

# KINGFISHER USV

UNMANNED SURFACE VESSEL

**USER MANUAL**



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# 1 INTRODUCTION

Clearpath Robotics Kingfisher is a rugged and easy-to-use Unmanned Surface Vessel (USV) for research and rapid prototyping applications. This guide contains information about the setup, operation, and maintenance of your Kingfisher USV.

## 1.1 What's Included

Included with each Kingfisher are the following:

- 1x Clearpath Robotics Kingfisher
- 2x 14.4V NiMH Battery Pack
- 1x Battery Pack Charger
- 1x Futaba Backup Remote Control (R/C)
- 1x Payload Connector Dummy Plug
- 1x Payload Connector Adapter Kit (plug and pins)
- 1x Ethernet Connector Adapter Kit

Each Kingfisher deployment (one or more Kingfisher vessels) also includes:

- Clearpath Robotics Base Station
- Base Station Battery
- Base Station Battery Charger

## 1.2 What's Required

The embedded PC onboard Kingfisher runs Ubuntu Linux 12.04 and ROS Hydro. For maximum simplicity, a development computer should be running the same operating system as the onboard computer; however, any version of Ubuntu supported by ROS Hydro will be adequate. If a laptop option was purchased with Kingfisher it will have been already configured with ROS and the appropriate ROS packages. For assistance setting up the development computer, please see the PC Setup section on page 14.

Kingfisher may also be driven using the included Futaba R/C controller as described in the Getting Started section on page 11. However, the R/C controller is intended as a backup to allow powered retrieval of Kingfisher in case of a PC or network malfunction while on the water. It has significantly reduced range and reliability compared with the standard high-power wireless radio.

## 2 THE BASICS

This section provides an overview of the key specifications of the Kingfisher platform. Figure 1 gives a tour of Kingfisher's major components.

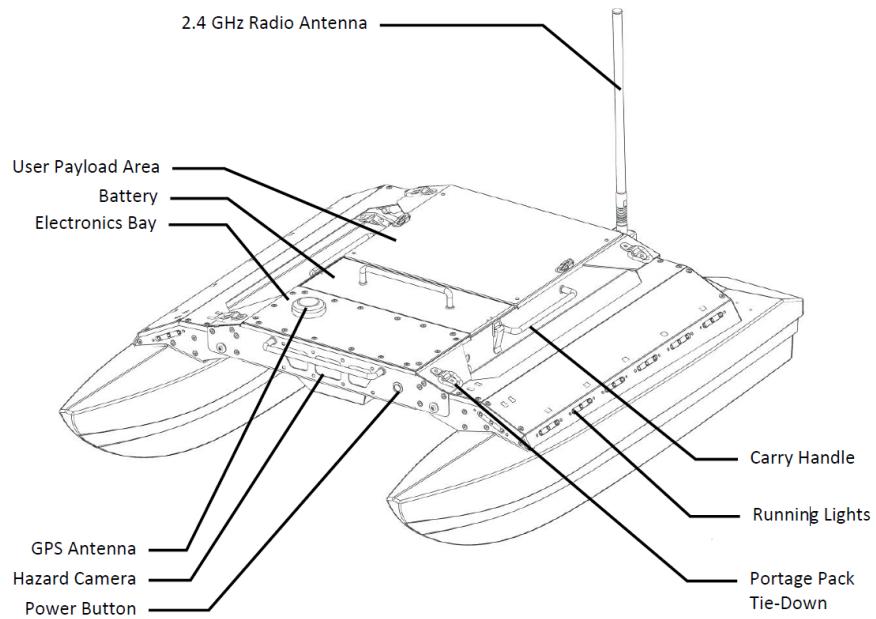


Figure 1: Kingfisher at a Glance (actual boat may vary slightly from image shown)

## 2.1 Hardware Architecture

Figure 2 gives an overview of the standard devices which make up Kingfisher. This diagram is provided to aid the user in understanding how Kingfisher is architected.

