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This document explains how the ADCS and the IHU are communication down to the byte by byte level.

ADCS Interface

Detailed Description of the ADCS and IHU Interface

Revision: 1.0.0



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# 1 Hardware Layer

The hardware interface between the ADCS and the IHU is I2C. It is a standard implementation of I2C with a clock wire and a data wire. See [Wikipedia’s I2C article](https://en.wikipedia.org/wiki/I%C2%B2C) for details on how it works.

# 2 Software Layer

The Attitude Determination Control System, located at 8b address 0xAC, is a slave board to the IHU. Data requests from the IHU to the ADCS as for telemetry packets. Upon receiving multiple duplicate commands in quick succession, the reading done by ADCS will reflect the most recent command.

## 2.1 Location Data Request

The latitude and longitude are represented by 32b unsigned double. Latitude is measured South (-90°) to North (90°), and longitude is East (-180°) to West (180°), and each degree holing 60 minutes, and each minute holding 60 seconds. Given this, Latitude needs an integer large that 648000 (90° 60’ 60”), longitude needing 1296000(180, to represent all seconds in a given direction.

|  |  |  |
| --- | --- | --- |
| Index | 0x00 | 0x01 |
| Function | 0x00: | 0x00: Latitude  0x01: Longitude |

### 2.1.1 Latitude Table

|  |  |  |
| --- | --- | --- |
| The South Pole | -90.0000 | -90° South |
| The Equator | 0.0000 | Equator |
| The North Pole | 90.0000 | 90° North |

### 2.1.2 Longitude Table

|  |  |  |
| --- | --- | --- |
| Antemeridian | -180.0000 | -180 East |
| Prime Meridian | 0.0000 | 0 |
| Antemeridian | 180.0000 | 180 West |

## 2.2 Orientation Data Request

Roll, Pitch, and Yaw are 16b unsigned integers. Zero represents 0°, and 64800 represents 360°.

|  |  |  |
| --- | --- | --- |
| Index | 0x00 | 0x01 |
| Function | 0x01: | 0x00: Roll  0x01: Pitch  0x02: Yaw |

## 2.2 Temperature Data Request

This command is used by the IHU when building a telemetry packet. The temperature being represented with an 8b unsigned integer with 1°C/LSB. the PWM being represented by 16b from 0-255 and the current represented by a 16b value with 150µA/LSB.

|  |  |  |
| --- | --- | --- |
| Index | 0x00 | 0x01 |
| Function | 0x02: | 0x00: ADCS Temp |

## 2.3 Pulse Width Modulation Data Request

The PWM is represented by a 16b unsigned integer.

|  |  |  |
| --- | --- | --- |
| Index | 0x00 | 0x01 |
| Function | 0x03: | 0x00: X PWM Out  0x01: Y PWM Out  0x02: Z PWM Out |

## 2.4 Current Data Request

The current is represented by a 16b unsigned integer with 150µA/LSB.

|  |  |  |
| --- | --- | --- |
| Index | 0x00 | 0x01 |
| Function | 0x04: | 0x00: X Current  0x01: Y Current  0x02: Z Current |

## 2.5 Orientation Command

The orientation command is send one of 4 arguments, or all at once:

1. Roll Orientation
2. Pitch Orientation
3. Yaw Orientation
4. Object ID to orient against

These are intended to serve one-off functions, and not govern how the satellite will point the solar panels towards the sun. An example use case is turning the satellite towards Earth for a picture, then surrendering control of the orientation to whichever system governs solar panel orientation.

At Roll = 0, Pitch = 0, Yaw = 0, and object ID 0 representing Earth, the satellite will point its camera towards earth with panels orthogonal to the plane of motion, this represents the standard position. A satellite originally at standard, when modified with a yaw of 180°, will spin backwards, facing directly away from Earth. All other axis will behave similarly.

|  |  |  |
| --- | --- | --- |
| Index | 0x00 | 0x01 |
| Function | 0x05 | 0x00 Roll against ID  0x01: Pitch against ID  0x02: Yaw against ID  0x03: Set ID |

# 3 Example Cases

## 3.1 Orient away from Earth

IHU: [0x0503] with an ID of 0

Sets orient ID to Earth

IHU: [0x0502] with a an argument of 180°

ADCS: Begins rotation of XY plane