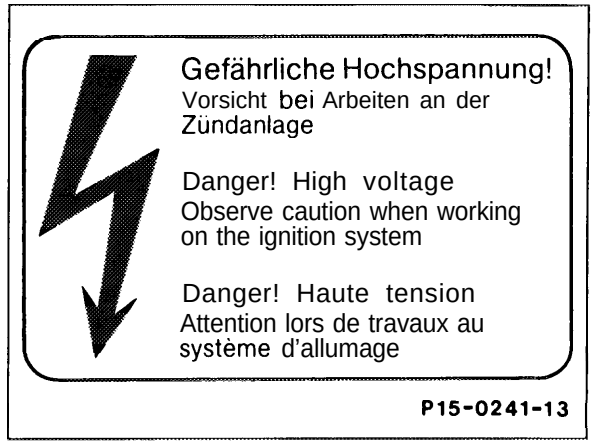
Job No.

15–505 Instructions regarding work on transistorized ignition system

A. Safety precautions

increased requirements of modern engines in respect of the ignition systems and the desire for freedom from maintenance have led to the standard use of electronic ignition systems.

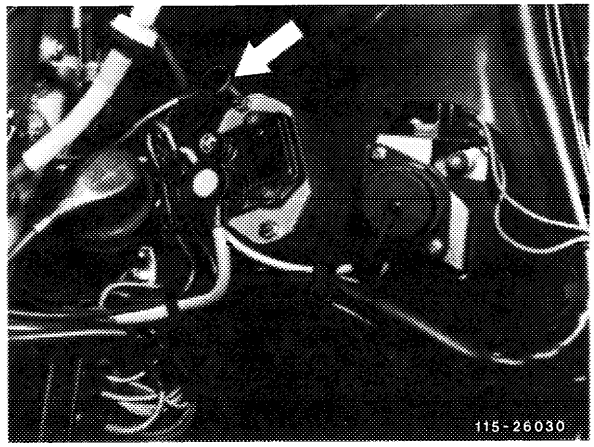
As a rule, the ignition capacities of electronic systems are higher than those of conventional systems; further increases in capacity are likely. Consequently, electronic ignition systems operate in a power range which may be hazardous if contact is made with live parts or terminals (see warning plate).



Warning plate in engine compartment

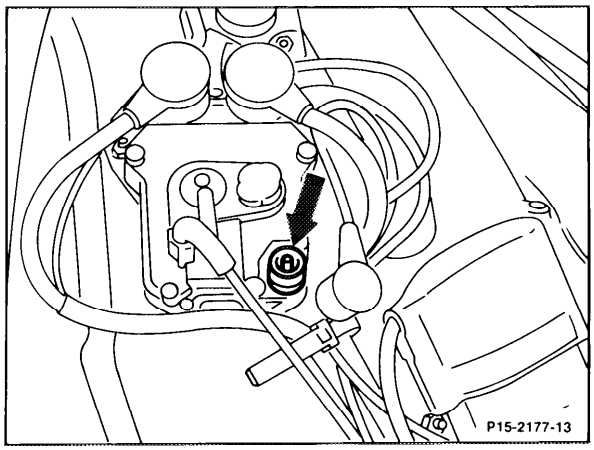
For this reason, the following safety precautions should always be observed when performing work on electronic ignition systems (distributor ignition, TSZ):

- Before performing work at cranking speed, e.g. testing compression or adjusting valve clearance, switch off ignition and detach control lead (arrow) at control module or plug protective connector Part No. 102 589 02 21 00 into the diagnostic connector.



TSZ ignition control module

- Persons with heart pacemakers should not work on such ignition systems.
- Do not grasp or detach any components of the ignition system at cranking speed or when the engine is running.



ignition control module

- Perform removal and installation work on the ignition system or connection and disconnection of sensors at ignition cables only when the engine is not running and the ignition is switched off.
- No adapters or plug-in sensors which are metallically blank to the outside may be installed in the ignition cables (e.g. cylinder 1).

B. Instructions for avoiding damage to ignition system

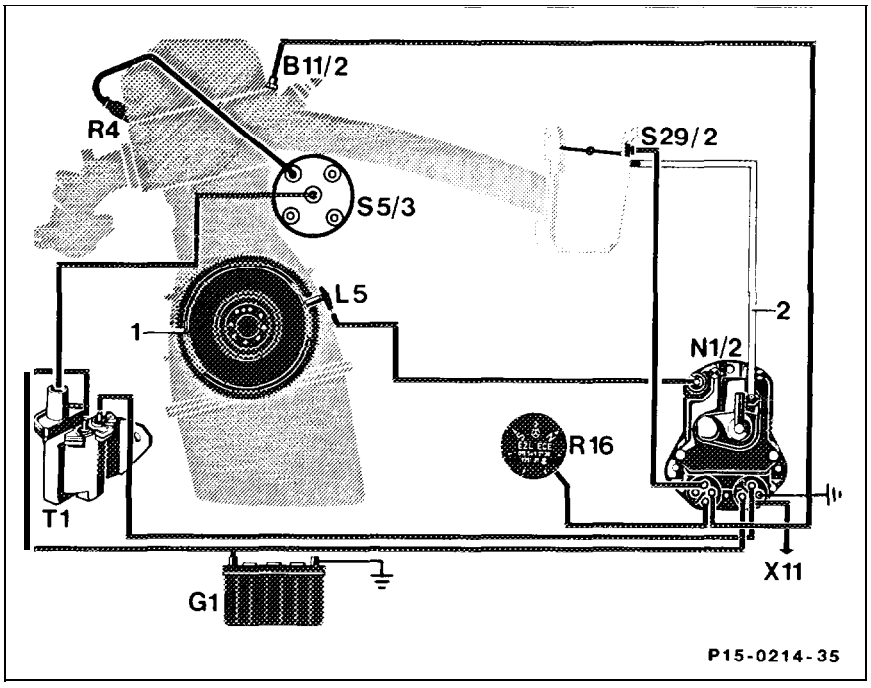
- **The control module connectors may only be unplugged and plugged in when the ignition is switched off in order to avoid damage to the ignition and TSZ control modules.**
- Do not connect a test lamp to terminal 1 of the ignition coil.
- Terminals 1 and 15 of the ignition coil must not be short circuited to ground, e.g. as an anti-theft protection.
- The threaded pins of the ignition coil have different diameters (M5 and M6) to eliminate the risk of incorrect polarity.
- Install only genuine ignition system parts.
- Do not operate ignition system at starting speed unless all the ignition cables are fully connected.

- The high voltage side of the ignition system must have a load of at least 2 kΩ (distributor rotor 1 kΩ, distributor cap per terminal 1 kΩ) to avoid damage to the ignition and/or TSZ control modules. Do not install 5 kΩ distributor rotors for interference suppression.
- The following work must not be performed at starting speed or when the engine is running:
  - holding ignition cable 4 at a distance to ground
  - unplugging spark plug connector
  - unplugging ignition cable 4 at ignition coil.
- The ignition control module is coated on the rear with heat-conducting paste to improve heat dissipation and covered with a heat-conducting protective film. The protective film must not be removed.
- If the short-circuit protection (cylinder comparison) is operated and the engine stops, the test cannot be performed with this tester.
- A load of not more than 28 kV may be applied to the ignition coil when performing the separate ignition coil test in order to avoid damaging the coil.
- If it is necessary to test the ignition spark when rendering roadside assistance, this must only be done with a spark plug at a cylinder ignition lead. Ensure a good contact to ground of the spark plug.
  WARNING! Risk of shock!

C. Instructlons for use of engine testers

- Connect and disconnect voltage clamp to ignition cable 4 and trigger clamp to ignition cable of cylinder 1 only when the engine is not running and the ignition is switched off.

15-510 Function of distributor ignition system (DI)



Function diagram of distributor ignition system (DI)
Engine 102.985

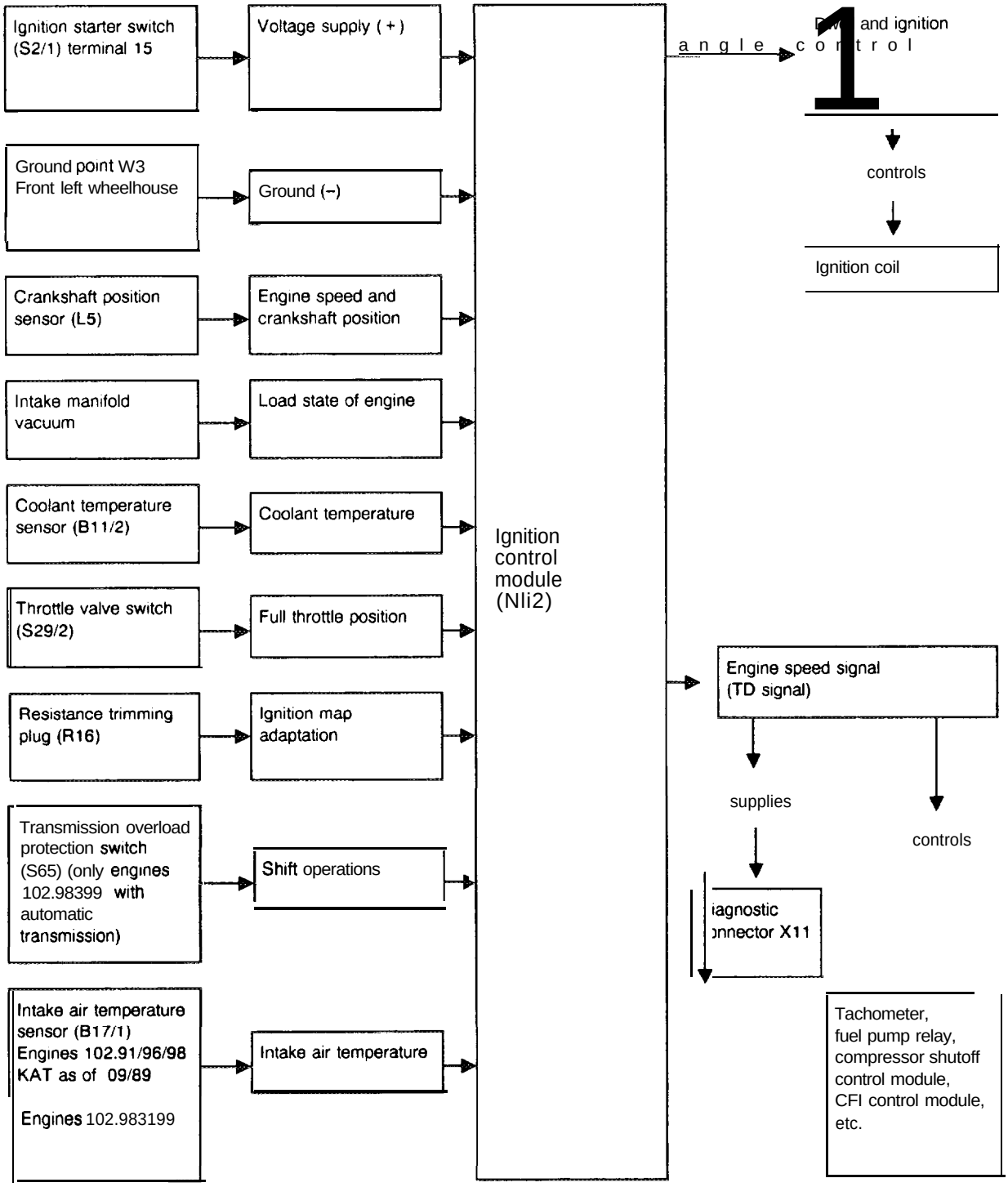
B11/2	Engine coolant temperature sensor
G1	Battery
L5	Crankshaft position sensor
N1/2	Ignition control module
R4	Spark plugs
R16	Reference resistor
S5/3	High voltage distributor
S29/2	Full throttle/idle speed detection throttle valve switch
T1	Ignition coil
Xl 1	Diagnostic connector/terminal block terminal TD
1	Segments on driver disk
2	Vacuum line

Engines 102.96/98 as of 09/89

The intake air temperature sensor (B17/1) supplies its temperature values to the ignition control module (intake air temperature sensor for CFI system no longer equipped).

Components and function

ignition control module (N1/2)



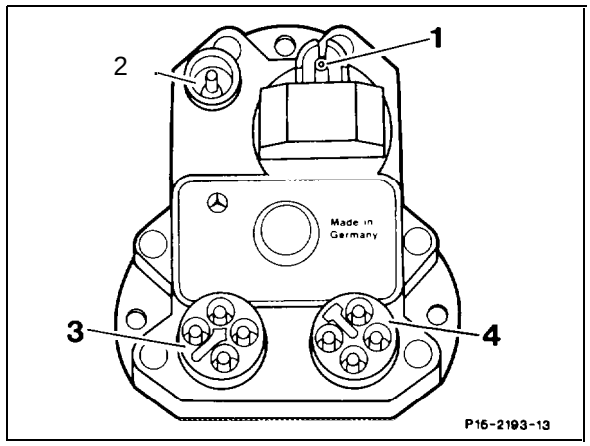
The ignition control module is located on the left wheelhouse panel.

It is installed with heat conducting paste to improve heat dissipation. When exchanging this part, the protective film must not be removed. The film does not impair heat dissipation. The ignition control module contains a microcomputer, a pressure sensor and the power output stage.

The ignition maps for typical load/engine speed ranges and a fixed idle speed ignition map are stored in the microprocessor of the ignition control module.

The ignition control module detects the momentary operating state of the engine from various input signals. Engine speed and crankshaft position are sensed by the position sensor.

The optimal ignition point for this operating state is output from the stored ignition maps by analyzing all the input signals.



1 Vacuum connection
2 Coaxial connector for control lead from position sensor
3 Sensor connector 4-pin
  1 Engine coolant temperature sensor
  2 Wide open throttle/closed throttle position switch
  3 Reference resistor
  4 Vacant (lead ends in wiring harness)
    or intake air temperature sensor
4 Supply connector 4-pin
  15 = Terminal 15
  16 = Ignition coil terminal 1
  TD = TD signal
  31 = Ground

The output end stage actuated by the micro-computer switches the primary current of the ignition coil between terminals 16 and 31 (4-pin supply connector).

The familiar functions of dwell angle control, primary current cutoff and primary current limiting are still contained in the ignition control module.

The speed-dependent TD signal is generated in the ignition control module (15-512).

When the engine is started and up to approx. 450/min the ignition point is controlled only via the segment edges of the flywheel. Only when a certain engine speed is reached (approx. 460/min) is a transition made from the fixed ignition point to the ignition point calculated for the momentary operating state.

In the warming-up range, various ignition maps are inhibited depending on coolant temperature in order to reach the operating temperature as rapidly as possible.

At idling speed and when decelerating a fixed ignition map is specified when the idle contact of a throttle valve switch is closed. This is influenced neither by the temperature sensor, the intake manifold vacuum nor by the reference resistor.

Note
If an interruption of the engine coolant temperature sensor occurs (resistance $\infty\Omega$) Bosch ignition control modules depart from the fixed idle speed curve and select a certain ignition point in the map, i.e. the ignition point is advanced.

At full load, the ignition point is determined by the full load ignition curve. The ignition control module detects full load from the intake manifold vacuum and engine speed input signals.

At full load, the ignition point is advanced (higher engine torque), taking into account the knock limit.

On engines 102.983199 two full load ignition characteristic curves are stored. The ignition point is determined as follows depending on the switch position of the intake air temperature sensor:

- By the advanced ignition characteristic curve below +25°C intake air temperature.
- By the retarded ignition characteristic curve above +25°C intake air temperature.

On engines 102.96/98 as of 09/89 with intake air temperature sensor, the ignition point is retarded as the intake air temperature rises. In addition, an ignition map is stored both for automatic and manual transmission. These maps are activated by the reference resistor.

The ignition points of certain ignition characteristic curves can be altered with the reference resistors. depending on the operating state.

Two maps for the following operating modes are stored in the ignition control module:

- For operation **with** catalytic converter (is activated via reference resistor).

The national version (USA) has a fixed resistance reference resistor.

Note
The ignition control module for engine 102.983 Standard has only one map. The ignition point IS altered for leaded and unleaded premium grade fuel with a special resistance trimming plug (inscription EZL and digits l-7).

Safety measures at control module
A safety retardation is automatically performed in the event that one or several sensors of the ignition system fail in order to protect the engine.

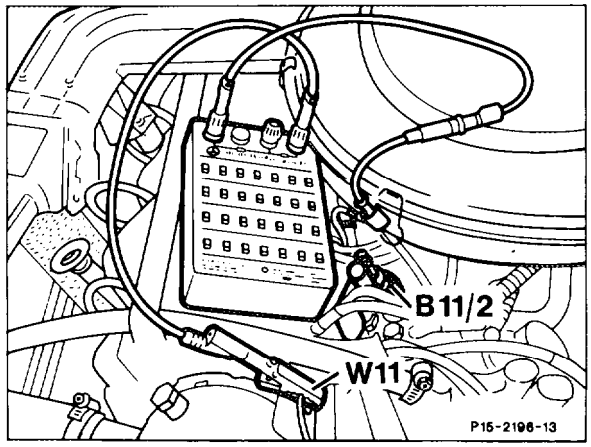
If the engine coolant temperature exceeds 90 °C or 100 °C (depending on version), certain ignition characteristic curves are retarded to counteract a further temperature rise (boiling protection correctton).

On engines 102.96/98 as of 09/88 up to 08/89 the use of the boiling protection correction has been advanced from 100 °C to 90 °C engine coolant temperature. From a coolant temperature of 90 °C the ignition point is retarded. The maximum retardation of 5” CKA is already reached at a coolant temperature of 100 °C.

Engines **102.996/98** as of **09/89**
The use of the boiling protection correction begins from 100 “C.
The retardation correction is:
100 °C → retarded 2” CKA (crank angle)
110 °C → retarded 4” CKA
120 °C → retarded 5” CKA

⚠
The correction of the boiling protection and of the intake air are added, i.e. 120 °C coolant temperature and 50 °C intake air temperature produce a maximum retardation of 12” CKA.

The Ignition point test must be performed at an engine coolant temperature between 75 °C and 90 °C because of 'he boiling protection correction as the ignition point is altered outside of this temperature range. To avoid an incorrect measurement of the ignition point, unplug connector for the engine coolant temperature sensor and feed in 320 Ω (= 80 °C engine coolant temperature) with the resistance decade.

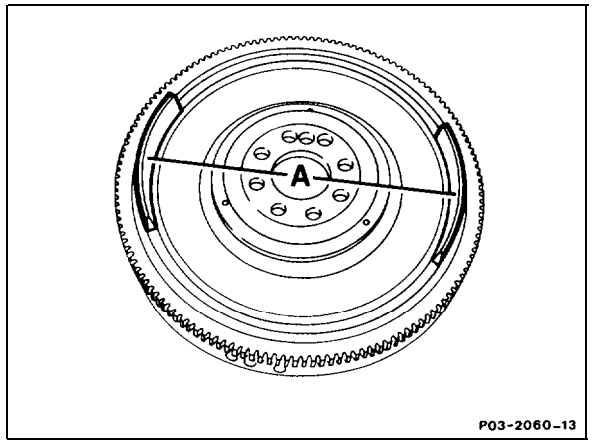


Engines 102.96/98
B11/2 Engine coolant temperature sensor
W1 1 Engine ground

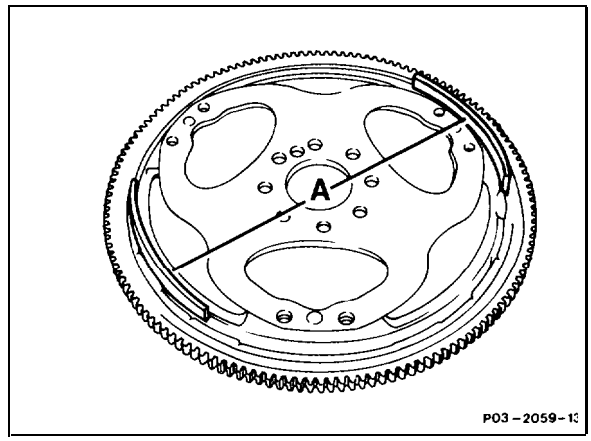
Flywheel disk with segments

Two segments offset 180" (A) are installed to the flywheel or to the flexplate.

As the segments pass the position sensor they produce an alternating voltage as a result of Induction.



Flywheel (manual transmission)



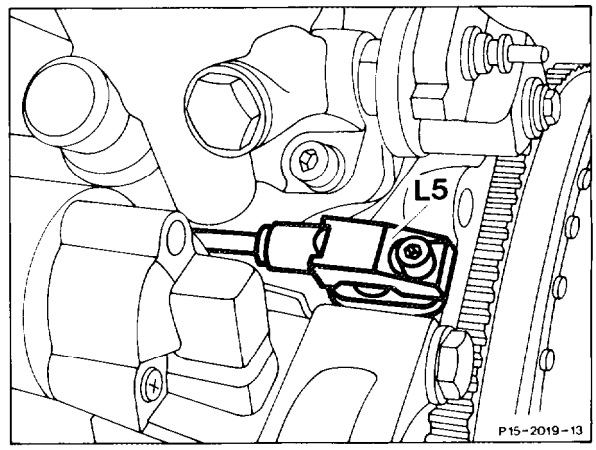
Flexplate with ring gear
(automatic transmission)

Position sensor (L5)

To activate the ignition control module, the position sensor (L5) detects the crankshaft position and the engine speed.

The position sensor is installed on the crankcase above the starter flange.

The coil body projects to just before the segments at the driver plate. Segment position and engine speed are sensed without contacts.

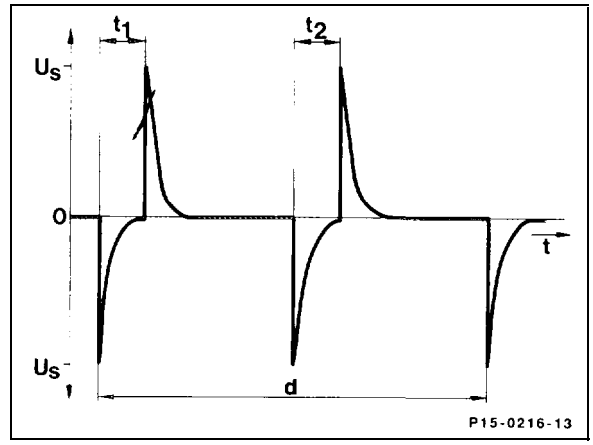


When the engine is rotating an alternating voltage is produced in the position sensor as a result of induction. The peak value of the voltage (U,) is approx. 1.5 volts at starter speed. As engine speed increases, the voltage rises (U, approx. 3 volts at 1200/min.).

Note
Measure peak value of voltage (U,) with the oscilloscope.

The crankshaft setting is detected from the voltage as follows:

The front edge of the segment produces a negative voltage signal.
The rear edge of the segment produces a positive voltage signal.

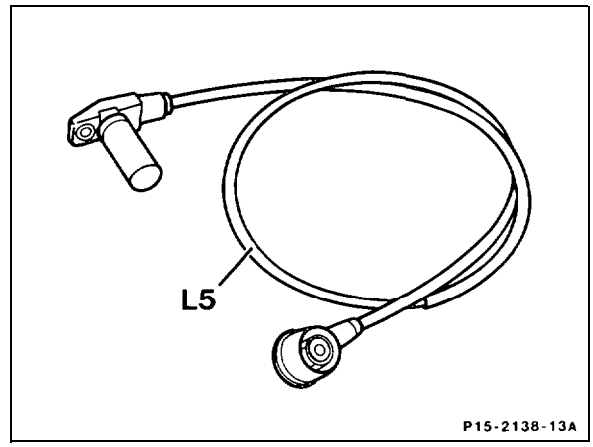


Position sensor voltage signal
t1 1 st segment
t2 2nd segment
d Period for one crankshaft revolution

The engine speed is determined by measuring the period.

The alternating voltage of the position sensor is passed along the control lead (coaxial lead) to terminal 7 at the ignition control module. The lead is a single-core cable and the screening is used as a second lead.

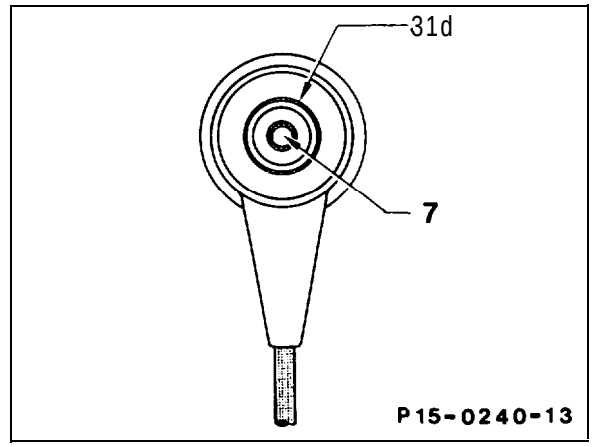
If the ignition control module does not receive a signal from the position sensor, the complete ignition system is inoperative, e.g. an interruption of the sensor coil can cause this.



The resistance of the position sensor between terminal (7) and (31d) is 680-1200 Ω.

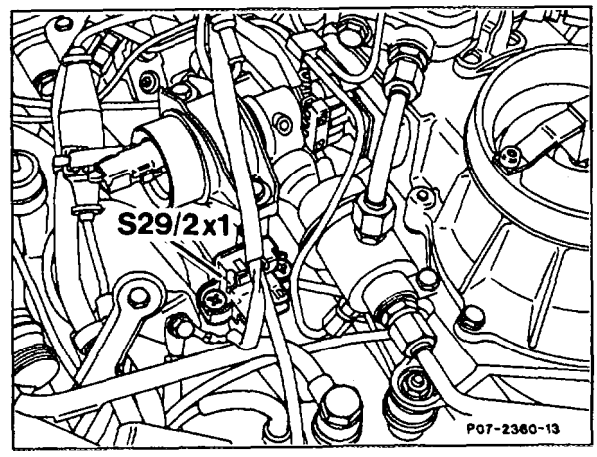
Notes regarding damage segments or mechanical damage to position sensor:

- Alternating voltage of position sensor below specification.
- Alternating voltage signals of individual segments vary greatly.
- No alternating voltage signal.



Wide open throttle/closed throttle position (WOT/CTP) switch (S29/2)

When the closed throttle **contact of** a WOT/CTP switch is closed (accelerator not depressed), the fixed idle speed/deceleration ignition characteristic curve is activated. The switching signal passes through the WOT/CTP switch connector (S29/2x1) and the 4-pin sensor connector (contact 2) to the ignition control module.



Engine coolant temperature sensor (B11/2)

Temperature sensors are equipped with 2-pin or 4-pin (from approx. 09/89) connections.

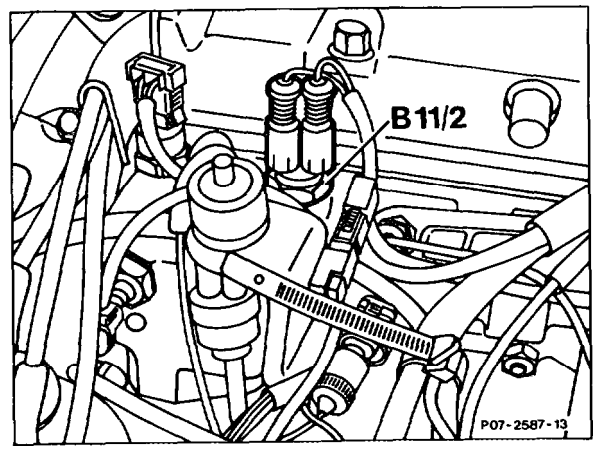
The temperature signal passes along the green/black cable at the 4-pin sensor connector (contact 1) to the ignition control module.
The engine coolant temperature sensor is positioned at the front at the cylinder head.

