

Ny utgave 2011

Vg2 elektro

Teori med
praktiske
øvinger

Kunnskaps-
løftet

Frank Fosbæk

Automatiserte anlegg

Vg2 automatisering

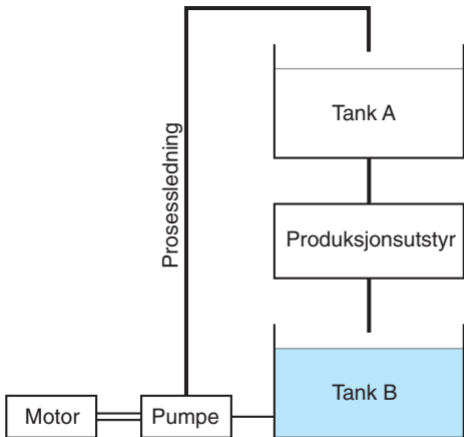
ELFORLAGET

Illustrasjoner til Automatiserte anlegg Vg2 automatisering

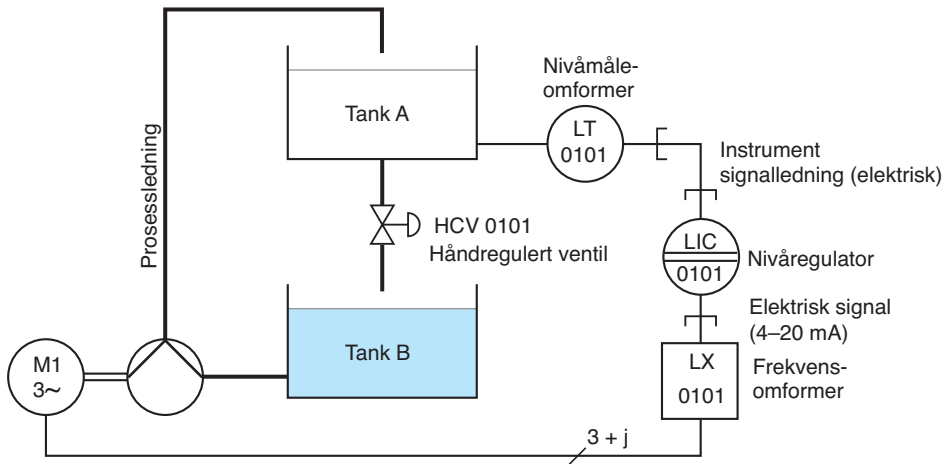
Kapittel 9

Illustrasjonene kan brukes fritt i undervisningen

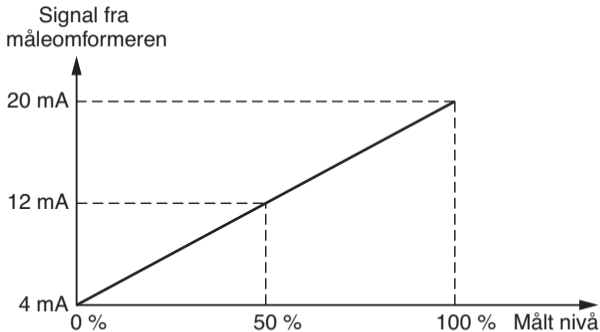
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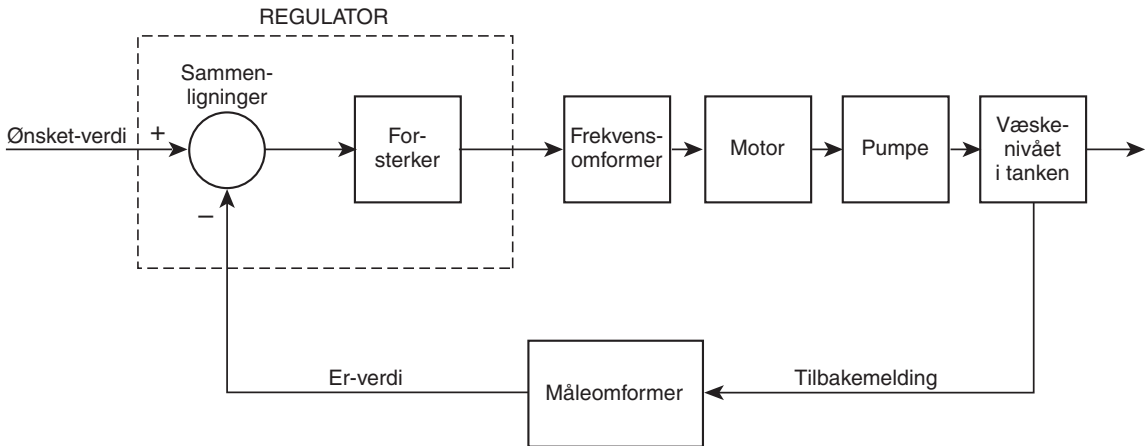
Figur 9.1 Skisse av anlegget som skal nivåreguleres



