

The Original GPS Smart Coupler User Manual

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The GPS Smart Coupler User Manual

Smart Coupler Description

What is it?

The Smart Coupler is a device that allows you to connect your hand-held global positioning system (GPS) receiver to your autopilot. The only requirements are that the GPS receiver has an serial output as described below and that the autopilot has a VOR tracking input. The Coupler decodes the serial output of any GPS receiver that transmits cross track error and that complies with the National Marine Electronics Association (NMEA) 183 or Aviation standard. Virtually all new handheld GPS receivers generate NMEA data. Most panel-mounted receivers generate Aviation data. See Appendix A for a list of receivers that are known to work with the Smart Coupler.

The Smart Coupler comes with a pre-wired harness. Installation consists of mounting the panel connector in a convenient location where you can plug in your GPS receiver, mounting the GPS OK indicator and attaching the six wires from the harness.

Once installed, your autopilot will track your GPS receiver as well or better than it will track your VOR. Remember that GPS course width is constant no matter how close you are to the waypoint. Practically, this means that you can track directly over a waypoint and your wings will never wiggle an inch! Also many GPS receivers calculate and follow a nicely radiused path when changing heading at a waypoint. Again, practically this means that you can track inbound on one heading, change headings to the outbound track and the aircraft will be well behaved throughout the heading change. Some autopilots will do this better than others; it depends on the rate of change of heading and the magnitude of heading change at the waypoint. If you have a heading bug on your DG you may still need to change the bug to reflect the heading of the new course leg.

What does it do?

The Smart Coupler listens to the serial output of a GPS receiver, extracts the left-right course information and makes an analog signal that is suitable for a CDI or autopilot input. The coupler can decode any GPS serial output that meets the NMEA 183 standard. See the specification section for the exact NMEA sentences decoded.

The Smart Coupler can produce a course width of 1.25, 2.5, 5 or 10 NM. This corresponds to 0.25, .5, 1 and 2 NM per dot on a normal course indicator. GPS course width does not depend on distance from a waypoint. The course width is fixed on installation and can usually be left at 1.25 NM (factory default). The Smart Coupler course width is independent of the course width selected for the GPS receiver's built-in course deviation indicator (CDI). This bears repeating – you cannot set the course width that the autopilot sees from the face of your GPS receiver. The information sent out the NMEA port is always expressed in nautical miles left or right of course.

Any time the Smart Coupler receives valid course information from the GPS receiver it sets the autopilot output accordingly and turns on the GPS OK course status indicator. If the Smart Coupler does not receive a new course value from the receiver for 5 seconds it blinks the GPS OK light as a warning. If the Smart Coupler does not receive a new course value from the receiver for approximately 30 seconds, it centers the autopilot output and turns off the GPS OK course status indicator.

When the coupler is turned off or if the coupler is not receiving valid left-right course information, the autopilot output is at 0 volts with respect to the reference. When the coupler is receiving course information from the GPS receiver, it drives the autopilot output in the range of ± 150 mv. The output is 0 volts when on course. It is plus or minus 150 mV when off course for the full course width and proportional in between. A minus output indicates right of course (turn left to get back to course). Some avionics manufacturers refer to these signals as +Right Deflection and +Left Deflection. See the pin out Table 1 below.

The GPS OK signal is generated with a open drain FET switch to ground capable of sinking 100 mA. It can operate an indicator lamp or a small relay. An appropriate green indicator is included. There is also a green LED built into the Smart Coupler that presents the GPS OK signal.

Guarantee

Return the Coupler within 90 days for a full refund if you are not completely satisfied. If the Coupler does not work with your NMEA-183-compliant GPS receiver, either return the Coupler for a refund or let us borrow your receiver and we will make it work with the coupler. In order for the Coupler to work properly, the NMEA receiver must transmit cross track error using the NMEA sentence GPRMB.

