Global Service Sites

Local dealers are available to provide services in each region, in addition to the sites below.

Brother Technology Center Chicago

BROTHER INTERNATIONAL CORP.

2200 North Stonington Avenue, Suite 270, Hoffman Estates, IL 60169, U.S.A. PHONE:(1)224-653-8415 FAX:(1)224-653-8821

Brother Technology Center Frankfurt

BROTHER INTERNATIONALE INDUSTRIEMASCHINEN GmbH

Hoechster Str.94, 65835 Liederbach, Germany PHONE:(49)69-977-6708-0 FAX:(49)69-977-6708-80

Brother Technology Center Bengaluru

BROTHER INTERNATIONAL (INDIA) PVT LTD.

SB-111-112, 1st Stage, 2nd Cross, Peenya Indl Estate, Bengaluru - 560058 Karnataka, India PHONE:(91)80-43721645

Brother Technology Center Shanghai

BROTHER MACHINERY (SHANGHAI) LTD.

Unit 01, 5/F., No.799, West Tianshan Rd., ChangNing District Shanghai 200335, P.R.China PHONE:(86)21-2225-6666 FAX:(86)21-2225-6688

Brother Technology Center Chongqing

BROTHER MACHINERY (SHANGHAI) LTD.

Room 30, 31, NO.104 Cuibai Road, Dadukou District, Chongqing Province, 400084, P.R.China

PHONE:(86)23-6865-5600 FAX:(86)23-6865-5560

Nangjing Office

BROTHER MACHINERY (SHANGHAI) LTD.

503 Room, Building No.1, No.39, Dongcun Road, Jiangning District, Nangjing City, Jiangsu Province, P.R.China PHONE:(86)25-87185503

Brother Technology Center Queretaro

BROTHER INTERNATIONAL DE MÉXICO, S.A. DE C.V.

Calle 1 No.310 Int 15, Zona Industrial Jurica, Parque Industrial Jurica, Queretaro, QRO C.P. 76100 México PHONE:(52)55-8503-8760 FAX:(52)442-483-2667

Brother Technology Center Bangkok

BROTHER COMMERCIAL (THAILAND) LTD.

317 Pattanakarn Road, Pravet Sub-District, Pravet District, Bangkok 10250, Thailand PHONE:(66)2321-5910 FAX:(66)2321-5913

Gurugram Service Center

BROTHER INTERNATIONAL (INDIA) PVT LTD.

CE SERVICED OFFICES PVT. LTD. DLF CYBER HUB, Building No 10, Tower A, Level 1, Phase 3, DLF Cyber City, Gurugram - 122002 Haryana - India

Brother Technology Center Dongguan

BROTHER MACHINERY (SHANGHAI) LTD.

1F, Fuyuan Business Center Building, No.5 Lane 13, Maiyuan Road, Xin'an community, Chang'an Town, Dongguan City, Guangdong Province, 523008, P.R.China PHONE:(86)769-2238-1505 FAX:(86)769-2238-1506

Ningbo Office

BROTHER MACHINERY (SHANGHAI) LTD.

1005-2 Room, Block C, Hebang building. No 899, Tiantong north road, Ningbo City, Zheijang Province P R China PHONE:(86)574-88139798 FAX:(86)57-88139792

Figures in brackets () are the country codes.

Please read the instruction manuals and safety manuals before using Brother products for your own safety.

When using oil-based coolant oil or when machining the materials which can cause a fire (ex. Magnesium, resin material), customers are requested to take thoroughgoing safety measures against fire.

Depending on the types of cutting material, cutting tools, coolant oil, lubrication oil, it may have an influence on the machine lifecycle. Further questions, please contact our sales representative in charge.

- Leave 700 mm between machines as a maintenance space.
- When exporting our machine, the machine is deemed to be included in the "applicable listed items" controlled by the Foreign Exchange and Foreign Trade Law of Japan. When exporting the machine, please obtain required permissions, including an export license, from the Ministry of Economy, Trade and Industry (METI) or Regional Bureaus of Economy, Trade and Industry before shipment. When re-selling or re-exporting the machine, you may need to obtain permissions from METI, and the government of the country where the machine is installed.
- When exporting our machine, as a machine conforming to Row 2 of Appended Table 1 of Export Trade Control Order, a relocation detection device is installed on the machine depending on the destination country. After relocating the machine with the detection device, the machine is locked and any operation is temporarily impossible. Please inform your local distributor of machine relocation in advance and apply to perform the release operation of relocated machine.

