Informatics and Mathematical Modelling
Technical University of Denmark

02207 : Advanced Digital Design Techniques

Exercise of Retiming

LAB 3

Group *dt07*

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Contents

1 Introduction

This document is report of the third exercise on DTU course Advanced Digital Design. In this exercise we studied the concept of retiming using a digit recurrence division implementation with radix-4 and carry-save adder.

In course of the exercise we examined two designs, the original design for digit recurrence division and the retimed design. We first compiled, simulated and synthesized the original design to get the power report and cell counts for it. We then modified the VHDL code for the original design to retime the recurrence. This retimed design was then also compiled, simulated and synthesized to get the power report and cell counts.

In the following sections we will briefly explain the concept of retiming, present the original circuit and the retimed circuit and the power dissipated and cells used in both. In the last section we will discuss the results.

1.1 Authors by Section

- *Rajesh Bachani - Simulating the retimed design, cell counts for original, Report: introduction, retimed design*
- *Josep Renard - Editing the top level, cell counts for retimed, Report: retiming, discussion*
- *Markku Eerola - Synthesis and power reports, Report: original design, appendices*

2 Retiming

Retiming is an optimizing technique where structural location of registers is manually moved without affecting the functionality of the circuit in order to improve its performance. This is done either by removing a register from each input to a block and adding a register to each output, or by adding registers to the inputs and removing registers from the outputs.

In our case the motivation for retiming was to create slack on a non-critical path, and to have the synthesizer substitute HS cells with LL cells on this path thus lowering the overall power dissipation in the whole circuit. According to the lecture slides the circuit we were studying should gain approximately 30% power savings from this kind of retiming.

3 Original Design

The original design upon which we aimed to improve with the retiming is presented in figure 1.

The Sel. function -block implements the quotient digit selection function. The selection function determines a 4-bit quotient digit using 3 most significant bits of the divisor d and 7 most significant bits from the results stored in registers Ws and Wc.

The MUX block selects the input for the divisor multiplication between the dividend, which is used only in the initialization phase of the division algorithm, and the result of the substraction of the quotient digit/divisor multiplication result from the dividend. The substraction result is stored in register Ws.

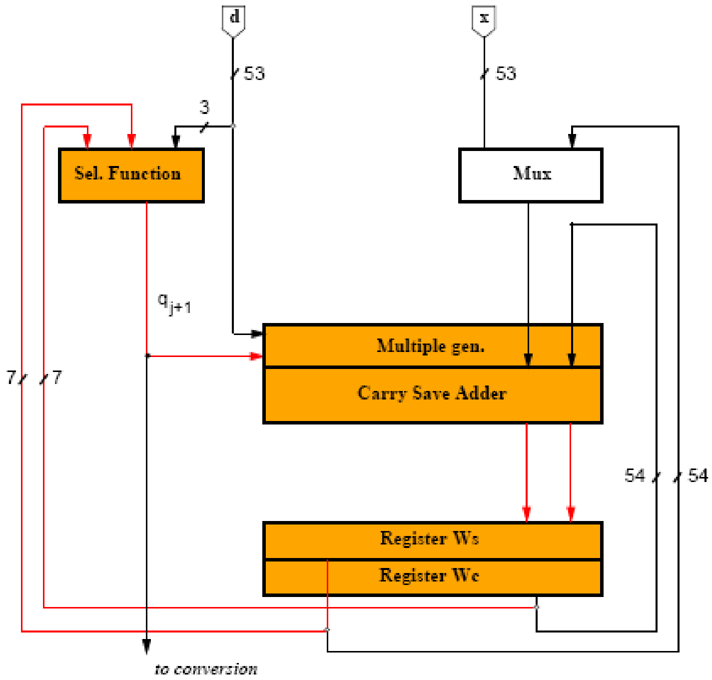

Figure 1: Digit recurrence division

The Multiple gen. -block implements the divisor multiplication ie. it multiplies the divisor d with the 4-bit quotient digit. This block is basically a multiplexer.

The Carry Save Adder -block implements the substraction of the result of the divisor multiplication from the dividend. The substraction is done with a carry-save adder as the name of the block suggests.

The registers Ws and Wc store the carry and the sum from the carry-save adder respectively.

The critical path of this circuit is marked with red arrows in the figure 1.

3.1 Power dissipation and cell count

The Synopsys VSS Simulator was used to annotate the switching activity based on a testbench and test vectors. This switching activity was used by Design Vision to estimate the power dissipation within the circuit. The results can be seen in table 1 for each composing block. The actual report is in appendix A. The table also shows the number of HVT and SVT cells in each composing block.

Table 1: Power dissipation in original circuit (uW) and cell count

Block	P static	P dynamic	P total	SVT cells	HVT cells
Control	0.8	35.7	36.5	21	24
Mux	0.12	28.3	28.4	1	57
Mult. gen.	6.8	124.0	130.8	226	51
CSA	7.4	196.4	203.8	141	35
SEL	3.3	68.1	71.4	80	5
Reg W	13.3	336.7	350.0	315	8
Total	31.7	789.2	820.9	784	180

4 Retimed Design

The retimed design is presented in figure 2.

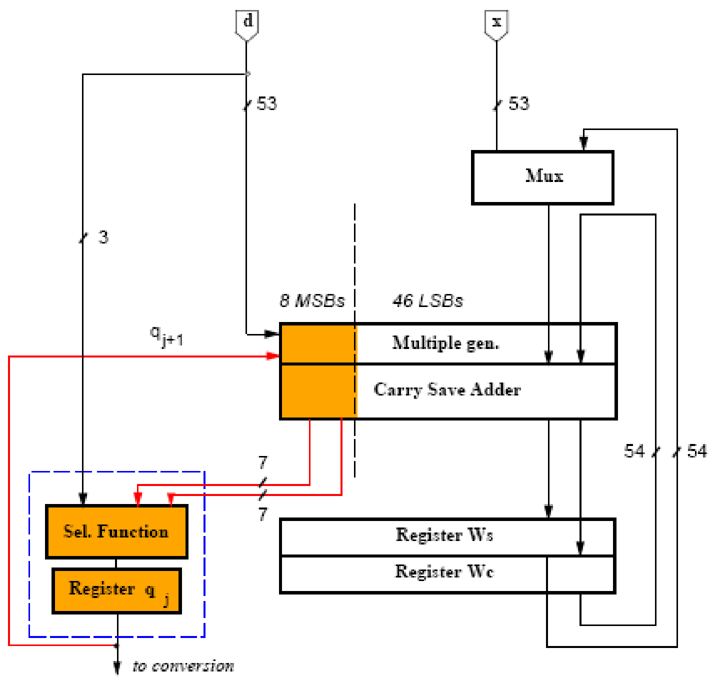

Figure 2: Digit recurrence division retimed

Since only the most significant bits of sum and carry are used in the quotient digit selection it makes sense to separate the most significant bits from the least significant bits to separate structural slices. This is done in the VHDL code by disconnecting the quotient digit selection block from the W registers thus *removing registers from the inputs* and adding new registers to the output of the block. This frees the W registers from the most significant slice. By also separating the implementation of the most significant bits of the adder and the multiplie generation from the implementation for the less significant bits more of the design is freed from the critical path.

We achieved these changes by editing the top-level VHDL file for the original design. We disconnected the higher bits of register W from the selection function and introduced the register q as a new component. We connected the high bits of CSA directly to the selection function and connected the new register between the selection and the multiple generation.

These changes do not affect the functionality of the circuit, but by dividing the implementation to most significant and least significant slices we get two paths. The critical path is marked with red arrows in the figure 2. The delay on the critical path is T(SEL)+T(reg q)+T(mux)+T(CSA). The delay on the non-critical path is at maximum T(reg W)+T(mux)+T(CSA). From this it can be seen that the non critical path has some slack which the synthesizer should be able to use to optimize the least significant slice for power, namely by replacing HS cells with LL cells.

4.1 Power dissipation and cell count

Just as with the original design the Synopsys VSS Simulator was used to annotate the switching activity based on a testbench and test vectors. This switching activity was again used by Design Vision to estimate the power dissipation within the circuit. The results can be seen in table 2 for each composing block. The actual report is in appendix B. The table also shows the number of HVT and SVT cells in each composing block.

