Friday, March 22, 2013
10:46 AM

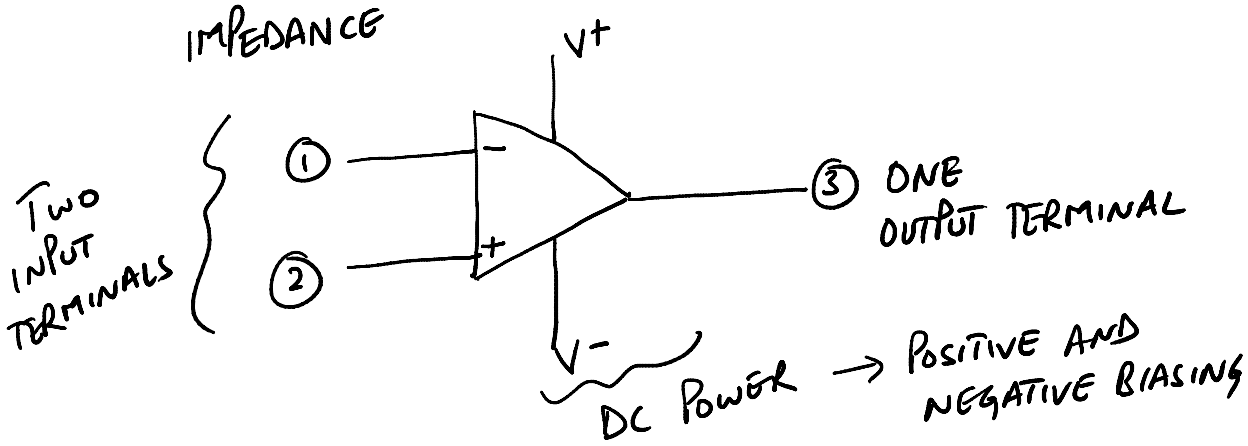
LECTURE -39

OPERATIONAL AMPLIFIERS

[OP-AMP]

COMPLEX DEVICE → MODELED AS A VCVS

HIGH GAIN, HIGH INPUT IMPEDANCE, LOW OUTPUT IMPEDANCE

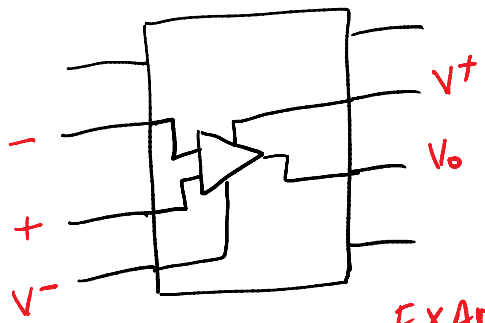


BIAS → ACTIVE REGION FOR AMPLIFICATION!

− TERMINAL → INVERTING TERMINAL

+ TERMINAL → NON-INVERTING TERMINAL

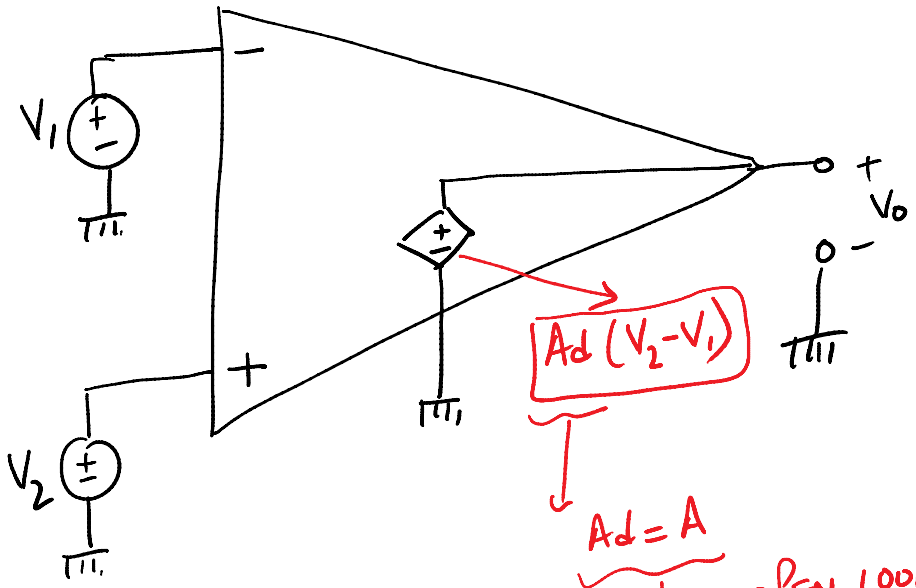
20-30 TRANSISTORS FORM AN OP-AMP AS A I.C



