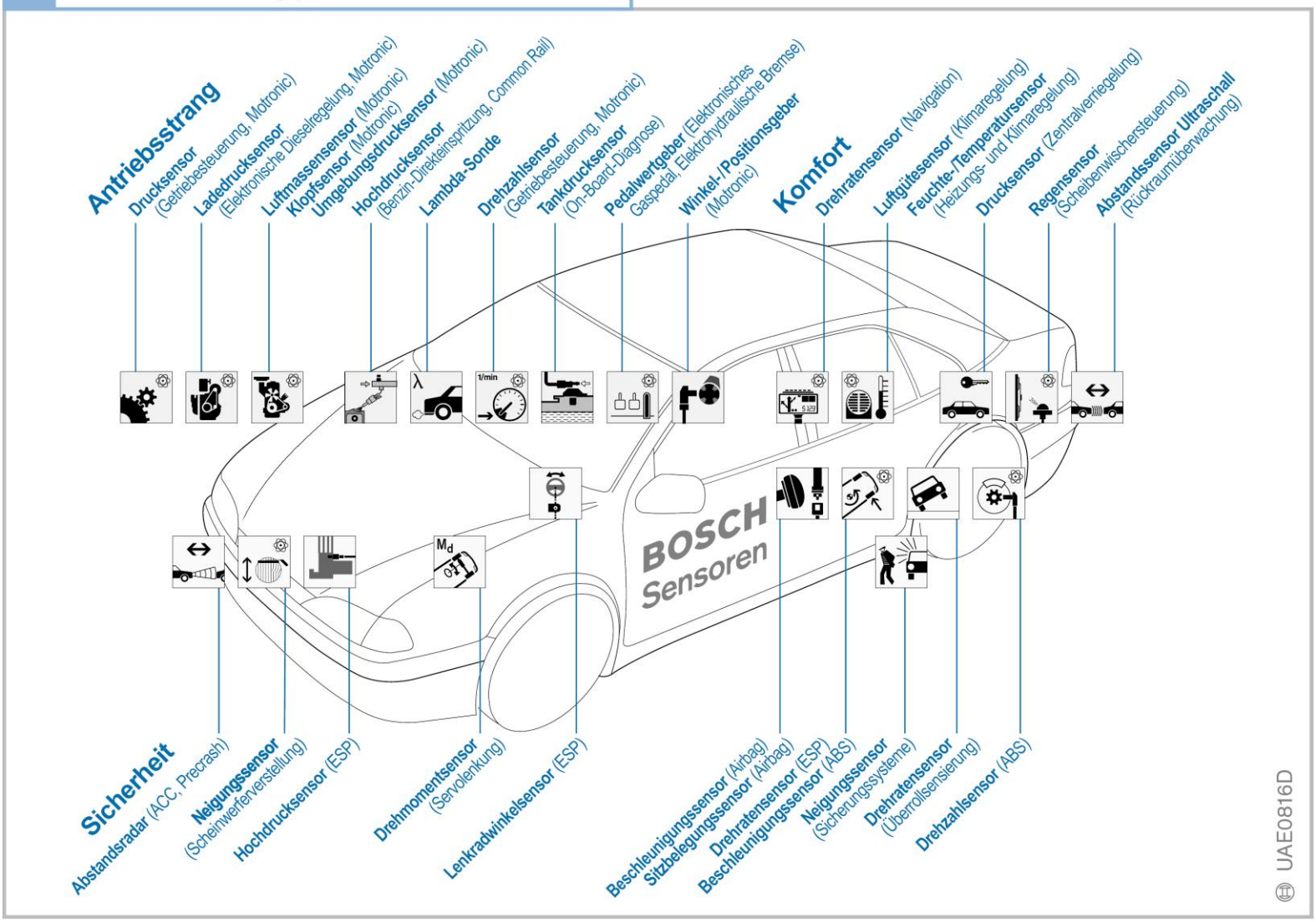
MJERNI PRETVORNICI - PRIMJENE

4 Vielfalt der Fahrzeugsysteme mit Sensoren



MJERNI SUSTAV

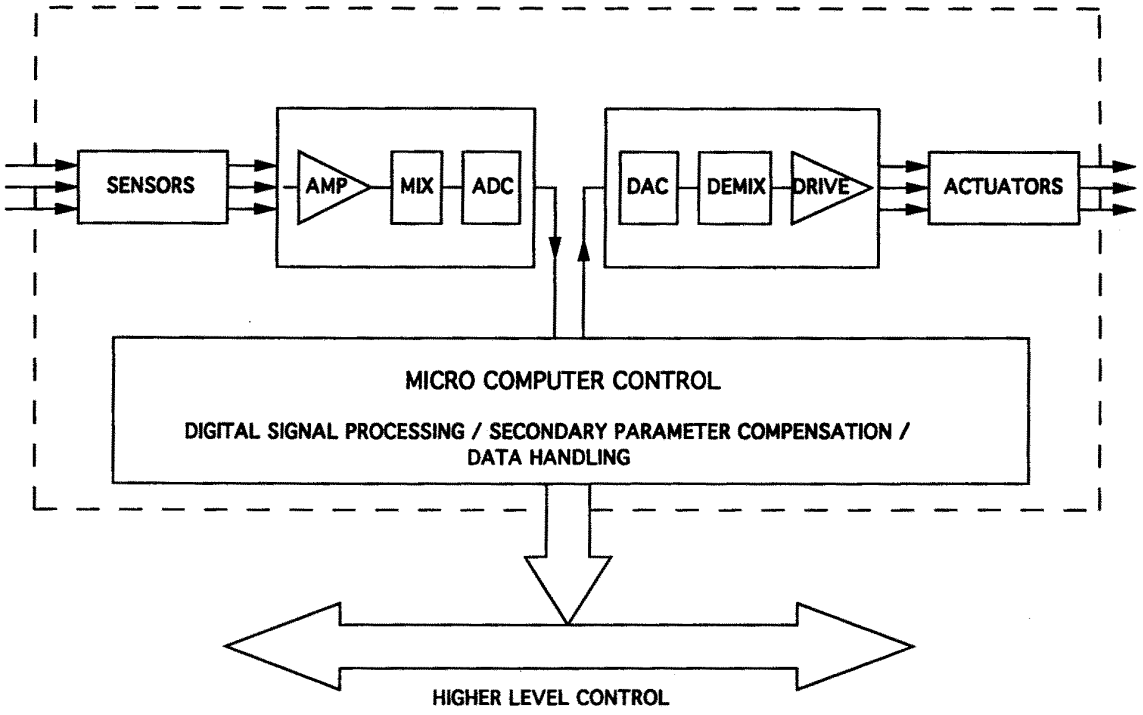


Figure 1.3 Seamless sensor system on the chip.

MJERNI PRETVORNIK = OSJETILO (SENZOR) + PRETVORNIČKI ELEMENT

MEASUREMENT TRANSDUCER = SENSING ELEMENT + TRANSDUCTION ELEMENT

PRIMJER: PRETVORNIK ZA MJERENJE TEMPERATURE

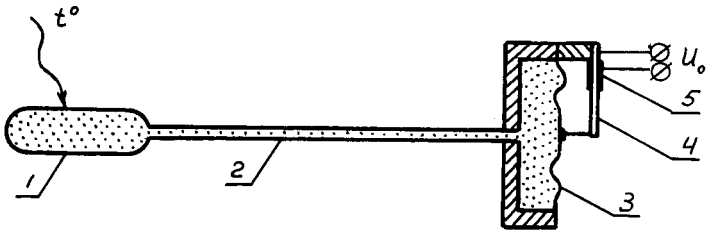


