Diagnosis - Diagnostic Trouble Code (DTC) Memory

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

On-off Ratio Test
The on-off ratio tests the operation of the O2S (Lambda) control system and additionally, recognizes certain malfunctions present during the test. Malfunctions are distinguished between those that occur with the **Ignition: ON** and those that occur with the **Engine: at CTP (idle).**
The on-off ratio can be checked with the on-off ratio tester or with the engine analyzer. For this purpose, the purge lines to the engine must be disconnected at both purge control valves and closed with plugs. Check on-off ratio at closed throttle speed and at 2500 rpm. A readout of 50% or an oscillating needle indicates that all input signals and the O2S control system are OK. Readouts of 10% to 90% or 95% refer to a particular malfunction source (see Malfunction Tables). In addition, after testing the on-off ratio, an impulse readout **must be performed** using the impulse counter scan tool.

Diagnostic Trouble Code (DTC) Readout with Impulse Counter Scan Tool.
Malfunctions which occur while starting or with the engine running are recorded by a malfunction counter. Malfunctions are assigned a specific value according to malfunction severity (e.g. hot wire MAF sensor 128, ECT sensor 32). The malfunction counter counts in stages up to a threshold value of 255. After reaching the threshold value of 128, intermittent malfunctions are stored into memory after switching off the ignition. Malfunctions which affect engine operation (128) are immediately stored into DTC memory by the malfunction counter after switching off the ignition.

If a malfunction is no longer present during a subsequent engine start or engine operation, the total value recorded by the malfunction counter is reduced by 1 every time the engine is switched off. This procedure repeats itself until the malfunction counter is cleared.

Stored malfunctions (DTC's) can be read with the impulse counter scan tool at the data link connector (X11/4). (Also see DM, Engines, Volume 2, section 5.)

⚠

The DTC memory readout must be performed with the engine **OFF** and the ignition switched **ON**.

Malfunctions occurring in the following areas are stored immediately:
•   CMP sensor,
•   Hot-wire MAF sensor,
•   Injectors.

A malfunction of the following is stored after more than 2 trips:
•   TN-signal (input).

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

Diagnosis - Diagnostic Trouble Code (DTC) Memory

DTC's can be read with the impulse counter scan tool. Numbers ranging from 1 to 32 may appear on the display of the impulse counter scan tool.
The number "꜌" indicates: No DTC recognized in system.
All further numbers refer to a particular malfunction source. If there are multiple system malfunctions, the malfunction assigned with the lowest number will be displayed first.
If the DTC number indicated first reappears after more than two DTC readouts, then no further malfunctions are stored in the system's memory.
After eliminating all malfunctions, they must be **cleared individually and the ignition must be switched off for a minimum of 15 seconds.**
In case of engine running complaints, the DTC memory must be read and the malfunction must be eliminated before proceeding with any additional repairs.

⚠

The DTC's of both LH-SFI control modules (N3/2 and N3/3) must be read.
Indicated DTC's in the left or right cylinder banks, if any, should be checked with the socket box tester (see   23).

LH-SFI Control Module Self-Adaptation Feature
A self-adaptation feature for the emission control system is incorporated into the LH-SFI control modules.
If malfunctions of the:
*   Hot-wire MAF sensor,
*   Injectors,
*   Purge control valve,
*   Diaphragm pressure regulator
*   Purge valve
occur or if intake air leaks are present, the LH-SFI control modules conduct a self-adaptation process whereby the correction factors are continuously calculated and permanently stored.

After eliminating the mentioned malfunction or after trial installation of a LH-SFI control module from another vehicle, the LH-SFI control module's self-adaptation feature must be reset to its mean value (see "Resetting LH-SFI Control Module's Self-Adaptation Feature to Mean Value"   11/4 or with HHT menu selection 5 "Self-Adaptation").

After performing repair work on the fuel injection system, the LH-SFI control modules will also adapt themself during the course of operation.

⚠

The LH-SFI control modules should not be switched (left to right – right to left).

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 as shown on the HHT
  are listed in the DM, Engines, Volume 1, section A.

- Actual values for ECT, IAT and MAF.
  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 shows 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.