EXAMPLE IC FOR 1 OP-AMP

Friday, March 22, 2013
10:55 AM

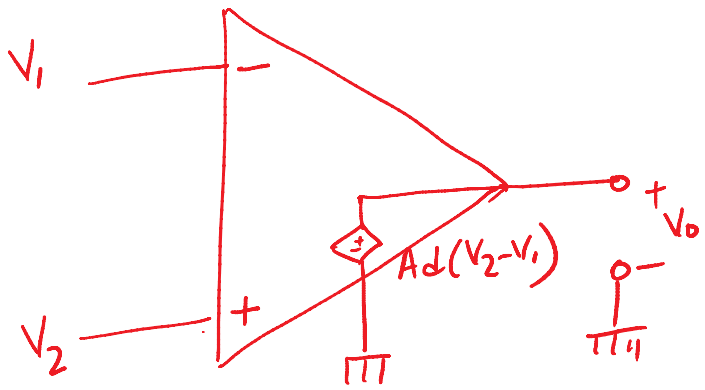
EQUIVALENT CIRCUIT



Ad = A

↳ OPEN LOOP GAIN

IDEAL OP-AMP → SENSES THE DIFFERENCE BETWEEN TWO INPUT SIGNALS AND AMPLIFIES THE DIFFERENCE TO PROVIDE AN OUTPUT



IDEAL

① RESISTANCE BETWEEN − + TERMINAL IS $\infty\ \Omega$ (R_{IN}) ← INPUT IMPEDANCE

② A_d → OPEN LOOP GAIN IS VERY LARGE
IDEALLY ∞ → PRACTICALLY → 200,000 - 300000

③ IF $V_1 = V_2$ $\quad O/P = 0$

IF $V_1 = V_2 \neq 0$ → COMMON MODE INPUT

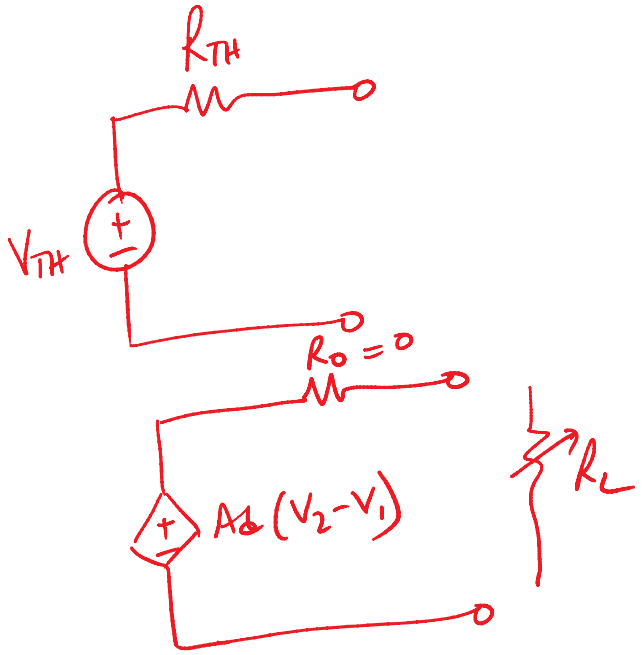
IDEAL COMMON MODE OUTPUT = 0

COMMON MODE REJECTION RATIO! (CMRR)

(4) V+ AND V⁻ (DIRECTLY COUPLED, NO COUPLING CAPACITORS NEEDED)

DC INPUT SIGNALS ALLOWED → DC OUTPUT

(5)



