Circuite si sisteme electrice auto

Curs 2

Cuprins

- Cerintele EAPA (EEEA)
- Conductori auto
- Componente E.E. auto
- Scule, masurare si testare
- Circ si sistem el si el. auto

Conditii generale de functionare ale EEEA

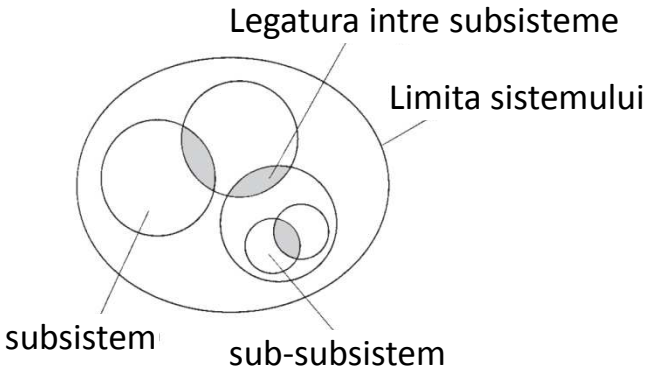
- **Definitie:** EEEA cuprinde totalitatea aparatelor si masinilor electrice avand drept scop alimentarea cu energie electrica, la tensiune constanta, a receptoarelor si consumatorilor autoveh. atat in timpul rularii cat si in timpul stationarii acestuia;
- **Clasificare**:
  - echipamente clasice (electrice): *pornire, aprindere, masura si control, iluminat, semnalizare optica, avertizare acustica, auxiliar, alimentare cu energie electrica*;
  - echipamente electronice: *injectia electronica (preparare amestec carburant + aprindere), transmisie, directie, franare, suspensie, siguranta, infotainment*;
  - distributia energiei electrice: *conectare, protectie, conductoare si piese de legatura*.

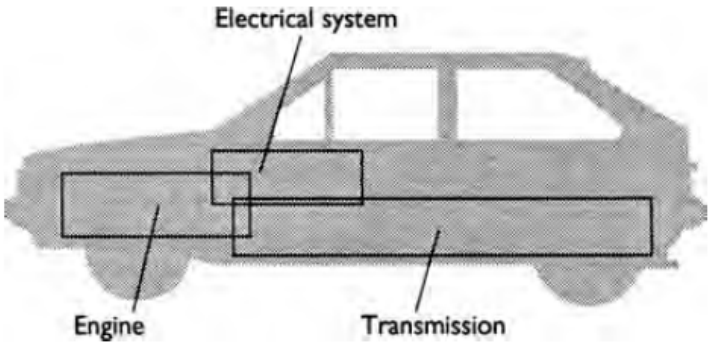
Conditii tehnice generale impuse EEEA

- **Temperatura**:-40÷ +120^{o}C; ambient max. 45^{o}C (20±5^{o}C , 25±5^{o}C); compartiment motor max. 80-95^{o}C; compartiment pasageri max. 65^{o}C; minim -40^{o}C (functionare sigura -20^{o}C) cu exceptia pornirii (-18^{o}C automob., -5^{o}C tractoare);
- **Umiditatea relativa**: 10-80%, incercarea se face la 95±3% (rezistenta de izolatie, capacitatea de functionare); pentru regiuni cu climat tropical (umed/uscat), caldura umeda, ceata salina, mucegai, microorganisme, radiatie solara);
- **Solicitari mecanice**: motor termic, motoare electrice, neregularitatile terenului, accel./decel. → socuri (amplit., frecv.), vibratii (amplit., frecv.);
- **Solicitari chimice**: combustibil, vapori de combustibil, gaze evacuare, etc.;
- **Protectia impotriva patrunderii corpurilor straine**: praf, noroi, apa → diferite grade de protectie (executie deschisa, inchisa, etansa);
- **Solicitari electrice**: important pt. tensiune inalta.

EEEA abordare sistemica

- Sistem – cuvant ce descrie o colectie de componente legate intre ele ce interactioneaza ca un intreg (sistemul de transport rutier, sistemul educational, calculatorul etc.)

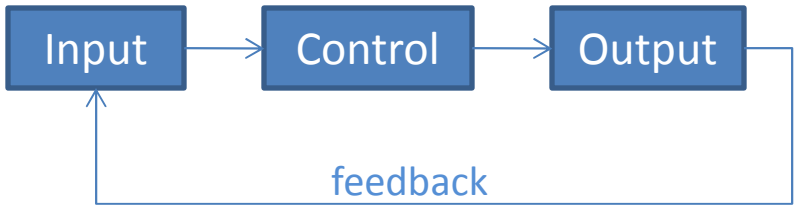


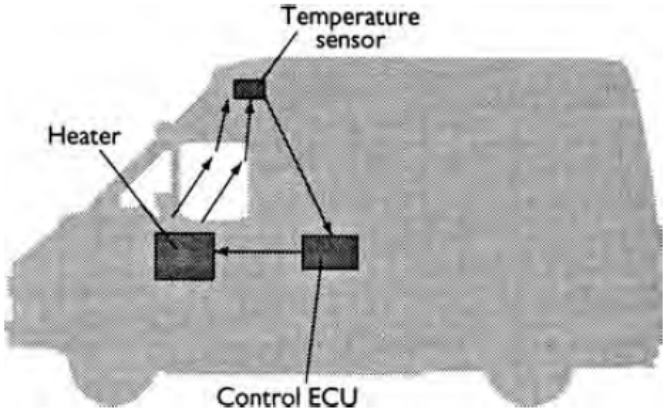


Sistem in bucla deschisa



Sistem in bucla inchisa



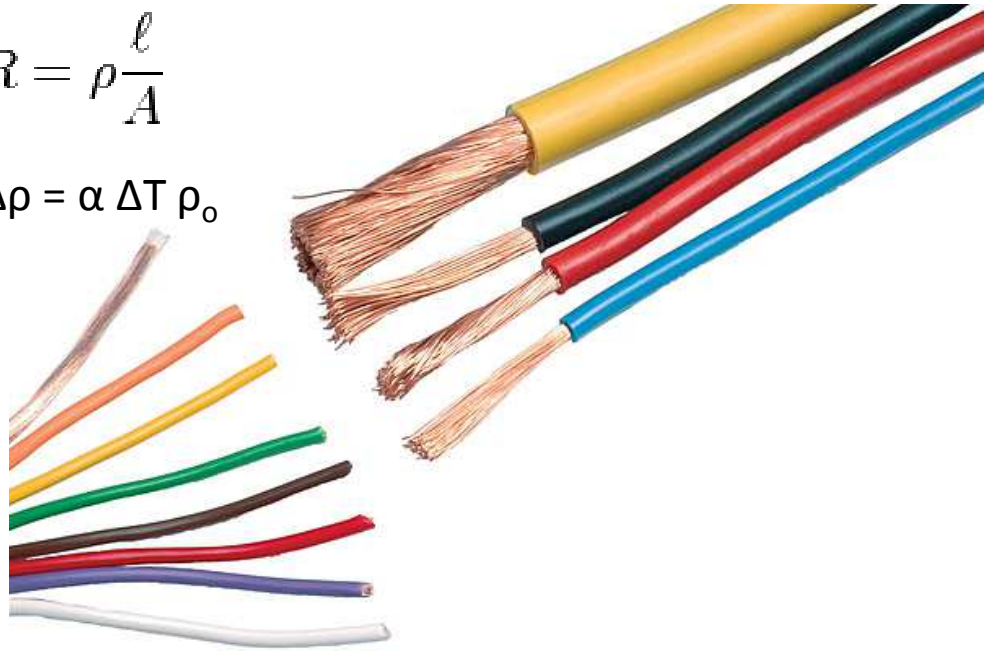


Conductori auto

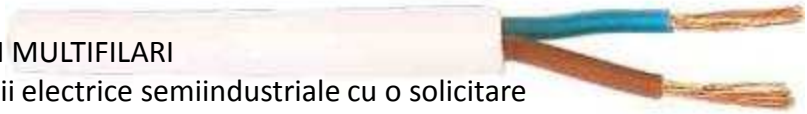
Material	Rezistivitate, ρ_o [Ω·m] la 20 °C	Coef. de temp., α [K^{-1}]
Silver	1.59×10^{-8}	0.0038
Copper	1.72×10^{-8}	0.0039
Gold	2.44×10^{-8}	0.0034
Aluminium	2.82×10^{-8}	0.0039
Calcium	3.36×10^{-8}	?
Tungsten	5.60×10^{-8}	0.0045
Zinc	5.90×10^{-8}	0.0037
Nickel	6.99×10^{-8}	?
Iron	1.0×10^{-7}	0.005
Platinum	1.06×10^{-7}	0.00392
Tin	1.09×10^{-7}	0.0045
Lead	2.2×10^{-7}	0.0039
Manganin	4.82×10^{-7}	0.000002
Constantan	4.9×10^{-7}	0.000 008
Mercury	9.8×10^{-7}	0.0009
Nichrome	1.10×10^{-6}	0.0004
Carbon	3.5×10^{-5}	−0.0005
Germanium	4.6×10^{-1}	−0.048
Silicon	6.40×10^{2}	−0.075
Glass	10^{10} to 10^{14}	?
Hard rubber	approx. 10^{13}	?
Sulfur	10^{15}	?
Paraffin	10^{17}	?
Quartz (fused)	7.5×10^{17}	?
PET	10^{20}	?
Teflon	10^{22} to 10^{24}	?

$$R = \rho\frac{\ell}{A}$$

$\Delta\rho = \alpha\,\Delta T\,\rho_o$



Cablu electric Build X-ELL MYYM model 2E / N[cond]: 2; S[mmp]: 1.0



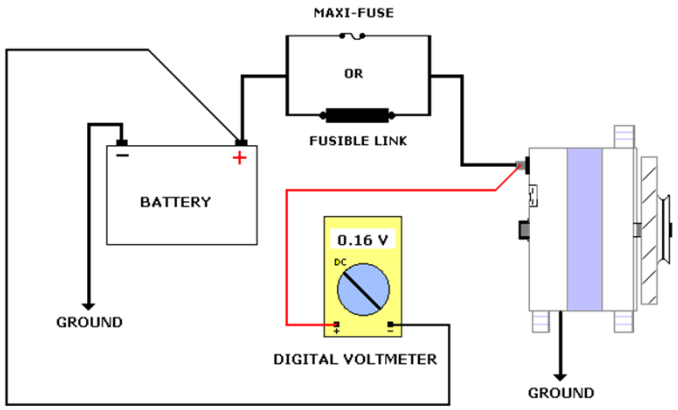
CONDUCTORI FLEXIBILI MULTIFILARI
Utilizati pentru instalatii electrice semiindustriale cu o solicitare mecanica medie.
1. Conductoare flexibile de cupru, clasa 5
2. Izolatie: PVC tip I 88
3. Manta: PVC tip F
Temperatura de functionare: -30 grade C - +70 grade C
Tensiunea nominala: 300/500 V.

