

# Digital System Designing using VHDL

An Industrial Training Presentation

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# Importance of VHDL in Industry

- 1 Used in Electronics Design Automation
- 2 Used to describe digital and mixed-signal systems
- 3 FPGA and IC industries use HDL languages including VHDL
- 4 Behavioural simulation before synthesis
- 5 Internationally standardized language
- 6 Can be used to describe concurrent systems
- 7 Portable

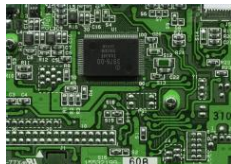


Figure 1: Integrated Circuits

## VHDL: VHSIC Hardware Description Language

VHSIC: Very High Speed Integrated Circuits

### About VHDL:

- Standardized by Institute of Electrical & Electronic Engineers (IEEE)
- Amalgamation of following languages:
  - Concurrent language
  - Sequential Language
  - Simulation Language
  - Test Language
- Powerful language constructs:
  - If.....else
  - With...select etc.
- Design hierarchies to create modular designs
- Supports design libraries
- Case insensitive language
- Facilitates device independent design and portability
- Strongly typed language

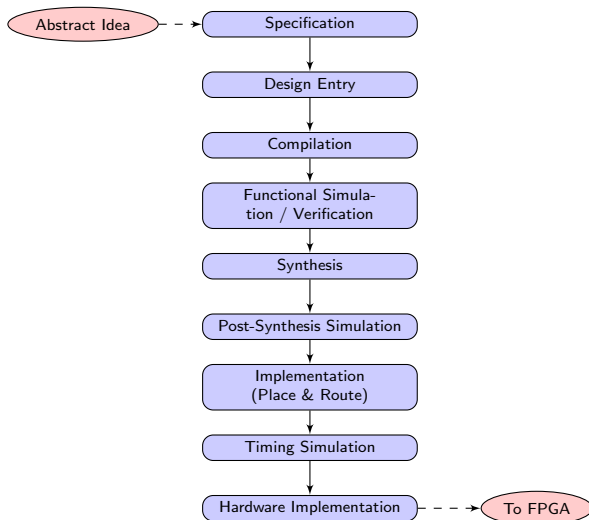


Figure 2: Flow Chart of designing techniques

## Building blocks:

- 1 Library
- 2 Entity
  - Declaration
  - Modes
- 3 Architectures
- 4 Configuration
- 5 Objects
- 6 Constructs
- 7 Constants
- 8 Signals
- 9 Variables
- 10 Generics

## Data types:

- 1 Pre-defined
- 2 User-defined
- 3 Subtypes
- 4 Arrays
- 5 Port-arrays
- 6 Records
- 7 Signed & Unsigned

## Operator types:

- 1 Logical
- 2 Arithmetic
- 3 Comparison
- 4 Shift
- 5 Concatenation

## 1 Behavioural

- It is a high-level description
- It contains a set of assignment statements to represent behaviour
- No need to focus on the gate-level implementation of a design

## 2 Dataflow

- It uses concurrent signal assignment statements.
- We already know signal flow throughout various point of the circuit

## 3 Structural

- Components from libraries are connected together
- Designs are hierarchical
- Each component can be individually simulated
- It makes use of component instantiation

## Traffic Light Controller through FPGA

Specification and features:

- 4 way 2 lane system
- Delay generation (1 second)
- 4 ports-each having Red, Yellow and Green bit
- Real LED PCB for hardware implementation
- Digilent-FPGA implementation
- Based on counter, ports bits are set high and low

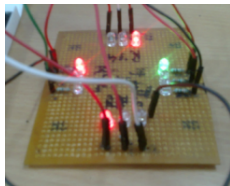


Figure 3: Traffic Lights PCB



Figure 4: FPGA Board



## **Learnings during the training are:**

- ① Digital System Modelling using EDA tools
- ② Levels of behaviour abstraction
- ③ Digital System-Design Flow
- ④ VHDL: Features, elements, constructs and tools
- ⑤ Project Experience:  
Digital Circuits & Traffic Light Controller through FPGA

## Books:

- 1 **The Designer's Guide to VHDL**  
Peter J. Ashenden, 2008.
- 2 **VHDL: Programming by Example**  
Douglas Perry, 2002.

## Websites:

- 1 **University of Regina, VHDL Lecture**  
<http://www.cs.uregina.ca/Links/class-info/301/Xilinx/lecture.html>
- 2 **Core Technologies, VHDL Documentaion**  
<http://www.1-core.com/library/digital/fpga-design-tutorial/simple-fpga-project.shtml>

## Project Website:

- <http://amitthakur.org/projects/vhdl>

## Queries & Discussion

# Thank You!

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