

The Lenz PowerKat[®] System for Porsche 911 turbo II 1990-1992



1. The Porsche 911 turbo II

After stopping production of the automotive legend 911 turbo, which enriched the world nearly unchanged from 1976 - 1989, the call was unmistakable for a technically modernized successor. The antiquated suspension technology without ABS and not the least at that time the painful power losses of the insurmountable catalyst technology exhaust hurdles required urgent modernization. Porsche had demonstrated in the meantime with the technology carrier 959, what potential the 911 idea and the turbo technology have. Accordingly high-set were also the expectations of the turbo-clientele for a successor. Under the development code 965, a super-Porsche was worked on, which would make use of the 959 ideas: permanent all-wheel drive, twin turbo and four-valve technology were the technical highlights in the project specifications. Sobriety followed the euphoria when at the Geneva automobile salon 1990 the base data of the new turbo II became known. Porsche obviously set on proven solutions with the new Turbo II. Understandably, because of the economic situation at that time, Porsche against the ambition of engineers, dictated cost-effective quickly marketable solutions, the expensive 965 experiment disappeared into the drawer. Only the Porsche 993 bi-turbo should then reclaim the high tech promises made with the 959.

So the 911 turbo II came to be a careful evolution of the proven and successful 911 turbo I. With the suspension technology of the Carrera 2, ABS, power steering, effective heating, airbags and increased to 320 HP, now with up-to-date catalyst technology equipped with a 3.3 liter engine it offered performance of 270 km/h top speed and 5 seconds for the standard sprint (0-100 kmh).

However, the Turbo II had to live with a fault: gasoline consumption is inordinately high, even when only minimal performance is called for. And the unsatisfactory response mode (turbo-lag), well-known from the Turbo I, had remained. This old-fashioned deficiency can be effectively overcome with the current state of engine technology, and this in connection with a most attractive increase in performance.

The newly developed Lenz PowerKat[®] system will do exactly this. The use of most modern technology with Lenz KatTronic[®] digital engine management and sport metal catalyst now makes it possible to connect a substantial reduction in consumption compared to the base engine with substantially improved performance development. This technical update of the engine to today's conditions of the engine

technology places a meaningful investment into the value retention of the Turbo II, which is particularly recommended regarding the substantially increased driving fun with moderate values consumed.

The Lenz PowerKat® system is offered for the 911 Turbo for II in the following versions:

- **Basic version with 385 HP**

No engine work is necessary. The performance level of the basic version corresponds to that of the 911 Turbo II S.

- **High-speed version with 440 HP**

In addition to the basic version, sport cam shafts as well as the Lenz PowerFlow® adjustable exhaust system with variable sound.

With the Lenz PowerKat®, the 911 turbo II realizes the technological and performance-related connection to the following turbo-generations, and this with up-to-date consumption and exhaust gas values. Our slogan *classic meets future* stands for this successful synthesis of automotive classic with high tech.

2. The requirement: Performance with PowerKat®

The Lenz PowerKat® system is conceived as an uncompromising high end system for the increase in output of high performance engines. It was developed with the philosophy to optimize using most modern technology the engine in the characteristics performance development, fuel economy and pollutant levels in relation to the series.

The system was optimized, in comparison to the non-catalyst base engine, regarding the critical parameters dynamic response mode (minimization turbo-lag), specific consumption, torque development, engine performance, and acceleration capacity according to most modern conditions of the engine control technology with the result that the advantages of the turbo technology can be fully used and the past disadvantages (turbo-lag, specifically high values consumed) could be almost eliminated. In the sum an excellent efficiency and a convincing total performance are obtained.

