

RIGID-FLEX TECHNOLOGY AND APPLICATIONS

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Introduction

Rigid-Flex PCBs have been more widely used in electronic products of late. What has changed in this technology and how can this help to make products more efficient and small?

This eBook provides a quick view on Rigid-Flex and its applications. Rigid Flex PCBs are now used in many different products within end markets such as automotive, telecom, smart devices, sensors, AR/VR, etc. We will provide an insight to TTM's Rigid-Flex capability and Rigid-Flex technology roadmap.

The author, Joe Jiang, is the Field Application Engineering Manager of our Communications & Computing (C&C) Business Unit, supports our customers in the cellular, networking and communications, and computing end markets.

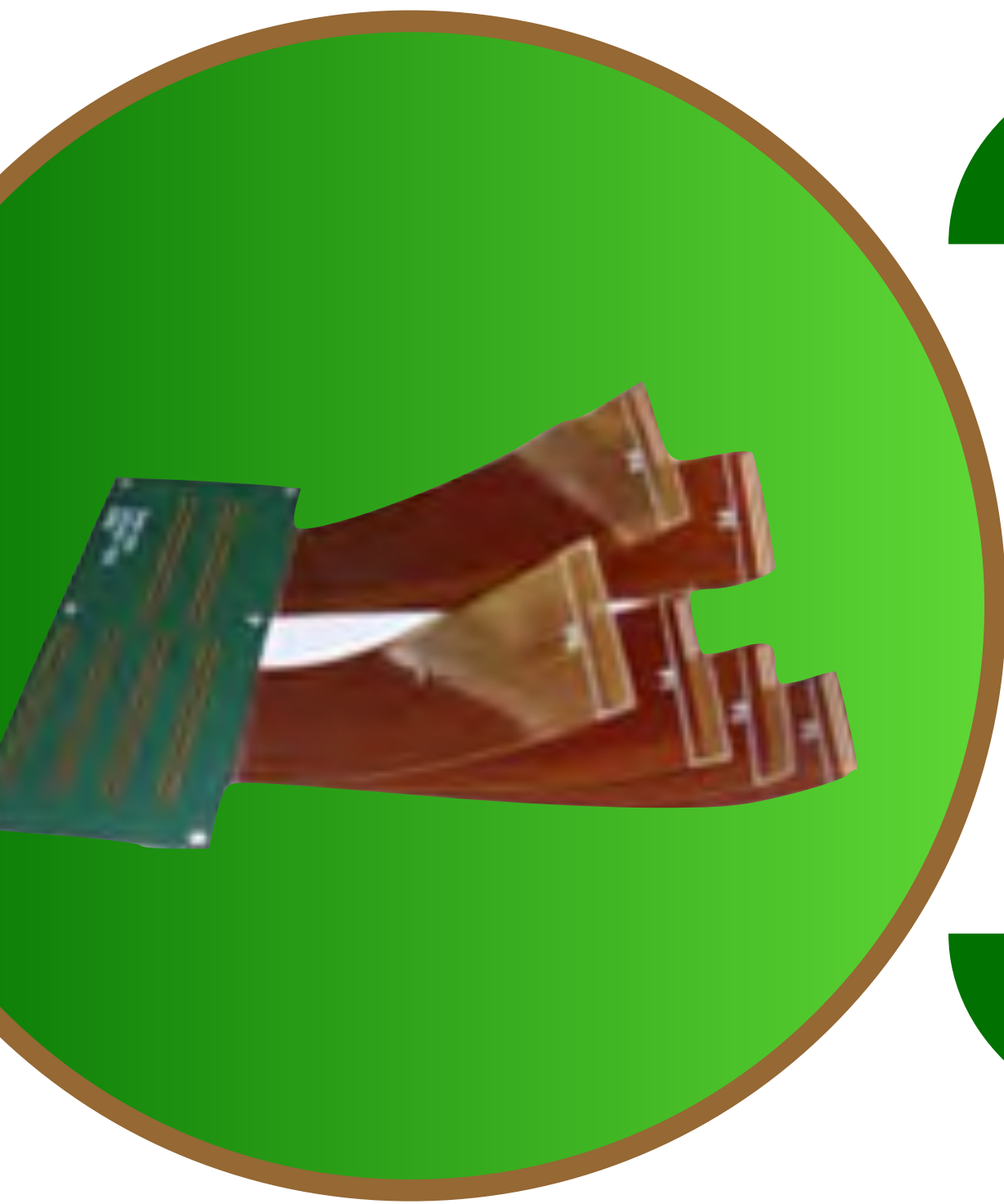
We look forward to meeting your technology and manufacturing needs.



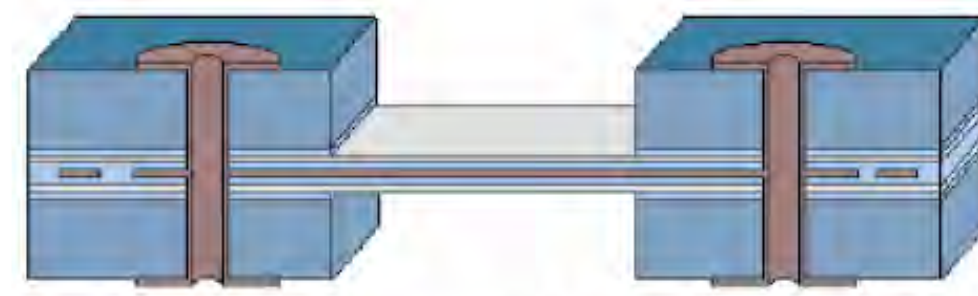
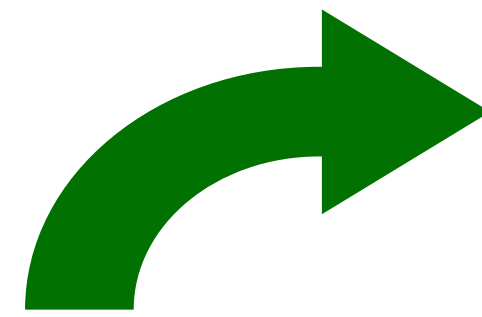
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WHAT IS RIGID-FLEX?

