28-1

Motronic ignition system

Technical data, spark plugs

Engine code		AHA
Engine idle RPM • Idle RPM cannot be adjusted, is corrected by Idle Air Control (IAC)		620 - 740 RPM (all-wheel drive)
	740 - 860 RPM (front-wheel drive)	
RPM limit • Operates by shutting off fuel injectors		approx. 6500 RPM
Ignition timing • Ignition timing cannot be adjusted; it is determined by the Engine Control Module (ECM)		
Firing order		1-4-3-6-2-5
Spark plugs	Tightening torque	30 Nm (22 ft lb)
	Part No. 1)	101 000 035 HJ (NGK)
	Manufacturer's code (if applicable)	BKR 6 EKUB (NGK)
	Electrode gap - mm	1.6 mm
	Maintenance interval	⇒ Owner's Manual

1) Part numbers listed here are for reference only. Always check with your Parts department for the latest information.

28-2

Camshaft Position (CMP) sensor -G40-, checking

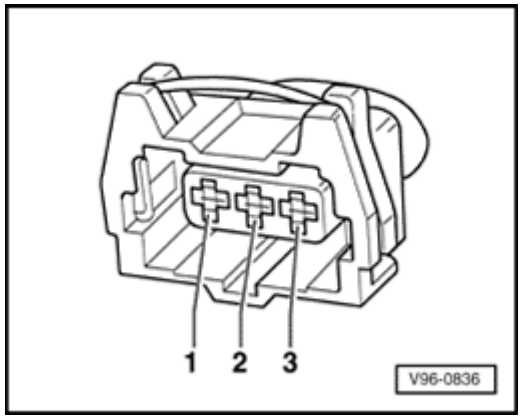
Notes:

- *Camshaft Position (CMP) sensor -G40- is located on the rear of the left cylinder head (bank 2).*
- *Checking -G163-* ⇒ *page 28-5*
- *Component location* ⇒ *page 24-1*

Required special tools and test equipment

- VAG1598/22 test box
- Multimeter US1119 (Fluke 83 or equivalent)
- VW1594 connector test kit
- Wiring diagrams

28-3



Checking

- Disconnect 3-pin harness connector from Camshaft Position (CMP) sensor -G40-.

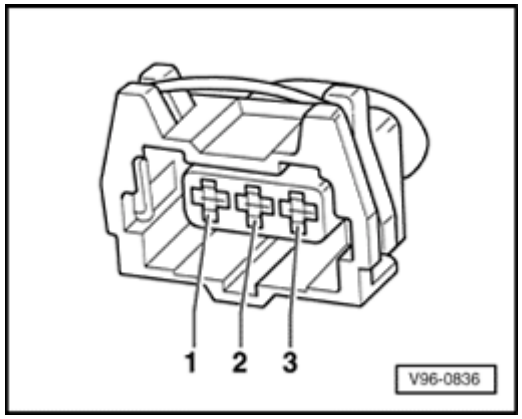
- Connect multimeter US1119 (Fluke 83 or equivalent) to measure voltage across CMP connector terminals 1 (B+) and 3 (Ground), using adapters from VW1594 connector test kit.
- Switch ignition on.
- Measure voltage between terminals 1 and 3.

  Specified value: 9-14.5 volts
- Switch ignition off.

If voltage is OK:

- Connect VAG1598/22 test box to Motronic ECM harness connector ⇒ page 01-67 .
- Check wiring for open circuit between ECM/test box and 3-pin harness connector, according to wiring diagram.
  - Connector terminal 1 to ECM/test box socket 11
  - Connector terminal 2 to ECM/test box socket 44
  - Connector terminal 3 to ECM/test box socket 14
  - Specified value: max. 1.5 Ω

28-4



- Check wiring for short circuit between ECM/test box and 3-pin harness connector, according to wiring diagram.
  - Connector terminal 3 to ECM/test box socket 44
  - Connector terminal 3 to ECM/test box socket 11
  - Connector terminal 2 to ECM/test box socket 11
  - Specified value: ∞ Ω

If wiring is OK (and voltage across terminals 1 and 3 is OK):

- Replace Camshaft Position (CMP) sensor -G40-.

