RECOGNISING ACHIEVEMENT

GCE

Electronics

Advanced GCE **A2 H465**

Advanced Subsidiary GCE **AS H065**

OCR Report to Centres

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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 specification 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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OCR REPORT TO CENTRES

F611 Simple Systems

General Comments

Once again, there were very few incidences of candidates not attempting questions; given the wide coverage of the specification in the paper this suggests that almost all candidates were broadly familiar with all parts of the specification. There were some excellent answers on many scripts with candidates showing a good understanding of electronics.

However, it useful for future candidates and their teachers to be aware of some of the more common mistakes so that they can prepare for exams and overcome some of the common misconceptions in the subject. There were some noticeable issues which limited the marks of a number of candidates.

Some weaker candidates had problems converting from milli and micro to base units.
Several candidates wrote down answers that were out by a factor of 10; this often indicates incorrect use of calculators when dealing with numbers in standard form.

Some candidates used too few significant figures in calculations and so gave an incorrect answer. This is a particular problem where candidates only used one significant figure in intermediate calculations so rounding errors compounded quickly.

Algebraic manipulation proved to be a problem for some weaker candidates who could not get the correct numerical answer to a question because they could not accurately rearrange a formula. Simple algebraic manipulation is an important skill.

There were some examples of candidates not answering the question as written on the paper. This may be due to not reading the question carefully due to the stress of the exam or it could be that the candidates were just writing down all that they knew associated with the topic. Most candidates are not short of examination time and should be able to read the question a second time to make sure that they know what they are being asked to do.

Some candidates incorrectly simplified Boolean algebra where no manipulation was necessary so lost marks. Unless candidates are completely secure with their Boolean algebra it is unwise to try to manipulate an equation unless asked to do so.

Written explanations continue to be a challenge for weaker candidates. There is a tendency for some answers to describe rather than explain what a circuit does. Many good answers used a structure which worked through the circuit from left to right or in time sequence. The use of bullet points or a number or short, single idea sentences can help focus answers and reduce repetition.

Candidates should be aware that multiple answers to the same question do not get marks even if one answer is correct unless all but one are clearly crossed out. There were some examples of candidates providing more than one answer to a question.

Comments on Individual Questions

1 **(c)** Was usually answered correctly with a surprisingly large number of candidates choosing to represent this as a sum of products $C = \overline{A}\cdot\overline{B} + A\cdot\overline{B} + \overline{A}\cdot B$. There were a number of candidates who do not show understanding of the length of the NOT symbol and incorrectly write $C = \overline{A}\cdot\overline{B}$

1 (e) A significant number of candidates had problems labelling the terminals of a MOSFET. There were a range of names for terminals with 'sink' being a commonly used and some quite random placing of labels.

1 (f) Was often well done but exposed those whose understanding was less than certain.

1 (g) Was well answered by almost all candidates and was intended to prepare them to answer part (h). However, (h) proved to be challenging for most candidates. Most candidates incorrectly looked for a device which could dissipate more than 0.6 W and chose the BS170 rather than looking for the cheapest device which could adequately sink 0.12 A. Some candidates may incorrectly think that the power dissipated by devices in series is the same or are failing to associate the power with a single component. This type of question tests the useful practical skill of selecting an appropriate component from a catalogue as well as testing understanding of electrical quantities.

2 (b) There were a range of answers for the graph showing the current-voltage characteristics of the zener diode. Many candidates failed to show that the zener diode begins to conduct at about 0.7 V when forward biased. There were a number of graphs that were symmetrical with conduction at ±3.6 V. Many graphs were insufficiently steep in the region where the zener diode conducts with some lines as shallow as 45°.

2 (c) Was usually done well but there were some issues with candidates not using enough significant figures in their calculations so arriving at imprecise answers. There were also some examples of poor rounding e.g. 2.56 rounded to 2.5

2 (d) Proved challenging for most candidates. Many candidates expressed poor notions of electricity referring to voltages flowing or not flowing. About 45% of candidates correctly stated that no current would flow through the diode and were awarded 1 mark (many of them correctly adding that the diode was reverse biased). However, there was little mention of the 22 k resistor, many candidates said that there was no effective connection and so the potential would be at 0 V rather than correctly stating that this would provide a floating and so undetermined input at the OR gate input. There were some excellent answers showing good understanding from about 10% of candidates.

