






Chapter 12 Body electrical systems

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Degrees of difficulty

Easy , suitable for novice with little experience 	Fairly easy , suitable for beginner with some experience 	Fairly difficult , suitable for competent DIY mechanic 	Difficult , suitable for experienced DIY mechanic 	Very difficult , suitable for expert DIY or professional 
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1 General information

The chassis electrical system of this vehicle is of 12-volt, negative earth type. Power for the lights and all electrical accessories is supplied by a lead/acid-type battery, which is charged by the alternator.

This Chapter covers repair and service procedures for various chassis (non-engine related) electrical components. For information regarding the engine electrical system components (battery, alternator, distributor and starter motor), see Chapter 5.



Warning: To prevent electrical short-circuits, fires and injury, always disconnect the battery negative terminal before

checking, repairing or renewing electrical components.



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code

before disconnecting the battery. Refer to the information on page 0-7 at the front of this manual before detaching the cable.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

2 Electrical system fault finding - general information



A typical electrical circuit consists of an electrical component, any switches, relays, motors, fuses, fusible links or circuit breakers, etc related to that component, and the wiring and connectors that link the components to both the battery and the chassis. To help you pinpoint an electrical circuit problem, wiring diagrams are included at the end of this book.

Before tackling any troublesome electrical circuit, first study the appropriate wiring diagrams to get a complete understanding of what makes up that individual circuit. Troublespots, for instance, can often be isolated by noting if other components related to that circuit are routed through the same fuse and earth connections.

Electrical problems usually stem from simple causes such as loose or corroded connectors, a blown fuse, a melted fusible link, or a bad relay. Inspect all fuses, wires and connectors in a problem circuit first.

The basic tools needed include a circuit tester, a high-impedance digital voltmeter, a continuity tester and a jumper wire with an in-line circuit breaker for bypassing electrical components. Before attempting to locate or define a problem with electrical test

instruments, use the wiring diagrams to decide where to make the necessary connections.

Voltage checks

Perform a voltage check first when a circuit is not functioning properly. Connect one lead of a circuit tester to either the negative battery terminal or a known good earth.

Connect the other lead to a connector in the circuit being tested, preferably nearest to the battery or fuse. If the bulb of the tester lights up, voltage is present, which means that the part of the circuit between the connector and the battery is problem-free. Continue checking the rest of the circuit in the same fashion.

When you reach a point at which no voltage is present, the problem lies between that point and the last test point with voltage. Most of the time, problems can be traced to a loose connection. **Note:** Keep in mind that some circuits receive voltage only when the ignition key is turned to a certain position.

Electrical fault diagnosis is simple if you keep in mind that all electrical circuits are basically electricity running from the battery, through the wires, switches, relays, fuses and fusible links to each electrical component (light bulb, motor, etc) and then to earth, from where it is passed back to the battery. Any electrical problem is an interruption in the flow of electricity to and from the battery.

Finding a short-circuit

One method of finding a short-circuit is to remove the fuse and connect a test light or voltmeter in its place. There should be no voltage present in the circuit. Move the electrical connectors from side-to-side while watching the test light. If the bulb goes on, there is a short to earth somewhere in that area, probably where the insulation has been rubbed through. The same test can be performed on each component in a circuit, even a switch.

Earth check

Perform an earth check to see whether a component is properly earthed (passing current back via the vehicle body). Disconnect the battery, and connect one lead of a self-powered test light (often known as a continuity tester) to a known good earth. Connect the other lead to the wire or earth connection being tested. The bulb should light, indicating a good earth connection. If not, dismantle the connection, and clean all relevant parts thoroughly. When re-making the connection, use serrated (shakeproof) washers if possible, and tighten all bolts, etc, securely.



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before disconnecting the battery, Refer to the information on page 0-7 at the front of this manual before detaching the cable.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

Continuity check

A continuity check determines if there are any breaks in a circuit - if it is conducting electricity properly. With the circuit off (no power in the circuit), a self-powered continuity tester can be used to check the circuit. Connect the test leads to both ends of the circuit, and if the test light comes on, the circuit is passing current properly. If the light doesn't come on, there is a break somewhere in the circuit. The same procedure can be used to test a switch, by connecting the continuity tester to the power-in and power-out sides of the switch. With the switch turned on, the test light should come on.

Finding an open-circuit

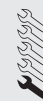
When diagnosing for possible open-circuits, it is often difficult to locate them by sight, because oxidation or terminal misalignment are hidden by the connectors. Intermittent problems are often caused by oxidised or loose connections. Merely wiggling an electrical connector may correct the open-circuit condition, albeit temporarily. Dismantle the connector, and spray with a water-dispersant aerosol. On simpler connectors, it may be possible to carefully



3.1 The fusebox is located in the engine compartment under a cover - the box also includes several relays

bend the connector pins inside, to improve the metal-to-metal contact - don't damage the connector in the process, however.

