

# **Set-up of FlySky FS-i6/FS-i6X Transmitter (Tx) and FS-iA6B Receiver (Rx) for RC Racing Yachts (David Flakelar - Sydney)**

## **Background**

These notes are written to help the beginner set-up the FlySky Tx/Rx system to operate with the DF65 and 95. There are also a few tips in an appendix that have nothing to do with the FlySky system but may provide some useful background.

Any feedback would be much appreciated.

The FlySky FS-i6 system operates under the Digital Proportional Protocol using an Automatic Frequency Hopping Digital System. It is a pulse digital system on carrier frequencies unique to a particular transmitter. You don't need to know how that works. The manufacturer claims there is no risk of interference from another transmitter.

## **Why I Bought the FlySky TX/Rx System**

1. It appears to be used by most of the fast sailors!
2. In Australia, the marginal cost is around \$20 compared to the Joysway model for many more useful features. (The cost of FS-i6 system less cost saving on buying the kit without Tx and Rx). At current Hobby Warehouse prices this represents an extra cost of (\$76 - (\$237-\$179)).
3. Minimal risk of interference from other sources.
4. Using its built-in telemetry capability, the condition of both batteries is displayed on Tx monitor. Visual and audible alarms for Rx battery can be set.
5. Expo (exponential) and or proportional control can be used on rudder and winch movements.
6. The same Tx can be used with several Rx.

## **Compatibility**

The FlySky Tx will only operate with a FlySky Rx of which there are several types. The Turnigy and Park Fly products appear to be FlySky re-badged?

## **FlySky Product Range**

The DFs require only a two channel Tx to control rudder and sail winch. The FS-i6 is a 6 channel controller and the FS-i6X provides 10 channels. There are two Rx types - the iA6A is a lightweight receiver generally not suitable for a marine environment with an exposed circuit board, while the "B" version has a more protected hard plastic case.

The supplied Rx from HWH is the FS-iA6B with 7 ports and for neatness the three cables (battery switch, rudder and sail winch) plug-in horizontally from the end with the black/brown cable on the bottom. A FS-iA6 Rx is available and has the same functionality but the seven ports are arranged vertically with exposed pins. Depends how you want to arrange cabling.

## **Instruction Manual**

A 32-page Instruction Manual is available from the web. Search "FlySky FS-i6 manual". These notes should be read alongside the manual, which is incomplete, while some functionality is not explained. I have given my interpretation, but this may be inaccurate and if I err, please let me know.

There are several of videos about the FlySky system used with RC yachts available on YouTube. Most others relate to control of model aircraft. Search on "FS-i6/RC yachts".

## Waterproofing

The Tx should not be used in the rain without a waterproof muff. The Rx should be mounted on the tray with all wires kept clear of the rudder linkages. Liberal use of CorrosionX or similar waterproofing is strongly recommended.

## Switching Sequence

Having assured the user there is no risk of interference from another radio frequency source, the maker recommends that a particular switching sequence be observed, which is: Tx ON, Rx ON... Rx OFF, Tx OFF.

Additionally, when switching on, if switches or sticks are not in their correct position, screen and audible warnings will be activated. If however sails have been rigged, after the Tx is switched ON, return the winch stick to a mid-range position before switching on Rx. This will prevent possible damage to sheets, sheet pulley or winch servo overload if sheets have been set too tight.

## FlySky Operational Range

The operational range of the FS-i6 is dependent on the condition of batteries and the orientation of both Rx antenna and how the Tx is held. The Rx may have one or two antennae. The latter should be mounted at a right angle to each other on the underside of the deck or as high as possible above the tray. Unless there is electro-magnetic interference, or signal attenuation from metal yacht masts, range should never be a limiting factor while sailing. Line-of-sight transmission is always important. Most sources quote a range of 300-400 m, but the system has been shown controlling a drone out to 2.3 km. At more than 100 metres, it may be difficult to see the yacht, but still have control.

## LCD Screen Brightness

LCD brightness can be controlled using **System Menu/LCD brightness**. Might be useful when operating in bright sunlight.

## Screen Saver

If the Tx is not used for a short period of time the screen brightness will fade and an audible alarm will sound. The brightness can be restored by pressing any button and the alarm can be switched off using the power switch. This can be changed by upgrading the software. Search YouTube for "FlySkyi6 Upgrade" videos.

