GCSE Engineering (Double Award)
Unit 2 – Engineered Products

Clock Project

URS: Assessment evidence

a) Evidence of a production plan and associated quality control - a1 a2 a3

There is enough evidence to suggest the candidate has an understanding of a range of engineering processes and has used ICT throughout to demonstrate this. A production plan has been produced, using ICT, that identifies various stages of quality control. There is limited evaluation that contains only brief reference to the production plan.

Points 5

b) A schedule for making the product, with the key features identified - b1 b2 b3

Evidence is given during the introduction of the candidates portfolio to indicate the importance of accurate production planning.
A clear schedule for the completion of the clock is identified within the production plan, however, there is only brief reference to how the schedule could be improved within the evaluation and little evidence of actual justification other than time saving.

Points 4

c) Identification of the production technique and critical control points - c1 c2 c3

Reference is made to safety throughout the candidate portfolio, as well as identifying key control points within the material specification, planning procedure and schedule of work. There is reference to quality control tests and a whole section is dedicated to Health and Safety at Work and safety systems, such as risk assessments.
There is no reference to how production planning or scheduling could be improved.

Points 6

d) Evidence of the use of ICT in the making of the product - d1 d2 d3

Throughout the portfolio there is reference to ICT and the candidate has included a materials list in table form as well as CAD drawings and digital images. The CAD drawings, however, are unsupported by any documentation to suggest how they were produced. There is brief reference on page 5 to programming language and why CNC was used in this production. There is, however, no evidence of any evaluation of the CNC or other aspects of ICT used in this production.

Points 4

e) A record of how the product was made - e1 e2 e3

The candidate has included a ‘schedule of work undertaken’ and a tool list. The importance of the tools, machinery and equipment used is identified within the schedule of work and the evaluation. There is a reference to changes made with the production plan, namely flame cutting substituted for plasma cutting. There is an evaluation of the equipment and processes with a number of recommendations. For this product the candidate has made good use of ‘real world’ engineering equipment. However there is no reference to ‘real world’ production techniques that may be applied to the production of the clock, such as the batch production of this particular product.

Points 9

Total Points 28

Evidence Criteria	Evidence Location
A1	Page 47
A2	Page 47
A3	Page 53
B1	Page 45
B2	Page 47
B3	Page 53
C1	Pages 47, 48, 49, 51, 52
C2	Pages 49, 51, 52
C3	Page 52
D1	Page 49 Appendix 1 and 2
D2	Page 49
D3	Page 52
E1	Pages 47, 49, 51
E2	Page 49
E3	Page 52

Introduction and Project Description

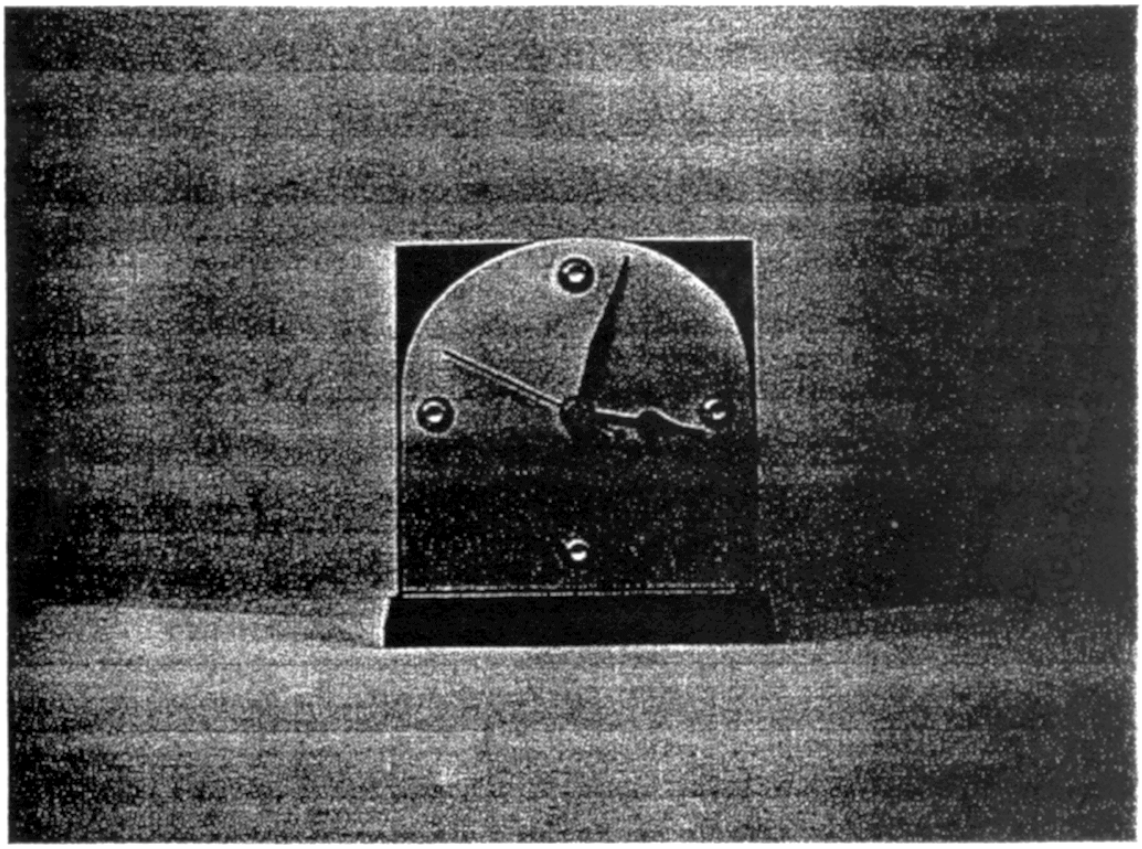
I will be producing a mild steel clock as part of my GCSE Engineering Project. I will produce my clock in three parts:

The front plate, back plate and the base, before final assembly.

I will work on the three parts individually and there will be a further description of these parts in the schedule of work under taken.

I am manufacturing this clock for a client and therefore I will have to meet quality standards as well as ensuring I meet all health and safety requirements. I will need to produce a production plan so that I know the sequence of how the clock will be produced.

Producing the clock will give me hands on experience in the use of wide range of engineering equipment.



Equipment Used To Complete Clock

- Engineers Blue
- Engineers Square
- Scriber
- Dividers
- Centre pop
- Hammer
- Hide Mallet
- Flat file
- Drilling machine
- Bridgeport CNC Vertical Machining Centre
- Bridgeport Milling Machine
- MMA welding machine and welding equipment
- Flame cutting equipment and profile block
- Grindstone
- M6 Taps- Taper
    - Intermediate
    - Final
- Counter bore
- Angle plates
- Emery cloth
- Spray Paint
- 20mm and 6mm slot drill
- 5, 9, 7mm Twist drills
- 32mm Sandvik Milling Cutter

Planning Procedure

- Hand cutting list in at the stores.
- Receive materials from the stores and check them .Use an engineers square and steel rule.
- File the ends of the plates to size working from a datum edge and checking tolerances for quality control.
- Mark out the base, then slot 6mm wide and 20mm pocket on CNC Bridgeport.
- Machine the 45° angle of the base using the CNC milling machine.
- Mark out the hole centres on the back and front plates. Use the engineers blue scriber, centre punch and hammer making sure pitch circle diameter is within tolerance.
- Drill and tap holes in front and back plates using the Bridgeport VMC CNC.
- Cut the radius on the front plate .Use the plasma cutter or alternative cutting process.
- Finish off the radius using a flat file and emery cloth.
- Attach the front plate to the back plate via four bolts.
- Fit the front / back plates to the base check that they are square.
- Weld the back plate into the base using Manual Metal Arc Welding
- Remove the front plate and spray it green. Spray the back plate and base silver.
- Refit the front plate via the four bolts and attach the clock mechanism.
- Test it is stable and that the clock mechanism works properly and keeps time correctly.

Material List For Clock Production

PART NO	MATERIAL	SIZE	Tolerance	Quantity	What for
1	Mild steel plate	108x101.6x 6.35	+/- 0.5mm	1	Back plate
2	Mild steel plate	114x 101.6 x6.35	+/- 0.5mm	1	Front Plate
3	Mild steel Plate	72x103x12	+/- 0.5mm	1	Base plate
4	Dome head bolts	M6x12	N/A	4	
5	Clock mechanism		N/A	1	

