INDUSTRIAL ELECTRONICS
DDPE 3103
TOPIC 2
POWER SUPPLY

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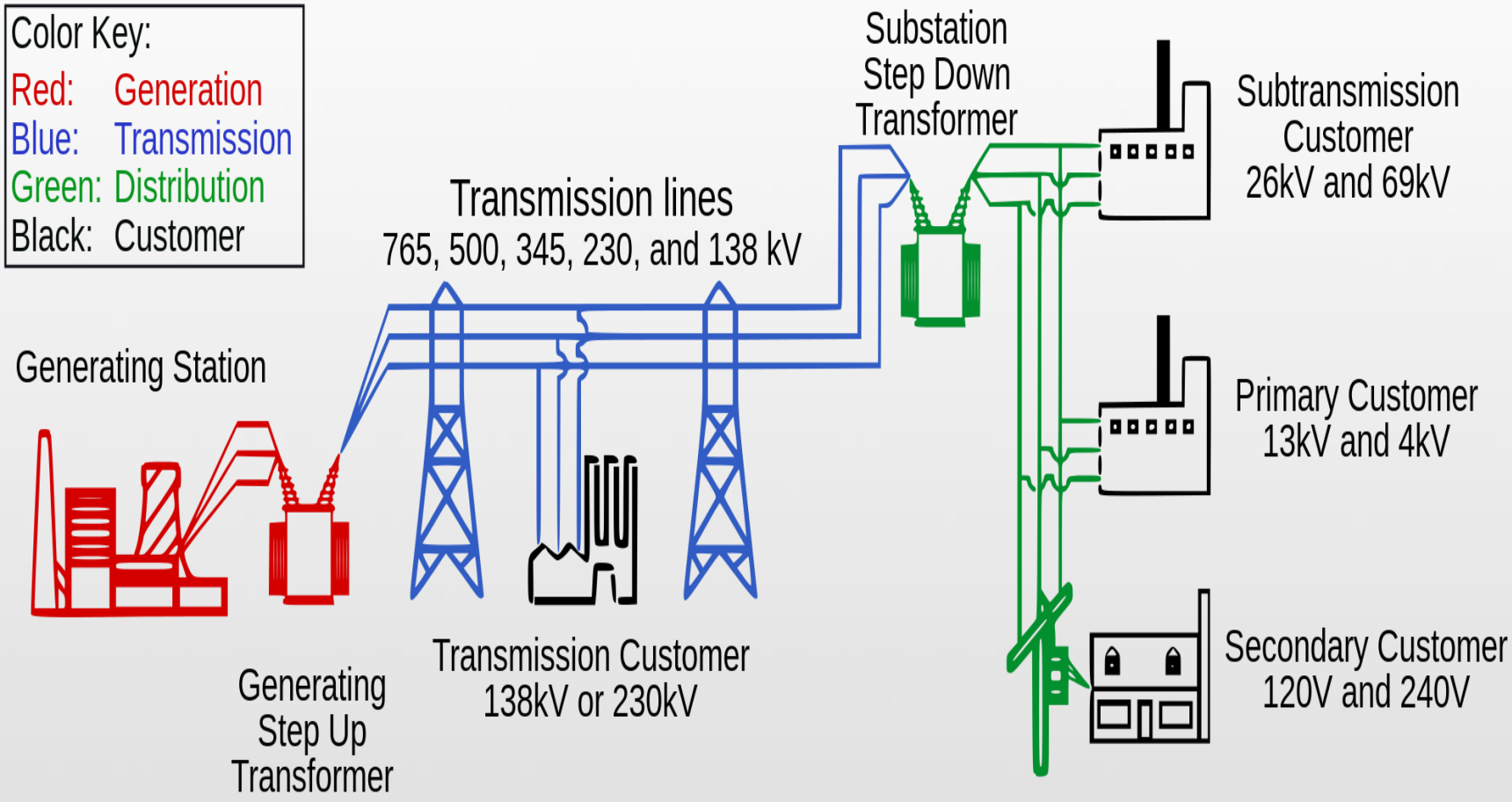
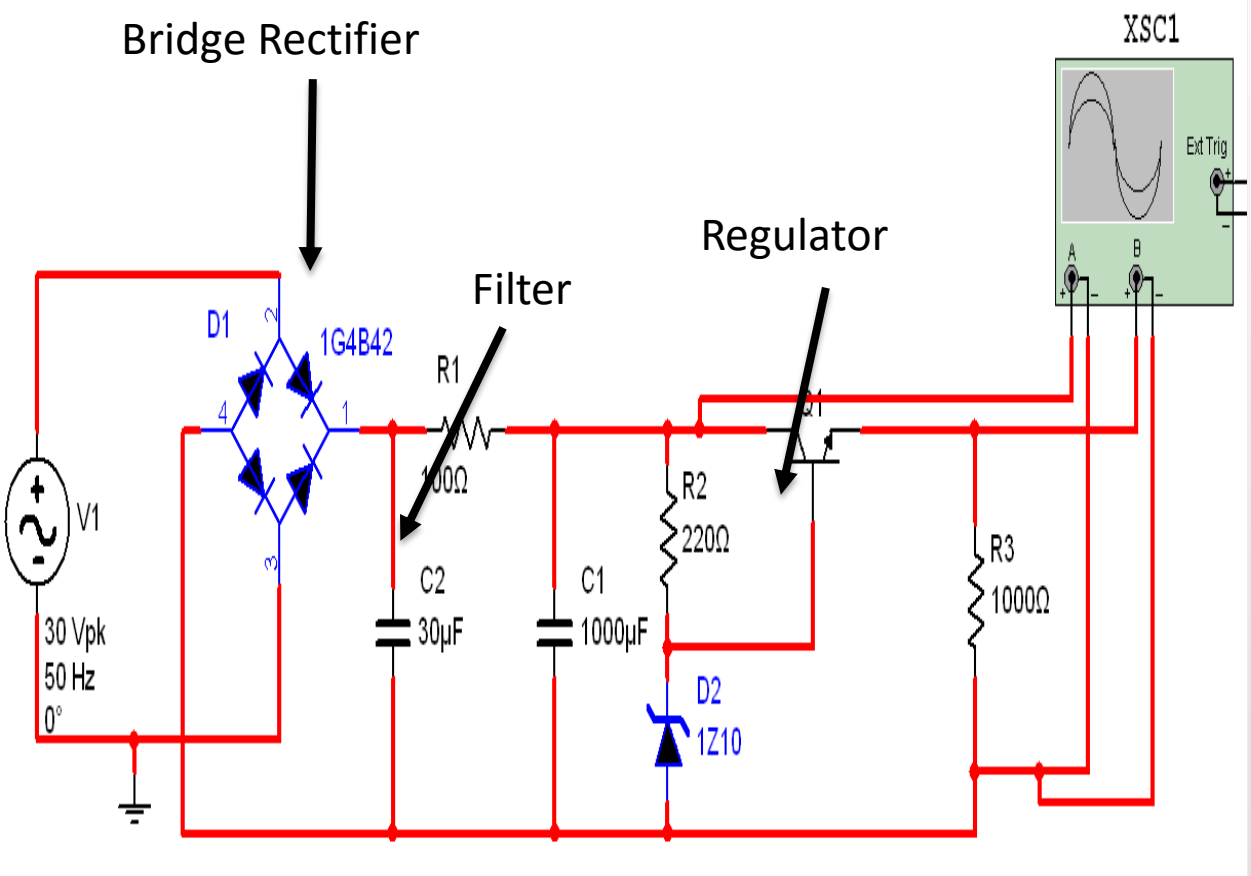
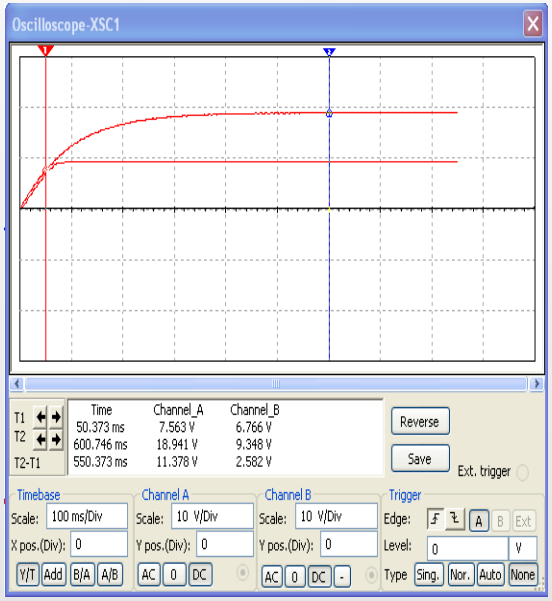
ELECTRICITY GENERATION



