“Some time last year, I wondered if it would be possible to do Manhattan construction by cutting the pad directly onto the substrate. The idea is really simple but would require exactly the right tool to be effective. So I started a hunt for a pad cutter ...”. The result is a 5mm diamond end mill that cuts beautiful 5mm “islands” in the copper and seems to last forever. With the construction advice of Jim Kortge, K8IQY, and the illustration genius of Paul Harden, N4SN. Dov AD0V explains how he found an ideal tool for creating “islands” for Manhattan-style construction. He calls it The NJ Islander”

I thought it would be interesting to share some of the blind alleys that I went down in my quest because it may help trigger some resource ideas for other problems that you may be trying to solve.

Never give up!

First, the most important point is not to give up. I have had a number of problems that I have worked on professionally that have seemed to evade solution. Very often, after one has lived with them for a while, one suddenly has an “Aha” experience. In a flash of insight one finds a path leading to the solution.

The problem that we are faced with is how to cut a circular path in the copper clad so as to circumscribe a pad of the right size.

I looked at the mechanical pencil I was using and pulled off the little metal cover at the back that protects the eraser. It is a hollow tube that is a little too large in diameter and is of course too soft to do the job. But it is a start. Okay, so how about finding a piece of metal tubing of about 4mm in diameter? Then cut it down to say 5cm in length and put it in a Dremel drill on a bench press. It will need to be hardened or have an edge put on it which will probably need to be constantly redone - which is undesirable. It may also be too wide for the miniature chuck – but let’s at least start with this. So I walked through the local hardware store looking for something suitable. No tubing available in this size! I could try an automotive parts store but I bet a hobby store will do better. None in close proximity so it will have to wait.

Figure 1: The NJ Islander Bit ... an inexpensive, diamond-tipped 5mm end mil

Then I remember some soldering tips I’ve seen. They have a little barrel that screws onto the iron, which then tapers down to the soldering point. They still carry them at Radio Shack. If you reverse this and load the thin tip into the drill chuck, then the barrel is the right shape to make the circle. This is unfortunately no good because it’s a little too large in diameter, too thick a cut and of course is made of copper, which is useless as a cutting tool. However, this is at least an example that I can use to explain the concept. Next time you go into a Radio Shack take a look at the soldering tips on display and you’ll see exactly what I mean. By the way, if anyone needs tips like this I would be happy to send you them to you free for the asking – I don’t have an iron that accepts them and I am happy to say that I no longer need them as an example.

Solution while in the dentist’s chair

In the meantime I had to see my dentist. This seems to be a constant state with me. Now we all know that dental picks are great tools to have in the shop for all kinds of work ... but there are lots of other goodies that your dentist uses that are great for the hobby. There are drill bits and grinding wheels and even those tiny root canal files (most of which are a little too soft for our use.) If you’re friendly with your dentist he may be happy to give you some of his bits and pieces that are no longer good enough for his work but are fine for ours. Make sure to sterilize any used tools in boiling water and handle all sharp edges very carefully especially before you sterilize them. An alternate source is a dental supply house. I have one locally and they often have damaged merchandise which they sell fairly cheaply.

So I ask the dentist if he has any ideas for a pad cutter. He is intrigued by the idea and we but around some possibilities but no solution presents itself.

Some other ideas that crossed my mind included:

a) If you browse through a Harbor Freight catalog you will find hollow core punches – a little too big and clumsy.

b) Use something like a compass or a pair of dividers with a cutting point instead of a pencil to score the circle – too clumsy though for a small circle and also too tedious.

I even checked some EMT supply catalogs – they have some interesting tools and great shears – but still no luck. While on this line of reasoning, a medical supply house, like the dental ones, are a great source of tools such as scalpels, rubber gloves, tweezers and hemostats.

A Piercing Thought

In the meantime my four year old is asking to have her ears pierced. I remember from my youth seeing a sign in ZS land outside a jewelry store that said, “Ears pierced while you wait!” and I asked myself – How else? Leave them there and come back for them in the morning? Anyway, many years back I bought a plastic gizmo that is a do it yourself ear-piercer. You load it up with the two supplied earring studs, which are sterile and have sharp points. Of course you have to have steady hands and find the correct position on the ear but it’s fairly easy to do it yourself. It even pops the backs on the studs automatically. Well I can’t find the studs for this gizmo and she really wants it quite badly.

