LENZ

Engine Management System

KatTronic®
TurboTronic®
PowerTronic®
PowerTronicLight®
TurboTronicLight®

EMS – Controllers and Peripheral Equipment

Version 2.0
Januar 2003

Herausgeber: Lenz **Motorentechnik Germany**

Weitere Informationen zu Lenz Motoren-Management-Systemen and zur Verstell-Software erhalten Sie bei

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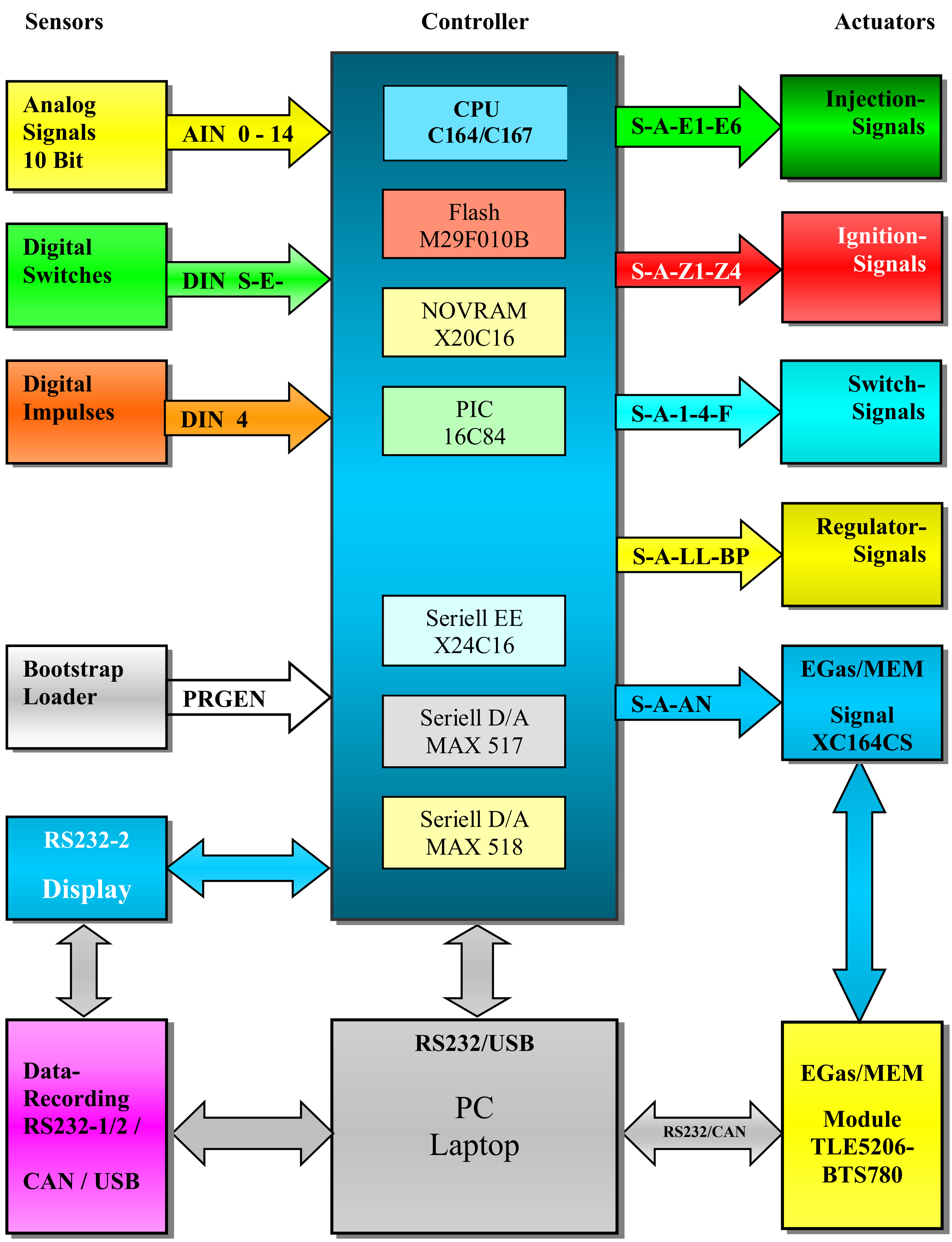
Table of Contents

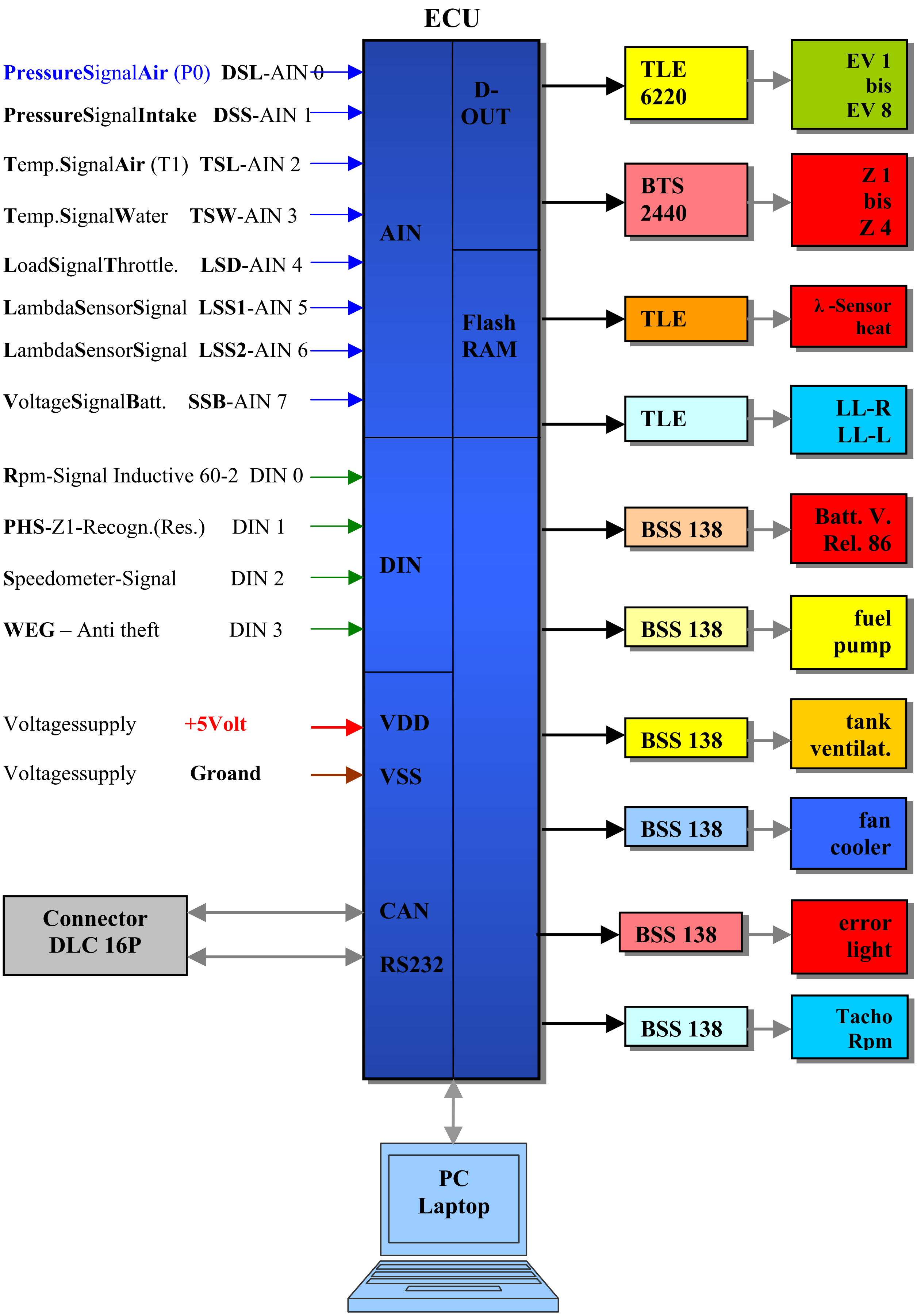
Further Descriptions

2. Controllers and Peripheral Equipment.

2.1 Controller Principle Representation and Structure as Block Circuit.



2.1.1 Definition of the signals in the KatTronic application.



2.2 Construction form and function of the controllers.

Introduction:

The basic control electronics are identical in all controllers (**EMS**). In this basic unit the electronic components essential for the optimization processes are brought together. This basic unit makes it possible for the user to integrate additional performance characteristics stepwise. It represents a complete engine management system and is without further electronic components fully functional.

Additional measurement values can be added as required. For this additional sensors are to be installed in the vehicle and connected to the controller.

This basic unit in electronic form remains unchanged. It contains already all components up for a fully functional EMS. The activation of additional sensors and the processing of the additional measurement values is realized stepwise in the various equipment expansion versions.

For each expansion version an individual software is installed. Expansions can also be retrofitted and reprogrammed.

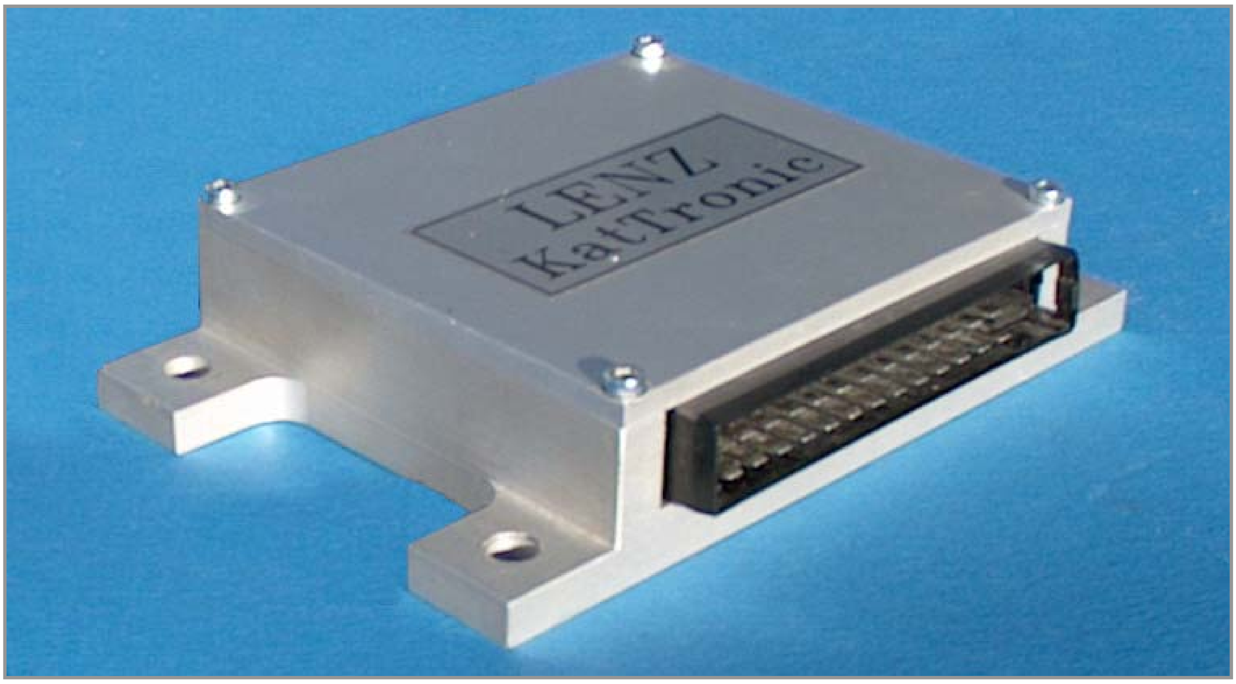
As controller construction forms, the equipment is built in different versions, **connector and pin compatible** to the standard equipment of the series manufacturers such as **Bosch**, **Siemens** or **Weber Marelli**.

