VER. 3

XCESSIVE COPPER PRINTED CIRCUITS

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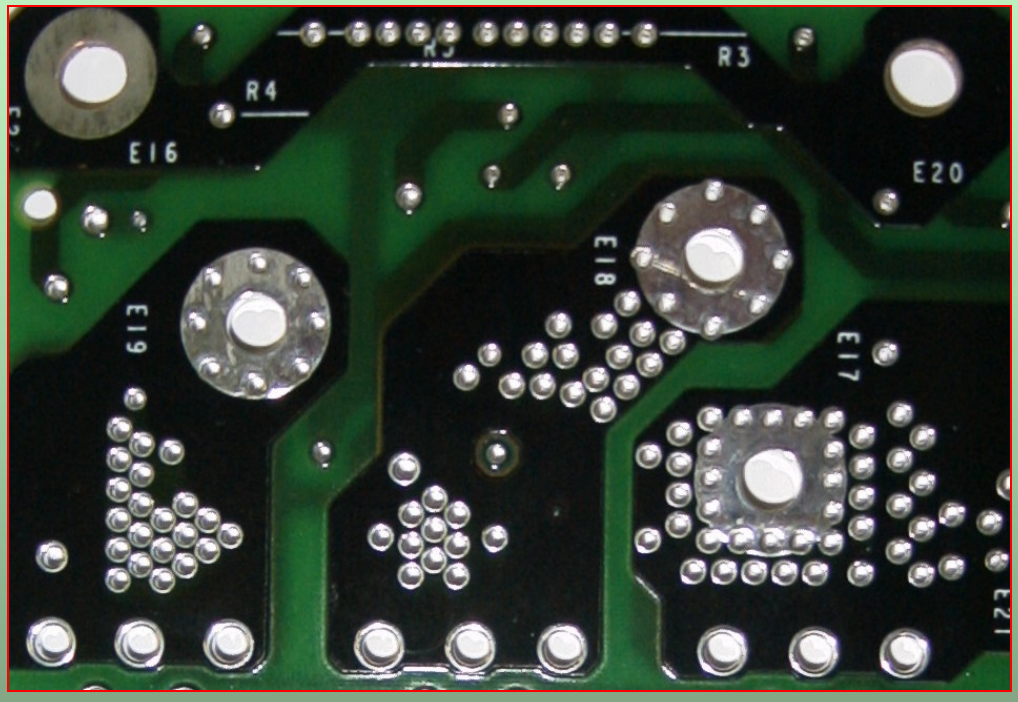

Written by
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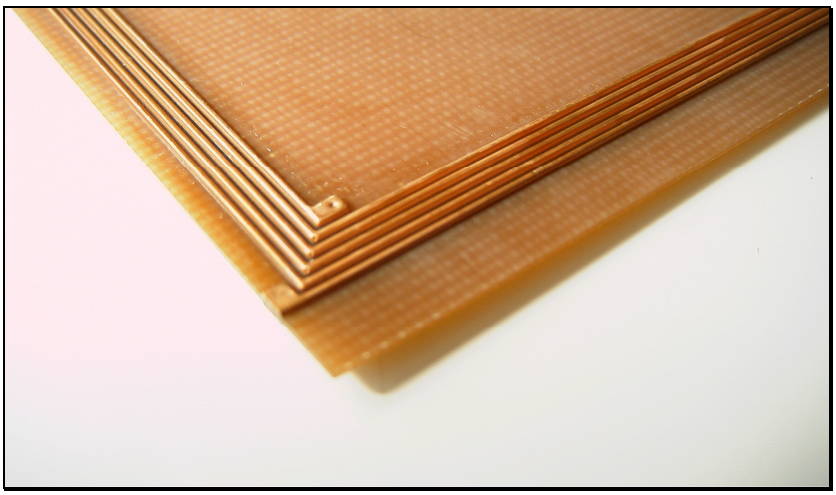
The information in this book is current to January 2009, as material specifications and manufacturing practices change and evolve, please ensure you are using up to date information.



