

## M-Max Series Drives for Machinery Applications

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### Product Description

Eaton's M-Max™ Series Sensorless Vector Adjustable Frequency AC Drives are the next generation of drives specifically engineered for today's machinery applications. These micro-processor-based drives have standard features that can be programmed to tailor the drive's performance to suit a wide variety of application requirements. The M-Max product line uses a 32-bit microprocessor and insulated gate bipolar transistors (IGBTs) that provide quiet motor operation, high motor efficiency, and smooth low-speed performance. The size and simplicity of the M-Max make it ideal for hassle-free installation. Models rated at 575 volts, three-phase, 50/60 Hz are available in sizes ranging from 1 to 7-1/2 hp. Models rated at 480 volts, three-phase, 50/60 Hz are available in sizes ranging from 1/2 to 25 hp. Models rated at 240 volts, single- or three-phase, 50/60 Hz are available in sizes ranging from 1/4 to 15 hp. Models rated at 115 volts, single-phase, 50/60 Hz are available in the 1/4 to 1-1/2 hp size range.

The standard drive includes a digital display, and operating and programming keys on a visually appealing, efficient application programming interface. The display provides drive monitoring, as well as adjustment and diagnostic information. The keys are used for digital adjustment and programming of the drive, as well as for operator control. Separate terminal blocks for control and power wiring are provided for customer connections.

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### Features

- Ease of use—preset application macros, startup wizard, diagnostic capabilities
- Compact, space-saving design
- Rugged and reliable—150% torque for one minute, 50C rated, conformal coated boards
- DIN rail and screw mountable
- Side-by-side installation
- Industry leading efficiency delivers energy savings to the customer
- Integrated 5% DC choke (FS4 and FS5)
- Integrated EMC filters make the unit suitable for commercial and industrial networks
- IP21 as standard, option for NEMA® 1 (FS4 and FS5)
- IP20 as standard, option for IP21 and NEMA 1 (FS1–FS3)
- Brake chopper as standard in three-phase, applications of frames 2 (FS2) and larger
- Temperature-controlled fan
- RS-485/Modbus® as standard
- PID controller as standard
- Several fieldbus options
  - PROFIBUS
  - DeviceNet
  - CANopen

## Standards and Certifications

### Product

- Complies with EN61800-3 (2004)

### EMC (At Default Settings)

- EMC Category C2, C3, and C4 (Level H): With an internal RFI filter option

### Safety<sup>①</sup>

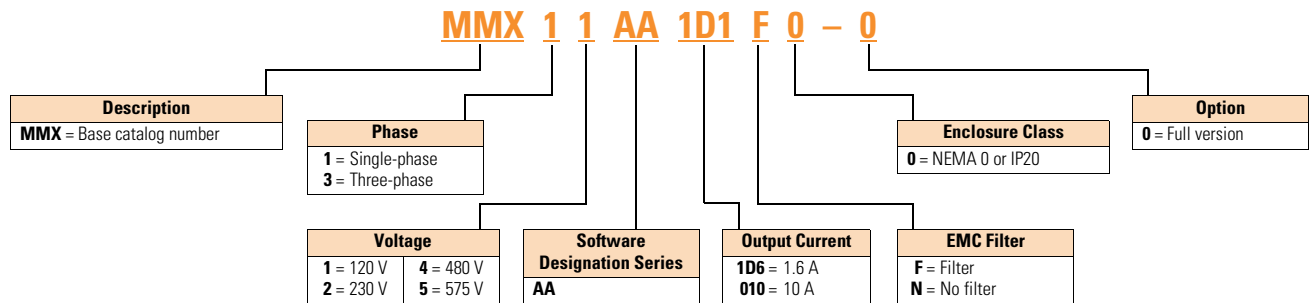
- 61800-5-1
- EN60204-1
- CE
- UL
- cUL
- IEC
- RoHS compliant



### Note

- <sup>①</sup> See unit nameplate for more detailed approvals.

