



*blue mountain avionics*

Product	BMA Autopilot Systems	
Release	ALL	
Subject	Troubleshooting Your Autopilot	
Original	03/26/2007	Greg Richter

## Introduction

This note is broken into sections for testing and setting up the AP, and for troubleshooting a system that is misbehaving. If the Autopilot has been working fine for a few hundred hours and is just starting to misbehave, go to the Troubleshooting section. If the AP hasn't been flown, work through the Testing procedure step by step to make sure there isn't a problem with the installation. Of the hundreds of call we get about Autopilot installations only a handful have ever been hardware issues. Almost all Autopilot troubles can be traced to either cabling or mechanical looseness.

## Testing -- Step by Step

This section will take you through commissioning a new autopilot installation OR checking out an existing one. Plan on one hour to make all the checks.

## Power

Verify that power is supplied to the AP from a source capable of supplying 10 Amperes of current. Wiring should be #18 or larger. Check the voltage AT THE CONNECTOR going into the autopilot controller and make sure it is within 11.5 - 32.0 volts.

There's a fad currently with essential buss battery systems which are just lovely. Your Autopilot draws too much current for even the largest of them and needs to be connected to the main buss. Under maneuvering loads, the AP can draw up to six (6) Amperes at 12 volts!

## **AP Disconnect**

Your *blue mountain* EFIS system has an Autopilot Disconnect input for a pushbutton that will ground the AP disconnect line commanding the Autopilot to disengage.

### **This is a common problem -- stuck AP Disconnect!**

Check with a voltmeter and read the voltage on the AP DISCONNECT pin going into your EFIS. It should read close to 5 volts, between 4.70 and 5.10 volts. If it is any lower than 4.50 volts, your Autopilot will not engage.

**As noted in Aircraft Wiring for Smart People (Greg's take on wiring for Not-So-Dummies) grounds are not all created equal. There's a ground pin on the EFIS for the AP Disconnect button -- use that and not some stray chunk of airframe. Really. It causes problems that can be very hard to find.**

## **Cabling**

Cables and connectors are the bane of all electronic systems and improperly mated connectors are responsible for MOST Autopilot problems. Verify that the cables are good pin-to-pin with an Ohmmeter, verify that they are screwed down and seated all the way on the Autopilot controller.

**DSUB-type connectors are held down with screws. Make SURE that the connector is seated solidly, and that there is nothing holding the connector from seating flush to the base plate.**

## **Physical Mounting**

Autopilots develop significant forces. The BMA rotary servos can develop up to 18 pounds of pull, the linear servos about 13.5 pounds. Make sure that the servos are mounted solidly, and that there is no potential interference with other controls. Servo travel on rotary servos should be more than 90 degrees and less than 180 degrees (to keep from going over-center).

**Hose clamps and bungees cords (yes, we've seen them both) aren't going to cut it here. Servos should be mounted solidly and not flex when forced by hand.**

## Heading Bug Test

On the ground:

Fire up the EFIS, go to the SET page and touch Set Level to instruct the AHRS that this attitude is zero for the purposes of our test.

Center the stick, go the AP page in the Lateral section, and touch HOLD to center the Heading Bug and engage the Autopilot.

The lateral (roll) servo should engage and hold the stick in the center, with the HDG annunciation on screen glowing solid. This indicates that the Autopilot is in Heading bug mode and is flying the airplane.

Walk out to the aileron and move the tip with your fingers until you feel the servo holding you back. What we are measuring is the amount of mechanical play (slop) in the control system. 0.250 inches is acceptable, more than that should be addressed. This looseness or free play means that the autopilot will move and the airplane won't respond, which makes for sloppy handling. RVs typically show 1/8" total play, Lancairs 1/4", EZs can be just plain awful -- we've seen 1" in some of them.

**Write down your aileron free play measurement here:**

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Walk back to the cockpit and turn the Heading Bug 90 degrees to the LEFT.

Look at your watch (or the EFIS!) and wait. Turn rate is dependent on airspeed, and it can take three (3) minutes on the ground for the system to respond at zero airspeed. The stick should move LEFT. If it goes to the right, all you have to do is go to the Setup screen and click the Invert [ ] checkbox to make the AP turn the other way. You can disengage the AP if you like.

If the AP went LEFT you have normal polarity. Right is inverted.

**Record your Aileron polarity here: [ ] Normal [ ] Inverted**

## **Climb Test**

Go the AP page and enter an Altitude that's a 1000 feet higher than what the EFIS Altimeter tape is reporting. Center the stick and click Engage to ask the AP to climb. Look at your watch (or the EFIS!) and wait. Climb rate is dependent on airspeed and VSI, and it can take three (3) minutes on the ground for the system to respond at zero airspeed. The stick should slowly move BACK in steps as the Autopilot asks for a climb.

If the stick goes forward, all you have to do is go to the Setup screen and click the Invert [ ] checkbox to make the AP pull back instead. You can disengage the AP if you like.

If the AP pulled BACK you have normal polarity. Push forward is inverted.

**Record your Elevator polarity here: [ ] Normal [ ] Inverted**

## **Troubleshooting**

If you're troubleshooting, remember that walking through the above install and commission procedure is probably a good idea first. Greg had a guy (who is a good pilot and smart man) fly six hours just to flip the aileron polarity. C'mon, it only takes a minute to run through it, may as well. If you get stuck, this is the place to come next.

### **Heading bug wanders with each swing getting worse**

Most likely polarity is flipped. Verify **Heading Bug Test** above.

### **Altitude hold dives for the deck**

Most likely polarity is flipped. Verify **Climb Test** above.

### **Lateral works but Vertical doesn't -or- Vertical works but Lateral doesn't**

Swap cables at the controller. Put the Lateral (roll) servo into Vertical (pitch) channel and Vertical Servo into the Lateral channel. Run the **Heading Bug Test** and **Climb Test** as above.

If the Heading Bug Test tries to climb or descend we know the elevator servo and cable is good.

If the Climb Test tries to turn the airplane we know that the roll and cable is good.

**If the problem follows the cable, check for bent or broken connector pins.**

### **Wanders around on Heading Bug**

Your *blue mountain* autopilot is a non-linear adaptive system and compensates and corrects for airframe type and dynamic capability. The only tunable parameter has to do with the mechanical advantage of the servo and this Gain may be adjusted on the Setup screen.

**Typical values for the Rv series      45**

**Lancair:                                      60**

**EZs and Velocity                          75**

You can also turn this gain up until the stick starts to oscillate back and forth indicating that the AP is moving faster than the airframe can respond. From that point, dial it back down five (5) points.

### **Wanders around on Altitude Hold**

The vertical section of the AP is self-tuning, so this is a bit rare. Check for mechanical looseness as indicated above. If you have an unusual aircraft, you may want to call BMA for technical assistance.

### **Altitude holds high or low**

This is usually caused by the Autopilot fighting an out-of-trim condition. Before you engage the Autopilot, go to the SET page and touch Set Level to let the AHRS know that this attitude is, in fact, flight level.

### **HDG flashes when I engage**

Heading Bug is a great tool for debugging, and this is typical of:

1. AP Disconnect stuck down
2. Magnetometer not connected
3. No communication to the controller