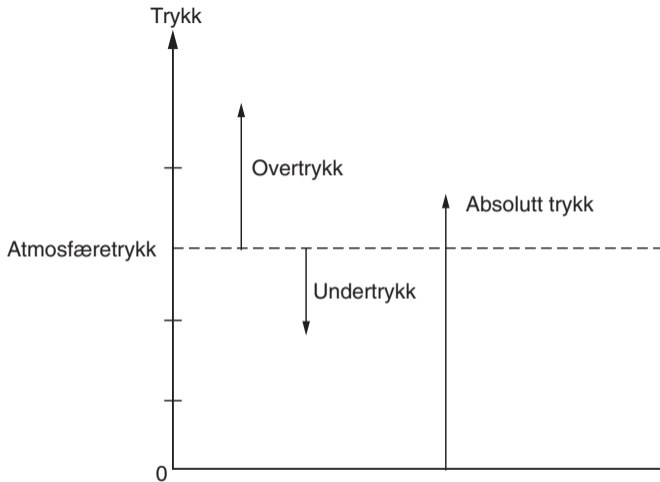
Figur 9.2 Teknisk flytskjema for modellen



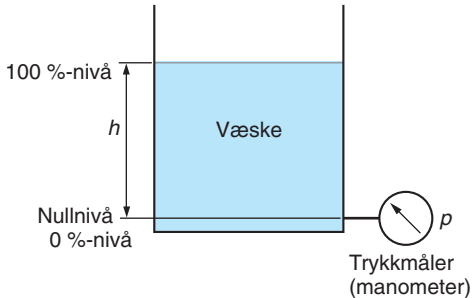
Figur 9.3 Forholdet mellom målt nivå i tanken og det elektriske signalet fra måleomformereren



Figur 9.4 Reguleringsloyfa



Figur 9.5 Forholdet mellom overtrykk, undertrykk og absolutt trykk



$$h = \frac{p}{\rho \cdot g}$$

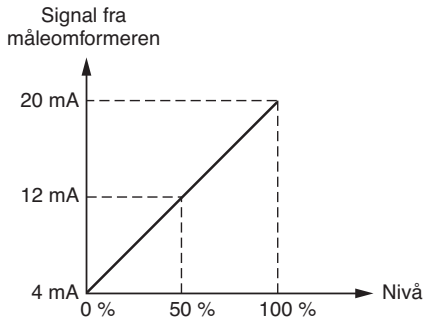
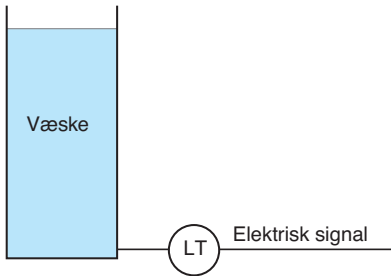
p er hydrostatisk trykk (Pa)

h er nivå (m)

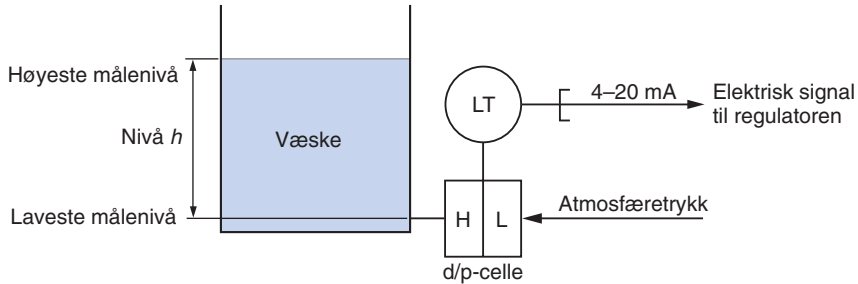
ρ er massetetthet (kg/m^3)

g er tyngdeakselerasjon (m/s^2)

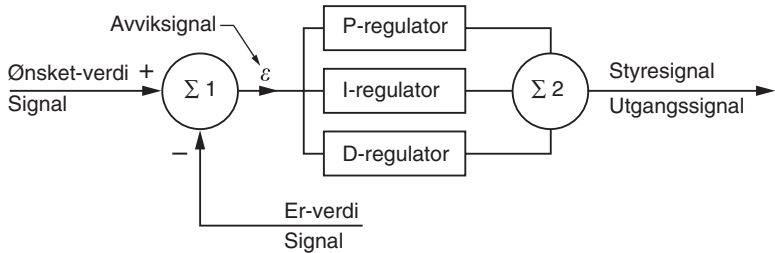
Figur 9.6 Nivåmåling med trykkmåler (manometer)



