Orcad Advanced Workshop

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Overview

- CMOS and TTL
- BJT Transistors – 2N3904(NPN) and 2N3906(PNP)
- Darlington Transistors – TIP122(NPN) and TIP127(PNP)
- MOSFETS – IRF840(NMOS) and IRF9510(PMOS)

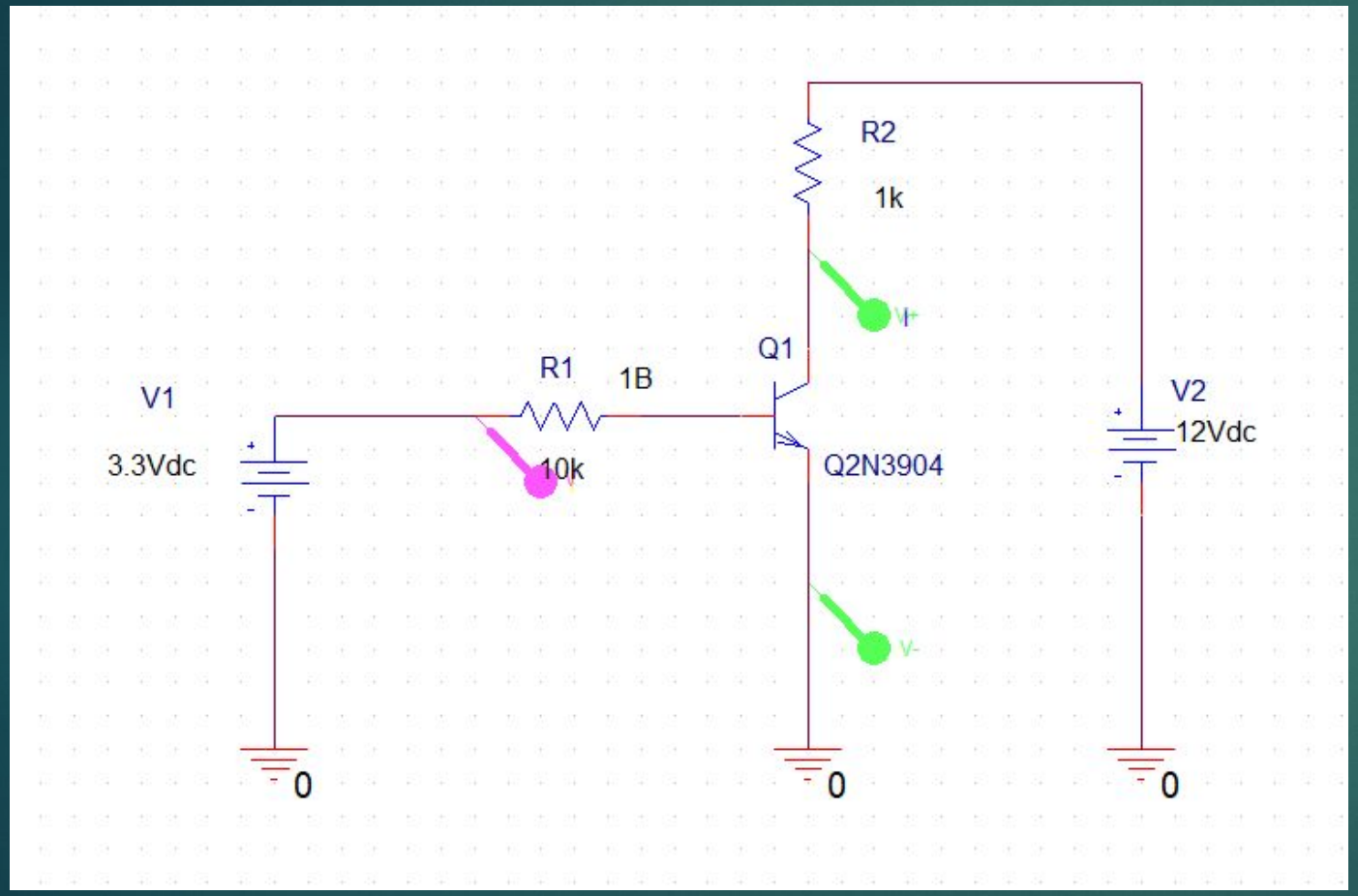
CMOS

- Stands for **C**omplementary **m**etal-**o**xide – **s**emiconductor
- Logic High = 3.3V
- Logic Low = 0V