Schedule of work undertaken

Back plate

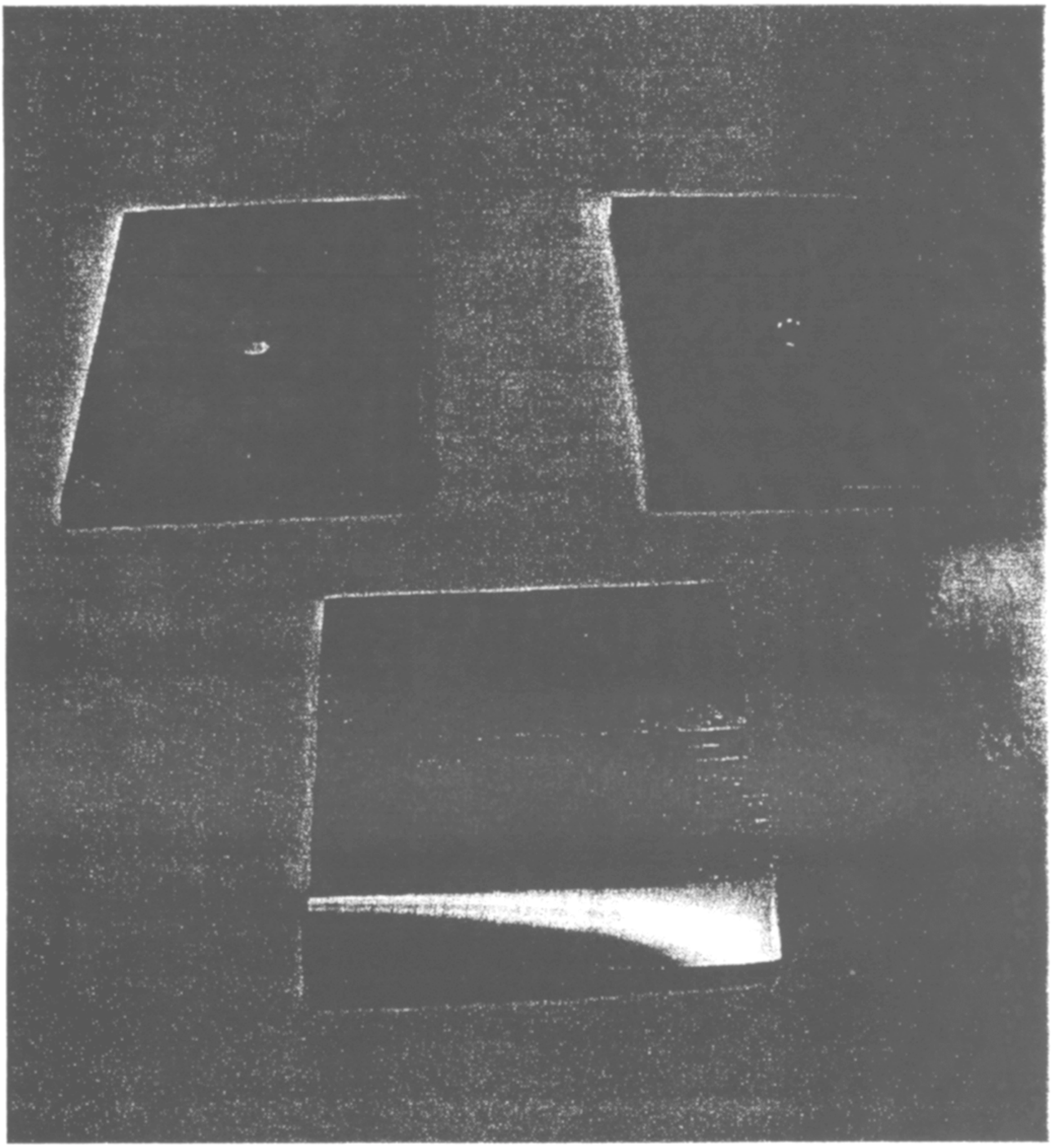
Following the working drawing we filed the 2 edges of the back plate to size and so it was square so it fitted into the base.
We marked out the holes finding the correct PCD (pitch circle diameter) using marking blue, scriber, vernier height gauge, dividers, hammer and centre pop. We did not need to think about making the plate the correct width because the material was 152.00mm Bright plate and the sides were already the correct size for what we wanted. The VMC Bridgeport 500 CNC Machine was then used to drill the holes in our work because it was quick and accurate and helped us with our quality control as it checked our marking out for us. The machine knew how and where to drill the holes because it was programmed and set using Heidhan programming language. The plate was held in the vice with a stop .A stop is screwed into the end of the vice and the work piece goes up against it .So I know it will be drilled in the right place. We had to make sure the holes were tapped square (threaded) so that the screws went in square and true.

Front plate

We fitted one edge square so it would fit on the base, we did not have to worry about the height because we were going to burn it out to the correct size with a flame cutter due to the plasma cutter not being available.
We marked out the holes and radius using our making out equipment. The radius for the top of the clock was centre popped so that we cut flame cut accurately and then file down to the pop marks.
We drilled the holes on the CNC in the vice so that the holes corresponded with the holes on the back plate.
We used a template that had been machining on the CNC machine to make sure the radius was correct when we flame cut the plate and we also had the trainer help us as this was a difficult process.
Emery cloth was again used to finish off the plates.

Base

First of all we machined the base on a Milling machine with the assistance of our trainer so that it was the same size as the front and back plates and within tolerances indicated on our working drawing.
We then cut the slot, using the 20 mm and 6mm slot drill, in the base of our clock using a Vertical Milling Machine. We used a vice to hold our base in place against a stop on the y axis.
A slot drill is a milling cutter, which we used to cut a slot in our base it can also be used to drill. The slot drills speed can be set using an N.C. facility (Numerical Control) this provides the cutting data. The information can be keyed in so it gives you a speed of 1300rpm .We put the angle on the base plate using a Milling Machine and a tipped cutter. The machine head was set over to 25° .The tipped cutter cuts materials very fast. Emery cloth was then used to finish off the base.



Assembly

Once all of the plates were complete and had been checked for finish quality and tolerance the front and back plates were bolted together using temporary bolts. They were then set squarely in the base and tacked from the underneath using Manual Metal Arc welding. One tack was put on to hold the plates then it was checked again with an engineering square. At this point I had to use a hide mallet to bring the plates back square then more weld was put on to secure the plates in position. While we were welding we had to make sure we had all of the necessary safety equipment on. We had to wear Proban flame retardant overalls, leather gauntlets and apron and a welders headscreen with a shade 11 filter lens. This helped protect us from the ultraviolet arc and the sparks from the welding.
After welding we had to remove any spatter from the welding then we used emery cloth to give the plates their final preparation before spraying. Roughening the plates with emery cloth helped the paint to stick to the metal. We used hammerite smooth spray paint to coat the clock. We took the bolts out at this point so that the base and back plate could be sprayed black and the front plate silver. Once it was dry our final task was to fit the clock movement after dome head allen key blots had been used to re fit the front and back plates.

Safety

While producing the clock we had to make sure we followed Health and Safety at Work procedures and also make sure that there were Risk Assessments carried out for every task that we completed. We had to wear all of the necessary safety equipment including overalls, safety boots, and light eye protection. Before we used the engineering workshops a full safety induction was given to us.

We were shown how to carry out a risk assessment and set them out correctly. The one below is a risk assessment we had to carry out for hacksawing.

Task Hacksawing

Persons at risk Pupils, trainers, teachers and visitors.

Hazards Broken blade, work not secure, work not de-burred, hacksaw, lighting, choice of blade (TPI), jewellery, clothing, long hair.

Risk Factor (1-5) Low (6-9)Medium (10-25)High

Likelihood of occurrence		**Severity of incident**	
Extremely unlikely	1	Minor Injury	1
Unlikely	2	Injury 3 days absent	2
Likely	3	Reportable	3
Very Likely	4	Major	4
Almost Certain	5	Fatal	5

Nature of risk	Likelihood	Severity	Risk Factor
Sharp material edges	3	1	3
Starting cut	3	1	3
Breaking through	4	1	4
Unsecure workpiece in vice	3	1	3
Incorrect sawing method	3	1	3
Incorrect sawing rate	4	1	4
Incorrect blade TPI	3	1	3

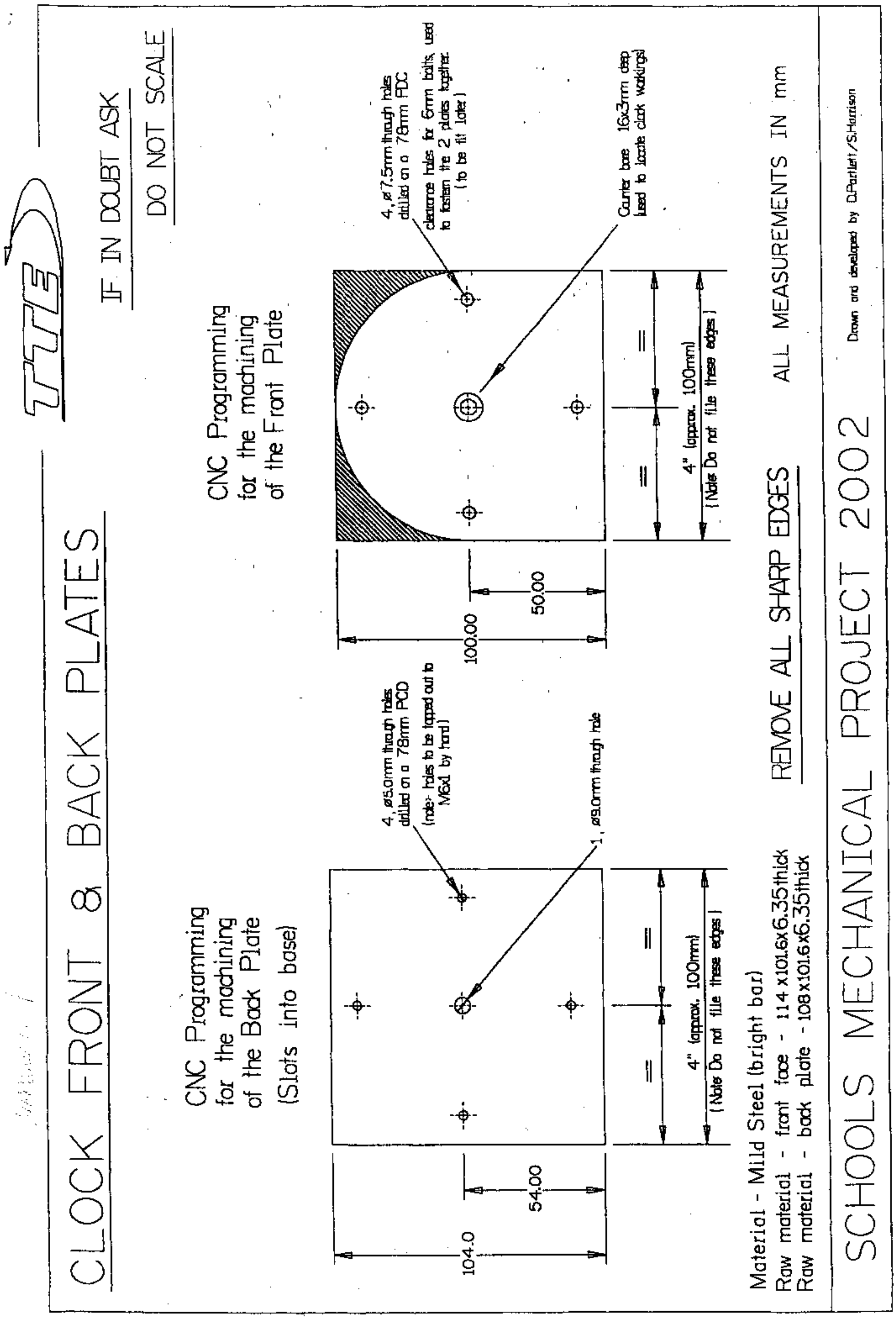
Total = 3 (Low)

