GCE

Electronics

Advanced Subsidiary GCE **AS H065**

Report on the Units

June 2009

H065/MS/R/09

Oxford Cambridge and RSA Examinations

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This report on the Examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the syllabus content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the Examination.

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

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Advanced Subsidiary GCE Electronics (H065)

REPORTS ON THE UNITS

F611 Simple Systems

General Comments

All but the very weakest candidates attempted all of the questions on this paper. The candidates showed knowledge of the whole specification for this component with no noticeable gaps. Most candidates answered questions about truth tables well and were clearly experienced with digital logic. Many candidates were comfortable with the calculations although there is room for improvement in showing their working. Candidates showed familiarity with the common prefixes (n, µ, m, k, M) that appeared on the paper although a few candidates did not remember the correct exponent for µ or just ignored the prefixes in their calculations. Calculations involving potential dividers or resistors in series with other devices often contained errors showing a misunderstanding of the underlying concepts. Where candidates had to describe or explain things most showed that they had learnt and could recall a lot of electronics although a significant number struggled to express the ideas fully. Candidates were able to complete circuit diagrams and showed good knowledge of circuit symbols. Almost all candidates were familiar with the conventions of Boolean algebra and showed experience of using the rules although accurate manipulation of expressions proved challenging for most candidates. Most candidates found the question requiring them to draw the graphs of voltage against time difficult.

Comments on Individual Questions

1 The vast majority of candidates answered parts a and b well. Most could produce the correct circuit for part c but a number had problems with NAND gate equivalences or drew symbols which were difficult to interpret. Most candidates could justify their circuits for part d, usually choosing to do so with a truth table but a significant number lost marks through not labelling all intermediate points in their circuit in c and not showing columns for the intermediate points in the truth table.

2 a Almost all candidates could identify the thermistor and knew that it was temperature dependent. A few candidates failed to identify how the temperature changed with resistance.

b i Most candidates knew how to connect a potentiometer but a significant proportion had difficulty with either connecting the third leg of the potentiometer or the symbol, showing a variable resistor or an invented symbol instead.

b ii Most candidates understood saturation but significant numbers failed to describe the sudden transition from -13 V to +13 V.

b iii Well done by almost all candidates who attempted this.

c i Most candidates realised that the diode was reverse biased but not all explained that it would not be conducting in this state.

c ii Many candidates made a reasonable attempt at this potential divider calculation but most had problems getting the correct answer through not identifying the correct resistor to find the voltage or failing to calculate the current correctly.

c iii Many candidates found this question challenging with a large proportion giving an answer of 0V.

c iv Very few candidates obtained more than 1 mark as most failed to mention the region of uncertainty and just suggested that 2.5 V was the threshold between logic 0 and logic 1.

3 a Most candidates answered this question well but significant numbers failed to remember that a resistor of at least 10 kΩ is needed and many forgot the 0.5 in the equation giving answers that were incorrect by a factor of 2. Some students had problems with μ, often showing this as 10^{-9} or just ignoring the prefix altogether.

a ii This presented little problems for most candidates.

bi & ii This question was challenging for the majority of candidates. Many candidates realised that the output was a square wave but did not always get the amplitude, period and phase of the inputs and outputs correct. A significant number of candidates drew a graph of the transfer characteristics of a Schmitt trigger.

b iii Most candidates could connect an oscilloscope correctly but most did not know the symbol. The mark was awarded for the connections not the symbol in this question. A number of students failed to correctly identify the input of the NOT gate.

c i Most candidates knew why the MOSFET was needed but a significant number wrongly mentioned voltage amplification or protecting the speaker.

c ii A significant number of candidates could not correctly label the MOSFET connections or even correctly identify where the connections were on the symbol.

c iii Good candidates realised the relationship between VGS and RDS but most failed to mention the big change in RDS around the threshold voltage. A significant number of candidates got the relationship the wrong way round or failed to mention RDS.

d Most candidates could calculate peak power but most failed to find the average power by halving the peak power.

