

TSTE05 Elektronik & mätteknik

Föreläsning 15

Fälteffekt-transistorer – GS-steg

Föreläsningen börjar 15:20

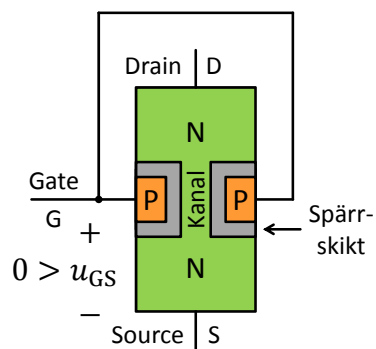
Mikael Olofsson

Institutionen för Systemteknik (ISY)

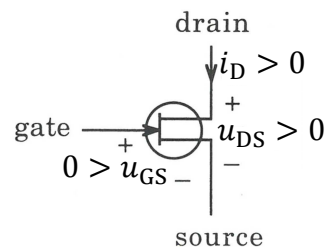
Ämnesområdet Elektroniska kretsar och system

N-kanal JFET-transistor Junction – Field Effect Transistor

Konstruktion

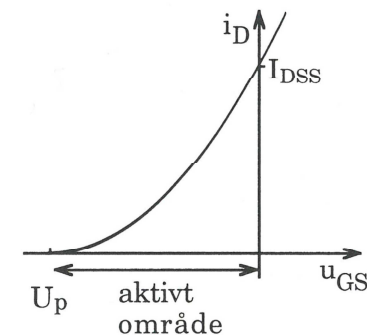
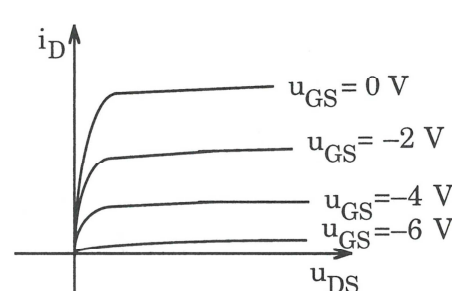


Symbol



*Ju mer negativ u_{GS} görs,
desto smalare blir kanalen.*

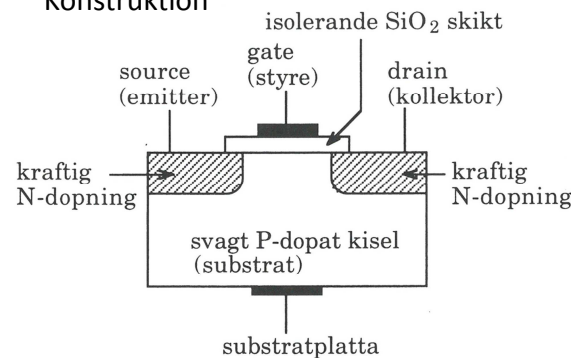
N-kanal JFET-transistor Karaktistika



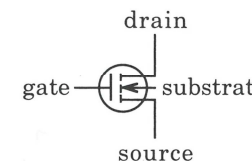
$$i_D \approx I_{DSS} \left(1 - \frac{u_{GS}}{U_p}\right)^2$$

