FANUC

CNC Series 30*i*/31*i*/32*i*

CNC Control Systems – Precise, Fast and Reliable

imagination at work

CNC Controls from the Market Leader:

GE Fanuc Automation

was founded in 1986 as a joint venture by General Electric Co. (GE), USA, and FANUC Ltd, Japan.

FANUC has more than 50 years of experience in production automation and is the world market leader in CNC technology.

FANUC Robotics, the world market leader in industrial robots, also belongs to the FANUC Group.

With its broad range of technology, manufacturing, and services, and 300,000 employees, GE is one of the largest companies in the world.

FANUC and GE Fanuc Automation develop and produce CNC systems for machine tools and other applications. The CNC control systems have an excellent reputation and are very popular with machine operators and users. To date, over 1.5 million CNC control systems have been sold world-wide, making FANUC and GE Fanuc the world number 1 for CNC control systems. The CNC product family includes control systems for entry-level machines as well as control systems for complex applications. GE Fanuc CNC control systems are known throughout the world for their high reliability, high precision, high speed and their simple operation.

FANUC – pioneer in this technology since the very beginning of CNC development:

- 1956 FANUC developed the first NC in the non-military sector.
- 1969 FANUC introduced the first fully modular CNC to the market.
- 1985 FANUC presented the CNC 0 Series – to date this is the most commonly used CNC in the world with sales of over 400,000 controls.
- 1997 Start of the *i* Series – the latest generation of high-precision, high-speed CNCs.
- 1999 FANUC launched the *is* series onto the market, the first CNC with Windows® CE.
- 2001 *i* Series MODEL B was introduced, the first CNC with an Ethernet interface as standard.
- 2003 Introduction of Series 30*i*, the fastest CNC, which controls up to 40 axes.
- 2004 Series 31*i* and 32*i* are added, offering the most up-to-date CNC technology for many types of machine.

Precise, Fast, Reliable and Easy to Use

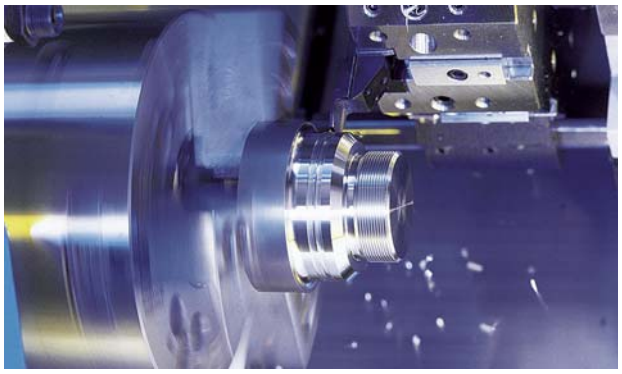
Both machine tool manufacturers and end users profit from the leading-edge technology of the *i* Series CNC. Thanks to the integrated LCD, the modular controls are ultra-compact and ultra-flat. The CNCs are equipped with an Ethernet interface as standard and have optional PC functionalities.

Highly integrated circuitry developed in-house contributes towards miniaturisation and a low component count. This contributes considerably to our renowned reliability and dependability.

Thanks to the limited number of components, the design of the control enclosure is simplified and requires a minimum of wiring.

If the control and the monitor are separated, an optical fibre connection provides failure-proof data interchange at distances of up to 100 m.

A similar optical fibre connection can also be utilised between the control and the drives. Digital technology throughout ensures that any data transfer can be performed quickly and loss-free.



Speed and precision

- Nano CNC system
- High-speed precision machining
- High-speed PMC
- 5-axis machining

