Installation And Set Up Of Sigma Multi Function Digital Cycling Computer Speedometer For The Lotus Elan S1-S4.

Brought To You By:
Col Croucher.
www.elantrikbits.com
Australia.

The First Question You Might Ask Is: Why Bother?

There comes a time when the repair of old analogue instruments becomes either to difficult and expensive or you can't find a repair centre to do the work for you at the right price. The writer was faced with the same scenario and began the task of investigating the possibility of installing a cycling computer in an S2 elan.

This action was prompted after reading an article in the lotus seven forums, where many lotus seven owners had carried out this project with great success. But the method of installation into the elan differs somewhat to that of the lotus seven. Many motorcycle owners have also resorted to this speedometer conversion, simply because it works and provides GPS accurate road speed-readings when calibrated correctly.

The brand of cycle computer that had been used was made by Sigma (No Commercial Intended), but the reference article is now several years old, technology has moved on, and many manufacturers of cycle computers are now going wireless, but for this application a wireless computer could spell trouble while trying to cope with the interference from the raw electrics and electronic pulses & flux emanating from a high voltage ignition coil, and the distance between sender and receiver may be stretching it a bit.

As it turned out, Sigma is still the right choice because they still produce **hard-wired cycle computers**, the model chosen for this project was the **BC 1609,** a multi function device and has quite a large instrument face & readout, these instruments are much like a mini digital Halda, you know, the popular devices used by Rally drivers and navigators, and a bonus is that this model has a back light for night function if you do any night driving in your elan. One important feature is that there is no need to switch the computer on or off, because it is activated when it detects a pulse from wheel motion. The instrument has a small battery which will need replacing maybe once a year, depending on the use it gets, so make sure to carry a **spare battery** or two with you at all times.

After a thorough investigation of the **Sigma BC1609**, the first step was to actually purchase one, and after parting with about fifty dollars (AU) (March 2012) from the local bike shop, the planning of the installation work could begin.

Perhaps you are wondering, why use a bike computer? Can they actually read a high enough speed for the elan? The elan has a max speed of about 125MPH (201.168KPH), which is a coincidence, because the Sigma BC1609 will compute speeds up to a maximum of 199.9 KPH, (124.2121MPH), enough to convince me that this little digital computing device will be more than adequate, and in most normal road driving conditions you wont be seeing 199.9KPH on the speedometer very often, if at all.

The main reason for choosing the digital speed monitoring solution in the elan was simply because the old smiths instrument is totally unreliable & very inaccurate, (But still records distance) and with the speed police out and about everyday here inAustralia, as well as having to watch out for fixed and mobile speed cameras everywhere, the chances of being pinged for speeding are pretty high, I don't particularly want a ticket to the policeman's ball, and I don't think you would either. For the low cost of fifty dollars and a bit of fiddly work with the installation it is well worth the effort to have an accurate speedo.

The Installation Process.
A word or two about the tools and skills required for the project should be mentioned before proceeding any further, you will need a lathe, (Or access to) an Oxy welding outfit, and of course, other tools in your workshop... you may even want to investigate how to do metal casting to make the small alloy **magnet holding block** which is located within the hub-disc rotor cavity, and also the **steering column speedo mounting block**, but there's perhaps no real need for that, because there are possibly other ways to produce the aluminium holding & mounting blocks, but for excellent results the casting method is certainly the best.

This project is what I would call a green field project, despite making a concentrated online search, we could not find any comprehensive notes written about attempts by other elan owners who had gone through the installation of a cycle computer as speed reading instrument, except for the references made in the lotus super seven forums.

The Sigma1609 Cycle Computer Kit.

The computer is supplied with cables, zip ties, sensor, holding bracket (Adjustable for Vert or Hor). The sensor cable length as supplied is to short for our purpose, so it will need to be lengthened to requirements. A simple cut, add & re-sheath, re-solder wiring job when we know just how much extra cable is required, there is no sense in making the lead too long.

Creating A Plaster Moulding Pattern Of The Disc Rotor Recess.