Figure 1.1 Gas-filled-bulb transducer for measuring temperature. 1 = gas-filled bulb, 2 = capillary tube, 3 = pressure-sensitive diaphragm, 4 = cantilever, 5 = strain gages.

PODJELA MJERNIH PRETVORNIKA

- s obzirom na mjerenu veličinu
- s obzirom na način pretvorbe mjerene veličine u električki signal

S OBZIROM NA MJERENU VELIČINU (FIZIKALNA VELIČINA, SVOJSTVO ILI STANJE)

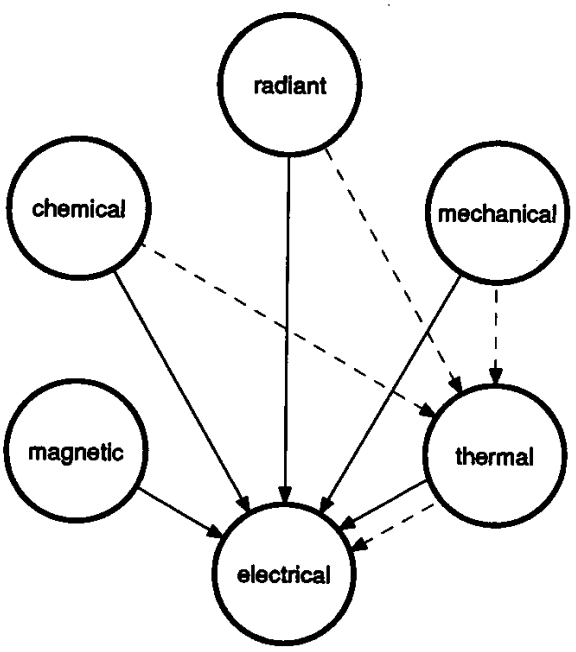


Figure 1.2 The six signal domains.