Specifications may be subject to change without any notice.



BROTHER INDUSTRIES, LTD.

Machinery Business Division

1-5, Kitajizoyama, Noda-cho, Kariya-shi, Aichi-ken 448-0803, Japan PHONE: 81-566-95-0075 : 81-566-25-3721

https://www.brother.com

SPEEDIO





Evolving Process Integration Machine

Brother's competitive high-productivity technologies are fused with process integrated machining where both turning and milling are performed on one machine, achieving great improvement in production efficiency when machining mass production parts.

Two new models have been added that can handle larger workpieces and with an option to install a manpower reduction unit, to become a Series that can handle a variety of machining.



SPEEDIO M300%3



SPEC

Basic specifications				
Max. spindle speed (min ⁻¹)	10,000 / 16,000 (Optional)			
Max. turning spindle speed (min ⁻¹)	M300X3 : 1,500 M200X3 : 2,000			
Travels (X, Y, Z) (mm)	M300X3 : X 300 Y 440 Z 305 M200X3 : X 200 Y 440 Z 305			
Travels (A, C) (deg.)	A 120∼–30、 C 360			
Tool storage capacity (pcs.)	22			
Rapid traverse rate (X, Y, Z) (m/min)	X 50 Y 50 Z 50			
Indexing feedrate (A, C) (min ⁻¹)	M300X3 : A50 C200 M200X3 : A60 C200			
Required floor space (mm)	M300X3 : 1,520 × 3,862 M200X3 : 1,280 × 3,862			
Coolant Through Spindle (CTS)	Optional			
BT dual contact spindle (BIG-PLUS)	Optional			

SPEEDIO M200%3



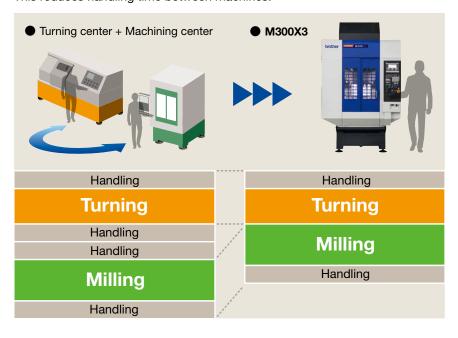
Machine Structure that Achieves Complex Machining



Features and effects

□ Process integration in one machine

Workpieces previously machined using a turning center and a machining center can now be machined on a single machine with machining processes integrated. This reduces handling time between machines.



☐ Example of process integration

Turning and multi-face milling are performed on one M200X3 (automotive parts).



Turning location

Milling location

Workpiece reattachment not necessary between turning center and machining center



Reduction of handling time between machines



Reduction of operators



Improvement of machining accuracy through one-time chucking

Target machining parts

EV motor housing



Artificial bone parts



Cylinder



Hub bearing



Piping parts



Scroll type compressor parts Constant-velocity joint



Cross roller



Machine structure

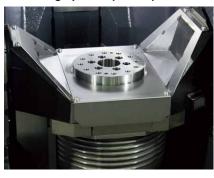
The machine has an original design, including the magazine structure, that keeps the machine compact while maintaining the rigidity of each axis and the balance of rigidity.

Tilt axis (A-axis)



A roller gear cam is used for the tilt axis (A-axis). High retention force and a backlashless structure achieve high-speed and high-accuracy indexing.

Turning spindle (C-axis)



A high-speed and high-output built-in DD motor is used for the turning spindle (C-axis). This achieves efficient turning and high-speed indexing.

Double plunger lock



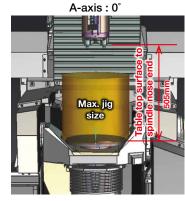
An original double plunger lock is used to secure turning tools, achieving excellent tool change repeatability.

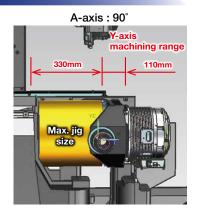
Expansion of machining area

Wide machining area has been secured to allow more flexibility for jig design to meet a variety of workpiece machining.

