

***SCADEREA ABANDONULUI SCOLAR,
REZULTAT AL CRESTERII MOTIVATIEI
INVATARII PRIN MOBILITATI EUROPENE***

2014-1-RO01-KA102-000708

TOULOUSE, FRANȚA 17.02.2015– 09.03.2015

**ÎNDRUMAR PREGĂTIRE
PRACTICĂ**

***Circuite cu LED-uri din capitolul Studiul
diodelor***



BASES SCIENTIFIQUES POUR LA MECATRONIQUE

CIRCUITS ANALOGIQUE

TRAVAUX PRATIQUES

CIRCUITS LOGIQUE

TRAVAUX PRATIQUES

SIMULATION AUTOMATISME

TRAVAUX PRATIQUES

BASES SCIENTIFIQUES POUR LA MECANIQUE ET L'ELECTRICITE

1. COMPOSANTS ELECTRONIQUES ELEMENTAIRES

- 1. Diode**
- 2. Transistor Bipolaire**
- 3. Transistor MOSFET**
- 4. Thyristor**
- 5. Triac**

2. APPLICATIONS ELEMENTAIRES

- 1. Commande d'intensité lumineuse**
- 2. Convertisseur AC/DC**
- 3. Chargeur de batterie**
- 4. Tubes fluorescent & lampe à économie d'énergie**
- 5. Capteur photovoltaïque**

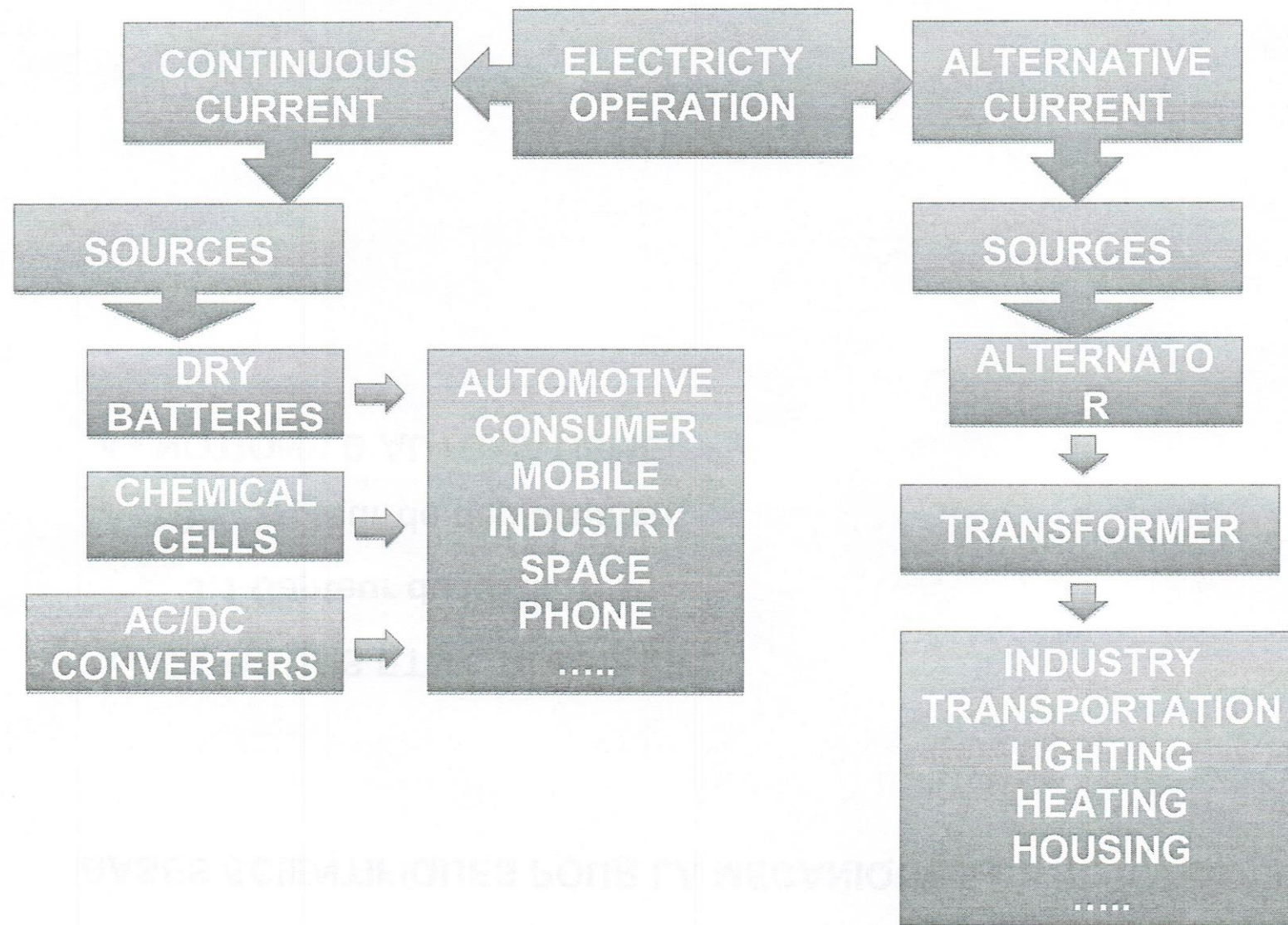
BASES SCIENTIFIQUES POUR LA MECANIQUE ET L'ELECTRICITE

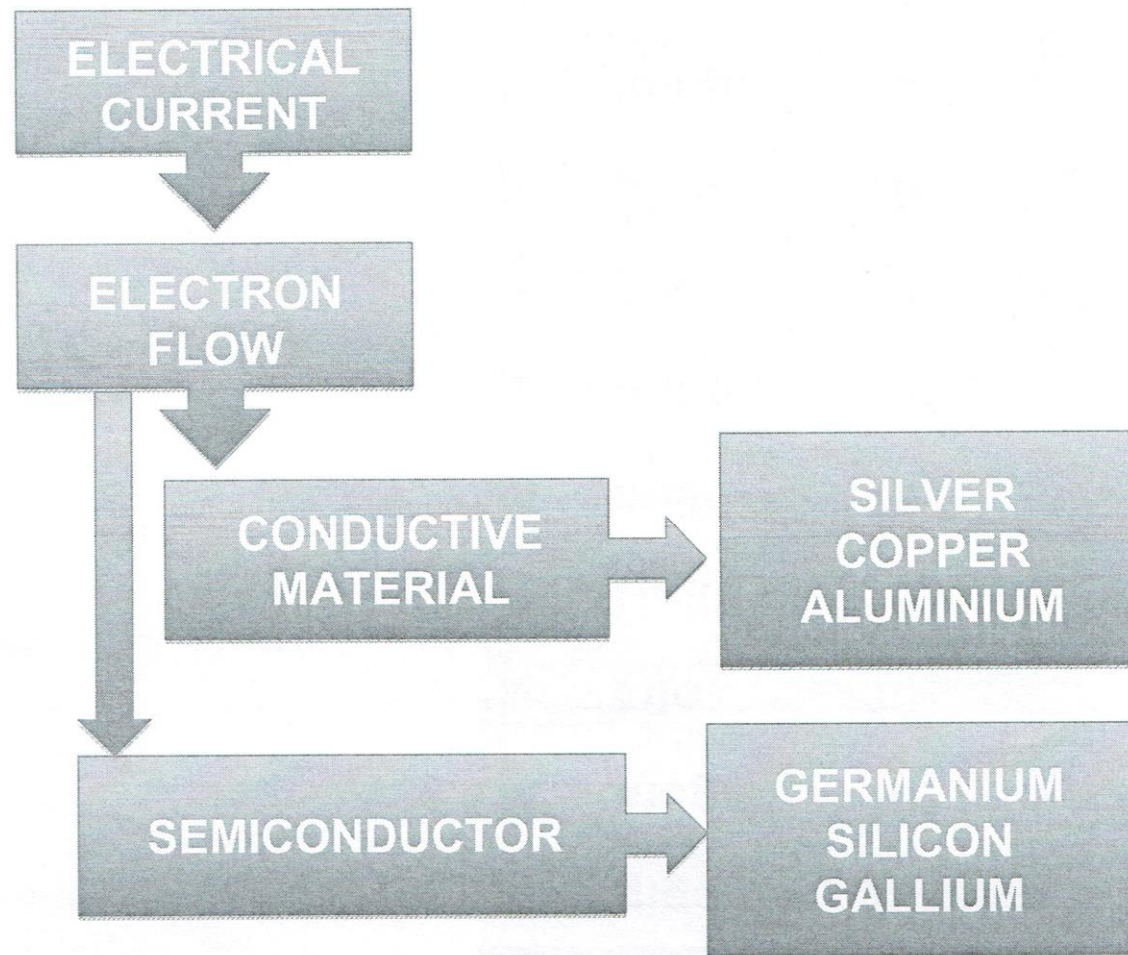
3 - CAPTEURS ET ACTIONNEURS

3.1 Capteur de lumière

3.2 Capteur de déplacement

4 - NOTIONS D'AUTOMATISME





Symbols and Definitions of Multiplier used in Physic

T	terra	10^{12}
G	giga	10^9
M	mega	10^6
k	kilo	10^3
	Unity	10^0
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
A	atto	10^{-18}

NORMALIZED MEASUREMENT UNITS

Parameter	10^{-12}	10^{-9}	10^{-6}	10^{-3}	1	10^3	10^6	10^9	
Volt			μV	mV	V	kV			Voltage
Ampere	pA	nA	μA	mA	A	kA			Current
Ohm			$\mu\Omega$	m Ω	Ω	k Ω	M Ω	G Ω	Resistor
Henry	pH	nH	μH	mH	H				Inductance
Farad	pF	nF	μF	mF	F				Capacitance
Hertz				mHz	Hz	kHz	MHz	GHz	Frequency
Coulomb	pC	nC	μC	mC	C				Charge
Watt			μW	mW	W	kW	MW		Power
Joule	pJ	nJ	μJ	mJ	J	kJ	MJ		Energy
Rho					ρ				Resistivity

Volta	Italien	1694-1778
Ampere	Français	1775-1836
Ohm	Allemand	1789-1854
Henry	Américain	1797-1878
Faraday	Britannique	1791-1867
Hertz	Allemand	1857-1894
Coulomb	Français	1736-1806
Watt	Ecossais	1736-1819
Joule	Britannique	1818-1889
Rho		

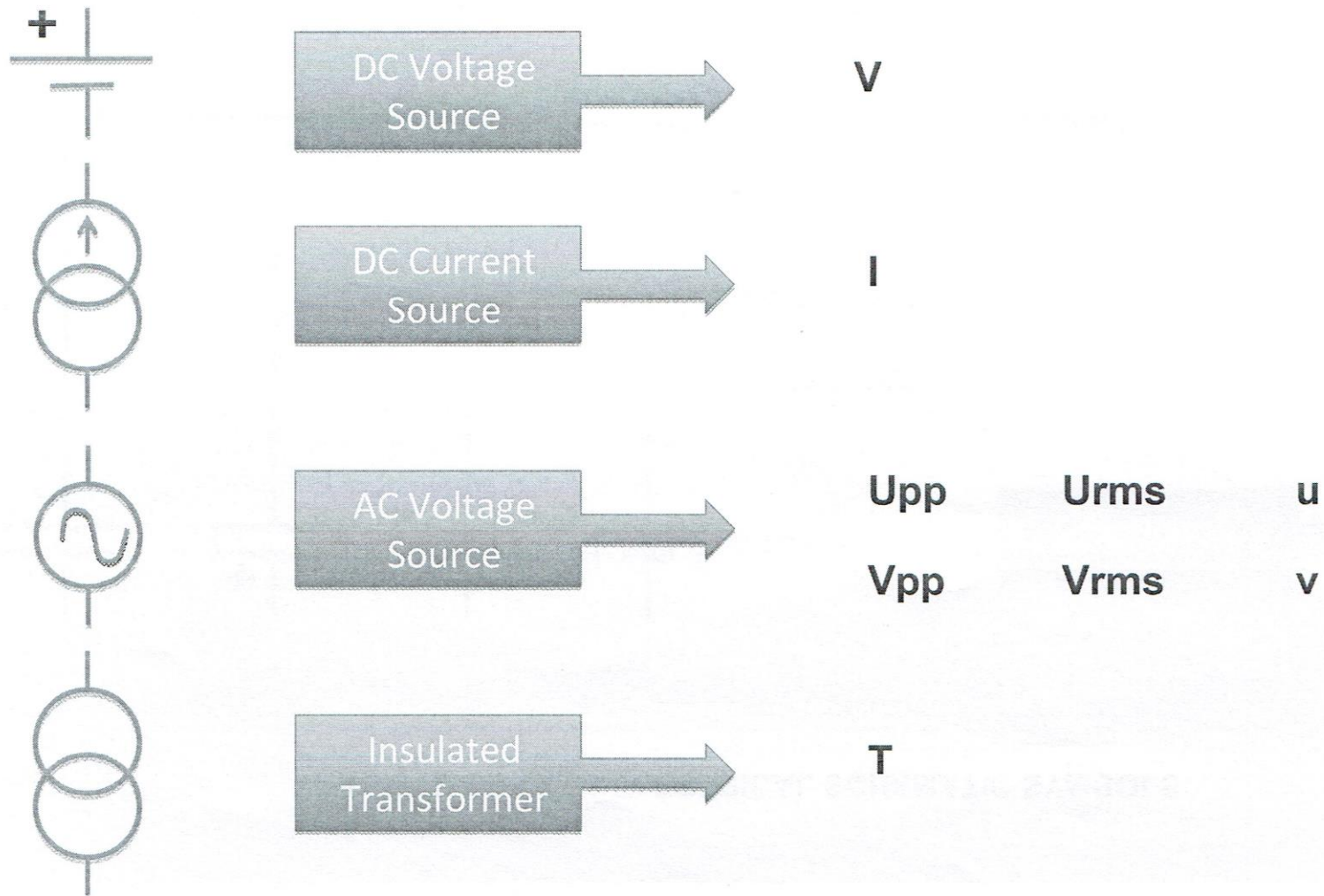
BASIC ELECTRICAL UNITS INTERNATIONAL DEFINITIONS

VOLT	Electrical potential equal to the difference of the electrical potential between two points on a conductive wire carrying a constant current of one ampere when the power dissipated between the two points is one watt.
AMPERE	Constant current that, maintained in two parallel conductors of infinite length and negligible cross section, placed at 1 meter apart in free space, produces a force of $2 \cdot 10^{-7}$ newton per meter between them.
OHM	The resistance between two points on a conductor that produces a current of 1 A when a constant 1 volt is applied to them.
COULOMB	One coulomb is the constant flow of $6.28 \cdot 10^{18}$ electrons per second.
WATT	The power dissipated by a constant current of 1A flowing across a potential difference of 1 Volt
Joule	Is equal to 1 watt per second

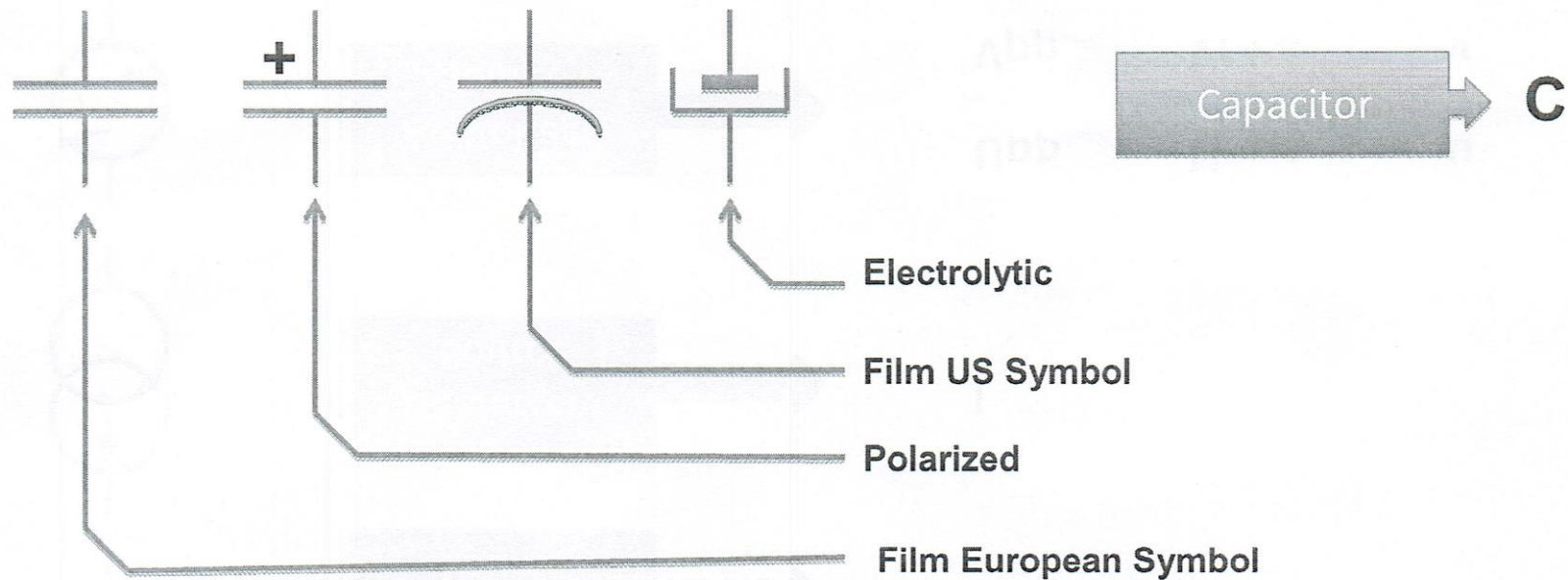
ELECTRICAL PROPERTIES OF COMMON MATERIALS

Conductive Material	Resistivity ρ @ $\Omega \cdot m$ @ $T=300K$	Resistance for a 10km long wire, diameter 20mm [$R = \rho * L/s$] with L : meter, s : m^2
Silver	$1.6 * 10^{-8}$	0.510 Ω
Copper 99.99%	$1.7 * 10^{-8}$	0.540 Ω
Gold	$2.4 * 10^{-8}$	0.764 Ω
Aluminum	$2.7 * 10^{-8}$	0.859 Ω
Brass	$7.0 * 10^{-8}$	2.220 Ω
Iron	$10.4 * 10^{-8}$	3.31 Ω
Tin	$18 * 10^{-8}$	5.73 Ω
Lead	$21 * 10^{-8}$	6.68 Ω
Nichrome	$100 * 10^{-8}$	31.84 Ω
De-ionized water	$1.8 * 10^5$	irrelevant
Polystyrene	10^{20}	irrelevant

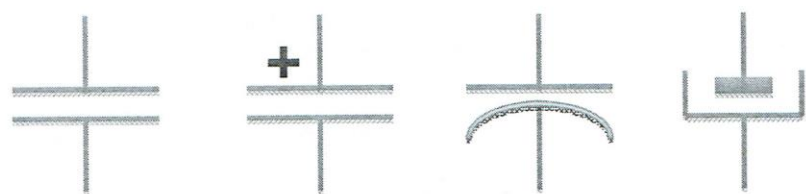
ACTIVE DIPOLES ELECTRICAL SCHEMATIC SYMBOLS



PASSIVE DIPOLES ELECTRICAL SCHEMATIC SYMBOLS



PASSIVE DIPOLES ELECTRICAL SCHEMATIC SYMBOLS



Capacitor → **C**



Resistor → **R**

Air Core

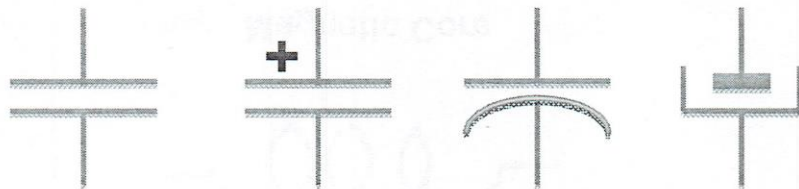


Inductor → **L**

Magnetic Core



PASSIVE DIPOLES ELECTRICAL SCHEMATIC SYMBOLS



Capacitor →

C



Resistor →

R



Inductor →

L



Impedance →

Z

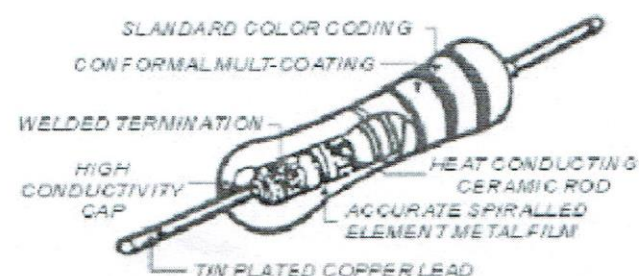
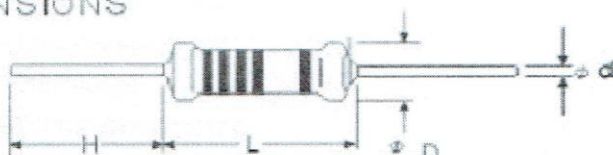
METAL FILM FIXED RESISTORS

INTRODUCTION:

MF series is a group of metal film-fixed resistors applying high Aluminum content base material vacuum sputtered by Ni-Cr alloy and excellent heat-and wet-proof special resin for protective coating. Those resistors are manufactured through integrated automatic production system and then have good stable and uniform property. Furthermore, they show excellent performance regardless open in air.

