1.1 Engine 104

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Diagnosis - Diagnostic Trouble Code (DTC) Memory

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

Note regarding diagnostic trouble code (DTC) readout:
The engine control module (N3/4) for the HFM-SFI system is equipped with diagnostic trouble code (DTC) memory. Malfunctions are recognized and stored as trouble codes and are distinguished as follows:

- Malfunctions which are constantly present,
- Malfunctions which occur longer than 3 seconds,
- Intermittent contact malfunctions which have occured 5× during a trip.

The DTC memory remains active even if the vehicle's battery is disconnected.

Malfunctions which are no longer present, are automatically erased again after a maximum of 19 trips. A trip has occured if:

- Vehicle speed >4 km/h (2.5 mph),
- Engine speed >700 rpm,
- Engine shut off for 30 seconds.

The stored diagnostic trouble codes (DTCs) can be read at the data link connector (X11/4) with the ignition switched "ON" or with the "engine running".

Diagnosis via an on-off ratio readout has been eliminated.

Note regarding mixture preparation self-adaptation:
The Lambda control system determines fuel injection duration precisely so that the fuel/air ratio is kept constant at Lambda level 1 (equals 14.7 kg air to 1 kg fuel) under all operating conditions.
Should malfunctions occur in the form of:

- Intake air leaks,
- Injector wear or carbon build-up,
- Engine wear,
- Contact resistance in MAF sensor,
- Defective diaphragm pressure regulator,
- Defective purge control valve,

the engine control module automatically performs a mixture adjustment. The degree of correction is calculated constantly and stored permanently. The self-adaptation is performed at idle and under partial load. Maximum correction towards rich or lean is 25%. After repair work is performed, the engine control module will automatically adapt itself again after approx. 10 trips. After eliminating a malfunction or after trial installation of an engine control module from another vehicle, the self-adaptation feature must be reset to its mean value (see "Resetting and Reactivating Engine Control Module Memory" 11/5).

Diagnosis - Diagnostic Trouble Code (DTC) Memory

Note regarding automatic recognition of vehicle equipment and/or version on vehicles up to 02/94 (up to HHT Diagnosis Version 42):
The engine control module recognizes and stores the following equipment and/or version information during the vehicle's initial operation:

- Catalytic converter/non-cataytic converter,
- Manual/automatic transmission,
- 4-Speed/5-speed automatic transmission,
- Cruise control,
- Electronic accelerator,
- (USA) version.

After replacing the engine control module or after trial installation of an engine control module from another vehicle, the stored data must be erased and the recognition feature reactivated (see "Resetting and Reactivating Engine Control Module Memory" 11/5).

Initial programming of engine control module.

Prerequisite for initial programming process:

- Battery voltage ⇒ 11 Volt minimum
- Vehicle speed signal ⇒ V = 0
- Engine rpm signal ⇒ n = 0
- Transmission range ⇒ P/N = 1
- Idle speed contact closed ⇒ CTP = 1
  (Caution: Vehicle can not be moved during initial programming process)
- Drive vehicle ⇒ V = > 5 km/h (3 mph)
  (Only then will the transmission version be recognized).

Note regarding version coding on vehicles as of 03/94 (as of HHT Diagnosis Version 45):
The engine control module is equipped with a version coding feature as of 03/94. The coding must be performed with the Hand-Held Tester (automatically or manually, see Notes for HHT 11/4) upon installation of a new control module.
The following vehicle version data must be determined for coding:

- Vehicle model,
- Catalytic converter (TWC),
- Non-catalytic converter (non-TWC),
- 5-speed manual transmission,
- 4-speed automatic transmission,
- 5-speed automatic transmission,
- Cruise control (CC),
- Acceleration slip regulation (ASR),
- Electronic traction system (ETS),
- Country version.

Diagnosis - Diagnostic Trouble Code (DTC) Memory

Note regarding drive authorization system (DAS):

- Up to the end of model year 1995, a starter lock-out system is installed which interrupts circuit 50 to the starter.

- On vehicles starting model year 1996 (HHT Diagnosis Version 46), the RCL system is enhanced with a so-called drive authorization system stage 2.
  The activation of the drive authorization system (DAS) is initiated by the RCL control module and transmitted to the engine control module via the CAN data bus.
  After activation of the drive authorization system (DAS), the fuel injection system is rendered inoperative by the engine control module.
  The drive authorization system (DAS) can be activated or deactivated with the infrared remote control transmitter or the master key.
  The engine control module and RCL control module are permanently locked with one another by an identification code. This identification code can not be erased (see HHT actual values “DAS“ menu selection 3/6).
  Therefore, trial installation of an engine control module or RCL control module from <u>another</u> vehicle is no longer possible.

  ⚠ **CAUTION!**
  If a **new** engine control module is installed for test purposes only, a maximum of 40 engine starts can be performed before the control modules are **permanently** locked with one another. **After 40 engine starts, the engine control module can no longer be used in any other vehicle.**

  Additionally, the code number and VIN must be entered (see HHT actual values “DAS”, menu selection 3/6).

Diagnosis - Diagnostic Trouble Code (DTC) Memory

Notes for HHT

- **Fault search with HHT**
  Diagnostic trouble code (DTC) memory: Select “Current DTC’s”.
  If the actual condition changes, e.g. when wiggling a connector, the change is reported optically and acoustically so that troubleshooting can be performed directly with the HHT.
- **Loose connections**
  Loose connections are stored if they occur several times in a certain time period. Therefore, they can appear only as “Stored DTC’s” and never as “Current DTC’s”.
- **Nominal values**
  All nominal values relative to the actual values shown on the HHT are listed in the Diagnostic Manual, Engines, Volume 1, section A.
- **Actual values for engine coolant temperature, intake air temperature and air mass**
  In case of an open or short circuit, the actual value is immediately replaced by a substitute value which is very close to the actual value. Therefore, a fault can not be recognized clearly. A readout of the fault is possible only via the diagnostic trouble code (DTC) memory.
- **Actual value for engine rpm**
  In case of the engine rpm’s, the HHT display indicates the closed throttle (idle) speed nominal value calculated by the control module on the left and on the right, the rpm actual value. Both values should differ from each other only slightly. The permissible tolerances are not yet determined.
- **Version coding with HHT as of 03/94 (as of HHT Diagnosis Version 45).**

  a) Before replacement of the engine control module, the existing code number must be read and stored with the HHT (menu selection 6 “Version coding”). After installation of the new control module, the previously read code number must be entered.
  Note:
  If returning a new control module to a PDC, the code number must be erased.

  b) If the code number can **not** be read, the vehicle equipment/version must be determined, the corresponding code number obtained from the Spare Parts Microfiche, Group 54 and manually entered with the HHT.

  c) When performing a trial installation of a control module with the same part number from another vehicle (to end of model year 1995), but with a different code number, the following must be observed:
  - Read and record code number from vehicle with complaint.
  - Exchange control modules.
  - Read and record code number from the exchanged control module.
  - Enter the code number from the original control module into the exchange control module.
  - Perform function test.
  - Before returning control module to other vehicle, enter recorded code number into exchange control module.
  - Exchange control modules.

Diagnosis - Diagnostic Trouble Code (DTC) Memory

Notes for HHT (continued)

- **Drive authorization system (DAS)**
  Upon replacement the engine control module must be version coded using the HHT. Additionally, the code number and VIN must be entered (see HHT nominal values “DAS”, menu selection 3/6).

Preparation for Test with Impulse Counter Scan Tool
Note:
The DTC memory readout, DTC memory clearing as well as resetting and reactivating the engine control module can be performed with the impulse counter scan tool only on vehicles up to HHT Diagnosis Version 46. On vehicles as of HHT Diagnosis Version 49, it is possible only with the HHT.

- Connect impulse counter scan tool to data link connector (X11/4) according to connection diagram.

Reading Diagnostic Trouble Code (DTC) Memory

a) Ignition: **ON**
b) Press start button for 2 to 4 seconds.
c) Read and record DTC.
d) Press start button again.
e) Read and record DTC.
Repeat steps d) and e) until the first DTC reappears.

Clearing Diagnostic Trouble Code (DTC) Memory

a) Press start button for 2 to 4 seconds (DTC appears).
b) Press start button for 6 to 8 seconds, thereby clearing the previously displayed malfunction (DTC) from memory.
c) Repeat steps a) and b) until the number “I” appears (no malfunctions stored).

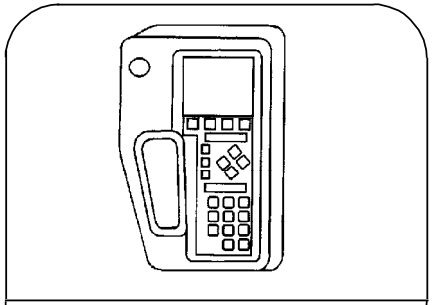
Resetting and Reactivating Engine Control Module Memory

a) Clear diagnostic trouble code (DTC) memory.
b) After the number “I” appears, press start button for 6 to 8 seconds.
c) Switch ignition **OFF** and wait a minimum of 2 seconds.
d) Turn ignition **ON**, wait a minimum of 10 seconds and then start engine.

Note:
Control modules manufactured by Bosch up to 8/93, the start button must be pressed 5 to 6 seconds to clear the DTC memory and 8 to 9 seconds to reset and reactivate the engine control module memory.

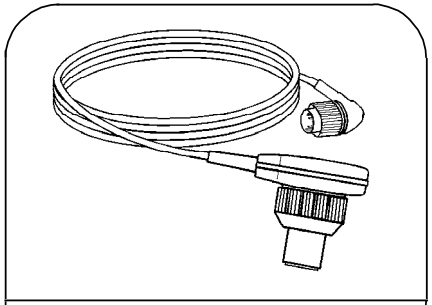
Diagnosis - Diagnostic Trouble Code (DTC) Memory

Special Tools



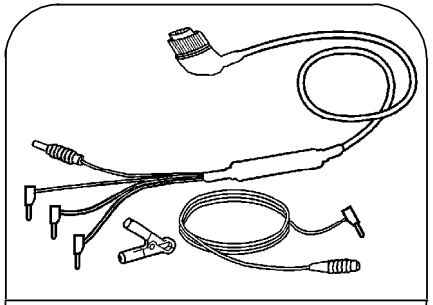
965 589 00 01 00

Hand-Held-Tester



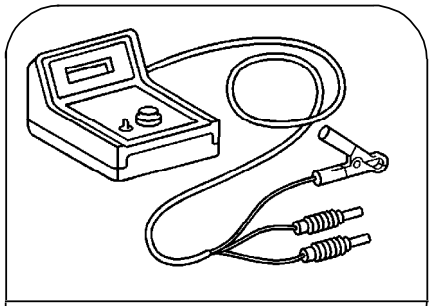
965 589 00 40 00

Test cable



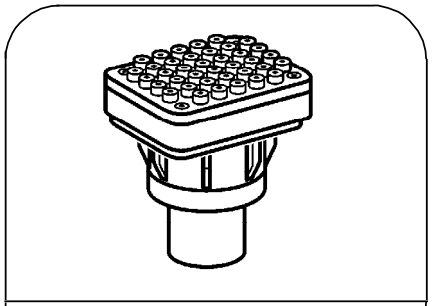
965 589 00 50 00

Adapter cable



124 589 19 21 00

Pulse counter



140 589 14 63 00

Adapter

Diagnosis - Diagnostic Trouble Code (DTC) Memory

Connection Diagram - Impulse Counter Scan Tool/ Hand-Held Tester (HHT)
Model 124

Impulse counter scan tool

Black wire circuit 31 (ground)	Socket 1
Red wire circuit 15 (ignition)	Socket 16

Hand-Held Tester (HHT)

Black wire circuit 31 (ground)	Socket 1
White wire circuit 15 (ignition)	Socket 16
Red wire circuit 30	Battery + or X4/10

Connect yellow wire of impulse counter scan tool/ Hand-Held Tester (HHT) as follows:

Engine control module	Socket 8
EA/CC/ISC control module	Socket 14
Diagnostic module	Socket 3

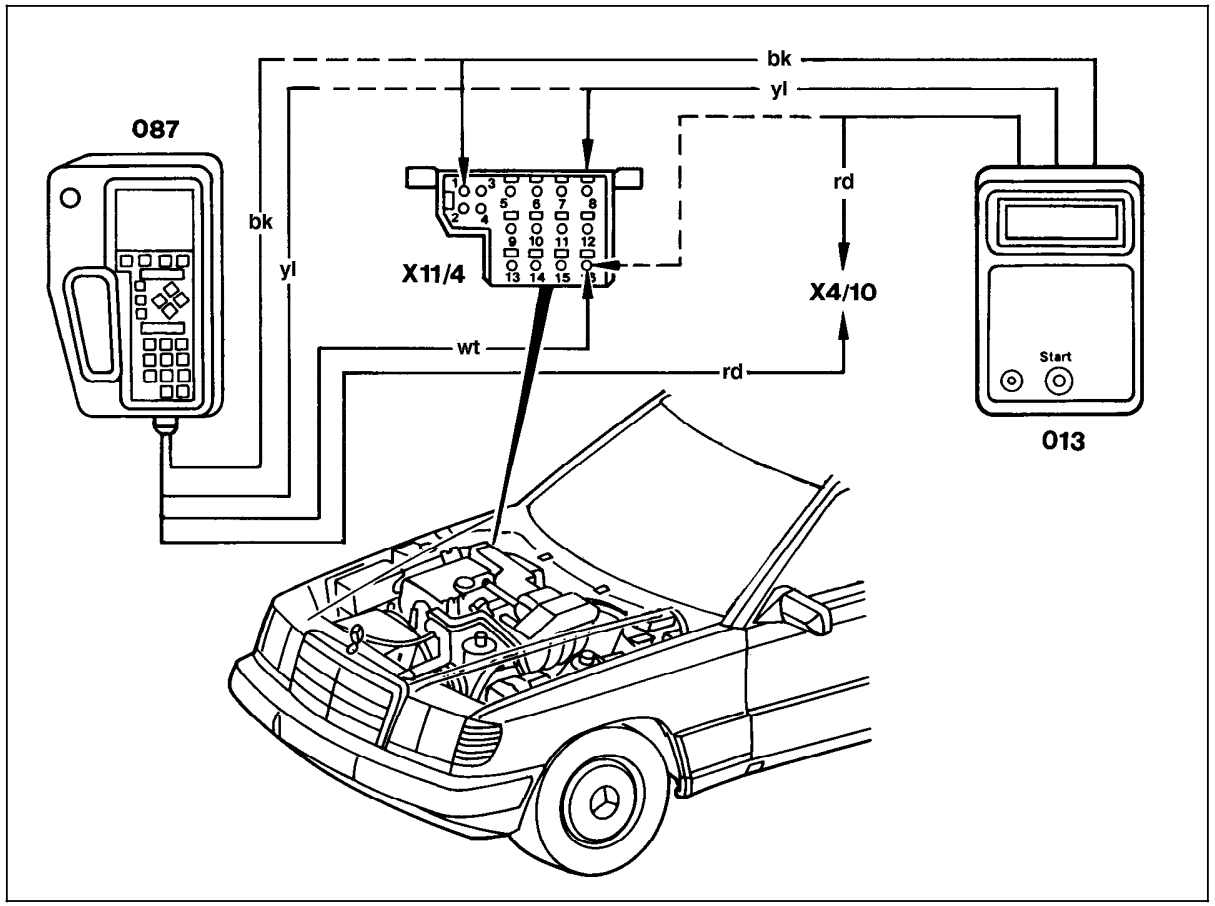


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Figure 1

013	Impulse counter scan tool (Hand-Held Tester 087 optional)
087	Hand-Held Tester (Impulse counter scan tool 013 optional)
X11/4	Data link connector (DTC readout) (16-pole)

Diagnosis - Diagnostic Trouble Code (DTC) Memory

Connection Diagram - Impulse Counter Scan Tool/ Hand-Held Tester (HHT)
Models 129, 140, 202 and 210

Note:
The DTC memory can be read with the impulse counter scan tool only on vehicles up to HHT diagnosis code 46. On vehicles starting HHT diagnosis code 49 it can be read only with the HHT.

Connect red wire of Impulse counter scan tool to socket 3, black wire of impulse counter scan tool to socket 1, and connect yellow wire as follows:

Engine control module (HFM-SFI)	Socket	4
EA/CC/ISC control module	Socket	7
Base module (except models 202, 210)	Socket	8
Rpm signal (TN output, except models 202, 210)	Socket	13
Rpm signal (TN output, model 202, 210)	Socket	17
Diagnostic module	Socket	19

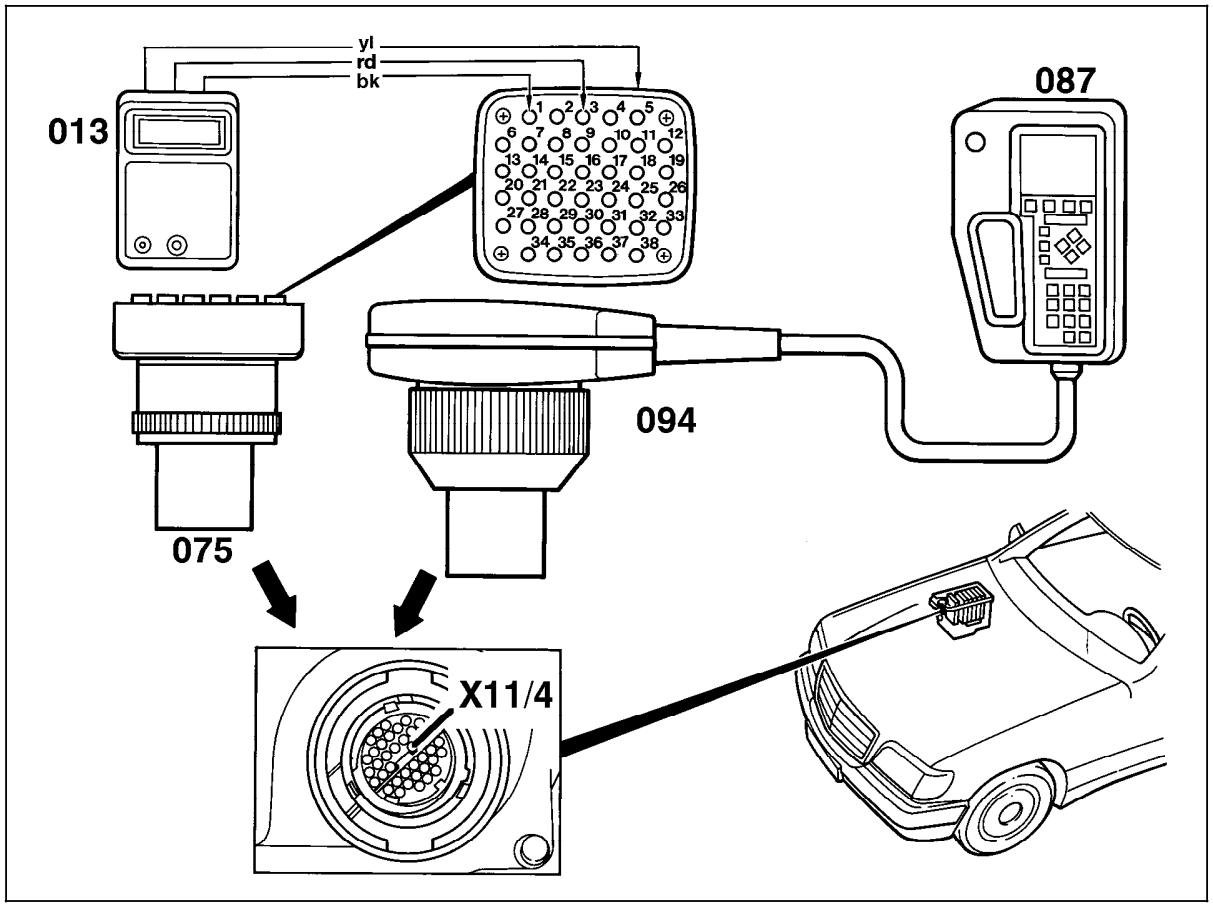

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Figure 2

013	Impulse counter scan tool (Hand-Held Tester 087 optional)
075	Impulse counter scan tool adapter
087	Hand-Held Tester (Impulse counter scan tool 013 optional)
094	Multiplexer
X11/4	Data link connector (DTC readout) (38-pole)

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC  7) 	Possible cause	Test step/Remedy 1)
1 –	No malfunction in system	–
2 002	ECT sensor (B11/3) short circuit	23⇒ 8.0
2 003	ECT sensor (B11/3) open circuit	23⇒ 8.0
2 004	ECT sensor (B11/3) implausible	23⇒ 8.0
2 005	ECT sensor (B11/3) intermittent contact	Contacts in connector of B11/3 or N3/4.
3 006	IAT sensor (B17) short circuit	23⇒ 9.0
3 007	IAT sensor (B17) open circuit	23⇒ 9.0
3 008	IAT sensor (B17) intermittent contact	Contacts in connector of B17 or N3/4.
4 009	Hot film MAF sensor (B2/5) air flow implausibly high	23 ⇒ 4.0 – 5.0 Engine friction excessive.
4 010	Hot film MAF sensor (B2/5) open circuit	23 ⇒ 4.0 – 5.0
5 011	CTP switch (M16/1s2 or M16/2s2) throttle valve angle implausibly large	23⇒ 11.0
5 012	CTP switch (M16/1s2 or M16/2s2) air flow implausibly high	23⇒ 11.0
5 013	CTP switch (M16/1s2 or M16/2s2) intermittent contact	23⇒ 11.0
6 014	*Not applicable for U.S.A. version vehicles*	–
6 015	*Not applicable for U.S.A. version vehicles*	–
6 016	*Not applicable for U.S.A. version vehicles*	–

1) Observe Preparation for Test, see 22.

7) Only possible up to end of model year 1995.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC  7) 	Possible cause	Test step/Remedy 1)
7 017	*Not applicable for U.S.A. version vehicles*	–
7 018	*Not applicable for U.S.A. version vehicles*	–
7 019	*Not applicable for U.S.A. version vehicles*	–
8 020	ISC system at lower control stop	Intake air leak, throttle body binding, CC or EA operating in “limp-home” mode.
8 021	ISC system at upper control stop	Intake air leak, throttle body binding, CC or EA operating in “limp-home” mode.
8 022	CC or EA indicates “limp-home” mode	Intake air leak, throttle body binding, adjust throttle linkage, erase DTC's in HFM-SFI control module.
9 2) 023	O2S 1 (before TWC) (G3/2) sensor voltage too high	23 ⇒ 14.0
9 2) 024	O2S 1 (before TWC) (G3/2) cold or open circuit	23 ⇒ 14.0
9 2) 025	O2S 1 (before TWC) (G3/2) sensor voltage implausible	23 ⇒ 14.0
10 026	Except model 124 O2S 2 (after TWC) (G3/1) sensor voltage too high	23 ⇒ 16.0
10 027	Except model 124 O2S 2 (after TWC) (G3/1) cold or open circuit	23 ⇒ 16.0
10 028	Except model 124 O2S 2 (after TWC) (G3/1) sensor voltage implausible	23 ⇒ 16.0

1) Observe Preparation for Test, see 22.
2) The DTC “9” can be displayed up to 12/92 even if no fault exists.
7) Only possible up to end of model year 1995.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC [7)]		Possible cause	Test step/Remedy [1)]
11	029	O2S 1 (before TWC) heater (G3/2) current too low	23 ⇒ 15.0
11	030	O2S 1 (before TWC) heater (G3/2) current too high	23 ⇒ 15.0
11	031	O2S 1 (before TWC) heater (G3/2) short circuit	23 ⇒ 15.0
12	032	Except model 124 O2S 2 (after TWC) heater (G3/1) current too low	23 ⇒ 17.0
12	033	Except model 124 O2S 2 (after TWC) heater (G3/1) current too high	23 ⇒ 17.0
12	034	Except model 124 O2S 2 (after TWC) heater (G3/1) short circuit	23 ⇒ 17.0
13	035	O2S system operating at rich limit, mixture too lean	Intake air leak, fuel injectors, diaphragm pressure regulator.
13	036	O2S system operating at lean limit, mixture too rich	Intake air leak, fuel injectors, diaphragm pressure regulator.
14	037	Injector (Y62y1), cylinder 1 short circuit to plus	23 ⇒ 19.0
14	038	Injector (Y62y1), cylinder 1 open/short circuit to ground	23 ⇒ 19.0
15	039	Injector (Y62y2), cylinder 2 short circuit to plus	23 ⇒ 20.0
15	040	Injector (Y62y2), cylinder 2 open/short circuit to ground	23 ⇒ 20.0

1) Observe Preparation for Test, see 22.

7) Only possible up to end of model year 1995.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC [7]		Possible cause	Test step/Remedy [1]
16	041	Injector (Y62y3), cylinder 3 short circuit to plus	23 ⇒ 21.0
16	042	Injector (Y62y3), cylinder 3 open/short circuit to ground	23 ⇒ 21.0
17	043	Injector (Y62y4), cylinder 4 short circuit to plus	23 ⇒ 22.0
17	044	Injector (Y62y4), cylinder 4 open/short circuit to ground	23 ⇒ 22.0
18	045	Injector (Y62y5), cylinder 5 short circuit to plus	23⇒ 23.0
18	046	Injector (Y62y5), cylinder 5 open/short circuit to ground	23⇒ 23.0
19	047	Injector (Y62y6), cylinder 6 short circuit to plus	23⇒ 24.0
19	048	Injector (Y62y6), cylinder 6 open/short circuit to ground	23⇒ 24.0
20	049	Self-adaptation at idle speed too rich	Intake air leak, fuel injectors, diaphragm pressure regulator, engine wear (reset self-adaptation following repair, see 11/5).
20	050	Self-adaptation at idle speed too lean	Intake air leak, fuel injectors, diaphragm pressure regulator, engine wear (reset self-adaptation following repair, see 11/5).

