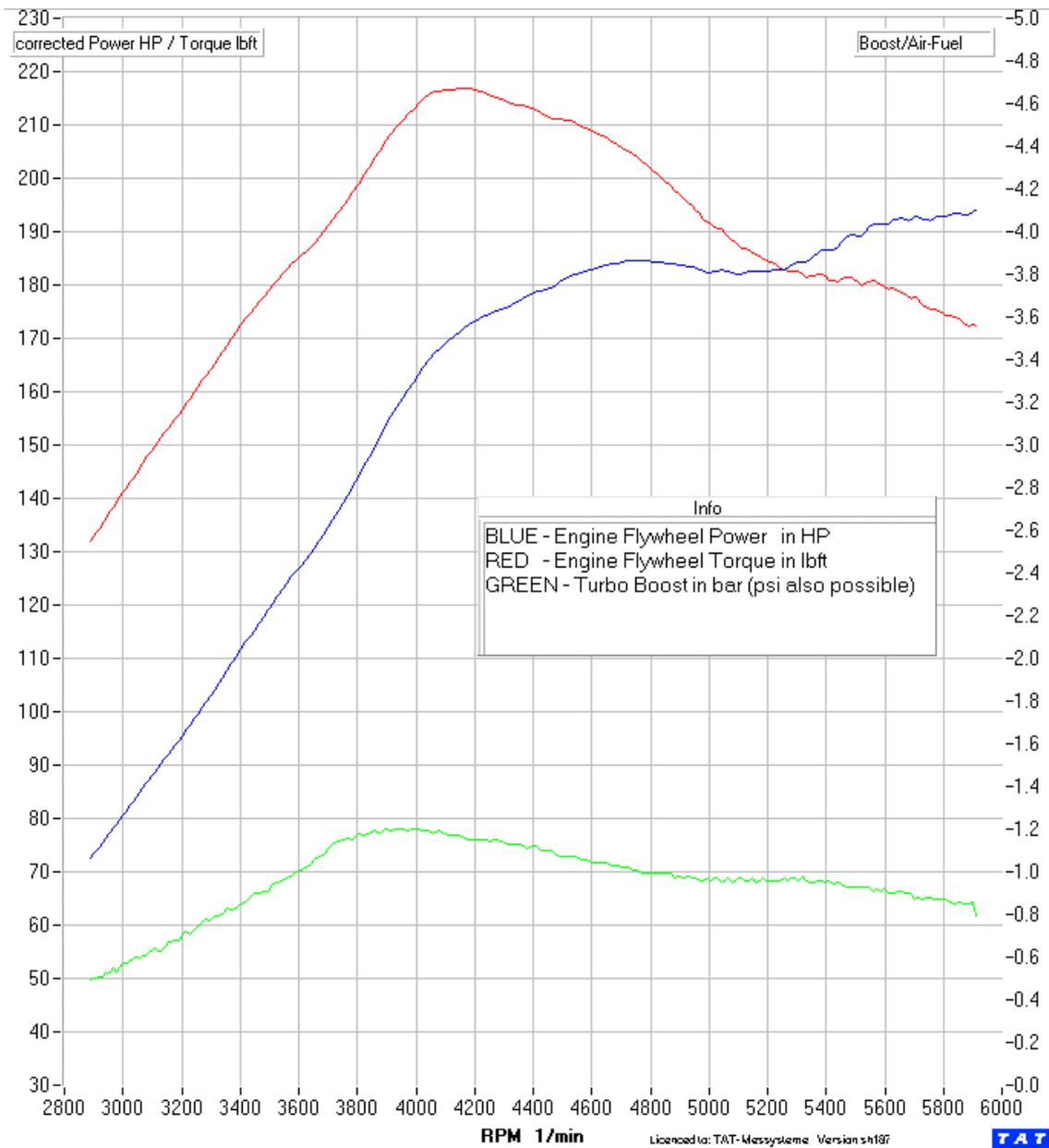# Fact Sheet on the *TAT* Dynamic Data Acquisition System
for any roller set i.e. *for any Chassis Dynamometer*

Picture 1 – results of a Power Run performed using a TAT Data Acquisition System

Above Diagram (Picture 1) is an example of how the results of a Power Run using a TAT Data Acquisition System can look. The car in this test was a turbocharged 2.0l 16V road car. As you will note – the TAT System provides curves for true corrected Flywheel Power and also Flywheel Torque. Not only do these figures allow a direct comparison with engine dynamometer figures, but they are more reliable than just relying on the figure for the Power at the wheels (see later discussion).