2 (e) Discriminated well between weak and strong candidates. The main task in this question was to find the voltages across each of the resistors and know what to do with them. Weak candidates did not know what to do here or did some Ohm's law calculations using either 5 V or 13 V as these were the voltages in the question stem with more than a third failing to get any marks. About a quarter of candidates ignored 0.7 V across the diode but otherwise approached the question appropriately and so got 2 out of 3 marks. Strong candidates found this unproblematic and produced succinct answers; about a quarter of candidates got full marks. A few candidates obtained answers by proportions of voltages rather than calculating the current through the resistors, this was sometimes successful but several candidates had problems knowing when to divide and when to multiply.

3 (a) Calculating the resistor for an LED continues to prove difficult for almost half of the candidates. The most common error is to not calculate the voltage across the resistor and wrongly divide 5 V by 4 mA showing a lack of awareness of Kirchoff's laws. These candidates would benefit from spending some time reviewing their understanding of basic electrical quantities and simple series circuits. A few candidates did not convert the 4 mA to amps or did so incorrectly.

3 **(c)** Most candidates knew what was happening here; where marks were lost this was usually due to candidates describing rather than explaining what happens to the LED as the temperature sensor warms up.

3 **(d)** Candidates could calculate the values of R and C for the circuit and mostly used appropriate values for R. A number of candidates transposed the position of R and C in the diagram.

4 The questions on Boolean algebra were discriminating. Parts (b) proved most challenging with fewer than half the candidates getting this correct, part (c) was answered correctly by almost 90% of candidates.

5 **(c)** Most candidates could draw the NAND gate equivalent of the circuit. Marks were lost by some candidates who failed to label their diagrams and may have got some marks if examiners had been able to identify the parts of the diagram.

6 **(b)** There were a variety of good and thoughtful answers about the use of block diagrams. Was not very well answered by 40% of the candidates, many of these candidates seemed to be answering a past paper question on the meaning of the arrows in a block diagram rather than the question on the paper.

6 **(c)** **(ii)** was the most challenging part of question 6. Most candidates could get some marks indicating that they were familiar with the circuit. The difficult mark proved to be the timing diagram for Y at 400 ms.

7 Question 7 was well done indicating that candidates had enough time to complete the exam. The most challenging parts where (d) and (e), examiners found that written explanations are always good at discriminating between candidates.

F612 Signal Processors

General Comments

There was no evidence that candidates ran out of time.

As always, too many candidates sometimes ignored the instructions and appeared to answer questions of their own devising. This was particularly true of the questions about the inner workings of complex systems such as microcontrollers or audio systems. Weak candidates need to be more aware of the distinction between the command words **describe**, **explain**, **show** and **state**. Many questions require candidates to do more than one thing, especially those which involve circuit design. Candidates need to not only draw a correct circuit, they also need to clearly state component values and show, by quoting an appropriate rule **and** substituting their values, that they produce the required outcome.

Comments on Individual Questions

1 This question tested the candidates understanding of non-inverting amplifiers. Few candidates had any trouble in correctly identifying the input and input impedance of the amplifier, but only half were able to correctly calculate the value of its gain – many selected the formula for an inverting amplifier or were confused in their choice of two of the three resistors on offer. Only a minority of candidates were able to state the correct value for the voltage of the non-inverting input (0 V was a very popular incorrect answer). The transfer characteristic graph discriminated well, with only a small minority of candidates failing to draw a straight line through the origin. A significant number of weak candidates were unable to say anything creditworthy about the transfer characteristics of an open-loop op-amp; too many simply described the transfer characteristic of a closed-loop gain op-amp system they had just sketched.

