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## 1. Introduction

Congratulations on your purchase of an AP-22 performance meter, designed and built by motorsport enthusiasts in England. If you have any suggestions for further enhancements please email us directly at [technical.support@race-technology.com](mailto:technical.support@race-technology.com).

This manual contains complete instructions on how to operate your performance meter and should be read to get the best from the unit. However, for those who want to get started straight away, please read the Quick Start guide.

The AP-22 performance meter uses a precision, micromachined silicon dual-axis 2g accelerometer to measure the acceleration of the vehicle. The accelerations are measured 100 times every second and from these, measurements of vehicle speed, distance traveled, and power at the wheels are calculated, all without the need for any connections to the car.

The performance meter is capable of the following modes of operation:

- Quarter mile timing
- Timed acceleration between any two speeds
- Braking time and distance
- Continuous g-force recording
- Power measurement
- Lateral and longitudinal g-force bar-graph
- g-Circle bar-graph

The performance meter can be configured to use metric or imperial units, whichever you prefer, and all data runs can be stored for later downloading to a computer, using the serial cable provided.

Finally the unit features automatic power-off to ensure many hours of use from the 2 AA cells (supplied).

**Note:** Throughout this manual units of mph and ft are assumed. This is just for clarity and the use of alternative units is covered in the configuration section.

## 2. Quick Start Guide

This section very briefly describes how to use the performance meter to do a timed run from 0-60mph. Please note that the power measurements will be inaccurate until the vehicle settings have been set, see Section 6.

- Attach performance meter to the car, see Section 9.
- 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 *Acceleration 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

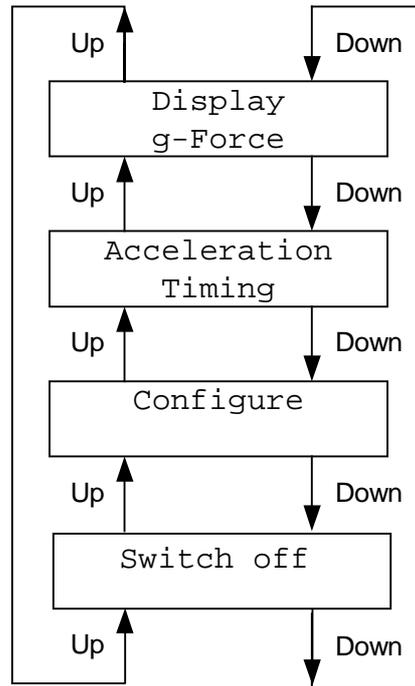
- Accelerate past 60mph.
- Once past 60mph the display will show the time taken to travel between 0 and 60mph, for example:

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

### 3. Main Modes of Operation

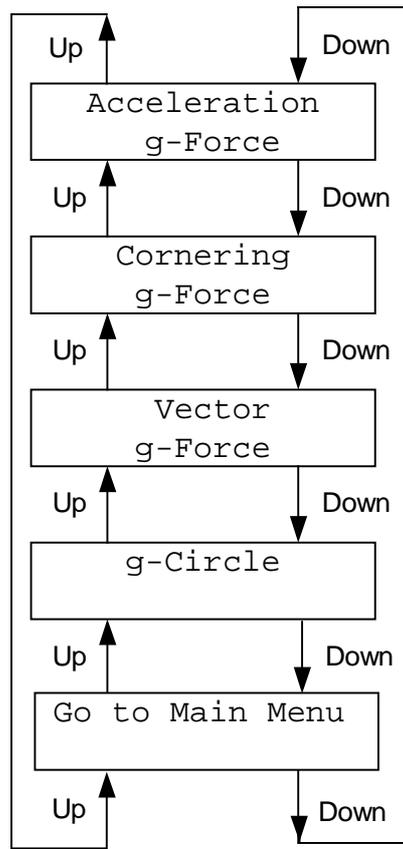
After the unit has been switched on *Race-Technology* will be displayed briefly before entering the top level menu. The top level menu allows you to select between measuring acceleration times, measuring g-force, configuring the performance meter or switching the unit off.



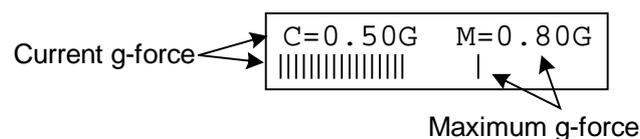
To switch the unit off, either select *switch off* from the menu, or leave it on the top level menu for around 45 seconds, it will then switch itself off automatically. Please note that the unit will not power off whilst in any other menu.

## 4. Display g-Force

After selecting *Display g-Force* from the main menu, pressing the *up* or *down* buttons will cycle through the following menu system:



Select any of these functions and the display will change to show both the current and maximum g-force as a numerical value and on a bar graph. The maximum value can be reset at any time by pressing either the *up* or *down* buttons. Pressing the *select* button at any time returns you to the main menu.



Whilst in *Acceleration g-Force* and *Cornering g-Force* modes, only the acceleration along a single axis is displayed. For example whilst displaying the *Acceleration g-Force*, any *Cornering g-Force* is ignored. However, when in *Vector g-Force* and *g-Circle* modes, the combined acceleration from both axes is displayed.