Controllers / Systems   Lenz PowerLine®

Lenz TurboTronic®
Lenz TurboTronicLight®
Lenz KatTronic®
Lenz PowerTonic®
Lenz PowerTonicLight®

2.2.1 Typee A-1 Connector AMP 25 pin.

Models: **K**at**T**ronic®
Power**T**ronic**L**ight®
Turbo**T**ronic**L**ight®



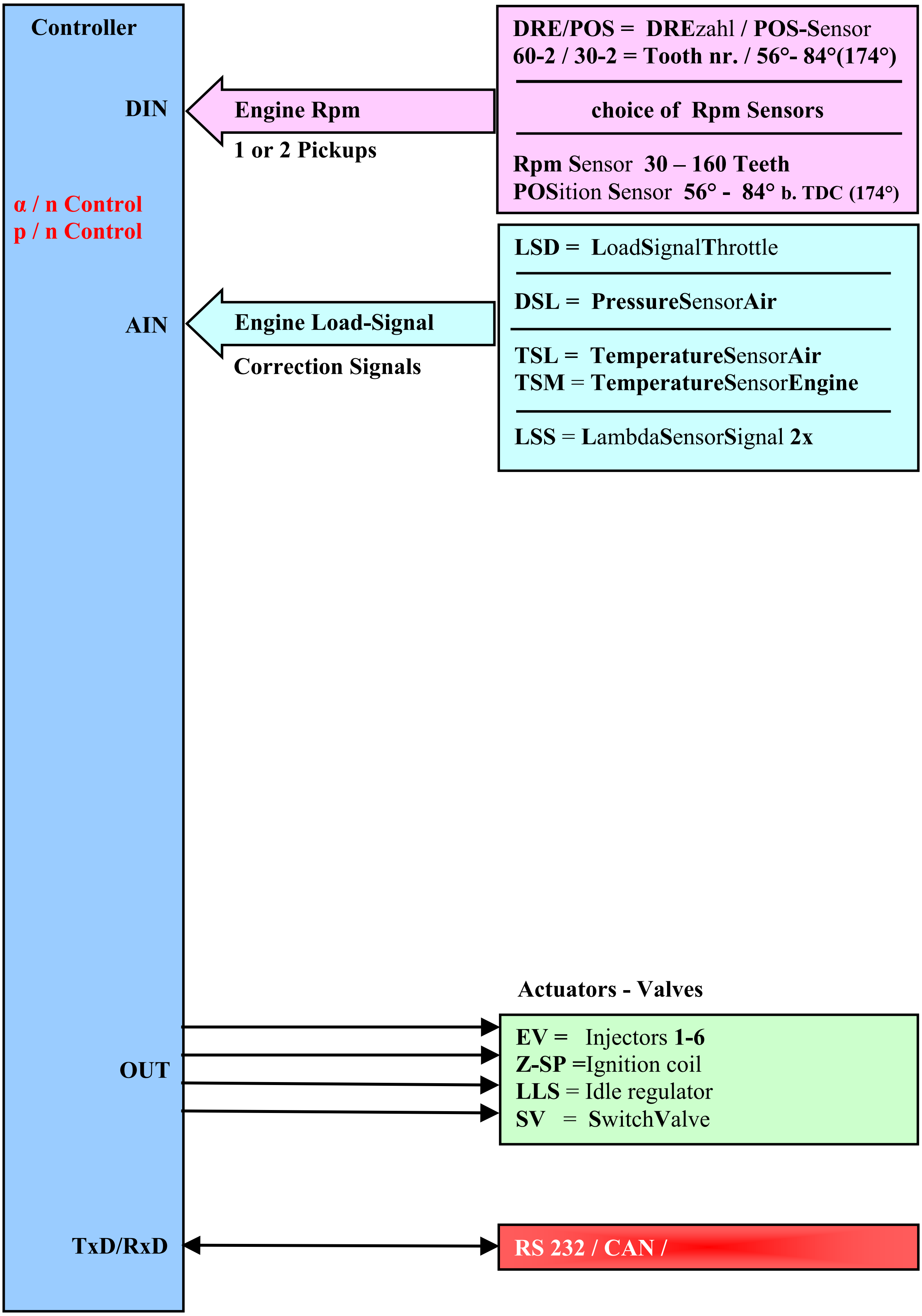
25 pin Controller.

1 A-1: **Lenz** Version A4.1

LENZ model: **Suitable for:** **BMW Marine Engine 4 / 6 Zylinder**

Functions

Basis Sensoren



2.2.2 Type B-1 / B-2 / B-3 / B-4 Connector AMP 35pin

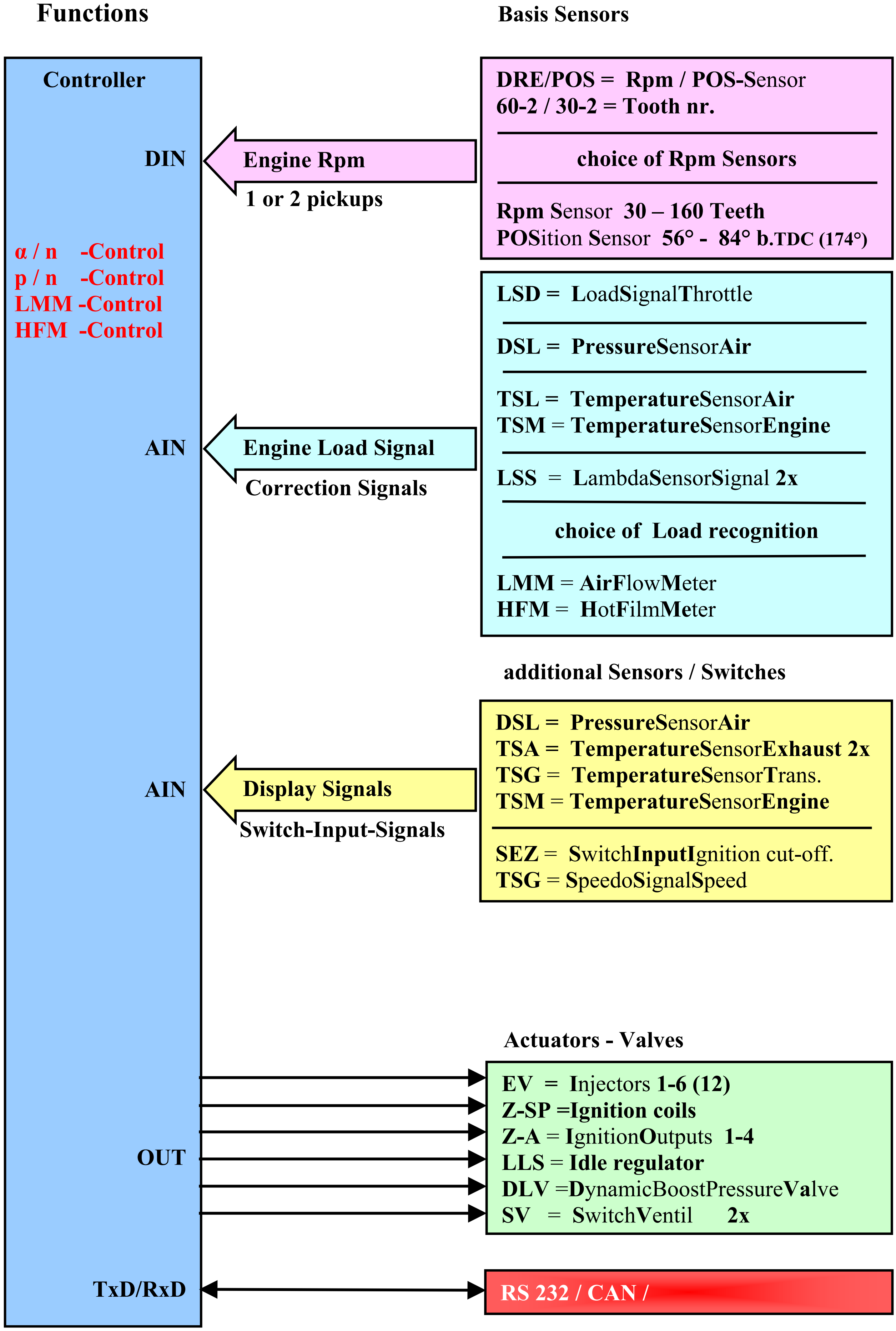
Models: KatTronic®
PowerTronic®
TurboTronic®

This **35pin** controller is **connector**- and **pin** compatible to

2	B-1:	**Bosch**	Version B5.3
3	B-2:	**Weber**	Version B5.2
4	B-3:	**Marelli**	Version B5.0
5	B-4:	**Weber-2**	Version B5.4

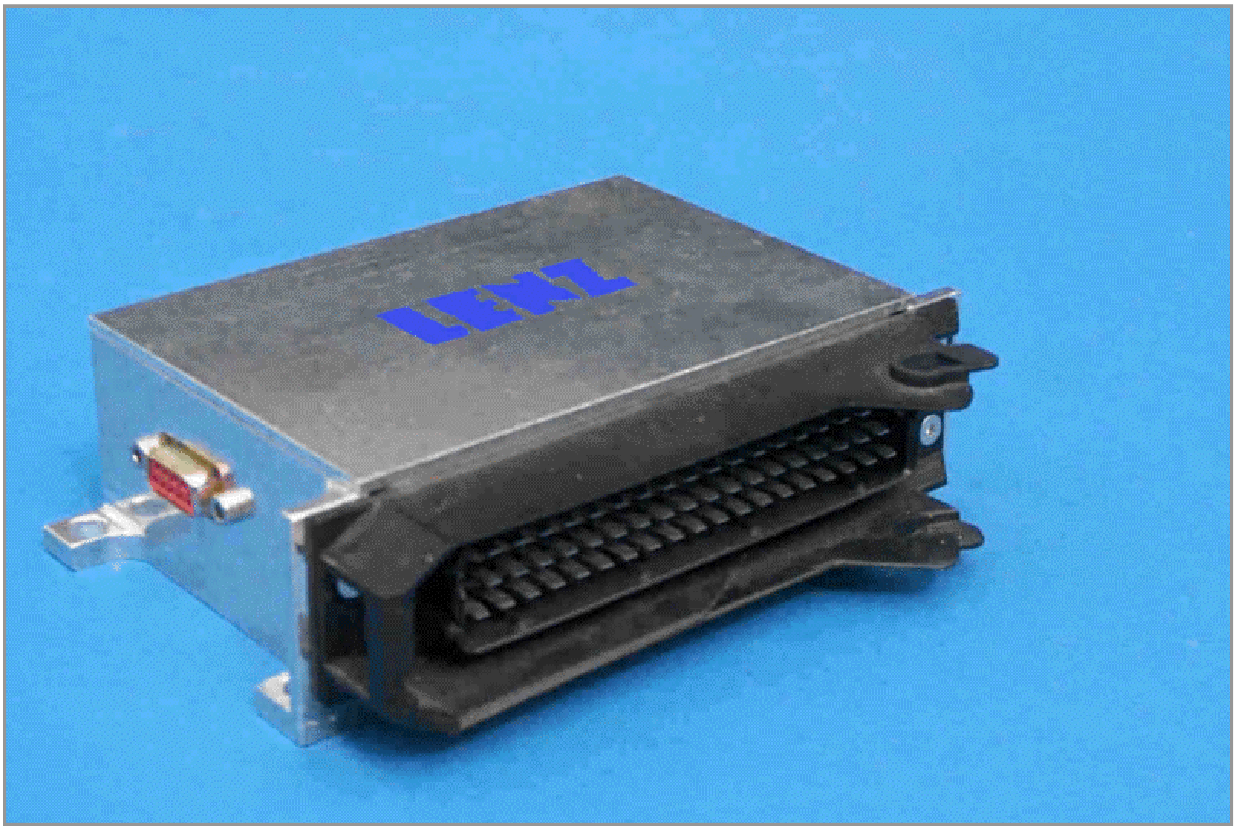
Bosch model:	**Suitable for:**	**Porsche Carrera 1** **Porsche 944 Turbo** **Porsche 956 Bi/Turbo** **Porsche 959 Bi/Turbo** **BMW E30 / M3 / 325 / 327 / Z1** **BMW E28 / M5 / 525 / 535i** **BMW M6 / M635i**
Marelli model:	**Suitable for:**	**Ducati 748**
Weber model:	**Suitable for:**	**Ducati 888 / 916** **Lancia Integrale**

Functions


Basis Sensors
Controller
DIN
α / n -Control
p / n -Control
LMM -Control
HFM -Control
AIN
AIN
OUT
TxD/RxD
Engine Rpm
1 or 2 pickups
Engine Load Signal
Correction Signals
Display Signals
Switch-Input-Signals
DRE/POS = Rpm / POS-Sensor
60-2 / 30-2 = Tooth nr.
choice of Rpm Sensors
Rpm Sensor 30 – 160 Teeth
POSition Sensor 56° - 84° b.TDC (174°)
LSD = LoadSignalThrottle
DSL = PressureSensorAir
TSL = TemperatureSensorAir
TSM = TemperatureSensorEngine
LSS = LambdaSensorSignal 2x
choice of Load recognition
LMM = AirFlowMeter
HFM = HotFilmMeter
additional Sensors / Switches
DSL = PressureSensorAir
TSA = TemperatureSensorExhaust 2x
TSG = TemperatureSensorTrans.
TSM = TemperatureSensorEngine
SEZ = SwitchInputIgnition cut-off.
TSG = SpeedoSignalSpeed
Actuators - Valves
EV = Injectors 1-6 (12)
Z-SP =Ignition coils
Z-A = IgnitionOutputs 1-4
LLS = Idle regulator
DLV =DynamicBoostPressureValve
SV = SwitchVentil 2x
RS 232 / CAN /