If wiring is OK (but still no voltage across terminals 1 and 3):

- Replace Motronic ECM -J220- ⇒ page 01-68 .
- Carry out adaptation of throttle valve control module to ECM ⇒ page 24-150 .
- Check readiness code ⇒ page 01-70 .

  If Diagnostic Trouble Code (DTC) memory has been erased, or ECM has been disconnected, generate new readiness code ⇒ page 01-73 .

28-5

Camshaft Position (CMP) sensor 2 -G163-, checking

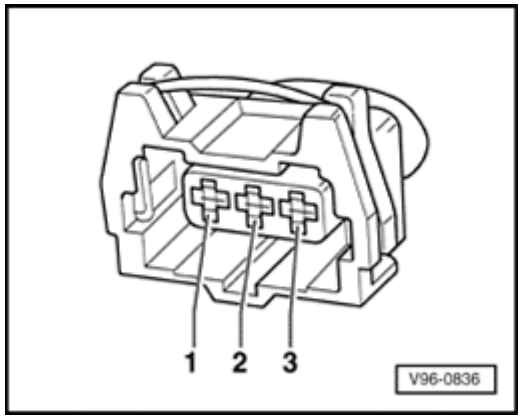
Notes:

- *Camshaft Position (CMP) sensor 2 -G163- is located on the front of the right cylinder head (Bank 1).*
- *Checking -G40-* ⇒ *page 28-2*
- *Component location* ⇒ *page 24-1*

Required special tools and test equipment

- VAG1598/22 test box
- Multimeter US1119 (Fluke 83 or equivalent)
- VW1594 connector test kit
- Wiring diagrams

28-6



Checking

- Disconnect 3-pin harness connector from Camshaft Position (CMP) sensor 2 -G163-.

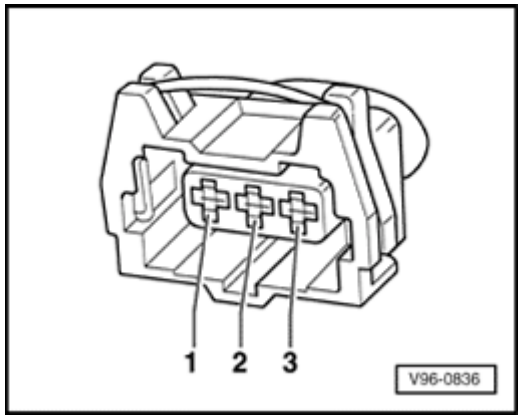
- Connect multimeter US1119 (Fluke 83 or equivalent) to measure voltage across CMP connector terminals 1 (B+) and 3 (Ground), using adapters from VW1594 connector test kit.
- Switch ignition on.
- Measure voltage between terminals 1 and 3.

  Specified value: 9-14.5 volts
- Switch ignition off.

If voltage is OK:

- Connect VAG1598/22 test box to Motronic ECM harness connector ⇒ page 01-67 .
- Check wiring for open circuit between ECM/test box and 3-pin harness connector, according to wiring diagram.
  - Connector terminal 1 to ECM/test box socket 11
  - Connector terminal 2 to ECM/test box socket 76
  - Connector terminal 3 to ECM/test box socket 67
  - Specified value: max. 1.5 Ω

28-7



- Check wiring for short circuit between ECM/test box and 3-pin harness connector, according to wiring diagram.
  - Connector terminal 3 to ECM/test box socket 76
  - Connector terminal 3 to ECM/test box socket 11
  - Connector terminal 2 to ECM/test box socket 11
  - Specified value: ∞ Ω

If wiring is OK (and voltage across terminals 1 and 3 is OK):

- Replace Camshaft Position (CMP) sensor 2 -G163-.

If wiring is OK (but still no voltage across terminals 1 and 3):

- Replace Motronic ECM -J220- ⇒ page 01-68 .
- Carry out adaptation of throttle valve control module to ECM ⇒ page 24-150 .
- Check readiness code ⇒ page 01-70 .

