

# **Design and Technology**

General Certificate of Secondary Education

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

## **Mark Scheme for June 2013**

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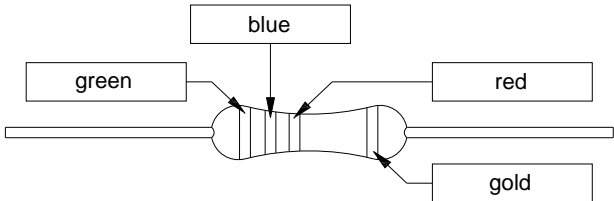
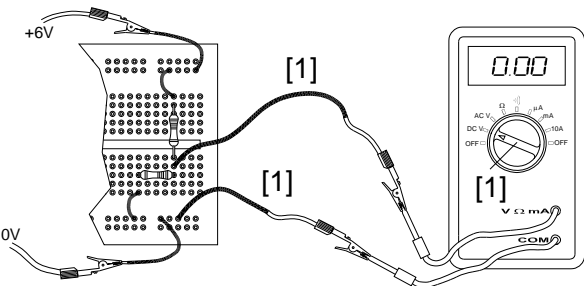
This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

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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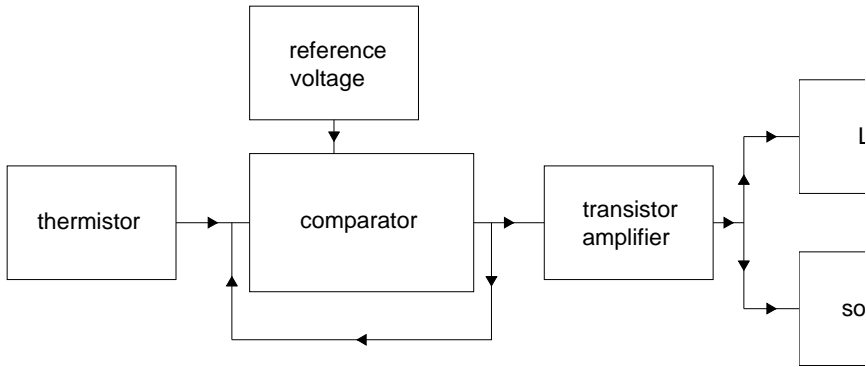
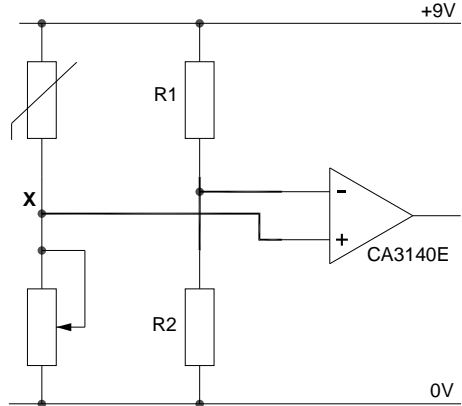
Question		Answer	Mark	Guidance
1	(a) (i)	 <p>1 mark for each colour correct, 3 x 1.</p>	[3]	
	(ii)	Upper value <b>5880Ω</b> Lower value <b>5320Ω</b>	[2]	Allow <b>5.88K</b> and <b>5.32K</b> Allow values in reverse order (5320R, 5880R)
	(b) (i)	Method <b>C</b> allows variation in the output voltage which <b>A</b> does not [1]. Method <b>C</b> does not allow resistance from positive to be less than 1K [1] This makes little difference to the voltage available at output but can protect components connected to the output [1] 2 x 1 marks.	[2]	Allow marks for clear understanding shown.
	(ii)	Substitution into formula $V_{out} = \frac{22}{5 + 22} \times 6$ [1] $= 4.89V$ [1]	[2]	Allow ecf for second mark. Allow <b>4.8V</b> and <b>4.9V</b> Correct answer with no working out award 2 marks
	(c)		[3]	Positive probe can go to any connection on vertical row with resistor junction. Common probe can go to any 0V point on breadboard. Dial must point to DC V. No mark for halfway between two positions.
<b>Total</b>			<b>[12]</b>	
Question		Answer	Mark	Guidance