TTL

- Stands for **T**ransistor-**T**ransistor **L**ogic
- Logic High 2V – 4.95V
- Logic Low 0 V – 0.8V

NPN 2N3904



Find IC and VCE when VBB = 3.3V

IB = (VBB – VBE)/RB
= (3.3 – 0.7)/10k
=260uA
IC = β(IB)
= 100(260nA)
= 26mA

VCE = VCC – ICRC
= 12V – (26mA)(1k)
= -14V(impossible oversaturated)

Find IC and VCE when VBB = 0V

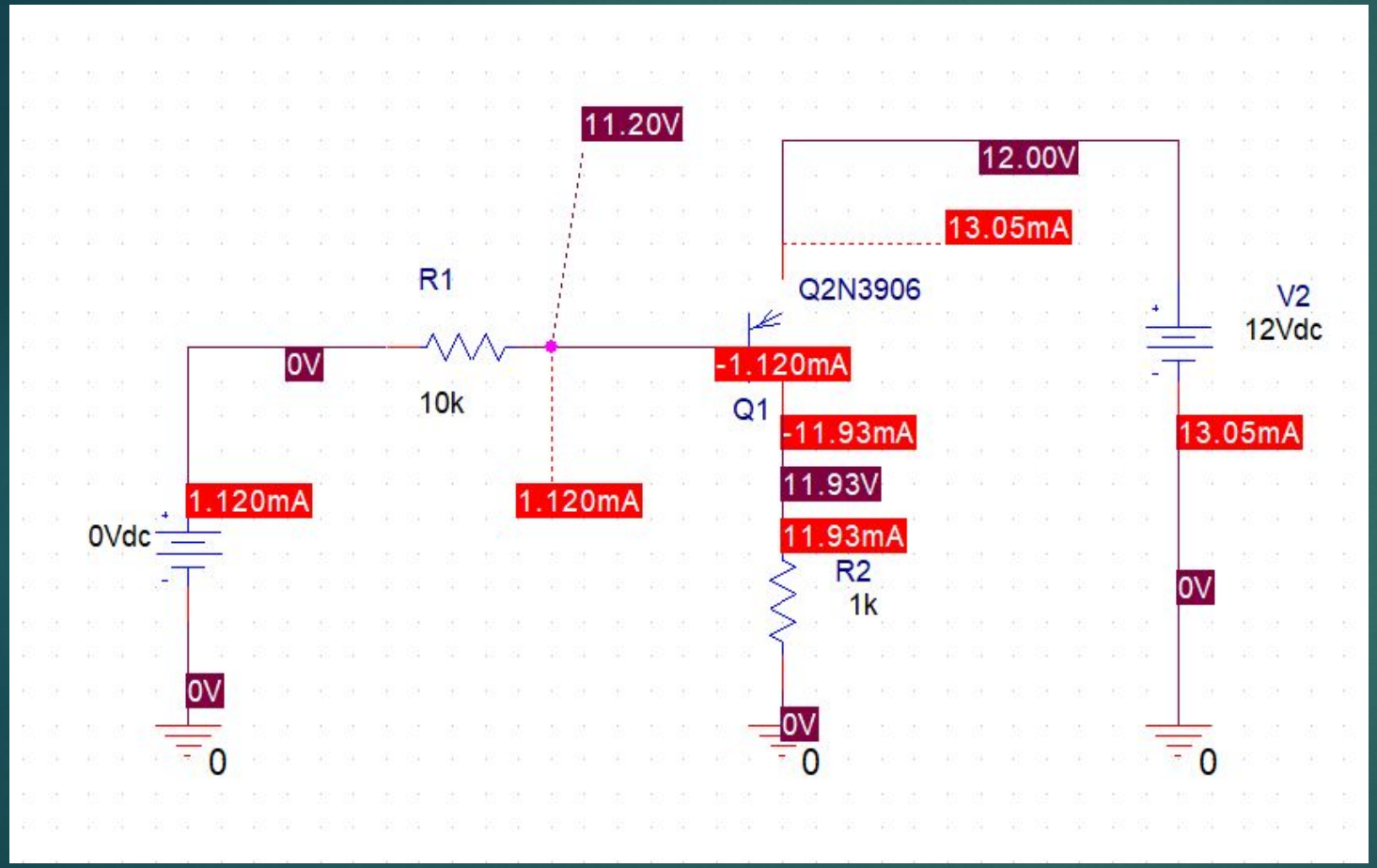
IB = (VBB – VBE)/RB
= (0 – 0.7)/10k
=-70uA
IC = β(IB)
= 100(-70nA)
= -7mA