1) Observe Preparation for Test, see 22.

7) Only possible up to end of model year 1995.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC  7) 	Possible cause	Test step/Remedy 1)
20 051	Self-adaptation at lower partial load too rich	Intake air leak, fuel injectors, diaphragm pressure regulator, engine wear (reset self-adaptation following repair, see 11/5).
20 052	Self-adaptation at lower partial load too lean	Intake air leak, fuel injectors, diaphragm pressure regulator, engine wear (reset self-adaptation following repair, see 11/5).
20 053	Self-adaptation at upper partial load too rich	Intake air leak, fuel injectors, diaphragm pressure regulator, engine wear (reset self-adaptation following repair, see 11/5).
20 054	Self-adaptation at upper partial load too lean	Intake air leak, fuel injectors, diaphragm pressure regulator, engine wear (reset self-adaptation following repair, see 11/5).
21 061	Ignition output 3 or ignition coil (T1/3) for cylinder 1 misfires	24 ⇒ 13.0, 16.0 and 19.0
21 062	Ignition output 3 or ignition coil (T1/3) for cylinder 6 misfires	24 ⇒ 13.0, 16.0 and 19.0
21 063	Ignition output 3 or ignition coil (T1/3) current value not obtained	24 ⇒ 13.0, 16.0 and 19.0
22 055	Ignition output 1 or ignition coil (T1/1) for cylinder 2 misfires	24 ⇒ 11.0, 14.0 and 17.0

1) Observe Preparation for Test, see 22.

7) Only possible up to end of model year 1995.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC [7]		Possible cause	Test step/Remedy [1]
22	056	Ignition output 1 or ignition coil (T1/1) for cylinder 5 misfires	24 ⇒ 11.0, 14.0 and 17.0
22	057	Ignition output 1 or ignition coil (T1/1) current value not obtained	24 ⇒ 11.0, 14.0 and 17.0
23	058	Ignition output 2 or ignition coil (T1/2) for cylinder 3 misfires	24 ⇒ 12.0, 15.0 and 18.0
23	059	Ignition output 2 or ignition coil (T1/2) for cylinder 4 misfires	24 ⇒ 12.0, 15.0 and 18.0
23	060	Ignition output 2 or ignition coil (T1/2) current value not obtained	24 ⇒ 12.0, 15.0 and 18.0
	061, 062, 063	see 11/13	
24	064	CKP sensor (L5) signal not recognized/implausible	24 ⇒ 7.0
24	065	CKP sensor (L5) magnet is missing (segment control) CKP sensor (L5) number of teeth implausible (increment control)	24 ⇒ 7.0
24	066	CKP sensor (L5) rpm implausibly high	24 ⇒ 7.0
25	067	CMP sensor (L5/1) implausible/not recognized (segment control) Camshaft Hall-effect sensor (B6/1) implausible/not recognized (increment control)	24 ⇒ 8.0 24 ⇒ 9.0
26	068	*Not applicable for U.S.A. version vehicles*	–
26	069	*Not applicable for U.S.A. version vehicles*	–
27	070	TN-signal output (rpm signal), short circuit to ground	23 ⇒ 10.0
27	071	TN-signal output (rpm signal), short circuit to plus	23 ⇒ 10.0
28	072	VSS not recognized	23 ⇒ 27.0

[1] Observe Preparation for Test, see 22.

[7] Only possible up to end of model year 1995.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC  7)		Possible cause	Test step/Remedy 1)
28	073	VSS implausibly high	23 ⇒ 27.0
29	075	*Not applicable for U.S.A. version vehicles*	–
30	076	FP relay module (K27) open/short circuit	23 ⇒ 6.0
31	077	*Not applicable for U.S.A. version vehicles*	–
	078	*Not applicable for U.S.A. version vehicles*	–
32	079	KS 1 (A16) open circuit	Replace knock sensors (KS).
32	080	KS 2 (A16) open circuit	Replace knock sensors (KS).
33	081	Maximum retard setting on at least one cylinder has been reached	Increased tendency to knock due to poor fuel quality, combustion chamber carbon build-up or mechanical damage.
33	082	Ignition angle deviation between the individual cylinders is > 6° CKA.	Increased tendency to knock due to poor fuel quality, combustion chamber carbon build-up or mechanical damage.
34	083	Knock control evaluation circuit in engine control module (N3/4) defective	N3/4.
	084	Momentary fault in self-adaptation of closed throttle speed/partial load	Momentary malfunction in fuel mixture preparation.
35	085	Model 124, 129 and 140: AIR pump switchover valve (Y32) and/or electromagnetic AIR pump clutch (Y33), model 202: AIR pump switchover valve (Y32) and/or AIR relay module (K17) open/short circuit	23 ⇒ 28.0
36	086	Purge control valve (Y58/1) open/short circuit	23 ⇒ 29.0 – 30.0

1) Observe Preparation for Test, see 22.
7) Only possible up to end of model year 1995.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC [7)]		Possible cause	Test step/Remedy [1)]
36	087	Purge control valve (Y58/1) short circuit to plus	23 ⇒ 29.0 – 30.0
37	088	Upshift delay switchover valve (Y3/3) open/short circuit	23 ⇒ 34.0
38	089	Adjustable camshaft timing solenoid (Y49) short circuit to plus	23 ⇒ 31.0 – 32.0
38	090	Adjustable camshaft timing solenoid (Y49) open/short circuit to ground	23 ⇒ 31.0 – 32.0
39	091	EGR switchover valve (Y27) short circuit to plus	23 ⇒ 38.0 – 40.0
39	092	EGR switchover valve (Y27) open/short circuit to ground	23 ⇒ 38.0 – 40.0
40	093	Transmission overload protection switch (S65) short circuit to ground	24 ⇒ 10.0
40	094	Transmission overload protection switch (S65) closed and 2nd gear recognized	24 ⇒ 10.0
40	095	Transmission overload protection switch (S65) open and 2nd gear recognized	24 ⇒ 10.0
40	096	Transmission overload protection switch (S65) implausible	24 ⇒ 10.0
41	097	CAN communication from engine control module (N3/4) defective	23 ⇒ 37.0
42	098	CAN communication from ASR control module (N30/1) defective	23 ⇒ 36.0
42	099	CAN communication from EA/CC/ISC control module (N4/1) or CC/ISC control module (N4/3) defective	23 ⇒ 36.0
42	100	CAN communication from diagnostic module (OBD II) (N59/1) defective	23 ⇒ 36.0
43	101	Starter signal (circuit 50) not present	23 ⇒ 7.0
44	102	*Not applicable for U.S.A. version vehicles*	–
44	103	*Not applicable for U.S.A. version vehicles*	–

1) Observe Preparation for Test, see 22.

7) Only possible up to end of model year 1995.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC [7]		Possible cause	Test step/Remedy [1]
45	104	Fuel safety shut-off of electronic accelerator or cruise control active	23 ⇒ 12.0 23 ⇒ 13.0
46	105	Resonance intake manifold switchover valve (Y22/6) short circuit to plus	23 ⇒ 33.0
46	106	Resonance intake manifold switchover valve (Y22/6) open/short circuit to ground	23 ⇒ 33.0
	107 [4]	Control of ignition coil preloading voltage exceeds limits	24 ⇒ 14.1 and 15.1 Engine control module (N3/4).
48	108	O2S 2 (after TWC) heater relay module (K35) short circuit to plus	23 ⇒ 18.0
48	109	O2S 2 (after TWC) heater relay module (K35) open/short circuit to ground	23 ⇒ 18.0
49	110	Voltage supply circuit 87 U at engine control module (N3/4) implausible	23 ⇒ 2.0
49	111	Voltage supply circuit 87 U at engine control module (N3/4) low voltage	23 ⇒ 2.0
50	112	Engine control module (N3/4)	N3/4.
	113 [5]	Engine control module (N3/4) not coded	Code N3/4.
	114 [5]	Engine control module identification of N3/4 faulty	Code N3/4, if necessary, replace N3/4.
	115 [5]	Engine control module code bytes of N3/4 faulty	Code N3/4, if necessary, replace N3/4.
	116 [6]	CAN communication from RCL control module (N54) faulty	23 ⇒ 36.1
	117 [6]	Engine starts with RCL system locked	Incorrect operation, clear DTC memory.

1) Observe Preparation for Test, see 22.
4) Starting 06/93
5) Starting 01/94
6) Starting model year 1996, models 140/210, the DTC 116 can be displayed from 09/95 and up to 11/95, even if no fault exists.
7) Only possible up to end of model year 1995.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC 	Possible cause	Test step/Remedy [1]
120	*Not applicable for U.S.A. version vehicles*	-
121	*Not applicable for U.S.A. version vehicles*	-
122	*Not applicable for U.S.A. version vehicles*	-
125 126	Engine control module (N3/4)	N3/4
127	ISC and CC/ISC actuators interchanged	Replace actuator
128 129	Engine control module (N3/4)	N3/4
130	*Not applicable for U.S.A. version vehicles*	–
131 132	Engine control module (N3/4)	N3/4
133	EA/CC/ISC or CC/ISC actuator	Perform learning process on engine control module with HHT. If the fault is still present, replace actuator.
134	Engine control module (N3/4)	N3/4
135	*Not applicable for U.S.A. version vehicles*	–
136	*Not applicable for U.S.A. version vehicles*	–
137	Engine control module (N3/4)	N3/4

[1] Observe Preparation for Test, see 22.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

DTC 	Possible cause	Test step/Remedy [1]
138	EA/CC/ISC or CC/ISC actuator	Perform learning process on engine control module with HHT. If the fault is still present, replace actuator.
139	*Not applicable for U.S.A. version vehicles*	-
140 141 142	Engine control module (N3/4)	N3/4
143	*Not applicable for U.S.A. version vehicles*	–
144	Engine control module (N3/4)	N3/4

[1] Observe Preparation for Test, see 22.

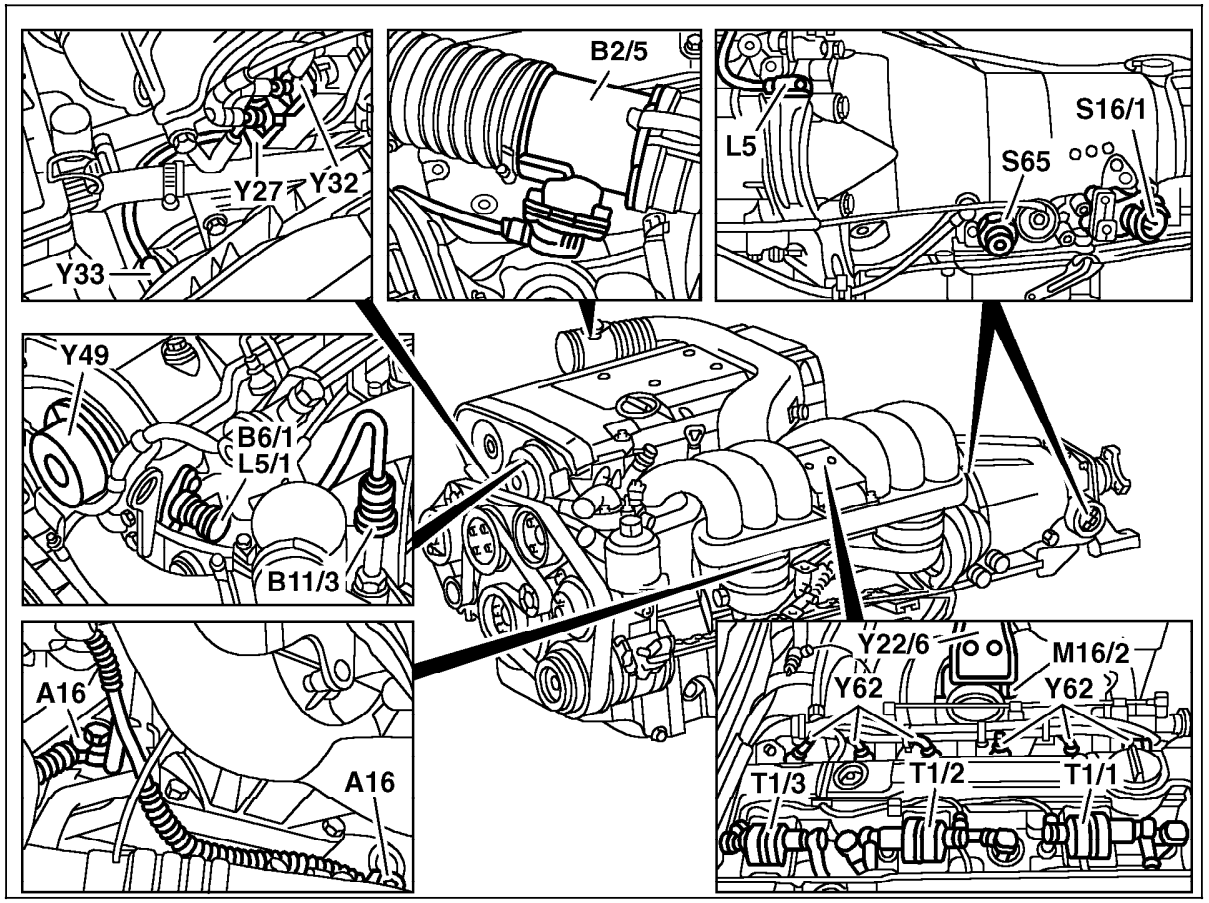
Diagnosis – Complaint Related Diagnostic Chart

Complaint/Problem	Possible cause	Test step/Remedy [1]
Engine starts poorly and accelerates poorly	Injector (Y62) control and injection time. Hot film MAF sensor (B2/5). ECT sensor (B11/3).	23 ⇒ 19.0 – 24.0 23 ⇒ 4.0 23 ⇒ 8.0
Engine does not start	No voltage supply from base module (N16/1), overvoltage protection relay module (K1/2) or relay module (K40). CKP sensor (L5) defective. FP relay module (K27) defective. Fuel pumps defective. Injector (Y62) control and injection time. Malfunction of drive authorization system (DAS) in all models as of model year 1996	23 ⇒ 1.0 – 3.0 24 ⇒ 7.0 23 ⇒ 6.0 34 ⇒ 2.0 23 ⇒ 19.0 – 24.0 Test see DM, Body and Accessories, Vol. 1 (RCL)
Engine has uneven idle	Injector (Y62) control and injection time. EGR valve defective.	23 ⇒ 19.0 – 24.0 23 ⇒ 40.0
Engine has uneven idle and insufficient engine output	Camshaft timing adjustment defective.	23 ⇒ 31.0 – 32.0

[1] Observe Preparation for Test, see 22.

Electrical Test Program – Component Locations

Engine 104



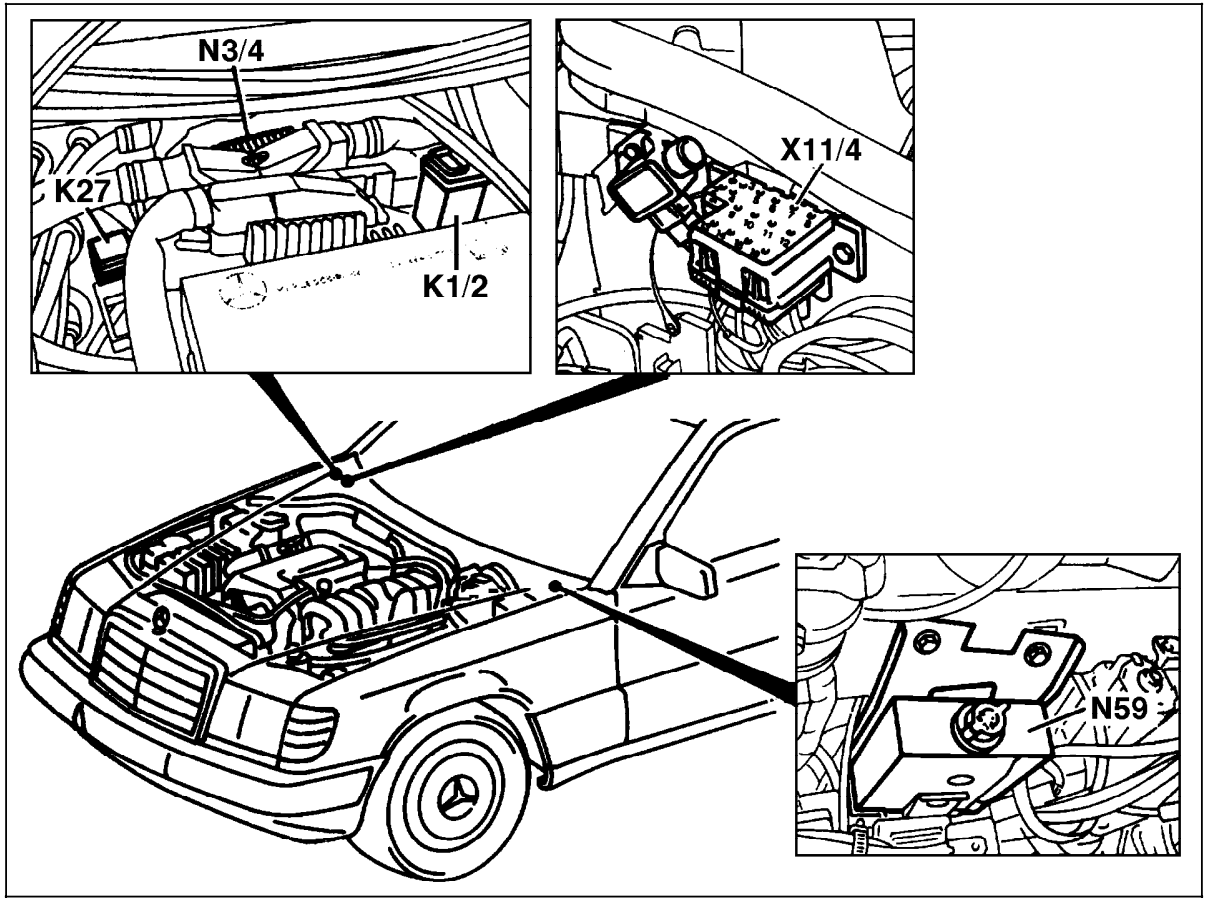
U07.51-0340-57

Figure 1

A16	Knock sensors
B2/5	Hot film MAF sensor
B6/1	Camshaft Hall-effect sensor (Model 210 only)
B11/3	ECT sensor
L5	CKP sensor
L5/1	CMP sensor (Models 124, 129, 140, 202)
M16/2	CC/ISC actuator
S16/1	Starter lock-out/backup lamp switch
S65	Transmission overload protection switch
T1/1	Ignition coil 1 (cylinders 2 and 5)
T1/2	Ignition coil 2 (cylinders 3 and 4)
T1/3	Ignition coil 3 (cylinders 1 and 6)
Y22/6	Resonance intake manifold switchover valve
Y27	EGR switchover valve
Y32	AIR pump switchover valve
Y33	Electromagnetic AIR pump clutch
Y49	Adjustable camshaft timing solenoid
Y62	Injectors

Electrical Test Program – Component Locations

Engine Compartment
Model 124



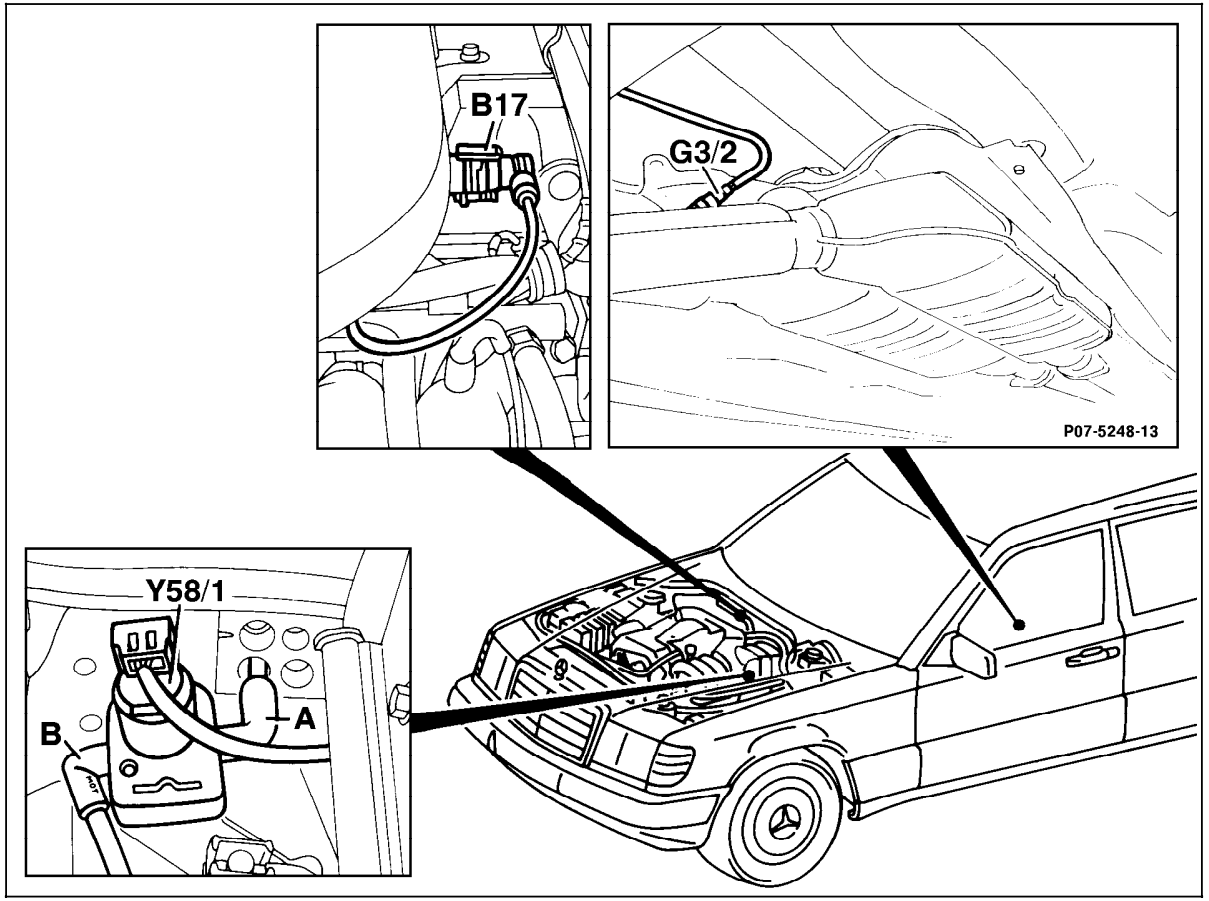
U07-5923-57

Figure 2

K1/2	Overvoltage protection relay module
K27	FP relay module
N3/4	Engine control module (HFM-SFI)
N59	Diagnostic module (OBD I) (California)
X11/4	Data link connector (DTC readout)

Electrical Test Program – Component Locations

Engine Compartment
Model 124



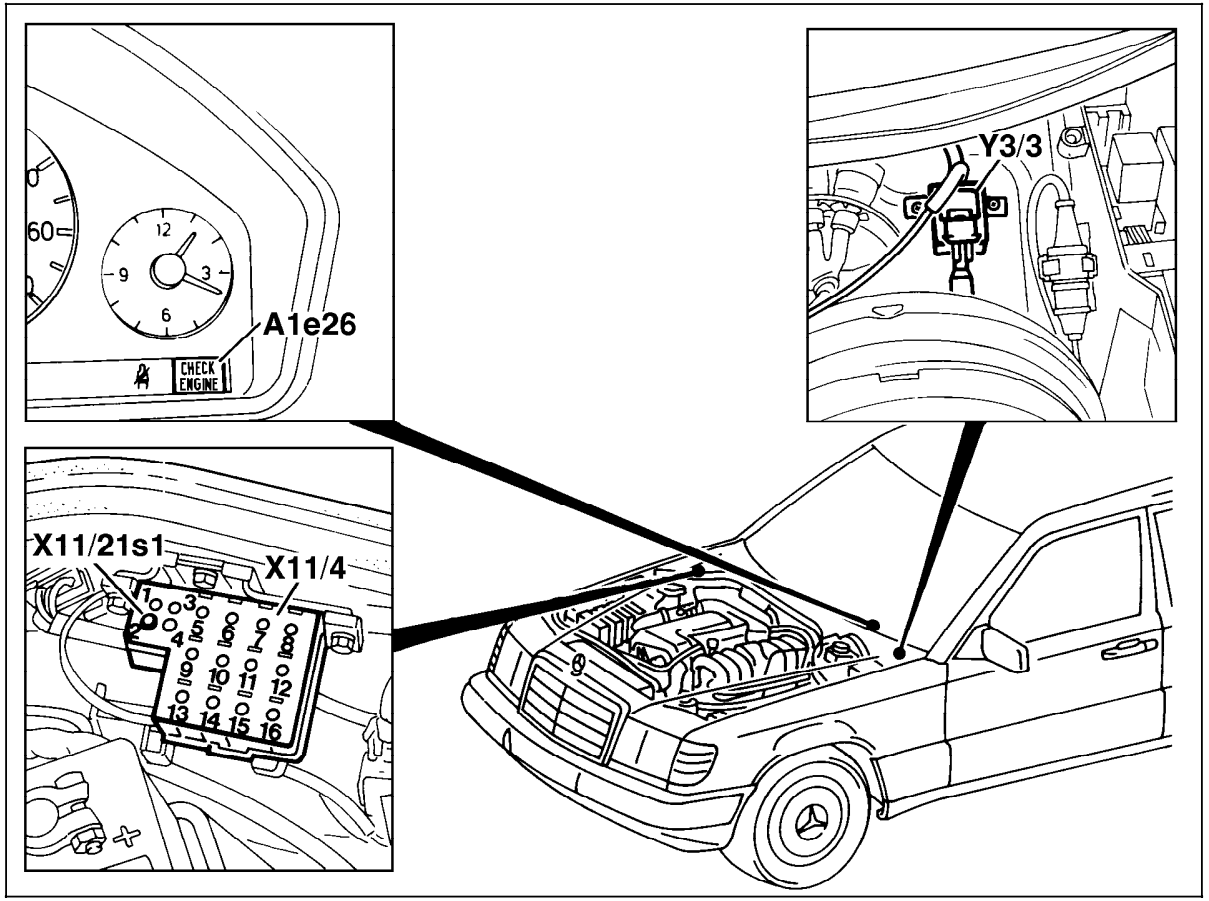
U07-5922-57

Figure 3

B17	IAT sensor
G3/2	O2S 1 (before TWC)
Y58/1	Purge control valve
A	Purge line from charcoal canister
B	Purge line to engine

