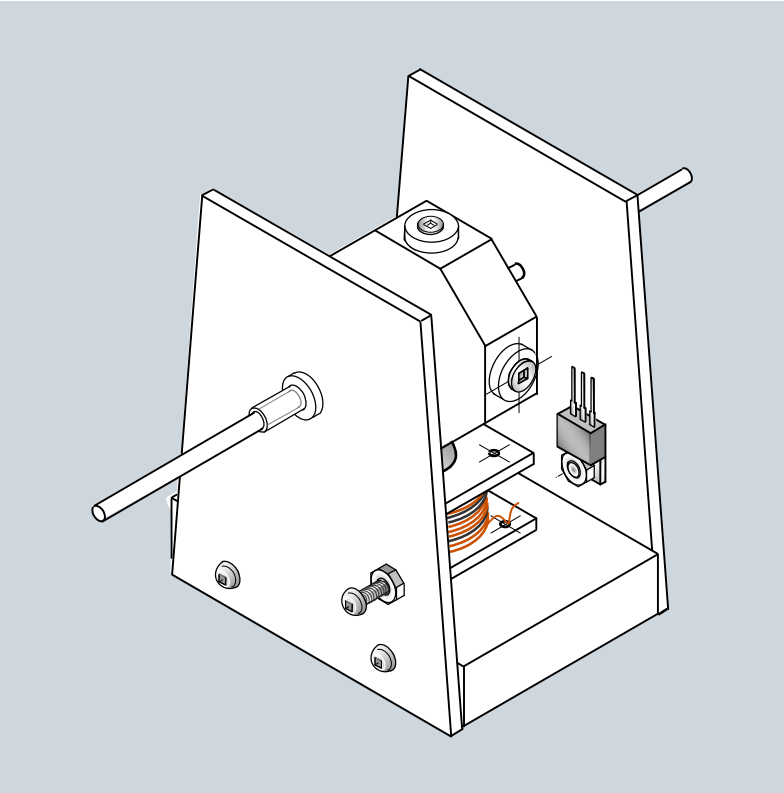
Working document



TECHNICAL FILE FOR THE REED SWITCH MOTOR (RSM) (with transistor)

December 2011

centre de développement pédagogique
pour la formation générale en science et technologie

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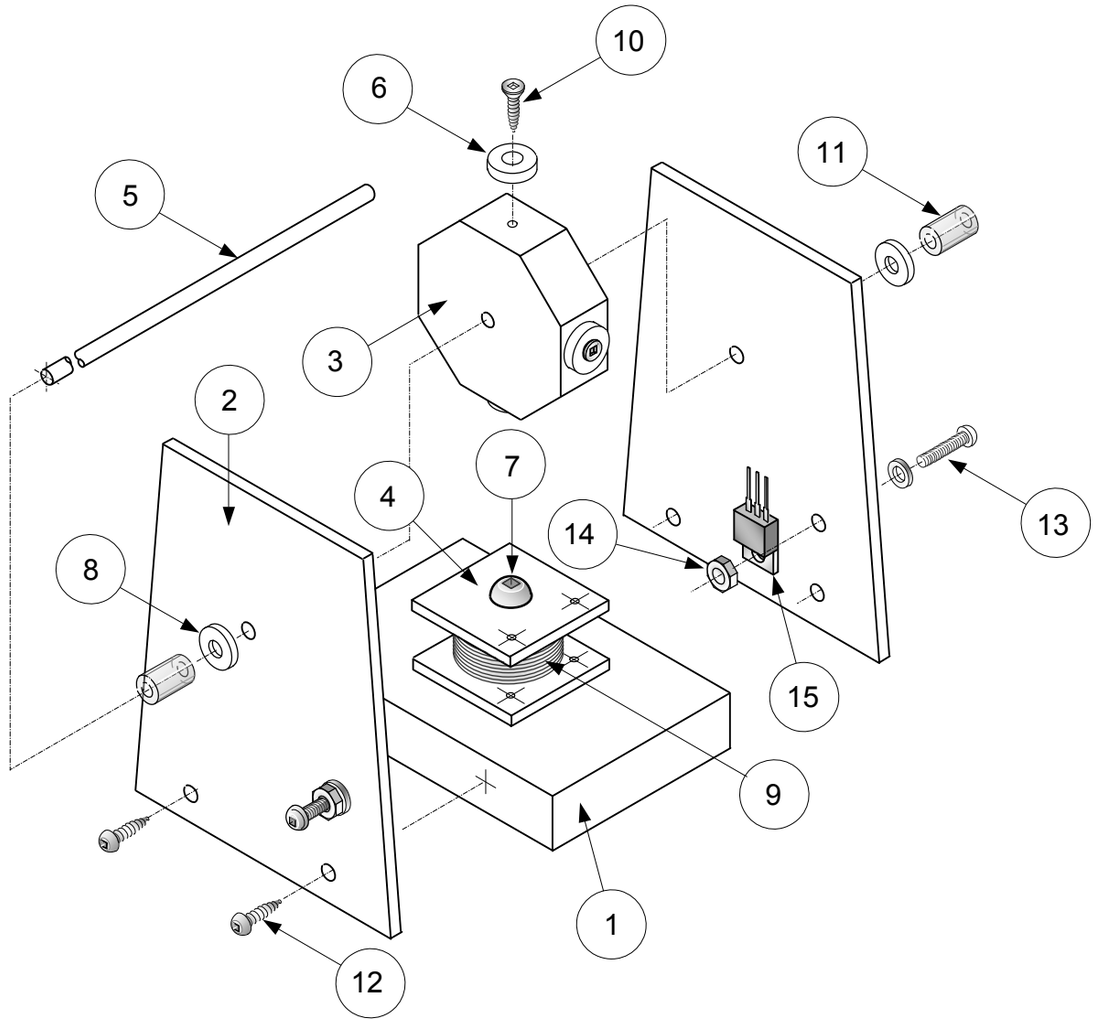

NOMENCLATURE

LOC	DESIGNATION	No	OBSERVATIONS
15	NPN Transistor	1	TIP122
14	Bolt	4	N° 6 x 32
13	Input terminals	2	Mechanical screw n° 6 x 32 x 1/2″
12	Screw – round head	4	Wood screw N° 6 x 3/4″
11	Butt tube	2	Flexible vinyl tubing 1/8″ int.
10	Milled cap screw	4	Wood screw n° 8 X 5/8″
9	Solenoid	1	Enameled copper wire 28
8	Washer	4	n° 8 flat washer
7	Solenoid core	1	Screw 1/4″ x 20 x 1 1/2″
6	Magnet	4	Rare-Earth magnet washers ∅ exterior 1/2″ ∅ interior 1/4″
5	Rotor tree	1	Dowel ∅ 1/8″, length 150
4	Solenoid butt	2	Polystyrene 35 x 35 x 3
3	Rotor	1	Pine 50 x 50 x 16
2	Side of motor	2	Polystyrene 90 x 100 x 3
1	Base of motor	1	Pine slat 64 x 90 x 16

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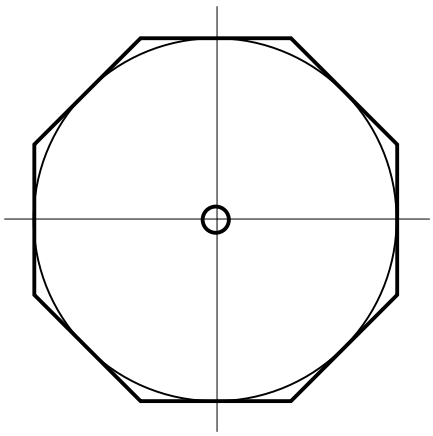
TITLE: **Reed switch motor**

