

Motivation

It is often the case that all the concurrent assertions that are placed in a design unit share the same clock and disable iff condition. While it is possible to define a default clocking for the assertions, it is not possible to do so for the disable iff condition. It is then necessary to repeat the same code in all the assertions. This proposal remedies the situation by introducing a default disable iff declaration which applies to all assertions in the scope where the default disable iff is declared. (Note that it is not applied to properties or sequences, only to assert property, assume property, cover property, cover sequence, and expect statements.) Note that its scoping rules are different from the current default clocking scoping rules in that default disable iff can be redefined in nested scopes such as nested module declarations. However, there is a Mantis ticket #1799 which asks to modify the default clocking scoping rules in the same way.

A byproduct of this proposal is the unification of the terminology: the argument of disable iff is sometimes called *reset expression*, sometimes *reset condition*, and sometimes unwieldy phrases like “expression in the **disable iff** clause”. The current proposal suggests using *disable condition* in all cases, since it is more consistent with other assertion terminology, e.g., *disabled execution*, *disabled attempt*, etc.

Another byproduct is a fix of a coloring problem in Syntax 14-3.

JH: 2007-11-07. Updated to change “default disable” to “default disable iff”. This frees “default disable” to be used by SV-EC. We still keep the phrase “disable condition” and “default disable condition”, but when talking about the declaration we call it “default **disable iff** declaration”. In the VPI stuff, *vpiDefaultDisable* is changed to *vpiDefaultDisableIff*. The rationale for this is that *vpiDefaultDisableIff* will be associated with the default **disable iff** declaration, which is new. For backward compatibility, *vpiDisableCondition* has been left as it was.

LRM references are to P1800-2008-draft4-PROTECTED.pdf.

LJP: added reference to the scope rules in 22.8. Fixed the heading of 16.48. Changed title of 16.15 to “Disable iff Resolution”

LJP: 11/19: In 1800/D4, 14.12 “Default clocking”, the “default clocking” is referred to once as “default cycle specification statement” and once as “default clocking specification”. The terminology should be consistent. The “cycle” is a clear typo, but there should also be consistency in whether it is a “specification statement” or just a “specification”. I changed it to use “default clocking specification statement”.

14.12 Default clocking

REPLACE in *Syntax 14-3—Default clocking syntax*

The syntax for the default cycle specification statement is as follows:

```
module_or_generate_item_declaration ::= //from A.1.4
...
| default clocking clocking_identifier ;
```

WITH

The syntax for **default clocking** ~~the default cycle~~ specification statement is as follows:

```
module_or_generate_item_declaration ::= //from A.1.4
```

```
...
| default clocking clocking_identifier ÷ ;
...
```

[Note to the Editor: There are two changes in the syntax itself. One is to change the font of the terminating semicolon from non-bold black to bold red. The other is to add the ellipsis (...) at the end to represent the omission of “default disable iff”, which is not relevant in this context.]

Also in 14.12 Default clocking

REPLACE

A default clocking is valid only within the scope containing the default clocking specification.

WITH

A default clocking is valid only within the scope containing the default clocking specification [statement](#).

16.5 Boolean expressions

REPLACE

There are two places where Boolean expressions occur in concurrent properties:

- In the sequences used to build properties
- In the top-level **disable iff** clause (see [16.12](#))

The expressions used in defining sequences are evaluated over the sampled values of all variables (other than local variables as described in [16.9](#)) and the current values of local variables and the sequence boolean methods `ended` and `matched` (see [16.13.6](#)). The expression in the **disable iff** clause is evaluated using the current values of variables (not sampled) and can contain the sequence boolean method `triggered`. It must not contain any reference to local variables and the sequence methods `ended` and `matched`. If a sampled value function (see [16.8.3](#)) is used in the expression, the sampling clock must be explicitly specified in the actual argument list. For example:

```
assert property ( @(posedge clk)
  disable iff (a && $rose(b, @(posedge clk))) trigger | => test_expr );
```

The **disable iff** expression will preempt the evaluation of the assertion in a time step where `a` is 1 and the sampled value function returns a 1 as determined by the rules of evaluation for use outside sequences described in [16.8.3](#).

