

## ECEN 714 LAB 7

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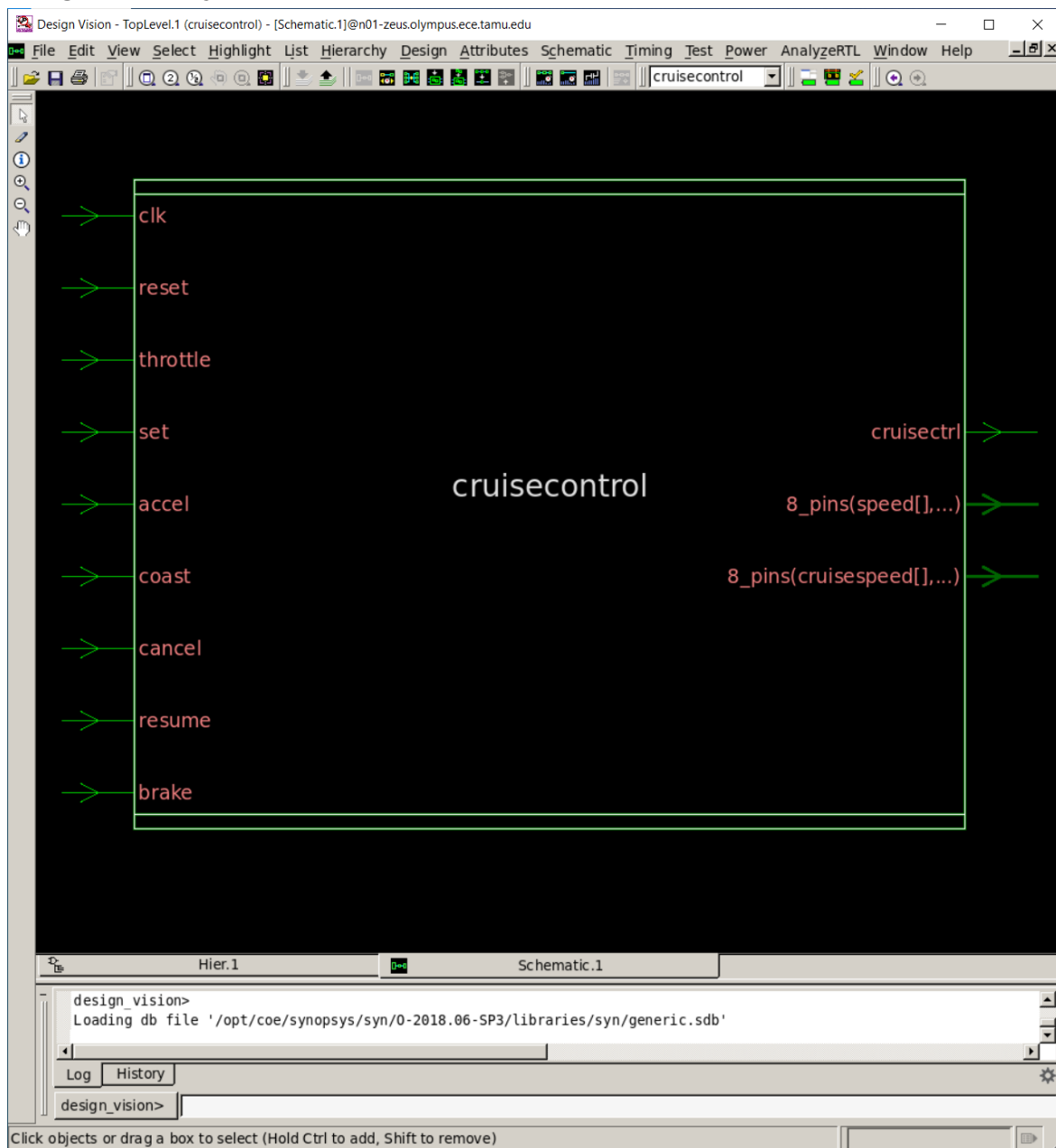
UIN: 234008126

Lab section: 507/607 Tuesday 19:00

TA: Shejuti Shehreen

### Part A: Logic Synthesis

#### Design Vision Symbol



## Constraint Report

The screenshot displays the Design Vision software interface. The main window shows a report titled "Report : constraint" with the following details:

- Report : constraint
- all\_violators
- verbose
- Design : cruisecontrol
- Version: 0-2018.06-SP3
- Date : Tue Oct 24 14:12:20 2023

The report concludes with the message: "This design has no violated constraints." and "\*\*\*\*\* End Of Report \*\*\*\*\*".

The bottom panel shows a command prompt with the following text:

```
design_vision> uplevel #0 { report_constraint -all_violators -significant_digits 2 -verbose }
```

The command prompt also displays the same report details as the main window.

The status bar at the bottom indicates "Ready" and "Other 2".

## Area report:

The screenshot shows the Design Vision software interface. The title bar indicates the file is 'Design Vision - TopLevel.1 (cruisecontrol) - [Report.8 - Area]@n01-zeus.olympus.ece.tamu.edu'. The menu bar includes File, Edit, View, Select, Highlight, List, Hierarchy, Design, Attributes, Schematic, Timing, Test, Power, AnalyzeRTL, Window, and Help. The toolbar contains various icons for file operations and design functions. The main window displays the 'cruisecontrol' report, which includes the following text:

```
*****
Report : area
Design : cruisecontrol
Version: O-2018.06-SP3
Date   : Tue Oct 24 14:12:55 2023
*****

Library(s) Used:

    iit018_stdcells (File: /home/grads/b/bidhanpoudel/ecen714/synthesis/iit018_stdcells.db)

Number of ports:          58
Number of nets:          343
Number of cells:          292
Number of combinational cells: 270
Number of sequential cells: 20
Number of macros/black boxes: 0
Number of buf/inv:        75
Number of references:     17

Combinational area:      8049.000000
Buf/Inv area:            1608.000000
Noncombinational area:   1920.000000
Macro/Black Box area:    0.000000
Net Interconnect area:   undefined (No wire load specified)

Total cell area:         9969.000000
Total area:              undefined

***** End Of Report *****
```

Below the main report, there are tabs for 'Hier.1', 'Report.7', and 'Report.8'. The 'Report.8' tab is active, showing a detailed view of the area report. The bottom status bar indicates 'Ready' and 'Other 2'.

