Multi-axis high speed response CNC for Industrial Machine

FANUC
Power Motion *i*
–MODEL A Plus

Multi-axis high speed response motion controller for industrial machines

FANUC Power Motion *i*-MODEL A Plus

Max. number of paths : 10 paths (*)
Max. total number of controlled axes : 32 axes
Max. number of simultaneous controlled axes : 4 axes

(*) Updates from **Power Motion** *i*-**MODEL A**

Easier to use, beautiful and powerful
Contributes to improving productivity and energy saving of industrial machines

Multi-axis high speed response motion control

- Further improved high speed response motion control with High-speed CPU
- Shortened cycle time by quick axis start/stop
- Improved accuracy for machines that require high speed operation by quick response to an external signal
- Shortened cycle time by high speed ladder execution cycle

Improving custom macros (*)

- Easier to use, such as adding array variables and SWITCH-CASE syntax
- High-speed CPU greatly improves the performance of custom macros

Functions for industrial machines

- Supports up to 32 axes by PMC axis control function that can be executed independently for each axis
- Shortened cycle time by acceleration/deceleration specification feed
- Position control, torque control, speed control, and pressure control can be performed to support various machines.
- Electronic cam function enables to downsize the machine and improve maintainability by replacing mechanical CAM with servo motor.

  Examples:
  ・ Press machines   ・ Die cushions   ・ Loaders   ・ Body assembly line
  ・ Wire saws   ・ Winding machines   ・ Filling machines   ・ Winding machine
  ・ Packing/wrapping machines   ・ Stamping machines
  ・ Press fitting machine   ・ Inserter   ・ Printing machine
  ・ Various dedicated machines
  ・ Replace hydraulic/Air cylinders with servo motor, etc.

Functions for press machines

- Easily control the link type servo press
- Improved forming quality by high accuracy pressure control
- Coordinated motion of transfer system with press machine can be performed easily by electric CAM function
- Easily replace hydraulic drive to servo drive with press related unctions

Servo motors and servo amplifiers

- Servo motors, DD motors, and linear motors line-up from small to large models can support to various industrial machines
- Servo amplifiers achieve significant energy savings with power source regeneration and the latest low–loss power devices

Extensive I/O unit lineup (*)

- Wide range of I/O units including **FANUC Slice I/O** can support various industrial machines

FANUC Power Motion *i*-**MODEL A Plus**

Servo Amplifier Achieving Energy Savings

Servo motors   wide range line-up

Variety of customized functions (*)

- With standardized easy to used **FANUC PICTURE**, original sophisticated screens can be created very easily.
- A highly reliable capacitive touch panel that supports multi-touch enables consolidation and miniaturization of the operation panel.
- Individualize industrial machines with C language executors
- Built-in high-speed, large-capacity multi-path PMC, and assets can be reused with the function block function.

Various types of field networks (*)

- Advancing the IoT adaptability with Multi-function Ethernet and various types of field networks
- Communication with PC and robot can be performed easily via embedded Ethernet
- Various information of machines can be collected and managed by using **FIELD system Basic Package**

Easy connection and control of robots (*)

- Easy connection with Industrial machine and robot（**Robot ON-SITE**）
- Robot can be controlled by G code command from CNC（**Robot G-CODE**）
- Robot path can be automatically generated by PC tool （**Robot Auto Path Generation**）

Advancing Energy saving (*)

- Advancing significant energy savings through servo motorization of hydraulic/pneumatic mechanisms
- Constant monitoring Power Consumption of industrial machine by Power Consumption Monitor function

Superior safety functions

- Integrated safety functions facilitate safety of machine by Dual Check Safety (DCS)
- Integration of motion control and safety
- Conformity with International Safety Standard "Functional Safety" ISO13849-1

High reliability and easy maintainability (*)

- Hardware built for high reliability allows robust operation in harsh industrial environments
- Enhanced diagnostics improve maintainability so the cause of trouble can be identified quickly reducing MTTR
- USB port can be used to transfer files or upload/download data in the controller using easily obtainable USB flash drives

System Configuration

CNC Control Unit (LCD mounted type/stand-alone type)

The display line-up supports a wide range of machines, from compact to large, including the FANUC *i*PC and PANEL *i*H/*i*H Pro with *i*HMI support, a 10.4" LCD unit, and more.

FANUC *i*PC 24″

FANUC *i*PC 21.5″

FANUC *i*PC 15″

PANEL *i*H/*i*H Pro 19″/15″/10.4″ LCD

Standard display 10.4″ LCD

Handheld Unit

Equipped with an emergency stop button and a manual pulse generator, this handy unit line-up achieves safe manual operation of machine tools.

*i*Pendant

Handy Machine Operator's Panel

Portable manual pulse generator

PC

USB memory

Handheld unit

Industrial machines

Operator's panel

Control cabinet

CNC control unit

FSSB

FANUC I/O Link *i*

Servo Amplifier

Servo Motor

I/O unit

Field networks

CNC

Robot

Peripheral device

Peripheral equipment

Compatible with various field networks
・FL-net
・EtherNet/IP
・PROFINET
・Modbus/TCP
・CC-Link IE Field
・DeviceNet
・PROFIBUS-DP
・CC-Link
・EtherCAT

Servo Motor

Line-up to meet the various needs of industrial machines and contribute to the energy saving and performance improvement of feed axes

SERVO MOTOR α*i*-D series

DD MOTOR D*i*S-B series

LINEAR MOTOR L*i*S-B series

Servo Amplifier

Line-up to be flexibly available for a variety of industrial machines and contribute to the downsizing of cabinets and energy saving

SERVO AMPLIFIER α*i*-D series

I/O Unit

Wide range of I/O units compatible with various installation locations and I/O devices.

