

## Tutorial for Chapter 8 – Logic Families

➤ 8-1. Two different logic circuits have the characteristics shown in Table 8-13

- Which circuit has the best LOW-state dc noise immunity? The best HIGH-state dc noise immunity?
- Which circuit can operate at higher frequencies?
- Which circuit draws the most supply current?

	Circuit A	Circuit B
$V_{\text{supply}}$ (V)	6	5
$V_{\text{IH(min)}}$ (V)	1.6	1.8
$V_{\text{IL(max)}}$ (V)	0.9	0.7
$V_{\text{OH(min)}}$ (V)	2.2	2.5
$V_{\text{OL(max)}}$ (V)	0.4	0.3
$t_{\text{PLH}}$ (ns)	10	18
$t_{\text{PHL}}$ (ns)	8	14
$P_{\text{D}}$ (mW)	16	10

➔ 8-1. (a) A; B (b) A (c) A

➤ 8-3. A certain logic family has the following voltage parameters:

$$\begin{aligned} V_{\text{IH(min)}} &= 3.5 \text{ V} & V_{\text{IL(max)}} &= 1.0 \text{ V} \\ V_{\text{OH(min)}} &= 4.9 \text{ V} & V_{\text{OL(max)}} &= 0.1 \text{ V} \end{aligned}$$

- What is the largest positive-going noise spike that can be tolerated?
- What is the largest negative-going noise spike that can be tolerated?

➔ 8-3. (a) 0.9 V (b) 1.4 V

8-4. For each statement, indicate the term or parameter being described.

- Current at an input when a logic 1 is applied to that input
- Current drawn from the  $V_{\text{CC}}$  source when all outputs are LOW
- Time required for an output to switch from the 1 to the 0 state
- A common measure used to compare overall performance of different IC families
- The size of the voltage spike that can be tolerated on a HIGH input without causing indeterminate operation
- An IC package that does not require holes to be drilled in the printed circuit board
- When a LOW output receives current from the input of the circuit it is driving
- Number of different inputs that an output can safely drive
- Arrangement of output transistors in a standard TTL circuit
- Another term that describes pull-down transistor  $Q_4$
- Range of  $V_{\text{CC}}$  values allowed for TTL
- $V_{\text{OH(min)}}$  and  $V_{\text{IH(min)}}$  for the 74ALS series
- $V_{\text{IL(max)}}$  and  $V_{\text{OL(max)}}$  for the 74ALS series
- When a HIGH output supplies current to a load

➤ 8-4. (a)  $I_{\text{IH}}$  (b)  $I_{\text{CCL}}$  (c)  $t_{\text{PHL}}$  (d) Speed-power product (e)  $V_{\text{NH}}$  (f) Surface-mount (g) Current sinking (h) Fan-out (i) Totem-pole (j) Sinking transistor (k) 4.75 to 5.25 V (l) 2.5 V; 2.0 V (m) 0.8 V; 0.5 V (n) Sourcing

- 8-5. (a) From Table 8-6, determine the noise margins when a 74LS device is driving a 74ALS input.  
 (b) Repeat part (a) for a 74ALS driving a 74LS.  
 (c) What will be the overall noise margin of a logic circuit that uses 74LS and 74ALS circuits in combination?  
 (d) A certain logic circuit has  $V_{IL(max)} = 450$  mV. Which TTL series can be used with this circuit?

**TABLE 8-6** Typical TTL series characteristics.

	74	74S	74LS	74AS	74ALS	74F
<b>Performance ratings</b>						
Propagation delay (ns)	9	3	9.5	1.7	4	3
Power dissipation (mW)	10	20	2	8	1.2	6
Speed-power product (pJ)	90	60	19	13.6	4.8	18
Max. clock rate (MHz)	35	125	45	200	70	100
Fan-out (same series)	10	20	20	40	20	33
<b>Voltage parameters</b>						
$V_{OH(min)}$	2.4	2.7	2.7	2.5	2.5	2.5
$V_{OL(max)}$	0.4	0.5	0.5	0.5	0.5	0.5
$V_{IH(min)}$	2.0	2.0	2.0	2.0	2.0	2.0
$V_{IL(max)}$	0.8	0.8	0.8	0.8	0.8	0.8

8-5. (a) 0.7 V; 0.3 V (b) 0.5 V; 0.4 V (c) 0.5 V; 0.3 V

#### 8-6. DRILL QUESTION

- (a) Define *fan-out*.  
 (b) In which type of gates do tied-together inputs always count as a single input load in the LOW state?  
 (c) Define “floating” inputs.

8-6. (b) AND, NAND (c) Unconnected inputs

8-12. How long does it take for the output of a typical 74LS04 to change states in response to a positive-going transition at its input?

8-12. 10 ns

8-19. Which of the following are advantages that CMOS generally has over TTL?

- (a) Greater packing density  
 (b) Higher speed  
 (c) Greater fan-out  
 (d) Lower output impedance  
 (e) Simpler fabrication process  
 (f) More suited for LSI  
 (g) Lower  $P_D$  (below 1 MHz)  
 (h) Transistors as only circuit element  
 (i) Lower input capacitance  
 (j) Less susceptible to ESD

8-19. a, c, e, f, g, h