

Project 2

ECE 6140: Digital System Testing

Topic: Design and implementation of deductive fault simulator

Data Structures for circuit and simulation (updates from project 1)

1. Node: class to hold the details of a node in the circuit
 - a. Files: Node.h and Node.cpp
 - b. Data structure updates:
 - i. isStuckAtOne/isStuckAtZero: Added new Boolean value to hold the applied faults at node (stuck-at-0 and/or stuck-at-1)
 - ii. listDeductiveFaults: Added new list to hold the deductive faults at the current node
 - c. Functionality updates:
 - i. Added function to calculate which of stuck-at-0 or stuck-at-1 is sensitized based on current value on node.
 - ii. Added function to update the deductive fault list from the Gate level data-structure.
2. Gate: class to hold the details of a gate in the circuit
 - a. Files: Gate.h and Gate.cpp
 - i. Functionality updates:
 - ii. Added function to decide the controlling value for its inputs based on gate type.
 - iii. Added function to decide the inversion parity of gate based on type.
 - iv. Updated the simulation logic to update the output deductive fault list based on the deductive fault lists on inputs, input values and output sensitized fault.
3. Circuit: class to hold the details of the complete circuit
 - a. Files: Circuit.h and Circuit.cpp
 - i. Updated “read_netlist” function to either apply all possible faults or specific faults (read from inputs file) on the circuit data-structure.
 - ii. “apply_test_vector” function auto-handles the deductive fault list and the gate simulation in point 2.a.i.3 was updated to set the output deductive fault list when it is simulated.
 - iii. Added additional logic to calculate the fault coverage and some debugs helper functions.

Logic for deductive fault simulation:

1. Circuit netlist is read and all data-structures are initialized as in Project 1.
2. Based on inputs (fault list file or apply all faults), the fault on each node are applied.
3. The “apply_test_vector” function is called it start the simulation.
4. For each input node it applies the Boolean value and calls the function on the Node data-structure to update the sensitized fault on node based on node value.
 - a. Each node is then added to a queue which tracks the nodes to be simulated.
 - b. For each node:
 - i. It checks the gates, it is connected to. If all the gate inputs are valid, it simulates the gates which also updates the deductive fault list on the output. It adds the output node to this queue so that the output node is also checked in further iterations.
 - ii. If all the gates connected to node are simulated, it removes the node from the list.
 - c. This simulation flow in turn updates all the output nodes with their Boolean value and the deductive fault list.

Logic for coverage analysis

1. "run_all" function is implemented which runs coverage analysis on the known netlist.
2. Coverage analysis is designed as follows:
 - a. It increase the numbers of tests to be applied from 0 to $2^{(\text{number of inputs})}$ iterative.
 - b. For each such iteration it the required number of randomly selected test vectors and checks the faults detected for all tests.
 - c. Using this it calculates the fault coverage by comparing it with the total faults in the circuit.
3. This data is dumped into a CSV file, which is then read into Microsoft Excel for plotting the curve of "fault coverage" vs "no. of applied tests".

Steps to run script:

1. Compile all the *.cpp and *.h files. Run either of the below commands.
 - a. Command: `g++ -std=c++11 *.cpp -o DSTProject2.out`
 - b. Command: `g++ -std=c++11 DST_project2.cpp Circuit.cpp Gate.cpp Node.cpp -o DSTProject2.out`
2. Input arguments:
 - a. -a: To run all possible tests from the netlist directory (s27.txt, s298f_2.txt, s344f_2.txt, s349f_2.txt)
 - b. -f <path to netlist file>: Path for single netlist to run (cannot be used with -a)
 - c. -d <path to netlist directory>: Path for all 4 netlists (must be used with -a)
 - d. -l: To run the circuit with all faults activated (cannot be used with -a)
 - e. -p <path to fault list>: Path to input fault list (cannot be used with -a and -l)
 - f. -t <test vector to apply>: Test vector to apply (cannot be used -a)
3. Run command: `<exe> <path_to_netlist> <input_vector> <path_to_fault_list>`
4. Fault list format (each in a new line):
 - a. <net no.> <stuck-at-value>
5. Example commands
 - a. To run all tests for coverage stats: `<exe> -a -d <path_to_netlist_dir>`
 - b. To run single netlist with all faults: `<exe> -f <path_to_netlist> -t <test_vector> -l`
 - c. To run single netlist with custom faults: `<exe> -f <path_to_netlist> -t <test_vector> -p <path_to_fault_list>`
6. Outputs:
 - a. For all netlists run for coverage stats:
 - i. "test_data.csv" in the run directory contains test vectors run and the fault coverage percentage for each circuit.
 - ii. The same data is output in the standard output.
 - b. For run on a single netlist:
 - i. Output vector is printed.
 - ii. List of detectable faults at the output are printed.
 - iii. Fault coverage statistics of the run are printed.

Simulations run for fault coverage:

1. Used a random number generator to generate random test vectors to apply within the range of 0 to $2^{(\text{no. of inputs})}-1$.
2. 100 tests vectors are randomly selected and applied to each netlist.
3. The cumulative uniquely detected faults are used to compute the fault coverage for each additional test vector that is applied.
4. Steps 1 to 3 were repeated 5 times and the final fault coverage for each test vector count was computed by taking the average of each of these runs.

5. Plot was generated by importing data into an excel sheet.

Tested on

1. Windows 10 machine
2. Gatech ECE Server (unix): ece-linlabsrv01.ece.gatech.edu

Simulation Data:

Part A: Fault list of each applied vector

NOTE: For list of specific faults detected, check Appendix A.

CONSIDERATION: All faults on each node in the circuit are checked.

Circuit Netlist	Test Vector	Total Faults	Faults Detected	Fault Coverage
s27.txt	1101101	40	9	22.5%
	0101001	40	13	32.5%
s298f_2.txt	10101011110010101	404	87	21.5347%
	11101110101110111	404	53	13.1188%
s344f_2.txt	10101010101011110111111	380	82	21.5789%
	111010111010101010001100	380	132	34.7368%
s349f_2.txt	10100000001010101111111	378	97	25.6614%
	111111101010101010001111	378	137	36.2434%

Part B: Fault coverage analysis

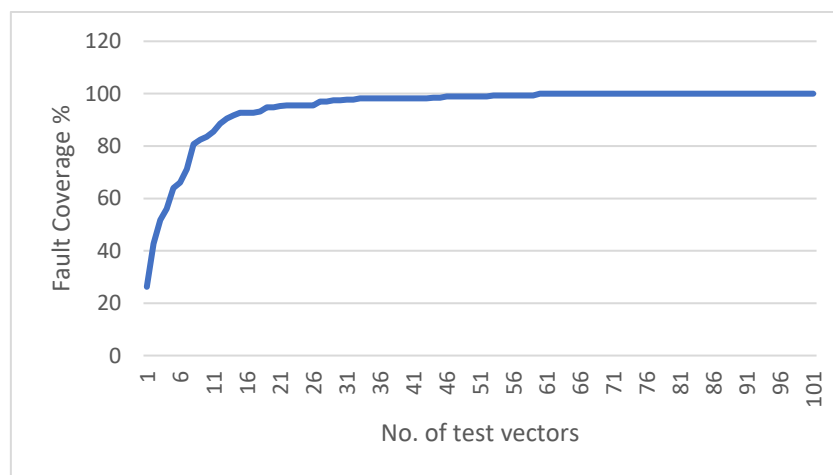
NOTE: For table of fault coverage vs test vectors run, check Appendix B.