## Verilog Netlist

```
//////////////////////////////////////////  
// Created by: Synopsys DC Expert(TM) in wire Load mode  
// Version    : 0-2018.06-SP3  
// Date       : Tue Oct 24 14:15:44 2023  
//////////////////////////////////////////
```

```
module cruisecontrol_DW01_inc_4 ( A, SUM );  
    input [7:0] A;  
    output [7:0] SUM;  
  
    wire [7:2] carry;  
  
    HAX1 U1_1_6 ( .A(A[6]), .B(carry[6]), .YC(carry[7]), .YS(SUM[6]) );  
    HAX1 U1_1_5 ( .A(A[5]), .B(carry[5]), .YC(carry[6]), .YS(SUM[5]) );  
    HAX1 U1_1_4 ( .A(A[4]), .B(carry[4]), .YC(carry[5]), .YS(SUM[4]) );  
    HAX1 U1_1_3 ( .A(A[3]), .B(carry[3]), .YC(carry[4]), .YS(SUM[3]) );  
    HAX1 U1_1_2 ( .A(A[2]), .B(carry[2]), .YC(carry[3]), .YS(SUM[2]) );  
    HAX1 U1_1_1 ( .A(A[1]), .B(A[0]), .YC(carry[2]), .YS(SUM[1]) );  
    XOR2X1 U2 ( .A(carry[7]), .B(A[7]), .Y(SUM[7]) );  
    INVX1 U1 ( .A(A[0]), .Y(SUM[0]) );  
endmodule
```

```
module cruisecontrol_DW01_inc_5 ( A, SUM );  
    input [7:0] A;  
    output [7:0] SUM;  
  
    wire [7:2] carry;  
  
    HAX1 U1_1_6 ( .A(A[6]), .B(carry[6]), .YC(carry[7]), .YS(SUM[6]) );  
    HAX1 U1_1_5 ( .A(A[5]), .B(carry[5]), .YC(carry[6]), .YS(SUM[5]) );  
    HAX1 U1_1_4 ( .A(A[4]), .B(carry[4]), .YC(carry[5]), .YS(SUM[4]) );  
    HAX1 U1_1_3 ( .A(A[3]), .B(carry[3]), .YC(carry[4]), .YS(SUM[3]) );  
    HAX1 U1_1_2 ( .A(A[2]), .B(carry[2]), .YC(carry[3]), .YS(SUM[2]) );  
    HAX1 U1_1_1 ( .A(A[1]), .B(A[0]), .YC(carry[2]), .YS(SUM[1]) );  
    XOR2X1 U2 ( .A(carry[7]), .B(A[7]), .Y(SUM[7]) );  
    INVX2 U1 ( .A(A[0]), .Y(SUM[0]) );  
endmodule
```

```

module cruisecontrol ( clk, reset, throttle, set, accel, coast, cancel,
resume,
    brake, speed, cruisespeed, cruisectrl );
    output [7:0] speed;
    output [7:0] cruisespeed;
    input clk, reset, throttle, set, accel, coast, cancel, resume, brake;
    output cruisectrl;
    wire  n300, n301, n302, n303, n304, n305, n306, n307, n308, n309, n310,
        n311, n312, n313, n314, n315, N128, N146, N147, N148, N149, N150,
        N151, N152, N153, n2, n3, n4, n5, n6, n7, n8, n9, n160, n161,
n162,
        n163, n164, n165, n166, n167, n168, n169, n171, n172, n173, n174,
        n175, n176, n177, n178, n179, n370, n371, n372, n373, n374, n375,
        n376, n377, n378, n379, n380, n381, n382, n383, n384, n385, n386,
        n387, n388, n389, n390, n391, n392, n393, n394, n395, n396, n397,
        n398, n399, n400, n401, n402, n403, n404, n405, n406, n407, n408,
        n409, n410, n411, n412, n413, n414, n415, n416, n417, n418, n419,
        n420, n421, n422, n423, n424, n425, n426, n427, n428, n429, n430,
        n431, n432, n433, n434, n435, n436, n437, n438, n439, n440, n441,
        n442, n443, n444, n445, n446, n447, n448, n449, n450, n451, n452,
        n453, n454, n455, n456, n457, n458, n459, n460, n461, n462, n463,
        n464, n465, n466, n467, n468, n469, n470, n471, n472, n473, n474,
        n475, n476, n477, n478, n479, n480, n481, n482, n483, n484, n485,
        n486, n487, n488, n489, n490, n491, n492, n493, n494, n495, n496,
        n497, n498, n499, n500, n501, n502, n503, n504, n505, n506, n507,
        n508, n509, n510, n511, n512, n513, n514, n515, n516, n517, n518,
        n519, n520, n521, n522, n523, n524, n525, n526, n527, n528, n529,
        n530, n531, n535, n540, n548, n550, n552, n554, n555, n556, n557,
        n558, n559, n560, n561, n562, n563, n564, n565, n566, n567, n568,
        n569, n570, n571, n572, n573, n574, n575, n576, n577, n578, n579,
        n580, n581, n582, n583, n584, n585, n586, n587, n588, n589, n590,
        n591, n592, n593, n594, n595, n596, n597, n598, n599, n600, n601,
        n602, n603, n604;
    wire  [2:0] state;

    DFFPOSX1 \cruisespeed_reg[0] ( .D(n179), .CLK(clk), .Q(n314) );
    DFFPOSX1 \cruisespeed_reg[7] ( .D(n178), .CLK(clk), .Q(n307) );
    DFFPOSX1 \cruisespeed_reg[6] ( .D(n177), .CLK(clk), .Q(n308) );
    DFFPOSX1 \speed_reg[0] ( .D(n176), .CLK(clk), .Q(N128) );
    DFFPOSX1 \state_reg[0] ( .D(n175), .CLK(clk), .Q(state[0]) );