GENERAL TOLERANCE: **± 1mm** | **N° 1**

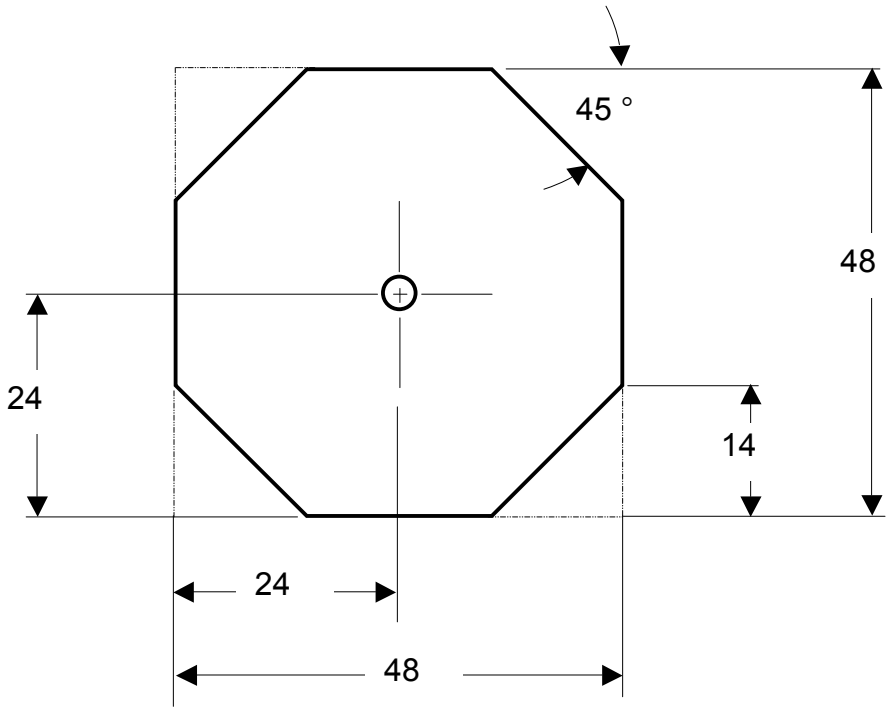
DATE: **23 DEC. 2011** | NOT TO SCALE

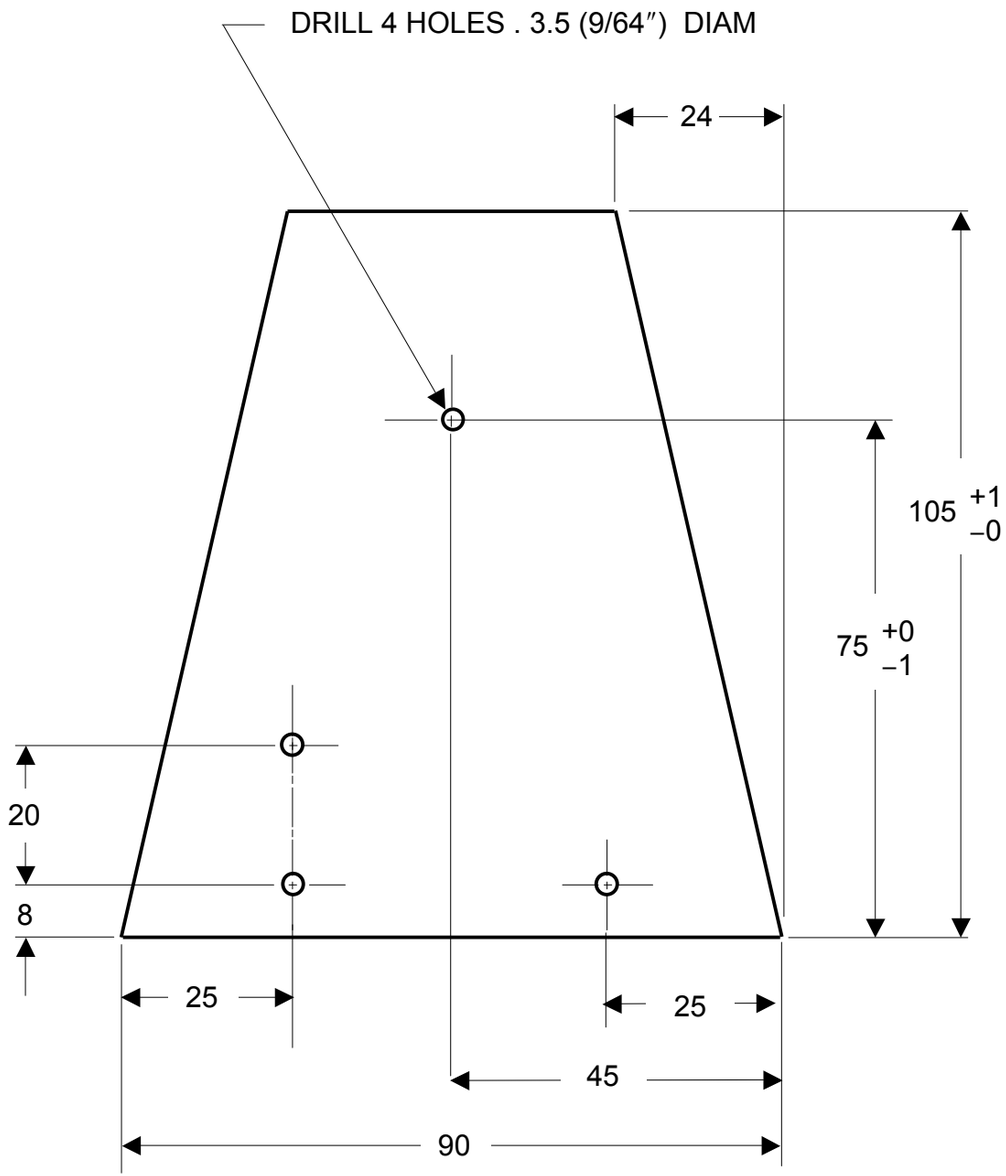
Gabarit du rotor



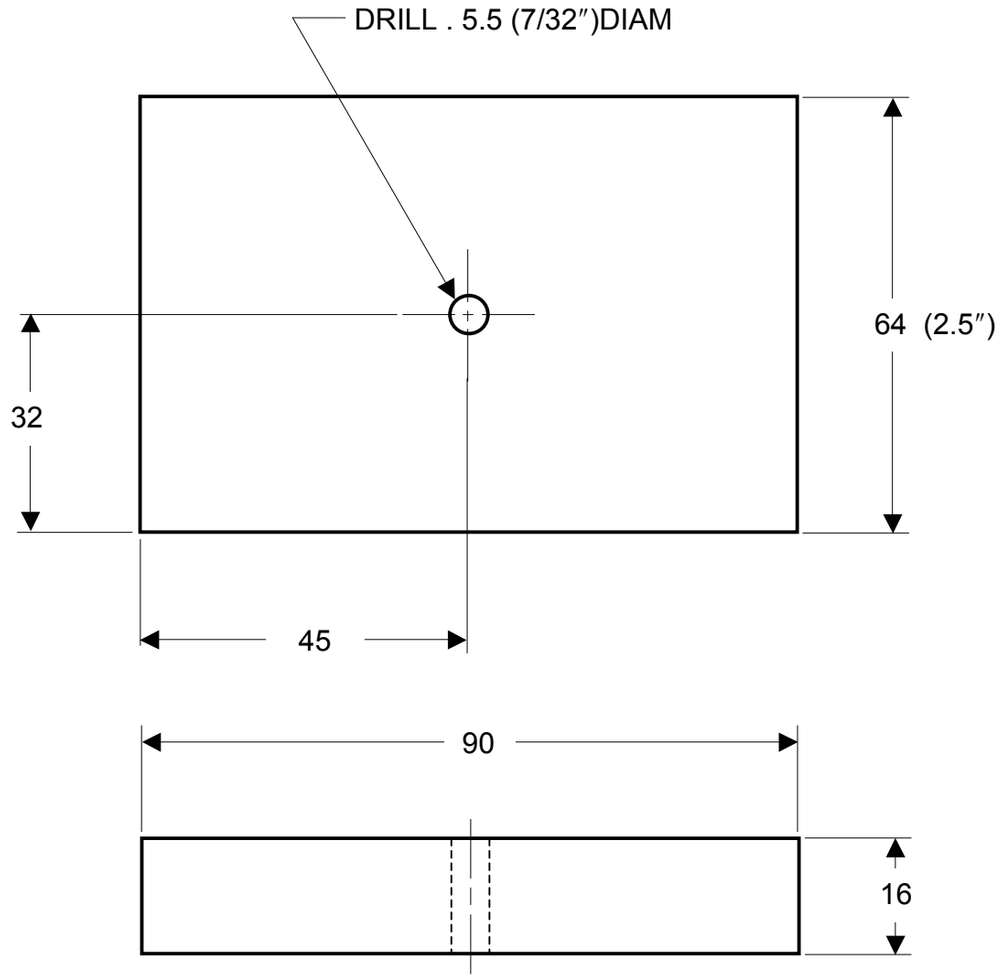
Ensure that the template is to scale after printing (see dimensions below)