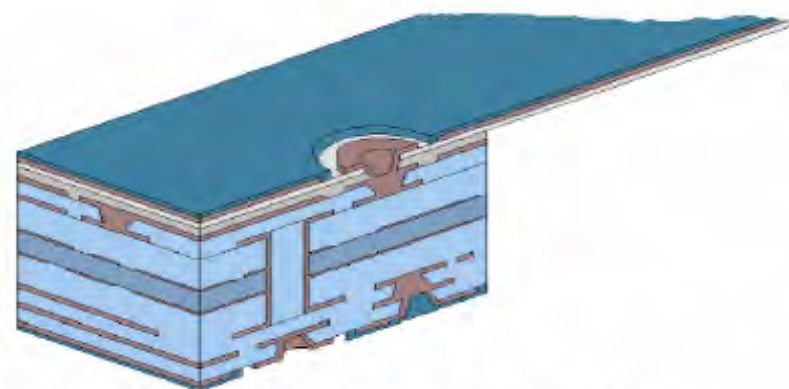
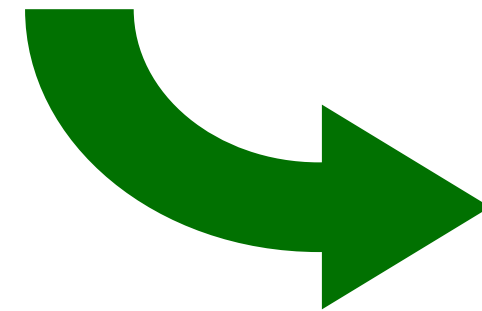


Rigid-Flex



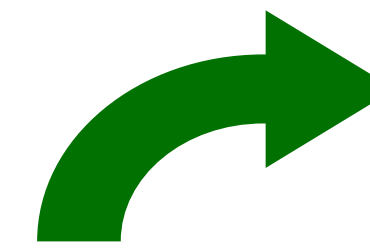
Conventional R-F HDI PCB

Flex part in the middle of the board

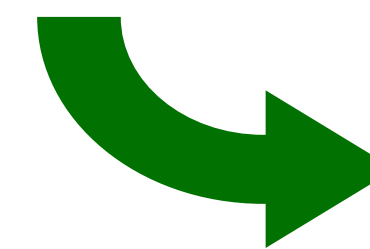


Semi-Flex HDI PCB

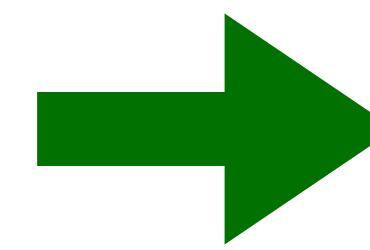
Flex part on the surface of the board



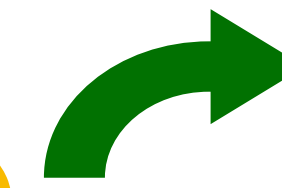
Balanced stack-up



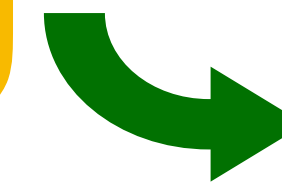
Unbalanced stack-up



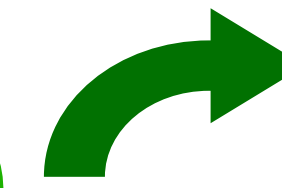
We call it semi-flex



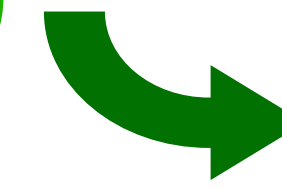
Balanced



Flying Tail



Unbalanced, X layer/X-2 layer

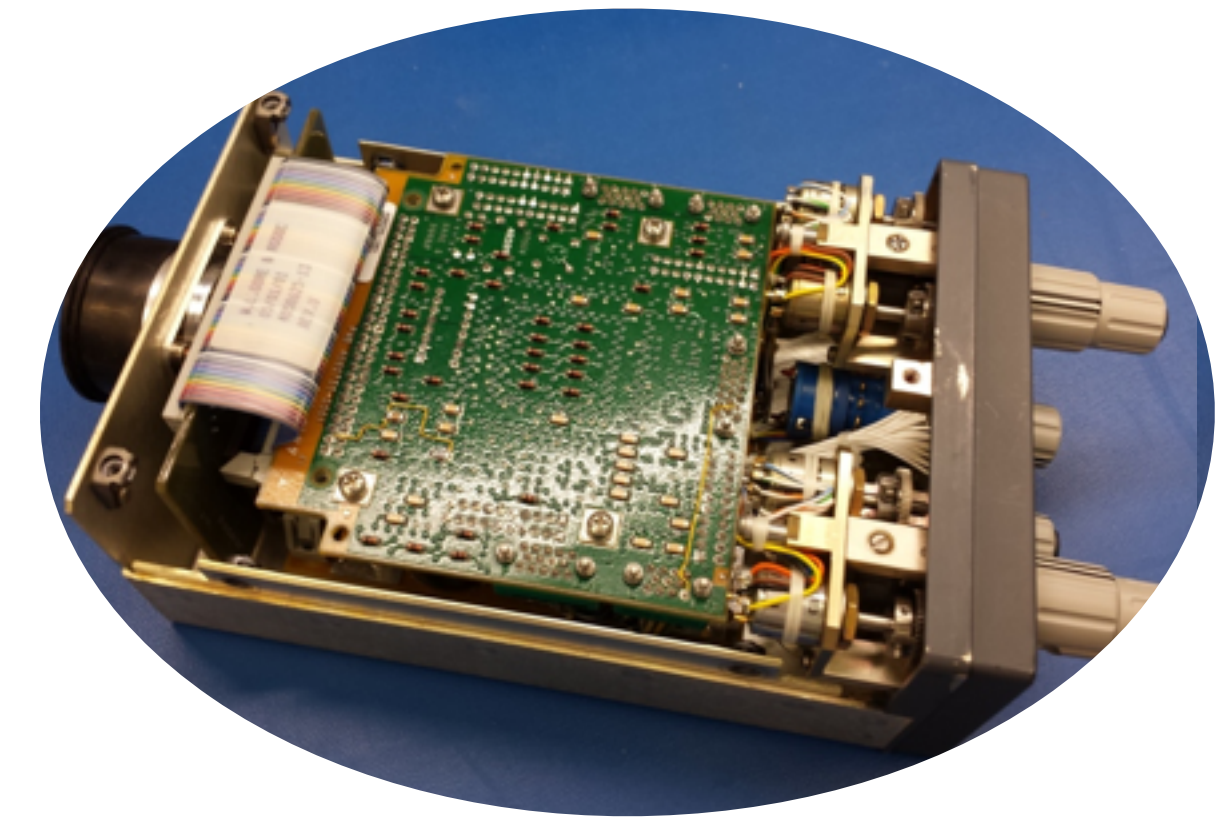


Unbalanced, Planar one side

WHY RIGID-FLEX?

