

5.1 Distributor Ignition System (DI)

Contents

5.1 Engines 104, 119 with Continuous Fuel Injection System (CFI)

Diagnosis

Diagnostic Trouble Code (DTC) Readout	11/1
Complaint Related Diagnostic Chart	12/1

Electrical Test Program

Component Locations	21/1
Preparation for Test	22/1
Test (Engine Does Not Run)	23/1
Test (Engine Runs)	24/1

Diagnosis - Diagnostic Trouble Code (DTC) Memory

Preliminary work:

Engine Test and Adjustment DM, Engine, Volume 1, Section B1

The individual test steps (e. g. ignition coils, distributor cap etc.) are organized into a test program.

If a complaint is determined through engine diagnosis in Engines, Volume 1, which refers to a specific test step, only the specific test step should be performed and not the entire test program.

The DTC readout is cleared by switching off the ignition. With the engine running, a DTC currently displayed can be cleared by pressing the start button for longer than 5 seconds.

Diagnostic Trouble Code (DTC) Readout with Impulse Counter Scan Tool

The ignition control module (N1/3) is equipped with diagnostics **without** DTC memory. In other words, the control module (N1/3) does not have the capability to store DTC's for recall at a later date.

The DTC readout can only be performed with the engine running. DTC's ranging from 1 to 17 may appear on the display of the impulse counter scan tool.

The DTC 1 indicates: No fault recognized in system.

All further DTC's refer to a particular malfunction source. If there are multiple system malfunctions, the malfunction assigned with the lowest DTC will be displayed first.

If the DTC indicated first reappears after more than two DTC readouts, then no further malfunctions are present in the system.

Diagnosis - Diagnostic Trouble Code (DTC) Memory

Preparation for Test with Impulse Counter Scan Tool

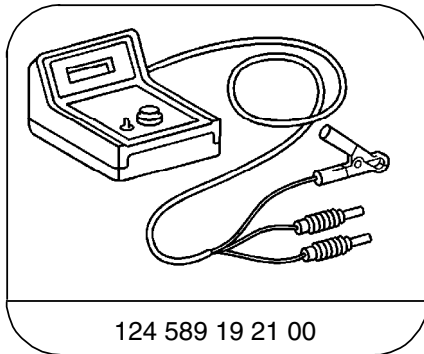
- Connect impulse counter scan tool according to connection diagram, perform DTC readout (see section 0).
Ignition control module socket 8.

Note:

- Check voltage between socket 1 and socket 16 of data link connector X11/4, nominal value 6 – 12 V.
- Start engine and run for at least 8 seconds at 3100 – 3600 rpm with vacuum hose connected to ignition control module (N1/3).
- Pull off vacuum hose with engine at idle.

- With engine at idle, move transmission range selector lever from “P” or “N” position to “D” and back again.
- Run engine for at least 2 seconds above 5000 rpm.
- With engine at idle, reconnect vacuum hose.
- Raise engine speed to approx. 2300 rpm and then briefly apply wide open throttle (wide open throttle contact must close briefly).
- Engine at idle.

Special Tools



124 589 19 21 00

Pulse counter

Diagnosis - Diagnostic Trouble Code (DTC) Memory

DTC	Possible cause	Remedy/test step ¹⁾
1	No fault in system	–
2	Maximum retard setting on at least one cylinder has been reached	24 ⇒ 1.0
3	Engine coolant temperature sensor (B11/2)	24 ⇒ 2.0
4	Load sensor in ignition control module (N1/3)	24 ⇒ 3.0
5	Knock sensors (A16) 1 and/or 2	24 ⇒ 4.0
6	Camshaft position sensor (L5/1)	24 ⇒ 5.0
7	Knock control–output switch in ignition control module (N1/3)	Ignition control module (N1/3)
8, 9	Transmission overload protection switch (S65)	24 ⇒ 6.0
10	Data exchange from ignition control module (N1/3) to CFI control module (N3) defective	24 ⇒ 7.0
11	Reference resistor (DI) (R16/2)	24 ⇒ 8.0
12	TN engine speed signal is outside the tolerance range	24 ⇒ 9.0
13	Wide open throttle contact does not open	24 ⇒ 10.0
14	Closed throttle position contact does not open	24 ⇒ 11.0
15	Ignition coil 1 output from ignition control module (N1/3)	24 ⇒ 12.0
Engine 119 only! 16	Ignition coil 2 output from ignition control module (N1/3)	24 ⇒ 13.0
17	Crankshaft position sensor (L5)	23 ⇒ 3.0, 24 ⇒ 14.0

¹⁾ Observe Preparation for Test, see 22.

Diagnosis - Complaint Related Diagnostic Chart

Complaint/problem	Possible cause	Remedy ¹⁾ /test step
Engine does not run	Crankshaft position sensor (L5) Ignition control module (N1/3)	23 ⇒ 3.0 23 ⇒ 1.0

¹⁾ Observe Preparation for Test, see 22.

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Component Locations

Engine 104 CFI

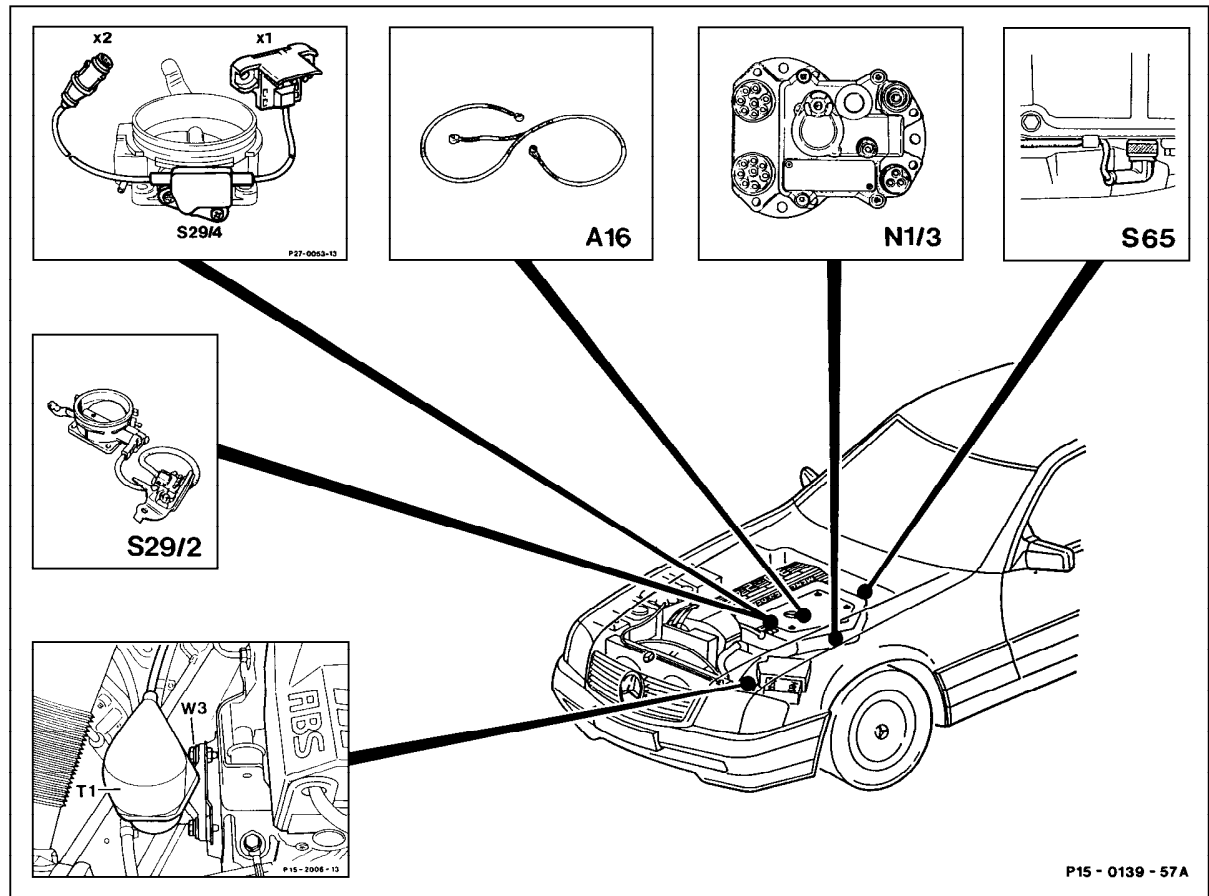


Figure 1

A16	Knock sensors
N1/3	Ignition control module
S29/2	Wide open throttle/closed throttle position switch
S29/4	Throttle body switch (5-speed automatic transmission)
S29/4X1	Throttle valve potentiometer connector
S29/4X2	Throttle position potentiometer connector
S65	Transmission overload protection switch, brake band B1
T1	Ignition coil

P15 - 0139 - 57A

P15-0139-57A

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Component Locations

Engine 104 CFI

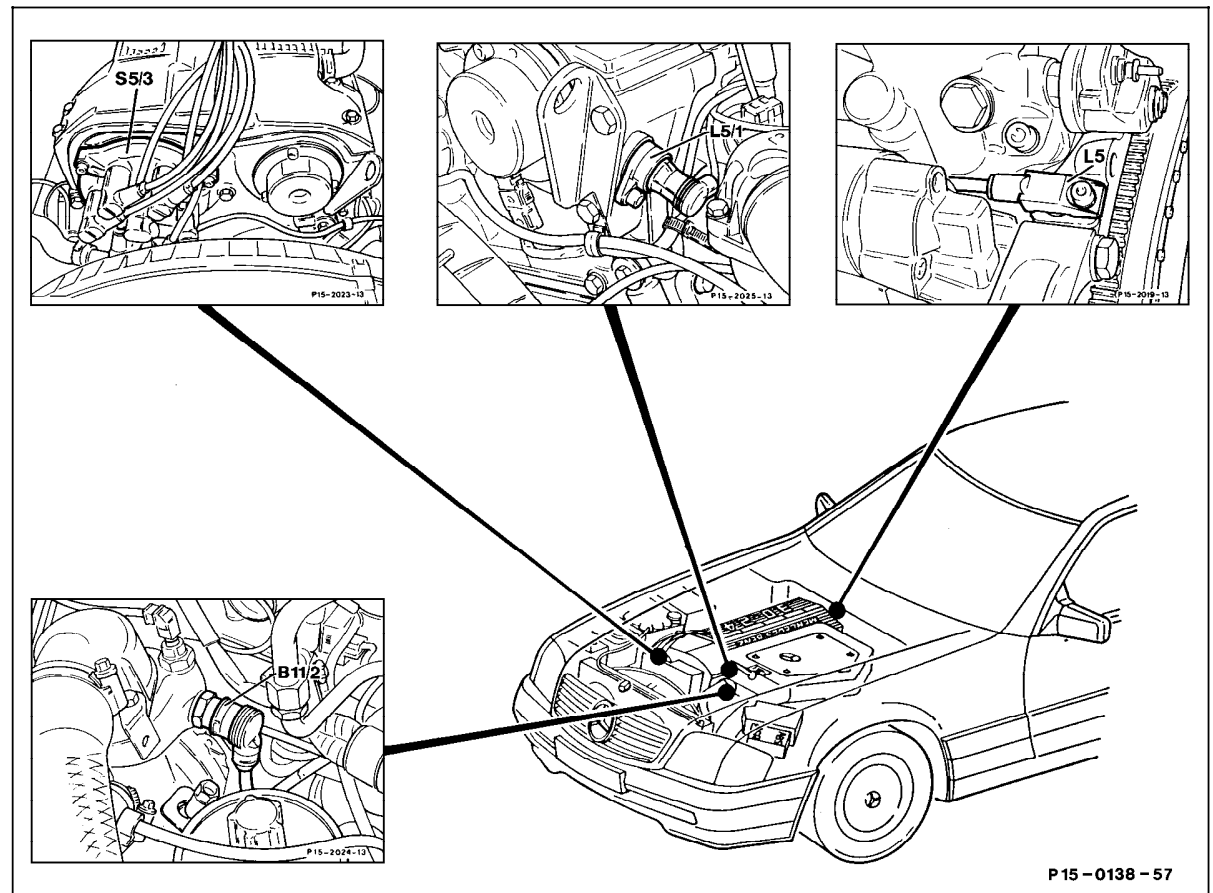


Figure 2

- B11/2 Engine coolant temperature sensor (DI/CFI)(4-pole)
- L5 Crankshaft position sensor
- L5/1 Camshaft position sensor
- S5/3 High-voltage distributor