The *g-Circle* and *Vector g-Force* modes are very similar. The *Vector g-Force* mode simply displays the combined acceleration from both axes. The *g-Circle* displays the combined acceleration from both axes and displays it as a percentage of the maximum g-force .

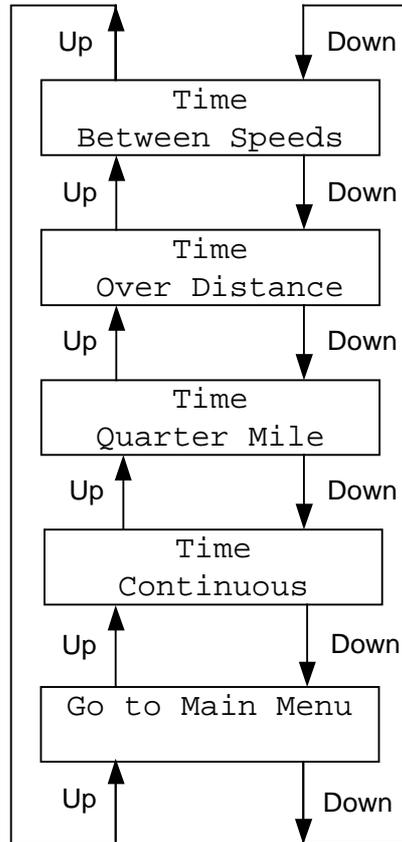
The *g-Circle* mode is intended to give an indication of how close to the maximum grip you are driving.

The tilt and roll factors are used when calculating the values to display on the bar graph, and an automatic offset is applied to the acceleration bargraph to account for the AP-22 not being

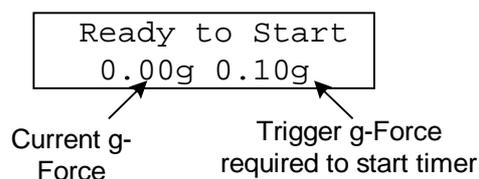
mounted completely level, so don't be surprised if you don't see exactly 1g when manually tilting the unit on it's side or back.

## 5. Acceleration Timing

After selecting the *Acceleration Timing* menu, pressing the up or down buttons will cycle through the following menus:



Once you are ready to start timing the vehicle acceleration, select one of the *Acceleration Timing* modes and the AP-22 will check if enough memory is available to store the run. If not, a message will be displayed informing you of the lack of memory, and the AP-22 will return to the acceleration menu. You will have to erase the current data before any more runs can be performed. If there is sufficient memory the display will change to start the run:



Start moving whenever you are ready. The timer will start as soon as the *Trigger g-Force* value is exceeded. This is set to 0.10g by default but can be changed in the configure menu.

The display will now change depending on the mode selected as described below.

## 5.1. Time Between Speeds

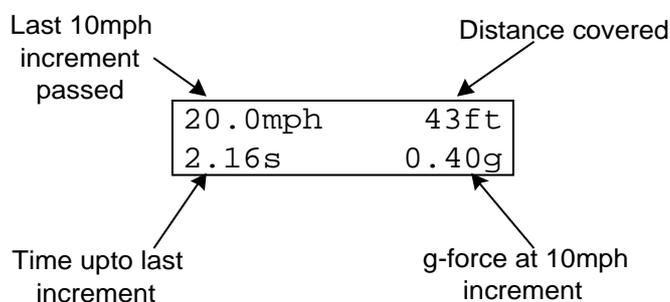
Depending on the *start speed* and *end speed* that is selected there are 3 different scenarios possible when timing between speeds:

- Acceleration timing starts from 0mph
- Acceleration timing starting from a non-zero speed
- Braking timing

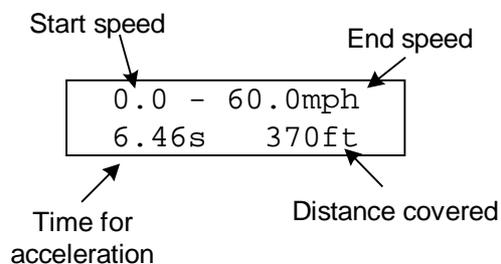
Each mode will be dealt with separately below.

### 5.1.1. Acceleration timing starting from 0mph

As timing is being performed, the display will be updated every time a 10mph threshold is passed displaying the speed, g-force, time and distance.



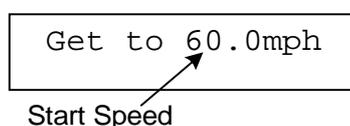
At the end of the run, the display will change to:



This shows that to accelerate from 0 to 60mph took 6.46 seconds and during that time a distance of 370ft was covered. Pressing any button here will go to the data storage screen as shown in 5.5.

### 5.1.2. Acceleration timing NOT starting from 0mph

If the start speed is not zero then the display will change to show:



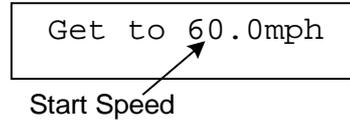
When the *start speed* is reached, the timer will start automatically and operation will continue as for timing from zero speed.

