



MULTI-TASKING MACHINE

PUMA MX

1600 • 2100 • 2600



DN SOLUTIONS

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PUMA MX series

DN Solutions brand multi-tasking machine which can be used to carry out turning and milling work on complex parts in the same machine, finally obtaining the finished part. Its perfect combination of lathe and machining centre makes it possible to perform a wide range of simple and complex operations with unprecedented flexibility.

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MX 1600/735

Series	Size	Max. turning length mm (inch)	Standard model	S-model	T-model	ST-model
PUMA MX1600/735	6-inch	700 (27.6)	○	○	○	○
PUMA MX1600		900 (35.4)	○	○	○	○
PUMA MX2100	8-inch	1020 (40.2)	○	○	○	○
PUMA MX2100L		1520 (59.8)	○	○	○	○
PUMA MX 2600	10-inch	1540 (60.6)	-	-	○	○

* Standard model : Left spindle + Tail stock

* S- model : Left spindle + Right spindle

* T-model : Standard model + Lower turret

* ST-model : S-model + Lower turret

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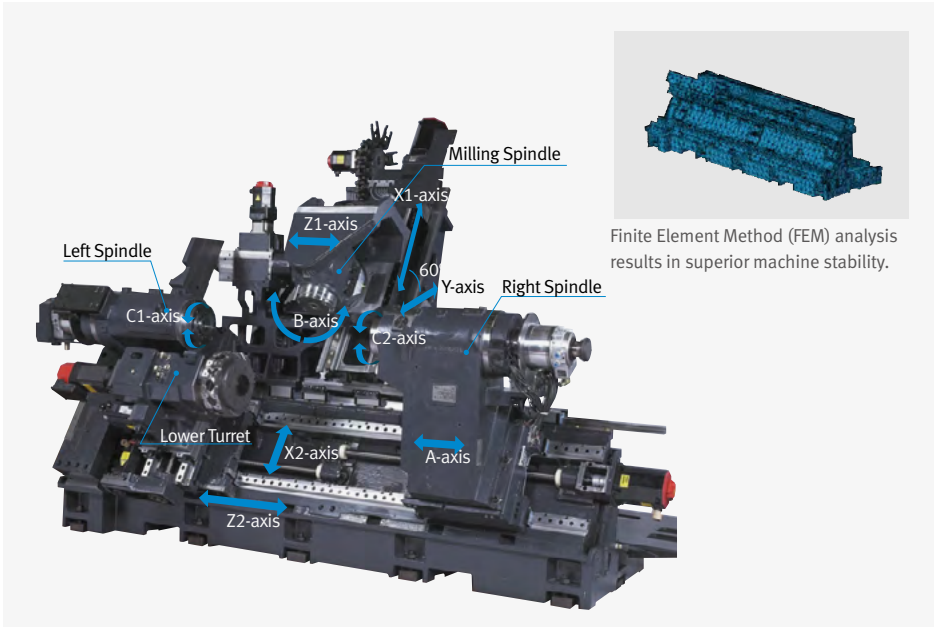
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The heavily ribbed torque tube design prevents twisting and deformation. All guide ways are wide wrap-around rectangular type further provide long-term stability and reliable production.

Robust design



Feed Axis

All carriages are mounted on roller-type, linear motion guides to provide high accuracy and rigidity while reducing non-cutting time.



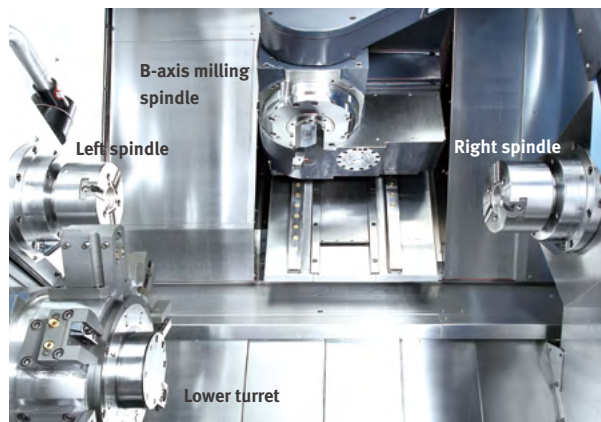
Axis travel				
Model	Unit	PUMA MX1600 _{/735} / 1600	PUMA MX2100 / 2100L	PUMA MX2600
X1-axis	mm (inch)	450 (17.7)	565 (22.2)	630 (24.8)
Z1-axis	mm (inch)	735 / 935 (28.9 / 36.8)	1050 / 1550 (41.3 / 61.0)	1585 (62.4)
Y-axis	mm (inch)	170(±85) (6.7(±3.3))		230(±115) (9.1(±4.5))
B-axis	deg.	240(±120)		
A-axis	mm (inch)	735 / 935 (28.9 / 36.8)	1050 / 1550 (41.3 / 61.0)	1550 (61.0)
X2-axis	mm (inch)	165 (6.5)	187 (7.4)	220 (8.7)
Z2-axis	mm (inch)	725 / 925 (28.5 / 36.4)	1050 / 1550 (41.3 / 61.0)	1515 (59.6)
Note1) A-axis is just for right spindle in S/ST model of MX series.				
Note2) X2/Z2-axis is jus for lower turret in T/ST model of MX serieis.				
Rapid traverse				
Model	Unit	PUMA MX1600 _{/735} / MX1600	PUMA MX2100 / MX2100L	PUMA MX2600
X1-axis	m/min (ipm)	36 (1417.3)		
Z1-axis	m/min (ipm)	36 (1417.3)		
Y-axis	m/min (ipm)	26 (1023.6)		
B-axis	m/min (ipm)	50 (1968.5)	42 (1653.5)	
A-axis	m/min (ipm)	30 (1181.1)		
X2-axis	m/min (ipm)	24 (944.9)		
Z2-axis	m/min (ipm)	36 (1417.3)		
Note1) A-axis is just for right spindle in S/ST model of MX series.				
Note2) X2/Z2-axis is jus for lower turret in T/ST model of MX serieis.				

Multi-axis control and its combination

ST model of MX series has whole controlled axis from 3 spindles (B-axis spindle to Left / Right spindle) with lower turret. Their perfect control combination is key factor to ensure multi-tasking performance.

Perfect integration of key axes

MX series provides unmatched flexibility with a wide variety of machine configurations. From simple turning and milling to complex multi-axis simultaneous machining, multiple operations can be completed within a single MX.



* This photo is for the major unit combination of ST model

- Multi-process capability
- Shorter setup times
- Optimal cycle distribution
- Automated operation support

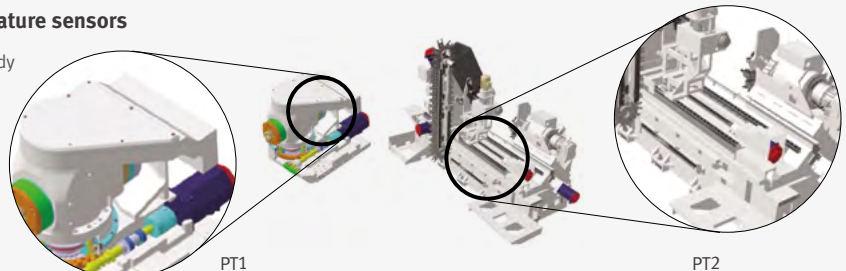
↓
MX series

Thermal compensation for B-axis

Milling spindle thermal growth can be compensated for spindle axis direction only. Effectively removes positional deviation of spindle nose due to changing rotational speed.

Position of temperature sensors

Milling spindle headbody (PT1), bed (PT2)



B-axis swivel control

B-axis index that can have swivel positioning of every 0.001° in $\pm 120^\circ$ performs not only horizontal front face machining but also angular machining.



Within its swivel $\pm 120^\circ$, B-axis can be indexed and braked precisely at 5° indexing (by coupling clamp)



Swivel and indexing of B-axis is by servo motor and roller gear cam with high-rigidity and high-precision

B-axis indexing time (in 90°)

PUMA MX1600 series

1.6 sec

PUMA MX2100/2600 series

2.0 sec

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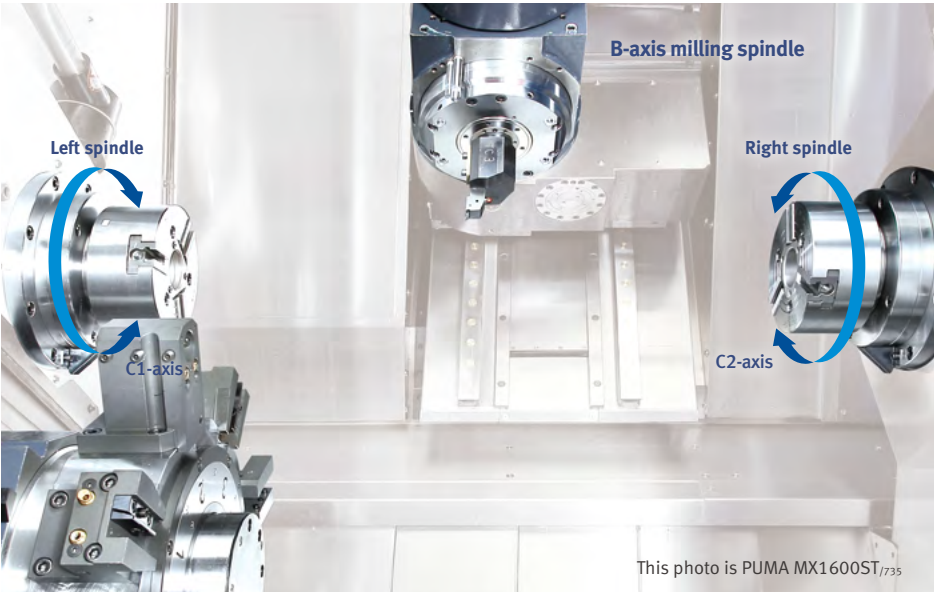
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Spindle

Perfect combination of 3 key spindles to ensure machining stability under various cutting conditions.

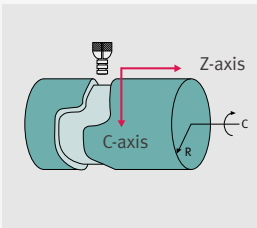
Left / Right Spindle

Both spindles, left and right, are engineered to minimize the loss of precision through thermal distortion, and to ensure superior performance in applications ranging from heavy-duty cutting at high power and low speed, to fine finishing at high speed.

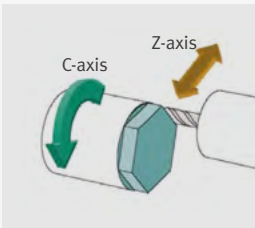


Perfect C-axis control of both spindles

All C1/C2-axis can do positioning control of every 0.001° in 360°. Left spindle of PUMA MX1600 series can perform C1-axis positioning control of every 0.0001° in 360°.



C&Z-axis cylindrical interpolation

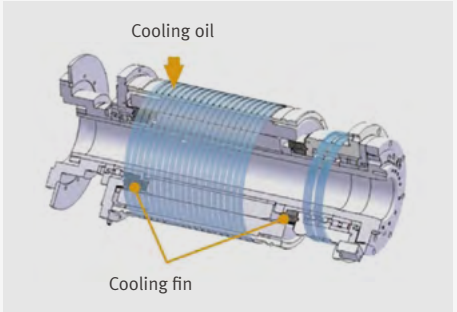


C&X-axis polar interpolation

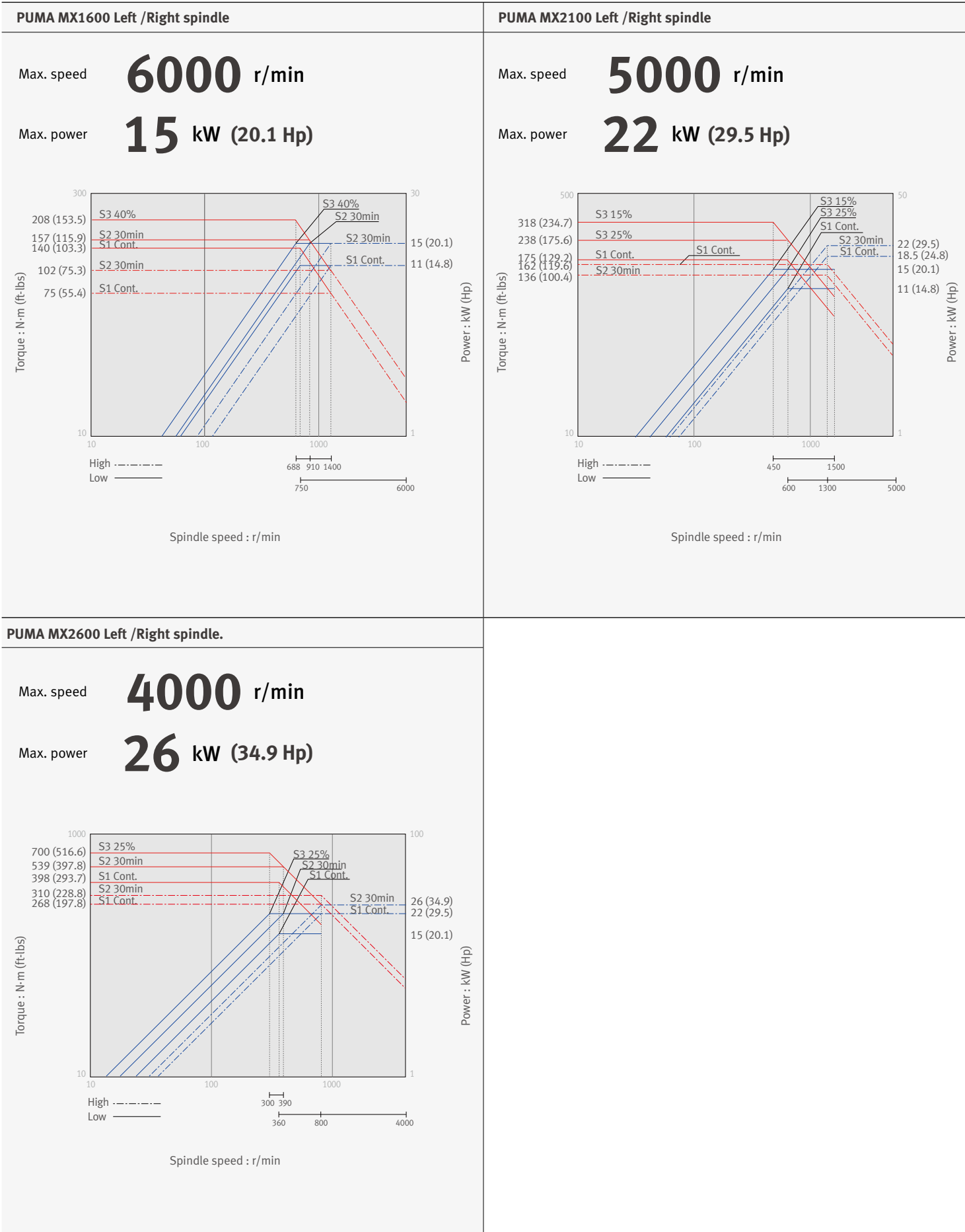
	C1/C2-axis contouring torque
PUMA MX1600 series	208N·m (153.5 lbf.ft)
PUMA MX2100 series	318N·m (125.5 lbf.ft)
PUMA MX2600 series	700N·m (516.6 lbf.ft)

Oil cooling unit for left & right spindles

Both the left and right spindles employ an integral cooling system that circulates coolants through the entire spindle structure. This eliminates thermal distortion in all applications from heavy-duty cutting at high power and low speeds to fine and finish cutting at high speed.



Left/Right Spindle Power-Torque Diagram



Spindle

Perfect combination of 3 key spindles to ensure machining stability under various cutting conditions.

Milling spindle

Oil-based coolants circulate through the milling spindle, allowing perfect integration of turning and milling applications. An air-gap sensor confirms the clamping status of both tools and parts.