Netlist #1: s27.txt

Vectors needed to get 75% coverage = 8

Vectors needed to get 90% coverage = 13

Fault coverage vs number of tests plot:

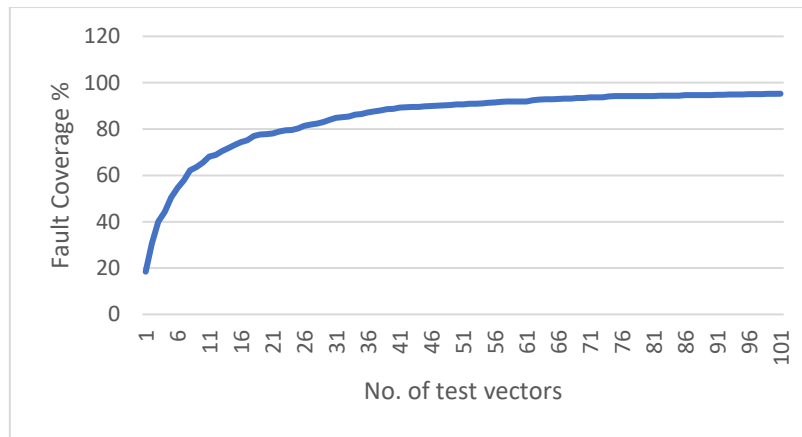


Netlist #2: s298f_2.txt

Vectors needed to get 75% coverage = 17

Vectors needed to get 90% coverage = 47

Fault coverage vs number of tests plot:

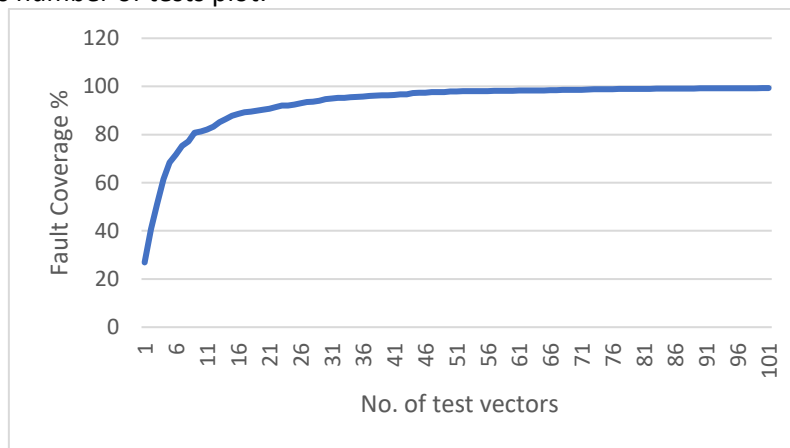


Netlist #3: s344f_2.txt

Vectors needed to get 75% coverage = 7

Vectors needed to get 90% coverage = 20

Fault coverage vs number of tests plot:

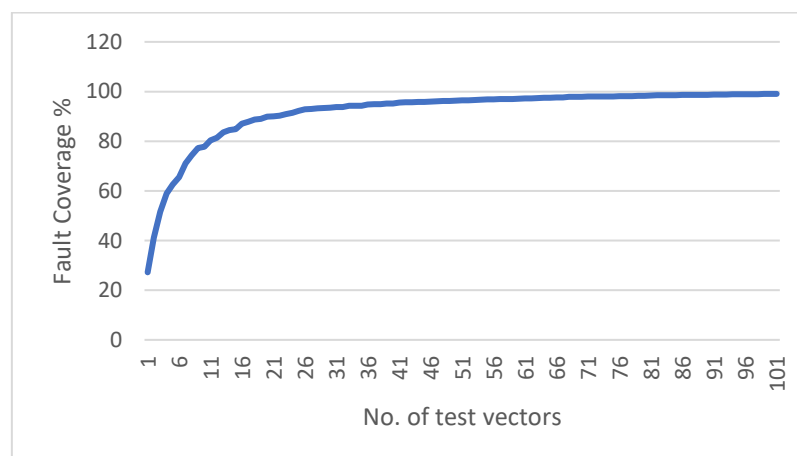


Netlist #4: s349_f.txt

Vectors needed to get 75% coverage = 9

Vectors needed to get 90% coverage = 21

Fault coverage vs number of tests plot:



Appendix A: Deductive Fault List

Test #1: Netlist: s27.txt, Test Vector: 1101101

Deductive fault list:

1 stuck at 0
3 stuck at 1
5 stuck at 0
7 stuck at 0
9 stuck at 1
11 stuck at 0
12 stuck at 0
13 stuck at 0
15 stuck at 1

Test #2: Netlist: s27.txt, Test Vector: 0101001

Deductive fault list:

1 stuck at 1
3 stuck at 1
5 stuck at 0
7 stuck at 1
8 stuck at 1
9 stuck at 1
11 stuck at 0
12 stuck at 1
14 stuck at 0
15 stuck at 1
16 stuck at 1
19 stuck at 1
20 stuck at 1

Test #3: Netlist: s298f_2.txt, Test Vector: 10101011110010101

Deductive fault list:

3 stuck at 0
5 stuck at 0
6 stuck at 1
7 stuck at 0
8 stuck at 0
9 stuck at 0
10 stuck at 0
11 stuck at 1
12 stuck at 1
15 stuck at 0
18 stuck at 1
19 stuck at 1
20 stuck at 1
21 stuck at 1
22 stuck at 1
23 stuck at 1
24 stuck at 0
25 stuck at 0
26 stuck at 0
27 stuck at 0
28 stuck at 1
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30 stuck at 1
31 stuck at 1
32 stuck at 0
33 stuck at 1
34 stuck at 0
35 stuck at 0
36 stuck at 1
37 stuck at 0
39 stuck at 1
41 stuck at 1
45 stuck at 1
48 stuck at 0
49 stuck at 0
50 stuck at 0
51 stuck at 0
52 stuck at 1
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54 stuck at 1
55 stuck at 1
56 stuck at 0
58 stuck at 0
64 stuck at 1
66 stuck at 0
67 stuck at 1
68 stuck at 1
95 stuck at 0
102 stuck at 0
103 stuck at 0
104 stuck at 0
107 stuck at 1
108 stuck at 1
109 stuck at 1
110 stuck at 1
111 stuck at 1
113 stuck at 1
115 stuck at 1
116 stuck at 1
118 stuck at 0
119 stuck at 0
121 stuck at 0
122 stuck at 0
132 stuck at 0
133 stuck at 0
135 stuck at 0
138 stuck at 0
143 stuck at 1
144 stuck at 1
145 stuck at 1
149 stuck at 0
152 stuck at 0
158 stuck at 0
159 stuck at 0
161 stuck at 0
163 stuck at 0
166 stuck at 1

167 stuck at 1
168 stuck at 1
169 stuck at 1
170 stuck at 1
173 stuck at 0
182 stuck at 1
183 stuck at 1
186 stuck at 1
187 stuck at 1
188 stuck at 1

Test #4: Netlist: s298f_2.txt, Test Vector: 11101110101110111

Deductive fault list:

1 stuck at 0
6 stuck at 0
7 stuck at 0
8 stuck at 1
9 stuck at 0
10 stuck at 1
11 stuck at 0
12 stuck at 0
15 stuck at 0
18 stuck at 1
19 stuck at 1
20 stuck at 1
21 stuck at 1
22 stuck at 1
23 stuck at 1
24 stuck at 1
25 stuck at 1
26 stuck at 1
27 stuck at 1
28 stuck at 1
29 stuck at 1
30 stuck at 1
31 stuck at 1
32 stuck at 0
33 stuck at 0
34 stuck at 0
35 stuck at 1
36 stuck at 0
37 stuck at 1
43 stuck at 0
45 stuck at 1
47 stuck at 1
49 stuck at 1
51 stuck at 1
53 stuck at 0
55 stuck at 0
57 stuck at 0
59 stuck at 0
63 stuck at 1
64 stuck at 0
65 stuck at 1

66 stuck at 1
67 stuck at 1
68 stuck at 1
102 stuck at 1
152 stuck at 1
166 stuck at 0
168 stuck at 0
170 stuck at 0
172 stuck at 0
173 stuck at 0
174 stuck at 0
182 stuck at 0

Test #5: Netlist: s344f_2.txt, Test Vector: 101010101010111101111111

Deductive fault list:

1 stuck at 0
2 stuck at 1
3 stuck at 0
4 stuck at 1
5 stuck at 0
6 stuck at 1
7 stuck at 0
8 stuck at 1
9 stuck at 0
10 stuck at 1
11 stuck at 0
12 stuck at 1
13 stuck at 0
14 stuck at 0
15 stuck at 0
16 stuck at 0
25 stuck at 1
26 stuck at 1
27 stuck at 1
28 stuck at 0
29 stuck at 0
30 stuck at 0
31 stuck at 0
32 stuck at 1
33 stuck at 0
34 stuck at 1
35 stuck at 0
36 stuck at 1
37 stuck at 0
38 stuck at 0
39 stuck at 0
40 stuck at 1
41 stuck at 0
42 stuck at 1
43 stuck at 0
44 stuck at 1
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46 stuck at 1
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48 stuck at 0
49 stuck at 1
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54 stuck at 1
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61 stuck at 1
62 stuck at 1
64 stuck at 0
65 stuck at 1
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67 stuck at 0
68 stuck at 1
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73 stuck at 1
76 stuck at 1
77 stuck at 1
78 stuck at 1
91 stuck at 0
92 stuck at 1
95 stuck at 1
96 stuck at 1
97 stuck at 0
99 stuck at 0
101 stuck at 0
105 stuck at 1
106 stuck at 0
108 stuck at 0
109 stuck at 1
110 stuck at 1
111 stuck at 1
112 stuck at 0
114 stuck at 0
115 stuck at 1
116 stuck at 1
144 stuck at 0
145 stuck at 0
146 stuck at 0
188 stuck at 1
189 stuck at 1
190 stuck at 1

Test #6: Netlist: s344f_2.txt, Test Vector: 111010111010101010001100

Deductive fault list:

1 stuck at 0
2 stuck at 0
3 stuck at 0
4 stuck at 1
5 stuck at 0
6 stuck at 1
7 stuck at 0
8 stuck at 0

9 stuck at 0
10 stuck at 1
11 stuck at 0
12 stuck at 1
13 stuck at 0
14 stuck at 1
15 stuck at 0
16 stuck at 1
25 stuck at 1
26 stuck at 1
27 stuck at 1
28 stuck at 0
29 stuck at 1
30 stuck at 0
31 stuck at 1
32 stuck at 0
33 stuck at 0
34 stuck at 0
35 stuck at 1
36 stuck at 1
37 stuck at 0
38 stuck at 1
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42 stuck at 1
43 stuck at 0
44 stuck at 1
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64 stuck at 1
65 stuck at 0
67 stuck at 0
68 stuck at 1
69 stuck at 0
70 stuck at 1
71 stuck at 0
72 stuck at 0
73 stuck at 1

76 stuck at 0
78 stuck at 0
79 stuck at 0
80 stuck at 0
82 stuck at 0
85 stuck at 0
86 stuck at 0
88 stuck at 0
91 stuck at 1
92 stuck at 0
93 stuck at 0
94 stuck at 0
95 stuck at 1
96 stuck at 1
97 stuck at 0
99 stuck at 1
100 stuck at 1
101 stuck at 0
103 stuck at 0
104 stuck at 1
117 stuck at 0
118 stuck at 1
119 stuck at 1
120 stuck at 1
122 stuck at 0
123 stuck at 0
124 stuck at 1
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127 stuck at 1
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171 stuck at 0
173 stuck at 1
174 stuck at 1
175 stuck at 0
179 stuck at 0
181 stuck at 1
182 stuck at 1
183 stuck at 1
184 stuck at 1
186 stuck at 1
188 stuck at 0
189 stuck at 0

Test #7: Netlist: s349f_2.txt, Test Vector: 101000000010101011111111

Deductive fault list:

1 stuck at 0
2 stuck at 1
3 stuck at 0
4 stuck at 1
5 stuck at 1
6 stuck at 1
7 stuck at 1
8 stuck at 1
9 stuck at 1
10 stuck at 1
11 stuck at 0
12 stuck at 1
13 stuck at 0
14 stuck at 1
15 stuck at 0
16 stuck at 1
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27 stuck at 0
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181 stuck at 0
183 stuck at 0
187 stuck at 1
188 stuck at 1
189 stuck at 1

Test #8: Netlist: s349f_2.txt, Test Vector: 101000000010101011111111

Deductive fault list:

1 stuck at 0
2 stuck at 0
3 stuck at 0
4 stuck at 0
5 stuck at 0
6 stuck at 0
7 stuck at 0
8 stuck at 1
9 stuck at 0
10 stuck at 1
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12 stuck at 1
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14 stuck at 1
15 stuck at 0
25 stuck at 1
26 stuck at 1
27 stuck at 1
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186 stuck at 1
187 stuck at 0
188 stuck at 0

Appendix B: Fault Coverage Analysis

Report for test vectors run up to 100 randomly generated test vectors across 10 runs

Netlist: s27.txt

	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10	Average of all runs
Test vectors run	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %
1	25	35	35	20	20	20	37.5	25	25	20	26.25
2	40	45	42.5	40	47.5	27.5	57.5	25	47.5	55	42.75
3	40	50	60	40	52.5	27.5	77.5	25	67.5	77.5	51.75
4	40	52.5	60	40	60	30	80	45	67.5	85	56
5	67.5	52.5	62.5	40	77.5	40	85	57.5	72.5	85	64
6	70	52.5	62.5	47.5	77.5	47.5	87.5	57.5	72.5	85	66
7	85	60	65	52.5	80	62.5	87.5	62.5	72.5	85	71.25
8	85	80	72.5	85	92.5	72.5	87.5	62.5	85	85	80.75
9	85	90	72.5	90	92.5	72.5	90	62.5	85	85	82.5
10	87.5	90	77.5	90	92.5	72.5	90	65	85	85	83.5
11	87.5	97.5	77.5	90	92.5	75	90	65	95	85	85.5
12	87.5	97.5	77.5	90	92.5	75	90	90	95	90	88.5
13	87.5	97.5	90	90	92.5	75	90	95	97.5	90	90.5
14	97.5	97.5	90	90	92.5	75	90	95	100	90	91.75
15	97.5	97.5	92.5	90	97.5	75	90	95	100	92.5	92.75
16	97.5	97.5	92.5	90	97.5	75	90	95	100	92.5	92.75
17	97.5	97.5	92.5	90	97.5	75	90	95	100	92.5	92.75
18	97.5	97.5	92.5	90	97.5	80	90	95	100	92.5	93.25
19	97.5	97.5	92.5	90	97.5	90	90	95	100	97.5	94.75
20	97.5	97.5	92.5	90	97.5	90	90	95	100	97.5	94.75

21	97.5	100	92.5	90	97.5	90	90	97.5	100	97.5	95.25
22	100	100	92.5	90	97.5	90	90	97.5	100	97.5	95.5
23	100	100	92.5	90	97.5	90	90	97.5	100	97.5	95.5
24	100	100	92.5	90	97.5	90	90	97.5	100	97.5	95.5
25	100	100	92.5	90	97.5	90	90	97.5	100	97.5	95.5
26	100	100	92.5	90	97.5	90	90	97.5	100	97.5	95.5
27	100	100	97.5	90	97.5	95	95	97.5	100	97.5	97
28	100	100	97.5	90	97.5	95	95	97.5	100	97.5	97
29	100	100	97.5	95	97.5	95	95	97.5	100	97.5	97.5
30	100	100	97.5	95	97.5	95	95	97.5	100	97.5	97.5
31	100	100	100	95	97.5	95	95	97.5	100	97.5	97.75
32	100	100	100	95	97.5	95	95	97.5	100	97.5	97.75
33	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
34	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
35	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
36	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
37	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
38	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
39	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
40	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
41	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
42	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
43	100	100	100	95	97.5	100	95	97.5	100	97.5	98.25
44	100	100	100	95	97.5	100	95	100	100	97.5	98.5
45	100	100	100	95	97.5	100	95	100	100	97.5	98.5
46	100	100	100	95	97.5	100	100	100	100	97.5	99
47	100	100	100	95	97.5	100	100	100	100	97.5	99
48	100	100	100	95	97.5	100	100	100	100	97.5	99
49	100	100	100	95	97.5	100	100	100	100	97.5	99

[illegible]