VCE = VCC – ICRC
= 12V – (-7mA)(1k)
= 19(also impossible cutoff)

Cut Off vs Saturation

Saturation	**Cutoff**
VCE = 0 IC = VCC/RC	VCE = VCC IC=0

PNP 2N3906



Find IC and VCE when VBB = 0V

IB = (Vee -Vbb - Vbe)/Rb

= (12-0-0.7)/10k

=1.13mA

IC = β *IB

= 113mA

VCE = VEE - ICRC

= 12 - (113mA*1k)

= -101(impossible oversaturated)

Find IC and VCE when VBB = 13V

IB = (Vee -Vbb - Vbe)/Rb

= (12-13-0.7)/10k

=-170uA

IC = β *IB

= -17mA

VCE = VEE - ICRC

= 12 - (-17mA*1k)

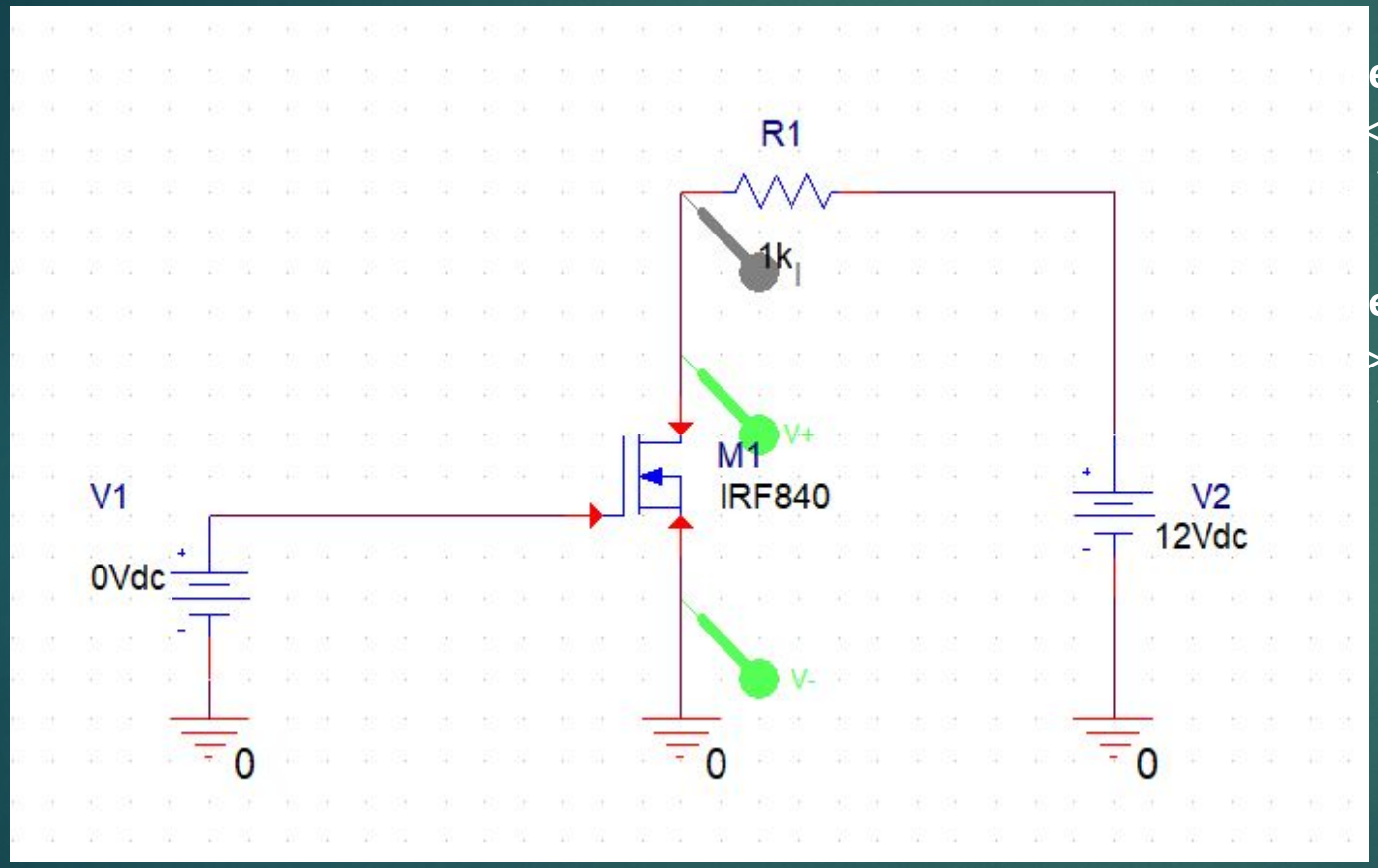
= 29 (impossible cutoff)