Electrical Test Program – Component Locations

Engine Compartment
Model 124



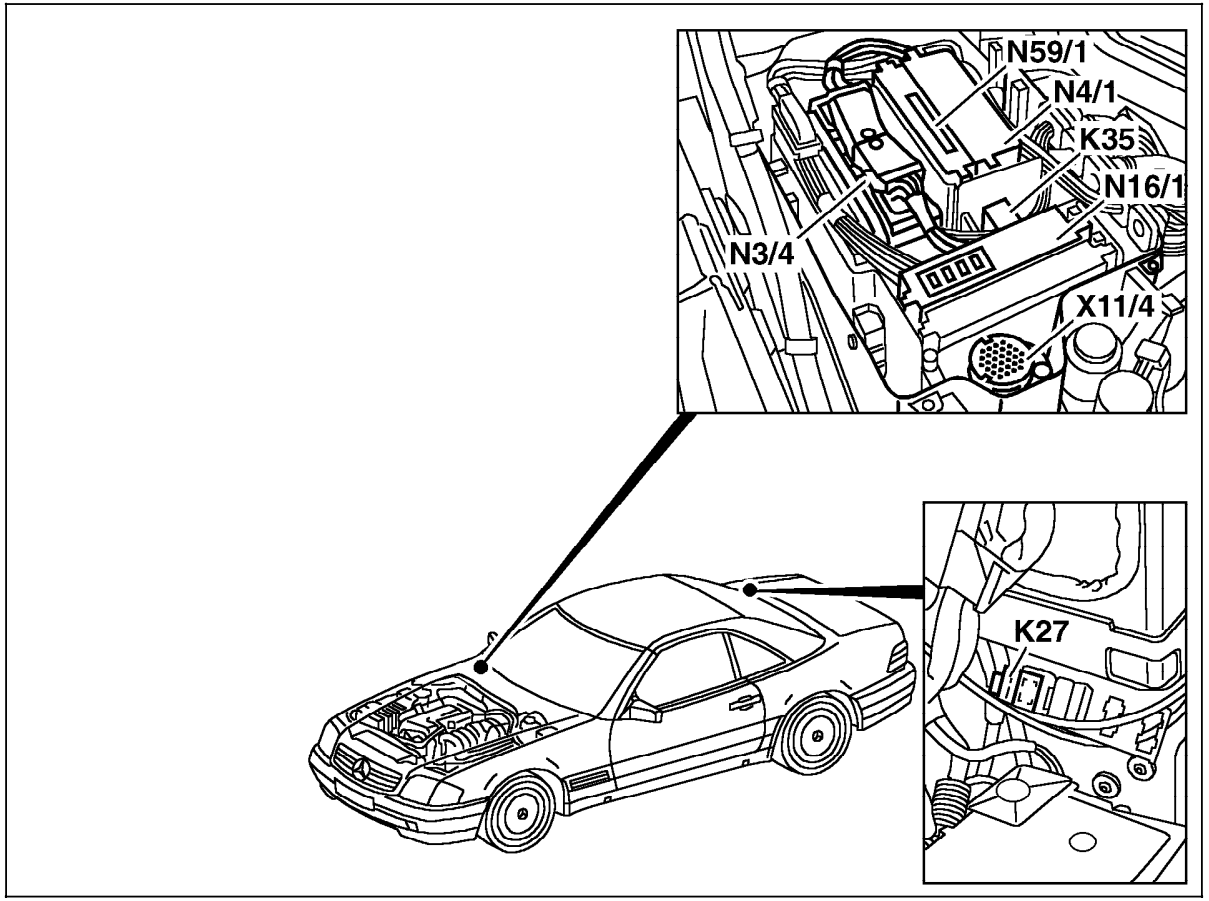
U07-5924-57

Figure 4

A1e26 "CHECK ENGINE" MIL
Y3/3 Upshift delay switchover valve
X11/4 Data link connector (DTC readout)
X11/21s1 Pushbutton (with LED) (USA) - California

Electrical Test Program – Component Locations

Engine Compartment
Model 129



U07.61-0262-57

Figure 5

K27	FP relay module
N3/4	Engine control module (HFM-SFI)
N4/1	EA/CC/ISC control module
N4/3	CC/ISC control module
N16/1	Base module
N59/1	Diagnostic module (OBD II)
K35	O2S 2 (after TWC) heater relay module (as of 06/95)
X11/4	Data link connector (DTC readout)

Electrical Test Program – Component Locations

Engine Compartment
Model 129

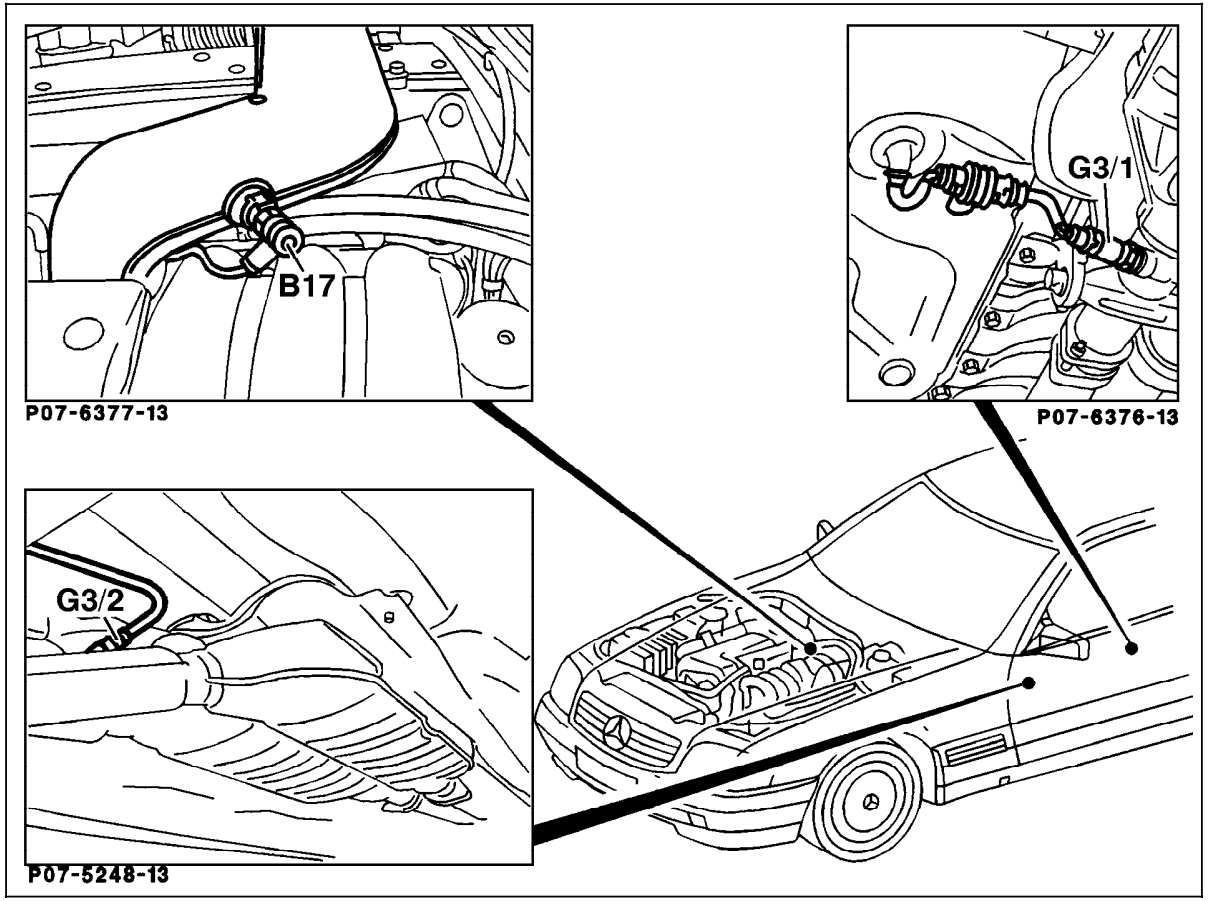
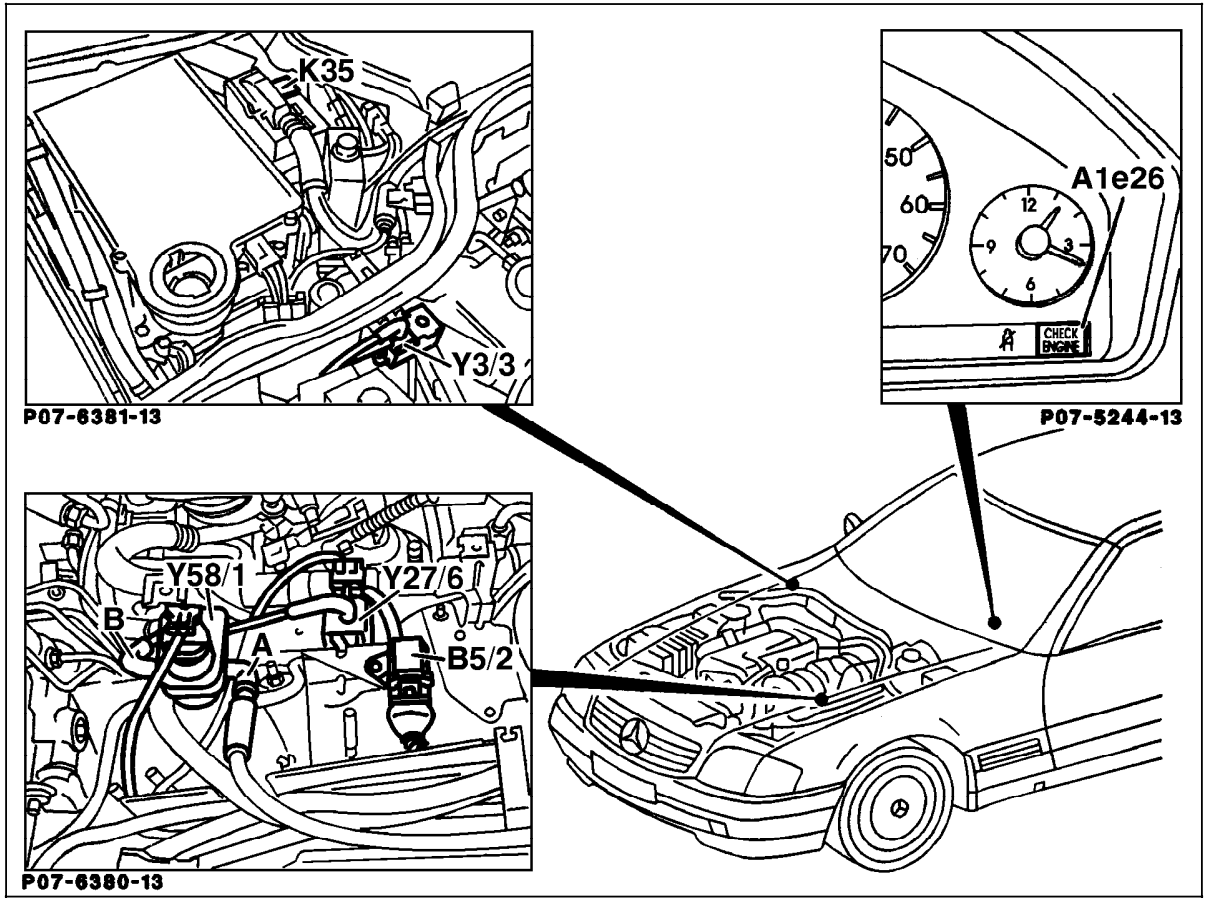


Figure 6

B17 IAT sensor
G3/1 O2S 2 (after TWC)
G3/2 O2S 1 (before TWC)

Electrical Test Program – Component Locations

Engine Compartment
Model 129



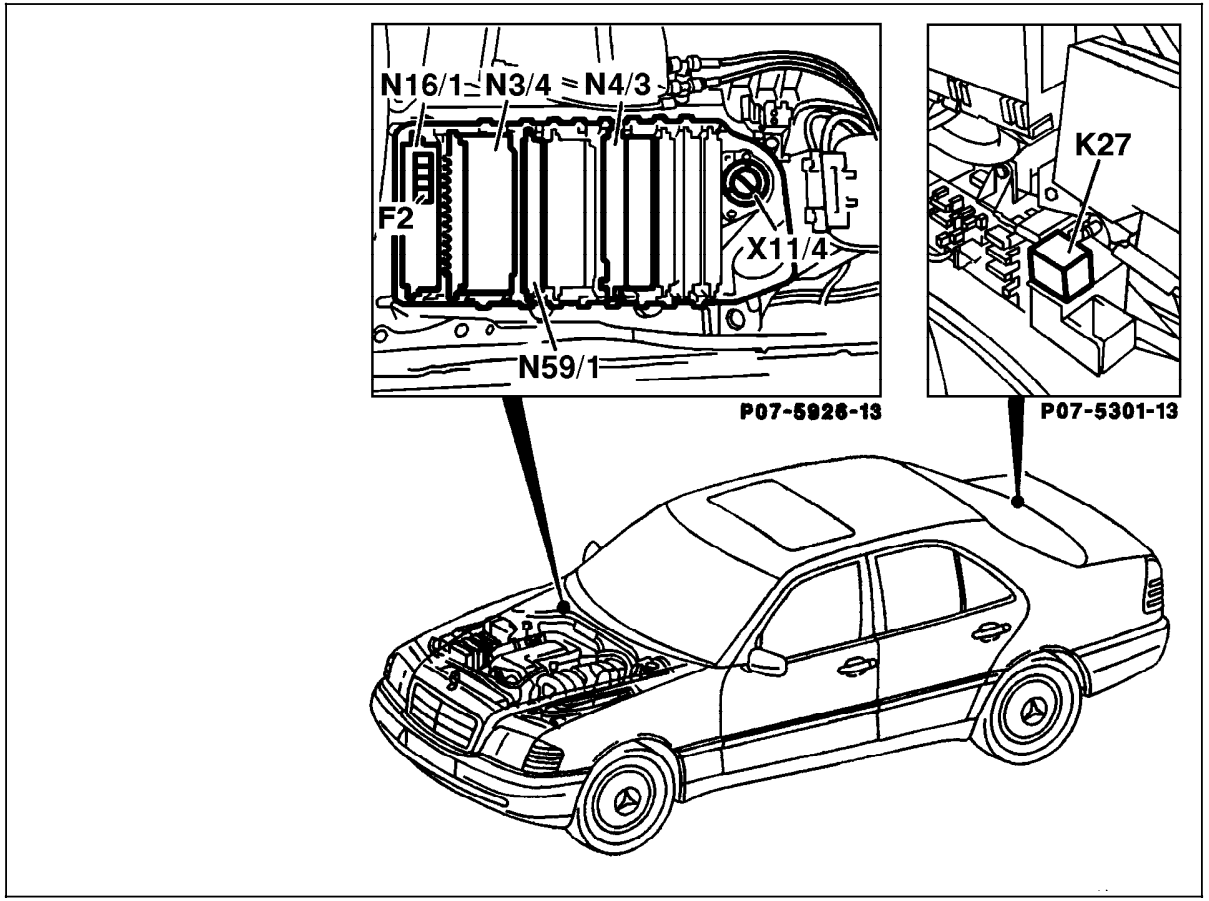
U07-6389-57

Figure 7

A1e26	"CHECK ENGINE" MIL
B5/2	DM pressure sensor (HFM-SFI)
K35	O2S 2 (after TWC) heater relay module (up to 05/95)
Y3/3	Upshift delay switchover valve
Y27/6	Purge flow switchover valve
Y58/1	Purge control valve
A	Purge line from charcoal canister
B	Purge line to engine

Electrical Test Program – Component Locations

Engine Compartment
Model 140



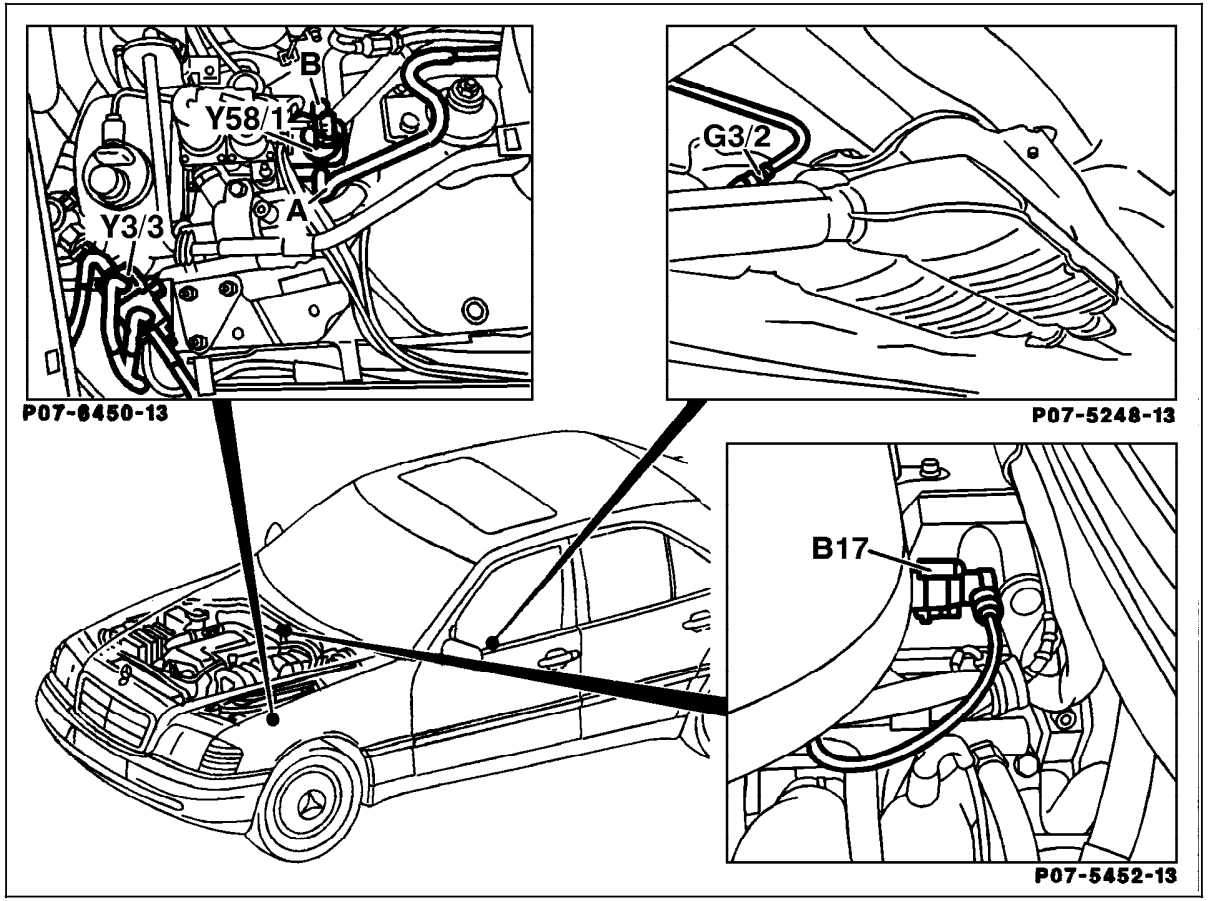
U07-6296-57

Figure 8

K27 FP relay module
N3/4 Engine control module (HFM-SFI)
N16/1 Base module
N59/1 Diagnostic module (OBD II)
X11/4 Data link connector (DTC readout)

Electrical Test Program – Component Locations

Engine Compartment
Model 140



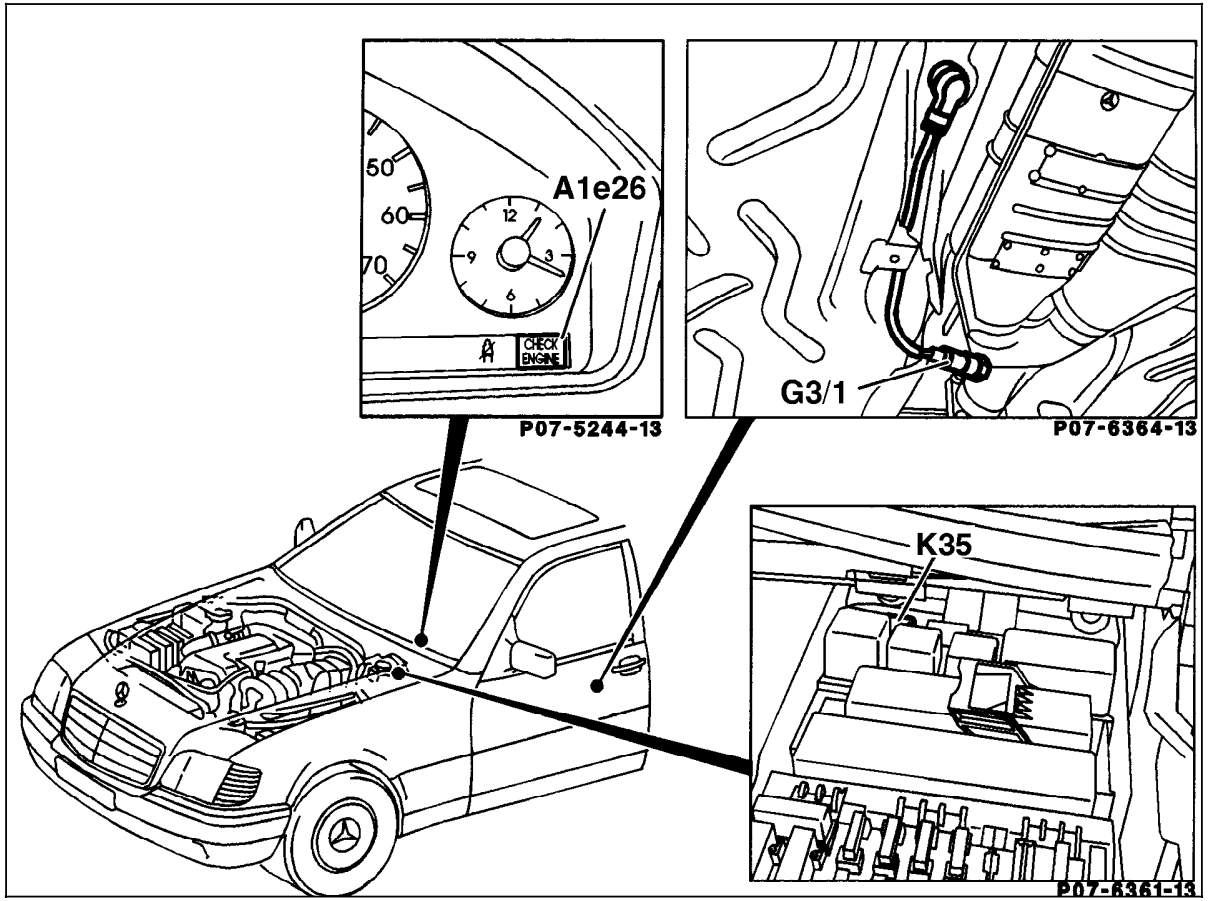
U07-6297-57

Figure 9

B17	IAT sensor
G3/2	O2S 1 (before TWC)
Y3/3	Upshift delay switchover valve
Y58/1	Purge control valve
A	Purge line from charcoal canister
B	Purge line to engine

Electrical Test Program – Component Locations

Engine Compartment
Model 140



U07-6393-57

Figure 10

A1e26 "CHECK ENGINE" MIL
G3/1 O2S 2 (after TWC)
K35 O2S 2 (after TWC) heater relay module

