202: Principles of electrical science  
**Handout 18: Electronic systems**

**Learning outcome**

The learner will:

1. Understand the types, applications and limitations of electronic components in electrical systems and equipment.

**Assessment criteria**

The learner can:

6.1 describe the function and application of electronic components that are used in **electrical systems**.

**Range**

**Electrical systems**: Security alarms, Telephones, Dimmer switches, Heating/boiler controls, Motor control, Wireless control systems.

**Electrical systems**

### Security alarm system

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| The diagram right shows a circuit diagram for a very simple alarm system to indicate the use of electronic components in everyday electrical equipment.  The normally closed alarm contact maintains the transistor base at ground potential turning the transistor hard off. R1 and R2 set the biasing for the transistor.  When the alarm contact is opened the base rises to a potential higher than the emitter so the transistor turns fully on.  This causes a rise in potential to the gate of the thyristor THY1 which then turns on and the sounder will operate. |  |

The thyristor will remain switched on even if the alarm contact is closed; the only way to turn off the thyristor and hence the sounder is to turn off the supply.

**Telephone systems**

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| Every Plug and Socket Telephone (PST) system must have one master socket, but can have any number of slave/secondary sockets (subject to cable lengths and whether the wiring goes out of the premises).  The Master Line Jack Unit (LJU) contains a capacitor, a resistor and a surge protector.  PBX master sockets used internally have the surge protector and resistor missing.  The capacitor is part of the ringing circuit, the resistor is for line testing purposes and the surge protector is for arresting high-voltage discharges (not lightning!). |  |

Secondary sockets on the other hand have no electrical components.

**Light dimming**

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| The circuit diagram, shown above, is an example of a dimmer switch, where a triac has been utilised for controlling the intensity of light.  When a.c. mains is fed to the above circuit, as per the setting of the pot, C2 charges fully after a particular delay providing the necessary firing voltage to the diac. |  | |
| The diac conducts and triggers the triac into conduction. However, this also discharges the capacitor whose charge reduces below the diacs’ firing voltage.  Due to this the diac stops conducting and so does the triac.  This happens for each cycle of the mains a.c. sine wave signal, which cuts it into discrete sections, resulting in well-tailored lower voltage output.  The setting of the pot sets the charge and the discharge timing of C2 which, in turn, decides for how long the triac remains in a conducting mode for the a.c. sine signals. | |  |

**Heating controls**

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When the temperature is lower than the preset temperature, TR2 transistor conducts and the relay activates the relay terminals to operate the heater.

**Motor control**

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This is speed controller circuit of 12-volt d.c. motor. The speed of rotation can be adjusted from 5‑60rpm.

How does the circuit work? The supply is fed through a transformer to reduce the voltage to 20 volts a.c. The bridge (full wave) rectifier then converts this a.c. to d.c. IC1 is a and gate type integrated circuit. It accepts the voltage from the bridge rectifier on pin 1. There is no filter to smooth the current.

The VR1, C1 and R1 is a phase shift or time delay to slow down or speed up the operation of IC1. The voltage from pin 3 triggers the gate of THY1 which starts conducting to power the motor, causing it to rotate. Speed control of the motor is achieved by adjusting VR1. The power supply input pin 14 of IC1 is filtered to smooth the current, by D2 and C2. D1 prevents the noise from the motor and D3 provides reverse-voltage protection of the motor. This can cause circuit damage.

**Wireless control systems**

With advances in electronics and particularly with most premises now having Wi-Fi, wireless control of accessories is now within the range of most households. This will have the following benefits:

* Allows portable and remote control of accessories.
* Control and adjustment of lights, on/off or create lighting scenes.
* Control shutters, blinds, gates, latches and garage doors.
* Manual or automatic control.
* Monitor window or door opening.
* Simulate occupancy when you are away from home.

Installation is greatly simplified because:

* No additional cables or wall cutting needed. Receivers can be installed behind light fittings or into suitable installation boxes.
* Flexible positioning makes wireless control ideal for installation within existing or newly constructed buildings. With wireless control, you can move switches freely and re-locate when required.
* Transmitters are powered by battery and so do not require any wiring or additional power supply.