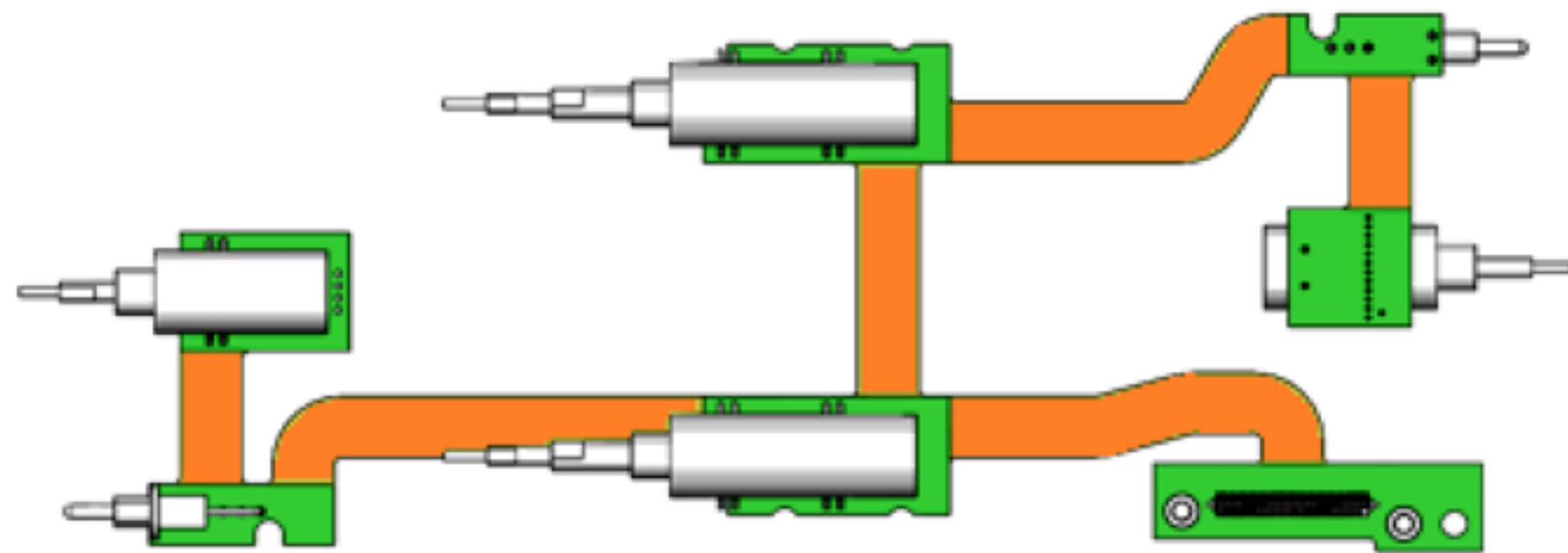
Advantages:

- Enabling technology for the next generation of products
- A single substrate for electronic system packaging
- Reduced system component & assembly operations
- Increased via reliability & fewer interconnections
- Improved signal integrity & impedance performance
- Increased functionality in less space
- Provides for a smaller, lighter & more reliable product

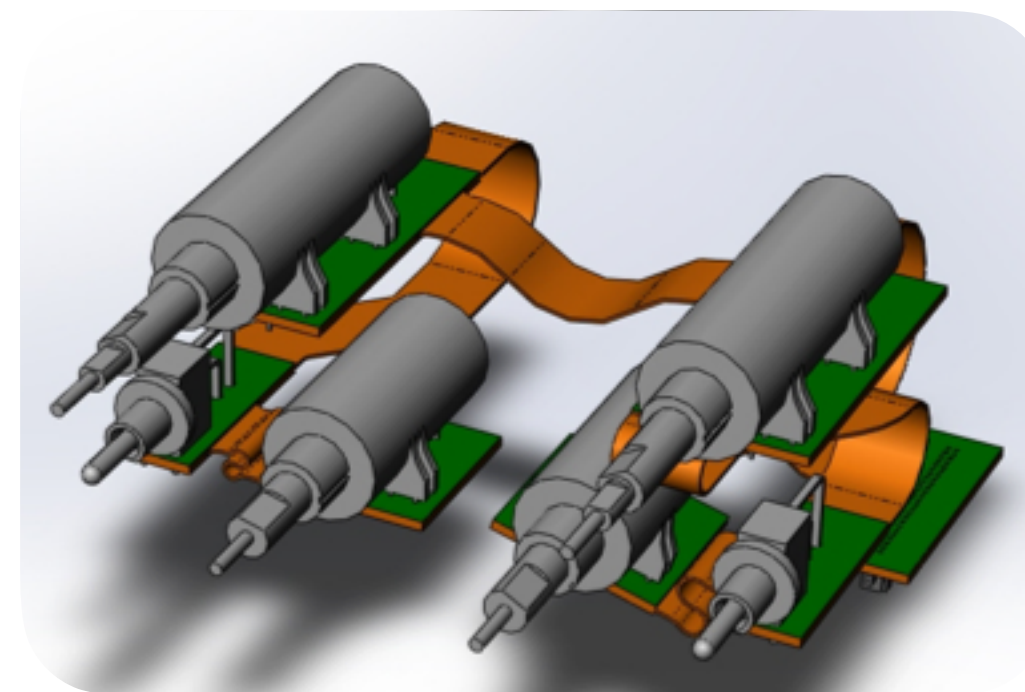


Before (Wire Bundles)

