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*Symbol:* LANSCE-1:01-054 (TM)  
*Date:* October 25, 2001

**SUBJECT: TRIP TO MULTI-PLATE CIRCUITS, INC.**

The purpose of this memo is to document two trips I made to Multi-Plate Circuits, Inc. in Dallas, Texas. I visited Multi-Plate in August 2001 and again in October 2001 to inspect the fabrication process of the meander line structures that are going to be used in the SNS Chopper. Prior to my visits, the vendor was delivering circuit boards that were "over etched" and, consequently, out of tolerance.

The first step in the process was to fabricate some sample pieces that could be used to measure critical dimensions. (See Figure 1.) It was determined that an "etch factor" was needed in the artwork in order to achieve our final specifications. I worked closely with a gentleman by the name of Mahesh Babaria (Engineering Consultant) to modify the existing electronic "gerber" files. We eventually concluded that the artwork needed to be plotted with a .0065" offset, or a .013" line weight. (See figure 2.)

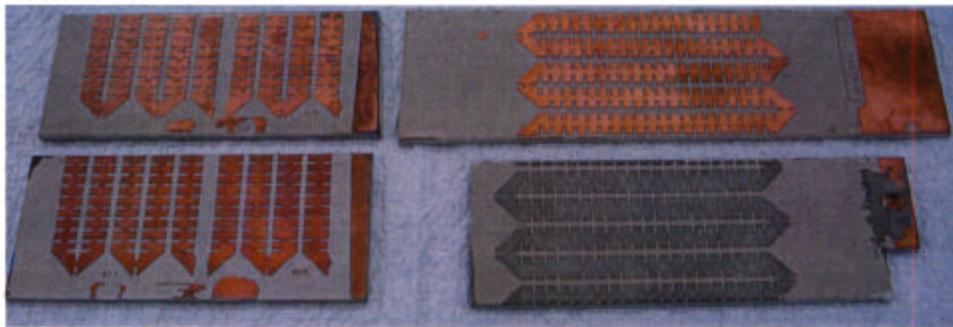


Figure 1: Test pieces of meander pattern.

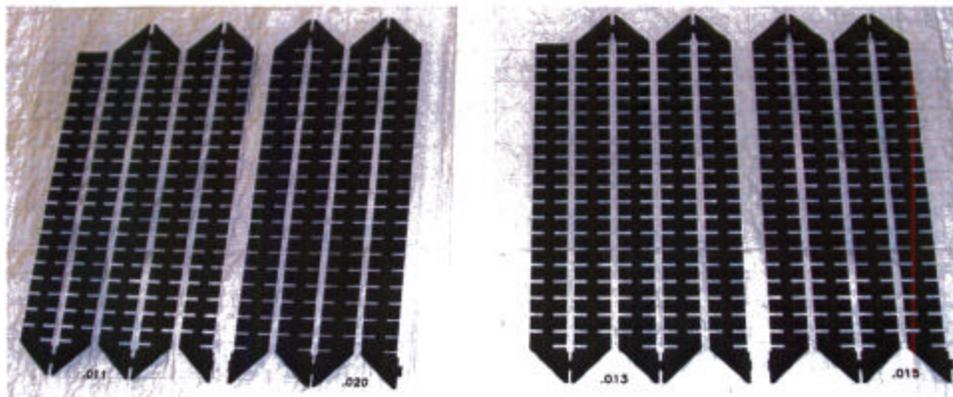


Figure 2: Sample pieces of artwork.

Next, I worked with a gentleman by the name of Robert Offield (Production Manager). Robert walked me through every step of the fabrication process. The first step was to etch the raw material down to the desired thickness. Next, a Photo-Image Resist was applied to the boards and they were then run through a developer. About 350 microns of tin/lead was then applied to the boards.

The boards were then run through an ammonia etcher. During this process, the conveyor belt speed and chemical pump speed were individually adjusted with each pass. The boards were measured on an optical comparator after each pass until desired dimensions were achieved. Finally, the tin/lead was stripped, the boards were run through a dryer, and the boards were routed to the final dimensions. (See Figure 3.)

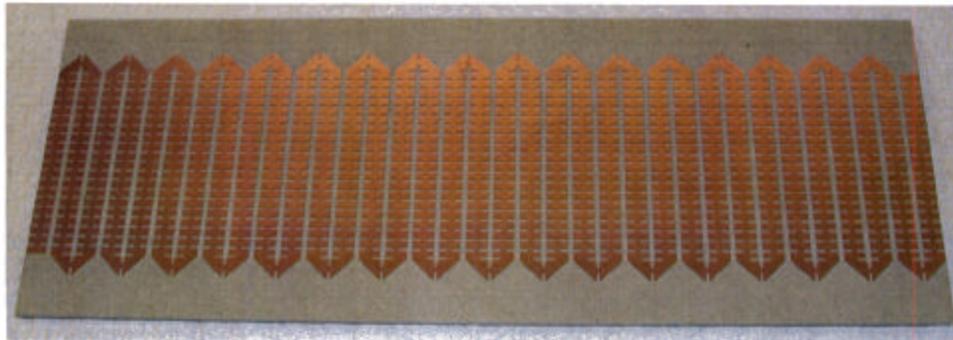


Figure 3: Finished Circuit Board.

Although not extremely difficult, the entire process was tedious and time consuming. Much attention was paid to every step of the process. I believe time spent at Multi-Plate was time well spent. Trying to communicate our requirements over the telephone would have been quite difficult. Also, personnel changes that occurred between my last two visits complicated matters.

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