2.2.3 Type C-1 / C-2 / C-3 Connector AMP 55 pin

Models: KatTronic®
PowerTronic®
TurboTronic®



This **55pin** controller is **connector**- and **pin** compatible to

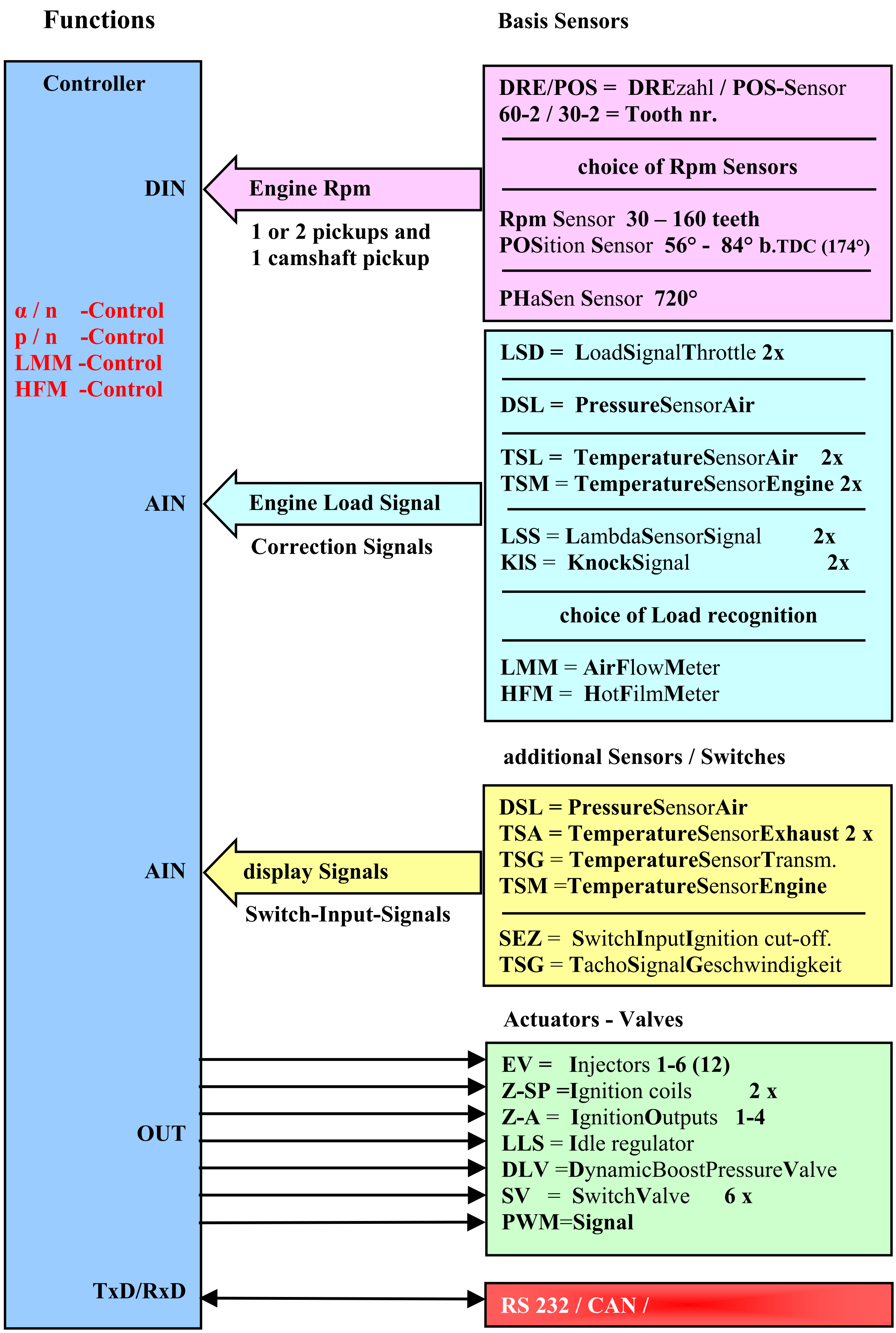
6	C-1: **Bosch**	Version B6.1
7	C-2: **Bosch**	Version B6.2
8	C-3: **Bosch**	Version B6.3

Bosch model: **Suitable for:**

Porsche Carrera 2/4
Porsche Carrera 993

BMW E34 / M5-3.6 / 328 / 528 / 535

Ferrari 348


Functions
Basis Sensors
Controller
DIN
α / n -Control
p / n -Control
LMM -Control
HFM -Control
AIN
AIN
OUT
TxD/RxD
Engine Rpm
1 or 2 pickups and
1 camshaft pickup
Engine Load Signal
Correction Signals
display Signals
Switch-Input-Signals
DRE/POS = DREzahl / POS-Sensor
60-2 / 30-2 = Tooth nr.
choice of Rpm Sensors
Rpm Sensor 30 – 160 teeth
POSition Sensor 56° - 84° b.TDC (174°)
PHaSen Sensor 720°
LSD = LoadSignalThrottle 2x
DSL = PressureSensorAir
TSL = TemperatureSensorAir 2x
TSM = TemperatureSensorEngine 2x
LSS = LambdaSensorSignal 2x
KIS = KnockSignal 2x
choice of Load recognition
LMM = AirFlowMeter
HFM = HotFilmMeter
additional Sensors / Switches
DSL = PressureSensorAir
TSA = TemperatureSensorExhaust 2 x
TSG = TemperatureSensorTransm.
TSM =TemperatureSensorEngine
SEZ = SwitchInputIgnition cut-off.
TSG = TachoSignalGeschwindigkeit
Actuators - Valves
EV = Injectors 1-6 (12)
Z-SP =Ignition coils 2 x
Z-A = IgnitionOutputs 1-4
LLS = Idle regulator
DLV =DynamicBoostPressureValve
SV = SwitchValve 6 x
PWM=Signal
RS 232 / CAN /

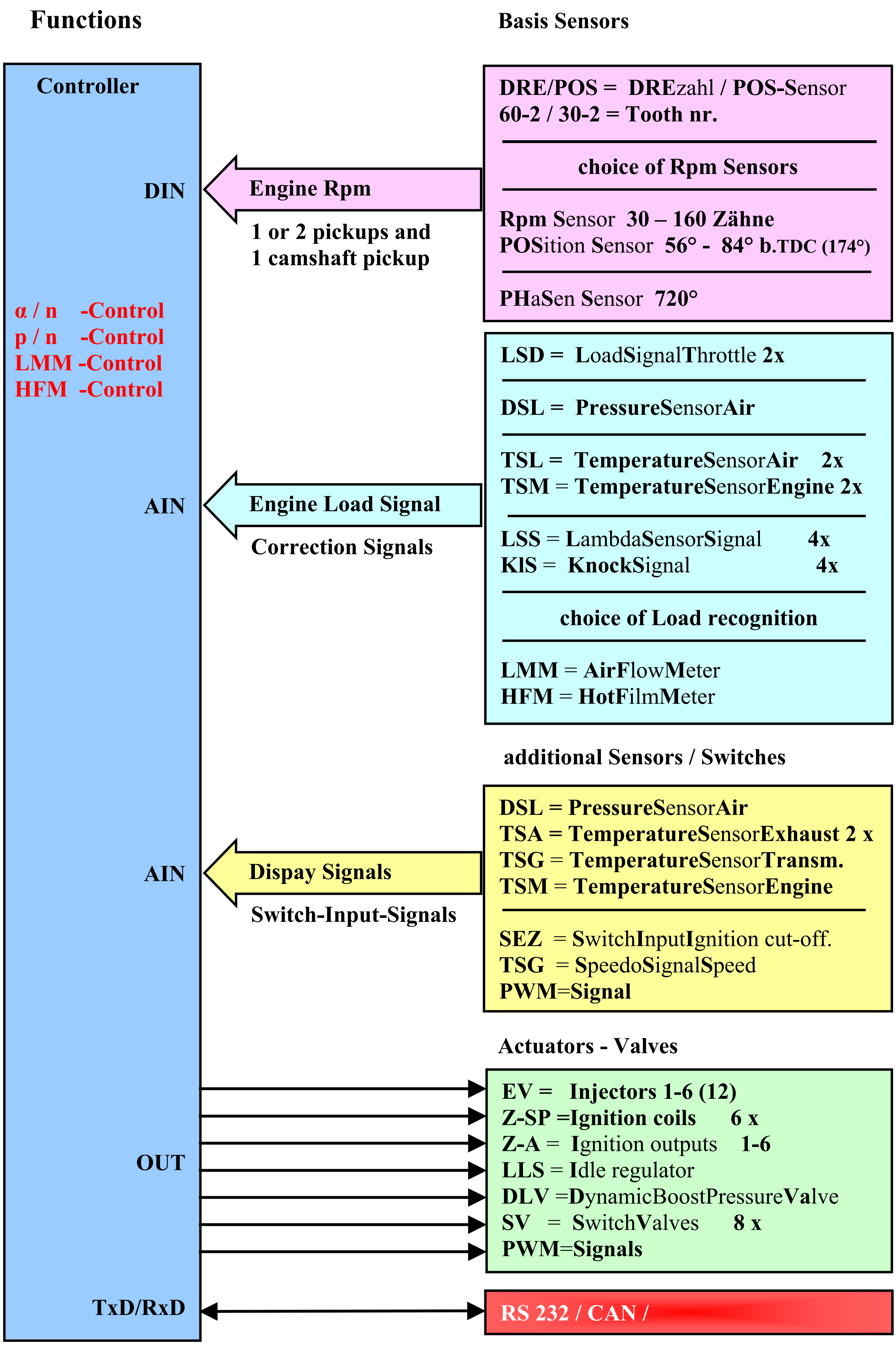
2.2.4 Type D-1 / D-2 / D-3 / D-4 Connector AMP 88 pin

Models: KatTronic®
PowerTronic®
TurboTronic®

This **88 pin**. controller is **connector**- and **pin** compatible to

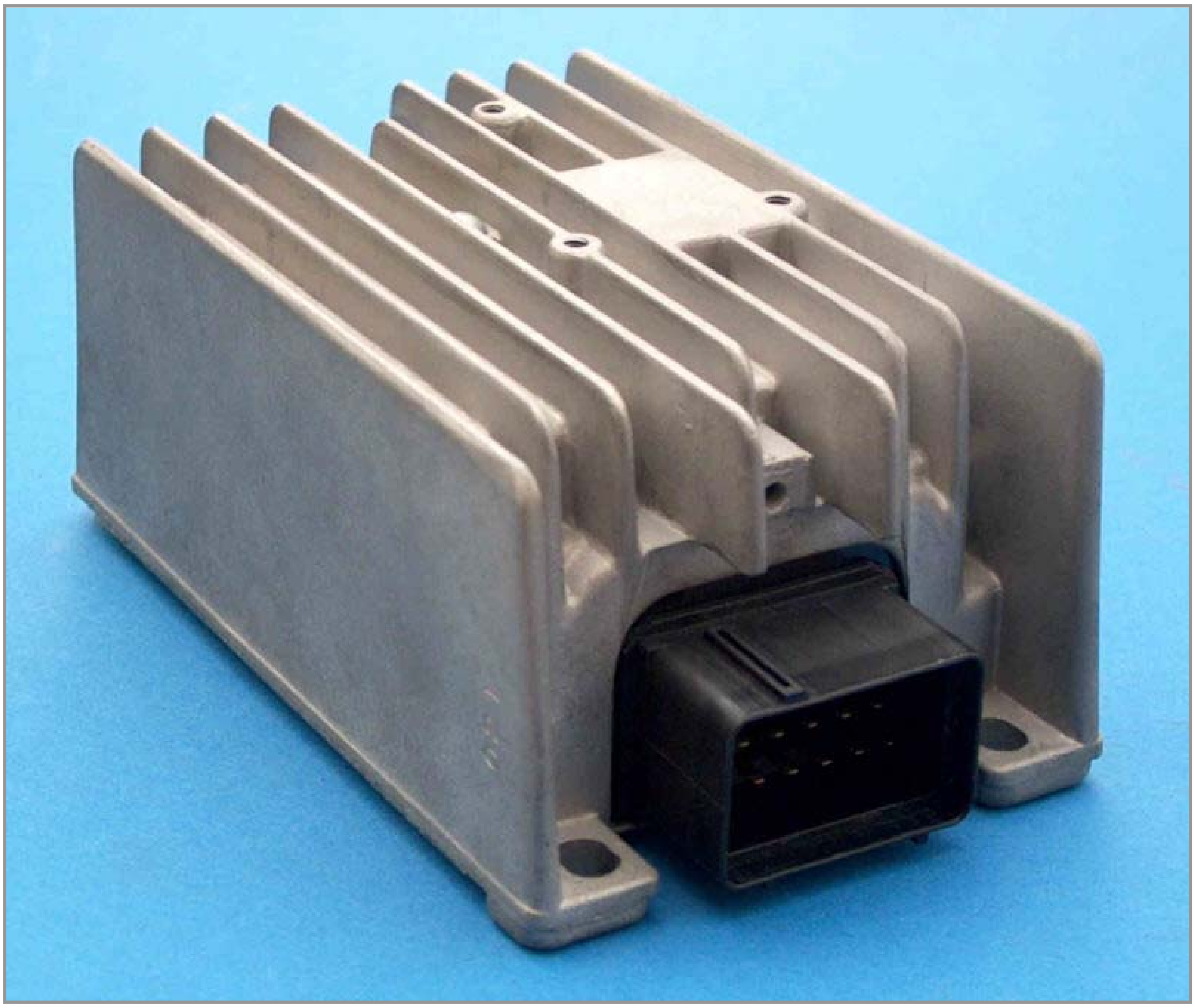
9	D-1: **Bosch**	Version B7.1
10	D-2: **Bosch**	Version B7.2
11	D-3: **Bosch**	Version B7.3
12	D-4: **Siemens**	Version B7.4

Bosch model:	**Suitable for:**	**Porsche Carrera 993** **Porsche Carrera 993-Turbo** **Porsche Carrera 996**
Siemens model:	**Suitable for:**	**BMW E36 / M3-3.0 / M3-3.2** **BMW E34 / M5-3.8**


Functions
Basis Sensors
Controller
DIN
α / n -Control
p / n -Control
LMM -Control
HFM -Control
AIN
AIN
OUT
TxD/RxD
Engine Rpm
1 or 2 pickups and
1 camshaft pickup
Engine Load Signal
Correction Signals
Dispay Signals
Switch-Input-Signals
DRE/POS = DREzahl / POS-Sensor
60-2 / 30-2 = Tooth nr.
choice of Rpm Sensors
Rpm Sensor 30 – 160 Zähne
POSition Sensor 56° - 84° b.TDC (174°)
PHaSen Sensor 720°
LSD = LoadSignalThrottle 2x
DSL = PressureSensorAir
TSL = TemperatureSensorAir 2x
TSM = TemperatureSensorEngine 2x
LSS = LambdaSensorSignal 4x
KlS = KnockSignal 4x
choice of Load recognition
LMM = AirFlowMeter
HFM = HotFilmMeter
additional Sensors / Switches
DSL = PressureSensorAir
TSA = TemperatureSensorExhaust 2 x
TSG = TemperatureSensorTransm.
TSM = TemperatureSensorEngine
SEZ = SwitchInputIgnition cut-off.
TSG = SpeedoSignalSpeed
PWM=Signal
Actuators - Valves
EV = Injectors 1-6 (12)
Z-SP =Ignition coils 6 x
Z-A = Ignition outputs 1-6
LLS = Idle regulator
DLV =DynamicBoostPressureValve
SV = SwitchValves 8 x
PWM=Signals
RS 232 / CAN /

