



NIDEC OKK CORPORATION

8-10, KITA-ITAMI, ITAMI
HYOGO 664-0831 JAPAN
International Sales Department
TEL: (81)72-771-1143
www.nidec.com/en/nidec-okk/
E-mail: nokk.ovsd@nidec.com

NIDEC OKK A DIVERSIFIED MANUFACTURER OF MACHINE TOOLS

Specializes In:

Machining centers
Graphite cutting machining centers
Grinding centers
CNC Milling machines
Conventional milling machines
Total die and mold making systems
Flexible manufacturing cells and systems

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NIDEC OKK USA CORPORATION
101 South Gary Avenue, Suite B, Roselle, IL 60172, U.S.A
TEL: (1)630-924-9000

NIDEC OKK Europe GmbH
HANSEMANSTR 33 41468 NEUSS, GERMANY
TEL: (49)2131-29868-0
FAX: (49)2131-29868-41

NIDEC OKK Machinery (THAILAND) Co., Ltd.
KUMTHORN HOLDING BUILDING 2nd FLOOR 897-897/1 Rama 3
Road, Bangpongpan, YANNAWA, BANGKOK 10120 THAILAND
TEL: (66)2-683-2160-2
FAX: (66)2-683-2163

NIDEC OKK (SHANGHAI) CO., LTD.
12F, TOWER B, 100 ZUNYI ROAD, CHANG NING DISTRICT,
SHANGHAI, CHINA
TEL: (86)21-62700930
FAX: (86)21-62700931



5-Axis Control Vertical Machining Center

VB-X SERIES

VB-X350

VB-X650

VB-X350 VB-X650



High-speed Compact 5-Axis Control Vertical Machining Center

Vertical 5 Axis VB-X350



Vertical 5 Axis VB-X650



Axial travel distance:
(X×Y×Z)
500×480×460mm
(B×C)
-30~+120°×360°

Rapid traverse rate:
(X·Y·Z)
63m/min
(B/C)
B:60min⁻¹
C:100min⁻¹

Maximum size of workpiece loadable on the table:
Φ450×H400mm (depends on a shape)
Maximum weight of workpiece loadable on the table:
200kg
Type of tool shank:
BT40 (Two-face contact type)

Axial travel distance:
(X×Y×Z)
850×610×510mm
(B×C)
-110~110°×360°

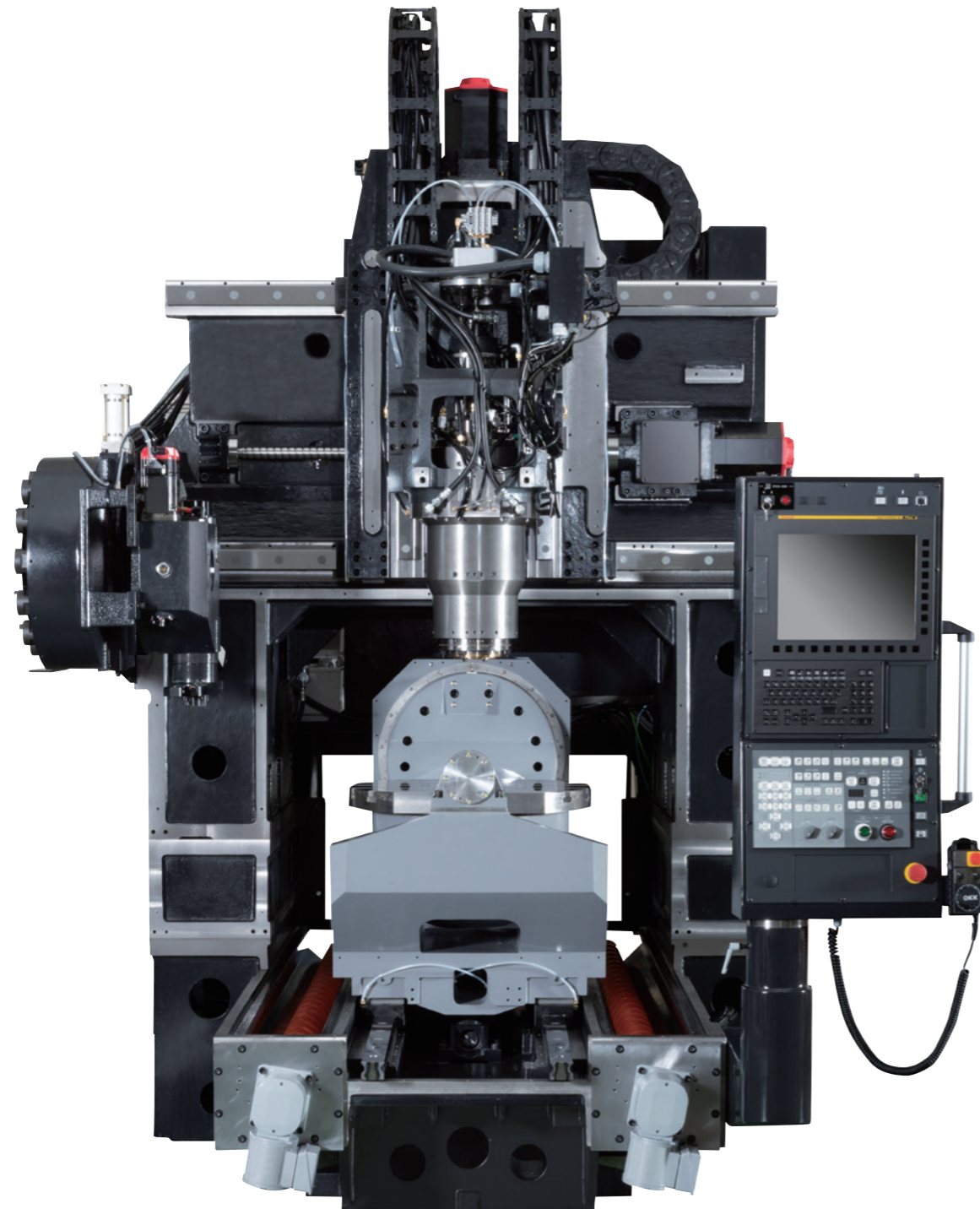
Rapid traverse rate:
(X·Y·Z)
63m/min
(B/C)
B:50min⁻¹
C:100min⁻¹

Maximum size of workpiece loadable on the table:
Φ650×H450mm (depends on a shape)
Maximum weight of workpiece loadable on the table:
350kg
Type of tool shank:
BT40 (Two-face contact type)

Structure and Features

NIDEC OKK's 5-axis control machining centers with consolidated processing steps make possible high-speed part machining with one clamping operation.

