



Digital Semiconductor

SPICE Models for Alpha Microprocessors :

An Application Note

This application note provides pin-to-model reference tables for design engineers who conduct SPICE simulations of Alpha microprocessors.

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|-------------------------------------|---|
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| Revision/Update Information: | This document supersedes the <i>SPICE Models for Alpha Microprocessors and Peripheral Chips: An Application Note</i> (EC-QA4XF-TE). |
| SPICE Level: | Level 28 SPICE Models |

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1 Document Organization

This document contains pin-to-model reference tables to assist you in cross-referencing Level 28 SPICE models with an 21164 Alpha microprocessor.

2 Intended Audience and Prerequisites

This application note is for users who are familiar with SPICE. This document provides information for design engineers who will conduct simulations of SPICE models for the 21164 Alpha microprocessor.

3 SPICE Model Description

You can use the SPICE models to simulate either *Worst Case* (WC) or *Best Case* (BC) operating conditions. The SPICE model files contain subcircuits, which provide a description of the connectivity and the parameters to be used with the model.

Most of the input pins have only one subcircuit that functions for either operating condition. However, all of the driver pins and some of the input pins have two separate driver subcircuits that correspond to the two operating conditions. Either subcircuit may be instantiated for SPICE simulation, depending on the operating condition desired.

4 Reference Table Conventions

The following conventions are used in all of the pin-to-model reference tables.

| Convention | Description |
|---------------------------------|---|
| Pin Name | This indicates the name of the signal pin on the chip. |
| Pin Type | This indicates whether the pin is an input (I), output (O), open drain output (OD), or bidirectional (I/O) pin. |
| File Name of Model | This indicates the name of the SPICE model file for the pin. |
| Subcircuit names ending with WC | This indicates the <i>Worst Case</i> operating condition. |
| Subcircuit names ending with BC | This indicates the <i>Best Case</i> operating condition. |
| Extents | Extents are specified by a pair of numbers in angle brackets (<>) that are separated by a colon (:) and are inclusive. For example, bits <0:3> indicates an extent including bits 0, 1, 2, and 3. |

5 21164 Alpha Microprocessor Pin-to-Model Reference Table

Table 1 lists all the signal pins and the corresponding Level 28 SPICE models to use for the 21164 Alpha microprocessor. The subcircuits are simulated with the following *Worst Case* (WC) and *Best Case* (BC) operating conditions:

- Subcircuit names ending with WC have an operating condition of **Vdd** at 3.00 V with a temperature of 85°C (185°F).
- Subcircuit names ending with BC have an operating condition of **Vdd** at 3.60 V with a temperature of 25°C (77°F).

Table 1 21164 Alpha Pins with Corresponding Level 28 Models

| Pin Name | Pin Type | File Name of Model | Model Subcircuits |
|---------------------------------|----------|--------------------|--------------------|
| addr_bus_req_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| addr_cmd_par_h | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| addr_h<39:4> | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| addr_res_h<2:0> | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| big_drv_en_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| cack_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| cfail_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| clk_mode_h<2:0> | I | I_21164.SPI | VIN_WC, VIN_BC |
| cmd_h<3:0> | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| cpu_clk_out_h | O | CO_21164.SPI | VCOUT_WC, VCOUT_BC |
| dack_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| data_bus_req_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| data_check_h<15:0> | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| data_h<127:0> | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| data_ram_oe_h | O | OL_21164.SPI | VOUtl_WC, VOUtl_BC |
| data_ram_we_h | O | OL_21164.SPI | VOUtl_WC, VOUtl_BC |
| dc_ok_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| fill_error_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| fill_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| fill_id_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| fill_nocheck_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| idle_bc_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| index_h<25:4> | O | OL_21164.SPI | VOUtl_WC, VOUtl_BC |
| int4_valid_h<3:0> | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| irq_h<3:0> | I | I_21164.SPI | VIN_WC, VIN_BC |
| mch_hlt_irq_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| oe_we_active_low_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| osc_clk_in_h | I | C_21164.SPI | VINC_WC, VINC_BC |
| osc_clk_in_l | I | C_21164.SPI | VINC_WC, VINC_BC |

