Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

**Danger**

indicates that death or severe personal injury will result if proper precautions are not taken.

**Warning**

indicates that death or severe personal injury may result if proper precautions are not taken.

**Caution**

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

**Caution**

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

**Notice**

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

**Qualified Personnel**

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by qualified personnel. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

**Prescribed Usage**

Note the following:

**Warning**

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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**Disclaimer of Liability**

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.
Preface

Scope of validity

This document provides you with an overview of the functional range of ShopTurn version 7.1, in use with the SINUMERIK 840D sl.

The document is oriented towards vendors and dealers of machine tools.

Organization of information

• Of the varied functional possibilities of this SINUMERIK product, we only designate those qualities which are of direct value to the machine’s user.

• All functions contained in the machine’s basic configuration will be identified as follows:
  ☑ Basic configuration

• All functions not contained in the machine’s basic configuration will be identified as follows:
  ☑ Option: ...

• A summary of the unique selling points of ShopTurn in comparison with competitors may be found in chapter “Summary of unique selling points”.

• For information on marketing options through the machine manufacturer, please see the technical description of each machine.

Subject to change without prior notice
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1.1 Application

ShopTurn is a customized technology package for all standard single-slide CNC turning machines used worldwide.

ShopTurn enables the simple operation of machine tools, supporting all operator actions with graphic help displays.

The functions in the manual mode enable a quick, practical machine set-up. More specifically, this consists of calculating the workpiece position in the machine, as well as the maintenance and measuring of the tools in use.

ShopTurn offers two options for programming:

The DIN/ISO editor is used to create DIN/ISO programs on the machine and correct externally created DIN/ISO programs.

The work plan editor is used for graphic programming on the machine. Here are the typical applications for finishing individual parts and small series. For example, DIN/ISO sections may be flexibly inserted for complex part machining steps.

ShopTurn offers a uniform control configuration which covers all required areas of application without additional start-up and training costs:

• Easy-to-use interface for all machine functions
• DIN/ISO programming on the machine or offline via CAD/CAM system
• Graphical programming
• Complete machining
• Measuring functions for workpieces and tools

1.2 Machine spectrum

ShopTurn is especially well-suited for the following types of machine:

1. Single-slide turning machines with X and Z axes
   – Turning
   – Centric drilling on the end face
2. Like 1.) with rotating tools (C axis mode)
   – Any drilling or milling on the end face and outer surface
3. Like 1.) or 2.) with additional Y axis
   – Any drilling or milling on the end face and outer surface
4. Like 1.) or 2.) or 3.) with additional counterspindle for front and rear machining
System overview

2.1 SINUMERIK 840D sl

The new SINUMERIK 840D sl offers modularity, openness, flexibility and a uniform structure for operation, programming and visualization. Integrated into the new, especially compact and reliable SINAMICS S120 drive system, it constitutes a completely digital system. It is best-suited for medium and high performance ranges.

- Digital drive controller
- Modular design for drive controller and power unit
- Up to 31 axes/spindles in up to 10 processing channels
- Intelligent control functions meeting the highest standards of machining technology

You can find further information in catalog NC 61

Highlights

- Flexible application and guaranteed future through modular design and comprehensive CNC functions
- Best dynamics, precision and surface quality through use of high performance processors
- Integrated, certified safety functions for man and machine are possible with Safety Integrated
2.2 Operator panel fronts

These operator panel fronts have an integrated CNC keyboard. We offer matched machine control panels for the version with mechanical keys (protection class IP54) and the version with membrane keys (protection class IP65). You have two choices:

OP 010C

Operator panel 483mm wide, 10.4” display, integrated CNC keyboard, with frontal USB port for memory stick, version with mechanical keys, separate machine control panel

Highlights

- All relevant functions at a glance, thanks to horizontal and vertical softkeys
- Brilliant color display, balanced and high-quality design of operator components
- Simple data handling with easily accessible USB memory stick
OP 010

Operator panel 483mm wide, 10.4” display, integrated CNC keyboard, with frontal USB port for memory stick, version with **membrane-type keys**, separate machine control panel

**Highlights**
- All relevant functions at a glance, thanks to horizontal and vertical softkeys
- Brilliant color display, balanced and high-quality design of operator components
- Simple data handling with easily accessible USB memory stick
System overview

2.2 Operator panel fronts

OP 010S

Operator panel 310mm wide, 10.4" display, mechanical keyboard, with frontal USB port for memory stick, separate CNC keyboard and machine control panel

Highlights

- Option of especially slim design
- All relevant functions at a glance, thanks to horizontal and vertical softkeys
- Brilliant color display, balanced and high-quality design of operator components
- Simple data handling with easily accessible USB memory stick
System overview
2.2 Operator panel fronts

OP 015
Operator panel 483mm wide, 15” display, membrane keys, with frontal USB port for memory stick, separate CNC keyboard and machine control panel

Highlight
• Option of especially large display for better readability and graphic display for high-class machines
• All relevant functions at a glance, thanks to horizontal and vertical softkeys
• Brilliant color display, balanced and high-quality design of operator components
• Simple data handling with easily accessible USB memory stick
2.3 Operator panel equipment

The ShopTurn software, the Ethernet connection and the slot for a CompactFlash Card are located directly on the SINUMERIK 840D sI module in the control cabinet. The slot for a USB memory stick is directly on the front side of the operator panel.