Figur 9.7 Måleomformeren koblet til en tank. Måleomformerens karakteristikk

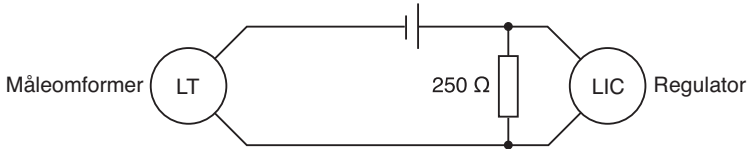


Figur 9.8 Nivåmåling med differansetrykkmåler

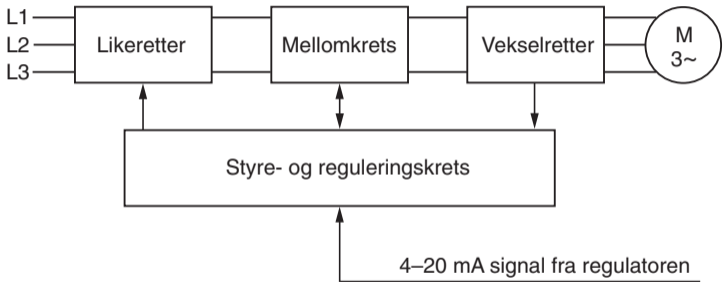


Figur 9.9 Blokkskjema for PID-regulatoren

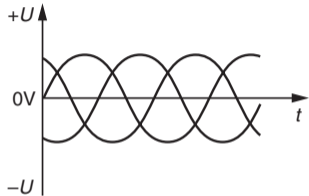
Strømforsyning 24 V



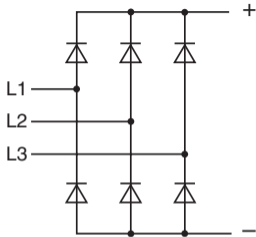
Figur 9.10 Sammenkobling av måleomformer, likestrømskilde og regulator



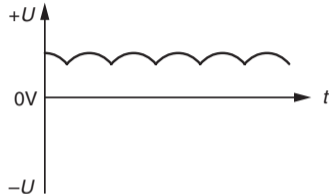
Figur 9.11 Blokkskjema for frekvensomformer



Trefaset vekselspanning

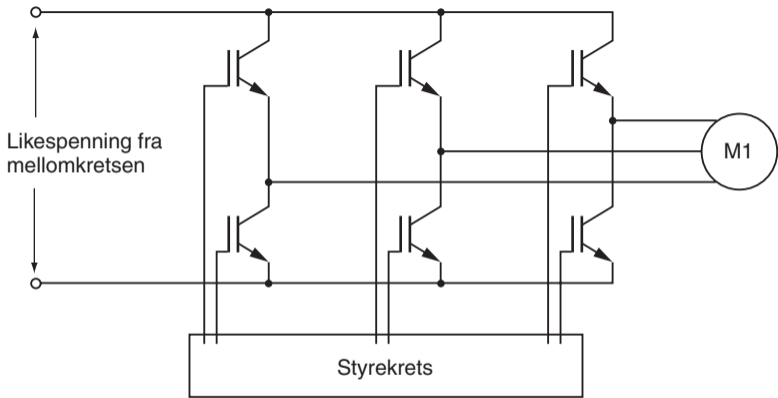


Trefaset likeretter

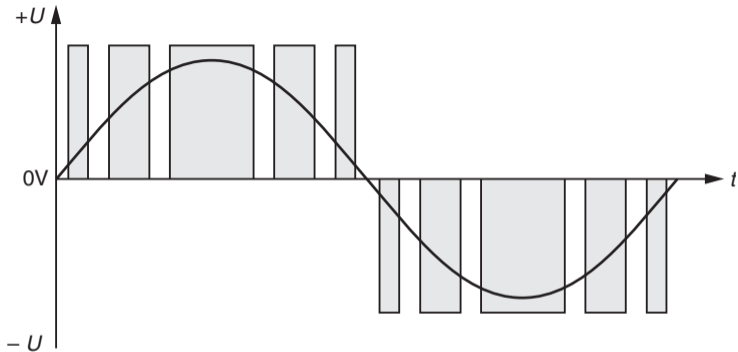


Pulserende likespenning

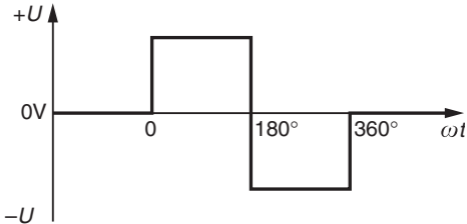
Figur 9.12 Skjema for en trefase likeretter med dioder



