Nidec
All for dreams

5-axis Vertical Machining Center

VB-X650

www.nidec.com/en/nidec-okk/

NIDEC OKK CORPORATION

Vertical 5 Axis

VB-X650

High-speed! Compact! Innovative! 5-axis Vertical Machining Center

Simple clamping with 5-axis machining center leads to process integration and higher productivity.
Highest rapid feed rate and most economical small footprint.
The highly rigid gantry structural design makes for maximum production efficiency.

Travel :
(X×Y×Z)
850×610×510mm (33.46"×24.02"×20.08")
(B×C)
-110~110°×360°

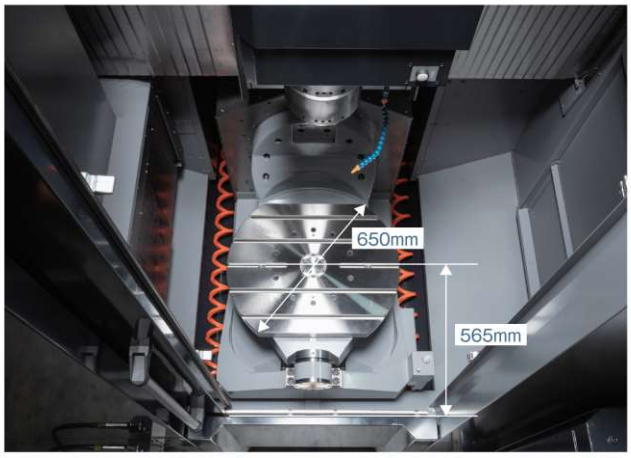
Rapid feed rates :
(X・Y・Z)
63m/min (2480ipm)
(B/C)
B:50min^{-1}
C:100min^{-1}

Max. workpiece dimensions :
ø650×H450mm (ø25.59"×H17.72") (Some restricted dimensions)
Max. table load :
350kg (772lbs)
Tool shank (nominal number) :
BT40 (Dual-contact BT40)

Structure, Features

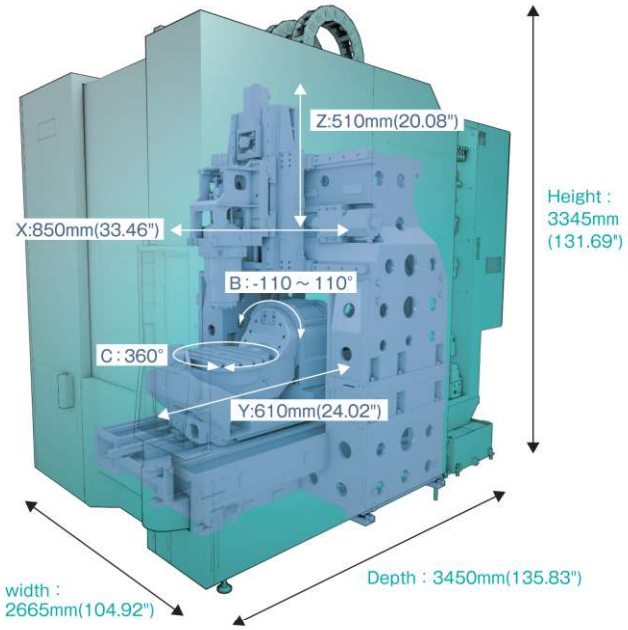
Easy accessibility

Designing the table support smaller, the distance from the setup door to the center of the table is 565mm even though it is a ø650 table.



Stroke and Floor space

Top class floor occupancy for machine strokes



Direct drive motor

The rotary table has a direct drive motor as standard.
Maintenance-free, No-backlash, High-speed machining.

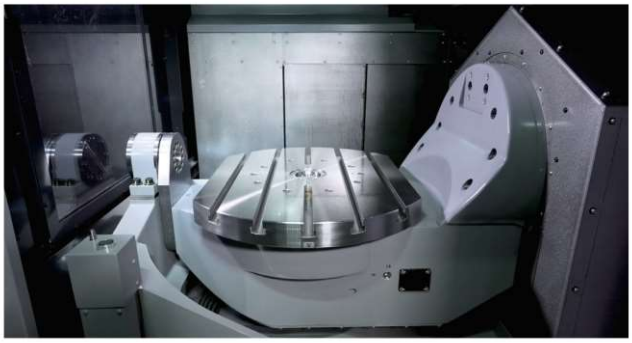
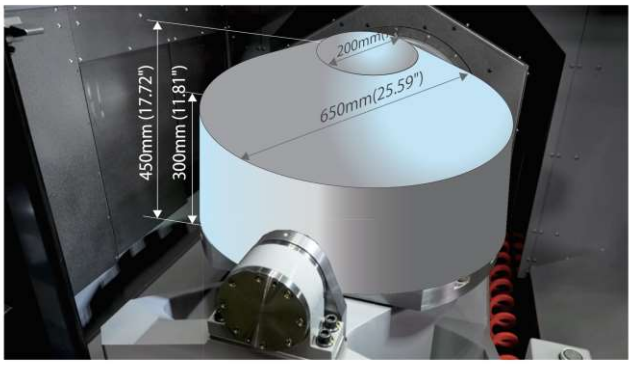


