FR-4 高Tg / 両面, 4層 (φ0.05mm - φ1.6mm)

FR-4 High Tg / Double sided & 4-layer

UNION TOOL CO.

穴明け機主軸回転数（Max 値）160 krpm *Maximum spindle speed 160 krpm*

直径 Diameter		回転数 Spindle speed	（周速）*2 (Velocity) *2	送り速度 Infeed rate		（チップロード）*2 (Chipload) *2	上昇速度 Retract rate		捨て板切り込み深さ Depth into back-up board		ヒット数 *3 Hits *3	再研磨回数 *3 Number of repoints *3	基板重ね枚数 Stack height *3, *4 基板厚 Board thickness [mm]		
[mm]	[inch]	[rpm]	[m/min]	[m/min]	[IPM]	[μm/rev]	[m/min]	[IPM]	[mm]	[inch]	-	-	t 0.8	t 1.0 - 1.2	t 1.6
0.05	0.0020	160,000	(25)	0.80	31	(5)	10	394	0.1	0.0039	1,000 - 2,000	1	1	N/A	N/A
0.075	0.0030	160,000	(38)	0.80	31	(5)	10	394	0.1	0.0039	1,000 - 2,000	1	1	1	N/A
0.09	0.0035	160,000	(45)	0.80	31	(5)	10	394	0.1	0.0039	1,000 - 2,000	1	1	1	1
0.1	0.0039	160,000	(50)	0.80	31	(5)	10	394	0.1	0.0039	1,000 - 2,000	1	1	1	1
0.12	0.0047	160,000	(60)	0.80	31	(5)	10	394	0.15	0.0059	1,000 - 2,000	1	1	1	1
0.15	0.0059	160,000	(75)	1.20	47	(8)	15	591	0.15	0.0059	1,000 - 2,000	2	1 - 2	1	1
0.2	0.0079	160,000	(101)	1.92	76	(12)	25.4	1000	0.2	0.0079	1,000 - 2,000	2	1 - 2	1 - 2	1
0.25	0.0098	140,000	(110)	2.24	88	(16)	25.4	1000	0.25	0.0098	1,000 - 2,000	2	2 - 3	1 - 2	1
0.275	0.0108	130,000	(112)	2.08	82	(16)	25.4	1000	0.3	0.0118	1,000 - 2,000	2	2 - 3	1 - 2	1 - 2
0.3	0.0118	120,000	(113)	1.92	76	(16)	25.4	1000	0.3	0.0118	2,000 - 3,000	2	3 - 4	2 - 3	2 - 3
0.35	0.0138	100,000	(110)	1.84	72	(18)	25.4	1000	0.35	0.0138	2,000 - 3,000	2	3 - 4	2 - 3	2 - 3
0.4	0.0157	95,000	(119)	1.90	75	(20)	25.4	1000	0.4	0.0157	2,000 - 3,000	3	3 - 4	3 - 4	2 - 3
0.45	0.0177	85,000	(120)	1.70	67	(20)	25.4	1000	0.45	0.0177	2,000 - 3,000	3	3 - 4	3 - 4	2 - 3
0.5	0.0197	75,000	(118)	1.68	66	(22)	25.4	1000	0.5	0.0197	2,000 - 3,000	3	3 - 4	3 - 4	3 - 4
0.55	0.0217	70,000	(121)	1.57	62	(22)	25.4	1000	0.55	0.0217	2,000 - 3,000	3	3 - 4	3 - 4	3 - 4
0.6	0.0236	65,000	(123)	1.95	77	(30)	25.4	1000	0.6	0.0236	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
0.65	0.0256	65,000	(133)	1.95	77	(30)	25.4	1000	0.65	0.0256	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
0.7	0.0276	60,000	(132)	1.80	71	(30)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
0.75	0.0295	60,000	(141)	1.80	71	(30)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
0.8	0.0315	57,000	(143)	1.71	67	(30)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
0.85	0.0335	57,000	(152)	1.71	67	(30)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
0.9	0.0354	55,000	(156)	1.65	65	(30)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
0.95	0.0374	52,000	(155)	1.56	61	(30)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1	0.0394	48,000	(151)	1.44	57	(30)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.05	0.0413	47,000	(155)	1.41	56	(30)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.1	0.0433	45,000	(156)	1.35	53	(30)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.15	0.0453	43,000	(155)	1.29	51	(30)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.2	0.0472	41,000	(155)	1.64	65	(40)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.25	0.0492	39,000	(153)	1.56	61	(40)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.3	0.0512	38,000	(155)	1.52	60	(40)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.35	0.0531	36,000	(153)	1.44	57	(40)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.4	0.0551	34,000	(150)	1.36	54	(40)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.45	0.0571	32,000	(146)	1.28	50	(40)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.5	0.0591	30,000	(141)	1.20	47	(40)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.55	0.0610	30,000	(146)	1.20	47	(40)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4
1.6	0.0630	30,000	(151)	1.20	47	(40)	25.4	1000	0.7	0.0276	2,000 - 3,000	3	4 - 5	3 - 4	3 - 4