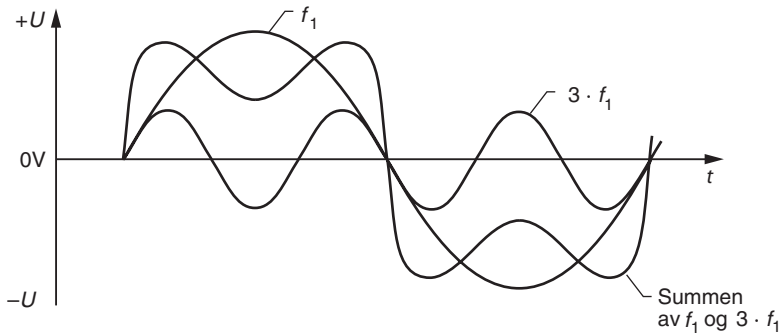
Figur 9.13 Prinsippskjema for en vekselretter med IGBT



Figur 9.14 Tilnærmet sinusformet vekselspanning dannet av like-spenningspulser med forskjellig pulsbredde



Figur 9.15 Ideell firkantspenning



Figur 9.16 Vekselspenninger med frekvensene f_1 og $3 \cdot f_1$ summert grafisk

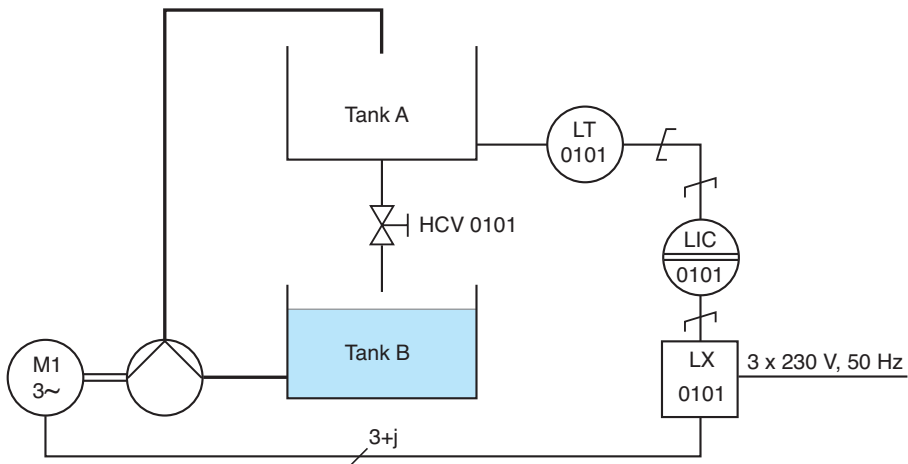
Pumpedata:

H maks. 5 m	Q min. 0,6 m ³ /h
H min. 3,6 m	Q maks. 2,4 m ³ /h

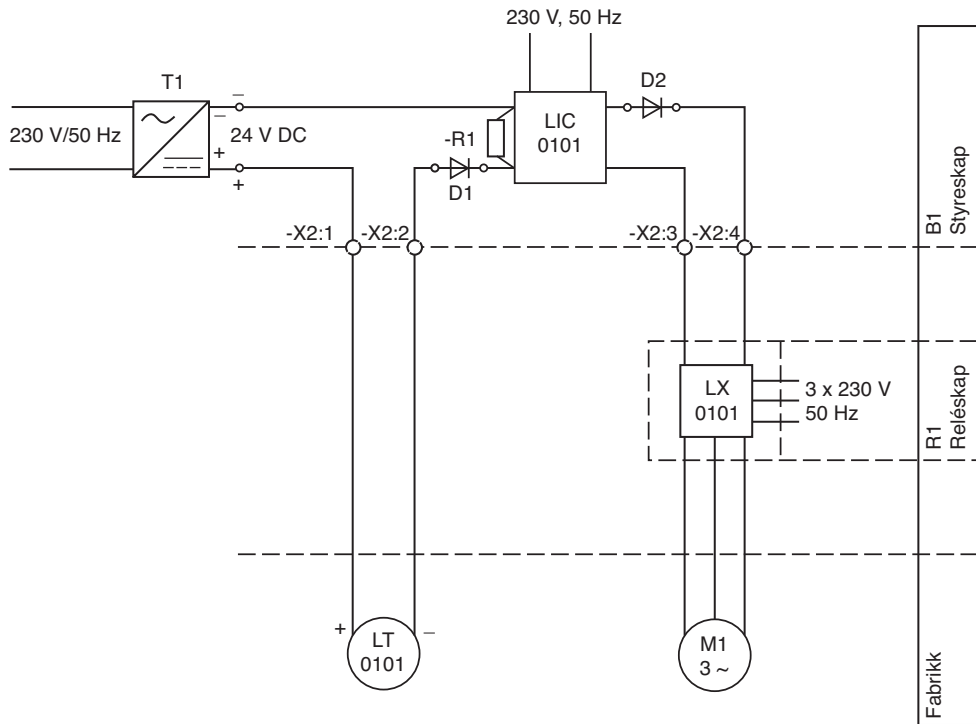
Motordata:

220–240 V/380–415 V	1,7–1 A
l.cl Fn 2900 r/min	
0,2 HP 0,15 kW	cos φ 0,5

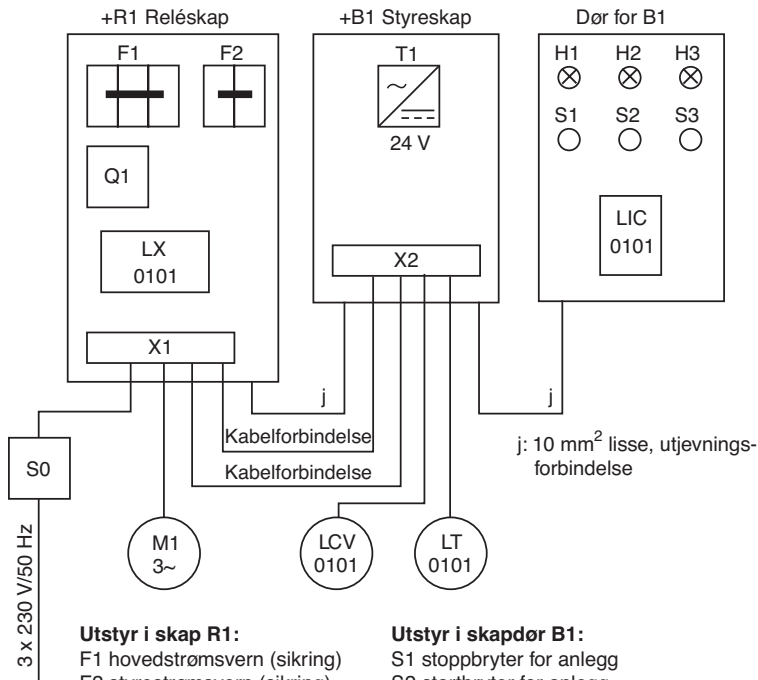
Figur 9.17 Data for pumpe og pumpemotoren



Figur 9.18 Teknisk flytskjema for modellen



Figur 9.19 Sloyfeskjema for instrumenteringen



Utstyr i skap R1:

- F1 hovedstrømsvern (sikring)
- F2 styrestrømsvern (sikring)
- Q1 kontaktor
- LX frekvensomformer
- X1 rekkelemme

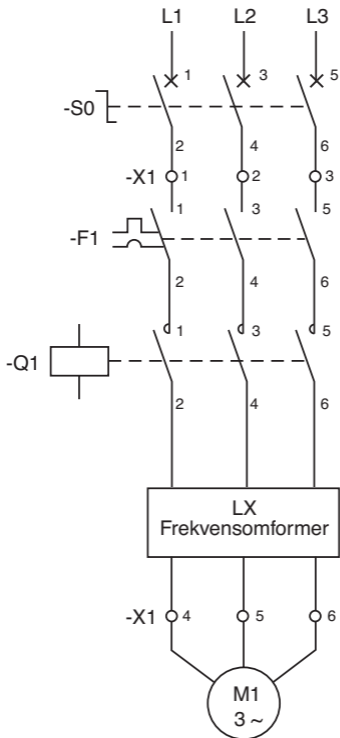
Utstyr i skap B1:

- T1 24 V likestrømsforsyning
- X2 rekkelemme

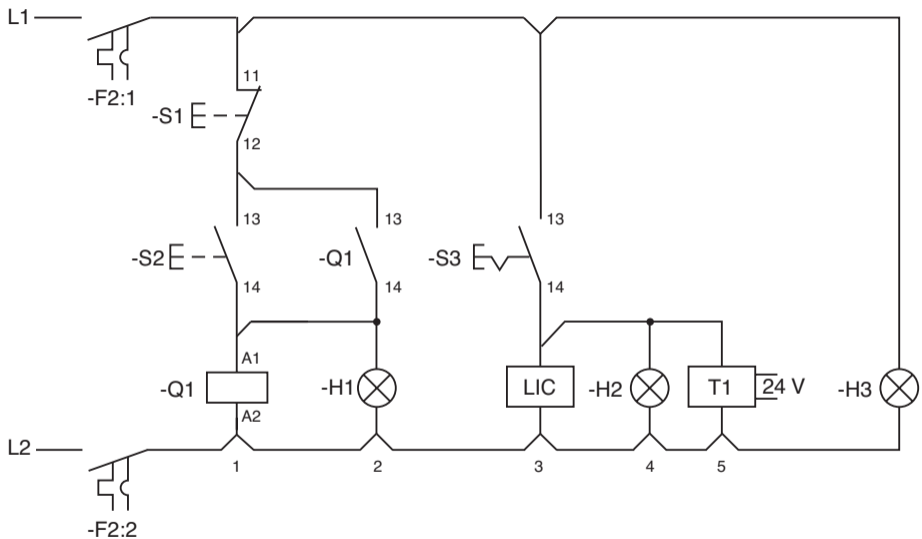
Utstyr i skapdør B1:

- S1 stoppbryter for anlegg
- S2 startbryter for anlegg
- S3 bryter for driftsstrøm til LIC
- H1 energikretsen til for LX innkoblet
- H2 driftsstrøm for LIC
- H3 anlegget koblet til elnettet
- LIC nivåregulator

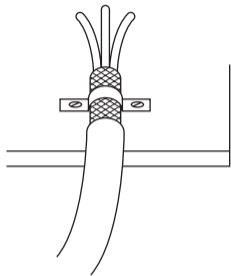
Figur 9.20 Arrangementstegning for den elektriske installasjonen og instrumenteringen



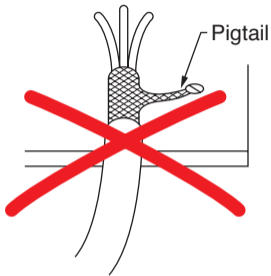
Figur 9.21 Hovedstrømsskjema



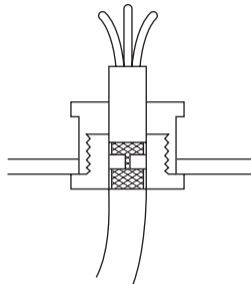
Figur 9.22 Styrestrømsskjema



God

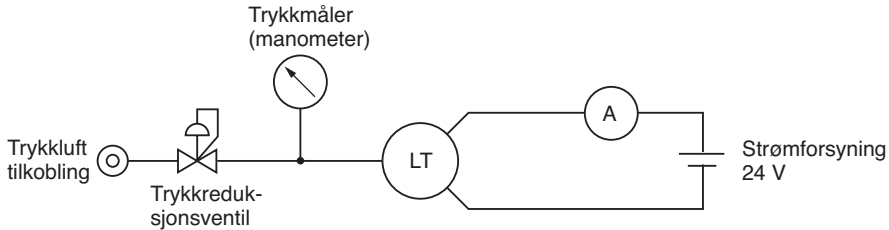


Dårlig