TCU

The Thin Client Unit (TCU) for the distributed configuration permits the spatial separation of the SINUMERIK operator panel front and the SINUMERIK NCU.

- Fewer parts for specifically flat design
- Competitive purchase price and inexpensive replacement parts

Highlight

- Rugged and cost-optimized solution, as there is no hard disk
- Signal transmission between PCU/NCU and operator panel front via Industrial Ethernet

PCU 50

For customers who require a hard disk and a Windows operating system, we offer the PCU 50.

- Windows XP operating system
- Additional CNC memory through hard disk
- Additional PCI slots on board

Highlights

- Flexible software expansion on Windows platform
- Flexible hardware expansion via PCI slots
3.1 Introduction

TCU  PCU 50  Option: Manual machine

We offer the manual machine function for beginners switching over from conventional machines, but also for experienced CNC machine operators who often only use individual machining steps.

The basic screen MANUAL is displayed immediately after booting the machine offering the direct machining options without having to create a part program.

3.2 Simple workpiece machining in manual mode

You can perform simple types of machining directly in "Manual" mode:
- Taper turning
- Straight, face or longitudinal turning

Simply select the tool, feedrate, spindle speed, direction of spindle rotation and, when necessary, the machining angle. Press start. Machining will begin immediately.

The active direction is graphically displayed in the basic screen by means of a wind rose.
3.3 Complex machining in manual mode

Each execution cycle can be started directly in manual mode, too:

- Drilling: Drill centered, thread centered, centering, drilling, reaming, deep hole drilling, threading, thread milling
- Turning: Stock removal, groove, undercut, threading, thread undercut, thread remachining
- Milling: Rectangular/circular slot, rectangular/circular spigots, longitudinal/circumferential slot, multiple edge, engraving

Simply traverse to the start point of the machining, select the desired function, enter the required value in the dialog screen and press start.

Highlights

- Save time with simple machining, as no part program is required
- Arrange your machining steps flexibly with MANUAL mode
4.1 Introduction

The graphical programming is done via a graphic, interactive work plan editor. Each program line represents a machining step (e.g.: Stock removal, groove, thread cutting) or geometric data required for the machining steps (turning / milling contours or position patterns). Machining steps belonging together are linked to each other. The interlinked machining steps are performed consecutively at the appropriate contours or position patterns.

Graphical programming offers, in comparison to DIN/ISO programming, a compact and easily comprehensible program overview.

Entering individual machining steps requires no knowledge of DIN/ISO. All required technical and geometric parameters are entered in screen forms.

Simple and intuitive programming with machining steps can always be flexibly expanded via entry of DIN/ISO blocks and control functions.

Highlights

- Intuitive program input, without knowledge of DIN/ISO or Operator Manual
- Thanks to the interlinking of machining steps, the position patterns and contours need only be entered or changed once, offering benefits in time and security.
- Compact, clearly arranged machining programs
4.2 Dynamic broken-line graphics

While programming, the previously entered machining steps will be continuously displayed to scale. A simulation is not required for this.

- Turning display
- End face and outer surface

Highlight

- More certainty during program input thanks to quick review of the resulting contour
4.3 Online help

☐ TCU  ☐ PCU 50  ☐ Basic configuration of machining step programming

All input parameters are clarified with dynamic help displays. In addition, explanatory cursor text is displayed. This enables creation of programs on the machine without a programmer handbook.

Toggles between the work plan and programming graphics as well as between the parameterization screen form with programming graphics and the parameterization screen form with the help display.

• Programming on the machine without a handbook
• Help key to toggle between help displays
4.4 Standard machining steps

A number of different machining operations are available in the work plan editor:

- **Turning operations**
  - Face turning
  - Stock removal, groove, threading
  - Undercut form E, F, thread undercuts
  - Longitudinal / face / taper threads, thread re-machining
  - Plunge-turning
  - Plunge-cutting

- **Drilling and milling operations**
  - Centric drilling and threading
  - Centering, drilling, boring, reaming, deep-hole drilling
  - Threading, thread milling
  - Circular and rectangular slots / spigots
  - Longitudinal / circular groove
  - Multiple edge

- **Engraving cycle**
  - Any text with special characters
  - Date, time, workpiece count, variable

- **Position pattern**
  - Position list, hide positions
  - Line / pitch circle / full circle / grid / frame

- **Basic elements**
  - Straight / circle / helix

- **Miscellaneous**
  - Marks / repetitions
  - Offset, rotation, scaling, mirroring

Drilling and milling operations may be linked any way with position patterns.