Optimized for operator's panels with its thin and space-saving design

Standard operator's panel with key input duplication

Handles the output/input of safety signals

Compatible with original operator's panels
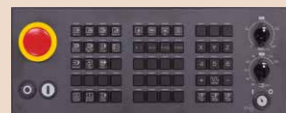
Safety Machine operator's panel

I/O module for operator's panel supporting safety function

I/O module for operator's panel

Optimized for control cabinets with high scalability and extensive modules such as the multi-point output/input type and the analog/digital output/input module

Small size I/O unit with improved expandability, workability and maintainability
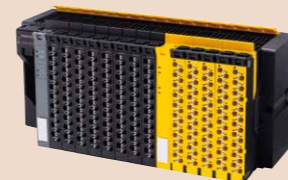
Excellent cost performance with multi-point output/input

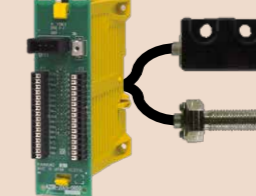Compact and with reduced wiring

Effective for thermal displacement compensation with multi-point temperature sensor input

FANUC Slice I/O

I/O unit for power magnetics cabinet

I/O unit for connector panel

Temperature sensor input unit
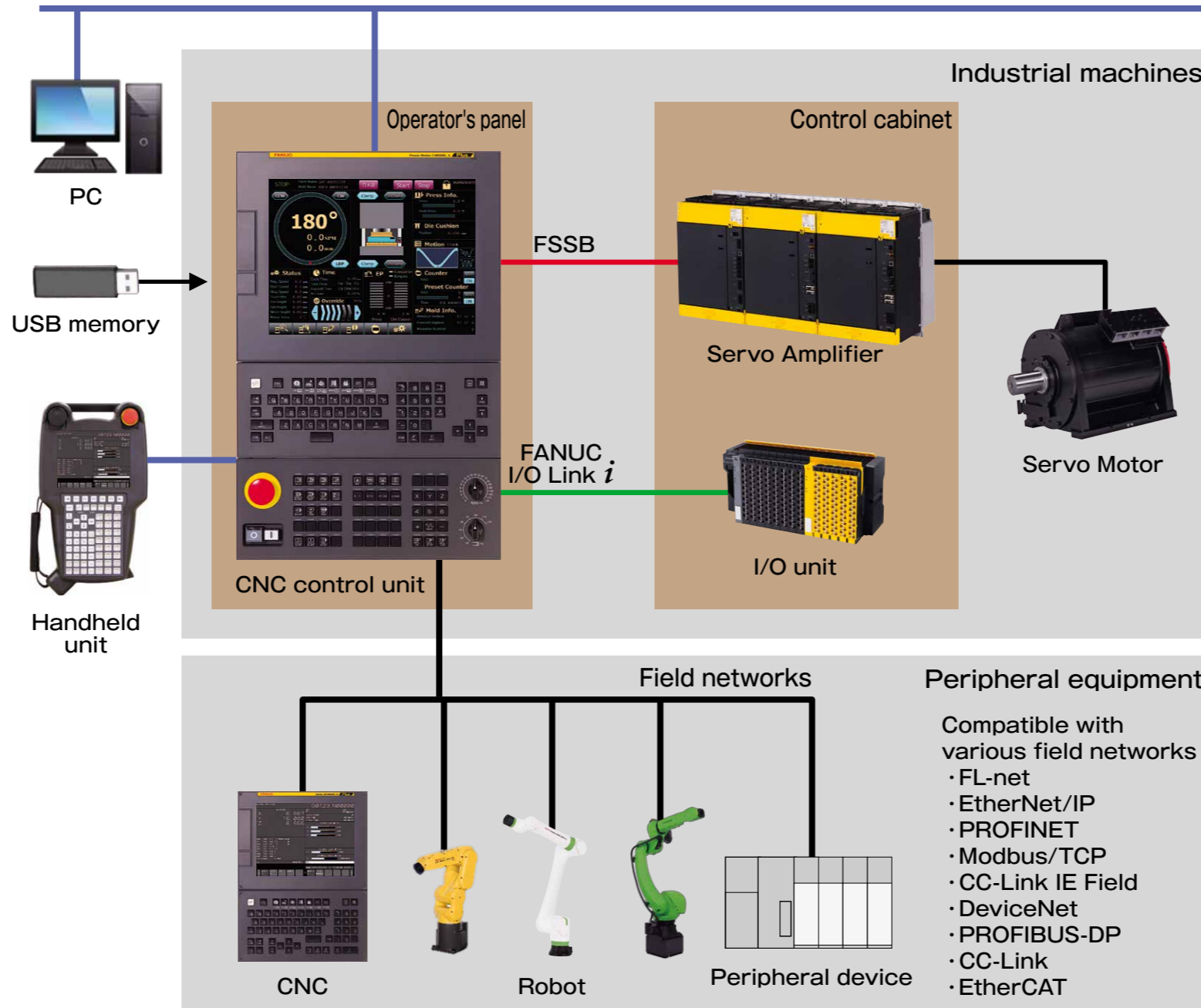
Optimized for reduced wiring by enabling distributed setup