  If Diagnostic Trouble Code (DTC) memory has been erased, or ECM has been disconnected, generate new readiness code ⇒ page 01-73 .

28-8

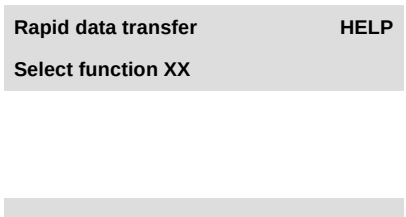
Knock sensor and knock sensor control, checking

Required special tools and test equipment

- VAG1551/1552 Scan Tool (ST) with VAG1551/3 adapter cable
- VAG1598/22 test box
- Multimeter US1119 (Fluke 83 or equivalent)
- VW1594 connector test kit
- Wiring diagrams

Checking

- Connect VAG1551/1552 Scan Tool (ST) and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ page 01-8 .



Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.

Read Measuring Value Block **HELP**

Input display group number XXX

< Indicated on display

28-9

- Press buttons corresponding to following display group numbers and press -Q- button to confirm input.

  - 022: Display group 22, for cylinders 1 and 2
  - 023: Display group 23, for cylinders 3 and 4
  - 024: Display group 24, for cylinders 5 and 6

Read Measuring Value Block 22 →

1 2 3 4

Indicated on display (1-4 = display groups)

Note:

The test must be carried out during a road test because the knock sensor system is only active with engine speed greater than 2600 RPM and engine load greater than 3 ms.

- Road test and compare display with specified values for knock sensor system in display field 1-4.

WARNING!

A second technician is required to operate the VAG1551 scan tool during the road test. Safety precautions ⇒ ***page 24-9*** .

28-10

	Display fields			
	1	2	3	4
Display group 22 1): Knock control				
Display	xxx RPM	xx.xx ms	xx.x °	xx.x °
Display	Engine speed (in 40 RPM steps)	Engine load	Ignition angle correction 1	Ignition angle correction 2
Work range	0 - 6800 RPM	0.00 - 12.75 ms	0.0 - 12.0 ° (crankshaft)	0.0 - 12.0 ° (crankshaft)
Specified Value	... RPM (test drive)	... ms (test drive)	0.0 - 10.0 ° (crankshaft)	0.0 - 10.0 ° (crankshaft)
	---	---	If displayed values are NOT OK ⇒ page 28-11 , Evaluating display groups 22, 23, 24	

1) Display also valid for display groups 23 (cyls. 3 and 4) and 24 (cyls. 5 and 6) .

If displayed values are OK:

- Press → button.
- Press buttons -0- and -6- to select "End Output" function 06, and press -Q- button to confirm input.

- Check readiness code ⇒ page 01-70 .

  If Diagnostic Trouble Code (DTC) memory has been erased, or ECM has been disconnected, generate new readiness code ⇒ page 01-73 .

28-11

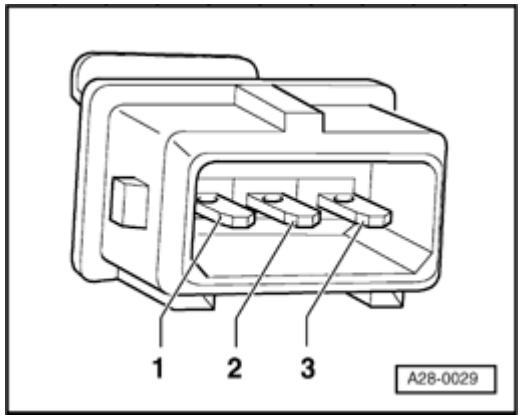
Evaluation of display groups 22, 23 and 24

