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★ ALL REVISED INFORMATION since last filming

Safety precautions

CAUTION

Observe the following precautions to prevent personal injury as well as possible damage to the ignition system components.

- do NOT disconnect the CIS-E Motronic control unit until at least 20 seconds after switching off the ignition
- switch **OFF** the ignition before connecting or disconnecting components or test equipment
- connect and disconnect battery **ONLY** with ignition switched **OFF** otherwise the control unit could be damaged
- if the engine must be cranked but not started (for compression testing etc.) disconnect power output stage of ignition coil
- after each start attempt wait at least one minute before trying again
- do NOT crank engine with injectors removed
- do **NOT** use battery booster longer than one minute nor should 16.5 volts be exceeded
- do **NOT** wash engine unless ignition is switched **OFF**
- disconnect **BOTH** battery terminals whenever arc or spot welding
- before towing, vehicles with a defective ignition system (or where this is suspected) must have terminal **1** (green) of the ignition coil disconnected
- do **NOT** connect a condenser of any kind to terminal 1 of the ignition coil
- when installing noise suppressors, **ONLY** use 1000 ohms for high tension wires and 5000 ohms for spark plug connectors
- do **NOT** replace distributor rotor (marked **R1**) with a different type
- if the vehicle is heated up (e.g. in a painting booth) do **NOT** start the engine until it has had sufficient time to return to room temperature

CAUTION

Before disconnecting a customers battery; **ALWAYS** ask for the radio code (if equipped with an anti-theft radio).

Note

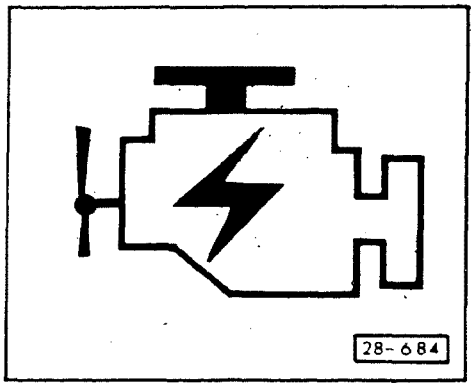
A variety of electrical connectors are used on this vehicle, **ALWAYS** use the **VW 1594** adaptor kit to connect test instruments to these connectors.

Fault Memory, general information

The term "vehicle self-diagnosis" refers to the vehicle's capability to detect and store problems that occur during vehicle operation.

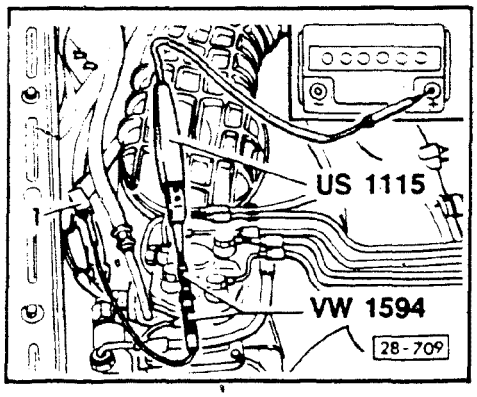
Emission related faults are stored in a Permanent Fault Memory. This fault memory must be erased after the fault has been corrected. see section D2-40.

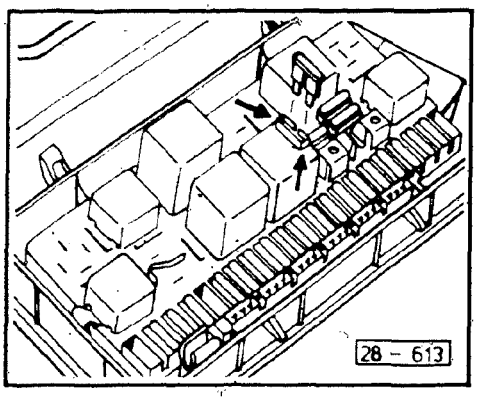
California version ONLY:

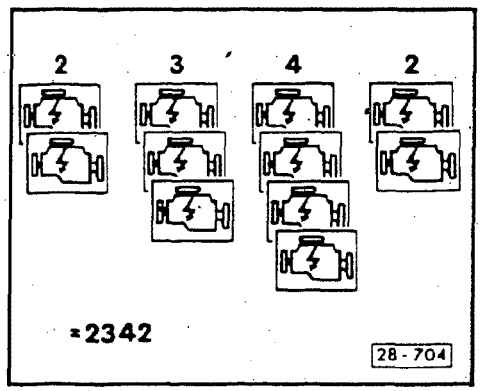


Emission related faults will be indicated by a flashing fault indicator lamp in the instrument panel insert, lasting as long as the fault is present.

For non-emission related faults, fault storage remains even with the ignition switched **OFF**, however; when the engine is started again, temporary memory is automatically erased.







50 state version

Fault codes are displayed via LED tester **US1115** when it is connected to test connection **1** and battery plus (+) with the ignition switch **ON**.

Each fault code consists of 4 digits, with a pause of approximately 2.5 seconds between each digit displayed.

The "digits" are constructed by adding the individual blink impulses together. The entire set of blink codes is listed in section D2-100.

If you initiate the fault code display sequence it will run as follows:

1 – After a start signal (fault or test lamp **ON**) with a subsequent pause (lamp **OFF**) of about 2.5 seconds, blink code construction will begin.

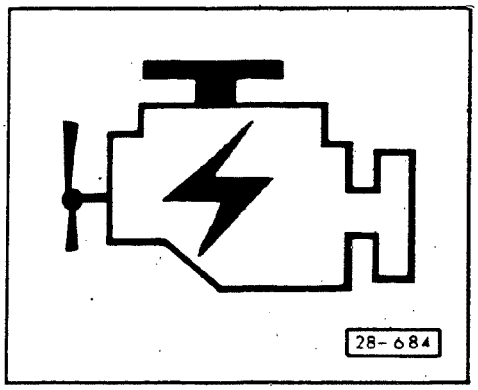
2 – The code display will repeat itself over and over until you insert a fuse into the fuel pump relay again. Then, the next code (if any) will begin construction, until finally an **end of fault display sequence** code appears. This code appears as a continuous flashing that occurs in 2.5 second **ON**, 2.5 second **OFF** intervals. It is given code designation **0 0 0 0**.

Construction example of fault code **2 3 4 2**

Fault memory, activating

Check these first:

- fuse 13, 14, and 28 **OK**
- ground connection to intake manifold **OK**
- coolant temperature 80°C (176°F) minimum
- engine speed must exceed 3000 RPM (at least once)
- gas pedal must momentarily be completely depressed then the engine must idle for at least another 2 minutes



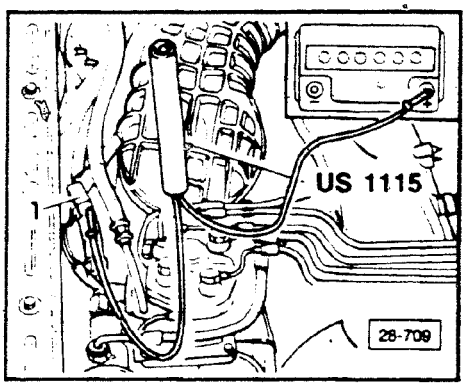
California version (in addition to above)

- fuse **12 OK**
- fault lamp **OK** (in instrument panel insert)

Note

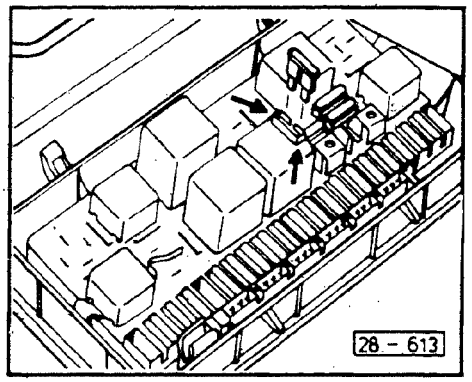
If the Permanent Fault Memory was erased or if the Temporary Memory erases by starting the engine, take a 5 minute test drive before activating the Fault Memory. If the engine does **NOT** start, turn the starter over for about 6 seconds.