2.2.5 Type E-1 / E-2 Connector AMP 18 pin

Models: KatTronic®
PowerTronicLight®
TurboTronicLight®

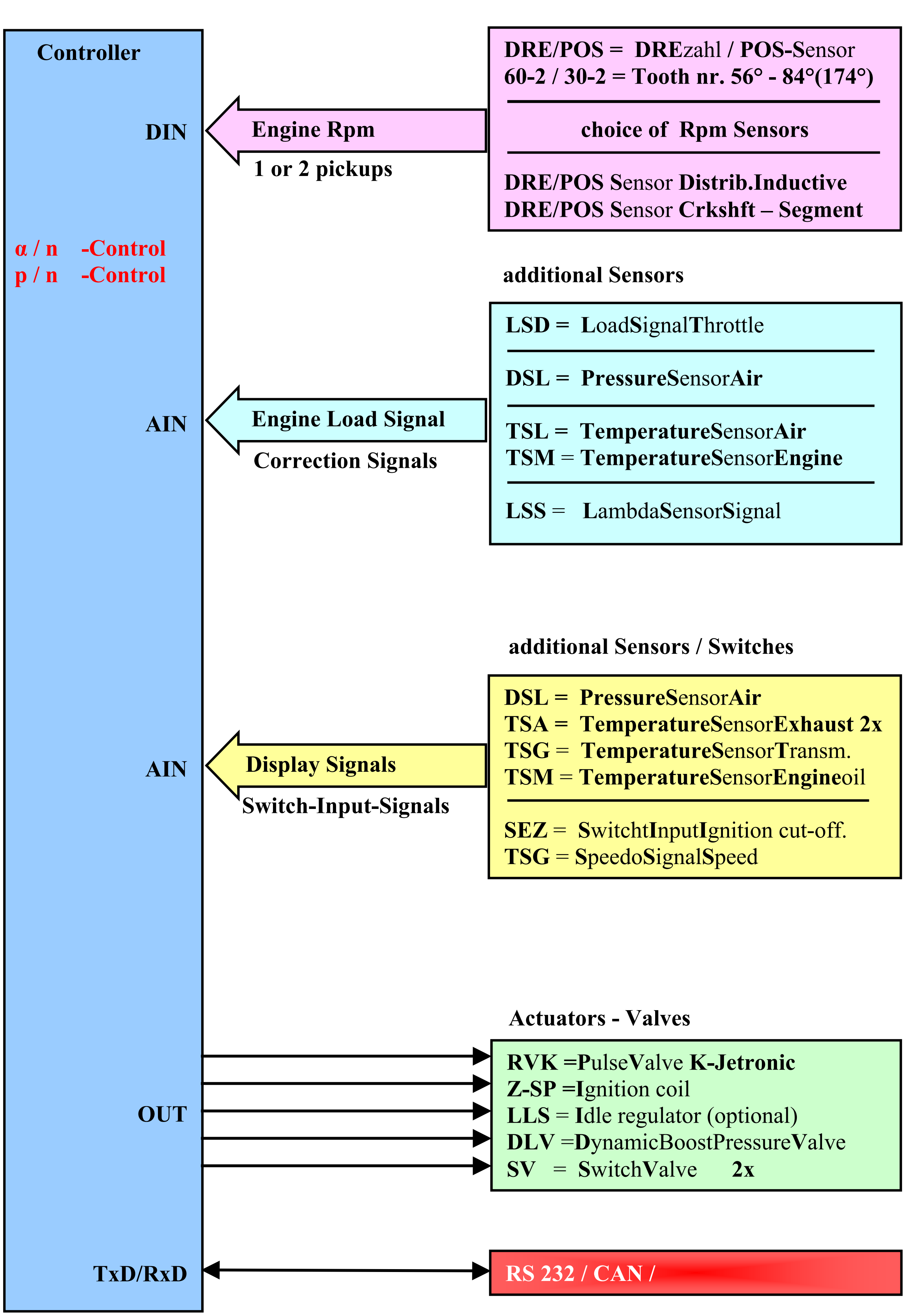


18 pin Controller

13	E-1: **LENZ**		Version B2.1
14	E-2: **LENZ**		Version B2.2

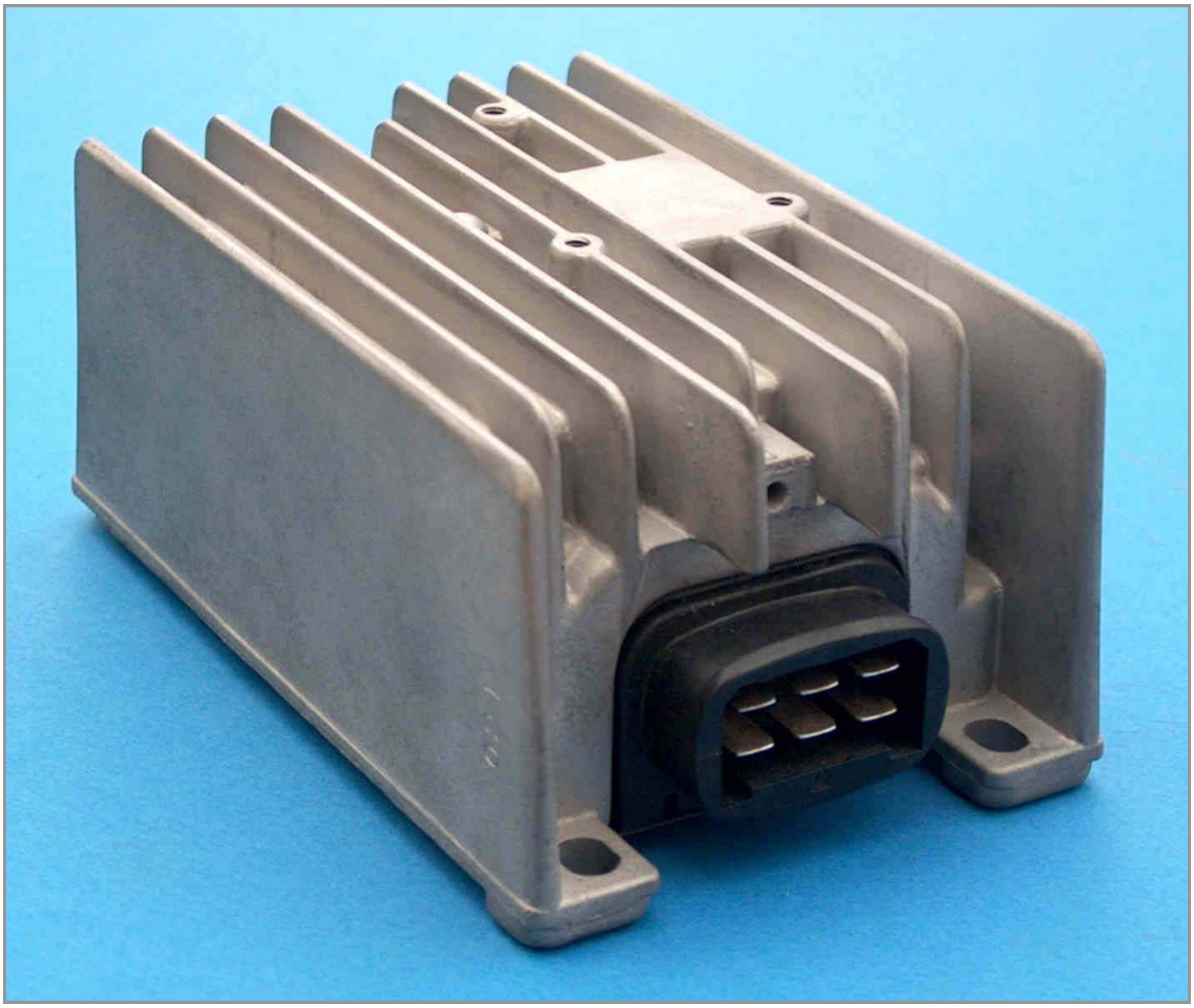
LENZ Model:	**Suitable for:**	**Porsche SC**
		Porsche Turbo 1

Functions


Basis Sensors
Controller
DIN
Engine Rpm
1 or 2 pickups
DRE/POS = DREzahl / POS-Sensor
60-2 / 30-2 = Tooth nr. 56° - 84°(174°)
choice of Rpm Sensors
DRE/POS Sensor Distrib.Inductive
DRE/POS Sensor Crkshft – Segment
α / n -Control
p / n -Control
additional Sensors
AIN
Engine Load Signal
Correction Signals
LSD = LoadSignalThrottle
DSL = PressureSensorAir
TSL = TemperatureSensorAir
TSM = TemperatureSensorEngine
LSS = LambdaSensorSignal
additional Sensors / Switches
AIN
Display Signals
Switch-Input-Signals
DSL = PressureSensorAir
TSA = TemperatureSensorExhaust 2x
TSG = TemperatureSensorTransm.
TSM = TemperatureSensorEngineoil
SEZ = SwitchtInputIgnition cut-off.
TSG = SpeedoSignalSpeed
Actuators - Valves
OUT
RVK =PulseValve K-Jetronic
Z-SP =Ignition coil
LLS = Idle regulator (optional)
DLV =DynamicBoostPressureValve
SV = SwitchValve 2x
TxD/RxD
RS 232 / CAN /

2.2.6 Type F-1 / F-2 Connector 6 / 12 pin

Models: **K**at**T**ronic®
Power**T**ronic**L**ight®

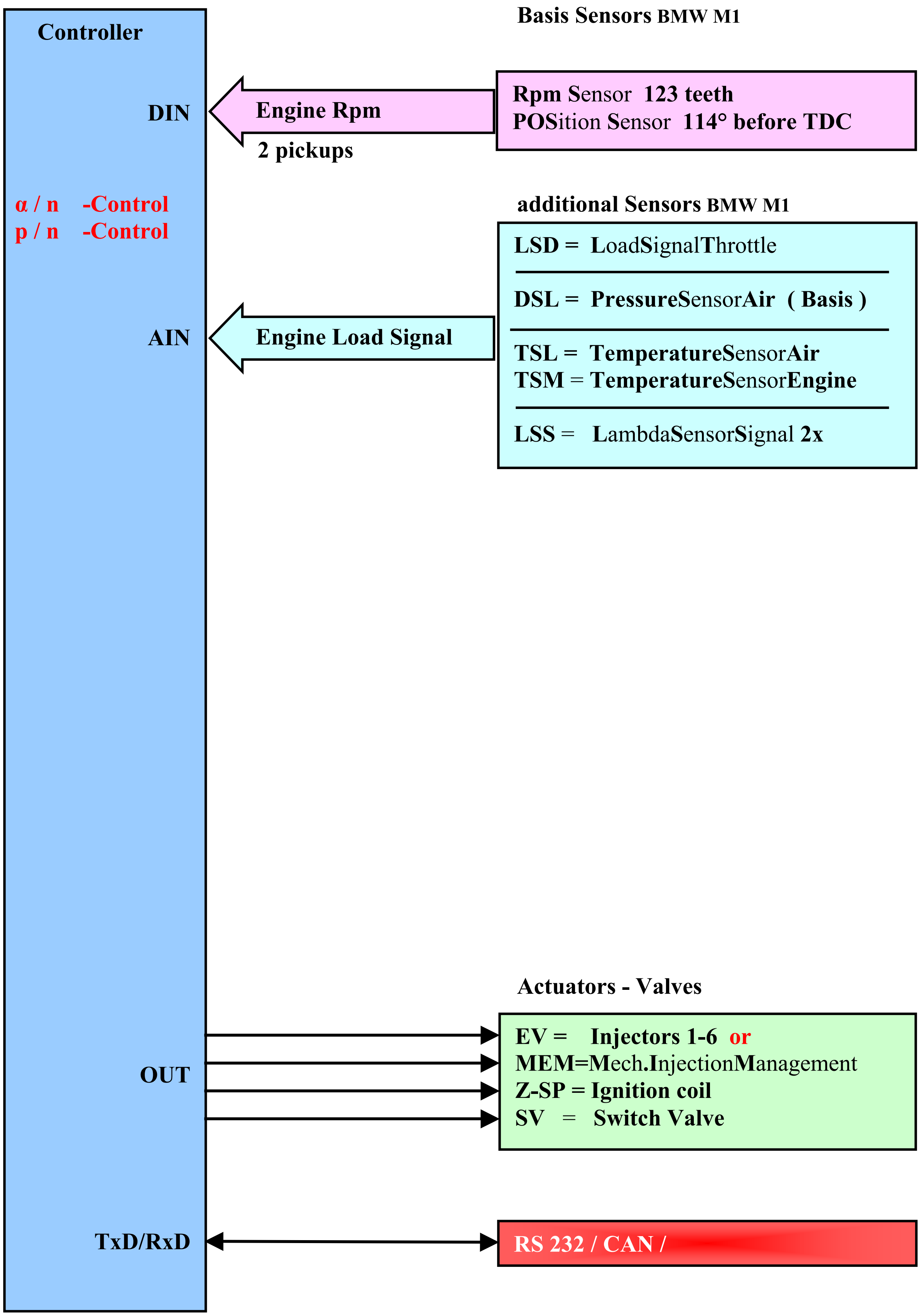


6+12 pin Controller

15 F-1: **LENZ** Version A1.1
16 F-2: **LENZ** Version A1.2

LENZ model:	**Suitable for:**	**BMW M1-ignition**
		BMW-M1-EMS

Functions


Controller
DIN
α / n -Control
p / n -Control
AIN
OUT
TxD/RxD
Basis Sensors BMW M1
Engine Rpm
2 pickups
Rpm Sensor 123 teeth
POSition Sensor 114° before TDC
additional Sensors BMW M1
Engine Load Signal
LSD = LoadSignalThrottle
DSL = PressureSensorAir (Basis)
TSL = TemperatureSensorAir
TSM = TemperatureSensorEngine
LSS = LambdaSensorSignal 2x
Actuators - Valves
EV = Injectors 1-6 or
MEM=Mech.InjectionManagement
Z-SP = Ignition coil
SV = Switch Valve
RS 232 / CAN /

2.3 Sensors and Pickups - Use

Different **sensor** and **actuator** types can be used in connection with the **Lenz** Engine Management Systems, whose characteristics will be shown as follows

2.3.1 Engine Rpm Sensors.

For the collection of engine rpms and the position in crankshaft ° an inductive pickup is most suitable. The output impulse which this rpm sensor per rotating tooth delivers, is dependent on the rpm and the tooth form (tooth – gap relationship).