- ●The distance between the table top surface and the spindle nose end has been increased to secure sufficient area for the jig, workpiece and tool in the Z-axis direction.
- Distance between table top surface and spindle nose end M300X3: 505mm M200X3: 455mm

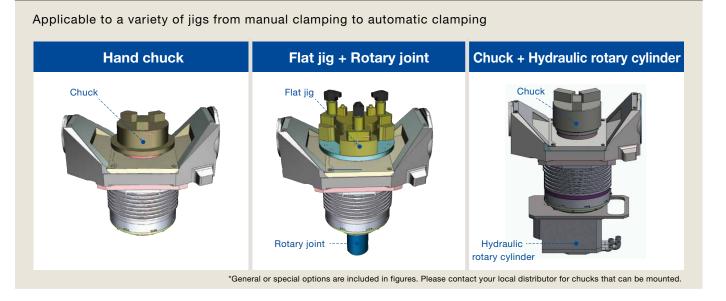
Max. jig size M300X3: φ350_{mm} × H350_{mm} M200X3: φ300_{mm} × H300_{mm}





*There is a contact area around the table top surface. Please refer to the table details.

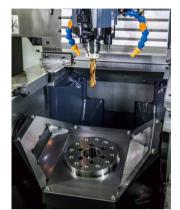
Example of jig configuration



 $_{
m 3}$

Productivity

Fast acceleration/deceleration spindle



Using a fast acceleration / deceleration spindle motor and highly-responsive servo control achieves quicker starting and stopping of the spindle and turning spindle.

Start / stop time

Spindle: 0.2s

High-speed tool change



Using a compact 22-tool magazine with excellent weight balance and optimal control achieves high-speed tool change, with any wasted operation eliminated.

M200X3

Chip-Chip: 1.4s Tool-Tool: 0.8s

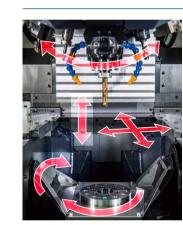
Original synchronized

at the fastest level in

the world.

tapping control enables high-accuracy tapping

Simultaneous operation



Wasted time is further reduced by positioning the X/Y/Z axes and A/C axes simultaneously with tool changes.

Reduction in non-cutting time

High-speed synchronized tapping



Peripheral speed: **377m/min**

* M20, spindle speed 6,000 min

Loading system for manpower reduction (M200X3)

Simple, compact, and easy installation/startup

Specialized for loading/unloading workpieces

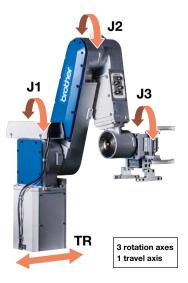
4-axis articulated arm for easy handling

Compactly installed on the side of machine

The loading system is integrated with the machine, requiring less installation space.

Controller incorporated in machine's control box

Wiring connection with NC is not necessary, and signal lines are connected. Piping, wiring, and valves for the hand are stored in the body, and the side door is standard equipped.





Milling capabilities

As the spindle can provide high torque even in the medium- and high-speed range, the machine fully demonstrates its capabilities in high-speed, high-efficiency machining of aluminum or steel.

Max. torque : 40Nm Max. output : 18.9kW



	Drilling Tool diameter mm (inch) × Feed mm (inch)/rev			Tapping Tool diameter mm (inch) ×			Facing Cutting amount cm³/min (inch³/min)			
		ADC	FC250	S45C	ADC	FC250	S45C	ADC	FC250	S45C
M300X3	10,000min ⁻¹	D28×0.2 (1.1 × 0.008)	D28×0.15 (1.1 × 0.006)	D23×0.1 (0.9 × 0.004)	M22×2.5 (7/8-9UNC)	M22×2.5 (7/8-9UNC)	M16×2.0 (5/8-11UNC)	611 (37.3)	110 (6.7)	54 (3.3)
M200X3	10,000min ⁻¹	D28×0.2 (1.1 × 0.008)	D28×0.15 (1.1 × 0.006)	D23×0.1 (0.9 × 0.004)	M22×2.5 (7/8-9UNC)	M22×2.5 (7/8-9UNC)	M16×2.0 (5/8-11UNC)	489 (29.8)	110 (6.7)	54 (3.3)

^{*} The A axis is 0 degrees and X/Y-axes are at their travel center. The above performance may not be achieved under some conditions, depending on usage environment, tools in use

Turning capabilities

High-efficiency machining is achieved by the high-output turning spindle with a maximum speed of 2,000min⁻¹(M200X3), and the turning tool secured by the double plunger lock.

