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Motion Control

SINUMERIK MC

Equipment for woodworking, glass working and stone working machines, as well as special technologies

Catalog
NC 64

Edition
January
2021

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Related catalogs

Motion Control NC 62
SINUMERIK 840
Equipment for Machine Tools

PDF (E86060-K4462-A101-A3-7600)



Motion Control Drives D 21.4
SINAMICS S120 and SIMOTICS

E86060-K5521-A141-A1-7600



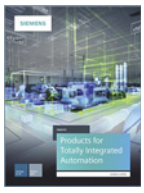
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Industrial Communication IK PI
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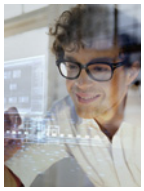
SITOP KT 10.1
SITOP
Power supply

E86060-D4001-A510-D8



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Industry Mall
Information and Ordering Platform
on the Internet:

www.siemens.com/industrymall



Scan the QR code to download the SINUMERIK MC Glossary as a PDF file to your tablet or smartphone.

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https://mall.industry.siemens.com/mall/ww/en/Catalog/Products/10368658

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Motion Control



Catalog NC 64 · January 2021

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Catalog NC NC 64 · March 2020

Refer to the Industry Mall for current updates of this catalog:
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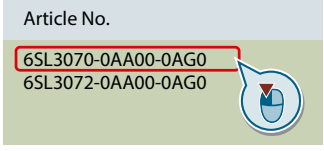
SINUMERIK CNC
SINUMERIK MC
1

Function overview
SINUMERIK MC
2

Appendix
Certificates of suitability
Partner
Notes on software
Metal surcharges
Conversion tables
Conditions of sale and delivery
Export regulations
3

NEW

Click on an Article No. in the catalog PDF to call it up in the Industry Mall and to obtain all the information.



Or directly on the Internet, e.g.
www.siemens.com/product?6SL3070-0AA00-0AG0

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Digital Enterprise

The building blocks that ensure everything works together perfectly in the digital enterprise

Digitalization is already changing all areas of life and existing business models. It is placing greater pressure on industry while at the same time creating new business opportunities. Today, thanks to scalable solutions from Siemens, companies can already become a digital enterprise and ensure their competitiveness.



Industry faces tremendous challenges

Reduce time-to-market

Today manufacturers have to bring products to market at an ever-increasing pace despite the growing complexity of these products. In the past, a major manufacturer would push aside a small one, but now it is a fast manufacturer that overtakes a slow one.

Boost flexibility

Consumers want customized products, but at a price they would pay for a mass-produced item. That only works if production is more flexible than ever before.

Improve quality

To ensure a high level of quality while meeting legal requirements, companies have to establish closed quality loops and enable the traceability of products.

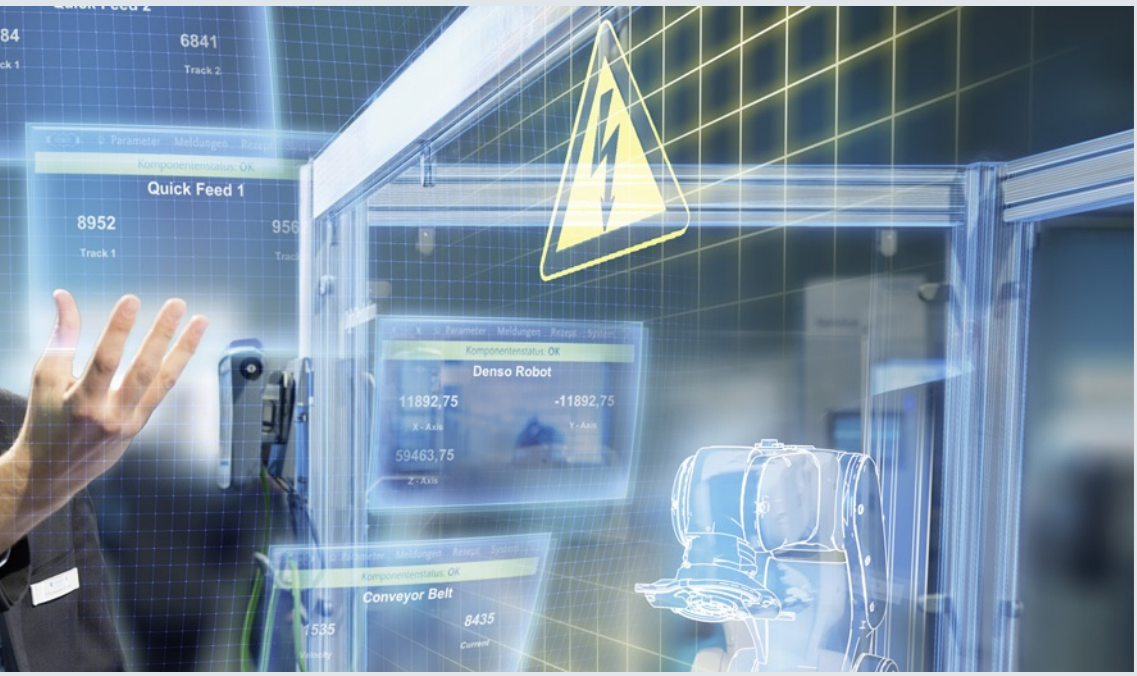
Boost efficiency

Today the product itself needs to be sustainable and environmentally friendly, while energy efficiency in production has become a competitive advantage.

Increase security

Increasing networking escalates the threat to production facilities of cyberattacks. Today more than ever, companies need suitable security measures.

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The digital enterprise has already become a reality

To fully benefit from all the advantages of digitalization, companies first have to achieve complete consistency of their data. Fully digitally integrated business processes, including those of suppliers, can help to create a digital representation of the entire value chain. This requires

- the integration of industrial software and automation,
- expansion of the communication networks,
- security in automation,
- and the use of business-specific industrial services.

MindSphere

The cloud-based open IoT operating system from Siemens

With MindSphere, Siemens offers a cost-effective and scalable cloud platform as a service (PaaS) for the development of applications. The platform, designed as an open operating system for the Internet of Things, makes it possible to improve the efficiency of plants by collecting and analyzing large volumes of production data.

Totally Integrated Automation (TIA)

Where digitalization becomes reality

Totally Integrated Automation (TIA) ensures the seamless transition from the virtual to the real world. It already encompasses all the necessary conditions for transforming the benefits of digitalization into true added value. The data that will form the digital twin for actual production is generated from a common base.

Digital Plant
Learn more about the digital enterprise for the process industry
www.siemens.com/digitalplant

Digital Enterprise Suite
Learn more about the digital enterprise for the discrete industry
www.siemens.com/digital-enterprise-suite

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Integrated Drive Systems

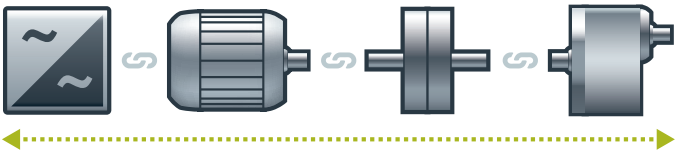
Faster on the market and in the black with Integrated Drive Systems

Integrated Drive Systems are Siemens' trendsetting answer to the high degree of complexity that characterizes drive and automation technology today. The world's only true one-stop solution for entire drive systems is characterized in particular by its threefold integration: Horizontal, vertical, and lifecycle integration ensure that every drive system component fits seamlessly into the whole system, into any automation environment, and even into the entire lifecycle of a plant.

The outcome is an optimal workflow – from engineering all the way to service that entails more productivity, increased efficiency, and better availability. That's how Integrated Drive Systems reduce time to market and time to profit.

Horizontal integration

Integrated drive portfolio: The core elements of a fully integrated drive portfolio are frequency converters, motors, couplings, and gear units. At Siemens, they're all available from a single source. Perfectly integrated, perfectly interacting. For all power and performance classes. As standard solutions or fully customized. No other player in the market can offer a comparable portfolio. Moreover, all Siemens drive components are perfectly matched, so they are optimally interacting.



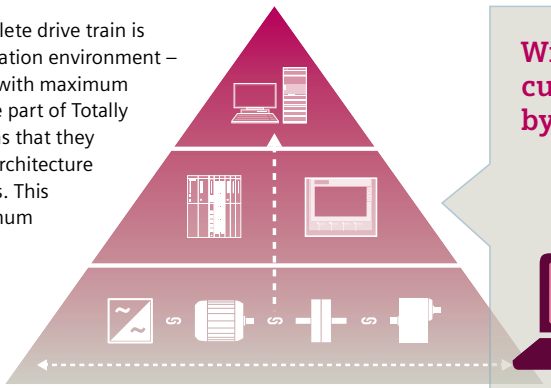
You can boost the availability of your application or plant to up to

99 %*

*e.g., conveyor application

Vertical integration

Thanks to **vertical integration**, the complete drive train is seamlessly integrated in the entire automation environment – an important prerequisite for production with maximum value added. Integrated Drive Systems are part of Totally Integrated Automation (TIA), which means that they are perfectly embedded into the system architecture of the entire industrial production process. This enables optimal processes through maximum communication and control.



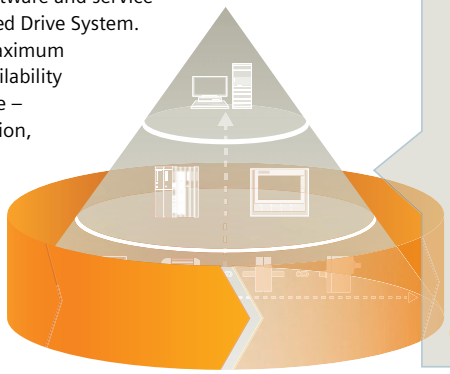
With TIA Portal you can cut your engineering time by up to

30 %

Lifecycle integration

Lifecycle integration adds the factor of time: Software and service are available for the entire lifecycle of an Integrated Drive System. That way, important optimization potential for maximum productivity, increased efficiency, and highest availability can be leveraged throughout the system's lifecycle – from planning, design, and engineering to operation, maintenance, and all the way even to modernization.

With Integrated Drive Systems, assets become important success factors. They ensure shorter time to market, maximum productivity and efficiency in operation, and shorter time to profit.



With Integrated Drive Systems you can reduce your maintenance costs by up to

15 %

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1/2 SINUMERIK MC
1/2 MCU 1720
1/2 Overview
1/2 Benefits
1/2 Application
1/2 Design
1/3 Function
1/4 Integration
1/5 Technical specifications
1/5 Selection and ordering data

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Overview



SINUMERIK MCU 1720

SINUMERIK MC: the open CNC for woodworking, glass working and stone working machines, as well as special technologies

The SINUMERIK MC is the ideal control system for machine solutions with customized user interfaces and maximum precision in motion control with G code.

Thanks to the Windows 10 operating system, the SINUMERIK MC CNC can easily integrate customized software for controlling and operating machine tools.

The open operating concept and the extensive range of interfaces make the SINUMERIK MC a universal, open control, which can be easily integrated into existing machine solutions. Equipped with the latest generation of the proven SINUMERIK NC kernel, it is ideally configured to satisfy the requirements of specific industries. It facilitates motion control with maximum accuracy and – with G-code programming – offers freedom and flexibility in machine control.

The integrated SIMATIC S7-1500F controller increases the speed of response which, in turn, improves the automation performance.

The SINUMERIK MC offers Safety Integrated as a uniform Siemens industry safety standard and implements the multi-level defense-in-depth concept for IT security.

Benefits

- Maximum openness
- Excellent motion control
- High automation performance
- Simple engineering

Application

The SINUMERIK MC is the ideal solution for machine tools with individual user interfaces and can be used for the following technologies:

- Woodworking, glass working and stone working machines
- Adhesive application
- Simple grinding applications
- Sheet metal cutting
- Laser and water jet cutting
- Additive manufacturing
- Machine tools that require best motion control performance

Design

The SINUMERIK MC comprises an industrial PC, an NC board, and the CNC software. The drive system and I/Os are connected via PROFINET.