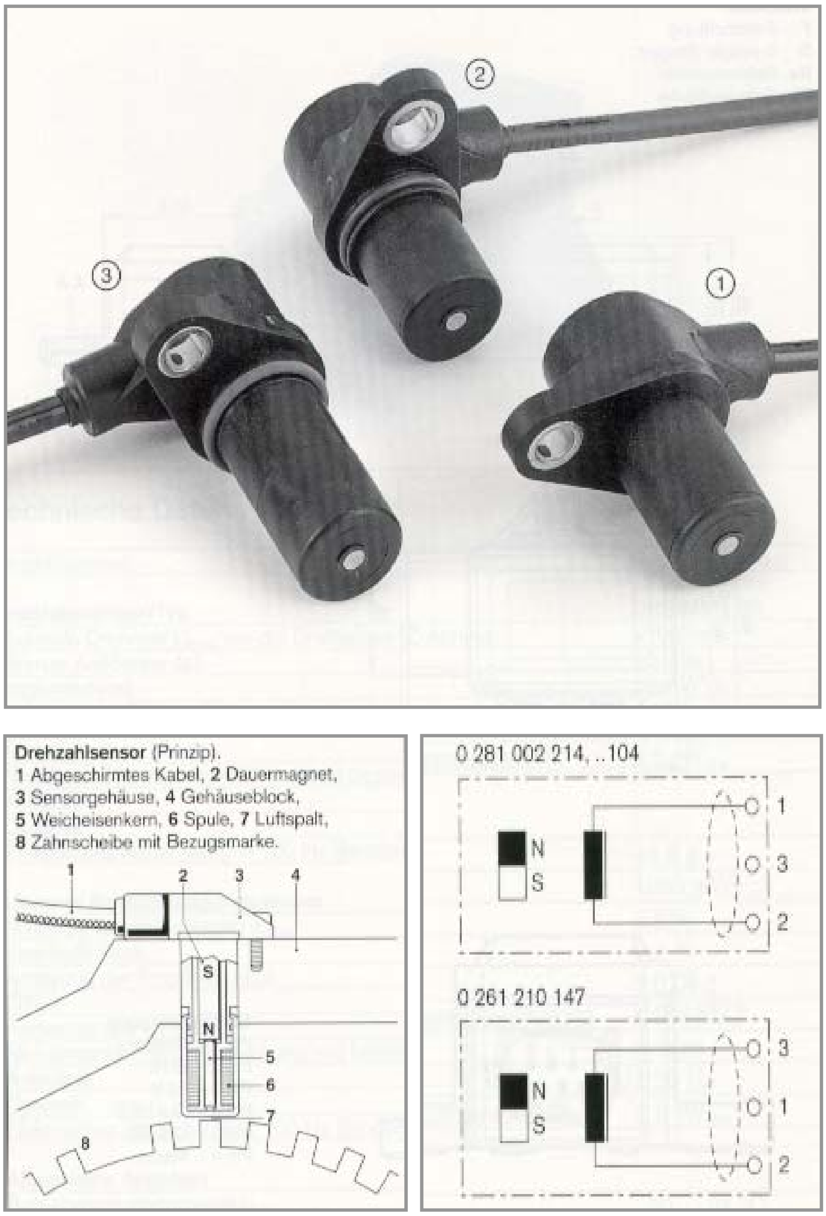


Abbildung von Bosch Rpm Signalpickupn mit Function-Prinzip and Anschlussbelegung.

The size of the air gap is dependent on the tooth material used.

Additionally with the rpms the amplitude of the output signal increases.

In order to reliably measure smallest voltages a minimum rpm is necessary.

The electronic signal processing takes place with a comparator switch in the Engine Management System.

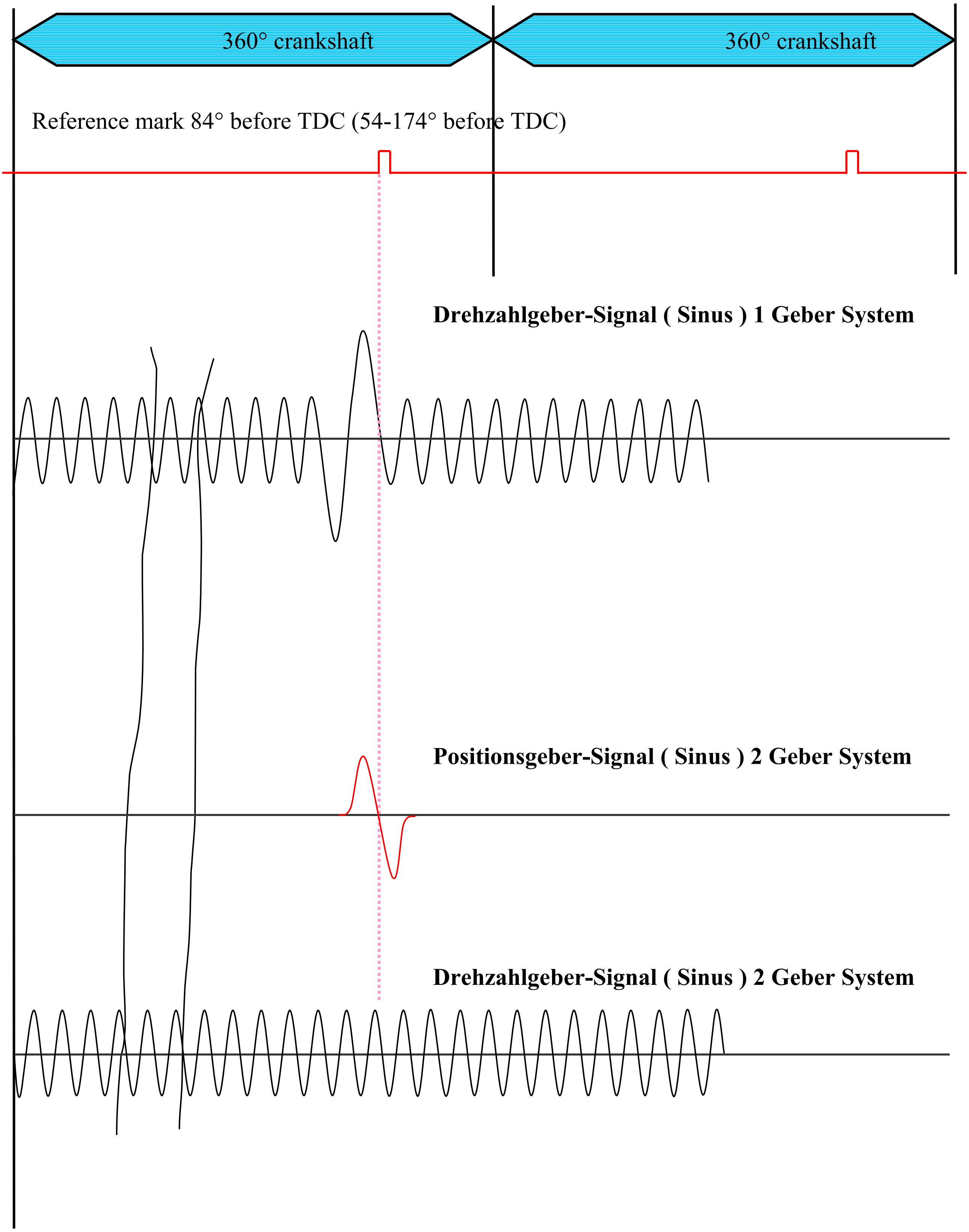
The application uses a 1 – pickup system with a tooth gear of 60 – 2 teeth, that means with 60 teeth 2 are removed. The reference mark is the first tooth after the gap.

For high-revving engines (up to 16,000 rpm) 30 – 2 teeth are used.

For a model with 2 – pickups continual teeth (30-160) are used with one tooth for position recognition.

The possible layout of the position tooth (reference mark) is from 54 – 84° crankshaft before TDC (8 cyl.), 54 - 114° crankshaft before TDC (6 cyl.) and 54 – 176° crankshaft before TDC (4 cyl.).

<u>Rpm signal layout for a 1 – 12 cylinder engine.</u>



2.3.2 Engine-Load-Sensors / Potentiometer

Potentio-metric angle pickups are used on engines as a throttle butterfly rotation angle pickup on the throttle shaft.

This picture shows two different potentiometer versions.

The angle pickups contain one or two linear control parameters. They are evaluated linearly or logrithmically in the EMS.

Additionally both control parameters can be used redundantly.

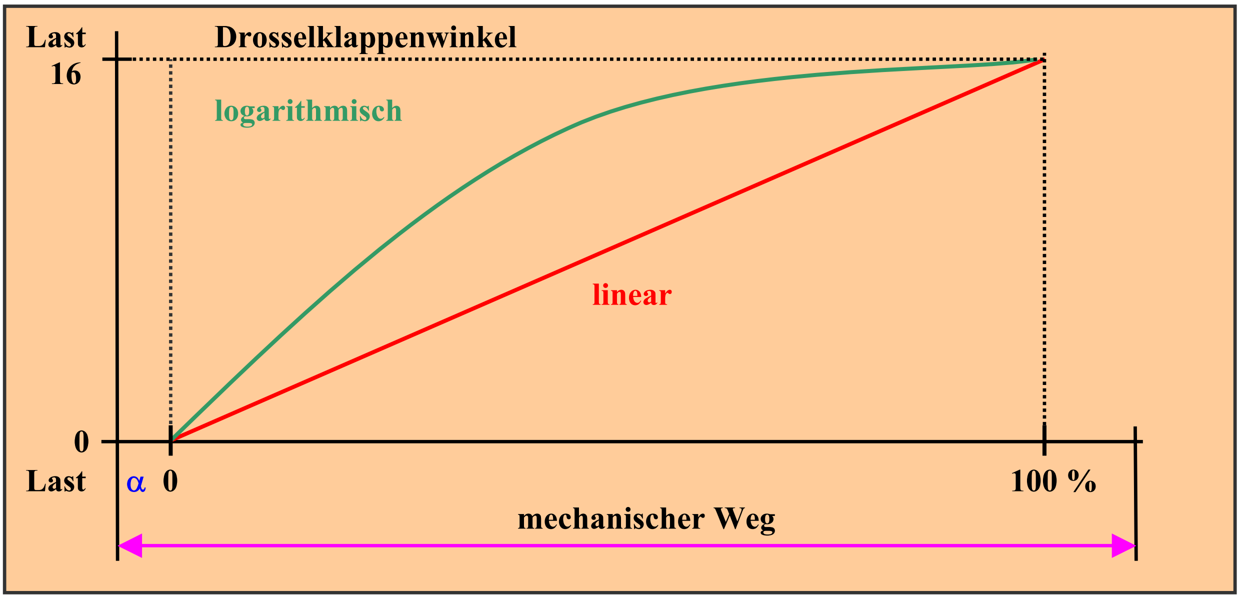
The possible mechanical potentiometer length is 100 to 110 ° **α**. The throttle butterfly as a rule moves in a range of 0° **α** bis 86° **α**.

This guarantees that with a middle placement, no mechanical contact of the potentiometer can occur. The exact electrical voltage values are compared automatically in the **EMS**. Smaller deviations in current operating conditions are continually corrected by an adaptive value storage.

In order to compensate the over proportional changes of the air mass flow for a **linear** change of the throttle angle **α,** the Lenz EMS converts them **logrithmically**.

This makes possible a good correlation of the injection values to be calculated in the lower **rpm** and **load** ranges in the EMS.

following picture shows two possibilities for the evaluation of the potentiometer control parameters.



2.3.2 *Pressure Sensors - DSL / DSA*

Pressure sensors are measurement adapters as a rule for non-aggressive, gas-shaped media and contain as a sensor element a pressure measurement cell. The main piece is a thinly etched silicium membrane with semiconductor resistance structures. A bending of the membrane leads to resistance changes according to the piezo-resistive effect. These are pressure proportional, reversible and can be evaluated electronically.