Operator friendliness

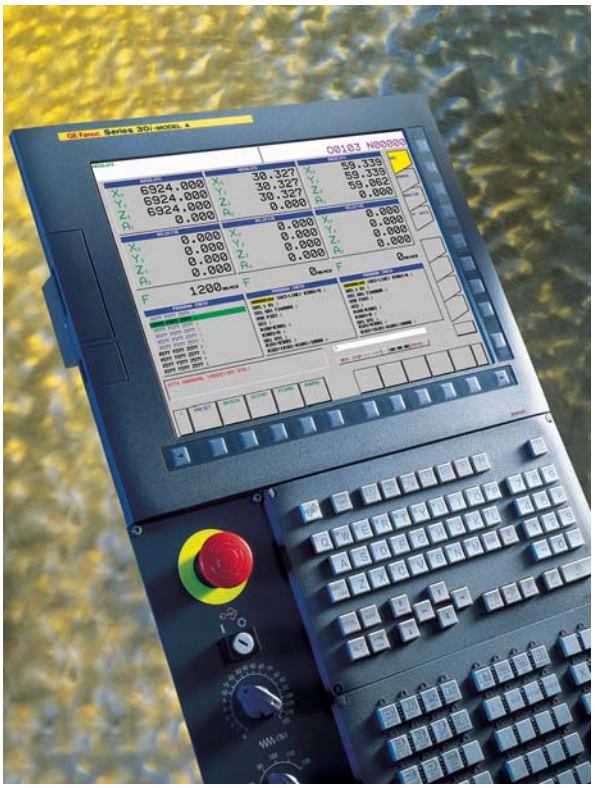
- Continuity in product development
- Ergonomic menu configuration
- Easy workshop programming

Openness and modularity

- Individual configuration
- Ethernet as standard
- Openness for components from other manufacturers

The Number 1 for the Most Demanding Applications

The Series 30*i* CNC control system is designed for highperformance machines based on the demands of machine tool manufacturers and machine operators. The control system is therefore ideal for modern, high-performance machines, requiring a large number of axes, multiple channels and complex and extremely fast functions. These include, for example, transfer machines, complex turning centres and multi-function machines for compound machining (turning and milling).



With high-tech in the 'fast lane': GE Fanuc Series 30*i*

The high-end CNC is the Series 30*i*, MODEL A. It is ideal for machine tool manufacturers and machine operators who expect that 'little bit extra' from a CNC control system. Utilising state-of-the-art technology, it offers the following features:

- Control of up to 40 axes, 24 of which may be interpolated simultaneously.
- Control of up to 10 paths.
- Up to 8 MB internal program – ideal for large programs, e.g. for Die & Mould.
- 25 nanoseconds per step execution time for PMC (machine interface) programs.
- Up to three PMC programs executed at the same time, with up to 4096 digital inputs and outputs.
- Faster interpolation times and up to 1000-block look-ahead for accurate contour control.
- Less than 30 seconds start-up time, from the moment the CNC is switched on.

The Right Choice for Many Machines

Offering compatible upgrade paths for current models, the Series 31*i* and 32*i* control systems have greatly enhanced specifications and are therefore ideally suited to many types of machine. Developed and manufactured to renowned standards of quality and reliability, these control systems offer solutions which include the ability to execute even more CNC programs simultaneously, improved surface handling and increased speed and user-friendliness.

Multi-talented CNCs: GE Fanuc Series 31i and 32i

The new GE Fanuc Series 31*i*-Model A CNC controls up to 20 axes and 6 spindles. Up to 4 paths are supported. Each path can be individually selected for milling, turning or loading processes, with a maximum of 12 controlled axes per path. With the Series 31*i*-A5, up to 5 axes can be controlled simultaneously.

The new Series 32*i*-Model A CNC controls up to 9 axes and 2 spindles, with 2 paths and a maximum of 6 axes per path.

The Series 31*i* and 32*i* have inbuilt PMC sequence control units with execution speeds of 25 ns/step for ladder programs, and the capability of executing up to 3 ladder programs simultaneously.

High Speed with Extremely High Precision

To minimise machining time, speed and precision of axial movement are particularly important. Precision and speed are features which would appear to contradict each other.

However, with the development of the Series 30*i*/31*i*/32*i* CNC control system, a level has been reached where high precision is achieved at a very fast machining speed.

Fast hardware

To attain short machining times, a fast machine control system is required. In this respect, the Series 30*i*/31*i*/32*i* CNC set new standards: they use a new, special high-speed processor, a faster internal bus and faster servo control.

The new technologies guarantee faster cycle times during interpolation, a 1000-block look-ahead for precise contour control, and block processing times of just 0.4 mS.

Integrated PLC/PMC (Programmable Machine Control)

An integrated, ultra-fast PMC processor controls and monitors the rapid and smooth operation of all machine peripheral devices. The PMC sequence control offers execution speeds of 25 ns/step for ladder logic programs, up to three of which can be executed at the same time.

