Challenges of Building RF Multi-Chip Modules

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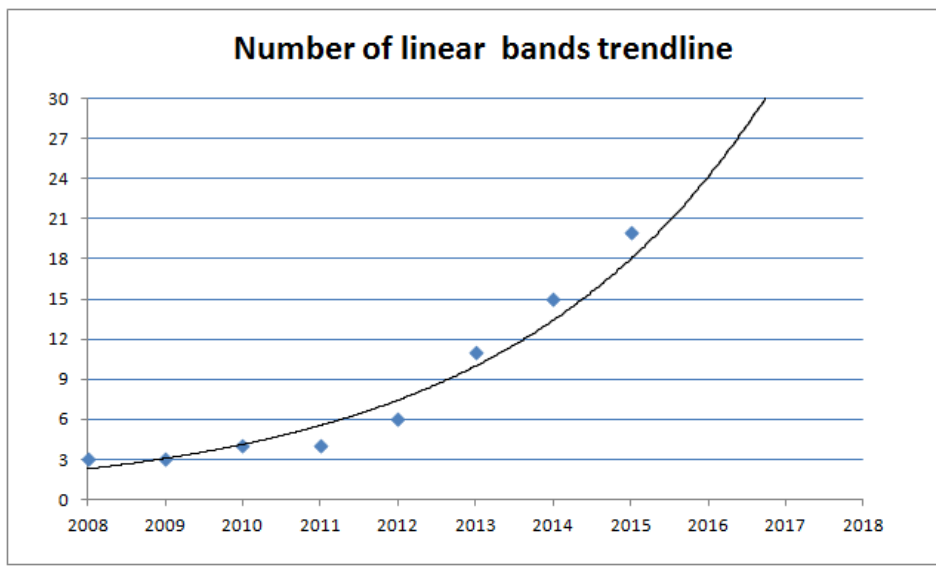
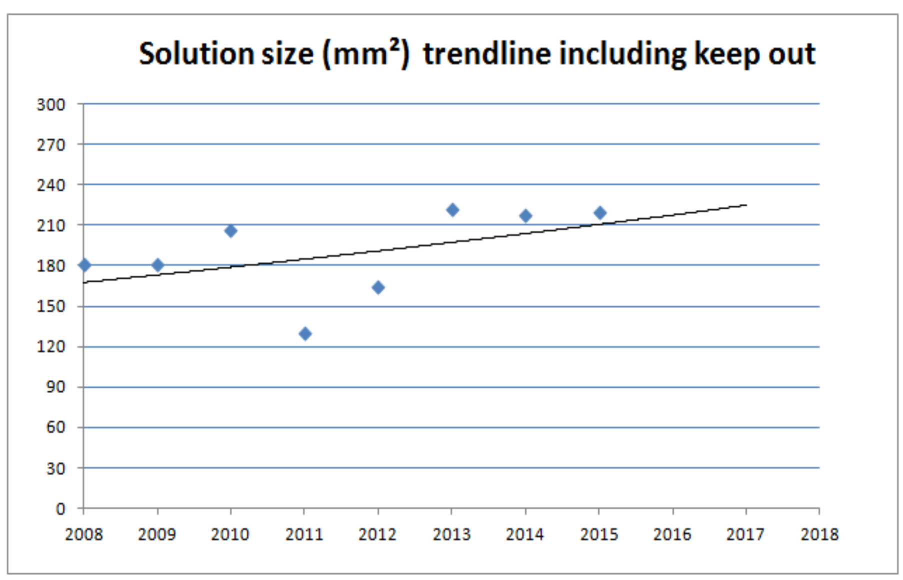
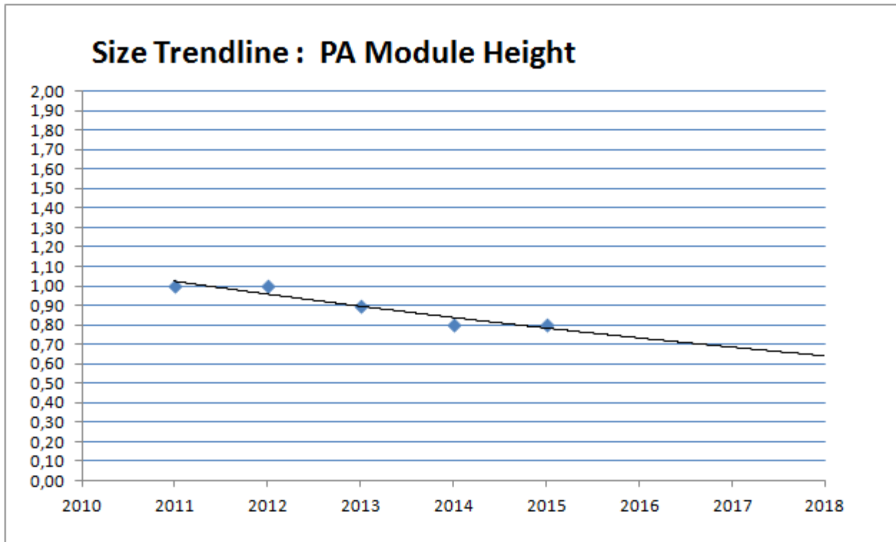
Market Trends







