GCE

Electronics

Advanced GCE **A2 H465**

Advanced Subsidiary GCE **AS H065**

OCR Report to Centres June 2017

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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.

OCR will not enter into any discussion or correspondence in connection with this report.

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OCR REPORT TO CENTRES

F611 Simple Systems

There were many very good candidates this year as in previous years, however, this report concentrates on the problems rather than the successes in order to help candidates and their teachers avoid these problems and better prepare for future examinations.

There were more candidates this year using an inappropriate number of significant figures in their calculations. Some candidates only used 2 s.f. or even 1 s.f. for their intermediate calculations producing compound rounding errors and leading to inaccurate values in their final answers. Some candidates inappropriately rounded their final answers to 1 significant figure.

Candidates tend to gain better marks for calculations than for written explanations. Written answers often expose misconceptions but marks are also lost for some candidates through a lack of clarity in written answers where it is difficult to judge if the candidate is unable to answer the question or unable to express the answer clearly.

A significant number of candidates lost marks due to poor symbols in diagrams leading to ambiguity in their answers.

Question 1

There were very few errors in parts (a), (b) and (c). Some candidates made errors in part (d) despite giving good answers to the previous parts suggesting that they had not considered the switches arrangement. Most answers to part (e) gained full marks, a few answers lost marks due to the transition being at the wrong voltage – typically 0.7 V. A number of candidates lost marks in part (e) because they failed to calculate the voltage across the resistor; this has been a common problem over all the years of the examination and is worth paying attention to.

Question 2

Part (a) was answered well, but a few candidates wrongly gave the answer of 45 W. There was a complete spread of marks for part (b); some candidates thought that the LED would flash, many candidates lost marks with weak or unclear explanations and not describing the NAND gate behaviour. Part (c) caused few problems with most answers receiving full marks. Part (d) produced a good spread of marks with very few candidates unable to gain some marks but only about 20% gaining full marks. The most common errors seen in part (d) were in the graph of the voltage at X and in getting a period of Y that was double the correct period.

Question 3

The description of the thermistor behaviour is well known by candidates although there was confusion between heat and temperature in some answers. Most answers to part (b) gained good marks with very few circuits that would not function; there were some very poor thermistor symbols and some circuits which would turn on at low temperature. Many candidates stated the behaviour of a diode but most could not suggest a good reason for including the diode in the circuit. The most common errors in the calculation of current were to use an incorrect voltage either from the op-amp or forget about the voltage across the resistor. Most candidates could choose the most suitable op-amp although a significant minority chose a device with a maximum output current just below their calculated current.

Question 4

About half of the candidates were awarded full marks on this question. The most challenging items in the question proved to be parts (b) and (d).

Question 5

Candidates generally performed well on this question. A number of candidates provided answers using only two input gates making the problem slightly more challenging. Some of the strongest candidates spotted the redundant term and so drew a very simple diagram for full marks.

Question 6

The circuit for sensing when a light beam is broken elicited some excellent responses but provided some challenge for weaker candidates. In part (a) some candidates mistook the diode for an LED. Many candidates wrongly stated that the diode was in forward bias when the output of the op-am was saturated low. A significant number of candidates showed misconceptions about electrical concepts with discussions of "negative voltages flowing" and "only 0.7 V can flow through the diode". Many failed to clearly explain how the resistor R_2 pulls the output low with some referring to the pd across R_1.

Many candidates found the calculation of the resistors in part (b) challenging and the weaker candidates often failed to taken into account the 0.7 V dropped across the diode. Most of the full marks answers were from candidates who calculated the voltage across each resistor and used Ohm's law with a chosen fixed current or ratios to calculate the resistors. Many less successful candidates were not helped by trying to use the equation $V = \frac{V_0 R_2}{R_1+R_2}$ which obscured the fundamental principles and which they found difficult to manipulate algebraically.

Just over half the answers to part (c) were completely correct. Many candidates realised that they needed to use 4.2 V in their calculation but failed to correctly find the voltage across the LDR by subtracting the 4.2 V from the 15 V supply.