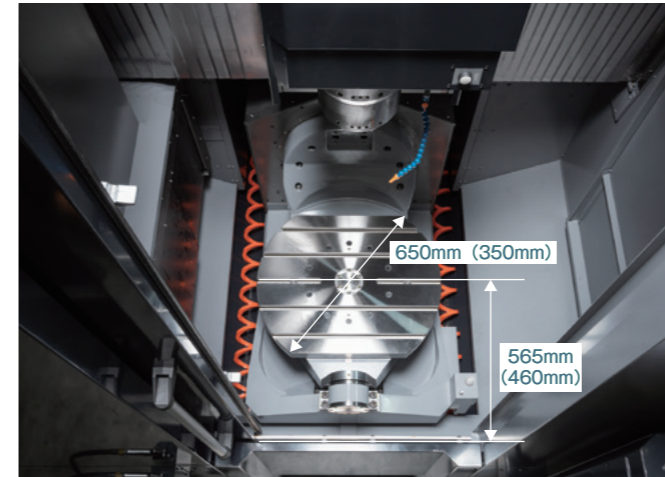
The machining centers' feed rate as high as 63 m/min, top-level space-saving performance among the machines in this class, and highly rigid gate type structure provide customers the highest ever production efficiency.



The photo above shows VB-X650.

Excellent accessibility

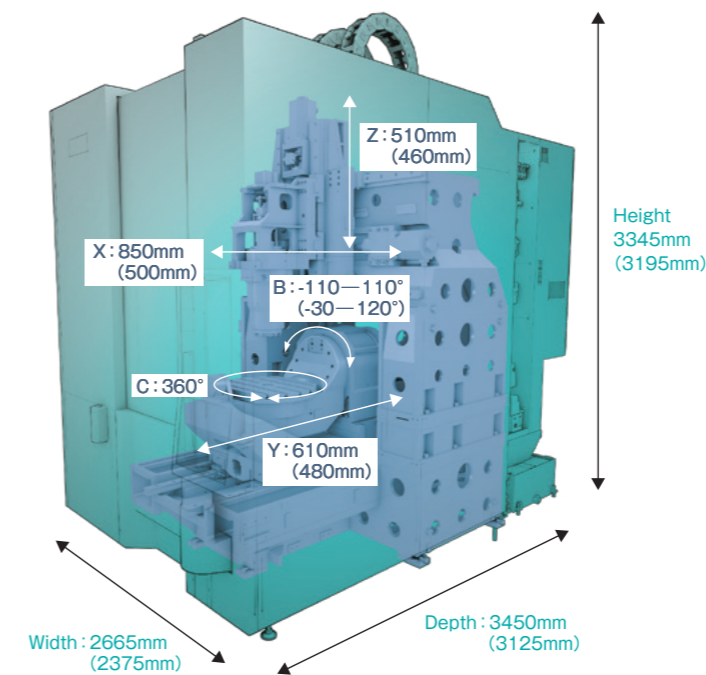
Although the table diameter is 650 mm, the distance to the center of the table from the door when changing a setup is 565 mm because of a compact design of the 5-axis table support part.



Dimensions in parentheses: VB-X350
 The photo above shows VB-X650.

Strokes and floor space

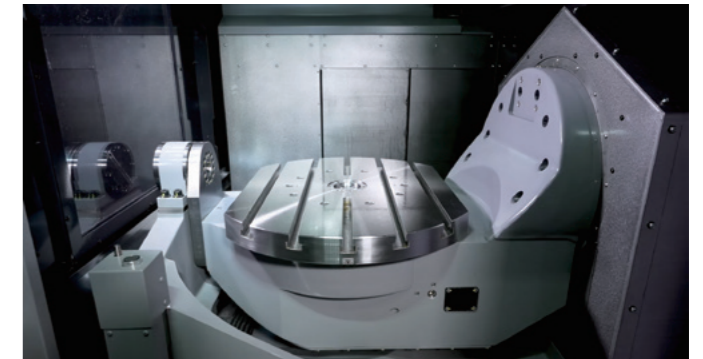
Compared to strokes, the machines' space efficiency is ranked high among the machines in this class.



Dimensions in parentheses: VB-X350

Direct drive motor

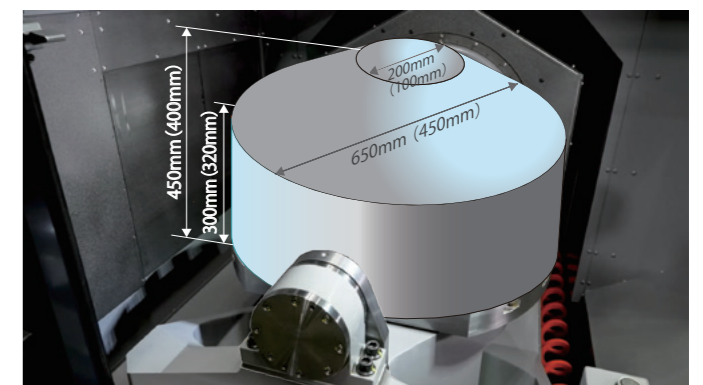
Tables are driven by direct drive motors as standard. Maintenance-free and nonbacklash high-speed machining is possible.



