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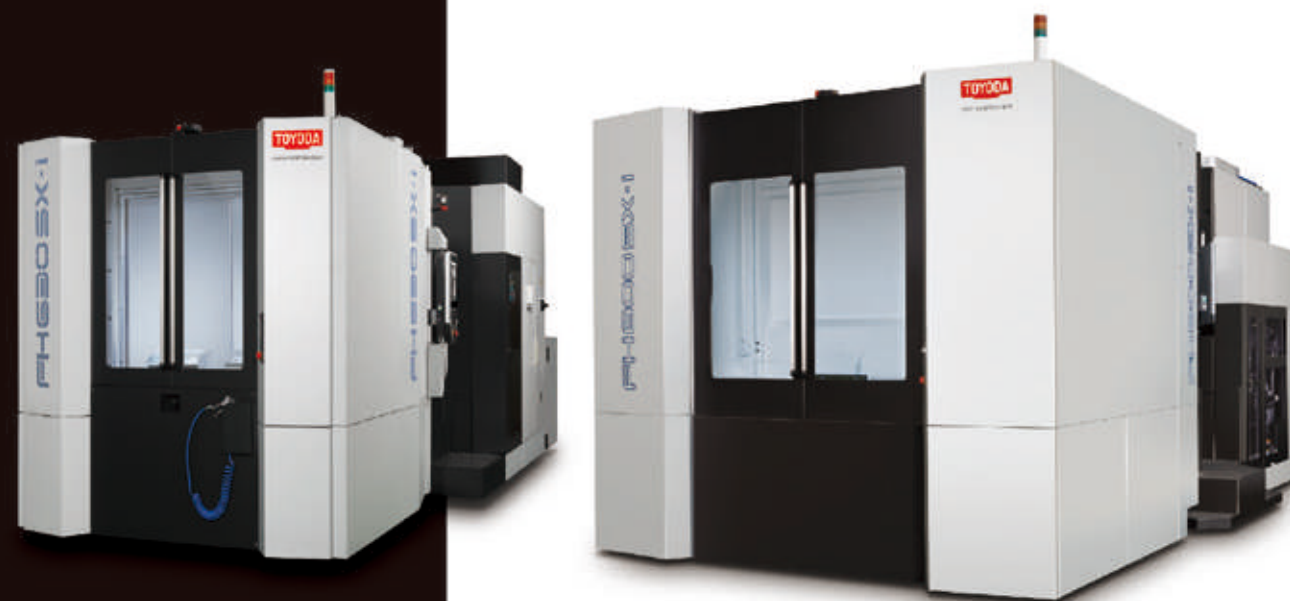
506-507, 5th Floor, Suncity Business Tower,  
Golf Course Road, Sector-54

Gurgaon-122002, Haryana, INDIA  
TEL: (91)-124-4264602  
FAX: (91)-124-4288355

**Horizontal Spindle Machining Centers**

**FH SERIES**

**FH630SX-i**  
**FH800SX-i**







A Machining Center with Prestige

Transportation machinery, construction machinery, energy-related industry, aerospace industry and industrial machinery

## Achieving top level machining of medium and large parts across all industries.

The FH630SX-i and FH800SX-i are machining centers, featuring both high speed performance and highly rigid machining.

Top-level performance in three features of “Large”, “Fast”, and “Strong”.

Additionally, building comfortable and safe machine is sought by improving accessibility to workpiece and visibility.

### ■ Workpiece range, the largest in the class

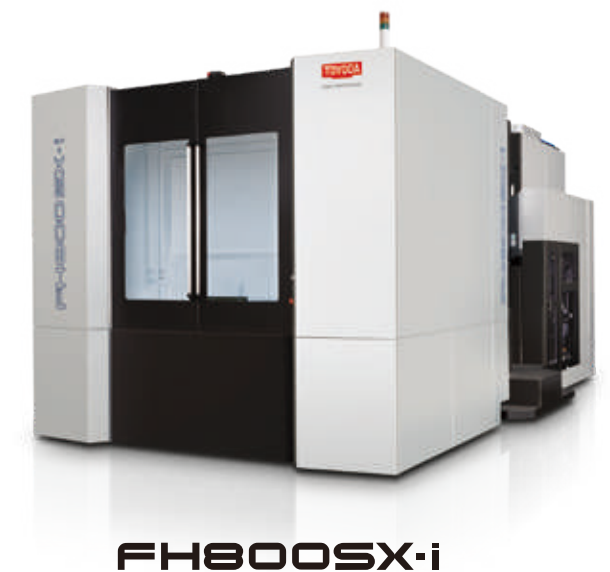
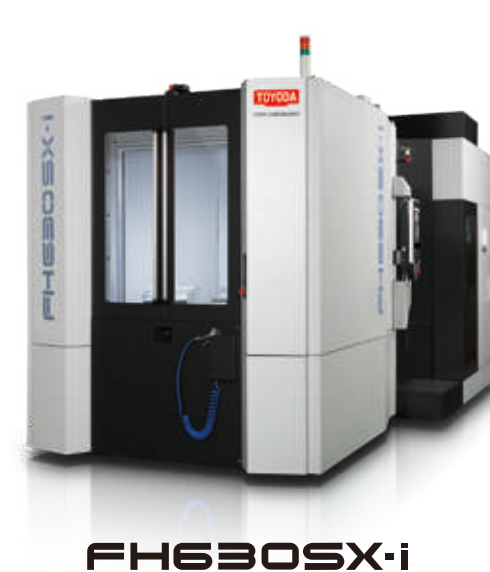
Maximum workpiece swing, maximum workpiece height and maximum stroke are realized to be the largest in the class.

### ■ Highest cutting performance in its class

High-torque main spindle capable of highly effective machining of large-size parts of every material is equipped.

### ■ Best speed performance in its class

Achieving over twice the speed of the horizontal boring machine and 5-face fabrication machine which are the representatives of large machine tools.





# MAXIMUM

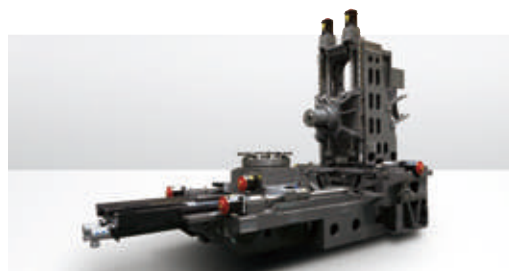
|           | Maximum workpiece range | Maximum load on pallet | Stroke (X×Y×Z)          |
|-----------|-------------------------|------------------------|-------------------------|
| FH630SX-i | φ1,170mm×1,250mm        | 1,500Kg (op)           | 1,050mm×900mm×1,050mm   |
| FH800SX-i | φ1,500mm×1,500mm        | 2,500Kg                | 1,450mm×1,250mm×1,550mm |



## The largest in the class New world of machining center

In recent years, efforts to combat environmental problems such as global warming have been hastening the development of eco-friendly diesel engines for trucks and agricultural/construction machinery, as well as fuel-efficient compact jet aircraft. While advancements have been accelerating within renewable energy sources such as wind power, demands have increased for equipment used in plants which supply new types of energy, such as shale gas. Equipment and devices used within these fields have a tendency to be designed larger to improve energy efficiency, which brings a demand for machines with a wider machining range and high productivity which can produce larger parts more efficiently.

For the FH630SX-i, the maximum workpiece swing is φ1,170 mm, and the maximum load mass is 1,500 kg. For the FH800SX-i, the maximum workpiece swing is φ1,500 mm, and the maximum load mass is 2,500 kg. These machines are capable of loading the largest workpieces in its class and have sufficient machine strokes. Featuring the largest Z axis stroke in its class which prevents interference during APC & ATC even for the largest tools and workpieces. It should also be noted that the shortest accessible distance from the table center to the spindle end face are 50 mm (FH630SX-i), 100 mm (FH800SX-i) by which it is possible to machine workpieces with short tools.



# FASTEST

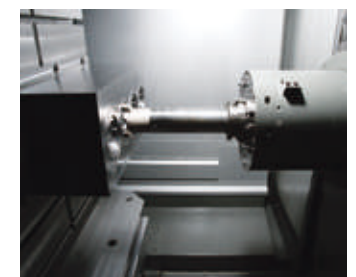
|           | Rapid feed rate | Tool changing time (C-C) | Table indexing time (90° indexing) |
|-----------|-----------------|--------------------------|------------------------------------|
| FH630SX-i | 60m/min         | 3.6sec.                  | 2.5sec./90°                        |
| FH800SX-i | 54m/min         | 4.4sec.                  | 4.0sec./90°                        |



## Boasting the best speed performance in the class while maintaining rigidity

Conventionally, machines that have box slides with a high damping capability to endure heavy loads are often used for the machining of medium and large parts. In recent years, however, there is a strong demand for high speed performance in medium and large machining centers, too, in order to improve productivity. The machining centers are now required to achieve a high machining speed that is as fast as that of small machines, while increasing the rigidity against cutting.

For feed axes, a cylindrical roller type linear guide is used to achieve both high speed and high rigidity. Thanks to this, the feed rate for all axes is 60 m/min for the FH630SX-i and 54 m/min for the FH800SX-i. Y and Z axes, which are most susceptible to machining load, have a dual-drive system which is made up of two ball screws. Major components supporting the axes, such as bed, column, and table, are designed by CAE to have the optimal layout of rib, thereby to give sufficient rigidity. Furthermore, the number of liner guide block in use has been increased from four, which is usual, to six. The linear guide and ball screws have been optimally positioned, a combination of which has resulted in higher rigidity of Y axis itself and shorter distance from the table center to spindle end face by increasing the extrusion of the spindle.



FH630SX-i / FH800SX-i



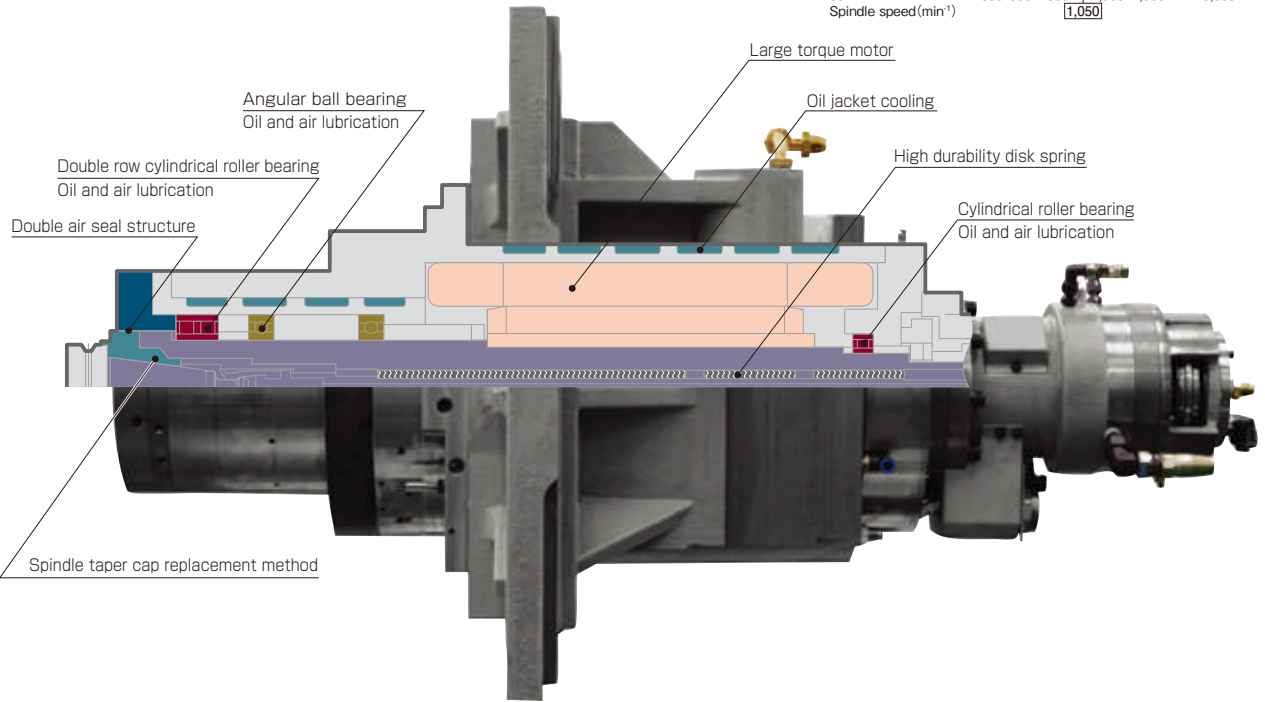
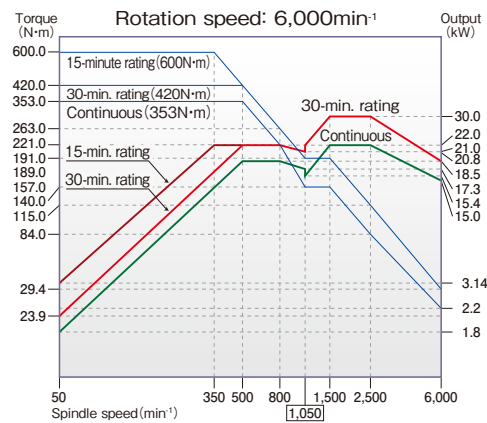


Each and every spindle is backed by its own specific type of outstanding technology.

