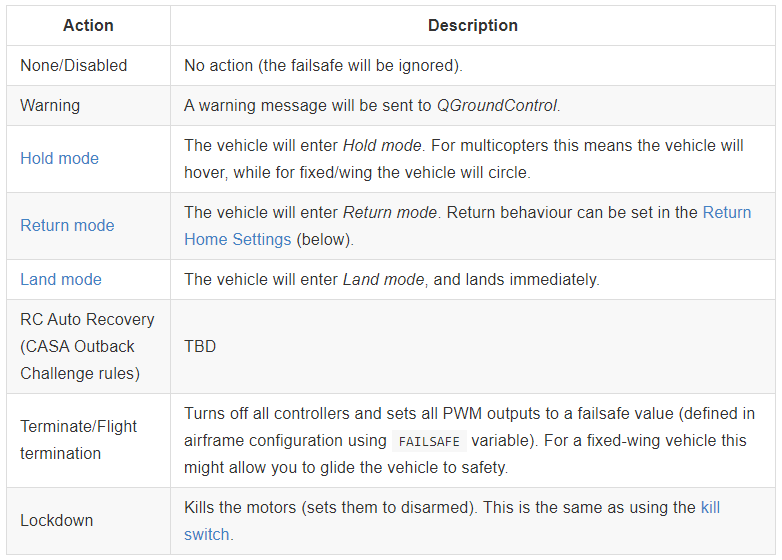
**General Questions & Answers:**

**Q1: Can QGroundControl interact with the autopilot while in flight?**

Yes Q-GroundControl can communicate with Pixhawk4 while in flight. Additional telemetry is required and has been added to the Quadcopter BOM.

**Q2: How can SLA software integrate into the [https://docs.px4.io/en/config/safety.html]“Safety Configuration (Failsafe)” modes available in PX4?**

PX4 has the following failsafe flight modes:



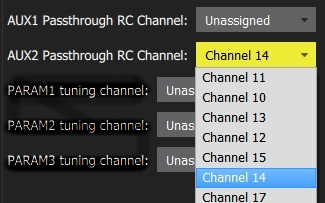
PX4 can transition between flight modes using switches on the remote or ground control station. These flight modes are activated based on the PWM value of a channel. The channel and the flightmode/PWM assignments are configured in Q-GroundControl. Using Single Channel Mode Selection up to 6 flight modes can be encoded on a single channel. Using Multi Channel Mode Selection you can assign modes to switch positions encoded in one or more channels. Single Channel Mode Selection is easier to configure and understand. The SLA software could communicate these PWM signals to the specified port to trigger the failsafe flight modes. These should also be programmed to switches on the remote control. [PX4 flight mode configuration](https://docs.px4.io/en/config/flight_mode.html)

**Q3a: Are there any command and control methods that could be bound to the “AUX Passthrough Channels” of a transmitter? Stablize ON/Off? Track enable? Landing Enable?**

AUX passthrough channels allow you to control arbitrary optional hardware from your transmitter (for example, a gripper).

To use the AUX passthrough channels:

1. Map up to 2 transmitter controls to separate channels.
2. Specify these channels to map to the AUX1 and AUX2 ports respectively, as shown below. Values are saved to the vehicle as soon as they are set.



**Q3b: If so, how does the receive/autopilot communicate that to the 1500-OEM?**

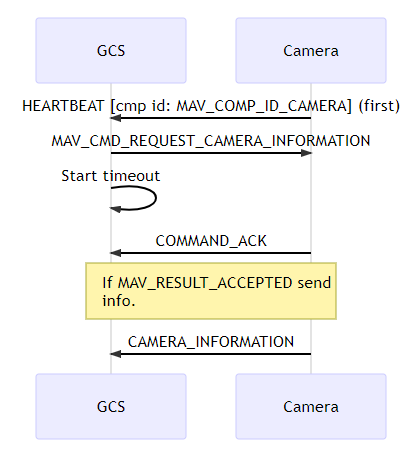
The flight controller will pass through the unmodified values from the specified channels out of AUX1/AUX2 to the connected servos/relays that drive your hardware.

You can assign command and control parameters to the aux outputs that are connected to the transmitter or Ground Control Station in Q-GroundControl outlined [here.](https://docs.qgroundcontrol.com/en/SetupView/Radio.html#param-tuning-channels-px4)

**Q4: How are the “Camera Controls” transmitted to a camera?**

Using Qgroundcontrol interface and MAVLink to control the camera.