When printing with "Acrobat Reader", it is important to not choose the option "print to scale" from the "print" menu





2 - DETAIL DRAWING OF SIDE OF ROTOR TREE



1 - DETAIL DRAWING OF BASE

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TITLE : **Reed switch motor**		
GÉNÉRAL TOLÉRANCE 1MM		**N° 2**
DATE: **23 DÉC. 2011**	**NOT TO SCALE**	

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Safety capsules

(9) Press drill




1. Wear safety glasses to protect against projections.
2. Tie long hair and roll your sleeves to avoid them becoming entangled around the chuck.
3. Do not wear bracelets, necklaces, jewellery, etc.
4. Careful! Risk of serious injury! Firmly affix materials to the table using clamps to avoid a part being hooked to the bit and spun around at great speeds.
5. Adjust the height and depth of the table and tidy the work surface before starting the drill.
6. Use a well sharpened bit, otherwise unnecessary effort could cause the bit to break and cause injury.
7. Remove the chuck key immediately after having tightened the drilling tool.
8. Take the time to think about each of your gestures.
9. Respect the security perimeter on the floor. The proximity of another person could distract the user.
10. Unplug the tool from the power source before changing a bit.




Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.

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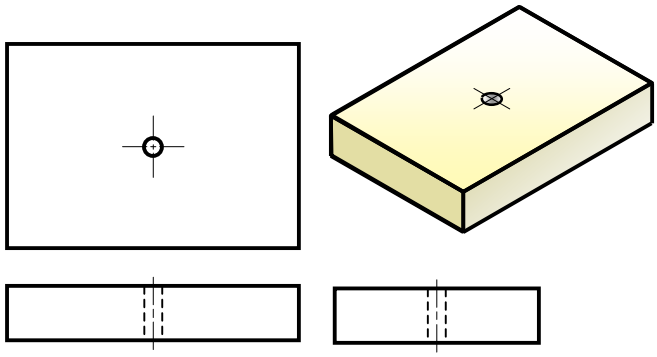
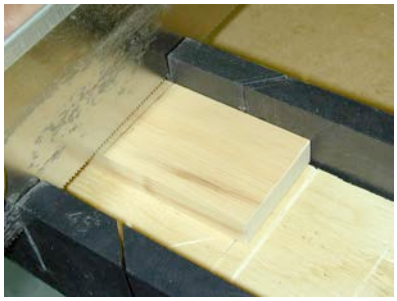
FABRICATION RANGE

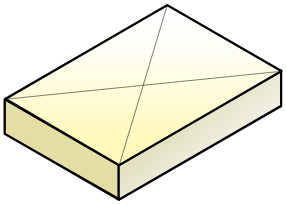
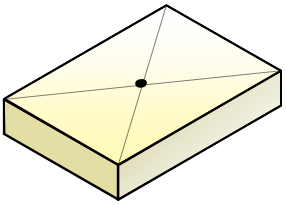
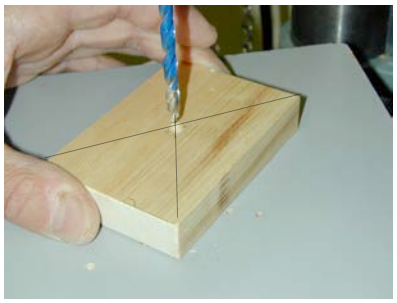
ELEMENT: **BASE**

SET: **Reed switch motor (RSM)**

RANGE: **1**	SHEET: 1 OF 2
DRAWING: 2	MATERIAL: **Pine**
NUMBER: **1**	



N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL TOOLS
10	**TRACING**		
11	Trace a 90 mm long line on a pine slat		- Ruler - Pencil - Square
20	**SAWING**		
21	Using a miter box saw the base following the line.		Hand saw Mitre box
30	**SANDING**		
31	Sand the edges.		- Sandpaper

GAMME DE FABRICATION DE LA BASE			FEUILLE : 2 de 2
N^{O}	**PHASE, SOUS-PHASE OU OPÉRATION**	**PHOTO OU DESSIN**	**MACHINE-OUTIL, OUTILLAGE**
40	**PERÇAGE**		
41	Trouver le centre du bloc en traçant deux diagonales.		- Règle - Crayon
42	Pointer le centre du trou.		- Pointeau - Marteau
43	À l'aide d'un foret de Ø 5,5, percer le trou au centre de la pièce.		- Foret Ø 5,5 - Perceuse sensitive - Lunettes de sécurité

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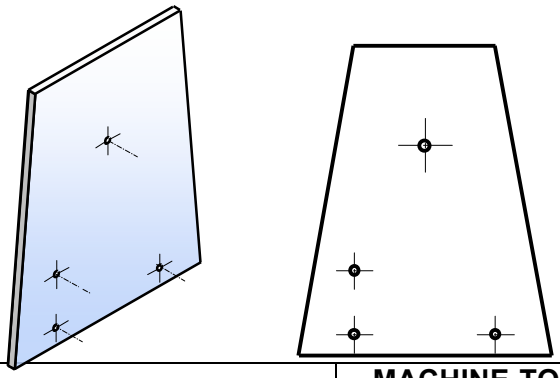
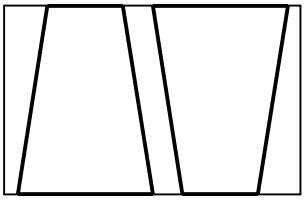
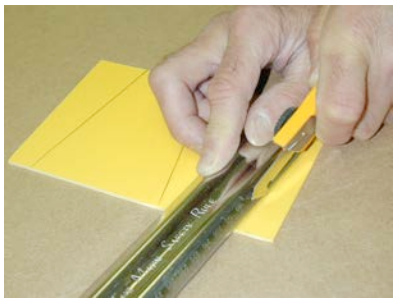
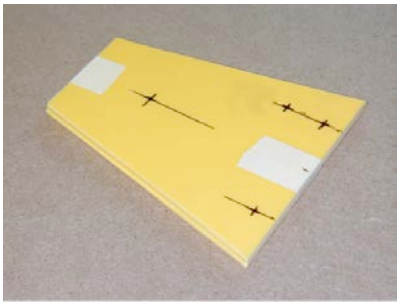
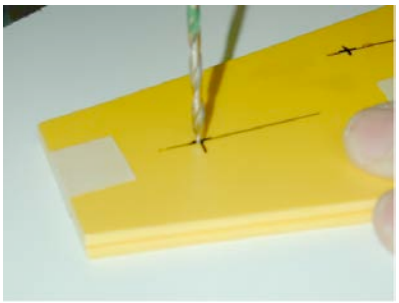
FABRICATION RANGE