Conductori auto

Caderea de tensiune pe cablu

$$I = P / U$$

$$U_c = I \rho l / A$$



Valori tipice ale caderii de tensiune

Circuit (12 V)	Load	Cable drop (V)	Maximum drop (V) incl. connections
Lighting circuit	<15 W	0.1	0.6
Lighting circuit	>15 W	0.3	0.6
Charging circuit	Nominal	0.5	0.5
Starter circuit	Maximum at 20 °C	0.5	0.5
Starter solenoid	Pull-in	1.5	1.9
Other circuits	Nominal	0.5	1.5

Cabluri si aplicatiile lor

Cable strand diameter (mm)	Cross-sectional area (mm^2)	Continuous current rating (A)	Example applications
9/0.30	0.6	5.75	Sidelights etc
14/0.25	0.7	6.0	Clock, radio
14/0.30	1.0	8.75	Ignition
28/0.30	2.0	17.5	Headlights, HRW
44/0.30	3.1	27.5	
65/0.30	4.6	35.0	Main supply
84/0.30	5.9	45.0	
97/0.30	6.9	50.0	Charging wires
120/0.30	8.5	60.0	
37/0.90	23.5	350.0	Starter supply
to		to	
61/0.90	39.0	700.0	

Conductori auto

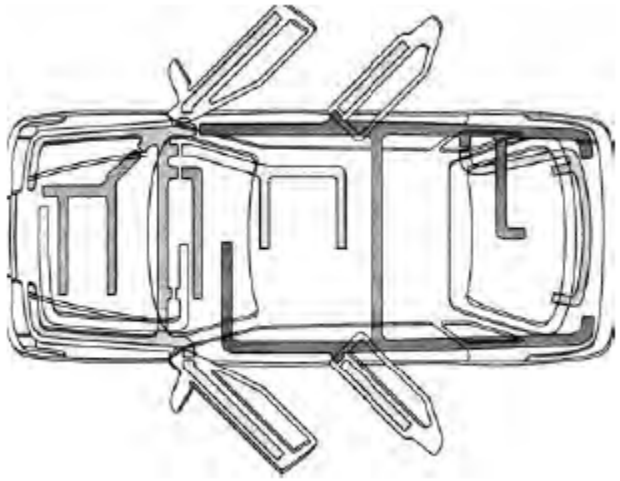
DIN 72 552

Popular terminal designation numbers

1	Ignition coil negative
4	Ignition coil high tension
15	Switched positive (ignition switch output)
30	Input from battery positive
31	Earth connection
49	Input to flasher unit
49a	Output from flasher unit
50	Starter control (solenoid terminal)
53	Wiper motor input
54	Stop lamps
55	Fog lamps
56	Headlamps
56a	Main beam
56b	Dip beam
58L	Left-hand sidelights
58R	Right-hand sidelights
61	Charge warning light
85	Relay winding out
86	Relay winding input
87	Relay contact input (change over relay)
87a	Relay contact output (break)
87b	Relay contact output (make)
L	Left-hand side indicators
R	Right-hand side indicators
C	Indicator warning light (vehicle)

European colour codes for cables

Colour	Symbol	Destination/use
Red	Rt	Main battery feed
White/Black	Ws/Sw	Headlight switch to dip switch
White	Ws	Headlight main beam
Yellow	Ge	Headlight dip beam
Grey	Gr	Sidelight main feed
Grey/Black	Gr/Sw	Left-hand sidelights
Grey/Red	Gr/Rt	Right-hand sidelights
Black/Yellow	Sw/Ge	Fuel injection
Black/Green	Sw/Gn	Ignition controlled supply
Black/White/Green	Sw/Ws/Gn	Indicator switch
Black/White	Sw/Ws	Left-hand side indicators
Black/Green	Sw/Gn	Right-hand side indicators
Light Green	LGn	Coil negative
Brown	Br	Earth
Brown/White	Br/Ws	Earth connections
Pink/White	KW	Ballast resistor wire
Black	Sw	Reverse
Black/Red	Sw/Rt	Stop lights
Green/Black	Gn/Sw	Rear fog light



31S-AC3A || 1.5 BK/RD

(sistemul FSC Ford)

Function
31 = ground/earth
S = additionally switched circuit

System
AC = headlamp levelling

Connection
3 = switch connection
A = branch

Size
1.5 = 1.5 mm^2

Colour
BK = Black (determined by function 31)
RD = Red stripe



Conductori auto



Circuit imprimat LH Jetronic ECU
(16V Saab C900)



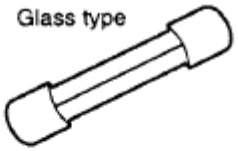
Circuit imprimat (folie) Honda Civic

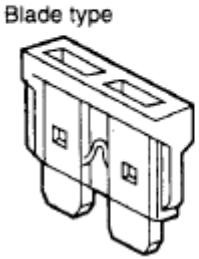


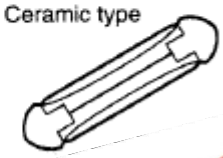
3D MID (Moulded Interconnect Devices) PCB

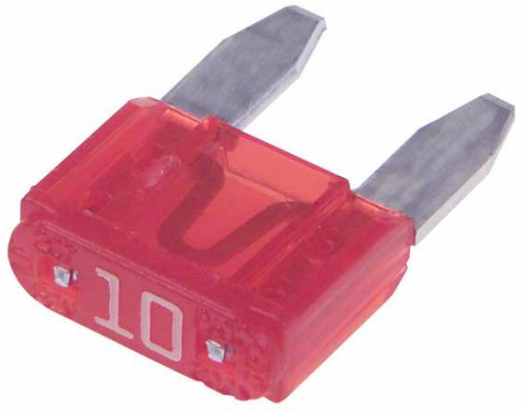
Sigurante fuzibile

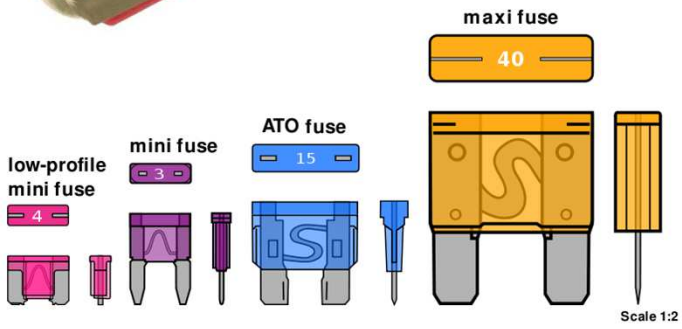






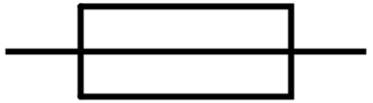








IEC



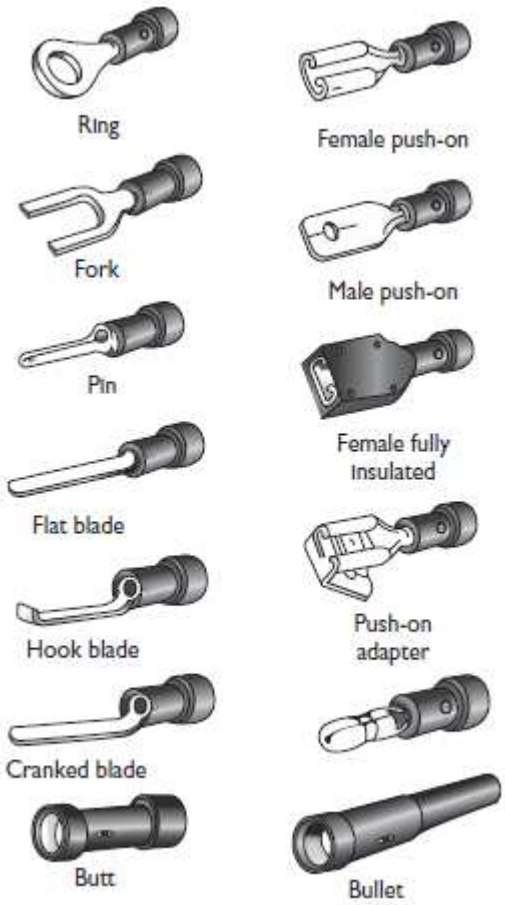
IEEE/ANSI



IEEE/ANSI

	Continuous current (A)	Colour
Blade type	3	Violet
	4	Pink
	5	Clear/Beige
	7.5	Brown
	10	Red
	15	Blue
	20	Yellow
	25	Neutral/White
	30	Green
Ceramic type	5	Yellow
	8	White
	16	Red
	25	Blue