3. Die technical implementation

The 911 turbo II is equipped with the mechanical K-Jetronic as the fuel injection system. The ignition is data table / map driven by a separate ignition controller. Principle item of the Lenz PowerKat® retrofit system is the Lenz KatTronic® digital engine management with which ignition and injection can be controlled extremely precisely in an integrated system. The controlling of the injection amount necessary for Lambda regulation takes place, as with the base engine, by means of an electrical pulse valve in the fuel pressure line for the fuel control valve of the K-Jetronic. The pulse valve permits the change of the turn slot cross sections and thus a variation in the quantity throughput of the continuously working injectors over influence of the actuating pressure. The control of the pulse valve takes place directly via the engine management, that as a function of the signal of the lambda probe, the engine load, number of rpms and the operating condition of the engine computes the optimal injection amount over an injection correction data table / map. Over special sensor technology, measured values for temperatures and pressure are considered. The Lenz KatTronic® ignition system operates likewise data table / map-controlled, the parameters number of rpms, load, intake manifold pressure and operating condition flow also into the computation of the optimal ignition

4. Performance optimization

In the optimal tuning of ignition degree, injection amount and boost pressure for each rpm and load point under consideration of the precise engine operational data lie especially with the turbo engine substantial reserves, which can be effectively used by modern engine control. The performance yield with the turbo engine depends, besides sensitively on the tuning of ignition on the boost pressure. The dynamic (rpm dependent) regulation of the maximum boost pressure has a substantial influence on the performance.

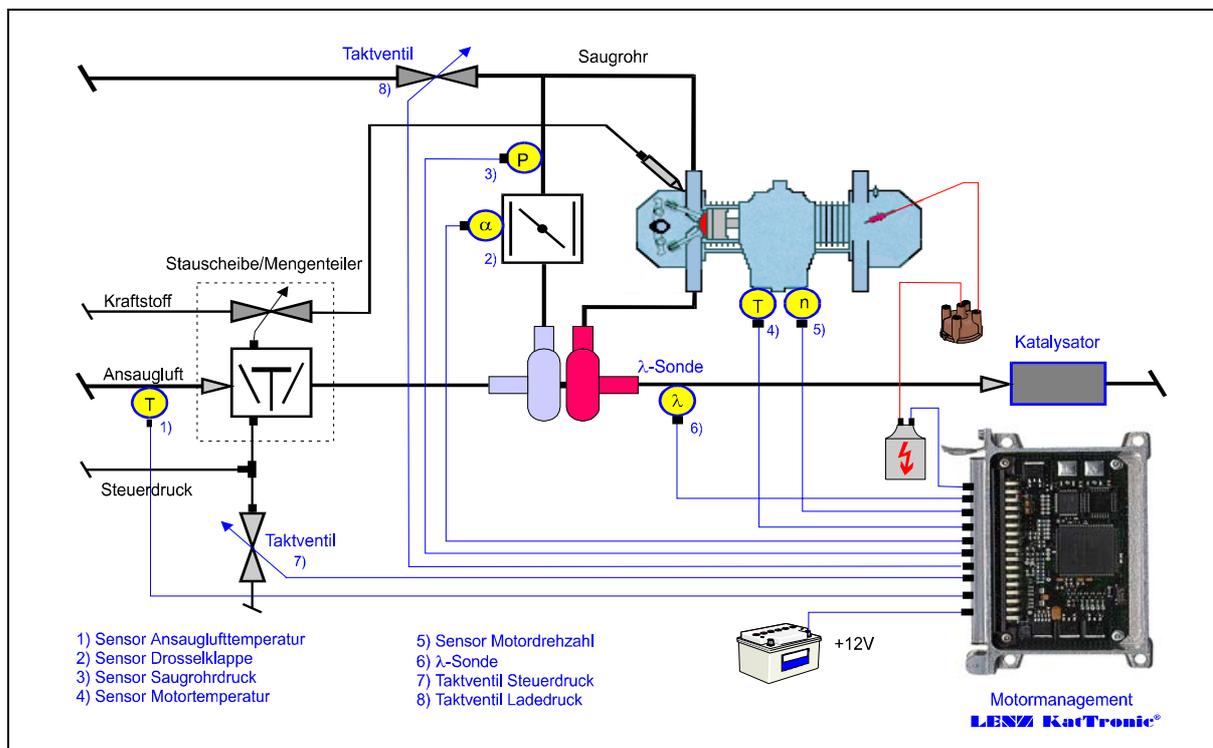
For the use of further performance potential changes in the timing (cam shafts) as well as in the exhaust system are necessary. The torque and the performance development can be improved thereby again substantially.

