DOOSAN

FM *linear* series

Ultra-high-speed, High-precision Vertical Machining Center Equipped with Linear Motors

FM *linear* series

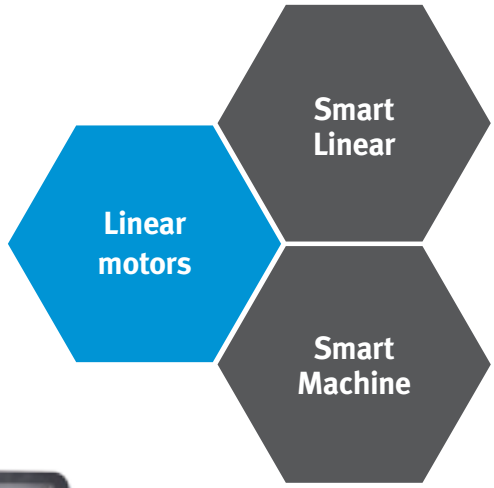
FM 200/5AX *linear*
FM 350/5AX *linear*
FM 400 *linear*

MACHINE GREATNESS™

reddot award 2015
winner

FM *linear* series

The FM Linear Series offers super-fast traveling and great reliability with its high-speed spindle and linear axes driven by linear motors, in addition to excellent stability in cutting operation due to the adoption of anti-vibration materials.



Contents

Sample work

Stable bed and structure design

Stable cutting based on anti-vibration materials and symmetrical gantry structure.

Stable cutting based on anti-vibration materials and symmetrical gantry structure.

Outstanding productivity and cutting accuracy are delivered with 42,000 rpm spindles, linear motors, and direct- drive motors.

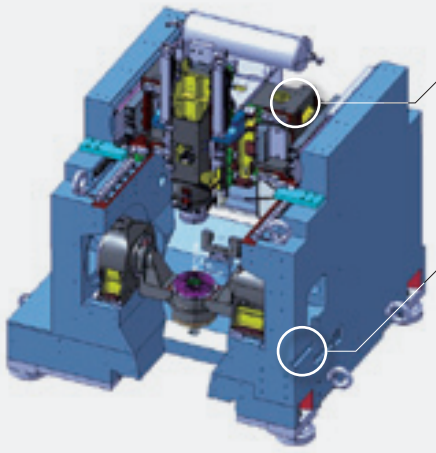
Heidenhain controller for maximum reliability

The adoption of Heidenhain controllers optimized for high-speed processing enhances machine reliability, visibility, and display applicability.

Basic Structure

Stable cutting based on symmetrical gantry structure and anti-vibration materials (mineral casting).

Structural and Material Features

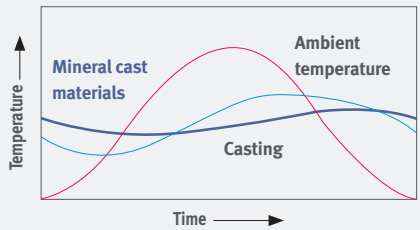


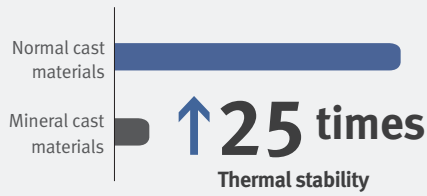
Gantry structure

Horizontally-symmetrical structure suitable for high-speed, high-precision machining
Guaranteed structural stability

Built with a mineral cast bed for stable performance

Built with a mineral cast bed for stable performance





Thermal stability 25 times greater

Axis System

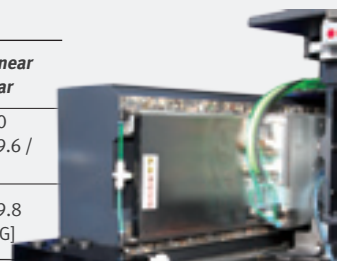
The linear axes and rotary axes deliver high speed and superior accuracy.

Linear Axes Equipped with Linear Motors

The X / Y / Z linear axes are driven by linear motors to realize high speed and accuracy, as well as superior positioning and repeatability.

Up to 2G

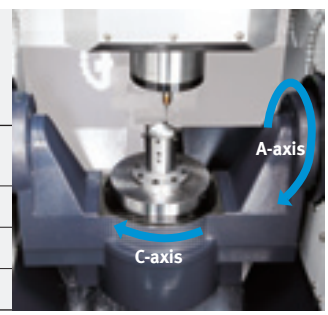
Description			FM 200/5AX *linear*	FM 350/5AX *linear* FM 400 *linear*
Rapid	X / Y / Z	m/min (ipm)	50 / 50 / 50 (1968.5 / 1968.5 / 1968.5)	80 / 80 / 80 (3149.6 / 3149.6 / 3149.6)
Acc. / Deceleration		m/sec²	14.7 / 14.7 / 14.7 [1.5G / 1.5G / 1.5G]	9.8 / 9.8 / 19.8 [1G / 1G / 2G]



Rotary Axes Equipped with Direct Drive Motors*

The rotary table is equipped with a direct drive motor for rapid rotation coupled with rapid acceleration and deceleration. Thermal error is minimized by the water cooling system.

