LEDs Part 2

In Part One I described the characteristics of Grain of Wheat and LED devices. In Part Two, I will deal with the practical issue of fitting and wiring a vessel with lights using LED's, to produce a neat and tidy model.

1. PLANNING THE LIGHTING

I suggest that you do not build a boat and then consider fitting the lights. Lighting is an integral part of the boats design, the installation of which should be considered in the early stages of construction. First consider what lighting you would like to fit to the vessel, then plan the method of fitting the lights and how to route the wires to the individual devices. Going about the lighting installation in this way should result in a very professional model with most of the wiring hidden away and out of site, however, if you require to fit lighting to an existing build, just sit back and think of what access there is and how you will be able to run the required wiring through the Hull and Superstructure without it being too obtrusive.

2. LIGHTING OPTIONS

Many different types of lights may be fitted to a vessel, the table below lists a fairly general range and all are certainly worth considering.

Item	Light Type	Colour
a	Port and Starboard Navigation	Red and Green
b	Mast Head – may be more than one	White + other colours if required
c	Stern	White (Yellow when towing)
d	Portholes (in the hull)	White
e	Cabin/superstructure	White
f	Bridge House instrumentation panels	Orange?
g	Deck area flood lighting	White
h	Spot Light(s)	White

3. INDIVIDUAL LIGHT ASSEMBLY and CONSTRUCTION

Now we will consider how to go about making the mountings, fitting and wiring the lights, based on the lighting options listed in the table above.

a) Port/Starboard Navigation Lights

Most commercially available Navigation Light housings will allow a 3 or 5mm LED's to be fitted within them, often they are supplied complete with a Grain-of-Wheat bulb. The housing may be an individual light or one fitted to a running board. A typical example of each type is shown in the Figs 1 and 2.

Having decided on the type of fitting to be used, the question now posed is how we get the wires into the superstructure of the vessel in such a way that they do not appear obtrusive.

If the navigation lights are to be fitted on top of the cabin roof then it is fairly easy to drill two small 0.8mm diameter holes in the roof to accommodate the LED wires and then fit the Navigation Light housing over the top. Cut the LED wires protruding through the roof to about 5mm long and solder some thin extension wires to them, job done! However if the lights are mounted on a running board which is to be mounted on the side of the vessel's superstructure it will take a little more thought as to what we do with the wires that protrude out the bottom of the Navigation Lamp mounting.

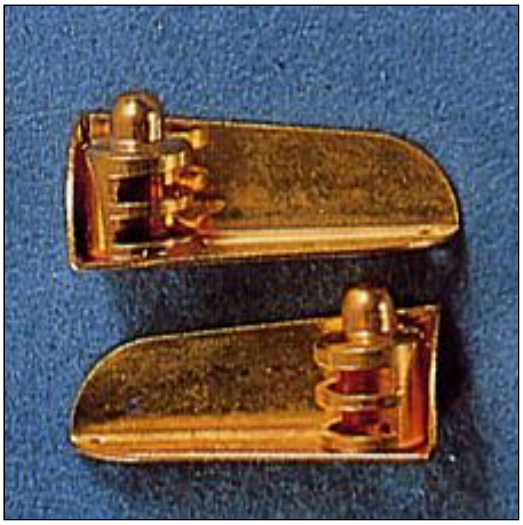


Fig. 1 Navigation Lights with Running Board (Corel fittings)

Fig. 2 Individual Navigation Lights (Billing fittings)

One method is to make a small plinth for mounting the LED, out of some copper clad laminate. First obtain a piece of copper clad board, Maplin is one suggested source. Cut a piece of the board whose width is the same diameter as that of the navigation light housing. Now cut off a piece of this strip approximately 10mm long, and using a junior hacksaw cut a slot down the centre on the copper side of the 10mm strip, but only deep enough to clear away the copper such that you are left with two long tracks.

File a radius on one end of the board; this should be the same radius as the Navigation Light housing. Now drill two 0.8mm diameter holes, one in each of the copper tracks, the distance between the holes being the same as the spacing between the LED wires (2.5mm), drill the holes on the centre line of the radius. See the Fig 3

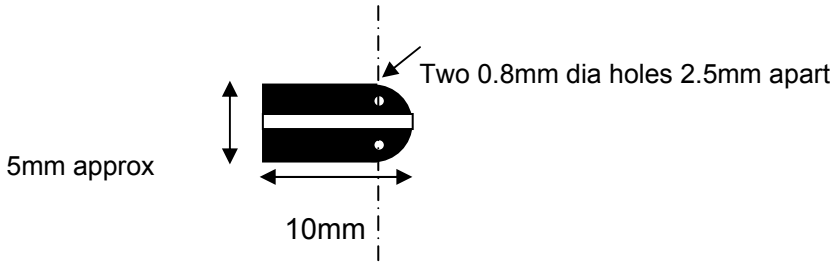


Fig 3 Plinth

Solder two small diameter wires to the opposite end of the Plinth to which the LED will be mounted; one red and one black, the red wire will be the LED positive supply. Suggested wire size is 7/0.2 general equipment wire or the very small diameter wire as fitted to the dolls house light fittings. Small reels of this wire are obtainable from any dolls house specialist shop. You can also use Enamel Covered Copper Wire (or Polyurethane Covered) this can be purchased in various gauges; however, it is not easy to remove the enamel from the wire which will be necessary in order to solder it. The polyurethane type is self fluxing and much easier to solder, this is obtainable from www.rs-components.com (part number 357918) the only disadvantage is that this type of wire is only available in one colour.

We are now ready to mount the Plinth onto the superstructure. To do this it will be necessary to cut and file a slot into the side of the superstructure in the position that you wish to mount the navigation light. The size of the slot should be the thickness and width of the Navigation Light Plinth, which is approximately 5mm x 1.6mm see Fig 4.

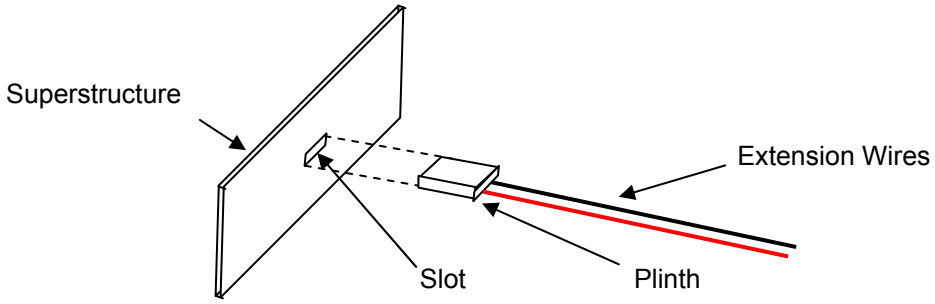


FIG 4 Plinth fitting to Superstructure

Insert the Plinth into the slot, (from inside of the superstructure), ideally it should be a firm fit so as to be self supporting. Fit the LED (Red) to the Plinth (do not solder it at this stage) and then place the Navigation light housing over the LED complete with running board. Push the complete assembly up against the superstructure side and adjust it into its final position. If you are happy with the result, carefully remove the Navigation Light Housing and LED, then apply a small amount of medium Cyanoacrylate glue between the superstructure and the Navigation Light Plinth, verify it is still in the correct position and allow to cure. When cured, fit the LED and position the housing over the top. Verify that it still fits snugly into position. Remove the housing and LED. Place a small piece of masking tape over the copper track and trim to the profile of the Plinth, the model may now be painted.