Electrical Test Program – Component Locations

Engine Compartment
Model 202

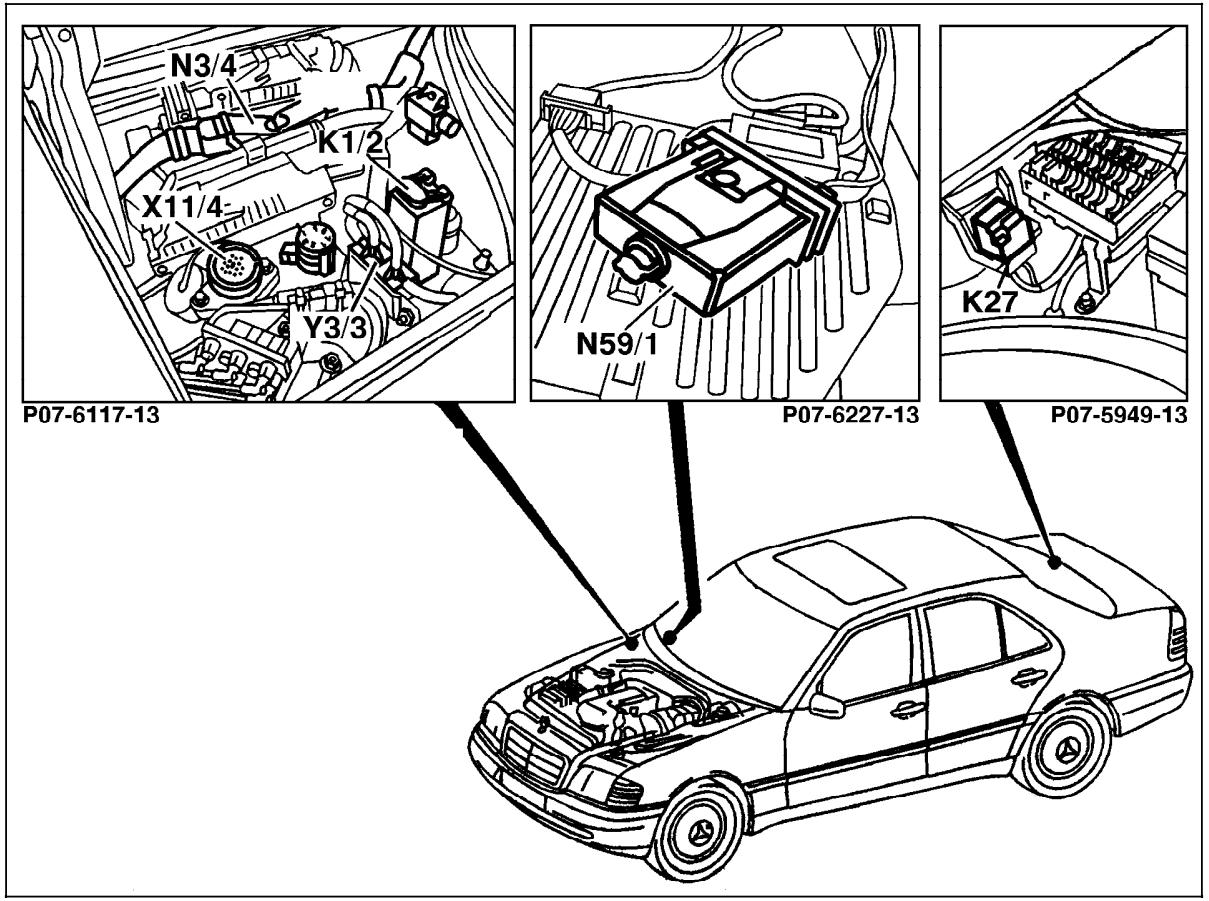
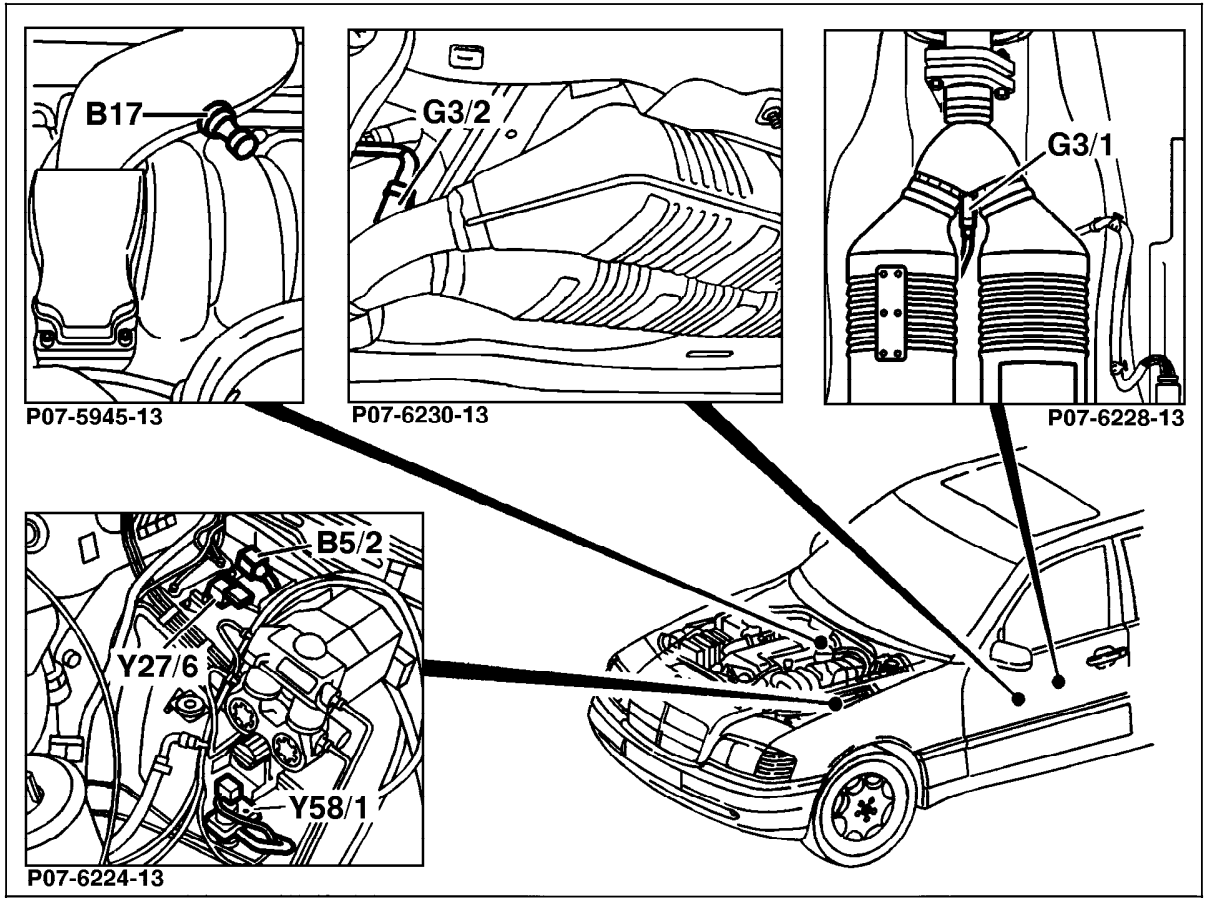


Figure 11

K1/2	Overvoltage protection relay module (87E/87L/30a, 9-pole)
K27	FP relay module
N3/4	Engine control module (HFM-SFI)
N59/1	Diagnostic module (OBD II)
X11/4	Data link connector (DTC readout)
Y3/3	Upshift delay switchover valve

Electrical Test Program – Component Locations

Engine Compartment
Model 202



U07-6286-57

Figure 12

B5/2	DM pressure sensor (HFM-SFI)
B17	IAT sensor
G3/1	O2S 2 (after TWC)
G3/2	O2S 1 (before TWC)
Y27/6	Purge flow switchover valve
Y58/1	Purge control valve

Electrical Test Program – Component Locations

Engine Compartment
Model 202

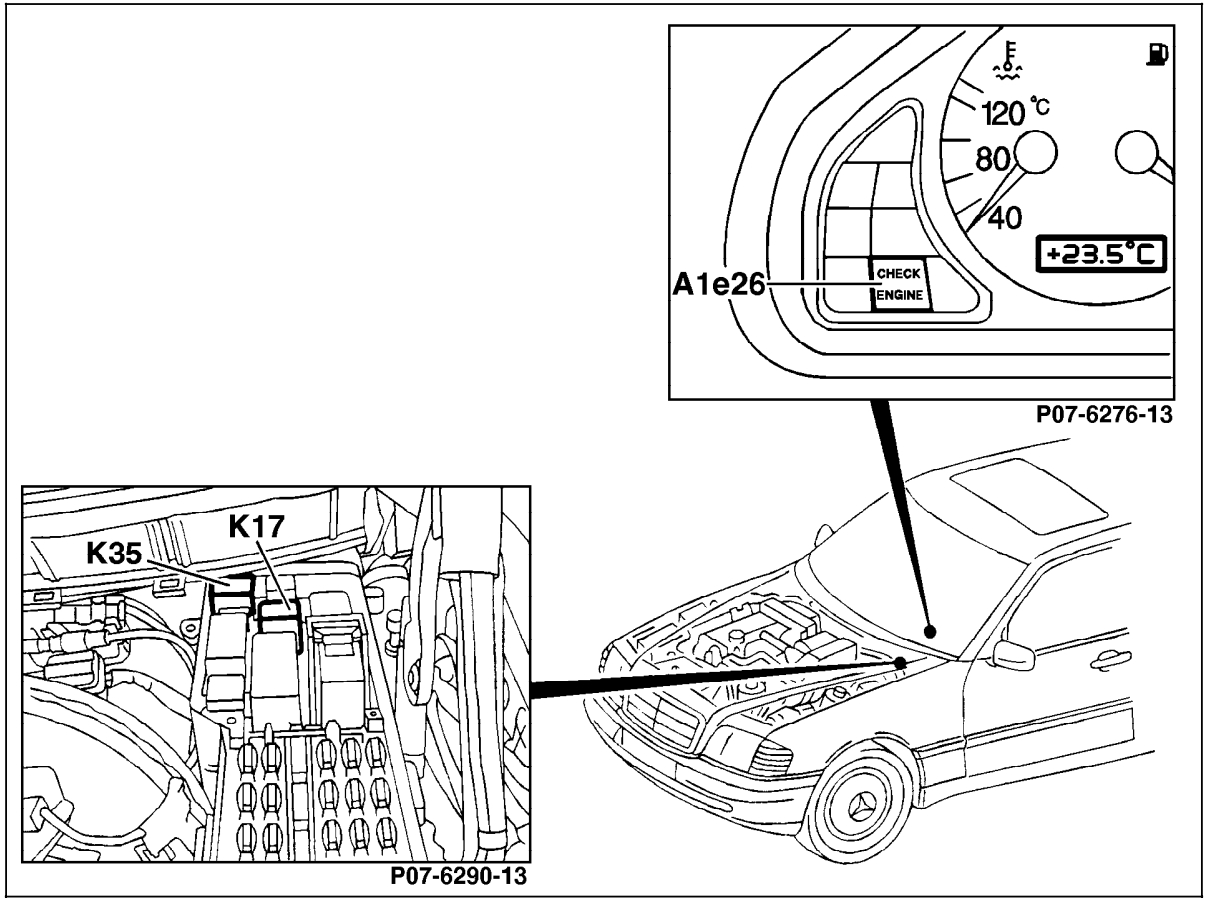
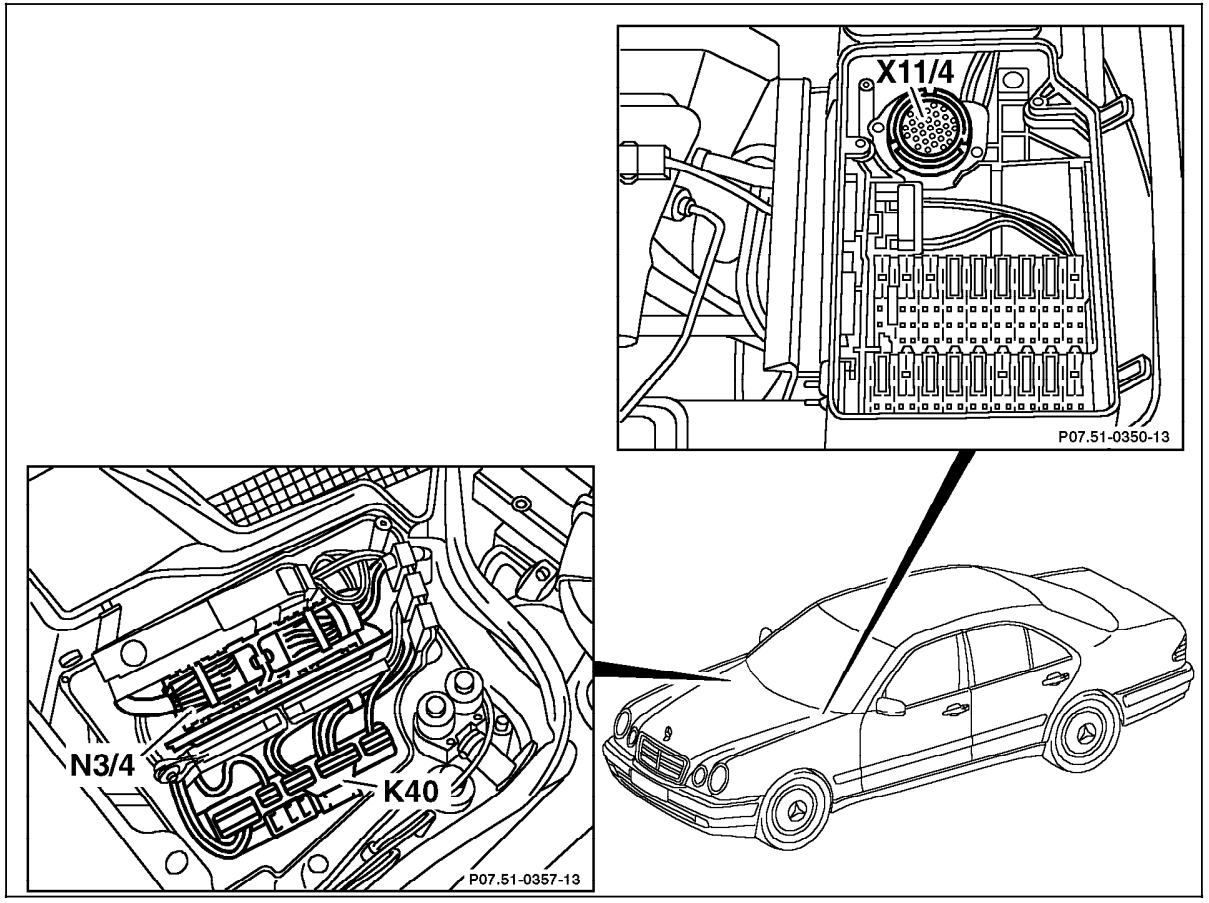


Figure 13

A1e26 "CHECK ENGINE" MIL
K17 AIR relay module
K35 O2S 2 (after TWC) heater relay module

Electrical Test Program – Component Locations

Engine Compartment
Model 210



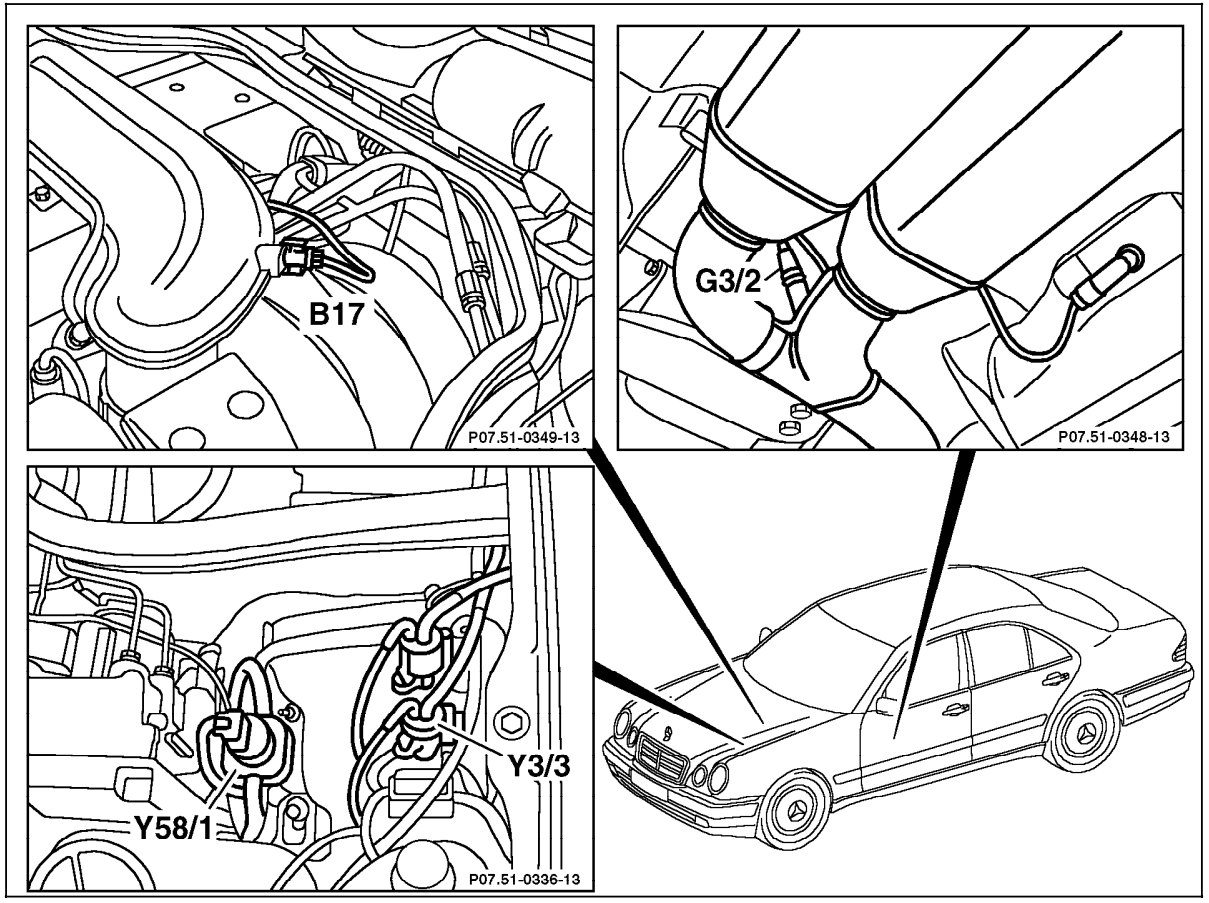
U07.51-0353-57

Figure 14

K40 Relay module
N3/4 Engine conrol module (HFM-SFI)
X11/4 Data link connector (DTC readout)

Electrical Test Program – Component Locations

Engine Compartment
Model 210



U07.51-0354-57

Figure 15

B17 IAT sensor
G3/2 O2S 1 (before TWC)
Y3/3 Upshift delay switchover valve
Y58/1 Purge control valve

Electrical Test Program – Preparation for Test

Preliminary work:
Diagnosis - Malfunction Memory 11

Preparation for Test

1. Ignition: **OFF**
2. Connect test cable with socket box to engine control module (N3/4) according to connection diagram.

- If installing an engine control module from another vehicle (only possible on vehicles without drive authorization system (DAS) stage 2 up to the end of model year 1995), the control module's memory must be erased and the control module must be reactivated, see 11/5.

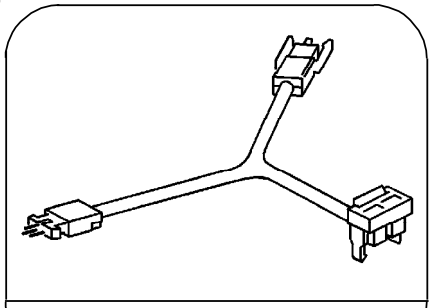
Electrical wiring diagrams, see Electrical Troubleshooting Manual.

Model 124
Model 129
Model 140
Model 202
Model 210

Note regarding "Test Connection" column:
The numbers indicated in parentheses, for example, ⇒ 1.0 (1.23) signify:
1= Connector 1 on wiring diagram,
23= Socket 23 on wiring diagram.

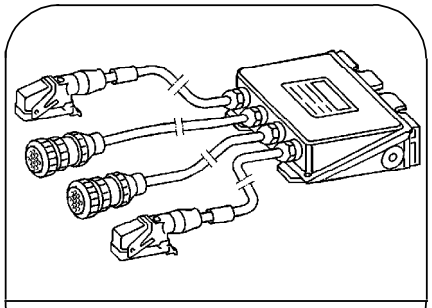
Electrical Test Program – Preparation for Test

Special Tools



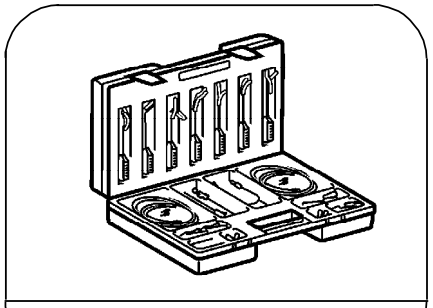
102 589 04 63 00

Test cable



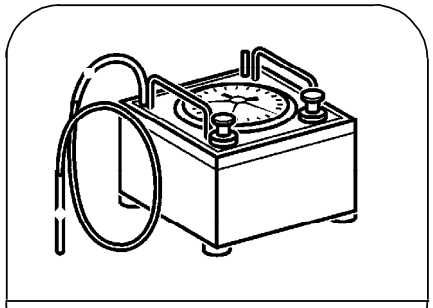
124 589 45 63 00

82-pin test cable CAN



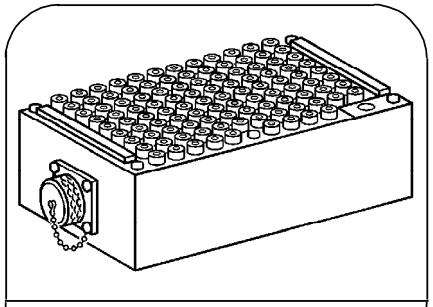
201 589 00 99 00

Electrical connecting set



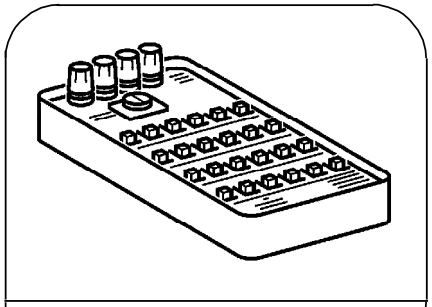
201 589 13 21 00

Tester



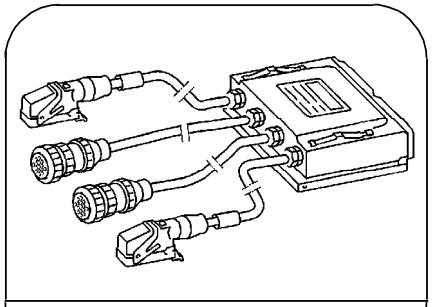
129 589 00 21 00

126-pin socket box



124 589 09 63 00

Ohm decade



140 589 29 63 00

CAN 140 82-pin test cable

Conventional tools, test equipment

Description	Brand, model, etc.
Multimeter [1]	Fluke models 23, 83, 85, 87
Engine analyzer [1]	Bear DACE (Model 40-960) Sun Master 3 Sun MEA-1500MB

[1] Available through the MBUSA Standard Equipment Program.

Electrical Test Program – Preparation for Test

To Avoid Damage to the Ignition System

- To avoid damage to the engine control module (N3/10), connect/disconnect the control module connectors only with the ignition: **OFF**.
- Do not connect a test lamp to circuit 1 or 15 of the ignition coil.
- Do not disconnect or ground any spark plug connector at cranking or idle speed.
- The high output side of the ignition system must carry at least 2 kΩ of load (spark plug connector).
- To avoid damaging the ignition coils during individual testing, do not load the coil with more than 28 kV.
- If assisting a disabled vehicle and it becomes necessary to perform an ignition spark test, perform this test only with a spark plug on one ignition cable. Ensure good ground connection to the spark plug.

⚠ **WARNING!**
High Voltage!

- Primary connections carry a voltage of up to 400 V. The iron core bracket of the ignition coils must always be connected to vehicle ground.
- Persons with pacemakers should not work on this type of ignition system.

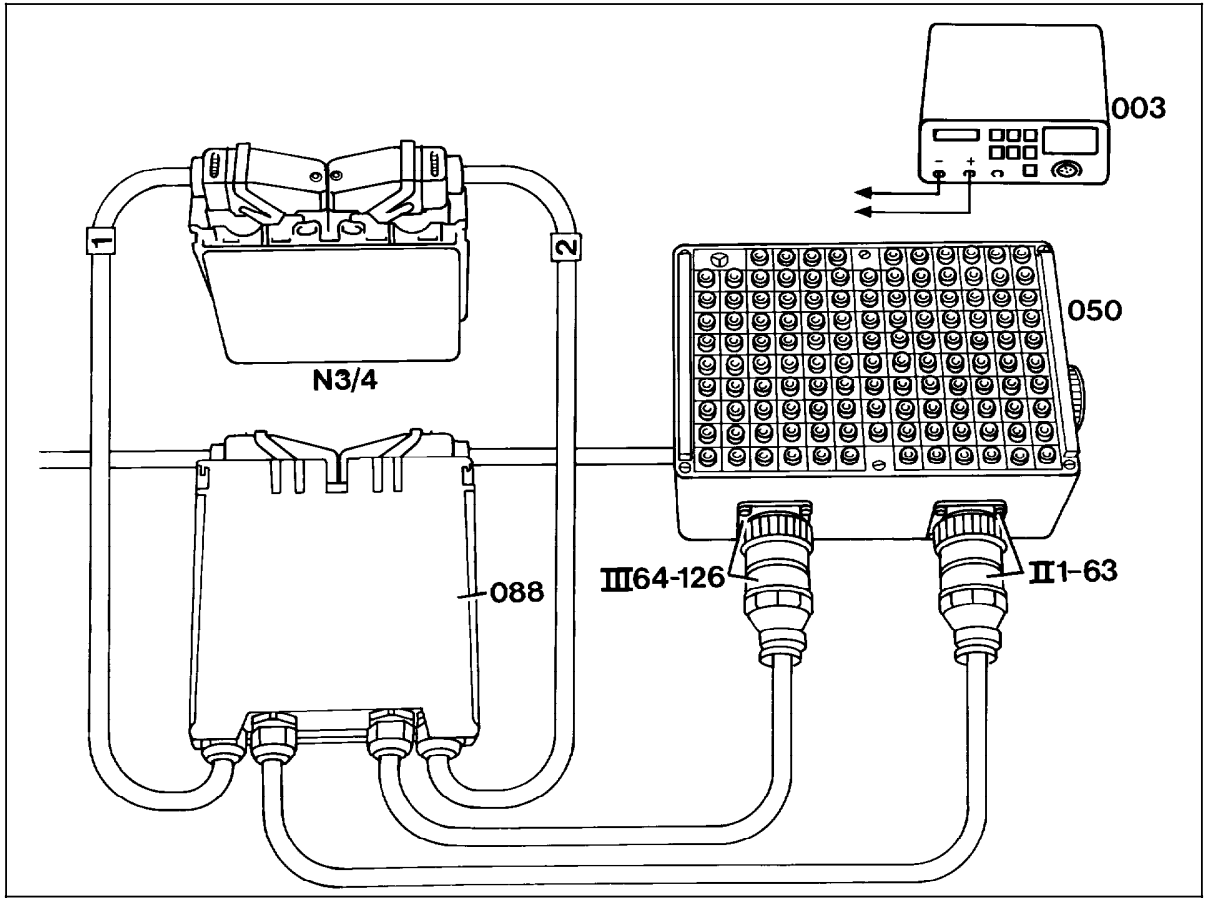
Using Test Equipment

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

See Service Microfiche System (SMS), Repair Instructions, group 15 for further safety precautions.