S OBZIROM NA NAČIN PRETVORBE MJERENE VELIČINE U ELEKTRIČKI SIGNAL

npr. promjena:

- otpora
- induktiviteta ili međuinduktiviteta
- kapaciteta
- naboja, napona ili struje generiranih od samog pretvornika

AKTIVNI PRETVORNICI (engl. self-generating, self-exciting)
PASIVNI PRETVORNICI (engl. modulating)

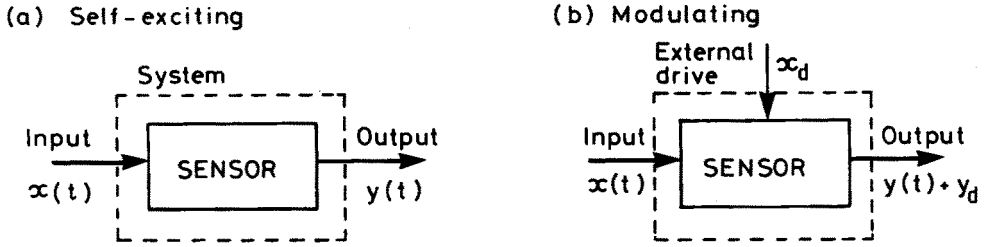


Figure 1.3 Basic representation of self-exciting and modulating sensor systems.

KARAKTERISTIKE MJERNIH PRETVORNIKA

STATIČKE KARAKTERISTIKE:

IDEALNA KARAKTERISTIKA

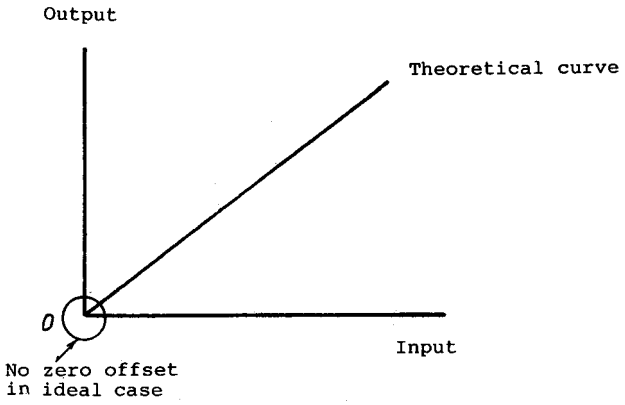


Figure 1.2 Ideal transducer characteristics.

PROMJENA OSJETLJIVOSTI

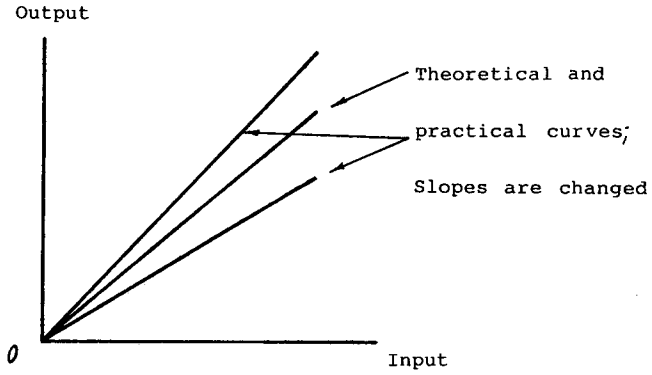


Figure 1.4 Transducer characteristics with change in sensitivity.