    DFFPOSX1 \speed_reg[1] ( .D(n174), .CLK(clk), .Q(n306) );

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DFFPOSX1 \speed_reg[7] ( .D(n173), .CLK(clk), .Q(n300) );
DFFPOSX1 \speed_reg[6] ( .D(n172), .CLK(clk), .Q(n301) );
DFFPOSX1 \speed_reg[5] ( .D(n171), .CLK(clk), .Q(n302) );
DFFPOSX1 \state_reg[1] ( .D(n531), .CLK(clk), .Q(state[1]) );
DFFPOSX1 \state_reg[2] ( .D(n169), .CLK(clk), .Q(state[2]) );
DFFPOSX1 \speed_reg[4] ( .D(n168), .CLK(clk), .Q(n303) );
DFFPOSX1 \speed_reg[3] ( .D(n167), .CLK(clk), .Q(n304) );
DFFPOSX1 \speed_reg[2] ( .D(n166), .CLK(clk), .Q(n305) );
DFFPOSX1 \cruisespeed_reg[4] ( .D(n165), .CLK(clk), .Q(n310) );
DFFPOSX1 \cruisespeed_reg[3] ( .D(n164), .CLK(clk), .Q(n311) );
DFFPOSX1 \cruisespeed_reg[2] ( .D(n163), .CLK(clk), .Q(n312) );
DFFPOSX1 cruisectl_reg ( .D(n162), .CLK(clk), .Q(n315) );
DFFPOSX1 \cruisespeed_reg[5] ( .D(n161), .CLK(clk), .Q(n309) );
DFFPOSX1 \cruisespeed_reg[1] ( .D(n160), .CLK(clk), .Q(n313) );
OR2X2 U168 ( .A(n472), .B(n473), .Y(n470) );
OR2X2 U169 ( .A(resume), .B(state[1]), .Y(n463) );
OR2X2 U170 ( .A(n602), .B(n485), .Y(n444) );
AOI21X1 U225 ( .A(n370), .B(n371), .C(reset), .Y(n531) );
NOR2X1 U226 ( .A(n372), .B(n581), .Y(n371) );
AOI22X1 U227 ( .A(n373), .B(set), .C(n374), .D(n602), .Y(n370) );
AND2X1 U228 ( .A(n375), .B(n579), .Y(n373) );
NAND2X1 U229 ( .A(n376), .B(n377), .Y(n179) );
AOI22X1 U230 ( .A(n576), .B(n568), .C(N146), .D(n580), .Y(n377) );
AOI22X1 U231 ( .A(speed[0]), .B(n578), .C(n314), .D(n378), .Y(n376) );
NAND2X1 U232 ( .A(n379), .B(n380), .Y(n178) );
AOI22X1 U233 ( .A(n381), .B(n556), .C(cruisespeed[7]), .D(n382), .Y(n380)
);
OAI21X1 U234 ( .A(n383), .B(n569), .C(n384), .Y(n382) );
NOR2X1 U235 ( .A(n308), .B(cruisespeed[7]), .Y(n381) );
AOI22X1 U236 ( .A(N153), .B(n580), .C(n300), .D(n578), .Y(n379) );
NAND2X1 U237 ( .A(n385), .B(n555), .Y(n177) );
OAI22X1 U238 ( .A(n387), .B(n308), .C(n569), .D(n384), .Y(n386) );
AOI21X1 U239 ( .A(n576), .B(n309), .C(n388), .Y(n384) );
AOI22X1 U240 ( .A(N152), .B(n580), .C(n301), .D(n578), .Y(n385) );
OAI21X1 U241 ( .A(N128), .B(n560), .C(n389), .Y(n176) );
AOI22X1 U242 ( .A(speed[0]), .B(n390), .C(n9), .D(n391), .Y(n389) );
NAND2X1 U243 ( .A(n392), .B(n393), .Y(n390) );
AOI21X1 U244 ( .A(n394), .B(n395), .C(reset), .Y(n175) );
OAI21X1 U245 ( .A(state[0]), .B(n396), .C(n397), .Y(n395) );
OAI21X1 U246 ( .A(brake), .B(n398), .C(n572), .Y(n397) );
NAND2X1 U247 ( .A(n593), .B(n602), .Y(n396) );
OAI21X1 U248 ( .A(n399), .B(n584), .C(n400), .Y(n174) );
AOI22X1 U249 ( .A(n401), .B(n584), .C(n8), .D(n391), .Y(n400) );

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OAI21X1 U250 ( .A(speed[0]), .B(n560), .C(n393), .Y(n401) );  
OAI22X1 U251 ( .A(n588), .B(n392), .C(n402), .D(n561), .Y(n173) );  
AOI21X1 U252 ( .A(n2), .B(n403), .C(n404), .Y(n402) );  
OAI21X1 U253 ( .A(n405), .B(n588), .C(n406), .Y(n404) );  
NAND3X1 U254 ( .A(n588), .B(n589), .C(n567), .Y(n406) );  
AOI21X1 U255 ( .A(n408), .B(n409), .C(n410), .Y(n405) );  
OAI21X1 U256 ( .A(n411), .B(n566), .C(n412), .Y(n410) );  
OAI21X1 U257 ( .A(n409), .B(n413), .C(n301), .Y(n412) );  
OAI21X1 U258 ( .A(n414), .B(n589), .C(n415), .Y(n172) );  
AOI22X1 U259 ( .A(n416), .B(n417), .C(n3), .D(n391), .Y(n415) );  
NOR2X1 U260 ( .A(n301), .B(n407), .Y(n416) );  
AOI21X1 U261 ( .A(n562), .B(n408), .C(n418), .Y(n414) );  
OAI21X1 U262 ( .A(n411), .B(n560), .C(n392), .Y(n418) );  
OAI21X1 U263 ( .A(n407), .B(n561), .C(n419), .Y(n171) );  
AOI22X1 U264 ( .A(n4), .B(n391), .C(n302), .D(n420), .Y(n419) );  
NAND2X1 U265 ( .A(n421), .B(n422), .Y(n420) );  
AOI22X1 U266 ( .A(n562), .B(speed[4]), .C(n423), .D(n424), .Y(n421) );  
AOI22X1 U267 ( .A(n409), .B(n586), .C(n413), .D(n411), .Y(n407) );  
NAND3X1 U268 ( .A(n590), .B(n550), .C(n425), .Y(n408) );  
AND2X1 U269 ( .A(n426), .B(n601), .Y(n169) );  
OAI21X1 U270 ( .A(state[1]), .B(n592), .C(n583), .Y(n426) );  
NAND2X1 U271 ( .A(n427), .B(n428), .Y(n168) );  
AOI22X1 U272 ( .A(n429), .B(n562), .C(n303), .D(n430), .Y(n428) );  
OAI21X1 U273 ( .A(n431), .B(n560), .C(n422), .Y(n430) );  