WITH

There are two places where [Boolean](#) boolean expressions occur in concurrent [properties](#) assertions:

- In [the sequences used to build properties](#) a sequence or property expression
- In the disable condition inferred for an assertion, specified either in a top-level **disable iff** clause (see [16.12](#)) or in a default **disable iff** declaration (see [16.15](#))

The **boolean** expressions used in defining **sequences** are a sequence or property expression shall be evaluated over the sampled values of all variables (other than local variables as described in 16.9) and the current values of local variables and of the sequence boolean methods `ended` and `matched` (see 16.13.6). The preceding rule shall not, however, apply to expressions in a clocking event (see 16.4). The **expression** expressions in **the disable iff clause** is a disable condition are evaluated using the current values of variables (not sampled) and **can** may contain the sequence boolean method `triggered`. ~~It must~~ They shall not contain any reference to local variables **and** or to the sequence methods `ended` **and** or `matched`. If a sampled value function (see 16.8.3) is used in **the expression** an expression in a disable condition, the sampling clock **must** shall be explicitly specified in the actual argument list. For example:

```
assert property ( @(posedge clk)
    disable iff (a && $rose(b, @(posedge clk))) trigger | => test_expr );
```

The **disable condition** specified in the **disable iff expression** clause will preempt the evaluation of the assertion in a time step where `a` is 1 and the sampled value function returns a 1 as determined by the rules of evaluation for use outside sequences described in 16.8.3.

16.12 Declaring properties

REPLACE

The expression of the **disable iff** is called the *reset expression*. The **disable iff** clause allows preemptive resets to be specified. For an evaluation of the *property_spec*, there is an evaluation of the underlying *property_expr*. If prior to the completion of that evaluation the reset expression becomes true, then the overall evaluation of the property results in disabled. A property has disabled evaluation if it was preempted due to a **disable iff** condition. A disabled evaluation of a property does not result in success or failure. Otherwise, the evaluation of the *property_spec* is the same as that of the *property_expr*. The reset expression is tested independently for different evaluation attempts of the *property_spec*. The values of variables used in the reset expression are those in the current simulation cycle, i.e., not sampled. The expression may contain a reference to an end point of a sequence by using the method *triggered* of that sequence. *Matched* and *ended* of a sequence and local variables cannot be used in the reset expression. If a sampled value function is used in the reset expression, the sampling clock must be explicitly specified in its actual argument list as described in 16.8.3. Nesting of **disable iff** clauses, explicitly or through property instantiations, is not allowed.

WITH

The expression of the **disable iff** is called the *reset-expression disable condition*. The **disable iff** clause allows preemptive resets to be specified. For an evaluation of the *property_spec*, there is an evaluation of the underlying *property_expr*. If prior to the completion of that evaluation the **reset-expression disable condition** becomes true, then the overall evaluation of the property results in disabled. A property has disabled evaluation if it was preempted due to a **disable iff** condition. A disabled evaluation of a property does not result in success or failure. Otherwise, the evaluation of the *property_spec* is the same as that of the *property_expr*. The **reset-expression disable condition** is tested independently for different evaluation attempts of the *property_spec*. The values of variables used in the **reset-expression disable condition** are those in the current simulation cycle, i.e., not sampled. The expression may contain a reference to an end point of a sequence by using the method *triggered* of that sequence. *Matched* and *ended* of a sequence and local variables cannot be used in the **reset-expression disable condition**. If a sampled value function is used in the **reset-expression disable condition**, the sampling clock must be explicitly specified in its actual argument list as described in 16.8.3. Nesting of **disable iff** clauses, explicitly or through property instantiations, is not allowed.

16.13.3 Clock flow

REPLACE

The scope of a clocking event does not flow into the reset condition of **disable iff**.

WITH

The scope of a clocking event does not flow into the **reset disable** condition of **disable iff**.

16.13.6 Sequence methods

REPLACE

The value of method `ended` evaluates to true if the given sequence has reached its end point at that particular point in time and false otherwise. The ended status of the sequence is set in the Observe region and persists through the Observe region. This method shall only be used to detect the end point of a sequence used in another sequence. It shall be considered an error if this method is used in **disable iff** boolean expression for properties. There shall be no circular dependencies between sequences induced by the use of `ended`.