1
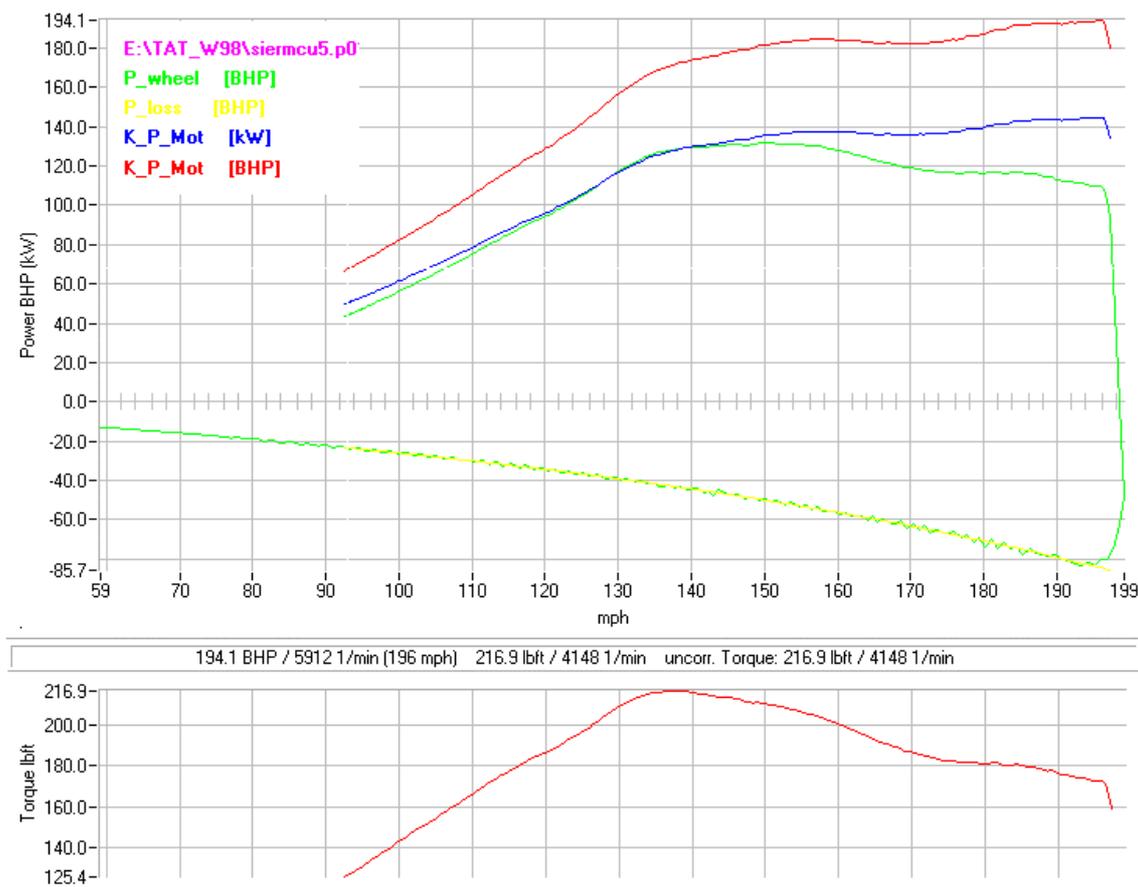
Picture 2 – Engine Flywheel Power and Torque calculation

Above Diagram (Picture 2):
 shows the Power and Torque curves which a TAT System provides:

- *Power at the wheels (green curve)*

- *Power losses in the drive train (yellow curve)*

- *Power at the Flywheel in kW(blue curve)*

- *Power at the Flywheel in Hp (red curve)*

- *Torque at the Flywheel (red curve)*

- *All values can be viewed versus road speed in mph or engine speed in rpm*

- *All Power data can be corrected to any desired Power correction factor, SAE old or new as well as EEC, DIN, or use your own*
  .
- *Readings for sensors such as Turbo Boost, Air/Fuel Ratio, Exhaust Gas Temperature(s), Fuel Flow, Turbo rpm, Intake Air Temperature, Exhaust Back Pressure before and after Turbo, Air Flow, etc. can also be logged as curves with every Power run (see the top graph picture 1 : this contains Power curves including the curve for the Boost Pressure).*

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How does it all work ?

The TAT System works on the principle of the so-called "Inertia Test". In the case of a chassis dynamometer this involves very accurately monitoring the rate of acceleration of the rollers.
If we can do this, we will be able to get an accurate indication of the Power at the wheels produced by the vehicle under test.

These are the laws of physics and unquestionably fact.

The difficulty lies in the practical application of this underlying concept. A very high degree of precision is required in monitoring the acceleration process. The TAT System is capable of achieving exactly this. It can determine the roller acceleration to an accuracy of 0,0000002 seconds…in other words: two tenths of a millionths of a second.

It is this extreme digital precision which is the reason why a TAT System is so successful in providing very comparable consistent Power Runs.

A further difficulty lies in correctly interpreting the power losses in the vehicles drive train so that the Engine Flywheel Power and Engine Flywheel Torque can be accurately calculated.

This requires very complex mathematics and TAT has invested substantial development efforts into ensuring that this is achieved. The TAT System not only Power figures, but it makes the complete calculation process accessible to the operator so that all calculations may be viewed.

Above diagram (Picture 2) is an example of this: This screen is displayed automatically by the TAT System immediately after a Power Run has been completed.

How is a Power Run performed using the TAT System ?

Accelerate the rollers gently in a low gear to a low speed in the region of maybe 20 mph. Then change into a high gear, preferably top gear. Gently further accelerate the rollers in this gear up to a roller and engine speed at which your engine will "pull" steadily and where you can accelerate it at full throttle.
Now, do exactly this and accelerate the engine under full throttle on the roller set right up to maximum engine speed. When this is reached, quickly depress the clutch for manual transmission and keep it depressed to allow the roller speed to coast down. On automatic transmissions select "N".

The TAT System will constantly display the Power at the Wheels during the whole test run and also instantly plot the Power curve. (see below Picture 3)
As soon as the rollers come to a stand still, the TAT System will automatically calculate the Engine Flywheel Power (see above Picture 2).

Can I also see other readings together with the Power and Torque curves ?