BASIC DC POWER SUPPLY



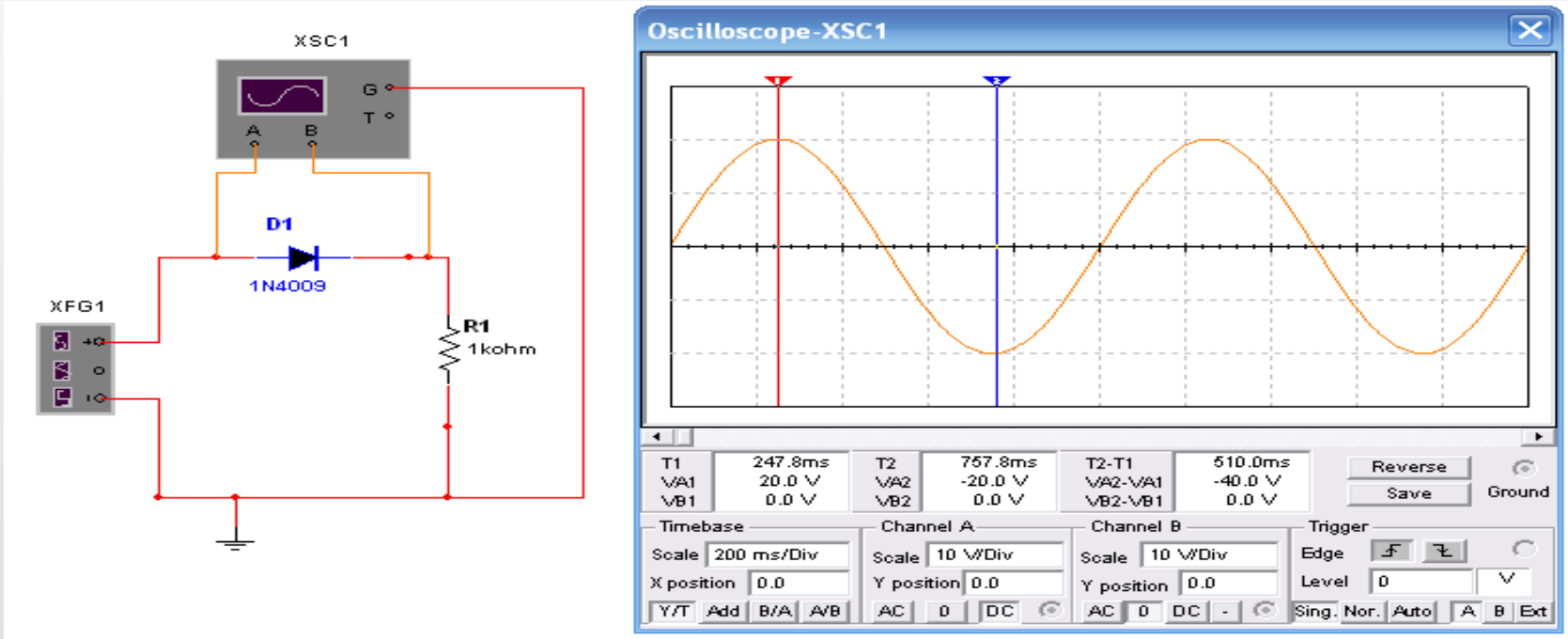


Output of the regulator

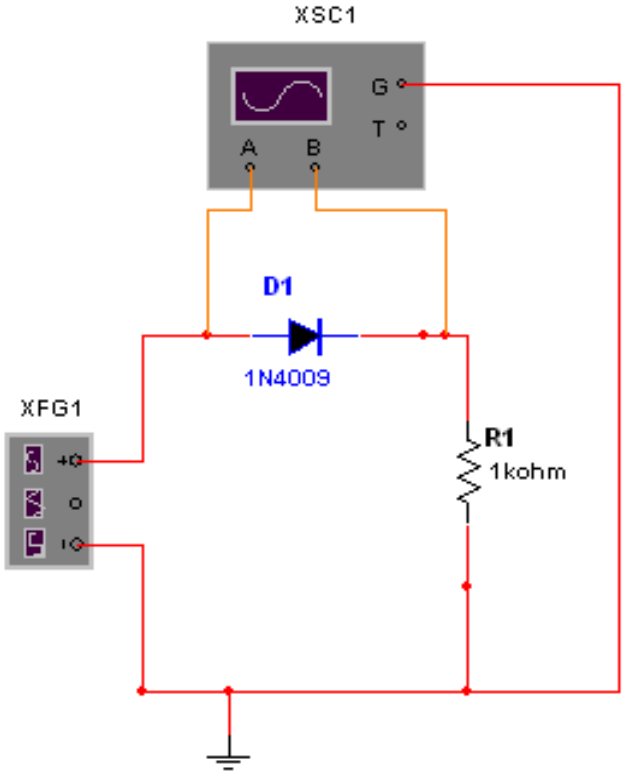
RECTIFIER : TWO TYPES

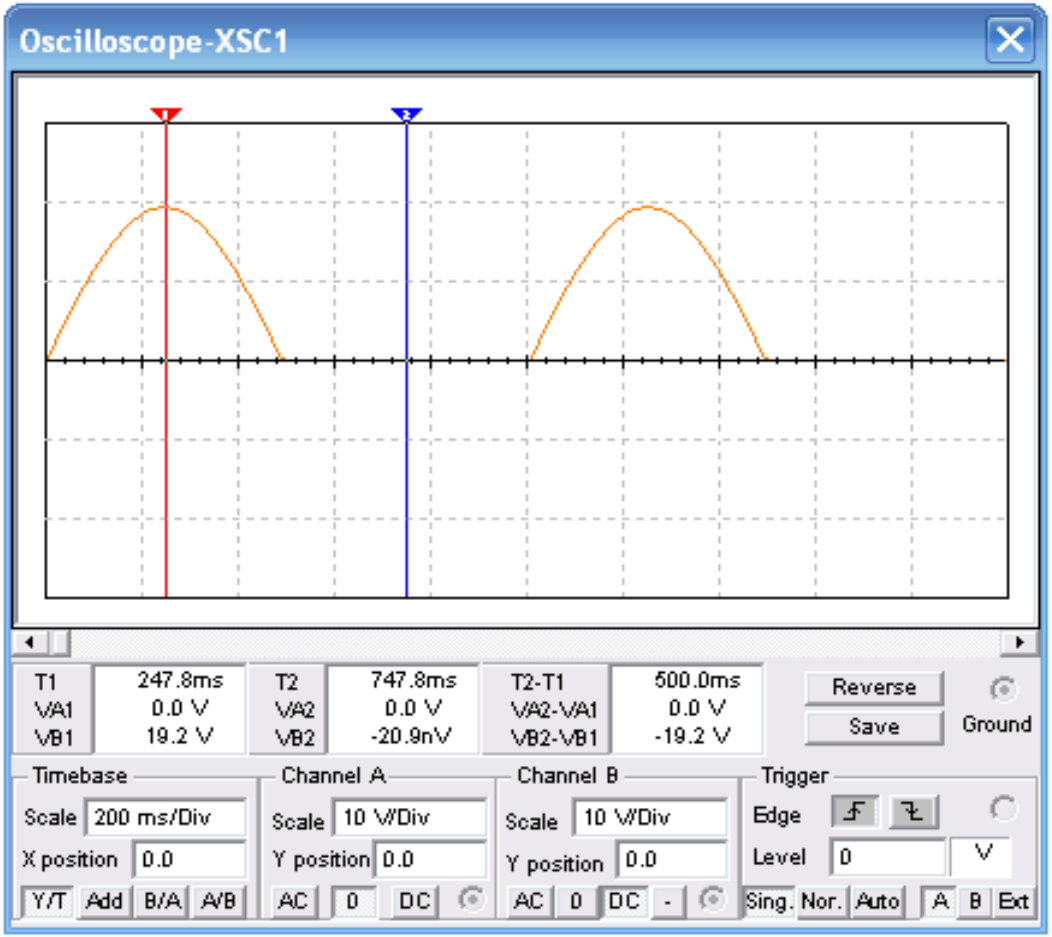
1. HALF – WAVE RECTIFIER - using only one diode