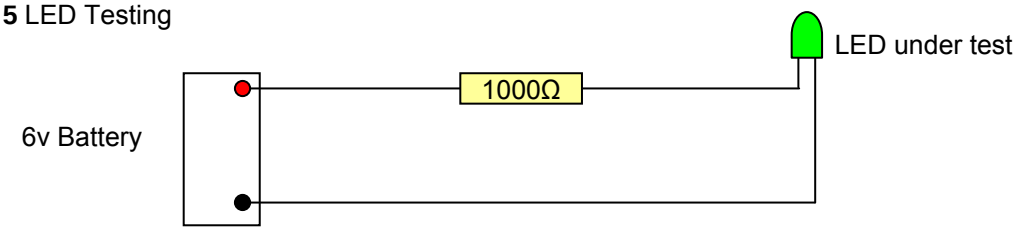
After painting, remove the masking tape from the copper side of the Navigation light Plinth; wipe the copper track with some solvent, taking care not to damage the new paint work.
Fit the LED into the 0.8mm holes in the Plinth; ensure you observe the correct polarity of the LED, (long lead to the positive track). Now solder the leads into position. Cut the leads as close as possible to the copper track and very carefully file the cut leads/soldered joints down to minimise their size but without filing away the entire joint and without damaging the new paintwork. Now hand paint the underside of the Plinth to match the superstructure.

You now have your RED navigation light, repeat the above process to make another using a GREEN LED then you will have both RED and GREEN (Port and Starboard) Navigation lights.

Note:-
When selecting LED's for coloured navigation lights, I would suggest that you choose the type that has a solid colour lens, not the opaque type that only shows its true colour when illuminated. This type of LED looks better on the model and also eliminates the possibility of fitting a LED of the wrong colour.

At this stage it is a good idea to test the light, just connect the wires that you have soldered to the end of the Plinth to a 6/7 volt battery via a 1000 ohm resistor, a simple diagram shown in (Fig 5) may assist in clarifying the connection method.

Fig 5 LED Testing



Having verified that the LED is working, you may now fit the housing. Position the housing over the LED, it should be a snug fit, you may either secure it using Cyanoacrylate, or use double sided tape, which is slightly less permanent.

An alternative method to using commercial type housings, and much cheaper, is to just paint the LED to form the housing cover, this may either be carried out carefully using a paint brush or mask the LED(s) to form the required lens area and then paint/spray the complete superstructure. Fig 6 shows Navigation lights mounted using this method.

Fig 6 Navigation Lights (LED's only)

LED's transmit their light through the rounded end of the lens, not a lot is transmitted through the sides. One suggestion (by Colin Saville) is to file the top of the LED flat (do not file down to the metal strips that are just visible through the lens). Now give the top several coats of paint to prevent any light escaping. Now the sides will illuminate softly.

Regarding the routing of the wiring and final connections including the series resistors, this will be discussed later on under **RESISTORS AND ROUTING OF CABLES.**

b) Mast Head Navigation Lights

When constructing Mast Head lights, the same comments apply regarding the Navigation Light housings in that they will accept both the 3 and 5mm diameter LED's depending on the scale. An example of a Mast Head Light is shown in Fig 7 below.

Fig 7 Mast Head Light (Corel Fittings)

Having chosen a Mast Head fitting we now need to mount it on the mast. The method of fitting and wiring depends on the firstly the type of mast and secondly how many lights are required.

i) Mast head Lights for Tugs

If you are building a Tug, Oil Rig Supply or Large Fishing Vessel, chances are, you will require a number of lights on the mast and these may be a mixture of colours, (Red, Green and White) you may also wish to switch the colour combinations on the mast to depict the changing situations of the vessel.

With such vessels, the mast is often square in section, not round like a yachts, this allows us to construct the mast of sheet material, thus forming a hollow box section into which we can channel the wiring for the lights. It is a good idea when initially constructing the mast, to only assemble and glue the front with two sides. Do not fit the rear face until after fitting the lights and associated wiring which will be channelled down the centre of the hollow mast (each wire being identified against its LED).

The same technique described above for making a plinth for each of the Port and Starboard Navigation Lights may be used to make the plinths for the Mast Head lights. An alternative method for making the plinths is to use either thin plywood or ABS sheet (plastiboard), 1.0 to 1.5mm thick. Cut and drill a piece of material in exactly the same way as before. Having done this, fit the LED wires into the two 0.8mm holes in the material and bend the LED leads at right angles flush up against the underside of the Plinth. Now bond the LED wires to the underside of the Plinth. See drawing in Fig 8.

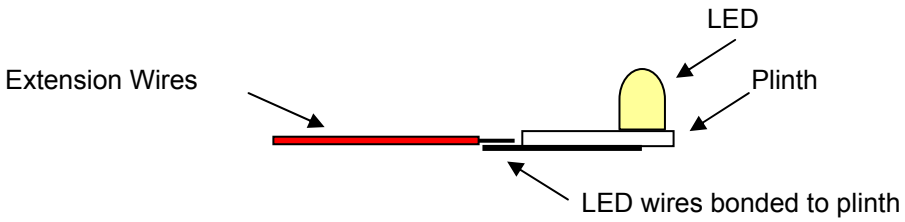


Fig 8 LED mounted on a Plinth

Cut the LED wires to leave approximately 3mm of wire protruding from the edge of the plywood plinth. Now solder two small diameter wires, one red and one black, the red wire going to the LED positive lead.

As before, it is a good idea to test the LED. Connect the two wires of the LED assembly as shown in Fig 5 and verify that the LED is functioning correctly. If this works, we are now ready to mount the light onto the mast assembly.

In order to mount the light onto the mast it will be necessary to cut/file a slot into the front/sides of the mast assembly in the position that you wish to mount the light, similar to the method described above for the Port and Starboard navigation lights. The size of the slot should be the size of the Mast Light mounting plinth which is approximately 5mm x 1.0mm, plus a small amount of clearance for the LED connecting wires on the underside of the plinth. Insert the LED plinth into the slot, ideally it needs to be a firm fit so as to be self supporting. Place the Navigation light housing over the LED and then push the complete assembly up to the mast face, easing it into its final desired position. If you are happy with the result, carefully remove the Navigation Light Housing and apply a small amount of thin Cyanoacrylate glue between the mast face and the plinth, verify it is still in the correct position and allow to cure. Now fit the LED and position the housing over it. It should fit snugly into position; you may secure it there using Cyanoacrylate adhesive.

As suggested previously a much cheaper method to using a commercial light housing is to paint the LED to form the housing cover, this may either be carried out carefully, using a paint brush or mask the LED(s) to form the required lens area and then paint/spray the complete mast when the assembly is completed.

If you require more than one Mast Head Light repeat the above procedure for as many lights as you require.

If the mast lights are all the same type and are to be illuminated at the same time, they may be joined together in parallel, thus greatly simplifying the wiring requirements. To do this, make all the Plinths complete with the LED's that are required to be fitted to the Mast.

Cut the mounting slots in the Mast and insert the LED/Plinth assemblies into the slots. Verify they are correctly aligned and then bond into position.

Now link all the LED positive leads together and all the negative leads together as shown in Fig 9. This may be done using some very thin Tin Copper wire. If you have not got any, try stripping the insulation from some mains cable or equipment wire, this will do just fine. Put the wire in a vice and stretch it straight, then cut a suitable length and solder it to the LED's pull the positive and negative wires apart and glue them to the inside walls of the mast. This will keep the positive and negative wires apart within the mast and you need not bother with any insulation.

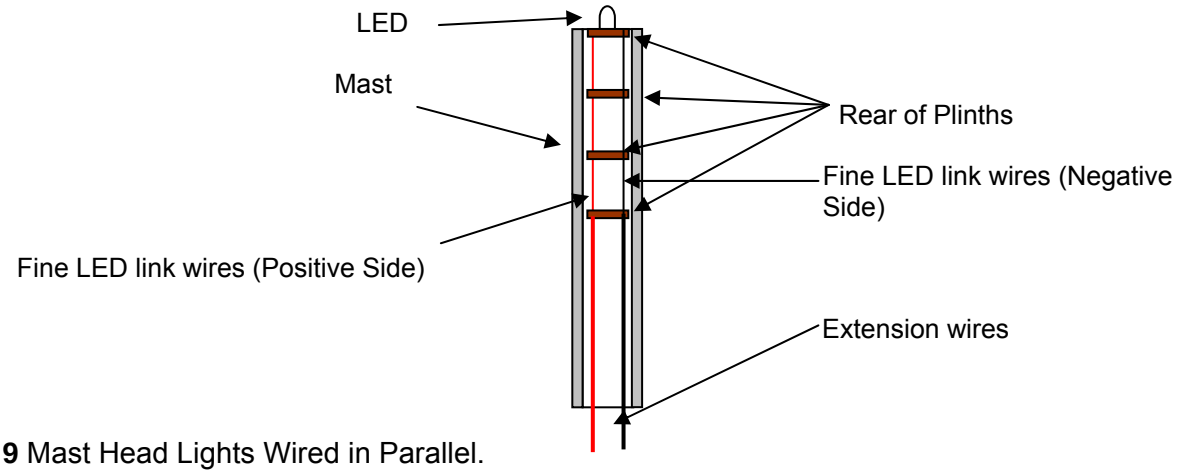


Fig 9 Mast Head Lights Wired in Parallel.

