Adam:

I'm not sure what to call the attached, in terms of legalisms or whatever --
either "Released into the Public Domain" or "I won't complain if other folks
make transparencies from this artwork, and then etch new Bally multi-carts" ...
or what? In any case, I'm sending all this zipped stuff to you, for you to put
on your web site. (As we had briefly discussed, before.)

To make it clear that I'm not sticking 100% to the letter of whatever, I ran
"strike-through" lines through the portions of the photo mask artwork that once
had a copyright message.

I guess my only concern is having folks credit my work, if they use all of part
of the design. If they do that, I can't imagine any other concerns I'd have? A
lot of things got released as an "I don't mind if you use this (old work
someone had done)" sort of thing. So ... "me too".

I realize some questions from collectors or electronically-inclined folks may
be inevitable. I'll try to answer them, later, as best I can ... but for now,
just tell your readers that any notes I had, which once equated to (one-man)
"factory" instructions, boiled down to four things:

(1.) Experience and personal memory. The multi-carts were all being done in
batches, one after another. So ... "I'll remember." (Yeah, sure! Then? Yes. Now
... not necessarily!) I had to re-figure some details out, via studying the
stuff I'm sending you now ... and via some stuff I didn't send, which I still
have PC backups of. (Mostly, other revisions to the mask artwork.)

(2.) Whenever I didn't remember some detail or other, I'd get out my "made for
Ward" multi-cart(s). I remember using that a lot, for things like remembering
the exact routing "map" -- and it was pretty picky: not much space inside that
cartridge shell! -- of the jumper wires, or just as a general purpose "copy
this" prototype, for things like where to solder each resistor. I had two such
carts: the first one ever made (which you now own: the "hole in case" one) and
a personal one that I sold to B.G.'s wife at around Christmas 2004. My memory
of it was that the personal one would have been more relevant as a template /
prototype ... the one you have (#00) that used to be mine, had enough subtle
changes to be a bit limiting, as time went on. The one B.G. has (#13) was at
least a revision B board; and therefore closer if not exactly like the real
thing. (I didn't track board revisions / cart ... I don't think, anyway?)

(3.) The attached "jumpers.txt" file was the closest thing I ever had, to
written assembly documentation. I don't recall absolutely for sure (and it
hardly matters) but I may have had a hand-scribbled "first draft" of that text
(which I would have thrown out, upon typing it all in: to avoid confusion on
which version superceded which). The text got revised a bit, as time went on:
mostly because I started routing jumpers a little different. (Later than the
big scans I'm sending, of cart #69. That seems to be a revision B board design;
before I ran out of two of the colors of wire I had used, for carts previous to
that. Reading the jumpers.txt again, today, and comparing it to the scans of
cart #69, some of the text is almost a "huh?" deal ... the two sources don't
seem to match, 100% ... so I must have been using one of the actual boards as a
"copy this" prototype, at about that time. Presumably, after having to desolder
the EPROM chip, to upgrade it for some new addition or other? That's my current
memory.

(4.) I'm not in any hurry to go back and re-read that old multi-cart FAQ! ...

especially given my weariness / attitude, towards the end of the production run! ... but I vaguely recall using it at times, to track things like dates or minor revisions to procedures; as I made my multi's. Kind of a quick "Oh, yeah" thing ... so I could get back to inhaling etching / soldering fumes.

Other assorted notes about the "history" of the 43 multi-carts I made for the Astrocade:

I don't recall exactly why multi-cart #69 was picked, for scanning in. Maybe it was just time for me to get more "organizee" on my little card table "assembly line"? I seem to remember thinking it'd be easier if I had a big blow-up on a screen, to look sideways at, as I soldered?

Related to that, is this: I went through my old hard drive backups, and came up with three slight revisions to the PC board's photo mask artwork. I didn't label the first revision, per se; and I didn't do much to distinguish the second from the first, as far as labeling it differently. (If anyone's really Wildly Jones-ing for such info, I can study the differences and come up a few words and pics?) By the time I got around to making revision "C," I felt it was time to put that info onto the PC board itself, as I etched each board. Those three revisions were what made up the 43 multi-carts that I made and sold around 2000/1 to 2003. I doubt many of the Revision A boards got made; most were probably Revision B boards; and a relatively small amount of Revision C boards, towards the last batches. (A-to-B was, I think, an "oops" deal in terms of electronics; which I probably corrected with a cutter in a Dremel tool, rather than have to waste all that work. The change from B-to-C, as I recall it now, was minor stuff that would just make it easier for me to assemble the boards by hand: longer solder pads, etc.)

The "Revision D" photo masks I'm sending to you now are essentially a slight (2008) revision to the (stable) "Revision C" artwork. I did that work tonight. I did not alter the circuit design, but I did make some changes to the text that gets etched into the board's metal surface.

To keep original owners happy, I stuck a "Reproduction --- not an original" notice on Rev. "D" -- in the hope that whatever collector value there is for the first 43 carts I made, stays intact: even if later MC's end up being made, if/when talented folks etch using the latest artwork? I see that as the best compromise I can do, to both accomodate older and newer MC users.

Initially, I couldn't remember the reason why I had two of each board, per "drawing" ... until I got out and studied my actual photo-etching transparencies. (Which I still have.) The reason behind two component "sides" plus two solder "sides" has to do with raw (uncut) PC board sizes. It was much more efficient for me to etch two of each (Bally or Emerson) multi-cart boards at once. Those two tops and two bottoms, when printed out as inkjet transparencies ("process camera," my foot! Ha! I wish, but not on my budget!) became the photo masks for the tops and bottoms of two boards-to-be, etched as if only one board; then cut into two of them. Etching pairs was much quicker / easier: a (very) little "economy of scale" going on. (When etching boards at home, you don't always get perfect results. Almost never, actually: which is one reason I drew it all with such "fat" traces. So: if one half was too messed up to use, after etching was completed, I hadn't wasted all of that etching time ... only half of it.)

I have some (cheapie 110 film) photos, somewhere, of my little card table "assembly line". I'd have to find them in my travels, but they're around here somewhere: seen 'em recent-ish.

If you (or your web site's viewers) have any questions about all this, I'll do what I can to figure out / remember what I did, six or seven years ago now ... and try to answer as best I can. (But I can't / won't describe every single technical step ... that's several years of college!)

Ward Shrake