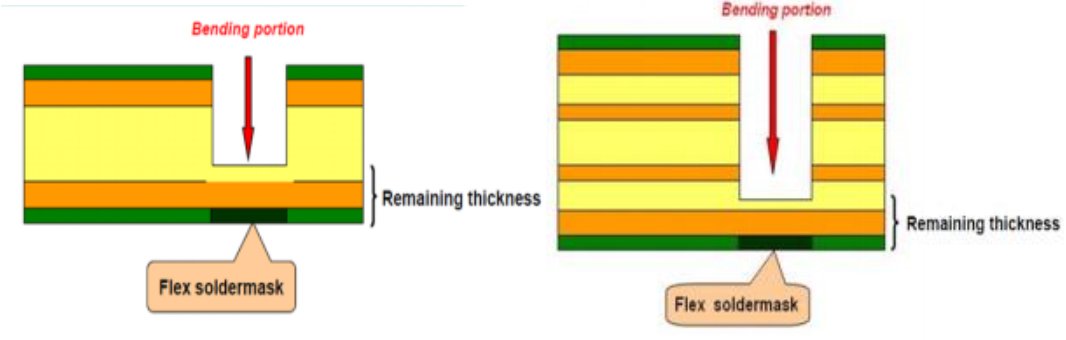
Semi-Flex PCB Technology

Updated in Oct. 2024

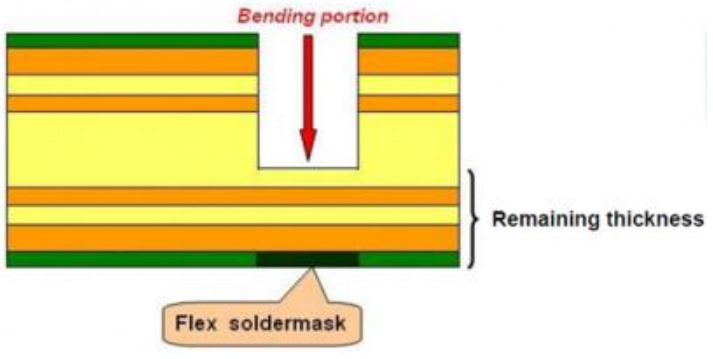
Contents

1. Semi-Flex PCB Types

The base material used in a semi-flex PCB is FR4. A semi-flex PCB is made by thinning a portion of a rigid FR4 PCB down to make it bendable up to a certain degree, while maintaining its structural integrity.

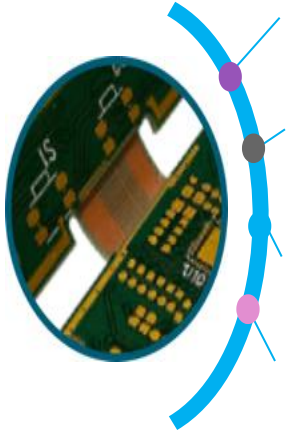


One Conductive Layer at bending area



Two Conductive Layer at bending area

2. Semi-Flex PCB Advantage and Application



Cost Efficient

Made only from FR4, FR4 Semi-Flex replaces 2 or more PCBs, simplifies the assembly process, eliminates connectors, and is cheaper than the Rigid-Flex solution

Reliability and Durability

Fewer solder joints and fewer connectors

Size Optimization

Using FR4 Semi-Flex optimizes the PCB size, saving the space of the connectors on both “rigid” parts.

Special Installation Performance

Can be locally bent on the basis of rigid PCB, which can not only provide the support of rigid PCB, but also achieve local bending according to product requirements.

2. Semi-Flex PCB Advantage and Application

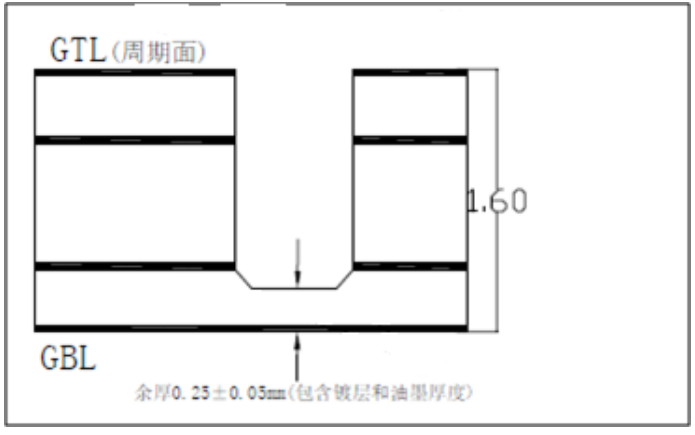
Semi-flex PCB are mainly used at situation that the bending status will be fixed after assembly. Only rework or repair may result in repeat bending. Under such a situation, semi-flex PCB might be an cost down solution if design can support.

