.TVINCLUDE

Test Vector Files

> **.TVINCLUDE** [**FILE**=]FILENAME [**COMP**=ON|OFF] [**ERRNODE**[=YES|NO]]

Test vectors can be included in a netlist. This file allows the user to define a bus, specify inputs and check output values. It is possible to compare simulation results using test vectors. A test vector is an external file containing a record of circuit stimulus and response.

Parameters

- FILE=

  Specifies the filename. Optional.

- FILENAME

  Test Vector filename.

- COMP=ON|OFF

  Define whether the output vector is compared to simulation results. Default is ON. Optional.

- ERRNODE[=YES|NO]

  If set to YES (default value), an error is printed for signals using undeclared nodes. If set to NO, the following warning is displayed:

  ```
  Warning 445: COMMAND .TVINCLUDE: node %s not found (%s).
  Test vector specifications ignored for this node.
  ```

Boundaries are set by using the following options:

> **.OPTION LOWVOLTAGE**=VAL **HIGHVOLTAGE**=VAL **LOWVTH**=VTH1 **HIGHVTH**=VTH2

- **LOWVOLTAGE** and **HIGHVOLTAGE** are used for input signals

- **LOWVTH** and **HIGHVTH** are used for output checking

- Default values are: **LOWVOLTAGE**=0, **HIGHVOLTAGE**=5, **LOWVTH**=2.4, **HIGHVTH**=2.6
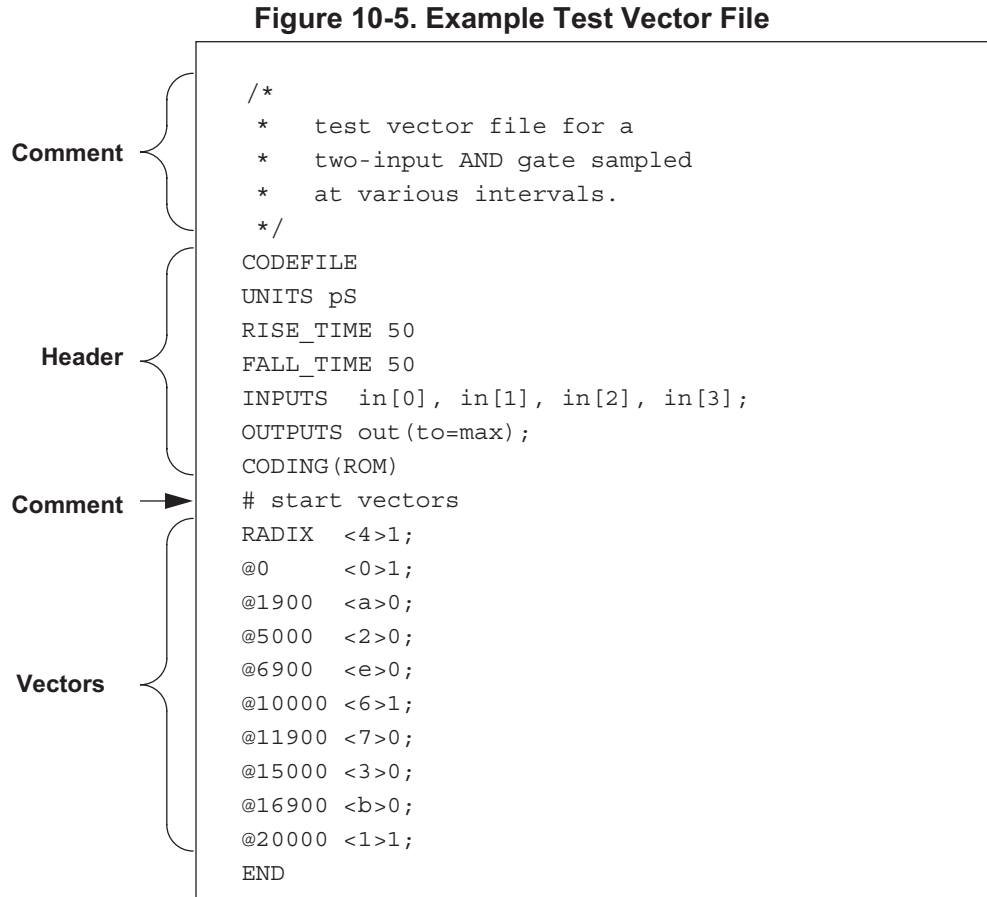
Note

For more details regarding the setting of boundaries with these options, please refer to "HIGHVOLTAGE=VAL" on page 939.

Test Vector File Format

Figure 10-5 shows the contents of a test vector file for a two-input AND gate.