### 5.1.3. Braking Timing

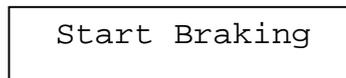
There are two methods of starting the braking timing, either by letting the AP-22 track the speed up to the start speed, or by indicating that you have reached the start speed manually:

#### Letting the AP-22 track the speed

Accelerate briskly, during this time the display will show.



When you are going faster than the start speed the display will change to:



As the vehicle decelerates past the start speed the timing will start.

#### Manually indicating you have reached the start speed

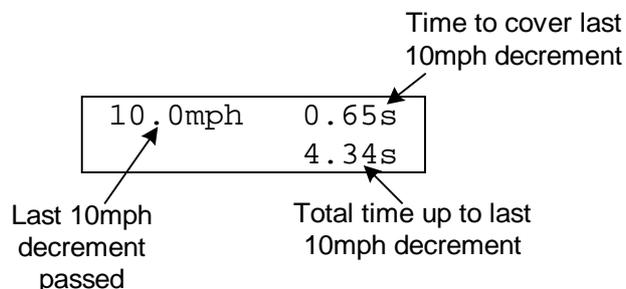
Pressing either the *up* or *down* buttons during the acceleration will cause the display to update and show a start speed 2mph faster than before. When you exceed this speed, stop accelerating and press the *up* or *down* buttons again, the display will now show the *Ready to Start* screen.

Timing will start when the trigger value is exceeded, so coast down to the start speed and then start braking.

**TIP:** When using this mode you might want to increase the trigger value from that used for normal acceleration runs. Also, this mode should only be used when a passenger is present to operate the unit, leaving the driver to concentrate on the driving.

#### Timing the Braking Run

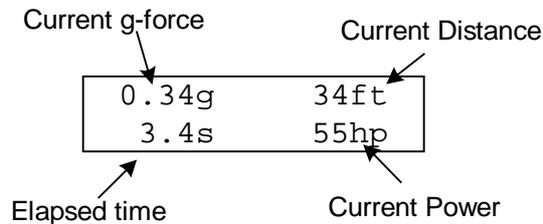
During braking, timing will stop when either the target speed is reached, or, if the speed is less than 10mph, when the deceleration stops. If the deceleration stops the unit will assume the vehicle has also stopped.



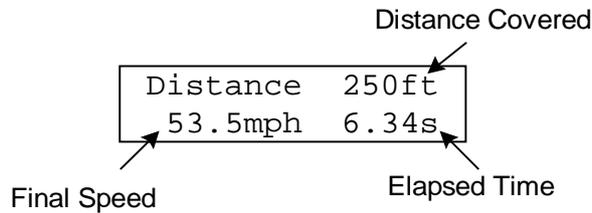
At the end of the braking run, the data will be displayed in the same way as for timing acceleration.

## 5.2. Timing Over Distance

During timing the display will show the current distance, g-force, time and power. As shown below:



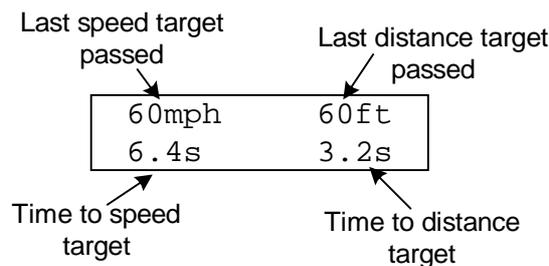
At the end of the timing, the display will show the distance, time taken and final speed.



Pressing any button here will go to the data storage screen as shown in 5.5.

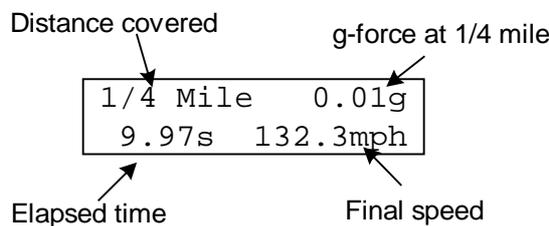
### 5.3. Time Quarter Mile

As timing is started, the display will change to:



The speed and distance targets will change as they are exceeded during the quarter mile run. These show the points at which data is available. They are: end of rollout (8 inches or 1ft), 60ft, 330ft, 660ft and 1320ft for distance, and 60 and 100mph for speed.

When the quarter mile run is finished. The display will change to:



Pressing any button here will go to the data storage screen as shown in 5.5.

