



## AP22 Performance Meter



- Digital accelerometers
- Built in flash memory
- Download data to a PC for analysis
- Upgradeable with more memory and GPS
- No Installation required – not even external power!
- Optional serial (RS232), analogue and CAN outputs

### What is the AP22?

The AP22 is our most popular product, it is now in its 2nd evolution and there are literally 1000's of them in use throughout the world by driving enthusiasts and professionals alike. Put simply, it is a box with a display that can be used to accurately measure your acceleration times, braking distances, tyre grip and other performance indicators – but the best part is that because it uses accelerometers (and optionally GPS) it does not require any installation in the car whatsoever. It can be placed on the dashboard (or other relatively flat surface) and you can start testing immediately. The AP22 runs off 2 internal “AA” batteries, so it doesn't even need a connection to the car's 12v supply.

### Who is the AP22 designed for?

Most AP22's are used by motoring enthusiasts who are either interested in how their car performs, or want to accurately measure some improvement they have made to their car's performance. The meters are also widely used in auto sport to measure 60ft times, tyre performance or improvements to suspension setup. We also sell 100's of meters to other more niche professional applications such as accident reconstruction, insurance companies assessing cars, driving instructors, the police testing HGV braking performance and car companies testing ride comfort to name just a few! Finally, because the AP22 doesn't require any connections to the car whatsoever, it can be used on anything from classic cars to dragsters!

## What does it do?

The AP22 contains a precision dual axis, digital accelerometer to accurately measure both how fast the vehicle is accelerating and how quickly it is cornering. The high performance microprocessor in the AP22 uses the measured accelerations to work out speed, distance, power (at the wheels), torque<sup>1</sup>, how close you are to the traction limit and even simple track maps.

## Features of the AP22 performance meter

The AP22 is a very accurate performance measurement instrument. In it's most basic form it is designed for short acceleration and braking runs. The data can be viewed on the screen and optionally stored for downloading to a computer at a later date for further analysis. With the optional analogue outputs and GPS3 module, the AP22 can be used for track mapping and integration into other data logging systems. The main features are as follows:

- **Summary timing modes.** For quick, easy, accurate performance measurements. The modes include: timing between any 2 speeds, timing over a set distance and timing over a quarter mile. Timing between speeds modes can be used for acceleration and braking runs, eg 0-60mph, 30-50mph or 100mph-0. Quarter mile timing is a special mode for drag racers and displays the times for rollout, 60ft, 330ft, 660ft, 0-60mph, 0-100mph as well as the quarter mile statistics.
- **Display mode.** Simply displays information on the screen eg. cornering force.
- **Continuous mode.** Logs all the data including speed and acceleration to the internal memory for analysis on the PC using the comprehensive software provided. With all the data stored up to 100 times every second, you can see exactly what is going on in incredible detail!
- **Configurable.** The AP22 is highly configurable: units can be set to either metric or imperial as required and set up details of up to 4 different cars can be stored for quick reference.
- **Simple operation.** The operation of the AP22 is very simple using its 3 buttons: up, down and select. The menu system is rather like operating a simple mobile phone.
- **Non-volatile memory.** The memory inside the AP22 keeps it's contents even when turned off and with the batteries removed. There are 3 different memory sizes available for the AP22, 10000 samples, 40000 samples or 80000 samples. At 100Hz sample rate the memory can store 100, 400 or 800 seconds respectively. At 25Hz sample rate the memory can store 400, 1600 or 3200 seconds (about 50minutes) respectively.
- **Optional GPS.** The AP22 is fully compatible with our GPS3 module which is available separately. If the GPS3 is attached to the AP22 then the speeds are even more accurate as the accelerometer "drift" is eliminated and the system can generate the same very high quality track maps that you get from our other "high end" logging products.
- **External serial port.** The serial port is used for downloading the logged data to your PC, upgrading the AP22 firmware or connecting the optional external GPS3 receiver.
- **Fast processor.** The AP22 uses the very latest, high speed RISC processor to ensure there is plenty of power for future expansion
- **Silicon accelerometer.** Inside the AP22 is a high precision dual axis accelerometer. The accelerometer is the same type that is used in our other products and uses a special digital output to ensure that the measurements are accurate and low noise.

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<sup>1</sup> Note that Torque is only available using the analysis software by knowing the gearing on the car.

# Frequently Asked Questions

## **How does the performance meter connect to the car?**

The performance meter does not make any direct or indirect connections to the car at all. Just to be absolutely clear it does not require wheel speed, engine speed, connections to power, or anything else. To measure your cars performance you take the performance meter out of the box, attach it to the dashboard or other flat(ish) surface, and away you go...