Input to the half – wave rectifier



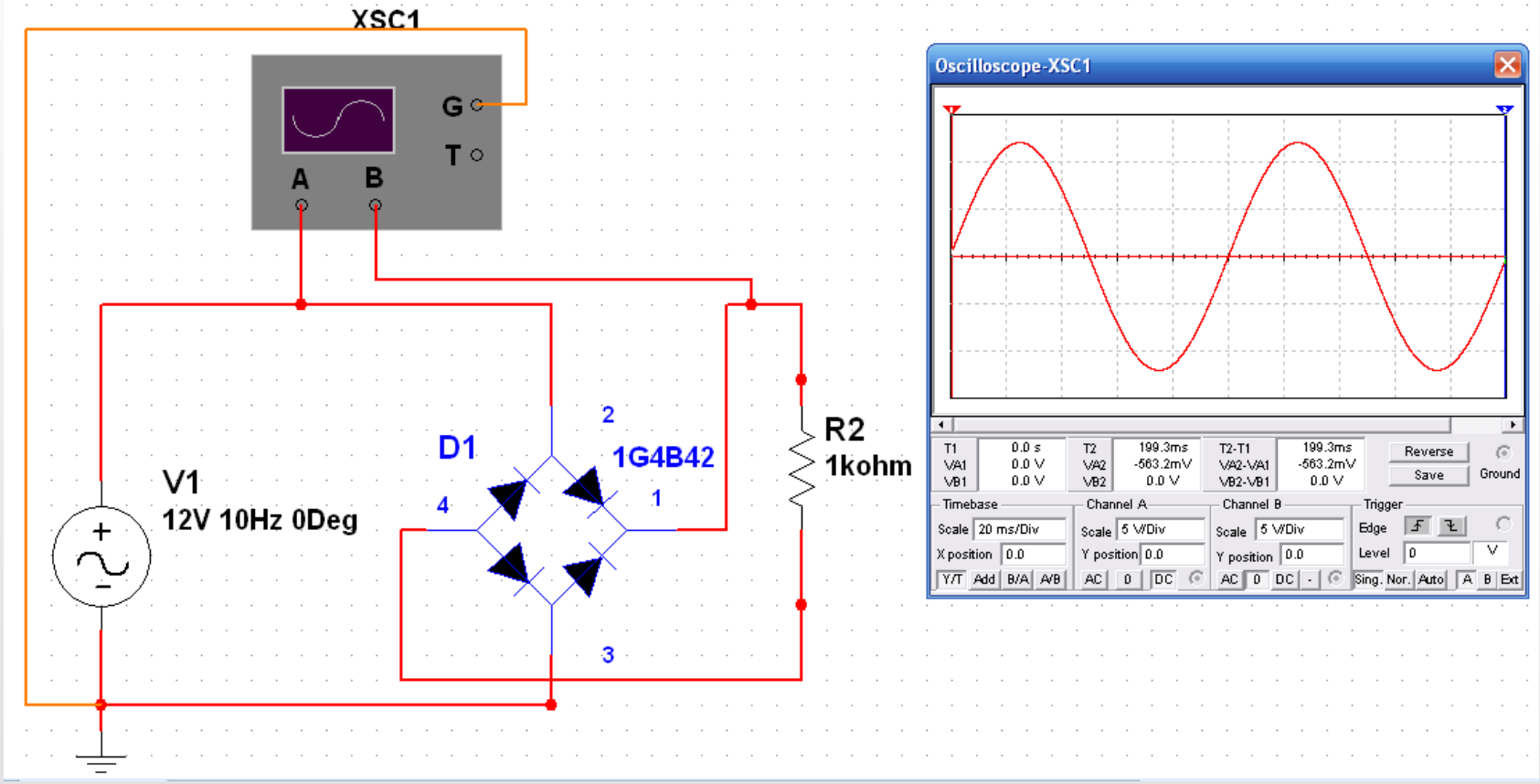
Output of the Half- Wave Rectifier



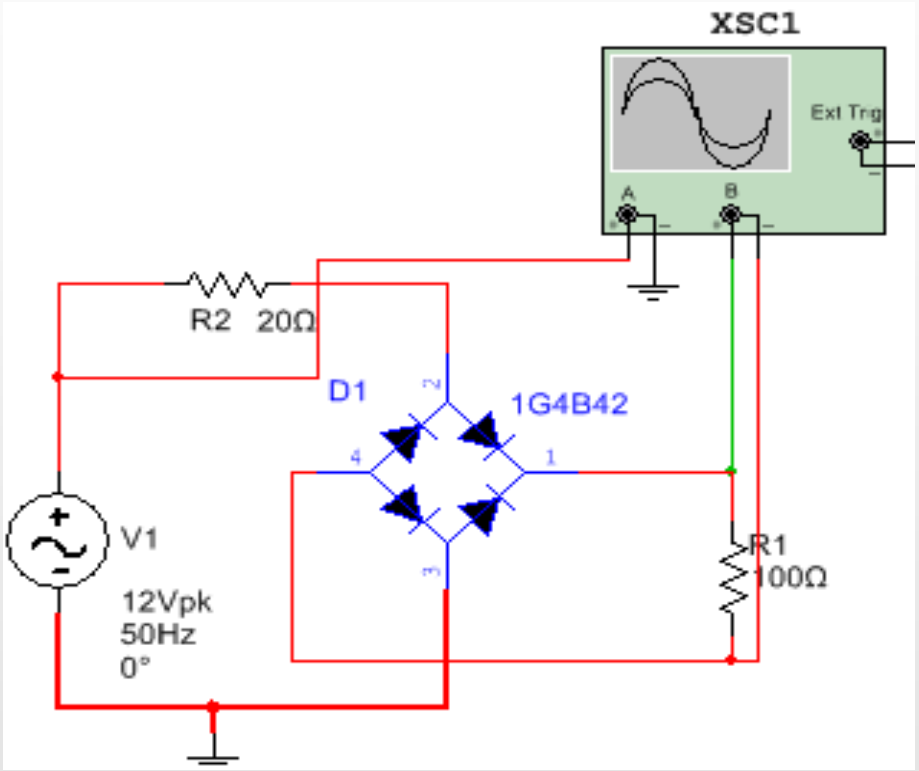


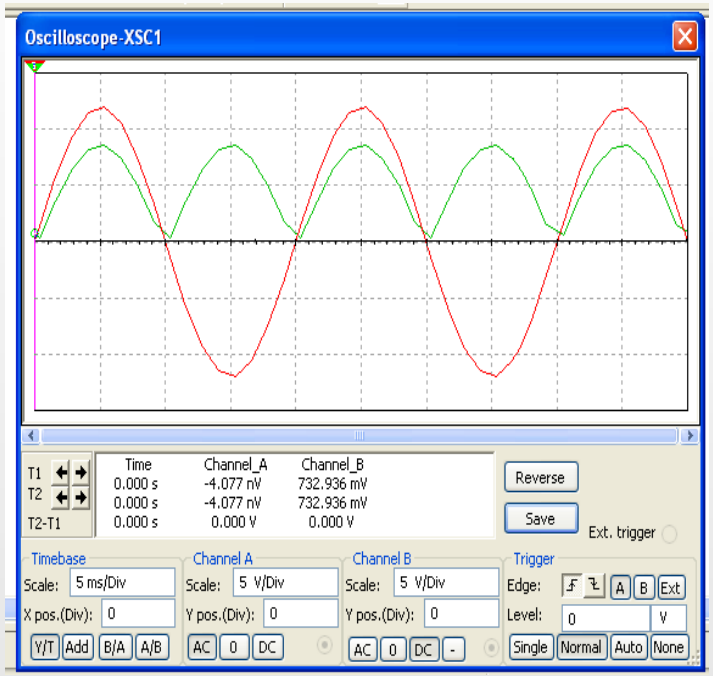
2. Full-Wave Rectifier

Input to the Full- Wave Rectifier



Output of the Full-Wave Rectifier





Red – input waveform

Green – output waveform

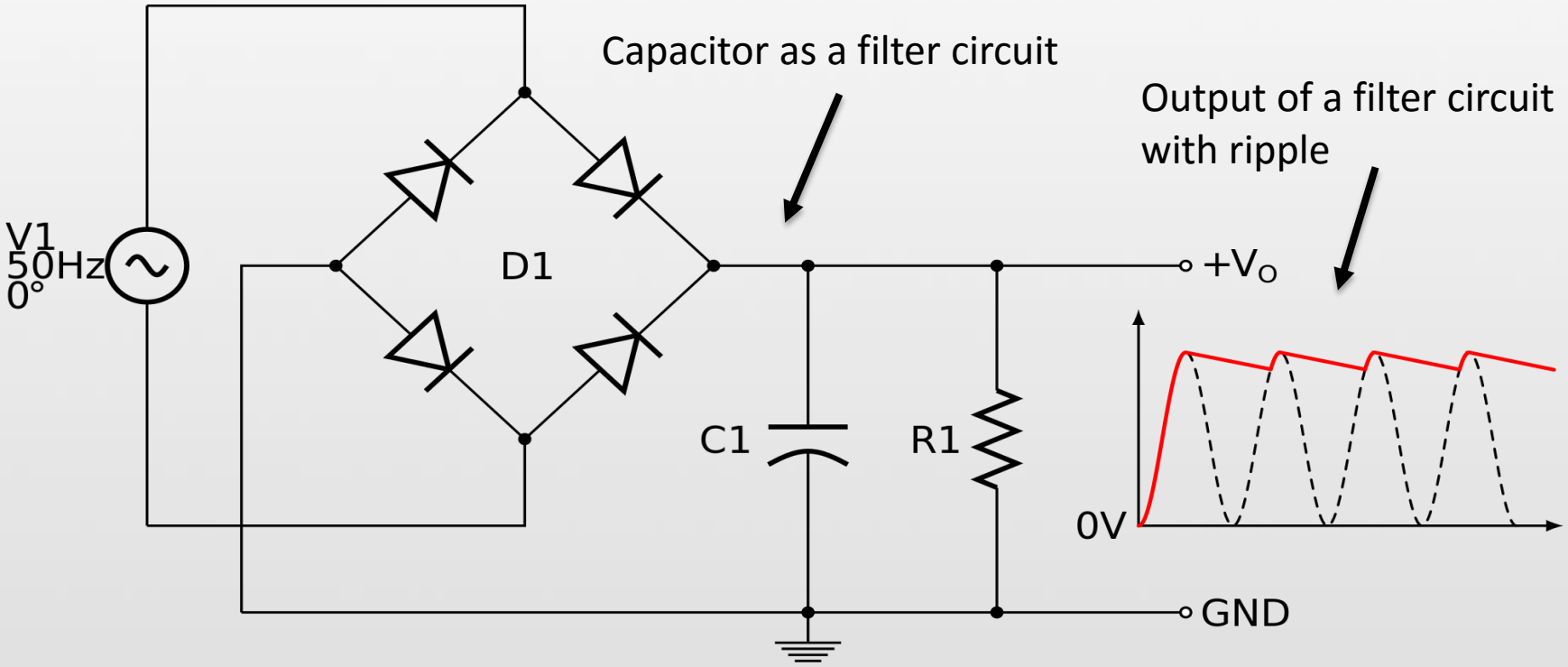
Rectifier Circuit DC Voltages

Rectifier	Ideal VDC	Realistic VDC
Half Wave Rectifier	$V_{DC} = 0.318V_m$	$V_{DC} = 0.318V_m - V_D$