Note

NTC = resistor with negative temperature coefficient, i.e. the resistance is less in the warm state.

2-pin engine coolant temperature sensor (B11/2)

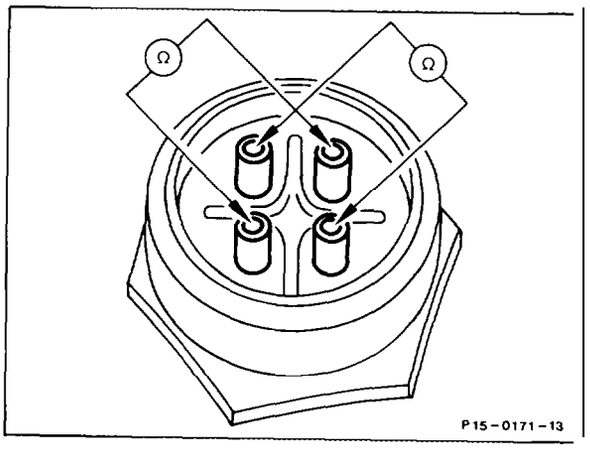
The engine coolant temperature sensor has two NTC resistors, each with **a** single-pin connection. One NTC for CFI and one NTC for the distributor ignition system.



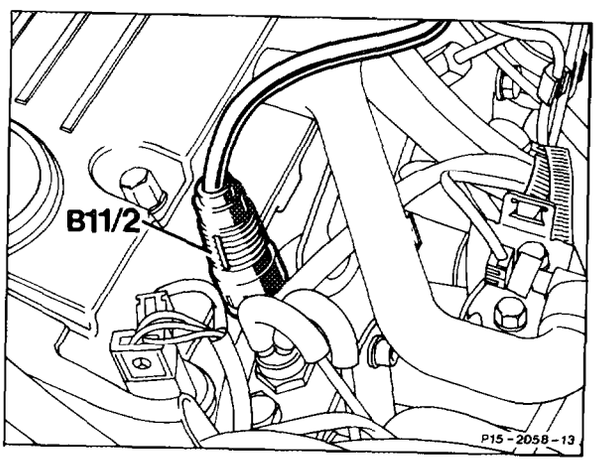
Engines 102.961985
B11/2 Engine coolant temperature sensor

4-pin engine coolant temperature sensor (B11/2)

It integrates two separate temperature sensors (NTC) which do *not* have any electrical connection to the housing of the engine coolant temperature sensor.

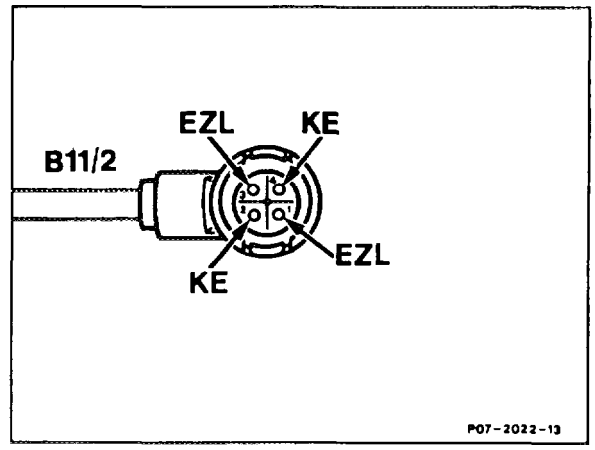


One temperature sensor is for the distributor ignition system (contacts **1** and 3) and one for the injection system (contacts 2 and 4).
The connector of the engine coolant temperature sensor is designed so that it can be plugged in in any position. The two temperature sensors are arranged diagonally.



Engines 102.96/98
B11/2 Engine coolant temperature sensor

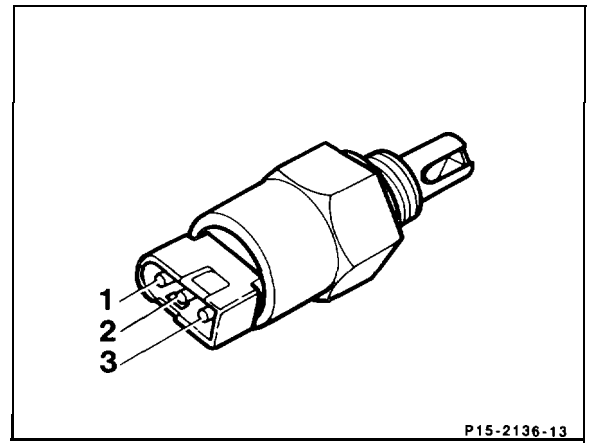
Pin assignment of coupling:
1 = Ignition temperature sensor
2 = CFI temperature sensor
3 = Ground W3, front left wheelhouse
4 = CFI control module ground



Notes regarding test
Engine coolant temperature sensor (B11/2)
When testing the engine coolant temperature sensor, measure the resistances 2 x diagonally and compare. The resistances of the characteristic curves are identical with those of the previous version.

An electronic switch is incorporated in the intake air temperature sensor which interrupts the connection between terminal 2 and terminal 3 (ground) at temperatures ≥ 25 °C. Continuity exists between the two terminals below this temperature.

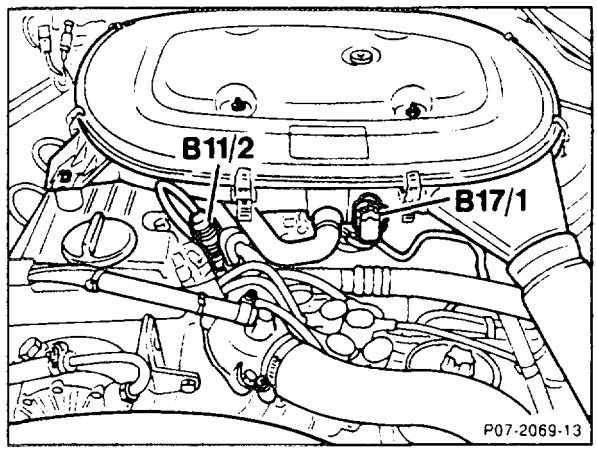
At terminal 1 the voltage for the electronic switch is supplied from terminal 15 via fuse 10.



1 Voltage supply
2 Ignition control module
3 Ground

b) **Engines 102.96/98 KAT as of 09/89**
The intake air temperature sensor installed on CFI now supplies its temperature values through the sensor connector contact 4 to the ignition control module. The resistance of the temperature sensor (NTC) becomes smaller as the temperature rises.

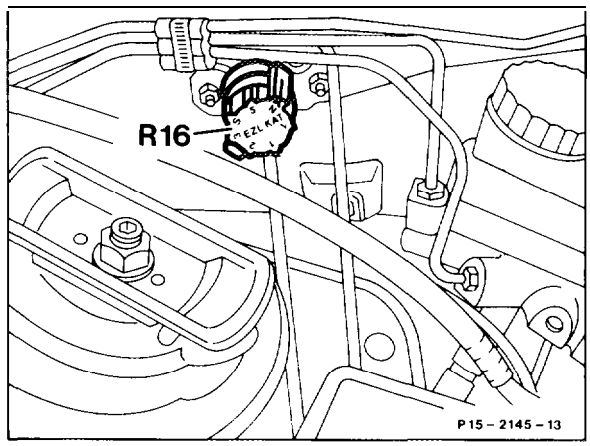
From an intake air temperature of 32 °C the ignition point is retarded and reaches its maximum at 50 “C.
e. g.: 32 °C → retarded 1° CKA
40 °C → retarded 5” CKA
50 °C → retarded 7° CKA



Engines 102.96/98
B17/1 Intake air temperature sensor

Reference resistor
Two different types of reference resistors are installed:

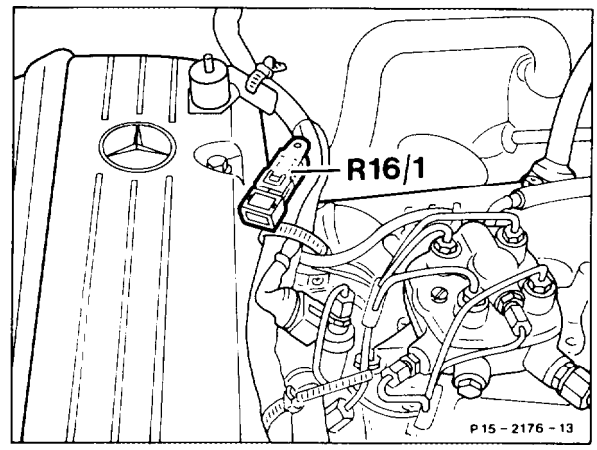
a) Variable resistance trimming plug (R16).
b) Reference resistor (R16/1) with fixed resistance (USA).



Model 124 shown
R 16 Reference resistor

b) Reference resistor (R16/1)

The reference resistor (R16/1) has a fixed resistance. The fixed resistances differ depending on Part No. as follows (see 15-515 for assignment):



Model 201

Part No.	Resistance
000 540 22 81	220 Ω
000 540 23 81	470 Ω
000 540 24 81	750 Ω
000 540 25 81	1300 Ω
000 540 26 81	2400 Ω

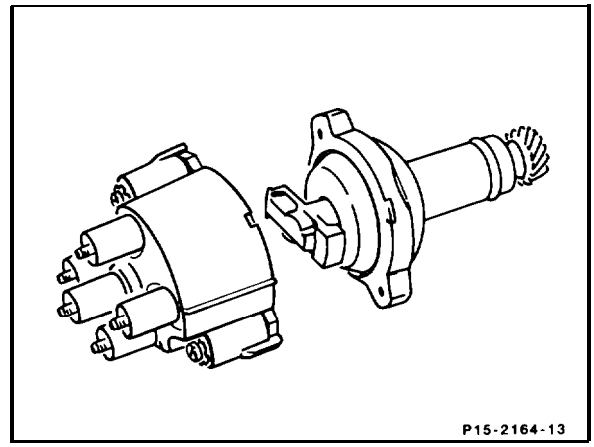
A certain ignition map is activated in the ignition control module with the reference resistor (R16/1).

Perform resistance measurement for testing the reference resistor (R16/1) at the ignition control module between sensor connector (contact 3) and ground.

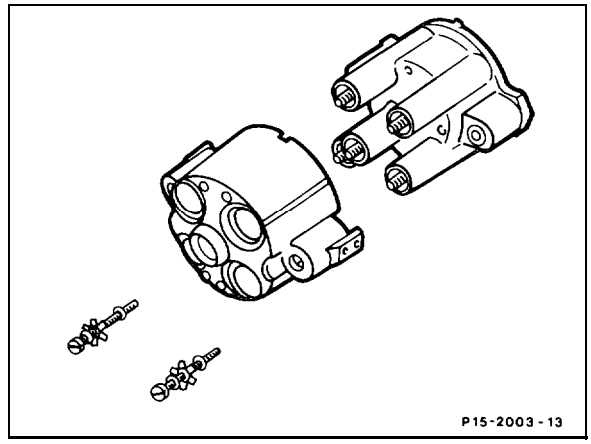
High voltage distributor (S5/3)

The singular task of the high voltage distributor is to distribute the ignition voltage. It is therefore no longer possible to set the ignition point. Activation and adjustment of the ignition point are performed by the position sensor and the ignition control module.

Interference suppression resistors: At distributor cap per terminal 1 kΩ, spark plug connector 1 kΩ, distributor rotor 1kΩ.

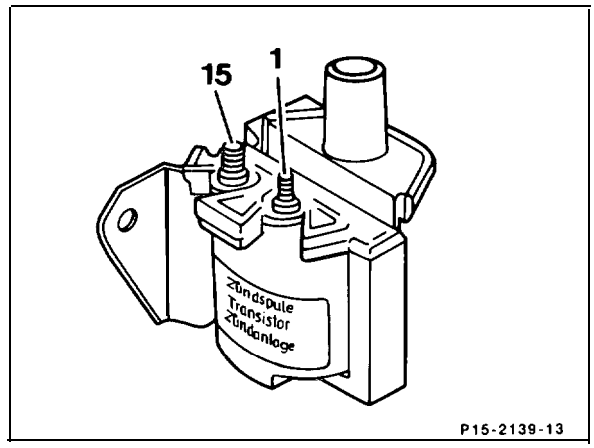


The distributor cap is attached to the high voltage distributor with M-6 special bolts.
The special cap for long-range interference suppression is mounted on the cap and attached with two metal stars.



Ignition coil(T1)

The ignition coil is matched to the ignition control module to achieve a higher ignition energy. The primary current can be further boosted as a result of the high switching capacity of the ignition control module. The primary winding is designed as a very low impedance (0,3–0,6Ω) for this purpose.
Stall current cutoff and primary current limiting enable the ignition coil to be operated without ballast resistor. Consequently, current limiting by the ballast resistor is eliminated. If the maximum primary current flows without limit in the ignition coil (e.g. stall current cutoff defective), the ignition coil is damaged after a short time by the high level of heat developed.

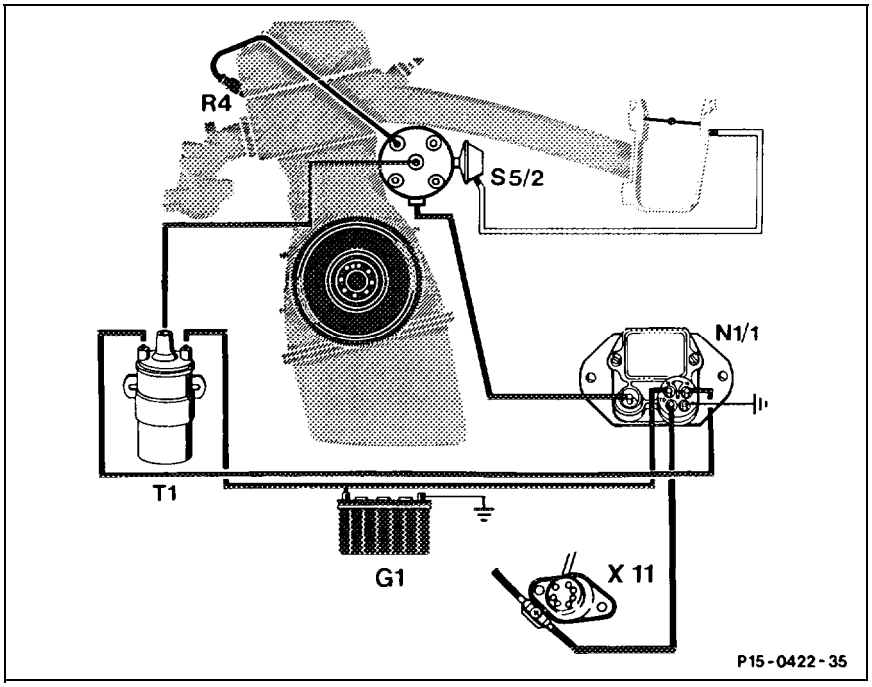


For distinguishing:

The ignition coils of 4- and 6-cylinder engines with distributor ignition systems are identical
Identification: yellow type plate.
The ignition coils cannot be interchanged with ignition coils for a-cylinder engines (identification: green type plate).
Pay attention to Part No. when exchanging.

Pay attention to instructions regarding work on electronic ignition systems (15–505).

15-512 Function of the breakerless transistorized ignition system (TSZ)



G1	Battery	S5/2	Breakerless distributor
N1/1	Transistorized ignition (TSZ) control module	T1	Ignition coil
R4	Spark plugs	x11	Diagnostic connector/terminal block terminal TD

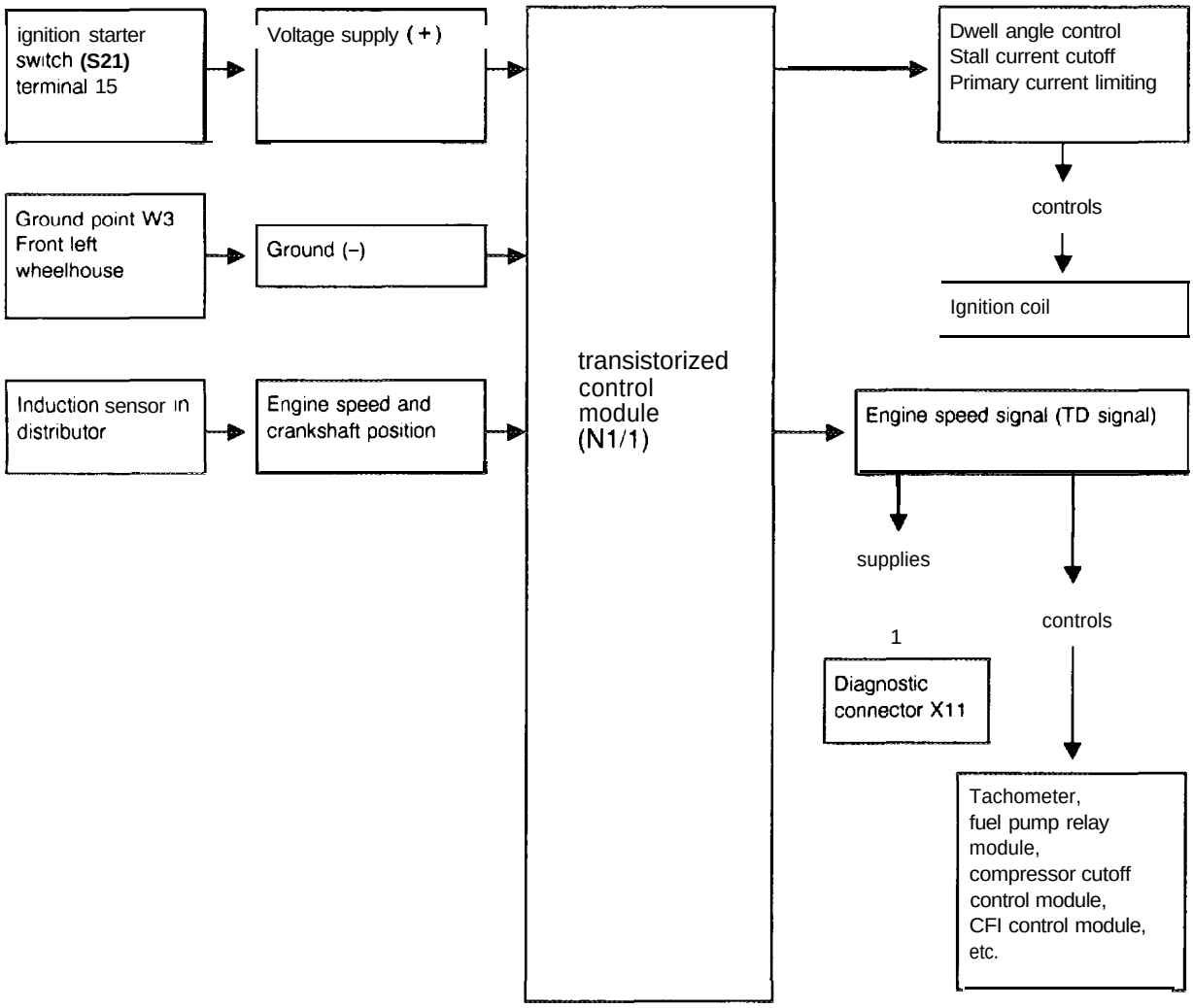
Note

Installation survey of engines with breakerless transistorized ignition system (TSZ), see 07.3-004.

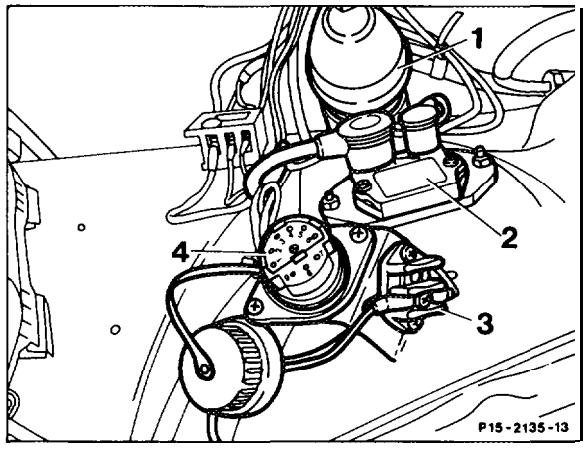
Only a 4-pin connector is plugged in at the small transistorized control module (distinguishing feature to ignition control module).

Components and function

transistorized control module **(N1/1)**



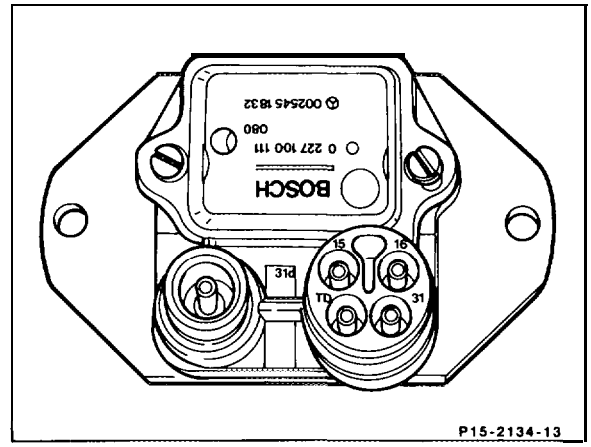
The transistorized control module is located on the left wheelhouse panel. It is designed in space-saving hybrid technology.



1 Ignition coil
2 transistorized control module
3 Terminal block terminal TD
4 Diagnostic connector

Pin assignment at transistorized control module

- Green control lead from induction sensor in distributor (coaxial connector).
- 4-pin round connector with terminals 15, 31, 16 and TD.



The electronic functions of primary current limitation and stall current cutoff in the transistorized control module enable the series resistors in the primary current circuit to be eliminated. Consequently, a higher ignition coil primary current and higher ignition capacity are possible.

The transistorized control module is activated by induction sensor in the distributor.

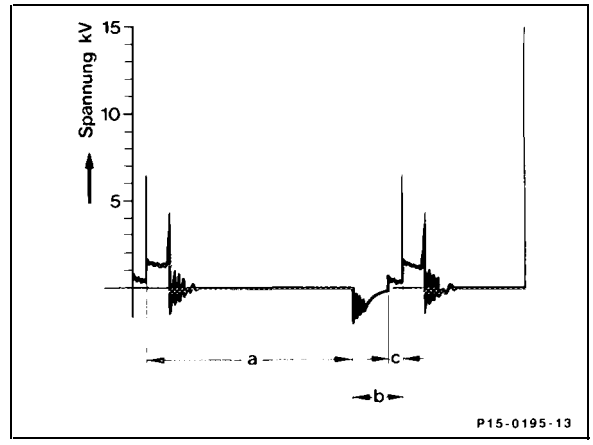
The optimal capacity of the ignition system is achieved by the dwell angle control in the transistorized control module. The dwell angle is controlled within the control range so that the same primary current is always achieved approximately in every operating state, i.e. at different battery voltages and engine speeds.

As a result of the elimination of the series resistors, the primary current is cut off by the transistorized control module (stall current cutoff) when the engine is not running and the ignition is switched on. The primary current is connected only once a certain pulse sequence is generated by the induction sensor in the distributor.

The maximum primary current of the ignition coil is determined by a current limiter in the transistorized control module.

The current limitation (c) can be recognized on the oscilloscope when the engine is at idle. Current limitation is no longer visible from an engine speed of approx. 2000imin.

The power output stage switches the primary current of the ignition coil between terminals 16 and 31. In addition, the power output stage performs the task of limiting the primary current.



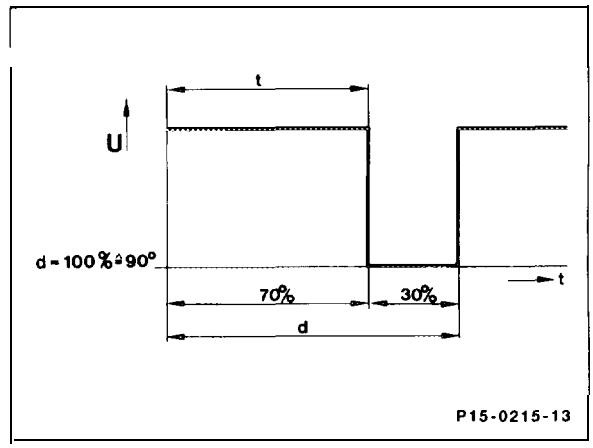
a Opening angle
b Dwell angle
c Current limiting

TD signal

The transistor engine speed (TD) signal is produced in the transistorized control module. This is an engine speed-dependent square-wave signal.

The engine speed is detected by the number of square-wave signals per minute.

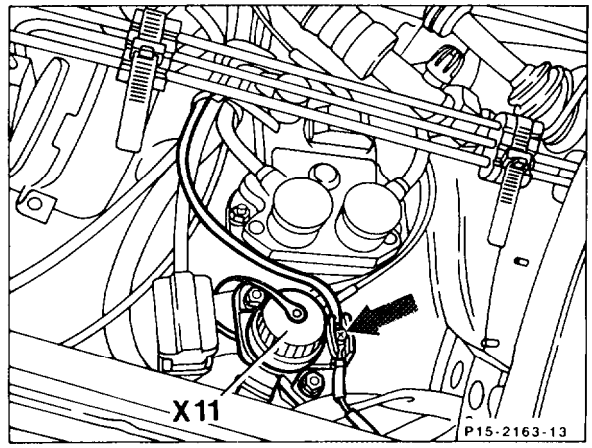
When performing tests, the On time (t, e.g. 70% of the individual square-wave pulses is measured as dwell angle in degrees or as on/off ratio in percent (related to period, d).



The TD signal can be measured:

- with the dwell angle tester or on/off ratio tester in percent and degrees.
- with the voltage meter 6 volts up to 12 volts direct voltage.
- with the oscilloscope – square-wave signals.

Note
No TD signal exists if a short to ground is present at the connected equipment or at the diagnostic connectorterminal block terminal TD (Xl 1). To locate the problem, detach cable connection (arrow). Rectify short to ground in the respective circuit.

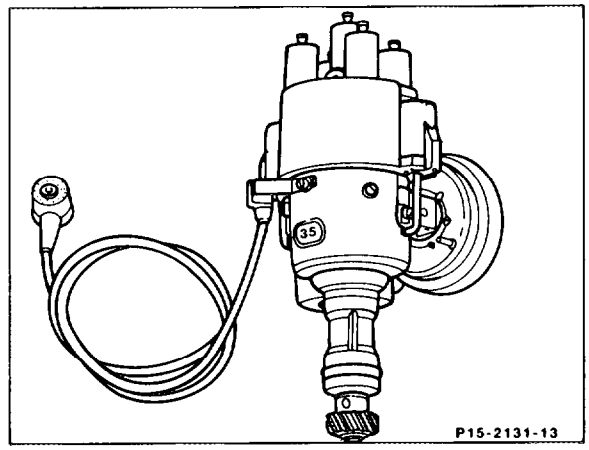


The following electronic components have a TD connection, e.g.:
Tachometer, CFI control module, fuel pump relay and compressor cutoff control module.