### Standard spindle optimum for machining of iron and cast metals

[Spindle speed] 6,000min<sup>-1</sup>  
 [Spindle nose shape] BT No.50  
 [Spindle motor (short-time/continuous)] 30/22kW  
 [Max. torque] 600N·m  
 [Spindle diameter (front bearing bore)]  $\phi 110$ mm

Both axial and radial rigidity is sought after in spindles operating with large cutters. To satisfy both requirements, the 6,000min<sup>-1</sup> spindle is equipped with a double row cylindrical roller bearing on its front. This bearing has a large radial load capacity and is therefore able to withstand heavy duty loads and impacting loads.



### High efficiency cutting of iron and cast metals

#### Elevator parts

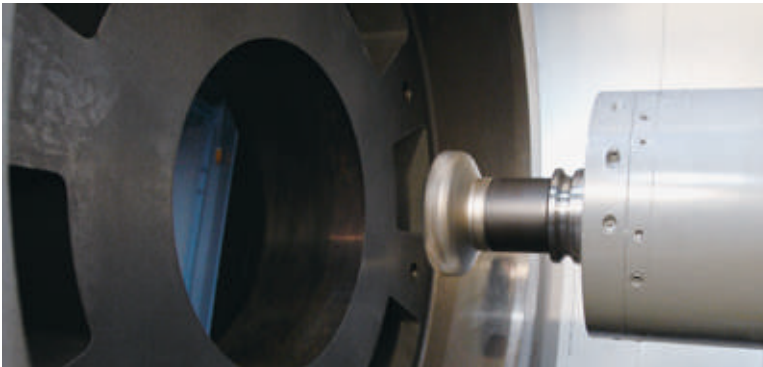
[Workpiece material] FCD450

Milling

[Tool]  $\phi 125$  face mill

[Spindle speed] 640min<sup>-1</sup>

[Cutting feed rate] 1,400mm/min



The performance of the machining center depends on the **Spindle.**

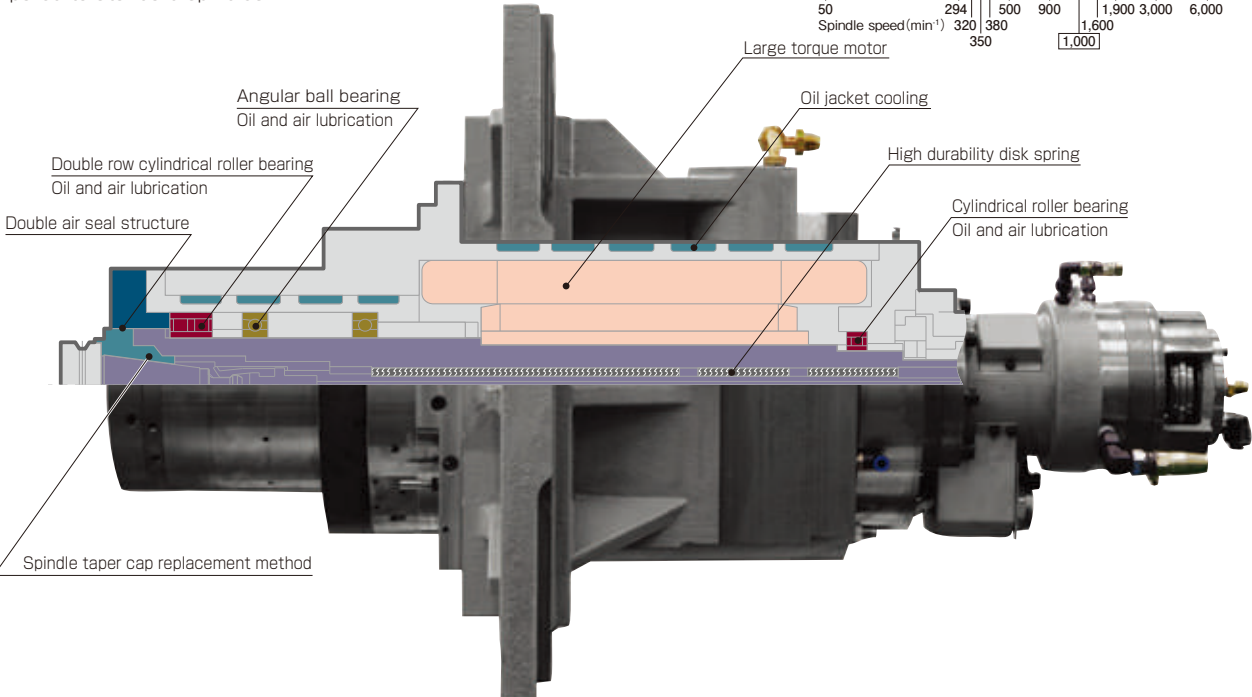
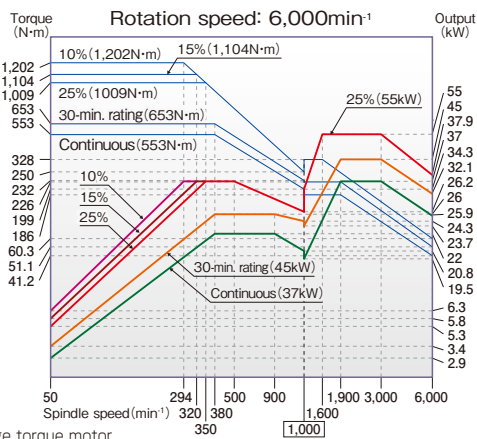
The spindle serves as a core of the machining center. JTEKT sticks to the spindle, which is important because it is located nearest the cutting point, to keep stable cutting accuracy.



Large torque 6,000min<sup>-1</sup> spindle achieving the best performance in its class Option

[Spindle speed] 6,000min<sup>-1</sup>  
[Spindle nose shape] BT No.50  
[Spindle motor (short-time/continuous)] 55 / 45 / 37kW  
[Max. torque] 1,202N·m  
[Spindle diameter (front bearing bore)] φ110mm

Both axial and radial rigidity is sought after in spindles operating with large cutters. To satisfy both requirements, the 6,000min<sup>-1</sup> spindle is equipped with a double row cylindrical roller bearing on its front. This bearing has a large radial load capacity and is therefore able to withstand heavy duty loads and impacting loads. This machine has a high-torque spindle of 1,202 N·m, with double the cutting ability in low speed ranges (under 500 min<sup>-1</sup>) compared to standard spindles.

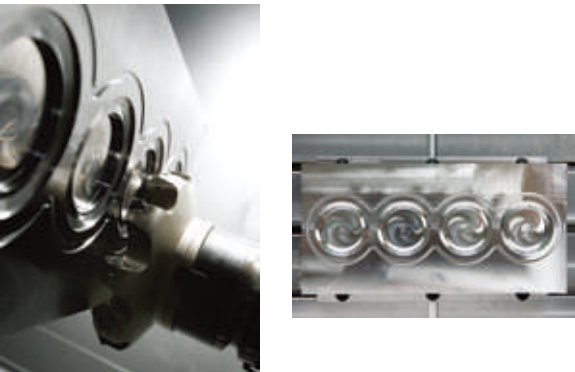
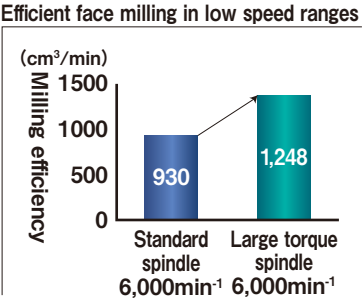


Best cutting performance in its class with a 1,202N·m large torque spindle

■ Model piece  
[Workpiece material] HPM7

■ Milling  
[Tool] φ160 face mill  
[Spindle speed] 400min<sup>-1</sup>  
[Feed rate] 1,600mm/min  
[Depth of cut/width] 6/130mm

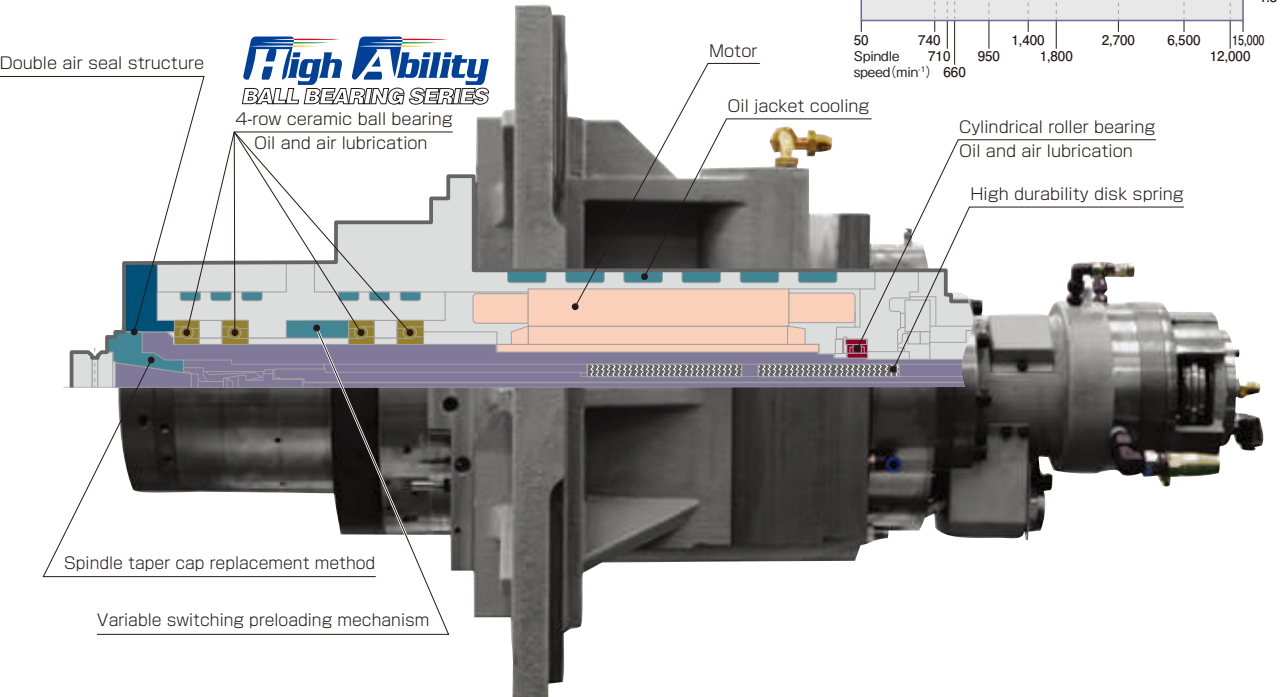
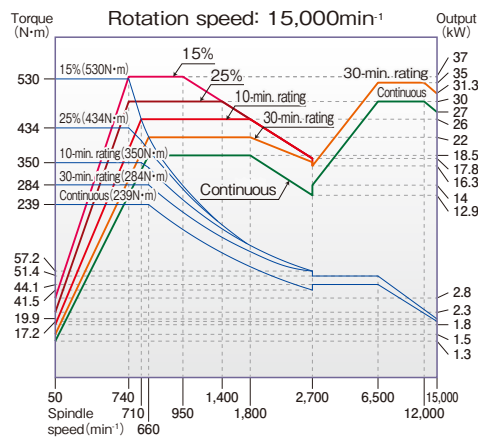
■ Bore hole machining  
[Tool] φ92 Boring  
[Spindle speed] 500min<sup>-1</sup>  
[Feed rate] 200mm/min



