IT3 Test Vehicle Assembly Yield Test

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1 OVERVIEW

The purpose of this test is to provide customer a way of quantifying the expected manufacturing yield of the IT3 connector system in a mass production environment. This is accomplished by providing statistical data that simulates IT3's mounting performance in a CEM/mass production setting, using pre-existing processes for both mounting and inspection.

2 TEST OBJECTIVES

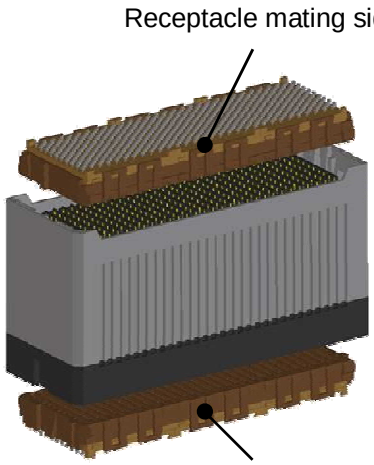
By using the combination of standard mounting processes, typical PCB configuration, and the IT3 connector system, the goal was to provide the following data:

- Statistical data including:
  - A set number of mounts to represent a mass production setting.
  - Differing connector pin-counts and mounting orientations to reflect real applications.
  - Single reflow and double reflow specification, to represent both, top and bottom mountings.
  - Differing process parameters such as paste volume and flux.
  - Reported percentage of any failures.
- 5DX inspection results
  - Standard mass-production inspection process.
- 2D x-ray inspection results
  - Determine real failure or false call from 5DX inspection results.

3 TEST VEHICLES

3.1 Connector Type

Mezzanine connector : Hirose IT3 series



❑ Receptacle

· IT3M-300S-BGA(57)…Mounting side
300 signal pins (Total 570 joints including ground pins)

· IT3D-300S-BGA(57)…Mating side
300 signal pins (Total 570 joints including ground pins)

· IT3M-200S-BGA(57)…Mounting side
200 signal pins (Total 380 joints including ground pins)

· IT3D-200S-BGA(57)…Mating side
200 signal pins (Total 380 joints including ground pins)

3.2 Build Matrix

The following number of boards and connectors were used to determine results.

Total Board Qty : 190

Total Connector Qty : 1900

The assembly yield tests were performed at two CEM mass production locations.

CEM1 (Flextronics, Austin)

Process order	Test board	Stencil type	Connector part No.	Board Qty.	Connector Qty.	Comments
1	DC	5mil	IT3D-200S-BGA(57)	30	150	Nitrogen atmosphere 2X reflow (2nd reflow with connector on bottom side)
			IT3D-300S-BGA(57)		150	
		7mil	IT3D-200S-BGA(57)	15	75	
			IT3D-300S-BGA(57)		75	
2	MB	5mil	IT3M-200S-BGA(57)	30	150	Nitrogen atmosphere 1 X reflow
			IT3M-300S-BGA(57)		150	
		7mil	IT3M-200S-BGA(57)	20	100	
			IT3M-300S-BGA(57)		100	
Total				95	950	

CEM2 (Jabil, Penang)

Process order	Test board	Connector part No.	Board Qty.	Connector Qty.	Comments
1	DC	IT3D-200S-BGA(57)	45	225	Nitrogen atmosphere 2x reflow (2nd reflow with connector on bottom side)
		IT3D-300S-BGA(57)		225	
2	MB	IT3M-200S-BGA(57)	50	250	Nitrogen atmosphere 1 X reflow
		IT3M-300S-BGA(57)		250	
Total			95	950	