MF系列是一組鋁材經鎳鉻合金真空噴灑及特殊樹脂表被防火、防潮的金屬膜固定電阻。這些電阻由整體自動化系統製造，所以有穩定及均勻品質。而且，即使暴露在空氣中仍有極佳的品質。

DIMENSIONS



GENERAL SPECIFICATIONS

MIL STYLE	STYLE	POWER RATING(W)	DIMENSION (mm)				MAX WORKING VOLTAGE	MAX OVERLOAD
			L	D	H(MIN)	d		
RN-50	MF-12	0.125W	3.7 ±0.4	1.8 ±0.2	27	0.46 ±0.02	200	400
RN-50	MF-16	0.125W	3.7 ±0.4	1.8 ±0.2	27	0.46 ±0.02	200	400
RN-55	MF-25	0.25W	6.8 ±0.5	2.5 ±0.2	27	0.58 ±0.02	250	500
RN-60	MF-50	0.5W	9.0 ±1.0	3.5 ±0.5	25	0.68 ±0.02	350	700
RN-65	MF-100	1W	12 ±1.0	4.5 ±0.5	33	0.80 ±0.03	500	1000
RN-70	MF-200	2W	16 ±1.0	5.5 ±0.5	33	0.80 ±0.03	500	1000
RN-75	MF-300	3W	17 ±1.0	6.0 ±0.5	30	0.80 ±0.03	600	1000

Metal Film Precision Resistor (CSR Series)

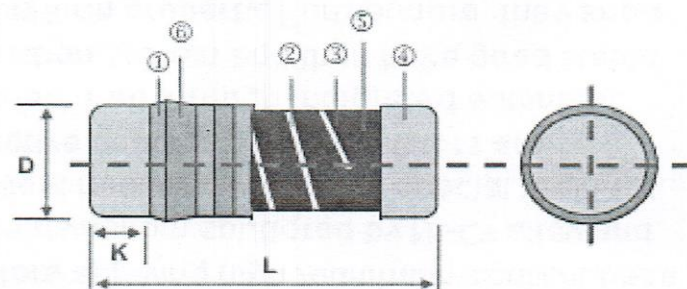
Features

- Excellent overall stability
- Tight tolerance down to $\pm 0.1\%$
- Extremely low TCR down to $\pm 10 \text{ PPM}/^\circ\text{C}$
- High power rating up to 1 Watts

Applications

- Automotive
- Telecommunication
- Medical Equipment

Construction



① Insulation Coating	④ Electrode Cap
② Trimming Line	⑤ Resistor Layer
③ Ceramic Rod	⑥ Marking

Dimensions

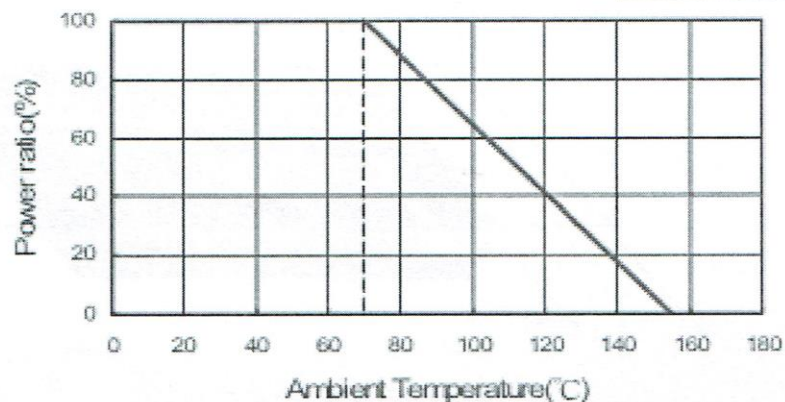
Unit: mm

Type	L	ΦD	K min.	Weight (g) (1000pcs)	Packaging
					180mm (7")
CSR0204	3.50 ± 0.2	1.40 ± 0.15	0.5	18.7	3000EA
CSR0207	5.90 ± 0.2	2.20 ± 0.20	0.5	80.9	2000EA

Part Numbering

CSR	0204	D	T	D	V	1000
Product Type	Dimensions (L×ΦD)	Resistance Tolerance	Packaging Code	TCR (PPM/°C)	Power Rating	Resistance
	0204: 3.5x1.4 0207: 5.9x2.2	B: ±0.1% C: ±0.25% D: ±0.5% F: ±1% J: ±5%	T: Taping Reel B: Bulk	B: ±10 N: ±15 C: ±25 D: ±50 E: ±100	T: 1W U: 1/2W V: 1/4W	0100: 10Ω 1000: 100Ω 2201: 2200Ω 1001: 1KΩ 1004: 1MΩ

Derating Curve

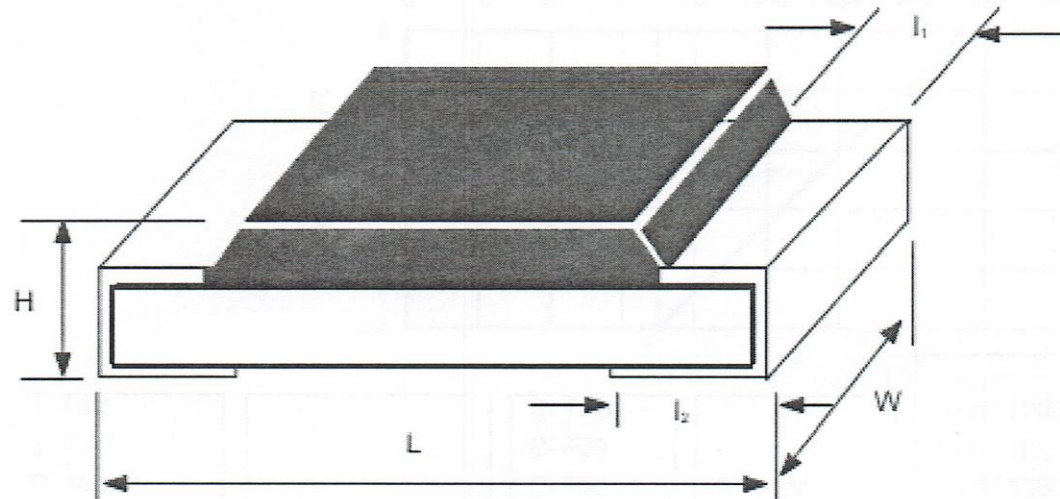


2 DIMENSION

The dimension is expressed as 4 digits number by SI unit (mm). <Table 1>

Left 2 digits are length of resistor, and the other 2 digits are width. <Fig 1>

<Fig 1>



<Table 1>

[Unit : mm]

Dimension	*0402	0603	1005	1608	2012	3216	3225	5025	6432
(inch)	(01005)	(0201)	(0402)	(0603)	(0805)	(1206)	(1210)	(2010)	(2512)
L	0.40±0.02	0.60±0.03	1.00±0.05	1.60±0.10	2.00±0.20	3.20±0.20	3.20±0.20	5.00±0.20	6.30±0.20
W	0.20±0.02	0.30±0.03	0.50±0.05	0.80±0.15	1.25±0.15	1.60±0.15	2.55±0.20	2.50±0.20	3.20±0.20
H	0.12±0.02	0.23±0.03	0.35±0.05	0.45±0.10	0.50±0.10	0.55±0.10	0.55±0.10	0.55±0.10	0.55±0.10
l ₁	0.10±0.03	0.10±0.05	0.20±0.10	0.30±0.20	0.40±0.20	0.45±0.20	0.45±0.20	0.60±0.20	0.60±0.20
l ₂	0.10±0.03	0.15±0.05	0.25±0.10	0.35±0.10	0.35±0.20	0.40±0.20	0.40±0.20	0.60±0.20	0.60±0.20

● RATED POWER

The Rated Power is classified by the dimension of the resistor. <Table 17>

<Table 17>

item \ Dimension	0603	1005	1608	2012	3216	3225	5025	6432
	(0201)	(0402)	(0603)	(0805)	(1206)	(1210)	(2010)	(2512)
Rated Power	1/20 W (0.05 W)	1/16 W (0.063 W)	1/10 W (0.100 W)	1/8 W (0.125 W)	1/4 W (0.25 W)	1/3 W (0.33 W)	2/3 W (0.67W)	1.0 W
Working Volt(Max)	25 V	50 V	50 V	150 V	200 V	200 V	200 V	200 V
STOL, IOL Volt(Max)	50 V	100 V	100 V	300 V	400 V	400 V	400 V	400 V

※ STOL : Short Time OverLoad
IOL : Intermittent OverLoad

※ The rated power is specified as continuous full loading power at the ambient temperature of $70\pm 2^{\circ}\text{C}$. In case of the temperature exceeding $70\pm 2^{\circ}\text{C}$, the power should be derated in accordance to <Fig 17>.

Valeur et multiplicateur						Tolérance	
		1er anneau	2ème anneau	3ème anneau		4ème anneau	
Noir	0				*1	Sans anneau	+20%
Marron	1				*10		Argent +10%
Rouge	2				*100		Or +5%
Orange	3				*10e3		Blanc +1%
Jaune	4				*10e4		
Vert	5				*10e5		
Bleu	6				*10e6		
Violet	7				*10e7		
Gris	8						
Blanc	9						



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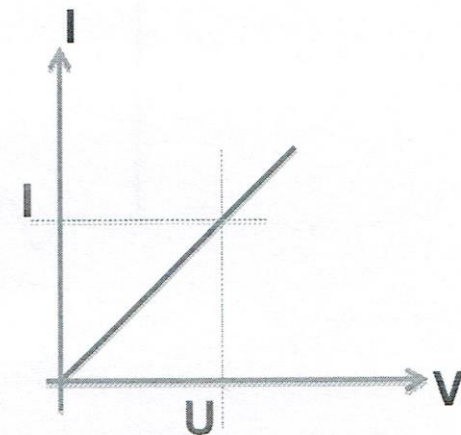
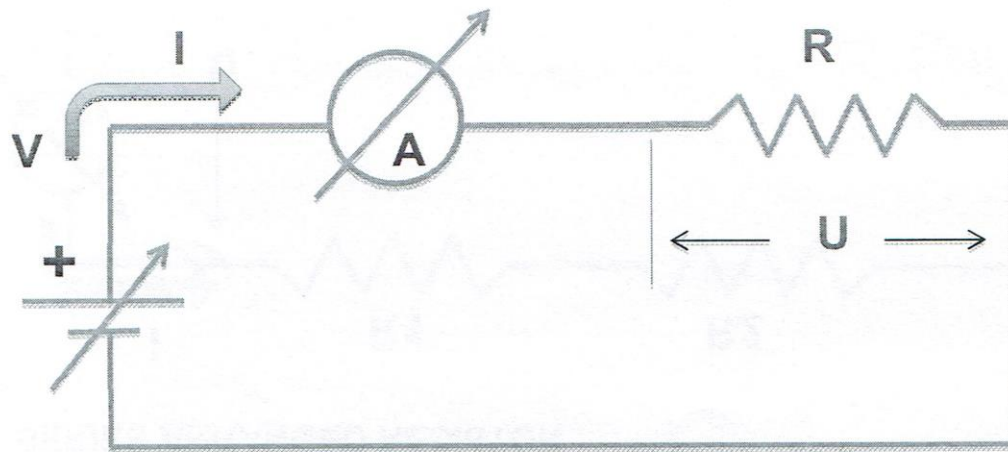
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RESISTOR BEHAVIOR

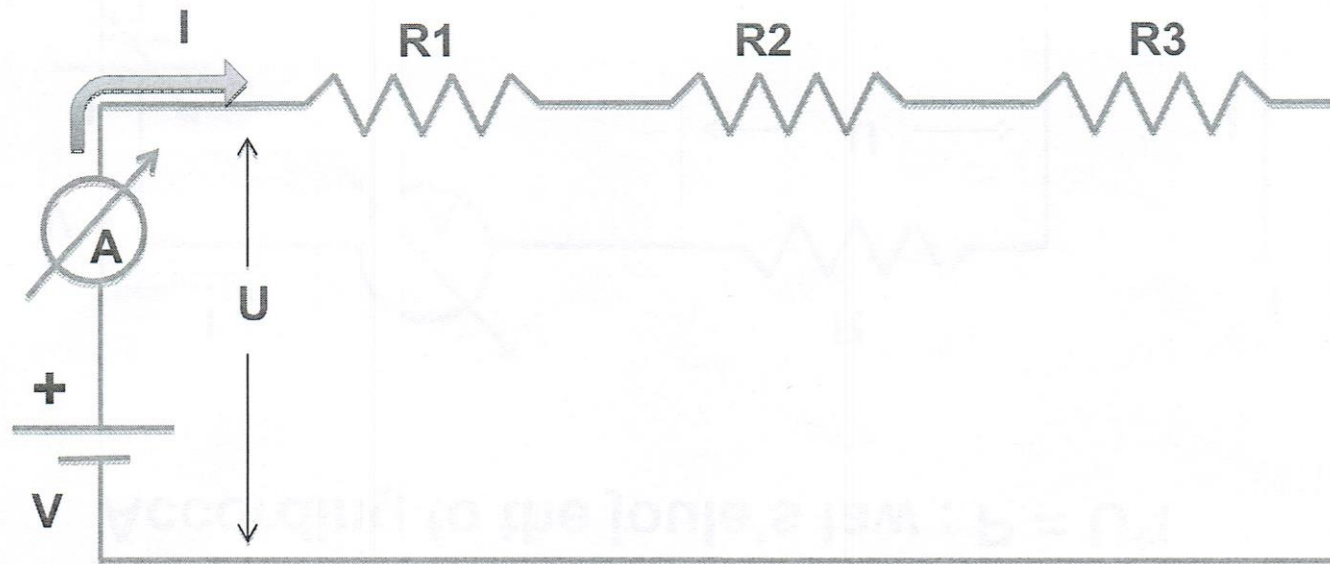
Resistor**Limits the electrical current**

According to the ohm's law : $U = R \cdot I$ $\Rightarrow I = \frac{U}{R}$

According to the joule's law : $P = U \cdot I$



SERIES ARRANGED RESISTOR

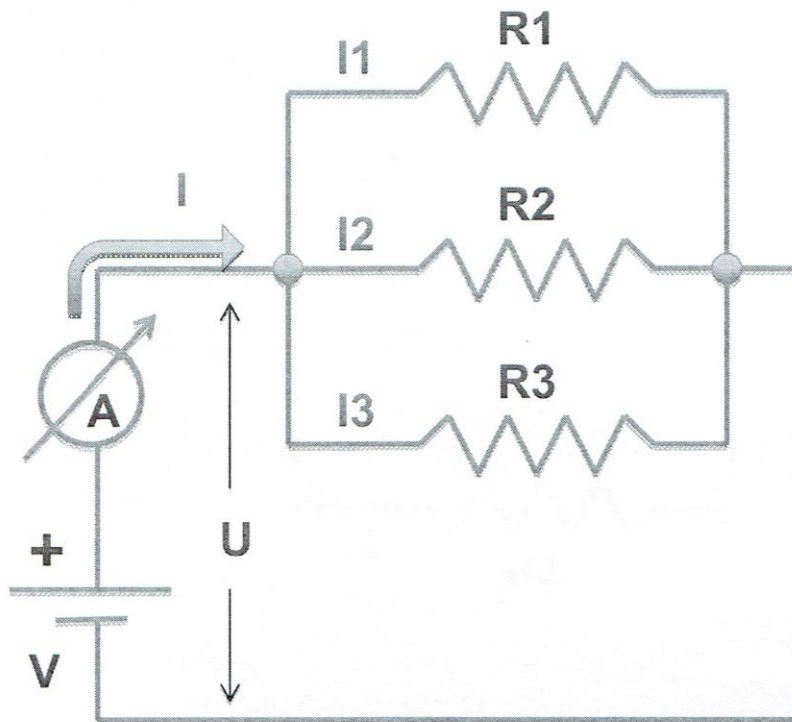


$$I = \frac{U}{R_1 + R_2 + R_3}$$

Equivalent : $\Sigma R = R_1 + R_2 + R_3$

$$\Rightarrow I = \frac{U}{\Sigma R}$$

PARRALLEL ARRANGED RESISTORS



$$\frac{1}{\Sigma R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$I = I_1 + I_2 + I_3$$