Can be positioned near sensors scattered inside and outside the machine cabinet

IP67 type

I/O Unit-MODEL B

Intelligent Servo System with High-Speed, Precision and Efficiency

Promoting High-Speed, Precision, Compact Size and High Efficiency of Industrial Machines

FANUC SERVO MOTOR αi-D series
DD MOTOR Dis-B series , LINEAR MOTOR Lis-B series

SERVO MOTOR, DD Motor and Linear Motor Achieving Servo Drive and High-Speed/High Precision Feed for Industrial Machines

● **Wide range of sizes**

Servo Motor: Motor ranges with continuous torque from 0.16Nm to 18000Nm
DD Motor: Motor range with continuous torque from 15Nm to 4500Nm
Linear Motor : Motor range with peak force from 300N to 21000N

Large servo motors with high torque and high power are suited to large industrial machines. It contributes to the use of electric servos in hydraulic/pneumatic mechanisms, high-speed, high-precision, and energy-saving.

FANUC SERVO AMPLIFIER αi-D series

Compact and Energy Saving Servo Amplifier

● **Compact size**

Downsizing of amplifier is achieved by optimum cooling design, also contributing to control cabinet downsizing.

● **Energy saving**

Power consumption is largely reduced by full line regeneration back to power source.
Reduction in power loss is achieved by using the latest high efficiency power devices.

● **Technology for larger output**

Large servo motors can be driven by multiple standard large servo amplifiers.
Supporting larger output application by multiple motor drive.

Reduce capacity of power source by Energy Charge Unit

● **Cutting peak power of power source**

Large servo motor needs high power to accelerate. This function provides power from buffering motor to driving motor, and can cut peak power from power source. By using FANUC SERVO MOTOR with high efficiency as buffering motor, the whole system is high efficiency.

Cutting peak power of power source

Buffering motor
Power from buffering motor

Power source Power supply Servo amplifier Large servo motor
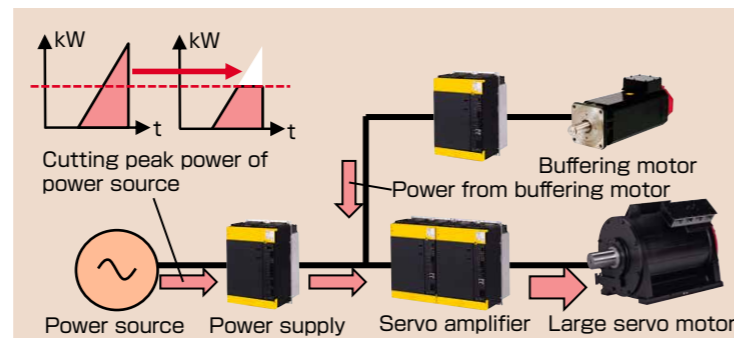
Small size I/O unit contributing to downsizing of control cabinet

FANUC Slice I/O

Small size I/O unit with superior expandability, workability and maintainability

● Optimizing configuration of I/O units due to extensive module lineup
● Flexibly expanding I/O points by adding I/O modules side by side
● Pre-assembled wires due to removable Front connector contributes to shorter assembling time
● Quick and easy wiring due to push-in type terminal block

Multi-axis high speed response motion control

Multi-axis high speed response function for quick axis start/stop
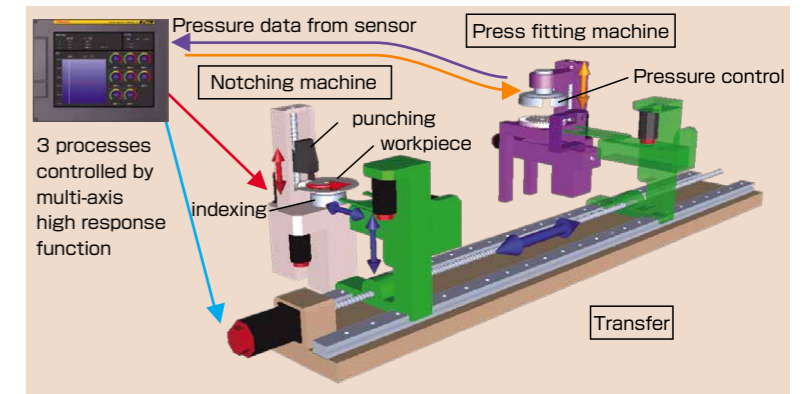
Simultaneous execution of multiple programs.

● Independent motion for each axis can be achieved by ISO G-code program as max. 24 programs can be executed at the same time.

Quick response is achieved for an external signal.

● Examples of machines where the accuracy can be improved are: notching machines, stamping machines, cutting machines, packaging/wrapping machines.
● High response and reduction of cycle time can be achieved by high-speed ladder execution cycle.
● The pressure control can be achieved with high accuracy by the pressure and position control.

