Sensori magnetici

Caratterizzazione dei sensori magnetici:

- principio di funzionamento e grandezza misurata

    1. Unità di misura del campo magnetico H e del campo di induzione magnetica B
    2. Valori di interesse del compo di induzione magnetica e principali applicazioni
    3. L'effetto magnetoresistivo

Sensori magnetici

Caratterizzazione dei sensori magnetici:

- tipi di dispositivi, circuito di lettura (read-out) e modello del sensore (sensibilità)

1. Magnetoresistori
2. Piatti di Hall integrati
3. DAMS (Differential Amplification Magnetic Sensor)
4. MAGFETs
5. Dual-Drain MAGFETs
6. Vertical MagnetoTransitor
7. Lateral MagnetoTransistor

Unità di misura del campo magnetico H e del campo di induzione magnetica B

H – campo magnetico: si misura in A/m

B – induzione magnetica: si misura in Tesla

$1T = 1 Weber/m^2 = 10^4$ gauss

$1T = 1\ Vs/m^2 \rightarrow (B\mu)$ è adimensionale, con μ-mobilità di elettroni o lacune

$H = \mu_r\ \mu_0\ B$

con $\mu_r\ \mu_0$ –permeabilità del materiale ($\mu_0 = 4\pi\ 10^{-7}$ H/m)

$\mu_r \approx 1$ per molti materiali (Hg, Ag, Au, Cu, W, H_2O, Pt)

ferrite di Nichel-Zinco → $\mu_r = 650$

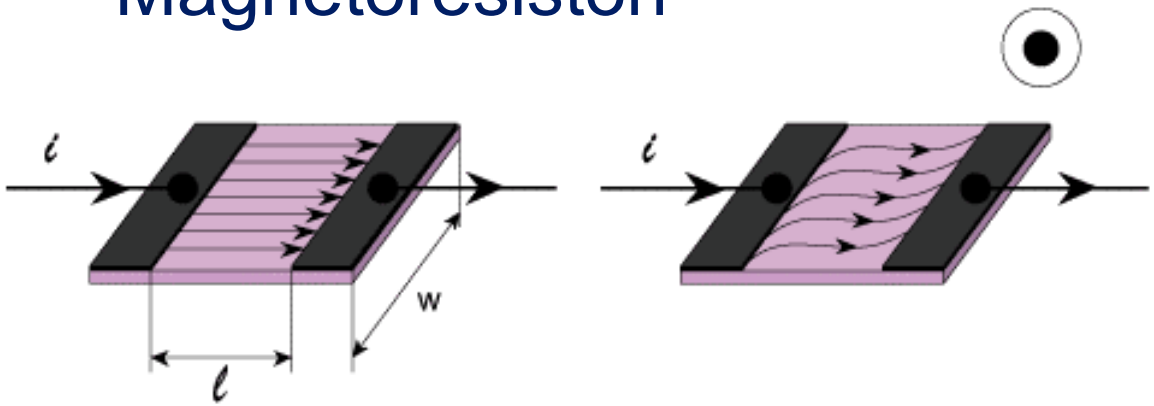
ferrite di Manganese-Zinco → $\mu_r = 1200$