N-kanal MOSFET av anrikningstyp Metal Oxid Semiconductor

Konstruktion

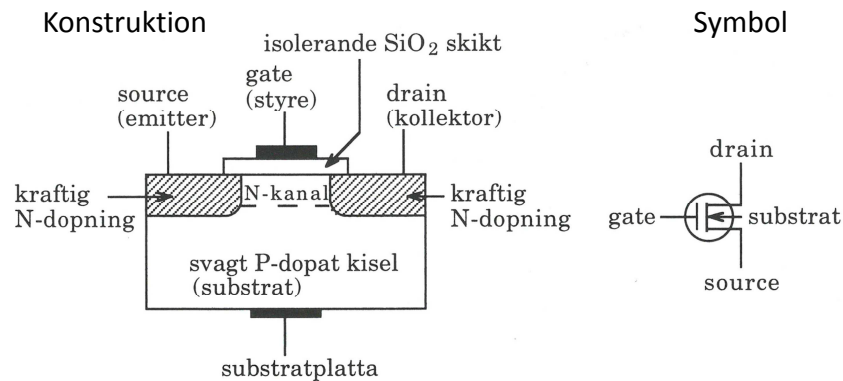


Symbol



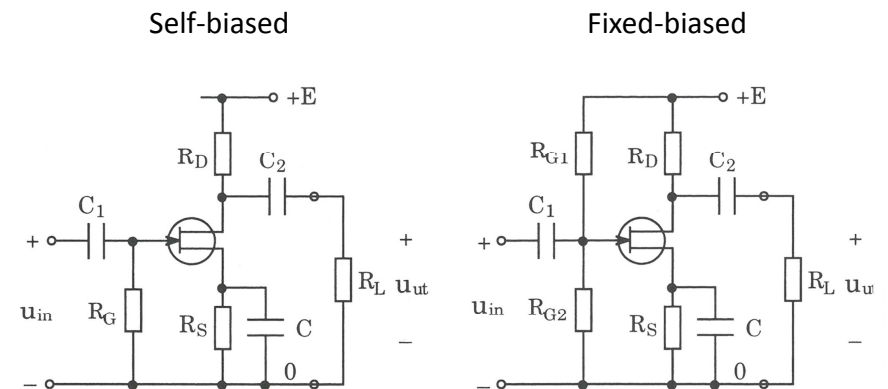
Ju mindre positiv u_{GS} görs, desto smalare blir kanalen.

N-kanal MOSFET av utarmningstyp Metal Oxid Semiconductor

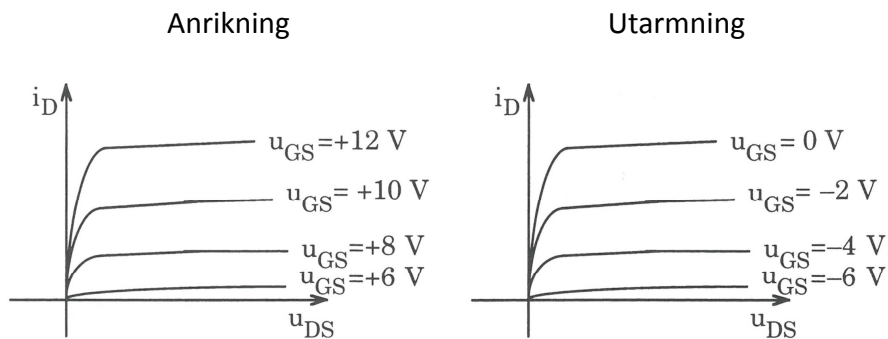


Ju mer negativ u_{GS} görs, desto smalare blir kanalen.

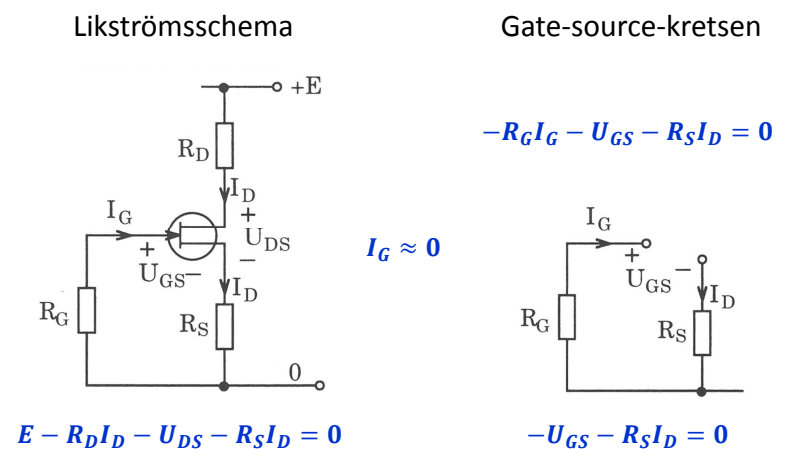
GS-steg – Gemensam Source (N-kanal)



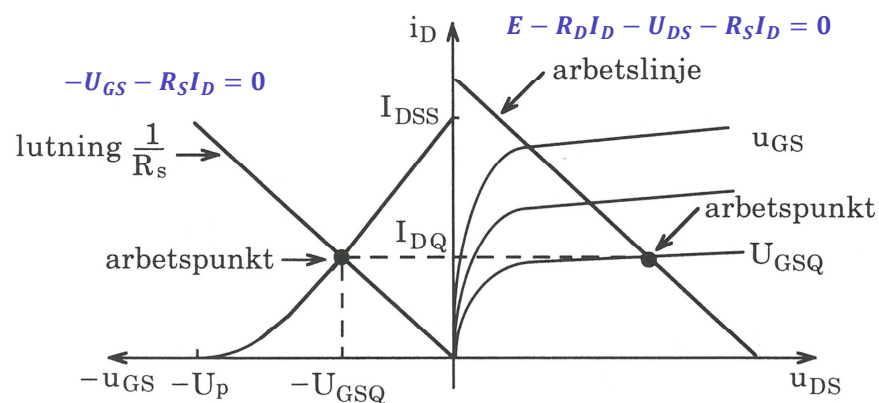
Draindiagram för N-kanal MOSFET – skillnad mellan anrikning och utarmning



