

Design and Technology

General Certificate of Secondary Education

Unit **A514/01** Electronics: Technical Aspects of Designing and Making

Mark Scheme for January 2012

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All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

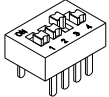
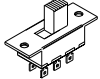
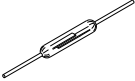

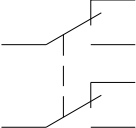
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Question			Answer	Marks	Guidance
1	(a)	(i)	<p>1 mark for each switch correctly identified, 3 x 1 marks.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p><u>DIP switch</u></p> </div> <div style="text-align: center;">  <p><u>slide switch</u></p> </div> <div style="text-align: center;">  <p><u>reed switch</u></p> </div> </div> <div style="display: flex; justify-content: center; margin-top: 10px;"> <div style="text-align: center;">  <p><u>press switch</u></p> </div> </div>	[3]	
		(ii)	Reed switch requires a magnet	[1]	Do not allow any tool to operate the DIP switch. Allow electromagnet.
		(iii)	<p>Any indication that there are two separate switches both of which are changeover; either drawing of symbol with notes or written description, eg</p> <div style="text-align: center;">  </div> <p>Double pole description, 1 mark. Double throw / changeover description, 1 mark.</p>	[2]	Correct symbol, 2 marks. "Double Pole Double Throw", 1 mark.

Question		Answer	Marks	Guidance
	(b) (i)	<p>Benefits of surface mount components could include:</p> <ul style="list-style-type: none"> • Physically small, will reduce size of final circuit • Components stay in position when glued before soldering • Components can be placed by machine • No drilling needed. • Easier to produce double sided board <p>Allow mark for other valid benefits.</p> <p>Problems with surface mount components:</p> <ul style="list-style-type: none"> • Circuit difficult to repair; • Components difficult to handle; • Difficult to solder using hand methods. <p>Allow mark for other valid problems.</p>	[1] [1]	Allow 'harder to remove'.
	(ii)	<p>Reasons for using a relay could include:</p> <ul style="list-style-type: none"> • Different input and output voltage; • To isolate PIR circuit from rest of alarm circuit; • Switching high current devices. <p>1 mark for valid reason.</p>	[1]	
	(c) (i)	<p>Reasons may include the following points:</p> <ul style="list-style-type: none"> • The terminal block will allow connection when the PIR is fixed in position • More than one wire can be connected to a terminal • Wires can be connected / disconnected quickly • No soldering required • Different wire thicknesses can be used. <p>2 marks for two points included in explanation Allow 2 marks for detailed explanation of one point.</p>	[2]	Allow reference to 'tidiness / neatness' of wiring. No mark for security of wires.
	(ii)	The screw head will allow either flat head or crosshead screwdriver to be used.	[1]	
Total			[12]	

Question		Answer	Marks	Guidance															
2	(a)	<p>LED cathode can be identified by:</p> <ul style="list-style-type: none"> • Flat on case; • Short leg nearest to cathode; • Test in breadboard; • Trial and error. <p>1 mark for each of two workable methods.</p>	[2]	No mark for 'there is a long and a short leg'.															
	(b)	<p>1 mark for each correct line in table, 3 x 1 marks.</p> <table border="1" data-bbox="461 518 949 820"> <thead> <tr> <th>SW1</th> <th>SW2</th> <th>light shown</th> </tr> </thead> <tbody> <tr> <td>off</td> <td>off</td> <td>none</td> </tr> <tr> <td>on</td> <td>off</td> <td>red</td> </tr> <tr> <td>on</td> <td>on</td> <td>yellow</td> </tr> <tr> <td>off</td> <td>on</td> <td>green</td> </tr> </tbody> </table>	SW1	SW2	light shown	off	off	none	on	off	red	on	on	yellow	off	on	green	[3]	
SW1	SW2	light shown																	
off	off	none																	
on	off	red																	
on	on	yellow																	
off	on	green																	
	(c)	If R1 and R2 are too high a value the LEDs will be very dim or may not show as current is too small.	[1]	Allow mark if only one resistor is mentioned as being too high a value.															