Smart Coupler Installation

Mechanical installation

Install the Smart Coupler securely in the aircraft where it is protected from extreme heat or cold. A position near the instrument panel and radio stack is appropriate. Avoid placing the Coupler closer than 24 inches from a transmitting antenna.

The Coupler is supplied with a piece of self-adhesive hook and loop fastener. Make sure the surface that you select for mounting is free of grease and oil. Remove the backing and press the fastener in place. The adhesive needs to cure for 24 hours after you stick it in place before you use it.

Secure the harness to the aircraft chassis near the Smart Coupler so that the weight of the harness is not pulling on the hook and loop fastener.

Electrical connections

Refer to Figure 1, Table 1 and Table 1 below for the Smart Coupler connector pin out and signal names. The coupler must be protected with a 1 amp fuse or circuit breaker. The coupler can be left powered all the time or can be fed from a switched source such as the autopilot on-off switch or avionics master. Current draw is negligible, less than 50 mA. The pin-out of the DB9 connector on the rear of the Smart Coupler chassis is shown below for reference. In a normal installation only the six pigtailed from the pre-wired harness are used.

For 28V aircraft there is an internal jumper that must be cut. This will be done by the factory if you ordered a 28V unit. If you hold the coupler with the built-in GPS OK indicator toward you, the jumper is located near the left rear corner of the internal PWB.

Two flag outputs are present on the Smart Coupler connector although they are not wired in the supplied harness. If your HSI or autopilot requires a TO flag or an equipment flag you can wire directly to the Smart Coupler connector.

Connection to GPS

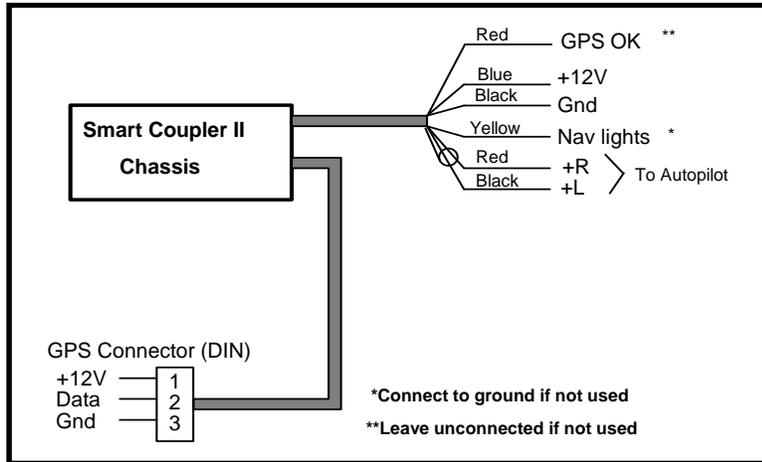


Figure 1 - Connections to pre-wired Smart Coupler harness

There is a five-position DIN panel connector pre-wired in the Smart Coupler harness that can be used to connect to your GPS receiver. The mating connector is supplied with the coupler. You must buy the power/data cable that plugs into your GPS receiver from the manufacturer of the receiver. Terminate this cable with the supplied DIN connector. Consult your GPS manual for the pin out and signal names of the serial output. The 12V is present in this connector to power your receiver.

Connection to autopilot

Consult the autopilot manual for appropriate connections. If you have other tracking inputs to your autopilot (such as a VOR or Loran), you must install a two-pole switch to select among them. That is since the output is differential; you must switch *both* the +Left *and* the +Right

wires. If you are using the flag outputs you may have to switch as many as six wires as the flag signals are differential as well. (2 wires for +L,+R; 2 wires for the TO flag; 2 wires for the equipment flag).

Pin	Description
1	Aircraft ground
2	Aircraft power. Select 24V by cutting internal jumper.
3	Flag 1 plus out
4	+Left Autopilot Output (to autopilot)
5	Light dimming sense input (see note below*)
6	Flag 2 plus out
7	GPS OK Status (see note below**)
8	+Right Autopilot Output (to autopilot) Flag 1 and Flag 2 reference out.
9	NMEA 0183 data input (from receiver)

Table 1 -Smart Coupler chassis connector pin out

Notes:

*Connect to ground if not used. This will make the lamps bright.