2014:	**0.8., 0.9mm**
2015:	**0.8mm**
2016:	**0.7mm**
2017:	**0.7, 0.6mm**
2018:	**0.6mm**

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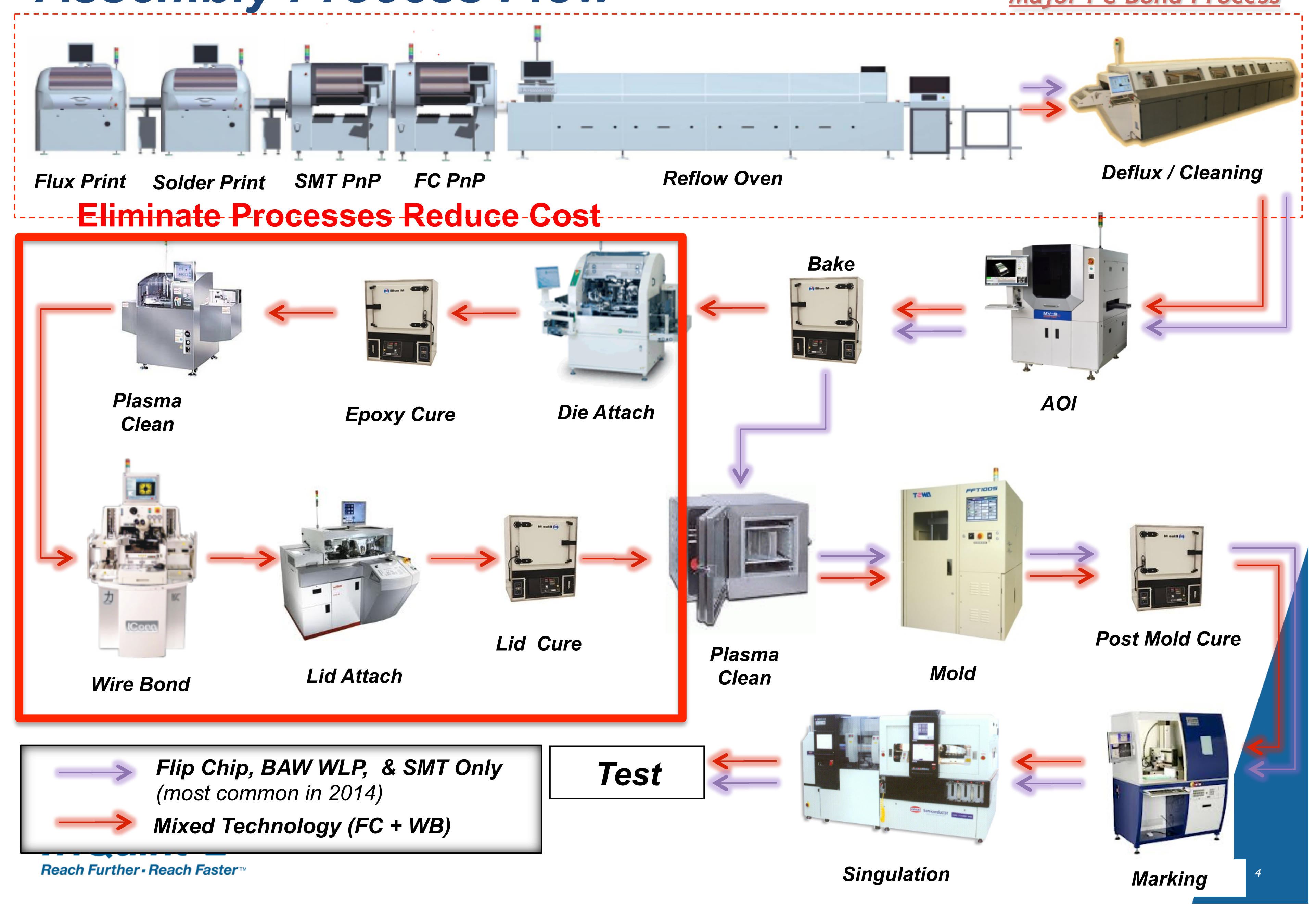
Biggest Challenges in RF Module Manufacturing