3. UG Semi-Flex PCB Technology Study

3.1 Test Board Design Information

图示	上层	下层	连通	上残铜	下残铜	代号	规格	数量
	L1					CU0078	HOZ 宽幅51inch/1295m	1
						PP0848	2116 RC58% 49.5*300m	1
						PP0847	1080 RC68% 49.5*300m	1
						PP0848	2116 RC58% 49.5*300m	1
	L2	L3		57	57	NC2530	FR4 0.70mm 1/1 41*49	1
						PP0848	2116 RC58% 49.5*300m	1
						PP0847	1080 RC68% 49.5*300m	1
						PP0848	2116 RC58% 49.5*300m	1
	L4					CU0078	HOZ 宽幅51inch/1295m	1

One conductive layer in bending area

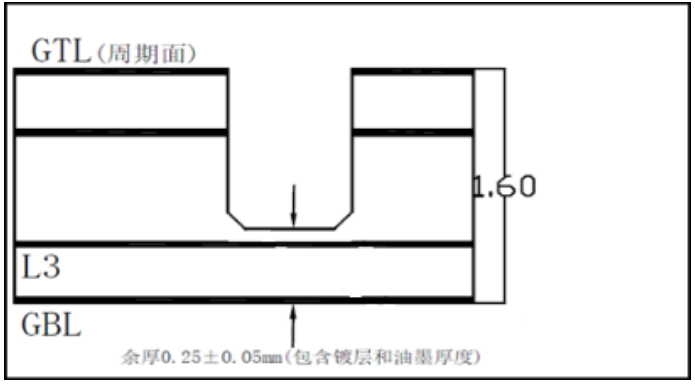


Remaining Thickness:0.25+/-0.0mm

外部导入 ◀ 左翻页 ▶ 右翻页

图示	上层	下层	连通	上残铜	下残铜	代号	规格	数量
	L1					CU0078	HOZ 宽幅51inch/1295m	1
						PP0916	106 RC70% 49.5*300m	1
						PP0916	106 RC70% 49.5*300m	1
	L2	L3		50	64	NC2537	FR4 1.30mm 2/2 41*49	1
						PP0916	106 RC70% 49.5*300m	1
						PP0916	106 RC70% 49.5*300m	1
	L4					CU0078	HOZ 宽幅51inch/1295m	1

Two conductive layer in bending area



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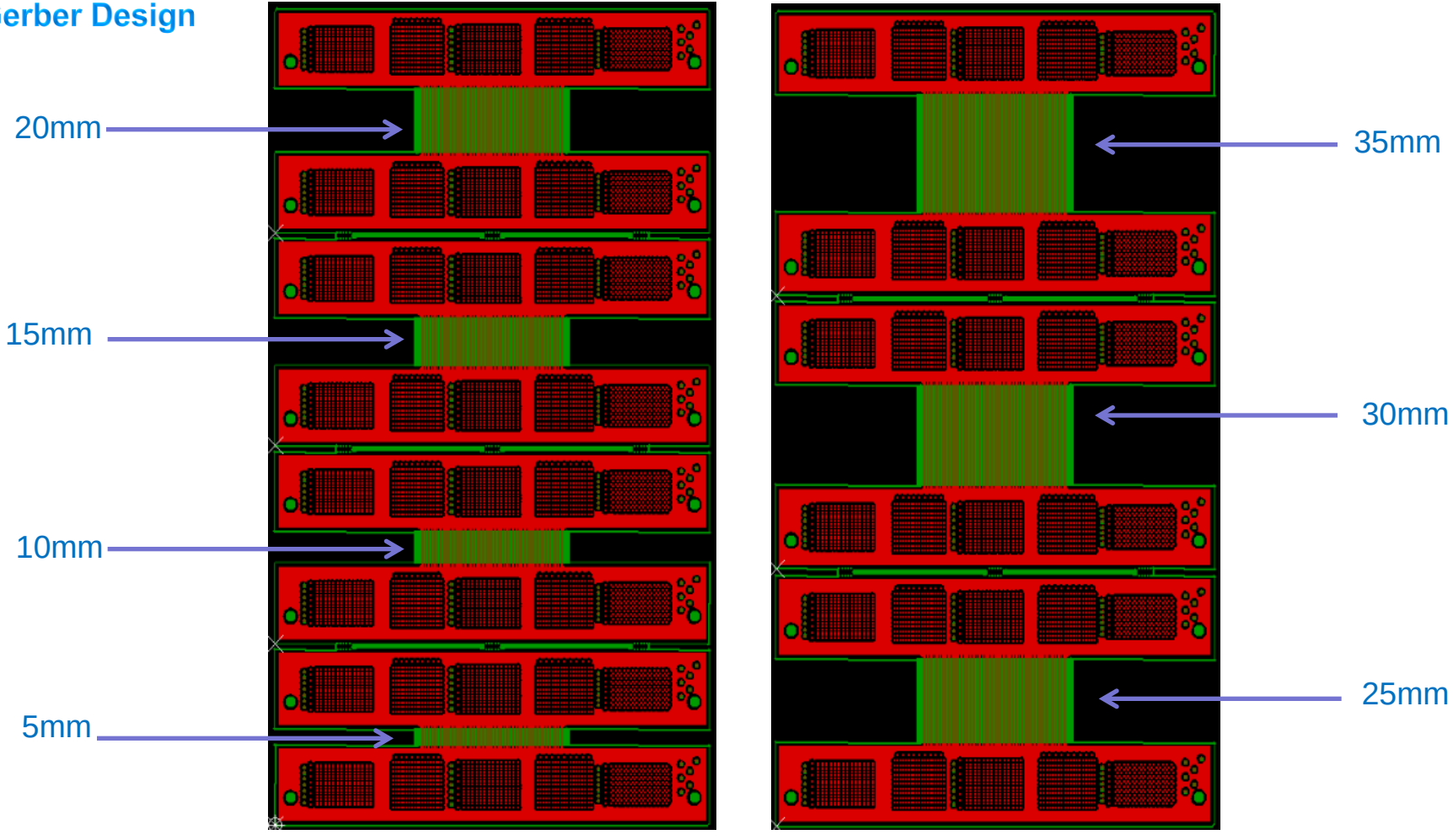
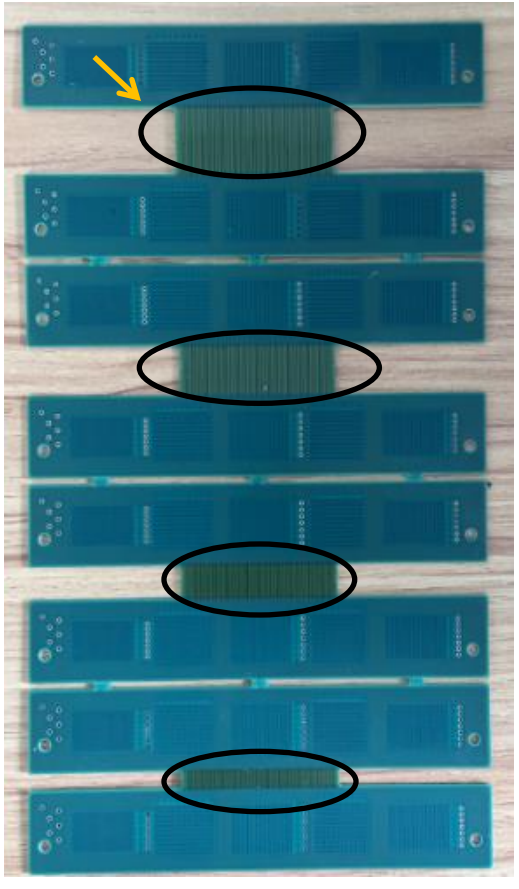
Gerber Design