The photo above shows VB-X650.

Table's loading capacity

Maximum weight of workpiece loadable on the table: 350 kg (200kg)



Dimensions in parentheses: VB-X350

Machining capability and accuracy

Spindle output and torque charts

12,000min⁻¹

	Low speed 100 — 3500min ⁻¹	High speed 3501 — 12000min ⁻¹
Output	Continuous rating 15.0kW 15-min rating 18.5kW 10%ED 22.0kW	Continuous rating 18.5kW 30-min rating 26.0kW 15%ED 37.0kW
Torque	Continuous rating 95.5N·m 15-min rating 118N·m 10%ED 250N·m	Continuous rating 35.3N·m 30-min rating 49.7N·m 15%ED 70.7N·m

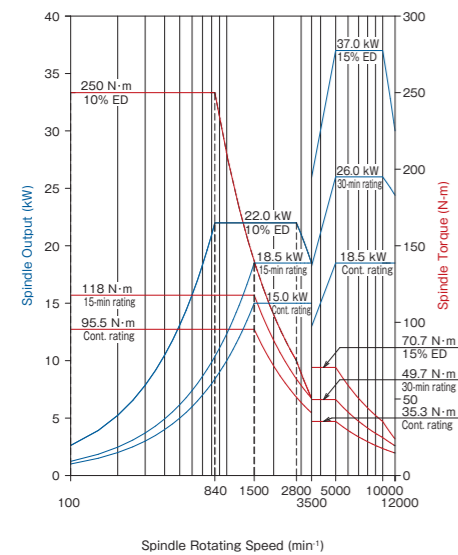
15,000min⁻¹

	Low speed 100 — 3500min ⁻¹	High speed 3501 — 15000min ⁻¹
Output	Continuous rating 15.0kW 15-min rating 18.5kW 10%ED 22.0kW	Continuous rating 18.5kW 30-min rating 26.0kW 15%ED 37.0kW
Torque	Continuous rating 95.5N·m 15-min rating 118N·m 10%ED 250N·m	Continuous rating 35.3N·m 30-min rating 49.7N·m 15%ED 70.7N·m

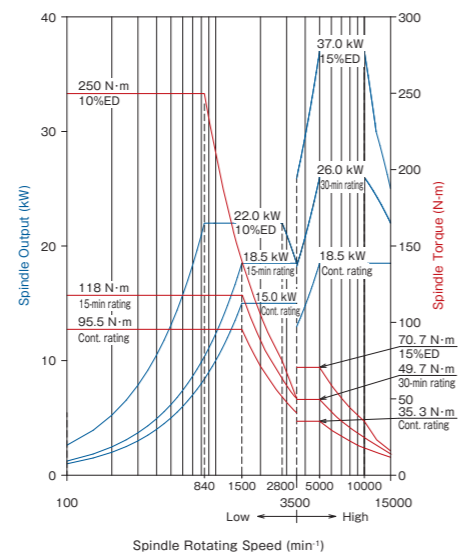
20,000min⁻¹

	Low speed 100 — 4000min ⁻¹	High speed 4001 — 20000min ⁻¹
Output	Continuous rating 15.0kW 15-min rating 18.5kW 10%ED 22.0kW	Continuous rating 18.5kW 30-min rating 26.0kW 15%ED 37.0kW
Torque	Continuous rating 95.5N·m 15-min rating 118N·m 10%ED 250N·m	Continuous rating 35.3N·m 30-min rating 49.7N·m 15%ED 70.7N·m

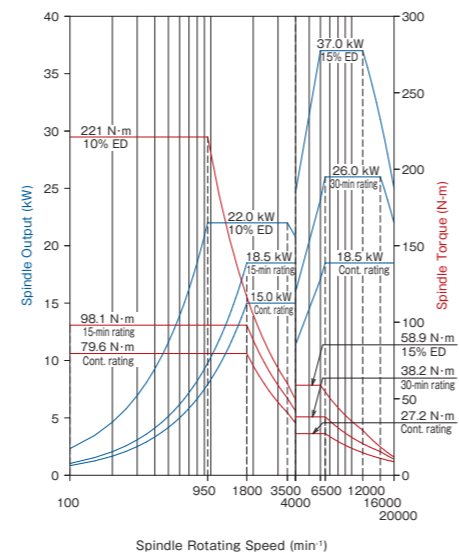
12,000min⁻¹ specification



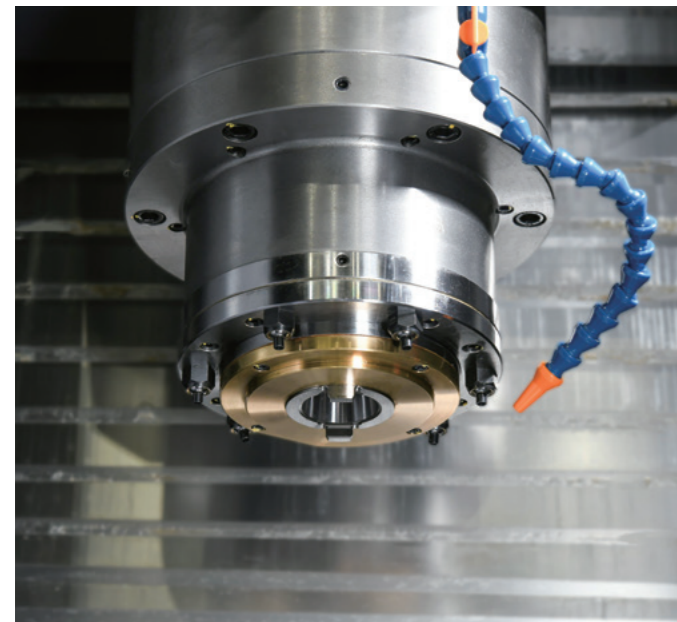
15,000min⁻¹ specification



20,000min⁻¹ specification



12,000min⁻¹ spindle



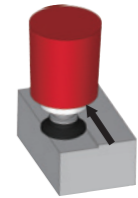
15,000min⁻¹ spindle



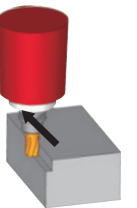
Machining capability

VB-X650

Item	Unit	Face milling Φ100×5T
Spindle rotating speed	min ⁻¹	600
Width of cut	mm	80
Depth of cut	mm	5
Feed rate	mm/min	840
Cutting rate	cm ³ /min	336
Spindle motor load	%	95
Workpiece material		S45C