1	23.5149	19.0594	15.5941	14.604	27.2277	11.6337	21.5347	18.8119	20.297	12.1287	18.441
2	28.4653	36.8812	35.8911	17.3267	38.8614	17.5743	36.8812	38.1188	41.8317	15.099	30.693
3	43.0693	37.8713	41.3366	38.1188	45.297	30.6931	52.9703	44.0594	52.2277	15.5941	40.124
4	44.3069	39.3564	46.7822	49.505	50	30.6931	55.6931	45.297	57.1782	24.0099	44.282
5	46.7822	45.5446	51.9802	52.2277	52.9703	43.3168	60.396	52.9703	62.8713	35.1485	50.421
6	50	47.5248	59.4059	52.9703	54.703	48.0198	60.8911	60.396	63.8614	47.7723	54.554
7	52.9703	50.7426	61.1386	58.6634	57.9208	49.2574	61.3861	64.604	69.802	52.2277	57.871
8	52.9703	55.9406	61.3861	63.6139	65.5941	56.4356	66.5842	68.0693	71.0396	60.396	62.203
9	53.2178	56.6832	62.3762	63.8614	66.5842	61.1386	67.0792	69.3069	71.0396	65.099	63.639
10	55.9406	57.6733	64.8515	63.8614	67.8218	61.3861	70.5446	73.5149	71.0396	68.5644	65.52
11	55.9406	59.6535	65.8416	68.3168	68.0693	67.5743	76.9802	77.2277	71.2871	70.297	68.119
12	55.9406	59.901	66.0891	69.0594	68.0693	67.5743	78.2178	77.2277	73.2673	72.2772	68.762
13	61.3861	59.901	70.297	69.0594	68.0693	69.5545	79.9505	77.2277	75.495	73.7624	70.47
14	61.3861	66.8317	70.297	69.0594	68.0693	72.2772	79.9505	77.2277	75.495	75.9901	71.658
15	61.8812	66.8317	72.2772	73.7624	68.5644	72.2772	81.6832	79.9505	77.2277	76.2376	73.069
16	63.6139	72.5248	73.5149	74.0099	68.5644	73.2673	81.9307	80.9406	77.2277	77.9703	74.356
17	63.6139	72.5248	76.2376	74.0099	71.5347	73.7624	81.9307	83.4158	77.2277	78.2178	75.248
18	64.1089	78.2178	76.4851	75.7426	72.7723	75	82.4257	83.4158	82.9208	78.2178	76.931
19	64.1089	78.2178	78.7129	78.4653	72.7723	75	82.4257	83.4158	83.1683	79.703	77.599
20	65.3465	78.2178	78.7129	78.4653	72.7723	75	82.4257	83.6634	83.4158	79.703	77.772
21	65.3465	80.4455	78.7129	78.4653	73.2673	75.2475	82.6733	83.6634	83.6634	79.703	78.119
22	65.3465	81.1881	78.9604	78.4653	78.9604	75.2475	83.6634	83.6634	83.6634	79.703	78.886
23	65.3465	81.1881	78.9604	78.4653	80.4455	75.9901	84.6535	83.6634	85.8911	79.9505	79.455
24	65.8416	81.4356	78.9604	78.4653	80.4455	75.9901	84.6535	83.6634	85.8911	80.198	79.554
25	66.5842	82.1782	78.9604	79.9505	80.4455	76.7327	85.8911	83.6634	88.6139	80.4455	80.347
26	66.5842	82.1782	81.1881	79.9505	81.6832	78.7129	86.1386	88.1188	88.6139	80.4455	81.361
27	66.5842	82.1782	81.1881	81.1881	82.1782	81.4356	86.1386	88.1188	88.8614	81.1881	81.906
28	67.3267	82.1782	81.4356	82.4257	83.6634	81.9307	86.1386	88.1188	88.8614	81.1881	82.327
29	68.0693	82.1782	81.4356	86.8812	84.901	81.9307	86.3861	88.1188	88.8614	81.1881	82.995

30	68.0693	82.6733	83.1683	87.1287	85.1485	82.1782	87.6238	88.1188	89.604	86.8812	84.059
31	74.0099	82.6733	83.6634	88.3663	85.1485	82.1782	87.6238	88.1188	89.604	86.8812	84.827
32	74.0099	82.6733	84.6535	88.6139	85.1485	82.9208	87.6238	89.1089	89.604	86.8812	85.124
33	75.2475	82.6733	84.6535	88.6139	85.1485	83.9109	87.6238	89.8515	89.604	86.8812	85.421
34	75.2475	83.1683	88.3663	88.8614	86.1386	83.9109	89.3564	90.099	90.099	86.8812	86.213
35	77.7228	83.1683	88.3663	88.8614	86.1386	83.9109	89.3564	90.099	90.099	87.1287	86.485
36	78.4653	85.1485	88.3663	88.8614	86.6337	83.9109	89.3564	91.0891	90.099	89.604	87.153
37	79.2079	87.8713	88.3663	88.8614	87.3762	83.9109	89.3564	91.0891	90.099	90.099	87.624
38	82.4257	88.8614	88.3663	88.8614	87.6238	83.9109	89.3564	91.0891	90.099	90.3465	88.094
39	82.9208	88.8614	92.0792	89.1089	87.6238	83.9109	89.8515	91.3366	90.099	90.3465	88.614
40	82.9208	89.604	92.0792	89.604	87.6238	83.9109	89.8515	91.3366	90.099	90.3465	88.738
41	82.9208	89.8515	92.3267	89.8515	87.6238	83.9109	90.099	93.5644	90.099	92.8218	89.307
42	82.9208	89.8515	92.3267	89.8515	87.6238	85.1485	90.099	93.5644	90.099	92.8218	89.431
43	83.6634	89.8515	92.3267	90.099	87.6238	85.1485	90.099	93.5644	90.099	92.8218	89.53
44	83.6634	89.8515	92.3267	90.099	87.6238	85.1485	90.099	93.5644	90.099	92.8218	89.53
45	83.6634	89.8515	92.3267	90.099	87.6238	85.1485	91.5842	93.5644	91.8317	92.8218	89.852
46	83.6634	89.8515	92.3267	90.099	87.6238	85.1485	92.3267	93.5644	91.8317	92.8218	89.926
47	84.4059	91.0891	92.3267	90.099	87.6238	85.1485	92.3267	93.5644	91.8317	93.0693	90.149
48	84.6535	91.0891	92.3267	90.099	87.6238	85.6436	92.3267	93.5644	91.8317	93.3168	90.248
49	84.6535	92.0792	92.3267	90.099	87.6238	85.6436	93.0693	93.5644	91.8317	93.3168	90.421
50	85.6436	92.0792	92.3267	91.3366	87.6238	85.6436	93.0693	93.5644	91.8317	93.3168	90.644
51	85.6436	92.0792	92.3267	91.5842	88.1188	85.6436	93.0693	93.5644	91.8317	93.3168	90.718
52	85.8911	92.0792	92.3267	91.5842	89.8515	85.6436	93.0693	93.5644	91.8317	93.3168	90.916
53	85.8911	92.0792	92.3267	91.5842	89.8515	85.6436	93.0693	93.5644	92.0792	93.3168	90.941
54	86.3861	92.0792	92.3267	91.5842	89.8515	85.6436	93.0693	94.0594	92.0792	93.3168	91.04
55	87.3762	92.0792	92.3267	91.5842	91.3366	85.6436	93.0693	94.0594	92.0792	94.0594	91.361
56	87.3762	92.0792	92.3267	91.5842	92.8218	85.6436	93.0693	94.0594	92.0792	94.0594	91.51
57	87.3762	92.0792	92.3267	91.5842	93.5644	85.6436	93.0693	94.0594	93.8119	94.0594	91.757
58	87.3762	92.8218	92.3267	91.5842	93.5644	85.8911	93.0693	94.3069	93.8119	94.0594	91.881