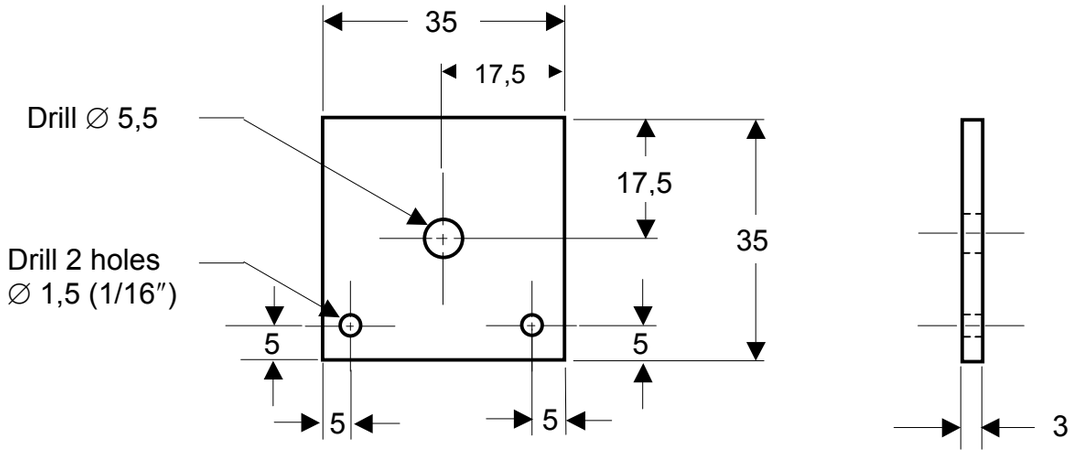
ELEMENT: ROTOR TREE SUPPORTS

SET**: Reed switch motor (RSM)**

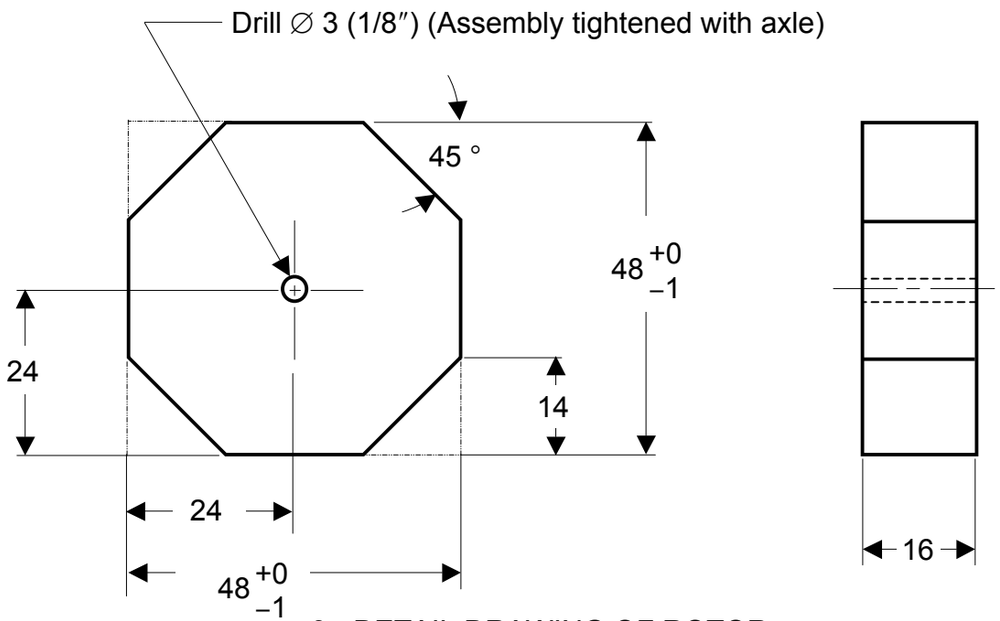
RANGE: 2	**SHEET: 1 of 1**
DRAWING: 2	MATERIAL:
NUMBER: 2	**Polystyrene**



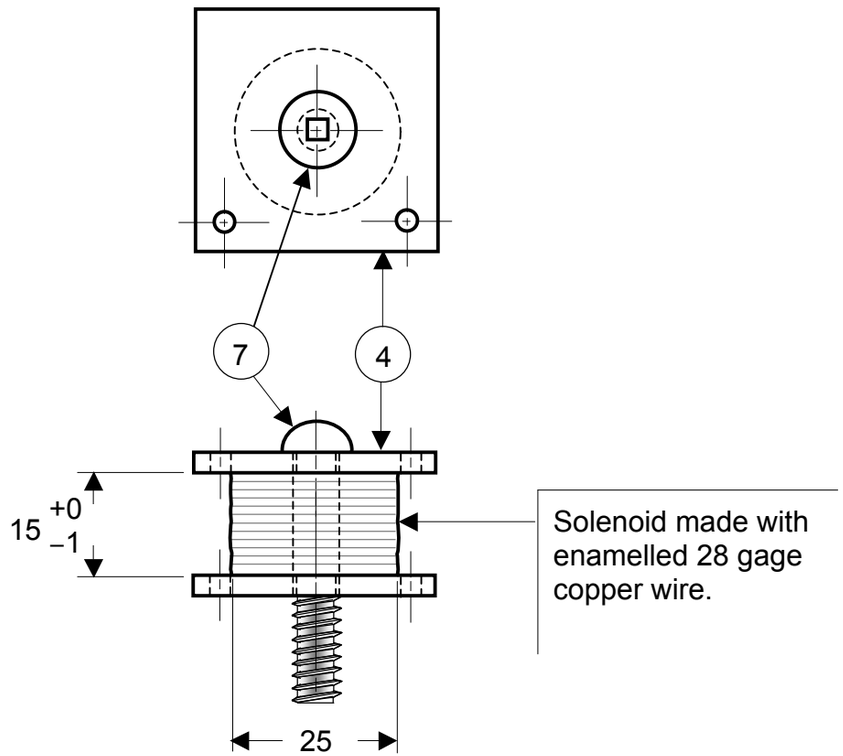
N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL TOOLS
10	**TRACING**		
11	In a strip of polystyrene and using **detail drawing N° 2,** trace the support twice. **Careful!** Take into account specific tolerances from drawing n° 2, this will make your design easier.		- Ruler - Pencil - Square **- Detail drawing N° 2**
20	**CUTTING**		
21	Using a knife for plastics cut along the outline of each side.		Knife for plastics - Safety ruler
22	Finish the edges with a scraper and sandpaper.		- Scraper - Sandpaper
30	**DRILLING**		
31	Using **detail drawing N° 2,** mark the places where holes are to be drilled. **Careful!** Take into account specific tolerances from drawing no2, this will make your design easier.		- Ruler - Pencil **- Detail drawing No 2**
32	Glue the two sides together temporarily to drill them at the same time.		- Masking tape
33	Punch and drill all 3.5 Ø holes.		- Punch - Hammer - 3.5 Ø drill bit
34	Unglue the two parts.		



4 - DETAIL DRAWING OF BUTT PLATES



3 - DETAIL DRAWING OF ROTOR



DRAWING OF SUB ASSEMBLY (ELECTROMAGNET)

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TITLE:	**Reed switch motor**	
GENERAL TOLERANCE	1mm	**N^{O} 3**
DATE: **NOVEMBER 12, 2009**		**NOT TO SCALE**

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Safety capsules

(4) Hand drill

1. Tie long hair to avoid it becoming entangled around the chuck.
2. Wear safety glasses to protect against projections.
3. Do not wear bracelets, necklaces, jewellery, etc.
4. Clean the work surface of any debris that could lead to dangerous movements or that could hamper the proper operation of the drill.
5. Use a well sharpened bit, otherwise unnecessary effort could cause break the bit and cause injury.
6. Take the time to think about each of your gestures.
7. Do not work close to a water supply (tap, drinking fountain, etc.). Water and electricity are not a good combination.
8. Unplug the tool from the power source before changing a bit.

Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.

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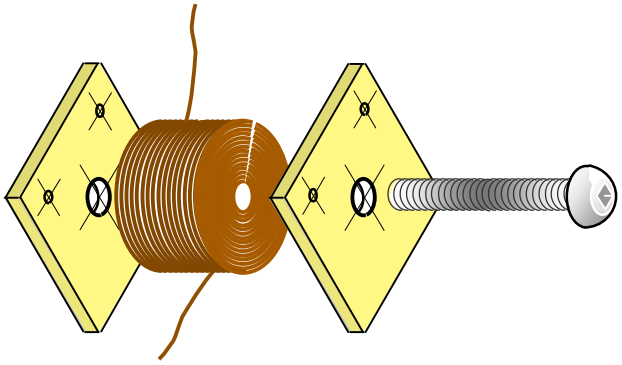
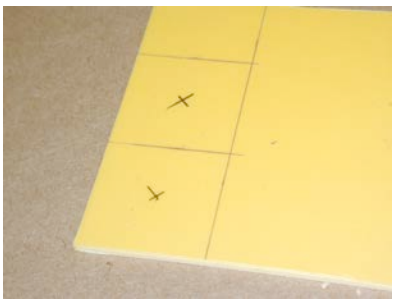
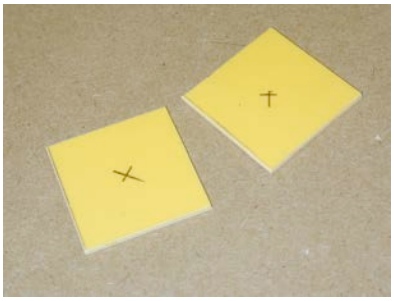
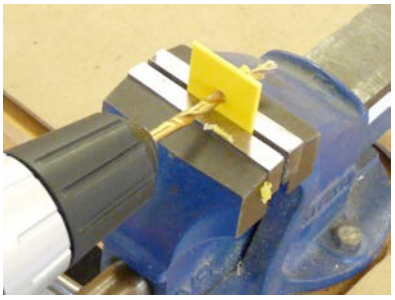
FABRICATION RANGE

