

Including

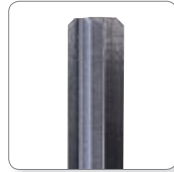


ADVANCED PRODUCT GROUP



Router Section 2018 Master Catalog

Where *high performance* is the *standard*®



Integrated Manufacturing Solutions



Product Catalog 2018

www.maford.com



Where **high performance** is the **standard**®



For more than 95 years, M.A. FORD® has been at the cutting edge of tooling design and manufacturing and has developed an enviable global reputation for performance and precision in advanced solid carbide tooling, serving over 60 countries worldwide.

Our innovative cutting geometries, materials and coating technologies are providing effective manufacturing solutions to an expanding and increasingly diverse range of industries from agriculture and construction to aerospace, power generation and automotive, to name but a few.

M.A. FORD® – Where high performance is the standard.®




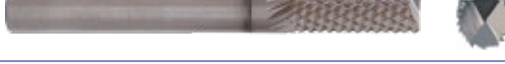
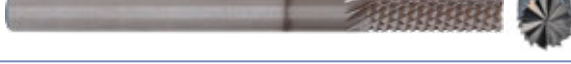



⚠ WARNING: This product can expose you to chemicals including nickel, cobalt, and lead, which are known to the State of California to cause cancer, and chemicals including lead which are known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

Series Number by Page








Routers	
Series No.	Page No.
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230CE	462
231	465
231B	465
231BCE	462
231CE	462
231D	465
231DCE	462
231F	465
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



Series	Tool Illustration	End Grind	Cut	Coating	Material Group	Page
230		Safe	Down	—		465
231		End Mill	Down	—		465
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230CE		Safe	Down	CERAedge®		462
231CE		End Mill	Down	CERAedge®		462
231BCE		Bur	Down	CERAedge®		462
231DCE		Drill	Down	CERAedge®		462
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Icon Glossary

Drill Icons




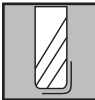



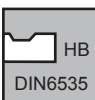



	Solid Carbide		Helix Angle 12°
	Coolant Fed		Coatings ALtima®
	Drill Length 3X		DIN Specs >3mm DIN 6537L
	Drill Point Angle 135°		

Workpiece Material Group




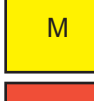


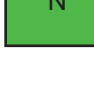
		Steels
		Hardened Steels (35-65Rc)
		Stainless Steels
		Cast Iron
		Special Alloys
		Non-Ferrous

HP Drill Selection Chart See Page 133.
Drill Terminology See Page 170.

End Mill Icons

	Number of Flutes Z3		Neck Relief N
	Center Cutting		Corner Radius
	Lengths		Shank
	Coatings ALtima®		Shank/DIN HB DIN6535
	Helix Angle 30°		Chipbreaker Chipbreaker
	Ball Nose		

Workpiece Material Group

		Steels
		Hardened Steels (35-65Rc)
		Stainless Steels
		Cast Iron
		Special Alloys
		Non-Ferrous

End Mill Terminology See Page 368.



Diamond Coated Routers The “Black Diamond”

Series 239

- GemX coating and uncoated options available
- Up cut router
- Excellent for composite materials and fiberglass applications
- Licensed for Boeing U.S. Patent 7,090,442*

Diamond Grind Routers

Series 230CE / 231CE / 231BCE / 231DCE

Featuring **CERAE** coating

- Down cut routers
- Excellent for glass reinforced printed circuit boards, phenolic–epoxy and other highly abrasive materials

Diamond Grind Routers

Series 230 / 231 / 231B / 231D / 231F

- Uncoated
- Down cut routers
- Excellent for glass reinforced printed circuit boards, phenolic–epoxy and other highly abrasive materials

Routers are available with a non-cutting safe end or in three popular end-cutting styles.

*M.A. Ford® has an agreement with The Boeing Company and has been granted license rights to use Boeing patents and proprietary data.



M.A. Ford®'s New Diamond Coated Routers

Series 239 Coated with GemX Diamond Coating

M.A. Ford® Coating	M.A. Ford® Tool Number Designation	Microhardness (HV)	Maximum Service Temp.	Friction Coefficient
GemX	GX	10,000	600° C / 1100° F	0.10

Benefits

- Excellent for composite materials and fiberglass applications
- Long Tool life
- Cut more linear inches
- Faster cycle times
- High routing rate
- Delivers great edge quality
- No delamination or flaking

Features

- Rake angles specially designed to reduce cutting forces
- Cutting edges specially treated for optimized tool life
- Carbide substrate uniquely compatible to GemX coating
- GemX coating specifically designed for maximum tool life in composites

Applications

- Trimming
- Routing
- Pocketing
- Interpolation of holes
- Low plastic content CFRP

