Evaluation of Substrate Surface Finishes for Pb-free Assembly Project

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Pb-free Surface Finish Project

Objective

Evaluate the effects of alternative surface finishes for circuit boards and package substrates on Pb-free solder joint reliability during accelerated stress testing.

Project Participants

Agere, ASE, Cisco, Cookson, Dage, Foxconn, Henkel, HP, IBM, Intel, Lucent, Plexus, Solectron, Sun Microsystems, Texas Instruments, TTM and Vitronics-Soltec

Abstract

The transition to the use of Pb-free solder alloys introduces new solder joint reliability concerns. The implementation of alternative surface finishes for circuit boards and package substrates compounds these concerns.
This iNEMI project is conducting comparative **four-point bend** testing, **drop** testing and **board-level thermal cycling** of Pb-free components assembled on test boards, as well as comparative **solder ball shear/pull** testing on BGA and CSP components.

The test packages include BGA, CSP and QFP devices, manufactured in a variety of Pb-free surface finishes. OSP and immersion Ag surface finishes are being evaluated for the circuit boards. Sn3Ag0.5Cu solder paste has been selected for the component attachment.

Project completion is targeted for March 2007.

Pb-free Surface Finishes

PWB Laminate

- OSP (Entek+ CU106AXHT)
- Immersion Ag (Alpha Star i-Ag)

BGA Substrates

- Electrolytic Ni/Au
- ENIG
- Ni/Pd/Au
- Cu (SOC, OSP & i-Sn)

Lead-frames

- Matte Sn
- Matte Sn/Ni
- Ni/Pd/Au

PWB Laminate

Thermal Cycle Test Board
- Polyclad 370HR
- 18 metal layers
- 2.35 mm (0.093 in.) thick

4-Point Monotonic Bend Test Boards
- Polyclad 370HR
- 18 metal layers
- 2.35 mm (0.093 in.) thick

