Digital Design

“Laboratuvar ”

Dr. Cahit Karakuş, February-2018

Teknik Personelin El Aletleri

Takım Çantası

- Pense, Kargaburun, Yan Keski,
- Saatçi Tornavida Takımı,
- Tornavida Takımı,
- Matkap,
- Havya Seti, lehim,
- Somun, Vida, Cıvata,
- Kontrol Kalemi,
- Cımbız Takımı,
- Entegre Söküm Aleti
- Aydınlatma, el lambası
- Mercek
- Kablo Ölçme Aletleri,
- Ölçü Aleti (Avometre)
- 2-tel, 4-tel burgulu)
- Kablo - Tel Sıyırma,
- El kitapları,
- Toprakla bağlantılı statik bilek bağı(statik elektriği önlemek için)

Teknik Personelin El Aletleri

Ölçüm Cihazları:

- Kablo Ölçme Aletleri,
- Ölçü Aleti (Avometre),
- Test Programları ve Cihazları,
- Osilaskop ve
- Sinyal üreteci vb.

Teknik Personelin El Aletleri

İş Güvenliği ve İş sağlığı:

- İş Elbisesi,
- Antistatik Bilezik,
- İlkyardım Malzemeleri,
- Toz Temizleyici Araçlar (Kompresör), Temizleyici Sprey,
- Temizleme Aletleri (Temizleyici Sıvı ve Spreyler, Temizleme Fırçaları),
- Elektrik Süpürge,
- Uyarı Levhaları,
- Plastik Eldiven,
- Merdiven,
- Aydınlatma,
- Zararlı Atık Depolama,
- Geri Dönüşümlü Atık Depolama ve Güvenliği,
- Işıklı Mercek,
- Özel Macun

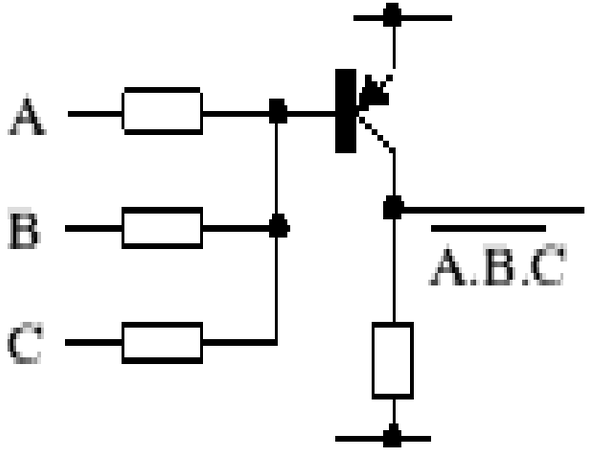
Teknik Personelin El Aletleri

Dökümanlar:

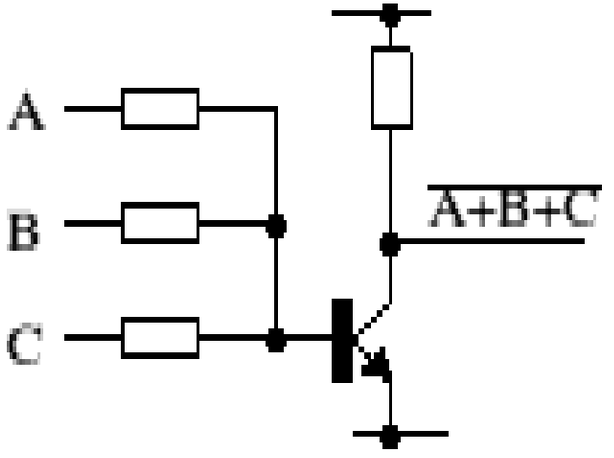
- Proje,
- İş bitirme Formu,
- Müşteri Bilgi Formu,
- Malzeme Talep Formu,
- Servis Formu,
- Şartnameler,
- Malzeme katalogları / El kitapları,
- Malzeme Fiyat Listesi,
- Hesap Makinesi

Teknik Personelin El Aletleri

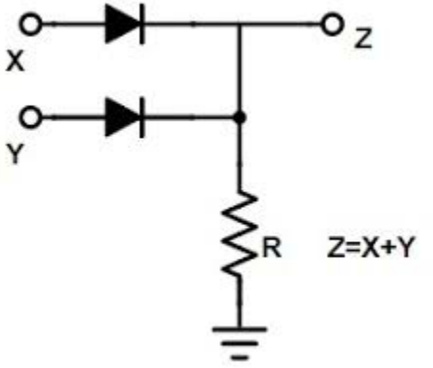
- **Enerji, zayıf akım güvenlik kabloları** (fiber, koaksiyel, 2-tel, 4-tel burgulu); PVC Kablo Kanalları ve tavalar, Numaralandırma Etiketi, İzolasyon Bandı, Kablo Bağı, Uzatma Kabloları, Tel Sarma ve Sökme Tabancaları, Kablo - Tel Sıyırma, Badi, Bağlama Dizisi, İzolasyon sıyırmalı kontak ve Tel İrtibatlıma Aleti
- **Yol Haritası ve navigasyon;** GPS
- **İletişim Araçları;** Telefon, faks, kablosuz, İnternet Bağlantısı
- **Bilgisayar;** CD ve DVD çantası, Harici Depolama Birimleri, İşletim Sistemi Kurulum CD si ve İşletim Sisteminin Katalogu, Güvenlik Programları, İşlemci Soğutucusu, Sistem Disketi, Sorun Giderici Yazılımlar, Taşınabilir Bellek, Temizleme CD' si ve Temizleme Disketi
- **Yazılımlar;** Donanım Sürümleri (Drivers) ve Donanım Teknik Dokümanları
- **Çevre Birimleri;** Yazıcı,Tarayıcı, webcam,dijital fotoğraf mak, ADSL modem, dijital kamera
- Toprakla bağlantılı statik bilek bağı(statik elektriği önlemek için)

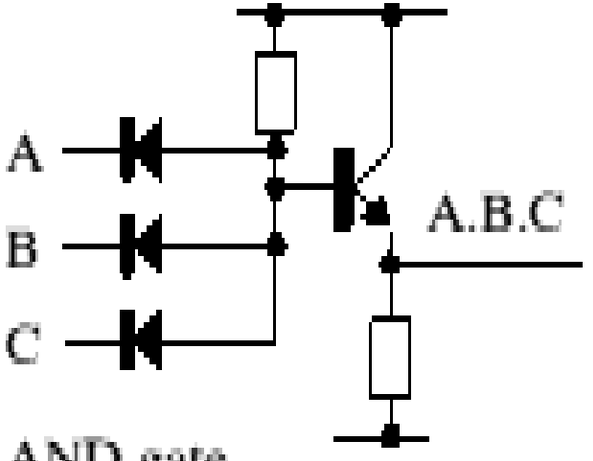


NAND gate

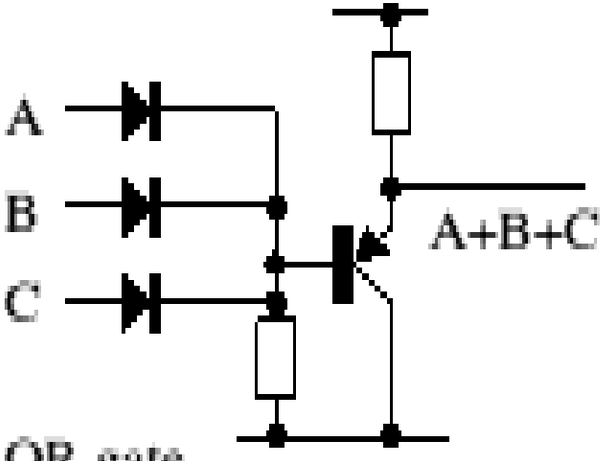


NOR gate

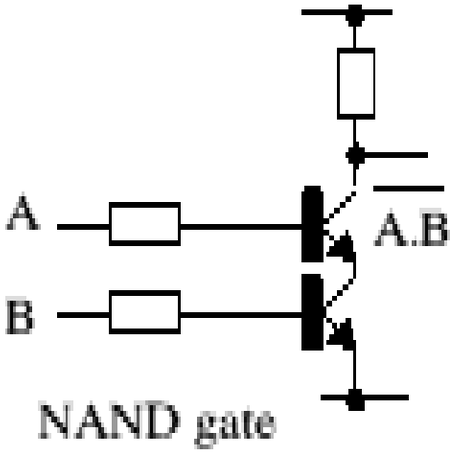




AND gate



OR gate



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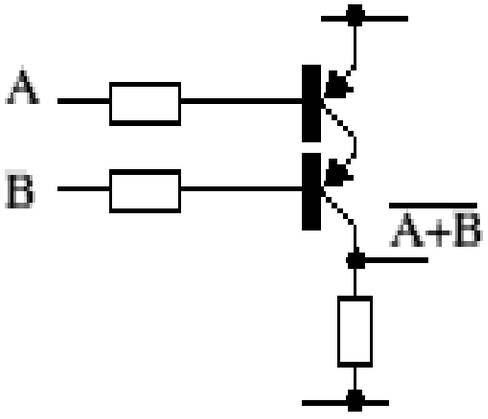

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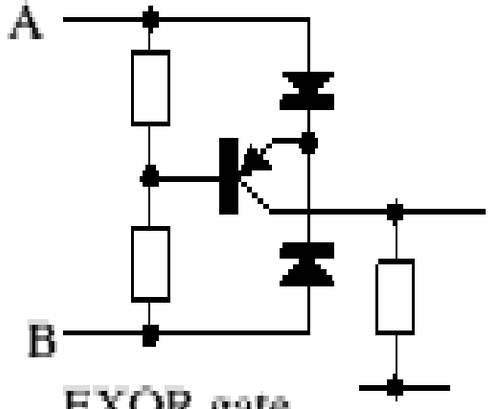