POSMAK NULE

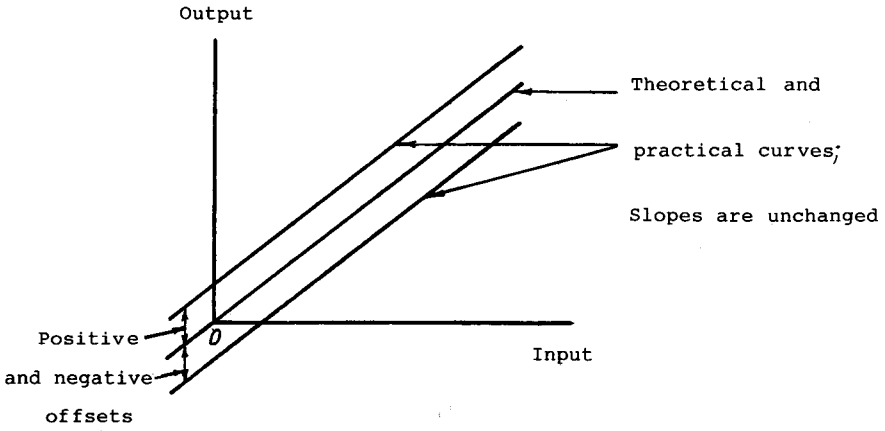


Figure 1.3 Transducer characteristics with zero offset.

NELINEARNA KARAKTERISTIKA

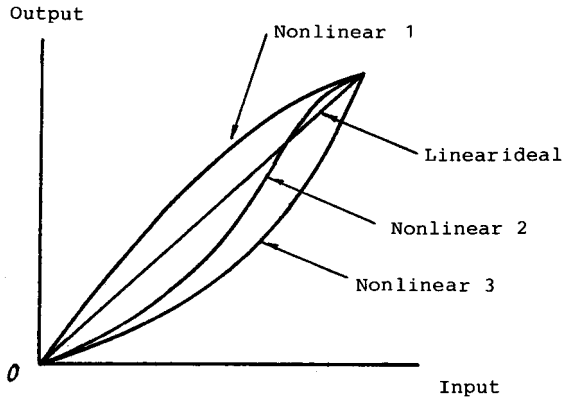


Figure 1.5 Nonlinear characteristics of transducer.

ISKAZIVANJE NELINEARNOSTI

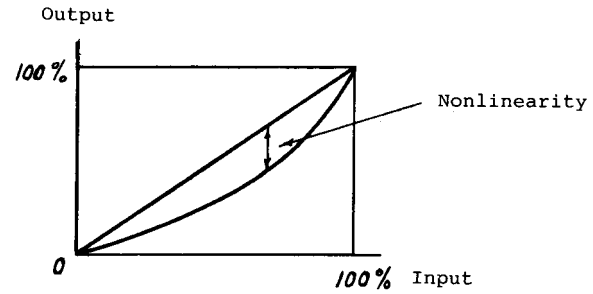


Figure 1.6 Nonlinearity with reference to zero-to-full-scale-output line.

ISKAZIVANJE NELINEARNOSTI

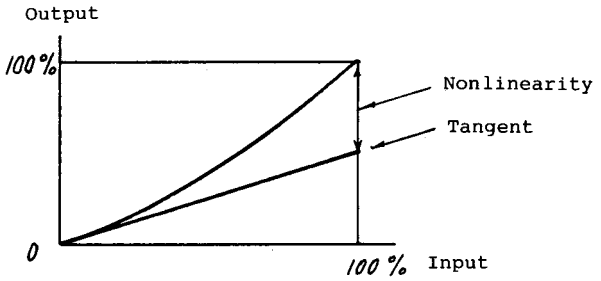


Figure 1.7 Nonlinearity with reference to tangent at origin.

ISKAZIVANJE NELINEARNOSTI

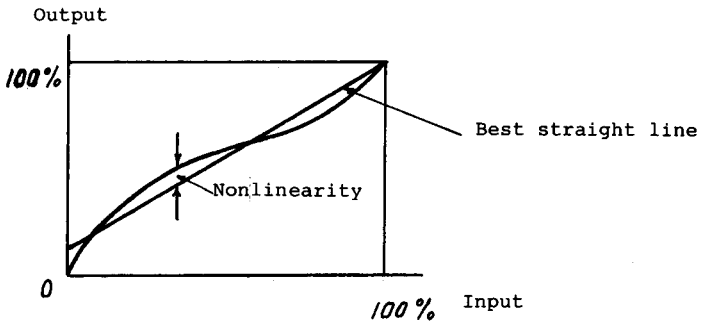


Figure 1.8 Nonlinearity with reference to best straight line.