Now solder two small diameter wires to the lowest LED within the mast assembly; one red and one black, the red wire will be the LED positive supply. Suggested wire size is as before 7/0.2 general equipment wire or the very small diameter wire as fitted to the dolls house light fittings.

As before, it is a good idea to test the LED(s). Connect the two wires of the LED assembly as shown in Fig 4 but using a 330 ohm resistor. Verify that the LED(s) are all functioning correctly. If all is satisfactory, the rear section of the mast may now be fitted and glued into position and the complete mast assembly fitted to the superstructure and painted

ii) Mast Head Lights for Yachts

If you are building a vessel with a solid wooden mast, like a yacht or small fishing vessel you will not have the advantage of a spacious hollow mast for channelling the wiring, so alterative arrangements will have to be sought.

The plinth system will work just fine using either copper clad laminate as for the Port/Starboard Lights or the ABS/Ply system for the Tug Mast lights, however the LED leads should be cut flush with the end of the plinth for this type of assembly.

Cut some slots into the solid wood mast to accommodate the plinths and then fit the Plinths into these slots as shown in Fig 10. When you are happy with the position and fit of the Plinths, bond them into position.

To wire all the Led(s) together on their plinths you will require some very fine tin copper wire, as mentioned previously you can strip some strands from equipment or mains cable but for this requirement it does need to be very fine as it is going to run down the outside the mast.

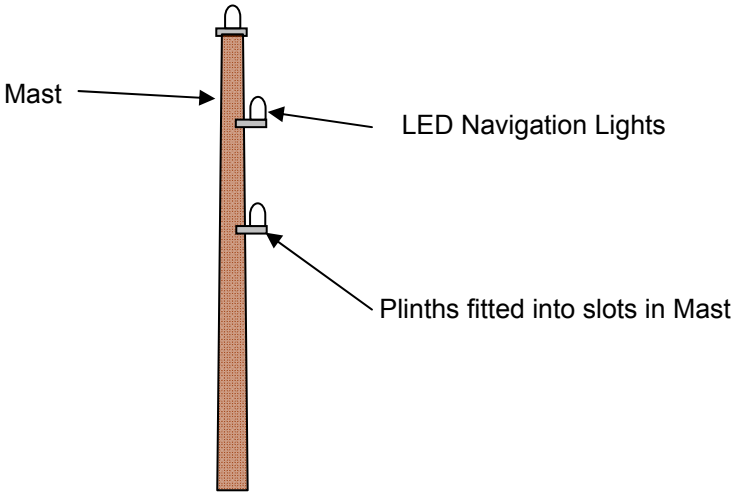


Fig 10 Plinths and LED(s) shown fitted into slots in a solid mast

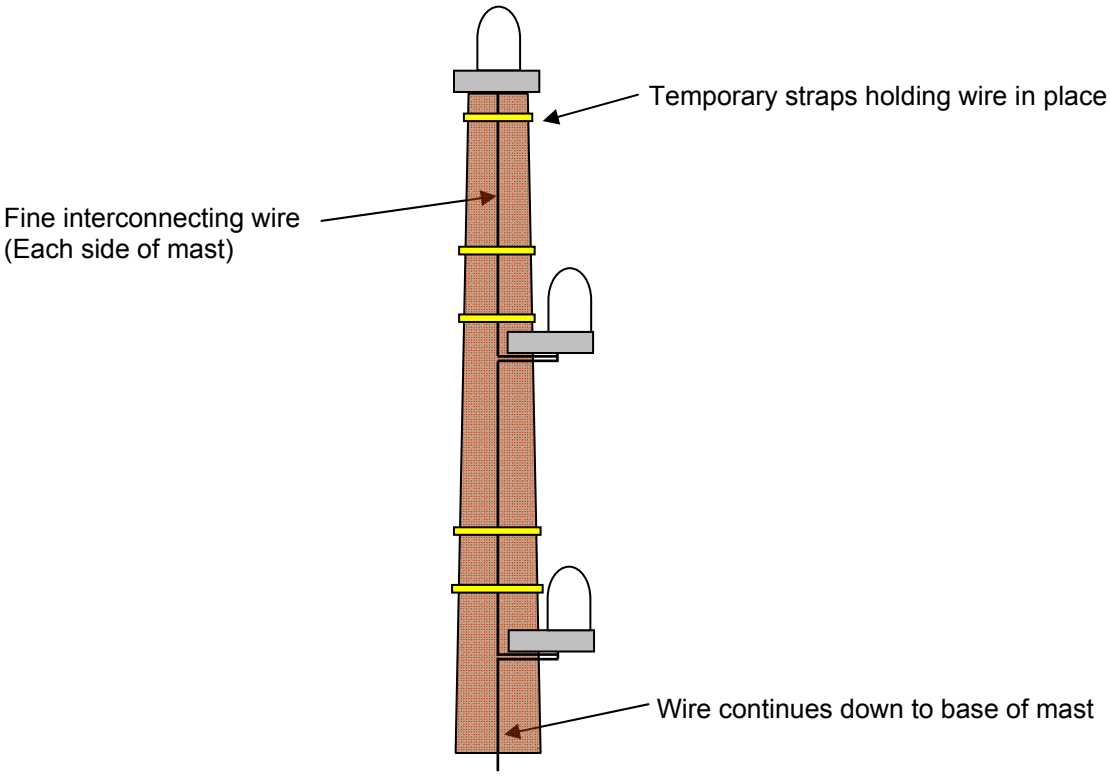


Fig 11 Mast Assembly with wires strapped into position

Solder one end of the fine wire to one leg of the LED on top of the mast. Route the wire down from the Plinth along the side of the Mast, and then bend it at right angles to run across to the second Plinth and solder it to the leg of the second LED. Now bend it back on itself and along to the centre of the mast, bend at right angles and down the mast again, connecting to the third LED the same as for the second. Use strips of masking tape to strap the wire into position on the mast, as shown in Fig 11. Continue with the wire and run it down to the base of the mast. At the base of the mast, it needs to be secured and terminated into some small equipment wire, 7/0.2 as used previously is just fine. This may be done by drilling two small holes into the base of the mast 5mm deep. Strip and tin the ends of two lengths of Red/Black 7/0.2 equipment wire (approximately 10mm). Push the tinned ends of the wire into the drilled holes in the base of the mast and bond into position, leaving approximately 5mm of tinned wire protruding out of the base of the mast. Now solder the LED mast wires to the tinned wire section protruding out of the base of the mast, see Fig 12.