<https://mavlink.io/en/services/camera.html> Here is more about how to control the camera using MAVLink. However, in Qgroundcontrol, they already set up the interface for camera control.



**Q5: What is the [https://docs.px4.io/en/advanced\_config/land\_detector.html]“Land Detector Configuration”?**

The land detector is a dynamic vehicle model representing key vehicle states from ground contact through to landed. Below are some main parameters that we can tune to improve the landing behavior:

* Auto-Disarming
* Multicopter Configuration
* Fixed Wing Configuration
* Land detector states:
* Ground Contact
* Maybe land
* Landed

**Q6: What else is needed for “Precision Landing”?**

For precision landing flight mode:

Installing the IR-Lock Sensor is required (ex: IR Lock MarkOne). When installing the sensor, the sensors’ x axis is aligned with the vehicle’s y axis; and the sensor’s y axis is aligned with vehicle -x direction.

<https://irlock.readme.io/v2.0/docs> IR Lock tutorial

Installing a distance sensor: Distance sensors provide distance measurement that can be used for terrain following, precision hovering (e.g. for photography), warning of regulatory height limits, collision avoidance etc. The sensors can usually be connected to either a serial (PWM) or I2C port (depending on the device driver), and is enabled on the port by setting a particular parameter. The list of distance sensor is supported by PX4: <https://docs.px4.io/en/sensor/rangefinders.html>

We use Pixhawk 4 which the firmware is installed by default. However, the precision landing firmware is not installed by default. Precision landing requires the modules “ir lock”  and “landing\_target\_estimator”.

This document: <https://docs.px4.io/en/advanced_features/precland.html> provided a lot of useful information about precision landing.

**Q7: Is it valuable to compare our landing aid to the IR-Lock MarkOne?**

**Sensor: [https://irlock.com/products/ir-lock-sensor-precision-landing-kit?variant=2022285059]IR-LOCK Sensor ($99) + Cable ($6)**

**Beacon: [https://irlock.com/collections/markone/products/markone-beacon-v2-0?variant=45031002691]MarkOne Beacon V2.0 ($139) - Additional cables and power supplies not listed**

IR-Lock sensor required MarkOne Beacon to be able to land which is small. However, Beacon needs a 10.8 -12V battery to power. Meanwhile, our landing pattern doesn’t require additional hardware to assist landing.

Need to install Pixymon software and IRlock firmware ~> hopefully no additional software needs to install in 1500 SLA landing aid kit.

Easy to connect with Pixhawk 4. We haven’t tested SLA1500 landing aid kit yet. So, there is no confirmation, how it’s connected to Pixhawk 4.

However, there is no information about the sensor installed in the IR-lock Sensor.

The range at which IR LEDs can be detected depends on many factors: lens, IR LED power, operating environment, etc. The typical range for our [360° IR Pod](http://irlock.com/products/360-tracking-pod?variant=770889867) is 30-60 ft (indoor/outdoor), and the range for [standard IR LEDs](http://irlock.com/products/5x-standard-ir-leds?variant=770884247) is ~15 ft (indoor). In order to increase range, the best solutions are to (a) change the lens to one with a narrower field of view, (b) increase the size/power of your IR marker, or (c) adjust your exposure setting in the Pixymon GUI. We can choose the different lens as long as the lens does not have an IR cutter, in other words, it needs to be able to pass infrared light.

Since IR-LOCK Pixy filters out most of the wavelengths of light that we are not interested in, it only gives false detections when other strong IR emitters are in your Pixy's line-of-site. The two primary causes of false detection are (1) when Pixy is looking directly at the bulb of an incandescent light, or (2) when a shiny/reflective object reflects sunlight back at Pixy (e.g., cars/trucks). We have included an 'exposure setting' which helps you account for your particular operating environment.

<https://irlock.com/pages/useful-links>

My question is “How efficient our landing aid kits is?” Is it comparable to IR-lock sensor both in market value and technology value?

**Q7b: Is there value in creating a plug in replacement for the IR-Lock Sensor?**

IR-Lock Sensor use 5V power from Pixhawk 4, as well as communicate with Pixhawk 4 using I2C.