---

**Highlights**

- Time saving through program input completely by dialog; complete with tool, feedrate and spindle speed or cutting rate
- Expanded selection of ready-made machining operations, including the innovative plunge turning
4.5  Example Thread-cutting

☐ TCU  ☐ PCU 50  ☐ Basic configuration of machining step programming

A threading cycle is available in the work plan editor:

**The following threads can be generated:**
- Longitudinal thread
- Face thread
- Tapered thread
- Linked threads via DIN/ISO cycle

**The following parameters can be specified:**
- Outer / inner thread
- Roughing, finishing, roughing & finishing
- Linear / degressive infeed
- Thread pitch in mm/rev, inch/rev, gear/inch, module
- Variable pitch
- Infeed at one or changing edge
- Number of non-cuts
- Start angle offset
- Multiple threads (up to 6)

**Highlight**
- All popular thread forms possible

4.6  Example Repair thread

☐ TCU  ☐ PCU 50  ☐ Basic configuration of machining step programming

By positioning the threading tool in the recutting thread, the synchronization point (starting angle) of the thread can be determined.

Then the thread can be remachined following the thread-cutting cycle.

**Highlight**
- Support for thread repair as standard
4.7 Contour calculator (graphical programming)

☑ TCU ☑ PCU 50 ☑ Basic configuration of machining step programming

A contour calculator is available in the work plan editor.

The following contours may be generated with this geometry calculator:

• Blank and finished-part contours for turning
• Contours for milling on the end face and outer surface

The contour calculator provides the following possibilities:

• Up to 250 geometry elements programmable
• Automatic calculation of only partly defined elements
• Chamfer or radius programmable in contour transitions
• Chamfer or radius programmable as the contour start or end element
• Definition of undercuts (form E, F, thread undercut) directly in the contour
• Polar geometry for milling contours on the end face and outer surface
• Separate feedrate for individual contour elements; chamfer and radius programmable
• Separate grinding allowance for contour elements programmable
• Direct entry of fitting measurements (ex.: F60H7)
• Conversion of contours and position patterns in DXF format with CAD Reader for PC; continued processing with the contour calculator in the control

Highlights

• Easy input of workpiece geometry: “Drawing dot to dot”
• Determination of contours with many unknown intermediate values is possible
• Speedy and certain from drawing to finished workpiece
4.8 Contour stock removal cycle

☑ TCU  ☑ PCU 50  ☐ Basic configuration of machining step programming

With the intelligent contour stock removal cycle, free contours can be processed in a variety of ways:

- Processing any contour calculator geometry
- Cylindrical blank, freely-defined blank, blank as allowance of finished-part contour
- Longitudinal / face / contour-parallel roughing on outside and inside
- Processing sloping contours (relief cuts)
- Consideration of tool's setting and plate angle
- Grooving any contours on outside, inside or end face
- Plunge turn any contours on outside, inside or end face
- Finishing with negative allowances (for machining electrodes)
- Roughing with feed interruption to reduce flow chips
- Optional number of cutting passes with orientation to workpiece edges
- Finishing with alternating cutting depth for longer tool life
- Arbitrary limitation to the machining segment with automatic blank actualization

**Highlights**

- Effective processing through orientation to the actually existing material
- Lower risk of accident and better chip disposal through feed interruption
- Reduced machining time through selectable cut segmentation
- Save on tool costs through finishing with alternating cutting depth
4.9 Residual material detection, segmental processing

- TCU
- PCU 50
- Option: Residual material detection and machining

Identification of residual material

Contour regions which do not permit machining by tools with large plate angles are automatically recognized in the stock removal cycle. The operator can rework these regions using a suitable tool with a smaller plate angle.

Segmental processing

The contour stock removal cycle allows any segmentation of the desired machining region. This enables individual segments to be processed with the technically suitable tools and cutting values.

Application examples:
- Inside machining first with small tools, then with larger and more stable tools
- A degressive infeed avoids an overly high cutting pressure for small workpiece diameters

A variety of stock removal strategies may be used here, such as longitudinal turning, contour grooving, plunge turning or any combination of these. The current machining procedure automatically actualizes the blank contour for the following step, so that programming time is kept to a minimum.

Highlights

- Detection of residual material: Time saving through avoiding idle cuts during residual stock removal
- Segmentation: Limit the machining process to always apply the optimum tool and cutting values
4.10 Contour slots, contour spigots

☑ TCU ☐ PCU 50 ☐ Basic configuration of machining step programming

ShopTurn offers stock removal for processing contour slots and spigots on the end face and outer surface. Up to 12 islands can be considered for each slot. The slot and island contours can be entered with the contour calculator directly into the control.

