

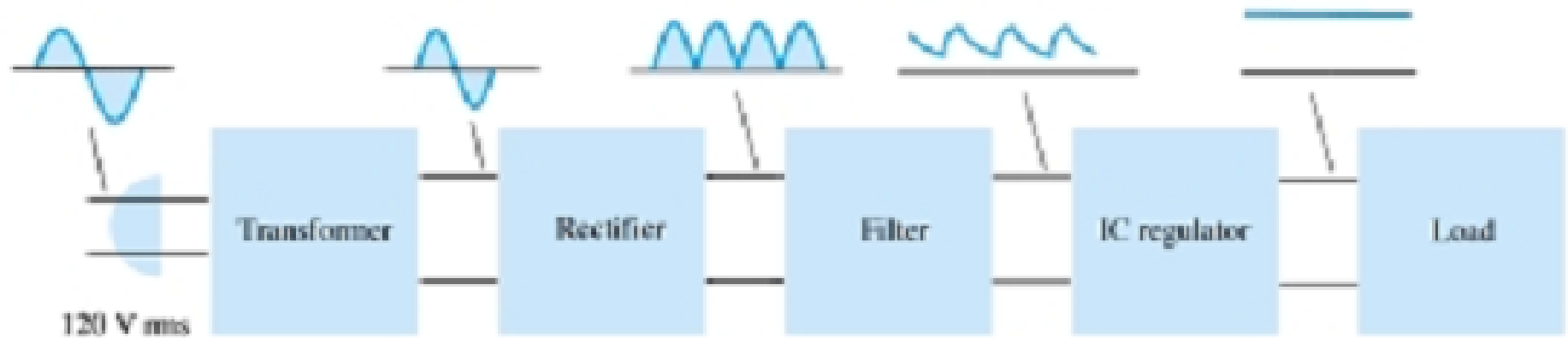
Power Supplies (Voltage Regulators)

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- ▶ A voltage regulator is an electronic regulator designed to automatically maintain a constant voltage level.
- ▶ Active regulators employ at least one active (amplifying) component such as a transistor or operational amplifier.
- ▶ In general, these active regulators can be divided into several classes:
 - Linear series regulators
 - Switching regulators

Block Diagram



Voltage Regulation

- ▶ An important factor in power supply
- ▶ It is the amount of dc output voltage change over a range of circuit operation.
- ▶ It is the amount of dc voltage change between no-load and load conditions.

$$\text{Voltage regulation} = \frac{\text{no-load voltage} - \text{full-load voltage}}{\text{full-load voltage}}$$

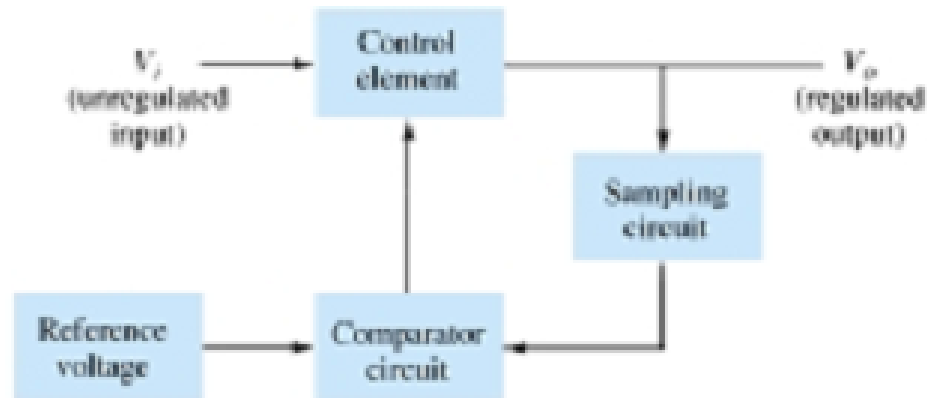
$$\%V.R. = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100\%$$

- ▶ The smaller the voltage regulation, the better the operation of the voltage supply circuit.

