Simply put, a data-logger could be the best £500 you ever spend on your car. Whether you circuit race, sprint, rally, off-road race or do the drags, you'll have a hard time discovering how you and your vehicle perform together without a data-logger. In other words, you

DATA LOGGING

It doesn't make your engine more powerful, give your brakes more bite or your tyres more grip. It just sits there, silently taking notes like a robot driving examiner. What's so great about data-loggers?

won't know if you're getting the best from all the other expensive bits until you start looking at some hard data. This data gives you two benefits: one, it tells you accurately how well the car goes, and two, it tells you objectively how well you're using the car's abilities. It's this second point that's often the most valuable. But how does it work?

A data-logger records info from the sensors you plug it into, and there's a huge range of possibilities here, but typically it'll record road speed, engine speed and accelerator pedal position as a basic set. From this you can see whether you change gear at the right speed and how well you use the engine and gears. You can also fit sensors to tell you about
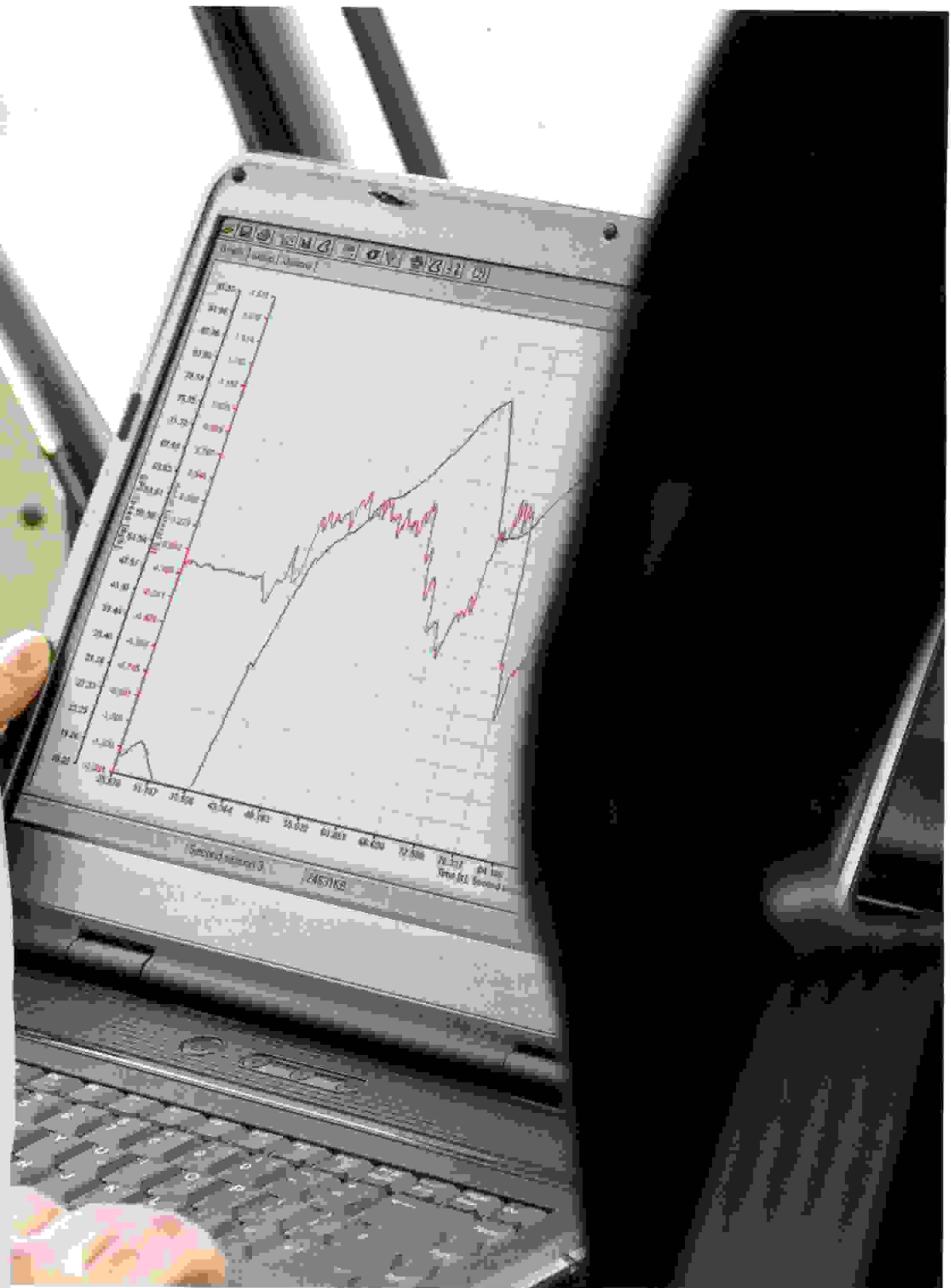
suspension travel and loadings, brake temperatures and so on – whatever you're interested in, these devices can tell you about it. Many now record acceleration (including cornering force) and your position on track from GPS data, thus giving you a plot of how fast you were as you went through each corner. This type has become significantly more affordable and there are many units available for under £500. It's these we'll concentrate on here.
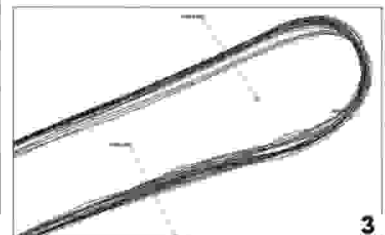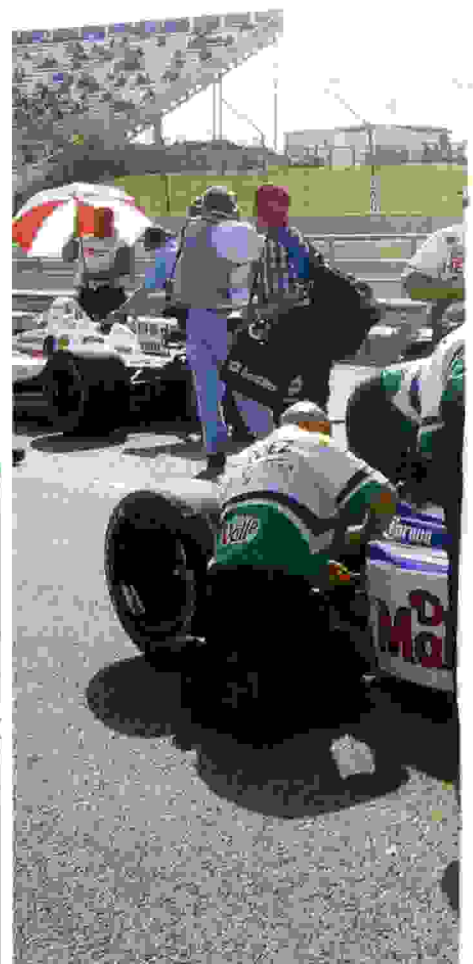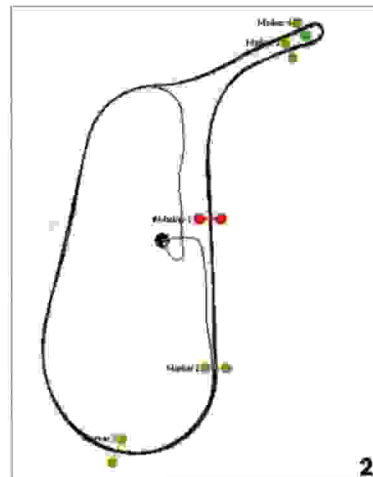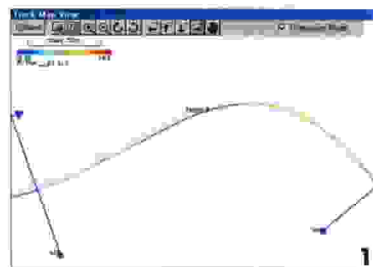
How data-loggers can help