Yes you can. In fact the TAT System is so powerful that it allows you to view any amount of curves (could be curves of all attached sensors) from up to a maximum of 8 Power runs overlayed. If we assume that you have a 16 channel system and would overlay all these from all 8 Data files on top that would mean 8x16 = 128 curves. This is probably not a sensible thing to do, but it shows the powerful and sheer endless capabilities of TAT's latest powerful analysis software.
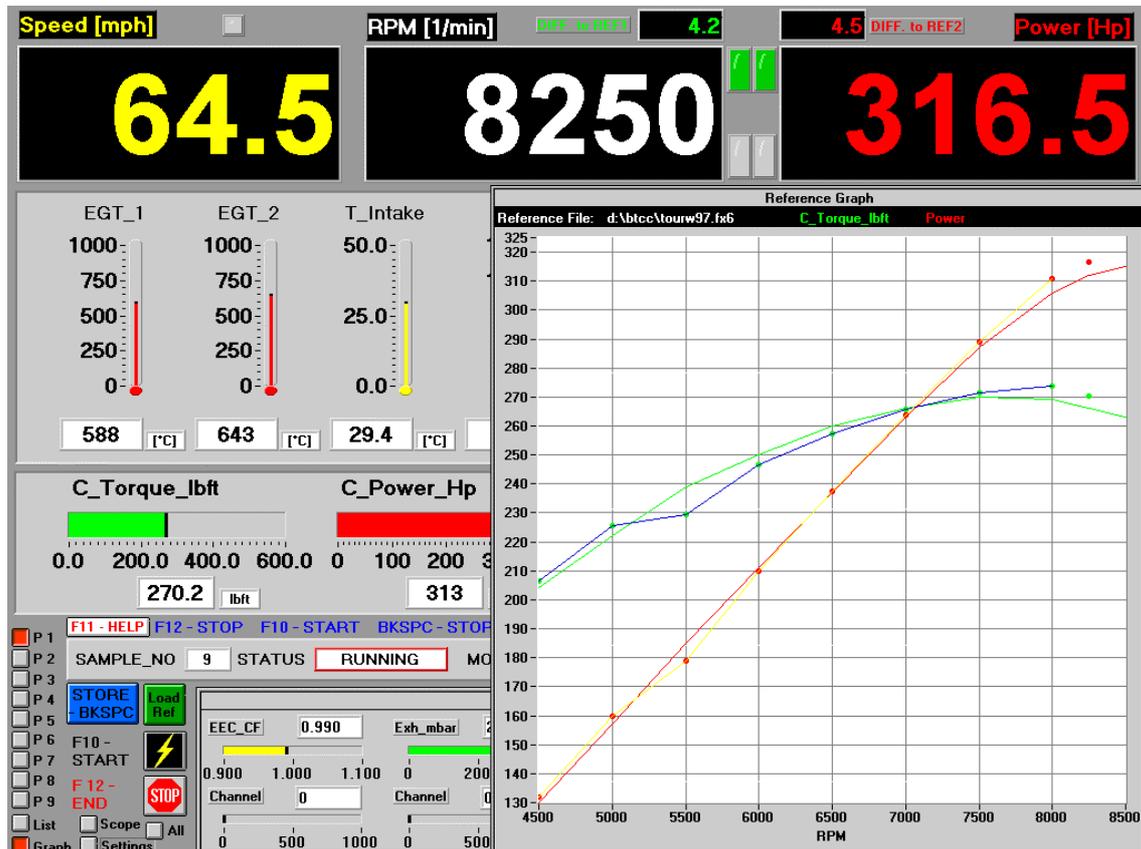
Diagram 3 – plotting the Power at the Wheels immediately during a Power run and display of Sensor Values

- *The TAT System can also display all relevant sensor values in real time during a Power Run*

- *The Display can be tailored and set up to the individual requirements for the vehicle under test by the user*

How consistent is a TAT system ?

A very important question, if not the most important question, regarding any chassis dynamometer should be:

a) how consistent are the test results of consecutive tests
b) how accurate are the test, i.e. are the values for power and torque seen, are these really the true figures one would observe on an engine dynamometer ?

Below you you will see two graphs: the first is a diagram of two consecutives tests performed on one of our test vehicles. Please see note how well the tests match. Consecutive tests performed with a TAT system can be as close as 1% (in this case the maximum difference is 1,4%) . As long as the engine power remains the same on consecutive runs, the TAT System will always give you repeatable and true figures.

The graph following this shows the engine performance of the test car, a Porsche 928 GTS 5,4l, on an engine dynamometer, tested by the Porsche factory.

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Fantastic Consistency – 2 Power Runs overlayed

Pictured below are two Power Runs for Power and Torque from a Porsche 928 GTS overlayed on top of each other.