20 oz copper; 10 mil lines

Introduction for Robert Tarzwell

One of the most amazing things that I have seen Robert Tarzwell do, and there are many, is the day he told the owner of a twenty million dollar board shop that he could take a walk through his shop and come up with savings of at least half a million dollars. The owner took him up on his challenge; Bob walked through the shop and came up with a list of things the owner could do to save money; all in about an hour's time frame. A few months later when I was again talking to that owner I asked him if he had ever followed any Bob's suggestions from the walk that day. *"Oh yes,'* he answered with enthusiasm, *"We took all of them and the only thing he was wrong about was that we actually are realizing savings larger than he predicted."*

Bob Tarzwell is truly one of the Printed Circuit Board industry's technology guru's. With his grasp of today's technology and his insight into the technologies of tomorrow he is the real "go-to" person for anyone who is looking for the right direction to take their company. Bob has that unique ability to take very complicated problems and come up with elegant and seemingly simple solutions. Whether you are talking about learning how to produce the absolutely best four layer board in the most cost efficient way possible, or talking about fabricating a circuit board with one mil lines and spacing Bob is literally the only person in the industry that I know of who can get it done.

Not being technical myself, Bob is the person I go to when I am working with a client who has a new technology and I need it explained to me. Bob will talk to the client for me and then come back and explain the technology in a way that makes it so clear to me that I not only understand it but then can proceed to do my job of helping the client sell it. There are not many people who can do that.

As An Wang once said *The true sign of a genius is someone who can take something very complicated and make it simple enough for everyone to understand.* And this surely applies to Bob Tarzwell.

Dan Beaulieu
President
D.B.Management Group L.L.C.

Chapter 1

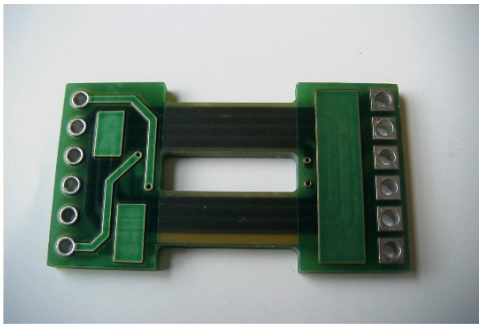
Heavy Copper Printed Circuits

Not many years ago, no one could manufacture a printed circuit board that could properly handle a large current in excess of 400 amps. Quite a few PCB shops now offer this high priced option, but with more electronics turning to power applications there exists a need for more heavy copper manufacturers. Through years of research and experiments, heavy copper technology slowly developed and perfected the high power printed circuit board.

New technologies have been developed and tested to create newer heavy copper multi-layers, bendable heavy copper circuits, buried copper, power circuits and multiple levels of copper on the same side. The result was an engineering system designed to handle just about any high current situation imaginable.

One requirement is to be able to accurately plate copper up to 20 oz. thick, when combined with the base starting copper. The combined heavy copper traces allow large currents to be carried with little heat generated. Yes, the price charged is higher for a heavy copper printed circuit board, which compensates for the extra dry film and plating time used. The large relays and capacitors that were attached off the circuit board through wire, terminal blocks and contained in large sheet metal enclosures could now be conveniently located on the heavy copper circuit board. The most redeeming feature of the heavy copper board is its ability to ***survive***. It can withstand repeated over current excursions, higher temperatures and repeated thermal cycling that would tear a normal printed circuit apart in a few cycles. ***The heavy copper circuit board can survive almost anything you can throw at it***. Its ability to withstand high-level vibrations, such as those encountered on aircraft and space shuttles, has greatly impressed the many design engineers at aircraft and aerospace vibration labs.