59	87.3762	92.8218	92.3267	92.0792	93.5644	85.8911	93.0693	94.3069	93.8119	94.0594	91.931
60	87.3762	92.8218	92.5743	92.0792	93.5644	85.8911	93.0693	94.3069	93.8119	94.0594	91.955
61	87.3762	92.8218	92.5743	92.0792	93.5644	85.8911	93.0693	94.3069	93.8119	94.0594	91.955
62	87.6238	92.8218	93.5644	92.0792	93.5644	88.3663	93.3168	94.3069	94.5545	94.0594	92.426
63	88.3663	92.8218	94.3069	92.0792	93.5644	88.3663	94.0594	94.3069	94.802	94.5545	92.723
64	88.3663	92.8218	94.3069	92.0792	93.8119	88.3663	94.0594	94.3069	94.802	95.5446	92.847
65	88.3663	92.8218	94.3069	92.0792	93.8119	88.3663	94.0594	94.3069	94.802	95.5446	92.847
66	88.3663	94.0594	94.3069	92.0792	93.8119	88.3663	94.0594	94.802	94.802	95.5446	93.02
67	88.3663	94.0594	94.3069	92.0792	93.8119	88.3663	94.0594	94.802	94.802	96.5347	93.119
68	88.3663	94.0594	94.802	92.0792	93.8119	88.3663	94.0594	94.802	94.802	96.5347	93.168
69	88.3663	94.0594	94.802	92.3267	93.8119	88.3663	94.0594	96.5347	94.802	96.5347	93.366
70	88.3663	94.0594	94.802	92.3267	93.8119	88.3663	94.3069	96.5347	94.802	96.7822	93.416
71	88.3663	94.0594	94.802	92.3267	96.7822	88.3663	94.3069	96.7822	95.0495	96.7822	93.762
72	88.3663	94.0594	94.802	92.3267	96.7822	88.3663	94.3069	96.7822	95.0495	96.7822	93.762
73	88.3663	94.0594	94.802	92.3267	96.7822	88.3663	94.3069	96.7822	95.0495	96.7822	93.762
74	88.3663	94.0594	94.802	92.3267	96.7822	91.8317	94.3069	96.7822	95.0495	96.7822	94.109
75	88.3663	94.0594	95.0495	92.3267	96.7822	92.5743	94.3069	96.7822	95.0495	96.7822	94.208
76	88.3663	94.0594	95.0495	92.3267	96.7822	92.8218	94.3069	96.7822	95.0495	96.7822	94.233
77	88.3663	94.0594	95.5446	92.3267	96.7822	92.8218	94.3069	96.7822	95.0495	96.7822	94.282
78	88.3663	94.0594	95.5446	92.3267	96.7822	92.8218	94.3069	96.7822	95.0495	97.0297	94.307
79	88.3663	94.0594	95.5446	92.3267	96.7822	92.8218	94.3069	96.7822	95.0495	97.0297	94.307
80	88.3663	94.0594	95.5446	92.3267	96.7822	92.8218	94.3069	96.7822	95.0495	97.0297	94.307
81	88.3663	94.0594	95.5446	92.3267	96.7822	92.8218	94.3069	96.7822	95.0495	97.0297	94.307
82	88.3663	94.0594	96.2871	92.3267	96.7822	92.8218	94.3069	96.7822	95.0495	97.0297	94.381
83	88.3663	94.0594	96.2871	92.3267	96.7822	93.0693	94.3069	96.7822	95.0495	97.0297	94.406
84	88.6139	94.0594	96.2871	92.3267	96.7822	93.0693	94.3069	96.7822	95.0495	97.0297	94.431
85	88.6139	94.0594	96.2871	92.3267	96.7822	93.0693	94.3069	96.7822	95.0495	97.0297	94.431
86	88.6139	94.0594	96.2871	92.3267	96.7822	93.0693	94.3069	96.7822	95.0495	98.7624	94.604
87	88.6139	94.0594	97.0297	92.3267	96.7822	93.0693	94.3069	96.7822	95.0495	98.7624	94.678

88	88.6139	94.0594	97.0297	92.3267	96.7822	93.0693	94.3069	96.7822	95.297	98.7624	94.703
89	88.8614	94.0594	97.0297	92.3267	96.7822	93.0693	94.3069	96.7822	95.297	98.7624	94.728
90	88.8614	94.0594	97.0297	92.3267	96.7822	93.0693	94.3069	96.7822	95.297	98.7624	94.728
91	88.8614	94.0594	97.0297	92.3267	96.7822	93.0693	94.3069	96.7822	95.5446	98.7624	94.752
92	88.8614	94.0594	97.0297	92.3267	96.7822	93.0693	94.3069	96.7822	95.5446	98.7624	94.752
93	88.8614	94.0594	97.0297	93.5644	96.7822	93.0693	94.3069	96.7822	95.5446	98.7624	94.876
94	88.8614	94.0594	97.0297	93.5644	96.7822	93.0693	94.3069	96.7822	95.5446	98.7624	94.876
95	88.8614	94.0594	97.0297	93.5644	96.7822	93.0693	95.5446	96.7822	95.5446	98.7624	95
96	88.8614	94.0594	97.0297	93.5644	96.7822	93.0693	96.7822	96.7822	95.5446	98.7624	95.124
97	88.8614	94.0594	97.0297	93.5644	96.7822	93.0693	96.7822	96.7822	95.5446	98.7624	95.124
98	88.8614	94.0594	97.0297	93.5644	96.7822	93.0693	96.7822	96.7822	95.5446	98.7624	95.124
99	88.8614	94.0594	97.0297	93.8119	96.7822	93.0693	96.7822	97.5248	95.5446	98.7624	95.223
100	88.8614	94.0594	97.0297	93.8119	96.7822	93.0693	96.7822	97.5248	95.5446	98.7624	95.223

Netlist: s344f_2.txt

	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10	Average of all runs
Test vectors run	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %
1	34.7368	33.9474	21.5789	35.5263	22.1053	20	33.9474	20	20	27.1053	26.895
2	48.6842	52.1053	25.2632	42.1053	32.3684	49.2105	48.4211	38.1579	32.6316	38.9474	40.789
3	60	62.1053	31.5789	44.2105	51.8421	58.1579	50	43.9474	53.4211	56.3158	51.158
4	70.5263	65.7895	52.3684	59.4737	52.6316	64.4737	60.5263	62.3684	56.5789	70	61.474
5	74.7368	69.4737	62.8947	68.1579	63.4211	77.6316	62.1053	63.9474	66.3158	75.5263	68.421
6	78.4211	77.3684	69.4737	69.4737	64.4737	80	62.6316	71.3158	68.9474	75.5263	71.763
7	78.4211	81.8421	71.8421	71.5789	74.2105	82.1053	74.7368	71.3158	70.5263	76.0526	75.263
8	78.4211	81.8421	72.1053	71.8421	77.6316	83.4211	80	74.7368	73.9474	77.3684	77.132
9	82.3684	82.1053	82.1053	73.4211	77.6316	87.3684	82.8947	83.4211	75	81.8421	80.816