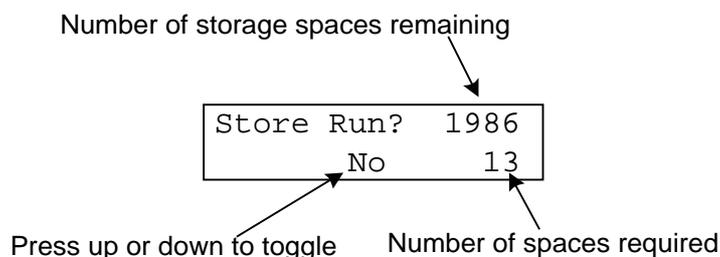
### 5.4. Time Continuous

When timing is started the display will show how many seconds of storage time are remaining. This will depend on how many runs have already been stored in the AP-22 and on the sampling rate selected. Sampling will be stopped either when the storage space runs out or when any button is pressed. You will then be asked if you wish to store the data (Section 5.5)

## 5.5. Ending a Timed Run

Pressing any button during a timed run will finish the run. If *Time Quarter Mile* is aborted the AP-22 will return to the acceleration menu. If *Timed Over Distance* is aborted, the run will be stopped at the current position and the data displayed. If *Time Between Speeds* is stopped, the run will be stopped at the last 10mph increment passed, if none have been passed then the AP-22 will return to the start menu. Pressing any button whilst on the *Ready to Start* screen will abort the run.

If there is data which can be stored after a run you will see the following:



Use the up or down button to toggle whether the run is stored or not. After this the AP-22 will return to the start menu.

## 6. Configuring the Performance Meter

One of the unique features of the race-technology performance meter is that it can be set-up according to the preferences of the user. Selecting *Configure* from the main menu allows a number of options to be set. Each of these options is described below.

### 6.1. Set-up Time Between Speeds

Select this to set the options that are associated with the *Time Between Speeds* function. There are 4 options that can be set for this function; the speed at which timing starts, the speed at which timing ends and 2 options that control the detail of information that is displayed after the timing is completed. Each of these options is explained below.

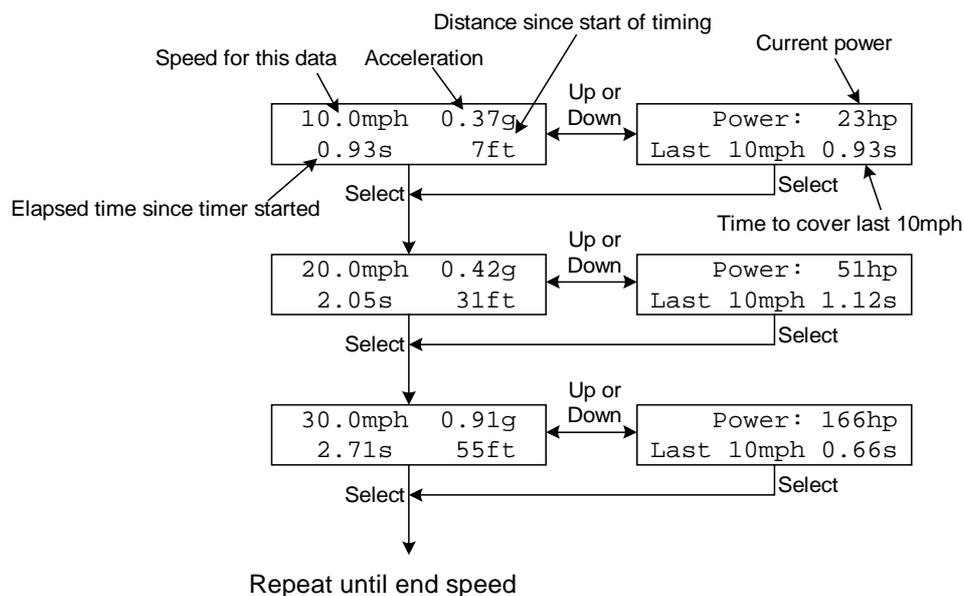
#### 6.1.1. Start Speed and End Speed

Once *Set-up Time Between Speeds* is selected the first thing that the user is asked for is the start speed. This is the speed at which timing starts. Pressing the *up* button will increase the *start speed* by 10mph and pressing the *down* button will reduce the *start speed* by 10mph. Pressing the *select* button at any time will set the new *start speed* and allow the *end speed* to be set in the same way. Note that holding down the up or down buttons changes the increment to 100 in this and other menus.

#### 6.1.2. View Intervals

After the *start speed* and *end speed* have been set you have the option of setting the *View Intervals* option. If the option is set to *Yes*, the performance meter will display additional information for each 10mph increment after the run has been completed. For example, after a 0-60mph run the meter will display the acceleration times for 0-10mph, 0-20mph, 0-30mph etc. These can be scrolled through by pressing the select button. Whilst viewing the intervals in this way, pressing either the up or down button will toggle between the main screen and a screen showing the last 10mph time as well as power at that point.

**TIP:** Since a *Time Between Speeds* run can be terminated at any time there is no harm in setting the end speed too high as long as the *View Intervals* option has been set to *Yes*. (Or if you store the data for downloading later)



### 6.1.3. View Maximums

Finally after the *View Intervals* option has been set, whether you *View Maximums* can be set. If *View Maximums* is selected, the maximum power and g-force achieved during the run will be displayed after the run has been completed.

## 6.2. Set-up Time Over Distance

Select this option to set the preferences associated with the *Time Over Distance* function. There are 3 things that can be set for this function; whether or not the reaction timer is used, the distance over which the acceleration is measured, and an option that controls the detail of information that is displayed after the timing is complete. Each of these options is explained below.

