With the SINUMERIK 802C base line, the spindle is a subfunction of the entire axis functionality. The machine data of the spindle are therefore to be found under the axis machine data (from MD35000). For this reason, data have to be entered for the spindle, too; these data are described for axis start–up.

Notice

With SINUMERIK 802C base line, the 4th machine axis (SP) is fixed for the spindle.

The spindle settings for the 4th machine axis are contained in the default machine data.

The spindle setpoint (±10 V analog voltage signal) is output to X7. The spindle measuring system must be connected to X6.

Spindle modes

The following modes are possible for the spindle:

- Control mode (M3, M4, M5)
- Oscillating mode (to assist gearbox change)
- Positioning mode (SPOS)

MD for spindle

see MD for axis and spindle

SD for spindle

Number	Description	Default Value
43210	Progr. spindle speed limitation G25	0
43220	Progr. spindle speed limitation G26	1000
43230	Spindle speed limitation with G96	100

Spindle MD parameterization

Spindle machine data are entered depending on the gear stages. Each gear stage is assigned a parameter record.

The set of parameters corresponding to the current gear stage is selected.

Example: 1st gear stage → set of parameters [1]

Notice

The field containing the parameter “0” is not used for the spindle machine data.

Machine data for setpoint and actual values

Setpoints:

MD 30130 CTRLOUT_TYPE [AX4] = 1

Actual values:

MD 30200 NUM_ENCS[AX4] = 0 ; Spindle without encoder
MD 30200 NUM_ENCS[AX4] = 1 ; Spindle with encoder
MD 30240 ENC_TYPE[AX4] = 2 ; Type of encoder

Interface signals of the spindle

	Interface signals
	“Speed change” 39032000 Bit 3
	“Actual gear stage” 38032000 bits 0 to 2
	“No speed monitoring on gear change” 38032000 bit 6
	“Speed is changed” 38032000 Bit 3
	“Set gear stage” 39032000 bits 0 to 2
	“Positioning mode” 39032002 bit 5
	“Oscillating through PLC”38032002 bit 4
	“Oscillating mode” 39032002 bit 6
	“Control mode” 39032002 bit 7
	“Traversing minus” 39030004 bit 6
	“Traversing plus” 39030004 bit 7

Reciprocation mode for gear change

The reciprocation mode of the spindle is intended to facilitate the gear change. For reciprocation mode, the following axis MD and interface signals are relevant:

MD	Description
35400	Reciprocation speed
35410	Acceleration when reciprocating
35430	Start direction in reciprocation
35440	Reciprocation time for M3 direction
35450	Reciprocation time for M4 direction
Interface signals	“Change gear” 39032000 bit 3
	“Reciprocation speed” 38032002 bit 5
	“Reciprocating by PLC” 38032002 bit 4
	“Set direction of rotation CCW” 38032002 bit 7

4.7.4 Completing the Start-Up

After start-up of the control system by the machine manufacturer, the following should be observed prior to delivery to the final customer:

1. Change the default password for access level 2 from ”EVENING” to your own password.

   If the machine manufacturer uses the password ”EVENING” for access level 2 during the start-up work, the password must be changed.

   — Press the softkey Change passw.

   — Enter the new password and press OK to confirm.

   — Note the password in the Manufacturer Documentation.

2. Reset the access level.

   To save the data which have been set during the start-up, an internal data saving is required. To this aim, set access level 7 (final customer); otherwise, access level 2 will also be saved.

   — Press the softkey Delete passw.

   — The access level will be reset.

3. Carry out internal data saving.

   — Press the softkey Save data.

4.7.5 Cycle start-up

Sequence of operations

When loading cycles into the control system, adhere to the following sequence of operations:

1. Save tool offset data and zero offsets either on the FLASH or on the PG (programming device).
   These data can be selected in the Services menu by pressing the Data outp./data...softkey.
2. Load all files of the selected technology path from the toolbox diskette into the control system via the V24 interface.
3. Carry out POWER ON.
4. Reload the recovered data.

4.8 Series machine start–up

Functionality

The objective of series machine start–up is:

- after commissioning, in order to bring another control system connected to the same machine type with minimum effort to the condition as after commissioning;

or

- under service conditions (after replacing hardware components), to bring a new control system to the initial state with minimum effort.

Precondition

To carry out commissioning, a PC/PG provided with a V24 interface for data transfer from/to the control system is necessary.

In the PC/PG, the WINPCIN tool must be used.

Sequence of operations

1. Create the series machine start–up file (transfer from the control system to the PC/PG).:

- Make a V24 cable connection between the PC/PG (COM port) and the SINUMERIK 802C base line (X2).
- Select Binary format and the same baud rate both in the WinPCIN tool and SINUMERIK 802C base line communication setting menu
- Make the following settings in WINPCIN tool:
  - Receive data
  - Select the path where you want to save your data
  - Save
  - The PC/PG will set itself to “Receive” and will wait for data from the control system.
- Enter the password for protection level 2 in the control system.
- Call the Services/RS232 setting menu.
- Select the Start–up data line from the Services menu and press Start data outp. to output the series machine start–up file.

2. Reading in the series machine start–up file into the SINUMERIK 802C base line:

- Enter the V24 interface settings as described under 1).
- Press the Data In Start button in the Service menu. The control system is thus ready to receive data.
- Use the WINPCIN tool in the PC/PG to select the series start–up file from the DATA_OUT menu and start data transfer.
- The control system is brought to “RESET with rebooting” three times during and at the end of data transfer. On completion of error–free data transfer, the control system is completely configured and ready to operate.

Series machine start–up file

The series machine start–up file contains:

- machine data
- R parameters
- display and alarm text files
- display machine data
- PLC user program
- main programs
- subroutines
- cycles
- Leadscrew error compensation data

Software Update 5

5.1 Updating the system software using a PC/PG

General

The following reasons may require a system software update:

- You wish to install new system software (new software version).
- After hardware replacement, if software versions other than the supplied are to be loaded.

Preconditions

To change the system software of the SINUMERIK 802C base line, you will need the following:

- Update software (Toolbox)
- A PG/PC with V24 interface (COM1 or COM2) and an appropriate cable.