Ignition distributor **(S5/2)**

- The induction sensor is installed in the distributor. It produces an alternating voltage up to approx. 100 volts for actuating the transistorized control module.

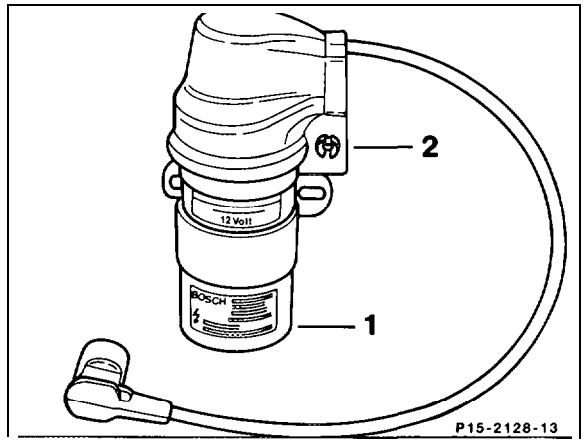
  The alternating voltage passes along the green control cable (coaxial cable) to the ignition control module. The cable is a single-wire lead. The screening is used as a second lead.



- Engine speed-dependent ignition advance by flyweights. Load-dependent ignition advance by vacuum (above approx. 60 °C coolant temperature).

- Interference suppression resistors: distributor rotor 1 kΩ (code number R1, on rotor), distributor cap 1 kΩ per cylinder.

Ignition coil (T1)



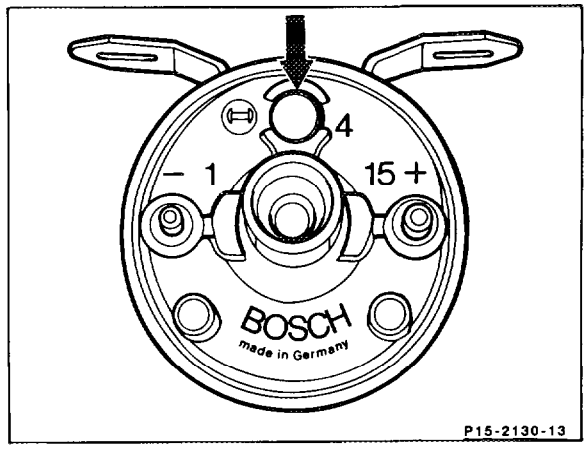
The ignition coil is matched to the ignition control module and designed for a higher ignition capacity. Identification: yellow sticker.

The ignition coil must on no account be replaced by one of the previous ignition coils.

Distinguishing features from previous ignition coils are:

- The safety plug in the cover of the ignition coil.
- A higher dome.
- Cable connection at terminal 1 with M5 thread.
- Cable connection at terminal 15 with M6 thread.

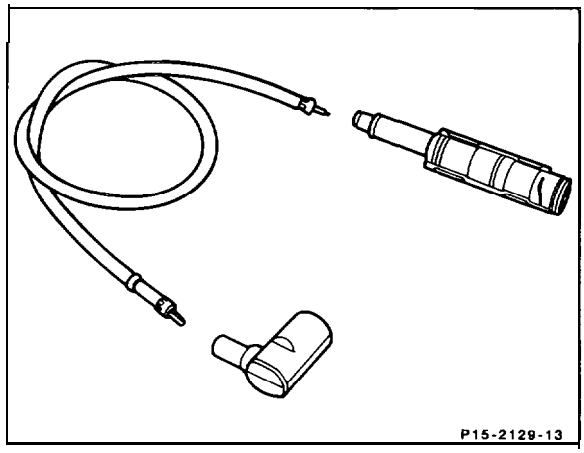
A 5.5 mm opening (arrow) which is sealed with a plug is located in the cover of the ignition coil. This cover detaches if an pressure as a result of severe heat formation is produced in the ignition coil by a defective output stage in the control module. The ignition coil is provided with a cover cap to prevent uncontrolled escape of the plug or of the sealing compound.



Ignition cables

The partially screened spark plug and angled distributor connectors are designed for high ignition voltage.

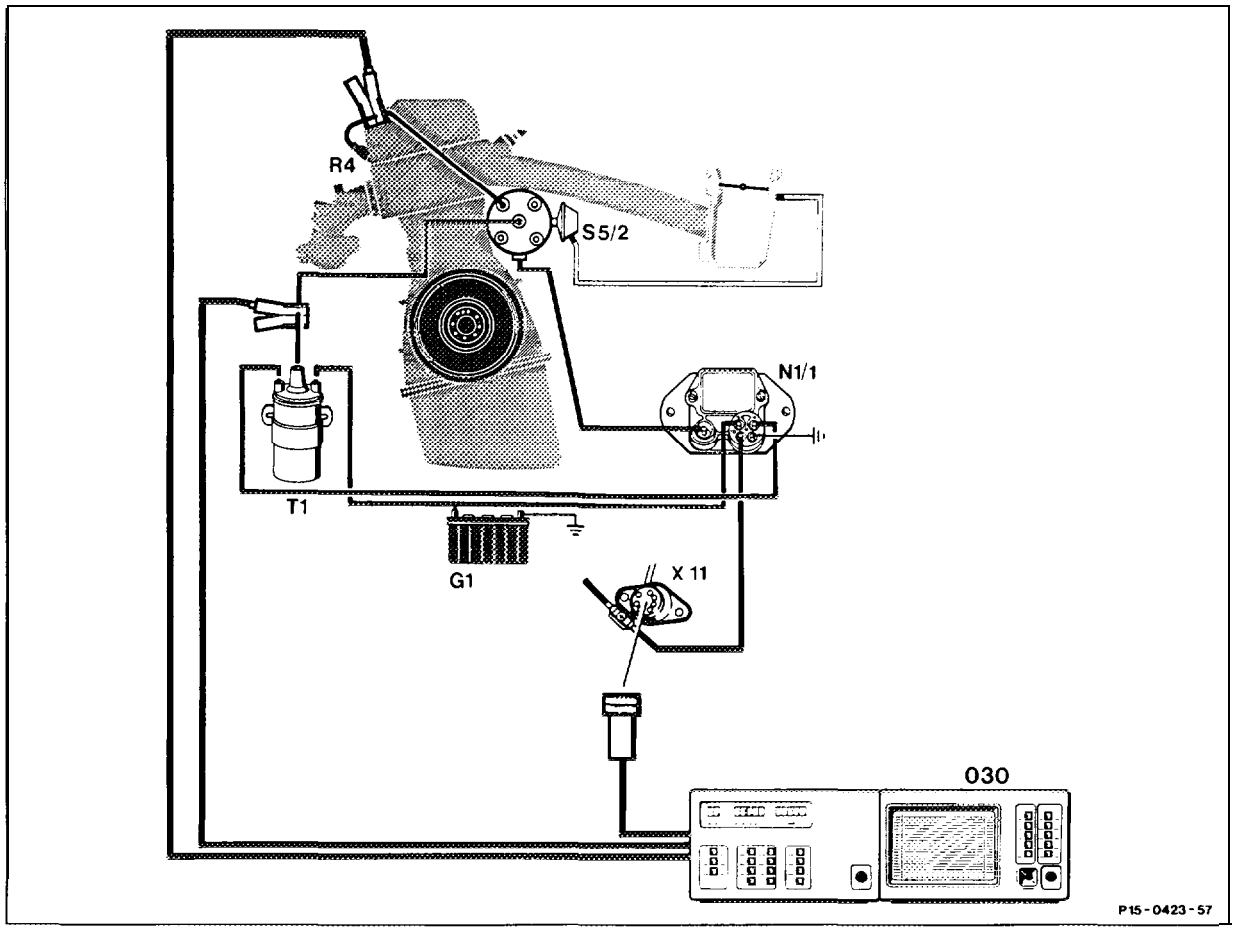
An interference suppression resistor of 1 kΩ is installed in the spark plug connectors. These can be unscrewed (M3 thread).



15-515 Testing ignition point

Preceding work:

A. Vehicles with TSZ ignition system



G1	Battery	**T1**	Ignition coil
N1/1	Transistorized ignition (TSZ) control module	x11	Diagnostic connector/terminal block terminal TD
R4	Spark plugs	030	Engine tester with oscilloscope
S5/2	Breakerless distributor		

Engine tester with oscilloscope (030)	connect to diagnostic socket (Xl 1).
Safety precautions	observe (15-505). Selector lever in position P or N. Apply parking brake.
Ignition point	test at specified engine speed with or without vacuum (see table).

Ignition point	set by turning distributor. Then re-test.
Flywheel vacuum advance	test at specified engine speeds (see table).

Commercially available testers

Engine tester (engine speed, dwell angle, ignition angle, oscilloscope, voltmeter	e. g.	Bosch, MOT 002.02 Sun, 1019

ignition point (TSZ) basic version

Engine	Type of fuel[3])	Distributor Bosch No.	Test and setting data [1]) of ignition point in °CKA BTDC ± 1 without/with vacuum		Ignition point advance in °CKA (crank angle) before TDC without vacuum			Vacuum advance of ignition point in "CKA BTDC at	installed value of ignition point in "CKA BTDC at starting speed without vacuum
			4500 1 min	at idle	at idle	1500/ min	3000/ min	4500 1 min	
102.961	un-leaded	0 237 002 084 0 237 002 059	27 without	– –	8 ± 3[4])	11–16	21–25	8-12	8
102.985	un-leaded	0 237 002 105	27 without	–	10 ± 3	13–19	21–25	8-12	8

See next page for footnotes.

Ignition po(TSZ :) basic version

Engine	Type of fuel [3])	Distributor Bosch No.	Test and setting data [1]) of ignition point in "CKA BTDC ± 1 without/with vacuum		Ignition point advance in "CKA (crank angle) before TDC without vacuum			Vacuum advance of ignition point in "CKA BTDC al:	Installed value of ignitron point in "CKA BTDC alt starting speed without vacuum
			4500/ min	at idle	at idle	1500/ min	3000/ min	4500/ min	
(USA) 102.961 1984	un-leaded	0 237 002 094	–	5 with	–	5–11	19–25[2])	24-28')	5
102.961 102.985 as of 1983		0 237 002 098				10-14	22–26[2])	14-I 8[2])	5

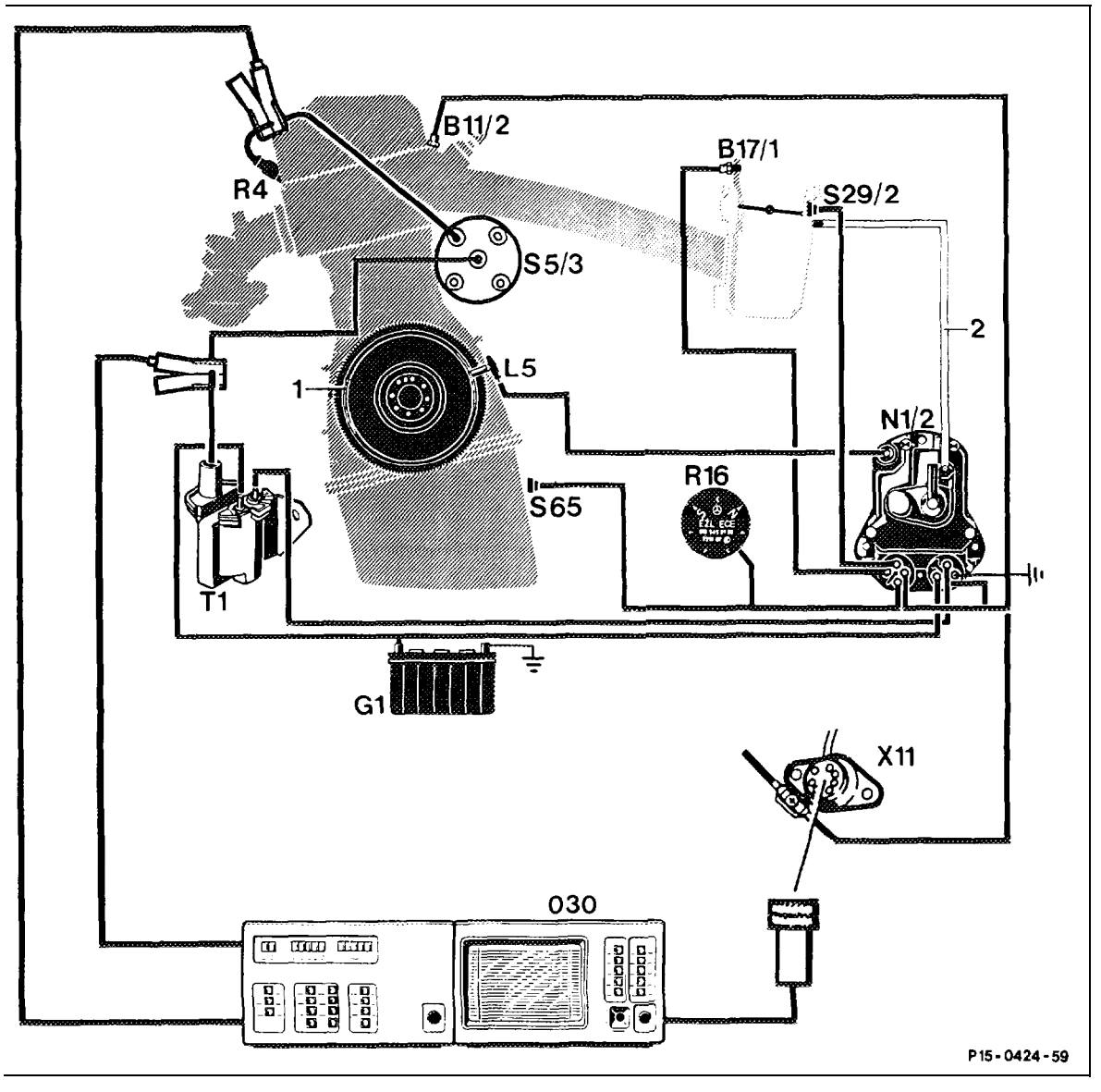
[1]) If normal-compression engines are operated with fuel of less than 98 RON (mm. 88 MON) or low-compression engines with less than 92 RON (mtn. 82 MON), the ignition point should be retarded and adapted to the octane number of the fuel used. A reference value for this adlustment is: retard ignition point by I-2 ° CKA per 1 RON. The maximum retardation must not exceed 6° CKA.
The Ignition correction should be entered by hand on the "engine setting data" Information plate.
Thrs results in reduced performance and increased fuel consumption. In addition, the engine must not be operated at full load.
The full ignition advance should be reset as soon as fuel of the specified octane number is again available.

[2]) Test at 3500/min.

[3]) Vehicles with catalytic converter must be ooerated with unleaded fuel.

4) This value must be identicalwith and without vacuum when engine at normal operating temperature: check ignition advance in warming-up phase if necessary (15–543).

B. Vehicles with distributor ignition system (DI)



B11/2	Engine coolant temperature sensor	S65	Transmission overload protection switch (only engines 102.983199)
B17/1	Intake air temperature sensor	T1	Ignition coil
G1	Battery	x11	Diagnostic connector/terminal block terminal TD
L5	Crankshaft position sensor		
N1/2	Ignition control module	1	Segments at flywheel/driver disk
R4	Spark plugs	2	Vacuum line
R16	Reststance trimming plug (EZL)	030	Engine tester with oscilloscope
S5/3	High voltage distributor		
S29/2	Wide open throttle/closed throttle position switch		

Engine tester with oscilloscope (030)	connect to diagnostic socket (Xl 1).
Safety precautions	observe (15–505). Selector lever position P or N. Apply parking brake.
Ignition point	test at a engine coolant temperature for approx. 80 °C with or without vacuum at specified engine speed (see table).

Engine 102.96/98 KAT as of 09/89
Detach engine coolant temperature sensor (B11/2) and intake air temperature sensor (B17/1) for test.

⚠
Following the test, the DTC memory must be erased (see 07.3-121, section "D"). Use impulse counter scan tool 124 589 19 21 00 for this or unscrew/ screw on negative pole terminal or battery.

Note
The ignition point cannot be set. If the ignition point is incorrect, test distributor ignition system (DI) (15-540).

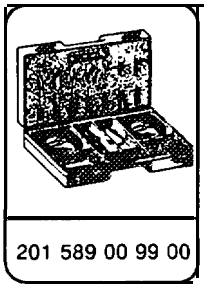
Radio with code
Following repairs to the vehicle which involve disconnecting the battery terminals, the radio must be made operational again by entering the code number. The CODE card must be available when repairs are performed.

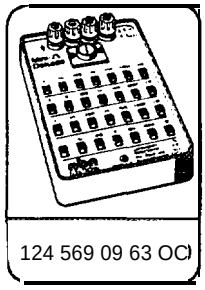
Engine	Version	Production break point Model year	Ignition control module Part No. alternatively	Engine speed 1/min	Resistance trimming plug setting, type of fuel [7]	**Ignition point** in °CKA BTDC **without** vacuum	**Ignition point** in °CKA BTDC **with** vacuum
102.983	(USA)	1986/1987	004 545 57 32 004 545 59 32	4000	Reference resistor 750 Ω	18–22 [3]	29–33 [3]
				Idling		**14–18**	**14–18**
102.985		1987/1988	005 545 30 32 005 545 32 32	3200		25–29	39–43
				Idling		18-12	18-12
102.985		1989	007 545 47 32 [5][6] 007 545 48 32 [5][6]	3200		23-27	39–43
				Idling		8-12	8-12
102.985		1991	010 545 59 32 010 545 60 32	3200	Reference resistor 1.3 kΩ (man. transm.) 2.4 kΩ (aut. transm.)	22-26 [9]	39–43 [9]
				Idling		8-12	8-12

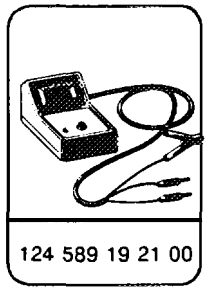
[1] Manual transmission.
[2] Automatic transmission.
[3] Intake air temperature sensor connector disconnected.
[4] Resistance trimming plug position results from setting.
[5] These ignition control units may also be installed in vehicles prior to 08/88. In this case the ignition point values are altered as shown in the table. The resistance trimming plug setting "7" is no longer permitted for these ignition control units.
[6] Test ignition point at 80 °C coolant temperature by unplugging the temperature sensor connector B11/2 and feeding in 320 Ω with resistance decade between green/black cable (coolant temperature sensor coupling 4-pin, contact 1) and engine ground.
[7] Vehicles with catalytic converter must be operated with unleaded fuel.
8) Reference resistor (resistance ∞ Ω) not fitted to vehicles with ignition control unit 003 545 70 32.
[9] For testing, detach the intake air temperature sensor and coolant temperature sensor connectors. Test ignition point at 80 °C coolant temperature by feeding in 320 Ω with resistance decade between contact 1 at 4-pin connector and engine ground.

Note
Ignition control unit with ignition map for manual and automatic transmission (actuated by different EZL resistance trimming plugs), boiling point correction (max. 5 °CKA), intake air correction (max. 7 °CKA) and safety retardation (6 °CKA) in the event of open circuit to reference resistance trimming plug.

Special tools


201 589 00 99 00


124 569 09 63 00

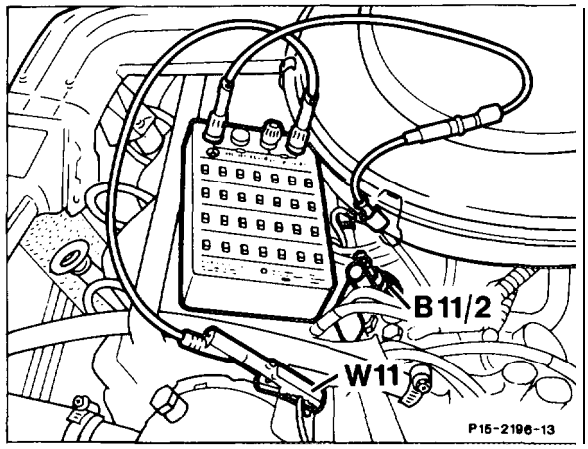

124 589 19 21 00

Commercially available testers

Engine tester (engine speed, dwell angle, ignition angle, oscilloscope, voltmeter)	e. g.	Bosch, MOT 002.02 Sun, 1019

Note

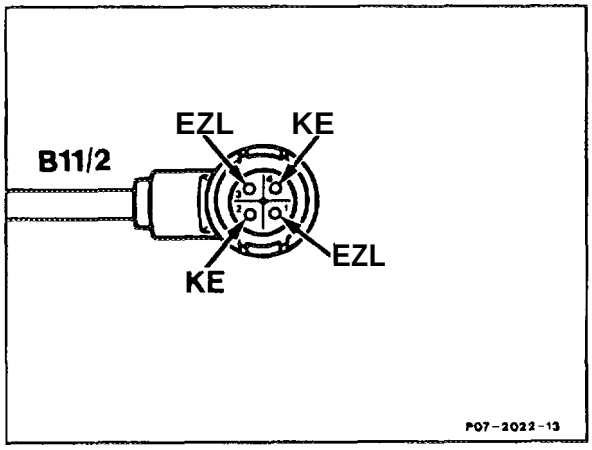
The ignition point test must be conducted at an engine coolant temperature between 75 °C and 90 °C because of the boiling protection correction as the ignition point alters outside of this temperature range. To avoid an incorrect measurement of the ignition point, detach connector for the engine coolant temperature sensor and feed in a resistance of 320 Ω (= 80°C engine coolant temperature) with the resistance decade.

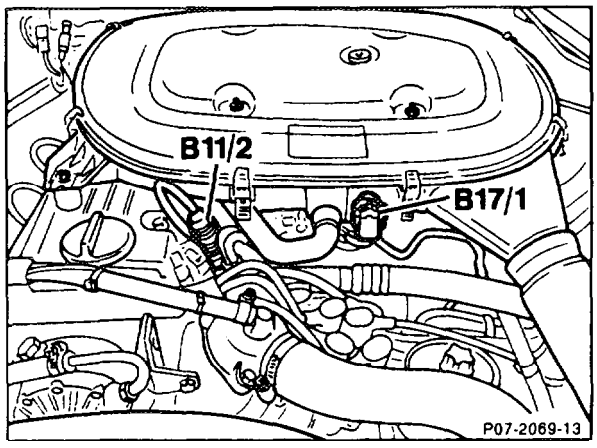


Engines 102.96/98
B11/2 Engine coolant temperature sensor
W1 1 Engine ground

Pin assignment of Cpin engine coolant temperature sensor (B11/2):

1 = Ignition temperature sensor
2 = CFI temperature sensor
3 = Ground W3, front left wheelhouse
4 = CFI control module ground





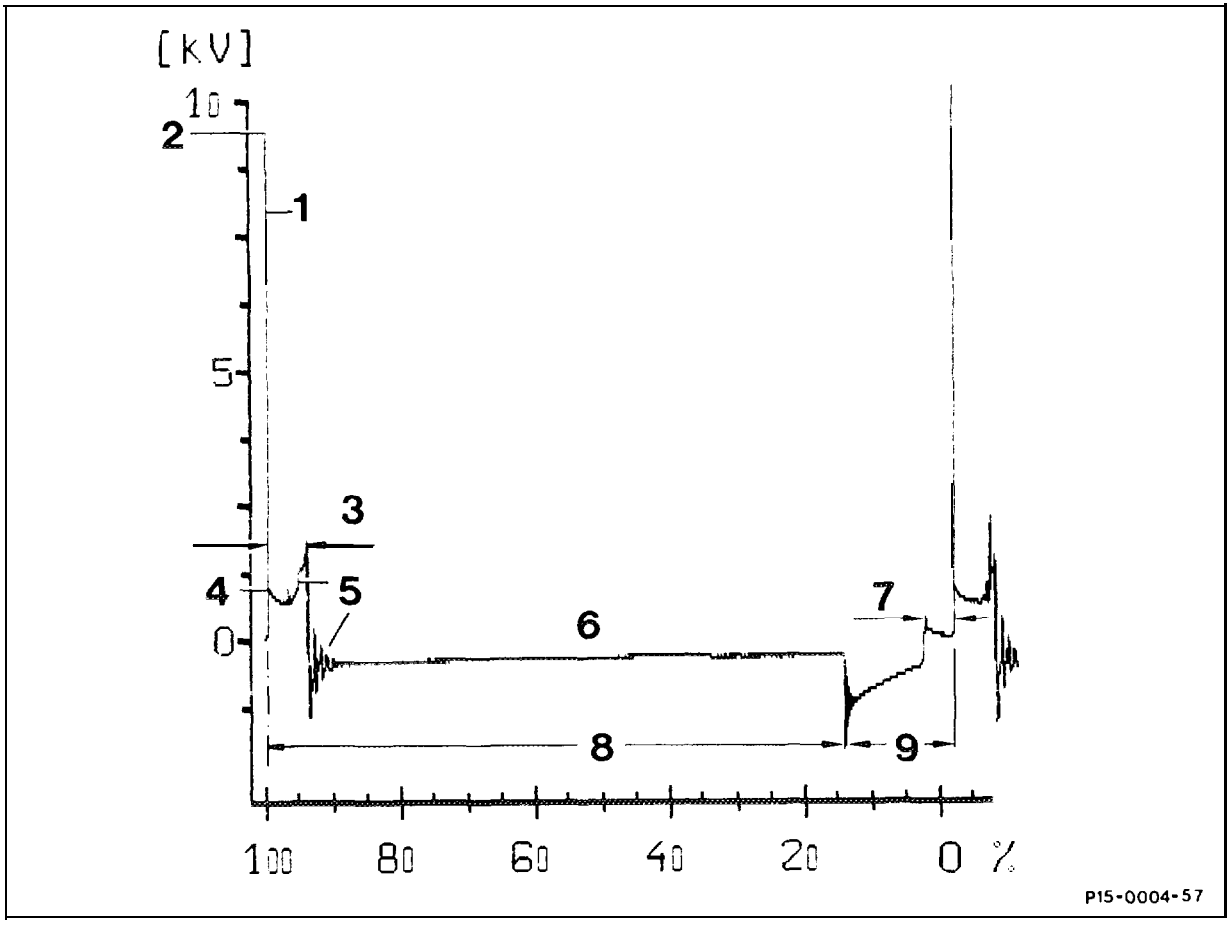
Engines 102.96/98 KAT
as of 09/89
B11/2 **Engine coolant temperature sensor**
B17/1 **Intake air temperature sensor**

15-525 Analyzing oscilloscope images

Description of oscilloscope image

Good image

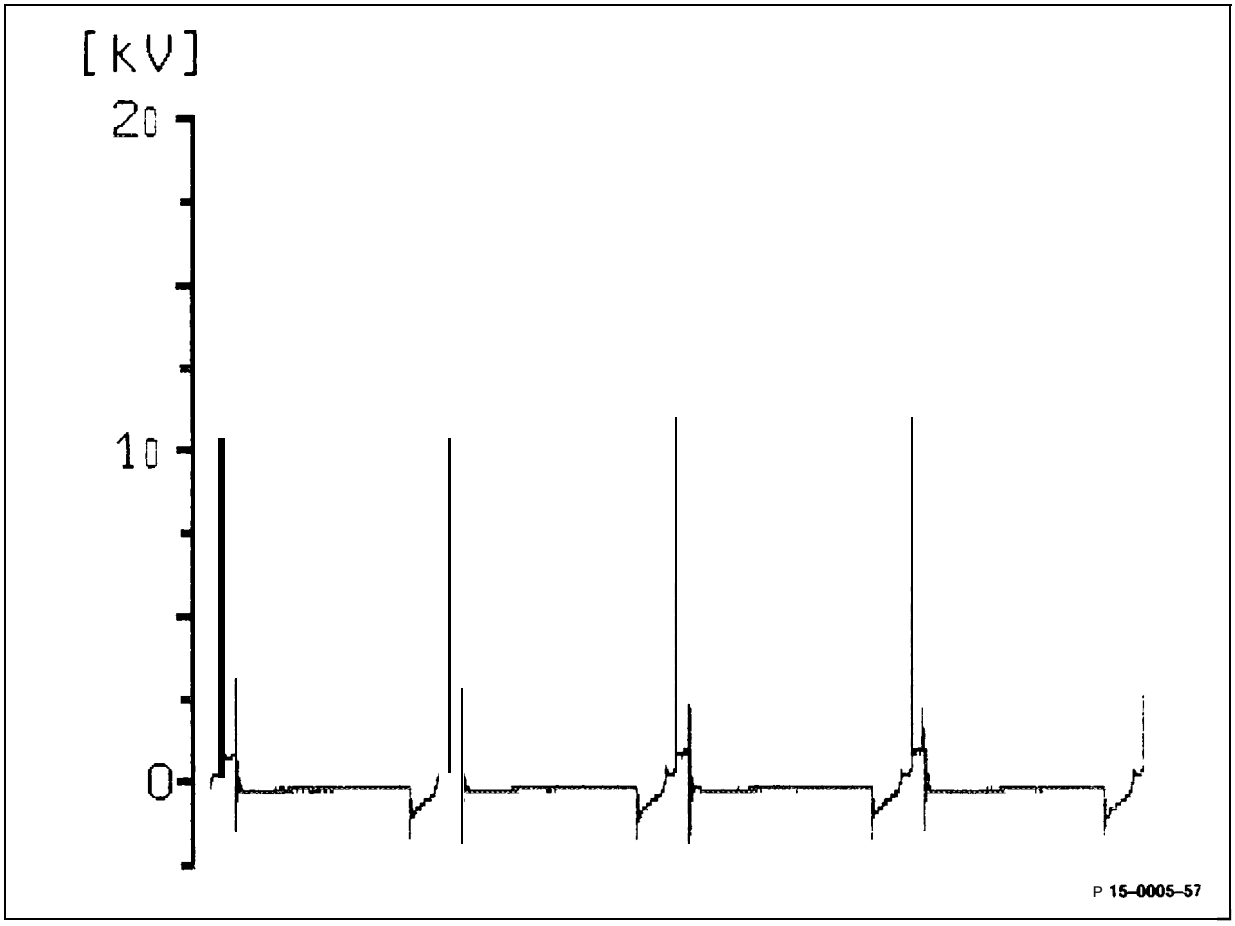
Note
Primary current limiter (7) is only operative up to approx. 2000/min.