The value of method `triggered` evaluates to true if the given sequence has reached its end point at that particular point in time and false otherwise. The triggered status of the sequence is set in the Observe region and persists through the remainder of the time step. This method shall only be used in **wait** statements or boolean expressions (see 9.4.4) outside of sequence context or in the **disable iff** boolean expression for properties. It shall be considered an error to invoke this method on sequences that treat their formal arguments as local variables. A sequence treats its formal argument as a local variable if the formal argument is used as an lvalue in `operator_assignment` or `inc_or_dec_expression` in `sequence_match_item`.

WITH

The value of method `ended` evaluates to true if the given sequence has reached its end point at that particular point in time and false otherwise. The ended status of the sequence is set in the Observe region and persists through the Observe region. This method shall only be used to detect the end point of a sequence used in another sequence. It shall be considered an error if this method is used in ~~the disable iff boolean expression for properties~~ a **disable condition**. There shall be no circular dependencies between sequences induced by the use of `ended`.

The value of method `triggered` evaluates to true if the given sequence has reached its end point at that particular point in time and false otherwise. The triggered status of the sequence is set in the Observe region and persists through the remainder of the time step. This method shall only be used in **wait** statements or boolean expressions (see 9.4.4) outside of sequence context or in **disable conditions** ~~the disable iff boolean expression for properties~~. It shall be considered an error to invoke this method on sequences that treat their formal arguments as local variables. A sequence treats its formal argument as a local variable if the formal argument is used as an lvalue in ~~operator_assignment operator_assignment~~ or ~~inc_or_dec_expression inc_or_dec_expression~~ in ~~sequence_match_item sequence_match_item~~.

16.15 Disable iff resolution

Note to editor: Shift the numeration of the following subsections accordingly.

Note to the editor: Add a Syntax Box containing the following text:

```
module_or_generate_item_declaration ::=
```

```
// from A.1.4
```

```
...
```

```
| default clocking clocking_identifier ;  
| default disable iff expression_or_dist ;
```

A default **disable iff** may be declared as an item within a module, interface, or program. It provides a default disable condition to all concurrent assertions in the scope of the default **disable iff** declaration, in accordance with the scope rules of 22.8. The scope can be the module, interface, or program in which the default **disable iff** is declared, but its effect is independent of the position of the declaration within that scope. Declaring more than one default **disable iff** item within the same module, interface, or program shall be an error. Furthermore, the scope also includes any nested module, interface, or program declaration. However, if a nested module, interface, or program declaration itself has a default **disable iff** declaration, then that default **disable iff** applies within the nested declaration and overrides any default **disable iff** from outside. The scope does not extend into any instances of modules, interfaces or programs.

In the following example, module `m1` declares `rst1` to be the default disable condition, and there is no default **disable iff** declaration in the nested module `m2`. The default disable condition `rst1` applies throughout the declaration of `m1` and the nested declaration of `m2`. Therefore, the inferred disable condition of both assertions `a1` and `a2` is `rst1`.

```
module m1;  
  bit clk, rst1;  
  default disable iff rst1;  
  a1: assert property (@(posedge clk) p1); // property p1 is defined elsewhere  
  ...  
  module m2;  
    bit rst2;  
    ...  
    a2: assert property (@(posedge clk) p2); // property p2 is defined  
elsewhere  
  endmodule  
  ...  
endmodule
```

If there is a default **disable iff** declaration in the nested module `m2`, then within `m2` this default disable condition overrides the default disable condition declared in `m1`. Therefore, in the following example the inferred disable condition of `a1` is `rst1`, but the inferred disable condition of `a2` is `rst2`.

```
module m1;  
  bit clk, rst1;  
  default disable iff rst1;  
  a1: assert property (@(posedge clk) p1); // property p1 is defined elsewhere  
  ...  
  module m2;  
    bit rst2;  
    default disable iff rst2;  
    ...  
    a2: assert property (@(posedge clk) p2); // property p2 is defined  
elsewhere  
  endmodule  
  ...  
endmodule
```

The following rules apply for resolution of the disable condition:

- a) If an assertion has a **disable iff** clause, then the disable condition specified in this clause shall be used and any default **disable iff** declaration ignored for this assertion.

- b) If an assertion does not contain a **disable iff** clause, but the assertion is within the scope of a default **disable iff** declaration, then the disable condition for the assertion is inferred from the default **disable iff** declaration.
- c) Otherwise, no inference is performed (this is equivalent to the inference of a 1'b0 disable condition).