Question		Answer	Mark	Guidance											
2	(a)	(i)	Injection moulding	[1]											
		(ii)	Suitable properties of ABS are: <ul style="list-style-type: none"> <li>• Shockproof/not brittle</li> <li>• Thermoplastic/can be injection moulded</li> <li>• Available in a variety of colours</li> <li>• Can be recycled</li> <li>• Hard surface/scratch resistant</li> <li>• Electrical insulator</li> <li>• Durable</li> </ul> 1 marks for suitable property.	[1]											
		(iii)	Possible reasons for the case being assembled using clips: <ul style="list-style-type: none"> <li>• Cut labour/parts costs</li> <li>• No serviceable parts inside</li> <li>• To prevent access.</li> </ul> 1 mark for suitable reason.	[1]	No marks for one word answers e.g. quicker, cheaper. These must be qualified for the mark.										
	(b)	(i)	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>will not bend</td> <td>electrical conductor</td> <td>magnetic</td> <td>electrical insulator</td> <td>resists corrosion</td> </tr> <tr> <td></td> <td>✓</td> <td></td> <td></td> <td>✓</td> </tr> </table> 1 mark for each correct. 2 x 1 marks.	will not bend	electrical conductor	magnetic	electrical insulator	resists corrosion		✓			✓	[2]	1 mark for each correct. No mark for 3 or more ticks.
will not bend	electrical conductor	magnetic	electrical insulator	resists corrosion											
	✓			✓											
		(ii)	The plastic block will support the legs of the LED [1], it sets the height of the LED [1] and stops the legs from touching [1], 2 x 1 marks.	[2]											
			<b>Total</b>	<b>[12]</b>											

Question	Answer	Mark	Guidance
	<p>(iii) Surface mount construction is used for the following reasons:</p> <ul style="list-style-type: none"> <li>• Reduce the size of circuit board</li> <li>• More suitable for CAM manufacture</li> <li>• Components can be picked and placed easily by machine</li> <li>• Reduced processing of PCB – no drilling</li> <li>• Low height can allow flexibility in design of casing</li> <li>• More suitable for double-sided boards</li> </ul> <p>2 x 1 marks.</p>	<b>[2]</b>	Allow reference to time e.g. quicker if justified by reference to specific work involved.
	<p>(c) Reasons for building in test points will include:</p> <ul style="list-style-type: none"> <li>• Not expensive at the PCB design stage</li> <li>• Test points allow easy access to particular point in the circuit</li> <li>• They allow test instruments to be applied quickly</li> <li>• Automatic testing of each board is made easier</li> <li>• Testing of boards after installation in product is easier</li> <li>• Less understanding of individual components needed by person carrying out the test</li> </ul> <p>3 x 1 marks</p>	<b>[3]</b>	<p>No marks for single word answers.</p> <p>Allow generic tests e.g. to make sure that the circuit works.</p>
	<b>Total</b>	<b>[12]</b>	

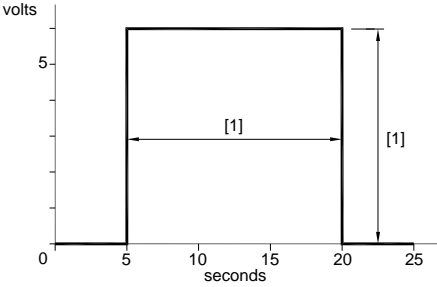
Question			Answer	Mark	Guidance
3	(a)	(i)	Benefits of the pillar drill will include: <ul style="list-style-type: none"> <li>• Drill is held rigid</li> <li>• Less chance of breaking drill bit</li> <li>• Depth can be set</li> <li>• Range of speeds available</li> <li>• Drills vertically</li> </ul> 1 mark for suitable benefit.	[1]	Allow other suitable benefits Do not allow reference to accuracy
		(ii)	Belt is in lowest position with smallest driving pulley therefore speed is 5000rpm.	[1]	
	(b)		Legs on components such as resistor and transistor can be bent to fit the hole [1] Components such as DIL IC and relay have legs which must be kept in line and are difficult to fit if holes are misaligned [1].	[2]	Allow 2 marks for a clear explanation for one type of component
	(c)		The micrometer is not so easy to read as the digital caliper, training required to read it. Limited opening, (0 – 25mm) digital caliper can also measure inside gaps and depth. Although micrometer is more accurate and does not need a battery the accuracy is sufficient for electronics work. 2 marks for a clear explanation of a single point or less detail and two points included.	[2]	Allow speed of use for caliper
<b>Total</b>				<b>[12]</b>	

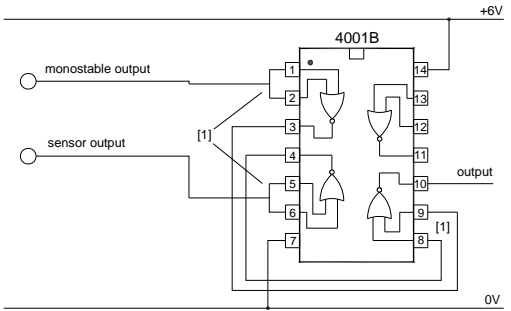
Question		Answer	Marks	Guidance	
				Content	Levels of response
	(d)*	<p>Factors will include the following:</p> <ul style="list-style-type: none"> <li>• Quality of the design/ergonomics/aesthetics</li> <li>• Materials – quality/consistency</li> <li>• Worker skill level/accuracy of machines</li> <li>• Dimensional accuracy of individual parts</li> <li>• Bought in component quality</li> <li>• Batch checking/checking each item</li> <li>• Health and safety/Legislation/BS/CE</li> <li>• Tolerance before rejecting items</li> <li>• Specialised quality control teams/down to individual worker.</li> </ul>	[6]		<p><b>Level 3 (5-6 marks)</b> Shows detailed understanding of factors affecting the overall quality of a commercially produced product and analyses most of the issues involved. 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> <p><b>Level 2 (3-4 marks)</b> Shows some understanding of factors affecting the overall quality of a commercially produced product. 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 structured format. There may be occasional errors in spelling, punctuation and grammar.</p> <p><b>Level 1 (1-2marks)</b> Shows limited understanding of factors affecting the overall quality of a commercially produced product. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised. Errors of grammar, punctuation and spelling may be intrusive.</p> <p><b>0</b> Response worthy of no marks.</p>
		<b>Total</b>	<b>[12]</b>		

