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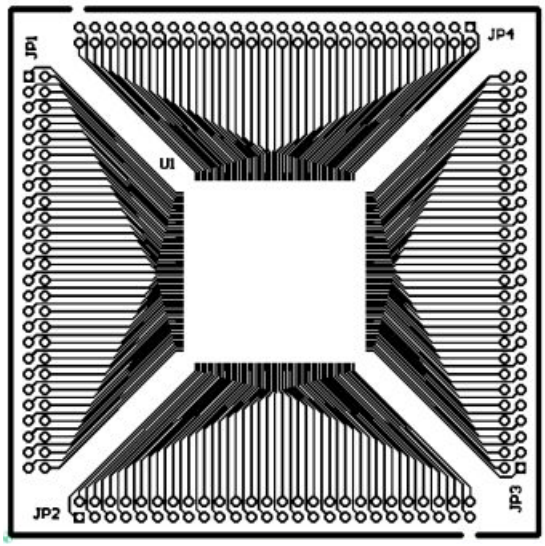
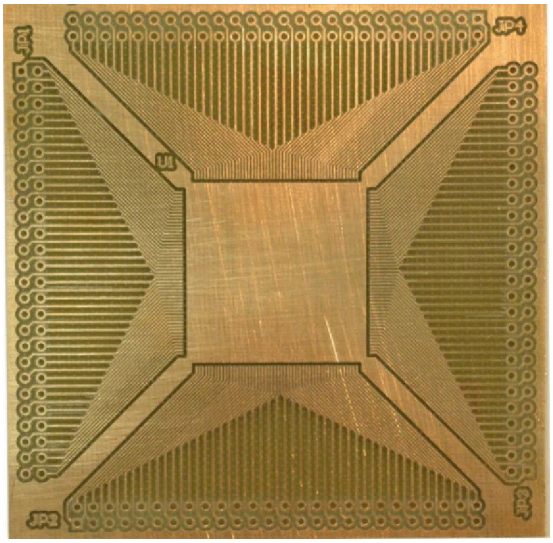
Board examples and Applications
208 pin QFP adapter board

Produced on MITS FP21T with Varipress TriPoint board hold down system

Board Facts:

Size:	85 mm, square
Material:	FR4, ½ oz copper
Trace Width:	0.010”
Trace Spacing:	0.007”
Pad Width:	0.065” (round), 0.011” (SMT)
Drill Diameter:	0.0394”
File Prep. Time:	20 minutes
Milling Time:	4 hours
Milling Length:	Approx. 54 meters
Copyright:	AEP, 2004





Not Actual Size

Board Production:

This board was milled using a fine 60 degree pointed mill, followed by a pass with a 0.007” and then 0.020” endmill. The pointed tool was run first to ease the milling load for the 0.007” endmill, this lengthens tool life but increases overall milling time. On the component side a 0.007” rubout procedure was run around the thru-hole pads to remove any copper islands that might cause a solder bridge when the board is populated.

The holes were drilled before milling the component side using an 0.0394” diameter carbide drill. This is recommend practice as drilling a milled pad may cause the pad to separate from the PCB substrate.

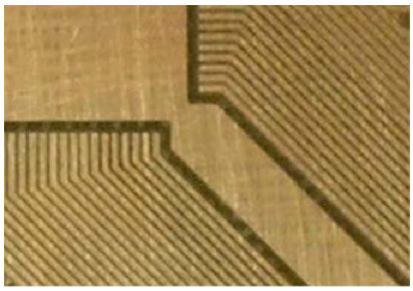
The board outline was routed out with a 0.032” carbide contour router, knock out tabs were provided to keep the board properly positioned throughout the routing procedure.