P15-0138-57

P15-0138-57

Electrical Test Program - Component Locations

Engine 119 CFI

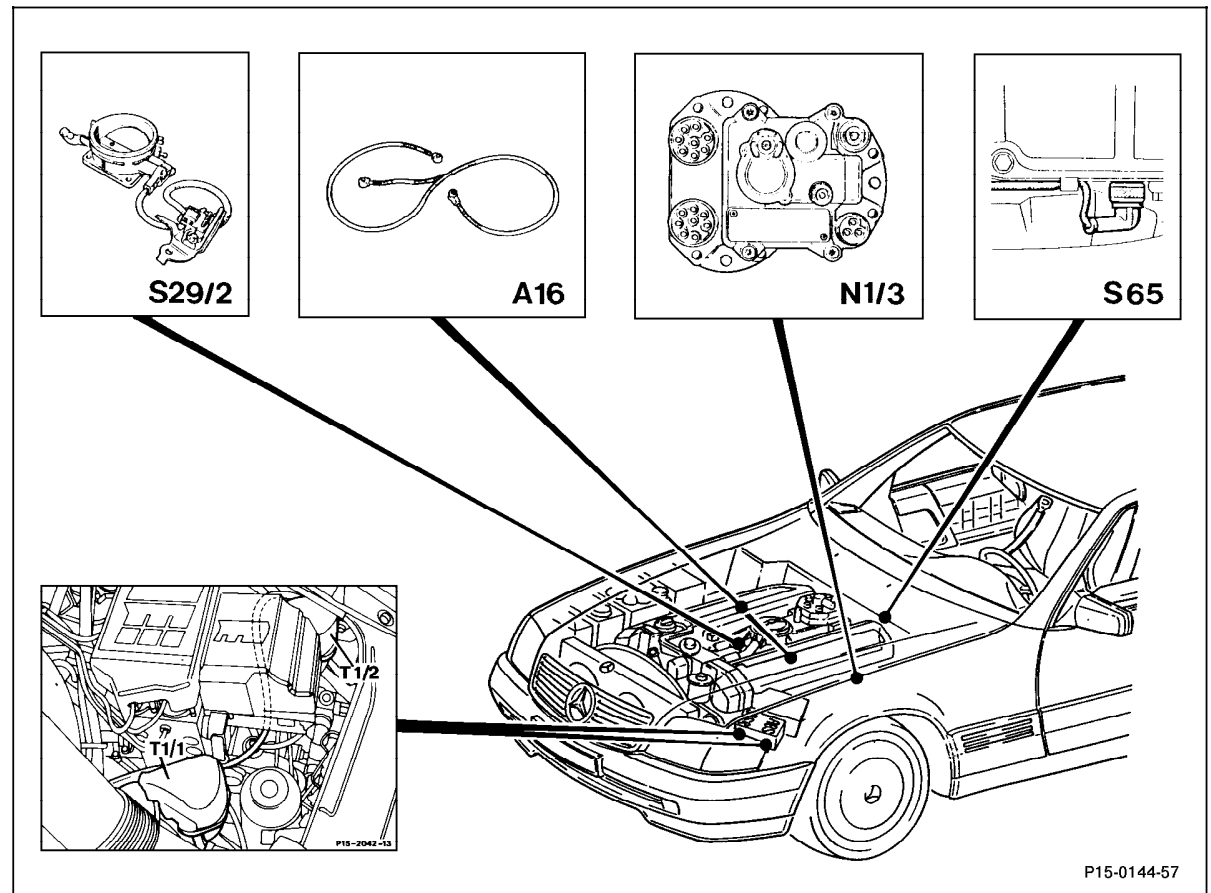


Figure 3

- A16 Knock sensors
- N1/3 Ignition control module
- S29/2 Wide open throttle/closed throttle position switch
- S65 Transmission overload protection switch, brake band B1
- T1/1 Ignition coil 1 (right cylinder bank)
- T1/2 Ignition coil 2 (left cylinder bank)

P15-0144-57

P15-0144-57

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Component Locations

Engine 119 CFI

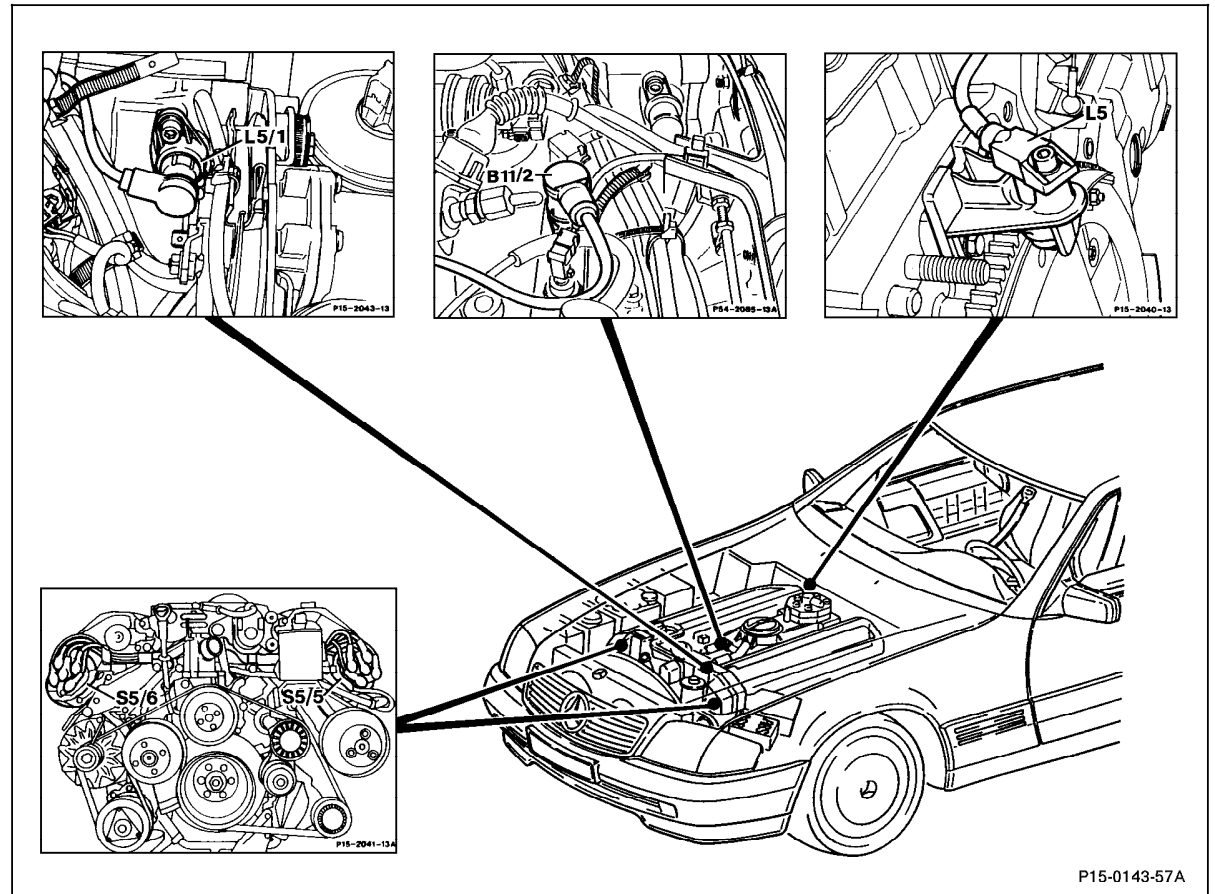


Figure 4

- B11/2 Engine coolant temperature sensor (DI/CFI)(4-pole)
- L5 Crankshaft position sensor
- L5/1 Camshaft position sensor
- S5/5 Left high-voltage distributor
- S5/6 Right high-voltage distributor

P15-0143-57A

P15-0143-57A

Electrical Test Program - Preparation for Test

Preliminary work: Engine Test, Adjustment, Engines, Volume 1 B.

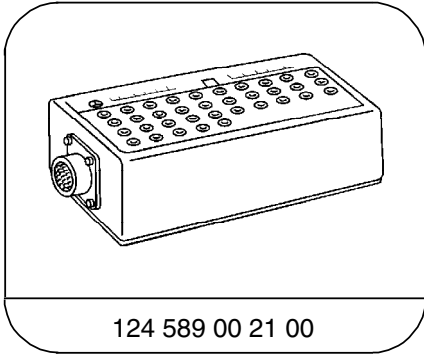
1. Ignition: **OFF**
2. Connect socket box to ignition control module (N1/3) with test cable set according to connection diagram.

Electric wiring diagrams, see Electrical Troubleshooting Manual.

5.1 Distributor Ignition System (DI)

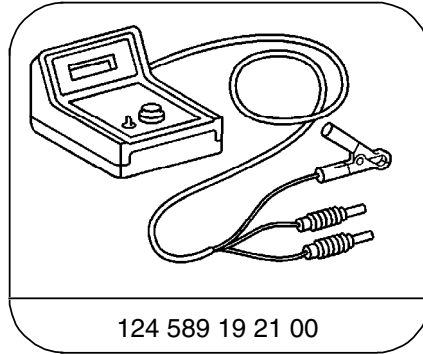
Engines 104, 119 CFI

Electrical Test Program - Preparation for Test



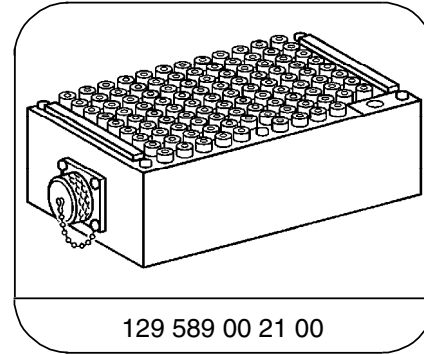
124 589 00 21 00

35-pin socket box



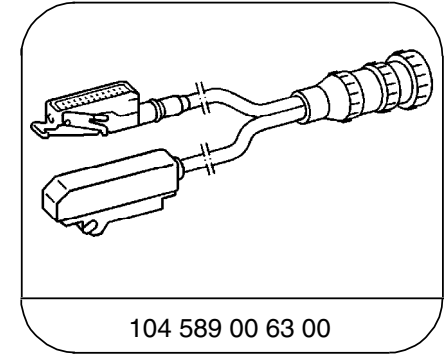
124 589 19 21 00

Pulse counter



129 589 00 21 00

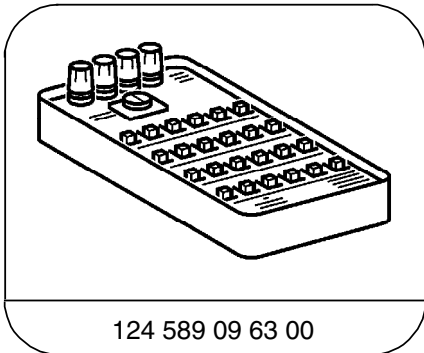
126-pin socket box



104 589 00 63 00

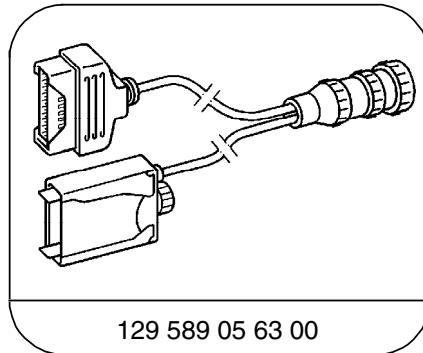
Test cable

Special Tools



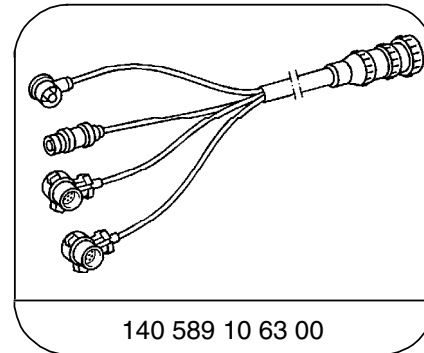
124 589 09 63 00

Ohm decade



129 589 05 63 00

22-pin test cable



140 589 10 63 00

Test cable

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Equipment

Digital multimeter ¹⁾	Sun DMM-5 Fluke model 23 with 80i-410 current probe
Engine analyzer ¹⁾	Bear DACE (Model 40-960) Sun EMT-1019/Master 3 Sun MCM-2110 Sun MEA-1500MB
Diagnostic interface adaptor unit ¹⁾	SUN, Bear

¹⁾ Available through the MBUSA Standard Equipment Program.

