COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

FINAL EXAMINATION PAPER-PENSTER 4 - 2014

CERTIFICATE IV IN ELECTRONICS ENGINEERING

EEE417:   DIGITAL ELECTRONICS 1B

DAY: Wednesday 08/10/2014   TIME: 0900 - 1110hrs VENUE: JNC

INSTRUCTIONS TO STUDENTS:

1.   You are allowed **10 minutes** extra **reading time** during which you are **NOT** to write.

2.   Begin each answer on a fresh page and use both sides of the sheet.

3.   Write your candidate number at the top of each attached sheet.

4.   Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with a string.

5.   For all sheets of paper on which rough/draft work has been done, cross each one through and attach these to your answer scripts.

6.   Write clearly the number(s) of the question(s) attempted on the top of each sheet.

7.   Answers to all questions must be written in ink on the answer sheets.

9.   Use of programmable calculator(s) is prohibited.

10.   The total marks for this question paper is 110 marks.

11.   Attempt **ALL** questions.

1) Which of the following is not a CMOS circuit?
    A) 74HC20
    B) 74HCT04
    C) CD4001
    D) 74LS08

2) A troubleshooter should expect all voltage levels in a TTL circuit to be
    A) 12 V dc
    B) Between 0.4 and 2.4 dc
    C) Less than 0.4 or greater than 2.4 V dc
    D) 240 V ac or zero

3) Which statement below best describes the function of a decoder?
    A) Decoders are special ICs that are used to make it possible for one brand of computer
       to talk to another.
    B) A decoder will convert a binary number into a specified output representing a
       particular character or digit.
    C) Decoders are used to prevent improper operation of digital systems.
    D) A decoder will convert a decimal number into the proper binary equivalent.

4) Which of the following is the first integrated logic family?
    A) RTL
    B) DTL
    C) TTL
    D) MOS

5) The functional capacity for LSI devices is _____.
    A) 12 to 99 gates.
    B) 1 to 11 gates.
    C) 100 to 10,000 gates.
    D) more than 10,000 gates.

6) What is the major advantage of ECL logic?
    A) Very high speed
    B) wide range of operating voltage
    C) very high power
    D) very low cost

7) How many inputs will a decimal-to-BCD encoder have?
    A) 4
    B) 8
    C) 9
    D) 10

8) A basic multiplexer principle can be demonstrated through the use of a:
   A) single-pole relay
   B) DPDT switch
   C) rotary switch
   D) linear stepper

9) One application of a digital multiplexer is to facilitate:
   A) Data generation
   B) serial-to-parallel conversion
   C)   parity checking
   D) data selector

10) A(n) _____ converts an analog input to a digital output.
   A) DAC
   B) ADC
   C) bipolar converter
   D) flash converter

11) The smallest change in the analog voltage that can be represented by a digital word is known as the _____ of an ADC or DAC.
   A) resolution
   B) linearity
   C) conversion time
   D) sampling rate

12) A binary-weighted resistor used in a digital-to-analog converter (DAC) is only practical up to a resolution of _____.
   A) 10 bits
   B) 2 bits
   C) 8 bits
   D) 4 bits

13) For a common-anode seven segment display, when the segments a, b and c are lit, the display will show the number:
   A) 1
   B) 7
   C) 4
   D) 3

14) Identify which display is illustrated in the diagram below?
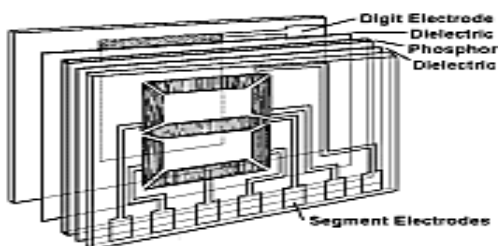
A) LED display

B) Plasma display

C) Electroluminescent display

D) Incandescent Filament display

15) A LCD consists of how many plates of glass, sealed around the perimeter, with a layer of liquid crystal fluid between them.

A) 2

B) 3

C) 4

D) 5

16) LEDs are made out of _____.

A) silicon.

B) germanium.

C) gallium.

D) silicon and germanium, but not gallium.

17) The storage element for a static RAM is the _____.

A) diode

B) capacitor

C) resistor

D) flip-flop

18) Select the statement the best describes Read-only memory (ROM).