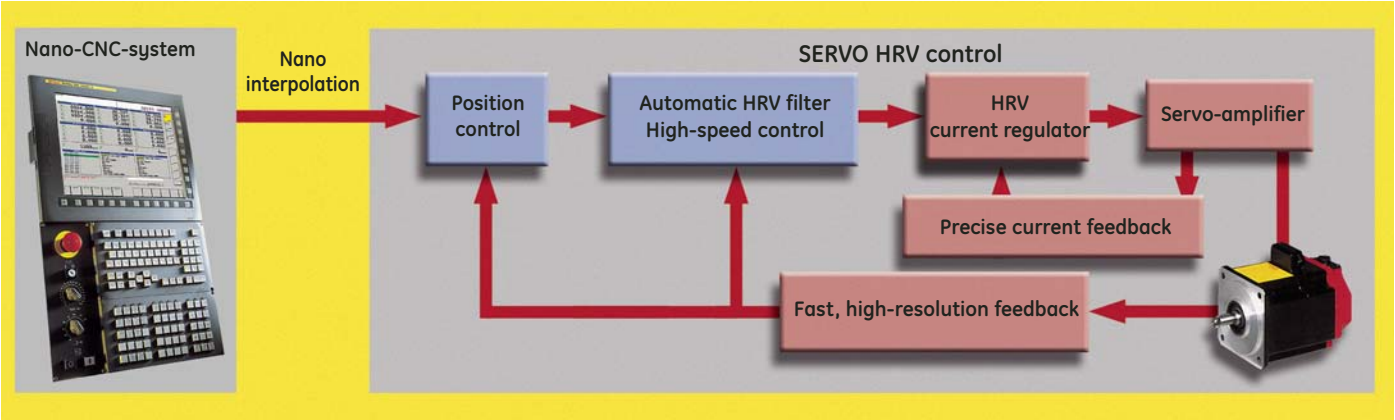
Precision in the nanometre range

No matter how accurate your machine, the Series 30*i*/31*i*/32*i* will satisfy your needs: even extremely high precision in the nanometre range is easily fulfilled by the control systems.

Nano-interpolation is responsible for improving the precision and surface quality of a part and is enhanced by: fast cyclic updates of both servo and spindle control, and high resolution pulse coders with 16,000,000 pulses per revolution.

Nano-interpolation calculates position commands in nanometres and is available for both turning and milling operations.

A further 'nano' function is nano smoothing, which optimises conventional three-axis, short block programs. Using this function, the control system records the original linear path segments and places an interpolated NURBS curve over them. This means that the milled surface has less irregularities, marks or 'shadows'.



5-axes machining

To save on machining production costs, machine tools are increasingly used with five simultaneously controlled axes. It is not only the reduction in fixturing and part set-up that constitute a savings potential: the efficient Series 30*i*/31*i* CNC also have functions to make implementation of five-axes machining easier and more efficient.

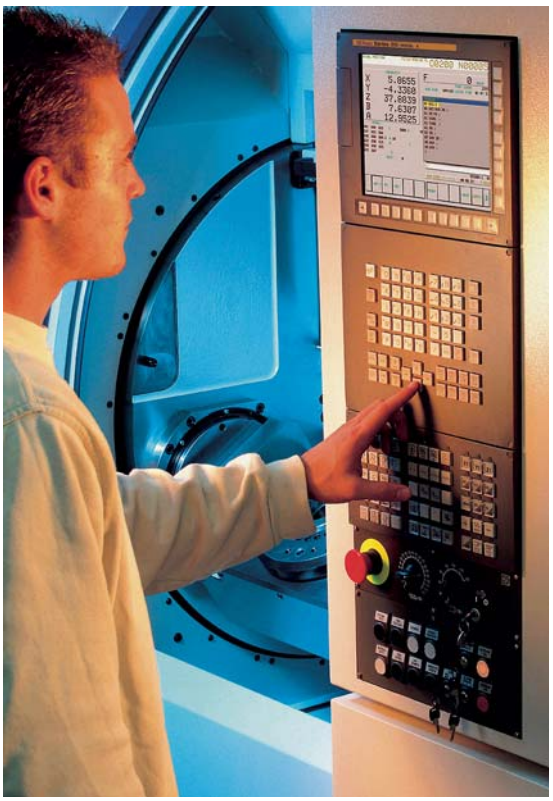
Special functions:

- Tilted working plane allows the simple transformation of coordinates from the conventional machining plane to an orientation to suit the part – without the need for complex re-programming.
- Tool length compensation with tool centre point control, and cutter radius compensation for five-axes simultaneous machining. This negates the need for re-calculation of the tool path in the CAM module during tool replacement, thus increasing productivity. Combining this with an automatic feed and anti-jerk control allows you to achieve high accuracy and excellent surface finish with very fast machining times.