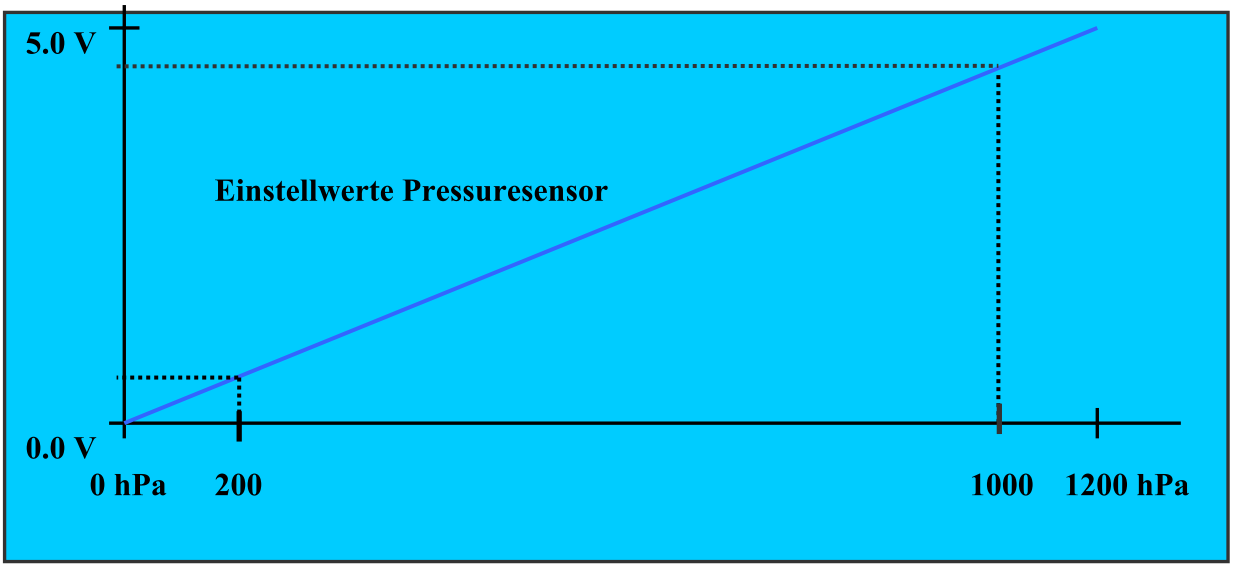
Absolute pressure sensors measure the pressure difference between the measured pressure and vacuum. The pressure measurement cell is evacuated .

Relative pressure sensors measure the pressure difference between the measured and environment pressure, for example, atmospheric air pressure. The pressure compensation for the inside takes place through a hole in the bottom plate of the housing.

The picture shows different pressure sensors from Bosch

When the pressure sensor is used for the calculation of the injection quantity in the **EMS**, then only an absolute pressure sensor is suitable. This assures that the pressure drop above sea level and in the intake system is compensated for.

The following picture shows a typical pressure sensor control parameter:



2.3.3 Air Mass Sensor- AFM

Back pressure air flow meters are suitable for the measurement of air flow in the intake manifold of passenger vehicle engines. With this air flow sensor, the air flow hits a moveable flap which as a result of the strength of the air stream is moved (back pressure).

With an increasing flap angle, the free flow diameter is increased. The flap angle and the air flow are in an exponential relationship.

A linear relationship exists between the output voltage U_A and the air flow, which does not change linearly with the increasing flap angle.

To capture the temperature dependent portion of the air density an NTC resistor installed in the housing is used.

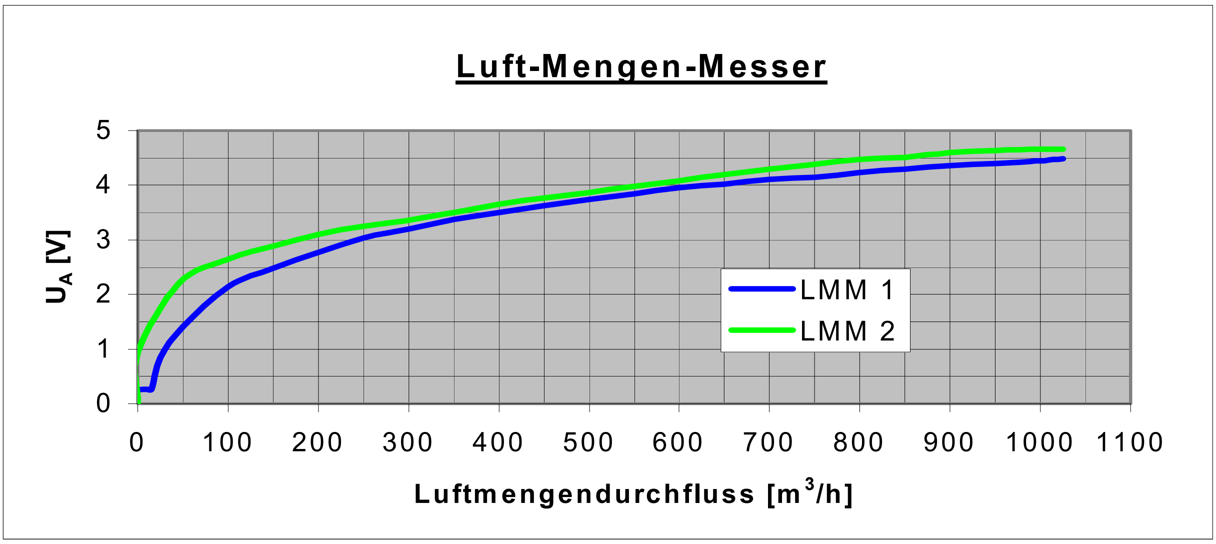
Because an air flow meter represents an intake manifold constriction in the higher load range, it is as a rule useful for only small increases in performance.

The picture shows a typical backpressure flap air flow meter.

For this reason as a rule a venturi tube instead of an air flow meter is used for the **Lenz EMS**, which means an increase in diameter of approximately 30%. The calculations take place according to the **α** / **n** principle.

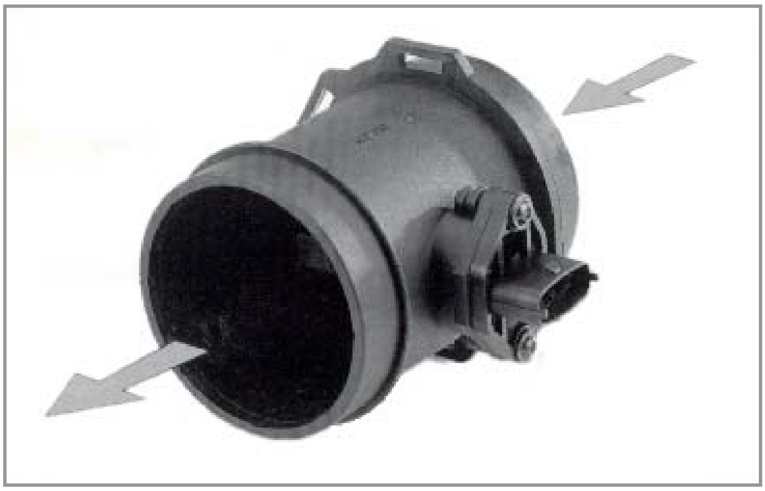
Due to the different control parameters and calculation mode (of origninal systems) it is not possible to simply exchange an air flow meter for a hot film meter...

The following picture shows two afm control parameters



2.3.4 *Air Mass Sensor - HFM*

Hot **F**ilm **M**eters serve to measure the air mass flow of combustion engines.



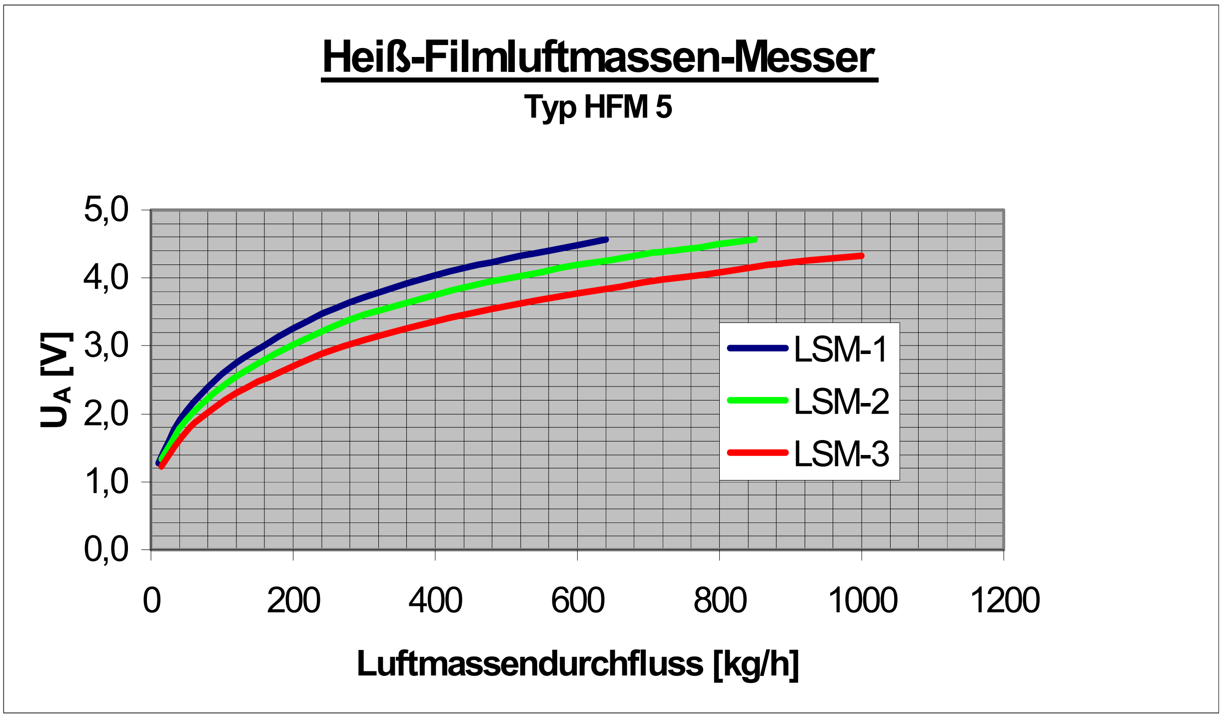
In the air flow meter housing there is a hot film air flow sensor in the form of an insertable feeler. This thermal flow through meter is exposed to the air flow to be measured.

The output voltage U_A of the **HFM** changes logarithmically to the air flow.

The picture shows an HFM air flow meter.

The respective control parameters of ***AFM*** and ***HFM*** can be stored in the **Lenz EMS** and then used for load evaluation and calculation.

The following picture shows different HFM control parameters.

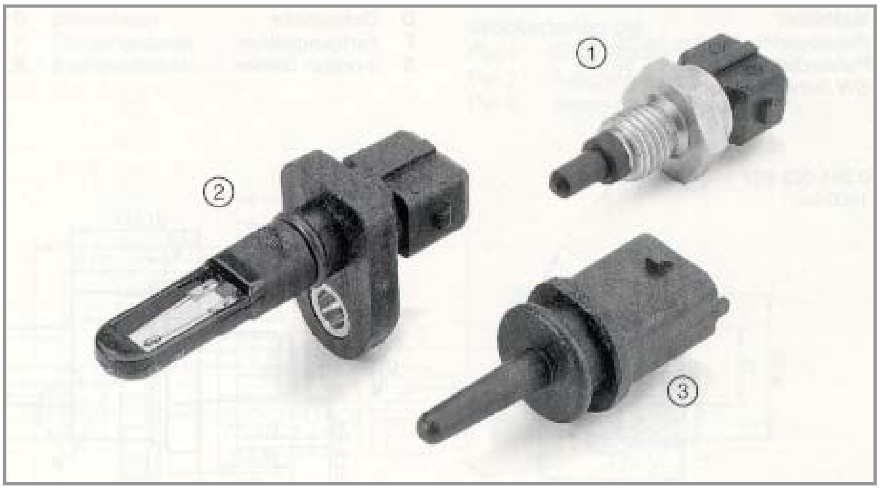


2.3.5 *Temperature Sensor Air intake manifold - Air / TSA -* TSL

Air temperature sensors i.e. ***NTC***- or heat conductor sensors perform measurements with ***temperature-dependent*** resistors.

Construction and Function

If heat conductors (**N**egative-**T**emperature-**C**oefficient) ***NTC*** are externally heated, their electrical resistance is drastically reduced. This characteristic can be used for temperature measurement..