Diagnosis - Diagnostic Trouble Code (DTC) Memory

Preparation for Test with Impulse Counter Scan Tool
- Connect impulse counter scan tool and on-off ratio tester 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 readout.
  d) Press start button again for 2 to 4 seconds.
  e) Read and record DTC readout.
     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 readout appears).
b) Wait 3 seconds, press start button for 6 to 8 seconds, thereby clearing the previously displayed DTC from memory.
c) Each stored DTC must be cleared individually.
d) Ignition: **OFF** and wait 15 seconds.
Check if all stored DTC's are eliminated.
e) Ignition: **ON**
f) Repeat DTC readout. The number "ı" (no DTC stored) must appear.
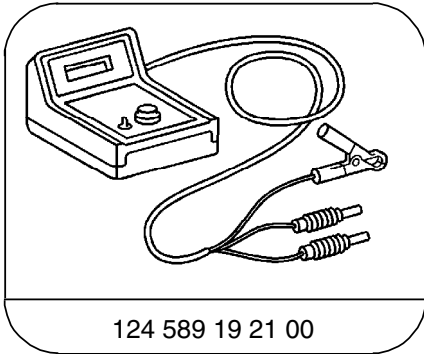
Resetting LH-SFI Control Module's Self-Adaptation Feature to Mean Value
After the number "ı" appears on the display, press start button for 6 to 8 seconds.
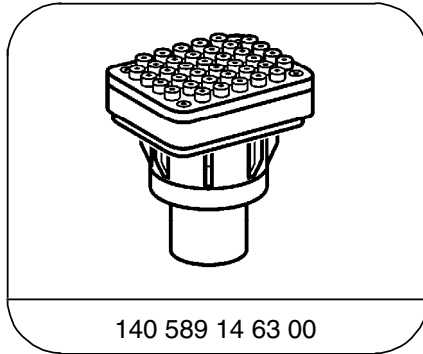Ignition: **OFF** and wait 30 seconds.

Diagnosis - Diagnostic Trouble Code (DTC) Memory
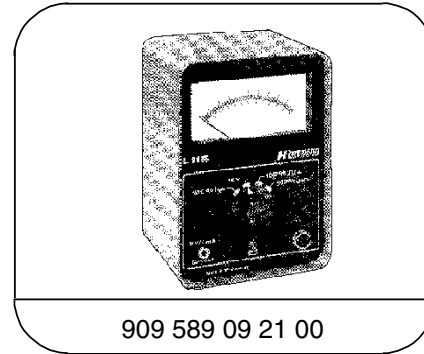
Special Tools

124 589 19 21 00

Pulse counter

140 589 14 63 00
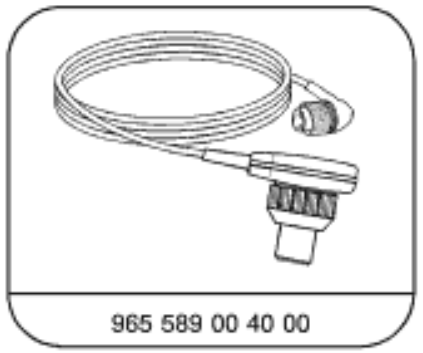
Adapter

909 589 09 21 00

On-Off Ratio Tester

965 589 00 01 00

Hand-Held-Tester

965 589 00 40 00

Test cable

Diagnosis - Diagnostic Trouble Code (DTC) Memory

Connection Diagram - Impulse Counter Scan Tool and On-Off Ratio Tester or Engine Analyzer with Diagnostic Socket X11/2 and X11/3