Update procedure

As far as not yet done, carry out external data saving before you update your updating system software (see Section 4.1.4 “Data Saving”).

1. Turn the start-up switch S3 to position “2” (software update on permanent memory).
2. Run Winpcin, make selection of binary format, 115200 of baud rate, then choose file named ENC0.abb under the path \system in toolbox CD.
3. Power on → message “ WAIT FOR SYSTEM – SW ” appeared on the screen.
4. Winpcin starts to transfer ENC0.abb.
5. Switch off system till “UPDATE OK“ appeared on the screen.
6. Turn the start-up switch S3 to position “1” (start-up with standard data)→ switch on the control system again.
7. Prior to the next POWER ON → start-up switch to “0“ position.

Notice

Reload the externally saved user standard data via V24.

5.2 Update errors

Table 5–1 Update errors

Error Text	Explanation	Remedial Action
ERROR UPDATE	Error when updating the system software via V24 • Data already in receive buffer (send from PC side started too early) • Error when erasing the FLASH memory • Error when writing to the FLASH memory • Inconsistent data (incomplete or faulty)	• Repeat update • Check link between control system and PC/PG • Check Toolbox
SINUMERIK 802C base line UPDATE NO DATA	Update without programming the code FLASH completed (no data received, transfer not started)	

Technical Appendix 6

6.1 List of machine and setting data

Data type	BOOLEAN	Machine data bit (1 or 0)
	BYTE	Integer values (from –128 to 127)
	DOUBLE	Real and integer values (from $\pm$ 4.19 x 10^{-307} to $\pm$ 1.67 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 65536)
	SIGNED WORD	Integer values (from –32768 to 32767)
	UNSIGNED DWORD	Integer values (from 0 to 4294967300)
	SIGNED DWORD	Integer values (from –2147483650 to 2147483649)
	WORD	Hex values (from 0000 to FFFF)
	DWORD	Hex values (from 00000000 to FFFFFFFF)
	FLOAT DWORD	Real values (from $\pm$8.43 x 10^{-37} to $\pm$3.37 x 10^{38})

6.1.1 Display machine data

Number	MD Name				
Representation	Name, Miscellaneous			Activated	User Class w/r
Unit	Standard value	Minimum value	Maximum value	Data type	

202	$MM_FIRST_LANGUAGE				
Decimal	Foreground language			**Power On**	2/3
0	1	1	2	Byte	

203	$MM_DISPLAY_RESOLUTION				
Decimal	Display resolution			**Power On**	2/3
0	3	0	5	Byte	

206	$MM_USER_CLASS_WRITE_TOA_GEO				
Decimal	User class Write tool geometry			**Immediately**	2/3
0	3	0	7	Byte	

207	$MM_USER_CLASS_WRITE_TOA_WEAR				
Decimal	User class Write tool wear data			**Immediately**	2/3
0	3	0	7	Byte	

208	$MM_USER_CLASS_WRITE_ZOA				
Decimal	User class Write settable zero offset			**Immediately**	2/3
0	3	0	7	Byte	

210	$MM_USER_CLASS_WRITE_SEA				
Decimal	User class Write setting data			**Immediately**	2/3
0	3	0	7	Byte	

216	$MM_USER_CLASS_WRITE_RPA				
Decimal	User class Write R parameters			**Immediately**	2/3
0	3	0	7	Byte	

217	$MM_USER_CLASS_SET_V24				
Decimal	User class Set V24			**Immediately**	2/3
0	3	0	7	Byte	

219	$MM_USER_CLASS_DIR_ACCESS				
Decimal	User class access directory			**Immediately**	2/3
0	3	0	7	Byte	

243	V24_PG_PC_BAUD				
Bit	PG: Baud rate (300, 600, 1200, 2400, 4800, 9600, 19200, 38400)			**Immediately**	3/3
	7	0	7	Byte	

277	$MM_USER_CLASS_PLC_ACCESS				
Decimal	User class access PLC project			**Immediately**	2/3
0	3	0	7	Byte	

278	**$MM_NCK_SYSTEM_FUNC_MASK**				
Decimal	Option data to enable system-specific functions			**POWER ON**	2/2
0	0	0	15	Byte	

280	**$MM_V24_PPI_ADDR_PLC**				
Decimal	PPI address of the PLC			**POWER ON**	3/3
0	2	0	126	BYTE	

281	**$MM_V24_PPI_ADDR_NCK**				
Decimal	PPI address of the NCK			**POWER ON**	3/3
0	3	0	126	BYTE	

282	**$MM_V24_PPI_ADDR_MMC**				
Decimal	PPI address of the HMI			**POWER ON**	3/3
0	4	0	126	BYTE	

283	**$MM_V24_PPI_MODEM_ACTIVE**				
Decimal	Modem active			**Immediately**	3/3
0	0	0	1	BYTE	

284	**$MM_V24_PPI_MODEM_BAUD**				
Decimal	Modem baud rate			**Immediately**	3/3
0	7	5	9	BYTE	

285	**$MM_V24_PPI_MODEM_PARITY**				
Decimal	Modem parity			**Immediately**	3/3
0	0	0	2	BYTE	

288	**$MM_STARTUP_PICTURE_TIME**				
Decimal	Average time of start up picture visibility in second			**POWER ON**	2/2
0	5	0	10	BYTE	

6.1.2 General machine data

Number	MD Name				
Unit	Name, Miscellaneous		Activated		
HW / function	Standard value	Minimum value	Maximum value	D type	User class

10074	PLC_IPO_TIME_RATIO				
–	PLC task factor for main run		POWER ON		
	2	1	50	DWORD	2/7

10240	SCALING_SYSTEM_IS_METRIC				
–	Basic system metric		POWER ON		
_always	1	***	***	BOOLEAN	2/7

11100	AUXFU_MAXNUM_GROUP_ASSIGN				
–	Number of auxiliary functions distr. amongst aux. fct. groups		POWER ON		
_always	1	1	50	BYTE	2/7