ODSTUPANJE OD KARAKTERISTIKE KOJA JE IZVORNO NELINEARNA

General Characteristics

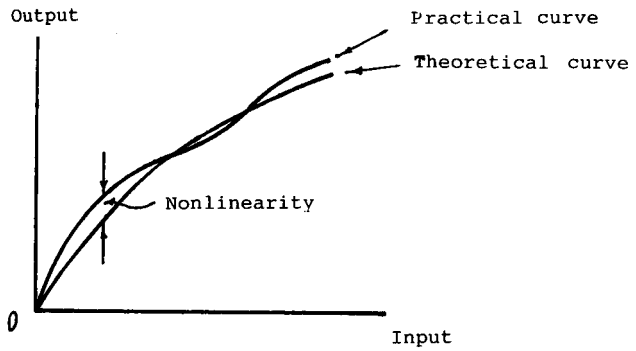


Figure 1.9 Nonconformity with reference to theoretical curve, which is naturally nonlinear.

HISTEREZA

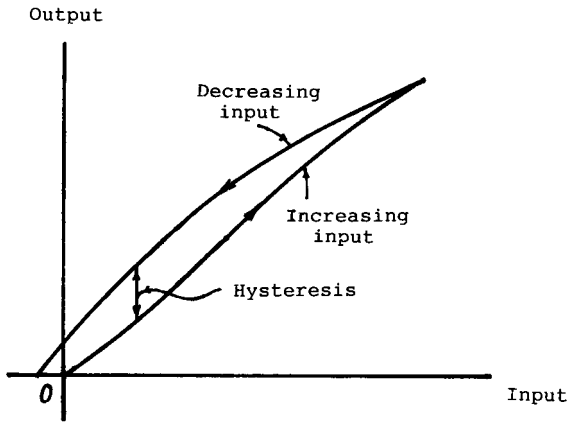


Figure 1.10 Transducer hysteresis.

PONOVLJIVOST I MRTVI HOD

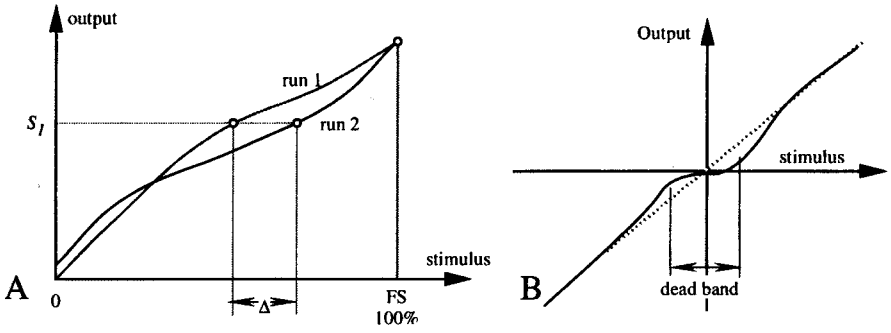


FIGURE 2.7. A: Repeatability error. The same output signal S_1 corresponds to two different input signals. B: Dead-band zone in a transfer function.

DEFINICIJA GRANICA POGREŠAKA

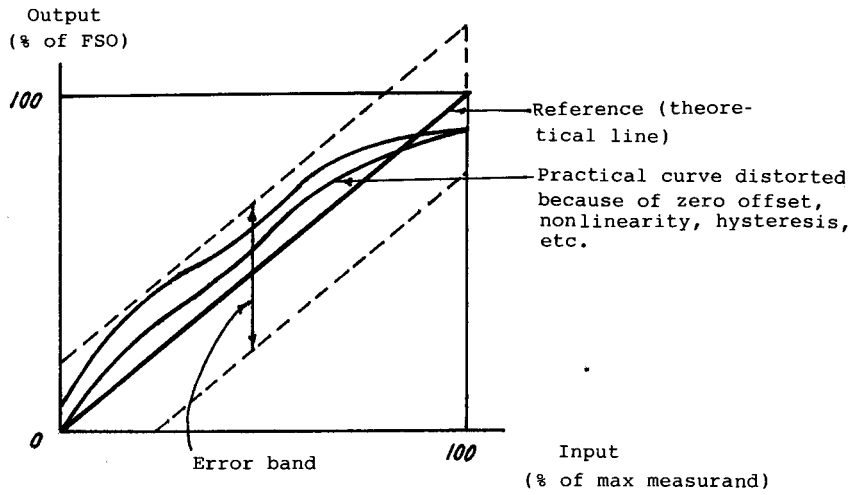


Figure 1.14 Static error band referred to theoretical line.