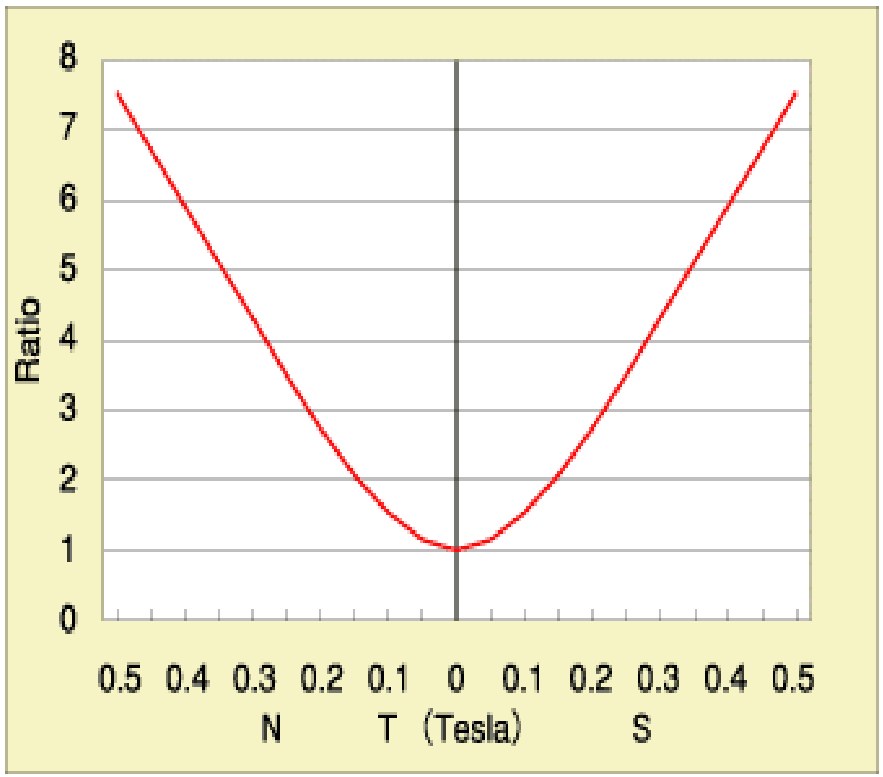
ferro puro al 99,96% → $\mu_r = 280000$

Range di valori di interesse del campo di induzione magnetica B

campo geomagnetico	30-60 μT
sistemi di memorizzazione di dati (hard-disk, floppy-disk, videocassette)	$\approx$ 1mT
sistemi di lettura di bande magnetiche	$\approx$ 1mT
sistemi di lettura di inchiostro magnetico delle banconote	$\approx$ 1mT
magneti permanenti usati negli interruttori e nei sensori	5 $\div$100 mT
magneti permanenti usati negli strumenti di misura	4 $\div$ 5 T

Magnetoresistori





$$\sigma_{nB} = \frac{\sigma_n}{1 + \mu_n^{*2} B_z^2}$$

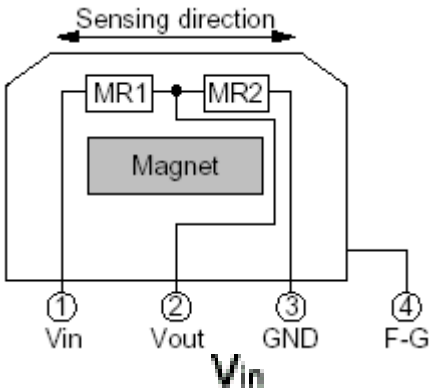
Magnetoresistori in Antimoniuro di Indio (InSb):