- Hardware: IPC (Intel Core i5, 8 GB RAM, Windows 10) + NC board, SSD 240 GB
- Operation: all screens with DisplayPort
- User interface: Integration of a user interface via SIMATIC WinCC Runtime Advanced or Run MyHMI /3GL (.NET, C++)
- Drives:
  - Isochronous slaves
  - SINAMICS S120 via PN IRT
  - SINAMICS S210
- CNC: max. 8 servo axes and 4 channels
- PLC:
  - Integrated SIMATIC S7-1500F (IEC 61131-3)
  - Programming languages (SCL, STL, LAD, FBD)
  - Max. 20 PLC axes (Standard Motion Control SMC)
- Safety Integrated: SIMATIC S7-1500F

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Function

Maximum openness

The integrated Windows operating system allows the user interface to be designed simply and matched to customer requirements. The open operator control concept and extensive interfaces make the SINUMERIK MC an integrated and open control system.

Excellent motion control

The proven SINUMERIK CNC technology enables maximum precision in motion control and - thanks to G code programming - ensures freedom and flexibility in machine control.

High automation performance

The short response times of the latest SIMATIC S7-1500F PLC enable increased machining speed and significantly boost automation performance.

Simple engineering

Symbolic programming, modern programming languages and extensive toolboxes for implementing standard applications make engineering in the TIA Portal portal simple and efficient.

- TIA Portal
- SIMATIC STEP 7 + option SINUMERIK STEP 7 Toolbox
- Create MyHMI /WinCC
- Create MyHMI /3GL (.NET, C++)
- Commissioning via SINUMERIK Operate Commissioning
- Commissioning of SINAMICS S210 via Startdrive

Even the basic version allows the implementation of simple processing machines, e.g., for glass cutting, adhesive application, or flat-bed grinding. The attractive option packages "ADVANCED", "PERFORMANCE", "TECHNOLOGY", "Fabrication ADVANCED", "Fabrication PERFORMANCE" and others offer the best possible adaptation to individual machine requirements.

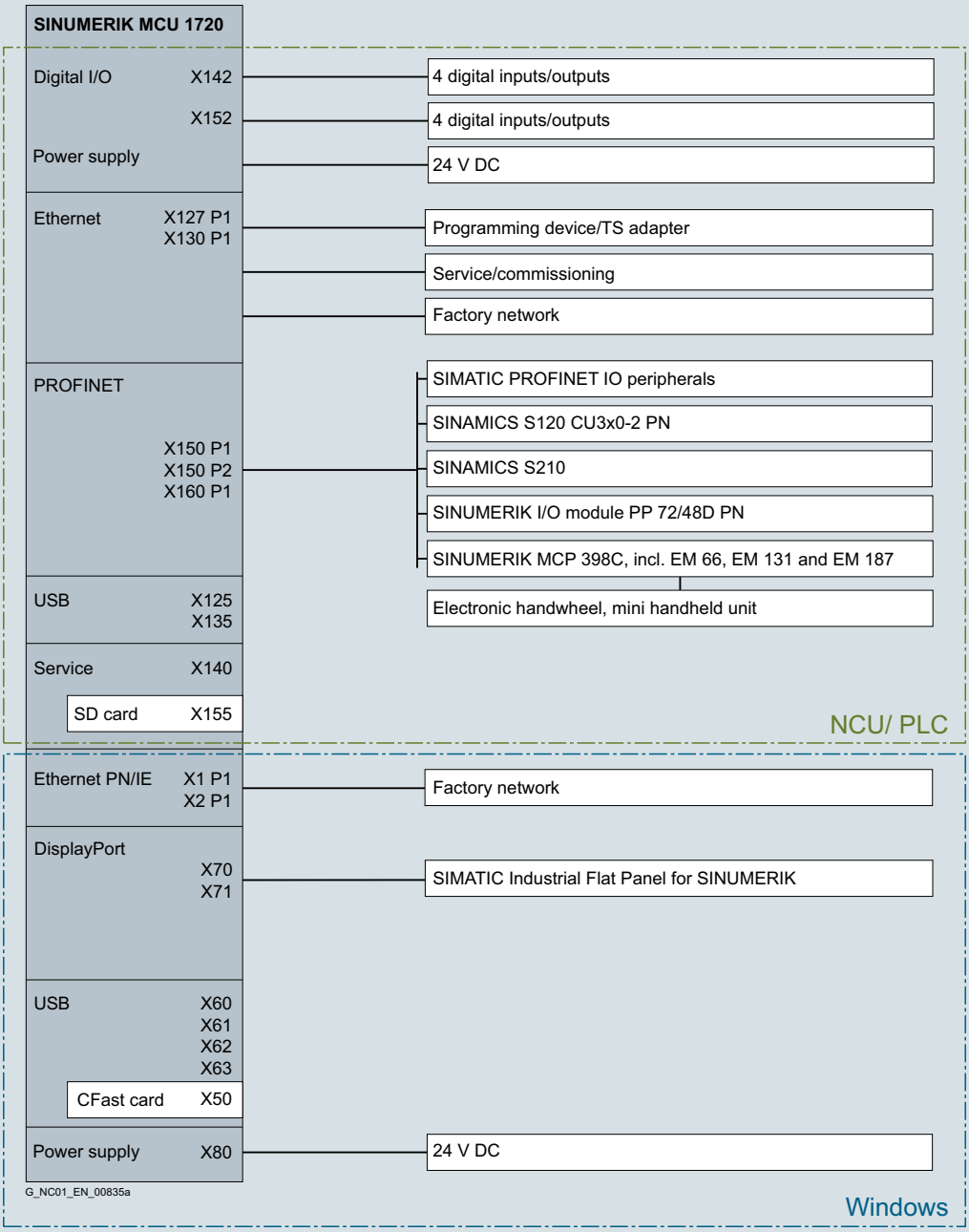
Integration

The following components can be connected to the SINUMERIK MC:

- SIMATIC Industrial Flat Panel (IFP),
  with optional HDBaseT transmitter module for up to 100 m
  - SIMATIC IFP1500, 15", multi-touch
  - SIMATIC IFP1900, 19", multi-touch
  - SIMATIC IFP2200, 22", multi-touch
  - SIMATIC IFP2400, 24", multi-touch
- SINUMERIK machine control panels and expansion modules
  - SINUMERIK MCP 398C
  - EM 66, EM 131 and EM 187
- SIMATIC PROFINET IO modules
- SINAMICS S120/SINAMICS S210 drive systems
- Feed and main spindle motors

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Integration (continued)



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Technical specifications

Article No.	6FC5222-1AA00-0AA0
Product brand name	SINUMERIK
Product type designation	SINUMERIK MC
Product short term	MCU 1720
Product designation	CNC
Operating system preinstalled	Windows 10
Processor version	Intel Core i5-6442EQ (6 MB cache, up to 2.7 GHz)
Supply voltage at DC	24 V (19.2 to 28.8 V)
Active power consumption	
• Maximum	82 W (at 24 V)
Buffering time in event of power failure	≥ 20 ms at 20.4 V (DC_FAIL is active after > 5 ms)
Degree of protection	IP20
Relative humidity at 25 °C (77 °F), during	
• storage	5 ... 95 %
• transport	5 ... 95 %
• operation	5% ... 80% (60% when corrosive gases and/or dusts are present)
Ambient temperature, during	
• storage	-40 ... +70 °C (-40 ... +158 °F)
• transport	-40 ... +70 °C (-40 ... +158 °F)
• operation	
- Horizontal mounting position	0 ... 50 °C (32 ... 122 °F)
- Vertical/ portrait mounting position:	0 ... 45 °C (32 ... 113 °F)
Width	262 mm (10.31 in)
Height	104 mm (4.09 in)
Depth	133 mm (5.24 in)
Net weight	3.75 kg (8.27 lb)
Certificate of suitability	CE, cULus, RCM, KC, CCC, EAC

Selection and ordering data

Description	Article No.
Hardware	
SINUMERIK MCU 1720 With integrated PLC 1500F	**6FC5222-1AA00-0AA0**
Software	
CNC software 8-3 for SINUMERIK MC	
CNC software Version with full functional scope with ECO package:	Export approval required
• Software version 1.14 with single license on SD card	**6FC5822-1XG45-4YA0**
• Software version 1.14 without license on SD card	**6FC5822-1XG45-4YA8**
• Software version 1.14 without license on DVD	**6FC5822-1XC45-4YA8**
• Software version 1.14 Electronic license as PDF	**6FC5822-1XF00-0VB0**
CNC software Export version with ECO package:	
• Software version 1.14 with single license on SD card	**6FC5822-1YG45-4YA0**
• Software version 1.14 without license on SD card	**6FC5822-1YG45-4YA8**
• Software version 1.14 without license on DVD	**6FC5822-1YC45-4YA8**
• Software version 1.14 Electronic license as PDF	**6FC5822-1YF00-0VB0**

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Notes

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2/2 SINUMERIK MC
2/2 Control structure and configuration
2/3 Drives
2/5 Connectable motors
2/6 Connectable measuring systems
2/7 Axis functions
2/7 Spindle functions
2/8 Interpolations
2/8 Couplings
2/9 Transformations
2/9 Measuring
2/10 Technologies
2/12 Motion-synchronous actions
2/13 CNC programming language
2/14 Operating modes
2/15 Tools
2/15 Communication and data management
2/16 Operation
2/18 Monitoring functions
2/18 Compensations
2/19 Programmable logic controller PLC
2/21 Safety functions
2/22 Engineering software

Important ordering notice:
Products with a product ID listed in addition to the article number can only be ordered using the corresponding product ID.
More information is available through your Siemens contact and on the Internet at: https://support.industry.siemens.com/cs/ww/en/view/109759136

The most important functions of the SINUMERIK MC are listed in the function overview.

This gives you quick and selective access to the individual functions.

The information in the function overview of the SINUMERIK MC is based on the following software version:

CNC	SW version
SINUMERIK MC	1.14

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Control structure and configuration

Description ✓ Basic version | O Option | – Not available	Instructions Footnotes are applicable line by line	Article No. Product ID	SINUMERIK MC MCU 1720
Control structure and configuration			
SINUMERIK MC, cabinet based:			
• MCU 1720 (IPC+ CNC + PLC 1500F)		**6FC5222-1AA00-0AA0**	O
• CU3x0-2	CU320-2 is always required for connection of SINAMICS S120 and SINAMICS S120 Combi.		O
Software for SINUMERIK MC:			
• CNC software 8-3, version with full functional scope with ECO package:	Export approval required		
- On SD card	Single license SW version 1.14	**6FC5822-1XG45-4YA0**	O
	Without license SW version 1.14	**6FC5822-1XG45-4YA8**	O
- On DVD	Without license SW version 1.14	**6FC5822-1XC45-4YA8**	O
- Without data storage medium	Electronic license (PDF) SW version 1.14	**6FC5822-1XF00-0VB0**	O
• CNC software 8-3, export version with ECO package:			
- On SD card	Single license SW version 1.14	**6FC5822-1YG45-4YA0**	O
	Without license SW version 1.14	**6FC5822-1YG45-4YA8**	O
- On DVD	Without license SW version 1.14	**6FC5822-1YC45-4YA8**	O
- Without data storage medium	Electronic license (PDF) SW version 1.14	**6FC5822-1YF00-0VB0**	O
Machining channels/mode groups:			✓ 1
• Machining channel, each additional		**6FC5800-0CC10-0YB0**	O
• Maximum configuration			4
Axes/spindles or positioning axes/auxiliary spindles CNC software:			✓ 3
• Axis/spindle, each additional		**6FC5800-0CA00-0YB0**	O
• Maximum configuration of axes			8
• Maximum configuration of spindles			8
• Configuration, axes incl. spindles per channel			8
• PLC-controlled axis			✓
• PLC positioning axis via PROFINET/PROFIBUS DP			✓
• Maximum configuration of axes/spindles CNC and PLC-controlled			8
• Maximum configuration axes/spindles, PLC-controlled	n = CNC-controlled axes/ spindles		20-n