Basis of the development is a careful analysis of the vibration response of the engine on the intake and exhaust side. For this, extensive measurements on the Lenz engine dynamometer were performed. Thereupon the basic adjustment of the system components took place in the stationary position. The dynamic driving behavior was optimized in numerous measuring runs. The experience of many years in motor sport flowed into the tuning, which resulted altogether in a performance-optimized overall system.

5. System structure

The engine-specific adaptation of the Lenz KatTronic® to the mechanical K-Jetronic injection system is effected through specially developed and adapted sensor/actuator components. For the precise measurement of the operating dimensions of the engine, high quality, select sensors are used.

Adaption Lenz KatTronic® for Bosch K-Jetronic 911 Turbo II



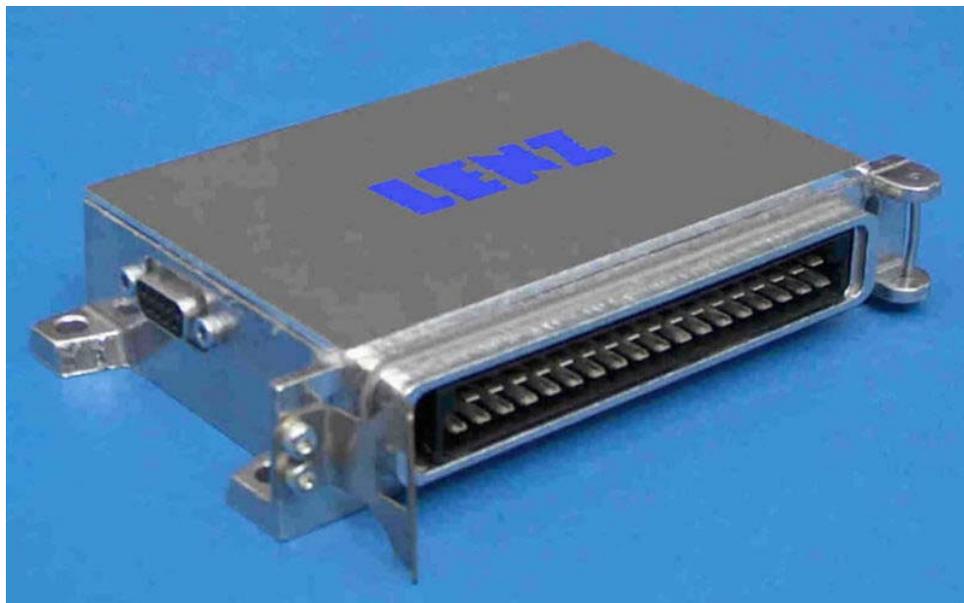
6. The Lenz KatTronic® engine management

Lenz KatTronic ® is a modern, modularly developed digital engine management for ignition and injection with the Infineon Microcontroller C509 as CCU. The storage of the data tables / maps and control parameters takes place in flash memories. A special, hardware-supported signal processing makes the ultra fast and highly exact processing of the sensor data and a high system throughput possible. The system software works real-time, i.e. each injection and ignition event is computed up to the maximum permissible engine speed in real time from the sensor data and operating dimensions. The result is a delay-free adjustment of the engine control to the respective operating condition.

Special algorithms have been implemented in the control software for the optimization of the dynamic behavior. The lambda regulation works according to a modified PID algorithm practically delay-free over the entire load / rpm spectrum, the reference is derived from a lambda data table / map with additional operating specific corrections. The regulation works adaptively, i.e. from the measured values of the lambda sensors model values are derived, which are stored in an adaptation data table / map. In the long-term performance data are kept on a constant level by continual updating of engine electronics. On board diagnostic routines permanently monitor the function of the sensor technology and store abnormal operating conditions as well as implausible sensor data for diagnostic purposes. A fail-safe program permits driving in the event of an error. A temperature-dependent rpm limiter protects the engine during the warming-up phase against excessive wear from too high rpms.

Future pollutant standards as well as improvements in performance as consequence of the continual development can be accomplished over an update of the system software without a problem. Therefore Lenz KatTronic ® is a future-safe investment.