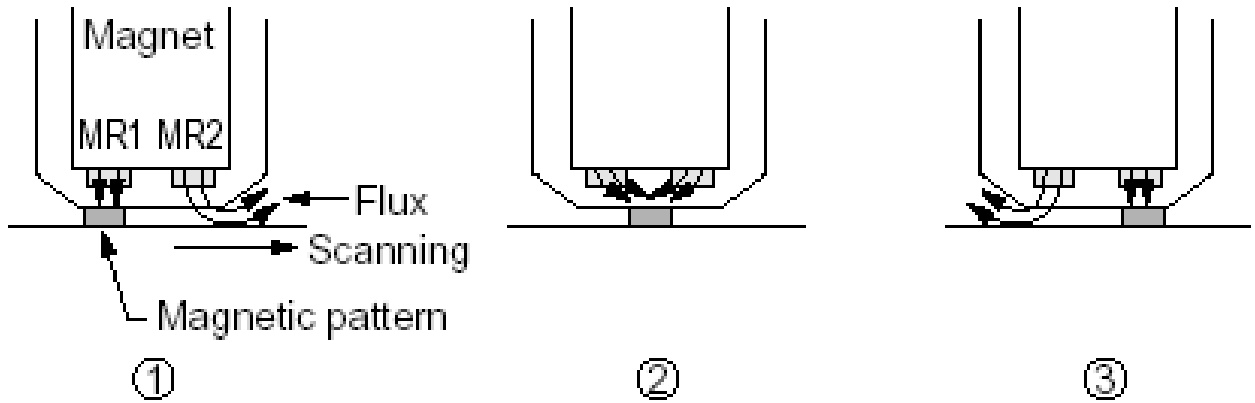
$\mu^* \approx 80000\ cm^2/Vs$

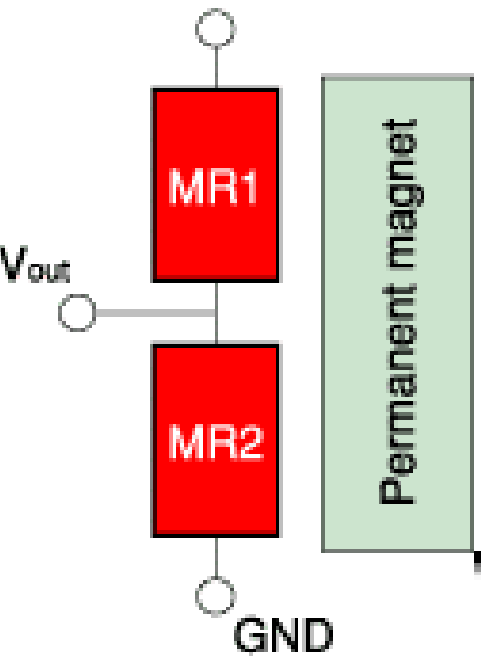
Magnetic Pattern Recognition Sensors

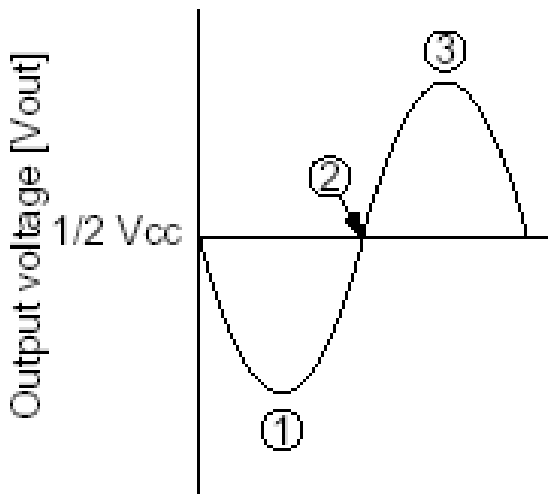
Standard Compact Type

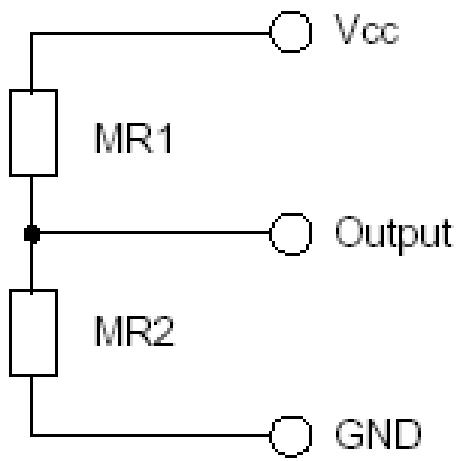
BS05C/N Series



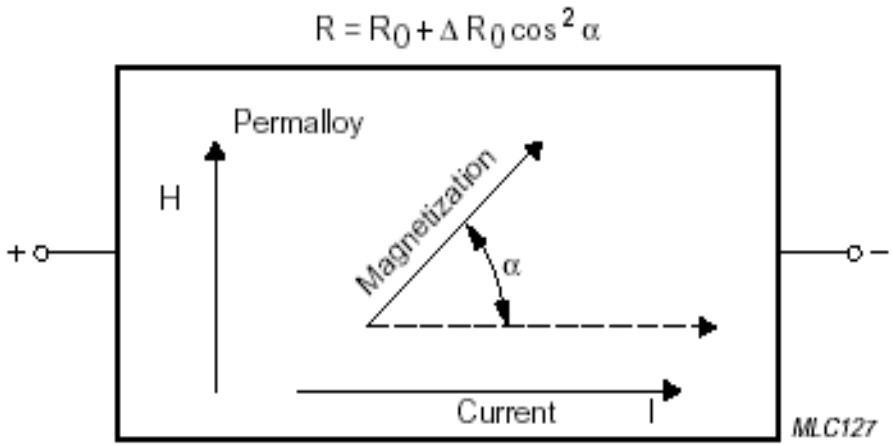


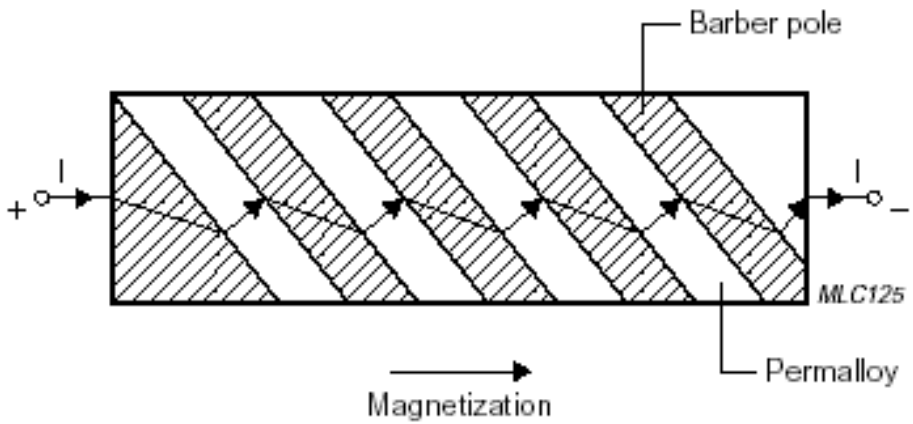




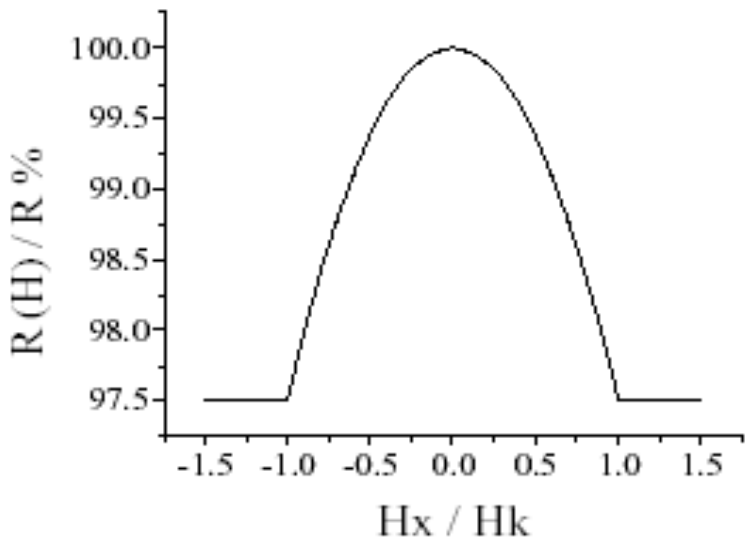


Magnetoresistori anisotropi (AMR)