Figure 10-5. Example Test Vector File

```
        /*
        *    test vector file for a
Comment *    two-input AND gate sampled
        *    at various intervals.
        */
        CODEFILE
        UNITS pS
        RISE_TIME 50
Header  FALL_TIME 50
        INPUTS  in[0], in[1], in[2], in[3];
        OUTPUTS out(to=max);
        CODING(ROM)
Comment → # start vectors
        RADIX  <4>1;
        @0     <0>1;
        @1900  <a>0;
        @5000  <2>0;
        @6900  <e>0;
Vectors @10000 <6>1;
        @11900 <7>0;
        @15000 <3>0;
        @16900 <b>0;
        @20000 <1>1;
        END
```

A test vector file consists of the following parts:

- Header
  The header specifies the units of time used in the test vectors and the direction and order of the inputs and outputs. Refer to "Header" on page 887.

- Comments in Test Vector Files
  Comments can appear anywhere in the file. Refer to "Comments in Test Vector Files" on page 888.

- Radix
  Test vectors can have a radix value of 1, 2, 3 or 4. By default the value is 1.

- Test Vectors
  Test vectors consist of a time stamp followed by the input and output signal data at the time indicated by the time stamp. Refer to "Test Vectors" on page 888.

Note

There is no provision for line continuation in test vector files. Test vector file line lengths are not limited.

Header

The keyword **CODEFILE** marks the beginning of the header; the keywords **CODING(ROM)** mark the end of the header. Within the header are three classes of statements:

- **UNITS** Statement

  Specifies the units used for time stamps (the time units of measure) in the test vectors. Format the **UNITS** statement as follows:

  ```
  UNITS units
  ```

  units

  Must be fs (femtoseconds), ps (picoseconds), ns (nanoseconds), us (microseconds), or ms (milliseconds). This optional parameter defaults to fs. Units are case insensitive.

- **RISE_TIME** and **FALL_TIME** Statements

  Specifies the rise and fall times for digital signals. The optional **RISE_TIME** and **FALL_TIME** statements are single-parameter declarations of the digital signal transition durations. If you omit the **RISE_TIME** and **FALL_TIME** statements, Eldo uses the DefaultRiseTime and DefaultFallTime simulation option values (default 1e-10). Format the statements as follows:

  ```
  RISE_TIME n
  FALL_TIME n
  ```

  n

  Specifies a digital transition rise or fall time. The **UNITS** statement specifies the units of time (fs, ps, ns, or us).

  The **RISE_TIME** and **FALL_TIME** definitions affect the timing of signals moving from one state to another. Refer to "Timing of Changing States" on page 889.

- **INPUTS** and **OUTPUTS** Statements

  Defines the direction and order of the signals in the test vectors. The **INPUTS** and **OUTPUTS** statements can be declared on single or multiple lines. Signals in the input and output lists can have one parameter denoting a time offset. A signal specification has the following general form:

  ```
  INPUTS signal [(to=n)]...;
  OUTPUTS signal [(to=n)]...;
  ```

  signal

  A Spice netlist signal name. Specify bidirectional signals in both **INPUTS** and **OUTPUTS** statements.

```
to=n
```

Specifies a time offset (to) that applies to both inputs and outputs. This parameter causes input forcing or output comparison to be delayed by *n* time units (fs, ps, ns, µs, or ms). The UNITS Statement specifies the units of time.

The time offset is relative to the time the vector is applied. For output signals, if *n* is replaced by the keyword **max**, then the comparison occurs one femtosecond before Eldo reads the next vector.

If no time offsets are specified, inputs start being forced at the vector time.

```
; (semicolon)
```

Terminates the **INPUTS** or **OUTPUTS**.

In the test vector file example illustrated in Figure 10-5 on page 886, all the inputs are forced at the same time, with no offsets. Output comparisons are delayed until just before the next vector is forced.

Comments in Test Vector Files

Comments can appear anywhere in a test vector file. They can take the form of C-style comments (delimited by **/*** and ***/**) or shell-style comments (prefixed by a # character). Comments that appear within the header are ignored when the test vector file is read.

Radix

Test vectors can have a radix value of 1, 2, 3 or 4. By default the value is 1. Table 10-32 lists the different radix values and their meanings:

Table 10-32. Test Vector Radix Values

Value	Radix
1	Binary
2	Decimal
3	Octal
4	Hexadecimal

Test Vectors

The vector portion of the test vector file starts after the header and ends with the keyword **END**. Format test vectors according to the following form:

```
@timestamp <input_data >output_data ;
```

```
timestamp
```

Specifies the simulation time in at which the vector was generated. Supply an integer value (with no decimal). The UNITS Statement specifies the units of time. Eldo applies the vector at this time during verification.

```
input_data
```

Specifies the states of the inputs at the simulation time shown by the timestamp. The less than symbol '<' precedes the input portion of the vector. Refer to Table 10-33 on page 889 for valid state characters.

```
output_data
```

Specifies the states of the outputs at the simulation time shown by the timestamp. The greater than symbol '>' precedes the output portion of the vector. Refer to Table 10-33 on page 889 for valid state characters.

```
; (semicolon)
```

Terminates the vector.