1	Ignition voltage line	6	Decay process
2	Ignition voltage	7	Primary current limiting
3	Combustion period	6	Opening section
4	Combustion voltage	9	Closing section (dwell angle)
5	Combustion voltage line		

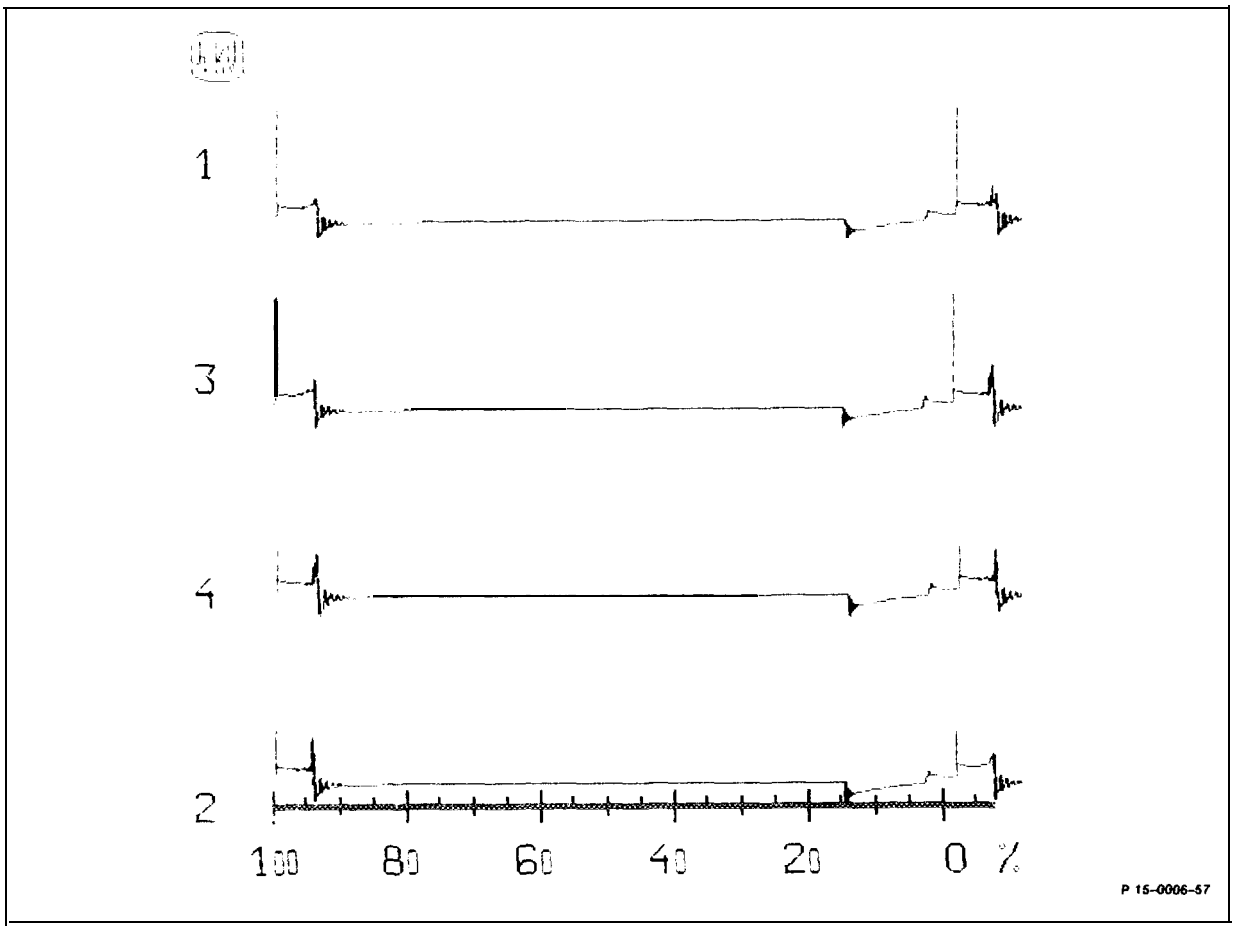
Good image

1. Secondary parade



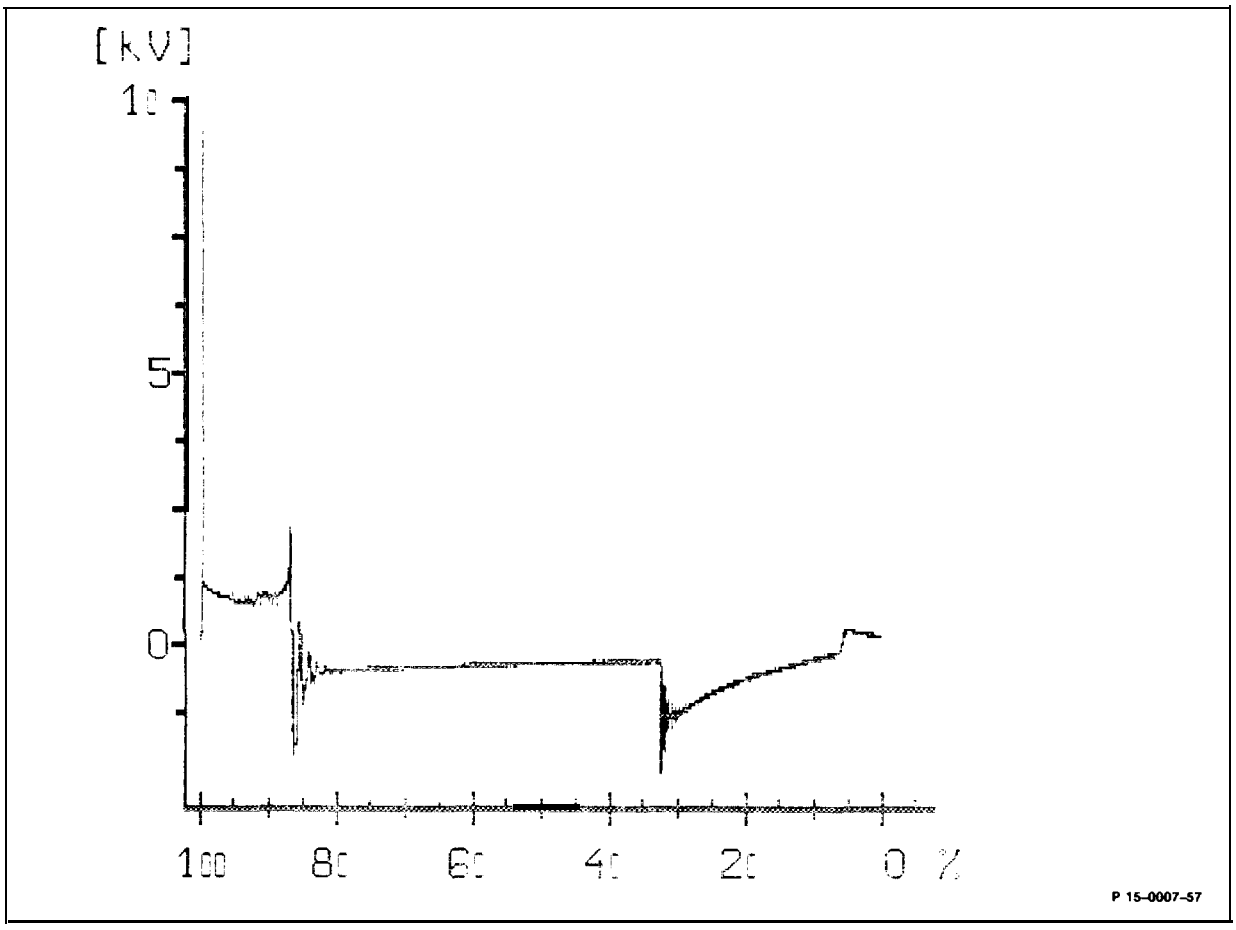
Good image

2. Secondary grid



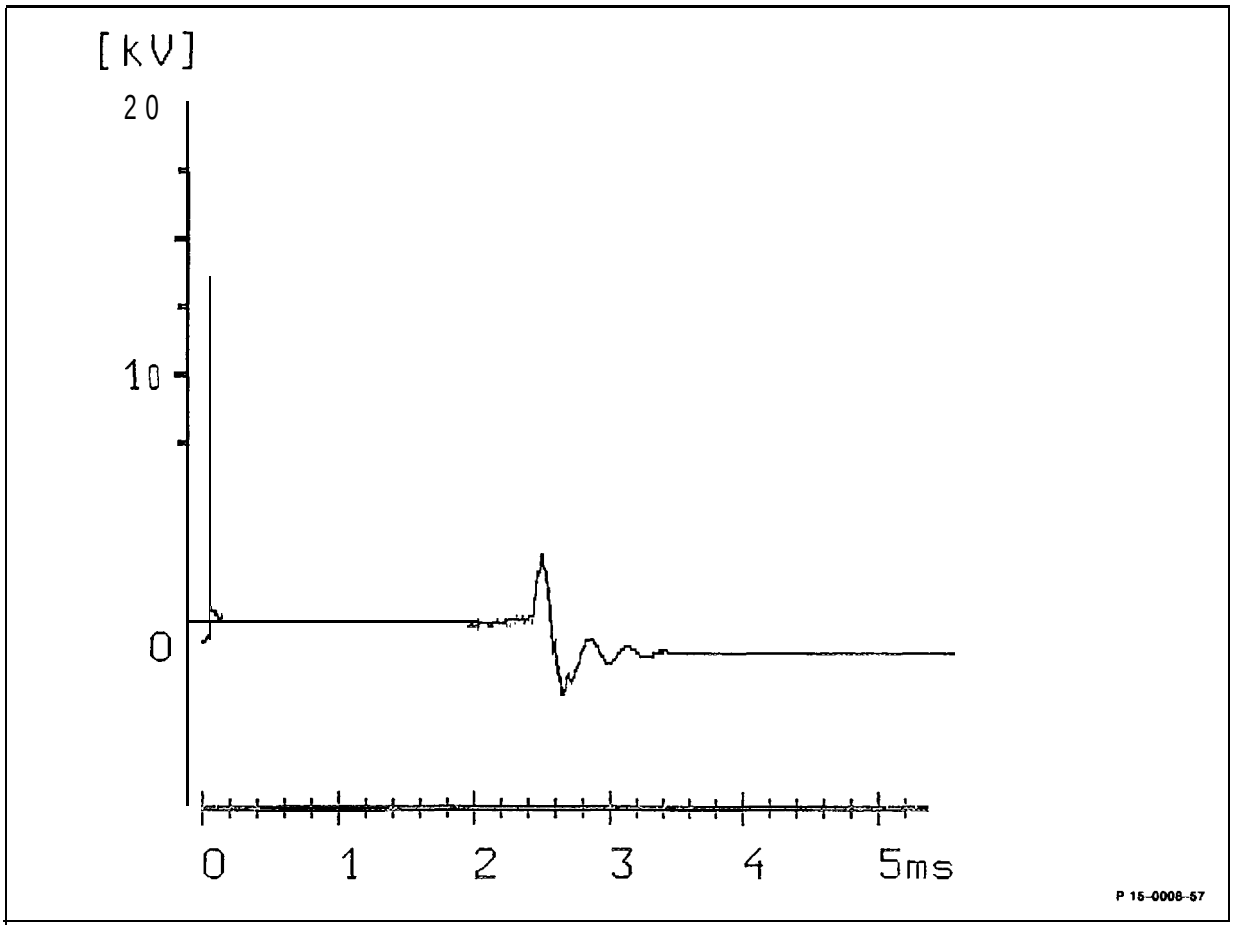
Good image

3. Secondary single image



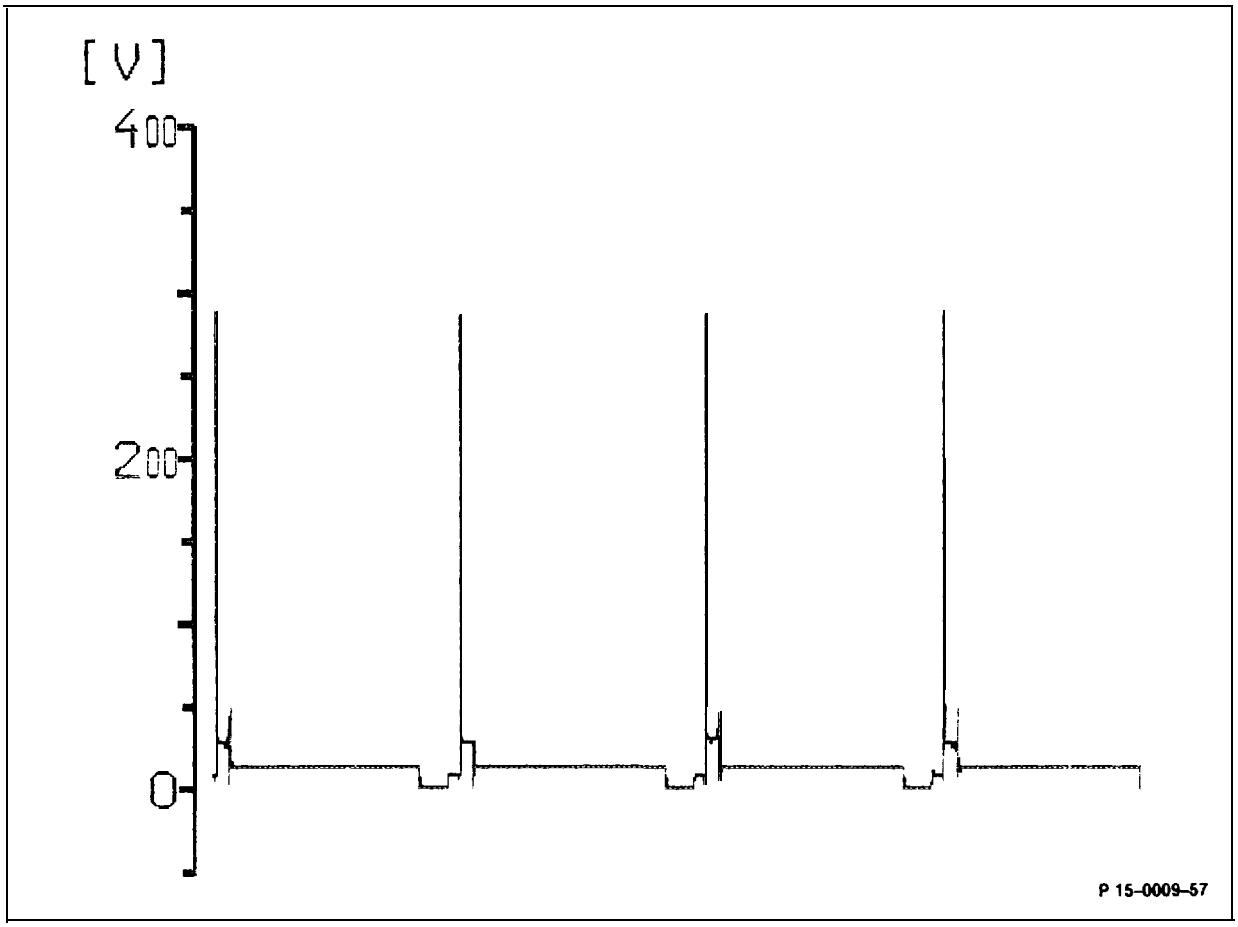
Good image

4. Secondary single image



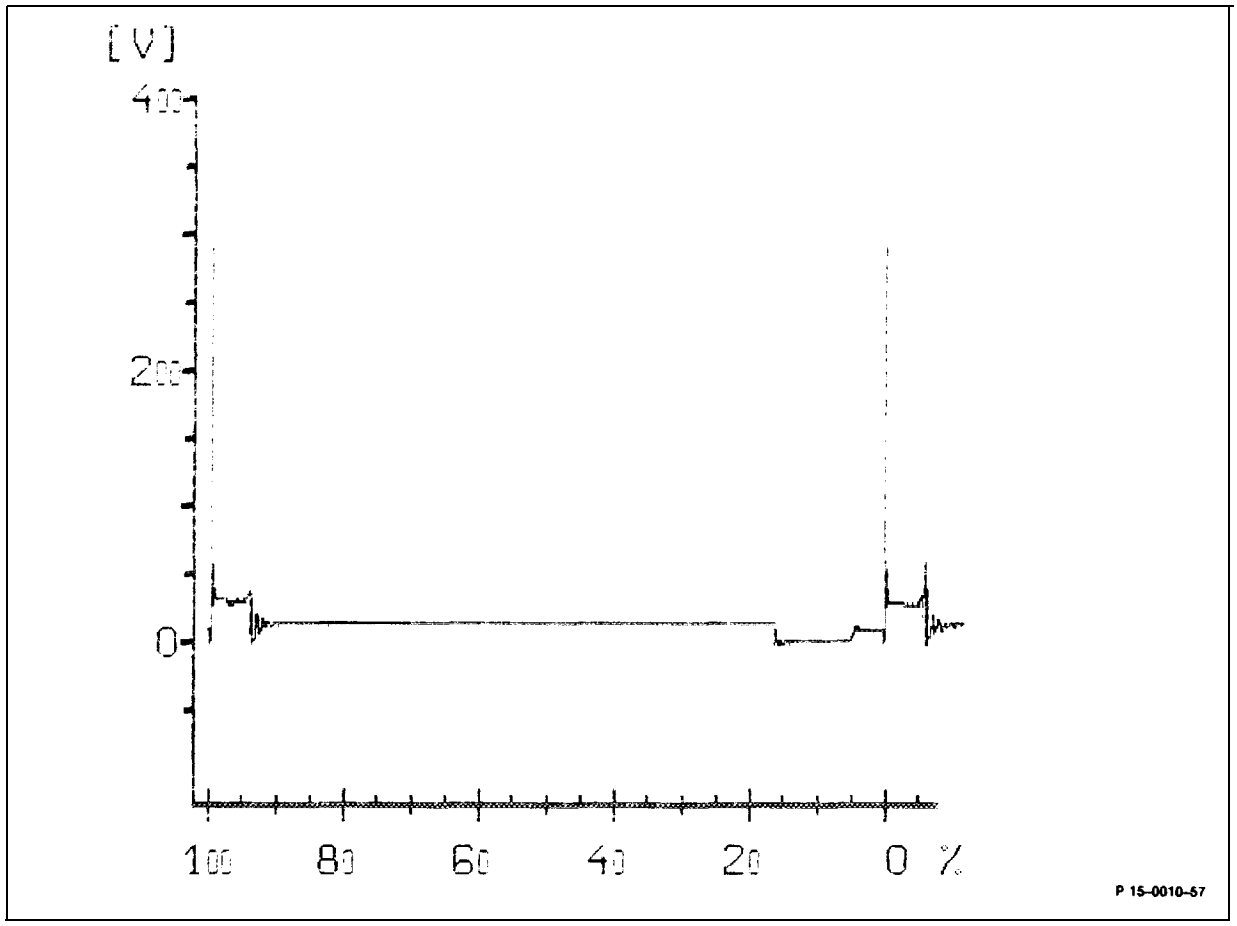
Good image

5. Primary parade



Good image

6. Primary single image



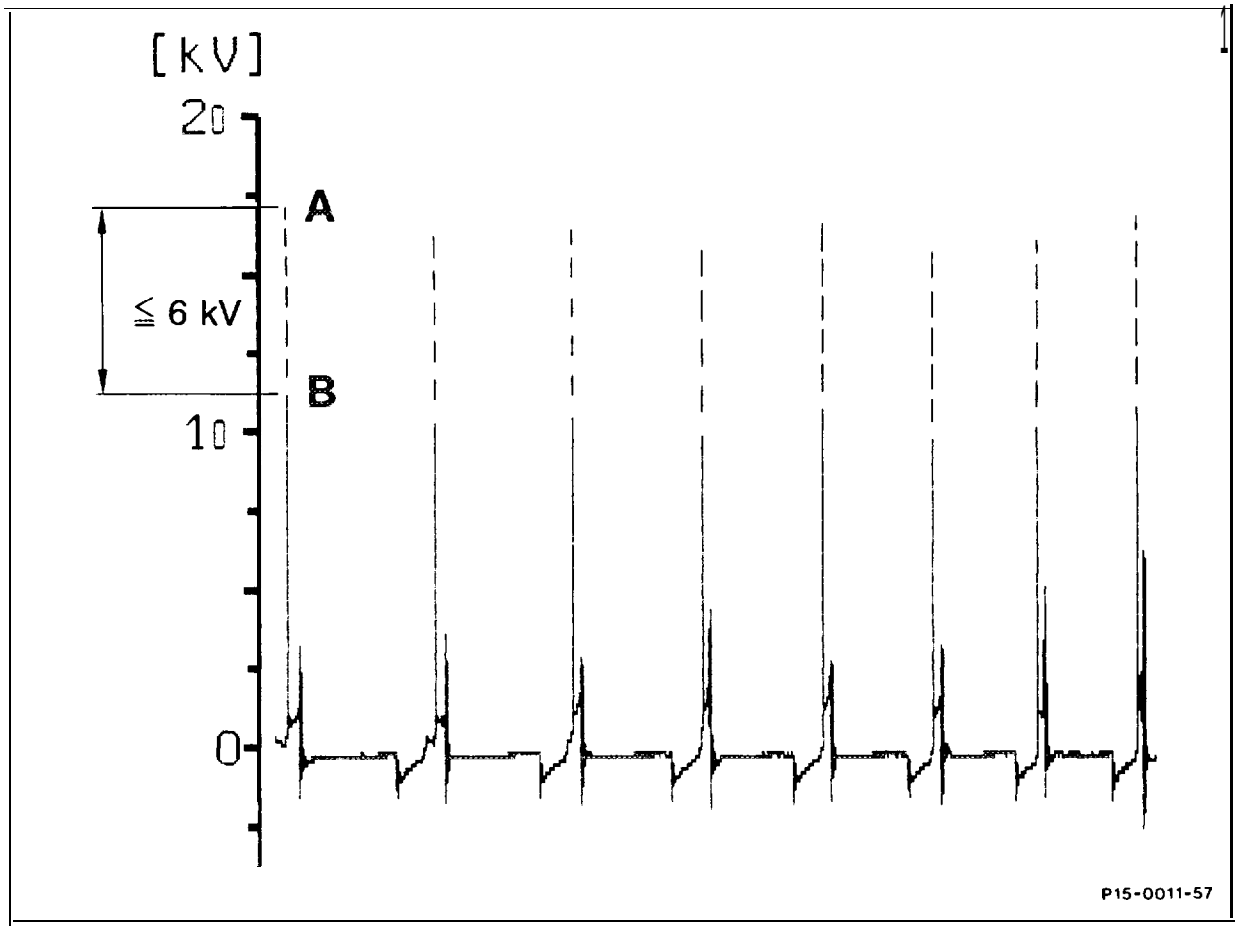
Good image

7. Blipping throttle

Test requirement: Repeatedly accelerate engine to approx. 3000/min by blipping throttle.