Large torque 15,000min<sup>-1</sup> spindle  
Multi-use spindle that achieves 530N·m in low speed ranges, even with a high-speed spindle Option

[Spindle speed] 15,000min<sup>-1</sup>  
[Spindle nose shape] BT No.50  
[Spindle motor (short-time/continuous)] 37/30kW  
[Max. torque] 530N·m  
[Spindle diameter (front bearing bore)] φ120mm

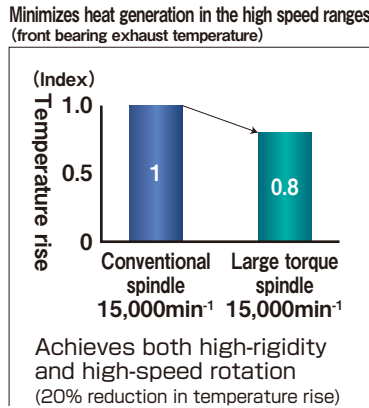
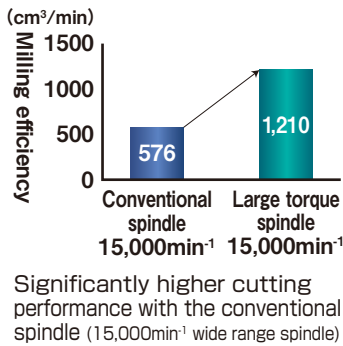
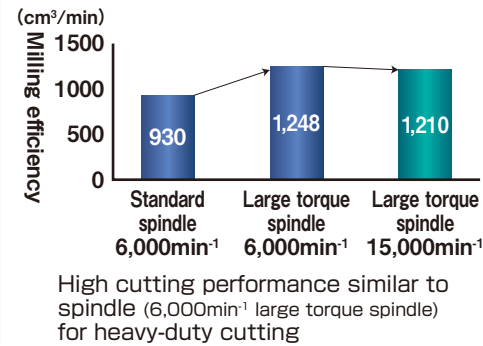
This is a multi-use type spindle that boasts high rigidity and rotational accuracy, enabling the machining of a wide range of workpieces, from the slow cutting of steel to the fast cutting of aluminum. This spindle utilizes a newly developed preloading adjustment mechanism that stabilizes high torque in low speed ranges and accuracy in high speed ranges.



High-efficiency and high-accuracy machining with 15,000min<sup>-1</sup> large torque spindle

■ Test piece  
[Workpiece material] S45C  
[Tool] φ125 face mill  
[Feed rate] 2,688mm/min  
[Spindle speed] 800min<sup>-1</sup>  
[Depth of cut/width] 4.5/100mm

Efficient face milling in low speed ranges





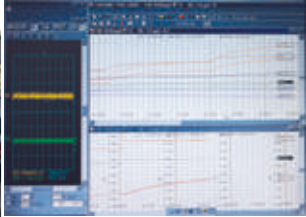
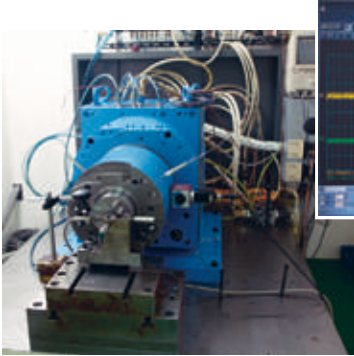
JTEKT’s spindle promises assurance over a long period and takes maintenance into consideration.

JTEKT’s dedicated spindle manufacturing

The spindle is the heart of the machining center, and as such it is manufactured under strict accuracy control. Confirmation checks look at dynamic balance, temperature, vibration, noise, and so forth. and, after ensuring all allowable limits have been maintained, the spindle is installed in the machine.



Dynamic balance measurement



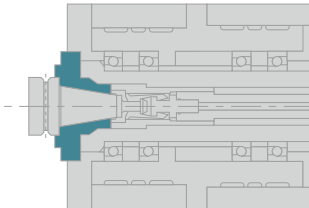
High-speed spindle running rest

Basic design particularly focusing on low vibration.  
A spindle vibration within 2 microns\* has been accomplished (measurement with a 15,000min<sup>-1</sup> spindle).

We have developed a low vibration, high speed spindle which suppresses vibration and runout across the entire range up to the maximum speed. This feature contributes not only to the improvement of cutting accuracy but also to the extension of tool life.

The spindle taper cap replacement method takes ease of maintenance into consideration.

Even in the rare chance that a failure does occur, a replacement spindle cartridge that has been checked at JTEKT for operation and quality can be installed in its place, keeping restoration time down to a minimum. Furthermore, the separate spindle taper makes individual cap replacement possible as it is integrated with the taper, even in the event of taper damage caused by accidental interference.



\* Not a guaranteed value

Technologies which have continuously supported the aerospace industry down through time are materialized in our machining center bearings.

We have been supporting the aircraft and aerospace industry for 30 plus years and our bearings are used in many of the jet engines manufactured in Japan. By providing the latest technology, we keep satisfying every rotation technology need from the ground to outer space. The technology cultivated over this period has been materialized in machining center bearings.



In 1984, JTEKT were the first in the world to succeed in the practical use of ceramic bearings. Over the years since, we have gradually built up the processes such as design technology, precision and high-efficiency machining technology and mass production needed to use ceramic materials in roller bearings, and consequently now meet those factors such as speed, reliability and price demanded of machining center spindles.

The High Ability bearing is adopted in the 15,000min<sup>-1</sup> BT No.50 spindle.





The photo is FH630SX-I.

A rigid Platform incomparable to any others assures stable production over a long period.

JTEKT's basic approach towards machine design is to minimize displacement caused by external forces that may impact on cutting accuracy. The rigid bed of the FH Series provides the answer towards withstanding large cutting resistance as well as inertial forces of feed acceleration and deceleration. --The immobile bed is placed as a solid stationary matter and moving bodies such as the column is light-weight but at the same time rigid-simple, yet requiring high level analysis techniques and material technology.

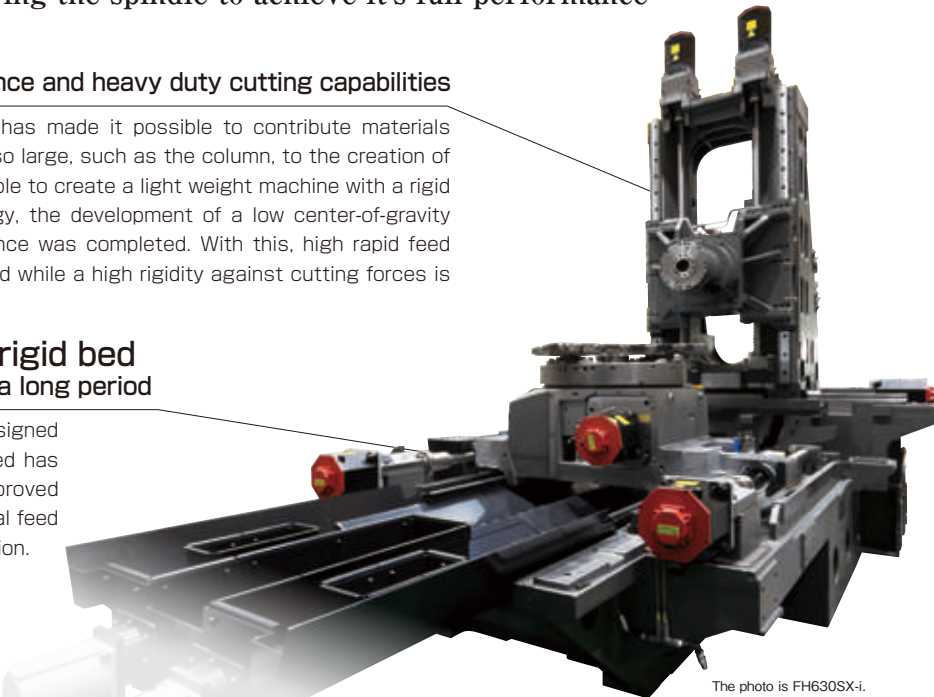
Unrivaed rigid platform allowing the spindle to achieve it's full performance

FCD600 column featuring both high speed performance and heavy duty cutting capabilities

JTEKT's original high casting technology has made it possible to contribute materials which are not only complex in shape but also large, such as the column, to the creation of the FCD600. As a result, it has been possible to create a light weight machine with a rigid column. Furthermore, using FEM technology, the development of a low center-of-gravity column with satisfactory moving performance was completed. With this, high rapid feed rate and high acceleration are accomplished while a high rigidity against cutting forces is maintained.

High grade cast iron high rigid bed keeping machine level stable over a long period

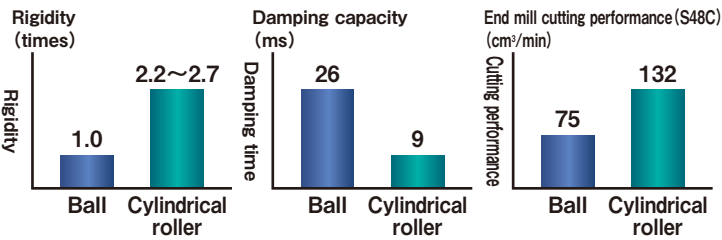
The bed supporting the moving body is designed using FEM analysis technology. And the bed has sufficient rigidity and substantially improved moving level. This feature makes stable axial feed possible with high speed and high acceleration.



The photo is FH630SX-I.

A Rigid cylindrical roller slide able to withstand high speed, high acceleration travel while still maintaining rigidity is adopted

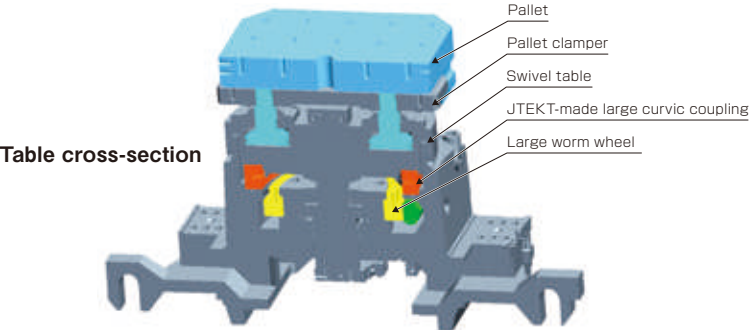
Compared to the ball guide, the cylindrical roller slide features less elastic deformation against loads and possesses superior vibration damping characteristics. This feature makes it possible to position quickly with smaller orientation changes upon sudden acceleration or stoppages, contributing to a higher level of production efficiency.



Because of JTEKT's assembling technology which allows for strict mounting face accuracies, the rigid cylindrical roller slide offers the best rapid feed rate and acceleration in it's class.

Highly rigid table that can withstand the weight of large parts

The plate-type pallet clamber system is adopted to firmly hold loads, thereby providing enough rigidity for supporting the weight of large parts. This system will minimize pallet surface vibrations even if it is subjected to offset and cutting loads, enabling high-precision machining.





# Unique Precision technology only achievable with the inside-out knowledge of the cutting field that JTEKT possess.

Various factors can effect cutting accuracy. The FH Series is packed with a number of precision technologies that only JTEKT have had the opportunity to cultivate down through the years with strong involvement in the mass production of automotive parts.