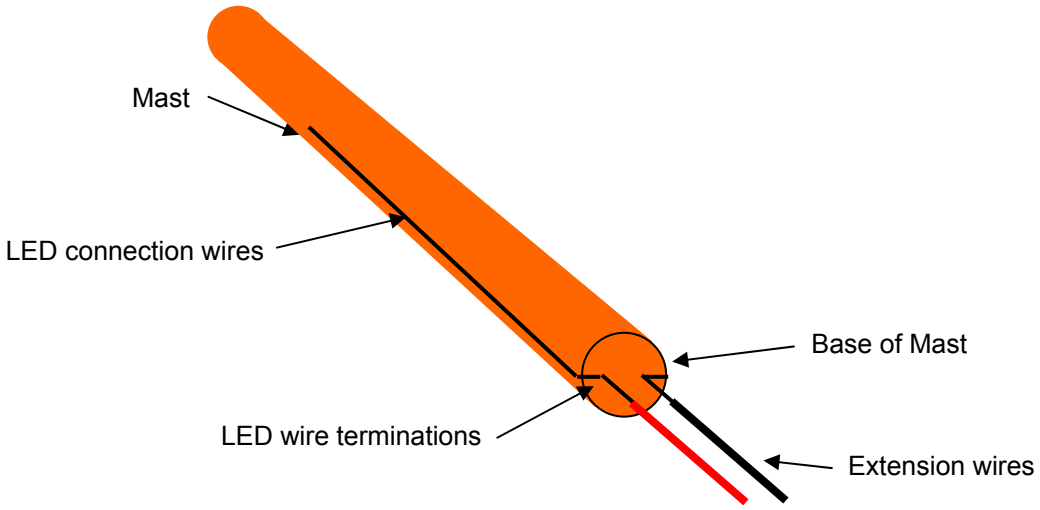


Fig 12 Method of Wire Termination

Varnish the wiring at the side of the mast and allow to dry, this should secure the fine wires into position. Carefully remove the strips of tape used to temporary secure the wire and complete the varnishing of the mast. The Mast wiring is now complete.

If further fittings are to be added to the mast and they are made of metal, please ensure that they do not short the two sets of wires either side of the mast; this will result in the navigation lights not working.

Regarding the routing of the wiring and final connections including the series resistors, this will be discussed later on under **RESISTORS AND ROUTING OF CABLES.**

c) Stern Light

The Stern Light for large vessels can mostly be found on the rear superstructure. On very small pleasure craft the Stern light is either fitted on top of the rear cabin roof or down on the Transom.

If the Stern Light is to be fitted to the superstructure, or in the case of a small vessel, on top of the rear cabin roof, the method of fitting will be the same as for fitting Port and Starboard Navigation Lights to a cabin roof, as described in Section (a). However if the stern light is to be fitted to the transom of a small craft a different approach will be required.

The Transom on most model boats will be made of a single skin therefore not giving much opportunity to hide the wiring, unlike modern cabin cruisers which are constructed of GRP and have a double skin into which a lot of the cabling is channelled

So how do we deal with this problem? If you are about to construct your vessel you could consider a minor modification by adding a second skin to its transom, it need only be 1mm thick plywood or ABS. This type of modification could also be adopted on some vessels that have already been built allowing the wiring to be sandwiched between the skins.

If you do not wish to add a complete second skin to the transom, consider just adding a narrow strip of plywood like a piece of conduit from the top of the transom to the deck well in order to take the two thin cables. Whichever approach you decide on, the method of construction will be very similar.

First decide on your choice of lamp, an example showing a selection of lamps can be seen in Fig 13.

Fig 13 Mast Head/Stern Lamps (R&B fittings)

In order to fit the Stern Light and LED, it will be necessary to either use a bracket or plinth in order to mount it on the Transom. In the following example, we will make a bracket for the mounting.

Fig 14 Stern Light mounting using a Brass Bracket

Fig 14 shows a bracket that has been made of sheet brass, the stern light housing having been soldered to the bracket and a Grain of Wheat bulb inserted into its base. Note the insulation on the connecting wires protruding from the bottom of the light. If we use an LED and make the bracket out of ABS sheet, we can improve on the appearance of the Stern Light by hiding any unsightly wiring.

Cut two pieces of 1.5mm thick ABS sheet 5mm wide x 7mm long. File a radius on one end of one of the pieces which should be the same radius as the Stern Light housing.

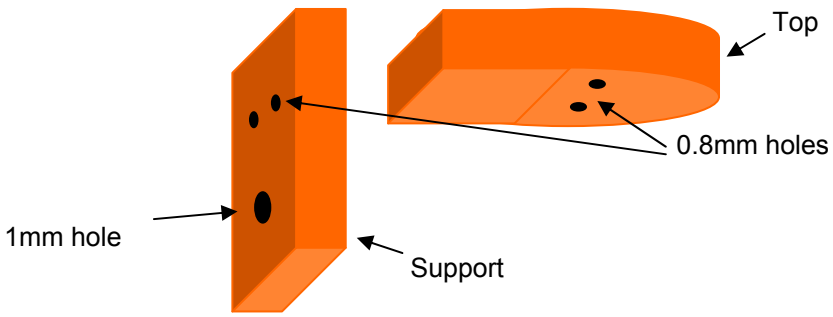


Fig 15 ABS Bracket

Drill two 0.8mm diameter holes in the top, 2.5mm apart and central to the radius end. Drill a further 2 holes in the Support 2.5mm apart and 1.6mm down from the edge. Drill a 1.5mm diameter hole in the Support 3mm up from the bottom as shown in Fig 15.

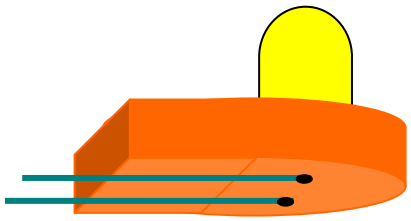


Fig 16 LED assembly

Insert the LED into the two holes in the Top and place the Stern Light housing over the LED. Ensure that the housing sits firmly on the Top, remove the housing. Bend the LED wires at right angles such that they lay flat against the underside of the Top, see Fig 16.

Insert the two LED wires protruding from the ABS base into the two 0.8mm holes in the Support, see Fig 17.

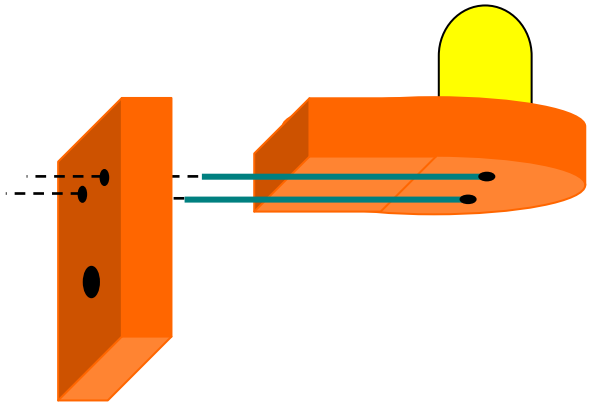


Fig 17 Fitting the Support to the Top

Push the Support up to the Top to ensure that it aligns correctly and glue the two halves together, ensuring that the Support is at right angles to the Top, see Fig 18.

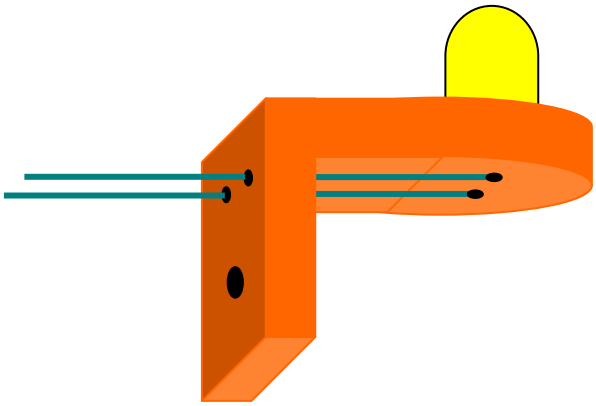


Fig 18 Bonding the stern light bracket.

When the glue has set, trim away any excess material to produce a clean assembly, be careful not to damage the LED. Now test the assembly to verify the LED is still working using the method described in section a) Fig 5. If all is satisfactory mask the LED and the wires that protrude out from the Support, the assembly may now be painted.

When the paint has dried, remove the masking and bond the Stern Light housing into position over the top of the LED. The assembly is now ready to fit onto the Transom.

Locate the position on the Transom that you wish to fit the Stern Light. Drill a pattern of three holes the same as where drilled previously into the Stern Light bracket Support, that is, one 1.5mm hole and two 0.8mm holes to take the LED wires. Place the Stern Light up against the Transom and insert the two LED wires into the two 0.8mm diameter holes. Push the assembly up to the Transom, see Fig 19.