Electrical Test Program - Preparation for Test

Safety Precautions

The increased demands on the ignition systems of modern engines and the desire for maintenance-free operation have led to the introduction of electronic ignition systems.

As a rule, the sparking power of an electronic system is higher than a conventional system; additional increases in performance are characteristic of this type of system.

DANGER! Contact with high-voltage components or connectors can be fatal.

WARNING!

Therefore, when working on the distributor ignition system (DI), the following safety precautions must be observed:

- Before performing work that requires cranking the engine (e. g. compression test) turn off ignition and disconnect connector 2 on the ignition control module (N1/3) or connect safety plug, part no. 102 589 02 21 00 to diagnostic connector.
- Persons with pacemakers should not work on this type of ignition system.
- At cranking or idle speed, do not touch or disconnect any components of the ignition system.
- Perform installation work on the ignition system or ignition wires only when the engine/ignition is turned off (as well as connecting/disconnecting sensors only with the ignition switched off).
- No exposed metal connectors or sending units may be installed in the ignition wires (e.g. ignition wire, cylinder 1).

Electrical Test Program - Preparation for Test

Note:

- The sequence and respective values for test conditions of the “Ignition Timing Test” and “Diagnostic Trouble Code (DTC) Readout” must be observed.
- Within a test step, if, for example, the value for point 1 is ok, then proceed to point 2. If the value is not ok, you must then proceed to point 1.1.

A. Ignition Timing Test

1. Engine at operating temperature (70 – 90 °C). To avoid a false reading, simulate 320 Ω (80 °C engine coolant temperature) with the resistance substitution unit. (Simulate at both sets of sockets of connector for engine coolant temperature sensor B11/2 to prevent CFI control module from reading a temperature deviation and storing this as a malfunction).
2. Run engine for at least 8 seconds at 3100 – 3600 rpm with vacuum line connected.
3. Disconnect vacuum line with engine at idle.
4. Run engine for at least 2 seconds above 3100 rpm.
5. Record firing point at idle without vacuum.
6. Reconnect vacuum line and record firing point.

Important Note!

- Do not turn the engine off during this test procedure.

Engine 119:

- During the entire test, the engine analyzer must be set to “4 cylinder”.
- During diagnosis, e.g. evaluation of oscilloscope screen, power balance test, etc., the diagnostic interface adaptor unit must be switched between the engine analyzer and diagnostic connector (see connection diagram), as otherwise false readouts may occur.
- The ignition timing test can be performed with or without the diagnostic interface adaptor unit, whereby the engine analyzer must be set to “4 cylinder”.

Electrical Test Program - Preparation for Test

B. To Avoid Damage to the Ignition System

- To avoid damage to the ignition control module (N1/3), connect/disconnect the control module connectors only when the ignition is turned off.
- Do not connect a test lamp to circuit 1 of the ignition coil.
- Circuits 1 and 15 of the ignition coil may not be shorted to ground, e. g. theft deterrence.
- To avoid reversing polarity, the threads on the ignition coil have different diameters (M5 and M6).
- Only original equipment components should be installed in the ignition system.
- Do not operate the ignition system at cranking speed unless the ignition harness is completely connected.
- To avoid damage to the ignition control module (N1/3), the high output side of the ignition system must carry at least 2 k Ω of load (distributor rotor 1 k Ω , each connection on the distributor cap 1 k Ω). Do not install a 5 k Ω distributor rotor for noise suppression.
- Do not perform any tests (grounding ignition cable 4, disconnecting a spark plug connector or pulling cable 4 out of the ignition coil) at cranking or idle speed.

- To better dissipate heat, the ignition control module (N1/3) is installed with thermal paste on the wheel well. When exchanging the control module, do not remove the foil shield, it does not influence heat dissipation.
- If the circuit breaker is activated (power balance test), and the engine stalls, then the test procedure with this tester cannot be performed.
- When testing the ignition coil separately, do not load the coil with more than 28 kV in order to avoid damage to the coil.
- If assisting a disabled vehicle and it becomes necessary to perform an ignition spark test, perform this test only on one ignition cable/spark plug. Ensure good ground connection to the spark plug.

 **WARNING!**
High Voltage!

C. Using Test Equipment

- Ensure that the engine and ignition are turned off when connecting/disconnecting equipment such as voltage signal pick-up on ignition cable 4 and trigger pick-up on cylinder 1.

Electrical Test Program - Preparation for Test

Connection of Engine Analyzer Engine 104 CFI

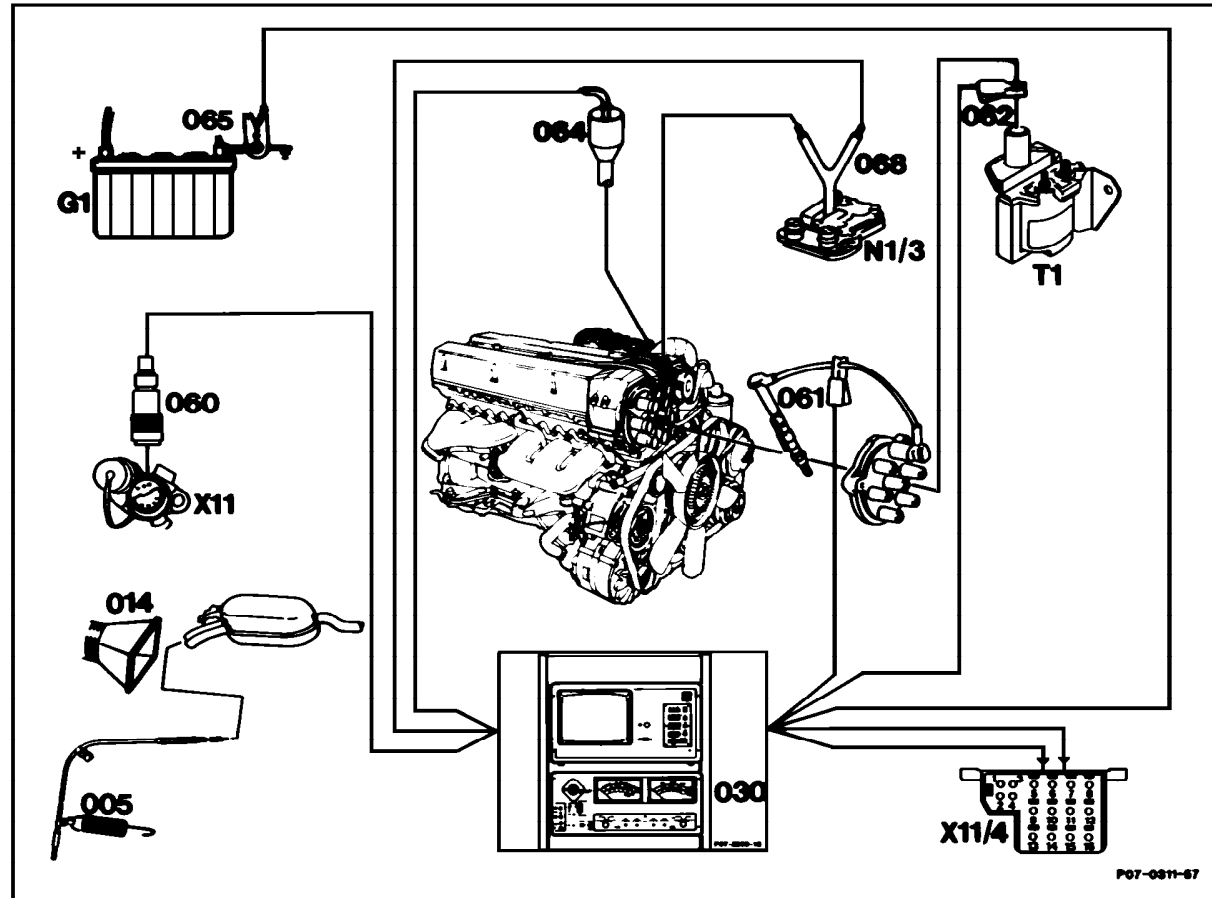


Figure 1

- G1 Battery
- N1/3 Ignition control module
- T1 Ignition coil
- X11 Diagnostic connector/terminal block (circuit TD)
- X11/4 Diagnostic connector, (DTC readout, 16-pole)
- 005 Oxygen sensor
- 014 Exhaust vent hose
- 030 Engine analyzer with oscilloscope
- 060 Diagnostic connector
- 061 Trigger clamp (cylinder 1)
- 062 Kilovolt clamp (on ignition coil)
- 064 Oil temperature gauge
- 065 DC inductive clamp
- 068 Y-adaptor (vacuum)

P07-0311-67

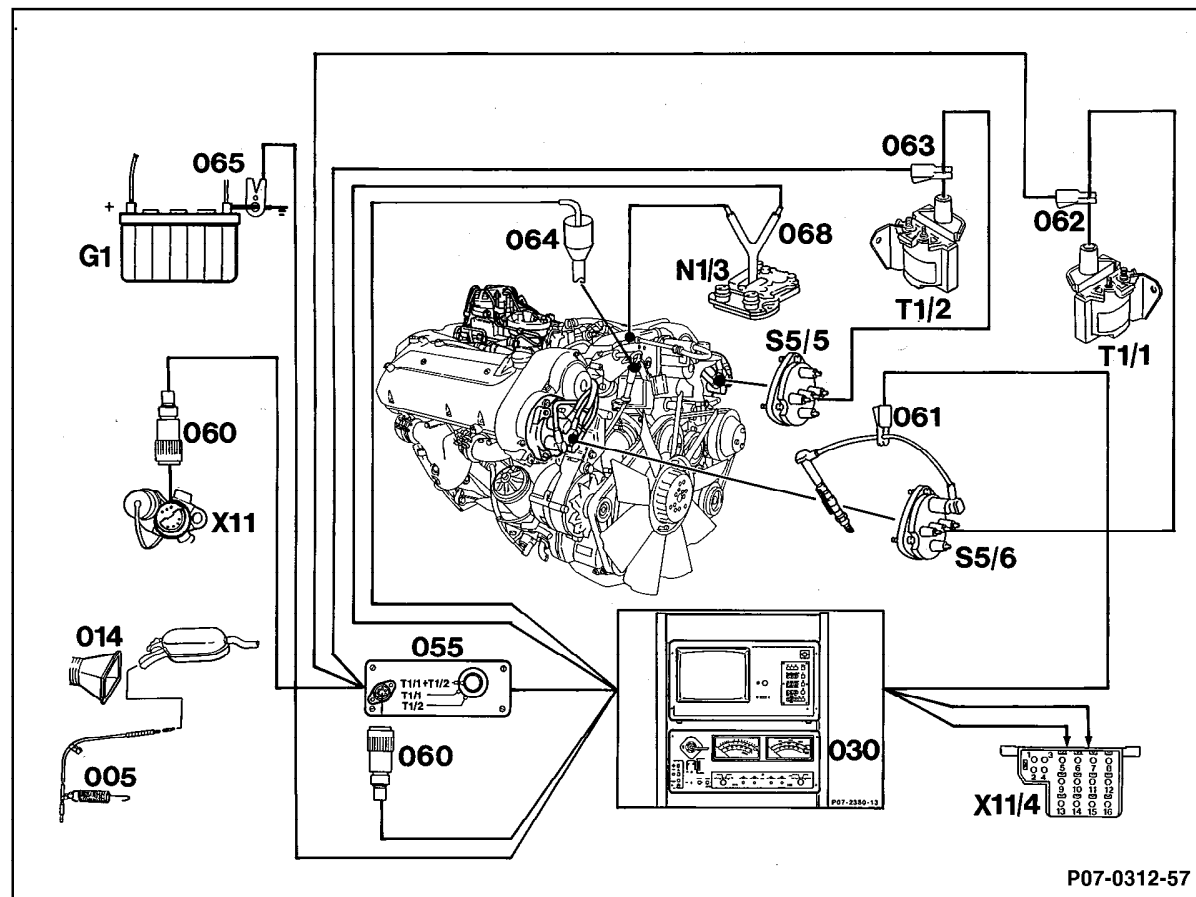
P07-0311-57

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Preparation for Test

Connection of Engine Analyzer Engine 119 CFI



P07-0312-57

P07-0312-57

Figure 2

- R4 Spark plugs
- N1/3 Ignition control module
- S5/5 Left high-voltage distributor
- S5/6 Right high-voltage distributor
- T1/1 Ignition coil 1 (right cylinder bank)
- T1/2 Ignition coil 2 (left cylinder bank)
- X11 Diagnostic connector/terminal block (circuit TD)
- X11/4 Diagnostic connector (DTC, 16-pole)
- 005 Oxygen sensor
- 014 Exhaust vent hose
- 030 Engine analyzer with oscilloscope
- 055 Diagnostic interface adaptor unit
- 060 Diagnostic connector
- 061 Trigger clamp (cylinder 1)
- 062 Right kilovolt clamp (on ignition coil)
- 063 Left kilovolt clamp (on ignition coil)
- 064 Engine oil temperature gauge
- 065 DC inductive clamp
- 068 Y-adaptor (vacuum)