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

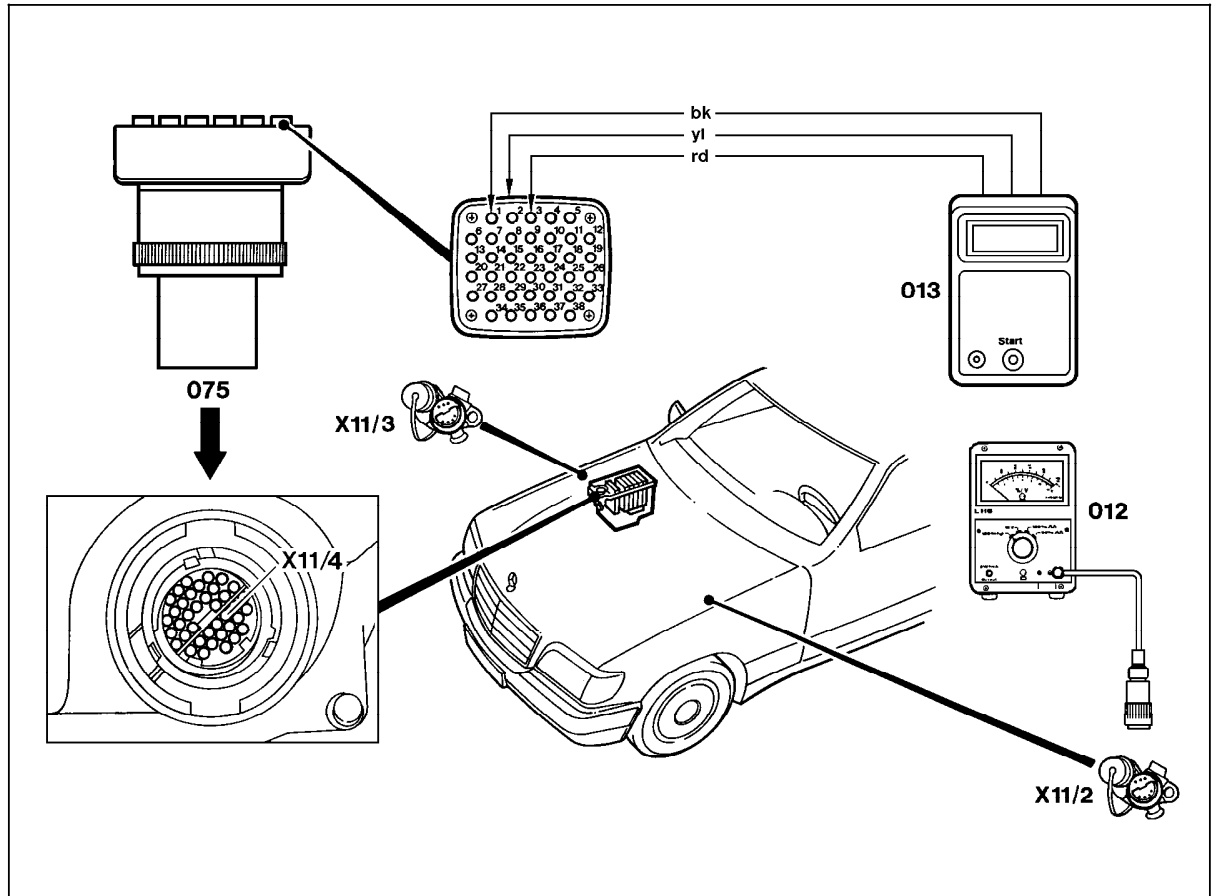|		
Left LH-SFI control module	Socket	5
Right LH-SFI control module	Socket	4
Left DI control module	Socket	18
Right DI control module	Socket	17
Base module	Socket	8
EA/CC/ISC control module	Socket	7
Diagnostic module	Socket	19

Figure 1

012	On-off ratio tester
013	Impulse counter scan tool
075	Impulse counter scan tool adaptor
X11/2	Left diagnostic socket (9-pole)
X11/3	Right diagnostic socket (9-pole)
X11/4	Data link connector (DTC readout)

U07-5016-57

Diagnosis - Diagnostic Trouble Code (DTC) Memory

**Connection Diagram - Impulse Counter Scan Tool/
Hand-Held Tester and On-Off Ratio Tester
without Diagnostic Socket X11/2 and X11/3**

Note:

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

Left LH-SFI control module	Socket	5
Right LH-SFI control module	Socket	4
Left DI control module	Socket	18
Right DI control module	Socket	17
Base module	Socket	8
EA/CC/ISC control module	Socket	7
Diagnostic module	Socket	19
Engine rpm signal (TN, output)	Socket	13
Right bank on-off ratio	Socket	14
Left bank on-off ratio	Socket	15
Circuit 31	Socket	1
Circuit 30	Socket	3