Fault memory can be activated with the engine running as well as when the engine is stalled (with the ignition switched **ON**).



50 State version

- connect LED tester **US 1115** to test connector 1 and battery plus (+). The **US 1115 MUST** light up
- switch **ON** ignition; but do **NOT** activate starter

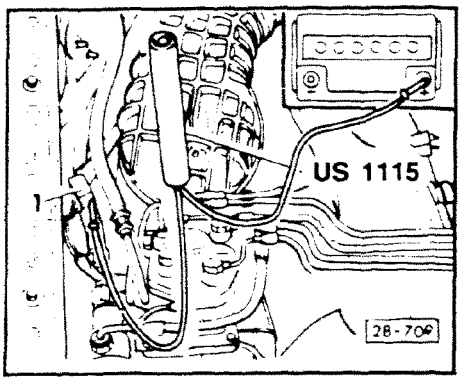


- insert spare fuse into fuel pump relay for at least 4 seconds, then remove fuse
  - the steady lighting of the **US 1115** must turn into flashing
- count flash impulses and record
- switch to the next step by again inserting a fuse into the fuel pump relay
- repeat test until the flash code **end of fault output** appears (Flash Code **0 0 0 0**)
- look up faults using chart , section D2-100, and repair as necessary.
- after faults have been corrected, erase both fault memories
  - erase Permanent Fault Memory – see section D2-40.
  - erase secondary fault memory by starting the engine
  - drive vehicle again for 5 minutes then recheck fault memory

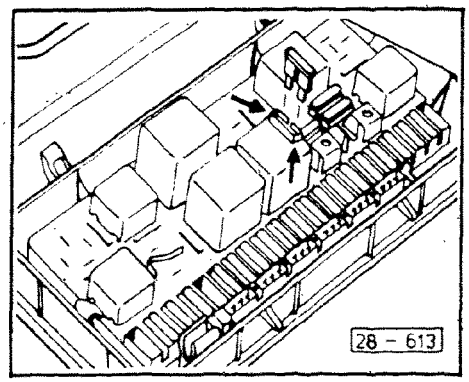
Note

If there are no more faults stored but the problems continue, perform an electrical check, see repair group 25.

Permanent fault memory, erasing



- connect LED tester **US 1115** to test connector 1 and battery (-)



- switch ignition **OFF**
- insert fuse in top of fuel pump relay
- switch ignition **ON**
  - LED tester **US 1115** must light up
- remove fuse after at least 4 seconds
  - lamp must switch off briefly then begin displaying flash code **0 0 0 0**
- insert fuse again for at least 10 seconds then remove again

If the test lamp lights up and stays **ON**: fault memory has been successfully erased.

Fault memory, activating

CAUTION

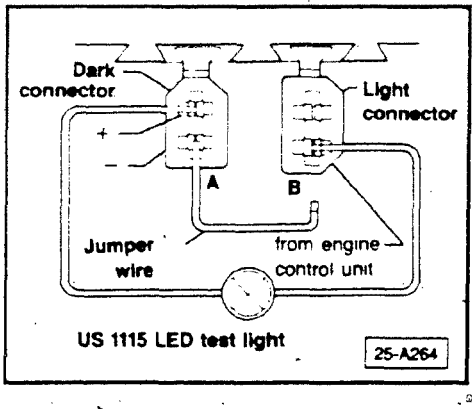
Starting with model year 1989:
diagnostic test connectors (for fault code activation and display) were installed in the driver's side footwell.

It will no longer be possible to activate the fault memory by means of the fuel pump relay on these vehicles.