Drop Test Boards
- Polyclad 370HR
- 8 metal layers
- 1.55 mm (0.062 in.) thick

Pb-free Components

Flip-Chip BGA

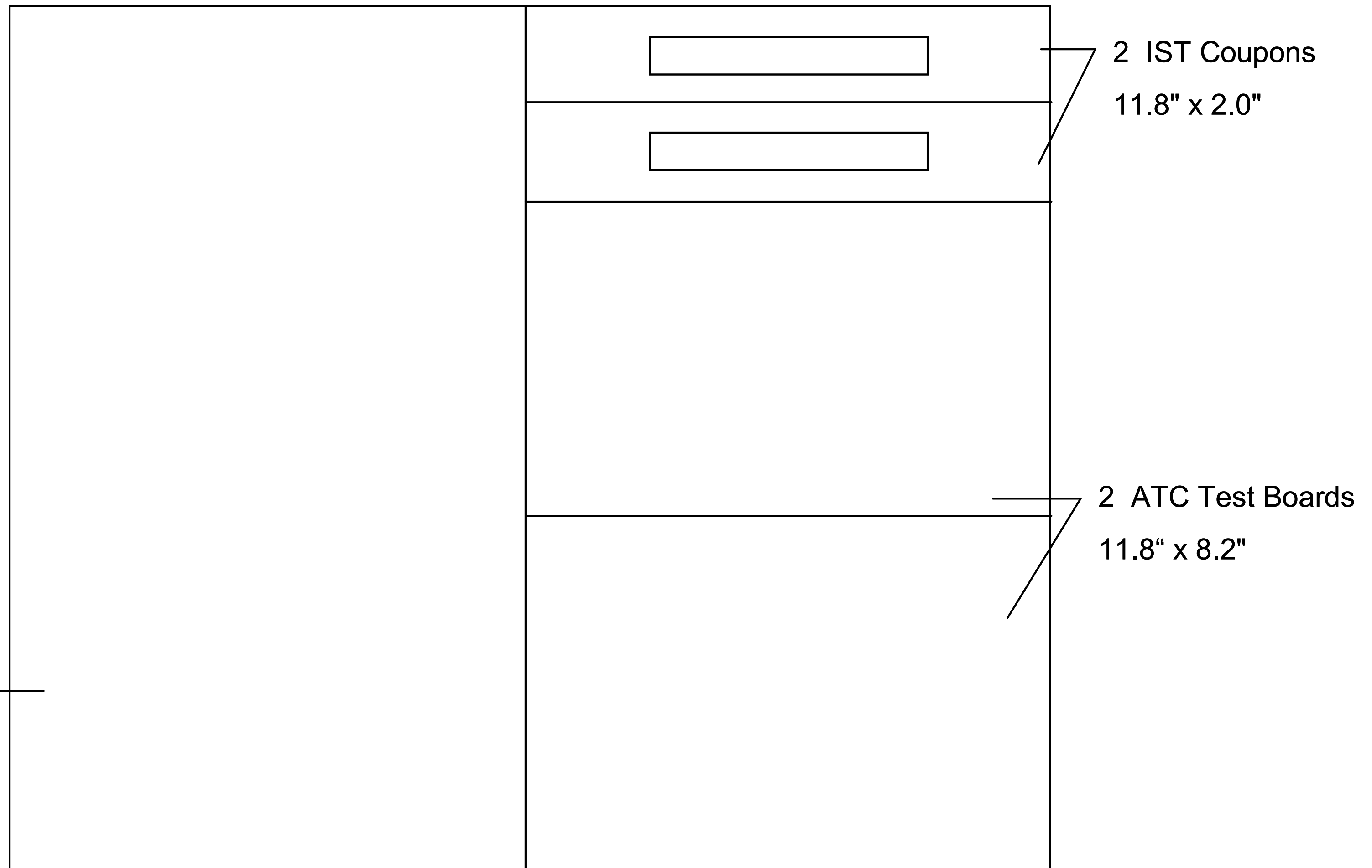
- 1681 FC-BGA, 42.5 mm sq., 1.0 mm pitch (ASE)
- 1680 FC-BGA, 42.5 mm sq., 1.0 mm pitch (IBM)
- 479 FC-BGA, 35 mm sq., 1.27 mm pitch (Intel)

Wirebond BGA/CSP

- 676 BGA, 27 mm sq., 1.0 mm pitch (Amkor)
- 84 CSP, 7 mm sq., 0.5 mm pitch (Amkor)
- 64 CSP, 8 mm sq., 0.8 mm pitch (Amkor)