Display groups: 22, 23 and 24	Possible malfunction cause	Corrective action
Display fields: 3, 4		
All cylinders retarded more than 10 ° (crankshaft)	♦ Knock sensor faulty	- Continuation ⇒ page 28-12
	♦ Connector corroded	
	♦ Knock sensor incorrectly torqued	- Loosen knock sensor and tighten to 20 Nm (15 ft lb)
	♦ Components loose on engine	- Tighten components
	♦ Poor fuel quality	- Change fuel
Value for one cylinder different from the others	♦ Connector corroded	- Continuation ⇒ page 28-12
	♦ Engine damage	- Check compression ⇒ Repair Manual, 2.8 Liter V6 5V Engine Mechanical, Repair Group 15
	♦ Components loose on engine	- Tighten components

28-12

Continuation

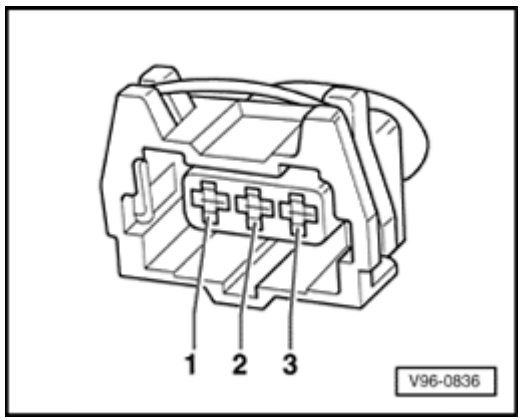
- Disconnect 3-pin connector from Knock Sensor (KS) 1 -G61-.



- Connect multimeter US1119 (Fluke 83 or equivalent) to measure resistance between connector terminals, using adapters from VW1594 connector test kit.
  - Connector terminals 1 and 2
  - Connector terminals 1 and 3
  - Connector terminals 2 and 3
  - Specified value: ∞ Ω

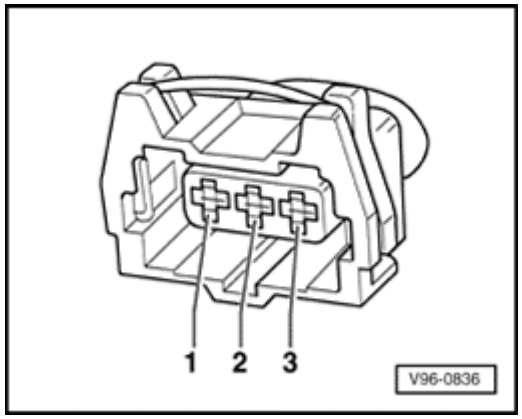
If resistance is OK (no continuity):

- Connect VAG1598/22 test box to Motronic ECM harness connector ⇒ page 01-67 .



- Check wiring for open circuit between ECM/test box and 3-pin harness connector, according to wiring diagram.
  - Connector terminal 1 to ECM/test box socket 68
  - Connector terminal 2 to ECM/test box socket 67
  - Connector terminal 3 to ECM/test box socket 67
  - Specified value: max. 1.5 Ω

28-13



- Check wiring for short circuits between terminals of 3-pin connector, and between connector and ECM/test box.
  - Connector terminal 2 to ECM/test box socket 68
  - Connector terminal 3 to ECM/test box socket 68
  - Specified value: ∞ Ω

If the wiring is OK:

- Loosen knock sensor and tighten to 20 Nm (15 ft lb).

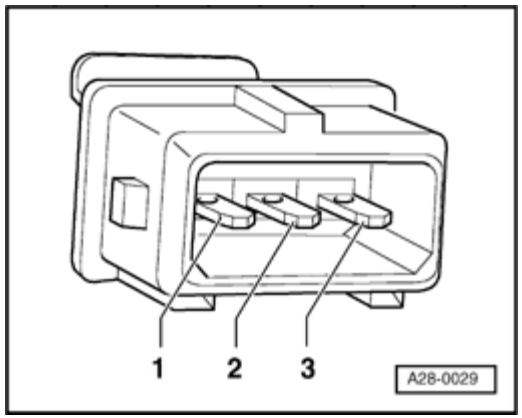
If the malfunction still exists (stored in DTC memory):

- Replace Knock Sensor (KS) 1 -G61-.
- Check readiness code ⇒ page 01-70 .