Question		Answer	Marks	Guidance	
	(d)*			Content	Levels of response
		<p>Discussion on benefits of using LEDs should include some of the following points:</p> <ul style="list-style-type: none"> • They are available in different colours, shapes, sizes and intensities; • Smaller and generally longer lasting than filament lamps; • Low current draw / energy use compared to filament lamps; • Available with two or three colours in a single package; • Can be connected into arrays for ease of fitting; • Lower cost than alternative forms of lighting. 	[6]	Maximum of 2 marks for a bullet pointed list with no further detail.	<p>Level 1: (0 – 2 marks) Basic comments discussing some of the benefits of LEDs, must relate to car, cycle or household applications. At least one of the listed benefits mentioned. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised. Errors of spelling, punctuation and grammar may be intrusive.</p> <p>Level 2: (3 – 4 marks) Adequate discussion, showing understanding of the improvements given. At least two specific benefits mentioned and one drawback of alternative light forms. There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structures format. There may be occasional errors in spelling, punctuation and grammar.</p> <p>Level 3: (5 – 6 marks) Clear discussion comparing benefits of using LEDs and drawbacks of other methods. Mention of benefits in environmental terms. Reference to at least one product as an example. At least two examples of use with comparisons included. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate can demonstrate the accurate use of spelling, punctuation and grammar.</p>
		Total	[12]		

Question			Answer	Marks	Guidance
3	(a)	(i)	Reasons for use could include: <ul style="list-style-type: none"> • Protect the IC from heat damage; • Allow easy replacement of IC; • Allow IC to be reused; • Avoid damage to IC legs. 1 mark for suitable reason	[1]	
		(ii)	Ensure correct orientation, 1 mark. Bend two legs to lock into place while soldering, 1 mark.	[2]	Allow other valid reasons eg ensure that all legs have been inserted into holes. No mark for reference to just placing in the PCB.
		(iii)	Avoids damage to IC legs, [1] by lifting from both sides at once,[1] allowing easy replacement. [1] Allow 2 marks for detailed explanation of one point.	[2]	Allow avoiding legs sticking into fingers, [1] Allow reference to small size re: removal by hand, [1]
(b)	(i)	Reason should relate to the static sensitive nature of CMOS ICs. 1 mark for understanding shown.	[1]		
		(ii)	Precautions when using CMOS ICs: <ul style="list-style-type: none"> • Store in special bags or tubes for static sensitive devices; • Store with legs in conductive foam; • Use earth strap, static mat; • Earth yourself before touching. 2 x 1 marks for suitable precautions	[2]	Allow - Not wearing synthetic clothing that can cause static. Answer must refer to damage from static.
(c)		Test for dry joints should be: Check for movement of joint, 1 mark Using a multimeter, 1 mark Resistance / continuity setting, 1 mark. One probe on the solder the other on track or pad, 1 mark.	[2]	Allow use of test wire with sounder, LED or bulb, 2 marks if placing on circuit is correctly drawn or described. No mark for visual inspection.	

Question		Answer	Marks	Guidance
	(d)	Test 1 result, HI LED is off, LO LED is on, 1 mark. Test 2 result, HI LED in on, LO led is off, 1 mark.	[2]	Allow check for low, (test 1) check for high, (test 2).
		Total	[12]	

Question		Answer	Marks	Guidance
4	(a)	<p>Internal connections in switch give more options when routing a track, 1 mark.</p> <p>Common connection to series of switches will have a break in it to allow other tracks to pass between pins, 1 mark.</p> <p>2 marks for two points included in explanation</p> <p>Allow 2 marks for detailed explanation of one point.</p>	[2]	
	(b) (i)	<p>1 mark for each correct connection.</p>	[3]	
	(ii)	<p>NC on pinout diagram means Not Connected, 1 mark.</p>	[1]	Allow 'not needed'.