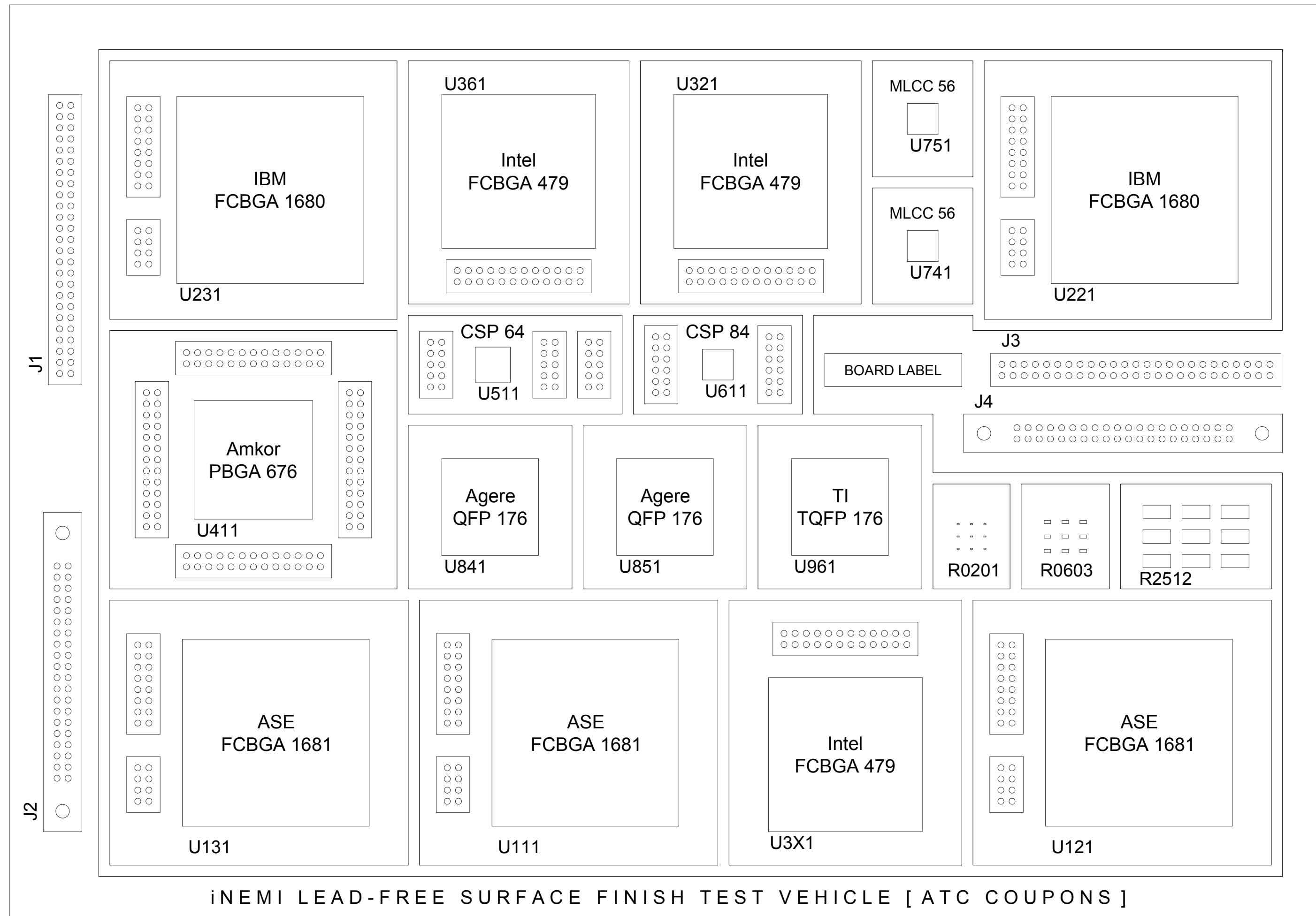
Wirebond Leadframe

- 56 MLCC, 7 mm sq., 0.4 mm pitch (Agere)
- 176 QFP, 20 mm sq., 0.4 mm pitch (Agere)
- 176 TQFP, 20 mm sq., 0.4 mm pitch (Texas Instruments)