Simple and Convenient to Operate

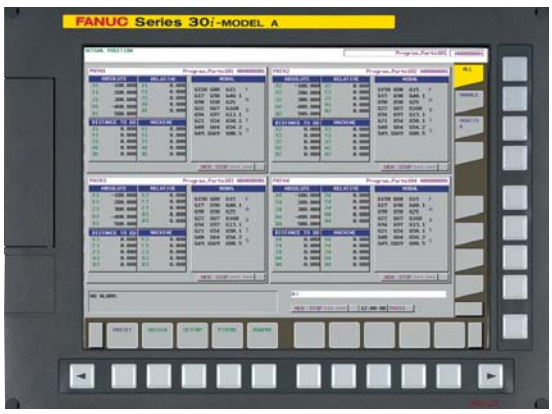
Operators benefit from the renowned continuity in product development at FANUC and GE Fanuc. During development of the Series 30*i*/31*i*/32*i* CNC, emphasis was placed, as always, on ease-of-use.

If users have already worked with FANUC or GE Fanuc CNCs, they will quickly become familiar with the Series 30*i*/31*i*/32*i* CNC. Upward compatibility of the software is guaranteed and even older programs run on the new control systems without any problems. And there are many further benefits to the user.



15 inch monitor & softkeys

The Series 30*i*/31*i*/32*i* CNC come complete with a large 15 inch colour LCD monitor. It can display more information in a clearly laid out form, especially for complex machines and machines with a large number of axis. To guarantee mounting compatibility with earlier models, the new control system series is also available with a 10.4 inch, 8.4 inch or 7.2 inch LCD. Various softkeys on the display facilitate handling of the control system. The buttons for screen selection are arranged vertically. Various machining masks can be called up, using the softkeys on the horizontal edge of the monitor.



Simple language selection

Without switching the CNC off, the user can change the language at any time. The CNC 30*i*/31*i*/32*i* currently supports the following 15 languages:

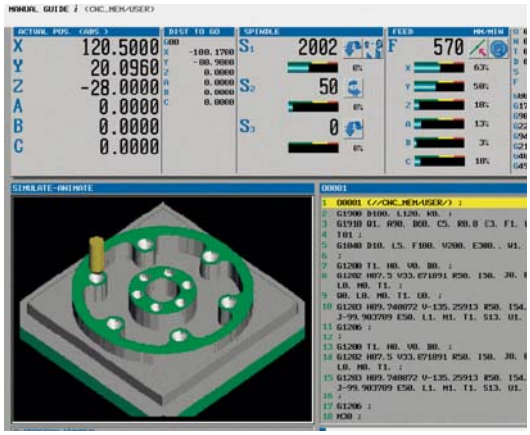
German, English, French, Italian, Spanish, Portuguese, Dutch, Danish, Hungarian, Polish, Swedish, Czech, Japanese, Chinese and Korean.

Fast Shop-floor Programming

The user-friendly shop-floor programming software, Manual Guide *i*, facilitates and improves the work of the machine operator. This innovative programming environment enables the completion of work, from the drawing right through to the manufactured article, within the shortest time possible. Using Manual Guide *i*, the CNC can be programmed very easily and quickly for turning, milling or compound machining.