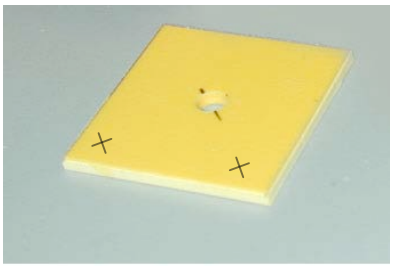
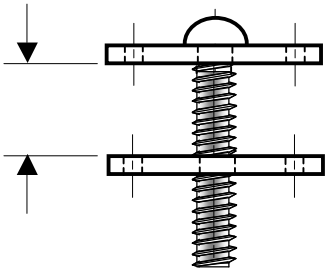
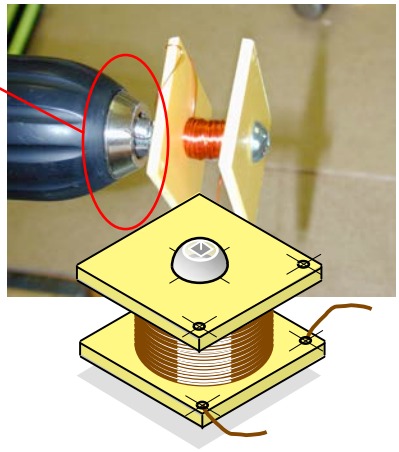
ELEMENT: **ELECTROMAGNET**

SET: Reed switch motor (RSM)

RANGE: 3	**SHEET: 1 of 2**
DRAWING: 3	MATERIALS: **Copper, polystyrene, steel**
NUMBER: 1	



No	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL TOOLS
10	**TRACING**		
11	On a piece of polystyrene, trace two squares with 35 mm sides and mark the centers. These squares will be the upper and lower butts of the electromagnet.		- Ruler - Pencil - Square
20	**CUTTING**		
21	Using a knife for plastics cut along the outline of each butt.		- Knife for plastics - Safety ruler
22	Finish the edges with a scraper and sandpaper.		- Scraper - Sandpaper
30	**DRILLING**		
31	Punch the holes.		- Punch - Hammer
32	Affix the butt in a vise and using a 5.5 Ø drill bit, drill the hole. Perform the same operations for the other butt. **<u>Note</u>: It is possible to glue the two pieces together before drilling them. This will avoid repeating the operations.**		- Hand drill - Vise - 5.5 Ø drill bit

FABRICATION RANGE FOR THE ELECTROMAGNET			SHEET: 2 of 2
N°	**PHASE, SUB-PHASE OR OPERATION**	**PHOTO OR DRAWING**	**MACHINE-TOOL, TOOLS**
40	**WORK AT THE WORKBENCH**		
41	Using **drawing N° 3,** mark the location of the two 1.5 Ø holes		**- Detail drawing n° 3** - Pencil - Ruler
42	Glue the two sides together temporarily to drill them at the same time.		
43	Punch the holes.		- Masking tape
44	Affix the parts in a vise and drill the two **1.5** Ø holes. These holes will allow the copper wire through. Drilling the 2 butts at the same time will avoid having to interchange the plates during assembly.		- Punch - Hammer - Vise - Hand drill - 1.5 Ø drill bit
45	Screw a 1½ inch long screw (1/4-20) into the lower butt (the screw will thread the hole).		- Vise- Screwdriver
46	Repeat the same operation with the other butt plate, leaving the space indicated on drawing n°3. **Careful!** Take into account the specific tolerance which will ensure that the motor operates correctly. Cover the threads of the screw between the two butt plates with adhesive tape. This will protect the varnish on the wire from abrasion.		-Masking tape
47	Affix the two butts attached to the screw into the chuck of a drill and roll the free end of the wire close to the chuck (about 15 cm. long). Roll the copper wire until the diameter of the solenoid is about 25 mm.		- Hand drill - Vise - 28 gauge varnished copper wire - Calliper
48	Insert the ends of the wires through the 1.5mm holes in order to affix them. Sand the two ends of the wires to remove the varnish When the wires are soldered, the tin must be in direct contact with the copper.		- Sandpaper

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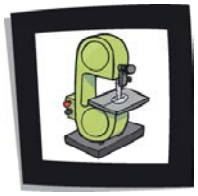
Safety capsules

(7) Band saw





1. Wear safety glasses to protect against projections.
2. Tie long hair and roll your sleeves to avoid them becoming entangled in the mechanism.
3. Do not wear bracelets, necklaces, jewellery, etc.
4. Clean the work surface of any debris that could lead to dangerous movements or that could hamper the proper operation of the saw.
5. Use a sharp blade, otherwise unnecessary effort could cause injuries.
6. Take the time to think about each of your gestures. Keep your hands further than 5 cm. from the cut line at all times.
7. Use a pusher for small parts in order to keep your hands far from the blade.
8. Respect the security perimeter on the floor. The proximity of another person could distract the user.
9. Activate the dust hood or wear a dust mask.
10. Wear acoustic protection to avoid auditory problems if the exposure to noise attains 85 decibels for a period of 8 consecutive hours.




Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.

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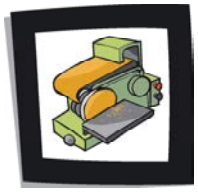
Safety capsules

(8) Disk and band sanders





1. Wear safety glasses to protect against projections.
2. Tie long hair and roll your sleeves to avoid them becoming entangled in the mechanism.
3. Do not wear bracelets, necklaces, jewellery, etc.
4. Clean the work surface of any debris that could lead to dangerous movements or that could hamper the proper operation of the sander.
5. Take the time to think about each of your gestures.
6. Respect the security perimeter on the floor. The proximity of another person could distract the user.
7. It is compulsory that the dust hood be activated when using the disk or band sander. If you are in the presence of a cancer causing contaminant (such as silica) the mask is also mandatory.
8. Call the workshop supervisor if the belt becomes misaligned.
9. Wear acoustic protection to avoid auditory problems if the exposure to noise attains 85 decibels for a period of 8 consecutive hours.




Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.

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FABRICATION RANGE

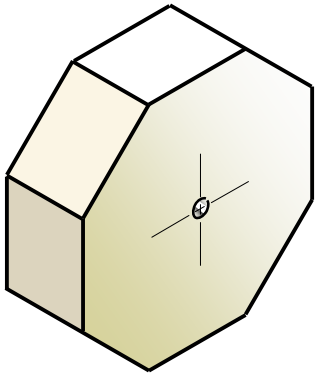
ELEMENT: **ROTOR**

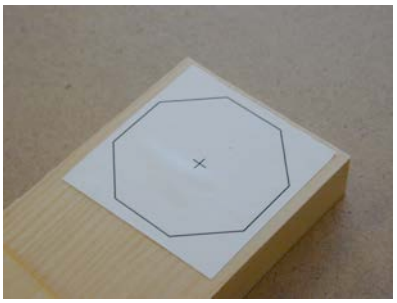
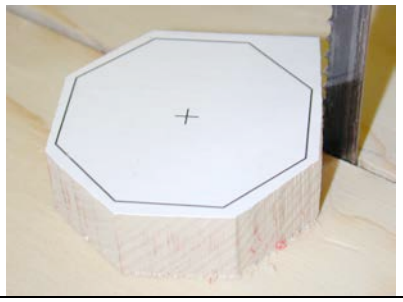
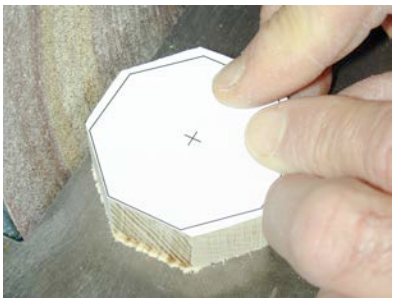
SET: Reed switch motor (RSM)