Electrical Test Program - Preparation for Test

Connection Diagram – Socket Box, Ignition Control Module (N1/3)

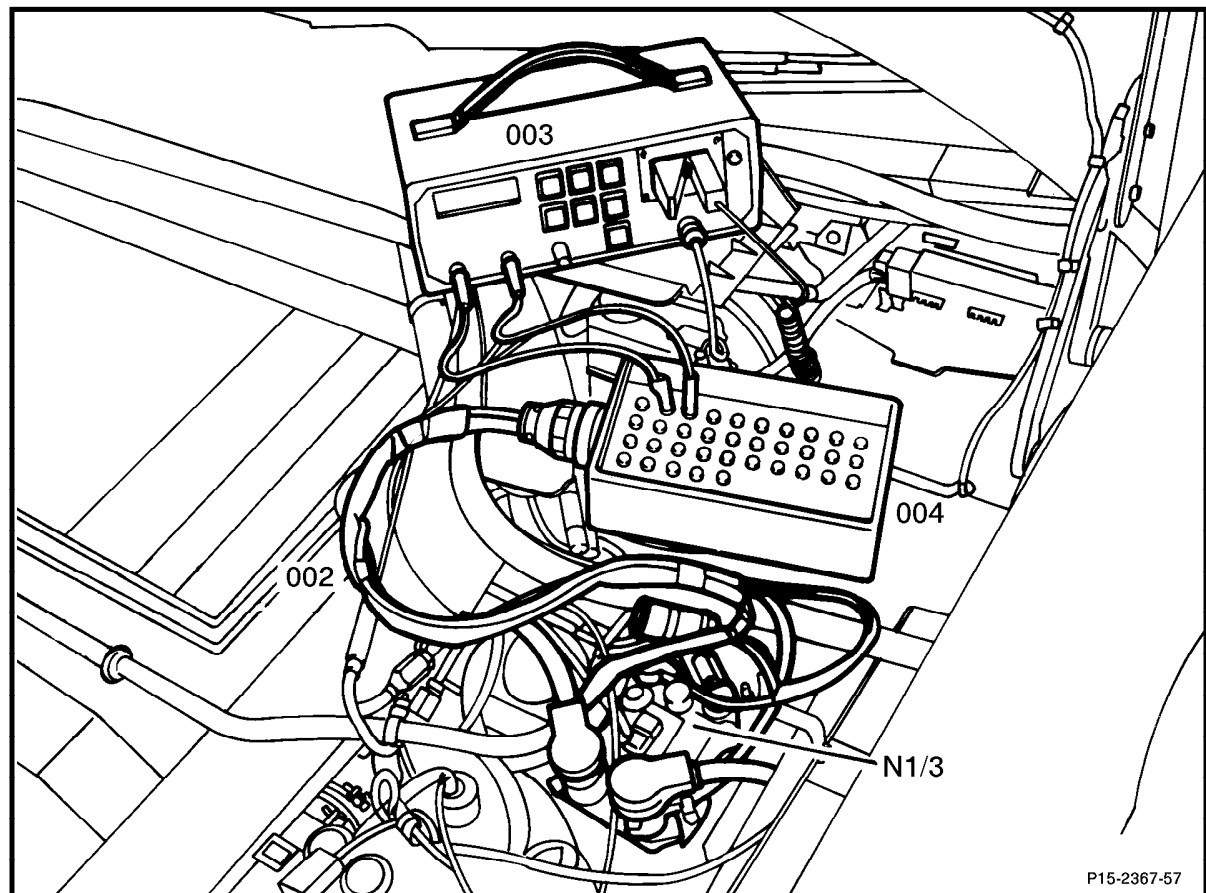


Figure 3

- 002 Test cable 140 589 10 63 00
- 003 Multimeter
- 004 Socket box (35-pole)
- N1/3 Ignition control module

P15-2367-57

P15-2367-57

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Preparation for Test

Connection Diagram - Socket Box, Engine Systems (MAS) and CFI Control Modules Engines 104, 119 CFI

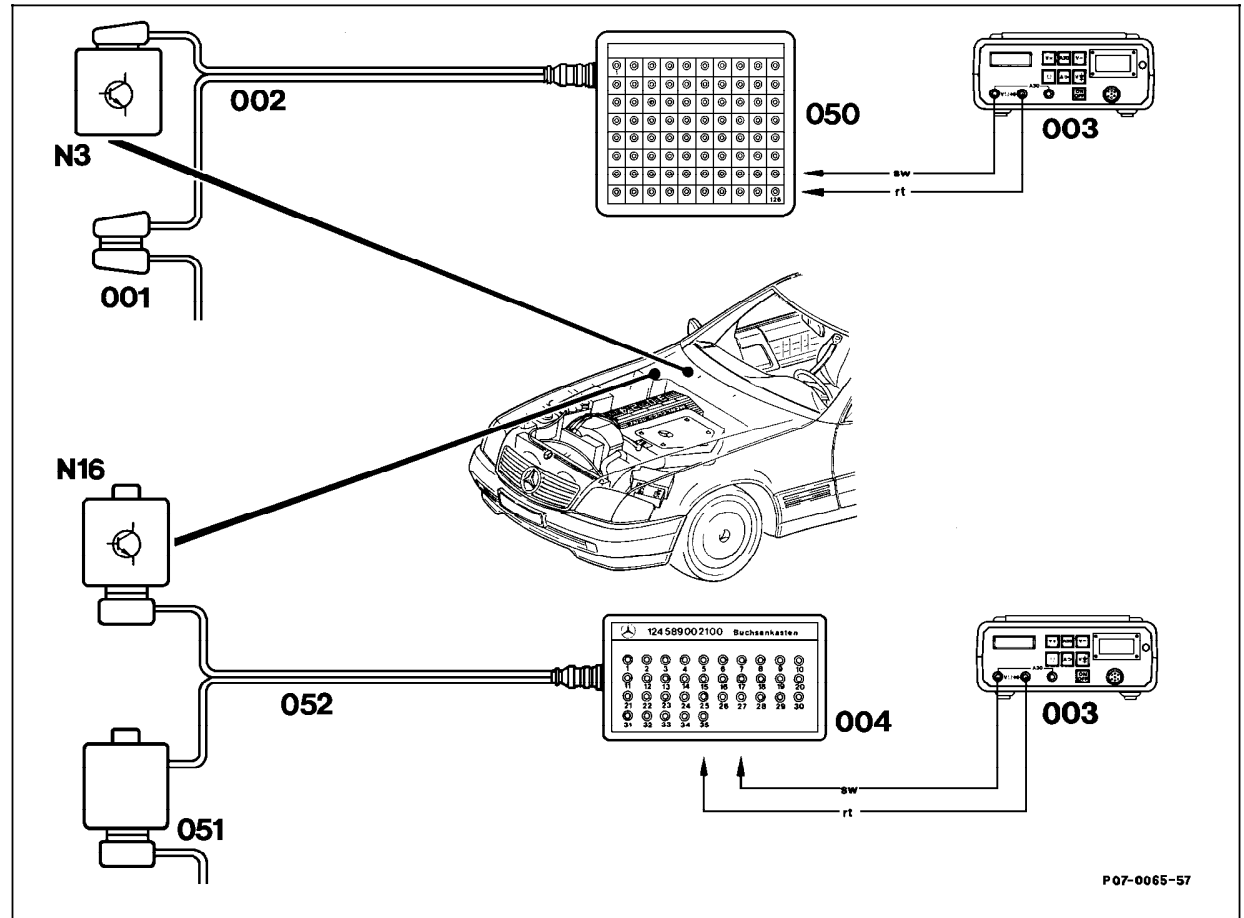


Figure 4

- 001 CFI control module connector
- 002 Test cable 104 589 00 63 00
- 003 Multimeter
- 004 Socket box (35-pole)
- 050 Socket box (126-pole)
- 051 Connector, engine systems control module (MAS)
- 052 Test cable 129 589 05 63 00
- N3 CFI control module
- N16 Engine systems control module (MAS)

P07-0065-57

P07-0065-57

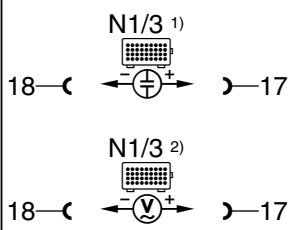

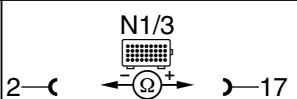
5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Test (Engine Does Not Run)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 1.0	Ignition control module (N1/3) Voltage supply	<p>N1/3 2 — (A.2) ← V → 3 (A.3)</p>	Connect socket box to N1/3. Ignition: ON	11 – 14 V	Wiring, ⇒ 1.1
⇒ 1.1	Ground connection at (W3) (left front wheelhousing)	<p>W3 ← V → 3 (A.3) N1/3</p>	Ignition: ON	11 – 14 V	Ground (W3) (left front wheelhousing)
⇒ 2.0	Engine 104: Ignition coil (T1) Voltage supply Engine 119: Ignition coil 1 (T1/1) (right cylinder bank) and ignition coil 2 (T1/2) (left cylinder bank) Voltage supply	<p>W3 ← V → T1 Cir. 15</p> <p>W3 ← V → T1/1 or T1/2 Cir. 15</p>	Ignition: ON Ignition: ON	11 – 14 V 11 – 14 V	Wiring

Electrical Test Program - Test (Engine Does Not Run)






Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 3.0 I1 3)	Crankshaft position sensor (L5)		Starter: Crank Starter: Crank	Signal, see 24, Figure 6 and 7. > 0.4 V	⇒ 3.1
⇒ 3.1 I1 3)	Resistance from crankshaft position sensor (L5)		Ignition: OFF	680 – 1200 Ω	Wiring, Crankshaft position sensor (L5) ⇒ 3.2
⇒ 3.2 I1 3)	Insulation of crankshaft position sensor (L5)		Ignition: OFF Unplug connector (2) for crankshaft position sensor (L5) at ignition control module (N1/3).	>20 kΩ	Crankshaft position sensor (L5), segments on starter ring gear (24, Figure 10).

1) Test with oscilloscope.




2) Test with multimeter only if oscilloscope is unavailable.

3) Diagnostic trouble code I1 is implemented in the ignition control modules only as of production code 946.