4 ASSEMBLY CONDITIONS

4.1 Test Board Design Details

❑ Test Board Design Details per IPC-9701

	Item	Requirement	Remarks
1	Thickness	93 mils (2.4mm)	—
2	# of Metal Layers	8 layers	—
3	Layer Structure	See Fig. 1	—
4	PCB Material	High Tg FR-4	—
5	Ground Layer	70% copper mesh	—
6	Signal Layer	30% copper weave	—
7	Daisy Chain	Top layer	All signal pads are connected in series for electrical measurement
8	Pad and Via	Pads for probing on the bottom layer through via	Simulate mechanical strength of actual PCBs with signal vias
9	Surface Finish	High Tg OSP (Organic solderability preservative)	—
10	Pad Design	NSMD (Non-solder mask defined) See Fig. 2	—
11	Copper Thickness	Outer layer: 35 microns (1 ounce) Inner ground: 35 microns (1 ounce) Inner signal: 18 microns (0.5 ounce)	—
12	# of Connectors	10 connectors per board	—

Note: Vias are not connected to any specific signal or ground layers. Ground pads and ground inner layers are left unconnected.

		thickness(mm)	Total thickness(mm)
1	Top layer (Signal : Dogbone via) + GND(Meshed, 70%copper)	0.035	
	FR-4 P.P	0.15	
3	Signal(X-Weaved、30% cupper)	0.018	
	FR-4 P.P	0.15	
4	Signal(Y-Weaved、30% cupper)	0.018	
	FR-4 P.P	0.15	
5	GND(Meshed, 70%copper)	0.035	
	FR-4 Core	1.3	2.4
6	GND(Meshed, 70%copper)	0.035	
	FR-4 P.P	0.15	
7	Signal(Y-Weaved、30% cupper)	0.018	
	FR-4 P.P	0.15	
8	Signal(X-Weaved、30% cupper)	0.018	
	FR-4 P.P	0.15	
9	Bottom layer (Signal pad dazy chain) + GND(Meshed, 70%copper)	0.035	