Table 2: Power dissipation in retimed circuit (uW) and cell count

Block	**P static**	**P dynamic**	**P total**	**SVT cells**	**HVT cells**
Control	0.9	34.9	35.8	21	22
Mux	0.3	24.9	25.2	9	53
Mult. gen.	0.7	48.1	48.8	20	154
CSA	1.6	116.3	117.9	26	150
SEL	3.0	64.2	67.2	71	7
Reg W	3.0	258.4	261.4	118	116
Reg q	0.7	16.3	17.0	20	3
Total	10.2	563.1	573.3	285	505

5 Discussion

Looking at the results from tables 1 and 2 we can see, that separating the design in two slices has reduced power dissipation. This split makes it possible for the synthesizing tool, Synopsys Design Vision, to optimize the slice with the critical path for speed and the non-critical part for low power. The composing blocks that have been separated from the critical path have been optimized for power by the synthesizer and this shows in SVT cells being replaced by HVT cells. Since these separated blocks contain the large register W and most of the CSA and multiple generator from the original design, the power savings are notable. Namely, we save approximately 30% - which was expected.

6 Appendix A: Power reports from the original design

Listing 1: Power Report - Original

```
****************************************
Report : power
        -net
        -cell
        -hier
        -analysis_effort low
        -sort_mode dynamic_power
Design : divr4_rec
Version: X-2005.09-SP1
Date   : Wed Nov 21 17:51:27 2007
****************************************




Library(s) Used:

    CORE90GPHVT (File: /cell_libs/cmos090_50a/CORE90GPHVT_SNPS-AVT_2.1.a/
          SIGNOFF/bc_1.10V_m40C_wc_0.90V_105C/PT_LIB/CORE90GPHVT_NomLeak.db)
    CORE90GPSVT (File: /cell_libs/cmos090_50a/CORE90GPSVT_SNPS-AVT_2.1/
          SIGNOFF/bc_1.10V_m40C_wc_0.90V_105C/PT_LIB/CORE90GPSVT_NomLeak.db)




Operating Conditions: NomLeak   Library: CORE90GPSVT
Wire Load Model Mode: enclosed

Design          Wire Load Model          Library
------------------------------------------------
divr4_rec              area_6Kto12K       CORE90GPSVT
CONTROL                area_0to1K         CORE90GPSVT
CONTROL_DW01_inc_0     area_0to1K         CORE90GPSVT
MUX                    area_0to1K         CORE90GPSVT
MULT                   area_2Kto3K        CORE90GPSVT
gl_csa32_n8            area_0to1K         CORE90GPSVT
csa32LSBs_n47          area_1Kto2K        CORE90GPSVT
gl_dualreg_ld_n10      area_1Kto2K        CORE90GPSVT
gl_dualreg_ld_n45      area_3Kto4K        CORE90GPSVT
QDSEL                  area_0to1K         CORE90GPSVT
QDS_TABLE              area_0to1K         CORE90GPSVT
QDS_ADDER              area_0to1K         CORE90GPSVT




Global Operating Voltage = 1
Power-specific unit information :
    Voltage Units = 1V
    Capacitance Units = 1.000000pf
    Time Units = 1ns
    Dynamic Power Units = 1mW    (derived from V,C,T units)
    Leakage Power Units = 1pW
```

Attributes

a – Switching activity information annotated **on** net
d – Default switching activity information **on** net

Net	Total Net Load	Static Prob.	Toggle Rate	Switching Power	Attrs
LOAD	0.764	0.939	0.0121	0.0046	a
W1[53]	0.058	0.462	0.0446	0.0013	a
W1[52]	0.047	0.455	0.0456	0.0011	a
W2[55]	0.063	0.335	0.0387	0.0012	a
W2[53]	0.057	0.347	0.0391	0.0011	a
W1[54]	0.057	0.432	0.0438	0.0012	a
W1[55]	0.056	0.543	0.0443	0.0012	a
W2[24]	0.047	0.320	0.0376	0.0009	a
W2[52]	0.041	0.320	0.0398	0.0008	a
W2[18]	0.044	0.326	0.0382	0.0008	a
W2[54]	0.055	0.355	0.0381	0.0011	a
W2[51]	0.036	0.320	0.0403	0.0007	a
W2[10]	0.044	0.271	0.0362	0.0008	a
W2[22]	0.045	0.324	0.0380	0.0009	a
W1[45]	0.032	0.446	0.0460	0.0007	a
W1[10]	0.032	0.486	0.0458	0.0007	a
W1[15]	0.032	0.457	0.0456	0.0007	a
W1[19]	0.032	0.468	0.0452	0.0007	a
W1[21]	0.032	0.482	0.0449	0.0007	a
WS[37]	0.028	0.478	0.0465	0.0007	a
W1[39]	0.032	0.495	0.0444	0.0007	a
W1[30]	0.032	0.443	0.0443	0.0007	a
W1[13]	0.032	0.480	0.0443	0.0007	a
W1[11]	0.032	0.489	0.0440	0.0007	a
W1[17]	0.032	0.473	0.0441	0.0007	a
W1[33]	0.032	0.456	0.0438	0.0007	a
W1[3]	0.032	0.447	0.0436	0.0007	a
W2[25]	0.042	0.307	0.0367	0.0008	a
W2[16]	0.028	0.299	0.0375	0.0005	a
W2[41]	0.023	0.314	0.0396	0.0005	a
W2[33]	0.025	0.322	0.0383	0.0005	a
W1[56]	0.039	0.612	0.0379	0.0007	a
W2[32]	0.023	0.304	0.0386	0.0004	a
W2[3]	0.025	0.322	0.0446	0.0006	a
Qj[0]	0.136	0.129	0.0240	0.0016	a
W1[50]	0.024	0.459	0.0457	0.0005	a
W2[43]	0.030	0.317	0.0390	0.0006	a
W2[21]	0.030	0.317	0.0386	0.0006	a
W2[13]	0.020	0.324	0.0374	0.0004	a
W2[28]	0.018	0.302	0.0385	0.0004	a
W2[11]	0.023	0.271	0.0357	0.0004	a
W2[37]	0.028	0.309	0.0398	0.0006	a
W2[7]	0.044	0.222	0.0307	0.0007	a

W2[35]	0.025	0.357	0.0403	0.0005	a
W2[47]	0.028	0.309	0.0384	0.0005	a
W2[19]	0.028	0.347	0.0383	0.0005	a
W2[0]	0.017	0.332	0.0462	0.0004	a
W2[31]	0.028	0.343	0.0381	0.0005	a
W2[38]	0.025	0.360	0.0395	0.0005	a
W2[6]	0.023	0.330	0.0416	0.0005	a
W2[29]	0.023	0.320	0.0406	0.0005	a
W2[36]	0.025	0.346	0.0388	0.0005	a
W2[17]	0.025	0.340	0.0385	0.0005	a
W2[9]	0.023	0.316	0.0401	0.0005	a
W2[30]	0.023	0.342	0.0403	0.0005	a
W2[40]	0.025	0.314	0.0380	0.0005	a
W2[48]	0.023	0.353	0.0397	0.0005	a
W2[42]	0.023	0.326	0.0393	0.0004	a
W2[23]	0.025	0.336	0.0372	0.0005	a
WS[56]	0.015	0.650	0.0388	0.0003	a
W2[46]	0.023	0.357	0.0387	0.0004	a
WS[29]	0.011	0.474	0.0463	0.0002	a
W1[2]	0.013	0.345	0.0462	0.0003	a
W2[49]	0.021	0.323	0.0389	0.0004	a
W1[49]	0.013	0.481	0.0462	0.0003	a
W1[14]	0.013	0.453	0.0463	0.0003	a
W2[27]	0.021	0.323	0.0388	0.0004	a
W1[28]	0.013	0.490	0.0457	0.0003	a
W2[20]	0.020	0.303	0.0385	0.0004	a
W1[38]	0.013	0.489	0.0456	0.0003	a
W2[26]	0.023	0.300	0.0364	0.0004	a
W1[27]	0.013	0.480	0.0458	0.0003	a
W1[12]	0.013	0.458	0.0452	0.0003	a
W1[48]	0.013	0.487	0.0452	0.0003	a
W1[47]	0.013	0.451	0.0449	0.0003	a
W1[29]	0.015	0.442	0.0446	0.0003	a
W1[37]	0.013	0.450	0.0448	0.0003	a
W1[32]	0.013	0.489	0.0451	0.0003	a
W1[44]	0.013	0.451	0.0449	0.0003	a
W1[22]	0.013	0.459	0.0448	0.0003	a
W1[18]	0.013	0.443	0.0447	0.0003	a
W2[12]	0.018	0.309	0.0393	0.0004	a
W1[8]	0.013	0.471	0.0445	0.0003	a
W1[9]	0.015	0.478	0.0444	0.0003	a
W2[44]	0.018	0.337	0.0387	0.0004	a
W1[23]	0.013	0.481	0.0441	0.0003	a
W2[14]	0.020	0.306	0.0367	0.0004	a
WS[1]	0.004	0.414	0.0477	9.500e−05	a
W2[45]	0.017	0.363	0.0390	0.0003	a
W1[24]	0.015	0.512	0.0433	0.0003	a
W2[15]	0.018	0.345	0.0381	0.0003	a
W2[39]	0.018	0.310	0.0376	0.0003	a
W2[56]	0.022	0.274	0.0349	0.0004	a
W2[34]	0.018	0.312	0.0379	0.0003	a
W1[7]	0.010	0.469	0.0454	0.0002	a
W1[41]	0.013	0.479	0.0452	0.0003	a
W1[31]	0.010	0.488	0.0451	0.0002	a
W1[16]	0.013	0.455	0.0449	0.0003	a
W1[20]	0.010	0.484	0.0451	0.0002	a
WS[28]	0.009	0.515	0.0475	0.0002	a

