**Avalon-Stream VVC** –Quick Reference

**VVC**

For general information see UVVM VVC Framework Essential Mechanisms located in uvvm\_vvc\_framework/doc.

Avalon-Stream Master

*avalon\_st\_vvc.vhd*

|  |
| --- |
| avalon\_st\_transmit (VVCT, vvc\_instance\_idx, [channel\_value], data\_array, msg, [scope]) |
| Example: avalon\_st\_transmit(AVALON\_ST\_VVCT, 0, v\_channel, v\_data\_array(0 to v\_numWords-1), “Send v\_numWords on v\_channel to DUT”, C\_SCOPE);  Example: avalon\_st\_transmit(AVALON\_ST\_VVCT, 0, (x”01”, x”02”, x”03”, x”04”), “Send 4 bytes to DUT”);  *Note that this procedure can only be called when the AVALON\_ST VVC is instantiated in master mode, i.e. setting the generic constant ‘GC\_MASTER\_MODE’ to true.* |

Avalon-Stream Slave

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| avalon\_st\_receive (VVCT, vvc\_instance\_idx, data\_array\_len, data\_word\_size, msg, [scope]) |
| Example: avalon\_st\_receive(AVALON\_ST\_VVCT, 1, v\_data\_array’length, v\_data\_array(0)’length, “Receive data which is stored in VVC and will be fetched later using fetch\_result() “);  *Note that this procedure can only be called when the AVALON\_ST VVC is instantiated in slave mode, i.e. setting the generic constant ‘GC\_MASTER\_MODE’ to false.* |

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| --- |
| avalon\_st\_expect (VVCT, vvc\_instance\_idx, [channel\_exp], data\_exp, msg, [scope, [alert\_level]]) |
| Example: avalon\_st\_expect(AVALON\_ST\_VVCT, 1, v\_channel, v\_data\_array(0 to v\_numWords-1), “Expect v\_numWords on v\_channel”, C\_SCOPE, ERROR);  Example: avalon\_st\_expect(AVALON\_ST\_VVCT, 1, (x”01”, x”02”, x”03”, x”04”), “Expect 4 bytes”);  *Note that this procedure can only be called when the AVALON\_ST VVC is instantiated in slave mode, i.e. setting the generic constant ‘GC\_MASTER\_MODE’ to false.* |



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| --- | --- |
| Avalon-Stream VVC Configuration record **´vvc\_config´ --** accessible via **shared\_avalon\_st\_vvc\_config** | **Common VVC procedures applicable for this VVC** |
| |  |  |  | | --- | --- | --- | | **Record element** | **Type** | **C\_AVALON\_ST\_VVC\_CONFIG\_DEFAULT** | | inter\_bfm\_delay | t\_inter\_bfm\_delay | C\_AVALON\_ST\_INTER\_BFM\_DELAY\_DEFAULT | | cmd\_queue\_count\_max | natural | C\_CMD\_QUEUE\_COUNT\_MAX | | cmd\_queue\_count\_threshold | natural | C\_CMD\_QUEUE\_COUNT\_THRESHOLD | | cmd\_queue\_count\_threshold\_severity | t\_alert\_level | C\_CMD\_QUEUE\_COUNT\_THRESHOLD\_SEVERITY | | result\_queue\_count\_max | natural | C\_RESULT\_QUEUE\_COUNT\_MAX | | result\_queue\_count\_threshold | natural | C\_RESULT\_QUEUE\_COUNT\_THRESHOLD | | result\_queue\_count\_threshold\_severity | t\_alert\_level | C\_RESULT\_QUEUE\_COUNT\_THRESHOLD\_SEVERITY | | bfm\_config | t\_avalon\_st\_bfm\_config | C\_AVALON\_ST\_BFM\_CONFIG\_DEFAULT | | msg\_id\_panel | t\_msg\_id\_panel | C\_VVC\_MSG\_ID\_PANEL\_DEFAULT | |  |  |  | | - See UVVM Methods QuickRef for details. |
| **await\_[any]completion**() **enable\_log\_msg**() **disable\_log\_msg**()  **fetch\_result**()  **flush\_command\_queue**() **terminate\_current\_command**() **terminate\_all\_commands**() **insert\_delay**()  **get\_last\_received\_cmd\_idx()** |
| Avalon-Stream VVC Status record signal **´vvc\_status´ --** accessible via **shared\_avalon\_st\_vvc\_status** |
| |  |  |  | | --- | --- | --- | | **Record element** | **Type** |  | | current\_cmd\_idx | natural |  | | | previous\_cmd\_idx | natural |  | | pending\_cmd\_cnt | natural |  | |