## Catalog Number Selection



#### Product Selection

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M-Max

#### M-Max Basic Controller



hp <sup>①</sup>	Volts <sup>②</sup>	100% Continuous Current I <sub>n</sub> (A)	Nominal Input Current (A)	Frame Size	Catalog Number <sup>③</sup>	
1/4	100–120 V single-phase in 230 V three-phase out	1.7	9.2	FS2	MMX11AA1D7N0-0 <sup>④</sup>	
1/2		2.4	11.6		MMX11AA2D4N0-0 <sup>④</sup>	
3/4		2.8	12.4		MMX11AA2D8N0-0 <sup>④</sup>	
1		3.7	15		MMX11AA3D7N0-0 <sup>④</sup>	
1-1/2		4.8	16.5		FS3	MMX11AA4D8N0-0 <sup>④</sup>
1/4	200–240 V single-phase in 230 V three-phase out	1.7	4.2	FS1	MMX12AA1D7N0-0	
1/2		2.4	5.7		MMX12AA2D4N0-0	
3/4		2.8	6.6		MMX12AA2D8N0-0	
1		3.7	8.3		FS2	MMX12AA3D7N0-0
1-1/2		4.8	11.2		MMX12AA4D8N0-0	
2		7	14.1		MMX12AA7D0N0-0	
3		9.6	15.8	FS3	MMX12AA9D6N0-0	
1/4	200–240 V three-phase in 230 V three-phase out	1.7	2.7	FS1	MMX32AA1D7N0-0	
1/2		2.4	3.5		MMX32AA2D4N0-0	
3/4		2.8	3.8		MMX32AA2D8N0-0	
1		3.7	4.3		FS2	MMX32AA3D7N0-0
1-1/2		4.8	6.8		MMX32AA4D8N0-0	
2		7	8.4		MMX32AA7D0N0-0	
3		11	13.4	FS3	MMX32AA011N0-0	
5		17	17	FS4	MMX32AA017N0-0	
7-1/2		25	25		MMX32AA025N0-0	
10		31	31	FS5	MMX32AA031N0-0	
15		38	38		MMX32AA038N0-0	
1/2	380–480 V three-phase in 460 V three-phase out	1.3	2.2	FS1	MMX34AA1D3N0-0	
3/4		1.9	2.8		MMX34AA1D9N0-0	
1		2.4	3.2		MMX34AA2D4N0-0	
1-1/2		3.3	4		FS2	MMX34AA3D3N0-0
2		4.3	5.6		MMX34AA4D3N0-0	
3		5.6	7.3		MMX34AA5D6N0-0	
4		7.6	9.6	FS3	MMX34AA7D6N0-0	
5		9	11.5		MMX34AA9D0N0-0	
7-1/2		12	14.9		MMX34AA012N0-0	
10		14	18.7		MMX34AA014N0-0	
10		16	16	FS4	MMX34AA016N0-0	
15		23	23		MMX34AA023N0-0	
20		31	31	FS5	MMX34AA031N0-0	
25		38	38		MMX34AA038N0-0	
1	575 V three-phase in 575 V three-phase out	1.7	2.0	FS3	MMX35AA1D7N0-0 <sup>⑤</sup>	
2		2.7	3.6		MMX35AA2D7N0-0 <sup>⑤</sup>	
3		3.9	5.0		MMX35AA3D9N0-0 <sup>⑤</sup>	
5		6.1	7.6		MMX35AA6D1N0-0 <sup>⑤</sup>	
7-1/2		9.0	10.4		MMX35AA9D0N0-0 <sup>⑤</sup>	

#### Notes

- ① Horsepower ratings are based on the use of a 240 V, 460 V, and 575 V NEMA B, four- or six-pole squirrel cage induction motor and are for reference only. Units are to be selected such that the motor current is less than or equal to the MMX rated continuous output current.
- ② For 208 V, 380 V, or 415 V applications, select the unit such that the motor current is less than or equal to the MMX rated continuous output current.
- ③ For EMC filtered unit, replace “NO-0” with “FO-0”.
- ④ EMC filters are not available on MMX11 units.
- ⑤ All 575 V units come with EMC filter standard.