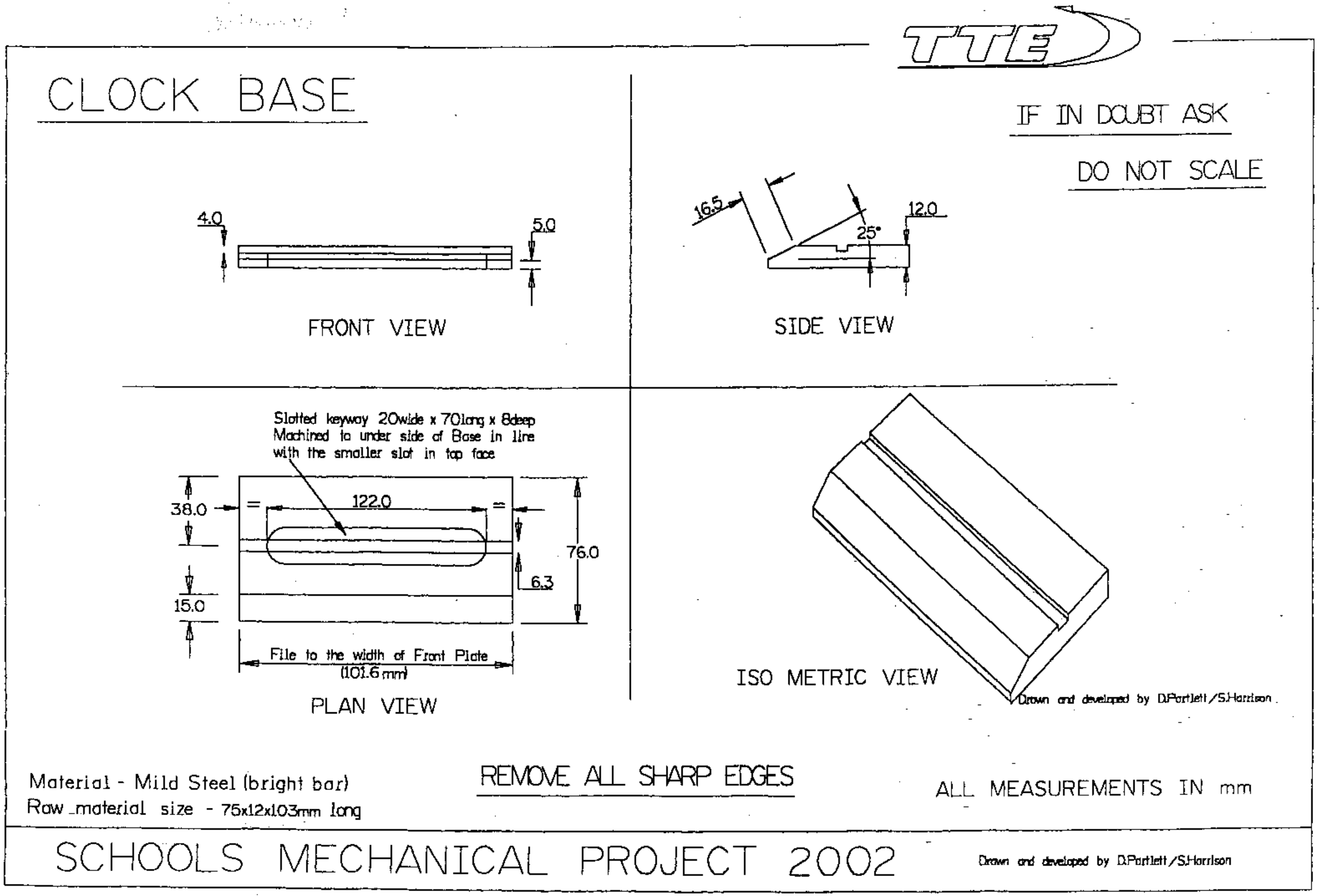
Evaluation

Some of my key findings during the completion of the clock were as follows:

- We used mild steel because of its good working characteristics i.e. it was easy to cut and weld.
- If possible I would have preferred to use another metal such as aluminium. This would have made the clock lighter and It would have been easier to file therefore time would have been saved completing the clock.
- Another option would have been to machine our work instead of filling because it would have been quicker.
- It was very important to make sure that the plates were fitted correctly in the vice because the clock would not assemble correctly if the holes were not lined up.
- We did intend using the Plasma cutter to cut the radius. This would have given us a much neater and more accurate cut, however the machine was in need of repair therefore we had to use the flame cutting equipment.
- It would have been better to programme the CNC machine to cut the radius rather than the flame cutter. It would have been more accurate, neater and quicker.

Overall I was pleased with the clock and it did meet the quality standards set be the customer. They were happy with the design, the finish and the overall production costs.

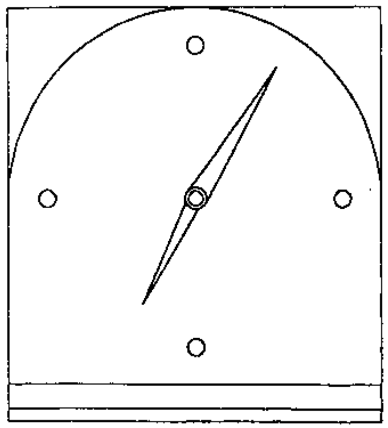

CLOCK FRONT & BACK PLATES
IF IN DOUBT ASK
DO NOT SCALE
CNC Programming for the machining of the Back Plate (Slots into base)
CNC Programming for the machining of the Front Plate
4, ø7.5mm through holes drilled on a 78mm PDC
clearance holes for 6mm bolts, used to fasten the 2 plates together (to be fit later)
Counter bore 16x3mm deep (used to locate clock workings)
4, ø5.0mm through holes drilled on a 78mm PCD
(note- holes to be tapped out to M6x1 by hand)
1, ø9.0mm through hole
100.00
50.00
104.0
54.00
=
4" (approx. 100mm)
(Note Do not file these edges)
REMOVE ALL SHARP EDGES
ALL MEASUREMENTS IN mm
Material - Mild Steel (bright bar)
Raw material - front face - 114 x 101.6 x 6.35 thick
Raw material - back plate - 108 x 101.6 x 6.35 thick
SCHOOLS MECHANICAL PROJECT 2002
Drawn and developed by D.Partlett/S.Harrison



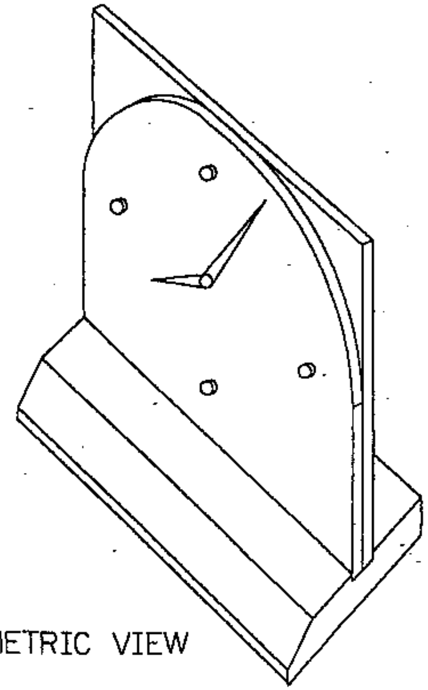
TTE
CLOCK BASE
IF IN DOUBT ASK
DO NOT SCALE
4.0
5.0
FRONT VIEW
16.5
25°
12.0
SIDE VIEW
Slotted keyway 20wide x 70long x 8deep
Machined to under side of Base in line
with the smaller slot in top face
38.0
122.0
76.0
6.3
15.0
File to the width of Front Plate
(101.6 mm)
PLAN VIEW
ISO METRIC VIEW
Drawn and developed by D.Partlett/S.Harrison
Material - Mild Steel (bright bar)
Raw material size - 75x12x103mm long
REMOVE ALL SHARP EDGES
ALL MEASUREMENTS IN mm
SCHOOLS MECHANICAL PROJECT 2002
Drawn and developed by D.Partlett/S.Harrison

IF IN DOUBT ASK

TWO VIEWS OF THE COMPLETED CLOCK



FRONT VIEW



ISO METRIC VIEW

Material - Mild Steel (bright bar)

REMOVE ALL SHARP EDGES

ALL MEASUREMENTS IN mm

SCHOOLS MECHANICAL PROJECT 2002

Drawn and developed by D.Partlett / S.Harrison

GCSE Engineering (Double Award)
Unit 2 – Engineered Products

Variable Voltage Power Supply

URS: Assessment evidence

a) Evidence of a production plan and associated quality control - a1 a2 a3

There are production plans included in this candidate's portfolio for each stage of the manufacturing process. There are indirect references to quality without specifically relating checks made during the production to actual 'quality control'. There are conclusions at the end of each production stage referring to how improvements could be made.

Points 8

b) A schedule for making the product, with the key features identified - b1 b2 b3

The candidate has included a 'sequence of events' but there is no explanation of the importance of accurate production planning. The plan does include a schedule for making the product but it lacks some detail. There is limited evaluation, in particular evaluation of how the schedule could be improved.

Points 5

c) Identification of the production technique and critical control points - c1 c2 c3

As indicated by the candidate, there are detailed production plans containing references to quality checks and also the Health & Safety issues related to the various tasks involved in producing the product.. Again, there is no explanation or justification of how the production plan or scheduling could be improved.

Points 6

d) Evidence of the use of ICT in the making of the product - d1 d2 d3

There is a good description of ICT used within the CNC aspect of the product. The candidate has also included CAD drawings for the fabrication section of the production and also included digital images of the product. There is no of explanation of why ICT has been used nor any evaluation of the ICT.