## Binding

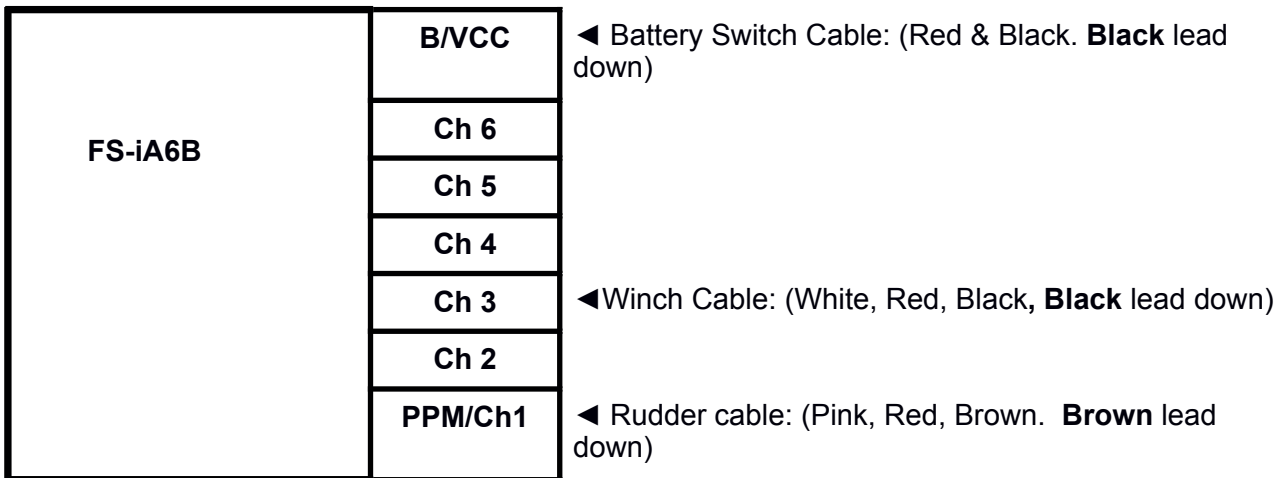
As explained above, each Tx has a unique ID, and the slave Rx must be programmed to process only those signals from the master transmitter. The maker advises the supplied Tx/Rx combination is already "bound" but you may wish to operate two or more Rx from the one Tx in different boats. Hence the need for further "binding". To bind a second Rx, you must first select a new model number. Both the Instruction Manual and YouTube tutorials are clear enough as to how binding is done. Follow the sequence exactly.

The FlySky system provides for the control of up to 20 models which means you could have different set-ups, but each would require separate binding.

## Binding Procedure

1. Rx should be adjacent Tx.
2. Insert battery in Tx but do not switch on.
3. Insert black binding key tool (supplied with the Tx) into B/VCC port on Rx
4. Insert Rx battery into any port (Ch1-Ch6). Red LED will flash indicating the Rx is not bound.
5. Hold down **BIND KEY** on Tx and switch on Tx - labelled **POWER**.
6. Release **BIND KEY** when binding is complete. The Red LED will remain steady.
7. Switch off both devices.
8. Remove the binding key tool.
9. Swap the Rx battery lead back into Rx B/VCC port
10. Switch on both devices in the correct sequence. Red LED will be steady.

## FS-iA6B Receiver Connections



Note that labels shown on Rx do not exactly align with ports below.

### Number of Models

Additional Rx can be purchased and assigned a new model number using **System Menu/Model select**. The binding procedure must follow for each new model number. The model can then be given its own name and be loaded with its own unique settings. Theoretically these Rx, each with their own settings, could be swapped in a boat (and re-bound), one Rx with its unique settings for each set of wind/wave conditions say. A lot of trouble for questionable gain. More likely each Rx could be mounted in a different boat each with a different rig.

### Settings - General

Tx has six channels and therefore offers six controls that presumably are required to operate a quad copter. Only two are required for the DFs – to control rudder and sail winch. These two controls are variously referred to as the gimbals, control sticks or stalks. Most right-handed sailors use the left-hand stick (North-South) to control the sail winch and the right-hand stick (East-West) to control the rudder. These can be reversed using the **Sticks** mode in **System menu**. Additionally, the rudder control can be reversed so that it operates like a tiller. Select **Ch 1** (rudder) and **Reverse** in menu.