11200	INIT_MD				
HEX	Standard machine data loaded on next Power On		POWER ON		
_always	0x0F	–	–	BYTE	2/7

11210	UPLOAD_MD_CHANGE_ONLY				
HEX	Saving only of modified MD (value=0: complete= no difference)		RESTART		
-	0x0F	-	-	BYTE	2/7

11310	HANDWH_REVERSE				
–	Threshold for direction change handwheel		POWER ON		
_always	2	0.0	plus	BYTE	2/7

11320	HANDWH_IMP_PER_LATCH				
–	Handwheel pulses per detent position (handwheel number): 0...1		POWER ON		
_always	1., 1.	–	–	DOUBLE	2/7

11346	HANDWH_TRUE_DISTANCE				
–	Handwheel		POWER ON		
_always	0	0	3	BYTE	2/2

14510	USER_DATA_INT [n]				
kB	User data (INT) 0 ... 31		POWER ON		
_always	–	0	–	DWORD	2/7

14512	USER_DATA_HEX [n]				
kB	User data (Hex) 0 ... 31		POWER ON		
–	0	0	0xFF	BYTE	2/7

14514	USER_DATA_FLOAT [n]			
–	User data (Float) 0 ... 7		POWER ON	
–	0.0	...	...	DOUBLE	2/7

14516	USER_DATA_PLC_ALARM [n]			
–	User data (Hex) Alarm bit 0 ... 31		POWER ON	
–	0	0	0xFF	BYTE	2/7

6.1.3 Channel–specific machine data

Number	MD Name			
Unit	Name, Miscellaneous		Activated	
HW / function	Standard value	Minimum value	Maximum value	D type	User class

20210	CUTCOM_CORNER_LIMIT			
Degrees	Maximum angle for compensation blocks with TRC		POWER ON	
_always	100	0.0	150.	DOUBLE	2/7

20700	REFP_NC_START_LOCK			
–	NC–Start disable without reference point		RESET	
_always	1	0	1	BOOLEAN	2/7

21000	CIRCLE_ERROR_CONST			
mm	Circle end point monitoring constant		POWER ON	
_always	0.01	0.0	plus	DOUBLE	2/7

22000	AUXFU_ASSIGN_GROUP			
–	Auxiliary function group (aux. fct. no. in channel): 0...49		POWER ON	
_always	1	1	15	BYTE	2/7

22010	AUXFU_ASSIGN_TYPE			
–	Auxiliary function type (aux. fct. no. in channel): 0...49		POWER ON	
_always	, ,	–	–	STRING	2/7

22030	AUXFU_ASSIGN_VALUE			
–	Auxiliary function value (aux. fct. no. in channel): 0...49		POWER ON	
_always	0	–	–	DWORD	2/7

22550	TOOL_CHANGE_MODE			
–	New tool compensation for M function		POWER ON	
_always	0	0	1	BYTE	2/7

27800	TECHNOLOGY_MODE			
–	Technology in the channel (value=0: milling, value=1: turning)		NEW CONF	
	1	0	1	BYTE	2/7

6.1.4 Axis–specific machine data

Number	MD Name				
Unit	Name, Miscellaneous		Activated		
HW / function	Standard value	Minimum value	Maximum value	D type	User class

30130	CTRLOUT_TYPE				
–	Output type of setpoint (setpoint branch): 0		POWER ON		
_always	0	0	2	BYTE	2/7

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

30200	NUM_ENCS				
–	Anzahl der Geber (1 oder kein Geber für die Spindel)		RESTART		
	1	0	1	BYTE	2/7

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	2/7

30350	SIMU_AX_VDI_OUTPUT				
–	Output of axis signals with simulation axes		POWER ON		
_always	0	***	***	BOOLEAN	2/7

30600	FIX_POINT_POS				
mm, degrees	Fixed–value positions of axis with G75 (position no.)		POWER ON		
_always	0.0	–	–	DOUBLE	2/7

31000	ENC_IS_LINEAR				
–	Direct measuring system (linear scale) (encoder no.)		POWER ON		
_always	0	***	***	BOOLEAN	2/7

31010	ENC_GRID_POINT_DIST				
mm	Division period for linear scales (encoder no.)		POWER ON		
_always	0.01	0.0	plus	DOUBLE	2/7

31020	ENC_RESOL				
–	Encoder markings per revolution (encoder no.)		POWER ON		
_always	2048	0.0	plus	DWORD	2/7

31030	**LEADSCREW_PITCH**				
mm	Pitch of leadscrew		POWER ON		
_always	10.0	0.0	plus	DOUBLE	2/7

31040	**ENC_IS_DIRECT**				
–	Encoder mounted directly to the machine (encoder no:)		POWER ON		
_always	0	***	***	BOOLEAN	2/7

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	2/7

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	2/7

31070	**DRIVE_ENC_RATIO_DENOM**				
–	Denominator resolver gearbox (encoder no.)		POWER ON		
_always	1	1	2147000000	DWORD	2/7

31080	**DRIVE_ENC_RATIO_NUMERA**				
–	Numerator resolver gearbox (encoder no.)		POWER ON		
_always	1	1	2147000000	DWORD	2/7

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

32000	**MAX_AX_VELO**				
mm/min, rev/min	Maximum axis velocity		NEW CONF		
_always	10000.	0.0	plus	DOUBLE	2/7

32010	**JOG_VELO_RAPID**				
mm/min, rev/min	Rapid treverse in jog mode		RESET		
_always	10000.	0.0	plus	DOUBLE	2/7

32020	**JOG_VELO**				
mm/min, rev/min	Jog axis velocity		RESET		
_always	2000.	0.0	plus	DOUBLE	2/7

32070	**CORR_VELO**				
%	Axis velocity for handwheel override, ext. ZO, cont. dressing, distance control		RESET		
_always	50	0.0	plus	DWORD	2/7

32100	**AX_MOTION_DIR**				
–	Traversing direction (not control direction)			POWER ON	
_always	1	–1	1	DWORD	2/7

32110	**ENC_FEEDBACK_POL**				
–	Sign actual value (control direction) (encoder no.)			POWER ON	
_always	1	–1	1	DWORD	2/7