VVC target parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Example(s)** | **Description** |
| VVCT | t\_vvc\_target\_record | AVALON\_ST\_VVCT | VVC target type compiled into each VVC in order to differentiate between VVCs. |
| vvc\_instance\_idx | integer | 0 | Instance number of the VVC |

VVC functional parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Example(s)** | **Description** |
| channel\_value  channel\_exp | std\_logic\_vector | x”01” | Channel number for the data being transferred or expected.  The value is limited by max\_channel in the bfm\_config. |
| data\_array  data\_exp | t\_slv\_array | (x“D0D1”, x“D2D3”) | An array of SLVs containing the data to be sent/received.  data\_array(0) is sent/received first, while data\_array(data\_array’high) is sent/received last.  For clarity, data\_array is required to be ascending, for example defined by the test sequencer as follows:  variable v\_data\_array : t\_slv\_array(0 to C\_MAX\_WORDS-1)(C\_MAX\_WORD\_LENGTH-1 downto 0);  For simplicity, the word\_length can only be the size of the configured symbol or the size of the data bus.  variable v\_data\_array : t\_slv\_array(0 to C\_MAX\_WORDS-1)(C\_SYMBOL\_WIDTH-1 downto 0);  variable v\_data\_array : t\_slv\_array(0 to C\_MAX\_WORDS-1)(C\_DATA\_BUS\_LENGTH-1 downto 0); |
| data\_array\_len | natural | 20 | Length of the data\_array expected to be received (number of words). |
| data\_word\_size | natural | 8 | Size of the data words in the data\_array expected to be received. |
| alert\_level | t\_alert\_level | ERROR or TB\_WARNING | Set the severity for the alert that may be asserted by the procedure. |
| msg | string | “Send data” | A custom message to be appended in the log/alert |
| scope | string | “AVALON\_ST\_VVC” | A string describing the scope from which the log/alert originates.  In a simple single sequencer typically "AVALON\_ST\_BFM". In a verification component typically "AVALON\_ST\_VVC ". |

VVC entity signals

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| --- | --- | --- |
| **Name** | **Type** | **Description** |
| clk | std\_logic | VVC Clock signal |
| avalon\_st\_vvc\_if | t\_avalon\_st\_if | See Avalon-Stream BFM documentation |

VVC entity generic constants

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Default** | **Description** |
| GC\_VVC\_IS\_MASTER | boolean | - | Set to true when this VVC instance is an Avalon-Stream master (data is output from BFM).  Set to false when this VVC is an Avalon-Stream slave (data is input to BFM.) |
| GC\_CHANNEL\_WIDTH | integer | 1 | Width of the Avalon-Stream channel signal.  *Note 1*: if CHANNEL is wider than 8, increase the value of the constant C\_AVALON\_ST\_CHANNEL\_MAX\_LENGTH in the local\_adaptations\_pkg.  *Note 2*: If the CHANNEL signal is not used, refer to description in Section 5. |
| GC\_DATA\_WIDTH | integer | - | Width of the Avalon-Stream data bus.  *Note*: if DATA is wider than 512, increase the value of the constant C\_AVALON\_ST\_WORD\_MAX\_LENGTH in the local\_adaptations\_pkg. |
| GC\_DATA\_ERROR\_WIDTH | integer | 1 | Width of the Avalon-Stream data error signal.  *Note*: If the DATA\_ERROR signal is not used, refer to description in Section 5. |
| GC\_EMPTY\_WIDTH | integer | 1 | Width of the Avalon-Stream empty signal.  *Note*: If the EMPTY signal is not used, refer to description in Section 5. |
| GC\_INSTANCE\_IDX | natural | - | Instance number to assign the VVC. |
| GC\_AVALON\_ST\_BFM\_CONFIG | t\_avalon\_st\_bfm\_config | C\_AVALON\_ST\_BFM\_  CONFIG\_DEFAULT | Configuration for the Avalon-Stream BFM, see Avalon-Stream BFM documentation. |
| GC\_CMD\_QUEUE\_COUNT\_MAX | natural | 1000 | Absolute maximum number of commands in the VVC command queue. |
| GC\_CMD\_QUEUE\_COUNT\_THRESHOLD | natural | 950 | An alert will be generated when reaching this threshold to indicate that the command queue is almost full. The queue will still accept new commands until it reaches C\_CMD\_QUEUE\_COUNT\_MAX. |
| GC\_CMD\_QUEUE\_COUNT\_THRESHOLD\_SEVERITY | t\_alert\_level | WARNING | Alert severity which will be used when command queue reaches GC\_CMD\_QUEUE\_COUNT\_THRESHOLD. |
| GC\_RESULT\_QUEUE\_COUNT\_MAX | natural | 1000 | Maximum number of unfetched results before result\_queue is full. |
| GC\_RESULT\_QUEUE\_COUNT\_THRESHOLD | natural | 950 | An alert with severity ‘result\_queue\_count\_threshold\_severity’ will be issued if result queue exceeds this count. Used for early warning if result queue is almost full. Will be ignored if set to 0. |
| GC\_RESULT\_QUEUE\_COUNT\_THRESHOLD\_SEVERITY | t\_alert\_level | WARNING | Severity of alert to be initiated if exceeding result\_queue\_count\_threshold. |