  If Diagnostic Trouble Code (DTC) memory has been erased, or ECM has been disconnected, generate new readiness code ⇒ page 01-73 .

28-14

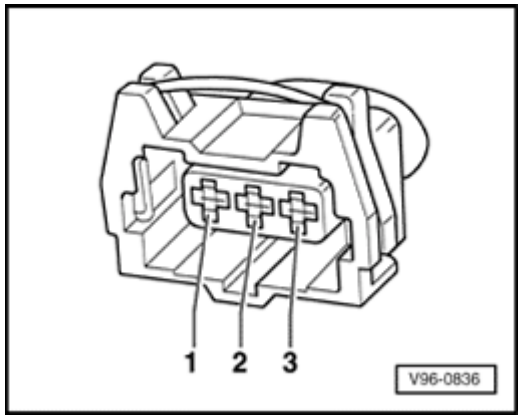
- Disconnect 3-pin connector from Knock Sensor (KS) 2 -G66-.



- Connect multimeter US1119 (Fluke 83 or equivalent) to measure resistance between connector terminals, using adapters from VW1594 connector test kit.
  - Connector terminals 1 and 2
  - Connector terminals 1 and 3
  - Connector terminals 2 and 3
  - Specified value: ∞ Ω

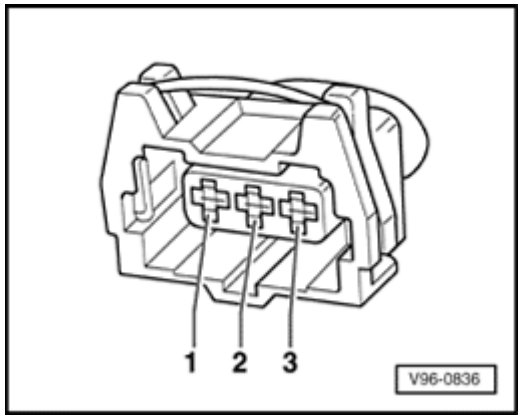
If resistance is OK (no continuity):

- Connect VAG1598/22 test box to Motronic ECM harness connector ⇒ page 01-67 .



- Check wiring for open circuit between ECM/test box and 3-pin harness connector, according to wiring diagram.
  - Connector terminal 1 to ECM/test box socket 60
  - Connector terminal 2 to ECM/test box socket 67
  - Connector terminal 3 to ECM/test box socket 67
  - Specified value: max. 1.5 Ω

28-15



- Check wiring for short circuits between terminals of 3-pin connector, and between connector and ECM/test box.
  - Connector terminal 2 to ECM/test box socket 60
  - Connector terminal 3 to ECM/test box socket 60
  - Specified value: ∞ Ω

If the wiring is OK:

- Loosen knock sensor and tighten to 20 Nm (15 ft lb).

If the malfunction still exists (stored in DTC memory):

- Replace Knock Sensor (KS) 2 -G66-.
- Check readiness code ⇒ page 01-70 .

  If Diagnostic Trouble Code (DTC) memory has been erased, or ECM has been disconnected, generate new readiness code ⇒ page 01-73 .

28-16

Misfire recognition, checking

Required special tools and test equipment

- VAG1551 or VAG1552 Scan Tool (ST) with VAG1551/3 adapter cable

Checking

- Connect VAG1551/1552 Scan Tool (ST) and press buttons -0- and -1- to insert "Engine Electronics" address word 01 (with engine running at idle) ⇒ page 01-8 .

Rapid data transfer HELP

Select function XX

Indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" function 08, and press -Q- button to confirm input.

Read Measuring Value Block HELP

Input display group number XXX

Indicated on display

- Press buttons -0-, -1- and -4- to input display group number 14 (014), and press -Q- button to confirm input.