Fig. 1 PCB Layer Structure

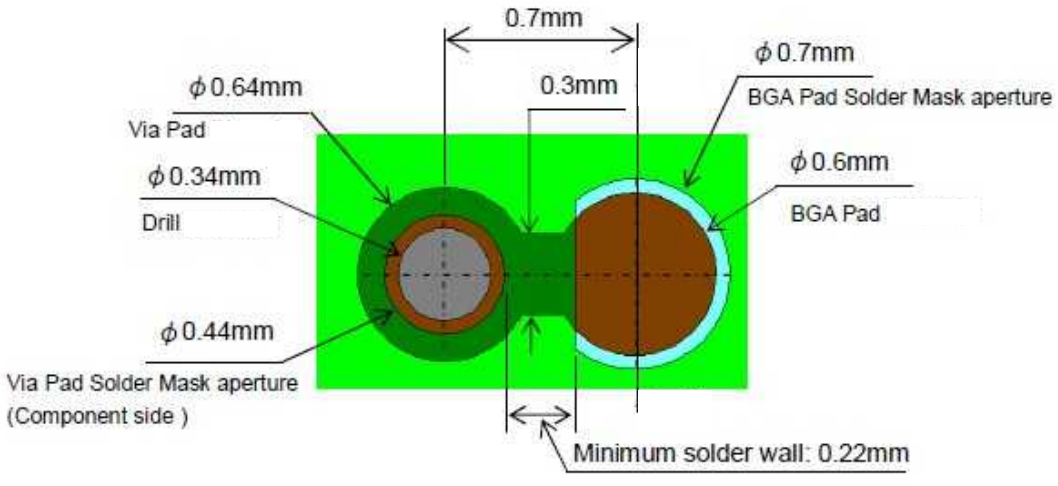


Fig. 2 PCB Pad Design

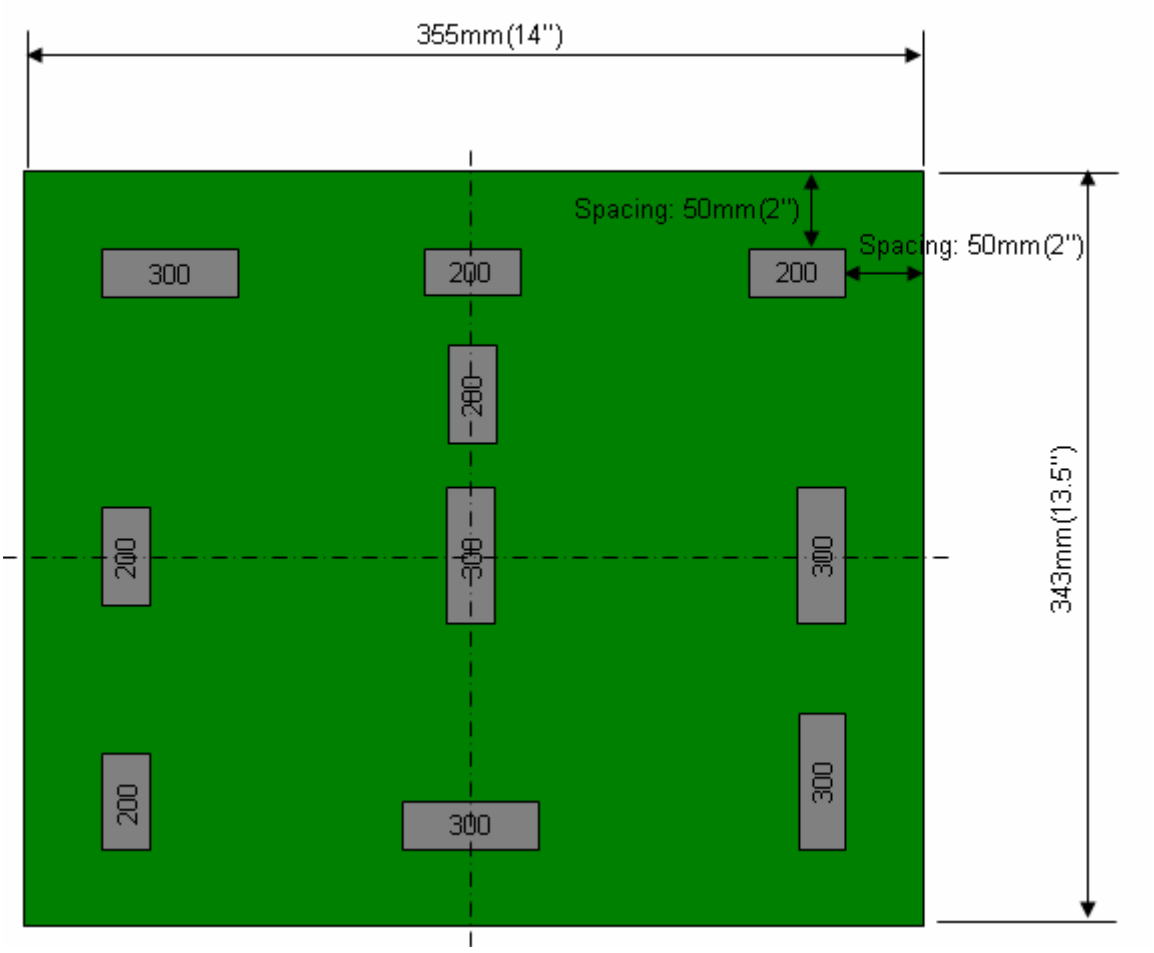
4.2 Test board layout

PCB size is the same as typical line-cards or motherboards.

Connectors were strategically placed around the perimeter in locations that have the highest chance of bad soldering, in both X & Y orientation, and, in a combination of 200 and 300 positions to represent actual application requirements.

Boards include a total of 10 connectors, with 8 being placed on the perimeter, and the balance along the center line to show the effects of any board warpage on the mounting of the connectors.

The minimum distance from connector edge to from the PCB edge was 50mm.



4.3 Test Vehicle Assembly

Major CEMs' followed current standard practices for mass-production assembly.