Below are two example modules illustrating the application of these rules.

```

module examples_with_default (input logic a, b, clk, rst, rst1);
  default disable iff rst;

  property p1;
    disable iff (rst1) a |=> b;
  endproperty

  // Disable condition is rst1 - explicitly specified within a1
  a1 : assert property (@(posedge clk) disable iff (rst1) a |=> b);

  // Disable condition is rst1 - explicitly specified within p1
  a2 : assert property (@(posedge clk) p1);

  // Disable condition is rst - no explicit specification, inferred from
  // default disable statement
  a3 : assert property (@(posedge clk) a |=> b);

  // Disable condition is 1'b0 . This is the only way to
  // cancel the effect of default disable.
  a4 : assert property (@(posedge clk) disable iff (1'b0) a |=> b);

endmodule

module examples_without_default (input logic a, b, clk, rst);
  property p2;
    disable iff (rst) a |=> b;
  endproperty

  // Disable condition is rst - explicitly specified within a5
  a5 : assert property (@(posedge clk) disable iff (rst) a |=> b);

  // Disable condition is rst - explicitly specified within p2
  a6 : assert property (@(posedge clk) p2);

  // No disable condition
  a7 : assert property (@(posedge clk) a |=> b);

  // Only enable condition and clocking event are inferred from an always
  // block
  // Assertion a8 is equivalent to
  // assert property (@(posedge clk) !bit'(rst!='b0) |-> (a |=> b));

  always @(posedge clk or posedge rst)
  if (rst)
    ...
  else begin
    a8 : assert property (a |=> b);
    ...
  end

endmodule

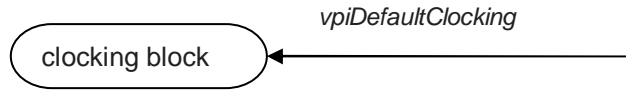
```

In assertion a8 the inferred enabling condition is from the **else** clause of the **if-else** statement, and thus it has to represent the complementary interpretation of the four-valued expression in the **if** condition. One such form is as indicated in the comment above a8. Other equivalent forms may be used, such as ((rst != 'b0) != 1'b1).