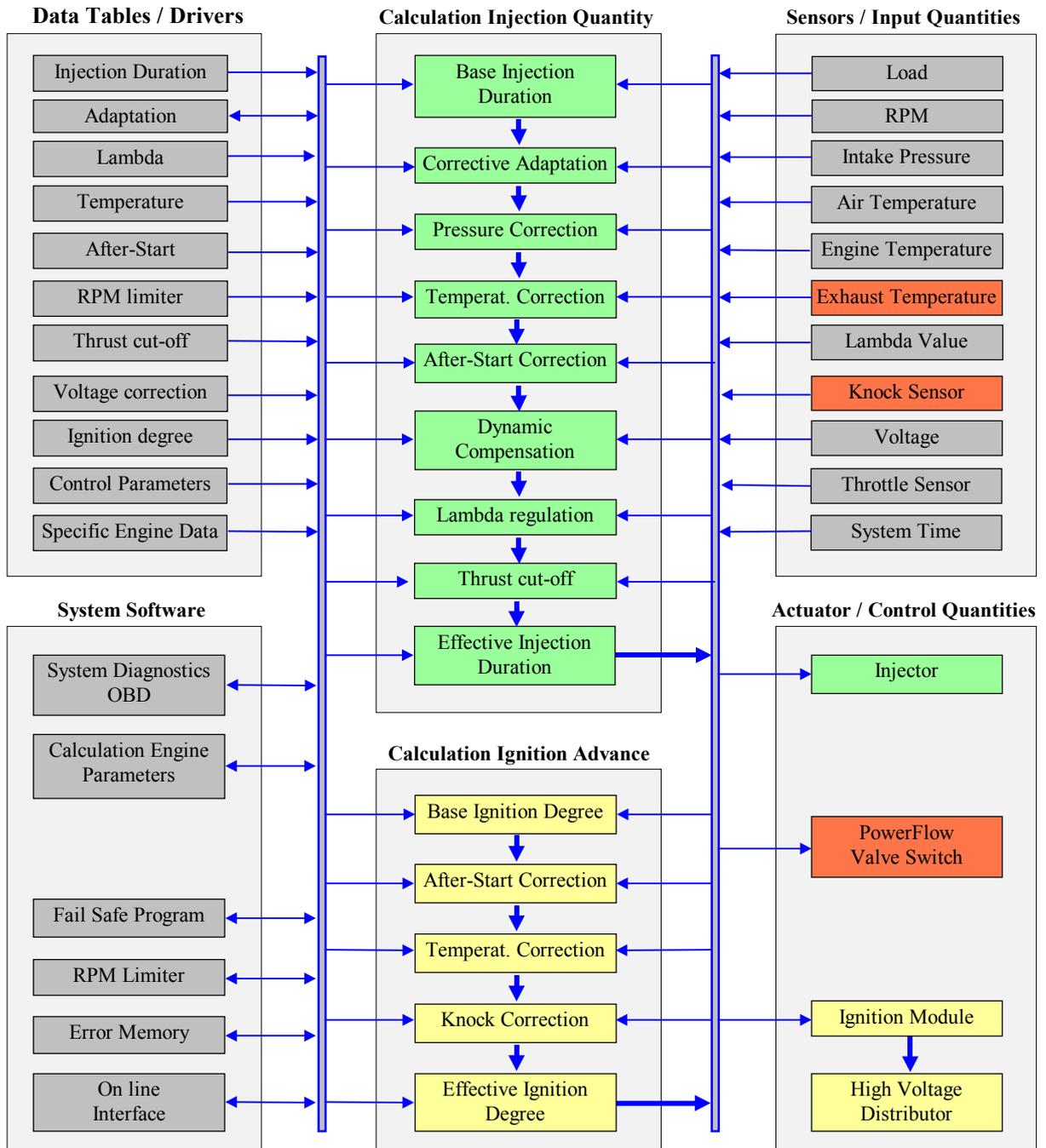
The Lenz KatTronic® engine management system



Picture of controller

All components of Lenz KatTronic ® are executed in modern SMD technique according to EMV guidelines. This represents a high measure of electromechanical security.

