

System Lenz PowerKat[®] for Ferrari 308/328



1. The Ferrari 308 / 328

At the Paris 1975 auto show Ferrari presented the brand new model 308 GTB to the automotive public. This was a prelude to an unparalleled successful model line for Ferrari, with 21.678 vehicles produced over 15 years, which would outnumber all prior models produced in Maranello. This creation drawn by Pininfarina skillfully united stylistic elements of 246 GT and 365 GT4 BB for its own beauty. “Bella Macchina” read rightfully the inspiring comment of car magazine “Auto Motor Sport”. In 1977 the Spider GTS version, based on the Berlinetta appeared. This version developed to the most popular variant of the 308. Of the total 12,143 308 units produced, there were 8,004 GTS.

The 90° V8-Motor with a displacement of 2927 cm³ and four overhead cam shafts developed an output of 255 HP at 7700 U/min. The family tree points thereby in direct line to the model Dino 308 GT4. The fuel intake took place via 4 Weber 40 DCNF double carburetors. Starting from autumn 1980 the carburetor was replaced by the Bosch K-Jetronic mechanical injection system. This normally performance increasing measure caused the 308, along with acoustic intake noise suppression, a loss of 41 HP. Two years later the quattrovalvole model variant performance could be increased by around 26 HP through use of four-valve technology.

At the 1985 Frankfurt IAA auto show the 308 was replaced by the successor 328, with larger dimensions, stylistic modifications and the front section inspired by the Testarossa. This model exhibited now 3186 cm³ displacement and produced 270 HP. In the course of world-wide increasingly intensified emissions regulations Ferrari offered the 328 also with regulated 3 way catalyst. This version developed a clearly lower performance with 255 HP. Due to conditions of catalyst technology (ceramic monolith) and the performance limits of engine electronics at that time no better result was attainable. In this configuration the fascinating engine character of the vehicle suffers greatly.

The present development in the area of emissions regulations with driving bans during ozone alarms and in the town center, drastically higher taxation and smaller resale chances increased the interest in a technically high-quality catalyst retrofit with an increase in output in the Ferrari models 308/328 strongly. So far there was no retrofit regulated 3 way catalyst offered for the Ferrari 308/328 models on the German market with which this vehicle fulfills an exhaust standard equivalent to Euro 1, not to

speak of a solution, which offers a clear increase in output in connection with a regulated 3 way catalyst.

The newly developed Lenz PowerKat® system achieves exactly this, particularly for demanding sport engines. On the basis of many years of know-how and most modern technology, the previously incompatible opposite optimal emission levels and markedly improved performance can be connected. The engine is updated to today's conditions of engine control technology by high performance digital engine management and metal catalysts. The system is recommended as an up-to-date, sensible and economical investment into the value retention and improved emission levels with at the same time clearly increased driving fun.

With the Lenz PowerKat® system the classic Ferrari 308/328 models achieve the technological and performance-related connection to today's model generations, and this with environmental friendly consumption and emission levels. Our slogan "classic meets future" stands for this successful synthesis of classic automobile with high tech.

2. The conception of the Lenz PowerKat® system

The Lenz PowerKat® system is conceived as an uncompromising high end system for catalyst retrofit with an increase in output. It was developed with the philosophy to retrofit the engine using most modern technology for improved performance with a regulated catalyst. The pollutant standard EEC guideline 91/441 in effect at present, with which the retrofitted vehicles are absolutely equivalent in comparison to the today's conditions of the catalyst technology and are classified as equivalent to the pollutant limit levels of today's new vehicles according to Euro-standard I.

For the Ferrari 308/328, the system was optimized in particular regarding the criteria engine performance, torque development, specific consumption and acceleration compared to the non-catalyst base engine with the result that with catalyst, the sporty engine character fully remains and the excellent performance is improved even more.

3. Technical implementation

The Ferrari models 308/328 use the mechanical Bosch K-Jetronic with a fuel control valve for the two cylinder banks. The exhaust manifolds of the two cylinder banks are thermally insulated and equipped with two lambda probes, whose signals are separately processed (dual lambda regulation). As catalyst a high-quality sport metal catalyst is used, which is integrated in the existing muffler. Both the original exhaust muffler or modified mufflers can be used.