Description		Unit	FM 200/5AX *linear*	FM 350/5AX *linear*
Rapid	A / C	r/min	100 / 200	50 / 100
Travel		deg	140 / 360	240 / 360
Load Capacity		kg (lb)	15 (33.1)	100 (220.5)



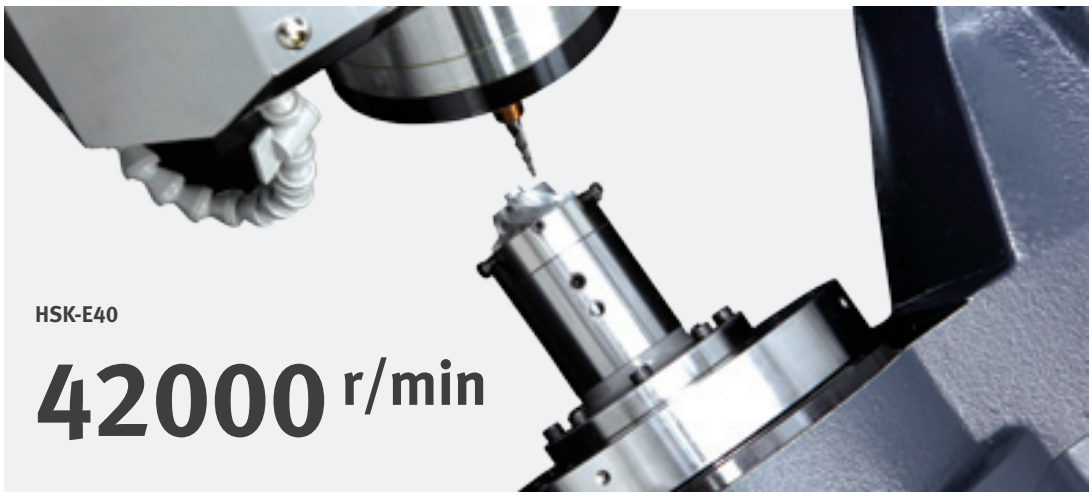
* For 5 axes only.

Spindle

The spindle provides incomparably high productivity and machining accuracy.

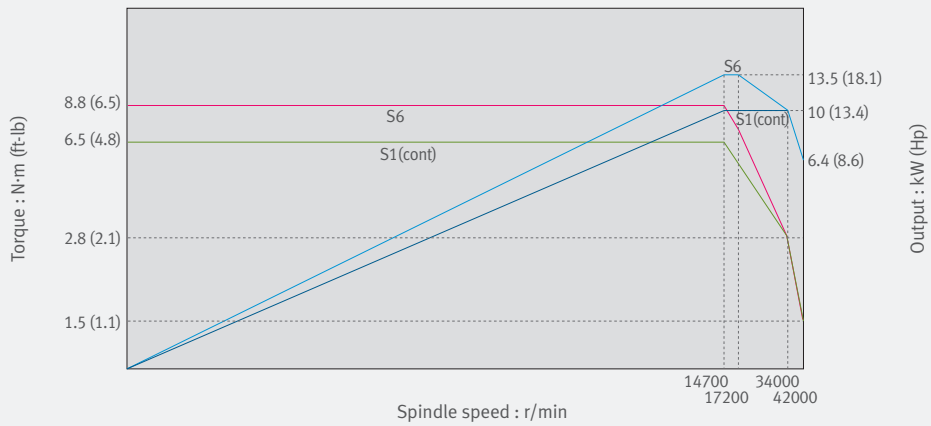
Ultra-high-speed Spindle

One of the highest-speed spindles in its class, the ultra-high-speed enhances productivity and machining accuracy.



HEIDENHAIN

Spindle Speed : 42000 r/min
Spindle Motor : 10 kW (13.4 Hp)

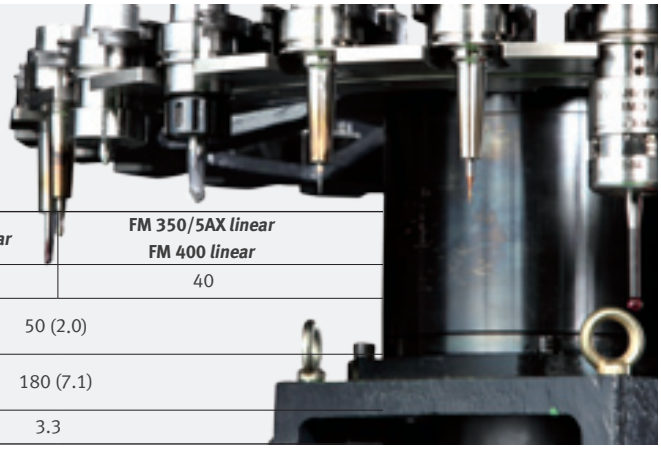


Magazine

The machine's structure has been simplified with the addition of a direct-drive motor, while the operator's convenience has been enhanced by manual magazine operation for tool storage.

* FM 200/5AX model

Tool Magazine



Description	Unit	FM 200/5AX *linear*	FM 350/5AX *linear* FM 400 *linear*
No.	ea	24	40
Max tool diameter	mm (inch)	50 (2.0)	
Max tool length	mm (inch)	180 (7.1)	
Tool change time	s	3.3	

Standard / Optional Specifications

Diverse optional features are available for customer-specific requirements.