A) Nonvolatile, used to store information that changes during system operation

B) Nonvolatile, used to store information that does not change during system operation

C) Volatile, used to store information that changes during system operation

D) Volatile, used to store information that does not change during system operation

19) What two functions does a DRAM controller perform?

A) address multiplexing and data selection

B) data selection and the refresh operation

C) address multiplexing and the refresh operation

D) data selection and CPU accessing

20) Which type of ROM can be erased by UV light?

A) EPROM

B) ROM

C) EEPROM

D) mask ROM

1. Which type of transistor do you find in a:
   a. TTL IC and
   b. CMOS IC?

                                                                                      (2 marks)

2. What are the three performance characteristics to identify any TTL IC.   (3 marks)

3. Refer to the table below and make your analysis on the three types of gates in terms of their speed, power consumption, noise margin, fan-in and fan-out. While comparing, state which one is best to use.
                              (5 marks)

Type of Gate	Fan-in	Fan-out	Propagation delay (ns)	Noise margin (V)	Power consumption (mW)
TTL	8	10	9	0.4	40
CMOS	8	50	30	1.5	1
ECL	5	50	1.1	0.4	30

4. Using the attached datasheet, determine:
   a) What DM74LS02 mean?   (2 marks)
   b) Nominal V_{CC}.   (1 mark)
   c) Power dissipation, P_D (3 marks)
   d) High-level noise margin, V_{NH} (2 marks)
   e) Low-level noise margin, V_{NL} (2 marks)

DM74LS02

Absolute Maximum Ratings (Note 1)

Supply Voltage	7V
Input Voltage	7V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units
V_{CC}	Supply Voltage	4.75	5	5.25	V
V_{IH}	HIGH Level Input Voltage	2			V
V_{IL}	LOW Level Input Voltage			0.8	V
I_{OH}	HIGH Level Output Current			−0.4	mA
I_{OL}	LOW Level Output Current			8	mA
T_A	Free Air Operating Temperature	0		70	°C

Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ (Note 2)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA			−1.5	V
V_{OH}	HIGH Level Output Voltage	V_{CC} = Min, I_{OH} = Max, V_{IL} = Max	2.7	3.4		V
V_{OL}	LOW Level Output Voltage	V_{CC} = Min, I_{OL} = Max, V_{IH} = Min		0.35	0.5	V
		I_{OL} = 4 mA, V_{CC} = Min		0.25	0.4	
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 7V			0.1	mA
I_{IH}	HIGH Level Input Current	V_{CC} = Max, V_I = 2.7V			20	µA
I_{IL}	LOW Level Input Current	V_{CC} = Max, V_I = 0.4V			−0.40	mA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 3)	−20		−100	mA
I_{CCH}	Supply Current with Outputs HIGH	V_{CC} = Max		1.6	3.2	mA
I_{CCL}	Supply Current with Outputs LOW	V_{CC} = Max		2.8	5.4	mA

Note 2: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 3: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Switching Characteristics

at V_{CC} = 5V and T_A = 25°C

Symbol	Parameter	R_L = 2 kΩ				Units
		C_L = 15 pF		C_L = 50 pF		
		Min	Max	Min	Max	
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output		13		18	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output		10		15	ns

For each of the following statements, write "True" or "False"

1. If a logic circuit has a fan-out of 5, the circuit has 5 outputs.

2. The high-state noise margin is the difference between V_{IH}(min) and V_{OH}(min).

3. A logic family with tpd(avg)=12ns and P_D(avg)=15mW has a greater speed-power product than one with 8ns and 30mW.

4. The basic function of a comparator is to compare the magnitude of two binary quantities to determine the relationship of those quantities.

5. An encoder is a combinational logic circuit that essentially performs the "reverse" decoder function. ``````

6. The basic function of a decoder is to detect the presence of a specified combination of bits (code) on its input and to indicate that presence by a specified output level.

7. A Multiplexer has a single input but many outputs.

8. A DeMultiplexer is a device that allows digital information from several sources to be routed into a single line for transmission over that line to a common destination.

9. A DAC is used to convert a digital input word into an analogue output voltage or current.

10. The majority of Light-Emitting Diodes are either Gallium Phosphide (GaP) or Gallium Arsenide Phosphide (GaAsP) devices.

11. There are two classes of liquid crystal known respectively as Neumatic and Smetic, but only the latter is used to display devices.

12. Seven segment displays are generally employed as indicators of decimal numbers and consist of a number of LEDs arranged in seven segments.