4 a i This provided full marks for most candidates.

a ii Most candidates thought that the arrows showed flow of current or voltage. Only a minority of candidates realised the significance of the arrows in a block diagram.

b The table was completed well and most candidates could describe how the circuit functioned although some failed to talk about the state of the switches or the LED restricting their comments to logic states.

c i Most candidates could explain the function of the resistor. Many candidates failed to adequately explain what would happen to the LED without the resistor with vague statement about the LED 'blowing' often being offered.

c ii Most candidates had no problems with this.

c iii Many candidates had problems finding the correct voltage across the resistor although almost all could use Ohm's law.

d Most candidates did not explain why the power lines were not shown for logic gates merely stating that they were not needed.

5 ai Many candidates got full marks here but some wrote $\overline{A \cdot B \cdot C}$ instead of $\overline{A} \cdot \overline{B} \cdot \overline{C}$. Some candidates tried to work backwards from part ii rather than look at the truth table.

a ii Few candidates got full marks for this. Many candidates showed evidence of being able to use the rules of Boolean algebra without being able to get to the desired answer and so obtained some of the marks. Although one of the Boolean algebra rules on page 2 of the exam paper contained a printing error, the mark scheme allowed candidates to earn full marks without necessarily providing a complete proof with the incorrectly printed rule.

a iii Most candidates could produce a circuit to implement the expression in ii.

b i Most candidates could produce the correct circuit but a number inverted the wrong input.

b ii Most candidates who answered i correctly and attempted this question could justify their circuit in i.

b iii Many candidates found it difficult to express their explanation clearly.

6 a Most candidates could do this calculation; some had problems with powers of 10. A few students used the wrong formula.

b Many candidates picked up some marks but were confused about charging and discharging.

c Many candidates failed to understand how the circuit would behave when the switch was released. Few candidates gave the correct time for the light to stay on, when candidates did write down a time it was often the time constant calculated in part a.

F612 Signal Processors

General Comments

This was the first paper for the new specification. As such, it contained two types of question - those similar to ones for the old specification, and others which were on completely new topics. The latter proved to be problematic for many candidates, particularly the one involving microcontrollers (see the comments on Q5 below). The change of specification has also resulted in a subtle change of emphasis where calculations are concerned. Since all formulae are listed on the first page of the paper, marks can no longer be awarded for recalling formulae used in calculations. Instead, marks are now awarded for applying a formula. The specification also has a greater emphasis on the transfer characteristics of subsystems and components, expressed as graphs, formulae and descriptions.

There was no evidence that candidates ran out of time. All of the marks were accessible, as one candidate managed to earn full marks. It was good to find that most candidates had attempted every question.

Comments on Individual Questions

1 The vast majority of candidates correctly completed the truth table and many were able to use the information provided to work out that the alarm started when the car was moved. However, most weak candidates failed to recognise the bistable arrangement of the gates and assumed that the alarm stopped when the car stopped moving again. In their explanations of circuit operation, even the strongest candidates failed to mention the state of D, or assumed that the switch had been pressed so that D was low. Many students clearly assumed an answer and worked back through the circuit to justify it - a risky practice.

2 This question was about amplifiers and audio signals, not normally a good topic for candidates, so it was pleasing to find that many earned high marks. The vast majority correctly used information from the graphs to work out the gain of the amplifier, but many weak candidates failed to indicate that it was negative. For the next part, candidates had to design an amplifier which matched their calculated gain, so many weak candidates were required to produce a non-inverting amplifier. Either way, it was good to find that the majority of candidates could earn full marks for this. Finally, adding the microphone, resistor and capacitor to the input provided a lot of discrimination, with weak candidates earning zero and a minority of strong candidates earning three marks - many candidates were unable to correctly draw the symbol for the microphone. Centres need to realise that drawing incorrect symbols (ie not as shown in the specification) risks a penalty.