There are four buttons on either side of the Tx screen that are used to navigate through the menu and establish winch and rudder settings. The menu is arranged in a hierarchical structure. The four buttons and their function are:

- OK**            Press to activate the displayed screen so that setting changes can be made. To select **MENU** a long hold **OK** is required.
- CANCEL**       Short press of **CANCEL** to cancel any changes and exit the screen. Default screen will be the screen at the next level. Hold the **CANCEL** button for a longer time to save any changes to the current setting/s. (A bit counter-intuitive!)
- UP**             Change the displayed or selected parameter upwards
- DOWN**         Change the displayed or selected parameter downwards

It is helpful to navigate through the menus to become familiar with the use of the buttons and the range of settings. Use a Model No. that is not in use. Alternatively, Exit the screen with a short **CANCEL** to ensure any changes made are not saved.

## FlySky Menus

The MENUs are selected by switching on Power and holding down **OK**. Two choices become available: **System Menu** and **Functions Menu**. Toggle between these using **UP/DOWN** buttons. Exit progressively to main display at any time by Short **CANCEL**.

## Selecting Model

The example below shows the steps required to assign your DF65 A+ rig to Model 10 in FS-i6 system

	<b>Action</b>	<b>Result on Screen</b>
1	Power up Tx	<b>Main screen</b>
2	Long <b>OK</b>	<b>MENU</b> <ul style="list-style-type: none"> <li>• <b>System (Crown icon)</b></li> <li>• <b>setup (Spanner icon)</b></li> </ul>
3	Using <b>UP/DOWN</b> buttons select "System"	System icon boxed
4	Short <b>OK</b> to select this SYSTEM MENU	<b>SYSTEM</b> è <b>Model select</b> <b>Model name</b> <b>Type select</b> etc.
5	If necessary, use <b>UP/DOWN</b> buttons to select <b>Model select</b>	<b>SYSTEM</b> è <b>Model select</b> <b>Model name</b> <b>Type select</b> etc.
6	If necessary, use <b>UP/DOWN</b> buttons to select required mode	<b>Model select</b> è <b>Model 10</b> <b>Flysky 10</b> <b>Aircraft icon</b>
7	Short <b>CANCEL</b> to exit next screen	<b>SYSTEM</b> è <b>Model select</b> <b>Model name</b> <b>Type select</b> etc.
8	Long <b>OK</b> to select and use <b>UP/DOWN</b> buttons to select <b>Model name</b>	<b>SYSTEM</b> <b>Model select</b> è <b>Model name</b> <b>Type select</b> etc.
9	Short <b>OK</b> to select	
10	Using cursor, and <b>OK</b> button, type model name "DF65 A+"	<b>Model Name</b> <b>Model 10</b> <b>DF65 A+</b> <b>Alphabet</b>

	<b>Action</b>	<b>Result on Screen</b>
11	Exit to upper level with short <b>CANCEL</b> and select "Type select"	<b>MENU</b> <b>Model select</b> <b>DF65 A+</b> <b>èType select</b>
12	Short <b>OK</b> to select Type of Aircraft	<b>MENU</b> <b>Model select</b> <b>Model name</b> <b>èType select</b>
13	Use <b>UP/DOWN</b> buttons to select Airplane or Glider	
14	Short <b>OK</b> to select Airplane Or Glider	<b>Type select</b> <b>Model 10</b> <b>DF65 A+</b> <b>è Airplane or</b> <b>èGlider</b> <b>Aircraft icon</b>
15	Long <b>CANCEL</b> to save and several short <b>CANCELS</b> to exit to Main Menu	<b>Main screen</b>

### **Tx Battery**

For convenience use four 1.2v NiMH 2500mAh AA rechargeable cells giving a nominal 4.8v output when fully charged, as an alternative to four 1.5v AA alkaline no-rechargeable cells (and helps save the planet!). Because of a higher voltage it is acknowledged the AA Alkaline provide more battery energy. Both have similar capacity in terms of mAh.