3 Fuses - general information



The electrical circuits of the vehicle are protected by a combination of fuses and circuit breakers. The fusebox is located in the left corner of the engine compartment (see illustration). On some later models, it is located under the rear seat cushion.

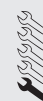
Each of the fuses is designed to protect a specific circuit, and on some models, the various circuits are identified on the fuse panel itself.

Miniaturised fuses are employed in the fuseboxes. These compact fuses, with blade terminal design, allow fingertip removal and renewal. If an electrical component fails, always check the fuse first. A blown fuse is easily identified through the clear plastic body. Visually inspect the element for evidence of damage. If a continuity check is called for, the blade terminal tips are exposed in the fuse body.

Be sure to renew blown fuses with the correct type. Fuses of different ratings are physically interchangeable, but only fuses of the proper rating should be used. Replacing a fuse with one of a higher or lower value than specified is not recommended. Each electrical circuit needs a specific amount of protection. The amperage value of each fuse is moulded into the fuse body.

If the new fuse immediately fails, don't renew it again until the cause of the problem is isolated and corrected. In most cases, the cause will be a short-circuit in the wiring caused by a broken or deteriorated wire.

4 Relays - general information



Several electrical accessories in the vehicle use relays to transmit the electrical signal to the component. If the relay is defective, that



4.2 Engine compartment relays

component will not operate properly. Relays are electrically-operated switches, which are often used in circuits drawing high levels of current, or where more complex switching arrangements are required.

The various relays are grouped together for convenience in several locations under the dash and in the engine compartment (see accompanying illustration and illustration 3.1).

If a faulty relay is suspected, it can be removed and tested by a dealer or qualified automotive electrician. No overhaul is possible. Like fuses, defective relays must be replaced with the correct type; some relays look identical, but perform very different functions.

5 Direction indicator/hazard warning flasher unit - check and renewal



Warning: Some later models are equipped with an airbag or Supplemental Restraint System (SRS). To avoid possible damage

to this system, the manufacturer recommends that, on airbag-equipped models, the following procedure should be left to a dealer service department, or other specialist, because of the special tools and techniques required. There is a risk of injury if the airbag is accidentally triggered.

1 The direction indicator/hazard flasher unit is a small canister- or box-shaped unit located in the wiring harness on or near the steering column. Access is gained by removing the steering column shrouds (see illustration).

2 When the flasher unit is functioning properly, a regular clicking noise can be heard from it when the indicators or hazard flashers are switched on. If the direction indicators fail on one side or the other, and the flasher unit does not make its characteristic clicking sound, a faulty direction indicator bulb is indicated.

3 If both direction indicators fail to blink, the problem may be due to a blown fuse, a faulty flasher unit, a broken switch or a loose or open connection. If a quick check of the fusebox



5.1 The direction indicator/hazard warning flasher unit is located on the steering column on most models - squeeze the tabs to detach it

indicates that the direction indicator and/or hazard fuse has blown, check the wiring for a short-circuit before fitting a new fuse.

4 Make sure that the new unit is identical to the original. Compare the old one to the new one before fitting it.

5 Refitting is the reverse of removal.

6 Steering column switches - removal and refitting



Warning: Some later models are equipped with an airbag or Supplemental Restraint System (SRS). To avoid possible damage to this system, the manufacturer recommends that, on airbag-equipped models, the following procedure should be left to a dealer service department, or other specialist, because of the special tools and techniques required. There is a risk of injury if the airbag is accidentally triggered.



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery, Refer to the information on page 0-7 at the front of this manual before detaching the cable.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

1 Disconnect the battery negative cable, remove the steering wheel (see Chapter 10) and steering column shrouds (see Chapter 11).

Direction indicator/headlight switch

2 Where necessary, remove the switch mounting screws. Depress the tabs and pull the switch out of the steering column mounting (see illustration).

3 Trace the switch wires down the steering column to the electrical connector, and unplug them (see illustration).

4 Refitting is the reverse of removal.



6.2 Squeeze the tabs to release the switch from the mounting

Wiper/washer switch

5 Where necessary, remove the switch mounting screws.

6 Depress the release clip, and detach the switch from the steering column mounting (see illustration). Trace the switch wiring down the steering column to the electrical connector, and unplug it.

7 Refitting is the reverse of removal.

Cruise control switch

8 Remove the wiper/washer switch.

9 Where necessary, remove the switch mounting screw. Squeeze the release tabs, and withdraw the switch from the mounting (see illustration).