Milling Spindle

12000 r/min

option 18000 r/min (on PUMA MX1600 series)



Tool shank

PUMA MX1600 series

CAPTO C5

PUMX MX2100/2600 series

CAPTO C6

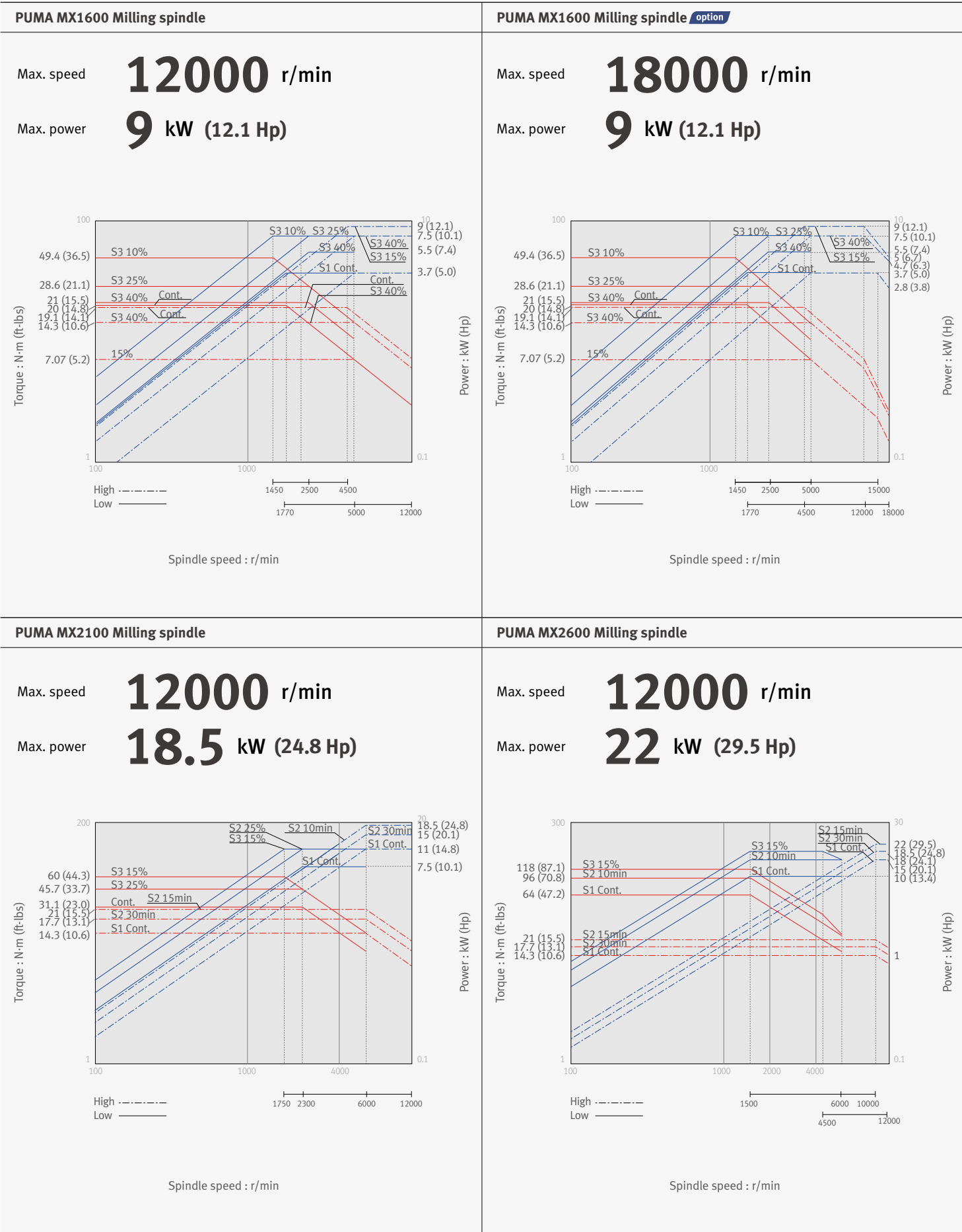
option HSK-A63



The 360° angular positioning of the milling spindle can accommodate multi insert turning tools that are equipped with two, three, or four inserts.

Left & Right Spindle					
Same-size integral motors on left and right spindles deliver enhanced flexibility and performance.					
Model		Unit	PUMA MX1600	PUMA MX2100	PUMA MX2600 /3100
Spindle		-	Left/Right Spindle		
Standard chuck		inch	6	8	10
Spindle speed	High winding	r/min	1400~6000/ 1400~6000 (S2 30min/S1 Cont.)	450~600/600~ 1500/600~1500 (S3 15%/S3 25%/S1 Cont.)	300~390/390~800/ 360~800 (S3 25%/S2 30min/S1 Cont.)
	Low winding		688~910/910~ 1400/750~1400 (S3 40%/S2 30min/S1 Cont.)	1300~5000/ 1300~5000 (S2 30min/S1 Cont.)	800~4000/ 800~4000 (S2 30min/S1 Cont.)
Power		kW (Hp)	15/11 (20.1/14.8) (S2 30min/S1 Cont.)	22/18.5 (29.5/24.8) (S2 30min/S1 Cont.)	26/22 (34.9/29.5) (S2 30min/S1 Cont.)
Torque		N·m (lbf·ft)	208 (153.5)	318 (234.7)	700 (516.6)
Note1) A-axis is just for right spindle in S/ST model of MX series.					
Note2) X2/Z2-axis is jus for lower turret in T/ST model of MX sereis.					
Milling Spindle					
Model		Unit	PUMA MX1600	PUMA MX2100	PUMA MX2600 /3100
Spindle		-	Milling spindle		
Tool shank		inch	CAPTO C5	CAPTO C6	
Spindle speed	High winding	r/min	4500~12000/5000~ 12000/5000~12000 (S3 15%/S3 40%/S1 Cont.)	6000~15000/6000~ 15000/6000~15000 (S2 10min/S2 30min/ S1 Cont.)	10000~12000 (S2 15min/S2 3 0min/S1 Cont.)
	Low winding		1450~2500/2500~5000/ 2500~5000/1770~5000 (S3 10%/S3 25%/S3 40%/S1 Cont.)	1750~2300/2300~ 6000/2300~6000 (S3 15%/S3 25%/S1 Cont.)	1500~4500/1500~ 6000/1500~6000 (S3 15%/S2 10min/ S1 Cont.)
Power		kW (Hp)	9/7.5/3.7 (6.6/5.5/2.7) (S3 15%/S3 40%/S1 Cont.)	18.5/15/11 (13.7/20.1/14.8) (S2 10min/S2 30min/S1 Cont.)	22/18.5/15(16.2/13.7/20.1) (S2 15min/S2 30min/ S1 Cont.)
Torque		N·m (lbf·ft)	49 (36.2)	81 (59.8)	118 (87.1)
Note1) A-axis is just for right spindle in S/ST model of MX series.					
Note2) X2/Z2-axis is jus for lower turret in T/ST model of MX sereis.					

Milling Spindle Power-Torque Diagram



Tailstock

More easier and faster set-up of the tailstock using M-code program by servo motor and ball screw

Servo driven tailstock

Servo tailstock make part set-up faster and easier. The operator inputs the proper M-code information in the control and tailstocks move to its proper positions automatically by linear motion control of servo motor and ball screw. No manual adjustments are required.



Model	Tailstock travel mm (inch)	Max. quill thrust force kN(lbs)	Tailstock center
PUMA MX1600/735 / MX1600	735 / 935 (28.9 / 36.8)	3.5 (786.8)	Built-in dead center MT#4
PUMA MX2100/L	1050 / 1550 (41.3 / 61)	7 (1573.6)	
MX 2600T	1550 (61)	10 (22480)	Built-in dead center MT#5

Lower Turret

Strong and rigid lower turret in multi-tasking is to provide more powerful manufacturing performance and a variety of new applications

Servo driven Lower turret on T/ST model

Turret rotation, acceleration and deceleration are controlled by a high-torque servo motor. Unclamp and rotation are virtually simultaneous. The fast index response keeps cycle times short.

Lower turret selections to match user applications



PUMA MX1600/2100/2600 T/ST series - Rotary tool spindle speed : 6000/5000/4000 r/min							
Lower turret T/ST series	Lower turret	Tool number	PUMA MX1600 ⁷³⁵	PUMA MX1600	PUMA MX2100	PUMA MX2600	
For Turning	DI base - 8 station	8	Standard	-	-	-	
	DI base - 12 station	12	-	-	-	option	
For Turn-milling	BMT 45P - 16 station	16	option	Standard	-	-	
	BMT 55P - 12 station	12	-	-	Standard	-	
		24	-	-	option	-	
	BMT 65P - 12 station	12	-	-	-	Standard	

* This photo is BMT55P with 12-station on PUMA MX2100ST

Lower turret for a variety of new applications

Case1) Guide Bush* option

Lower turret to support small and thin parts for biomedical complex shaped using guide bush



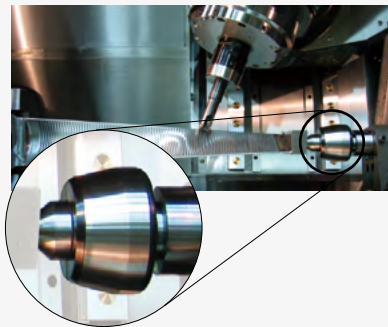
Fixed guide bush

Bar dia. $\phi 22\text{mm} \sim \phi 42\text{mm}$
($\phi 0.9\text{inch} \sim \phi 1.7\text{inch}$)



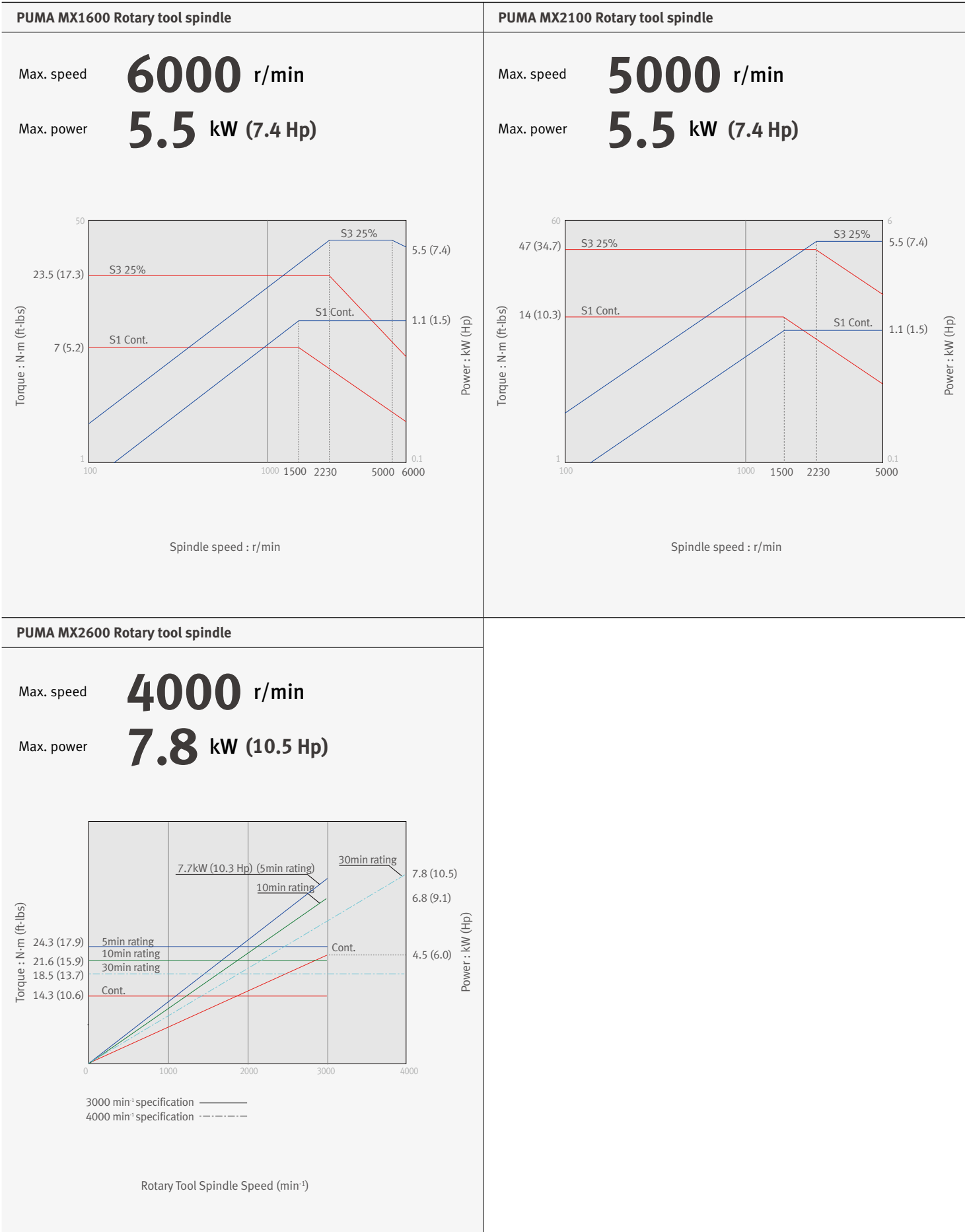
* : PUMA MX1600T / ST

Case2) Lower turret to support long parts with tail center application option



Lower turret of MX series can be available as tailstock function by inserting tail center into tool holder to support light weighted long shaft cutting.

Rotary Tool Spindle Power-Torque Diagram

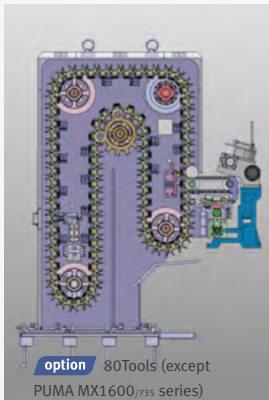


Automatic Tool Changer

Servo ATC and Servo tool magazine ensuring fast and reliable tool indexing.

Servo driven ATC & Tool magazine

The tool magazine can be increased up to 80 tools(except PUMA MX1600/735 series). Tools are selected by a fixed address method that follows the shorter path.



Tool storage
40 tools

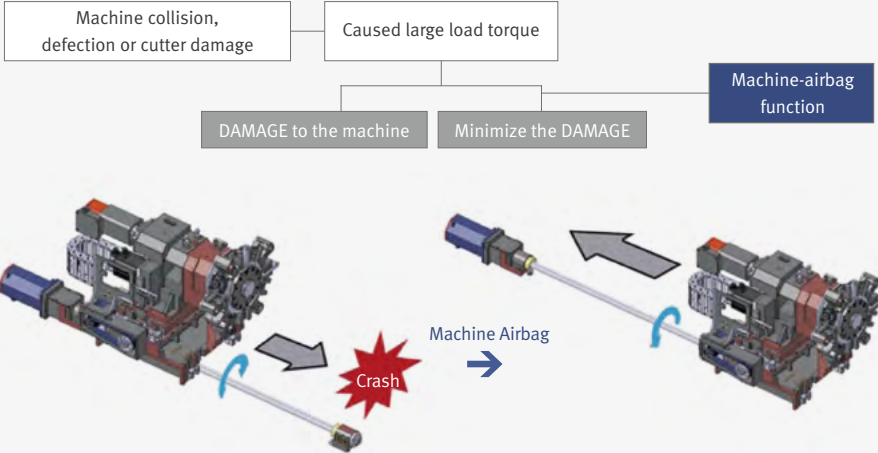
Model	Unit	PUMA MX1600	PUMA MX2100	PUMA MX 2600
Max. tool length (from gauge line)	mm (inch)	200 (7.9)	300 (11.8)	400 (15.8)
Max. tool weight	kg (lb)	4 (8.8)	9 (19.8)	10 (22.0)
Max. tool diameter (continuous)	mm (inch)	70 (2.8)	90 (3.5)	90 (3.5)
Max. tool diameter (adjacent pots are empty)	mm (inch)	95 (3.7)	120 (4.7)	130 (5.1)
Max. tool moment	N·m (ft·lbs)	3.9 (2.9)	8.2 (6.1)	9.8 (7.2)

Safety design to decrease collision-caused damage

Machine Airbag Function

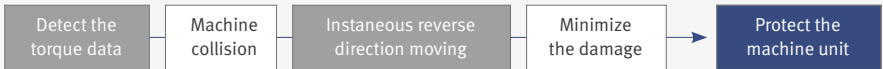
Machine airbag function minimizes damage in the event of a machine collision, defect or heavy load by detecting sudden axis load increase.

- It is available on the servo axis (X, Z, B, Y-AXIS).
- This function can not prevent collision but can minimize collision damage.



The principle of Machine-airbag Function

1. Higher torque load can be detected than setting vale if machine come into collision.
2. Servo Unit automatically move in the reverse direction instaneously.



Various application and performance

PUM MX series is ideal for heavy and interrupted cutting and also your productivity by machining your part with fewer set-ups, shorter changeover and lead time.

Improved productivity



Simultaneous machining

Simultaneous machining can be executed by milling spindle and lower turret. This is effective for automated operation when using gantry loader or robot.

Balance cutting

Both milling spindle and lower turret can do the balance cutting to save machining time and high accuracy when machining small diameter shaft.

Powerful Machining

	OD (Heavy duty cutting)		
		Unit	MX 2600
	Spindle speed	r/min	910
	Cutting speed	m/min (ipm)	200 (7874)
	Feedrate	m/rev	0.4
	Cutting depth	mm (inch)	10 (0.4)
	Material removal rate	cm ³ /min (inch ³ /min)	800 (315.0)
	Face milling (Milling 1)		
		Unit	MX 2600
	Milling Spindle speed	r/min	1100
	Tool [6Z]	mm (inch)	Ø80 (3.2)
	Feedrate	m/rev	5 (0.2)
	Cutting depth	mm (inch)	1.0
	Material removal rate	cm ³ /min (inch ³ /min)	330 (129.9)
	End milling (Milling 2)		
		Unit	MX 2600
	Milling Spindle speed	r/min	380
	Tool [6Z]	mm (inch)	Ø25 (1.0)
	Feedrate	m/rev	25 (1.0)
	Cutting depth	mm (inch)	0.5
	Material removal rate	cm ³ /min (inch ³ /min)	119 (46.9)
	Drilling (Milling 3)		
		Unit	PUMA MX2100
	Milling Spindle speed	r/min	2000
	Tool [U-drill]	mm (inch)	Ø40 (3.2) [6Z]
	Feedrate	m/rev	0.2
	Material removal rate	cm ³ /min (inch ³ /min)	503 (9.7)

- Workpiece material, KS (JIS) : SM45C (S45C), Carbon steel
- The cutting test results indicated above are obtained as an example through real test cutting.
- The results, indicated in this catalogue are provides as example. They may not be obtained due to differences in cutting conditions and environmental conditions during measurement.



