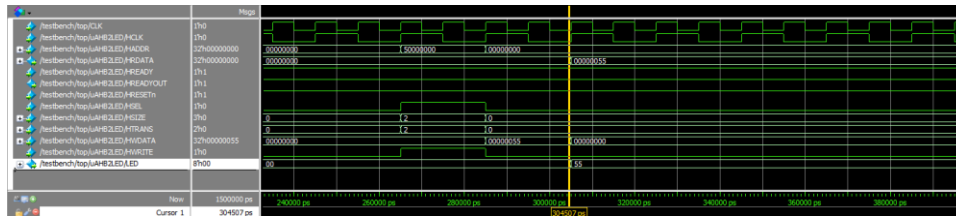


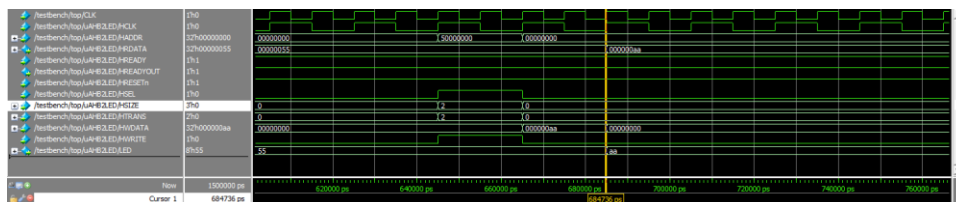
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1.

The clock time for CLK is 10ns, for HCLK it is 20ns. All signals are added from uAHB2LED module. When the LED signal is assigned 8'h55, the simulation timing is 305ns. HWRITE, HSEL signal is switched to high, and HTRANS, HSIZE is switched from 0 to 2, HADDR changes from 32'h0 to 32'h5000_0000 on two HCLK cycles before LED signal assignment. HWDATA is 32'h055 in previous HCLK cycle. And HRDATA changed from 32'h0 to 32'h55 in 305ns. The LED signal holds for 8'h55 380ns.

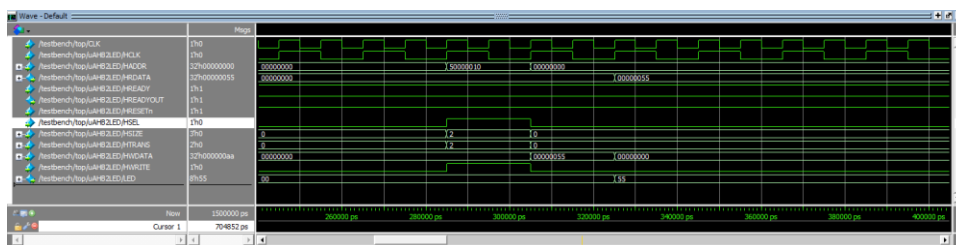


When LED signal is assigned 8'haa in 685ns. Similar operations are taken on the AHB-bus to LED peripheral. HWRITE, HSEL signal is switched to high, and HTRANS, HSIZE is switched from 0 to 2, HADDR changes from 32'h0 to 32'h5000_0000 on two HCLK cycles before LED signal assignment. Difference is about data transmit, HWDATA is 32'h0aa in previous HCLK cycle, HRDATA changed from 32'h0 to 32'haa in 685ns. The LED signal holds for 8'haa 400ns

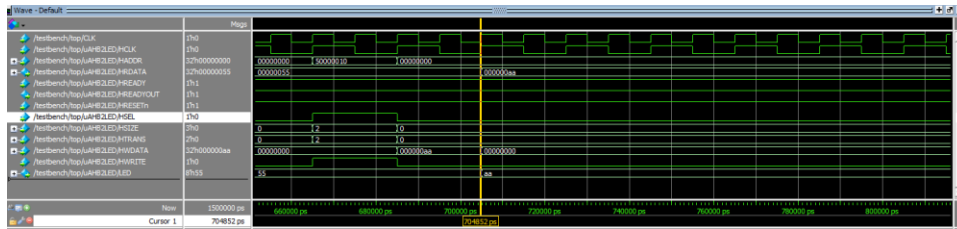


2.

After the loading address changing from 0x5000_0000 to 0x5000_0010, the LED assigns to 8'h55 in 325ns. HADDR 32'h5000_0010 is load to the processor. The address shifts 8 bits and the clock time shifts 20ns.

