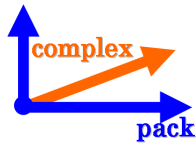


complexpack user manual



Title	complexpack (VHDL complex arithmetic package).
Author	Nikolaos Kavvadias 2009, 2010, 2011, 2012, 2013, 2014
Contact	nikos@nkavvadias.com
Website	http://www.nkavvadias.com
Release Date	30 November 2014
Version	0.1.3
Rev. history	
v0.1.3	2014-11-30 Added project logo to README.
v0.1.2	2014-06-17 Changed README to README.rst.
v0.1.1	2014-03-04 Added support for the "abs" and the negation ("-") operators as those are needed by the complexarrpack package project.
v0.1.0	2014-03-03 Added get_real, get_imaginary, magnitude, and operators: lt, gt, le, ge, eq, ne. New library dependency: IEEE.math_real.
v0.0.1	2014-02-24 Changed documentation format to RestructuredText. Code has been reorganized into new directory structure.
v0.0.0	2009-10-02 First public release.

1. Introduction

complexpack is a simple complex arithmetic package written in VHDL. It is based on a code example present in the RASSP series of VHDL lectures. Compared to the RASSP version, the following have been added:

- conjugate function.
- magnitude function.

- comparison operators.
- get real and get imaginary part functions.

A complex number is defined by the pair (real-part, imaginary-part) where both items of the pair are numbers. A common algebraic representation for complex numbers is:

$$z = a + i*b,$$

where:

- z is the resulting complex number
- a is the real part of the number also written as $a = \text{Re}(z)$
- b is the imaginary part of the number also written as $b = \text{Im}(z)$
- i is the imaginary unit and has the value of $\text{sqrt}(-1)$.

Currently, the `complexbank` package implements the following:

- the constants `re` and `im`, which specify addresses for an array-based representation of a complex number
- type definition for a complex number
- interface and implementation for complex arithmetic functionality

1.1. Implemented functions and operators

This is a summary of the currently supported functions, procedures and operators by the `complexbank` package.

- `to_complex(real, real)`: form a complex number
- `+`: add two complex numbers
- `-`: subtract one complex number from another
- `-`: negate a complex number
- `*`: multiply two complex numbers
- `/`: divide two complex numbers
- `conjugate(complex)`: return the conjugate of the given complex number

All functions above return an item of the complex data type.

- `get_real(complex)`: get the real part of a complex number
- `get_imaginary(complex)`: get the imaginary part of a complex number
- `magnitude(complex)`: return the magnitude (distance of point 0,0) of the complex number
- `abs(complex)`: alias for magnitude

All functions above return an item of the real data type (a scalar quantity).

- <: less than comparison for two complex numbers
- >: greater than comparison for two complex numbers
- <=: less than or equal comparison for two complex numbers
- >=: greater than or equal comparison for two complex numbers
- =: equality comparison for two complex numbers
- /=: non-equality comparison for two complex numbers

All functions above return an item of the boolean data type (TRUE or FALSE).

The definition of `magnitude` requires a square root computation. For this task, a call to the `sqrt` function found in the `IEEE.math_real` library is used.

`complexpack` is distributed along with a simple VHDL testbench exercising basic functionalities.

2. File listing

The `complexpack` distribution includes the following files:

/complexpack	Top-level directory
AUTHORS	List of <code>complexpack</code> authors.
BUGS	Bug list.
ChangeLog	A log for code changes.
LICENSE	The LGPL, version 3, governs <code>complexpack</code> .
README.rst	This file.
README.html	HTML version of README.rst.
README.pdf	PDF version of README.rst.
THANKS	Acknowledgements.
TODO	A list of future enhancements.
VERSION	Current version of the project sources.
complexpack.png	PNG image for the <code>complexpack</code> project logo.
rst2docs.sh	Bash script for generating the HTML and PDF versions.
/bench/vhdl	Benchmarks VHDL directory
complexpack_tb.vhd	A simple testbench.
/doc	Documentation directory
/rtl/vhdl	RTL source code directory for the package
complexpack.vhd	The complex arithmetic package.
/sim/rtl_sim	RTL simulation files directory
/sim/rtl_sim/out	RTL simulation output files directory
complexpack_results- .txt	Output generated by the <code>complexpack_tb.vhd</code> test.
/sim/rtl_sim/run	RTL simulation run scripts directory

complexpack.mk	GNU Makefile for running GHDL simulations.
run.sh	A bash script for running the GNU Makefile for GHDL.

3. complexpack usage

The complexpack package test script can be used as follows:

```
$ ./run.sh
```

as run from within the `./sim/rtl_sim/run` subdirectory.

After this process, the `complexpack_results.txt` file is generated containing simulation results.

4. Prerequisites

- Standard UNIX-based tools (tested on cygwin/x86 and MinGW/x86 and MinGW/x64)
 - make
 - bash

- GHDL simulator (<http://ghdl.free.fr>)

Provides the "ghdl" executable and corresponding simulation environment. Versions throughout 0.26 to 0.31 (mcode) have been used for testing.