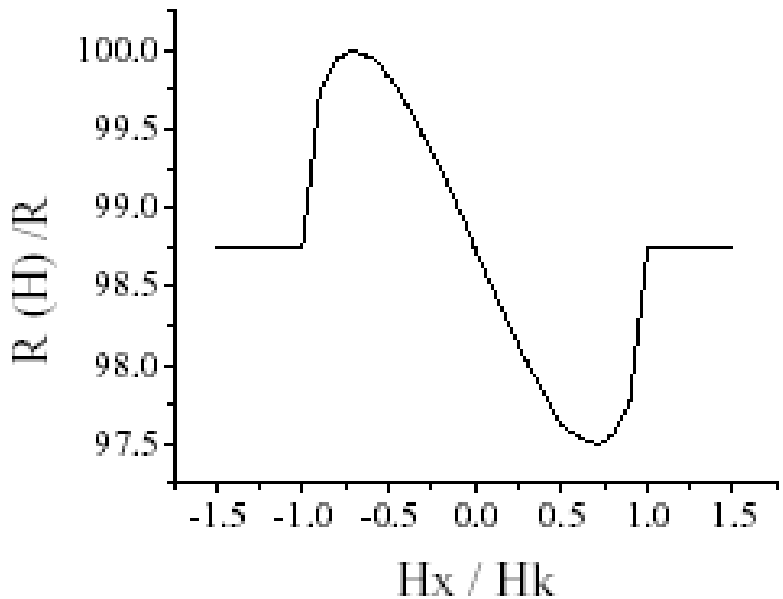




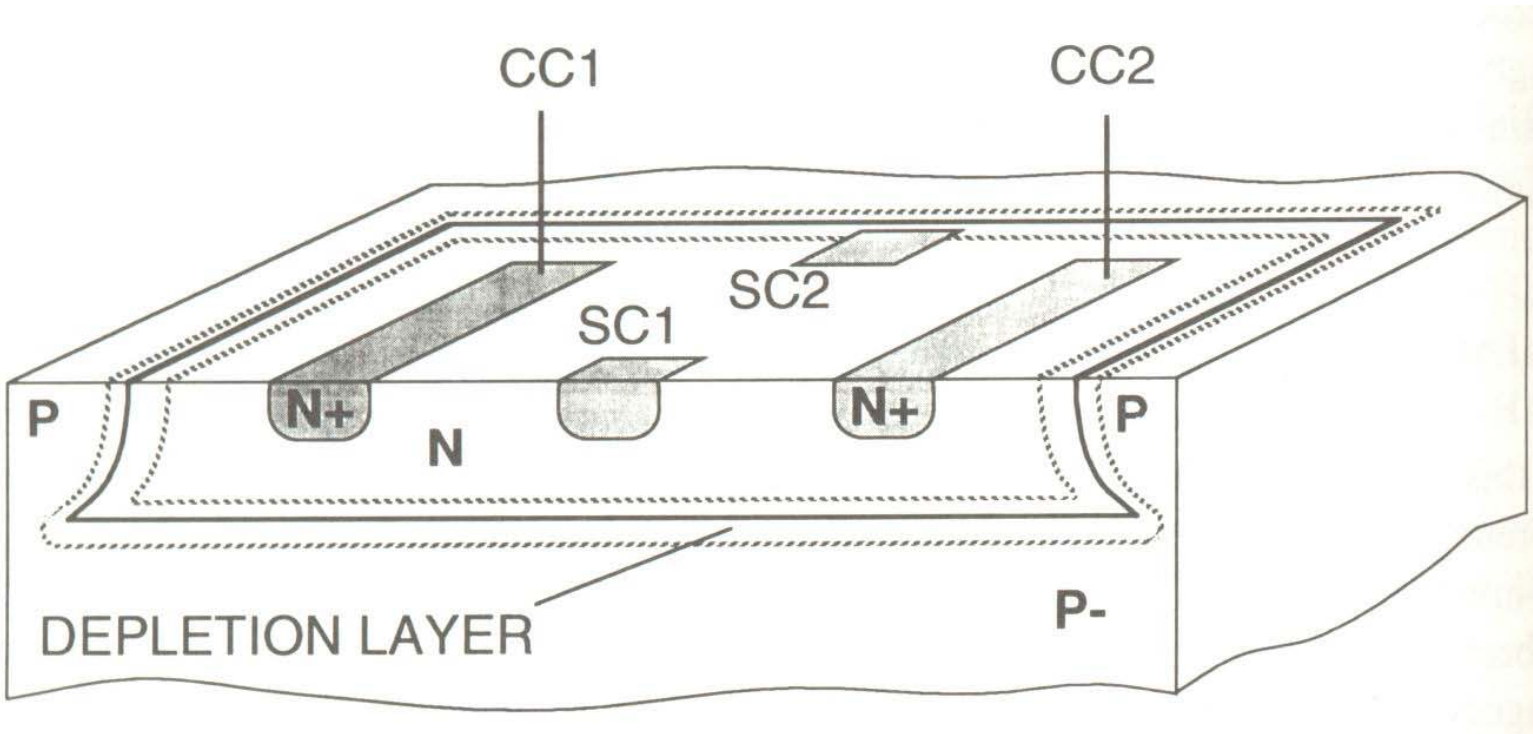
Permalloy is 19%Fe-81%Ni