● Standard ○ Optional X N/A

NO.	Description	Features	FM 200/5AX *linear*	FM 350/5AX *linear*	FM 400 *linear*
1	Tool magazine	24 tools	●	X	X
2		40 tools	X	●	●
3	Tool shank type	HSK-E40	●	●	●
4	Auto door lock		●	●	●
5	Rotary table	Ø200	●	X	X
6		Ø350	X	●	X
7	Linear scale	X-axis	●	●	●
8		Y-axis	●	●	●
9		Z-axis	●	●	●
10	Spindle	42000 r/min	●	●	●
11		Spindle head cooling system	●	●	●
12		Thermal error compensation system	●	●	●
13	Spindle motor power	10 kW (HEIDENHAIN)	●	●	●
14	Auto tool measuring device	NT-2_BLUM	●	●	●
15	Auto work measuring device	OMP400_RENISHAW (W/Receiver)	○	○	○
16		OMI-2C_RENISHAW (Receiver Only)	○	○	○
17	Master tool for auto tool measurement	CALIBRATION TOOL_BLUM (HSK E40)	○	○	○
18	Auto power cut-off		○	○	○
19	Coolant	FLOOD (0.7kW_0.8MPa)	●	X	X
20		FLOOD (1.5 kW_0.69MPa)	X	●	●
21		SHOWER	○	○	○
22		Coolant level switch : Sensing level - Low / High **	○	○	○
23	Chip bucket		○	○	○
24	Chip conveyor	Chip pan	●	●	●
25		Hinged type	X	○	○
26		Drum type	○	X	X
27	Table	500 x 600 mm	X	X	●
28	Test bar		○	○	○
29	AIR	AIR BLOWER	●	●	●
30	MPG	Portable MPG	●	●	●
31	MQL		○	○	○
32	NC system	HEIDENHAIN iTNC530	●	●	●
33	OIL SKIMMER	BELT TYPE	○	X	X
34		TUBE TYPE	X	○	○

* Please contact Doosan to select detail specifications. ** Special Quotation.

Standard / Optional Specifications

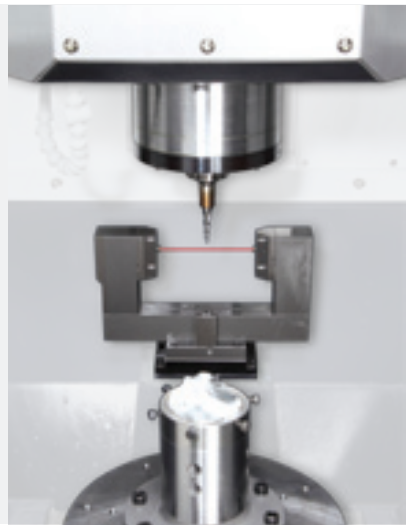
Diverse options for enhanced work efficiency and operator convenience.

Convenient operation panel

The ergonomically–designed Heidenhain operation panel and 19-inch large screen enhance the operator's convenience

Tool length measurement device

The standard tool length laser measuring device secures the highest degree of accuracy even at super-high- speed operation. (The touch probe is optional.)



Roller LMG

The roller-type LM Guideway has been adopted to ensure excellent rigidity and accuracy of the linear travel axes.

Linear scale (standard for all axes)

All axes are equipped with the linear scale as a standard feature to maintain the highest degree of accuracy over many hours of operation.

Gantry loader option

Information on detailed specifications required prior to ordering.

OMP 400 option

FM 200/5AX implementation

Recommendations for Machine Operation

Unlike ball-screw-type machines, a water chiller is used to cool down the linear motors and direct-drive motors. As such, the machine is sensitive to the control temperature of the chiller. Since the water chiller is controlled according to the ambient temperature, machine accuracy can be maintained and guaranteed in a constant temperature environment.

- Recommended operating conditions: Ambient temperature: 20±1.5°C, Temperature change: 0.4 °C/hr or less, ±1.5°C/24hr, Relative humidity: 20~80%

HEIDENHAIN TNC640

Superior Hardware Specifications

19" LCD and capacious 21GB memory

19" LCD

Description	HEIDENHAIN 640	Remarks
Screen size	19" Std	-
Storage memory	21GB Std.	-
Interference prevention system	Std.	-
Kinematic OPT.	Std.	Measuring device not included
Look-ahead block	5000 blocks	-
3D line graphics	Std.	-

Convenient Features

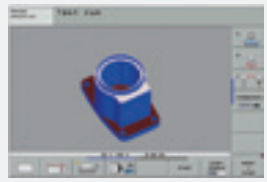
Data are controlled in the folder structure; convenient communication enabled by USB devices.

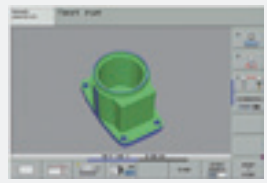
Various built-in pattern cycles for a wider scope of application.

Tool length, diameter and work pieces are measured using stored tool measurement graphic cycles.

Graphic simulation

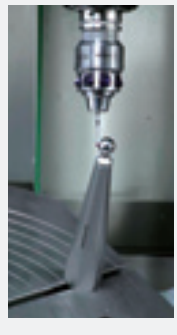
Before starting the actual cutting process, graphic process simulation of the NC program can be carried out using TEST RUN. The cutting time can be estimated.





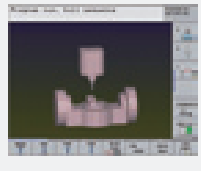
Kinematic Opt (rotary axes center correction)

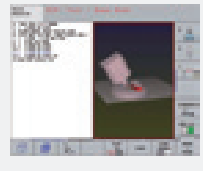
The interactively (graphically) supported fixed cycle enables easy measurement of the centers of the rotary axes.



Collision Protection System option

The motion of the machine can be simulated on a 3D basis to substantially prevent mechanical interference.
(Tool length is also recognized.)