AOI21X1 U274 ( .A(n585), .B(n562), .C(n563), .Y(n422) );  
NOR2X1 U275 ( .A(n303), .B(n585), .Y(n429) );  
AOI22X1 U276 ( .A(n5), .B(n391), .C(n423), .D(n570), .Y(n427) );  
NAND2X1 U277 ( .A(n432), .B(n433), .Y(n167) );  
AOI22X1 U278 ( .A(n6), .B(n391), .C(n304), .D(n434), .Y(n433) );  
OAI21X1 U279 ( .A(n435), .B(n560), .C(n436), .Y(n434) );  
AOI21X1 U280 ( .A(n562), .B(n587), .C(n563), .Y(n436) );  
AOI22X1 U281 ( .A(n423), .B(n431), .C(n562), .D(n425), .Y(n432) );  
NOR2X1 U282 ( .A(n587), .B(n304), .Y(n425) );  
NAND2X1 U283 ( .A(n437), .B(n438), .Y(n166) );  
AOI21X1 U284 ( .A(n7), .B(n391), .C(n439), .Y(n438) );  
AOI21X1 U285 ( .A(n399), .B(n440), .C(n595), .Y(n439) );  
OAI21X1 U286 ( .A(n562), .B(n423), .C(n306), .Y(n440) );  
AOI21X1 U287 ( .A(speed[0]), .B(n423), .C(n563), .Y(n399) );  
AND2X1 U288 ( .A(n417), .B(n403), .Y(n391) );  
OAI21X1 U289 ( .A(n565), .B(n441), .C(n572), .Y(n403) );  
NAND3X1 U290 ( .A(n443), .B(n444), .C(n445), .Y(n442) );  
AOI22X1 U291 ( .A(accel), .B(n581), .C(throttle), .D(n579), .Y(n445) );  
NAND3X1 U292 ( .A(n574), .B(n591), .C(n592), .Y(n443) );

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NAND2X1 U293 ( .A(n447), .B(n603), .Y(n441) );
AOI22X1 U294 ( .A(n562), .B(n449), .C(n423), .D(n435), .Y(n437) );
NOR2X1 U295 ( .A(n561), .B(n566), .Y(n423) );
NAND3X1 U296 ( .A(n450), .B(n394), .C(n451), .Y(n413) );
AOI22X1 U297 ( .A(n447), .B(n452), .C(n374), .D(n602), .Y(n451) );
NAND2X1 U298 ( .A(state[0]), .B(n453), .Y(n394) );
NAND3X1 U299 ( .A(n582), .B(n604), .C(cancel), .Y(n450) );
NAND2X1 U300 ( .A(n417), .B(n409), .Y(n393) );
OAI21X1 U301 ( .A(n398), .B(n604), .C(n454), .Y(n409) );
NOR2X1 U302 ( .A(n563), .B(reset), .Y(n417) );
NAND3X1 U303 ( .A(n455), .B(n456), .C(n457), .Y(n392) );
NOR2X1 U304 ( .A(n458), .B(n459), .Y(n457) );
NAND2X1 U305 ( .A(n573), .B(n460), .Y(n459) );
OAI21X1 U306 ( .A(n591), .B(n461), .C(n462), .Y(n374) );
NAND2X1 U307 ( .A(n574), .B(n593), .Y(n461) );
OAI21X1 U308 ( .A(n463), .B(n464), .C(n465), .Y(n458) );
OAI21X1 U309 ( .A(n452), .B(n466), .C(n582), .Y(n465) );
OAI21X1 U310 ( .A(throttle), .B(n448), .C(n603), .Y(n452) );
AOI21X1 U311 ( .A(n467), .B(n468), .C(n469), .Y(n448) );
OAI22X1 U312 ( .A(n470), .B(n471), .C(n589), .D(n308), .Y(n468) );
AOI21X1 U313 ( .A(speed[4]), .B(n596), .C(n474), .Y(n473) );
OAI22X1 U314 ( .A(n309), .B(n590), .C(n475), .D(n476), .Y(n474) );
OAI21X1 U315 ( .A(speed[3]), .B(n597), .C(n477), .Y(n476) );
OAI21X1 U316 ( .A(n312), .B(n595), .C(n478), .Y(n477) );
AOI22X1 U317 ( .A(n479), .B(n480), .C(speed[3]), .D(n597), .Y(n478) );
OAI21X1 U318 ( .A(n552), .B(n481), .C(n482), .Y(n480) );
NAND2X1 U319 ( .A(n483), .B(n568), .Y(n481) );
OAI21X1 U320 ( .A(n571), .B(n484), .C(state[0]), .Y(n464) );
NAND2X1 U321 ( .A(n588), .B(n589), .Y(n484) );
NOR2X1 U322 ( .A(n424), .B(n302), .Y(n411) );
NAND2X1 U323 ( .A(n431), .B(n550), .Y(n424) );
AND2X1 U324 ( .A(n435), .B(n548), .Y(n431) );
NOR2X1 U325 ( .A(n587), .B(speed[0]), .Y(n435) );
NOR2X1 U326 ( .A(n306), .B(n305), .Y(n449) );
AND2X1 U327 ( .A(n444), .B(n454), .Y(n456) );
NAND3X1 U328 ( .A(n574), .B(n591), .C(n446), .Y(n454) );
NOR2X1 U329 ( .A(n593), .B(resume), .Y(n446) );
AOI22X1 U330 ( .A(n593), .B(n574), .C(n603), .D(n447), .Y(n485) );
AOI21X1 U331 ( .A(n486), .B(n453), .C(n487), .Y(n455) );
AND2X1 U332 ( .A(n574), .B(n466), .Y(n486) );
OAI21X1 U333 ( .A(n469), .B(n488), .C(n467), .Y(n466) );
NAND2X1 U334 ( .A(cruisespeed[7]), .B(n588), .Y(n467) );
AOI21X1 U335 ( .A(n308), .B(n589), .C(n489), .Y(n488) );
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NOR2X1 U336 ( .A(n471), .B(n490), .Y(n489) );
OAI21X1 U337 ( .A(n309), .B(n590), .C(n491), .Y(n490) );
OAI21X1 U338 ( .A(speed[4]), .B(n596), .C(n492), .Y(n491) );
AOI21X1 U339 ( .A(n594), .B(n493), .C(n472), .Y(n492) );
NOR2X1 U340 ( .A(n599), .B(n302), .Y(n472) );
OAI21X1 U341 ( .A(speed[3]), .B(n564), .C(n494), .Y(n493) );
OAI21X1 U342 ( .A(n548), .B(n495), .C(n311), .Y(n494) );
OAI21X1 U343 ( .A(n305), .B(n598), .C(n496), .Y(n495) );
NAND2X1 U344 ( .A(n479), .B(n497), .Y(n496) );