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	2/7

32250	**RATED_OUTVAL**				
%	Ratedoutput voltage (setprint brauch):0			NEW CONF	
_always	80	0.0	10	DOUBLE	2/7

32260	**RATED_VELO**				
rev/min	Rated motor speed (setpoint branch): 0			NEW CONF	
_always	3000	0.0	plus	DOUBLE	2/7

32300	**MAX_AX_ACCEL**				
mm/s^2, rev/s^2	Axis acceleration			NEW CONF	
_always	1	0	***	DOUBLE	2/7

32420	**JOG_AND_POS_JERK_ENABLE**				
-	Enable axial jerk limitation			NEW CONF	
_always	0	***	***	BOOLEAN	2/2

32430	**JOG_AND_POS_,AX_JERK**				
-	Axial jerk			NEW CONF	
_always	1000 (mm/s^3) 2777,77 (degrees/s^3)	10^{-9}	***	DOUBLE	2/2

32450	**BACKLASH**				
mm	Backlash			NEW CONF	
_always	0.000	*	*	DOUBLE	2/7

32700	**ENC_COMP_ENABLE**				
–	Interpolatory compensation (encoder no.): 0,1			POWER ON	
_always	0	***	***	BOOLEAN	2/7

32900	**DYN_MATCH_ENABLE**				
–	Dynamic response adaptation			NEW_CONF	
	0	0	1	BYTE	2/7

32910	**DYN_MATCH_TIME**				
–	Time constant of dynamic adaption (control parameter set no): 0...5			NEW_CONF	
	0	0.0	plus	DOUBLE	2/7

32920	**AC_FILTER_TIME**				
s	Smoothing factor time constant for adaptive control			POWER ON	
_always	0.0	0.0	plus	DOUBLE	2/7

33050	**LUBRICATION_DIST**				
mm, deg.	Traversing distance for lubrication from PLC			NEW CONF	
_always	100000000	0.0	plus	DOUBLE	2/7

34000	**REFP_CAM_IS_ACTIVE**				
–	Axis with reference point cam			RESET	
_always	1	***	***	BOOLEAN	2/7

34010	**REFP_CAM_DIR_IS_MINUS**				
–	Approach reference point in minus direction			RESET	
_always	0	***	***	BOOLEAN	2/7

34020	**REFP_VELO_SEARCH_CAM**				
mm/min, rev/min	Reference point approach velocity			RESET	
_always	5000.0	0.0	plus	DOUBLE	2/7

34030	**REFP_MAX_CAM_DIST**				
mm, deg.	Maximum distance to reference cam			RESET	
_always	10000.0	0.0	plus	DOUBLE	2/7

34040	**REFP_VELO_SEARCH_MARKER**				
mm/min, rev/min	Creep speed (encoder no.)			RESET	
_always	300.0	0.0	plus	DOUBLE	2/7

34050	**REFP_SEARCH_MARKER_REVERSE**				
–	Direction reversal to reference cams (encoder no.)			RESET	
_always	0	***	***	BOOLEA	2/7

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	2/7

34070	REFP_VELO_POS				
mm/min, rev/min	Reference point positioning velocity		RESET		
_always	1000.0	0.0	plus	DOUBLE	2/7

34080	REFP_MOVE_DIST				
mm, deg.	Reference point distance/target point for distance–coded system		RESET		
_always	–2.0	–	–	DOUBLE	2/7

34090	REFP_MOVE_DIST_CORR				
mm, deg.	Reference point offset/absolute offset distance–coded		POWER ON		
_always	0.0	–	–	DOUBLE	2/7

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	2/7

34100	REFP_SET_POS				
mm, deg.	Reference point value/irrelevant for distance–coded system: 0 ... 3		RESET		
_always	0., 0., 0., 0.	–	–	DOUBLE	2/7

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	2/7

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	2/7

35010	GEAR_STEP_CHANGE_ENABLE				
–	Gear change possible. Spindle has several gear steps		POWER ON		
_always	0	***	***	BOOLEAN	2/7

35040	SPIND_ACTIVE_AFTER_RESET				
–	Own spindle reset		POWER ON		
_always	0	***	***	BOOLEAN	2/7

35100	SPIND_VELO_LIMIT				
rev/min	Maximum spindle speed		POWER ON		
_always	10000	0.0	plus	DOUBLE	2/7

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	2/7

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	2/7

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	2/7

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	2/7

35150	**SPIND_DES_VELO_TOL**				
Factor	Spindle speed tolerance		RESET		
_always	0.1	0.0	1.0	DOUBLE	2/7

35160	**SPIND_EXTERN_VELO_LIMIT**				
rev/min	Spindle speed limitation from PLC		NEW CONF		
_always	1000	0.0	plus	DOUBLE	2/7

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	2/7

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	2/7

35220	**ACCEL_REDUCTION_SPEED_POINT**				
Factor	Speed for reduced acceleration		RESET		
_always	1.0	0.0	1.0	DOUBLE	2/7

35230	**ACCEL_REDUCTION_FACTOR**				
Factor	Reduced acceleration		RESET		
_always	0.0	0.0	0.95	DOUBLE	2/7

35240	**ACCEL_TYPE_DRIVE**				
–	Type of acceleration		RESET		
	0	0	1	BOOLEAN	2/7

35300	SPIND_POSCTRL_VELO				
rev/min	Position control switch–on speed			NEW CONF	
_always	500	0.0	plus	DOUBLE	2/7

35350	SPIND_POSITIONING_DIR				
–	Direction of rotation when positioning			RESET	
_always	3	3	4	BYTE	2/7

35400	SPIND_OSCILL_DES_VELO				
rev/min	Reciprocation speed			NEW CONF	
_always	500	0.0	plus	DOUBLE	2/7

35410	SPIND_OSCILL_ACCEL				
rev/s^2	Acceleration during reciprocating			NEW CONF	
_always	16	2	***	DOUBLE	2/7

35430	SPIND_OSCILL_START_DIR				
-	Starting direction during reciprocation 0-2: As last direction of rotation (zero-speed M3) 3: M3 direction 4: M4 direction			RESET	
_always	0	0	4	BYTE	2/7