(continued on next page)

Table 1 (Cont.) 21164 Alpha Pins with Corresponding Level 28 Models

| Pin Name | Pin Type | File Name of Model | Model Subcircuits |
|---------------------------------|----------|---------------------------------|-------------------------|
| perf_mon_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| port_mode_h<1:0> | I | I_21164.SPI | VIN_WC, VIN_BC |
| pwr_fail_irq_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| ref_clk_in_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| scache_set_h<1:0> | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| shared_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| srom_clk_h | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| srom_data_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| srom_oe_l | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| srom_present_l | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| st_clk1_h | O | OL_21164.SPI | VOUTL_WC, VOUTL_BC |
| st_clk2_h | O | OL_21164.SPI | VOUTL_WC, VOUTL_BC |
| system_lock_flag_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| sys_clk_out1_h | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| sys_clk_out1_l | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| sys_clk_out2_h | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| sys_clk_out2_l | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| sys_mch_chk_irq_h | I | I_21164.SPI | VIN_WC, VIN_BC |
| sys_reset_l | I | I_21164.SPI | VIN_WC, VIN_BC |
| tag_ctl_par_h | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| tag_data_h<38:20> | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| tag_data_par_h | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| tag_dirty_h | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| tag_ram_oe_h | O | OL_21164.SPI | VOUTL_WC, VOUTL_BC |
| tag_ram_we_h | O | OL_21164.SPI | VOUTL_WC, VOUTL_BC |
| tag_shared_h | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| tag_valid_h | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| tck_h | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| tdi_h | I | IU_21164.SPI | VINU_WC, VINU_BC |
| tdo_h | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| temp_sense | I | Model not provided ¹ | Subcircuit not provided |
| test_status_h<1:0> | O | O_21164.SPI | VOUT_WC, VOUT_BC |
| tms_h | I | IU_21164.SPI | VINU_WC, VINU_BC |
| trst_l | I/O | B_21164.SPI | VIOD_WC, VIOD_BC |
| victim_pending_h | O | O_21164.SPI | VOUT_WC, VOUT_BC |

¹ **temp_sense** should be left floating and not connected to etch, a voltage, or **Vss**.

Support, Products, and Documentation

If you need technical support, a *Digital Semiconductor Product Catalog*, or help deciding which documentation best meets your needs, visit the Digital Semiconductor World Wide Web Internet site:

<http://www.digital.com/semiconductor>

For documentation and general information, call the Digital Semiconductor Information Line:

| Area | Phone Number |
|--------------------------|-----------------------|
| United States and Canada | 1-800-332-2717 |
| Outside North America | 1-510-490-4753 |

For technical support, call the Digital Semiconductor Technology Center:

| Phone or FAX | Phone Number |
|--------------------------------|-----------------------|
| Phone (U.S. and international) | 1-508-568-7474 |
| FAX: | 1-508-568-6698 |

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To order Digital Semiconductor devices and for more information about a motherboard kit, contact your local distributor. To obtain a *Digital Semiconductor Product Catalog*, contact the Digital Semiconductor Information Line.