## Technical Data and Specifications

### Ratings

#### M-Max Basic Controller IP20 Standard Ratings

Description	Specification
<b>Protections</b>	
Overcurrent protection	Trip limit $4.0 \times I_{fl}$ instantaneously
Overvoltage protection	115/230 V series: 437 Vdc; 400 V series: 874 Vdc; 575 V series: 1048 Vdc trip level
Undervoltage protection	115/230 V series: 183 Vdc; 400 V series: 333 Vdc; 575 V series: 460 Vdc trip level
Ground fault protection	Ground fault is tested before every start. In case of ground fault in motor or motor cable, only the frequency converter is protected
Overtemperature protection	Yes
Motor overload protection	Yes
Motor stall protection	Yes
Motor underload protection	Yes
Short-circuit protection	100 kAIC with Type J fuses

#### Programmable Parameters

Description
Application macros: basic, pump, fan and high load (hoist)
Programmable start/stop and reverse signal logic (sinking or sourcing)
Reference scaling
Programmable start and stop functions
DC-brake at start and stop
Programmable V/Hz curve
Adjustable switching frequency
Autorestart function after fault
Protections and supervisions (all fully programmable; off, warning, fault)
Current signal input fault
External fault
Fieldbus communication
Eight preset speeds
Analog input range selection, signal scaling and filtering
PID controller
Skip frequencies

### Specifications

#### M-Max Series Drives

Description	Specification
<b>Input Ratings</b>	
Input voltage ( $V_{in}$ )	+10%/–15%
Input frequency ( $f_{in}$ )	50/60 Hz (variation up to 45–66 Hz)
Connection to power	Once per minute or less (typical operation)
<b>Output Ratings</b>	
Output voltage	0 to $V_{in}$ ①
Continuous output current	Continuous rated current $I_N$ at ambient temperature max. 122 °F (50 °C), overload $1.5 \times I_N$ max. 1 min/10 min
Output frequency	0 to 320 Hz
Frequency resolution	0.01 Hz
Initial output current ( $I_{fl}$ )	Current $2 \times I_N$ for 2 seconds in every 20-second period Torque depends on motor
<b>Control Characteristics</b>	
Control method	Frequency control (V/Hz) open loop or sensorless vector control
Switching frequency	1.5 to 16 kHz; default 4 kHz
Frequency reference	Analog input: resolution 0.1% (10-bit), accuracy $\pm 1\%$ V/Hz Panel reference: resolution 0.01 Hz
Field weakening point	30 to 320 Hz
Acceleration time	0 to 3000 sec
Deceleration time	0 to 3000 sec
Braking torque	DC brake: $30\% \times T_n$ (without brake option)
<b>Brake Resistor (Minimum Values) ②</b>	
230 V Series	FS2 35 ohms and FS3 26 ohms, FS4 14 ohms, FS5 9 ohms
400 V Series	FS2 75 ohms and FS3 54 ohms, FS4 28 ohms, FS5 17 ohms
575 V Series	FS3 103 ohms
<b>Ambient Conditions</b>	
Ambient operating temperature	14 °F (–10 °C), no frost to 122 °F (+50 °C): Rated loadability $I_N$
Storage temperature	–40 °F (–40 °C) to 158 °F (70 °C)
Relative humidity	0 to 95% RH, noncondensing, non-corrosive, no dripping water
Air quality	Chemical vapors: IEC 721-3-3, unit in operation, Class 3C2; Mechanical particles: IEC 721-3-3, unit in operation, Class 3S2
Altitude	100% load capacity (no derating) up to 3280 ft (1000 m); 1% derating for each 328 ft (100 m) above 3280 ft (1000 m); max. 6560 ft (2000 m)
Vibration	EN 60068-2-6; 3 to 150 Hz, displacement amplitude 1 mm (peak) at 3 to 15.8 Hz, max. acceleration amplitude 1G at 15.8 to 150 Hz
Shock	EN 50178, IEC 68-2-27 UPS Drop test (for applicable UPS weights); storage and shipping: max. 15 g, 11 ms (in package)
Enclosure class	IP20 (FS1–FS3) IP21 (FS4 and FS5)

#### Notes

- ① Exception: 115 V single-phase in, 230 V three-phase out.
- ② Only three-phase FS2 and FS3 drives are equipped with brake chopper circuit.