Item	Unit	X-axis direction	Y-axis direction
		Side milling Φ16×4T	
Spindle rotating speed	min ⁻¹	4000	4000
Width of cut	mm	30	30
Depth of cut	mm	2.5	3
Feed rate	mm/min	2000	2000
Cutting rate	cm ³ /min	150	180
Spindle motor load	%	34	40
Workpiece material		S45C	

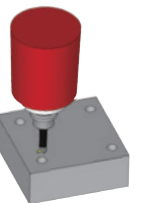


Accuracy

Positioning accuracy

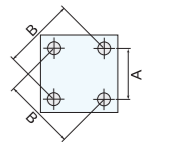
	Without linear scale	With linear scale
Positioning accuracy	X/Y/Z: ±0.0020/full stroke	X/Y/Z: ±0.0010/full stroke
Repeated positioning accuracy	X/Y/Z: ±0.0010/full stroke	X/Y/Z: ±0.0005/full stroke

(NIDEC OKK tolerance)



	With encoder
Positioning accuracy	B-axis: ±5 sec C-axis: ±3 sec

(NIDEC OKK tolerance)



Positioning machining accuracy

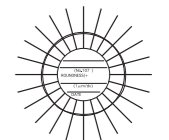
	NIDEC OKK tolerance	Example of actual machining
Axial direction	0.015	VB-X350 : 0.003 VB-X650 : 0.003
Diagonal direction	0.015	VB-X350 : 0.004 VB-X650 : 0.004
Difference in diameter	0.010	VB-X350 : 0.003 VB-X650 : 0.002

A	200.000
B	282.843



Circular cutting accuracy

	NIDEC OKK tolerance	Example of actual machining
Circularity	0.005	VB-X350 : 0.0016 VB-X650 : 0.0037



*1: The data of the short-term machining are shown above as an example. The results of the continuous machining may be different from the above.
*2: The accuracy data obtained under NIDEC OKK's in-house cutting test conditions are shown above as an example. The results may vary with the cutting tools and the used jigs.
*3: The above accuracy data are the laboratory data obtained by installing the machine according to NIDEC OKK's foundation drawing and carrying the inspection based on NIDEC OKK's inspection standard in an environment with controlled temperature.

Automatization and labor-saving

Peripheral equipment (Options)

Measures for automatization and labor-saving

Opt.

Large-capacity pallet stockers and extended magazines are available optionally. You can realize automatization and labor-saving by combining them with robots.

Pallet stocker



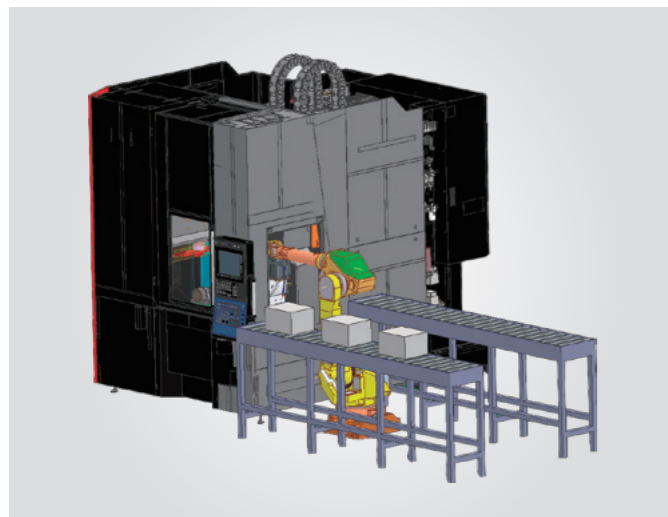
*The above figure shows an image of 18APC (6 pallets × 3 layers), 12APC (2 layers) and 6APC (1 layer) are also available.
*The above figure shows an image of VB-X650.



System 3R Transformer
Dynafix Pallet Jig
Automatic Pallet Change System

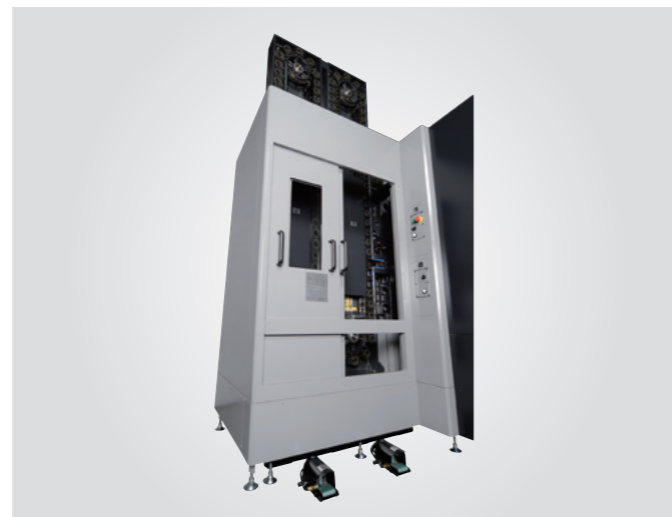
*The above figure shows an image of APC.
*The above figure shows an image of VB-X650.

Example of a combination with a robot



*The above figure is just an image.
*The above image shows VB-X650.

Tool magazine



60-tool, 116-tool, and 172-tool magazines are available.

