Power-Saving Oriented Visual Enhancement Engine (VEE) Calibration Procedure Under Android Debug Bridge (ADB) Environment

● ● ● ● ● ● **QuickLogic Application Note 104**

Calibration Goal

During the calibration process, the system designer can use the VEE technology in two ways:

1. To maintain display viewability with the best battery life possible through reduced display brightness.

2. To increase display viewability with the best viewing experience possible, with power savings a secondary goal.

This document describes condition **1**.

Objectives and Outputs

QuickLogic VEE technology improves mobile display viewability, especially under lower display brightness or high ambient light. This is achieved through a combination of viewability enhancements and reduction of display brightness, therefore reducing the power consumption and extending battery life. VEE technology enables power-saving enhanced auto-brightness. **Figure 1** shows a comparison of two mobile devices.

Figure 1: Comparison of Two Mobile Devices
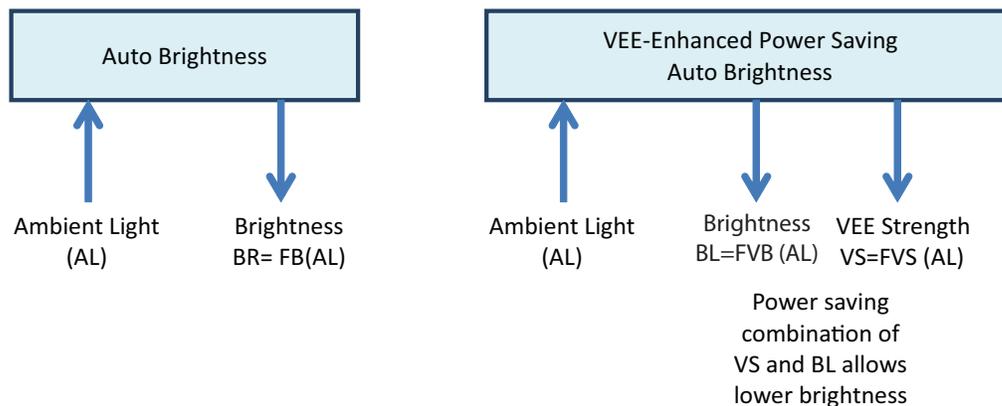
The VEE calibration process optimizes two parameters for the VEE auto-brightness software:

• Brightness: The brightness table determines the display brightness with the input of the ambient light viewing environment. The calibration process minimizes the display brightness, savings system power without negative effects to the user experience.

• VEE Strength: VEE strength improves the viewability of images. However, if VEE strength is too strong, artifacts (such as saturation) can be observed in certain areas of the pictures. Therefore, VEE strength tables must be carefully optimized to generate the best results.

Setup

Figure 2 illustrates the recommended tuning setup using two mobile devices.

Figure 2: Tuning Setup for Two Mobile Devices
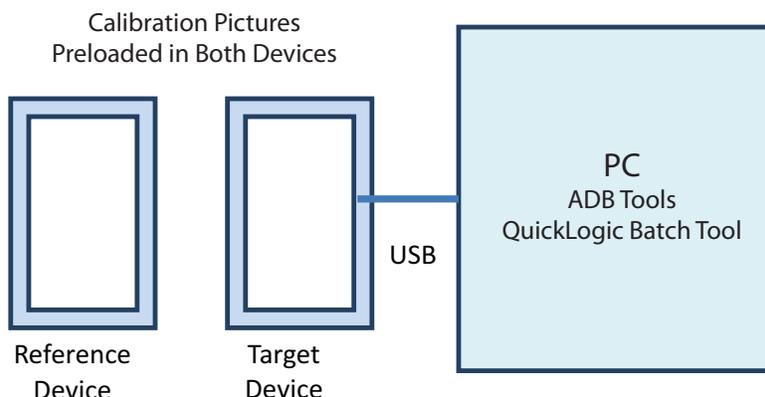
- Reference Device: Use the reference device to compare the display of the target device. VEE strength is always set as 0 for this device.

  NOTE: Verify the standard auto-brightness setting activated on the reference device. Document the "ambient light versus display brightness" curve for use later.

- Target Device: Use the target device for VEE calibration. For this device, display brightness and VEE strength must be controlled by the software batch file and ADB tool.

The following software tools shall be setup in the PC.

- QuickLogic Batch Tool: This batch receives VEE strength and brightness inputs. The batch generates ADB commands to control the target tablet. See the details in readme.txt of the batch file.

- ADB Tools: The Android ADB tools must be installed in the PC.

The devices should be preloaded with sets of pictures for testing and calibration. Two sets of pictures used for calibration:

- Calibration pictures: This type of picture ideally has large dark areas with complex texture. This type of picture is more sensitive to brightness conditions and ideally suitable for calibration. QuickLogic can provide samples images if needed.

- Others: This set of pictures is used to examine the artifacts for the tuning procedure. QuickLogic can provide samples images if needed.

Ambient Light Tuning Conditions

Normally, a minimum of three different ambient light (AL) environments are used for calibration; these often include a dark room (10 lux), indoor room (125 lux), and outdoors (1,000 to 10,000 lux). The number of ambient light conditions is at the discretion of the OEM/system designer, with the rule that at least three should be chosen for best results.

The system designer should choose how many environments will be used, and be certain that those light levels can be maintained throughout the calibration procedure, and are repeatable.

Record the ambient light sensor values for each lighting condition. Take the value with a light meter, measured directly at the display. The measurement location and equipment should be consistent from measurement to measurement.

Tuning Procedure

Repeat the following steps to determine the optimal VEE strength and brightness under each ambient light condition:

1. Select an ambient light tuning condition.

2. Display the same picture on the reference device and target device.

3. Using the data from the reference devices 'auto brightness' curve, determine what the display brightness is currently set at on the reference system. Set that same brightness level on the target device. Both the reference device and target device should provide an identical viewing experience at this point.

4. On the target device, set VEE strength to 10 (approximately 30% of full scale).

5. On the target device, reduce the display brightness by approximately 50%. For example, if the display brightness was set at 80%, drop to 40% or if set at 60%, drop to 30%.

6. On the target device, evaluate the picture for the following objectives:

   a. Viewability: Verify that target device picture is equivalent to the reference device picture.

      ‣ If the picture on the target device is significantly more viewable, further reduce display brightness.

      ‣ If the picture on the target device is significantly less viewable, increase display brightness.

   b. Artifacts: Verify That no artifacts are observed on the target device:

      ‣ If artifacts are observed, reduce VEE strength.

      ‣ If no artifacts are observed and further viewability improvements are desired, increase VEE strength.

Repeat step 6 until the best display brightness and VEE strength settings are determined for the chosen ambient light environment. Additional images can be used to gather a more rounded calibration.

Repeat steps 1 through 6 for each additional ambient light condition determined in the **Ambient Light Tuning Conditions** on page 3.

Tuning Procedure Results

At the end of calibration procedure, two tables are generated for each ambient light condition:

- Brightness
- VEE strength

To complete the calibration process perform the following steps:

1. Integrate these two tables into the VEE-enhanced power-saving auto-brightness functions.

2. Inspect the display again, under auto-brightness, using the VEE calibration.

3. Measure the power consumption in various lighting conditions and compare the power consumption against the reference platform.

After performing the above steps, the calibration procedure is completed.

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Revision History

Revision	Date	Originator and Comments
A	March 2013	Ying Wu and Kathleen Bylsma

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