Combinational Logic

HIGHER NATIONAL DIPLOMA

组合逻辑

【英】苏格兰学历管理委员会（SQA）

Unit Student Guide

ELECTRONIC ENGINEERING DG3C 34




中国时代经济出版社

SCOTTISH QUALIFICATIONS AUTHORITY

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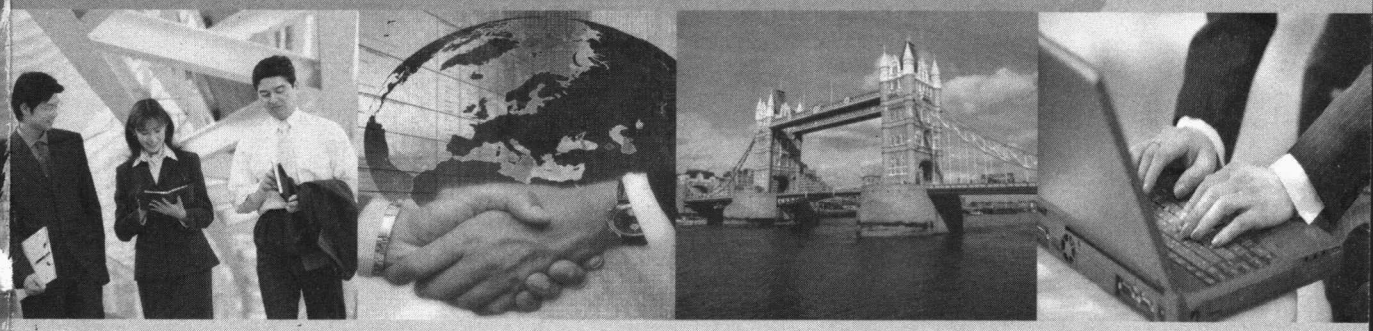

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组合逻辑

Combinational Logic

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Contents

1 Introduction to the unit

1.1 What this unit is about

This unit **DG3C 34 Combinational Logic** develops an understanding of digital electronics. It starts by looking at the nature of analogue and digital signals then goes on to explore the number systems, arithmetic and logic gates commonly found in digital systems. Techniques are developed for designing, constructing, simulating and testing digital circuits.

1.2 Outcomes

There are four outcomes that this unit hopes to achieve. When you have completed it you should be able to:

1. Solve problems involving number systems and binary arithmetic.

2. Draw truth tables for common logic gates and derive combinational logic expressions.

3. Interpret TTL and CMOS data sheets and use these devices in digital systems.

4. Design and implement combinational circuits.

1.3 Unit structure

This unit contains the following study sections:

Section number and title		Approximate study time
1	Digital signals	0.5 hours
2	Number systems	4.5 hours
3	Logic gates	3 hours
4	Arithmetic logic	3 hours
5	Combinational logic	4 hours
6	Karnaugh maps	5 hours
7	Circuit implementation	12 hours
8	Device characteristics	6 hours

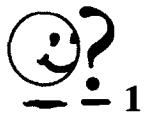
1.4 How to use these learning materials

Work through each section in sequence. Look ahead to other sections if you need to.

1.5 Symbols used in this unit

These learning materials allow you to work on your own with tutor support. As you work through the course, you will encounter a series of symbols which indicate that something follows that you are expected to do. You will notice that as you work through the study sections you will be asked to undertake a series of self assessed questions (SAQs), activities and tutor assignments. An explanation of the symbols used to identify these is given on the next page.

Self-Assessed Question



This symbol is used to indicate a self-assessed question (SAQ). They are used to check your understanding of the material that has already been covered in the sections.

This type of assessment is self contained; everything is provided within the section to enable you to check your understanding of the materials.

The process is simple:

- you are set SAQs throughout the study section
- you respond to these by writing either in the space provided in the assessment itself or in your notebook
- on completion of the SAQ you turn to the back of the section to compare the model SAQ answers to your own
- if you are not satisfied after checking your responses, turn to the appropriate part of the study section and go over the topic again

Remember that the answers to SAQs are contained within the study materials. You are not expected to guess at these answers.

Activity


1

This symbol indicates an activity, which is normally a task that should improve or consolidate your understanding of the subject in general or a particular feature of it.

The suggested responses to activities follow at the end of each section.

Remember that the SAQs and activities contained within your package are intended to allow you to check your understanding and monitor your own progress throughout the course. It goes without saying that the answers to these should only be checked after the SAQ or activity has been completed. If you refer to these answers before completing the activities, you cannot expect to obtain maximum benefit from your course.

Tutor assignment—formative assessment


1

This symbol means that a tutor assignment follows. These will be found at the end of each study section. The aim of the tutor assignment is to cover and/or

incorporate the main topics of the section and prepare you for the unit (summative) outcome assessment.

1.6 Other resources required

Students will need access to some form of prototyping system such as a logic tutor or breadboard and power supply as well as TTL and CMOS integrated circuits for the NOT, AND, NAND, OR, NOR and EXOR gates. Logic simulation software is also required as well as a scientific calculator. Access to manufacturer's datasheets is also needed.

1.7 Assessment information

How you will be assessed

This unit will be assessed by a 1-hour written assessment covering all of Outcomes 1, 2 and 3. Outcome 4 will be assessed separately by a 1-hour circuit design and practical build exercise.