W1[6]	0.013	0.473	0.0443	0.0003	a
W1[34]	0.008	0.447	0.0463	0.0002	a
W1[46]	0.010	0.460	0.0441	0.0002	a
W1[5]	0.013	0.418	0.0438	0.0003	a
W1[1]	0.007	0.377	0.0462	0.0002	a
WS[47]	0.028	0.477	0.0464	0.0007	a
W1[35]	0.008	0.458	0.0452	0.0002	a
W1[0]	0.007	0.332	0.0462	0.0002	a
W1[36]	0.008	0.457	0.0449	0.0002	a
W1[26]	0.008	0.481	0.0444	0.0002	a
W1[42]	0.008	0.498	0.0440	0.0002	a
W1[40]	0.008	0.504	0.0443	0.0002	a
W1[43]	0.008	0.467	0.0441	0.0002	a
W1[25]	0.008	0.474	0.0435	0.0002	a
W1[4]	0.007	0.447	0.0440	0.0002	a
WS[52]	0.011	0.491	0.0468	0.0002	a
muxW	0.243	0.121	0.0061	0.0007	a
W2[8]	0.020	0.204	0.0293	0.0003	a
WS[24]	0.011	0.543	0.0448	0.0002	a
WC[46]	0.028	0.340	0.0400	0.0006	a
WS[4]	0.004	0.479	0.0456	9.084e−05	a
W2[5]	0.025	0.145	0.0199	0.0003	a
qjD[56]	0.011	0.385	0.0438	0.0002	a
WS[19]	0.015	0.489	0.0468	0.0003	a
WS[14]	0.015	0.507	0.0473	0.0003	a
qjD[53]	0.020	0.343	0.0427	0.0004	a
W2[4]	0.021	0.132	0.0168	0.0002	a
qjD[34]	0.016	0.387	0.0442	0.0004	a
CLR	0.502	0.970	0.0060	0.0015	a
WS[32]	0.028	0.492	0.0464	0.0007	a
WC[30]	0.028	0.352	0.0415	0.0006	a
WS[22]	0.028	0.510	0.0459	0.0007	a
Qj[1]	0.068	0.214	0.0312	0.0011	a
WS[55]	0.028	0.529	0.0458	0.0006	a
WS[7]	0.028	0.501	0.0466	0.0007	a
WS[51]	0.028	0.487	0.0466	0.0007	a
WC[24]	0.015	0.335	0.0394	0.0003	a
WC[50]	0.028	0.328	0.0399	0.0006	a
qjD[29]	0.024	0.346	0.0437	0.0005	a
qjD[8]	0.016	0.349	0.0448	0.0004	a
WS[53]	0.009	0.541	0.0430	0.0002	a
W1[51]	0.047	0.488	0.0449	0.0011	a
WC[40]	0.009	0.329	0.0395	0.0002	a
qjD[33]	0.021	0.364	0.0436	0.0005	a
qjD[18]	0.019	0.345	0.0439	0.0004	a
qjD[6]	0.019	0.374	0.0443	0.0004	a
qjD[20]	0.020	0.373	0.0450	0.0004	a
WC[44]	0.005	0.322	0.0405	9.170e−05	a
WC[27]	0.005	0.359	0.0399	9.030e−05	a
WC[34]	0.005	0.350	0.0391	8.844e−05	a
qjD[23]	0.016	0.352	0.0438	0.0004	a
qjD[52]	0.017	0.363	0.0431	0.0004	a
qjD[15]	0.016	0.334	0.0434	0.0004	a
qjD[46]	0.017	0.341	0.0434	0.0004	a
I_CTRL/ROUND	0.003	0.061	0.0121	1.886e−05	a
WC[38]	0.028	0.370	0.0408	0.0006	a
qjD[44]	0.013	0.349	0.0441	0.0003	a

WS[33]	0.015	0.510	0.0448	0.0003	a
WC[49]	0.028	0.331	0.0401	0.0006	a
WS[45]	0.013	0.502	0.0471	0.0003	a
WC[33]	0.028	0.335	0.0395	0.0006	a
WC[23]	0.028	0.319	0.0387	0.0005	a
WS[49]	0.009	0.482	0.0478	0.0002	a
WC[39]	0.028	0.321	0.0389	0.0006	a
WS[50]	0.009	0.485	0.0475	0.0002	a
I_CTRL/DIGIT	0.004	0.879	0.0061	1.169e−05	a
WC[21]	0.011	0.328	0.0404	0.0002	a
WC[43]	0.011	0.356	0.0407	0.0002	a
WC[14]	0.028	0.318	0.0381	0.0005	a
WS[41]	0.009	0.479	0.0469	0.0002	a
WC[12]	0.010	0.344	0.0403	0.0002	a
WC[36]	0.011	0.328	0.0404	0.0002	a
WS[2]	0.009	0.404	0.0485	0.0002	a
WS[48]	0.010	0.517	0.0462	0.0002	a
WS[5]	0.009	0.445	0.0457	0.0002	a
WS[27]	0.009	0.537	0.0471	0.0002	a
WS[18]	0.009	0.475	0.0462	0.0002	a
WC[19]	0.011	0.325	0.0393	0.0002	a
WS[9]	0.011	0.479	0.0452	0.0002	a
WS[10]	0.007	0.513	0.0472	0.0002	a
W2[2]	0.018	0.000	0.0000	0.0000	a
WS[8]	0.009	0.530	0.0452	0.0002	a
WS[20]	0.007	0.514	0.0462	0.0002	a
W2[1]	0.018	0.000	0.0000	0.0000	a
WS[15]	0.007	0.485	0.0472	0.0002	a
WS[16]	0.009	0.509	0.0460	0.0002	a
WS[38]	0.009	0.521	0.0469	0.0002	a
WS[31]	0.007	0.489	0.0464	0.0002	a
WS[46]	0.007	0.518	0.0459	0.0002	a
WS[6]	0.009	0.473	0.0454	0.0002	a
WS[12]	0.009	0.515	0.0465	0.0002	a
WS[21]	0.007	0.485	0.0463	0.0002	a
qjD[40]	0.020	0.367	0.0452	0.0004	a
qjD[4]	0.022	0.343	0.0445	0.0005	a
WS[17]	0.007	0.505	0.0458	0.0001	a
qjD[35]	0.019	0.335	0.0439	0.0004	a
WS[34]	0.005	0.476	0.0476	0.0001	a
qjD[25]	0.020	0.346	0.0427	0.0004	a
qjD[11]	0.019	0.363	0.0436	0.0004	a
qjD[28]	0.017	0.380	0.0449	0.0004	a
WC[41]	0.005	0.360	0.0413	9.350e−05	a
WC[22]	0.007	0.366	0.0395	0.0001	a
WS[39]	0.007	0.493	0.0454	0.0002	a
WC[26]	0.009	0.338	0.0375	0.0002	a
qjD[9]	0.019	0.373	0.0453	0.0004	a
WC[13]	0.007	0.306	0.0387	0.0001	a
qjD[2]	0.013	0.372	0.0476	0.0003	a
WS[54]	0.006	0.444	0.0453	0.0001	a
WS[35]	0.005	0.485	0.0467	0.0001	a
WS[11]	0.005	0.486	0.0456	0.0001	a
qjD[37]	0.017	0.374	0.0438	0.0004	a
WS[36]	0.005	0.486	0.0460	0.0001	a
WS[42]	0.005	0.493	0.0458	0.0001	a
WS[30]	0.007	0.474	0.0456	0.0002	a