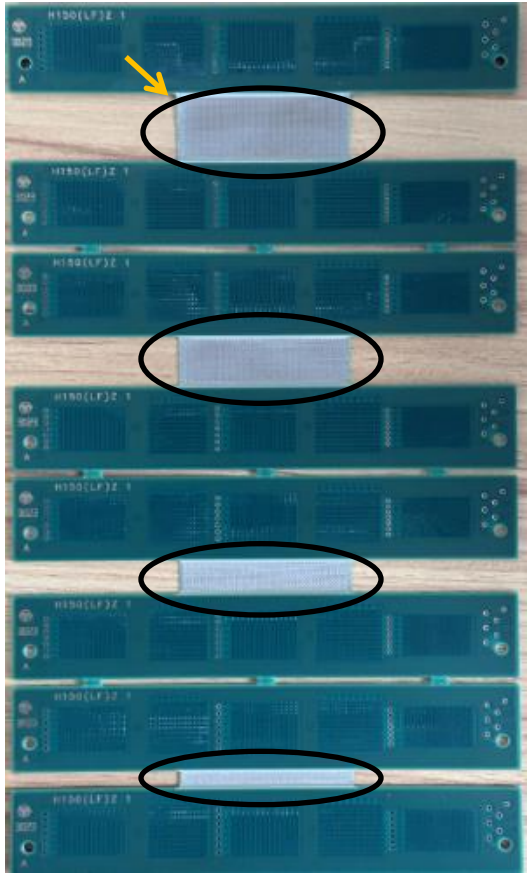
3. UG Semi-Flex PCB Technology Study

3.2 Semi-flex PCB Critical Control—Depth Control at Bending Area

“Flex” part，
flex solder mask at bottom side

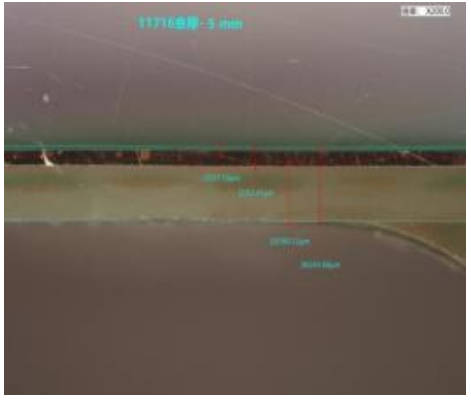


Flex part after depth control routing

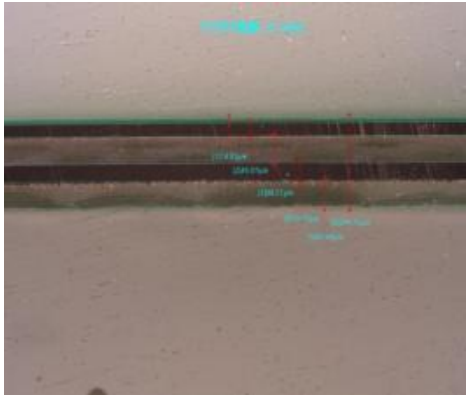


Cross Section of Bending Area

One conductive layer



Two conductive layer



3. UG Semi-Flex PCB Technology Study

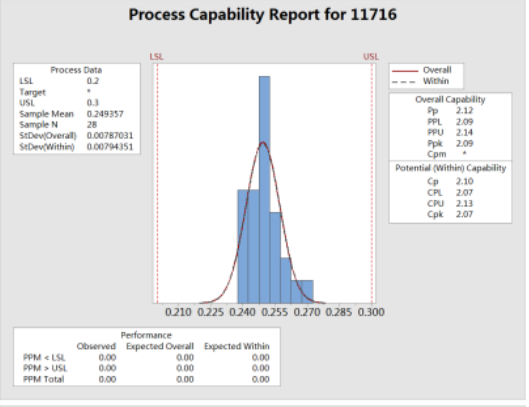
3.3 Bending Area Remaining Thickness CPK Data