## **So how does it work?**

At the heart of the performance meters is a tiny silicon "micromachined" accelerometer. This consists of very small weight on a silicon chip, as the vehicle accelerates, the weight moves. You can demonstrate the same effect by suspending a weight on a length of string, as you pull away the pendulum will move backwards, if you brake the pendulum will move forward. By very precisely measuring exactly how much the weight moves the car's acceleration can be calculated.

## **How does it measure speed and distance?**

Once you know how fast your car is accelerating, it is easy to calculate the speed. If you accelerate at 1g from 0mph, you will be travelling at around 22mph after 1 second. If you measure this 100 times per second, then for each 1g of acceleration, your speed increases by 0.22mph at each measurement. Distance is calculated by knowing how fast you are travelling. So if your speed is 60mph, your distance will increase by 10.5 inches each time a measurement is taken.

## **How big are the performance meters?**

The meters outside maximum dimensions are about 126mm x 68mm x 40mm.

## **How much do the performance meter weigh?**

The basic meter weighs in at about 200g.

## **What software comes with the performance meters?**

The AP22 meters comes with a comprehensive data analysis package for detailed analysis on a PC, a live monitor system that allows you to check the meters output in real time and a "reflash" utility that enables the user to update the meter to the latest firmware version.

## **Why do the performance meters use a 2 axis accelerometer, not a 3 axis accelerometer?**

The answer is in our Truths and Myths FAQ on our web site... but the short answer is we don't do it because it doesn't help!

## **How is the meter powered?**

The meter uses 2 "AA" type batteries.

## **So I've got the meter, what do I do?**

Go out and use it! For example, to do a 0-60mph test: Attach performance meter to the car. To turn the unit on press the select button (marked ·). Race Technology will appear briefly before entering the main menu. Press the up or down button until Summary Timing is displayed. Press the select button.

Press the up or down button until Time Between Speeds is displayed. With the car stationary, press select. Wait until the display changes to: "Ready to Start, 0.00g 0.10g" Accelerate past 60mph. Once past 60mph the display will show the time taken to travel between 0 and 60mph, for example: "0.0 - 60.0mph, 6.46s 370ft". After pressing select you will then be asked if you wish to store the data, pressing select again will return you to the main menu without storing the data.

## **What leads come with the performance meter?**

All performance meters are now shipped with a "RS232" style serial lead; this lead is required to download the data from AP22 meters as well as reflashing the firmware when required.

## **My laptop doesn't have a serial connection, what do I do?**

The easiest option is to get hold of a USB to serial adapter - these are available either from us at a cost of £30, or from your local computer store.

**How is the meter packed?**

The meter is supplied in a high quality, hinged black plastic case with a custom foam interior. The system is shipped in a plain cardboard box and protected with foam chips.

**What guarantee comes with the performance meter?**

The meter comes with a full 1 years guarantee and lifetime email backup service.

**I've damaged my meter, can it be repaired?**

No problem, we don't aim to make any profit from repairs - we just do them at our cost of time and materials. Drop us an email to arrange the details.

**How do I change the meters batteries?**

Gently squeeze the top half of the performance meter between finger and thumb. You should now be able to prise the top half of the case from the bottom. The front and back panels must remain with the TOP of the case. Inside the unit you should see two AA batteries. With the unit switched off, remove these and replace with two new cells, making sure the correct polarity is observed. Replace the bottom half of the unit and test. This will not affect any of the AP-22's settings, or any of the data stored in the internal memory.

**Can I use the meter to replace/calibrate my speedometer?**

If you are using the AP22 in conjunction with the GPS3, then it can (and is) used for calibration of the speedometer - but it isn't really practical to replace your speedometer! If the AP22 is used in standalone mode then speed can't be displayed continuously, so it isn't really practical to use it for speedometer calibration.

**I have to accelerate to about 68mph before the meter registers I've done a 0-60mph test, what's wrong?**

This is quite common! The speedometer is normally designed to read about 10% too high at about 70mph.

**How long do the batteries last?**

The batteries last for about 30 hours continuous use... that's a lot of acceleration runs!

**What is the resolution of the performance meter?**

There are two parts to the resolution; the internal resolution at which calculations are done, and the external resolution at which the results are displayed. Internal g-force resolution is 1/256 g. speed calculation resolution is, 54.3 inches per hour. Distance resolution is 0.04 inches, External g-force resolution is 0.01g, speed resolution is 0.1mph or 0.1kph. Distance resolution is 1ft or 1m. Power resolution is 1hp or 1kW.

**How accurate is the performance meter?**

After a great deal of testing the performance meter on all sorts of different vehicles, it has proved to be accurate to within 2-3% straight out of the box. Once it has been set up for your particular car (for example at a drag strip), measurements will be within 1%.

