High reliability and high cost-performance Nano CNC

FANUC Series Oi - MODEL D
FANUC Series Oi Mate - MODEL D
High reliability and high cost-performance Nano CNC

**FANUC Series 0i-MODEL D**

**FANUC Series 0i Mate -MODEL D**

FANUC Series 0i / FANUC Series 0i Mate are the high reliability and high cost-performance Nano CNCs.

**FANUC Series 0i-MD**

Suitable CNC for Machining center
Max. total number of control axes: 8 axes *1

**FANUC Series 0i-TD**

Suitable CNC for lathe
Max. total number of control axes in 1path system: 8 axes *1
Max. total number of control axes in 2path system: 11 axes *1

**FANUC Series 0i Mate-MD**

Suitable CNC for Machining center
Max. total number of control axes: 5 axes *1

**FANUC Series 0i Mate-TD**

Suitable CNC for lathe
Max. total number of control axes: 5 axes *1

(*1: Total number of control axes means the total of the numbers of feed axes and spindle axes. Refer to Specifications about the maximum feed axis number and the maximum spindle axis number of each CNC.)
High reliability and high cost-performance Nano CNC

- Packages of the most efficient CNC features
- Leading-edge technology achieves ultra-compact CNC with simplified cables and high-reliability
- Cost-performance oriented configuration with \( \beta \) series servo
- Network by Embedded Ethernet as basic \(^*2\)
- Integrated safety function
  Dual Check Safety \(^*2\)

Excellent operation

- Integrated Operation & Programming Guidance with extremely simplified operations
  \textbf{FANUC MANUAL GUIDE \( \iota \) \(^*2\)}
- Programming Guidance with extremely simplified operations
  \textbf{FANUC MANUAL GUIDE \( \alpha \iota \)}
- Integrated Operation Guidance for NC program-less conventional lathe machining
  \textbf{FANUC TURN MATE \( \iota \)}
- Direct editing and operation program in Memory Card

Enriched control functions

- Basically mounted Nano interpolation enhances surface smoothness
- High-speed, High-precision, High-quality machining with AI contour control and Nano Smoothing \(^*2\)
- Suitable for various machines from general machining center / lathe to 2-path lathe \(^*2\)
- Machining condition selecting function for achieving desired machining easily

Plenty of customize functions

- C language executor for customizing CNC display and operation \(^*2\)
- FANUC PICTURE for easy creating machine operation screen \(^*2\)
  
  \(^*2\) \( \alpha \iota \) only

Advanced digital servo technology

- SERVO HRV3 Control for high speed and high precision
- SPINDLE HRV3 Control for quick acceleration and response
- “One-shot setting” “One-shot tuning” for powerfully support Startup and Tuning of CNC system
- Quick & smart tuning
  \textbf{FANUC SERVO GUIDE}
- Energy saving by power source regeneration, use of latest low loss device and high efficiency of servo & spindle control
Advanced Technology on Hardware

Ultra-Compact CNC with Simplified Cables, High-reliability

Ultra-compact CNC is realized through LCD display with integrated CNC. A few number cables are provided for ultra high-speed serial communication. The adoption of ECC technology, which corrects an error during data transfer, realizes further high reliability.

Ultra Compact, Ultra Thin CNC
The small-size CNC integrated with the LCD display realizes the quite thin CNC control unit in depth of 70mm (in case of no optional slot).

High number-crunching Power
Data processing capacity is improved remarkably by the latest high-speed microprocessor. Therefore, this CNC realizes the state-of-the-art features, such as Nano Interpolation, High-Speed & High-precision Machining, Integrated Safety Function and so on, without additional hardware.

High reliability Hardware
Aggressive adoption of ECC (Error Correction Code) technology, which corrects an error generated by the noise, realizes further high reliability.

Embedded Ethernet as basic
Series 0i is equipped with Embedded Ethernet as basic. It becomes easy to make a network in factory. The Fast Ethernet board can be mounted as an option.