Borne si conectori

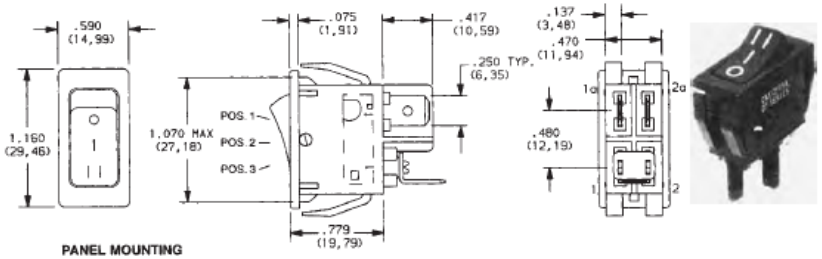




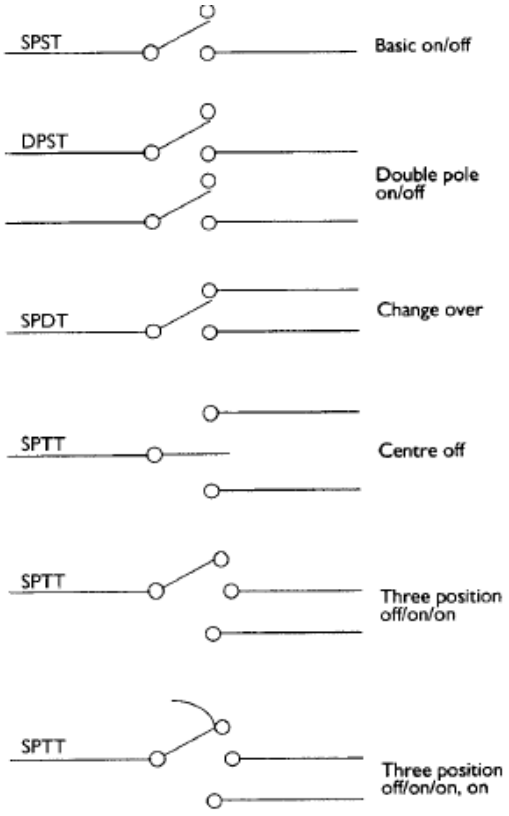


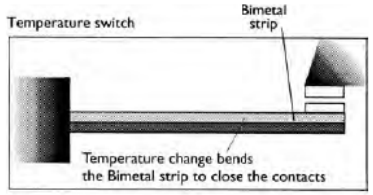


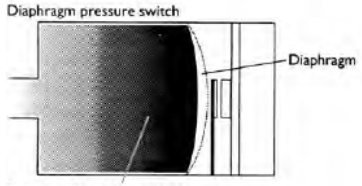
Intrerupatoare si comutatoare

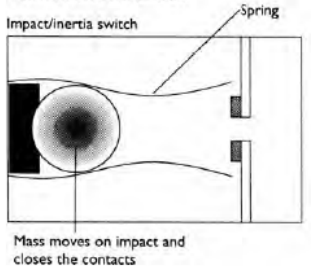


SWITCH FUNCTION			CONNECTED TERMINALS		
POS. 1	POS. 2	POS. 3	POS. 1	POS. 2	POS. 3
OFF	ON	ON	OPEN	2-2A	1-1A, 2-2A





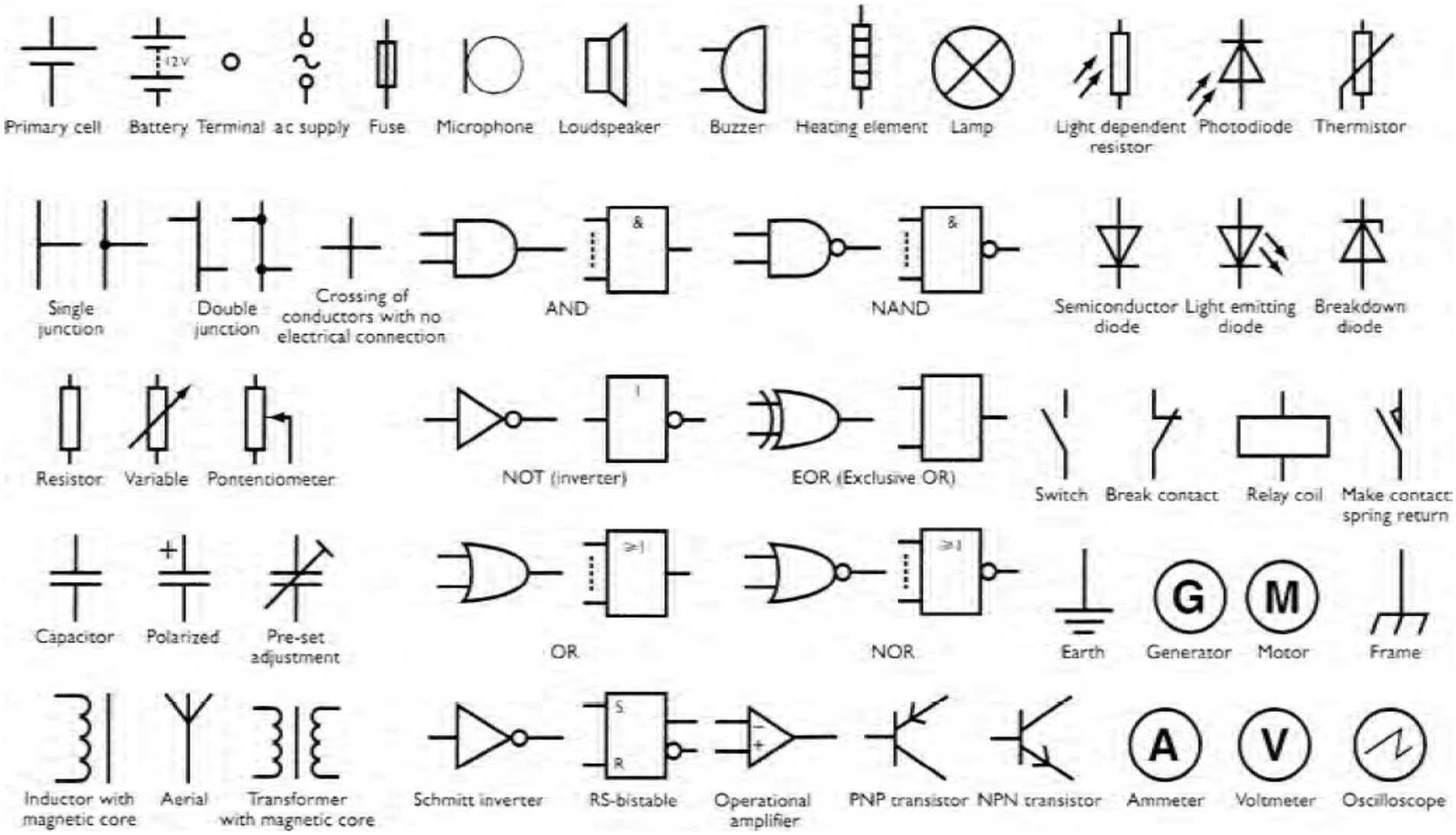




IEC 60617 graphic symbol database
(DIN EN 60617-2 to DIN EN 60617-12)

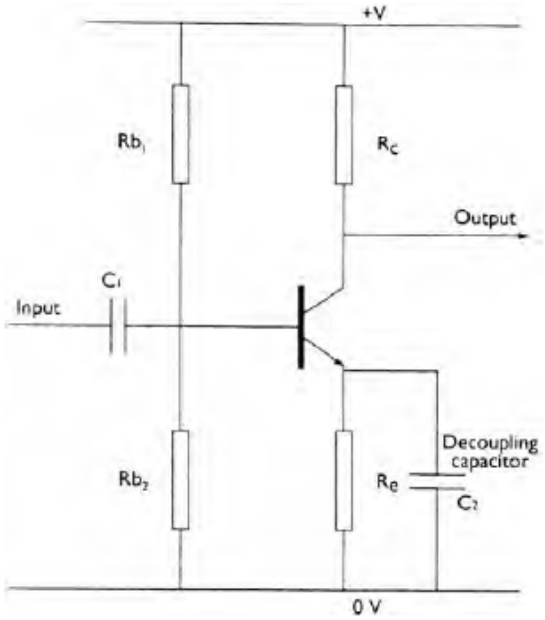
NEMA ICS 19-2002, ANSI Y32.2/
IEEE 315/315 A, CSA Z99

