

## g09\_DaySeconds

*Convert the input time into number of seconds since midnight*

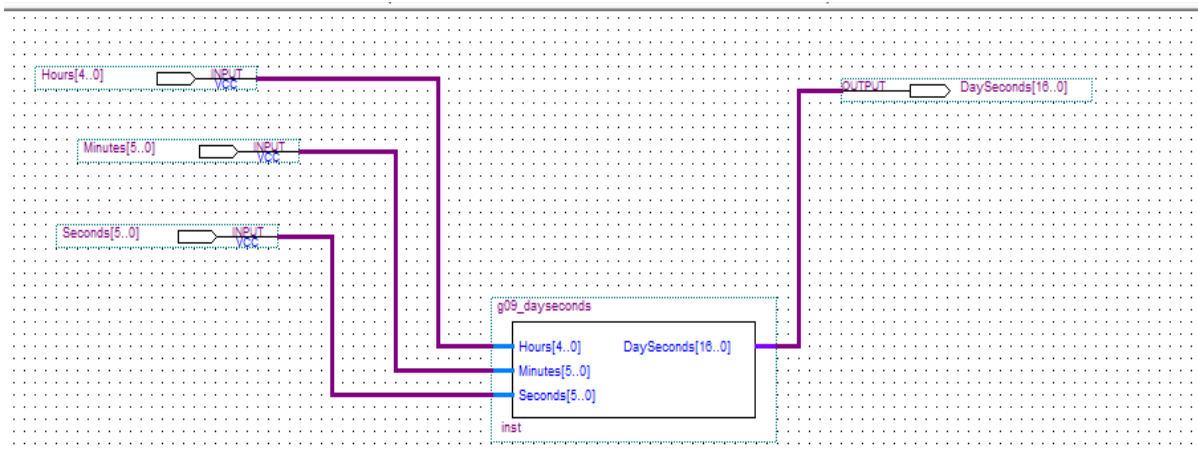
For this lab, we designed a circuit, using VHDL, which would take time as input in the form of Hours, Minutes and Seconds and convert it into seconds since midnight.

The task can be performed in either of the two ways:

$$\text{DaySeconds} = \text{Seconds} + (60 * \text{Minutes}) + (3600 * \text{Hours}) \text{ or}$$
$$\text{DaySeconds} = \text{Seconds} + (60 * (\text{Minutes} + (60 * \text{Hours})))$$

Our aim was to design an efficient circuit so we used the second equation, as it uses lesser number of gates and results in a smaller circuit. We used the VHDL Library modules lpm\_add\_sub and lpm\_multiply to perform the addition and multiplication operations.

The input to the circuit was Hours (5 bit unsigned), Minutes (6 bit unsigned) and Seconds (6 bit unsigned), while the output was DaySeconds (17 bit unsigned). The symbol diagram of our circuit is given below:



Symbol Diagram of the DaySeconds Circuit

### Testing:

We tested the circuit using Functional simulation. The total number of input patterns to the circuit were  $2^5 * 2^6 * 2^6 = 2^{17}$ . We tested the circuit using ALL of the possible input patterns and the outputs obtained were compared to the expected values. The outputs were equal to the expected values, showing that the circuit designed was correct.

Screenshot of a section of the Vector Waveform File for the functional simulation is shown below:

Name	0 ps	20,0 ns	40,0 ns	60,0 ns	80,0 ns	100,0 ns	120,0 ns	140,0 ns	160,0 ns	180,0 ns	200,0 ns	220,0 ns											
	21.05 ns																						
DaySeconds	0	3661	7322	10983	14644	18305	21966	25627	29288	32949	36610	40271	43932	47593	51254	54915	58576	62237	65898	69559	73220	76881	80542
Hours	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Minutes	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Seconds	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Vector Waveform File for DaySeconds Circuit