Electrical Test Program – Component Locations

Connection Diagram - Socket Box
Models 124, 202, 210 as well as Model 129,
140 starting Model Year 1996



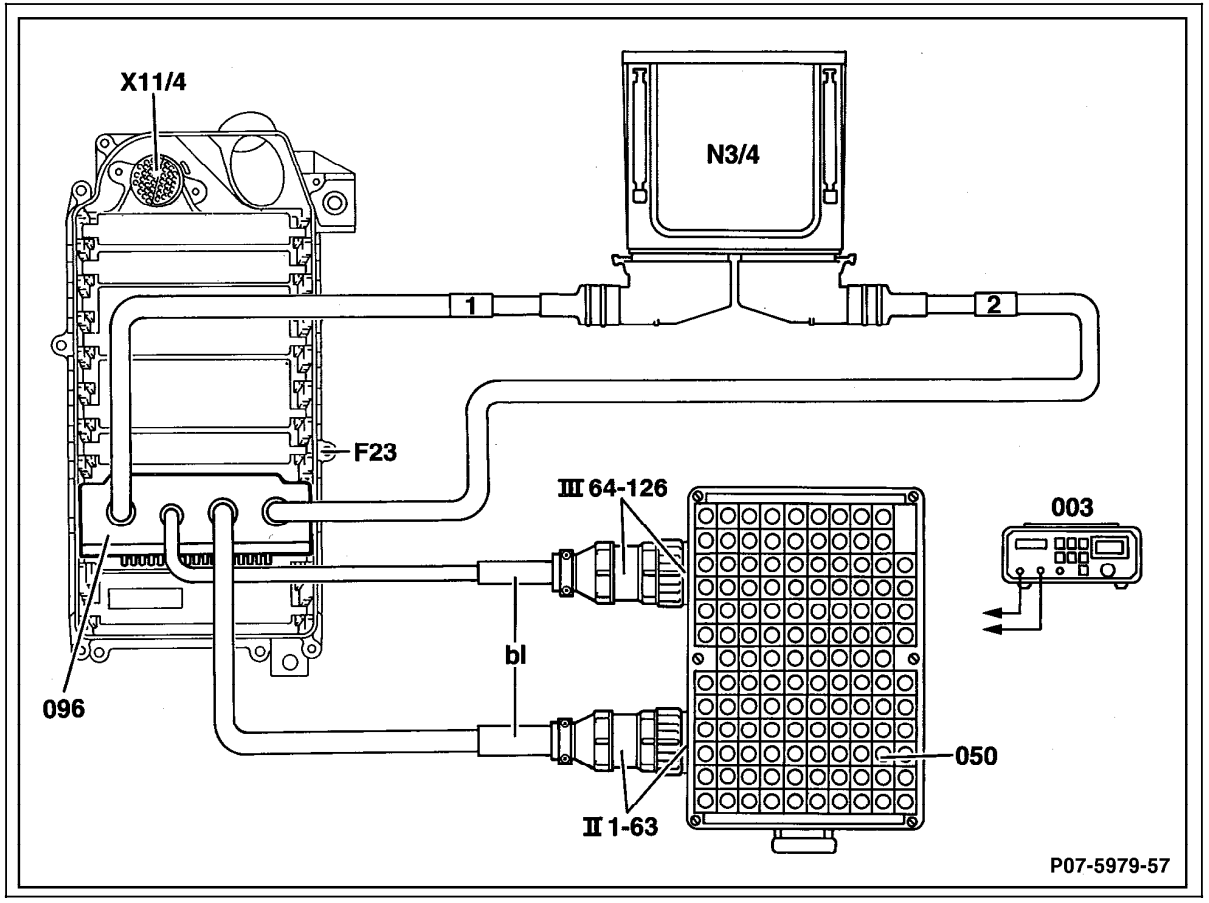
P07-5931-57

Figure 1

003 Multimeter
050 Socket box (126-pole)
088 Test cable
N3/4 Engine control module (HFM-SFI)

Electrical Test Program – Component Locations

Connection Diagram - Socket Box
Models 129 and 140 up to Model Year 1995



P07-5979-57

Figure 2

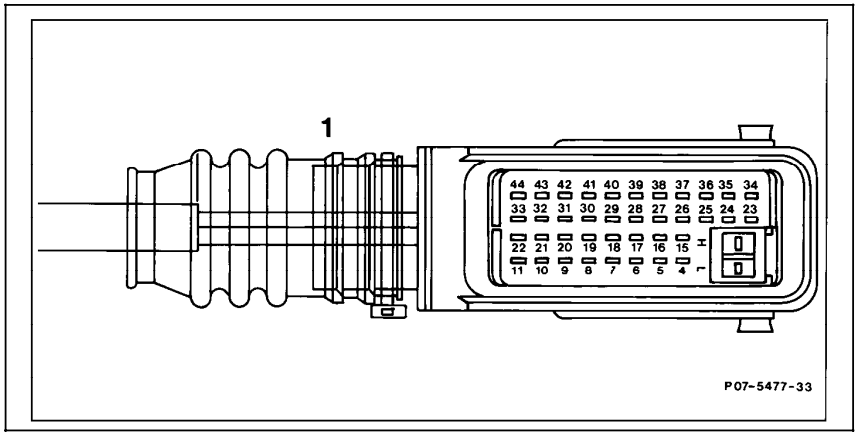
003 Multimeter
050 Socket box (126-pole)
096 Test cable
N3/4 Engine control module (HFM-SFI)

Electrical Test Program – Preparation for Test

Layout
Engine Control Module Connector “1” – Interior

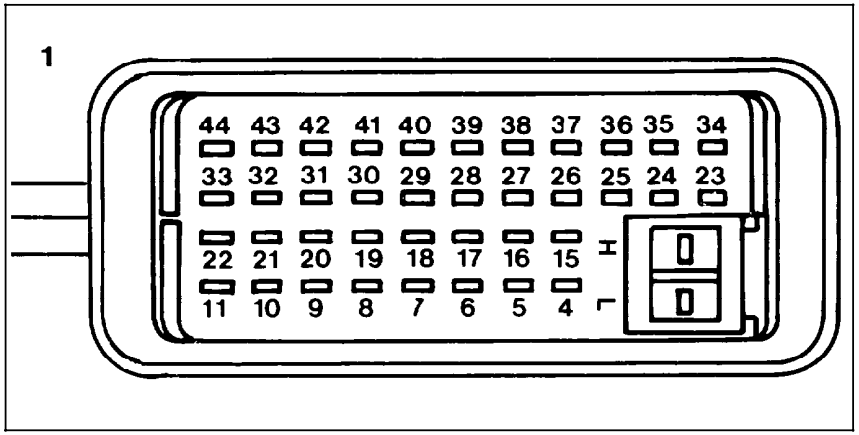
Figure 3

1 – 3	Not used
4	Fuel safety shut-off from EA/CC/ISC control module Fuel safety shut-off from CC/ISC control module (model 202, 210)
5	–
6	–
7	Fuel consumption signal
8	VSS from ABS control module (automatic 5-speed transmission only)
9	Transmission overload protection switch
10	CTP recognition from EA/CC/ISC control module
11	Not used
12 – 14	Not used
15	OS2 1 (before TWC) signal (except model 124)
16	OS2 2 (after TWC) signal (except model 124)
17	CMP sensor output signal (except model 124)
18	TN-signal (engine rpm output signal)
19	Diagnostic wire
20	Starter lock-out and backup lamp switch (transmission range P/N recognition) (4-speed automatic only)
21	Starter signal, circuit 50
22	Not used
23	Not used
24	OS2 2 (after TWC) ground (except model 124)
25	OS2 2 (after TWC) signal (except model 124)
26	OS2 2 (after TWC) insulation (except model 124)
27	Voltage supply (circuit 87M)



Models 124, 202, 210

P07-5477-33



Models 129 and 140

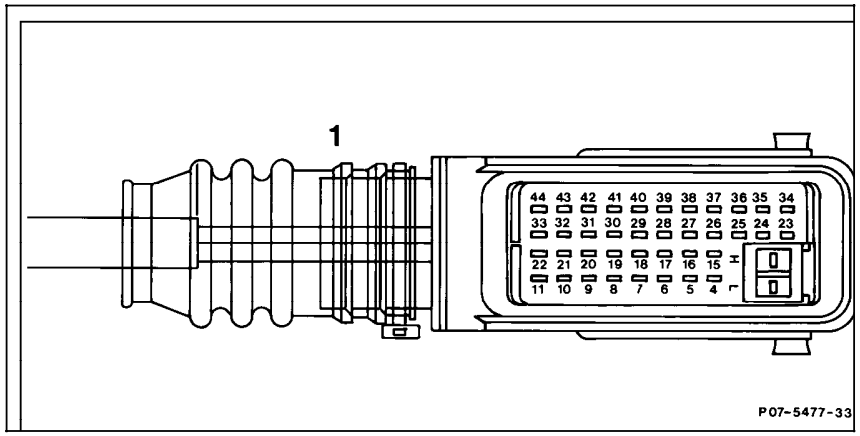
P07-5936-33

Electrical Test Program – Preparation for Test

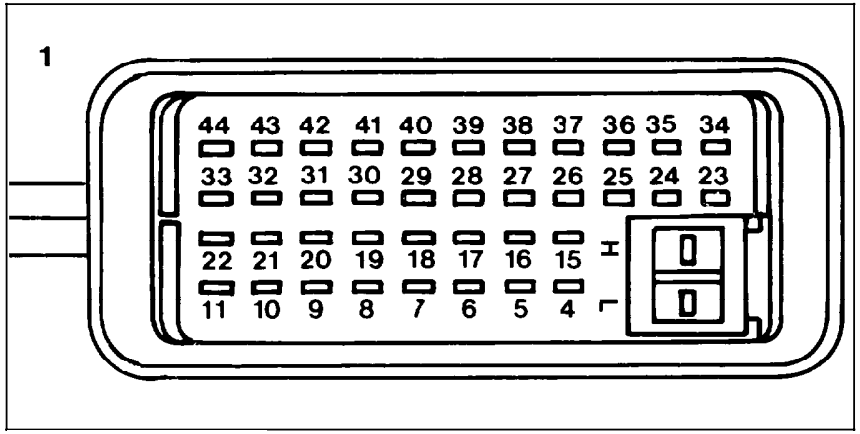
Layout
Engine Control Module Connector "1" – Interior (continued)

Figure 3a

28	Not used
29	FP relay module, on model 210 relay module (K40)
30	OS2 1 heater
31	OS2 2 (after TWC) heater relay module (except model 124, 210)
32	Electronics ground (W10/1) (model 124) Electronics ground, right footwell (W15/1) (models 129 and 140) Ground (component compartment - right, W16/6) (model 202, 210)
33	Battery ground (W10) (model 124) Ground (module box bracket, W27) (model 129) Ground (output ground - right footwell, W15) (model140) Ground (component compartment - right, W16/4) (model 202, 210)
34	OS2 1, ground
35	OS2 1, signal
36	OS21, wire insulation (until 11/94)
37	Not used
38	Not used
39	Voltage supply (circuit 87U)
40	Voltage supply (circuit 30)
41	OS2 2 (after TWC) heater (except model 124)
42	Transmission upshift delay switchover valve
43	Purge switchover valve
44	Ground for OS2 2 signal (until 7/93, except model 124)
L	CAN (–) Controller area network (HFM-SFI, RCL [as of MY 1996], EA, CC, ETC, Diagnostic module)
H	CAN (+) Controller area network (HFM-SFI, RCL [as of MY 1996], EA, CC, ETC, Diagnostic module)



Models 124, 202, 210 P07-5477-33



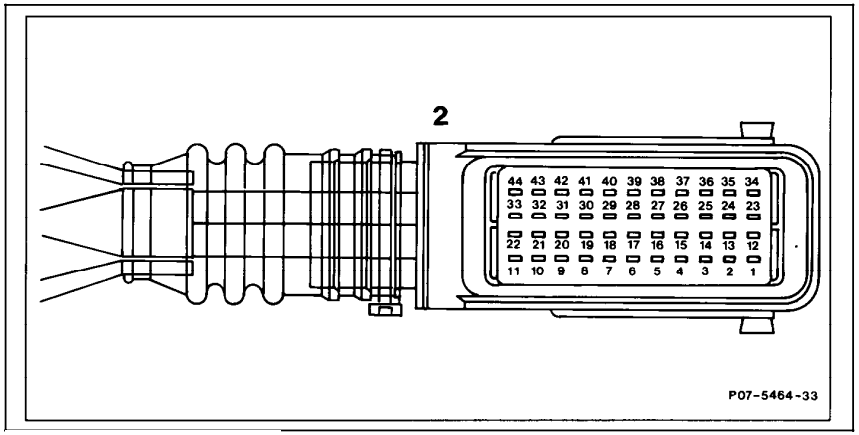
Models 129 and 140 P07-5936-33

Electrical Test Program – Preparation for Test

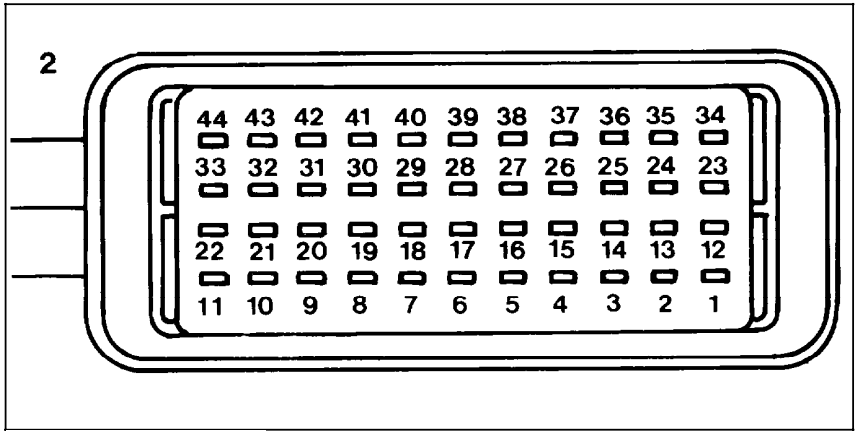
Layout
Engine Control Module Connector “2” – Engine Compartment

Figure 4

1	Adjustable camshaft timing solenoid
2	Injector 3
3	Injector 4
4	Not used
5	MAF sensor signal
6	Not used
7	Not used
8	CMP sensor signal
9	Ignition coil T1/1 (terminal 1) (Models 124, 129, 140, 202 up to Model Year 1995) Ignition coil T1/2 (terminal 1) (Models 129, 140, 202, 210 starting Model Year 1996)
10	Ignition coil T1/2 (terminal 1) (Models 124, 129, 140, 202 up to Model Year 1995) Ignition coil T1/3 (terminal 1) (Models 129, 140, 202, 210 starting Model Year 1996)
11	Not used
12	Injector 5
13	Injector 2
14	Resonance intake manifold switchover valve
15	Electromagnetic AIR pump clutch or AIR relay module (K17)
16 – 17	Not used
18	Not used
19	CMP sensor ground
20	Not used
21	Ignition coil T1/3 (terminal 1) (Models 124, 129, 140, 202 up to Model Year 1995) Ignition coil T1/1 (terminal 1) (Models 129, 140, 202, 210 starting Model Year 1996)
22	Electronics ground (W10/1) (model 124) Ground (electronics - right footwell, W15/1) (models 129 and 140) Ground (component compartment - right, W16/6) (models 202, 210)



Models 124, 202, 210 P07-5464-33



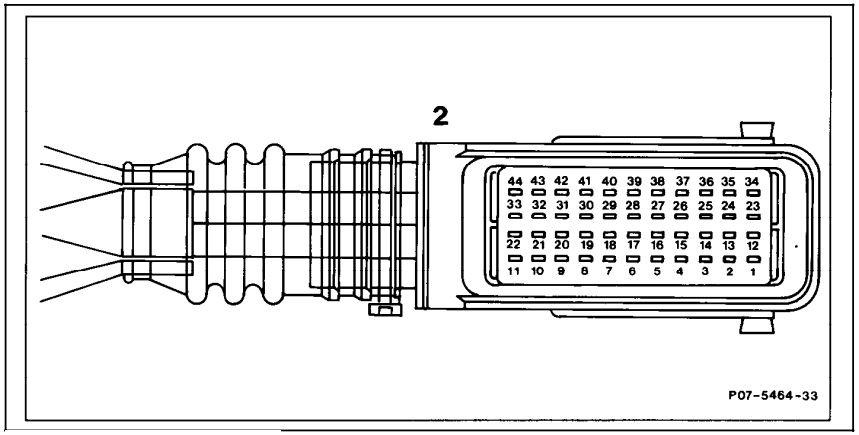
Models 129 and 140 P07-5937-33

Electrical Test Program – Preparation for Test

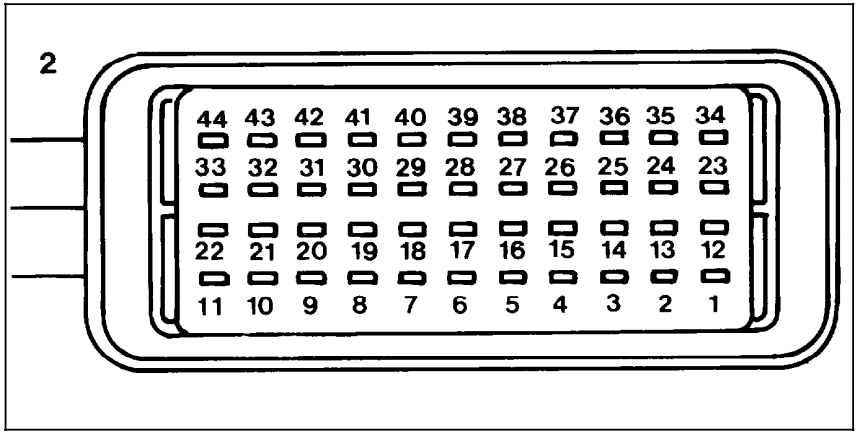
Layout
Engine Control Module Connector "2" – Engine Compartment (continued)

Figure 4a

23	Injector 1
24	Injector 6
25	EGR switchover valve
26	Not used
27	MAF sensor signal ground
28	ECT sensor ground
29	CKP sensor ground
30	CKP sensor signal
31	Not used
32	Not used
33	Not used
34	Not used
35	Not used
36	ECT sensor
37	IAT sensor
38	Not used
39	Not used
40	KS 1 ground
41	KS 1 signal
42	KS 2 ground
43	KS 2 signal
44	Not used



Models 124, 202, 210 P07-5464-33



Models 129 and 140 P07-5937-33

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
1.0		**Engine control module (HFM-SFI) (N3/4)** Voltage supply Circuit 30	N3/4 33 — (1.33) 40 — (1.40)	Ignition: **ON**	11 – 14 V	⇒ 1.1
1.1		Ground wire	N3/4 33 — (1.33) X11/4 2 [1]	Ignition: **ON**	11 – 14 V	Ground wire, **Model 124** Battery ground (W10), **Model 129** Ground, module box bracket (W27), **Model 140** Wiring harness ground, right footwell (W15), **Model 202, 210** Ground (component compartment - right [W16/4]), ⇒ 1.2
1.2		Voltage supply Circuit 30	X11/4 1 — N3/4 40 — (1.40)	Ignition: **ON**	11 – 14 V	Wire to terminal block X4/10 or X4/22.

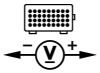
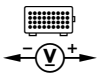
[1] For models 129, 140 and 202. On model 124, connect to socket 16.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
2.0		**Engine control module (HFM-SFI) (N3/4)** Voltage supply Circuit 87U	N3/4 32 (1.32) — V — 39 (1.39)	Ignition: **ON**	11 – 14 V	⇒ 2.1
2.1		Electronics ground	N3/4 32 (1.32) — V — X11/4 2 [1]	Ignition: **ON**	11 – 14 V	Wiring, **Model 124** Electronic ground (W10/1), **Model 129 and 140** Electronic ground, right footwell (W15/1), **Model 202, 210** Ground in component compartment right, electronic ground (W16/6), ⇒ 2.2
2.2		Voltage supply Circuit 87U	X11/4 1 — V — N3/4 39 (1.39)	Ignition: **ON** Ignition: **OFF**	11 – 14 V < 1 V	Wiring, Overvoltage protection relay module (K1/2), base module (N16/1) or relay module (K40), Ignition/starter switch (S2/1).

[1] For models 129, 140 and 202. On model 124, connect to socket 16.

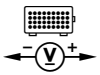
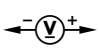
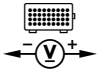
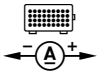
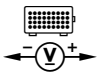
Electrical Test Program – Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
3.0		**Engine control module (HFM-SFI) (N3/4)** Voltage supply Circuit 87M	N3/4 66 — (2.22)  — 27 (1.27)	Ignition: **ON**	11 – 14 V	Wiring, Fuse, Overvoltage protection relay module (K1/2), base module (N16/1) or relay module (K40), ⇒ 3.1
3.1		Electronics ground	N3/4  66 — (2.22)  X11/4 — 2 [1]	Ignition: **ON**	11 – 14 V	Wiring, **Model 124** Electronics ground (W10/1), **Model 129 and 140** Electronic ground, right footwell (W15/1), **Model 202, 210** Electronic ground in component compartment right (W16/6),
4.0	009 010	**Hot film MAF sensor (B2/5)** Voltage at hot film	N3/4  71 — (2.27) — 49 (2.5)	Engine: **at Idle** Engine coolant temperature >70°C	 0.8 – 1.1 V [2]	Wiring, ⇒ 4.1, ⇒ 5.0, Air intake system leak, B2/5.

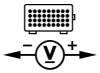
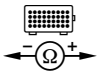
[1] For models 129, 140 and 202. On model 124, connect to socket 16.

[2] Voltage increases with increasing rpm.

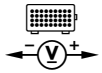
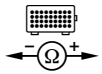
Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
4.1		Voltage supply	N3/4  71 (2.27) — 39 (1.39)	Ignition: **ON**	11 – 14 V	Wiring, Engine control module (N3/4).
5.0	009 010	**Ground wire for hot film MAF sensor (B2/5)**	B2/5  4 — 2	Disconnect connector on B2/5 and measure directly at sockets 2 (rt/bl) and 4 (br). Ignition: **ON**	11 – 14 V	Ground wire.
6.0	076	**FP relay module (K27) or relay module (K40)** Control signal	N3/4  32 (1.32) — 29 (1.29)	Engine: **Start**	6 – 14 V while cranking.	⇒ 6.1, N3/4.
6.1		Current draw	N3/4  29 (1.29) — 39 (1.39)	Ignition: **ON**	0.1 – 0.3 A	Wiring, K27 or K40
7.0	101	**Starter signal** Circuit 50	N3/4  32 (1.32) — 21 (1.21)	Engine: **Start**	6 – 14 V while cranking.	Wiring.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
8.0	002 003 004 005	**ECT sensor (B11/3)** Voltage	N3/4  72 (2.28) — 80 (2.36)	Ignition: **ON**	°C V 20 3.5 30 3.1 40 2.7 50 2.3 60 1.9 70 1.5 80 1.2 90 1.0 100 0.8 ±5 %	⇒ 8.1, Engine control module (N3/4).
8.1		Resistance	N3/4  72 (2.28) — 80 (2.36)	Ignition: **OFF** Unplug connector 2 on engine control module (N3/4).	°C Ω 20 2500 30 1700 40 1170 50 830 60 600 70 435 80 325 90 245 100 185 ±5 %	Wiring, B11/3.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
9.0	006 007 008	**IAT sensor (B17)** Voltage	N3/4  72 (2.28) — 81 (2.37)	Ignition: **ON**	°C V 10 3.2 20 2.6 30 2.1 40 1.6 50 1.2 60 0.9 70 0.7 80 0.5 ±5 %	⇒ 9.1, Engine control module (N3/4).
9.1		Resistance	N3/4  72 (2.28) — 81 (2.37)	Ignition: **OFF** Unplug connector 2 on engine control module (N3/4).	°C Ω 10 9670 20 6060 30 3900 40 2600 50 1760 60 1220 70 860 80 620 ±5 %	Wiring, B17.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
10.0	070 071	**Engine control module (N3/4)** TN-signal output (engine rpm output signal)	N3/4 [3] 32 (1.32) — ⏚ — 18 (1.18) N3/4 [4] 32 (1.32) — V — 18 (1.18)	Engine: **Start** or Engine: **at Idle**	Signal, see Figure 1. 5 – 7.5 V	Wiring, Engine control module (N3/4).
11.0		**Closed throttle position recognition signal** EA/CC/ISC actuator (M16/1) or CC/ISC actuator (M16/2)	N3/4 32 (1.32) — V — 10 (1.10)	Ignition: **ON** Accelerator pedal in closed throttle position. Accelerator pedal in wide open throttle position.	4.8 V 5.5 V	Wiring, M16/1 or M16/2 (see electronic accelerator or cruise control/idle speed control tests in Diagnostic Manual, Engines, Volume 3, sections 6 or 7).
12.0	104	**Fuel safety shut-off** from EA/CC/ISC actuator (M16/1) or CC/ISC actuator (M16/2)	N3/4 32 (1.32) — V — 4 (1.4)	Ignition: **ON**	2.2 – 11 V (voltage fluctuates)	Wiring, M16/1 or M16/2 (see electronic accelerator or cruise control/idle speed control tests in Diagnostic Manual, Engines, Volume 3, sections 6 or 7).