Standard / Optional Specifications

● Standard ○ Optional X Not applicable

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No.	Division	Applications		PUMA MX1600/735	PUMA MX1600	PUMA MX2100	PUMA MX2600
1	Tool shank	CAPTO C5		●	●	X	X
2		CAPTO C6		X	X	●	●
3		HSK-A63		X	X	○	○
4	Tool magazine	40 tools		●	●	●	●
5		80 tools		X	○	○	○
6	Work holding device	Left spindle	No chuck	○	○	○	○
7			Hydraulic chuck (6")	●	●	X	X
8			Hydraulic chuck (8")	X	X	●	X
9			Hydraulic chuck (10")	X	X	order base	●
10			Hardened&Ground hard jaw	○	○	○	○
11			Soft jaw	○	○	○	○
12			Dual pressure chucking	○	○	○	○
13			Chuck clamp confirmation	○	○	○	○
14			Chuck pressure check switch	○	○	○	○
15		Right spindle (S/ST model)	Hydraulic chuck (6")	●	●	X	X
16			Hydraulic chuck (8")	X	X	●	X
17			Hydraulic chuck (10")	X	X	order base	●
18			Hardened&Ground hard jaw	○	○	○	○
19			Soft jaw	○	○	○	○
20			Dual pressure chucking	○	○	○	○
21			Chuck clamp confirmation	○	○	○	○
22			Chuck pressure check switch	○	○	○	○
23		Lower turret (T/ST model)	Lower turret for turning (8-station)	●	X	X	X
24			Lower turret for turning (12-station)	X	X	X	○
25			Lower turret for turn-milling (12-station)	X	X	● BMT55P	● BMT65P
26			Lower turret for turn-milling (16-station)	○ BMT45P	● BMT45P	X	X
27			Lower turret for turn-milling (24-station)	X	X	○ BMT55P	X
28			Tail center on lower turret	○	○	○	○
29			Inner shaft hyd. Supply for Steady rest or guide bush	○	○	X	X
30			Steady rest (SLU3.1)	○	○	○	○
31			Semi steady rest (Holder type)	X	X	○	○
32			Fixed type guide bush (Turn-Mill turret only)	○	○	X	X
33		Servo driven steady rest(Z movement)	Select one among SLU3.0 to SLU5.0	X	X	○ (only MX2100L/LS)	X
34			Select one among SLU3.1 to SLU5.0	X	X	X	○ (only MX2100L/LS)
35		Servo driven steady rest(X/Z movement)	Select one among SLU3.0 to SLU5.0	X	X	○ (only MX2100L/LS)	X
36			Select one among SLU3.1 to SLU5.0	X	X	X	○ (except T/ST model)

* Please contact your DN Solutions representative for detailed machine information.



Fire Safety
Precautions

There is a high risk of fire when using non-water-soluble cutting fluids, processing flammable materials, neglecting the controlled and careful use of coolants and modifying the machine without the consent of the manufacturer. Always check the SAFETY GUIDELINES carefully before using the machine.

● Standard ○ Optional ✕ Not applicable

No.	Division	Applications		PUMA MX1600/735	PUMA MX1600	PUMA MX2100	PUMA MX2600
37	Coolant	T-T-C (Through Tool coolant for Milling spindle)	Pressure 1.0MPa(145 psi)/bag filter	●	●	●	●
38			Pressure 2.0MPa(290 psi)/cyclone bag filter	○	○	○	○
39			Pressure 7.0MPa(1015 psi)/dual bag filter	○	○	○	○
40			Pressure 7.0MPa(1015 psi)/paper filter	○	○	○	○
41			MQL(Minimum quantity lubrication) system	○	○	○	○
42		For Lower turret (T/ST model)	Pressure 0.45MPa(65.3 psi)/Tank screen filter	●	●	●	●
43			Pressure 0.7MPa(101.5 psi)/Tank screen filter	○	○	○	○
44			Pressure 1.0MPa(145 psi)/Tank screen filter	○	○	○	○
45			Pressure 1.45MPa(210.3 psi)/Tank screen filter	○	○	○	○
46		For flushing and others	Pressure 0.45MPa(65.3 psi)/Tank screen filter	●	●	●	●
47		Coolant chiller(temperature control)*		○	○	○	○
48		Oil skimmer		○	○	○	○
49		Coolant pressure switch		○	○	○	○
50		Coolant level switch : Sensing level - Low		○	○	○	○
51	Chip disposal	Chip conveyor (Right disposal)	Hinged belt type for steel	○	○	○	○
52			Magnetic scraper type for casting	○	○	○	○
53			Special conveyor	order made	order made	order made	order made
54		Chip bucket		○	○	○	○
55		Air blower (for Left or Right spindle chuck)		●	●	●	●
56		Chuck coolant (for Left or Right spindle chuck)		○	○	○	○
57		Through spindle coolant (Left or Right spindle)		○	○	○	○
58		Through spindle air (Left or Right spindle)		○	○	○	○
59		Coolant gun		○	○	○	○
60		Mist collector (Interface only or Integrated)		○	○	○	○
61	High accuracy	Thermal compensation of X1-axis for B-axis spindle		●	●	●	●
62		Linear scale feed back (X1-axis)		○	○	○	○
63		Linear scale feed back (Y-axis)		○	○	○	○
64		Linear scale feed back (Z1-axis)		○	○	○	○
65		Linear scale feed back (X2-axis of Lower turret in T/ST model)		○	○	○	○
66	Measurement	Manual tool setter (Left/ Renishaw)		X	X	X	X
67		Auto tool setter (Left/ Renishaw)		○	○	○	○
68		Portable tool setter (Right/Renishaw)		X	X	X	X
69		Auto workpiece measurement (RMP60)		○	○	○	○
70	Automation	Parts unloader and conveyor		○	○	○	○
71		Workpiece ejector (for right spindle)		○	○	○	○
72		Bar feeder interface		○	○	○	○
73		Automatic front door (with safety device)		○	○	○	○
74	Others	Air gun		○	○	○	○
75		Automatic power off		○	○	○	○
76		DN Solutions tool monitoring system		●	●	●	●
77		Rotary type window wiper		○	○	○	○
78		Signal tower		●	●	●	●
79		Workpiece cutoff confirmation (Electrical type)		●	●	●	●
80		Quick change tooling(CAPTO) **		○	○	○	○
81	Standard Accessories *****	FOUNDATION BOLT FOR ANCHORING		●	●	●	●
82	Customized Special Option***	PARTS UNLOADER AND CONVEYOR_GRIPPER TYPE ****		○	○	○	X
83		V STAND FOR SHAFT WORKPIECE		○	○	○	○
84		CHIP COVEYOR_DRUM FILTER TYPE		○	○	○	○
85		SHOWER COOLANT		○	○	○	○
86		AIR LIMIT SENSING ON CHUCK_PREPARATION		○	○	○	○
87		TOOL SETTER EXTENSION FOR SPECIAL CHUCK		○	○	○	○
88		MAIN/LEFT SPINDLE AIR CURTAIN		○	○	○	○
89		TOOL SETTER_NON-CONTACTING_NC4_RENISHAW		○	○	○	○
90		TOOL SETTER_NON-CONTACTING_BLUM		○	○	○	○
91		COOLANT FOR MILLING SPDL_MULTI PRESSURE		○	○	○	○
92		MQL SYSTEM		○	○	○	○
93		ANGULAR HEAD FOR MILLING SPINDLE MANUAL		○	○	○	○

* Coolant chiller is highly recommended to prevent temperature rise and minimize thermal deformation, when using a water-insoluble coolant or high-pressure coolant system of which the power is over 1.5 kw.

** Lower turret Applicable

*** Additional option #1 : STEADY REST HOLDER_ON TURRET is available for PUMA MX1600T/T 735/ST/ST 735, Additional option #2 : SUB/RIGHT SPINDLE AIR CURTAIN is available for PUMA MX1600S/S 735/ST/ST 735, PUMA MX2100S/ST/LS/LST, MX 2600S/ST

***** PARTS UNLOADER AND CONVEYOR_GRIPPER TYPE is not available for MX 2600/T ***** It is standard on all MX series

FANUC 31i/32i PLUS

Basic information

Basic Structure
Cutting Performance

Detailed Information

Options
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Customer Support Service

FANUC 31i/32i PLUS maximizes customer productivity and convenience.

15" Touch screen + New OP

DN Solutions Fanuc 31iB/B5 Plus' operation panel enhances operating convenience by incorporating common design buttons and layout. It features a Qwerty keyboard for fast and easy data input and operation.



Fanuc 31i/32i Plus

- 15-inch color display
- Intuitive and user-friendly design

USB & PCMCIA card QWERTY keyboard

- EZ-Guide i standard
- Ergonomic operator panel
- 4MB Memory
- Hot keys
- Enhance AICC BLOCK
- Touch pen provided as standard



iHMI touchscreen

- iHMI provides an intuitive interface that uses a touchscreen for quick and easy operation.

Range of applications

- Providing various applications related to planning, machining, improvement and utility, for customer convenience.

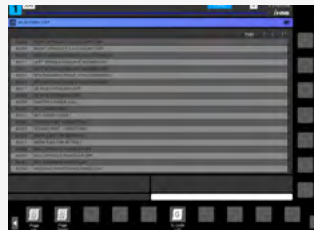
EZwork

Tool load monitoring, Setup guide, Status monitoring, Operation and Recovery guide can provide more convenience and efficiency increasing for user operation.



Tool load monitoring

Real-time tool load monitoring and display various tooling information.



Operation and Recovery guide

Provides step-by-step operation guides and help so even unskilled users can operate it safely and easily.



Status monitoring

Real-time confirmation of machine operation abnormality for effective maintenance using actuator/sensor base operation status notifications.



Thermal Compensation

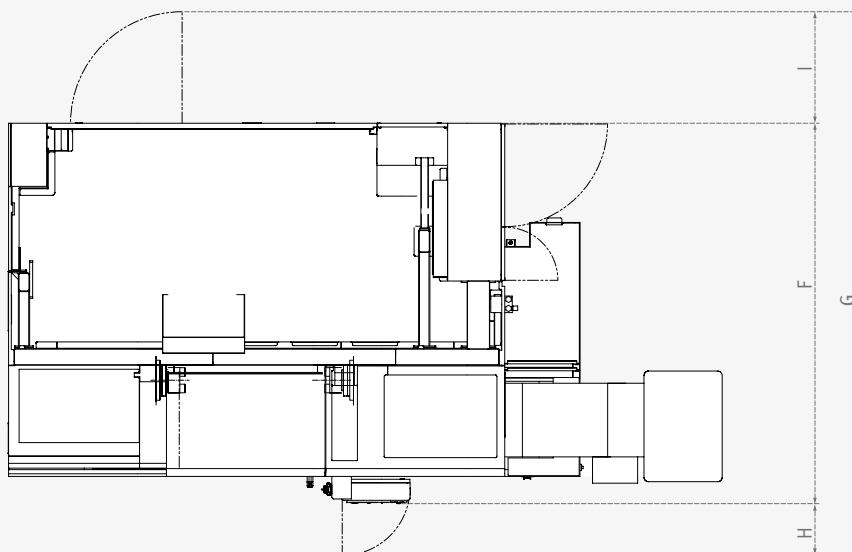
Improve the machining precision through temperature sensor detection and deflection compensation of the structure in real-time.

External Dimensions

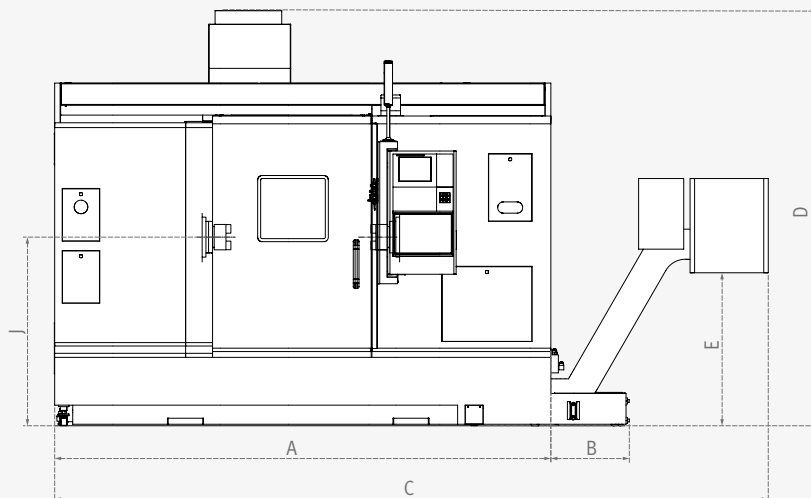
PUMA MX1600 / MX2100 series

Unit : mm (inch)

Top View



Front view



		A	B	C	D	E	F	G	H	I	J
40 Tools	PUMA MX1600/735 series	2900 (114.2)	400 (1.7)	4365 (171.9)	2774 (109.2)	1090 (42.9)	2681 (105.5)	3768 (148.3)	345 (13.6)	742 (29.2)	1265 (49.8)
	PUMA MX1600 series	3300 (129.9)	522 (20.6)	4746 (186.9)	2764 (108.8)	1018 (40.1)	2531 (99.6)	3618 (142.4)			1255 (49.4)
	PUMA MX2100 series	3890 (153.2)	957 (37.3)	5386 (212.1)	2805 (110.4)	1071 (42.2)	2525 (99.4)	3660 (144.1)	405 (15.9)	730 (28.7)	1245 (49.0)
80 Tools	PUMA MX1600 series	3300 (129.9)	522 (20.6)	4765 (187.6)	2646 (104.2)*	1080 (42.5)	2521 (99.3)	4054 (159.6)	401 (15.8)	1132 (44.6)	1255 (49.4)
	PUMA MX2100 series	3890 (153.1)	957 (37.7)	5386 (212.1)	2805 (110.4)	1071 (42.2)	2525 (99.4)	4045 (159.3)	405 (15.9)	1115 (43.9)	1245 (49.0)

* Up to top of the 80 tool magazine

* Some peripheral equipment can be placed in other places

External Dimensions

Basic information

Basic Structure
Cutting Performance

Detailed Information

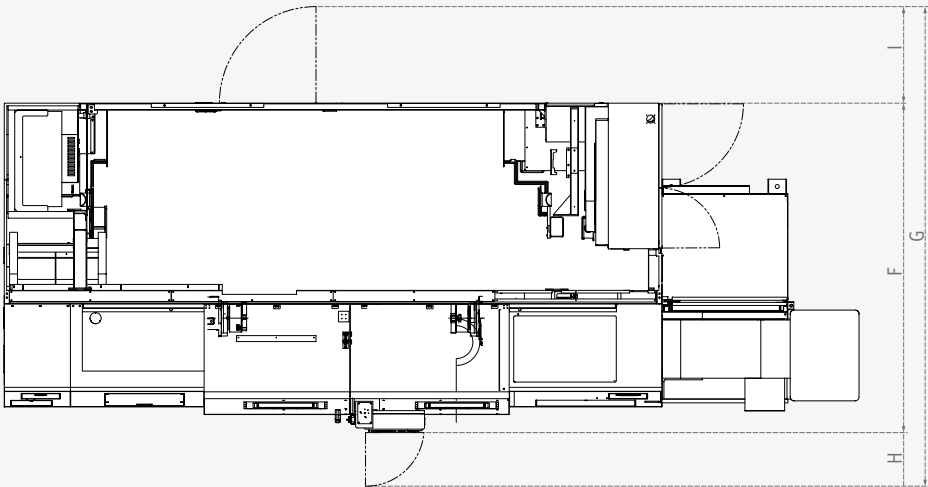
Options
Application
Diagrams
Specifications

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Service

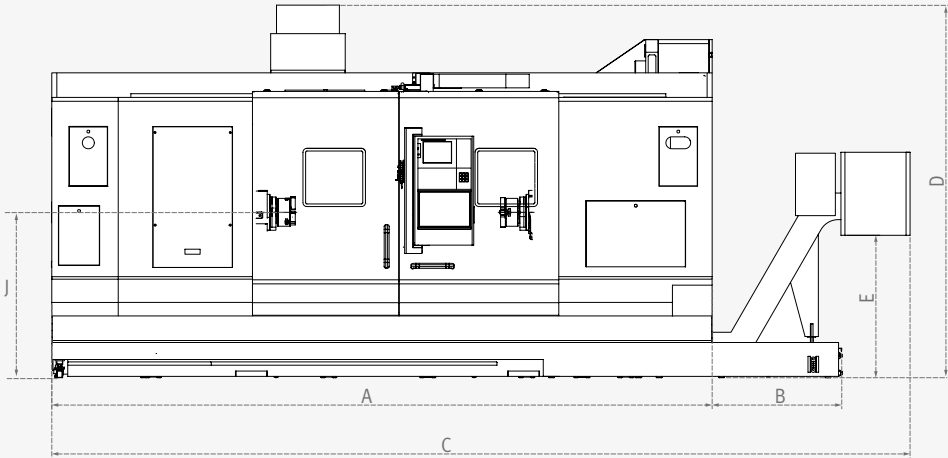
PUMA MX2100L / MX2600 series

Unit : mm (inch)