2 This question was about a one-shot sequence generator. It followed the familiar format of testing candidates on parts of the circuit before asking them to describe the behaviour of the whole system. Most candidates earned the majority of the marks for explaining the operation of the D flip-flop, with many only losing marks by not being explicit enough about the rising-edge at CK; they needed to make it quite clear that the device was only transparent during the transition rather than while CK was high. The vast majority of candidates were able to select appropriate component values for the oscillator and complete the circuit diagram for the three-bit counter. The timing diagram at the end of the question proved to be much more discriminating, with almost as many candidates earning full marks as earning none. This was probably because it required candidates to analyse the circuit instead of simply remember information, clearly a higher order skill in electronics. So, as expected, many candidates experienced difficulty with the reset condition.

3 Many candidates are not very good at explaining electronics through extended prose, usually by not being precise enough in their use of technical terms. So the use of vague terms like signal or information instead of byte or word could lose the candidate a mark. ll. Only a minority of candidates clearly indicated that microprocessor ports deal with words rather than bits, allowing information to enter and leave the registers inside. Most candidates were able to mention at least one use of a register during the running of a program, but a significant minority thought that they stored the program itself. Similarly, many candidates fell into the trap of using the words analogue, digital and convert when trying to describe the function of an analogue-to-digital converter. However, the vast majority of candidates successfully demonstrated their ability to inter-convert words in binary and hexadecimal. Only a minority of candidates could satisfactorily explain **two** advantages of using a microcontroller circuit – many provided a list of different advantages without any attempt to explain them in sufficient detail.

4 It was good to find that even the weakest candidates could correctly complete the timing diagram for the latch and the truth table for its logic system. The final circuit for the bistable proved to be more challenging, with as many candidate earning full marks as none. Candidates could either draw a diagram complete in all respects or draw one with no feedback at all.

5 This question about the design of a bandpass filter provided excellent discrimination, with as many candidates earning full marks as earning none. Although the majority of candidates were able to draw a correct circuit, weak candidates often lost marks by not correctly identifying which of the RC pairs provided the bass or treble filtering. Some strong candidates lost marks by failing to justify their values by showing their working.– it was not enough to quote the break frequency formula and state the RC values, they needed to show that their values delivered the required break frequency.

6 There were three parts to this microcontroller flowchart question. Many candidates had little trouble earning most of the marks for the first two parts, provided that they stuck rigidly to the syntax of the symbols on the Data Sheet. This included appropriate use of capitals. Quite a few weak candidates appeared to be unfamiliar with the **read adc,S0** command and made up their own alternatives such as **let S0 = adc**. Worryingly, less than half of the candidates wrote **pause 1000** for the second part of the question, with many using capital letters, placing a comma after the 1 or using the word wait instead of pause. Perhaps candidates should be advised to browse the Data Sheet before tackling this type of question? The last part of the question required candidates to explain the effect of a given flowchart in terms of the input and output devices connected to the microcontroller. Strong candidates used binary to describe the state of the output port and related that to the state of all three output devices, as well as explaining the effect of the switch on the binary word fed into the input port. Weak candidates ignored the instructions and simply translated the commands in each box of the flowchart into English, completely ignoring the devices connected to the ports. It was worrying that many of the candidates assumed that the MOSFET was driving a buzzer instead of a loudspeaker.

7 The vast majority of candidates were able to correctly complete the flowchart for an audio amplifier system. Although most weak candidates were able to draw a correct circuit for an inverting amplifier, they often lost marks by failing to set the input resistor to the required value or using the wrong gain formula to calculate the value of the feedback resistor. The last three parts of the question required candidates to describe the transfer characteristics of three blocks and give a reason why it is needed for an audio system. Many candidates, even strong ones, ignored the first instruction and were also unable to do the second part without using the words in the block name. For example, stating that "a volume control is needed to control the volume of the signal" earned no marks.

8 This final question was about the design of a continuous sequencer system. Most candidates had no difficulty in correctly completing the block diagram or writing down correct Boolean expressions for the outputs of the logic system from the truth table. Although nearly all candidates earned at least one mark for their drawing of the required logic gate circuit, some strong candidates lost a mark by failing to draw both circuits.