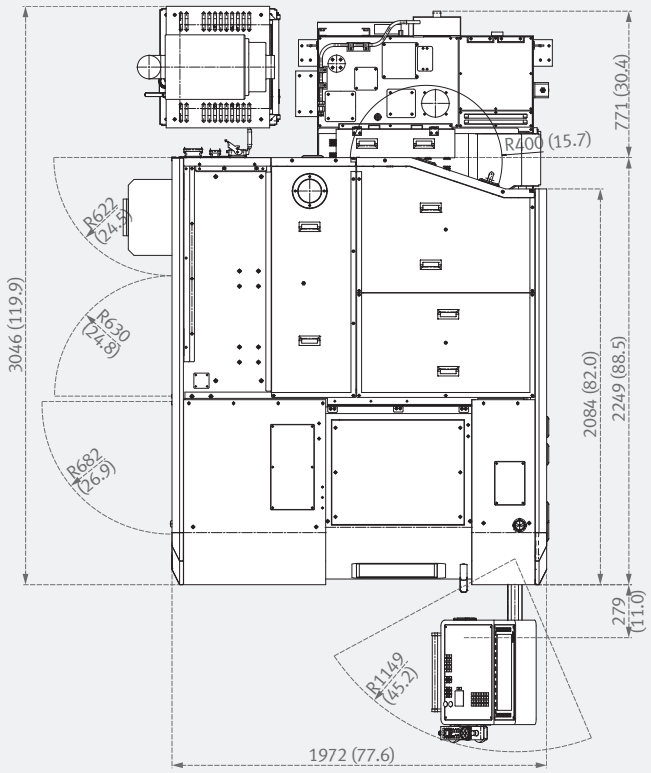


External Dimensions

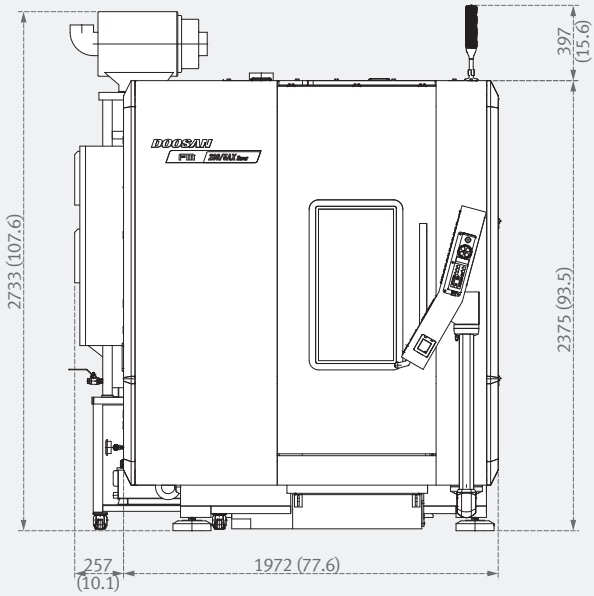
FM 200/5AX *linear*

Unit: mm (inch)

Top View



Front View



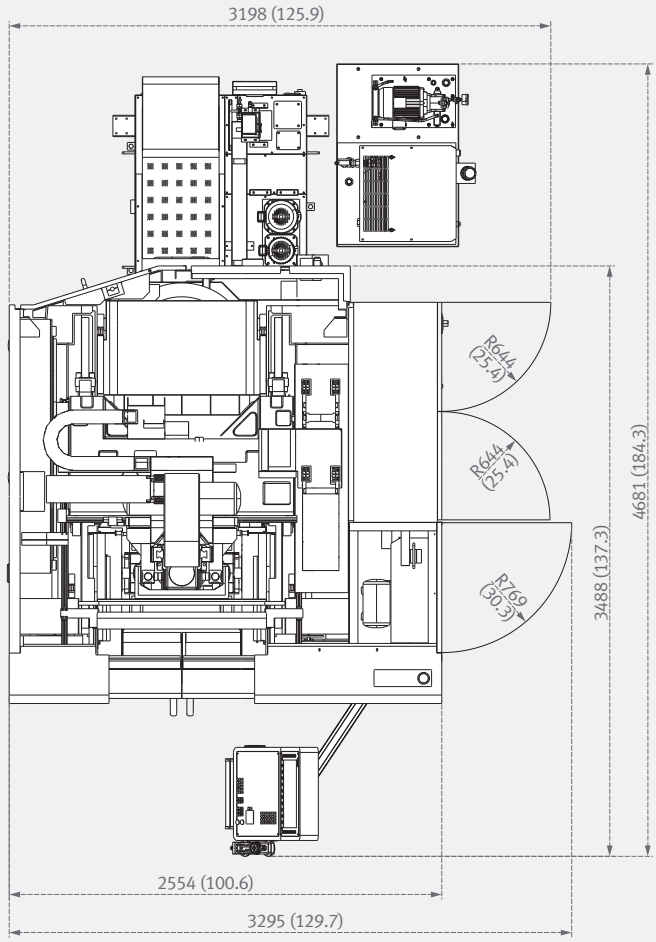
* Some peripheral equipment can be placed in other places