The following operations are available:
- Emptying, edge / base finishing
- Direct or helical plunging
- Manual or automatic allocation of plunging point
- Optional predrilling at plunging point

Highlight

- Also program and machine complex contour slots within a short time

4.11 Detection of residual material when milling

☑ TCU ☐ PCU 50 ☐ Option: Residual material detection and machining

Contour regions which do not permit milling with large diameter tools are automatically recognized in the contour slots cycle. The operator can rework these regions using a smaller tool.

Highlight

- Shorter machining times through automatic detection of residual material
4.12 Path Milling Cycle

- TCU
- PCU 50
- Basic configuration of machining step programming

A path milling cycle is available for path machining of milling contours:
- Milling with or without radius compensation
- Traversing in quarter circle, half circle or straight
- Grooving on parallel walls of the outer surface

Highlight

- Soft approach and retraction on any milling contour
5.1 DIN/ISO language

The SINUMERIK 840D sl's CNC interpreter can also process complex CNC commands, in addition to DIN66025 standard commands. The commands are presented in clearly readable form.

The following commands are available:

- **G Functions**: G0, G1, G2, G71, etc.
- **Language commands (extended G functions)**: CIP, DIAMON, SOFT, BRISK, FFWON, etc.
- **Frame operations (programmable work offsets)**: The workpiece coordinate system can be shifted, scaled, mirrored or rotated with the commands TRANS, SCALE, MIRROR, ROT.
- **Arithmetic operations**: Arithmetic operations are available to combine the variables:
  - Arithmetic operations + - * / sin cos exp etc.
  - Logical operations == <> >= etc.
- **User data**: The user can define his/her own variables by name and type.
- **R parameters (calculation parameters)**: 100 predefined R parameters are available as arithmetic parameters (floating comma format).
- **System variables**: System variables can be read / written in all programs. They enable access to zero offsets, tool offsets, axis positions, measurement values, control conditions etc.
- **Program control structures**: BASIC-style language commands are available for flexible programming of the user cycles: IF-ELSE-ENDIF, FOR, CASE etc.

**Highlights**

- Unbeatable range of language commands for flexible and time-optimzed part programs
- Better program overview via user variables in plaintext format
5.2 DIN/ISO editor / G code editor

ShopTurn can accept direct input of DIN/ISO programs. To this end, a line-oriented DIN/ISO editor is available. The DIN/ISO editor enables one to directly enter or edit CNC language commands. Thereby, the complete range of CNC functions are available for the most complex machining.

The following possibilities arise:
- Creation of DIN/ISO programs at the control
- Edit externally rendered DIN/ISO programs (ex.: CAD/CAM programs)

The following functions are included in the DIN/ISO editor:
- Contour calculator
- Tool selection directly from tool list
- Support screens for standard machining and measuring cycles
- "Copy", "Insert" and "Cut" key group
- "Find", "Replace" and "Replace All" character string
- Renumber program
- Direct execution from any NC program block (block search)
- Jump to program start and program end

Highlight

- Save time by programming with efficient DIN/ISO editor
5.3 Machining cycles

Machining cycles for standard machining, turning, milling and drilling may be started from the DIN/ISO editor. Input screens with dynamic help displays are available for the convenient input of machining parameters.

The following machining cycles are available:

- **Turning**
  - Face turning, stock removal, groove, undercut (form A, B, C, D, E, F), thread cutting, thread chaining

- **Drilling**
  - Centering, drilling, boring, reaming, deep-hole drilling, threading

- **Position pattern**
  - Line, circle, grid

- **Milling**
  - Face milling, elongated holes, circumferential slot, slot milling, path milling, engraving, circular pockets and spigots, rectangular pockets and spigots, contour slot

**Highlight**

- Graphical support of cycles as an expansion of the highly flexible DIN/ISO programming
5.4 **Contour calculator (DIN/ISO)**

☑ TCU ☑ PCU 50 ☑ Basic configuration

A contour calculator is available in the DIN/ISO editor.

The following contours may be generated with this geometry calculator:
- Contours for turning
- Contours for milling on the end face and outer surface

The contour calculator provides the following possibilities:
- Up to 250 geometry elements programmable
- Automatic calculation of unknown elements ("drawing dot to dot")
- Chamfer or radius programmable in contour transitions
- Open DIN/ISO input field (e.g. for element-based feedrates)
- Conversion of contours and position patterns in DXF format with CAD Reader for PC; continued processing with the contour calculator in the control

**Highlights**

- Easy input of workpiece geometry: Drawing dot to dot
- Determination of contours with many unknown intermediate values is possible
- Speedy and certain from drawing to finished workpiece
Setup functions