Componente electrice si electronice

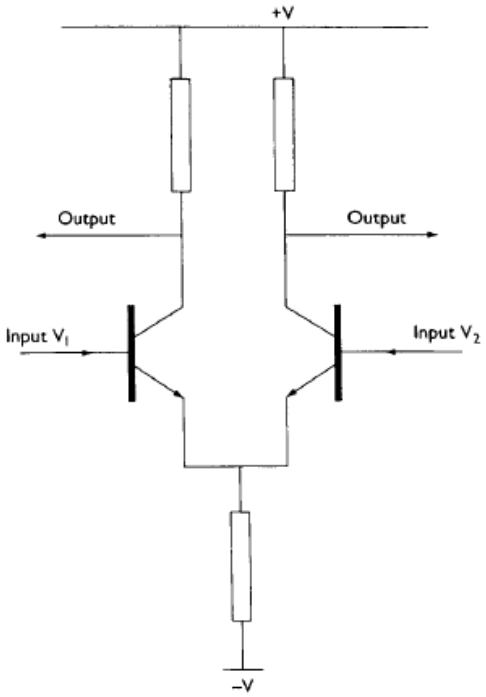


Amplificatoare

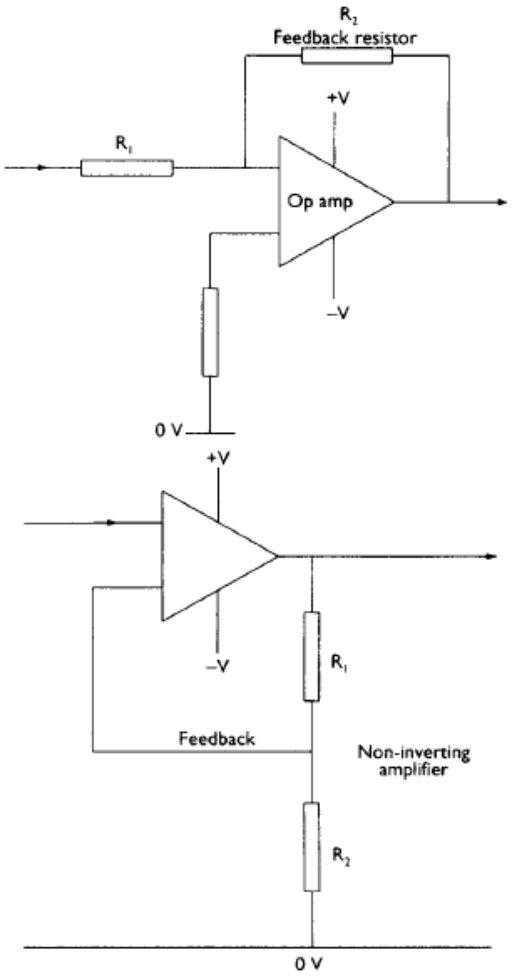
Amplificator c.a.



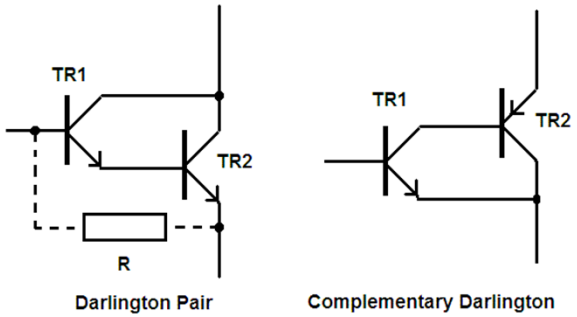
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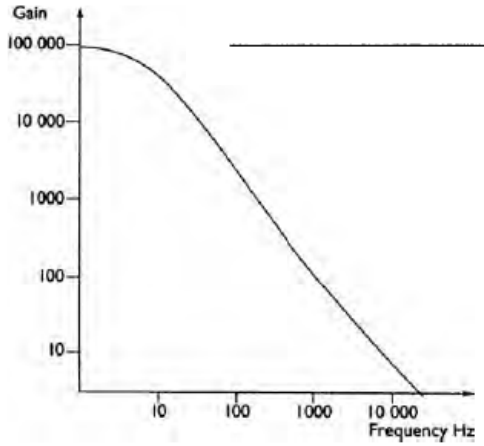


Amplificator operational



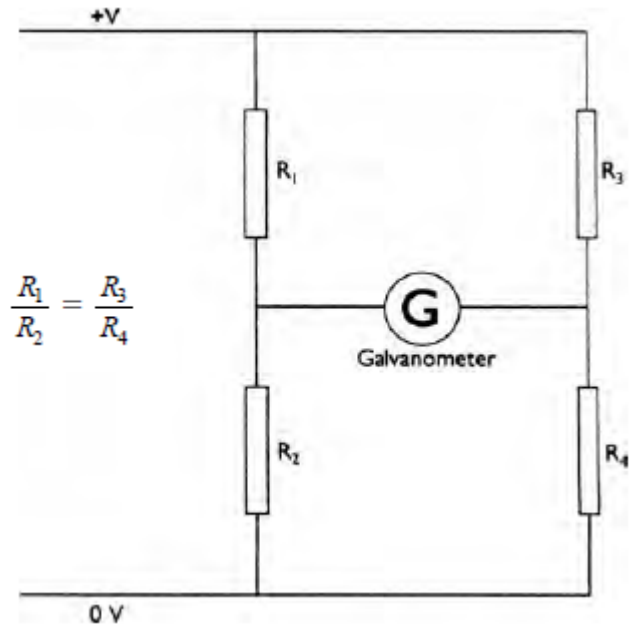
Amplificator curent



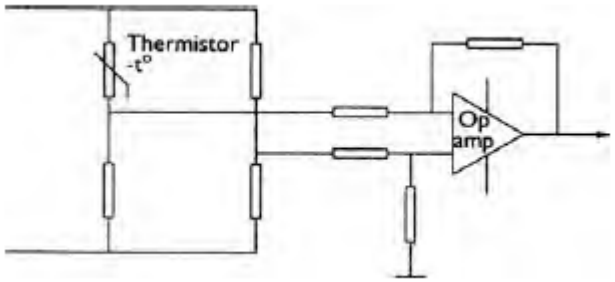


Punti de masura

Puntea Wheatstone

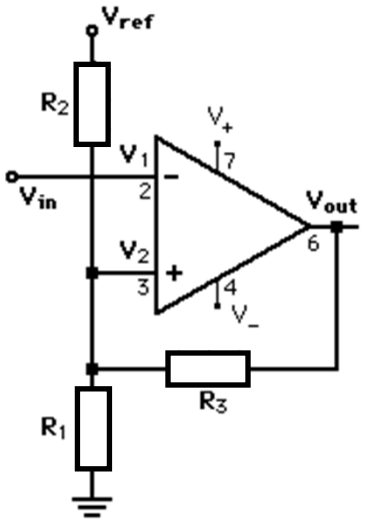


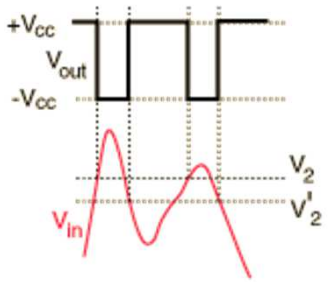
$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$