Adding library files into OrCAD

- Find .OLB and .LIB versions of your library files
- Add or overwrite .lib file into C:\OrCAD\OrCAD_16.6_Lite\tools\pspice\library
- Add or overwrite .olb file into C:\OrCAD\OrCAD_16.6_Lite\tools\capture\library\pspice

NMOS IRF840

Threshold for IRF840 = 3.879V



en VG = 0V

< 3.879V

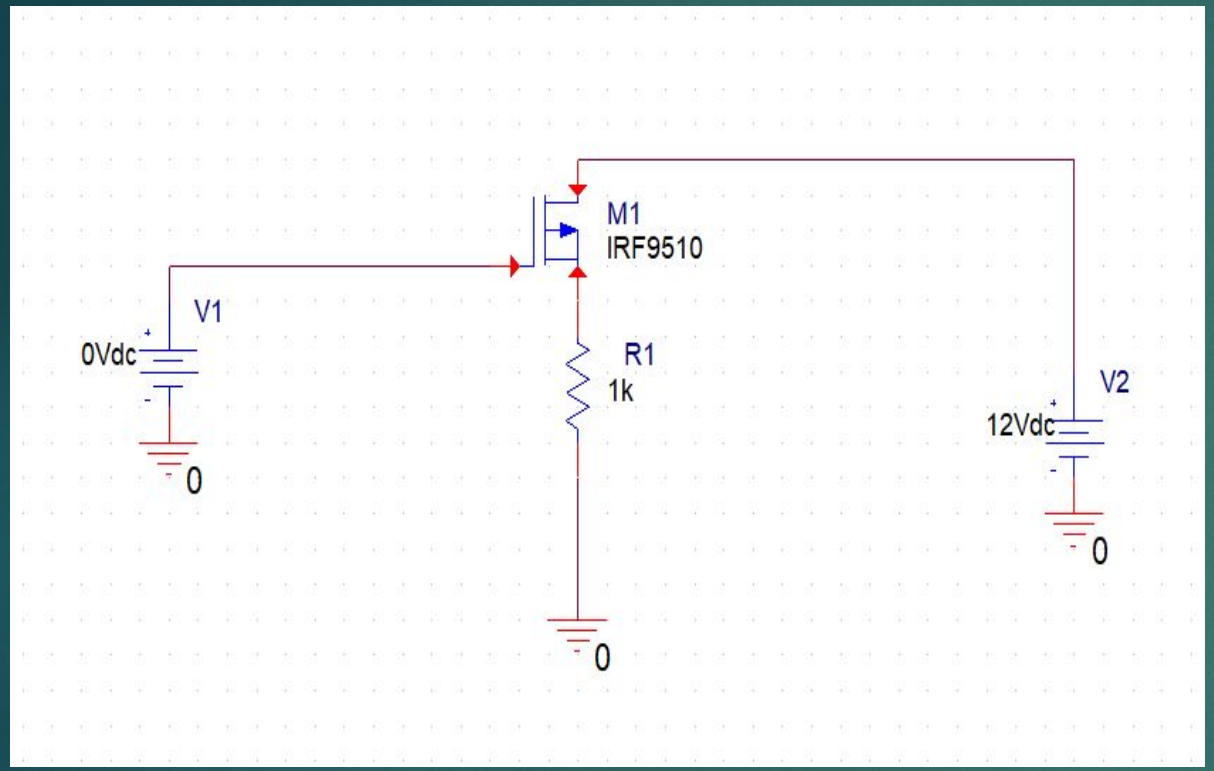
V2/R1 = 12V/1k =12mA(cutoff)

en VG = 5V

> 3.879V

V2/R1 = 0V/1k =0mA(saturated)