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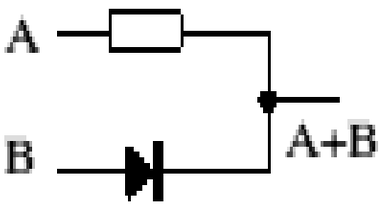
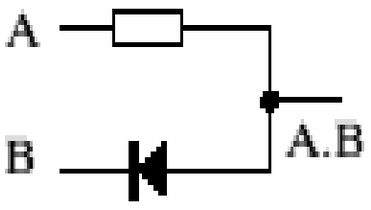
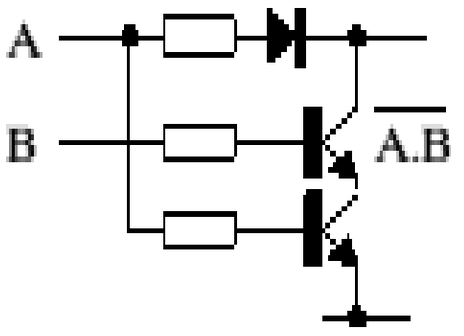


OR gate

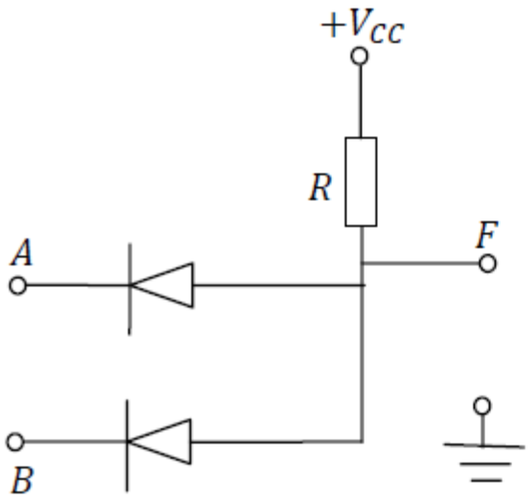


AND gate



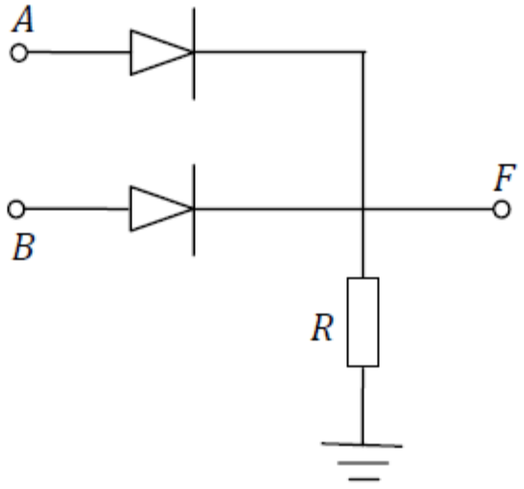
EXOR gate

AND Kapısı



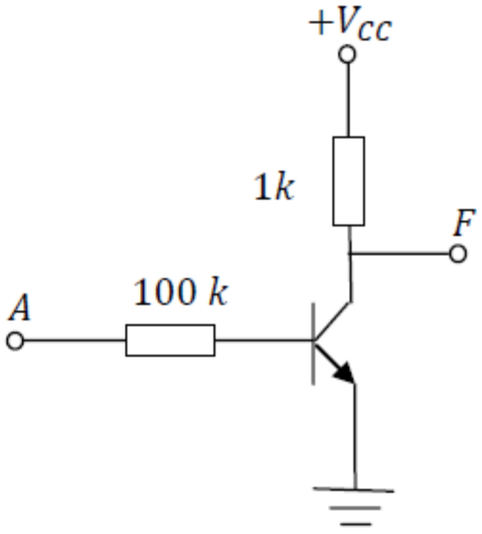
A	*B*	*F*
0	0	0
0	1	0
1	0	0
1	1	1

OR Kapısı



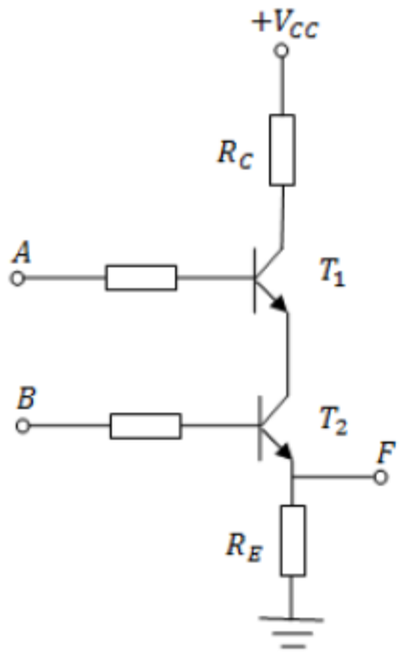
A	*B*	*F*
0	0	0
0	1	1
1	0	1
1	1	1

NOT Kapısı

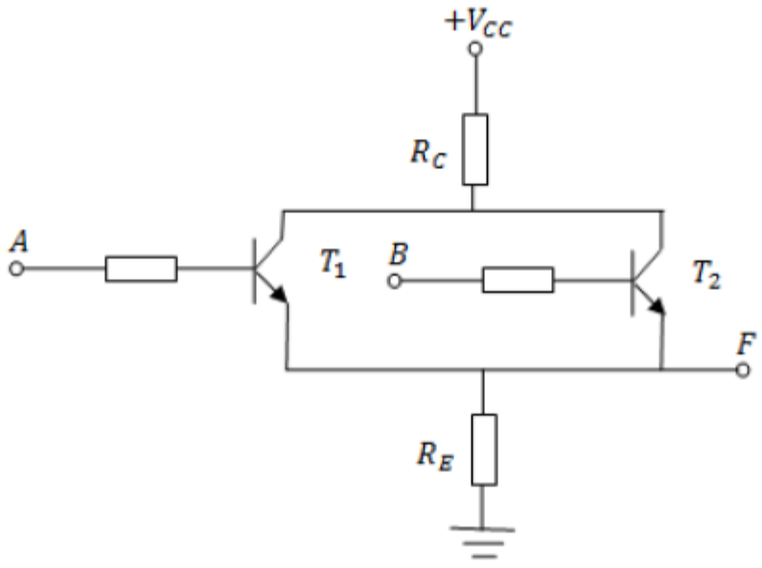


A	*F*
0	1
1	0

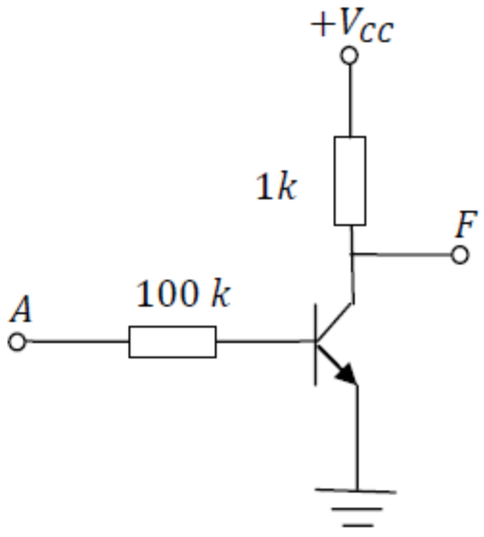
AND Kapısı



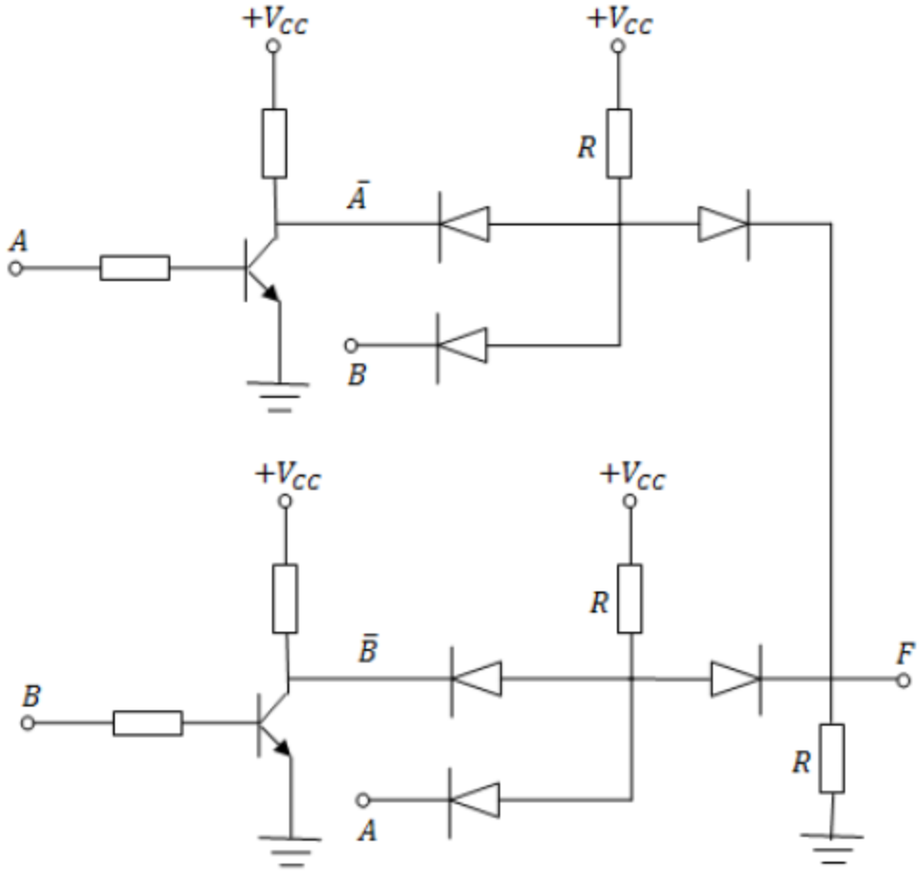
OR Kapısı

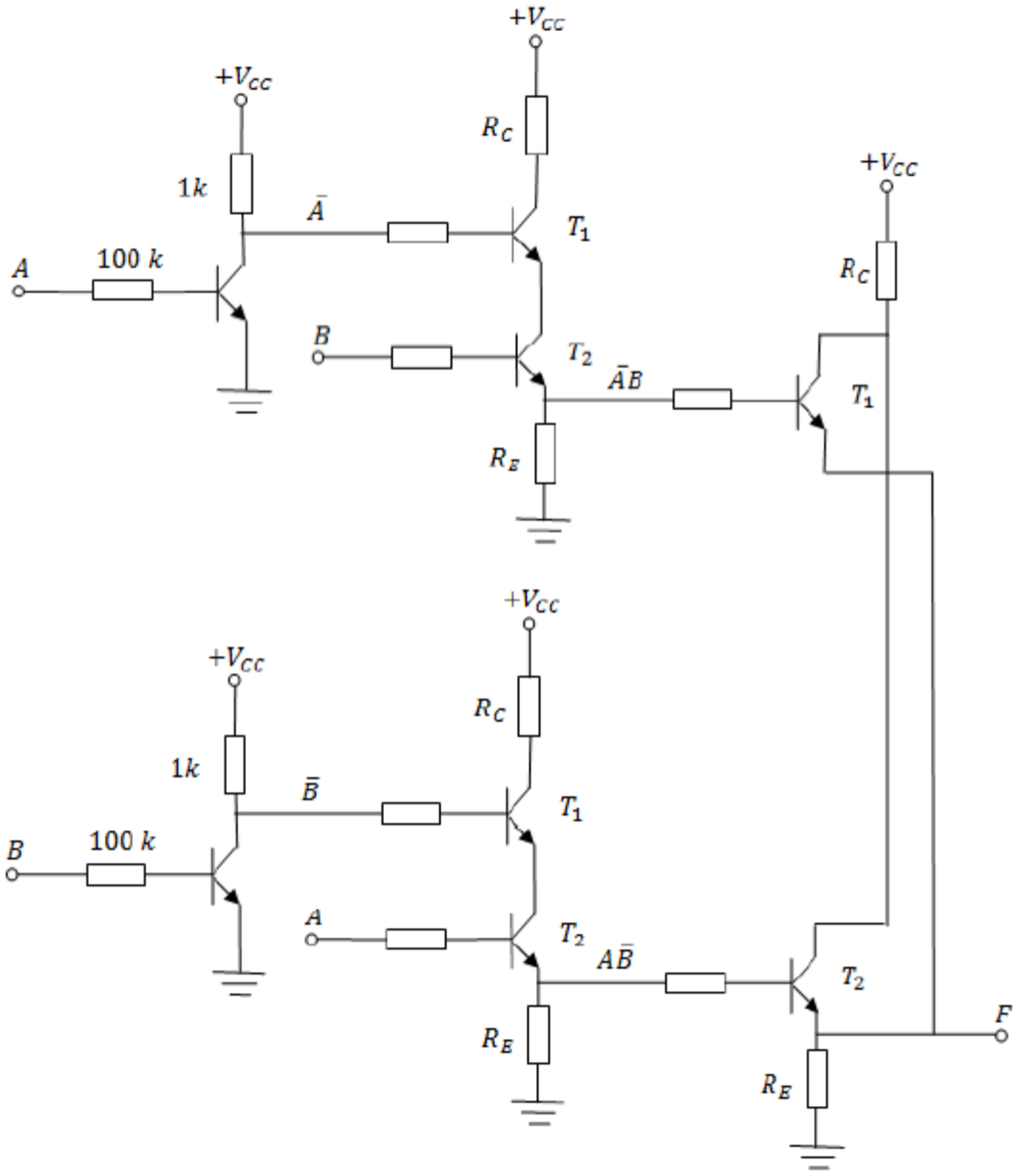


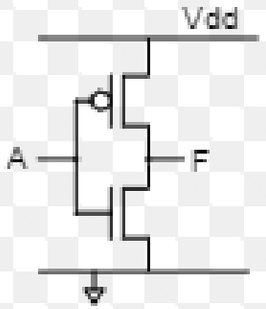
NOT Kapısı



$F = A \oplus B = \bar{A}B + A\bar{B}$ fonksiyonunu DL ile gerçekleştiriniz.

