SDK6 AN: A9 DRAM Tuning (Shmoo Tool)

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II Preface

This document provides technical details using a set of consistent typographical conventions to help the user differentiate key concepts at a glance.

Conventions include:

Example	Description
AmbaGuiGen, **DirectUSB** **Save, File > Save** **Power, Reset, Home**	Software names GUI commands and command sequences Computer / Hardware buttons
Flash_IO_control **da**, **status**, **enable**	Register names and register fields. For example, **Flash_IO_control** is the register for global control of Flash I/O, and bit 17 (**da)** is used for DMA acknowledgement.
GPIO81, **CLK_AU**	Hardware external pins
VIL, VIH, VOL, VOH	Hardware pin parameters
INT_O, RXDATA_I	Hardware pin signals
amb_performance_t ***amb_operating_mode_t*** **amb_set_operating_mode()**	API details (e.g., functions, structures, and type definitions)
`/usr/local/bin` `success = amb_set_operating_mode (amb_base_address, & operating_mode)`	User entries into software dialogues and GUI windows File names and paths Command line scripting and Code

Table II-1. Typographical Conventions for Technical Documents.

Additional Ambarella typographical conventions include:

- Acronyms are given in UPPER CASE using the default font (e.g., AHB, ARM11 and DDRIO).
- Names of Ambarella documents and publicly available standards, specifications, and databooks appear in *italic* type.

1 Overview

1.1 Overview: Introduction

This application note describes the procedure of implementing the tool of DDR parameter Shmoo. The main goal of the DDR Shmoo is to obtain tested, working values for the programmable DDR timing parameters and tap values, which are finally programmed into the A9 controller registers in the code. The Shmoo items include A9 DLL values, driving strength and termination value of pads, if any. To find stable values, recording and playback will be run with each modified parameter to increasing system loading. The operating range of the DRAM may be exceeded in order to determine the boundary between passing and failing parameter values. The failing value will result in system instability or cause the system to hang. The following sections show how to port the tool to the target:

- (Section 2.1) : How to Hook Up the Shmoo Tool onto Test Firmware
- (Section 2.2) : How to Run the Tool
- (Section 2.3) : How to Analyze the Shmoo Results and Find A Good Set of DDR Parameter

2 DDR Shmoo

2.1 : How to Hook Up the Shmoo Tool onto Test Firmware

The Shmoo tool helps to find timing parameters, A9 driving strength, and the termination value of pad operating range of DRAM. Video recording and playback with modified DDR timing parameters are run in the testing target.

The following is the sample code. At DoDdrShmoo(), please fill up the correct configuration: AMBA_DDR_SHMOO_CONFIG_s DdrShmooCtrl.

The configuration includes AmbaShmooTaskStack task priority, stack size, recode time, function pointer of recoding start and stop, playback and file delete function.

The AmbaDdrShmooTask_Start(&DdrShmooCtrl) function is the first step in starting the Shmoo algorithm.

```
DoDdrShmoo() {
  AMBA_DDR_SHMOO_CONFIG_s DdrShmooCtrl =
  {
      .Priority = 80,
      .StackByteSize = sizeof(AmbaShmooTaskStack),
      .pStack = AmbaShmooTaskStack,
      .RecordTime = 10,                                  //The duration of video
recording and playback
      .VideoRecordStart = UserDefined_VideoRecordStart,      //Function pointer of
      function to start video recording
      .VideoRecordStop = UserDefined_VideoRecordStop,        //Function pointer of
      function to stop video recording
      .VideoPlayback = UserDefined_VideoPlayback,            //Function pointer of
      function to start video playback
      .VideoFileDelete = UserDefined_VideoFileDelete,        //Function pointer of
      function to delete files
   };
   AmbaDdrShmooTask_Start(&DdrShmooCtrl);
}
```


2.2 : How to Run the Tool

The above section shows the related function of the tool. The following steps are the detailed steps for running the Shmoo tool.

1. During the Shmoo test, a system hang may occur. When it happens, user has to re-boot in order to perform the next step of the test. To simplify, please added Shmoo API - DoDdrShmoo() to system boot up code. After boot up finishes, the Shmoo tool will auto-run to check next parameters.
2. Shmoo API: DoDdrShmoo(&DdrShmooCtrl) start to run Shmoo.
3. Please remember to insert an SD card before the test. The Shmoo experiment results are stored in the SD card.

2.3 : How to Analyze the Shmoo Results and Find A Good Set of DDR Parameter

The shmoo result will be saved in drive C (in the SD card). Please open the file and check the PASS results. Find the pass operating ranges of each parameter and use the central value as the final setting.

E.g. Each DLL byte is represented with bit[5] and bit[3:0]. Bit[3:0] which represents the delay value. Bit[5] is the sign bit. Based on the following result, the recommended value is 0x20.

Shmoo result:

```
DLL Byte2(Write)
================================
BYTE2+ = 0x20 OK
BYTE2+ = 0x00 OK
BYTE2+ = 0x01 OK
BYTE2+ = 0x02 OK
BYTE2+ = 0x03 OK
BYTE2+ = 0x04 OK
BYTE2+ = 0x05 OK
BYTE2+ = 0x06 OK
================================
BYTE2- = 0x20  OK
BYTE2- = 0x21  OK
BYTE2- = 0x22  OK
BYTE2- = 0x23  OK
BYTE2- = 0x24  OK
BYTE2- = 0x25  OK
BYTE2- = 0x26  OK
BYTE2- = 0x27  OK
```

1 Additional Resources

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3 Revision History

NOTE: Page numbers for previous drafts may differ from page numbers in the current version.

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0.1	October 20, 2014	Formatted to SDK6

Table 3-1. Revision History.