Series 239 Case Studies

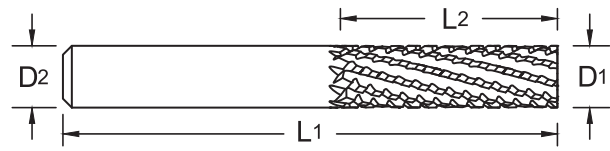
Roughing	
Tool:	0.5" 14-Flute Router 0.5"Ø x 1" LOC x 3" OAL
Chuck:	HSK63A Haimer Shrink Fit Chuck P/N A63.140.1/2Z
Spindle Speed:	12,000 RPM
Feed Rate:	2,500 mm/min (98in/min)

Finishing	
Tool:	0.5" 14-Flute Router 0.5"Ø x 1" LOC x 3" OAL
Chuck:	HSK63A Haimer Shrink Fit Chuck P/N A63.140.1/2Z
Spindle Speed:	15,000 RPM
Feed Rate:	3,000 mm/min (118in/min)

Routers Series 239



Diamond grind GemX coated or uncoated



Bur End



End Mill



Safe End



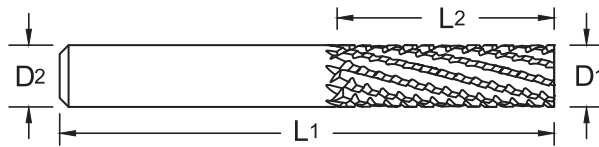
Fishtail
Metric
Sizes Only

Uncoated		GemX		Diameter			Shank		OAL		Flute Length		# Flutes (RHC)	End Cut
Tool Number	EDP	Tool Number	EDP	D1			D2		L1		L2			
				Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm		
239M0300	24039				3.0	.1181		3.0		38		12.0	6	Safe
239M0300B	23945	239M0300BGX	23969		3.0	.1181		3.0		38		12.0	6	Bur
239M0300E	23946	239M0300EGX	23970		3.0	.1181		3.0		38		12.0	6	End Mill
239M0300F	23947	239M0300FGX	23971		3.0	.1181		3.0		38		12.0	6	Fishtail
23912500	23994			1/8		.1250	1/8		1-1/2		1/4		6	Safe
23912500B	23901	23912500BGX	23900	1/8		.1250	1/8		1-1/2		1/4		6	Bur
23912510	23996			1/8		.1250	1/8		1-1/2		3/8		6	Safe
23912510E	23903	23912510EGX	23902	1/8		.1250	1/8		1-1/2		3/8		6	End Mill
23912520	23997			1/8		.1250	1/8		1-1/2		1/2		8	Safe
23912520E	23905	23912520EGX	23904	1/8		.1250	1/8		1-1/2		1/2		8	End Mill
239M0400	24021				4.0	.1575		4.0		50		15.0	6	Safe
239M0400B	23948	239M0400BGX	23972		4.0	.1575		4.0		50		15.0	6	Bur
239M0400E	23949	239M0400EGX	23973		4.0	.1575		4.0		50		15.0	6	End Mill
239M0400F	23950	239M0400FGX	23974		4.0	.1575		4.0		50		15.0	6	Fishtail
23918700	23998			3/16		.1875	3/16		2		3/8		6	Safe
23918700B	23907	23918700BGX	23906	3/16		.1875	3/16		2		3/8		6	Bur
23918710	23999			3/16		.1875	3/16		2		9/16		6	Safe
23918710E	23909	23918710EGX	23908	3/16		.1875	3/16		2		9/16		6	End Mill
23918720	24000			3/16		.1875	3/16		2		3/4		8	Safe
23918720E	23911	23918720EGX	23910	3/16		.1875	3/16		2		3/4		8	End Mill
239M0500	24041				5.0	.1968		5.0		50		20.0	6	Safe
239M0500B	23951	239M0500BGX	23975		5.0	.1968		5.0		50		20.0	6	Bur
239M0500E	23952	239M0500EGX	23976		5.0	.1968		5.0		50		20.0	6	End Mill
239M0500F	23953	239M0500FGX	23977		5.0	.1968		5.0		50		20.0	6	Fishtail
239M0600	24043				6.0	.2362		6.0		63		20.0	10	Safe
239M0600B	23954	239M0600BGX	23978		6.0	.2362		6.0		63		20.0	10	Bur
239M0600E	23955	239M0600EGX	23979		6.0	.2362		6.0		63		20.0	10	End Mill
239M0600F	23956	239M0600FGX	23980		6.0	.2362		6.0		63		20.0	10	Fishtail
239M0601	24027				6.0	.2362		6.0		75		25.0	10	Safe
239M0601B	23957	239M0601BGX	23981		6.0	.2362		6.0		75		25.0	10	Bur
239M0601E	23958	239M0601EGX	23982		6.0	.2362		6.0		75		25.0	10	End Mill
239M0601F	23959	239M0601FGX	23983		6.0	.2362		6.0		75		25.0	10	Fishtail
23925000	24001			1/4		.2500	1/4		2-1/2		1/2		8	Safe
23925000B	23913	23925000BGX	23912	1/4		.2500	1/4		2-1/2		1/2		8	Bur

*Stock available for desired end features with a quicker turnaround than most manufacturing suppliers!