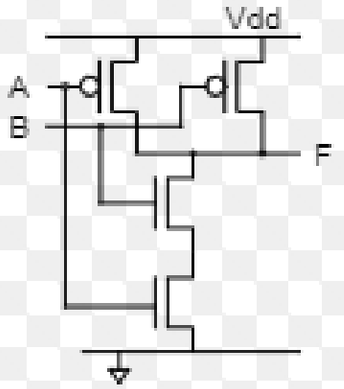






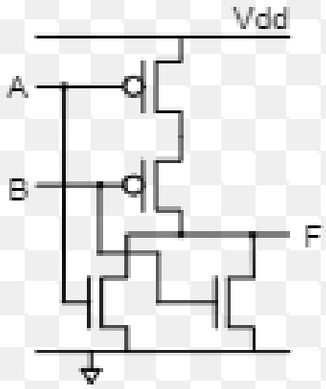
A	F
L	H
H	L

CMOS INVERTER



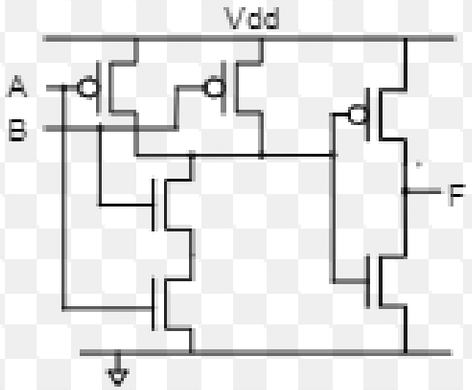
A	B	F
L	L	H
L	H	H
H	L	H
H	H	L

CMOS NAND



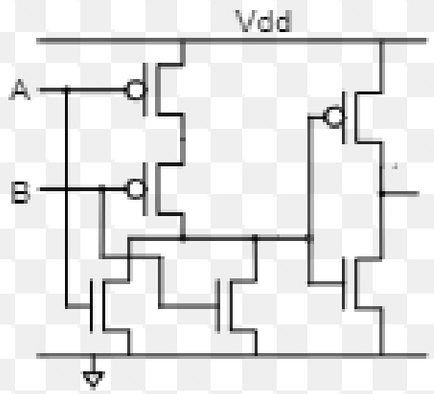
A	B	F
L	L	H
L	H	L
H	L	L
H	H	L

CMOS NOR



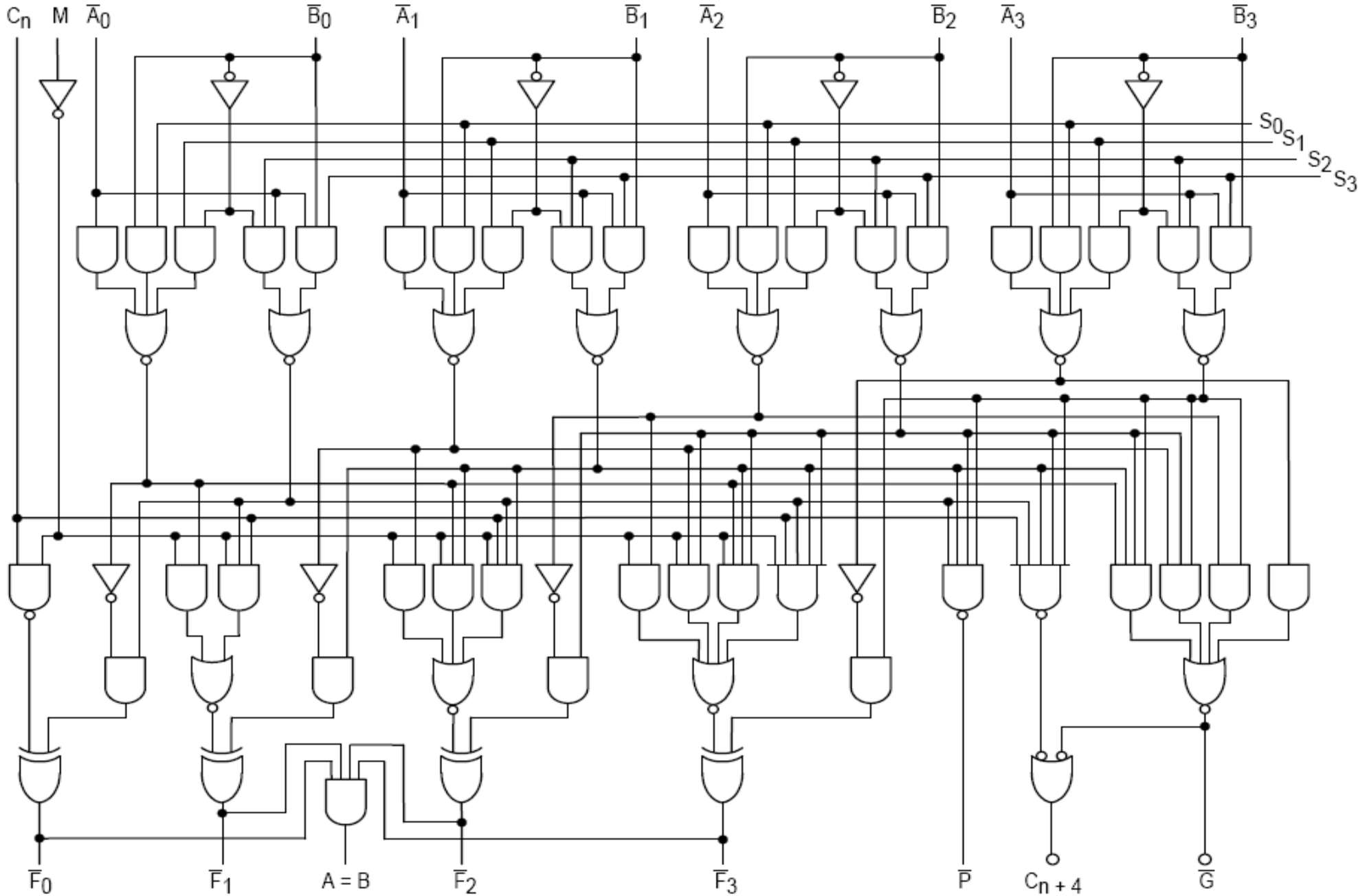
A	B	F
L	L	L
L	H	L
H	L	L
H	H	H

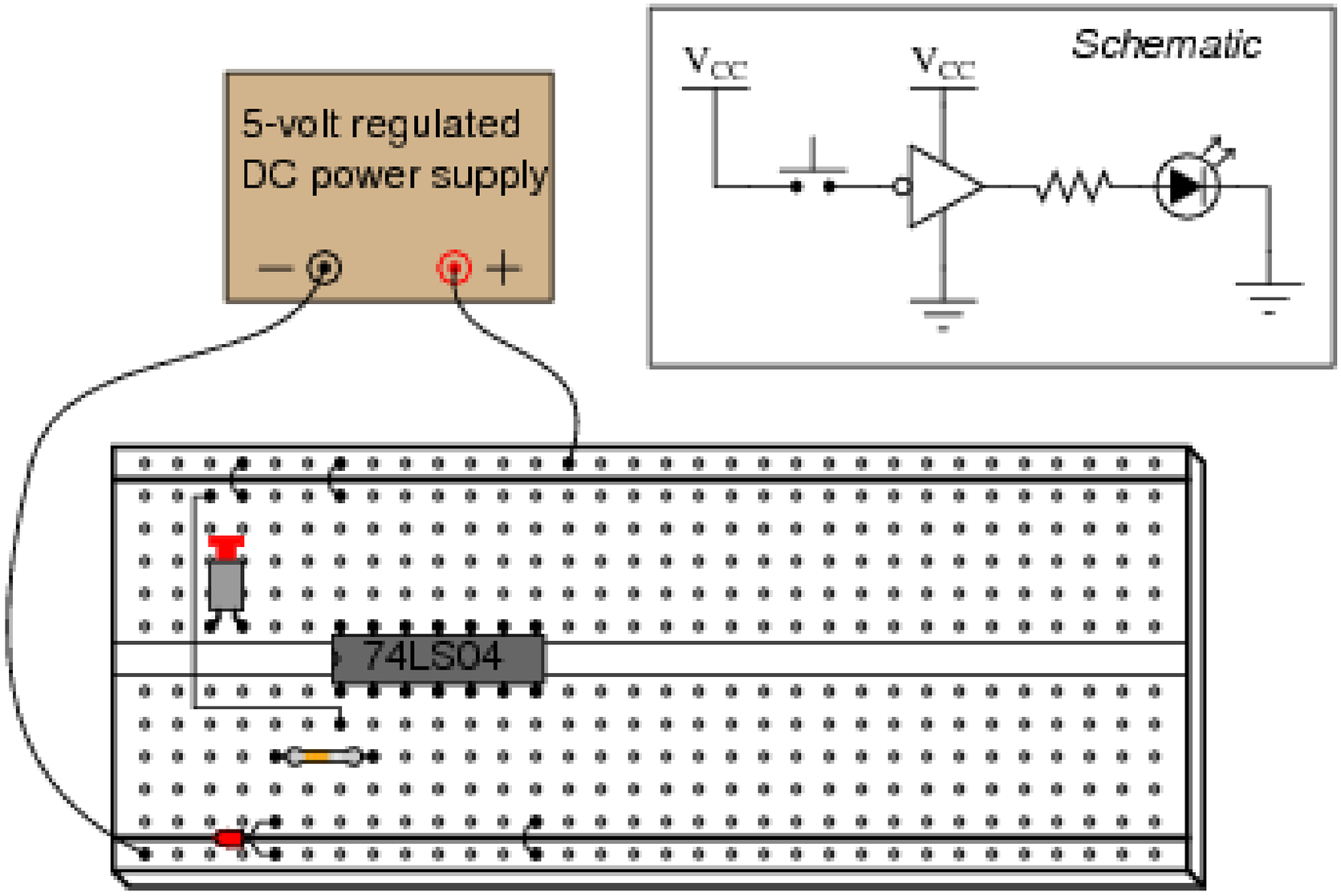
CMOS AND



A	B	F
L	L	L
L	H	H
H	L	H
H	H	H

CMOS OR


C_n
M
$\overline{A}_0$
$\overline{B}_0$
$\overline{A}_1$
$\overline{B}_1$
$\overline{A}_2$
$\overline{B}_2$