VVC details

All VVC procedures are defined in vvc\_methods\_pkg (dedicated this VVC), and uvvm\_vvc\_framework.td\_vvc\_framework\_common\_methods\_pkg (common VVC procedures).   
It is also possible to send a multicast to all instances of a VVC with ALL\_INSTANCES as parameter for vvc\_instance\_idx.   
*Note: Every procedure here can be called without the optional parameters enclosed in [ ].*

# VVC procedure details

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| --- | --- |
| **Procedure** | **Description** |
| **avalon\_st\_transmit()** | **avalon\_st\_transmit (VVCT, vvc\_instance\_idx, channel\_value, data\_array, msg, [scope])**  The avalon\_st\_transmit() VVC procedure adds a transmit command to the Avalon-Stream VVC executor queue, which will run as soon as all preceding commands have completed. When the command is scheduled to run, the executor calls the Avalon-Stream BFM avalon\_st\_transmit() procedure, described in the Avalon-Stream BFM QuickRef.  The avalon\_transmit() procedure can only be called when the AVALON VVC is instantiated in master mode, i.e. setting the generic constant ‘GC\_MASTER\_MODE’ to true. |
| **avalon\_st\_receive()** | **avalon\_st\_receive (VVCT, vvc\_instance\_idx, data\_array\_len, data\_word\_size, msg, [scope])**  The avalon\_st\_receive() VVC procedure adds a receive command to the Avalon-Stream VVC executor queue, which will run as soon as all preceding commands have completed. When the command is scheduled to run, the executor calls the Avalon-Stream BFM avalon\_st\_receive() procedure, described in the Avalon-Stream BFM QuickRef.  The avalon\_receive() procedure can only be called when the AVALON VVC is instantiated in slave mode, i.e. setting the generic constant ‘GC\_MASTER\_MODE’ to false.  The value received from the DUT will not be returned in this procedure call since it is non-blocking for the sequencer/caller, but the received data and metadata will be stored in the VVC for a potential future fetch (see example with *fetch\_result* below).  **Example with fetch\_result() call**: Result is placed in **v\_result**  variable v\_cmd\_idx : natural; -- Command index for the last receive  variable v\_result : work.vvc\_cmd\_pkg.t\_vvc\_result; -- Result from receive (data and metadata)  (…)  avalon\_st\_receive(AVALON\_ST\_VVCT, 1, v\_data\_array’length, v\_data\_array(0)’length, “Receive data in VVC”);  v\_cmd\_idx := get\_last\_received\_cmd\_idx(AVALON\_ST\_VVCT, 1);  await\_completion(AVALON\_ST\_VVCT, 1, 1 ms, “Wait for receive to finish”);  fetch\_result(AVALON\_ST\_VVCT, 1, v\_cmd\_idx, **v\_result**, “Fetching result from receive operation”); |
| **avalon\_st\_expect()** | **avalon\_st\_expect (VVCT, vvc\_instance\_idx, channel\_exp, data\_exp, msg, [scope, [alert\_level]])**  The avalon\_st\_expect() VVC procedure adds an expect command to the Avalon-Stream VVC executor queue, which will run as soon as all preceding commands have completed. When the command is scheduled to run, the executor calls the Avalon-Stream BFM avalon\_st\_expect() procedure, described in the Avalon-Stream BFM QuickRef.  The avalon\_expect() procedure can only be called when the AVALON VVC is instantiated in slave mode, i.e. setting the generic constant ‘GC\_MASTER\_MODE’ to false. |
|  |  |