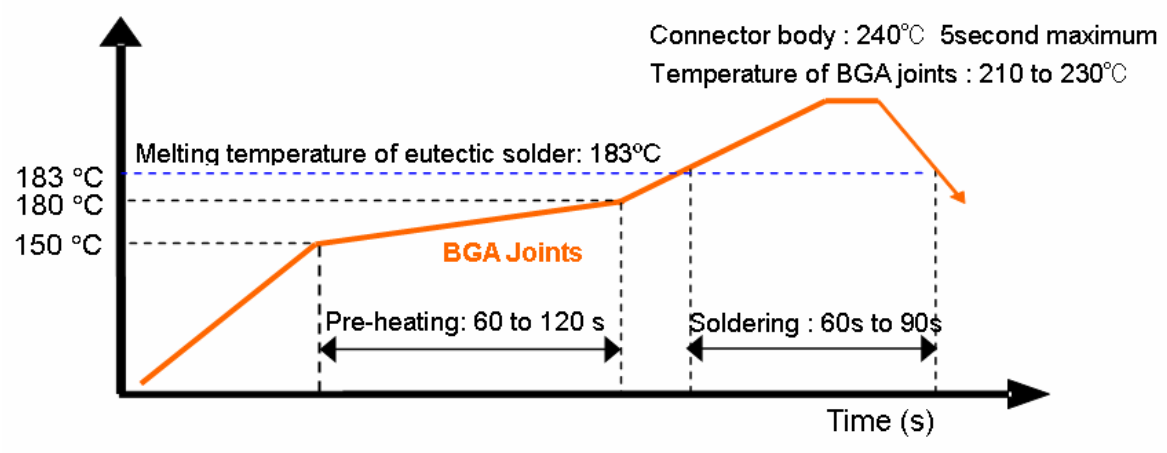
4.3.1 Assembly Parameters

Process parameters followed during the test.

Items	Requirements
Type of Reflow Equipment	Mass-reflow conveyor furnaces
Pre Conditioning	Dry package
Stencil / Theoretical paste volume	1. 23 mil round, 5 mil thk / 2076 mil^3 (Flextronics) 2. 28 mil round, 7 mil thk / 4308 mil^3 (Flextronics) 3. 22.4×21.1 ellipse, 5 mil thk / 1943 mil^3 (Jabil)
Solder Ball Composition	Eutectic: Sn63 Pb37
Solder Paste (Composition)	1. Kester HM531 water-soluble eutectic solder paste (Flextronics) 2. Kester R560 Type 3 water-soluble eutectic solder paste (Jabil)
Process Parameters	See attached reports from CEMs
Reflow atmosphere	Nitrogen atmosphere (low O2)

4.3.2 Reflow Temperature Profile

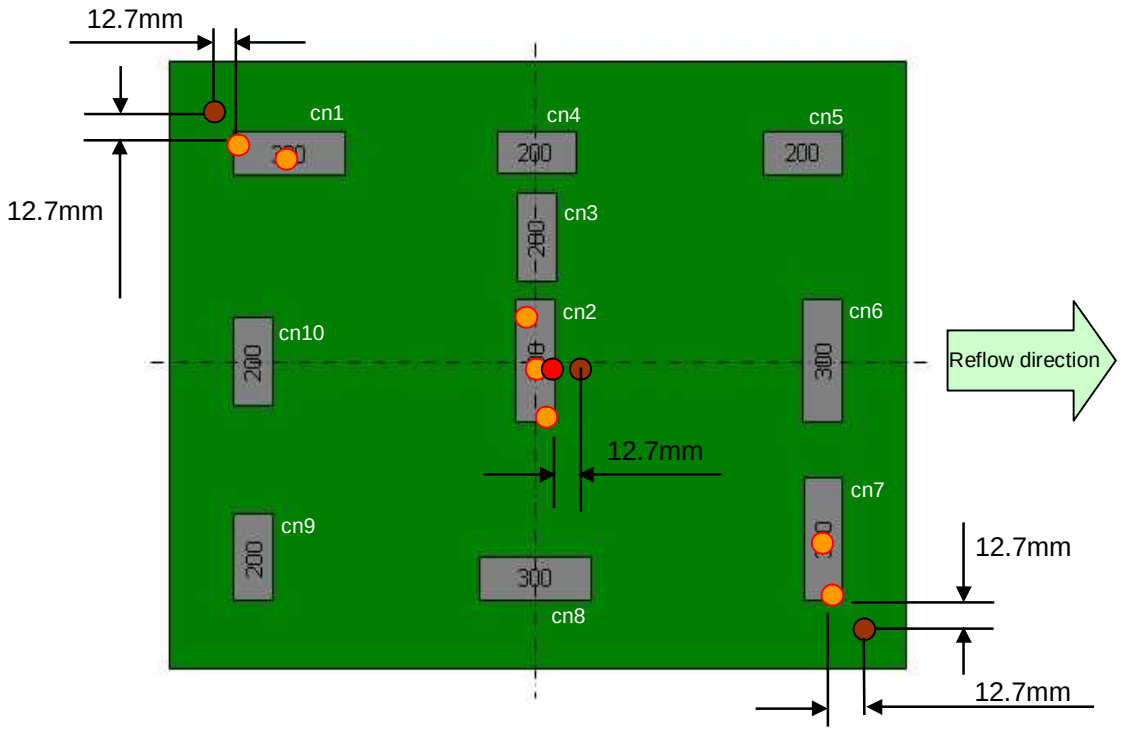
CEMs defined reflow temperature profile based on their own pre-existing process referring to HIROSE suggested reflow profile.



