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# Definitions

HIL: Hardware In the Loop

# Documentation

Text means that this highlighted code has been reviewed.

Text means that this highlighted code has been tested.

Text means that this highlighted code has errors/bugs.

Text means that this highlighted code has been edited.

## Error Codes

All error codes will be comprised ofa string of 5 fields of numeric digits separated by dashes, such as:

“1-3-7-5-1”

“5-14-0-1”

etc.

Unless otherwise specified, all fields that are not specified are not used.

### Field 1: System

Indicates what System the Error Code is being reported from.

|  |  |
| --- | --- |
| ***Digit 1*** | ***Description*** |
| 1 | Flyer |
| 2 | Not Used, Reserved for Future Use: Additional Vehicle |
| 3 | Not Used, Reserved for Future Use: Additional Vehicle |
| 4 | Not Used, Reserved for Future Use: Additional Vehicle |
| 5 | Ground Station |
| 6 | Not Used, Reserved for Future Use: Additional Ground Station |
| 7 | Remote Control |
| 8 | Not Used, Reserved for Future Use. |
| 9 | Not Used, Reserved for Future Use. |

### Field 2: Subsystem

Indicates which Subsystem the Error Code is being reported from.

|  |  |  |
| --- | --- | --- |
| ***Field 1*** | ***Field 2*** | ***Description*** |
| x | 0 | Entire System |
| 1 | 1 | Primary Controller |
| 1 | 2 | Flight Controller |
| 1 | 3 | Flight Controller GPS |
| 1 | 4 | Motion Controller |
|  |  |  |
|  |  |  |

### Field 3: Error Type

Indicated the general type of failure

|  |  |
| --- | --- |
| ***Field 3*** | ***Description*** |
| 0 | No Error |
| 1 | Electrical |
| 2 | Software |
| 3 | Communication |
| 4 | Sensors |
| 5 | Actuators |
| 6 | Data Storage |
| 9 | General Error |
|  |  |

### Field 4: Severity

Indicates the Error Severity Level

|  |  |
| --- | --- |
| ***Field 4*** | ***Description*** |
| 0 | No Error |
| 1 | Information |
| 2 | Minimal |
| 3 | Caution |
| 4 | Severe |
| 5 | Emergency |
|  |  |
|  |  |
|  |  |
|  |  |

### Field 5: Error Message

|  |  |
| --- | --- |
| ***Field 5*** | ***Description*** |
| 0 | No Error, Normal Operation |
| 1 | Initializing |
| 2 | Initialization Error |
| 3 | General Error |
| 4 | Dropping Packets |
| 5 | Missing Heartbeats |
| 6 | Device not Present or Available |
|  |  |

# ICARUS Communications Protocol

**Packet Structures**

All packets will consist of a start ‘$’ character, the message code, the message length (8 bytes) and the message itself.

**Packet Types**

General Packets

*CAM*: Camera

$CAM,<SubPacketType>,L<Message>

-SubPacketType:

“DFV”: Drone Front View, where the Message is the binary stream of a image.

*TGT*: Target

$TGT<SubPacketType>,L<Message>

-Message:

“DFV”: Drone Front View, Value 1 is the Target Class, Value 2 is the Target’s Column Position,Value 3 is the Target’s Row Position and Value 4 is ther Certainty (0-100%) of the prediction.

*CAL*: Calibration

$CAL,<Message>|,<Value>\*

-Message:

"INFO":  Set Value on Vehicle.

“NEXT”: Go to next step in Calibration Procedure, where Value is the step.

“DONE”: When Calibration is complete.

*CAM*: Camera

$CAM,<Message>|,<Value,|<Value 2>, …<Value n>\*

-Message:

“DIST”: Depth Camera, where Value is the Value in inches from the Depth Sensor to the nearest obstacle in each Sector.

$CAM,DIST,000,111,222,333,444,555,666,777,888\* Distance to 9 Sectors. Sector 2 is 0 distance, meaning it is within the sensor’s minimum range.

*CON*: Control

$CON,<Message>|,<Value>\*

-Message:

“BOOT”: Selects Boot mode, where Value is the specific Boot Mode.

$CON,BOOT,1\*

“RESET”: Reboot Device.

$CON,RESET\*

"OFF":  Kills Device.

$CON,OFF\*

"TAKEOFFVTOL":  Command Device to enter TAKEOFF-VTOL Mode.

$CON,TAKEOFFVTOL\*

"HOVER":  Command Device to enter HOVER Mode.

$CON,HOVER\*

"LANDVTOL":  Command Device to enter LAND-VTOL Mode.

$CON,LANDVTOL\*

"CRUISE":  Command Device to enter CRUISE Mode.

$CON,CRUISE\*

"MANUAL":  Command Device to enter MANUAL Mode.

“ADVANCED”: Command Device to enter ADVANCED Mode.

$CON,ADVANCED\*

“MODE”: Command Device to change MODE based on the MAVLink Protocol:

$CON,MODE,256\* ‘Sets Mode to MAV\_MODE\_MANUAL\_DISARMED

*INF*: Informational Message

$INF, <Message>\*

-Message:  Any information to be passed between Interface and Vehicle.

*ERR*:  Error Message

$ERR,<Error #>\*

-Error Number is Error Code as described in Documentation.

$ERROR,12345&345\*12

*MOT:* Motor Control

$MOT,<Value 1>|<Value 2>...<Value n>\* Value 1 - 4 is a PWM value from 0-2000.  \*This packet controls each motor specifically.