Some of the benefits which Manual Guide *i* has to offer for cycle programming are:

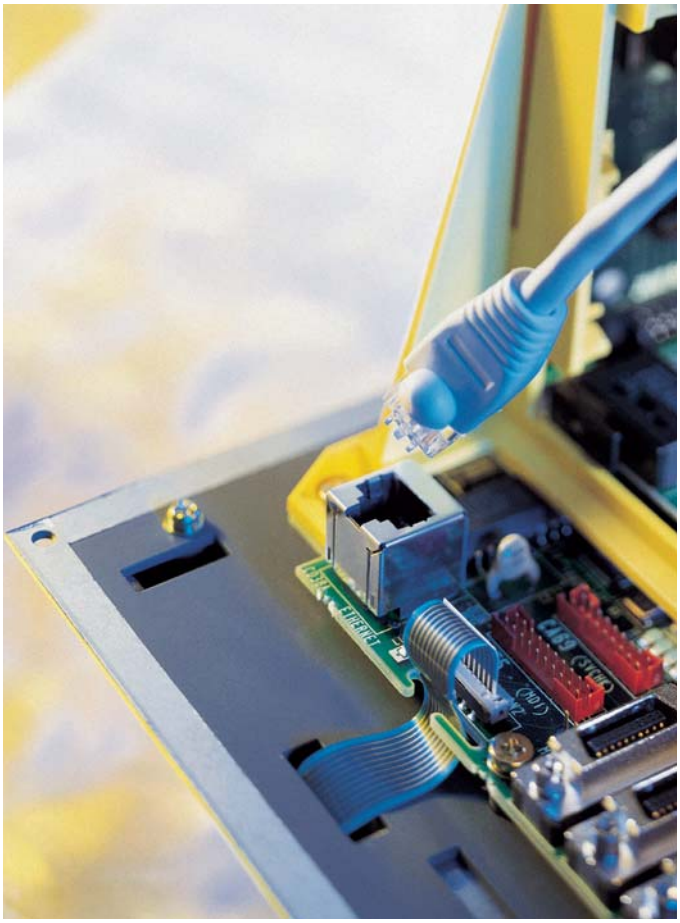
- All the relevant information is presented on one single CNC screen. There is no need to switch constantly between several different screens, and users do not run the risk of losing their way in a multitude of pop-up windows.
- Self-explanatory icons ensure that users can work intuitively. Even a skilled worker without any special CNC programming experience can create a program without the aid of documentation.
- Any workpieces to be processed can be constructed graphically on the screen in interactive mode and simulated using the solid model.
- The NC programs generated can be edited as if using a word processing program – program sections can be cut and pasted at will.



High memory capacity

Up to 8 MB of internal program memory can be assigned for large programs. This memory is not lost even if the control system is switched off.

The Series 30*i*/31*i*/32*i* CNC can be upgraded with additional memory. Slots have been provided for an ATA Flash (maximum 2 GB*) or Compact Flash storage card (maximum 512 MB*). Furthermore, the CNCs can be connected to a GE Fanuc Fast Data Server with up to 2 GB* of ATA Flash memory.



Protection against operating errors & regular back-up

To exclude the possibility of operating errors before the start of CNC machining, the control system carries out various plausibility tests. This involves a check of operator input as well as the program and machine status.

The Series 30*i*/31*i*/32*i* CNC guarantees simple maintenance because user data can be backed-up regularly in the Flash memory.

High-Speed-Ethernet 'on board'

As with the other control systems in the Series *i*, the Series 30*i*/31*i*/32*i* CNC have an on-board Ethernet interface. This allows the user to integrate the CNC control systems in the company network, to supply the control system with programs from a server, and to evaluate the production data. World-wide links can be set up via the Internet. This makes remote diagnosis and maintenance, including online training, possible.

* Situation 1/2004

Flexible Application and Improved Safe

Open communication to field components

CNC control system in the Series 30*i*/31*i*/32*i* are open at the field level. Via conventional bus systems (Profibus DP, DeviceNet, I/O Link II, FL-net), any of your own, or external I/O components, can be connected.

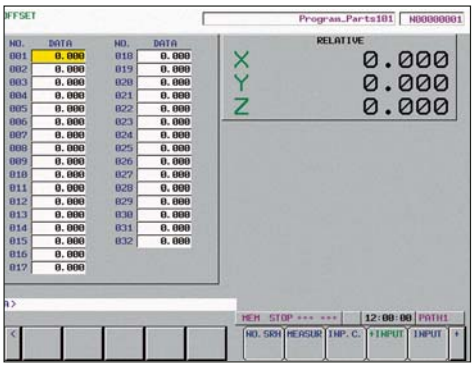
Customer-specific adaptation

The CNC control systems in the Series 30*i*/31*i*/32*i* have various tools for the customisation of special applications. This gives machine tool manufacturers flexibility and the option to arrange the control system interface to suit their requirements and to introduce their own functions.