10	83.4211	82.6316	82.1053	73.9474	77.6316	87.6316	84.2105	83.4211	75	82.8947	81.289
11	83.4211	82.6316	84.2105	73.9474	78.6842	87.6316	87.3684	83.4211	76.0526	83.6842	82.105
12	83.4211	82.6316	84.2105	75.5263	78.6842	88.1579	88.6842	84.4737	80.7895	85.7895	83.237
13	83.4211	82.8947	87.8947	83.4211	79.2105	88.1579	88.6842	88.4211	80.7895	87.8947	85.079
14	83.4211	82.8947	88.9474	87.6316	80.7895	89.7368	91.5789	88.4211	81.5789	90.2632	86.526
15	84.7368	82.8947	91.0526	87.6316	80.7895	89.7368	91.5789	92.3684	87.1053	90.2632	87.816
16	87.1053	83.9474	93.6842	87.6316	80.7895	89.7368	91.5789	93.4211	87.8947	90.7895	88.658
17	88.6842	83.9474	93.6842	87.6316	82.3684	90.2632	92.3684	93.4211	89.4737	90.7895	89.263
18	88.6842	83.9474	94.2105	88.6842	82.6316	91.3158	92.3684	93.4211	89.4737	90.7895	89.553
19	88.6842	83.9474	94.4737	88.6842	83.6842	93.1579	92.3684	93.6842	89.4737	91.0526	89.921
20	88.6842	86.3158	95.5263	88.6842	83.6842	93.1579	92.3684	94.4737	89.4737	91.0526	90.342
21	88.6842	86.3158	95.7895	89.2105	84.7368	93.1579	92.3684	94.4737	90.5263	92.6316	90.789
22	88.6842	91.0526	96.3158	89.2105	84.7368	93.1579	92.3684	94.4737	90.5263	92.8947	91.342
23	88.6842	91.0526	96.3158	90.7895	89.7368	93.1579	92.8947	94.4737	90.7895	92.8947	92.079
24	88.6842	91.0526	96.3158	90.7895	89.7368	93.1579	92.8947	94.4737	90.7895	92.8947	92.079
25	88.9474	91.0526	96.8421	93.9474	89.7368	93.1579	92.8947	94.4737	90.7895	93.1579	92.5
26	88.9474	91.0526	96.8421	94.4737	89.7368	93.1579	94.2105	96.3158	91.3158	93.1579	92.921
27	92.3684	92.8947	97.1053	94.4737	89.7368	93.1579	94.2105	96.3158	91.3158	93.4211	93.5
28	93.1579	93.9474	97.1053	94.4737	89.7368	93.1579	94.2105	96.3158	91.3158	93.4211	93.684
29	93.4211	93.9474	98.4211	94.4737	91.5789	93.1579	94.4737	96.3158	91.8421	93.4211	94.105
30	93.9474	93.9474	98.4211	94.4737	92.6316	93.9474	95.5263	96.3158	93.9474	93.4211	94.658
31	94.2105	93.9474	98.4211	94.4737	93.6842	93.9474	96.3158	96.3158	94.7368	93.4211	94.947
32	94.2105	93.9474	98.4211	95	93.6842	93.9474	97.1053	96.3158	94.7368	94.4737	95.184
33	94.4737	94.2105	98.4211	95	93.6842	93.9474	97.1053	96.3158	94.7368	94.7368	95.263
34	94.7368	94.2105	98.4211	95.7895	93.6842	93.9474	97.1053	96.3158	96.3158	94.7368	95.526
35	94.7368	94.2105	98.4211	95.7895	95.2632	93.9474	97.1053	96.3158	96.3158	94.7368	95.684
36	94.7368	94.2105	98.4211	96.5789	95.2632	93.9474	97.1053	96.3158	96.8421	94.7368	95.816
37	96.3158	94.2105	98.4211	96.5789	95.2632	93.9474	97.1053	96.3158	98.1579	94.7368	96.105
38	96.3158	94.2105	98.4211	96.5789	95.2632	93.9474	97.1053	97.3684	98.1579	94.7368	96.211

39	96.3158	94.2105	98.4211	96.5789	95.7895	93.9474	97.1053	97.3684	98.1579	94.7368	96.263
40	96.3158	94.2105	98.4211	97.1053	96.0526	93.9474	97.1053	97.3684	98.1579	94.7368	96.342
41	96.5789	94.2105	98.6842	97.6316	96.3158	93.9474	97.1053	97.3684	98.1579	94.7368	96.474
42	97.6316	94.4737	98.9474	97.6316	96.3158	93.9474	97.1053	97.6316	98.4211	94.7368	96.684
43	98.4211	94.4737	98.9474	97.6316	96.3158	93.9474	97.1053	97.6316	98.4211	94.7368	96.763
44	98.4211	96.8421	98.9474	97.6316	97.8947	95	97.1053	97.6316	98.4211	94.7368	97.263
45	98.4211	96.8421	98.9474	97.6316	97.8947	95.2632	97.3684	97.6316	98.4211	94.7368	97.316
46	98.4211	96.8421	98.9474	97.6316	97.8947	95.2632	97.3684	97.6316	98.4211	95.5263	97.395
47	98.9474	96.8421	98.9474	98.1579	97.8947	95.2632	97.3684	98.4211	98.4211	95.5263	97.579
48	98.9474	96.8421	98.9474	98.1579	97.8947	95.2632	97.3684	98.4211	98.4211	95.5263	97.579
49	98.9474	96.8421	98.9474	98.1579	97.8947	95.7895	97.3684	98.4211	98.4211	95.5263	97.632
50	98.9474	96.8421	98.9474	98.1579	97.8947	97.6316	98.6842	98.4211	98.4211	95.5263	97.947
51	98.9474	96.8421	98.9474	98.1579	97.8947	97.6316	98.6842	98.4211	98.4211	95.5263	97.947
52	99.2105	96.8421	98.9474	98.1579	97.8947	97.6316	98.6842	98.4211	98.4211	95.5263	97.974
53	99.2105	96.8421	98.9474	98.1579	97.8947	97.6316	98.6842	98.4211	98.6842	95.5263	98
54	99.2105	96.8421	98.9474	98.1579	97.8947	97.6316	98.6842	98.4211	98.9474	95.5263	98.026
55	99.2105	96.8421	98.9474	98.6842	97.8947	97.6316	98.6842	98.4211	98.9474	95.5263	98.079
56	99.2105	96.8421	98.9474	98.6842	97.8947	97.6316	98.6842	98.4211	98.9474	95.5263	98.079
57	99.2105	96.8421	98.9474	98.6842	97.8947	98.4211	98.6842	98.4211	98.9474	95.5263	98.158
58	99.2105	96.8421	98.9474	98.6842	97.8947	98.4211	98.6842	98.4211	98.9474	95.5263	98.158
59	99.2105	96.8421	98.9474	98.6842	97.8947	98.4211	98.6842	98.4211	98.9474	95.5263	98.158
60	99.2105	96.8421	98.9474	98.6842	97.8947	98.4211	98.6842	98.6842	98.9474	95.5263	98.184
61	99.2105	97.3684	98.9474	98.6842	97.8947	98.4211	98.6842	98.6842	98.9474	95.5263	98.237
62	99.2105	97.3684	98.9474	98.6842	97.8947	98.4211	98.6842	98.6842	98.9474	95.5263	98.237
63	99.2105	97.3684	98.9474	98.6842	97.8947	98.4211	98.9474	98.6842	98.9474	95.5263	98.263
64	99.2105	97.3684	98.9474	98.6842	97.8947	98.6842	98.9474	98.9474	98.9474	95.5263	98.316
65	99.2105	97.3684	98.9474	98.6842	97.8947	98.6842	98.9474	98.9474	98.9474	95.5263	98.316
66	99.2105	97.3684	98.9474	98.6842	97.8947	98.6842	98.9474	98.9474	98.9474	97.1053	98.474
67	99.2105	97.3684	98.9474	98.6842	97.8947	98.6842	99.2105	98.9474	98.9474	97.1053	98.5