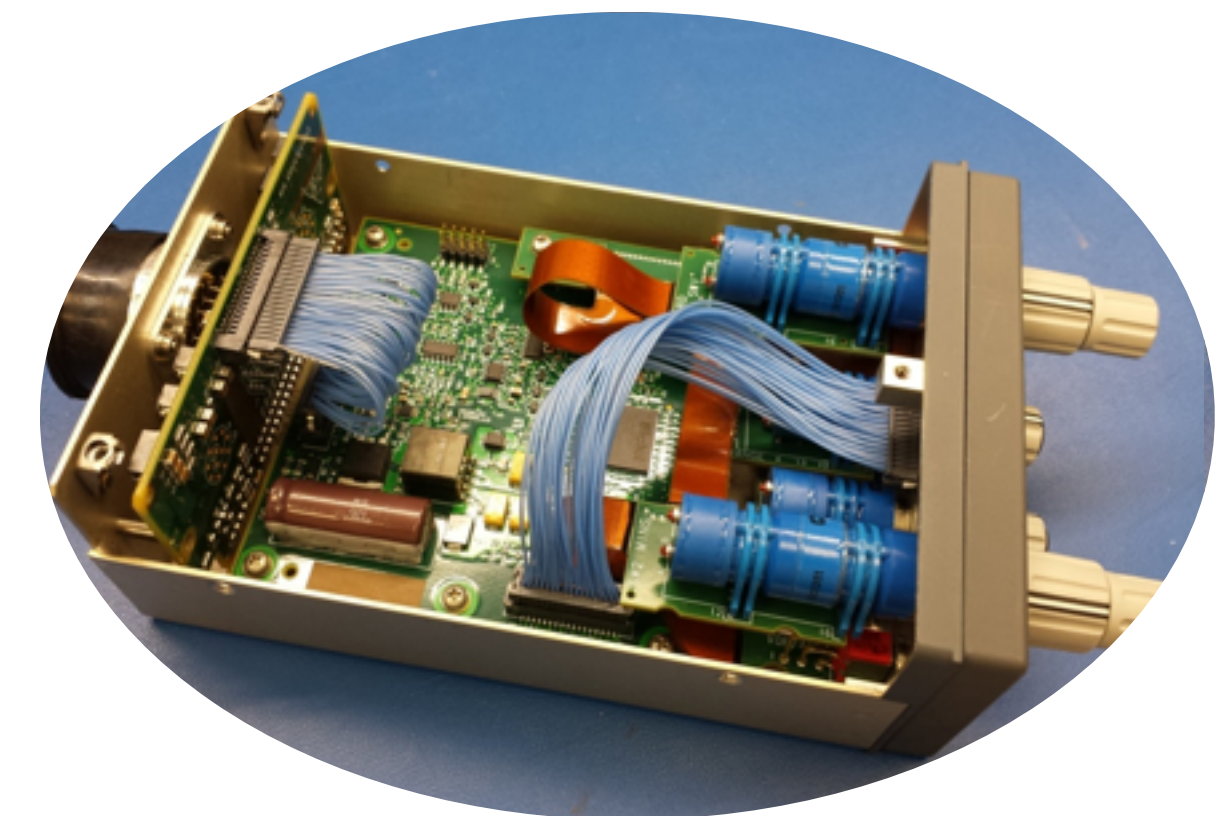
Solving Complex Design Challenges by Thinking in 3 Dimensions



Flat Layout...