COST

SIZE

Assembly Process Flow



New Passive sizes Revolutionizes Placement Systems

0402
(01005)
0201
0603
(0201)
(008004)
0.25mm x 0.125mm
muRata

Metric code	Actual size	Imperial code
0402		01005
0603		0201
1005		0402
1608		0603
2012		0805
2520		1008
3216		1206
3225		1210
4516		1806
4532		1812
5025		2010
6332		2512

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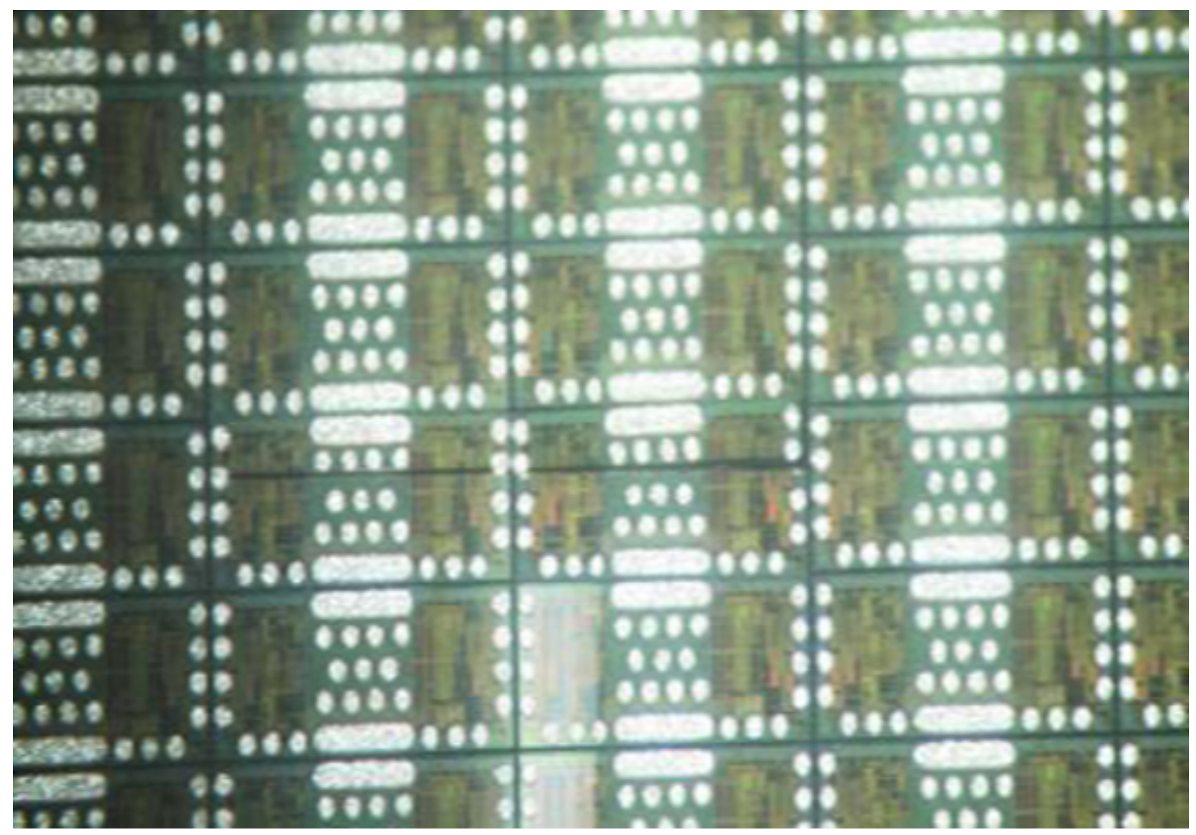
Typical RF Flip Chip Die on Wafer