$MOT,1000,1100,1900,2000\*

*NET*: Network Messages

$NET,<Message>|,<Value>\*

-Message:

"ACK", Message is received and acknowledged.

$NET,NCK\*12

"NCK", Message was not received correctly and is not acknowledged.

$NET,ACK&345\*12

"TEST": Performs Network Test, Vehicle Should respond back with: "$NET,ACK\*"

$NET,TEST&345\*12

“ID”: Network ID, where Value is the Channel between 0x00 and 0xFF.

$NET,ID,255&345\*12

“BAUD”: Network Baud Rate, where Value is the Baud Rate.

$NET,BAUD,1152&345\*12

“HRT”, Heartbeat, where Value is the Heartbeat ID

$NET,HRTBT,122\*

“TIME”,Time, where Value1 thru Value3 is the current GPS Time signal, in hours,minutes,seconds, respectively.

$NET,TIME,17,38,17\* *NOTE: This represents the time: 5:38 PM and 17 seconds.*

*SEN*: Sensor Data

$SEN,<Sensor Type>,<Value 1>,|<Value 2>, …<Value n>\*

-Sensor Types:

"ACC": Value 1 - x axis, Value 2 - y axis, Value 3 - z axis, in meters/second^2.

$SEN,ACC,0000,1111,2222\*12

"CMP":  Value 1 - heading, in degrees.

$SEN,CMP,000$345\*12

"ULT":  Value n - Ultrasonic Distance for Sensor n, in inches.

$SEN,ULT,000,111,222,333,444,555\*

"GYR":  Value 1 - yaw, Value 2 - roll, Value 3 - pitch, in degrees/second.

$SEN,GYR,0000,1111,2222\*12

"ENC":  Value n - Motor Speed for Encoder n, in revolutions per minute.

$SEN,ENC,0000,1111,2222,3333\*12

"ALT":  Value 1:  Altitude in meters

$SEN,ALT,123&345\*12

"INU":  Value 1 - x-axis displacement, Value 2 - y-axis displacement, Value 3 - z-axis displacement, in meters.  Value 4 - Pitch Angle, Value 5 - Roll Angle, Value 6 - Yaw Angle, in Degrees.

$SEN,INU,0000,1111,2222,3333,4444,5555\*12

"GPS":  Value 1 - Time, Value 2 - Latitude, Value 3 - Longitude, Value 4 - Altitude.

$SEN,GPS,000000,111111,222222,333333\*12

"PWMIN":  Values 1-4 are PWM Values ranging from 1000 to 2000

$PWMIN,1100,1300,1500,1700\*

*STA*: Status

$STA,<Message>|,<Value>\*

-Message:

"ALT":  Current Altitude in meters.

$STA,ALT,1000&345\*

“ARMED”: Armed State of device

$STA,ARMED,64\* Device is in Manual Control-Disarmed Mode.

“BEAR”: Current bearing to target, where Value is bearing in degrees.

$STA,BEAR,180&345\*

“DIST”: Current distance to target, where Value is distance in feet.

$STA,DIST,1000&345\*

“ERR”: Error Code, Errors defined in:

$STA,ERR,000001\*

"GPSFIX":  GPS Location is available.

$STA,GPSNOFIX&345\*

"GPSNOFIX":  GPS Location is not available.

$STA,GPSNOFIX&345\*

"INUFIX":  INU Data is available.

$STA,INUNOFIX&345\*

"INUNOFIX":  INU Data is not available.

$STA,INUNOFIX&345\*

“MODE”: Current MAVLink Flight Mode of device.

$STA,MODE,1\*

“POW5V”: Power level, where Value is the 5V battery voltage, in mV.

$STA,POW5V,1300&345\*

“POWMV”: Power level, where Value is the Main Supply Voltage, in mV

$STA,POWMV,1100&345\*

“QRY”: Query device for current status

$STA,QRY\*

“STATE”: Current MAVLink State of device.

$STA,STATE,1\* Device is in state MAV\_STATE\_BOOT

“VID”: Vehicle ID, where Value is the Vehicle ID.

$STA,VID,1000&345\*

New Packets

*SRV:* Servo Control

$SRV,<Value 1>,<Value 2>,<Value 3>,<Value 4>,<Value 5>,<Value 6>,<Value 7>,<Value 8>\*

Value 1-8 is a PWM value in mS for Servo Channels 1-8.

$SRV,1000,1100,1200,1500,1600,1700,1900,2000\*

Minimized Packets

The purpose of these packets is to minimize the overhead required.

*Motor Control*

Packet will be built like so:

Each motor, M1, M2, M3, M4 gets a value from 0x00 - 0xFE (0 - 254).

Packet will have a start byte of 0xFF.  So a sample packet would be:

0xFF01020304

Test Plan Packets

The purpose of these packets is for different Tests that must be performed to measure sensor and system characteristics.

*Phase 1 Test 2*

$RSSI,latitude,longitude,rssi\_value\*

*Phase 1 Test 5*

$RSSI,latitude,longitude,rssi\_value,seq\_number\*

GPS Packets

GPS Packets will follow the same conventions, following the NMEA 0183 Standard.

*RMC*: Recommended Minimum Specific GPS Data, gives Latitude/longitude, bearing, ground speed, etc.

*GSV*: Gives number of Satellite Views, etc.