Pressure data from sensor   Press fitting machine
Notching machine   Pressure control
punching   workpiece
3 processes controlled by multi-axis high response function
indexing
Transfer

Enhanced functionality of custom macros and improved performance

● Ease of use has been pursued by adding array variables and SWITCH-CASE branch syntax etc.
● A high-speed model can be selected for machines that frequently use custom macros. The custom macro calculation performance has been greatly improved (more than double the **Power Motion i-A**[1]).

*1): Results may vary depending on conditions.

Applicable functions for industrial machines

Flexible support for various machine configurations by multi-axis and multi-path functions

One CNC can support up to 10 paths and 32 axes – this includes multi-axis machines.

● Up to 10 ISO G-code programs can be simultaneously executed. Independent operation such as press operation and loader operation, etc. can be easily achieved. Synchronization between two or more executing programs can be easily achieved by the waiting M-codes function.
● Simple motion profiles can be achieved by using the ISO G-code programs and/or PMC axis control functions.

Integrated functions for press machine

Control function for link type press

● Link type servo press where deceleration ratio in slider part changes according to the main gear position angle can be controlled easily.

Electric CAM function

● Synchronized motion between transfer machine and press machine can be performed by electric CAM function.
● Electronic cam function enables to downsize the machine and improve maintainability by replacing mechanical CAM with servo motor.
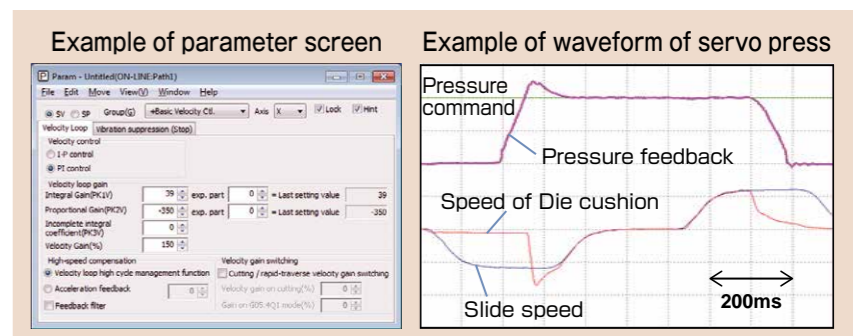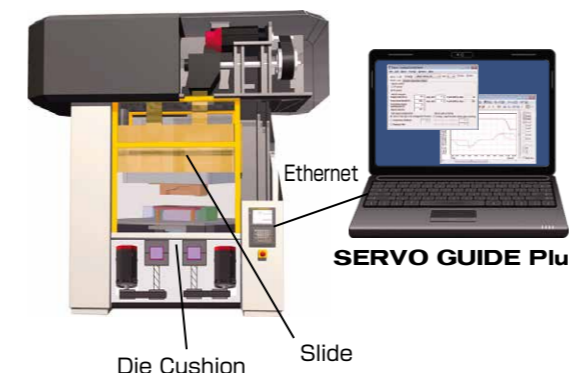
position data from press machine
Press machine
cooperate with press machine
Transfer   workpiece
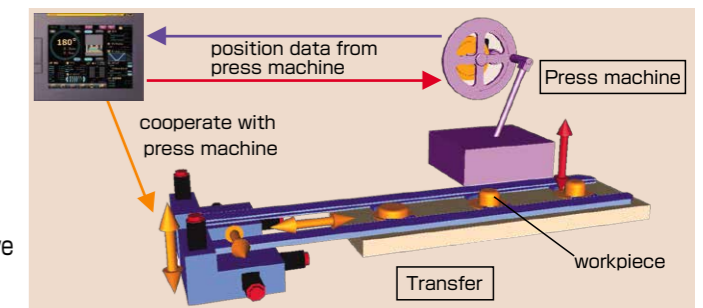
Useful servo tuning tool

FANUC SERVO GUIDE Plus

● FANUC SERVO GUIDE is tuning tool of the servo axis in an integrated manner, including setting parameters and measuring data.
● Observing the motions of each servo axis as waveform data contribute to servo tuning and trouble shooting of industrial machine.
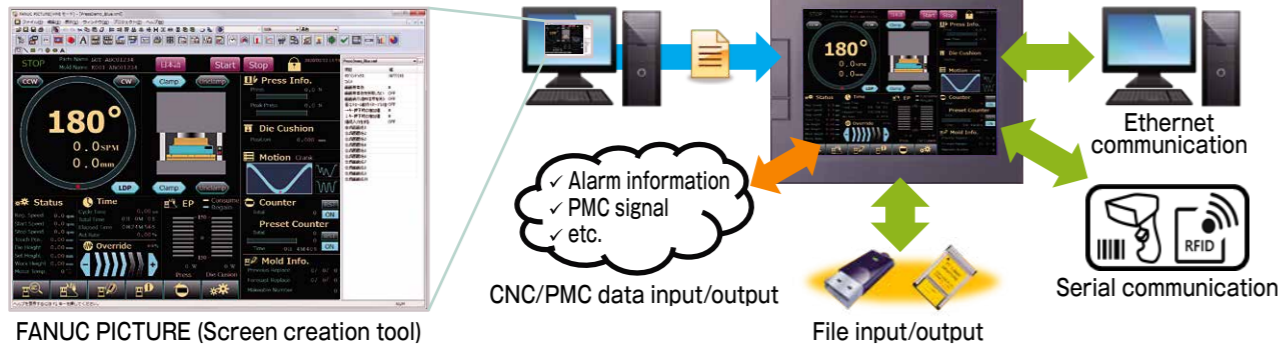
Ethernet
SERVO GUIDE Plus

Example of parameter screen   Example of waveform of servo press
Pressure command
Pressure feedback
Speed of Die cushion
Slide speed
200ms
Die Cushion   Slide

Many Customizable Functions

FANUC PICTURE

This tool enables you to create a machine operation screen simply by pasting screen components such as buttons and lamps on the PC.