Note

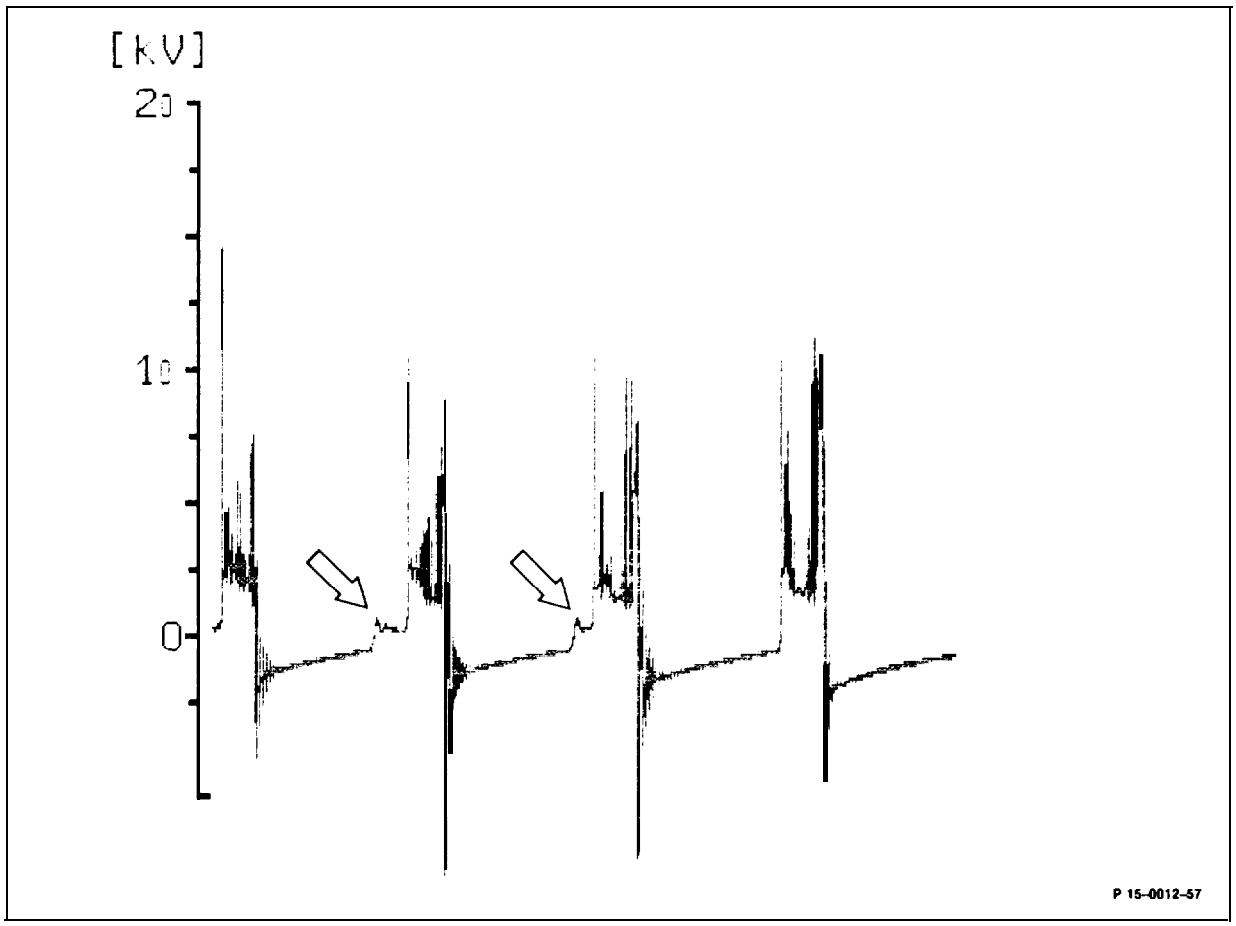
- As a result of the acceleration process, several cylinders are recorded in turn according to the firing sequence, e. g. image example (1 st 3rd 4th 2nd, 1 st 3rd 4th 2nd, etc.)
- The ignition voltage rises uniformly at all the cylinders during the acceleration phase. The ignition voltage rise must not exceed 6 kV.



Good image

8. Primary current limitation

Note
Primary current limitation may occur intermittently at individual or at all cylinders at engine speeds above 2000/min with and without load.

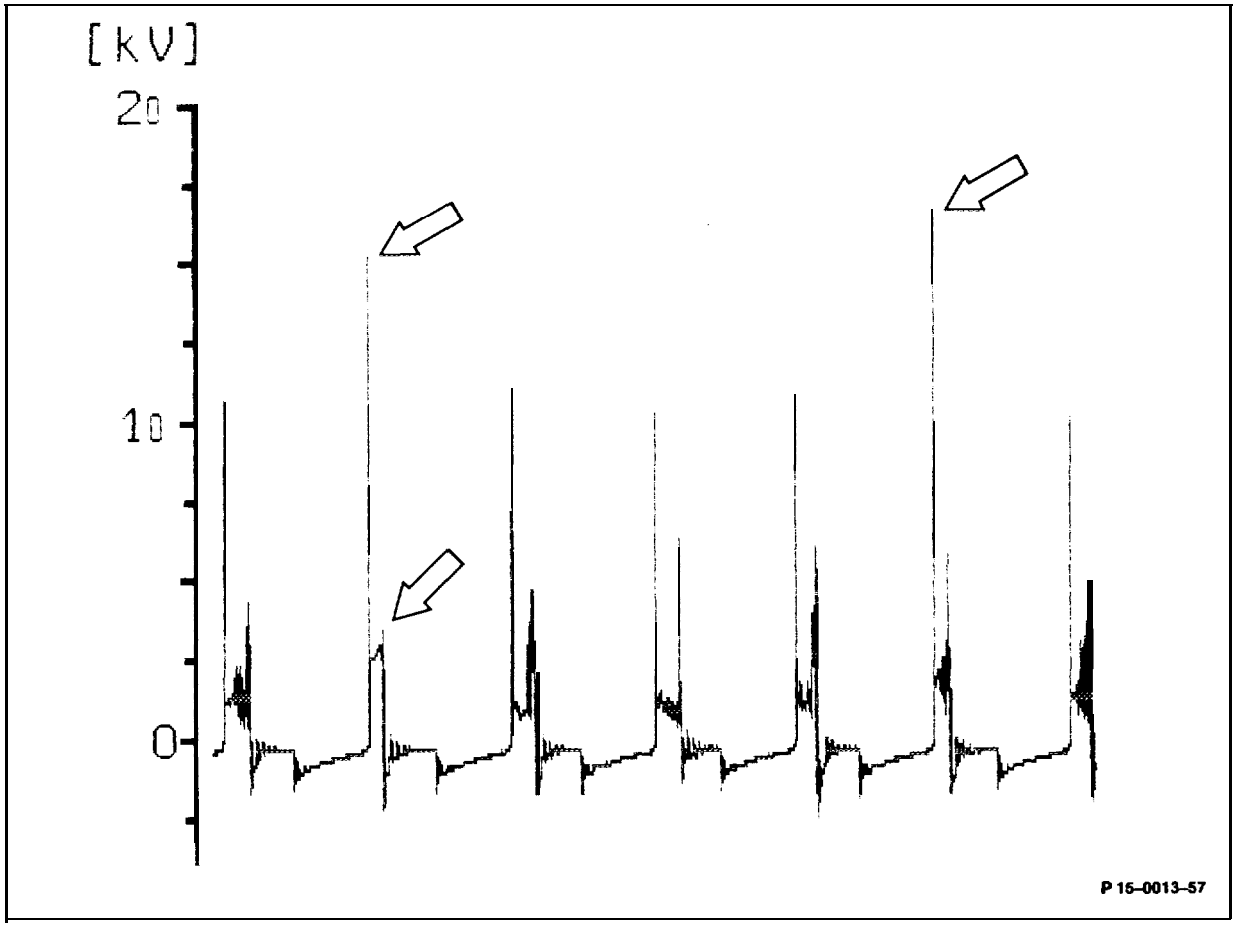


Fault image

9. Ignition voltage too high/combustion period shorter.

Test requirement: May occur at any engine speed with or without load.

Cause
Spark plug electrode gap too large; additional spark gap at secondary side; fuel/air mixture too lean.

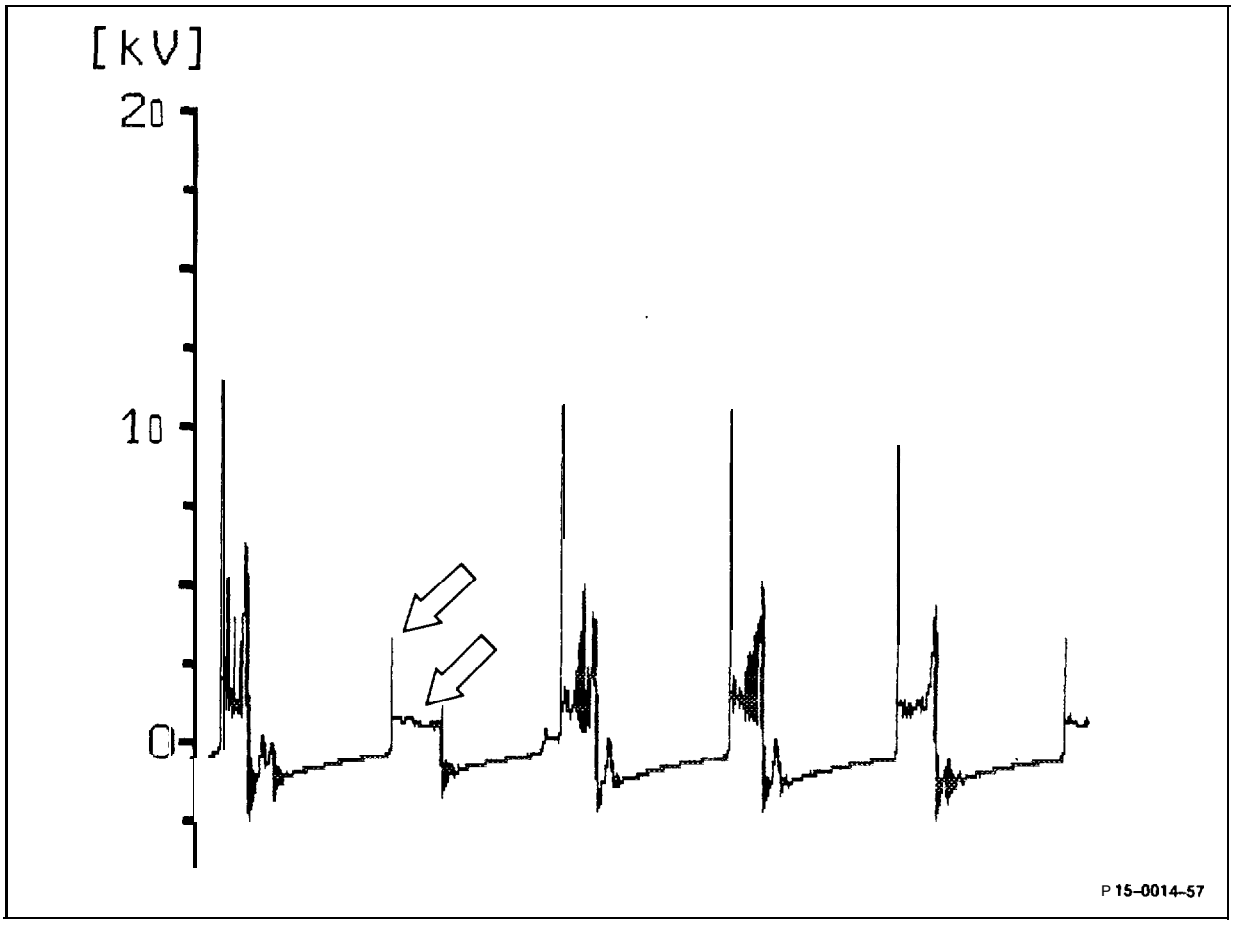


Fault image

10. Ignition voltage too low/combustion period longer.

Test requirement: May occur **at** any engine speed with or without load.

Cause
Spark plug electrode gap too small;
fuel/air mixture too lean;
compression loss.



Fault image

11. Decay process too high

Test requirement: Accelerate engine repeatedly to approx. 3000/min by blipping throttle or run engine under load on roller dynamometer.

Cause

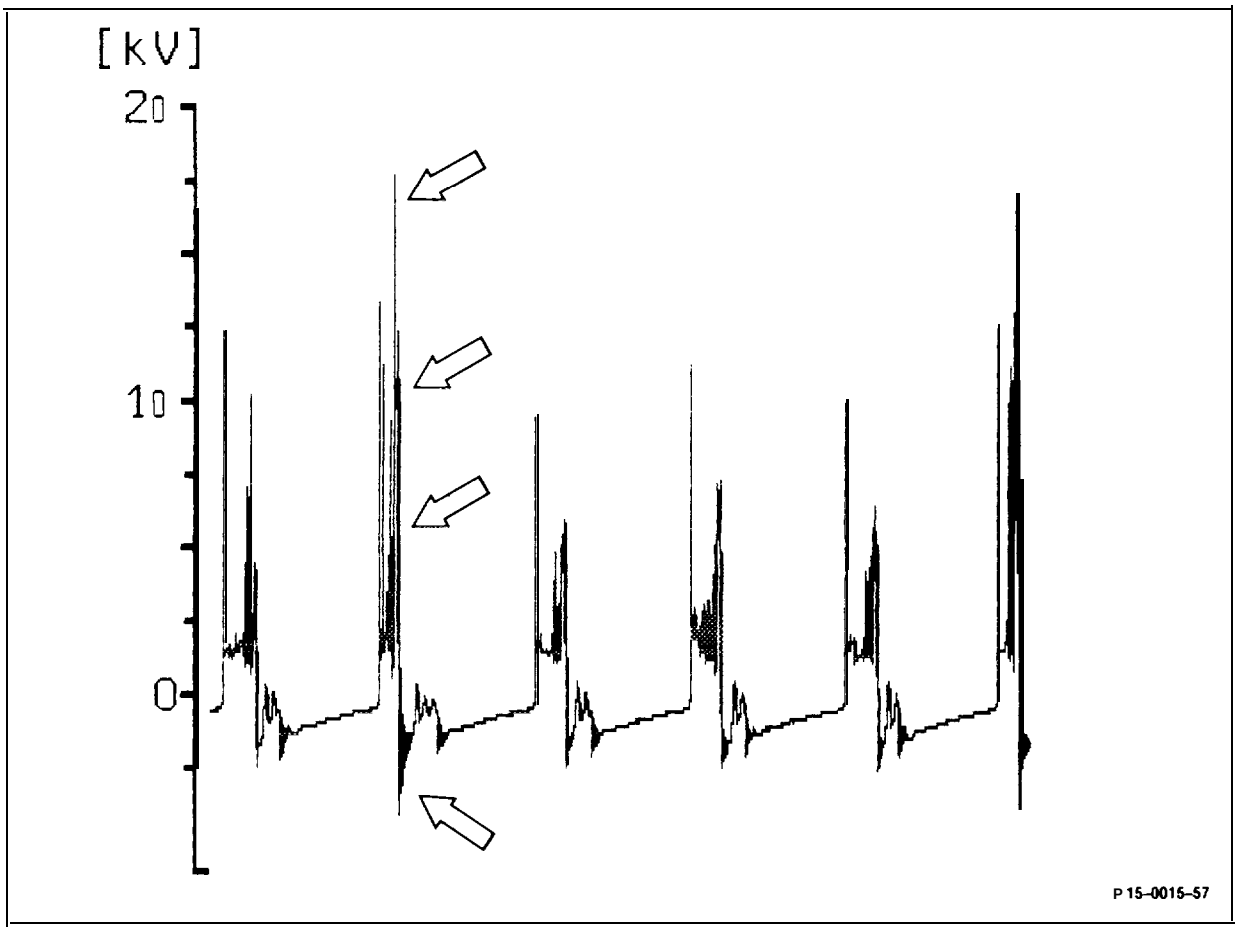
Fuel/air mixture at one cylinder too lean.

Note

If engine running is rough (does not run on all cylinders) after start, the engine should be switched off at operating temperature and restarted after a lengthy period (approx. 30 minutes) to obtain a better diagnosis.
It is essential to pay attention to test requirement when repeating the starting operation.

⚠Warning!

Problem may only occur briefly.



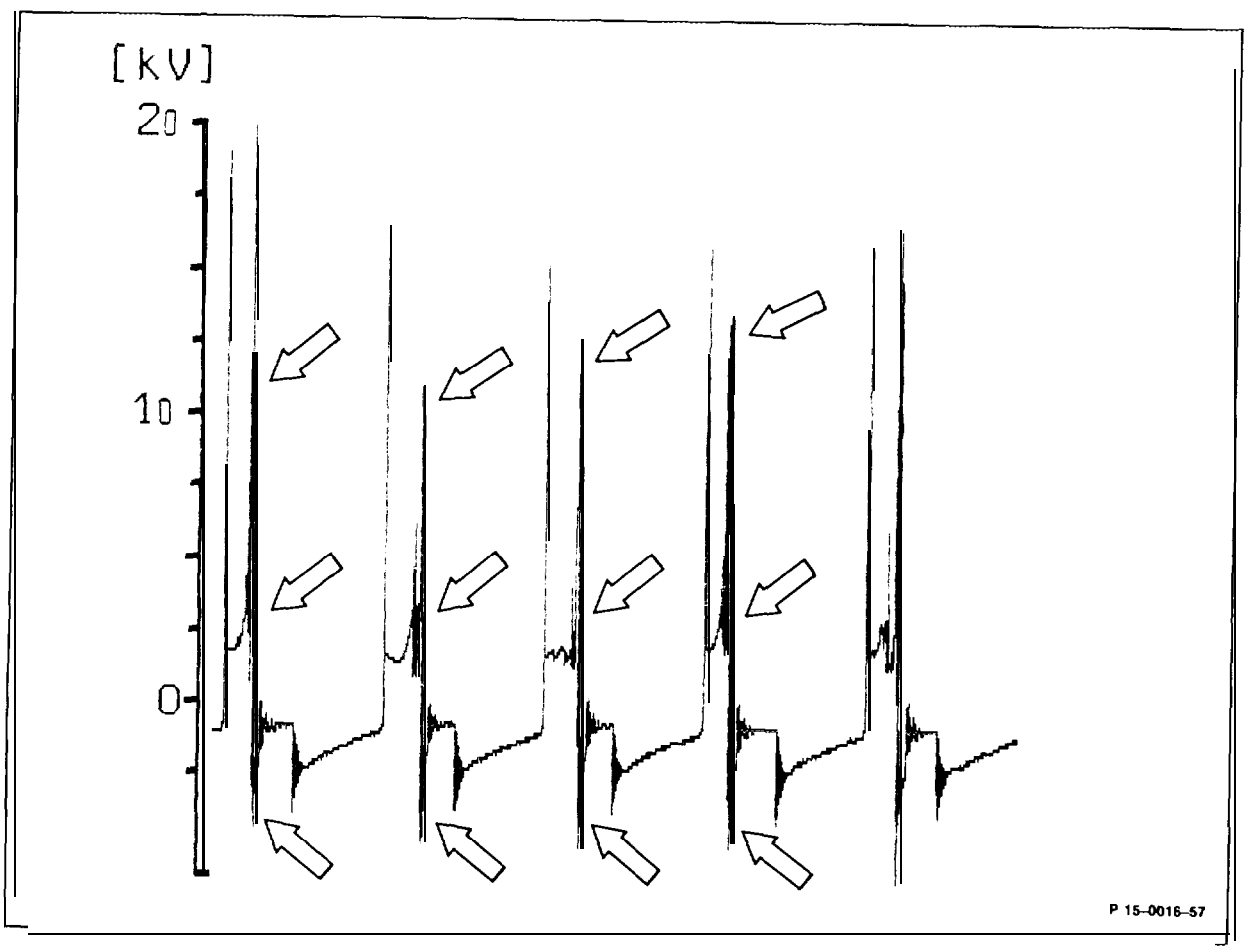
Fault image

12. Decay processes too high.

Test requirement: Accelerate engine repeatedly to approx. 3000/min by blipping throttle or run engine under load on roller dynamometer.

Cause

Fuel/air mixture on all cylinders too lean.



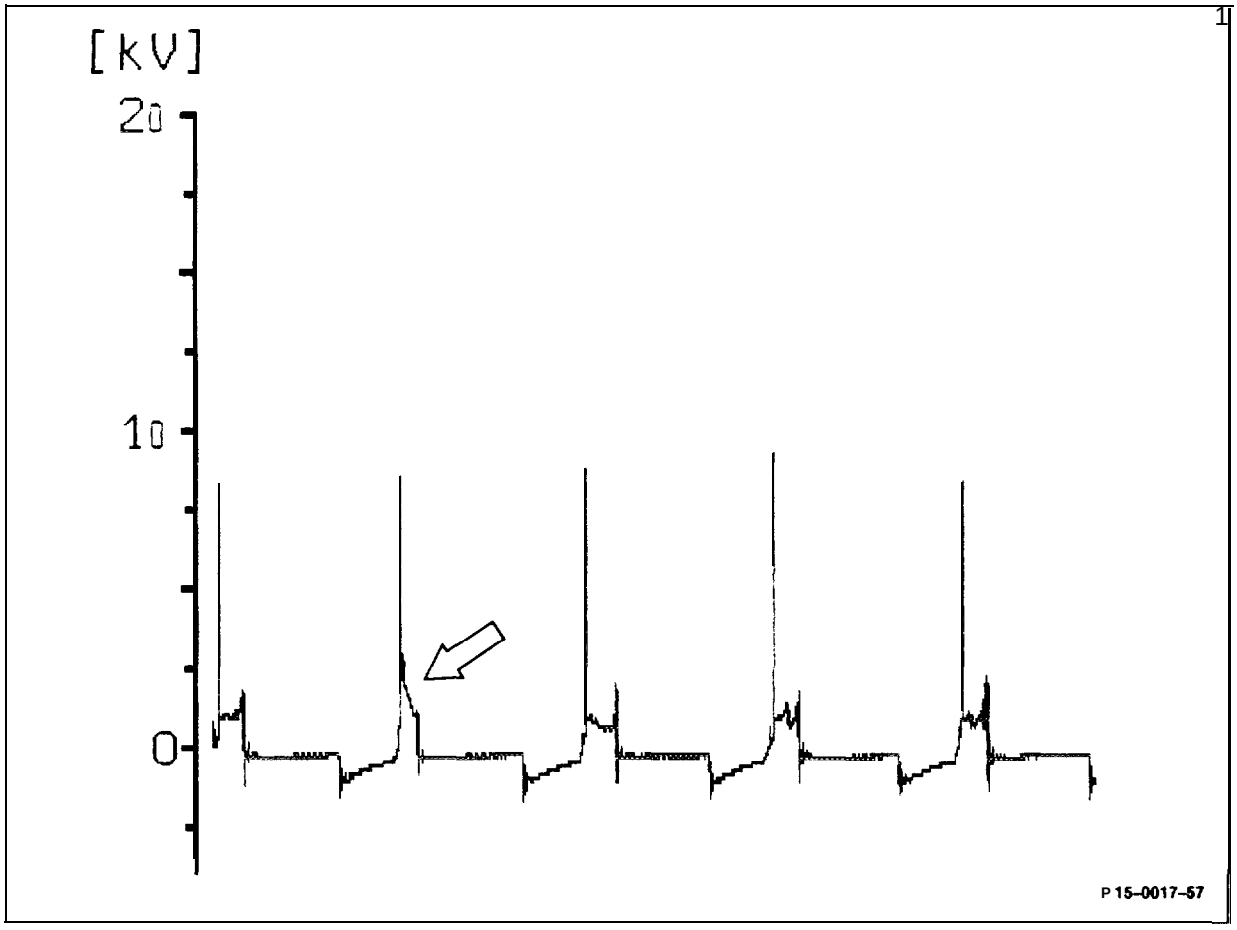
Fault image

13. Higher combustion voltage > 1.5 kV at single cylinder.

Test requirement: May occur at any engine speed with or without load.

Cause

Soot, oil, lead deposits on spark plug.
Too high ohmic resistance at secondary side.

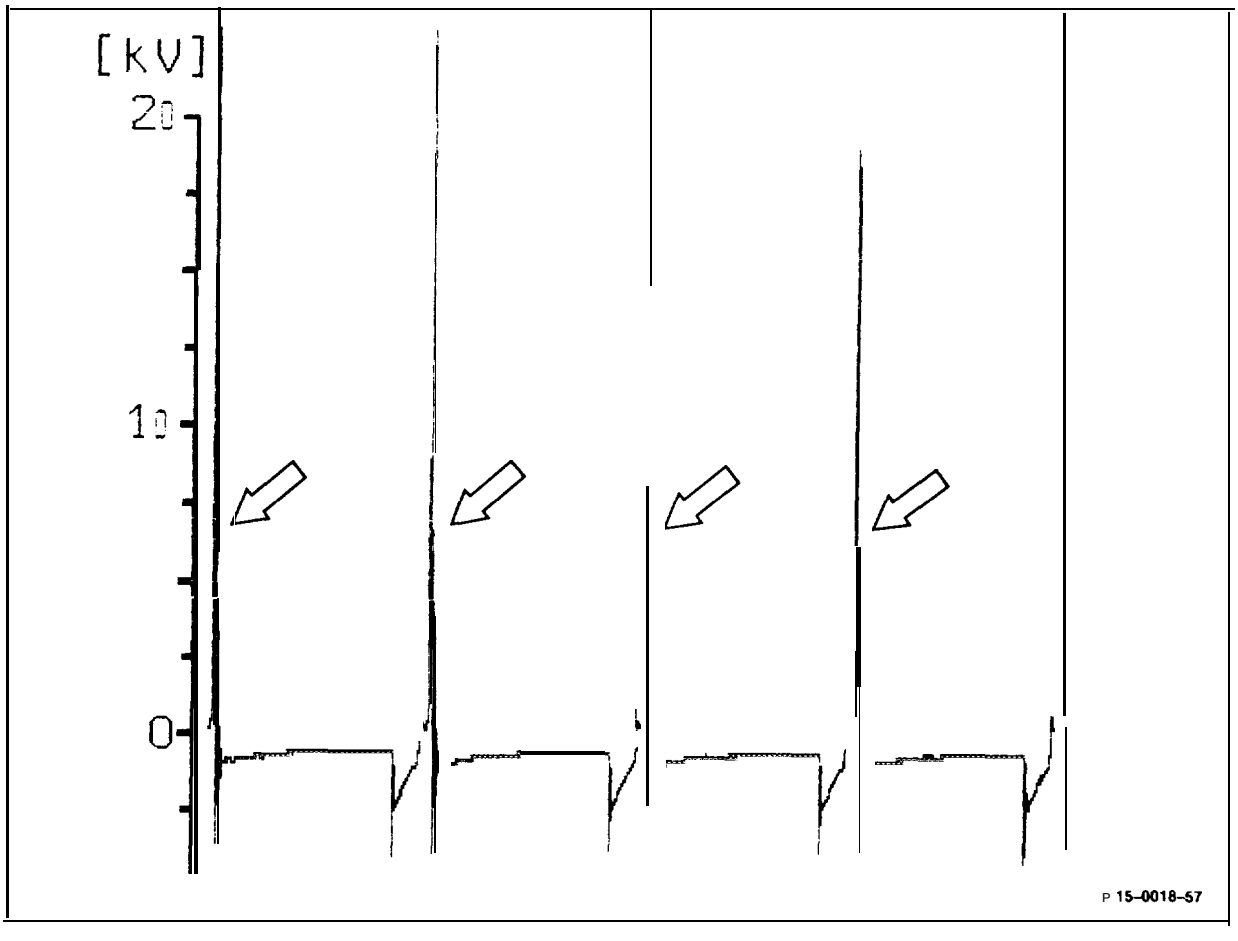


Fault image

14. Higher combustion voltage > 1.5 kV at all cylinders.

Test requirement: May occur at any engine speed with or without load.

Cause
Too high ohmic resistance at secondary side.