10 Disconnect the switch electrical connector from the harness at the base of the steering column.

11 Refitting is the reverse of removal.

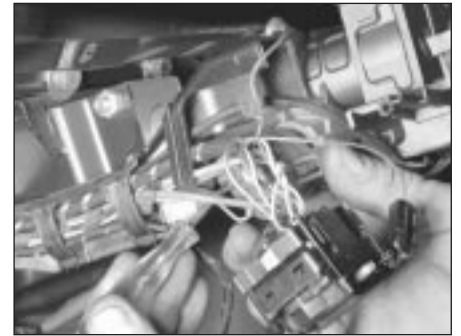
7 Ignition switch - removal and refitting



Warning: Some later models are equipped with an airbag or Supplemental Restraint System (SRS). To avoid possible damage to this system, the manufacturer recommends that, on airbag-equipped models, the following procedure should be left to a dealer service department, or other specialist, because of the special



6.6 Squeeze the wiper/washer switch tabs and pull it directly out of the mounting



6.3 Follow the wiring down the steering column to the connector

tools and techniques required. There is a risk of injury if the airbag is accidentally triggered.



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery. Refer to the information on page 0-7 at the front of this manual before detaching the cable.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

Removal

1 Disconnect the battery negative cable.

2 Remove the steering wheel (see Chapter 10).

3 Remove the steering column shrouds (see Chapter 11).

4 Where necessary, remove the direction indicator/headlight control switch (see Section 6).

5 Detach the clips by inserting a small screwdriver into the openings on the sides while pulling out on the switch (see illustration).

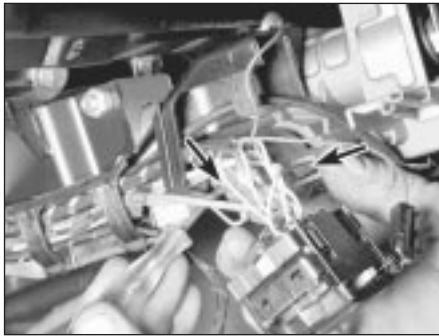
6 Unplug the electrical connector from the harness at the base of the steering column, and remove the switch.

Refitting

7 Refitting is the reverse of removal.



6.9 Cruise control switch removal



7.5 Insert a screwdriver into the openings (arrowed) on each side of the switch to release the clip while pulling out

8 Radio - removal and refitting



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code

before disconnecting the battery, Refer to the information on page 0-7 at the front of this manual before detaching the cable.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

Removal

- 1 Disconnect the battery negative cable.
- 2 The radios on most models are held in place by internal clips which are usually located at the sides or corners of the unit faceplate. Removal requires a special tool which is inserted into the holes to release the clips so the radio can be pulled out. These tools can be fabricated from heavy wire, or are available from your dealer or a car audio specialist. On anti-theft radios, the clips are moved in and out by internal screws which require another type of tool. Insert the tool into the holes until the clips release, then withdraw the radio from the dash panel. Disconnect the wiring from the radio and remove it.



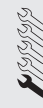
10.3 Use a Phillips screwdriver to remove the instrument cluster retaining screws

- 3 On some models, the radio is held in place by screws located beneath the faceplate. The control knobs must be pulled off before the faceplate can be withdrawn.

Refitting

- 4 Refitting is the reverse of removal.

9 Aerial - removal and refitting



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code

before disconnecting the battery, Refer to the information on page 0-7 at the front of this manual before detaching the cable.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

Removal

- 1 Disconnect the battery negative cable.
- 2 Use circlip pliers to unscrew the aerial mounting nut.
- 3 Open the boot lid/tailgate and remove the left side trim panel. On some models, the jack and tail light cluster cover will have to be removed first.
- 4 Unplug the aerial power and radio lead connectors (as applicable), remove the retaining bolts, and remove the aerial and motor assembly.

Refitting

- 5 Refitting is the reverse of removal.

10 Instrument cluster - removal and refitting



Caution: The instrument cluster and components are very susceptible to damage from static electricity. Make sure you are earthed and have discharged



10.4 Push on the levers to detach the cluster electrical connectors

any static electricity (by touching an object such as a metal water pipe) before touching the cluster or components.

Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code

before disconnecting the battery, Refer to the information on page 0-7 at the front of this manual before detaching the cable.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

Removal

- 1 Disconnect the battery negative cable.
- 2 As necessary, remove the steering column shrouds and lower trim panel (see Chapter 11).
- 3 Remove the screws holding the cluster to the fascia (see illustration). Note the location of the lower screws to ensure they are refitted in the same place. On 3-Series models, the length of the two lower inner screws must not exceed 9.5 mm.
- 4 Tilt the top of the cluster back, reach behind it and detach the electrical connectors by pressing on the levers, then lift the cluster out of the fascia opening (see illustration).
- 5 For access to the cluster components, release the catches or remove the screws, and separate the two halves (see illustration).