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Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Drives			
SINAMICS S120 booksize format Internal air cooling:	See Siemens Industry Mall		
• Single Motor Modules:		6SL3120-1TE..-.AA.	O
- C type		6SL3120-1TE2.-.AC.	O
- D type		6SL3120-1TE..-.AD.	O
• Double Motor Modules:			
- C type		**6SL3120-2TE21-8AC0**	O
- D type		6SL3120-2TE..-.AD.	O
SINAMICS S120 booksize format Active Line Modules Internal air cooling		6SL3130-7TE..-.AA.	O
SINAMICS S120 booksize format Active Interface Modules to match the approved Active Line Modules			O
SINAMICS S120 booksize format Smart Line Modules Internal air cooling		6SL3130-6.E..-.A..	O
SINAMICS S120 booksize format Basic Line Modules Internal air cooling		6SL3130-1TE..-0AA0	O
SINAMICS S120 Combi Power Modules	See Siemens Industry Mall		
• 3-axis Power Modules		**6SL3111-3VE21-6FA2** **6SL3111-3VE21-6EA1** **6SL3111-3VE22-0HA1**	O
• 4-axis Power Modules		**6SL3111-4VE21-0EA1** **6SL3111-4VE21-6FA2** **6SL3111-4VE21-6EA1** **6SL3111-4VE21-6EC1** **6SL3111-4VE21-6ED1** **6SL3111-4VE22-0HA1**	O
SINAMICS S120 booksize compact format as expansion for SINAMICS S120 Combi	See Siemens Industry Mall		
• Single Motor Modules		**6SL3420-1TE13-0AA1** **6SL3420-1TE15-0AA1** **6SL3420-1TE21-0AA1** **6SL3420-1TE21-8AA1**	O
• Double Motor Modules		**6SL3420-2TE11-7AA1** **6SL3420-2TE13-0AA1** **6SL3420-2TE15-0AA1**	O
SINAMICS S120 blocksize format PM240-2 Power Modules standard variant Internal air cooling:	See Siemens Industry Mall For complete Article No., see PM240-2 Power Modules Power Modules > 90 kW are not permissible		
• Without integrated line filter:			
- 200 ... 240 V 1 AC/3 AC		6SL3210-1PB..-.UL0	O
- 200 ... 240 V 3 AC		6SL3210-1PC..-.UL0	O
- 380 ... 480 V 3 AC		6SL3210-1PE..-.UL.	O
• With integrated line filter class A:			
- 200 ... 240 V 1 AC/3 AC		6SL3210-1PB..-.AL0	O
- 200 ... 240 V 3 AC		6SL3210-1PC..-.AL0	O
- 380 ... 480 V 3 AC		6SL3210-1PE..-.AL.	O
SINAMICS S120M Distributed servo drive	See Siemens Industry Mall For complete Article No., see SINAMICS S120M	6SL3532-6DF71-0R.. 6SL3540-6DF71-0R.. 6SL3542-6DF71-0R.. 6SL3562-6DF71-0R.. 6SL3563-6DF71-0R..	O

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Drives

Description ✓ Basic version | O Option | – Not available	Instructions Footnotes are applicable line by line	Article No. Product ID	SINUMERIK MC MCU 1720
Drives (continued)			
SINAMICS S120 Control Units for single-axis drives without CompactFlash card:	For positioning tasks via PLC		
• CU310-2 PN		**6SL3040-1LA01-0AA0**	O
SINAMICS S120 Control Units without CompactFlash card:			
• CU320-2 PN		**6SL3040-1MA01-0AA0**	O
CompactFlash card with SINAMICS firmware:			
• License for basic performance	FW version 5.2	**6SL3054-0FC00-1BA0**	O
- with Z option High output frequency J01		**6SL3054-0FC00-1BA0-Z**	O
• License incl. performance expansion firmware option	FW version 5.2	**6SL3054-0FC01-1BA0**	O
- with Z option High output frequency J01		**6SL3054-0FC01-1BA0-Z**	O
• License (paper) High output frequency e.g. for application with HF spindle (in conjunction with SINUMERIK MC without export restriction) with existing CompactFlash card		**6SL3074-0AA02-0AA0**	O
CUA31 Control Unit Adapter		**6SL3040-0PA00-0AA1**	O
SINAMICS S120 Sensor Modules Cabinet-Mounted:			
• SMC10 for resolvers		**6SL3055-0AA00-5AA3**	O
• SMC20 for sin/cos 1 V_{pp} absolute encoders: EnDat		**6SL3055-0AA00-5BA3**	O
• SMC30 for TTL/HTL encoders or SSI combination encoders		**6SL3055-0AA00-5CA2**	O
• SMC40 for EnDat 2.2 encoders		**6SL3055-0AA00-5DA0**	O
SINAMICS S120 Sensor Modules External:			
• SME20 for sin/cos 1 V_{pp} encoders, IP67 degree of protection		**6SL3055-0AA00-5EA3**	O
• SME25 for EnDat 2.1 absolute encoders, IP67 degree of protection		**6SL3055-0AA00-5HA3**	O
• SME120 for sin/cos 1 V_{pp} encoders, PTC and KTY inputs with safe electrical isolation, IP67 degree of protection		**6SL3055-0AA00-5JA3**	O
• SME125 for EnDat 2.1 absolute encoders, PTC and KTY inputs with safe electrical isolation, IP67 degree of protection		**6SL3055-0AA00-5KA3**	O
SINAMICS S120 TB30 Terminal Board		**6SL3055-0AA00-2TA0**	–
SINAMICS S120 TM Terminal Modules:			
• TM15 for connecting probes and cam outputs		**6SL3055-0AA00-3FA0**	O
• TM31 with digital and analog I/Os		**6SL3055-0AA00-3AA1**	O
• TM41 with digital and analog I/Os as well as incremental encoder emulation		**6SL3055-0AA00-3PA1**	O
• TM120 for connecting PTC and KTY inputs		**6SL3055-0AA00-3KA0**	O
SINAMICS S120 VSM10 Voltage Sensing Module		**6SL3053-0AA00-3AA1**	O
AM600 adapter module		**6SL3555-2BC10-0AA0**	O
SINAMICS S120 DRIVE-CLiQ Hub Modules:			
• DMC20		**6SL3055-0AA00-6AA1**	O
• DME20, IP67		**6SL3055-0AA00-6AB0**	O
DRIVE-CLiQ extension		**6SL3555-0AA00-6AB0**	O
Hybrid cabinet bushing		**6SL3555-2DA00-0AA0**	O

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Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Drives (continued)			
Voltage protection for SIMOTICS M- 1PH8/ 1FE1/1FE2/2SP1 motors, external via Voltage Protection Module VPM:	See Siemens Industry Mall		
• VPM 120 for rated motor current 120 A, max.		**6SN1113-1AA00-1JA1**	O
• VPM 200 for rated motor current 200 A, max.		**6SN1113-1AA00-1KA1**	O
• VPM 200 DYNAMIC for rated motor current 200 A, max.		**6SN1113-1AA00-1KC1**	O
SINAMICS S210	Commissioning via Startdrive	6SL3210-5H...	O
Connectable motors			
Feed motors, synchronous motors: • SIMOTICS S-1FT7 • SIMOTICS S-1FK2 (1-cable and 2-cable connections) • SIMOTICS S-1FK7	See Siemens Industry Mall		O
Main spindle motors, asynchronous (induction) motors: • SIMOTICS M-1PH8 • SIMOTICS M-1PH3 • SIMOTICS M-1PH2 • SIMOTICS M-2SP1	See Siemens Industry Mall		O
Main spindle motors, synchronous motors: • SIMOTICS M-1PH8 • SIMOTICS M-1FE1/-1FE2 • SIMOTICS M-2SP1	See Siemens Industry Mall		O
Linear motors, synchronous motors: • SIMOTICS L-1FN3	See Siemens Industry Mall		O
Torque motors, synchronous motors: • SIMOTICS T-1FW6	See Siemens Industry Mall		O

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Connectable measuring systems

Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Connectable measuring systems			
Measuring systems without DRIVE-CLiQ interface on SIMOTICS motor:			
• Resolver	SMC10		✓
• Incremental encoder sin/cos 1 V_{pp}	SMC20/SME20		✓
• Absolute encoder EnDat 2.1	SMC20/SME25		✓
Measuring systems per axis, maximum number			2
Absolute encoder:			
• With DRIVE-CLiQ interface	Via SINAMICS S120		✓
• With DRIVE-CLiQ interface integrated in SIMOTICS S-1FT7/-1FK2/-1FK7 and SIMOTICS M-1PH8 motors	Via SINAMICS S120		✓
Incremental encoder:			
• With DRIVE-CLiQ interface integrated in SIMOTICS S-1FK702 and SIMOTICS M-1PH3/-1PH8 motors	Via SINAMICS S120		✓
Resolver:			
• With DRIVE-CLiQ interface integrated in SIMOTICS S-1FK7 motors	Via SINAMICS S120		✓
• As external machine encoder	SMC10		✓
Rotary measuring systems:	Via SINAMICS Sensor Modules:		
• Incremental encoder with RS422 (TTL)	SMC30		✓
• Incremental encoder with sin/cos 1 V_{pp}	SMC20/SME20		✓
• Incremental encoder with distance-coded reference marks	SMC20/SME20		✓
• Absolute encoder with EnDat 2.1	SMC20/SME25		✓
• Absolute encoder with EnDat 2.2	SMC40		✓
Linear scale LMS:	Via SINAMICS Sensor Modules:		
• Incremental encoder with sin/cos 1 V_{pp}	SMC20/SME20		✓
• Incremental encoder with distance-coded reference marks	SMC20/SME20		✓
• Absolute encoder with EnDat 2.1	SMC20/SME25		✓
• Absolute encoder with EnDat 2.2	SMC40		✓

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Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Axis functions			
Traversing range, decades			± 9
Rotary axis, turning endlessly			✓
Velocity, maximum			300 m/s
Acceleration with jerk limitation			✓
Programmable acceleration			✓
Follow-up mode			✓
Measuring systems 1 and 2, selectable			✓
Feedrate interpolation			✓
Separate feedrate for roundings and chamfers			✓
Travel to fixed stop			✓
Tangential control			✓ (ECO package)
Position switching signals/cam controller: • Pairs, maximum number			✓ (ECO package) 16
Axis container	Within 31 axes		✓
Spindle functions			
Digital spindle speed			✓
Spindle speed, maximum programmable range of values	Display ± 999 999 999.9999		10^6 … 10^{-4}
Gear stages			5
Gear stage selection, automatic			✓
Oriented spindle stop			✓
Spindle speed limitation, minimum/maximum			✓
Constant cutting rate			✓
Spindle control via PLC Positioning, oscillation			✓
Changeover to axis mode			✓
Axis synchronization on-the-fly			✓
Thread run-in and run-out, programmable			✓
Thread cutting with constant or variable pitch			✓
Tapping with compensating chuck/rigid tapping			✓

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Interpolations – Couplings

Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Interpolations			
Floating point accuracy			✓ 80 bits
Linear interpolating axes:			4
• Maximum number	Restricted functionality of the export version The number of simultaneously traversing axes is restricted to 4.		8
Fast Interpolation Cycle	Reduction of interpolation cycle to 2 ms possible. Restriction: No spindle function	**6FC5800-0CM11-0YB0**	Fabrication PERFORMANCE package
Circle via center point and end point			✓
Circle via interpolation point			✓
Helical interpolation	Restricted functionality of the export version: 2D+2		2D+6
Universal interpolator NURBS (non-uniform rational B splines)			✓
Continuous-path mode with programmable rounding clearance			✓
Compressor for 3-axis/5-axis machining			✓
Continue machining at the contour (retrace support) Run MyCC /RESU	Requirement: Cross-mode actions ASUB and synchronized actions. Included in the ECO package		Fabrication ADVANCED package Fabrication PERFORMANCE package
Spline interpolation (A, B and C splines)			TECHNOLOGY package
Polynomial interpolation			PERFORMANCE package
Multi-axis interpolation > 4 interpolating axes	Requirement: CNC SW version with full functional scope		TECHNOLOGY package
Motion control:			
• Advanced Surface		**6FC5800-0CS07-0YB0**	O PERFORMANCE package TECHNOLOGY package
Couplings			
Pair of synchronized axes (gantry axes) incl. NC axis:		**6FC5800-0CM02-0YB0**	O
• Maximum number			4
Generic couplings:			
• CP-Standard: - 4 axis pairs in simultaneous coupled motion			✓
• Generic coupling CP-Basic - 4 axis pairs in simultaneous coupled motion and - 1 × synchronous spindle/multi-edge turning and/or master value coupling/curve table interpolation and/or axial coupling in the machine coordinate system	Restricted functionality of the export version The number of simultaneously traversing axes is restricted to 4.		ADVANCED package
• Generic coupling CP-Comfort - 4 axis pairs in simultaneous coupled motion and - 4 × synchronous spindle/multi-edge turning and/or master value coupling/curve table interpolation and/or axial coupling in the machine coordinate system and - 1 × electronic gear for 3 leading axes without curve table interpolation, without cascading	Restricted functionality of the export version The number of simultaneously traversing axes is restricted to 4.		PERFORMANCE package