Functional Structure of the Lenz Katronic® Engine Management System



Overview Lenz KatTronic® engine management

Input Values

Intake Manifold Pressure
 Engine Temperature
 Air Temperature
 Lambda Sensors
 Exhaust Gas Temperature
 Throttle Butterfly position
 Rpm Sensor
 Knock Sensor

Output Values

Idle
 Injection
 Ignition
 Fuel Pump
 Boost Regulation

Data Tables / Maps

Injection (2)
 lambda Value
 Ignition degree
 Lambda regulation
 Adaptation
 Boost Pressure
 Load Evaluation

Data Table Drivers

Lambda Sensor
 Engine Temperature
 Air Temperature
 Warm Up
 Start Quantity
 After-Start Faktor
 Voltage Correction

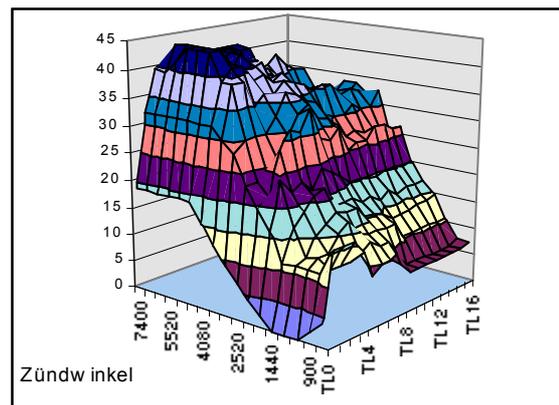
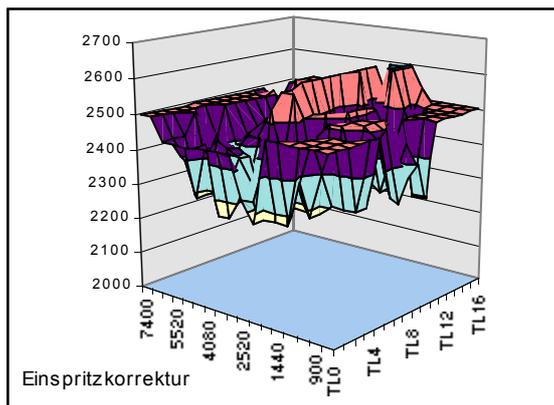
Base Functions

Warm Up
 Idle Regulation
 Temperature Dependent Thrust reduction
 Temperature Compensation
 Dynamic Transition Compensation
 Boost Control

Monitoring Functions

Fail-Safe Program
 Sensor Monitoring
 Operating Hour Counter
 Temperature Dependent Speed Limiter
 Error Memory
 Extreme Value Memory

Data tables / Maps for injection duration and ignition degree



7. The Lenz KatTronic® software

A singular feature of the Lenz KatTronic® is the integrated serial interface to standard PC (operating system MSDOS) executable software. In the standard version important system data can be displayed on-line during current driving on a graphics display (e.g. laptop with MSDOS) and diagnostic data for service purposes can be read-out. For the professional application an extended version is available. This contains functions for system calibration as well as the on-line editing of the data tables / maps and system parameters, with which an individual fine tuning is possible on the respective engine. Further measuring data can be recorded (data recording / telemetry).

9. Results P – C - S

❑ Performance increase

The Lenz PowerKat ® system for the 911 turbo II achieves a drastic improvement in the response mode (throttle response), the performance and the accelerating power compared to the base engine. The dynamic optimization results from special algorithms in the controller software. Emphasis was put on increase in performance in a wide as possible rpm range.