- The screen creation tool is FANUC's proprietary easy-to-use user interface that is optimized for creating screens for CNCs.
- A screen usable on a display unit with or without a touch Complicated controls such as network communication and file control can be easily implemented by using general-purpose scripts. In addition, in the PANEL *i*H series display device, it is possible to create screens that leverage the performance of display devices.
- You can display the font for each language of any desired size.
- You can display buttons, lamps, and high precision images in full color.

FANUC PICTURE (Screen creation tool)

Ethernet communication

✓ Alarm information
✓ PMC signal
✓ etc.

CNC/PMC data input/output

File input/output

Serial communication

C Language Executor

- In addition to standard ANSI functions, many functions are available for controls and PMCs.
- High-level tasks to which high execution priority is assigned can monitor signal and position information.

Powerful Internal PMC

High-Speed, Large Capacity, and Multi-path PMC

High-Speed and Large Capacity

The internal PMC functions can also process large-scale sequence control at a high speed through the use of a powerful dedicated processor and the latest custom LSI.

- Program capacity Max. 300,000 steps (Total of all PMC paths)
- Internal relay (R) Max. 60,000 bytes
- Data table (D) Max. 60,000 bytes
- PMC paths Max. 5 paths (Max. 40 ladder programs)

Multi-path PMC

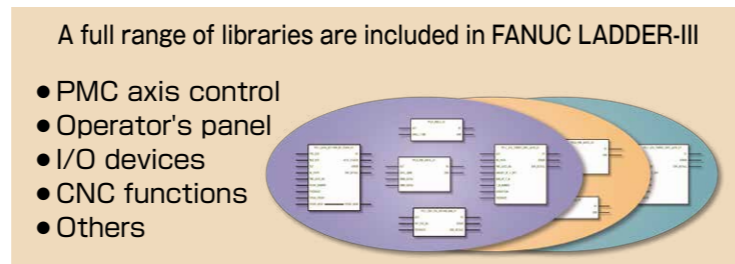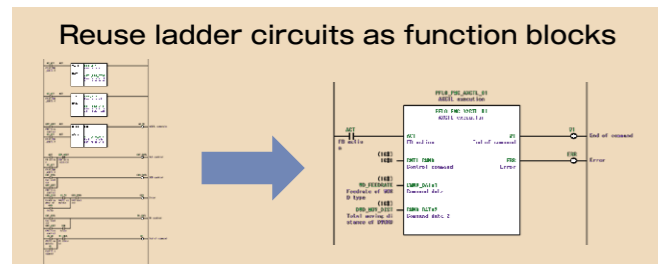| 1st ladder Machine control | 2nd ladder Loader control | 3rd ladder Peripheral equipment control |

Multi-path PMC

One PMC can execute up to five independent ladder programs, including loader control and peripheral equipment control.

- Ladder programs can easily be developed according to each user's machine configuration.
- Cost reductions are achieved by eliminating external PLCs or other devices for peripheral equipment control.
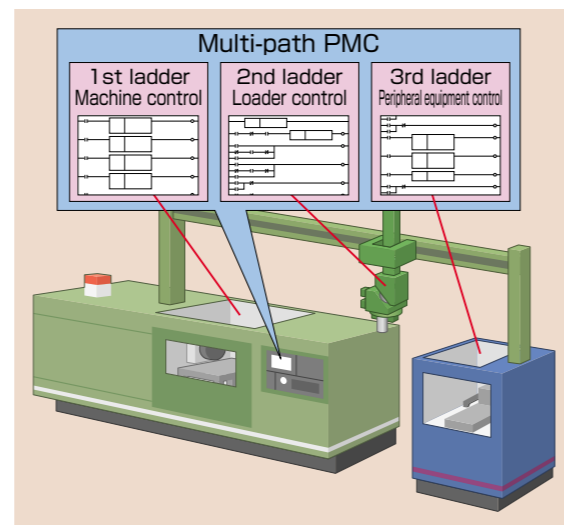
Function Block function

- This function enables repeated ladder circuit patterns to be arranged in function blocks and easily reused.
- The PMC function libraries attached to FANUC LADDER-III include functions ready for immediate embedding such as PMC axis and peripheral equipment control, and can be freely customized.