The plaster of Paris mould will create an exact replica of the **inner hub cavity** where the cast alloy block will be inserted later in the project and fastened with 3/16" UNC cap screws. If you are unable to do metal casting, then you might have to fashion an alloy block by hand filing, grinding and linishing... a bit of a chore, but doable... The metal casting process will produce two “perfect fit” aluminium blocks in less than 30 mins from a cold start with basic metal casting equipment. I might also add that there are endless opportunities to make special things when you learn and understand the **skills of basic hobby metal casting.**

The plaster mould pattern above might look like blue vein cheese but I can assure you it is not, it is a simple plaster of Paris mould, in effect, an exact

replica of the cavity in the wheel hub-disc rotor as shown above. The plaster pattern plug will be used as a foundry pattern in the green sand mould.
Making the Plaster Pattern Mould Cont'd.

Place a piece of masking tape to seal off the inside to create a dam, mix up a plaster slurry, pour the slurry into the cavity and allow to set over night, but before hand, make sure to smear plenty of grease or heavy oil over the cast iron to act as a parting agent. It is also a good idea to spend some time with a die grinder cleaning up the rough cast iron surface finish for easier removal of the plaster mould plug .The plug will be used as a pattern to cast two aluminium blocks, one will be used as the **magnet holding block**, the other as a **counterweight. You must employ an aluminium block to embed or hold the magnet**, **DO NOT** use a Ferris or mild steel block; otherwise the project will simply not work. And don't be tempted to use a resin block because it may break down or melt due to the heat generated by the disc brakes.

Machining (facing) Of The Counter Weight.

Mark out and clear drill two 3/16" holes in the alloy block as shown, use two cap or Allen screws to secure the alloy block to the disc rotor and hub, then place the disc rotor in the three jaw lathe chuck and face the counter weight, do not remove more than is required before the mag block is installed as both blocks are required to be faced or machined at the same time to make sure they are identical in height & weight, and that there is sufficient clearance between the steering arm bolt heads as you will see a little further on.

Lathe plate Jig Set Up To **Bore The Cast Alloy Magnet Holding Block.**

The first thing noticeable in the image above is that the hole for the magnet is off centre, there is no reason other than the block was not marked out correctly with the marking out blue, and note also that the bore needs to be as near to the outer edge as possible so as to locate the magnet in the best possible position for the cycle **computer sensor** to relay the mag pulses to the computer. Because the cast alloy block is an irregular size and shape, the best way to hold and carry out the boring operation is to mount the block on a mild steel plate, which has been drilled and tapped to accept the cap screws. Then all that is required is to set-up & centralise the plate and alloy block to the required centre of the bore in the **four jaw chuck** and proceed to counter bore the hole for the magnet.

Use Heat tolerant Samarium Cobalt (Ultra Strong) Magnet Inserted Into Cast Alloy Block Machined Bore.

Alloy Counter Weight Block & Magnet Holding Block Located & Fastened To The Rotor cavity - Hub Assembly.
(Note the magnet counter bore location.)

Because the alloy holding block was cast from the plaster pattern cavity replica, the fitment of the blocks are perfect... another reason why you should employ a **cast alloy block**, the upper face of the magnet sits just below the block face, while the cap screws are recessed about 1mm below the surface, to avoid confusion don't forget to stamp each block and the inside rim of the rotor with corresponding numbers or letters so that they don't get mixed up.

The original magnet supplied with the Cycle computer is discarded, give it to a cycling friend as a spare, the OEM cycle magnet is far to weak to for this application. Locate a good Magnet Supply shop, any Aussie elan owner thinking about this project, contact **The Mag Lab located at 43/5 Ponderosa Pd Warriewood NSW 2102. 02 997 996 77.** Samarium Cobalt Magnets are designed for high temperature applications, they are rare earth type, very strong, **samarium cobalt magnets are the best choice** for use in disc brake applications. Other types of magnets will fail with exposure to heat from the disc brakes.

The magnet required cost about $4.00, the freight was $12.00.The size of the magnet is about 10 X 5mm, and is very strong. The standard cycle magnet supplied will pulse at a max distance of 5mm, the samarium magnet will pulse at a **max dist of 12mm which is ideal for this project**.

When the counter bore for the magnet is correct, and the height of the blocks are correct, and nothing fouls anywhere, insert the magnet into the counter bore with **Araldite epoxy glue**, and for good measure place three **centre pop** indents around **the rim** of the hole to crimp the magnet into place to prevent it ever coming loose, **place three crimps or centre pop dimples at 120deg around the edge of the magnet**.