F613 Build and Investigate Electronic Circuits

General Comments

This year, the quality of the vast majority of the reports submitted for this module was very high.. In addition, the presentation of the reports and associated documentation was neat and well-prepared with every script showing where the raw mark had been awarded. It is important to be clear about every criterion point and only award the mark if there is evidence within the report to justify the mark. Since all three pieces of work submitted for F613 are essentially the same, an error of judgement with a particular criterion is compounded and exceeding the tolerance becomes a likely outcome. The following is to remind centres of the criteria that continue to cause trouble.

Comments on Individual Questions

1 (a) For this criterion, moderators look for a good description of the circuit, a relevant use of the circuit, and some testable predictions. It is in this section that candidates must score the maximum mark of 4/4 if full marks can be awarded in two other sections (1b and 3c). This does not mean that every candidate should be awarded 4/4 in this section.

1 (b) This remains the criterion that gives the most problems. Some candidates are unclear about the nature of a test plan. Many just describe how the testing was done; this would score 0/3. A test plan can be considered to be a ‘wish list’ for testing a subsystem, in other words, it is a plan (i.e. done before actual testing) of how to fully test a given subsystem and will indicate what instruments are to be used, how they are to be used, and what signals are to be inputted into the subsystem (if appropriate). It is clear that even at A2 level, some candidates still struggle with this. Getting it right at this level will help candidates in the future.

2 (a) In order to score highly for the circuit build quality, components should be flat against the board, the wiring neat and straight, and some recognisable colour code used.

3 (b) Presentation of the results of the test must be in table or graph form to score the higher mark. A series of photographs showing test results would not qualify for high marks in this section. Also, for a digital circuit, the actual voltage levels should be shown, rather than ‘logic 0’ or ‘logic 1’.

4 (a) Moderators look for a correct circuit diagram with all component values shown. In addition to this, they also look for other diagrams which enhance the written communication.

The criteria above represent the ones that usually cause problems with the raw marking.

F614 Electronic Control Systems

General Comments

The paper provided a good coverage of the specification and it was pleasing to see that even weaker candidates could achieve marks across the whole range of topics indicating that the specification is thoroughly taught. There were some excellent thoughtful and inventive answers to some of the more stretching questions. This report will not cover all questions but will focus on those questions that candidates found more challenging and where misconceptions may lie in order that future candidates and teachers can concentrate on areas that are likely to both improve their marks and their electronics.

Comments on Individual Questions

Question 1 was about the MOSFET amplifier and was mostly completed well. Some candidates did not know how to calculate transconductance in 1 (c) (iii) and 9% just left out this question altogether. Drawing graphs often discriminates strongly and part 1 (d) (ii) proved to be the most challenging aspect of the question. There were a number of answers that showed a sine wave of 0.5 V amplitude centred around 7 V in phase with VG. The candidates who realised that VD was inverted with respect to VG tended to get all the other marks for this part of the question. Part d (iii) was answered correct by about 70% of candidates, many of the incorrect answers were given as 0.5 Hz with candidates having failed to convert the ms to s.

Question 2 was largely well answered but some candidates failed to accurately present some detail of power supplies. 2(a) was correctly answered by about half the candidates, others gained partial credit with the most straightforward element being the placement of the comparator as the obvious device with two inputs. Candidates showed a familiarity with the full-wave rectification with almost all candidates getting the correct type of output wave but only about 20% got full marks and showed 0 V flats where the input was less than ±1.4 V. There were some good answers to 2 (c) but some candidates lost marks by not answering the question but instead writing about the purpose of the opto-isloator in the circuit. Most candidates knew that transformers did something to voltages in power supplies but there was a reasonable amount of confusion from some weaker candidates about whether this was with ac or dc signal or even if the transformer converted ac to dc. Some of the best answers showed a familiarity with transformer and their efficiency well beyond what was expected for this question.