Refitting

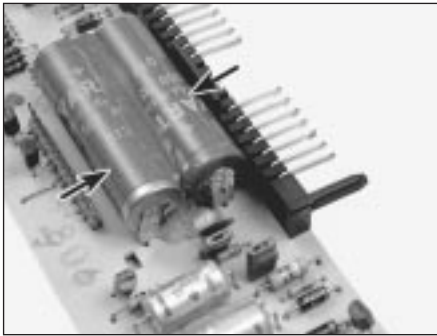
- 6 Refitting is the reverse of removal.

11 Service Indicator (SI) board - general information

All models that have service indicator lights are equipped with a Service Indicator (SI) board located in the instrument cluster. This board turns the lights on at the proper mileage intervals. The lights can only be turned off using a special tool which plugs into the engine check connector (see Chapter 1). The



10.5 Turn the plastic knobs to release the back of the cluster (some models use screws)



11.2 These batteries (arrowed) power the Service Indicator (SI) board

SI board is a self-contained computer which includes a chip and batteries.

The rechargeable SI board nickel cadmium (nicad) batteries maintain power to the computer memory in the event of a power drop (such as during starting) or complete power loss (such as a dead or disconnected battery) (see illustration). This assures power so the computer can continue to keep track of mileage and turn the lights on at the proper interval.

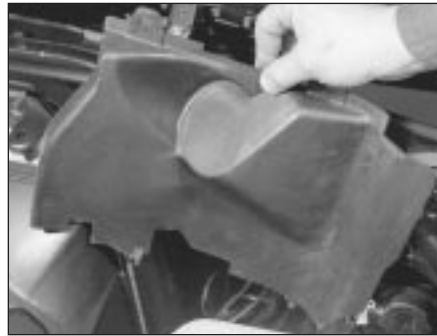
The batteries have a life of approximately six years, at which time they must be replaced with new ones. Also, since they are recharged by the engine charging system, they can run down prematurely if power is cut off for some reason (such as a blown fuse, a fault in the wiring, or extended storage of the vehicle). Excessive heat or cold can also shorten battery life, with heat the greatest enemy. Extreme heat can cause the batteries to actually split open, allowing acid to drip into the instrument cluster.

Several instruments controlled by the SI board can be affected by low or discharged batteries. Symptoms of low or dead SI board batteries can include inconsistent tachometer and temperature gauge readings, background radio noise, and the inability to turn the service lights off with the special tool.

Although only complete SI boards are available from the manufacturer, batteries are available separately from aftermarket sources. While it is possible for the home mechanic to renew the batteries, they are soldered to the board, so unless you are skilled at this and have the proper tools, this job should be left to an experienced electronics technician. Considerable savings can be realised by removing the instrument cluster (see Section 10) and taking it to an electronics specialist.



Caution: the instrument cluster and components are very susceptible to damage from static electricity. Make sure you are earthed and have discharged any static electricity (by touching an object such as a metal water pipe) before touching the cluster components.



12.8 Removing the headlight rear outer cover (3-Series shown)



12.9 Twist and release the headlight inner cover

12 Headlights - bulb renewal



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code

before disconnecting the battery. Refer to the information on page 0-7 at the front of this manual before detaching the cable.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

- 1 Disconnect the battery negative cable.

Sealed-beam type

- 2 Remove the grille (see Chapter 11).
- 3 Remove the headlight retainer screws, taking care not to disturb the adjustment screws.
- 4 Remove the retainer and pull the headlight out enough to allow the connector to be unplugged.
- 5 Remove the headlight.
- 6 To refit the headlight, plug the connector in, place the headlight in position, and refit the retainer and screws. Tighten the screws securely.



12.10 Disconnecting the wire from the rear of the headlight bulb

- 7 Refit the grille. Connect the battery negative cable.

Halogen bulb type



Warning: Halogen gas-filled bulbs are under pressure, and may shatter if the surface is scratched or the bulb is dropped. Wear eye protection, and handle the bulbs carefully, grasping only the base whenever possible. Do not touch the surface of the bulb with your fingers, because the oil from your skin could cause it to overheat and fail prematurely.



If you do touch the headlamp bulb surface, clean it with methylated spirit.

- 8 From behind the headlight assembly, remove the outer cover (see illustration).
- 9 Twist and release the inner cover from the rear of the headlight (see illustration).
- 10 Disconnect the wire from the rear of the headlight bulb (see illustration).
- 11 Release the clips, and withdraw the bulb from the headlight unit (see illustration).
- 12 Fit the new bulb using a reversal of the removal procedure. Make sure that the clips engage the bulb correctly.
- 13 Connect the battery negative cable.



12.11 Removing the headlight bulb (do not touch the surface of the bulb with your fingers)

13 Headlights - adjustment



Note: The headlights must be aimed correctly. If adjusted incorrectly, they could momentarily blind the driver of an oncoming vehicle and cause a serious accident, or seriously reduce your ability to see the road. The headlights should be checked for proper aim every 12 months (as is done during the MOT test), and any time a new headlight is fitted or front-end body work is performed. It should be emphasised that the following procedure will only provide a temporary setting until the headlights can be adjusted by a properly-equipped garage.

