

Creating High-Resolution PDF's suitable for IC Plotting

Have you ever wondered if there was an easy way to quickly create views of your IC design, which could easily be reviewed by colleagues, sent via e-mail, achieved, or plotted directly?

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The goal of this white paper is to explore the possibilities of creating a High-Resolution (600-2400 DPI) PDF file suitable for complex IC Plotting that can easily be viewed, shared, archived, and directly plotted by anyone.

No one can argue that PDF files are now the standard in document sharing from office, to engineering, to manufacturing. Most commercial Operating Systems such as Windows®, Solaris, RedHat®/Suse® Linux®, etc. already include software for PDF viewing and printing; you can also freely download these PDF products from the Internet. However, to this point PDF files haven't been created to efficiently handle the complexity of IC designs, so some experimentation was necessary, before an exceptional result was achieved.

In order for a PDF file to be useful in the IC plotting world, it must have a minimum resolution of 600 DPI over an 'E' size media (34"X44"), and handle up to 2400 DPI if necessary; to fully utilize resolutions of today's standard plotting devices such as HP Design Jet, HP Desk Jet, Calcomp, OCE, and more. The PDF file must still be relatively small & portable so that it may be shared and reviewed amongst design team members in its electronic form.

In our first attempt, we tried printing out our IC design to a generic postscript driver and then outputting to PDF using a distiller (both postscript driver and distiller can be downloaded free from Adobe® Inc.). On small media such as 'A' size (8.5" X 11") paper with low resolution (300 DPI) this method worked fine; however plot resolutions were low, file sizes were relatively large, and it was difficult to output anything accurately over a 'C' size (17" X 22") media. Printing to a generic postscript driver/distiller method is fine for general purpose use, but it was never intended for large complex IC plotting.

In our second attempt, we tried outputting a PDF using only vector objects (such as lines, arcs, polygons). Vector objects are true representations of the original geometries; they are directly supported inside a PDF file, and vector objects can be plotted to any resolution available. The PDF generated from our IC design was extremely large, and viewing in Acrobat® took over 1 minute just for redraws alone. When we made an effort to plot this PDF, our computer basically froze; because it had to convert all those vector objects back into raster images that the plotter could handle. Using Vectors was definitely not the way to go because PDF's are more adapt at handling images and text, rather than true vector objects (such as lines, arcs, polygons).

Our third attempt was to output a PDF using multiple raster-bitmapped images. Basically we sliced our design into sectioned bitmaps, where each bitmap represents a small area of the overall design, and then laid them side by side (essentially like a puzzle) – until we had our complete design. The resulting PDF consisted of hundreds of these raster-bitmapped images. This seemed to work fine for large 'E' size paper with a low resolution such as 300 DPI, and it printed out quickly because the images were already raster, making output to the plotter much more efficient. However, as soon as we tried increasing to 600 DPI, memory became an issue – our 2 GB RAM machine consistently ran out of memory. The 600 DPI PDF's we did successfully create were huge ~800 MB, and not very useful for viewing, sharing, or printing in a reasonable timeframe.

In concluding with these three experiments, it became clear - to achieve our PDF requirements, a more advanced solution was essential. Using the driver/distiller or the vector method for PDF generation would not be effective, but creating a raster-bitmapped PDF had potential if we could reduce overall file size and memory constraints.

Creating High-Resolution PDF's suitable for IC Plotting – Cont.

To reduce PDF file size we needed to develop a highly optimized raster image algorithm by removing or blending non-essential pixels for maximum plotter resolution, because ultimately it is the plotted media quality that counts. In addition, by omitting any objects that were too small to be visible in the plot would decrease the memory consumption required during the raster conversion.

Numerical Innovations, LLC has developed this revolutionary new solution for creating Optimized, High-Resolution PDF files and is available today as the "PDF Plot Tool" (a plug-In inside our popular GDSII viewer Visual Chip 2007 [Inspector]). Anyone can now easily create plots from their IC designs which can be shared, e-mailed, and plotted directly in a snap! Visual Chip 2007 [Inspector] together with the "PDF Plot Tool" Plug-In sells under \$3k for a site license. For more information or to request a 21-day "Full" evaluation, please visit our website: <http://www.numericalinnovations.com>.