First, let's look at some data so you can see what we're on about. You can see from the screen shots to the right how the logger traces out your position round the track – in this case, Mallory Park. You can then put in 'way points' on the laptop to mark out bits of the track that you're interested in, such as entry and exit speeds for each corner. Once you've put these points in then you can call up the data as a table or as a graph, depending on which you find easier to read.

But why bother with all this gubbins? As an example, consider a test day for a circuit racer. You do ten laps at full tilt. As you settle into a pace your lap times fall and become more consistent. So far, so good. Normally you would check the tyres and if everything seemed optimised, you'd finish the session satisfied that you'd made progress.

In reality you probably took each corner very slightly differently each lap, with your entrance to one bend affecting the next. If you look at the data-logger's print-out you can see the differences lap to lap, and one corner may stand out as having a high variation in

1

2

3

> ## "You can even construct 'dream' laps, taking your best time from each sector to find out how fast you could go if everything clicked"

speed (that'll be the one that never felt quite right). Now if you look at the data you can see what gave you the best results: what speed you went in at, where you started accelerating, where you turned in and so on. With this knowledge you can now go back and try to get that corner just right. This kind of 'fault-find and fix' approach is difficult to do armed only with lap times.

You can also construct a 'dream' lap. Take the best times for each corner and add them up. This gives you a lap time that you could do if you took every corner to the best of your current ability.

Well that's not entirely true; sometimes you have to trade speed at one corner to get the best out of the next, but you get the general idea. It's about showing yourself accurately where you can improve.

Common faults the data-logger is good at showing up include

hesitation moving from accelerator to brake at the end of a long straight, hitting the rev limiter when changing up and coming back on the power too early or late. All of these can be seen clearly in the data traces your logger will produce.

Getting real, accurate data is also very valuable when you're making modifications to the car set-up or tune. Often a car can feel quicker just because it requires more concentration, but this could be because the power delivery is harsher or the steering is more twitchy, or even because you forgot your ear plugs. For example, if you're trying different damper settings you can see how it affected corner entry and exit speeds.

Recording suspension movement is very useful for off-road racing. Seeing how often you hit the bump stops and when the wheel is at full droop (off the ground) can help you
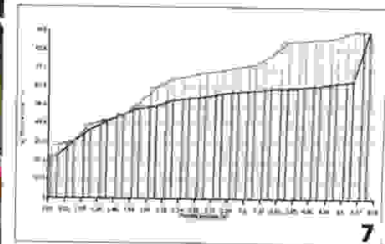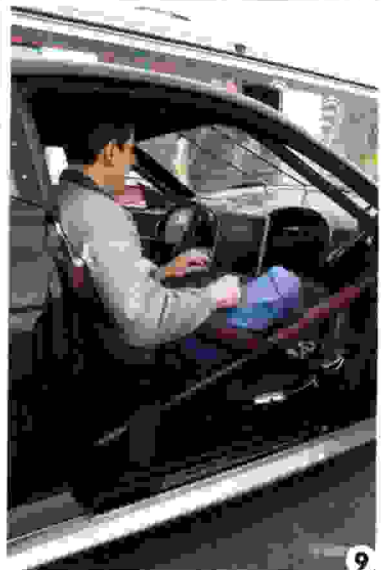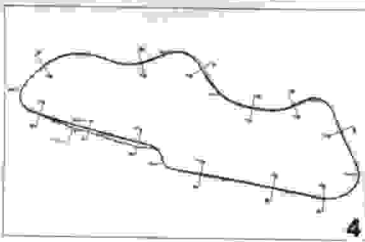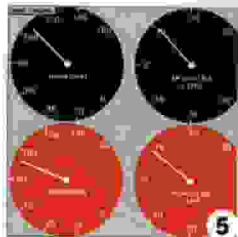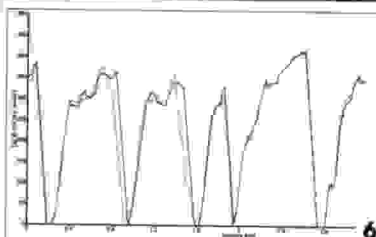
get the most out of the suspension and thus the available traction.

Interpreting the traces is something of a skill, and if you've never done anything like this before then it's worth spending some time with someone who has. If you look at the traces of the hairpin at Mallory Park you can see the different lines taken on each lap. You can then call up the data showing which line was fastest for you and your car. With a bit of practice you can also see which is the best line when overtaking, too.

Which to choose?

There's a huge range of data-loggers on the market, with more arriving all the time. The simplest is a rev counter with a memory and a playback function, which is excellent for drag racing where gear shifts are critical. Then there are digital dash boards which record and display

1: Compare progress against your best lap — red is slower, blue is faster.

2: A typical track map, here of Mallory Park, as generated by a GPS logger

3: Variety of different lines around the Mallory hairpin is obvious here.

4: The marks across the tracks are points you can insert to section the data.

5: Not all the displays are graphs – digital dials are easy to grasp at a glance.

6: Power usage. You can even plot how much you're using throughout the lap.

7: Sometimes histograms show things most clearly – here, it's throttle usage.

8: You can get the raw numbers up in tables as well as showing graphs.

9: Need a quick check on engine operation? Sit down and plug in.

sensor data, typically engine and road speed, engine temperature, boost pressure and other things you would expect to see on a dash.

Then there are the stand alone 'black box' units with a number of speed and voltage inputs plus an in-built set of acceleration sensors to tell you braking, acceleration and cornering forces.

The ones that combine this with GPS data can give you a nice picture of the race track and overlay how well you were doing on top of it.