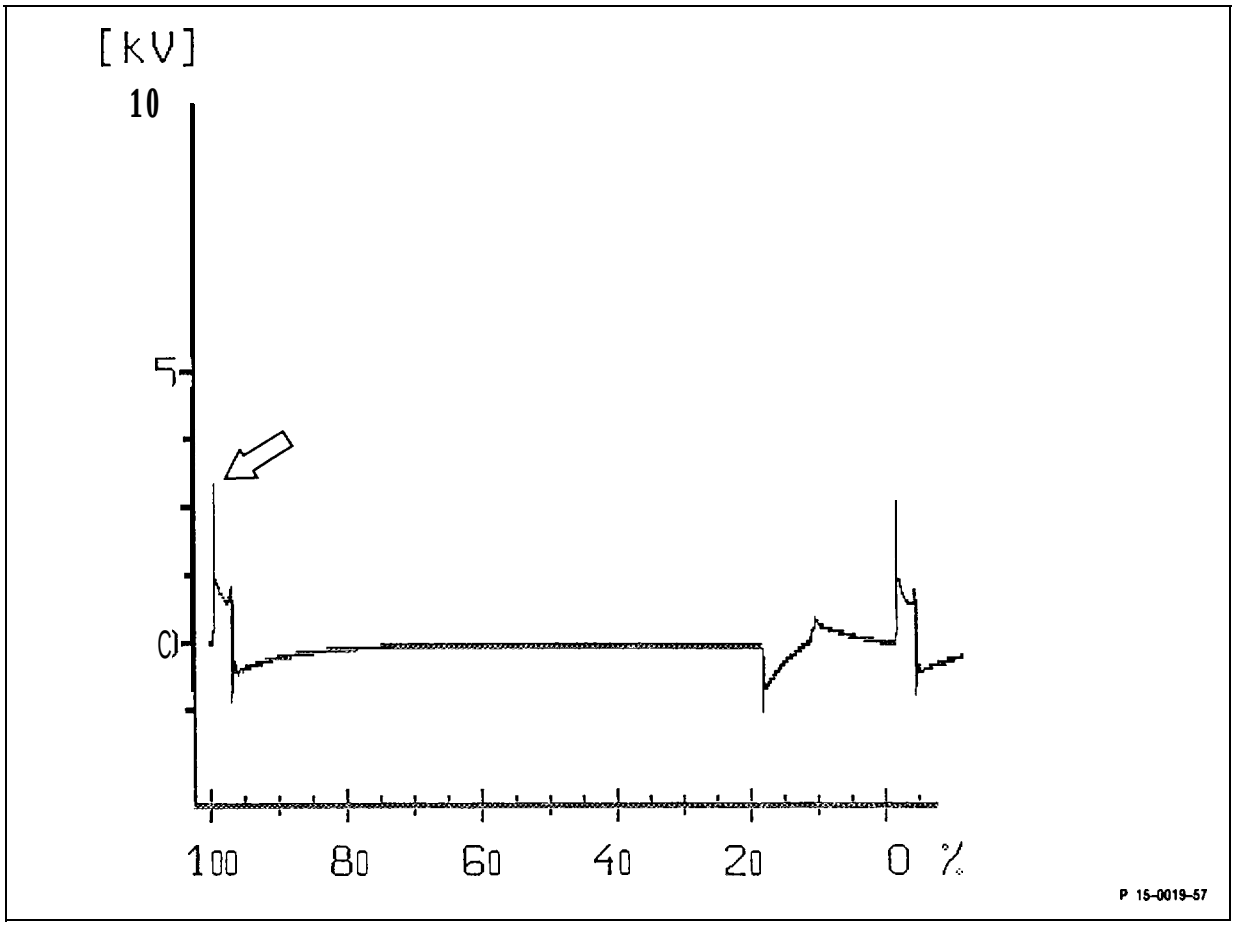
Fault image

15. Ignition voltage **< 8** kV at terminal **4**

Test requirement: Starting speed.

Cause
Ignition coil

Note
Engine does not start



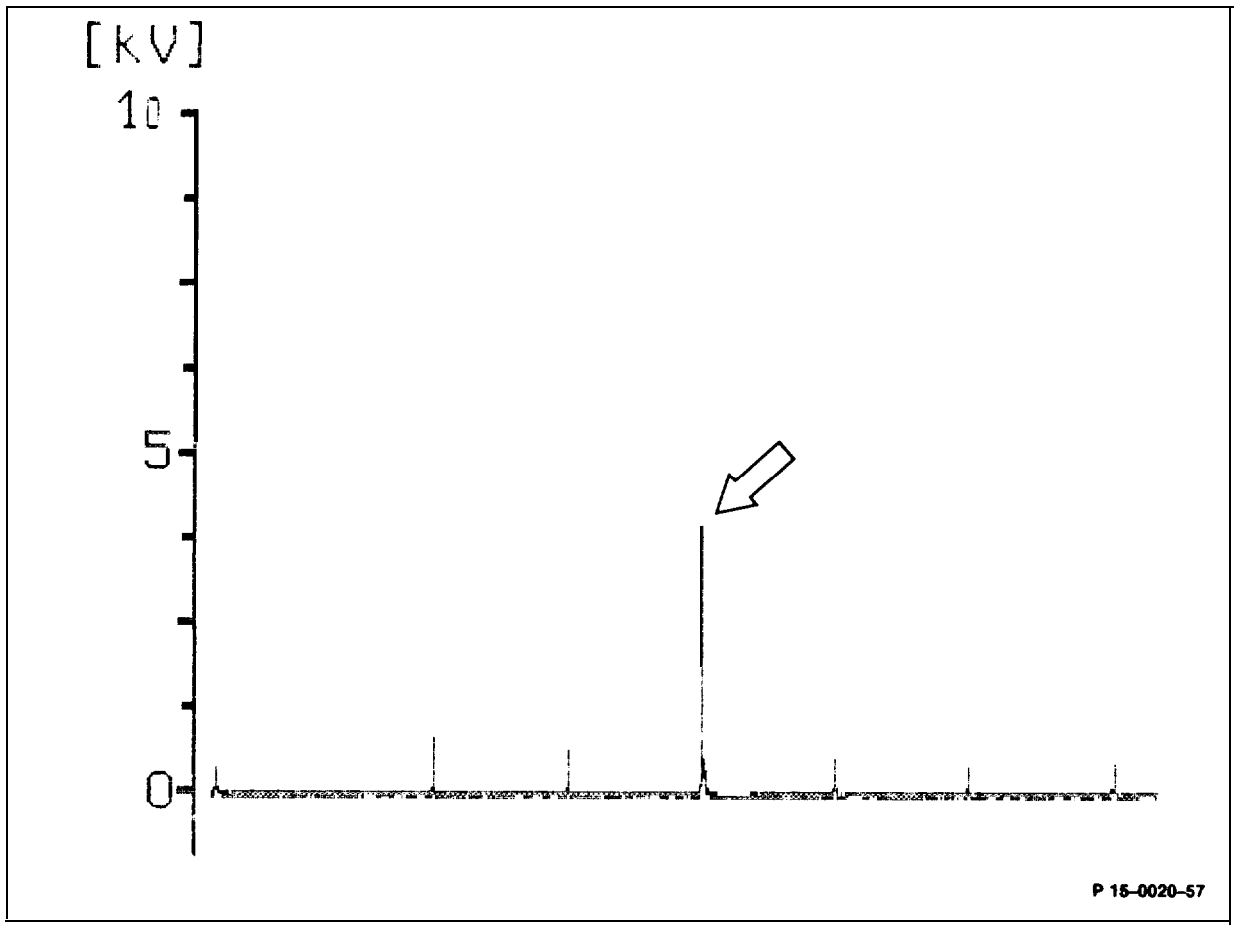
Fault image

16. Ignition voltage **< 6 kV** at single cylinder

Test requirement: Starting speed

Cause
Ignition coil

Note
Engine does not start



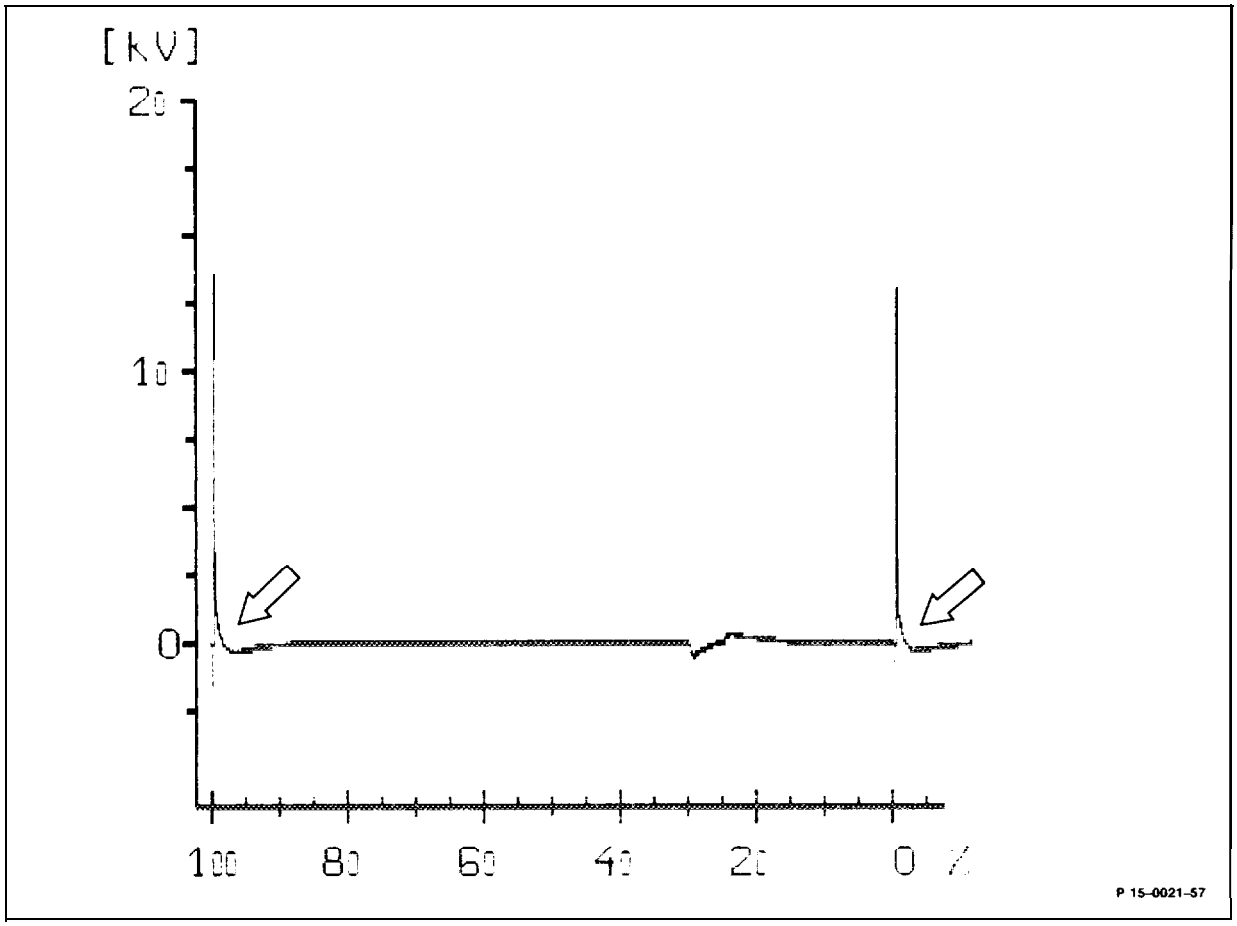
Fault image

17. **No** decay process

Test requirement: Starting speed

Cause
Ignition coil or ignition control module.

Note
Engine does not start



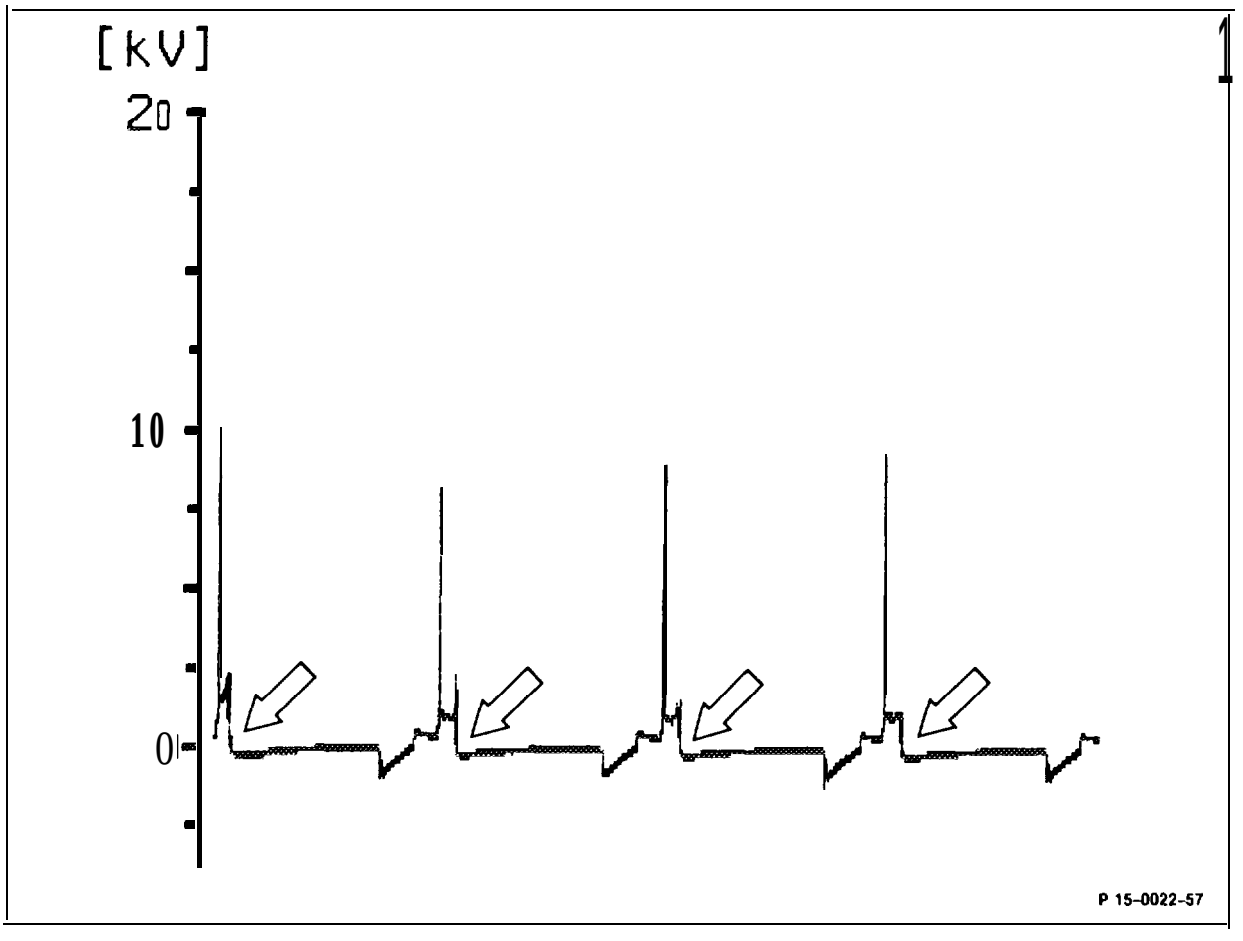
Fault image

18. Too few decay processes

Test requirement: May occur at any engine speed with or without load.

Cause

Ignition coil or ignition control unit

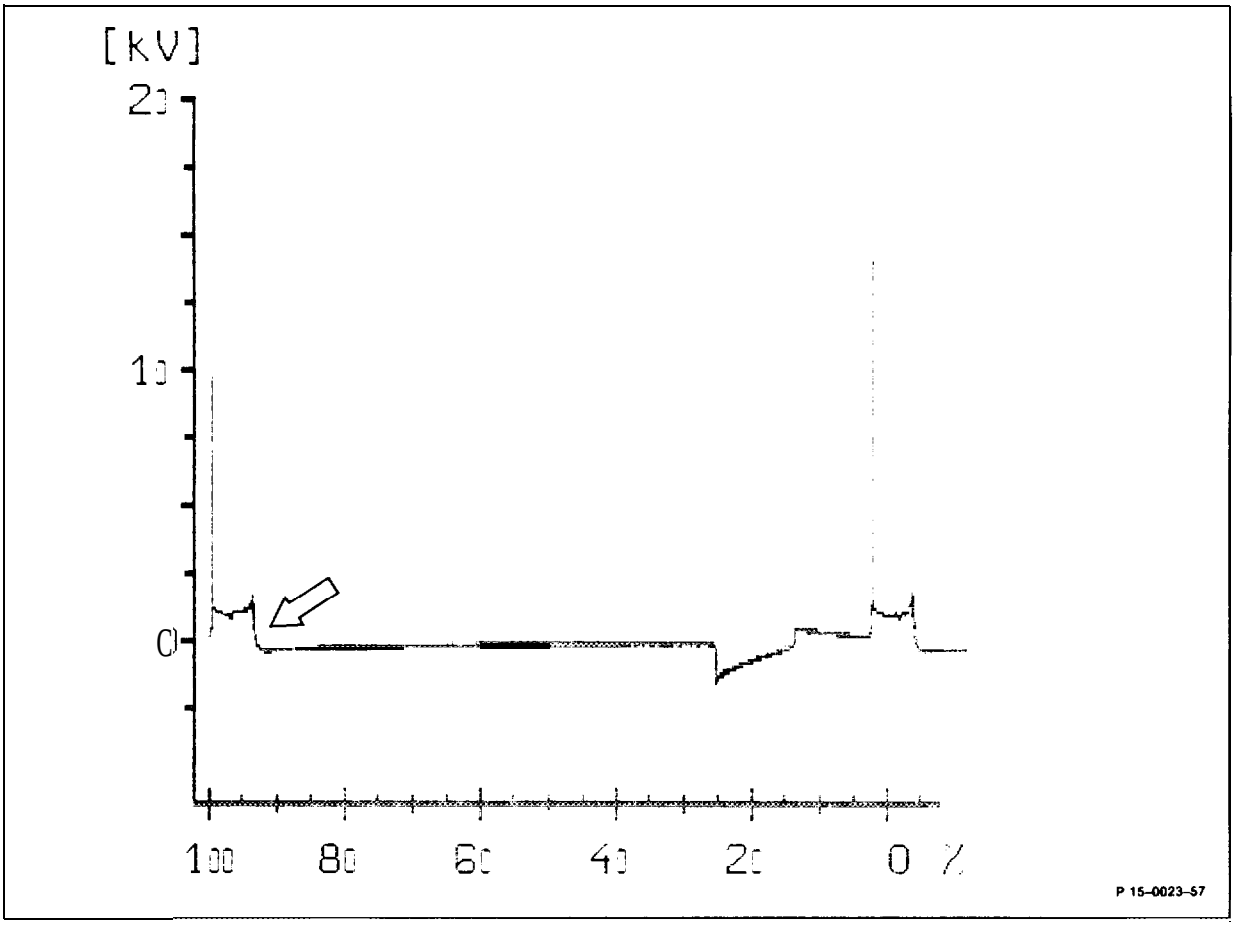


Fault image

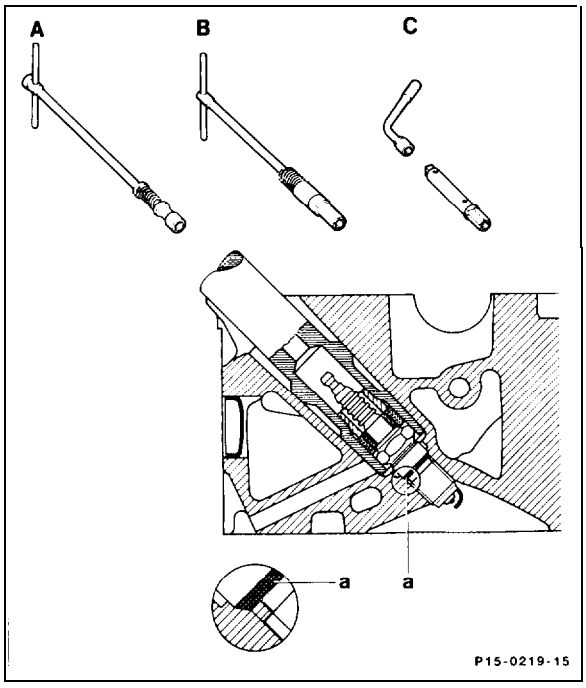
19. Too few decay processes.

Test requirement: May occur at any engine speed with or without load.

Cause
Ignition coil or ignition control module.



15–530 Replacing spark plugs



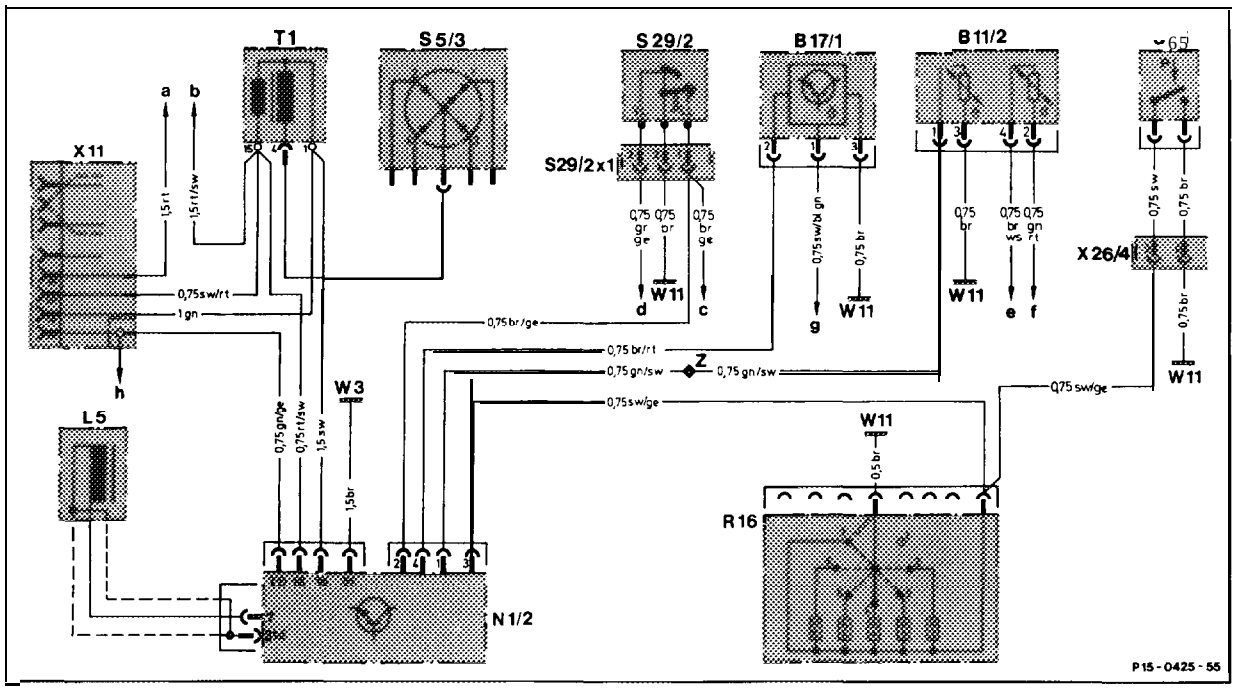
Spark plug connector	loosen by turning to left and right and pull off. Blow out recesses with compressed air.
Ignition cables	clean, when installing, ensure the ignition cables are correctly laid. Firing sequence: l-4-3-2
Spark plugs	remove, install, use only approved spark plug wrench (with Nm limiter "B"). A 102589020900 B 16258901 0900 C Vehicle tool

Installation note

Install only approved spark plugs with tapered seat (a).
Tightening torque 20 Nm.

1 s-535 Removal and installation of ignition or high voltage distributor

Preceding work:



Distributor cap	unscrew, screw on.
With TSZ, vacuum line and sensor cable (2)	detach at distributor, fit on.
Engine	set to ignition TDC of No. 1 cylinder by aligning markings on distributor rotor (3) and distributor housing (1). In addition, the pointer (8) on timing case cover must be above the TDC mark of vibration damper (arrow).

Caution!
Crank engine only in direction of rotation.

Distributor mounting (5)	loosen. Remove distributor.

Installation	set engine to ignition TDC by aligning the pointer (8) on timing case cover exactly to TDC mark of vibration damper.
Sealing disc and distributor rotor (3)	install at distributor. Align distributor rotor to marking on housing. Insert distributor. With EZL ignition system, align screw in middle of oblong hole (pay attention to note). With TSZ ignition system, set ignition point (15-515).
Screw (5)	tighten.
Ignition cables	Install. Firing sequence l-4-3-2

Note

It is not possible to set the ignition point on the EZL ignition system by turning the high voltage distributor. The ignition point is determined by the Ignition control module. Test distributor ignition system, if necessary (15-540).

If the engine has been cranked with the distributor removed, set ignition TDC of No. 1 cylinder (05-215).

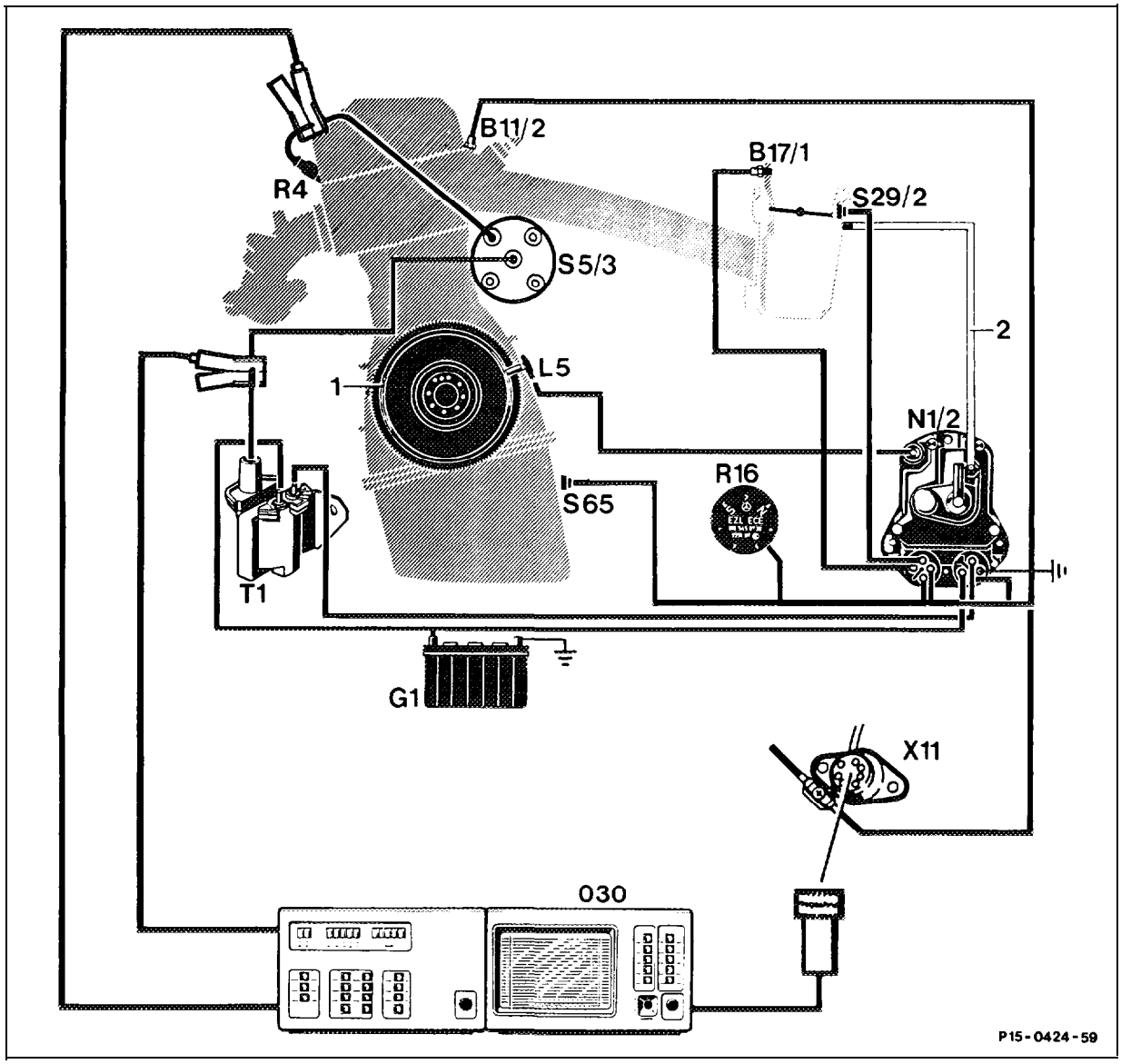
15-540 Testing distributor ignition system (DI)

Preceding work:
Testing, adjusting engine (07.3-1 10)

Precondition for test

Spark plugs, Ignition cables, distributor rotor and distributor cap in proper mechanical and electrical order.

