OABench Version 2.0   Benchmark Name: Ghostscript®

Highlights

- **Benchmarks potential performance of a PostScript® printer engine**
- **9 different test files stress different printer aspects**
- **6 different output drivers stress different aspects of output formatting and rendering**
- **Based on open source AFPL Ghostscript® code base**

Application The Ghostscript benchmark provides an indication of the potential performance of an embedded processor running a PostScript printer engine. Performance is measured using nine input files reflecting different aspects of PostScript language processing, as well as six output drivers reflecting the different types of processing found in common printer engines.

Benchmark Description *Ghostscript is an application developed to render print format files on a host application. This task must perform all of the processing normally found in a PostScript printer engine. Additionally, this task must produce final output for a wide range of available printers and fax formatted results. This makes Ghostscript an ideal application to measure embedded processor capabilities to perform printer functions with a single consolidated score.*

EEMBC Ghostscript* contains a significant number of functions and algorithms used in PostScript printer engines. These functions are implemented within a portable test harness that allows execution on a wide range of processors and DSPs without source code changes in the main application. This benchmark is supported by an embedded compressed RAMfile system required to support this application.

Every PostScript printer engine contains a built-in interpreter that executes PostScript instructions. The engine also contains modules for reading a variety of input raster formats, fonts for rendering text characters, and an output driver to produce each page in a format for the printer engine.

The EEMBC Ghostscript application benchmark provides:

- An interpreter for the PostScript language;
- Input modules (utilities) for reading a variety of formats, including Postscript and Encapsulated PostScript;
- Output modules (drivers) for a wide variety of raster file formats, and printers.

Benchmark Description (continued)	▪ The Ghostscript library, a set of procedures to implement the graphics and filtering capabilities that are primitive operations in the PostScript language.
	Libraries are incorporated to handle graphics formats such as BMP, JPEG, PNG and tiff.
Ghostscript Benchmark Printer Drivers	Ghostscript is an interpreter for the PostScript language. A PostScript interpreter takes as input a set of commands. The output is usually a page bitmap, which is then sent to an output device such as a printer or display. PostScript is embedded in many printers.
	The following printer output drivers are implemented in EEMBC Ghostscript and applied to each input file:

- TIFF G4 (Fax formatting)
- 256 Color BMP Bitmap format
- CMYK - 1bpp/2bpp/4bpp/8bpp color separated CMYK data

PostScript™ Features Supported	There are three versions of PostScript: Level 1, Level 2, and PostScript 3. Level 2 PostScript, which was released in 1992, has better support for color printing. PostScript 3, released in 1997, supports more fonts, has better graphics handling, and includes several features to speed up PostScript printing.
	The following PostScript Language Level 3 features are available in EEMBC Ghostscript:

- Anti-aliased text and graphics on continuous-tone devices
- Alpha value for displays
- ICC-based color support
- Device "N" color support (6+ colors at 8 bits)
- "Argyll" color management system
- Band-at-a-time rendering for high-resolution printers

Ghostscript Input Data Set Descriptions

The following section contains a description of each input file used in the EEMBC Ghostscript application benchmark.

Rotate-fontlist	This dataset is a full listing of all standard ASCII characters of 2 fonts, printed in landscape orientation.
Banner	This dataset is comprised of several lines of text, warped to create text effects (Circle, wave). Sixteen copies are sent and printed n-up 4x4.
Presentation	This dataset is a typical business Powerpoint® presentation and includes text combined with diagonal lines for background and a vertical gradient. There is a PS version that is printed with four copies n-up (all slides are on

the same output page). There is a PDF version that is printed one slide per output page.

Mandel	This postscript data file includes a mathematical equation describing the Mandelbrot set combined with a text caption. This dataset results in a significant amount of floating point computation to create the output pixels. The output is set to full page at 300 DPI color.
Fractal Fern	This postscript includes a mathematical equation that yields a leaf-like shape. This dataset results in a significant amount of floating point computation to create the output pixels. The output is set to full page at 72 DPI, monochrome.
Spreadsheet	This dataset is a typical excel spreadsheet that results in two pages, with tables and charts. The output is n-up 2x2, with two copies of the spreadsheet printed to a single page.
Photo	This postscript file contains a full-color encapsulated JPEG image of a firefighter at a burning house. A caption is included. Four copies are printed full color, one copy per page.
Ebreadme	This dataset is a typical text document and includes two pages of text taken from the EnergyBench readme file. Eight copies are sent and printed n-up 4x4 on a single output page.

Training datasets only

3Dcolor:	This dataset includes postscript instructions to cover all available color space in a 3D-like cube.
Font catalogue	This dataset prints a full listing of each available font. This is based on the default script included with Ghostscript.

Analysis of Computing Resources	Ghostscript is a fully functional printer application with PostScript language interpretation, low-level graphics conversions, and printer drivers. Internally, the file system required for font selection and processing is also implemented with over 400 resources used during the processing on an embedded platform.
Profiling Analysis	The Ghostscript benchmark with the above-mentioned datasets was profiled, and the resulting data categorized to show that the following functions are being performed by the benchmark.

- Dithering / half toning (Color and Monochrome)
- Error diffusion
- Color adjustment
- Color conversion
- Image transforms (rotate, scale, clip, mirror, etc.)
- Compression
- Fill
- PostScript Interpreter

Optimizations Allowed	Out of the Box/Standard C
	Full Fury/Optimized

- The C code must not be changed for Out-of-the-Box unless it must be modified to get it to compile. All changes must be documented, authorized by the certification authority, and must not have a performance impact.

- For Out-of-the-Box, additional hardware can be used if it does not require code changes.

- All optimized libraries must be part of the standard compiler package, and/or available to all customers.

- The EEMBC Test Harness Lite must be used. Test harness changes may be made for portability reasons if they do not impact performance

- For Optimized, the basic algorithm may be changed and/or the code can be rewritten in assembler, as long as the output is identical (bit-exact) to output produced by Out-of-the-box implementation on the same platform.

- For Optimized, optimized libraries can be used if they are publicly available.

- For Optimized, hardware-assist can be used if it is on the same processor as that being benchmarked.

- For Optimized, in-lining is allowed.

- Additional data files may be used during certification to ensure the correctness of the optimized benchmark. You should not assume data patterns during optimization.

- Profile directed optimization is allowed using the training data set, colormap.ps and/or the font catalogue data set.

*This version of Ghostscript is based on AFPL 8.54.