DEFINICIJA GRANICA POGREŠAKA

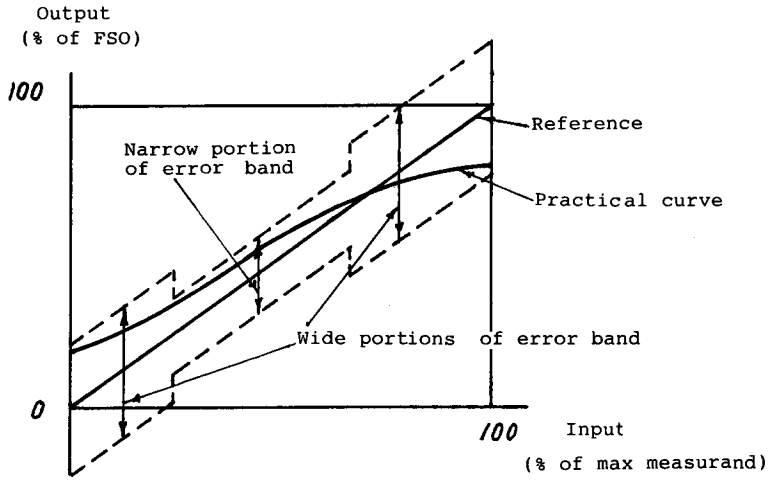


Figure 1.15 Stepped error band referred to theoretical line.

DINAMIČKE KARAKTERISTIKE:

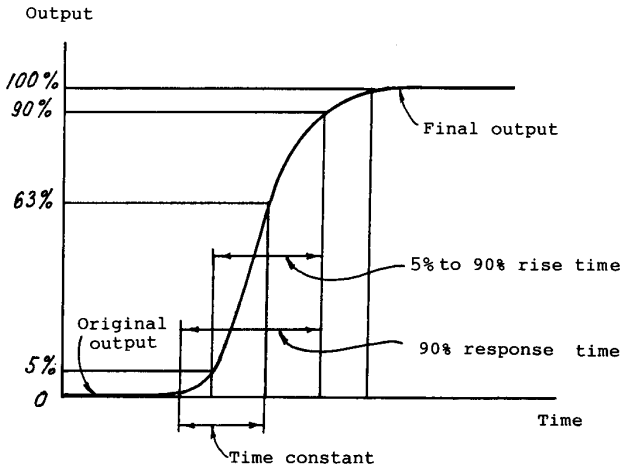


Figure 1.12 Transducer's time characteristics.

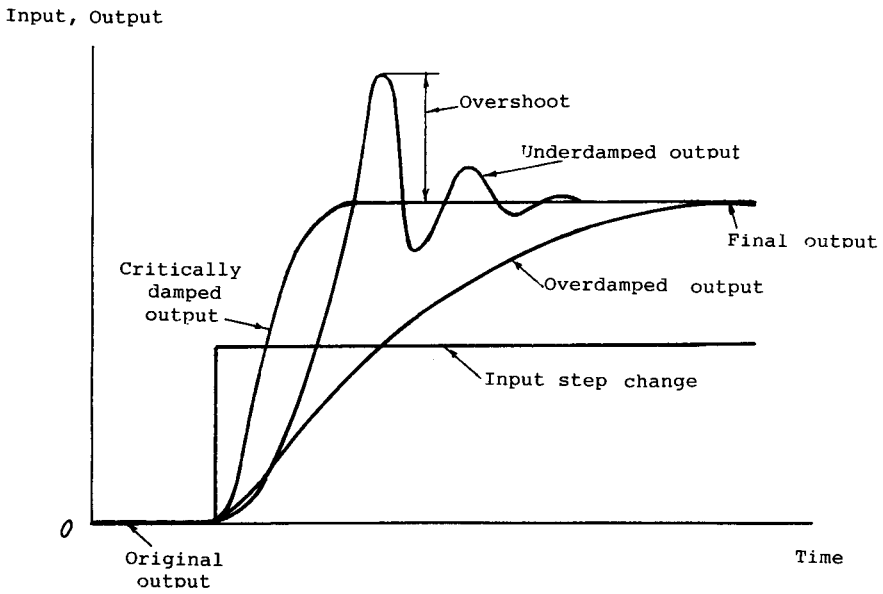


Figure 1.11 Response of transducer to step change in measurand.