Top View



Front view



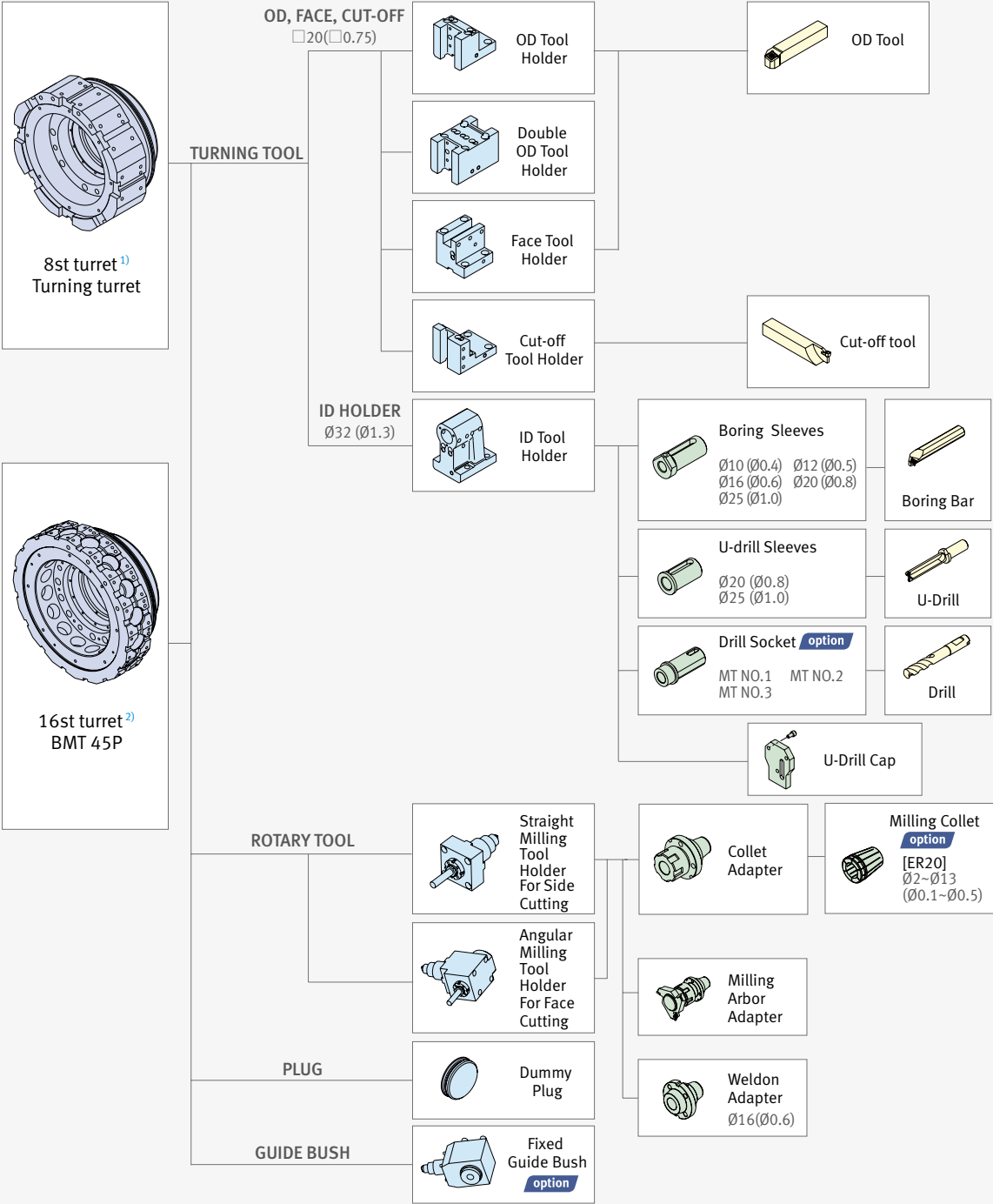
		A	B	C	D	E	F	G	H	I	J
40 Tools	PUMA MX 2100L series	4969 (195.6)	975 (38.4)	6458 (254.3)	2965 (116.3)*	1072 (42.2)	3742 (147.3)	4689 (185.6)	405 (15.9)	542 (21.3)	1245 (49.0)
	PUMA MX 2600 series	5125 (201.8)	945 (37.2)	6690 (263.4)	3025 (119.1)	1200 (47.2)	3825 (150.6)	4710 (185.4)	393 (15.5)	492 (19.4)	1265 (49.8)
80 Tools	PUMA MX 2100L series	4969 (195.6)	975 (38.4)	6458 (254.3)	2805 (110.4)	1072 (42.2)	2490 (98.0)	3625 (142.7)	405 (15.9)	730 (28.7)	1245 (49.0)
	PUMA MX 2600 series	5125 (201.8)	945 (37.2)	6647 (261.7)	3011 (118.6)	1200 (47.2)	2682 (105.6)	3762 (148.1)	392 (15.4)	688 (27.1)	1265 (49.8)

* Up to top of the 80 tool magazine

* Some peripheral equipment can be placed in other places

Lower turret of PUMA MX1600/735 and MX1600 series (T/ST model)

Unit : mm (inch)



1) Standard for T/ST model of MX1600/735
2) Standard for T/ST model of MX1600 and Option for T/ST model of MX1600/735

Basic information

Basic Structure
Cutting Performance

Detailed Information

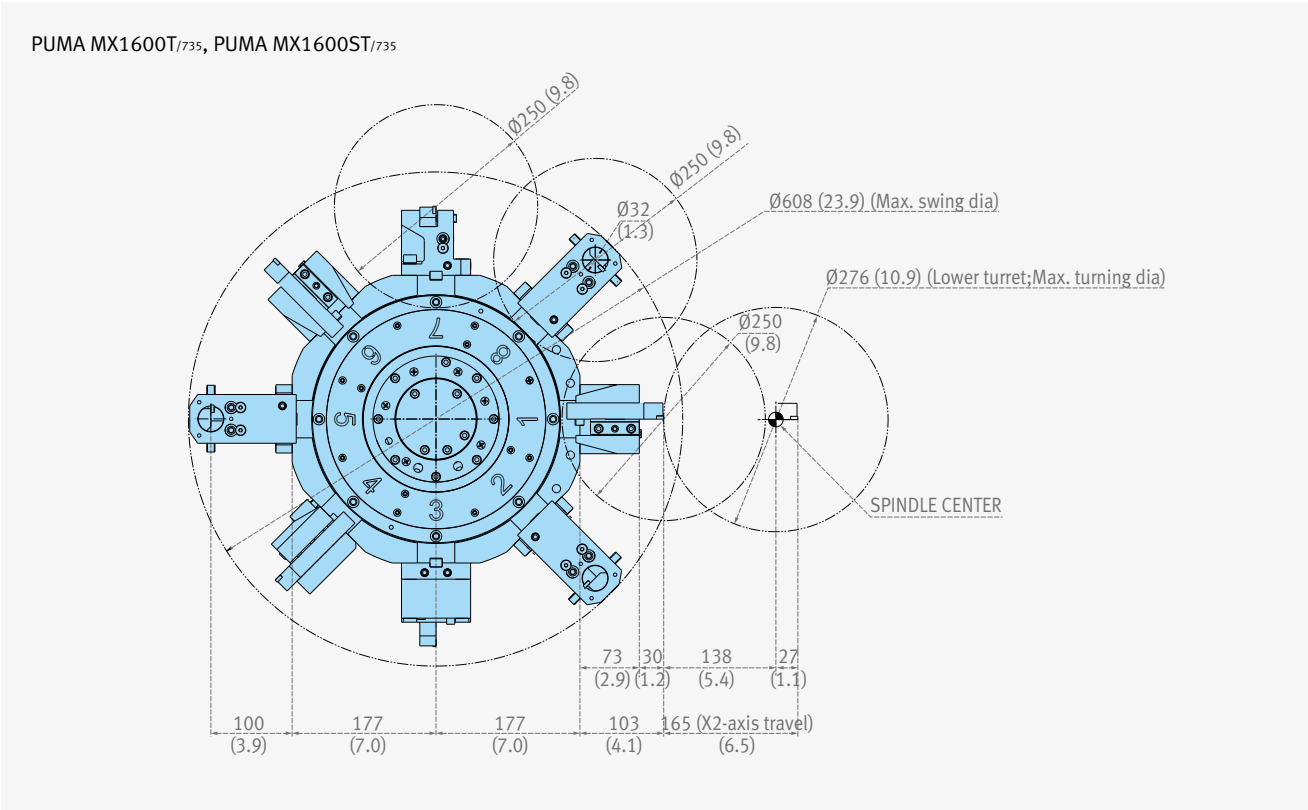
Options
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Tool Interference Diagram of Lower Turret

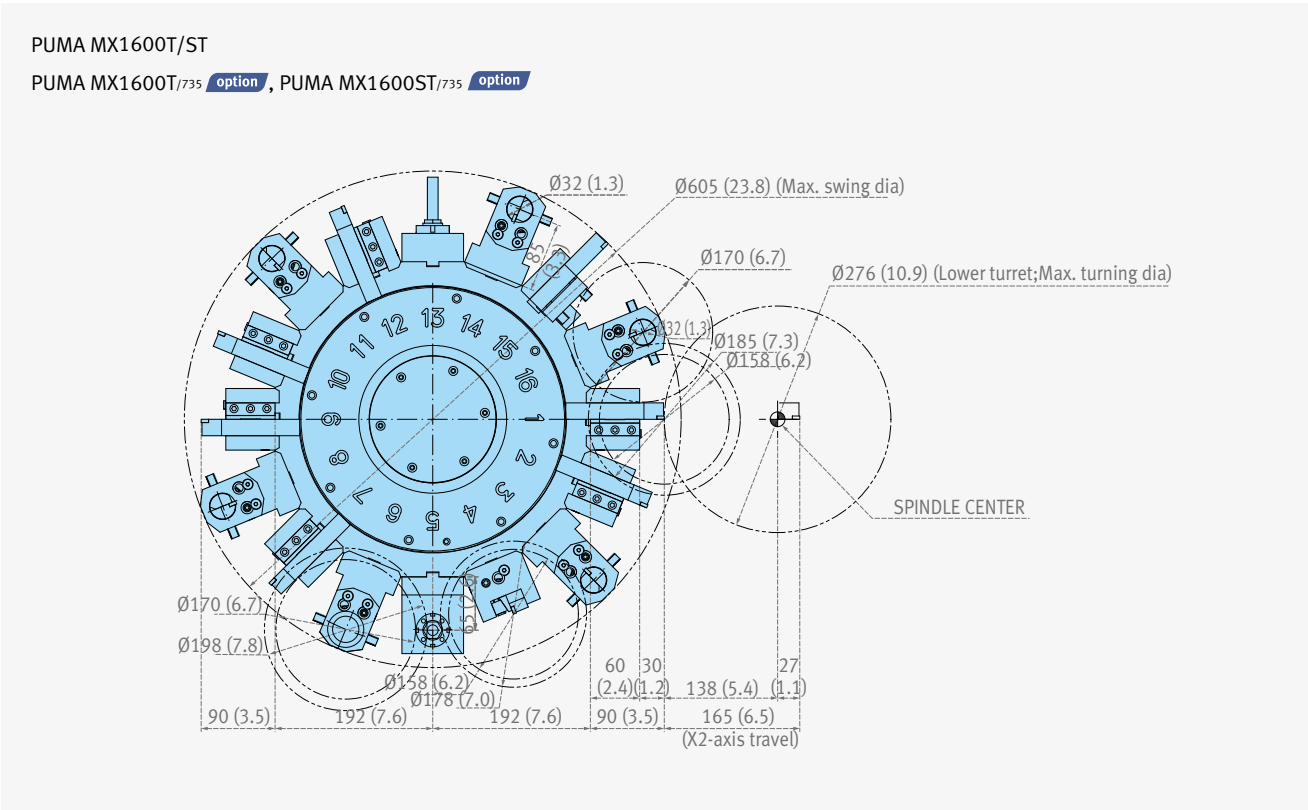
For Turning (8 Stations)

Unit : mm (inch)



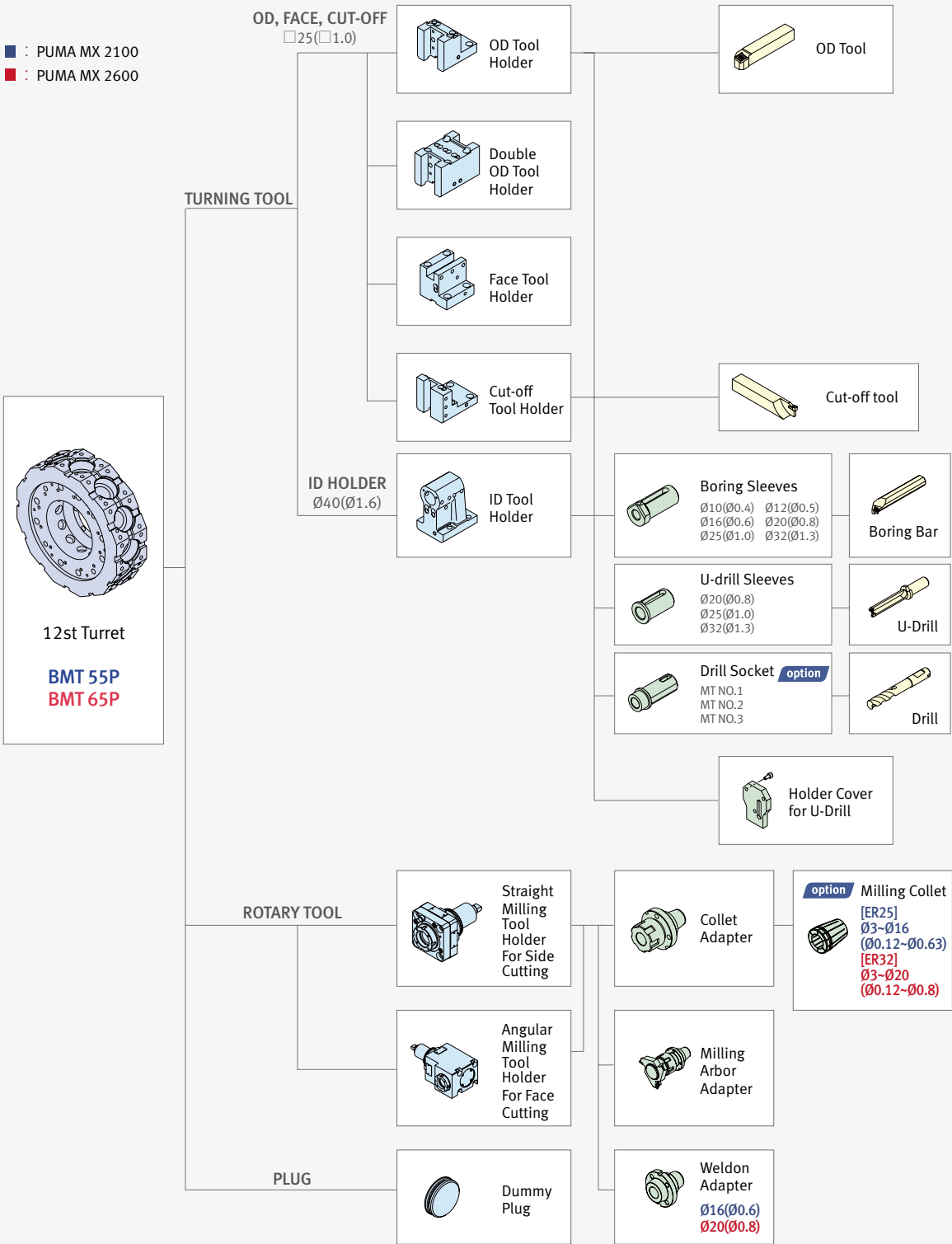
For Turn-Milling (16 Stations, BMT45P)

Unit : mm (inch)



Lower turret of PUMA MX2100/2600 series (T/ST model)

Unit : mm (inch)



Note) PUMA MX2100T/ST series can have 24 tools on BMT55P by adding special Double OD and Triple ID tool holders. Tool indexing angle will be controlled by every 15 degree. This application is available as option.