OAI21X1 U345 ( .A(n568), .B(n498), .C(n483), .Y(n497) );
NAND2X1 U346 ( .A(n313), .B(n584), .Y(n483) );
NAND2X1 U347 ( .A(n482), .B(n552), .Y(n498) );
NAND2X1 U348 ( .A(n306), .B(n600), .Y(n482) );
XNOR2X1 U349 ( .A(n312), .B(n305), .Y(n479) );
XNOR2X1 U350 ( .A(n310), .B(n550), .Y(n475) );
XOR2X1 U351 ( .A(n308), .B(n301), .Y(n471) );
NOR2X1 U352 ( .A(n588), .B(cruisespeed[7]), .Y(n469) );
NAND2X1 U353 ( .A(n499), .B(n500), .Y(n165) );
AOI22X1 U354 ( .A(n310), .B(n501), .C(n557), .D(n576), .Y(n500) );
OAI21X1 U355 ( .A(n383), .B(n597), .C(n558), .Y(n501) );
AOI22X1 U356 ( .A(N150), .B(n580), .C(n303), .D(n578), .Y(n499) );
NAND2X1 U357 ( .A(n503), .B(n504), .Y(n164) );
AOI22X1 U358 ( .A(n505), .B(n559), .C(n311), .D(n502), .Y(n504) );
OAI21X1 U359 ( .A(n559), .B(n383), .C(n577), .Y(n502) );
NOR2X1 U360 ( .A(n311), .B(n383), .Y(n505) );
AOI22X1 U361 ( .A(N149), .B(n580), .C(n578), .D(n304), .Y(n503) );
NAND2X1 U362 ( .A(n506), .B(n507), .Y(n163) );
AOI22X1 U363 ( .A(n312), .B(n508), .C(n559), .D(n576), .Y(n507) );
OAI21X1 U364 ( .A(n383), .B(n600), .C(n554), .Y(n508) );
AOI22X1 U365 ( .A(N148), .B(n580), .C(n578), .D(n305), .Y(n506) );
AND2X1 U366 ( .A(n510), .B(n601), .Y(n162) );
OAI21X1 U367 ( .A(state[1]), .B(n575), .C(n511), .Y(n510) );
AOI21X1 U368 ( .A(cruisectl), .B(n583), .C(n372), .Y(n511) );
AND2X1 U369 ( .A(resume), .B(n453), .Y(n372) );
NOR2X1 U370 ( .A(n593), .B(state[1]), .Y(n453) );
NAND2X1 U371 ( .A(n513), .B(n514), .Y(n161) );
AOI21X1 U372 ( .A(n309), .B(n388), .C(n556), .Y(n514) );
NAND3X1 U373 ( .A(n576), .B(n599), .C(n557), .Y(n387) );
OAI21X1 U374 ( .A(n557), .B(n383), .C(n577), .Y(n388) );
NAND3X1 U375 ( .A(n596), .B(n597), .C(n559), .Y(n515) );
NAND3X1 U376 ( .A(n600), .B(n568), .C(n598), .Y(n516) );
AOI22X1 U377 ( .A(N151), .B(n580), .C(n578), .D(n302), .Y(n513) );
NAND2X1 U378 ( .A(n517), .B(n518), .Y(n160) );

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AOI22X1 U379 ( .A(n519), .B(n576), .C(n313), .D(n509), .Y(n518) );
OAI21X1 U380 ( .A(n383), .B(n568), .C(n577), .Y(n509) );
NAND3X1 U381 ( .A(n577), .B(n601), .C(n447), .Y(n383) );
NOR2X1 U382 ( .A(n520), .B(accel), .Y(n447) );
NOR2X1 U383 ( .A(n314), .B(n313), .Y(n519) );
AOI22X1 U384 ( .A(N147), .B(n580), .C(n578), .D(n306), .Y(n517) );
OAI21X1 U385 ( .A(n487), .B(n579), .C(n522), .Y(n521) );
NOR2X1 U386 ( .A(reset), .B(n378), .Y(n522) );
NOR2X1 U387 ( .A(n512), .B(n523), .Y(n378) );
OAI21X1 U388 ( .A(n398), .B(n603), .C(n460), .Y(n523) );
AOI21X1 U389 ( .A(n582), .B(accel), .C(reset), .Y(n460) );
OAI21X1 U390 ( .A(n524), .B(n525), .C(n583), .Y(n512) );
NAND2X1 U391 ( .A(throttle), .B(set), .Y(n525) );
NAND2X1 U392 ( .A(n579), .B(n375), .Y(n524) );
OAI21X1 U393 ( .A(n526), .B(n590), .C(n527), .Y(n375) );
NOR2X1 U394 ( .A(n301), .B(n300), .Y(n527) );
AOI21X1 U395 ( .A(n528), .B(n306), .C(speed[4]), .Y(n526) );
NOR2X1 U396 ( .A(n548), .B(n595), .Y(n528) );
NAND3X1 U397 ( .A(n591), .B(n593), .C(state[0]), .Y(n462) );
NOR2X1 U398 ( .A(n398), .B(n529), .Y(n487) );
NAND3X1 U399 ( .A(n581), .B(n601), .C(accel), .Y(n530) );
NAND2X1 U400 ( .A(n529), .B(n582), .Y(n520) );
NAND3X1 U401 ( .A(state[0]), .B(n593), .C(state[1]), .Y(n398) );
NOR2X1 U402 ( .A(brake), .B(cancel), .Y(n529) );
cruisecontrol_DW01_inc_4 add_118 ( .A({cruisespeed[7], n308, n309, n310,
    n311, n312, n313, n314}), .SUM({N153, N152, N151, N150, N149, N148,
    N147, N146}) );
cruisecontrol_DW01_inc_5 r118 ( .A({n300, n301, n302, speed[4:3], n305,
n306,
    speed[0]}), .SUM({n2, n3, n4, n5, n6, n7, n8, n9}) );
INVX8 U403 ( .A(n588), .Y(speed[7]) );
INVX1 U404 ( .A(n300), .Y(n588) );
INVX8 U405 ( .A(n600), .Y(cruisespeed[1]) );
INVX1 U406 ( .A(n313), .Y(n600) );
INVX8 U407 ( .A(n568), .Y(cruisespeed[0]) );
INVX1 U408 ( .A(n314), .Y(n568) );
INVX2 U409 ( .A(n307), .Y(n535) );
INVX8 U410 ( .A(n535), .Y(cruisespeed[7]) );
INVX8 U411 ( .A(n599), .Y(cruisespeed[5]) );
INVX1 U412 ( .A(n309), .Y(n599) );
INVX8 U413 ( .A(n595), .Y(speed[2]) );
INVX1 U414 ( .A(n305), .Y(n595) );
INVX8 U415 ( .A(n589), .Y(speed[6]) );