The following table lists some of the products available from Digital Semiconductor:

| Product | Order Number |
|---|--------------|
| 21164 Alpha 300-MHz Microprocessor for Windows NT | 21164-P4 |
| 21164 Alpha 366-MHz Microprocessor for Windows NT | 21164-P5 |
| 21164 Alpha 333-MHz Microprocessor | 21164-EB |
| 21164 Alpha 400-MHz Microprocessor | 21164-FB |
| 21164 Alpha 433-MHz Microprocessor for Windows NT | 21164-P6 |
| 21164 Alpha 433-MHz Microprocessor | 21164-HB |
| 21164 Alpha 466-MHz Microprocessor | 21164-IB |
| 21164 Alpha 500-MHz Microprocessor for Windows NT | 21164-P7 |
| 21164 Alpha 500-MHz Microprocessor | 21164-JB |
| 21164 Alpha 533-MHz Microprocessor | 21164-KB |
| 21164 Alpha 533-MHz Microprocessor for Windows NT | 21164-P8 |
| 21164 Alpha 566-MHz Microprocessor | 21164-LB |
| 21164 Alpha 600-MHz Microprocessor | 21164-NB |
| 21164 Alpha 633-MHz Microprocessor | 21164-MB |

Motherboard Kits

Motherboard kits include the motherboard and the motherboard user's manual.

| Product | Order Number |
|---------------------------------|--------------|
| AlphaPC 164 WinNT Motherboard | 21A04-B0 |
| AlphaPC 164 UNIX Motherboard | 21A04-B2 |
| AlphaPC 164LX WinNT Motherboard | 21A04-C0 |

Design Kits

Design kits include full documentation and schematics. They do not include evaluation boards or related hardware.

| Product | Order Number |
|------------------------------------|--------------|
| AlphaPC 164 Motherboard Design Kit | 21A04-12 |

Ordering Digital Semiconductor Documentation

The following table lists some of the available Digital Semiconductor documentation.

| Title | Order Number |
|--|--------------|
| Alpha AXP Architecture Reference Manual ¹ | EY-T132E-DP |
| Alpha AXP Architecture Handbook | EC-QD2KB-TE |
| Digital Semiconductor 21164 Alpha Microprocessor Data Sheet | EC-QP98B-TE |
| Digital Semiconductor 21164 Alpha Microprocessor Hardware Reference Manual | EC-QP99B-TE |
| Digital Semiconductor 21164 Alpha Microprocessor Product Brief | EC-QP97C-TE |
| Alpha 21164 Evaluation Board Read Me First | EC-QD2VB-TE |
| Alpha 21164 Evaluation Board Product Brief | EC-QCZZD-TE |
| Alpha 21164 Evaluation Board User's Guide | EC-QD2UC-TE |
| Alpha 21164 Microprocessor Motherboard Product Brief | EC-QSAGA-TE |
| Alpha 21164 Microprocessor Motherboard User's Manual | EC-QLJLB-TE |
| AlphaPC 164 Motherboard User's Manual | EC-QPG0B-TE |
| AlphaPC 164 Motherboard Design Kit Read Me First | EC-QPFZA-TE |
| Alpha Evaluation Boards Software Developer's Kit and Firmware Update Read Me First | EC-QERSE-TE |
| Alpha Microprocessors Evaluation Board Debug Monitor User's Guide | EC-QHUVD-TE |
| Alpha Microprocessors Evaluation Board Software Design Tools User's Guide | EC-QHUWB-TE |
| Alpha Microprocessors Evaluation Board Windows NT 3.51 and 4.0 Installation Guide | EC-QLUAF-TE |

¹To purchase the *Alpha AXP Architecture Reference Manual*, call **1-800-DIGITAL** from the U.S. or Canada, contact your local Digital office, or call Butterworth-Heinemann (Digital Press) at 1-800-366-2665.

| Title | Order Number |
|--|---------------------|
| Alpha Microprocessors SRM Mini-Debugger User's Guide | EC-QHUXB-TE |
| Alpha SRM Console for Alpha Microprocessor Evaluation Boards User's Guide | EC-QK8DE-TE |
| Digital Semiconductor 21164 Alpha Microprocessor Evaluation Board User's Guide | EC-QD2UD-TE |
| Digital Semiconductor 21164 Alpha Microprocessor Motherboard User's Manual | EC-QLJLC-TE |
| PALcode for Alpha Microprocessors System Design Guide | EC-QFGLC-TE |