Question 3 proved to be quite testing, candidates seem to be generally less comfortable with microcontroller theory than with writing and understanding code. Over a quarter of candidates could accurately add the busses to the diagram of the microcontroller in 3(a) but many struggled, particularly with the control and address busses. Some weaker candidates seemed unfamiliar with the idea of busses in general and drew point to point links between groups of two blocks rather than connecting all blocks to a common bus and so ended up with several different data connections. The question about the machine cycle was answered perfectly by about a quarter of candidates but exposed misunderstandings in others. Most candidates knew that the program counter was incremented at some point but the nature of registers, stacks, pointers and memory seemed unclear to a significant portion.

Question 4 was about programming and showed that candidates were familiar with coding in assembly with most candidates getting most of the marks for parts (a) to (c). Part (d) was challenging with only 1 in 6 getting full marks. Many candidates were not sure about what the EOR instruction was doing. A large portion of the candidates did not answer the question written and chose to tell us about what each line of the subroutine did rather than describe what happened to the seven segment display and the bell. Part (e) elicited a full range of answers with a variety of approaches to produce the required behaviour and some excellent use of the available instructions. The most common errors were to not to turn the bell off at the end of the subroutine and for candidates to not preserve the state of the display whilst controlling the bell. A few candidates tried to use instructions not present in the published instruction set.

Question 5 was generally well answered and presented few problems for all but the weaker candidates who struggled with accurately completing the truth table in part (a).

Question 6 was about feedback and control. Candidates had few problems with parts (a) to (d) (ii) although some weaker candidates divided 47k by 30k to get the 1.6 in part (b). Many candidates found it difficult to explain how the circuit worked in (d) (iii) often failing to tell us that the motor slowed as it approached the required position. Part (e) proved very challenging and exposed some misconceptions for a number of candidates, many of whom seemed to confuse on-off feedback with open loop systems.

Question 7 was about memory. Parts (a) and (b) where straightforward for the vast majority. In part (c) some candidates found it difficult to structure their answers and did not give a clear sequence. There was some confusion about the active low nature of the signals for some of the weaker candidates who described the functions as being activated when signals were high. More than half the candidates were awarded full marks for part (d) but many of the weaker candidates thought that the fact that each data line could be 0 or 1 doubled the number of memory cells. Part (d) discriminated well with most candidates knowing what to do with data, read and write but fewer able to accurately deal with CE and decode A0. About 40% of candidates produced full mark answers with a wide variety of solutions using either logic or demultiplexers and showing good understanding of this topic.

F615 Communication Systems

General Comments

There was no evidence that candidates ran out of time, and none of the questions proved to be inaccessible to all candidates.

There was some evidence that weak candidates were declining to answer the extended prose questions, concentrating their efforts on calculations, graphs and circuit diagrams. This is a poor strategy. Many calculations on this paper require candidates to remember rules which aren't on the Data Sheet, and few of them are of the show-that type where the answer is given in advance, so it is easy for a weak candidate to earn no marks at all for a calculation. Although it is often hard for strong candidates to earn full marks for an extended prose explanation or description, the first couple of marks are usually very accessible.

Candidates need to remember at all times that each of the questions are asked in a context, and need to be answered in that context. Strong candidates are able to manage this, but weak ones tend to treat each question as stand-alone and ignore all of the information and context that led up to it.

This paper contains a lot of synoptic material, testing understanding of skills which candidates acquired in their study of AS Electronics. As ever, many candidates struggle with these aspects of the exam, and would probably benefit from more extensive revision of their first year work.

Comments on Individual Questions

1 The first part of this question requires the candidates to relate the word length of a converter to its other properties. Many candidates lost a mark by failing to show **all** the steps in their calculation – they didn't show the sum required to calculate the number of levels from the range and the resolution. Less than half of the candidates calculated the bandwidth correctly, with many assuming that the bit rate was the bandwidth. Most candidates failed to earn the marks for (b)(ii); vague answers, such as poor picture quality or incorrect ones, such as flickering, earned nothing. This was probably because they were not relating the question to the system described at the start of the question. Similarly, some candidates failed to state **how** the refresh rate would have to change for the next part. Nevertheless, many candidates managed to provide enough detail to earn most of the marks. The majority of candidates were able to calculate the line sync frequency from the information provided.