These tests have been conducted with TAT's all new high speed Dynamic Data Acquisition System on a chassis dynamometer with very low inertia (which is in fact disadvantageous). Nonetheless, the curves for Power and Torque are extremely precise and highly consistent. The acceleration time from 50-280 km/h (30-175mph) only took 7,8 seconds on this very light roller set. Regardless of this, the TAT system collected 218 data points.
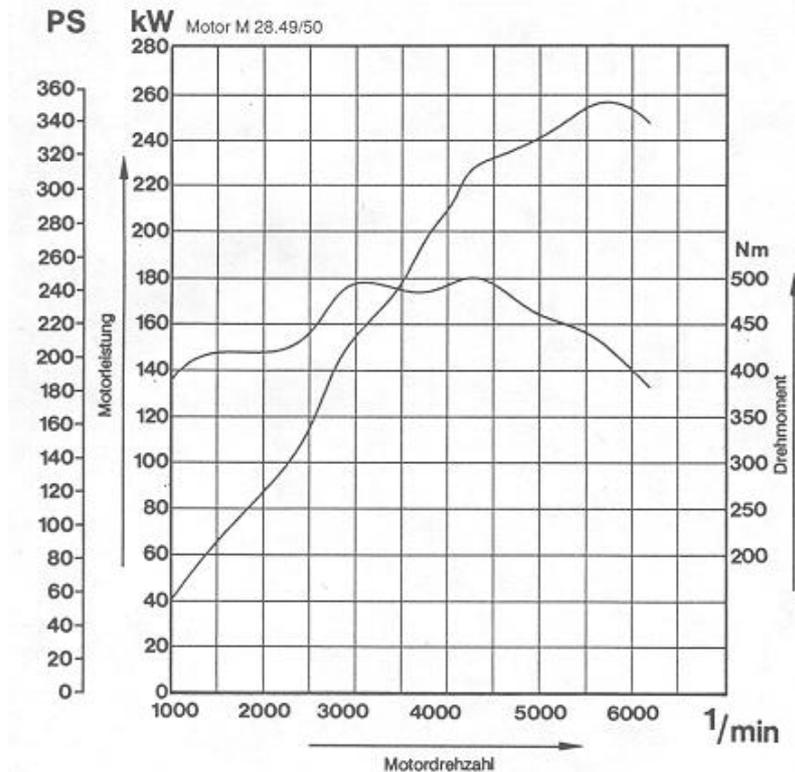This means that one data point has been acquired every 0,032 seconds which is a very respectable figure in this very short time period. This is also the reason for the very smooth and highly consistent and accurate curves for Power and Torque.
THESE AND BETTER RESULTS CAN BE ACHIEVED WITH NEARLY ANY ROLLER SET / CHASSIS DYNAMOMETER, WHEN USING A TAT Data Acquisition System.
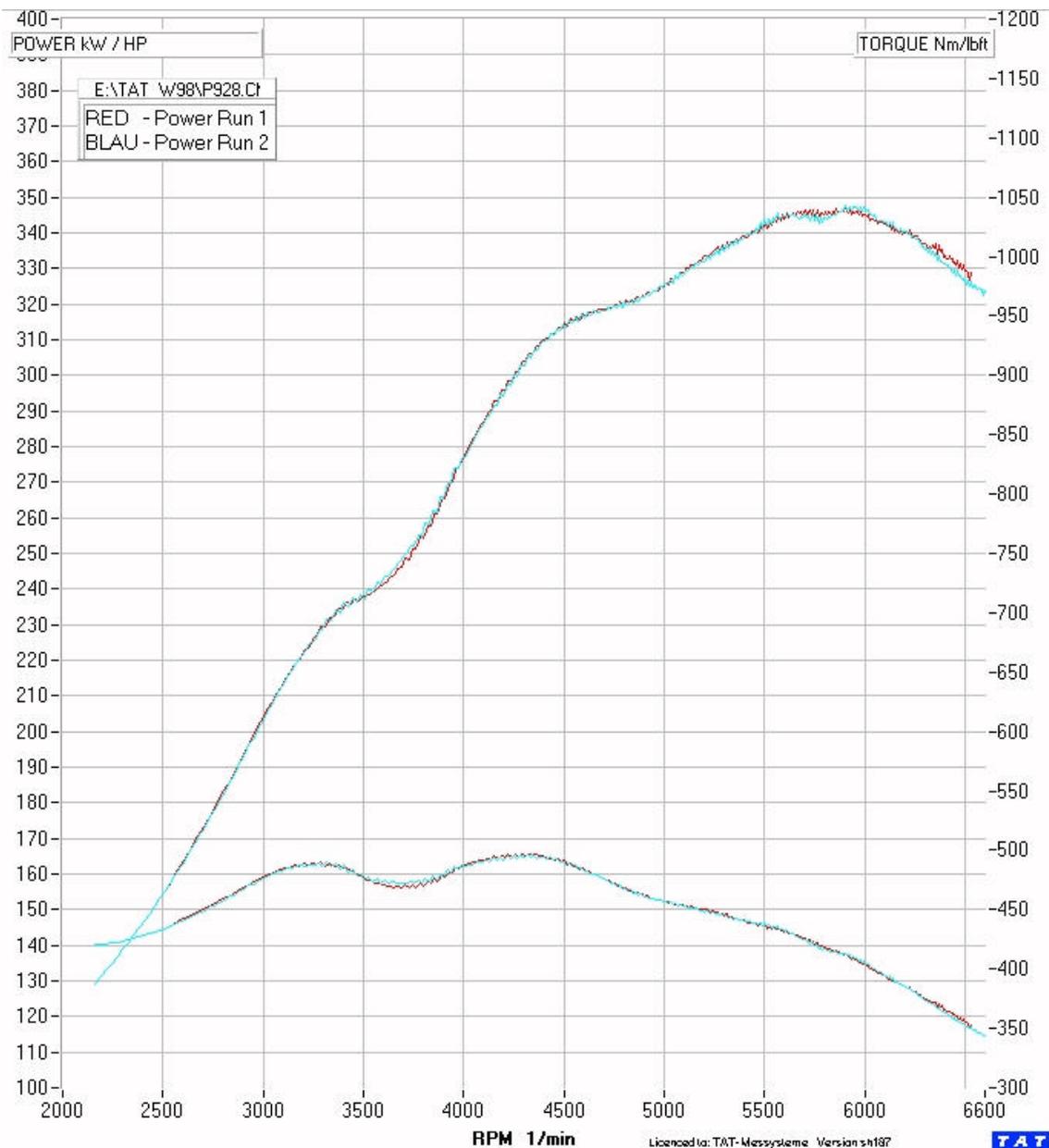
Picture 4 – two Power Runs from a Porsche 928 GTS 5,4l , 350 HP (257 kW)@5,700 rpm / 369 lbft (500Nm)@4,250 rpm

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Power Test for above engine performed on an engine dynamometer.