$\overline{A}_3$
$\overline{B}_3$
S_0
S_1
S_2
S_3
$\overline{F}_0$
$\overline{F}_1$
A = B
$\overline{F}_2$
$\overline{F}_3$
$\overline{P}$
C_{n+4}
$\overline{G}$


5-volt regulated
DC power supply
−
+
74LS04
Schematic
V_{CC}
V_{CC}

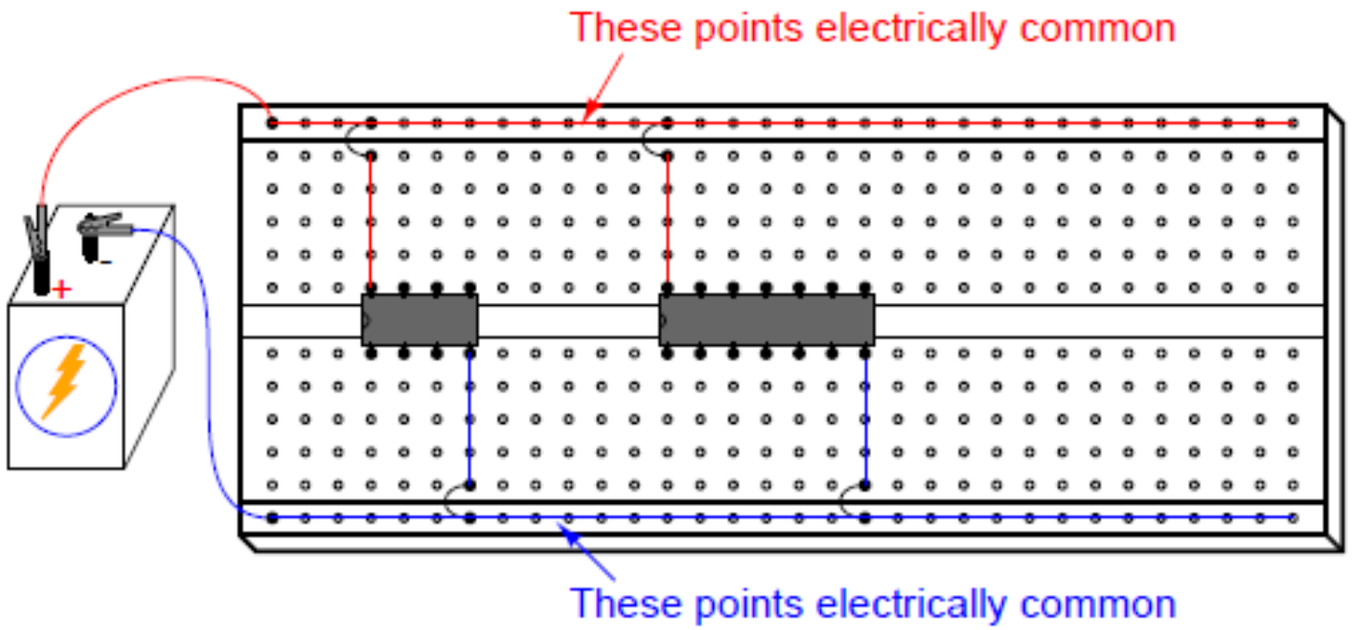
Uygulamalar

1- Basic gate function

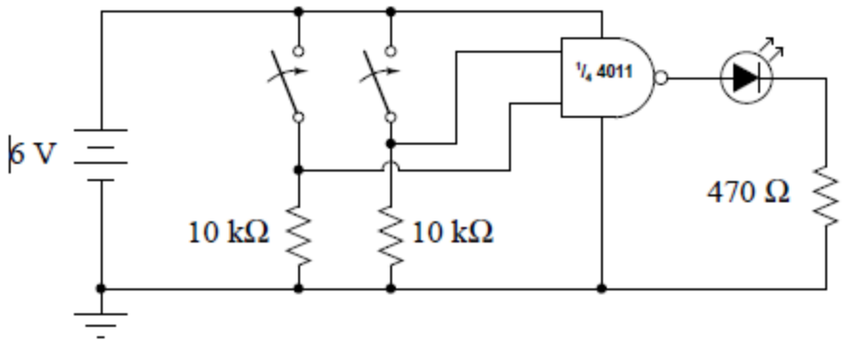
- 4011 quad NAND gate
- Eight-position DIP switch
- Ten-segment bargraph LED
- One 6 volt battery
- Two 10 k resistors
- Three 470 resistors
- Caution! The 4011 IC is CMOS, and therefore sensitive to static electricity!