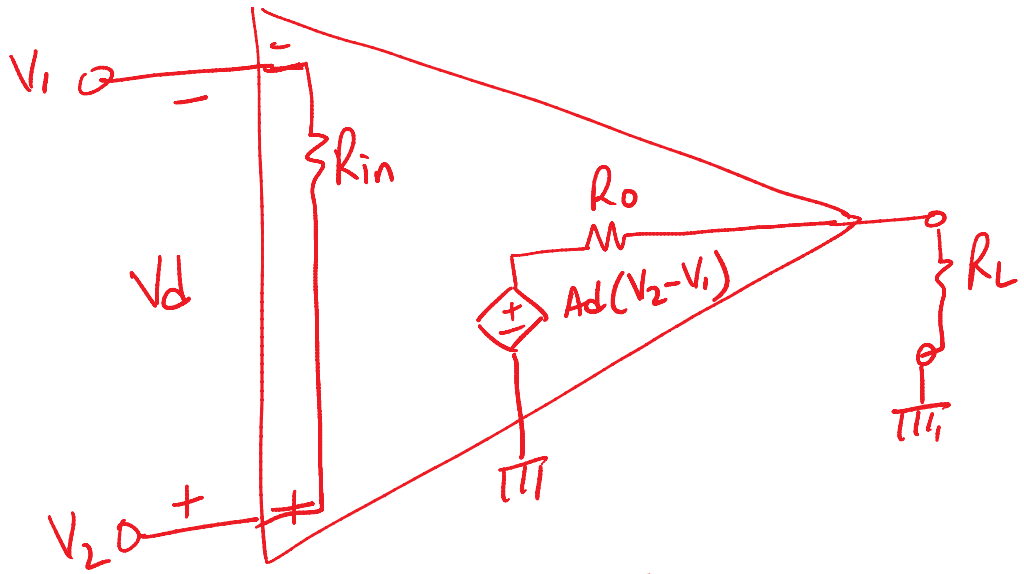
R_o → OUTPUT RESISTANCE $= 0 \approx 0$

DIRECTLY CONNECTED TO THE DEPENDENT VOLTAGE SOURCE → O/P VOLTAGE IS INDEPENDANT OF LOAD!