Pad arrayed on die not just peripheral

Larger bump can remove more heat improving performance

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Key Developments Make Flip Chip Cost Effective

- **Bumping of wafers in the FAB is lower cost than S-via formation**
  - Cost of copper pillar bumping in high volume is much less than S-via formation in RF die
  - Die shrink is easier with arrayed I/Os versus peripheral pads
- **New SMT placement equipment must be able to place 01005 sized passive components**
  - With the new accuracy and precision required for extremely small passives you get flip chip placement accuracy at high speed
  - New vision and laser alignment optics can pick out bump locations
- **High speed die sort equipment can quickly and accurately tape and reel flip chip die**
  - T&R equipment can T&R die in greater than 14K die per hour
  - SMT equipment is optimized for T&R component presentation

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Old Method of Die Placement (DDF)

Direct die feed (DDF) place flip chip die at 1800 UPH
Many issues with die drop and tape stretch

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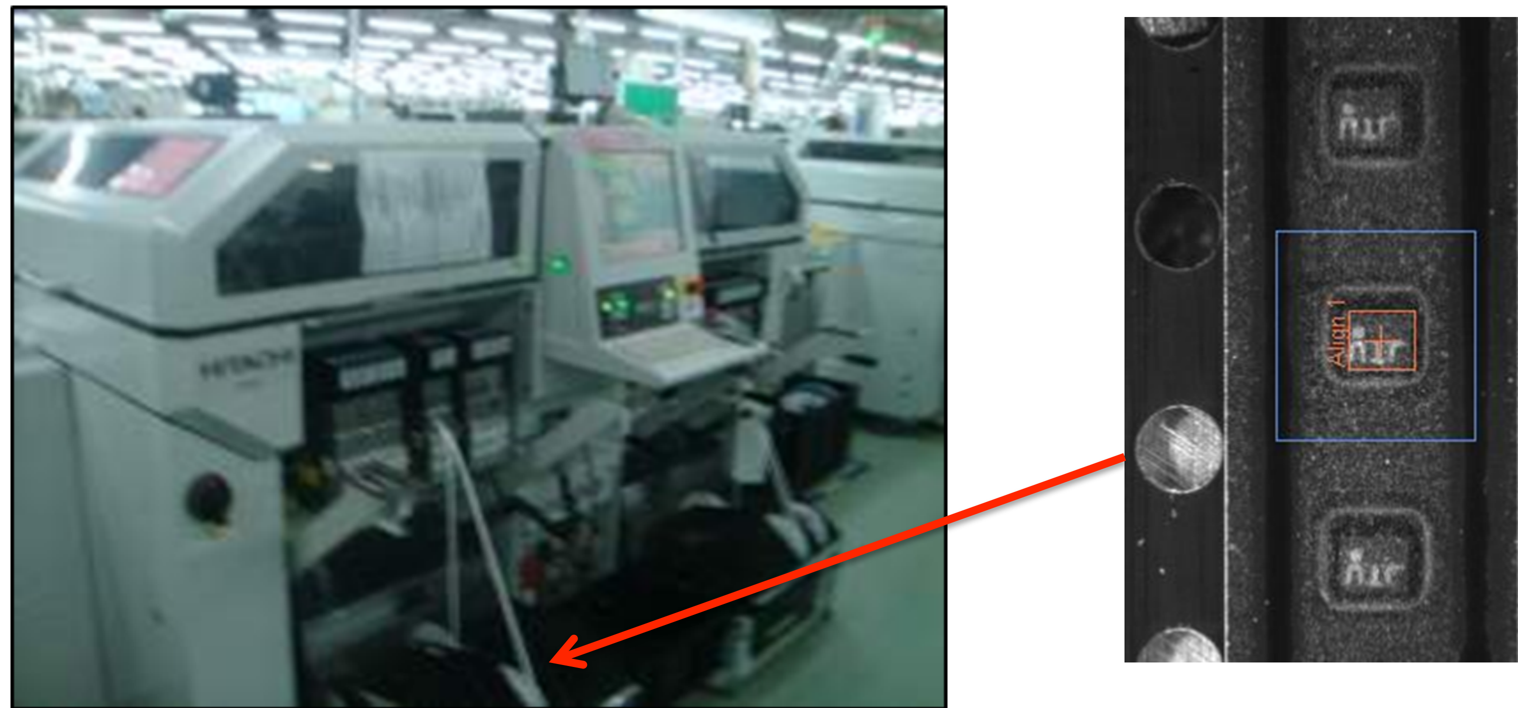
New High Accuracy & Speed SMT Equipment