68	99.2105	97.3684	98.9474	98.6842	97.8947	98.6842	99.7368	98.9474	98.9474	97.1053	98.553
69	99.2105	97.3684	98.9474	98.6842	97.8947	98.6842	99.7368	98.9474	98.9474	97.1053	98.553
70	99.7368	97.3684	98.9474	98.6842	97.8947	98.6842	99.7368	98.9474	98.9474	97.1053	98.605
71	99.7368	97.3684	98.9474	98.6842	97.8947	98.6842	99.7368	98.9474	98.9474	97.1053	98.605
72	99.7368	97.3684	98.9474	99.7368	97.8947	98.6842	99.7368	98.9474	98.9474	97.1053	98.711
73	99.7368	97.3684	100	99.7368	97.8947	98.6842	99.7368	98.9474	98.9474	97.1053	98.816
74	99.7368	97.3684	100	99.7368	97.8947	98.6842	99.7368	98.9474	98.9474	97.1053	98.816
75	99.7368	97.3684	100	99.7368	97.8947	98.6842	99.7368	98.9474	98.9474	97.6316	98.868
76	99.7368	97.3684	100	99.7368	97.8947	98.6842	99.7368	98.9474	98.9474	97.6316	98.868
77	99.7368	97.3684	100	99.7368	97.8947	98.6842	99.7368	99.4737	98.9474	97.6316	98.921
78	99.7368	97.3684	100	99.7368	97.8947	98.6842	99.7368	99.4737	98.9474	97.6316	98.921
79	99.7368	97.3684	100	99.7368	97.8947	98.6842	99.7368	99.4737	98.9474	97.6316	98.921
80	99.7368	97.3684	100	99.7368	97.8947	98.6842	99.7368	99.4737	98.9474	97.6316	98.921
81	99.7368	97.3684	100	99.7368	97.8947	98.6842	99.7368	99.4737	98.9474	97.6316	98.921
82	99.7368	97.3684	100	99.7368	97.8947	98.6842	99.7368	99.4737	98.9474	97.8947	98.947
83	99.7368	98.6842	100	99.7368	97.8947	98.6842	99.7368	99.4737	98.9474	97.8947	99.079
84	99.7368	98.6842	100	99.7368	97.8947	98.6842	99.7368	99.4737	98.9474	97.8947	99.079
85	99.7368	98.6842	100	99.7368	97.8947	98.6842	99.7368	99.4737	98.9474	97.8947	99.079
86	99.7368	98.6842	100	99.7368	97.8947	98.6842	99.7368	99.4737	98.9474	98.4211	99.132
87	99.7368	98.6842	100	99.7368	98.1579	98.6842	99.7368	99.4737	98.9474	98.4211	99.158
88	99.7368	98.6842	100	99.7368	98.1579	98.6842	99.7368	99.4737	98.9474	98.4211	99.158
89	99.7368	98.6842	100	99.7368	98.1579	98.6842	99.7368	99.4737	98.9474	98.4211	99.158
90	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	98.9474	98.4211	99.184
91	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	98.9474	98.4211	99.184
92	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	98.9474	98.4211	99.184
93	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	98.9474	98.4211	99.184
94	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	98.9474	98.4211	99.184
95	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	98.9474	98.6842	99.211
96	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	98.9474	98.6842	99.211

97	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	98.9474	98.6842	99.211
98	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	98.9474	98.6842	99.211
99	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	99.2105	98.6842	99.237
100	99.7368	98.6842	100	99.7368	98.4211	98.6842	99.7368	99.4737	100	98.6842	99.316

Netlist: s349f_2.txt

	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10	Average of all runs
Test vectors run	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %	Fault Coverage %
1	26.7196	27.5132	25.9259	18.5185	34.6561	21.9577	35.1852	19.8413	35.1852	26.455	27.196
2	41.2698	39.9471	34.9206	46.8254	44.1799	29.8942	44.9735	28.0423	52.9101	48.6772	41.164
3	47.8836	48.9418	59.5238	57.1429	46.8254	38.6243	52.381	48.4127	57.9365	57.9365	51.561
4	48.6772	50.7937	67.1958	61.1111	61.1111	58.4656	54.7619	60.3175	64.5503	61.9048	58.889
5	48.9418	51.3228	79.1005	61.3757	68.254	59.7884	57.672	63.4921	64.5503	70.6349	62.513
6	51.3228	53.1746	79.3651	62.6984	69.0476	63.7566	65.0794	66.6667	72.2222	71.6931	65.503
7	64.5503	55.8201	82.5397	70.8995	76.1905	64.0212	76.1905	73.545	73.2804	73.545	71.058
8	69.8413	69.8413	82.8042	71.6931	80.1587	66.6667	77.2487	76.455	73.2804	74.6032	74.259
9	78.0423	71.4286	85.1852	71.9577	85.1852	66.6667	80.1587	81.746	74.8677	76.7196	77.196
10	78.0423	73.545	86.7725	71.9577	85.1852	66.9312	80.1587	81.746	76.1905	76.9841	77.751
11	78.5714	74.8677	89.1534	77.2487	88.3598	67.1958	82.0106	81.746	83.0688	80.6878	80.291
12	79.6296	75.1323	89.1534	77.2487	88.8889	67.1958	82.0106	85.7143	87.5661	80.6878	81.323
13	82.8042	75.1323	89.1534	78.836	88.8889	78.5714	82.0106	85.7143	87.5661	87.037	83.571
14	82.8042	75.1323	89.418	81.4815	91.2698	78.836	82.0106	85.9788	90.2116	87.5661	84.471
15	82.8042	75.1323	89.9471	81.746	91.7989	78.836	82.0106	85.9788	92.8571	87.5661	84.868
16	82.8042	79.8942	89.9471	81.746	93.9153	80.9524	87.3016	90.4762	92.8571	90.7407	87.063
17	84.6561	79.8942	89.9471	86.5079	93.9153	80.9524	87.3016	91.2698	93.3862	91.0053	87.884
18	84.6561	79.8942	91.5344	86.5079	93.9153	87.3016	87.3016	91.2698	93.3862	91.0053	88.677

19	84.6561	79.8942	92.8571	86.5079	94.4444	88.3598	87.3016	91.2698	93.6508	91.0053	88.995
20	89.1534	79.8942	94.4444	87.5661	95.5026	88.3598	87.3016	91.5344	94.1799	91.0053	89.894
21	90.2116	80.1587	94.4444	87.5661	95.5026	88.6243	87.3016	91.5344	94.1799	91.0053	90.053
22	90.4762	80.1587	94.4444	87.5661	95.5026	88.6243	87.3016	92.5926	94.1799	91.2698	90.212
23	90.4762	85.4497	94.4444	87.5661	95.5026	89.1534	89.1534	92.5926	94.1799	91.2698	90.979
24	90.4762	85.4497	94.4444	88.0952	95.5026	89.1534	91.7989	93.3862	94.1799	91.2698	91.376
25	90.4762	85.7143	94.4444	90.4762	96.5608	89.1534	94.1799	93.3862	94.1799	93.1217	92.169
26	90.4762	86.7725	94.4444	91.7989	96.5608	89.1534	96.0317	96.0317	94.1799	93.1217	92.857
27	90.4762	86.7725	94.4444	91.7989	97.0899	89.6825	96.0317	96.0317	94.1799	93.1217	92.963
28	90.4762	87.3016	94.709	91.7989	97.0899	89.6825	96.0317	96.0317	94.1799	94.4444	93.175
29	90.4762	87.3016	94.709	91.7989	97.0899	91.0053	96.0317	96.0317	94.4444	94.4444	93.333
30	91.0053	87.3016	94.709	91.7989	97.0899	92.328	96.0317	96.0317	94.4444	94.4444	93.518
31	91.0053	87.3016	94.9735	91.7989	97.3545	93.9153	96.0317	96.0317	94.4444	94.4444	93.73
32	91.2698	87.3016	94.9735	91.7989	97.3545	93.9153	96.0317	96.0317	94.4444	94.4444	93.757
33	94.709	87.3016	94.9735	92.328	97.3545	93.9153	96.0317	97.0899	94.4444	94.709	94.286
34	94.9735	87.3016	94.9735	92.328	97.3545	93.9153	96.0317	97.0899	94.4444	94.709	94.312
35	94.9735	87.3016	94.9735	92.328	97.3545	93.9153	96.0317	97.0899	94.4444	94.709	94.312
36	94.9735	91.5344	94.9735	92.328	97.3545	94.4444	96.0317	97.0899	94.4444	94.709	94.788
37	94.9735	91.5344	94.9735	92.328	98.1481	94.9735	96.0317	97.0899	94.4444	94.709	94.921
38	94.9735	91.5344	94.9735	92.5926	98.1481	94.9735	96.0317	97.3545	94.4444	94.709	94.974
39	94.9735	91.5344	94.9735	92.5926	98.1481	96.2963	96.0317	97.3545	94.4444	94.709	95.106
40	94.9735	91.5344	94.9735	92.5926	98.1481	96.2963	96.0317	97.3545	94.4444	94.709	95.106
41	94.9735	91.5344	96.0317	92.5926	98.1481	97.8836	96.0317	97.3545	94.4444	96.0317	95.503
42	94.9735	91.5344	96.2963	92.5926	98.1481	97.8836	96.0317	97.3545	96.0317	96.0317	95.688
43	94.9735	91.5344	96.2963	92.5926	98.1481	97.8836	96.0317	97.3545	96.0317	96.0317	95.688
44	94.9735	92.8571	96.2963	93.1217	98.1481	97.8836	96.0317	97.3545	96.0317	96.0317	95.873
45	94.9735	92.8571	96.2963	93.1217	98.1481	97.8836	96.0317	97.3545	96.0317	96.0317	95.873
46	94.9735	92.8571	96.2963	93.1217	98.1481	97.8836	96.0317	97.3545	96.8254	96.0317	95.952
47	94.9735	92.8571	96.2963	94.1799	98.1481	97.8836	96.2963	97.3545	96.8254	96.0317	96.085