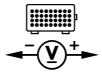
[3] Test with oscilloscope.

[4] Test with multimeter only if oscilloscope is not available.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
13.0.	104	**Fuel safety shut-off**	N3/4 32 (1.32) — 4 (1.4)	Engine: **Start** and apply wide open throttle.	Engine speed surges between 1000 – 2000 rpm.	Engine control module (N3/4).
14.0	023 024 025	**O2S 1 (before TWC) (G3/2)** O2S 1 signal	N3/4 34 (1.34) — V — 35 (1.35)	Engine: **at Idle** and at operating temperature > 80 °C let engine run for a minimum of 2 minutes.	Oscillates between – 0.2 and + 1.0 V by more than 0.3 V	Wiring, G3/2, ⇒ 14.1, ⇒ 15.0
14.1		Insulation, O2S 1 wire	N3/4 35 (1.35) — Ω — 36 (1.36)	Ignition: **OFF** Unplug connector 1 on N3/4.	>20 kΩ	Wiring.
15.0	029 030 031	**O2S 1 (before TWC) (G3/2)** O2S 1 heater Control signal	N3/4 32 (1.32) — V — 30 (1.30)	Engine: **at Idle** and at operating temperature > 80 °C let engine run for a minimum of 2 minutes.	11 – 14 V	⇒ 15.1, N3/4.
15.1		Current draw	N3/4 30 (1.30) — A — 39 (1.39)	Ignition: **ON**	0.6 – 3.4 A	Wiring, G3/2.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
16.0	026 027 028	**Except model 124** Perform both measurements simultaneously **O2S 2 (after TWC) (G3/1)** O2S 2 signal	N3/4  24 (1.24) — 25 (1.25)	Start engine at engine coolant temperature > 80°C. Maintain an engine speed of 2000 – 3000 rpm for approx. 3 minutes until O2S 2 (after TWC) heater is switched on (see second multimeter or HHT).	450 mV constant Voltage changes	Wiring, ⇒ 16.1, ⇒ 17.0, ⇒ 18.0, G3/1.
		Note to Test connection: Connect second multimeter **Except model 210** **O2S 2 (after TWC) heater relay module (K35)** Control signal	N3/4  31 (1.31) — 27 (1.27)	Accelerate briefly. O2S 2 (after TWC) heater not switched on. O2S 2 (after TWC) heater switched on. **Note:** After the O2S 2 (after TWC) heater is switched on, the O2S signal must change.	Voltage changes by > 100 mV 11 – 14 V < 1 V	

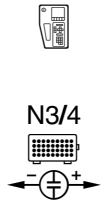
Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
16.1		Insulation, O2S 2 wire	N3/4 25 (1.25) — Ω — 26 (1.26)	Ignition: **OFF** Unplug connector 1 on engine control module (N3/4).	>20 kΩ	Wiring.
17.0	032 033 034	**Except model 124** **O2S 2 (after TWC) (G3/1)** O2S 2 heater Control signal	N3/4 32 (1.32) — V — 41 (1.41)	Engine: **at Idle** and at operating temperature > 80 °C let engine run for a minimum of 2 minutes.	11 – 14 V	⇒ 17.1. Engine control module (N3/4).
17.1		Current draw	N3/4 41 (1.41) — A — 39 (1.39)	Ignition: **ON**	0.6 – 3.4 A	Wiring, O2S 2 (after TWC) heater relay module (K35), O2S 2 (G3/1).
18.0	108 109	**Except model 124, 210** **O2S 2 (after TWC) heater relay module (K35)** Control signal	N3/4 31 (1.31) — V — 27 (1.27)	Disconnect ECT sensor (B11/3) and simulate 2.5 kΩ at sockets 1 and 2 with resistance substitution unit. Engine: **at Idle**	11 – 14 V	⇒ 18.1, N3/4.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
18.1		Current draw	N3/4 33 — (1.33) – A + — 31 (1.31)	Ignition: **ON**	0.1 – 0.3 A	Wiring, K35.
19.0	037 038	**Injector (Y62y1)** Control and injection time	N3/4 67 — (2.23) – ⏚ + — 39 (1.39)	**ECT approx. 20 °C** at start → **ECT approx. 80 °C** at idle → accelerate briefly →	Injection time: approx. 8 ms approx. 3 – 5 ms approx. 17 ms (see signals, Figures 2 and 3)	⇒ 19.1, Engine control module (N3/4), **Further possibilities:** ECT sensor (B11/3), IAT sensor (B17), O2S 1 (G3/2).
19.1		Resistance	N3/4 67 — (2.23) – Ω + — 53 (2.9)	Ignition: **OFF** Connector 2 on engine control module unplugged.	14 – 17 Ω	Wiring, Y62y1.

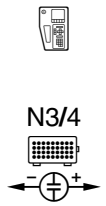
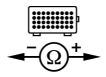
Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
20.0	039 040	**Injector (Y62y2)** Control and injection time		**ECT approx. 20 °C** at start → **ECT approx. 80 °C** at idle → accelerate briefly →	Injection time: approx. 8 ms approx. 3 – 5 ms approx. 17 ms (see signals, Figures 2 and 3)	⇒ 20.1, Engine control module (N3/4), **Further possibilities:** ECT sensor (B11/3), IAT sensor (B17), O2S 1 (G3/2).
20.1		Resistance		Ignition: **OFF** Connector 2 on engine control module unplugged.	14 – 17 Ω	Wiring, Y62y2.
21.0	041 042	**Injector (Y62y3)** Control and injection time		**ECT approx. 20 °C** at start → **ECT approx. 80 °C** at idle → accelerate briefly →	Injection time: approx. 8 ms approx. 3 – 5 ms approx. 17 ms (see signals, Figures 2 and 3)	⇒ 21.1, Engine control module (N3/4), **Further possibilities:** ECT sensor (B11/3), IAT sensor (B17), O2S 1 (G3/2).

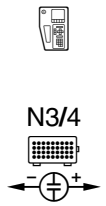
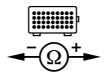
Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
21.1		Resistance	N3/4 46 (2.2) — Ω — 53 (2.9)	Ignition: **OFF** Connector 2 on engine control module unplugged.	14 – 17 Ω	Wiring, Y62y3.
22.0	043 044	**Injector (Y62y4)** Control and injection time	N3/4 47 (2.3) — 39 (1.39)	**ECT approx. 20 °C** at start → **ECT approx. 80 °C** at idle → accelerate briefly →	Injection time: approx. 8 ms approx. 3 – 5 ms approx. 17 ms (see signals, Figures 2 and 3)	⇒ 22.1, Engine control module (N3/4), **Further possibilities:** ECT sensor (B11/3), IAT sensor (B17), O2S 1 (G3/2).
22.1		Resistance	N3/4 47 (2.3) — Ω — 53 (2.9)	Ignition: **OFF** Connector 2 on engine control module unplugged.	14 – 17 Ω	Wiring, Y62y4.

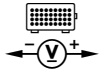
Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
23.0	045 046	**Injector (Y62y5)** Control and injection time	 N3/4 56 (2.12) — 39 (1.39)	**ECT approx. 20 °C** at start → **ECT approx. 80 °C** at idle → accelerate briefly →	Injection time: approx. 8 ms approx. 3 – 5 ms approx. 17 ms (see signals, Figures 2 and 3)	⇒ 23.1, Engine control module (N3/4), **Further possibilities:** ECT sensor (B11/3), IAT sensor (B17), O2S 1 (G3/2).
23.1		Resistance	 N3/4 56 (2.12) — 53 (2.9)	Ignition: **OFF** Connector 2 on engine control module unplugged.	14 – 17 Ω	Wiring, Y62y5.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
24.0	047 048	**Injector (Y62y6)** Control and injection time	 N3/4 68 (2.24) 39 (1.39)	**ECT approx. 20 °C** at start → **ECT approx. 80 °C** at idle → accelerate briefly →	Injection time: approx. 8 ms approx. 3 – 5 ms approx. 17 ms (see signals, Figures 2 and 3)	⇒ 24.1, Engine control module (N3/4), **Further possibilities:** ECT sensor (B11/3), IAT sensor (B17), O2S 1 (G3/2).
24.1		Resistance	 N3/4 68 (2.24) 53 (2.9)	Ignition: **OFF** Connector 2 on engine control module unplugged.	14 – 17 Ω	Wiring, Y62y6.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
25.0	068 069	***Non-USA vehicles only.*** ***Continue to next test step.***				
26.0	077 078	***Non-USA vehicles only.*** ***Continue to next test step.***				
27.0	072 073	***Non-USA vehicles only.*** ***Continue to next test step.***				
28.0	085	**Models 124, 129, 140: Electromagnetic AIR pump clutch (Y33) and AIR pump switchover valve (Y32)** **Model 202, 210: AIR pump switchover valve (Y32) and AIR relay module (K17)** Control signal	N3/4  32 (1.32) — 59 (2.15)	Disconnect ECT sensor (B11/3) and simulate 2.5 kΩ at sockets 1 and 2 with resistance substitution unit. Engine: **at Idle**	11 – 14 V (for approx. 2 minutes after start **and** AIR pump runs)	⇒ 28.1, Engine control module (N3/4).

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
28.1		Current draw	N3/4 59 (2.15) — 39 (1.39)	Ignition: **ON**	**Models 124, 129, 140** 3.0 – 4.5 A **Model 202, 210** 0.4 – 0.7 A	Wiring, **Models 124, 129, 140** Y32, Y33. **Model 202, 210** Y32, K17.
29.0	086 087	**Purge control valve (Y58/1)** Control signal	N3/4 43 (1.43) — 39 (1.39)	Engine: **at Idle** and at operating temperature.	After approx. 1 minute, purge control valve (Y58/1, Figure 5) must cycle noticeably (signal, see Figure 4).	⇒ 29.1, ⇒ 30.0, Engine control module (N3/4).
29.1		Current draw	N3/4 32 (1.32) — 43 (1.43)	Ignition: **ON**	0.2 – 0.3 A	Wiring, Purge control valve (Y58/1).

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
30.0		**Purge control valve (Y58/1)** Vacuum control		**Note to test connection:** Connect vacuum tester to Y58/1 (Figure 5), connection (A). Engine: **at Idle** and at operating temperature.	After approx. 1 minute, > 400 mbar	Vacuum lines, Y58/1.
31.0	089 090	**Adjustable camshaft timing solenoid (Y49)** Current draw	Y49 1 — (A) — 2	**Note to test connection:** Connect test cable (102 589 04 63 00) to solenoid. Engine: **Start** and raise engine speed to approx. 3000 rpm.	Briefly approx. 1.5 A, then 1 A	⇒ 31.1, ⇒ 32.0, N3/4.
31.1		Resistance	N3/4 45 — (Ω) — 53 (2.1) (2.9)	Ignition: **OFF**	4 – 8 Ω	Wiring, Y49.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
32.0		**Adjustable camshaft timing solenoid (Y49)** Mechanical operation	N3/4 45 (2.1) — 66 (2.22)	Engine: **at Idle** Bridge socket box sockets for maximum of 10 seconds.	Engine runs unevenly or stalls	Mechanical camshaft adjustment (see SMS, Repair Instructions, Engine 104, Job No. 05–216).
33.0	105 106	**Resonance intake manifold switchover valve (Y22/6)** Control signal	N3/4 58 (2.14) — V — 39 (1.39)	Engine: **Start** Engine speed: < 3900 rpm Engine speed: > 3900 rpm	0 V 11 – 14 V	⇒ 33.1, Engine control module (N3/4).
33.1		Current draw	N3/4 32 (1.32) — A — 58 (2.14)	Ignition: **ON**	0.4 – 0.6 A	Wiring, Y22/6.
34.0	088	**Upshift delay switchover valve (Y3/3)** Current draw	N3/4 42 (1.42) — A — 39 (1.39)	Ignition: **ON**	0.4 – 0.6 A	Wiring, Y3/3, ⇒ 35.0

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
35.0		**Pneumatic upshift delay** Vacuum control and sealing	N3/4 42 (1.42) — 39 (1.39)	**Note to test connection:** Connect vacuum tester to upshift delay switchover valve (Y3/3) according to Figure 13 and connect bridge. Engine: **at Idle**	 > 400 mbar	Vacuum lines, Y3/3.
36.0	098 099 100	**Serial data bus (CAN)**	N3/4 L — Ω — H	Ignition: **OFF**	55 – 65 Ω	⇒ 36.1, ⇒ 37.0, Data line.

Electrical Test Program – Test

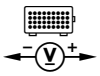
⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
36.1		**CAN element in CC/ISC (N4/3) or EA/CC/ISC (N4/1) control module** **RCL control module (N54)** [5] Resistance	N4/1 N4/3 N54 L — ◄–Ω+► — H	Remove N4/3, N4/1 or N54 control module and measure resistance directly at control module (see Figure 8 to 10 and 15).	115 – 125 Ω	N4/1, N4/3 or N54.
37.0	097	**CAN element in engine control module** Resistance	N3/4 L — ◄–Ω+► — H	Ignition: **OFF** **Models 124, 129, 140, 202, 210 as of 6/95** Unplug connector 1 on N3/4 and measure resistance directly at engine control module (Figure 11). **Models 129, 140 up to 5/95** Remove N3/4 and measure resistance directly at engine control module (Figure 12).	115 – 125 Ω	Engine control module (N3/4)

[5] As of model year 1996.

Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
38.0	091 092	**EGR switchover valve (Y27)** Vacuum control	N3/4 69 (2.25) — V — 39 (1.39)	Engine: **at Idle** Engine coolant temperature > 60 °C Apply briefly full throttle.	11 – 14V	⇒ 38.1, Engine control module (N3/4), ⇒ 39.0 – 40.0
38.1		Current draw	N3/4 32 (1.32) — A — 69 (2.25)	Ignition: **ON**	0.3 – 0.5 A	Fuse, Wiring, Y27.
39.0		**EGR switchover valve (Y27)** Vacuum control		**Note to test connection:** Connect vacuum tester to the EGR valve (Figure 14). Engine control module (N3/4) plugged in. Engine: **Start** and run at > 3000 rpm.	> 400 mbar	EGR valve.

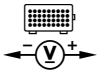
Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
40.0		**EGR valve** Mechanical test		**Note to test connection:** Connect vacuum tester directly to EGR valve. Engine: **at Idle** Apply 500 mbar vacuum with vacuum tester. Engine: **Off** Apply 500 mbar vacuum with vacuum tester and pull off vacuum line.	 Engine runs unevenly EGR valve closes audibly	EGR valve.
41.0		***Non-USA vehicles only.*** ***Continue to next test step.***				
42.0		**P/N position recognition** **5-speed AT only!**	N3/4  20 (1.20) — 39 (1.39)	Ignition: **ON** Selector lever position: P → R → N → D – 3 – 2 →	 11 – 14 V < 1 V 11 – 14 V < 1 V	Wiring, Starter lock-out/backup lamp switch (S16/1).
43.0		***Non-USA vehicles only.*** ***Continue to next test step.***				
44.0		***Non-USA vehicles only.*** ***Continue to next test step.***				

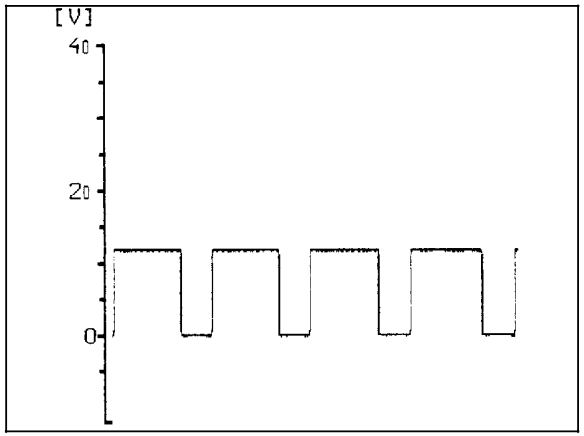
Electrical Test Program – Sequential Multiport Fuel Injection System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
45.0		**Models 129, 140, 202, 210** **O2S 1 (before TWC) (G3/2)** O2S 1 signal for diagnostic module (OBD II)	N3/4 34 (1.34) — V — 15 (1.15)	Engine: **at Idle** and at operating temperature > 80 °C let engine run for a minimum of 2 minutes.	Oscillates in range between -0.2 and+1.0 V by more than 0.3 V	Wiring, Engine control module (N3/4).
46.0		**Models 129, 140, 202, 210** **O2S 2 (after TWC) (G3/1)** O2S 2 signal for diagnostic module (OBD II)	N3/4 24 (1.24) — V — 16 (1.16)	At operating temperature > 80 °C start engine. and run at 2000 – 3000 rpm for a minimum of 3 minutes. Accelerate briefly.	450 mV constant. Voltage fluctuates. Voltage fluctuates by >100 mV	Wire, N3/4.
47.0		**Models 129, 140, 202** **CMP sensor (L5/1)** Signal for diagnostic module (OBD II) **Model 210** **Camshaft Hall-effect sensor (B6/1)** Signal for diagnostic module (OBD II)	N3/4 32 (1.32) — V — 17 (1.17) N3/4 17 (1.17) — V — 27 (1.27)	Engine: **at Idle** Engine: **at Idle**	9.5 - 10.5 V 1.3 – 1.7 V Value fluctuates	Wiring, N3/4.

Electrical Test Program – Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
48.0		**Fuel consumption signal**	N3/4  7 (1.7) — 39 (1.39)	Engine: **at Idle** Accelerate briefly.	approx. 0.85 V > 1 V	Wiring, Engine control module (N3/4).

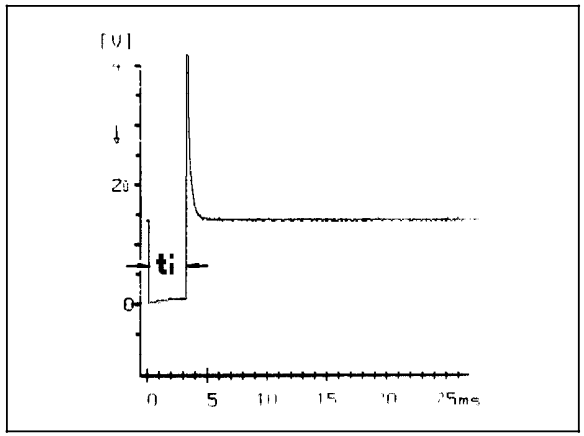
Electrical Test Program – Sequential Multiport Fuel Injection System Test



P15-0370-13

Figure 1

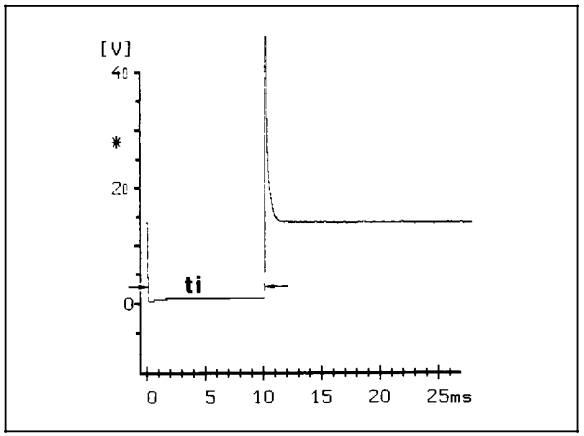
TN signal (engine rpm)



P07-0699-13

Figure 2

Injection time signal “ti” of injectors at idle speed

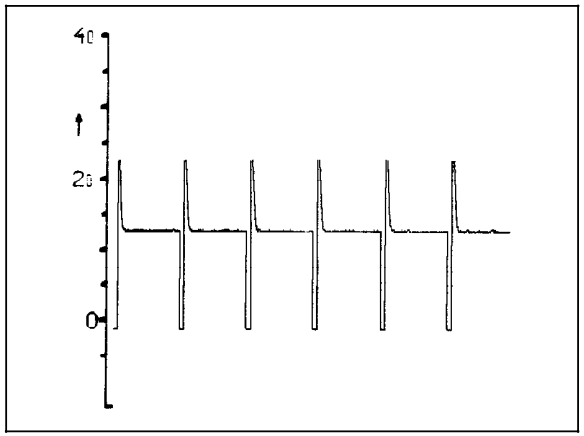


P07-0700-13

Figure 3

Injection time signal “ti” of injectors when briefly accelerating

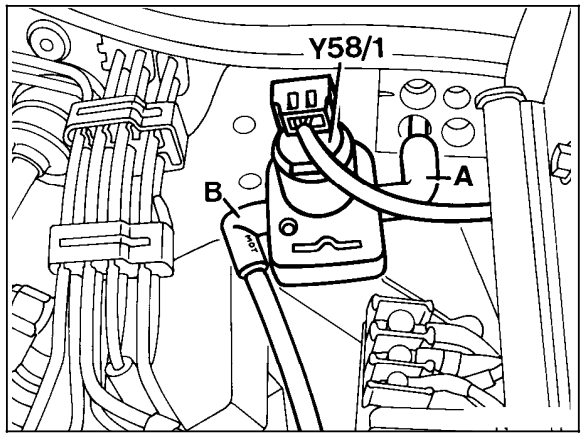
Electrical Test Program – Sequential Multiport Fuel Injection System Test



P07-5330-13

Figure 4

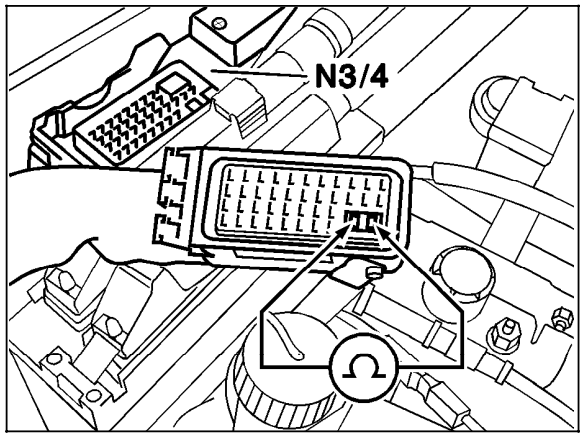
Purge control valve control signal



P07-5455-13

Figure 5 As shown on Model 124)

Y58/1	Purge control valve
A	Line to charcoal canister
B	Line to engine



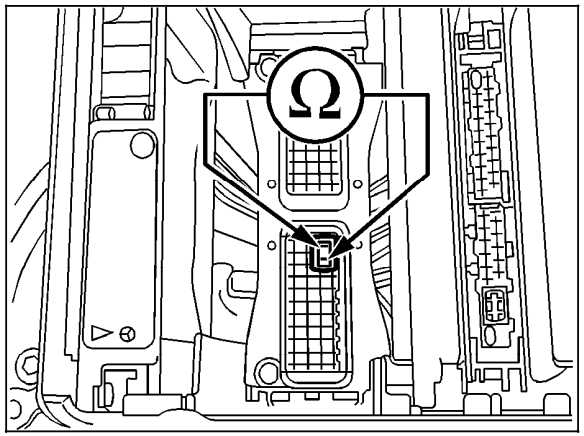
P07-6115-13

Figure 6

Model 124, 202, 210

N3/4	Engine control module (HFM-SFI)

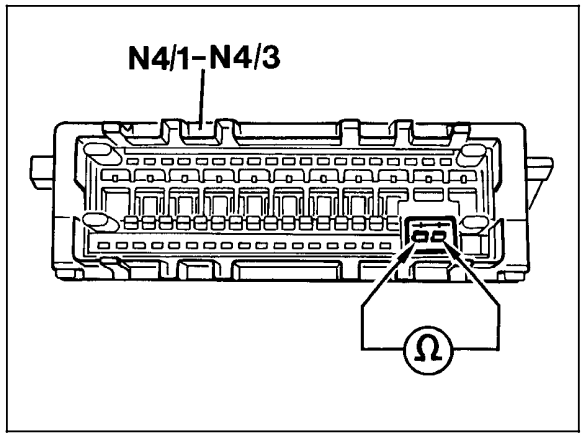
Electrical Test Program – Sequential Multiport Fuel Injection System Test



P07-6366-13

Figure 7
Model 129, 140

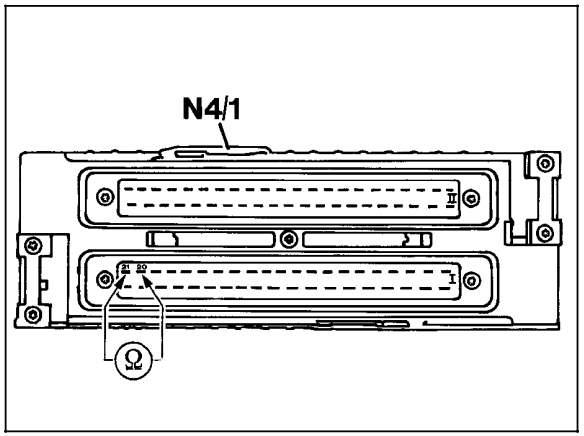
N3/4 Engine control module (HFM-SFI)