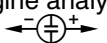
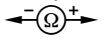
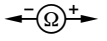
Electrical Test Program - Test (Engine Does Not Run)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 4.0	Dwell angle	Engine analyzer 	Engine: Start	M104 1 – 30° or 1 – 50 % M119 9 – 49° or 10 – 54 %	⇒ 3.0, ⇒ 4.1, Ignition control module (N1/3).
⇒ 4.1	Rest current shut-off Engine 104: Engine 119:	<p>Cir. 1  T1 Cir. 15</p> <p>Cir. 1  T1 Cir. 15</p> <p>Cir. 1  T1/1 or T1/2 Cir. 15</p> <p>Cir. 1  T1/1 or T1/2 Cir. 15</p>	<p>Ignition: ON</p> <p>Engine: Start</p> <p>Ignition: ON</p> <p>Engine: Start</p>	<p>0 V</p> <p>0.3 – 0.5 V</p> <p>0 V</p> <p>0.3 – 0.5 V</p>	<p>Ignition control module (N1/3) and ignition coil (T1)</p> <p>< 0.3 V: Open circuit in wire from ignition coil (T1) to N1/3, > 0.5 V: Ignition coil (T1)</p> <p>Ignition control module (N1/3) and T1/1 (right cylinder bank) or T1/2 (left cylinder bank).</p> <p>< 0.3 V: Open circuit in wire from ignition coil (T1/1 or T1/2) to N1/3, > 0.5 V: Ignition coil (T1/1 or T1/2).</p>




Electrical Test Program - Test (Engine Does Not Run)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 5.0	Ignition coil (T1) or ignition coil 1 (T1/1) (right cylinder bank) Primary voltage Engine 104: T1 Engine 119: T1/1	Engine analyzer  Primary pattern measurement range 400 V, duration 100%, voltage signal pick-up connected to ignition coil (T1 or T1/1).	Engine: Start	> 200 – 350 V	Ignition control module (N1/3), Ignition coil (T1 or T1/1).
⇒ 6.0 Engine 119 only!	Ignition coil 2 (T1/2) (left cylinder bank) Primary voltage	Engine analyzer  Primary pattern measurement range 400 V, duration 100%, voltage signal pick-up connected to ignition coil (T1/2).	Engine: Start	> 200 – 350 V	Ignition control module (N1/3), Ignition coil (T1/2).
⇒ 7.0	Primary voltage limitation	Engine analyzer  Secondary overload	Engine: Start Accelerate briefly to 3000 rpm.	see 24, Figure 27.	Ignition control module (N1/3).

Electrical Test Program - Test (Engine Does Not Run)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 8.0	Ignition coil (T1) or ignition coil 1 (T1/1) (right cylinder bank) Ignition voltage Engine 104: T1 Engine 119: T1/1	Engine analyzer  Secondary pattern measurement range 10 kV, duration 100%, voltage signal pick-up connected to ignition coil (T1 or T1/1).	Engine: Start	8 – 20 kV	⇒ 8.1
⇒ 8.1	Primary winding of ignition coil (T1) or ignition coil 1 (T1/1) Engine 104: T1 Engine 119: T1/1	T1 or T1/1 Cir. 1  Cir. 15	Ignition: OFF Disconnect wires of circuit 1 and 15 at ignition coil (T1 or T1/1).	0.3 – 0.6 Ω	Ignition coil (T1 or T1/1), ⇒ 8.2
⇒ 8.2	Secondary winding of ignition coil (T1) or ignition coil 1 (T1/1) Engine 104: T1 Engine 119: T1/1	T1 or T1/1 Cir. 1  Cir. 4	Disconnect wire of circuit 4 from ignition coil (T1 or T1/1).	8 – 13 kΩ	Ignition coil (T1 or T1/1), Ignition control module (N1/3).





Electrical Test Program - Test (Engine Does Not Run)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 9.0 Engine 119 only!	Ignition coil 2 (T1/2) (left cylinder bank) Ignition voltage	Engine analyzer  Secondary Pattern, measurement range 10 kV, duration 100%, voltage signal pick-up connected to ignition coil T1/2.	Engine: Start	> 8 kV	⇒ 9.1
⇒ 9.1	Primary winding of ignition coil 2 (T1/2)	Cir. 1  T1/2 Cir. 15	Ignition: OFF Disconnect circuits 1 and 15 from the ignition coil.	0.3 – 0.6 Ω	Ignition coil (T1/2), ⇒ 9.2
⇒ 9.2	Secondary winding of ignition coil 2 (T1/2)	Cir. 1  T1/2 Cir. 4	Disconnect cable for circuit 4 at ignition coil.	8 – 13 kΩ	Ignition coil (T1/2), Ignition control module (N1/3).

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI





Electrical Test Program - Test (Engine Does Not Run)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 10.0	High voltage distributor (S5/3) or left high voltage distributor (S5/5) Ignition voltage Engine 104: S5/3 Engine 119: S5/5	Engine analyzer  Secondary Parade, measurement range 20 kV, voltage signal pick- up connected to ignition cable for cylinder 5.	Engine: Start	8 – 20 kV	⇒ 10.1
⇒ 10.1	Distributor cap (individual terminals)	Distributor cap inside  outside center  center outside electrode	Ignition: OFF Remove distributor cap. Unplug ignition cables (Disconnect cables one at a time).	700 – 1300 Ω at each connection	Distributor cap, ⇒ 10.2
⇒ 10.2	Rotor	Rotor center  point	Distributor cap removed.	700 – 1300 Ω	Rotor.

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

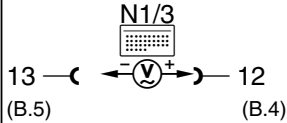
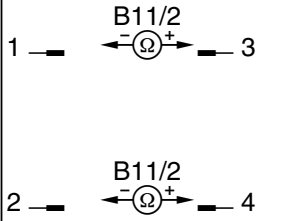
Electrical Test Program - Test (Engine Does Not Run)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 11.0 Engine 119 only!	Right high voltage distributor (S5/6) Ignition voltage	Engine analyzer  Secondary Parade, Connect voltage signal pick-up to ignition cable for cylinder 1.	Engine: Start	8 – 20 kV	⇒ 11.1
⇒ 11.1	Distributor cap (individual terminals)	Distributor cap inside  outside center  center outside electrode	Ignition: OFF Remove distributor cap. Unplug ignition cables (Disconnect cables one at a time).	700 – 1300 Ω at each connection	Distributor cap, ⇒ 11.2
⇒ 11.2	Rotor	Rotor center  point	Distributor cap removed.	700 – 1300 Ω	Rotor.
⇒ 12.0	Spark plugs	Visual inspection.	Ignition: OFF	Electrode gap 0.8 mm (0.032")	Replace as required.

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Test (Engine Runs)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 1.0 2	Maximum retard setting on at least one cylinder has been reached	—	—	—	Increased knock tendency, i.e. due to poor fuel quality, carbon build-up, mechanical damage.
⇒ 2.0 3 ¹⁾	Engine coolant temperature sensor (B11/2) Fault circuit		Ignition: ON	see table I.	Wires, Engine coolant temperature sensor (B11/2), ⇒ 2.1
⇒ 2.1	Resistance		Ignition: OFF Unplug connector on engine coolant temperature sensor (B11/2).	see table I.	Engine coolant temperature sensor (B11/2).
⇒ 3.0 4	Ignition control module (N1/3) Load sensor	Connect vacuum gauge.	Engine: at Idle	>450 mbar	Vacuum supply to N1/3 interrupted, Ignition control module (N1/3).
⇒ 4.0 5	Knock sensor (A16)	—	Ignition: OFF	—	Connector (1) for A16 not connected to ignition control module (N1/3), Knock sensor (A16).

¹⁾ DTC 3 is implemented in the ignition control modules made by Bosch, part no. 007 545 70 32, only as of production code 946.


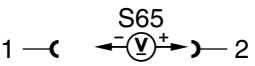
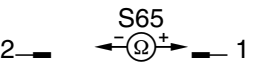
Electrical Test Program - Test (Engine Runs)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 5.0	Camshaft position sensor (L5/1) Signal		Engine: Start	Signal, see Figure 8. >0.25 V	⇒ 5.1
⇒ 5.1	Resistance of camshaft position sensor (L5/1)		Ignition: OFF Unplug test cable with connector B on N1/3.	900 – 1600 Ω	Wiring, Camshaft position sensor (L5/1), ⇒ 5.2
⇒ 5.2	Insulation of camshaft position sensor (L5/1)		Ignition: OFF Unplug test cable with connector B on N1/3.	> 20 kΩ	Wiring, Camshaft position sensor (L5/1).


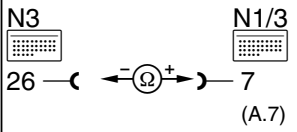
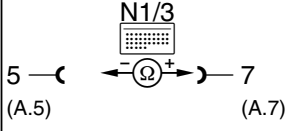

2) Test with oscilloscope.

3) Test with multimeter only if oscilloscope is unavailable.

Electrical Test Program - Test (Engine Runs)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 6.0  AT only!	Transmission overload protection switch (S65) Fault circuit	1 —  2	Plug on S65 connected. Unscrew threaded ring, push back rubber boot and measure voltage with points of multimeter leads. Parking brake set. Engine: at Idle Selector lever in transmission range: P/N D	P/N > 4.7 – 5.3 V D < 1 V	Wires, ⇒ 6.1
⇒ 6.1	Transmission overload protection switch (S65) Resistance	2 —  1	Unscrew connector on transmission overload protection switch (S65). Parking brake set. Engine: at Idle Selector lever in transmission range: P/N D	P/N > 20 kΩ D < 1 Ω	S65,


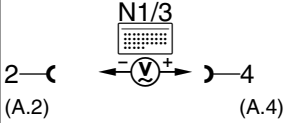
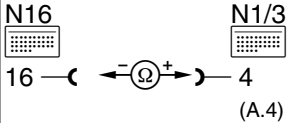
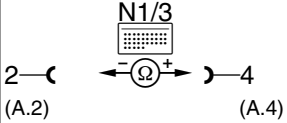
Electrical Test Program - Test (Engine Runs)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 7.0 	Data line between ignition control module (N1/3) and CFI control module (N3).	–	Visual inspection: Check if N1/3 and N3 are correctly matched.	see Parts Microfiche.	Data line from N1/3 to N3, ⇒ 7.1.
⇒ 7.1	Wire for continuity	 <p>N3 26 — Ω — 7 (A.7)</p>	Ignition: OFF	< 1 Ω	Data line from N1/3 to N3, ⇒ 7.2
⇒ 7.2	Wire shorted to ground	 <p>N1/3 5 — Ω — 7 (A.5) (A.7)</p>	Ignition: OFF	200 Ω	Data line from N1/3 to N3.
⇒ 8.0 	Reference resistor (R16/2)	–	Visual inspection: Check if R16/2 is properly installed and is correctly matched	Part number, 015 545 67 28.	⇒ 8.1


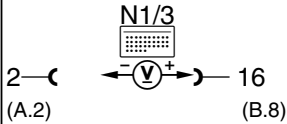
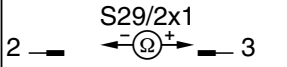
5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

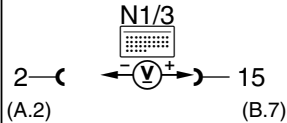
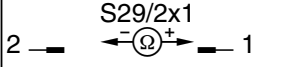
Electrical Test Program - Test (Engine Runs)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 8.1	Reference resistor (DI) (R16/2)		Ignition: OFF Unplug R16/2 from ignition control module (N1/3) (see Figure 2).	2.4 k Ω	Reference resistor (R16/2), If nominal value is obtained, replace ignition control module (N1/3).
⇒ 9.0 12	TN-signal		Engine: at Idle	6 V	⇒ 9.1
⇒ 9.1	Wire, TN-signal for continuity		Ignition: OFF	< 1 Ω	Wire from N1/3 to N16, ⇒ 9.2
⇒ 9.2	Wire, TN-signal shorted to ground		Ignition: OFF	200 Ω	Wire from N1/3 to N16, Ignition control module (N1/3).

