CLASS #3: OTHER CIRCUIT ELEMENTS

READ: CH 2.6 - 2.10 DORF

OBJECTIVES:
1. EXPLORE DEPENDENT SOURCES
2. INTRODUCE TRANSISTORS, SWITCHES & TRANSDUCERS

1. DEPENDENT SOURCES:

DEPENDENT SOURCES MODEL CASE WHEN VOLTAGE OR CURRENT OF ONE ELEMENT IS PROPORTIONAL TO ANOTHER'S ELEMENT VOLTAGE OR CURRENT

EX: - TRANSISTORS
    - AMPLIFIERS

- SYMBOL

\[ V = 5i_r \]

\[ I = 2v \]

VOLTAGE (DEPENDENT)

CURRENT (DEPENDENT)

VOLTAGE = 5 \( i_r \)

\( i_r \) PROP.

CONST

(GAIN)

CURRENT IN SOME ARBITRARY ELEMENT

\[ i \]

\[ 5i \]

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- **TYPES:**

  ![Diagrams of different types of controlled voltage and current sources](image)

  - Current Controlled Voltage Source (CCVS)
  - Voltage Controlled Voltage Source (VCVS)
  - Voltage Controlled Current Source (VCCS)
  - Current Controlled Current Source (CCCS)

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**1. TRANSISTOR**

- **Building Block of All Modern Electronics**
- Acts as a **Switch** (Digital → On/Off → 1/0)
- Acts as an **Amplifier**

![Diagram of a transistor with labels](image)

- **Base** (`b`)
- **Collector** (`c`)
- **Emitter** (`e`)

- If `b` is high, then **current flows (amplified)**
- If `b` is low, then **current does not flow**

- **Current Amplification**

  \[ i_c = g_m V_{be} \]

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2) **TRANSDUCER**

- Device converts physical quantities to electrical, vice versa
- Essentially a sensor or actuator

\[ \text{PHY} \rightarrow \text{ELECT} \quad \text{ELECT} \rightarrow \text{PHY} \]

(sensor) (actuator)

- Ex: thermal couple (temperature sensor)

\[ T \rightarrow i \]

\[ T(t) \rightarrow i(t) \]

3) **SWITCHES**

- Device that opens & closes circuit
- When closed, short-circuit

"single pole, single throw"

"single pole, double throw"
EXAMPLE:

\[ i_x \quad \text{R}=3\Omega \quad 2i_R \]

\[ \pm 10V \]

WHAT IS \( i_x \)?

\[ V_{ccvs} = 2i_R \quad ; \quad V_R = 3i_x \]

\[ 10V - 3i_x - 2i_x = 0 \]

\[ i_x = 2A \]

EXAMPLE:

\[ 5A \uparrow \quad 2\Omega \quad 3i_x \downarrow \]

\[ i_{ccs} = 3i_x \]

\[ 5A = i_x + 3i_x \]

\[ i_x = \frac{5}{4}A \]