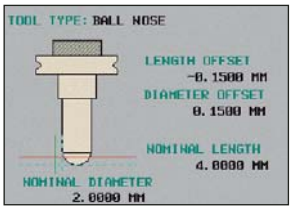
Special screens can be created using C-Executer (the programming language is C) and these may be used instead of, or in combination with, the standard CNC screens. The utility program FANUC PICTURE assists users in setting up their own screens by arranging predefined icons as display components and operator selection buttons.

Macros that use M and G codes can also be created. In this way, users are offered fixed cycles, which can be called up at the push of a button.

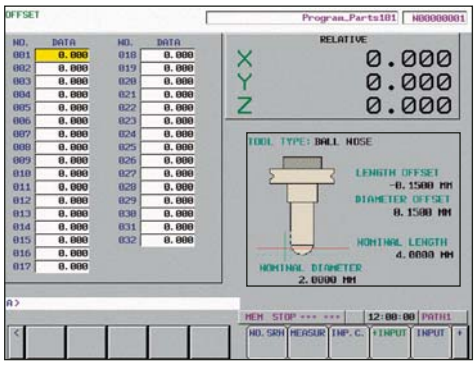
The machine tool manufacturer can also influence the machine control. For example, applications can be developed that are closely aligned to the machine ladder logic program.



Tool offset compensation input mask



Customer-specific control system interface



Customer-specific template

ety

Open CNC

At FANUC and GE Fanuc, the designation 'Open CNC' refers to the optimised combination of CNC and PC via a serial high-speed interface, which allows transfer of large volumes of data.

The Series 30*i*/31*i*/32*i* CNC have two 'open' versions: The 300*i*/310*i*/320*i* are an open, high-performance CNCs under Windows® 2000/XP.

The Series 300*is*/310*is*/320*is* use the industry-compatible Windows® CE.NET, which does not require a hard disk.

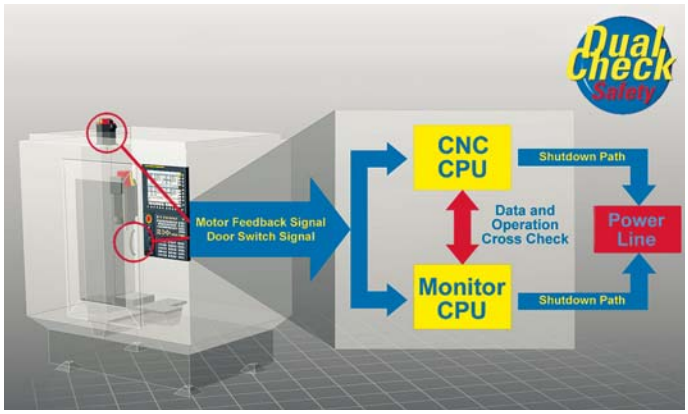
Both models support the fast protocol FOCAS2 (FANUC Open CNC API Specification Version 2) for exchanging data between the CNC and the PC.

An open CNC enables the use of individual applications on machines that have to be adapted by machine tool manufacturers to special customer requirements. Open CNC permits individual operation via the graphical user interface (GUI) for CNC machine tools, the exchange of large volumes of data via networks, tool file management on a database, and many more functions.

Integrated safety

Present day machine tools usually have to comply with safety category 3 (EN 954-1). With Dual Check Safety, the Series 30*i*/31*i*/32*i* have a safety function integrated in the CNC that complies with European safety standards.

Using in-built redundancy, a special processor for monitoring safety-related parameters guarantees the safety of the system by following the actual position and speed of the servomotors, spindle motors and the I/O interfaces. One advantage of this software solution is that more space is created in the switching cabinet, as previously required mechanical components are no longer needed.