Discrete Transistor Voltage Regulation

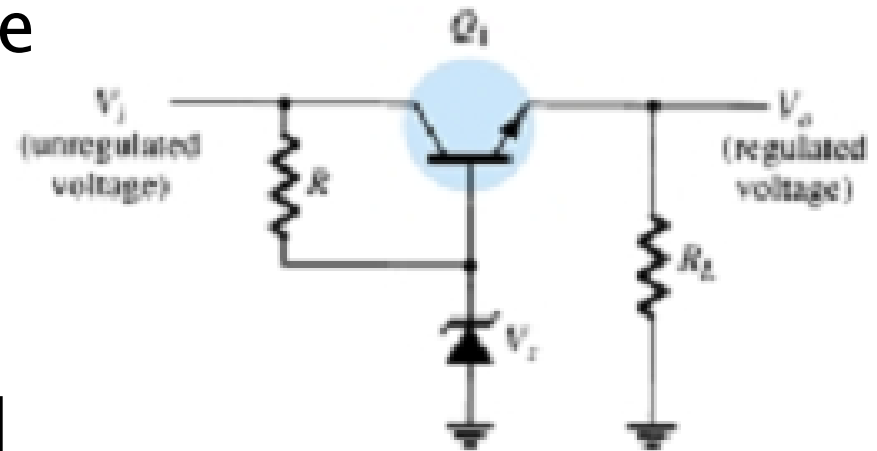
- ▶ Two types of voltage regulators:
 - Series
 - Shunt

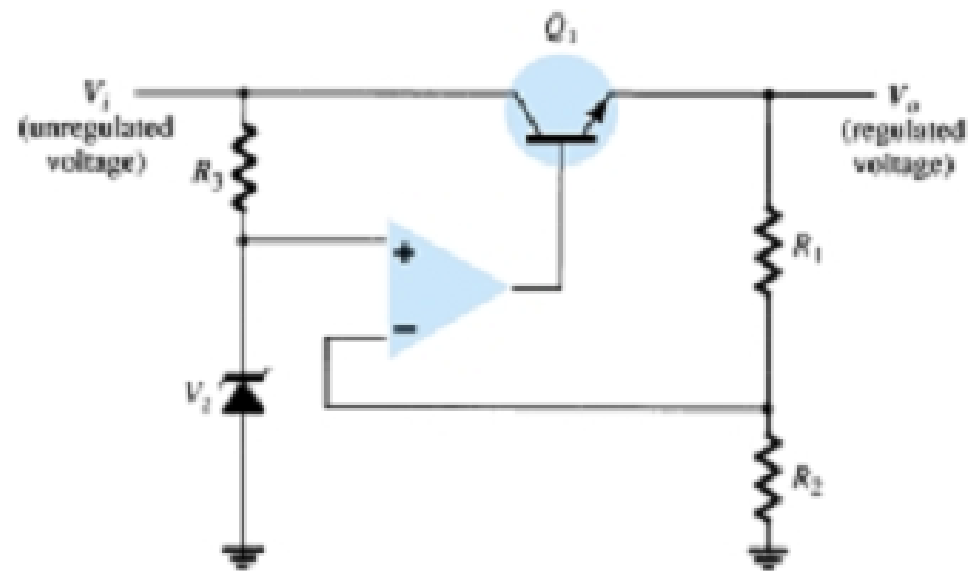
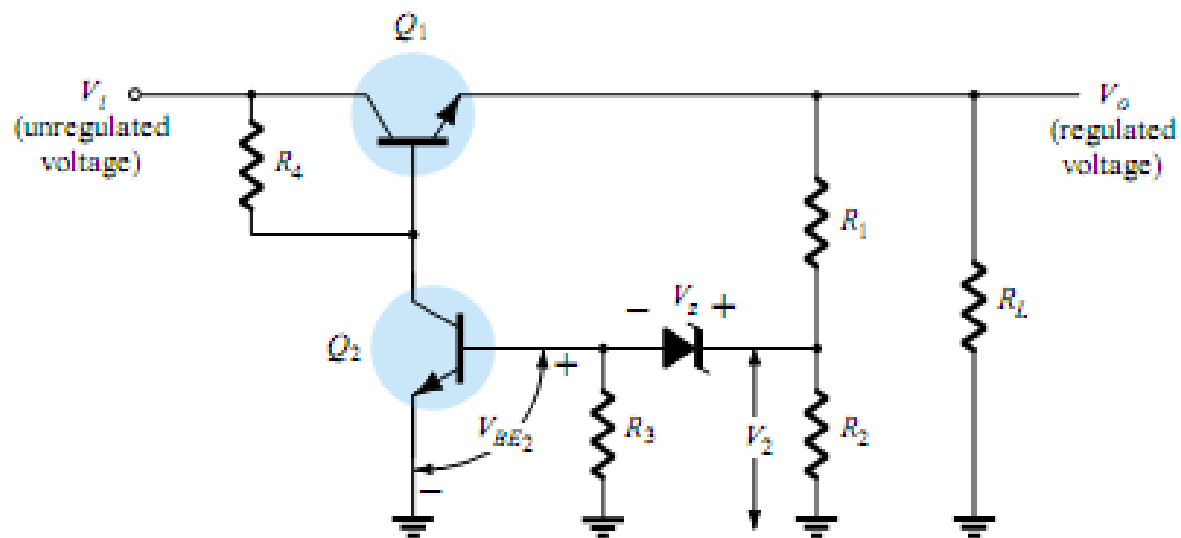
Series Voltage Regulation