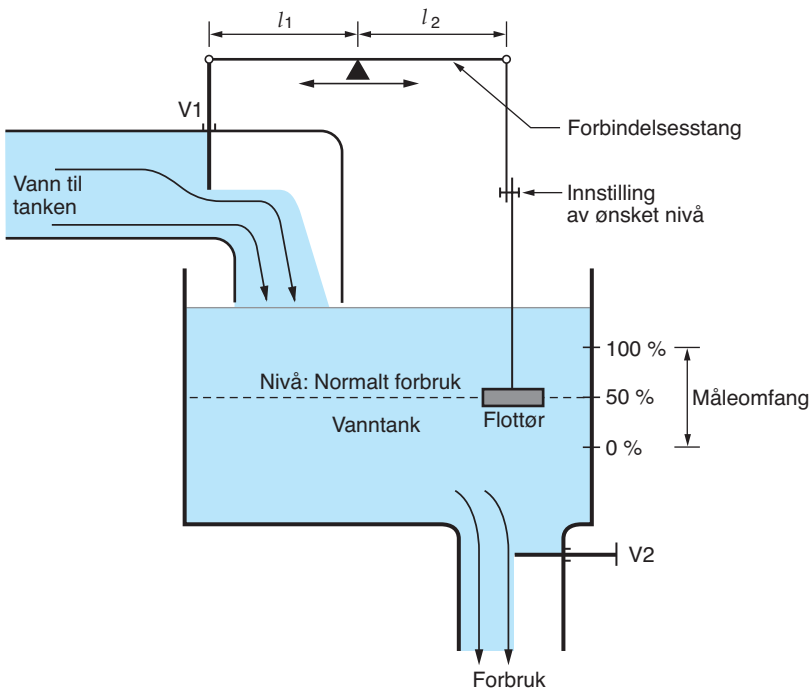


God

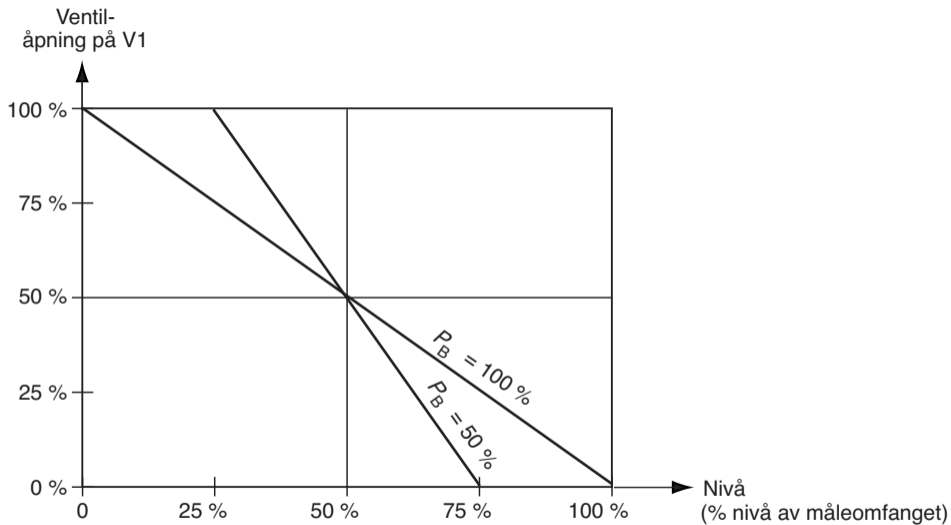
Figur 9.23 God og dårlig forbindelse til skjermen



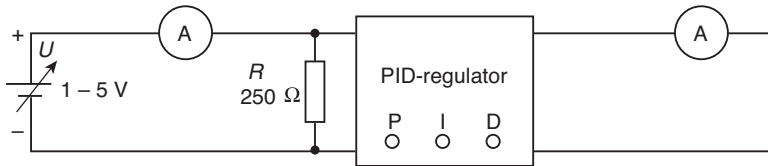
Figur 9.24 Koblingskjema for benkinnstilling av nivåmåleomformeren



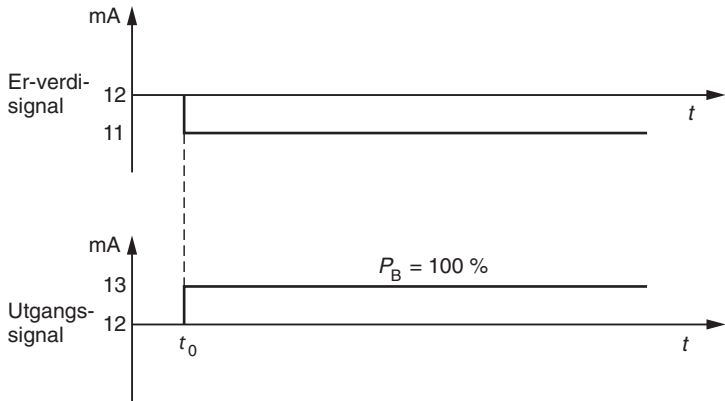
Figur 9.25 Nivåregulering med flottør



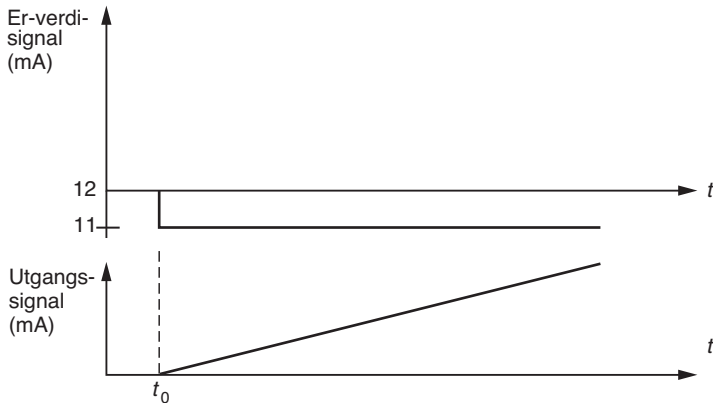
Figur 9.26 Forholdet mellom ventilåpningen på V1 og proporsjonalbåndet



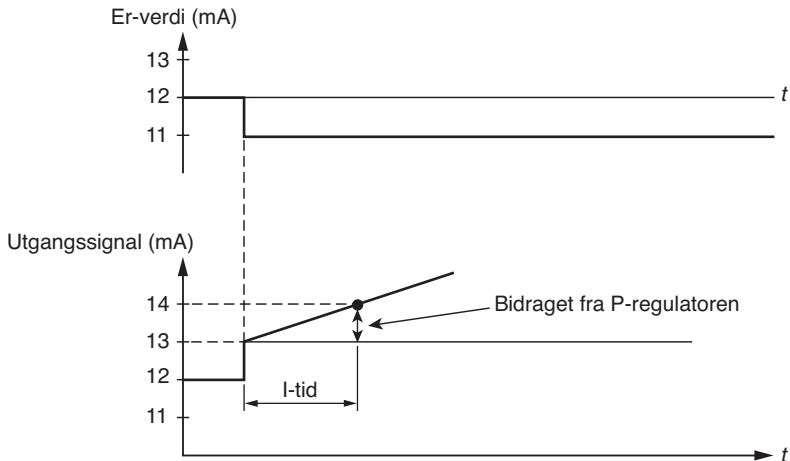
Figur 9.27 Elektronisk PID-regulator koblet for sprangsvaranalyse