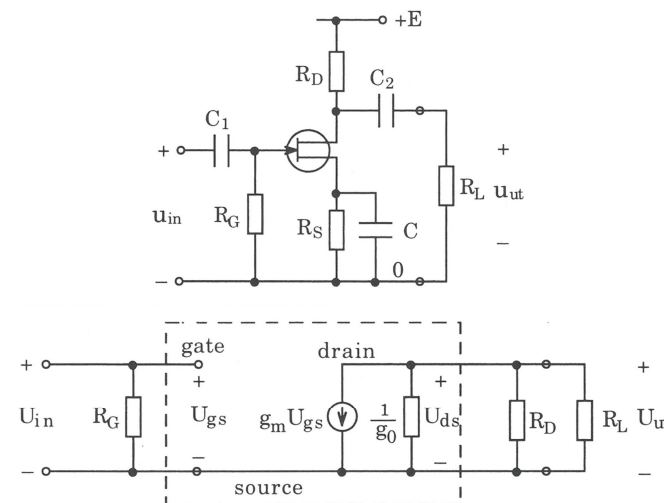
Self-biased GS-steg – likströmsschema



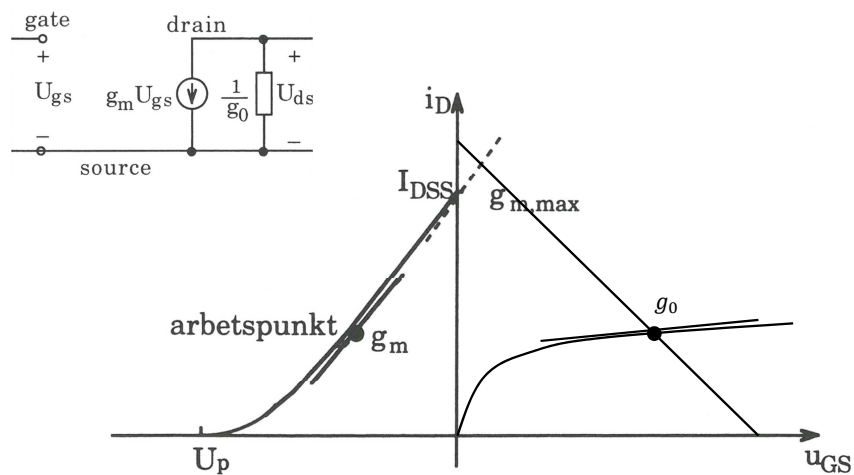
Arbetspunkten för en FET-transistor



GS-steget – Ekvivalent småsignalschema

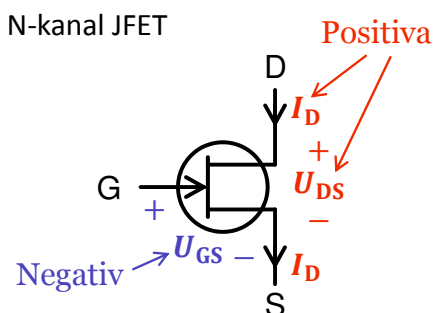


FET – småsignaler – g-parameterschema

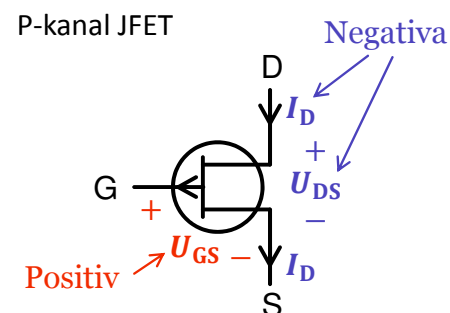


Fälteffekttransistorer (FET)

