# EM406 GPS-UAV
# Self-Testing

# EM406 GPS-UAV Self-Testing

This document describes a test procedure for the EM406 GPS-UAV, using the self-testing firmware.

## Preparation

In addition to the GPS-UAV unit that you are testing, you will need an RC transmitter, an RC receiver, three servos, and a 4.8 volt battery. In other words, you need the RC equipment that would normally be used for remote control of a model. The transmitter and receiver should handle at least 4 channels that would normally be used for rudder, elevator, ailerons and throttle for an airplane. You can use any PWM servo that uses positive pulses 1-2 milliseconds wide, such as the Futaba S3101 or the S3103.

You will need to make sure the board has been programmed with the self-test firmware. The units ship with the self-test firmware installed. You can re-install it by programming it directly with the self-test hex file available from Spark Fun, or by compiling the self-test source code. It does not make any difference if the GPS radio/antenna is connected or not while you do the programming. There is no power connection on the board, power it up by applying around 5 volts, plus 5 to any one of the + pins on the servo/radio connectors, and ground to any one of the – pins.

After you have programmed the board, disconnect the ISCP programming cable from the board and remove power.

Connect 3 servos to the servo connectors, ground pin toward the edge of the board. Connect 4 working channels to the radio inputs on the board, ground pin toward the edge of the board. Sequence does not matter, just make sure that the channels work. Connect the receiver's 4.8 volt battery into the receiver. Power will backfeed into the board. Center the sticks and trims on the transmitter. Set the throttle stick for about half throttle. Positions of normal/reverse switches on the transmitter do not matter. Turn on the receiver and transmitter in either order.

It makes no difference whether you connect the GPS to the board now or later. Most of the tests do not require the GPS to be connected, and are easier to perform without it, so you may want to wait to connect the GPS after you complete the other tests.

## Testing

The self-test firmware powers up and self-zeros the analog inputs almost instantly. The two LEDS should come on for 2 seconds, and then may start blinking depending on the results of some of the self tests. Do the following checks in any order immediately after power up.

1. Check the channels from the radio. Wiggle the stick for each channel. One and only one of the servos should move for each channel. Because there are 4 channels and 3 servos, two of the channels are averaged to a single servo.

2. Check the gyros. This test can be done without the GPS connected to the board, if you want. Select the gyros by setting the SR1, SR2, and SR3 switches all to the right (toward the GPS connector). Switch SRX (X=1,2,3) selects between gyro and accelerometer for channel X, so the combination of the gyro and the accelerometer test also check the switches. For each of the

three axis, twist the board around that axis. This should cause one of the servos to deflect in proportion to the rate of twisting. X, Y, and Z axis are labeled on the board. Rotation around the X, Y, and Z axis should produce responses by servos 1, 2, and 3, in that order. Labels on the board refer to the direction and sign of the accelerometer axis. Directions are the same for the gyros, except you must refer to the gyro boards to determine the sign. (Note to production: if you are testing boards without gyros, simply skip this step!)

3. Check the accelerometers. This test can be done without the GPS connected to the board, if you want. Select the accelerometer axis by setting the SR1, SR2, and SR3 switches all to the left (away from the GPS connector). Switch SRX (X=1,2,3) selects between gyro and accelerometer for channel X, so the combination of the gyro and the accelerometer test also check the switches. For each of the three axis, shake the board along that axis. This should cause one of the servos to deflect in proportion to acceleration along that axis. Labels on the board refer to the direction and sign of the accelerometer axis. Axis X, Y, and Z should produce responses by servos 1, 2, and 3.

4. Check the GPS. Obviously, this must be done with the GPS connected, connect it now if you have not already done so. LEDs are used to indicate the results of the GPS communications self test. When the board first powers up, both LEDs on the board should turn on for 2 seconds, and then either go off or start to blink. This checks the LEDs themselves. When the GPS powers up, its onboard LED should also come on. Shortly after power up, the CPU begins to check communications with the GPS. Status LED#1 indicates communications errors by toggling each time there is a framing error for a transmission from the GPS to the CPU. Normally, LED #1 should come on for 2 seconds and then stay off during self test. A blinking LED #1 indicates a problem in communications from the GPS to the CPU. Status LED#2 is used to indicate that the GPS responds to messages it receives from the CPU. Normally it toggles once a second, each time the CPU receives a valid “VTG” message from the GPS. If LED#2 does not blink, that is an indication that the GPS is not receiving messages from the CPU. Finally, once the GPS achieves satellite lock, its onboard LED should start blinking. In summary, under normal operation, LED#2 and the GPS onboard LED should blink while LED#1 should not.

The self test firmware also tests the spare pins on the board, RE0, RE2, RE4, RE8, TXO, and RXI. If you are not planning on using them, do not connect anything to them during the self test. If you are planning on using them, install a header and perform the following extended tests:

1. RE0, 2, 4, and 8 are digital I/O. The self-test firmware treats them as digital outputs. Connect whichever ones you plan to use in series with suitable resistors to LEDs. RE0, 2, and 4 will steadily blink. RE8 is used to indicate self-test of RXI.

2. TXO and RXI are the pins for the spare USART. The self test firmware echoes the GPS data to TXO, and blinks RE8 each time a single character is received on RXI. Connect TXO to the RX of an RS232 level shifter, and the RXI to its TX. Connect the RS232 side to a terminal set for 4,800 baud, 8 bit, no parity, 1 stop bit. If you are using a hyperterminal, select no flow control. The GPS data stream will appear. Each time you press a single key (anything except “Enter”) the LED connected to RE8 will toggle.