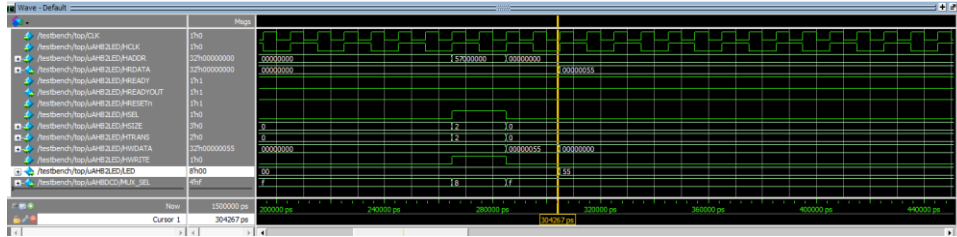


When LED signal is assigned to 8'haa in 704ns, the clock time also shifts 1 HCLK period.



3.

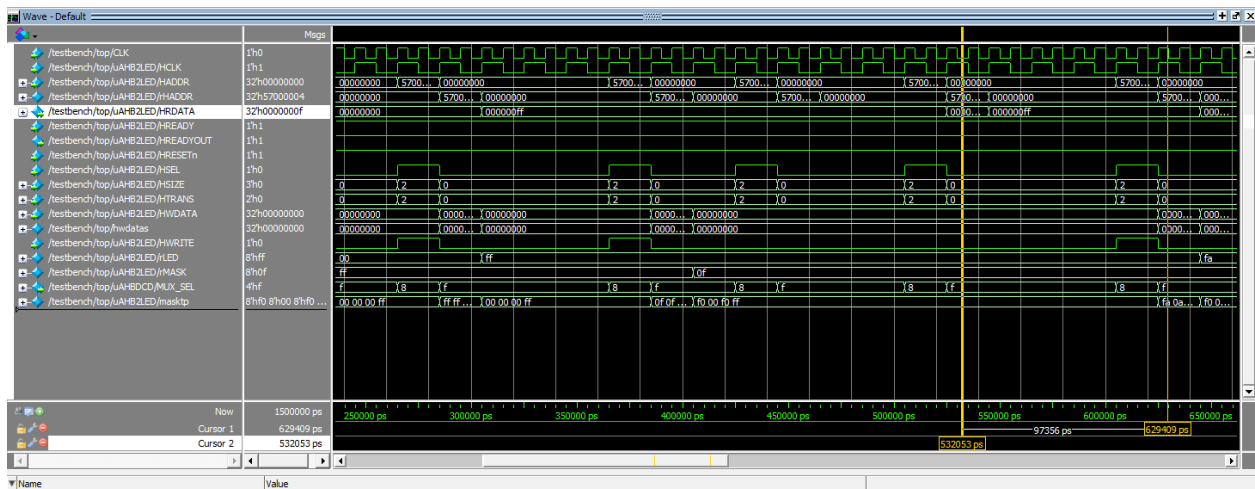
The register loading address is modified from 0x5000_0000 to 0x5700_0000, get the following waveforms:



The LED signal changes to 8'h55 in 305ns and to 8'haa in 685ns. File ARMSOC_TOP.v modifies AHBDCCD module to map led port from HSEL_S1 to HSEL_S8, the decoding address is stored in AHBDCCD.v file. Now the LED address is changed to 0x5700_0000. MUX_SEL signal is switched from 4'hf to 4'h8 on two HCLK cycle earlier.

4.

Mask register value is stored at 0x57000004, and LED register value is stored at 0x57000000. The initial value of mask is 8'hff and LED is 8'h00. When LED is first assigned 8'hff, it is not affected by masking operation because the mask bits are all ones at the beginning of simulation. Then the mask value is assigned 8'h0f. Both LED and mask value is read from memory to processor in the following instructions.



At last, the LED value 8'haa is written to bus, the masking operation write the masked LED value 8'fa to LED register and stores in memory address 0x57000000. The masking operation is done in hardware by a couple of bit logic operations as below. The register value of LED and MASK is stored in rLED and rMASK registers.

```

always @(*) begin
    masktp[1] <= rLED | rMASK;
    masktp[2] <= masktp[1] ^ rMASK;
    masktp[3] <= rMASK & HWDATA[7:0];
    masktp[4] <= masktp[3] | masktp[2];
end

```