Figure 2

012	On-off ratio tester
013	Impulse counter scan tool
034	Test cable
	Red alligator clip to socket 3
	Black alligator clip to socket 1
	Black male plug to socket 14
	Green male plug not connected
	Yellow male plug not connected
075	Impulse counter scan tool adaptor
087	Hand-Held Tester (optional with impulse counter scan tool)
094	Multiplex cable
X11/4	Data link connector (DTC readout)
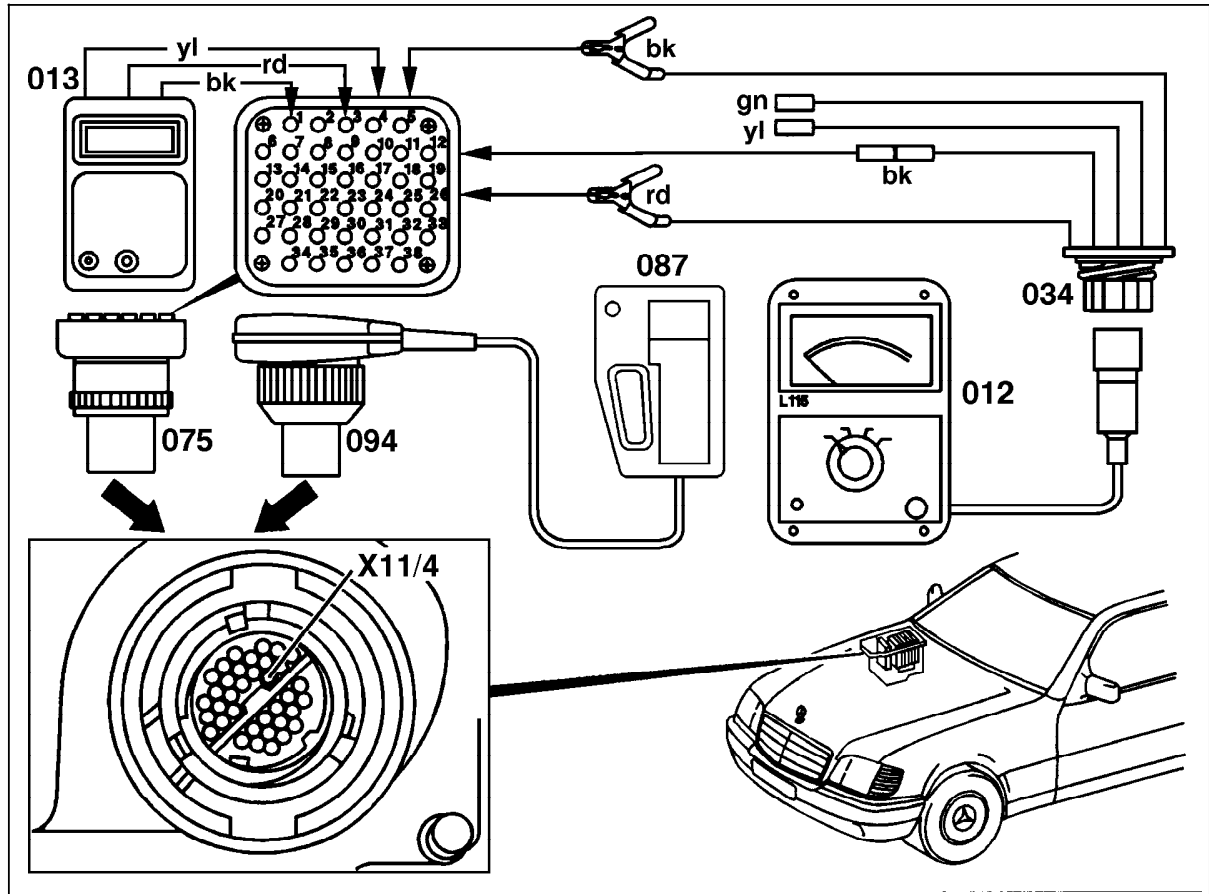
U07-6491-57

Diagnosis - Diagnostic Trouble Code (DTC) Memory

a)   On-Off Ratio Test, Ignition: ON

On–off Ratio %	Possible cause	Test step/Remedy [1]
0	Voltage supply from socket 3 of data link connector (X11/4) open circuit	Repair harness
10	CTP (idle) recognition inactive	23 ⟹ 16.0
20	WOT (full load) recognition active	23 ⟹ 16.0
30	Engine coolant temperature < 70 °C or >110 °C	23 ⟹ 10.0, 11.0
40	Not used	
50	Input signals OK	
60	TN-signal (rpm signal) or CMP sensor signal not present while starting	23 ⟹ 13.0 – 15.0
70	Starter engaged	23 ⟹ 9.1
80	CAN-data exchange defective	23 ⟹ 39.0
90	Fuel safety shut-off active	Check EA (see DM, Engines, Volume 3, Section 6.3)

[1]   Observe Preparation for Test, see   22.

Diagnosis - Diagnostic Trouble Code (DTC) Memory

b)   On-Off Ratio Test, Engine: at CTP (idle)

On–off Ratio %	Possible cause	Test step/Remedy [1]
0	Short circuit to battery + in wire to data link connector (X11/4), socket 3	Repair harness
10	CTP (idle) recognition applied constantly	23 ⟹ 16.0
20	Output of fuel injectors or one or more fuel injectors have open circuit	23 ⟹ 32.0, 33.0
30	Left or right ECT sensor (B11/9 or B11/10)	23 ⟹ 10.0 – 11.1
40	Left or right hot wire MAF sensor (B2/3 or B2/4)	23 ⟹ 6.0 – 7.0
50 [2]	Left or right O2S 1 (before TWC) (G3/3 or G3/4) not operational or defective, open circuit	23 ⟹ 19.0 – 20.0
60	Left or right CMP sensor (L5/2 or L5/3)	23 ⟹ 15.0
70	TN-signal (rpm signal)	23 ⟹ 13.0 – 14.0
80	CAN-data exchange defective	23 ⟹ 39.0 Either EA/CC/ISC control module or DI control module not transmitting.
90	Vehicle speed signal	Check EA (see DM, Engines, Volume 3, Section 6.3)
95	Deceleration shut-off active	Check EA (see DM, Engines, Volume 3, Section 6.3)
100	No voltage at left or right LH-SFI control module (N3/2 or N3/3)	23 ⟹ 1.0 – 3.0