When the recommended rechargeable NiMH cell is used, the voltage shown on the LCD screen would be typically Tx.V1:4.8v. Additionally the number of bars in a screen battery icon provides a quick visual reference. Note that the Tx Product Specification shows a power source of 4x1.5v AA Alkaline cells. When 4 x 1.2v NiMH cells are used, the visual indication shows the reduced voltage i.e., fewer bars. The Tx battery voltage does not have to be set and there are no alarms available.

It is strongly recommended that Tx battery be recharged after every outing.

### **Rx Battery**

Use a 2S (meaning 2 cells in series) 850mAh LiFe (LiFePO<sub>4</sub>) rechargeable battery with a nominal output of 6.6v (2 x 3.3v) when fully charged. The DF Class Rules require a minimum Rx battery weight of 45 grams. Tape a washer or coin to the battery to bring it up to the minimum weight. The battery is usually mounted on the keel box with Velcro, and this will require a 15-20mm battery extension cable. Since there are two cells in series it is important the charger has the capability to give a balanced charge.

The horizontal bars display the battery charge remaining – a key feature of the Tx.

The bars show a relative measure of the available voltage and can be changed depending on the type of battery in the boat. It is pre-set for 6 volts from 4 x 1.5 volt AA batteries, and no changes are required.

When using a **LiFe battery** in the boat, the voltage ranges should be changed to alter the warning alarms. Using **System setup/Rx Setup/Rx Battery** the FlySky6 allows the user to setup the following Rx battery voltages:

**High:** If LiFe battery is used, set to 6.6v. The Rx battery charge status will be reflected in the number of bars shown in the battery icon. This is a quick reference guide to the battery condition. The actual Rx voltage will also be shown digitally in the pane below.

**Alarm:** Set this to a voltage at which you would like to initiate an audible low battery voltage alarm, say 5.2v. Time to recover boat and replace battery.

**Low:** Set this to a voltage (say 4.9v) at which you would like the Rx battery to become disconnected to prevent further drain and possible permanent damage.

It is strongly recommended that the Rx battery be recharged after every outing.

## RXL Pane

The lower part of the LCD display shows the RXL pane which shows:

Int V1:6.6v (Rx voltage)

Tx.V1: 4.8v (Tx voltage)

Signal Strength

## Signal Strength

A typical reading is **Err1:1%**. The manual gives no details this metric or how it works, but a higher error rate percentage means a reduction in signal strength at the Rx.

## Failsafe

Use **System setup/Rx Setup/Failsafe** to set the fail-safe feature when control is lost. This is a useful function to aid physical recovery of the boat. Set a permanent rudder deflection and eased sheets when there is a Rx battery or signal failure, so the boat does not sail over the horizon.

## Setting Rudder End Points

A rudder throw of no more than 35 degrees from centre is recommended to prevent stalling. Placing small marks or shallow scratches on the hull will provide greater accuracy. Use a straight edge ruler from the keel box through the centre of the rudder hole to mark the exact centre.

- Select Function **setup/Endpoints/Ch1** on Tx.
- Position the hull so that physical mid-point and 35 deg. markings can be seen.
- Place steering stalk fully to starboard and using **Up/Down** controls to move rudder until aligned with 35 deg. mark.
- Repeat for port.
- If the display reaches the maximum setting of 120 % before the 35 deg. mark is reached, then an increased rudder throw can be achieved by repositioning the connection point on the rudder arm closer to the rudder post. The existing hole on the arm will have to be enlarged to accomplish this. It may be necessary to bend the connection rod to ensure it does not contact the hull opening, causing friction and servo failure. The bellows may have to be temporarily removed to check this.

## Setting Sail Winch End Points

The winch line travel should be about 115mm. Change the number of turns on the drum to locate the main sheet attachment point at the back of the main hatch opening when fully sheeted in. Alternatively, undo the retaining screw on the winch drum and rotate in the desired direction. Slightly ease bowsies to ensure winch servo does not become overloaded, then

- Power-up, and sheet-in.
- Set the close-hauled position for both booms using their bowsies. Hold the hull vertically and ensure both booms fall under gravity.
- The fully eased point of both booms can be adjusted using **Function setup/ Endpoints/Ch3/ Up-Down** so that the main is at about 80 deg. and jib about 85 deg. In very windy conditions it may be appropriate to reduce the sail load to prevent nosediving by either easing both booms well beyond their normal settings or haul them in. This can be done by manual winch control or using Sw A to invoke Sports mode. See later explanation.