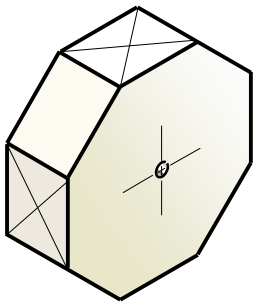
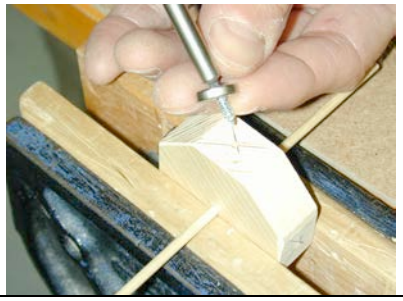
RANGE**: 4** | SHEET: **1 of 2**

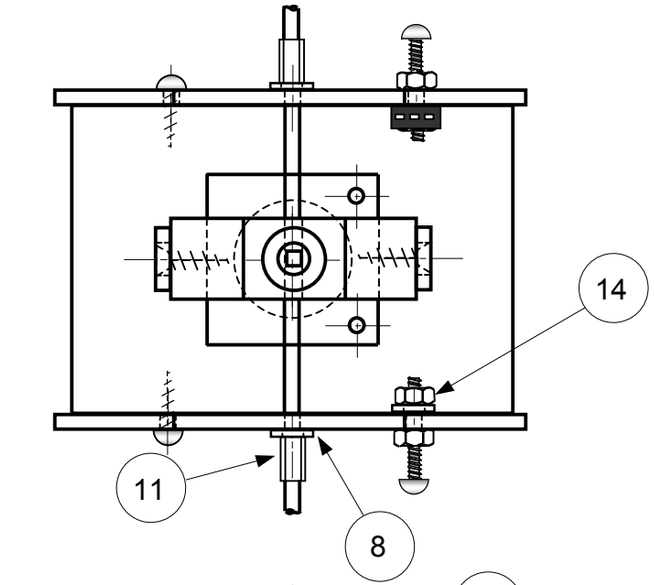
DRAWING**: 3** | MATERIAL: **Pine**

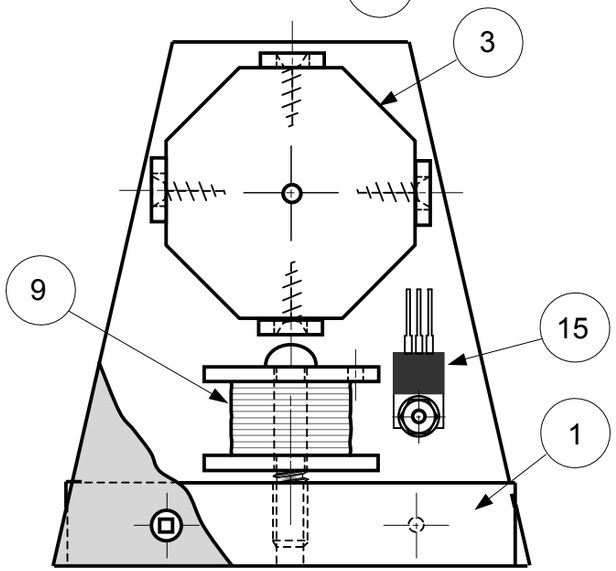
NUMBER: **1**

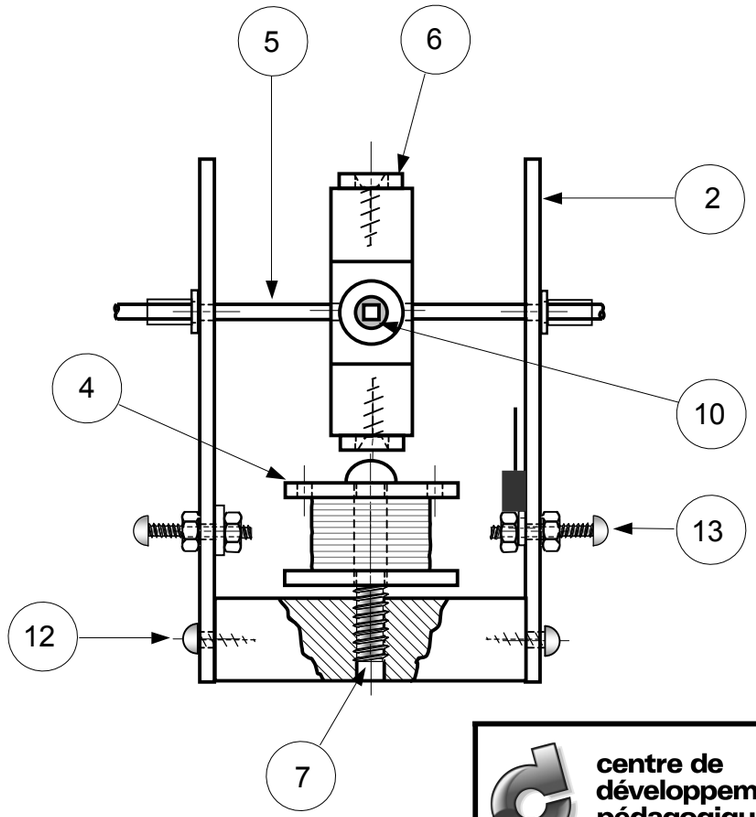


N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL TOOLS
10	**TRACING**		
11	Cut out the template for the rotor and glue it on a piece of wood with 50mm sides.		- Rotor template - Scissors - Glue stick
20	**CUTTING**		
21	Using a saw, cut out the outline of the octagon.		- Hand saw or - Band saw
30	**SANDING**		
31	Sand the edges of the octagon, coming as close as possible to the lines and taking the specific tolerances from **detail drawing N° 3** into account.		- Sander **- Detail drawing N° 3**
32	Measure and ensure that the shape of the rotor respects the functional quotation in drawing n°3. **<u>Note:</u>** Respecting these specific tolerances will make the design of the switch easier.		- Ruler

ROTOR FABRICATION RANGE			SHEET: 2 of 2
N°	**PHASE, SUB-PHASE OR OPERATION**	**PHOTO OR DRAWING**	**MACHINE-TOOL, TOOLS**
40	**DRILLING**		
41	Using a 3 Ø diameter bit, drill a hole in the middle of the octagon. (Depending on the diameter of the dowel, a wider (1/8 in or 3.18mm) hole may be necessary). **Note:** The drill hole must be perpendicular to the work surface.		- 3 Ø drill bit - Press drill - Drill vice - Safety glasses
50	**WORK AT THE WORKBENCH**		
51	Measure and cut a 150mm long, 3mm (1/8'') Ø dowel.		- Ruler - Pencil - Hand saw - Mitre box
52	Insert the dowel into the hole in the octagon.		- Hammer
53	Find the center of every second face (4 faces) on the outer edge of the rotor by drawing diagonal lines.		- Ruler - Pencil
54	Punch and pilot-hole the four 2Ø holes.		- Punch - Hammer - Hand drill - 2 Ø drill bit
55	Screw a magnet onto every second face of the octagon.		- Screwdriver







SET DRAWING OF THE **R**EED **S**WITCH **M**OTOR

REF	No.	DESIGNATION
15	1	Transistor NPN
14	4	Bolt
13	2	Input terminal
12	4	Round head screw
11	2	Butt tube
10	4	Milled cap screw
9	1	Solenoid
8	4	Washer
7	1	Solenoid core
6	4	Magnet
5	1	Rotor tree
4	2	Solenoid butt
3	1	Rotor
2	2	Side (support) of motor
1	1	Base of motor

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TITLE: **REED SWITCH MOTOR (RSM)**

PROJECT: **MOTOR** | **N° 4**

DATE: **23 DEC. 2011** | **NOT TO SCALE**

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Safety capsules

(1) Lead, tin and other soldering





1. Watch out for burns that can be caused by the iron at more than 200°C. (Do not wear rubber or latex gloves, these substances could melt on your hands.)
2. Wear safety glasses to protect yourself from solder projections.
3. Use a soldering iron rest to avoid setting your clothing, hair, paper or plastic etc. on fire.
4. Do not shake the iron to clean it: use the sponge designed for the job.
5. Avoid touching the solder to your mouth or teeth - it is extremely toxic. (You must neither eat nor drink while soldering.)
6. Never solder components under tension.
7. Use in a well aired room or solder under the hood designed for this use in order to limit inhaling the vapours, since they are toxic.
8. Use a desoldering bulb to remove a faulty solder.
9. Wash your hands after your work, and clean the work table to avoid any risk of intoxication.

Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.