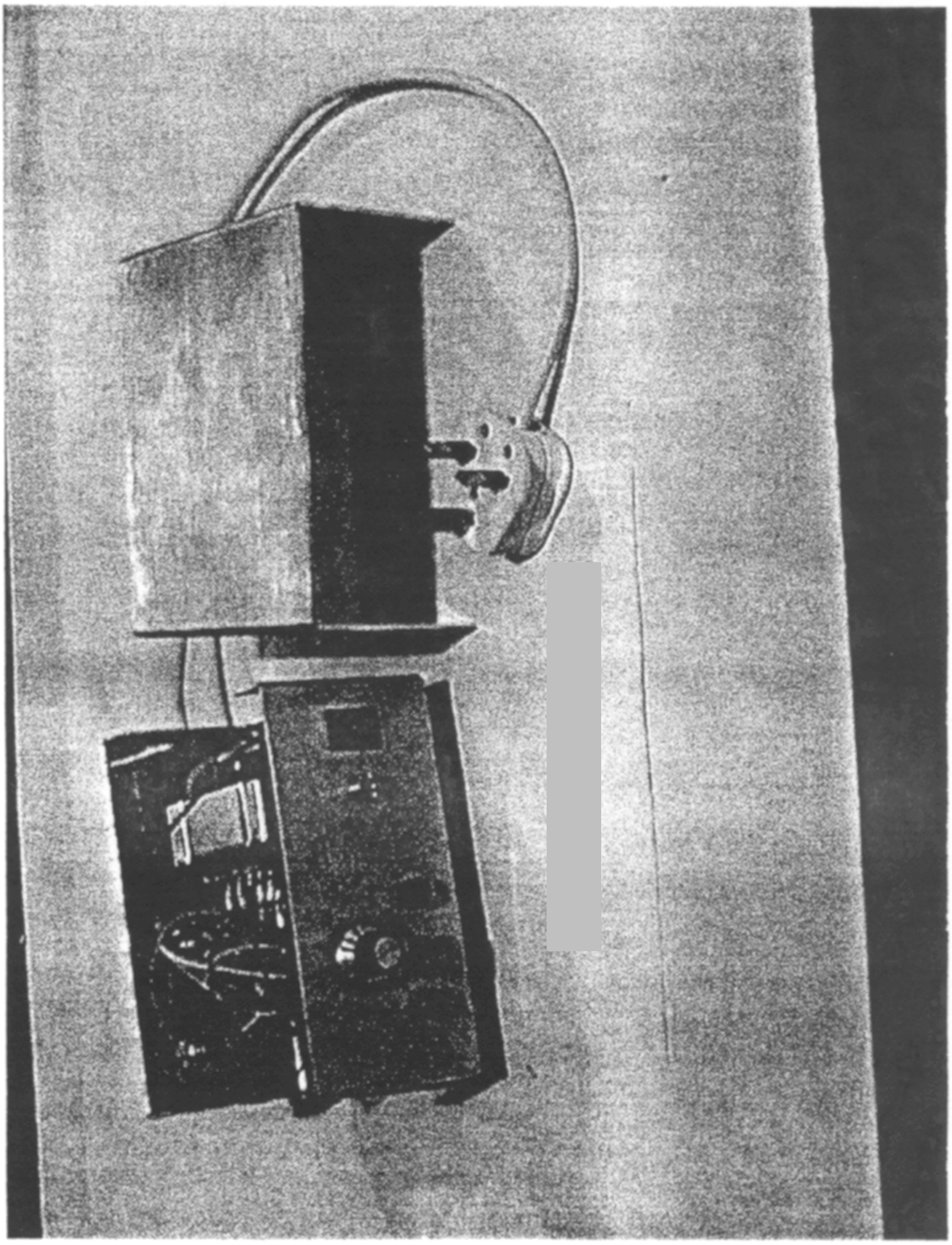
Points 7

e) A record of how the product was made - e1 e2 e3

The candidate has described in detail each stage of the production of the power supply. Detailed drawings are included as well as a component list. There is an evaluation of the equipment and processes with a number of recommendations, however in most cases the candidate has said he was happy with the manufacture of this product. For this product the candidate has made good use of 'real world' engineering equipment. However there is no reference to 'real world' production techniques that may be applied to the power supply such as batch production of this particular product.

Points 12

Total Points 38



GCSE Engineering

Product Specification

The task set is to build an AC Input Power Supply of 230 volts, the output will range from 3, 6, 9 and 12 volts DC, this will be a maximum current of 1.5 amps.

The electronics will be housed inside an aluminium case, the feet of the case are also aluminium, the output from the power supply is protected against short circuiting and over heating.

To ensure a long life and reliability a high standard of quality workmanship should be carried out.

All areas of construction must be of a high standard, these areas include:

- Crimping
- Tolerance
- Folding
- Marking Out
- Drilling
- Pop Riveting
- Soldering
- Shearing
- Tightening of nuts, bolts and use of washers
- Working to a tolerance in fabrication of ± 0.5mm

The circuit design is from rapid electronics catalogue, it has been modified to have four fixed voltage outputs.

Sequence of Events

The 230 volt power unit will be made in the following order:

Machining

A manual lathe was used to produce three feet, these feet were designed to my own specifications.

Fabrication

To form the case and the lid a sending machine was used to manipulate the aluminium plate, the CNC (Computer Numerical Cutting) machine was also used to cut and etch holes and markings.

Electrical and Electronic

Both electrical and electronic components are together, these are installed in the case that was made in the above order, the unit is then tested.

Pop rivet the lid onto the case with all electrical and electronic components inside.

Conclusions.

Production Plan for Machining

For this module I have decided to use aluminium, after considering the different materials on offer to me, I decided that aluminium would be the best option for me. Its light weight and low cost compared with brass. The aluminium is also resistant to normal atmospheric corrosion, aluminium has a density of one third of steel, as a result of these factors I decided to use aluminium. Other factors included how aluminium can be cut and manipulated with ease.

To machine the material a Harrison 300 Centre Lathe, to hold the work in place, I used a three jaw chuck, this is not as strong as a four jaw but as a result of the aluminium being soft, the three jaw is better and more appropriate.

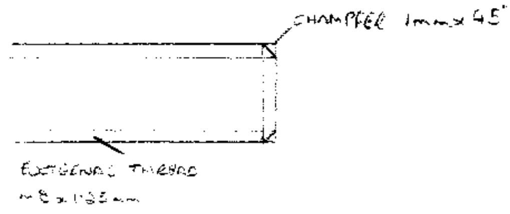
The first task to complete is to face the metal off, using a high speed steel tool, with aluminium the higher the speed of the lather the better the lathe will cut with a better finish. As well as the high speed tool a chamfer tool, and a tungsten tipped tool.

When parting the work a iscar parting tool is used to cut and tap the thread as M8 die / die holder and M8 taps / tap wrench 1.25mm, to show that I can work to a high standard of work I decided to have a tolerance of 0.2 of a mm. I feel that this measurement has been a good test for me to achieve.

With regards to safety the health and safety 1974, and COSHH are all applied, in addition to this PPE is also taken into account, light eye protection, safety boots and overalls are all used. As well as these sleeves must be rolled up and watches and other items of jewellery must be removed.

Once the preparation has been done the work can start to be turned, I have listed below the order in which the work was done:

- Secure metal in three jaw chuck, have no more than 40mm of metal out of the chuck jaw
- Turn metal down to largest diameter, leave enough for finish cut (25mm)
- Measure length for three (12mm), turn diameter down to 8mm
- Next cut thread using M8 die and wrench (M8 × 1.25)
- The end of the thread should have a 1mm chamfer, this is one with the chamfer



- Part work off using the parting tool
- Face the work off that is still in the chuck

- Use a 6.8mm diameter drill bit to drill a hole 2mm in depth, in the centre of the work.

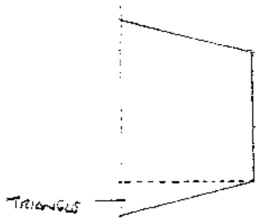
- Tap hole using M8 taps and tap wrench
- Screw the cut off section into the tapped hole, this will allow work to be carried out on the opposite end of the thread
- Calculate angle of tapper using trigonometry, to calculate the angle of taper take the highest point and minus the smallest from that, eg:

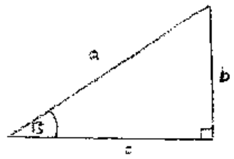
  16 – 10 = 6mm

  now divide that answer by two:

  6 ÷ 2 = 3mm

- Create trainable within diagram to find angle, this will make the process a lost easier





- The formula for a right angled triangle is:

  B = 3 ÷9 = 0.33 with this number refer to the table of natural tangents, in the zeus book, this equal 18°.

- With the chamfer tool set table to 18°, this is done by undoing the nuts on either side of the tool
- Cutting with small cuts to increase the quality of cut and finish
- Once angle has been created a radius needs to be cut
- Again cut with small regular movements, this will create a radius on the bottom of the foot.
- My sources of information to aid my creation and production are as follows:

  Lathe course notes

  Zeus Book

  Instructor advice

- The tolerance for the work was set at 0.2mm ±, any cuts will be measured with either as rule or for diameters a micrometer will be used
- Throughout cutting tools are continually sharpened to ensure precise cuts are made, work area will be kept clean and tidy, as well as tools are kept clean and clear of swarf