6.1 Measure workpiece

☑ TCU ☑ PCU 50 ☑ Basic configuration

The workpiece can be measured as follows:
• Reference tool

Highlight
• Fast zero point definition by dialog
6.2 Zero/work offset

☑ TCU ☑ PCU 50 ☑ Basic configuration

The following settable work offsets are available in ShopTurn:
- A basic offset
- Maximum of 99 work offsets (G54, G55 ...)
- Each work offset with its own fine offset

Highlight
- Flexible machining due to great number of settable work offsets

6.3 Measure tool

☑ TCU ☑ PCU 50 ☑ Basic configuration

The tool compensation value can be directly determined in the machine set-up.
The following variants are available:
- Touch chuck
- Determine lengths via reference diameter
- Tool measuring probe (tooleye) or magnifier

Highlight
- Save time by determining the tool measurements directly in the machine
6.4 TSM universal cycle

☐ TCU ☑ PCU 50 ☑ Basic configuration

A universal cycle is available in the setup for the most commonly used machine functions:
- Tool change with direct access via the tool table (T)
- Spindle speed and direction (S)
- M functions (M)
- Activation of work offsets

Highlight
- Take-over and change-in tools directly from the tool table

6.5 Positioning cycle

☐ TCU ☑ PCU 50 ☑ Basic configuration

The machine axes can be positioned directly via input screens in the setup:
- Linear axes / spindles
- Feedrate / rapid traverse

Highlight
- Simple axis positioning without manual input, directly over the dialog screen
6.6 Stock removal

Stock removal is conveniently available in the set-up. Soft collet chucks can, for example, be turned with this cycle.

The following parameters can be specified:
- Roughing or finishing
- Undercut for soft collet chucks

Highlight
- Preparation of workpiece or collet chuck without having to create a part program
Tool management

7.1 Tool table

- TCU
- PCU 50
- Basic configuration

Tools with their complete information may be managed in the tool list. The cutting plate geometry is displayed to scale.

(The maximum number of tools is defined by the machine manufacturer.)

Tools are assigned to the desired turret positions with the load function. With the unload function, you may remove tools from the turret but retain the tool data.

The following data can be stored for each tool:

- Tool type (rougher, finisher, engraver, drilling and milling tools ....)
- Tool name in plaintext (ex.: "ROUGHING_80")
- Max. of 9 cutting edges per tool
- Tool length and cutting plate geometry
- Nose angle for drills or number of teeth for milling tools
- Direction of spindle rotation and coolant (level 1 and 2)

Highlights

- All tool data at a glance
- Simple and secure handling via unmistakable tool names
- Take over tools directly from the list to the program
7.2 Tool monitoring, sister tools

ShopTurn offers efficient tool management for the activation of replacement tools.

- Monitor cutting time (T) or number of exchanges (C)
- Prewarning limit for timely preparation of new tools
- Automatic exchange of sister tools for automatic operation possible (duplo number DP)

### Highlights

- Reduction of machine standstill times via tool monitoring
- Support of tool life monitoring or job time monitoring as standard
Program management, user memory

8.1 Program manager

☐ TCU ☐ PCU 50 ☐ Basic configuration

The program manager supports plaintext file names up to 24 characters.

![Table of file names and sizes]

Part programs can be saved complete with set-up data like tool data and zero points.

![Save data table]

Highlights

- Part programs can be created, retrieved and saved within a very short time
- User-friendly data handling in typical PC style with copying, pasting, renaming, etc.
8.2 User memory and data management

8.2.1 Buffered CNC work memory

- TCU
- PCU 50

<table>
<thead>
<tr>
<th>Device</th>
<th>Basic Configuration</th>
<th>Expandable To</th>
</tr>
</thead>
<tbody>
<tr>
<td>SINUMERIK 840D sl NCU 710</td>
<td>3 MByte</td>
<td>9 MByte</td>
</tr>
<tr>
<td>SINUMERIK 840D sl NCU 720 and NCU 730</td>
<td>3 MByte</td>
<td>15 MByte</td>
</tr>
</tbody>
</table>

Highlight

- Exceptionally large storage space in basic configuration already

8.2.2 USB memory stick

- TCU
- PCU 50
- Option: Only USB memory stick required

A USB memory stick can be used on the front side of the operator panel. User data stored on the PC can be quickly transferred to the internal CNC memory. Execution from USB memory sticks is not possible for security reasons. Instead, we offer a CompactFlash Card solution.

Highlights

- User-friendly solution, as memory slot is located at front
- Extremely cost-efficient, as no software option required
8.2.3 CompactFlash card

☑ TCU ☑ PCU 50 ☑ Option: Additional 256MB user memory on the CompactFlash Card of the NCU

You can find a CompactFlash Card for the system software as standard in the SINUMERIK 840D sl control cabinet. An additional 256 MB may be used as additional user memory. Executing the part program directly from the CompactFlash Card is possible. Furthermore, Ethernet networking is recommended.