External Dimensions

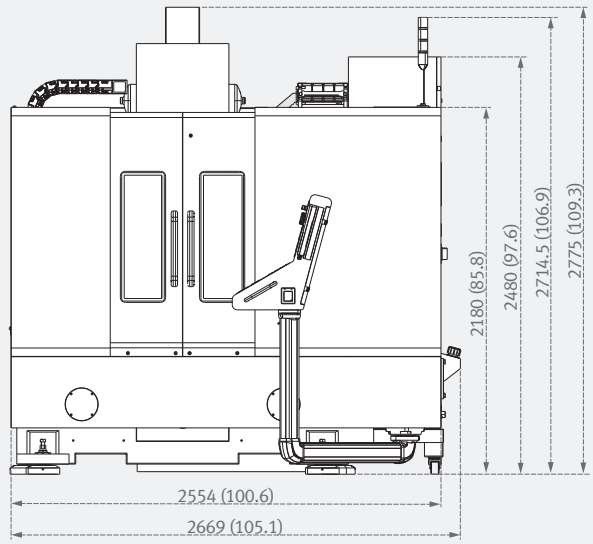
FM 400 *linear*
FM 350/5AX *linear*

Unit: mm (inch)

Top View



Front View

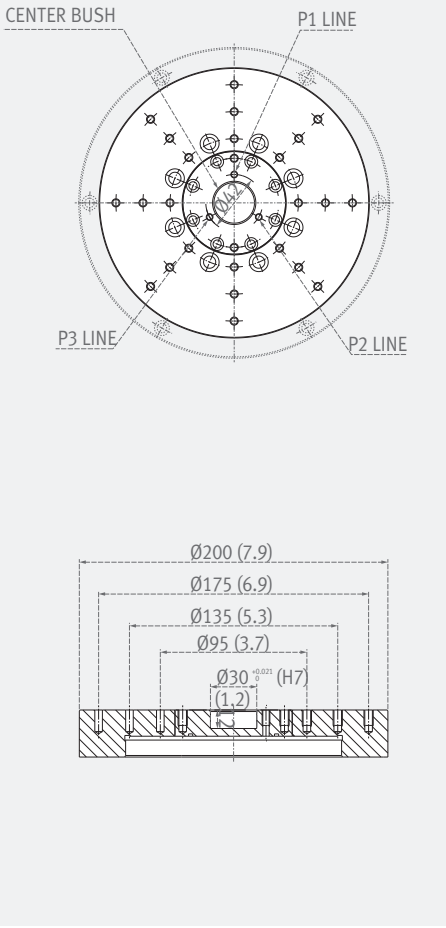


* Some peripheral equipment can be placed in other places

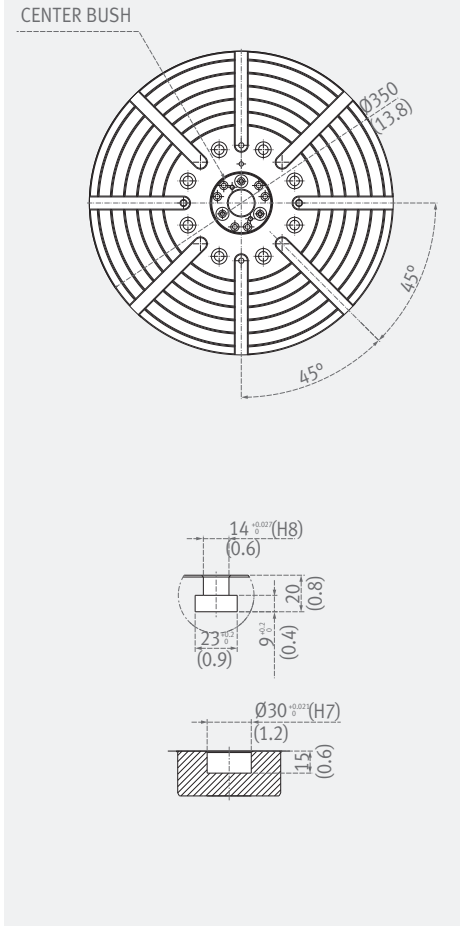
Table

Unit: mm (inch)

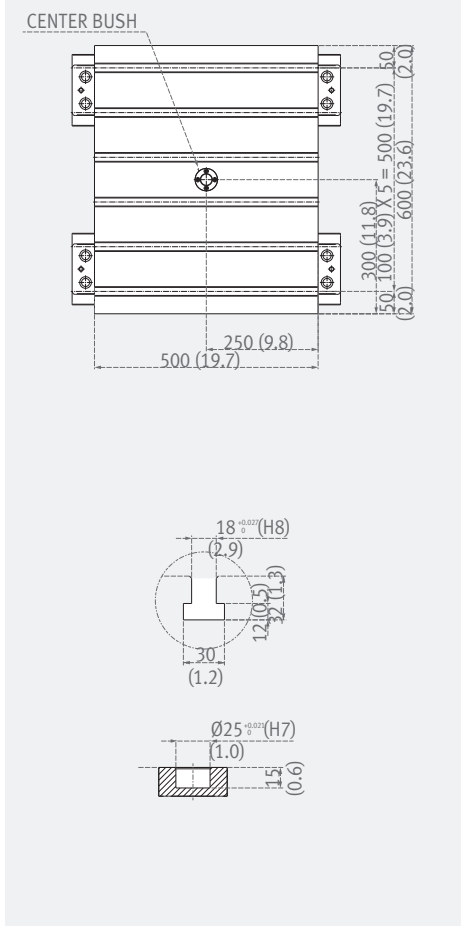
FM 200/5AX *linear*



FM 350/5AX *linear*



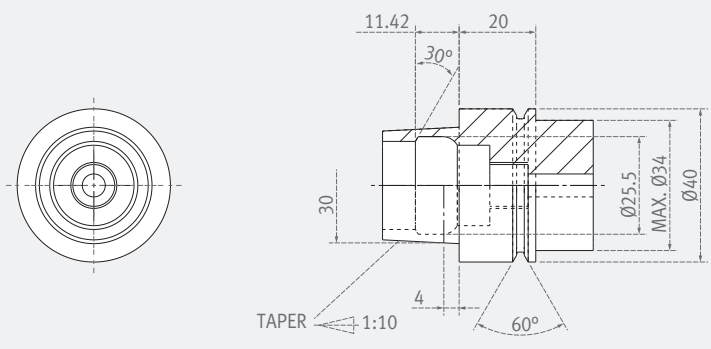
FM 400 *linear*



Tool Shank

Unit: mm (inch)