LEARNING OBJECTIVES

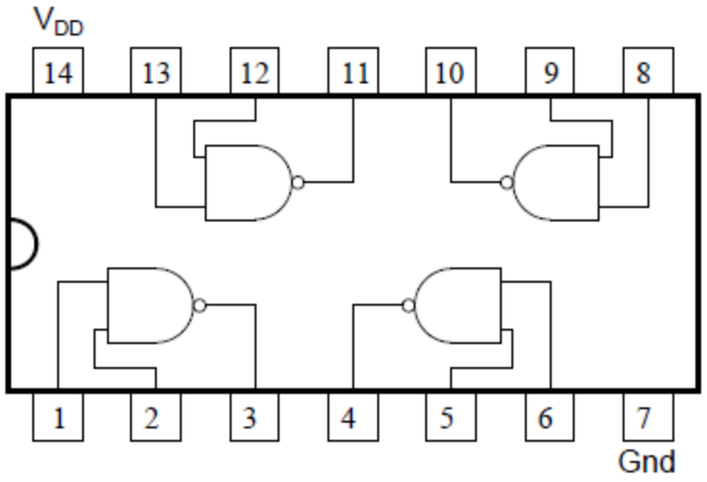
- Purpose of a "pulldown" resistor
- How to experimentally determine the truth table of a gate
- How to connect logic gates together
- How to create different logical functions by using NAND gates

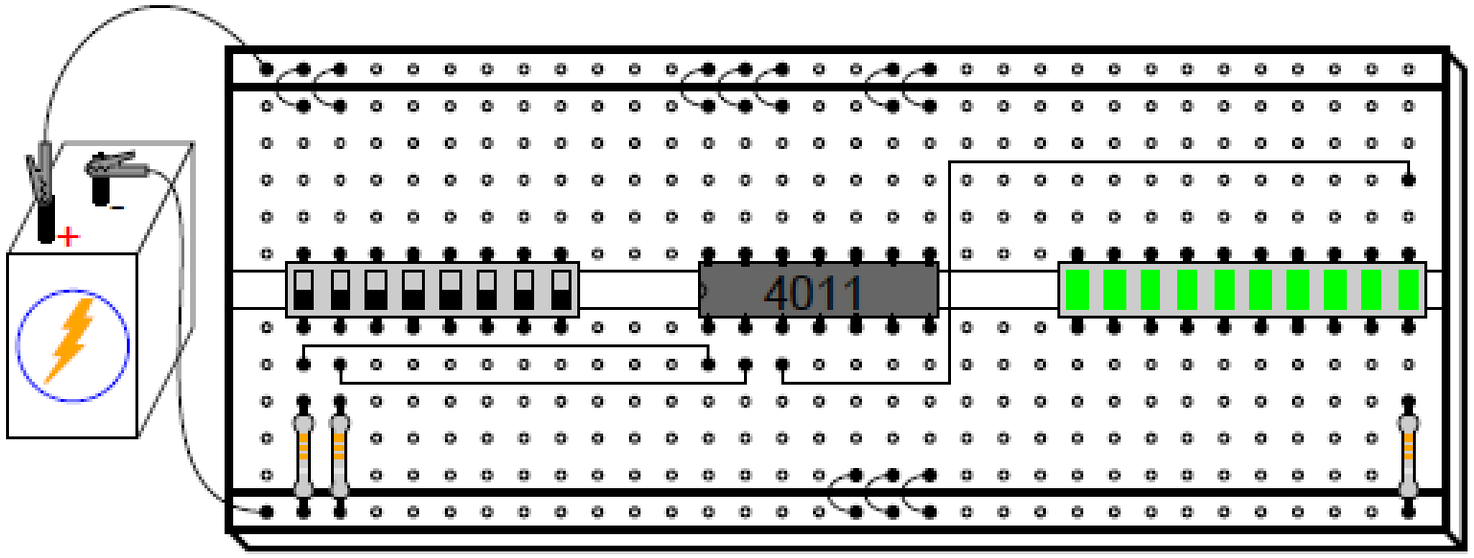

These points electrically common
+
-
These points electrically common

SCHEMATIC DIAGRAM



"Pinout," or "connection" diagram for the 4011 quad NAND gate





Grup - A

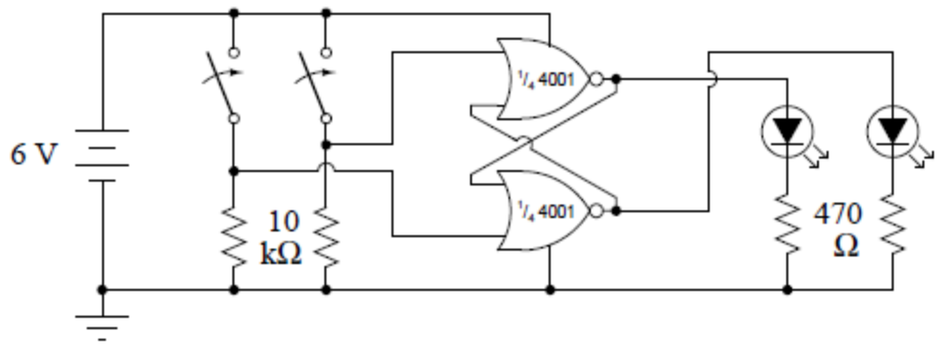
2- NOR gate S-R latch

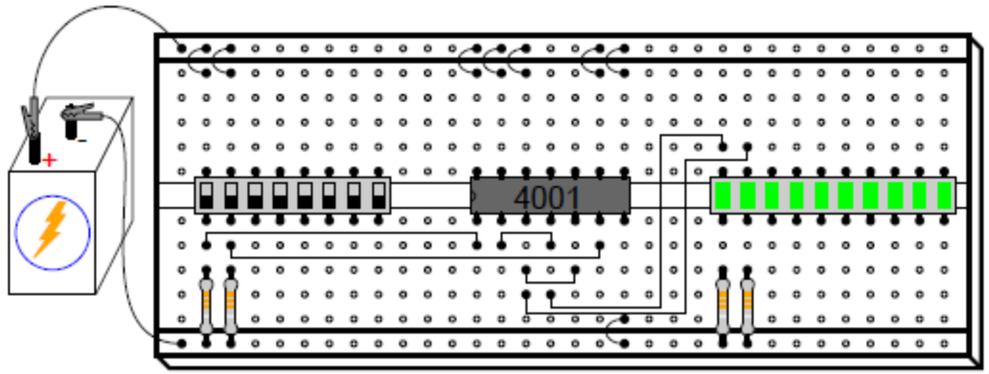
PARTS AND MATERIALS

- 4001 quad NOR gate
- Eight-position DIP switch
- Ten-segment bargraph LED
- One 6 volt battery
- Two 10 k resistors
- Two 470 resistors
- Two 100 resistors
- Caution! The 4001 IC is CMOS, and therefore sensitive to static electricity!

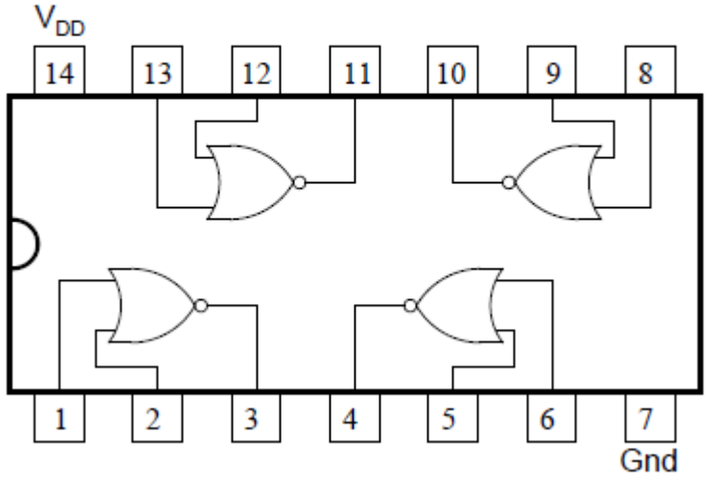
- LEARNING OBJECTIVES
- The effects of positive feedback in a digital circuit
- What is meant by the "invalid" state of a latch circuit
- What a race condition is in a digital circuit
- The importance of valid "high" CMOS signal voltage levels

SCHEMATIC DIAGRAM





"Pinout," or "connection" diagram for the 4001 quad NOR gate



Grup - B

3- NAND gate S-R enabled latch

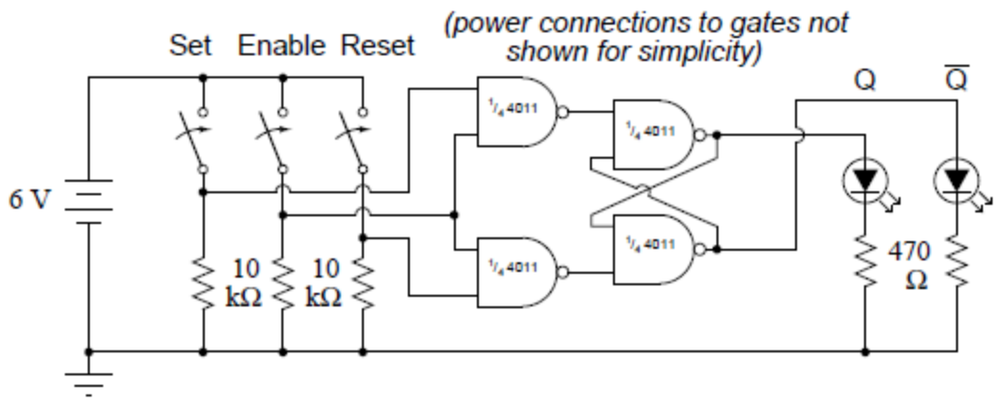
PARTS AND MATERIALS

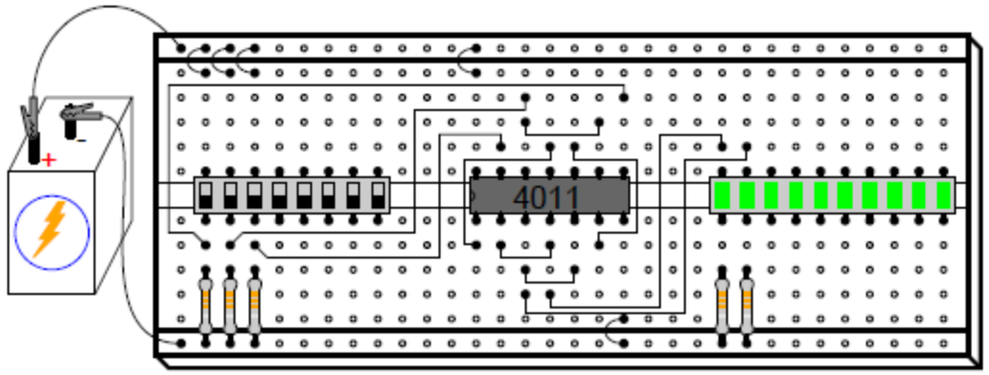
- 4011 quad NAND gate
- Eight-position DIP switch
- Ten-segment bargraph LED
- One 6 volt battery
- Three 10 k resistors
- Two 470 resistors
- Caution! The 4011 IC is CMOS, and therefore sensitive to static electricity!