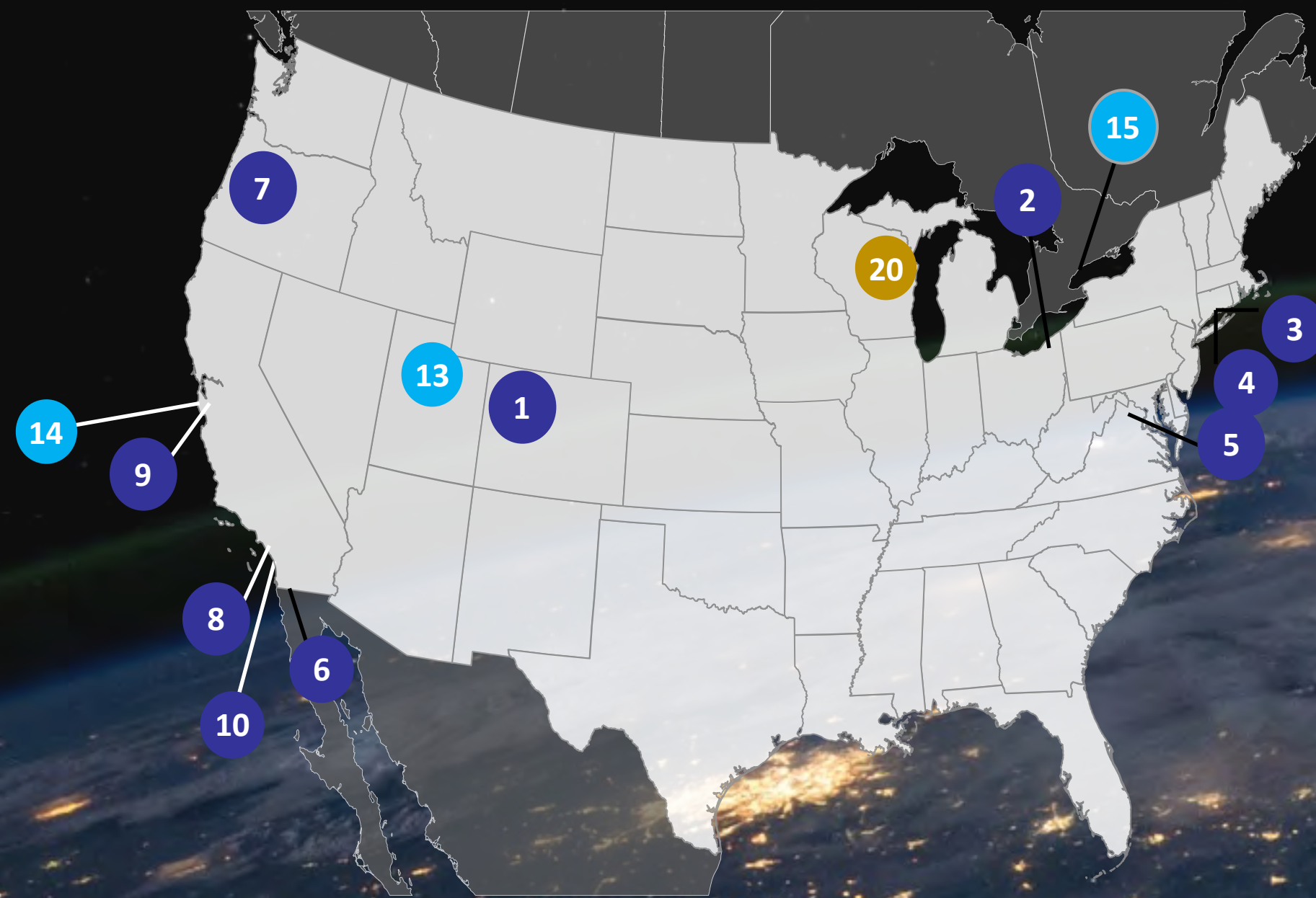


...As Installed



After (Rigid Flex)

TTM RIGID-FLEX SITES



A&D

Aerospace & Defense

- 1 Denver - DEN
- 2 North Jackson - NJ ★
- 3 Stafford - ST ★
- 4 Stafford Springs - SS
- 5 Sterling - STE

Specialty

- 6 Anaheim - ANA
- 7 Forest Grove - FG
- 8 Santa Ana - SA
- 9 Santa Clara - SC ★
- 10 San Diego - SD

AMI&I

Automotive

- 11 Zhongshan - ZS

Medical, Ind, Inst

- 12 Huiyang - HY
- 13 Logan - LG
- 14 San Jose - SJ
- 15 Toronto - TOR ★

C&C

Mobility

- 16 Guangzhou - GME
Guangzhou - FPC ★
- 17 Shanghai - SME ★
- 18 Shanghai - SP

Communications

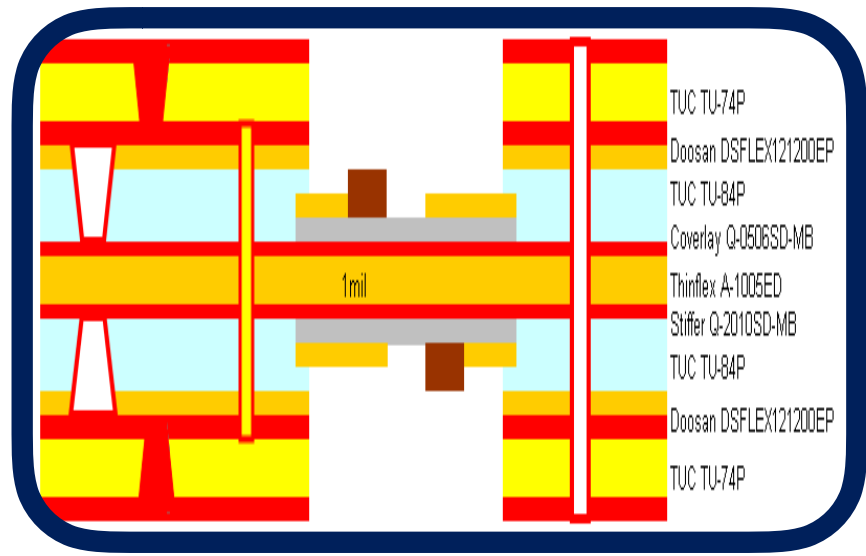
- 19 Hong Kong - OPCM
- 20 Chippewa Falls - CF
- 21 Dongguan - DMC
- 22 Guangzhou - GZ