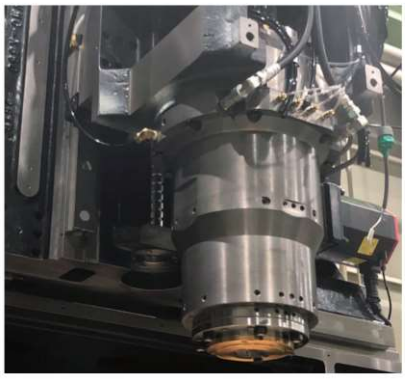
Table loading dimensions

Max. table load: 350 kg (772 lbs)



15000min^{-1} spindle as standard

37/26/18.5kW high horsepower spindle as standard.
High-speed specifications of 20,000min^{-1} are available as an option.



Cutting Capability · Accuracy

Spindle Output · Spindle Torque diagram

■ 15,000min-1

		Low speed 100~3500min-1		High speed 3501~15000min-1	
Output	Cont.rating	15.0kW	Cont.rating	18.5kW	
	15min rating	18.5kW	30min rating	26.0kW	
	10%ED	22.0kW	15kW(20HP)	37.0kW	
Torque	Cont.rating	95.5N · m	Cont.rating	35.3N · m	
	15min rating	118N · m	30min rating	49.7N · m	
	10%ED	250N · m	15kW(20HP)	70.7N · m	

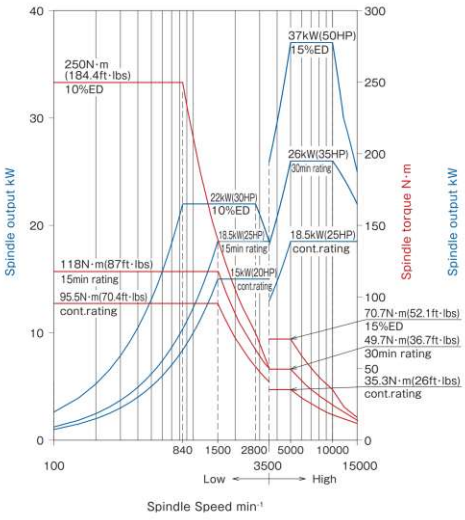
■ 20,000min-1

		Low speed 100~4000min-1		High speed 4001~20000min-1	
Output	Cont.rating	15.0kW	Cont.rating	18.5kW	
	15min rating	18.5kW	30min rating	26.0kW	
	10%ED	22.0kW	15kW(20HP)	37.0kW	
Torque	Cont.rating	79.6N · m	Cont.rating	27.2N · m	
	15min rating	98.1N · m	30min rating	38.2N · m	
	10%ED	221N · m	15kW(20HP)	58.9N · m	

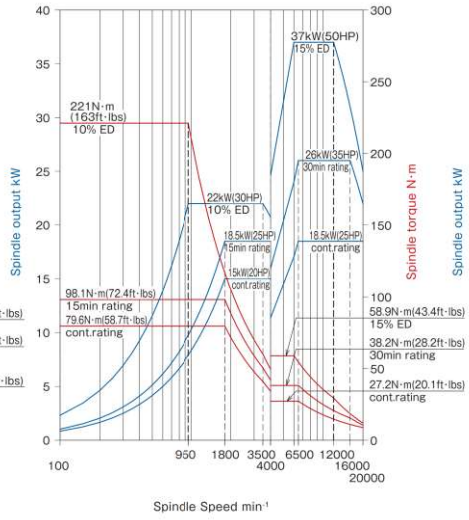
■ 12,000min-1

		Low speed 100~3500min-1		High speed 3501~12000min-1	
Output	Cont.rating	15.0kW	Cont.rating	18.5kW	
	15min rating	18.5kW	30min rating	26.0kW	
	10%ED	22.0kW	15kW(20HP)	37.0kW	
Torque	Cont.rating	95.5N · m	Cont.rating	35.3N · m	
	15min rating	118N · m	30min rating	49.7N · m	
	10%ED	250N · m	15kW(20HP)	70.7N · m	

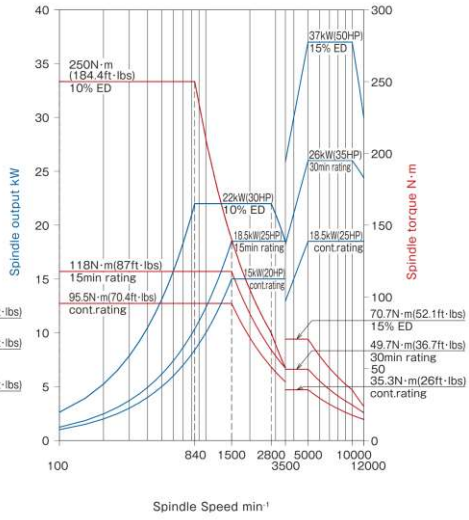
■ 15,000min-1



■ 20,000min-1

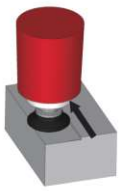


■ 12,000min-1

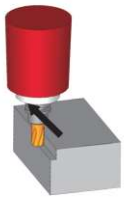


Cutting Capability

Item	Unit	Face mill ϕ100(3.94")×5T
Spindle Speed	min-1	600
Cutting width	mm	80
Depth of cut	mm	5(0.20")
Feed rate	mm/min	840(33ipm)
Cutting rate	cm3/min	336(20.5in3/min)
Spindle motor load	%	95
Work material		S45C