Reuse ladder circuits as function blocks

A full range of libraries are included in FANUC LADDER-III

- PMC axis control
- Operator's panel
- I/O devices
- CNC functions
- Others

Network Support Functions

Advancing the IoT adaptability of industrial machines with extensive network functions

Ethernet / Industrial Ethernet / Field Network

Multi-function Ethernet is included as standard in addition to embedded Ethernet. Moreover, information communication functions such as NC program transfer and remote diagnosis are supported as standard, as is control I/O communication. Multi-function Ethernet enables high-speed communication using a dedicated processor, and can be used for various types of industrial Ethernet communication.
Various types of field networks are also supported as options. Industrial Ethernet and field networks enable connection with various peripheral devices, that includes the control of peripheral devices such as waterproof I/O devices and the collection of sensor information. It is also possible to read information from collision sensors, temperature sensors, etc., through an I/O Link *i*-connected multi-sensor I/O unit.
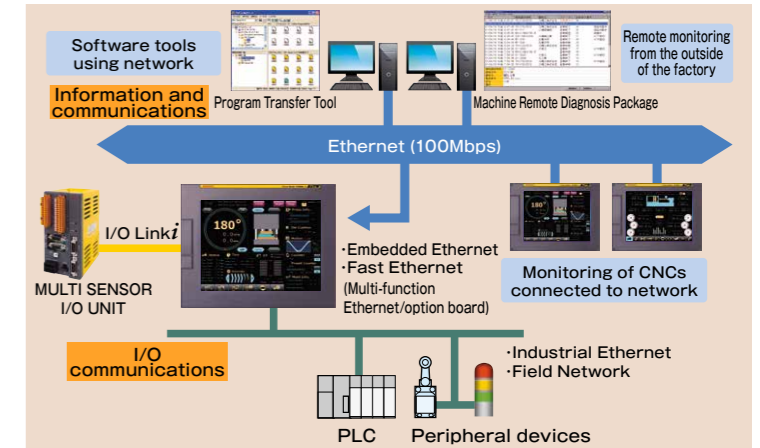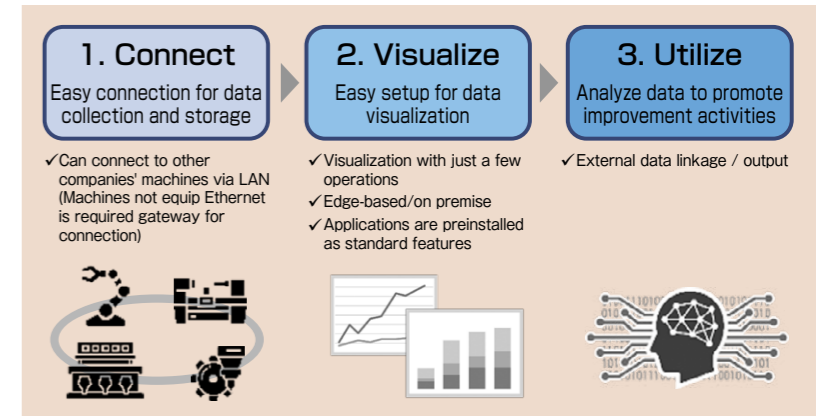

Supported Industrial Ethernet/Field Networks

- FL-net
- EtherNet/IP (master/slave)
- PROFINET (master/slave)
- Modbus/TCP (slave)
- CC-Link IE Field (slave)
- DeviceNet (master/slave)
- PROFIBUS-DP (master/slave)
- CC-Link (slave)
- EtherCAT (master)

FIELD system Basic Package (Factory Data Utilization Platform)

FIELD system Basic Package is an all-in-one data utilization platform that connects to on-site equipment via a network, making previously invisible equipment data visible and enabling the use of that data.
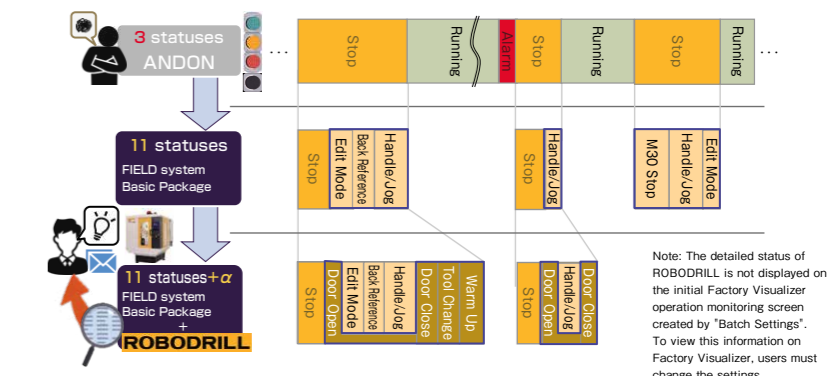
- Necessary functions are pre-installed as applications. Simply connect FIELD system Basic Package to the in-house network and enter the machine's IP address to start collecting data.
- Six types of screens are automatically created as on-site electronic ANDONs by simply connecting the machine and selecting from the screens. You can start visualizing and analyzing machine operation on the first day of installation.

1. Connect Easy connection for data collection and storage
✓ Can connect to other companies' machines via LAN (Machines not equip Ethernet is required gateway for connection)

2. Visualize Easy setup for data visualization
✓ Visualization with just a few operations
✓ Edge-based/on premise
✓ Applications are preinstalled as standard features

3. Utilize Analyze data to promote improvement activities
✓ External data linkage / output

### Supports collection and analysis of various factory data, and link with external systems

Data collected from FANUC CNC machine tools can be used to classify operation status into 11 types. These analyses can be used to improve machine uptime.

- Setup operations such as CNC screen editing, handle operation, and return to origin, as well as standby status can be classified and visualized.
- By combining data collected from machines and defining and classifying unique statuses, visualization and analysis can be performed according to on-site operations.

