GCE

Electronics

Advanced GCE **A2 H465**

Advanced Subsidiary GCE **AS H065**

OCR Report to Centres June 2014

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

General Comments

There is some evidence that candidates understanding of some key topics has improved over the lifetime of the specification with improved answers on some commonly examined topics.

Comments on Individual Questions:

Question 1 was a gentle introduction to the paper with generally good candidate performance throughout. There were some vague and imprecise explanations in part d resulting in many candidates only receiving half of the marks available. Candidate performance in part e is improved over similar questions in previous years however; there are still a minority of candidates who are at a loss as to how to connect a MOSFET to an external device. It is noticeable that many more candidates can accurately draw a MOSFET than in previous years.

Question 2 was about comparator circuits. The question was generally completed well. It was pleasing to see so many good explanations of why the LDR does not glow in the dark, suggesting that this topic is well understood by the candidature; this is an improvement over the life of the specification. Part c was completed well by many candidates but there remains a sizeable proportion of the candidates who do not know how to get started with this type of problem. A number of candidates seem to have a misconception about comparators and the inequality at the inputs required for saturation, with several assuming switching did not occur until there was a 1V difference between the inputs.

Question 3 parts a and b were completed well by the vast majority of candidates. Part c was generally answered well, showing much improvement on this type of question, with most candidates using the correct pd across the resistor. The explanations in 3d were largely accurate up to the output at S, but the action of the diode and relaxation oscillator proved problematic for the majority candidates. In part g many candidates showed that they cannot recall the symbol for the oscilloscope. Many candidates showed 2½ periods in part h rather than 2 and so lost a mark.

Question 5 In part a, the XOR gate preceded by a NOT gate at one of the inputs proved problematic for a significant proportion of candidates. Part b was generally well done, but candidates were often only giving one of the marking points rather than two and not taking a hint from the command “explain” and the number of marks available. In part c many candidates could not show how to connect an ammeter correctly, often showing this in parallel with the resistor and LED. A surprisingly large minority could not show how to connect and LED and resistor correctly.

Question 6 was discriminating. Many candidates found part c challenging, almost all could draw X, but Y was more challenging, with a small minority showing the correct shape using the information from b to judge how narrow the spikes should be. There were some good answers to part di, but it was not well done by many candidates who often failed to not refer to the signal at Y.

Question 7 was completed well by most candidates. There were few problems with the switch in part b. The questions on the block diagram showed a good understanding of the conventions on the arrows in part d, but a lesser understanding of the purpose of the block diagrams, with many candidates saying something similar in parts c and d. In part f there are still some candidates who wrongly choose the component with the closest characteristics, in this case JP234.

All candidates attempted the last question, indicating that they had sufficient time to complete the paper.

F612 Signal Processors

General Comments:

The general weakness in candidates' ability to handle algebra was evident this year. Electronics is full of formulae which are used for calculating component values and system characteristics, and candidates ought to know how to transpose and combine these formulae to obtain other formulae. In particular, they should be able to use basic rules like $V = IR$ to derive the gain formulae for the various amplifiers created by applying feedback to op-amps.

As ever, manipulating Boolean algebra and binary-to-hexadecimal conversion seem to be beyond the abilities of weak candidates.

Comments on Individual Questions:

Question No.

1 The vast majority of candidates were able to correctly complete the truth table for a NOR gate and explain why the LED glowed when the switch was pressed. Although most candidates realised that releasing the switch left the bistable in the same state, only some were able to convincingly explain why. Weak candidates often lost marks by not using the labels P and Q provided in the diagram, so that it was unclear which gate they were referring to. The timing diagram proved to be more challenging for weak candidates.

2 Although most candidates were able to describe the effect of the set and reset terminals on the flip-flop, too many failed to earn full marks for the second part. Instead of describing how to use the flip-flop to store a bit, they described how the state of D was transferred to Q, without mentioning that the bit needed to be placed at D in the first place.

3 The vast majority of candidates were able to calculate the voltage gain of the amplifier. Too many ignored the instructions of the next question and worked out the amplitude of the signal at the output of the signal generator instead of the amplifier. Although most candidates knew that increasing the amplitude to 3 V would saturate the amplifier, only a minority could convincingly describe the clipping of the waveform; too many seemed to forget that the signal was AC, and treated the 3 V as a DC signal. As ever, only half the candidates spotted the virtual earth at the inverting input of the amplifier, but the majority were able to correctly calculate the power of the cell. Calculating the power output of the amplifier proved harder for many candidates. Weak candidates didn't know what to do, and many other candidates forgot to take account of the gain of the amplifier.