Touch sensor system

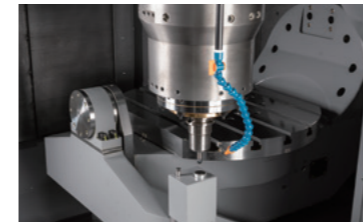
Opt.

Centering and measurement of a workpiece are possible by attaching a workpiece measurement sensor to a spindle. Measuring a tool length and detecting breakage of a tool are possible by attaching a tool length measurement sensor to a table.

T1-A



T1-C



Function	Details	Name of the system
Workpiece measurement/compensation	<ul style="list-style-type: none"> A touch sensor is attached to the spindle, and the touches the workpiece in automatic operation. Based on its travel distance, A required amount of compensation is calculated and set to the workpiece coordinate system. A measurement/compensation program is executed after it is created by using a specified format. 	T1-A
Tool length measurement	<ul style="list-style-type: none"> 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. A measurement/compensation program is executed after it is created by using a specified format. This function can be used for drills and taps. 	T1-B
Tool break detection	<ul style="list-style-type: none"> A tool is moved for a specified distance by using a program for tool break detection. Whether the tool is broken or not is determined by checking whether a tip of the tool contacts the tool sensor placed on a table. You can monitor tool break at a desired timing by adding a call for a tool break detection program to a machining program. This function can be used for drills and taps. Operations after a tool is judged to be broken vary with specifications of the relevant machine. 	T1-C

Lift-up chip conveyor

Opt.

Types of chips and suitable lift-up chip conveyors

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

Type of chip conveyor		Hinged type		Scraper type		Magnet Scraper type		Backwash filter type for aluminum chips		Backwash filter type for aluminum/cast chips			
		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.

The photo below shows a hinged pan chip conveyor (option). (Fixed-type and tilting-type chip buckets are available as separate options.)



*The photo above is shown as one of the examples of lift-up chip conveyors.

VB-X350 Main Body's Main Specifications

List of specifications

Standard specifications

Item	Unit	Specification
Travel on X axis (Saddle longitudinal direction)	mm	500
Travel on Y axis (Table cross direction)	mm	480
Travel on Z axis (Spindle vertical direction)	mm	460
Travel on B axis (Table tilting)	deg	-30 — +120
Travel on C axis (Table rotating)	deg	360
Distance from table top surface to spindle nose	mm	90 — 550
Distance from column front to spindle center	mm	445
Table work surface area	mm	Φ350
Max. workpiece mass loadable on table	kg	200 (Uniformly distributed load)
Table work surface configuration (Nominal dimension of T slots)	mm	14
Distance to the table work surface from the floor	mm	1040
Spindle rotating speed	min ⁻¹	100 — 12000
Number of spindle rotating speeds		Electrically controlled two speeds (MS)
Spindle taper hole		7/24-tapered No. 40 (Two-face contact type)
Spindle bearing bore diameter	mm	Φ65
Rapid traverse rate for X, Y and Z axes	mm/min	63,000
Rapid traverse rate for B and C axes	min ⁻¹	B:60 C:100
Cutting feed rate for X, Y and Z axes	mm/min	1 — 40,000 *1
Cutting feed rate for B and C axes	min ⁻¹	B:60 C:100 *1
Type of tool shank		JIS B 6339 BT40
Type of pull stud		MAS1 45°
Number of storable tools	tools	40
Maximum tool diameter (with tools in adjoining pots)	mm	Φ75
Maximum tool diameter (with no tools in adjoining pots)	mm	Φ125
Maximum tool length (from the gauge line)	mm	300
Maximum tool mass	kg	8
Maximum tool moment	N·m	9.8
Tool selection method		Memory random method
Tool exchange time (cut-to-cut)	sec	3.7
Motor for spindle	kW	37 (15% ED) / 26 (30-min rating) / 18.5 (continuous rating)
Motors for X, Y and Z feed axes	kW	5.5
Motors for B and C feed axes	kW	B:4.7 C:2.3
Motor for hydraulic pressure	kW	1.5
Motor for spindle/table cooling pump (compression/discharge)	kW	1.1/0.4
Motor for cutting oil	kW	60Hz:1.1 50Hz:0.75
Motor for cleaning gun pump	kW	60Hz:1.1 50Hz:0.75
Motor for ceiling shower/cleaning below a table	kW	60Hz:1.1 50Hz:0.75
Motor for ATC	kW	0.75
Motor for tool magazine	kW	1.2
Motor for coil-type chip conveyor	kW	0.1×2
Power supply *2	kVA	61
Supply voltage and supply frequency	V·Hz	200V±10% 50/60Hz±1Hz 220V±10% 60Hz±1Hz
Compressed air supply pressure *3	MPa	0.4 — 0.6
Compressed air supply flow rate (atmospheric pressure) *2, *3	L/min (ANR)	400
Cutting oil tank capacity	L	280
Spindle and table cooling oil tank capacity (oil cooler)	L	20
Hydraulic unit's tank capacity	L	20
Machine height	mm	3195
Required floor space incl. maintenance area (width × depth)	mm	3375×3625
Machine mass	kg	8500
Temperature of operation environment	°C	5 — 40
Humidity of operation environment	%	10 — 90 (No condensation)

*1: Feed rates under the HQ or Hyper HQ control.

*2: The value for the standard specification. It may vary with added options.

*3: Purity of the supplied air should be equivalent to or higher than the Classes 3, 5 and 4 specified in ISO 8573-1 / JIS B8392-1.