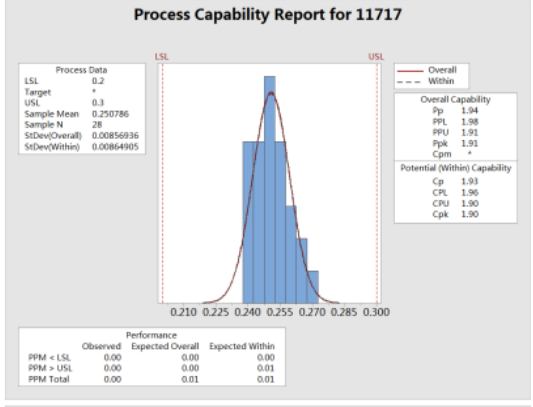
余厚（0.25±0.05mm）	料号					
	11716	11717	11757	11758	11760	11761
1	0.243	0.253	0.246	0.256	0.260	0.264
2	0.250	0.267	0.252	0.249	0.251	0.263
3	0.251	0.253	0.245	0.247	0.259	0.259
4	0.254	0.260	0.256	0.254	0.254	0.261
5	0.269	0.270	0.262	0.259	0.269	0.258
6	0.266	0.264	0.257	0.267	0.261	0.263
7	0.258	0.257	0.265	0.261	0.253	0.256
8	0.248	0.252	0.252	0.242	0.243	0.245
9	0.249	0.255	0.268	0.258	0.235	0.252
10	0.256	0.248	0.258	0.262	0.238	0.260
11	0.252	0.245	0.256	0.264	0.256	0.249
12	0.255	0.238	0.248	0.256	0.258	0.248
13	0.248	0.244	0.256	0.255	0.262	0.256
14	0.245	0.255	0.253	0.248	0.248	0.252
15	0.238	0.248	0.254	0.249	0.250	0.262
16	0.245	0.242	0.262	0.256	0.252	0.260
17	0.252	0.240	0.258	0.252	0.260	0.258
18	0.260	0.258	0.245	0.255	0.249	0.252
19	0.249	0.245	0.252	0.248	0.248	0.255
20	0.248	0.252	0.260	0.245	0.245	0.248
21	0.245	0.239	0.249	0.238	0.260	0.245
22	0.242	0.238	0.248	0.246	0.262	0.238
23	0.238	0.245	0.245	0.238	0.252	0.245
24	0.243	0.252	0.252	0.243	0.255	0.238
25	0.239	0.260	0.255	0.244	0.248	0.236
26	0.248	0.249	0.248	0.252	0.245	0.240
27	0.238	0.248	0.245	0.248	0.238	0.242
28	0.253	0.245	0.238	0.245	0.245	0.245
最小值	0.238	0.238	0.238	0.238	0.235	0.236
最大值	0.269	0.270	0.268	0.267	0.269	0.264
Cpk	2.07	1.90	2.23	2.12	1.92	1.86

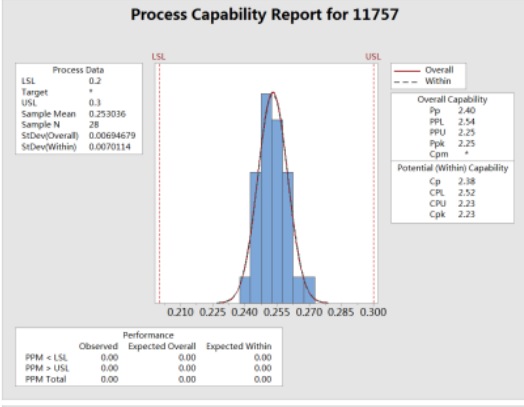
***The above data show value ranges within 0.235mm-0.270mm, max difference is 0.035mm, this verifies that machine capability can meet +/-0.05mm requirement.

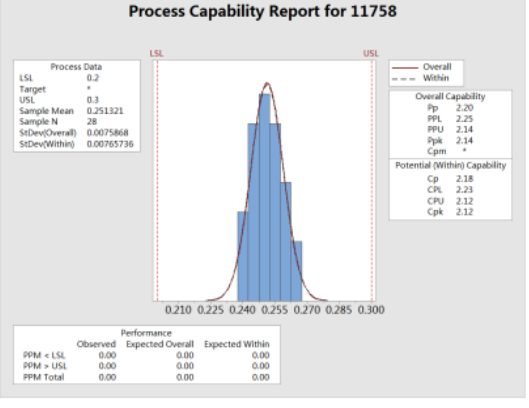
3. UG Semi-Flex PCB Technology Study

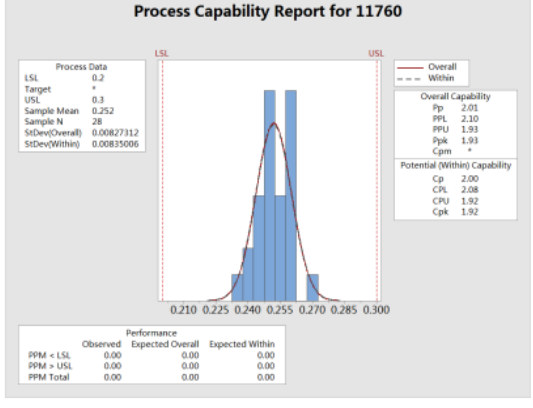
3.3 Bending Area Remaining Thickness CPK Data