**SERIES / PARRALLEL
ARRANGED RESISTORS**

Let : $U = 100V$

$R1 = 150\Omega$

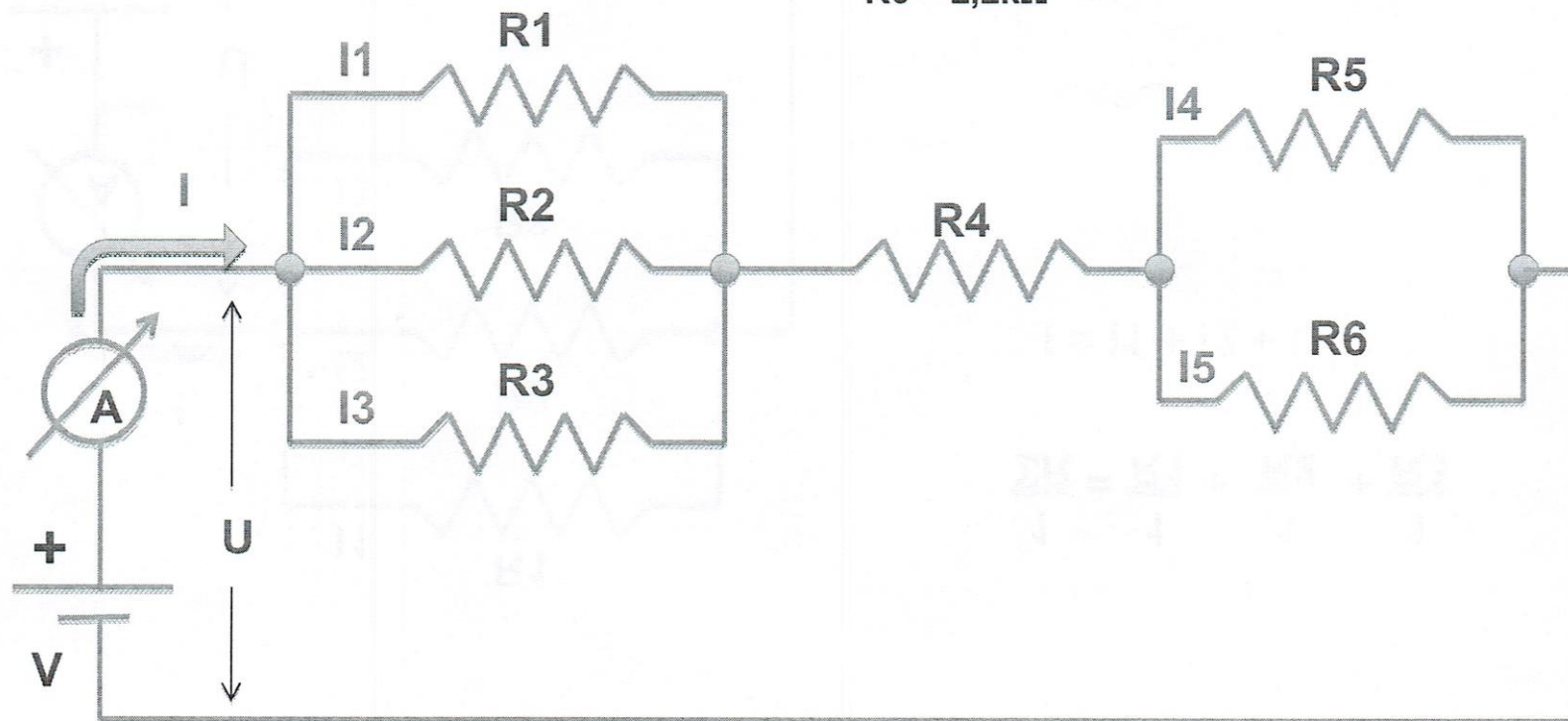
$R2 = 220\Omega$

$R3 = 560\Omega$

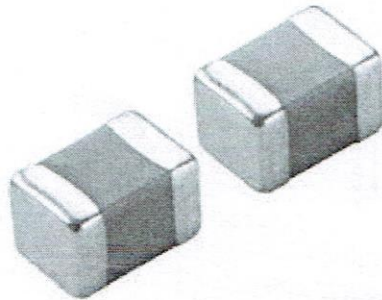
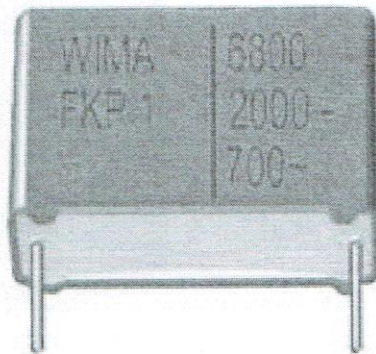
$R4 = 56\Omega$

$R5 = 1k\Omega$

$R6 = 2,2k\Omega$



CAPACITOR



Dielektrikum:

Polypropylen (PP) Folie

Beläge:

Aluminiumfolie und doppelseitig metallisierte Kunststoff-Folie

Innerer Aufbau:

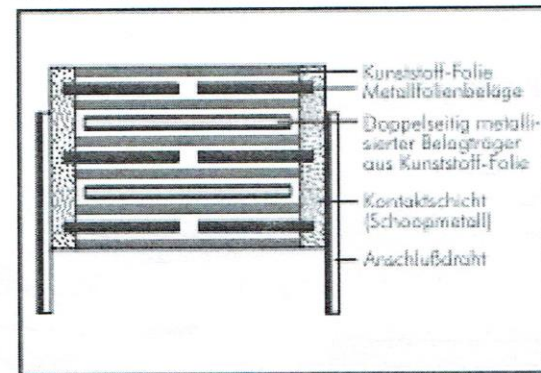
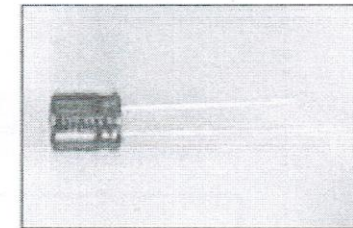
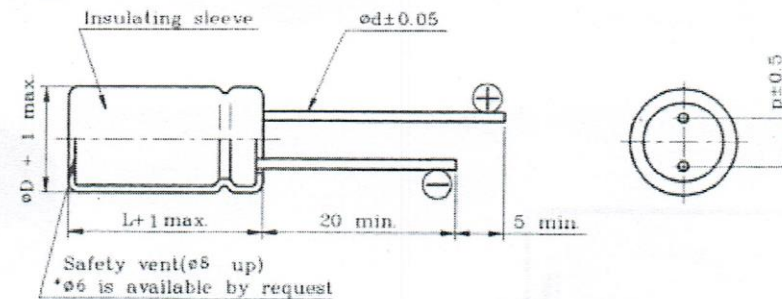


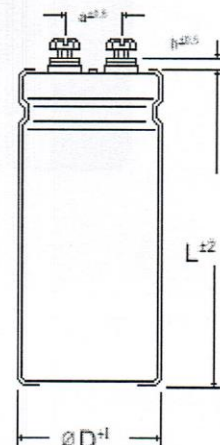
Diagram of dimensions



D ϕ	4	5	6	8
F	1.5	2.0	2.5	3.5
d ϕ	0.45			0.5



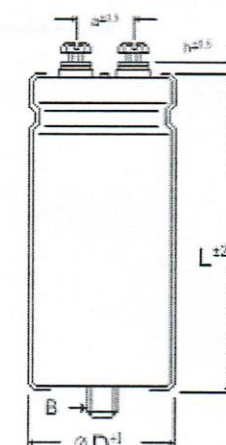
clamp mounted



D	h	a	B	terminals
[mm]	[mm]	[mm]		
35	6	13	M 8 x 12	M 5
40	5	18	M 8 x 12	M 5
50	5	22	M 12 x 16	M 5
65	5	28,5	M 12 x 16	M 5
75	5	31,7	M 12 x 16	M 5 (M 6)
90	5	31,7	M 12 x 16	M 6

	thread	max. tightening torque
terminals	M 5	2,0 Nm
terminals	M 6	2,5 Nm
mounting	M 8	4,0 Nm
mounting	M 12	10,0 Nm

bolt mounted



CAPACITOR BEHAVIOR

Capacitor **Store electrostatic charge**

Capacitor Stored Charge : $Q = C \cdot u = C \cdot E \left(1 - e^{-\frac{t}{R \cdot C}} \right)$

 **R.C : time constant**

Capacitor Stored Energy : $W = \frac{1}{2} C \cdot V^2$

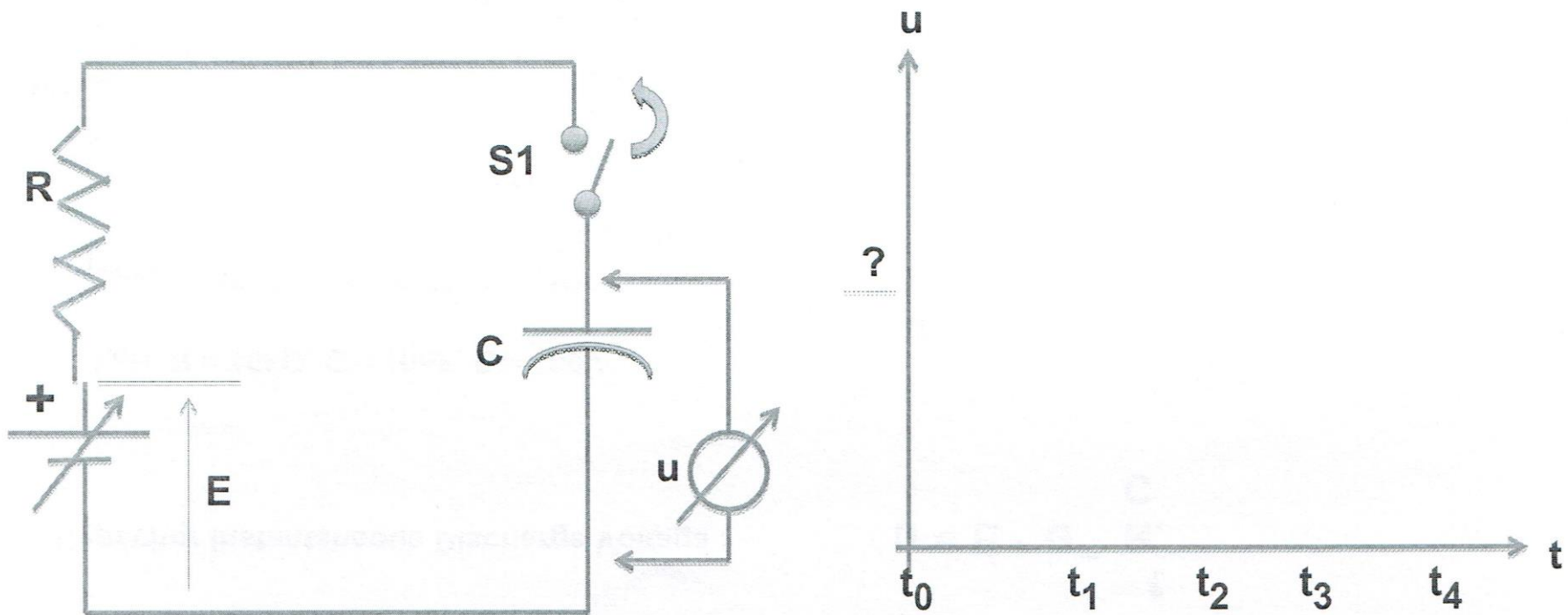
Current : $i = C \frac{dV}{dt}$

Capacitor Time Constant

t	RC	2,3 RC	4,6 RC	6,9 RC	α
i	$E \left(1 - \frac{1}{e} \right)$	$\frac{9 E}{10}$	$\frac{99 E}{100}$	$\frac{999 E}{1000}$	E

Capacitor Instantaneous Charging Voltage : $u = E \left(1 - e^{-\frac{t}{R.C}} \right)$

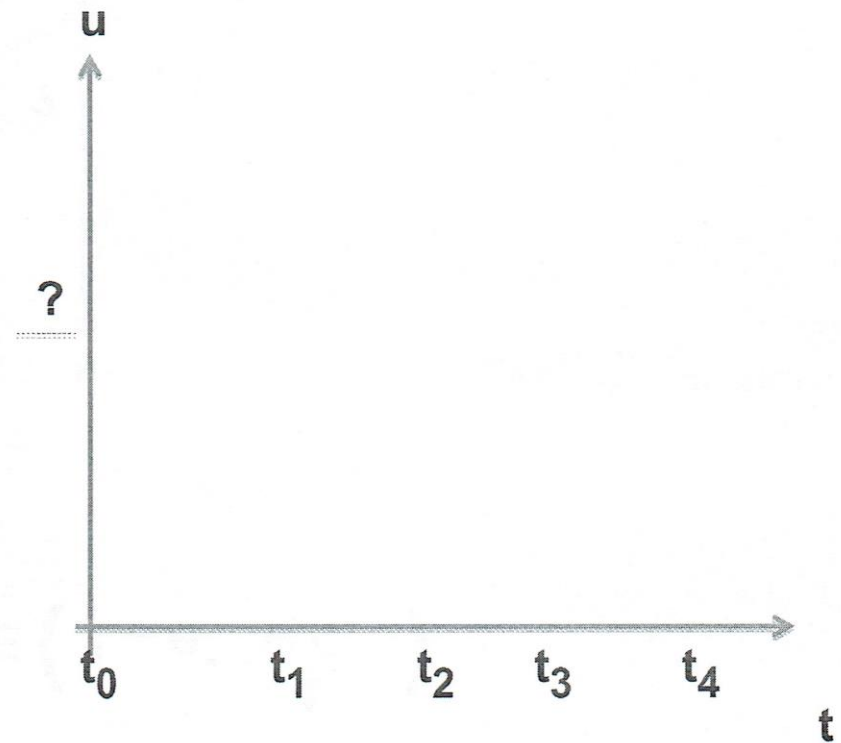
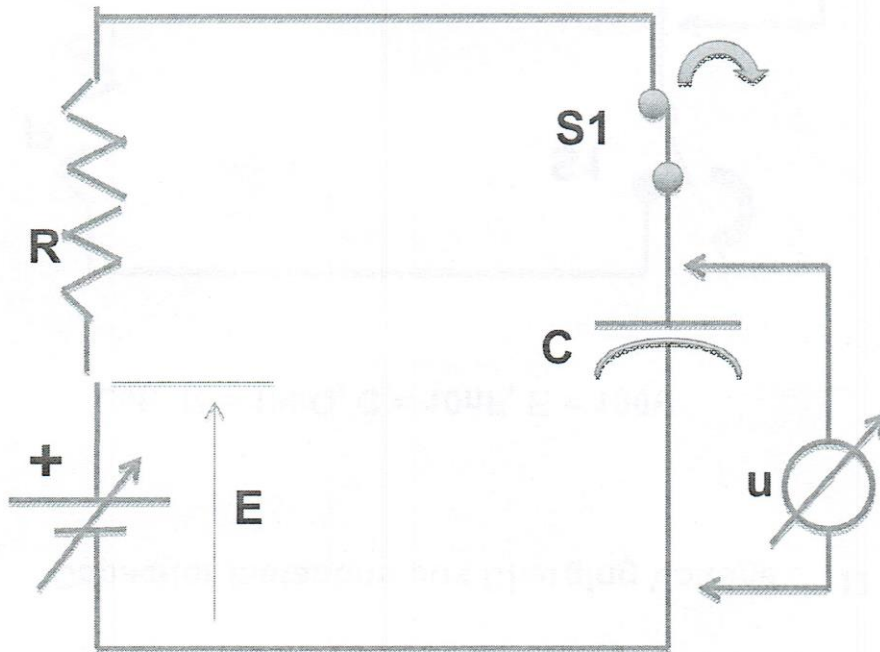
Let: $R = 10k\Omega$, $C = 10nF$, $E = 100V$

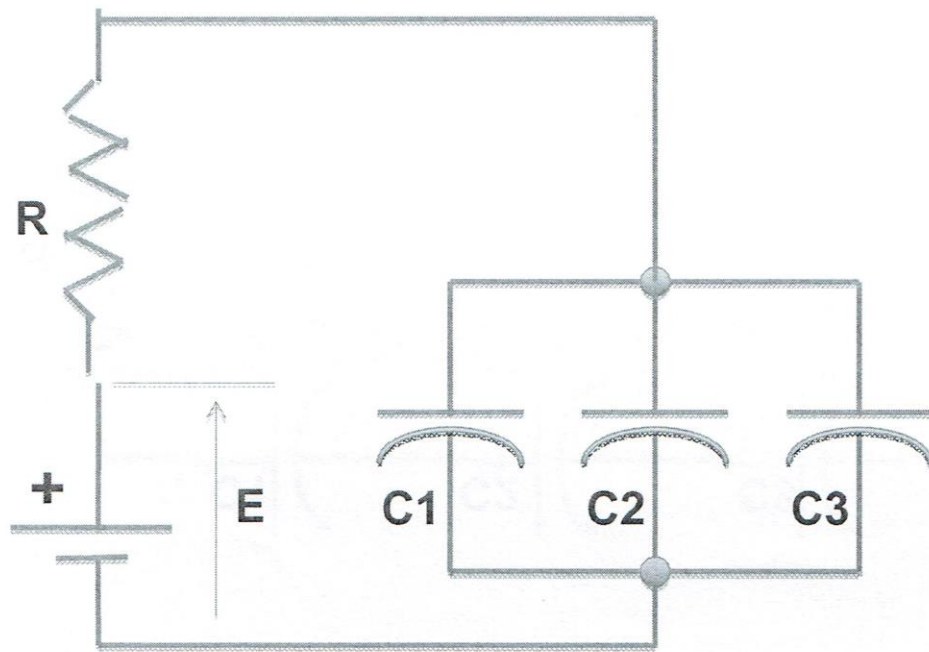


Capacitor Instantaneous Discharge Voltage :

$$u = E * e^{-\frac{t}{R \cdot C}}$$

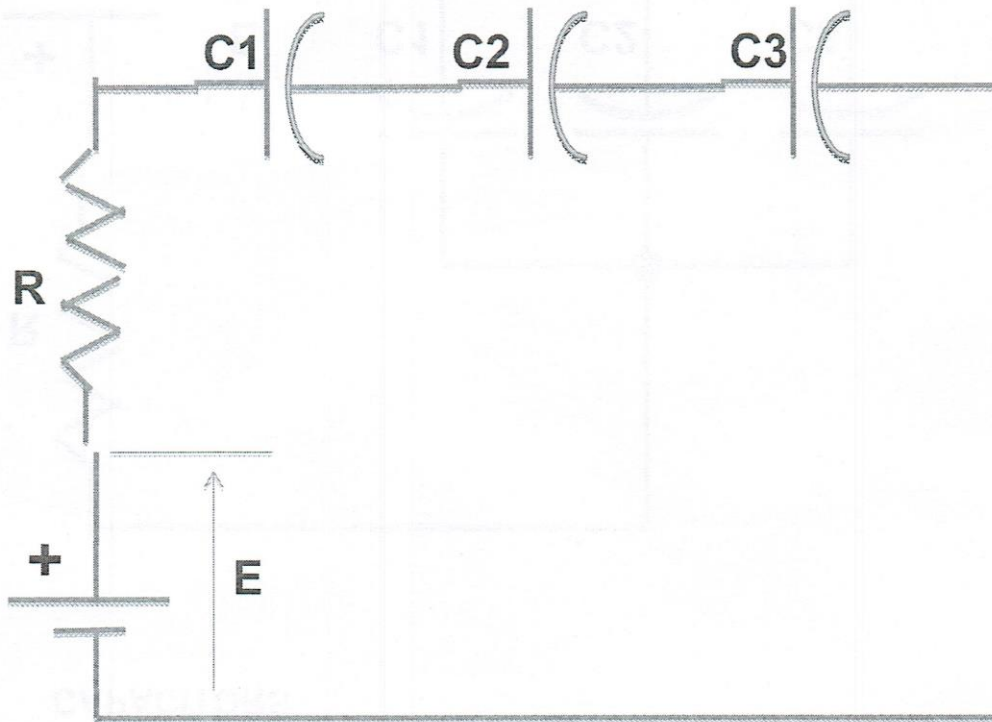
Let: $R = 10k\Omega$, $C = 10nF$, $E = 100V$