Example of typical IT3 reflow profile

Temperature measurement points on Connectors

- Attached to a BGA joint (Under the connector by inserting T/C through drilled hole on PCB)
- Attached to a connector body
- Attached to PCB surface



4.4 X-ray Inspection

X-ray inspection after assembly was conducted. Any connector showing the following failures is checked. : “solder-bridge”, “open joint”, “voids”, “solder ball mis-alignment”, or “insufficient solder”.

- All Mother boards and daughter cards were 100% inspected using 5DX x-ray.
- All 5DX calls were reported, and then verified with 2D x-ray to determine if real failure.

5. RESULTS

See attached reports from CEMs (Flextronics and Jabil) for more details.

1. No issues were found in this validation run with respect to board design and it's manufacturability.
2. 99.9% connector yield was achieved (Total connector failure rate 0.1%).
3. Total pin failure rate 2.2 DPMJ (Defect Per Million Joints)
4. Three paste volumes showed good results.
5. Both Kester HM531 and R560 solder pastes showed good results.

		Signal Pin	Stencil Type	Connectors Tested	Pins Tested	5DX Calls				Failure			
						Connector		Pin		Connector		Pin	
						# of Conn.	Call Rate %	# of Pins	Call Rate DPMJ	# of Conn.	Failure Rate %	# of Pins	Failure Rate DPMJ
CEM1 Flextronics	DC	300 pins	5mil	150	85,500	0	0	0	0	0	0	0	0
			7mil	75	42,750	6	8.0	6	140.4	0	0	0	0
		200 pins	5mil	150	57,000	0	0	0	0	0	0	0	0
			7mil	75	28,500	3	4.0	3	105.3	0	0	0	0
	MB	300 pins	5mil	150	85,500	3	2.0	4	46.8	1	0.7	1	11.7
			7mil	100	57,000	12	12.0	19	333.3	1	1.0	1	17.5
		200 pins	5mil	150	57,000	2	1.3	2	35.1	0	0	0	0
			7mil	100	38,000	27	27.0	57	1500.0	0	0	0	0
	Total			950	451,250	53	5.6	91	201.7	2	0.2	2	4.4
CEM2 Jabil	MB	300 pins	5mil	250	142,500	0	0	0	0	0	0	0	0
		200 pins	5mil	250	95,000	0	0	0	0	0	0	0	0
	DC	300 pins	5mil	225	128,250	0	0	0	0	0	0	0	0
		200 pins	5mil	225	85,500	0	0	0	0	0	0	0	0
	Total			950	451,250	0	0	0	0	0	0	0	0
Total				1,900	902,500	53	2.8	91	100.8	2	0.1	2	2.2

6. REVISION RECORD

Revision no.	Description (Major changes)	Date
	Initial release	June 23rd, 2008