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Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Transformations			
Cartesian Point-to-Point travel PTP			✓
Concatenated transformations (inclined axis TRAANG after TRAORI/ cardanic milling head/TRANSMIT/TRACYL)			✓
Generic transformation	Requirement: Machining package 5 axes (option M30) or Milling technology package SINUMERIK MDynamics 5 axes (option S33)		✓
TRANSMIT/cylinder surface transformation			TECHNOLOGY package
Measuring			
Logging of measurement results in automatic mode			✓
Measuring stage 1 2 probes (switching) with/without deletion of distance-to-go			✓
Measuring cycles for drilling/milling and turning: • Calibrating workpiece probes • Workpiece measurement • Tool measurement			TECHNOLOGY package
Measure kinematics			TECHNOLOGY package

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Technologies

Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Technologies			
ECO package Contains the functions: • Tangential control • Position switching signals/cam controller [1] • Oscillation functions block-related, modal and asynchronous • Synchronized actions, stage 2 [2] • Evaluation of internal drive variables [3] • Cross-mode actions ASUB and synchronized actions in all CNC operating modes • Execution from external storage EES (e.g. local network, server, USB flash drive, …) • Use extended HMI applications Run MyHMI /3GL [4] • CNC user memory, expanded, for programs and OEM cycles, on SD card	[1] Pairs, maximum 16 [2] Restricted functionality of the export version. The number of simultaneously traversing path and positioning axes is restricted to 4. [3] Requirement for Adaptive Control [4] OEM contract required		✓
ADVANCED package Contains the functions: • Contour handwheel • Sag compensation, multi-dimensional [1] • Generic coupling CP-Basic [2]	[1] Restricted functionality of the export version The correctable tolerance band is restricted to 1 mm. [2] Restricted functionality of the export version The number of simultaneously traversing axes is restricted to 4.	**6FC5800-0CW61-0YB0**	O
PERFORMANCE package Contains the functions: • Polynomial interpolation • Leadscrew error compensation, bidirectional [1] • Generic coupling CP-Comfort [2] • Advanced Surface motion control • Monitoring for max. tool speed/acceleration	[1] Restricted functionality of the export version The correctable tolerance band is restricted to 1 mm. [2] Restricted functionality of the export version The number of simultaneously traversing axes is restricted to 4.	**6FC5800-0CW62-0YB0**	O
TECHNOLOGY package Contains the functions: • TRANSMIT/cylinder surface transformation • Multi-axis interpolation • 5-axis functionality (TRAORI, RTCP) • 3D tool radius compensation • Measuring cycles for drilling/milling and turning (calibrate workpiece probe, workpiece measurement, tool measurement) • Measure kinematics (L996) • Spline interpolation • Advanced Surface motion control	Requirement: CNC SW version with full functional scope	**6FC5800-0CW63-0YB0**	O
Fabrication ADVANCED package Contains the functions: • Run MyCC /CLCX • Run MCCC /RESU		**6FC5800-0CW64-0YB0**	O
Fabrication PERFORMANCE package Contains the functions: • Run MyCC /CLCX • Run MCCC /RESU • Run MyCC /HSLC • Fast Interpolation Cycle	Note: No spindle function	**6FC5800-0CW65-0YB0**	O

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Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Technologies (continued)			
Handwheel override			✓
Contour handwheel			ADVANCED package
Machining package 5 axes Contains the option: • Multi-axis interpolation > 4 interpolating axes	Requirement: CNC SW version with full functional scope		TECHNOLOGY package
Grinding:			
• Multiple feedrates in one block, e.g. for calipers			✓
• Continuous dressing, parallel dressing online modification of tool offset			✓
• Oscillation functions block-related, modal and asynchronous			✓ (ECO package)
Block change times (block processing times), typical [1]:	[1] Requirements: Use of the compressor All specifications concerning time values currently have the status "In planning/development" and have to be verified.		0.9 ms
Easy connection of robots and handling systems Run MyRobot /EasyConnect			✓

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Motion-synchronous actions

Description ✓ Basic version | O Option | – Not available	Instructions Footnotes are applicable line by line	Article No. Product ID	SINUMERIK MC MCU 1720
Motion-synchronous actions			
CNC inputs/outputs, high-speed I/O on-board:			
• Digital inputs or outputs on-board			8
• Analog outputs on-board			–
• Expansion via SIMATIC S7 I/O	See Siemens Industry Mall		O
Synchronized actions and fast auxiliary function output incl. 3 synchronous functions (max. 159 elements for synchronized actions):	Restricted functionality of the export version The number of simultaneously traversing axes is restricted to 4.		✓
• Number of simultaneously active synchronous functions SYNFC			24
Synchronized actions stage 2	Restricted functionality of the export version The number of simultaneously traversing path and positioning axes is restricted to 4.		✓ (ECO package)
Positioning axes and spindles via synchronized actions (command axes)			✓
Analog value control in the interpolation cycle	Requirement: Analog input		✓
Path velocity-dependent analog output (laser power control)			✓ (ECO package)
Laser switching signal, high-speed Run MyCC /HSLC			Fabrication PERFORMANCE package
Clearance control:			
• 1D in interpolation cycle via synchronized actions			✓
• Clearance control Run MyCC /CLCX	Restricted functionality of the export version Without Run MyCC /CLCX, the number of interpolating axes is limited to 4, and with Run MyCC /CLCX to 3.		Fabrication ADVANCED package Fabrication PERFORMANCE package
Evaluation of internal drive variables	Requirement for Adaptive Control		✓ (ECO package)
Asynchronous subprograms ASUB	High-speed CNC inputs/outputs		✓
Cross-mode actions ASUB and synchronized actions in all CNC operating modes			✓ (ECO package)

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Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
CNC programming language			
Programming language DIN 66025 and high-level language expansion			✓
Main program call from main program and subprogram			✓
Subroutine levels, maximum			16
Interrupt routines, maximum			2
Number of subprogram passes			≤ 9999
Number of levels for skip blocks			0 ... 8
Polar coordinates			✓
1/2/3-point contours			✓
Dimensions metric/inch, changeover via operator action or program			✓
Inverse-time feedrate			✓
Auxiliary function output via:			
• M word, maximum programmable range of values			INT 2^{31}-1
• H word, maximum programmable range of values REAL ± 34028 ex 38	Display ± 999 999 999.9999		INT -2^{31} ... 2^{31} -1
CNC high-level language with:			
• User variables, configurable			✓
• Predefined user variables (arithmetic parameters)			✓
• Predefined user variables (arithmetic parameters), configurable			✓
• Read/write system variables			✓
• Indirect programming			✓
• Program jumps and branches			✓
• Program coordination with WAIT, START, INIT			✓
• Arithmetic and trigonometric functions			✓
• Comparison operations and logic combinations			✓
• Macro techniques			✓
• Control structures IF-ELSE-ENDIF			✓
• Control structures WHILE, FOR, REPEAT, LOOP			✓
• Commands to HMI			✓
• STRING functions			✓
Program functions:			
• Preprocessing memory, dynamic FIFO			✓
• Look Ahead, recorded part program blocks	Advanced Surface		3000
• Look Ahead, IPO blocks, buffered			1000
• Frame concept			✓
• Inclined-surface machining with frames			✓
• Axis/spindle interchange			✓
• Geometry axes, switchable online in the CNC program			✓
• Program preprocessing			✓
Online ISO dialect interpreter			✓

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CNC programming language – Operating modes

Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
CNC programming language (continued)			
Program/workpiece management:			
• Part programs, maximum number	In total a maximum of 512 files per directory		1000
• Workpieces, maximum number	In total a maximum of 256 directories		250
• Workpieces on the SSD of the SINUMERIK MCU 1720, maximum number	In total a maximum of 10000 user files		10000
• Templates for programs and workpieces			✓
• Job lists			✓
• On integrated SSD in the SINUMERIK MCU 1720			✓
• On USB storage medium, e.g. USB flash drive	Requirement: Flash drive		✓
• On network drive			✓
Basic frames, maximum number			16
Settable offsets, maximum number			100
Work offsets, programmable (frames)			✓
Work offsets, external via PLC			✓
Global and local user data			✓
Global program user data			✓
Display system variables, including in online configurable display, and log them	[1] Function depends on operating software		[1]
Operating modes			
JOG CNC operating mode:			✓
• Handwheel selection			✓
• Inch/metric changeover			✓
• Reference point approach automatic/via CNC program			✓
MDI CNC operating mode (Manual Data Input):			✓
AUTO CNC operating mode:			✓
• Execute directly:			
- From real CNC user memory (in line with basic scope)			✓ 10 MB
• Execute with external call:			
- From the storage medium to the USB interface			✓
- From user memory on the SSD of the SINUMERIK MCU 1720			✓
- From the network drive			✓
- From external storage EES e.g. local network, server, USB flash drive, … - One part program memory for several NCUs	Includes the function CNC user memory for programs and OEM cycles, expanded on SD card		✓ (ECO package)
• DRF offset			✓

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Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Tools			
Tool types:			
• Drilling/milling			✓
• Turning			✓
• Groove sawing			✓
• Grinding			✓
Tool radius compensations in plane with:			
• Approach and retract strategies			✓
• Transition circle or transition ellipse at outside corners			✓
Configurable intermediate blocks with tool radius compensation active			✓
3D tool radius compensation			TECHNOLOGY package
Tool change via T number			✓
Tool carrier with orientation capability			✓
Look-ahead detection of contour violations			✓
Grinding wheel peripheral speed, programmable			✓
Development-oriented interpolation:	Requirement: TECHNOLOGY package (machining package 5 axes (option M30))		O
• Tool offset selection via T and D numbers			✓
• Tools, maximum			100
• Cutting edges, maximum			150
• Tool life monitoring and workpiece count			✓
Communication and data management			
CNC user memory for programs and OEM cycles, buffered internally			✓ 10 MB
CNC user memory for programs and OEM cycles, expanded on SD card			✓ (ECO package)
User memory for CNC programs, OEM cycles and HMI on SSD of the SINUMERIK MCU 1720:			✓
• On external storage medium (e.g. local network, server, USB flash drive, ...)			✓ Unlimited
Data backup:			
• SD card of the CNC software (backup/restore) on flash drive or on network			✓
• On integrated SSD of the SINUMERIK MCU 1720			✓
• With Ghost (backup/restore) on SINUMERIK MCU 1720 or in network			✓
Networking: OPC UA server / client for SINUMERIK	See SINUMERIK Engineering software		
• Access MyMachine /OPC UA for SINUMERIK MC – PLC	License for PLC		O