Series 239 Continued



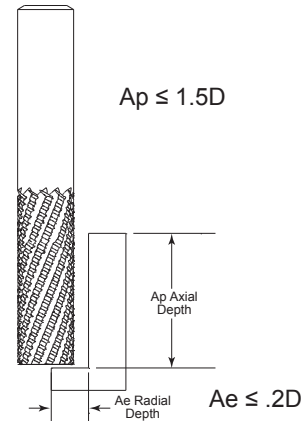
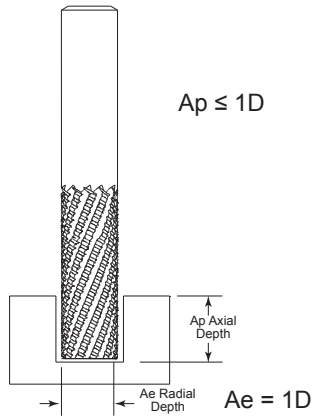
Uncoated		GemX		Diameter			Shank		OAL		Flute Length		# Flutes (RHC)	End Cut
Tool Number	EDP	Tool Number	EDP	D1			D2		L1		L2			
				Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm		
23925010	24003			1/4		.2500	1/4		2-1/2		3/4		10	Safe
23925010B	23915	23925010BGX	23914	1/4		.2500	1/4		2-1/2		3/4		10	Bur
23925010E	23917	23925010EGX	23916	1/4		.2500	1/4		2-1/2		3/4		10	End Mill
23925020	24005			1/4		.2500	1/4		3		1		10	Safe
23925020B	23919	23925020BGX	23918	1/4		.2500	1/4		3		1		10	Bur
23925020E	23921	23925020EGX	23920	1/4		.2500	1/4		3		1		10	End Mill
23925030	23923	23925030GX	23922	1/4		.2500	1/4		4		1-1/4		12	Safe
23931200	24009			5/16		.3125	5/16		2 1/2		1		10	Safe
23931200E	23925	23931200EGX	23924	5/16		.3125	5/16		2-1/2		1		10	End Mill
239M0800	24045				8.0	.3150		8.0		75		25.0	10	Safe
239M0800B	23960	239M0800BGX	23984		8.0	.3150		8.0		75		25.0	10	Bur
239M0800E	23961	239M0800EGX	23985		8.0	.3150		8.0		75		25.0	10	End Mill
239M0800F	23962	239M0800FGX	23986		8.0	.3150		8.0		75		25.0	10	Fishtail
23937500	24011			3/8		.3750	3/8		2-1/2		3/4		12	Safe
23937500B	23927	23937500BGX	23926	3/8		.3750	3/8		2-1/2		3/4		12	Bur
23937510	24035			3/8		.3750	3/8		3		1-1/8		12	Safe
23937510B	23929	23937510BGX	23928	3/8		.3750	3/8		3		1-1/8		12	Bur
23937510E	23931	23937510EGX	23930	3/8		.3750	3/8		3		1-1/8		12	End Mill
23937520	24015			3/8		.3750	3/8		4		1-1/2		12	Safe
23937520B	23933	23937520BGX	23932	3/8		.3750	3/8		4		1-1/2		12	Bur
23937520E	23935	23937520EGX	23934	3/8		.3750	3/8		4		1-1/2		12	End Mill
23937530	23937	23937530GX	23936	3/8		.3750	3/8		4		2		12	Safe
239M1000	24047				10.0	.3937		10.0		90		30.0	12	Safe
239M1000B	23963	239M1000BGX	23987		10.0	.3937		10.0		90		30.0	12	Bur
239M1000E	23964	239M1000EGX	23988		10.0	.3937		10.0		90		30.0	12	End Mill
239M1000F	23965	239M1000FGX	23989		10.0	.3937		10.0		90		30.0	12	Fishtail
239M1200	24033				12.0	.4724		12.0		100		40.0	14	Safe
239M1200B	23966	239M1200BGX	23990		12.0	.4724		12.0		100		40.0	14	Bur
239M1200E	23967	239M1200EGX	23991		12.0	.4724		12.0		100		40.0	14	End Mill
239M1200F	23968	239M1200FGX	23992		12.0	.4724		12.0		100		40.0	14	Fishtail
23950000	24037			1/2		.5000	1/2		3		1		14	Safe
23950000B	23939	23950000BGX	23938	1/2		.5000	1/2		3		1		14	Bur
23950000E	23941	23950000EGX	23940	1/2		.5000	1/2		3		1		14	End Mill
23950010	23943	23950010GX	23942	1/2		.5000	1/2		4		2		16	Safe
23950010B	23993	23950010BGX	23944	1/2		.5000	1/2		4		2		16	Bur

*Stock available for desired end features with a quicker turnaround than most manufacturing suppliers!



