

### Ignition Circuit Monitor

Both ignition circuits of the engine in 1989 model 928 S 4 cars are monitored, in order to guarantee that the catalytic converter system is not destroyed in case of ignition circuit failure.

The catalytic converter system could be destroyed, if uncombusted gasoline would enter the catalytic converter due to failure of an ignition circuit.

### Description

One each thermo element is screwed in exhaust ports of cylinders 4 and 8, where secondary air injection is connected in cars without a catalytic converter. These thermo elements monitor the exhaust temperature of cylinders 4 and 8.

#### Division of Ignition Circuits:

Ignition Circuit I: 1 7 6 4

Ignition Circuit II: 3 2 5 8

If an ignition circuit (e.g. ignition circuit I) would now fail, there would no longer be combustion in cylinder 4 and the exhaust temperature would drop. This drop in exhaust temperature is registered by the thermo element and sent as an electric signal to an ignition circuit monitoring relay. This relay recognizes the temperature difference (as voltage difference) and switches off the corresponding injection circuit for the failed ignition circuit.



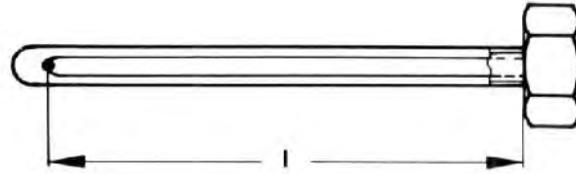
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### Thermo Element

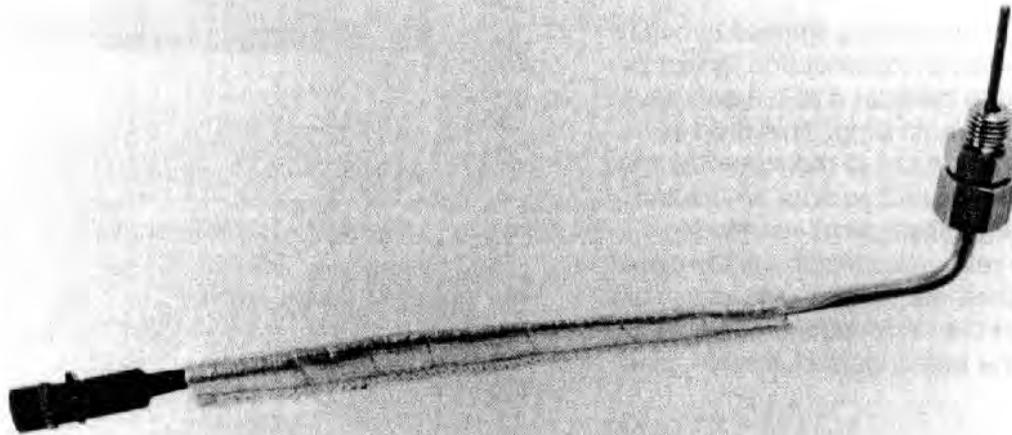
Two wires made of different metals (nickle-chrome and nickle) are welded together on one end. If the point of connection is heated, electric voltage (thermo voltage) is produced.

The amount of voltage depends on the thermically effective wire length ( $l$ ), the materials of wires and the applied temperature.

Basically it concerns very low voltage, which is in a range of 4 mV for each 100° C difference in temperature.



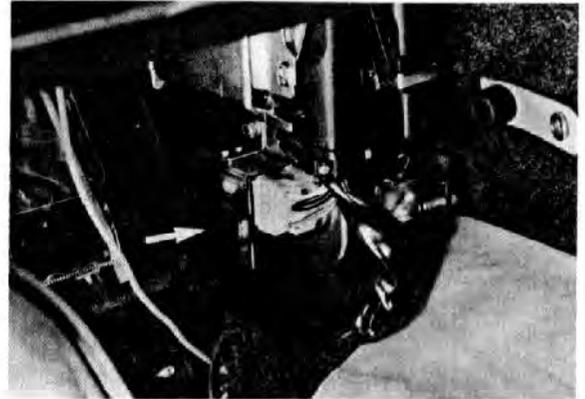
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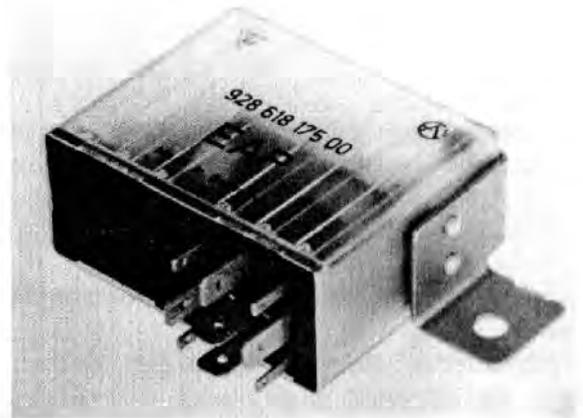
**Ignition Circuit Monitoring Relay**

The ignition circuit monitoring relay is mounted on the holder of control units for LH and EZK (fuel injection and ignition).