Item	Unit	X axis	Y axis
		End mill	ø16×4T
Spindle Speed	min-1	4000	4000
Cutting width	mm	30(1.18")	30(1.18")
Depth of cut	mm	2.5(0.10")	3(0.12")
Feed rate	mm/min	2000(79ipm)	2000(79ipm)
Cutting rate	cm3/min	150(9.2in3/min)	180(11in3/min)
Spindle motor load	%	34	40
Work material		S45C	



※1. This data example is a short-time processing example; results may differ for continuous processing.
※2. This data example is accuracy under Nidec OKK's in-house cutting test conditions. Results may vary depending on the condition of the cutter and mounting jig.
※3. The above accuracy values are based on the Nidec OKK inspection standards when installed in accordance with the Nidec OKK foundation drawings and at a constant ambient temperature.

Accuracy

■ Positioning accuracy

(mm)

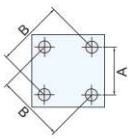
	when Linear scale is not used	when Linear scale is used
Positioning accuracy	X、Y、Z: ±0.0020(0.00008")/ full stroke	X、Y、Z: ±0.0010(0.00004")/ full stroke
Positioning repeatability	X、Y、Z: ±0.0010(0.00004")/ full stroke	X、Y、Z: ±0.0005(0.00002")/ full stroke

(Nidec OKK tolerance)

(mm)

	when Rotary encoder is not used	when Rotary encoder is used
Positioning accuracy	C-axis : ±10sec	B-axis : ±5sec C-axis : ±3sec

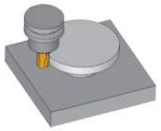
(Nidec OKK tolerance)



A	200.000(7.87402")
B	282.843(11.13555")

■ Positioning machining accuracy (mm)

	Nidec OKK tolerance	Example of results
Each axis direction	0.015(0.00006")	0.003(0.00001")
Diagonal direction	0.015(0.00006")	0.004(0.00002")
Hole diameter difference	0.010(0.00039")	0.002(0.00008")



■ Circular machining accuracy (mm)

	Nidec OKK tolerance	Example of results
Circularity	0.005(0.00020")	0.0037(0.00015")

Automation and labor-saving

Automation and labor-saving support

Opt.

Large-capacity pallet stockers and expansion magazines are available as options.
Automation and labor-saving can be achieved by combining with robots.

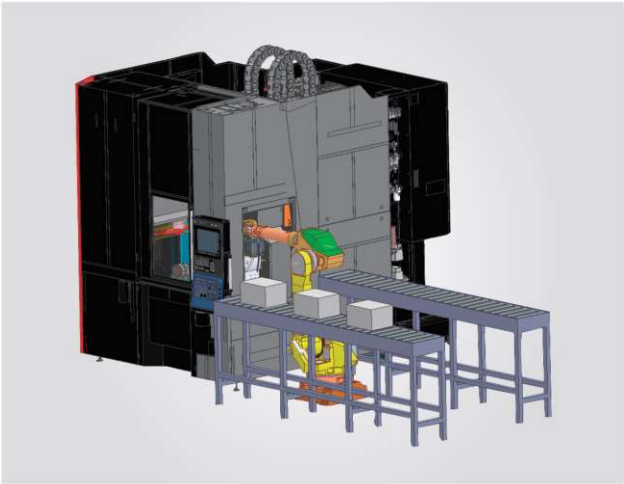
Pallet stocker

※ Figure shows 18APC (6 Pallets x 3 stages)
12APC (2-stages) and 6APC (1-stage) are also available

System 3R Transformer
Dynafix Tooling
Auto Pallet Changer System

※ Figure shows an image of APC

Example of robot support



※ Figure is an image.

Tool magazine

60 tools/116 tools/172 tools Selectable

※ Figure is an image.

Peripheral Devices(Option)

Touch sensor system

Opt.

Workpiece centering/measurement is performed using a workpiece measurement sensor mounted on the spindle.
Tool length measurement and Tool breakage detection are also performed using a tool length measurement sensor installed on the table.

T1-A

T1-C

Function	Description	System name	
Workpiece measurement and compensation	• The appropriate compensation value is calculated from the amount of movement at that time and set in the workpiece coordinate system. • Create and execute measurement and correction programs according to the specified format.	T1−A	T1−B
Tool length measurement	• The tool is brought into contact with the tool length sensor on the table in automatic operation, the tool length is calculated from the amount of movement at that time, and the compensation amount is automatically set to the specified compensation number. • Create and execute measurement and correction programs according to the specified format. • Applicable tools: drills and taps	T1−C	
Tool breakage detection	• Using the tool break detection program and the tool is moved a certain amount. At this time, breakage tool is judged by whether or not the cutting edge of the tool contacts the tool sensor on the table. • Tool break can be monitored at any time by additionally inserting a call to the Tool break detection program in the machining program. • Applicable tools: drills and taps • Operation after break detection depends on the machine specifications.		