## 3 approaches for achieving precision cutting

### Suppress heat generation

- [Ball screw shaft cooling] Reduction of heat by cooling the spindle core **FH800SX-i**
- [Spindle oil jacket cooling] Reduction of spindle temperature rise
- [Dual ball screw drive] Reduced heat generation through motor size reduction
- [Large torque 15,000min<sup>-1</sup> spindle] Reduction of spindle temperature rise with a variable switching preloading mechanism **Option**
- [High Ability bearing] 30% reduction of bearing temperature rise **Option**
- [Working oil cooling] **Option**
- [Coolant cooling] **Option**

### Elimination of heat transmission

- [Center trough structure] Suppressing the effects of chips and coolant heat
- [Y-axis motor heat isolation coupling box cooling] Suppression of ball screw elongation

### Heat effect control

- [Large heat capacity bed] Reducing the effect of thermal displacement
- [Optimum thermal volume colum] Minimizes column deformation caused by uneven temperature distribution
- [Thermally symmetrical structure] Reducing heat-related column twist
- [BTS (Ballscrew Thermo Stabilizer) function] Direct measurement and correction of ball screw elongation **FH630SX-i**
- [Spindle Thermo Stabilizer function] Direct measurement and correction of spindle elongation **Option**
- [Scale feedback] **Option**
- [Touch sensor function] **Option**

## Manufacturing technology for realizing precision cutting



Table reference face sheet scraping

Accuracy machining of linear guide mounting face

Spindle balancing

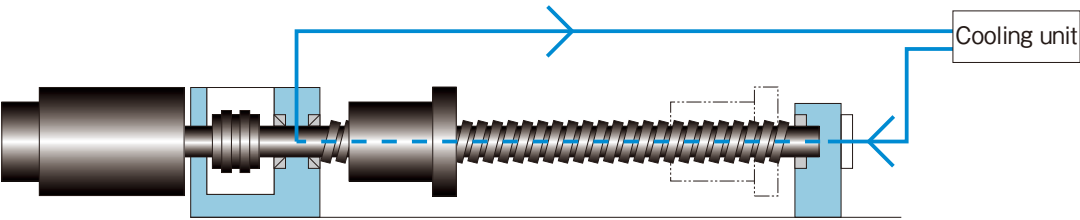
Precision assembling work

## Ball screw shaft cooling

### Spindle core cooling performing stable and high accuracy machining

**FH800SX-i**

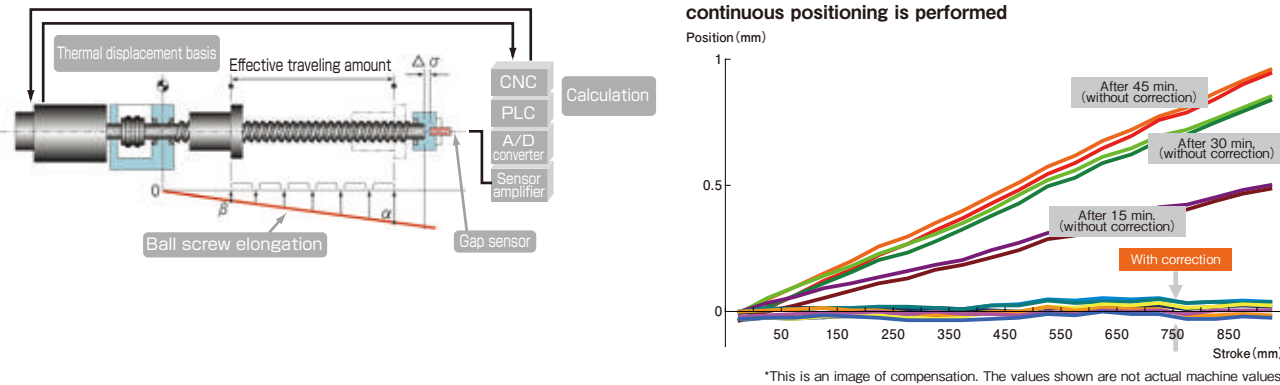
Heat displacement is restrained and stable and high accuracy machining is performed by always discharging the controlled cooling oil to the spindle core of ball screw which has core empty structure in order to follow the bed temperature. Furthermore, this machine is of highly reliable design in which excessive load due to thermal expansion of ball screw is not given against the support bearing restrained by means of double anchor method.



### Ball screw thermal displacement correction function stabilizing repetitive positioning accuracy

**FH630SX-i**

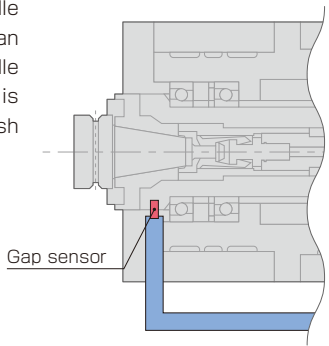
The BTS function is installed as a standard feature to stabilize the repetitive positioning accuracy in parts cutting. With the BTS function, the displacement sensor installed at the end of the ball screw measures the elongation of the entire screw, which is distributed into offsets for each stroke position to correct the positioning accuracy. With this function, accuracy can be stabilized without any costly accessories such as linear scales which require maintenance. Furthermore, continuous cutting operation over a long time becomes possible. In addition, the structure is simpler and the reliability is higher when compared with the ball screw shaft center cooling method, and the function is environmentally friendly.



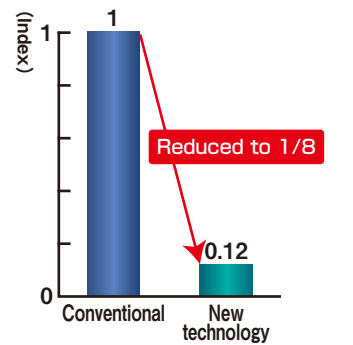
### Spindle Thermo Stabilizer function **Option**

#### Spindle thermal displacement correction function used to correct spindle elongation formed after an extended period of operation

A displacement sensor installed at the end of the spindle is used to directly detect spindle edge position, which can be easily displaced by heat generated inside the spindle during extended operation. Z-axis direction deviation is suppressed as much as possible in order to accomplish precision cutting.



#### Amount of cutting edge variation





Reliability starts with chip disposal. The design of a Center trough that makes it possible to deal with chip disposal directly beneath the cutting point.



**1 Center trough**  
Smoothly processing machining chips with a large chip discharge port in the bed center.



**3 External nozzle coolant**  
The nozzle installed at the spindle nose supplies coolant to the cutting point.

**2 X-axis protective cover against chips**  
To prevent damage to the cover from chip entanglement, an aluminum cover is adopted which operates jointly with the X axis stroke so that chips don't become caught.



**4 Overhead shower coolant**  
The coolant nozzle installed in the ceiling discharges coolant, keeping chip accumulation inside the machine down to a minimum.

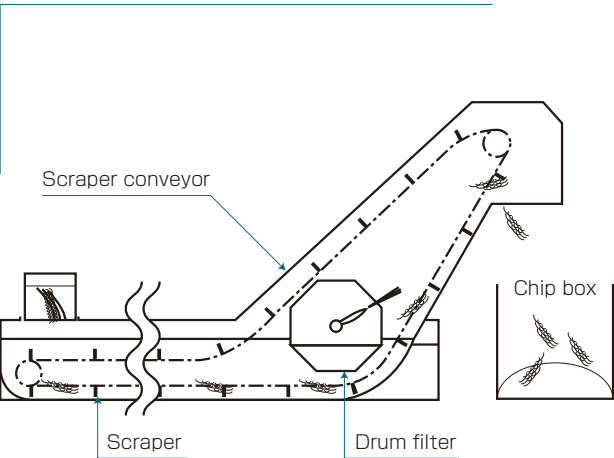
**5 Spindle-through coolant 1MPa/3MPa/7MPa Option**  
Coolant is supplied through the spindle center to the cutting edge. It is effective for lubrication and cooling of the cutting point, chip disposal and extension of tool life.



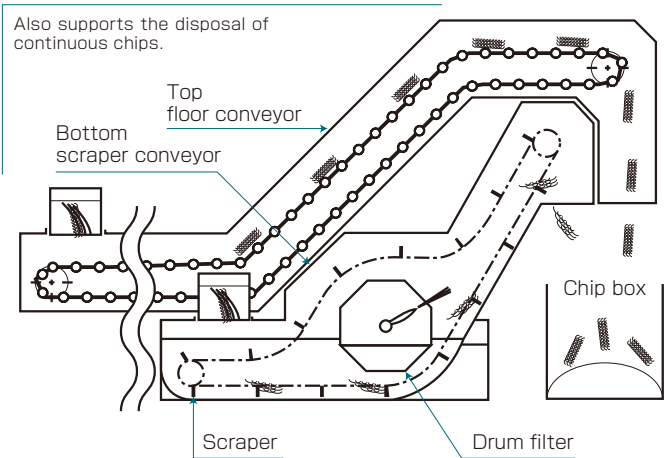
Spindle-through coolant 3MPa

**6 Coolant supply unit with take-up chip conveyor**  
Chips collected in the center trough are transported outside of the machine by the chip conveyor. Two types of chip conveyors are provided to choose from depending on chip shape and material.

**Standard scraper type coolant supply unit**



**Option Two-tiered coolant supply unit**

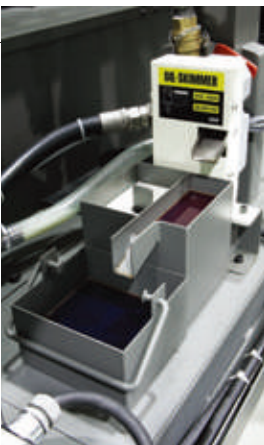


**Option Optional parts**

Oil skimmer, coolant cooling, chip box, mist collector and other optional accessories can be added.



Splash gun



Oil skimmer



Coolant cooling





## The pursuit of Reliability - one of JTEKT's starting points

Stable accuracy and an improved MTBF (mean time between failures) are both necessary in order for the customer to feel assured with reliability. The design of the FH Series pursues high quality, high performance and long life.



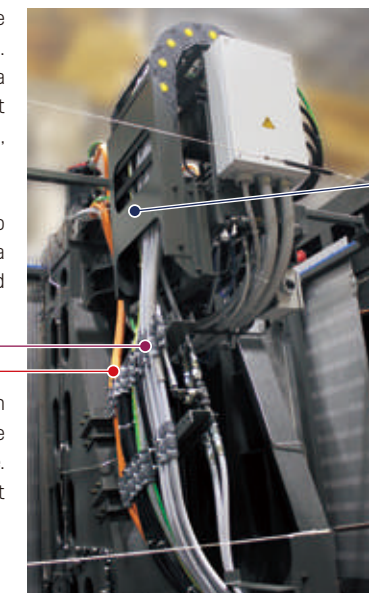
To provide the customer with assured operation, we work hard to make even the unseen portions of the machine more reliable.

### Improved reliability in wiring and piping supporting higher speeds and acceleration

In addition to higher spindle feedrate and higher acceleration, the reliability of hoses and wire cables is also extremely important. Hoses and cables often rub against each other, and can sustain a large amount of damage from brackets. Hoses and cables must therefore be designed with the utmost care towards routing, bracket strength, and maintainability.

Piping and cables are organized to prevent stray hoses or wiring as a means of ensuring high speed and high acceleration.

The color of motor power cables and that of communication cables are differentiated to make maintenance work on the wiring routed to the spindle and Y-axis motor more simple. This feature also helps to reduce the time taken in pinpoint the cause of machine trouble.



Brackets designed using strength analysis

The photo is FH630SX-L

### Concentrated device layout making daily maintenance easier

The central lubrication, hydraulic and pneumatic devices are arranged together for easier daily inspections.



The photo is FH630SX-L

### Field bus system improving control system reliability

The field bus is the digital communication signal exchange of communication signals between devices and the controller. Compared with the earlier signal wiring method, it can send multiple signals on a single cable, contributing to the substantial reduction in the number of cables. Using this method, control system reliability is improved. Additional merits of digital communication include sophisticated trouble diagnosis functions.

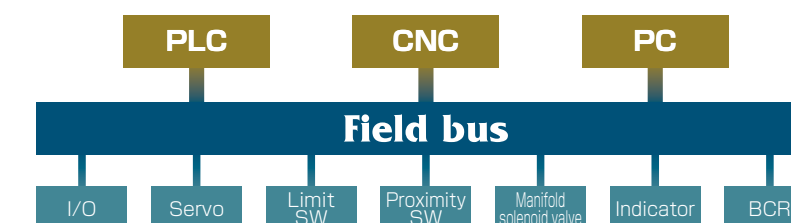
#### Field bus features

##### [Reduced wiring]

- Connection of devices with twisted pair cables including power cables
- Feeder branching connection possible

##### [Easy maintenance]

- Identification of trouble through sophisticated diagnosis functions





# Workability

Aiming to perfect a production system both environmentally and people-orientated

At JTEKT, we never lose sight of our motto 'pursue technological dreams to deliver valuable innovations to you' and are always striving to achieve a style of manufacturing friendly to both people and the planet.