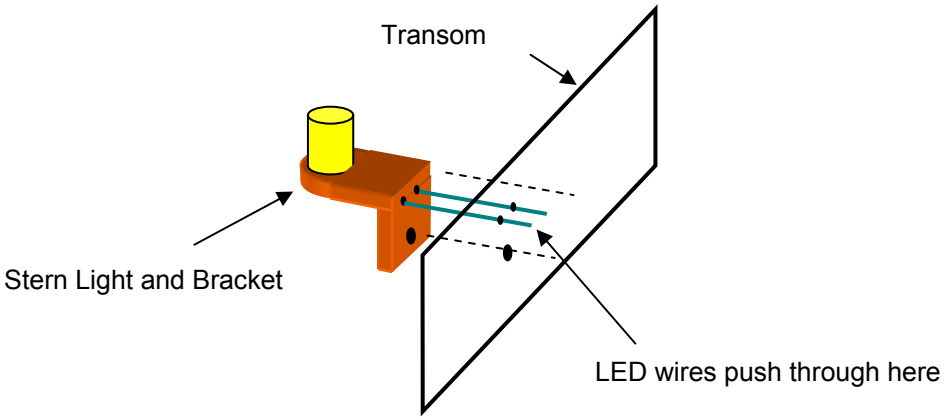


Fig 19 Fitting the Stern Light to the Transom

With the Stern Light in position on the Transom fit a 12BA nut, bolt and washer through the 1.5mm holes in the Stern Light bracket and Transom. Tighten the assembly into position (finger tight). Extend the two LED wires by soldering two lengths of fine tin/copper wire to them, as mentioned previously you can strip some strands from equipment wire or mains cable. Having done this, bend the LED wires at right angles down onto the rear Transom face, ensure they are not shorting to the small nut/bolt holding the bracket in position.

The two LED wires (extended) need to travel down into the hull and then be terminated into some equipment wire (7/0.2mm) which will continue on to the battery supply. If a deck has been fitted it will be necessary to drill it at the base of the Transom with two small 0.8mm diameter holes in order to pass the two LED extension wires through and into the hull.

Having done this, hold the fine wires in position on the transom with adhesive tape and tack them in position using a very small amount of medium Cyanoacrylate glue. When dry remove the adhesive tape from the wires.

Cover the wires that are running down the inside of the Transom with a strip of 1.5mm plywood about 10mm wide and long enough to stretch from the top of the Transom down to the deck level. Drill a 1.0mm hole in the top end of the plywood strip to match the hole drilled in the Transom. Now remove one layer of ply about 5mm wide from the centre of the rear face of the plywood strip, stretching from the deck level up to where the LED wires protrude through the Transom, see Fig 20. (as an alternative the cover may be made out of two pieces of plywood).

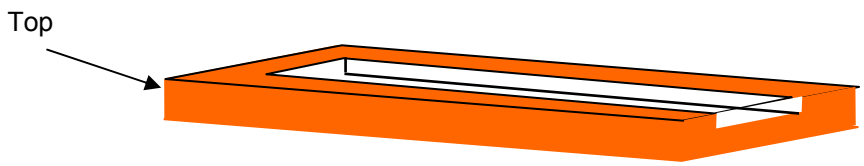


Fig 20 Transom Wiring Cover

Remove the nut and washer from the 12BA bolt and place the cover in position. Screw the bolt into the cover like a self tapping screw and tighten, file down the part of the bolt that may be protruding out of the cover. The Stern light wiring is now completed.

Fig 21 Transom wiring cover in position

Regarding the routing of the wiring and final connections including the series resistors, this will be discussed later on under **RESISTORS AND ROUTING OF CABLES.**

d) Porthole Lighting (Hull)

Lighting up the inside of the Hull to provide light at the Portholes may be accomplished by illuminating each individual Porthole or by having a central lighting system that creates sufficient light within the vessel to illuminate all the Portholes within a specified area.

i) Porthole - Individual Lighting

It is easier to illuminate Portholes that to make Navigation lights. Basically all that is required is a means of mounting the LED up against the Porthole. This may be done by using Strip board (see Fig22).

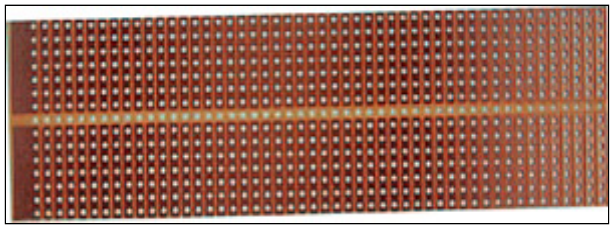


Fig 22 Strip Board (Also known as Vero Board)

Cut the Strip Board into short lengths about 15mm long with two strips of copper track on one side. Cut the leads of a white LED to about 20mm long and solder them to one end of the Strip Board, note which lead is positive. On the other end solder two leads, one Red (positive) and one Black, using 7/0.2mm equipment wire, see example Fig 23.

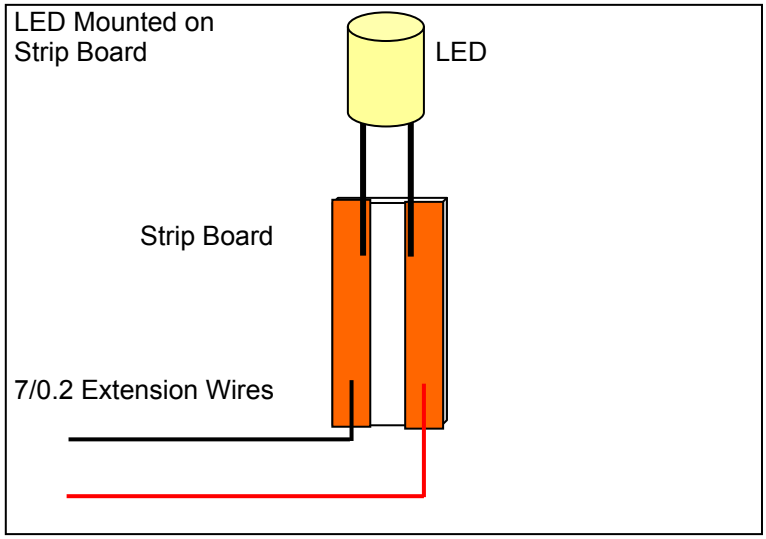


Fig 23 LED mounted on Strip Board

Place the LED inside the Hull so that the lens is adjacent to the Porthole; hold it in this position by using some adhesive tape. Test the LED by connecting the extension leads to a battery as shown in Fig 5. The LED should be illuminated and you may judge if the LED has been placed in the correct position, you may also adjust the proximity of the LED to the Porthole to vary the illumination intensity. This type of small assembly may now be repeated for the remaining Portholes of the vessel.

ii) Porthole - Central Lighting

Strip Board may also be used to produce a central lighting unit, but this method of lighting is a little bit 'Hit & Miss' due to the fact that the constructor needs to judge the number of LED's required and exactly where to place them to achieve satisfactory illumination of all the Portholes.

One idea for making a lighting strip, using Strip Board is shown in Fig 24, this time a long strip of Board has been cut and the LED's place along the two copper strips at intervals with the extension supply wires fitted at one end. In this configuration all the LED's will be fed from a single resistor/supply.

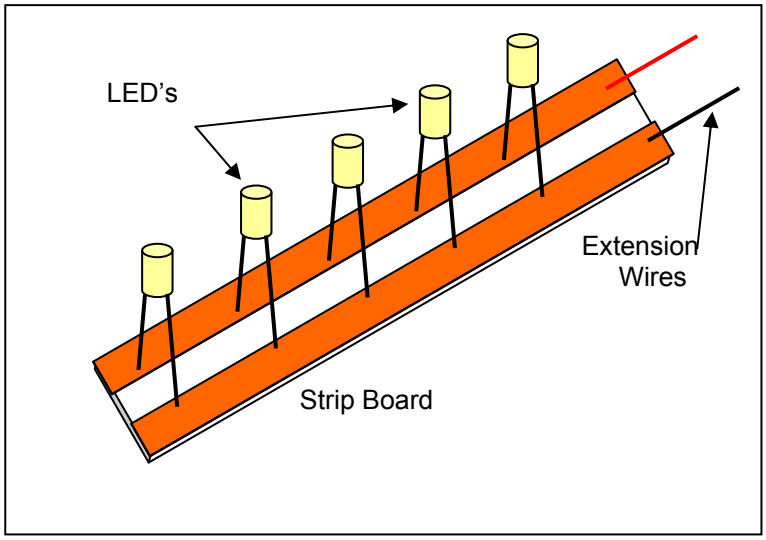


Fig 24 Strip of LED's

All is required now is to place the assembly into the vessel with the LED's illuminated and move the assembly around to determine the best position. You may consider there to be too much light, in which case remove some of the LED's. If there is too little light you will have to add more LED's, or make up another assembly.