Bridge Rectifier	$V_{DC} = 0.636V_m$	$V_{DC} = 0.636V_m - 2V_D$
Centre-tap Transformer Rectifier	$V_{DC} = 0.636V_m$	$V_{DC} = 0.636V_m - V_D$

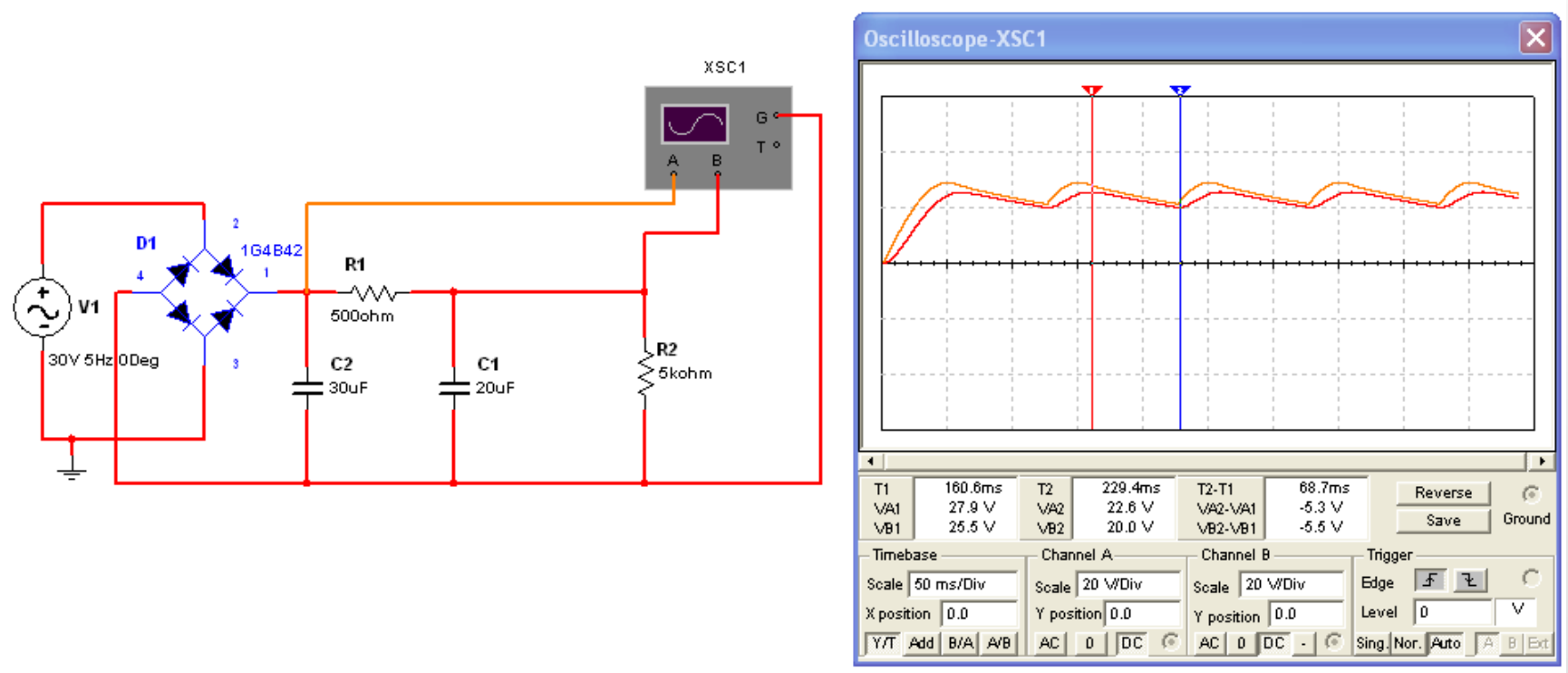
Note: V_m is the peak voltage of the AC input signal
V_D the diode voltage used in the circuit

Filter Circuit

- Filter circuit consists of a capacitor which is used to smooth the pulsating DC output of the rectifier
- Ripple voltage exist at the output of the filter circuit.



The ripple voltage can further be decreased by adding another RC circuit.



Formula for the output of the filter

$$Vrms = \frac{Idc}{4\sqrt{3}} \times \frac{1}{fC} = \frac{2.4Idc}{C} = \frac{2.4Vdc}{C\,RL}$$

where I_{dc} is in mA, C is in μF and R_L is in kΩ

$$Vdc = Vm - \frac{Idc}{4fC} = Vm - \frac{4.17Idc}{C}$$

where V_m is the peak rectifier voltage, I_{dc} is the load current in mA and C is in μF

Regulator

- The function of a voltage regulators is to provide a steady supply voltage to the load.