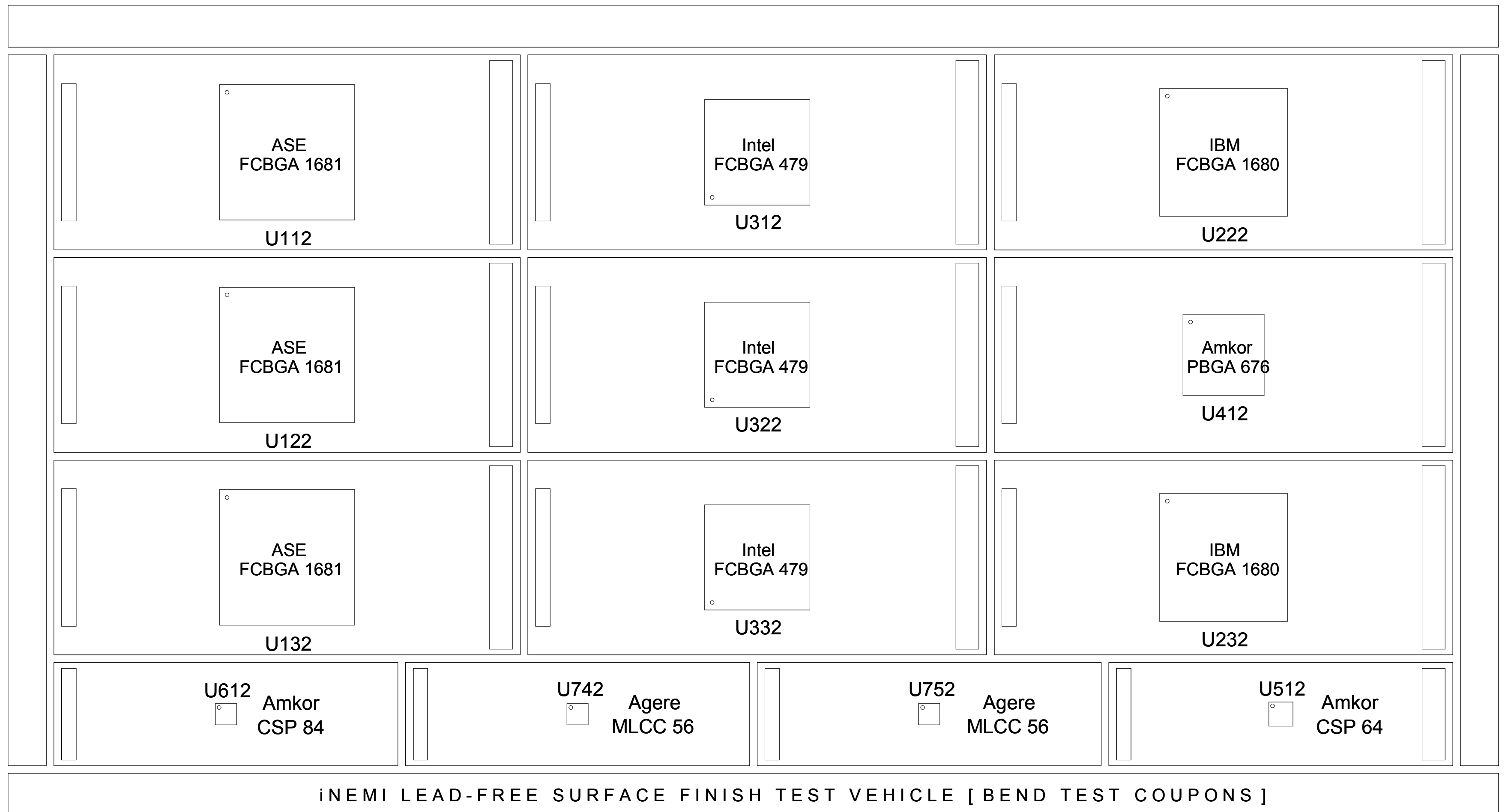


iNEMI PANEL A LAYOUT [24” x 21” PANEL SIZE]