## Standards

### I/O Specifications

- Digital inputs DI1–DI6 are freely programmable. The user can assign multiple functions to a single input
- Digital, relay, and analog outputs are freely programmable

Includes:

- Six digital inputs
- Two analog inputs
  - 4–20 mA
  - 0–10 V
- One analog output
- One digital output
- Two relay outputs
- RS-485 interface

### Reliability

- Pretested components
- Computerized testing
- Final test with full load
- Conformal-coated boards
- Eaton's Electrical Services & Systems: national network of AF drive specialists

### M-Max I/O Interface

Terminal	Signal	Factory Preset	Description
1	+10 V	—	Ref. output voltage
2	AI1	Freq. reference <sup>P1</sup>	Analog signal in 1
3	GND	—	I/O signal ground
6	24 V	—	24 V output for DIs
7	GND	—	I/O signal ground
8	DI1	Start forward <sup>P1</sup>	Digital input 1
9	DI2	Start reverse <sup>P1</sup>	Digital input 2
10	DI3	Preset speed <sup>P1</sup>	Digital input 3
A	A	FB communication	RS-485 signal A
B	B	FB communication	RS-485 signal B
4	AI2	PI actual value <sup>P1</sup>	Analog signal in 2
5	GND	—	I/O signal ground
13	GND	—	I/O signal ground
14	DI4	Preset speed B1 <sup>P1</sup>	Digital input 4
15	DI5	Fault reset <sup>P1</sup>	Digital input 5
16	DI6	Disable PI contr. <sup>P1</sup>	Digital input 6
18	A0	Output frequency <sup>P1</sup>	Analog output
20	DO	Active = READY <sup>P1</sup>	Digital signal out
22	R011	Active = RUN <sup>P1</sup>	Relay out 1
23	R012		
24	R021	Active = FAULT <sup>P1</sup>	Relay out 2
25	R022		
26	R023		

### Note

<sup>P1</sup> Parameter-selectable function.

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## Adjustable Frequency Drives

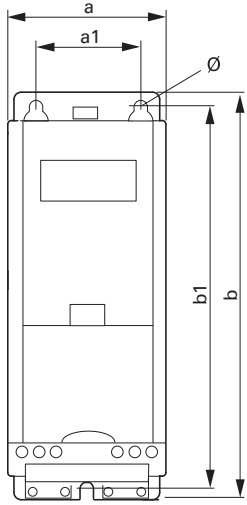
### M-Max Series Drives

#### Dimensions

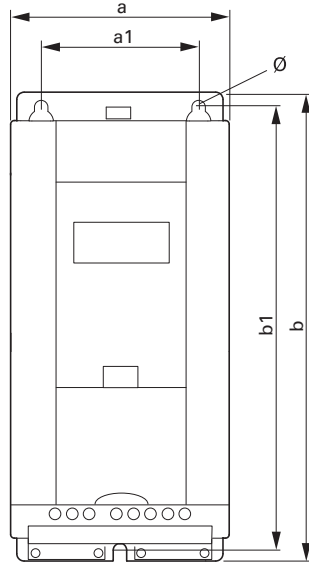
Approximate Dimensions in Inches (mm)

2

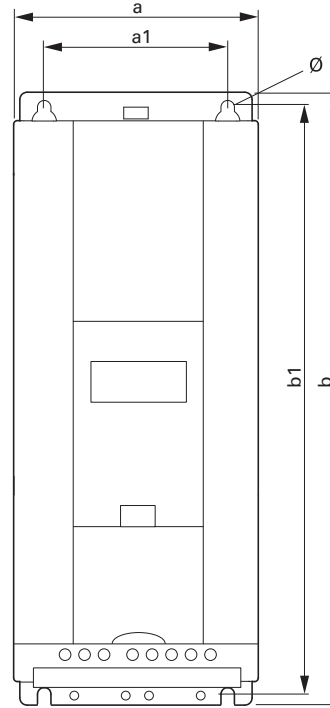
#### Dimensions and Frame Sizes, FS1–FS3 (FS = Frame Size)