PS kW Motor M 28.49/50

(graph axes and labels) Motorleistung, Drehmoment, Motordrehzahl — PS / kW / Nm — 1/min

Picture 5 – Engine Dyanamometer Power test of Porsche 928 GTS 5,4l engine

Just look how close the Engine Dynamometer figures match the Chassis Dynamometer figures which used the TAT System – throughout the range the difference is never greater much than 1%. This is a very respectably figure by all standards.
(* If you wish to calculate for yourself,divide the Hp figures by 1.36 to get kW and multiply the lbft figures by 1.36.)

Why is it not enough to rely only on the figures for the Power at the wheels ?

On a chassis dynamometer we have to rely on the tyres to transmit the engine power to the rollers. With changes in tyre temperature and tyre loading, the power losses due to the tyre friction on the rollers will also change. These Power losses go by unseen into tyre deformation and heat. However, a chassis dynamometer running in constant load mode will not be able to display these losses as it can only sense the torque which acts on its brake's load-cell. Considering this, it becomes clear, that for accurate comparison of the actual engine Power we have, we cannot simply compare the Power observed at the wheels. We must therefore always take the current Power losses into account, if we want to have an accurate figure for the Power developed by the vehicle.
Of course we not only have to look at the losses due to the tyre, but also the losses due to the drive train. It will also be clear to us, that cold and thick oil in the gearbox and rear axle will cause substantially higher Power losses than when this is hot. All these varying influences will reduce the overall accuracy and reliability of your Power measurements.

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The TAT System takes all current Power losses into account at the time they occur and its results are therefore not affected by aforementioned varying influences. This is the reason why the TAT System does not only provide extremely accurate but also highly consistent test figures, run after run. Please see the relevant diagrams which prove our point.

A further diagram of two consecutive Power Runs, yet again observe how close the results of these consecutive Power Runs match

Picture 6 – two Power Runs from a BMW M 635 CSI 24V overlayed

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- Please note: All units are possible, metric or imperial (HP, lbft, mph, psi, mmHg, km/h, kW, m/sec. and so on) – all software is available also in English language.

- All Data can be viewed versus road speed as well as Engine rpm

- *The **TAT** System provides not only the Power at the wheels but true SAE / DIN / EEC corrected Engine Flywheel Power and Torque*

- *The **TAT** System displays the Power at the wheels immediately during a Power Run as well plotting the corresponding curve for the Power at the wheels*

How do I connect the TAT System to my chassis dynamometer ?

All that is required is a connection to roller speed sensor. Most chassis dynamometers have an inductive speed sensor which is actuated by a toothed wheel. If your chassis dynamometer does not posses such a sensor, TAT can provide a suitable and easy-to-install alternative speed sensor.

How many sensors can I connect to a TAT System ?

The smallest TAT System allows the connection of up to 8 sensors. These sensors can be of any type.
TAT stocks a full range of sensors suitable for all applications. All TAT Systems can be upgraded at any time to allow the connection of further sensors. The maximum number of sensors can be as many as 256 Sensors. Upgrades can be made in multiples of 8 or 16 sensor inputs.
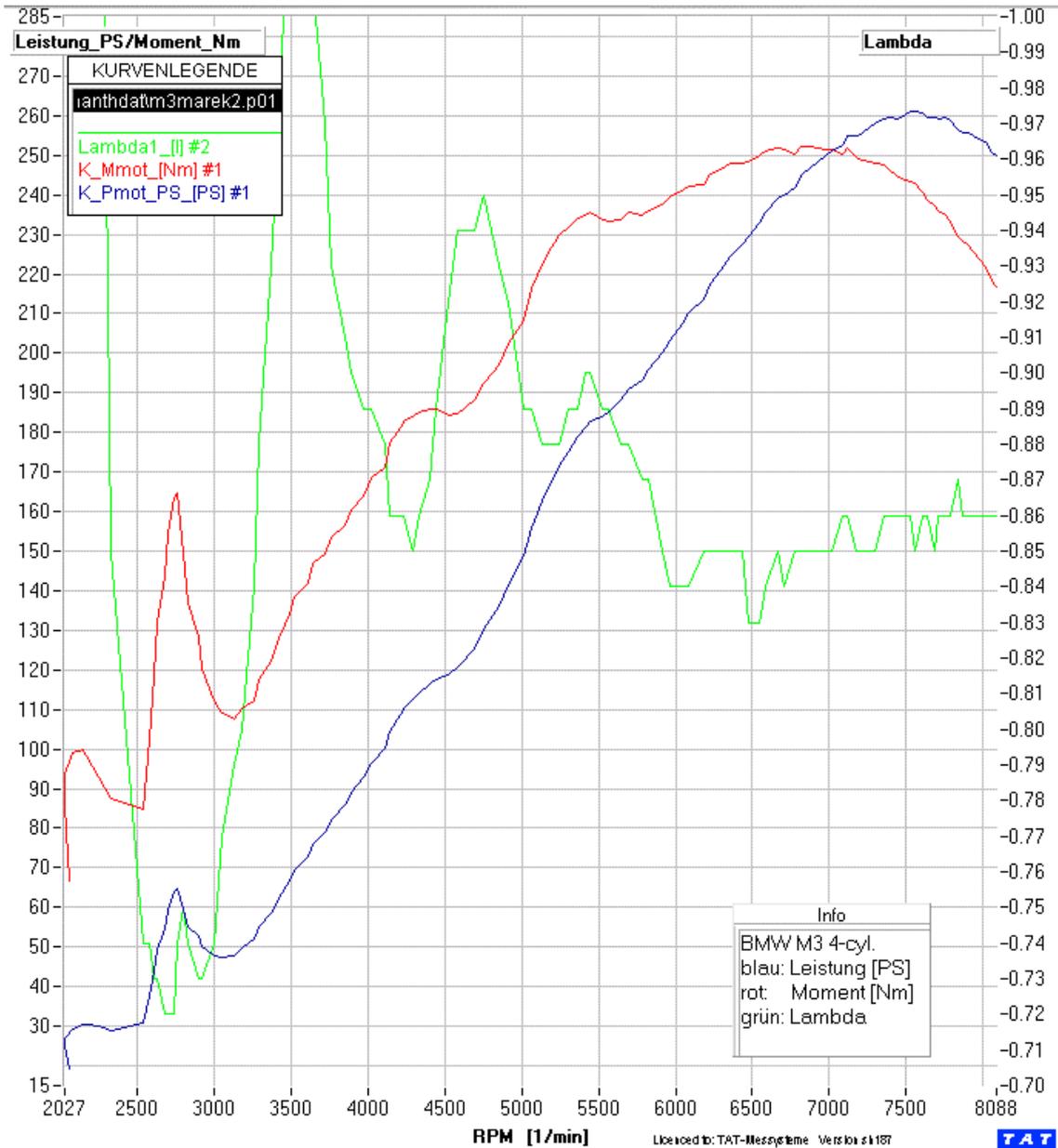
Further sources of Information on the TAT Systems