There were many good explanations of the operation of the circuit in part (d) with most candidates obtaining 4 or 5 marks.

Question 7

Most candidates correctly answered part (a) which has appeared in various forms in other exam papers but there were still a significant minority who answered incorrectly with a variety of answers such as current. There were many candidates who failed to use the correct symbol for the MOSFET in their diagrams and produced answers which were ambiguous and so lost marks. A number of answers put the lamp at the source rather than the drain. The vast majority of candidates answered part (c)((ii) correctly, a small number had trouble converting from □F to F. Many answers to part (c)(iii) wrongly stated that the LED would flash. As in previous exams, many candidates struggled to explain the function of the resistor with a switch in a digital input.

Question 8

Most candidates provided good answers to the final question with every candidate getting to the last question suggesting that there were few problems with completing the paper in the allotted time.

F612 Signal Processors

General Comments:

The examination paper produced a good spread of marks, with a reasonably uniform distribution. The overall standard was consistent with that of previous years, including Quality of Written Communication which was mostly acceptable if rarely outstanding.

No Items (part questions) provided notably high or low facilities, but marks for complete questions generally discriminated well between stronger and weaker candidates.

Candidates scored well on numerical items requiring use of appropriate formulae, conversion of units, correct substitutions and subsequent arithmetic. Most drew operational circuits in response to Question 5, scoring at least some of the available marks.

All but the very best answers lost some of the marks for Items such as 3b(iii) and 4(c), requiring description of a sequence of events. This was mostly due to the incompleteness of responses, rather than fundamental lack of understanding of system operation.

Comments on Individual Questions:

Question 1

This proved the easiest question overall and, as such, did not discriminate as well as most others between stronger and weaker candidates.

(a) (i) and (ii) Candidates scored well on the truth-tables, although, in (i), a minority wrote the input states of the first two rows in reverse order.
(iii) Most circuits showed correct gate symbols with appropriate feedback connections, but many lost the third mark through incomplete labelling (particularly omission of the NOT Q output).

(b) This item had a lower facility than part (a), many responses failing to identify the essential difference of the two circuits' response to clock/enable signals. Few candidates incorrectly described circuit behaviour in reverse order, however.

Question 2

(a) (i) Substitution of quantities, with correct units, into the break frequency formula and subsequent arithmetic to obtain the given result were almost invariably correct.
(ii) Almost half the Bode plots showed incorrect "roll-off" (to the bottom left-hand corner of the given axes). Incorrect "treble cut" filter response, or the wrong gain beyond break frequency, was shown in relatively few cases.
(iii) Most candidates scored the mark for stating correctly that impedance/reactance of the capacitor decreases as signal frequency increases. Explanations of how signal strength at point T is thus affected by frequency were generally too vague to receive full credit, however.

(b) (i) Correct unity gain was seen on all but the weakest scripts.
(ii) Many marks were lost through failure to specify *negative* feedback or to include the significance of very high open-loop gain.

(c) *Either* the attenuation of low frequency signals *or* the necessity for current/power amplification was well-explained in most answers, but few included all relevant factors. Only a small minority incorrectly cited voltage amplification.

Question 3

(a) (i) Strong candidates generally scored all three marks for the timing diagram. Otherwise, most scored the first mark but fewer the second, which almost invariably led to loss of the third.
(ii) Some good, complete descriptions of flip-flop behaviour were seen, most being worth at least two of the three available marks.

(b) (i) The first mark was awarded for specifying (even implicitly) a square-wave generator, but many failed to do so. The mark for 2Hz / 0.5s was usually scored, however.
(ii) The word "decoder" triggered a relatively easy mark on most responses.
(iii) A common mistake, costing at least one mark, was stating that the repeated sequence included "0". Most candidates had the correct notion of a displayed number, incrementing every 0.5 s up to a maximum of "5", then resetting when the count reached binary 110.

Question 4

(a) Both marks were scored by approximately half the candidates. "Switches Pressed" proved more difficult than either the binary or hexadecimal codes in the second and third columns. These alone, although almost invariably correct, were unable to score either mark.