The Standard Elan Front Disc Rotor.

If you have been the observant reader, you may have noticed that the disc rotor we have been showing in this project differs from the standard elan, the above photo above shows a standard elan front disc rotor, the one we have been using in this project is in fact a 2500TC Triumph disc adapted to the elan for larger brakes, a conversion made possible only with 14"X 6" wheels, I thought I better include that bit of info before you get too excited. With the plain recess of the elan disc rotor, an alloy ring could easily be machined from aluminium plate and then segmented into two blocks, employ one for the counter weight and the other for the mag holding block, fastened with cap screws as shown previous.

Backing Plate Sensor Access Slot.

Once the cast alloy blocks are almost complete, attention can be turned to the mounting of the sensor, if your elan has disc rotor **backing plates**, a slot will be required to be cut as shown, nothing fancy is called for, just some careful work with hand tools, files, and perhaps a air or electric die grinder, the metal removed from the front of the brake calliper mounting plate is to allow the computer sensor to be placed nearer to the magnet, don't remove any more sheet metal than what is shown here.

View Showing Backing Plate Sensor Slot In Relation To Magnet.

As you can see here, (Above) the magnet is in full view, there should not be any problem with the sensor receiving a strong pulse to activate the reed switch computer sensor switch, which in turn will activate & drive the computer and calculate the speed.

How The Cycle Speedo Works.

Cycle speedometers work with a magnet attached to the front spoke, or in our case, **it is embedded into the alloy holding block**, when the magnet passes it trips the switch that is mounted on the fork, or in our case**, the special bracket on the back plate** every single time it rotates passed the switch.

The switch is actually a reed switch, which is a hermetically sealed casing that contains two overlapping reeds that are made up of a magnetic material.

As the wheel turns, the magnet installed passes by the reed switch and an electromagnetic signal is generated and sent to the computer which delivers a speed reading. **BUT**, before that happens the computer **MUST** be calibrated correctly to give the correct speed... **make sure to read the set up manual, it is quite simple once you get your head around it. It does not matter what kind of wheel and tire combination you use the speedo can be calibrated to give dead accurate speed readings.**

Front View Of Access Slot Through Backing Plate.

This is where the going gets a little tougher, note that the bolt heads have been machined to reduce the height, the upper most bolts are 5/16" HT bolts, it is OK to remove about 1.5mm from the bolt head, like wise for the lower 7/16" HT bolts that locate the steering arm, this is acceptable engineering practice, and is required to provide clearance for the alloy blocks from the bolt heads while rotating.

The **magnet size is 12mm Dia X 5mm Thick**, this size works great, but if a stronger magnet was employed the alloy blocks could be reduced in height and the **bolt heads may not require machining**, small tweaks are required to **get the magnet close enough to the sensor to trigger the reed switch as it rotates.** Much the same principle as used in ABS braking and other electronic control devices.

I f you are willing to experiment with the project, you may get better results than what we have come up with here. Also the spring washers were removed from the bolts for a small amount of extra clearance, **the bolt threads should be cleaned and assembled (Tightened) with thread locking compound to prevent the bolts from undoing, nuts should be of the nyloc type**

Note: Distance covered so far is in excess of five thousand KMs since this modification was carried out, and no faults or problems have appeared during that time.

Sensor Mounting Bracket Threaded Tabs.

The most intricate part of the whole project is setting up the mounting points for the sensor holding bracket, I cant give you exact dimensions, because it is a bit of an eyeball kind of exercise. Two small machined and threaded (3/16"UNC) MS tabs are silver brazed to the backing plate, if there is no backing plate, then a small MS bracket could be tack welded to the steering arm to mount the sensor holding bracket, what ever method is used, with a strong magnet, the **sensor must be within 7 to 11 mm of the magnet** in order to be triggered by the magnetic pulses. **(The stronger the magnet the better and further the pulse will travel through the air)**

Fabricated Computer Sensor Holding Bracket.

This is the simple sensor bracket, it is attached to the disc rotor backing plate with very short cap screws (3/16"UNC), the tube is machined from 1/2" MS tube and silver brazed to the sheet metal right angle bracket, the corners are removed with careful linishing to make it neater before zinc plating. The front suspension components have all been painted glossy black since this project was begun; so they look much neater than what is shown here, but the photos were all taken at various stages of progress... accept them as project realism.