**How is the performance meter calibrated?**

Each unit is individually calibrated during production. The calibration is stored internally and should never need changing (although it can be reset by the user if required).

**How is the performance meter mounted in the car?**

The performance meter should be mounted on a flat, level surface in the car, such as the dashboard or centre console. We found that the best way to mount it was either using sticky back velcro or simply blu-tac, both of which are supplied.

**What if I can't mount it level?**

When timing operations are started, the performance meter checks how level it is, and compensates for any tilt errors. If the tilt is too much it will display a message telling you. If it's within range, the unit will compensate for the tilt using Active Tilt Compensation. This reduces the error for large tilt angles by accounting for not only the offset caused by the unit's tilt, but also for the reduction in sensitivity caused by the tilt. This extra compensation increases the angle you can mount it at before you get a 1% error from less than 8 degrees to over 23 degrees.

**My car squats down at the back when accelerating. Won't this affect the results?**

Indeed it will, as the angle of the performance meter changes, two factors come into effect. The first is that the earth's gravity will affect the reading, increasing it. The second is that the sensitivity to the vehicles acceleration will be decreased. The overall result is in optimistic readings from the accelerometer. To overcome this, we have a built in "Tilt Factor", which applies a clever correction algorithm to compensate for the effect. Ideally this would be set by testing against a known timing system such as at a quarter mile strip, and changed until the results are closest. However, typical values for different car types are given in the instruction manual.

**What is Rollout?**

At the start of a quarter mile strip, there are two sets of timing beams, the pre-stage and the stage. The car must break both beams before it is said to be staged. The timing will start when the stage beam is re-made as the vehicle moves forward. Because of this, it is possible for the vehicle to move some distance before the timing starts. This is called the rollout and can be up to a foot.

**What are CdA and Rolling Resistance?**

In car specifications, the drag coefficient (Cd) is sometimes quoted. This may be a figure like 0.30 for a sleek saloon car, or up to 0.70 or more for a car like a lotus 7. What they don't usually tell you though is the frontal area of the car. The bigger the frontal area (A), the more drag, as  $CdA = Cd \times A$ . If you know the frontal area and Cd of the car, you can calculate the drag power.

Rolling resistance is the resistance between the tyres and the road. The power required to overcome this increases in proportion to speed.

**How do I calculate CdA and Rolling Resistance?**

The easiest way to calculate the CdA and the rolling resistance is to use the Race-Technology Coastdown Calculator Which is available from our website. To use this you need to drive at around 50mph and time how long it takes to coast down to a lower speed.

**If the GPS3 is attached, how often do you get GPS speed updates?**

The GPS system calculates speed 5 times a second. However, this data is combined with the data from the accelerometers to calculate speed 100 times every second with very high accuracy.

**If the GPS3 is attached, how often do you get GPS position updates?**

The GPS system calculates position 5 times a second. However, this data is combined with the data from the accelerometers to calculate position 100 times every second with very high accuracy.

**If the GPS3 is attached what benefits do I get?**

Once the GPS3 is attached, the AP22 automatically senses it and uses the data. The GPS data is combined with accelerometers to calculate speed and position 100 times every second. Using an AP22 without GPS means that the speed/track maps will "drift off". They are only really accurate for about a minute on flat road. With GPS data available the "drift" is eliminated - so for short runs you won't see much benefit, but longer runs the data still be very accurate enabling whole races to be logged and analysed.

**Are they in stock?**

We normally have a few hundred in stock at any one time.

## Technical Specification

<b>Display Type</b>	16 x 2 characters, STN type
<b>Memory</b>	Integrated flash memory with a capacity for approximately 10000 samples, 40000 samples or 80000 samples
<b>Serial Port</b>	Fixed 115kbaud when communicating with the software, user settable to lower rates for text transfer mode
<b>Accelerometers</b>	2 axis, precision digital output. A guaranteed 2g deflection in all directions with a resolution of better than 0.005g.
<b>Speed</b>	Derived from longitudinal acceleration. GPS data combined in real time when available.
<b>Position</b>	Derived from acceleration. GPS data combined when available.
<b>Power Supply</b>	Powered from 2 AA batteries. 5v derived internally.
<b>GPS (optional)</b>	Update 5 times a second of position, speed with no interpolation. Tracking loops optimised for auto sport applications up to about 4g. Tracking of all satellites in view
<b>Analogue Output (Optional)</b>	Updated at 100Hz, 0-5v output. 2.5v output at 0g, 1v per G.
<b>CAN Output (Optional)</b>	CAN interface to suit user specifications, up to 100Hz update rate, 11 or 29bit addressing.