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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 |
|  |  |
|  |  |
|  |  |
|  |  |

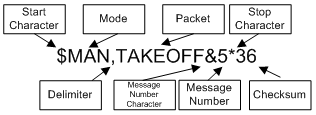
### Field 5: Error Message

|  |  |
| --- | --- |
| ***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 be started with a “$”, their 3 character type code, any parameters, a "&", the message number, and will be terminated by a “\*”, and be delimited by a “,”.  Immediately following the "\*" character will be the complete packet size, starting with the "$" character and ending with the "\*" character.



\*DEPRECATED\* Sequence Numbers will be unsigned and 3 decimal digits long and will rollover after reaching 255.

Values encoded in the Packet Payload will be of varying datatypes and precisions with the following definitions:

PWM values range between 1000 and 2000.

GPS values (latitude and longitude) will be up to 3 digits long before a decimal point, 6 digits after with an optional sign bit.

INTEGERS will be unsigned and 4 decimal digits long and will rollover after reaching 9999.

DECIMAL will be 4 decimal digits (with an optional sign byte) and represent the value scaled by the number that is defined with that Data Type (to avoid any decimal point).

Orange packets are for example only, the document [ICARUS Protocol Specifications](https://spreadsheets.google.com/ccc?key=0As1I5roXKLwsdG9qZ1A4T29ONU1xeTZhR1BLYnU0TEE&hl=en#gid=0) should be used for further reference.

**Packet Types**

General Packets

*CAM*: Camera

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

-Message:

“FV”: Drone Front View, where each Value is the bytecode after the image is flatted to a 1-dimensional vector.

*TGT*: Target

$TGT,<Message>|,<Value,|<Value 2,|<Value 3>,|<Value 4>,|<Value 5>\*\*

-Message:

“FV”: Drone Front View, Value 1 is the Image Index, Value 2 is the Target Class, Value 3 is the Target’s Column Position,Value 4 is the Target’s Row Position and Value 5 is ther Certainty (0-100%) of the prediction.

$TGT,FV,17,CHIEFSECURITY,360,640,91\*

*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.