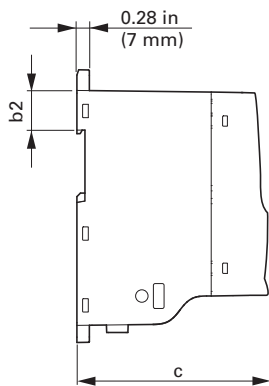
FS1



FS2

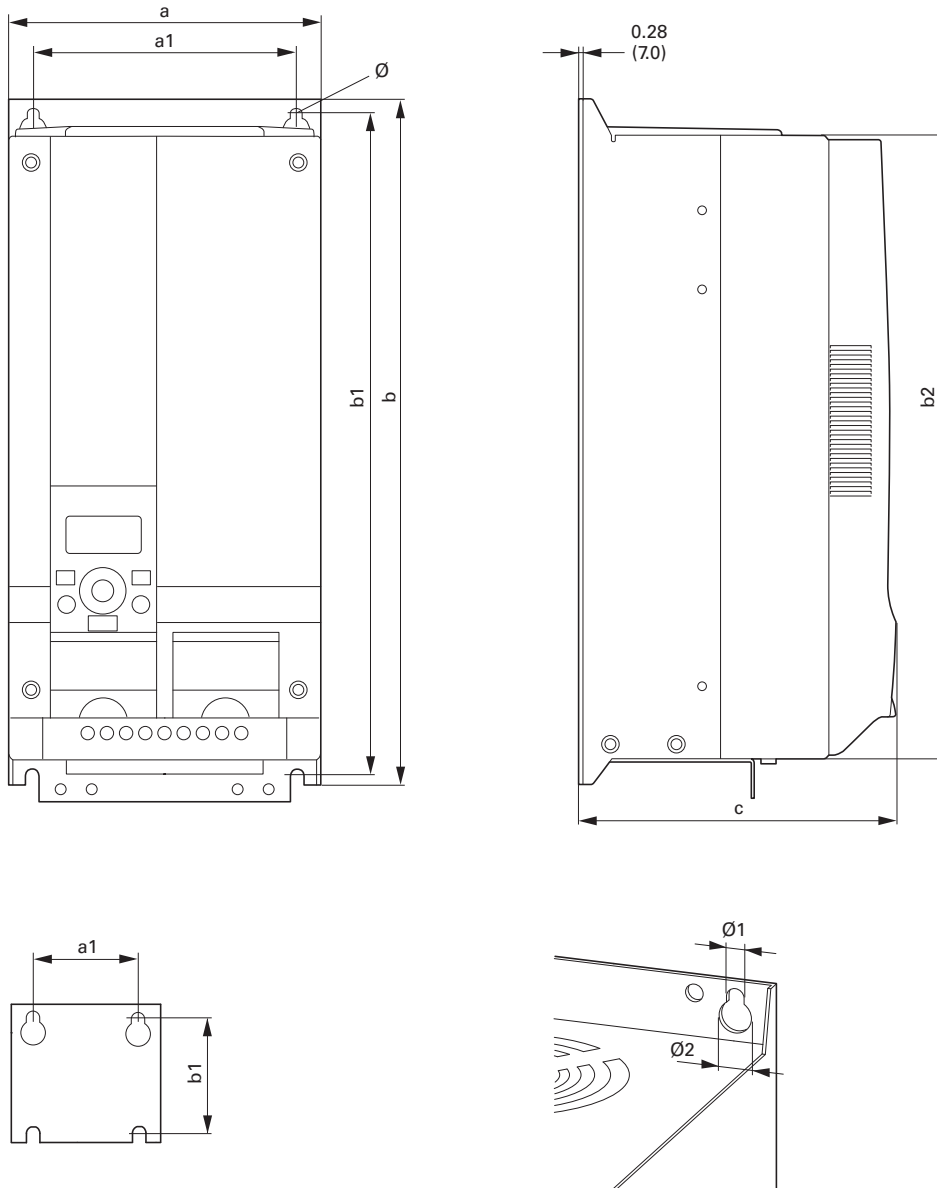


FS3



Approximate Dimensions in Inches (mm)