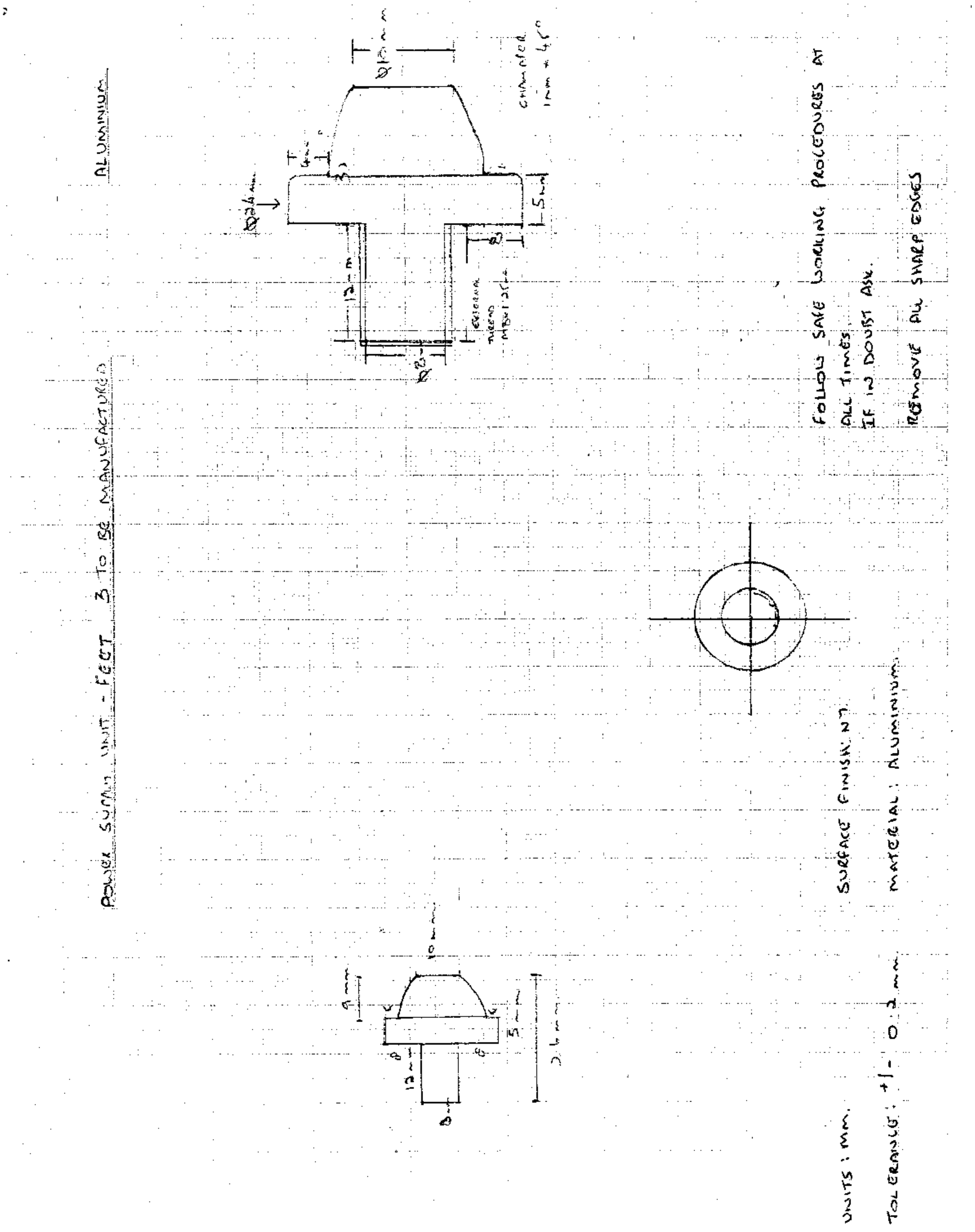
Conclusion

With a job of this nature mistakes can be made, I myself found difficulties with keeping within the tolerance of 0.2mm ±, however to ensure this a micrometer was used, to ensure accuracy. Other ways to combat this would be to cut with very small cuts at a time, no more than 0.5mm at any one time.

Throughout machining a wide range of processes were used, these include the Bridgeport CNC, manual lathe and the bending machine, to ensure a consistent standard measurements were continual checked using a micrometer and rule.

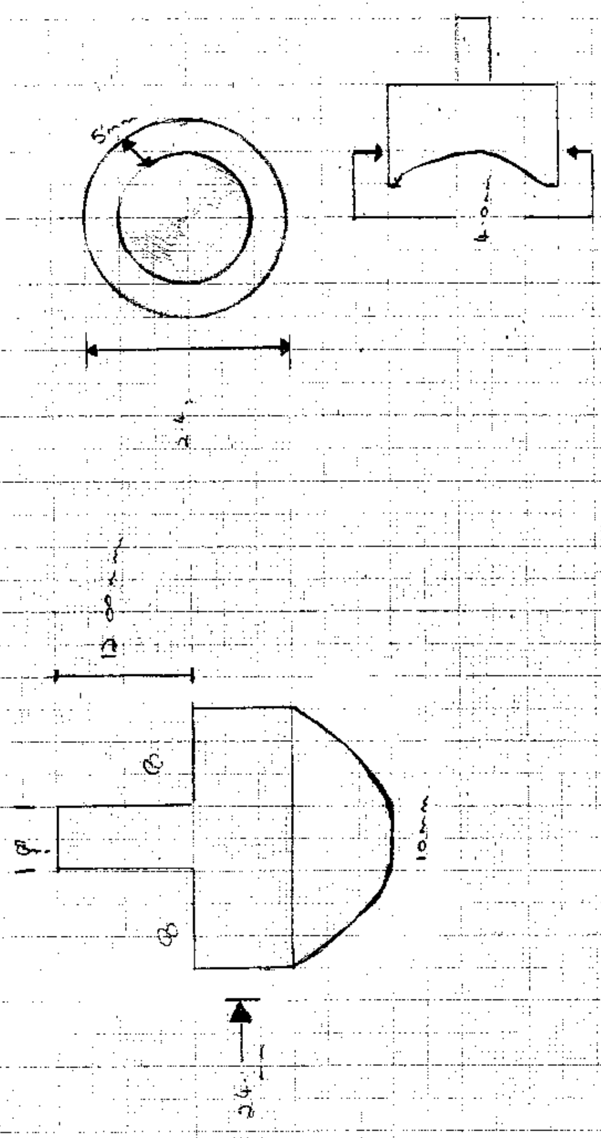
Alternative methods and materials may include using steel instead of aluminium, however steel is more expensive and harder to manipulate. Brass can also be used, however brass is heavy and again like steel it is expensive, if the process was repeated my tolerance would be smaller, the finish would be better as the machine would be faster turning.

The reason why is used a slow speed and not a fast one is down to confidence, as I gain more confidence on the lathe, then I will increase the speed.


POWER SUMO UNIT - FEET 3 TO BE MANUFACTURED
ALUMINIUM
FOLLOW SAFE WORKING PROCEDURES AT ALL TIMES.
IF IN DOUBT ASK.
REMOVE ALL SHARP EDGES
SURFACE FINISH: N7
MATERIAL: ALUMINIUM
UNITS: MM.
TOLERANCE: +/- 0.1 mm

APPENDIX 1

E1. POSSIBLE IDEAS



7

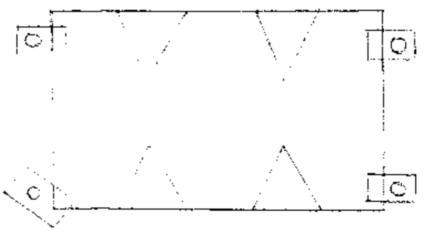
Production Plan for Fabrication

To begin this project, I firstly selected all appropriate materials and tools, there were taken from a mixture in store rooms and tool boxes, these included the following:

- Guillotine
- 6" File (bastard)
- Rule
- Aluminium plate
- De-burring tool
- Bending machine
- 10" File (bastard)
- Scribe

The aluminium plate was measured and marked out to size, folding lines and cutting lines are all included when marking out, once these have been etched the CNC machine is next to be used. When cutting the aluminium a 32 TPI blade should be used, the blade should be checked for any missing teeth or other damage, as they will weaken the blade.

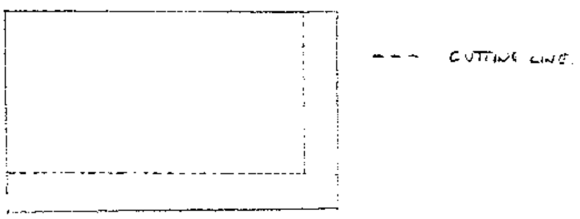
CNC stands for Computer Numerical Cutting, the machine cuts, drills and engraves markings and holes, in a sheet of metal. The metal should be securely fixed using a number of clamps, the perfect clamping procedure can be seen below:



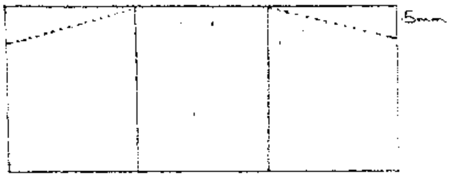
Work should be clamped with the corner directly in line with the x - y zero line.

Once the work is securely clamped, set the CNC machine running, when finished the plate will look like the following page. An alternative to the CNC is to mark and cut the holes and engravings, however this would take a lot of time and would also most certainly not be as accurate and as good as that done by the CNC.

The lid firstly needs to be cut, below is a diagram of cuts to be made:



A slight angle needs also to be cut, this is simply done by measuring 5mm in from the side of the plate, this will therefore create a slight overhang on the lid of the box.



Trigonometry is not needed for this, as a single measurement and line is used.

To cut these off the guillotine is used, the solid lines in the diagram above indicate the folding lines, once lines are cut edges are de-burred. The bending machine is again used to fold along the lines (see diagram above).

Once again my instructor helped with guidance as well as a selection of brief notes, although I did not make any mistakes when cutting and bending, I did concentrate a lot, in order not to not make mistakes. As a result people who do not concentrate will inevitable make mistakes, as a result people will need to change their style in order to produce good work.

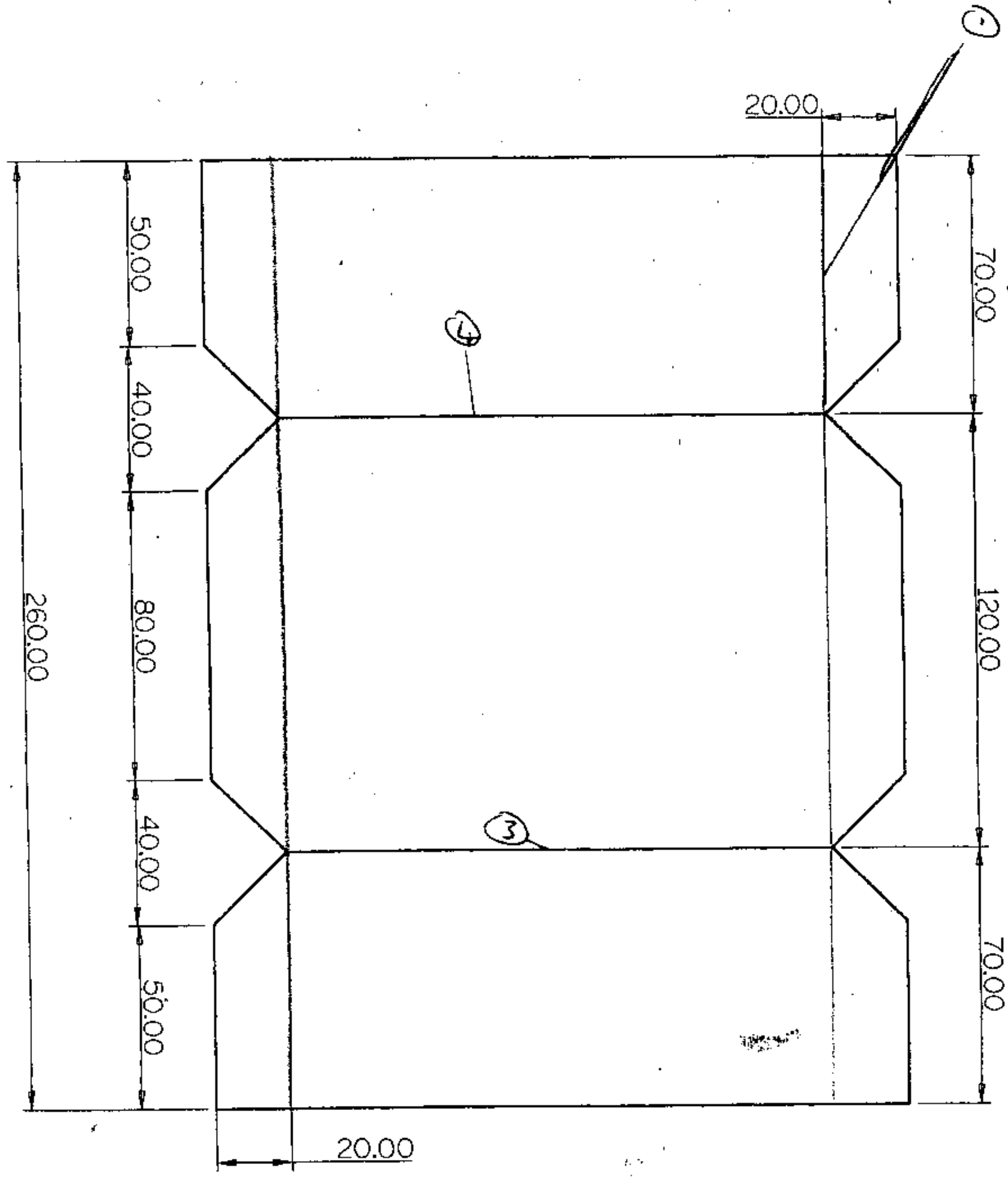
The Lid

When producing the lid for the box all appropriate materials and tools need to be select, fortunately, the lid requires the use of the same tools as the box itself:

- Guillotine
- De-burr tool
- Aluminium plate
- Rule
- Bending machine
- Scribe

The plate firstly needs to be measured to size, folding lines and cutting are all marked out with a rule and a scribe edges should be de-burred to ensure safety.

FOLDING LINES AND MEASUREMENTS.



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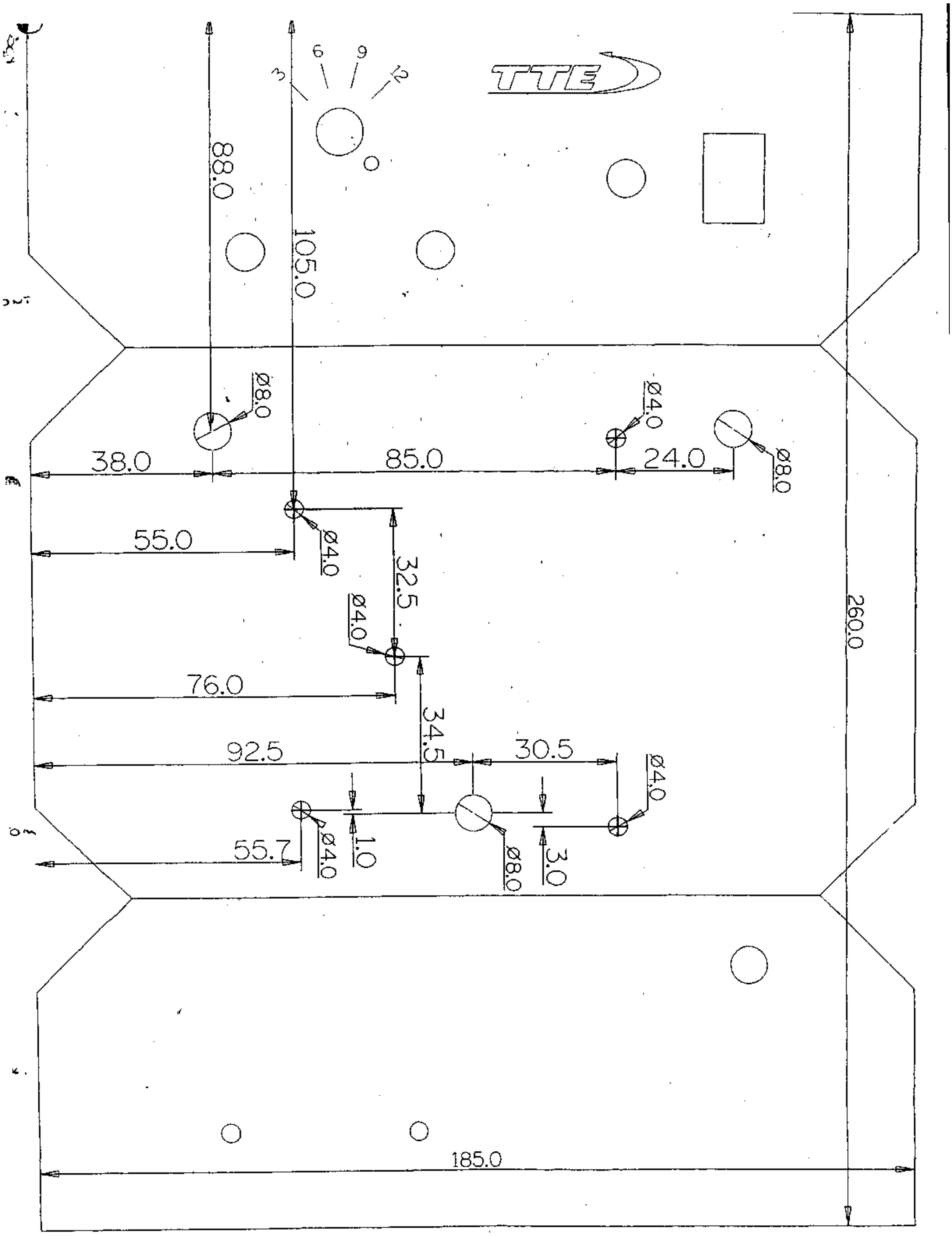

TTE
3
6
9
12
88.0
105.0
Ø8.0
Ø4.0
38.0
85.0
24.0
Ø8.0
55.0
Ø4.0
32.5
Ø4.0
76.0
34.5
92.5
30.5
Ø4.0
55.7
Ø4.0
1.0
Ø8.0
3.0
260.0
185.0

The CNC Bridgeport (Computer Numerical Cutting)

When using the CNC, the following tools are used to create the holes and etch markings into the plate:

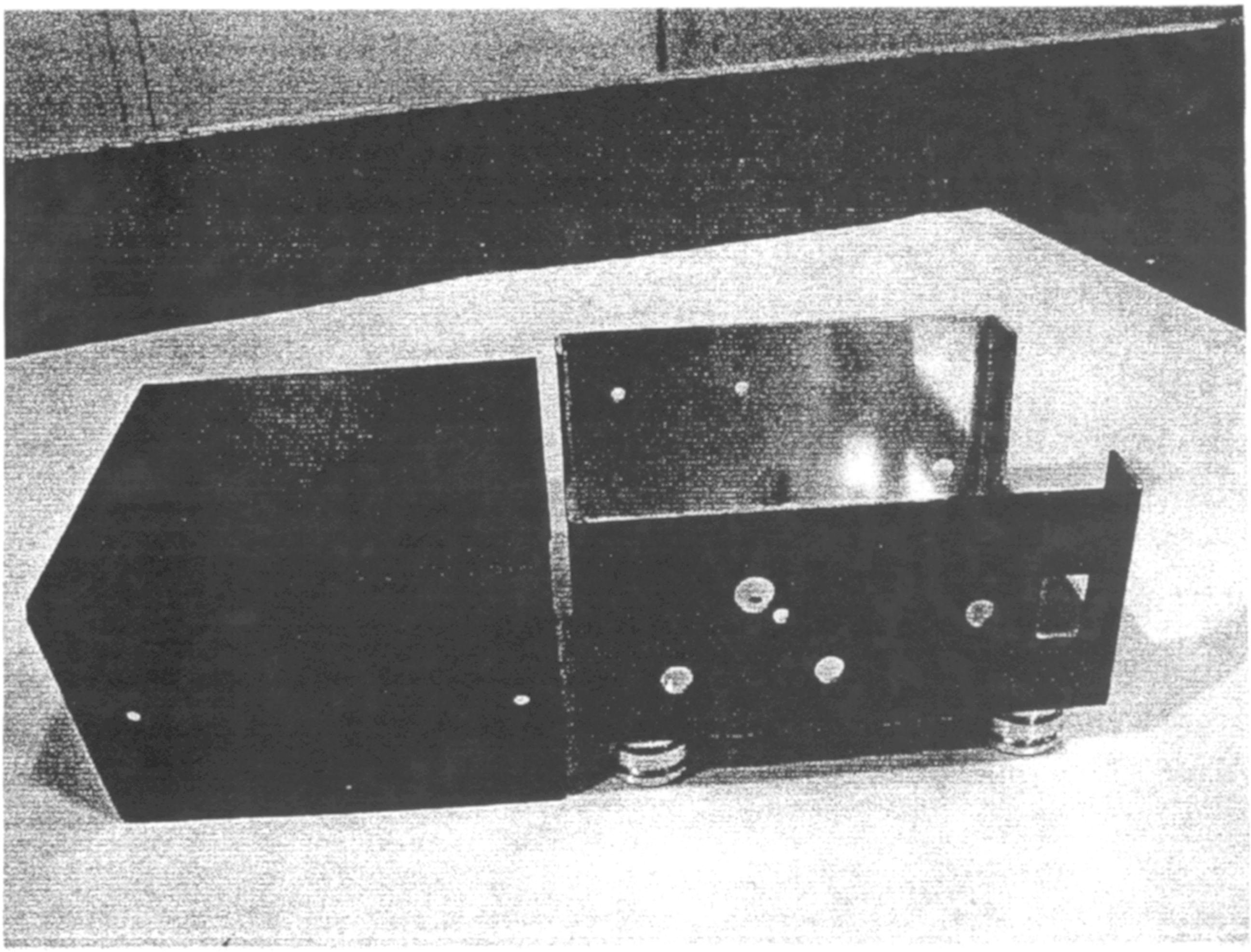
- Etching tool
- 4mm Slot drill
- 6mm Slot drill
- 8mm Slot drill

The slot drill is a milling cutter that is able to drill and cut in the plate, the cutters are made from a high speed steel, when positioning the plate it must be set at the x + y = zero axis.

Once the plate has been cut and engraved, a protective film / tape is placed on one side, this will protect the etched side from any scratches, this is important because the side that is being protected will be the front of the box. As a result, protecting the front from any scratches will save time when finishing the surface at a later date.

The next stage for the box is to fold / bend the sides, this is done on the bending machine. The fold line that has been etched is lined up with the line on the machine, the lever is then pushed and the table that the plate is positioned on moves upwards bending the metal as it moves.