Lift-up Chip Conveyor (Option)

Opt.

■ Suitable Lift-up Chip Conveyor according to Type of Chips

◎ : Most suitable; ○ : Usable; △ : Conditionally usable; × : Not usable; — : Not applicable

Type of chip conveyor				Hinged type		Scraper type		Magnet scraper type		Scraper type with drum filter		Magnet scraper type with drum filter	
Use or not use of coolant oil				Use	Not use	Use	Not use	Use	Not use	Use	Not use	Use	Not use
Type of chips	Magnetizable chips	Steel	Short curl	◎	◎	○	○	◎	◎	○	-	◎	-
			Spiral	◎	◎	△※2	△※2	△※2	△※2	×	-	×	-
			Long	◎	◎	×	×	×	×	×	-	×	-
			Needle shape	×	△※1	×	○	○※3	○	○	-	◎	-
			Powder or small lump	×	△※1	×	○	○※3	○	○	-	◎	-
		Cast iron	Needle shape	×	△※1	×	○	○※3	○	○	-	◎	-
			Powder or small lump	×	△※1	×	○	○※3	○	△※3	-	◎	-
	Non-magnetizable chips	Aluminum	Short curl	×	◎	△※4	○	-	-	◎	-	◎	-
			Spiral	○	◎	○	○	-	-	△※5	-	△※5	-
			Long	○	◎	○	○	-	-	△※5	-	△※5	-
			Needle shape	×	△※1	×	○	-	-	◎	-	◎	-
			Powder or small lump	×	△※1	×	○	-	-	◎	-	◎	-

※1 Minute chips can enter the conveyor casing through a gap between hinged plates. Therefore, cleaning inside the conveyor frequently is needed.

※2 Long chips can easily be caught by a scraper. Therefore, measures for shortening the chips such as the step feed and removing the caught chips are needed.

※3 If the coolant flow rate is large, chips can flow out of the conveyor casing and cause clogging of filters. Therefore, combined use of a magnet plate is recommended.

※4 If the coolant flow rate is large, chips can flow out of the conveyor casing and cause clogging of filters. Therefore, cleaning filters frequently is needed.

※5 Long chips can easily be caught by a scraper. Therefore, removing them regularly is needed. Drum filters are damaged if they are not removed.

Photo is Hinge type (Option) .
Chip bucket is another option.
There are fixed type and swivel type.

※Example of Lift-up chip conveyor

SPECIFICATIONS

Main Specifications

Standard specifications

Item	Unit	Specification
Travel on X axis(Saddle right / left)	mm	850(33.46")
Travel on Y axis (Table back / forth)	mm	610(24.02")
Travel on Z axis (Spindle head up / down)	mm	510(20.08")
Travel on B axis (Table tilting)	deg	-110 ~ +110
Travel on C axis (Table turning)	deg	360
Distance from table top surface to spindle nose	mm	150 to 660(5.91" to 25.98")
Distance from column front to spindle center	mm	445(17.52")
Table work surface area	mm	ø650×520(ϕ25.59"×17.72")(2 sides width)
Max. table load	kg	350(772lbs)(Equally distributed load)
Table work surface configuration(T-slot nominal x spacing x number of T-slots)	mm	18×100×5(0.71"×3.94"×0.20")
Distance from floor surface to table work surface	mm	1080(42.52")
Spindle rotating speed	min^{-1}	100 ~ 15000
Number of spindle rotating speeds		Electric stepless speed change(MS)
Spindle nose (Nominal number)		7/24 taper, No.40
Spindle bearing bore diameter	mm	ø70(ϕ2.76")
Rapid feed rates XYZ:	mm/min	63000(2480ipm)
Rapid feed rates BC:	min^{-1}	B:50 C:100
Cutting feed rate XYZ:	mm/min	1 ~ 40000(0.04 to 1575ipm) ※1
Cutting feed rate BC:	min^{-1}	B:50 C:100 ※1
Type of tool shank (Nominal number)		JIS B6339 BT40
Type of pull stud (Nominal number)		MAS1 45°
Number of storable tools	tools	40
Max. tool diameter	mm	ø75(ϕ2.95") (ø125 (ø4.92")when adjacent pot is empty)
Max. tool length (from the gauge line)	mm	300(11.81")
Max. tool weight	kg	8(17.6lbs)
Max. tool moment	N·m	9.8(7.23ft·ibs)
Tool selection method		Memory random method (Pod No. type)
Tool exchange time(cut-to-cut)	sec	3.4
Spindle motor	kW	37(50HP)(15%ED) / 26(35HP)(30min rating)/ 18.5(25HP)(cont.rating)
Feed motor XYZ:	kW	5.5(7HP)
Feed motor BC:	kW	B:11.3(15.2HP) C:4.1(5.5HP)
Motor for hydraulic pump	kW	1.5(2HP)
Motor for spindle head cooling pump(compression/discharge)	kW	1.1(1.5HP)/0.4(0.5HP)
Coolant pump motor	kW	60Hz:1.1(1.5HP) 50Hz:0.75(1HP)
Motor for Cleaning shower gun pump	kW	60Hz:1.1(1.5HP) 50Hz:0.75(1HP)
Motor for Ceiling shower and Table cleaning pump	kW	60Hz:1.1(1.5HP) 50Hz:0.75(1HP)
Motor for ATC	kW	0.75(1HP)
Motor for turning the magazine	kW	1.2(1.6HP)
Motors for coil-type chip conveyors	kW	0.1(0.1HP)×2
Power supply ※2	kVA	72
Supply voltage × supply frequency	V·Hz	200V±10% 50/60Hz±1Hz 220V±10% 60Hz±1Hz
Compressed air supply pressure ※3	MPa	0.4 to 0.6(58psi to 87psi)
Compressed air supply flow rate ※2, ※3	L/min (ANR)	650 (172 gal) or more
Coolant tank capacity	L	340(90 gal)
Spindle head cooling oil tank capacity (oil cooler)	L	20(5.3 gal)
Spindle lubrication tank capacity(Oil air)	L	2(0.53 gal)
Hydraulic unit tank capacity	L	20(5.3 gal)
Machine height from the floor surface	mm	3345(131.69")
Required floor space(including maintenance area) (left/right x depth)	mm	3665×4950(144.29"×194.88")
Machine weight	kg	11000(24250lbs)
Temperature of operation environment	℃	5 to 40
Humidity of operation environment	%	10 to 90 (No condensation)

