Besides your boat, you will need Radio Control Equipment in order to effect and maintain control over it.

**Most yachts use two channels for control:**
1. Control of the rudder for steering.
2. Control of the sails via cords known as ‘sheets’.

Some class rules for racing yachts only permit a maximum of 2 channels to be used, however, larger yachts and scale yachts may use more for independent sail control and auxiliary functions.

Radio control equipment operates on a number of frequency bands worldwide. Currently in the UK the bands available for surface models are 27 MHz, 40 MHz and 2.4GHz. Within each band there are a number of frequency channels available; 32 for 27 MHz and 34 for 40 MHz each identified by a number system and normally selected by a pair of crystals, one for the transmitter and one for the receiver. Some newer sets are available with digital channel selection and do not require crystals. The 2.4 GHz band has 79 channels. Frequency channel selection on this band is automatically selected by the equipment which scans the band and selects a free channel.

**The main elements of the Radio Control system are:**
- The Transmitter
- The Receiver
- Rudder Servo
- Sail Winch(es)

**Transmitters**
There are a number of variations in the design of transmitters although the function of them is largely similar.

The differences really come down to the levels of sophistication that are built into them. The basic sets have 2 control channels, adequate for basic control of a yacht. More sophisticated sets may have 9 channels or more. The majority now include a means of adjusting the servo travel and direction. More sophisticated sets allow the user to programme and store multiple settings for different models. This can allow one transmitter to be set up and used for different models without having to change settings. It does, however, require the skipper to make sure they select the correct model memory to match the boat to be controlled.

Transmitters are typically about 20 cm wide, 15 cm tall and 5 cm deep with an antenna which may extend to as much as 1 metre or more. Some form of protection should be placed on the end of the antenna in order for others to be able to see it more easily and to help avoid accidental injury such as it being poked in someone else’s eye.

The antenna on a 2.4 GHz transmitter is less than 8 cm long.

**Protecting Your Transmitter**
It must be borne in mind that regardless of the cost of these units which can vary from as little as just a few tens of pounds up to several hundred pounds, they are still precision electronic units and need to be looked after carefully.
When transmitters are used to control boats, water is never far away!!
Transmitters and water do not mix well!!
Radio Controlled sailing is undertaken in most weather conditions and users will frequently be seen with ‘muffs’ or some form of protection from the elements. They also help to keep fingers warm in cold conditions!

**Frequency Crystals**

Traditionally the operating frequency of the transmitter was determined by a crystal. To change frequency the user would change crystals in the transmitter and receiver. It is generally useful to own a number of crystals especially when travelling to other clubs and events. Although housed in fairly robust cans, crystals are delicate and should be protected from shock to prevent malfunction.

There are now sets available that do not require crystals. These sets contain programmable synthesizers which allow the channel number to be selected via key entry or multi-position switches. 2.4 GHz sets take this a step further by automatically scanning the band and selecting a free channel.

**Safety First**

- Never use the 35MHz frequency band, this is for aircraft only.
- Always check the frequency or peg board to ensure your desired frequency is free.
- When starting Switch on the transmitter first and then the receiver
- When finishing Switch off the receiver first and then the transmitter

**Receivers**

This is typically a small unit approximately 5 cm x 2 cm x 1.5 cm that picks up the signal from the transmitter and converts it into instructions for the servo and/or winch. The receiver uses a crystal to determine the frequency of transmission that it will pick up or as described above may be programmable. Due to the way 2.4 GHz sets operate, the receiver is normally “bound” to the desired transmitter using a programming lead during initial setting up. This allows it to learn the unique code of the transmitter regardless of which frequency channel is chosen.

**Protecting Your Receiver**

Apart from interference from another transmitter, the receiver’s worst enemy is moisture. Depending on the space available and style of boat the receiver is usually protected from moisture by placing it in a radio pot, film can or a simple balloon. After sailing it is important to ventilate the enclosure to ensure there can be no build up of condensation.

Ventilating the boat is also recommended, usually by removing a hatch or deck patch to prevent condensation causing damage to the servos and winch housed in the boat. Moisture inside a receiver invariably brings control difficulties and loss of control. Significant water ingress may well lead to permanent damage electrical shorting and even fire in worse cases.