13. If Alphanumerical characters are to be displayed, either a 16 segment, or a dot matrix display is required.

14. A TSM7752B is a 16 segment display driver module.

SECTION-D   **SHORT ANSWER QUESTIONS**   **[20 Marks]**

1. List three performance characteristics of the TTL IC when compared to the CMOS IC .   (3 marks)

2. Which type of the transistor do you find in a CMOS IC?   (1 mark)

3. Determine from the given table, which one is the best to use and give a reason to support your answer.
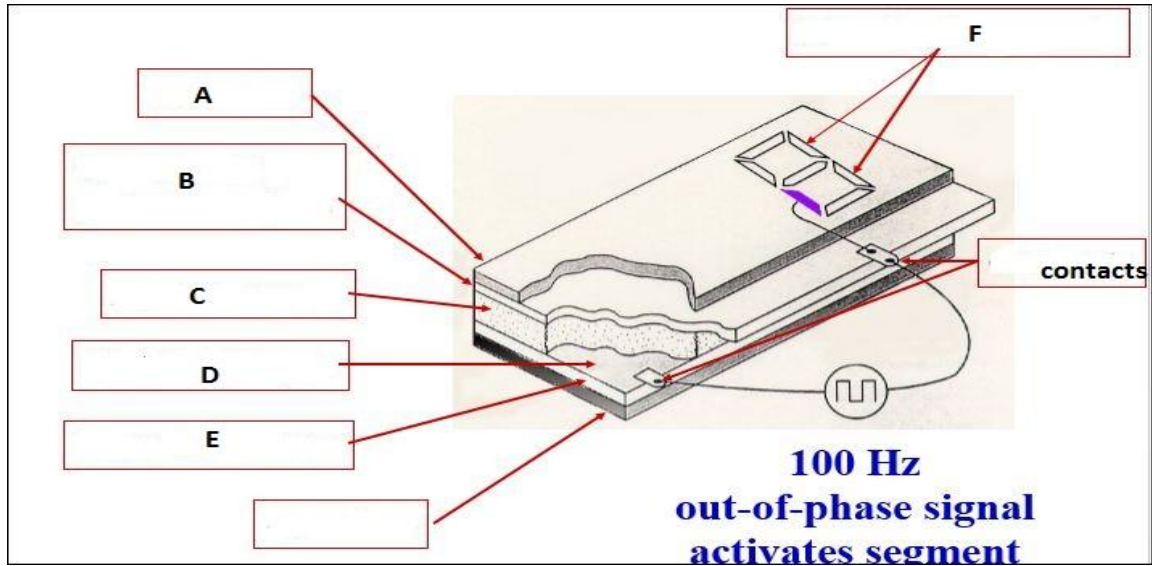   (2 marks)

Technology	CMOS (silicon-gate)	TTL Std.
Device Series	74HC	74LS
Static power Dissipation	2.5 nW	10 mW
Propagation Delay Time	8 ns	10 ns
Fan-out	*4000	10