### 6.2.1. Use Reaction Timer

When the reaction timer mode is selected (available in *time over distance* and *time quarter mile* modes), at the start of an acceleration run, the AP-22 will no longer show the current g-force and trigger g-force. Instead it will show "Ready to Start". Then after a few seconds, it will show:

Ready to Start  
 Ready

Then 0.4 seconds later:

Ready to Start  
 Start

If you exceed the trigger force at exactly the time Start is displayed, you will get a perfect 0.4s reaction time. Your reaction time is shown at the end of the run. The time is not added onto your run time and so does not affect any other readings

### 6.2.2. Distance

This option simply sets the distance over which the acceleration is measured. The distance can be edited in a very similar way to the start and end speed described in section 6.1.1.

### 6.2.3. View Maximums

After the distance has been set, you have the choice of whether to set the *View Maximums* option. If *View Maximums* is selected, the maximum power and g-Force obtained will be displayed after the run has been completed.

## 6.3. Set-up Time Quarter Mile

Select this option to set your preferences that are associated with the *Time Quarter Mile* function. There are a total of 6 items that can be set for this function, as described below.

### 6.3.1. Use Reaction Timer

See 6.2.1

### 6.3.2. Enable Rollout

The first option that can be set is whether rollout compensation is required. Rollout is the distance between the front of the car and the light beam that starts the official timer at the drag strip. The effect of rollout is that the vehicle can move as much as 12 inches before the official timer starts, this obviously has a direct impact on officially recorded quarter mile time. To allow for this and allow direct comparison of the performance meter times with the official times, the performance meter allows an optional rollout distance of 8 or 12 inches. Note that while the quarter mile timer is only started at the end of the rollout, the 0-60mph and 0-100mph times are calculated from when the vehicle starts moving.

### 6.3.3. Rollout Distance

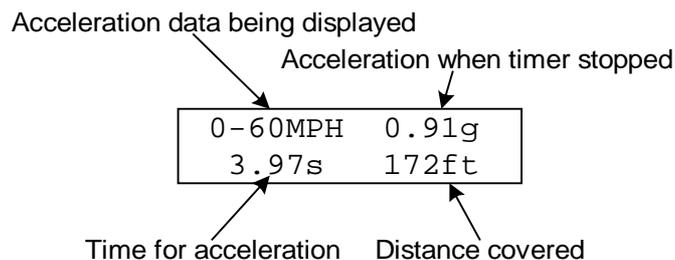
This option will only show when rollout is enabled, it toggles between 8 inches and 12 inches for the rollout distance. NOTE When actually doing the quarter mile run, rollout will always show on the screen as 1 ft.

### 6.3.4. View Intervals

If the *View Intervals* option is set to *Yes* then the g-force, time and speed at the end of the rollout, at 60ft, at 330ft and at 660ft, will be displayed in addition to the data for ¼ mile.

### 6.3.5. View Accel

When selected, the acceleration times for 0-60mph and 0-100mph will be shown after the run.



### **6.3.6. View Maximums**

If *View Maximums* is selected, the maximum power and g-force obtained during the run will also be displayed.

### **6.4. Trigger Value**

The *Trigger Value* is the value of g-force that must be exceeded before the timer starts in all timing modes.

### **6.5. Vehicle Data**

The *Vehicle data* section enables you to set-up the AP-22 for your particular car. It is important to realise that until these values are set correctly for your car the performance meter's estimates of power will be inaccurate.

#### **6.5.1. Mass**

This is the total mass of the vehicle as it is being tested. Note that figures given in the car handbook may not include a full tank of fuel, the weight of the driver and passengers, so these would have to be included.

#### **6.5.2. CdA and Rolling Resistance**

CdA is a measure of how aerodynamically efficient the car is. A low CdA means that the car is aerodynamic while a high figure indicates that the car is less aerodynamic.

*Roll(ing) Resistance* is a measure of how much friction there is between the road and the vehicle. A high figure indicates that there is a lot of friction and the vehicle is hard to move.

The easiest way to get the rolling resistance and CdA of your car is to perform what is known as a coastdown test. To be accurate, this test should be done on a flat surface with no wind. The procedure is as follows.

Accelerate past 60mph (about 65mph would be fine) and select neutral. As the vehicle slows down, time how long it takes for the speed to drop from 60mph to 55mph. Make a note of this time.

In a similar way, time how long it takes to decelerate from 15-10mph and make a note of it.

Using the two deceleration times that you have measured, the following formulae can be used to calculate the CdA and the rolling resistance. Note that you also need to know the mass of your car.

*Time<sub>1</sub>* is the time to decelerate from 60mph to 55mph in seconds

*Time<sub>2</sub>* is the time to decelerate from 15mph to 10mph in seconds

*Mass* is the total weight of the car in kilograms

$$CdA = \frac{Mass \times (Time_2 - Time_1)}{169 \times Time_1 \times Time_2}$$

$$Rolling\ Resistance = \frac{238 \times Time_1 - 11 \times Time_2}{1000 \times Time_1 \times Time_2}$$

Alternatively a program is available on our Internet site ([www.race-technology.com](http://www.race-technology.com)) to work out the equations for you.