Tool Interference Diagram of Lower Turret

Basic information

Basic Structure

Cutting Performance

Unit : mm (inch)

Detailed Information

Options

Application

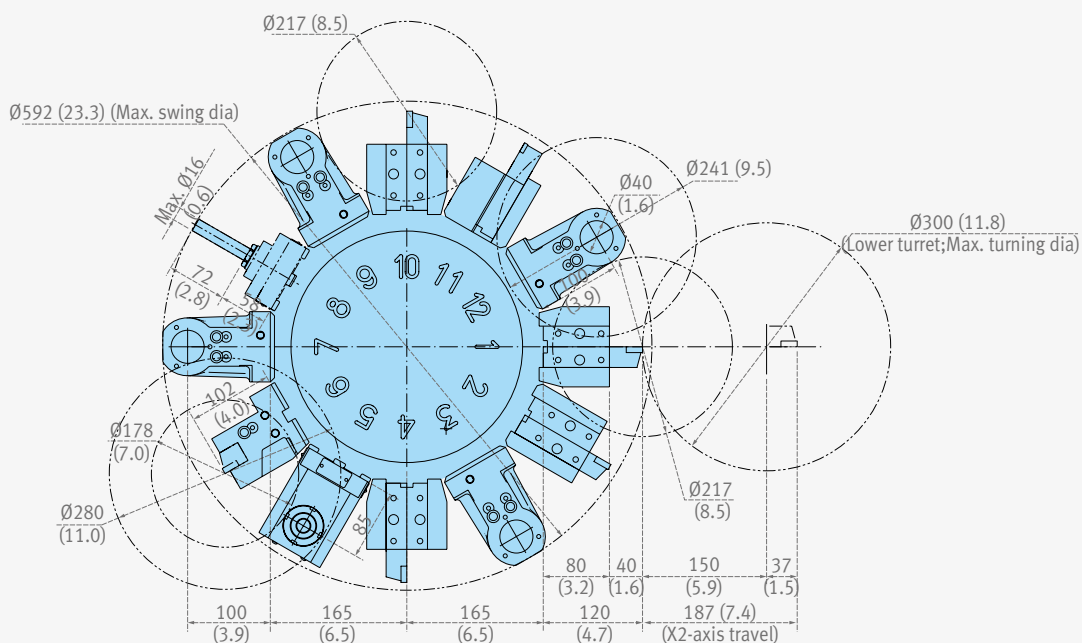
Diagrams

Specifications

Customer Support Service

For Turn-Milling (12 Stations, BMT55P)

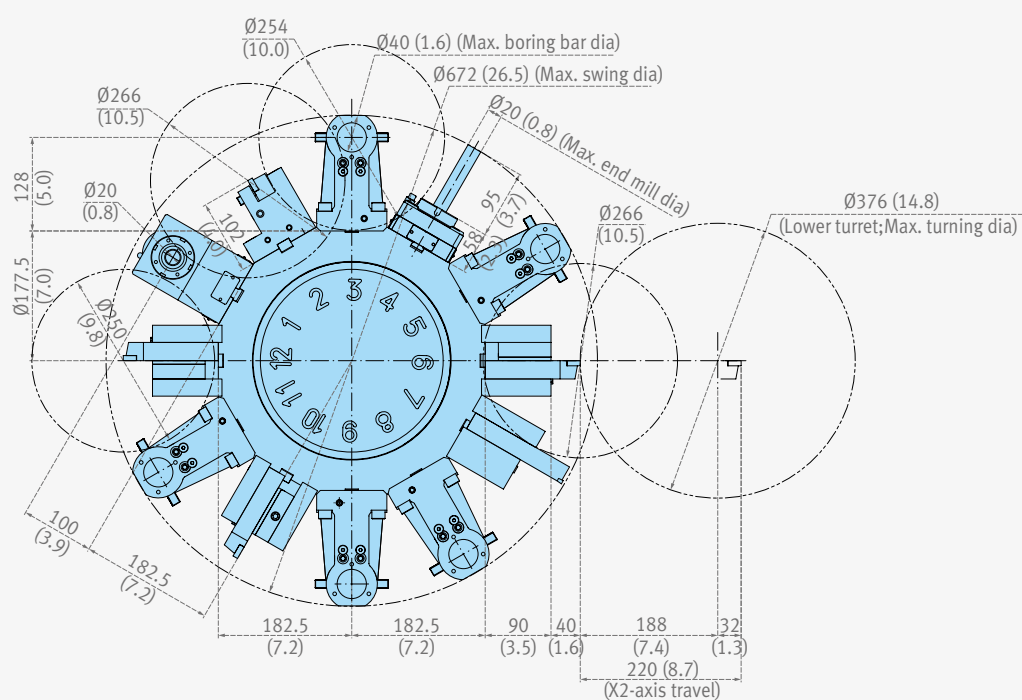
PUMA MX2100T/LT/ST/LST



For Turn-Milling (12 Stations, BMT65P)

Unit : mm (inch)

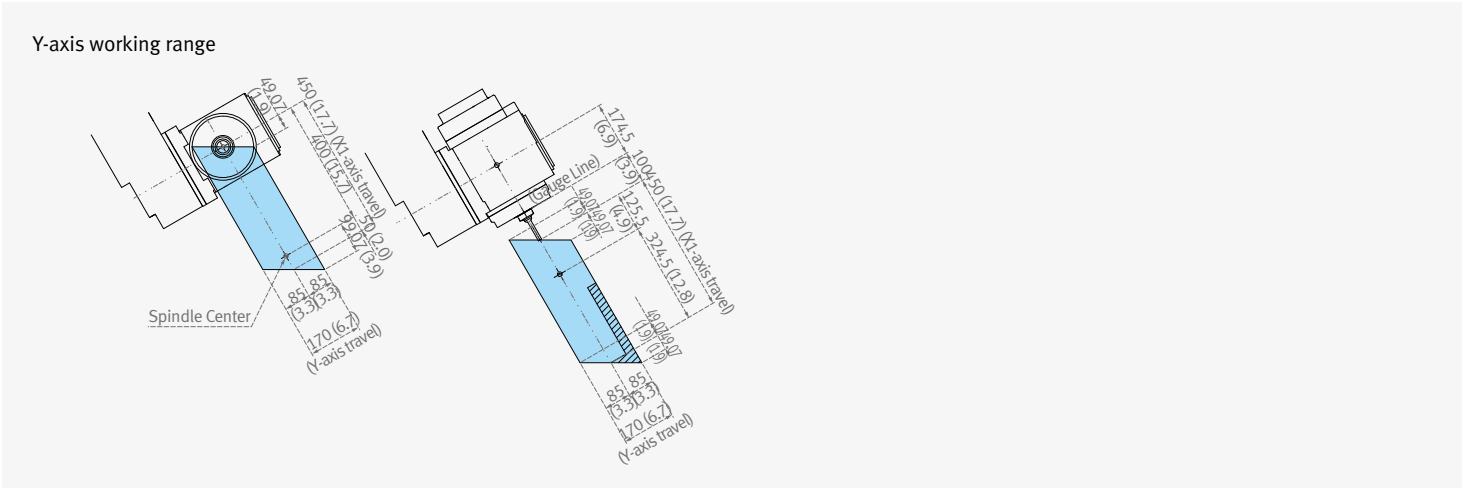
MX 2600T/ST



Working Range of B-axis and Y-axis

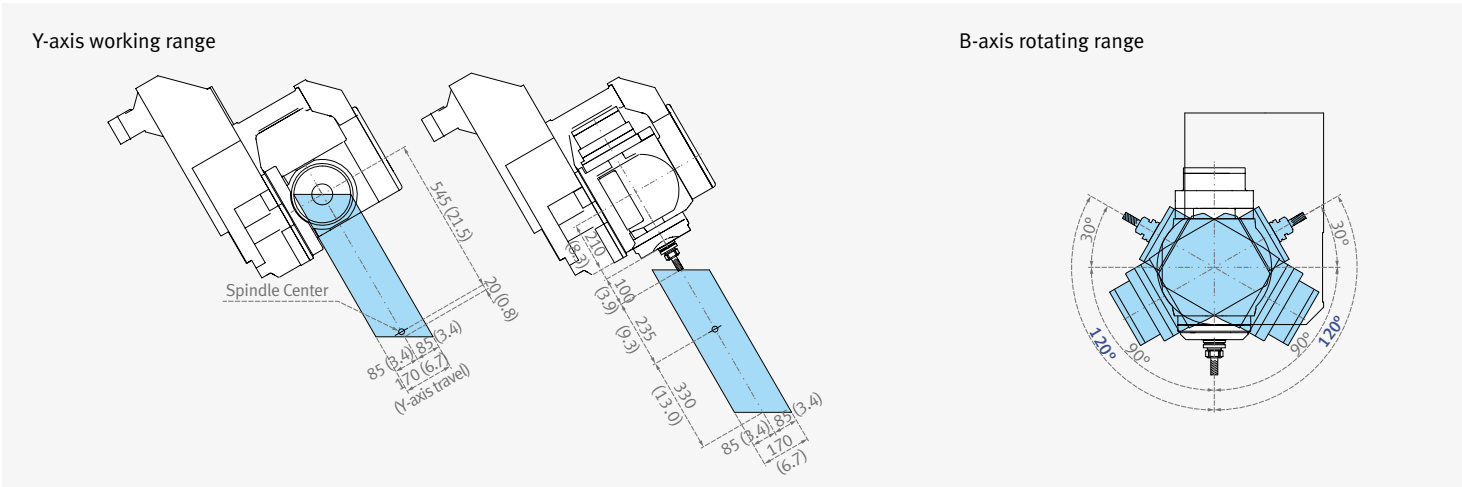
PUMA MX1600/735 series, PUMA MX1600 series

Unit : mm (inch)



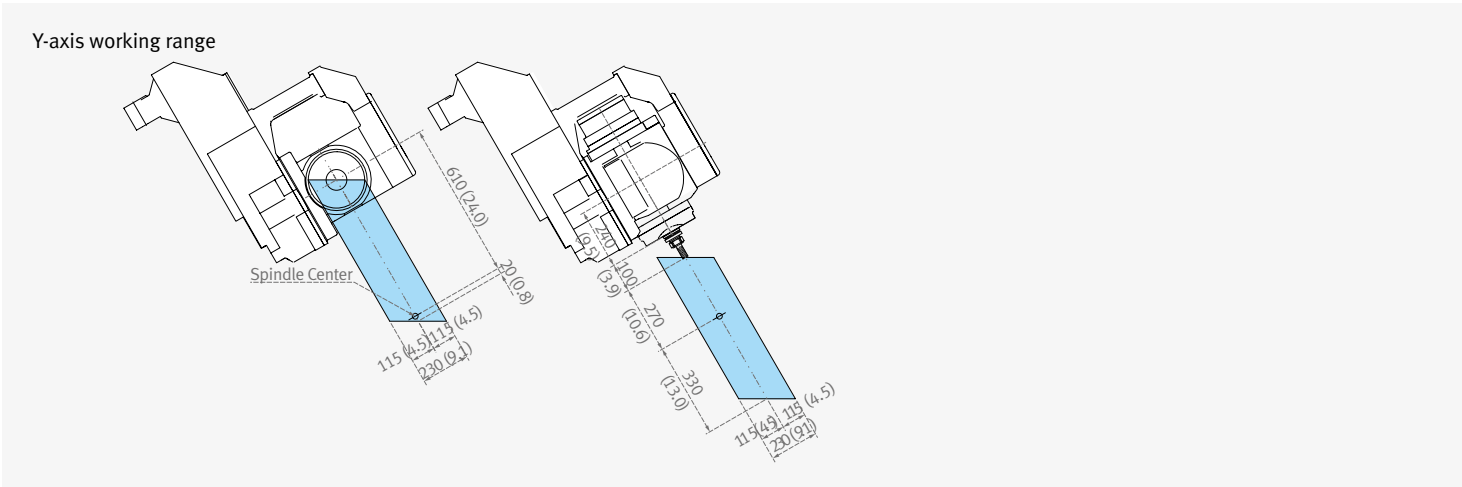
PUMA MX2100 series

Unit : mm (inch)



MX 2600 series

Unit : mm (inch)



Working Range

Basic information

- Basic Structure
- Cutting Performance

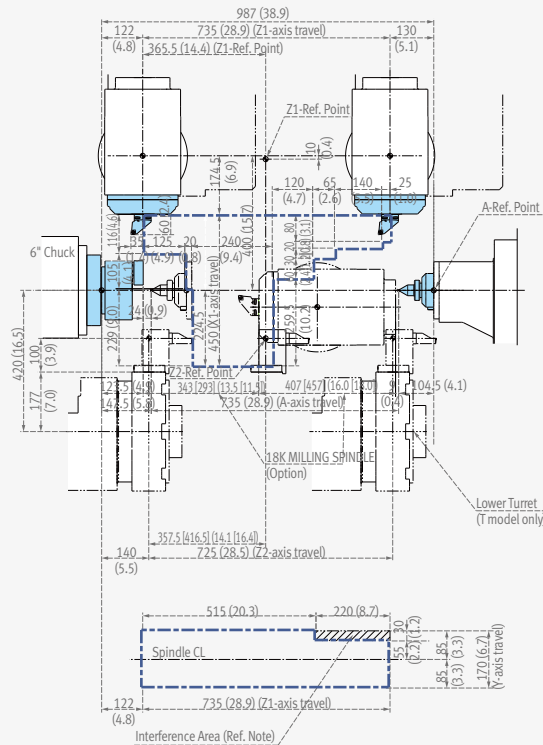
Detailed Information

- Options
- Application
- Diagrams
- Specifications

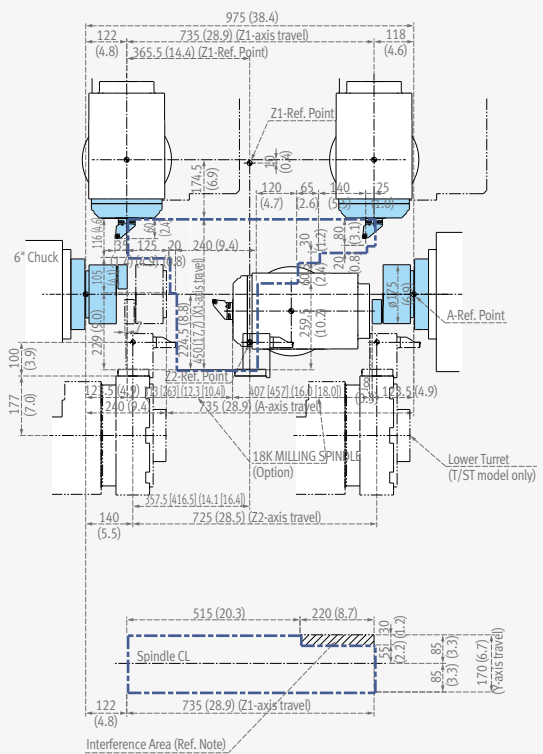
Customer Support Service

Unit : mm (inch)

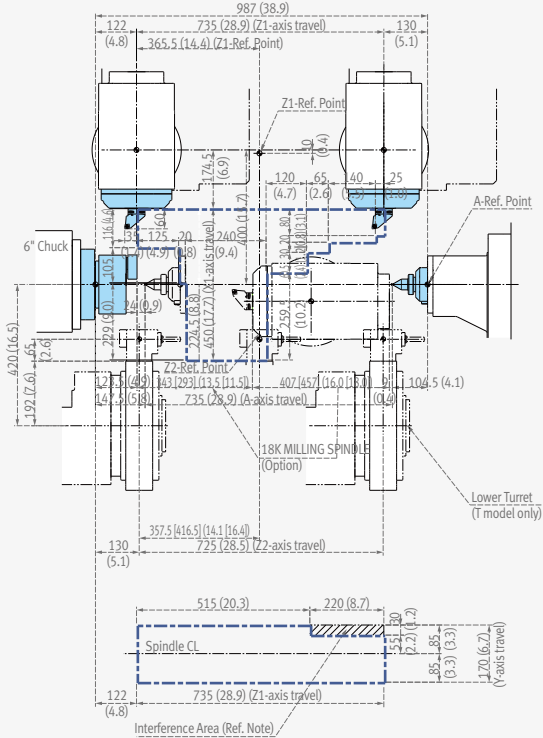
PUMA MX1600/735, PUMA MX1600T/735
(Lower turret for turning with 8 stations)



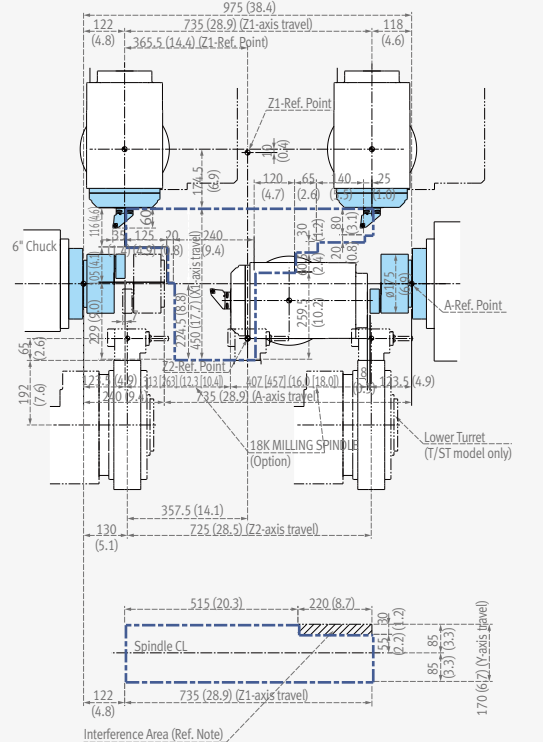
PUMA MX1600S/735, PUMA MX1600ST/735
(Lower turret for turning with 8 stations)



PUMA MX1600T/735
(Lower turret for turn-milling with 16 stations)



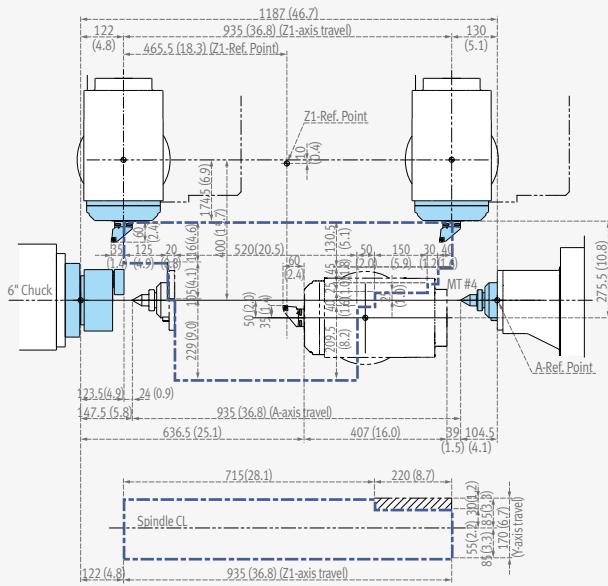
PUMA MX1600ST/735
(Lower turret for turn-milling with 16 stations)