**Leave unconnected if not used.

Pin	Description
1	Aircraft power (+14V) (see note below*)
2	Data output (from receiver)
3	Aircraft ground
4	Unused
5	Unused

Table 2 - GPS receiver DIN panel connector pin-out

*The GPS power wire is wired directly to the blue +14V power wire in the Smart Coupler II harness. This will not work to power a 14V handheld in a 28V aircraft. Other provisions must be made to supply proper voltage to the handheld.

Note that the DIN panel connector pins are numbered 1-4-2-5-3 clockwise looking at the front of the panel connector. Pin one is at the 9:00 o'clock position if you hold the connector so that the single chassis

ground recess is at the bottom while the 5 other recesses are arrayed at the top from 9:00 O'clock through 12:00 O'clock to 3:00 O'clock.

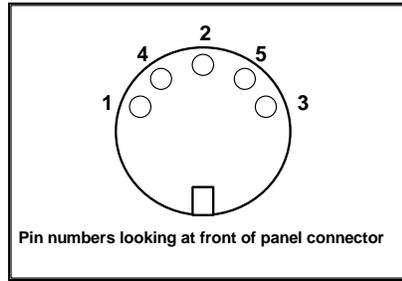


Figure 2- DIN panel connector pin locations

Navigation light connection

The coupler uses this yellow wire to sense whether the navigation lights are on or off. If the sensed voltage is greater than 2.5V, the Smart Coupler dims the GPS OK indicator. If the sensed voltage is less than 2.5V, the GPS OK indicator is full bright. There is no in between, the GPS OK indicator is either bright or dim. Connect this wire to ground if you don't want to dim the indicator at night. You can adjust how dim the lamp gets using a computer and the utilities supplied with the Coupler. See Appendix III.

Using these utilities you can also make the OK indicator dim with your panel lights rather than simply switch between bright and dim. When using this option the yellow wire is connected to the panel lamp bus.

GPS OK indicator

The supplied indicator is a green, incandescent lamp. Wire one side to +14V (+28V) and the other to the red wire from the harness. You are free to use any indicator you wish, as the red wire is simply switched to ground when the Smart Coupler wants to light the indicator. The green LED showing at one end of the Smart Coupler enclosure is also a GPS OK indicator.

Course Width Selection

Normally, the course width is left at 1.25 nautical miles. This means that if the GPS receiver signals the coupler that the aircraft is one and a quarter miles right or left of course, the coupler will output -150 mV or $+150$ mV respectively. This is the same as five dots left or right on a VOR head. If course width is set to 10, the coupler will output 150 mV for ten miles off course. Course width can be set to 1.25, 2.5, 5 or 10 nautical miles. The maximum voltage from the Smart Coupler is 150 mV. If the aircraft is more than the selected course width off course, the Smart Coupler will send full scale – either plus or minus 150 mV.

Course width affects system gain when the autopilot is in any navigation mode. A course width of 1.25 has four times the gain of a course width of 10. Normally you choose the narrowest course width that the autopilot will follow and still be stable. If your autopilot is nice and stable when not coupled to the GPS but overshoots the course or continuously banks left and right after coupling, it usually means the gain is too high. Try increasing the course width.

You can set the course width by sending a special calibration sentence to the Smart Coupler II. See appendix III for details.

Installation check

After the installation is completed, you can quickly check if the Coupler is receiving and decoding information from the GPS receiver.

1. Apply power to the Coupler.
2. The GPS OK indicator will blink a couple of times, and then go out.
3. Turn on the GPS receiver and put in a course from the present position to a nearby waypoint.
4. Enable the serial output to the Coupler.
5. The GPS OK indicator should light. There should be 0 ± 2 millivolts difference between the wires connected to the autopilot. If you have a wing leveler type of autopilot and if you enable the autopilot in course mode, you should be able to center the ailerons with the trim knob.