35440	SPIND_OSCILL_TIME_CW				
s	Reciprocation time for M3 direction			NEW CONF	
_always	1.0	0.0	plus	DOUBLE	2/7

35450	SPIND_OSCILL_TIME_CCW				
s	Reciprocation time for M4 direction			NEW CONF	
_always	0.5	0.0	plus	DOUBLE	2/7

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

35510	SPIND_STOPPED_AT_IPO_START				
–	Feedrate enable for spindle stopped			RESET	
_always	0	***	***	BOOLEAN	2/7

36000	STOP_LIMIT_COARSE				
mm, deg.	Exact positioning coarse			NEW CONF	
_always	0.04	0.0	plus	DOUBLE	2/7

36010	STOP_LIMIT_FINE				
mm, deg.	Exact positioning fine			NEW CONF	
_always	0.01	0.0	plus	DOUBLE	2/7

36020	**POSITIONING_TIME**				
s	Delay exact positioning fine		NEW CONF		
_always	1.0	0.0	plus	DOUBLE	2/7

36030	**STANDSTILL_POS_TOL**				
mm, deg.	Zero–speed tolerance		NEW CONF		
_always	0.2	0.0	plus	DOUBLE	2/7

36040	**STANDSTILL_DELAY_TIME**				
s	Delay zero–speed monitoring		NEW CONF		
_always	0.4	0.0	plus	DOUBLE	2/7

36050	**CLAMP_POS_TOL**				
mm, deg.	Clamping tolerance		NEW CONF		
_always	0.5	0.0	plus	DOUBLE	2/7

36060	**STANDSTILL_VELO_TOL**				
mm/min, rev/min	Maximum velocity/speed ”axis/spindle stopped”		NEW CONF		
_always	5 (0.014)	0.0	plus	DOUBLE	2/7

36100	**POS_LIMIT_MINUS**				
mm, deg.	1st software limit switch minus		RESET		
_always	–100000000	–	–	DOUBLE	2/7

36110	**POS_LIMIT_PLUS**				
mm, deg.	1st software limit switch plus		RESET		
_always	100000000	–	–	DOUBLE	2/7

36120	**POS_LIMIT_MINUS2**				
mm, deg.	2nd software limit switch minus		RESET		
_always	–100000000	–	–	DOUBLE	2/7

36130	**POS_LIMIT_PLUS2**				
mm, deg.	2nd software limit switch plus		RESET		
_always	100000000	–	–	DOUBLE	2/7

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	2/7

36300	ENC_FREQ_LIMIT				
Hz	Encoder limit frequency		POWER ON		
_always	300000	0	plus	DOUBLE	2/7

36302	ENC_FREQ_LIMIT_LOW				
%	Encoder limit frequency at which encoder is switched on again. (Hysteresis)		NEW CONF		
_always	99.9	0	100	DOUBLE	2/7

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	2/7

36400	CONTOUR_TOL				
mm, deg.	Contour monitoring tolerance band		NEW CONF		
_always	1.0	***	***	DOUBLE	2/2

36500	ENC_CHANGE_TOL				
mm, deg	Portion of distance for backlash working		NEW CONF		
_always	0,1	0.0	plus	DOUBLE	2/7

36610	AX_EMERGENCY_STOP_TIME				
s	Duration of the deceleration ramp for error states		NEW CONF		
_always	0.05	0.0	plus	DOUBLE	2/7

36620	SERVO_DISABLE_DELAY_TIME				
s	Cutout delay servo enable		NEW CONF		
_always	0.1	0.0	plus	DOUBLE	2/7

36700	DRIFT_ENABLE				
–	Automatic drift compensation		NEW CONF		
_always	0	***	***	BOOLEAN	2/7

36710	DRIFT_LIMIT				
%	Drift limit value for automatic drift compensation		NEW CONF		
_always	1.000	0.0	plus	DOUBLE	2/7

36720	DRIFT_VALUE				
%	Drift basic value		NEW CONF		
_always	0.0			DOUBLE	2/7

38000	MM_ENC_COMP_MAX_POINTS				
–	Number of intermediate points for interpolatory compensation (SRAM)		POWER ON		
_always	0, 0	0	5000	DWORD	2/7

6.1.5 Setting data

Number	MD Name				
Unit	Name, Miscellaneous		Activated		
HW / function	Standard value	Minimum value	Maximum value	D type	User class

41110	JOG_SET_VELO				
mm/min	Axis speed for JOG		Immediately		
_always	0.0	0.0	plus	DOUBLE	4/4

41200	JOG_SPIND_SET_VELO				
rev/min	Speed for spindle JOG mode		Immediately		
_always	0.0	0.0	plus	DOUBLE	4/4

43210	SPIND_MIN_VELO_G25				
rev/min	Progr. spindle speed limitation G25		Immediately		
_always	0.0	0.0	plus	DOUBLE	4/4

43220	SPIND_MAX_VELO_G26				
rev/min	Progr. spindle speed limitation G26		Immediately		
_always	1000	0.0	plus	DOUBLE	4/4

43230	SPIND_MAX_VELO_LIMS				
rev/min	Spindle speed limitation with G96		Immediately		
_always	100	0.0	plus	DOUBLE	4/4

52011	STOP_CUTCOM_STORE				
	Alarm response for TRC and feedforward stop		Immediately		
–	1	0	1	BOOLEAN	4/4

6.2 PLC user interface signals

The following tables of the user interface signals between PLC and CNC (and vice versa) are handled by the integrated fixed user program.

These signals can be displayed using PLC Status in the Diagnosis/Start-Up/PLC Status menu.