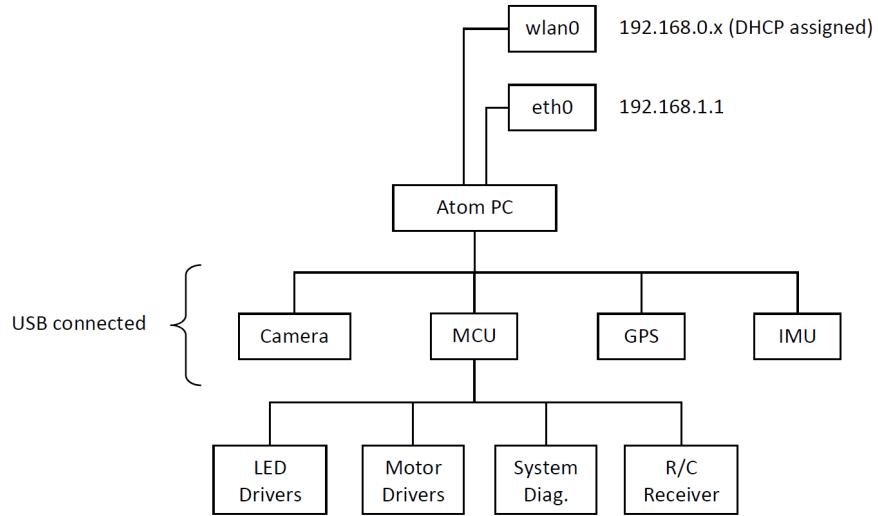


Figure 2: Kingfisher Architecture

The eth0 interface is connected to a weatherproof connector in the User Payload Area. This connector is used to connect Ethernet payloads, such as an IP camera or LIDAR, but may also be used to connect to the vehicle over SSH, especially to adjust the wireless configuration (for example, to change the wireless password, or to associate with a different base station).



## 2.2 Status Indicators

The red and green running lights on the port and starboard sides of Kingfisher indicate vehicle status based on the frequency and pattern of flashing. These patterns are described in Table 1.

Light Pattern	Description
Solid	<b>No errors.</b> PC and wireless are active, and a command stream is being received and processed.
Slow Single Pulse	<b>No command.</b> Indicates that the system is fully up, but the thrusters are not active due to an absence of command messages. Command messages must be sent at 10Hz or faster to maintain steady operation.
Slow Double Pulse	<b>Wireless Error.</b> Indicates that the onboard PC is unable to find the base station's wireless network. If this indication is seen, check the battery level and indicator lights in the base station.
Slow Triple Pulse	<b>Computer Error.</b> Indicates that the microcontroller in Kingfisher cannot see the onboard PC. This is expected for about two minutes when first powering on, while the computer boots up.
Fast Single Pulse	<b>Manual Override.</b> Indicates that manual control by the Futaba R/C controller is active, and any commands originating from the PC will be disregarded.
Fast Double Pulse	<b>Critical Battery Pack.</b> Indicates that the system battery level is at or below 13V. Return to shore immediately.

Table 1: Kingfisher Status Indicators

The precedence order in the table is downward—that is, the bottom-most condition which is true will be what is indicated by the lights.

## 2.3 R/C Controller

Kingfisher ships with a Futaba R/C transmitter integrated as a means of backup control. The intention is always to operate with PC control, but for scenarios where the PC or network malfunctions it is convenient to have an alternate means of retrieving Kingfisher. It's recommended to remove all AA batteries and store them in a cool dry location when the R/C controller is not in use.

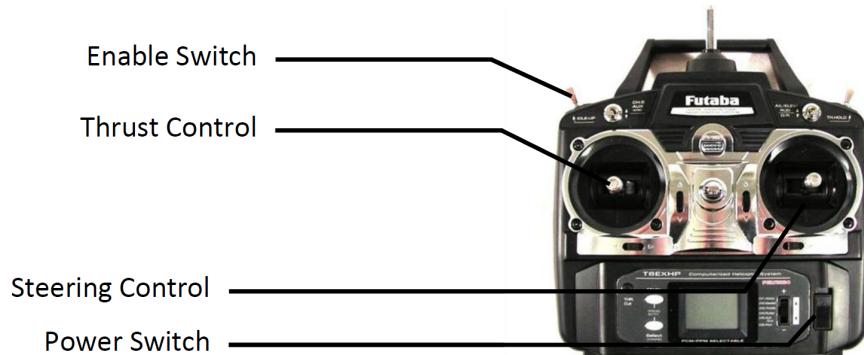


Figure 3: Futaba R/C Transmitter

Please see Backup R/C Operation on page 13 for details of operating Kingfisher with the RC controller.

## 2.4 System Specifications

Key specifications of Kingfisher are shown in Table 2.

Deployed Dimensions	1300 mm length	51.2 in length
	940 mm width	37 in width
	340 mm height	13.4 in height
Stowed Dimensions	1300 mm length	51.2 in length
	550 mm width	21.6 in width
	340 mm height	13.4 in height
Chassis Weight (no battery)	20 kg	44 lbs
Battery Weight	9 kg	20 lbs
Draft	150 mm	5.9 in
Maximum Payload	10 kg	22 lbs
Rated speed (forward)	1.7 m/s	5.6 ft/s
Operating Time	2.5 hours typical	
	10 hours standby (no motion)	
Battery Pack	14.4V 29 Ah	
	NiMH	
Battery Pack Charger	Short-circuit, over-current, over-voltage, and reverse voltage protection.	
Charge Time	10 hours	
User Power	12V fused at 2.5A	
Communication	USB, TCP/IP, RS232, RS485	
Standard Sensing	Battery Voltage, GPS, IMU, Hazard Camera	

Table 2: Kingfisher System Specifications