```

```
IN VX1 U416 ( .A(n301), .Y(n589) );
IN VX2 U417 ( .A(n315), .Y(n540) );
IN VX8 U418 ( .A(n540), .Y(cruisectl) );
IN VX8 U419 ( .A(n596), .Y(cruisespeed[4]) );
IN VX1 U420 ( .A(n310), .Y(n596) );
IN VX8 U421 ( .A(n597), .Y(cruisespeed[3]) );
IN VX1 U422 ( .A(n311), .Y(n597) );
IN VX8 U423 ( .A(n598), .Y(cruisespeed[2]) );
IN VX1 U424 ( .A(n312), .Y(n598) );
IN VX8 U425 ( .A(n590), .Y(speed[5]) );
IN VX1 U426 ( .A(n302), .Y(n590) );
IN VX8 U427 ( .A(n584), .Y(speed[1]) );
IN VX1 U428 ( .A(n306), .Y(n584) );
IN VX8 U429 ( .A(n569), .Y(cruisespeed[6]) );
IN VX1 U430 ( .A(n308), .Y(n569) );
IN VX2 U431 ( .A(n304), .Y(n548) );
IN VX2 U432 ( .A(n303), .Y(n550) );
IN VX2 U433 ( .A(N128), .Y(n552) );
IN VX8 U434 ( .A(n548), .Y(speed[3]) );
IN VX8 U435 ( .A(n550), .Y(speed[4]) );
IN VX8 U436 ( .A(n552), .Y(speed[0]) );
IN VX2 U437 ( .A(n509), .Y(n554) );
IN VX2 U438 ( .A(n386), .Y(n555) );
IN VX2 U439 ( .A(n387), .Y(n556) );
IN VX2 U440 ( .A(n515), .Y(n557) );
IN VX2 U441 ( .A(n502), .Y(n558) );
IN VX2 U442 ( .A(n516), .Y(n559) );
IN VX2 U443 ( .A(n423), .Y(n560) );
IN VX2 U444 ( .A(n417), .Y(n561) );
IN VX2 U445 ( .A(n393), .Y(n562) );
IN VX2 U446 ( .A(n392), .Y(n563) );
IN VX2 U447 ( .A(n495), .Y(n564) );
IN VX2 U448 ( .A(n448), .Y(n565) );
IN VX2 U449 ( .A(n413), .Y(n566) );
IN VX2 U450 ( .A(n407), .Y(n567) );
IN VX2 U451 ( .A(n424), .Y(n570) );
IN VX2 U452 ( .A(n411), .Y(n571) );
IN VX2 U453 ( .A(n442), .Y(n572) );
IN VX2 U454 ( .A(n374), .Y(n573) );
IN VX2 U455 ( .A(state[0]), .Y(n574) );
IN VX2 U456 ( .A(n512), .Y(n575) );
IN VX2 U457 ( .A(n383), .Y(n576) );
IN VX2 U458 ( .A(n378), .Y(n577) );
```

```
IN VX2 U459 ( .A(n521), .Y(n578) );
IN VX2 U460 ( .A(n462), .Y(n579) );
IN VX2 U461 ( .A(n530), .Y(n580) );
IN VX2 U462 ( .A(n520), .Y(n581) );
IN VX2 U463 ( .A(n398), .Y(n582) );
IN VX2 U464 ( .A(n487), .Y(n583) );
IN VX2 U465 ( .A(n425), .Y(n585) );
IN VX2 U466 ( .A(n408), .Y(n586) );
IN VX2 U467 ( .A(n449), .Y(n587) );
IN VX2 U468 ( .A(state[1]), .Y(n591) );
IN VX2 U469 ( .A(n446), .Y(n592) );
IN VX2 U470 ( .A(state[2]), .Y(n593) );
IN VX2 U471 ( .A(n475), .Y(n594) );
IN VX2 U472 ( .A(reset), .Y(n601) );
IN VX2 U473 ( .A(throttle), .Y(n602) );
IN VX2 U474 ( .A(coast), .Y(n603) );
IN VX2 U475 ( .A(brake), .Y(n604) );
endmodule
```