**PARALLEL ARRANGED
CAPACITORS**

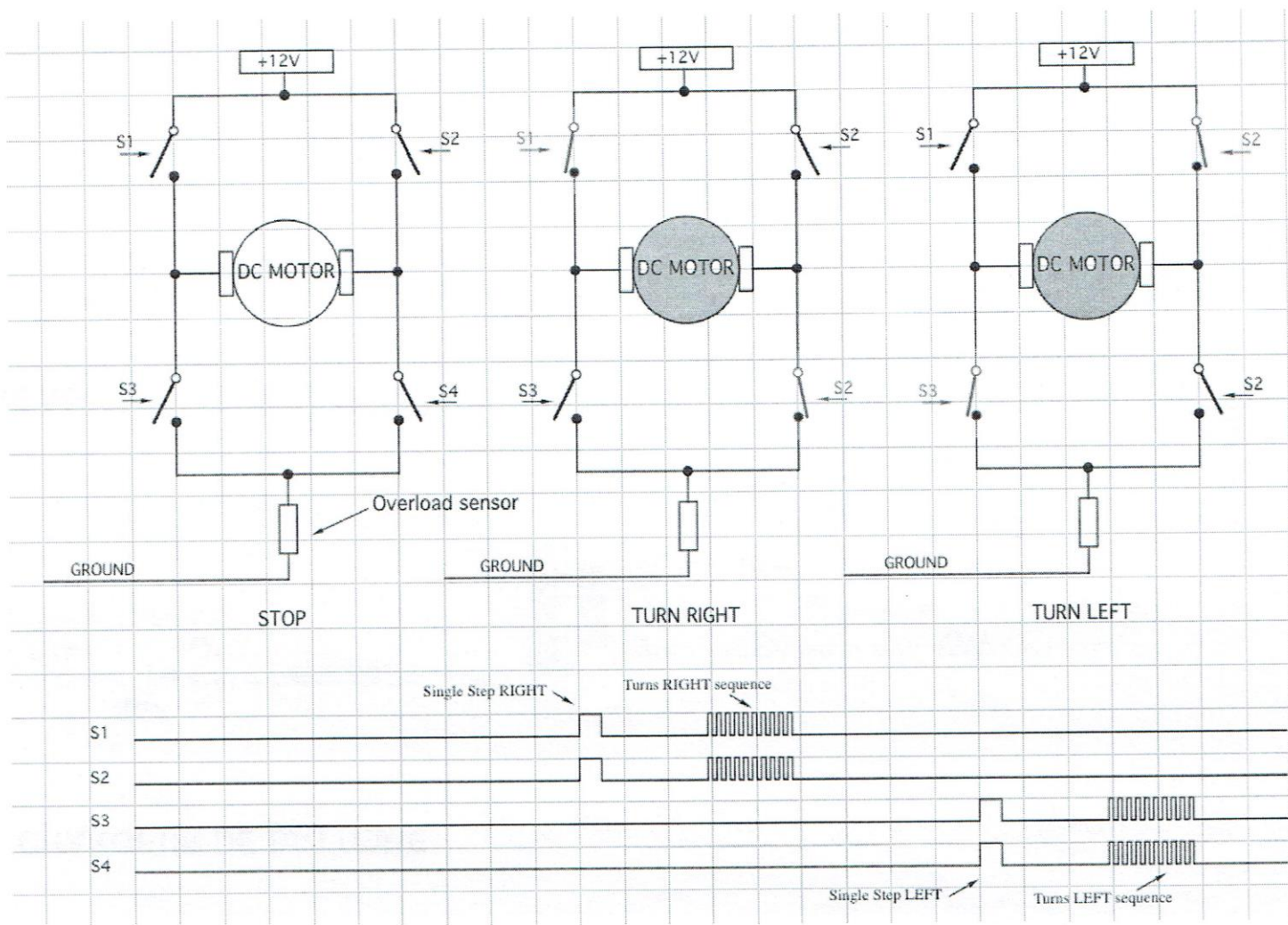
$$\Sigma C = C1 + C2 + C3$$

SERIES ARRANGED CAPACITORS

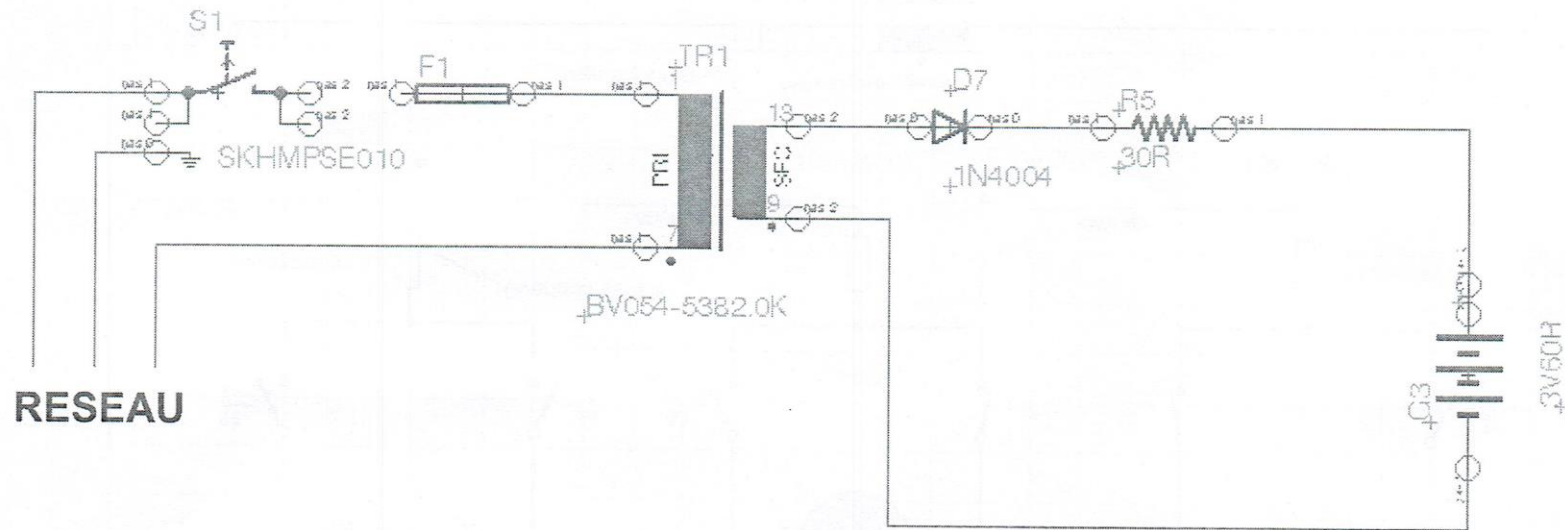


$$\frac{1}{\Sigma C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3}$$

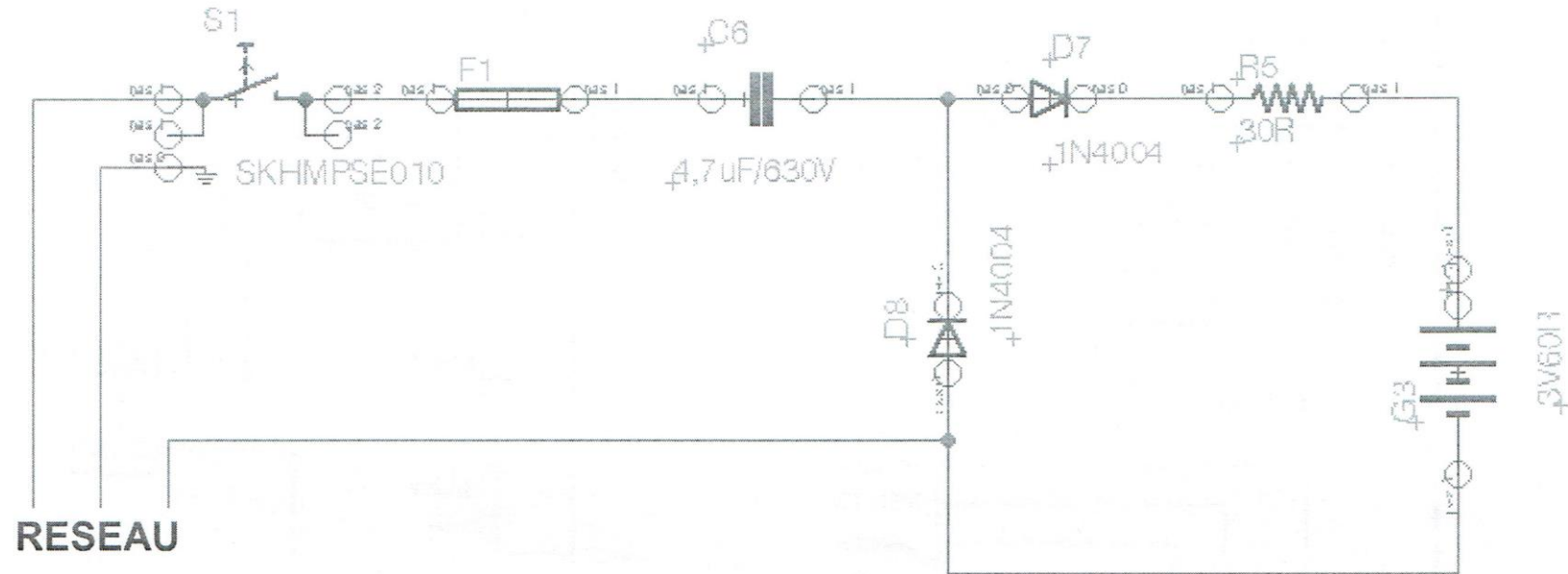
PRINCIPE COMMANDE MOTEUR A COURANT CONTINU



CHARGEUR DE BATTERIE



LOW COST BATTERY CHARGER



HIGH END Li-Ion BATTERY CHARGER

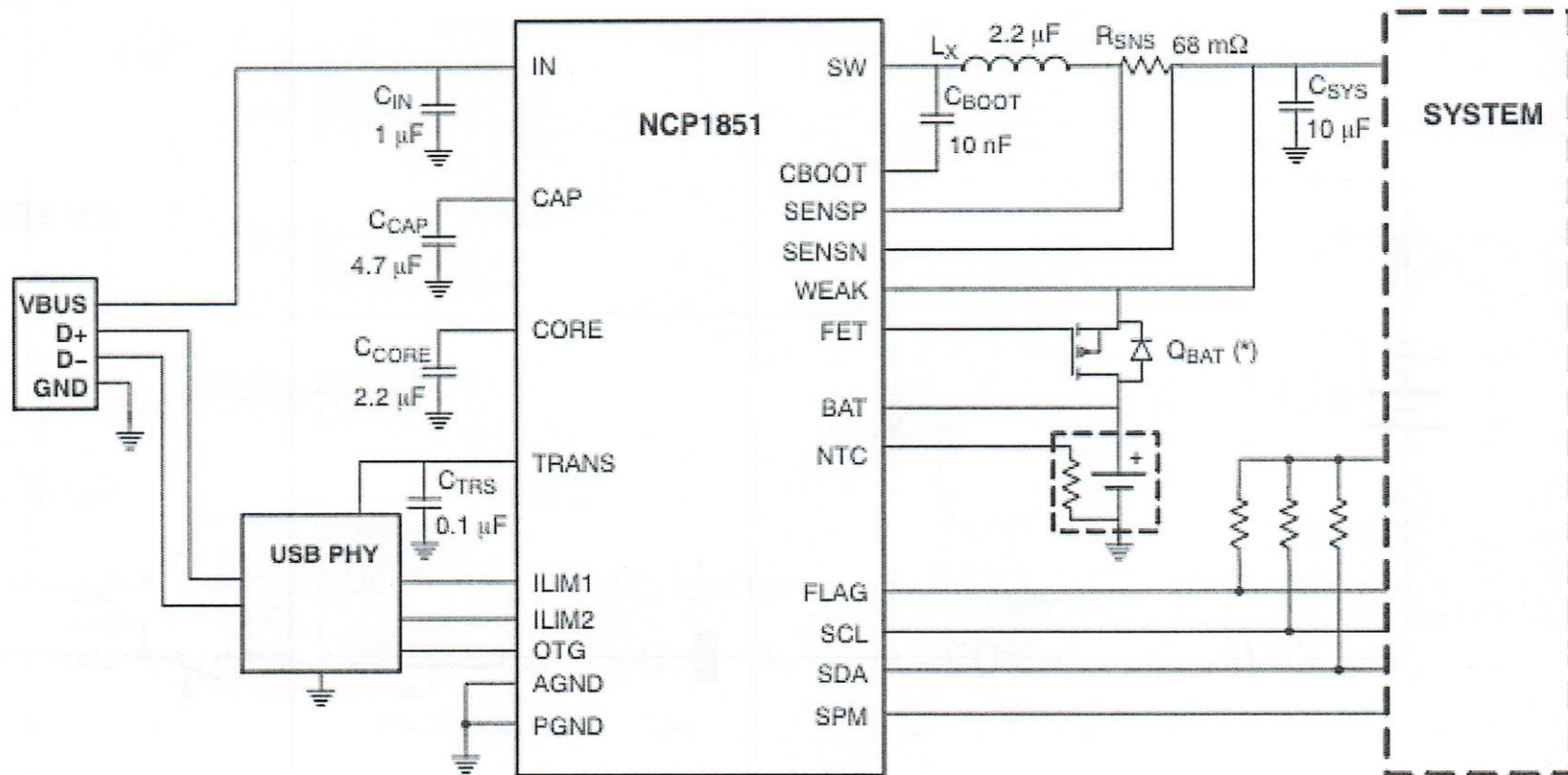


Figure 23. NCP1851 Typical Application Example

HIGH END Li-Ion BATTERY CHARGER: BLOCK DIAGRAM

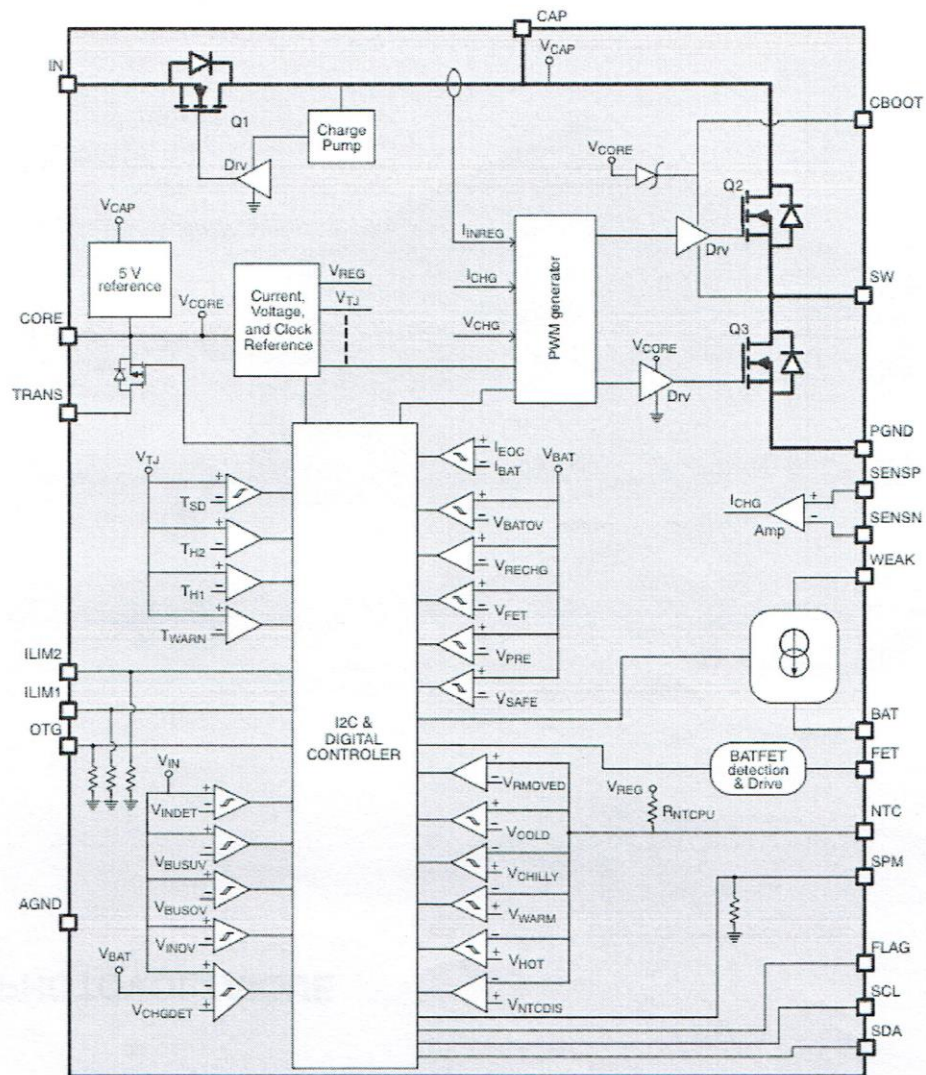
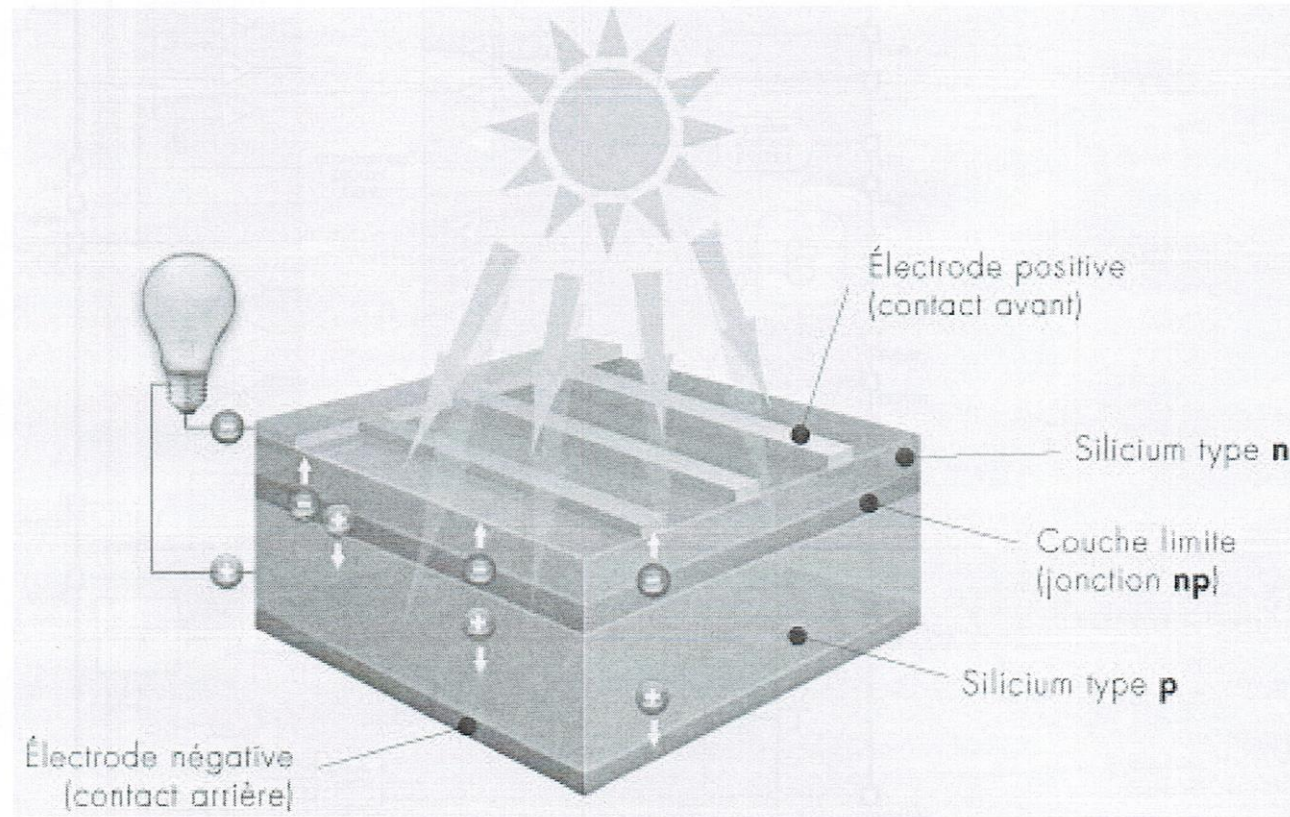
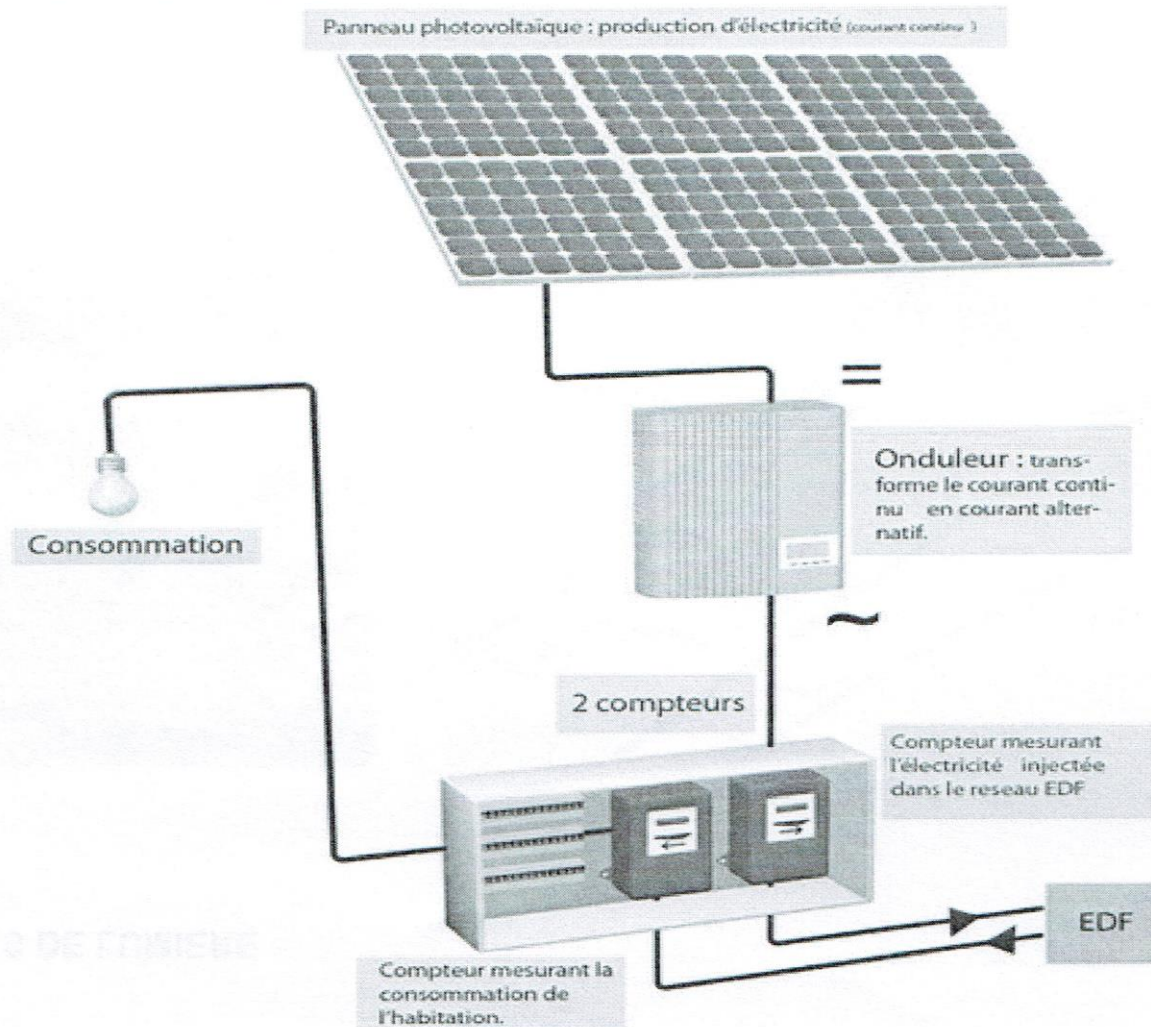