- ▶ If the output voltage increases, the comparator circuit provides a control signal to cause the series control element to decrease the amount of the output voltage—thereby maintaining the output voltage.
- ▶ If the output voltage decreases, the comparator circuit provides a control signal to cause the series control element to increase the amount of voltage output.

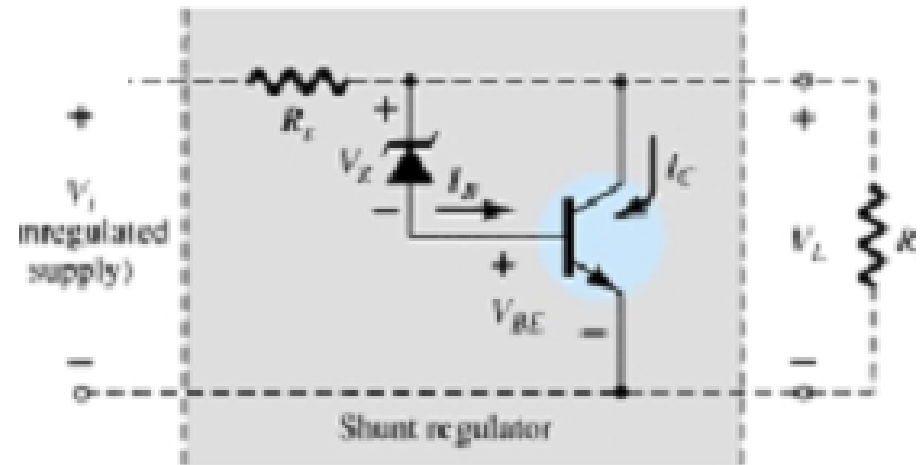
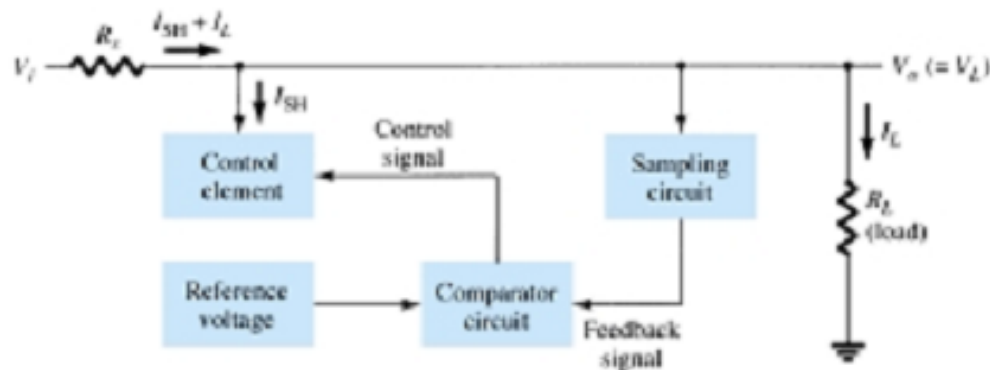
- ▶ If the output voltage decreases, the increased base-emitter voltage causes transistor Q1 to conduct more, thereby raising the output voltage, thereby maintaining the output constant.
- ▶ If the output voltage increases, the decreased base-emitter voltage causes transistor Q1 to conduct less, thereby reducing the output voltage – maintaining the output constant.