Read Measuring Value Block 14 →

1 2 3 4

Indicated on display (1-4 = display groups)

28-17

- Compare displayed values with specified values for misfire recognition (display fields 3-4):

	Display groups			
	1	2	3	4
Display group 14: Misfire recognition				
Display	xxx RPM	xx.xx ms	xxx	activated deact
Indicates	Engine speed (in 40 RPM steps)	Engine load	Misfire harmful to emissions (total)	Misfire recognition status
Range	0 - 6800 RPM	0.00 - 12.75 ms	---	---
Specified value	620 - 740 RPM (all-wheel drive)	1.0 - 2.5 ms	30	activated
	740 - 860 RPM (front-wheel drive)			
	---	---	If displayed values are NOT OK ⇒ page 28-18 , display groups 15, 16	

If displayed values are OK:

- Press → button.

- Press buttons -0- and -6- to select "End Output" function 06, and press -Q- button to confirm input.

- Check readiness code ⇒ page 01-70 .

  If Diagnostic Trouble Code (DTC) memory has been erased, or ECM has been disconnected, generate new readiness code ⇒ page 01-73 .

28-18

If displayed values are NOT OK:

- Press -C- button.

- Press buttons -0-, -1- and -5- to input display group number 15 (015), and press -Q- button to confirm input.

Read Measuring Value Block 15 →

1 2 3 4

Indicated on display (1-4 = display groups)

- Compare displayed values with specified values for misfire recognition (display fields 1-4):

	Display groups			
	1	2	3	4
Display group 15: Misfire recognition				
Display	xxx	xxx	xxx	activated deact
Indicates	Misfire harmful to emissions, Cyl. 1	Misfire harmful to emissions, Cyl. 2	Misfire harmful to emissions, Cyl. 3	Misfire recognition status
Range	500	500	500	---
Specified value	0 - 5	0 - 5	0 - 5	activated
	If displayed values are NOT OK ⇒ page 28-20 , Evaluation of display groups 15 and 16			

28-19

If displayed values are OK:

- Press -C- button.

- Press buttons -0-, -1- and -6- to input display group number 16 (016), and press -Q- button to confirm input.

Read Measuring Value Block 16 →

1 2 3 4

Indicated on display (1-4 = display groups)

- Compare displayed values with specified values for misfire recognition (display fields 1 and 4):

	Display groups			
	1	2	3	4
Display group 16: Misfire recognition				
Display	xxx	xxx	xxx	activated deact
Indicates	Misfire harmful to emissions, Cyl. 4	Misfire harmful to emissions, Cyl. 5	Misfire harmful to emissions, Cyl. 6	Misfire recognition status
Range	500	500	500	---
Specified value	0 - 5	0 - 5	0 - 5	activated
	If displayed values are NOT OK ⇒ page 28-20 , Evaluation of display groups 15 and 16			

28-20

Evaluation of display groups 15 and 16

Display groups: 15 and 16 Display fields: 2 and 3	Possible malfunction cause	Corrective action
greater than 5	♦ Ignition coil faulty ♦ Spark plug connector faulty ♦ Spark plug faulty ♦ Power output stage for ignition coil faulty	- Check ignition coils -N-, -N128- and -N158- with power output stage -N122 ⇒ page 28-21
	♦ Fuel injector faulty ♦ Not enough fuel	- Check fuel injectors ⇒ page 24-102 - Check fuel in tank

28-21

Ignition coils and power output stage, checking

Notes:

- *The ignition coils and power output stage are one component.*
- *Measuring the primary resistance of the ignition coils is not possible.*
- *Measure secondary resistance first with ignition wires connected to the ignition coil via the spark plug connector of the respective cylinder (with this method the interference resistances of the ignition cables are also measured).*
- *Component locations* ⇒ *page 24-1*

Required special tools and test equipment

- Multimeter US1119 (Fluke 83 or equivalent)
- VW1594 connector test kit

Test conditions

- No fuel injector malfunction stored in DTC

memory

28-22

Checking

- Check DTC memory ⇒ page 01-16 .

  - There must be no malfunctions stored

- If DTC memory is not clear (malfunctions recognized):

  - Make necessary repairs and erase DTC memory.

  - Stop engine and start engine again.