Production Steps (component side):

Drill:	208 holes, 0.0394” diameter
First isolation:	18 meters, 0.004” path using a pointed tool
Second isolation:	18 meters, 0.007” path using an endmill
Third isolation:	18 meters, 0.020” path using an endmill
Rubout:	0.007” endmill, around pads only

Production Steps (solder side):

First isolation:	0.007” endmill, around pads only
Second isolation:	0.020” endmill, around pads only
Contour routing:	0.031” router



Detailed view of SMD pads and traces

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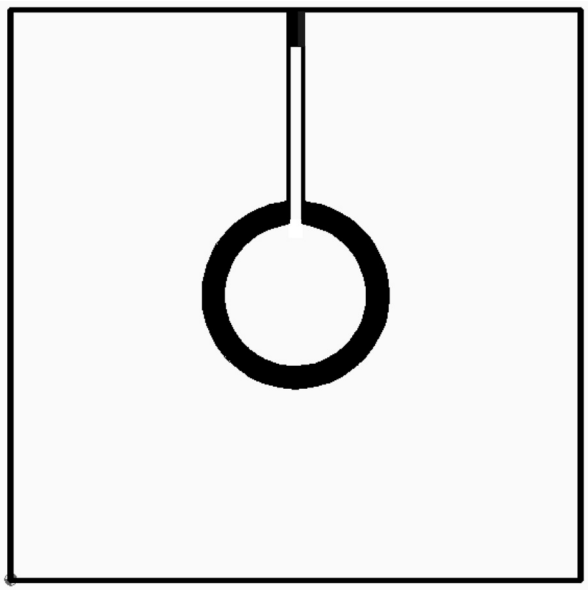
Board examples and Applications
Thin/ Flexable Board Material (Arlon, 0.005" thick)

Produced on MITS FP21T with Varipress TriPoint hold down system

Board Facts:

Size:	100 mm x 100 mm
Material:	Arlon, (single sided, 0.005" thick)
Trace Width:	0.020"
Trace Spacing:	0.020"
Pad Width:	N/A
Drill Diameter:	N/A
File Prep. Time:	10 minutes
Milling Time:	25 minutes
Milling Length:	Approx. 2 meters
Copyright:	AGC America, 2004



Board Production:

This board is a single sided design and was milled on the top (copper clad) side only using a single 0.020" endmill for both the isolation and rubout operations. A 0.030" endmill was then used for contour routing of the final board shape.

For isolation and rubout the depth of cut was set to cut just through the adhesive while leaving the substrate untouched. The board was run using the VariPress TriPoint contacting head.

The isolation gap in this board was a consistent 0.020" wide so only a single pass of the milling tool was required. For rubout the 0.020" endmill was left in place and a rubout pattern, with a 70% tool overlap, was run to remove any additional copper in a single pass and give a clean finish.

During milling the Arlon board material was held in place using self adhesive back-up material. Board material was press rolled onto the backup material to provide as flat a milling surface as possible.

Production Steps (top side):

First isolation:	0.020" endmill
Second isolation:	0.020" endmill, 70% tool overlap
Contour routing:	0.030" endmill, single cut through material

Milling Settings

0.020" endmill, Spindle Speed: 33K RPM, Feed: 4mm/s
0.020" endmill, Spindle Speed: 33K RPM, Feed: 4mm/s
0.030" endmill, Spindle Speed: 35K RPM, Feed: 3mm/s

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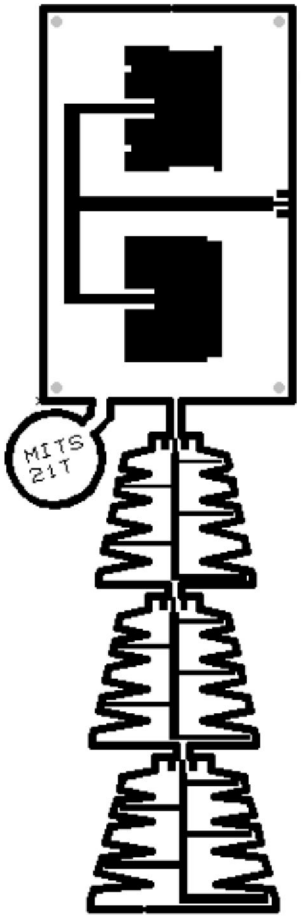
Board examples and Applications
Fine Geometry Antenna Elements