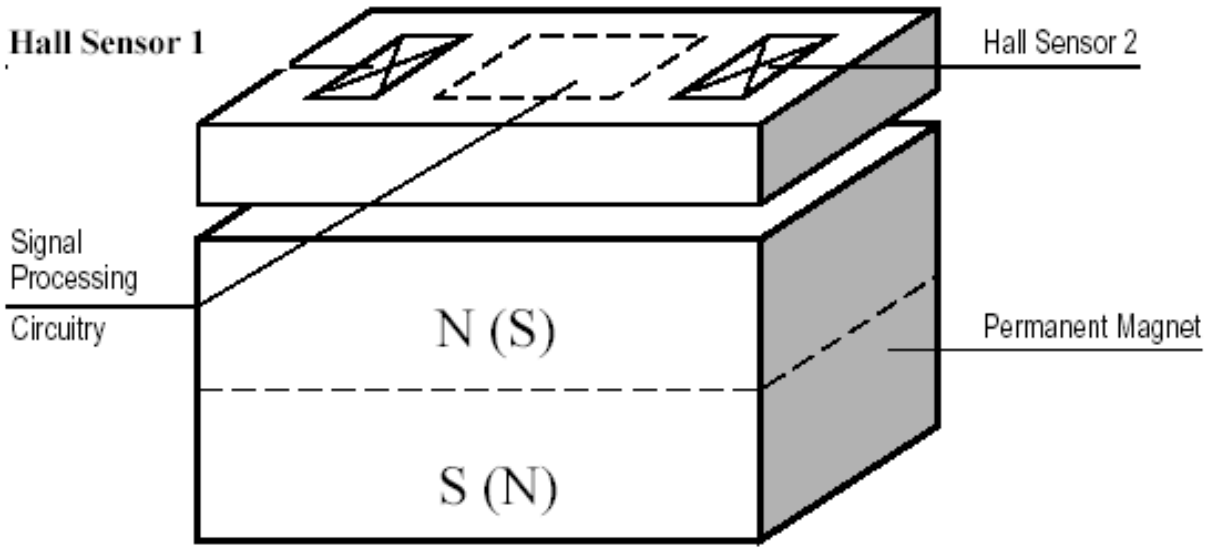
Stripes are Al



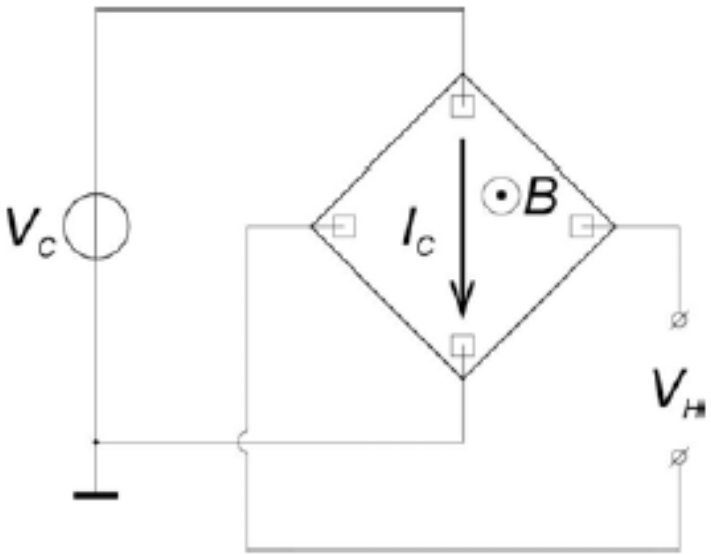
Piatti di Hall integrati