E-MS

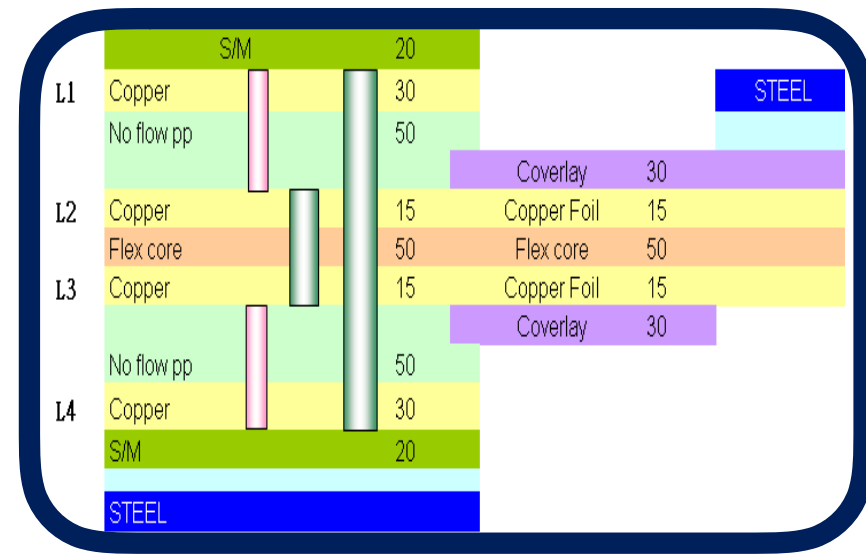
E-M Solutions

- 23 Shanghai - SH
- 24 Shanghai - SH E-MS
- 25 Shenzhen - SZ

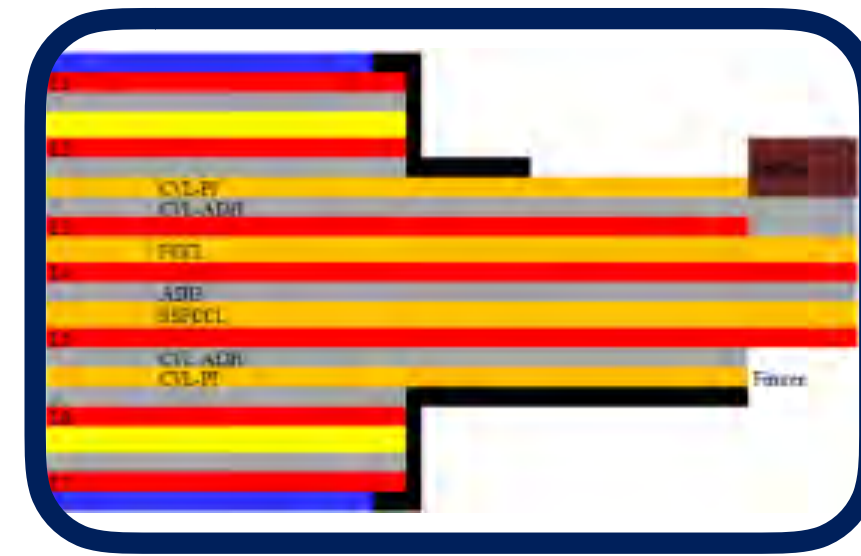
★ Flex / Rigid-Flex sites



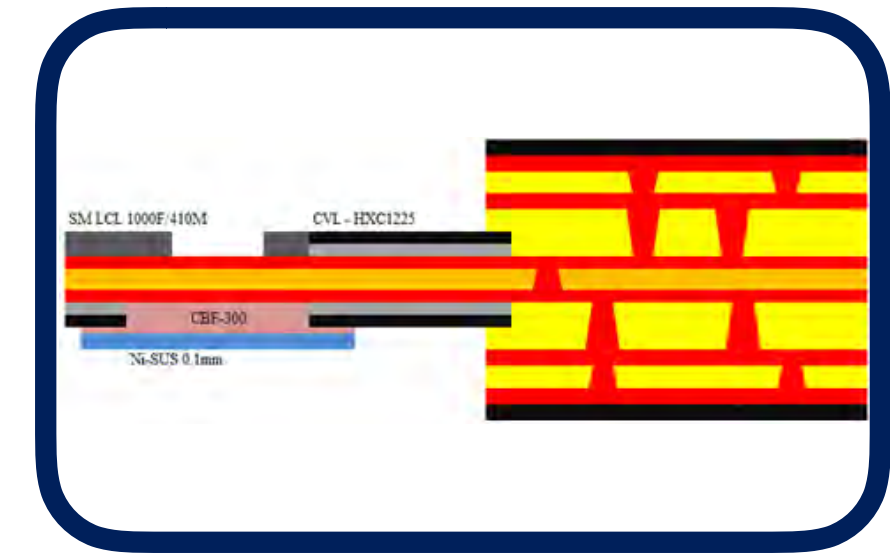
MP3 main board
6L 2+ HDI



Camera module
4L 1+ HDI



Headset jack/Speaker/USB interface (7L)