When and where you will be assessed

Assessment will take place at the end of the unit.

What you have to achieve

Refer to the individual sections.

Opportunities for reassessment

Normally, you will be given one attempt to pass an

assessment with one reassessment opportunity.

Your centre will also have a policy covering exceptional circumstances, for example if you have been ill for an extended period of time. Each case will be considered on an individual basis and is at your centre's discretion (usually via written application). They will decide whether or not to allow a third attempt. Please contact your tutor for details regarding how to apply.

2 Section 1: Digital signals

2.1 Introduction to this section

What this section is about

In this section you will be introduced to some basic ideas about the nature of analogue and digital signals.

Outcomes, aims and objectives

In this section you will learn to recognise analogue and digital signals, and understand the continuous and discrete nature of these signals.

Approximate study time

0.5 hour.

Other resources required

None.

2.2 Assessment information for this section

How you will be assessed

Assessment for this section will be covered by the by the 1-hour written unit assessment covering Outcomes 1, 2 and 3.

When and where you will be assessed

Assessment will take place under supervised exam conditions at the end of the unit.

What you have to achieve

For this section you will be expected to:
state whether a given signal is digital or analogue.

Opportunities for reassessment

Reassessment will be possible at a time and place arranged by your centre.

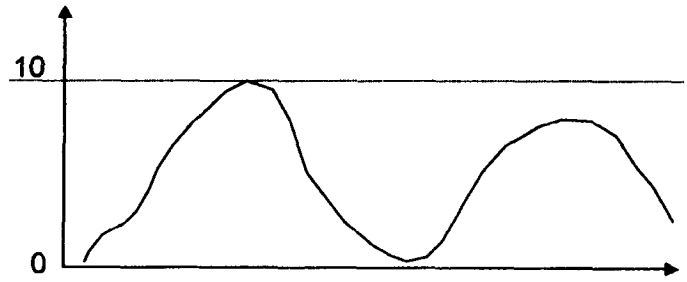
2.3 Analogue and digital signals

In the world of electronics there are two types of circuit:

- analogue circuits
- digital circuits.

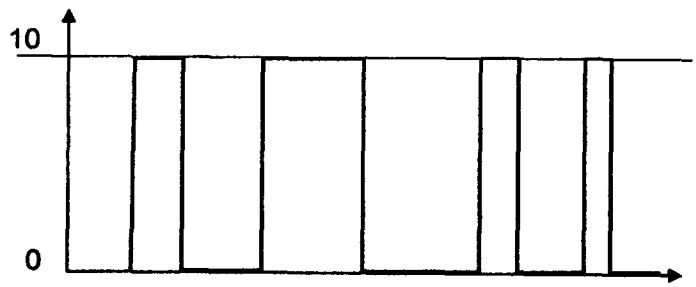
Analogue circuits process analogue signals and digital circuits process digital signals.

An analogue signal is a continuous unbroken signal, whereas a digital signal is discontinuous or discrete.



Analogue signal

The analogue signal can be seen to be continuous, that is it changes from one value to the next without a break. There is a smooth transition between one level and another. The analogue signal can therefore take on any value between 0 and 10, for example 1.49, 7.3, etc.



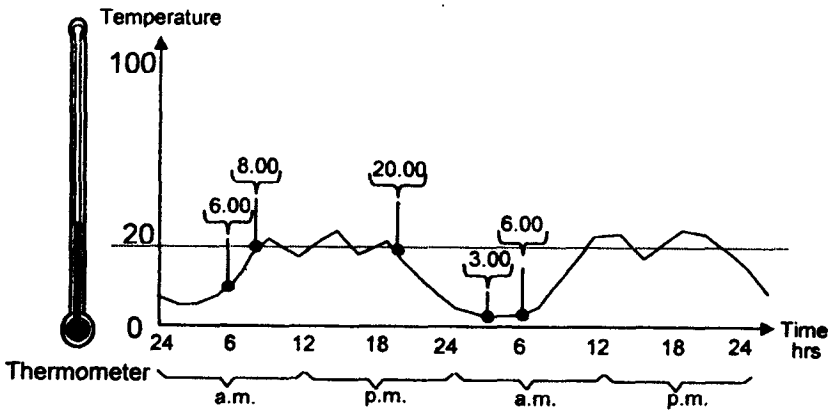
Digital signal

The digital signal above is discontinuous, it is discrete, it has only two levels and there is an abrupt change between one level and the next. It can therefore take on only two values, 0 or 10.

With these two types of signal all physical processes can be described.

Nature of analogue and digital signals

The height of a column of mercury in a thermometer can be recorded and plotted on a graph as an analogue signal.



Analogue temperature signal

The analogue signal above shows the temperature in a building over the course of two days in midwinter, as recorded by the height of the thermometer.

The heating system in a building runs from 6.00 a.m. to 6.00 p.m. and the temperature change over the course of each day is recorded on the graph above. Starting with a low temperature in the morning at 6.00 a.m. the temperature rises progressively towards 20℃ by around 8.00 a.m. in the morning. The temperature cycles about the set temperature until around 8.00 p.m. with a gradual decrease in temperature towards 0℃ around 3.00 a.m. in the morning until the cycle starts again at 6.00 a.m. During this time the temperature can be any