**Number of registers = 20**

## Part B: Static Time Analysis

### Max\_paths\_txt

\*\*\*\*\*

Report : timing

-path\_type full

-delay\_type max

-slack\_lesser\_than 5.00

-max\_paths 3

-sort\_by slack

Design : cruisecontrol

Version: 0-2018.06-SP3

Date : Tue Oct 24 14:53:12 2023

\*\*\*\*\*

Startpoint: cruisespeed\_reg[6]

(rising edge-triggered flip-flop clocked by clk)

Endpoint: cruisespeed[6]

(output port clocked by clk)

Path Group: clk

Path Type: max

Point	Incr	Path
-----		
---		
clock clk (rise edge)	0.00	0.00
clock network delay (ideal)	0.00	0.00
cruisespeed_reg[6]/CLK (DFFPOSX1)	0.00	0.00 r
cruisespeed_reg[6]/Q (DFFPOSX1)	0.18	0.18 r
U176/Y (INVX1)	0.27	0.44 f
U175/Y (INVX8)	0.77	1.21 r
cruisespeed[6] (out)	0.00	1.21 r
data arrival time		1.21
clock clk (rise edge)	10.00	10.00
clock network delay (ideal)	0.00	10.00
clock reconvergence pessimism	0.00	10.00
output external delay	-5.00	5.00
data required time		5.00

```

-----
---
data required time                    5.00
data arrival time                    -1.21

-----
---
slack (MET)                          3.79

Startpoint: cruisespeed_reg[0]
      (rising edge-triggered flip-flop clocked by clk)
Endpoint: cruisespeed[0]
      (output port clocked by clk)
Path Group: clk
Path Type: max

Point                                Incr      Path
-----
---
clock clk (rise edge)                0.00      0.00
clock network delay (ideal)          0.00      0.00
cruisespeed_reg[0]/CLK (DFFPOSX1)    0.00      0.00 r
cruisespeed_reg[0]/Q (DFFPOSX1)     0.14      0.14 r
U184/Y (INVX1)                       0.26      0.40 f
U183/Y (INVX8)                       0.77      1.17 r
cruisespeed[0] (out)                 0.00      1.17 r
data arrival time                    1.17

clock clk (rise edge)                10.00     10.00
clock network delay (ideal)          0.00     10.00
clock reconvergence pessimism        0.00     10.00
output external delay                -5.00      5.00
data required time                    5.00

-----
---
data required time                    5.00
data arrival time                    -1.17

-----
---

```

slack (MET) 3.83

Startpoint: cruisespeed\_reg[5]  
(rising edge-triggered flip-flop clocked by clk)  
Endpoint: cruisespeed[5]  
(output port clocked by clk)  
Path Group: clk  
Path Type: max

Point	Incr	Path
-----		
---		
clock clk (rise edge)	0.00	0.00
clock network delay (ideal)	0.00	0.00
cruisespeed_reg[5]/CLK (DFFPOSX1)	0.00	0.00 r
cruisespeed_reg[5]/Q (DFFPOSX1)	0.14	0.14 r
U182/Y (INVX1)	0.23	0.37 f
U181/Y (INVX8)	0.76	1.12 r
cruisespeed[5] (out)	0.00	1.12 r
data arrival time		1.12
clock clk (rise edge)	10.00	10.00
clock network delay (ideal)	0.00	10.00
clock reconvergence pessimism	0.00	10.00
output external delay	-5.00	5.00
data required time		5.00
-----		
---		
data required time		5.00
data arrival time		-1.12
-----		
---		
slack (MET)		3.88

Warning: report\_timing has satisfied the max\_paths criteria. There are 33 further endpoints which have paths of interest with slack less than 5.00 that were **not** considered when generating this report. (UITE-502)

## Min\_path\_txt

\*\*\*\*\*

Report : timing

-path\_type full  
-delay\_type min  
-slack\_lesser\_than 5.00  
-max\_paths 3  
-sort\_by slack

Design : cruisecontrol

Version: 0-2018.06-SP3

Date : Tue Oct 24 14:53:29 2023

\*\*\*\*\*

Startpoint: reset (input port clocked by clk)

Endpoint: cruisectl\_reg

(rising edge-triggered flip-flop clocked by clk)

Path Group: clk

Path Type: min

Point	Incr	Path
-----		
clock clk (rise edge)	0.00	0.00
clock network delay (ideal)	0.00	0.00
input external delay	0.00	0.00 f
reset (in)	0.04	0.04 f
U154/Y (OAI21X1)	0.08	0.12 r
cruisectl_reg/D (DFFPOSX1)	0.00	0.12 r
data arrival time		0.12
clock clk (rise edge)	0.00	0.00
clock network delay (ideal)	0.00	0.00
clock reconvergence pessimism	0.00	0.00
cruisectl_reg/CLK (DFFPOSX1)		0.00 r
library hold time	0.00	0.00
data required time		0.00
-----		
data required time		0.00



data arrival time -0.12

-----  
slack (MET) 0.12

Startpoint: cruisespeed\_reg[3]  
(rising edge-triggered flip-flop clocked by clk)

Endpoint: cruisespeed\_reg[3]  
(rising edge-triggered flip-flop clocked by clk)

Path Group: clk

Path Type: min

Point	Incr	Path
-------	------	------

-----		
---		
clock clk (rise edge)	0.00	0.00
clock network delay (ideal)	0.00	0.00
cruisespeed_reg[3]/CLK (DFFPOSX1)	0.00	0.00 r
cruisespeed_reg[3]/Q (DFFPOSX1)	0.14	0.14 r
U128/Y (AOI22X1)	0.06	0.19 f
U126/Y (NAND2X1)	0.06	0.25 r
cruisespeed_reg[3]/D (DFFPOSX1)	0.00	0.25 r
data arrival time		0.25
clock clk (rise edge)	0.00	0.00
clock network delay (ideal)	0.00	0.00
clock reconvergence pessimism	0.00	0.00
cruisespeed_reg[3]/CLK (DFFPOSX1)		0.00 r
library hold time	0.00	0.00
data required time		0.00

-----	
---	
data required time	0.00
data arrival time	-0.25

-----	
---	
slack (MET)	0.25

Startpoint: cruisespeed\_reg[5]

(rising edge-triggered flip-flop clocked by clk)  
 Endpoint: cruisespeed\_reg[5]  
 (rising edge-triggered flip-flop clocked by clk)  
 Path Group: clk  
 Path Type: min

Point	Incr	Path
-----		
---		
clock clk (rise edge)	0.00	0.00
clock network delay (ideal)	0.00	0.00
cruisespeed_reg[5]/CLK (DFFPOSX1)	0.00	0.00 r
cruisespeed_reg[5]/Q (DFFPOSX1)	0.14	0.14 r
U122/Y (AOI22X1)	0.06	0.19 f
U120/Y (NAND2X1)	0.06	0.25 r
cruisespeed_reg[5]/D (DFFPOSX1)	0.00	0.25 r
data arrival time		0.25
clock clk (rise edge)	0.00	0.00
clock network delay (ideal)	0.00	0.00
clock reconvergence pessimism	0.00	0.00
cruisespeed_reg[5]/CLK (DFFPOSX1)		0.00 r
library hold time	0.00	0.00
data required time		0.00
-----		
---		
data required time		0.00
data arrival time		-0.25
-----		
---		
slack (MET)		0.25