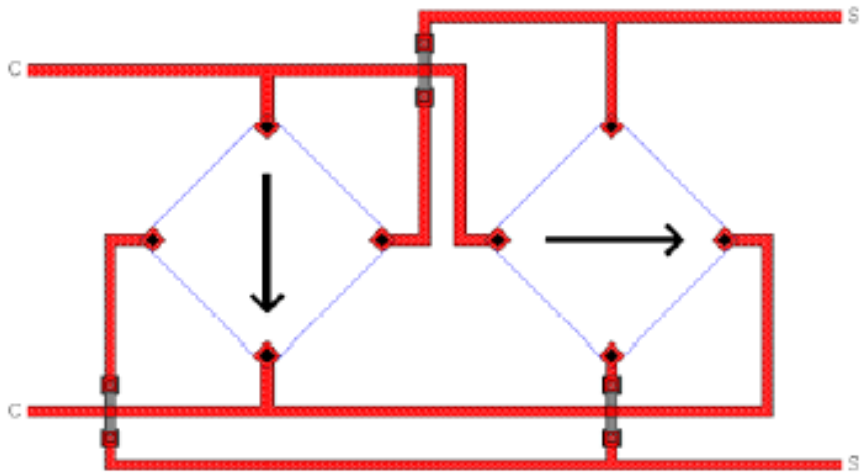


Piatti di Hall integrati

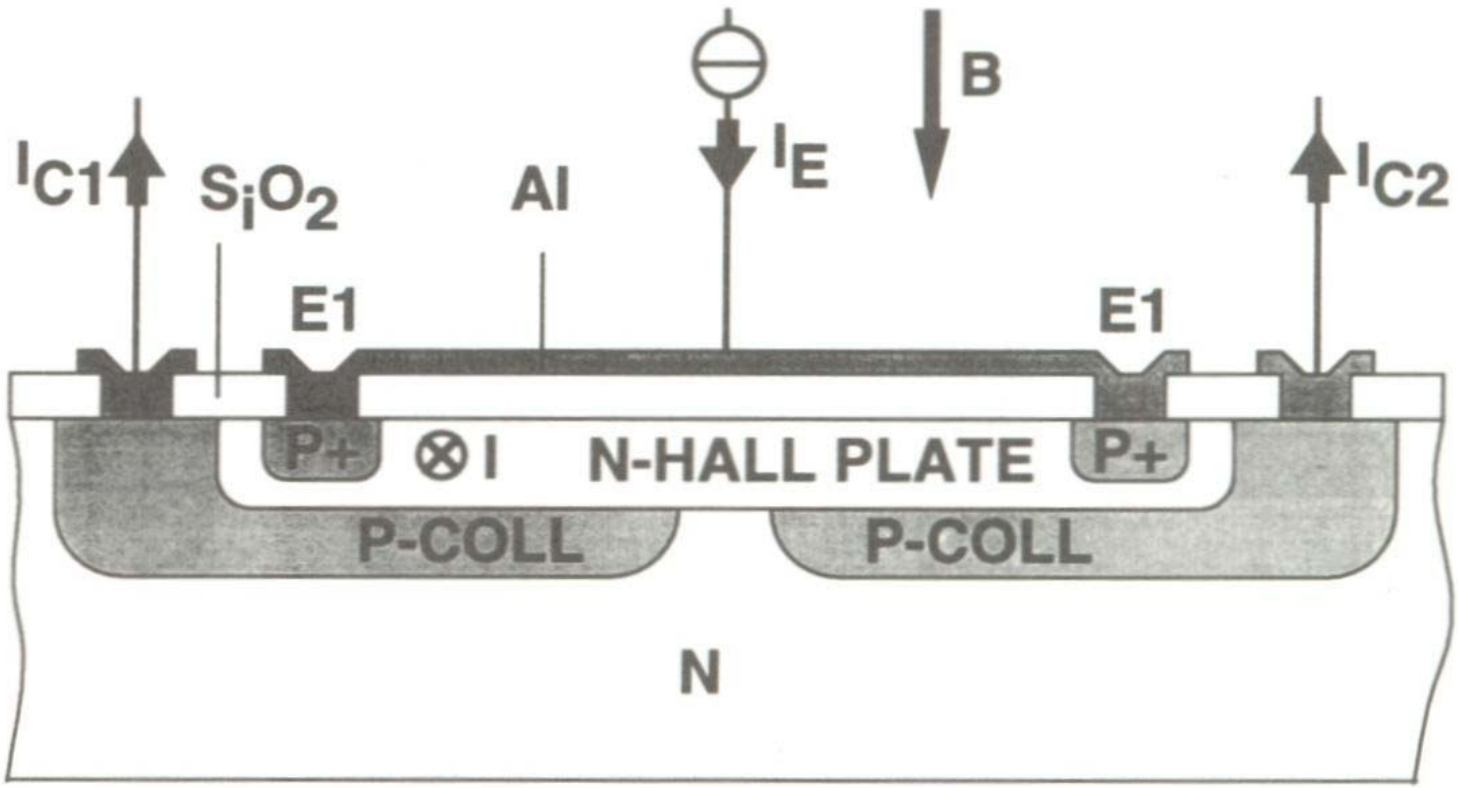


Piatti di Hall integrati