48	94.9735	92.8571	96.2963	94.1799	98.1481	97.8836	96.2963	97.3545	97.3545	97.0899	96.243
49	94.9735	92.8571	96.2963	94.1799	98.1481	97.8836	96.2963	97.3545	97.3545	97.0899	96.243
50	96.2963	92.8571	96.2963	94.1799	98.1481	97.8836	96.2963	97.3545	97.3545	97.0899	96.376
51	96.2963	92.8571	96.2963	94.1799	98.4127	97.8836	96.2963	97.3545	97.3545	97.0899	96.402
52	96.2963	92.8571	96.5608	94.1799	98.4127	97.8836	96.8254	97.3545	97.3545	97.0899	96.481
53	96.2963	93.3862	96.5608	94.1799	98.4127	97.8836	96.8254	97.3545	97.3545	97.0899	96.534
54	97.619	93.3862	96.5608	94.1799	98.4127	97.8836	96.8254	97.3545	97.8836	97.0899	96.72
55	97.8836	93.3862	96.8254	94.1799	98.4127	97.8836	96.8254	98.4127	97.8836	97.0899	96.878
56	97.8836	93.3862	96.8254	94.4444	98.4127	97.8836	96.8254	98.4127	97.8836	97.0899	96.905
57	97.8836	93.9153	96.8254	94.4444	98.4127	97.8836	96.8254	98.4127	97.8836	97.0899	96.958
58	97.8836	93.9153	96.8254	94.4444	98.4127	97.8836	96.8254	98.4127	97.8836	97.8836	97.037
59	97.8836	93.9153	96.8254	94.4444	98.4127	97.8836	96.8254	98.4127	97.8836	97.8836	97.037
60	97.8836	93.9153	96.8254	94.4444	98.4127	97.8836	97.0899	98.9418	97.8836	97.8836	97.116
61	98.1481	93.9153	96.8254	94.4444	98.6772	98.1481	97.0899	98.9418	97.8836	97.8836	97.196
62	98.1481	93.9153	96.8254	94.4444	98.6772	98.4127	97.0899	98.9418	97.8836	97.8836	97.222
63	98.1481	94.9735	96.8254	94.4444	98.6772	98.4127	97.0899	98.9418	97.8836	98.6772	97.407
64	98.1481	94.9735	96.8254	94.4444	98.6772	98.4127	97.3545	98.9418	97.8836	98.6772	97.434
65	98.1481	94.9735	96.8254	94.4444	98.6772	98.4127	97.3545	98.9418	97.8836	98.6772	97.434
66	98.1481	96.2963	96.8254	94.4444	98.6772	98.4127	97.3545	98.9418	97.8836	98.9418	97.593
67	98.1481	96.2963	96.8254	94.9735	98.6772	98.4127	97.3545	98.9418	97.8836	98.9418	97.645
68	98.4127	97.3545	96.8254	95.7672	98.6772	98.4127	97.3545	98.9418	97.8836	98.9418	97.857
69	98.4127	97.3545	96.8254	95.7672	98.6772	98.4127	97.3545	99.2063	97.8836	98.9418	97.884
70	98.4127	97.3545	96.8254	95.7672	98.6772	98.4127	97.3545	99.2063	97.8836	98.9418	97.884
71	98.6772	97.3545	97.0899	95.7672	98.9418	98.4127	97.3545	99.2063	97.8836	98.9418	97.963
72	98.6772	97.3545	97.0899	95.7672	98.9418	98.4127	97.3545	99.2063	97.8836	98.9418	97.963
73	98.6772	97.619	97.0899	95.7672	98.9418	98.4127	97.3545	99.2063	97.8836	98.9418	97.989
74	98.6772	97.619	97.0899	95.7672	98.9418	98.4127	97.3545	99.2063	97.8836	98.9418	97.989
75	98.6772	97.619	97.0899	96.0317	98.9418	98.4127	97.3545	99.2063	97.8836	98.9418	98.016
76	98.6772	97.619	97.0899	97.3545	98.9418	98.4127	97.3545	99.2063	97.8836	98.9418	98.148

77	98.6772	97.619	97.0899	97.3545	98.9418	98.4127	97.3545	99.2063	97.8836	98.9418	98.148
78	98.6772	97.619	97.0899	97.3545	98.9418	98.4127	97.619	99.2063	97.8836	98.9418	98.175
79	98.6772	97.619	97.3545	97.3545	98.9418	98.4127	98.6772	99.2063	97.8836	98.9418	98.307
80	98.6772	97.619	97.3545	97.3545	98.9418	98.4127	98.6772	99.2063	97.8836	98.9418	98.307
81	98.6772	97.619	97.3545	98.1481	98.9418	98.4127	98.6772	99.2063	97.8836	98.9418	98.386
82	98.6772	97.619	97.3545	98.1481	99.2063	98.6772	98.6772	99.4709	97.8836	98.9418	98.466
83	98.6772	97.619	97.3545	98.1481	99.2063	98.9418	98.6772	99.4709	97.8836	98.9418	98.492
84	98.6772	97.619	97.3545	98.9418	99.2063	98.9418	98.6772	99.4709	97.8836	98.9418	98.571
85	98.6772	97.619	97.3545	98.9418	99.2063	98.9418	98.6772	99.4709	97.8836	98.9418	98.571
86	99.4709	97.619	97.3545	98.9418	99.2063	98.9418	98.6772	99.4709	97.8836	98.9418	98.651
87	99.4709	97.619	97.3545	98.9418	99.2063	98.9418	98.6772	99.4709	97.8836	98.9418	98.651
88	99.4709	97.619	97.3545	98.9418	99.2063	98.9418	98.6772	99.4709	97.8836	98.9418	98.651
89	99.4709	97.619	97.3545	99.2063	99.2063	98.9418	98.6772	99.4709	97.8836	98.9418	98.677
90	99.4709	97.619	97.3545	99.2063	99.2063	98.9418	98.6772	99.4709	97.8836	98.9418	98.677
91	99.4709	97.619	98.4127	99.2063	99.2063	98.9418	98.6772	99.4709	97.8836	98.9418	98.783
92	99.4709	97.619	98.4127	99.2063	99.2063	98.9418	98.6772	99.4709	98.4127	98.9418	98.836
93	99.4709	97.619	98.4127	99.2063	99.2063	98.9418	98.6772	99.4709	98.4127	98.9418	98.836
94	99.4709	97.619	99.2063	99.2063	99.2063	98.9418	98.6772	99.4709	98.4127	98.9418	98.915
95	99.4709	97.619	99.2063	99.2063	99.2063	98.9418	98.6772	99.4709	98.4127	98.9418	98.915
96	99.4709	97.8836	99.2063	99.2063	99.2063	98.9418	98.6772	99.4709	98.4127	98.9418	98.942
97	99.4709	97.8836	99.2063	99.2063	99.2063	98.9418	98.6772	99.4709	98.4127	98.9418	98.942
98	99.4709	97.8836	99.2063	99.2063	99.2063	98.9418	98.6772	99.4709	98.4127	98.9418	98.942
99	99.4709	97.8836	99.2063	99.2063	99.2063	98.9418	98.9418	99.4709	98.4127	99.7354	99.048
100	99.4709	97.8836	99.2063	99.2063	99.2063	98.9418	98.9418	99.4709	98.4127	99.7354	99.048