# VVC Configuration

|  |  |  |  |
| --- | --- | --- | --- |
| **Record element** | **Type** | **C\_AVALON\_ST\_VVC\_CONFIG\_DEFAULT** | **Description** |
| inter\_bfm\_delay | t\_inter\_bfm\_delay | C\_AVALON\_ST\_INTER\_BFM\_DELAY\_DEFAULT | Delay between any requested BFM accesses towards the DUT. - TIME\_START2START: Time from a BFM start to the next BFM start   (A TB\_WARNING will be issued if access   takes longer than TIME\_START2START).  - TIME\_FINISH2START: Time from a BFM end to the next BFM start. Any insert\_delay() command will add to the above minimum delays, giving for instance the ability to skew the BFM starting time. |
| cmd\_queue\_count\_max | natural | C\_CMD\_QUEUE\_COUNT\_MAX | Maximum pending number in command queue before queue is full. Adding additional commands will result in an ERROR. |
| cmd\_queue\_count\_threshold | natural | C\_CMD\_QUEUE\_COUNT\_THRESHOLD | An alert with severity “cmd\_queue\_count\_threshold\_severity” will be issued if command queue exceeds this count. Used for early warning if command queue is almost full. Will be ignored if set to 0. |
| cmd\_queue\_count\_threshold\_severity | t\_alert\_level | C\_CMD\_QUEUE\_COUNT\_THRESHOLD\_SEVERITY | Severity of alert to be initiated if exceeding cmd\_queue\_count\_threshold |
| result\_queue\_count\_max | natural | C\_RESULT\_QUEUE\_COUNT\_MAX | Maximum number of unfetched results before result\_queue is full. |
| result \_queue\_count\_threshold | natural | C\_RESULT\_QUEUE\_COUNT\_THRESHOLD | An alert with severity ‘result\_queue\_count\_threshold\_severity’ will be issued if result queue exceeds this count. Used for early warning if result queue is almost full. Will be ignored if set to 0. |
| result \_queue\_count\_threshold\_severity | t\_alert\_level | C\_ RESULT\_QUEUE\_COUNT\_THRESHOLD\_SEVERITY | Severity of alert to be initiated if exceeding result\_queue\_count\_threshold. |
| bfm\_config | t\_avalon\_st\_bfm\_config | C\_AVALON\_ST\_BFM\_CONFIG\_DEFAULT | Configuration for Avalon-Stream BFM. See quick reference for Avalon-Stream BFM. |
| msg\_id\_panel | t\_msg\_id\_panel | C\_VVC\_MSG\_ID\_PANEL\_DEFAULT | VVC dedicated message ID panel. |

The configuration record can be accessed from the Central Testbench Sequencer through the shared variable array, e.g.:

shared\_avalon\_st\_vvc\_config(1).inter\_bfm\_delay.delay\_in\_time := 50 ns;

shared\_avalon\_st\_vvc\_config(1).bfm\_config.clock\_period := 10 ns;

# VVC Status

The current status of the VVC can be retrieved during simulation. This is achieved by reading from the shared variable shared\_avalon\_st\_vvc\_status record from the test sequencer. The record contents can be seen below:

|  |  |  |
| --- | --- | --- |
| **Record element** | **Type** | **Description** |
| current\_cmd\_idx | natural | Command index currently running |
| previous\_cmd\_idx | natural | Previous command index to run |
| pending\_cmd\_cnt | natural | Pending number of commands in the command queue |

# Activity watchdog

The VVCs support an activity watchdog which monitors VVC activity and will alert if no VVC activity is registered within a selected timeout value. The VVCs will register their presence to the activity watchdog at start-up, and report when busy and not, using dedicated activity watchdog methods and triggering the global\_trigger\_activity\_watchdog signal, during simulations.

Include activity\_watchdog(num\_exp\_vvc, timeout, alert\_level, msg) in the testbench to start using the activity watchdog.   
More information can be found in UVVM Essential Mechanisms PDF in the UVVM VVC Framework doc folder.