1 Each headlight has two adjusting screws, one controlling up-and-down movement and one controlling left-and-right movement (see illustration). It may be necessary to remove the grille (see Chapter 11) for access to these screws.

2 There are several methods of adjusting the headlights. The simplest method requires a blank wall (or garage door) 25 feet in front of the vehicle, and a level floor.

3 Position masking tape vertically on the wall, to mark the vehicle centreline and the centreline of both headlights. **Note:** It may be easier to position the tape on the wall with the vehicle parked only a few inches away, and then move the vehicle back the required distance when all marks have been made.

4 Make a horizontal line on the wall to mark the centreline of all headlights.

5 Move the vehicle back so that it is 25 feet away from the marked wall (keep the front end of the vehicle square to the wall). Adjustment should be made with the vehicle sitting level, the fuel tank half-full, and with no unusually heavy loads in the vehicle.

6 Switch on the dipped beam. The bright spots on the wall should be two inches below the horizontal line, and two inches to the left of the headlight vertical lines. Adjustment is made by turning the adjusting screw to raise or lower the beam. The other adjusting screw



13.1 The headlight adjustment screws (arrowed) are accessible from the back of the headlight on 3-Series models

should be used in the same manner to move the beam left or right.

7 With main beam on, the bright spots on the wall should be exactly on the vertical lines, and just below the horizontal line. **Note:** It may not be possible to position the headlight aim exactly for both main and dipped beams. If a compromise must be made, keep in mind that the dipped beam is most used, and will have the greatest effect on driver safety.

8 Have the headlights adjusted by a dealer service department or qualified garage at the earliest opportunity.

14 Headlight housing - removal and refitting



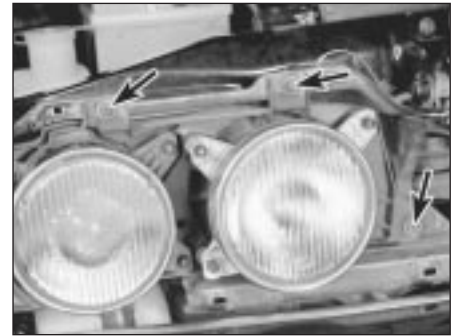
Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code

before disconnecting the battery, Refer to the information on page 0-7 at the front of this manual before detaching the cable.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

Removal

1 Disconnect the battery negative cable.



14.4 Remove the screws (arrowed) and detach the headlight housing

2 Remove the side grille (see Chapter 11), then remove the rear cover(s) where necessary.

3 Unplug the headlight (sealed beam-type) or remove the bulb (halogen bulb-type).

4 Remove the screws and detach the housing (see illustration).

Refitting

5 Refitting is the reverse of removal.

15 Bulb renewal



1 The lenses of many lights are held in place by screws, which makes it a simple procedure to gain access to the bulbs.

2 On some lights, the lenses are held in place by clips. The lenses can be removed by using a small screwdriver to prise them off.

3 Several bulbs are mounted in self-earthing holders, and are removed by pushing in and turning them anti-clockwise (see illustration). The bulbs can then be removed (see illustrations).

4 The tail lights on 3-Series models are accessible after removing the housing, then removing the bulbs (see illustrations).

5 To gain access to the facia lights, the instrument cluster will have to be removed first (see illustration).



15.3a The tail light bulbs on later 5-Series models are in self-earthing holders which can be simply pulled out of the housing - the bulb is then removed from the holder



15.3b On models with high-mounted centre brake lights, the self-earthing holder is accessible from the luggage area - pull the holder out . . .



15.3c . . . then pull the bulb from the holder



15.4a On 3-Series models, the entire tail light housing assembly is self-earthing through the mounting screw - loosen the plastic screw and pull the housing back . . .



15.4b . . . then remove the bulb from the housing



15.5 After removing the instrument cluster (see Section 10), turn the bulbholder anti-clockwise to remove the bulb

16 Windscreen/tailgate wiper motor - removal and refitting



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code

before disconnecting the battery, Refer to the information on page 0-7 at the front of this manual before detaching the cable.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

1 Disconnect the battery negative cable.

Windscreen wiper motor

2 Remove the covers and nuts, then detach the wiper arms (see illustrations).

3 Prise out the retaining clips and detach the cowl grille for access to the wiper assembly.

4 Remove the screws or nuts and detach the wiper cover located on the engine compartment bulkhead.

5 Unplug the electrical connector and detach the wiper linkage.

6 Mark the relationship of the wiper shaft to the linkage. Detach the wiper link from the motor shaft by prising carefully with a screwdriver.

7 Remove the three retaining bolts and remove the wiper motor from the vehicle.

8 Refitting is the reverse of removal. When fitting the motor, if necessary plug in the

connector and run the motor briefly until it is in the "neutral" (wipers parked) position.