(b) Most answers were completely correct, only an incorrect hex. code in the decision box causing loss of one mark for the minority.

(c) Some good explanations were seen but few scored all seven available marks, even the best responses usually omitting one or more salient points. Responses consisting of no more than a step-by-step translation of program instructions from the "Data Sheet" should not expect to earn credit. Candidates were required to describe the physical effects of input switches on the behaviour of each section of the program and the corresponding outputs displayed.

(d) Almost all responses correctly included a continuous program loop and, usually, the correct hex. codes for "keeping LEDs on" and "switching MOSFET on and off". The main marking penalties were for incorporating only a single "pause" command (generally of 4ms) and for syntax errors.

Question 5

(a) Almost all candidates elected to draw separate low-pass and high-pass filters on the two op amps., although full credit was given to any who had a correct dual-purpose filtering stage followed, or preceded, by a voltage amplifier with appropriate gain.
A very high proportion lost the mark for including 0V label(s), and many had gain=9 on *both* stages (i.e. x81 total). Otherwise, correct circuits, application of formulae and calculations of corresponding resistor/capacitor combinations were generally well-done and earned the marks.

(b) (i) and (ii) Many incorrect circuits (usually attempts at inverting amplifiers) were drawn. In such cases, the input impedance mark was widely forfeit also. Credit was given wherever the appropriate gain formula led to resistance values in ratio 1:99, correctly positioned in the circuit. Potentiometer symbols were almost always correct, but not the corresponding connections, numerous examples having one end connected to a 5V supply rail (particularly where the pot. was incorporated before the amplifier). Missing 0V connections were not penalised in both (i) and (ii).

(c) Most candidates understood the existence of power loss between stages, but did not always specify how this occurred. The need for a large impedance ratio to minimise losses was usually appreciated, but the potential divider concept was rarely included in explanations.

Question 6

(a) The first mark was very rarely scored and the term "*word*", rather than just "number" or "code", essential to earn the second, was also quite widely omitted.

(b) The wide variety of acceptable answers helped candidates to score well on this item.

(c) The role of the host computer in compiling the program from a higher-level language into binary code recognisable by the microcontroller was generally missing. "Creating" the program (where this might be regarded as human activity) was not given credit.

(d) Only about half the responses earned both marks. A more relaxed interpretation, than in (a) or (b) of terms associated with binary output, allowed many to score the "digital" mark, but "analogue" was often not identified with voltage.

(e) Understanding that the program inside the microcontroller memory dictates its behaviour was good, but describing it as a set of instructions was not always included in answers.

F613 Build and Investigate Electronic Circuits

General Comments:

As might be expected for a well-established specification, the majority of Centres have developed a good understanding of both the coursework process and the correct administration procedure for the submission of marks and the sending of report samples to moderators. The standard of the work submitted by candidates continues to be high. For those new to the process or as a reminder to more experienced practitioners, the following comments have been made by moderators which merit inclusion in this report.

Many but not all Centres were aware that the moderator no longer requires a copy of the CCS160 form and there was some confusion in a small number of Centres as to what, if anything, replaced the MS1 form. The new IMS1 form is needed to check entries and is a vital part of the coursework package that is sent to moderators.

It was encouraging to see many Centres making good use of annotated comments on the reports and in some instances, providing additional commentary to support the decisions that had been reached regarding the allocation of marks. There was also clear evidence from some Centres of detailed internal standardisation having taken place. Without such annotation, it can be particularly difficult for moderators to support Centres in their judgements. Unfortunately, in a very few cases supporting comments were of little value or non-existent which was disappointing.

At this stage, it would be hoped that most Centres would have a library of tried and tested circuits to be investigated at this level. With such a library, it would be very unlikely that candidates would build and test exactly the same circuit. Even if the same basic circuit was used, for example, a relaxation oscillator, by the use of different component values, every candidate would be able to investigate a unique circuit. It is therefore difficult to understand why a small number of Centres should have submitted a sample of work where all the candidates have attempted an identical circuit. These Centres should consider revisiting their circuits and introduce some diversity to the circuits available to their candidates.