  - Road test.

  - Check and erase DTC memory again.

- By briefly disconnecting fuel injector connectors with engine running, check which cylinder is misfiring, or not firing at all.

A misfiring cylinder can also be isolated by examining the spark plugs (for a carbon-fouled plug).

-
  Interchange spark plug with one from cylinder

that is OK.

If a different cylinder now misfires:

- Replace faulty spark plug.

If the original cylinder misfires:

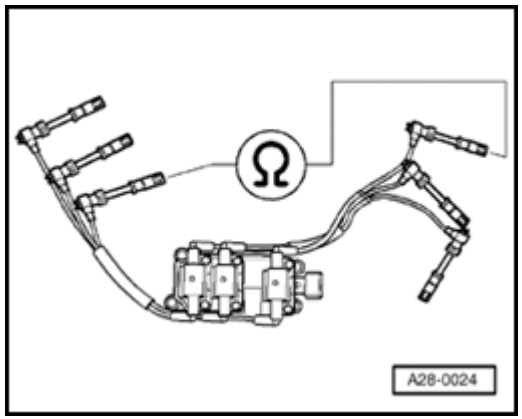
- Check ignition coil ⇒ page 28-23 .

28-23

Checking ignition coils -N-, -N128- and -N158-

- Disconnect 5-pin connector from ignition coil assembly.

- Remove ignition wires from spark plugs.



- Using multimeter and adapters from VAG1594 connector test kit, measure resistance between both spark plug connectors of respective ignition circuit (across coil).

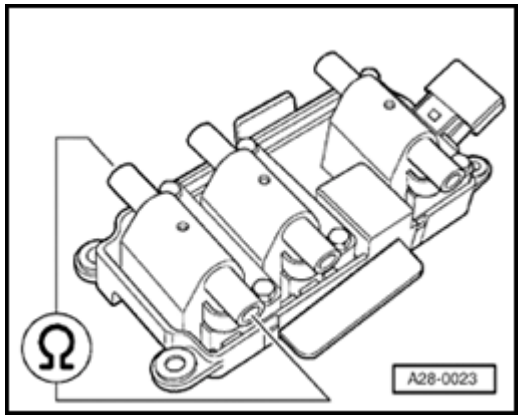
  Specification: approx. 18-25 kΩ.

If resistance is NOT OK:

- Remove ignition wires from ignition coils and measure resistance between ends of respective ignition wires.

  Specification: approx. 4.0-6.0 kΩ

28-24



- Using multimeter and adapters from VAG1594 connector test kit, measure resistance across both ignition wire connectors of respective ignition coil.

  Specification: 8.0-14.0 kΩ

If resistance values are not as specified:

- Replace coils.

If resistance values are OK:

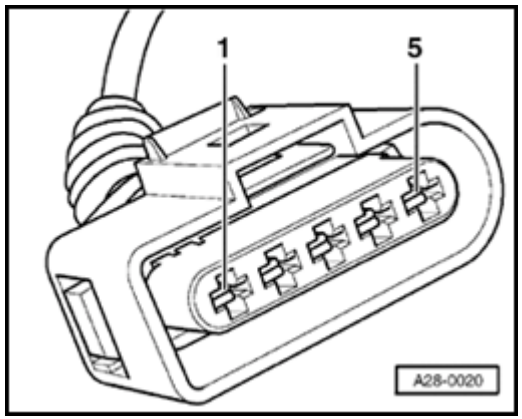
- Check signal for power output stage ⇒ page 28-25 .

28-25

Checking signal for power output stage

- Remove connectors from all 6 injectors (DTC memory will have to be checked and erased later).

- Switch ignition on.