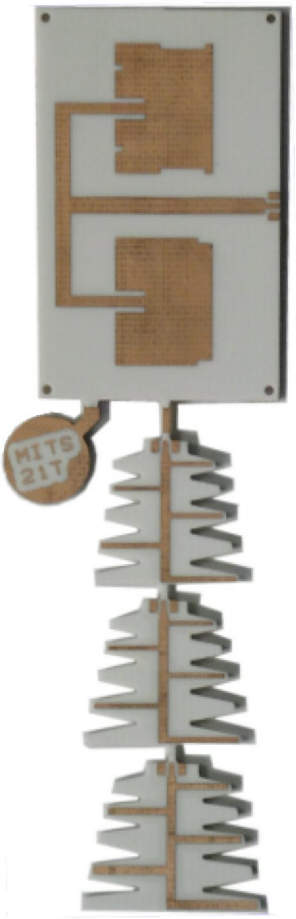
Produced on MITS FP21T with Varipress TriPoint board hold down system (AirPoint system recommend)

Board Facts:

Size:	120mm x 33mm, four elements
Material:	FR4, 1oz copper
Trace Width:	Various
Trace Spacing:	Various, tight tolerances
Pad Width:	0.394” (Mounting holes)
Drill Diameter:	N/A
File Prep. Time:	25 minutes
Milling Time:	3.5 hours
Milling Length:	Approx. 261 meters
Copyright:	ATX Labs, 2004



Antenna Elements



Milled Elements

Board Production:

These antenna elements were milled on both sides using a 0.010” endmill for initial electrical isolation followed by a 0.030” and then a 0.007” endmill. Running the 0.007” endmill last allowed us to use the large diameter endmills to do the bulk of the electrical isolation which greatly extended the life of the fine more expensive 0.007” tool.

Rubout was run on both sides using a 0.007” endmill (in selected areas) to remove any fine copper islands left between elements. This was followed by second full rubout using a 0.030” endmill to remove the remaining areas of copper.

Mounting holes were drilled before milling the component side using an 0.0394” diameter carbide drill.

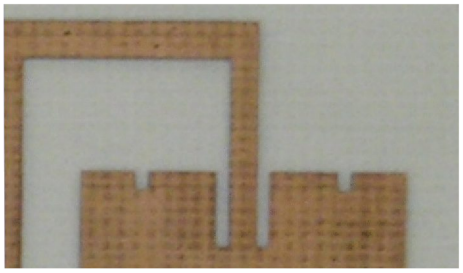
The board outline was routed out with a 0.032” carbide contour router after both sides had been isolated and rubbed out. Knock out tabs were provided to keep the antenna elements properly positioned throughout the routing procedure.

Production Steps (top side):

Drill:	4 holes, 0.0394” diameter
First isolation:	18 meters, 0.010” path using an endmill
Second isolation:	18 meters, 0.030” path using an endmill
Third isolation:	18 meters, 0.007” path using an endmill
Rubout:	0.007” endmill, selected areas only
	0.030” endmill, remaining copper

Production Steps (bottom side):

First isolation:	9 meters, 0.010” path using an endmill
Second isolation:	9 meters, 0.030” path using an endmill
Third isolation:	9 meters, 0.007” path using an endmill
Rubout:	0.007” endmill, selected areas only
	0.030” endmill, remaining copper
Contour routing:	0.031” contour router



Detail view, note flatness of rubout and sharpness of inside/ outside corners

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Board examples and Applications
Fine Traces test board for MITS FP21T Prototyper