In terms of the raw marking, many Centres achieved a high level of appreciation of the mark criteria and their application. Moderators largely agreed with the raw marks and many Centres were within acceptable tolerance. For some Centres, their interpretation of the mark criteria gave rise to generous marking (and in a very few cases harsh marking) and this tended to be most evident when assessing a specific number of the criteria.

Section 1 - Introduction

Criterion 1a is important as it sets out the circuit under investigation, how the circuit works, its predicted behaviour and therefore what is to be tested. An appropriate use or application of the circuit must be given for the full mark of 4 to be given. Although many candidates were very specific when describing the use or application, some were too vague. For example, for an active filter, comments such as “in an amplifier” do not warrant any credit, whereas something like “as part of a tone control in an amplifier” would be acceptable. In addition, for a maximum mark, the circuit must be described at a quantitative level. For example, a candidate when describing the action of a relaxation oscillator would include detailed reference to the role of the capacitor in its charging and discharging cycle in conjunction with the switching voltages of the Schmidt Trigger. The requirement of this level of detail was not recognised by some Centres when giving high marks.

The approach taken by candidates when producing a test plan or procedure, required for criterion 1b, still sometimes presents a problem as does the application of the mark criterion by a few Centres. As a plan, it should also be written in the future tense to indicate that it is a procedure that a candidate intends to follow and many candidates are clearly aware of this. However too many candidates are still using the past tense, describing what they did. In some cases, Centres are accepting this when allocating marks whereas no marks should be given. For the maximum mark, test plans should also be very detailed and include such information as how any data will be collected, the range of measurements to be made and the placement of test equipment. Although many candidates clearly knew how to collect their data as could be seen from their results tables, test plans were often brief and, in a few instances, were simply stated “as shown in the diagram”.

Section 3 – Testing

The Testing Objective requires that data is collected, presented and analysed and many candidates met this requirement in the Digital and Analogue tasks. However, for the Microcontroller task, some candidates did not collect data as such, relying on visual evidence to confirm the successful operation of their circuit. However, photographs alone should not be regarded as sufficient evidence that predictions have been met and should be supported by, for example, picoscope or oscilloscope traces, or voltmeter values. Where tasks do not give rise to data being collected, the marks available are likely to be limited and Centres should give consideration as to how these tasks may better meet the assessment objectives. For Analogue and Digital tasks, marks should only be given for criterion 3b if data is presented in table or graph form. Analysing data may be regarded as a high-level skill. Many candidates demonstrated their aptitude relating the data collected to their original predictions and this was recognised by Centres in criterion 3c. Where a simple statement of fact is made with no reference to predictions then higher marks for 3c are not appropriate.

Section 4 – Report

Reports were generally well constructed and indicated that candidates had taken note of the requirements of the criteria with good use of terminology in evidence. Many candidates included circuit diagrams showing where test equipment was placed to collect their data, using appropriate symbols as found in the appendix of the specification. There was more evidence of candidates using pointers instead of circuit symbols and this should be discouraged as it not acceptable for criterion 4a.

Moderators remark each year on the quality of work produced by candidates which reflects the tremendous amount of effort that goes into the setting, the marking, the preparation for the submission of marks and the sending of the samples and fully appreciate the time and effort that is involved.

Should any Centre feel that further clarification or support is needed with this module then please contact OCR at http://www.ocr.org.uk/.

F614 Electronic Control Systems

The vast majority of candidates continue to show evidence of good coverage of the specification with very few candidates omitting questions or not being able to say something about the aspect of electronics being examined, even if only half remembered for some of the weaker answers. Many candidates continue to find written answers more challenging than calculations. The best candidates show an excellent grasp of the subject with some clear explanations and a range of imaginative solutions to questions. This report will concentrate on the areas that proved most challenging for candidates so as to help future candidates and their teacher prepare them for future examinations.