**Dimensions and Frame Sizes, FS4 and FS5 (FS = Frame Size)**



## Dimensions and Frame Sizes

## Approximate Dimensions in inches (mm)

Part Number	a	a1	b	b1	b2	c	Ø, Ø1	Ø2	Installation Size
MMX12AA1D7_ MMX12AA2D4_ MMX12AA2D8_	2.60 (66)	1.50 (38)	6.30 (160)	5.79 (147)	1.26 (32)	4.02 (102)	0.18 (4.5)	—	FS1
MMX32AA1D7_ MMX32AA2D4_ MMX32AA2D8_									
MMX34AA1D3_ MMX34AA1D9_ MMX34AA2D4_									
MMX11AA1D7_ MMX11AA2D4_ MMX11AA2D8_ MMX11AA3D7_	3.54 (90)	2.46 (62.5)	7.68 (195)	7.17 (182)	1.26 (32)	4.14 (105)	2.17 (5.5)	—	FS2
MMX12AA3D7_ MMX12AA4D8_ MMX12AA7D0_									
MMX32AA3D7_ MMX32AA4D8_ MMX32AA7D0_									
MMX34AA3D3_ MMX34AA4D3_ MMX34AA5D6_									
MMX11AA4D8_ MMX12AA9D6_ MMX32AA011_	3.94 (100)	2.95 (75)	9.96 (253)	9.53 (242)	1.34 (34)	4.41 (112)	2.17 (5.5)	—	FS3
MMX34AA7D6_ MMX34AA9D0_ MMX34AA012_ MMX34AA014_									
MMX35AA1D7_ MMX35AA2D7_ MMX35AA3D9_ MMX35AA6D1_ MMX35AA9D0_									
MMX32AA012_ MMX32AA017_ MMX32AA025_	6.50 (165.0)	5.51 (140.0)	14.57 (370.0)	13.82 (351.0)	13.27 (337.0)	6.61 (168.0)	0.28 (7.0)	0.55 (14.0)	FS4
MMX34AA016_ MMX34AA023_									
MMX32AA031_ MMX32AA038_	6.50 (165.0)	5.51 (140.0)	16.30 (414.0)	15.67 (398.0)	15.08 (383.0)	8.07 (205.0)	0.28 (7.0)	0.55 (14.0)	FS5
MMX34AA031_ MMX34AA038_									

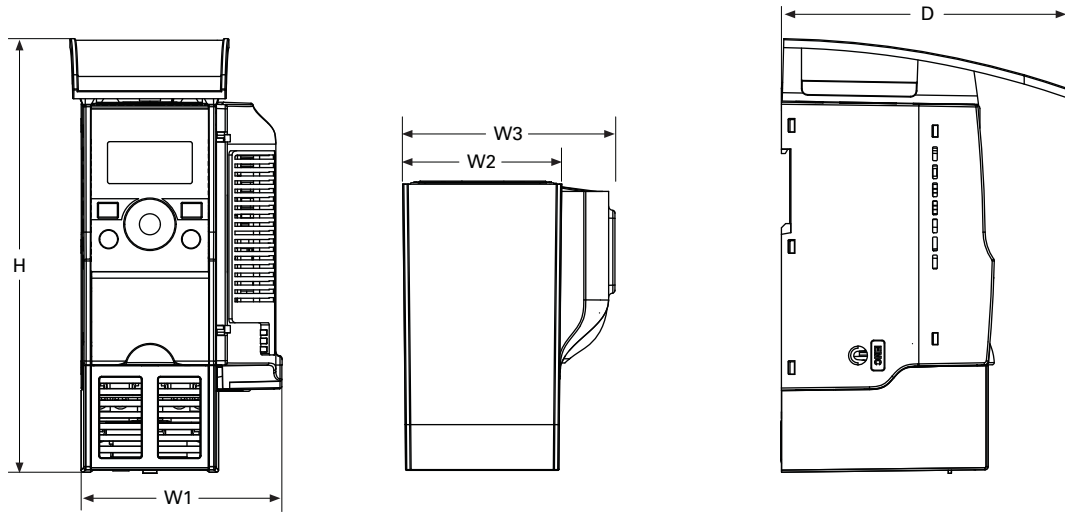
**Note**

1 in = 25.4 mm, 1 mm = 0.0394 in



Approximate Dimensions in Inches (mm)

### NEMA 1/IP21 M-Max Drives and Communication Adapter Kit



Frame Type	H	W1	W2	W3	D
FS1	8.14 (206.7)	3.77 (95.7)	2.99 (75.9)	3.98 (101.2)	5.41 (137.5)
FS2	9.90 (251.5)	4.72 (120.0)	3.97 (100.8)	4.94 (125.5)	5.68 (144.2)
FS3	12.26 (311.5)	5.12 (130.1)	4.36 (110.8)	5.33 (135.3)	6.32 (160.5)
FS4	16.40 (416.6)	—	6.50 (165.0)	—	6.61 (166.0)
FS5	18.10 (460.1)	—	6.50 (165.0)	—	8.07 (205.0)