Max. torque

мзоохз: **102Nm**

м200х3: **55Nm**

Max. output

м300X3:9.9kW M200X3:8.7kW



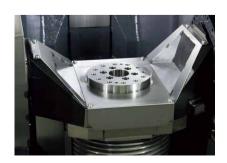
Improved clamp torque

C-axis clamp torque

The C-axis mechanical clamp torque has almost doubled (compared to previous model). This enables more stringent cutting conditions to be set for machining that results in load being applied in the C-axis rotation direction, improving production efficiency.

C-axis clamp torque

мзоохз:450Nm м200х3:345Nm

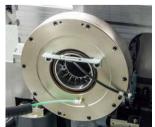


A-axis clamp (optional)

The mechanical clamp enables the machine to demonstrate high machining capabilities even in high-load machining. In addition, stable rotation and less vibration during lathe turning have been achieved, improving machining accuracy.

A-axis clamp torque M300X3 / M200X3:500Nm

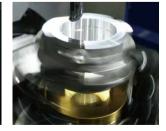
Standard specifications Holding torque (max./continuous):400Nm/200Nm



A-axis clamp (M300X3)



Improves machining accuracy and capabilities when the A-axis is tilted or machining is performed in a full machining range.



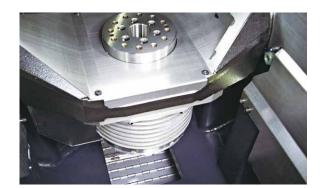
Vibration caused by imbalance of the jig or workpiece during C-axis rotation has been minimized, achieving stable rotation to prevent the decrease in machining accuracy.

Reliability

Chip discharge performance and handling capability have been improved along with the expansion of the machine area. In addition, the machine is equipped with functions to improve reliability, such as chip shower and air-assisted tool washing.

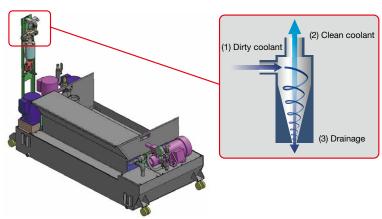
Center trough structure

Chip discharge performance has been improved by the tilted base and the center trough structure.



☐ Tank with cyclone filter (special option for CTS)

Coolant is returned to a clean tank through a tank with a cyclone filter with fine chips removed. This reduces the filter change frequency and extends the service life of the pump.



Operability

The machine is equipped with our original "CNC-C00 Series" controller, created through machine/controller integrated development.



Equipped with tool monitoring functions

ATC monitoring

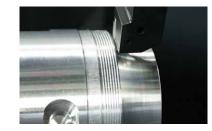
The presence of a spindle tool is detected without using a sensor.

■ Machining load monitoring function

The machining load applied to the spindle is monitored to detect an abnormality of the tool or machining.

Thread cutting function

Straight thread cutting and tapered-thread cutting are possible.

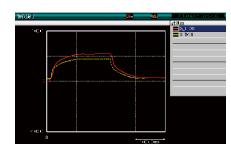


Control box size

Space has been increased for system expansion in case of automation etc.

■ USB interface

In addition to file input/output, various data in the CNC, including waveform data, can be output.



PLC function

Standard equipped with PLC. Input and output points can be expanded to up to 1,024 points each (optional).





Chip conveyor tank

A two-step structure (hinged plate and scrapper) is used, enabling discharge of chips in a variety of sizes and shapes. An oil skimmer can be



Manual pulse generator

A cable is provided for the manual pulse generator, making setup easier.



Coolant tank with chute

Coolant flows through the chute to

discharge chips. The chute can be

separated from the coolant tank,

making maintenance easier. *1

Automatic door with switch panel 10 holes

A motor-driven door is used, achieving smooth operation and reducing openina/closina time.



Chip shower

Chip shower pipes are located at the upper section inside the machine for more efficient flow, and flexible shower nozzles can be directed to the side of the machine cover or sections where chips tend to accumulate.



Side cover with transparent window

External light is drawn in to make the inside of the machine brighter and improve visibility.



Tool breakage detector, touch type

A touch switch type tool breakage detector is used.



Coolant Through Spindle (CTS)

1.5 MPa CTS used for BT spindle. *Please consult your local distributor for use of 3 MPa CTS.



Side door with transparent window

This makes setup from the side easier. It is possible to check the machining room through the transparent window and operate the manual pulse generator through the side door.