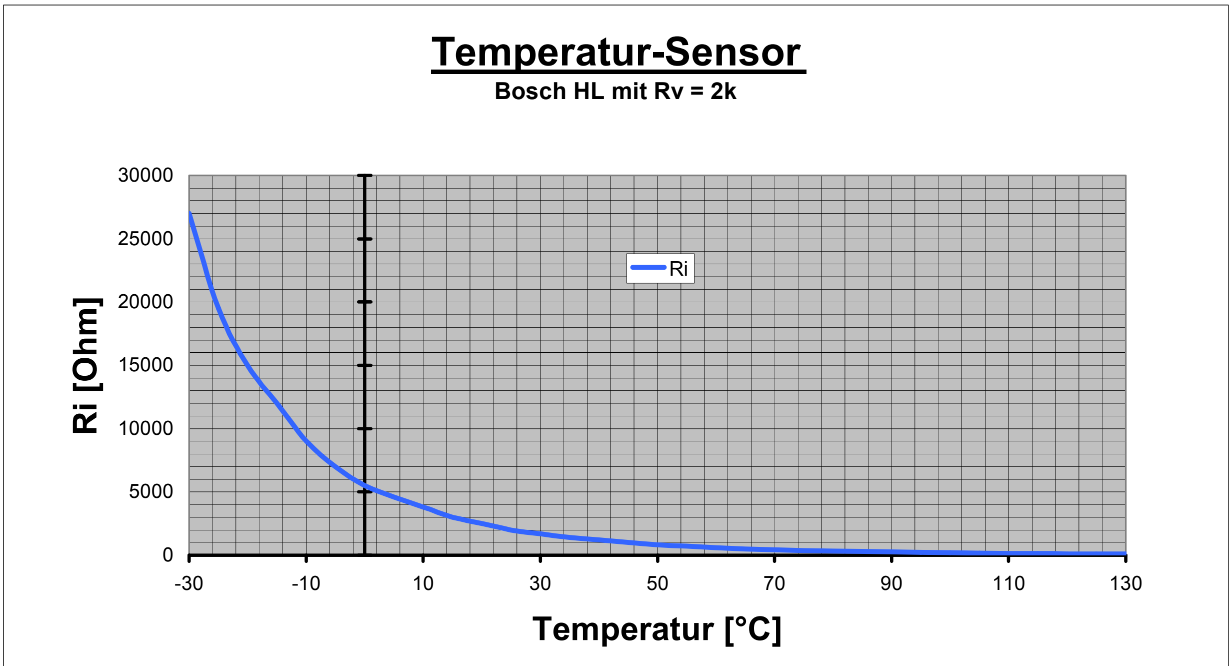
NTC-Sensors are suitable for various environmental requirements. They facilitate temperature measurement in a wide range.

For the measurement of air temperature the NTC temperature sensor is located in a plastic housing.

The picture shows different NTC air temperature sensors.

A data table stored in the **Lenz EMS** makes a simple ultrasound for the measurement of intake air temperatures possible. These are then used for the calculation of injection and ignition data.

The picture shows a NTC intake manifold air temperature control parameter



2.3.6 Temperature Sensor Water / Oil - TSM

NTC water temperature sensors i.e. - or heat conductor sensors perform measurements with **temperature dependent** resistors.

Construction and Function.

If heat conductor (**N**egative-**T**emperature-**C**oefficient) ***NTC*** are externally heated, their electrical resistance is drastically reduced. This chararcteristic is used for temperature measurement.

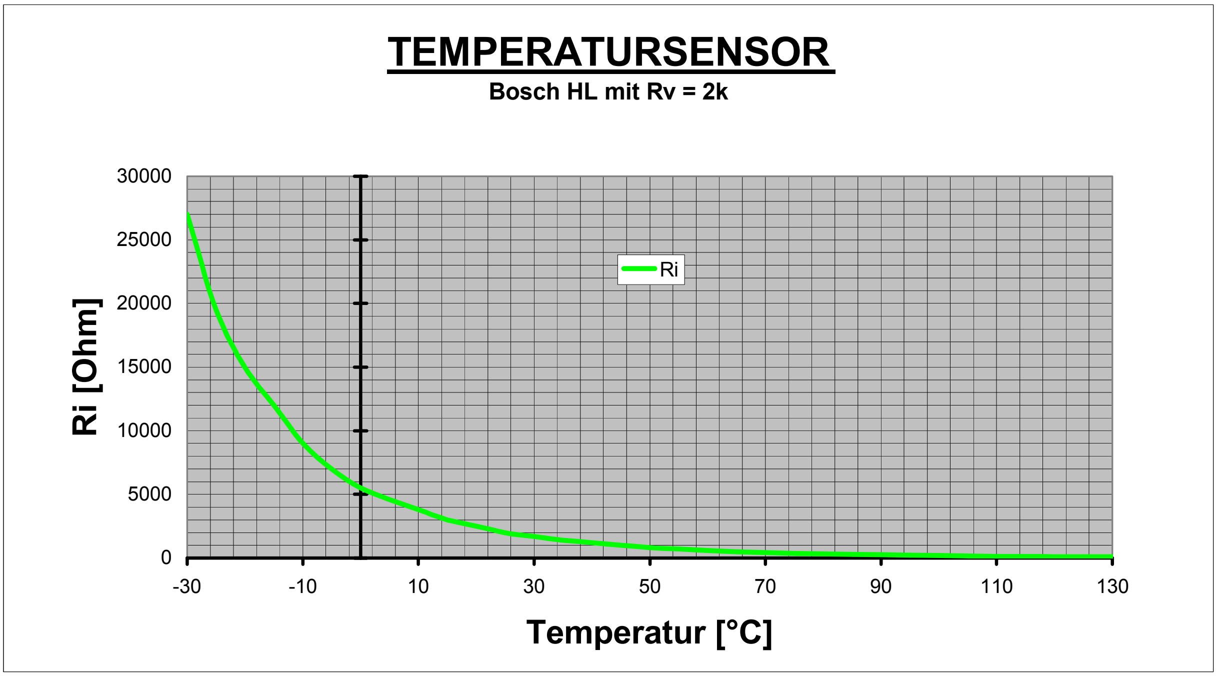
NTC-Sensors are suitalbe for various environmental requirements. They facilitate temperature measurement in a wide range.

For measurement of the engine water and engine oil temperatures the NTC temperature sensor is placed located in a brass housing.

The picture shows two NTC – water- oil- Temperature sensors

A data table stored in the **Lenz EMS** makes a simple ultrasound for measurement of the engine temperatures possible. These are used then for the calculation of injection and ignition data.

The picture shows a NTC engine temperature control parameter



2.3.7 *Lambda Signal Sensor* - LSS

With the lambda sensor (λ) it has to do with a special oxygen sensor, which determines the exhaust composition and transfers the data to the EMS. With the lambda sensor the proportional mixture of air (oxygen) and fuel is permanently measured. Based on this relationship conclusions can be won regarding **performance behavior**, **consumption behavior** as well as **pollutant behavior** of the engine.

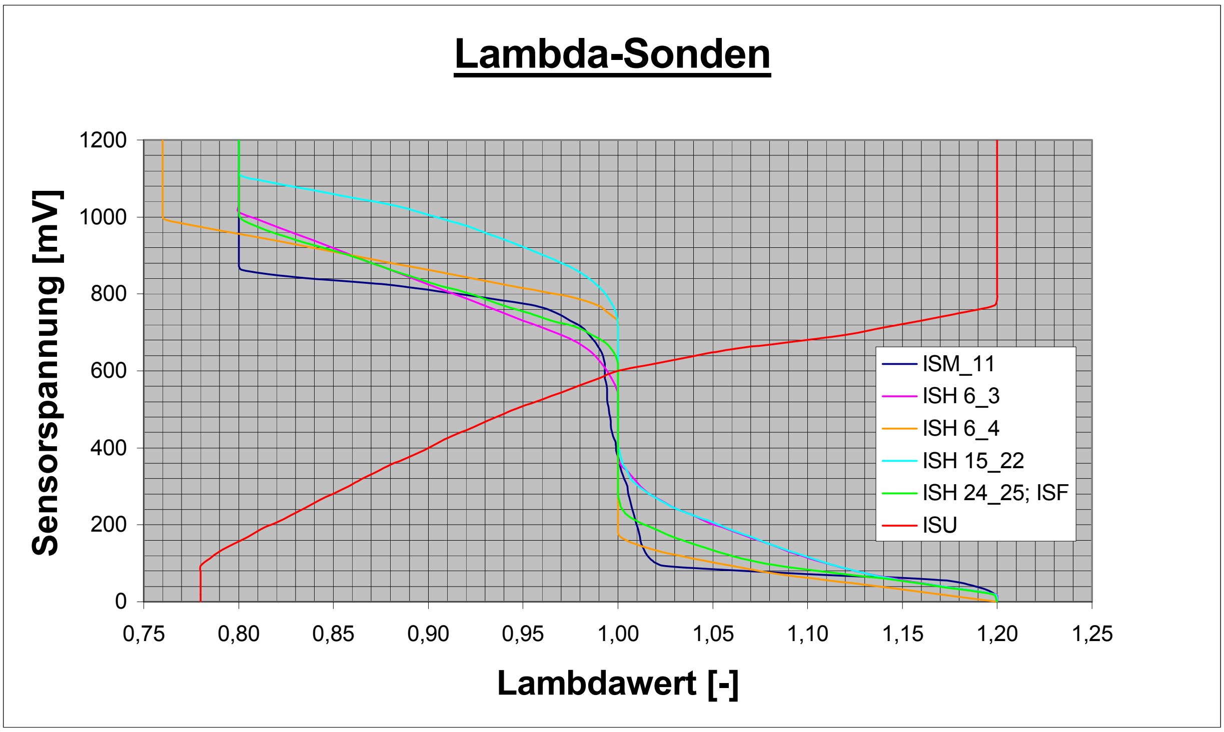
In the simple version the lambda sensor data are shown on a display for the driver, without the measurement data included in the optimization.
The lambda sensor signals are used in the regulation of the injection.

The regulation occurs as a PID – Algorithm with unsymmetrical layout.

Lambda sensor LSH

In the framework of optimization the lambda sensor signal is processed by the **EMS** which there from determines the optimal injection amount.

The following picture shows different control parameters of lambda sensors



2.3.9 Temperature-Sensor-Exhaust - TSA

For the exact monitoring of exhaust temperatures PT 1000 sensors von ***Sensor-Nite*** are suitable. With them exhaust temperatures from 0 – 1055 °C can be displayed and also used for correction calculations for injection and ignition of an EMS.

Platinum temperature sensors work on the basis of the temperature dependent change of the electrical platinum resistor. This relation can be described through the following characteristic polynomial:

$$R_t = R_0 (1+at+bt^2)$$

The constants are determined in the international standards for platinum temperature sensors. **b** ist so small, that for the most uses, a linear dependency between R_t and the temperature can be assumed.

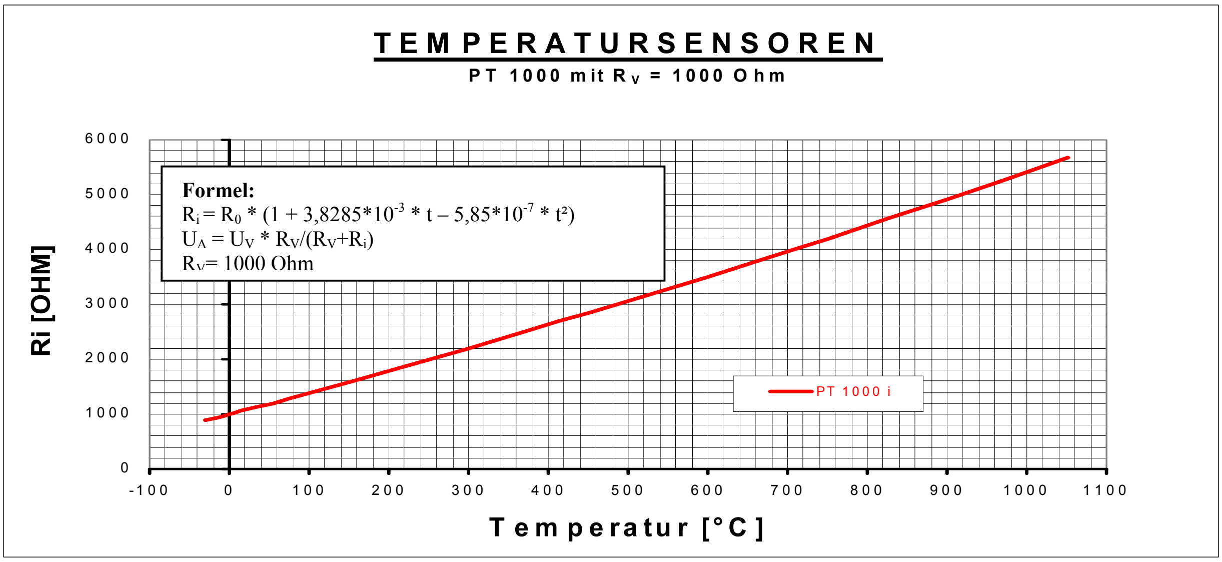
Picture of an exhaust temperature sensor.

Platininum temperature sensors with high resistance have a higher sensitivity as others with low resistance, because the control parameter increase is directly proportional to R_0.