Pb-free Surface Finish Project

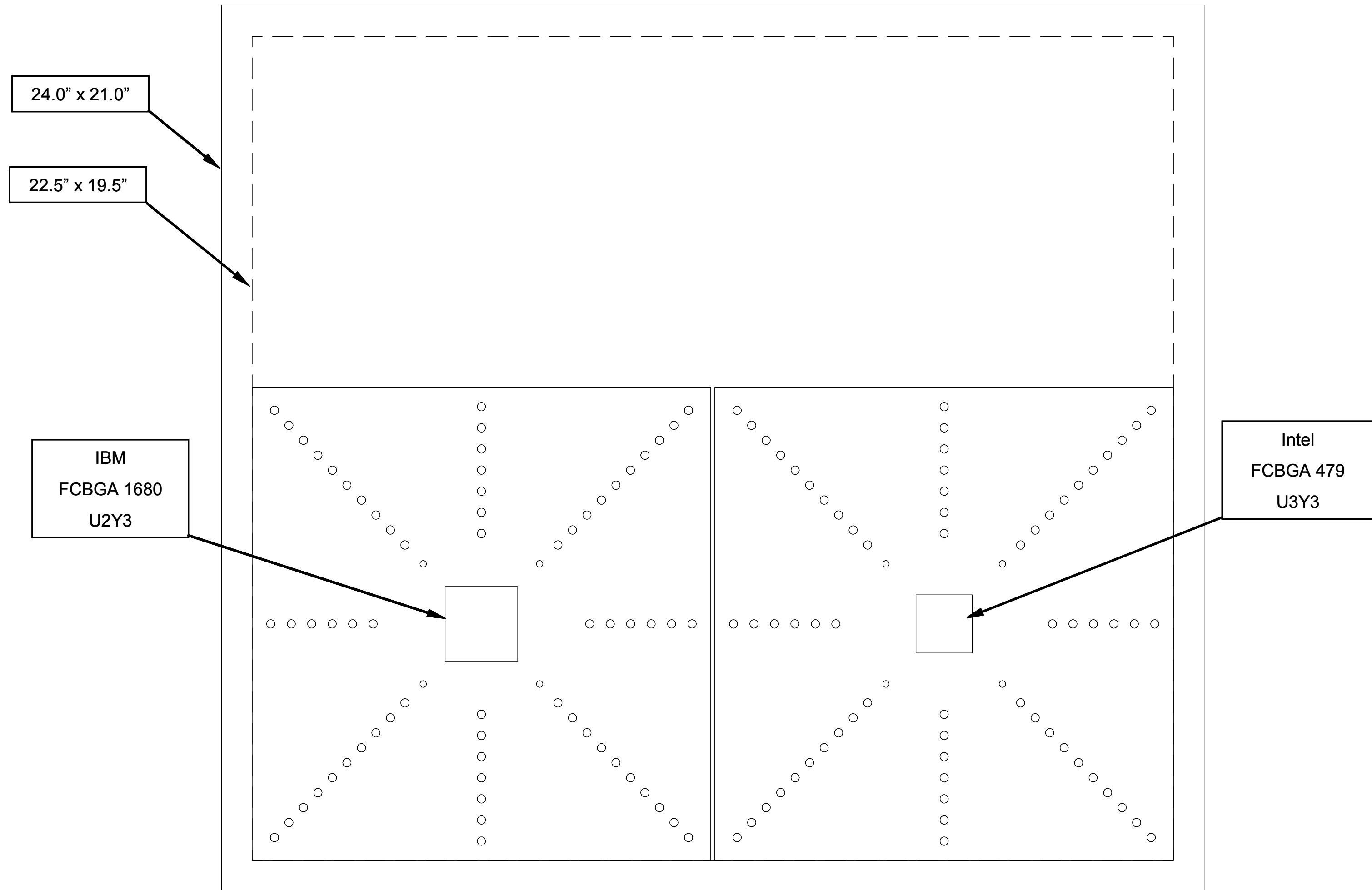


ATC TEST BOARD LAYOUT (iNEMI PANEL A)