PCMCIA interface
Easy setup and maintenance operation are available by using PCMCIA interface on the front of LCD display. Memory card editing/operation can be performed with a compact flash card completely stored in the CNC control unit.

- Saving and restoring CNC data with memory card
- Memory card editing/operation
- FANUC LADDER-Ⅲ and FANUC SERVO GUIDE are available by connecting PC via PCMCIA LAN card.
reliability.

**FANUC AC SERVO MOTOR**

High cost-performance AC SERVO MOTOR suited to feed axis of machine tools

- Smooth rotation and compact size
- Quick acceleration and deceleration
- High speed servo motors for live tool added to line-up
- Compact and high-resolution \( \beta \) series Pulsecoder

**FANUC AC SPINDLE MOTOR**

High cost-performance AC SPINDLE MOTOR suited to spindle axis of machine tools

- Achieving high power and high torque with compact size
- High efficiency and low heat generation by SPINDLE HRV Control
- Achieving the same torque as \( \beta \) series by \( \beta \) series with smaller amplifier

**FANUC SERVO AMPLIFIER**

High reliability and high cost-performance SERVO AMPLIFIER

- High cost-performance all-in-one type amplifier with 3-axis servo and 1-axis spindle
- All-in-one structure reducing the number of wiring cables
- Line-up with 2-axis servo models and 3-axis servo model Cs contouring control applied to sensor configuration with \( \alpha l \) Position coder for position feedback
- Energy saving by power source regeneration, use of latest low loss device and high efficiency of servo & spindle control

**Stand-alone type**

Machine Tool Builder can develop individual and intelligent machine tools by using Stand-alone type Series \( 0i-D \) combining with PANEL \( i \) featuring personal computer functions.

**FANUC Serial Servo Bus (FSSB)**

High-speed and noise tolerant optical communication is adopted for the connection between CNC and amplifiers. Moreover FANUC original communication protocol and ECC technology are incorporated. High-reliability and high-speed communication realizes high-performance and simplified cable connecting.

**FANUC I/O Link**

The FANUC I/O Link is an I/O network used to establish a serial I/O connection with various I/O devices. General-purpose I/O, I/O module for operator’s panel, SERVO AMPLIFIER \( \beta l \) series for additional axes control and so on can be connected.

**Easy maintenance**

Detachable fan motor and battery realize further easy maintenance.
High performance

High-Speed, High-Quality Machining

NANO Interpolation

The NANO interpolation generates position commands for digital servo control in nanometer. This enables smooth path in position commands for digital servo control and enhances surface smoothness.

![Diagram of NANO Interpolation and CNC System](image)

- **CNC**: NC Program → NANO Interpolation → Servo HRV Control → Machine Tool
- **NANO Interpolation**: Calculate position precisely
- **Smooth position command in nanometer unit**: High Gain Servo Control

Tapering at an X:Y ratio of 3:1

**Conventional Type**

![Graph comparing Conventional Type and NANO Interpolation](image)

- **X(μm)**: 0, 3, 6, 9
- **Y(μm)**: 1, 2, 3, 4

**NANO Interpolation**

- **1 div = 1 nano**

Al contour control

Al contour control achieves the optimum feedrate and acceleration/deceleration control by looking ahead multi-blocks of the part program. This can perform high-speed machining of complex free-form curved surfaces of aircraft, automobile parts and metal dies that are specified in continuous small blocks.

Jerk control

At a corner which is not sharp but has a large jerk, feedrate can be controlled automatically so that mechanical shock is reduced. And very smooth acceleration/deceleration can be executed. Enhanced smooth motion can reduce mechanical shock to improve surface finish.

Machining condition selecting function

Desired machining can be achieved easily by tuning between highest velocity and highest precision.

![Precision level selection screen](image)

- **Highest velocity** → **Precision Level 1** → **Precision Level 5** → **Precision Level 10** → **Highest Precision**
Nano smoothing
The desired path is estimated by NURBS curves within a tolerance from minute line command points created by a CAD/CAM system and interpolated in nanometer unit. This gives a smooth machined surface approximate to the designed figure and reduces manual finishing processes. And a minute line segment program is used, so the previously used programs can be executed without modifications.