The Sensor Mounted To The Holding Bracket.

In the picture above the sensor is held with the strong "O" rings supplied with the unit, and you’ll be happy to learn that there is no need to change over to zip ties or soft wire. Since fitment and 5000kms + of hard road driving has had no effect from the heat generated by the disc brakes on the rubber “O” rings, and that includes several long and fast Alpine drives. Race circuit testing has not been carried out as yet, but there is a possibility the increased heat may damage the rubber O rings, only time and more testing will tell.

To help cool the rotors, small air ducts are used to force air into the centre of the disc rotor through the backing plate, helping to reduce the temperature.

The last job to do is to repaint where any welding and or cutting work has been carried out.

There are also other things to attend to, the wire from the pulse sensor will need to be extended and routed safely and held with zip ties to prevent being caught, stretched, or broken, a mounting bracket for the computer will also need to be built to allow mounting on top of the steering column. With a little more work the project will be complete, luckily the instrument can be set up and dialled in long before the need for a road test.

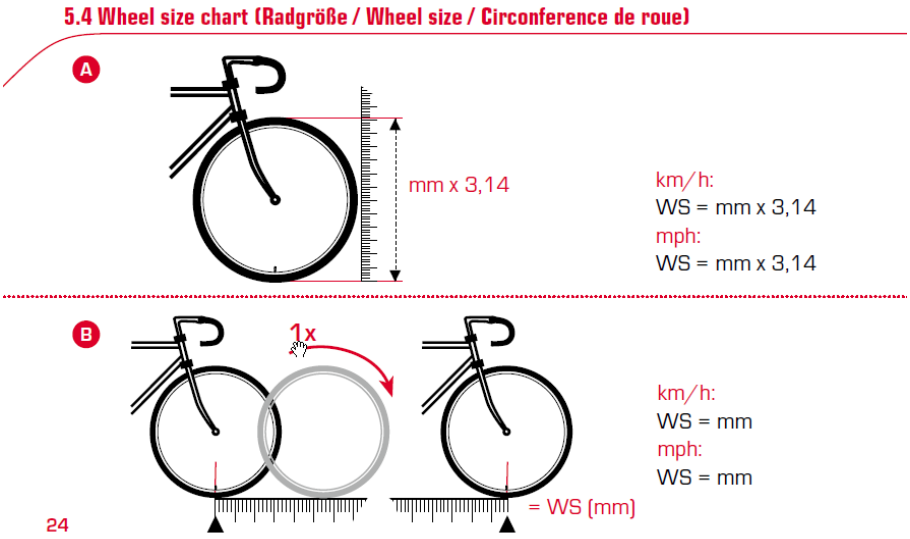
This project has already been bench tested and the results so far are excellent. Cycle computers are capable of delivering highly accurate speed readings right through out the speed range.

The most important function is the actual **calibrating of the device to the wheel size on your car**, this can be based on the wheel size diameter using a special formula, (See below) but the most accurate method is to carry out a physical roll out measurement of the wheel diameter, then input the result as a **custom setting,** which can be **MPH or KPH**, you can even + or - the custom setting to make the readings more accurate.

The **Sigma BC1609** has another neat accessory which is a PC docking station, software can be purchased which enables full set-up on your PC or laptop, and it is possible to also download and analyse all of the data collected from the days drive - sprint or whatever. How good is that, and all this from a cool little cycle computer. (Move over Motec?) - (Joke).

One of the big advantages of having the magnet integrated into the hub is that once installed you can almost forget it, there will be no need to reset anything whenever a tire/wheel rotation is done, or when replacing bearings, or while doing other work, the **alloy holding blocks will remain inside the hub**, and the sensor can be removed and replaced from the special mount post without losing settings or any adjustments, and you certainly don't need a science degree to set this up on your elan.

Below you will be able to learn how to perform a wheel roll out, if you are a bike rider and you've ever been involved in track racing in your younger years you will understand first hand about roll outs for gear checking, but this rollout is for checking how far the wheel travels in one revolution, and get this, the rollout will be affected with tire air pressure, a different roll out figure will also be given if the wheel is on the car and or done off the car, it will be just a few millimetres but it makes a difference to accuracy when inputting the custom setting. See more below.