New equipment has fast placement speed and 30um placement accuracy

Replaces DDF feed equipment with Taped components

Taped component placement speed of 30,000 uph

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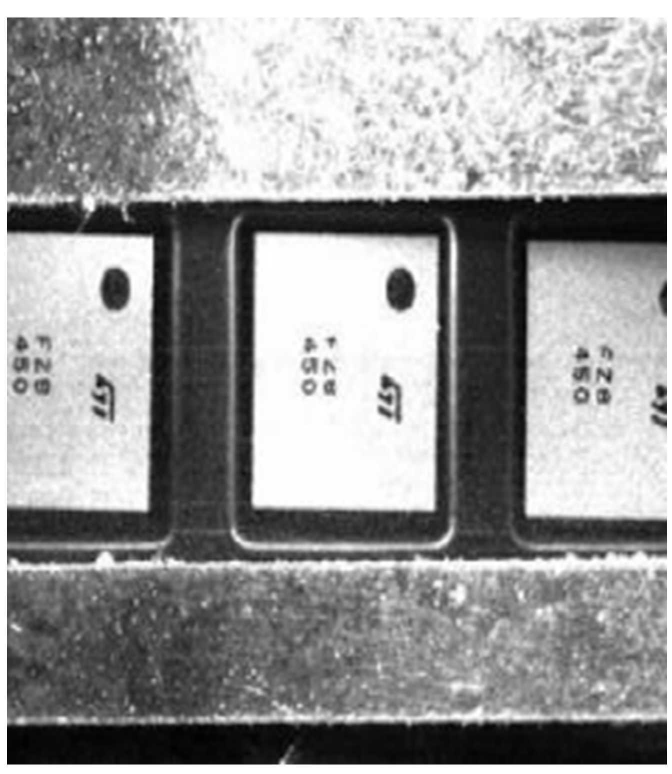
High Speed Die Sort and Tape Equipment



Reads wafer map to find good die

Place die into tape at 14,000UPH

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Summary

- New SMT equipment improves SMT and F/C placement speeds
- Flip chip has now become lower cost that chip and wire processing
- New high speed die sort tools make tape and reel die cost effective
- Flip chip allows for closer spacing and denser modules resulting in smaller more functional modules at a lower cost

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