

# **Unit 22: Electronic Circuits and Devices**

<b>Unit code</b>	<b>F/615/1496</b>
<b>Unit level</b>	<b>4</b>
<b>Credit value</b>	<b>15</b>

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## **Introduction**

Electronics is all around us today: in our homes, the workplace, cars and even on or in our bodies. It's hard to believe that it was only in 1947 that the transistor was developed by American physicists John Bardeen, Walter Brattain, and William Shockley. The invention of the transistor paved the way for cheaper radios, calculators and computers.

This unit introduces students to the use of electronics manufacturers' data to analyse the performance of circuits and devices, the operational characteristics of amplifier circuits, the types and effects of feedback on a circuit performance, and the operation and application of oscillators. They will also be introduced to the application of testing procedures to electronic devices and circuits, and use the findings of the tests to evaluate their operation.

Among the topics included in this unit are: power amplifiers, class A, B and AB; operational amplifiers, inverting, non-inverting, differential, summing, integrator, differentiator; types such as open, closed, positive and negative feedback; frequency, stability, frequency drift, distortion, amplitude, wave shapes and testing procedures.

On successful completion of this unit students will be able to determine the operational characteristics of amplifier circuits, investigate the types and effects of feedback on an amplifier's performance, examine the operation and application of oscillators and apply testing procedures to electronic devices and circuits.

## **Learning Outcomes**

By the end of this unit students will be able to:

1. Determine the operational characteristics of amplifier circuits.
2. Investigate the types and effects of feedback on an amplifier's performance.
3. Examine the operation and application of oscillators.
4. Apply testing procedures to electronic devices and circuits.

## Essential Content

### LO1 Determine the operational characteristics of amplifier circuits

*Operational characteristics:*

Power amplifiers: class A, B and AB

Operational amplifiers: inverting, non-inverting, differential, summing, integrator, differentiator, comparator, instrumentation, Schmitt trigger, active filters

Gain, bandwidth, frequency response, input and output impedance

Distortion and noise

### LO2 Investigate the types and effects of feedback on an amplifier's performance

*Types and effects:*

Types including open, closed, positive and negative feedback

Effect of feedback on gain, bandwidth, distortion, noise, stability, input and output impedance

### LO3 Examine the operation and application of oscillators

*Operation and application:*

Types of oscillators such as Wien bridge, Twin-T, R-C ladder, L-C coupled, transistor, operational amplifier, crystal

Frequency, stability, frequency drift, distortion, amplitude and wave shapes

### LO4 Apply testing procedures to electronic devices and circuits

*Testing procedures:*

Measuring performance, using practical results and computer simulations

Voltage gain, current, bandwidth, frequency response, output power, input and output impedance

Distortion and noise

*Devices to test:*

Semiconductors

Integrated circuits

Amplifiers

Oscillators

Filters

Power supplies

Integrated circuit (IC) voltage regulators

Combined analogue and digital IC's

*Component manufacturer's data:*

Specifications, manuals and circuit diagrams

*Use of testing equipment:*

Meters, probes and oscilloscopes

Signal generators and signal analysers, logic analysers

Virtual test equipment

## Learning Outcomes and Assessment Criteria

Pass		Merit	Distinction
<b>LO1</b> Determine the operational characteristics of amplifier circuits			<b>D1</b> Assess the results obtained from the application of practical and virtual tests on amplifier circuits studied
<b>P1</b> Describe the types of amplifiers available and their applications <b>P2</b> Examine the different performance characteristics of types of amplifier	<b>M1</b> Explain the results obtained from applying practical tests on an amplifier's performance		
<b>LO2</b> Investigate the types and effects of feedback on an amplifier's performance			<b>D2</b> Evaluate the results of practical and virtual tests to analyse the effect of feedback on an amplifier's performance
<b>P3</b> Examine the types of feedback available and their effect on the amplifier's performance <b>P4</b> Describe a circuit which employs negative feedback	<b>M2</b> Perform practical tests to show the effect of feedback on an amplifier's performance		
<b>LO3</b> Examine the operation and application of oscillators			<b>D3</b> Analyse the results obtained from applying practical and virtual tests on oscillators studied
<b>P5</b> Examine types of available oscillators and their applications	<b>M3</b> Assess the performance characteristics of types of oscillators		
<b>LO4</b> Apply testing procedures to electronic devices and circuits			<b>D4</b> Analyse and compare the results obtained from applying practical and virtual tests on devices and circuits studied
<b>P6</b> Select suitable electronic devices and their parent circuits and identify the appropriate manufacturer's data sheets <b>P7</b> Interpret relevant information from manufacturer's data when testing electronic devices and circuits	<b>M4</b> Perform tests on electronic devices and circuits, recording results and recommending appropriate action		

## Recommended Resources

### Textbooks

BOYLESTAD, R.L. and NASHELSKY, L. (2013) *Electronic Devices and Circuit Theory*. 11th Ed. Pearson.

FLOYD, T.L. and BUCHLA, D. (2013) *Electronics Fundamentals: Circuits, Devices & Applications*. 8th Ed. Pearson.

HOROWITZ, P. and HILL, W. (2015) *The Art of Electronics*. 3rd Ed. Cambridge University Press.

### Websites

<a href="http://www.electronics-tutorials.ws">www.electronics-tutorials.ws</a>	Electronic Tutorials Amplifiers (Tutorials)
<a href="http://www.learnabout-electronics.org">www.learnabout-electronics.org</a>	Learn About Electronics Amplifiers (Tutorials)
<a href="http://www.learnabout-electronics.org">www.learnabout-electronics.org</a>	Learn About Electronics Oscillators (Tutorials)
<a href="http://www.electronics-tutorials.ws">www.electronics-tutorials.ws</a>	Electronic Tutorials Oscillators (Tutorials)
<a href="http://learn.mikroe.com/">http://learn.mikroe.com/</a>	Mikro Elektronika Introduction to checking components (E-Book)

### Links

This unit links to the following related units:

*Unit 43: Machines and Drives*