4. Using the attached datasheet, determine:
    a)   What DM74LS00 mean?   (4 marks)
    b)   Nominal V_{CC}.   (1 mark)
    c)   Power dissipation, P_D (4 marks)
    d)   High-level noise margin, V_{NH} (2.5 marks)
    e)   Low-level noise margin, V_{NL} (2.5 marks)
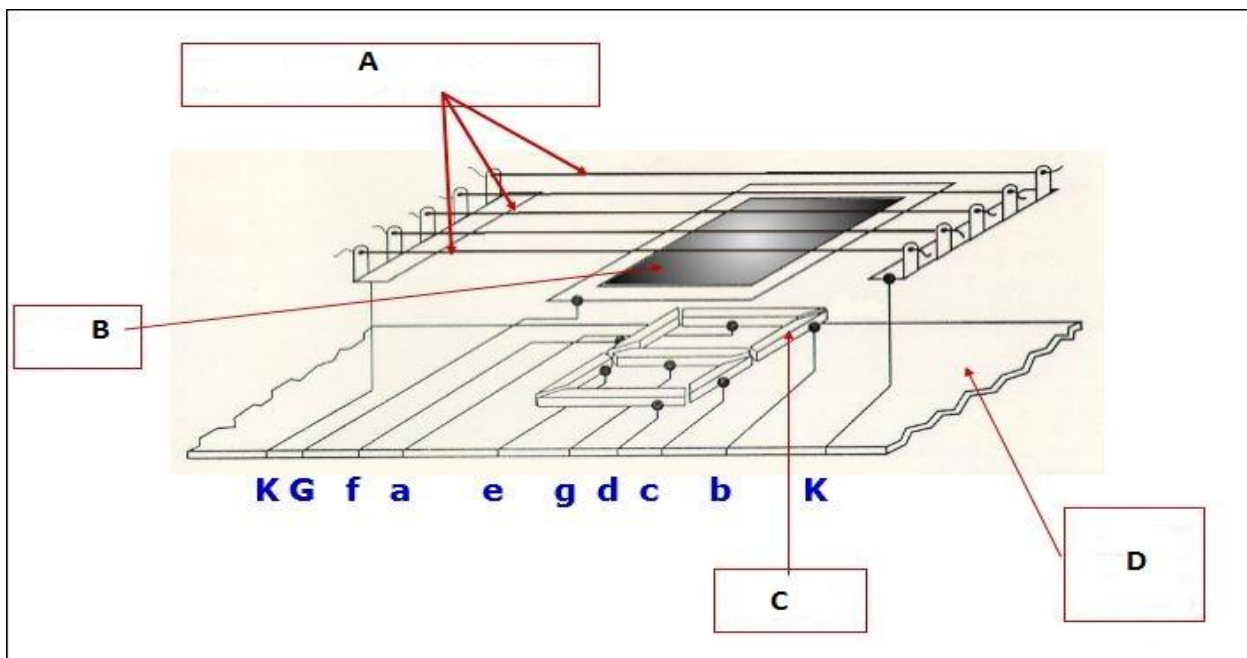
1. Identify the following displays and label them.
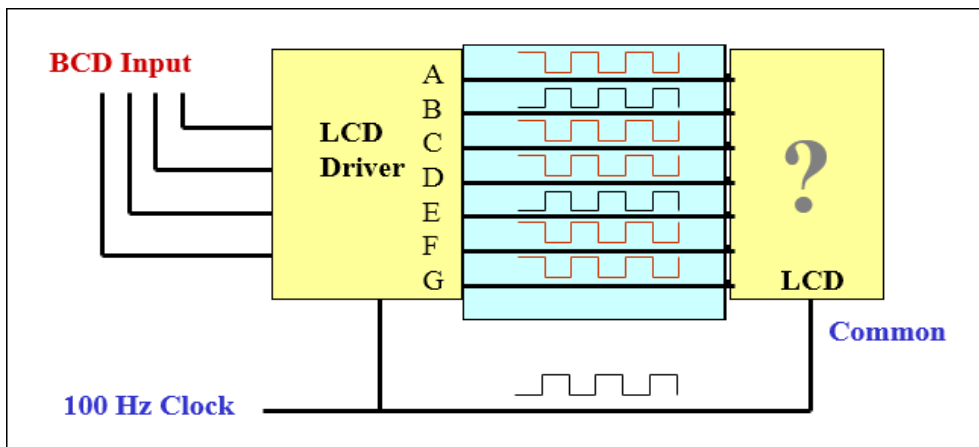   i)   (7 marks)

F

A

B

C

contacts

D

E

**100 Hz
out-of-phase signal
activates segment**

    ii)   (5 marks)