Please visit our website www.TATDyno.htm/sitemap.htm to find numerous informative pages regarding the supplied electronics, test results, screen shots as well as TAT's own 1,000 HP chassis dynamometers.for 2WD and 4WD.

Picture 7 – a Power run from a BMW M3 4-cyl. with a high resolution curve for Air-Fuel Ratio (Lambda)

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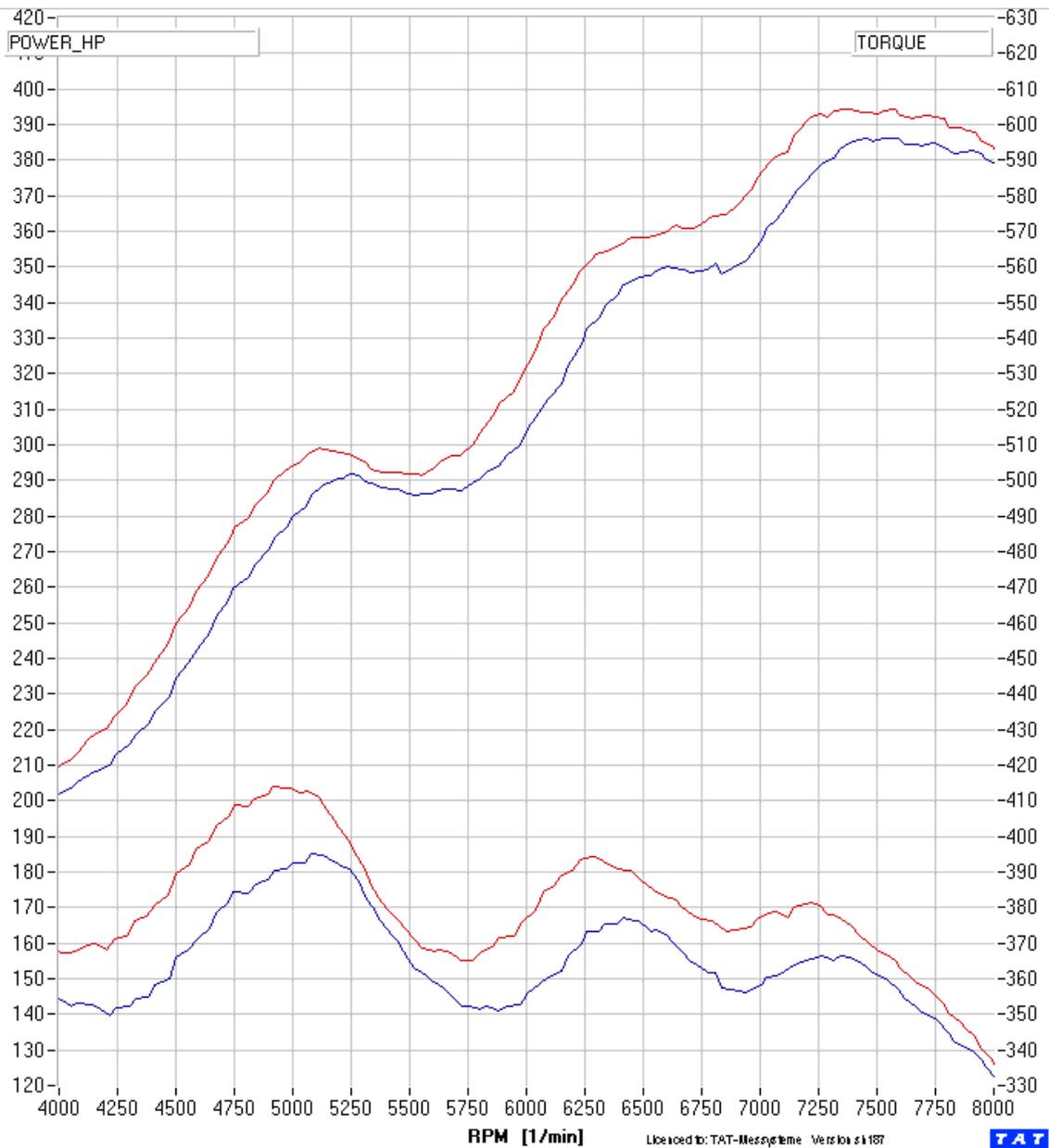**D- 75015 Bretten 4 - Germany**