Enter these values for rolling resistance and CdA into the vehicle data section, in the configure menu, along with the vehicle mass. Typical values for CdA are in the range of 0.7 for a modern saloon car, up to 1.3 for a Lotus 7 style car. The rolling resistance is normally in the range of 0.01 to 0.03, depending on suspension setup, tyres and road.

**TIP:** If you want accurate power measurements keep your gear changes smooth. If you rev the car inbetween gear changes, the energy stored in the engine flywheel will cause the car to surge forward causing high power estimates. Also bear in mind that the AP-22 calculates power at the wheels, not engine power which manufacturers often publish.

### **6.5.3. Tilt Factor**

When a vehicle accelerates it will tilt backwards causing the performance meter to read high for speeds and distances. To correct for this, a tilt factor has been included into the vehicle data section. The tilt causes a reduction in the g-force reading, proportional to the g-force measured. The standard setting should be satisfactory for most vehicles with firm sports suspension. However, if readings are consistently too fast, try increasing the tilt factor or if readings are consistently too slow try reducing the factor.

**TIP:** Using the standard *Tilt Factor* should give speed measurements at least as accurate as your speedometer. The best time to fine tune the *Tilt Factor* for your car is at the drag strip were very accurate timing equipment is available.

### **6.5.4. Roll Factor**

As the tilt factor accounts for suspension squat under acceleration, a roll factor has been introduced to account for the effect of body roll during cornering

### **6.5.5. Smoothing**

During hard acceleration there will be a large spike in the g-force measurement just after a gearchange. This is due to the energy stored in the flywheel being released to accelerate the car. To compensate for this a smoothing factor can be used to reduce the effect of sudden changes in acceleration.

**NOTE:** The smoothed value is only used for horsepower and peak g-force measurements. It will have no effect on acceleration timing. A typical value is 0.004 or 0.005

## **6.6. Current Units**

Each of the units of measurement below can be set independently to either metric or imperial, they do not all have to be the same.

### **6.6.1. Distance**

Distance is either measured in kilometers (metric) or feet (imperial).

### **6.6.2. Speed**

Speed is measured in either kilometers per hour (metric) or miles per hour (imperial).

### **6.6.3. Mass**

Mass is measured in either kilograms (metric) or pounds (imperial).

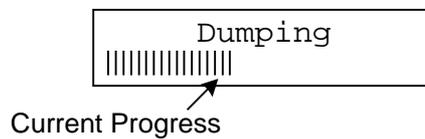
### 6.6.4. Power

Power is measured in either kilowatts (metric) or horsepower (imperial).

## 6.7. Data Dump

Plug the AP-22 into a standard 9 pin RS-232 port using the cable provided. Make sure the AP-22 and the computer are both switched off before plugging them in. Start whichever communication software you are using and set the port settings to those shown at the back of the instruction book. If you do not have any dedicated communications software and are using the Windows™ operating system, then you can use the hyperterminal software as described in Section 10.

Selecting "Data Dump" on the configure menu will display how many pages of data are remaining for storage. Pressing select will move onto the screen for selecting data rate. Use the *Up* and *Down* buttons to select the desired speed from the choice of 9.6kb, 19.2kb, 38.4kb, 57.6kb or 115.2kb. This value is stored so will not need to be set every time. Press select to start the data dump. During the data dump a bargraph will appear on the bottom of the screen showing the progress:



Pressing any button during the data dump will skip the remaining data. After dumping the data you are given the choice to delete it:

```
Erase ?
      No
```

Use the *Up* / *Down* buttons to select whether or not to erase and then press select. This will return to the configure menu.

The dumped data will look something like this:

```
Reaction Time    0.72s

Distance    87ft  20.8mph  4.57s

Pk Power:   17.3mph  2.68s   31ft   35hp
Peak G:    15.6mph  2.45s   25ft   0.36g

-----

Start Speed    0.0mph
mph      s      g      ft      hp
10.0    1.38  0.38    9    22
20.0    2.37  0.49   30   59
30.0    3.22  0.54   61   99
40.0    4.04  0.57  104  141
50.0    5.04  0.35  170  115
60.0    6.94  0.19  325   85

Pk Power:   42.5mph  4.24s  116ft  146hp
Peak G:    41.7mph  4.17s  111ft  0.57g

-----

Reaction Time    0.59s

Roll out    1.10s  0.30g   3.1mph
60 ft      2.90s  0.44g  26.4mph
330 ft     6.99s  0.30g  62.0mph
1/8 Mile  10.14s  0.34g  81.6mph
1/4 Mile  14.88s  0.21g 106.2mph
```

```

0-60MPH  7.80s 0.35g  304ft
0-100MPH 14.62s 0.21g 1115ft

Pk Power: 106.2mph  14.88s  1321ft  216hp
Peak G:   28.0mph  3.06s   66ft   0.44g

```

```

-----
Start Speed  0.0mph
mph          s    g    km    kW
10.0        1.75 0.30 0.003  13
20.0        3.07 0.36 0.012  33
30.0        4.43 0.25 0.027  36

Pk Power:   26.0mph  3.81s  0.019km  44kW
Peak G:    25.6mph  3.75s  0.019km  0.37g