Figure 3. Block Diagram

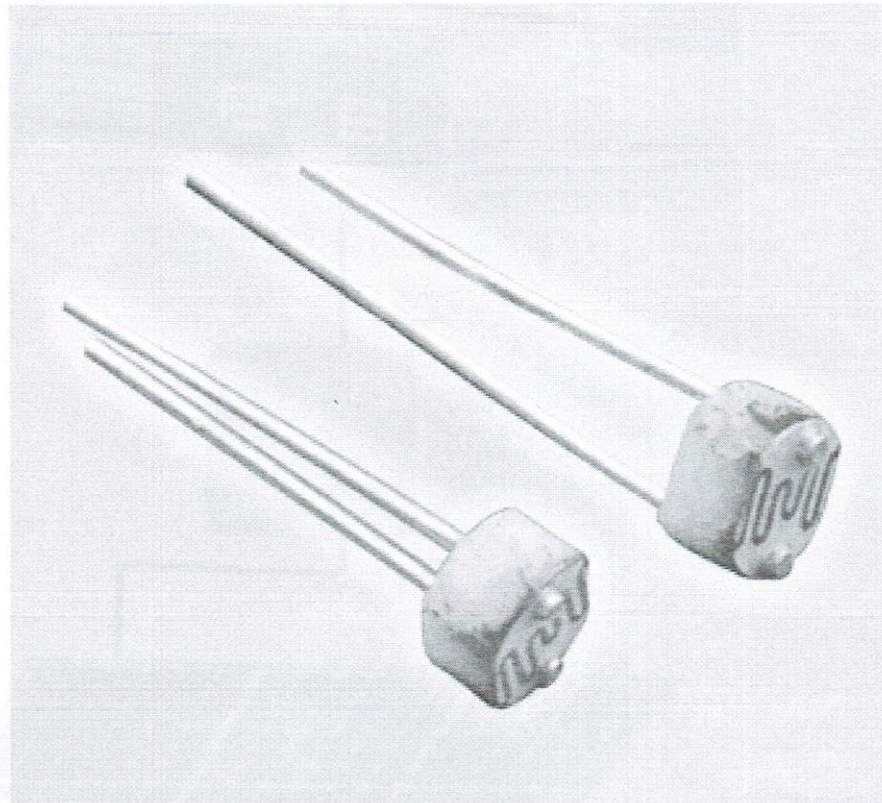
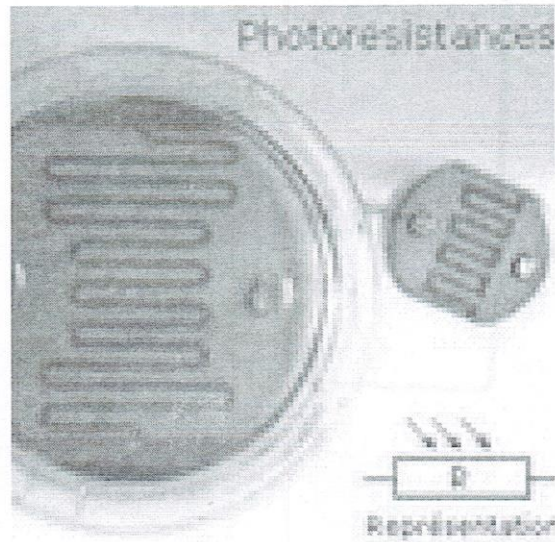
PANNEAU PHOTOVOLTAÏQUE



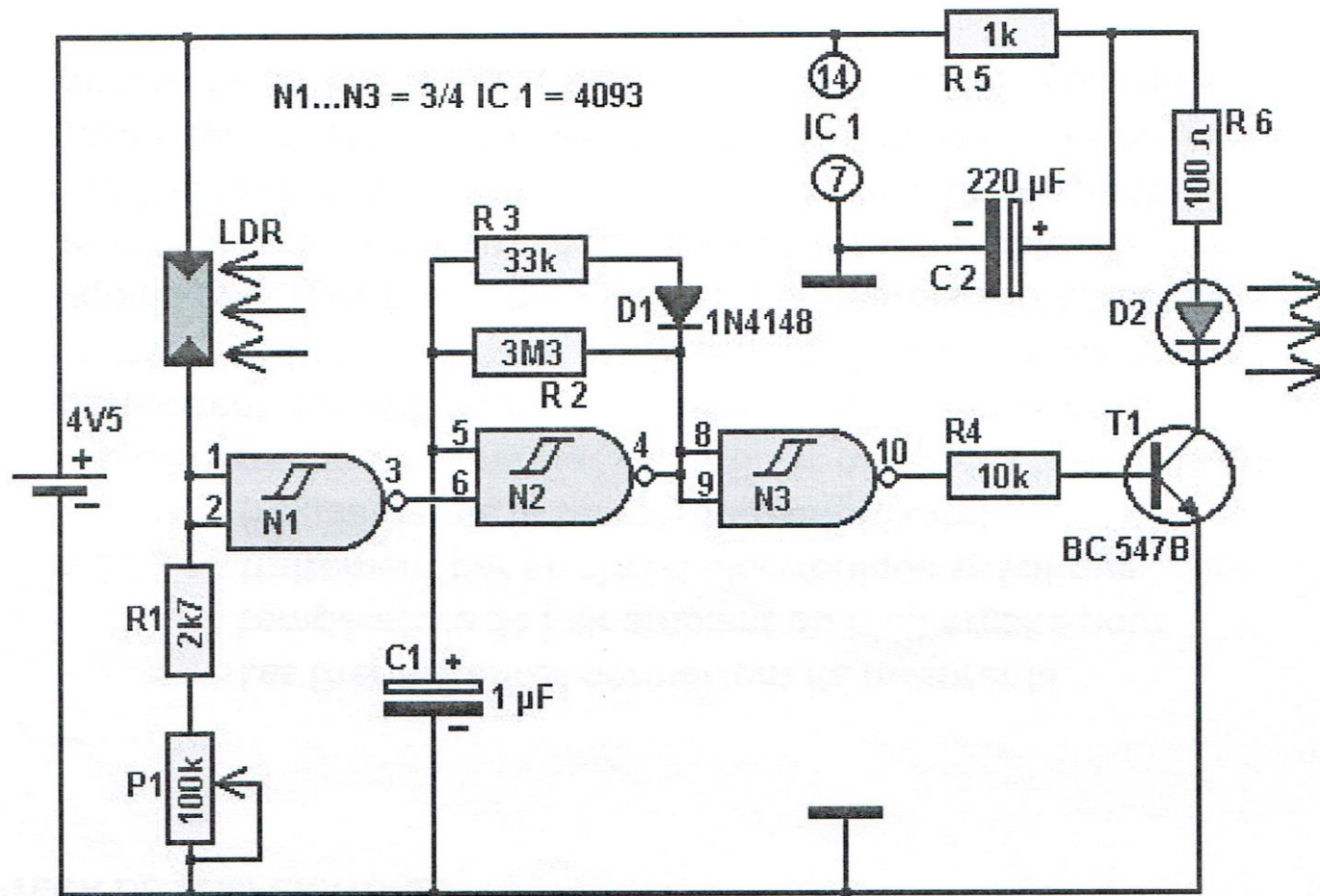
PANNEAU PHOTOVOLTAÏQUE



CAPTEURS DE LUMIERE



APPLICATION ECLAIRAGE DE SECURITÉ

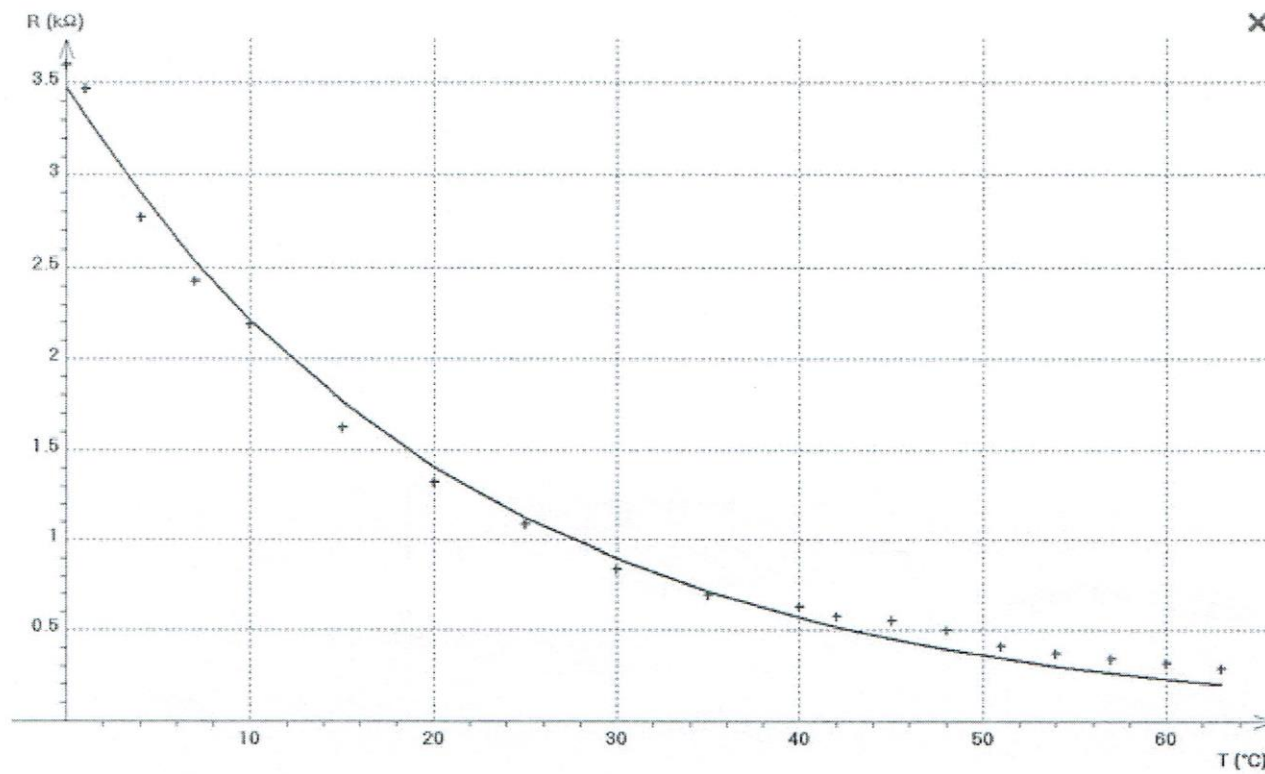


CAPTEUR DE TEMPERATURE:

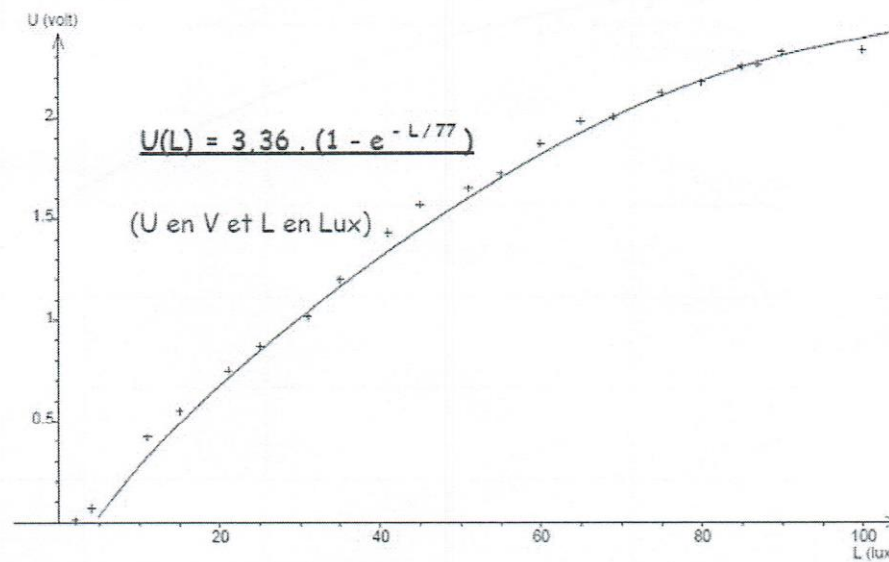
Les thermistances permettent de mesurer la température de l'air ambiant ou d'un organe pour traitement par un circuit électronique spécifique (régulation de la température ambiante).

Ces composants sont fabriqués à partir de matériaux résistants qui permettent une utilisation dans une gamme de température limitée. En effet, il n'est pas pratique de concevoir la mesure d'un liquide ou un gaz à une température supérieure à 150°C avec ce type de composant. Dans ce cas précis, il est préférable d'utiliser soit des couples purement métallique (chromel fer/constantan, type J, type K, etc ...), soit des résistances fabriquées avec du platine. Le problème devient alors le coût de ce type de produits.