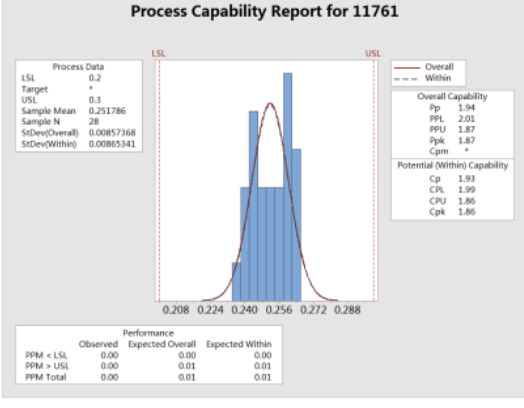










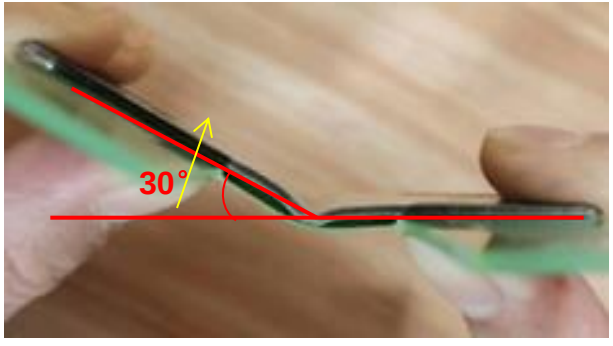


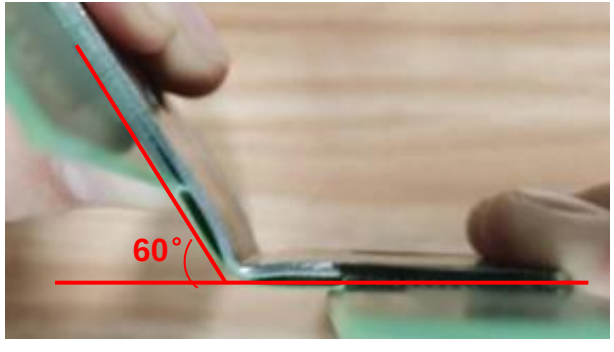
Remark: The Cpk data show remaining thickness at bending area can meet requirement.

3. UG Semi-Flex PCB Technology Study

3.4 Bending Test

As illustrated below, use mold with 30°、60°、90° and 120° to test.





Test method： First, press one side of the pcb tightly against the mold, bend another part of PCB from horizontal line tightly against the other side of the mold by hand, as shown in the above figure,

3. UG Semi-Flex PCB Technology Study

3.4 Bending Test

Item	PN	Laminate	Conductive Layer	Remain thickness part prepreg structure	Bending Angle	5mm	10mm	15mm	20mm	25mm	30mm	35mm
1	11716	A	One Conductive layer	Copper +2116+1080	30°	40/45	50+/50	50	50	50	50	50
					60°	32/33	50+/50	50	50	50	50	50
					90°	20/18	35/38	50	50	50	50	50
					120°	0	20	36	50	50	50	50
2	11717		Two Conductive layer	Copper+ 106+106+ 20Z copper +106	30°	25/29	50+/50	50	50	50	50	50
					60°	7/16	50+/50	50	50	50	50	50
					90°	0/5	15/20	50	50	50	50	50
					120°	0/0	8	16	50	50	50	50
3	11757	B	One Conductive layer	Copper + 2116+1080	30°	38/42	50+/50	50	50	50	50	50
					60°	30/35	50+/50	50	50	50	50	50
					90°	15/8	50+/50	50	50	50	50	50
					120°	0	32	40	50	50	50	50
4	11760		Two Conductive layer	Copper + 106+106+copper +106	30°	22/26	50+/50	50	50	50	50	50
					60°	8/11	50+/50	50	50	50	50	50
					90°	0/0	50+/50	50	50	50	50	50
					120°	0	15	28	50	50	50	50
5	11758	C	One Conductive layer	Copper + 2116+ 1080+	30°	32/38	50+/50	50	50	50	50	50
					60°	11/14	50+/50	50	50	50	50	50
					90°	0/0	50+/50	50	50	50	50	50
					120°	0	10/12	22	50	50	50	50
6	11761		Two Conductive layer	Copper + 106+106+2 0Z copper +106	30°	13	33	50	50	50	50	50
					60°	2/4	14/16	50	50	50	50	50
					90°	0/0	0/0	50	50	50	50	50
					120°	0/0	0/0	13	50	50	50	50

Remark: the bending result is judged by people.