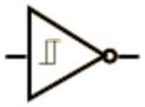


Comparatoare

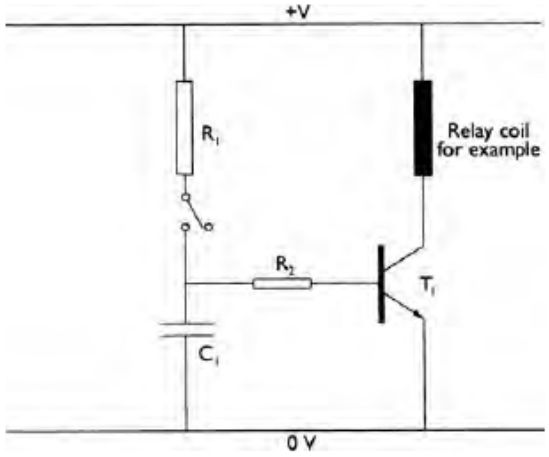
Comparatorul Schmitt

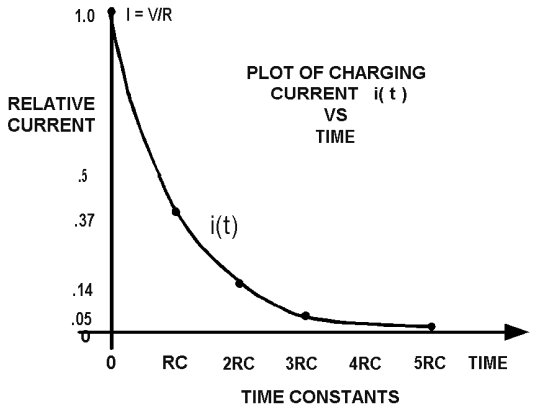




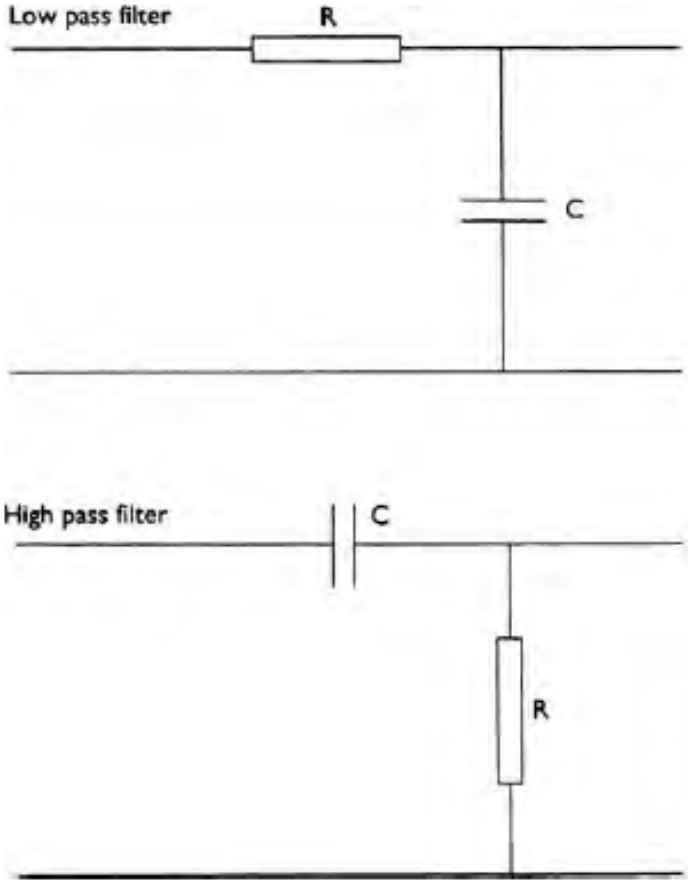


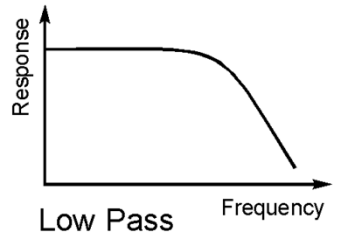
Temporizatoare

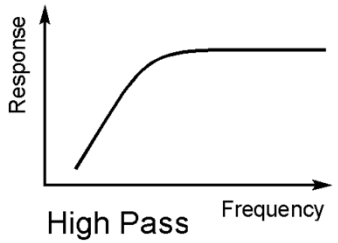


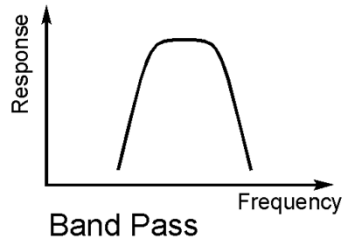


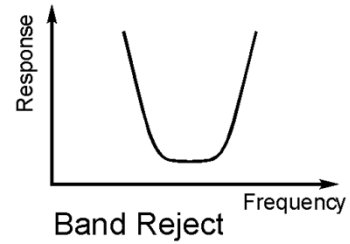
Filtre



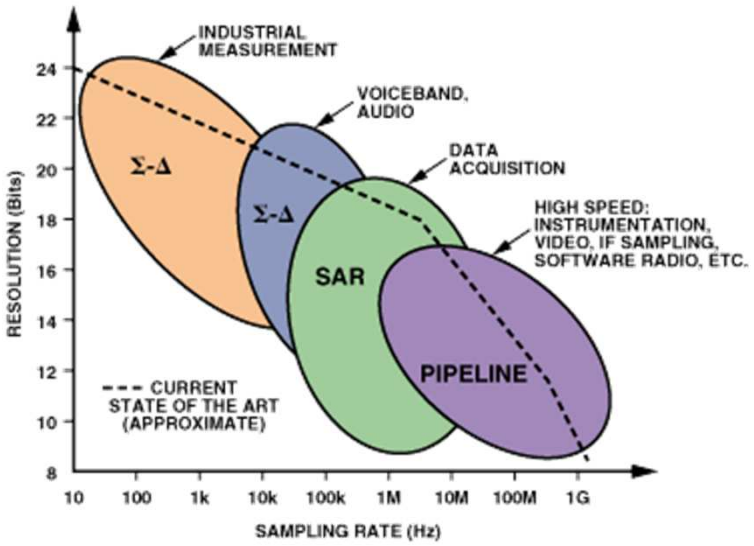


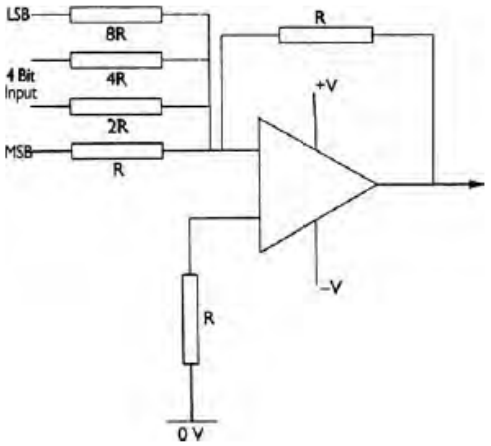


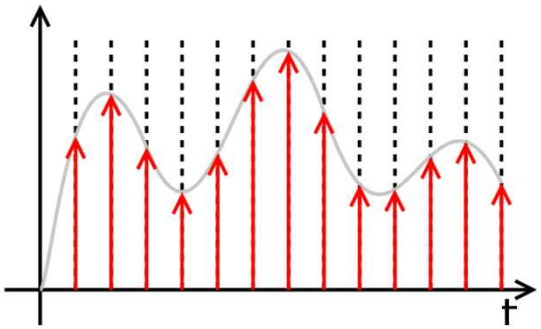


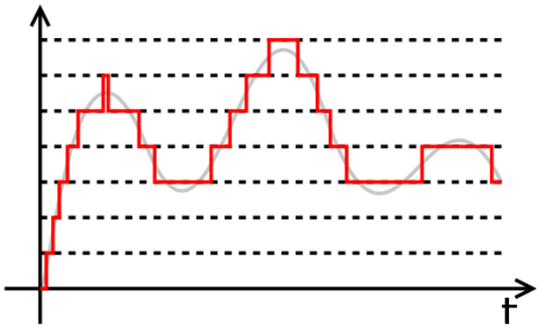


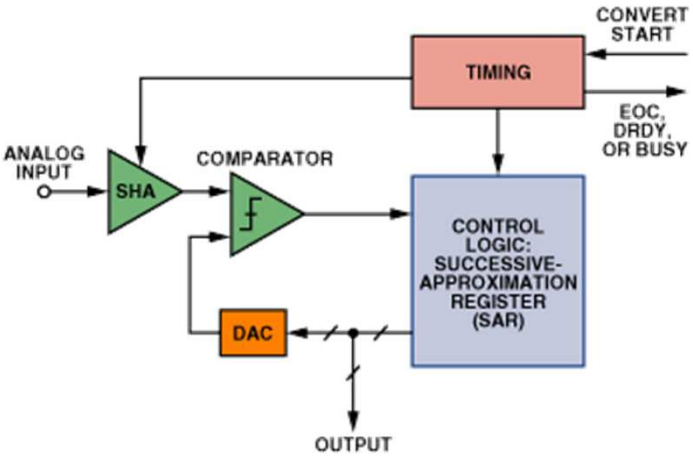
Convertoare AD-DA

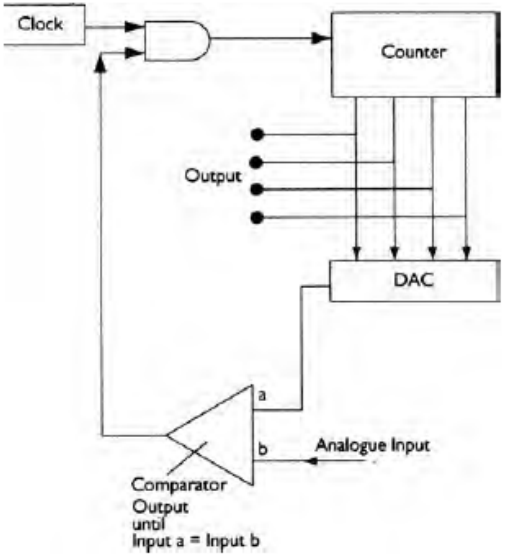


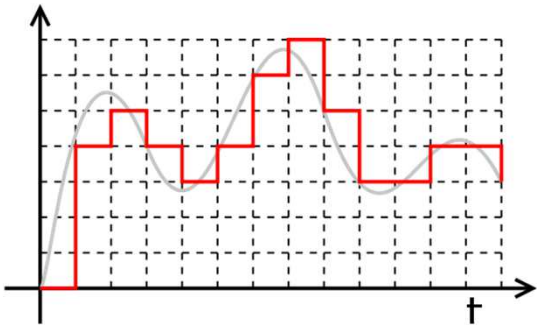








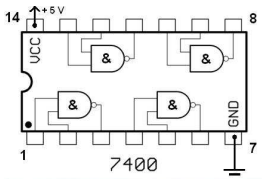


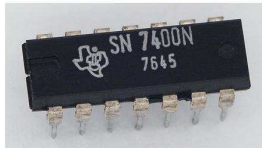


Electronica digitala

Frana de mana? ON 1

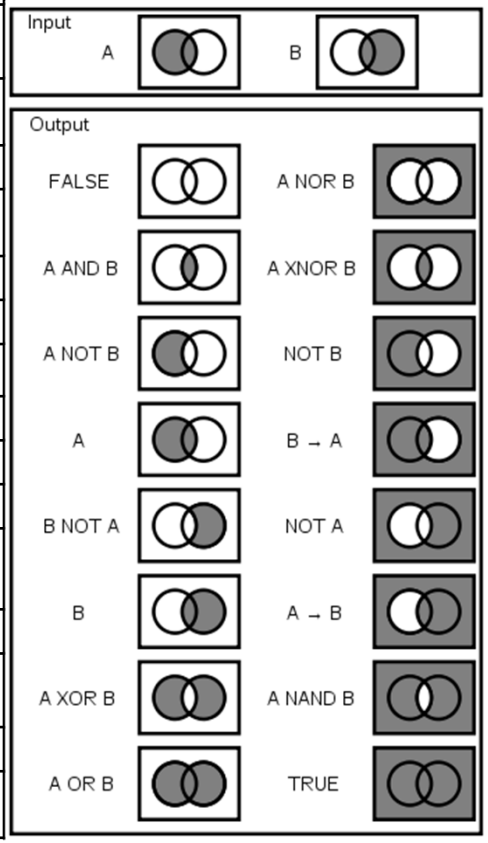
Nivel combustibil, ulei , lichid racire? OFF 0