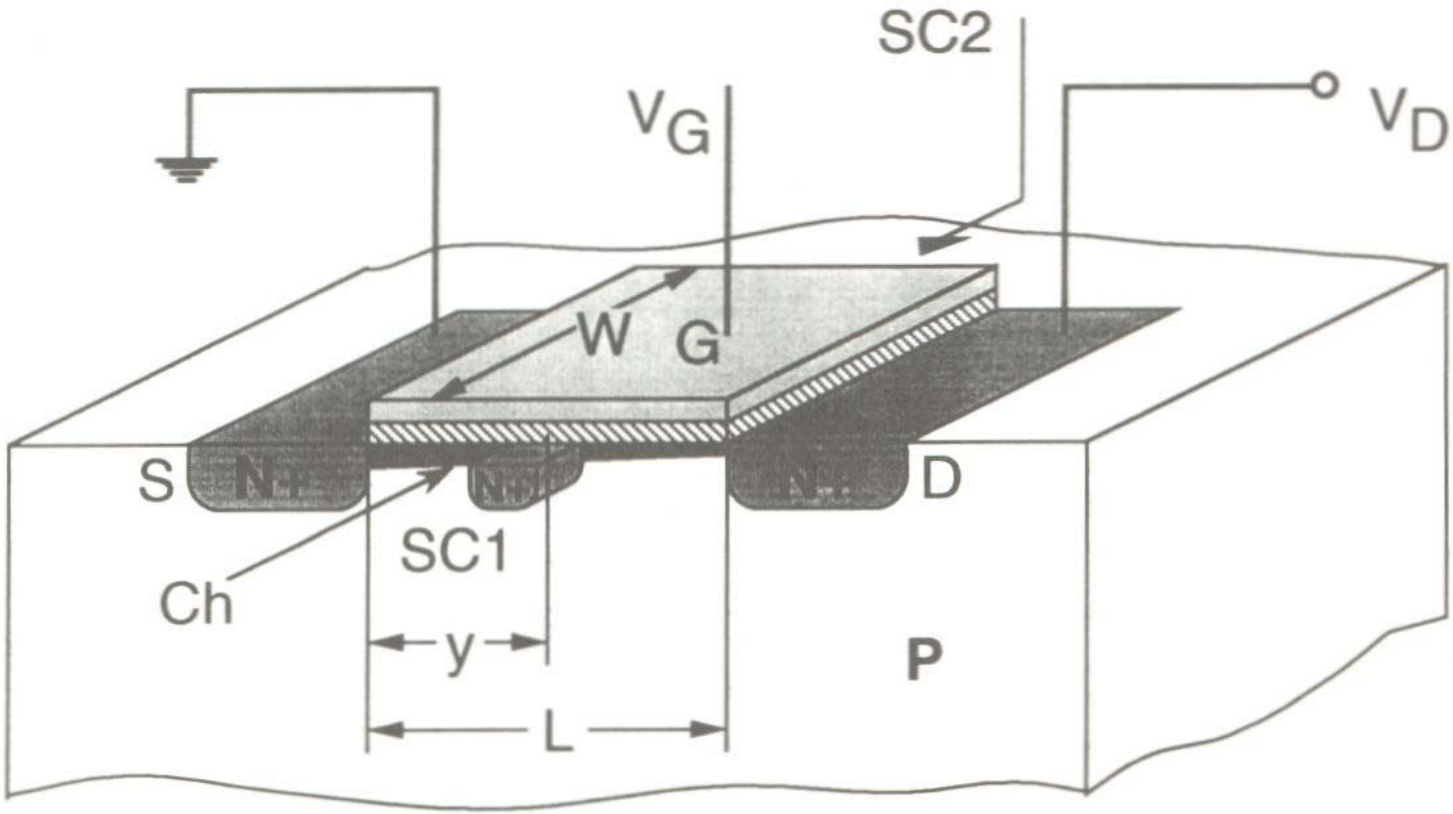




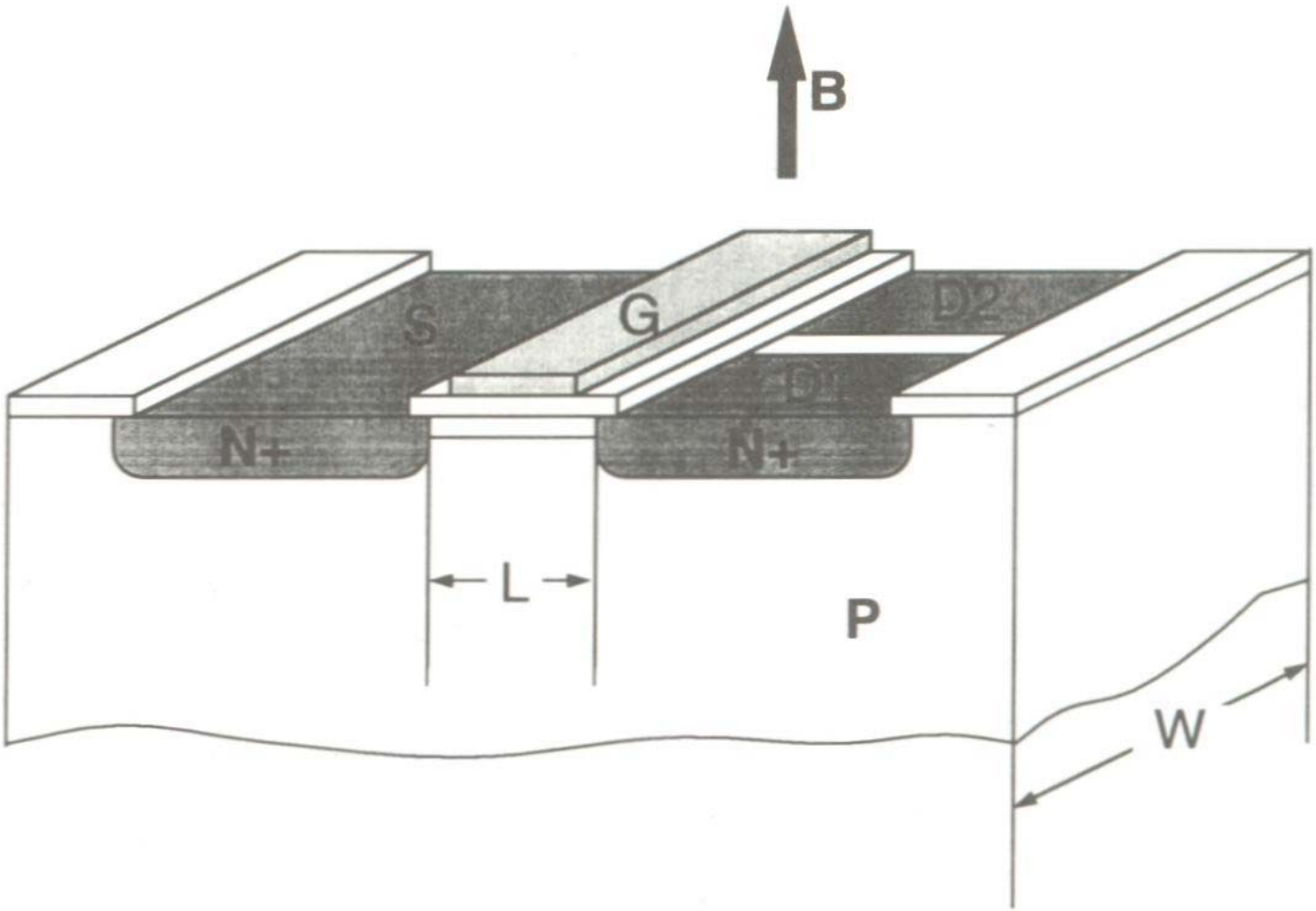
DAMS (Differential Amplification Magnetic Sensor)