# VVC Interface

In this VVC, the interface has been encapsulated in a signal record of type *t\_avalon\_st\_if* in order to improve readability of the code. Since the Avalon-Stream interface buses can be of arbitrary size, the interface std\_logic\_vectors have been left unconstrained. These unconstrained SLVs needs to be constrained when the interface signals are instantiated. For this interface, this could look like:

signal avalon\_st\_if : t\_avalon\_st\_if (

channel(C\_CHANNEL\_WIDTH-1 downto 0),

data(C\_DATA\_WIDTH-1 downto 0),

data\_error(C\_ERROR\_WIDTH-1 downto 0),

empty(log2(C\_DATA\_WIDTH/C\_SYMBOL\_WIDTH)-1 downto 0));

The widths of *channel, data\_error* and *empty* are declared even when not used or connected to DUT.

Set the widths of unused signals to 1, for example C\_CHANNEL\_WIDTH = 1.

# Additional Documentation

Additional documentation about UVVM and its features can be found under “/uvvm\_vvc\_framework/doc/”.

For additional documentation on the Avalon-Stream standard, refer to “Avalon® Interface Specifications, Chapter: Avalon Streaming Interfaces”, document number MNL-AVABUSREF, available from Intel.

# Compilation

Avalon-Stream VVC must be compiled with VHDL 2008.   
It is dependent on the following libraries

* ***UVVM Utility Library (UVVM-Util), version 2.10.0 and up***
* ***UVVM VVC Framework, version 2.7.0 and up***
* ***Avalon-Stream BFM***
* ***Bitvis VIP Scoreboard***

Before compiling the Avalon-Stream VVC, assure that uvvm\_vvc\_framework, uvvm\_util and bitvis\_vip\_scoreboard have been compiled.

See UVVM Essential Mechanisms located in uvvm\_vvc\_framework/doc for information about compile scripts.

**Compile order for the Avalon-Stream VVC:**

|  |  |  |
| --- | --- | --- |
| **Compile to library** | **File** | **Comment** |
| bitvis\_vip\_avalon\_st | avalon\_st\_bfm\_pkg.vhd | Avalon-Stream BFM |
| bitvis\_vip\_avalon\_st | local\_adaptations\_pkg.vhd | Avalon-Stream adaptations package for local modifications. |
| bitvis\_vip\_avalon\_st | transaction\_pkg.vhd | Avalon-Stream transaction package with DTT types, constants etc. |
| bitvis\_vip\_avalon\_st | vvc\_cmd\_pkg.vhd | Avalon-Stream VVC command types and operations |
| bitvis\_vip\_avalon\_st | ../uvvm\_vvc\_framework/src\_target\_dependent/td\_target\_support\_pkg.vhd | UVVM VVC target support package, compiled into the Avalon-Stream VVC library. |
| bitvis\_vip\_avalon\_st | ../uvvm\_vvc\_framework/src\_target\_dependent/td\_vvc\_framework\_common\_methods\_pkg.vhd | UVVM framework common methods compiled into the Avalon-Stream VVC library |
| bitvis\_vip\_avalon\_st | vvc\_methods\_pkg.vhd | Avalon-Stream VVC methods |
| bitvis\_vip\_avalon\_st | ../uvvm\_vvc\_framework/src\_target\_dependent/td\_queue\_pkg.vhd | UVVM queue package for the VVC |
| bitvis\_vip\_avalon\_st | ../uvvm\_vvc\_framework/src\_target\_dependent/td\_vvc\_entity\_support\_pkg.vhd | UVVM VVC entity support compiled into the Avalon-Stream VVC library |
| bitvis\_vip\_avalon\_st | avalon\_st\_vvc.vhd | Avalon-Stream VVC |

# Simulator compatibility and setup

See README.md for a list of supported simulators.

For required simulator setup see ***UVVM-Util*** Quick reference.

IMPORTANT

This is a simplified Verification IP (VIP) for Avalon-Stream. The given VIP complies with the basic Avalon-Stream protocol and thus allows a normal access towards an Avalon-Stream interface. This VIP is not Avalon-Stream protocol checker. For a more advanced VIP please contact Bitvis AS at [support@bitvis.no](mailto:support@bitvis.no)

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