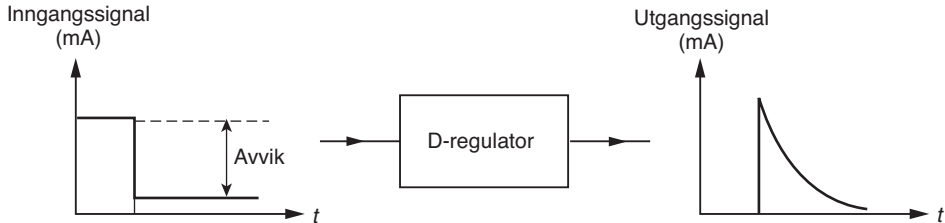
Figur 9.28 Sprangsvardiagram for en reverserende P-regulator



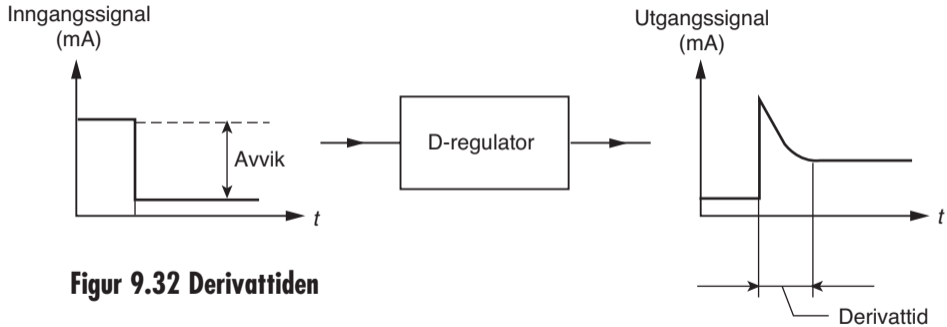
Figur 9.29 Sprangsvar diagram for reverserende I-regulator



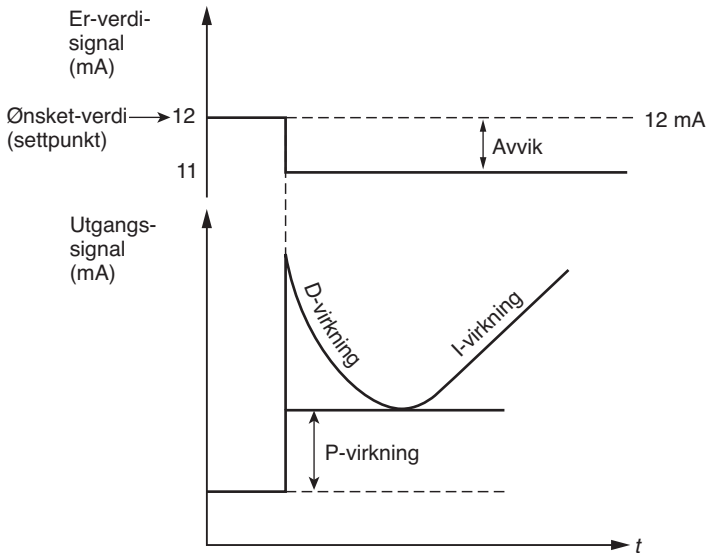
Figur 9.30 Sprangvardiagram for en reverserende PI-regulator



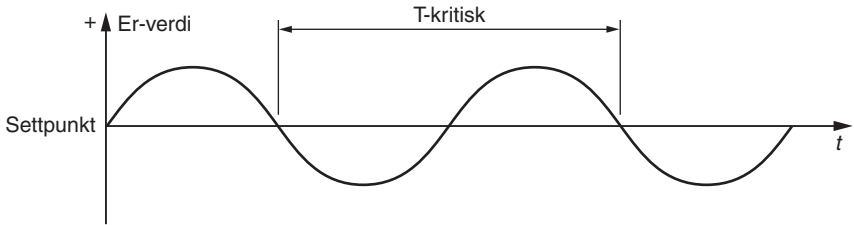
Figur 9.31 D-forsterkerens reaksjon på et sprang i inngangssignalet



Figur 9.32 Derivattiden



Figur 9.33 En PID-regulators svar på et sprang i inngangssignalet



Figur 9.34 Kontinuerlig svingeforløp