qjD[43]	0.021	0.337	0.0434	0.0005	a
WS[25]	0.005	0.503	0.0451	0.0001	a
WS[13]	0.005	0.504	0.0456	0.0001	a
WS[26]	0.005	0.513	0.0459	0.0001	a
qjD[26]	0.020	0.370	0.0428	0.0004	a
WC[10]	0.007	0.313	0.0377	0.0001	a
WS[40]	0.005	0.533	0.0453	0.0001	a
qjD[5]	0.016	0.335	0.0433	0.0004	a
qjD[31]	0.016	0.319	0.0441	0.0004	a
qjD[13]	0.016	0.356	0.0442	0.0004	a
WS[43]	0.005	0.526	0.0455	0.0001	a
WC[3]	0.011	0.331	0.0463	0.0002	a
qjD[42]	0.020	0.370	0.0435	0.0004	a
WC[0]	0.029	0.372	0.0476	0.0007	a
qjD[50]	0.016	0.346	0.0433	0.0004	a
qjD[10]	0.016	0.375	0.0431	0.0003	a
qjD[41]	0.016	0.374	0.0433	0.0004	a
qjD[21]	0.019	0.371	0.0431	0.0004	a
qjD[47]	0.014	0.368	0.0439	0.0003	a
WC[15]	0.015	0.329	0.0397	0.0003	a
qjD[17]	0.014	0.337	0.0426	0.0003	a
qjD[14]	0.015	0.373	0.0435	0.0003	a
qjD[16]	0.016	0.368	0.0438	0.0004	a
qjD[30]	0.013	0.368	0.0432	0.0003	a
WC[51]	0.012	0.361	0.0413	0.0002	a
qjD[27]	0.016	0.356	0.0440	0.0004	a
qjD[48]	0.013	0.330	0.0426	0.0003	a
WC[9]	0.010	0.333	0.0419	0.0002	a
WC[35]	0.011	0.365	0.0413	0.0002	a
WC[6]	0.009	0.341	0.0430	0.0002	a
qjD[51]	0.011	0.373	0.0451	0.0002	a
qjD[7]	0.016	0.319	0.0427	0.0003	a
qjD[55]	0.013	0.350	0.0400	0.0003	a
WC[29]	0.009	0.328	0.0415	0.0002	a
WC[20]	0.010	0.343	0.0399	0.0002	a
WC[7]	0.007	0.256	0.0317	0.0001	a
WC[54]	0.011	0.351	0.0403	0.0002	a
WC[47]	0.011	0.318	0.0397	0.0002	a
WC[17]	0.011	0.320	0.0397	0.0002	a
WC[42]	0.009	0.365	0.0410	0.0002	a
WC[37]	0.009	0.314	0.0409	0.0002	a
qjD[12]	0.016	0.336	0.0434	0.0004	a
WC[53]	0.009	0.359	0.0403	0.0002	a
WC[16]	0.011	0.338	0.0388	0.0002	a
WC[32]	0.009	0.315	0.0400	0.0002	a
WC[8]	0.007	0.209	0.0301	0.0001	a
WC[31]	0.009	0.355	0.0395	0.0002	a
WC[11]	0.009	0.283	0.0372	0.0002	a
WC[55]	0.007	0.335	0.0393	0.0001	a
qjD[36]	0.016	0.333	0.0431	0.0003	a
WC[56]	0.011	0.301	0.0352	0.0002	a
qjD[45]	0.006	0.373	0.0435	0.0001	a
WC[45]	0.005	0.346	0.0405	9.170e−05	a
WC[28]	0.005	0.313	0.0402	9.090e−05	a
WS[44]	0.009	0.507	0.0461	0.0002	a
WS[23]	0.009	0.501	0.0458	0.0002	a
qjD[24]	0.021	0.364	0.0438	0.0005	a

qjD [49]	0.019	0.345	0.0439	0.0004	a
Qj [2]	0.017	0.255	0.0355	0.0003	a
Qj [3]	0.063	0.116	0.0170	0.0005	a
qjD [3]	0.012	0.338	0.0432	0.0003	a
qjD [39]	0.021	0.350	0.0448	0.0005	a
WC[5]	0.028	0.124	0.0211	0.0003	a
qjD [19]	0.015	0.339	0.0433	0.0003	a
MXLA[24]	0.022	0.481	0.0448	0.0005	a
W2[50]	0.024	0.348	0.0389	0.0005	a
n114	0.011	0.129	0.0240	0.0001	a
WS[3]	0.007	0.474	0.0444	0.0001	a
qjD [54]	0.013	0.363	0.0438	0.0003	a
qjD [22]	0.013	0.338	0.0433	0.0003	a
n109	0.028	0.786	0.0312	0.0004	d
qjD [32]	0.013	0.345	0.0432	0.0003	a
qjD [38]	0.013	0.331	0.0431	0.0003	a
MXLA[43]	0.018	0.518	0.0453	0.0004	a
MXLA[33]	0.018	0.502	0.0449	0.0004	a
MXLA[23]	0.018	0.502	0.0448	0.0004	a
MXLA[39]	0.018	0.491	0.0447	0.0004	a
MXLA[45]	0.018	0.492	0.0437	0.0004	a
WS[0]	0.004	0.372	0.0476	9.488e−05	a
WC[18]	0.012	0.332	0.0394	0.0002	a
MXLA[26]	0.018	0.541	0.0430	0.0004	a
MXLA[20]	0.017	0.471	0.0454	0.0004	a
MXLA[49]	0.017	0.485	0.0454	0.0004	a
MXLA[40]	0.017	0.526	0.0453	0.0004	a
MXLA[29]	0.017	0.509	0.0456	0.0004	a
MXLA[12]	0.017	0.520	0.0455	0.0004	a
WC[52]	0.011	0.359	0.0411	0.0002	a
MXLA[21]	0.017	0.500	0.0451	0.0004	a
MXLA[9]	0.017	0.509	0.0453	0.0004	a
MXLA[18]	0.017	0.483	0.0450	0.0004	a
MXLA[25]	0.017	0.496	0.0443	0.0004	a
MXLA[7]	0.017	0.454	0.0444	0.0004	a
MXLA[42]	0.017	0.521	0.0440	0.0004	a
MXLA[6]	0.017	0.479	0.0441	0.0004	a
MXLA[35]	0.017	0.483	0.0438	0.0004	a
MXLA[11]	0.017	0.495	0.0438	0.0004	a
MXLA[2]	0.014	0.363	0.0481	0.0003	a
MXLA[4]	0.014	0.384	0.0473	0.0003	a
MXLA[3]	0.014	0.412	0.0465	0.0003	a
MXLA[30]	0.014	0.514	0.0465	0.0003	a
MXLA[56]	0.016	0.401	0.0418	0.0003	a
MXLA[36]	0.014	0.468	0.0461	0.0003	a
MXLA[16]	0.014	0.475	0.0463	0.0003	a
MXLA[46]	0.014	0.477	0.0456	0.0003	a
MXLA[22]	0.014	0.507	0.0452	0.0003	a
MXLA[31]	0.014	0.479	0.0451	0.0003	a
MXLA[50]	0.014	0.507	0.0452	0.0003	a
MXLA[37]	0.014	0.487	0.0451	0.0003	a
MXLA[38]	0.014	0.487	0.0450	0.0003	a
MXLA[14]	0.014	0.481	0.0451	0.0003	a
MXLA[10]	0.014	0.500	0.0447	0.0003	a
MXLA[48]	0.014	0.492	0.0446	0.0003	a
MXLA[41]	0.014	0.525	0.0445	0.0003	a
MXLA[15]	0.014	0.502	0.0445	0.0003	a

```
MXLA[8]                         0.014      0.516      0.0443       0.0003    a
MXLA[54]                        0.014      0.431      0.0445       0.0003    a
MXLA[34]                        0.014      0.515      0.0442       0.0003    a
MXLA[44]                        0.014      0.525      0.0442       0.0003    a
MXLA[19]                        0.014      0.496      0.0441       0.0003    a
n113                            0.010      0.214      0.0312       0.0002    a
MXLA[32]                        0.014      0.475      0.0439       0.0003    a
MXLA[28]                        0.014      0.492      0.0441       0.0003    a
MXLA[5]                         0.014      0.470      0.0437       0.0003    a
MXLA[13]                        0.014      0.512      0.0436       0.0003    a
MXLA[55]                        0.014      0.434      0.0432       0.0003    a
MXLA[47]                        0.013      0.470      0.0463       0.0003    a
MXLA[27]                        0.014      0.500      0.0430       0.0003    a
MXLA[52]                        0.012      0.498      0.0458       0.0003    a
WC[25]                          0.012      0.313      0.0377       0.0002    a
MXLA[51]                        0.012      0.509      0.0462       0.0003    a
MXLA[17]                        0.012      0.486      0.0457       0.0003    a
MXLA[53]                        0.012      0.579      0.0440       0.0003    a
n104                            0.013      0.320      0.0403       0.0003    a
WC[4]                           0.005      0.138      0.0176    3.969e-05    a
WC[48]                          0.009      0.362      0.0409       0.0002    a
n112                            0.010      0.116      0.0170    8.670e-05    a
n106                            0.013      0.348      0.0389       0.0002    a
n111                            0.019      0.884      0.0170       0.0002    d
n105                            0.003      0.652      0.0389    6.093e-05    d
MXLA[1]                         0.012      0.059      0.0045    2.639e-05    a
WC[2]                           0.005      0.008      0.0009    1.931e-06    a
MXLA[0]                         0.012      0.000      0.29e-4   1.725e-07    a
WC[1]                           0.005      0.000      0.29e-4   6.659e-08    a
GND                             0.054      0.000      0.0000       0.0000    a
--------------------------------------------------------------------------------
Total (358 nets)                                               132.1090 uW


  Attributes
  ----------
      h - Hierarchical cell


                          Cell       Driven Net   Tot Dynamic       Cell
                          Internal   Switching    Power             Leakage
Cell                      Power      Power        (% Cell/Tot)      Power         Attrs
--------------------------------------------------------------------------------------
U11                       7.152e-04  1.627e-03    2.34e-03 (31%)    87144.8984
U6                        4.637e-04  1.057e-03    1.52e-03 (31%)    64390.7773
U4                        1.562e-04  5.338e-04    6.90e-04 (23%)    41128.3047
U10                       1.609e-04  4.421e-04    6.03e-04 (27%)    13943.4912
U7                        1.269e-04  2.527e-04    3.80e-04 (33%)      527.7838
U9                        3.124e-05  2.440e-04    2.75e-04 (11%)      621.4948
U5                        9.715e-05  1.594e-04    2.57e-04 (38%)    13236.0986
U8                        3.022e-05  6.093e-05    9.12e-05 (33%)       85.9794
I_CSA1                       0.0201        N/A         N/A (N/A)    1109096.7500
                                                                                h
I_CSA2                       0.1132        N/A         N/A (N/A)    6325460.0000
                                                                                h
I_CTRL                       0.0232        N/A         N/A (N/A)    791643.9375
```