*1 赤字のドリル径は160krpm以上の高速回転加工で穴品質ならびにドリル折損率が改善されます。
*2 周速ならびにチップロードはメートル表記です。
*3 ヒット数、再研磨回数、重ね枚数は目安です。穴品質をご確認の上設定願います。
*4 t0.8mm未満の基板に関しては、半導体パッケージ用基板の加工条件をご参考下さい。
*5 上記表に適合しない基板厚や重ね枚数で加工される場合については、別途お問い合わせ願います。
*6 穴明加工機のスピンドル性能等によっては条件設定を改善する必要があります。
*7 穴明加工機のプレッシャーフット、及びバキューム性能は、穴品質に影響を及ぼすことがありますので定期的な点検をお奨めします。
*8 当板、捨板の材料、厚さは穴品質に影響を及ぼすことがありますので、選定にあたっては十分ご注意ください。
*9 基材メーカーならびに基材型番によって加工特性が大きく異なります。目標品質をクリアできるヒット数ならびに基板重ね枚数をご検討願います。

*1 Diameters written in RED will gain improved hole quality when drilling with over 160krpm spindle speed.
*2 Velocity and chipload are shown in metric units.
*3 Hits, number of repoints and stack heights are for general information. They should be determined by hole quality.
*4 For panels below t0.8mm, please refer to our "Package Substrate" parameters.
*5 Where the board thickness and/or stack height are not shown in the table, please contact Union Tool's Technical support team.
*6 These parameters can be affected by the condition and performance of both the spindle and drilling machine.
*7 The pressure foot and vacuum performance of the drilling machine can affect hole quality. Periodic inspection, maintenance and measurement is strongly recommended.
*8 The thickness of the entry and back-up board, together with the material type can affect the drilling conditions and care should be taken to choose an appropriate product for the application being drilled.
*9 Drilling performance changes differently depending on PWB makers and model types. Hit counts and PWB stack height should be determined by hole quality target.

FR-4 高Tg / 両面, 4層 (φ1.65mm - φ6.5mm)

FR-4 High Tg / Double sided & 4-layer

UNION TOOL CO.