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Operation

Description ✓ Basic version | O Option | – Not available	Instructions Footnotes are applicable line by line	Article No. Product ID	SINUMERIK MC MCU 1720
Operation			
Operator panels *blackline plus* in new neutral design for SINUMERIK MCU 1720:			
• SIMATIC IFP1500 ext V2, 15", multi-touch, extended version up to 100 m (328 ft)		**6AV7863-5MA10-2NA0**	O
• SIMATIC IFP1900 ext V2, 19", multi-touch, extended version up to 100 m (328 ft)		**6AV7863-6MA10-2NA0**	O
• SIMATIC IFP2200 ext V2, 22", multi-touch, extended version up to 100 m (328 ft)		**6AV7863-4MA10-2NA0**	O
• SIMATIC IFP2400 ext V2, 24", multi-touch, extended version up to 100 m (328 ft)		**6AV7863-7MA10-2NA0**	O
SINUMERIK machine control panels *blackline plus*	For operator panels *blackline plus*		
• SINUMERIK MCP 398C:	For 15" operator panels	**6FC5303-0AF25-0AA0**	O
- EM 66 expansion module	For 19" operator panels MCP 398C + EM 66	**6FC5303-0AF30-0AA0**	O
- EM 131 expansion module	For 22" operator panels MCP 398C + EM 131	**6FC5303-0AF31-0AA0**	O
- EM 187 expansion module	For 24" operator panels MCP 398C + EM 187	**6FC5303-0AF28-0AA0**	O
• Accessories for operator panels:	See Siemens Industry Mall		
- Switch SCALANCE XB005 unmanaged		**6GK5005-0BA00-1AB2**	O
- Switch SCALANCE X005 unmanaged		**6GK5005-0BA10-1AA3**	O
- Switch SCALANCE XC108 unmanaged		**6GK5108-0BA00-2AC2**	O
- Switch SCALANCE XC208 managed		**6GK5208-0BA00-2AC2**	O
- Switch SCALANCE X208 PRO managed		**6GK5208-0HA10-2AA6**	O
Accessories for operator panels:			
• Service package mounting clips	For SIMATIC IFP	**6AV6671-8XK00-0AX3**	O
• Accessories for SIMATIC Industrial Flat Panel:			
- Cable set (CAT6 cable, HDBaseT transmitter module, mounting material)	Length 10 m (33 ft) Length 15 m (49 ft) Length 20 m (66 ft) Length 30 m (98 ft)	**6AV7860-1EX21-0AB1** **6AV7860-1EX21-5AB1** **6AV7860-1EX22-0AB1** **6AV7860-1EX23-0AB1**	O
- Cable, unassembled, without connector		**6XV1878-2C**	O
- CAT6 connector		**6AV7860-1EY00-0AA0**	O
- Transmitter module		**6AV7860-3EH00-0AA0**	O
• USB interface for mounting in control cabinet, with connection between cabinet mounting component and the USB connector	Length 1 m (3.28 ft)	**6FC5347-0AF01-1AA0**	O
• Accessories for machine control panels:			
- Emergency stop mushroom pushbutton, latching, red, 22 mm (0.78 inches)		**6FC5347-0AF20-1AA1**	O
- Contact block		**6FC5347-0AF20-2AA1**	O
- Cable set for additional control devices		**6FC5247-0AA35-0AA0**	O
- Spindle/rapid traverse override rotary switch, 1×16G, T=24, cap, button, pointer, rapid traverse and spindle dials		**6FC5247-0AF12-1AA0**	O
- Feedrate/rapid traverse override rotary switch, 1×23G, T=32, cap, button, pointer, rapid traverse and feedrate dials		**6FC5247-0AF13-1AA0**	O
Interface for customer machine control panel SINUMERIK MCP Interface PN		**6FC5303-0AF03-0AA0**	O

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Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Operation (continued)			
Handheld units:			
• Mini handheld unit with coiled connecting cable		**6FX2007-1AD03**	O
• Mini handheld unit with straight cable		**6FX2007-1AD13**	O
• Accessories for mini handheld units:			O
- Connection kit		**6FX2006-1BG03**	O
Electronic handwheels:			
• With 120 mm × 120 mm front panel, 5 V DC, RS422		**6FC9320-5DB01**	O
• With 76.2 mm × 76.2 mm front panel, 5 V DC, RS422		**6FC9320-5DC01**	O
• With 76.2 mm × 76.2 mm front panel, 24 V DC, HTL		**6FC9320-5DH01**	O
• Without front panel, without setting wheel, 5 V DC, RS422		**6FC9320-5DF01**	O
• Without front panel, with setting wheel, 5 V DC, RS422		**6FC9320-5DM00**	O
• Portable in housing, 2.5 m spiral cable, 5 V DC, RS422		**6FC9320-5DE02**	O
• Accessories for handwheels and mini handheld units:			
- Flange socket for portable handwheel		**6FC9341-1AQ**	O
- Adapter set for three-point mounting of the handwheel		**6FC9320-5DN00**	O
- Holder for mini-handheld unit 6FX2007-1AD03/-1AD13 and electronic handwheel in housing 6FC9320-5DE02		**6FX2006-1BG70**	O
Memory and storage devices:			
• 8 GB CompactFlash card	SINUMERIK MCU 1720	**6FC5313-6AG00-0AA0**	O
• Industrial USB Hub 4	SINUMERIK MCU 1720	**6AV6671-3AH00-0AX0**	O
• SIMATIC USB flash drive 32 GB		**6AV6881-0AS42-0AA1**	O

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Monitoring functions – Compensations

Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Monitoring functions			
Working area limitation			✓
Limit switch monitoring Software and hardware limit switches			✓
Position monitoring			✓
Standstill monitoring			✓
Clamping monitoring			✓
2D/3D protection areas			✓
Contour monitoring			✓
Axis limitation from the PLC			✓
Spindle speed limitation			✓
Collision avoidance:			
• ECO collision avoidance		**6FC5800-0CS03-0YB0**	O
Compensations			
Backlash compensation			✓
Leadscrew error compensation			✓
Measuring system error compensation			✓
Feedforward control:			
• Velocity-dependent			✓
• Acceleration-dependent			✓
Weight counterbalance, electronic			✓
Temperature compensation			✓
Quadrant error compensation			✓
Circularity test			✓
Leadscrew error compensation, bidirectional	Restricted functionality of the export version: The correctable tolerance band is restricted to 1 mm.		PERFORMANCE package
Sag compensation, multi-dimensional	Restricted functionality of the export version: The correctable tolerance band is restricted to 1 mm.		ADVANCED package

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Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Programmable logic controller PLC			
SIMATIC S7-1500F integrated			✓
PLC user memory: Program memory in MB / Data memory in MB			✓ 1.5 / 5
Standard motion control functionality Motion control resources:			✓ 2400
• Typ. PLC-cycle time [1)]	[1)] Preconditions: The specification of a typ. PLC-cycle time is highly dependent on the size and configuration of the PLC program All specifications concerning time values currently have the status "In planning/development" and have to be verified.		15 ... 20 ms
Fieldbus communication via PROFINET IO RT/IRT (X150): • Number of interfaces / Number of ports			✓ 1 / 2
Distributed I/O via PROFINET (RT/IRT):	See Siemens Industry Mall or Catalog ST 80		
• Minimum update time for RT	Min. update time is determined by the time slice set for PROFINET IO communication, by the number of IO devices used, and by the amount of configured user data.		125 µs 250 µs
• Distributed PROFINET slaves, maximum number			512
• Of which IO devices with IRT, max.			64
Plant communication via PROFINET IO RT (X160): • Number of interfaces / Number of ports			✓ 1 / 1
Distributed I/O via PROFINET (RT):	See Siemens Industry Mall or Catalog ST 80		
• Update time for RT (for send cycle of 1 ms)	Min. update time is also determined by the time slice set for PROFINET IO communication, by the number of IO devices used, and by the amount of configured user data.		1 … 512 ms
• Distributed PROFINET slaves for RT, max. number			128
PROFINET IO controller			✓
PROFINET IO device			✓
I/O address area:			
• Inputs – all inputs are in the process image	16 KB via integrated PROFINET IO interface X150, 8 KB via integrated PROFINET IO interface X160 and 8 KB via integrated PROFIBUS DP interface		32 KB
• Outputs – all outputs are in the process image	16 KB via integrated PROFINET IO interface X150, 8 KB via integrated PROFINET IO interface X160 and 8 KB via integrated PROFIBUS DP interface		32 KB

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Programmable logic controller PLC

Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Programmable logic controller PLC (continued)			
Bit memory			16 KB
S7-timers			2048
IEC-timers			Any
S7-timers			2048
IEC-counters			Any
Retentive data area			768 bytes
Usable retentive memory for bit memories, timers, counters, DBs and technological data (axes)			700 bytes
FBs:	Usable numbers 30 ... 999 and 1024 ... 24999		
• Largest number			65535
• max. size			1 MB
FC:	Usable numbers 30 ... 999 and 1024 ... 24999		
• Largest number			65535
• max. size			1 MB
DB:	Usable numbers 62 ... 70 and 1100 ... 24999		
• Largest number			59999
• Max. size (optimized / non-optimized block access)			16 MB / 64 KB
Know-how protection:			
• User program protection			✓
• Copy protection			✓
• Block protection			✓
• Access protection			✓
• "Write protection" protection level			✓
• "Read/write protection" protection level			✓
• "Complete protection" protection level			✓
SINUMERIK PP 72/48D PN I/O module	Quantity limited by I/O quantity structure of PLC	**6FC5311-0AA00-0AA0**	O
SINUMERIK PP 72/48D 2/2A PN I/O module	Quantity limited by I/O quantity structure of PLC	**6FC5311-0AA00-1AA0**	O
PLC programming language STEP 7 Professional:	With TIA Portal from V15.1		O
• Ladder diagram (LAD)			O
• Function block diagram (FBD)			O
• Statement list (STL)			O
• Structured Control Language (SCL)			O
• GRAPH for sequential processes			O
Company network interface (X130), RJ45 Number of interfaces / Number of ports:			✓ 1 / 1
• Data transfer rate, max.			1000 Mbps
Service network interface (X127), RJ45 Number of interfaces / Number of ports:			✓ 1 / 1
• Data transfer rate, max.			1000 Mbps

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Description ✓ Basic version | O Option | – Not available	Instructions Footnotes are applicable line by line	Article No. Product ID	SINUMERIK MC MCU 1720
Safety functions			
SINUMERIK Safety Integrated:			
• Safe Torque Off (STO) via on-board terminals			✓
• Safe Brake Control (SBC) via on-board terminals			✓
• Safe Stop 1 (SS1) (time-controlled) via on-board terminals			✓
• Safe shutdown (stops) via PROFIsafe:	Requirement: Safety Integrated Functions		O
- Safe Torque Off (STO)	Requirement: Safety Integrated Basic Functions		O
- Safe Brake Control (SBC)	Requirement: Safety Integrated Basic Functions		O
- Safe Stop 1 (SS1), time or velocity-controlled shutdown	Requirement: Safety Integrated Basic Functions		O
- Safe Stop 2 (SS2), safe shutdown combined with Safe Operating Stop (SOS)	Requirement: Safety Integrated Extended Functions		O
- Safe Stop 2e (SS2e), safe shutdown via external stop	Requirement: Safety Integrated Extended Functions		O
- Safe Stop 2 (SS2 ESR), extended stop and retract, e.g. in the event of a power failure	Requirement: Safety Integrated Extended Functions		O
• Safe Operating Stop (SOS)	Requirement: Safety Integrated Extended Functions		O
• Safely-Limited Speed (SLS) incl. SLS override with control between 0 … 100 %	Requirement: Safety Integrated Extended Functions		O
• Safe Speed Monitor (SSM)	Requirement: Safety Integrated Extended Functions		O
• Safe Acceleration Monitor (SAM)	Requirement: Safety Integrated Extended Functions		O
• Safely-Limited Position (SLP)	Requirement: Safety Integrated Advanced Functions		O
• Safe Cam (SCA)	Requirement: Safety Integrated Advanced Functions		O
• Safe Position (SP)	Requirement: Safety Integrated Advanced Functions		O
• Safely-Limited Speed (SLS), encoderless	Requirement: Safety Integrated Extended Functions		O
• Safe Direction (SDI)	Requirement: Safety Integrated Extended Functions		O
• Safe Brake Management (SBM):	Requirement: Safety Integrated Extended Functions		O
- Safe Brake Control (SBC)	Requirement: Safety Integrated Extended Functions		O
- Safe Brake Test (SBT) – diagnostic function	Requirement: Safety Integrated Extended Functions		O
• Safety-related communication via standard bus (PROFIsafe with SIMATIC ET 200 range)	See Siemens Industry Mall or Catalog ST 70		O
• Safe integration of sensors via the SIMATIC DP / AS-i F-Link	See Siemens Industry Mall or Catalog IK PI		O

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Safety functions – Engineering software

Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Safety functions (continued)			
Safety Integrated:			
• F-PLC Enabling of the F-PLC integrated in the SINUMERIK MCU 1720 for fail-safe programming		**6FC5800-0CS60-0YB0**	O
• Extended Functions for 1 axis/spindle	Requirement: Safety Integrated F-PLC	**6SL3074-0AA10-0AA0**	O
• Advanced Functions for 1 axis/spindle	Requirement: Safety Integrated F-PLC	**6SL3074-0AA20-0AA0**	O
Safety Integrated acceptance test executed with:			
• SINUMERIK Operate Commissioning Tool			✓
Engineering software			
Integrated commissioning for the SINUMERIK CNC and the SINAMICS S120 drive system	Requirement: SINUMERIK Operate Commissioning Tool		✓
Commissioning functions for the SINAMICS S120 drive system Auto Servo Tuning AST, fully automatic speed and position controller optimization:	Requirement: SINUMERIK Operate Commissioning Tool		✓
• Single-axis optimization, incl. gantry axes			✓
• Speed controller optimization, incl. current setpoint filter setting			✓
• Position controller optimization, incl. speed setpoint filter setting			✓
• Setting of feedforward control			✓
• Overview of optimization results			✓
• Closed circuit can be manually tuned according to Bode plot			✓
• Optimization of path interpolation			✓
• Assignment of torque feedforward control			✓
• Complete user strategy, freely parameterizable			✓
• Backward and forward during optimization, re-optimization of the speed controller			✓
• Generating reports, individual axis and path interpolation			✓
• Optimization project can be loaded and optimized offline on the PC			✓
Trace	Requirement: SINUMERIK Operate Commissioning Tool		✓
Circularity test	Requirement: SINUMERIK Operate Commissioning Tool		✓
Measuring functions for manual drive optimization			✓