4 This question was about a counter circuit. The format was similar to previous years, with candidates being presented with a block diagram and then asked to describe and explain the function of the various components of the system. It was good to find that the vast majority were able to correctly complete the circuit for a three-bit counter; the most common error was connecting the clock of a flip-flop to Q of the previous flip-flop. The majority of candidates correctly identified and described the decoder and LED display and nearly all of them were able to fill in the table linking the number displayed to the state of the counter outputs. However, many candidates struggled to explain why the counter displayed 1 immediately after 6, with too many assuming that the binary for 6 was 111. In other words, they failed to realise that when attempting to display 7 (111), the reset condition was achieved. Calculation of the resistor value for the relaxation oscillator proved surprisingly problematic for many candidates; too many used the wrong formula, or were simply unable to transpose the correct formula.

5 This question was about a one-shot sequencer. The vast majority of candidates completed the pulse table correctly and wrote down a Boolean statement for X, but only a small minority were able to convincingly simplify it to the required expression. It was good to see that most candidates could draw the correct logic gate circuit for the simplified statement. The last part of the question required candidates to analyse the circuit given at the start; too many candidates lacked this skill and were unable to convincingly explain the state of the system at the end of the sequence.

6 Although nearly all candidates knew that the missing block was a ower amplifier, only a minority could explain why it was necessary. As ever, weak candidates tried to use the word power in their explanation, earning no credit. Too many candidates assumed that a power amplifier increased the voltage of a signal, as well as the current, and only a minority knew that the likely current output of the previous stage was going to be insufficient to drive a low resistance load like a loudspeaker. It was disappointing to find so many candidates struggling to draw the circuit for a non-inverting amplifier; arranging the feedback network around the non-inverting input was a very popular error. Calculation of the break frequency of the bass cut filter was straightforward for most candidates (probably because they didn't have to transpose the formula), but too many made mistakes in completing the gain-frequency graph. Forgetting to take account of the high-frequency gain of the amplifier was understandable, but failing to draw the line at 45^o below the break frequency by many candidates was disappointing. Too many candidates drew their line so that it met the fatal attraction point at the bottom left of the graph.

7 The microcontroller question always discriminates well, with weak candidates earning almost no marks and strong candidates earning almost all of them. Candidates tend to lose marks through poor use of syntax (not using the flowchart symbols listed in the data sheet) or being unable to convert binary into hexadecimal and vice versa, but more often by just being very confused. For each part of the question, weak candidates floundered and strong candidates got it completely right. For part (b), candidates were required to explain the effect of two output commands on the system; too many attempted to do so without writing down the binary equivalent of the hexadecimal words being output.

8 The final question concerned a voltage follower circuit. Very few candidates were able to convincingly combine the two expressions to prove the required gain formula, even though they should have met it before as part of the course. Although many candidates were able to state that the voltage gain was 1, some lost the mark by writing down 0.9 instead. The majority of candidates were able to draw the transfer characteristic correctly, with only a minority forgetting about the saturation at +13 V and -13 V.

F613 Build and Investigate Electronic Circuits

General Comments:

Again this year, the quality of the vast majority of the reports submitted for this module was very high and few centres saw a scaling of the raw marks. Most centres had annotated scripts to indicate where marks had been awarded and this is an enormous help for the moderation process. The application of annotations is not an onerous task and does assist marking.
As last year, centres whose marks fell outside the current tolerance are experiencing the same problems. 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. It is useful to note that an error in marking for one of the pieces is often repeated in the other 2 pieces and this can easily lead to a centre being outside tolerance.

The following is a reminder of the criteria that continue to cause trouble.

Comments on Individual Questions:

Question No.

1a 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.

1b This remains the criterion that still gives the most problems, so it is useful to repeat the advice of last year. A significant number of 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, where they are to be placed, what signals are to be inputted into the subsystem (if appropriate) and at what frequency/amplitude if appropriate. It is often useful to write in the future tense, for example, 'in order to test this subsystem, I am going to ……etc.'

2a 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. The placing of the components should also be sensible and not take up excessive space on the board. Also, a mark cannot be given for this section if colour photos are not included in the report. Finally, a small number of centres presented circuits made on pcb – this practice should not continue as it is time-consuming, inappropriate, and cannot lead to high marks being awarded.

3b 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'.

4a 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. They especially look for diagrams which show how the testing is to be carried out and where test equipment is to be placed.