Highlight

• Efficient and reliable solution for handling a large volume of user data

8.2.4 Ethernet networking

☑ TCU ☑ PCU 50 ☑ Option: Manage network drives

Sinumerik 840D sl NCU comes ready for Ethernet as standard (RJ45 connection). The data transfer rate is 10 / 100 Mbit/s.

Access to the network drive is available directly from the ShopTurn program manager. No additional software is required on the server.

Highlight

• Easy and economical connection via Ethernet (TCP/IP) to Windows PCs or Unix workstations
8.2.5 Hard disk drive

☐ TCU ☑ PCU 50 ☑ Basic configuration

A hard disk with 12GB of user memory is available on the PCU 50 for expansion of the CNC memory.

Highlights

• Hard disk can still be used as a data carrier

8.2.6 Disk drive

☑ TCU ☑ PCU 50 ☑ Option: Only a disk drive required

TCU and PCU 50 prepared for connection to a USB disk drive as standard. Access to the disk drive is available directly from the ShopMill program manager.

Highlights

• Disk can still be used as a data carrier
The simulation integrated in ShopTurn offers an optimal process reliability. This is guaranteed as it is calculating with exactly the same tool geometry as for the actual machining process.

The simulation can be controlled by start, stop and reset softkeys. For critical machining, the simulation can be operated in single block mode. The current data for axis position, machining block, tool and feedrate will be displayed.

The ShopTurn simulation allows the display of the following programs:
- DIN/ISO program, also with machining cycles
- Sequence program, counterspindle machining also included

The following displays are possible:
- 3-window view as standard
- Single block operation and start / stop possible at any time
- Simulation velocity adjustable with the feedrate override of the machine control panel
- The required machining time is automatically calculated and displayed in the simulation

Option: 3D simulation of the finished part
- 3D volume model of the finished part with section planes and detailed view

Highlight
- Simulation as real assistance for programming and offer calculation
10.1 Counterspindle

- TCU
- PCU 50
- Option: Synchronous spindle
- Option: Travel to fixed stop

The SINUMERIK 840D solution line enables the use of a fully-fledged counterspindle. The main spindle and counterspindle can be operated under conditions of angular synchronism.

**DIN/ISO programming**

The commands for spindle synchronization and the axis movements for workpiece transfer can be programmed as DIN/ISO language commands.

**Machining step programming**

A counterspindle cycle is conveniently available for spindle synchronization and axis movements for workpiece transfer.

**Highlights**

- Simple and secure programming of all counterspindle functions
- High quality of workpieces by workpiece transfer in synchronous spindle mode
10.2 Counterspindle machining

☑ TCU ☑ PCU 50 ☑ Basic configuration of machining step programming

A control cycle for counterspindle machining is available in the work plan editor with the following functions.

- **Gripping**
  
  Gripping the workpiece with counterspindle in synchronous mode

- **Pulling**
  
  Pulling long workpieces with the counterspindle

- **Rear side**
  
  Machining the rear side of the workpiece in the counterspindle.
  
  The programming is the same as with machining the main spindle. The Z axis value is mirrored.

- **Front**
  
  Switchover from counterspindle machining to main spindle machining for bar stock

- **Complete**
  
  Gripping, pulling, threading and counterspindle machining with bar stock

All main spindle machining steps are supported by the counterspindle.

**Highlights**

- Easy programming of complete machining process by dialog
- Security while programming the counterspindle machining via familiar cycle support; Z axis value is mirrored
10.3 Additional components

☑ TCU ☑ PCU 50 ☐ Basic configuration

Control cycles and input screens for the DIN/ISO and machining step programming are available for the following additional components: bar loaders, parts grippers and tailstocks. The control cycles and input screens must be adjusted by the machine manufacturer to the machine's actual conditions.

Highlight

• Simple programming of additional components
Drilling and milling can be performed on the front surface of workpieces in the main and counterspindle with ShopTurn.

The part program is easily created in a right-angle coordinate system with the front surface transformation TRANSMIT (C axis mode).

The path movements are conducted with the linear axes X / Z and the rotary axis C.

**Machine without Y axis**
- Machining with TRANSMIT

**Machine with Y axis**
- Machining with Y axis
- Machining with TRANSMIT

**Highlights**
- Full functional range for drilling and milling on the front surface
- Reduction of set-up times by complete machining on one machine
10.5 Peripheral surface machining

☑ TCU       ☑ PCU 50       ☐ Option: TRANSMIT and peripheral surface transformation

Drilling and milling can be performed on the outer surface of workpieces in the main and counterspindle with ShopTurn and the outer surface transformation TRACYL.