6. Now enable a flight plan such that your present position is at least 1.25NM (or whatever you have selected as course width) off course.
7. The GPS OK indicator should still be on. Now there should be 150 ± 5 mV difference between the wires going to the autopilot. The ailerons should deflect up or down.
8. Think carefully about the direction of deflection of the ailerons. Imagine your aircraft is pointing in the same direction as the course leg that you put into your GPS receiver. The ailerons should be deflected in the direction to turn your aircraft toward the course – that is, the ailerons should be UP on the same side as the course. If the ailerons are deflected in the wrong direction, you have switched the +Left and +Right wires from the Coupler to the autopilot.
9. Turn off the GPS receiver but leave the power applied to the Coupler.
10. After 5 seconds the GPS OK indicator will start to blink to show that the receiver is not sending any data.
11. After approximately 30 seconds, the GPS OK indicator should go off to show that the receiver is not working.
12. This completes the installation check.

Smart Coupler Use

Normal procedure

- Put a course in to the GPS receiver.
- Enable the NMEA 183 output from the receiver. Ensure the receiver is not in battery saver mode.
- Fly your aircraft to place it on course and on the correct heading. Use the CDI in the GPS receiver to help do this.
- Note that the GPS OK indicator is lighted. This verifies that the Coupler is receiving and decoding course information.
- Enable your autopilot.

Note that the sensitivity of the CDI built into the GPS receiver is separate from the course width that the Smart Coupler sends to the autopilot. Many GPS receivers allow you to set the sensitivity of the

built in CDI. The autopilot output course width remains constant independent of the CDI sensitivity.

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Smart Coupler Specifications

Power

- Voltage: 7-16 or 14-28 VDC (jumper selected)
Current: 50 mA

Physical

- 2.3" x 2.4" x 1.1" shielded, fire resistant ABS plastic box, UL94-V0, 2 ounces

Autopilot output

- Differential analog signal, not referred to ground
- ± 150 mv full scale (selectable 1.25, 2.5 5 or 10 NM off course).
- Positive means turn right to return to course.
- The transmitted output is cross track error. This is an analog signal representing the shortest distance from the current position to the selected ground track.
- There is a simple one-pole filter on the autopilot output with a time constant of approximately two seconds. No other filtering or integration is done in the Smart Coupler. Serial information is translated to analog information and immediately transmitted.

Flag outputs

- Differential analog signal, not referred to ground
- ± 300 uA into 1000 ohms

Serial input

- Designed to decode NMEA-183 and Aviation transmitted signal
- 4800 or 9600 baud (selected automatically), 8 bits, no parity, 1 or 2 stop bits.

GPS OK output

- Open collector FET, 100 mA max. current, 60V max. voltage, 1 watt max. power.
- Only turns on when the Smart Coupler is decoding navigation information.

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Appendix I - GPS receivers

GPS Receivers and requirements

All modern receivers (with the exception of the Magellan below) will work with the coupler. We used to maintain a list, but we found that *all* hand-held receivers that claim an NMEA output will work. All panel mounted receivers that transmit Aviation data will also work. Aviation format data is sometimes referred to as Argus data.

Specifically, all Garmin aviation handheld receivers since the Garmin 95 will work. All Lowrance receivers will work. The King Skymap works. Porcine Associates does not know of any handheld receivers other than those listed below that do not work.

The receivers listed below are those that are known to have special requirements.

Receiver	Comments
Magellan SkyStar series of receivers	These receivers will not work without a special power supply. They require that a -12volt source is connected to the RS-232 receive line before the RS-232 transmit line will work. The Smart Coupler does not supply the necessary -12V.
Garmin Pilot III	Some older Smart Couplers will not work. Call the factory for an upgrade.
Garmin 100	with tray – Has CDI output, Smart Coupler not needed without tray – use with Smart Coupler, no special requirements
Ross Engineering LCA 200	183-1, 183-3 - Don't use 183-2 - No special requirements

Figure 3 - Receivers with special requirements

The following receiver will *not* work with the Smart Coupler:
Tremble Flightmate (not NMEA compliant, no data output)

Intentionally left blank.