- Voltage regulation is the ability of the regulator to maintain its specified output voltage with changes in the load.

where V_{NL} = no-load voltage
V_{FL} = full-load voltage

$$\%VR = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100\%$$

DISCRETE TRANSISTOR VOLTAGE REGULATION

Two types of transistor voltage regulators

- **the series voltage regulator , Figure A**
- **the shunt voltage regulator , Figure B**

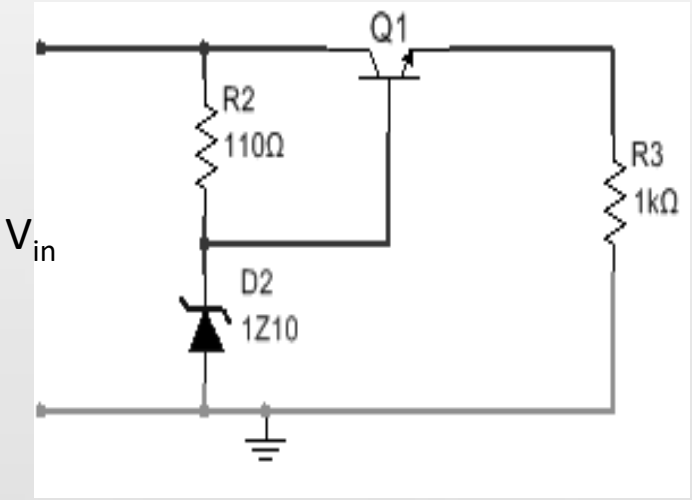


Figure A

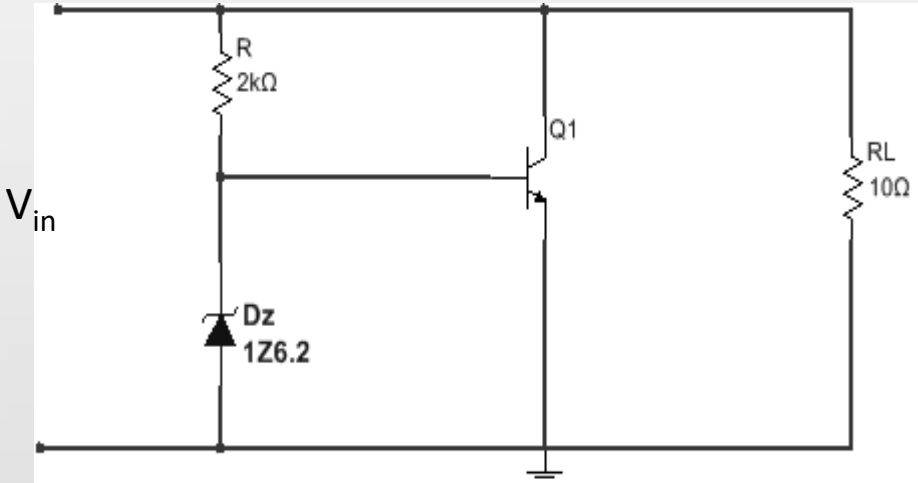


Figure B

IC Voltage Regulators

- **Three-Terminal Voltage Regulators**

1. **Fixed Voltage Regulator**
2. **Adjustable Voltage Regulator**

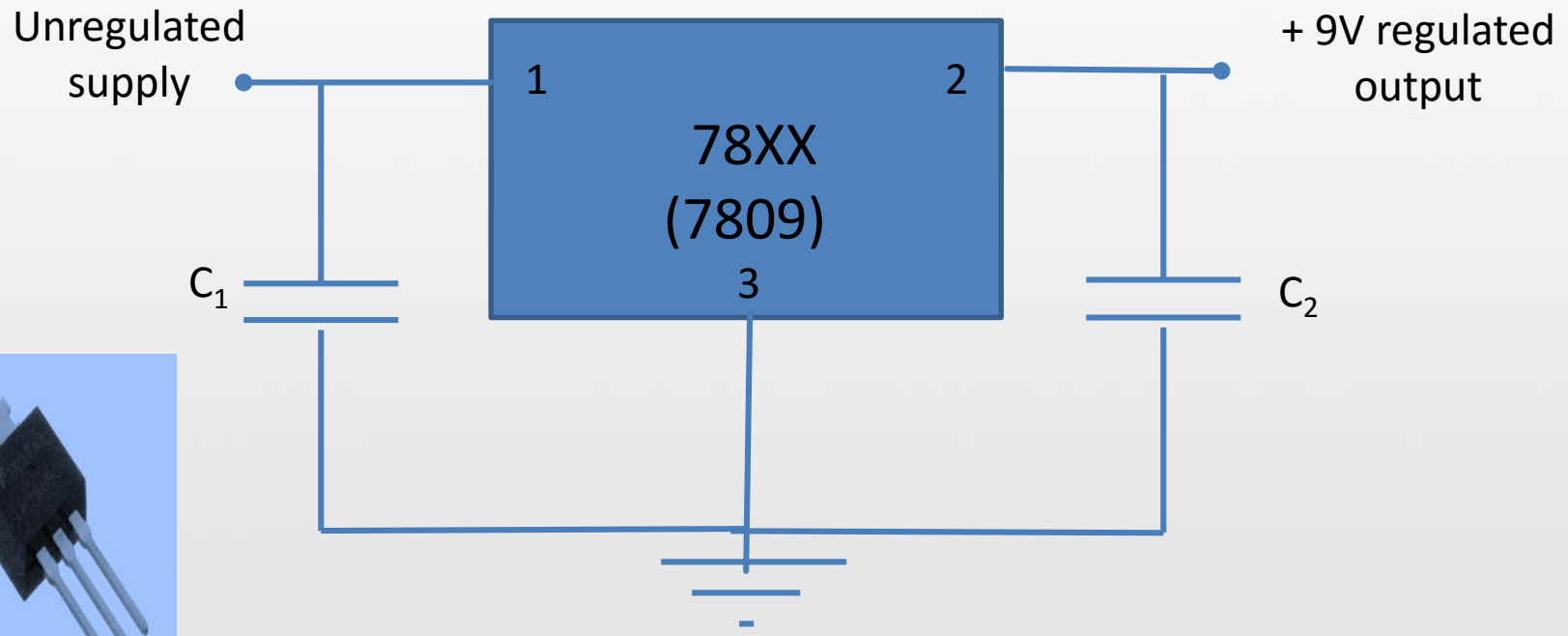
Fixed Voltage Regulator

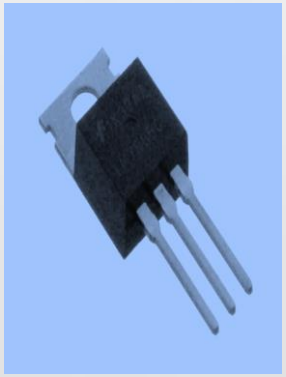
- **IC three terminal** fixed voltage regulators provide a constant output voltage and can be a positive or a negative voltage regulator.