Standard accessories

Name	Qty	Remark
LED lamp	1 set	One LED lamp
Coolant unit (Separate coolant tank)	1 set	Tank capacity: 280L
Overall machine cover (Splash guard)	1 set	Interlocked operator door and magazine door
Slideway protection steel sliding covers for X, Y and Z axes	1 set	
Spindle and table cooling oil temperature controller	1 set	
Automatic grease lubrication of guides and ball screws	1 set	
Coil-type chip conveyor (with a reverse rotation function)	1 set	
Hydraulic unit (installed separately)	1 set	
Ceiling shower / Cleaning below a table	1 set	
Air blower	1 set	
Signal lamp	1 set	3-lamp type with buzzer
Workpiece cleaning gun	1 set	
Coolant-through preparation	1 set	
ATC shutter	1 set	
Rotary encoder	1 set	
Leveling block	1 set	
Foundation parts for locking a machine (Bond anchor)	1 set	Incl. bond
Rotary joint for jig's piping	1 set	5 ports
Earth leakage breaker	1 set	
Automatic power off	1 set	
Electrical spare parts (fuses)	1 set	
Instruction manuals	1 set	
Electrical instruction manuals	1 set	Incl. electrical diagrams

Special accessories for machine main body

Item	Specification
Type of feeding equipment	8-mm lead ball screw
Spindle rotating speed	15,000min ⁻¹ (37/26/18.5kW) 20,000min ⁻¹ (37/26/18.5kW)
Type of tool shank	CAT40 / DIN40
Type of pull stud	OKK90° / MAS 2 (60°)
Number of storable tools	60 tools
APC	T-slots on pallet work surface Tapped holes on pallet work surface
Automatically opened and closed front door	
Ejection of chips from the machine	Chip flushing with coolant (Sharing with the coil-type chip conveyor is not possible.)
Lift-up type chip conveyor	Hinged type / Scraper type / Scraper type with floor magnet / Backwash filter type for aluminum chips / Backwash filter type for aluminum/cast chips / Chip discharge from left / right side
Chip bucket	Fixed chip bucket / Tilting chip bucket
Oil skimmer	Screw type
Compatibility with through-spindle	2-MPa coolant / 7-MPa coolant / Air
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	Bluebe EcoBooster / External nozzle
Swirl stopper block	BIG / NIKKEN / Others () For high-power spindle / For angle attachment
Mist collector	Installed separately / Installation of the supplied equipment
Signal lamp	2-lamp type with/without buzzer alarm
Linear scale	X, Y and Z axes / X and Y axes
Touch sensor T1	T1-A (Workpiece measurement) / T1-B (Workpiece measurement / Tool length measurement and tool break detection) / T1-C (Tool length measurement and tool break detection)

Main dimensions

Stroke diagram

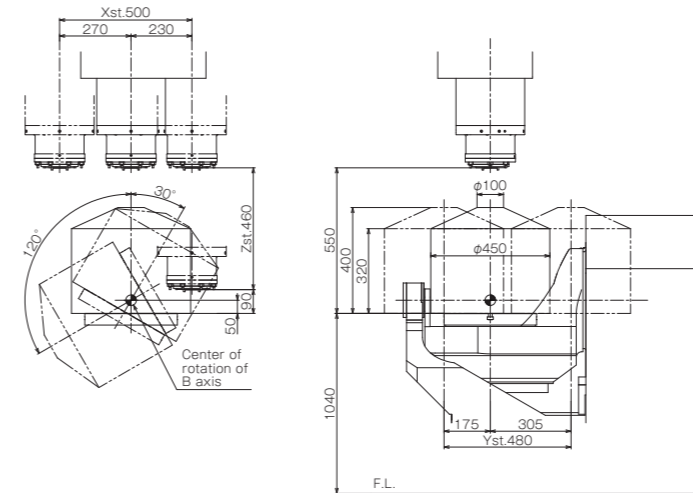
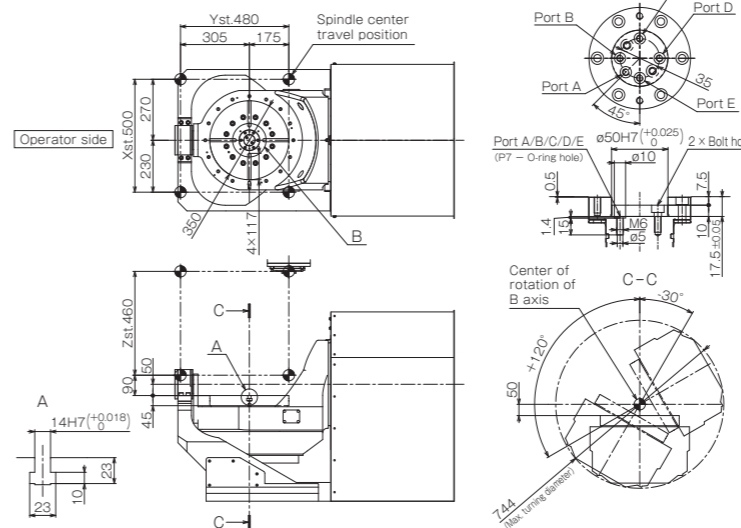
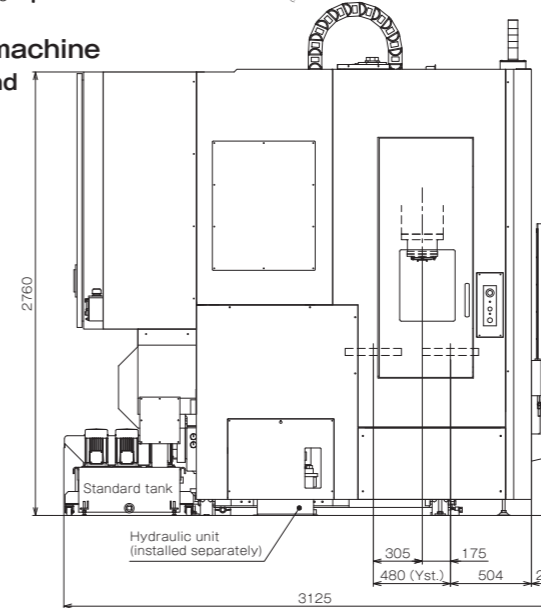