Routers Series 239

Recommended Cutting Data - Inch



Finishing Slotting 300 (Sfm)		
Tool Diameter	RPM	IPM
1/8	9000	10
3/16	6000	12
1/4	5000	15
5/16	4000	18
3/8	3000	20
1/2	2000	25

Roughing Slotting 600 (Sfm)		
Tool Diameter	RPM	IPM
1/8	18000	20
3/16	12000	25
1/4	9000	30
5/16	7000	35
3/8	6000	40
1/2	5000	50

Feed adjustment to part thickness	
≤ 0.5D	x 150%
0.5D - 1D	x 120%
1D - 2D	x 80%
3D-4D	x 50%

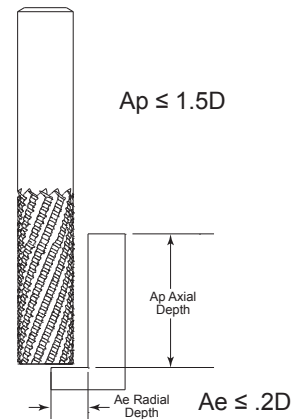
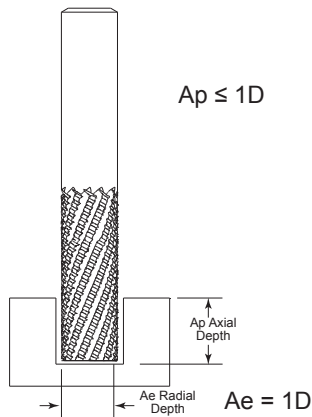
Finishing Side Milling 400 (Sfm)		
Tool Diameter	RPM	IPM
1/8	12000	20
3/16	8000	25
1/4	6000	30
5/16	5000	35
3/8	4000	40
1/2	3000	50

Roughing Side Milling 800 (Sfm)		
Tool Diameter	RPM	IPM
1/8	24000	40
3/16	16000	50
1/4	12000	60
5/16	10000	70
3/8	8000	80
1/2	6000	100

** Tool must have end grind to slot.

Note: The parameters in this table are for common material thickness of 1/4". You must use the Radial Depth (Ae) of 20% or less for Side Milling. For best surface finish conventional mill is recommended. Higher feed rates are possible but surface finish may change.

Recommended Cutting Data - Metric



Finishing Slotting 90 (m/min)		
Tool Diameter	RPM	mm/min
3	9000	254
5	6000	304
6	5000	381
8	4000	457
10	3000	508
12	2000	635

Roughing Slotting 180 (m/min)		
Tool Diameter	RPM	mm/min
3	18000	508
5	12000	635
6	9000	762
8	7000	889
10	6000	1016
12	5000	1270

Feed adjustment to part thickness	
≤ 0.5D	x 150%
0.5D - 1D	x 120%
1D - 2D	x 80%
3D-4D	x 50%

Finishing Side Milling 120 (m/min)		
Tool Diameter	RPM	mm/min
3	12000	508
5	8000	635
6	6000	762
8	5000	889
10	4000	1016
12	3000	1270

Roughing Side Milling 240 (m/min)		
Tool Diameter	RPM	mm/min
3	24000	1016
5	16000	1270
6	12000	1524
8	10000	1778
10	8000	2032
12	6000	2540

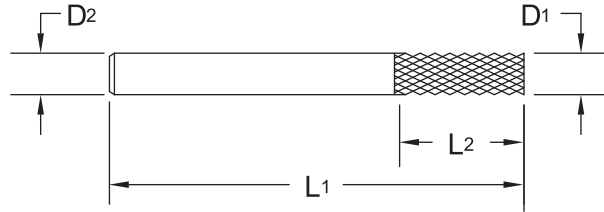
** Tool must have end grind to slot.

Note: The parameters in this table are for common material thickness of 6mm. You must use the Radial Depth (Ae) of 20% or less for Side Milling. For best surface finish conventional mill is recommended. Higher feed rates are possible but surface finish may change.

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

For product information, call your local distributor.

CERAedge® Coated Routers
Diamond Grind Routers
Series 230CE / 231CE
231BCE / 231DCE



Diamond Grind

- Designed for routing of glass-reinforced printed circuit boards, phenolic-epoxy, composites and other highly abrasive materials.
- Ultra fine micrograin carbide.