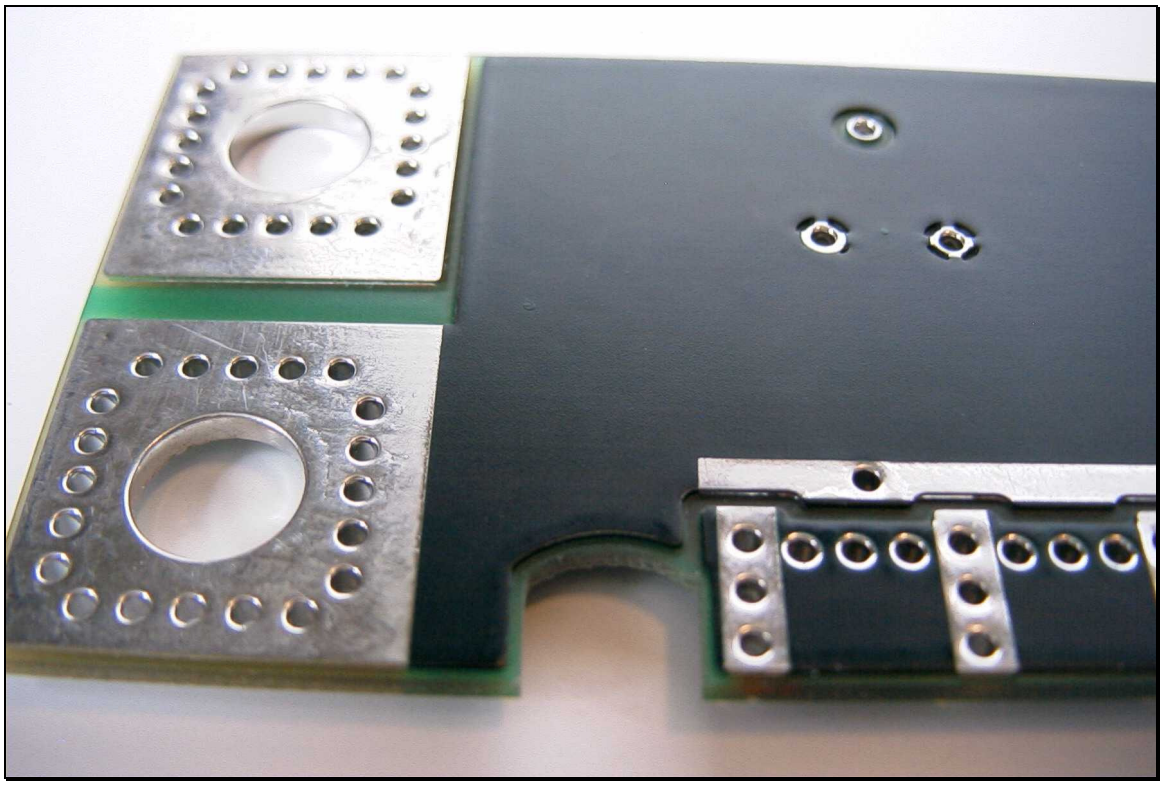
One potential downfall of the heavy copper printed circuit has always been its unavailability in the market place. Previously, printed circuit board shops could not even quote a double-sided board design over 3 oz. A few facilities could scratch out an easy print and etch type 4 oz. board but nothing like the sophisticated heavy copper 12 oz circuits that are required today.