Repair procedures that refer to fault code activation via the fuel pump relay **remain the same** with the exception that the diagnostic connectors outlined on this page **MUST** be used **INSTEAD** of the fuel pump relay.

The instrument panel fault lamp will remain functional **ONLY** in vehicles with OBD capability.

The fault lamp has been deleted from "**49 States**" vehicles.



Dark colored connector **A**: contains **two** terminals; power (which is protected via fuse **21**) and ground (observe the shape: angled corners on the short side).

Light colored connector **B**: contains a **single** terminal from the engine control unit (observe the shape: angled corners on the long side).

Use the **Diagnostic** connectors to display the contents of the fault memory (as well as System Output checks, where installed) by using the US 1115 LED tester as follows:

- connect positive terminal of **US 1115** LED tester to the positive terminal in connector **A**
- connect negative terminal of **US 1115** LED tester to the (only) terminal in connector **B**
- connect one end of a jumper wire to the negative terminal in connector **A**, touch the other end to the terminal in connector **B** for at least 4 seconds
  - fault codes will now be displayed (as flashing) by the **US 1115**

To advance to the next fault code in the sequence:

- touch the free end of the jumper wire to the terminal in connector **B** again for a minimum of four seconds

Note

This procedure achieves the same result as installing a fuse in the fuel pump relay for 4 seconds as in the 1988 fault code system.

Fault memory, erasing (using VAG 1551 in mode 2, blink code output)

- connect **VAG 1551** tester (if not already connected, see section D2-75)
  - display should then alternate between the two following displays:

    VAG – SELF-DIAGNOSIS **HELP**
    1 – Rapid data transmission

    VAG – SELF-DIAGNOSIS **HELP**
    2 – Blink code output

- press **2** to select Blink code output
  - display will appear as follows:

    Blink code output **HELP**

Initiate with the ➡ button

- depress ➡ button
  - display will appear as follows:

    Blink code output will be initiated!

- press ➡ button and hold until following display appears

Blink code output, continuous short circuit on permanent ground exciter wire

- switch **ON** ignition and push ➡ button briefly
  - following display will appear:

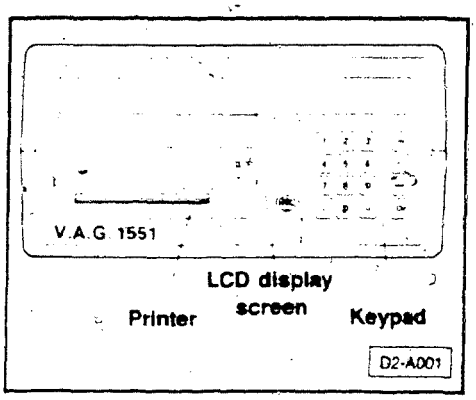
    Blink code 0000

    End output

- press ➡ button
  - ignition still switched **ON** for at least 5 seconds
  - **VAG 1551** connected

    Fault memory is erased.

VAG 1551 tester, general information



The **VAG 1551** tester is a diagnostic tool that reads system faults recorded by control units equipped with permanent fault memories.

VAG 1551 tester, features and operation

Cancel (or Clear) key

- push this key to cancel an input or to stop the program from running

Q (or Enter) key

- push this key after making inputs
- push this key anytime a **Q** is displayed in the upper right hand corner of the LCD display

Arrow (or Run) key

- push this key to advance to the next step in your sequence
- push this key anytime the ➡ is displayed in the upper right hand corner of the LCD display

Help key

- pushing this key also selects the printer function
- push this key to obtain additional operating instructions or explanations of tester functions
- push this key to obtain hints for possible problems when the **VAG 1551** does not respond the way you think it should
- push this key to obtain a list of the Address Words and Function Words to supply the **VAG 1551** when it asks for them

Print key

- push this key whenever you want a printed copy of the information in the display window