Question	Answer	Mark	Guidance
<p>4 (a)</p>	 <p>1 correct, 1 mark. 2 correct, 2 marks. 3 or 4 correct 3 marks.</p>	<p>[3]</p>	
<p>(b) (i)</p>	 <p>Point X to non-inverting terminal, [1]. R1 connected to R2 and to inverting terminal, [1].</p>	<p>[2]</p>	
	<p>(ii) Any values that are the same for both R1 and R2.</p>	<p>[1]</p>	<p>Values of resistors must be 1K or greater</p>
<p><b>Total</b></p>		<p><b>[12]</b></p>	



Question		Answer	Marks	Guidance	
	(c)*			Content	Levels of response
		<p>Benefits of simulation software could be:</p> <ul style="list-style-type: none"> <li>• Faster circuit building</li> <li>• Easier to change component values</li> <li>• No expense if components destroyed</li> <li>• Simulated test instruments can be used</li> <li>• Results can be exported for circuit manufacture.</li> </ul> <p>Drawbacks could be:</p> <ul style="list-style-type: none"> <li>• Precise components not available on screen</li> <li>• Physical sizes not always apparent for casing design</li> <li>• Test results may not match real life/real time testing</li> <li>• Expense of software</li> <li>• Need for a computer to carry out building and testing.</li> </ul>	[6]		<p><b>Level 3 (5-6 marks)</b> Shows detailed understanding and analyses most of the issues involved in simulated circuits 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> <p><b>Level 2 (3-4 marks)</b> Shows some understanding and makes reference to both simulation and real circuits. 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 structured format. There may be occasional errors in spelling, punctuation and grammar.</p> <p><b>Level 1 (1-2marks)</b> Shows limited understanding of circuit simulation or of benefits/drawbacks. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised. Errors of grammar, punctuation and spelling may be intrusive.</p> <p><b>0</b> Response worthy of no marks.</p>
		<b>Total</b>	<b>[12]</b>		

Question			Answer	Mark	Guidance																									
5	(a)	(i)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">sensor</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">monostable</td> <td>X</td> <td>Y</td> <td>Z</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</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>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> </tr> </table> <p style="text-align: center;">[1] [1] [1]</p> <p>1 mark for each column correct. 3 x 1</p>	sensor	monostable	X	Y	Z	0	0	1	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	0	1	[3]	
sensor	monostable	X	Y	Z																										
0	0	1	1	0																										
0	1	0	1	0																										
1	0	1	0	0																										
1	1	0	0	1																										
		(ii)	 <p>Amplitude correct , 1 mark. 15s pulse starting anywhere, 1 mark.</p>	[2]	<p>Allow amplitude between 5 and 6V                      Rise <b>and</b> fall must be visible</p>																									

Question		Answer	Mark	Guidance
(b)	(i)	 <p>Inputs tied and connected, 1 mark, gates 1 and 2 outputs to gate 3, 1 mark.</p>	[2]	Allow LH outputs to gate 3 inputs to cross the IC outline
	(ii)	Pins 12 and 13 connected to either positive or 0V rail, 1 mark.	[1]	
(c)		<p>Benefits of using a PIC will include:</p> <ul style="list-style-type: none"> <li>• Accurate timing built in</li> <li>• Reduced parts count, all processing in one IC</li> <li>• Program can be altered during development without removing components</li> <li>• Additional inputs and outputs available for circuit development.</li> </ul> <p>2 x 1 marks for suitable benefits.</p>	[2]	Allow any other valid benefits.
(d)		<p>Electrical safety can be ensured by:</p> <ul style="list-style-type: none"> <li>• Earth circuit</li> <li>• Double insulated casing</li> <li>• Using a fuse matched to power consumption of device</li> <li>• Connecting through an RCD device</li> <li>• Designing and testing to British Standards / ISO.</li> </ul> <p>Description including two points, 2 marks.</p>	[2]	Allow 2 marks for one point well described. Allow restricted access to casing. Answer must refer to electrical safety.
<b>Total</b>			<b>[12]</b>	

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