The input and output portions of the vector contain columns of state characters. Each column is associated with one signal, in the order defined in the input and output lists in the header. If a signal is bidirectional, it could have one column in the input portion of the vector and one column in the output portion of the vector.

Table 10-33 lists the different state characters and their meanings:

Table 10-33. Test Vector State Characters

| State *	Meaning for Inputs	Meaning for Outputs
0 or **L**	Force LOW	Verify LOW
1 or **H**	Force HIGH	Verify HIGH
X	Ignore; do not force	Do not verify
. or **Z**	Do not force	Do not verify

* Logic level states (L, H, X, and Z) are case insensitive in Eldo.

Timing of Changing States

Eldo imposes the following timing rules while changing signal states specified by test vectors:

- **Forced state to forced state**
  A signal changing from a forced state (non-Z) to another forced state begins its transition **RISE_TIME** (or **FALL_TIME**) before the vector time so that the signal reaches the new value at the vector time.

- **High impedance to forced state**
  A signal changing from high impedance state (Z) to a forced state starts to be forced **RISE_TIME** (or **FALL_TIME**) before the vector time.

- **Forced state to high impedance**
  A signal changing from a forced state to a high impedance state (Z) is tri-stated (released) at the vector time.

- Eldo uses the greater value of the **RISE_TIME** and **FALL_TIME** definitions in determining output evaluation timing (refer to Figure 10-6). The input signals always arrive at the evaluation time. However, if the **RISE_TIME** and **FALL_TIME** values are different, one evaluation will be performed some time before the transition begins.

Figure 10-6. Test Vector Output Evaluation
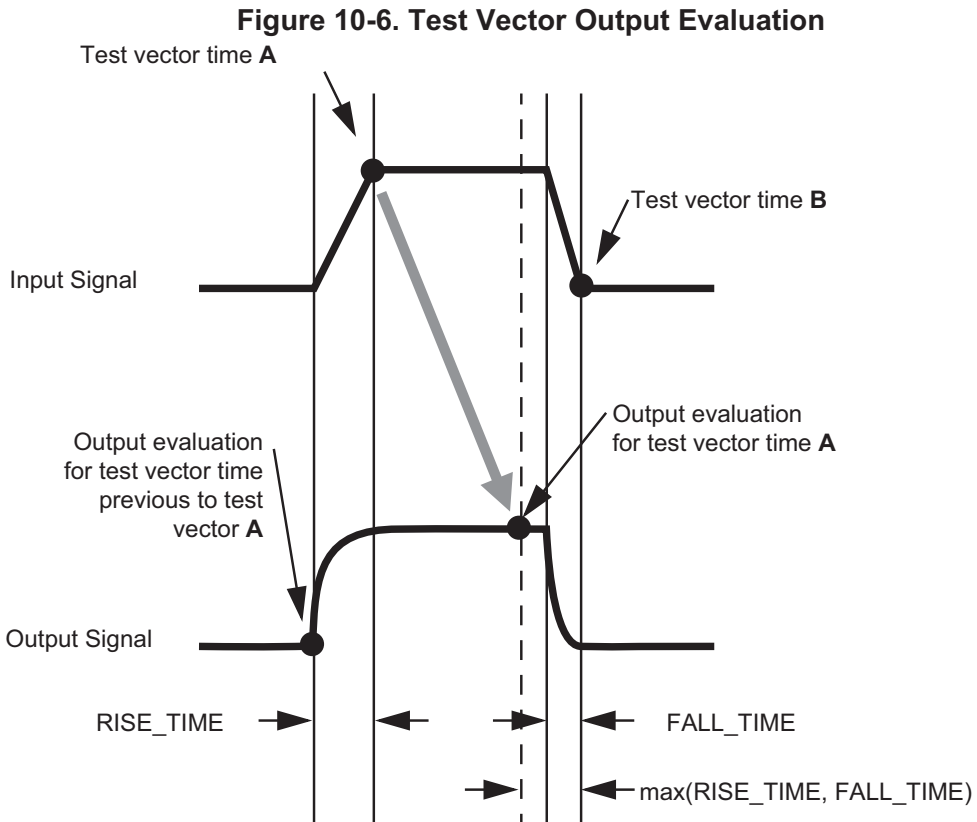
> **Note**
>
> Because Eldo determines the test vector output evaluation based on the maximum value of **RISE_TIME** and **FALL_TIME**, caution should be exercised when assigning them different values.

The following output evaluations occur:

- The minimum time step (1 fs) before the next transition begins if the next transition is determined by the *greater* value of **RISE_TIME** and **FALL_TIME**.

- Before the next transition begins by the difference between **RISE_TIME** and **FALL_TIME** if the next transition is determined by the *lesser* value of **RISE_TIME** and **FALL_TIME**.