HSK E40



Machine Specifications

Description			Unit	FM 200/5AX *linear*	FM 350/5AX *linear*	FM 400 *linear*
Travel	Travel distance	X-axis	mm (inch)	200 (7.9)	400 (15.7)	
		Y-axis	mm (inch)	340 (13.4)	600 (23.6)	
		Z-axis	mm (inch)	300 (11.8)	350 (13.8)	
		A-axis	deg	140 (-10 ~ +130)	240	-
		C-axis	deg	360		-
	Distance from spindle center to table top		mm (inch)	110~410 (4.3~16.1)	50~400 (2.0~15.7)	150~500 (5.9~19.7)
	Distance from spindle center to column		mm (inch)	230 (9.1)	300 (11.8)	
Feed rate	Rapid traverse rate	X-axis	m/min (ipm)	50 (1968.5)	80 (3149.6)	
		Y-axis	m/min (ipm)	50 (1968.5)	80 (3149.6)	
		Z-axis	m/min (ipm)	50 (1968.5)	80 (3149.6)	
		A-axis	r/min	100	50	-
		C-axis	r/min	200	100	-
	Cutting feed rate		m/min (ipm)	20 (787.4)	30 (1181.1)	30 (1181.1)
Table	Table size		mm (inch)	ø 200 (ø 7.9)	ø 350 (ø 13.8)	500 x 600 (19.7 x 23.6)
	Loading capacity		kg (lb)	15 (33.1)	100 (220.5)	600 (1322.8)
Spindle	Max. spindle speed		r/min	42000		
	Spindle taper		-	HSK E40		
	Max. spindle torque		N·m (ft-lb)	6.5 (4.8)		
Automatic tool changer	Tool shank type		-	HSK E40		
	Tool storage capacity		ea	24	40	
	Max tool diameter		mm (inch)	50 (2.0)		
	Max. tool length		mm (inch)	180 (2.9)		
	Max. tool weight		kg (lb)	1 (2.2)		
	Tool selection		-	FIXED		
	Tool change time (tool to tool)		s	3.3		
	Tool change time (chip to chip)		s	4.1		
Motor	Spindle motor power		kW (Hp)	10 (13.4)		
	Coolant pump motor power		kW (Hp)	0.7 (0.9)	1.5 (2.0)	
Power Source	Power consumption		kVA	66.4	88.3	63.5
	Compressed air pressure		MPa (psi)	0.54 (78.3)		
Tank Capacity	Coolant tank capacity		L	310	300	
	Lubricant tank capacity		L	5		
Tank Capacity	Height		mm (inch)	2375 (93.5)	2775 (109.3)	
	Length		mm (inch)	2249 (88.5)	2585 (101.8)	
	Width		mm (inch)	1972 (77.6)	2669 (105.1)	
	Weight		kg (lb)	6800 (14991.2)	12000 (26455.1)	
Controller			-	HEIDENHAIN TNC 640		

Recommended operating conditions: Ambient temperature: 20 ± 1.5°C
Temperature change: ‹ 0.4°C/h ‹ ±1.5°C/24h
Relative humidity: 20~80%