Appendix II - Troubleshooting

The Smart Coupler Troubleshooting Guide

1.0 Start Here

Does the GPS OK Status Indicator blink ON for about a second when power is first applied?

YES	goto 2.0
NO	goto 13.0
I didn't install the GPS OK Status Indicator	goto 14.0

2.0 GPS OK Status Indicator Blinks on power-up

Does the GPS OK Status Indicator turn on and stay on when you have your GPS receiver plugged into the Smart Coupler?

YES	goto 3.0
NO	goto 12.0

3.0 GPS OK Status stays on when GPS is connected

Try the following experiment while on the ground:

Enter a flight plan in your GPS receiver so that the aircraft is approximately 10NM off course. (You cannot just use the GOTO button as it draws a course line from your present position to a waypoint.) Turn on your GPS receiver and your autopilot. If your installation has an autopilot source selection switch, make sure it is turned to GPS (or whatever position you have used for the Smart Coupler). If you have a heading bug on your DG set the DG and the bug so that it appears that the aircraft is on same heading as the course leg that you entered. Wait for the GPS OK Status indicator to light, indicating that the GPS receiver has acquired the minimum number of satellites.

Do the ailerons go to full lock (or maximum deflection allowed by the autopilot)?

YES goto 4.0

NO goto 11.0

4.0 Ailerons deflect

Keep the setup as in 3.0 except now enter a course into the GPS receiver so that you are exactly on course. One way of doing this is to use the GOTO button. If you have a bug on your DG, set the DG and bug so that it appears that you are on the same heading as the course you put into the GPS receiver. Wait for the GPS OK Status indicator to light.

Can you center the ailerons with the autopilot trim knob?

YES goto 5.0

NO goto 10.0

5.0 Ailerons will center with trim knob

When flying, does the aircraft fly in circles whenever the Smart Coupler is engaged?

YES goto 6.0

NO goto 9.0

6.0 Flies in circles

Do you center the Course Deviation Indicator on the GPS receiver by flying to the course before you engage the autopilot?

YES goto 7.0

NO goto 8.0

7.0 CDI centered before engaging autopilot

Almost certainly the two wires that connect the Smart Coupler to the autopilot are reversed. This causes the aircraft to diverge from course instead of converging on course. Reverse the wires.

8.0 CDI not centered

The Smart Coupler will not automatically intercept a course. The pilot must place the aircraft on course and on heading before engaging the autopilot.

9.0 Aircraft does not fly in circles

According to the tests made so far, the Coupler should guide the aircraft correctly. Call Porcine Associates for more help.

10.0 Ailerons will not center with trim

or

11.0 Ailerons do not deflect at all

There is probably a miswire in the wiring between the Coupler and the autopilot.

The Coupler generates a standard CDI signal that can be used by a passive CDI, an HSI or an autopilot. This signal is $0 \pm 150\text{mv}$ not referred to ground. This means that the voltage between the two wires that go from the Coupler to the autopilot (the differential voltage) is always between $+150\text{mv}$ and -150mv . The voltage from either wire to ground is not defined and should not matter.

When the aircraft is on course, the differential voltage is 0mv . When the aircraft is full scale off course, the voltage will be $+150\text{mv}$ or -150mv depending on if the aircraft is right or left of course.

The most straightforward method of troubleshooting this is to monitor the voltage getting to the autopilot after all the switches. Most installations have a switch to select among the various autopilot signal sources - VOR1, VOR2, LORAN, GPS, etc. Temporarily wire in a millivoltmeter monitoring the voltage between the two wires that run between this switch and the autopilot. Remember, we are interested in the *differential* voltage, not the voltage from the wires to ground.