Series 230CE

Down Cut
Safe End



Series 231CE

Down Cut
End Mill Type Point



Series 231BCE

Down Cut
Bur End Point



Series 231DCE

Down Cut
Drill Point



Series 230CE		Series 231CE		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	D1			D2		L1		L2	
				Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
23011810CE	90839	23111810CE	91047		3.0	.1181		3.0		38		12.5
23012500CE	90845	23112500CE	91071	1/8		.1250	1/8		1-1/2		1/2	
23018750CE	90847	23118750CE	91082	3/16		.1875	3/16		2		5/8	
23019680CE	90850	23119680CE	91094		5.0	.1968		5.0		51		16.0
23023620CE	90853	23123620CE	91106		6.0	.2362		6.0		51		19.0
23025010CE	90859	23125010CE	91130	1/4		.2500	1/4		2-1/2		3/4	

Series 231BCE		Series 231DCE		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	D1			D2		L1		L2	
				Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
23111810BCE	91050	23111810DCE	91053		3.0	.1181		3.0		38		12.5
23112500BCE	91074	23112500DCE	91077	1/8		.1250	1/8		1-1/2		1/2	
23118750BCE	91085	23118750DCE	91088	3/16		.1875	3/16		2		5/8	
23119680BCE	91097	23119680DCE	91100		5.0	.1968		5.0		51		16.0
23123620BCE	91109	23123620DCE	91112		6.0	.2362		6.0		51		19.0
23125010BCE	91133	23125010DCE	91136	1/4		.2500	1/4		2-1/2		3/4	

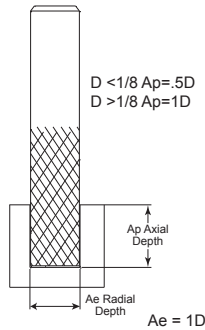
Routers are available with color coded depth setting rings upon request for 1/8" shanks.



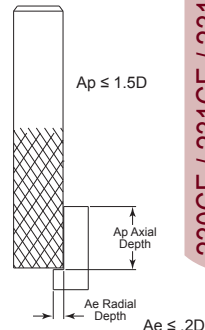
**CERAedge® Coated Routers
Diamond Grind Routers
Series 230CE / 231CE
231BCE / 231DCE**

Recommended Cutting Data - Inch

Slotting 300 (Sfm)			Slotting 600 (Sfm)		
Tool Diameter	RPM	IPM	Tool Diameter	RPM	IPM
1/32	36000	29	1/32	73000	58
3/64	24000	24	3/64	48000	48
1/16	18000	27	1/16	36000	54
3/32	12000	24	3/32	24000	48
1/8	9100	22	1/8	18000	45
3/16	6100	18	3/16	12000	36
1/4	4500	16	1/4	9000	32
5/16	3600	14	5/16	7000	28



Side Milling 400 (Sfm)			Side Milling 900 (Sfm)		
Tool Diameter	RPM	IPM	Tool Diameter	RPM	IPM
1/32	48000	39	1/32	90000	72
3/64	32000	32	3/64	73000	73
1/16	24000	36	1/16	55000	83
3/32	16000	32	3/32	36000	72
1/8	12000	30	1/8	27000	68
3/16	8100	24	3/16	18000	54
1/4	6100	21	1/4	13000	46
5/16	4800	19	5/16	11000	44

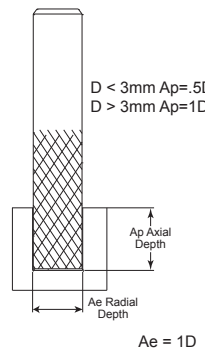


** Tool must have end grind in order to slot.

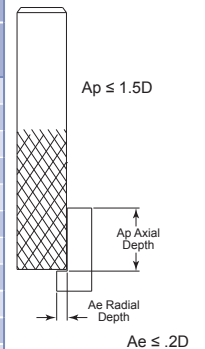
Note: The parameters in this table are for common material thickness of 1/4". You must use the Radial Depth (Ae) of 20% or less for Side Milling. For best surface finish conventional mill is recommended. Higher feed rates are possible but surface finish may change.

Recommended Cutting Data - Metric

Slotting 90 (m/min)			Slotting 182 (m/min)		
Tool Diameter	RPM	mm/min	Tool Diameter	RPM	mm/min
0.8	35000	141	0.8	72000	289
1	28000	226	1	57000	463
1.2	23000	306	1.2	48000	627
1.5	18000	376	1.5	38000	771
1.6	17000	388	1.6	36000	795
2	14000	423	2	28000	868
2.4	11000	447	2.4	24000	916
3	9400	480	3	19000	984
5	5600	395	5	11000	810
6	4700	423	6	9600	868
8	3500	353	8	7200	723



Side Milling 120(m/min)			Side Milling 240 (m/min)		
Tool Diameter	RPM	mm/min	Tool Diameter	RPM	mm/min
0.8	47000	190	0.8	95000	381
1	38000	305	1	76000	610
1.2	31000	413	1.2	63000	826
1.5	25000	508	1.5	50000	1017
1.6	23000	524	1.6	47000	1049
2	19000	572	2	38000	1145
2.4	15000	604	2.4	31000	1208
3	12000	648	3	25000	1297
5	7600	534	5	15000	1068
6	6300	572	6	12000	1145
8	4700	477	8	9500	954



** Tool must have end grind in order to slot.

Note: The parameters in this table are for common material thickness of 6mm. You must use the Radial Depth (Ae) of 20% or less for Side Milling. For best surface finish conventional mill is recommended. Higher feed rates are possible but surface finish may change.