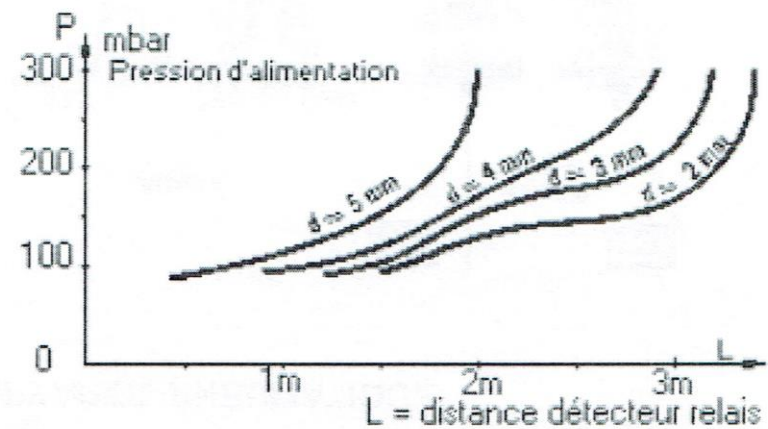
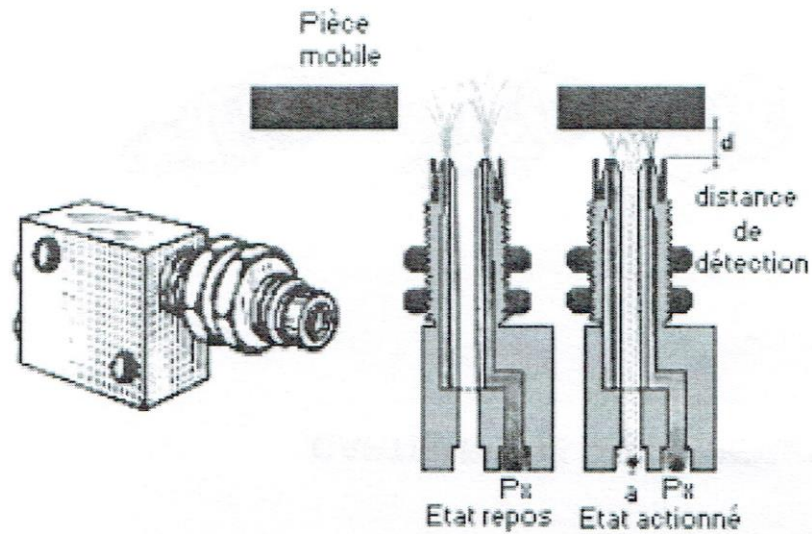
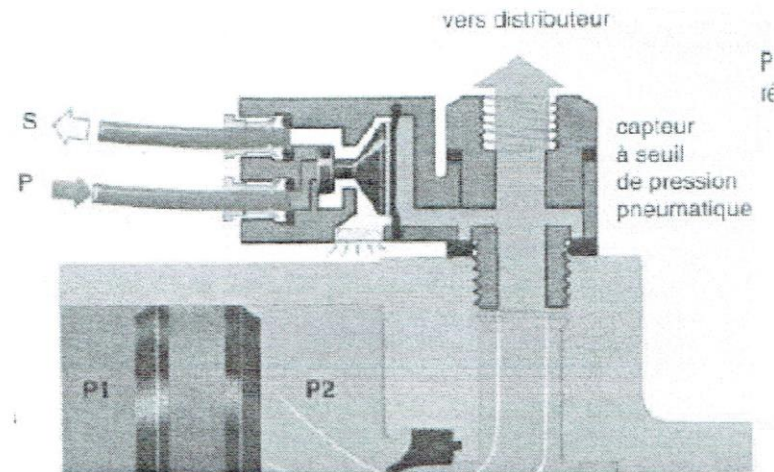
CAPTEUR DE TEMPERATURE:



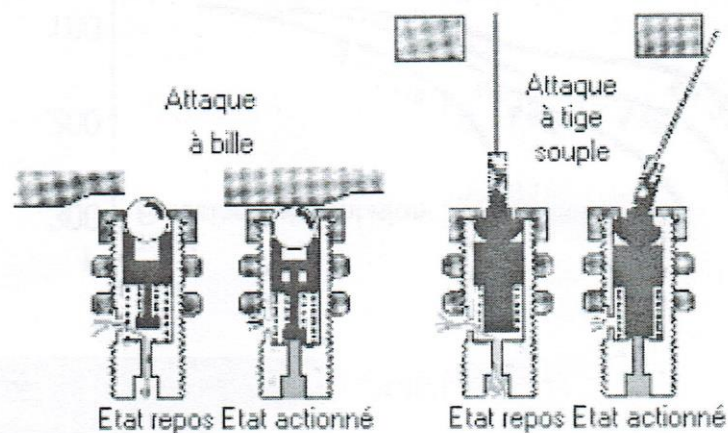
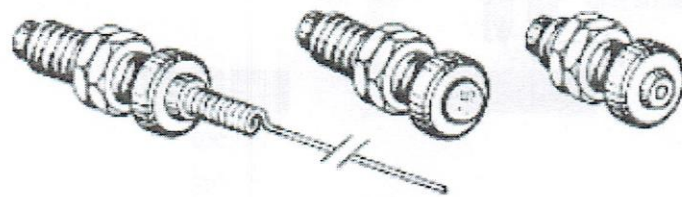
CAPTEUR DE TEMPERATURE:



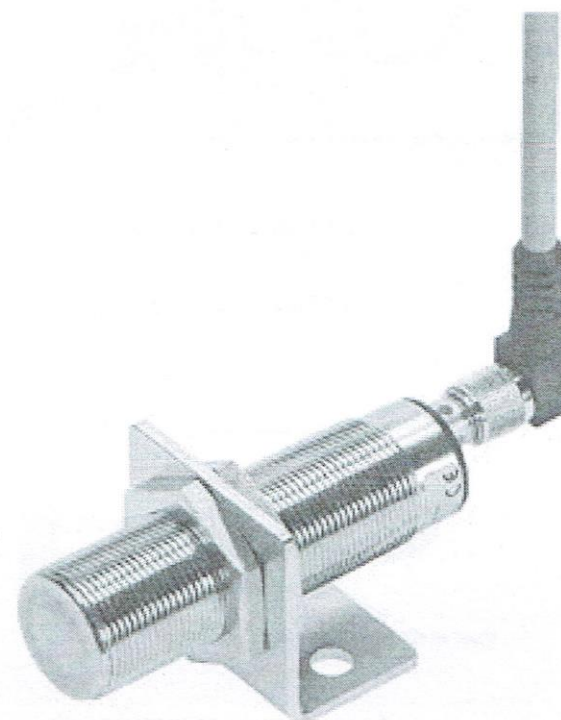
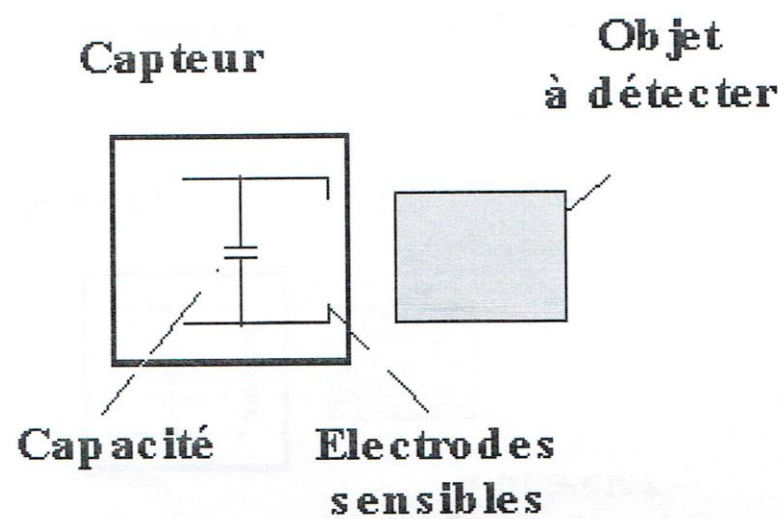
CAPTEURS DE DEPLACEMENT: APPAREIL PNEUMATIQUE



CAPTEURS DE DEPLACEMENT: APPAREIL PNEUMATIQUE

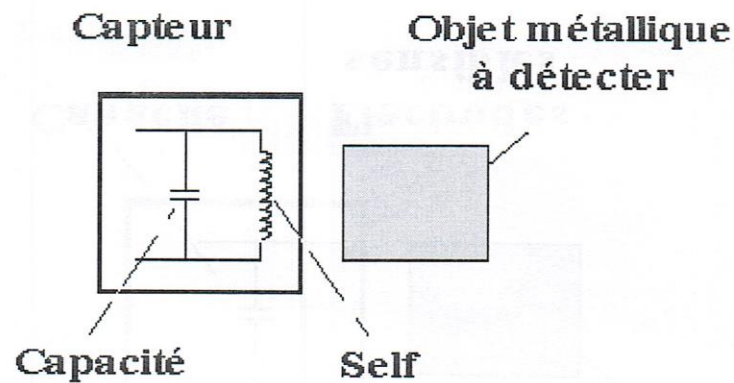


CAPTEURS DE DEPLACEMENT: APPAREIL CAPACITIF

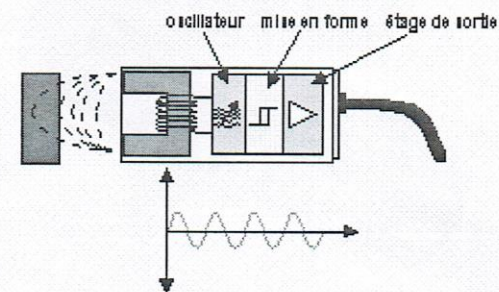


(doc Festo)

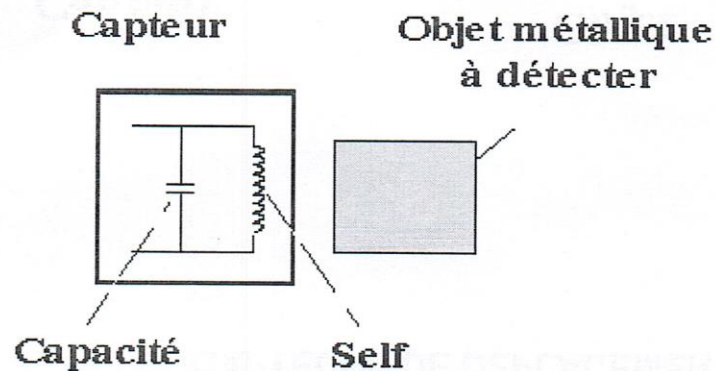
CAPTEURS DE DEPLACEMENT: APPAREIL INDUCTIF



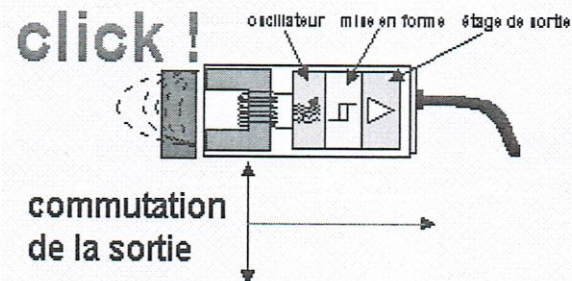
(doc lamaintenance.fr)



Oscillateur (Sitelec)



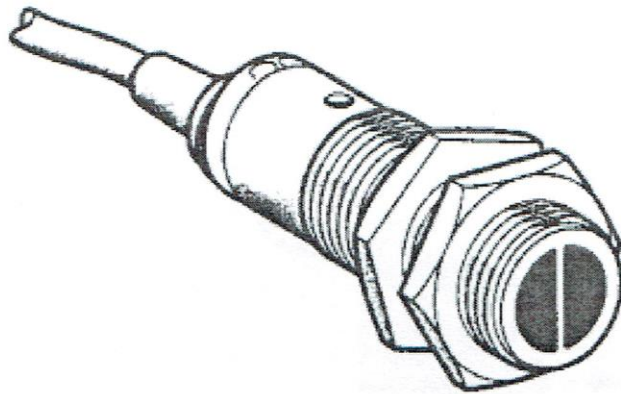
(doc lamaintenance.fr)



Oscillateur (Sitelec)

CAPTEURS DE DEPLACEMENT: APPAREIL PHOTOELECTRIQUE

exemples :



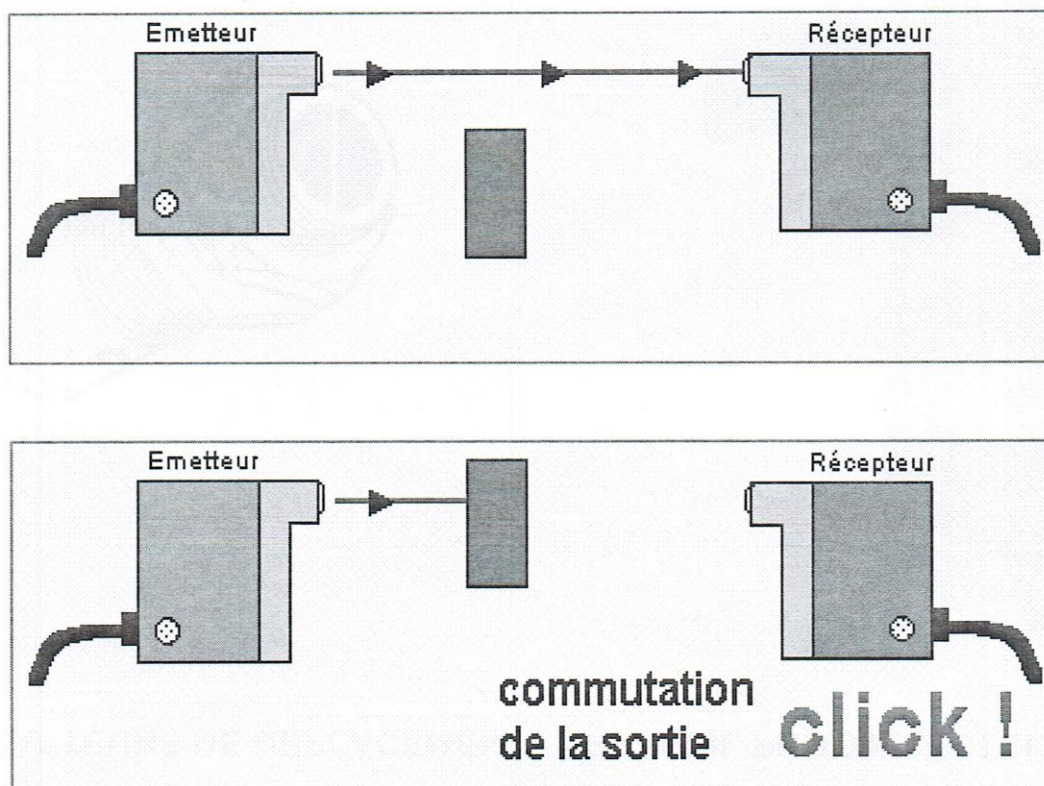
Détecteur photoélectrique cylindrique
(doc Télémécanique)



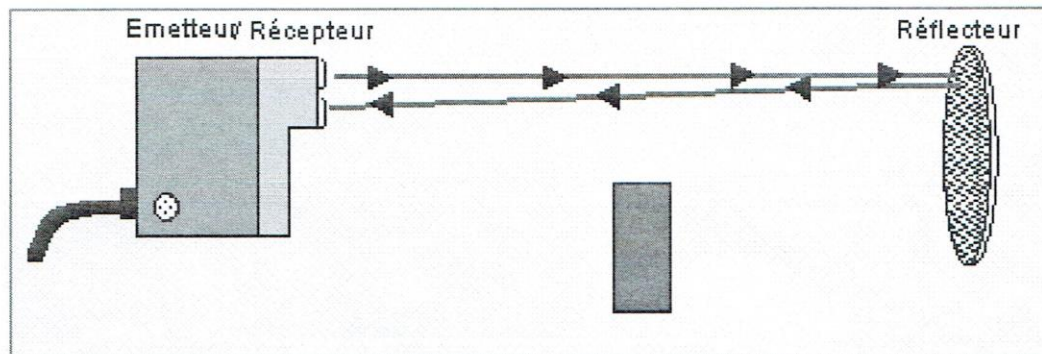
Détecteur photoélectrique

CAPTEURS DE DEPLACEMENT: APPAREIL PHOTOELECTRIQUE

Système barrage (Sitelec)

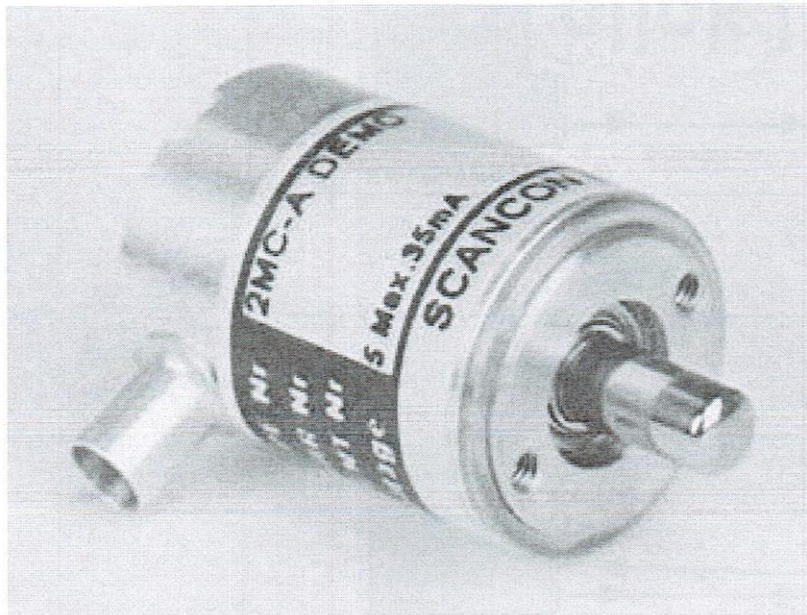


CAPTEURS DE DEPLACEMENT: APPAREIL PHOTOELECTRIQUE

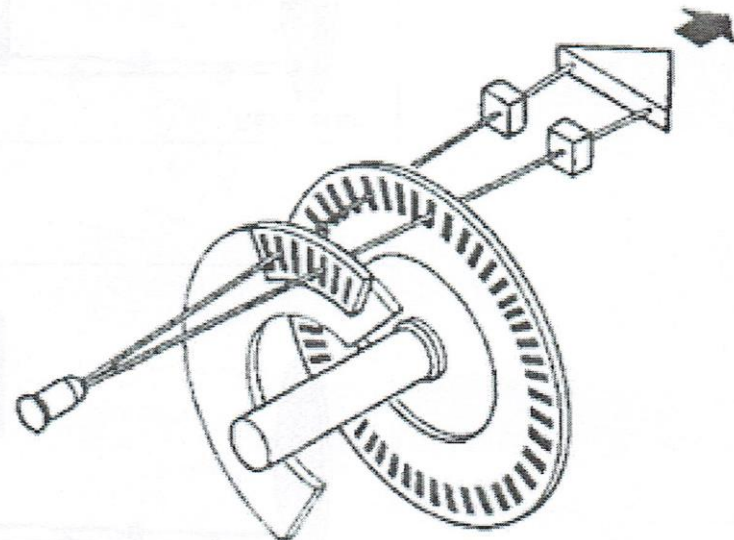


CAPTEURS DE DEPLACEMENT: APPAREIL PHOTOELECTRIQUE

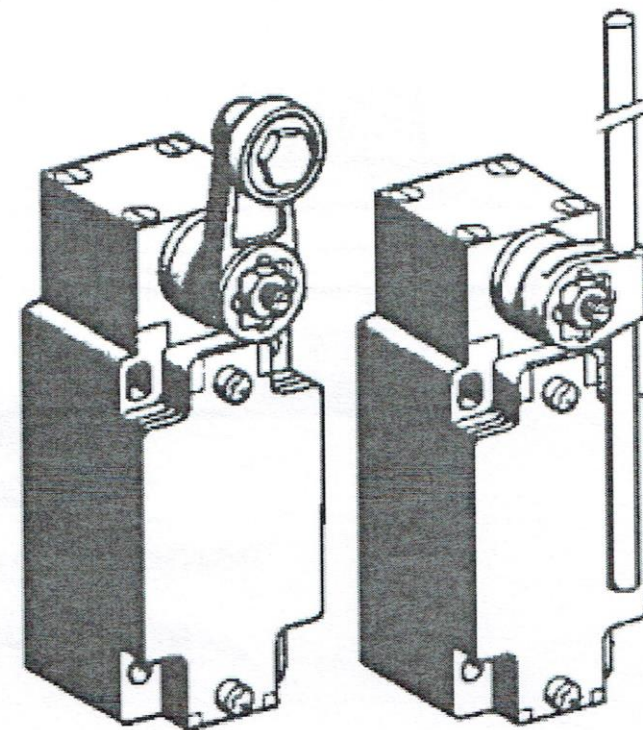
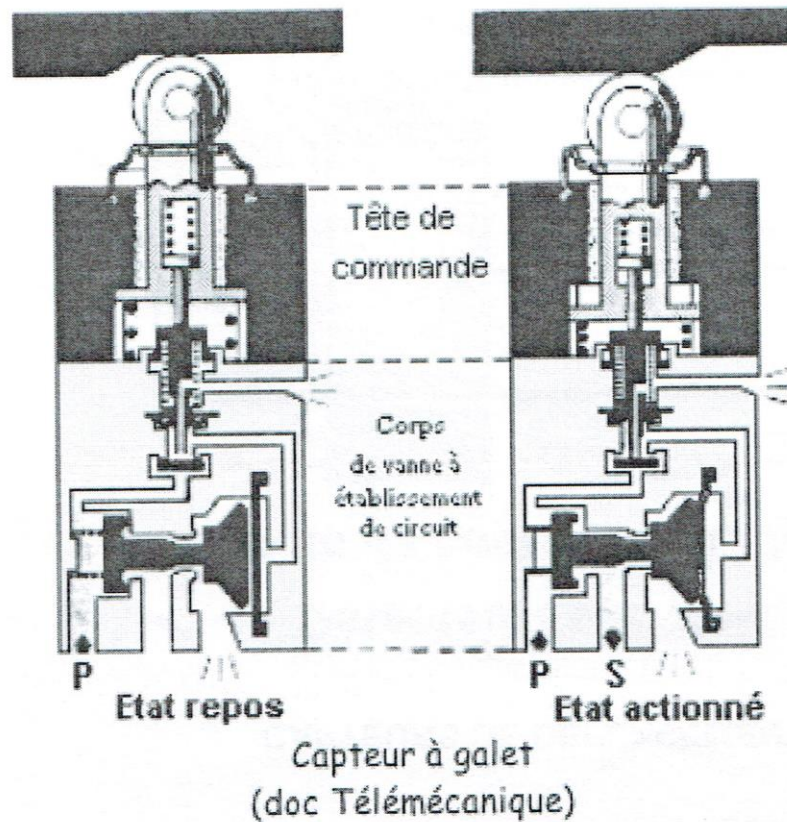
Codeurs rotatifs