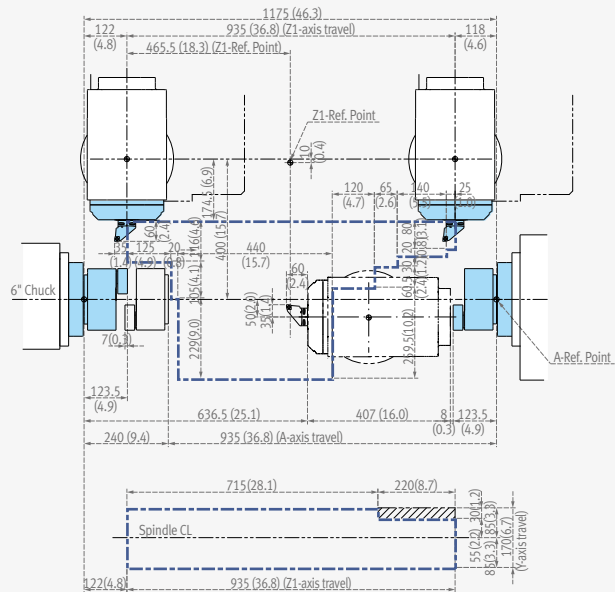
PUMA MX1600 series

Unit : mm (inch)

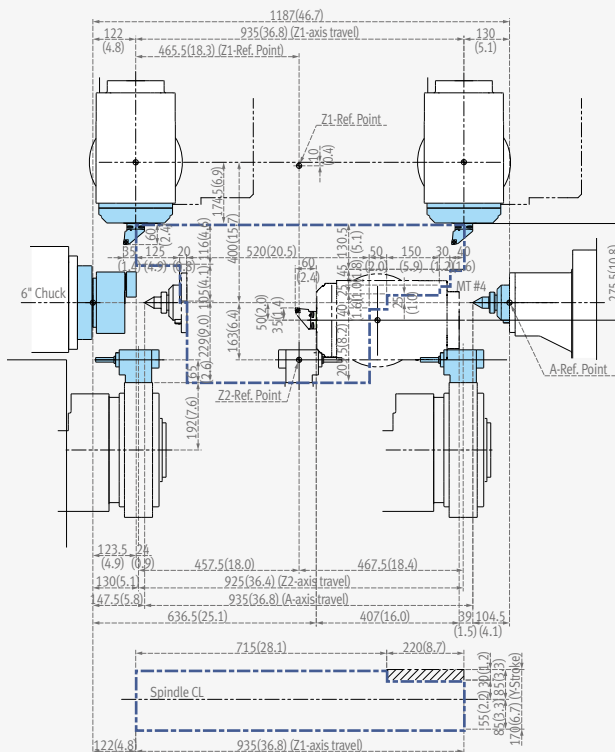
PUMA MX1600



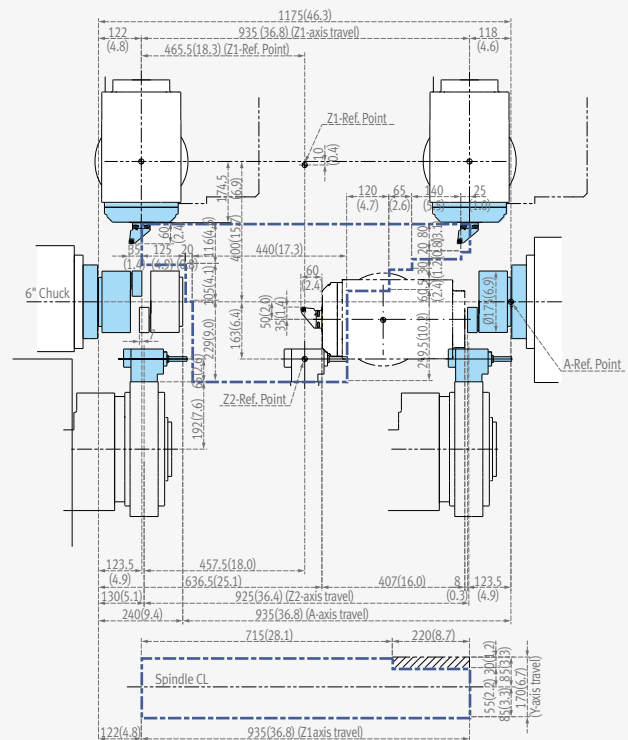
PUMA MX1600S



PUMA MX1600T



PUMA MX1600ST

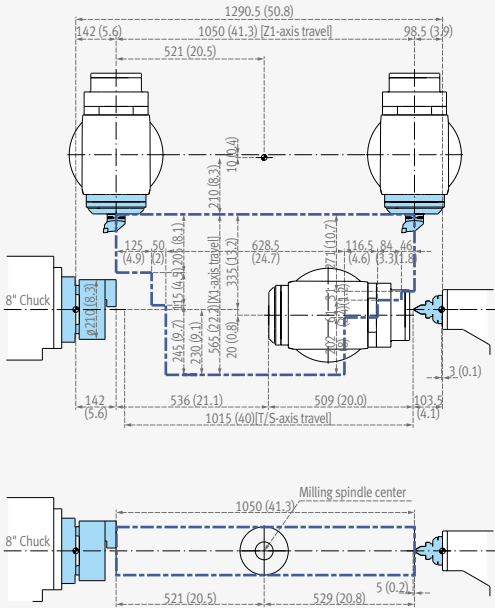


Working Range

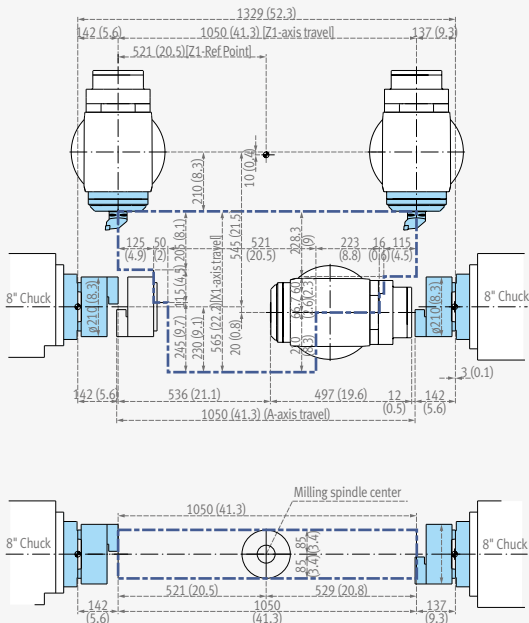
PUMA MX2100 series

Unit : mm (inch)

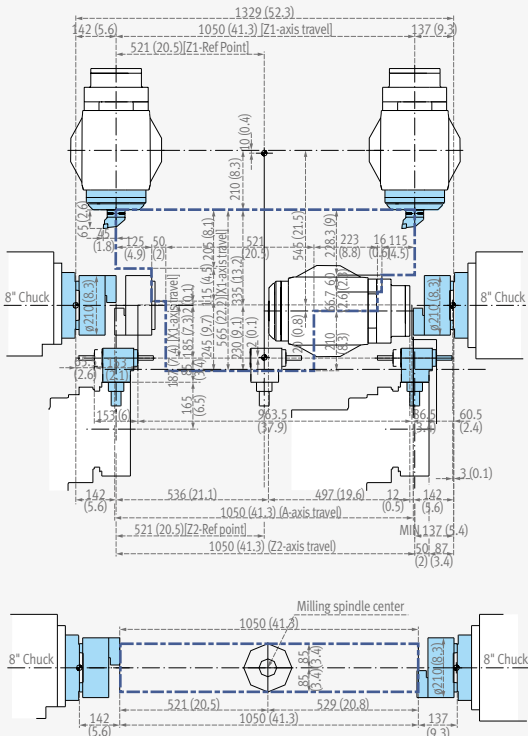
PUMA MX2100



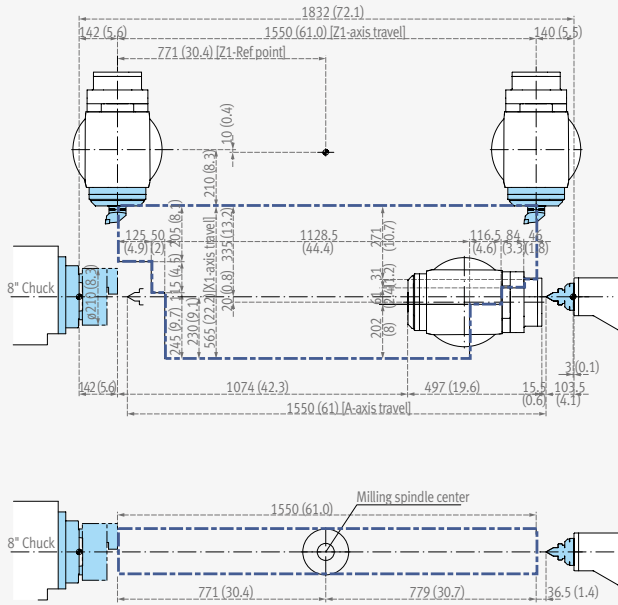
PUMA MX2100S



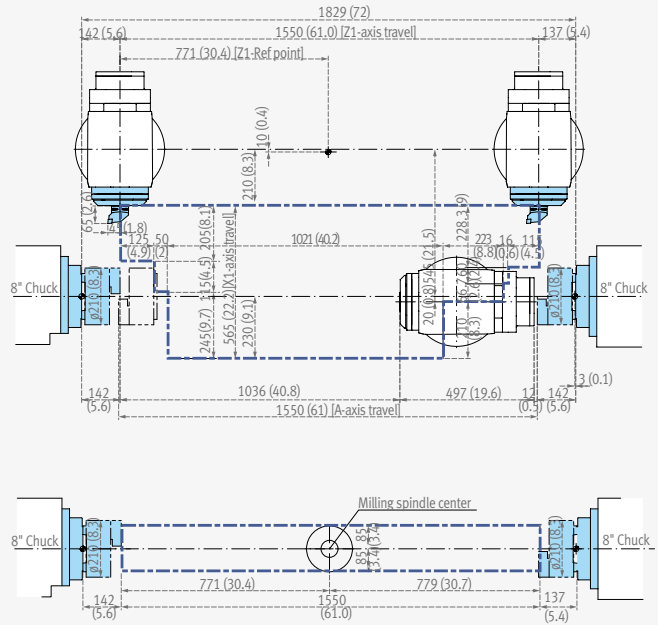
PUMA MX2100ST



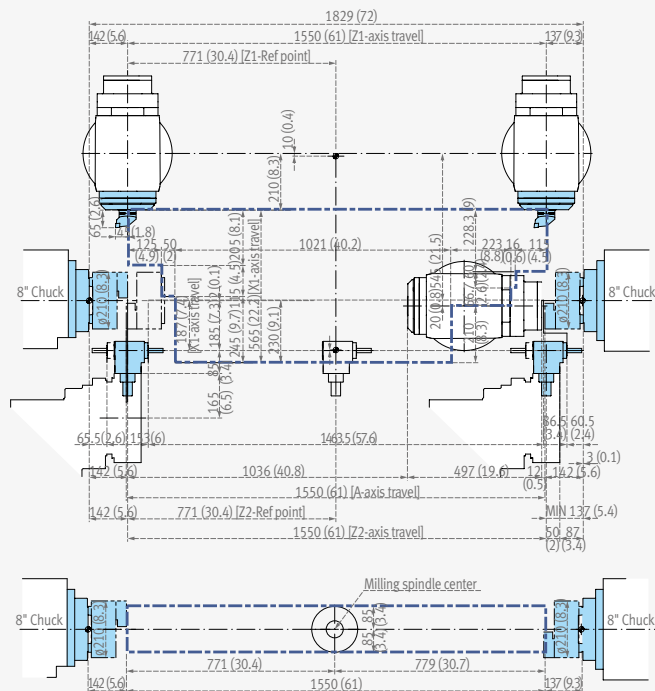
PUMA MX2100L



PUMA MX2100LS



PUMA MX2100LST



Working Range

Basic information

- Basic Structure
- Cutting Performance

Detailed Information

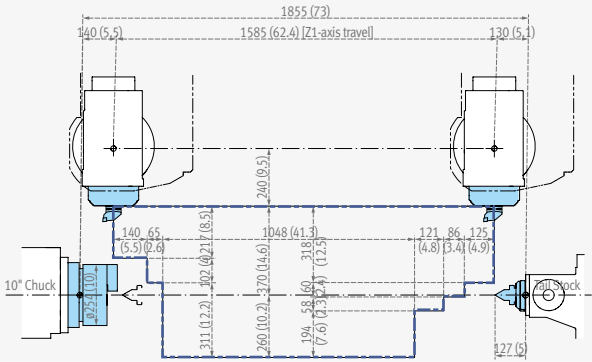
- Options
- Application
- Diagrams
- Specifications

Customer Support Service

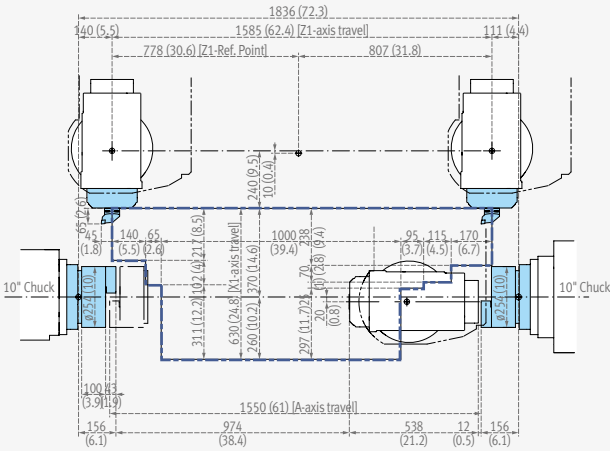
PUMA MX 2600 series

Unit : mm (inch)

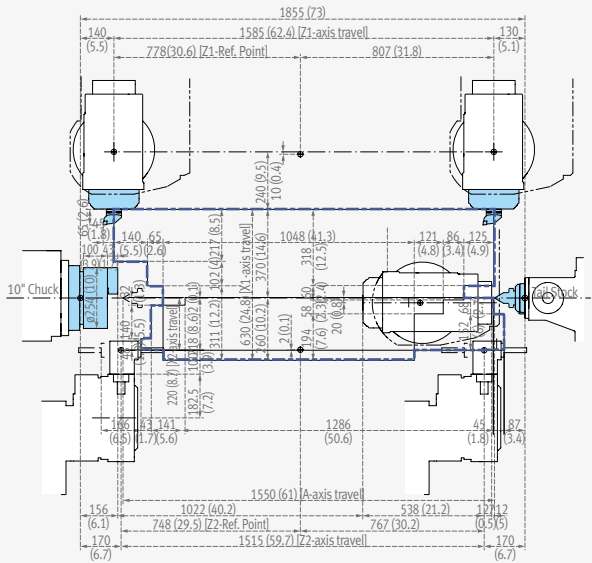
MX 2600



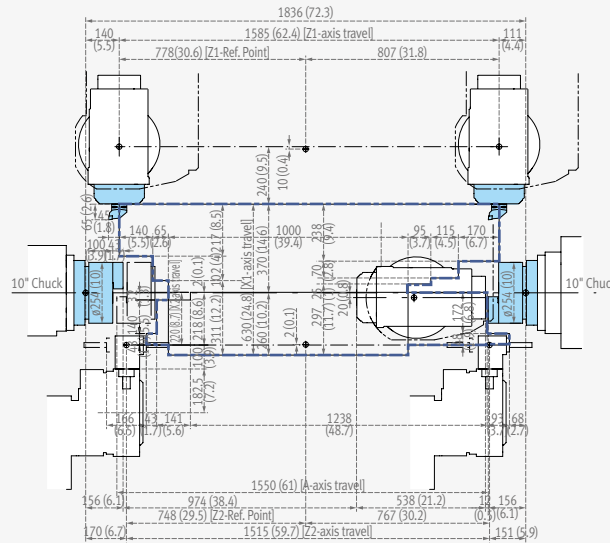
MX 2600S



MX 2600T



MX 2600ST

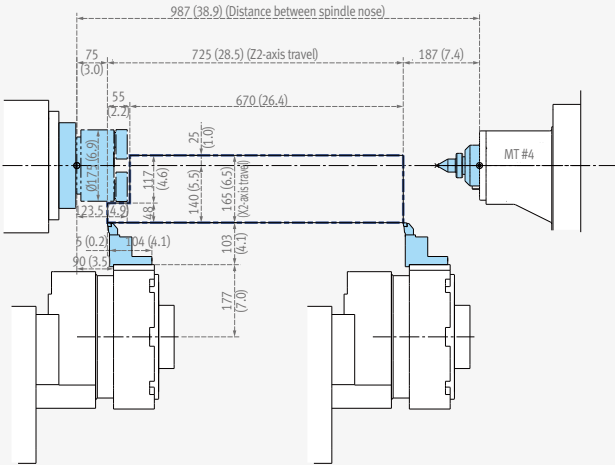


Working Range of Lower Turret (For Turning, 8 stations)