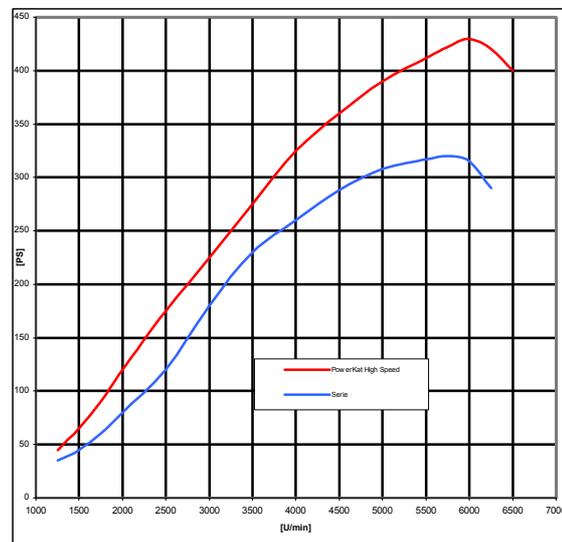
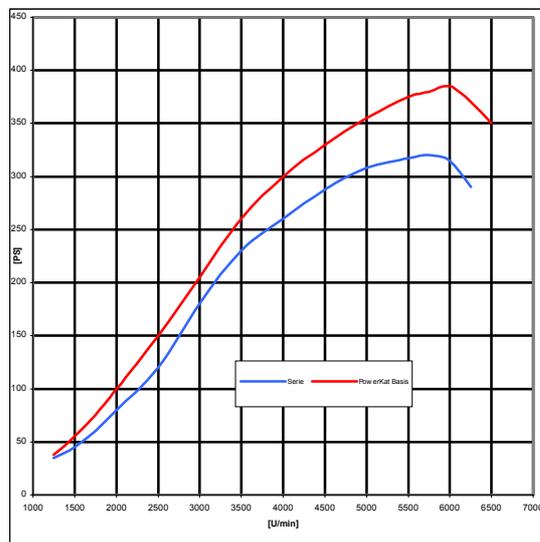
❑ Consumption optimization

The precise adherence to the ideal values for ignition and injection amount and the measurement of the operating condition with high-quality sensors result in a specific consumption particularly favorable in comparison to the series engine. The theoretically higher efficiency of turbo engines is actually used with Lenz KatTronic®. The Lambda regulation works over the entire load and rpm spectrum as a dynamically regulated system of high quality. Thus in mixed driving very favorable values consumed are obtained. Consumption reductions within the range of 3-7 Liter/100 km are to be expected in normal use.

❑ Pollutant reduction

The Lenz PowerKat ® system for the 911Turbo II fulfills the EEC guideline 91/441 to and is therefore classified as low-pollution in according to Euro-standard I.

Full load curves Lenz system PowerKat ® in relation to series



Performance comparison

Version	HP	Torque	Top speed
Series engine (factory specs)	320 HP	450 Nm	270 km/h
Lenz PowerKat®	385 HP	500 Nm	290 km/h
Lenz PowerKat® High-Speed	440 HP	560 Nm	300 km/h

10. TÜV certification

The Lenz PowerKat ® system was certified by the TÜV Munich for the 911 Turbo II. In the test report the performance and pollutant values, maximum speed and sound levels were documented. With the available TÜV certification, an entry of the Lenz PowerKat ® system into the registration papers is possible, problem-free.

11. Installation, start up, maintenance and guarantee

A substantial advantage of Lenz PowerKat ® system is the lack of mechanical intervention into the engine. The components can be installed by the manufacturer or in authorized workshops problem-free. If necessary, the vehicle at relatively small expenditure can be returned back again to the original state. Under normal conditions the Lenz PowerKat ® system is maintenance-free. The special software necessary for the diagnosis and adjustment of the engine control Lenz KatTronic ® is available only from the manufacturer or in authorized workshops.

Basic condition for optimal functionality of the Lenz PowerKat ® system and achievement of the performance data is naturally a mechanically intact, not worn engine, which was maintained according to the factory specifications. Only in this case can a guarantee for the indicated performance data be made. On the components of the system a 1 year warranty starting from delivery date is made.

The price for the Lenz PowerKat ® system includes expressly only the components of the basic version and their assembly. Additionally necessary service work and the exchange of defective and/or worn components are charged for as incurred.

The technical data refer - if nothing different is mentioned - to the basic version of Lenz PowerKat ® system for the Porsche 911 Turbo II.

Technical changes remain reserved for.

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