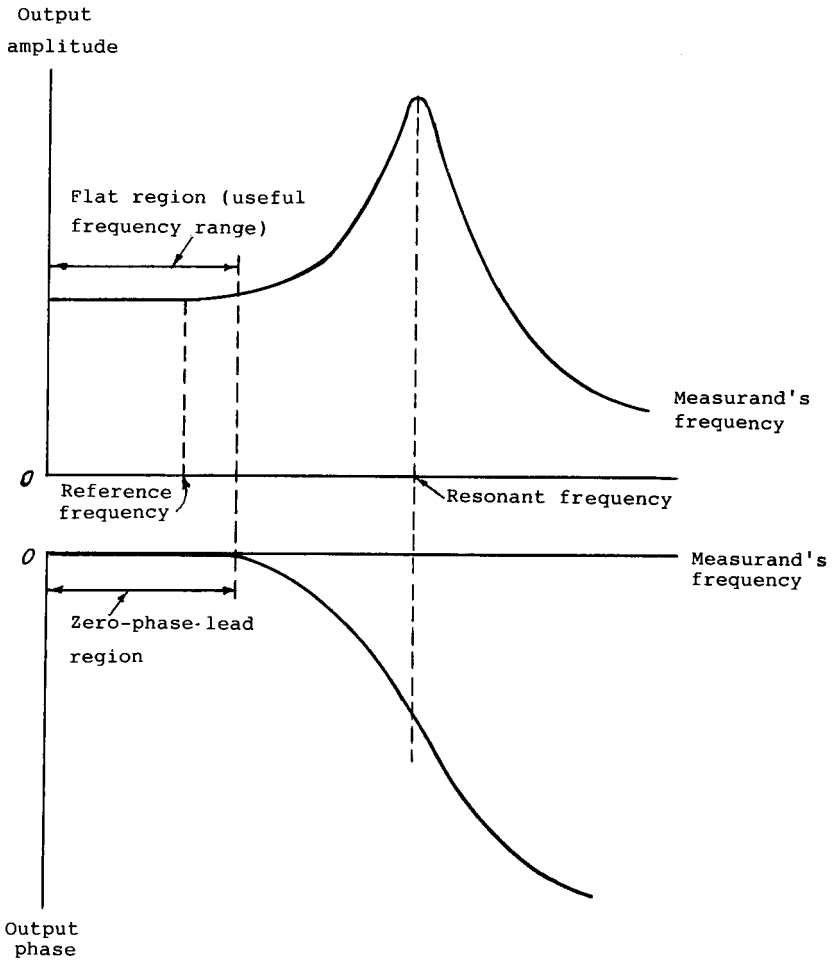
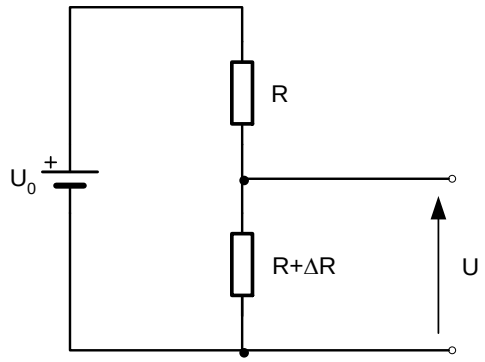


Figure 1.13 Transducer's frequency response.



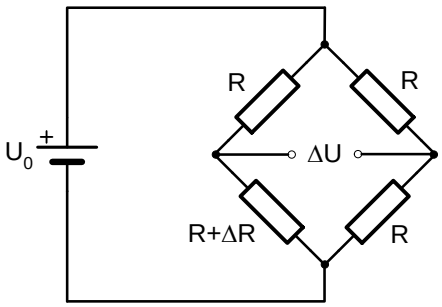
$$U = U_0 \frac{R + \Delta R}{R + R + \Delta R} = U_0 \frac{R + \Delta R}{2R + \Delta R}$$

$$U = U_0 \frac{R}{2R + \Delta R} + U_0 \frac{\Delta R}{2R + \Delta R}$$

velika DC razina + male promjene

Neuravnoteženi mostovi

1. promjena u jednoj grani

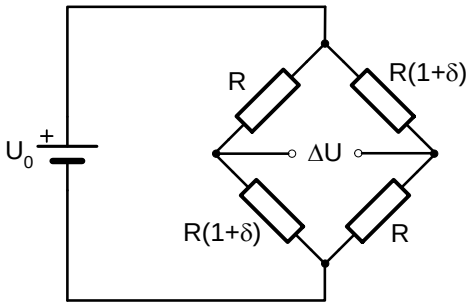


$$\Delta U = U_0 \frac{R + \Delta R}{R + R + \Delta R} - U_0 \frac{R}{2R}$$

$$\Delta U = U_0 \left(\frac{R + \Delta R}{R\left(2 + \frac{\Delta R}{R}\right)} - \frac{1}{2} \right) \quad uz \quad \frac{\Delta R}{R} = \delta \quad dobivamo$$

$$\Delta U = U_0 \left(\frac{1 + \delta}{2 + \delta} \right) - \frac{1}{2} = U_0 \frac{\delta}{2(2 + \delta)} \quad nelinearno$$