Principal item of the retrofit system is the Lenz KatTronic® digital engine management with which injection and ignition can be controlled extremely precisely. Control of the injection amount necessary for lambda regulation is made by an electrical pulse valve in the fuel pressure line for the fuel control valve of the Bosch 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 probes, the engine load, the number of rpms and the operating condition of the engine computes the optimal injection amount over an injection correction map / data table. Over a special sensor technology measured values for temperatures and pressure are considered. The Lenz KatTronic® ignition system operates likewise, map / data table controlled, the parameters number of rpms, load, intake manifold pressure and operating condition flow into the computation of the optimal ignition degree. The ignition is made by high voltage distribution (distributor).

Exclusively first-class technology from in house development using selected components of well known manufacturers (Bosch, Siemens) are used in the Lenz PowerKat® system

In addition to the base retrofit, fully electronic injection systems (intermittent injection) and single coil ignition are also available for high performance engines. In this case the load measurement is made by an alpha/n system with low-resistance, flow optimized air intake.

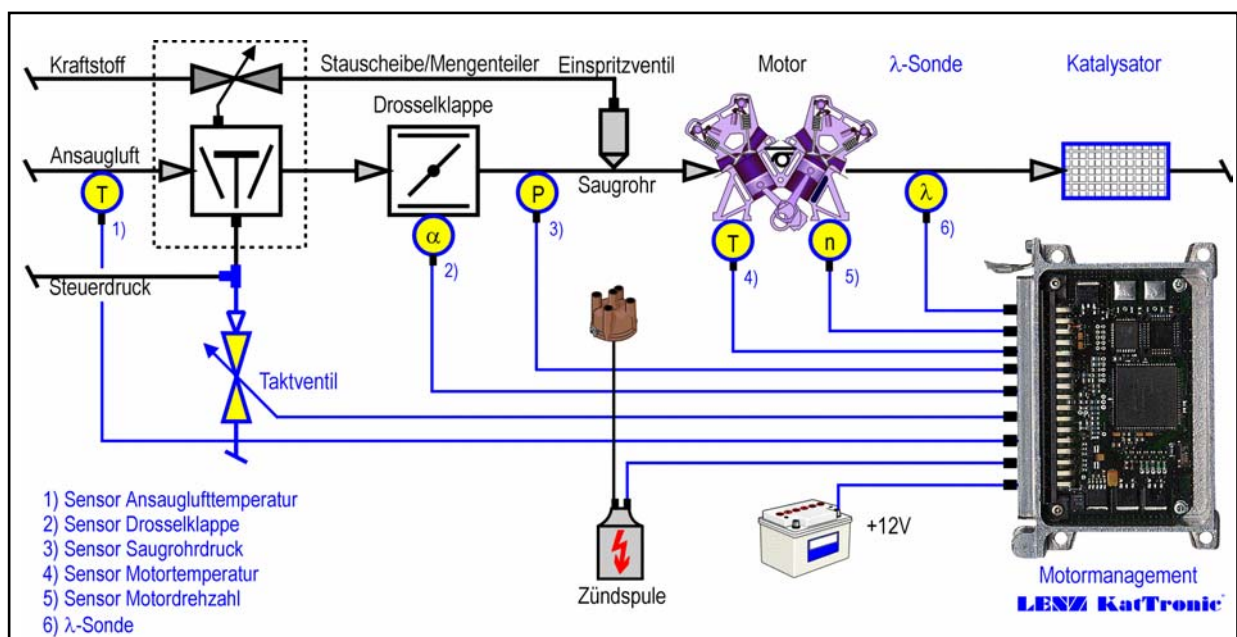
4. Performance optimization

Only through the efficiency of modern engine controls can the constructional potential of a sport engine be effectively used. Base of the development is a careful analysis of the vibration response of the engine on the intake and the exhaust side. For this, extensive measurements on the Lenz engine dynamometer were performed. Thereupon the basic adjustment of the system components took place in stationary operation. The dynamic behavior of the engine was optimized in numerous measuring phases. From the analysis of data recorded while driving (data-recording) substantial information about improvement potentials in the dynamic behavior could be won, which were transferred to engine control on the software level. Experiences of many years in motor sport flowed into the development, which resulted altogether in an performance-optimized total system.