6.2.1 Address ranges

Operand Identifier	Description	Range
V	Data	V0.0 to V79999999.7 (see below)
T	Timers	T0 to T15
C	Counters	C0 to C31
I	Image of digital inputs	I0.0 to I7.7
Q	Image of digital outputs	Q0.0 to Q7.7
M	Flags	M0.0 to M127.7
SM	Special flags	SM0.0 to SM 0.6 (see below)
AC	ACCU	AC0 ... AC3

Generating the V address range

Type Identifier (DB No.)	Range No. (Channel / Axis No.)	Subrange	Offset	Addressing
10 (10–79)	00 (00–99)	0 (0–9)	000 (000–999)	symbolic (8–digit)

Definition of special flag bits (SM) (read-only)

SM Bits	Description
SM 0.0	Flags with a defined ONE signal
SM 0.1	Initial position: first PLC cycle ‘1’, following cycles ‘0’
SM 0.2	Buffered data lost – only valid in the first PLC cycle (‘0’ – data o.k., ‘1’ – data lost)
SM 0.3	Power On: first PLC cycle ‘1’, following cycles ‘0’
SM 0.4	60 s clock (alternating ‘0’ for 30 s, then ‘1’ for 30 s)
SM 0.5	1 s clock (alternating ‘0’ for 0.5 s, then ‘1’ for 0,5 s)
SM 0.6	PLC cycle clock (alternating one cycle ‘0’, then one cycle ‘1’)

Notice

All empty user interface fields in the following tables are Reserved for SIEMENS and may neither be written, nor evaluated by the user!

All fields with a “0” contain the value “logic =”.

Variable access rights

[r] is used to mark a read-only range
[r/w] is used to mark a read/write range

6.2.2 Retentive data area

1400 Data block	Retentive Data [r/w] Interface CNC -----> PLC							
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
14000000	User Data							
14000001	User Data							
14000002	User Data							
	...							
	...							
	...							
14000062	User Data							
14000063	User Data							

6.2.3 CNC signals

2600 Data block	General signals to CNC [r/w] Interface PLC -----> CNC							
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
26000000	Protection level 4	5	6	7		Acknowl. EMER-GENCY STOP	EMER-GENCY STOP	
26000001						Request distances to go by the axes	Request actual distances to go by the axes	
26000002								
26000003								

2700 Data block	General signals from CNC [r] Interface CNC -----> PLC							
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
27000000							EMER-GENCY STOP active	
27000001								
27000002		Drive ready						
27000003		Ambient Tempera-ture alarm						CNC alarm present

3000 Data block		**Mode signals to CNC [r/w] Interface PLC -----> CNC**						
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
30000000	Reset			Mode Change lock		Mode JOG	MDA	AUTOM.
30000001						Machine function REF		TEACH IN
30000002								
30000003								

3100 Data block		**Mode signals from CNC [r] Interface CNC -----> PLC**						
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
31000000					READY	Active mode JOG	MDA	AUTOM.
31000001						Active machine function REF		TEACH

6.2.4 Channel signals

Control signals to CNC channel

3200 Data block			Signals to CNC channel [r/w] Interface PLC -----> CNC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
32000000		Activate dry run feed	Activate M01	Activate Single Block[4)]				
32000001	Activate Program Test							Activate Referenc-ing
32000002								Activate Skip Block
32000003								
32000004	Feed override [2)]							
	H	G	F	E	D	C	B	A
32000005	Rapid traverse override [3)]							
	H	G	F	E	D	C	B	A
32000006	Feed [1)] override enabled	Rapid traverse override enabled		Program level abortion		Delete distance to go	Read-in disabled	Feed lock
32000007				CNC stop axes plus spindle	CNC stop	CNC stop to block limit	CNC start	CNC start inhibited

Notes:

[1)]+ Feed override enabled Even if the feed verrideisnot enabled (=100%), the 0% position is active.

[2)]+ Feed override 31 positions (Gray code) with 31 MD for % weighting

[3)]+ Rapid traverse override 31 positions (Gray code) with 31 MD for % weighting

[4)]+ Single Block Use the softkey to select Single Block Type Preselection (SBL1/SBL2) see “User Manual”

Control signals to axes in the WCS

3200 Data block			Signals to CNC Channel [r/w] Interface PLC -----> CNC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
32001000	Axis 1 in WCS Traversing keys +	 -	Rapid traverse override	Travers-ing key lock	Feed stop	Activate handwheel	2	1
32001001	Axis 1 in WCS Continu-ous				Machine function 1000 INC	100 INC	10 INC	1 INC
32001002								
32001003								
32001004	Axis 2 in WCS Traversing keys +	 -	Rapid traverse override	Travers-ing key lock	Feed Stop	Activate handwheel	2	1
32001005	Axis 2 in WCS Continu-ous				Machine function 1000 INC	100 INC	10 INC	1 INC
32001006								
32001007								
32001008	Axis 3 in WCS Traversing keys +	 -	Rapid traverse override	Traversi-ng key lock	Feed stop	Activate handwheel	2	1
32001009	Axis 3 in WCS Continu-ous				Machine function 1000 INC	100 INC	10 INC	1 INC
32001010								
32001011								

Status signals from CNC channel

3300 Data block	Signals from CNC channel [r] Interface CNC -----> PLC							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
33000000			M0 / M1 active					
33000001	Program test active		M2 / M30 active	Block search active		Revolutional feed active		Referencing active
33000002								
33000003	Channel state: Reset	Channel state: Interrupted	active	Program state: aborted	Interrupted	Program state: stopped	waiting	running
33000004	CNC alarm with stop of machining present	CNC alarm channel-specific present			All axes stopped	All axes Referenced		
33000005								
33000006								
33000007								

Status signals: Axes in WCS

3300 Data block			Signals from CNC channel [r] Interface CNC -----> PLC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
33001000	Axis 1 in WCS Traversing command plus	minus					Handwheel active 2	1
33001001	Axis 1 in WCS	Continu-ous			Machine function 1000 INC	100 INC	10 INC	1 INC
33001002								
33001003								
33001004	Axis 2 in WCS Traversing command plus	minus					Handwheel active 2	1
33001005	Axis 2 in WCS Active machine function	Continu-ous			1000 INC	100 INC	10 INC	1 INC
33001006								
33001007								
33001008	Axis 3 in WCS Traversing command plus	minus					Handwheel active 2	1
33001009	Axis 3 in WCS Active machine function	Continu-ous			1000 INC	100 INC	10 INC	1 INC
33001010								
33001011								

Transfer of auxiliary functions from the CNC channel

2500 Data block	Auxiliary functions from CNC channel [r] Interface PLC							
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
25000000								Modify decoded M functions 0-99
25000001				Modify T funct. 1				
25000002								
25000003								

Decoded M signals (M0 - M99)

2500 Data block	**M functions from CNC channel [r] Interface CNC**							
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
25001000	Dynamic M functions M7	M6	M5	M4	M3	M2	M1	M0
25001001	Dynamic M functions M15	M14	M13	M12	M11	M10	M9	M8
25001002	Dynamic M functions M23	M22	M21	M20	M19	M18	M17	M16
	...							
	...							
	...							
25001012	Dynamic M functions				M99	M98	M97	M96
25001013								
25001014								
25001015								

Notes: + Static M functions must be generated by the PLC user from the dynamic M functions.