Test e. g. by visual inspection, measuring resistance and ignition oscilloscope.



Connection diagram for engine tester with oscilloscope

B11/2	Engine coolant temperature sensor	N1/2	Ignition control module
B17/1	Intake air temperature sensor	R4	Spark plugs
G1	Battery	R16	Reference resistor
L5	Crankshaft position sensor		

S5/3	High voltage distributor	1	Segments on flywheel/driver disc
S29/2	Wide open throttle/closed throttle position switch	2	Vacuum line
T1	Ignition coil	030	Engine tester with oscilloscope
x11	Diagnostic connector/terminal block terminal TD		

Note

Pay attention to the safety precautions (15-505) when performing work on the ignition system. Switch off ignition when unplugging and connecting the connectors at the Ignition control module.

The test is split up into two sections:

A. Engine not running

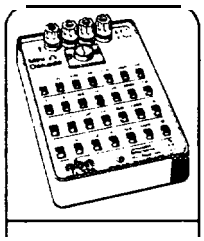
The basic functions of the ignition system are tested in this section.

B. Engine running

Fault sources in the ignition advance or at the appropriate components may affect the handling of the vehicle.

If a complaint is received regarding the handling of the vehicle, first of all test the ignition system. Then, continue troubleshooting at the CFI system.

Special tools



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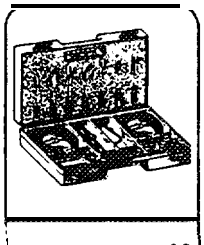


201 589 00 99 00

Commercially available testers

Multimeter	e. g. Sun, DMM-5 Fluke, Multimeter 23 Hermann, Avometer 2003
Engine tester	e. g. Hermann, Datascope 9800 Bosch, MOT 301/400 Sun, 2110 BEAR, D AC E

Test data

Resistances (test data from O-100" C)

Ignition coil	primary (terminals 1 and 15)	Ω	0.3–0.6
Ignition coil	secondary (terminals 1 and 4)	kΩ	8–13
Position sensor	coil resistance (terminals 7 and 31d)	Ω	660-l 200
	insulation (terminal 7 and ground)	kΩ	≥ 200
Distributor cap per terminal, distributor rotor, spark plug connector		Ω	700-l 300

Voltages, engine not running, ignition switched on

Terminals 15 and 31 (contacts 5 and 2 diagnostic connector)		Battery voltage
Between terminals 1.5 and 1 (contacts 5 and 4 diagnosis socket)	V	0
4-pin round connector terminals 15 and 31	V	Battery voltage
4-pin round connector terminals 16 and 31	V	Battery voltage

Dwell angle

At starter speed	9–49° or 10–54%
At 3200/min	27–54° or 30–60%

Ignition point at starter speed	in ° CKA	TDC ± 2°

Test ignition points with engine running (15-515).

A. Engine not running

Note

If the specified value of a test step, e. g. test step 1 .0, is in order, continue immediately with test step 2.0.

If the specified value of step 1.0 is not in order, it is then necessary to continue with step 1 .1.

key to symbols:

- Multimeter direct voltage mode
- Multimeter resistance mode
- Oscilloscope
- c Contact
- Connector
- Ground

On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
–	1.0 Voltage supply	N1/2 31 — (V) — 15	Ignition: ON	Battery voltage	Test wiring and contacts according to wiring diagram (from battery via ignition lock to Ignition control module).
	2.0 Crankshaft position sensor L5	L5 31d — (Ω) — 7	Ignition: **OFF** Detach crankshaft position sensor connector at Ignition control module.	680–1200 Ω	Replace crankshaft position sensor (L5).

On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
	2.1	L5 31d —(-Ω+)— 7'	Detach crankshaft position sensor connector at Ignition control module. Engine: **Start**	see diagram $U_S \geq 1$ V	Signal too small/no signal: replace position sensor. Different voltage height: test segments. Replace Ignition control module.
	2.2 Insulation of sensor coil	L5 —(-Ω+)— 7 ⊥	Detach crankshaft position sensor connector at Ignition control module.	≥200 kΩ	Replace crankshaft position sensor.
	3.0 Dwell angle	Engine tester	Engine: **Start**	9°–49° or 10–54%	Dwell angle not to tolerance: replace Ignition control module. No dwell angle: test stall current cutoff.
–	4.1 Stall current cutoff	T1 Cir. 1 -V+ Cir.	Ignition: ON	0V	Replace Ignition control module and ignition coil.
			Engine: **Start**	0V >0V	Test wiring and contacts from Ignition control module to ignition coil or replace Ignition control module. Replace ignition coil.
–	4.2 Ignition coil primary T1	T1 Cir. 1 -Ω+ Cir.	Ignition: OFF Unscrew wiring at ignition coil.	0.3–3.6 Ω	Replace ignition coil.

On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
–	5.0 Primary current	Engine tester Scope image: primary parade	Engine: **Start**	> 200 v	Replace Ignition control module.
–	6.0 Primary current limiting	Engine tester Scope image: Secondary overlap	Engine: **Start**	see diagram	Replace Ignition control module.
–	7.0 Ignition voltage at terminal 4 ignition coil	Engine tester Scope image: Secondary parade	Engine: **Start**	≥ 8 kV	Test ignition cable terminal 4, distributor rotor, distributor cap and ignition coil.
–	7.1 Ignition cable terminal 4	T1 Cir. 4 — S5/3 Cir. 4	Ignition: **OFF** Detach ignition cable terminal 4 at ignition coil and distributor cap.	< 1 Ω	Replace ignition cable terminal 4.
–	7.2 Distributor rotor	Distributor rotor Middle — Peak	Ignition: OFF Remove distributor cap.	700-1300 Ω and visual inspection	Replace distributor rotor.
–	7.3 Distributor cap	S5/3 Cir. 4 — Carbon	Ignition: OFF Distributor cap removed and detach ignition cable terminal 4.	700-1300 Ω per terminal and visual inspection	Replace distributor cap.

On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
	7.4 Ignition coil secondary T1	T1 Cir. 4 Ω Cir. 1	Ignition: OFF Unscrew cables at ignition coil.	3-13 kΩ	Replace ignition coil.
	8.0 Ignition voltage at single cylinder	Engine tester Scope image: Secondary parade High voltage clamp at cylinder ignition cable (e. g. cylinder 3)	Engine: **Start**	> 6 kV	Test distributor cap, distributor rotor, ignition cables with spark plugs.
–	8.1 Ignition cable with spark plug connector	Ignition cable Spark plug connector	Ignition: OFF Detach ignition cable with spark plug connector at spark plug and distributor.	700– 1300 Ω	Replace ignition cable with spark plug connector.
–	8.2 Spark plugs	Visual inspection	Ignition: OFF Remove spark plug.	Electrode gap 0.8 mm	Replace according to condition.

Test A completed.

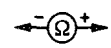
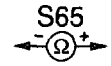
B. Engine running

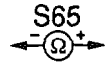
Pay attention to safety precautions (15-505).

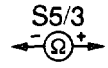
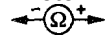
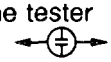
On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
	1.0 Ignition point	Engine tester	Engine: Test at normal operating temperature at specified speeds and with/without vacuum.	see table (15-515)	Reference resistor, coolant temperature sensor, WOT/CTP switch, vacuum advance, transmission overload protection (102.983199).
–	1.1 Reference resistor (R16)	N1/2 ⊥ Ω + 3 Sensor connector 4-pin	Ignition: **OFF** Detach sensor connector at Ignition control module. Pay attention to assignment engine/ reference resistor.	depending on reference resistor setting, see table	Reference resistor, cables, contacts.
–	1.1.1 Reference resistor (R16)	R16 Ω Middle A Z	Ignition: **OFF** Detach reference resistor.	see table	Reference resistor
–	1.1.2 Cables and contacts	R16 — N1/2 Ω + 3 Sensor connector 4-pin	Ignition: **OFF** Detach reference resistor. Detach sensor connector at Ignition control module.	> 1 Ω	Replace cables or contacts.
		R16 ⊥ Ω +		> 1 Ω	Test negative cable to W1 1 or W10, replace.

On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
–	1.2 Engine coolant temperature sensor (B1 li2)	N1/2 ⊥ Ω 1 Sensor connector 4-pin	Ignition: **OFF** Detach sensor connector at Ignition control module	at 80 °C 290-360 Ω further values, see diagram	Coolant temperature sensor (B11/2) Cables, contacts.
–	1.2.1 Engine coolant temperature sensor (B1112)	B11/2 (2-pin) ⊥ Ω Green/black cable B11/2 (4-pin) Ω	Ignition: **OFF** Detach sensor connector at Ignition control module	measure 2 x diagonally	Replace coolant temperature sensor (B11/2) (07.3-251). Replace coolant temperature sensor (B11/2) (07.3-251).
–	1.2.2 Cables and contacts	B11/2 Green/ black cable Ω N1/2 1 Sensor connector 4-pin	Ignition: **OFF** Detach connector at temperature sensor and sensor connector at Ignition control module.	< 1 Ω see note	Replace cables or contacts.
–	1.3 WOTCTP switch closed throttle position detection	2 , S29/2x Ω 1	Ignition: **OFF** Detach connector (S29/2x).	Idle position: < 1Ω Other positions: ∞	Set or replace WOT/CTP switch. Open circuit.

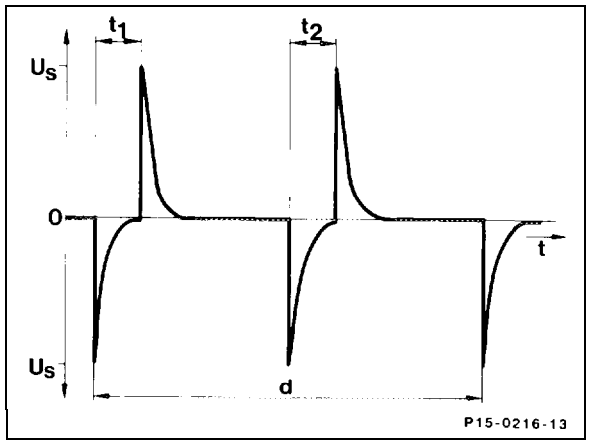
Onioff ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
–	1.3.1 Cables and contacts	N1/2 N3 2 — Ω — 13 Sensor connector 4-pin	Ignition: OFF Detach sensor connector at Ignition control module and CFI control module.	< 1Ω	Replace cable or contact.
–	1.4 Vacuum advance	Engine tester	Engine: normal operating temperature, speed 1500/min. Detach vacuum hose at Ignition control module. Connect vacuum hose at Ignition control module.	Ignition point retarded Ignition point advanced	Vacuum hose leaking. Connection at intake manifold blocCFId. Pressure sensor in Ignition control module faulty.
–	1.5	L5 31d — ⏚ — 7	Detach crankshaft position sensor connector at Ignition control module. Engine: **Start**	see diagram $U_S \geq 1V$	Different voltage heights: Test segments (visual inspection) Replace flywheel/driver disc with segments.

On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
	1.6 Transmission overload protection, only engine 102.983199 with automatic transmission	 N1/2 — 4 Sensor connector 4-pin	Depress parking brake. Pay attention to safety precautions. Engine: **Start** Idle speed selector lever position: "D"	< 1Ω	Transmission overload protection switch (S65) Cables Contacts
			Selector lever position: "P" or "N"	∞	Transmission overload protection switch (S65) Cables Contacts
	1.6.1 Transmission overload protection switch (S65)	 S65	Detach connector at transmission overload protection switch S65. Depress parking brake. Pay attention to safety precautions. Engine: **Start** Idle speed selector lever position "D"	< 1Ω	Replace transmission overload protection switch (S65).
			Selector lever position: "P" or "N"	∞	Replace transmission overload protection switch (S65).

On/off ratio readoutt	Test step/ Test scope	Test connection	Operation/ Requirement:	Specifi- cation	Possible cause/Remedy
–	1.6.2 Cables and contacts	S65 – c  Nli2 4 Sensor connector 4-pin	Ignition: OFF Detach connector at transmission overload protection switch (565) and Ignition control module (N1/2).	< 1Ω	Replace cable or contact.
		 S65 - L	Ignition: OFF Detach connector at transmission overload protection switch (S65) and Ignition control module (N1/2).	< 1Ω	Replace cable or contact.
–	2.0 Dwell angle	Engine tester	Engine speed 3200/min, normal operating temperature. Detach sensor connector at Ignition control module and vacuum line. Engine: **Start**	27–54° or 30–60%	Replace Ignition control module.
–	3.0 High voltage distributor/ distributor rotor	Visual inspection	Ignition: OFF Remove distributor cap.	-	Distributor cap, distributor rotor has cracks, interference suppression resistors faulty.

On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
	3.1 Distributor cap	S5/3 	Ignition: OFF Remove distributor cap.	700-1300 Ω per terminal	Replace distributor cap.
	3.2 Distributor rotor	Distributor rotor  Middle Peak	Ignition: OFF Remove distributor cap.	700-1300 Ω and visual inspection	Replace distributor rotor.
–	4.0 Scope images	Engine tester  Scope images Parade Overlap Raster	Engine: **Start** At idle.	**see** scope images 15-525	Ignition coil Distributor Ignition cables Spark plugs

Test B completed.

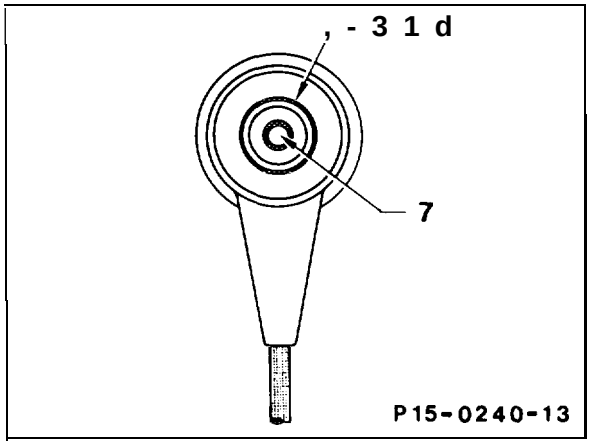


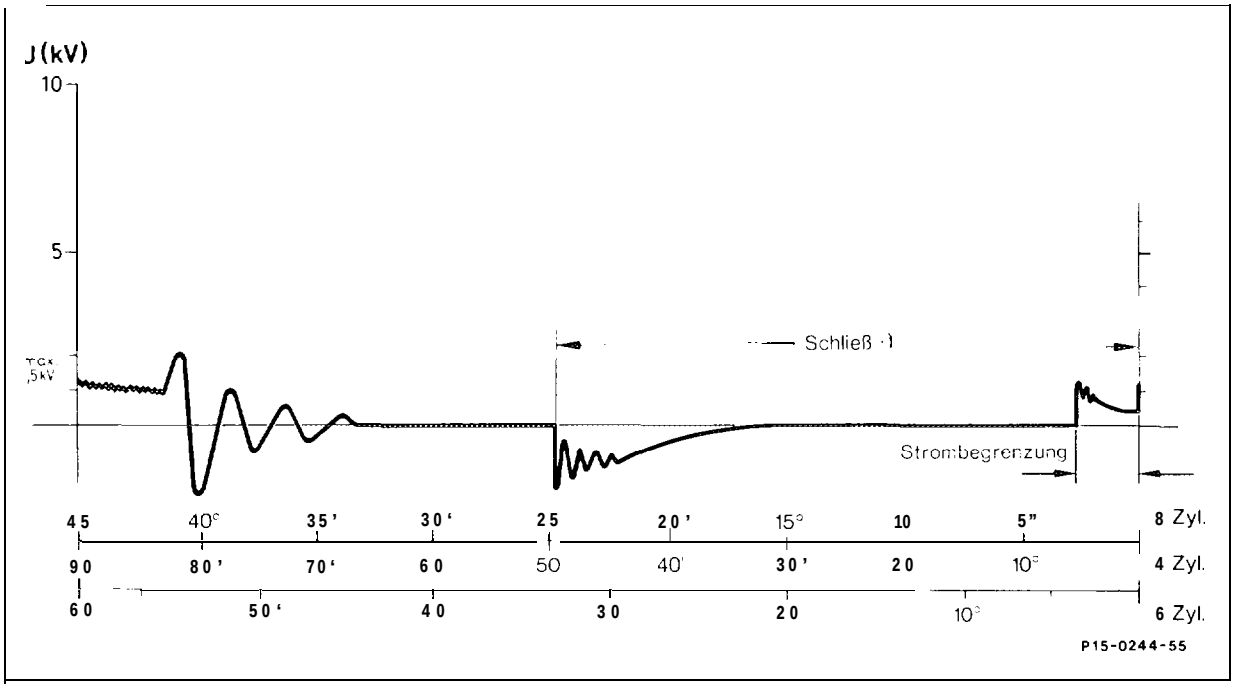
Crankshaft position sensor signal L5

t1 1st segment
t2 2nd segment
d Period for one crankshaft revolution
Us Voltage (≥1V)

Crankshaft position sensor connector L5

Test resistance or voltage signal between connection 7 and 31d.





Current limiting

Notes regarding test
Engine coolant temperature sensor (B11/2)

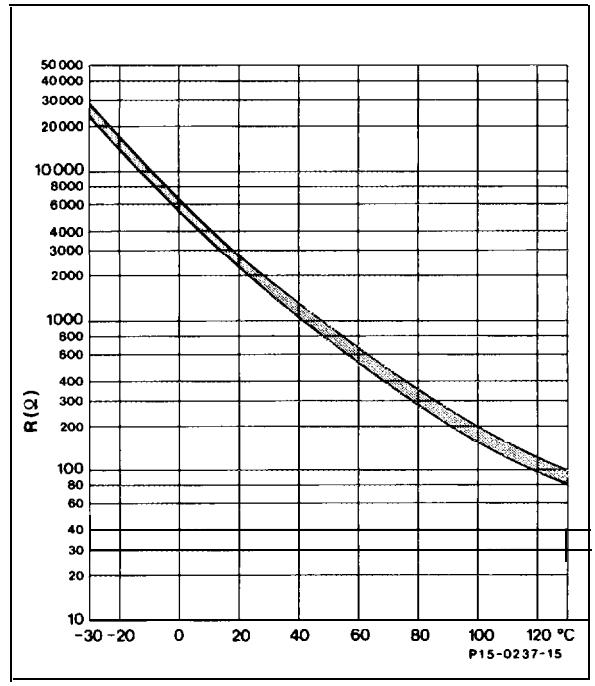
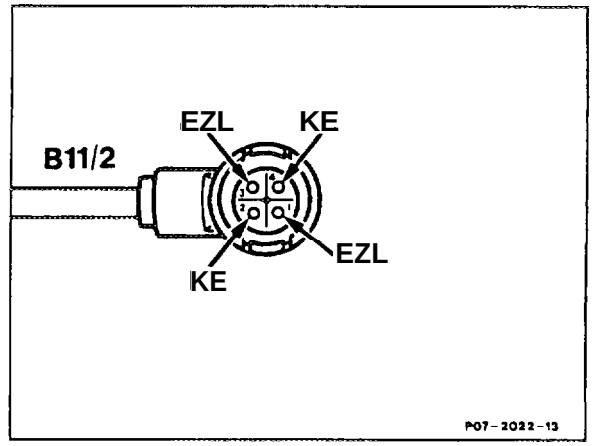


Diagram of coolant temperature sensor (B11/2)

4-pin engine coolant temperature sensor



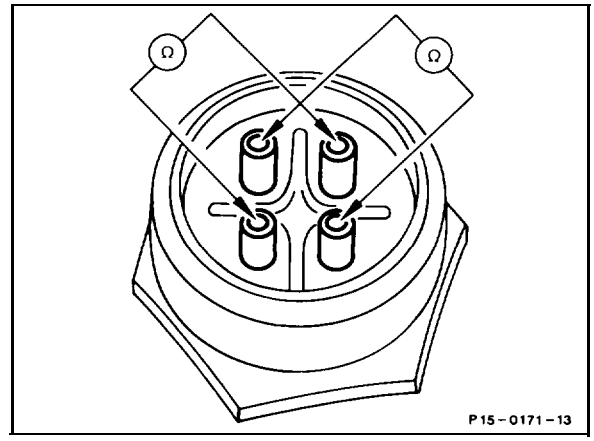
Pin assignment of connector:

1 = Ignition system temperature sensor
2 = CFI temperature sensor
3 = Engine ground at intake manifold for DI
4 = CFI control module ground

Note

National version (USA) 1988 without connector designations.

When testing the engine coolant temperature sensor, measure the resistances 2 × diagonally and compare.

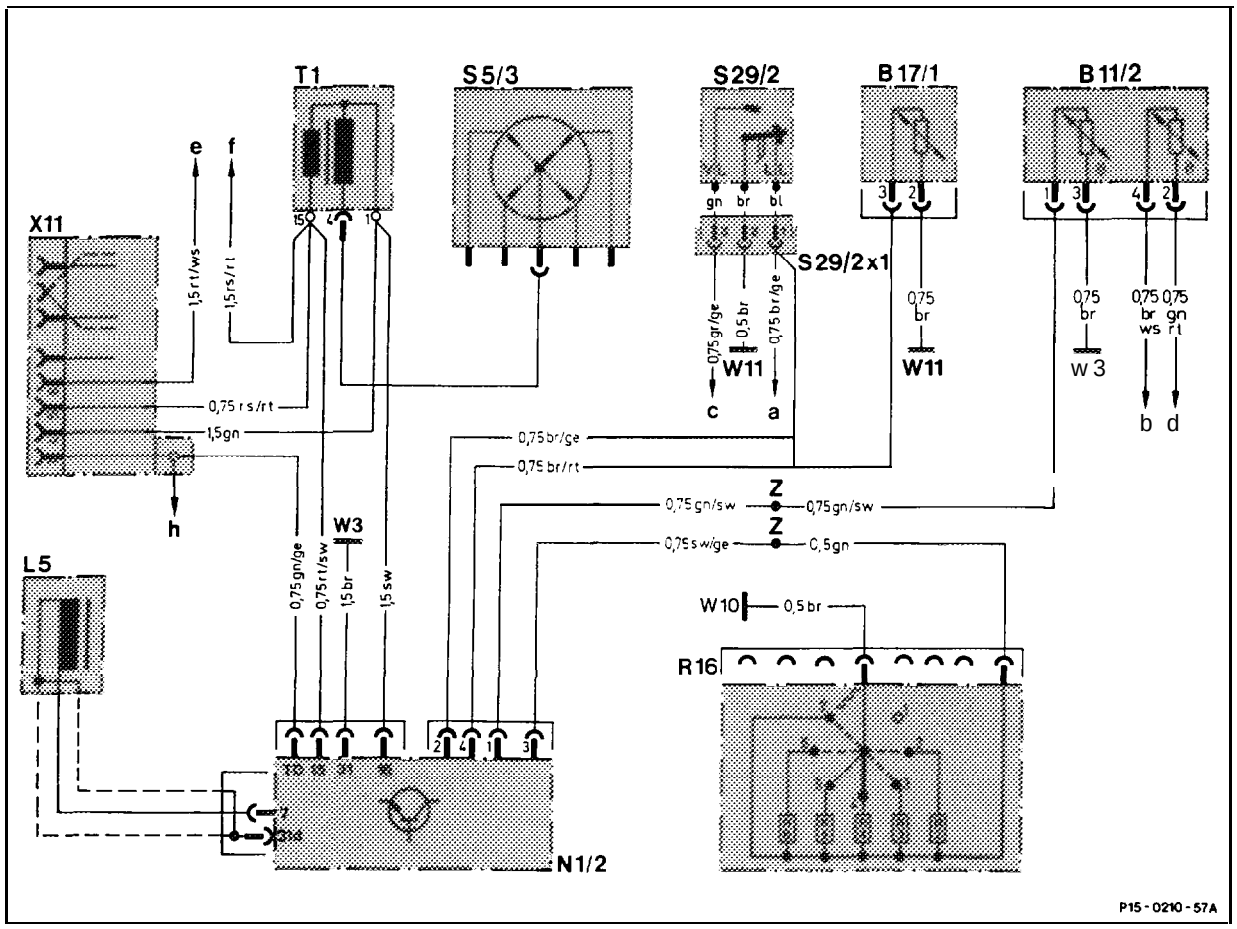


Note regarding ignition distributor

Improved distributor rotor with polyamid bush.