Porsche 996 GT3 4,0l

FILE: c:\tat\gt3401.r01 DATE: 5/6/2000 TIME: 10:11:25
KENNZEICHEN: HN-GT 996   KUNDE: Hr. K.   FAHRZEUG: Porsche GT3 4,0l
290.0 kW (394.4 PS) / 7366 1/min (259 Km/h) 414.1 Nm / 4915 1/min

FILE: c:\tat\gt3402.r01 DATE: 5/6/2000 TIME: 10:27:38
KENNZEICHEN: HN-GT 996   KUNDE: Hr. K.   FAHRZEUG: Porsche GT3 4,0l
284.0 kW (386.3 PS) / 7547 1/min (266 Km/h) 395.2 Nm / 5079 1/min

Picture 8 – two Power run from a modified Porsche 996 GT3 overlayed

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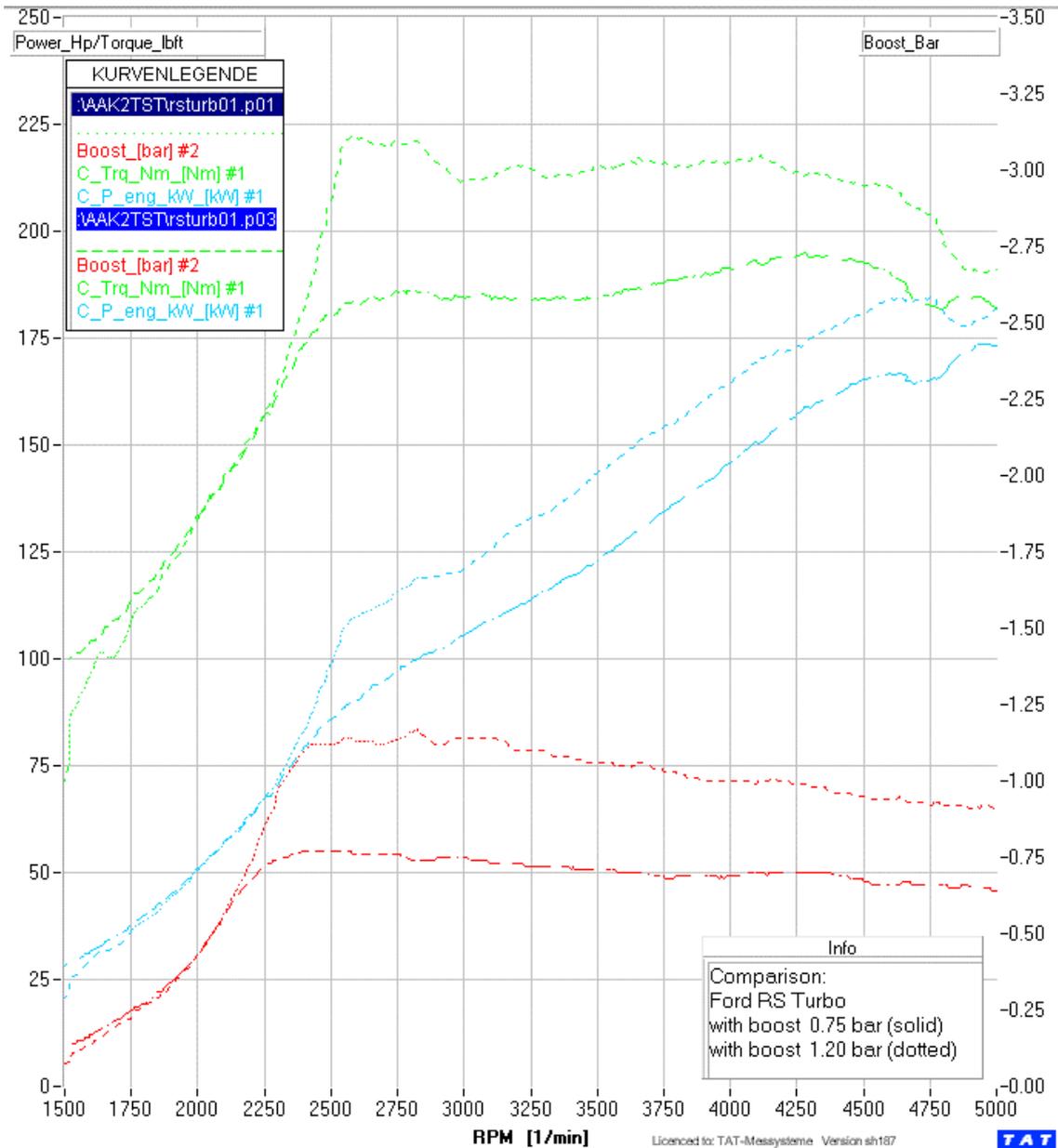**Tel. 07252/84258 Fax. 07252/957584**

Ford RS Turbo

FILE: c:\tat\rsturb01.r01 DATE: 5/6/2001 TIME: 19:37:02
<Ford Escort RS Turbo> Owner: Alex Buckland.   Mods: 1.1 bar, Cam, Filter, Factory exhaust, intercooler
185.5 kW (252.3 BHP) / 5077 1/min (179 mph) 222.7 lbft / 2581 1/min

