

Contents

About This Manual

1. Introducing HDL Compiler for Verilog

What's New in This Release	1-2
New Verilog Netlist Reader	1-3
Hardware Description Languages	1-3
HDL Compiler and the Design Process	1-5
Using HDL Compiler With Design Compiler	1-6
Design Methodology	1-7
Verilog Example	1-9
Verilog Design Description	1-9
Synthesizing the Verilog Design	1-12

2. Description Styles

Design Hierarchy	2-2
Structural Descriptions	2-3

Functional Descriptions	2-4
Mixing Structural and Functional Descriptions	2-4
Design Methodology	2-7
Description Style	2-7
Language Constructs	2-7
Design Constraints	2-8
Register Selection	2-8
Asynchronous Designs	2-9
3. Structural Descriptions	
Modules	3-2
Macromodules	3-3
Port Definitions	3-4
Port Names	3-5
Renaming Ports	3-6
Module Statements and Constructs	3-6
Structural Data Types	3-7
parameter	3-8
wire	3-9
wand	3-10
wor	3-11
tri	3-12
supply0 and supply1	3-13
reg	3-13

Port Declarations	3-13
input	3-14
output	3-14
inout	3-15
Continuous Assignment	3-15
Module Instantiations	3-16
Named and Positional Notation	3-18
Parameterized Designs	3-19
Using Templates—Naming	3-21
Using Templates—list -templates Command	3-22
Gate-Level Modeling	3-23
Three-State Buffer Instantiation	3-24
4. Expressions	
Constant-Valued Expressions	4-2
Operators	4-3
Arithmetic Operators	4-4
Relational Operators	4-5
Equality Operators	4-6
Handling Comparisons to X or Z	4-7
Logical Operators	4-8
Bitwise Operators	4-9
Reduction Operators	4-10
Shift Operators	4-11
Conditional Operator	4-12
Concatenation Operators	4-13

Operator Precedence	4-15
Operands	4-17
Numbers	4-17
Wires and Registers	4-17
Bit-Selects	4-18
Part-Selects	4-18
Function Calls	4-19
Concatenation of Operands	4-19
Expression Bit-Widths	4-20
5. Functional Descriptions	
Sequential Constructs	5-2
Function Declarations	5-3
Input Declarations	5-5
Output From a Function	5-5
Register Declarations	5-6
Memory Declarations	5-7
Parameter Declarations	5-8
Integer Declarations	5-9
Function Statements	5-9
Procedural Assignments	5-10
RTL Assignments	5-11
begin...end Block Statements	5-14
if...else Statements	5-15
Conditional Assignments	5-17

case Statements	5-17
Full Case and Parallel Case.	5-19
casex Statements	5-22
casez Statements	5-24
for Loops	5-25
while Loops	5-27
forever Loops	5-28
disable Statements	5-29
task Statements.	5-31
always Blocks	5-33
Event Expression.	5-33
Incomplete Event Specification	5-36
6. Register, Multibit, Multiplexer, and Three-State Inference	
Register Inference	6-2
Reporting Register Inference.	6-2
Configuring the Inference Report.	6-3
Selecting Latch Inference Warnings.	6-5
Controlling Register Inference	6-5
Attributes That Control Register Inference	6-6
Variables That Control Register Inference	6-8
Inferring Latches	6-10
Inferring SR Latches.	6-10
Inferring D Latches	6-12
Simple D Latch.	6-15
D Latch With Asynchronous Set or Reset	6-16

D Latch With Asynchronous Set and Reset	6-19
Inferring Master-Slave Latches.	6-20
Inferring Flip-Flops	6-25
Inferring D Flip-Flops	6-25
Understanding the Limitations of D Flip-Flop Inference	6-40
Inferring JK Flip-Flops	6-41
JK Flip-Flop With Asynchronous Set and Reset	6-43
Inferring Toggle Flip-Flops	6-46
Getting the Best Results.	6-50
Understanding the Limitations of Register Inference	6-55
Multibit Inference	6-55
Controlling Multibit Inference	6-56
Directives That Control Multibit Inference.	6-57
Variable That Controls Multibit Inference	6-57
Inferring Multibit Components	6-58
Reporting Multibit Inference.	6-62
Using the report_multibit Command.	6-63
Listing All Multibit Cells in a Design	6-64
Understanding the Limitations of Multibit Inference.	6-64
Multiplexer Inference	6-65
Reporting Multiplexer Inference	6-65
Controlling Multiplexer Inference	6-66
HDL Compiler Directive That Controls Multiplexer Inference.	6-66
Variables That Control Multiplexer Inference	6-67
Inferring Multiplexers	6-69
Understanding the Limitations of Multiplexer Inference	6-72