Regarding the routing of the wiring and final connections including the series resistors, this will be discussed later on under **RESISTORS AND ROUTING OF CABLES.**

e) Cabin Lighting

If the cabin on your model is not just an empty space but has been fitted out with furniture etc. the methods described previously in section d) will probably not be suitable. There are some commercial light fittings for such situations one of which is shown in Fig 25.

Fig 25 Interior Lamp (Graupner)

To fit an LED into the lamp firstly cut the leads of the LED very short only leaving about 1.5mm of wire protruding out of the plastic lens. Now solder some very fine insulated wire to the short LED leads. Having done this, check the function of the LED as described previously, if it functions satisfactory insulate the soldered joints behind the LED by covering the joints with a small amount of araldite, just enough to cover the joint. When fully cured fit the LED into the lamp and re-check that it still functions correctly. Another method, should there be sufficient room within the lamp housing, is to mount the LED on a small piece of ply or copper clad board that has been cut round in order to fit inside the back of the lamp housing. Drill two 0.8mm diameter holes in the board and fit the LED. Cut the LED wires short and add the extension wires, now fit the assembly into the back of the lamp.

An alternative is to make your own strip-light or pseudo fluorescent light. Cut a piece of Perspex approximately 40mm long and 4mm square. If you cannot find anything thick enough then use two pieces laminated together. Having done this, drill a 3mm diameter hole centrally in each end and insert a LED into each them, add a strip of silver foil to the back edge to act as a reflector and you have your strip light, see fig 26.

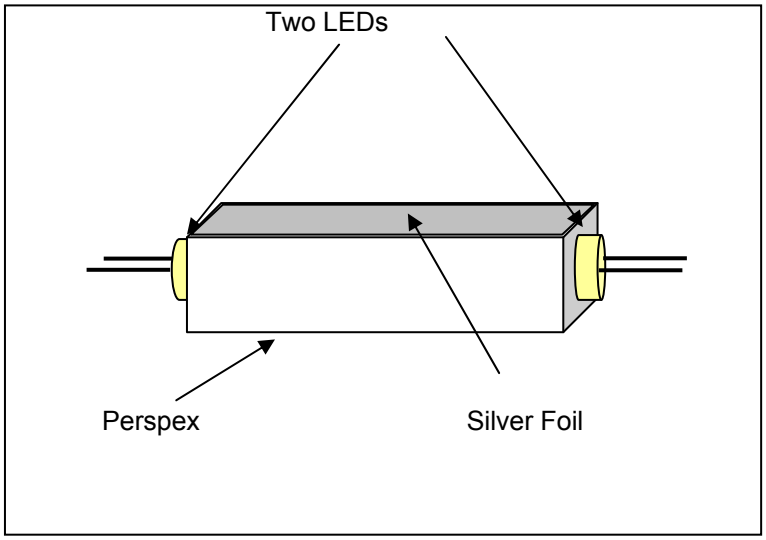
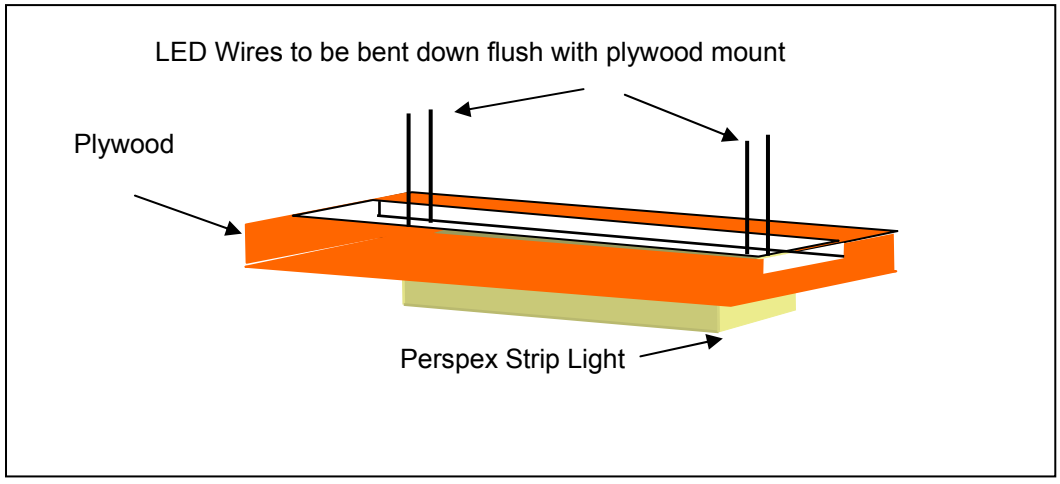


Fig 26 Strip Light

To mount the light onto the cabin roof use a strip of 1.5mm plywood 10mm wide, remove one layer of the plywood 4mm wide, from the centre to form a central channel for the wiring. Now bend the leads of the LED's at 90 degrees and offer them up to the plywood strip, mark their positions. Drill four 0.8mm diameter holes in the plywood strip as marked for the leads. Insert the leads into the plywood and bend over flush to the plywood face, see fig 27.

Fig 27 LED light mounting



Connect the two pairs of wires, observing the positive and negative connections of the LED's and extend the wires using 7/.02 equipment wire, in order to connect to the battery supply.

Regarding the routing of the wiring and final connections including the series resistors, this will be discussed later on under **RESISTORS AND ROUTING OF CABLES.**

f) Instrumentation Panel Lighting
Some large model kits are supplied with excellent detailed instrumentation Consol's for the bridge. This situation lends itself to having the panel(s) back-lit like the real McCoy.

Providing there is enough free space under the Bridge Consol, a couple of orange LEDs placed strategically behind the Panel(s) will provide the desired results.

To mount the LED(s) use the method shown in Fig 24. cutting the LED leads short. If there is limited room, the LED(s) may be folded flat against the mounting board surface.

If the model is made of thin ABS sheet or is a ready made thin moulding, there may be a problem with the light from the LED(s) shining through the thin plastic. To overcome this problem, mask the Instrumentation Panel (Dials etc.) on the Consol from the inside. Then paint the inside matt black. When the paint has dried, remove the masking, this will leave the instrumentation areas clear. The light from the LED(s) should shine through the panel without giving the whole of the consol an orange glow.

Regarding the routing of the wiring and final connections including the series resistors, this will be discussed later on under **RESISTORS AND ROUTING OF CABLES.**

g) Deck Area Flood Lighting
Tugs and Oil Rig Supply Vessel's have the ability to flood light their deck areas and some Cruise ships also flood light certain decks. Two examples of commercially available Deck Lamps are shown in Fig 28.

Fig 28 **Deck Lamp – Aeronaut** **Deck illumination Lamp - Billing**

If you buy a Lamp with a Grain-of wheat bulb already fitted, you may be able to replace it with a LED, this will depend on its size and the amount of room inside the lamp. To replace the bulb with an LED cut the leads of the LED very short only leaving about 1.5mm of wire protruding out of the plastic lens. Now solder some very fine insulated wire similar to that used with the bulb. Now check the function of the LED as described previously, if it functions satisfactory insulate the soldered joints behind the LED by covering the joints with a small amount of araldite, just enough to cover the joint. When fully cured thread the LED wires through the back of the Lamp housing and fit the LED inside the Deck Lamp, fit the front cover, test the lamp to check that it works and the job is completed. If you cannot change the bulb, the lamp will have to be used as purchased. Alternatively you could make your own Deck Lamp out of ABS sheet material.

In order to make a simple housing for a Deck Lamp, cut some ABS sheet to the following sizes.