The criteria highlighted above are the ones that typically cause centres the most problems. If any centre is still unclear about any aspect of the moderation process or would like further support, then they should contact OCR.

F614 Electronic Control Systems

Comments on Individual Questions:

Question 1 was a gentle introduction to the paper which tested the use of a MOSFET as a switch. Candidates performed well on this question. Some marks were lost in the explanation for 1b(i), with some vague explanations not referring to the threshold and a significant minority of candidates stating that the voltage at the gate when the switch was open would be 0 V rather than -5 V.

Question 2 was generally well done. The timing diagram in 2b(i) proved testing for the weaker candidates. There were many examples of the order of the binary digits being reversed in 2b(ii), however most candidates could convert their answer in 2b(ii) to decimal for 2b(iii).

Question 3 was about assembly language programming and showed a general proficiency in programming by candidates, suggesting some significant practical experience of this.
Part a was very competently completed, with most candidates testing for the switch using the AND function and calculating the correct mask; there were many fewer candidate than previous years using SUB for testing a switch. Part b was well done, candidates can create a lookup table to operate outputs in a defined pattern.

The explanation in c of how a section of code worked proved more testing, the use of a lookup table increased the challenge in this question. A significant number of candidates were confused about setting the pointer to zero and thought that this would turn off all of the LEDs.

Part d was also a good discriminator. Most candidates could write some code but many failed to be able to turn on the buzzer whilst maintaining the display. There were some good time delays but some slips with were to jump back to when counting down. Many candidates failed to turn off the buzzer, this may indicate a lack of understanding amongst some candidates about the latching nature of the output ports in a microcontroller.

Question 4 proved to be a good discriminator. A surprising number of candidates had difficulty drawing a correct rectifier in part a. There is clearly some confusion about what a voltage regulator does for a significant number of candidates with some describing the function of a smoothing circuit and some a rectifier. Part c discriminated well as is often the case when candidates are required to draw a circuit diagram.

Question 5 proved relatively straightforward for most candidates who showed a good understanding of this material. The answers to b and d where generally very good, part c was a little more challenging but most candidates identified the lack of feedback as an issue. There were plenty of good answers for e, with everyone starting at 2 V but some incorrect positive and negative gradients.

Question 6 showed some good understanding of subroutines in a. In part b there appeared to be some confusion between the stack and the stack pointer for some candidates and many neglected to increment/decrement the SP.

Part c proved challenging as expected as this was aimed at A* candidates. There were a variety of correct solutions and we saw all of them. However most candidates picked up fewer than half marks. The question revealed a range of misconceptions. Some candidates stored the return address in the stack pointer rather than the stack. Many candidates moved all of the data in the stack up or down by one address not understanding the role of the SP. A significant number of candidates added one to every number they could find, remembering something about incrementing.

Question 7 a and bi proved straightforward, but bii was testing, with about a fifth of the candidates getting the correct answer. In this multi-stage calculation many candidates got stuck after the first stage. Part c was also testing, with many candidates suggesting that 18V was too high for the resistor and VD being chosen because it was a lower voltage.

Question 8 was about memories and tristates. Most candidates showed some understanding of tristates with good answers to ai, but aii proved more testing as is often the case when candidates are given a space in which to design a circuit. Part c is of the form of many questions on previous papers and as in previous years proved to be a good discriminator, with a complete range of marks. Part d was answered correctly by almost all the candidates with a minute number failing to provide an answer suggesting that candidates had sufficient time to complete the paper.

F615 Communication Systems

General Comments:

A large number of the marks for this paper are synoptic. It was noticeable that although candidates were generally able to do calculations for component values in circuits which they had met during the AS course, they were often unable to draw them.

Many calculations on this paper require two steps. Weak candidates seem unable to do this; if they can't plug values straight into a formula from the data sheet, they don't know what to do.

Comments on Individual Questions:

Question No.

1 The first part of this question required candidates to explain a raster scan for a video display. Only a minority bothered to mention that pixels were scanned one by one along a line, with too many candidates stating that the line sync pulse signalled the refreshing of a whole line at once. Otherwise, it was well answered by the majority of candidates. The subsequent calculation discriminated well; weak candidates failed to spot that the packet needed stop and start bits and invented their own rules to achieve the required number of levels. The calculation of the packet rate required two steps, with many candidates stopping after the first one; since the conversion between bit rate and bandwidth is not on the data sheet, many weak candidates multiplied by 2 instead of dividing. It was good to find that the majority of candidates were able to interpret the CRO trace of a frame sync signal and use it to calculate the frame refresh rate.