Rotary joint 4P A rotary joint with four ports (two

common for hydraulic, coolant, and pneumatic) has been prepared. which is attached to the bottom of the turning spindle motor. *2

hydraulic, one pneumatic, and one

- *1 Chips may not be discharged correctly depending on the shape of chips. When you select the coolant tank with chute, you must also select the chip shower. Please contact your local distributor for details
- *2 The rotary joint must be used with hydraulic oil supplied. If hydraulic oil is not supplied, only conduct indexing operation or remove the rotary joint from the turning spindle motor.

*Depending on the type of coolant, it may have a significant influence on the machine lifecycle. It is recommended to use the coolant which is commercially designated as high lubricity, for example Emulsion type Especially, the coolant of chemical solution type (ex. Synthetic type) is prohibited to use, because it may cause machine damages

*When using CTS (Coolant Through Spindle) function, usage of the coolant of combustible type (ex. Oil-based type) is prohibited.

881 **B**52 855

- Mesh basket for collecting chips Head coolant nozzle
- Tool washing, air-assisted typeRotary joint 4P
- 370L for CTS 1.5MPa with cyclone Tool breakage detector, touch type Chip shower
 - Cleaning gun

Automatic oil lubricator / Automatic grease lubricator

Regularly applies oil or grease to all lubricating points on the three axes.

*Manual greasing is required for the standard specification model.

- Fixture shower valve unit
- A-axis clamp Automatic oil lubricator
- Automatic grease lubricator
- Work light, 1 or 2 lamps
- Signal light, 1, 2, or 3 lamps
 - Area sensor
 - Automatic door with switch panel 10
 - holes
 - Specified color

right side

- Manual pulse generator

- Spindle override
- Grip cover for tool magazine
- Side cover with transparent windov (single side, both sides)
- additional #1 Side door with transparent windov ② EXIO board, input32/output32, additional #2

Switch panel 8 or 10 holes

100V outlet in control box

Power supply expansion 50A

Memory expansion 500 Mbytes

① EXIO board, input32/output32,

Master on circuit

Breaker handle cover

EXIO board assembly

- Fieldbus RS232C 25pin connector at control box
 - 1 CC-Link, master station
 - 2 CC-link, remote device station 3 PROFIBUS DP, slave
 - 4 DeviceNet, slave PLC programming software for Windows® Vista, 7, and 8.1

 - * Windows® is a trademark or registered trademark of Microsoft Corporation in the United States and/or other countries.
 *Please contact your Brother dealer for details.

8

Coolant tank

370L

1.5Mpa

1) Two-step chip conveyor tank,

② Two-step chip conveyor tank,

3 Coolant tank, 150L with chute

1.5MPa with chute and cyclone

(4) Coolant tank, 150L for CTS

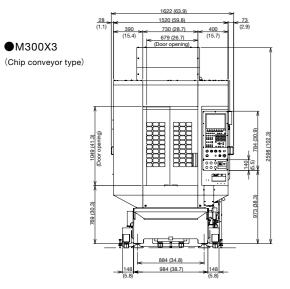
Coolant Through Spindle (CTS)

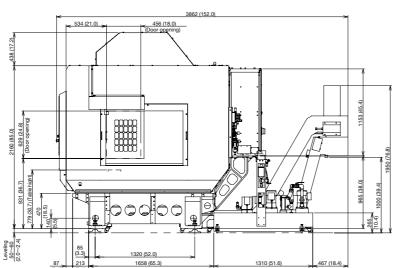


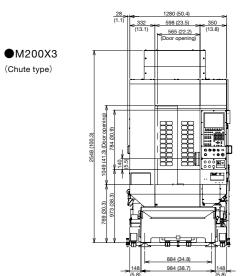
Specifications

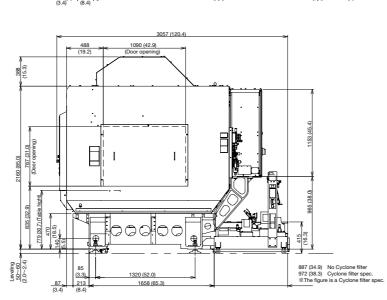


Outline drawing



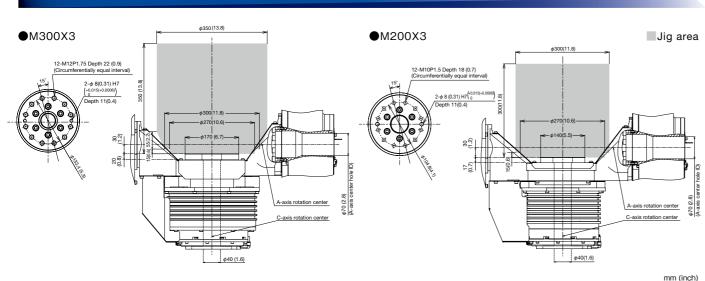






Secure 700 mm (27.6 inch) between machines as maintenance space.