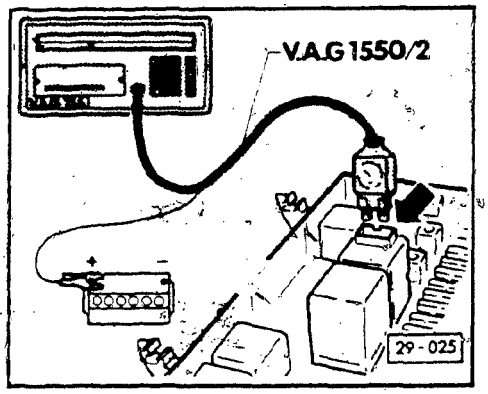
Note

The printer is **ON** whenever the LED in the button is lit.

Printer paper advance key

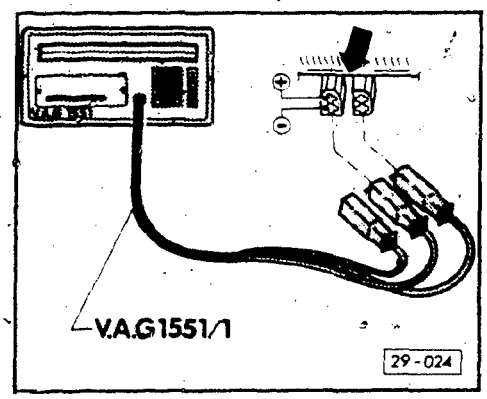
- push this key to advance the paper **BEFORE** you tear it off of the tester

VAG 1551 diagnostic tester, connecting



Model year 1988:

- remove central electric cover
- connect **VAG 1551** to fuel pump relay (**arrow**) using adaptor **VAG 1551/2**, connect single wire on adaptor to battery positive (+)



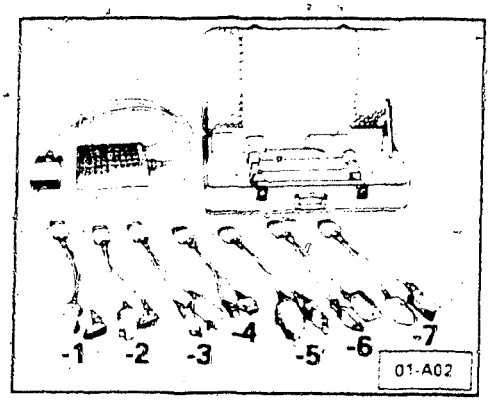
Model years 1989 and 1990:

- connect **VAG 1551** diagnostic tester to diagnostic connectors (above pedal (s) in drivers side footwell) using **VAG 1551/1** connector harness as follows:
  - **BLACK** wire to **BLACK** diagnostic connector
  - **WHITE** wire to **BROWN** diagnostic connector
  - **BLUE** wire – **NOT** connected

Note

Voltage supply is via fuse **21**.

VAG 1598 Test box, description



The **VAG 1598** test box and adaptor set was introduced in May of 1989. It consists of a main harness with test box (that universally connects to all of the adaptor harnesses) and a set of adaptor harnesses. A hardshell storage case is provided to protect the set when not in use.

The **VAG 1598** is used in conjunction with several other pieces of test equipment consisting of:

- **US 1119** multimeter
- **US 1115** LED tester
- **VW 1594** adaptor wire kit

Note

New adaptor harnesses will be made available for the **VAG 1598** in the future as new applications require them.