How To Calculate Wheel Size or Wheel Roll Out. (WS = Wheel Size) Think of the bike wheel as the wheel & tire on the elan.

Note:
Every wheel size and tire combination will give a different diameter or roll out measurement, **air pressure of the tire can also have an effect**, the load in the vehicle will have a slight effect.

If you do a roll out with the wheel off the vehicle and then do a roll out with the wheel on the vehicle, both roll outs will provide a slightly different measurement, it wont be much, but it will be enough to cause a small speed calc error.

The beauty of the cycle computer is that a **custom setting** can be input for higher accuracy, which means that micro fine-tuning can be accomplished if that is what you want, but a setting that is almost correct will provide a fairly accurate speed monitoring for day to day motoring.

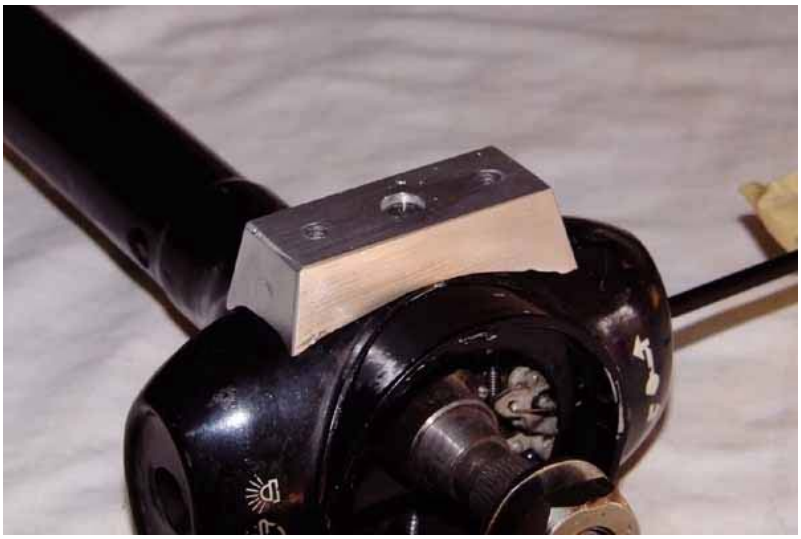
Cast Aluminium Mounting Block.

Underneath View of Cast Aluminium Mounting Block.

Before the project could be considered finished, a special mounting block and bracket is required for the top of the steering column, yes, I know what you are thinking... just mount the computer on one of the steering wheel spokes...well no, I did not want to do that, because of the possibility that the transmitter wire could get caught and broken... better to do things properly, which is why the special cast alloy mounting block was made to enable the Sigma BC1609 to be mounted in the correct place, and also to keep it in your line of sight while driving.

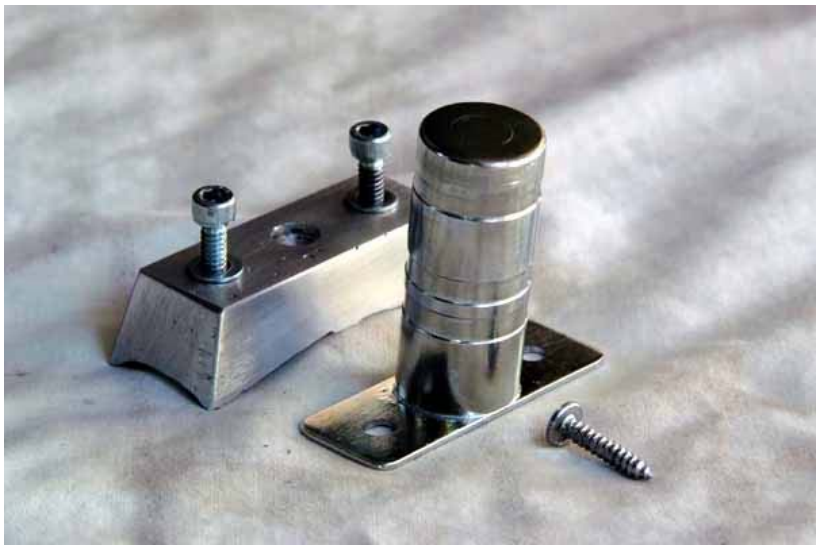
Top View Of Cast Aluminium Mount Block.