Question 1

The start of the question was answered well by almost all candidates. Part b(ii) was a little more challenging with a number of candidates finding V_{GS} from the graph but failing to subtract the V_{GS} from their answer to b(i). Part b(iv) proved testing; more than 80% of candidates could get some marks but less than 20% obtained full marks with the most common problem being the showing of the correct offset voltage. A number of candidates failed to obtain good marks to part (c) because answers were not clear about whether the input or output was being discussed; a number of candidates made mistakes when using the term impedance confusing high and low impedance, there were fewer mistakes of this nature when candidates discussed current.

Question 2

Candidates were generally familiar with all of the terms about microcontrollers with some excellent answers from good candidates but a lack of clarity from some weaker candidates and some misconceptions. The question about reset was generally answered well but many candidates were not able to clearly explain the function of the clock. Most candidates could say something worthy of marks for part (c) but for a number of candidates there was some mixing up of registers and memory and a number of candidates suggested that the microcontroller compiled the program as it ran much like an interpreted language. Most candidates showed familiarity with the machine cycle with the most common errors being missing out stages, particularly the transfer of the instruction from memory to the instruction register, and getting the order of event wrong, particularly the incrementing of the program counter.

Question 3

The question on memory was generally well answered. The most common errors were in part (b) to include too many address lines and in part (d) not making the data line bidirectional. Many candidates failed to give two reasons for the tristate in the memory cell but most could find one.

Question 4

The question on MOSFET amplifiers provided some challenge and discriminated well between stronger and weaker candidates. Candidates generally knew that the potential divider provided a constant voltage for the circuit but some struggled to explain why this was needed. There were a range of answers to part (b), the most common error was failing to find the amplitude of the output from the graph. The majority of calculation for the transconductance of the MOSFET obtained full marks. Part (d) was challenging for most candidates but elicited some excellent answers from strong candidates.

Question 5

The temperature control question was generally well answered with many good diagrams in parts (a) and (b). Part (c) was the most challenging aspect of this question with the most common error being the showing of the saturation of the output.

Question 6

The microcontroller programs in parts (a) and (b) gained high marks for the majority of candidates. The most common errors in part (a) were not using RCALL when using the wait1ms routine, using a register not in the range s0 – s7 and jumping back to the wrong part of the subroutine. In part (b) there were some errors in getting the correct hexadecimal value to produce the required output on the 7-segment display. In parts (c) and (d) many candidates lost marks through lack of clarity in their answers and failing to refer to the effect of the subroutine on the output devices.

Question 7

The question on switched-mode power supplies provided some challenge for weaker candidates. Many candidates did not relate the transformer's need for ac to the oscillator. Some answers showed confusion about the oscillator in the switched-mode power supply suggesting that the frequency of the oscillator changed. Some weaker candidates failed to get the orientation of the diodes correct in the rectifier. Many of the explanations lacked clarity and some indicated confusion about the operation of the power supply, a significant number of candidates did not explain this as an on-off control system. Most candidates could provide one advantage of the supply but struggled to find a second advantage.

Question 8

The question on adding and subtracting binary numbers produced high marks for many candidates showing familiarity with this material. All candidates answered the question indicating that they had sufficient time to complete the paper.

F615 Communication Systems

General Comments:

Standards appeared similar to previous years, and it was not clear to what extent the imminent closure of the specification may have affected the cohort.

Candidates were typically less happy when asked to give an explanation than when asked to perform a calculation.

Conversions between SI units and scientific notation remain an area of difficulty for some candidates.

Comments on Individual Questions:

Question 1

For section (a)(i) most candidates realised that there were three colours of Pixel, and named them correctly, usually stating that they were needed for a 'Full Colour' display, some went further by explaining that any colour could be made by a suitable mixture of the three.

In question (a)(ii) most could calculate that a 4 bit word could provide 16 levels.

For (b)(i) lessons had been learned from last year and most candidates offered a clear explanation for the 2 extra bits (start and stop) and their purpose in the transmission system.