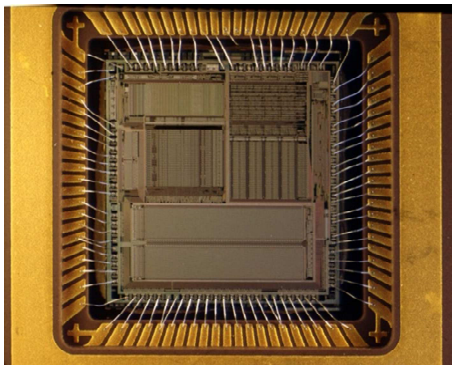


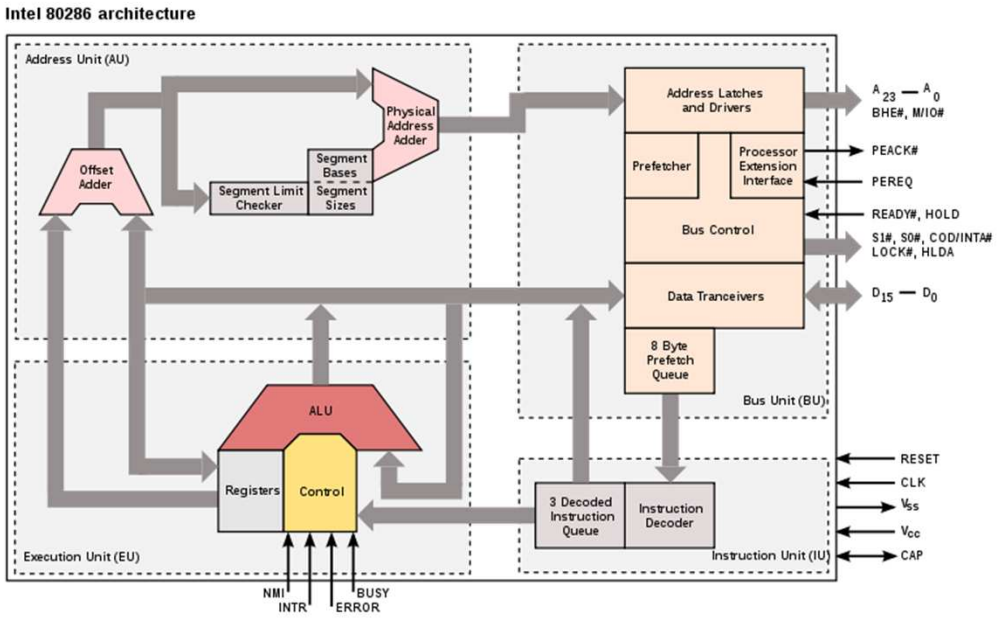
INPUT	A	0	0	1	1	Meaning
	B	0	1	0	1	
OUTPUT	FALSE	0	0	0	0	Whatever A and B, the output is false. Contradiction.
	A AND B	0	0	0	1	Output is true if and only if (iff) both A and B are true.
	A $\not\rightarrow$ B	0	0	1	0	A doesn't imply B. True iff A but not B.
	A	0	0	1	1	True whenever A is true.
	A $\not\leftarrow$ B	0	1	0	0	A is not implied by B. True iff not A but B.
	B	0	1	0	1	True whenever B is true.
	A XOR B	0	1	1	0	True iff A is not equal to B.
	A OR B	0	1	1	1	True iff A is true, or B is true, or both.
	A NOR B	1	0	0	0	True iff neither A nor B.
	A XNOR B	1	0	0	1	True iff A is equal to B.
	NOT B	1	0	1	0	True iff B is false.
	A $\leftarrow$ B	1	0	1	1	A is implied by B. False if not A but B, otherwise true.
	NOT A	1	1	0	0	True iff A is false.
	A $\rightarrow$ B	1	1	0	1	A implies B. False if A but not B, otherwise true.
	A NAND B	1	1	1	0	A and B are not both true.
	TRUE	1	1	1	1	Whatever A and B, the output is true. Tautology.

Diagramele Venn

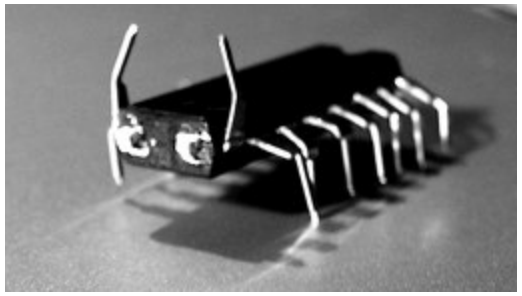


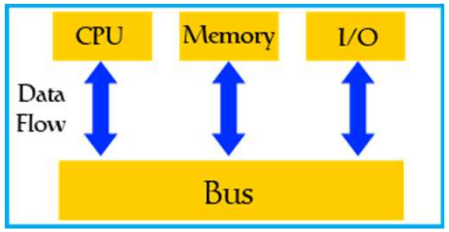
Microprocesoare

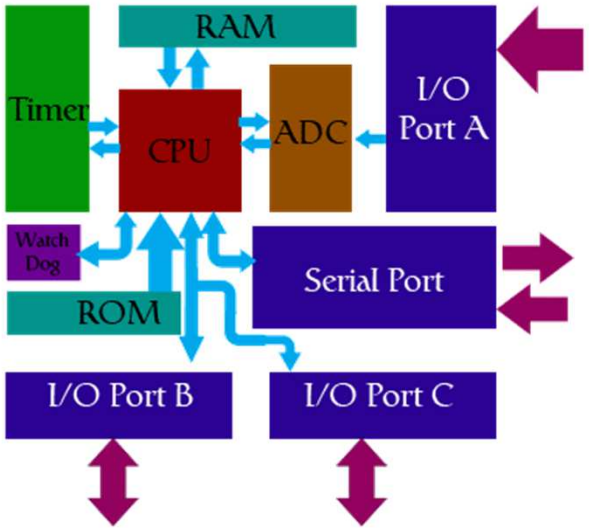




Microcontroler







Scule, masurare si testare

Scule de mana





Multimetru

Precizia instrumentului de masura:

-decide asupra nivelului de precizie dorit

- vrei sa stii ca tensiunea bateriei este 12.6 V sau 12.635V

-alege corect instrumentul de masura

- micrometru, subler sau liniar pentru a verifica grosimea unei saibe

- asigurati-va ca instrumentul de masura a fost verificat si calibrat

- cele mai multe instrumente se vor decalibra dupa o perioada de timp. Asigurati intretinerea si/sau calibrarea periodic prin service autorizat/comparare cu un instrument nou

- studiati instructiunile de utilizare. Intrebati-va daca citirea facuta are valoarea asteptata

- diametrul pistonului este 70.75 mm sau 170.75 mm

- daca faci mai multe masuratori, noteaza-le

- nu te baza pe memorie, scrie-le pe hartie (suporta orice! ☺)

Function	Range	Accuracy
DC Voltage	500 V	0.3%
DC Current	10 A	1.0%
Resistance	0–10 MΩ	0.5%
AC Voltage	500 V	2.5%
AC Current	10 A	2.5%
Dwell	3,4,5,6,8 cylinders	2.0%
RPM	10,000 rpm	0.2%
Duty cycle	% on/off	0.2%/kHz
Frequency	over 100 kHz	0.01%
Temperature	>900 °C	0.3% + 3 °C
High current clamp	1000 A (DC)	Depends on conditions
Pressure	3 bar	10.0% of standard scale

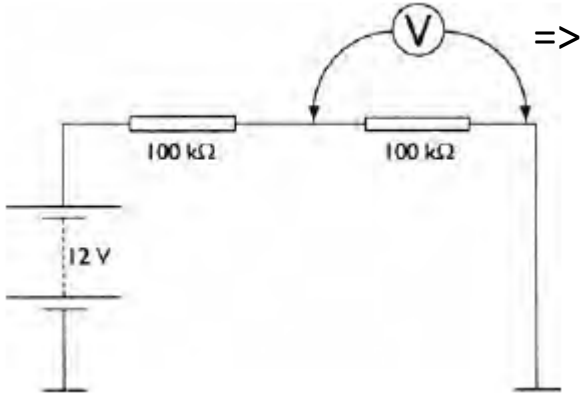




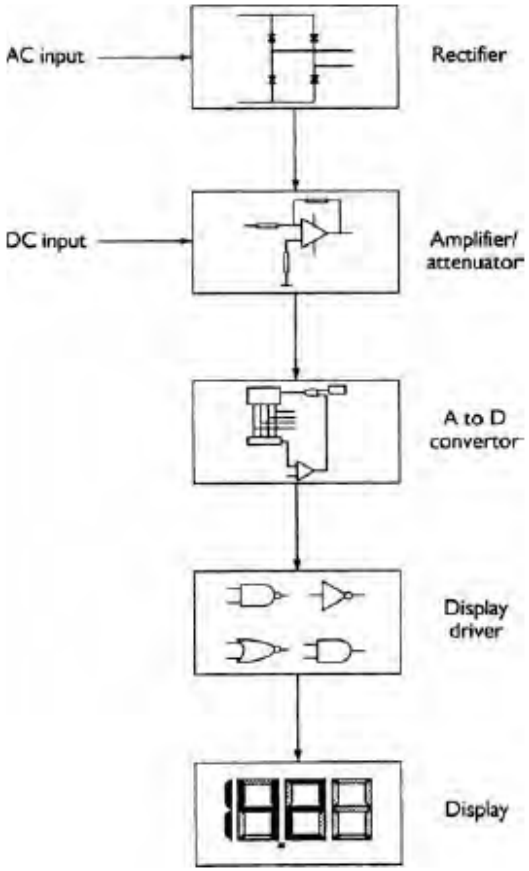
Multimetru

Calitatea aparatului de masura:

-Precizie de masurare
-Efectul instrumentului asupra masurarii
-Circuite de protectie



=> U_{mas} = 6 V (teoretic)



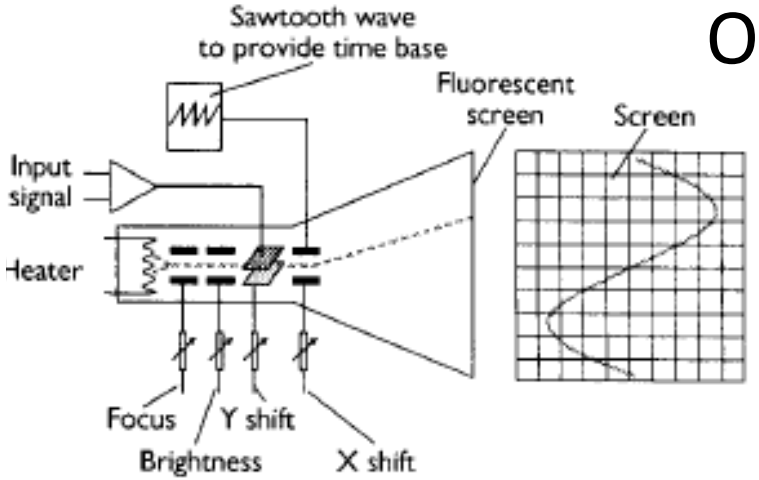
Dar daca, R_{int} = 1 MΩ $\quad \frac{1}{\mathbf{R_e}} = \frac{1}{\mathbf{R_1}} + \frac{1}{\mathbf{R_2}} \Rightarrow \mathbf{R_e} = 91\,\mathbf{k\Omega}; \quad \mathbf{U_2} = \mathbf{IR_2} = \frac{12}{100+91} \cdot 91 = 5.71\,\mathbf{V} \quad \Rightarrow \boldsymbol{\varepsilon} \cong \mathbf{5\%}$

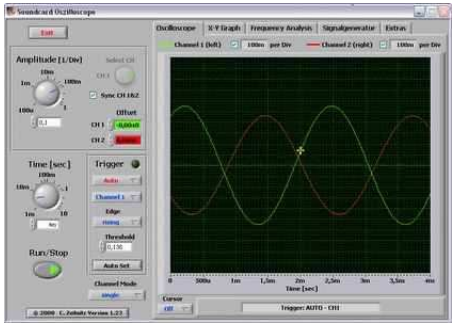
R_{int} = 10 MΩ $\quad \frac{1}{\mathbf{R_e}} = \frac{1}{\mathbf{R_1}} + \frac{1}{\mathbf{R_2}} \Rightarrow \mathbf{R_e} = 99\,\mathbf{k\Omega}; \quad \mathbf{U_2} = \mathbf{IR_2} = \frac{12}{100+99} \cdot 99 = 5.97\,\mathbf{V} \quad \Rightarrow \boldsymbol{\varepsilon} \cong \mathbf{0.5\%}$

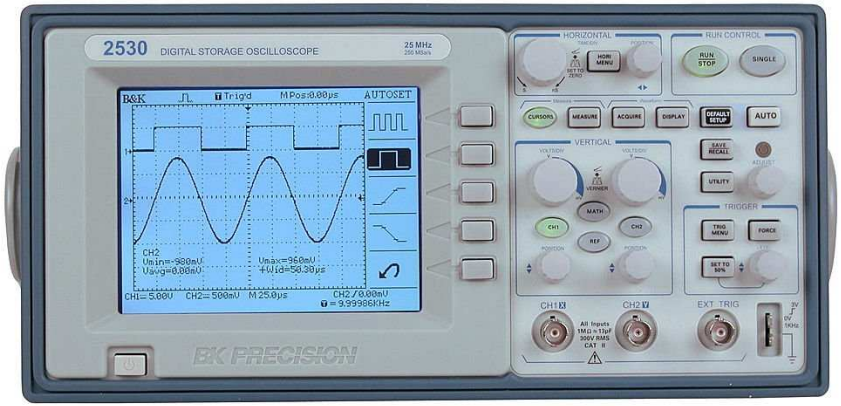
+ precizia instrumentului de masura

Osciloscop


ST16B 10MHz OSCILLOSCOPE
POWER
INTENSITY
FOCUS
PROBE ADJUST
VOLTS/DIV
SEC/DIV
POSITION
TRIM
LEVEL
INPUT


Sawtooth wave
to provide time base
Fluorescent
screen
Screen
Input
signal
Heater
Focus
Brightness
Y shift
X shift



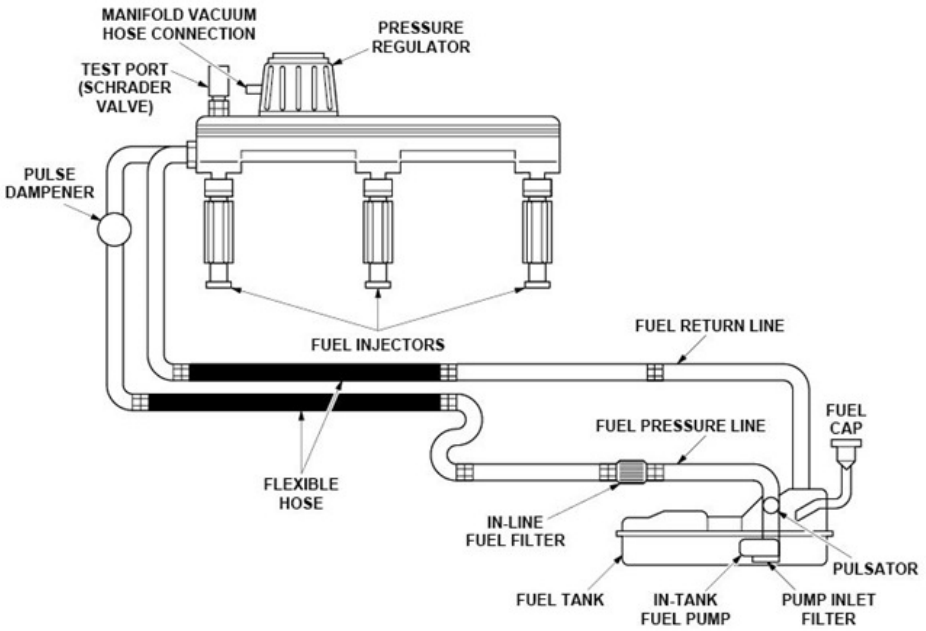

2530
DIGITAL STORAGE OSCILLOSCOPE
25 MHz
HORIZONTAL
RUN CONTROL
RUN STOP
SINGLE
AUTOSET
VERTICAL
TRIGGER
EXT TRIG
BK PRECISION