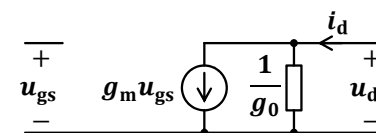
N-kanal JFET



P-kanal JFET

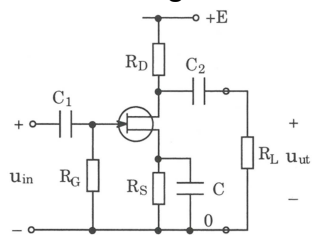


Men: Likadant
småsignalschema

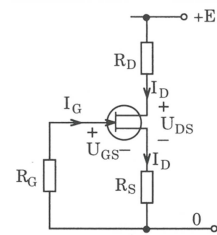


Gemensam source-steg (GS-steg)

Förstärkarsteget



Likströmsschema



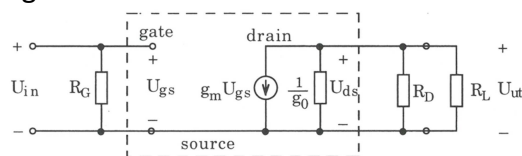
$$I_G \approx 0$$

$$E - R_D I_D - U_{DS} - R_S I_D = 0$$

$$-U_{GS} - R_S I_D = 0$$

$$I_D = I_{DSS} \left(1 - \frac{U_{GS}}{U_P}\right)^2$$

Småsignalschema

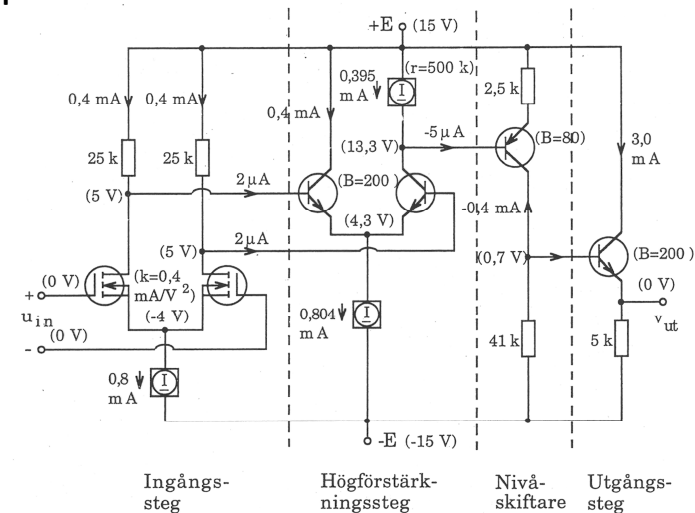


$$Z_{in} = R_G$$

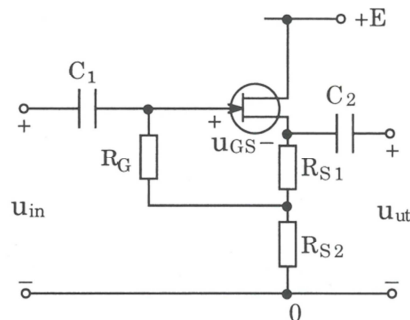
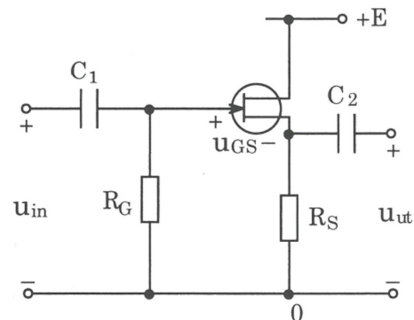
$$F = \frac{u_{ut}}{u_{in}} = -g_m \left(\frac{1}{g_0} \parallel R_D \parallel R_L \right)$$

$$Z_{ut} = \frac{1}{g_0} \parallel R_D$$

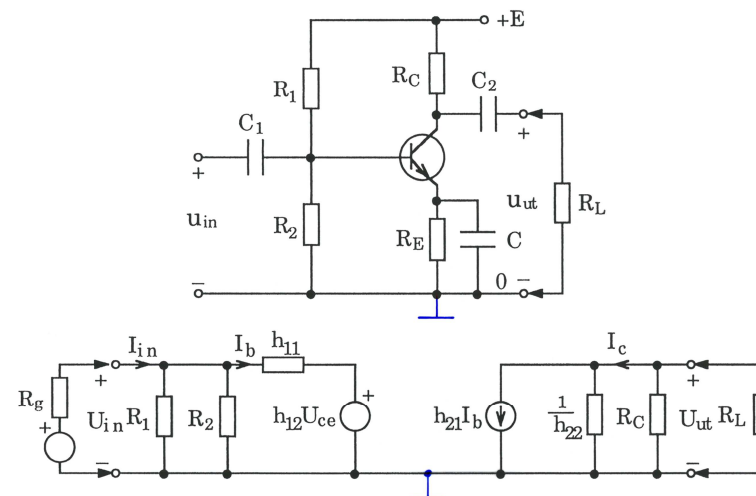
Operationsförstärkare



Sourceföljare

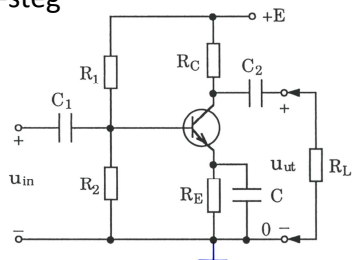


GE-steget (Gemensam emitter)