15mm x 7mm x 1.5mm thick - 1 piece
15mm x 5mm x 1mm thick – 1 piece
8mm x 8mm x 1mm thick – 2 pieces
15mm x 9mm x 1mm thick – 1 piece

Drill a 3mm diameter hole in the centre of the 15 x 7mm piece of material, now glue this part to the 15 x 5mm part as shown in Fig 29.

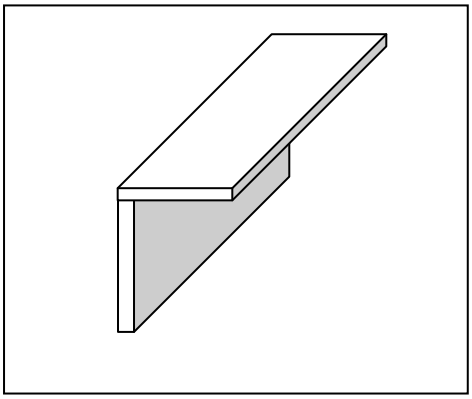


Fig 29

Glue the two 8 x 8mm pieces of material onto each end of the assembly as shown in Fig 30.

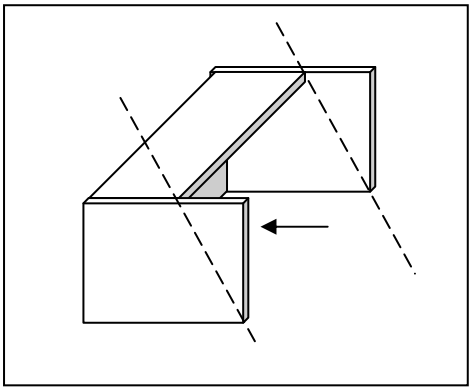


Fig 30

When the glue is set cut the sides along the dotted line, as shown in Fig 30. Using an emery board, sand the front angle to produce a smooth bevel over the whole front face. Glue the 15 x 9mm piece of material to the angled front face. When dry sand down top, bottom and sides to produce a smooth finish. The assembled item may now be painted. After painting line the inside of the assembly with silver foil to act as a reflector. Insert a LED through the hole in the back of the light, trim the LED wires short and add some extension wires made from 7/0.2 equipment wire. The Deck Light is now completed. See Fig 31

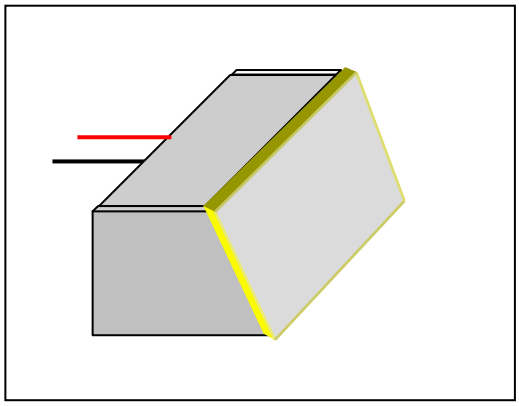


Fig 31 Completed Deck Light

Regarding the routing of the wiring and final connections including the series resistors, this will be discussed later on under **RESISTORS AND ROUTING OF CABLES.**

h) Spot Lights

Installation of Spot Lamps is much the same as for deck lights, that is, if you buy a Lamp with a Grain-of wheat bulb already fitted, you may be able to replace it with a LED; this will depend on its size and the amount of room inside the lamp. An example of a commercially available Spot Light is shown in Fig 32 below.

Fig 32 Spot Light (Aeronaut)

Regarding the routing of the wiring and final connections including the series resistors, this will be discussed later on under **RESISTORS AND ROUTING OF CABLES.**

All of the methods described above for the fitting and mounting of the various types of lights may be adopted and mixed to suit the particular situations or materials available when it comes to fitting lights to a vessel.

4. RESISTORS AND ROUTING OF CABLES

a) Resistors

Each LED or set of LED's requires a series resistor to limit the amount of current taken by the device (see article on LED's in previous issue of Club Magazine).

If space permits the resistor(s) may be fitted in series with the positive lead of the LED as shown in Fig 33. However my personnel preference is to route all wiring for the vessels lighting to one point, there all the resistors may be mounted on some form of junction board and the wires terminated accordingly. An example of such a board is shown in Fig 34.

Fig 33 Resistor in Positive Lead

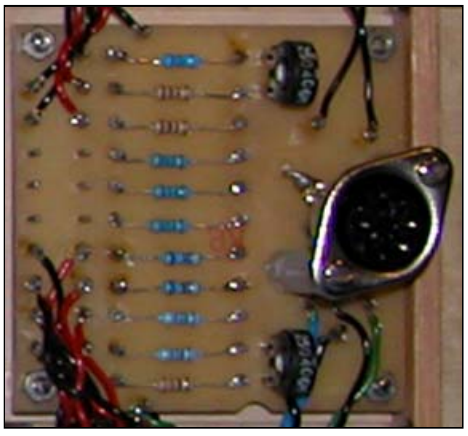


Fig 34 Junction Board with Pins

A Junction board may be constructed in a number of ways. Board material such as SRBP (Bakelite) or fibreglass sheet would be an ideal choice, but 1.5mm thick plywood will do just as well. As for a method of terminating the resistors/wire leads, small size terminal blocks could be used or drill 1mm diameter holes in the board material and insert Maplin terminal pins (part No FL24B). Using the latter method will require soldering the resistors and the leads to the pins. Figure 34 shows an example of a board with pins inserted and the wires/resistors soldered. Fig 35 shows an example of a Junction board, but using terminal blocks, note the common negative Bus-Bar where all the negative wires from the LED's are connected. All the positive wires go to the series resistors. If you're LED has a resistor in series with its positive lead it may be connected direct to the battery end of the Junction Board.

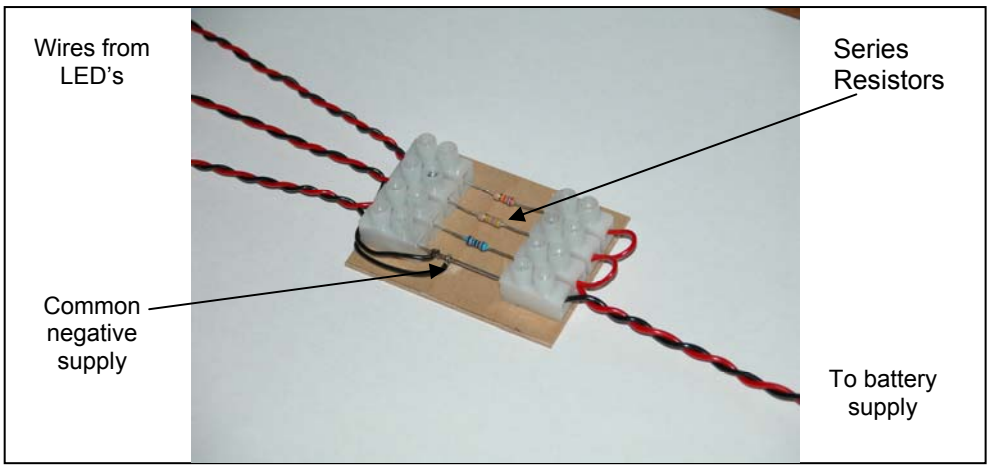


Fig 34 Junction Board using Terminal Blocks

If you have placed all your series resistors in the supply leads to the LED's you will still require some form of Junction Board in order to bring all the wires to the battery supply.
Next you need to decide exactly where to place the Junction Board, if most of your lighting is within the superstructure then it would seem sensible to place it there, which means you will only require two leads from the board in the superstructure, to the battery in the Hull.

However there is no reason for you not to have another Junction Board in the Hull if the amount of lighting fitted warrants it.

Having made your Junction Board and fitted the required resistors mount it on spacers and secure it to a mounting block within the vessel using small screws or bolts. Now you are ready to attach all the wires. Attach all the negative wires to the common point as shown in Fig 34. Now verify that you have the correct LED lead and connect it to the appropriate resistor connection point. Connect a battery to the battery leads and verify that the LED is illuminated. Repeat for the remaining LED's.

