

## Unit 10 POWER ELECTRONICS

Lead in

What is power electronics?

What applications of power electronics can you think of?

### Quiz

1. A silicon controlled rectifier (SCR) is a
  - a. unijunction device
  - b. device with 3 junctions
  - c. device with 4 junctions
  - d. none of the above
2. Which of the following finds application in speed control of a dc motor
  - a. FET (Field-effect transistor)
  - b. NPN transistor
  - c. SCR
  - d. none of the above
3. A chopper can be used to step up a dc voltage
  - a. true
  - b. false
4. A dc chopper converts directly from dc to dc
  - a. true
  - b. false
5. A triac is
  - a. 2 terminal switch
  - b. 2 terminal bilateral switch
  - c. 3 terminal unilateral switch
  - d. 3 terminal bidirectional switch
6. Thyristor is a \_\_\_ layered semiconductor device.
  - a. 2
  - b. 3
  - c. 4
7. An inverter converts
  - a. dc to ac
  - b. ac to dc
  - c. ac to ac
8. The value of current flowing through a semi-conductor switch below which it will return to its off state is called
  - a. leakage current
  - b. latching current
  - c. holding current

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**2. Read the text about power electronics and transform the words in brackets.**

The electric energy is not normally used in the form in which it was produced or distributed. Practically all electronic systems require some form of energy \_\_\_\_\_ (convert). A device that transfers electric energy from a given source to a given load using \_\_\_\_\_ (electronics) circuits is referred to as Power Supply (although "power converter" is a more accurate term for such a device).

A typical \_\_\_\_\_ (apply) of a DC power supply unit (PSU) is to convert utility AC voltage into regulated DC voltages required for electronic equipment. What is SMPS? Nowadays in most PSU the energy flow is controlled with semiconductors that are \_\_\_\_\_ (continue) switching on and off with high \_\_\_\_\_ (frequent). Such devices are referred to as switch mode power supplies or **SMPS**. They offer greater efficiency compared with linear supplies because a switch can control energy flow with low \_\_\_\_\_ (lose): when a switch is on, it has low voltage drop and will pass any current imposed on it; when it is off, it blocks the flow of current. As the result, in such a switch the power \_\_\_\_\_ (dissipate) which is the product of voltage and current, can be relatively low in both states. Switching mode units are also smaller in size and lighter in weight due to the reduced size of passive components and lower heat \_\_\_\_\_ (generate). The industry trend toward \_\_\_\_\_ (minute), advancements in semiconductor technology, as well as various energy efficiency regulations have made "switcher" the dominant type of PSU across practically the full spectrum of applications. Most of the PSU manufactured today for AC input applications include a PFC front end. In general, SMPS can be classified into four types according to the form of input and output voltages: AC to DC (also called off-line DC power supply), DC to DC (voltage or current converter), AC to AC (frequency changer or cycloconverter), and DC to AC (inverter). The field of engineering that deals with the design and \_\_\_\_\_ (analyse) of power conversion circuits and devices is called power electronics, although power supply design is a true cross-disciplinary task.

*What do the abbreviations stand for?*

AC \_\_\_\_\_ DC \_\_\_\_\_  
SMPS \_\_\_\_\_  
UPS \_\_\_\_\_  
PFC \_\_\_\_\_

What is Power Supply?

What is SMPS?

Why is SMPS more efficient than linear supplies?

Why is it the dominant type of PSU?

### 3. Complete the sentences with words from the previous exercises

1. \_\_\_\_\_r\_\_\_\_\_ are commonly used to supply AC power from DC sources.
2. A \_\_\_\_\_i\_\_\_ is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC).
3. C \_\_\_\_\_ or a switch-mode power supply converts a dc voltage to another dc voltage.
5. A \_\_\_\_\_r\_\_\_ is a static device that transfers electrical energy from one circuit to another through inductively coupled conductors
6. A \_\_\_\_\_c\_\_\_\_\_ is a material with electrical conductivity due to electron flow (as opposed to ionic conductivity) intermediate in magnitude between that of a conductor and an insulator.

### 4. Listening

In pairs try to answer the questions

1. What are MEMS?
2. What is the purpose of sensors and actuators?
3. How have MEMS influenced
  - Crash systems
  - Printers
  - Displaying images
4. What are the two common examples of MEMS improving existing technology?
5. How can MEMS influence the future of
  - a. Computer market
  - b. Electronics market
  - c. Medicine

Now watch the presentation and check your answers.

5. Fill the gaps with words from the box

usable; milliwatt; capacity; generation; depleted; efficiency; converts; comparable; consumption; surpass
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A breakthrough in piezoelectric power (1)\_\_\_\_\_ is the new voltage regulation circuits that we developed at Louisiana Tech University that efficiently (2)\_\_\_\_\_ the piezoelectric charge into a (3) \_\_\_\_\_ voltage.

A conversion circuit converts the high voltage to a regulated 3 V output for charging batteries or for directly powering electronics at better than 70% conversion(4) \_\_\_\_\_. New voltage regulation circuits can convert the piezoelectric charge in a shoe into a usable

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voltage and combined with the polymer transducer give a time-averaged power of two milliwatts per shoe on an average walk - that's (5) \_\_\_\_\_ to lithium coin/button cells and enough to power running sensors, RF transponders and GPS receivers.

The generated power output can be compared to typical storage (6) \_\_\_\_\_ of 30 mAh for lithium coin/button cells -- with an average current (7) \_\_\_\_\_ 0.5 mA, a miniature coin cell is (8) \_\_\_\_\_ in less than three days whereas the shoe power generator gives power output as long as the user keeps walking. The total energy output can therefore easily (9) \_\_\_\_\_ conventional batteries. In addition to running sensors and inertial navigation, the shoe power generator can be used to power RF transponders, GPS receivers, and locator tags that require a (10) \_\_\_\_\_ power source.

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