P07-6011-13

Figure 8
Model 124, 202

N4/3 CC/ISC control module

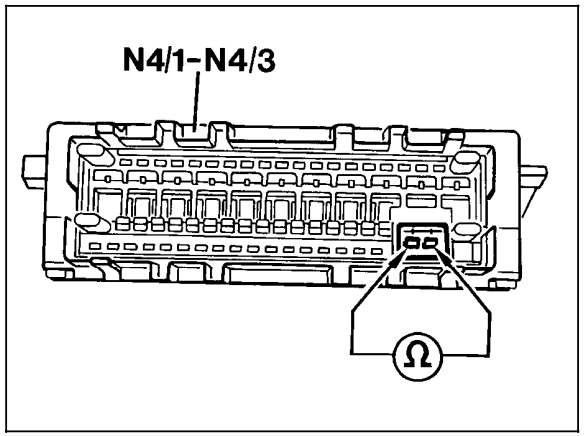


P07-6009-13

Figure 9
Model 124, 202, 210

N4/1 EA/CC/ISC control module

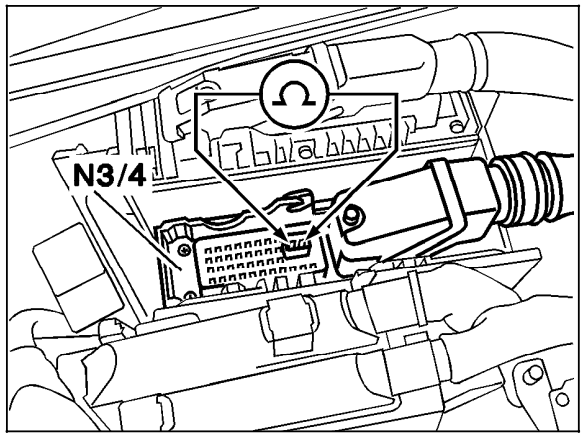
Electrical Test Program – Sequential Multiport Fuel Injection System Test



P07-6008-13

Figure 10
Model 129, 140

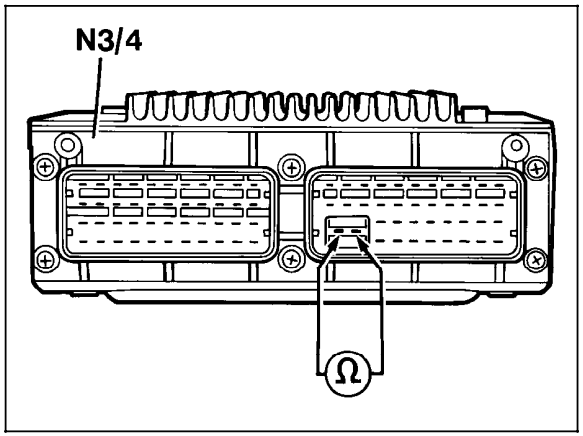
N4/1 EA/CC/ISC control module
N4/3 CC/ISC control module



P07-6116-13

Figure 11
Model 124, 202, 210 and 129/140 as of 06/95

N3/4 Engine control module (HFM-SFI)

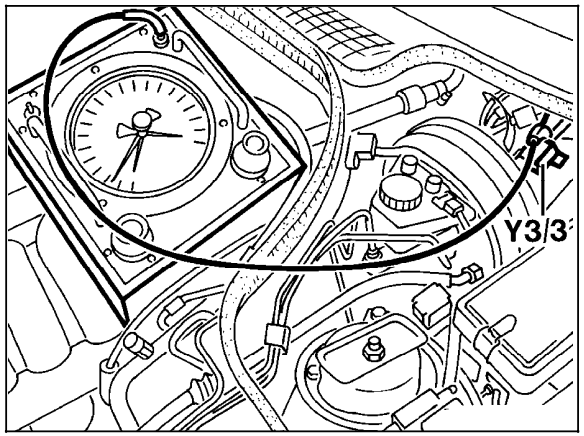


P07-6010-13

Figure 12
Model 129, 140 up to 05/95

N3/4 Engine control module (HFM-SFI)

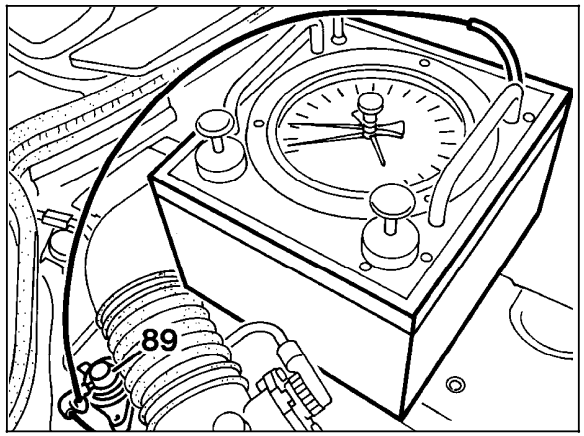
Electrical Test Program – Sequential Multiport Fuel Injection System Test



P07-5735-13

Figure 13 As shown on Model 124

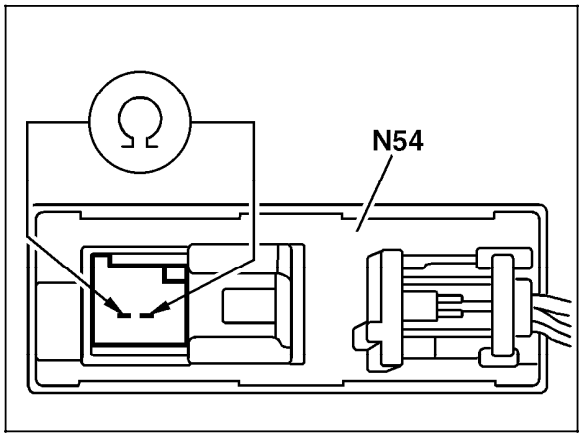
Y3/3 Upshift delay switchover valve



P07-5733-13

Figure 14

89 EGR valve



P07.51-0338-13

Figure 15

N54 RCL control module

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
1.0		**Engine control module (N3/4)** Voltage supply, circuit 30	N3/4 33 — (1.33) V — 40 (1.40)	Ignition: **ON**	11 – 14 V	⇒ 1.1
1.1		Ground wire	N3/4 33 — (1.33) V X11/4 — 2 [1]	Ignition: **ON**	11 – 14 V	Wiring, **Model 124** Battery ground (W10). **Model 129** Ground, module box bracket (W27). **Model 140** Output ground, right footwell (W15). **Model 202, 210** Ground, component compartment - right (W16/4).
1.2		Voltage supply, circuit 30	X11/4 1 — V N3/4 — 40 (1.40)	Ignition: **ON**	11 – 14 V	Wire to terminal block X4/10 or X4/22.

[1] On models 129, 140 and 202. On model 124, connect to socket 16.

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
2.0		**Engine control module (N3/4)** Voltage supply, circuit 87U	N3/4 32 (1.32) — V — 39 (1.39)	Ignition: **ON**	11 – 14 V	⇒ 2.1
2.1		Electronics ground	N3/4 X11/4 32 (1.32) — V — 2 [1]	Ignition: **ON**	11 – 14 V	Wiring, **Model 124** Electronics ground (W10/1), **Models 129, 140** Electronics ground, right footwell (W15/1), **Model 202, 210** Electronics ground, component compartment - right (W16/6), ⇒ 2.2
2.2		Voltage supply, circuit 87	X11/4 N3/4 1 — V — 39 (1.39)	Ignition: **ON** Ignition: **OFF**	11 – 14 V < 1 V	Wiring, Overvoltage protection relay module (K1/2), base module (N16/1) or relay module (K40), Ignition/starter switch (S2/1).

[1] On models 129, 140 and 202. On model 124, connect to socket 16.

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
3.0		**Engine control module (N3/4)** Voltage supply, circuit 87	N3/4 66 (2.22) — V — 27 (1.27)	Ignition: **ON**	11 – 14 V	Wiring, Fuse, Overvoltage protection relay module (K1/2), base module (N16/1) or relay module (K40), ⇒ 3.1
3.1		Electronics ground	N3/4 66 (2.22) — V — X11/4 2 [1]	Ignition: **ON**	11 – 14 V	Wiring, **Model 124** Electronics ground (W10/1). **Models 129, 140** Electronics ground, right footwell (W15/1). **Model 202, 210** Ground component compartment - right (W16/6).

[1] On models 129, 140 and 202. On model 124, connect to socket 16.

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
4.0		**Ignition coil (T1/1)** Voltage supply **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 33 (1.33) — V — 53 (2.9) N3/4 33 (1.33) — V — 65 (2.21)	Ignition: **ON** Starter: **Crank**	11 – 14 V > 6 V	Wire to T1/1, Ignition coil T1/1, Engine control module (N3/4).
5.0		**Ignition coil (T1/2)** Voltage supply **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 33 (1.33) — V — 54 (2.10) N3/4 33 (1.33) — V — 53 (2.9)	Ignition: **ON** Starter: **Crank**	11 – 14 V > 6 V	Wire to T1/2, Ignition coil T1/2, Engine control module (N3/4).

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
6.0		**Ignition coil (T1/3)** Voltage supply **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 33 (1.33) — V — 65 (2.21) N3/4 33 (1.33) — V — 54 (2.10)	Ignition: **ON** Starter: **Crank**	11 – 14 V > 6 V	Wire to T1/3, Ignition coil T1/3, Engine control module (N3/4).

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
7.0	064 065 066	**CKP sensor (L5)**	N3/4 [2] 73 — (2.29) 74 — (2.30)	Starter: **Crank**	Signal, see Figure 1 and 2.	⇒ 7.1, Segments (magnets) on starter ring gear.
			N3/4 [3] 73 — (2.29) 74 — (2.30)	Starter: **Crank** Engine: **at Idle**	> 0.4 V > 1 V [4]	
7.1		Resistance of L5	N3/4 73 — (2.29) 74 — (2.30)	Ignition: **OFF** Unplug connector 2 on engine control module (N3/4).	700 – 1400 Ω	⇒ 7.2
7.2		Insulation of L5	N3/4 32 — (1.32) 74 — (2.30)	Ignition: **OFF** Unplug connector 2 on engine control module (N3/4).	> 20 kΩ	CKP sensor (L5).

2) Test with oscilloscope.
3) Test with multimeter only if oscilloscope is unavailable.
4) Voltage increases with increasing rpm.

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
8.0	067	**Model 124, 129, 140, 202** **CMP sensor (L5/1)**	N3/4 [2] 63 (2.19) — (±) — 52 (2.8)	Engine: **at Idle**	Signal, see Figure 3.	⇒ 8.1, Check distance between sensor (L5/1) and pickup (Refer to SMS, Engine 111, Engine Combustion, Job No. 15-2143)
			N3/4 [3] 63 (2.19) — (V) — 52 (2.8)	Engine: **at Idle**	> 0.2 V [4]	
8.1		Resistance of L5/1	N3/4 63 (2.19) — (Ω) — 52 (2.8)	Ignition: **OFF** Unplug connector 2 on engine control module (N3/4).	900 – 1600 Ω	Wiring, ⇒ 8.2
8.2		Insulation of L5/1	N3/4 32 (1.32) — (Ω) — 52 (2.8)	Ignition: **OFF** Unplug connector 2 on engine control module (N3/4).	> 20 kΩ	CMP sensor (L5/1).

2) Test with oscilloscope.
3) Test with multimeter only if oscilloscope is unavailable.
4) Voltage increases with increasing rpm.

Electrical Test Program – Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
9.0	067	**Model 210** **Camshaft Hall-effect sensor (B6/1)** Signal	N3/4 [2] 63 (2.19) — 52 (2.8) N3/4 [3] 52 (2.8) — 27 (1.27)	Engine: **at Idle** Engine: **at Idle**	Signal see Figure 4 1.3 – 2 V Value changes	Wiring, ⇒ 9.1, Camshaft Hall-effect sensor (B6/1).
9.1		Camshaft Hall-effect sensor (B6/1) Voltage supply	B6/1 1 — 3	Ignition: **ON** Unplug connector on camshaft Hall-effect sensor and measure at socket 1 (rd/bl) and 3 (pk/gn).	11 – 14 V	Wiring.

2) Test with oscilloscope.

3) Test with multimeter only if oscilloscope is unavailable.

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
10.0	093 094 095 096	**Transmission overload protection switch (S65)**	N3/4 33 (1.33) — V — 9 (1.9)	Engine: **at Idle** Selector lever in transmission range “D” 1) Selector lever in park/neutral position.	 < 1 V > 4 V	Wiring, S65.
11.0	055 056 057	**Closure duration for ignition coil (T1/1)** **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 53 (2.9) — ⏚ — 39 (1.39) N3/4 65 (2.21) — ⏚ — 39 (1.39)	Starter: **Crank** Engine: **at Idle**	20 - 100 ms 2 – 4 ms	⇒ 7.0 Engine control module (N3/4).

1) Vehicles starting off in first gear must be driven on the dynamometer with selector lever in transmission range “D” at > 12 mph (20 km/h).
On vehicles with ASR, sockets 1 and 6 on the data link connector (DTC readout) (X11/4) must be bridged.

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
[11.0]		Testing with multimeter: T1/1 **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 53 — (2.9) 39 — (1.39) N3/4 65 — (2.21) 39 — (1.39)	Ignition: **ON** Starter: **Crank**	0 V 0.3 – 0.5 V	Ignition coil (T1/1), Engine control module (N3/4), < 0.3 V: Open circuit in wire from T1/1 to N3/4, > 0.5 V: T1/1.
12.0	058 059 060	**Closure duration for ignition coil (T1/2)** **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 54 — (2.10) 39 — (1.39) N3/4 53 — (2.9) 39 — (1.39)	Starter: **Crank** Engine: **at Idle**	20 – 100 ms 2 – 4 ms	⇒ 7.0, Engine control module (N3/4).

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
[12.0]		Testing with multimeter: T1/2 **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 54 (2.10) — V — 39 (1.39) N3/4 53 (2.9) — V — 39 (1.39)	Ignition: **ON** Starter: **Crank**	0 V 0.3 – 0.5 V	Ignition coil (T1/2), Engine control module (N3/4), < 0.3 V: Open circuit in wire from T1/2 to N3/4, > 0.5 V: T1/2.
13.0	061 062 063	**Closure duration for ignition coil (T1/3)** **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 65 (2.21) — ⏚ — 39 (1.39) N3/4 54 (2.10) — ⏚ — 39 (1.39)	Starter: **Crank** Engine: **at Idle**	20 – 100 ms 2 – 4 ms	⇒ 7.0, Engine control module (N3/4).

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
[13.0]		Testing with multimeter: T1/3 **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 65 — (2.21) — V — 39 (1.39) N3/4 54 — (2.10) — V — 39 (1.39)	Ignition: **ON** Starter: **Crank**	0 V 0.3 – 0.5 V	Ignition coil (T1/3), Engine control module (N3/4), < 0.3 V: Open circuit in wire from T1/3 to N3/4, > 0.5 V: T1/3.
14.0	055 056 057 107	**Primary voltage** of ignition coil (T1/1) for cylinder no. 2 and 5 **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 53 — (2.9) — ⏚ — 39 (1.39) N3/4 65 — (2.21) — ⏚ — 39 (1.39)	**Note to test connection:** Primary pattern, measurement range 400 V, duration 100%, voltage signal pick–up connected to T1/1. Starter: **Crank**	 200 – 350 V	⇒ 14.1, Engine control module (N3/4).

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
14.1		Primary winding of T1/1 and T1/2 **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 53 (2.9) — Ω — 54 (2.10) N3/4 65 (2.21) — Ω — 54 (2.10)	Ignition: **OFF**	0.9 – 1.9 Ω [5]	T1/1 or T1/2.

[5] Resistance of coil T1/1 and T1/2. Resistance of single coil is 0.3 - 0.6 Ω

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
15.0	058 059 060 107	**Primary voltage** of ignition coil (T1/2) for cylinder no. 3 and 4 **Up to end of M.Y. 1995**	N3/4 54 (2.10) — 39 (1.39)	**Note to test connection:** Primary pattern, measurement range 400 V, duration 100%, voltage signal pick–up connected to T1/2.		⇒ 15.1, Engine control module (N3/4).
		As of M.Y. 1996	N3/4 53 (2.9) — 39 (1.39)	Starter: **Crank**	200 – 350 V	
15.1	107	Primary winding of T1/2 and T1/3 **Up to end of M.Y. 1995**	N3/4 54 (2.10) — 65 (2.21)	Ignition: **OFF**	0.9 – 1.9 Ω [5]	Ignition coils (T1/2 or T1/3).
		As of M.Y. 1996	N3/4 53 (2.9) — 54 (2.10)			

[5] Resistance of coil T1/2 and T1/3. Resistance of single coil is 0.3 - 0.6 Ω

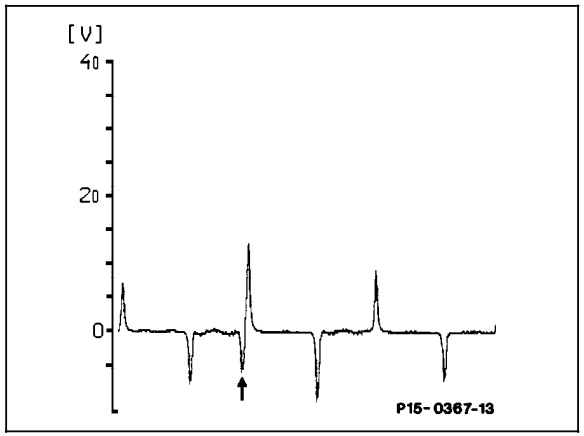
Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
16.0	061 062 063 107	**Primary voltage** of ignition coil (T1/3) for cylinder no. 1 and 6 **Up to end of M.Y. 1995** **As of M.Y. 1996**	N3/4 65 (2.21) — 39 (1.39) N3/4 54 (2.10) — 39 (1.39)	Starter: **Crank**	200 – 350 V	Primary winding of ignition coil T1/3, Engine control module (N3/4).
17.0	055 056 057	**Firing voltage** of ignition coil (T1/1) for cylinder no. 2 and 5	Engine analyzer	**Note to test connection:** Secondary pattern, measurement range 20 kV, duration 100%, voltage signal pick–up connected to ignition coil (T1/1). Starter: **Crank**	 8 – 30 kV	⇒ 17.1, Spark plugs, Spark plug cable, Spark plug connector, Engine control module (N3/4).
17.1		Secondary winding of T1/1	T1/1 ter. 4a — ter. 4b	Unplug both ignition cables on T1/1.	5.2 – 8.5 kΩ	Ignition coil (T1/1).

Electrical Test Program – Ignition System Test

⇒		Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy
18.0	058 059 060	**Firing voltage** of ignition coil (T1/2) for cylinder no. 3 and 4	Engine analyzer	**Note to test connection:** Secondary pattern, measurement range 20 kV, duration 100%, voltage signal pick–up connected to ignition coil (T1/2). Starter: **Crank**	 8 – 30 kV	⇒ 18.1, Spark plugs, Spark plug cable, Spark plug connector, Engine control module (N3/4).
18.1		Secondary winding of T1/2	T1/2 ter. 4a ter. 4b	Unplug both ignition cables on T1/2.	5.2 – 8.5 kΩ	Ignition coil (T1/2).
19.0	061 062 063	**Firing voltage** of ignition coil (T1/3) for cylinder no. 1 and 6	Engine analyzer	**Note to test connection:** Secondary pattern, measurement range 20 kV, duration 100%, voltage signal pick–up connected to ignition coil (T1/3). Starter: **Crank**	 8 – 30 kV	⇒ 19.1, Spark plugs, Spark plug cable, Spark plug connector, Engine control module (N3/4).
19.1		Secondary winding of T1/3	T1/3 ter. 4a ter. 4b	Unplug both ignition cables on T1/3.	5.2 – 8.5 kΩ	Ignition coil (T1/3).

Electrical Test Program – Ignition System Test

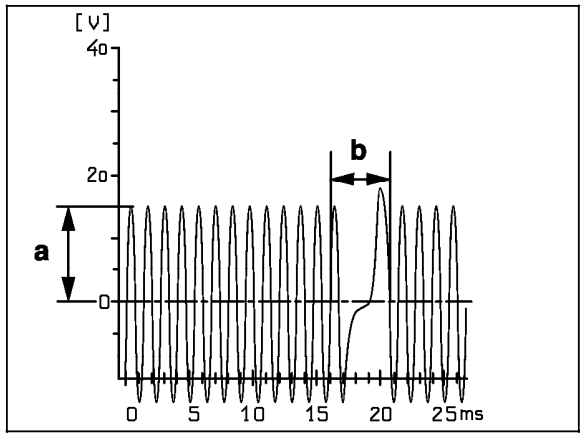


P15-0367-13

Figure 1
Model 124, 129, 140, 202

Crankshaft position sensor (L5) signal

(arrow = magnet for control of ignition coil T1/1 for cylinder no. 1 and 6)

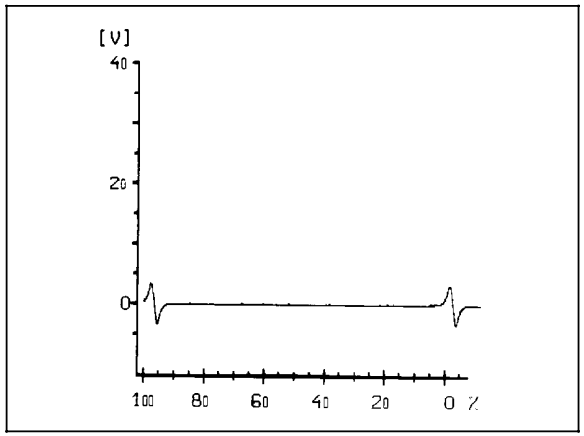


P07.61-0215-13

Figure 2
Model 210

Crankshaft position sensor (L5) signal

(b = 2 missing teeth for control of ignition coil T1/1 for cylinder no. 1 and 6)



P15-5093-13

Figure 3
Model 124, 129, 140, 202

Camshaft position sensor (L5/1) signal

Electrical Test Program – Ignition System Test

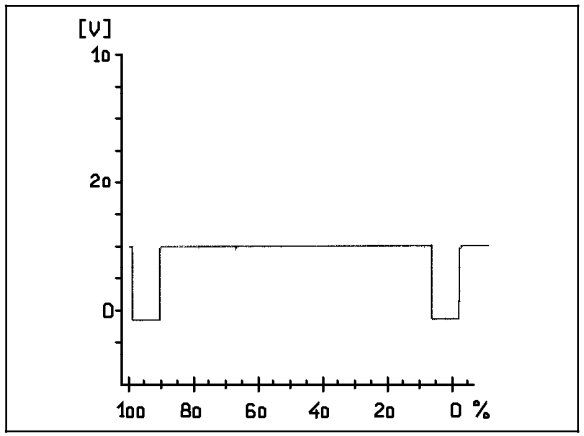


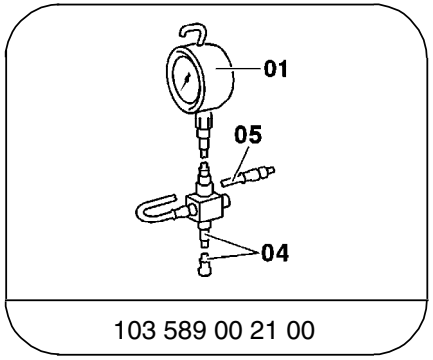
Figure 4
Model 210
Camshaft Hall-effect sensor (B6/1) signal

Hydraulic Test Program - Preparation for Test (Fuel System Pressure and Internal Leakage Test)

Preparation for Test

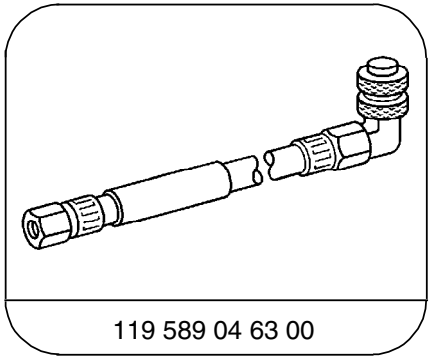
- Connect pressure gauge to test connection.
- After completing test, using measurement glass (055), release fuel pressure and allow residual fuel to drain into glass (see Figure 1).