穴明け機主軸回転数(Max 値) 160 krpm *Maximum spindle speed 160 krpm*

直径 Diameter		回転数 Spindle speed	(周速) *2 (Velocity) *2	送り速度 Infeed rate		(チップロード) *2 (Chipload) *2	上昇速度 Retract rate		捨て板切り込み深さ Depth into back-up board		ヒット数 *3 Hits *3	再研磨回数 *3 Number of repoints *3	基板重ね枚数 Stack height *3, *4 基板厚 Board thickness [mm]		
[mm]	[inch]	[rpm]	[m/min]	[m/min]	[IPM]	[μm/rev]	[m/min]	[IPM]	[mm]	[inch]	-	-	t 0.8	t 1.0 - 1.2	t 1.6
1.65	0.0650	30,000	(156)	1.65	65	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
1.7	0.0669	27,000	(144)	1.49	58	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
1.75	0.0689	27,000	(148)	1.49	58	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
1.8	0.0709	25,000	(141)	1.38	54	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
1.85	0.0728	25,000	(145)	1.38	54	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
1.9	0.0748	22,000	(131)	1.21	48	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
1.95	0.0768	22,000	(135)	1.21	48	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2	0.0787	20,000	(126)	1.10	43	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.05	0.0807	20,000	(129)	1.10	43	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.1	0.0827	18,000	(119)	0.99	39	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.15	0.0846	18,000	(122)	0.99	39	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.2	0.0866	16,000	(111)	0.88	35	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.25	0.0886	16,000	(113)	0.88	35	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.3	0.0906	15,000	(108)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.35	0.0925	15,000	(111)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.4	0.0945	15,000	(113)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.45	0.0965	15,000	(115)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.5	0.0984	15,000	(118)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.55	0.1004	15,000	(120)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.6	0.1024	15,000	(123)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.65	0.1043	15,000	(125)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.7	0.1063	15,000	(127)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.75	0.1083	15,000	(130)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.8	0.1102	15,000	(132)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.85	0.1122	15,000	(134)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.9	0.1142	15,000	(137)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
2.95	0.1161	15,000	(139)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
3	0.1181	15,000	(141)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
3.05	0.1201	15,000	(144)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
3.1	0.1220	15,000	(146)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
3.15	0.1240	15,000	(148)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
3.175	0.1250	15,000	(150)	0.83	32	(55)	25.4	1000	0.7	0.0276	1,500 - 2,500	4	4 - 5	3 - 4	3 - 4
3.2 - 3.95	0.126 - 0.156	25,000	-	0.75	30	(30)	25.4	1000	0.7	0.0276	500-1000	4	4 - 5	3 - 4	3 - 4
4.0 - 4.95	0.157 - 0.195	20,000	-	0.60	24	(30)	25.4	1000	0.7	0.0276	500-1000	4	4 - 5	3 - 4	3 - 4
5.0 - 5.95	0.197 - 0.234	16,000	-	0.64	25	(40)	25.4	1000	0.7	0.0276	500-1000	4	4 - 5	3 - 4	3 - 4
6.0 - 6.5	0.236 - 0.256	15,000	-	0.53	21	(35)	25.4	1000	0.7	0.0276	500-1000	4	4 - 5	3 - 4	3 - 4

*1 穴周囲バリならびに内壁荒れが見られる場合はチップロードを下げて下さい。
*2 周速ならびにチップロードはメートル表記です。
*3 ヒット数、再研磨回数、重ね枚数は目安です。穴品質をご確認の上設定願います。
*4 t0.8mm未満の基板に関しては、半導体パッケージ用基板の加工条件をご参考下さい。
*5 上記表に適合しない基板厚や重ね枚数で加工される場合については、別途お問い合わせ願います。
*6 穴明加工機のスピンドル性能等によっては条件設定を改善する必要があります。
*7 穴明加工機のプレッシャーフット、及びバキューム性能は、穴品質に影響を及ぼすことがありますので定期的な点検をお奨めします。
*8 当板、捨板の材料、厚さは穴品質に影響を及ぼすことがありますので、選定にあたっては十分ご注意ください。
*9 基材メーカーならびに基材型番によって加工特性が大きく異なります。目標品質をクリアできるヒット数ならびに基板重ね枚数をご検討願います。

*1 In the case of burring and hole wall roughness problems, please decrease the chipload.
*2 Velocity and chipload are shown in metric units.
*3 Hits, number of repoints and stack heights are for general information. They should be determined by hole quality.
*4 For panels below t0.8mm, please refer to our "Package Substrate" parameters.
*5 Where the board thickness and/or stack height are not shown in the table, please contact Union Tool's Technical support team.
*6 These parameters can be affected by the condition and performance of both the spindle and drilling machine.
*7 The pressure foot and vacuum performance of the drilling machine can affect hole quality. Periodic inspection, maintenance and measurement is strongly recommended.
*8 The thickness of the entry and back-up board, together with the material type can affect the drilling conditions and care should be taken to choose an appropriate product for the application being drilled.
*9 Drilling performance changes differently depending on PWB makers and model types. Hit counts and PWB stack height should be determined by hole quality target.