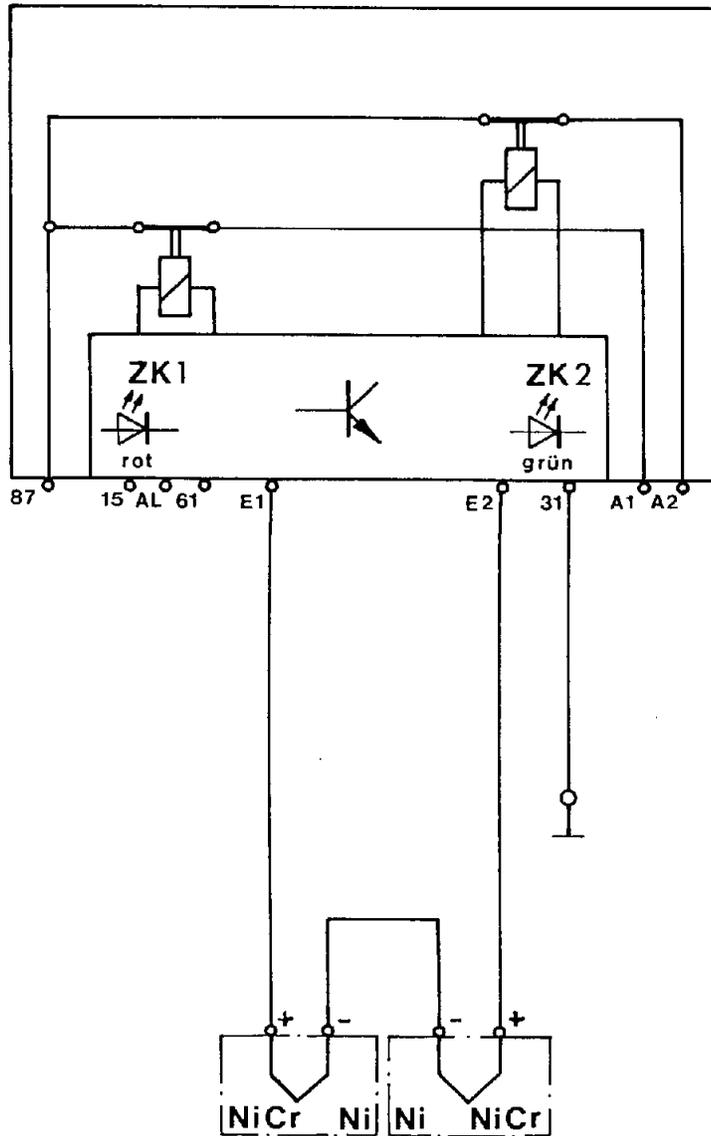
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The relay has a riveted sheet metal holder, which is bolted on the stud of the control unit holder.



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Wiring Diagram of Ignition Circuit Monitoring Relay



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- Term. 87 – From LH-Jetronic relay of CEL
- Term. 15 – Ignition
- Term. AL – To LH control unit term. 28
- Term. 61 – From alternator
- Term. E2/E2 – To/from thermo elements
- Term. E1 – Ignition circuit I (cyl. 4)
- Term. E 2 – Ignition circuit II (cyl. 8)
- Term. 31 – Ground
- Term. A1 – To fuel injectors for cyl. 1-4-6-7 (ignition circuit I)
- Term. A2 – To fuel injectors for cyl. 2-3-5-8 (ignition circuit II)
- ZK1/ZK2 – Light emitting diodes for ignition circuit failure indicator (red/green)

### Description

Terminals E1 and E2 of the ignition circuit monitoring relay will each have the same voltage after starting the engine and heating-up of thermo elements (with perfect condition ignition circuits).

If one ignition circuit would fail and the exhaust temperature drops, there would be less voltage on the pertinent terminal (E1 or E2), depending on which ignition circuit has failed. This difference in voltage will be recognized by the ignition circuit monitoring relay.

A relay contact in the relay belonging to the failed ignition circuit is opened and interrupts the supply of power to the fuel injectors of this ignition circuit. One of two colored light emitting diodes in the relay lights up at the same time.

It is easy to recognize which ignition or injection circuit is concerned when an injection circuit is switched off because of the different colored light emitting diodes and transparent relay housing.

Red LED:	Ignition Circuit I
Green LED:	Ignition Circuit II

The relay switches off fuel injection as from a voltage difference of 6 mV, which is equal to a difference in temperature of about 150° C.

