

Simple Calibration.

The Yellow Box v.II features simple and exact calibration. The switch on the far left (sw 1) selects whether the ratio is POSitive or NEGative.

Sw 1 on = NEG (fixes speedo that reads too SLOW)

Sw 1 off = POS (fixes speedo that reads too FAST)

Almost every sportbike has a speedo that reads too fast, so POS ratio is the normal setting, with the switch OFF (down).

Sw 2 - sw 8 are used to set the amount of speedo correction. **Remember to switch the Yellow Box off and then on again to activate the new switch settings.** Our new simple calibration system adds an exact correction value for every switch that is ON. For example, sw 2 adds 16% correction. Sw 3 adds 8% correction. Each switch adds a slightly smaller amount of correction until the last switch, sw 8, adds only 0.25% correction. This is shown in our diagram above.

This simple system gives exact adjustment in steps of 0.25%. See the "complete list" over the page for all valid ratio settings.

Example.

If you have measured your speedo as reading 9% too fast, simply set the 8% switch to on, and also set the 1% switch to on (with all other switches off) This will give 9% correction. The switch on the far left, sw 1, selects for Pos or Neg speed correction, so in this case because your speedo reads fast it is left in the normal off position. It is as simple as that.

Tech info: The Yellow Box computer uses a highly accurate internal math table to add exactly the right correction for each switch you select. These high-accuracy correction values are then "built up" into a single binary number that the computer uses for all speedo correction calculations. If you add an extra 1% you get exactly an extra 1%.

Using the Correction Table.

We have provided a full table of every valid correction ratio (over the page). You may find it easier to use the table. If you have measured your speedo error using our formula and have a result of 1.09 (speedo 9% fast) simply look down the table to find the ratio closest to 1.09, and next to it are shown the switch settings (0010 0100). You may notice that this is the

same as the example shown above where the 8% and 1% switch are both set to on to give 9% correction. **Note!** When using the **special kph/mph conversion** feature, only positive correction is enabled (for speedos that read too fast).

How to measure your speedo error.

As the Yellow Box can be adjusted quickly and exactly it is important to find out how much speedo error you have.

The method we suggest uses freeway markers, signs that are on many freeways showing 0 miles, 5 miles, 10 miles etc. The markers are laid by professional surveyors and are extremely accurate. **Make sure your Yellow Box has all switches set to OFF (down) before doing this test.**

Step 1. Stop at the first marker (0 miles) and reset your tripmeter.

Step 2. Drive to the next marker (5 miles) and stop and make note of your tripmeter reading. This should be accurate to the nearest 0.1 miles.

Step 3. If you want a more accurate reading, instead of stopping at the 5 mile marker, drive slowly past at 36 mph (or 36kph for kph speedos). At 36mph, each second equals 0.01 miles. If you count the seconds from passing the marker to your tripmeter clocking the next 0.1 digit, this will allow you to work out the trip meter reading to within 0.01 miles accuracy. This may sound complicated but can be done quite easily.

The Formula.

Now you have your speedo tripmeter reading over 5 miles, you can work out your speedo error. This is very simple.

$$\text{Ratio} = \text{Indicated} / \text{Actual}$$

Let's say your indicated distance on your tripmeter was 5.45 miles, and you know the actual distance is 5 miles exact.

$$\text{Ratio} = 5.45 \text{ miles} / 5 \text{ miles} \quad (\text{so, Ratio} = 1.09)$$

Now you just look down the table of ratios we provided and find the closest ratio to 1.09 which is 1.0900 and has the switch settings of 0010 0100. If you have measured correctly you can simply set the switches to 0010 0100 as shown and you will have no more speedo error.

Other methods of measuring speedo error.

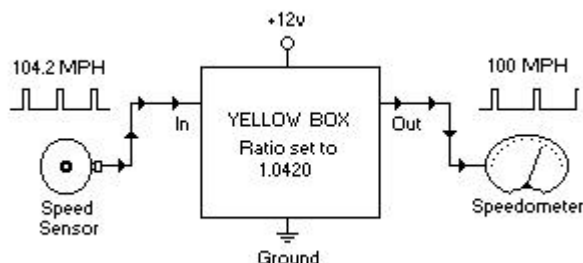
Some people measure their speedo error by comparing to a bicycle computer that has already been calibrated. Other popular methods include comparison with GPS systems, radar speed signs, even using a stopwatch over a measured distance. The method we recommend is the freeway marker system above. It gives good measurement over an exact distance.