**Batteries**

Most transmitters are powered by eight AA cells although some newer sets may only use six cells. A freshly charged
Radio Control Equipment

transmitter pack will generally provide a day’s sailing providing the transmitter is switched off when it is not being used. Some transmitters can be powered using standard alkaline cells however, for frequent sailors it is more economical to use rechargeable cells.

The number of cells required in the boat will depend on the installation. If neither the receiver nor the winch contains a Battery Eliminator Circuit (BEC) then 4 or 5 cells are required. If the winch contains a BEC then typically 6 cells can be used providing more power for the winch. The winch then provides the correct voltage for the receiver and rudder servo. Always check the manufacturers instructions if you are unsure or ask the supplier, some provide additional leaflets. It is very easy to cause irreparable damage. Never power a winch from another winches BEC or a receiver’s BEC running on six cells, the circuit will overheat and may be permanently damaged.

Note the term cell used above refers to Alkaline, NiCad and NiMH battery technologies. Newer Lithium battery technologies have a higher cell voltage. Always take care when storing batteries to avoid shorting the terminals together and take care to observe the correct polarity when connecting the battery.

Safety First

• You must cover the end of your transmitter aerial with either a rubber ball or a practice golf ball as shown.
• Mandatory at all MYA events.

Rudder Servos

Servos are available in a range of sizes and power output but generally standard size servos are used to operate the rudder in the majority of sailboats (Typically 4 cm x 4 cm x 1.5cm)

Servos convert the position instructions from the receiver into a mechanical output. The servo output disc or arm rotates approximately 45 degrees either side of the centre position for full stick movement on the transmitter. Whilst it is possible to pay perhaps £50 or so for a servo, much cheaper ones, sensibly looked after will normally do the job just as well. The secret is to make sure they are kept as dry as possible.

Even though they appear to be a sealed plastic container, moisture has an annoying habit of getting to the electronic elements. A smear of grease or silicone around the joints of the casing will help but especially if silicone is used it must not be allowed to come into contact with the rotating parts.

Servo to Rudder Linkage

This is normally effected via rod or wire and can be done in basically one of two ways; a single push rod or two rods or wires. It must be borne in mind that the rudder will be required to move both left and right and that if a single rod link is used, there will be occasions when the linkage is under pressure (when it is pushing) or under tension (when it is pulling). To maintain good control it is essential that the servo mount, rudder tube mounting and the pushrod are rigid.
The two rod system can operate in tension only but requires careful setting up to maintain constant tension. With either system it is useful to include some form of adjustment capability. Final adjustment is provided by the use of the trim function on the transmitter.

Sail Winches
The winch provides control of the sails. There are two principal types of winch; the Lever Arm and the Drum. The Lever Arm type winch is basically a servo. For very small boats a standard servo is sufficient, however, medium sized boats require a larger more powerful unit to cope with the sail loads.

The output arm on the servo has to be considerably longer, up to 4 inches (100mm), to enable sufficient movement to be obtained when the servo is operated so that full throw allows the sails to go from fully sheeted out’ to ‘close hauled’ or ‘fully sheeted in’ positions. If there is insufficient room in the boat to accommodate the required arm length, a pulley can be attached to the arm to provide additional sheeting movement. In stronger winds the arm winch can sometimes struggle to ‘sheet in’ and also can consume a lot of power holding the sail in the commanded position.

The Drum winch is basically the same as a normal servo except the output provides typically 3 to 6 turns for full stick movement. A circular ‘drum’ mounted on the output shaft allows the sheeting chord to be wound in and out. Sheet length for full stick movement can be adjusted by choice of drum size and on many winches, a turns adjustment screw. Drum winches in RC model yachts normally employ a closed loop under tension and most drums provide two separate sections, one for reeling in cord and one for paying out cord. The sail sheeting lines are taken off of the closed loop.

This is necessary to keep the sheeting on the winch drum. An alternative rarely used now is to provide a sufficient length of elasticated chord to maintain tension on the winch. The drum winch, particularly some of the more powerful ones, should be set up with care to avoid damage to the winch or the boat and its fittings.

Pulley
Ensure the area that the pulley is attached to can take twice the pull of the winch