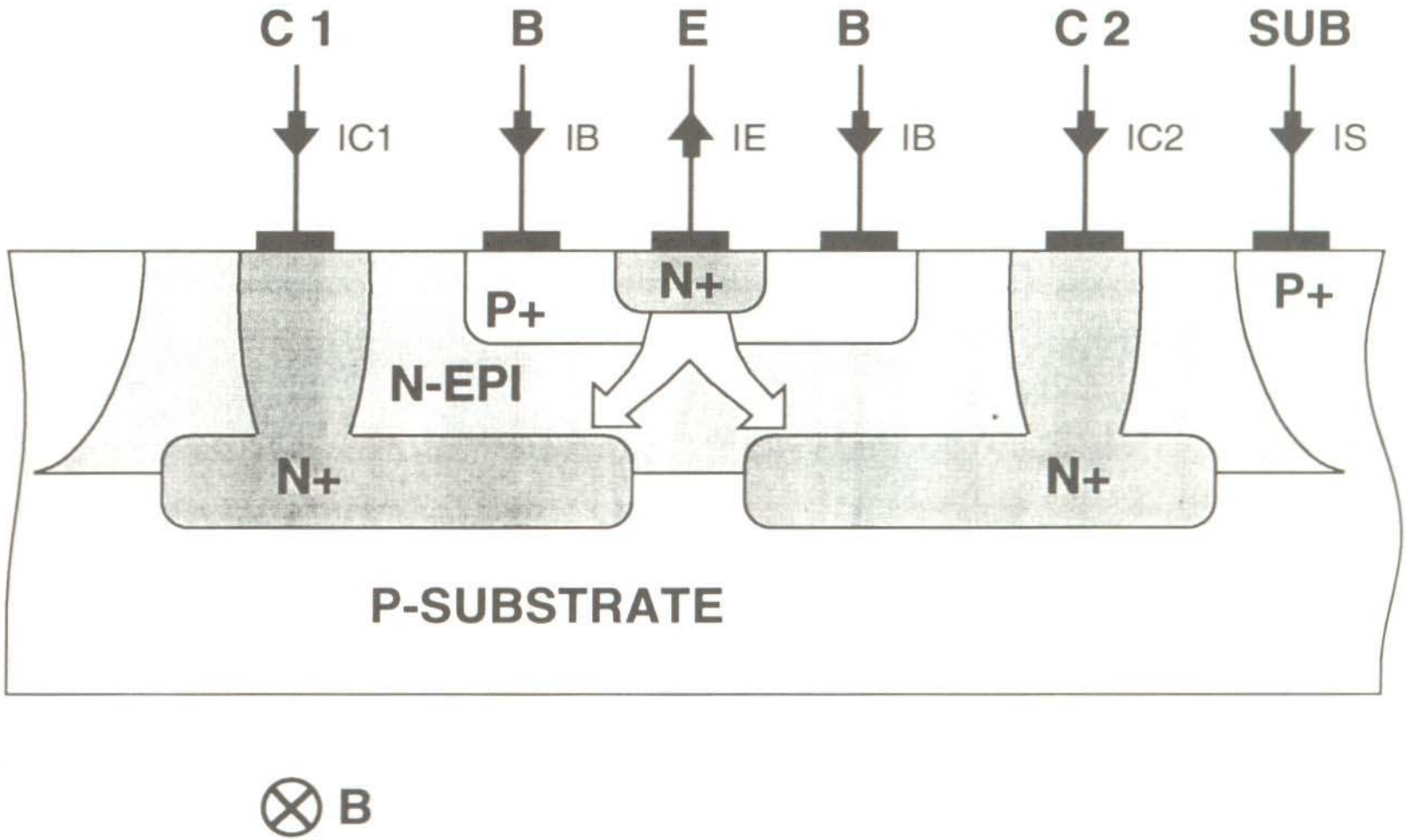
MAGFETs



Dual-Drain MAGFETs



Vertical MagnetoTransitor



Lateral MagnetoTransitor