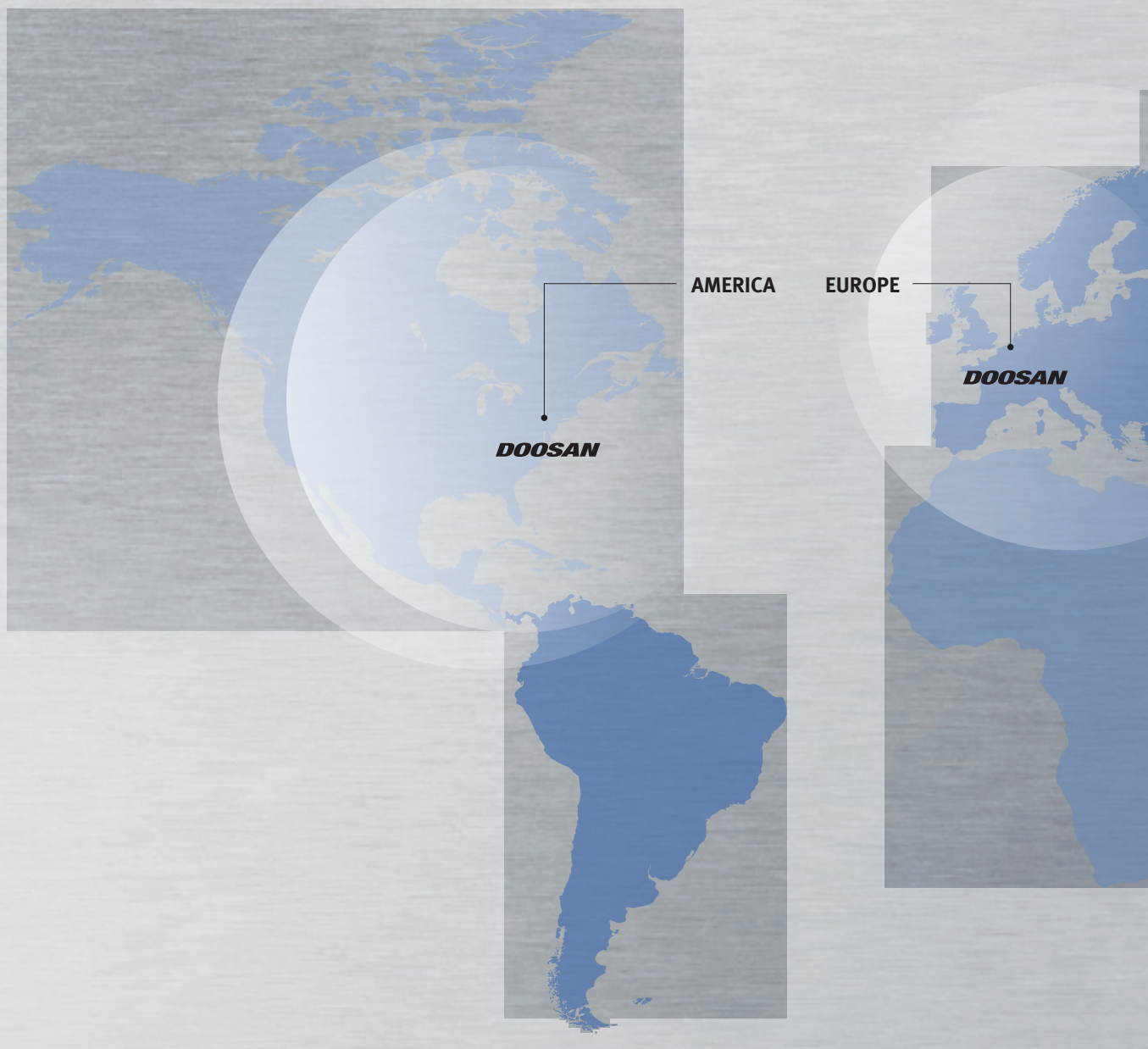
NC Unit Specifications

HEIDENHAIN

● Standard ○ Optional X N/A

No.	Item		Spec.	TNC 640
1	Controlled axis	Controlled axes	3 axes	X
2			4 axes	X
3			5 axes	X,Y,Z,C,A
4		Additional controlled axes	6 axes	X
5		Simultaneously controlled axes	Controlled axes	●
6		Controlled axes	Max. 18 axes in total	OPT(Max. 18 axes)
7		Least command increment	0.0001 mm (0.0001 inch), 0.0001°	●
8		Least input increment	0.0001 mm (0.0001 inch), 0.0001°	●
9		Maximum commandable value	±99999.999mm (±3937 inch)	●
10		Axis feedback control	Double-speed control loops for high-frequency spindles and torque/linear motors	○
11		MDI / DISPLAY unit	19 inch TFT color flat panel	●
12		Program memory for NC programs	SSDR	21GB
13		Block processing time		0.5 ms
14		Cycle time for path interpolation	CC 61xx	3 ms
15		Encoders	Absolute encoders	EnDat 2.2
16	Interpolation	Straight line		5 AXES
17		Circle		3 axes
18		Helix, Combination of circular and linear motion		●
19		Spline interpolation		●
20	Configuration	Machine parameters	Numerical structure	X
21			Tree structure with symbolic names of the parameters	●
22			Tabular representation	X
23	Commissioning and diagnostics	Integrated oscilloscope		●
24		OnLine monitor (OLM)		●
25		BUS diagnostics		●
26		DriveDiag		●
27		ApiData function		●
28		Trace function		●
29		Table function		●
30		Logic diagram		●
31		I/O-Force List		●
32		Log		●
33		Machine operating panel	TE 735	●
34			TE 745	○
35		Electronic handwheels	HR 410	●
36		Data interfaces	Ethernet interface	●
37			USB interface (USB 2.0)	●
38	Machine functions	Feedrate override	0 - 150 % (10% unit)	●
39		Spindle orientation		●
40		Spindle speed command	S5 digits	●
41		Spindle speed override	0 - 150 %	●
42		Monitoring functions	Position monitoring	●
43			Movement monitoring	●
44			Standstill monitoring	●
45			Positioning window	●
46			Temperature monitoring	●
47			Amplitude of encoder signals	●
48			Edge separation of encoder signals	●
49			Nominal speed value	●
50			Buffer battery	●
51			Run-time of PLC program	●
52			Emergency-stop monitoring	●
53			Internal power supply and housing fan	●
54		Gantry axes and master-slave torque control		●
55		Look-ahead (Intelligent path control by calculating the path speed ahead of time)	Max. 1024 blocks.	X
56			Max. 5000 blocks.	●
57		ADP (Advanced Dynamic Prediction)		●
58		HSC filters		●
59		Switching the traverse ranges		●
60		C-axis operation	Spindle motor drives the rotary axis	●
61	User functions	Program input	According to ISO	●
62			With smarT.NC	X
63			With smartSelect	●
64		Position entry	Nominal positions for lines and arcs in Cartesian coordinates	●
65			Incremental or absolute dimensions	●
66			Display and entry in mm or inches	●