Friday, March 22, 2013
11:04 AM

PRACTICAL

$V_d = V_2 - V_1$

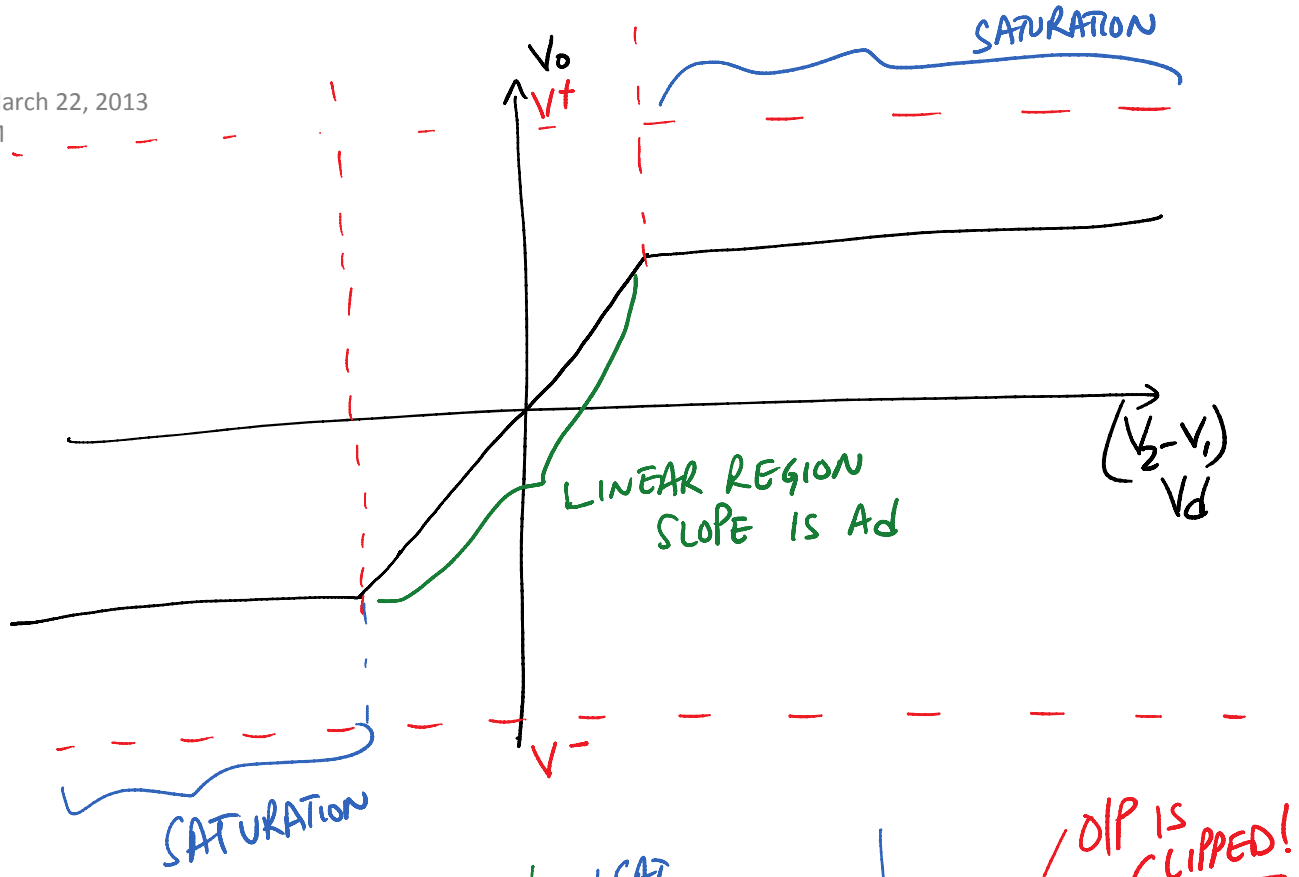


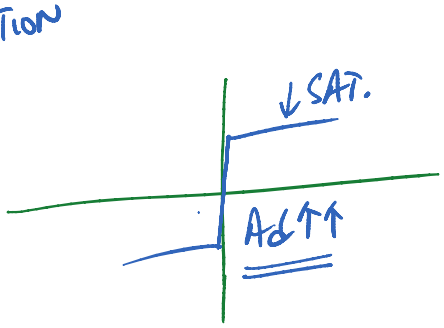
$A_d \geq 10{,}000$

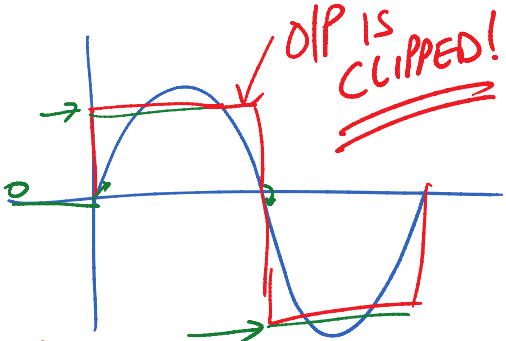
$R_{IN} \geq 100\,K\Omega$

$R_{OUT} \leq 100\,\Omega$

Friday, March 22, 2013
11:06 AM





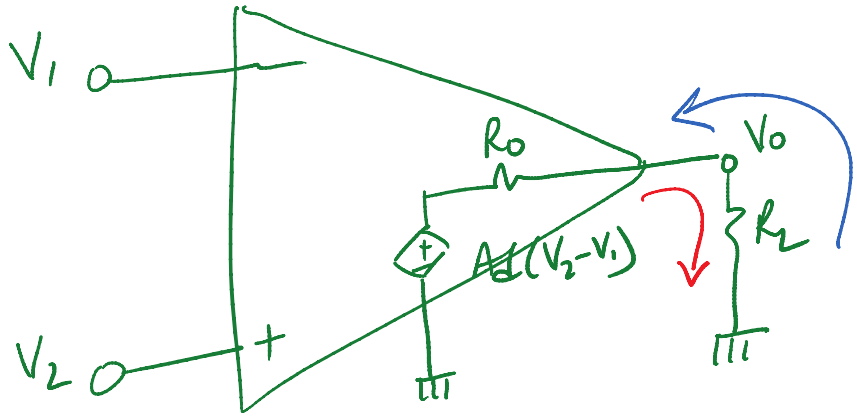


* APPLICATION OF USING THE OP-AMP IN OPEN LOOP

→ ZERO CROSSING DETECTOR

Friday, March 22, 2013
11:10 AM

OUTPUT CURRENTS



IF $V_o > 0$ → LOAD CURRENT IS SUPPLIED BY OP-AMP

IF $V_o < 0$ → OP-AMP SINKS THE LOAD CURRENT

TYPICAL VALUES = ± 20mA