**Machine without Y axis**
- Any drill holes on the outer surface
- Any milling without slot wall offset on the outer surface

**Machine with Y axis**
- Any drill holes on the outer surface
- Any milling without slot wall offset on the outer surface
- Any milling with slot wall offset on the outer surface
- Grooving on parallel walls of the outer surface with milling radius correction

**Highlights**
- Full functional range for drilling and milling on the outer surface
- Reduction of set-up times by complete machining on one machine
Measuring cycles are available in the DIN/ISO editor for measuring tasks in automatic mode. Input screens with dynamic help displays are used for convenient entry of the measuring parameters.

The following measuring variants are available:
- Calibrate workpiece and tool measuring inputs
- Tool measurement with tool measuring input
- Single-point workpiece measurement with reversal
- Two-point workpiece measurement

The following measuring tasks can be made:
- Automatic value correction for tool geometry or work offset
- Display measurement results
- Log measurement results

**Highlights**

- Reliable quality of the manufactured parts by automatic measurement in the machine
- Easy adjustment via input displays with graphic support
12.1 CAD reader for PC

☐ TCU ☐ PCU 50 ☑ Option: CAD reader for PC

Contours and position patterns can be converted on the PC from DXF files into a format understandable to the control with the software package "CAD Reader for PC". The contours can be reworked in the contour calculator on the controller.

Highlight

- Time saving with conversion of contours and position patterns from DXF files
- Work preparation and training at the PC without occupying the machine
- Further editing at the controller using the contour calculator possible at any time
12.2 ShopTurn on PC, SinuTrain

☑ TCU ☑ PCU 50 ☑ Option: SinuTrain ShopTurn

Controller-identical PC system for work preparation and CNC training
• Full functional range of ShopTurn
• Networking of several student and trainer units possible

Highlight
• PC software for training and work preparation without occupying the machine

12.3 ShopTurn for self-learning

☑ TCU ☑ PCU 50 ☑ Option: ShopTurn for self-learning

Multimedia introduction to turning technology with ShopTurn.
• Programming exercises with directed examples

Highlight
• Graphically supported instruction software for beginners
13.1 Program control

- TCU
- PCU 50
- Basic configuration

**Single block**
Single block mode can be activated for startup of the program. For this purpose a program stop occurs after each traversing block. Work plan programs offer the alternative of halting processing after each plane infeed.

**Program test**
Programs can be checked before processing in a program test mode. The program is executed to completion with stationary axes.

**Program editing**
In machine status STOP, the program can be edited directly at the location of the fault, e.g. erroneous DIN/ISO blocks or falsely parameterized machining steps. After editing of the program, the machining process can be directly continued (a block search is carried out for machining step programs).

**Repositioning to the contour**
In machine status STOP, the machining axes can be moved to and away from the workpiece surface during machining using the handwheel or the direction keys.

**Highlights**
- Secure startup of new part programs
- Continue machining quickly after interruptions
13.2 Simultaneous recording

☐ TCU ☐ PCU 50 ☐ Option: Simultaneous recording (Simulation of the current machining)

The tool paths can be simultaneously recorded on the control screen while machining.

- Workpiece graphics and views correspond to the graphic simulation
- Color-coordinated differentiation of rapid traverse and feedrate

Highlights

- Machining can also be monitored in a complex machine room

13.3 Block search

☐ TCU ☐ PCU 50 ☐ Basic configuration

A block search may be performed in machine condition RESET, e.g. after a program interruption or to search for a resume point. The program data will be readied so as all relevant parameters (tool, zero offsets, M functions, etc.) are available upon continuation of the program.

The following search variants are available:

- To the interruption point
- To any CNC block in a DIN/ISO program
- To any subroutine levels in DIN/ISO programs
- To any sequence in work plan programs
- To any position in the position patterns for the work plan programming

Highlights

- Time-saving and secure re-start at any program point, as no editing of the part program is required
- Highlight: Direct continuation from an individual position of a position pattern during work plan programming is possible, providing huge savings in time
13.4 Basic block display

☑ TCU ☑ PCU 50 ☑ Basic configuration

The individual traversing blocks are displayed as DIN/ISO commands during execution of machining steps or machining cycles.

The basic block display guarantees an especially high process security while running-in programs in single block mode.

<table>
<thead>
<tr>
<th>N38 Resid. cutting</th>
<th>G00 X62.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N35 Stock removal</td>
<td>X62.2 Z-66.27</td>
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<tr>
<td>N48 Grooving</td>
<td>G01 X58.2</td>
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<tr>
<td>N45 Thread long.</td>
<td>G04 S1=1</td>
</tr>
<tr>
<td>N58 Rectang.pocket</td>
<td>G00 X57.2</td>
</tr>
<tr>
<td>N55 Centering</td>
<td>Z-67.09</td>
</tr>
<tr>
<td>N60 DRILL</td>
<td>G01 Z-68.09</td>
</tr>
</tbody>
</table>

Highlights

• Optimal control of the program execution, as well in complex sequences or machining cycles, especially in single block mode
14.1 Jerk limitation

The control calculates a steady acceleration profile instead of jumps in acceleration. This enables jerk-free velocity characteristics for the involved path axes. The jerk limitation can also be directly activated in the part program with the »SOFT« NC language command.