2 Although the vast majority of candidates were able to correctly identify the carrier frequency from the frequency spectrum, many weak candidates could not identify the a.f. signal frequency – they either assumed it was double the actual value or failed to do the subtraction correctly. The voltage-time graph provided excellent discrimination, with strong candidates using all of the information provided to draw their sketches. Candidates who ignored the carrier frequency data and drew an arbitrary number of cycles of the carrier lost a mark, and those who ignored the signal frequency data and didn't draw two cycles of modulation across the screen lost another mark. The majority of candidates could correctly identify the inputs for the carrier and a.f. signal on the circuit provided. Although strong candidates were able to explain, in detail, how the circuit operated, most weak candidates opted to describe its transfer characteristic instead. The final part of this question was synoptic, with a surprising number of candidates being unable to correctly draw a relaxation oscillator. Weak candidates often forgot to convert the carrier frequency into a period before applying the formula from the Data Sheet.

3 It was good to find that many candidates were able to earn full marks for their design of bandpass filter. Weak candidates often failed to correctly identify which RC pair went with which break frequency, and there were many imaginative (but incorrect) attempts at putting a passive bass cut filter in front of an active treble cut filter. The calculation of the carrier bandwidth proved to be hard; too many candidates calculated the bandwidth of the a.f. signal instead. However, about half of the candidates could explain why restriction of the bandwidth was important, showing an understanding of frequency modulation in the context of frequency division multiplexing. Only a minority of candidates earned full marks for their description of the transfer characteristic of the oscillator. The mark scheme identified five different features which could earn a mark; candidates only had to mention three to get full marks. Many lost a mark by not stating that the frequency of the output depended on the voltage of the input; too many used the vague term **signal** or an incorrect term such as **amplitude**, **current** or **frequency** instead.

4 Many weak candidates were unable to correctly draw the circuit for a non-inverting Schmitt trigger, but were nevertheless able to correctly sketch the shape of its transfer characteristic. Only the strongest candidates were able use all of the information provided in the voltage-time graphs to draw completely correct transfer characteristics. Similarly, the calculation of the component values for the ramp generator discriminated well, with many strong candidates able to substitute correct values from the graphs into the appropriate formula. Many candidates assumed that the input voltage was 5 V or 15 V instead of 13 V. The last part of this question was designed as a stretch-and-challenge one. To earn full marks, candidates had to show an understanding of the Nyquist criteria (that at least two cycles of a signal needed to be sampled) rather than just name it.

5 Too many weak candidates are still unaware of the difference between noise and interference, thinking that both are caused by signals from other circuits. Nevertheless, the majority of candidates were able to explain the difference, so stood a chance of being able to explain the operation of twisted-pair cable in interference reduction. However, many chose to consider just the cable and ignore the circuit that it was embedded in and invoke the use of earthed shielding. Only the strongest candidates answered the whole question by explaining why noise was **not** reduced but interference was; many candidates concentrated on the latter. The last part of the question concerned the use of a Schmitt trigger. Many candidates only gave descriptions of Schmitt trigger behaviour, ignoring its effect on noise and interference, earning only half marks.

6 The vast majority of candidates were able to correctly complete the block diagram of the AM radio receiver and draw a circuit diagram for the diode demodulator. However, only the strongest candidates were able to explain the operation of the circuit in sufficient detail. The vast majority of candidates were able to correctly identify at least one change to the system which would increase its sensitivity.

7 This question was about superhet radio receivers. Few candidates failed to earn both marks for their calculation of the reactance of the inductor and sketch of its reactance-frequency curve. However, many weak candidates didn't even attempt to draw the curve for a resistor, although the majority of strong candidates had no trouble with this. Many strong candidates failed to earn the final mark for the last part by failing to describe clearly enough the improvement in filter performance conferred by the different capacitor values; too many included meaningless sketch graphs with unlabelled axes. Although the majority of candidates could correctly identify the mystery component as an amplifier or buffer, few were able to explain its presence in terms of not altering the transfer characteristics of an LC circuit by letting it source current into the next LC circuit.