Three-State Inference	6-73
Reporting Three-State Inference	6-73
Controlling Three-State Inference	6-74
Inferring Three-State Drivers	6-74
Simple Three-State Driver	6-74
Registered Three-State Drivers	6-79
Understanding the Limitations of Three-State Inference	6-82
7. Resource Sharing	
Scope and Restrictions	7-2
Control Flow Conflicts	7-4
Data Flow Conflicts	7-9
Errors	7-10
Resource Sharing Methods	7-11
Automatic Resource Sharing	7-11
Source Code Preparation	7-12
Functional Description	7-12
Resource Area	7-12
Multiplexer Area	7-12
Example of Shared Resources	7-13
Input Ordering	7-15
Automatic Resource Sharing With Manual Controls	7-17
Source Code Preparation	7-18
Functional Description	7-20
Operations and Resources	7-30
Manual Resource Sharing	7-40
Source Code Preparation	7-41

Functional Description	7-41
Input Ordering	7-42
Resource Sharing Conflicts and Error Messages	7-44
User Directive Conflicts	7-44
Module Conflicts	7-45
Control Flow Conflicts	7-47
Data Flow Conflicts	7-48
Reports	7-49
Generating Resource Reports	7-49
Interpreting Resource Reports	7-49
8. Writing Circuit Descriptions	
How Statements Are Mapped to Logic	8-2
Design Structure	8-3
Using Design Knowledge	8-6
Optimizing Arithmetic Expressions	8-7
Merging Cascaded Adders With a Carry	8-7
Arranging Expression Trees for Minimum Delay	8-8
Sharing Common Subexpressions	8-15
Using Operator Bit-Width Efficiently	8-18
Using State Information	8-19
Describing State Machines	8-22
Minimizing Registers	8-27
Separating Sequential and Combinational Assignments	8-30
Design Compiler Optimization	8-33

Don't Care Inference	8-33
Limitations of Using Don't Care Values	8-34
Differences Between Simulation and Synthesis.	8-34
Propagating Constants	8-35
Synthesis Issues	8-36
Feedback Paths and Latches.	8-36
Synthesizing Asynchronous Designs.	8-36
Designing for Overall Efficiency.	8-39
Describing Random Logic	8-39
Sharing Complex Operators	8-40
9. HDL Compiler Directives	
Verilog Preprocessor Directives	9-2
Define Option to the analyze Command	9-2
dc_shell Variables	9-3
'ifdef, 'else, and 'endif Directives	9-4
DC Macro	9-4
'define Verilog Preprocessor Directive	9-5
Notation for HDL Compiler Directives	9-6
translate_off and translate_on Directives	9-6
parallel_case Directive	9-8
full_case Directive	9-10
state_vector Directive	9-13
enum Directive.	9-15

template Directive	9-21
Embedding Constraints and Attributes	9-22
Limitations on the Scope of Constraints and Attributes.	9-23
Component Implication	9-24
10. Design Compiler Interface	
Starting Design Compiler	10-3
Starting the dc_shell Command Interface	10-3
Starting Design Analyzer	10-4
Reading In Verilog Source Files	10-5
Reading Structural Descriptions	10-5
Design Compiler Flags and dc_shell Variables	10-6
Array Naming Variable	10-8
Template Naming Variables	10-9
Building Parameterized Designs	10-10
Synthetic Libraries	10-12
Optimizing With Design Compiler	10-14
Flattening and Structuring	10-15
Grouping Logic.	10-15
Busing	10-16
Correlating HDL Source Code to Synthesized Logic.	10-17
Writing Out Verilog Files	10-17
Setting Verilog Write Variables	10-18

Appendix A. Examples

Count Zeros—Combinational Version	A-2
Count Zeros—Sequential Version	A-5
Drink Machine—State Machine Version	A-8
Drink Machine—Count Nickels Version	A-13
Carry-Lookahead Adder	A-15

Appendix B. Verilog Syntax

Syntax	B-2
BNF Syntax Formalism	B-2
BNF Syntax	B-3
Lexical Conventions.	B-13
White Space.	B-13
Comments	B-14
Numbers	B-14
Identifiers	B-16
Operators.	B-16
Macro Substitution	B-17
include Construct	B-18
Simulation Directives	B-18
Verilog System Functions	B-19
Verilog Keywords	B-20
Unsupported Verilog Language Constructs.	B-21

Glossary

Index