### Highlights
- Longer machine lifespan through protection of the mechanical components
- Higher path accuracy through softer acceleration
14.2 Dynamic feedforward control

- TCU
- PCU 50
- Basic configuration

Inaccuracies in the resulting workpiece contour due to following errors can practically be eliminated using dynamic feedforward control FFWON. The result is excellent machining precision even at high tool path feedrates. This is clarified with a circularity test on the machine.

Example:

Highlight

• Higher path accuracy through compensation of contouring errors
15.1 SINUMERIK Safety Integrated

☑ TCU ☑ PCU 50 ☑ Option: Safety Integrated

SINUMERIK Safety Integrated provides integrated safety functions that support the implementation of highly effective personnel and machine protection. The safety functions comply with the requirements of Category 3 according to EU standard EN 954-1 and safety integrated level SIL2 of IEC 61508. Consequently, important requirements for functional safety can be easily and efficiently implemented. Secure monitoring of velocity and standstill belong to the range of functionalities.

Highlights

- **High level of flexibility:** With Safety Integrated, setup with an open guard door is possible
- **High level of security:** Complete implementation of the safety functions in Category 3/SIL 2
- **Increased availability:** Absence of interference-susceptible electromechanical switching elements
Option list for the SINUMERIK package

The basic options and their Siemens order numbers are listed in the following:

**ShopTurn additional functions**
- Manual machine: 6FC5800-0AP11-0YB0
- Machining step programming: 6FC5800-0AP04-0YB0
- Residual material detection and machining: 6FC5800-0AP13-0YB0
- 3D simulation of the finished part (volume model): 6FC5800-0AP20-0YB0
- Simultaneous recording (real-time simulation of current machining): 6FC5800-0AP24-0YB0

**Memory expansion and networking**
- CNC user memory in NCU expanded by 2 MB each: 6FC5800-0AD00-0YB0
- Additional 256 MB user memory on the CompactFlash Card of the NCU: 6FC5800-0AP12-0YB0
- Network drive management via Ethernet: 6FC5800-0AP01-0YB0
- Hard disk (PCU 50) instead of TCU: 1), 2)
- Diskette drive: 1), 2)

**CNC additional functions**
- TRANSMIT and peripheral surface transformation when using driven tools: 6FC5800-0AM27-0YB0
- Travel to fixed stop and synchronous spindle when using counterspindle: 1), 2)
- Turning, drilling and milling measuring cycles for workpiece and tool measurement: 6FC5800-0AP28-0YB0
- Safety Integrated: 1), 2)

**PC software**
- SinuTrain ShopTurn, without CAD Reader (CD-ROM): 6FC5463-0GA50-0AG0
- SinuTrain ShopTurn, with CAD Reader (CD-ROM): 6FC5463-0GA51-0AG0
- CAD Reader for PC (CD-ROM): 6FC5260-0AY00-0AG0
- ShopTurn for self-learning (CD-ROM): 6FC5095-0AB00-0BG0

1) Notice: Commissioning expense required.
2) Please discuss with machine manufacturer.
Summary of unique selling points

The control and drive package which Siemens offers in the SINUMERIK 840D solution line and ShopTurn has the following prominent characteristics.

Especially in comparison to European control providers:

- **Increased productivity**
  - Blank contours with path optimization avoid idle cuts and reduce the machining time for pre-formed parts, e.g. castings.
  - Stock removal with orientation to workpiece edges instead of a uniform number of cutting passes avoids an unfavorable minimum infeed and thereby raises the quality of the workpiece.
  - With the manual machine function, individual machining steps can be executed without having to create a part program.

- **Better result for workpieces**
  - Programmable jerk limiting and velocity feedforward control provide for a better workpiece surface in conjunction with extremely dynamic drives.
  - Reliable parts quality through in-process measuring with automatic correction of the tool data or work offsets

- **More flexibility with DIN/ISO programming**
  - Unbeatable command range with G codes, variables and HLL elements

And in further comparison to Asian control providers:

- **User-friendlier interface**
  - Plaintext descriptions for part programs and tools offer greater transparency.
  - Take-over or change-in tools directly from the tool list to the program.
  - Machining step programming complete with specifications for the tool, feedrate and spindle speed or cutting rate; no entries required in DIN/ISO

- **Greater guarantee for the future via intelligent control functions**
  - Residual material detection and engraving cycle save time for programming and machining.
  - Chaining of machining steps avoids multiple entry of contours/pattern positions.

- **PC software enabling the machine more time available for production**
  - Conversion of contours and position patterns in DXF format with CAD Reader for PC; continued processing with the contour calculator in the control
  - Controller-identical PC software SinuTrain for training and work preparation
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