6~12L any-layer
Wearable product

2008

2009

2010

2011

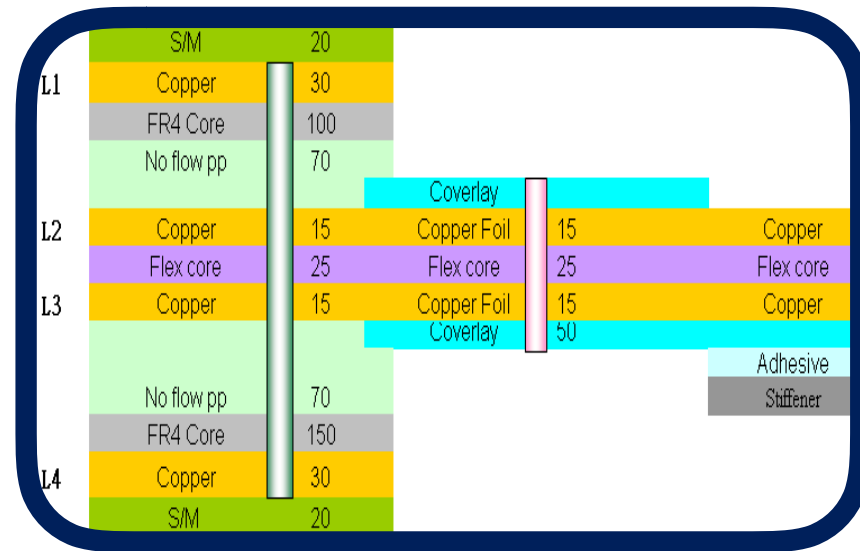
2012

2013

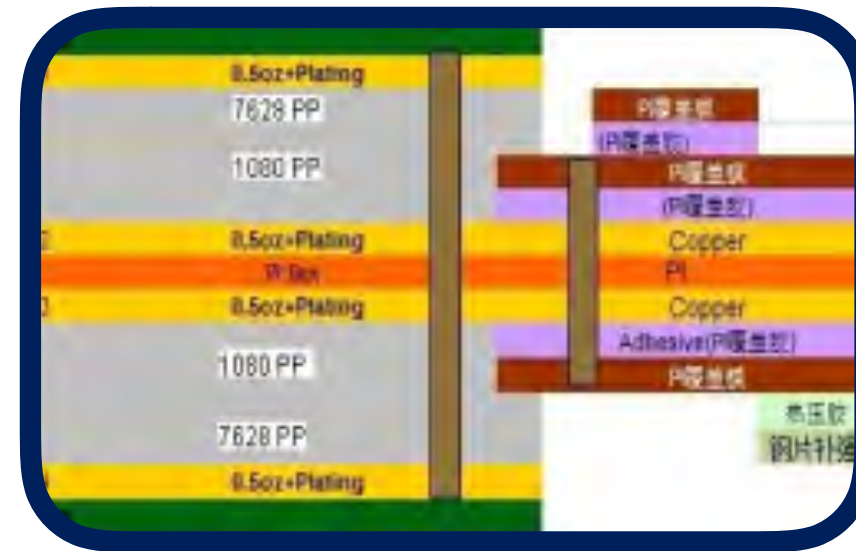
2014

2015

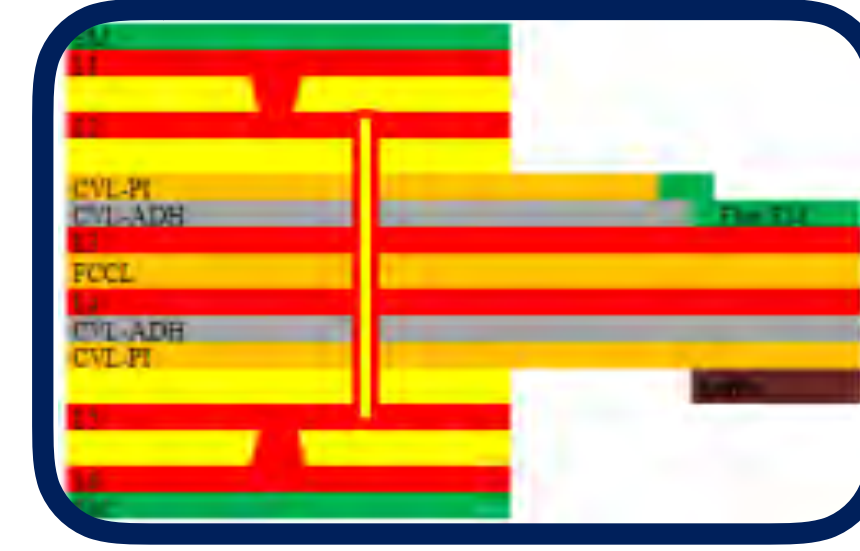
PRESENT



Smartphone Touch Module (4L)



Smartphone Battery (4L)



Wristband
6L 1+HDI

HIGHEST POINT OF RIGID-FLEX OUTPUT: 80K SQFT/MONTH

MEDICAL , INDUSTRIAL & INSTRUMENTATION

MOBILITY

COMPUTER AND COMMUNICATIONS

AUTOMOTIVE



TTM RIGID-FLEX TECHNOLOGY MILESTONE

Mass production stage

*For TTM Shanghai (SME)



TTM RIGID-FLEX TECHNOLOGY ROADMAP

*For TTM Shanghai (SME)



Item		Mass Production	2017	2018	2019
Total rigid-flex Layer count		16	24	24	24
Flex Layer Count		4	6	6	6
Max. Production Panel Size		410x500mm	457x508mm	457x508mm	533x610mm
Board Thickness	Min(6L)	0.35mm	0.3mm	0.3mm	0.27mm
Min. Base Copper	Flex Section	12um	12um	12um	12um
	Outer Layer	12um	12um	12um	12um
Min. Dielectric Thickness	Flex Section	25um	20um	20um	12.5um
	Rigid Section	43um	38um	30um	30um
Min. Mechanical Drill Size / Pad Size	Flex Section	150/350um	100/300um	100/275um	100/250um
	Rigid Section	150/350um	100/300um	100/300um	100/300um

Item		Mass Production	2017	2018	2019
Stack up		Anylayer & multilayer of flex with air-gap	Anylayer & multilayer of flex with air-gap		
Stacked via		Anylayer	Anylayer		
Min Line Width / Spacing / (Cu Thickness)	Inner Layer	50/50/(18)um	45 / 45/(18)um	40/40/(18um)	40/40/(18um)
	Outer Layer	50/50/(22)um	40/50(18um)	40/50(18um)	40/40(15um)
Copper Filling Dimple Size		15um	10um	5um	5um
Min Laser Drill Size / pad size		100/250um	75/210um	70/210um	60/180um
Max Laser Via Aspect Ratio		0.75:1	0.8:1	0.8:1	0.8:1
Soldermask Registration		+/-38um	+/-30um	+/-25um	+/-25um
Max. Low flow PP/Adhesive squeeze-out (mm)		0.5/0.4	0.4/0.3mm	0.3/0.3mm	0.3/0.25mm

TTM RIGID-FLEX TECHNOLOGY ROADMAP

*For TTM Shanghai (SME)



KEY EQUIPMENTS



Lamination



LDI



Horizontal Plating

*For TTM Shanghai (SME)