Table dimensions

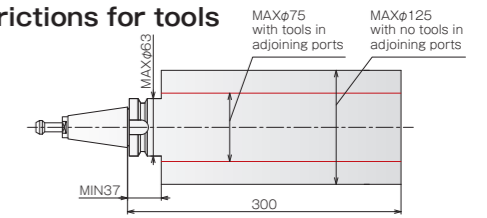


Outline of the machine

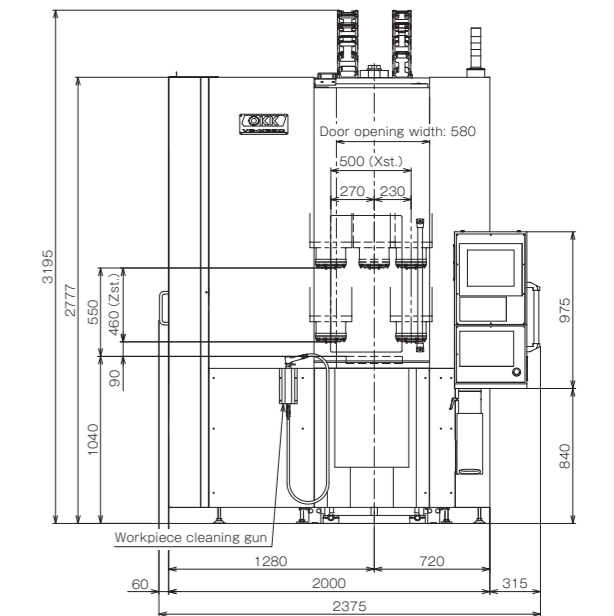
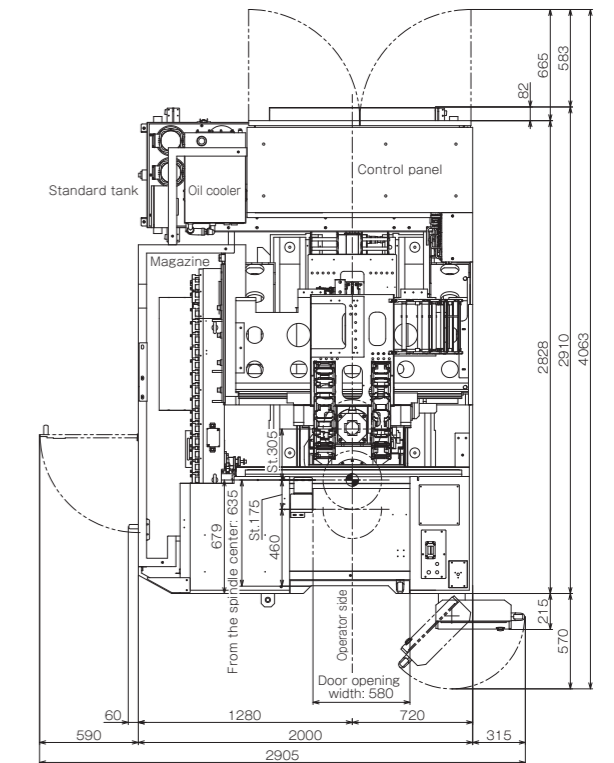
Left-side view and front view



Restrictions for tools



Floor space

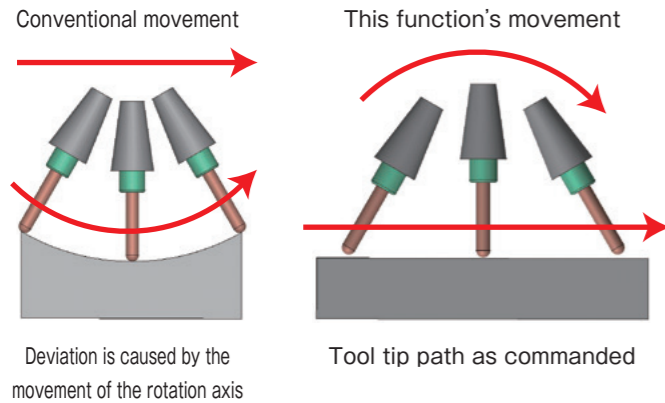


5-axis machining support technologies

Controller

5-axis control function

■ Tool Center Point (TCP) Control

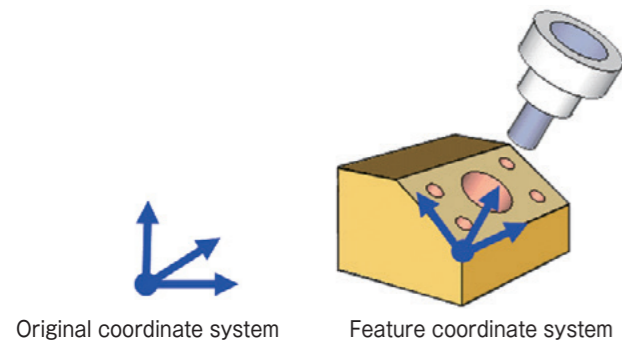


Normally the linear interpolation while changing the tool posture requires the commands for the changes in the tool shaft direction in accordance with the changes in the angle of the tool posture. Thus, the relevant machining data using minute line segments become complicated.

With the Tool Center Point (TCP) control, the tool tip path is as commanded regardless of the commands for the rotation axis. As the speed of the tool tip is constant (the commanded speed), high-quality surfaces can be achieved.

5-axis indexing function

■ Tilted working plane indexing (Option)



The inclined surface indexing (machining) commands allow defining flexibly the surface to be machined by setting a new coordinate system (feature coordinate system) so that the machining programs can be created efficiently similarly to the ones for the normal 3-axis machining centers.

