SEMICONDUCTOR DEVICES

$V_{P_{sec}}$ when $V_{P_{pri}}$ given:

$$V_{P_{sec}} = (\frac{N_{sec}}{N_{pri}})(V_{P_{pri}})$$

$V_{rms_{sec}}$ when $V_{rms_{pri}}$ given:

$$V_{rms_{sec}} = (\frac{N_{sec}}{N_{pri}})(V_{rms_{pri}})$$

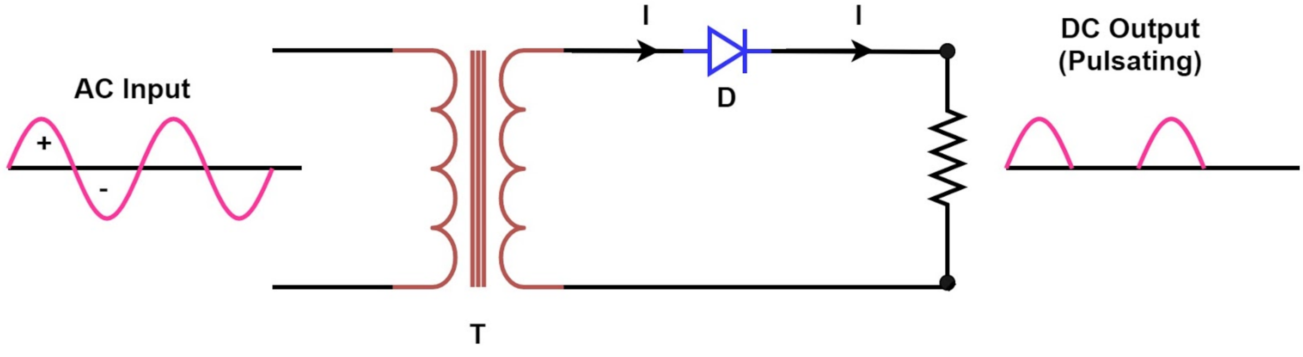
Convert $V_{rms_{sec}}$ to $V_{P_{sec}}$:

$$V_{P_{sec}} = (\sqrt{2})(V_{rms_{sec}})@\ 1.414\ V_{rms_{sec}}$$

RECTIFIER

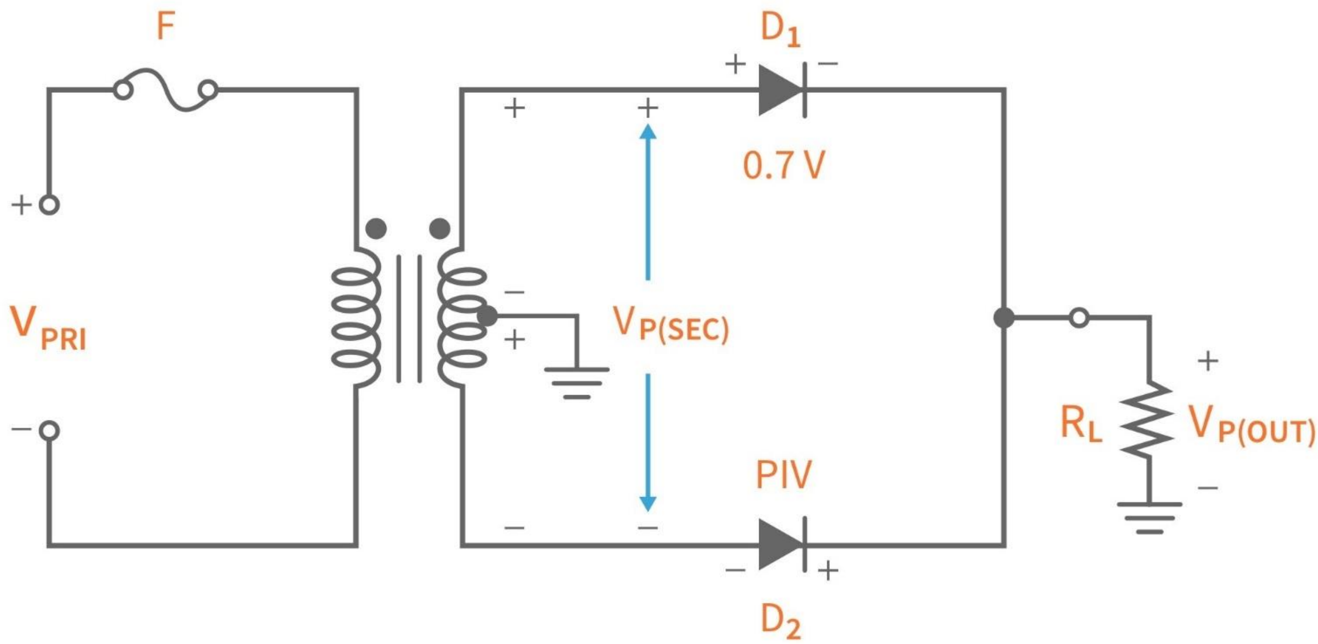
	Half wave Rectifier	Full wave Rectifier	Bridge Rectifier
No. of diodes	1	2	4
Output Voltage (V_o)	$V_{P_{sec}} - 0.7V$	$\frac{V_{P_{sec}}}{2} - 0.7V$	$V_{P_{sec}} - 1.4V$
Average Voltage (V_{avg})	$\frac{V_o}{\pi}$ $or\ 0.318\ V_o$	$\frac{2V_o}{\pi}$ $or\ 0.636\ V_o$	
Average Current (I_{avg})	$\frac{V_{avg}}{RL}$		
Root Mean Square Voltage (V_{rms})	$\frac{V_{P_{sec}}}{\sqrt{2}}$ $or\ 0.707\ V_{P_{sec}}$		
Output Frequency	Same as input Frequency	2 x input Frequency	