### Special Features of Ignition Circuit Monitoring Relay

Since the four cylinders still draw in air after switching off the injection circuit, the oxygen sensor would recognize excessive air and regulate the air/fuel mixture of the perfect condition cylinders in rich direction. Oxygen sensor control is switched off together with switching off the ignition circuit, in order to prevent this.

Terminal 15 of the relay has voltage via CEL when turning on the ignition.

Terminal AL of the relay (this wire leads to LH control unit term. 28) has ground with "ignition on". With "ignition on" the LH control unit will be coded for operation without catalytic converter via term. AL of the relay, since the coding, whether with or without catalytic converter, for the LH control unit is accomplished via positive or ground on term. 28 of the LH control unit. If the engine is started and term. 61 of the relay has alternator voltage, voltage is supplied to term. AL and the LH control unit is therefore coded for operation "with catalytic converter".

If an ignition circuit would now fail and the pertinent relay contact opens, ground would be applied on term. AL and the LH control unit switches over to operation "without catalytic converter".

Since, however, in cars without catalytic converter idle speed CO level adjustments are made via a potentiometer and this potentiometer on the other hand is not installed in cars with catalytic converter (adaptive oxygen sensor control), a 150 ohm resistor integrated in the coding plug of the LH or EZK control unit sends a fixed value (replacement value) to the LH control unit for guarantee of engine idling when the ignition circuit monitoring relay switches and therefore oxygen sensor control is switched over to control without oxygen sensor.

### Delayed Switching

The relay is inoperative for about 18 seconds after each engine start, in order to prevent unwanted switching of the ignition circuit monitoring relay due to non-uniform cooling of a stopped engine. There must also be a difference in voltage of > 6 mV on connections E1 and E2 for at least 2.5 seconds before activation of the relay.

### Self-monitor

Great differences in voltage on connections E1 and E2 are recognized as faults on the thermo elements or their power supplying leads by a circuit integrated in the ignition circuit monitoring relay. This always causes switching off of fuel injection circuit for ignition circuit II and activation of the green light emitting diode. Resistance can be measured on connections E1 and E2 of a disconnected relay plug with an ohmmeter to check the thermo elements and power supplying leads.

Approx. 5 to 10 ohms between E1 and E2 for perfect condition thermo elements and leads.

Ohmmeter displays open ( $\infty$  ohms) in case of a fault.

### TDC Sensor and Exhaust Test Pipe

The TDC sensor for checking the ignition timing with engine testers as well as both exhaust test pipes leading into the engine compartment are omitted in 1989 models, because of control units (LH and EZK) capable of diagnosis and the monitoring of the throttle valve switch and oxygen sensor control in conjunction with them.

Exhaust test points, instead of exhaust test pipes, are provided for the left and right banks of cylinders and are sealed with plugs, which only have to be removed in case of fault (fault stored in memories of LH or EZK). When installing plugs in exhaust test points, it is important to make sure that the threads of plugs are treated thoroughly with a suitable high temperature paste (e.g. Optimoly HT).

It is, of course, still possible to check the ignition timing when necessary with help of an ignition timing gun and marks provided on the torsion damper of the crankshaft.



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LH-Jetronic, EZK Ignition

Coding of Control Units

Wiring Diagram	Version	Porsche No.
	ECE, manual transmission without catalytic conv.	928.607.431.00
	ECE, automatic transmission without catalytic conv.	928.607.432.00
	Worldwide, (U.S.A.) manual transmission with catalytic conv.	928.607.438.00
	Worldwide, (U.S.A.) automatic transmission with catalytic conv.	928.607.439.00
	Fuel grade 91 RON unleaded gasoline, manual transmission	928.607.440.00
	Fuel grade 91 RON unleaded gasoline, automatic transmission	928.607.441.00

150 Ω

Identification of Throttle Valve Housings

Throttle valve housings have a cast unfinished part number since 1987 in order to simplify classification and eliminate sources of error. This unfinished part number is reported to classification authorities and not changed, as long as the outside shape and diameter of the throttle valve housings are not changed. The part number is supplemented by a label containing a code letter and date of production.

928 4-valve	928.110.121.0R	928.110.093.01	A
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## Fuel Pump

The fuel pump is modified and pump rollers now run in an elliptically shaped path.

An intank pump is installed in addition to the fuel pump, in order to guarantee the correct delivery rate for all temperature ranges of the gasoline.



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## Fuel Hoses Made of Plastic (Polyamide)

Fuel hoses are components, which are subjected to considerable loads due to pressure, temperature and the gasoline itself.

Rubber hoses in eight cylinder engine cars were replaced by rubber-lined, polyamide pipes in the course of the 1988 model year already, in order to cope with these conditions even better and improve the service life. (Polyamide is a plastic, which is produced from carbons, phenol and nitrogen.)

**Rubber-lined, polyamide pipes, however, can no longer be handled in the same manner as rubber hoses.**