Made in USA

ISO 9001:2008 Certified

Safety Note

Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded.

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

Diamond Grind Routers

Diamond Grind Routers are designed specifically for routing printed circuit boards. These tools are available with a non-cutting safe end, or in four popular end-cutting styles all with down cut geometries.

Router Application Data

When machining circuit boards, board stack height should be limited to 2-1/2 times the router diameter. In general, as total stack height increases, cutting speed RPM (n) should be decreased.

Polyamid or Teflon circuit boards should not be stacked.

When routing outside edges, the router should be fed counterclockwise. Conversely, for inside edges, the router should be fed clockwise.

Speeds and Feeds

Diamond Grind Routers are designed to operate between 600 and 900 surface-feet-per-minute (180-275 vc-m/min) - Approximately 30,000 RPM (n) for a 3/32-inch (2.4mm) router and 23,000 RPM (n) for a 1/8-inch (3.175mm) router. Speeds must be reduced for Teflon circuit boards. See recommended cutting data charts on page 466.

Diamond Grind Routers should be fed approximately .002 inch-per-revolution (.05 mm/rev.). For a 3/32-inch (2.4mm) router, this is 60-80 IPM (1524-2032 mm/min.). A 1/8-inch (3.175mm) router should be fed approximately 40-50 IPM (1016-1270 mm/min.). See recommended cutting data charts on page 466.

If the feed rate is too low, heat will cause melting of epoxy materials, causing the router flutes to load up, reducing tool life. For multi-layer boards, feed rates should be reduced, depending on the number of inner layers. The higher the number of inner layers, the slower the feed rate must be. See recommended cutting data charts on page 466.

Safety Note

Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded.

Diamond Grind Routers Series

Series 230

Series 231

Series 231B

Series 231D

Series 231F

ISO 9001:2008 Certified

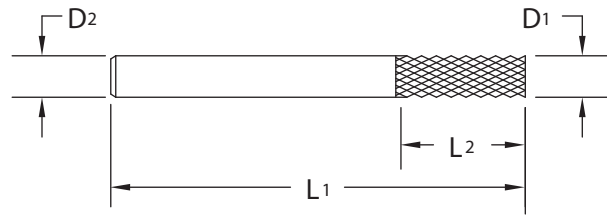
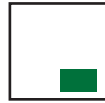


Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

Diamond Grind Routers

Series 230 / 231

231B / 231D / 231F



Designed for routing of glass-reinforced printed circuit boards, phenolic-epoxy and other highly abrasive materials.

Series 230

Down Cut
Safe End



- Ultra fine micrograin carbide.
- Routers are available with color coded depth setting rings upon request.