Question (b)(ii) was mostly done well ,though some did not refer to the signals as being 'sync' or 'synchronisation'

In (b)(iii) some candidates lost credit by failing to explain what they were doing, occasionally multiplying by 3 (colours) rather than 6 (bits) which left them having to find a factor of 2 from somewhere at the end of the question.

In (b)(iv) candidates usually found it unproblematic to halve the bit rate from (b)(iii).

Question 2

In (a)(i) and (ii) few candidates mentioned that the signals were sine waves, more got the frequency correct.

For (a)(ii) most candidates correctly mentioned the 5V offset, and that it was the same signal as in (a)(ii).

There were some good responses for (b), mentioning that the gain was variable, controlled by the input signal.

For (c)(i) and (ii) most candidates could draw and explain the demodulator circuit, though some made the break frequency very high.

Question 3

In (a) candidates should recall that the analogue voltage at the input is represented by a binary word at the output and (b)(i) and (ii) were usually well done, with some clear calculations.

(c)(i) was mostly done well, with errors in the last column being the most frequent cause of lost marks.

For (c)(ii) there was an opportunity for simplifying the circuit, which was not always taken, so some candidates produced a system for the full Truth Table.

Question (c)(iii) was often done well, though some found it daunting, usually forgetting the 0.7V drop across the diode when in forward bias.

Question 4

Section (a) was often done well but a lack of clarity over what was changing in FM, and what caused the change produced most errors.

Part (b)(i) was often well done and most errors were due to forgetting that FM bandwidth is 5x the highest modulating frequency, so offering 1000 channels for use.

In (b)(ii) most got the idea, but candidates were often not clear in their explanations.

In (c)(i) the idea of AM allowing more channels than FM because of the smaller bandwidth of AM was usually clear.

For (c)(ii) many candidates did not express the greater difficulty of removing noise from an AM signal well.

Question 5

There were two possible designs for this PISO circuit, depending on whether logic gates or multiplexers were employed, and either was acceptable. Candidates often struggled to bring their design to completion.

Question 6

(a)(i) and (ii) were usually well done, most candidates named the missing blocks correctly and describing their function, though some failed to mention that loudspeakers emit sound waves.

Again (b)(i) and (ii) were mostly done well, though some candidates got confused converting from index notation to SI prefixes.

In part (c) some candidates were tempted to overcomplicate this piece of circuit design, surprisingly the voltage follower seems to have been the source of some difficulty.

Question 7

In (a)(i) most candidates could do this by different routes, though the summing amplifier formula was rarely invoked.

Question (a)(ii) was usually done well with alternative routes being acceptable.

In (a)(iii) many candidates got both correct, errors were usually confined to the higher of the two voltages, as candidates generally realised that the range began at 0V.

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For (b)(i) marks were lost mainly by lack of precision in expressing their response.

In (b)(ii) most got the idea, but found expressing it more challenging.

In (c) many and varied explanations were given for the TDM system, one offering commonly made was some form of system where signals competed for access to the link.

F616 Design Build and Investigate Electronic Circuits

General Comments:

As befitting a well-established specification, the majority of Centres have developed a good understanding of both the coursework process and the correct administration procedure for the submission of marks and the sending of report samples to moderators. Many but not all Centres were aware that the moderator no longer requires a copy of the CCS160 form and there was some confusion in a small number of Centres as to what, if anything, replaced the MS1 form. The new IMS1 form is needed to check entries and is a vital part of the coursework package that is sent to moderators.

The quality of the investigations undertaken by candidates continues to be high. As in previous years, many Centres have also shown an excellent understanding and application of the marking criteria whilst some are overly generous (and even fewer overly harsh) when making judgements with the raw marking of certain criteria. With only a maximum number of 60 marks available for the report, it is quite easy to fall outside of tolerance. Effectively, if only two or three criteria have been marked generously this can push the raw mark outside of tolerance.