Now switch to a source *other* than the Coupler. Repeat the experiment in paragraph 3 and 4 above with the other source. For example if you are using a VOR, tune in a nearby VOR station and set the OBS knob so that the needle is just off scale left or right. Note the ailerons deflect. Then center the needle. Note the ailerons are near neutral. Watch the millivoltmeter when you do this. Now switch to the Coupler and again repeat paragraphs 3 and 4. You should be able to note the differences and trace back to find the problem.

If the installation is still not working, please note the experiments that you have done, and then call Porcine Associates for advice.

12.0 GPS OK indicator blinks on power-up but otherwise stays off.

They're several possible problems. In general, it means that the Coupler is not receiving the serial data from the GPS receiver, or not receiving it in a format that it likes.

12.1 GPS data turned off

Make sure that the data port of your GPS receiver has been turned on and set to transmit NMEA 0183 version 1.x, 2.x or 3.x data. Make sure that the GPS receiver transmits the NMEA sentence GPRMB. Each GPS receiver has its own method of doing this, the logical switches are usually found on one or more of the setup screens.

You can make a gross check on if the receiver is transmitting using a voltmeter. Connect the voltmeter from the serial data out wire to ground. Configure the receiver just as you do when it is in the airplane - data port ON, course put in, etc. The receiver normally transmits a burst every second, so the voltmeter will show some reading, but will change slightly once a second. The absolute numbers are not important, look for a once per second fluctuation.

If you have a computer, you can also receive the NMEA data on the screen. Use a terminal emulation program such as HyperTerminal (on a Microsoft Windows machine). Set the port to 4800 baud, no parity, 8 data bits, 1 stop bit. The NMEA data will appear on the screen. Once a second several NMEA sentences will appear on the screen. They have a general format something like the following:

```
$GPXTE,V,V,0.234,L,N*35
```

Sentences always start with a dollar sign (\$). The next five characters identify the sentence. Fields are separated with commas. The two characters after the asterisk ("*") is the checksum for the sentence. The Coupler needs to receive the NMEA sentence GPRMB.

12.2 Data cable not wired correctly

Make sure that the data out from the GPS receiver is reaching pin 9 on the Smart Coupler and the ground is connected to pin 1.

12.3 GPS receiver has no course programmed

You must program the GPS receiver with a course to follow. Use the instructions that came with the receiver to do this. A coupler will not respond to simulated flights.

12.4 GPS receiver has not acquired the minimum number of satellites

The screen of the receiver will show when it has acquired the minimum number.

12.5 GPS receiver does not append the NMEA checksum to its data stream

The checksum is not optional for sentence GPRMB. If the checksum is not present the receiver is not compliant with the NMEA 183 standard.

If you still do not get a GPS OK indication, call Porcine Associates for more advice.

13.0 GPS OK Indicator does not blink on power-up

There are three possible problems:

13.1 The Coupler is not getting power

The coupler requires +14VDC (or +28VDC) to pin 2 and common (aircraft ground) to pin 1. Power requirements are 50ma or less, so the Coupler can be wired to the same fused source as your autopilot.

13.2 The GPS OK Lamp is not wired correctly

One lead of the GPS OK Indicator must be wired directly to +14 or +28. The other lead must be connected to pin 7 on the Smart Coupler. If you have a 28V aircraft, make sure that the indicator is a 28V indicator. Porcine Associates supplies an indicator with a CM-73 bulb for 14V operation and a CM-85 bulb for 28V operation. The CM-73 bulb is found in some older Volkswagen and Mercedes cars as panel lamps.

14.0 Indicator not installed

Porcine Associates strongly recommends that you install this indicator. It is your only in-flight indication that left-right course information is being sent to your autopilot. There are many factors that can interrupt this data flow. These are, among others, forgetting to turn on the GPS data port, letting the GPS receiver batteries go dead, accidentally unplugging the GPS receiver from the panel, loss of satellites, and receiver malfunction.

As an alternate, you can install the Smart Coupler enclosure where you can see the built-in GPS OK lamp.

Go back to paragraph 2 when you have installed the GPS OK lamp or some other indication of the state of pin 7.