That week I have a meeting in uptown Manhattan, not far from 47th Street, which is known as the diamond district in New York. The whole area is jewelry stores and related items. So I take a detour on my way back and ask a few stores if anyone sells these studs. I start to get the run-around from store to store like a treasure hunt – with no luck. Finally, just as my time is running out with my patience right behind it, someone sends me to a jewelry tool store. They have the professional guns for piercing ears and the refil studs. So I buy some studs hoping that they’ll fit my amateur gizmo and then run for the subway.

When I get home, I can’t find that plastic gizmo anywhere. You know the feeling ... saw it just last week but I can’t recall where. Anyway it should turn up soon … but it doesn’t! In fact as of the time I am writing this article it still hasn’t! But this is good because I decide to purchase the professional gun. The price isn’t too steep and it will be useful for extended family members to use as well – if I don’t misplace it.

Well I call them up to ship me one because I won’t have a chance to get back up-town for a while – I’m stuck down in the Wall street area and can’t spare the time for the round trip during working hours. Well, while I’m placing the order I wonder if they have something that can cut a Manhattan pad in copper. I won’t go into the details of how I described what I was looking for – try to do this yourself without using your hands or any of Paul Harden’s fabulous illustrations. I was ecstatic when he said that they
had something that may work. We discussed various sizes as he checked inside and out-
side diameters with a caliper. So we settle on
3 different sizes that he has in stock and he
includes these in my order. They weren’t
cheap (neither is his rent) but I was happy
to pay it.

So I now have three different sized bits
to experiment with. One is definitely too
large, the next one has a pad diameter of about
5mm and seems to work just fine. A neat cut
and a clean pad, but it’s slightly larger than
what I want. The smaller one is 5mm outside
diameter and about 3.5mm inside diameter.
Perfect size! However, I discovered that it
would rip out the center pad about 20% of
the time. The small pad size could not main-
tain enough adhesion to the fiberglass back-
ing to overcome the circumferential torque.
So I went with the larger size when I ordered
a couple extra of these. I wanted to get some
expert unbiased opinion about their effec-
tiveness. Of course after the order was
placed, I tried some other boards and found
that it held perfectly for all the drill sizes – I
had just been experimenting on some poor
quality board.

I shipped these bits together with a note
of explanation to some of our world-re-
nowned QRP folk to get their opinion. I got
back a thumbs up from both George Heron
and Jim Kortge together with some excellent
suggestions. So my four-year old now has
her ears pierced and we have the NJ Islander
– not sure who is happier. George suggests
doing a piece for QRP Homebrewer together with
Paul Harden’s excellent artwork and Jim
Kortge’s construction (after seeing photo’s
of his impeccable work we have to retire the
term “ugly construction”).

At about this time, a discussion of this
idea was initiated by Bob Kimbrell, AC7BN,
on the QRP-L email reflector. If an idea is
good, then it probably will occur to more
than one individual. A number of ideas were
posted but no elegant solution appeared. We
were still not ready to release this as we had
not yet procured a reasonable source for
these bits and were still ironing out the kinks.
So I emailed Bob directly with my solution
and told him that the NJQRP club was hop-
ing to source these to the community.

Be careful!

You have to use this in a drill press or
the bit will just run all over the board and
scrape it up! The desire was to have a bit
without a center pin, as this would ruin the
pad. Well, this obviously means there is noth-
ing to keep the bit in position – hence the
need for the drill press. You will not be able
to hold it steady with your hand! I do not
have a heavy-duty drill press – I am using
this with a Dremel tool in a small “hobbyist”
Dremel drill press.

You can do this right by setting the
depth stop so that the cut just clears the
copper. Once set for a given thickness this is
foolproof. On the other hand, you can just
use your intuition and cut until you see the
fiberglass dust starting to appear. It does not
take long to get the pressure right to cut the
hole. If it’s not enough to cut through the
copper, then just apply some more pressure
and you’re done. However, if you do this in
a rush you run the risk of drilling right through
the board.

This is an excellent alternative for those
of you who have complained about the va-
pors from heated crazy glue and the inevi-
table stuck fingers. However, take heed! You
will probably be holding the board by hand.
If you do drill too deep, the board could bind
to the drill and spin out of your grip! A small
board spinning with your hands in the im-
mediate vicinity is instant disaster! Please
think ahead and take it slowly.

I have done a lot of testing with many
different sized bits and have never had the
cut go through the board nor have I had even
a partial binding of the board to the bit. How-
ever, as always, use caution at all times.

There is no need to worry about the
pads interrupting the ground plane at HF
frequencies. If this really worries you, then
you can use double-sided board to overcome
this. However, I suggest that if you worry
about these things, then you will also worry
about pad capacitance. (Have you seen those
emails on the reflector too? Chuck Adams
checked it out and that’s enough for me. No
need to repeat it – I trust his results implic-
tly). With single sided board there will be
no capacitance effect with the pads!