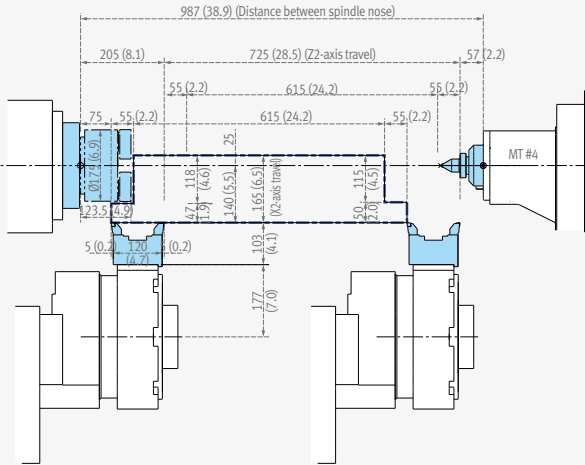
PUMA MX1600T/735

Unit : mm (inch)

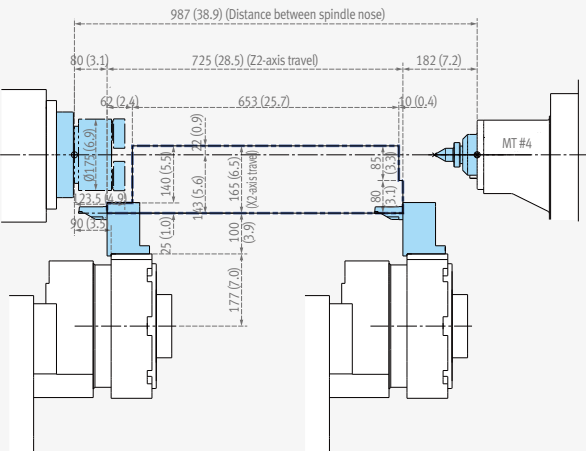
Single OD Holder



Double OD Holder



ID Holder



Basic information

Basic Structure
Cutting Performance

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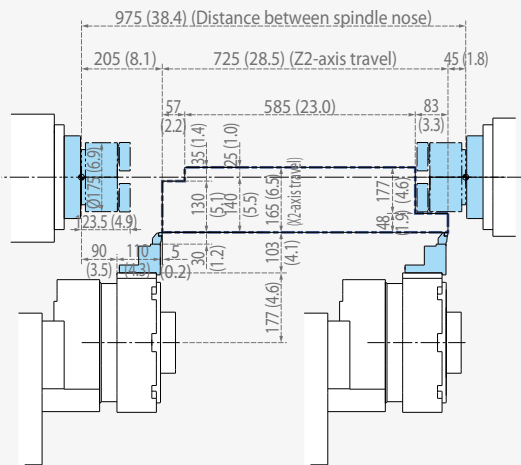
Customer Support
Service

Working Range of Lower Turret (For Turning, 8 stations)

PUMA MX1600ST_{/735}

Unit : mm (inch)

Single OD holder

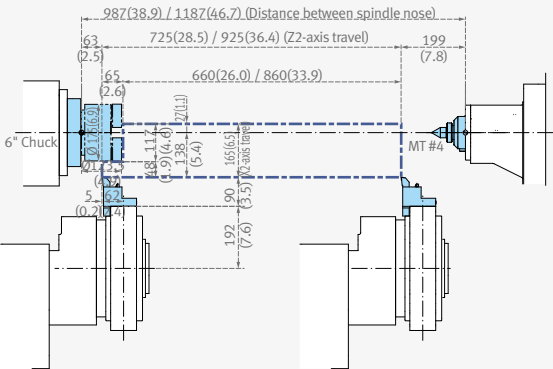


Working Range of Lower Turret (For Turn-Milling, 16 stations, BMT45P)

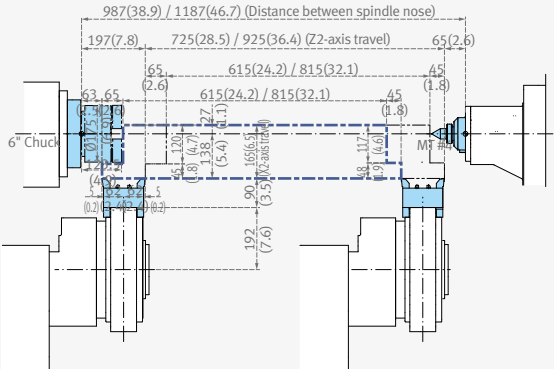
PUMA MX1600T₇₃₅ / 1600T

Unit : mm (inch)

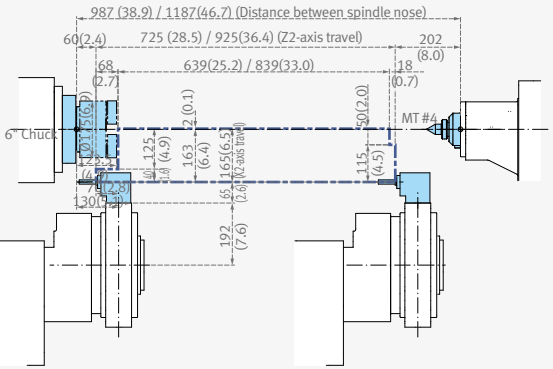
Single OD Tool holder



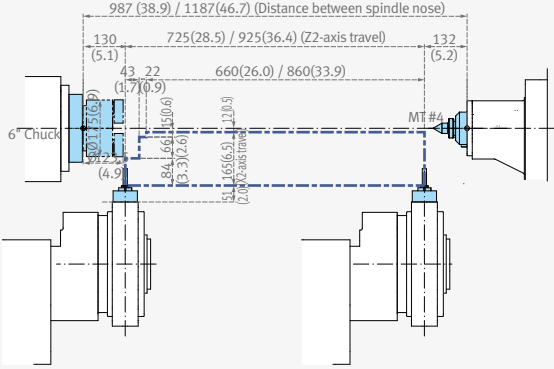
Double OD Tool holder



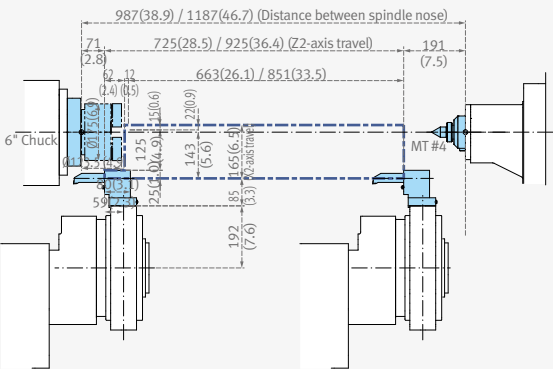
Angular milling tool holder



Straight milling tool holder



ID Tool holder



Working Range of Lower Turret (For Turn-Milling, 16 stations, BMT45P)

Basic information

- Basic Structure
- Cutting Performance

Detailed Information

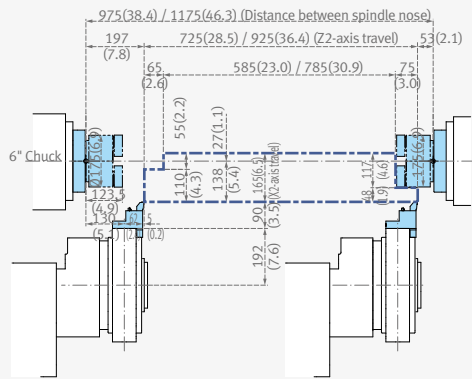
- Options
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Customer Support Service

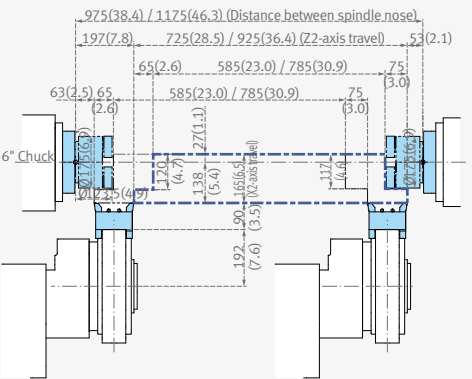
PUMA MX1600ST_{/735} / 1600ST

Unit : mm (inch)

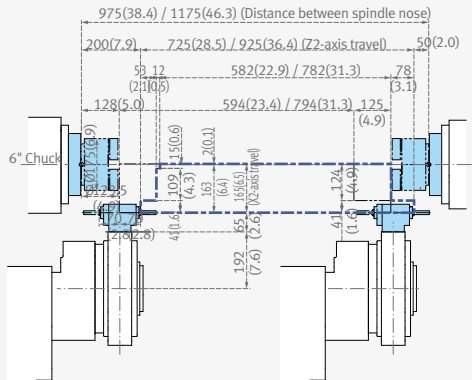
Single OD Tool holder



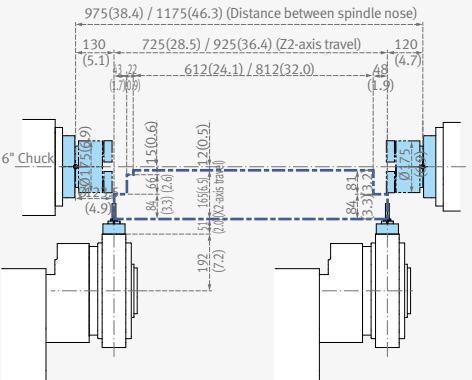
Double OD Tool holder



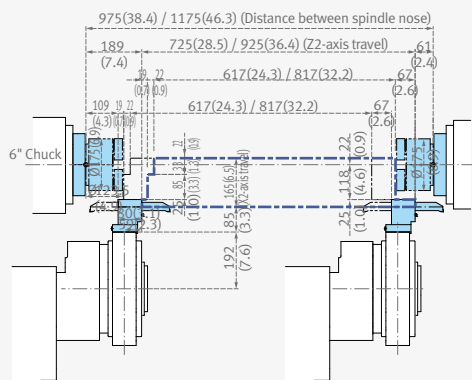
Angular milling tool holder



Straight milling tool holder



ID Tool holder

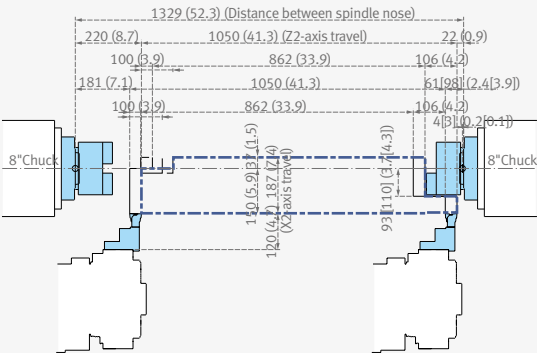


Working Range of Lower Turret (For Turn-Milling, 12 stations, BMT55P)

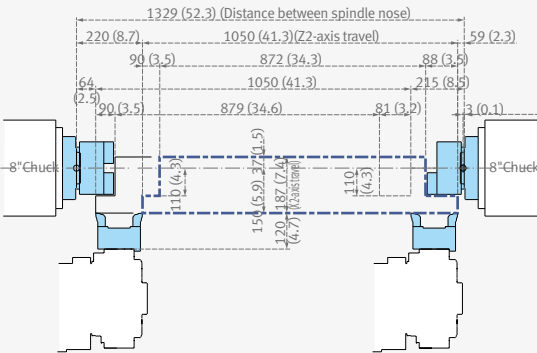
PUMA MX2100ST

Unit : mm (inch)

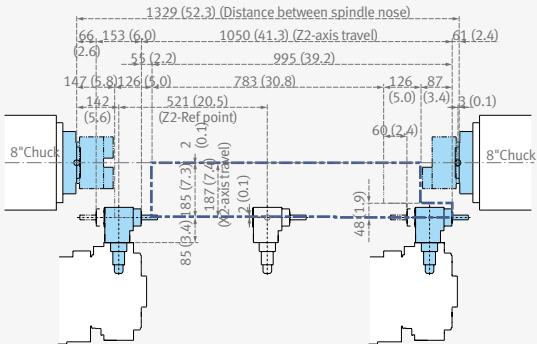
Single OD Tool holder



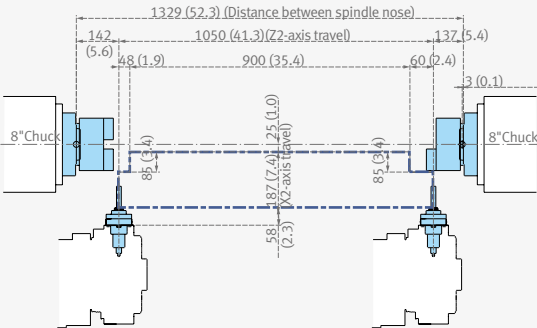
Double OD Tool holder



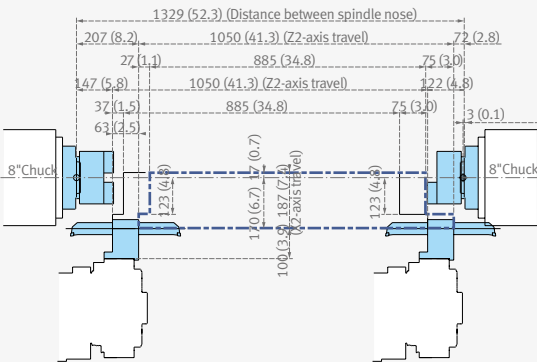
Angular milling tool holder



Straight milling tool holder



ID Tool holder



Working Range of Lower Turret (For Turn-Milling, 12 stations, BMT55P)

Basic information

- Basic Structure
- Cutting Performance

Detailed Information

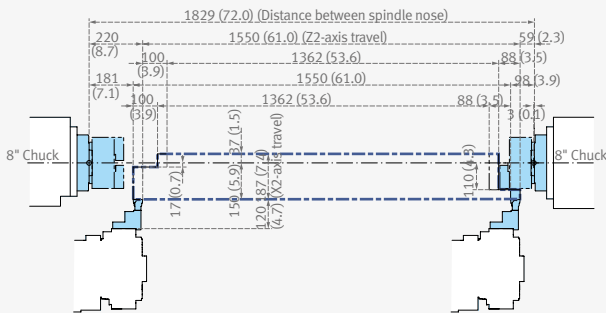
- Options
- Application
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- Specifications

Customer Support Service

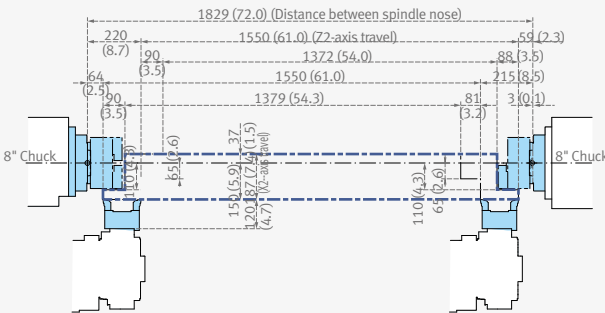
PUMA MX2100LST

Unit : mm (inch)

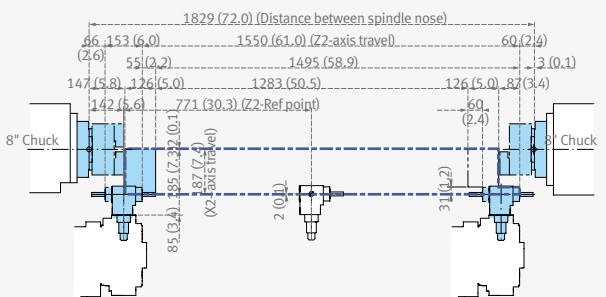
Single OD Tool holder



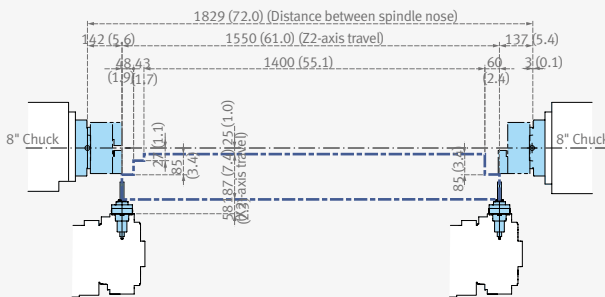
Double OD Tool holder



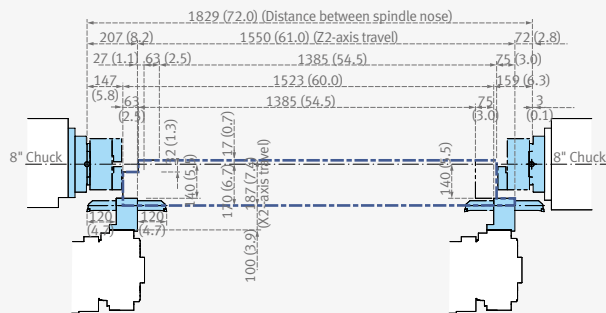
Angular milling tool holder



Straight milling tool holder

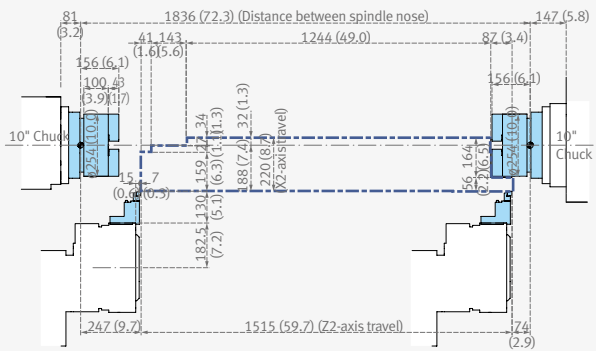


ID Tool holder



MX 2600ST

Single OD Tool holder

[illegible]