Finishing off.

During speedo testing and calibration it is easiest to leave your Yellow Box in a handy location. Once you are happy with the adjustment you may want to mount it in a secure location. We also advise putting silicone sealant or hot-melt glue over the switches so they are protected from water and moisture. Most users find they soon forget about the Yellow Box and just enjoy having an accurate speedo. <end>

How it works.

The Yellow Box contains a high-speed microprocessor (tiny computer) that constantly measures the incoming speed pulses, mathematically changes the speed to correct it, and outputs the correct speed to the bike's speedometer.



Every single input pulse is measured, calculated and corrected, ensuring instant response to speed changes and maximum accuracy.

Quality Electronics.

To ensure utmost reliability of our unit we have included three stage regulation in the power section, with top quality metal film resistors (not carbon), solid substrate capacitors (not electros) and five separate spike filtering systems. The unit will also withstand reverse polarity power connection for a short time, but this is not recommended.

The designer has gone to great lengths to design a very high quality unit. In terms of part selection we have used top quality parts, rated well within their heat and current limits. Manufacture has been "in house" at one of our shops here in Australia, each unit hand assembled and visually inspected by our staff. This is NOT a mass produced Asian electronic device! It should give many years of trouble free service.

The unit will be extremely reliable in the vehicle we have supplied it for. The unit draws very little power, around 60mA, and will not flatten your battery or blow fuses (if installed correctly).

Both the input and output circuits contain filtering to protect the bike's sensor, speedometer and the unit itself.

The unit is NOT waterproof, the switches we have used are "splash resistant" (for what that is worth) but are not rated for submersion in

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water. If you mount the unit in a place where it may be exposed to water, we recommend that you put a layer of silicone sealant over the switches and wire entry points and allow this to set properly before wetting the unit.

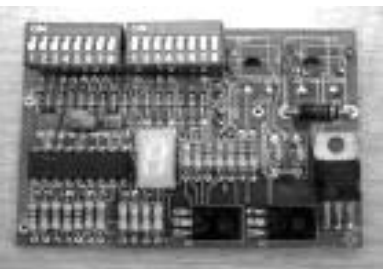
Please do not install the unit on a different type of vehicle other than the one originally agreed, as it may have been set up specifically for that type of vehicle. If you wish to try it in a different model vehicle, please contact us.

We have supplied a jumper plug, this can be used INSTEAD of our unit, and will return the vehicle to the original wiring configuration. It simply connects the input directly to the output, and ignores the power connections. See the diagrams. This is useful if you need to remove our unit for comparison purposes, or if our unit was to become faulty you can return the vehicle to original speedo function.

We have provided a one-digit number display on the unit, this is a quality feature and reads out the switch settings and software version number. This is useful as a confirmation that you have set the switches correctly.

Each unit has been tested on our bench setup before shipping to you.

NOTE! We have chosen to encapsulate (set in plastic) the Yellow Box. This was done as the best system of protecting the product from damage. Like most automotive electrical products of this type, there may be slight imperfections like indents, bubbles or small



cracks in the surface finish of the plastic. This is a normal feature of the molding process and will not affect the performance of the product.

Accuracy Concerns.

Many vehicle owners, like racers and land-speed record drivers may need 100% accuracy - or as close to that as possible. There are many factors that affect accuracy, and the more you

understand about these factors the better the accuracy you can get from your vehicle and our product.

Our product will never be the limiting factor in your search for perfect accuracy. It uses digital measurement, and digital calculation, and it has VERY HIGH accuracy. You can adjust it through 2048 very fine steps to the exact ratio you require. As such it has an accuracy of better than 0.00025 ratio, or 1/40th of 1 percent.