Production breakpoint: January 1989

Model	Engine	Engine end No. manual transmission	Engine end No. automatic transmission
201.024	102.962	211498	108898
201.028	102.985	30070	78183



Distributor ignition system wiring diagram, engines 102.96/98 KAT as of 09/89

B11/2	Engine coolant temperature sensor (DI/CFI)	a	To CFI control module contact 13
B17/1	Intake air temperature sensor (DI)	b	To CFI control module contact 7 (ground)
L5	Crankshaft position sensor	c	To CFI control module contact 5
N1/2	Transistorized ignition control module (DI)	d	To CFI control module contact 21
R16	Reference resistor (DI)	e	Voltage supply terminal 30 Model 201: to fuse 13 via electrical center connector S, contact 11
S5/3	High voltage distributor		
S29/2	Wide open throttle/closed throttle position switch		
S29/2x1	Wide open throttle/closed throttle position switch plug connection	f	Voltage supply terminal 15, unfused Model 201: electrical center connector S, contact 4
T1	Ignition coil		
W3	Ground, front left wheelhouse (ignition coil)	h	Equipment with terminal TD (e. g. tachometer, fuel pump relay, CFI control module, compressor cutoff control module)
W10	Battery ground		
W11	Engine ground (electric cable bolted on)		
x11	Diagnosis socket/terminal block terminal TD	z	Connector sleeve (soldered connector in wiring harness)

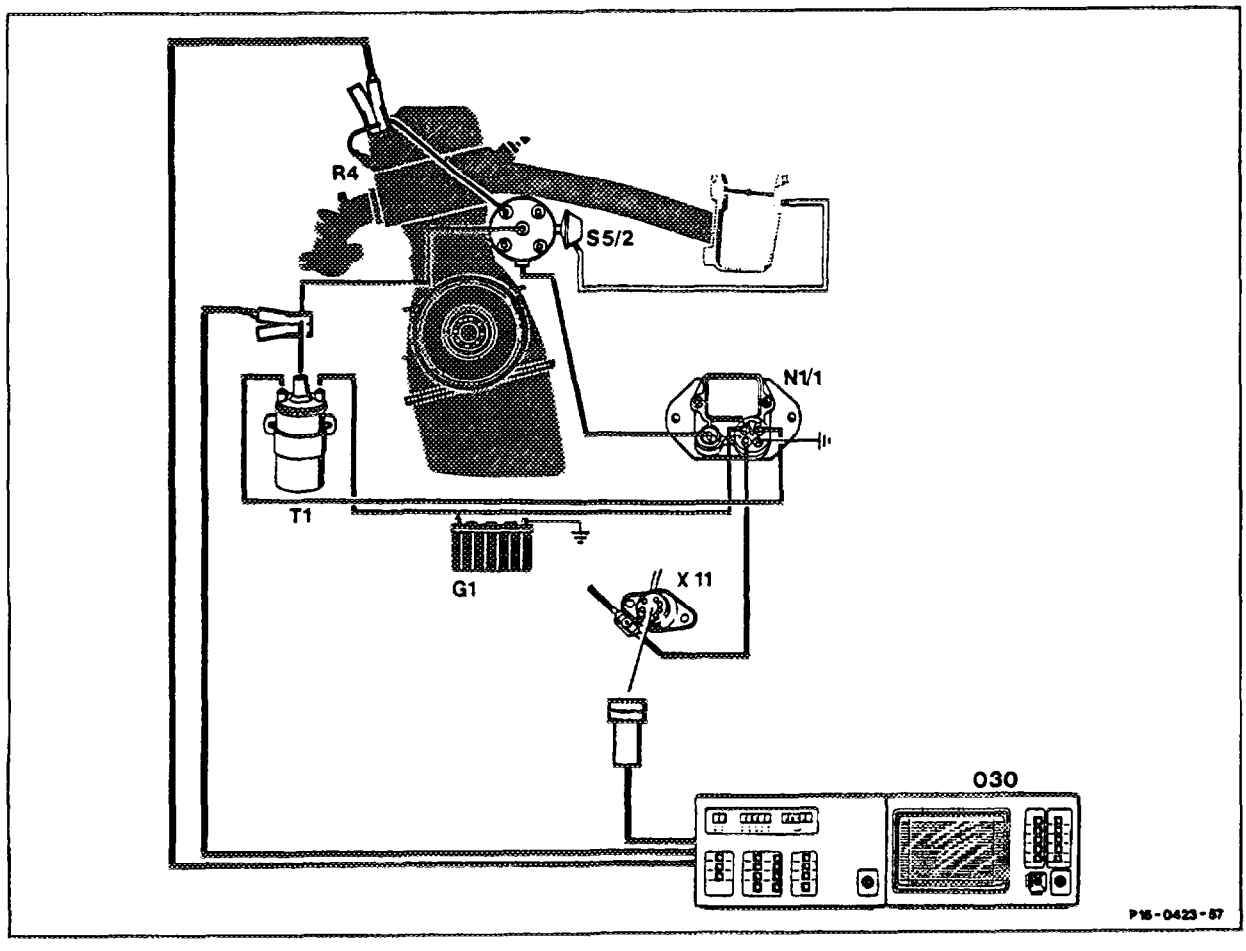
15–542 Testing breakerless transistorized ignition (TSZ)

Preceding work:
Testing, adjusting engine (07.3-I 10)

Precondition for test

Spark plugs, ignition cables, distributor rotor and distributor cap in proper mechanical and electrical condition.

Test e. g. by visual inspection, measuring resistance and ignition oscilloscope.

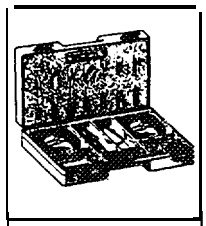


Connection diagram for engine tester with oscilloscope

G1	Battery	S5/2	Breakerless distributor
N1/1	Transistorized ignition (TSZ) control module	TI	Ignition coil
R4	Spark plugs	XI 1	Diagnostic connector/terminal block terminal TD
		030	Engine tester with oscilloscope

Note
Pay attention to the safety precautions (15-0505) when performing work on the ignition system. Switch off ignition when unplugging and connecting the contacters at the TSZ control module.

Special tool



201 589 00 99 00

Commercially available testers

Multimeter	e. g. Sun, DMM-5 Fluke, Multimeter 23 Hermann, Avometer 2003
Engine tester	e. g. Hermann, Datascope 9800 Bosch, MOT 3011400 Sun, 2110 BEAR, D AC E

Test **data**

Resistances (test values at approx. 20 °C)

Ignition coil	primary (terminals 1 and 15)	Ω	0.5-0.9
Ignition coil	secondary (terminals 1 and 4)	kΩ	6–16
Induction sensor	Coil resistance (terminals 7 and 31d) Insulation (terminal 7 and ground)	 Ω kΩ	 600f 100 ≥ 200
Distributor cap per terminal, distributor rotor, spark plug connector		Ω	700-l 300

Voltages, engine not running, ignition switched off

Terminals 15 and 31 (contacts 5 and 2 diagnostic connector)		Battery voltage
Between terminals 15 and 1 (contacts 5 and 4 diagnostic connector)	V	0

Dwell angle

At starter speed	7–34°

gnition pont (TSZ) national version

Engine	Type of fuel[3])	Distributor Bosch No.	Test and setting value [1]) of ignition point in "CKA BTDC ± 1 without/with vacuum		Ignition advance in °CKA BTDC without vacuum			Vacuum advance of ignitior point in °CKA 3TDC at	Installed value of ignition point in °CKA before TDC at starting speed without vacuum
			4500/ min	idling	Idling	1500/ min	3000/ min	4500/ nin	
(USA) 102.961 1984	un-leaded	0 237 002 094	–	5 with	·	5–11	19-252)	24–28[2])	5
102.961 102.985 as of 1983		0 237 002 098				10–14	22–26[2])	14-I 8[2])	5

) If normal-compression engines are operated with fuel of less than 98 RON min. 88 I)N) or low-compressron engines with fuel of less than 92 RON (min. 82 MON), the ignition point should be retar ed and adapted to the octane number of the fuel used. A reference value for this adjustment is: retard ignition point by 1 – 2" CKA per 1 RON. The maximum retardation must not exceed 6° CKA.
The ignition correction should be entered by hand on the "engine setting data" information plate.
The result is reduced power output and increased fuel consumption. In addition, the engine must not be operated at full load.
The full ignition advance should be re-set as soon as fuel of the specified octane number is again available.

2) Test at 3500/min.

3) Vehicles with catalytic converter must be operated with unleaded fuel.

4) This value must be identical at normal operating temperature of engine with and without vacuum: test ignition advance in the warming-up phase if necessary (15-543).

Note

If the specified value of a test step, e. g. test step 1.0, is in order, continue immediately with test step 2.0.

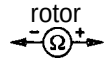
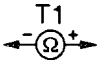
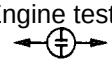
If the specified value of step 1.0 is not in order, it is then necessary to continue with step 1.1.

Key to symbols:

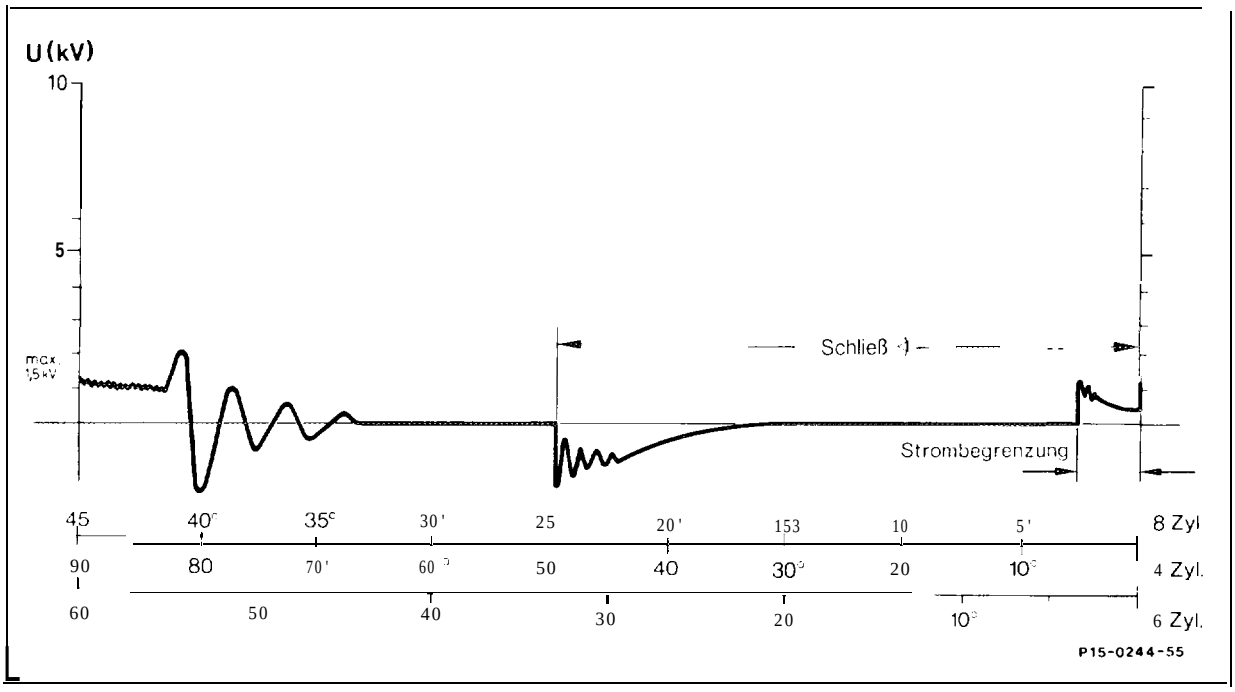
- Multimeter direct voltage mode
- Multimeter resistance mode
- Oscilloscope
- Contact
- Connector
- Ground

On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
	1.0 Voltage supply	N1/1 31 — (V) — 15	Ignition: ON	Battery voltage	Test cables and contacts according to wiring diagram (from battery via ignition lock to TSZ control module), ground connection (W3).
–	2.0 Induction sensor	Connector 31d — (Ω) — 7	Ignition: **OFF** Detach induction sensor connector at TSZ control module (green cable).	600 Ω ± 100 Ω	Replace induction sensor. Test cables and contacts from TSZ control module to distributor.
–	2.1 Insulation of sensor coil	Sensor coil ⊥ (Ω) ▬	Detach induction sensor cable connector at distributor.	≥ 200 kΩ	Replace induction sensor.
–	3.0 Dwell angle of (TD signal)	Engine tester	Engine: **Start**	7-34”	Dwell angle not to tolerance: replace TSZ control module. No dwell angle: test stall current cutoff. Pay attention to notes on TD signal (15-512).

On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
–	4.0 Stall current cutoff	T1 Cir. 1 ⊖ V ⊕ Cir.	Ignition: ON Engine: **Start**	0V 0V >0V	Replace TSZ control module and ignition coil. Test cables and contacts from TSZ control module to ignition coil or replace TSZ control module. Replace ignition coil.
–	4.1 Ignition coil primary T1	T1 Cir. 1 ⊖ Ω ⊕ Cir.	Ignition: **OFF** Unscrew cables at ignition coil.	0.5– 0.9 Ω	Replace ignition coil.
–	**5.0** Primary voltage	Engine tester Scope image Primary parade	Engine: **Start**	>200 V	Replace TSZ control module.
–	6.0 Primary current limiting	Engine tester Scope image Secondary overlap	Engine: **Start**	**see** diagram	Replace TSZ control module.
–	7.0 Ignition voltage at terminal 4 ignition coil	Engine tester Scope image Secondary parade	Engine: **Start**	ha kV	Test ignition cable terminal 4, distributor rotor, distributor cap and ignition coil.
–	7.1 Ignition cable terminal 4	T1 S5/2 Cir. 4 ⊖ Ω ⊕ Cir. 4	Ignition: OFF Detach ignition cable terminal 4 at ignition coil and distributor cap.	<1 Ω	Replace ignition cable terminal 4.

On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	Possible cause/Remedy
–	7.2 Distributor rotor	Distributor rotor  Middle Peak	Ignition: OFF Remove distributor cap	700-1300 a and visual inspection	Replace distributor rotor.
–	7.3 Distributor cap	S5/2 Cir. 4  Carbon	Ignition: OFF Distributor cap removed and detach ignition cable terminal 4.	700-1300 Ω per terminal and visual inspection	Replace distributor cap.
–	7.4 Distributor cap/rotor	Visual inspection	Ignition: OFF Remove distributor cap.		Distributor cap, distributor rotor has cracks.
	7.6 Ignition coil secondary T1	T1 Cir. 4  Cir. 1	Ignition: OFF Unscrew cables at ignition coil.	6-16 kΩ	Replace ignition coil.
	8.0 Ignition voltage at single cylinder	Engine tester  Scope image Secondary parade High voltage clamp at cylinder ignition cable (e. g. cylinder 3)	Engine: Start	>6 kV	Test distributor cap, distributor rotor, ignition cables with spark plugs.
	8.1 Ignition cable with spark plug connector	 Ignition cable Spark plug connector	Ignition: OFF Detach ignition cable with spark plug connector at spark plug and distributor.	700-1300 a	Replace ignition cable with spark plug connector.

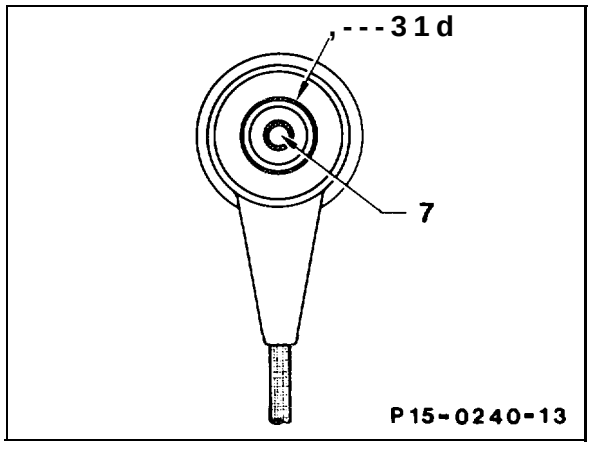
On/off ratio readout	Test step/ Test scope	Test connection	Operation/ Requirement	Specification	possible cause/Remedy
	8.2 Spark plugs	Visual inspection	Ignition: OFF Remove spark plugs.	Electrode gap (I.8 mm	Replace according to condition.
	3.0 Ignition point	Engine tester	Engine: Test at normal operating temperature at specified speeds and with/without vacuum.	see table	Setting of vacuum advance Ignition advance in warm-up phase (15–545).
	9.1 Vacuum advance	Engine tester	Engine: Normal operating temperature, speed approx. 1500:min. Detach vacuum hose. Fit on vacuum hose.	Ignition point retarded Ignition point advanced	Vacuum hose leaking Connection at intake manifold blocked. Vacuum unit faulty. Distributor faulty.



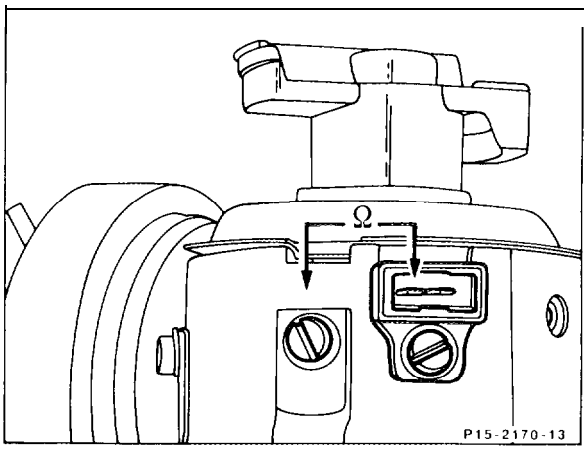
Current limiting

induction sensor connector

Test resistance between connections 7 and 31d.

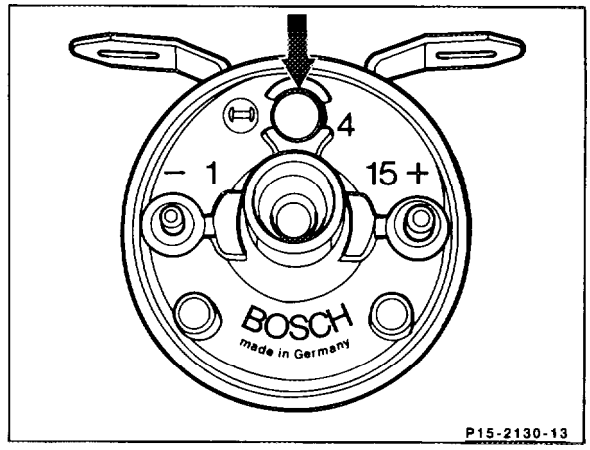


Test insulation of induction sensor coil to ground (≥ 200 kΩ).

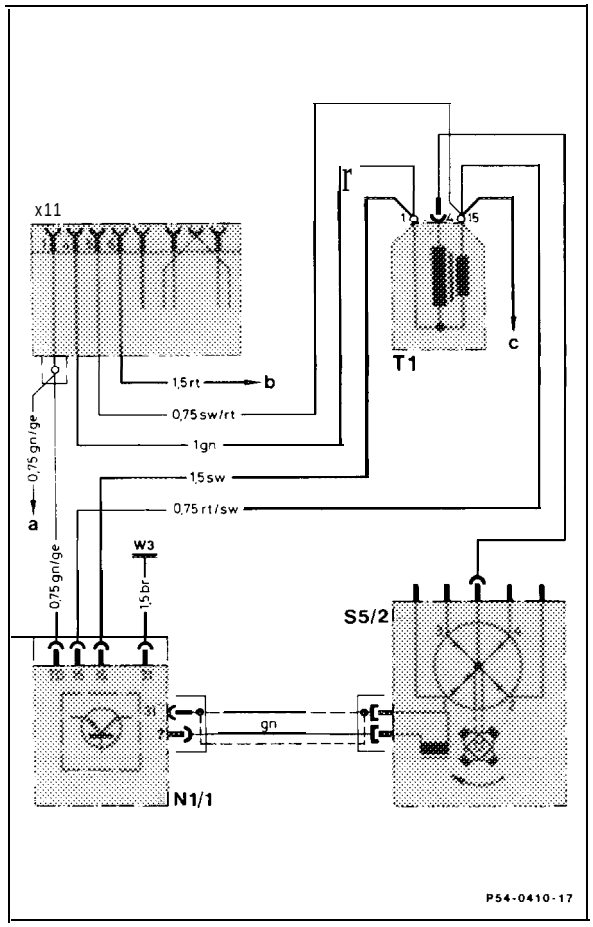


Ignition coil (T1)

If plug (arrow) pressed out, replace.



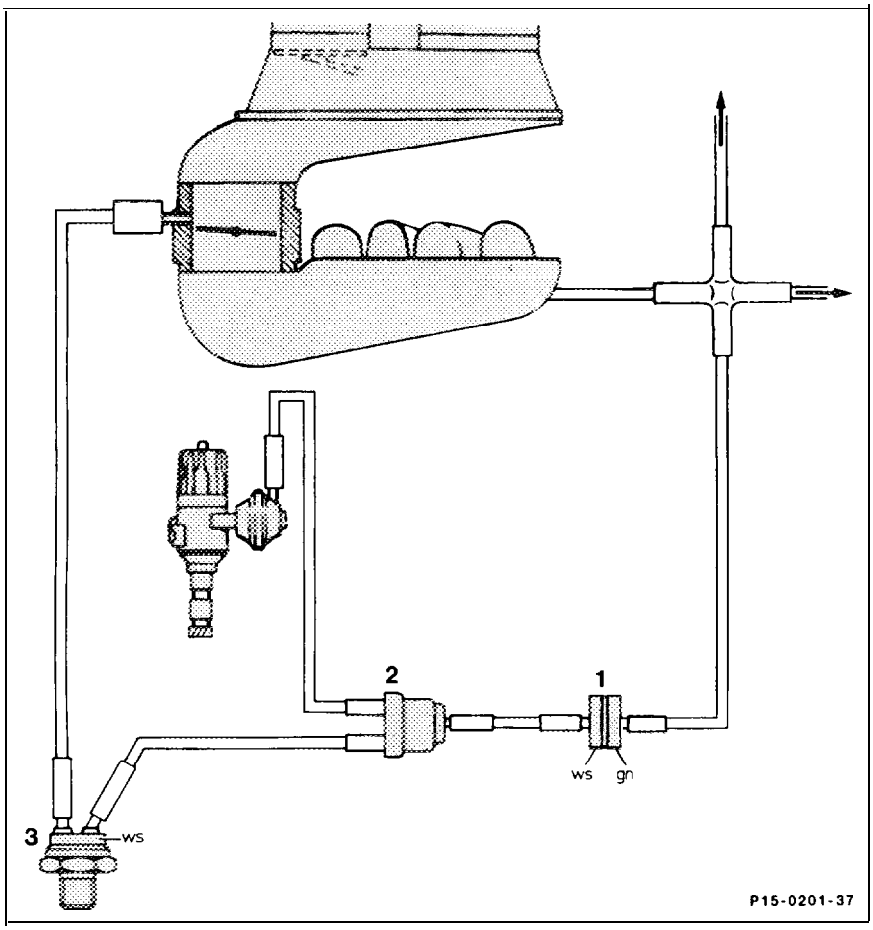
TSZ wiring diagram



N1/1 Transistorized ignition control module
S5/2 Distributor
T1 Ignition coil
W3 Ground, front left wheelhouse (ignition coil)
x11 Diagnostic connector/terminal block terminal TD
a Equipment with terminal TD
(e.g. tachometer, fuel pump relay, CFI control module, compressor cutout control module)
b Voltage supply terminal 30
Model 201: to fuse 13 via electrical center coupling S, contact 11
c Voltage supply terminal 15, unfused
Model 201: electrical center coupling S, contact 4

15-543 Testing ignition advance in warm-up phase (only TSZ)

Engine 102.961 Basic Version



Tester	connect (16415).
Engine	warm up to approx. 80 °C engine coolant temperature. Run at idle speed and take reading of ignition point.
Vacuum line	white/red, detach at thermo valve (3). The ignition point must not alter.

If the ignition point alters, check whether vacuum lines are correctly laid and leaktight. Check thermo valve. The thermo valve should have clear passage above approx. 60 °C.

Vacuum line . . . . . white/red, detach at thermovalve (3) and plug the vacuum connection at thermovalve. The ignition point must be advanced approx. 8 – 12”.

If the ignition point is not advanced, check restrictor (1) for clear passage, check valve (2) and vacuum unit at distributor for leaktightness.

Function description

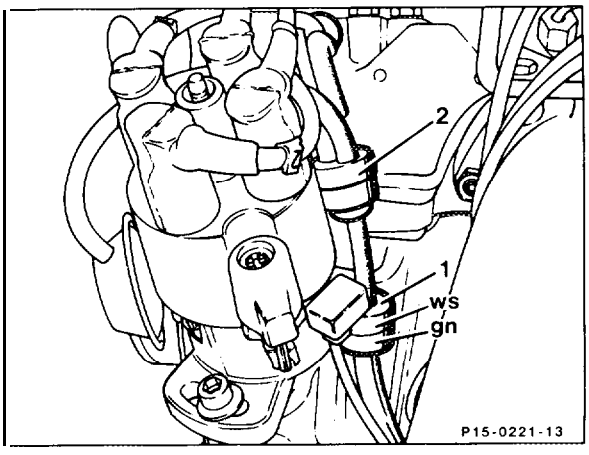
To improve the perfprmance in the warm-up phase, the ignition point is advanced 8 – 12” CKA via the vacuum unit at the distributor up to a coolant temperature of approx. + 60 °C in addition to the centrifugal advance.

Below approx. 60 °C engine coolant temperature (thermo valve closed) the vacuum passes from the intake manifold via the restrictor (1) and check valve (2) to the vacuum unit at the distributor when the engine starts.

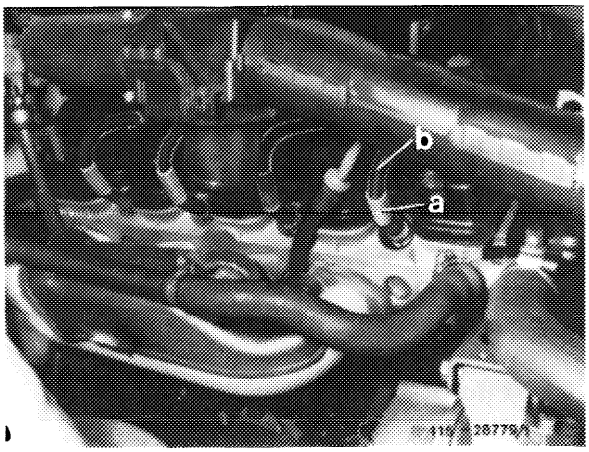
The check valve (2) ensures that the maximum vacuum is retained at the distributor ‘(also when accelerating) which results in the additional ignition advance via the vacuum unit.

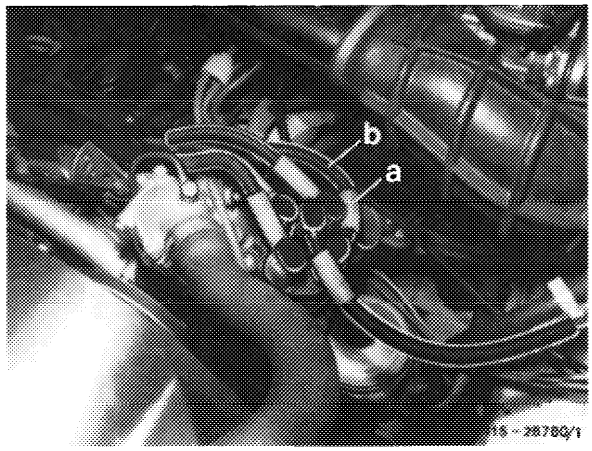
Above approx. 60 °C the thermovalve (3) opens, and the vacuum is reduced at idle speed to the throttle valve assembly.

A restrictor (1) is installed to ensure that the vacuum for the other connected components cannot escape through the connection at the intake manifold at idle speed.



15-547 Retrofitting corrugated hoses for ignition cables





Corrugated hoses (a) Ø 13 mm and (b) Ø 10 mm	cut to size according to table as protection against beech martens biting through cables. Push corrugated cables (a) Ø 13 mm and (b) Ø 10 mm approx. 10 mm together.
Spark plug connector	unplug, plug in. Unscrew spark plug connector from ignition cables, screw on. Push corrugated hoses onto ignition cables.
Angled connector at distributor	unplug, plug in. Unscrew angled connector from ignition cables, screw on. Push corrugated hoses appropriate length onto ignition cables.

Qty.	Length (mm)*	Assignment
Corrugated hose Ø 10 mm (total length approx. 1260 mm)		
4	110	Ignition cable at spark plug connector
2	125	Ignition cable at distributor, cylinders 1 and 4
1	175	Ignition cable at distributor, cylinder 2
1	75	Ignition cable at distributor, cylinder 3
1	320	Ignition cable from distributor to ignition coil
Corrugated hose Ø 13 mm (total length approx. 300 mm)		
10	30	1 ea. at each spark plug and angled connector

* Maximum length; shorten ignition cable accordingly, if necessary.

Parts

Designation	Part No.
Corrugated hose (10 mm diameter) running meters	000 159 01 83
Corrugated hose (13 mm diameter) running meters	000 159 02 83

Available from: ZEG Germersheim

Time allowed

Basic work: 02-I 508/01

Combined work: 02-I 509/0 1