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Description ✓ Basic version | O Option | – Not available	**Instructions** Footnotes are applicable line by line	**Article No.** **Product ID**	**SINUMERIK MC** **MCU 1720**
Engineering software (continued)			
Series commissioning via:			
• USB interface with storage medium, e.g. USB flash drive			✓
• Network drive			✓
SINUMERIK Toolbox	On DVD-ROM of the CNC software		O
STARTER commissioning tool SINAMICS and MICROMASTER	For topology and diagnostics	6SL3072-0AA00-0AG0	–
Alarms and messages			✓
PLC status	Via SIMATIC STEP 7 on PG/PC always possible		✓
Remote diagnostics, data transfer and commissioning support Access MyMachine:			
• Access MyMachine /P2P for PC/PG (PC software for Windows 7/10) Software on CD-ROM	Single license SW version 4.7	**6FC5860-7YC44-0YA0**	O
Program screens, operating areas and user interfaces Create MyHMI /3GL:	OEM contract required		✓
• Programming package Create MyHMI /3GL Software for PC on DVD-ROM	Single license Current SW version	**6FC5861-1YC00-0YA0**	O
	Single license SW version 4.93 HF2	**6FC5861-1YC46-3YA0** **MCS1200**	O
	Single license Without data storage medium	**6FC5861-1YP00-0YB0** **MCS1200**	O
	Software update service	**6FC5861-1YP00-0YL8** **Maintenance package**	O
• Use extended HMI applications Run MyHMI /3GL			✓ (ECO package)
Configure screens and operating areas Create MyHMI:			
• Create MyHMI /WinCC software for PC on DVD-ROM	Single license Current SW version	**6FC5861-3YC00-0YA0** **MCS1210**	O
	Single license SW version 16	**6FC5861-3YC46-0YA0** **MCS1210**	O
	Single license Without data storage medium	**6FC5861-3YP00-0YB0** **MCS1210**	O
	Software update service	**6FC5861-3YP00-0YL8** **MCS1210-MT**	O
• Run MyHMI /WinCC	Electronic license as PDF	**6FC5800-0CP61-0YB0**	O
Integrate OEM-specific solutions in the CNC kernel based on customer-specific solutions Create MyCCI	Please contact your sales and marketing specialist	On request	–

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3/2 **Certificates of suitability**

3/4 **Partner**

3/5 **Notes on software**
3/5 Software licenses
3/7 Setup texts and software update services

3/8 **Conversion tables**

3/10 **Metal surcharges**

3/13 **Conditions of sale and delivery/ Export regulations**

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Overview

Many of the products in this catalog fulfill requirements, e.g. for UL, CSA or FM and are labeled with the corresponding approval designation.

All of the certificates of suitability, approvals, certificates, declarations of conformity, test certificates, e.g. CE, UL, Safety Integrated etc. have been performed with the associated system components as they are described in the Catalogs and Configuration Manuals.

The certificates are only valid if the products are used with the described system components, are installed according to the Installation Guidelines and used for their intended purpose.

In other cases, the vendor of these products is responsible for arranging for the issue of new certificates.

Test code	Tested by	Device series/ Component	Test standard	Product category/ File-No.
UL: Underwriters Laboratories Independent public testing body in North America				
	UL according to UL standard	SINUMERIK	Standard UL 508, CSA C22.2 No. 142	NRAQ/7.E164110 NRAQ/7.E217227
		SIMOTION	Standard UL 508, CSA C22.2 No. 142	NRAQ/7.E164110
	UL according to CSA standard	SINAMICS	Standard UL 508, 508C, 61800-5-1 CSA C22.2 No. 142, 274	NRAQ/7.E164110, NMMS/2/7/8.E192450, NMMS/2/7/8.E203250, NMMS/7.E214113, NMMS/7.E253831
	UL according to UL and CSA standards			NMMS/2/7/8.E121068 NMMS/7.E355661 NMMS/7.E323473
	UL according to UL standard	SIMODRIVE	Standard UL 508C, CSA C22.2 No. 274	NMMS/2/7/8.E192450 NMMS/7.E214113
	UL according to CSA standard	SIMOTICS	Standard UL 1004-1, 1004-6, 1004-8, CSA C22.2 No. 100	PRGY2/8.E227215 PRHZ2/8.E93429 PRHJ2/8.E342747 PRGY2/8.E253922 PRHZ2/8.E342746
	UL according to UL and CSA standards			
		Line/motor reactors	Standard UL 508, 506, 5085-1, 5085-2, 1561, CSA C22.2 No. 14, 47, 66.1-06, 66.2-06	XQNX2/8.E257859 NMTR2/8.E219022 NMMS2/8.E333628 XPTQ2/8.E257852 XPTQ2/8.E103521 NMMS2/8.E224872 XPTQ2/8.E354316 XPTQ2/8.E198309 XQNX2/8.E475972
		Line filters, dv/dt filters, sine-wave filters	UL 1283, CSA C22.2 No. 8	FOKY2/8.E70122
		Resistors	UL 508, 508C, CSA C22.2 No. 14, 274	NMTR2/8.E224314 NMMS2/8.E192450 NMTR2/8.E221095 NMTR2/8.E226619
TUV: TUV Rheinland of North America Inc. Independent public testing body in North America, Nationally Recognized Testing Laboratory (NRTL) TÜV: TÜV SÜD Product Service Independent public testing body in Germany, Nationally Recognized Testing Laboratory (NRTL) for North America				
	TUV according to UL and CSA standards	SINAMICS	NRTL listing according to standard UL 508C	U7V 12 06 20078 013 U7 11 04 20078 009 U7 11 04 20078 010 U7 11 04 20078 011
		SIMOTION	NRTL listing according to standard UL 508	U7V 13 03 20078 01
		SIMODRIVE	NRTL listing according to standard UL 508C, CSA C22.2. No. 14	CU 72090702
		Motion Control Encoder	NRTL listing according to UL 61010-1 CSA C22.2 No. 61010-1	U8V 10 06 20196 024

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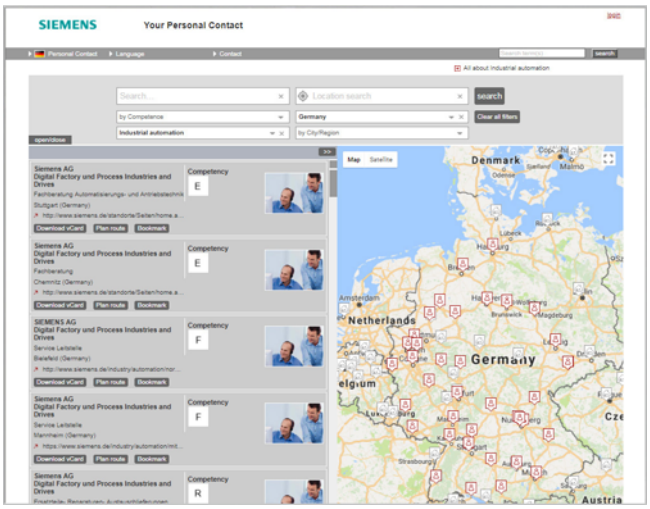
Overview (continued)

Test code	Tested by	Device series/ Component	Test standard	Product category/ File-No.
CSA: Canadian Standards Association Independent public testing body in Canada				
	CSA according to CSA standard	SINUMERIK	Standard CSA C22.2 No. 142	2252-01: LR 102527
FMRC: Factory Mutual Research Corporation Independent public testing body in North America				
	FM according to FM standard	SINUMERIK	Standard FMRC 3600, FMRC 3611, FMRC 3810, ANSI/ISA S82.02.1	–
EAC: Ivanovo-Certificate Independent public testing body in the Russian Federation				
	EAC in accordance with the EAC Directive	SINAMICS SINUMERIK SIMOTION	Standard IEC 61800-5-1/-2, IEC 61800-3	–
RCM: Australian Communications and Media Authority Independent public testing body in Australia				
	RCM according to EMC standard	SINAMICS SINUMERIK SIMOTION	Standard IEC AS 61800-3, EN 61800-3	–
KC: National Radio Research Agency Independent public testing body in South Korea				
	KC according to EMC standard	SINAMICS SINUMERIK SIMOTION	Standard KN 11	–
BIA Federal Institute for Occupational Safety				
–	Functional safety	SINAMICS SINUMERIK SIMOTION	Standard EN 61800-5-2	–
TÜV SÜD Rail				
–	Functional safety	SINAMICS SINUMERIK SIMOTION	Standard EN 61800-5-2	–

More information about certificates can be found online at:
https://support.industry.siemens.com/cs/ww/en/ps/cert

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Partner at Siemens



At your service locally, around the globe for consulting, sales, training, service, support, spare parts on the entire portfolio of Digital Industries.

Your partner can be found in our Personal Contacts Database at:
www.siemens.com/automation-contact

You start by selecting

- the required competence,
- products and branches,
- a country and a city

or by a

- location search or free text search.

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Overview

Software types

Software requiring a license is categorized into types.
The following software types have been defined:

- Engineering software
- Runtime software

Engineering software

This includes all software products for creating (engineering) user software, e.g. for configuring, programming, parameterizing, testing, commissioning or servicing.

Data generated with engineering software and executable programs can be duplicated for your own use or for use by third-parties free-of-charge.

Runtime software

This includes all software products required for plant/machine operation, e.g. operating system, basic system, system expansions, drivers, etc.

The duplication of the runtime software and executable programs created with the runtime software for your own use or for use by third-parties is subject to a charge.

You can find information about license fees according to use in the ordering data (e.g. in the catalog). Examples of categories of use include per CPU, per installation, per channel, per instance, per axis, per control loop, per variable, etc.

Information about extended rights of use for parameterization/configuration tools supplied as integral components of the scope of supply can be found in the readme file supplied with the relevant product(s).

License types

Siemens Industry Automation & Drive Technologies offers various types of software license:

- Floating license
- Single license
- Rental license
- Rental floating license
- Trial license
- Demo license
- Demo floating license

Floating license

The software may be installed for internal use on any number of devices by the licensee. Only the concurrent user is licensed. The concurrent user is the person using the program. Use begins when the software is started.
A license is required for each concurrent user.

Single license

Unlike the floating license, a single license permits only one installation of the software per license.

The type of use licensed is specified in the ordering data and in the Certificate of License (CoL). Types of use include for example per instance, per axis, per channel, etc.

One single license is required for each type of use defined.

Rental license

A rental license supports the "sporadic use" of engineering software. Once the license key has been installed, the software can be used for a specific period of time (the operating hours do not have to be consecutive).
One license is required for each installation of the software.

Rental floating license

The rental floating license corresponds to the rental license, except that a license is not required for each installation of the software. Rather, one license is required per object (for example, user or device).

Trial license

A trial license supports "short-term use" of the software in a non-productive context, e.g. for testing and evaluation purposes. It can be transferred to another license.

Demo license

The demo license support the "sporadic use" of engineering software in a non-productive context, for example, use for testing and evaluation purposes. It can be transferred to another license. After the installation of the license key, the software can be operated for a specific period of time, whereby usage can be interrupted as often as required.

One license is required per installation of the software.

Demo floating license

The demo floating license corresponds to the demo license, except that a license is not required for each installation of the software. Rather, one license is required per object (for example, user or device).

Certificate of License (CoL)

The CoL is the licensee's proof that the use of the software has been licensed by Siemens. A CoL is required for every type of use and must be kept in a safe place.

Downgrading

The licensee is permitted to use the software or an earlier version/release of the software, provided that the licensee owns such a version/release and its use is technically feasible.

Delivery versions

Software is constantly being updated.
The following delivery versions

- PowerPack
- Upgrade

can be used to access updates.

Existing bug fixes are supplied with the ServicePack version.