### **Rudder Mid-Point Trim and Weather Helm**

It is ideal for the DFs to sail to windward perfectly balanced (i.e., no rudder adjustment necessary). If one tack has a marked tendency to round-up on the other tack, it may be due to asymmetrical sheet settings and this should be checked, particularly the position of main sheet bridle on both tacks. It may also be due to the rudder being slightly off centre.

This mid-point can be reset during racing by the rudder trim tab below the stick. When used, the audible tone indicates the direction of movement and the mid position. Alternatively, when not racing the rudder mid-point can be set using **Functions setup/Subtrim/Ch 1** and the **UP/DOWN** buttons.

### **Rudder Movement - Rate**

This can be useful when running downwind in strong winds, when even very slight rudder movements can have a dramatic effect on direction. In its factory setting, rudder movements are proportional or linear. A 50% movement of the stick to the right will result in a 50% movement of the rudder to the right, within the pre-set range.

There are two ways of controlling the relationship between stick movement and rudder movement. The first is **Rate**, the other is **Expo**. They can be used alone or together. The impact of the setting is shown graphically in the LCD display.

When **Rate** is used, a default setting of 100 will result in a full rudder throw. If the **End point** has been set at 35 deg. a full stick movement will result in a rudder movement of 35 deg. If a rate of **50** is used the rudder will move half the distance or 17.5 deg. A rate of **50** and a **50%** stick movement will result in a rudder movement of around 9 deg. In effect, use **Rate** to de-sensitise stick movement in a linear way over the entire stick range.

### **Rudder Movement - Expo (exponential)**

**Expo** is the other way of controlling the relationship between stick and rudder. **Rate** and **Expo** can both be used to control rudder movement, either singularly or combined. A second set of **Rate/Expo** settings can be used using Switch A (SWA) to invoke the **Sports** mode. More later.

With the use of **Expo**, the stick/rudder relationship changes from linear to one of a theoretically infinite number of exponential curves. For example, with **Expo**, a 50% stick movement to the right (or left) might result in only a 30% rudder movement – depends on the **Expo** setting. More rudder movement leads to proportionally higher response.

The extent of **Expo** applied is a matter of personal preference.

So, both **Rate** and **Expo** alter the default linear curve to one that either is less sensitive (positive expo) or more likely, more sensitive (negative expo) around the middle range. When using **Expo**, a typical starting point might be 30%. - depends on whether **Rate** is also used.

### **Rudder Movement Using Sport mode**

Use Switch A (SWA) to invoke the **Sports** mode to provide a second **Rate/Expo** setting. Only one set of **End points** can be used.

### **How to Set Dual rate/Exp. For Alternative Rudder Control**

- Power-up Tx/Rx
- Select model number as described above.
- Using the **Function setup** menu, and short **OK**, index through to **Dual rate/expo**. Select with **OK**.
- Short **OK** and if necessary, index to **Ch1** (Rudder is selected)
- Throw Switch A (down) and **SPORT** will be displayed.
- Set-up **Rate** using **Up/Down** buttons. Index to **Expo** and again using **Up/Down** buttons select an **Expo** setting.

- Long **CANCEL** to save.

Experimentation on the water should give an indication of the optimal rudder settings for **Sport** mode. Depends on its intended use.

### **Control of Winch in a Gust – Use of Throttle curve**

The most appropriate response in a gust is to ease sheets rather than use the rudder to counter the inevitable rounding-up. Of course, with fine motor skills, sheets can be fractionally eased at any time however it is suggested that a desensitised winch may be appropriate. This can be set-up using **Throttle ease** and Switch B (**SWB**). The curve should be not dissimilar to that used in the Rudder **Sports** mode. At Position 1, I have used 8%, Position 2 25%

### **Back Up of Settings**

When using FlySky it is very easy to initiate system changes that don't work and to then forget what has been changed. It is possible to either reset model settings using **System setup/Model reset** (Manual 7.4) or reset factory settings using **System setup/Factory reset** (Manual 7.12).

The manual does not make clear what model setting is being reset. Perhaps a safer way would be to establish a dummy model using a unique model number and name. In the event of losing or corrupting the working model the back-up version could be copied to it using the Model Copy function.