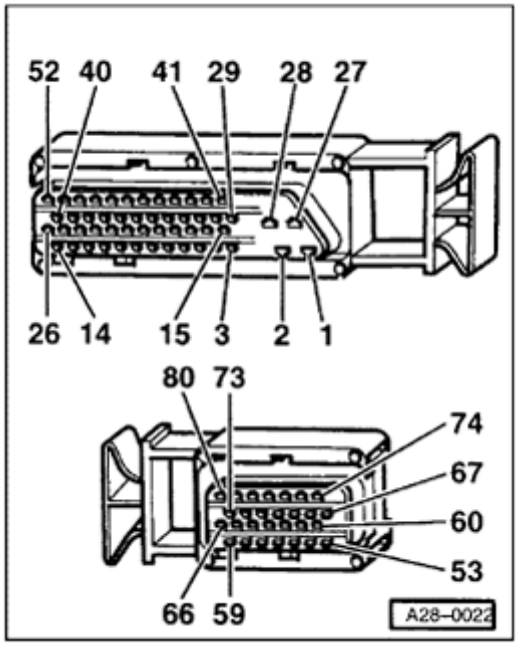
- Connect LED tester VAG1527 between engine ground and connector terminal 3.
- Crank starter for several seconds.

  LED in voltage tester must flash.
- Repeat test on 5-pin connector terminals 4 and 5.

If LED flashes:

- Replace ignition coils -N-, -N128- and -N158- with power output stage -N122-.

28-26



If LED does not flash:

- Connect VAG1598/22 test box to ECM harness connector ⇒ page 01-67 .

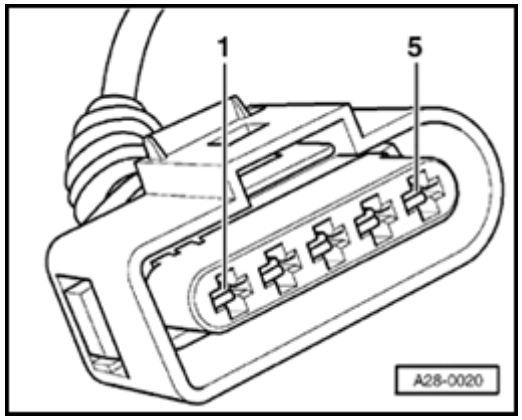
- Check wiring between ECM/test box and 5-pin connector for continuity and/or short circuit per wiring diagram.
  - Connector terminal 3 to ECM/test box socket 71
  - Connector terminal 4 to ECM/test box socket 78
  - Connector terminal 5 to ECM/test box socket 70

If wiring is OK:

- Replace Motronic ECM -J220- ⇒ page 01-68 .
- Carry out adaptation of throttle valve control module to ECM ⇒ page 24-150 .
- Check readiness code ⇒ page 01-70 .

  If Diagnostic Trouble Code (DTC) memory has been erased, or ECM has been disconnected, generate new readiness code ⇒ page 01-73 .

28-27



Checking ground for power output stage

- Disconnect 5-pin connector from ignition coils.

- Connect VAG1527 LED voltage tester between B+ and terminal 2 (ground) of connector.

  LED in tester must light up.

If LED does not light up:

- Check wires for open circuit per wiring diagram.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

28-28

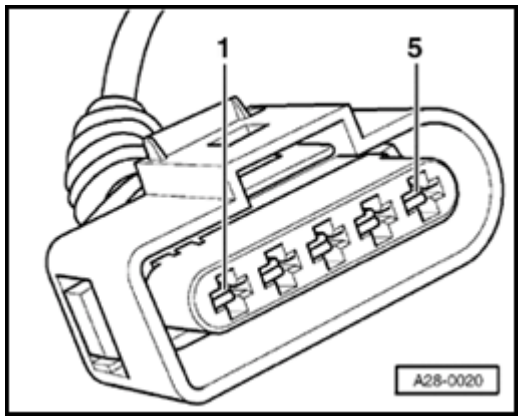
Checking voltage supply of ignition coils

Test requirement

- Fuse for ignition coils OK

- Disconnect 5-pin connector from ignition coils.

- Switch ignition on.



- Connect VAG1527 LED voltage tester between engine ground and terminal 1 (B+) of connector.

  LED in tester must light up.

If LED does not light up:

- Check wires for open circuit per wiring diagram.
- Check fuse for ignition coils.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*