Note 1: The feed rate under the HQ or Hyper HQ control.
Note 2: The value for the standard specification. It may vary with added options.
Note 3: The cleanliness of the supply air should be equivalent to or better than ISO 8573-1 JIS B8392-1 grade 3.4.5.

Standard Accessories

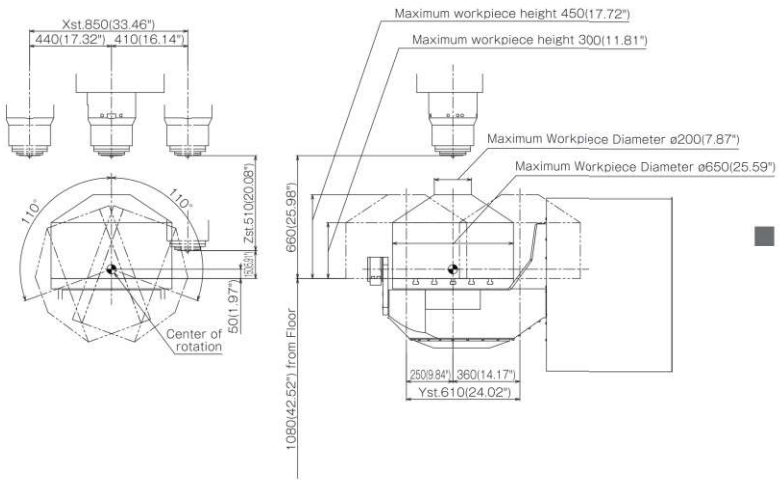
Name	Qty	Remark
LED lamps	1 set	LED Light ×1
Coolant unit (Separately-installed coolant tank)	1 set	Tank capacity : 340L(90 gal)
Splash guard Magazine safety cove	1 set	With electromagnetic lock
Sliding surface protection steel slide covers for X, Y and Z axis	1 set	
Oil temperature control device for spindle and table cooling	1 set	
Guide and ball screw grease automatic lubrication	1 set	
Coil-type chip conveyor(including the reverse rotation function)	1 set	1 set each for right and left side
Hydraulic unit (separate installation)	1 set	
Ceiling shower and Table cleaning	1 set	
Air blower	1 set	
Signal lamp	1 set	3-lamp type including buzzer alarm
Workpiece shower gun	1 set	Shower gun type
ATC shutter	1 set	
Rotary encoder	1 set	B axis (tilting axis) and C axis (turning axis)
Leveling block	1 set	
Oil-air unit	1 set	
Foundation parts for machine fixing	1 set	For bond anchoring method
Rotary joint for jig piping	1 set	4ports
Earth leakage breaker	1 set	
Automatic power off	1 set	
Electrical spare parts (fuses)	1 set	
Instruction manual	1 set	
Electrical manuals	1 set	operation, maintenance, parts list,hardware diagrams