Laser Drilling



AVI



Auto stiffener placement



Plasma

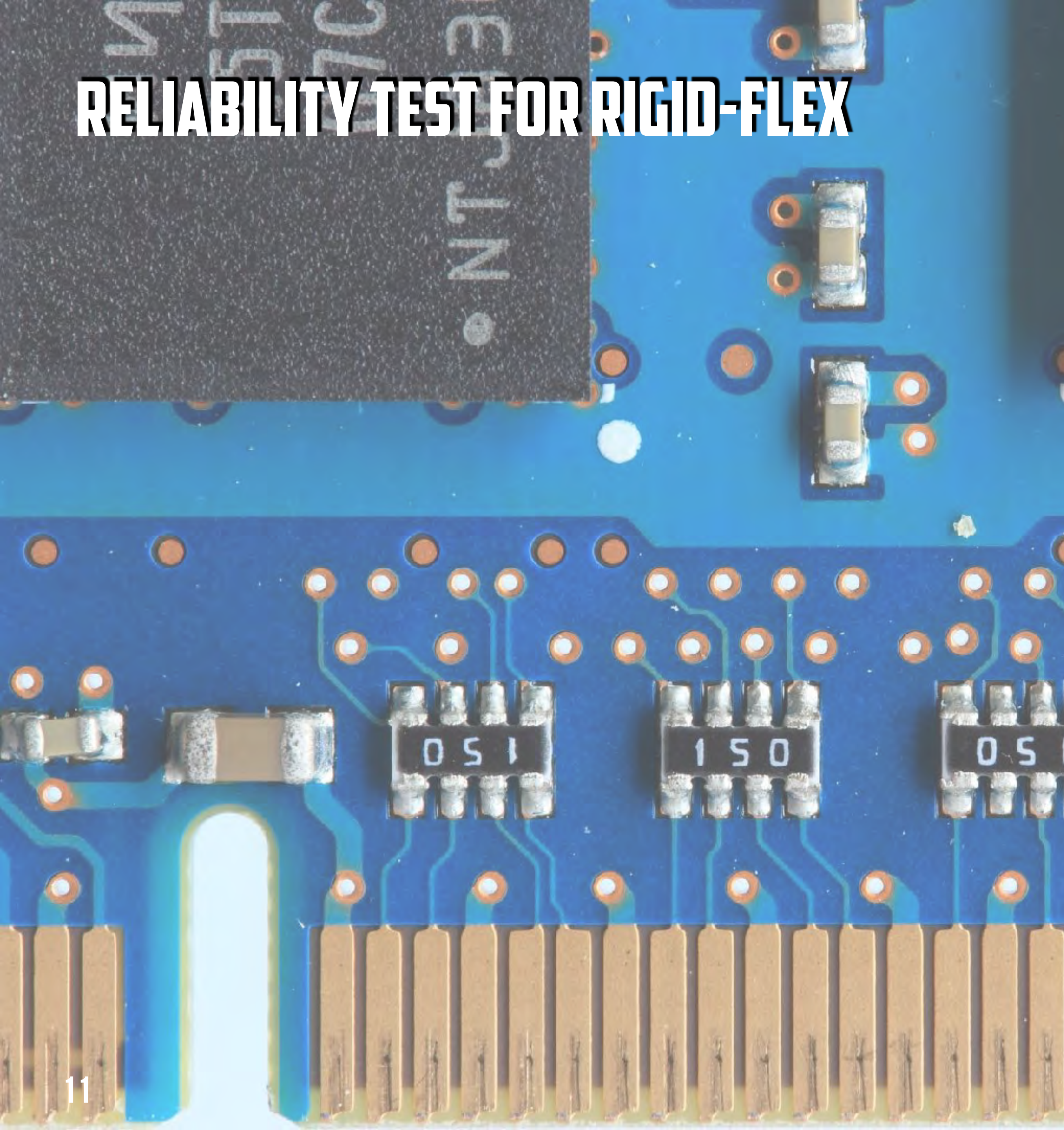


Yamaha Punch



UV Laser

RELIABILITY TEST FOR RIGID-FLEX



#	Test	Condition	Acceptance Criteria	Result
1	Solder Float	260C X 10s, 3 times solder float	1)No delamination, 2)No visual defects on cross section inspection.	Pass
2	Solder Dip	260C X 10s, 3 times solder dip	1)No delamination, 2)No visual defects on cross section inspection.	Pass
3	IR-Reflow	Lead free profile, 260C peak temperature, 6 times.	1)No delamination, 2)No visual defects on cross section inspection	Pass
4	Hot Oil	20C X 20s ~ 260C X 20, total 60 cycles.	1)No visual defects on cross section inspection, 2)Resistance change $\leq 10\%$.	Pass, Max. change: 2.54%.
5	Air to Air Thermal Shock (AATS)	-65C X 30min. ~ 125C X 30min., total 1000 cycles.	1)No visual defects on cross section inspection, 2)Resistance change $\leq 10\%$.	Pass, Max. change: 7.8%.
6	High Temperature and High Humidity Bias Test (HHBT)	85C, 85%RH, DC 50V X 1000 hours	Test every 5 hours, the resistance should $\geq 1 \times 10^6$ Ohm.	Pass, Min. resistance: 1.09×10^9 Ohm.

TTM RIGID-FLEX SOLUTION - TTM SHANGHAI (SME)



Established Year	1997
Total Employees	1,700
Facility Size	248,406 Sq ft
Product Focus	400,000 Sq ft/ Month
Certificates	Rigid Flex (HDI & Rigid), Advanced HDI (2+, 3+, & Any Layer)
Location	TS16949, ISO14001, ISO9001, OHSAS18001, ISO27001, Sony Green Partner
Transportation	By Car to Town Centre

Contact Us

NORTH AMERICA

✉ NAMarketing@TTM.com

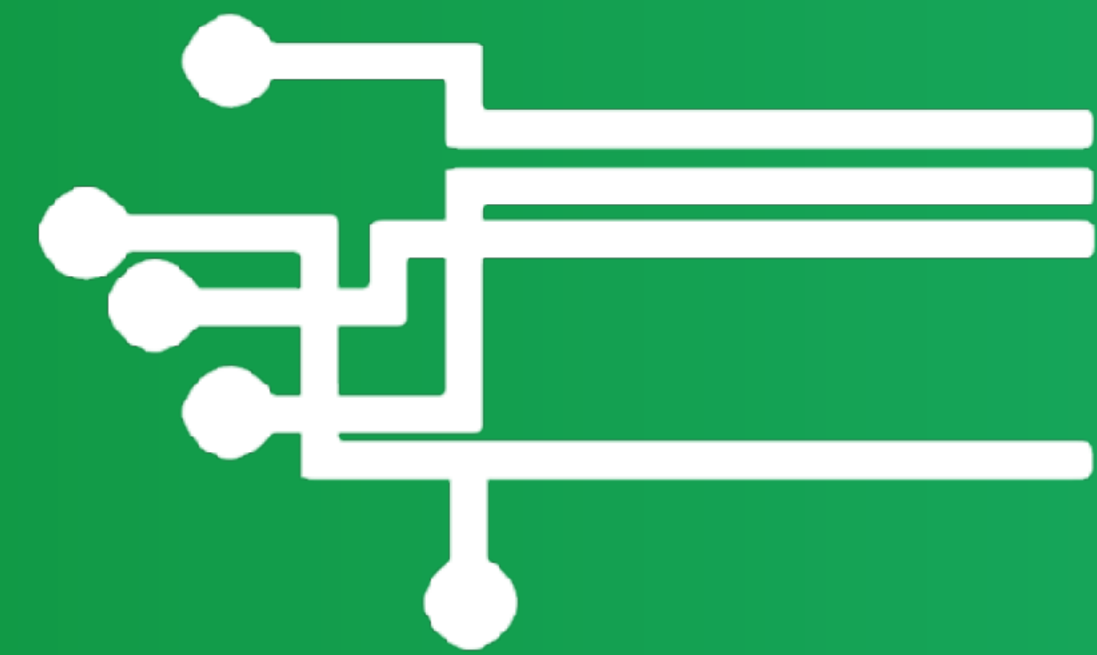
ASIA PACIFIC

✉ APMarketing@TTM.com



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About TTM Technologies, Inc.

TTM Technologies, Inc. is a leading global printed circuit board ("PCB") manufacturer, focusing on quick-turn and volume production of technologically advanced PCBs, flex and rigid flex PCBs, backplane assemblies and electro-mechanical solutions. TTM stands for time-to-market, representing how TTM's time-critical, one-stop manufacturing services enable customers to shorten the time required to develop new products and bring them to market. Additional information can be found at www.ttm.com.

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