					h
I_MULT	0.0642	N/A	N/A (N/A)	6805544.0000	h
I_MUX	8.958e−03	N/A	N/A (N/A)	116396.2422	h
I_REG1	0.0711	N/A	N/A (N/A)	3329028.2500	h
I_REG2	0.2676	N/A	N/A (N/A)	9979037.0000	h
I_SEL	0.0410	N/A	N/A (N/A)	3254091.0000	h
Totals (16 cells)	611.244uW	N/A	N/A (N/A)	31.931uW	

Hierarchy	Switch Power	Int Power	Leak Power	Total Power	%
divr4_rec	0.281	0.611	3.19e+07	0.924	100.0
I_SEL (QDSEL)	2.71e−02	4.10e−02	3.25e+06	7.13e−02	7.7
I_2 (QDS_ADDER)	1.58e−02	2.61e−02	1.98e+06	4.39e−02	4.8
I_1 (QDS_TABLE)	1.13e−02	1.49e−02	1.28e+06	2.74e−02	3.0
I_REG2 (gl_dualreg_ld_n45)	6.87e−02	0.268	9.98e+06	0.346	37.5
I_REG1 (gl_dualreg_ld_n10)	2.58e−02	7.11e−02	3.33e+06	0.100	10.8
I_CSA2 (csa32LSBs_n47)	5.29e−02	0.113	6.33e+06	0.172	18.7
I_CSA1 (gl_csa32_n8)	1.04e−02	2.01e−02	1.11e+06	3.17e−02	3.4
I_MULT (MULT)	5.98e−02	6.42e−02	6.81e+06	0.131	14.2
I_MUX (MUX)	1.93e−02	8.96e−03	1.16e+05	2.84e−02	3.1
I_CTRL (CONTROL)	1.25e−02	2.32e−02	7.92e+05	3.65e−02	3.9
add_54 (CONTROL_DW01_inc_0)	8.31e−04	7.63e−03	4.15e+05	8.88e−03	1.0

7 Appendix B: Power reports from the retimed design

Listing 2: Power Report - Retimed

```
****************************************
Report : power
         -net
         -cell
         -hier
         -analysis_effort low
         -sort_mode dynamic_power
Design : divr4_rec
Version: X-2005.09-SP1
Date   : Fri Nov 23 17:51:57 2007
****************************************




Library(s) Used:

    CORE90GPHVT (File: /cell_libs/cmos090_50a/CORE90GPHVT_SNPS-AVT_2.1.a
            /SIGNOFF/bc_1.10V_m40C_wc_0.90V_105C/PT_LIB/CORE90GPHVT_NomLeak.db)
    CORE90GPSVT (File: /cell_libs/cmos090_50a/CORE90GPSVT_SNPS-AVT_2.1
            /SIGNOFF/bc_1.10V_m40C_wc_0.90V_105C/PT_LIB/CORE90GPSVT_NomLeak.db)




Operating Conditions: NomLeak   Library: CORE90GPSVT
Wire Load Model Mode: enclosed

Design          Wire Load Model          Library
------------------------------------------------------------
divr4_rec                 area_6Kto12K     CORE90GPSVT
CONTROL                   area_0to1K       CORE90GPSVT
CONTROL_DW01_inc_0        area_0to1K       CORE90GPSVT
MUX                       area_0to1K       CORE90GPSVT
MULT                      area_1Kto2K      CORE90GPSVT
gl_csa32_n8               area_0to1K       CORE90GPSVT
csa32LSBs_n47             area_1Kto2K      CORE90GPSVT
gl_dualreg_ld_n56_1       area_1Kto2K      CORE90GPSVT
gl_dualreg_ld_n56_0       area_1Kto2K      CORE90GPSVT
QDSEL                     area_0to1K       CORE90GPSVT
QDS_TABLE                 area_0to1K       CORE90GPSVT
QDS_ADDER                 area_0to1K       CORE90GPSVT
gl_dualreg_ld_n3          area_0to1K       CORE90GPSVT




Global Operating Voltage = 1
Power-specific unit information :
    Voltage Units = 1V
    Capacitance Units = 1.000000pf
    Time Units = 1ns
    Dynamic Power Units = 1mW    (derived from V,C,T units)
```

Leakage Power **Units** = 1pW

Attributes
----
a - Switching activity information annotated **on** net
d - Default switching activity information **on** net

Net	Total Net Load	Static Prob.	Toggle Rate	Switching Power	Attrs
LOAD	0.511	0.939	0.0121	0.0031	a
Qj[2]	0.051	0.255	0.0355	0.0009	a
WS[51]	0.038	0.487	0.0466	0.0009	a
W2[49]	0.025	0.323	0.0389	0.0005	a
Qj[1]	0.049	0.214	0.0312	0.0008	a
WS[50]	0.028	0.485	0.0475	0.0007	a
Qj[3]	0.235	0.116	0.0169	0.0020	a
W2[47]	0.026	0.309	0.0384	0.0005	a
W2[48]	0.024	0.353	0.0397	0.0005	a
W2[0]	0.014	0.332	0.0462	0.0003	a
W2[3]	0.014	0.322	0.0446	0.0003	a
WS[54]	0.056	0.443	0.0452	0.0013	a
W2[6]	0.014	0.330	0.0416	0.0003	a
W2[51]	0.015	0.320	0.0403	0.0003	a
W2[50]	0.017	0.348	0.0389	0.0003	a
W1[48]	0.010	0.487	0.0452	0.0002	a
W2[29]	0.014	0.320	0.0406	0.0003	a
W1[47]	0.013	0.451	0.0449	0.0003	a
W2[30]	0.014	0.342	0.0403	0.0003	a
W2[35]	0.014	0.357	0.0403	0.0003	a
W2[41]	0.014	0.314	0.0396	0.0003	a
W2[37]	0.014	0.309	0.0398	0.0003	a
W2[9]	0.014	0.316	0.0401	0.0003	a
W2[52]	0.014	0.320	0.0398	0.0003	a
W2[38]	0.014	0.360	0.0395	0.0003	a
W1[49]	0.008	0.481	0.0462	0.0002	a
W2[12]	0.014	0.309	0.0393	0.0003	a
W2[42]	0.014	0.326	0.0393	0.0003	a
W2[45]	0.014	0.363	0.0390	0.0003	a
W1[2]	0.007	0.345	0.0462	0.0002	a
W2[36]	0.014	0.346	0.0388	0.0003	a
W2[46]	0.014	0.357	0.0387	0.0003	a
W2[43]	0.014	0.317	0.0390	0.0003	a
W1[1]	0.007	0.377	0.0462	0.0002	a
W2[32]	0.014	0.304	0.0386	0.0003	a
W1[0]	0.007	0.332	0.0462	0.0002	a
W2[27]	0.014	0.323	0.0388	0.0003	a
W2[21]	0.014	0.317	0.0386	0.0003	a
W1[14]	0.007	0.453	0.0463	0.0002	a
W1[34]	0.007	0.447	0.0463	0.0002	a
W2[44]	0.014	0.337	0.0387	0.0003	a
W2[20]	0.014	0.303	0.0385	0.0003	a