5. System structure

The engine-specific adaptation of the Lenz KatTronic® to the mechanical Bosch 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



6. The engine management Lenz KatTronic®

The Lenz KatTronic® is a modern, modular structured digital engine management for injection and ignition with the Siemens Microcontroller SAB80C517A as CPU. The storage of the data tables / maps and control parameters takes place in flash memories. A special, hardware-supported signal processing enables the ultra fast and highly exact processing of the sensor data and a high system throughput. The

system software operates real-time, i.e. calculates each injection and ignition phase 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 are implemented in the software management for the optimization of the dynamic behavior. The lambda regulation operates according to a modified PID rule algorithm practically delay-free over the entire load/rpm spectrum, the reference is derived from a lambda data table / map with additional specific corrections. The regulation operates adaptively, i.e. from the measured values of the lambda sensors parameters are derived, which are stored in an adaptation data table / map. In long-term operation performance data are maintained by up-dating of engine electronics on a constant level. 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 speed limiter protects the engine during the warming-up phase against excessive wear by too high rpms.

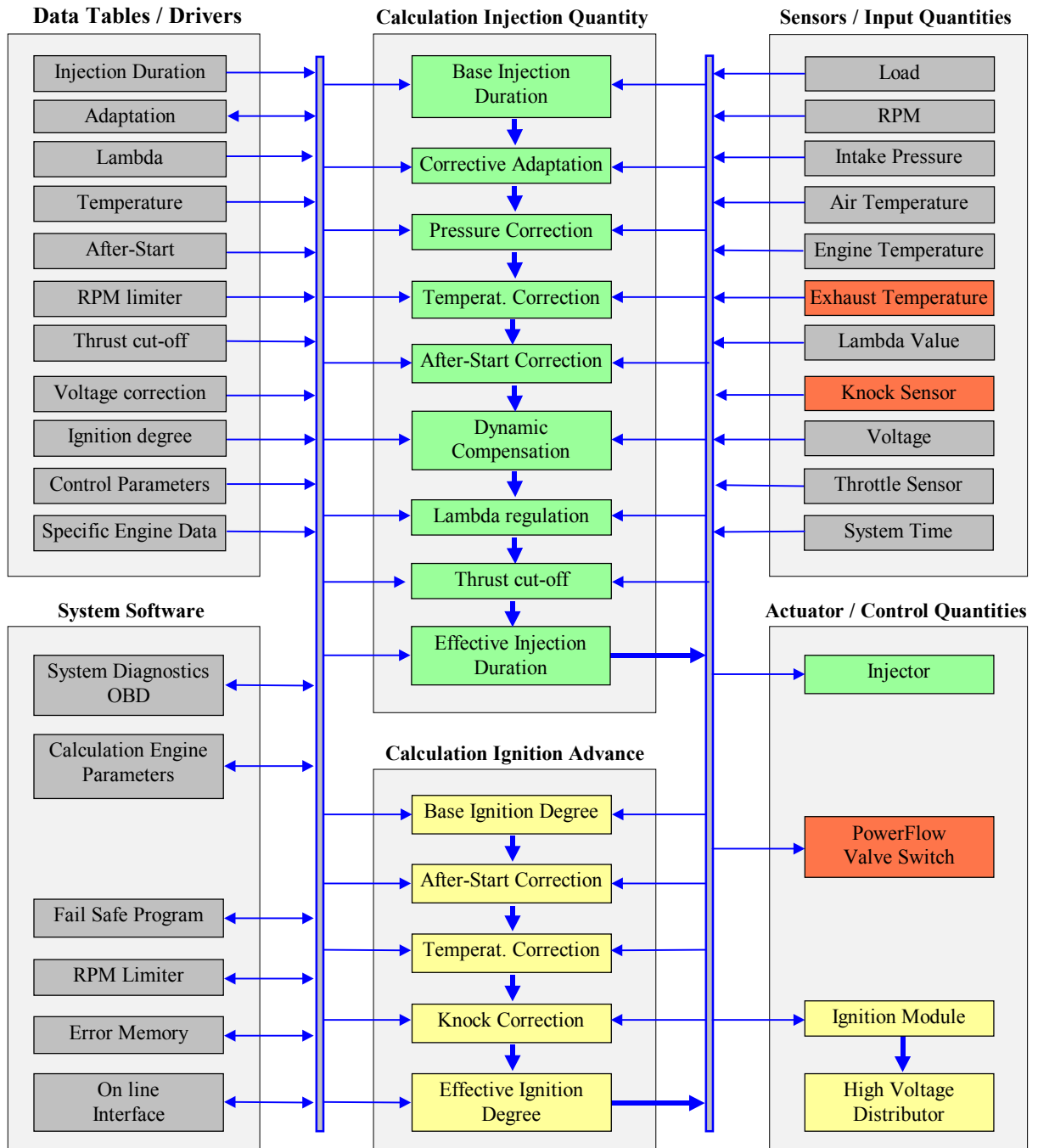
The Lenz KatTronic® Engine Management System