Tailgate wiper motor

9 On 3-Series models, remove the cover and nut, then detach the wiper arm (see illustration). On 5-Series models, open the rear window away from the tailgate.

10 As applicable, remove the trim panel(s), then disconnect the washer tube and the wiring plug.

11 Unscrew the mounting nuts and withdraw the wiper motor (see illustrations). On 5-Series models, the wiper blade and pivot mechanism may be removed from the rear window if necessary after removing the trim panels (see illustration).



16.2a Use a small screwdriver to detach the wiper arm nut cover, or swivel the cover up



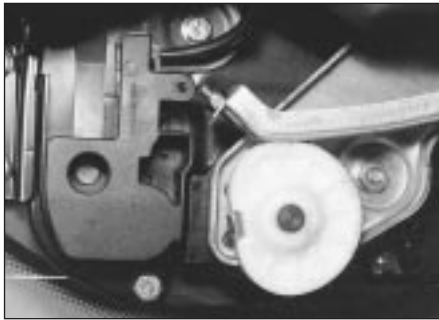
16.2b After removing the nut, use a magnet to lift out the metal washer



16.9 Removing the tailgate wiper arm nut (3-Series)



16.11a Removing the tailgate wiper motor (3-Series)



16.11b Tailgate wiper motor (5-Series)

12 Refitting is a reversal of removal. When fitting the motor, if necessary plug in the connector and run the motor briefly until it is in the "neutral" (wiper parked) position.



16.11c Wiper blade and pivot mechanism on the rear window (5-Series)

12 Allow the repair to cure for 24 hours before removing the tape and using the heated rear window.



18.3 The SRS system crash sensors (arrowed) are located in the engine compartment - check the wiring regularly for damage

17 Heated rear window - check and repair



1 The heated rear window consists of a number of horizontal elements on the glass surface.

2 Small breaks in the element can be repaired without removing the rear window.

Check

3 Switch on the ignition and the heated rear window.

4 Place the positive lead of a voltmeter to the heater element nearest to the incoming power source.

5 Wrap a piece of aluminium foil around the negative lead of the voltmeter on the positive side of the suspected broken element, and slide it slowly towards the negative side. Watch the voltmeter needle - when it moves from zero, you have located the break.

Repair

6 Repair the break in the line using a repair kit recommended specifically for this purpose, such as BMW repair kit No. 81 22 9 (or equivalent). Included in this kit is plastic conductive epoxy. The following paragraphs give general instructions for this type of repair; follow the instructions supplied with the repair kit if they are different.

7 Prior to repairing a break, switch off the circuit and allow it to cool down for a few minutes.

8 Lightly buff the element area with fine steel wool, then clean it thoroughly.

9 Use masking tape to mask off the area of repair, leaving a slit to which the epoxy can be applied.

10 Mix the epoxy thoroughly, according to the instructions on the package.

11 Apply the epoxy material to the slit in the masking tape, overlapping the undamaged area about 20 mm on each end.

18 Supplemental Restraint System (SRS) - general information

Later models are equipped with a Supplemental Restraint System (SRS), incorporating an airbag. This system is designed to protect the driver from serious injury in the event of a head-on or frontal collision. It consists of an airbag module in the centre of the steering wheel, two crash sensors mounted on the front inner wing panels, and a crash safety switch located inside the passenger compartment.

The airbag module contains a housing incorporating the airbag and the inflator units. The inflator assembly is mounted on the back of the housing over a hole through which gas is expelled, inflating the bag almost instantaneously when an electrical signal is sent from the system. This signal is carried by a wire which is specially wound with several turns, so the signal will be transmitted regardless of the steering wheel position.

The SRS system has three sensors: two at the front, mounted on the inner wing panels (**see illustration**), and a safety switch located inside the passenger compartment. The crash sensors are basically pressure-sensitive switches, which complete an electrical circuit during an impact of sufficient force. The electrical signal from the crash sensors is sent to a third sensor, which then completes the circuit and inflates the airbag.

The module containing the safety switch monitors the system operation. It checks the system every time the vehicle is started, causing the AIRBAG warning light to come on, then go out if the system is operating correctly. If there is a fault in the system, the light will stay on. If the AIRBAG warning light does stay on, or if it comes on while driving, take the vehicle to your dealer immediately.

19 Cruise control system - description and check



The cruise control system maintains vehicle speed using a vacuum-actuated servo motor located in the engine compartment, which is connected to the throttle linkage by a cable. The system consists of the servo motor, clutch switch, brake switch, control switches, a relay, and associated vacuum hoses.