Responding to Customers Anytime, Anywhere



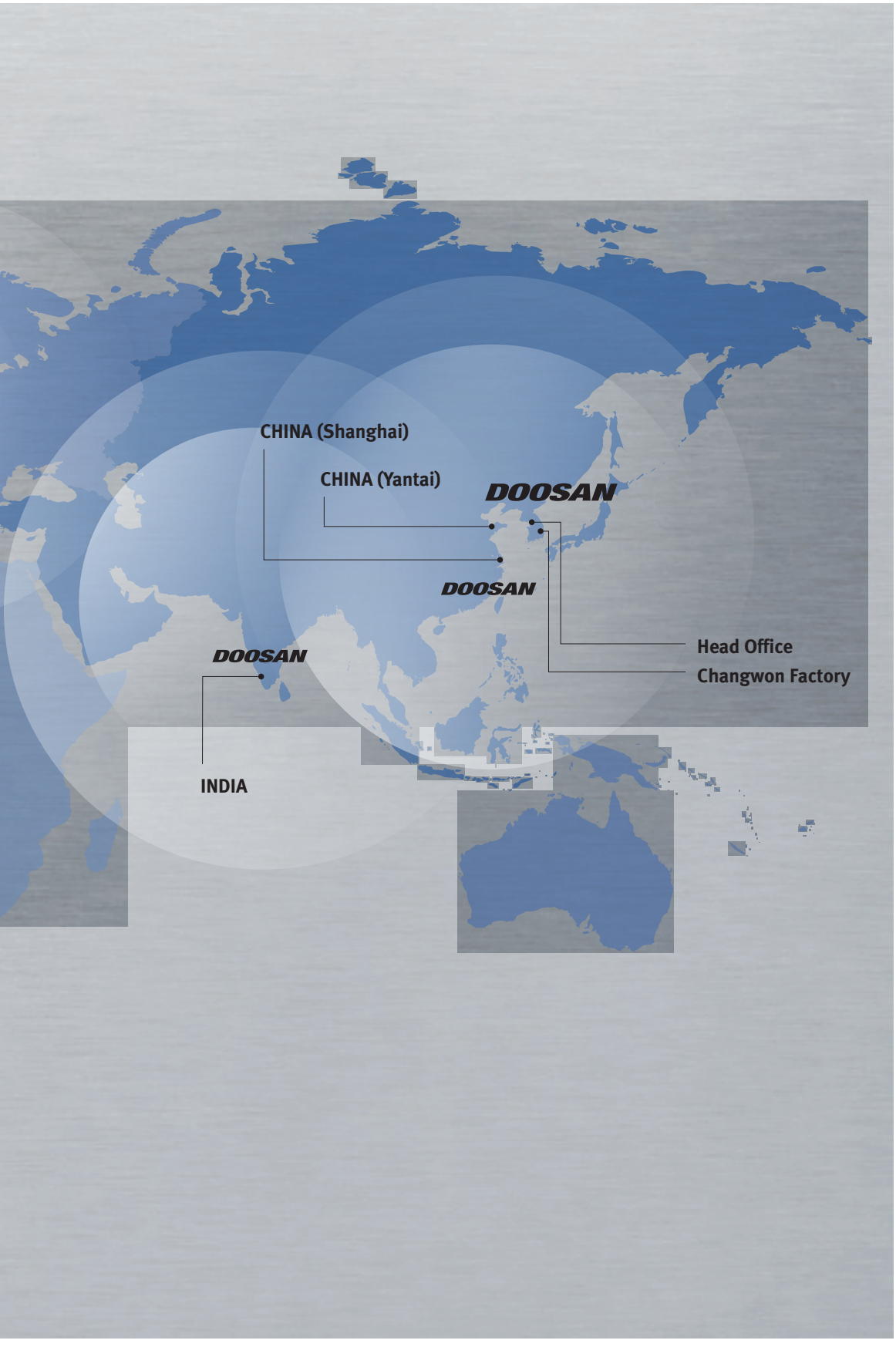
Global Sales and Service Support Network

Corporations	Dealer Networks	Technical Centers	Service Post	Factories
4	164	51	198	3

Technical Center: Sales Support, Service Support, Parts Support

Doosan Machine Tools' Global Network, Responding to Customer's Needs nearby, Anytime, Anywhere

Doosan machine tools 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 Doosan 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

Major Specifications

FM *linear* series

Description	UNIT	FM 200/5AX *linear*	FM 350/5AX *linear*	FM 400 *linear*
Max. spindle speed	r/min	42000		
Motor power	kW (Hp)	10 (13.4)		
Tool taper	taper	HSK E 40		
Travel distance (X / Y / Z)	mm (inch)	200 / 340 / 300 (7.9 / 13.4 / 11.8)	400 / 600 / 350 (15.7 / 23.6 / 13.8)	
Tool storage capacity	ea	24	40	
Table size	mm (inch)	Ø 200 (Ø 7.9)	Ø 350 (Ø 13.8)	500 x 600 (19.7 x 23.6)
Table tilting / rotation angle (A / C)	deg	140 / 360	240 / 360	-

Doosan Machine Tools

www.doosanmachinetools.com

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* The specifications and information above-mentioned may be changed without prior notice.
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Fire Safety Precautions | There is a high risk or fire when using non-water-soluble cutting fluids, processing flammable materials, neglecting use coolants and modifying the machine without the consent of the manufacturer. Please check the SAFETY GUIDANCE carefully before using the machine.

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