Table details



	Item			M300X3 / M300X3 RD *8	M200X3 / M200X3 RD *8	
CNC Unit				CNC-C00		
	X axis mm(inc		mm(inch)	300 (11.8)	200 (7.9)	
	Y axis		mm(inch)	440 (17.3)	440 (17.3)	
Travels	Z axis		mm(inch)	305 (12.0)	305 (12.0)	
	A axis (deq.)		(deg.)	120 ∼ −30	120 ~ −30	
	C axis		(deg.)	360	360	
	Distance betw	een table top and spindle	e nose end mm (inch)	200 ~ 505 (7.9 ~19.9)	150 ~ 455 (5.9 ~ 17.9)	
	Work area size mm(inch)			Ф170 (Ф6.7) Ф140 (Ф5.5)		
Table	Shape of table top			In compliance with table nose No.5 of ISO702-4 (JISB6109-2)		
	Max. loading capacity(uniform load) kg (lbs)			Table side 75 (165.3) / Tale side 11 (24.3) Table side 40 (88.2) / Tale side		
	Max. table lo	oad inertia	kg·m² (lb·inch²)	Table side 0.58 (1982) / Tale side 0.04 (137)	Table side 0.29 (991) / Tale side 0.04 (137)	
	Spindle spee	ed	min ⁻¹	10,000min ⁻¹ specifications : 1~10,000 16,00	0min⁻¹ specifications (Optional) : 1~16,000	
	Speed during tapping min ⁻¹			MAX.	6,000	
Spindle	Tapered hole	e		7/24 tape	red No.30	
	BT dual contact spindle(BIG-PLUS)			Opti	onal	
	Coolant Through Spindle(CTS)			Opti	onal	
Turning spindle	Max. spindle	e speed	min ⁻¹	1,500	2,000	
	Rapid traver	rse rate(XYZ-area)	m/min(inch/min)	50 × 50 × 50 (1,96	9 × 1,969 × 1,969)	
Feed rate	Cutting feed	l rate	mm/min(inch/min)	X, Y, Z axis: 1 ~ 30,000 (0.04 ~ 1,181) *7		
	Indexing fee	edrate(A and C)	min ⁻¹	A axis: 50 C axis: 200	A axis: 60 C axis: 200	
	Tool shank type			MAS-BT30		
	Pull stad typ	oe *4		MAS-P30T-2		
	Tool storage capacity pcs.			22		
ATC unit	Max. tool ler	ngth	mm(inch)	200 (7.9)		
	Max. tool dia	ameter	mm(inch)	80 (3.1)		
	Max. tool we	eight *1	kg (lbs)	3 (6.6)		
	Tool selection	on method		Random shortcut method		
*5	Tool To To	ool	sec.	0.8	0.8	
Tool change time	Chip To Chip sec.		sec.	1.6	1.4	
	Main spindle	e motor(10min/contin	uous) *2 kW	10,000min ⁻¹ specifications: 10.1/7.0 16,000min ⁻¹ specifications (Optional): 7.4/5.1		
Electric motor	Axis feed motor kW			X,Y axis: 1.0 Z axis: 1.8 A axis: 1.35	X,Y axis: 1.0 Z axis: 1.8 A axis: 0.8	
	Turning spindle motor kW			4.6	4.2	
	Power supp	ly		AC 200V±10%, 50/60Hz±1Hz		
D	Power capa	city(continuous)	kVA	10,000min ⁻¹ specifications: 9.5 16,000min ⁻¹ specifications (Optional): 9.5		
Power source		. Regular air pressure MPa		0.4~0.6 (recommended value : 0.5MPa) *6		
	Air supply	Required flow	L/min	165		
	Height		mm(inch)	2,653 (104.4)	2,603 (102.5)	
Machining dimensions	Required flo	or space	mm(inch)	1,520 × 3,862 (59.8 × 152.0)	1,280 × 3,862 (50.4 × 152.0)	
	Weight kg (lbs)			2,880 (6,349) 2,750 (6,063) [3,050 (6,724) with BV7-870]		
	Accuracy of bidi	irectional axis positioning(ISC	0230-2:1988) mm (inch)	X, Y, Z axis: 0.006~0.020 (0.00024~0.00079) A, C axis: 28 sec or less		
Accuracy *3	Repeatability of bidirectional axis positioning(ISO230-2:2014) mm (inch)			X, Y, Z axis: Less than 0.004 (0.00016) A, C axis: 16 sec or less		
Standard accessorie	s			Instruction Manual (1 set), leveling bolts (4 pcs.), leveling plates (4 pcs.)		