```

```

-----
      s    g    g    g    mph    ft    hp
0.10 -0.02 0.12 0.05 0.2     0     0
0.20 -0.02 0.14 0.09 0.5     0     0
0.30 -0.03 0.17 0.13 0.9     0     0
0.40 -0.03 0.19 0.16 1.3     0     1
0.50 -0.03 0.21 0.18 1.8     0     1
0.60 -0.04 0.24 0.21 2.4     0     2
0.70 -0.04 0.25 0.23 2.9     1     3
0.80 -0.05 0.27 0.25 3.5     1     5
0.90 -0.04 0.27 0.26 4.1     2     6
1.00 -0.04 0.28 0.27 4.7     2     7
1.10 -0.04 0.28 0.27 5.4     3     8
1.20 -0.03 0.29 0.28 6.0     4    10
1.30 -0.04 0.31 0.29 6.7     5    11
1.40 -0.04 0.32 0.31 7.4     6    14

```

The data from the three standard runs is self-explanatory in terms of measurements, with the units in which the data is stored being stored along with the readings. The continuous storage data is formatted thus:

```

      s    g    g    g    mph    ft    hp
0.10 -0.02 0.12 0.05 0.2     0     0
0.20 -0.02 0.14 0.09 0.5     0     0
0.30 -0.03 0.17 0.13 0.9     0     0
0.40 -0.03 0.19 0.16 1.3     0     1

```

The first column is the time, second column lateral acceleration, third column longitudinal acceleration, fourth column is the smoothed acceleration as used for peak detection (see smoothing 6.5.5), fifth column is the speed in whatever the selected units are, then distance traveled and finally power.

By dumping the data and analysing the speed and power data, it is possible to fine-tune the rolling resistance, CdA and vehicle mass values to give the same answers as a rolling road. This can be done by dumping the data, changing the vehicle parameters and then dumping the data again.

Note: Because all the calculations are done during the actual data dump, when the sample resolution is decreased to provide increased storage time, the accuracy of the speed, distance and power figures will suffer. For best accuracy always use a sample interval of 0.01s. The larger sample interval values might be used for checking braking g-forces into a corner or looking at cornering forces through various corners or on consecutive laps, when a sampling interval of 0.1 seconds and a data storage time of 10 minutes would be more useful.

## **7. Changing The Batteries, Low Battery Warning.**

The batteries supplied with your accelerometer should last for many hours of continuous use. Each time the unit is turned on, the AP-22 checks the battery voltage, when this voltage drops below a certain level a low battery warning will be displayed. To change the batteries, this is what you do:

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.

## **8. Calibration**

The performance meter is calibrated and tested during manufacture. To further ensure accuracy, the calibration is adjusted to account for a sloping vehicle mounting before each timed run. However, if at any time you think that the unit would benefit from being re-calibrated please email us at [technical.support@race-technology.com](mailto:technical.support@race-technology.com).

## **9. Mounting The AP-22 in the Car**

Mounting the performance meter correctly in the car is important for accurate operation. The most important aspects of the mounting are:

- The AP-22 should be mounted squarely in the car, pointing in the direction of travel
- The AP-22 should be mounted as level as possible
- The AP-22 should not be subjected to severe vibration

During testing we found that the best results were gained with the AP-22 mounted on a flat area of the dashboard, using either the Velcro™ tape (supplied) or BluTak™.

However and wherever the AP-22 is mounted in the vehicle, please ensure that is not a distraction whilst driving and it is securely and safely fastened down. Also please bear in mind that we (AutoMotion Ltd) cannot be responsible for any damage to the interior caused by fitting the AP-22 in the car.

## 10. Hyperterminal and Excel

This section will explain how to use hyperterminal to setup hyperterminal for downloading data, and how to import the captured data files into Excel

### 10.1. Using Hyperterminal

Hyperterminal is a terminal program supplied with the Windows 95, 98 and NT4.0 operating system. To start Hyperterminal, go to the start menu and select Programs : Accessories : HyperTerminal. A folder will open on the desktop; double click on Hypertrm.exe to start the program. You will be prompted to enter a name for the connection.



After typing in AP-22 clicking OK will bring up the next dialog box.



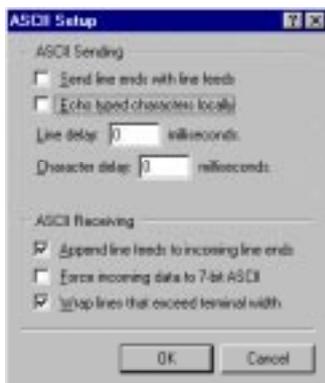
Select the port being used, most likely Com 1 or Com 2 and click OK again.



Now setup the port settings as shown above. When OK is clicked the terminal program will start. Before the data can be collected, further setup is required. Select the File menu and then Properties The following dialog box should appear.



Select the Settings tab and then click on ASCII Setup



Make sure “Append line feeds to incoming line ends” is selected. Click on OK.

You are now ready to download data.