Note: The detailed status of ROBODRILL is not displayed on the initial Factory Visualizer operation monitoring screen created by "Batch Settings". To view this information on Factory Visualizer, users must change the settings.

Data collected from various devices can be imported into external systems via industry-standard interfaces, allowing on-site data to be utilized.

- Device data can be acquired from tools you already have, such as MES, BI tools, and Excel, using OPC UA or REST API.
- Data can be acquired without having to be aware of the connection protocols and data models of each device, allowing for easy system integration and data utilization.
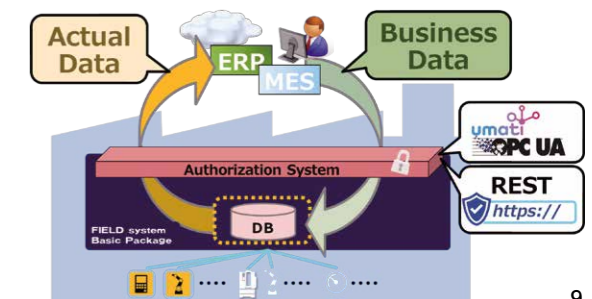
Easy Robots Connection and Control

Easier to connection and control of robots

Equipped with the following functions that allow you to quickly and easily introduce robots to industrial machines.

Manual Pulse Generator

G-code

Robot Control by G-CODE Command (Robot G-CODE)

It is possible to control the robot from CNC.
- By using CNC program (G-code commands), robots can be controlled like a loader
- By using familiar industrial machine's handles, robots can be positioned and taught easily from CNC screen

Automatic Robot Path Generation (Robot Auto Path Generation)

This function makes it possible to automatically generate a robot path that does not interfere with PC tools.
- Automatically generate path that does not interfere with the machine tool just by specifying the start point and end point
- The generated path can be confirmed by simulation, reducing man-hours for teaching robot.

Coordination with robots using macro variables (Robot ON-SITE)

Robots can be installed on existing machines without changing industrial machines.
- No need to change ladder and software of industrial machines
- Coordinating CNC and robot operations using custom macro variables

Existing Machine
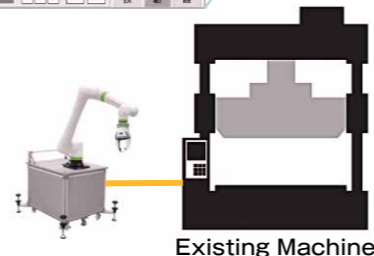
Advancing Energy Saving

Monitoring Power Consumption of Industrial machine

Power Consumption Monitor Function

It can be checked the power consumption data of the servo and spindle axis and the energy saving effect of power regeneration on the power consumption monitor screen. It can also be read using the PMC window, FOCAS2 function, etc., and it is possible to promote energy saving by monitoring the power consumption of industrial machine.

- Equipped with power consumption monitor screen as standard
- Constant display of power consumption bar graph is possible
- It is possible to create your own application by acquiring power data with the PMC window and FOCAS2 function.

Integral power   Instantaneous power
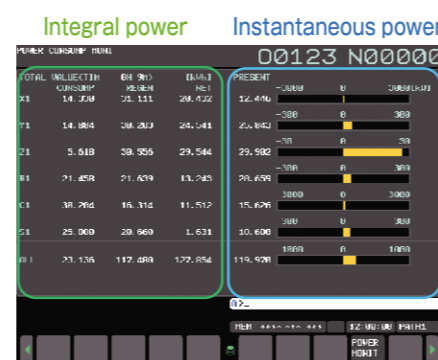
Safety Functions

Integration of Motion Control and Safety Function

Dual Check Safety Function

This is a safety function integrated into the CNC that conforms to ISO 13849-1 PL d.
Multiple processors perform dual monitoring of the actual positions, speed, and safety-related I/O of servo motors and spindle motors, securing a high level of safety by providing duplicated paths for cutting off power.
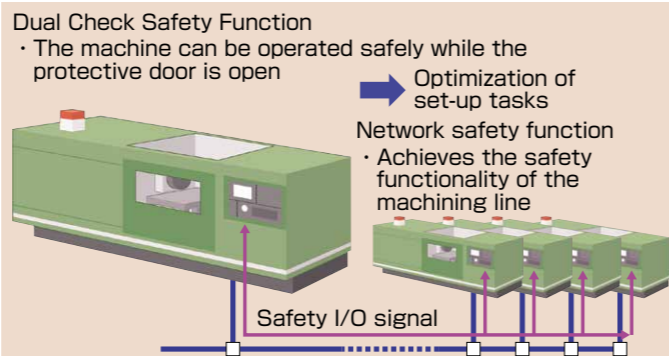
Network safety function

By combining this function with the Dual Check Safety function, safety functionality of the machining line is achieved.

- Safety function by FL-net
- EtherNet/IP Adapter Safety function
- PROFINET IO Device Safety function
- PROFINET IO Controller Safety function

Safe Torque Off (STO) function

This is a safety function integrated in servo amplifiers that conforms to IEC 61800-5-2.
Motor power can be safely cut off by the duplicated cut-off path within the amplifier.