## Securing accessibility and work space

### Operation door with good workability FH630SX-i

By opening the operation door to the ceiling, the lighting has been improved when the door is opened and the operator is protected from chip fluid dripping down from the ceiling cover.



The photo is FH630SX-i.

### Accessible operation door FH800SX-i

The bottom of the operating door is folded inwards, making it possible to work from a closer proximity. Also, the left-hand side operation panel means there is minimal movement with the wide opening and the viewing point, alleviating physical load on the operator.



The photo is FH800SX-i.

### APC with good workability FH630SX-i

The wide door opening makes loading/unloading of the workpiece much easier. The open-out ceiling design ensures the safe loading and unloading of large parts, fixtures and angle steels with the use of the crane.



The photo is FH630SX-i.

### APC door with good accessibility FH800SX-i

In make for easy loading\unloading of large workpieces a platform has been provided at the top of the APC. It is possible to stand close to the pallet and work can be carried out safely.



The photo is FH800SX-i.



# TOYOPUC-Touch

HMI in the IoE\* era  
Simple, safe and connectable



Renewed operability

J-Operate

Realization of simple operation

J-Navigate

Visualization of equipment status

J-Support

Batch management of equipment information

J-Manage

Equipment diagnosis utilizing IoE

J-Care

\* JTEKT supports the IoE (Internet of Everything) that connects people, things, information, and services.

## Renewed operability

J-Operate

### Visible and effective operation thanks to batch data display

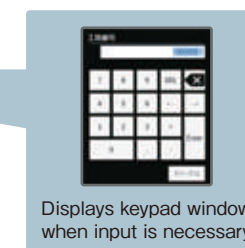
Consolidates information onto a single large-size display screen, and displays a keypad window when necessary



Operation status screen



Tool list screen



Displays keypad window when input is necessary

### Realization of inspirational operation

Screen swiping and pinching in/out mimics the operability of a smart phone, making the TOYOPUC-Touch easy to use and easy to learn



Pictures and letters can be made easier to read by enlarging the display

Enables page scrolling and fast list searching



## Realization of simple operation

J-Navigate

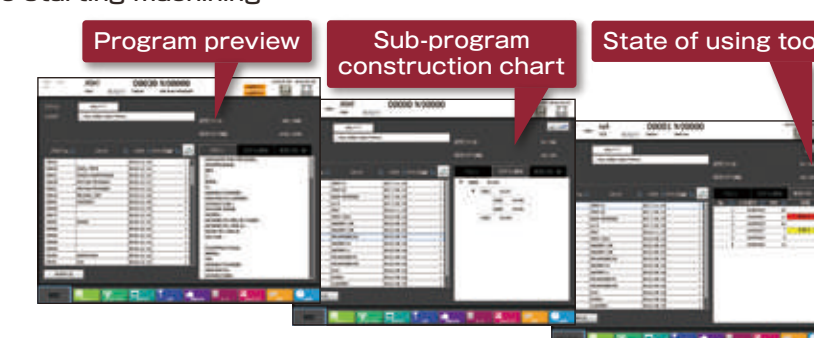
### Minimal number of screen calling operations

With the itemized menu lists, a screen can be called up in a maximum of two steps from any screen.



### Easy program status check before starting machining

Details, subprogram construction, and tool status can all be checked before starting machining just by selecting a program from the program list screen





Visualization of equipment status

J-Support

Supports operations performed at customer work sites with functions that visualize equipment status

Visualization of inspection ~Periodic inspection function~



Notifies the user of inspection periods and provides reliable inspection support

- Notification of inspection periods via messages
- Inspection areas and inspection procedures can be viewed without consulting a manual
- Registration of completed past inspections/measurement results

Visualization of longevity ~Management function for replacement parts service life~



Supports planned maintenance through notifications of when life is almost over

- Notifies the user of inspections for parts that are nearing the end of their lives
- Minimizes machine stop time through preventive inspection/part preparation
- Inspection areas and inspection procedures can be viewed without consulting a manual

Visualization of status ~Equipment diagnosis~



Supports maintenance by allowing on-screen assessment of equipment status

- ON/OFF status of devices can be viewed without having to check devices directly
- Device locations can be identified easily through image enlargement
- Internal ladder circuits can also be viewed easily

Visualization of performance ~Operation monitor~



Supports production control and improvement via graphs showing past operation performance/machining performance

- Performance can be viewed easily on graphs and tables, and data entry is also possible
- Current performance can be compared with past performance of the selected period
- Performance can be viewed easily by shift

Visualization of fault ~Fault analysis function~



Displaying error records through graphs for fault analysis

- Displays analysis results in graphs and tables making them easy to understand, and enables data output
- Displays analysis results for a specified period. The number of errors that occurred can be monitored for each of the alarms.
- Helps gain an understanding regarding trends in occurrence for each of the past alarms

Renewed operability

J-Manage

Batch management of tool/pallet information



**Tool management function**

- Allows automatic indexing of the selected pot without having to know the tool installation position
- Protects tools by using ATC speed commands suited to each tool
- Enables prior assessment of abnormal or insufficient tooling



**Pallet management function**

- Automatically calls the machining programs set for each pallet
- Enables the setting of compensation values for each pallet
- Enables omission of unnecessary machining

Equipment diagnosis utilizing IoT

J-Care

Shortens error recovery time thanks to quick support



Support provided whenever required by the customer

Information on ID/Password

Remote access

Connects to equipment in real time



Additional functions of TOYOPUC-Touch

●: Standard / □: Optional

| Classification | Function name                           | Included  |
|----------------|---|---|
| J-Navigate     | Basic functions                         | Running status display                                    |
|                |   | Program list display/editing                              |
|                |   | Command list display                                      |
|                |   | Macro variables list display/editing                      |
|                |   | Workpiece coordinate system offset display/editing        |
|                |   | Operation guidance function                               |
|                |   | Parameter settings  |
|                |   | User registration   |
|                |   | Message board   |
|                |   | Function switch   |
| J-Support      | Basic functions                         | Document browsing   |
|                |   | Fault list display  |
|                |   | Fault history   |
|                |   | Operation history   |
|                |   | Signal status   |
|                |   | System information  |
|                | Production support functions            | Backup  |
|                |   | Operation monitor   |
|                |   | Machining performance                                     |
|                | Energy saving functions                 | Operation performance                                     |
|                |   | Cycle time measurement                                    |
|                | Servicing functions                     | Energy monitoring   |
|                |   | Energy saving settings                                    |
|                | Maintenance functions                   | Periodic inspection function                              |
|                |   | Management function for replacement parts service life    |
|                |   | Equipment diagnosis                                       |
|                |   | Manual ATC recovery (easy-to-recover function)            |
|                |   | Software diagnosis function                               |
| J-Manage       | Tool management functions               | Fault analysis function                                   |
|                |   | Tool number conversion function                           |
|                |   | Tool offset function                                      |
|                |   | Tool longevity management function                        |
|                |   | ATC variable speed function                               |
|                |   | Offset updating function                                  |
|                |   | AC function   |
|                |   | Machining condition setting function                      |
|                |   | Stored tool data save function                            |
|                |   | Tool position display                                     |
|                |   | Tool display in magazine                                  |
|                |   | Abnormal tool list display                                |
|                |   | Spare tool list display                                   |
|                |   | Tools scheduled to be used                                |
|                |   | Tools not used for a long period of time display          |
|                |   | High-performance magazine operation panel                 |
|                |   | Automatic indexing function for tools that require change |
|                |   | Data updating function at tool mounting/removal           |
|                |   | Tool ID function  |
|                | Pallet information management functions | APC management  |
|                |   | Pallet compensation                                       |
|                |   | Multiple workpiece mounting                               |
| J-Care         | Remote support                          | Diagnosis data collection function                        |
|                |   | Remote diagnosis function (using Team Viewer)             |



TIPROS

An easy to use, comprehensive production system that keeps on evolving.

JTEKT has delivered many systems since the first FMS sold in 1972 and has come to be seen by both domestic and overseas customers as an innovative company offering high reliability while exceeding industry expectations, and as such, indispensable in the FA era. At JTEKT, we manufacture the best FMC/FMS by combining our original thorough mechatronics technologies with cutting-edge software modules - delivering numerous records.



Hardware

- Flexible machine tool supports high speed, high efficiency and high precision
- Intelligent peripheral units

Software

- Flexible control functions
- Enriched unmanned operation support functions
- Superior control functions

**FPA: Flexible Pallet Automation** (pallet transfer method)  
Expandability and unmanned operation

**FDT: Flexible Directly Transfer** (workpiece transfer method)  
Low-cost unmanned operation of low-variety, high-volume production

**RGV (rail-guided vehicle) + stacker crane**



**Robot method**



FMS software for TIPROS FPA (CL30, MG30, TL30)

Data setting is possible with a simple click. Workpiece behind schedule are displayed in red. The machine automatically decides which fixtures need replacing in line with the schedule.

| FMC software | PC type | Stacker crane method, carrier method |            |            |
|--------------|---------|--------------------------------------|------------|------------|
|              |         | FMS Level1                           | FMS Level2 | FMS Level3 |
|              |         | [Transfer control] CL30              |            |            |
|              |         | [DNC control] MG30                   |            |            |
|              |         | [Tool control] TL30                  |            |            |

Option: Scheduling, preventive maintenance, multiple-parts loading, etc.

Intuitive and easy to use

Directly specifying what is to be set

Pallet setting screen

Drag & drop

A visual part no. changeover setting

Completion timing is decipherable

Scheduling by equipment

Scheduling by work

Easy fixture management

Abundant pallet types

Automatically deciding fixture replacement



This is an example of FH800SX-I and RGV (rail guided vehicle)



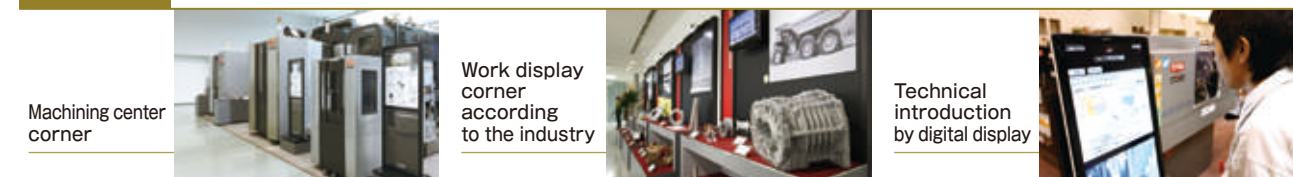
## A convincing before-after sales system centered on a permanent exhibition site

JTEKT's Customer Center was opened in Kariya, Aichi Pref. in 1999 as one of the largest permanent exhibition sites in Japan. The sales, before-sales and after-sales service and training school divisions accepting direct contact with customers are integrally located in this center so that the best solution to meet customer's requirements can be found.