^{*1.} The maximum tool weight differs depending on the configuration and center of gravity. The figures shown here are for reference only. *2. Spindle motor output differs depending on the spindle speed. *3. Measured in compliance with ISO standards and Brother standards. Please contact your local distributor for details. *4. Brother specifications apply to the pull studs for CTS. *5. Measured in compliance with JIS B6336-9 and MAS011-1987. *6. Regular air pressure varies depending on the machine specifications, machining program details, or use of peripheral equipment. Set the pressure higher than the recommended value. *7. When high accuracy mode B is used (When not used, 1 ~ 10,000 mm/min for X/Y axes and 1 ~ 20,000 mm/min for Z 3. Axes and 1 ~ 20,000 mm/min for Z 3. The machine needs to be equipped with a relocation detection device depending on the destination. Machines equipped with a relocation detection device come with "RD" at the end of the model name.

CNC model	CNC-C00				
Control axes	5 axes (X,Y,Z,A,C)				
	Positioning 5 axes (X,Y,Z,A,C)				
o: "	Interpolation Linear: 4 axes				
Simultaneously controlled axes	(X, Y, Z, one additional axis)				
	Circular: 2 axes				
	Helical/conical: 3 axes(X,Y,Z)				
Least input increment	0.001mm, 0.0001inch, 0.001 deg.				
Max.programmable dimension	±9999.999mm, ±999.9999inch				
Display	12.1-inch color LCD				
Memory capacity	Approx.100 Mbytes				
	(Total capacity of program and data bank)				
External communication	USB memory interface, Ethernet, RS232C 1ch				
No.of registrable programs	4,000 (Total capacity of program and data bank)				
Program format	NC language *Conversation language not available				

	Standard NC functions	
Absolute / incremental Inch / metric Corner C / Corner R Rotational transformation Synchronized tap Coordinate system setting Dry run Restart Backlash compensation Rapid traverse override Cutting feed override Alarm history (1,000 pieces) Status log Machine lock Computer remote	Graphic display Subprogram Helical / conical interpolation Tool washing filter with filter clogging detection Automatic power off (energy saving function) Servomotor off standby mode (energy saving function) Chip shower off delay Automatic coolant off (energy saving function) Automatic work light off (energy saving function) Heat expansion compensation systemII (X,Y,Z axes)	Screen shot Auto notification Inverse time feed Spindle load monitoring function ATC monitoring function Expanded workpiece coordinate systel Scaling Mirror image Menu programming Programmable data input Tool length compensation Cutter compensation Macro function Local coordinate system One-way positioning
Built-in PLC Motor insulation resistance measurement Operation log High accuracy mode AIII Tool length measurement Tool life management / spare tool Background editing	(x, 1,2 axes) Tap return function Automatic workpiece measurement *1 Waveform display Operation level External input signal key High accuracy mode BI(look-ahead 40 blocks) Waveform output to memory card	Operation in tape mode (Turning function) Constant peripheral speed contro Feed per revolution control Tool position compensation XYZ Nose R compensation Thread cutting function
	Optional NC functions	
Memory expansion 500 Mbytes High-speed processing *2 Rotary fixture offset Involute interpolation	High accuracy mode BII, look-ahead 200 blocks, with smooth path offset Submicron command *3	Feature coordinate setting functio Spindle override Interrupt type macro

- *1. Measuring instrument needs to be prepared by users. *2. Minute block processing time can be changed
- *3. When the submicron command is used, changing to the conversation program is disabled.

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