For quality, precision and feedrate level adjustments, machining surface quality level adjustment screen is provided, which is designed so that every user can perform intuitive and easy operations. By using the cursor keys, the user can find the degree of the adjusted level to the current setting at a glance.

Enriched CNC functions

Spindle control with servo motor
Spindle functions such as rotation command of spindle and rigid tapping etc. are realized by servo motor.

Tool management function
A tool management data table for managing a variety of tool data and a cartridge management table for defining the relationships between tool numbers and set numbers enable the integrated management of tool information.

Unexpected disturbance torque detection function
The disturbance torque is detected becoming unexpected level by a machine collision, etc. and axis stops immediately or returns to the opposite direction. This reduces the machine damage.

Composite control
Move commands can be interchanged between an axis in one path and an axis in the other path.
High performance

Advanced digital servo technology

SERVO Motor System

SERVO AMPLIFIER \( \alpha i \) series

AC SPINDLE MOTOR \( \alpha i \) series

SERVO AMPLIFIER \( \beta l \) series

AC SPINDLE MOTOR \( \beta l \) series

SERVO HRV3 Control

High speed and high precision servo control
By combination of hardware technology such as “Servo motor with ultra smooth rotation”, “Accurate current detection”, “High response and high resolution Pulescorder”, and software technology such as the latest servo control HRV3 (as standard), high speed and high precision control with nano-meter level is ensured. Mechanical resonance can be suppressed by Auto-following HRV filter even though its frequency is changed.

SPINDLE HRV3 Control

Quick acceleration and response spindle control
High response and high precision spindle control is achieved with fast velocity loop processing and high resolution detector circuit.
In rigid tapping with high response control and feed-forward, reduced synchronous error and shorter cycle time are expected.
Optimum spindle orientation minimizes orientation time, under condition of various load inertia also by making always full use of spindle motor torque.

FANUC SERVO GUIDE

Quick & smart tuning of servo and spindle
This software provides the integrated environment for making test programs, setting parameters, and data measurement needed for servo and spindle tuning. It is useful not only for servo tuning but also for the measurement of spindle characteristic.
It has substantial automatic tuning functions for gains filters, and others.
With SERVO GUIDE, quick and smart optimization of servo and spindle can be achieved.
Excellent Operation

User friendly operation and assistance

Program Editing

The CNC program can be edited easily by PC like operation such as cut and paste. The operator can edit the CNC program efficiently. The operating CNC program can be confirmed safely by the reference mode of background editing.

Memory Card / Data Server Editing • Operation

The programs stored in a memory card and Data Server can be edited by the CNC edit functions and can be executed as well as the programs in built-in CNC program memory. Memory card and Data Server can be used as large-capacity program memory together with built-in CNC memory.

Data Server is for 0i only.

Support of Multiple Languages and Dynamic Display Language Switching

If different operators display in different languages, the display language can be changed to another with a simple operation without turning the power to the CNC off. This function eliminates the need for stopping the machine at the change of operators, which improves work efficiency.

The CNC operation screen supports 18 languages.
Excellent Operation

Integrated Operation & Programming Guidance with extremely simplified operations

**FANUC MANUAL GUIDE i**

MANUAL GUIDE i is an integrated operation guidance, which provides handy operation guidance from programming through machine operation on one single screen. It can be applied to lathe, milling machine and machining center.

- Integrated operating screen
- ISO code part programming
- Powerful program editing functions
- Various machining cycles
- Realistic machining simulation
- Set-up guidance
- Multi-path lathe function

Free figure input screen  Machining simulation screen

Programming Guidance with various machining cycles

**FANUC MANUAL GUIDE Oi**

MANUAL GUIDE Oi is a part programming guidance, which is concentrated to the functionality for creating a part program, and it pursues the extreme simple operation. It can be applied to lathe, milling machine and machining center.