- All those IC's in the **78XX** series are fixed positive voltage regulators and all those IC's in the **79XX** series are fixed negative voltage regulators.

- The **part XX denotes** the value of the regulated output voltage. Examples:- 7805, 7806, 7809, 7905, 7910 etc.

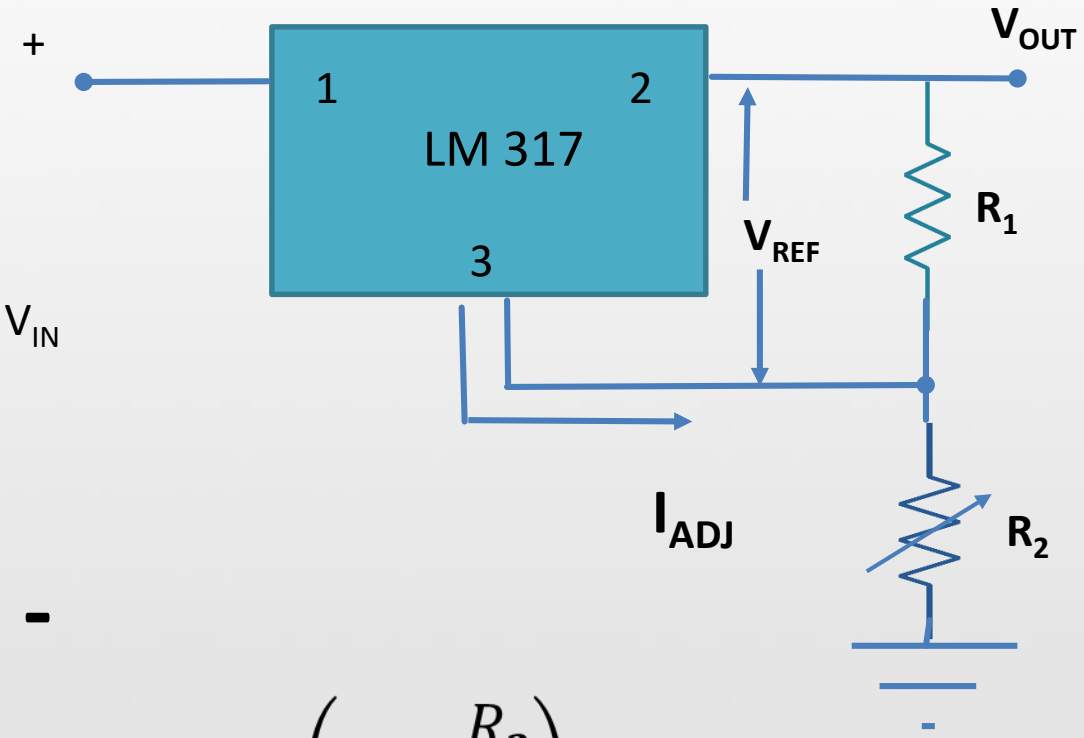
IC THREE TERMINAL FIXED POSITIVE OUTPUT REGULATOR

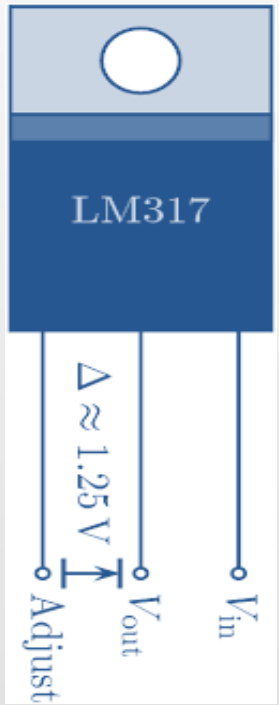




Adjustable Voltage Regulator

LM 317 IC regulator has adjustable output voltages. The output voltage is commonly selected using a variable resistor as example R_2.





$$V_{OUT} = 1.25V\left(1 + \frac{R_2}{R_1}\right) + I_{ADJ}(R_2)$$

References

1. Power Semiconductor Applications Philips Semiconductors
2. Electronic Devices and Circuit Theory , Robert L. Boylestad & Louis Nashelsky , 9th Edition, 2006
3. Electronic Devices, Thomas L. Floyd, 5th Edition, 1999
4. Wikimedia Commons for images