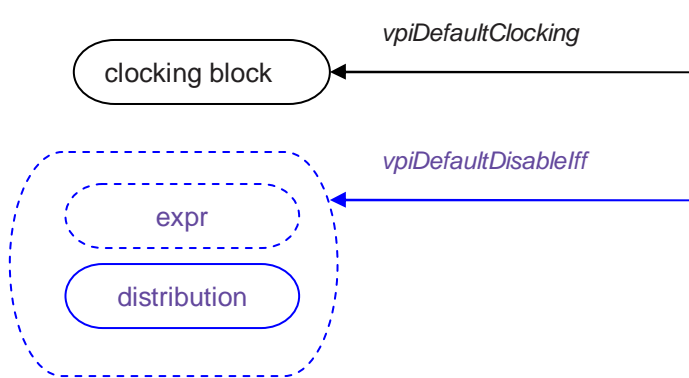
36.4 Module

Note to editor: in the diagram

REPLACE



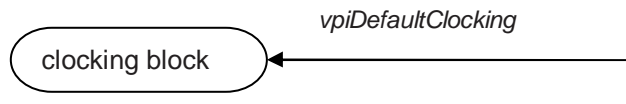
WITH



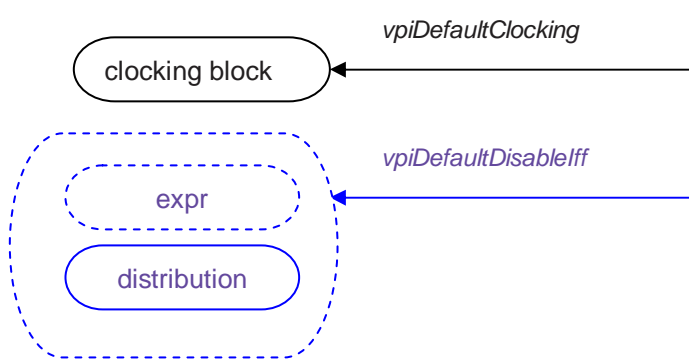
36.5 Interface

Note to editor: in the diagram

REPLACE



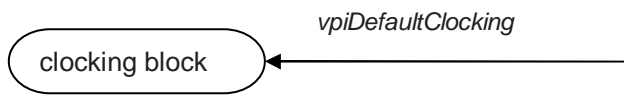
WITH



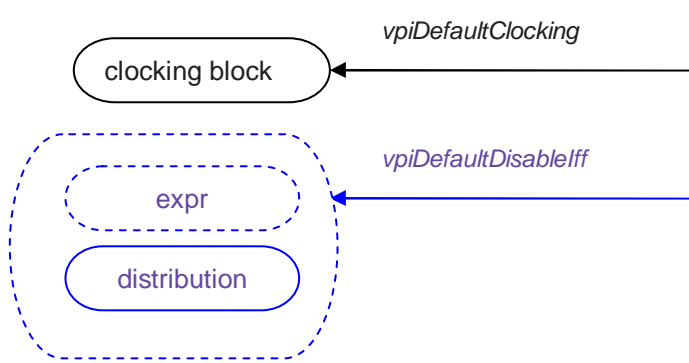
36.8 Program

Note to editor: in the diagram

REPLACE

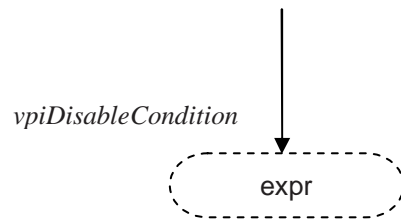


WITH

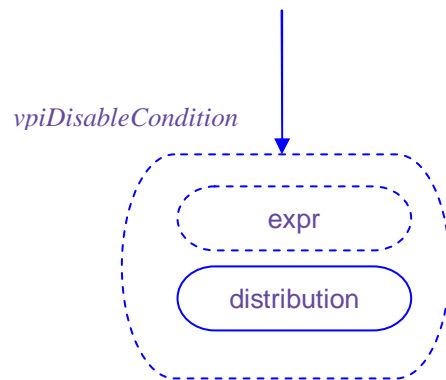


36.43 Concurrent assertions

REPLACE

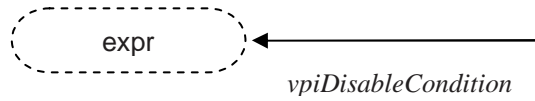


WITH

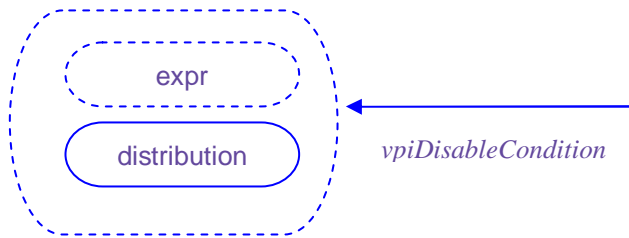


36.45 Property specification

REPLACE

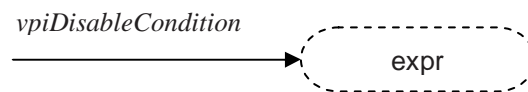


WITH

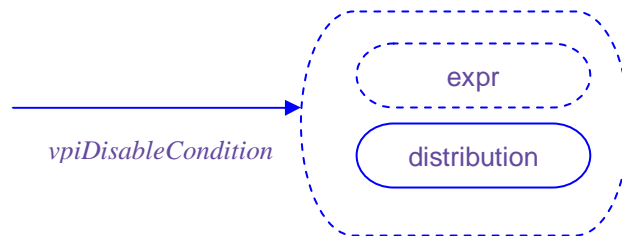


36.48 Multiclock sequence expression

REPLACE



WITH



A.1.4 Module items

REPLACE

```
module_or_generate_item_declaration ::=  
    package_or_generate_item_declaration  
    | genvar_declaration  
    | clocking_declaration  
    | default clocking clocking_identifier ;
```

WITH

```
module_or_generate_item_declaration ::=  
    package_or_generate_item_declaration  
    | genvar_declaration  
    | clocking_declaration  
    | default clocking clocking_identifier ;  
    | default disable iff expression_or_dist ;
```

M.2 Source code

REPLACE

```
#define vpiDefaultClocking 709
```

WITH

```
#define vpiDefaultClocking 709  
#define vpiDefaultDisableIff Editor to fill
```