



**AT91 ARM[®]
Thumb[®]
Microcontrollers**

**Application
Note**

Use of the AT91 External Bus Interface Timing Calculator

Introduction

This Application Note describes the use of the spreadsheet *AT91 Timings Calculator.xls* that can be downloaded and unzipped from Atmel's Web site. This spreadsheet automatically calculates all the timing parameters of the External Bus Interface (EBI) for the following AT91 devices:

- AT91M40800, AT91F40816, AT91R40807, AT91FR4081, AT91M40807, AT91R40008, AT91M42800A, AT91M55800A.

For definitions of these timing parameters, refer to the Electrical Characteristics Datasheet for the corresponding AT91 product.

Restrictions

This tool applies to the following (or subsequent) Datasheet revisions:

- AT91M40800: Literature No.1393B
- AT91R40807: Literature No. 1367C
- AT91M40807: Literature No. 1391B
- AT91R40008: Literature No. 1795A
- AT91M42800A: Literature No. 1776A
- AT91M55800A: Literature No. 1727B

Rev. 2620A-01/02



Overview

The Microsoft® Excel workbook *AT91 Timings Calculator.xls* provides a quick calculation tool for the AT91 EBI signal timings depending on the application environment in terms of power supply level, ambient temperature and output load capacitance.

The workbook is made up of several worksheets:

- One worksheet of instructions (entitled Readme)
- One user interface worksheet (entitled Timing Results).
- One worksheet producing all the derating tables to be applied (entitled Derating Abacus)
- One worksheet per AT91 device producing the basic timing parameter data (entitled AT91M40800_AT91F40816 etc.).

Data Source

All basic timing parameter data has been extracted from the related AT91 Electrical Characteristics Datasheet.

All derating table data has been extracted from the relevant Atmel Process Technology Library Databook.

Directions for Use

The user interface is the worksheet entitled Timing Results. This is the only worksheet that needs to be opened for normal use of the timing calculator.

Inputs

In the User Input section of this worksheet:

Fill in the following fields:

- Operating Master Clock Frequency (Master Clock Frequency (MHz) field)
- Operating Ambient Temperature (Operating Temperature (°C) field)
- V_{DDIO} or V_{DD} (for the single voltage x40 Series Family) Power Supply Levels (V_{DD}/V_{DDIO} Power Supply Level (V) field)
- V_{DDCORE} Power Supply Level (V_{DDCORE} Power Supply Level (V) field)
- The load capacitance on each output signal of interest (Output Signals Capacitance Loads (pF) table)

Note: Be sure to enter values consistent with the associated Electrical Characteristics Datasheet parameters.

- If they are known, the Memory/Peripheral Device Parameters Used for Wait-States and Data Float Time Cycles Calculation (ns). See “Optional Inputs” on page 3.

Choose the appropriate item in each of the following pull-down menus:

- The AT91 microcontroller of interest (AT91 Device field)
- The number of Wait-States programmed to access the memory to interface (Number of EBI Standard Wait-States (0 to 8) field)

Note: In some cases this field should only be filled in after the number of wait-states has been displayed corresponding to the selected memory/peripheral device. See the “Application Example” on page 4.

Outputs

The worksheet then automatically computes and displays the timing parameters in the Timing Calculation Results area.

Note: The NRD and NWR Capacitance Loads consistency regarding Master Clock Frequency status field informs the user whether or not the Master Clock Frequency is consistent with the NRD and NWR Capacitance Loads. If it is not, the advice given in this status field should be followed.

Optional Inputs

As an option, fill in the Memory/Peripheral Device Parameters Used for Wait-States and Data Float Time Cycles Calculation fields with the parameters extracted from the datasheet describing the device to be interfaced:

- t_{CE} is the Chip Select assertion to Output Data Valid maximum delay in the read cycle
- t_{OE} is the Output Enable assertion to Output Data Valid maximum delay in the read cycle
- t_{DH} is the Output Data Hold Time (as a Maximum) from Output Enable deassertion in the read cycle
- t_{WP} is the Minimum Write Pulse Width in the write cycle
- t_{DS} is the Data In Setup Time (as a Minimum) to Write Enable deassertion in the write cycle

Optional Output

If the above data is entered, the worksheet automatically computes and displays in the Timing Calculation Results area the number of Wait-States to add, related to the read and write cycles, and the number of Data Float Time cycles to program.

Application Example

As an example, the AT91 Timing Calculator will be used to find out the number of standard wait states to program in the EBI Chip-select Register in order to interface the AT91R40807 microcontroller with an AT49BV1604-90 Flash boot memory.

The AT91R40807 is clocked at 40 MHz, powered at 3.3V and the application temperature is up to 85° C. The load capacitance of each AT91R40807 output pin is 10 pF with the exception of MCK0 which is not connected.

The steps are as follows:

In the User Input section of the Timing Results page of the worksheet, fill in the following values:

- Choose the AT91R40807 in the AT91 Device pull-down menu.
- Fill in the Master Clock Frequency (MHz) field at 40.
- Fill in both the V_{DD}/V_{DDIO} and V_{DDCORE} Power Supply Level (V) fields at 3.3.
- Fill in the Operating Temperature (°C) field at 85
- Fill in all the Output Signal Capacitance Loads (pF) at 10, with the exception of MCK0 which should remain 0.
- Fill in the Memory/Peripheral Device Parameter fields (ns) as follows:
 - $t_{CE} = 90$
 - $t_{OE} = 40$
 - $t_{DH} = 25$
 - $t_{WP} = 50$
 - $t_{DS} = 40$
- Note that in the NRD and/or NWR Capacitance Loads Limitation field both NRD and NWR capacitances are consistent with the Master Clock Frequency.
- Note that in the Number of Wait-States and Data Float Times table:
 - The Number of Wait-States to add due to the Read Access (Standard Read Protocol) is 4.
 - The Number of Data Float Time cycles to program is 1.
- Select 4 as the number of EBI Standard Wait-States from the pull-down menu at the top of the page.

All the EBI Parameters are now valid for the connection of an AT49BV1604-90 Flash memory to an AT91R40807 microcontroller. These may be printed or saved as required.



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