Special Tools



103 589 00 21 00

Tester

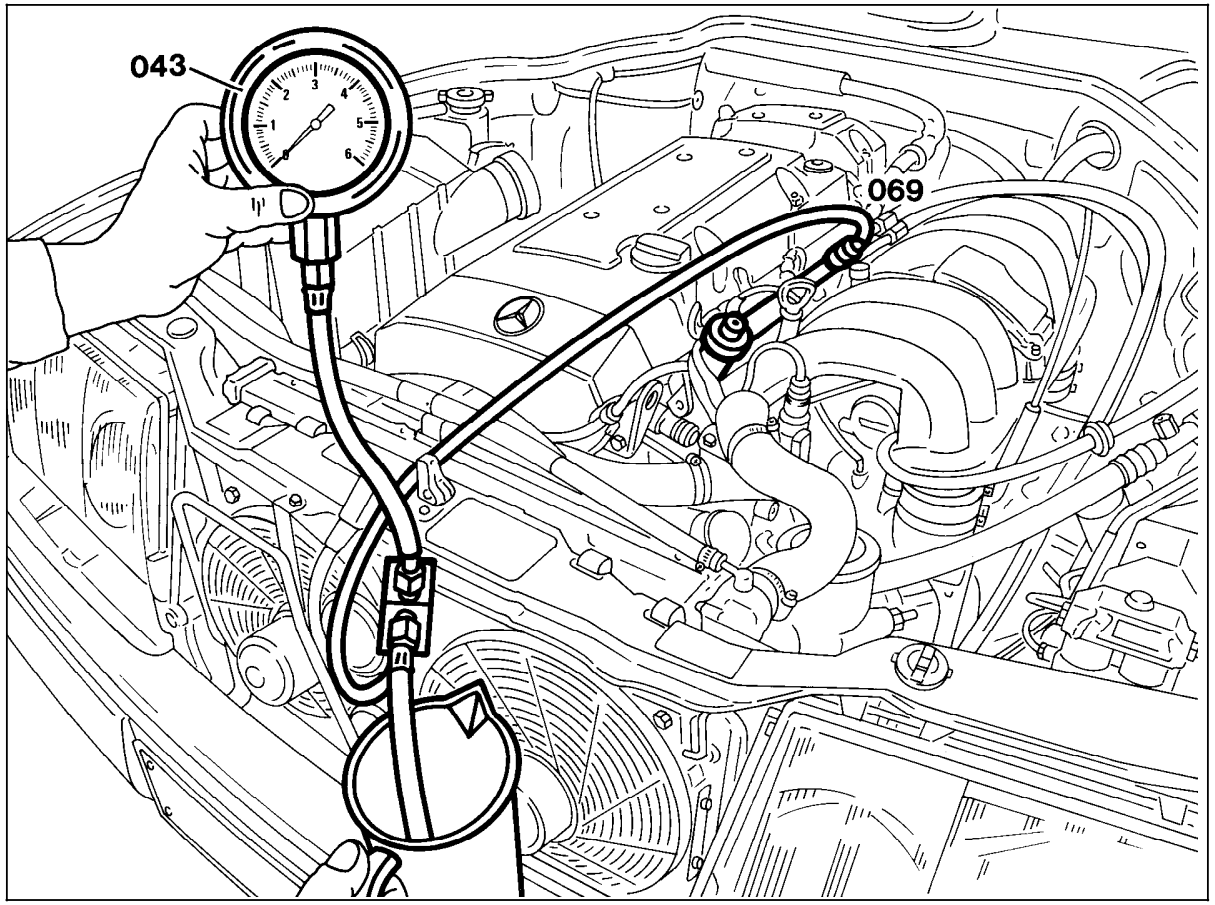


119 589 04 63 00

Pressure hose

Hydraulic Test Program - Preparation for Test (Fuel System Pressure and Internal Leakage Test)

Connection Diagram - Pressure Gauge/ Pressure Hose



P07-5644-57

Figure 1

043	Pressure gauge, part no. 103 589 00 21 00
055	Measurement glass
069	Pressure hose, part no. 119 589 04 63 00

Hydraulic Test Program - Test (Fuel System Pressure and Internal Leakage Test)

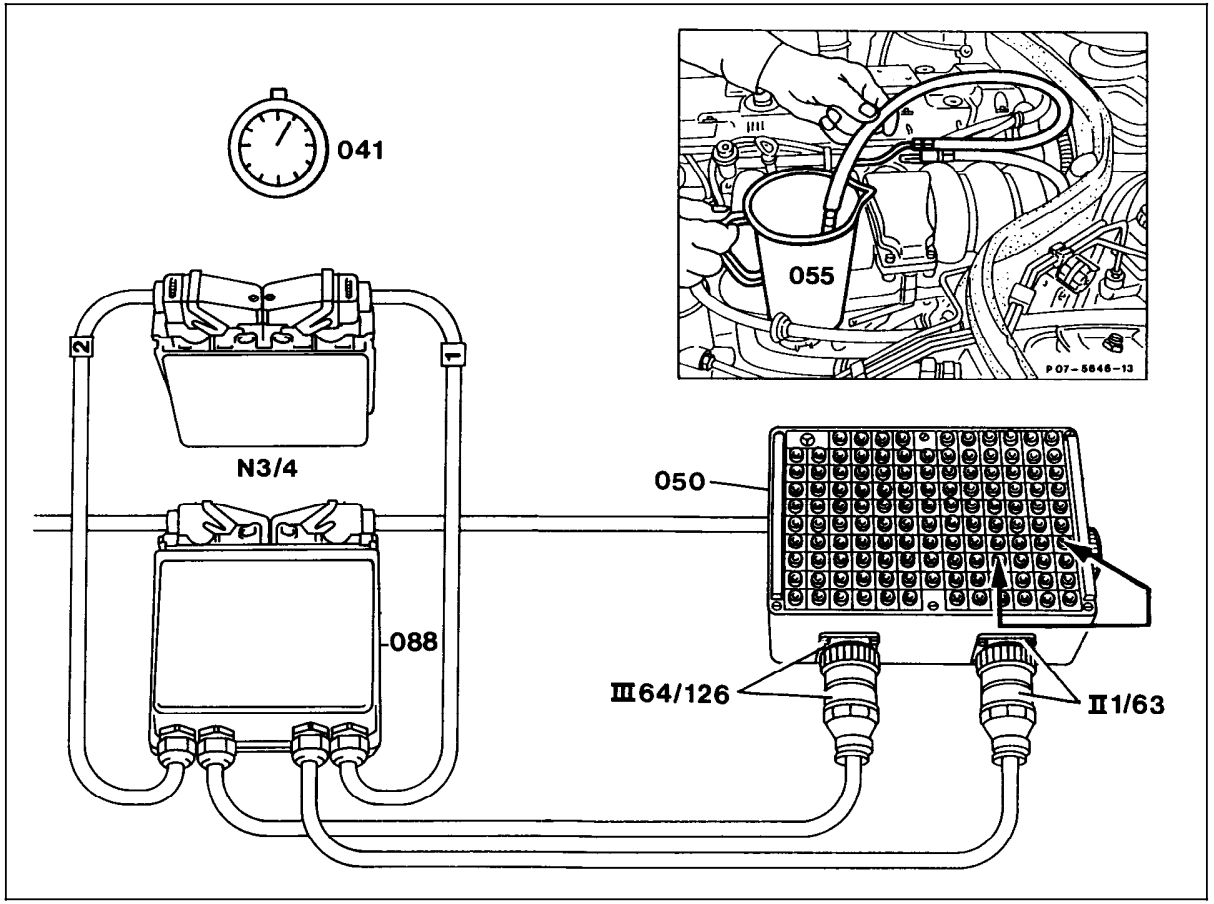
Test step **DTC**	Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy [1]
⇒ 1.0	**Fuel pressure at idle (with vacuum)**	Pressure gauge connected to test connection.	Engine: **at Idle** Valve on pressure gauge closed.	3.2 – 3.6 bar	Check fuel pumps 33, Replace diaphragm pressure regulator.
⇒ 2.0	**Fuel pressure at idle (without vacuum)**	Pressure gauge connected to test connection.	Engine: **at Idle** Disconnect vacuum hose from diaphragm pressure regulator.	3.7 – 4.2 bar	Replace diaphragm pressure regulator.
⇒ 3.0	**Fuel system leakage**	Pressure gauge connected to test connection.	Shut off engine. After 30 minutes	> 3.0 bar > 2.5 bar	If the pressure drops quickly, replace check valve in fuel pumps. If the pressure drops slowly, check injectors 36, Replace diaphragm pressure regulator or O-rings on diaphragm pressure regulator.

[1] Observe Preparation for Test, see 22.

Hydraulic Test Program - Preparation for Test (Fuel Pump Test)

Connection Diagram - Delivery Test

- Connect socket box to engine control module (N3/4).



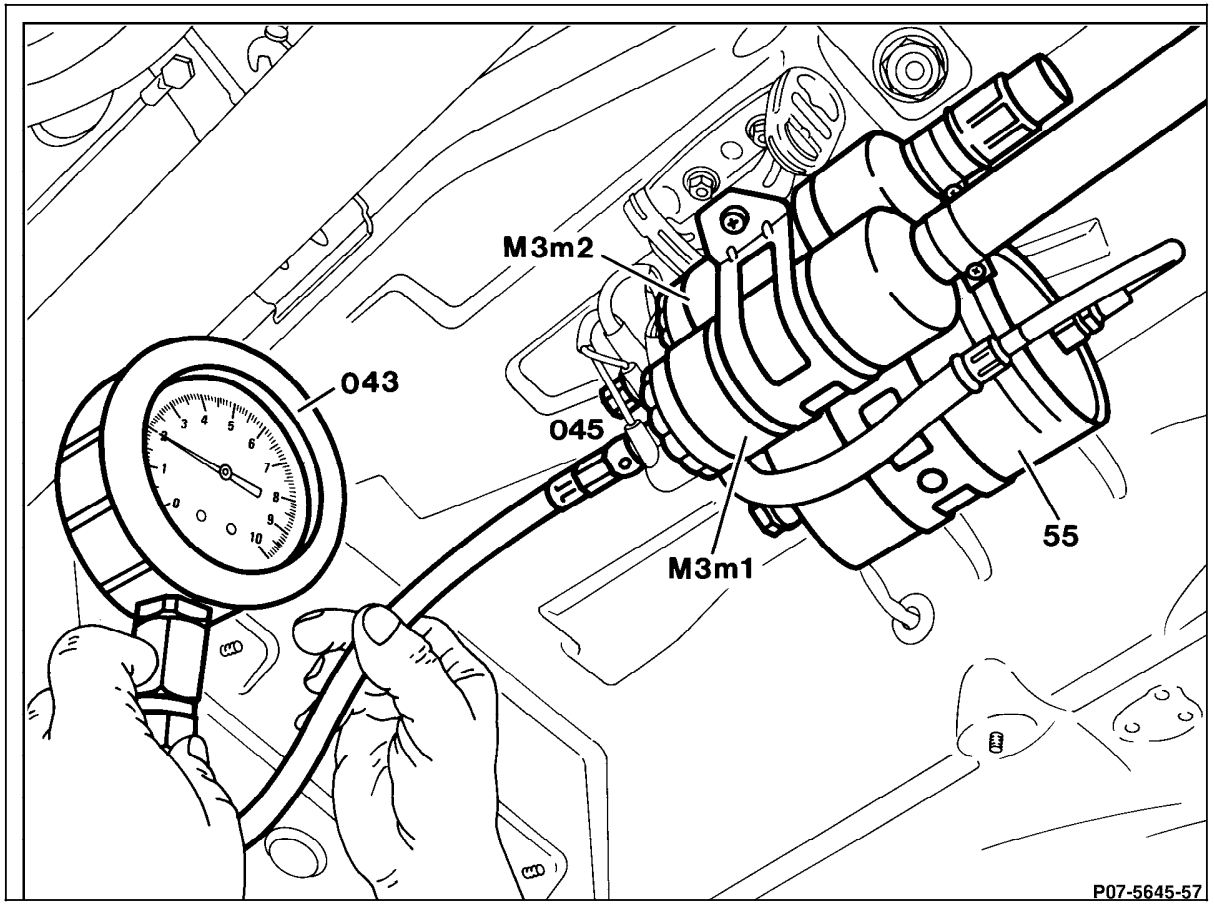
P07-5707-57

Figure 1

003	Multimeter
041	Stop watch
050	Socket box (126-pole)
055	Measuring glass
088	Test cable

Hydraulic Test Program - Preparation for Test (Fuel Pump Test)

Connection Diagram - Fuel Pump Pressure Test



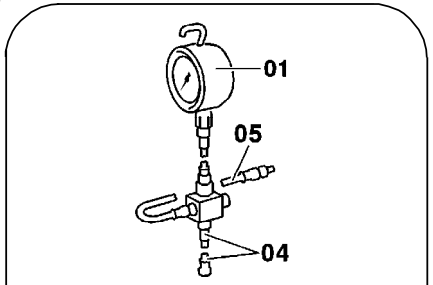
P07-5645-57

Figure 2

043	Pressure gauge, part no. 103 589 00 21 00
045	Adaptor, part no. 103 589 02 63 00
55	Fuel filter
M3m1	Fuel pump 1
M3m2	Fuel pump 2

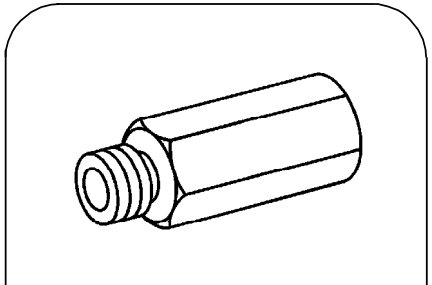
Hydraulic Test Program - Preparation for Test (Fuel Pump Test)

Special Tools



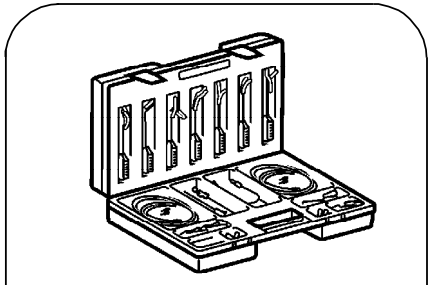
103 589 00 21 00

Tester



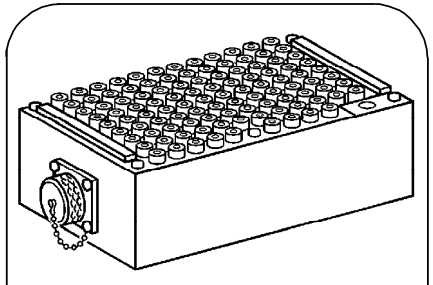
103 589 02 63 00

Adapter



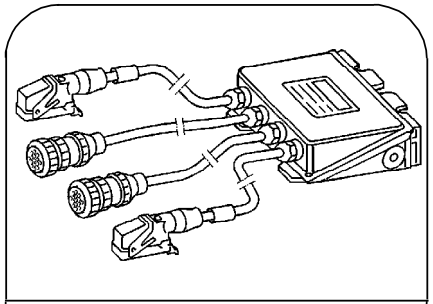
201 589 00 99 00

Electrical connecting set



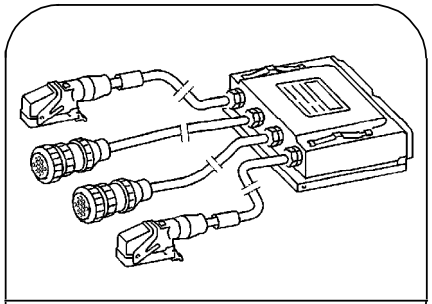
129 589 00 21 00

126-pin socket box



124 589 45 63 00

82-pin test cable CAN



140 589 29 63 00

CAN 140 82-pin test cable

Equipment

Fuel hose (500 mm, 20 in)	local purchase
Measuring glass (1 liter minimum)	local purchase
Stop watch	local purchase
Multimeter [1]	Fluke models 23, 83, 85, 87

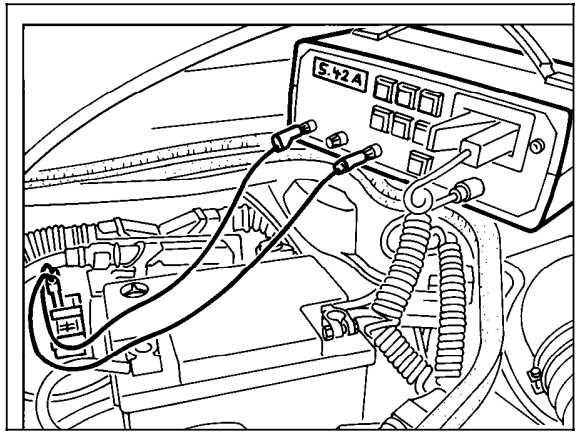
[1] Available through the MBUSA Standard Equipment Program.

Hydraulic Test Program - Test (Fuel Pump Test)

Test step **DTC**	Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy [1]
⇒ 1.0	**Fuel pumps** Delivery capacity	N3/4 29 (1.29) — 39 (1.39)	Connect special tool fitting, part no. 000 589 01 91 00, and fuel hose to diaphragm pressure regulator instead of fuel return line. Place other end of fuel hose in measuring glass. Ignition: **ON**	1 liter after max. 35 seconds.	Check fuel lines for restrictions (kinks and dents). Replace fuel filter, ⇒ 2.0, ⇒ 3.0.
⇒ 2.0	**Fuel pumps** Current draw	connected to sockets 1 and 3 (Figure 1).	Unplug fuel pumps relay module. Ignition: **ON**	5 – 9 A	Fuel pump 1 or 2. **Note:** If current draw > 8 A, also replace fuel pumps relay module.
⇒ 3.0	**Fuel pressure** after fuel pump 1	N3/4 29 (1.29) — 39 (1.39)	Unscrew cap on fuel pump 1 (M3m1). Connect adaptor (045) and pressure gauge (043). Ignition: **ON** Read fuel pressure. Disconnect pressure gauge (043) and adaptor (045) and check for leaks.	1 – 3 bar	Fuel pressure <1 bar: Voltage at fuel pump 1 < 11 V, Replace fuel pump 1 (M3m1). Fuel pressure >3 bar: Voltage at fuel pump 2 < 11 V, Replace fuel pump 2 (M3m2).

[1] Observe Preparation for Test, see 22.

Hydraulic Test Program - Test (Fuel Pump Test)



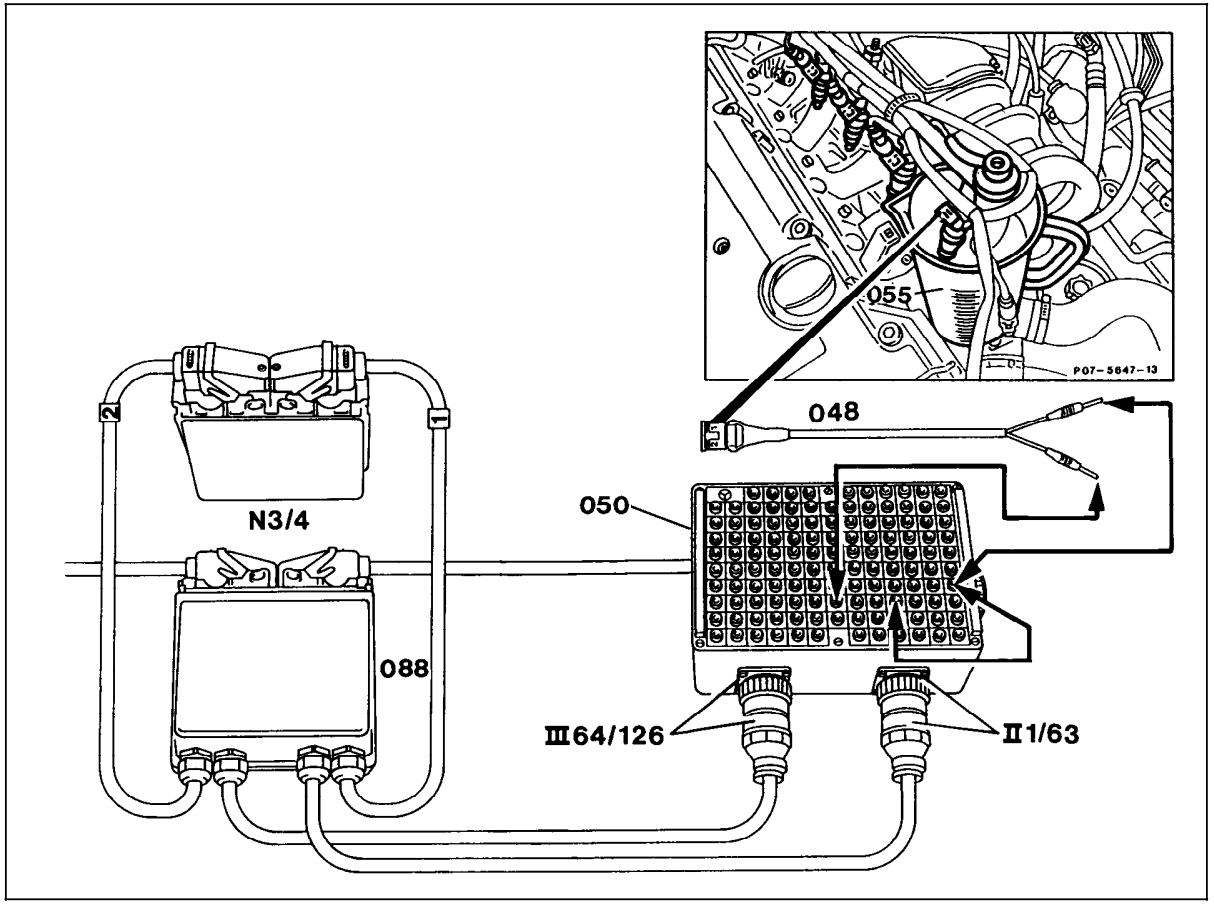
P07-5736-13

Figure 1

Hydraulic Test Program - Preparation for Test (Injector Test)

Preparation for Test

1. Connect socket box to engine control module (N3/4).
2. Unplug 2-pole connectors on injectors.
3. Remove fuel rail with injectors, thereby **not** disconnecting the fuel feed and return lines.
4. Connect self-made harness (048) one after another to each injector.
5. Hold each injector one after another in measuring glass.



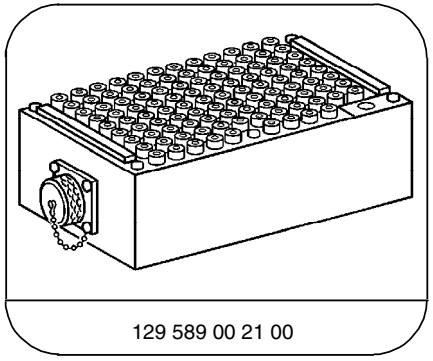
P07-5706-57

Figure 1

N3/4	Engine control module (HFM-SFI)
048	Self-made harness
050	Socket box (126-pole)
055	Measuring glass
088	Test cable

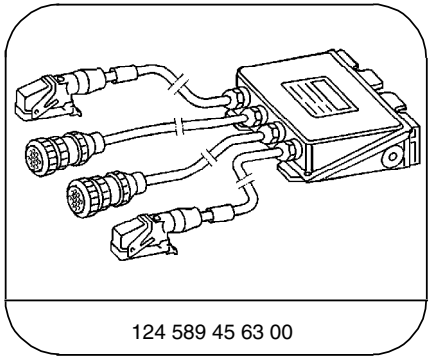
Hydraulic Test Program - Preparation for Test (Injector Test)

Special Tools



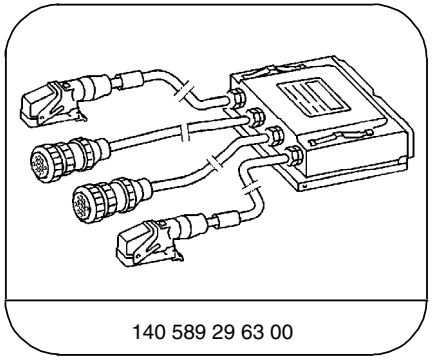
129 589 00 21 00

126-pin socket box



124 589 45 63 00

82-pin test cable CAN



140 589 29 63 00

CAN 140 82-pin test cable

Equipment

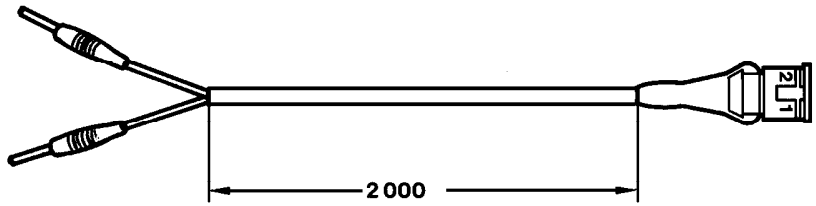
Measuring glass (1 liter minimum)	local purchase

Hydraulic Test Program - Preparation for Test (Injector Test)

Self-made Tool

Test harness consisting of:

1X	Connector 140 545 35 28
2X	Contact spring 004 545 56 26
1X	Banana plug (red)
1X	Banana plug (black)
2.2 m	Wire (red, 1.5 mm dia.)
2.2 m	Wire (brown, 1.5 mm dia.)
2 m	Harness tubing (6 mm dia.)



Connector layout
Position 1 = red
Position 2 = brown

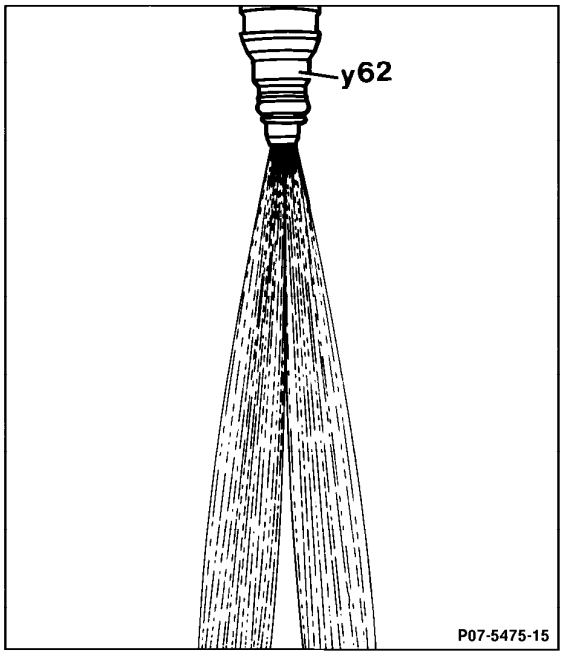
P07-0625-33

Hydraulic Test Program - Test (Injector Test)

Test step **DTC**	Test scope	Test connection	Test condition	Nominal value	Possible cause/Remedy [1]
⇒ 1.0	**Injectors** Leakage test	N3/4 29 (1.29) — 39 (1.39)	Fuel rail and fuel injectors removed. Ignition: **ON**	Injectors must not drip.	Replace dripping injectors, ⇒ 2.0.
⇒ 2.0	**Injectors** Operation and spray pattern test	N3/4 29 (1.29) — 39 (1.39)	Ignition: **ON** Hold each injector, one after another, into a container and, using the self-made test harness, manually activate the injector by connecting harness banana plugs to socket box sockets 32 (–) and 39 (+).	Injectors must spray evenly (Figure 1).	Replace defective injectors.

[1] Observe Preparation for Test, see 22.

Hydraulic Test Program - Test (Injector Test)



P07-5475-15

Figure 1

Y62 Injector
Acceptable injector spray pattern.