cocotbext mil-std-1553

March 7, 2025

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Contents

1 Usage

1.1 Introduction

Cocotb extension to test mil-std-1553 transmit and receive.

1.2 Dependencies

The following are the dependencies of the cores.

- iverilog (simulation)
- cocotb (simulation)
- machester (python)

1.3 In a Simulation

Below is a simple example for reading and writing data over mil-std-1553 in the cocotb extension.

```
source  = MILSTD1553Source(dut.data)

sink = MILSTD1553Sink(dut.data)

test_data = 128

data = test_data.to_bytes(2, byteorder="little")

await source.write_cmd(data)

await source.write_data(data)

rx_data = await sink.read_cmd()

rx_data = await sink.read_data()
```

2 Architecture

Please see 4 for more information.

MILSTD1553Source tests mil-std-1553 receive devices. This is uses the machester encoder library in python, then this is bit banged out using timers. The sync is sent based upon which write command is used. write_cmd will write the data and use a command sync out. write_data will write the data and use a data sync out.

MILSTD1553Sink tests mil-std-1553 transmit devices. This is uses the machester decoder library in python, then this is bit banged in using timers. Once a sync is identified the data is put in one of two queues. The data queue contains data that came from a message that started with a data sync. The command queue contains data that came from a message that started with a command/status sync.

2.1 Directory Guide

Below highlights important folders from the root of the directory.

1. **docs** Contains all documentation related to this project.
    - **manual** Contains user manual and github page that are generated from the latex sources.
2. **cocotbext** Contains source files for the extension
3. **tests** Contains test files for cocotb

3 Simulation

A simulation for testing the cores can be run to verify operation.

3.1 cocotb

To use the cocotb tests you must install the following python libraries.

```
$ pip install cocotb
$ pip install -e .
```

Then you must enter the tests folder and enter the mil-std-1553 folder. From there you may execute the following command which will kick off the test.

```
$ make
```

4 Code Documentation

Natural docs is used to generate documentation for this project. The next lists the following sections.

- **init** python init code
- **mil-std-1553** cocotb extension library.
- **test mil-std-1553 verilog** Verilog test bench for cocotb.
- **test mil-std-1553 python** cocotb unit test functions.

__init__.py

AUTHORS

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DATES

2025/03/06

INFORMATION

Brief

MIL-STD-1553 define for packages license: License MIT Copyright 2025 Jay Convertino

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"""

mil_std_1553.py

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2025/03/06

INFORMATION

Brief

MIL-STD-1553 cocotb

License MIT

MILSTD1553Source

MILSTD1553Source

A mil-std-1553 transmit test routine.

FUNCTIONS

__init__

```
def __init__(
self,
data,
*
args,
**
kwargs
)
```

Initialize the object

VARIABLES

self._data

```
self._data
```

Set internal data connection to 1553 differential bus

self._base_delay

```
self._base_delay
```

1 MHz is 1000 nano seconds need half that due to manchester encoding method

self._idle

```
self._idle
```

Event trigger for cocotb

self._data

Event trigger for cocotb

self._run_cr

```
self._run_cr
```

Thread instance of _run method

FUNCTIONS

_restart

```
def _restart(
self
)
```

kill and restart _run thread.

write_cmd

```
async def write_cmd(
self,
data
)
```

Write data to send that uses the command sync

write_data

```
async def write_data(
self,
data
)
```

Write data to send that uses the data sync

write_nowait_cmd

```
def write_nowait_cmd(
self,
data
)
```

Write data to send that uses command sync but do not wait after writting.

write_nowait_data

```
def write_nowait_data(
self,
data
)
```

Write data to send that uses data sync but do not wait after writting.

count

```
def count(
self
)
```

How many items in the queue

empty

```
def empty(
self
)
```

Is the quene empty?

idle

```
def idle(
self
)
```

Is the queue empty and the _run is not active processing data.

clear

```
def clear(
self
)
```

Remove all items from queue

_check_type

```
def _check_type(
self,
data
)
```

Check and make sure we are only sending 2 bytes at a time and that it is a bytes/bytearray

_cmd_sync

```
async def _cmd_sync(
self,
data
)
```

Generate a command sync on the diff output

_data_sync

```
async def _data_sync(
self,
data
)
```

Generate a data sync on the diff output

wait

```
async def wait(
self
)
```

Wait for the run thread to become idle.

_run

```
async def _run(
self,
data
)
```

Thread that processing queue and outputs data in mil-std-1553 format.

MILSTD1553Sink

MILSTD1553Sink

A mil-std-1553 transmit test routine.

FUNCTIONS

__init__

```
def __init__(
self,
data,
*
args,
**
kwargs
)
```

Initialize the object

VARIABLES

self._data

```
self._data
```

Set internal data connection to 1553 differential bus

self._base_delay

```
self._base_delay
```

1 MHz is 1000 nano seconds need half that due to manchester decoding method

self._base_delay

```
self._base_delay_half
```

1 MHz is 1000 nano seconds need half of half that due to manchester decoding method

_cmd_sync

```
self._cmd_sync
```

command sync array value

_data_sync

```
self._data_sync
```

data sync array value

self._run_cr

```
self._run_cr
```

Thread instance of _run method

FUNCTIONS

_restart

```
def _restart(
self
)
```

Kill and restart run function

read_cmd

```
async def read_cmd(
self
)
```

Read any data that was identified with a command sync

read_nowait_cmd

```
def read_nowait_cmd(
self
)
```

Read any data that was identified with a command sync, and do not wait for data to become available.

read_data

```
async def read_data(
self
)
```

Read any data that was identified with a data sync.

read_nowait_data

```
def read_nowait_data(
self
)
```

Read any data that was identified with a data sync, and do not wait for data to become available.

count_cmd

```
def count_cmd(
self
)
```

How many elements are in the command queue?

count_data

```
def count_data(
self
)
```

How many elements are in the data queue?

empty_cmd

```
def empty_cmd(
self
)
```

Is the queue empty?

empty_data

```
def empty_data(
self
)
```

Is the queue empty?

idle

```
def idle(
self
)
```

Is _run waiting to process data?

clear_cmd

```
def clear_cmd(
self
)
```

Clear the command queue

clear_data

```
def clear_data(
self
)
```

Clear the data queue

wait_cmd

```
async def wait_cmd(
self,
timeout
 =
0,
timeout_unit
 =
'nsreg_data'
)
```

Wait for command data

wait_data

```
async def wait_data(
self,
timeout
 =
0,
timeout_unit
 =
'nsreg_data'
)
```

Wait for data data.

_run

```
async def _run(
self,
data
)
```

Thread that takes input data in mil-std-1553 format and puts it in the proper command or data queue.

TB

TB

Create the device under test which is the source/sink.

FUNCTIONS

run_test

```
async def run_test(
dut,
payload_data
 =
None
)
```

Tests the source/sink for valid transmission of data.

incrementing_payload

```
def incrementing_payload()
```

Generate a list of ints that increment from 0 to 2^16

random_payload

```
def random_payload()
```

Generate a list of random ints 2^16 in the range of 0 to 2^16

test_mil_std_1553

```
def test_mil_std_1553(
request
)
```

Main cocotb function that specifies how to put the test together.

test_mil_std_1553.v

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INFORMATION

Brief

Test bench wrapper for mil-std-1553 cocotb

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test_mil_std_1553

```
module test_mil_std_1553 (
                                                                    inout [
1:0]
data
)
```

Simple loop of MIL-STD-1553 source/sink

Ports

data inout[1: 0]	Differential mil-std-1553 data	