2. promjena u dvije nasuprotne grane

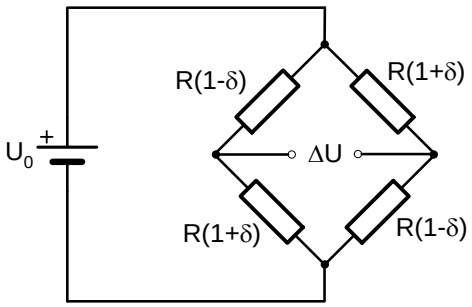


$$\Delta U = U_0 \left(\frac{R(1 + \delta)}{R + R(1 + \delta)} - \frac{R}{R + R(1 + \delta)} \right)$$

$$\Delta U = U_0 \frac{R(1 + \delta) - R}{R + R(1 + \delta)} = U_0 \frac{1 + \delta - 1}{1 + 1 + \delta}$$

$$\Delta U = U_0 \frac{\delta}{2 + \delta} \quad za \ \delta << 2 \Rightarrow \frac{\Delta U}{U_0} = \frac{\delta}{2}$$

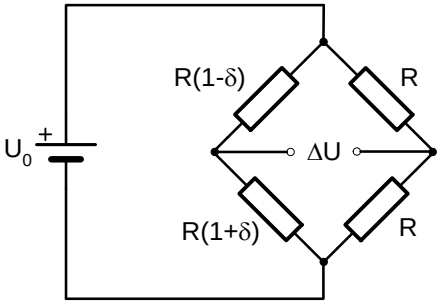
3. promjena u sve četiri grane



$$\Delta U = U_0 \left(\frac{R(1 + \delta)}{2R} - \frac{R(1 - \delta)}{2R} \right)$$

$$\Delta U = U_0 \delta \quad linearnost$$

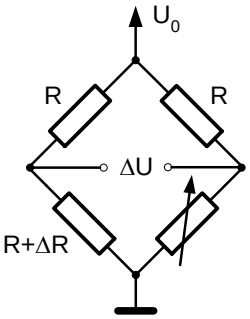
4. polumost, najčešća izvedba

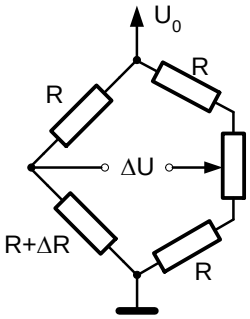


$$\frac{\Delta U}{U_0} = \frac{R(1+\delta)}{2R} - \frac{R}{2R} = \frac{1+\delta-1}{2}$$

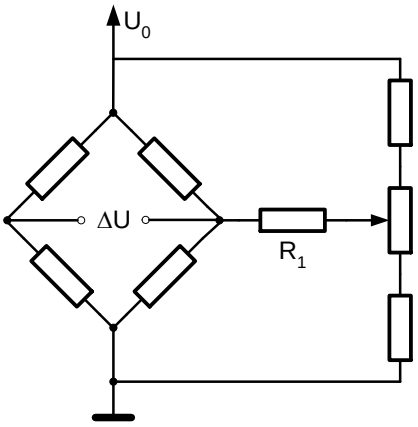
$$\Delta U = U_0 \frac{\delta}{2} \quad linearnost$$

Uravnoteženje mosta



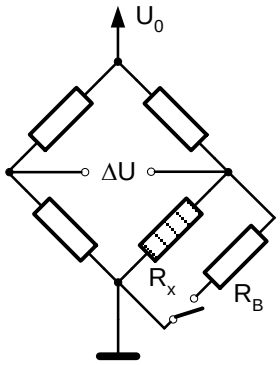


Grubo podešavanje



Najčešće se koristi kod tenzometara.
Što je R_1 veći to je finije podešavanje

Umjeravanje (baždarenje) mjernog lanca



Razdesimo most ubacivanjem otpornika R_B poznatog iznosa što treba rezultirati točno određenom promjenom ΔU. Na temelju toga podesimo pojačanje.