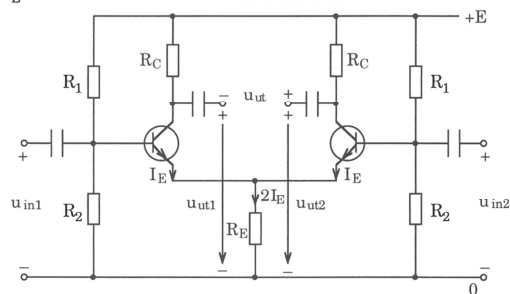


Differentialförstärkare

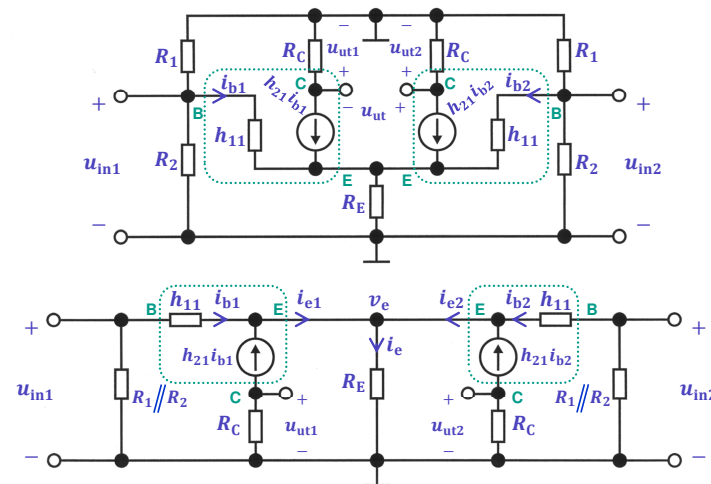
GE-steg



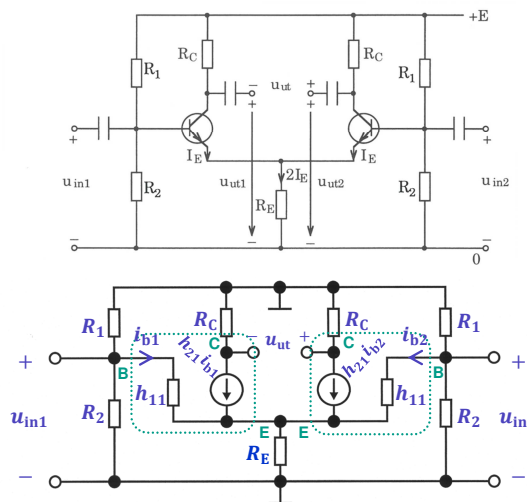
Differentialförstärkare



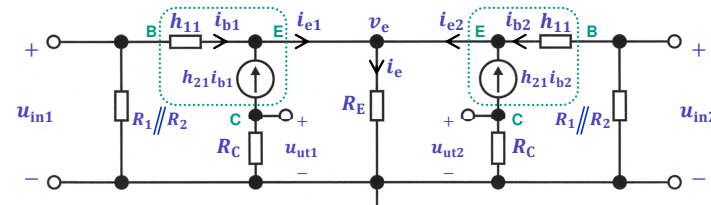
Omritat småsignalschema



Differentialförstärkarens småsignalschema



Superposition igen



Uppdelning av insignaler

$$u_{in1} = u'_{in1} + u''_{in1}$$

$$u_{in2} = u'_{in2} + u''_{in2}$$

Superposition med två fall

Fall 1: Likfasiga signaler

$$u'_{in1} = u'_{in2} = \frac{u_{in1} + u_{in2}}{2}$$

Fall 2: Oliktfasiga signaler

$$u''_{in1} = -u''_{in2} = \frac{u_{in1} - u_{in2}}{2}$$

Mikael Olofsson
ISY/EKS

www.liu.se