Optional Accessories

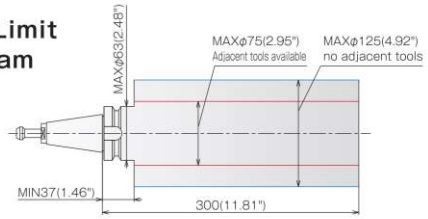
Item	Specification
Feed unit type	Ball screw lead 8mm Specifications
Spindle rotating speed	12,000min^{-1}(37/26/18.5kW(50/35/25HP))
	20,000min^{-1}(37/26/18.5kW(50/35/25HP))
Type of tool shank	CAT40 ／ DIN40
Type of pull stud	OKK90°／ MAS 2(60°)
Number of storable tools	60/116/172 tools
APC equipment	Pallet work surface area □400mm(15.75"), Multi pallet stocker (18 pallets), Pallet top surface configuration T-slot specification/Screw hole specification
Front door automatic opening and closing specification	
Ejection of chips from the machine	Chip Flow Coolant (Cannot be used with coil conveyor)
Lift-up type chip conveyor	Hinged type / Scraper type / Scraper type with floor magnet / Scraper type with drum filter for aluminium / Scraper type with drum filter for aluminum and casting Chip discharge from left / right side
Chip bucket	Fixed chip bucket/Tilting chip bucket
Oil skimmer	Screw type
Compatibility with through-spindle	2 MPa(290psi) coolant / 7 MPa(1015psi) coolant Air/ Preparation for coolant
Coolant cooler	Separate tank specification/ Integrated with the high-pressure unit (High-pressure unit needs to be-selected separately.)
Spare Thickener bag filter	6 pieces (1 set)
Oil mist blower	
Minimal quantity coolant supply system	External nozzle specifications/Spindle through specification
Spindle-nose swirl stopper block	BIG/NIKKEN/Other( ) For high spindle/For angle attachment
Mist collector	Installed separately / Installation of the supplied equipment
Signal lamp	2-lamp types with/without buzzer alarm
Linear scale	X·Y·Z axis ／ X·Y axis
Touch sensor system T1	T1-A (Workpiece measurement) / T1-B (Workpiece measurement / Tool length measurement· Tool break detection) / T1-C (Tool lengtTool length measurement· Tool break detection)

Main Dimensions

XYZ axis travel diagrams



Tool Limit Diagram



Floor Space Diagram

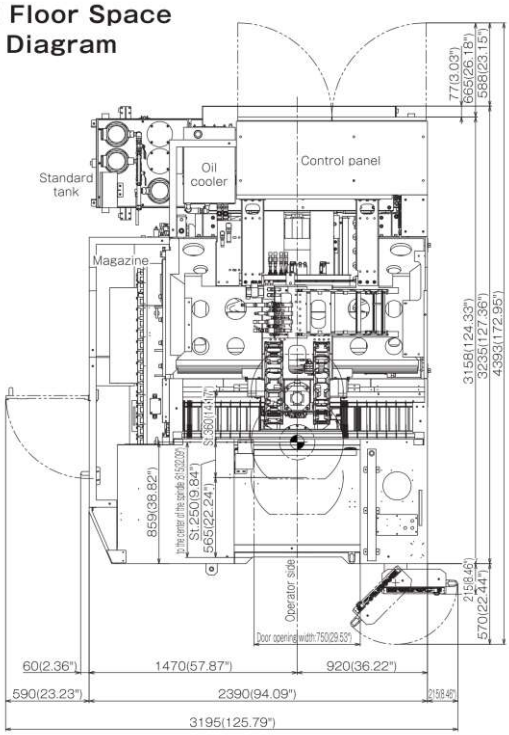
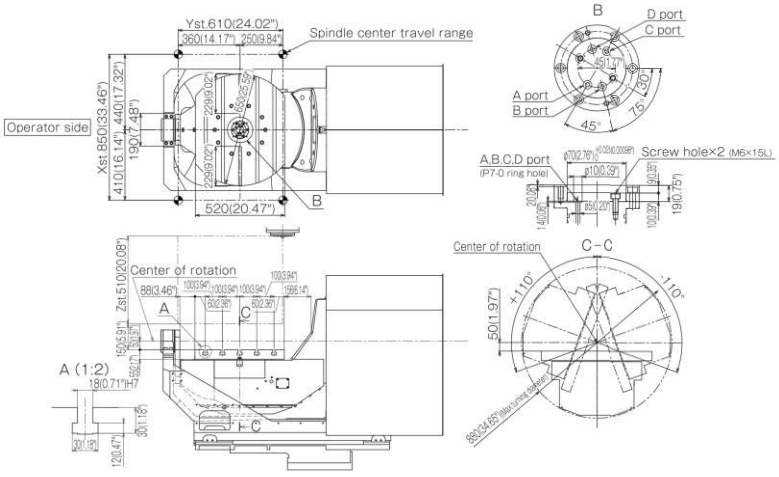
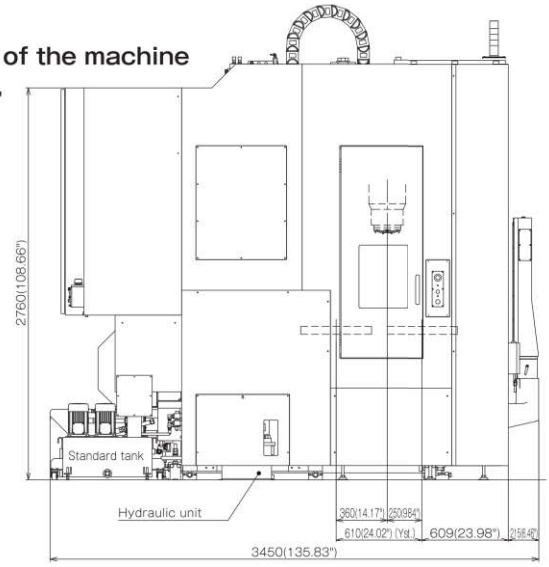
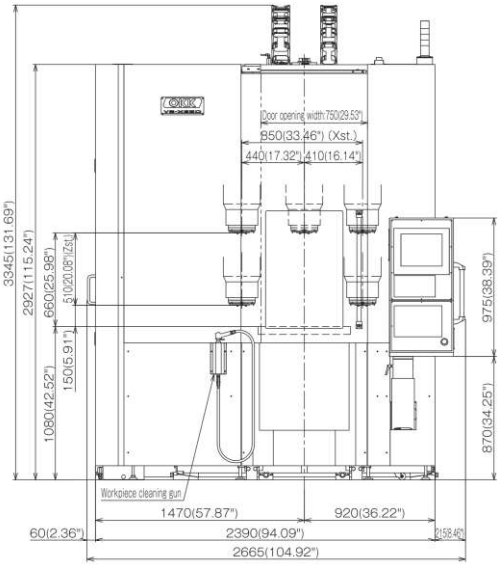