### **10.1.1. Using Hyperterminal to capture data**

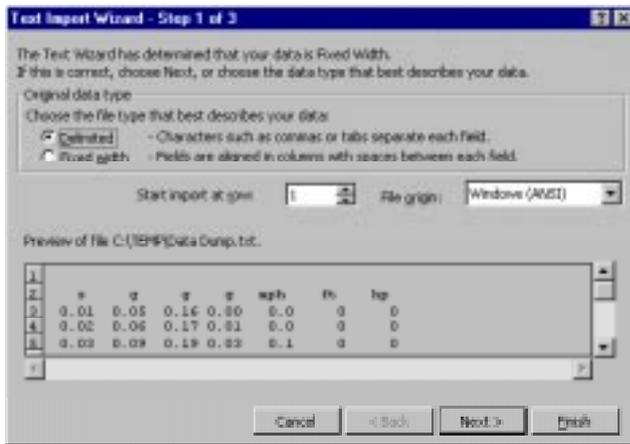
If you wish to save the data to disk, select the Transfer menu and then Capture. Type in the file you wish to save too, or use the Browse option to select a place on your disk to save the data.

All data will now be saved to the file. To stop select Transfer, Capture and then Stop. The captured file can then be loaded into a text editor or spreadsheet for editing.

When you exit the program, you can save the session. Next time you want to dump the data, double click on AP-22 instead of Hypertrm.exe to start the program.

## **10.2. Importing data into Excel**

When a continuous timed run has been captured to a text file, it can be opened into a spreadsheet such as Excel™ for analysis. To do this, start Excel and open the file. The first page of the Text Import Wizard will appear as shown below:



Select "Delimited" for data type, then click on Next



Now select Space for the delimiter then click on Finish. You are now ready to graph the data.

## 11. Technical Specification

Maximum Acceleration Range	<i>+/- 2 g (minimum)</i>
Acceleration Resolution	<i>0.01 g</i>
Acceleration Sampling Rate	<i>100 Hz</i>
Maximum Measurable Speed	<i>990 mph / 999 kph</i>
Speed Measurement Resolution	<i>0.1 mph / 0.1 kph</i>
Maximum Measurable Distance	<i>65.535 km / 65535 ft</i>
Distance Resolution	<i>1 m / 1 ft</i>
Maximum Measurable Power	<i>5000 hp / 3750 kW</i>
Power Resolution	<i>1 hp / 1 kW</i>
Overall Accuracy	<i>Typically 1%</i> <i>(For Accelerations &gt; 0.2g)</i>
Auto Power Off Time	<i>45 Seconds</i>

## 12. Data Storage Capacities

The AP-22 can store any mixture of data runs from preset runs or continuous data storage. Below is a list of the storage capacities of different types of run.

### 12.1.1. Continuous Data Storage

Sample Interval	Time Available
0.01s	60s
0.02s	120s
0.03s	180s
0.05s	300s
0.1s	600s

### 12.1.2. Standard Timed Runs

Type of run	Maximum number stored
Quarter mile run	499
Time over distance	999
Time between speeds:	
60mph / kph between start and end speeds	249
80mph / kph between start and end speeds	199
100mph / kph between start and end speeds	166
200mph / kph between start and end speeds	90

## 12.2. Serial port settings

Data Rate:	User Selectable 9600 19200 38400 57600 115200 (Default)
Data Bits:	8
Parity:	None
Stop Bits:	1
Flow control:	None

In the ASCII settings, set to automatically append line ends to line feeds, otherwise each line of new data will overwrite the last one.

### 13. Factory Settings

<b>Set-up Time Between Speeds</b>	Start Speed	<i>0 mph</i>
	End Speed	<i>60 mph</i>
	View Intervals	<i>No</i>
	View Maximums	<i>No</i>
<b>Set-up Time Over Distance</b>	Reaction Timer	<i>No</i>
	Distance	<i>250ft</i>
	View Maximums	<i>No</i>
<b>Set-up Time Quarter Mile</b>	Reaction Timer	<i>No</i>
	Enable Rollout	<i>Yes</i>
	Rollout Distance	<i>8 inches</i>
	View Intervals	<i>No</i>
	View Accel	<i>No</i>
	View Maximums	<i>No</i>
<b>Trigger Value</b>		<i>0.10a</i>
<b>Vehicle Data</b>	Mass	<i>1000ka</i>
	CdA	<i>0.9</i>
	Rolling	<i>0.013</i>
	Tilt Factor	<i>0.007</i>
	Roll Factor	<i>0.011</i>
	Smoothing	<i>0.004</i>
<b>Current Units</b>	Distance	<i>ft</i>
	Speed	<i>mph</i>
	Mass	<i>ka</i>
	Power	<i>hp</i>
<b>Serial Port</b>	Data Rate	<i>115.2kbaud</i>

## 14. Vehicle Specifications

	Value
Type	
Registration	
Mass	
CdA	
Rolling Resistance	
Tilt Factor	
Roll Factor	

	Value
Type	
Registration	
Mass	
CdA	
Rolling Resistance	
Tilt Factor	
Roll Factor	

	Value
Type	
Registration	
Mass	
CdA	
Rolling Resistance	
Tilt Factor	
Roll Factor	