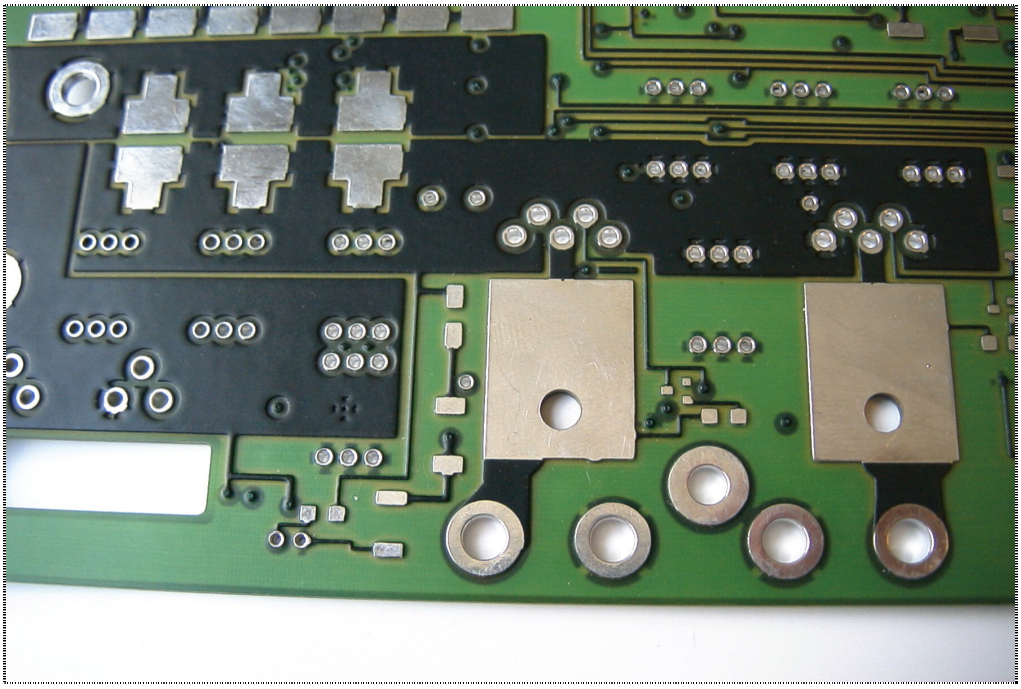
Chapter 2

Manufacturing a Heavy Copper Printed Circuit

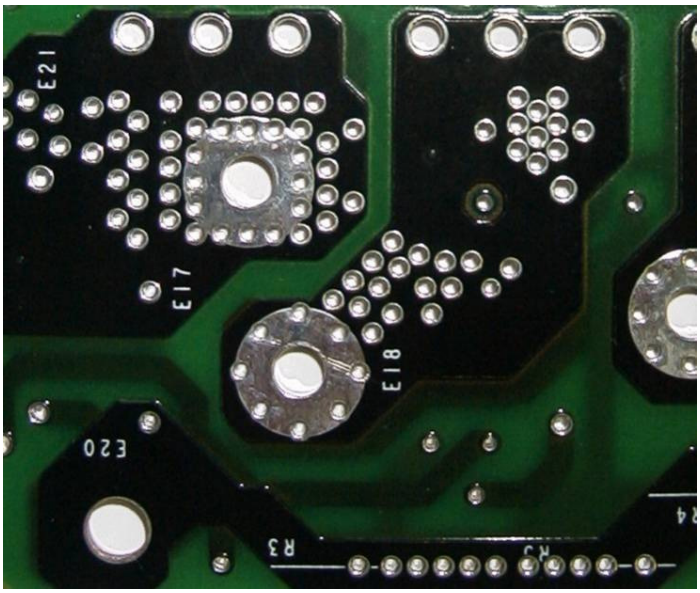
The biggest difference between shops who can successfully manufacture heavy copper boards and ones who fail is knowledge. One shop I sold heavy copper to had a engineering manager who thought he knew better than all the learning we have done over 20 yeas of making heavy copper. When a simple order would come in, he would not want to understand the start copper thickness versus plate situation and would screw the job up every time by over etching. It is important for everyone involved to understand why we do things and to change is asking for problems. Sure, we will all find better ways but they need to be properly tested and understood before releasing to production. The big challenge is to understand the customer's current/power requirements and how much copper is needed in the holes, on the inner layers and outer layers. At many spots on the board, we need to put extra current vias around big pads and on big traces to help carry the current required as well as keep the pad or track secured to the board. Many heavy copper boards get very hot during operations and the holes provide extra attachment force.



Notice the extra via holes around the pad.



This picture shows the thermal connection to a ground hole. The copper mass of the board is so big that soldering to a ground plane hole is impossible. We add wagon wheel type thermals to ground plane holes to allow soldering.



This picture shows the extreme, with adding holes for more current capability.
Notice the quality of the solder mask. This was done with the roller method.

A simple, double sided 400-amp circuit would consist of a .059 Fr4 core with initially a 6 oz. or .008 " thick soft copper sheet laminated to it. The bare copper coated board is drilled and any slots or mechanical plated features are machined into its surface. By conventional through hole plating with an electroless copper bath, the holes are made conductive.

To reveal the secret behind manufacturing heavy copper PCB please purchase this book.