2 This question was about frequency modulation. The majority of candidates were able to use the graph to design a suitable voltage divider and justify the values with calculations. Many weak candidates assume that the value of the gain given in the question was the voltage required and calculated resistor values accordingly. Insertion of the capacitor proved to be more challenging for weak candidates, with many opting to feed the audio frequency signal into the amplifier input instead of the gain control. The next part of the question was stretch-and-challenge, intended to be inaccessible to weak candidates: and so it proved, with only the strongest candidates correctly identifying the range of voltages over which the audio frequency signal could alter the gain of the amplifier. Too many candidates lost marks by assuming that the non-linear portion of the graph led to saturation and clipping of the audio signal. Most candidates were able to calculate a value for the capacitor in the demodulator, but too many opted for the wrong break frequencies of 450 kHz, 50Hz or 5.05 kHz. It was good to find that many candidates could sketch the signal at the output of the demodulator, although only a minority remembered to take account of the forward voltage drop of the diode.

3 This question was about frequency modulation. The majority of candidates were able to explain the function of the Schmitt trigger. However, only a small minority were able to correctly draw the circuit for a monostable, although the majority had no trouble selecting and justifying component values for it. The filter question posed little difficulty for most candidates, although too many had too steep a drop above the break frequency; the bottom right-hand corner of the graph seemed to be fatally attractive. To successfully calculate the bandwidth of the f.m. carrier required candidates to remember a rule which was not in the data sheet; many weak candidates assume a factor of 2 instead of 5.

4 The first part of the question discriminated well. It required candidates to show how to calculate trip thresholds for a Schmitt trigger. Only the strongest candidates explained that one terminal needed to be held at 0 V for change to happen and then used current and voltage calculations to explain the rest. Weak candidates either used the inverting amplifier voltage gain formula to get the right numbers but no credit, or produced a rule of their own invention. The time calculation for the ramp generator proved to be equally discriminating, with strong candidates getting it correct and weak candidates inserting the wrong voltages (15 V or 8 V were the usual incorrect values instead of 13 V). The calculation of the highest frequency that the encoder could handle required two steps; most candidates incorrectly assumed that the time they had just calculated was the period of the sampling signal, when it was actually half of the period, with only the strongest candidates able to get the correct answer. However, most candidates were able to correctly complete the block diagram for the decoder, and about half could explain why the last stage was a power amplifier in terms of the need for current amplification, not voltage amplification.

5 This question about optical fibre and radio wave transmission systems was poorly answered by most candidates. Although the majority knew that optical fibre requires infra red pulses, few knew that they were attenuated as they passed through the fibre. Most assumed that the next part of the question was about the fibre rather than the whole transmission system (as clearly specified in the question stem), so didn't explain how degraded pulses at the end of the fibre could be regenerated. Too many candidates seemed unaware that radio signals are rapidly attenuated as they move away from their source, making them very susceptible to corruption by signals from other sources, and only a minority knew that coding signals with FM or PWM made them more resistant to interference; the majority suggested that a more selective receiver, such as a superhet, was the answer. As ever, weak candidates confused noise with interference, often treating them as the same thing.

6 Too many candidates failed to understand the term "frequency division multiplexing", so couldn't explain why it was used for mobile telephones. This didn't stop the vast majority from being able to calculate the number of channels for the mast, although the equivalent calculation for frequency modulation proved to be much more challenging for weak candidates. Too many tried to do this two-step calculation in one step and got it wrong. The bandpass filter proved to be an excellent discriminator, with strong candidates earning all the marks and weak candidates none - usually because they didn't know how to arrange the components.

7 Although the vast majority of candidates were able to place the mixer and oscillator for the superhet receiver, only a minority selected and placed the filter, demodulator and amplifier in the correct boxes. A surprising number of candidates placed the filter **after** the demodulator, suggesting that they had very little understanding of how the system worked. It was good to find that most candidates were able to calculate the capacitor value for the tuned circuit; weak candidates were usually unable to manipulate the formula correctly. As ever, only the strongest candidates were able to correctly explain the improved selectivity of the superhet receiver. The amplifier design proved tricky for many candidates, usually because they couldn't remember the correct circuit diagram for a non-inverting amplifier.