There are many units of this sort available for club-level use. One of the cheapest is the GPS Dyno Star logger (available at demon-tweeks.co.uk) which is less than £300 with seven analogue inputs for position sensors etc, and four wheel or shaft sensor inputs. From the USA comes Racepak, who have been logging on drag racers for decades. The current exchange rate means you

get full GPS-based logging and a dash display unit for about £500, and although you can add loads of extra sensors, each one has to be on a network called Vnet and it can become costly. Back over to the UK, Race Technology (race-technology.com) make the country's biggest-selling data-logger, the DL1 (£499+VAT) from which much of the data illustrating this feature comes. It has eight analogue inputs and four wheel/shaft sensor inputs. Pi Research (piresearch.com) are introducing some new loggers specifically aimed at the club racer which we hope to review soon.

At the upper end of the clubbie scale, Stack's sexy 'dash-loggers' offer combined digital dash and data-logging roles. The ST8812S Dash-Logger can be configured to work with a wide range of sensors, allowing the system to be set up to suit most engine and driver
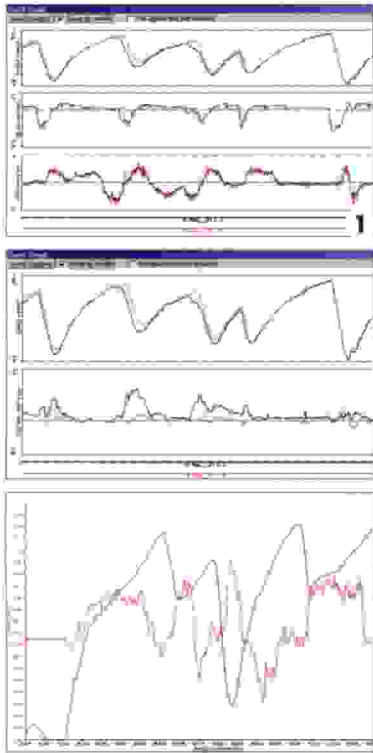
monitoring requirements. On it's own the Dash-logger will monitor and record up to 9 individual sensor channels, up to 3 internal G sensors, battery voltage and lap times, giving a total of 14 channels. There are options to display predictive lap timer, performance meter, and brake bias. See stackltd.com for more.

Everyone from gadget junkies to race pros or driver coaches will love the combined video and data-logging system that Aim Technologies (aimsports.com) offer. DaVid overlays in-car video footage with live data, so you can admire your progress (or otherwise) after every session. We hope to be taking a closer look at this one soon, too.

Farringdon Instruments' FD20 logger records onto an SD memory card, dispensing with leads and long download times. It'll record speed, RPM, oil pressure and temperature, water temperature, fuel pressure, longitudinal and lateral G, gear, battery condition, logger temperature and of course lap time. See farringdoninstruments.co.uk.

Fitting and figuring out

Fitting a data-logger is relatively straightforward, depending on how many extra sensors you want wired in. At a basic level you can fit the unit near the middle of the car, feed it 12 volts and tape the GPS aerial to the roof. This will give you acceleration and your position on the track.

More use can be had by feeding in accelerator position and brake pedal position. If these two don't already have sensors on (for engine management) then you'll have to fit them. These can be home made from a potentiometer and a couple of bent bits of ally, and the same arrangement can also be used for suspension sensing so that you can record roll, dive and squat.

Connecting up road speed and engine speed from the ignition LT side or crank sensor will help you hone your gear shifts and if you compare your road speed sensor with the GPS speed you can see where wheelspin is costing you time. That's fine for most clubbies and will give you happy hours of honing.

Going a step further, you can record each individual wheel speed and steering angle in order to start analysing yaw angle, slip rates, under/over steer and steering effort. This can be used to hone the driver and the car set-up too.

Further still, you can record all sorts of temperatures, pressures and suspension movements, but you need to know what to do with the data to get any benefit from this. But anyone with a good understanding of their car's handling set-up stands a chance of benefiting.

If you turned up at a club race meet ten years ago with a data-logger fitted, you were probably thought of as a spendthrift in danger of taking it all a bit too seriously. Nowadays, with £500 laptop computers available on any high street and cheaper, better loggers appearing all the time, you'd have to think up a damn good excuse not to invest. Hardly anything else has the potential to improve your overall performance so significantly.

This image: Doesn't look like much, but a discreet black box can tell you an awful lot

1: Traces showing relationships between speed and G, RPM etc

2: You don't have to be in something like this to benefit from data-logging.