The cast aluminium mounting block is designed to fit snugly onto the standard elan steering column, note that it is cast to follow the contours of the indicator and headlamp switch covers, painted matt or gloss black, it will blend in with the rest of the steering column.



Computer Speedo Alloy Mount Block Situated On Top Of Column.

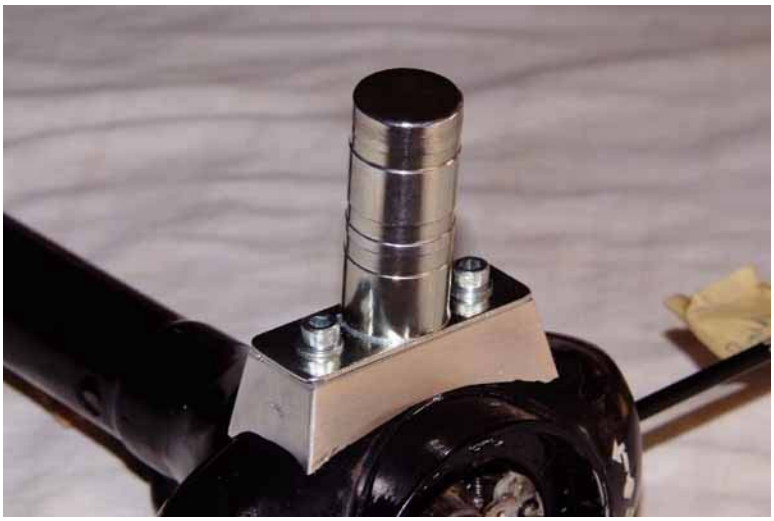
The photo above clearly shows how neatly the cast alloy mount block fits onto the steering column, the block is secured by a self tapper screw that picks up the **original centre hole** for securing the oval shaped shells, the other two threaded holes are for mounting the small bracket fabricated to hold the cycle computer, see photo below.



Fabricated Bracket & Cast Alloy Block Mounting Components.

The simple set up for mounting the Sigma computer to the top of the steering column, note that there are no extra holes, nor any irreversible modifications made to the steering column, the mount block & bracket assembly can be

removed at any time with out leaving any trace of a mounting bracket being situated on top of the steering column.



Steering Column On The bench Showing A Clear View Of The Set Up.

The bracket attached to the cast alloy block is made from steel wishbone tube and a short strip of 16G MS sheet metal, a machined cap is brazed to seal the top, and the tube is brazed to the flat base and secured with 3/16" UNC cap screws, DIY bright zinc plating completes the bracket.

This Is How The Complete Unit Looks When Assembled.

The unit is easily assembled and does not look out of place. The pulse sender wire length running between the sensor and the computer is much to short at 900mm, so it will need to be cut - lengthened, and carefully rejoined again, perhaps a better idea is to use a male-female spade terminal so that it can be disconnected when maintenance or work is required to be done.

The Drivers View In The Cockpit - *(Minus the horn Button which BTW is **not** lost.)*

The final result of the installation. The elan purist probably wont like this, but if it make's the difference between getting a speeding ticket or not, then I'm all for it, I've had enough of an inaccurate speedo that flops all over the dial like a drunken sailor. If the seven owners can make use of this cool technology, then why cant elan owners do the same. BTW, The clock operates on a 24hr system, not that it matters, you'll be having way to much fun in your elan to worry about what time it is.

So there you are, if you own an elan and suffer from analogue Speedometer problems, then this might help prevent speeding tickets, unless you live in a region where the authorities don't particularly care what speeds you drive at in your car, but unfortunately, here in Australia, any kind of speeding is frowned upon, so we require accurate speed reading instruments, but if you want to really give your elan a workout, the race track is the place for that, isn't it.

We hope you have enjoyed reading about this project, this information is specifically for elan owners, but of course could be adapted to other car makes as well, if you have questions please use the contact form at: http://www.elantrikbits.com/contact.html

Please read carefully the set up instruction manual supplied for the digital speedo, the reading accuracy will depend on how much attention is paid to the custom wheel size setting.

Always carry out a final speed test comparison with a GPS or other vehicle that you know is speed accurate.