Picture of Controller

The Lenz KatTronic® is built using modern SMD technology according to EMV guidelines.

Functional Structure of the Lenz Katronic® Engine Management System



Overview of the 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
 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 Factor
 Voltage Correction

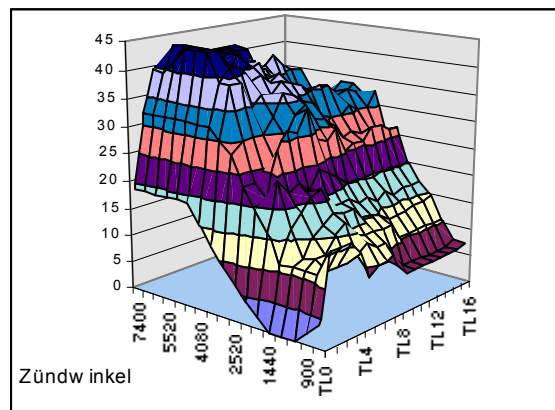
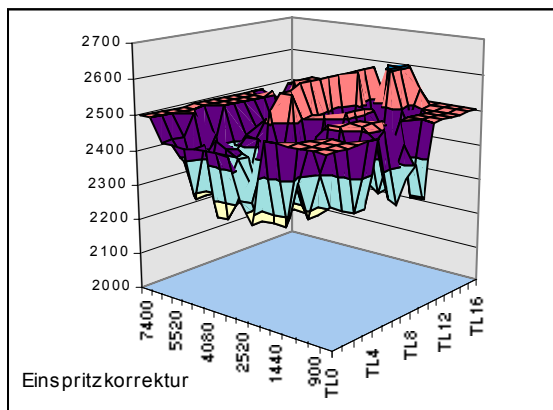
Base Functions

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

Monitoring Functions

fail-safe Program
 Sensor Monitoring
 Operating Hour Counter
 Temperature Dependent Speed Limiter
 Error Memory
 Extreme Value Memory
 Serial Interface (RS-232)

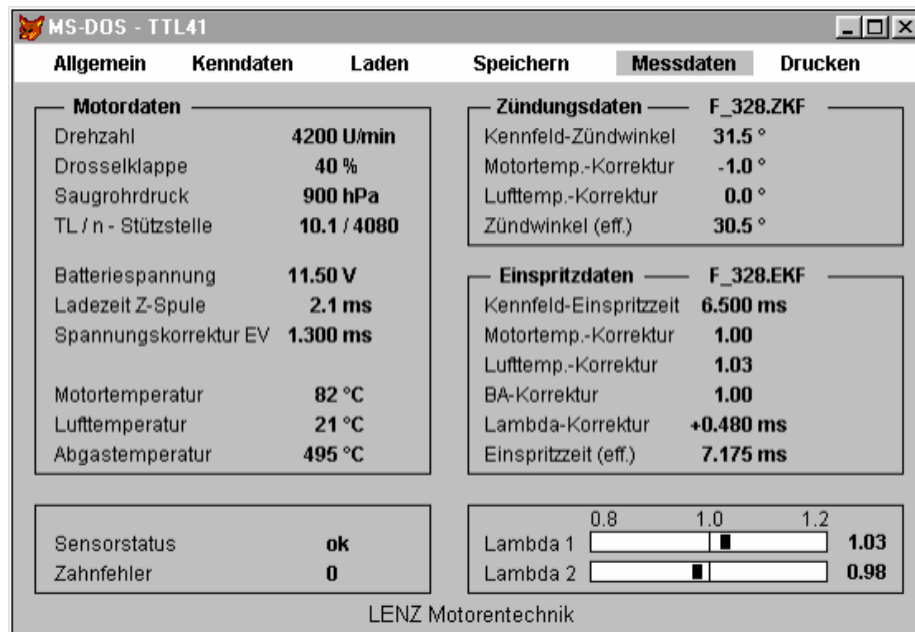
Data tables / Maps for injection duration and ignition degree