The side of the box should be done first, this is marked ① on the diagram (folding lines and measurements) when using the bending machine one should be careful not to trap one's fingers, the next step is to fold along lines ③ and ④. If required the edges should be de-burred.

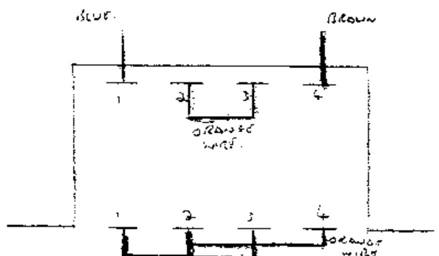


Production Plan for Electrical

To begin this project, I firstly selected all appropriate materials and components, tools and equipment. All equipment and components were taken from the store room, these included the following:

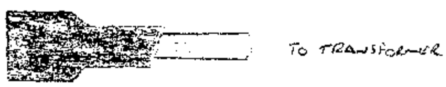
- Solder Iron
- Wire (red, green, black etc.)
- Bridge rectifier
- Solder
- Transformer
- L.E.D
- Crimpers
- Regulators
- Rotary switch
- Snips
- Heat gun

I firstly had to wire the transformer up, the transformer has eight ⑧ terminals, four ④ on the top and ④ on the bottom, all terminals should be tinned before soldering wires on. Great care should be taken when connecting wires as too much heat for long periods of time will damage the transformer. The diagram below shows how the transformer is wired, the wires should also be tinned.



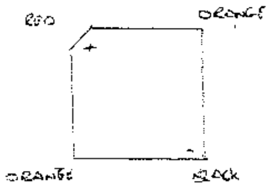
Terminals 1 and 3 are connected together, whilst terminals 2 and 4 are also. On the top a blue wire is connected to number 1, whilst a brown wire is connected to number 4. 2 and 3 are connected to increase voltage (v) to 240v.

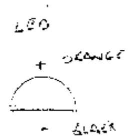
The tails from terminals 2 and 1 should be no shorter than 150mm in length, receptacle crimples should be crimped at the end of the wire.



When wires have been connected small pieces of plastic tubing should be placed over the connection, this is to aid insulation. However the newly formed connection must be cool before tubing is used, as the plastic tube will melt. Using a heat gun the tube should be heated and manipulated until moulded around the connection, be careful not to burn one's self.

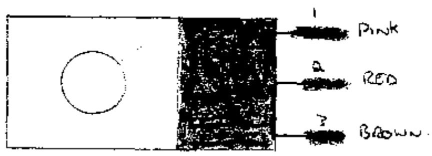
Next is the bridge rectifier, connecting leads should again be tinned as well as the connection pins. 6" tails should be connected, red + and black –, the remaining two pins are connected with orange wire, see diagram below:





The pins on the L.E.D should be snipped to 5mm in length, again pins should be tinned as well as the wire. The length of the wire should be no longer than 150mm, the orange connection should be sleeved using plastic tubing and heat gun.

Next the regulator LM317T is prepared, the three wire/pins should be cut in half and tinned, do not hold iron on long enough to cause damage, 6" lengths of pink, red and brown wire should be connected, see below:



After the regulator, the rotary switch is prepared, the nut and two washers are removed. Place the washer with the single pin/stopper, in hole number, between 4 and 5, this will only allow the switch to move four tines. Replace second washer and tighten nut, the following wires should be tinned and connected in the following order:

- A = Black
- 1 = Purple
- 2 = Grey
- 3 = Green
- 4 = Yellow

All connections should be secure and neat. No two terminals should be wrongly connected.

Through the production my instructor continually advised me whilst I was also aided with a brief outline of course notes, with regards to safe working procedures and work to be undertaken.

To make sure connections were strong and neat, my iron was continually cleaned with a wet sponge, however the iron was only dabbed and not held on the sponge for any length of time as this will greatly reduce the heat of the iron.

When wiring the transformer the plastic sieving needs to be placed over the top four terminals, however, after I had connected pins 2 and 3, I realised the insulation had not been added, therefore I had to disconnect, add the insulation and reconnect.

After each connection I inspected the quality and strength, if the connection was not neat and tidy in appearance, this I disconnected and reconnected until I was happy with it.

Conclusion

If I were to carry out the task again, I would not have changed anything, I feel confident that the manner in which I carried out the production, was right. However the quality of my soldering would be better now that I have had practice.

Production Plan for Electronic

In order to gain experience at soldering small components we were firstly given the task and soldering a number of resistors in close proximity to each other.

To begin this project I firstly had to select all appropriate materials and components, tools and equipment. All tools and components were taken from the store room, these are listed below:

- Snips
- Stripboard
- Solder Iron
- Solder
- Cutter
- 2 × 2k Ω resistor
- 1 × 1k3 Ω resistor
- 1 × 820 Ω resistor
- 1 × 300 Ω resistor
- 1 × 220 Ω resistor
- 2 × 10 µf capacitor
- 1 × 1 µf capacitor
- 1 × 2,200 µf capacitor
- 1 × in 4002 diode

On the following sheet is a layout diagram of how the stripboard was set up, the first task to be completed was to mark and drilling the stripboard cutters, three holes that will enable the board to be fixed (screwed), to the case, these screws holes are marked with an x on the sheet.

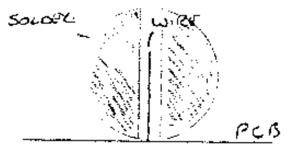
Once again course notes were issued in brief bullet points, whilst it also gained assistance from my instructor, these all helped during the production of the board.

In order for the board to have a high standard of consistency, I approached the task in a systematic order, as a result I soldered the components from left to right, I began with CI (for following terms and positions, see layout diagram).

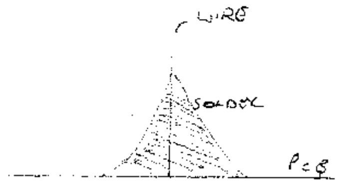
Followed by C2, R1, R2, R3, R4, R5, R6, D1 and C3.

To maintain the quality of the soldering, I continually cleaned the iron, with a wet sponge, my work area was cleaned regularly.

To ensure connections were strong and good, I made sure that the shape of the solder was like a 'volcano'.



This is known as a dry solder. The 'ball' like shape does not have the connection surface as the volcano.

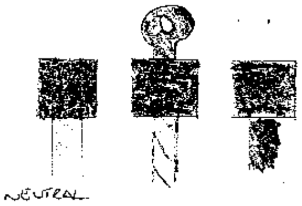


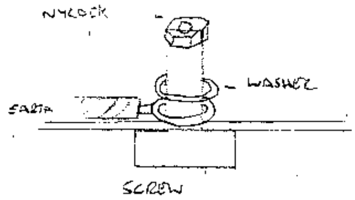
This shape of solder, is a perfect one, there is a large surface area of solder connecting to the board allowing the current to run freely.

Once connection is dry and cool, the wires/legs of the components are snipped off, using the snips. Some of the connections are not as they should have been and therefore they had to be re-done, this was due to the solder being a ball shape and not volcano.

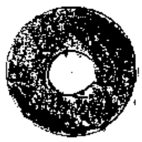
On the whole I was very pleased with the standard of my work, all joints are strong and there are no dry solders, as a result I would not change anything.

Firstly the eye crimp should be crimped on, this eye crimp must on the earth wire, the rectangular crimps are crimped onto the blue:.





The mains lead wad connected next, this was fed in the back of the unit through the 18mm hole, in order to have lead a tight fit a rubber grommet was also fitted inside the hole.



The transformer is next to be mounted, the nuts are nylocks, this is a very tight locking nut as it has a nylon thread that grips the threads of the screw. With the nuts being very tight assistance was needed in-order for the task to be completed, once the transformer is positions the stripboard supports are fixed in place. These screws are self tapping screws.

The red and black 4mm terminals are then attached, there is no correct way that these are positioned, the rotary switch is measured and cut to size. It must be checked that the pointer clicks on each of the numbers.

After the rotary switch, the mains switch is attached and connected, the brown and blue wires from the transformer are attached as well as the live and neutral wires from the mains leads. Both of the blue leads as well as the brown need to be lined up vertically.of the unit, this must not be over tightened as this can damage the rectifier. Next to be mounted is the regulator, this is done with the mounting kit, this includes:

- Insulation Washer
- Mica Washer

Production Plan for Electrical

Through out the electronic module a number of processes were used, these included soldering wire, stripping and cutting, plus breaking the track through drilling holes.

Once the components were all connected to the stripboard, it was time to connect the electrical components to the board, in order to connect these the layout information was supplied via a sheet.

The mains plug was then wired, when I checked to see if my power supply worked, when I turned the power on there was no output. This surprised me as I was confident that all connections were correct.

I firstly checked that all connections were correct, after this I then checked the plug, it was here that I realised that I had not put the fuse in the plug. I then put the plug back together and again tried the test, this time the light got progressively brighter as the number of volts increased.

To test for accuracy I checked the output using the AVO, I have tabulated my results below:

Specified Voltage	Actual Voltage
3	2.979
6	5.96
9	8.74
12	12.78

After testing the voltage I decided to carry out more tests with regards to accuracy, I then checked the tolerance of my case and lid, the tolerance was 0.2mm ±.

These tests have continually been carried out through each stage of:

- Machining
- Fabrication
- Electrical
- Electronic

This ensured that my work was a high standard as well as being consistent.

Production Plan for Fabrication

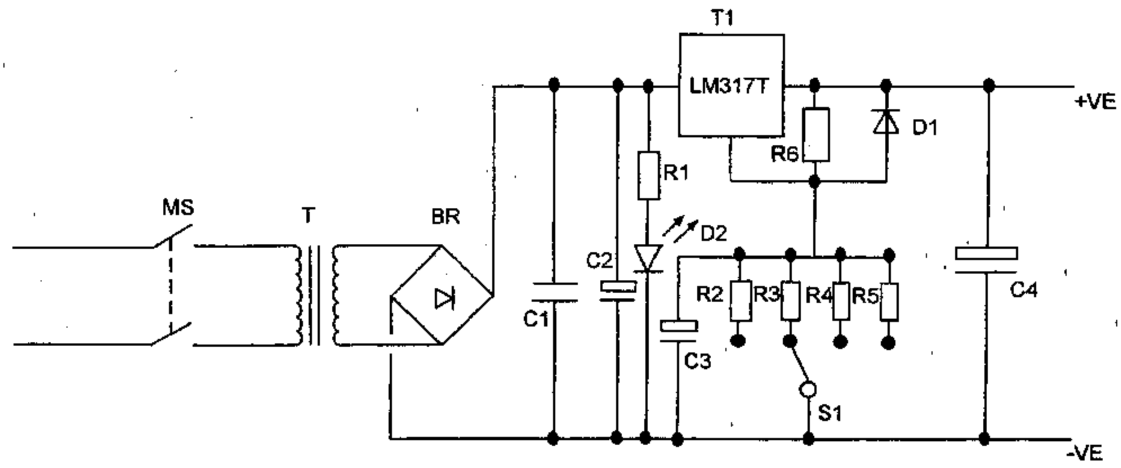
I have decided to simplify the task by placing the lid on the box and marking the holes, this will make the markings more accurate.