- ISO code part programming
- G-code and M-code assistance
- Various machining cycles
- Contour programming

Cycle selection screen  Hole position input screen

Integrated Operation Guidance for NC program-less conventional lathe machining

**FANUC TURN MATE i**

TURN MATE i has accomplished NC program-less turning operation for conventional lathe. It is possible to carry out turning easily only by following guidance drawings on screen and inputting data.

- Plain all in one screen
- Application to display with and without touch panel
- Various machining cycles
- Sequential execution of machining cycles (Max. 20)
- NC program conversion function of machining cycles

Cycle selection screen  Cycle data input screen
Network Support Functions

With plenty of network functions, you can construct an optimum system for CNC machine tools

**High-speed Ethernet**

Embedded Ethernet of 100 Mbps is supported as a basic function. CNC can be connected to a personal computer to transfer NC programs and monitor CNC status. The Fast Ethernet board can be mounted as an option. Data can be transferred simultaneously among multiple computers at a high speed. These features are suited to construct a production system which exchanges information among machining lines and factory host computer.

**Fast Data Server**

NC programs can be stored in the built-in compact flash card in the Fast Data Server for high-speed machining. Other Ethernet functions can be used simultaneously with operation with the Data Server.

- High speed transfer between Data Server and PC
- Up to 4 G bytes capacity for storing NC programs
- Memory operation and program editing

**Field network**

The following field networks are supported, which allows user-specified system construction and peripheral incorporation.

- FL-net
- PROFIBUS-DP(Master/Slave)
- DeviceNet(Master/Slave)
Powerful built-in PMC

**Built-in PMC function**

**High-speed and large capacity ladder**
The large capacity built-in PMC, with Max. 32,000 ladder steps for 0i or Max 8,000 ladder steps for 0i Mate, is available for complex sequence control of machine and peripheral devices. The PMC and the CNC are connected with high-speed internal bus closely and this enables to transfer various data between PMC and CNC at a high speed.

**Extended PMC Ladder Instruction function**
The enhanced computation instructions enable to program complex sequence control of machine into a simple ladder circuit with high readability. The new function helps reduce redundant descriptions of relay contacts and coils, thereby reducing the number of nets and steps of ladder program. The enhanced PMC function enables to correspond flexibly to an abundant array of machine sequence control requirements and realizes efficient ladder development and maintenance by machine tool builders.

**Function Block function**
This function enables to call up repeatedly used ladder circuit patterns in blocks. By combining multiple Function Blocks, machine tool builders can create complex ladder programs more efficiently, as if assembling components, with fewer steps for ladder program development and fewer ladder diagram drawings for maintenance.

![Extended PMC Ladder Instruction function](image1)

![Function Block function](image2)

**Positive Safety Measures**

**Dual Check Safety**
Dual Check Safety, incorporated into the CNC, is a safety function that conforms to the international safety standard (IEC 61508 SIL2). This function offers a high level safety by using multiple microprocessors that redundantly monitor the actual servo motor position/speed, the actual spindle speed and safety-related input/output and by providing duplicate paths of breaking power for the servo/spindle amplifier.

![Setting Screen](image3)

![Axis status display](image4)

**Prevention of Operator Errors**
Various types of checks are made and many confirmation messages are displayed for CNC operation, which prevents unintentional operator errors from occurring.
Plenty of Customize Functions

Customize the machine tools uniquely

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C language executor

Machine tool builders can create their own operation screens, which enables unique CNC display and operation.

- C language is used for programming.
- Operation screens using the touch panel can be created.
- In addition to standard ANSI functions, many functions are available for CNCs and PMCs.

FANUC PICTURE

FANUC PICTURE enables a machine operation screen to be created only by pasting screen components such as buttons and lamps on the personal computer.

- An easy-to-use user interface that is unique to FANUC and close to the operability of Visual Basic is provided.
- A screen usable on a display unit with and without a touch panel can be created.
- A created screen is executed by the C language executor.

Machine operation menu

The machine operator’s panel can be implemented by the CNC soft keys. This makes the operator's panel more compact and machine functions can be easily added or changed.

- A hierarchical menu can be structured and a maximum of 210 buttons can be created.
- The machine operation menu can easily be created using the definition file without special programming.