It was encouraging to note that Centres are making increasingly effective use of annotations both in the reports and with supplementary commentary. These not only aid the marking process but also make the moderation process easier as it provides further clarity as to how Centres reached their decisions regarding mark allocation. It would be good to be able to say that all Centres have the same approach to annotating work but this is not the case and remains a challenge.

An issue noted by moderators in previous Reports to Centres was still evident in that a small number of Centres submitted projects that were similar in nature. Within reasonable limits it has always been the expectation that all candidates undertake investigations that are sufficiently different. It is the responsibility of the Centre to ensure that, as far as possible, this uniqueness is maintained.

As is often the case some candidates were very inventive with their project choice and very skilled in their investigations. Some of the more novel projects included a Hands-Free Paper Towel Dispenser, a Temperature Sensing Shower Timer and a Monitoring System for the Charging of a Mobile Phone. With such projects, there were a clearly defined set of sub-systems but some Centres were generous in their interpretation of what represents a sub-system. The specification states that “for the purposes of project design, a sub-system is an electronic circuit that has an active component”. Moderators noted that sets of input switches, an LDR-resistor potential divider and a group of LEDs on an output stage were accepted as sub-systems although having no active components.

Moderators largely agreed with the raw marks for many Centres but for some where their interpretation gave rise to generous marking this tended to be evident when assessing a specific number of the mark criteria.

Section 1 – Introduction

The specification (criterion 1b) not only applies to the full circuit but also to each sub-system. It is the combination of both which leads to the final mark for 1b. Power supplies are an obvious specification point missed out by many candidates. Candidates must include numeric data in the specifications for at least 5 sub-systems and the final circuit to be considered for the maximum mark. Purely qualitative specifications would not lead to the award of such high marks. The lack of numeric data is likely to have an impact on the marks available for criterion 2b.

Test plans (criterion 1c) continue to be an issue even though it is an integral part of the AS course. Where a candidate describes how a test was carried out this will score zero marks. The plan should be a discussion of how a particular sub-system (or indeed the final circuit) is to be tested including such detail as how the test equipment is to be used, the range of data to be collected, and how the data is to be used to meet the specifications. Any diagrams included should show the positioning of test equipment using appropriate symbols.

Section 2 - Circuit

The description of circuit behaviour (criterion 2b) continues to be challenging for many candidates. Some of the reason for this stems from a lack of numeric data provided by candidates in their specification. Although candidates may have described the project behaviour at component level, without numeric data no calculations of component values were provided thereby restricting the marks available.

Candidates must explicitly state whether fault finding (criterion 2e) was necessary or not and, if so, what remedial work was undertaken for up to 5 sub-systems for maximum marks to be given. There were a large number of instances when Centres gave marks where no comments regarding fault finding were included in the report.

Section 3 – Testing

Evidence of testing (criterion 3a) and the subsequent collection of data was provided in the form of photographs, oscilloscope and picoscope traces for sub-systems but, as has been mentioned in previous Reports to Centres, a significant number of candidates are still failing to include evidence of testing for their final completed circuit. The emphasis in Section 3 is on the collection, presentation and analysis of test data, purely photographic evidence is not sufficient for the higher marks for criteria 3a and, in particular, 3b, where tables and graphs are a requirement. It is also difficult to meet the requirements of both 3c and 3d when the overall specification has not included numeric values.

Results analysis (criterion 3c) is a difficult criterion to achieve high marks in as it involves high level skills. Candidates must clearly demonstrate that they have analysed, and not simply stated, the test results. Too many candidates were given high marks with little or no justification and it continues to be the most common criterion where moderators disagree with the raw mark. Specification points must be considered in the analysis and so must the testing of the final circuit and how that compares to the specification. Centres also need to remind their candidates that the higher marks for criteria 3a and 3c are only available where 5 sub-systems are included in their design.

Moderators remark each year on the quality of work produced by candidates which reflects the tremendous amount of effort that goes into the setting, the marking, the preparation for the submission of marks and the sending of the samples and fully appreciate the time and effort that is involved.

Should any Centre feel that further clarification or support is needed with this module then please contact OCR at http://www.ocr.org.uk/.

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

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