Question		Answer	Marks	Content	Guidance
	(c)*				Levels of response
		<p>Benefits for using modular components could include:</p> <ul style="list-style-type: none"> • Quick to fit and replace; • Modules can be updated if new version becomes available; • Can cut assembly time for complete circuit; • Tested technology so reduces development time • Will often use surface mount technology so size can be reduced; • Can be mounted away from main circuit giving casing flexibility. <p>Problems with using modular components could include:</p> <ul style="list-style-type: none"> • May not match design requirements exactly; • Working voltage may not match main circuit; • Can include unwanted features that will not be used; • Generally not repairable so can lead to waste; • Difficult to remove components for recycling. • Can require larger casing. 	[6]	Maximum of 2 marks for a bullet pointed list with no further detail.	<p>Level 1: (0 – 2 marks) Basic comments discussing some of the benefits or problems with using modules At least one of the above benefits or problems mentioned. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised. Errors of spelling, punctuation and grammar may be intrusive.</p> <p>Level 2: (3 – 4 marks) Adequate discussion, showing understanding of the use of modular components. At least one specific benefit and one problem mentioned. There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structures format. There may be occasional errors in spelling, punctuation and grammar.</p> <p>Level 3: (5 – 6 marks) Clear discussion comparing benefits and problems. Discussion to include at least two benefits and two problems from above lists. At least two examples of use with comparisons included. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate can demonstrate the accurate use of spelling, punctuation and grammar.</p>
		Total	[12]		

Question			Answer	Marks	Guidance																														
5	(a)	(i)	<p>1 mark for each correct truth table, 2 x 1 marks.</p> <p style="text-align: center;">gate A gate B</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>in 1</td><td>in 2</td><td>out</td> <td>in 1</td><td>in 2</td><td>out</td> </tr> <tr> <td>0</td><td>0</td><td>0</td> <td>0</td><td>0</td><td>0</td> </tr> <tr> <td>0</td><td>1</td><td>1</td> <td>0</td><td>1</td><td>0</td> </tr> <tr> <td>1</td><td>0</td><td>1</td> <td>1</td><td>0</td><td>0</td> </tr> <tr> <td>1</td><td>1</td><td>1</td> <td>1</td><td>1</td><td>1</td> </tr> </table>	in 1	in 2	out	in 1	in 2	out	0	0	0	0	0	0	0	1	1	0	1	0	1	0	1	1	0	0	1	1	1	1	1	1	[2]	
in 1	in 2	out	in 1	in 2	out																														
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		(ii)	<p>Advantage of using one type of gate is</p> <ul style="list-style-type: none"> • Only one type of IC has to be stocked. • Gates can be combined to form any type of logic meaning that spare gates can often be used up. <p>1 mark for understanding shown.</p>	[1]	Allow reference to lower manufacturing cost.																														
		(iii)	<p>The two gates removed are both inverters or NOT gates, 1 mark.</p> <p>The two NOT gates cancel each other out so are not needed, 1 mark.</p>	[2]	Allow 'not needed'.																														
	(b)	(i)	<p>Unused inputs on a CMOS IC should be connected to a logic level, pin 14 is the nearest point to connect the unused inputs, 1 mark for understanding shown.</p>	[1]																															

Question		Answer	Marks	Guidance								
	(ii)	Terminal 2 is the hot water thermostat, 1 mark Terminal 3 is the time clock, 1 mark. <table border="1" data-bbox="481 303 851 486"> <thead> <tr> <th>terminal</th> <th>connection</th> </tr> </thead> <tbody> <tr> <td>1</td> <td><i>room thermostat</i></td> </tr> <tr> <td>2</td> <td><i>hot water thermostat</i></td> </tr> <tr> <td>3</td> <td><i>time clock</i></td> </tr> </tbody> </table>	terminal	connection	1	<i>room thermostat</i>	2	<i>hot water thermostat</i>	3	<i>time clock</i>	[2]	
terminal	connection											
1	<i>room thermostat</i>											
2	<i>hot water thermostat</i>											
3	<i>time clock</i>											
	(c)	Substitution into formula and rearrangement, 1 mark. $6 = I \times 150 \quad I = \mathbf{6/150}, 1\text{mark}$ $I = 0.04\text{A} = \mathbf{40 mA}, 1\text{ mark.}$	[2]									
	(d)	<ul style="list-style-type: none"> • Once set up the logic system will not need altering, . • Cost of logic IC is less than PIC; • No program to write with the logic system. • Fewer areas where the system can go wrong. • Mains spike can wipe program. Explanation that includes two relevant points, 2 marks. One point fully explained, 2 marks.	[2]	Do not accept 'cheaper' with no justification.								
Total			[12]									

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