+ Dynamic M functions are decoded by the basic program (M00 to M99).

Transferred T functions

2500 Data block	T functions from CNC channel [r] Interface PLC							
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
25002000	T function 1 (DINT)							
25002004								
25002008								
25002012								

6.2.5 Axis/spindle signals

Signals to axis/spindle

Common signals to axis/spindle

3800...3803 Data block			Signals to axis/spindle [r/w] Interface PLC -----> CNC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
380x0000	Feed override H	G	F	E	D	C	B	A
380x0001	Override enabled		Position encoder 1	Follow-up mode	Axes/ spindle lock			
380x0002					Clamping process running	Delete distance to go/ spindle reset	Servo enable	
380x0003		Speed/ spindle speed limitation						
380x0004	Traversing keys plus	minus	Rapid traverse override	Travers-ing key lock	Feed stop Spindle stop		Activate handwheel 2	1
380x0005	Machine function	Continu-ous			1000 INC	100 INC	10 INC	1 INC
380x0006								
380x0007								

Signals to axis

3800...3802 Data block			Signals to axis [r/w] Interface PLC -----> CNC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
380x1000 (axis)	Delay Ref.-point approach				2nd software limit switch plus	minus	Hardware limit switch plus	minus
380x1001 (axis)								
380x1002 (axis)								
380x1003 (axis)								

Signals to spindle

3803 Data block			Signals to spindle [r/w] Interface PLC -----> CNC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
38032000 (spindle)					Gear is changed	Actual gear stage C	B	A
38032001 (spindle)		Invert M3/M4						Spindle feed override valid
38032002 (spindle)	Set direction of rotation CCW	CW	Recipro-cating speed	Recipro-cating by PLC				
38032003 (spindle)	Spindle override H	G	F	E	D	C	B	A

General signals from axis/spindle

3900...3903 Data block			Signals from axis/spindle [r] Interface CNC -----> PLC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
390x0000	Position reached with exact pos. fine	with exact pos., coarse		Referen-ced/ Synchro-nized 1		Encoder limit frequency exceeded 1		Spindle/ no axis
390x0001	Current controller active	Speed controller active	Position controller active	Axis/spindle stopped ($n < n_{min}$)	Follow-up active			
390x0002								
390x0003								
390x0004	Motion command plus	minus					Handwheel active 2	1
390x0005	Active machine function	Continu-ous			1000 INC	100 INC	10 INC	1 INC
390x0006								
390x0007								

Signals from axis

3900...3903 Data block			Signals from axis [r] Interface CNC -----> PLC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
390x1000 (axis)								
390x1001 (axis)								
390x1002 (axis)								Lubrica-tion pulse
390x1003 (axis)								

Signals from spindle

3903 Data block			Signals from spindle [r] Interface CNC -----> PLC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
39032000 (spindle)					Change gear	Set gear stage C	B	A
39032001 (spindle)	Actual direc-tion of rotation CW		Spindle within set range			Set speed increased	Set speed limited	Speed limit exceeded
39032002 (spindle)	Active spindle mode Control mode	Recipro-cating mode	Position-ing mode		Tapping without compen-sating chuck			
39032003 (spindle)								

6.2.6 Signals from/to MMC

Program control signals from MMC (retentive area) (see also signals to channel V32000000)

1700 Data block			MMC signals [r] Interface MMC -----> PLC					
DBB	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
17000000 (MMC ---> PLC)		Dry run feed selected	M01 selected					
17000001 (MMC --> PLC)	Program test selected				Feed override for rapid traverse selected			
17000002 (MMC --> PLC)								Select Skip Block
17000003 (MMC ---> PLC)								

Dynamic mode signals from MMC

1800 Data block			Signals from MMC [r] Interface MMC -----> PLC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
18000000								
18000001					Machine function			TEACH IN
18000002								
18000003								

General selection/status signals from MMC (retentive area)

1900 Data block	**MMC Signals [r] Interface MMC -----> PLC**							
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
19001000 (MMC ---> PLC)								
19001001 (MMC ---> PLC)								
19001002 (MMC ---> PLC)								
19001003 (MMC ---> PLC)	Machine axis			Axis number for handwheel 1			B	A
19001004 (MMC ---> PLC)	Machine axis			Axis number for handwheel 2			B	A
19001005 (MMC ---> PLC)								
19001006 (MMC ---> PLC)								

Control signals to operator panel (retentive range)

1900 Data block	**Signals to operator panel [r/w] Interface PLC -----> MMC**							
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
19005000						OP key lock		
19005001								
19005002								
19005003								

6.2.7 Machine control panel signals (MCP signals)

Status signals from MCP

1000			Signals from MCP [r] Interface MCP ----->PLC					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
10000000	K14 JOG	K13 INC	K6 User-defined	K5 User-defined	K4 User-defined	K3 User-defined	K2 User-defined	K1 User-defined
10000001	K22 Axis key	K21 Spindle start -	K20 Spindle stop	K19 Spindle start +	K18 MDA	K17 SBL	K16 AUTO	K15 REF
10000002	K30 Axis key	K29 Axis key	K28 Axis key	K27 Axis key	K26 Axis key	K25 Axis key	K24 Axis key	K23 Axis key
10000003	K10 User-defined	K9 User-defined	K8 User-defined	K7 User-defined		K39 NC START	K38 NC STOP	K37 NC RESET
10000004				Feed override K35 Feed override -		K33 Feed override 100%		K31 Feed override +
10000005				Spindle override K36 Spindle override -		K34 Spindle override 100%		K32 Spindle override +