LEARNING OBJECTIVES

- Principle and function of an enabled latch circuit

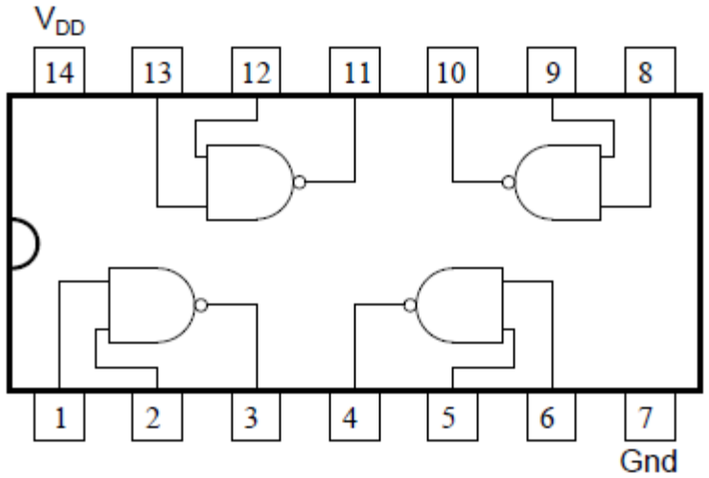
SCHEMATIC DIAGRAM





Grup - c

"Pinout," or "connection" diagram for the 4011 quad NAND gate



4- LED sequencer

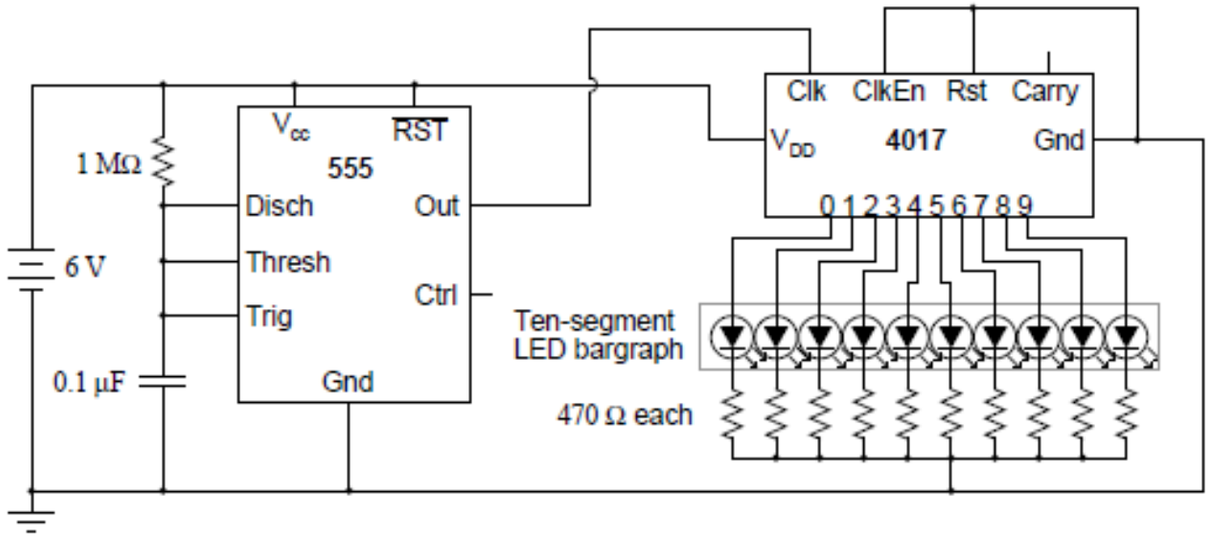
PARTS AND MATERIALS

- 4017 decade counter/divider
- 555 timer IC
- Ten-segment bargraph LED
- One SPST switch
- One 6 volt battery
- 10 k resistor
- 1 M resistor
- 0.1 ¹F capacitor (Radio Shack catalog # 272-135 or equivalent)
- Coupling capacitor, 0.047 to 0.001 ¹F
- Ten 470 resistors
- Caution! The 4017 IC is CMOS, and therefore sensitive to static electricity!

LEARNING OBJECTIVES

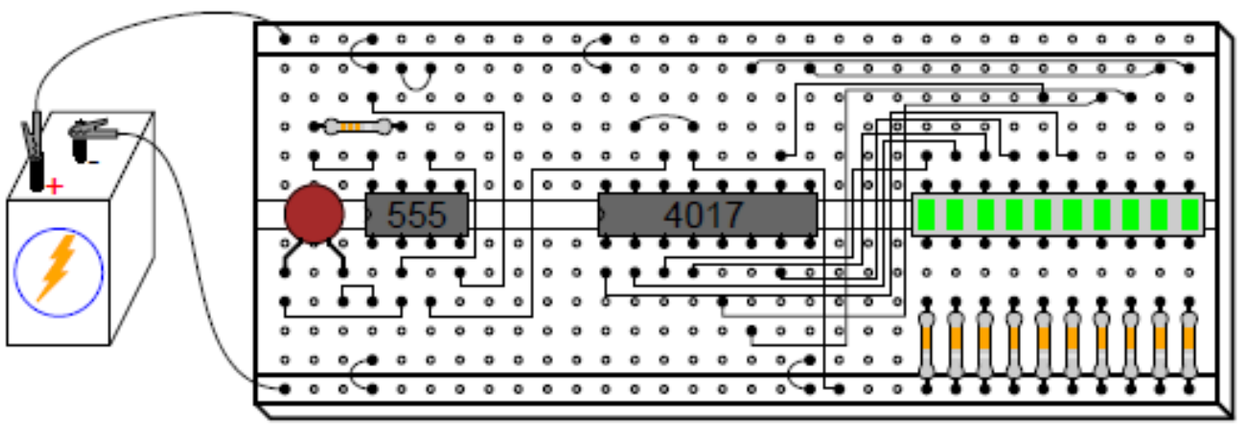
- Use of a 555 timer circuit to produce "clock" pulses (astable multivibrator)
- Use of a 4017 decade counter/divider circuit to produce a sequence of pulses
- Use of a 4017 decade counter/divider circuit for frequency division
- Using a frequency divider and timepiece (watch) to measure frequency
- Purpose of a "pulldown" resistor
- Learn the effects of switch contact "bounce" on digital circuits
- Use of a 555 timer circuit to "debounce" a mechanical switch (monostable multivibrator)