Because of the complexity of the cruise control system, repair should be left to a dealer service department. However, it is possible for the home mechanic to make simple checks of the wiring and vacuum connections for minor faults which can be easily repaired. These include:

- Inspect the cruise control actuating switches for broken wires and loose connections.
- Check the cruise control fuse.
- The cruise control system is operated by vacuum, so it's critical that all vacuum switches, hoses and connections are secure. Check the hoses in the engine compartment for loose connections, cracks, or obvious vacuum leaks.

20 Central locking system - description and check



The central door locking system operates the door lock actuators mounted in each door. The system consists of the switches, actuators and associated wiring. Diagnosis is limited to simple checks of the wiring connections and actuators for minor faults which can be easily repaired. These include:

- Check the system fuse and/or circuit breaker (where applicable).
- Check the switch wires for damage and loose connections. Check the switches for continuity.
- Remove the door trim panel(s), and check the actuator wiring connections to see if they're loose or damaged. Inspect the actuator rods to make sure they aren't

bent or damaged. The actuator can be checked by applying battery power momentarily. A discernible click indicates that the solenoid is operating properly.

21 Electric window system - description and check



The electric window system operates the electric motors mounted in the doors which lower and raise the windows. The system consists of the control switches, the motors, window mechanisms (regulators) and

associated wiring. Removal of the motors and regulators is described in Chapter 11.

Diagnosis is usually limited to simple checks of the wiring connections and motors for minor faults which can be easily repaired. These include:

- a) *Check the electric window switches for broken wires and loose connections.*
- b) *Check the electric window fuse/and or circuit breaker (where applicable).*
- c) *Remove the door trim panel(s) and check the electric window motor wires to see if they're loose or damaged. Inspect the window mechanisms for damage which could cause binding.*

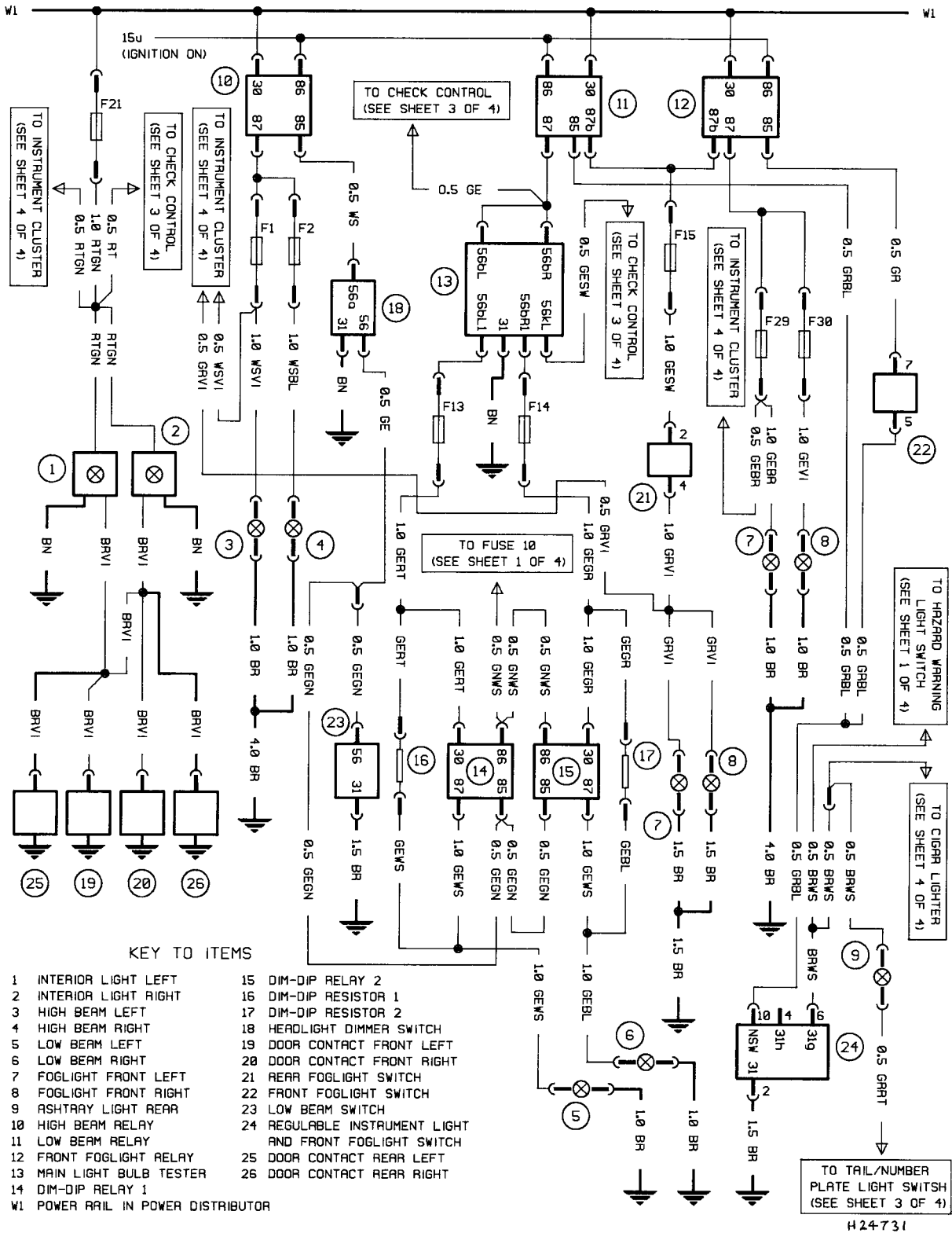
22 Wiring diagrams - general information

Since it isn't possible to include all wiring diagrams for every model year covered by this manual, the following diagrams are those that are typical and most commonly needed.