3 This question was about sequential systems. Most candidates were able to connect the flip-flops to make a binary counter, with only a minority getting confused about the order of the outputs A, B and C. About 10% of candidates omitted to add the logic gate to reset the counter on every fifth pulse, with only the strongest candidates able to earn both marks. Unexpectedly, completing the truth table for the sequential system proved to be an easy task for most candidates, despite the complications of a NOT gate at one of the inputs of the EOR gates, suggesting that candidates have had lots of experience at sorting out the behaviour of logic systems. The timing diagram was also well answered, although many candidates tended to lose marks because they forgot about the reset from the AND gate they had added. Candidates need to realise that each of the eight (or so) questions on the paper develop a different theme, where later parts often incorporate earlier developments and calculations made by the candidate.

4 Most candidates had no difficulty in identifying the circuit as a treble cut filter. Weak candidates were often unable to correctly calculate the break frequency, often failing to convert units correctly or using the wrong resistor. The use of error-carried-forward throughout the paper meant that each of these errors only incurred a penalty of one mark. Too many weak candidates were unable to calculate the low frequency gain - perhaps they hadn't appreciated that all active filters become inverting amplifiers when the capacitor can be ignored. To earn full marks, the gain-frequency graph had to follow candidates' answers to the previous parts of the question. Although many candidates were able to draw graphs for the correct gain and break frequency, only a minority drew the roll-off at 45 degrees.

5 Microcontrollers are a new topic for AS Electronics. As such, care was taken with this question to ensure that its style matched that of the question in the Specimen Paper. Nevertheless, the performance of many candidates was disappointing. Too many candidates did not know that Q7 was the msb of the word at the output port, so was the first digit of the word, and were unable to convert the binary word that they did write down into hexadecimal. Only a minority of candidates related the flowchart to the behaviour of the circuit, despite clear instructions to do so. There were no marks awarded for using the information at the start of the paper to write down the sequence of operations inside the microcontroller unless they also mentioned the effect of the switches or the effect on the LEDs and the beeper. The flowchart for the missing part of the program was also badly answered, for several reasons. Candidates lost marks by omitting arrows between symbols, using the incorrect shape of symbol and not restricting themselves to the symbols on page 3. For example, many candidates wrote "let output = 80" in a square box. This suggests that in their practical work, many centres had allowed their candidates to use the full range of commands available instead of just the ones required by OCR.

6 This question was about the transfer characteristics of a non-inverting amplifier. All candidates correctly added the voltmeter, but some failed to use the correct formula to calculate the gain of the amplifier. The graph was well drawn by many candidates, with many weak candidates forgetting about saturation at +13 V.

7 For this question, candidates had to analyse the operation of a one-shot sequencer. Many candidates clearly needed more practice at this. Only a minority realised that the flip-flop would reset on the eighth pulse so the LEDs would display 0 for eight seconds and beyond. Too many candidates described what the circuit did instead of explaining it.

8 Although most candidates could use the information provided to do the voltage calculation, very few were able to explain the effect of releasing the switch or calculate its effect on the input voltage. This suggests that they didn't have a good mental model of the circuit at the input. Impedance matching is a difficult topic, but good candidates should be able to apply a voltage divider model - as indeed, some did.

F613 Build and Investigate Electronic Circuits

In this first coursework module of the new specification, the raw marks submitted by centres were found by the moderators to be very accurate for the vast majority. This is undoubtedly due to the tighter marking criteria and the requirement that every mark awarded must be justified on the piece of work being marked. The specification suggests that this justification is done by using a red pen to indicate on the script where the individual mark has been awarded. This marking system has 2 benefits:

1 It allows centres to focus on the awarding of marks.

2 It allows moderators to identify any problem areas encountered during the moderation process.

The vast majority of centres adhered to this system and I do believe that it is a very useful system which helps to ensure parity of marking across the entire cohort. Interestingly, for those centres who failed to use this system (which, it must be stressed, is a requirement of the specification), the majority fell outside the tolerance allowed by OCR.

I also believe that the main aim of this new coursework, namely to better prepare candidates for the building, testing, and analysing of subsystems, has been achieved. The comments that have been passed on to me from centres have been very positive and centres are encouraged to pass all comments regarding coursework on to the Qualifications Manager for Electronics at OCR.