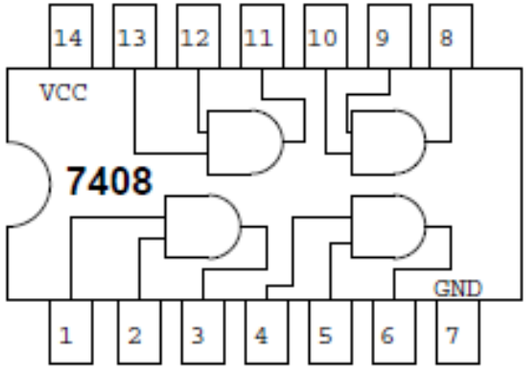
SCHEMATIC DIAGRAM

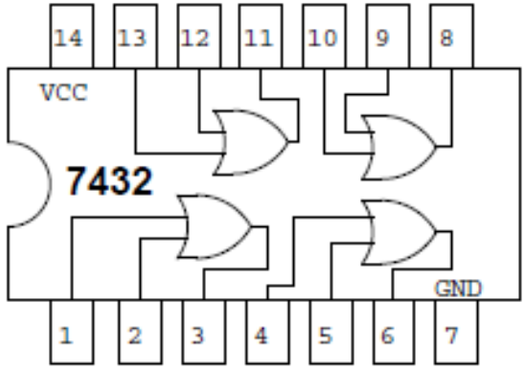


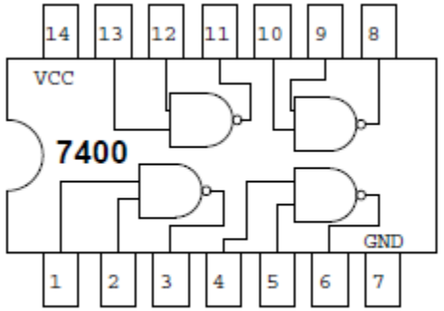
Grup - D

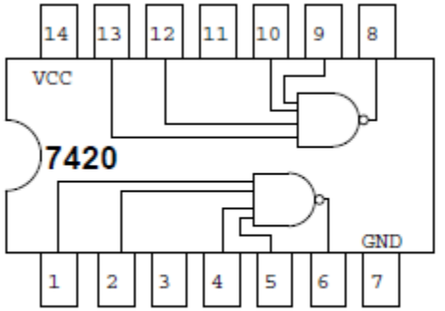
ILLUSTRATION

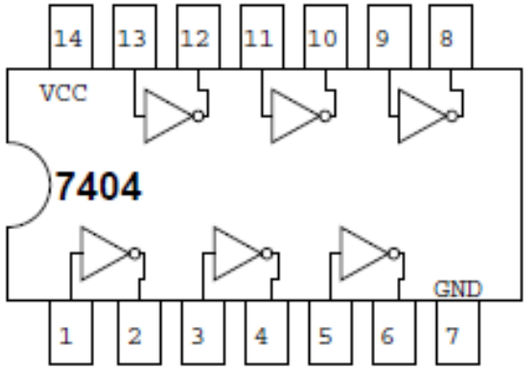


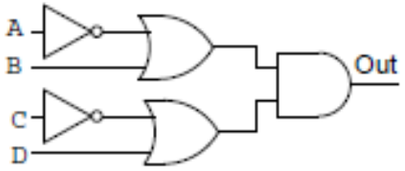




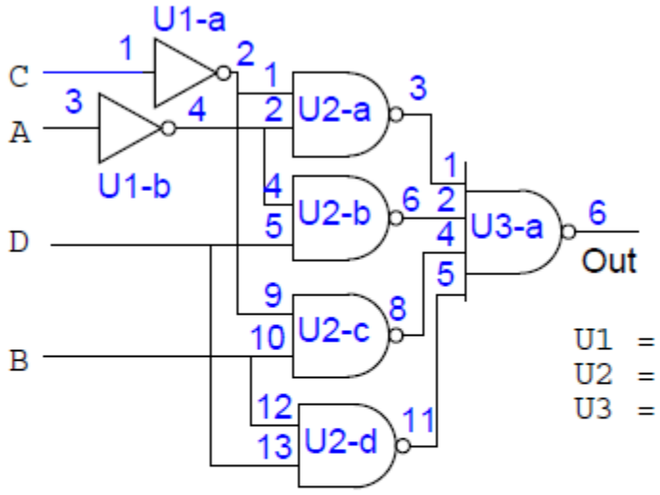








Out= $(\overline{A}+B)(\overline{C}+D)$



U1 = 7404
U2 = 7400
U3 = 7420

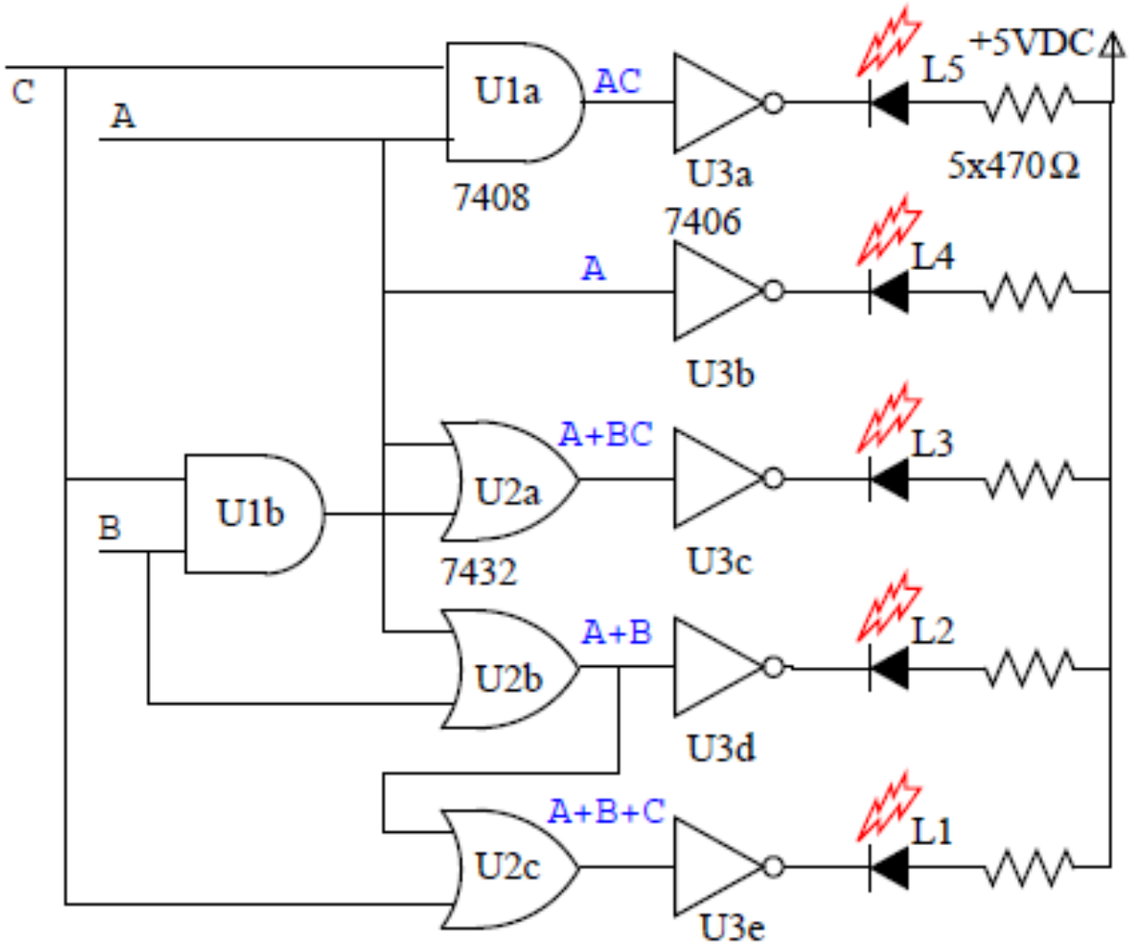
Out= $\overline{(\overline{A}\overline{C})(\overline{A}D)(B\overline{C})(BD)}$ Boolean from diagram

Out= $\overline{\overline{A}\overline{C}} + \overline{\overline{A}D} + \overline{B\overline{C}} + \overline{BD}$ DeMorgan's

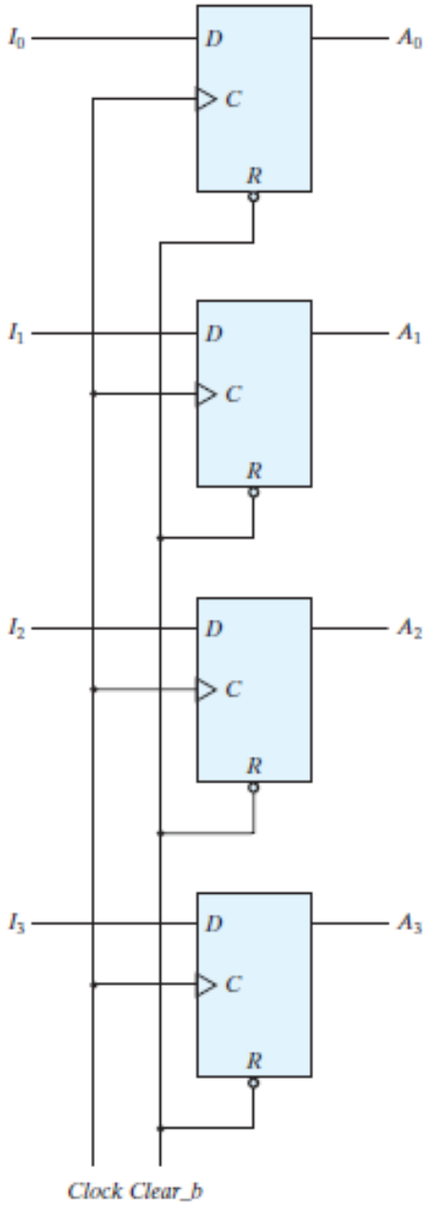
Out= $\overline{A}\overline{C} + \overline{A}D + B\overline{C} + BD$ Double negation

Grup – E ve F

Grup - A


C
A
U1a
AC
U3a
L5
+5VDC
5x470Ω
7408
7406
A
L4
U3b
A+BC
U2a
L3
U1b
B
U3c
7432
A+B
U2b
L2
U3d
A+B+C
U2c
L1
U3e

6- Register



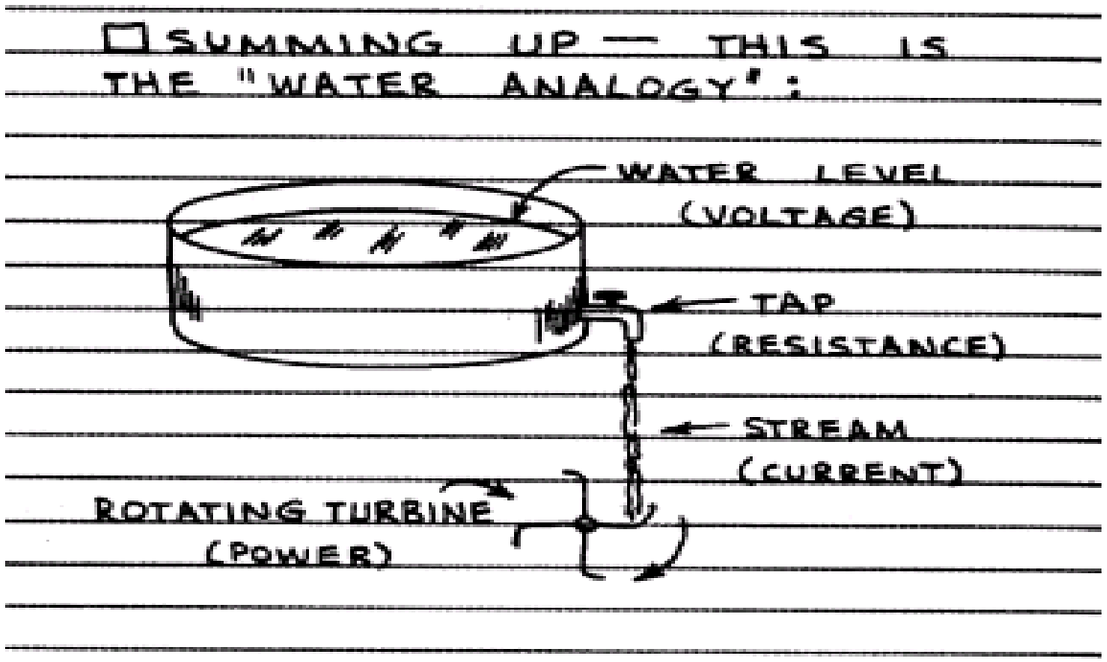
OHM KANUNU

Basic Electronics

Current (I): Amount of charge passing a given point per unit time

Voltage (V): Electrical pressure or force. If we compare current to water flowing through a pipe then voltage is the the water pressure.

Resistance (R): Conductors are not perfect. They resist the flow of current.