Codeur rotatif incrémental

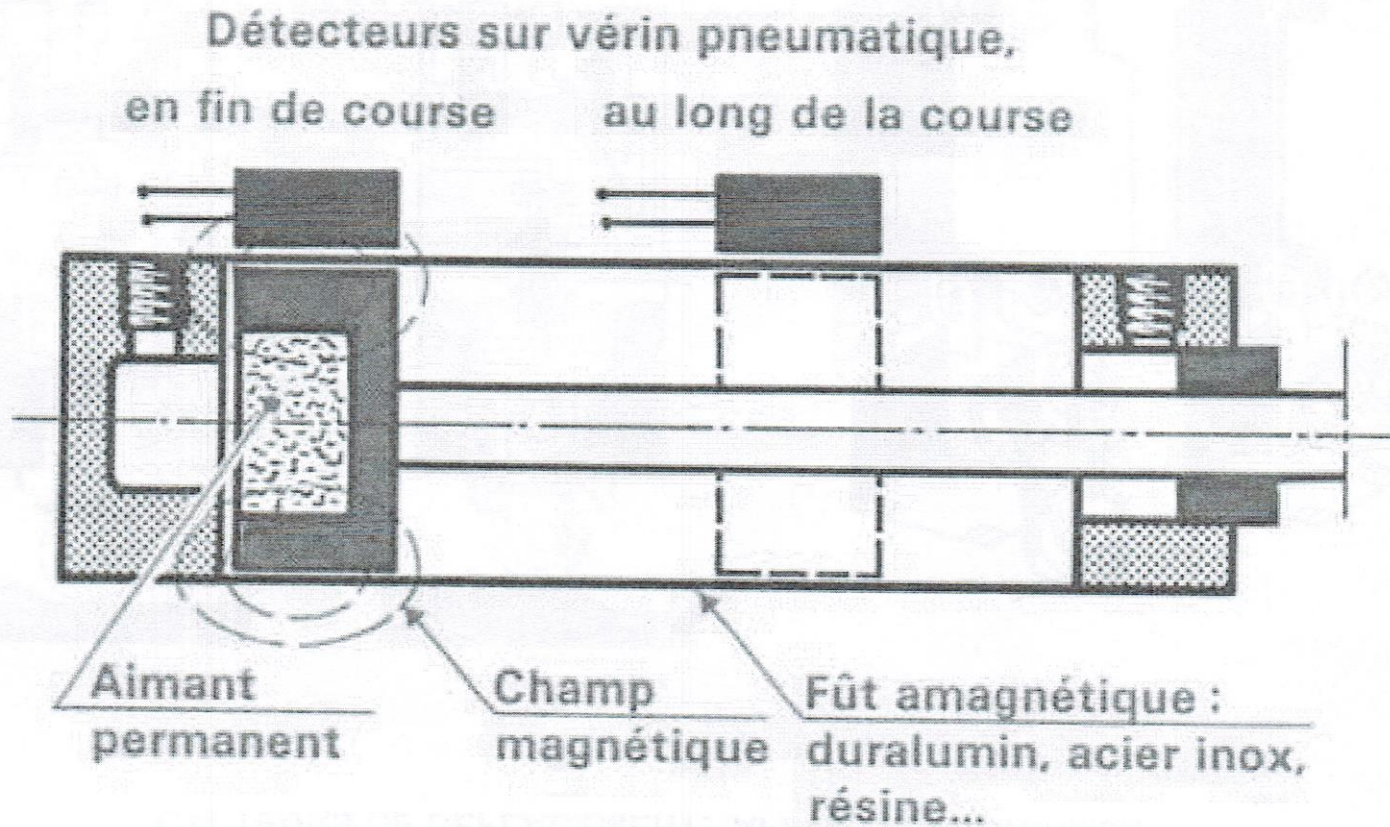


CAPTEURS DE DEPLACEMENT: APPAREIL MECANIQUE

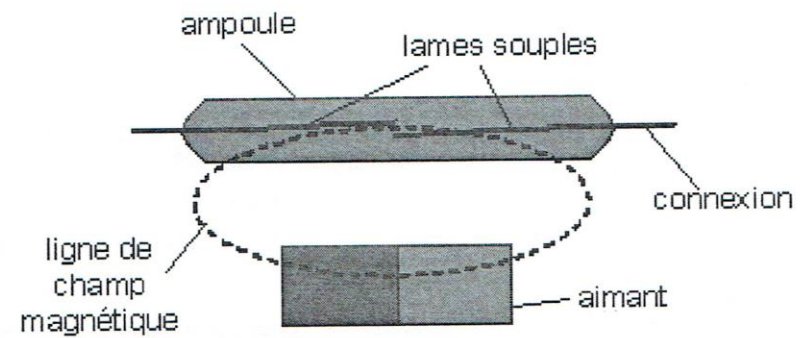
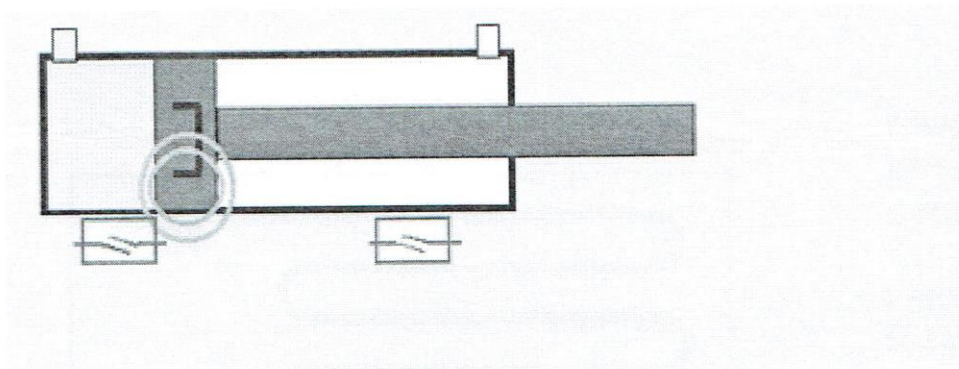


Capteurs à levier et à tige souple
(doc Télémécanique)

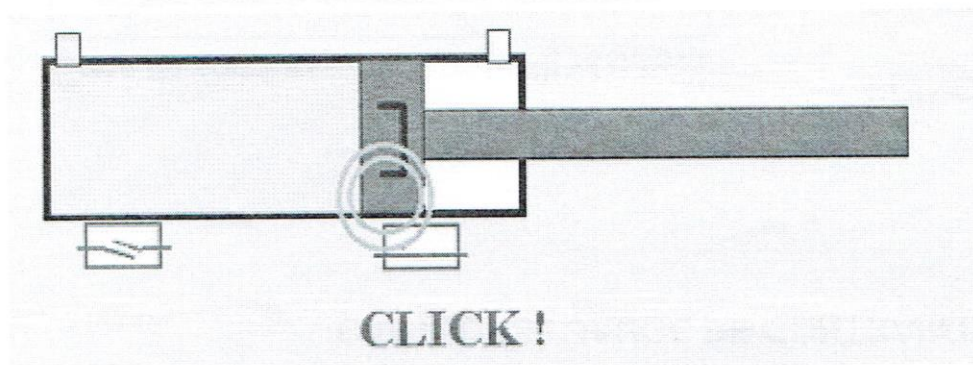
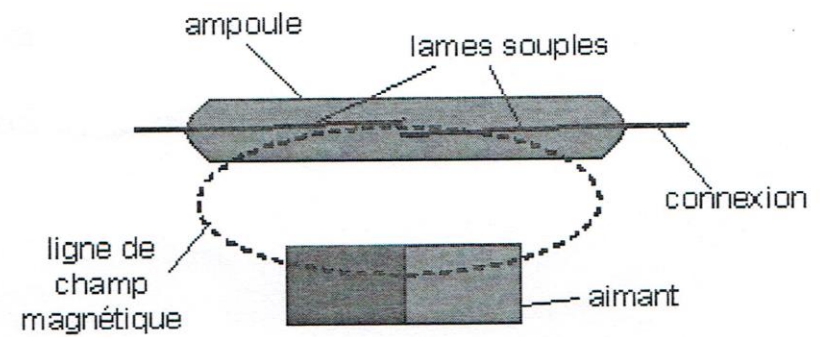
CAPTEURS DE DEPLACEMENT: APPAREIL LAME SOUPLE



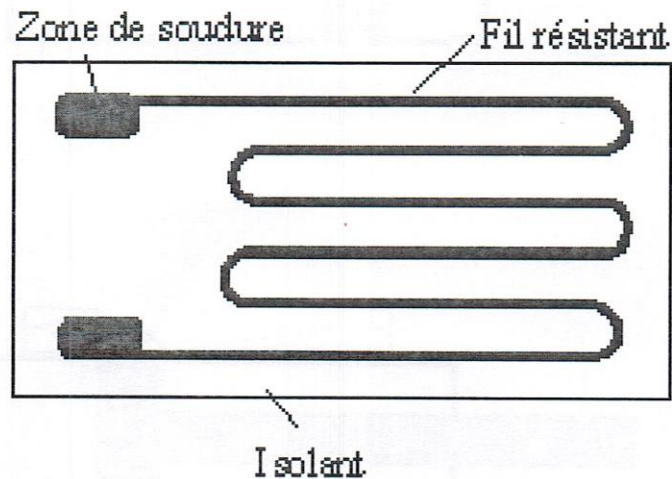
CAPTEURS DE DEPLACEMENT: APPAREIL LAME SOUPLE



doc www.teaser.fr



CAPTEURS : JAUGE DE CONTRAINTE



PRINCIPE DE FONCTIONNEMENT:

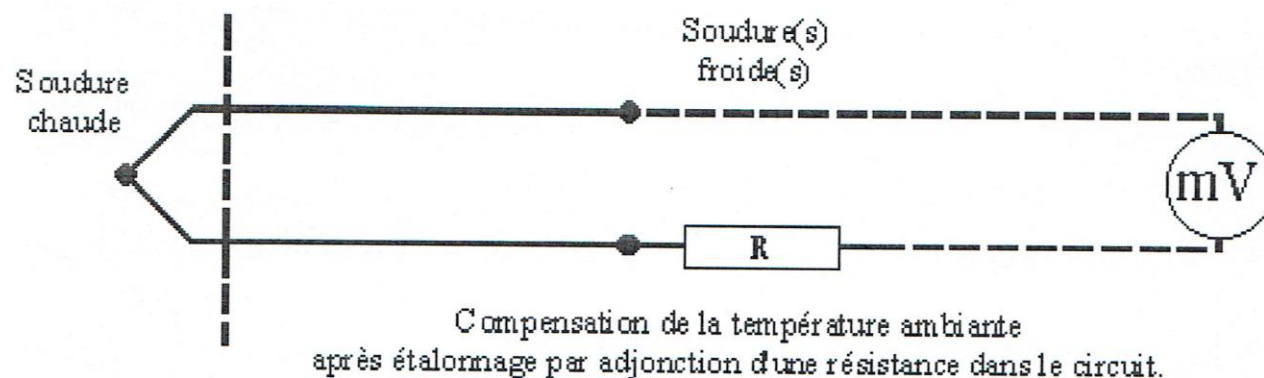
$$R = \rho * L/S$$

Toute traction sur le fil augmente sa résistance = la mesure de R donne l'élongation du capteur

Calibres habituels:

Epaisseur du fil : 5 μ m

Epaisseur du substrat = 10 μ m

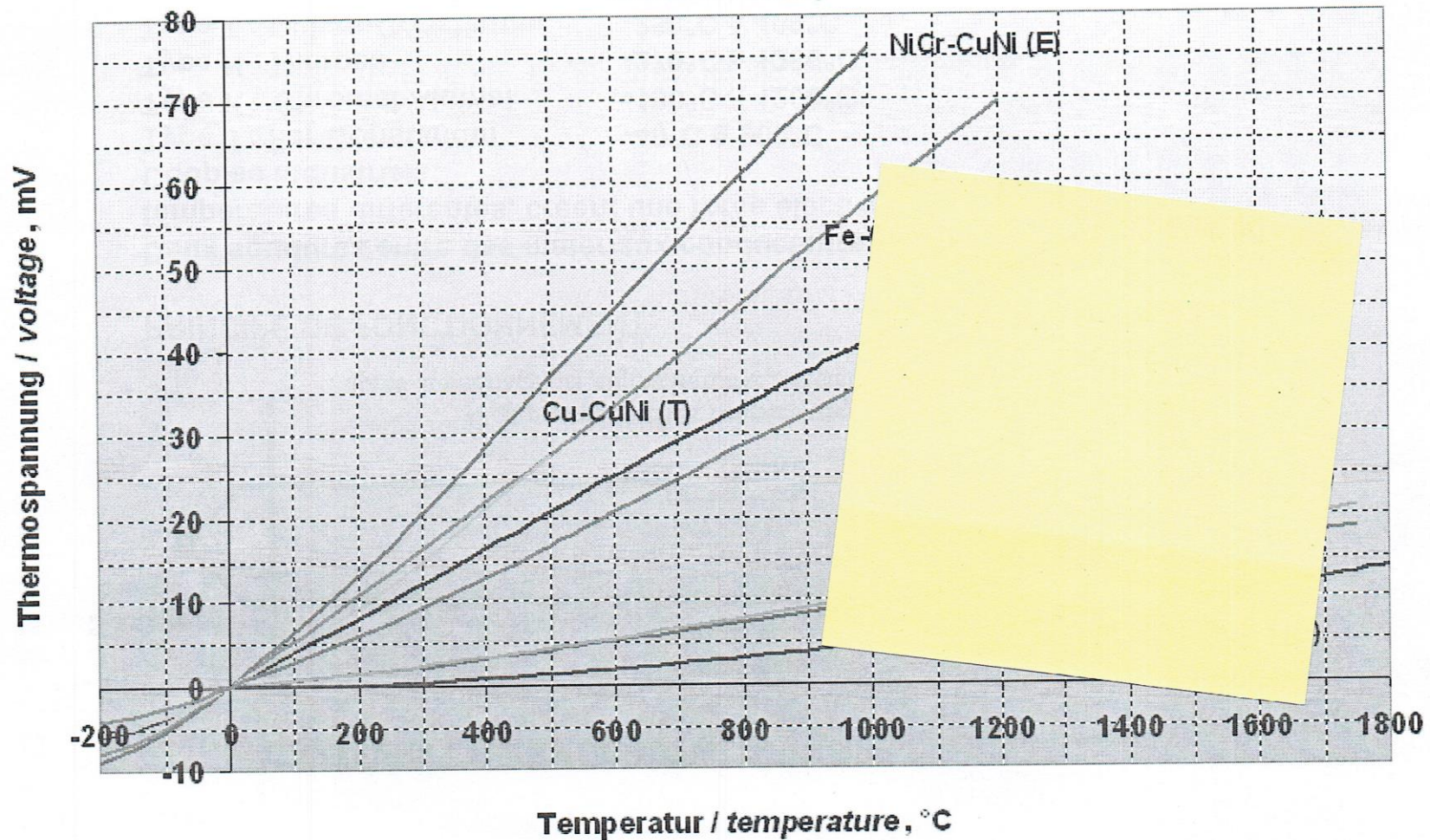
CAPTEURS : THERMOCOUPLE**PRINCIPE DE FONCTIONNEMENT:**

Deux soudures entre des matériaux conducteurs différents, soumises à des températures différentes, créent une force électromotrice.