### Observe

- Exhibition**
- Exhibition of cells/machines most suited to the customer
  - Introduction to leading edge technologies
  - Exhibition of total engineering potentials including those of group companies



### Touch and confirm

- Confirm**
- Confirmation of technology by carrying out before-sales service tests
  - Education of SFC, personnel training
  - Operation training at the training school



\*SFC (Sequential Function Chart)

### Have discussions

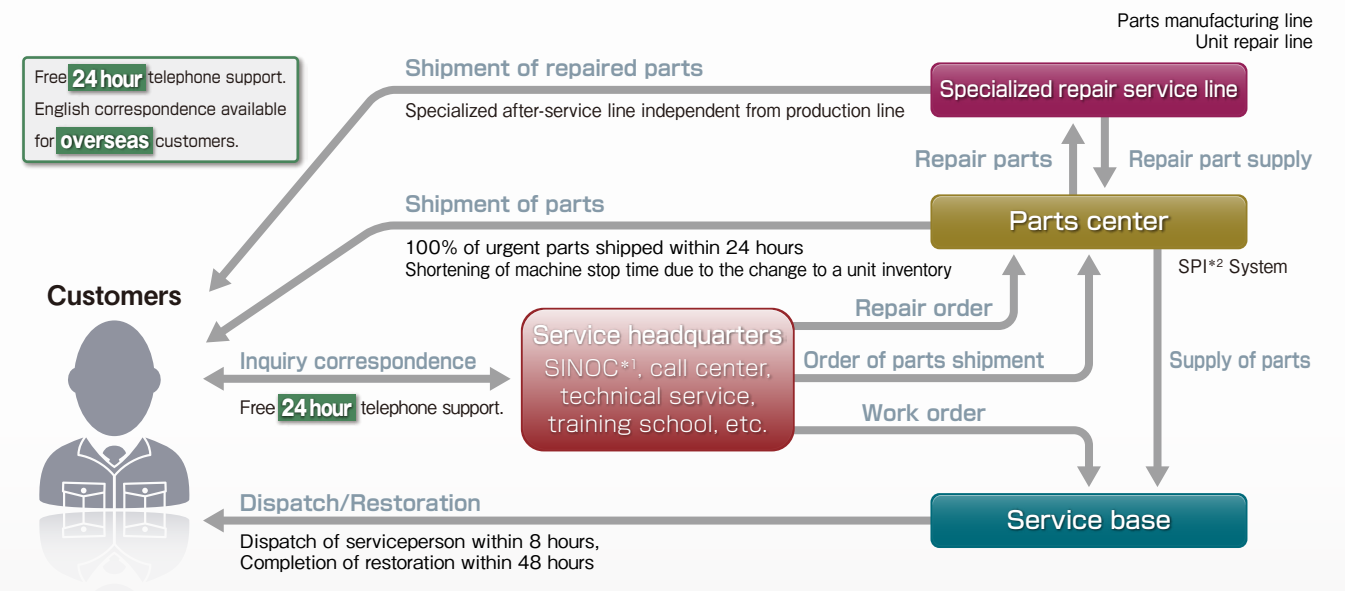
- Consultation**
- Technical exchange meeting by DE\* utilization
  - Exchange of the latest information through events
  - Machining consultation before the machines



\*DE (Digital Engineering)

## Speedy and precise customer correspondence.

We have established Service Headquarters in Kariya to consolidate the management of customer equipment information, and have arranged a system where call centers allow direct correspondence with customers, and parts can be supplied quickly.



■ Information management using SINOC\*1 \*1: SINOC (Service Information Network Operation Center)

■ Dispatch of serviceperson within 8 hours Completion of repairs within 48 hours

■ Shipment of urgent parts within 24 hours

■ Global parts management by SPI\*2 System \*2: SPI (Service Parts Inquiry)

### ■ Specialized repair service line

#### ●Parts manufacturing line

Flexible correspondence to express orders through specialized service parts manufacturing lines. Able to manufacture parts of older equipment.

#### ●Unit repair line

We provide swift response to sudden breakdowns of machining center spindles/ATCs/tables, grinder workheads/wheel spindles/tailstocks, etc. with our independent, specialized after-service line.



### ■ Training school

Attend training courses on machine operation, programming, maintenance and so on using actual machines for each training curriculum.





Machine specifications

| Item                     |   | Unit                 | FH630SX-i                    |                                   | FH800SX-i                   |                                   |           |
|--------------------------|---|----------------------|------------------------------|-----------------------------------|-----------------------------|-----------------------------------|-----------|
|                          |   |                      | Standard specifications      | Special specifications            | Standard specifications     | Special specifications            |           |
| Table & Pallet           | Table dimensions (pallet dimensions)              | mm                   | □630 (Pallet)                |                                   | □800 (Pallet)               |                                   |           |
|                          | Rotary table indexing angle                       | °                    | 1                            | 0.001                             | 1°                          | 0.001° (NC)                       |           |
|                          | Pallet height (from floor)                        | mm                   | 1,250                        |                                   | 1,320                       |                                   |           |
|                          | Max load on pallet                                | kg                   | 1,200                        | 1,500                             | 2,500                       |                                   |           |
|                          | Table indexing time (90° indexing)                | sec                  | 2.5                          | 2.5                               | 4.0                         | 4.0                               |           |
|                          | Pallet change time                                | sec                  | 18                           |                                   | 20                          |                                   |           |
| Stroke                   | X-axis  | mm                   | 1,050                        |                                   | 1,450                       |                                   |           |
|                          | Y-axis  | mm                   | 900                          |                                   | 1,250                       |                                   |           |
|                          | Z-axis  | mm                   | 1,050                        |                                   | 1,550                       |                                   |           |
|                          | Distance between spindle nose and table center    | mm                   | 50~1,100                     |                                   | 100~1,650                   |                                   |           |
|                          | Distance between spindle center and top of pallet | mm                   | 100~1,000                    |                                   | 100~1,350                   |                                   |           |
|                          | Max. workpiece swing × Max. workpiece height      | mm                   | φ1,170 × 1,250 ※1            |                                   | φ1,500 × 1,500 ※1           |                                   |           |
| Feeds                    | Rapid feed rate (X, Y and Z)                      | m/min                | 60                           |                                   | 54                          |                                   |           |
|                          | Cutting feed rate (X, Y and Z)                    | m/min                | 0.001~30                     |                                   | 0.001~30                    |                                   |           |
|                          | Rapid acceleration (X, Y and Z)                   | m/s <sup>2</sup> (G) | 6.86 (0.7)                   |                                   | 4.9 (0.5)                   |                                   |           |
|                          | Ball screw diameter (X, Y and Z)                  | mm                   | φ50 (X) , φ45 (Y,Z)          |                                   | φ50                         |                                   |           |
| Spindle                  | Spindle speed                                     | min <sup>-1</sup>    | 50~6,000                     | 50~6,000 50~15,000                | 50~6,000                    | 50~6,000                          | 50~15,000 |
|                          | Spindle diameter (front bearing bore)             | mm                   | φ110                         | φ110 φ120                         | φ110                        | φ110                              | φ120      |
|                          | Spindle nose shape                                |                      | BT No.50                     | HSK                               | BT No.50                    | HSK                               |           |
|                          | Spindle motor, short-time/continuous              | kW                   | 30 / 22                      | 55/45/37 37 / 30                  | 30 / 22                     | 55/45/37                          | 37 / 30   |
| ATC                      | Tool holding capacity                             | tool                 | 40                           | 60, 121, 122 or more tools        | 60                          | 121, 122 or more tools            |           |
|                          | Tool selection                                    |                      | Absolute address             |                                   | Absolute address            |                                   |           |
|                          | Tool (dia. × length)                              | mm                   | φ120 × 600 ※2                |                                   | φ120 × 800 ※2               |                                   |           |
|                          | Tool mass   | kg                   | 27                           |                                   | 35                          |                                   |           |
|                          | Tool change time (Tool-to-Tool)                   | sec                  | 2.5 (~15kg)<br>2.8 (15~27kg) |                                   | 2.7 (15kg)<br>3.2 (15~35kg) |                                   |           |
|                          | Tool change time (Chip-to-Chip)                   | sec                  | 3.6 (~15kg)<br>4.0 (15~27kg) |                                   | 4.4 (15kg)<br>5.0 (15~35kg) |                                   |           |
|                          | Tools Holder                                      |                      | MAS BT50                     |                                   | MAS BT50                    |                                   |           |
|                          | Pull stud   |                      | MAS P50T-1                   |                                   | MAS P50T-1                  |                                   |           |
| Dimensions & Weight      | Floor space (width × depth)                       | mm                   | 3,600 × 6,885 ※3             |                                   | 4,680 × 7,920 ※3            |                                   |           |
|                          | Machine height                                    | mm                   | 3,208 ※3                     |                                   | 3,680                       |                                   |           |
|                          | Machine weight                                    | kg                   | 19,600                       |                                   | 28,000                      |                                   |           |
| Various Capacities       | Working oil                                       | L                    | 18                           |                                   | 18                          |                                   |           |
|                          | Slide lubricant                                   | L                    | 2.9                          |                                   | 2.9                         |                                   |           |
|                          | Spindle oil air                                   | L                    | 2.9                          |                                   | 2.9                         |                                   |           |
|                          | Table   | L                    | 3.5                          | 2.5                               | 3.5                         | 5.5                               |           |
|                          | Spindle coolant                                   | L                    | 20                           | 35                                | 20                          | 35                                |           |
|                          | Power supply capacity                             | kVA                  | 45                           | 51                                | 50                          | 56                                |           |
|                          | Control voltage                                   | V                    | DC24                         |                                   | DC24                        |                                   |           |
|                          | Air source capacity                               | NL/min               | 800                          |                                   | 900                         |                                   |           |
|                          | Air source pressure                               | MPa                  | 0.4~0.5                      |                                   | 0.4~0.5                     |                                   |           |
| Capability & Performance | Positioning accuracy ※4                           | mm                   | ±0.003                       | ±0.002                            | ±0.003                      | ±0.002                            |           |
|                          | Repeatability ※4                                  | mm                   | ±0.0015                      | ±0.001                            | ±0.0015                     | ±0.001                            |           |
|                          | Table indexing accuracy ※4                        | sec                  | ± 3                          | ±7 (NC)<br>±3.5 (with NC encoder) | ± 3                         | ±7 (NC)<br>±3.5 (with NC encoder) |           |
|                          | Table indexing repeatability ※4                   | sec                  | ± 3                          | ±3.5 (NC)<br>±2 (with NC encoder) | ± 3                         | ±3.5 (NC)<br>±2 (with NC encoder) |           |
|                          |   |                      |                              |                                   |                             |                                   |           |

※1 Partial limitations exist for Workpiece swing × Height. For detail shape, refer to the tooling data.  
※2 Partial limitations exist for Tool (diameter × length) . For detail shape, refer to the tooling data.  
※3 For details, refer to the layout plan.   ※4 According to our inspection method

CNC unit FANUC 31i. ● Standard / □ Optional

| Division                 | Name   | FH630SX-i | FH800SX-i |
|--------------------------|--|-----------|-----------|
| Axis control             | Min. input increment (0.001mm)   | ●         | ●         |
|                          | Machine lock   | ●         | ●         |
|                          | Absolute position detection  | ●         | ●         |
|                          | Inch/metric switch   | □         | □         |
| Operation                | Dry run  | ●         | ●         |
|                          | Single block   | ●         | ●         |
|                          | Manual handle feed 1 unit  | ●         | ●         |
|                          | Program restart  | □         | □         |
|                          | Manual handle interrupt  | □         | □         |
|                          |  |           |           |
| Interpolation function   | Nano interpolation   | ●         | ●         |
|                          | Positioning (G00)  | ●         | ●         |
|                          | Exact stop mode (G61)  | ●         | ●         |
|                          | Tapping mode (G63)   | ●         | ●         |
|                          | Cutting mode (G64)   | ●         | ●         |
|                          | Exact stop (G09)   | ●         | ●         |
|                          | Linear interpolation (G01)   | ●         | ●         |
|                          | Arc interpolation (G02, G03)   | ●         | ●         |
|                          | Dwell (G04)  | ●         | ●         |
|                          | Helical interpolation  | ●         | ●         |
|                          | Reference point return (G28, G29)  | ●         | ●         |
|                          | Second reference point return (G30)  | ●         | ●         |
|                          | Third and fourth reference point return (G30)                                | ●         | ●         |
| Feed function            | AI contour control I (pre-read 30 blocks)                                    | ●         | ●         |
|                          | F1-digit feed  | □         | □         |
|                          | AI contour control II (pre-read 200 blocks)                                  | □         | □         |
| Program entry            | Local coordinate system (G52)  | ●         | ●         |
|                          | Machine coordinate system (G53)  | ●         | ●         |
|                          | Workpiece coordinate system (G54 to G59)                                     | ●         | ●         |
|                          | Additional workpiece coordinate systems (48 sets)                            | □         | □         |
|                          | Additional workpiece coordinate systems (300 sets)                           | □         | □         |
|                          | Custom macro   | ●         | ●         |
|                          | Additional custom macro common variables (#100 to #199, #500 to #999)        | ●         | ●         |
|                          | Fixed drilling cycle (G73, G74, G76, G80 to G89, G98 and G99)                | ●         | ●         |
|                          | Additional optional block skip (9 pieces)                                    | □         | □         |
|                          | Automatic corner override  | □         | □         |
| Spindle function         | Rigid tap  | ●         | ●         |
| Tool function            | Tool corrections (99)  | ●         | ●         |
| Tool correction function | Tool corrections (200)   | □         | □         |
|                          | Tool corrections (400)   | □         | □         |
|                          | Tool corrections (499)   | □         | □         |
|                          | Tool corrections (999)   | □         | □         |
|                          | Tool position offset   | ●         | ●         |
|                          | Tool diameter and cutter radius compensation                                 | ●         | ●         |
|                          | Tool length compensation (G43, G44 and G49)                                  | ●         | ●         |
| Editing operation        | Program storage capacity (128K bytes)  | ●         | ●         |
|                          | Program storage capacity (256K bytes)  | □         | □         |
|                          | Program storage capacity (512K bytes)  | □         | □         |
|                          | Program storage capacity (1M byte)   | □         | □         |
|                          | Program storage capacity (2M bytes)  | □         | □         |
|                          | Program storage capacity (4M bytes)  | □         | □         |
|                          | Program storage capacity (8M bytes)  | □         | □         |
|                          | Number of registered programs (250)  | ●         | ●         |
|                          | Number of registered programs (500) ※Storage capacity 256K bytes compulsory  | □         | □         |
|                          | Number of registered programs (1000) ※Storage capacity 512K bytes compulsory | □         | □         |
|                          | Number of registered programs (2000) ※Storage capacity 1M bytes compulsory   | □         | □         |
|                          | Number of registered programs (4000) ※Storage capacity 2M bytes compulsory   | □         | □         |
|                          | Simultaneous multi-program editing (incl. background editing)                | ●         | ●         |
|                          |  |           |           |
| Data entry/display       | Touch panel control  | ●         | ●         |
| Communication function   | Built-in Ethernet  | ●         | ●         |

FANUC is a registered trademark of FANUC LTD.