7. The software for the Lenz KatTronic®

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 in current driving conditions on a graphic 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). In the extended version all functions can be used also over radio data transmission (cell phone with GSM Card) from a stationary PC (telemetry).

View of Measurement Data Display



Future pollutant standards as well as performance improvements in the course of continuing development can be realized as updates to the operational software problem-free. Therefore the Lenz KatTronic® is a future-safe investment.

8. System Components

The Lenz PowerKat® system for the Ferrari models 308/328 with Bosch K-Jetronic consists of the following components in the base version:

- Wiring loom
- 2 lambda sensors
- Lenz KatTronic® Engine management
- Heat insulated exhaust headers to muffler
- Metal catalyst to be integrated into the muffler
- Pressure and temperature sensors (alpha/n air measurement system)

For the construction of high performance engines additional system components are required, they will depend on the individual specification.

9. Results P - C - P

□ Performance optimization

The Lenz PowerKat[®] system for the Ferrari models 308/328 clearly improves the response mode (throttle response), the performance and the accelerating power compared to the base engine, and this, in connection with a catalyst. The dynamic optimization results from special algorithms in the controller software. The values of the torque curve are 5% higher than the series engine over almost the entire rpm range and 300 horsepower is achieved for the 328. The rpm limiter is set at 7,800 so that the top speed can take advantage of the additional engine performance. Top speed is 280 kmh (175 mph).

□ Consumption optimization

With the Lenz KatTronic[®] system, the Ferrari models 308/328 fulfill the EC guideline 91/441 and are therefore classified as low-pollution equivalent to Euro-standard I. Thus a Ferrari equipped with the Lenz PowerKat[®] system does not fall under a driving ban during ozone alarm, and the ozone plaque can be issued for the vehicle.

□ Pollutant optimization

The precise adherence to the ideal values for injection amount and ignition degree 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 lambda regulation operates over the entire load and rpm spectrum as a dynamically regulated system of high quality. Thus in mixed driving favorable values consumed are obtained

10. TÜV certification

The Lenz PowerKat[®] system was certified by the TÜV Munich for the Ferrari models 308/328. 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 KatTronic[®] into the title / registration papers is possible, problem-free.

11. Installation, set-up, maintenance and guarantee

A substantial advantage of the Lenz PowerKat[®] system is the lack of mechanical interventions 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.

For the installation and initial set-up, the instructions in the installation and operating manual absolutely must be followed. Incorrect assembly of the components can cause malfunctions or damage, in this case the guarantee for the system components expires.

If the vehicle was previously operated with leaded gasoline, then the tank as far as possible must be run dry and before installation, the vehicle absolutely must be driven with a full tank of unleaded fuel in order to exclude damage to the catalyst by lead. Relevant investigations by car manufacturers (Mercedes Benz) regarding lead free operation of engines with not-hardened valve seats conclusively

show that as a result of prior long-term actual operating time with leaded gasoline sufficient lead diffuses into the valve seats (memory effect), so that no negative effects are to be expected on the life span of the valve seats. We recommend nevertheless the use of suitable lead replacement additives, which have proven innocuous for emission control systems (e.g. Castrol).

Basic condition for optimal functionality of the Lenz PowerKat ® system 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 Lenz PowerKat ® system, a 1 year warranty starting from delivery date is made.

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

The technical specifications refer - if nothing different is mentioned - to the basic version of the Lenz PowerKat - system for the Ferrari 308/328 with K-Jetronic fuel injection. Carbureted engines can also be converted to electronic fuel injection using the Lenz KatTronic ® with a regulated catalytic converter. More information is available on request.

As an option, the innovative, actively controlled Lenz PowerFlow ® system is available, with a variable exhaust sound and improved performance and torque development over the entire rpm range. Additional information is available on request.

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