Ohm's Law

$$V = I * R \text{ !!!!!}$$

$$V = I * Z \text{ !!!!!}$$

DC

An electrical current can flow in either of two directions. If it flows in only one direction, it is called direct current (DC).

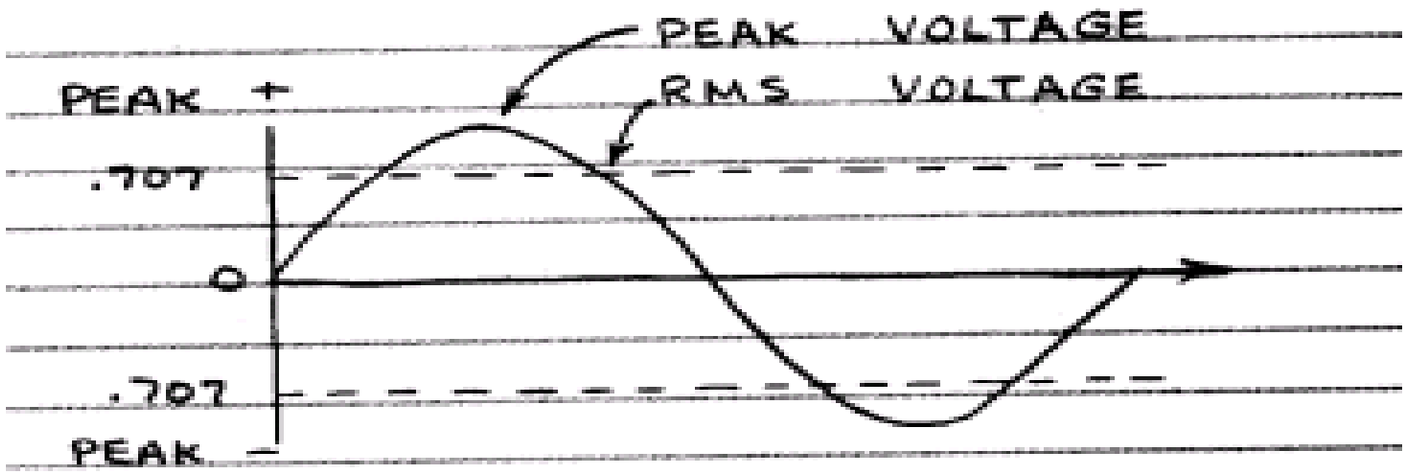
A battery is an example of a DC voltage that can supply DC current!

Electrical engineers also use the term DC to refer to an average (or constant part of) a voltage or current signal.

AC

A current which alternates in direction or polarity is called an alternating current (AC).

The current flowing from a wall outlet is an example of an AC current!



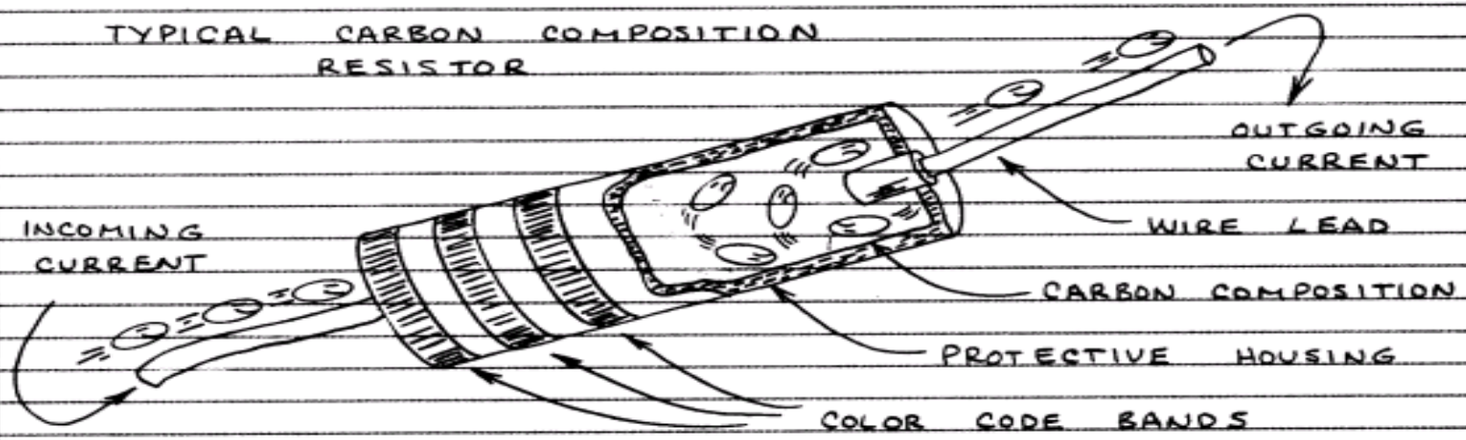
DC voltage, RMS Voltage, Frequency, Period

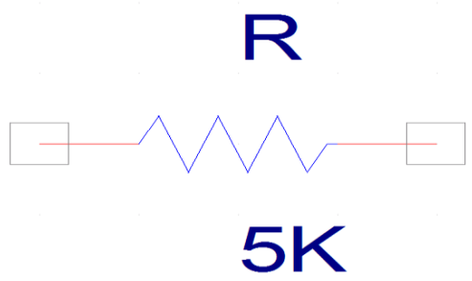
Resistors

RESISTORS COME IN DOZENS OF SIZES AND SHAPES BUT THEY ALL DO THE SAME THING: LIMIT* CURRENT. MORE ABOUT THAT LATER. FIRST, LET'S SEE HOW A TYPICAL RESISTOR IS MADE:

*OR RESIST

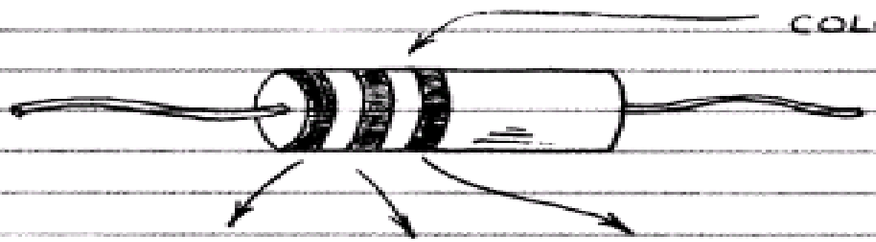
TYPICAL CARBON COMPOSITION RESISTOR





Resistor Color Code

☐ RESISTOR COLOR CODE — SEE THOSE COLOR CODE BANDS ON THE RESISTOR PICTORIAL? IN REAL LIFE THEY'RE KIND OF PRETTY. BUT THEY HAVE A FAR MORE IMPORTANT PURPOSE: THEY INDICATE THE RESISTANCE OF THE RESISTOR THEY DECORATE. HERE'S HOW:



COLOR	1	2	3 (MULTIPLIER)
BLACK	0	0	1
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	(NONE)

NOTE: SOMETIMES THERE'S A FOURTH BAND. IT INDICATES THE TOLERANCE* OF THE RESISTOR:

GOLD = ±5 %
SILVER = ±10 %
NONE = ±20 %

* OR ACCURACY

Kirchoff's Voltage Law

There must always be a closed path (or loop) for current to flow!

Summation of voltages around any closed loop is 0!

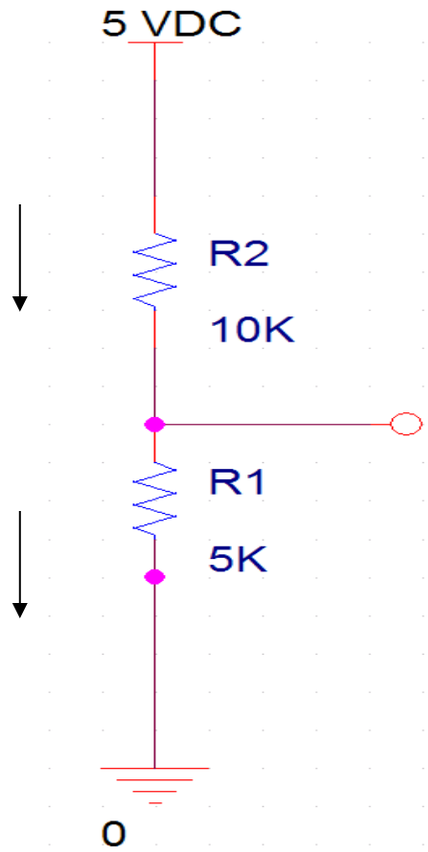
Kirchoff's Current Law

Summation of currents into a node must equal 0.

Electrons cannot just suddenly appear or disappear!

Voltage Divider

+VDD = 5 VDC



Use Ohm's Law, KCL, KVL!

I_2= 5 / (15K) = 0.33 mA

I_1= VDD / (R1 + R2) = 0.33 mA

I_1= 5 / (15K) = 0.33 mA

Vout = [R1 / (R1 + R2)] * VDD

Vout = 5/3 Volts

Kaynakça

- https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-111-introductory-digital-systems-laboratory-spring-2006/lecture-notes/
- http://web.ee.nchu.edu.tw/~cpfan/FY92b-digital/Chapter-4.ppt
- http://www.cs.nccu.edu.tw/~whliao/ds2003/ds4.ppt
- http://www.just.edu.jo/~tawalbeh/cpe252/slides/CH1_2.ppt
- Lessons In Electric Circuits, Volume IV { Digital By Tony R. Kuphaldt Fourth Edition, last update July 30, 2004.
- Digital Electronics Part I – Combinational and Sequential Logic Dr. I. J. Wassell.
- Digital Design With an Introduction to the Verilog HDL, M. Morris Mano Emeritus Professor of Computer Engineering California State University, Los Angeles; Michael D. Ciletti Emeritus Professor of Electrical and Computer Engineering University of Colorado at Colorado Springs.
- Digital Logic Design Basics, Combinational Circuits, Sequential Circuits, Pu-Jen Cheng.