### **Model Copy**

- To copy, Model 3 to Model 4 say, ensure Model 3 has been selected. This becomes the source model.
- Select **System setup/ Model copy**.
- Select **Target model** and long **CANCEL** to save, then several short **CANCELs** to return to main screen.
- Check settings on target model.

### **Model Reset**

As the Manual says “This function will reset selected model settings to default but does not make clear what these default settings are. The other models will not be affected. May be useful when a set-up is going nowhere and needs a fresh start.

### **Reverse Rudder Movement**

Sometimes, the rudder moves the opposite way to what you prefer. This can be reversed using the feature in **Functions Set Up – Reverse menu**

### **Other FlySky Functions**

The FlySky system provides the rich functionality required for model aircraft and many features have no relevance to RC yacht racing. Not described here are **Model name**, **Sticks mode** (useful for changing from wheel operation to tiller operation), **Display** (mid position and end points of all channels) and **Sub trim**. Refer Manual for more details.

### **Advanced Settings**

There is a “secret” Factory Setting Menu for experienced users. It is accessed by holding both sticks down at 45 degrees to the left before turning the Tx on. The menu options are not discussed here, and more information is available by searching YouTube videos.

### **Disclaimer**

The Dual Rate features of the FlySky system have been described to highlight the available functionality. It does not follow they should be used. Moreover, some of the suggested settings are nothing more than that. Personal preference and experience are the best guide. I'd like to draw on that experience and over time I'm sure the best techniques and settings will evolve.



I'm mindful of my experience with a compass on a Laser; when first used, I spent an inordinate amount of time watching the compass and far too little time watching the big picture i.e., getting my head out of the boat.

So, any speed gain made by using say **Throttle curve** in gusts during the race may all be lost in one bad mark rounding.

Concentrate on the important things first.

All will become clear over time as gifted sailors develop and refine what is fast for this class and provide feedback to the plodders.

Questions and feedback would be very welcome.

**David Flakelar**

Email [dflakelar@tpg.com.au](mailto:dflakelar@tpg.com.au)

Mob +61 404 829 414 or +61 2 9412 1742.

## Appendix

### Discussion on Weather Helm, Rudder Use and Starting a Race

#### Weather Helm

These musings are meant to provide some background to the set-up of the DF65 winch and rudder using the FlySky system.

When racing, ideally, in steady-state conditions, we want the boat to track in a straight line particularly to windward with nil or only slight weather helm. If there is too much the boat will round-up and go into irons.

There are several measures theoretically possible to achieve balance:

1. Constant and skilful rudder movement will provide straight line tracking however rudder movement is slow as the rudder when used provides a greater projected surface area in the direction of travel. It acts a bit like a brake.
2. Mast rake by adjusting deck plate (the movement fore'n'aft can swing the top of the mast through 100mm), forestay and backstay tension. By these adjustments, the sail's combined Centre of Effort (CE) can be moved fore and aft relative to the foil's Centre of Lateral Resistance (CLR). By this we are essentially controlling the couple between these two forces. There is plenty of reading on the internet and elsewhere about this and won't be repeated here. Generally, a small amount of weather helm is safer, and it is desirable to provide a bit of feedback to the helmsman otherwise the steering will feel dead. The latter does not apply to RC yachting.

There is no known easy way of setting up optimal mast rake except by trial-and-error. The recommended measurement from a reference point on the upper mast to a point on the deck is about all there is. This method is a guide only and not very accurate. See [Soch Sails DF65 Rig Tuning Guide](#).

3. Changing the CLR by lifting the centreboard/keel (impossible with DF65)
4. Reduce the power of mainsail by easing main sheet (more of this later), flattening foot or ease boom vang to soften leech (i.e., spill more wind from back of sail)
5. Reef main
6. Increase power of jib by moving its CE forward and thus moving the entire rig CE forward. In an RC yacht a bit of weather helm is desirable, not for feel, but for another reason. When moving through the water the foils provide lift. This is analogous to the wing (foil) on an aircraft, particularly a glider. The downward gravitational force of the glider is balanced or counter-acted by the lift provided by the wing. One approach with DF65s might be to use the Trim tab referred to earlier and this might be a quick fix on one tack however it may have to be removed or re-applied on the other tack. There is no known way that an RC yacht can be provided with an offset rudder to provide the required minimal amount of rudder on both tacks.