A

B

D

K G f a   e   g d c b   K

C

2. What will be the output on the LCD display? (2 marks)

3. Name 3 display devices apart from LED, LCD and VFD. (3 marks)

4. Use the data sheet where necessary to answer the following questions:

DATA SHEET - 2

7-SEGMENT LEDs

Characteristics	LTS312AR Z 4117	LTS313AR Z 4103	LTS5303AR Z 4150	LTS5503AE Z 4151	LTS546AR Z 4145	LTS313AG Z 4105	30240A	LSD5115 Z 4118	LSD5114 Z-4130	LSD5365 Z4146
Common Terminal Pol.	Anode	Cathode	Cathode	Cathode	Anode	Cathode	Anode	Cathode	Cathode	Anode
Digit Size	7.6mm	7.6mm	14.2mm	14.2mm	13.2mm	7.6mm	7.6mm	13.1mm	14.2mm	14.2mm
Colour	Red	Red	Red	Orange	Red	Green	Red	red	Orange	Red
Av. Fwd. Seg. Current	25mA	25mA	25mA	25mA	25mA	25mA	25mA	25mA	25mA	25mA
Segment Voltage	1.7	1.7	1.7	2.1	1.7	2.1	2.0	1.7	2.0	1.7
Min. Rev. Brkdn. Volt.	5	5	5	5	5	5	5	5	5	5
Max. Rev. Current	100uA	100uA	100uA	100uA	100uA	100uA	100uA	10uA	10uA	10uA
Seg. Intensity (typ.)	450ucd	450ucd	500ucd	2200ucd	500ucd	2000ucd	750ucd	6000ucd	4500ucd	8500ucd
Max. Seg. Dissipation	55mW	55mW	55mW	75mW	55mW	75mW	85mW	110mW	100mW	110mW
Connections										
Seg. A	1	10	7	7	7	10	1	7	7	7
Seg. B	13	9	6	6	6	9	13	6	6	6
Seg. C	10	8	4	4	4	8	10	4	4	4
Seg. D	8	5	2	2	2	5	8	2	2	2
Seg. E	7	4	1	1	1	4	7	1	1	1
Seg. F	2	2	9	9	9	2	2	9	9	9
Seg. G	11	3	10	10	10	3	11	10	10	10
Dec. Pt.	9	7	5	5	5	7	6, 9	5	5	5
Common	3, 14	1, 6	3,8	3,8	3,8	1, 6	3, 14	3,8	3,8	3,8

Z 4145 Z 4150 Z 4151
Z 4130 Z 4133 Z 4146

Z 4103 Z 4105
Z 4117 Z 4118

(a) Calculate the value of the safety resistor to display a digit 3 using a Z 4117 display. (3 marks)

SECTION-F   ACRONYMS   [16 Marks]

Determine the names of the memories devices represented by the following Acronyms:-

1. RAM
2. DRAM
3. FPMDRAM
4. EDORAM
5. BEDORAM
6. SRAM
7. VRAM
8. SIMM
9. DIMM
10. ROM
11. ROMBIOS
12. PROM
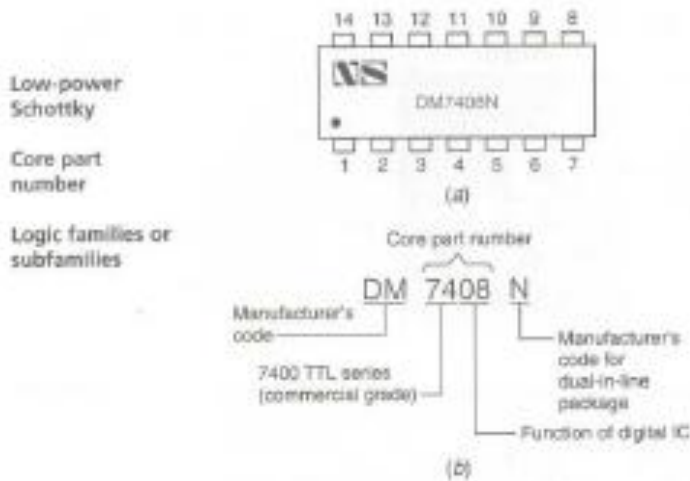13. EPROM
14. EEPROM
15. FDD
16. HDD

DATA SHEET-3

Low-power
Schottky

Core part
number

Logic families or
subfamilies

DM 7408 N

Manufacturer's
code

7400 TTL series
(commercial grade)

Manufacturer's
code for
dual-in-line
package

Function of digital IC

(b)

Marking on a
typical digital IC

Decoding the
part number on
a typical IC

Fig. 3-34 (a) Marking on a typical digital IC. (Courtesy of National Semiconductor Corporation.) (b) Decoding the part number on a typical IC.

