Course: BTEC L3 Extended Diploma in Engineering / Diploma in Electrical / Electronic Engineering

Student:

Unit/s: 57: Principles and Applications of Analogue Electronics

Outcome/s: 2, 3 Analogue Devices

Grading criteria:

| P4 | Explain the operation of three common analogue integrated circuit devices |
| P5 | Describe two system applications of each of three common analogue integrated circuit devices |
| P6 | Use computer-based simulation methods to produce a possible design solution for three different analogue circuit systems |
| M2 | Justify the selection of specific analogue integrated circuit devices to meet a given design specification |
| D1 | Analyse the results of a designed electronic circuit with reference to measured signal in terms of both voltage and frequency |
| D2 | Evaluate computer-based and practical methods used to analyse the behaviour of an analogue circuits with respect to their effectiveness in the design process |

Pass: |Merit:| Distinction:

Instructions:

- attempt all questions
- work to be legible and succinct, with an adequate grasp of grammar, punctuation and spelling
- calculators may be used but show working step by step
- ensure sketches & diagrams are clear, accurate & labelled
- true graphs, titled & axes labelled
- list sources where appropriate.

Student feedback:

Student declaration – The assignment attached is my own work
Signed: Date:

Assessor feedback:

Signed: Date:

Internal verification (Before issue) Issue date Student hand in date Internal verification (assessment decision)

RP 5/3/13
## Grading Criteria and Feedback

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Assignment – Analogue Devices

Using your class notes and any other suitable resources, attempt the following tasks. Show all of your workings and draw supporting circuit diagrams.

This practical and written assignment provides evidence for satisfaction of the Learning Outcomes P4, P5 and P6, and the opportunity to achieve M2, D1 and D2. (The relevant grading criteria are given in brackets after each task).

Tasks

1 Operational Amplifiers

a. Explain the operation and main characteristics of the operational amplifier IC, include in your answer reference to open and closed loop gains, bandwidth, input and output impedances, size and cost.  

(P4 part)

b. Describe the operation of the summing amplifier shown in figure 1; reference should be made to Kirchhoff’s laws and to the concept of the “virtual earth”. State the equation for determining the output voltage of the circuit shown in figure 1. Describe an example where a summing amplifier would be used.  

(P5 part)

c. Draw the basic circuit diagram for differential amplifier using an operational amplifier and briefly describe the operation of the circuit. Give an example where a differential amplifier circuit may be applied.  

(P5 part)

2 Weighted Resistor Summing Amplifier

Design a circuit design for the weighted resistor summing amplifier shown in figure 1. Determine the suitable resistor values for the circuit. The reference voltage $V_{ref} = -5V$ and $R_1 = R_5$.  

Both practically build and simulate the circuit, using the MultiSim application. Record the output voltage for all possible switch combinations for both the practical and simulated circuits.  

(P6 part)
3 Analogue Switches

a. Explain the operation and main characteristics of the analogue switch IC, include in your answer reference to on/off impedances, speed of operation, etc.

Support your answer with suitable internal structure diagrams and with data drawn from manufacturers' datasheets.  

(P4 part)

b. Describe two applications of analogue switch ICs. 
Support your answer with typical circuit diagrams.

(P5 part)

4 Weighted Resistor DAC

Using the MultiSim application, modify your circuit design developed in task 2 (Figure 1) above by replacing the manual switches with a suitable analogue switch to create a weighted resistor DAC circuit.

Simulate the circuit design and record the output voltage for all possible switch combinations.

(P6 part)
5 Timer Circuits

a. Explain the operation and main characteristics of the 555 Timer IC. Make reference to the major internal component structures, e.g. voltage dividers, comparators, registers, switches and buffers.

Support your answer with suitable internal structure diagrams and with an IC pin out drawing.

(P4 part)

b. Describe two applications of the 555 timer circuit. Support your answer with circuit diagrams and relevant component selection equations.

(P5 part)

6 555 Timer Astable

Using the MultiSim application, produce a circuit design for the astable circuit shown in figure 2. Determine the suitable component values for the circuit. The design pulse repetition frequency is 1 kHz and the duty cycle is to be 67%.

Simulate and record the voltage waveforms produced across the capacitor and at the output.

(P6 part)
7 Component Selection

Justify your selection of the analogue switch and operational amplifier integrated circuit devices used in tasks 2 and 4 to meet the given design specification. Make reference to relevant data on the manufacturers' datasheets to support your answer.  

(M2)

8 Measured Circuit Signal Analysis

Analyse the results obtained for the 555 Timer astable electronic circuit (task 6) with reference to the measured signals in terms of both voltage and frequency. Discuss the switching capacitor voltages with reference to the circuit operation, and the effect of the capacitor charge and discharge circuit resistances on the frequency and dutycycle of the output waveform  

(D1)

9 Circuit Analysis Method Evaluation

Evaluate computer-based and practical methods used to analyse the behaviour of one of the above the analogue circuits with respect to their effectiveness in the design process. Your answer is to include advantages and disadvantages for both methods.  

(D2)