W2[17]	0.014	0.340	0.0385	0.0003	a
W2[28]	0.014	0.302	0.0385	0.0003	a
W1[45]	0.007	0.446	0.0460	0.0002	a
W2[19]	0.014	0.347	0.0383	0.0003	a
W2[53]	0.013	0.347	0.0391	0.0003	a
W1[50]	0.007	0.459	0.0457	0.0002	a
W2[33]	0.014	0.322	0.0383	0.0003	a
W2[18]	0.014	0.326	0.0382	0.0003	a
W1[27]	0.007	0.480	0.0458	0.0002	a
W2[22]	0.014	0.324	0.0380	0.0003	a
W1[10]	0.007	0.486	0.0458	0.0002	a
W2[31]	0.014	0.343	0.0381	0.0003	a
W2[40]	0.014	0.314	0.0380	0.0003	a
W1[15]	0.007	0.457	0.0456	0.0002	a
W1[28]	0.007	0.490	0.0457	0.0002	a
W2[34]	0.014	0.312	0.0379	0.0003	a
W2[15]	0.014	0.345	0.0381	0.0003	a
W1[7]	0.007	0.469	0.0454	0.0002	a
W1[19]	0.007	0.468	0.0452	0.0002	a
W1[52]	0.007	0.455	0.0456	0.0002	a
W1[38]	0.007	0.489	0.0456	0.0002	a
W2[24]	0.014	0.320	0.0376	0.0003	a
W1[41]	0.007	0.479	0.0452	0.0002	a
W2[39]	0.014	0.310	0.0376	0.0003	a
W1[20]	0.007	0.484	0.0451	0.0002	a
W1[35]	0.007	0.458	0.0452	0.0002	a
W2[16]	0.014	0.299	0.0375	0.0003	a
W2[13]	0.014	0.324	0.0374	0.0003	a
W1[16]	0.007	0.455	0.0449	0.0002	a
W1[31]	0.007	0.488	0.0451	0.0002	a
W1[18]	0.007	0.443	0.0447	0.0002	a
W1[12]	0.007	0.458	0.0452	0.0002	a
W1[29]	0.007	0.442	0.0446	0.0002	a
W1[36]	0.007	0.457	0.0449	0.0002	a
W1[21]	0.007	0.482	0.0449	0.0002	a
W1[53]	0.007	0.462	0.0446	0.0002	a
W1[30]	0.007	0.443	0.0443	0.0002	a
W1[22]	0.007	0.459	0.0448	0.0002	a
W1[23]	0.007	0.481	0.0441	0.0002	a
W1[37]	0.007	0.450	0.0448	0.0002	a
W1[32]	0.007	0.489	0.0451	0.0002	a
W1[44]	0.007	0.451	0.0449	0.0002	a
W1[6]	0.007	0.473	0.0443	0.0002	a
W2[23]	0.014	0.336	0.0372	0.0003	a
W1[39]	0.007	0.495	0.0444	0.0002	a
W1[4]	0.007	0.447	0.0440	0.0002	a
W1[9]	0.007	0.478	0.0444	0.0002	a
W1[40]	0.007	0.504	0.0443	0.0002	a
W1[17]	0.007	0.473	0.0441	0.0002	a
W1[26]	0.007	0.481	0.0444	0.0002	a
W1[13]	0.007	0.480	0.0443	0.0002	a
W1[5]	0.007	0.418	0.0438	0.0002	a
W2[26]	0.014	0.300	0.0364	0.0003	a
W1[43]	0.007	0.467	0.0441	0.0002	a
W1[46]	0.007	0.460	0.0441	0.0002	a
W1[3]	0.007	0.447	0.0436	0.0002	a
WC[50]	0.038	0.328	0.0399	0.0008	a

W1[33]	0.007	0.456	0.0438	0.0002	a
W2[14]	0.014	0.306	0.0367	0.0003	a
W1[42]	0.007	0.498	0.0440	0.0002	a
W1[54]	0.007	0.432	0.0438	0.0002	a
W2[10]	0.014	0.271	0.0362	0.0003	a
W1[11]	0.007	0.489	0.0440	0.0002	a
W1[8]	0.007	0.471	0.0445	0.0002	a
W2[25]	0.014	0.307	0.0367	0.0003	a
W1[25]	0.007	0.474	0.0435	0.0002	a
W2[11]	0.014	0.271	0.0357	0.0003	a
W1[24]	0.007	0.512	0.0433	0.0002	a
W1[51]	0.008	0.488	0.0449	0.0002	a
W2[54]	0.010	0.355	0.0381	0.0002	a
I_REG1/ZS[55]	0.003	0.543	0.0443	7.675e−05	a
W2[7]	0.014	0.222	0.0307	0.0002	a
I_REG2/ZS[55]	0.003	0.335	0.0387	6.701e−05	a
W2[8]	0.014	0.204	0.0293	0.0002	a
I_REG1/ZS[56]	0.003	0.612	0.0379	6.568e−05	a
WS[52]	0.038	0.491	0.0468	0.0009	a
CLR	0.522	0.970	0.0060	0.0016	a
I_REG2/ZS[56]	0.003	0.274	0.0349	6.048e−05	a
WC[51]	0.039	0.361	0.0413	0.0008	a
Qj[0]	0.016	0.129	0.0240	0.0002	a
W2[5]	0.014	0.145	0.0199	0.0001	a
W2[4]	0.014	0.132	0.0168	0.0001	a
WS[55]	0.036	0.529	0.0458	0.0008	a
I_CTRL/ROUND	0.003	0.061	0.0121	1.886e−05	a
WC[52]	0.025	0.359	0.0411	0.0005	a
I_CTRL/DIGIT	0.004	0.879	0.0061	1.169e−05	a
WC[54]	0.041	0.351	0.0403	0.0008	a
W2[2]	0.014	0.000	0.0000	0.0000	a
W2[1]	0.014	0.000	0.0000	0.0000	a
WC[53]	0.023	0.359	0.0403	0.0005	a
qjD[51]	0.018	0.373	0.0450	0.0004	a
qjD[49]	0.017	0.345	0.0439	0.0004	a
n110	0.025	0.507	0.0452	0.0006	a
MXLA[50]	0.010	0.507	0.0452	0.0002	a
WS[53]	0.023	0.541	0.0430	0.0005	a
MXLA[49]	0.027	0.485	0.0454	0.0006	a
muxW	0.259	0.121	0.0061	0.0008	a
qjD[50]	0.019	0.346	0.0432	0.0004	a
WS[56]	0.015	0.650	0.0388	0.0003	a
MXLA[51]	0.018	0.509	0.0462	0.0004	a
WC[55]	0.020	0.335	0.0393	0.0004	a
WC[0]	0.026	0.372	0.0476	0.0006	a
n109	0.019	0.493	0.0452	0.0004	d
P2	0.009	0.147	0.0261	0.0001	a
qjD[52]	0.013	0.363	0.0430	0.0003	a
WS[49]	0.004	0.482	0.0478	9.327e−05	a
P1	0.010	0.215	0.0318	0.0002	a
MXLA[53]	0.012	0.579	0.0440	0.0003	a
qjD[53]	0.010	0.343	0.0427	0.0002	a
MXLA[52]	0.017	0.498	0.0458	0.0004	a
qjD[2]	0.011	0.372	0.0476	0.0003	a
WS[0]	0.004	0.372	0.0476	9.298e−05	a
WS[1]	0.004	0.414	0.0477	9.309e−05	a
qjD[8]	0.011	0.349	0.0448	0.0002	a