[1]   Observe Preparation for Test, see   22.
[2]   Needle oscillates if all monitored signals are OK.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

c)   LH-SFI Control Module DTC Readout

DTC	Possible cause	Test step/Remedy [1]
1	No malfunction in system	–
2	Left or right ECT sensor (B11/9 or B11/10) sensor circuit 1, open/short circuit	23 ⟹ 10.0 – 10.2
3	Left or right ECT sensor (B11/9 or B11/10) sensor circuit 2, open/short circuit	23 ⟹ 11.0 – 11.2
4 [2]	Voltage at left or right hot wire MAF sensor (B2/3 or B2/4) insufficient or too high, or open circuit in ground wire at hot wire MAF sensor	23 ⟹ 6.0 – 7.0
5	Not used	–
6	Not used	–
7	TN-signal (rpm signal) incorrect or open/short circuit	23 ⟹ 13.0
8	Left or right CMP sensor (L5/2 or L5/3) signal, open/short circuit	23 ⟹ 15.0
9	Starter signal (circuit 50) missing, open/short circuit	23 ⟹ 9.1
10 [3]	CTP (idle) recognition from EA/CC/ISC control module (N4/1), short circuit	23 ⟹ 16.0
11 [4]	AIR pump system, open/short circuit	23 ⟹ 24.0

[1]   Observe Preparation for Test, see   22.
[2]   DTC 4 can be displayed on vehicles up to 7/91 even if no fault is present.
[3]   DTC 10 can be displayed on vehicles up to 7/91 even if no fault is present.
[4]   DTC 11 can be displayed on vehicles up to 7/91 even if no fault is present.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

c)   LH-SFI Control Module DTC Readout

DTC	Possible cause	Test step/Remedy [1]
12	Burn-off control for hot wire MAF sensor, open/short circuit	23 ⟹ 8.0
13	Left or right IAT sensor (B17/5 or B17/6), open/short circuit	23 ⟹ 12.0 – 12.1
14	Not used	–
15	Not used	–
16 [5]	Left or right EGR switchover valve (Y27/2 or Y27/3), open/short circuit	23 ⟹ 21.0 – 21.1
17 [6]	No CAN data transmission with EA/CC/ISC control module (N4/1)	23 ⟹ 39.0 or N4/1 not transmitting.
18	No CAN data transmission with left or right DI control module (N1/4 or N1/5)	23 ⟹ 39.0 or N1/4 or N1/5 not transmitting.
19	No CAN data transmission between left and right LH-SFI control module	23 ⟹ 39.0
20	No CAN data transmission from left or right LH-SFI control module (N3/2 or N3/3)	Replace N3/2 or N3/3.
21	Left or right O2S 1 (before TWC) (G3/3 or G3/4), open/short circuit	23 ⟹ 19.0

[1]   Observe Preparation for Test, see   22.
[5]   DTC 16 can be displayed on vehicles up to 7/91 even if no fault is present.
[6]   DTC 17 can be displayed even if no fault is present.

Diagnosis – Diagnostic Trouble Code (DTC) Memory

c)   LH-SFI Control Module DTC R3eadout

DTC	Possible cause	Test step/Remedy [1]
22	O2S 1 heater, open/short circuit	23 $\Rightarrow$ 20.0 – 20.1
23	Left or right purge control valve (Y58/2 or Y58/3), open/short circuit	23 $\Rightarrow$ 25.0 – 25.1
24	Not used	–
25	Left or right adjustable camshaft timing solenoid (Y49/1 or Y49/2), open/short circuit	23 $\Rightarrow$ 27.0 – 27.1
26	Upshift delay switchover valve (Y3/3), open/short circuit	23 $\Rightarrow$ 33.0
27	Left or right injectors (Y63 or Y64), open/short circuit	23 $\Rightarrow$ 31.0
28	Left or right LH-SFI control module coding, open circuit	23 $\Rightarrow$ 41.0

[1]   Observe Preparation for Test, see 22.