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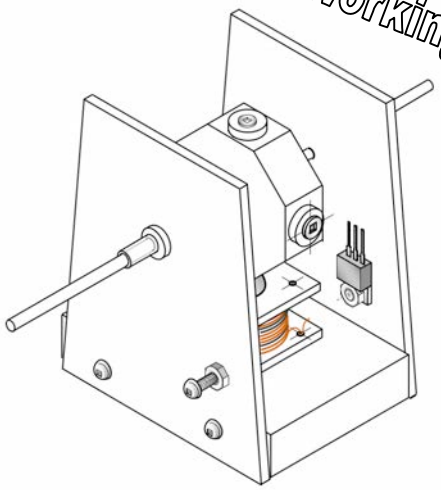
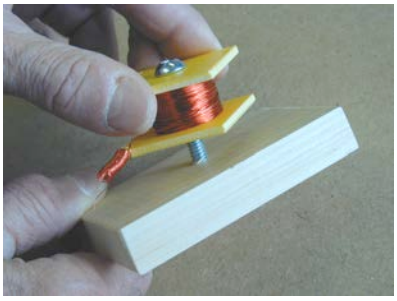
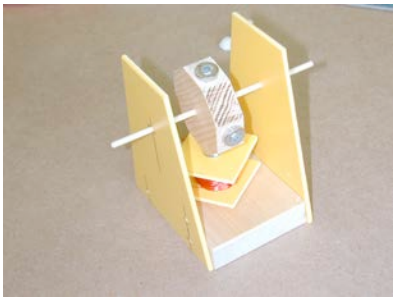
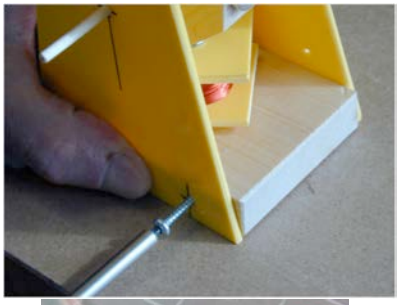
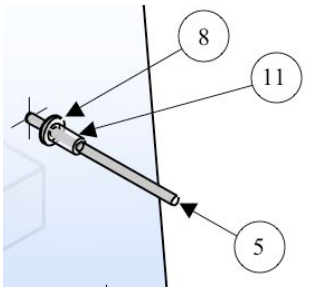
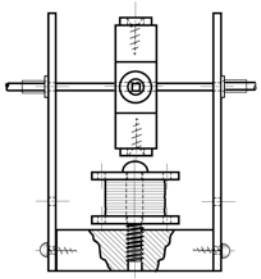
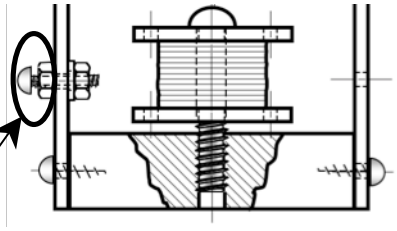
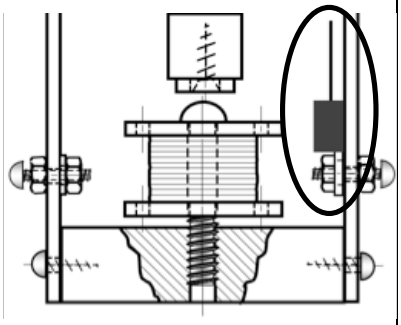
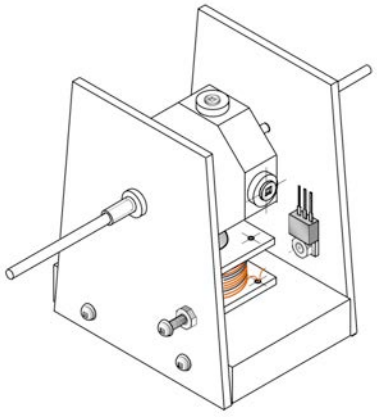
ASSEMBLY RANGE

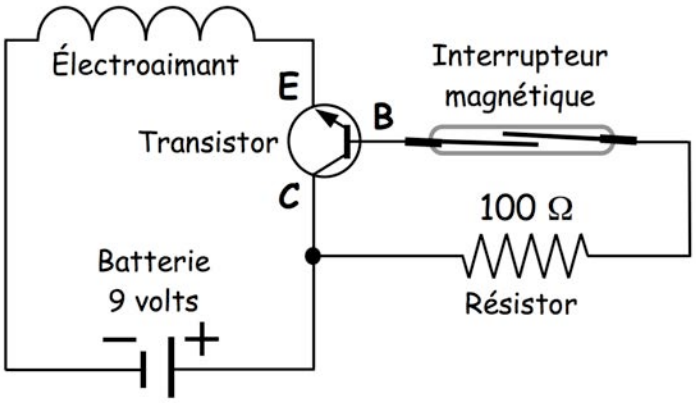
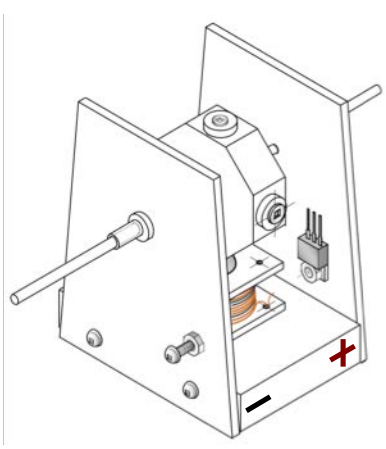
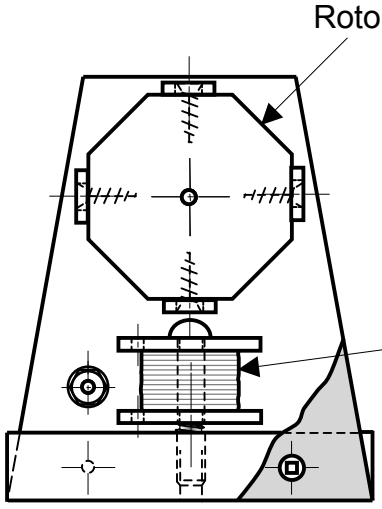
Reed switch motor (with transistor)

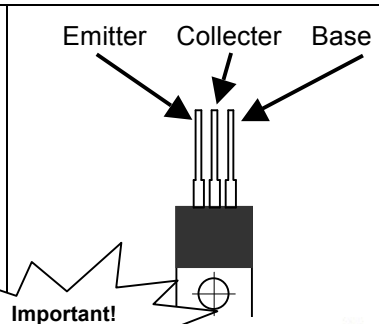
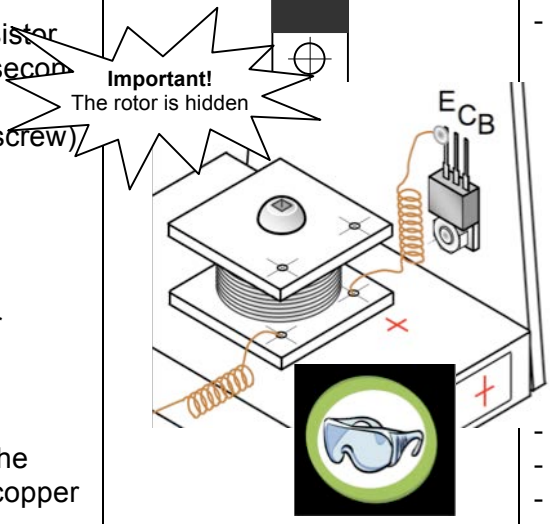
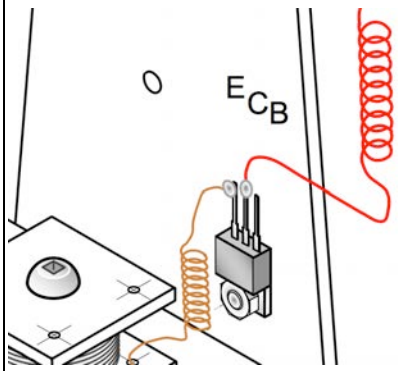
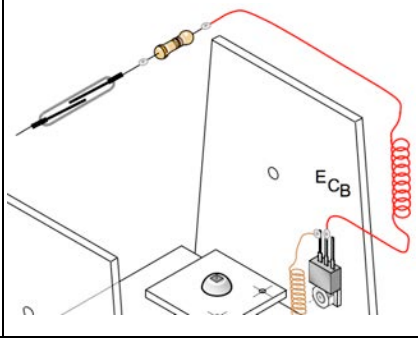
RANGE: 5	SHEET: **1 of 6**
DRAWING**: 4**	MATERIALS: **Various**
NUMBER: **1**	