qjD[12]	0.011	0.336	0.0433	0.0002	a
WS[2]	0.004	0.404	0.0485	9.459e−05	a
qjD[9]	0.011	0.373	0.0453	0.0002	a
qjD[28]	0.011	0.380	0.0449	0.0002	a
MXLA[2]	0.011	0.363	0.0481	0.0003	a
qjD[4]	0.011	0.342	0.0445	0.0002	a
qjD[54]	0.011	0.362	0.0438	0.0002	a
WS[15]	0.004	0.485	0.0472	9.212e−05	a
qjD[40]	0.011	0.367	0.0451	0.0002	a
qjD[39]	0.011	0.350	0.0448	0.0002	a
qjD[31]	0.011	0.319	0.0441	0.0002	a
qjD[6]	0.011	0.374	0.0443	0.0002	a
qjD[20]	0.011	0.373	0.0450	0.0002	a
WS[38]	0.004	0.521	0.0469	9.160e−05	a
qjD[35]	0.011	0.335	0.0439	0.0002	a
MXLA[4]	0.011	0.384	0.0473	0.0003	a
WS[31]	0.004	0.489	0.0464	9.062e−05	a
WS[19]	0.004	0.489	0.0468	9.143e−05	a
qjD[24]	0.011	0.364	0.0438	0.0002	a
qjD[37]	0.011	0.374	0.0438	0.0002	a
qjD[34]	0.011	0.387	0.0442	0.0002	a
qjD[27]	0.011	0.355	0.0440	0.0002	a
qjD[18]	0.011	0.345	0.0439	0.0002	a
WS[7]	0.004	0.501	0.0466	9.091e−05	a
WS[35]	0.004	0.485	0.0467	9.108e−05	a
qjD[44]	0.011	0.349	0.0441	0.0002	a
WS[27]	0.004	0.537	0.0471	9.194e−05	a
qjD[13]	0.011	0.356	0.0442	0.0002	a
WS[14]	0.004	0.507	0.0473	9.229e−05	a
qjD[11]	0.011	0.363	0.0436	0.0002	a
qjD[5]	0.011	0.335	0.0432	0.0002	a
qjD[43]	0.011	0.337	0.0434	0.0002	a
qjD[23]	0.011	0.352	0.0438	0.0002	a
qjD[16]	0.011	0.368	0.0438	0.0002	a
qjD[36]	0.011	0.333	0.0431	0.0002	a
WS[12]	0.004	0.515	0.0465	9.079e−05	a
WS[32]	0.004	0.492	0.0464	9.062e−05	a
WS[28]	0.004	0.515	0.0475	9.263e−05	a
qjD[42]	0.011	0.370	0.0435	0.0002	a
qjD[47]	0.011	0.368	0.0438	0.0002	a
WS[48]	0.004	0.517	0.0462	9.022e−05	a
qjD[22]	0.011	0.337	0.0432	0.0002	a
WS[34]	0.004	0.476	0.0476	9.281e−05	a
WS[45]	0.004	0.502	0.0471	9.183e−05	a
qjD[38]	0.011	0.331	0.0431	0.0002	a
WS[29]	0.004	0.474	0.0463	9.039e−05	a
WS[36]	0.004	0.486	0.0460	8.970e−05	a
qjD[30]	0.011	0.368	0.0432	0.0002	a
MXLA[3]	0.011	0.412	0.0465	0.0003	a
qjD[33]	0.011	0.364	0.0436	0.0002	a
WS[10]	0.004	0.513	0.0472	9.206e−05	a
qjD[29]	0.011	0.345	0.0437	0.0002	a
MXLA[30]	0.011	0.514	0.0465	0.0003	a
qjD[32]	0.011	0.345	0.0432	0.0002	a
WS[5]	0.004	0.445	0.0457	8.913e−05	a
WS[41]	0.004	0.479	0.0469	9.154e−05	a
qjD[7]	0.011	0.319	0.0427	0.0002	a

WS[18]	0.004	0.475	0.0462	9.016e−05	a
qjD[14]	0.011	0.373	0.0435	0.0002	a
WS[17]	0.004	0.505	0.0458	8.942e−05	a
qjD[21]	0.011	0.371	0.0431	0.0002	a
qjD[45]	0.011	0.373	0.0435	0.0002	a
WS[46]	0.004	0.518	0.0459	8.964e−05	a
MXLA[47]	0.011	0.470	0.0463	0.0002	a
MXLA[16]	0.011	0.475	0.0463	0.0002	a
qjD[46]	0.011	0.341	0.0433	0.0002	a
qjD[15]	0.011	0.334	0.0433	0.0002	a
qjD[19]	0.011	0.339	0.0432	0.0002	a
WS[22]	0.004	0.510	0.0459	8.964e−05	a
WS[47]	0.004	0.477	0.0464	9.062e−05	a
WS[37]	0.004	0.478	0.0465	9.074e−05	a
qjD[3]	0.011	0.338	0.0432	0.0002	a
MXLA[36]	0.011	0.468	0.0461	0.0002	a
WS[44]	0.004	0.507	0.0461	8.987e−05	a
WS[43]	0.004	0.526	0.0455	8.884e−05	a
qjD[41]	0.011	0.374	0.0433	0.0002	a
WS[20]	0.004	0.514	0.0462	9.022e−05	a
WS[21]	0.004	0.485	0.0463	9.039e−05	a
qjD[48]	0.011	0.330	0.0425	0.0002	a
WS[23]	0.004	0.501	0.0458	8.942e−05	a
qjD[10]	0.011	0.375	0.0431	0.0002	a
qjD[25]	0.011	0.345	0.0427	0.0002	a
WS[26]	0.004	0.513	0.0459	8.959e−05	a
WS[16]	0.004	0.509	0.0460	8.976e−05	a
MXLA[17]	0.011	0.486	0.0457	0.0002	a
WS[4]	0.004	0.479	0.0456	8.901e−05	a
qjD[26]	0.011	0.370	0.0428	0.0002	a
qjD[17]	0.011	0.337	0.0426	0.0002	a
MXLA[29]	0.011	0.509	0.0456	0.0002	a
MXLA[46]	0.011	0.477	0.0456	0.0002	a
WS[39]	0.004	0.493	0.0454	8.867e−05	a
MXLA[12]	0.011	0.520	0.0455	0.0002	a
WS[13]	0.004	0.504	0.0456	8.907e−05	a
MXLA[20]	0.011	0.471	0.0454	0.0002	a
WS[11]	0.004	0.486	0.0456	8.901e−05	a
WS[42]	0.004	0.493	0.0458	8.936e−05	a
MXLA[40]	0.011	0.526	0.0453	0.0002	a
WS[8]	0.004	0.530	0.0452	8.827e−05	a
MXLA[43]	0.011	0.518	0.0453	0.0002	a
MXLA[9]	0.011	0.509	0.0453	0.0002	a
WS[30]	0.004	0.474	0.0456	8.890e−05	a
MXLA[22]	0.011	0.507	0.0452	0.0002	a
WS[25]	0.004	0.503	0.0451	8.809e−05	a
MXLA[31]	0.011	0.479	0.0451	0.0002	a
MXLA[21]	0.011	0.500	0.0451	0.0002	a
MXLA[37]	0.011	0.487	0.0451	0.0002	a
MXLA[14]	0.011	0.481	0.0451	0.0002	a
MXLA[18]	0.011	0.483	0.0450	0.0002	a
MXLA[38]	0.011	0.487	0.0450	0.0002	a
WS[40]	0.004	0.533	0.0453	8.838e−05	a
MXLA[33]	0.011	0.502	0.0449	0.0002	a
MXLA[24]	0.011	0.481	0.0448	0.0002	a
WS[33]	0.004	0.510	0.0448	8.746e−05	a
MXLA[10]	0.011	0.500	0.0447	0.0002	a