Electrical Test Program - Test (Engine Runs)

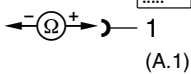
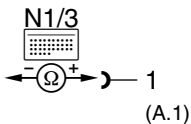
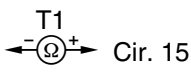
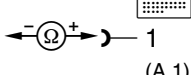
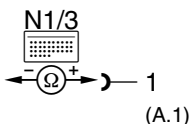
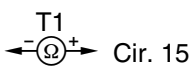
Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 10.0 	Wide open throttle/closed throttle position switch (S29/2) Wide open throttle contact		Ignition: ON Accelerator pedal position: Closed throttle Wide open throttle	11 – 14 V < 1 V	⇒ 10.1
⇒ 10.1	Wide open throttle/closed throttle position switch (S29/2)		Ignition: OFF Unplug connector (S29/2x1) on S29/2. Accelerator pedal position: Closed throttle Wide open throttle	> 20 kΩ < 1 Ω	Wiring, Wide open throttle/closed throttle position switch (S29/2).

Electrical Test Program - Test (Engine Runs)












Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 11.014 ⁴⁾	Wide open throttle/closed throttle position switch (S29/2) Closed throttle position contact		Vacuum line remains connected to N1/3. Ignition: ON Accelerator pedal position: Closed throttle Partial load	< 1 V 11 – 14 V	⇒ 11.1
⇒ 11.1	Wide open throttle/closed throttle position switch (S29/2) Resistance		Ignition: OFF Unplug connector (S29/2x1) on S29/2. Accelerator pedal position: Wide open throttle Closed throttle	> 20 kΩ < 1 Ω	Wiring, Wide open throttle/closed throttle position switch (S29/2).

⁴⁾ DTC 14 may be displayed even though there is no malfunction in the system. Control modules made by Bosch, part no. 007 545 70 32, as of production code 946 and those made by Siemens, part no. 007 545 71 32, as of production code 27/89, have had this problem corrected.

Electrical Test Program - Test (Engine Runs)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 12.0 15	Output in ignition control module (N1/3) Engine 104:	T1 Cir. 1 	Ignition: OFF Disconnect terminal 1 on ignition coil (T1) .	< 1 Ω	Wiring, Ignition coil (T1), Ignition control module (N1/3).
			> 20 kΩ		
		T1 Cir. 1 	Ignition: OFF Disconnect ignition coil (T1).	0.3 – 0.6 Ω	
	Output 1 in ignition control module (N1/3) Engine 119:	T1/1 Cir. 1 	Ignition: OFF Disconnect terminal 1 on ignition coil 1 (right cylinder bank) (T1/1) .	< 1 Ω	Wiring, Ignition coil (T1/1), Ignition control module (N1/3).
			> 20 kΩ		
		T1 Cir. 1 	Ignition: OFF Disconnect ignition coil (T1/1).	0.3 – 0.6 Ω	

Electrical Test Program - Test (Engine Runs)


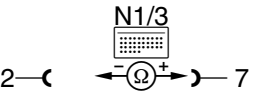
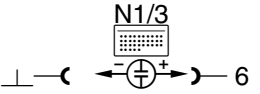
Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 13.0  Engine 119 only!	Output 2 in ignition control module (N1/3)	<p>T1/2  6 (A.6) Cir. 1 </p> <p> 2 (A.2)  6 (A.6)</p> <p>T1/2 T1/1 Cir. 1  Cir. 15</p>	<p>Ignition: OFF Disconnect terminal 1 on ignition coil 2 (left cylinder bank) (T1/2).</p> <p>Ignition: OFF Disconnect ignition coil (T1/2).</p>	<p>< 1 Ω</p> <p>> 20 kΩ</p> <p>0.3 – 0.6 Ω</p>	Wiring, Ignition coil (T1/2), Ignition control module (N1/3).
⇒ 14.0 	Crankshaft position sensor (L5)	<p>²⁾ 18  17</p> <p>³⁾ 18  17</p>	<p>Starter: Crank</p> <p>Starter: Crank</p>	<p>Signal, see Figures 6 and 7.</p> <p>> 0.4 V</p>	⇒ 14.1

2) Test with oscilloscope.

3) Test with multimeter only if oscilloscope not available.

5) DTC 17 is implemented in ignition control modules made by Bosch, part no. 007 545 70 32, only as of production code 946, and in control modules made by Siemens, only as of production code 27/89.

Electrical Test Program - Test (Engine Runs)

Test step DTC	Scope of test	Test connection	Test condition	Nominal value	Possible cause/remedy
⇒ 14.1	Resistance from crankshaft position sensor (L5)		Ignition: OFF Unplug connector (2) for L5 at ignition control module (N1/3) (see Figure 1).	680 – 1200 Ω	Wiring, Crankshaft position sensor (L5), ⇒ 14.2
⇒ 14.2	Insulation of crankshaft position sensor (L5)		Ignition: OFF Unplug connector (2) for L5 at ignition control module (N1/3) (see Figure 1).	> 20 kΩ	Crankshaft position sensor (L5), check flexplate segments.
⇒ 15.0 Engine 104 only!	Load signal for 5-speed automatic transmission to transmission control module (N15/1)	 <p>(A.6)</p> <p>Engine analyzer: Primary pattern, measurement range 40 V, duration 100%, auxiliary signal input.</p>	Engine: at Idle Electrical consumers shut off. Vacuum connection on ignition control module (N1/3) connected. Vacuum connection on ignition control module (N1/3) disconnected.	2 – 4 % (Table II) see Figure 25. 5 – 10 % (Table II) see Figure 26.	Ignition control module (N1/3), Vacuum line, Wiring.

Electrical Test Program - Test (Engine Runs)

Table I Engine coolant temperature sensor (B11/2) (4-pole)

Temperature (°C)	Resistance (Ω) at engine coolant temperature sensor (B11/2)	Voltage (V) at engine coolant temperature sensor (B11/2)
- 20	15700	5.12 – 5.60
- 10	10000	4.49 – 5.11
0	5900	4.12 – 4.48
10	3700	3.77 – 4.11
20	2500	3.36 – 3.76
30	1700	2.92 – 3.35
40	1170	2.51 – 2.91
50	830	2.09 – 2.50
60	600	1.69 – 2.08
70	435	1.36 – 1.68
80	325	1.09 – 1.35
90	245	0.88 – 1.08
100	185	0.75 – 0.87

Electrical Test Program - Test (Engine Runs)

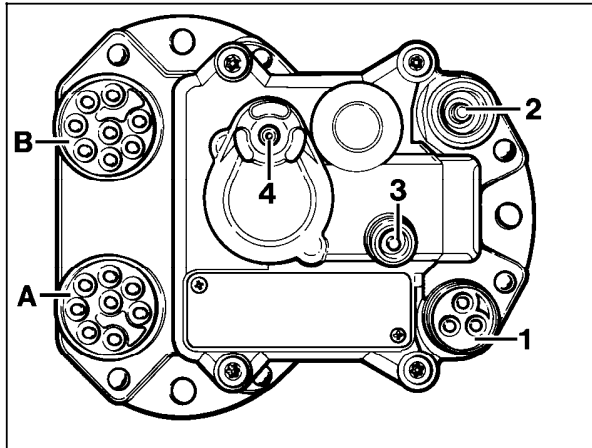
Table II Load signal from ignition control module to transmission control module (N15/1)

Engine speed rpm	Load signal with vacuum (mbar)				Load signal without vacuum (mbar)			On-off ratio %
	200	300	400	500	800	900	1000	
600	1.1	1.8	2.5	3.3	5.4	6.1	6.2	
650	1.2	2.0	2.7	3.6	5.8	6.6	7.4	
700	1.3	2.1	2.9	3.8	6.3	7.1	8.0	
750	1.4	2.3	3.1	4.0	6.8	7.7	8.6	

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

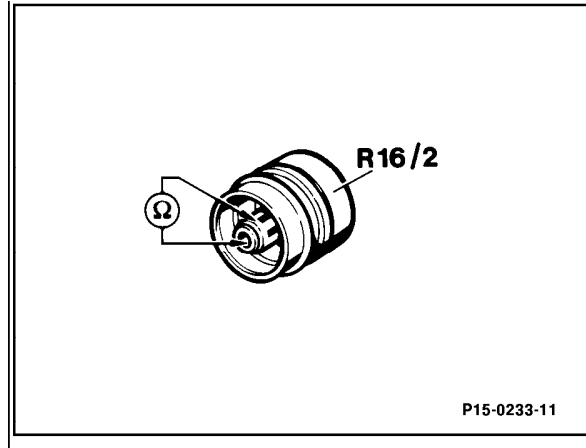
Electrical Test Program - Test (Engine Runs)



P15-2030-13A

Figure 1

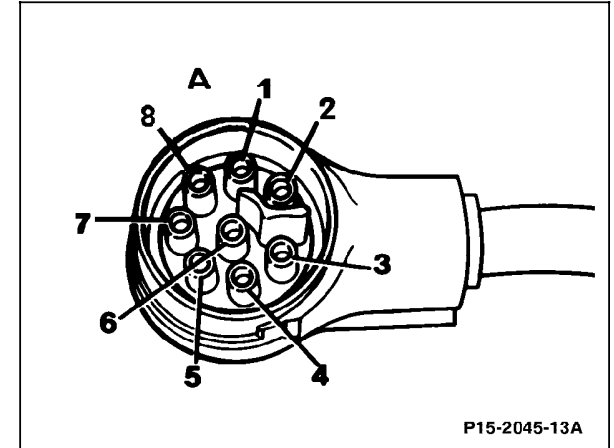
- A 8-pole plug connection
- B 8-pole plug connection
- 1 Connection for knock sensors (A16)
- 2 Connection for crankshaft position sensor (L5)
- 3 Connection for reference resistor (R16/2)
- 4 Vacuum connection



P15-0233-11

Figure 2

R16/2 Reference resistor



P15-2045-13A

Figure 3

N1/3 Connector A for ignition control module

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Test (Engine Runs)

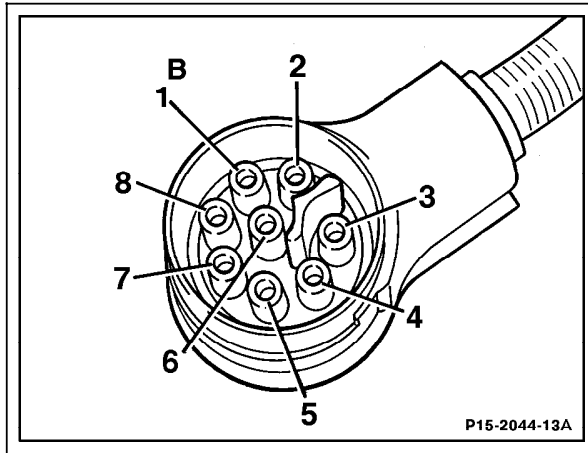


Figure 4 P15-2044-13A

N1/3 Connector B for ignition control module

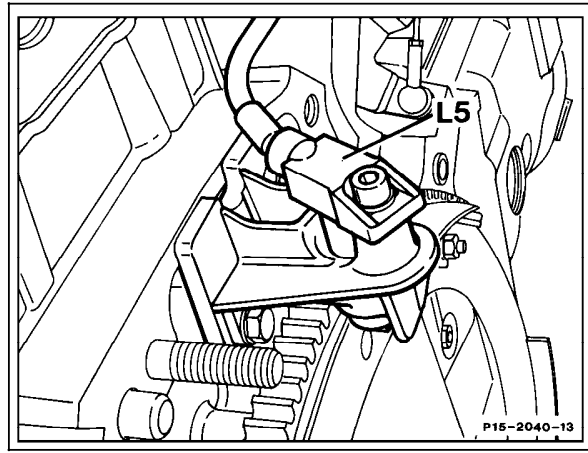


Figure 5 P15-2040-13

Crankshaft position sensor (L5) connector

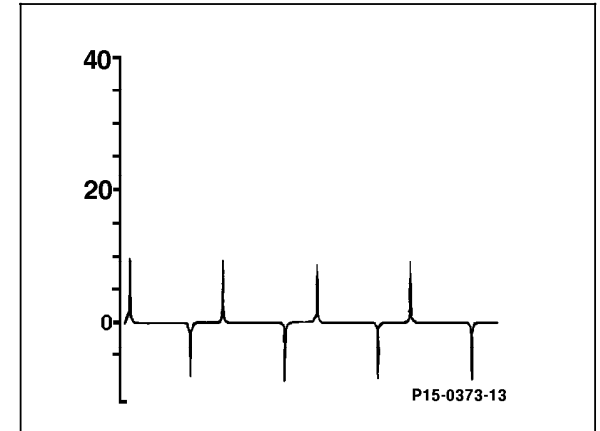
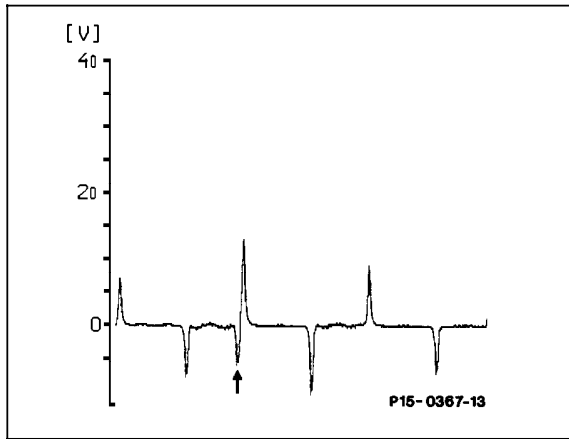