The diameter of the hole is 3.5mm, the holes will be drilled using an electric power drill, the hole will then need to be de-burred.

Using a 1½ lb ball peen hammer the rivets will be knocked in one by one, this will hold the case together with great strength, other ways of inserting the rivets is with a rivet gun.

As a result of using rivets and not screws or any device means that the power supply will be securely fastened, thus making it suitable for children to use.

SCHEMATIC DIAGRAM OF GCSE POWER SUPPLY



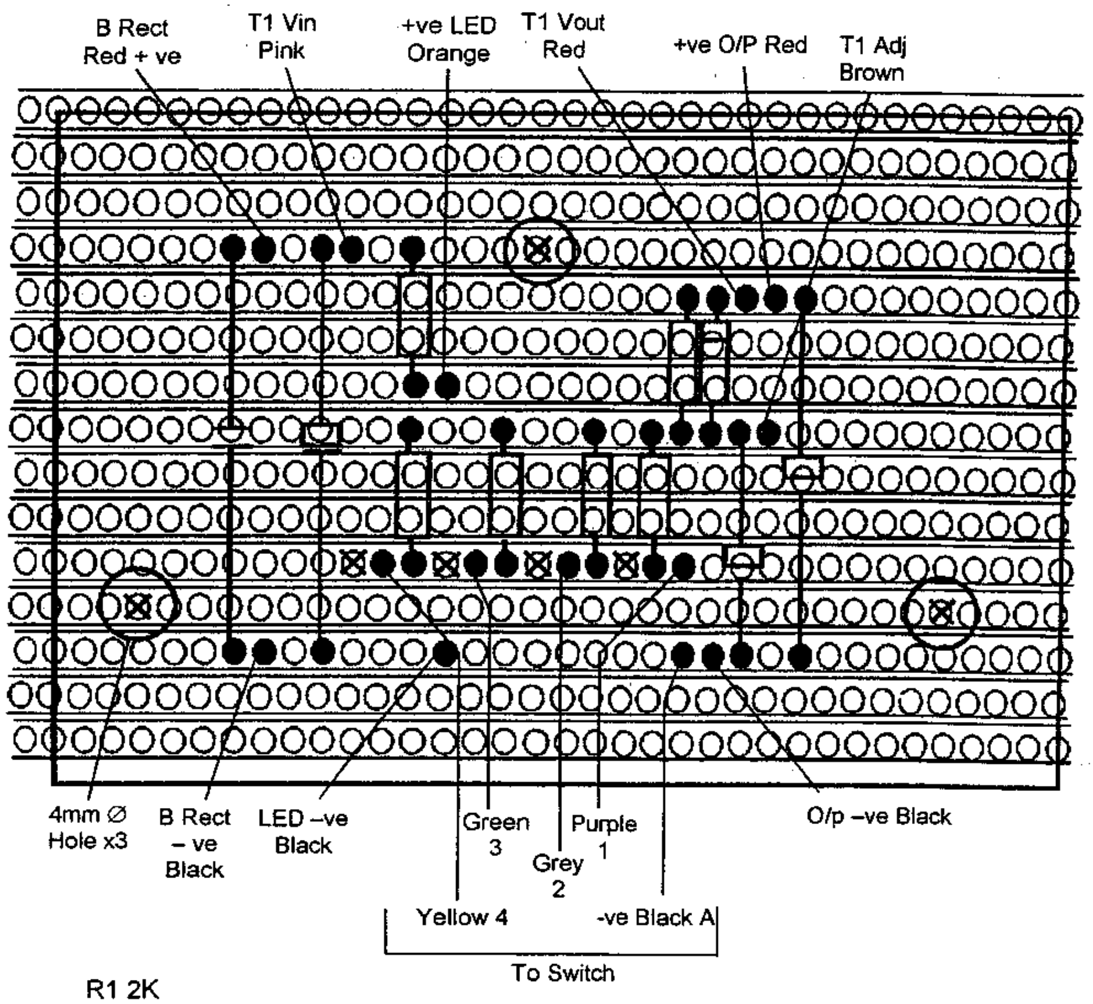
C1 10nf
C2 2200µf
C3 10µF
C4 1µf

R1 2KΩ
R2 2KΩ
R3 1K3Ω
R4 820Ω
R5 300Ω
R6 220Ω

D1 1N4002
T1 LM317T
D2 LED
S1 1P4W
Br Bridge Rectifier
T Transformer
MS Main switch

APPENDIX 2

LAYOUT DIAGRAM OF GCSE POWER SUPPLY



R1 2K
R2 2K
R3 1K3
R4 820
R5 300
R6 220

C1 10μF
C2 2,200μF
C3 10μF
C4 1μF

D1 IN4002
T1 LM317T

APPENDIX 3

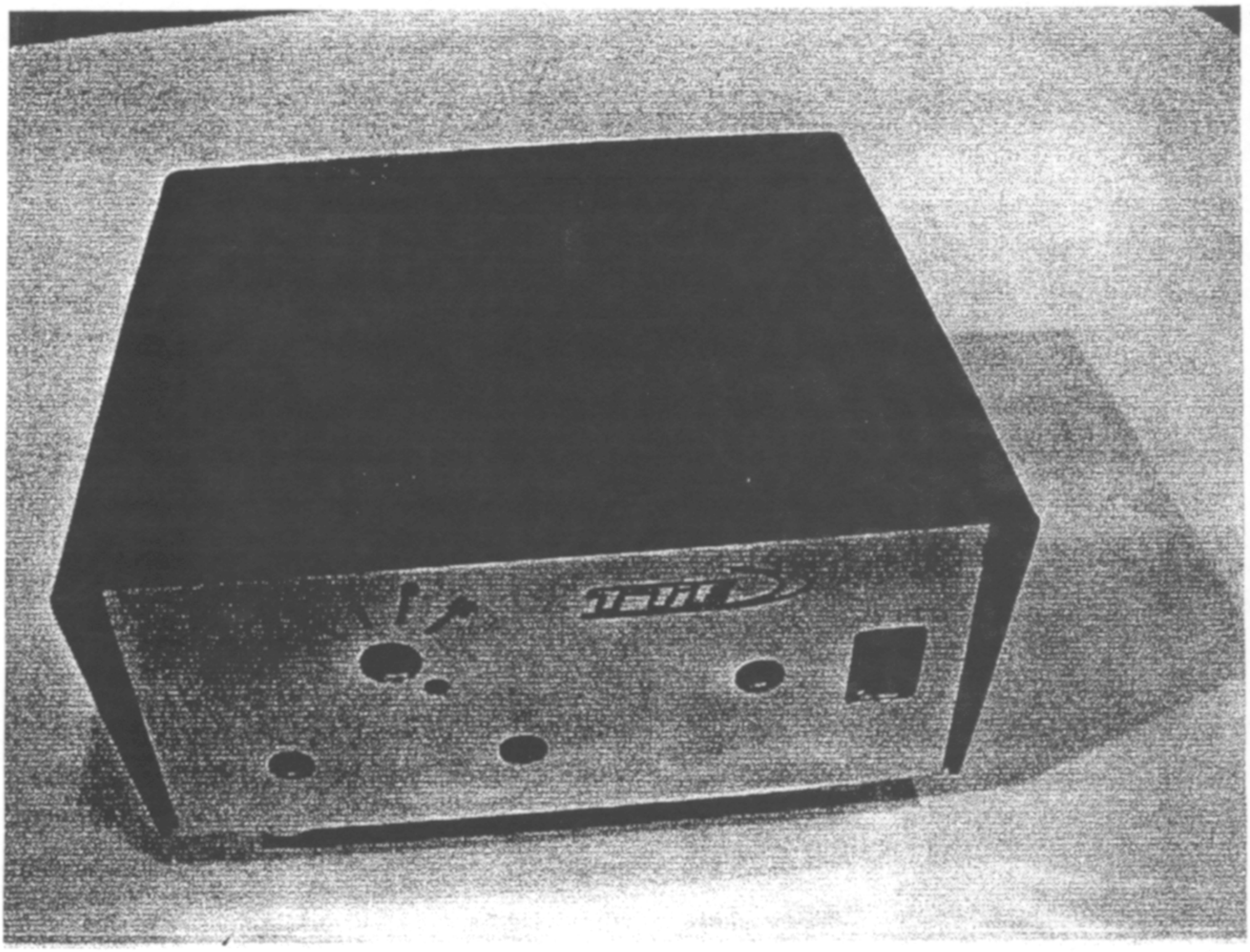
OCR Component List GCSE Engineering TTE

Name:- ______________________ Group:- ________ Clock Number ____________

Electronic Component List For GCSE Power Supply

QUANTITY	ITEM
1	240V / 12V Transformer @ 2A
1	Bridge Rectifier 4A
1	Smoothing Capacitor 2,200uF
1	Regulator LM317T
1	Capacitor 10nF
1	Capacitor 1uF
1	Capacitor 10uF
1	Resistor 220Ω
1	Resistor 300Ω
1	Resistor 820Ω
1	Resistor 1K3Ω
2	Resistor 2KΩ
1	Diode 1N4002
1	4mm Socket Black
1	4mm Socket Red
1	Rotary Switch 1P4W
1	Light Emitting Diode Green
1	L.E.D. Holder
1 Mtr	3A Mains Cable
1	Mains Plug
1	Rubber Grommet
1	Cable Tie
3	P.C.B. Mounts
1	1 Amp 1" Mains Plug Fuse
1	Switch DPST
1	Mounting Kit
Various	M3, M4 Machine Screws & Nylocks
3	No6 Self Tapping Screws
1	Strip Board
Various	Coloured Hook Up Wire 7/0.2mm

APPENDIX 4



APPENDIX 5