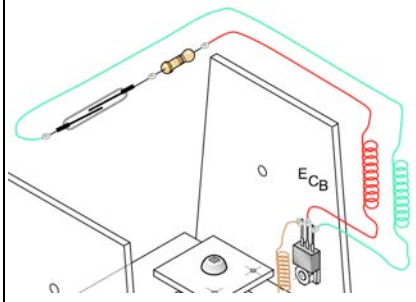
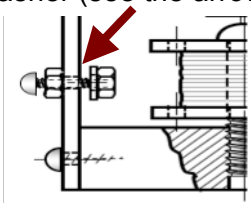
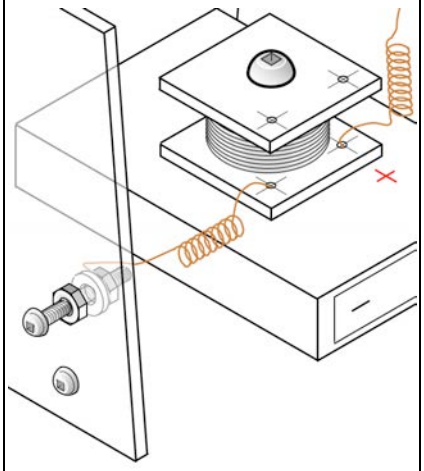
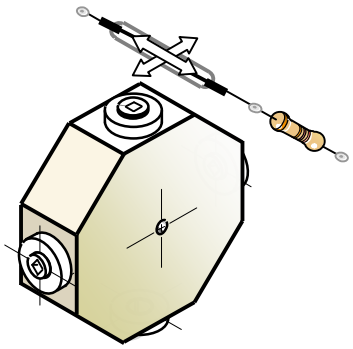
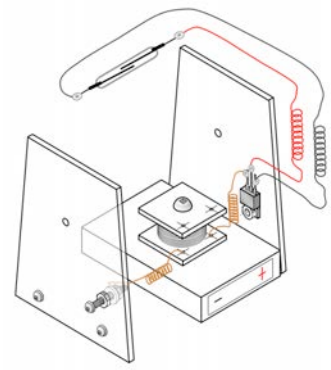


N°	PHASE, SUB-PHASE OR OPERATION	PHOTO OR DRAWING	MACHINE-TOOL TOOLS
10	**ASSEMBLY**		
11	Manually screw electromagnet onto the base. **Note:** Tightening the electromagnet more or less allows you to adjust the space between it and the magnets on the rotor.		- Base - Electromagnet
12	Insert the rotor tree into the holes in the supports. (**Drawing n° 2**). Position the supports onto the base		- Rotor tree - Supports - Drawing n° 2
13	Ensuring that they are well aligned, screw the supports onto the base.		- Screwdriver - N° 6 X 3/4" round head screw
14	Measure and cut 2 pieces of 10mm vinyl tubing. They will be used as butt tubes to maintain the rotor tree in place.		- Retractable blade knife - Ruler - Cutting mat or martyr

ASSEMBLY RANGE FOR THE RSM			SHEET: 2 of 6
N°	**PHASE, SUB-PHASE OR OPERATION**	**PHOTO OR DRAWING**	**MACHINE-TOOL, TOOLS**
15	Insert a washer and a butt tube onto the rotor tree on each side of the motor. See **set drawing n° 4.**		- Set drawing n° 4 - Washers - Butt tubes
16	Align the rotor so that it lines up perfectly with the electromagnet.		
17	Screw in the first terminal that will be used for the electrical connection. **<u>Note</u>:** Leave a fairly large space between the screw head and the outer bolt. This will allow enough room to easily connect an alligator clip.		- Screwdriver - Bolts - n° 6 x 32 x ½'' mechanical screw - Washer
18	Affix the transistor, head down, using the second terminal (the head of the transistor replaces the washer)		- Screwdriver - Bolts - no 6 x 32 x ½'' mechanical screw - NPN TIP122 transistor
19	Adjust the height of the electromagnet in order to bring it as close as possible to the rotor. Ensure that the rotation of the rotor is not hindered. The motor is now ready for its circuit to be wired.		

20	**WIRING THE CIRCUIT**		
21	Carefully examine the following circuit. • It is made up of two loops. In the left hand loop, strong current supplies the electromagnet. In the right hand loop, a current, stepped down by the resistor, flows through the magnetic switch (since the current is weak in this loop, the switch can be very small). • When the weak current gets to base **B** of the transistor, it lets the strong current, from its collector, **C,** to its emitter, **E.**	 The operation of a transistor is broached in the Gaussbusters LES.	
22	Identify the terminal where the transistor is connected as the positive terminal. Identify the other terminal as the negative terminal.		
23	Determine the positive side of the electromagnet by connecting it to a 9V power source. • Since our motor must work on repulsion, by supplying the electromagnet, the rotor should move away from the electromagnet. • If the rotor magnet tries to move towards the electromagnet, reverse the polarity of the source. Temporarily identify the positive side of the electromagnet with masking tape.		- 9V power source - Two alligator clip wires - Masking tape

ASSEMBLY RANGE FOR THE RSM			SHEET: 4 of 6
N°	**PHASE, SUB-PHASE OR OPERATION**	**PHOTO OR DRAWING**	**MACHINE-TOOL, TOOLS**
24	Carefully examine the configuration of the following transistor: Emitter ⇒ E Collector ⇒ C Base ⇒ B Note that the head of the transistor (that is downwards here) is a second electrode of the collector. The positive terminal of the RSM (screw) is in direct contact with this electrode.	 	- NPN TIP122 transistor
25	Solder the positive side of the electromagnet to the transistor emitter. **Notes:** • Using sandpaper, remove the varnish on the ends of the copper wires to be soldered. • It is always preferable to tin the wires and electrodes before soldering **(see the video "Tin soldering" on the CDP website)**		- Sandpaper - Soldering iron - Soldering tin (flux) - Safety glasses
26	Cut a 20 cm length of stiff (red) AWG 25 "telephone" type wire. Strip a 5 mm length off the ends. Roll the wire around a pencil to shape it like a ringlet. Solder one of the ends of the wire to the transistor collector.		- Wire strippers - Needle nosed pliers - Ruler - Pencil - Stiff AWG 25 wire - Soldering iron - Soldering tin (flux) - Safety glasses
27	Cut the 100 Ω resistor electrodes to 5 mm. Solder the free end of the wire to one of the resistor electrodes. Solder the free resistor electrode to the magnetic switch.		- Needle nosed pliers - Ruler - Soldering iron - Soldering tin (flux) - Safety glasses

ASSEMBLY RANGE FOR THE RSM			SHEET: 5 of 6
N°	**PHASE, SUB-PHASE OR OPERATION**	**PHOTO OR DRAWING**	**MACHINE-TOOL, TOOLS**
28	Cut a 20 cm length of stiff (green) AWG 25 "telephone" type wire. Strip a 5 mm length off the ends. Roll the wire around a pencil to shape it like a ringlet. Solder one of the ends of the wire to the free electrode on the switch and the other to the base of the transistor.		- Wire strippers - Needle nosed pliers - Ruler - Pencil - Stiff AWG 25 wire - Soldering iron - Soldering tin (flux) - Safety glasses
29	Connect the negative end of the electromagnet to the negative terminal of the RSM, tightening it under the washer (see the arrow, below).  **Note:** Using sandpaper, remove the varnish on the ends of the copper wires to be soldered.		- Screwdriver - Needle nosed pliers - Sandpaper
30	Apply 9 volts of power to the RSM terminals. Don safety glasses and bring the magnetic switch close to the magnet located on top of the motor. When you find the ideal position for the switch in relation to the magnet, the motor should start to turn. (The motor works better if the magnetic switch is off-center from the magnet).	 	 - 9V power source - Safety glasses

ASSEMBLY RANGE FOR THE RSM			SHEET: 6 of 6
N°	**PHASE, SUB-PHASE OR OPERATION**	**PHOTO OR DRAWING**	**MACHINE-TOOL, TOOLS**
	Your RSM is now ready for you to design the switch bracket. **Now it's your turn to be ingenious!!**		