Shunt Voltage Regulation

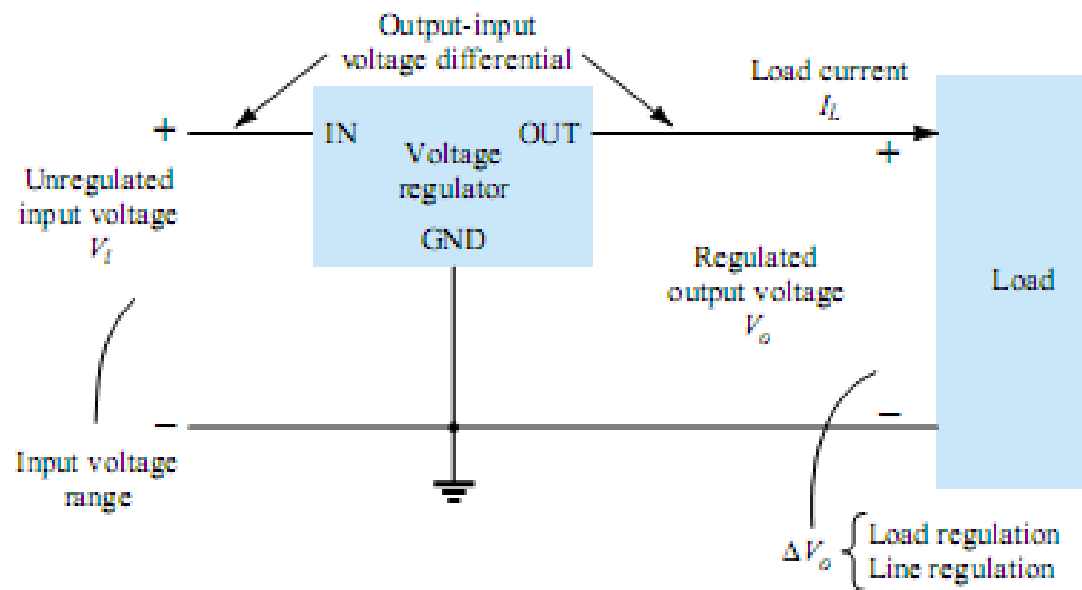
- It provides regulation by shunting current away from the load to regulate the output voltage.



IC Voltage Regulators

- ▶ Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC.
- ▶ The internal construction of the IC is somewhat different from that described for discrete voltage regulator circuits, the external operation is much the same.
- ▶ IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage.