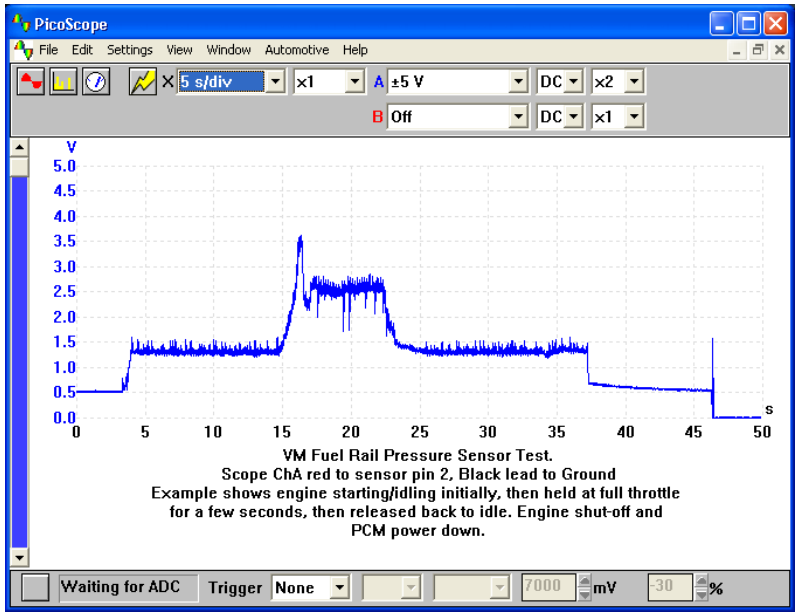




Masurarea presiunii









Testere si analizoare

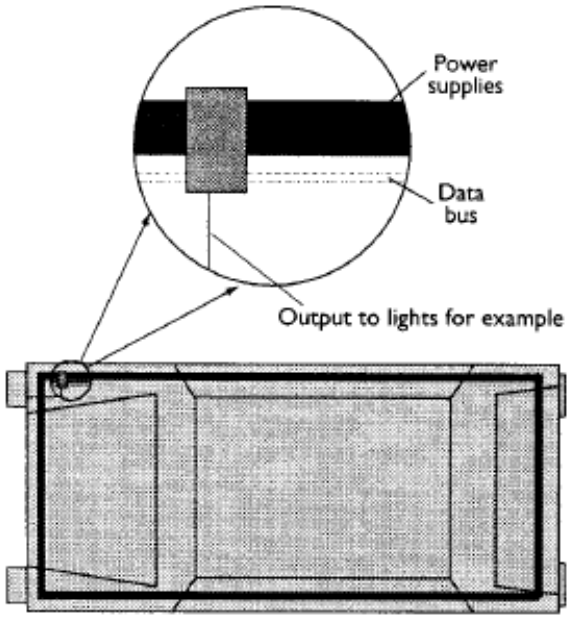


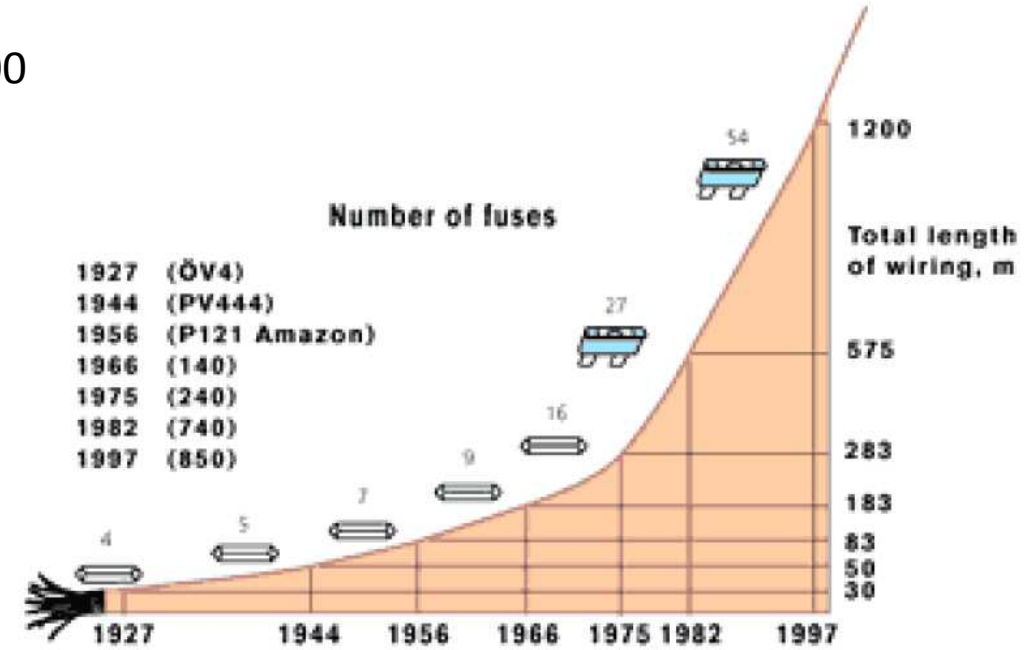




Sisteme multiplexate

Nr. conductori intr-un vehicul modern >1500
Nr conductori in portiera ≈50
Nr. conductori in zona bordului >100



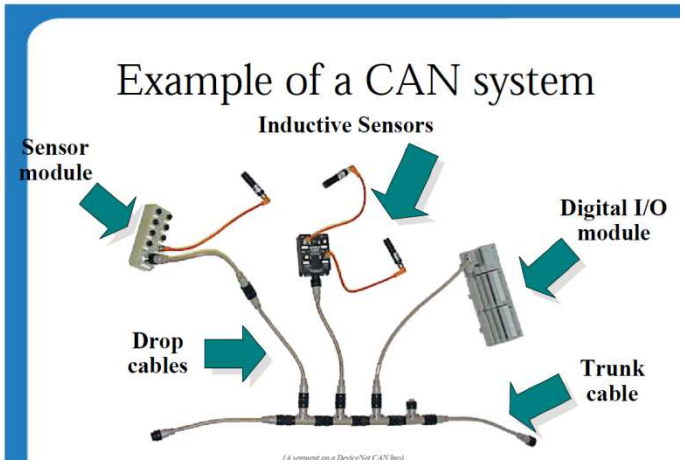


Port de date multiplexat:

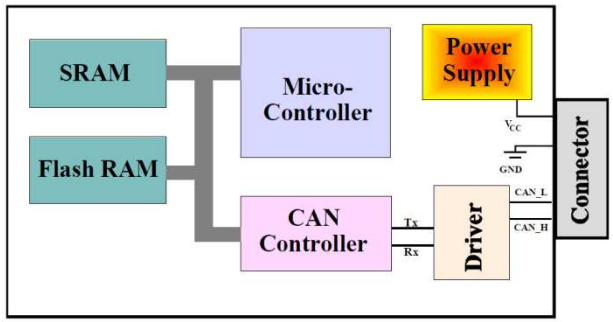
- Metoda de adresare
- Secventa de transmitere
- Semnal de control
- Detectarea erorilor
- Tratarea erorilor
- Viteza sau rata transmisiei
  - Mediul de transmisie (Cu, fibra optica)
  - Codificarea transmisiei (analogica, digitala)
  - Tipul de semnal (tensiune, curent, frecventa)

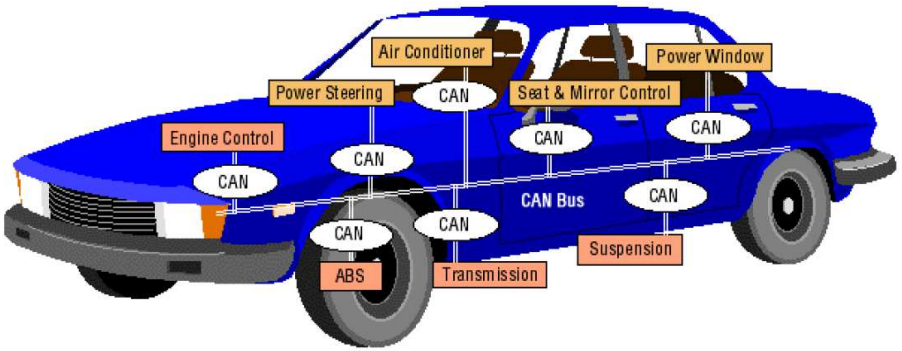
KELANI Cable Code	Conductor		Nominal Insulation Thickness	Max. Overall Diameter	Approx. Weight	Max d.c. Resistance at 20 °C	Colour	Packing	
	Nominal Cross sectional area	No. & Dia. of wires						Drum Type	Cable Length
	mm^2	x/mm	mm	mm	kg/km	Ω/km			m
1A112020ZN	0.50	16/0.20	0.5	2.2	8.1	37.1	Red Black Blue Yellow Purple Brown Green White Y/Red Y/Green Y/Black Y/Blue Y/Purple W/Red W/Green W/Black W/Blue W/Purple	Coil	30
1A113030ZN	0.65	9/0.30	0.6	2.5	11.7	29.35		Coil	30
1A114025ZN	0.7	14/0.25	0.6	2.5	12.0	27.15		Coil	30
1A116030ZN	1	14/0.30	0.6	2.7	15.5	18.84		Coil	30
1A119030ZN	1.5	21/0.30	0.6	3.1	21.4	12.57		Coil	30
1A121030ZN	2	28/0.30	0.6	3.4	27.9	9.42		Coil	30
1A122030ZN	2.5	35/0.30	0.7	3.8	34.9	7.54		Coil	30
1A123030ZN	3	44/0.30	0.8	4.2	43.4	6.00		Coil	30
1A125030ZN	4.5	65/0.30	1.0	5.1	64.2	4.06		Coil	30
1A126030ZN	6	84/0.30	1.0	5.9	81.8	3.14		Coil	100
1A127030ZN	7	97/0.30	1.0	6.2	88.6	2.72		Coil	100
1A128030ZN	8	120/0.30	1.2	7.0	118.0	2.2		Coil	100
1A129040ZN	10	80/0.40	1.3	7.5	178.0	1.82		Coil	100
1A131075ZN	16	37/0.75	1.3	8.3	196.0	1.1		Coil	100
1A131040ZN	16	126/0.40	1.3	8.7	203.0	1.16		Coil	100
1A131030ZN	20	266/0.30	1.3	9.5	236.6	0.99		Coil	100
1A132090ZN	25	37/0.90	1.5	9.7	278.4	0.762		Coil	100
1A135090ZN	40	61/0.90	1.6	11.8	443.0	0.462		Coil	100
1A136113ZN	60	61/1.13	1.7	14.1	677.3	0.293		Coil	100

Sisteme multiplexate

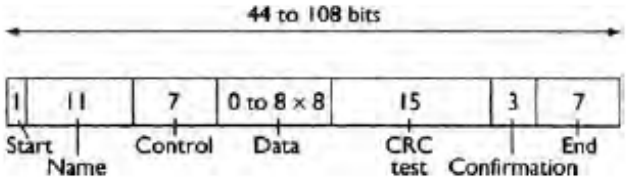


Schematic of a CAN module





Bosch CAN



ISO 11898 (CAN High Speed) standard

Signal	Recessive state			Dominant state		
	min	nominal	max	min	nominal	max
CAN-High	2.0 V	2.5 V	3.0 V	2.75 V	3.5 V	4.5 V
CAN-Low	2.0 V	2.5 V	3.0 V	0.5 V	1.5 V	2.25 V

ISO 11519 (CAN Low Speed) standard

Signal	Recessive state			Dominant state		
	min	nominal	max	min	nominal	max
CAN-High	1.6 V	1.75 V	1.9 V	3.85 V	4.0 V	5.0 V
CAN-Low	3.1 V	3.25 V	3.4 V	0 V	1.0 V	1.15 V

CAN bus cable length

Bus length (m)	Maximum bit rate
40	1 Mbit/s
100	500 kbit/s
200	250 kbit/s
500	125 kbit/s

Fibra optica

EMC

	USB	Bluetooth
Data throughput	+ +	-
Latency	++	--
Security	+	-
Mobility	-	+++
Price	+	_
Versatility	-	+++

Bluetooth (Visteon Bluetooth, Chrysler Uconnect, MS Windows Automotive