Couples industriels:

Type J : Fer-Constantan	-40°C à 900°C
Type K : Chromel-Alumel	-180°C à 1200°C
Type N : Nicrosil	-270°C à 1280°C
Type T : Cuivre-Constantan	-250°C à 400°C

Thermospannungen verschiedener Thermopaare bezogen auf eine Vergleichsstellentemperatur von 0°C (DIN EN 60 584)
 Voltages of different thermocouples relative to a reference temperature of 0°C (according to DIN EN 60584)



CALCUL EN BASE 2

Circuit Analogique : toutes valeurs discrètes possibles

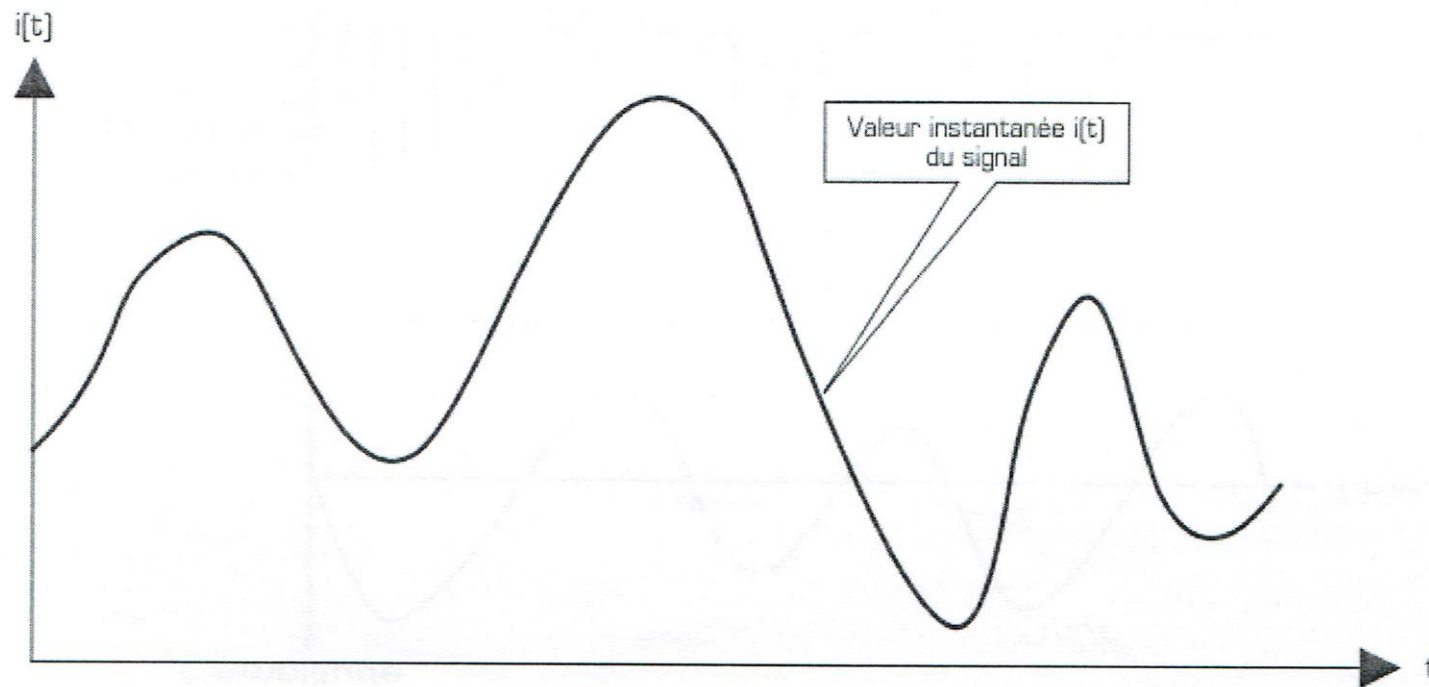
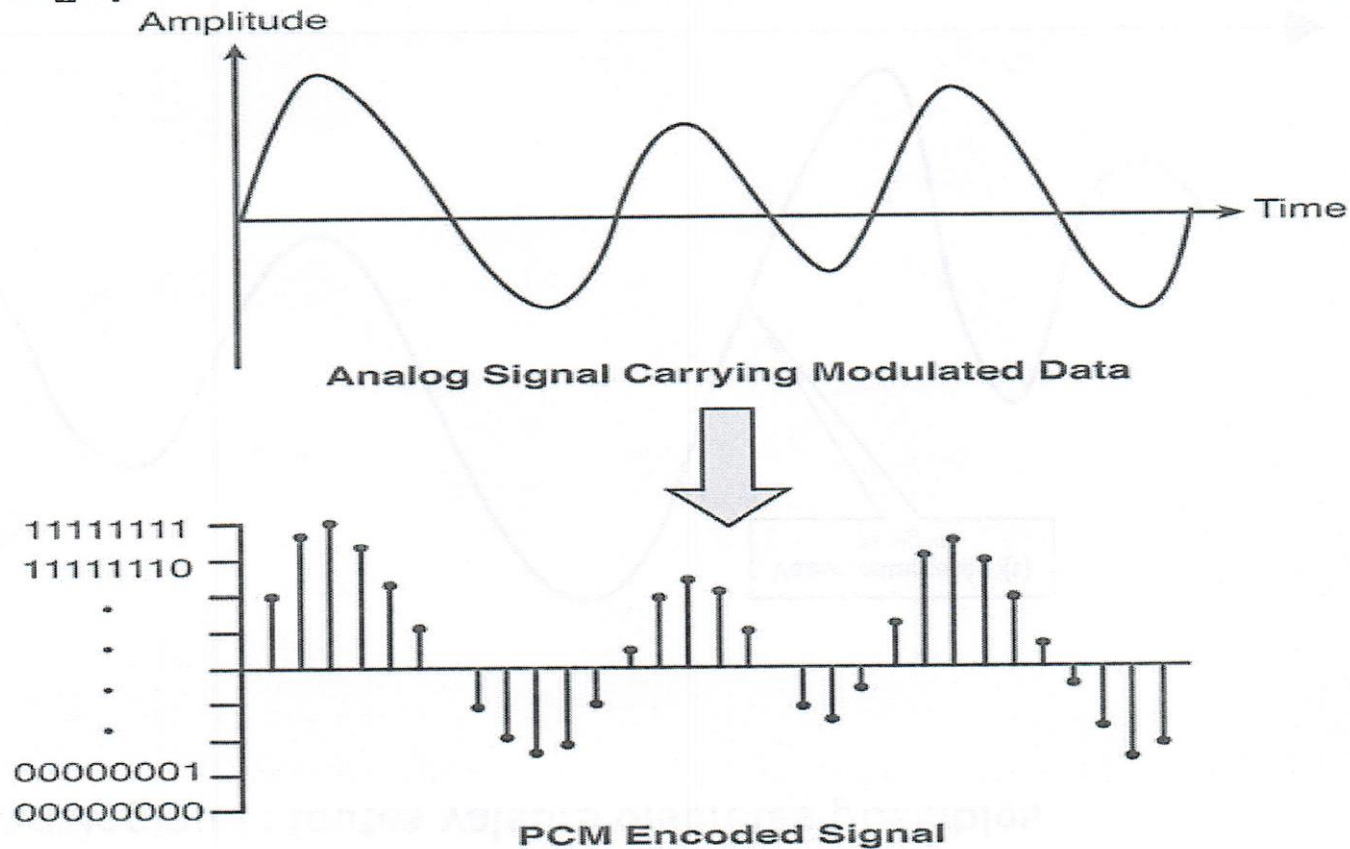


Figure 1 : Exemple de signal analogique variable

CALCUL EN BASE 2

Circuit Digital (numérique) : valeurs incrémentées, traduites en nombre de bit
Niveau logique = deux valeurs possible : 1 ou 0



Méthode utilisée : Conversion Analogique Numérique

CALCUL EN BASE 2

Les bits sont comptés en puissance de 2, de la droite vers la gauche

$$2^0 = 1$$

$$2^1 = 2$$

$$2^2 = 4$$

$$2^3 = 8$$

$$2^4 = 16$$

$$2^5 = 32$$

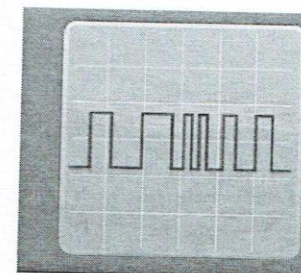
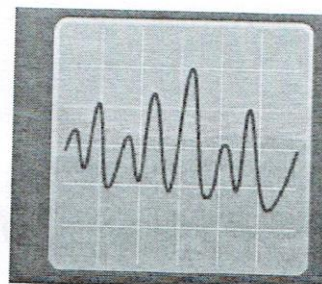
$$2^6 = 64$$

$$2^7 = 128$$

$$2^{16} = 65536$$

$$2^{32} = 4\ 294\ 967\ 296$$

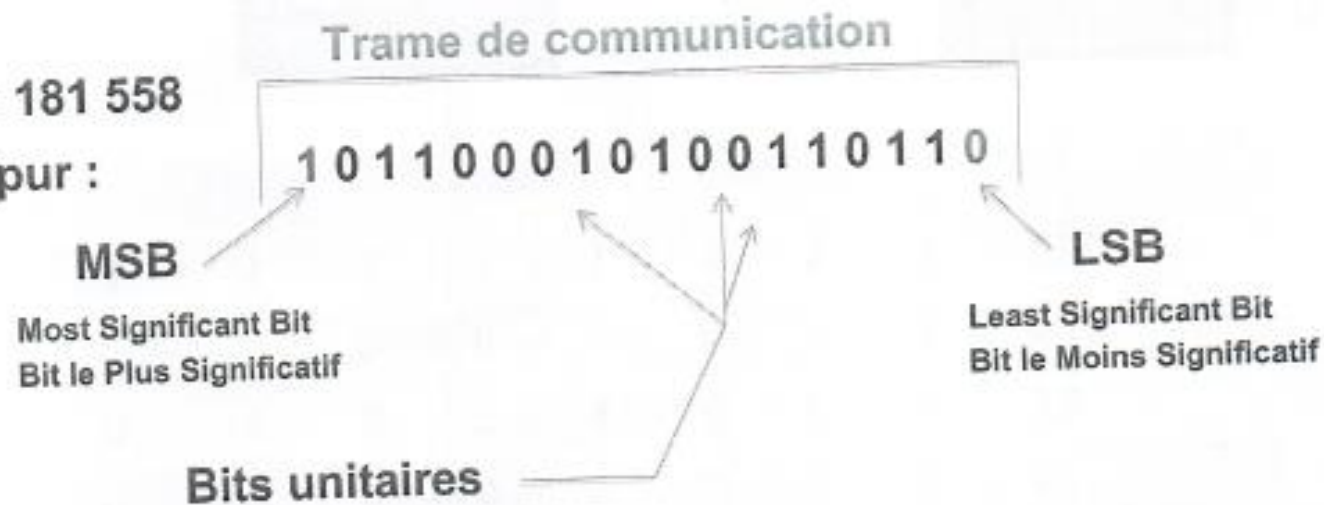
128	64	32	16	8	4	2	1	Base 10
0	0	0	0	0	0	0	0	0
0	1	0	0	1	0	0	1	73
1	0	0	0	0	0	1	0	130
1	1	1	1	1	1	1	1	255



REPRESENTATION & CALCUL BINAIRE

Valeur décimale: 181 558

Codage binaire pur :



REPRESENTATION & CALCUL BINAIRE

Valeur décimale: 181 558

Codage binaire pur

Valeurs décimales/octet

octet	octet	octet	octet	octet
				00000000
1 0	1 1 0 0	0 1 0 1	0 0 1 1	0 1 1 0
2	12	5	3	6

REPRESENTATION & CALCUL BINAIRE

Valeur décimale: 181 558

Codage binaire pur

Valeurs décimales/octet

Codage hexadécimal

octet	octet	octet	octet	octet
1 0	1 1 0 0	0 1 0 1	0 0 1 1	0 1 1 0
2	12	5	3	6
2	C	5	3	6

Convention décimal : 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Hexadécimal: 0 1 2 3 4 5 6 7 8 9 A B C D E F

Formats d'écriture normalisé:

- \$2C536**
- 0x2C536**
- 2C536H**

RESEAU CAN AUTOMOBILE

ADDITION BINAIRE

Valeur décimale: 181

558

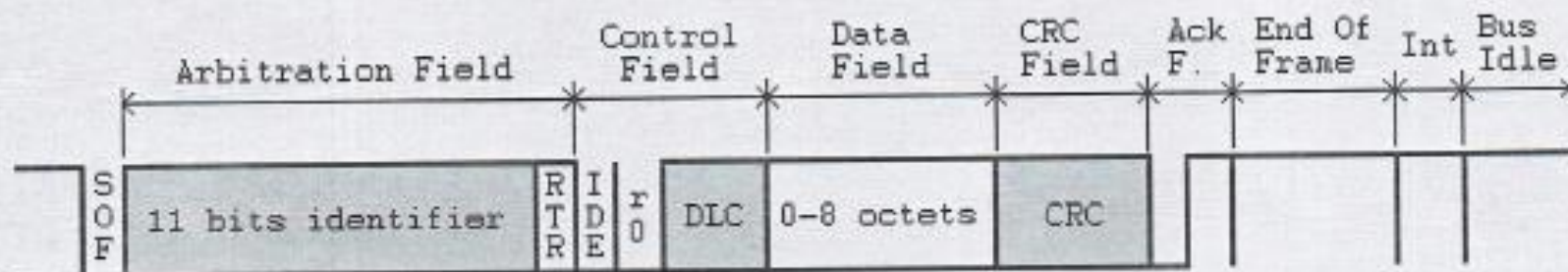
Valeur décimale: 32 875

Valeur décimale: 214

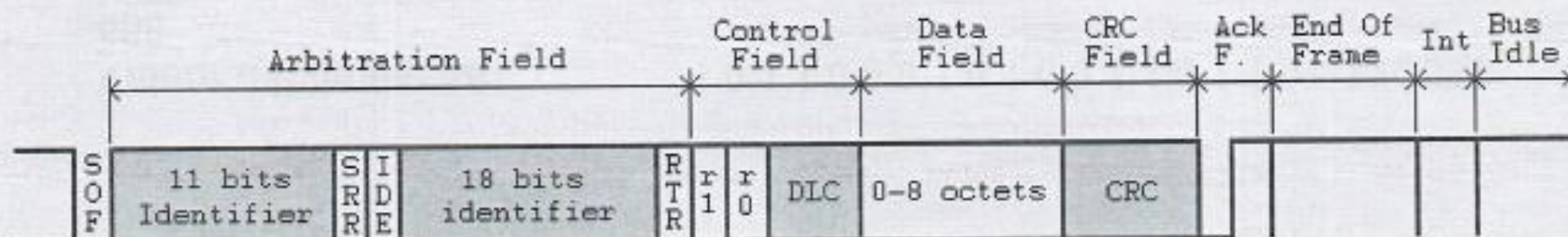
633

octet	octet	octet	octet	octet	
				0 1 2 3 4	
1 0	1 1 0 0	0 1 0 1	0 0 1 1	0 1 1 0	\$2C536
0 0	1 0 0 0	0 0 0 1	0 0 1 1	0 0 1 1	\$08133
1 1	0 1 0 0	0 1 1 0	0 1 1 0	1 0 0 1	\$34669

RESEAU CAN AUTOMOBILE



Trame des messages au format standart (spécification CAN 2.0A)



Trame des messages au format étendu (spécification CAN 2.0B)

NOTIONS DE FONCTIONS LOGIQUE

OR (Buffer)



NOR (Buffer)



NOR (Schmitt)



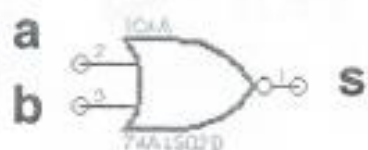
a	s
0	0
1	1
0	1
1	0
0	1
1	0

NOTIONS DE FONCTIONS LOGIQUES

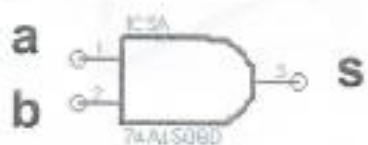
OR



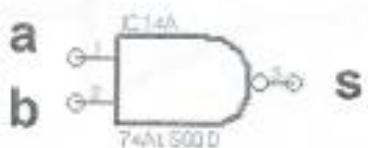
NOR



AND

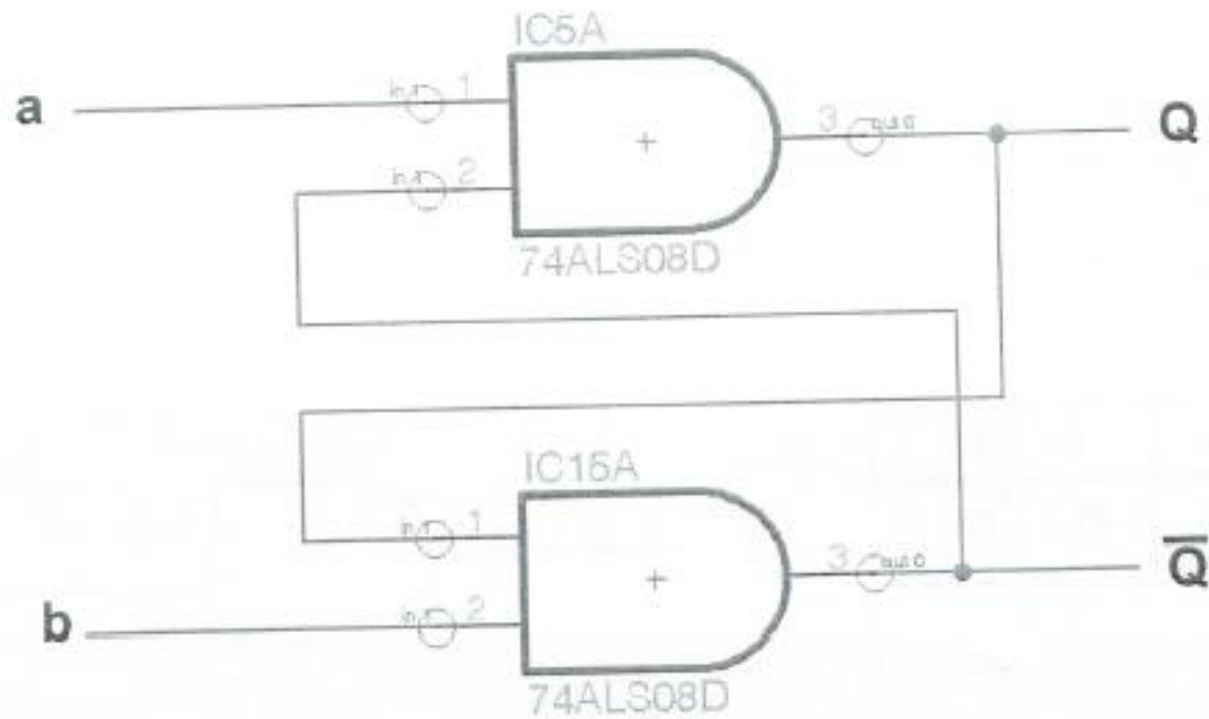


NAND

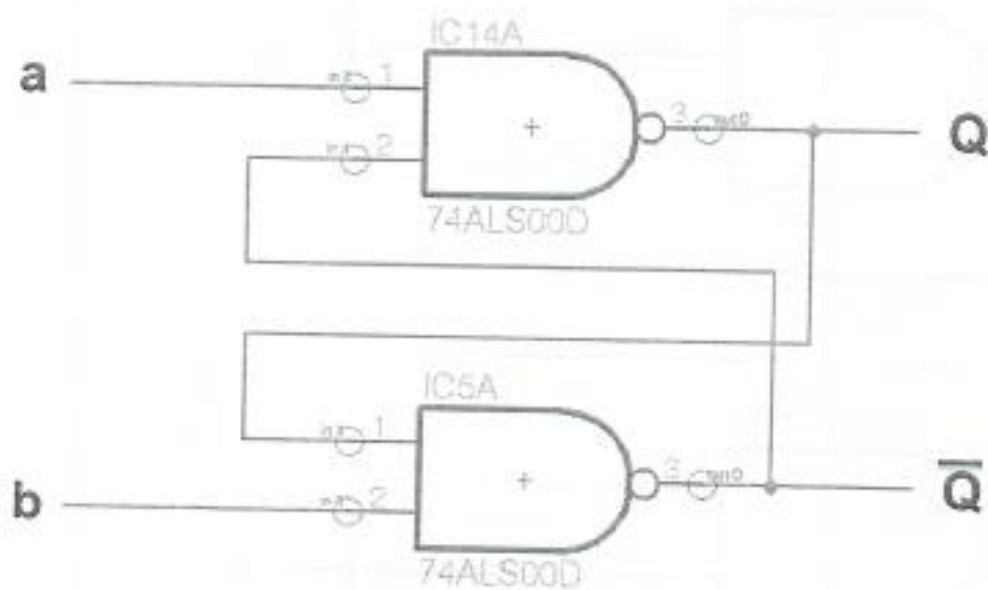


a	b	s
0	0	0
1	0	1
0	1	1
1	1	1
0	0	1
1	0	0
0	1	0
1	1	0
0	0	0
1	0	0
0	1	0
1	1	1
0	0	1
1	0	1
0	1	1
1	1	0

NOTIONS FONCTIONS LOGIQUE : MEMOIRE



NOTIONS FONCTIONS LOGIQUE : MEMOIRE



a	b	Q	$\overline{Q}$	Status
1	1	?	?	?
0	1	1	0	Transient
1	1	1	0	Locked
1	0	0	1	Transient
0	0	1	1	?

BASCULE FLIP/FLOP ELEMENTAIRE

COMPTEUR DIGITAL