PowerPack

PowerPacks can be used to upgrade to more powerful software. The licensee receives a new license agreement and CoL (Certificate of License) with the PowerPack. This CoL, together with the CoL for the original product, proves that the new software is licensed.
A separate PowerPack must be purchased for each original license of the software to be replaced.

Upgrade

An upgrade permits the use of a new version of the software on the condition that a license for a previous version of the product is already held.
The licensee receives a new license agreement and CoL with the upgrade. This CoL, together with the CoL for the previous product, proves that the new version is licensed.
A separate upgrade must be purchased for each original license of the software to be upgraded.

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Software licenses

Overview (continued)

ServicePack

ServicePacks are used to debug existing products. ServicePacks may be duplicated for use as prescribed according to the number of existing original licenses.

License key

Siemens Industry Automation & Drive Technologies supplies software products with and without license keys.

The license key serves as an electronic license stamp and is also the "switch" for activating the software (floating license, rental license, etc.).

The complete installation of software products requiring license keys includes the program to be licensed (the software) and the license key (which represents the license).

Software Update Service (SUS)

As part of the SUS contract, all software updates for the respective product are made available to you free of charge for a period of one year from the invoice date. The contract will automatically be extended for one year if it is not canceled three months before it expires.

The possession of the current version of the respective software is a basic condition for entering into an SUS contract.

You can download explanations concerning license conditions from https://mall.industry.siemens.com/legal/ww/en/terms_of_trade_en.pdf

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Overview

The "General License Conditions for Software Products for Automation and Drives" are applicable for supplies and deliveries of DI software products.

Legal notes during setup for new software products

All software products feature a uniform reference to the license conditions. The license conditions are enclosed either with the documentation or in the software pack. When software is downloaded from the Internet, the license contract is displayed before the ordering procedure and must be accepted by the user before downloading can continue.

Notice:
This software is protected by German and/or US copyright laws and the regulations of international agreements. Unauthorized reproduction or sale of this software or parts of it is a criminal offense. This will lead to criminal and civil prosecution, and may result in significant fines and/or claims for damages. Prior to installing and using the software, please read the applicable license conditions for this software. You will find these in the documentation or packaging.

If you have received this software on a CD-ROM that is marked Trial version, or accompanying software that is licensed for your use, the software is only permitted to be used for test and validation purposes in accordance with the accompanying conditions for the trial license. To this end, it is necessary for programs, software libraries, etc. are installed on your computer. We therefore urgently recommend that installation is performed on a single-user computer or on a computer that is not used in the production process or for storing important data, since it cannot be completely excluded that existing files will be modified or overwritten. We accept no liability whatsoever for damage and/or data losses that result from this installation or the non-observance of this warning. Every other type of use of this software is only permitted if you are in possession of a valid license from Siemens is obtained.

If you are not in possession of a valid license that can be proven by presenting an appropriate Certificate of License/software product certificate, please abort installation immediately and contact a Siemens office without delay to avoid claims for damages.

Overview (continued)

Software update services

Order
To order the software update service, an article number must be specified. The software update service can be ordered when the software products are ordered or at a later date. Subsequent orders require that the ordering party is in possession at least of a single license.

Note:
It is recommended that the software update service is ordered as early as possible. If a new software version of a software product is released for delivery by Siemens, only those customers will receive it automatically who are entered in the appropriate delivery list at Siemens at this time. Previous software versions, or the current software version are not supplied when the software update service is ordered. The software update service requires that the software product is up-to-date at the time of completion of the contract for the software update service.

Delivery
When a software update service is ordered, you will be sent the contractual conditions of this service and the price is due for payment. At the same time, you will be included in a delivery list for the software product to be updated. If Siemens releases a new software version for the corresponding software product for general sale (function version or product version), it will be delivered automatically to the goods recipient specified in the delivery address within the contract period.

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Rotary inertia (to convert from A to B, multiply by entry in table)

A \ B	lb-in^2	lb-ft^2	lb-in-s^2	lb-ft-s^2 slug-ft^2	kg-cm^2	kg-cm-s^2	gm-cm^2	gm-cm-s^2	oz-in^2	oz-in-s^2
lb-in^2	1	6.94×10^{-3}	2.59×10^{-3}	2.15×10^{-4}	2.926	2.98×10^{-3}	2.92×10^{3}	2.984	16	4.14×10^{-2}
lb-ft^2	144	1	0.3729	3.10×10^{-2}	421.40	0.4297	4.21×10^{5}	429.71	2304	5.967
lb-in-s^2	386.08	2.681	1	8.33×10^{-2}	1.129×10^{3}	1.152	1.129×10^{6}	1.152×10^{3}	6.177×10^{3}	16
lb-ft-s^2 slug-ft^2	4.63×10^{3}	32.17	12	1	1.35×10^{4}	13.825	1.355×10^{7}	1.38×10^{4}	7.41×10^{4}	192
kg-cm^2	0.3417	2.37×10^{-3}	8.85×10^{-4}	7.37×10^{-5}	1	1.019×10^{-3}	1000	1.019	5.46	1.41×10^{-2}
kg-cm-s^2	335.1	2.327	0.8679	7.23×10^{-2}	980.66	1	9.8×10^{5}	1000	5.36×10^{3}	13.887
gm-cm^2	3.417×10^{-4}	2.37×10^{-6}	8.85×10^{-7}	7.37×10^{-8}	1×10^{-3}	1.01×10^{-6}	1	1.01×10^{-3}	5.46×10^{-3}	1.41×10^{-5}
gm-cm-s^2	0.335	2.32×10^{-3}	8.67×10^{-4}	7.23×10^{-5}	0.9806	1×10^{-3}	980.6	1	5.36	1.38×10^{-2}
oz-in^2	0.0625	4.34×10^{-4}	1.61×10^{-4}	1.34×10^{-5}	0.182	1.86×10^{-4}	182.9	0.186	1	2.59×10^{-3}
oz-in-s^2	24.13	0.1675	6.25×10^{-2}	5.20×10^{-3}	70.615	7.20×10^{-2}	7.09×10^{4}	72.0	386.08	1

Torque (to convert from A to B, multiply by entry in table)

A \ B	lb-in	lb-ft	oz-in	N-m	kg-cm	kg-m	gm-cm	dyne-cm
lb-in	1	8.333×10^{-2}	16	0.113	1.152	1.152×10^{-2}	1.152×10^{3}	1.129×10^{6}
lb-ft	12	1	192	1.355	13.825	0.138	1.382×10^{4}	1.355×10^{7}
oz-in	6.25×10^{-2}	5.208×10^{-3}	1	7.061×10^{-3}	7.200×10^{-2}	7.200×10^{-4}	72.007	7.061×10^{4}
N-m	8.850	0.737	141.612	1	10.197	0.102	1.019×10^{4}	1×10^{7}
kg-cm	0.8679	7.233×10^{-2}	13.877	9.806×10^{-2}	1	10^{-2}	1000	9.806×10^{5}
kg-m	86.796	7.233	1.388×10^{3}	9.806	100	1	1×10^{5}	9.806×10^{7}
gm-cm	8.679×10^{-4}	7.233×10^{-5}	1.388×10^{-2}	9.806×10^{-5}	1×10^{-3}	1×10^{-5}	1	980.665
dyne-cm	8.850×10^{-7}	7.375×10^{-8}	1.416×10^{-5}	10^{-7}	1.0197×10^{-6}	1.019×10^{-8}	1.019×10^{-3}	1

Length (to convert from A to B, multiply by entry in table)

A \ B	inches	feet	cm	yd	mm	m
inches	1	0.0833	2.54	0.028	25.4	0.0254
feet	12	1	30.48	0.333	304.8	0.3048
cm	0.3937	0.03281	1	1.09×10^{-2}	10	0.01
yd	36	3	91.44	1	914.4	0.914
mm	0.03937	0.00328	0.1	1.09×10^{-3}	1	0.001
m	39.37	3.281	100	1.09	1000	1

Power (to convert from A to B, multiply by entry in table)

A \ B	hp	Watts
hp (English)	1	745.7
(lb-in) (deg./s)	2.645×10^{-6}	1.972×10^{-3}
(lb-in) (rpm)	1.587×10^{-5}	1.183×10^{-2}
(lb-ft) (deg./s)	3.173×10^{-5}	2.366×10^{-2}
(lb-ft) (rpm)	1.904×10^{-4}	0.1420
Watts	1.341×10^{-3}	1

Force (to convert from A to B, multiply by entry in table)

A \ B	lb	oz	gm	dyne	N
lb	1	16	453.6	4.448×10^{5}	4.4482
oz	0.0625	1	28.35	2.780×10^{4}	0.27801
gm	2.205×10^{-3}	0.03527	1	1.02×10^{-3}	N.A.
dyne	2.248×10^{-6}	3.59×10^{-5}	980.7	1	0.00001
N	0.22481	3.5967	N.A.	100000	1

Mass (to convert from A to B, multiply by entry in table)

A \ B	lb	oz	gm	kg	slug
lb	1	16	453.6	0.4536	0.0311
oz	6.25×10^{-2}	1	28.35	0.02835	1.93×10^{-3}
gm	2.205×10^{-3}	3.527×10^{-2}	1	10^{-3}	6.852×10^{-5}
kg	2.205	35.27	10^{3}	1	6.852×10^{-2}
slug	32.17	514.8	1.459×10^{4}	14.59	1

Rotation (to convert from A to B, multiply by entry in table)

A \ B	rpm	rad/s	degrees/s
rpm	1	0.105	6.0
rad/s	9.55	1	57.30
degrees/s	0.167	1.745×10^{-2}	1

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Temperature Conversion

°F	°C	°C	°F
0	–17.8	–10	14
32	0	0	32
50	10	10	50
70	21.1	20	68
90	32.2	30	86
98.4	37	37	98.4
212	100	100	212
subtract 32 and multiply by $^5/_9$		multiply by $^9/_5$ and add 32	

Mechanism Efficiencies

Acme-screw with brass nut	~0.35–0.65
Acme-screw with plastic nut	~0.50–0.85
Ball-screw	~0.85–0.95
Chain and sprocket	~0.95–0.98
Preloaded ball-screw	~0.75–0.85
Spur or bevel-gears	~0.90
Timing belts	~0.96–0.98
Worm gears	~0.45–0.85
Helical gear (1 reduction)	~0.92

Friction Coefficients

Materials	μ
Steel on steel (greased)	~0.15
Plastic on steel	~0.15–0.25
Copper on steel	~0.30
Brass on steel	~0.35
Aluminum on steel	~0.45
Steel on steel	~0.58

Mechanism	μ
Ball bushings	<0.001
Linear bearings	<0.001
Dove-tail slides	~0.2++
Gibb ways	~0.5++

Material Densities

Material	lb-in^3	gm-cm^3
Aluminum	0.096	2.66
Brass	0.299	8.30
Bronze	0.295	8.17
Copper	0.322	8.91
Hard wood	0.029	0.80
Soft wood	0.018	0.48
Plastic	0.040	1.11
Glass	0.079–0.090	2.2–2.5
Titanium	0.163	4.51
Paper	0.025–0.043	0.7–1.2
Polyvinyl chloride	0.047–0.050	1.3–1.4
Rubber	0.033–0.036	0.92–0.99
Silicone rubber, without filler	0.043	1.2
Cast iron, gray	0.274	7.6
Steel	0.280	7.75

Wire Gauges[1)]

Cross-section mm^2	Standard Wire Gauge (SWG)	American Wire Gauge (AWG)
0.2	25	24
0.3	23	22
0.5	21	20
0.75	20	19
1.0	19	18
1.5	17	16
2.5	15	13
4	13	11
6	12	9
10	9	7
16	7	6
25	5	3
35	3	2
50	0	1/0
70	000	2/0
95	00000	3/0
120	0000000	4/0
150	–	6/0
185	–	7/0

1) The table shows approximate SWG/AWG sizes nearest to standard metric sizes; the cross-sections do not match exactly.

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Explanation of the raw material/metal surcharges[1)]

Surcharge calculation

To compensate for variations in the price of the raw materials silver, copper, aluminum, lead, gold, dysprosium[2)] and/or neodym[2)], surcharges are calculated on a daily basis using the so-called metal factor for products containing these raw materials. A surcharge for the respective raw material is calculated as a supplement to the price of a product if the basic official price of the raw material in question is exceeded.