VAG 1598 advantages:

- the fragile terminals in the control unit connector no longer risk damage from test leads and probe connections. Connections formerly made on the control unit connector are now made on the **VAG 1598** test box which has large conveniently accessible terminals
- raised, highly visible numbers on the test box eliminate any uncertainty as to connector terminal numbering
- certain components (e.g. Hall sender) can now be checked dynamically (engine running)
- electrically checking miniature and unusual size terminals is now made possible regardless of terminal size
- standard size adaptors are used to make and test all connections resulting in dependable, accurate measurements

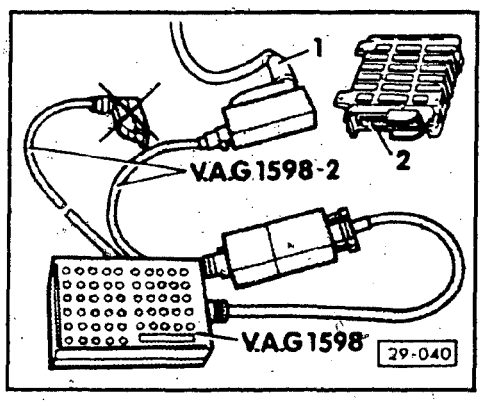
VAG 1598 Test box, connecting

Example: CIS-E Motronic Fuel/Ignition system control unit

- select the appropriate adaptor harness from the list (based on the connector you wish to connect to) for this example use adaptor harness **VAG 1598/2**
- connect adaptor harness **VAG 1598/2** to main test box harness by joining the two rectangular connectors, then tighten via knobs on main harness connector

Note

The rectangular connector which is on every adaptor cable can only be connected one way. Examine the connector and you will see where the threaded connectors of the test box harness attach to the adaptor connector.



- disconnect CIS-E Motronic control unit harness connector **1** from control unit
- connect test adaptor **VAG 1598/2** male connector to control unit harness connector **1**

Note

In this example the wiring up to the control unit is being checked statically, making it un-necessary to connect the control unit to the adaptor harness; however, for dynamic checks you will have to make this connection.

Fault memory, activating/interrogating (using VAG 1551)

Requirements

- fuses **13**, **21**, **27**, and **28** must be **OK**
- A/C switched **OFF**
- engine ground connection (near ignition distributor) **OK**

Notes

The fault memory must first be interrogated before it can be erased.

Using the **VAG 1551** tester eliminates the possibility of interpretive or written errors because the faults can be both displayed and printed by the tester.

If engine **CANNOT** be started:

- connect **VAG 1551** tester (see section D2-75)
- operate starter for about 6 seconds but do **NOT** switch ignition **OFF** afterwards
- activate fault memory (see next page)

If engine **CAN** be started:

- test drive vehicle for at least 5 minutes

During test drive

- coolant temperature must reach 80°C (176°F) minimum
- engine speed must exceed 3000 rpm
- accelerator pedal must be fully depressed at least once

- after test drive, allow engine to idle for at least 2 minutes
- switch **OFF** ignition
  - engine must **NOT** be re-started

CAUTION

A portion of the fault memory is erased when the engine is started. Adhere to the sequence in the following procedure so that **ALL** faults are recognized. Do **NOT** skip any of the steps.

Activating fault memory

- connect **VAG 1551** tester, see section D2-75
- switch **ON** ignition but do **NOT** start engine
  - display should then alternate between the two following displays:

VAG – SELF-DIAGNOSIS HELP
1 – Rapid data transmission

VAG – SELF-DIAGNOSIS HELP
2 – Blink code output

- press **2** to select Blink code output
  - display will appear as follows:

Blink code output HELP
Initiate with the ➡ button

- depress ➡ button
  - display will appear as follows:

*** Blink code output will be initiated!**

- press ➡ button and hold until following display appears

Blink code output, continuous short circuit on permanent ground exciter wire

Note

The asterisk in the upper left hand corner of the display will now start to flash. The asterisk flashes just as LED tester **US 1115** would if it were connected to the system instead.

The **VAG 1551** will count the number of flashes and convert them into a four digit fault code.

If **NO** faults are stored in the memory, the following display will appear:

Blink code 4444 ➡
No fault recognized

- switch **OFF** ignition but do **NOT** erase fault memory

If a fault in the system is found, the **VAG 1551** will display the appropriate fault code, a description of the fault and an alphanumeric code for the faulty component.