Dual Check Safety, basic functions:

- Redundant brake monitoring
- Safe speed (4 stages)
- Safe stop
- Secure position
- Secure cams
- Safe I/Os

Technical Data

	30*i* / 300*i* / 300*is*
Maximum number of controlled axes	40
Maximum number of servo-axes	32
Maximum number of controlled spindle axes	8
Maximum number of simultaneously interpolated axes	24
Maximum number of controlled paths	10
Power Mate CNC Manager for additional axes on I/O LINK	•
Maximum part program memory length	8 MB
Maximum resolution 0.0001 mm, 0.0001 degrees, 0.00001 inches	•
Maximum resolution 0.00001 mm, 0.00001 degrees, 0.000001 inches	•
Maximum resolution 0.000001 mm, 0.000001 degrees, 0.0000001 inches	•
Maximum look-ahead	1000 blocks
PMC system	SB7
µs per step	0.0025
Maximum PMC paths (simultaneous program processing)	3
Maximum number of steps	112000 for 3 paths
Maximum number of I/O points	4096/4096
I/O modules for operating field installation	•
Autonomous field bus I/O modules	•
PMC axis control	•
Number of available extension plug-in cards (version with LCD)	0 or 2
Number of available extension plug-in cards (stand-alone version)	2 or 4
Available additional extension plug-in cards	Axis card PROFIBUS DP DeviceNet Fast Ethernet/Data Server I/O Link II FL-net
Integrated Ethernet port	•
Open CNC-System	• (300*i*/300*is*)
Integrated safety 'Dual Check Safety'	•
Data communication	RS232 DNC1, DNC2 Ethernet PROFIBUS-DP DeviceNet I/O Link II FL-net AS-*i*
PCMCIA slot accessible from front side	ATA Flash storage card CompactFlash™ storage card Ethernet card Modem card
Standard display	
Monochrome LCD display for ONG-type keyboard	7.2 inches
TFT-LCD colour display for ONG-type keyboard	8.4 inch or 10.4 inch
TFT-LCD colour display for QWERTY-type keyboard	10.4 inch or 15 inch
PCMCIA accessible from front side	•
USB accessible from front side	• (10.4 inch or 15 inch)
CNC display with Windows® (only 300*i*, 310*i*, 320*i*)	
Processor	Intel® Celeron™/Pentium®
Memory	up to 512 MB
Hard disk minimum capacity	40 GB
Operating system	Windows® 2000 or XP
ATAPI ports	2
Floppy disk port	1
PCMCIA port accessible from front side	1
USB ports accessible from front side	2
USB port accessible from rear side	1
Serial ports	2
Parallel port	1
Ethernet port (100BASE-TX)	1
Keyboard port	1
Mouse port	1
TFT-LCD colour display for QWERTY-type keyboard	10.4 inch or 15 inch
Maximum screen resolution	640 x 480 (10.4 inch) 1024 x 768 (15 inch)

Some of the above-listed functions are optional. They depend on the CNC configuration and cannot be used in combination with other functions. To balance availability and compatibility, please contact one of our sales partners. A detailed list of all functions is contained in the manual 'Descriptions' of the Series 30*i*/31*i*/32*i* CNC.

31*i* / 31*i* - A5 / 310*i* / 310*is*	32*i* / 320*i* / 320*is*
26	11
20	9
6	2
12	5
4	2
•	•
8 MB	2 MB
•	•
•	•
•	
1000 blocks	80 blocks
SB7	SB7
0.0025	0.0025
3	3
112000 for 3 paths	112000 for 3 paths
3072/3072	3072/3072
•	•
•	•
•	•
0 or 2	0 or 2
2 or 4	2 or 4
Axis card	Axis card
PROFIBUS DP	PROFIBUS DP
DeviceNet	DeviceNet
Fast Ethernet/Data Server	Fast Ethernet/Data Server
I/O Link II	I/O Link II
FL-net	FL-net
•	•
• (310*i*/310*is*)	• (320*i*/320*is*)
•	•
RS232	RS232
DNC1, DNC2	DNC1, DNC2
Ethernet	Ethernet
PROFIBUS-DP	PROFIBUS-DP
DeviceNet	DeviceNet
I/O Link II	I/O Link II
FL-net	FL-net
AS-*i*	AS-*i*
ATA Flash storage card	ATA Flash storage card
CompactFlash™ storage card	CompactFlash™ storage card
Ethernet card	Ethernet card
Modem card	Modem card
7.2 inches	7.2 inches
8.4 inch or 10.4 inch	8.4 inch or 10.4 inch
10.4 inch or 15 inch	10.4 inch or 15 inch
•	•
• (10.4 inch or 15 inch)	• (10.4 inch or 15 inch)
Intel® Celeron™/Pentium®	Intel® Celeron™/Pentium®
up to 512 MB	up to 512 MB
40 GB	40 GB
Windows® 2000 or XP	Windows® 2000 or XP
2	2
1	1
1	1
2	2
1	1
2	2
1	1
1	1
1	1
1	1
10.4 inch or 15 inch	10.4 inch or 15 inch
640 x 480 (10.4 inch)	640 x 480 (10.4 inch)
1024 x 768 (15 inch)	1024 x 768 (15 inch)