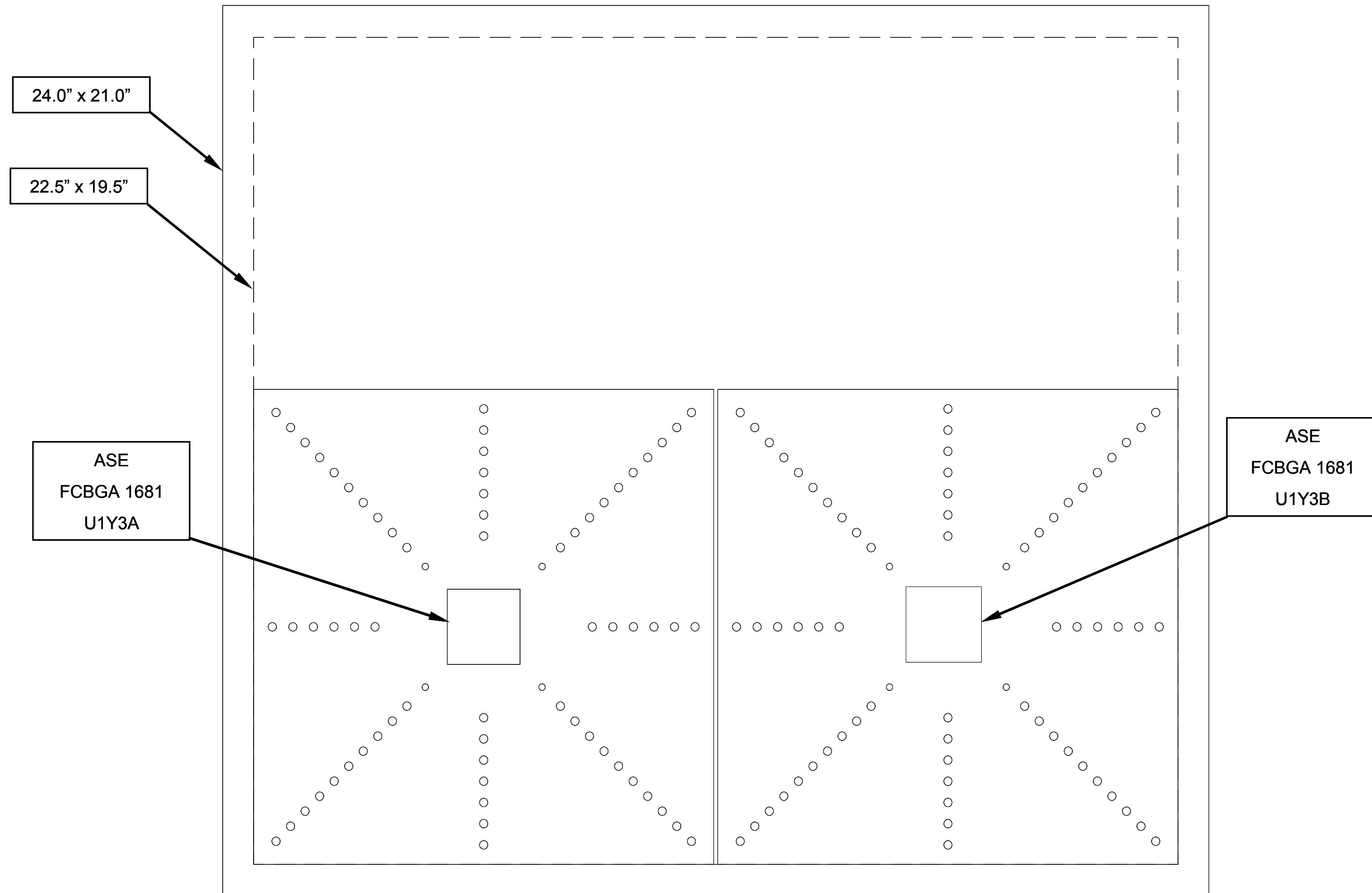


BEND TEST BOARD LAYOUT (iNEMI PANEL A)

Pb-free Surface Finish Project



DROP TEST PANEL LAYOUT (iNEMI PANEL B)



DROP TEST PANEL LAYOUT (iNEMI PANEL C)

Project Status

During 2005 a comprehensive test plan was developed, and the daisy-chain test packages (BGA, CSP, QFP, etc.) were fabricated and delivered. Time-zero component characterization (cross-section, X-ray, CSAM, coplanarity, etc.) of these components was completed. Extensive low/high speed solder ball shear and pull testing was also completed. Thermal cycle and monotonic bend test board designs were released for fabrication.