Series 231

Down Cut
End Mill Type Point



Series 231B

Down Cut
Bur End Point



Series 231D

Down Cut
Drill Point



Series 231F

Down Cut
Fishtail Point



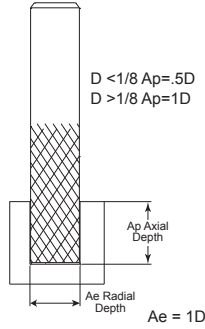
Page 466

Series 230		Series 231		Series 231B		Series 231D		Series 231F		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	D1			D2		L1		L2	
										Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
23003120	90801	23103120	90901	23103120B	90904	23103120D	90907	23103120F	90910	1/32		.0312	1/8		1-1/2		1/8	
23003150	90804	23103150	90913	23103150B	90916	23103150D	90919	23103150F	90922		0.8	.0315		3.175		38		3.0
23003940	90807	23103940	90925	23103940B	90928	23103940D	90931	23103940F	90934		1.0	.0394		3.175		38		4.0
23004690	90810	23104690	90937	23104690B	90940	23104690D	90943	23104690F	90946	3/64		.0469	1/8		1-1/2		5/32	
23004720	90813	23104720	90949	23104720B	90952	23104720D	90955	23104720F	90958		1.2	.0472		3.175		38		4.0
23005910	90816	23105910	90961	23105910B	90964	23105910D	90967	23105910F	90970		1.5	.0591		3.000		38		5.0
23005911	90819	23105911	90973	23105911B	90976	23105911D	90979	23105911F	90982		1.5	.0591		3.175		38		5.0
23006251	90822	23106251	90985	23106251B	90988	23106251D	90991	23106251F	90994	1/16		.0625	1/8		1-1/2		3/16	
23006300	90825	23106300	90997	23106300B	91000	23106300D	91003	23106300F	91006		1.6	.0630		3.175		38		5.0
23007870	90828	23107870	91009	23107870B	91012	23107870D	91015	23107870F	91018		2.0	.0787		3.175		38		8.0
23009370	90831	23109370	91021	23109370B	91024	23109370D	91027	23109370F	91030	3/32		.0937	1/8		1-1/2		3/8	
23009450	90834	23109450	91033	23109450B	91036	23109450D	91039	23109450F	91042		2.4	.0945		3.175		38		9.5
23011810	90837	23111810	91045	23111810B	91048	23111810D	91051	23111810F	91054		3.0	.1181		3.000		38		12.5
23011811	90840	23111811	91057	23111811B	91060	23111811D	91063	23111811F	91066		3.0	.1181		3.175		38		12.5
23012500	90843	23112500	91069	23112500B	91072	23112500D	91075	23112500F	91078	1/8		.1250	1/8		1-1/2		1/2	
23018750	90846	23118750	91081	23118750B	91084	23118750D	91087	23118750F	91090	3/16		.1875	3/16		2		5/8	
23019680	90849	23119680	91093	23119680B	91096	23119680D	91099	23119680F	91102		5.0	.1968		5.000		51		16.0
23023620	90852	23123620	91105	23123620B	91108	23123620D	91111	23123620F	91114		6.0	.2362		6.000		51		19.0
23025000	90855	23125000	91117	23125000B	91120	23125000D	91123	23125000F	91126	1/4		.2500	1/4		2		3/4	
23025010	90858	23125010	91129	23125010B	91132	23125010D	91135	23125010F	91138	1/4		.2500	1/4		2-1/2		3/4	
23025020	90861	23125020	91141	23125020B	91144	23125020D	91147	23125020F	91150	1/4		.2500	1/4		3		3/4	
23031250	90864	23131250	91153	23131250B	91156	23131250D	91159	23131250F	91162	5/16		.3125	5/16		2-1/2		7/8	
23031500	90867	23131500	91165	23131500B	91168	23131500D	91171	23131500F	91174		8.0	.3150		8.000		64		22.0
23037500	90870	23137500	91177	23137500B	91180	23137500D	91183	23137500F	91186	3/8		.3750	3/8		2-1/2		7/8	

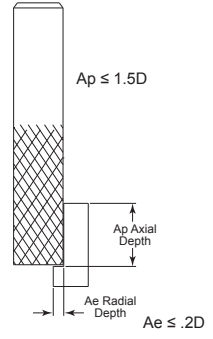
Diamond Grind Routers Series 230 / 231 231B / 231D / 231F

Recommended Cutting Data - Inch

Slotting 300 (Sfm)			Slotting 600 (Sfm)		
Tool Diameter	RPM	IPM	Tool Diameter	RPM	IPM
1/32	36000	29	1/32	73000	58
3/64	24000	24	3/64	48000	48
1/16	18000	27	1/16	36000	54
3/32	12000	24	3/32	24000	48
1/8	9100	22	1/8	18000	45
3/16	6100	18	3/16	12000	36
1/4	4500	16	1/4	9000	32
5/16	3600	14	5/16	7000	28



Side Milling 400 (Sfm)			Side Milling 900 (Sfm)		
Tool Diameter	RPM	IPM	Tool Diameter	RPM	IPM
1/32	48000	39	1/32	90000	72
3/64	32000	32	3/64	73000	73
1/16	24000	36	1/16	55000	83
3/32	16000	32	3/32	36000	72
1/8	12000	30	1/8	27000	68
3/16	8100	24	3/16	18000	54
1/4	6100	21	1/4	13000	46
5/16	4800	19	5/16	11000	44

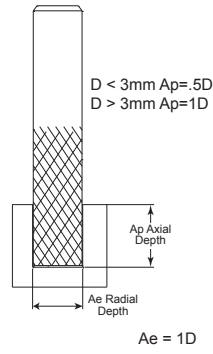


** Tool must have end grind in order to slot.

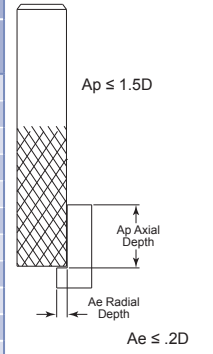
Note: The parameters in this table are for common material thickness of 1/4". You must use the Radial Depth (Ae) of 20% or less for Side Milling. For best surface finish conventional mill is recommended. Higher feed rates are possible but surface finish may change.

