



# **HDL\_EMUL**

## **Emulation Model - CMOS IOs**

### **Application Notes**

**July 2010**

**Version 1.1**



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#### **Highlights**

- Emulation model for MAT10 packages of IOs
- Defines all internal components of ST

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## Revision History

| Date           | Document Version | Comments                         |
|----------------|------------------|----------------------------------|
| 4-October-2007 | 1.0              | First release                    |
| 21-July-2010   | 1.1              | ST_KEEPER_EN functionality added |



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# Table of Contents

|  |          |
|--|----------|
| <b>1 General Description</b>                           | <b>1</b> |
| <b>2 Functional Specification - ST Pull Primitives</b> | <b>1</b> |
| <b>2.1 ST_PULLUP</b>                                   | <b>1</b> |
| 2.1.1 Functional Description                           | 1        |
| 2.1.2 Module Declaration                               | 1        |
| 2.1.3 Primitive Description                            | 1        |
| <b>2.2 ST_PULLDOWN</b>                                 | <b>2</b> |
| 2.2.1 Functional Description                           | 2        |
| 2.2.2 Module Declaration                               | 2        |
| 2.2.3 Primitive Description                            | 2        |
| <b>2.3 ST_PULLUP_EN</b>                                | <b>2</b> |
| 2.3.1 Functional Description                           | 2        |
| 2.3.2 Module Declaration                               | 2        |
| 2.3.3 Primitive Description                            | 2        |
| <b>2.4 ST_PULLDOWN_EN</b>                              | <b>3</b> |
| 2.4.1 Functional Description                           | 3        |
| 2.4.2 Module Declaration                               | 3        |
| 2.4.3 Primitive Description                            | 3        |
| <b>2.5 ST_PULLUP_EN_AH</b>                             | <b>3</b> |
| 2.5.1 Functional Description                           | 3        |
| 2.5.2 Module Declaration                               | 3        |
| 2.5.3 Primitive Description                            | 3        |
| <b>2.6 ST_PULLDOWN_EN_AH</b>                           | <b>4</b> |
| 2.6.1 Functional Description                           | 4        |
| 2.6.2 Module Declaration                               | 4        |
| 2.6.3 Primitive Description                            | 4        |
| <b>2.7 ST_KEEPER_EN</b>                                | <b>4</b> |
| 2.7.1 Functional Description                           | 4        |
| 2.7.2 Module Declaration                               | 4        |
| 2.7.3 Primitive Description                            | 4        |
| <b>3 Special Cases</b>                                 | <b>5</b> |
| <b>3.1 Analog Cells</b>                                | <b>5</b> |
| <b>4 Contact Information</b>                           | <b>5</b> |

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## 1. General Description

This document details the definitions of all internal components of ST that are used in emulation models provided in MAT10 packages in IO libraries. This enables the user to map these pull up/pull down devices with components from a particular technology library.

## 2. Functional Specification - ST Pull Primitives

The following table lists the primitives defined in the HDL\_EMUL views provided in the IO library packages.

**Table 1: ST Pull Primitive List**

| ST Pull Primitive Name | Description                                 |
|------------------------|---|
| ST_PULLUP              | Pull up component with NO control pin       |
| ST_PULLDOWN            | Pull down component with NO control pin     |
| ST_PULLUP_EN           | Pull up component with ACTIVE LOW enable    |
| ST_PULLDOWN_EN         | Pull down component with ACTIVE LOW enable  |
| ST_PULLUP_EN_AH        | Pull up component with ACTIVE HIGH enable   |
| ST_PULLDOWN_EN_AH      | Pull down component with ACTIVE HIGH enable |

### 2.1 ST\_PULLUP

#### 2.1.1 Functional Description

This primitive is used to model a pull up circuit.

#### 2.1.2 Module Declaration

- ST\_PULLUP (pin name)
- ST\_PULLUP (IO)

where,

IO = output pin (for this primitive).