3.4 Remarks to The Bending Test

1. Pass bending test judgement : no sound was heard during bending, no crack was visually found with naked eyes after bending.

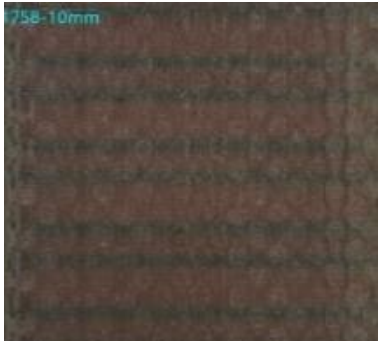
2. Bending times is much lowered for bending width 5mm and 10mm compared with 15mm; the smaller the bending angle, the more bending times it can support.

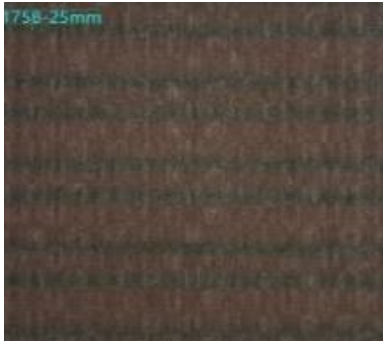
3. Prepreg type in bending part is critical to bending performance. In case a double-sided PCB most probably consisting of 7628 prepregs , the bending performance would be worse than the remain part consisting of thinner prepreg type such as 2116, 1080 or 106. Need to increase the bending length ,ie. Bending radius to improve bending angle.

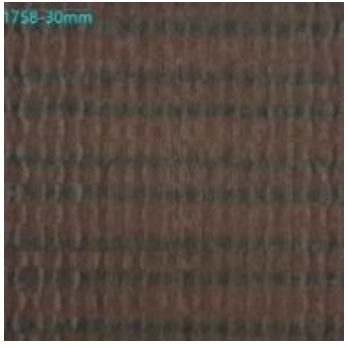
4. Bending test is assisted with a tool. In theory, the bigger radius, the less negative impact to bending result. The bending tools was not precisely made so the bending direction was set to match the tools. In a real design, an effective supporting to the bending area while bending is of big help.

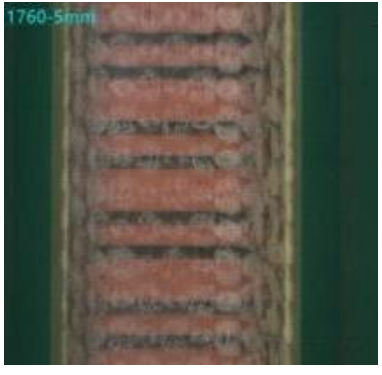
3. UG Semi-Flex PCB Technology Study

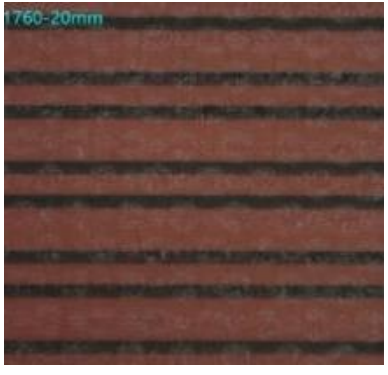
3.4 Glass Fiber Appearance Checking after Bending











The status after bending test: no break or crack was found on laminate surface by naked eyes.

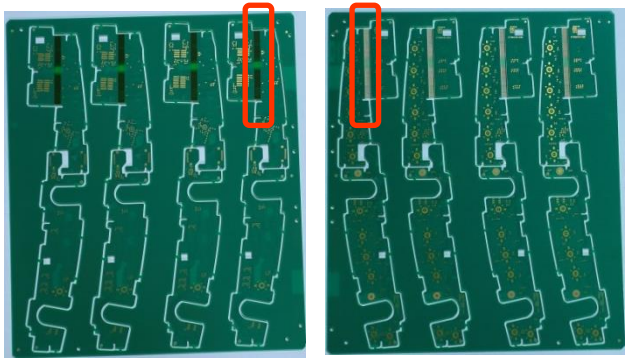
4. UG Semi-Flex PCB Capability

Semi-Flex PCB Control Points	Semi-Flex PCB **Technology Capability**
Layer Count	≤16L， bending area with 1-2 conductive layer
Material	FR4 + Flex solder mask
Remaining Thickness and tolerance at Bending Area	0.25mm+/-0.05mm.
Bending Capability	bending angle and times are decided by remain thickness, prepreg type in the bending part and bending length. This need to be tested case by case.
Surface Finishing	OSP, ENIG, Gold finger, Immersion Ag, Immersion Tin, HASL

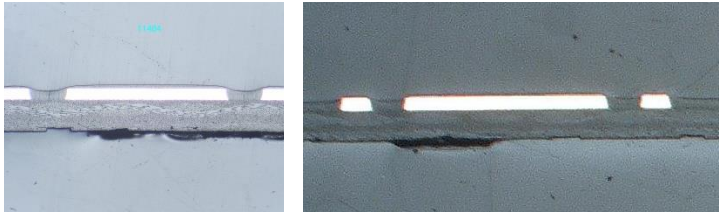
5. UG Semi-Flex PCB Product

Semi-Flex PCB	
Layer Count	4L (11404)
Application	Automotive Armrest Side winder Pxxx
Bending Portion Conductive Layer	1
Bending Angle	24°，5 times max
Bending Width	5+/-0.1mm
Remaining Thickness	0.25±0.05mm
Laminate Type	S1000H
Bending Portion Solder Mask Type	PSR-9000 FLX501
Bending Area PP Type and Structure	1080+2116