Figure 6 P15-0373-13
Engine 104

L5 Crankshaft position sensor signal

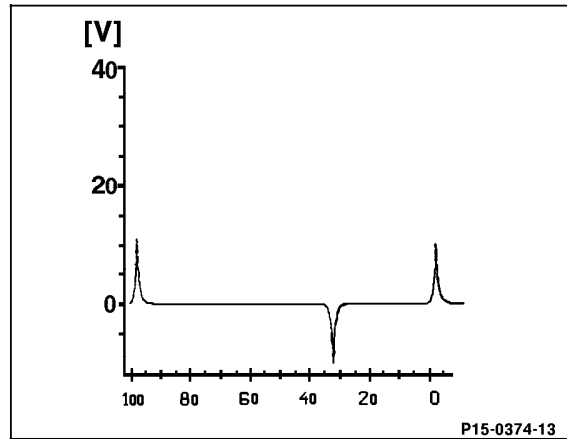
Electrical Test Program - Test (Engine Runs)



P15-0367-13

Figure 7

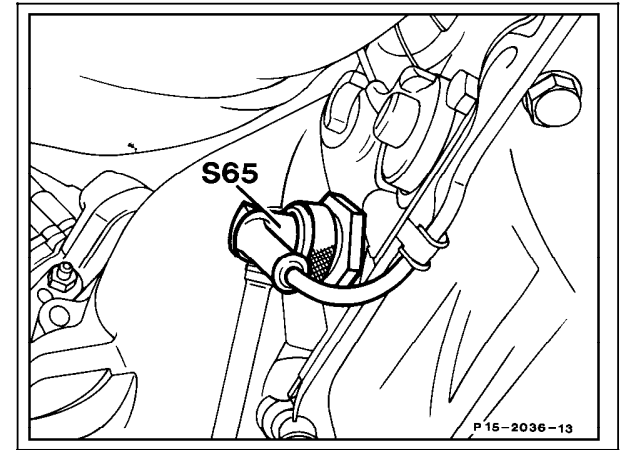
L5 Crankshaft position sensor sensor signal (magnet, arrow)



P15-0374-13

Figure 8

L5/1 Camshaft position sensor sensor signal



P15-2036-13

Figure 9

S65 Transmission overload protection switch, brake band B1

Electrical Test Program - Test (Engine Runs)

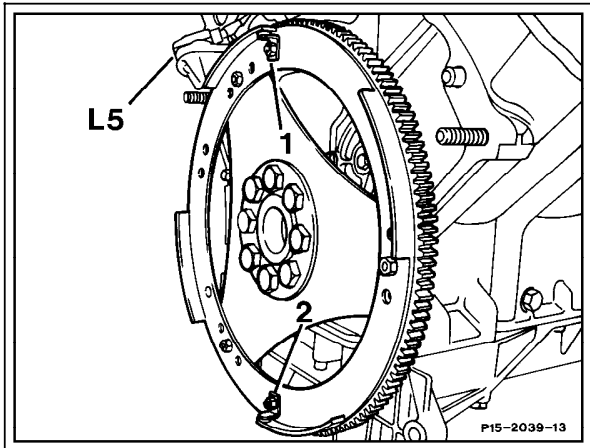


Figure 10
Crankshaft position sensor (L5) segments with magnets 1 and 2

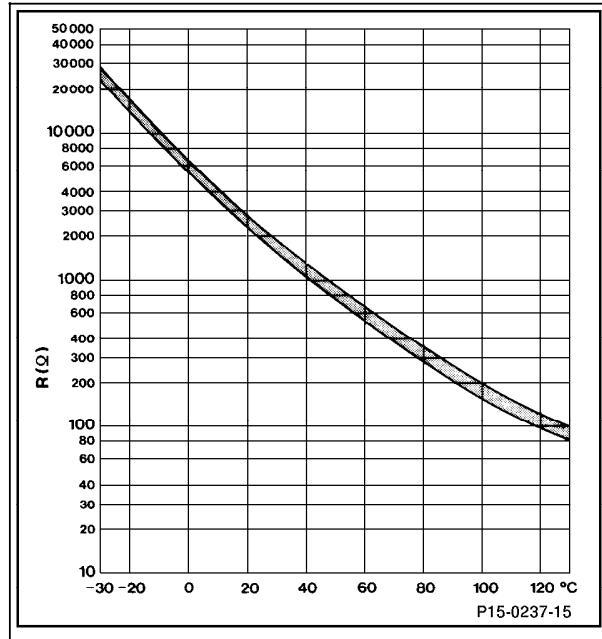


Figure 11
B11/2 Diagram, engine coolant temperature sensor (4-pole)

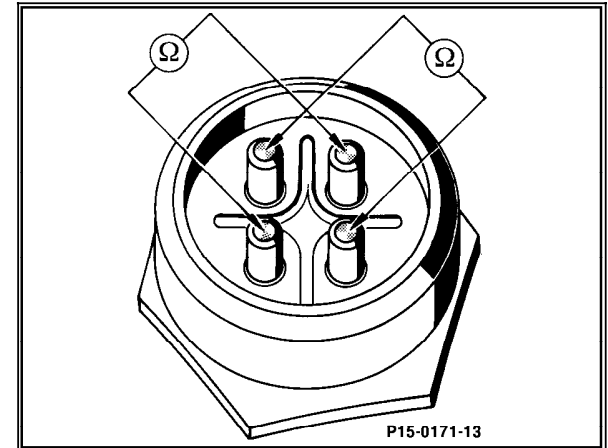


Figure 12
B11/2 Engine coolant temperature sensor (4-pole)

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Test (Engine Runs)

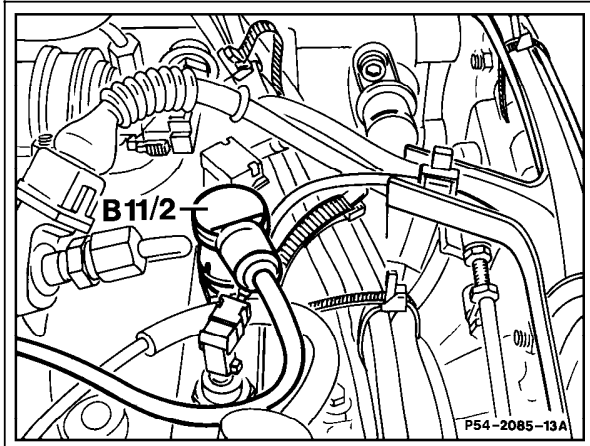


Figure 13 P54-2085-13A

B11/2 Engine coolant temperature sensor (4-pole)

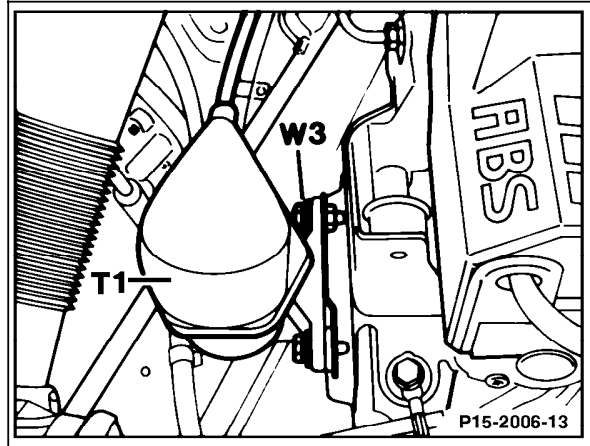


Figure 14
Engine 104

T1 Ignition coil

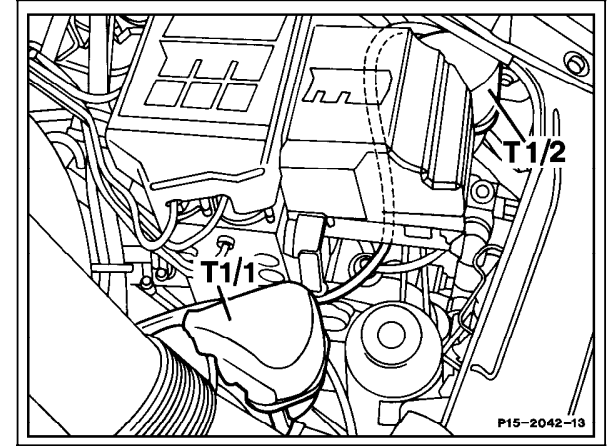


Figure 15
Engine 119

T1/1, T1/2 Ignition coil 1 and ignition coil 2

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Test (Engine Runs)

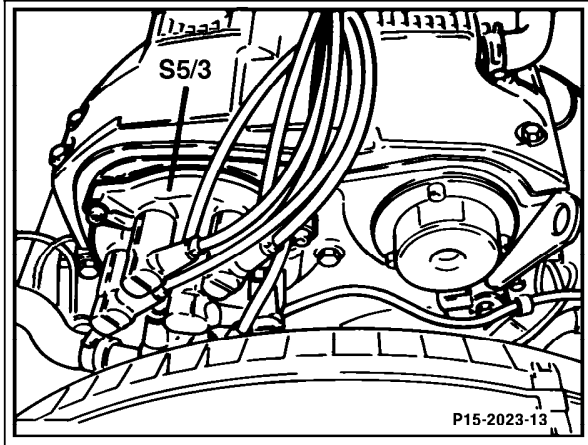


Figure 16
Engine 104
S5/3 High-voltage distributor

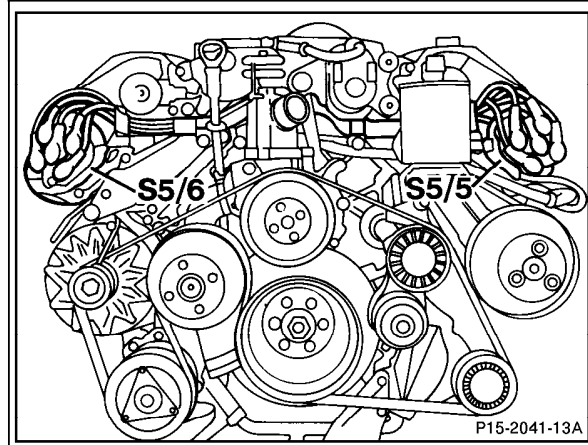


Figure 17
Engine 119
S5/5, S5/6 High-voltage distributor (left, right)