■ MULTI-FACER II

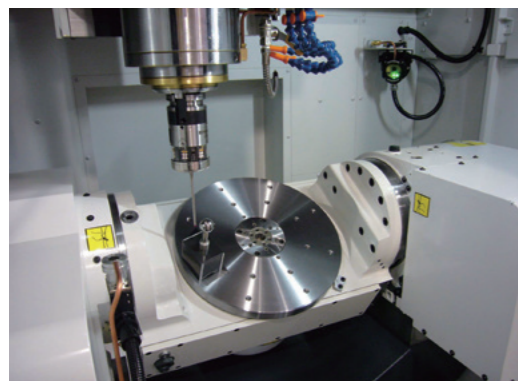


At the time of indexing the surface to be machined with the 5-axis machining center, it may take time to set the workpiece origin.

MULTI-FACER II makes it possible to create the programs for indexing easily without using calculators and to set the workpiece origin easily.

A⁵ system

Opt.



Geometric errors (inclination and displacement of a rotation axis) have significant effects on machining accuracy of 5-axis machining. This function measures and corrects geometric errors automatically by using a touch sensor and improves further high-accuracy 5-axis indexing and high-quality simultaneous 5-axis machining.

*This function does not intend to adjust accuracy of orthogonal three axes.

VB-X350/VB-X650 controller

■ FANUC Controller F31i-B5 Plus

Standard specification	Standard specification	Optional specification
Number of controlled axes: 5 axes (X, Y, Z, B, C)	Machine lock	Data server: ATA card (4GB)
Number of simultaneously controlled axes: 5 axes	Z-axis feed cancel	RS232C interface: RS232C-1CH
Least input increment: 0.001 mm / 0.0001 inch	Auxiliary function lock	Spindle contour control (Cs contour control)
Max. programmable dimension: ±999999.999 mm / ±39370.0787 inch	Graphic display	3-dimensional cutter compensation
Inch/metric conversion: G20/G21	Program number search	Tool offset settings: Total 499 settings
Program format: FANUC standard format	Sequence number search	Tool offset settings: Total 999 settings
Decimal point input / Pocket calculator type decimal point input	Program restart	Addition of workpiece coordinate system settings (Total 300 settings): G54.1 P1 — P300
Absolute/incremental programming: G90/G91	Cycle start	Addition of optional block skip: 9 in total
Program code: ISO/EIA automatic discrimination	Feed hold	Manual handle interruption
Program format for FS15 switching function	Manual absolute (ON/OFF setting with PMC parameter)	Tool retract and return
Nano interpolation (internal)	Auto restart	Figure copy
Positioning: G00	Program stop: M00	Interruption type custom macro
Linear interpolation: G01	Optional stop: M01	Tilted working plane indexing
Circular interpolation: G02/G03 (CW/CCW) incl. radius designation	Sequence number comparison and stop	Chopping
Helical interpolation	Sub program control	Manual Guide i (Milling cycle)
Single direction positioning: G60	Canned cycle: G73, G74, G76, G80 to G89	Addition of tool life management sets: Total 1024 sets
Cutting feed rate: 6.3-digit F-code, direct command	Mirror image parameters	High-speed skip
Rapid traverse override: 0/1/10/25/50/100%	Custom macro	3-dimensional coordinate conversion
Cutting feed rate override: 0 to 200% (every 10%)	Programmable mirror image	
Feed rate override cancel: M49/M48	Programmable data input: G10	
Rigid tapping: G84, G74 (Mode designation: M29)	Automatic corner override	
Manual handle feed: Minimum input increment ×1, ×10, ×100/scale	Manual Guide i (Basic)	NIDEC OKK's special control functions
Dwell: G04	Exact stop check/mode	Machining support integrated software (help guidance, etc.)
One-digit F-code feed	Scaling: G50, G51	Tool support
Inverse time feed	Addition of custom macro common variables: Total 1000 sets	Program editor
Part program storage capacity: Total 10240m [4MB] (Total 1000 programs)	Coordinate system rotation: G68, G69	Easy PRO
Part program editing	Optional chamfering/corner R	A ⁵ system A (Measurement of center of rotation)
Background editing: Possible to program or edit the machining program while NC machining is executed.	Playback	A ⁵ system B (Measurement of center of rotation and geometric errors)
Extended part program editing	Interpolation-type pitch error compensation	Work Manager
15-inch color LCD / QWERTY-key MDI	Backlash compensation for each rapid traverse and cutting feed	HQ control
Clock function	Smooth backlash compensation	Hyper HQ control Mode B
MDI operation	Skip function	MULTI-FACER II
Run hour and parts count display	Tool life management: Total 256 sets	Special canned cycle (incl. circular cutting)
Memory card interface / USB interface	Manual tool length measurement	Cycle Mate F
Spindle function: Direct designation of spindle rpm with 5-digit S-codes	Emergency stop	Soft Scale II
Spindle speed override: 50 to 150% (every 5%)	Data protection key	Touch sensor T0 software
Tool function: Direct designation of tool number to be called with 4-digit T-codes	NC alarm display / Alarm history display	Soft CCM (Cutting failure monitoring)
ATC tool registration	External alarm display	Soft AC (Adaptive control)
Auxiliary function: Designation of auxiliary functions with 3-digit M-codes	Stored stroke check 1 (Movement range allowed for the machine coordinate system set by the manufacturer)	Automatic restart at the time of tool breakage
Multiple M-codes in 1 block: Possible to designate three auxiliary functions simultaneously in one block (Max. 20 sets can be set)	Stored stroke check 2 (Movement range allowed for the machine coordinate system set by the user)	
Tool length compensation: G43, G44/G49	Load monitor	
Tool diameter and cutting edge R compensation: G41, G42/G40	Self-diagnosis function	
Tool offset settings: Total 400 settings	Absolute position detection	
Tool offset memory C	Tool Center Path (TCP) control for 5-axis machining	
Tool position offset	Data server: ATA card (1GB)	
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 — G59, G54.1 P1 — P48		
Local coordinate system: G52		
Polar coordinate instruction: G15, G16		
Manual reference position return		
Reference position return check: G27		
Optional block skip: /		
Single block		
Dry run		