- **Physical Board**



- **Micro section**



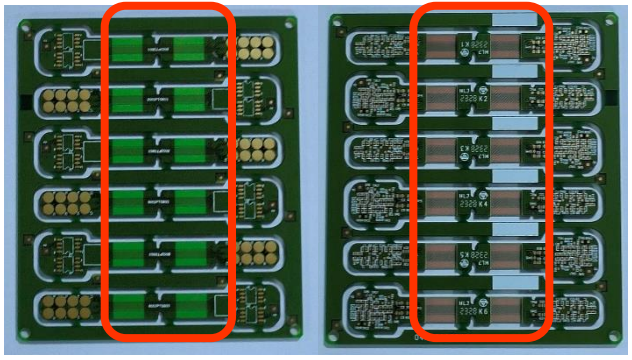
- **bended picture**

Actual test at about 24°

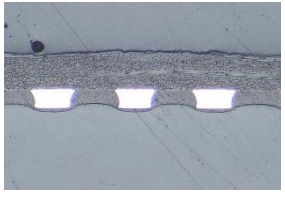
5. UG Semi-Flex PCB Product

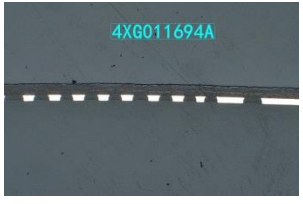
Semi-Flex PCB	
Layer Count	4L(11694)
Application	Chassis Control System
Bending Portion Conductive Layer	1
Bending Angle	90°，10times max
Bending Width	10.56+/-0.15mm
Remaining Thickness	0.20±0.1
Laminate Type	S1000H
Bending Portion Solder Mask Type	PSR-9000 FLX501
Bending Area PP Type and Structure	1080+2116

- **Physical Board**



- **Micro section**



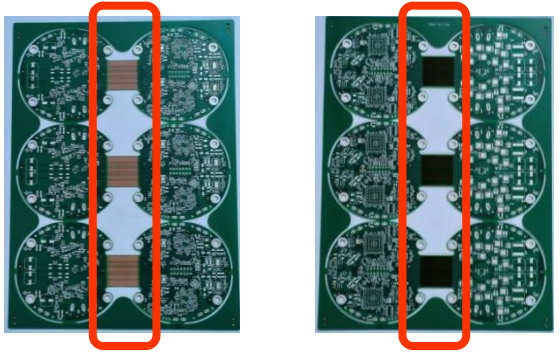


- **bended picture**

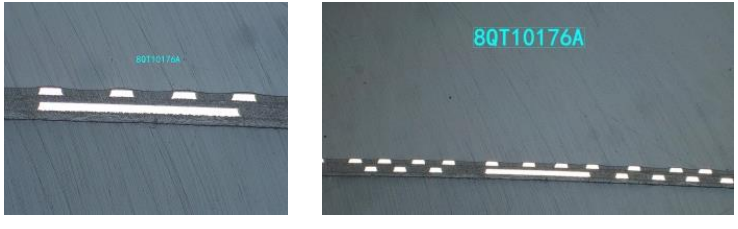
5. UG Semi-Flex PCB Product

Semi-Flex PCB	
Layer Count	8L (10176)
Application	Car Steering System-- Bxxx Hxxxx STEEING SYSTEMS
Bending Portion Conductive Layer	2
Bending Angle	90°，5times max
Bending Width	29.1+/-0.2mm
Remaining Thickness	0.3±0.05mm
Laminate Type	IT158
Bending Portion Solder Mask Type	PSR-4000 MH
Bending Area PP Type and Structure	1027

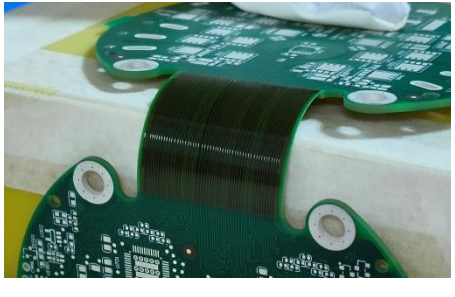
- **Physical Board**



- **Micro section**



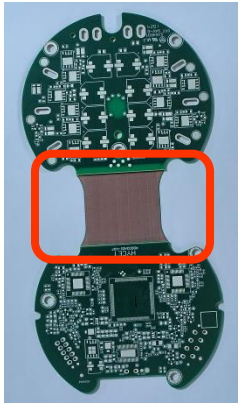
- **bended picture**

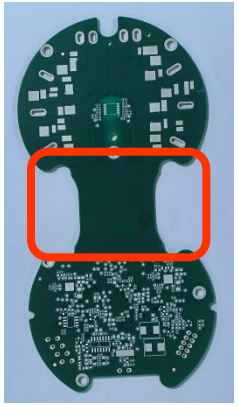


5. UG Semi-Flex PCB Product

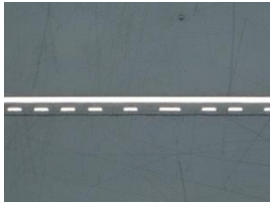
Semi-Flex PCB	
Layer Count	8L(12719)
Application	Car Steering System – Gxxxx Wxxx
Bending Portion Conductive Layer	2
Bending Angle	90°, 50times max
Bending Width	34.0+/-0.1mm
Remaining Thickness	0.25+/-0.05mm
Laminate Type	S1000H+ Semi-Flex material
Bending Portion Solder Mask Type	PSR-9000 FLX501
Bending Area PP Type and Structure	1080

