Quad over Bluetooth Universal Protocol (QoBUP) Communication Developer ICD

Rev 1.0

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# Overview

This document describes the communication protocol between the Bluetooth transmitter and the QoBUP Universal Ground Station Receiver for the Hubsan X4. The ICD is designed to be extensible to accommodate other dimensions of control for quadcopters which may be more sophisticated than the Hubsan X4. At the time of writing this ICD several assumptions are being made about the transmitter/receiver pair. There are highlighted as follows:

* The protocol only provides functionality for one-way control communication, that is transmitter to receiver
* Only status responses will be provided back to the transmitter for diagnostics/error checking
* All timing is based off of a serial (RX/TX) transmission rate of 115200 N8 between the Bluetooth module and the ground station processor
* Messages are made of 8-bit words
* Command queuing is currently unimplemented meaning if duplicate command block IDs are present in a single message then only the last command block will take effect
* A messages contents will only take effect if no errors were detected in the message (ie. the returned status flags are all 0)

# Commands (from Transmitter)

## Overall Message Structure

|  |  |
| --- | --- |
| **Word (8-bits)** | **Description** |
| Message Header | Identifies the type of message |
| Message word count | Number of 8-bit words in entire message, including the header and footer |
| Message unique ID | A unique 8-bit value (used for status reporting) |
| Command block 1 |  |
| Command block 2 |  |
| Command block 3 |  |
| … |  |
| Message footer | Always 0xA5 |
| Footer length | Always 0x02 |

## Command Blocks Structure

|  |  |
| --- | --- |
| **Word (8-bits)** | **Description** |
| Block ID | Identifies the type of block |
| Message word count | Number of 8-bit words in entire message, including the header and footer |
| User defined block data |  |
| … |  |
| … |  |

## Command Block Definitions

### Throttle Update

|  |  |
| --- | --- |
| **Word (8-bits)** | **Description** |
| Block ID | 0x00 |
| Message word count | 0x03 |
| Throttle value | 0x00 (no throttle) to 0xFF (max throttle) |

### Yaw Update

|  |  |
| --- | --- |
| **Word (8-bits)** | **Description** |
| Block ID | 0x01 |
| Message word count | 0x03 |
| Yaw value | [0x00 (max left yaw), 0xFF (max right yaw)] (0x80 = no yaw) |

### Pitch Update

|  |  |
| --- | --- |
| **Word (8-bits)** | **Description** |
| Block ID | 0x02 |
| Message word count | 0x03 |
| Pitch value | [0x00 (max pitch forward), 0xFF (max pitch backwards)] (0x80 = no pitch) |

### Roll Update

|  |  |
| --- | --- |
| **Word (8-bits)** | **Description** |
| Block ID | 0x03 |
| Message word count | 0x03 |
| Roll value | [0x00 (max roll right), 0xFF (max roll left)] (0x80 = no roll) |

### Flight Control Update

This block updates all flight controls in a single block command

|  |  |
| --- | --- |
| **Word (8-bits)** | **Description** |
| Block ID | 0x04 |
| Message word count | 0x06 |
| Throttle value | 0x00 (no throttle) to 0xFF (max throttle) |
| Yaw value | [0x00 (max pitch forward), 0xFF (max pitch backwards)] (0x80 = no pitch) |
| Pitch value | [0x00 (max pitch forward), 0xFF (max pitch backwards)] (0x80 = no pitch) |
| Roll value | [0x00 (max roll right), 0xFF (max roll left)] (0x80 = no roll) |

# Status (to Transmitter)

|  |  |
| --- | --- |
| **Word (8-bits)** | **Description** |
| Status header ID | Echoed from command’s “Message unique ID” |
| Status flags | Error flags from returned message processing |

## Status Flag Definition

|  |  |
| --- | --- |
| Bits | Description |
| 0 | Indicates an unknown message ID was received |
| 1 | Indicates an unknown block ID was received in message |
| 2 | Indicates a bad message size |
| 3-7 | Reserved |

# Timing Considerations

As stated in the assumptions list above, the interface between the Bluetooth module and the ground station processor is an 115200 N8 (RX/TX) UART port. This makes the theoretical max transfer rate of controls roughly 14,400 bytes per second. The max message size for this protocol is 256 bytes long including any headers and footer blocks. Thus, the maximum transfer bandwidth from the transmitter to the ground station can be:

These timing measurement should be kept in mind when designing controls for the Quadcopter you are targeting. For the Hubsan X4, the calculated numbers above are conservative as that Quadcopter requires flight control packets be sent every 10ms regardless of control values. The Ground Station will abstract these timing requirements away from the transmitter developer as it will do the necessary padding/combining of controls if the rate of controls being received is not the same as the timing requirements for control transmission to the Quadcopter. However, the developer should keep in mind the effects of sending controls faster or slower rate than the intended rate.