8 Only half of the candidates were able to describe the function of a digital to analogue converter without recourse to the terms digital and analogue. However, most were able to do the range calculation and explain the behaviour of the block labelled latch. Strong candidates realised that the block was edge-triggered; too many weak candidates assumed that the latch became transparent when the signal labelled L was high. Although most candidates could produce a correct calculation of the sample rate, only a minority could explain it in terms of the number of steps of the DAC in each cycle; too many candidates earned no credit by treating the counter as a frequency divider. A disappointing number of weak candidates tried to explain the operation of the ADC by describing the flow

of signals between the blocks, instead of describing the changes in those signals caused by the blocks. Strong candidates fared much better with this question, although few bothered to mention that the output of the DAC stepped up each time the counter value increased.

9 Each part of this question discriminated well, with weak candidates earning no marks and strong ones earning all of them. Only the strongest candidates mentioned all four parts of the packet, with many candidates omitting to mention the data. Too many candidates ignored the fact that this question was about asynchronous transmission, and assumed that there was a master timing signal which gave each computer a time slot for their access to the data line. Although many candidates knew that the analogue switch had to be in the transmitter, many could not explain why in terms of interfering with the outputs of other computers trying to use the data line.

F616 Design Build and Investigate Electronic Circuits

As was the case for module F616 last year, moderators reported that the raw marking was on the whole very good and that few centres would have required amendments to marks. The same comment made for F613 about the annotation of marks can also be applied to this module and it cannot be overstated the benefit of using concise comments or references in the report to where criteria have been achieved. The annotation of scripts can be built into the marking system and can be used to tally the number of times a particular criterion has been achieved. This technique is an excellent guide for markers and moderators.

The number of centres submitting work to the OCR Repository still remains low. Whilst paper versions are still acceptable, the marking of scripts using a digital technique does have advantages. Submission of work for moderation is very easy and quick to do; there are no costs incurred in the submission of work and the carbon footprint is reduced; the marked work by centres is easily saved.

As with last year, a small number of clerical errors crept into this module and the main culprit was again the addition of marks. Centres must have each script checked by an independent person before submission. Many centres use spreadsheets to record marks and this does help to reduce errors.

The range of projects attempted was again impressive with a number of candidates attempting some very challenging circuits. Many of these candidates produced circuits requiring a large number of subsystems; more than the five required to be eligible for the maximum mark of 60/60. A common feature, though, of many candidates' work is the lack of final testing of the full circuit and comparing the results of the final circuit testing with the initial full circuit specification. Whilst the marking was generally very good this year, small discrepancies still arose and it is instructive to consider the main problem areas described below.

To achieve high marks for Research, criterion 1a, candidates should offer some useful and relevant numeric or circuit information. For example, if a candidate attempts a motor speed controller circuit using a closed loop system and presents research solely based on the benefits of using closed loop systems, the mark for this criterion is not likely to be high. Examples of good research include particular circuit diagrams needed to build a subsystem, how a circuit works, the value of the break frequency of a filter, etc. The report must contain statements about how the research has helped the design or production of the circuit.

The specification, criterion 1b, should contain some numeric information for each subsystem and the final circuit. This enables analysis to be carried out on test results for each subsystem and the final circuit. A poor specification is likely to result in a low mark for criteria 1b, 3c and 3d. Thus, if high marks are to be achieved, it is important to present detailed final circuit and subsystem specifications.

The test plans (criterion 1c) are often not given the high profile they deserve. The plans are often poorly done and do not contain the detail needed to score the higher marks. When writing test plans, candidates should adopt the future tense, for example, 'to test this subsystem, I am going to……'

For fault finding (criterion 2e), in order to score high marks, candidates must present the faults and discuss how these were resolved. It was found on several occasions that a report contained no reference to fault finding, yet marks had been awarded for criterion 2e. The faults should be detailed clearly and the steps to finding the solution given.

Analysis of results (criterion 3c) is a higher level skill that candidates can find difficult. If a subsystem or the final circuit has been specified well, then the task facing the candidate is to discuss, quoting evidence, whether the subsystem or final circuit performs as predicted. For example, if a voltage amplifier subsystem is attempted, and the gain is quoted as ten, then the results taken should be analysed to show the actual gain obtained. A brief statement of the kind, ‘as you can see, the subsystem works’, is not analysis and does not score a mark.

For circuit diagrams, criterion 4a, all component values must be shown on the diagram and must be correct to score full marks.

Finally, for the acknowledgement of sources of assistance (criterion 4d), the acknowledgement should include a detailed reference to the source and what assistance was obtained.
If centres would like further training or support then they should contact OCR immediately.

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