Warning: report\_timing has satisfied the max\_paths criteria. There are 17 further endpoints which have paths of interest with slack less than 5.00 that were **not** considered when generating this report. (UITE-502)

## Part C: Automatic Place and Route

```
olympus.ece.tamu.edu (bidhanpoudel)
Terminal Sessions View X server Tools Games Settings Macros Help

Quick connect...
/home/grads/bidhanpoudel/ecen714/synth.v

Name
├── cadence
├── cty_con
├── do
├── libraries
├── sta
├── verilog
├── WORK
├── zymoprep_dtdc_setup
├── command.log
├── constraint.bst
├── cruisecontrol.ddc
├── cruisecontrol_DW01_nc_4.ddc
├── cruisecontrol_DW01_nc_5.ddc
├── cruisecontrol_netlist.v
├── default.svf
├── filenames.log
├── n018_stdcells.db
├── innovus.cmd
├── innovus.cmd1
├── innovus.log
├── innovus.log1
├── innovus.logv
├── innovus.logv1
├── p1.tst
├── p1.tst_command.log
├── Report_area.bst
├── Report_constraint.bst
├── Report_constraints.bst

Remote monitoring
Follow terminal folder

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#2 olympus.ece.tamu.edu (bidhanpoudel)

**WARN: (IMPSP-9513): Timing constraint file does not exist
**WARN: (IMPSP-9514): Non-TimingDriven placement will be performed.
*** Starting placeDesign default flow ***
Deleted 0 physical inst (cell - / prefix -).
INFO: #ExclusiveGroups=0
INFO: There are no Exclusive Groups.
*** Starting "NonPlace(TM) placement v#7 (mem=1748.9M)" ...
No user-set net weight.
Net fanout histogram:
2      : 186 (59.8%) nets
3      : 42 (13.5%) nets
4      : 82 (26.4%) nets
15     : 1 (0.3%) nets
40     : 0 (0.0%) nets
80     : 0 (0.0%) nets
160    : 0 (0.0%) nets
320    : 0 (0.0%) nets
640    : 0 (0.0%) nets
1280   : 0 (0.0%) nets
2560   : 0 (0.0%) nets
5120+  : 0 (0.0%) nets
Options: clkGateAware ignoreScan pinGuide congEffort=auto gpeffort=medium
Screen chains were not defined.
#stdCell=290 (0 fixed + 290 movable) #buf cell=0 #inv cell=0 #block=0 (0 floating + 0 preplaced)
#vinst=0 #nets=11 #term=979 #term/net=3.15, #fixedIo=0, #floatIo=0, #fixedPin=0, #floatPin=26
stdCell: 290 single + 0 double + 0 multi
Total standard cell length = 1.0296 (mm), area = 0.0103 (mm^2)
Average module density = 0.606.
Density for the design = 0.606.
= stdcell_area 1287 sites (10296 um^2) / alloc_area 1848 sites (14784 um^2).
Pin Density = 0.5298.
= total # of pins 979 / total area 1848.
== LastAutoLevel = 5
**WARN: (IMPSP-9531): Turning off clkGateAware when timingDriven is off
Iteration 1: Total net bbox = 9.153e-12 (1.80e-12 7.35e-12)
Est. stn bbox = 9.702e-12 (1.95e-12 7.75e-12)
cpu = 0:00:00.0 real = 0:00:00.0 mem = 1894.0M
Iteration 2: Total net bbox = 9.153e-12 (1.80e-12 7.35e-12)
Est. stn bbox = 9.702e-12 (1.95e-12 7.75e-12)
cpu = 0:00:00.0 real = 0:00:00.0 mem = 1894.0M
Iteration 3: Total net bbox = 5.156e+00 (2.63e+00 2.52e+00)
Est. stn bbox = 5.725e+00 (2.93e+00 2.80e+00)
cpu = 0:00:00.0 real = 0:00:00.0 mem = 1911.4M
Iteration 4: Total net bbox = 5.455e+03 (3.20e+03 2.25e+03)
```

```
olympus.ece.tamu.edu (bidhanpoudel)
Terminal Sessions View X server Tools Games Settings Macros Help

Quick connect...
/home/grads/bidhanpoudel/ecen714/synth.v

Name
├── cadence
├── timing_file_38814.tsf.gz
├── cruisecontrol.lspcf
├── cruisecontrol_netlist.v
├── n018_stdcells.lef
├── n018_stdcells.lib
├── n018_stdcells.tff
├── innovus.cmd
├── innovus.cmd1
├── innovus.conf
├── innovus.log
├── innovus.log1
├── innovus.logv
├── innovus.logv1

Remote monitoring
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# By Layer and Type :
#      MetSpc  Totals
#      metal1  1      1
#      Totals  1      1
#cpu time = 00:00:01, elapsed time = 00:00:01, memory = 1369.17 (MB), peak = 1404.59 (MB)
#start 1st optimization iteration ...
# number of violations = 0
#cpu time = 00:00:00, elapsed time = 00:00:00, memory = 1369.07 (MB), peak = 1404.59 (MB)
#Complete Detail Routing
#Total wire length = 9493 um.
#Total half perimeter of net bounding box = 10183 um.
#Total wire length on LAYER metal1 = 918 um.
#Total wire length on LAYER metal2 = 3966 um.
#Total wire length on LAYER metal3 = 3924 um.
#Total wire length on LAYER metal4 = 383 um.
#Total wire length on LAYER metal5 = 214 um.
#Total wire length on LAYER metal6 = 0 um.
#Total number of vias = 1516
#Up-Via Summary (total 1516):
#
#-----
# metal1      897
# metal2      558
# metal3       51
# metal4       10
#-----
#              1516
#
#Total number of DRC violations = 0
#Cpu time = 00:00:01
#Elapsed time = 00:00:01
#Increased memory = 10.27 (MB)
#Total memory = 1369.08 (MB)
#Peak memory = 1404.59 (MB)
#
#Start Post Route wire spreading..
#
#Start DRC checking..
# number of violations = 0
#cpu time = 00:00:00, elapsed time = 00:00:00, memory = 1369.16 (MB), peak = 1408.63 (MB)
#CELL VIEW cruisecontrol.init has no DRC violation.
#Total number of DRC violations = 0
#
#Start data preparation for wire spreading...
```

Total Wire Length: 9403 um  
Number of Vias : 1516  
Number of standard cells: 290

## Generated Layout