	30*i* / 300*i* / 300*is*
CNC display with Windows® CE.Net 4.1 (only 300*is*, 310*is*, 320*is*)	
Processor	HITACHI SH-4
Memory	64 MB or 128 MB
File storage	CompactFlash™ card
TFT-LC colour display for QWERTY-type keyboard	10.4 inch or 15 inch
Maximum screen resolution	640 x 480 (10.4 inch) 1024 x 768 (15 inch)
USB port	2
Ethernet port (100BASE-TX)	1
PCMCIA accessible from front side	1
Touchscreen	•
Hand device, machine operating field	•
PMC C-language	•
CNC Macro Executor	•
CNC customer macro	•
CNC C-language Executor	•
Dialogue programming MANUAL GUIDE *i*	•
Display	
Graphic display	•
Multi-path display	•
Status/program/parameter	•
PMC monitoring and editing	•
Servo and spindle device	•
Alarm/operating archive	•
Remote diagnosis	•
Support for several languages	•
Customer-specific configuration	•
Milling functions	•
Turning functions	•
Combination machining function	•
Electronic gear unit/generating milling cutter functions	•
Grinding functions	•
Tool functions	•
Measuring functions	•
Operating prompting for machine set-up functions	•
Accuracy compensation functions	•
Linear interpolation/circular interpolation	•
Exponential interpolation	•
Helix interpolation	•
Involute interpolation	•
Cylindrical interpolation	•
Polar coordinate interpolation	•
Interpolation with imaginary axis	•
Taper/helical interpolation	•
Sliding interpolation	•
Nano interpolation	•
NURBS interpolation	•
5-axes machining functions	•
3D circular interpolation	•
Nano smoothing	•
Extended Look-Ahead control system	•
AI continuous-path control, type I (look-ahead)	30 blocks
AI continuous-path control, type II (look-ahead)	200 blocks
Look-ahead extension for AI continuous-path control, type II	600 or 1000 blocks
Anti-jerk control	•
Rigid Tapping	•
Axis Synchronisation	•
Tandem control	•
Extended tandem control functions	•
Torque control	•
Extended acceleration/delay control functions	•

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31*i* / 31*i* -A5 / 310*i* / 310*is*	32*i* / 320*i* / 320*is*
HITACHI SH-4	HITACHI SH-4
64 MB or 128 MB	64 MB or 128 MB
CompactFlash™ card	CompactFlash™ card
10.4 inch or 15 inch	10.4 inch or 15 inch
640 x 480 (10.4 inch)	640 x 480 (10.4 inch)
1024 x 768 (15 inch)	1024 x 768 (15 inch)
2	2
1	1
1	1
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30 blocks	30 blocks
200 blocks	80 blocks
600 or 1000 blocks	
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Automation from a single source

GE Fanuc can supply you with everything an automated machine tool needs – CNC control systems, amplifiers, servomotors and spindle motors, I/O modules, stationary and mobile operating devices and the relevant cables. Robot solutions from FANUC Robotics can be combined with the CNC control system solutions without any problems. We are therefore the only supplier in the world who can offer you complete automation for the whole machine from a single source. All products are designed as a system and are perfectly tuned to one another to achieve top performance.

Our extensive Service Operation provides support to our customers effectively all over the world. Our portfolio extends from application support and training to spare parts supply and maintenance. Further information is available from the addresses listed below.

GE Fanuc Automation Information Centers

USA and the Americas:
1- 800-GE FANUC
or (434) 978-5100

Europe, Middle East and Africa:
(352) 727979-1

Asia Pacific:
86-21-3222-4555

Additional Resources

For more information, please visit the GE Fanuc web site at:
www.gefanuc.com