Control signals to MCP

1100			Signals to MCP [r/w] Interface PLC -----> MCP					
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
11000000	LED8 User-defined	LED7 User-defined	LED6 User-defined	LED5 User-defined	LED4 User-defined	LED3 User-defined	LED2 User-defined	LED1 User-defined
11000001	LED16 Spindle override	LED15 Feed override	LED14 Spindle override	LED13 Feed override	LED12 User-defined	LED11 User-defined	LED10 User-defined	LED9 User-defined

6.2.8 PLC machine data

INT values (MD 14510 USER_DATA_INT)

4500 Data block	Signals from CNC [r] Interface CNC -----> PLC
Byte	
45000000	Int value (WORD/ 2 bytes)
45000002	Int value (WORD/ 2 bytes)
45000004	Int value (WORD/ 2 bytes)
45000006	Int value (WORD/ 2 bytes)
45000060	Int value (WORD/ 2 bytes)
45000062	Int value (WORD/ 2 bytes)

HEX values (MD 14512 USER_DATA_HEX)

4500 Data block	Signals from CNC [r] Interface CNC -----> PLC
Byte	
45001000	Hex value (BYTE)
45001001	Hex value (BYTE)
45001002	Hex value (BYTE)
45001003	Hex value (BYTE)
45001030	Hex value (BYTE)
45001031	Hex value (BYTE)

FLOAT values (MD 14514 USER_DATA_FLOAT)

4500 Data block	Signals from NCK [r] Interface CNC -----> PLC							
Byte								
45002000	Float value (REAL/ 4 bytes)							
45002004	Float value (REAL/ 4 bytes)							
45002008	Float value (REAL/ 4 bytes)							
45002012	Float value (REAL/ 4 bytes)							
45002016	Float value (REAL/ 4 bytes)							
45002020	Float value (REAL/ 4 bytes)							
45002024	Float value (REAL/ 4 bytes)							
45002028	Float value (REAL/ 4 bytes)							

HEX-BYTE values (MD 14516 USER_DATA__PLC_ALARM)

4500 Data block	Signals from NCK [r] Interface NCK -----> PLC							
Byte								
45003000	Alarm reaction / clear criterion of alarm 700000							
45003001	Alarm reaction / clear criterion of alarm 700001							
45003002	Alarm reaction / clear criterion of alarm 700002							
45003031	Alarm reaction / clear criterion of alarm 700031							

6.2.9 User alarm

Alarm activation

1600 Data block	Alarm activation [r/w] Interface PLC -----> MMC							
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
16000000	Activation of alarm no. 700007	700006	700005	700004	700003	700002	700001	700000
16000001	Activation of alarm no. 700015	700014	700013	700012	700011	700010	700009	700008
16000002	Activation of alarm no. 700023	700022	700021	700020	700019	700018	700017	700016
16000003	Activation of alarm no. 700031	700030	700029	700028	700027	700026	700025	700024

Variable for alarm

1600 Data block	Variable for alarm [r/w] Interface PLC -----> MMC
Byte	
16001000	Variable for alarm 700000
16001004	Variable for alarm 700001
16001008	Variable for alarm 700002
	...
16001116	Variable for alarm 700029
16001120	Variable for alarm 700030
16001124	Variable for alarm 700031

Active alarm response

1600 Data block		Active alarm response [r] Interface PLC -----> MMC						
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
16002000				PLC-STOP	NOT-AUS	Feed lock of all axes	Read-in disable	NC start inhibited
16002001								
16002002								
16002003								

Axis actual value and distances to go

5700 ... 5704 Data block		Signals from axis/spindle [r] Interface PLC -----> MMC						
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
570x0000	Axis actual value (REAL)							
570x0004	Axis distance to go (REAL)							

6.3 Unipolar spindle

A spindle that requires not a positive voltage of +/-10 volts, but a positive voltage and separate binary sign signals for controlling is called unipolar spindle. The voltage is output via the analog spindle setpoint output, and the sign signals via binary outputs.

The 802SC base line is able to run a unipolar spindle.

Configuring

The “Unipolar spindle” mode is set via the axis machine data MD 30134 IS_UNIPOLAR_OUTPUT of the spindle. There are 2 different modes for controlling the unipolar spindle.

- MD input value “0”:
  Bipolar setpoint output with positive/negative voltage
  The PLC output bits O0 and O1 may be used by the PLC.
- MD input value “1”:
  Unipolar setpoint output with positive voltage
  The PLC output bits O0 and O1 must not be used by the PLC.
  PLC output bit O0 = servo enable
  PLC output bit O1 = negative direction of travel
- MD input value “2”:
  Unipolar setpoint output with positive voltage
  The PLC output bits O0 and O1 must not be used by the PLC.
  PLC output bit O0 = servo enable positive direction of travel
  PLC output bit O1 = servo enable negative direction of travel

Special features

1. The spindle must be the 4th axis.
2. The binary outputs used for the unipolar spindle must not be used by the PLC. This must be guaranteed by the user, as they are not any monitoring functions in the control system. Not observing this fact will result in undesired reactions of the control system.

SIEMENS AG
A&D MC BMS
Postfach 3180

D–91050 Erlangen

(Tel. +49 180 / 5050 – 222 [Hotline]
Fax +49 9131 / 98 – 2176 [Documentation]
Mailto: motioncontrol.docu@erlf.siemens.de)

Suggestions

Corrections

for Publication/Manual:

SINUMERIK 802C base line

Manufacturer Documentation

From

Name

Company/dept.

Street

Zip code: City:

Telephone: /

Telefax: /

Start-Up

Order No.: 6FC5597–4AA21–0BP0
Edition: 08.03

Should you come across any printing errors when reading this publication, please notify us on this sheet.
Suggestions for improvement are also welcome.

Suggestions and/or corrections

SINUMERIK 802S/C base line Document Structure