It is always worthwhile in these reports to highlight problem areas that moderators have experienced during the moderation process. I shall deal mainly with the digital/analogue descriptors, as the problem areas for the microcontroller descriptors are very similar.

Digital/Analogue Circuit Descriptors

1a This section is designed to get candidates thinking about the circuit and understanding its operation in order to predict expected behaviour. 4/4 marks can only be awarded if the candidate has given a practical use of the circuit, **fully** described the circuit, and made **detailed** predictions of expected behaviour. The circuit must be given to the candidates and **no designing is to be done by the candidates**. This last point was not always adhered to by some centres who let the candidates do some designing of the circuit values. This is not required for this module.

1b This section is about designing a test routine **BEFORE** the test is carried out. There was some evidence that a few candidates had done the testing and then retrospectively did a test routine, or simply did not write about the test routine but just went ahead and did some testing. In this case, 0/3 would be awarded for this section. The actual tests must be evidenced in the report so candidates should consider this at this early stage. 3/3 marks cannot be awarded here if 4/4 has not been achieved in 1a. Some centres fell foul of this. If moderators thought that section 1a was not worth 4/4, then 3/3 cannot be awarded for 1b – potentially, 2 marks could be lost here if the marking is not accurate.

2 Circuit build is always a little subjective but most centres were accurate in their assessment. It is planned that more support in the form of photos of marked circuit builds will be posted on the OCR support website – look out for these.

3c This section awards marks to candidates who are able to analyse fully the data taken from the test routine. It is a vital skill to be learned. The analysis is likely to involve some numerical work which candidates must specifically show in the report. Some reports contained analyses which were too vague for the awarded mark. Some test equipment is now able to analyse results automatically. Should a centre possess such equipment, the candidates would still be expected to show how the analysis has been done and justify the analysis, not simply quote it.

4a 1 mark for this is awarded for a correct circuit diagram. The circuit diagram should show power supplies, have inputs on the left, outputs on the right, and integrated circuits should NOT be shown simply as a pin-out diagram. It is much more logical to arrange integrated circuits as inputs on the left, outputs on the right. Further marks are awarded for diagrams that support the written communication. This will undoubtedly include a diagram (or more) to show **how** the testing is to be done. These diagrams must show how the test equipment is to be connected to inputs/outputs. In other words, if a voltmeter is the chosen test equipment for the input, the correct voltmeter symbol must be included in the correct position on the diagram. Other diagrams that candidates may wish to include in the report could be, for example, correct explanatory diagrams for circuit predictions.

Microcontroller Circuit Descriptors

The above comments also apply to the microcontroller circuit. However, since the microcontroller circuit is the only one which candidates are expected to design, it is worthwhile highlighting a couple of important points.

Firstly, candidates are expected to design the flowchart and circuit by themselves. If they cannot do this, or need an excessive amount of support, then the marks for 1a will not be high. Secondly, it is a requirement of the microcontroller circuit that it contains a minimum of 2 inputs, one of which should be time-dependent. A few circuits have been seen which do not contain this minimum. A time-dependent input is one whose state can change over time. This could be analogue or digital, but the flowchart has to respond in some way to this changing signal. Examples of typical time-dependent signals could be a square wave which the circuit counts, a varying analogue signal which is put into the ADC input pin, or even a switched digital input which, for example, changes the rate at which traffic lights go through the routine. In addition to the minimum of 2 input pins used, there is also the requirement that a minimum of 2 output pins are used.

For further advice and support with coursework, please contact the Qualifications Manager at OCR.

Grade Thresholds

Advanced GCE Electronics (H065 H465)
June 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
F611	Raw	90	59	52	45	39	33	0
	UMS	110	88	77	66	55	44	0
F612	Raw	90	56	49	42	36	30	0
	UMS	110	88	77	66	55	44	0
F613	Raw	80	63	55	47	39	31	0
	UMS	80	64	56	48	40	32	0

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
H065	300	240	210	180	150	120	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
H065	27.4	39.4	56.0	69.1	81.7	100.0	487

497 candidates aggregated this series

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

(General Qualifications)
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553