As I mentioned above, I have been us-
ing a Dremel tool mounted in a drill press. It
has a variable speed control and the speed
(and hence the vibrations) will vary the neat-
ness of the cut – needs some experimenting
to get it right but it’s not critical. Also, if one
lets the drill stick out a lot from the chuck, it
may have more vibrations and the circumfer-
ence that is shaved will be slightly wider.

Be careful that no copper fillings get
left in the groove and short the pad to ground.
This can actually be a very insidious prob-
lem if you’re not careful. Blow the residual
cuttings and dust out of the hole or brush
them out with a fine-toothbrush. To be sure,
check that the pad is indeed isolated by us-
ing an ohmmeter. I can’t stress this enough!

The pad does not stick up from the
board, so the component’s 2nd lead that is
normally parallel to the board will have to
either bend down at 90 deg over the pad or
have a step in it. Take a look at the illustra-
tions to see what this means.

The last point is that once a design is
done, a paper template can be made. This
will allow a copy to be produced by simply
marking the template pads on the board and
drilling them in one shot! Take about 2 min-
utes flat. Of course a misplaced pad is going
to remain there permanently – you can’t
unglue it, and you just have to drill the new
one in the correct position; but it doesn’t
look bad. One can also use a punched pad
 glued on top of it if one needs to move it
only slightly. I think this heats punching and
gluing.

The real benefit I got out of this was
my correspondence with Jim Kortge. He not
only gave me valuable feedback on the bit
but gave me insight into a lot of other con-
struction questions I had. He is a real gentle-
man in every sense of the word. I would like
to end by quoting from an email Jim sent me:

“I tried it out last night down on the
drill press, and it works great. I used my
drill press running a moderate speed, and
set the depth stop so that the drill only went a
very small amount through the copper layer.
No sense drilling the fiberglass underneath.
I’d say the depth was on the order of 1/32 to
1/64th of an inch below the copper surface.

That seem to work quite well, and as I was
doing the drilling, I kept some water on the
surface, so that the softer copper would not
clog the diamond cutter. There seems to be
a bit of embedded copper, but that could prob-
ably be removed with a quick cut on a scrap
piece of ceramic tile.

“The downside as you have remarked,
is putting a pad in the wrong location. Two
choices are available; re-do the pad at a dif-
ferent location, if that location if somewhat
far removed, or glue down a small piece of 1/
32 inch PC board material over the affected
area, and redo the cut. Either one would prob-
ably be fine.

“I see the most use for the tool in ren-
dering multiple copies of a board, perhaps
after a good layout has been achieved, and
several more like boards are desired. For
example, that approach would have been very
nice to use with the 2N2/40 project. As it was,
the AZ QRP gang silkscreened the pad loca-
tions on a blank piece of PC board material,
and sold that to help potential builders know
where the pads were to be glued down. Hav-
ing the pads already cut would have been
terrible. I also thought that approach would
be quite easy to setup on an N/C milling ma-
icine. The pad locations could be set up, and
away you go. As many boards as you want,
all with the pad locations where they are sup-
posed to be.”

I would like to thank George Heron for
his continuous hard work that we are all con-
stantly benefiting from. In particular for help-
ing me to push this idea forward. I hope that
we will soon see a directory in the NJQRP
web site of NJ Islander templates, perhaps
in pdf form, for all those great classic designs
like Jim’s 2N2/40 (how about it AZ QRP?).

Finally, don’t throw away your punch
– they work beautifully for punching the
front panel of your chassis for your con-
trols.

Happy cutting!

Basil “Dov” Rabinowitz, AD0V
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Using the NJ Islander  
by Paul Harden, NA5N

NJ Islander bit can be chucked up in a bench mounted drill press, or just as easily in a hobbyist’s Dremel tool and inexpensive tool stand.

It’s important to drill the islands perpendicular to the board to prevent “bit walking”. A little water on the cutting surface helps. Be careful not to cut all the way through the fiberboard substrate, and to carefully clean out the drilling debris from the circular holes.

NJ Islander bit dimensions

NJ Islander bit creates an “island” from the surrounding ground plane. Components may be soldered to the island just like when using Manhattan pads.

Make the island cuts at 90-degrees at Dremel speed “5”.

Lower bit and drill thru copper clad layer — just into fiberglass
A Circuit Constructed with the NJ Islander

Jim Kortge, K8IQY

“Standard” Crystal Checker, per ARRL Handbook

Notice clean-cut “islands”