#### 2.1.3 Primitive Description

**Table 2: Primitive Description**

| IO    |
|-------|
| pull1 |



## 2.2 ST\_PULLDOWN

### 2.2.1 Functional Description

This primitive is used to model a pull down circuit.

### 2.2.2 Module Declaration

- ST\_PULLDOWN (pin name)
- ST\_PULLDOWN (IO)

where,

IO = output pin (for this primitive).

### 2.2.3 Primitive Description

**Table 3: Primitive Description**

| IO    |
|-------|
| pull0 |

## 2.3 ST\_PULLUP\_EN

### 2.3.1 Functional Description

This primitive is used to model a pull up circuit with active low enable (PMOS).

### 2.3.2 Module Declaration

- ST\_PULLUP\_EN (pin name)
- ST\_PULLUP\_EN (IO, EN)

where,

IO = output pin (for this primitive).

EN = input pin (enable pin).

### 2.3.3 Primitive Description

**Table 4: Primitive Description**

| EN | IO    |
|----|-------|
| 1  | Z     |
| 0  | pull1 |



## 2.4 ST\_PULLDOWN\_EN

### 2.4.1 Functional Description

This primitive is used to model a pull down circuit with active low enable (PMOS).

### 2.4.2 Module Declaration

- ST\_PULLDOWN\_EN (pin name)
- ST\_PULLDOWN\_EN (IO, EN)

where,

IO = output pin (for this primitive).

EN = input pin (enable pin).

### 2.4.3 Primitive Description

Table 5: Primitive Description

| EN | IO    |
|----|-------|
| 1  | Z     |
| 0  | pull0 |

## 2.5 ST\_PULLUP\_EN\_AH

### 2.5.1 Functional Description

This primitive is used to model a pull up circuit with active high enable (NMOS).

### 2.5.2 Module Declaration

- ST\_PULLUP\_EN\_AH (pin name)
- ST\_PULLUP\_EN\_AH (IO, EN)

where,

IO = output pin (for this primitive).

EN = input pin (enable pin).

### 2.5.3 Primitive Description

Table 6: Primitive Description

| EN | IO    |
|----|-------|
| 0  | Z     |
| 1  | pull1 |

## 2.6 ST\_PULLDOWN\_EN\_AH

### 2.6.1 Functional Description

This primitive is used to model a pull down circuit with active high enable (NMOS).

### 2.6.2 Module Declaration

- ST\_PULLDOWN\_EN\_AH (pin name)
- ST\_PULLDOWN\_EN\_AH (IO, EN)

where,

IO = output pin (for this primitive).

EN = input pin (enable pin).

### 2.6.3 Primitive Description

Table 7: Primitive Description

| EN | IO    |
|----|-------|
| 0  | Z     |
| 1  | pull0 |

## 2.7 ST\_KEEPER\_EN

### 2.7.1 Functional Description

This primitive is used to model a bus keeper circuit with active low enable.

It keeps the previous value of IO port with weak strength when EN is low and it is transparent (IO will have current value) when EN is high.

### 2.7.2 Module Declaration

- ST\_KEEPER\_EN (pin name)
- ST\_KEEPER\_EN (IO, EN)

where,

IO = output pin (for this primitive).

EN = input pin (enable pin).

### 2.7.3 Primitive Description

Table 8: Primitive Description

| EN | IO  |
|----|---|
| 0  | IO keeps the previous value with weak strength. |
| 1  | IO is transparent                               |

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## 3. Special Cases

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### 3.1 Analog Cells

In cells, such as HV\* and ANA\* with two or more INOUT ports, the HDL\_EMUL model is unidirectional. This model should not be used for functional verification. The emulation flow uses the synthesized model. The HDL\_EMUL model present in package can be synthesized. The synthesized netlist from this model is functionally correct and complete (bidirectional behavior).

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## 4. Contact Information

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For more information about this document, please write to [HELPDESK](#).