Appendix III - Setup and Calibration

The Smart Coupler II has on on-board EEPROM (non-volatile storage) that is used to store several set-up parameters. These parameters are: output offset, course gain, night dimming factor and hardware configuration. If you need to change any of these parameters, you will need to use an IBM-PC or clone, the cable described below and the set-up utility program that is available from the Porcine Associates web site www.porcine.com. The rest of this section describes the use of this program. Normally the Coupler can be used as it is delivered from the factory.

When do I need to set up the Smart Coupler?

All couplers leave the factory with the zero set. Course width is set to 1.25NM unless otherwise arranged. The dimming factor is set to least bright.

The zero determines the magnitude of the error from the desired course or heading that your aircraft will actually travel. This is difficult to determine after installation, as the autopilot also has a zero adjustment. If your autopilot always tracks significantly to the left or right of your GPS course, you can check the Smart Coupler's zero using the procedure outlined below.

Course width determines the system gain of the Smart Coupler/Autopilot/Aircraft. If your aircraft will track a VOR or Loran course well, but continuously banks left and right when tracking the Smart Coupler try decreasing the gain by increasing the course width. Navaid installations and most S-Tek installations work well with 1.25NM course width (the factory default). Some Century II and III autopilots work best with the course width set to 5NM.

Required tools

Meter

Setting the zero requires a voltmeter that can measure voltages less than one millivolt. A meter is not required to set course width.

Fixture

The Smart Coupler II can be set up using any IBM-PC/AT compatible computer and the cable shown in Figure 4 and Figure 5 below.

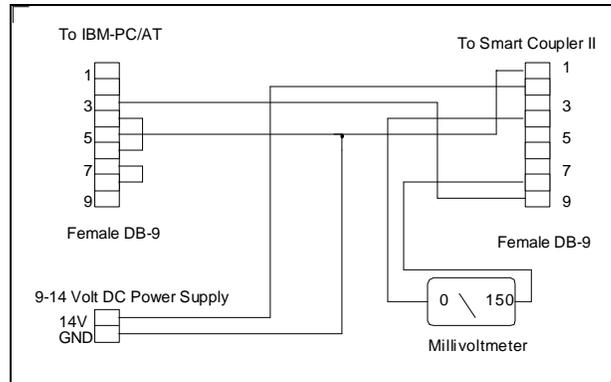


Figure 4 - External setup and calibration fixture

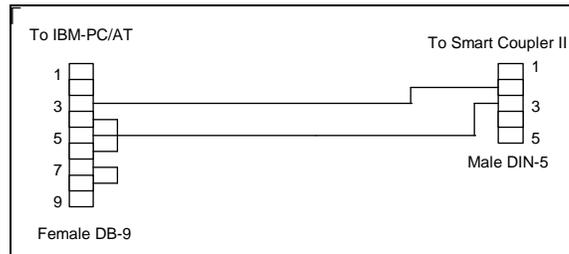


Figure 5 - In-aircraft setup and calibration fixture

If you have a portable computer, you can calibrate the Smart Coupler in your aircraft using the cable shown in figure A3-2. Using this cable you will have to connect your voltmeter to the +left and +right wires in the aircraft in order to monitor the zero.

Software

SimNMEA is available from the Porcine Associates web site www.porcine.com. SimNMEA runs under Microsoft Windows. The computer must have a serial port. If the computer has only USB ports, you must use a USB to serial adaptor.

Setup instructions

Connecting the Smart Coupler

One DB-9 of the external fixture (Fig A3-1) connects to the machine running SimNMEA. The other DB-9 plugs into the Smart Coupler. Be careful, as the two connectors are identical mechanically but differ electrically. A nine-volt battery will power the fixture and the Coupler. For 28V aircraft use 2 9-volt batteries. Of course you can use a bench power supply.

If you use in in-aircraft setup (Fig A3-2), the two connectors are different, but the meter connections must be made externally. They are not part of the fixture.