The only way an RC yacht can move in a straight is by the accurate alignment of CLR and CE. However any particular setting is only good for a particular set of wind and wave conditions. And may only be good for a particular tack.

In a wind gust these balanced forces become out-of-balance. The wind force on the sails increases with the square of the wind velocity but the counteracting force from velocity of water over the foils does not increase because in the instant the gust hits the boat speed has not increased and the boat rounds up.

The second impact of a gust is to heel the boat. The underwater shape of the hull changes from one that is symmetrical (when mast is vertical) to one where the line of least resistance is for the hull to move to weather. So to counter the boat rounding-up, rudder is used to force the bow down. But as the hull heals the rudder has less effective area in the direction of travel and more and more rudder has to be used. Any rudder movement slows the boat because of Newtons First law and the greater the rudder movement the greater the impact on speed. In short, any rudder movement is slow.

The other means of countering the effect of a gust is to ease the sheets for the duration of the gust and a way of doing this is by a **Throttle curve** set-up using Switch B – Winch Control. It is acknowledged that the sheets can be eased manually at any time. But use of SwB might just make it easier and more consistent.

Also, in a gust the apparent wind moves aft and as we have suggested, the impact on heeling-over and rounding-up can be minimised by easing sheets and increasing velocity. However this is not the only possible response. Theoretically one could remain close-hauled and benefit from this velocity lift by sailing a slightly higher course. In dinghies, this is often possible by hiking harder and thus keeping the hull flat.

The recommended response to a wind gust is to slightly ease sheets although this needs to be contested.

No recommendation is made regarding taking the velocity lift and I would welcome feedback for further dissemination.

### **Rudder Use**

If during the starting sequence or when racing in a variable wind, and the boat is above close-hauled and either stationary or moving slowly, like a dinghy, it is possible that by sculling, she may be brought down to a close-hauled course. This does not violate RRS 42 Propulsion. See RRS 42.3 (d). That is, if the hull lies above close-hauled on the Port tack, by moving the rudder stick to the right and releasing so that the spring loading moves it to the centre neutral position, the scull may force the bow down to close-hauled.

This suggests the rudder **End points** setting may have to be greater than that required for normal steering. This cannot be done using **SW A** in **Sport** mode. There can only be one set of end points.

It is essential to have a physical mid rudder reference point on the underside of hull so that before launching one can determine whether the rudder is physically aligned fore-and-aft. To establish this neutral rudder reference point, remove rudder and turn the hull upside down. Carefully align a straight edge between centre of keel and centre of rudder post opening. Using a fine permanent marker, draw a short line aft of the rudder trailing edge position. This will be a reference for a neutral rudder.

Assuming a 35 degrees rudder throw say, and using a protractor, mark the position of the trailing edge of rudder when helm is hard over - both tacks.

If there is any rudder slop, insert a short length of rigging line into the rudder post hole and trim excess later. Replace rudder and secure after carefully aligning with neutral helm marker. Ensure rudder moves freely.

### **Starting a Race**

There are fundamentally two ways of starting in a yacht race.

Displacement yachts will usually start their approach coming from distance because their inherent design and weight means they cannot easily be parked and subsequently accelerated away. The primary skills are to pick the right lane, at the right end, (consistent with line bias and whether the right, or middle or left-hand side of the course is likely to be favoured) and judge the speed of advance on distance so that the boat is at speed, in clear air, just behind the line when the gun goes. Simple.

The start of a dinghy race is usually fundamentally different. In say a quality Laser fleet, once the position on the line is determined, the boat is "parked" about one boat length back from the line and held in position by mainsail trim, so the leech just catches the wind. This, together with judicious sculling with the rudder, the dinghy can be parked to not move down the line onto other boats to leeward. Weather boats keep clear!

The process is; about n seconds from the start, where n will depend on the type of boat and how well it accelerates, simultaneously quickly sheet-on, hike to keep the boat flat, and as the boat accelerates, pull-away to close hauled. This procedure is preferred to the keel boat type start because the need to judge time on distance is minimised.

It is not known which is best for the DF65? Maybe a mixture of both?