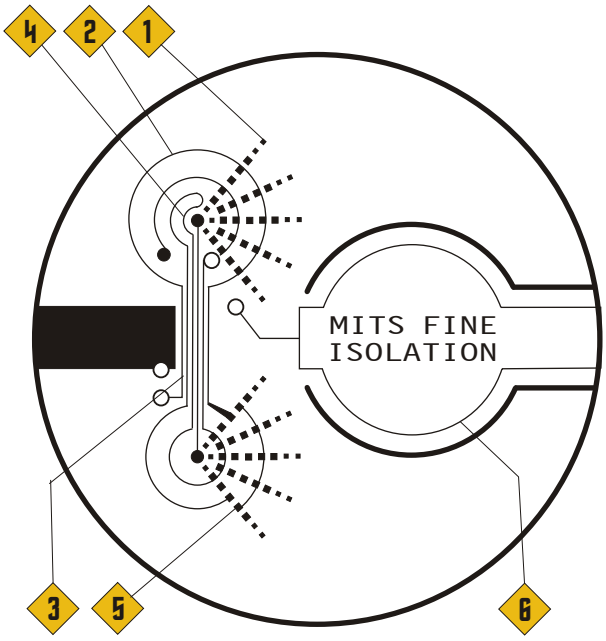
Finer machine accuracy and stability allows MITS prototypers to exceed the industry benchmark

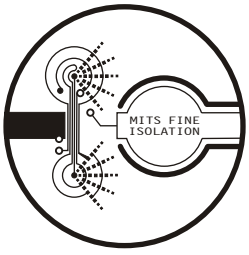
Board Facts:

Size:	35 mm, round
Material:	FR4, ½ oz copper
Trace Width:	Sub 4 mil
Trace Spacing:	Sub 4 mil
Pad Width:	Various, 6 - 12 mil
Drill Diameter:	0.024”
Copyright:	Ximetrix Systems, 2003

Board Production:

This board was milled using a fine 60 degree pointed mill on FR4 type board material. The holes were drilled before milling using an 0.024” diameter carbide drill. The board outline was routed out with a 0.032” carbide contour router.





Test Board
Actual Size

Board Application:

This board is designed test the positional and repeatability accuracy of the FP21T family of PCB prototyping machines as it applies to the generation of fine (sub 4 mil) traces in ½ oz. Copper board material using a pointed tool.

The test board incorporates several unique features that provide a way to test and measure how well the machine can handle the task of milling very fine sub 4 mil traces:

1. Radial Square Pads: These test the ability of the machine to mill fine discrete elements, of various sizes, rotated at different angles, without error or separation from the substrate. The pad pattern is repeated twice to test for positional repeatability - the sizes of the pads in top pattern should match those in the second pattern. In addition this tests the ability of the machine to mill short non-consistent vectors without positional error.

2. Circular Traces: These test the ability to of the machine to finely index the milling head through 360 degrees without positional error or trace deformation during the procedure. This is a difficult task as it requires both the X and Y positioning/ drive systems to run both forward and backwards in a single procedure without loss of positional accuracy due to lead screw backlash and/ or steeper motor errors. In addition this test will display the amount of stair stepping used by the machine to generate circular features.

3. Fine Parallel Traces: These test the ability of the machine to mill fine traces without effecting adjoining traces. This is a very difficult milling procedure as any positional error will cause the traces previously milled to be clipped or torn off the substrate.

4. Complex Vector Traces: These test the ability of the machine to mill a fine trace that make several directional changes over a small distance. Again, a difficult task as any error in the positional/ drive system will result in incorrectly formed or broken out traces.

5. Complex Fine Element Traces: These test the ability of the machine to mill a fine trace which incorporate other fine features such as pads, or changes in trace width (fillets). With this type of task the milling head must make several start/ stop moves, or very fine stair stepping, to route out the required trace shape. Any errors will result in noticeable changes in trace width between features, or rough edges on fillets.