Example Of Halfwave Rectifier

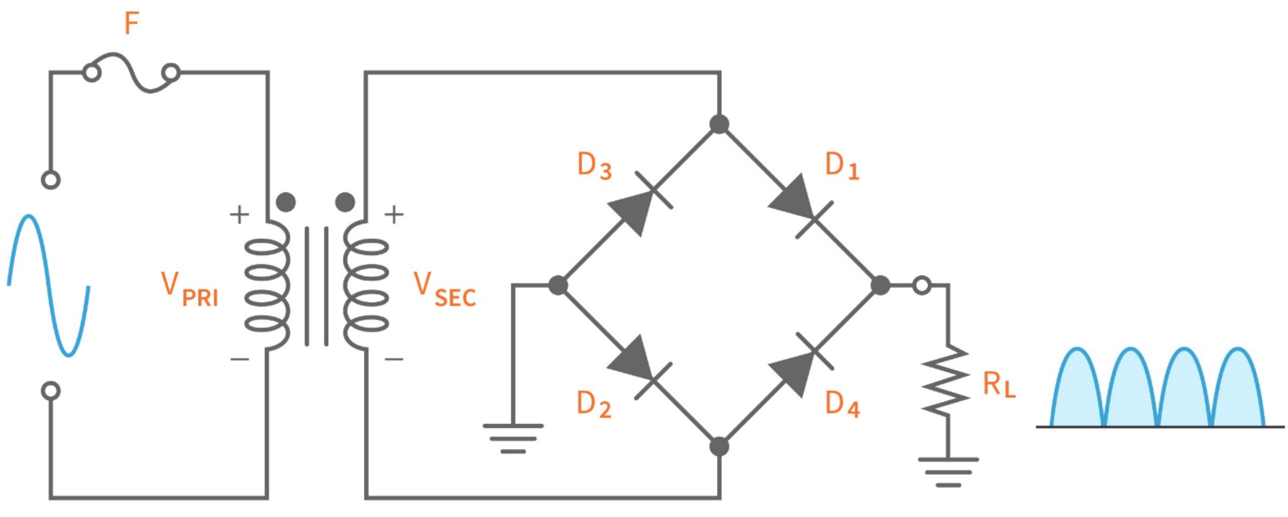


Half Wave Rectifier

Example Of Fullwave Rectifier



Example Of Bridge Rectifier



TRANSISTOR

	Common Base	Common Emitter	Common Collector
Common Terminal	Base	Emitter	Collector
Input Terminal	Emitter	Base	Base
Output Terminal	Collector	Collector	Emitter
Input Equation	$VEE = VRE + VEB$ $VEE = IERE + VEB$	$VBB = VRB + VBE$ $VBB = IBRB + VBE$	
Output Equation	$VCC = VRC + VCB$ $VCC = ICRC + VCB$	$VCC = VRC + VCE$ $VCC = ICRC + VCE$	
Current Gain	NO GAIN $Ai = \frac{Out\ Current}{In\ Current} = \frac{IC}{IE}$ Known; IE=IC	HIGH $Ai = \frac{Out\ Current}{In\ Current} = \frac{IC}{IB}$ Known; IC > IB	HIGH $Ai = \frac{Out\ Current}{In\ Current} = \frac{IE}{IB}$ Known; IE > IB
Input Resistance	Low	Low	High
Output Resistance	High	High	Low
Power Gain	Low	High	High
Voltage Gain	High	High	Low
Phase Shift	No Phase Shift	180° Phase Shift	No Phase Shift

Maximum Input Voltage, $V_{i_{(\max)}}$

$$V_{i_{(\max)}} = \frac{V_o}{A_v}$$

$$A_v = \frac{rc}{re'}$$

$$re' = \frac{25mv}{ie}$$

$$ie \approx ic$$

Voltage Divider

$$I_c = \frac{R_2}{R_1 + R_2}\ x\ \frac{V_{cc}}{R_E}$$

Maximum Voltage Gain (Avmax)

$$Avmax = \frac{V_o}{V_i}$$

Maximum Voltage Gain in dB

$$Avmax\ (dB) = 20 \log Avmax$$

Cut-off frequency (fc1 and fc2)

- Gain of 3Db @ 0.707 falls at the cut off frequency.
- Low cut-off frequency (fc1): when Am ≈ 0.707 Am.
- High cut-off frequency (fc2): when Am less than 0.707 Am.

Frequency Bandwidth (BW)

$$BW = fc_2 - fc_1$$

Center Frequency

$$f_o = \sqrt{(fc_1\, fc_2)}$$

POSITIVE FEEDBACK

Overall Voltage Gain (G):

$$\frac{V_o}{A} = V_i + BV_o$$

$$V_o = AV_i + ABV_o$$

$$V_o - ABV_o = AV_i$$

$$V_o(1 - AB) = AV_i$$

$$\frac{V_o}{V_i} = \frac{A}{1 - AB}$$

A= Open loop Gain

G= Close loop Gain @ Overall Gain

AB= Loop Gain

POSITIVE FEEDBACK

Overall Voltage Gain (G):

$$\frac{V_o}{A} = V_i - BV_o$$

$$V_o = AV_i - ABV_o$$

$$V_o + ABV_o = AV_i$$

$$V_o(1 + AB) = AV_i$$

$$\frac{V_o}{V_i} = \frac{A}{1 + AB}$$

A= Open loop Gain

G= Close loop Gain @ Overall Gain

AB= Loop Gain

Relationship Between I_D and V_{GS}:

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

I_{DSS}= Saturation Drain Current

V_P= Pinch-off Voltage

DC loadline

$$ID(sat) = \frac{VDD}{RL}$$

$$VDS\ (cut - off) = VDD$$

$$VDSQ = \frac{VDD}{2}$$

$$IDSQ = \frac{VDD/2}{RS + RL}$$