- **Physical Board**





- **Micro section**

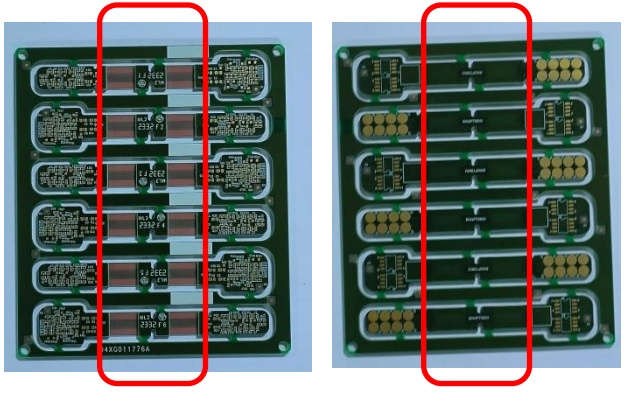


- **bended picture**

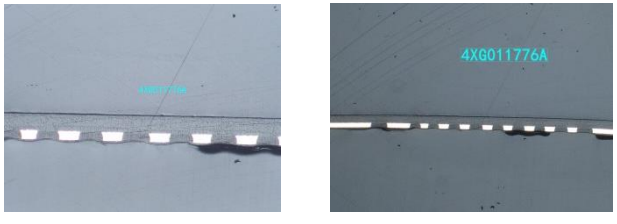
5. UG Semi-Flex PCB Product

Semi-Flex PCB	
Layer Count层数	4 L(11776)
Application	Chassis Control System
Bending Portion Conductive Layer	1
Bending Angle	90°, 10times max
Bending Width	10.56+/-0.15mm
Remaining Thickness	0.20±0.1
Laminate Type	S1000H
Bending Portion Solder Mask Type	PSR-9000 FLX501
Bending Area PP Type and Structure	1080+2116

- **Physical Board**



- **Micro section**

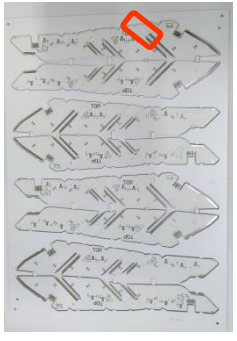


- **bended picture**

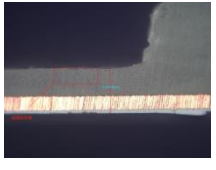
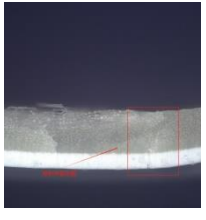
5. UG Semi-Flex PCB Product

Semi-Flex PCB	
Layer Count	2L(13435)
Application	Automotive Application ICAPE
Bending Portion Conductive Layer	1
Bending Angle	7.87°, required 5times max
Bending Width	3.0+/-1.0mm
Remaining Thickness	0.22-0.24mm
Laminate Type	SB170G
Bending Portion Solder Mask Type	PSR-9000 FLX501
Bending Area PP Type and Structure	7628

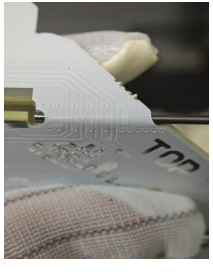
- **Physical Board**

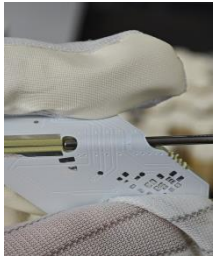


- **Micro section**

- **bended picture**

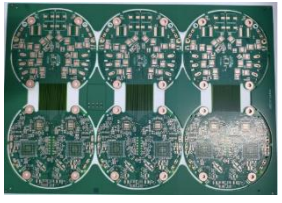


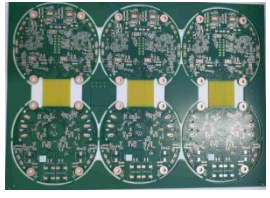


5. UG Semi-Flex PCB Product

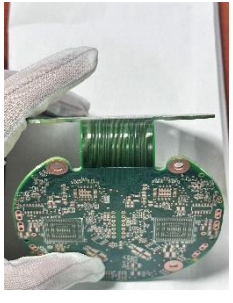
Semi-Flex PCB	
Layer Count	8L (15219)
Application	Automotive Application
Bending Portion Conductive Layer	1
Bending Angle	180°
Bending Width	30
Remaining Thickness	Max：0.28mm
Laminate Type	IT−158
Bending Portion Solder Mask Type	PSR-9000 FLX501
Bending Area PP Type and Structure	1027

- **Physical Board**





- **bended picture**




THANK YOU!