# QBALL 2

The Quanser QBall 2 is a fully integrated, open-architecture unmanned aerial vehicle (UAV) solution optimized for advanced mission research in indoor environments.

System specifications on reverse page.

## STUDY UNMANNED AERIAL VEHICLES INSIDE YOUR LAB

The Quanser QBall 2 is an innovative indoor rotary wing platform suitable for a wide variety of unmanned vehicle research applications, including vehicle modeling and control, motion planning, obstacle avoidance, sensor fusion, fleet maintenance, fault-tolerant control, autonomous and supervisory operation, advanced multi-agent navigation, and more.

Fully integrated with QUARC, Quanser's robust real-time control software, the QBall 2 offers researchers a platform for quick development and application of controllers and control algorithms, without the need to integrate disparate hardware and software resources. The open-architecture design allows users to add other off-the-shelf sensors supported by QUARC.

Designed for safe use in indoor laboratories, the QBall 2 is also an ideal tool for teaching basic vehicle navigation and control.

## HOW IT WORKS

The QBall 2 is a quadrotor helicopter, enclosed in a carbon fiber cage (patent pending). The cage protects the vehicle and ensures safe operation in an indoor lab environment.

To measure on-board sensors and drive motors, the QBall 2 utilizes Quanser's on-board avionics data acquisition card (DAQ) and a wireless embedded computer. The DAQ also provides several I/O channels for interfacing additional sensors, allowing users to customize the platform for their research needs.

The QBall 2 operates using a host-target structure. The controllers are developed on the ground station computer (host) using MATLAB®/Simulink®. The QUARC control software downloads real-time code from the host to the QBall 2 embedded computer (target), and allows users to run, modify, and monitor the code remotely from the host. The controllers on-board the QBall 2 are open-architecture and fully modifiable. Watchdogs and data-logging routines are included to maintain safety and to debug flight problems.

The position of the QBall 2 in the workspace is tracked and accurately measured using an infrared camera localization system, fully integrated with QUARC. This allows users to conduct localization-based control experiments in real time more easily. Additional cameras (up to total of 24) can be used for advanced localization requirements.

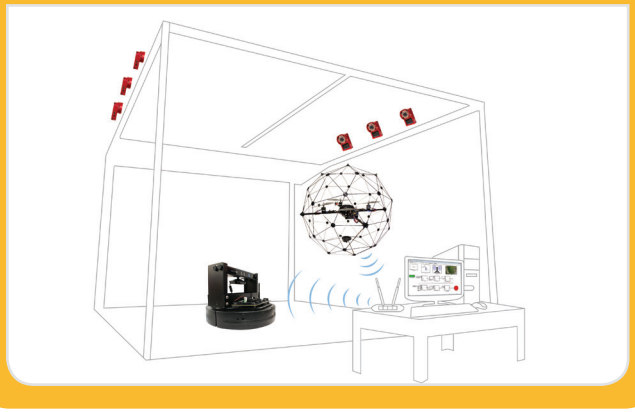
## QBALL 2 PLATFORM COMPONENTS

Qball 2 unit with a joystick
Ground station with QUARC real-time control software for MATLAB®/Simulink®
6-camera OptiTrack localization system
Performance router
User Manual and Quick Start Guide (provided in digital format)
Pre-built controllers

## BUILD A MULTI-AGENT PLATFORM

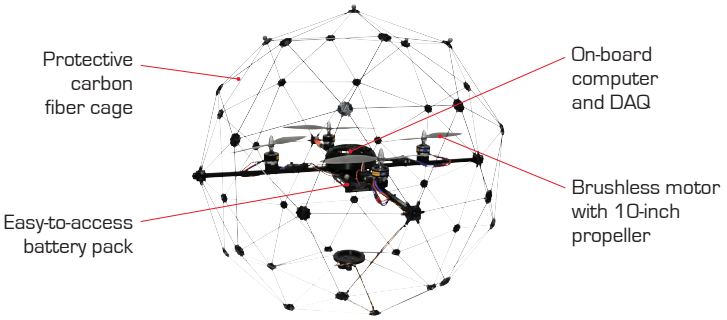
*Integrating the Quanser QBall 2 system with additional QBall and QBot ground robot units allows researchers to build a flexible, open- architecture, multi-agent platform for research.*

*The Unmanned Vehicle Systems (UVS) Lab from Quanser provides a turn-key, integrated environment for exploring a wide range of advanced research applications.*



# SYSTEM SPECIFICATIONS

## QBall 2




## FEATURES

- Protective carbon fiber cage for indoor use, enclosing motors, propellers, embedded computer and DAQ
- Ready for use out of the box, no assembly required
- High-definition on-board avionics data acquisition card
- Low power on-board computer with Linux operating system for high-level, real-time decision making and task execution
- Built-in sensors (3-axis accelerometer, 3-axis gyroscope, sonar height sensor)
- Customizable with off-the-shelf sensors supported by QUARC (digital - SPI, UART, I²C; analog sensor)
- Accurate localization and tracking system
- Wireless inter-vehicle communication capabilities for multi-agent research applications
- Fully compatible with MATLAB®/Simulink®
- Fully documented system models and parameters provided for MATLAB®/Simulink®
- Open architecture design allowing users to design their own controllers

## DEVICE SPECIFICATIONS

| | |
|---|---|
| *QBall 2* | |
| Diameter | 0.7 m |
| Power | 2 LiPo rechargeable batteries, 2700 mAh, 3-cell |
| Flight time | Up to 10 min per battery charge |
| Weight (with batteries) | 1.8 kg |
| Maximum payload | 300 g |
| *Embedded Computer* | |
| On-board computer | Gumstix DuoVero Zephyr with integrated 802.11 b/g/n WiFi |
| Processor | ARM Cortex-A9, 1 GHz |
| Memory | 1 GB DDR SDRAM |
| QUARC maximum sample rate | 1,000 Hz |
| *I/O Channel Specifications* | |
| PWM motor outputs | 4 available |
| Configurable PWM outputs | 2 available |
| 3-axis gyroscope | 250 deg/s - 500 deg/s - 2,000 deg/s selectable range |
| 3-axis accelerometer | ± 2g - ± 4g - ± 8g selectable range |
| Sonar height sensor | 0.2 m - 7.65 m range<br>1 cm resolution |
| Analog input | 2 available, 12-bit, 0 - 5 V |
| SPI | 1 available |
| Reconfigurable digital I/O | 8 available |
| UART | 1 serial 3.3 V |
| I²C | 1 available |

## COMPLETE WORKSTATION COMPONENTS

| | |
|---|---|
| Plant | QBall 2 vehicle with joystick |
| Control design environment | Quanser QUARC® add-on for MATLAB®/Simulink®<br>Stateflow® Simulink add-on *(not supplied by Quanser, must be purchased separately from The MathWorks)* |
| Documentation | User Manual, Quick Start Guide, pre-designed controllers |
| Real-time targets | Linux DuoVero |
| Data acquisition devices | Embedded high-resolution IMU and avionics I/O card |
| Localization system | 6 synchronized infrared OptiTrack cameras with mounts |
| Wireless access point | Performance router |

### About Quanser:

Quanser is the world leader in education and research for real-time control design and implementation. We specialize in outfitting engineering control laboratories to help universities captivate the brightest minds, motivate them to success and produce graduates with industry-relevant skills. Universities worldwide implement Quanser's open architecture control solutions, industry-relevant curriculum and cutting-edge work stations to teach Introductory, Intermediate or Advanced controls to students in Electrical, Mechanical, Mechatronics, Robotics, Aerospace, Civil, and various other engineering disciplines.