Table Dimensions



External view of the machine
Left Side View,
Front View

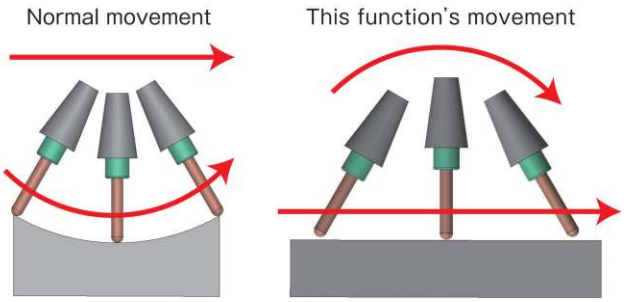




5-axis support technologies

5-axis Control Function

■ Tool center point control (Standard)



Errors are caused by the movement of the rotary axis.

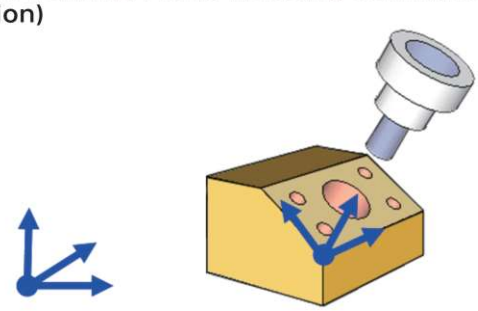
Locus of the tool tip as instructed

Normally, if linear interpolation is performed while changing the tool posture, it is necessary to command changes in the tool axis direction according to changes in the tool posture angle, resulting in complicated machining data using minute line segments.

With tool tip point control, the tool tip trajectory is as commanded regardless of the rotation axis command. Furthermore, since the tool tip speed is constant (command speed), a higher quality surface profile can be obtained.

5-axis indexing function

■ Tilted Working Plane indexing command (Option)



Original coordinate system　Feature coordinate system

In the Tilted Working Plane indexing command, the machining plane can be freely defined as a new coordinate system (feature coordinate system).
This allows for efficient creation of machining programs in the same way as with ordinary 3-axis machines.

■ 5-axis processing software MULTI-FACERII

When indexing a machined surface on a 5-axis machine, it is sometimes time-consuming to set the workpiece coordinate system. With Multifacer II, you can easily create a program for indexing without using a calculator, and the workpiece coordinate system can be easily set.

A5 system

Opt.

In the machining of 5-axis machines, geometric errors (tilt and misalignment of rotary axes) greatly affect machining accuracy.
This function automatically measures and compensates for geometric errors using a touch sensor.
This enables 5-axis indexing and 5-axis simultaneous machining with higher accuracy and quality.

Note: This function does not adjust the accuracy of linear 3 axes.

VB-X650 CONTROLLER

FANUC Controller F31i-B5 Plus

(WindowsCE-installed Open CNC)