6. Long Trace Runs: These test the ability of the machine to mill runs of continuous traces without positional error or trace breakage. This is a very good test of ability of the X/ Y positioning system to accurately hold the milling head in the correct position over time, to mill the traces without trace clipping, break out, or seperation from the substrate.

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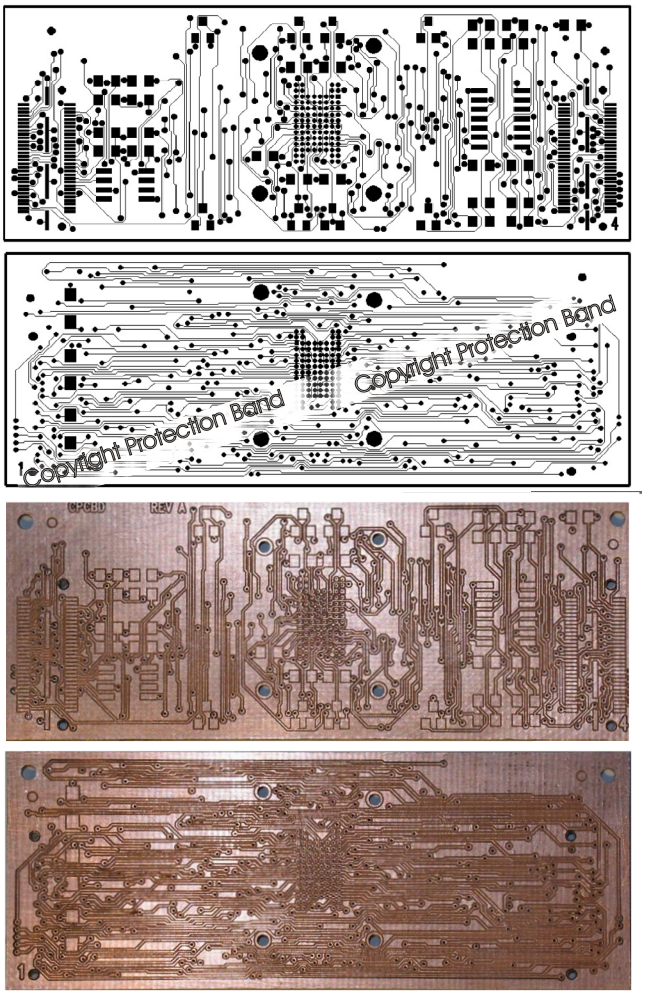
Board examples and Applications
4 Layer Fine Pitch Adapter Board

Produced on MITS FP21T with Varipress AirPoint hold down system

Board Facts:

Size:	84 mm x 32 mm
Material:	FR4, ½ oz copper
Trace Width:	0.004”
Trace Spacing:	0.004”
Pad Width:	Various, fine pitch SMT, uBGA, and via pads
Drill Diameter:	Various
File Prep. Time:	30 minutes
Milling Time:	7 hours total (for four layer assembly)
Production Time:	16 hours (completed board - ready to test)
Milling Length:	Approx. 170 meters
Copyright:	BP Micro, 2004



Shown Actual Size

Board Production:

Each layer of this board was milled using a single 0.004” endmill for all traces and pads. The internal layers were milled first on 0.031” FR4. This partial board assembly was then removed from the prototyper and prepreg (adhesive/ dielectric material) and copper foil was applied to the top and bottom sides. The assembly was put into the press to create the multilayer assembly. Once the assembly had cooled it was removed from the press and remounted on the prototyper for drilling. When the drilling was completed the board was prepared for plating by applying the conductive ink and curing it in a oven. The final step was to remount the board and mill the top and bottom sides of the board.

Production Steps:

Mill:	Internal layers, 2 hours
Press prep:	Apply Prepreg and Foil, 0.5 hours
Press:	Heat/ Cool, 10 hours
Drill:	Via and mounting holes, 1 hour
Plate:	Prep and plating holes, 1 hour
Mill:	Top/ bottom layers, 3 hours
Contour:	Cut board out line, 2 minutes