This alphanumeric code is the same code used on the wiring diagrams and in the troubleshooting tables. For example:

Blink code 2232
Air flow sensor – G70/G19

- press the ➡ button to advance to the next fault (if any)
  - display will appear as follows:

Blink code XXXX
Blink code signal is continued

If another fault is found it will be displayed as before.

If **NO** additional faults are found, the display will appear as follows:

Blink code 0000 ➡
Output end

If the vehicle being tested features more control units with fault memory, the blink code of the next control unit can be started by pressing the button.

If no other control units are to be tested, the following display will appear:

Blink code output ➡
is ended!

- switch **OFF** ignition
- press **C** button once
- repair the faults and then erase the fault memory, see section D2-60

- take vehicle for another road test (minimum of 5 minutes)
- check fault memory again to verify that **ALL** faults have been corrected

Fault code, troubleshooting chart

Code	Location of fault	Problem	Solution
1 1 1 1	control unit	control unit (internal)	replace control unit, see Repair Group 25
2 1 1 3	no speed signal from Hall sensor, 28.32 (Group 28) or false signal from potentiometer	Hall sensor defective, disconnected wire sensor plate/adjustment, air flow sensor lever hard to move/hangs up	check Hall sensor, see Repair Group 28 check wires check adjustment, see Repair Group 25 check adjustment of lever, see Repair Group 25
2 1 2 1	idle switch	idle switch defective, (always closed), wire has a short	check idle switch, see Repair Group 25 check wire
2 1 2 3	full throttle switch	full throttle switch defective (always closed), wire has a short	check full throttle switch, 25.109 check wires
2 1 4 1	knock regulation at the control limit *(fault lamp lights up during maximum ignition retard adjustment)	engine vibrates, knocks fuel octane too low ignition timing point adjusted wrong knock sensor wire shielding damaged	compression test, check injection system, see Repair Group 25 change fuel to a higher octane adjust timing, see Repair Group 25 check knock sensor wires
2 1 4 2	knock sensor *(fault lamp lights up continuously until engine is shut off)	disconnected wire or short in sensor wire defective knock sensor	check wire between knock sensor and control unit replace knock sensor
2 2 3 1	idle stabilization control limits exceeded	basic adjustment of throttle intake system leaks ignition timing incorrectly adjusted	perform basic adjustment of throttle, see Repair Group 25 check intake system for leaks adjust timing, check idle, see Repair Group 25
2 2 3 2	potentiometer on airflow sensor	disconnected wire or short between control unit and potentiometer	check potentiometer, see Repair Group 25

Code	Location of fault	Problem	Solution
2 3 1 2	coolant temperature sensor	disconnected wire or short in sensor line, temperature sensor defective	check wires check temperature sensor
2 3 4 1	oxygen regulation at the control limit *(fault lamp lights up, if fault occurs for at least 2 minutes)	CO content not within specifications, oxygen sensor grounded cold start valve leaks Carbon canister valve open constantly intake system leaks	check CO content, see Repair Group 25 check oxygen sensor wire per wiring diagram, check oxygen sensor control, see Repair Group 25 check cold start valve, see Repair Group 25 evaporative system checking, see Repair Group 20 check intake system for leaks
2 3 4 2	oxygen sensor does not control *(fault lamp lights up)	disconnected wire to oxygen sensor or defective oxygen sensor	check oxygen sensor control, see Repair Group 25
2 3 4 3	mixture control, **lean** limit exceeded	idle **NOT OK**	check idle, see Repair Group 25
2 3 4 4	mixture control, **rich** limit exceeded	intake air system leaks, idle **NOT OK**	check intake system for leaks check idle, see Repair Group 25
4 4 3 1	idle stabilizer valve	disconnected wire, defective idle stabilizer valve	check wires replace stabilizer valve, replace control unit, see Repair Group 25
4 4 4 4	no faults stored in memory	—	—

CAUTION

After all test and adjustment work has been performed, erase fault memory, section D2-30.