Accessories ● Standard accessories / □ Optional accessories / — Not available

| Item                                       | Equipment name                                   |   | FH630SX-i | FH800SX-i |
|--|--|---|-----------|-----------|
| Table and pallet                           | Indexing table                                   | 1" indexing table   | ●         | ●         |
|  |  | NC indexing table   | □         | □         |
|  |  | NC indexing table (with encoder)  | □         | □         |
|  | Pallet   | Standard pallet screw hole  | ●         | ●         |
|  |  | T-groove pallet   | □         | □         |
|  | Addition of pallet                               | Single piece screw hole   | □         | □         |
|  |  | Single piece T-groove   | □         | □         |
| Max. load on pallet                        | 1,500kg pallet load spec                         |   | □         | —         |
| Spindle relations                          | Specifications                                   | 6,000min <sup>-1</sup> BT No. 50 (30/22kW) spindle (with spindle-through coolant spec)  | ●         | ●         |
|  |  | 6,000min <sup>-1</sup> BT No. 50 (55/45/37kW) large torque spindle (with spindle-through coolant spec)                        | □         | □         |
|  |  | 15,000min <sup>-1</sup> BT No. 50 (37/30kW) large torque spindle (with spindle-through coolant spec)                          | □         | □         |
|  |  | Filler block for oil hole holder  | □         | □         |
|  |  | Positioning block for angle head holder   | □         | □         |
|  | Collet   | HSK specifications  | □         | □         |
|  |  | BIG PLUS specifications   | □         | □         |
|  |  | MAS I   | ●         | ●         |
|  |  | JIS   | □         | □         |
|  |  | MAS II  | □         | □         |
| Tool magazine                              | Tool capacity                                    | 40 tools  | ●         | —         |
|  |  | 60 tools  | □         | ●         |
|  |  | 121 tools   | □         | □         |
|  |  | 122 or more tools   | □         | □         |
| Coolant relations                          | Coolant supply unit                              | Coolant supply unit (water soluble/with take-up chip conveyor/scrapper type/without spindle-through coolant spec)             | ●         | ●         |
|  |  | Coolant supply unit (water soluble/with take-up chip conveyor/scrapper type/spindle-through coolant spec/1MPa through pump)   | □         | □         |
|  |  | Coolant supply unit (water soluble/with take-up chip conveyor/scrapper type/spindle-through coolant spec/3MPa through pump)   | □         | □         |
|  |  | Coolant supply unit (water soluble/with take-up chip conveyor/scrapper type/spindle-through coolant spec/7MPa through pump)   | □         | □         |
|  |  | Coolant supply unit (water soluble/with take-up chip conveyor/2-tank type/spindle-through coolant spec/1MPa through pump)     | □         | □         |
|  |  | Coolant supply unit (water soluble/with take-up chip conveyor/2-tank type/spindle-through coolant spec/3MPa through pump)     | □         | □         |
|  |  | Coolant supply unit (water soluble/with take-up chip conveyor/2-tank type/spindle-through coolant spec/7MPa through pump)     | □         | □         |
|  |  | External nozzle coolant   | ●         | ●         |
|  | Coolant cooling                                  | Overhead shower coolant   | ●         | ●         |
|  |  | Internal chip flushing coolant  | ●         | ●         |
|  |  | Chip flow coolant in pallet changer   | □         | ●         |
|  |  | Internal screw conveyor   | ●         | ●         |
|  |  | Coolant cooling   | □         | □         |
|  |  | Oil skimmer   | □         | □         |
|  |  | Chip box  | □         | □         |
|  |  | Splash gun (at APC)   | ●         | ●         |
|  | Air blower                                       | Mist collector  | □         | □         |
|  |  | Air blower  | □         | □         |
|  |  | External nozzle type  | □         | □         |
| Splash guard                               | Enclosure guard                                  | Enclosure guard   | ●         | ●         |
|  |  | Door interlock at operating position  | ●         | ●         |
|  |  | APC door interlock  | ●         | ●         |
|  |  | Internal lighting   | ●         | ●         |
| Operation control function, others         | Ground fault interrupter                         | Ground fault interrupter  | □         | □         |
|  |  | Ground fault interrupter  | □         | □         |
|  |  | Automatic fire extinguisher   | □         | □         |
|  |  | Universal design cover  | □         | □         |
| Labor saving function                      | Pallet changer (APC)                             | No pallet manual swivel function  | ●         | ●         |
|  |  | With pallet manual swivel function  | □         | □         |
| Support for high accuracy                  | Spindle cooling unit                             | Spindle cooling unit  | ●         | ●         |
|  |  | Ball screw shaft cooling  | —         | ●         |
|  | BTS (Ballscrew Thermo Stabilizer) function       | BTS (Ballscrew Thermo Stabilizer) function  | ●         | —         |
|  |  | Scale feedback (X-, Y- and Z-axes)  | □         | □         |
|  | Touch sensor function                            | If installation is requested, the BTS function is excluded.   | □         | □         |
|  |  | Optical type (without energization): with alignment and datum face correction functions                                       | □         | □         |
|  |  | Optical type (with energization): with alignment, datum face correction, gap elimination and tool breakage detection function | □         | □         |
|  |  | Automatic tool length measurement function and datum face for measurement (interference area caused)                          | □         | □         |
|  |  | Automatic measurement function  | □         | □         |
|  |  | Automatic measurement correction function   | □         | □         |
|  |  | Rotary coordinate system correction function  | □         | □         |
| Automatic tool length measurement function | Tool breakage detection unit inside the magazine | Fixed table type  | □         | □         |
|  |  | Touch switch type   | □         | □         |
|  |  | Spindle thermo stabilizer function  | □         | □         |
|  |  |   | □         | □         |

When the scale feedback is equipped, the model name becomes FH630SX5-i-L and FH800SX5-i-L.

Maximum workpiece

FH630SX-i

●Limitations apply if the optional tool length measurement unit is equipped.

FH800SX-i

●Limitations apply if the optional tool length measurement unit is equipped.

pallet

Threaded hole pallet

●Pitch tolerance of M16 screw is ±0.2  
●No alignment reference hole is provided for the edge locator.

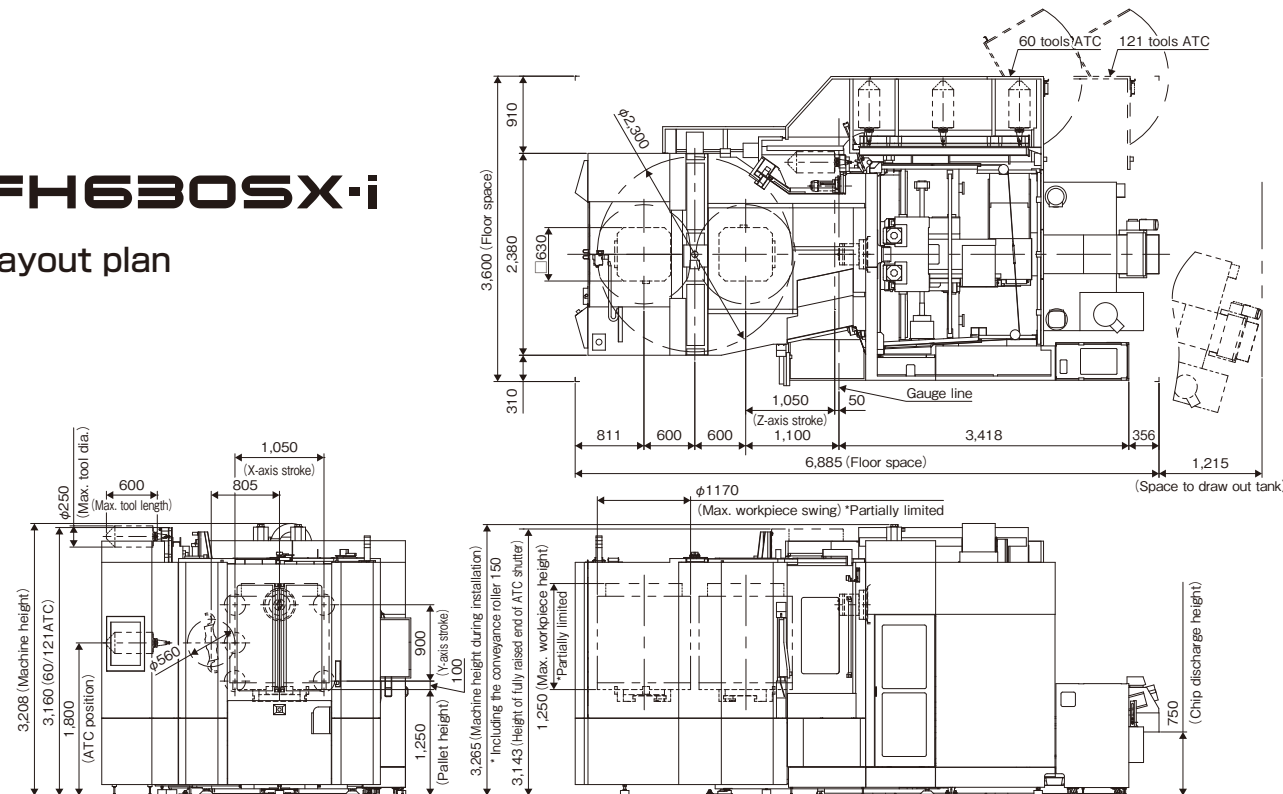
T-groove pallet

●T-groove pitch tolerance is ±0.2  
●No alignment reference hole is provided for the edge locator.