Starting the setup/calibration program

Instructions for loading SimNMEA are also on the web site. Once installed you will find the program in the start menu:

“Start|Programs|Porcine Associates|SimNMEA|Launch SimNMEA”.

If your coupler is one that will accept data at 4800 baud and 9600 baud, it may not recognize the calibration command the first time. The GPS OK lamp will blink when the coupler accepts a command. If the OK lamp does not blink, simply re-issue the same command.

Open the calibration panel with the calibrate command that can be found in the SimNMEA file menu.

Setting Course Width

Course width can be set to 1.25, 2.5, 5 or 10NM. You cannot tell what the old course width was set to. Couplers are set at the factory to 1.25 NM unless we are instructed to do otherwise.

Setting the zero

You cannot tell what the old calibration factor was set to. Calibrate the Smart Coupler zero by stepping through the following sequence:

1. Let the Smart Coupler warm up for 2-3 minutes. Note the voltage on the meter. If it is $0 \pm 1\text{mv}$, no further calibration is needed.
2. Set the calibration factor to zero.
3. Note the voltage on the meter.
4. Set the calibration factor to the number of millivolts that show on the meter above. If the meter shows +3mv, use a calibration factor of three. If the meter shows -2mv, use a calibration factor of -2.
5. After calibration, the meter should read $0 \pm 1\text{mv}$. If it does not, adjust the calibration factor accordingly and try again.

Setting the lamp dimming factor

For the original coupler you can choose a dimming factor from 0 (not dimmed) to 6 (most dim). SimNMEA will allow you to select 0-9, but 7-9 do not work with the original Smart Coupler. If you prefer to have the GPS OK brightness follow your panel dimmer, select external dimming.

Appendix IV - Differences from previous models

Starting in March 2006 Porcine Associates phased in shipping an improved Smart Coupler model. This is the third complete redesign of the Smart Coupler hardware since the Smart Coupler was introduced in 1995. The new hardware has serial numbers starting with 6000.

Improved night dimming of indicators

Couplers can now use the panel dimmer bus voltage to control the GPS OK lamp brightness. In this case the brightness will vary with the dimmer bus voltage. Connect the yellow wire to +12 or to ground for full bright. In between the brightness will follow the bus voltage.

Use the utility SimNMEA to change dimming modes. SimNMEA is described in appendix III.

Built-in GPS OK indicator

This indicator is useful when troubleshooting and for installations where the Smart Coupler is removable. For normal, permanent installations the indicator is not used after initial troubleshooting.

Couplers include two flag outputs

Some autopilots and some HSIs require a TO flag and/or an equipment flag. These outputs are on pins 3 and 6 of the 9-pin Smart Coupler connector. Reference is on pin 8. These outputs are $\pm 300\mu\text{A}$ into 1000 ohms differential. See the pinouts below.

Couplers include a more capable processor

Processors have improved immensely since the first coupler shipped in 1995. With the new capability I am looking forward to including some GPSS-like features in the Smart Coupler – stay tuned! Owners of model B will be able to update with a modest upgrade fee.

Connector pinout has changed

Note that the power connections have changed to make room for the flag outputs. If updating from a previous design make sure that you use the new connection scheme.

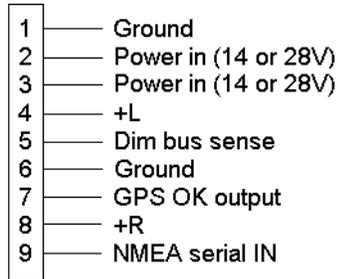


Figure 6 - Previous model connector pinout

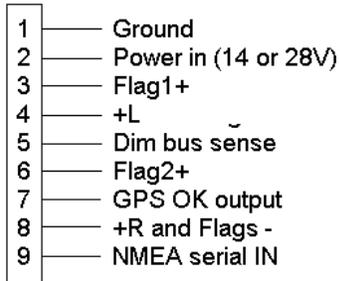


Figure 7- Model B connector pinout