Commercial
grade

Instruments. On this unit, the suffix "J" stands for a ceramic DIP packaging. This is typically referred to as the *commercial grade*. The core part number of the IC in Fig. 3-35 is 74LS08. This is similar to the 7408 quadruple two-input AND gate IC discussed earlier. The let-
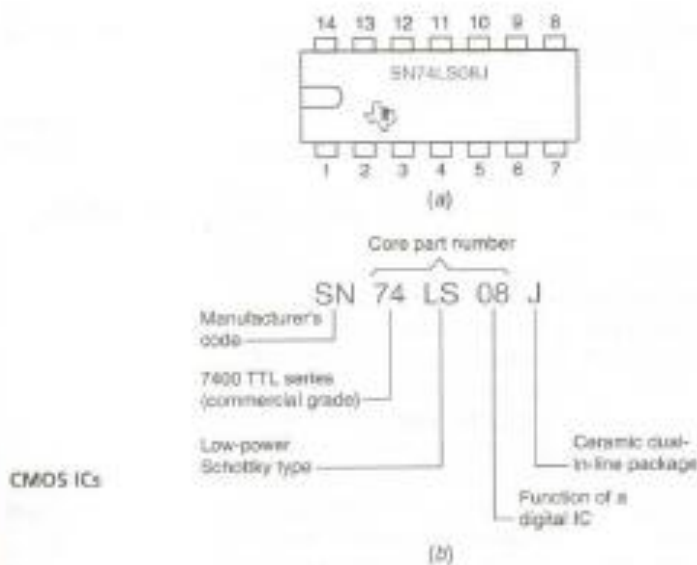

Core part number

SN 74 LS 08 J

Manufacturer's
code

7400 TTL series
(commercial grade)

Low-power
Schottky type

Ceramic dual-
in-line package

Function of a
digital IC

CMOS ICs

(b)

Fig. 3-35 (a) Markings on a Texas Instruments digital IC. (b) Decoding the part number of a typical low-power Schottky IC.

ters "LS" in the center of the core number designate the type of TTL circuitry used in the IC. In this case "LS" stands for *low-power Schottky*.

The internal letter(s) in a core part number of a 7400 series IC tell something about the *logic* family or *subfamily*. Typical internal letters used are:

AC = FACT Fairchild Advanced CMOS Technology logic (a newer advanced family of CMOS)

ACT = FACT Fairchild Advanced CMOS Technology logic (a newer family of CMOS with TTL logic levels)

ALS = advanced low-power Schottky TTL logic (a subfamily of TTL)

AS = advanced Schottky TTL logic (a subfamily of TTL)

C = CMOS logic (an early family of CMOS)

F = FAST Fairchild Advanced Schottky TTL logic (a new subfamily of TTL)

FCT = FACT Fairchild Advanced CMOS Technology logic (a family of CMOS with TTL logic levels)

H = high-speed TTL logic (a subfamily of TTL)

HC = high-speed CMOS logic (a family of CMOS)

HCT = high-speed CMOS logic (a family of CMOS with TTL inputs)

L = low-power TTL logic (a subfamily of TTL)

LS = low-power Schottky TTL logic (a subfamily of TTL)

S = Schottky TTL logic (a subfamily of TTL)

The internal letters give information about the speed, power consumption, and process technology of digital ICs. Because of these speed and power consumption differences, manufacturers usually recommend that exact part numbers be used when replacing digital ICs. When the letter "C" is used inside a 7400 series part number, it designates a CMOS and not a TTL digital IC. The internal letters "HC," "HCT," "AC," "ACT," and "FCT" also designate CMOS ICs.

Data manuals from manufacturers contain much valuable information on digital ICs. They contain pin diagrams and packaging information. Data manuals also contain details on part

FAIRCHILD
SEMICONDUCTOR™

August 1986
Revised March 2000

DM74LS00 Quad 2-Input NAND Gate

DM74LS00
## Quad 2-Input NAND Gate

General Description

This device contains four independent gates each of which performs the logic NAND function.

Ordering Code:

Order Number	Package Number	Package Description
DM74LS00M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150 Narrow
DM74LS00SJ	M14D	14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
DM74LS00N	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Connection Diagram
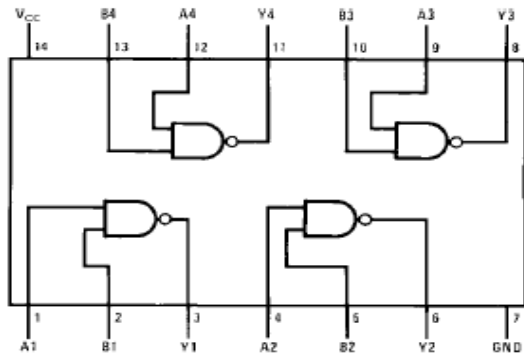
Function Table

$$Y = \overline{AB}$$

Inputs		Output
A	B	Y
L	L	H
L	H	H
H	L	H
H	H	L

H = HIGH Logic Level
L = LOW Logic Level