The product palette of Heraeus Sensor-Nite is conceived for a temperature range from **–200°C to 1000°C** . The temperature coefficient (T_k or **α**) of platinum temperature sensors is positive and defined as:

$$T_k (R_{100}-R_0) / (100*R_0)$$

It has to do with the increase of the linear approximation of the characteristic of the polynomial between 0° C and 100° C . The norm DIN EN 60751 for platinum temperature sensors specifies a **T_k 0,003850 / °C**



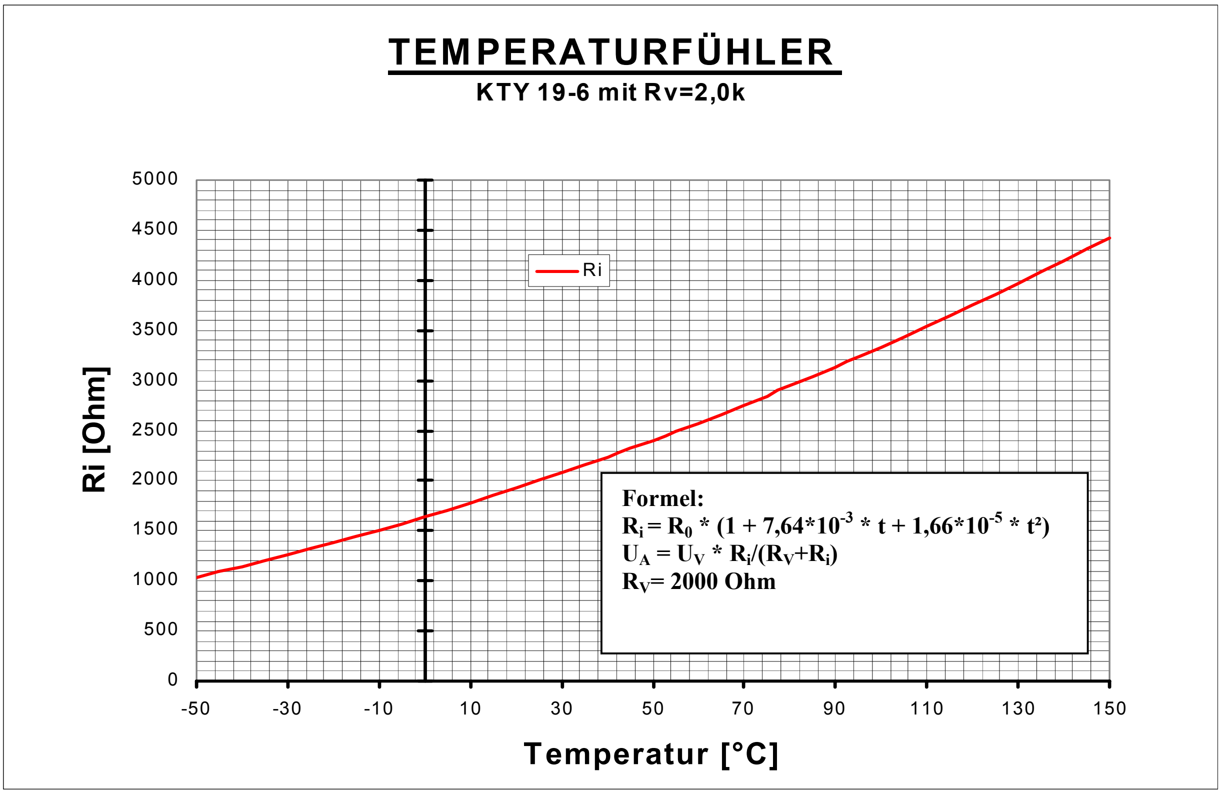
2.3.10 Temperature Sensor ÖL / Engine-Getriebe - TSÖ

Silicium temperature sensors are suitable for measurement, control and regulation of air, gases and liquids in the temperature range from **–50 ° C to +150 ° C**. They consist of an n-conducting silicium crystal in planar technology. The electrical resistance of silicium has a **p**ositive **t**emperature **c**oefficient PTC. For the temperature determination a spreading resistance between two contact surfaces is used. It can be reproduced well.

The lightly crooked control parameter $R_{(T)} = f\,(T_A)$ can be linear-sized well through external resistance circuitry.

A data table stored in the **Lenz EMS** makes a simple ultrasound for measurement of engine and transmission temperatures possible.

Die folgende Abbildung zeigt eine KTY Kennlinien zur Öltemperature-Messung



2.3.11 Knock Sensor Engine

Description follows

2.3.12 Additional Sensor Signals

In preparation.

2.4 Actuators and Uses

2.4.1 Injectors electronic.

In order to fulfill the high demands of the system layout (**performance optimized** – **consumption reduction** –**pollutant minimization**) in combustion engines, electronic inectors with exact dosage are necessary. An electromagnetic injector is therefore assigned to each cylinder. This injects into each cylinder the amount of fuel calculated by the EMS exactly. This takes place in blockwise or sequential control of the injectors.

The injectors have different construction sizes and different injection quantities over time.
(g/min oder ml/min)
additionally different cone shaped spray angles from 1 or more spray holes.

The ohm resistance is as a rule **14 –16 Ω**.
The electronic control occurs with regulated (battery voltage dependent) power supplies. The following injector correction values refer exclusively to measurement values with gasoline and the power supplies of the Lenz EMS.

Following table of different Injectors (Injector_correction time).

Injector / Voltage[Volt]	**9.3 V**	**10.2 V**	**11.2V**	**12.1 V**	**13.1 V**	**14.0 V**	**15.0 V**	**16.0 V**
Bo 0 280 150 455 / **222ml**	1400	1200	1020	900	780	700	620	580
Bo 0 280 150 701 / **266ml**	1450	1260	1090	1010	910	830	750	700
Bo 0 280 150 714 / **204ml**	1710	1464	1308	1178	1064	958	900	850
Bo 0 280 150 731 / **187ml**	1500	1410	1320	1230	1140	1060	950	900
Bo 0 280 150 737 / **338ml**	1530	1370	1230	1110	1020	900	820	750
Bo 0 280 150 786 / **227ml**	1380	1200	1080	980	880	820	760	720
Bo 0 280 150 791 / **426ml**	1740	1550	1370	1190	1110	1010	930	850
Bo 0 280 150 923 / **336ml**	1864	1818	1520	1400	1254	1128	1008	900
Si 000 788 123 / **280ml**	1880	1520	1300	1110	1000	870	760	650
IW 069 0848/0 / **555ml**	1650	1430	1270	1130	1010	900	800	730

Injection amounts are in ml/min at 3 Bar fuel pressure, correction time injector in µS.

Changing the fuel pressure results in a change of the injection amount , which is not linear to the change of pressure !

This is considered in a formula of the Lenz EMS.

2.4.2 Ignition Coils for High Voltage-Distributors

An ignition coil stores the necessary ignition energy and creates the required high voltage (> 12.000 Volt) for the spark break through at the time of ignition. The control, –K1 primary side of the ignition coil, can take place through an external ignition module or an ignition power supply built into the Engine Management (Zünd-IGBT).

As a rule low ohm coils (**approx 0,5Ω**) are primarily used. The

Dwell angle / Loading time

of the ignition coils is calculated in the **EMS** dependent on the battery- voltage and thereby controls the ignition power supply.

Through a necessary loading time > 2 mS per switching event, there must be sufficient closing angle at low engine rpms and large ignition point jumps.

Following table of different dwell angles / Loading times.

Ign. coil / Voltage[Volt]	9.3 V	10.2 V	11.2V	12.1 V	13.1 V	14.0 V	15.0 V	16.0 V
Time-Line 1	3.5	2.9	2.5	2.2	2.0	1.8	1.6	1.5
Time-Line 2	4.0	3.5	3.0	2.6	2.3	2.0	1.8	1.7
Time-Line 3	4.7	4.0	3.5	3.2	3.0	2.7	2.5	2.3

The **battery voltage corrections** are presented in mS and are taken into account in the EMS for ignition coil loading time. This data is combined with an engine rpm dependent correction.

These correction tables can be used for different ignition coils.

2.4.3 Single or multiple Ignition Coils for electronic high voltage

Single, double, or multiple ignition coils are meant to be installed in engines without a high voltage distributor.

This electronic high voltage distribution does not bring any weight advantages but a considerably lower electro-magnetic disturbance level, no rotating electrical parts (distributor rotor, shaft, etc) and a reduced number of high voltage connections (with individual coils).

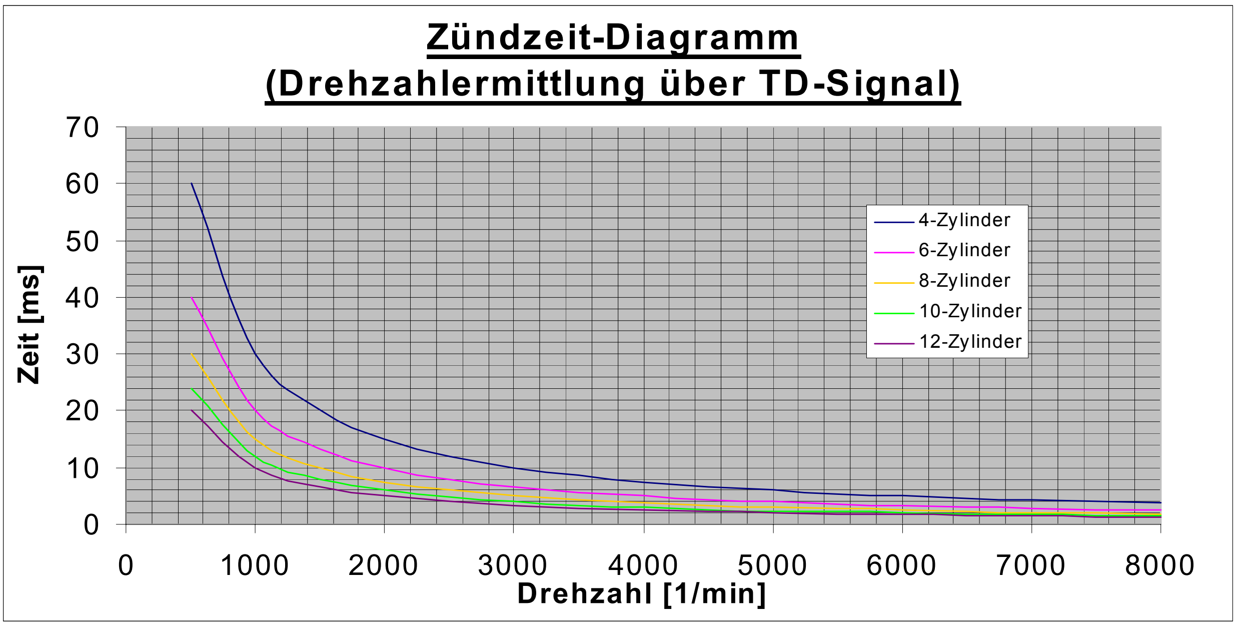
Meant for optimal and disturbance free ignition of the individual cylinder.

Additionally an optimal individual single ignition (cylinder) monitoring can be achieved.

Control takes place with an ignition IGBT (350 – 500 Volt).

This picture shows 3 different ignition coils.

Following picture shows the different switching times in relation to rpm.



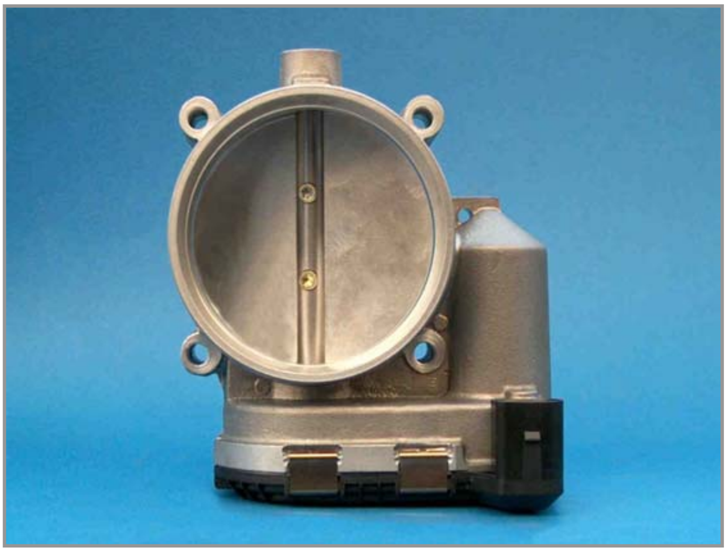
2.4.4 Idle regulator for Idle regulation

An idle regulator is meant for air filling during the idle regulation function. With this rpm changes and load switches can be compensated. The control takes place with a 12V - PWM – signal with different frequencies (preferably 100 Hz).

The model is one or two phased, either a signal with reset spring or two signals for right and left running.

2.4.5 EGas with Idle regulation

Electronic Throttle Body (**EGas**) .



Description follows

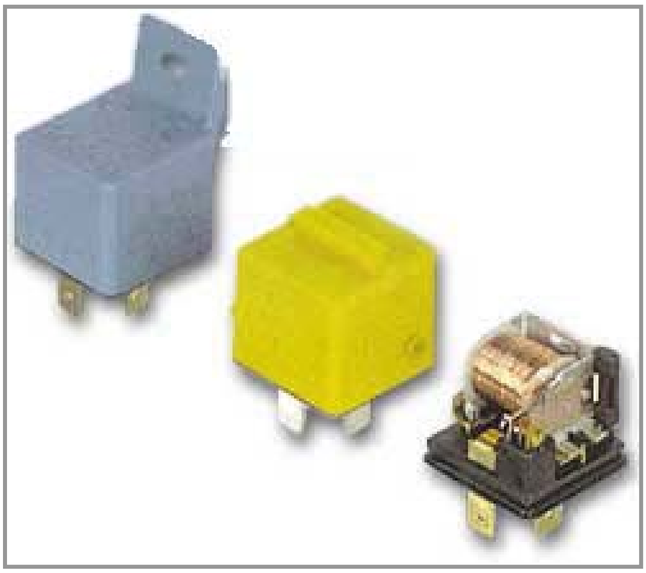
2.4.6 Switch Valves and Switch Relays

Different switch valves for switching of various equipment and engines. For use with dynamic boost pressure control with varying pulse frequency (preferably 15Hz). Active or passive boost pressure control is possible.

Simple switch valves are used as well for switching of electro-pneumatic switch valves, for example, the Lenz PowerFlow System.

Additionally different switch relays for varying purposes can be used, also for switching of the fuel pump or the lambda sensor heating.

Switch relays can as well control different fan motors, which are subject to certain temperature dependent switch parameters.



These pictures show various pulse and switch relays.

2.4.7 Fan Control electronic.

Fan ventilators can be switched on or off by a relay. Ideally they are driven steplessly.

This is made possible with **PWM** Control of the EMS. For this H-bridge modules are used.

Engine fans are controlled in different ways. Suitable für Water- or air-cooled engines, as well as oil coiling.

2.4.8 Additional Actuators.

Further Information about Lenz Engine Management Systems available from:

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