FILE: c:\tat\rsturb01.r03 DATE: 5/6/2001 TIME: 20:02:59
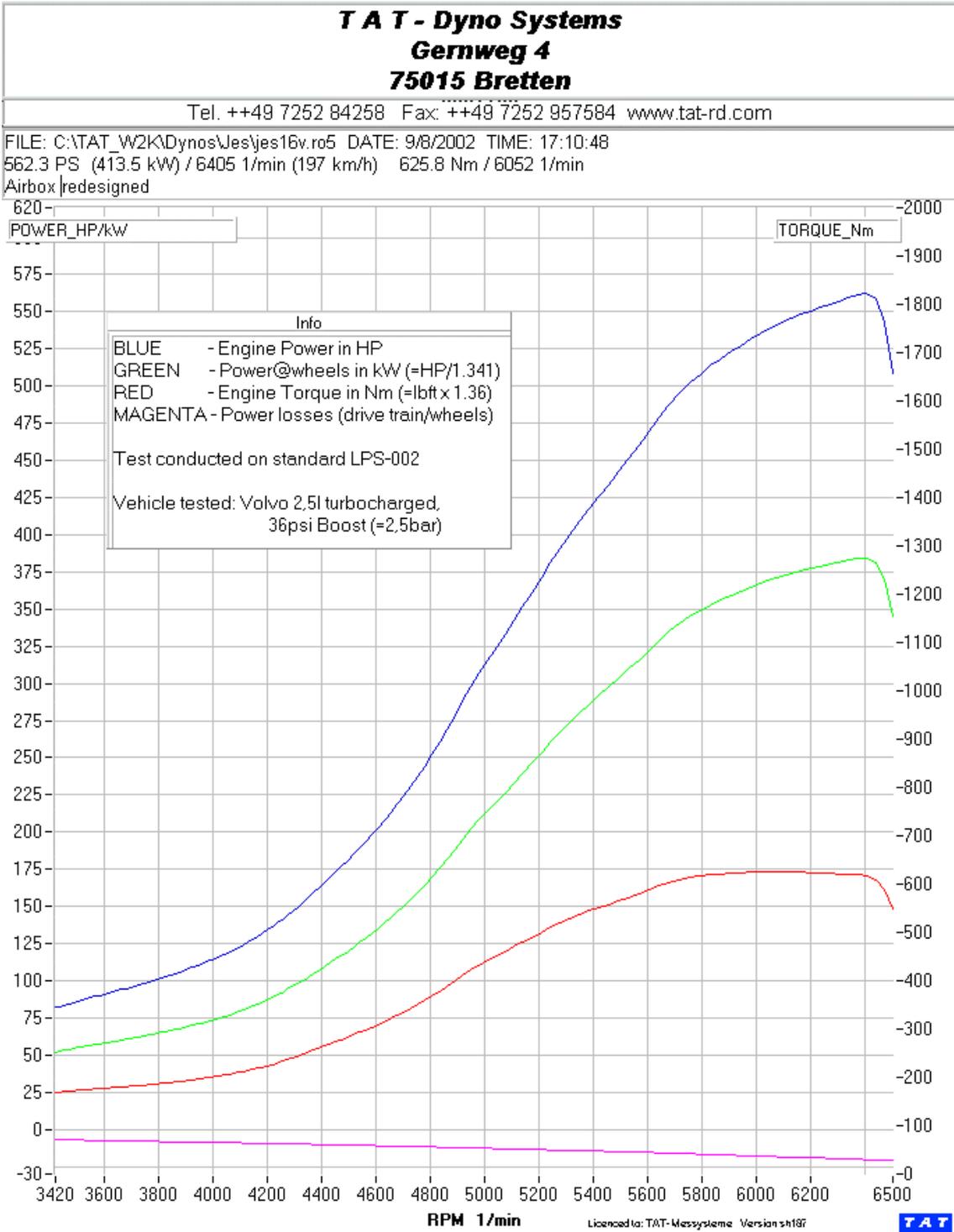<Ford Escort RS Turbo> Owner: Alex Buckland.   Mods: 0.76 bar, Cam, Filter, Factory exhaust, intercooler
174.9 kW (237.8 BHP) / 5079 1/min (179 mph) 194.9 lbft / 4281 1/min

Picture 9 – two Power Runs from a Ford RS Turbo overlayed with Boost Curve

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FILE: C:\TAT_W2K\Dynos\Jes\jes16v.ro5 DATE: 9/8/2002 TIME: 17:10:48
562.3 PS (413.5 kW) / 6405 1/min (197 km/h)   625.8 Nm / 6052 1/min
Airbox redesigned

POWER_HP/kW   TORQUE_Nm

Info
BLUE   - Engine Power in HP
GREEN   - Power@wheels in kW (=HP/1.341)
RED   - Engine Torque in Nm (=lbft x 1.36)
MAGENTA - Power losses (drive train/wheels)

Test conducted on standard LPS-002

Vehicle tested: Volvo 2,5l turbocharged,
                36psi Boost (=2,5bar)

RPM 1/min   Licenced to: TAT-Messysteme Version sh187

Picture 10: this test was performed on a roller set which was never intended for cars of more than 280 HP (Bosch LPS 002) – nonetheless, just look what smooth and detailed curves the TAT Data Acquisition managed to record of this very powerful and highly turbocharged Volvo car which produced a very respectable Power output of
562 HP and 625 Nm (460 lbft) of Torque

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