Three Terminal Voltage Regulators

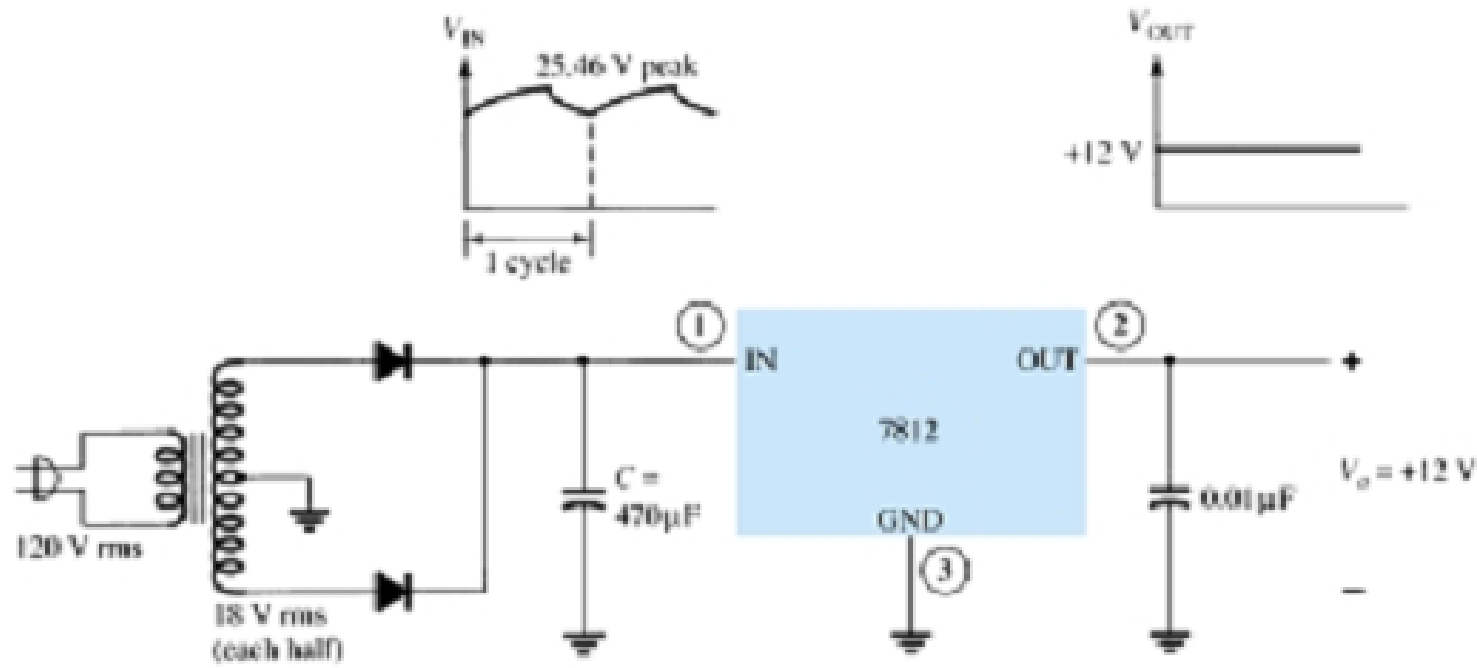


- ▶ For a selected regulator, IC device specifications list a voltage range over which the input voltage can vary to maintain a regulated output voltage over a range of load current.
- ▶ The specifications also list the amount of output voltage change resulting from a change in load current (load regulation) or in input voltage (line regulation).

Fixed Positive

TABLE 19.1 Positive Voltage Regulators in 7800 Series

IC Part	Output Voltage (V)	Minimum V_i (V)
7805	+5	7.3
7806	+6	8.3
7808	+8	10.5
7810	+10	12.5
7812	+12	14.6
7815	+15	17.7
7818	+18	21.0
7824	+24	27.1



Fixed Negative

TABLE 19.2 Negative Voltage Regulators in 7900 Series

IC Part	Output Voltage (V)	Minimum V_1 (V)
7905	-5	-7.3
7906	-6	-8.4
7908	-8	-10.5
7909	-9	-11.5
7912	-12	-14.6
7915	-15	-17.7
7918	-18	-20.8
7924	-24	-27.1

Adjustable

- ▶ Allows the user to set the output voltage to a desired regulated value.