FANUC LADDER- III

For machine customization, a machine tool builder’s own sequence control can be incorporated into the built-in PMC. A PMC sequence program can be created on the personal computer by using FANUC LADDER- III, the highly easy-to-use programming tool with many useful functions.

- A program can be created with ladder and function block.
- A program can be coded using signal names instead of signal addresses.
- Online monitoring and editing can be performed by connecting the personal computer with the CNC via Ethernet. (PCMCIA LAN card is necessary to connect with Oi Mate.)
Easy Setup and Maintenance

Powerfully support Startup and Tuning of CNC system

Parameter Setting Support Screen

Parameter Setting Support Screen powerfully supports the necessary parameter setting for start-up and adjustment of CNC, Servo and Spindle. In menu screen, various setting and adjustment screens are selected by the cursor operation, and the parameter is set on each screen.

“One-shot setting” for Servo axes and “One-shot tuning” of Velocity gain

The recommended parameters for high speed and high precision machining can be set only by pressing soft-key once. Practically enough precision can be achieved with only this “One-shot setting”. If higher precision is required, stable and optimum velocity gain for each machine can also be set automatically by only pressing soft-key for Parameter Tuning of Velocity Gain.

“One-shot setting” for Spindle axes

The initial parameters for start-up of spindle can be set by “One-shot setting”. The necessary parameters are set automatically by inputting spindle configuration items, such as motor model, maximum speed, sensors. This screen supports the initial setting also for the optimum orientation function and the parameters for high speed rigid tapping.
# Powerful Software Tools

Support development of machine tool builders in a variety of fields such as simulation and data management

## Simulation Tools Supporting Utilization of High-Level CNC Functions

Software tools for CNC operation simulation on the personal computer are provided to fully utilize the ever advancing CNC functions. Two types of packages are available to meet applications:

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<th>FANUC NCGuide</th>
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<td>For application software development</td>
<td>FANUC NCGuidePro</td>
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### FANUC NCGuide (Training tool that enables learning of CNC / MANUAL GUIDE ｉ operations)

The FANUC NCGuide is a software tool that enables training of CNC/MANUAL GUIDE ｉ operations on the personal computer without using an actual CNC. This software tool allows operators to be trained without using an actual machine tool. This software tool can also be used for CNC training in school.

- CNC and MANUAL GUIDE ｉ training is possible.
- Machining programs and machining cycles can be edited in the EDIT mode.
- Machining simulation (animated simulation and tool path drawing) is possible.

### FANUC NCGuidePro (Development tool that supports PMC ladder and customized software debugging)

The FANUC NCGuidePro is a development support tool that enables ladder to be executed on the personal computer. Moreover, the C language executor and macro executor can be executed, so that this development support tool can be used to debug a custom screen created by a machine tool builder.

- PMC ladder can be executed on PC.
- Ladder debugging operation interacting with the CNC simulation is enabled.
- Ladder editing and display interacting with FANUC LADDER-Ⅱ are possible.
- PMC axis control simulation is possible.
- Customized software created with FANUC PICTURE, C language executor, or macro executor can be executed.

## FANUC Program Transfer Tool

FANUC Program Transfer Tool is a software tool for transferring part programs and data by connecting PC and CNC via Ethernet.

Files in the CNC program memory are displayed on the tool in an easy-to-understand way, so input/output operation can be easily performed with a mouse.

## FANUC CNC Setting Tool

FANUC CNC Setting Tool is a software tool used to set and manage CNC parameters on a personal computer. Parameters can be set and managed efficiently without referring to the manual.

- Parameters are classified by the CNC function.
- Detailed explanation is displayed by selecting a parameter.
- CNC parameter is transmitted via Ethernet or memory card.
Maintenance and Customer Support

Worldwide Customer Service and Support

FANUC operates customer service and support network worldwide through subsidiaries and affiliates. FANUC provides the highest quality service with the prompt response at any location nearest you.

FANUC Training Center

FANUC Training Center operates versatile training courses to develop skilled engineers effectively in several days.
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