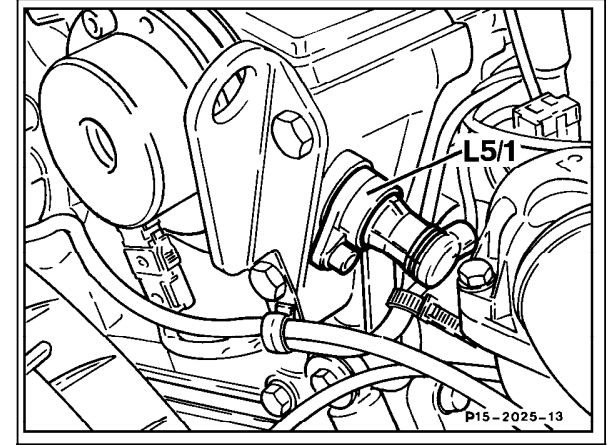


Figure 18
Engine 104
L5/1 Camshaft position sensor

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Test (Engine Runs)

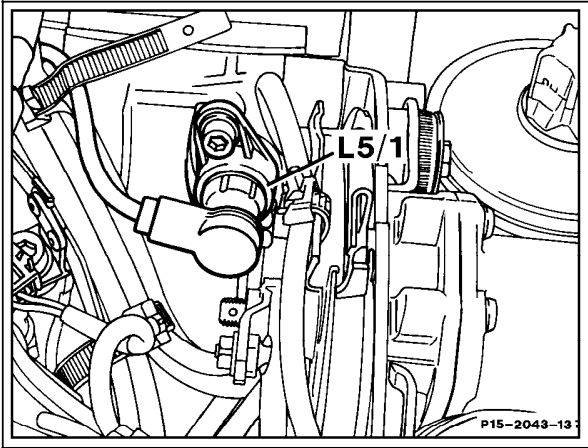


Figure 19
Engine 119

L5/1 Camshaft position sensor

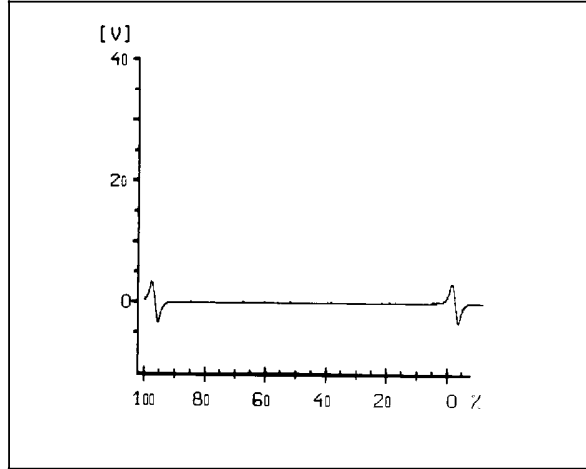


Figure 20
P15-5093-13

Camshaft position sensor (L5/1) signal

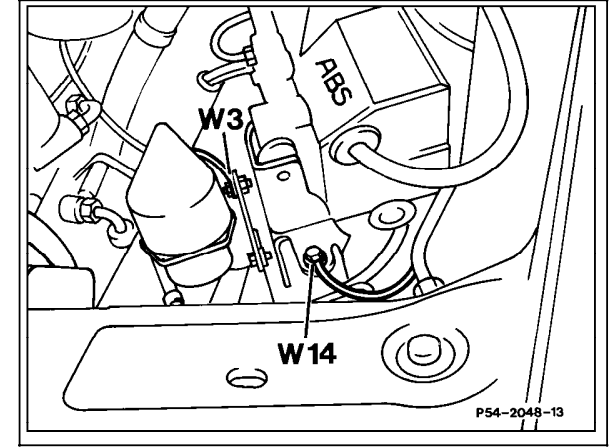


Figure 21
P54-2048-13

W3 Ground (left front wheelhousing at ignition coil)

5.1 Distributor Ignition System (DI)

Engines 104, 119 CFI

Electrical Test Program - Test (Engine Runs)

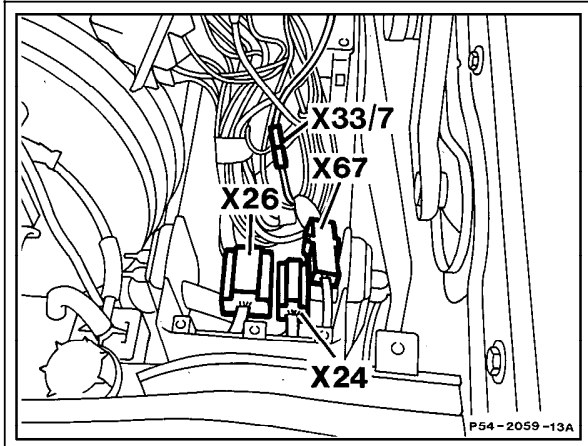


Figure 22

P54-2059-13A

X24 Headlamp harness connector (6-pole)
X26 Interior/engine connector

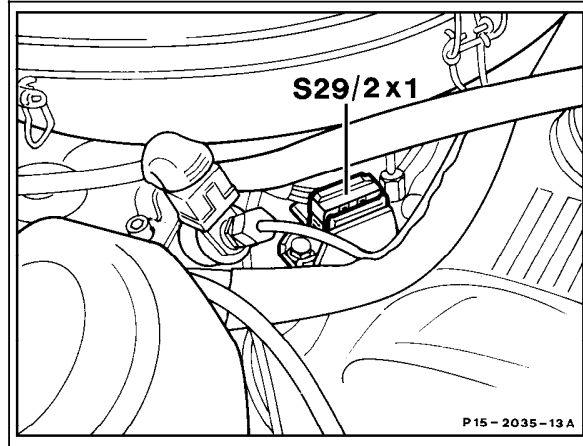


Figure 23

P15-2035-13A

S29/2x1 Wide open throttle/closed throttle position switch connector

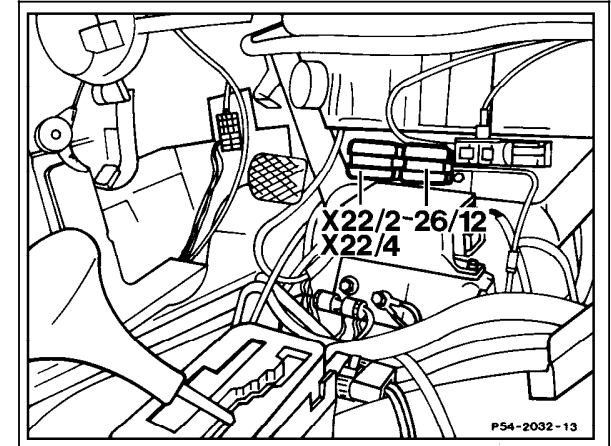


Figure 24

P54-2032-13

X22/2 Connector, automatic transmission/engine (8-pole)

Electrical Test Program - Test (Engine Runs)

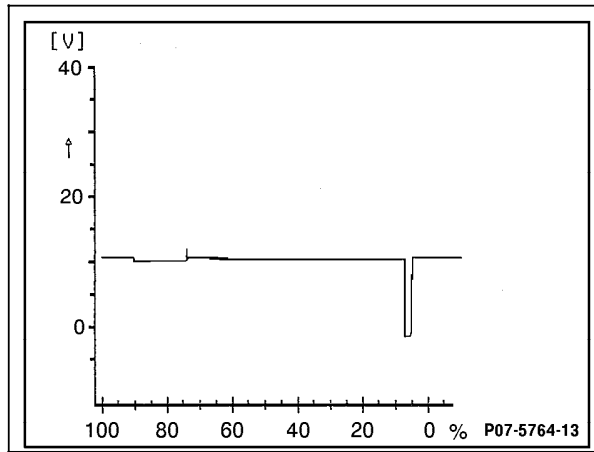


Figure 25
Engine 104

Load signal to automatic transmission control module (N15/1) with vacuum line connected at ignition control module (N1/3)

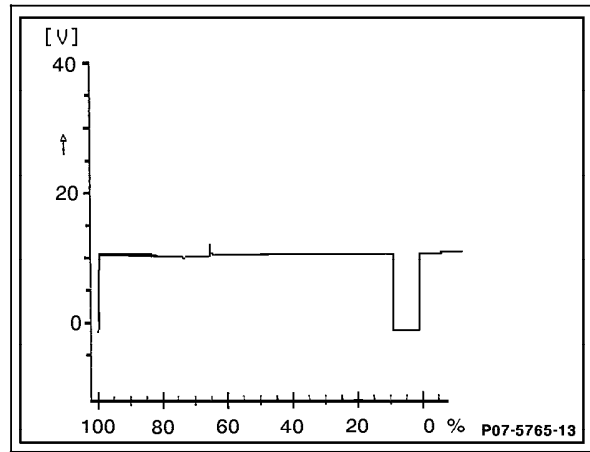


Figure 26
Engine 104

Load signal to automatic transmission control module (N15/1) with vacuum line disconnected at ignition control module (N1/3)

Electrical Test Program - Test (Engine Runs)

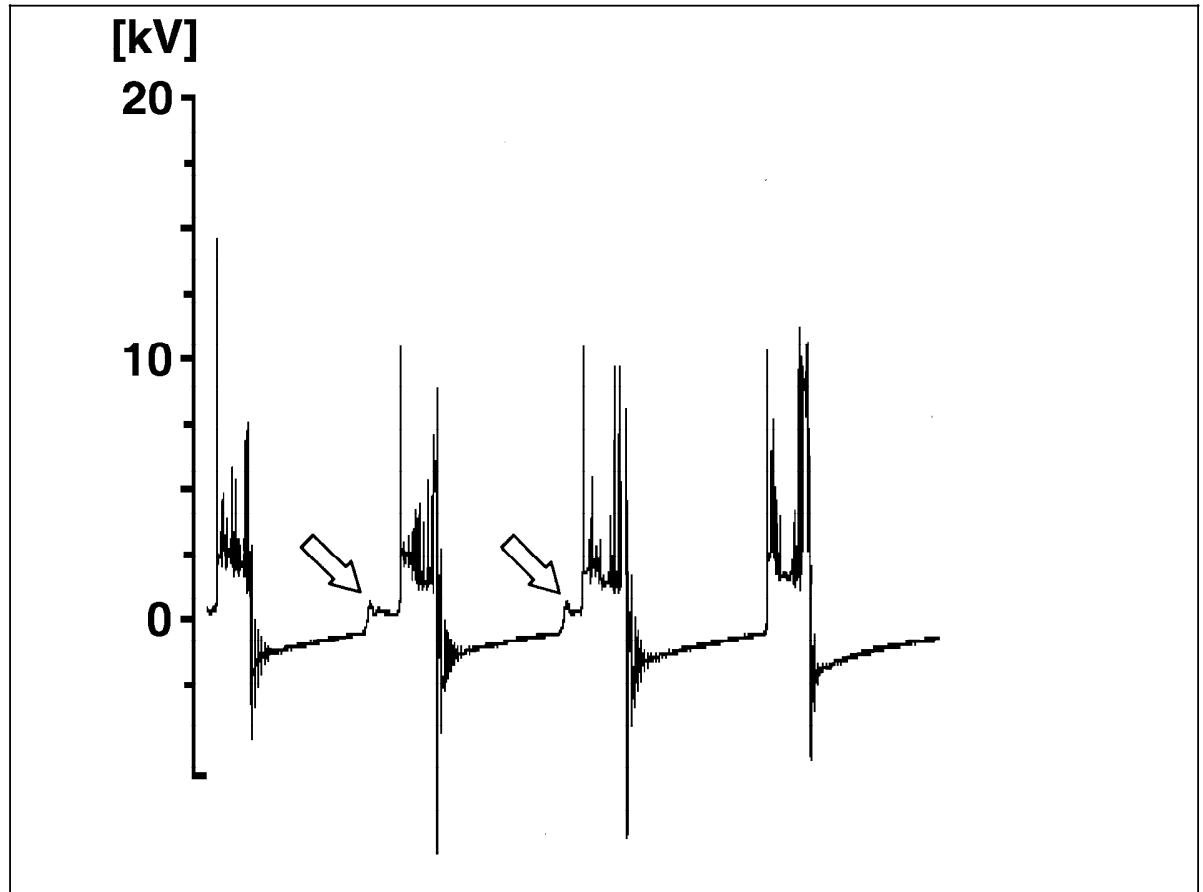


Figure 27

Primary circuit voltage limitation, secondary overload

P15-0012-57