The surcharges are calculated in accordance with the following criteria:

- Basic official price of the raw material
  Basic official price from the day prior to receipt of the order or prior to release order (daily price) for[3)]
  - Silver (sales price, processed)
  - Gold (sales price, processed)

  and for[4)]
  - Copper (lower DEL notation + 1 %)
  - Aluminum (aluminum in cables)
  - Lead (lead in cables)
- Metal factor of the products
  Certain products are displayed with a metal factor. The metal factor determines the official price (for those raw materials concerned) as of which the metal surcharges are applied and the calculation method used (weight or percentage method). An exact explanation is given below.

Structure of the metal factor

The metal factor consists of several digits; the first digit indicates whether the percentage method of calculation refers to the list price or a possible discounted price (customer net price) (L = list price / N = customer net price).

The remaining digits indicate the method of calculation used for the respective raw material. If no surcharge is added for a raw material, a "-" is used.

1st digit	List or customer net price using the percentage method
2nd digit	for silver (AG)
3rd digit	for copper (CU)
4th digit	for aluminum (AL)
5th digit	for lead (PB)
6th digit	for gold (AU)
7th digit	for dysprosium (Dy)[2)]
8th digit	for neodym (Nd)[2)]

Weight method

The weight method uses the basic official price, the daily price and the raw material weight. In order to calculate the surcharge, the basic official price must be subtracted from the daily price. The difference is then multiplied by the raw material weight.

The basic official price can be found in the table below using the number (1 to 9) of the respective digit of the metal factor. The raw material weight can be found in the respective product descriptions.

Percentage method

Use of the percentage method is indicated by the letters A-Z at the respective digit of the metal factor.

The surcharge is increased - dependent on the deviation of the daily price compared with the basic official price - using the percentage method in "steps" and consequently offers surcharges that remain constant within the framework of this "step range". A higher percentage rate is charged for each new step. The respective percentage level can be found in the table below.

Metal factor examples

L E A – – – – –

- Basis for % surcharge: List price
- Silver Basis 150 €, Step 50 €, 0.5 %
- Copper Basis 150 €, Step 50 €, 0.1 %
- No surcharge for aluminum
- No surcharge for lead
- No surcharge for gold
- No surcharge for dysprosium
- No surcharge for neodym

N – A 6 – – – –

- Basis for % surcharge: Customer net price
- No surcharge for silver
- Copper Basis 150 €, Step 50 €, 0.1 %
- Aluminum acc. to weight, basic offic. price 225 €
- No surcharge for lead
- No surcharge for gold
- No surcharge for dysprosium
- No surcharge for neodym

– – 3 – – – – –

- No basis necessary
- No surcharge for silver
- Copper acc. to weight, basic official price 150 €
- No surcharge for aluminum
- No surcharge for lead
- No surcharge for gold
- No surcharge for dysprosium
- No surcharge for neodym

1) Refer to the separate explanation on the next page regarding the raw materials dysprosium and neodym (= rare earths).
2) For a different method of calculation, refer to the separate explanation for these raw materials on the next page.
3) Source: Umicore, Hanau (www.metalsmanagement.umicore.com).
4) Source: Schutzvereinigung DEL-Notiz e.V. (www.del-notiz.org).

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Explanation of the raw material/metal surcharges for dysprosium and neodym (rare earths)

Surcharge calculation

To compensate for variations in the price of the raw materials silver[1], copper[1], aluminum[1], lead[1], gold[1], dysprosium and/or neodym, surcharges are calculated on a daily basis using the so-called metal factor for products containing these raw materials. The surcharge for dysprosium and neodym is calculated as a supplement to the price of a product if the basic official price of the raw material in question is exceeded.

The surcharge is calculated in accordance with the following criteria:

- Basic official price of the raw material[2]
  Three-month basic average price (see below) in the period before the quarter in which the order was received or the release order took place (= average official price) for
  - dysprosium (Dy metal, 99 % min. FOB China; USD/kg)
  - neodym (Nd metal, 99 % min. FOB China; USD/kg)
- Metal factor of the products
  Certain products are displayed with a metal factor. The metal factor indicates (for those raw materials concerned) the basic official price as of which the surcharges for dysprosium and neodym are calculated using the weight method. An exact explanation of the metal factor is given below.

Three-month average price

The prices of rare earths vary according to the foreign currency, and there is no freely accessible stock exchange listing. This makes it more difficult for all parties involved to monitor changes in price. In order to avoid continuous adjustment of the surcharges, but to still ensure fair, transparent pricing, an average price is calculated over a three-month period using the average monthly foreign exchange rate from USD to EUR (source: European Central Bank). Since not all facts are immediately available at the start of each month, a one-month buffer is allowed before the new average price applies.

Examples of calculation of the average official price:

Period for calculation of the average price:	Period during which the order/release order is effected and the average price applies:
Sep 2016 - Nov 2016	Q1 in 2017 (Jan - Mar)
Dec 2016 - Feb 2017	Q2 in 2017 (Apr - Jun)
Mar 2017 - May 2017	Q3 in 2017 (Jul - Sep)
Jun 2017 - Aug 2017	Q4 in 2017 (Oct - Dec)

Structure of the metal factor

The metal factor consists of several digits; the first digit is not relevant to the calculation of dysprosium and neodym.

The remaining digits indicate the method of calculation used for the respective raw material. If no surcharge is added for a raw material, a "-" is used.

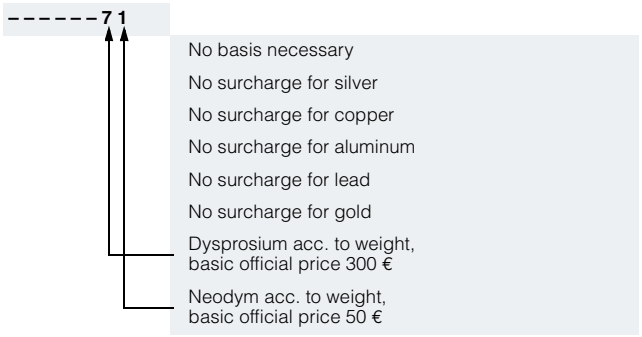
1st digit	List or customer net price using the percentage method
2nd digit	for silver (AG)[1]
3rd digit	for copper (CU)[1]
4th digit	for aluminum (AL)[1]
5th digit	for lead (PB)[1]
6th digit	for gold (AU)[1]
7th digit	for dysprosium (Dy)
8th digit	for neodym (Nd)

Weight method

The weight method uses the basic official price, the average price and the raw material weight. In order to calculate the surcharge, the basic official price must be subtracted from the average price. The difference is then multiplied by the raw material weight.

The basic official price can be found in the table below using the number (1 to 9) of the respective digit of the metal factor. Your Sales contact can inform you of the raw material weight.

Metal factor examples



[1] For a different method of calculation, refer to the separate explanation for these raw materials on the previous page.
[2] Source: Asian Metal Ltd (www.asianmetal.com)

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Values of the metal factor

Percentage method	Basic official price in €	Step range in €	% surcharge 1st step	% surcharge 2nd step	% surcharge 3rd step	% surcharge 4th step	% surcharge per additional step
			Price in €	Price in €	Price in €	Price in €	
			150.01 - 200.00	200.01 - 250.00	250.01 - 300.00	300.01 - 350.00	
A	150	50	0.1	0.2	0.3	0.4	0.1
B	150	50	0.2	0.4	0.6	0.8	0.2
C	150	50	0.3	0.6	0.9	1.2	0.3
D	150	50	0.4	0.8	1.2	1.6	0.4
E	150	50	0.5	1.0	1.5	2.0	0.5
F	150	50	0.6	1.2	1.8	2.4	0.6
G	150	50	1.0	2.0	3.0	4.0	1.0
H	150	50	1.2	2.4	3.6	4.8	1.2
I	150	50	1.6	3.2	4.8	6.4	1.6
J	150	50	1.8	3.6	5.4	7.2	1.8
			175.01 - 225.00	225.01 - 275.00	275.01 - 325.00	325.01 - 375.00	
O	175	50	0.1	0.2	0.3	0.4	0.1
P	175	50	0.2	0.4	0.6	0.8	0.2
R	175	50	0.5	1.0	1.5	2.0	0.5
			225.01 - 275.00	275.01 - 325.00	325.01 - 375.00	375.01 - 425.00	
S	225	50	0.2	0.4	0.6	0.8	0.2
U	225	50	1.0	2.0	3.0	4.0	1.0
V	225	50	1.0	1.5	2.0	3.0	1.0
W	225	50	1.2	2.5	3.5	4.5	1.0
			150.01 - 175.00	175.01 - 200.00	200.01 - 225.00	225.01 - 250.00	
Y	150	25	0.3	0.6	0.9	1.2	0.3
			400.01 - 425.00	425.01 - 450.00	450.01 - 475.00	475.01 - 500.00	
Z	400	25	0.1	0.2	0.3	0.4	0.1
	Price basis (1st digit)						
L	Calculation based on the list price						
N	Calculation based on the customer net price (discounted list price)						
Weight method	**Basic official price in €**						
1	50	Calculation based on raw material weight					
2	100						
3	150						
4	175						
5	200						
6	225						
7	300						
8	400						
9	555						
Miscellaneous							
-	No metal surcharge						

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Prices are subject to change without prior notice. We will charge the prices valid at the time of delivery.

To compensate for variations in the price of raw materials (e.g. silver, copper, aluminum, lead, gold, dysprosium and neodym), surcharges are calculated on a daily basis using the so-called metal factor for products containing these raw materials.
A surcharge for the respective raw material is calculated as a supplement to the price of a product if the basic official price of the raw material in question is exceeded.

The metal factor of a product indicates the basic official price (for those raw materials concerned) as of which the surcharges on the price of the product are applied, and with what method of calculation.

You will find a detailed explanation of the metal factor on the page headed "Metal surcharges".

To calculate the surcharge (except in the cases of dysprosium and neodym), the official price from the day prior to that on which the order was received or the release order was effected is used.

To calculate the surcharge applicable to dysprosium and neodym ("rare earths"), the corresponding three-month basic average price in the quarter prior to that in which the order was received or the release order was effected is used with a one-month buffer (details on the calculation can be found in the explanation of the metal factor).

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[1] The text of the Terms and Conditions of Siemens AG can be downloaded at
https://mall.industry.siemens.com/legal/ww/en/terms_of_trade_en.pdf

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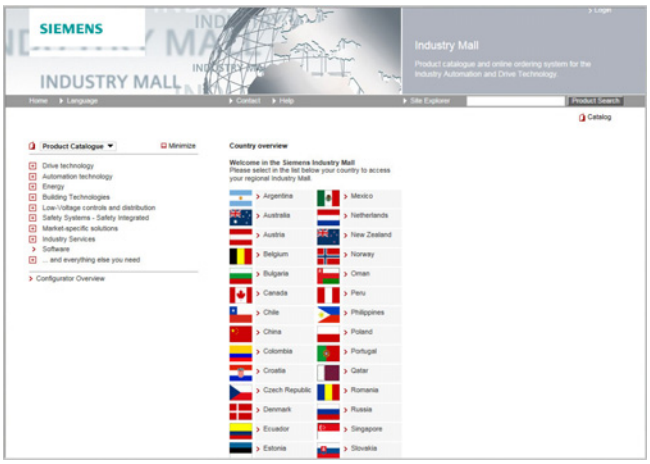
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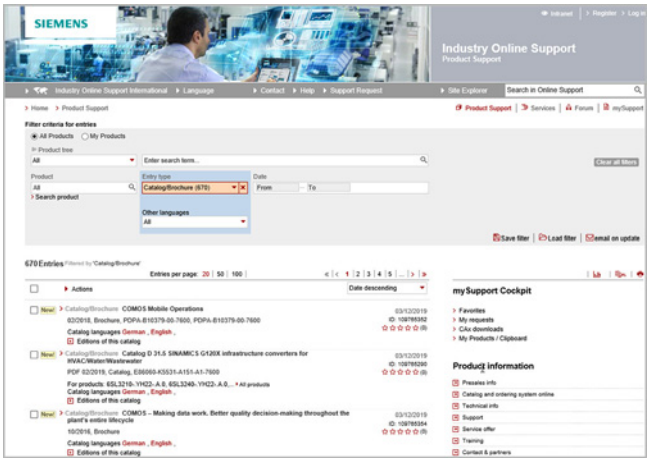
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