**Q8: Is it valuable to compare to a range finder?**

**Sensor: [https://irlock.com/collections/rangefinders/products/sf30-c-100-m?variant=15891310346291]SF30/C ($399)**

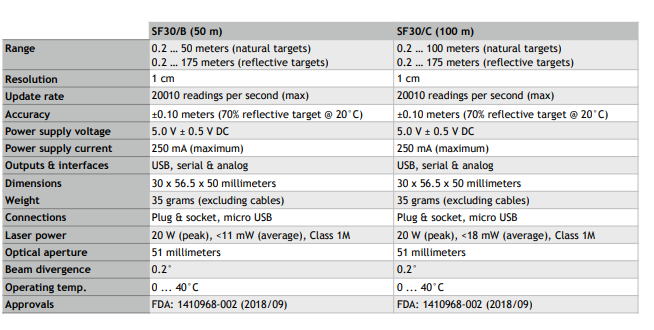
**Resolution/when it works/range finder ~ software.**

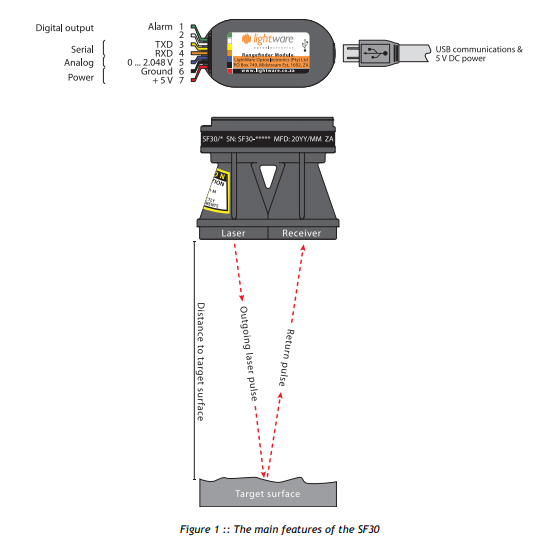
**Why did they pick I2C/Serial.**

SF30/C range finder is a long range (0 – 100m), light weight, laser altimeter specially for use on UAVs

Typical applications of SF30/C:

* Warning of FAA flight limits.
* Precision photography.
* Terrain following.
* Assist with takeoff, landing and hovering

It includes digital (serial and I2C) and analog (12 bit) outputs along with a micro USB configuration port



**Feature:**

* 20k reading per second
* Accurate and reliable measurements unaffected by speed, wind, and changes in environment.
* Fully calibrated and ready to run.

They give no information about why did they use Serial/I2C, I seemly think that because it’s popular and easy to use. Since, I consider Serial / I2C are universal communication. Therefore, they can use a lot of resource to assist the design progress as well as easier for customer as well.

For more information, please visit: <http://documents.lightware.co.za/SF30%20-%20Laser%20Altimeter%20Manual%20-%20Rev%208.pdf>

Yes, it’s valuable to have Range finder to improve the precision landing aid. However, this should be treated as additional feature which we will plan to develop later in this project (Spring term).

**Q9: Calibrating the 1500-OEM with the Pixhawk should involve some alignment of X&Y axis. How is this done?**

I’m unsure about this question. I actually don’t know how to do it. However, I found some resources which could help:

<https://docs.qgroundcontrol.com/en/SetupView/Radio.html>

<https://docs.px4.io/en/config/flight_controller_orientation.html>

<https://docs.px4.io/en/advanced_config/advanced_flight_controller_orientation_leveling.html>

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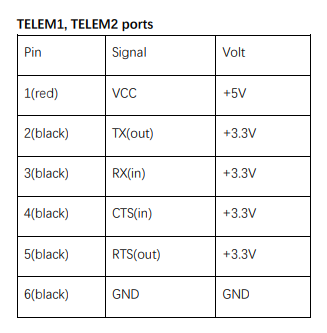
**Here is some additional question that we should consider.**

**Telecom1: is it also provide power to OEM?** It’s better to provide both power and serial, so we just need to use Tele1 to provide both power and serial for 1500 OEM which will reduce the complexity and the weight of the design.

The TELEM1 port is used as default port for MAVLink (or GCS telemetry stream)

The TELEM 1 port does provide power Vcc = 5V

<http://www.holybro.com/manual/Pixhawk4-Pinouts.pdf> here for port information



The UART serial port also provide 5V power.

**How to fly indoor safely?**