IRF9510



Threshold for IRF9510 = -3.9V

When VG = 0V

VGS = VG – Vs = 0 – 12V = -12V

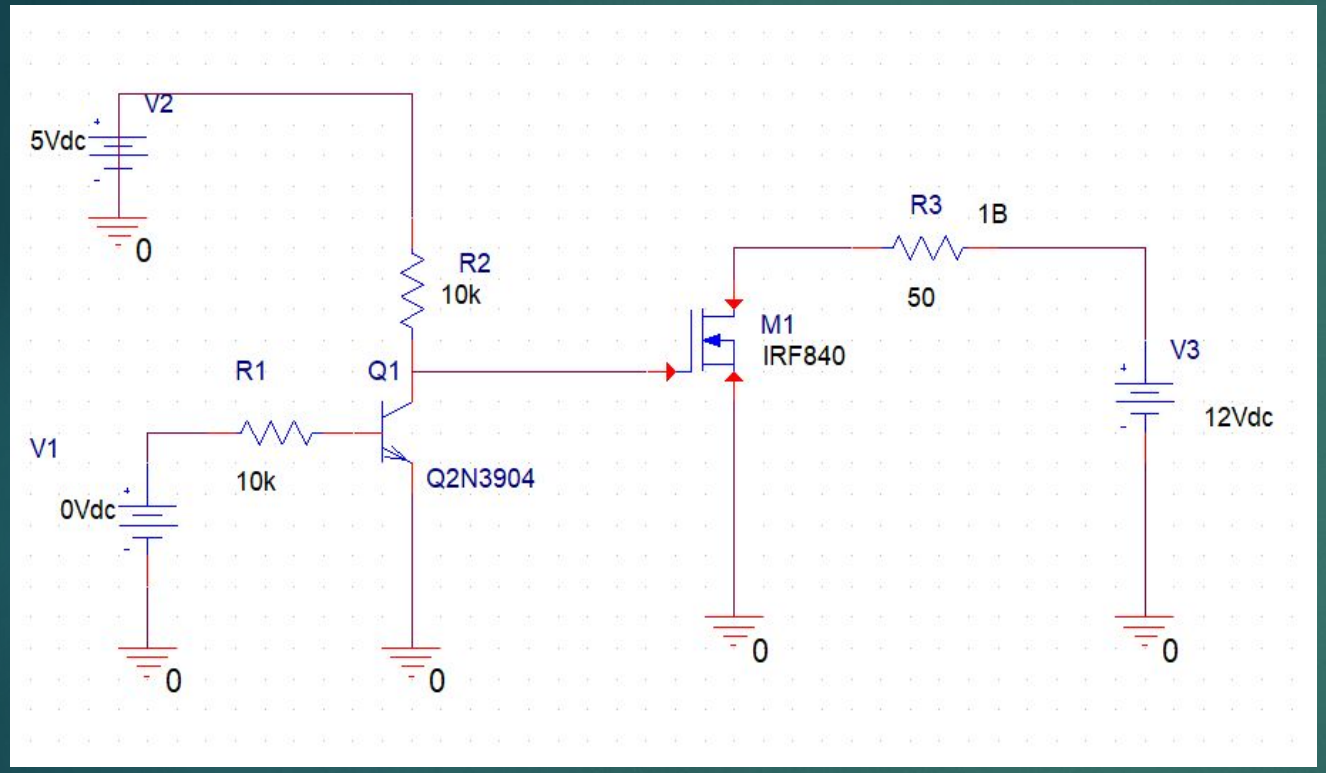
IL = V2/R1 = 0V/1k =0mA(saturated)

When VG = 12V

VGS = VG – Vs = 12 – 12V = 0V

IL = V2/R1 = 12V/1k =12mA(cutoff)

Level Shifting with IRF840



When input is Logic 1 = 3.3V
IR1 = (V1-VBE)/R1
= (3.3-0.7)/10k
=260uA
IR2 = β*IR1
=26mA
VCE = V2 - (IR2*R2)
= 5 - (26mA*10k)
= -248(same as VCE = 0 - oversaturated)

0V will go into IRF840

IR3 = V3/R3
= 12/50
= 240mA(cutoff)