Dual Check Safety Function
· The machine can be operated safely while the protective door is open

→ Optimization of set-up tasks

Network safety function
· Achieves the safety functionality of the machining line

Safety I/O signal

Easy Maintenance

Functions for maximizing uptime

Contribution to Preventive Maintenance
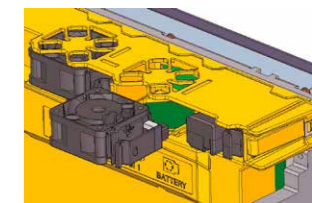
Cooling Fan Warning Function

By monitoring a decrease in the rotational speed of each cooling fan motor of the CNC and the servo amplifier, signs of fan abnormalities can be detected.
This function enables preventive maintenance.
Fans are stored in a cartridge and can be replaced quite easily, so maintainability is enhanced.

Failure Part Detection

Trouble Diagnosis Function

Various failure detection functions provided to the I/O Link i and FSSB can detect interruptions in the power supply to the I/O modules or servo amplifier and identify disconnection locations of the communication cable.
In addition to that, I/O Link i can detect the ground fault of each DO.

The trouble diagnosis function enables you to see diagnosis information helpful in determining the status when an alarm occurs on the CNC screen.
- Trouble diagnosis guidance screen
- Trouble diagnosis monitor screen
- Trouble diagnosis graph screen

Power failure detection

Disconnection detection

I/O Link i

DO alarm detection
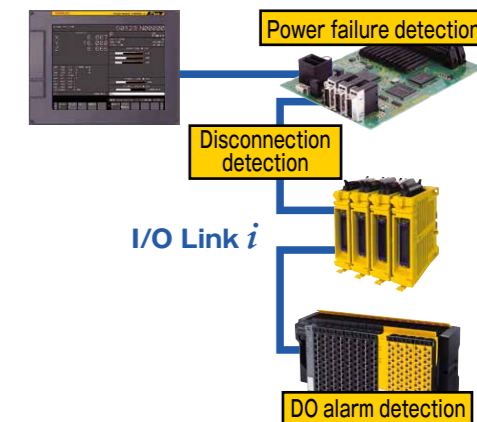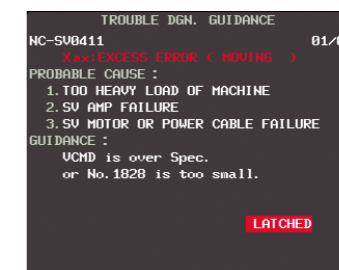
Encoder Communication Check Circuit

This check circuit enables a quick recovery from encoder communication alarm by identifying which part such as encoder, feedback cable or servo amplifier has failed.

Reduction of Recovery Time

FANUC Slice I/O

Exchangeable of electronics housing without removing wires due to 3-Pieces Structure; "Front connector", "Electronics" and "Base".

In addition to that, following functions can easy detect failure module.
- LED indication for each signal state and unit status
- Enable voltage check of each I/O terminal
- Display nickname of each module on the front of module

Base   Electronics

Front connector (Removable)
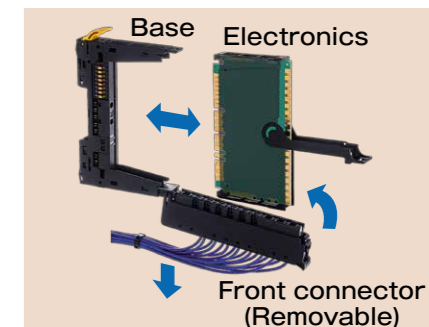
Prevent Machine Damage at Power Failure

Machine Protection at Power Failure

Damage of machines and workpieces at power failure is prevented where a power supply is unstable or in a lightning-prone areas.
- Gravity-axis drop prevention
  The holding brake of gravity axis are quickly activated by detecting power failure in the circuit incorporated into the amplifier.
- Stop distance reduction [*1]
  Feed axes are quickly stopped to avoid a crash in high-speed machine tools.

*1) "Power Failure Backup Module (Hardware)" or "Power Failure Backup Function (Software)" shall be applied.

PFB-24   PFB-R   PFB-C Capacitor Module

Power Failure Backup Module
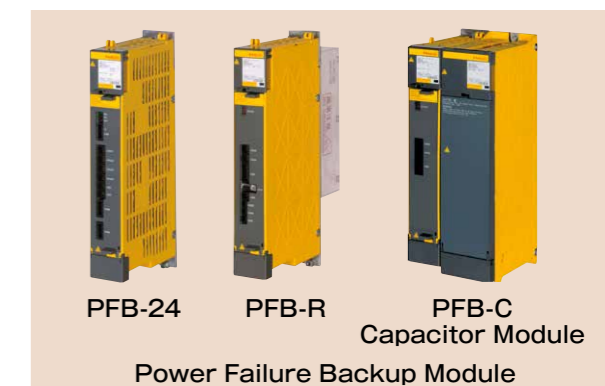
Service & Support

Excellent Maintenance Services

FANUC service team delivers customer trust and confidence based on direction of service "Maximizing Uptime", "Global Service" and "Lifetime maintenance".

Service First

Conforming to the spirit of "Service First", FANUC provides lifetime maintenance to its products for as long as they are used by customers, through more than 270 service locations supporting more than 100 countries and regions throughout the world.

Maximizing Uptime

Global Service

Lifetime Maintenance

FANUC ACADEMY

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

FANUC CORPORATION

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