Recommended Cutting Data - Metric

Slotting 90 (m/min)			Slotting 182 (m/min)		
Tool Diameter	RPM	mm/min	Tool Diameter	RPM	mm/min
0.8	35000	141	0.8	72000	289
1	28000	226	1	57000	463
1.2	23000	306	1.2	48000	627
1.5	18000	376	1.5	38000	771
1.6	17000	388	1.6	36000	795
2	14000	423	2	28000	868
2.4	11000	447	2.4	24000	916
3	9400	480	3	19000	984
5	5600	395	5	11000	810
6	4700	423	6	9600	868
8	3500	353	8	7200	723



Side Milling 120(m/min)			Side Milling 240 (m/min)		
Tool Diameter	RPM	mm/min	Tool Diameter	RPM	mm/min
0.8	47000	190	0.8	95000	381
1	38000	305	1	76000	610
1.2	31000	413	1.2	63000	826
1.5	25000	508	1.5	50000	1017
1.6	23000	524	1.6	47000	1049
2	19000	572	2	38000	1145
2.4	15000	604	2.4	31000	1208
3	12000	648	3	25000	1297
5	7600	534	5	15000	1068
6	6300	572	6	12000	1145
8	4700	477	8	9500	954



** Tool must have end grind in order to slot.

Note: The parameters in this table are for common material thickness of 6mm. You must use the Radial Depth (Ae) of 20% or less for Side Milling. For best surface finish conventional mill is recommended. Higher feed rates are possible but surface finish may change.



ISO 9001:2008 Certified

Safety Note

Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded.

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

Coatings

ALtima®

Aluminum Titanium Nitride (AlTiN). ALtima® is the original high performance coating. This coating allows tools to be run at higher speeds and feeds in a wide array of materials. Also, it allows the option of running tools dry due to the high oxidation temperature of the coating.

ALtima® Plus

This Aluminum Titanium Nitride (AlTiN) multi-layer coating has optimized coating structure, with pre and post treatment of the coating for optimized high performance drilling in any ferrous material.

ALtima® 52

Aluminum Titanium Nitride (AlTiN). ALtima® 52 is specially designed for milling hardened steels 52 Rc and above. It has very high hardness and the oxidation temperature of the coating makes this the absolute best choice for hardened steel milling. ALtima® 52 is designed to allow for dry machining.

ALtima® Blaze

Aluminum Chromium Nitride (AlCrN). ALtima® Blaze is designed to allow higher material removal rates. This coating has a higher oxidation temperature than a typical TiAlN coating. It has shown very good results in nickel alloys, titanium, and other difficult to machine materials. Tools coated with ALtima® Blaze can be used in dry machining.

ALtima® Micro

An ultra thin, nano structured, TiAlN coating developed specifically for micro tool applications.

Fordlube

Titanium DiBoride (TiB₂) is a unique coating with low Aluminum affinity, smooth surface finish and high hardness. It is ideal for Aluminum and Magnesium alloys as it prevents build-up on cutting edge, provides superior chip flow along with extended wear resistance.

Gem+

Recommended for aluminium and aluminium alloys up to 12% Si, non-ferrous metals and composites. Gem+ provides excellent wear resistance and maintains sharp cutting edges.

GemX

A CVD diamond coating for composites and aluminum that offers the maximum hardness and wear resistance of any of our coatings.

TiN

Titanium Nitride (TiN). TiN coating has shown good results in low carbon steels and many iron-based applications. It is a very popular coating used in the industry today.

TiCN

Titanium Carbonitride (TiCN). TiCN is a multi-layer coating. Because of the multi-layer composition, TiCN is tougher than TiN, even though TiCN is harder. The added toughness of the TiCN coating makes it a good choice for mechanically stressed edges like in end mill applications. The higher hardness makes TiCN a good choice for abrasive applications where higher wear resistance is required.

CERAedge®

CERAedge® is a unique coating that provides excellent performance in titanium, aluminium, and composites.

Special Coatings

Upon request, M.A. Ford® can provide any commercially available coating. Any standard M.A. Ford® cutting tool can be provided with coating if requested.

Coating Properties

M.A. Ford® Coating	M.A. Ford® Tool Number Designation	Microhardness (HV)	Maximum Service Temp.	Friction Coefficient
ALtima®	A	3100	1100° C / 2012° F	0.42
ALtima® Plus	AP	3200	1100° C / 2012° F	0.25
ALtima® 52	A	3600	1200° C / 2192° F	0.40
ALtima® Blaze	B	3200	1100° C / 2012° F	0.35
ALtima® Micro	AM	3300	900° C / 1652° F	0.30-0.35
Fordlube	F	4000	700° C / 1292° F	0.30
Gem+	GP	4710	500° C / 932° F	0.30
GemX	GX	10000	600° C / 1100° F	0.10
TiN	T	2300	600° C / 1112° F	0.40
TiCN	C	3000	400° C / 752° F	0.40
CERAedge®	CE	3400	1100° C / 2012° F	0.25