8 Although it was placed in a communications context, this question was largely synoptic. A surprising number of candidates simply used the values of voltage and current given in the question to calculate a resistance, earning no marks. Strong candidates considered the circuit diagram before doing the calculation, earning full marks accordingly. A disappointing number of candidates were unable to write down a correct Boolean expression for the NAND gate circuit, or use De Morgan's Theorem to simplify it. Similarly, many candidates struggled to earn full marks for their truth table. Part (c) required candidates to explain how the stated values of resolution, word length and range were related to each other. Only a minority of candidates gave quantitative answers and earned full marks; the same number who ignored the question and simply wrote out definitions of the three quantities earned no marks at all. As expected, only the strongest candidates could calculate the maximum input frequency for the encoder, many forgot that two samples needed to sampled in each cycle.

9 The majority of candidates **still** assume that the stop bit informs the receiver that the word has just finished arriving along the line. In their calculation of the clock frequency, few candidates took account of the word length, let alone select the correct value of 6 bits. However, the majority of candidates earned most of the marks for their shift register circuit, with some losing marks by not labelling the outputs correctly. It was disappointing to find that the majority of candidates were unable to draw a correct timing diagram for the shift register.

F616 Design Build and Investigate Electronic Circuits

General Comments

As with F613, this module caused no problems for many centres. The raw marking was excellent, and the organisation of the reports and associated documentation was correct and well-presented. As with every year, some of the circuits attempted were very ambitious yet the candidates managed to complete the task and write a superb report of the process.

With this module, in order for the candidates to be eligible for the full mark of 60, a minimum of 5 subsystems must be attempted. A subsystem is difficult to define but in general a subsystem will contain an active device. However, a 2-input AND gate would not be considered a subsystem, nor would LEDs attached to an output device. Some centres marked the reports as if 5 subsystems had been attempted yet, in reality, the number of subsystems was only 4 or less.

In response to the main concerns noted by moderators, below is a description of the criteria that gave the most trouble and how to avoid problems.

Comments on Individual Questions

1 (a) The research must be useful to the design of the circuit or a particular subsystem; it must have a relevance within the project. A single piece of research would not normally score the full mark.

1 (b) In order to score high marks for the specification, subsystems must be specified as well as the whole circuit. In addition, high marks cannot normally be given without numeric references.

1 (c) As mentioned in the report for F613, test plans do present some problems for candidates, even at this level. This should be a plan designed before the testing is carried out, and includes the test equipment to be used along with a description of exactly how they will be used. A diagram showing placement of the test equipment is a useful accompaniment.

2 (b) To score high marks for the description of circuit behaviour, a component level view should be taken. This does not mean, for example, that the inner workings of an opamp have to be discussed. However, if we consider the case of an amplifier made with an opamp, the gain should be quoted and then the level of the output voltage for a given input voltage calculated.

2 (c) For circuit build, to score high marks, moderators look for neat wiring which is close to the board, colour coding, sensible placement of components, and all components close to the board.

2 (e) Fault finding is sometimes given a mark by centres when there is no reference to it in the report. There must be reference to problems solved by candidates throughout the build process and if no problems were found this must be stated.

3 (a) In order to score high marks, the final circuit must also be tested along with all subsystems; there must be evidence of testing within the report for both subsystems and the final circuit.

3 **(c)** Analysis of test results is an area candidates find difficult. If the subsystem (or final circuit) has been well-specified, then candidates should discuss whether the results obtained from the test routine confirm that the subsystem (or final circuit) has achieved the specification. A bland statement of ‘as can be seen, it works’ scores no marks.

3 **(d)** Few candidates are awarded 2/2 for this criterion. Either testing of the final circuit was not done, or the initial circuit specification was too vague to award the mark.

4 **(a)** Circuit diagrams must be correct and labelled to score marks – a surprising number are incorrect or would not work.

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

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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