WS[6]	0.004	0.473	0.0454	8.855e−05	a
MXLA[23]	0.011	0.502	0.0448	0.0002	a
WS[24]	0.004	0.543	0.0448	8.746e−05	a
MXLA[39]	0.011	0.491	0.0447	0.0002	a
WC[56]	0.014	0.301	0.0352	0.0003	a
MXLA[48]	0.011	0.492	0.0446	0.0002	a
WS[9]	0.004	0.479	0.0452	8.821e−05	a
MXLA[41]	0.011	0.525	0.0445	0.0002	a
MXLA[7]	0.011	0.454	0.0444	0.0002	a
MXLA[15]	0.011	0.502	0.0445	0.0002	a
WS[3]	0.004	0.474	0.0444	8.660e−05	a
MXLA[8]	0.011	0.516	0.0443	0.0002	a
MXLA[25]	0.011	0.496	0.0443	0.0002	a
MXLA[34]	0.011	0.515	0.0442	0.0002	a
MXLA[44]	0.011	0.525	0.0442	0.0002	a
MXLA[6]	0.011	0.479	0.0441	0.0002	a
MXLA[28]	0.011	0.492	0.0441	0.0002	a
MXLA[19]	0.011	0.496	0.0441	0.0002	a
MXLA[32]	0.011	0.475	0.0439	0.0002	a
MXLA[42]	0.011	0.521	0.0440	0.0002	a
MXLA[35]	0.011	0.483	0.0438	0.0002	a
MXLA[45]	0.011	0.492	0.0437	0.0002	a
MXLA[11]	0.011	0.495	0.0438	0.0002	a
MXLA[5]	0.011	0.470	0.0437	0.0002	a
MXLA[13]	0.011	0.512	0.0436	0.0002	a
qjD[55]	0.010	0.350	0.0400	0.0002	a
MXLA[27]	0.011	0.500	0.0430	0.0002	a
MXLA[26]	0.011	0.541	0.0430	0.0002	a
MXLA[54]	0.010	0.431	0.0445	0.0002	a
M1	0.007	0.281	0.0359	0.0001	a
MXLA[55]	0.009	0.434	0.0432	0.0002	a
M2	0.010	0.138	0.0192	9.814e−05	a
qjD[56]	0.005	0.385	0.0438	9.852e−05	a
WC[3]	0.004	0.331	0.0462	9.022e−05	a
MXLA[56]	0.006	0.401	0.0418	0.0001	a
WC[6]	0.004	0.341	0.0430	8.390e−05	a
WC[29]	0.004	0.328	0.0415	8.103e−05	a
WC[9]	0.004	0.332	0.0419	8.171e−05	a
WC[30]	0.004	0.352	0.0415	8.091e−05	a
WC[35]	0.004	0.365	0.0413	8.051e−05	a
WC[41]	0.004	0.360	0.0413	8.062e−05	a
WC[42]	0.004	0.365	0.0410	8.005e−05	a
WC[48]	0.004	0.362	0.0409	7.982e−05	a
WC[37]	0.004	0.314	0.0409	7.976e−05	a
WC[38]	0.004	0.370	0.0408	7.959e−05	a
WC[43]	0.004	0.355	0.0407	7.936e−05	a
WC[21]	0.004	0.328	0.0403	7.873e−05	a
WC[45]	0.004	0.346	0.0405	7.907e−05	a
WC[44]	0.004	0.322	0.0405	7.907e−05	a
WC[12]	0.004	0.344	0.0403	7.867e−05	a
WC[36]	0.004	0.327	0.0403	7.873e−05	a
WC[28]	0.004	0.313	0.0402	7.838e−05	a
WC[46]	0.004	0.340	0.0400	7.804e−05	a
WC[49]	0.004	0.331	0.0400	7.815e−05	a
WC[32]	0.004	0.315	0.0399	7.792e−05	a
WC[27]	0.004	0.359	0.0399	7.786e−05	a
WC[17]	0.004	0.320	0.0396	7.735e−05	a

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WC[15]                                 0.004     0.329     0.0397    7.746e-05   a
WC[20]                                 0.004     0.343     0.0398    7.775e-05   a
WC[47]                                 0.004     0.318     0.0397    7.746e-05   a
WC[31]                                 0.004     0.355     0.0395    7.706e-05   a
WC[40]                                 0.004     0.329     0.0395    7.712e-05   a
WC[33]                                 0.004     0.335     0.0395    7.712e-05   a
WC[22]                                 0.004     0.366     0.0394    7.695e-05   a
WC[24]                                 0.004     0.335     0.0393    7.677e-05   a
WC[19]                                 0.004     0.325     0.0392    7.654e-05   a
WC[18]                                 0.004     0.332     0.0393    7.677e-05   a
WC[34]                                 0.004     0.350     0.0391    7.626e-05   a
WC[13]                                 0.004     0.306     0.0386    7.539e-05   a
WC[39]                                 0.004     0.321     0.0389    7.585e-05   a
WC[16]                                 0.004     0.338     0.0388    7.568e-05   a
WC[23]                                 0.004     0.319     0.0386    7.539e-05   a
WC[14]                                 0.004     0.318     0.0380    7.424e-05   a
WC[10]                                 0.004     0.312     0.0377    7.350e-05   a
WC[25]                                 0.004     0.313     0.0377    7.355e-05   a
WC[11]                                 0.004     0.283     0.0372    7.252e-05   a
WC[26]                                 0.004     0.337     0.0374    7.304e-05   a
WC[7]                                  0.004     0.256     0.0317    6.189e-05   a
WC[8]                                  0.004     0.208     0.0301    5.873e-05   a
WC[5]                                  0.004     0.124     0.0210    4.103e-05   a
n108                                   0.004     0.487     0.0466    9.085e-05   a
WC[4]                                  0.004     0.138     0.0175    3.419e-05   a
n107                                   0.003     0.513     0.0466    7.293e-05   d
MXLA[1]                                0.011     0.059     0.0045    2.430e-05   a
WC[2]                                  0.004     0.008     0.0008    1.609e-06   a
MXLA[0]                                0.011     0.000     0.29e-4   1.588e-07   a
GND                                    0.049     0.000     0.0000       0.0000   a
WC[1]                                  0.004     0.000     0.0000       0.0000   a
--------------------------------------------------------------------------------------
Total (358 nets)                                                     80.5342 uW


  Attributes
  ----------
      h - Hierarchical cell


                         Cell      Driven Net  Tot Dynamic       Cell
                         Internal  Switching   Power             Leakage
Cell                     Power     Power       (% Cell/Tot)      Power         Attrs
--------------------------------------------------------------------------------------
U4                       4.077e-04 5.666e-04   9.74e-04 (42%)    38614.9570
U7                       2.337e-04 4.244e-04   6.58e-04 (36%)    16052.9209
U6                       3.742e-05 9.085e-05   1.28e-04 (29%)      680.3178
U5                       3.610e-05 7.293e-05   1.09e-04 (33%)       79.2676
I_CSA1                      0.0234       N/A        N/A (N/A)    1339850.8750
                                                                           h
I_CSA2                      0.0486       N/A        N/A (N/A)    210952.7344
                                                                           h
I_CTRL                      0.0237       N/A        N/A (N/A)    875802.5625
                                                                           h
I_MULT                      0.0197       N/A        N/A (N/A)    744449.9375
                                                                           h
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I_MUX	0.0102	N/A	N/A (N/A)	322361.5625 h
I_REG1	0.1147	N/A	N/A (N/A)	1539512.2500 h
I_REG2	0.1056	N/A	N/A (N/A)	1479738.7500 h
I_REG3	0.0102	N/A	N/A (N/A)	714367.0000 h
I_SEL	0.0379	N/A	N/A (N/A)	3042233.5000 h
Totals (13 cells)	394.742uW	N/A	N/A (N/A)	10.325uW

Hierarchy	Switch Power	Int Power	Leak Power	Total Power	%
divr4_rec	0.170	0.395	1.03e+07	0.575	100.0
I_REG3 (gl_dualreg_ld_n3)	6.06e−03	1.02e−02	7.14e+05	1.69e−02	2.9
I_SEL (QDSEL)	2.63e−02	3.79e−02	3.04e+06	6.73e−02	11.7
I_2 (QDS_ADDER)	1.49e−02	2.31e−02	1.89e+06	3.99e−02	7.0
I_1 (QDS_TABLE)	1.14e−02	1.48e−02	1.15e+06	2.74e−02	4.8
I_REG2 (gl_dualreg_ld_n56_0)	2.10e−02	0.106	1.48e+06	0.128	22.3
I_REG1 (gl_dualreg_ld_n56_1)	1.64e−02	0.115	1.54e+06	0.133	23.1
I_CSA2 (csa32LSBs_n47)	2.77e−02	4.86e−02	2.11e+05	7.65e−02	13.3
I_CSA1 (gl_csa32_n8)	1.66e−02	2.34e−02	1.34e+06	4.14e−02	7.2
I_MULT (MULT)	2.84e−02	1.97e−02	7.44e+05	4.89e−02	8.5
I_MUX (MUX)	1.47e−02	1.02e−02	3.22e+05	2.52e−02	4.4
I_CTRL (CONTROL)	1.12e−02	2.37e−02	8.76e+05	3.58e−02	6.2
add_54 (CONTROL_DW01_inc_0)	8.28e−04	7.71e−03	4.15e+05	8.95e−03	1.6