Standard Specification
No. of controlled axis: 5 axis (X, Y, Z ,B ,C)
No. of simultaneously controlled axes: 5 axes
Least input increment: 0.001mm / 0.0001"
Max. programmable dimension: ±999999.999mm / ±39370.0787"
Inch/Metric conversion : G20 / G21
Program format: FANUC standard format
Decimal point input / Pocket calculator type decimal point input
Absolute / Incremental programming: G90 / G91
Program code: ISO / EIA automatic discrimination
FS15 tape format
Nano interpolation (internal)
Positioning: G00
Linear interpolation: G01
Circular interpolation: G02 / G03 (CW / CCW) (Including radius designation)
Helical interpolation
Unidirectional positioning: G60
Cutting feed rate: 6.3-digit F-code, direct designation
Rapid traverse override: 0 / 1 / 10 / 25 / 50 / 100%
Cutting feed rate override: 0 to 200% (every 10%)
Feed rate override cancel: M49/M48
Rigid tapping: G84, G74 (Mode designation: M29)
Manual handle feed: Least input increment ×1, ×10, ×100 / graduation
Dwell: G04
One-digit F code feed
inverse time feed
Part program storage capacity: total 10240m [4MB] (total 1000 programs)
Part program editing
Background editing: Possible to program or edit the machining program while NC machining is executed.
Extended part program editing
15-inch color LCD/QWERTY key MDI
Clock function
MDI (manual data input) operation
Run hour and parts count display
Memory card / USB interface
Spindle function: Direct designation of spindle speed with 5-digit S-code
Spindle speed override: 50 to 150% (every 5%)
Tool function: Direct designation of called tool number with 4-digit T-code
ATC tool registration
Auxiliary function: Designation with 3-digit M-code
Multiple M-codes in 1 block: Maximum 3 codes in 1 block (Maximum 20 settings)
Tool length offset: G43, G44 / G49
Tool diameter and cutting edge R compensation:G41, G42/ G40
Tool offset sets: total 400 sets
Tool offset memory C
Tool position offset
Automatic reference position return: G28 / G29
2nd reference position return: G30
Machine coordinate system: G53
Coordinate system setting: G92
Automatic coordinate system setting
Workpiece coordinate system: G54 to G59 G54.1 P1~P48
Local coordinate system: G52
Polar coordinate command: G15, G16
Manual reference position return
Reference position return check: G27
Optional block skip: /
Single block
Dry run
Machine lock

Standard Specification
Z-axis feed cancel
Auxiliary function lock
Graphic function
Program number search
Sequence number search
Program restart
Cycle start
Feed hold
Manual absolute (ON / OFF with PMC parameter)
Auto restart
Program stop: M00
Optional stop: M01
Sequence number collation and stop
Sub program control
Canned cycle: G73, G74, G76, G80 to G89
Mirror image function parameter
Custom macro
Programmable mirror image
Programmable data input: G10
Automatic corner override
Manual Guide i (Basic) ※1
Exact stop check / mode
Scaling: G50, G51
Additional custom macro common variables:1000
Coordinate system rotation: G68, G69
Optional chamfering / corner R
Playback
Interpolation type pitch error compensation
Backlash compensation for each rapid traverse and cutting feed
Smooth backlash
Skip function
Tool life management: total 256 sets
Tool length manual measurement
Emergency stop
Data protection key
NC alarm display / alarm history display
Machine alarm display
Stored stroke check 1
Stored stroke check 2
Load monitor
Self-diagnosis
Absolute position detection
Tool center point control
Multi-spindle control ※2
Constant surface speed control ※2
Multiple repetitive canned cycle ※2
Tool offset for Milling and Turning function ※2
Tool geometry/wear compensation ※2
Turning/Machining G code system switching function ※2
Turning G code system B / C ※2
Data server: ATA card (1GB)

Optional Specification
Least input increment: 0.0001mm / 0.00001"
Spiral / Conical interpolation
Cylindrical interpolation
Hypothetical axis interpolation
Involute interpolation

Optional Specification
NURBS interpolation
Smooth interpolation (Hyper HQ control B mode is required)
Handle feed 3 axes: Standard pulse handle is removed
Part program storage capacity: total 20480m [8MB] (1000 in total)
Machining time stamp
Data server: ATA card (4GB)
RS232C interface: RS232C-1CH
Spindle contour control (Cs contour control)
Tool position offset
Tool offset sets: total 499 sets
Tool offset sets: total 999 sets
Addition of workpiece coordinate system (total 300 sets): G54.1 P1 to P300
Optional block skip: Total 9
Manual handle interruption
Tool retract and return
Figure copy
Interruption type custom macro
Instruction of inclined plane indexing
Chopping
Manual Guide i (Milling cycle) ※1
Addition of tool life management sets: total 1024 sets
High-speed skip
3D Coordinate transformation

Original Nidec OKK Software	
Integrated machining support software (incl. help guidance, etc.)	STD
Tool support	STD
Program Editor	STD
EasyPRO	STD
A5-system (A) Measurement of turning center	Opt
A5-system (B) Measurement of turning center + Measurement of geomentric error	Opt
Work Manager	Opt
HQ control	STD
Hyper HQ control mode B	STD
Multi-Facer Ⅱ (5-Axis processing soft ware)	STD
Special canned cycle (including circular cutting)	Opt
Cycle Mate F	Opt
Soft Scale Ⅱ m	STD
Touch sensor T0 software	Opt
Soft CCM (Tool failure detection system)	Opt
Soft AC (Adaptive control unit)	Opt
Automatic restart at tool damage	Opt

STD: Standard Opt: Option

Nidec
All for dreams

VB-X650

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Flexible manufacturing cells and systems

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