Another idea is to fit a variable series resistor (potentiometer), with a value of about 5,000 ohms. This will allow individual adjustment to the LED intensity; however a word of warning, a fixed resistor (470 ohms) must be fitted in series with the potentiometer. This will prevent damage to the LED, should the potentiometer be turned down to zero ohms.

b) Routing Cables
If you wish to make your model look professionally built, do pay attention to wiring the model vessel in a neat and tidy manner. do not just connect the wiring by the shortest possible route giving the completed model the appearance of a 'Birds Nest'. Pairs of wires from each LED or sets of LED's should be twisted together, normally referred to as 'Twisted Pairs'. See example in Fig 35.

Fig 35 Example of Twisted Pairs of wires

Route all the wiring along the Superstructure or Hull and secure at intervals to the structure by using some type of clip or cable-tie, for very light cable just using strips of masking tape. An example is shown in Fig 36. Adopting this approach to the wiring will result in a very neat and tidy model.

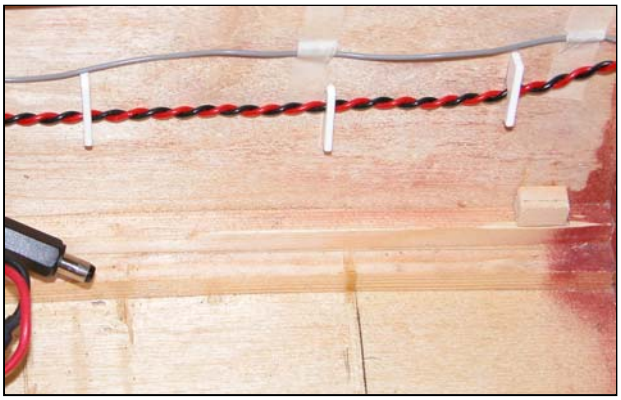


Fig 36 Cables secured within a vessels Hull

5. BATTERY SUPPLY OR VOLTAGE REGULATOR

Running your LED lighting direct from the battery supply will be just fine, however, you may find that as the battery discharges, the voltage drops and consequently the LED brightness fades. To alleviate this problem, consider running the lighting from a 5 volt voltage regulator, it is easy to construct and will certainly product excellent results.

To make the 5 volt regulator you will only require three electronic components, details as follows:-

1) Three Terminal Regulator IC L78S05CV Maplin P/N UJ54J
2) 10uf capacitor 16 volt working Maplin P/N VH06G
3) 0.1uf capacitor 16 volt working Maplin P/N JL01B

The regulator will require to be mounted on a board, similar to the Junction Board which may be made from SRBP (Bakelite), fibreglass or 1.5mm thick plywood. As for a method of terminating the components, small size terminal blocks could be used or terminal pins as used for the Junction Board. A pictorial diagram is shown in Fig 37.

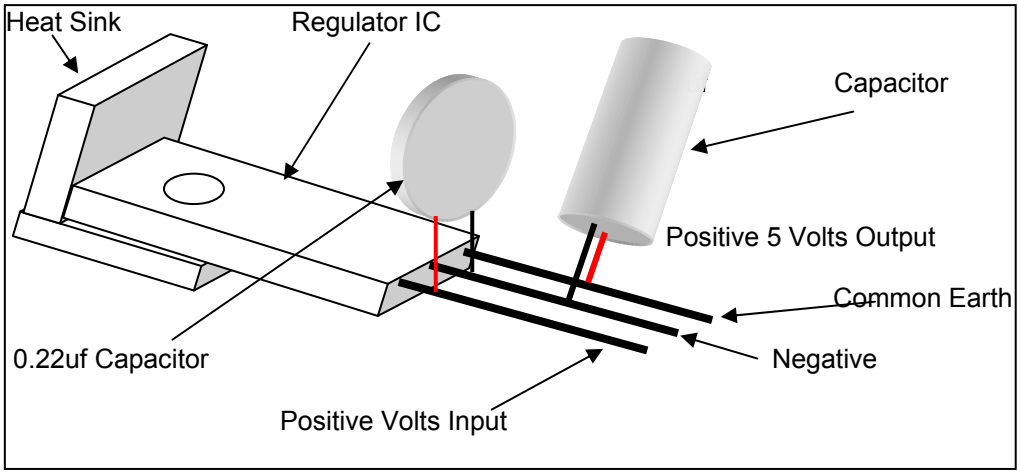


Fig 37 Five Volt Regulator Pictorial Diagram

It will be noted that in the pictorial diagram a heat sink has been fitted to the 5 volt regulator. This may not be required; it depends on the current load it is subjected to. If there are only a few LED lights and the current is only about 0.1 amp, then a heat sink will not be required. However if you have a full compliment of lights and the current is approaching 1.0 amp then a heat sink is advisable. It can be made of a small piece of aluminium or copper, drilled and bent as shown and bolted to the Regulator IC including the mounting board if required.
Fig 38 shows a five volt regulator constructed, using a connector block mounted on a piece of plywood with an aluminium heat sink.

The 10uf capacitor is an electrolytic and as such is polarised (positive lead must be fitted to the Regulator +5 volt output lead) it also needs to be rated at 6.3v dc or greater (note that the component list specifies lists 16v).

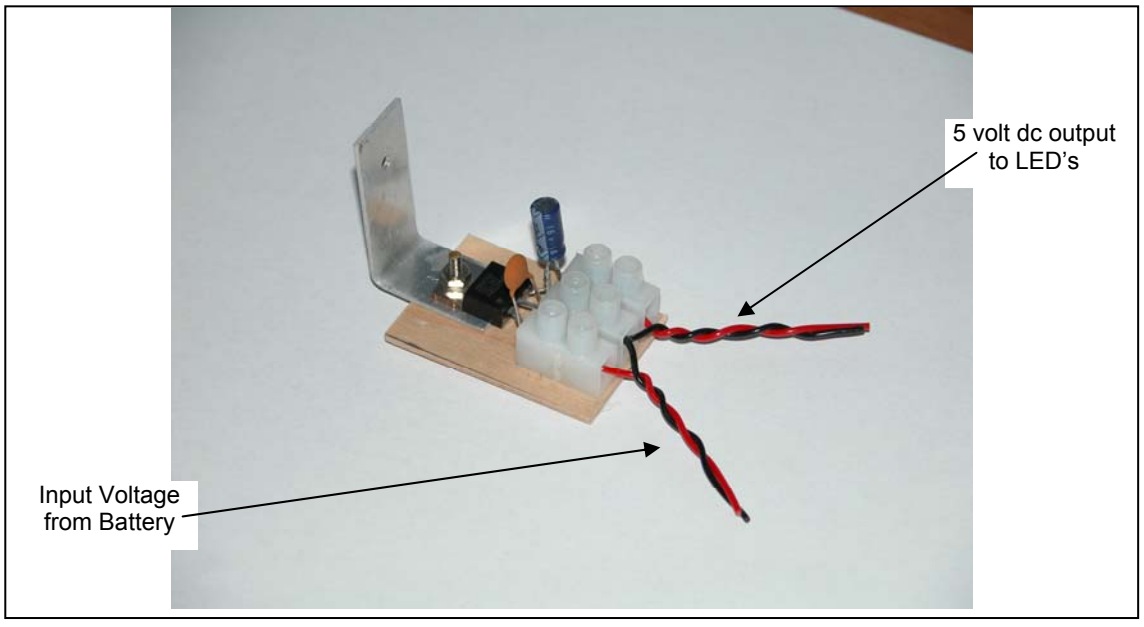


Fig 38 Five Volt Regulator Assembly

6. SWITCHING ON THE LIGHTS

The simplest way to switch the lights is to place a single pole switch in the positive lead between the LED's and the battery. Fit the switch in a place where it will not get wet, but at the same time is reasonably accessible.

Fancy switching the lights using your radio, then there is a circuit you may consider building. It only uses one IC and seven other components for a single switch and you can build two or three to run from one output channel of your receiver, which will allow you to switch the navigation lights, cabin lights and deck flood lights of your vessel in sequence. This circuit is described fully in a separate newsletter, How to Build your own R/C Switch.

Tony Dalton.