Machine Specifications

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Customer Support
Service



Description			Unit	PUMA MX1600 ^{/735} / 1600	PUMA MX1600S ^{/735} / 1600S	PUMA MX1600T ^{/735} / 1600T	PUMA MX1600ST ^{/735} / 1600ST
Capacity	Swing over bed		mm (inch)	680 (26.8)			
	Recom. Turning diameter		mm (inch)	170 (6.7)			
	Max. Machining diameter		mm (inch)	330 (13.0)			
	Max. Turning length		mm (inch)	700 / 900 (27.6 / 35.4)			
	Chuck size		inch	6			
	Bar working diameter		mm (inch)	51 (2.0)			
Travels	Travel distance	X1-axis	mm (inch)	450 (17.7)			
		Z1-axis	mm (inch)	735 / 935 (28.9/ 36.8)			
		Y-axis	mm (inch)	170 (±85) (6.7 (±3.3))			
		X2-axis	mm (inch)	-	-	165 (6.5)	
		Z2-axis	mm (inch)	-	-	725 / 925 (28.5 / 36.4)	
		A-axis	mm (inch)	-	735/935 (28.9 / 36.8)	-	735/935 (28.9 / 36.8)
Feedrate	Rapid Traverse Rate	X1-axis	m/min (ipm)	36 (1417.3)			
		Z1-axis	m/min (ipm)	36 (1417.3)			
		Y-axis	m/min (ipm)	26 (1023.6)			
		X2-axis	m/min (ipm)	-	-	24 (944.9)	
		Z2-axis	m/min (ipm)	-	-	36 (1417.3)	
		A-axis	m/min (ipm)	-	30 (1181.1)	-	30 (1181.1)
Left spindle	Max. Spindle speed		r/min	6000			
	Spindle nose		ASA	A2-5			
	Spindle bearing diameter (Front)		mm (inch)	100 (3.9)			
	Spindle through hole		mm (inch)	62 (2.4)			
	Min. spindle Indexing angle(C-axis)		deg.	0.0001			
	Right spindle	Max. Spindle speed		r/min	-	6000	-
Spindle nose		ASA	-	A2-5	-	A2-5	
Spindle bearing diameter (Front)		mm (inch)	-	100 (3.9)	-	100 (3.9)	
Spindle through hole		mm (inch)	-	62 (2.4)	-	62 (2.4)	
Min. spindle Indexing angle(C-axis)		deg.	-	0.001	-	0.001	
Milling spindle		Max. spindle speed		r/min	12000 {18000}*		
	Min. spindle Indexing angle(B-axis)		deg.	0.001			
Automatoaic Tool Changer	Tool storage capa. (Max.)		ea	40 / 40 {80}*			
	Tool changer arm			SWING ARM			
	Tool selection			FIXED ADDRESS			
	Max. tool diameter	Continous	mm (inch)	70 (2.8)			
		Without Adjacent Tools	mm (inch)	95 (3.7)			
	Max. tool length		mm (inch)	200 (7.9)			
	Max. tool weight		kg (lb)	4 (8.8)			
	Max. tool moment		N·m (ft·lbs)	3.9 (2.9)			
	Tool change time (T-T-T)		s	2.1			
Lower Turret	No. of tool stations		ea	-	-	8{16, BMT45P}* / 16, BMT45P	
	OD tool size		mm (inch)	-	-	20 x 20 (0.8 x 0.8)	
	Max. boring bar size		mm (inch)	-	-	32 (1.3)	
	Turret Indexing time(1 station swivel)		s	-	-	0.2 / 0.35	
	Max. Rotary tool speed		r/min	-	-	{6000}* / 6000	
Servo driven Tailstock	Quill diameter		mm (inch)	-	-		-
	Quill bore taper		MT	Built-in dead #4	-	Built-in dead #4	-
	Quill travel		mm (inch)	735/935 (28.9/36.8)	-	735/935 (28.9/36.8)	-
Motors	Left spindle motor power		kW (Hp)	15 / 11 (20.1 / 14.8) (S2 30min/S1 Cont.)			
	Right spindle motor power		kW (Hp)	-	15 / 11 (20.1 / 14.8)	-	15 / 11 (20.1 / 14.8)
	Milling spindle motor power		kW (Hp)	9/7.5/3.7 (12.1/10.1/4.7)			
	Coolant pump motor power		kW (Hp)	2.5(3.4)			
Power source	Electric power supply (rated capacity)		kVA	48.43	62.33	50.77	69.57
Machine Dimensions	Height		mm (inch)	2780 / 2760 (109.4 / 108.7)			
	Length		mm (inch)	3300 / 3800 (129.9 / 149.6)			
	Width		mm (inch)	2686 / 2530 (105.7 / 99.6)			
	Weight		kg (lb)	10800 / 11100 (23809.9 / 24470.9)	11100 / 11400 (24470.9 / 25132.3)	11000 / 11300 (24250.8 / 24911.9)	11300 / 11600 (24911.9 / 25573.2)

PUMA MX2100 series



Description			Unit	PUMA MX2100[L]	PUMA MX2100S[LS]	PUMA MX2100T[LT]	PUMA MX2100ST[LS]	PUMA MX2600T	PUMA MX2600ST
Capacity	Swing over bed		mm (inch)	750 (29.5)				1000 (39.4)	
	Recom. Turning diameter		mm (inch)	210 (8.3)				255 (10.0)	
	Max. Machining diameter		mm (inch)	540 (21.3)				760 (29.9)	
	Max. Turning length		mm (inch)	1020 [1520] (40.2 [59.8])				1540 (60.6)	
	Chuck size		inch	8				10	
	Bar working diameter		mm (inch)	65 (2.6)				76(3.0)	
Travels	Travel distance	X1-axis	mm (inch)	565 (22.2)				630 (24.8)	
		Z1-axis	mm (inch)	1050 [1550] (41.3 [61.0])				1585 (62.4)	
		Y-axis	mm (inch)	170 (±85) (6.7 (±3.3))				230(±115) (9.1(±4.5))	
		X2-axis	mm (inch)	-	-	187 (7.4)		220 (8.7)	
		Z2-axis	mm (inch)	-	-	1050 [1550] (41.3 [61.0])		1515 (59.6)	
		A-axis	mm (inch)	-	1050 [1550] (41.3 [61.0])	-	1050 [1550] (41.3 [61.0])	-	1550 (61.0)
Feedrate	Rapid Traverse Rate	X1-axis	m/min (ipm)	36 (1417.3)					
		Z1-axis	m/min (ipm)	36 (1417.3)					
		Y-axis	m/min (ipm)	26 (1023.6)					
		X2-axis	m/min (ipm)	-	-	24 (944.9)			
		Z2-axis	m/min (ipm)	-	-	36 (1417.3)			
		A-axis	m/min (ipm)	-	30 (1181.1)	-	30 (1181.1)	-	30 (1181.1)
Left spindle	Max. Spindle speed		r/min	5000				4000	
	Spindle nose		ASA	A2-6				A2-8	
	Spindle bearing diameter (Front)		mm (inch)	110 (4.3)				130 (5.1)	
	Spindle through hole		mm (inch)	76 (3.0)				86 (3.4)	
	Min. spindle Indexing angle(C-axis)		deg.	0.001					
Right spindle	Max. Spindle speed		r/min	-	5000	-	5000	-	4000
	Spindle nose		ASA	-	A2-6	-	A2-6	-	A2-8
	Spindle bearing diameter (Front)		mm (inch)	-	110 (4.3)	-	110 (4.3)	-	130 (5.1)
	Spindle through hole		mm (inch)	-	76 (3.0)	-	76 (3.0)	-	86 (3.4)
	Min. spindle Indexing angle(C-axis)		deg.	-	0.001	-	0.001	-	0.001
Milling spindle	Max. spindle speed		r/min	12000					
	Min. spindle Indexing angle(B-axis)		deg.	0.001					
Automatic Tool Changer	Tool storage capa. (Max.)		ea	40 {80}*					
	Tool changer arm			SWING ARM					
	Tool selection			FIXED ADDRESS					
	Tool shank			CAPTO C6 {HSK A63}*					
	Max. tool diameter	Continuous	mm (inch)	90 (3.5)					
		Without Adjacent Tools	mm (inch)	120 (4.7)				130 (5.1)	
	Max. tool length		mm (inch)	300 (661.4)				400 (881.8)	
	Max. tool weight		kg (lb)	9				10	
	Max. tool moment		N-m (ft-lbs)	8.2 (6.1)				9.8 (7.2)	
	Tool change time (T-T-T)		s	2.0					
Lower Turret	No. of tool stations		ea	-	-	12, BMT55P		12, BMT65P	
	OD tool size		mm (inch)	-	-	25 x 25 (1.0 x 1.0)			
	Max. boring bar size		mm (inch)	-	-	40 (1.6)			
	Turret Indexing time(1 station swivel)		s	-	-	0.2			
	Max. Rotary tool speed		r/min	-	-	5000		4000	
Servo driven Tailstock	Quill bore taper		MT	Built-in dead #4	-	Built-in dead #4	-	Built-in dead #5	-
	Quill travel		mm (inch)	1050 [1550] (41.3 [61.0])	-	1050 [1550] (41.3 [61.0])	-	1550 (61.0)	-
Motors	Left spindle motor power		kW (Hp)	22 / 18.5 (29.5 / 24.8)				26 / 22 (34.9 / 29.5)	
	Right spindle motor power		kW (Hp)	-	22 / 18.5 (29.5 / 24.8)	-	22 / 18.5 (29.5 / 24.8)	-	26 / 22 (34.9 / 29.5)
	Milling spindle motor power		kW (Hp)	18.5 / 15 / 11 (24.8 / 20.1 / 14.8) (S2 30min/S1 Cont.)				22/18.5/15 (29.5/24.8/20.1) (S2 30min/S1 Cont.)	
	Coolant pump motor power		kW (Hp)	2.5 (3.4)					
Power source	Electric power supply (rated capacity)		kVA	57.85	82.03	50	88.64 [89.36]	69.37	94.42
Machine Dimensions	Height		mm (inch)	2805 (110.4)				3011 (118.6)	
	Length		mm (inch)	4850 [5945] (190.9 [234.1])				6070 (239.0)	
	Width		mm (inch)	2525 [2490] (99.4 [98.0])				2682 (105.6)	
	Weight		kg (lb)	11500 [12800] (25352.8 [28218.8])	11800 [13800] (26014.2 [30423.3])	11700 [13700] (25793.7 [30202.9])	12000 [14000] (26455.1 [30864.3])	14900 (32848.4)	15500 (34171.1)

- The specifications and information above-mentioned may be changed without prior notice.
- For more details, please contact DN Solutions.

*{ } : Option

CNC Specifications

● Standard ○ Optional ✕ Not applicable

Basic information

Basic Structure
Cutting Performance

Detailed Information

Options
Application
Diagrams
Specifications

Customer Support
Service



Division	Item	Spec.	PUMA MX1600, 2100(L)	PUMA MX1600S, 2100(L)S	PUMA MX1600T, 2100(L)T, 2600T	PUMA MX1600ST, 2100(L)ST, 2600ST	PUMA MX1600, 2100(L)	PUMA MX1600S, 2100(L)S	PUMA MX1600T, 2100(L)T, 2600T	PUMA MX1600ST, 2100(L)ST, 2600ST
			Fanuc 31i Plus	Fanuc 31i Plus	Fanuc 31i Plus	Fanuc 31i Plus	Fanuc 31i-5 Plus	Fanuc 31i-5 Plus	Fanuc 31i-5 Plus	Fanuc 31i-5 Plus
Controlled axis	Controlled axes	Note *1) {Z2} could be supplied as Servo Steady Rest option except for T/ST type.	7 {X, Z, C, B, Y, A, {Z2}}	8 {X, Z, C1, B, Y, C2, A, {Z2}}	8 {X1, Z1, C, B, Y, X2, Z2, A}	9 {X1, Z1, C1, B, Y, X2, Z2, C2, A}	7 {X, Z, C, B, Y, A, {Z2}}	8 {X, Z, C1, B, Y, C2, A, {Z2}}	8 {X1, Z1, C, B, Y, X2, Z2, A}	9 {X1, Z1, C1, B, Y, X2, Z2, C2, A}
	Simultaneously controlled axes		4 {Upper X, Z, C, Y} + 1 {Lower {Z2}}	4 {Upper X, Z, C1, Y} + 3 {Lower {Z2}, C2, A}	4 {Upper X1, Z1, C, Y} + 3 {Lower X2, Z2, A}	4 {Upper X1, Z1, C1, Y} + 4 {Lower X2, Z2, C2, A}	5 {Upper X, Z, C, B, Y} + 1 {Lower {Z2}}	5 {Upper X, Z, C1, B, Y} + 3 {Lower {Z2}, C2, A}	5 {Upper X1, Z1, C, B, Y} + 3 {Lower X2, Z2, A}	5 {Upper X1, Z1, C1, B, Y} + 4 {Lower X2, Z2, C2, A}
Data input/output	Fast data server		○	○	○	○	○	○	○	○
	Memory card input/output		●	●	●	●	●	●	●	●
	USB memory input/output		●	●	●	●	●	●	●	●
	Larger capacity memory_2GB	not CUFOS only (15" display)	○	○	○	○	○	○	○	○
	SSD data server	CUFOS only (19" display)	○	○	○	○	○	○	○	○
Interface function	Embedded Ethernet		●	●	●	●	●	●	●	●
	Fast Ethernet		○	○	○	○	○	○	○	○
	Enhanced Embedded Ethernet function		●	●	●	●	●	●	●	●
Operation	DNC operation	Included in RS232C interface.	●	●	●	●	●	●	●	●
	DNC operation with memory card	G5.1 Q_, 600 Blocks	●	●	●	●	●	●	●	●
Feed function	AI contour control II		✕	✕	✕	✕	✕	✕	✕	✕
	AI contour control II	G5.1 Q_, 1000 Blocks	●	●	●	●	●	●	●	●
	High-speed smooth TCP		✕	✕	✕	✕	●	●	●	●
Operation Guidance Function	EZ Guide i (Conversational Programming Solution)		●	●	●	●	●	●	●	●
	iHMI with Machining Cycle		●	●	●	●	●	●	●	●
	EZ Operation package		●	●	●	●	●	●	●	●
Setting and display	CNC screen dual display function		●	●	●	●	●	●	●	●
Network	FANUC MTConnect		*	*	*	*	*	*	*	*
	FANUC OPC UA		*	*	*	*	*	*	*	*
Others	Display unit (Note *2)	15" color LCD with Touch Panel	*	*	*	*	*	*	*	*
		19" color LCD with Touch Panel	*	*	*	*	*	*	*	*
	Part program storage size & Number of registerable programs	1280M(512KB)_1000 programs	✕	✕	✕	✕	✕	✕	✕	✕
		2560M(1MB)_1000 programs	✕	✕	✕	✕	✕	✕	✕	✕
		5120M(2MB)_1000 programs	✕	✕	✕	✕	✕	✕	✕	✕
		10240M(4MB)_1000 programs	●	●	●	●	●	●	●	●
		20480M(8MB)_1000 programs	○	○	○	○	○	○	○	○
		10240M(4MB)_4000 programs	○	○	○	○	○	○	○	○
		20480M(8MB)_4000 programs	○	○	○	○	○	○	○	○

Responding to Customers

Anytime, Anywhere

DN Solutions' Global Network, Responding to Customer's Needs nearby, Anytime, Anywhere

DN Solutions provides a system-based professional support service before and after the machine tool sale by responding quickly and efficiently to customers' demands. By supplying spare parts, product training, field service and technical support, we can provide top class support to our customers around the world.



Customer Support Service

We help customers to achieve success by providing a variety of professional services from pre-sales consultancy to post-sales support.



Supplying Parts

- Supplying a wide range of original DN Solutions spare parts
- Parts repair service



Field Services

- On site service
- Machine installation and testing
- Scheduled preventive maintenance
- Machine repair



Technical Support

- Supports machining methods and technology
- Responds to technical queries
- Provides technical consultancy



Training

- Programming / machine setup and operation
- Electrical and mechanical maintenance
- Applications engineering



dn-solutions.com

Head Office

22F T Tower, 30, Sowol-ro 2-gil
Jung-gu, Seoul, Korea, 04637

Tel: +82-2-6972-0370/0350
Fax: +82-2-6972-0400

DN Solutions America

19A Chapin Road, Pine Brook
New Jersey 07058, United States

Tel: +1-973-618-2500
Fax: +1-973-618-2501

DN Solutions Europe

Emdener Strasse 24, D-41540
Dormagen, Germany

Tel: +49-2133-5067-100
Fax: +49-2133-5067-111

DN Solutions India

No.82, Jakkuar Village
Yelahanka Hobli, Bangalore-560064

Tel: + 91-80-2205-6900
E-mail: india@dncompany.com

DN Solutions China

Room 101,201,301, Building 39 Xinzhuang
Highway No.258 Songjiang District
China Shanghai (201612)

Tel: +86 21-5445-1155
Fax: +86 21-6405-1472

Sales inquiry

sales@dncompany.com

* For more details, please contact DN Solutions.

* Specifications and information contained within this catalogue may be changed without prior notice.