# FH630SX-i

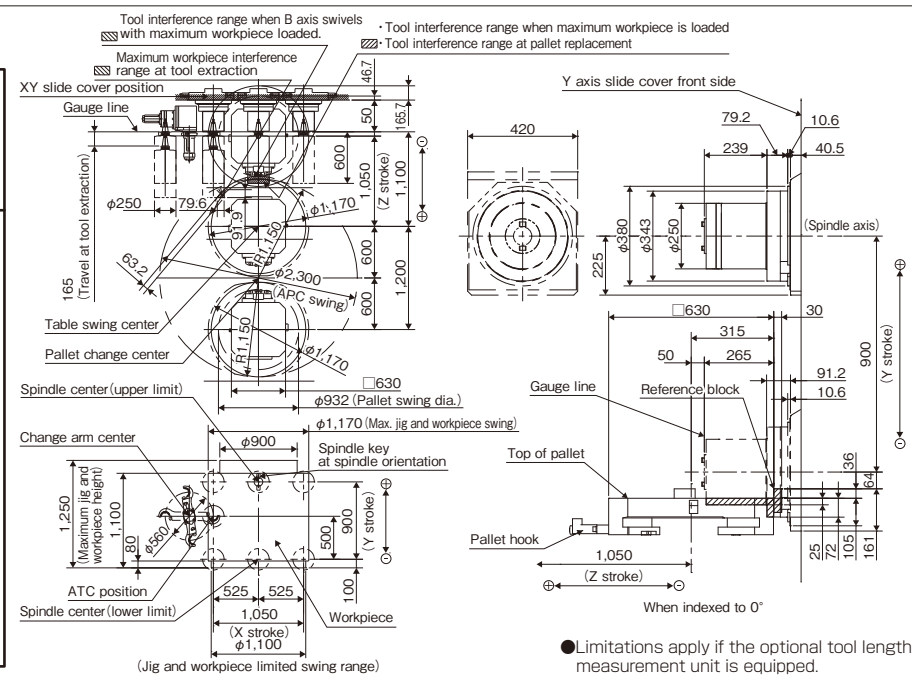
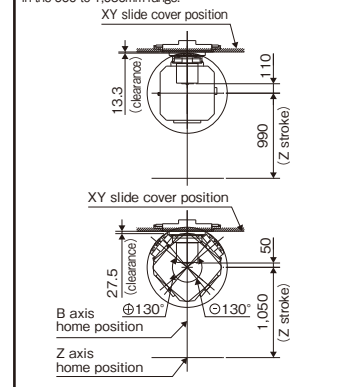
## Layout plan



Interference area

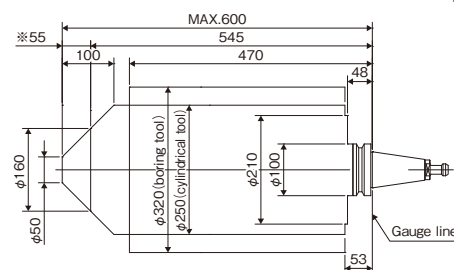
Important1) Table indexing operation for Z-axis minus end is within interference range with the XYZ slide cover. Do not perform indexing over the interference range shown in the figure, after moving the table in the Z-axis plus direction.  
The interference range with the maximum  $\phi 1,170\text{mm}$  workpiece is 165.7mm.  
The interference range for a pallet swing of  $\phi 932\text{mm}$  is 46.7mm.

Important 2) The table can swivel  $\pm 180^\circ$  from the B axis home position when the Z axis is in a stroke range of 0 to 990mm. The B axis can only swivel  $\pm 130^\circ$  when the Z axis is in the 990 to 1,050mm range.



### Limitations in tool holder shape (JIS,CAT,DIN,Big+ #50)

- The tool holder is subject to shape limitations when performing ATC (Automatic Tool Change). Tools with a maximum diameter exceeding  $\phi 100\text{mm}$  must have an outside diameter within  $\phi 100\text{mm}$  of the 48mm range from the gauge line. Within a 53mm range from the gauge line, the outside diameter must be within  $\phi 210\text{mm}$ .
  - The total mass must be 27kg and the length from the gauge line must be within 600mm.
- \* Tool lengths of 545mm or above are subject to limitations from the relation to the largest workpiece. Tool length must be as follows:  
 $(\text{Largest workpiece swing (diameter)})/2 + \text{Tool length} \leq 1,130\text{mm}$

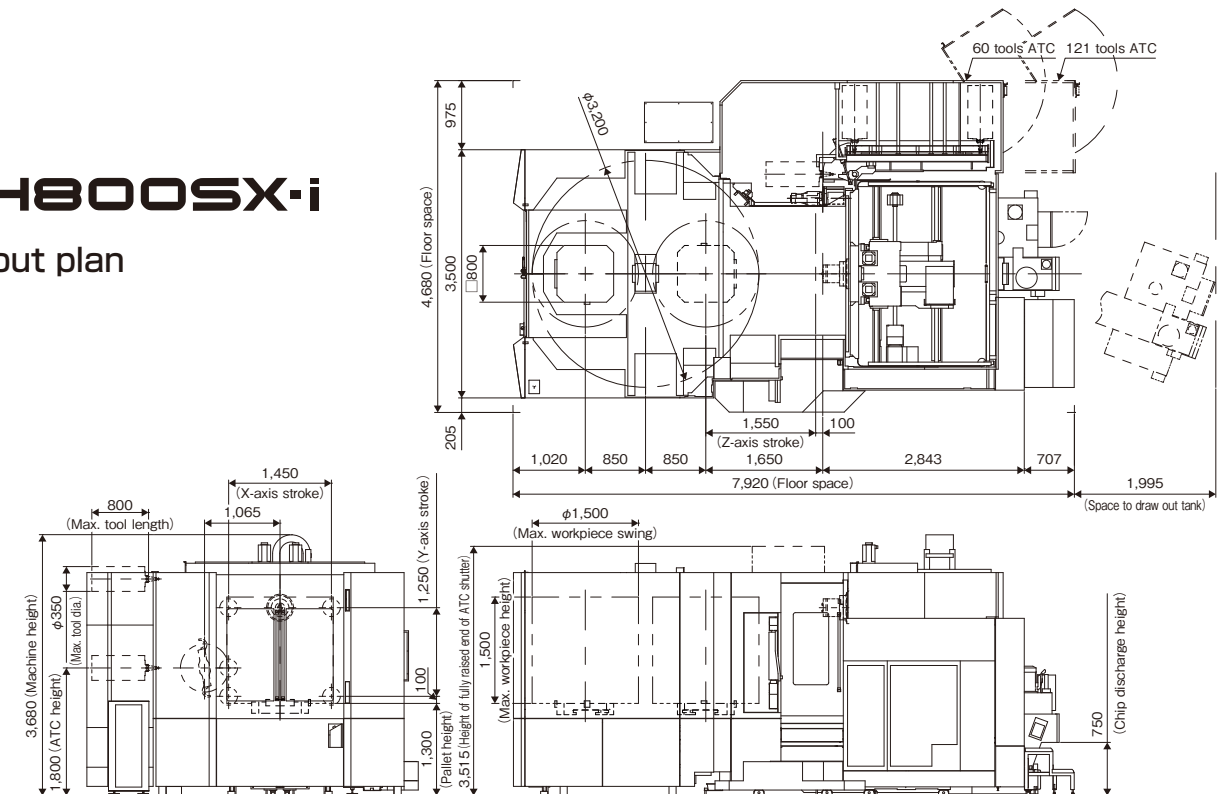


| Item           | Max. spec   |
|----------------|---|
| Tool length    | 600mm   |
| Tool diameter  | With 40 or 60 tools magazine: $\phi 120\text{mm}$ (with no limitations caused by adjacent tools)<br>With 121 tools magazine: $\phi 130\text{mm}$ (with no limitations caused by adjacent tools)   |
| Tool weight    | 27kg: The moment at the spindle nose must be within 29N-m.  |
| Tool imbalance | $30 \times 10^{-6}\text{N-m}$ or less (tools not exceeding 6,000min <sup>-1</sup> )<br>$10 \times 10^{-6}\text{N-m}$ or less (tools between 6,000min <sup>-1</sup> and 8,000min <sup>-1</sup> )<br>$3 \times 10^{-6}\text{N-m}$ or less (tools exceeding 8,000min <sup>-1</sup> ) |

Tools with diameters exceeding those described above are subject to limitations in the diameter of adjacent tools in the magazine, key grood position of the tool holder and so on.

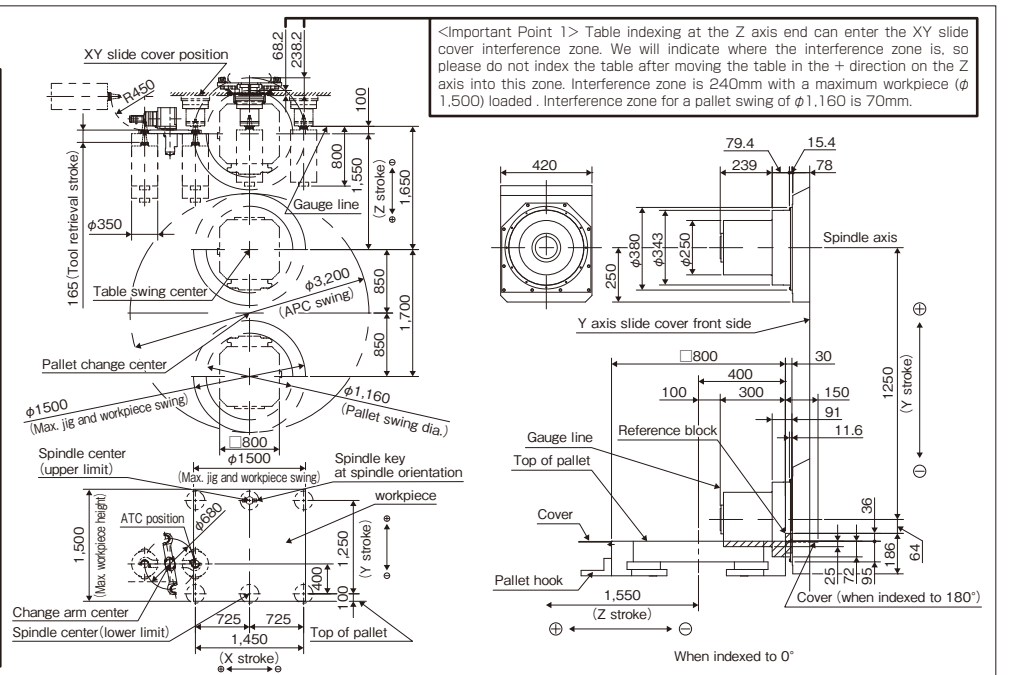
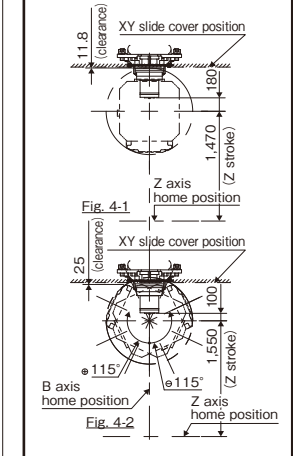
# FH800SX-i

## Layout plan



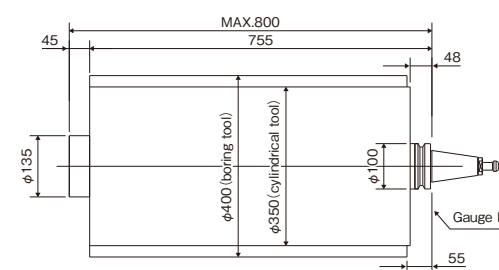
## Interference area

<Important Point 2> The table can swing  $\pm 180^\circ$  from the B axis home position when it is 1470mm from the Z axis home position. (See Fig. 4-1). When the Z axis is at a stroke between 1470 and 1550mm, B axis can swing  $\pm 115^\circ$



### Limitations in tool holder shape (JIS,CAT,DIN,Big+BT No.50)

- The tool holder is subject to limitations in the shape during ATC (automatic tool change). If the maximum tool diameter exceeds  $\phi 100\text{mm}$ , the 48mm range from the gauge line must be  $\phi 100\text{mm}$  in the outside diameter. The 55mm range from the gauge line must be within  $\phi 210\text{mm}$  in the outside diameter. The total mass must be within 35kg and the length from the gauge line must be within 800mm.



|                |  |
|----------------|--|
| Item           | Max. spec  |
| Tool length    | 800mm  |
| Tool diameter  | With 60 tools magazine: $\phi 120\text{mm}$ (with no limitations caused by adjacent tools)<br>With 121 tools magazine: $\phi 130\text{mm}$ (with no limitations caused by adjacent tools)  |
| Tool weight    | 35kg: The moment at the spindle nose must be within 29N·m.   |
| Tool imbalance | $30 \times 10^{-5}\text{N}\cdot\text{m}$ or less (tools not exceeding $6,000\text{min}^{-1}$ )<br>$10 \times 10^{-5}\text{N}\cdot\text{m}$ or less (tools between $6,000\text{min}^{-1}$ and $8,000\text{min}^{-1}$ )<br>$3 \times 10^{-5}\text{N}\cdot\text{m}$ or less (tools exceeding $8,000\text{min}^{-1}$ ) |

Tools with diameters exceeding those described above are subject to limitations in the diameter of adjacent tools in the magazine, key grood position of the tool holder and so on.