As your tyres wear down, your accuracy will change. The average motorcycle rear tyre is about 300mm radius, and will wear down about 6mm from a new tyre to bald tyre. This represents a 2% change in speedo reading. You can set your accuracy with a "half worn" tyre, so your speedo will read up to 1% slow when the tyre is new, and 1% fast when the tyre is worn out. This is quite acceptable considering your stock speedo was probably sold with an error of about 8%! Or, if you are prepared to measure your speedo (as outlined above) once a month, you can change the switch settings once a month as your tyre wears down, and keep your speedo very close to perfect accuracy.

Speed will also affect accuracy. As the wheel spins faster, centrifugal force "stretches" the rubber tyre to become larger, so your speedo will actually read a fraction slower at high speed, and a fraction faster at low speeds. This effect, often called "tyre growth" will be different for each tyre. A typical growth would be 1% to 2% at the maximum speed of a sportbike. The best solution for this is to calibrate your unit for the speed you most often ride at. For most riders this will be "cruising" speed. A racer may want to set his unit to be most accurate on the racetrack's main straight, at a very high speed. Likewise for a rider doing maximum speed tests or land-speed records.

One very critical factor, especially when measuring speed on a DYNO, is tyre slip. With a high powered vehicle like a modern sportbike, the engine produces enough power to slip the rear wheel. This is not always obvious, but at high power there is ALWAYS some slip between the tyre and the road (or dyno roller). It is constantly slipping a tiny bit. Even with a heavy rider and the bike strapped down, you can only reduce the tyre slip under power and not totally eliminate it. When the bike is at full power, the tyre is constantly slipping from 2% to 10%, maybe even more on a curved dyno roller that doesn't offer the same tyre contact patch as a flat road. All big bikes do this, some dynos even estimate a standard few percent slip and allow for this in the horsepower calculation they do. It is a problem for everyone.

Black Robotics – Makers of the Yellow Box speedo recalibrator. This text is reproduced on our web site.

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If you plan on using a dyno to measure wheel (bike) speed, be sure to get the bike up to the desired speed, then back off to a "coasting" throttle setting where the bike engine is not accelerating or decelerating. Hold this speed steady for a few seconds, and at this point you can trust that there is very little slip between the tyre and the dyno roller. Important! There is a type of dyno that applies a LOAD to the roller to measure horsepower, with this type of dyno the bike will not be able to "coast" at a constant speed and will not give an accurate speed reading. Discuss this with your dyno operator if you are unsure. Most common dynos WILL allow the bike to coast. Trying to calculate speedo accuracy from a full power dyno run will NOT work.

Human error and rounding errors will affect accuracy too. Most people could not easily tell the difference between 100mph and 101mph (a 1% error) on a dial type speedo. Especially from a quick glance - similar to road or race conditions. Also, another error is created if you move your eye relative to the speedo, by moving your head sideways or up or down. Don't expect accuracy of better than 1% from a dial type speedo unless you have a skilled person who can view from a standard eye position and take a couple of seconds to do so. Digital speedos should be easier! Ideally, they display 100mph or 101mph in clear numbers. But then we have rounding errors. At some point, probably 100.5, the speedo changes from 100 to 101. This is another error. At lower speeds, like 50mph, this error can be up to 2%, typically 1%. These are normal errors which are to be expected from the type of speedos we have on modern vehicles.

Lastly, there may be slight speedo errors in the stock speedo instrument, even with an exact signal going to the unit, it might read with a small error. Digital units are usually very good, and even dial type speedos can be quite accurate. The late model Suzuki dial speedos have excellent accuracy, they use an internal computer chip and stepper motor to position the needle to the exact spot on the dial. We measured one on our test equipment which was accurate to 1/5th of 1% - which by the way was the limit of our (eye) ability to measure the needle position

Due to the errors discussed above, you can still expect a "real world" speedo error of up to 1%. Professional testers and racers may have the equipment and skills to keep their speedo calibrated higher than this. We have been able to keep our test motorcycle at 0.2% error (example 100.2kph=100.0kph) through the life of a rear tyre.

Typical modern motorcycles have an average 5% to 8% speedo error. By changing the front sprocket down one tooth in size this error will be increased to about 10% to 20%. Using our product you should be able to calibrate your speedo to a level of accuracy that is almost perfect.
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