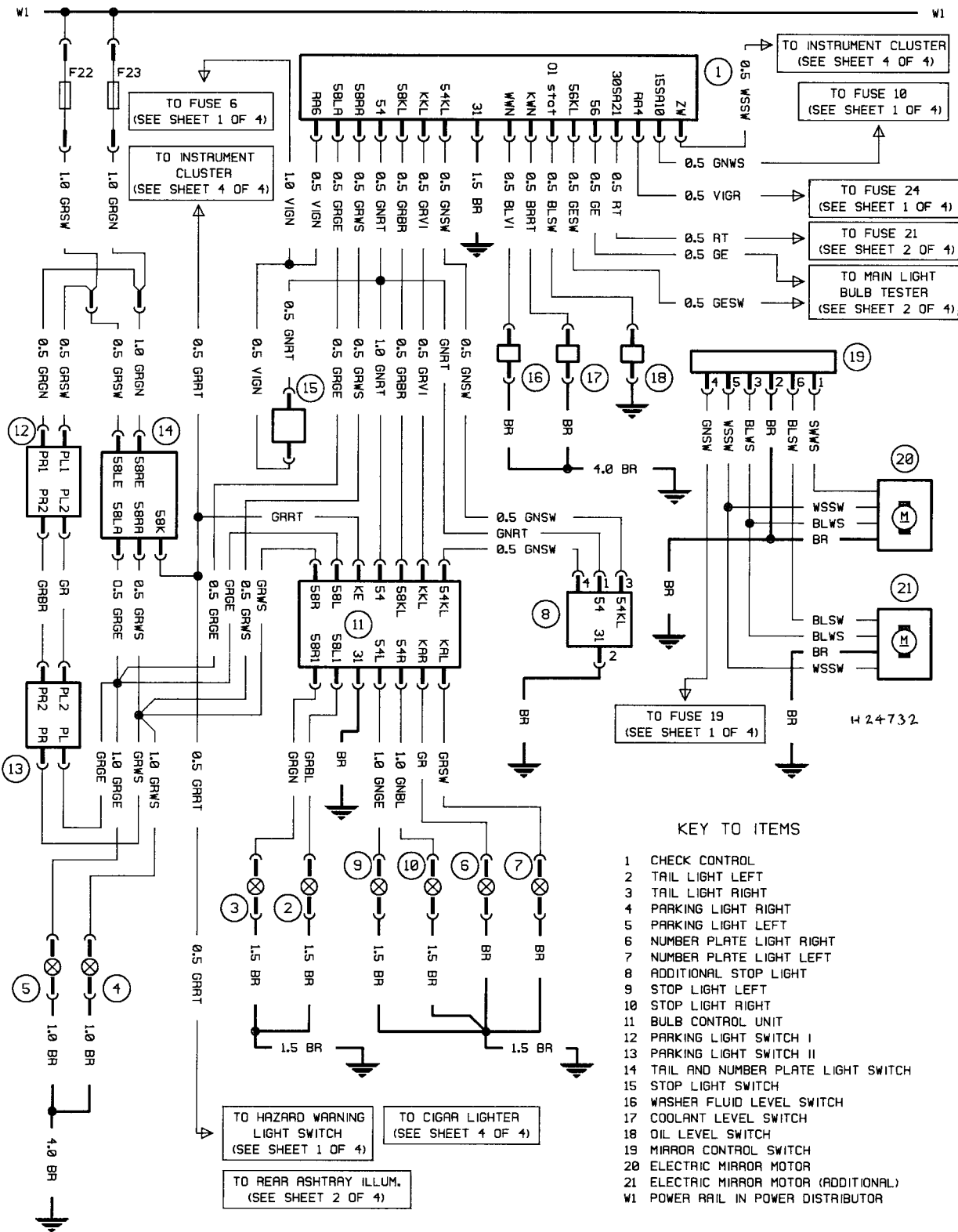
Prior to checking any circuit, check the fuses and circuit breakers to make sure they're in good condition. Make sure the battery is fully charged and check the cable connections (see Chapter 1). Make sure all connectors are clean, with no broken or loose terminals.

Colour codes

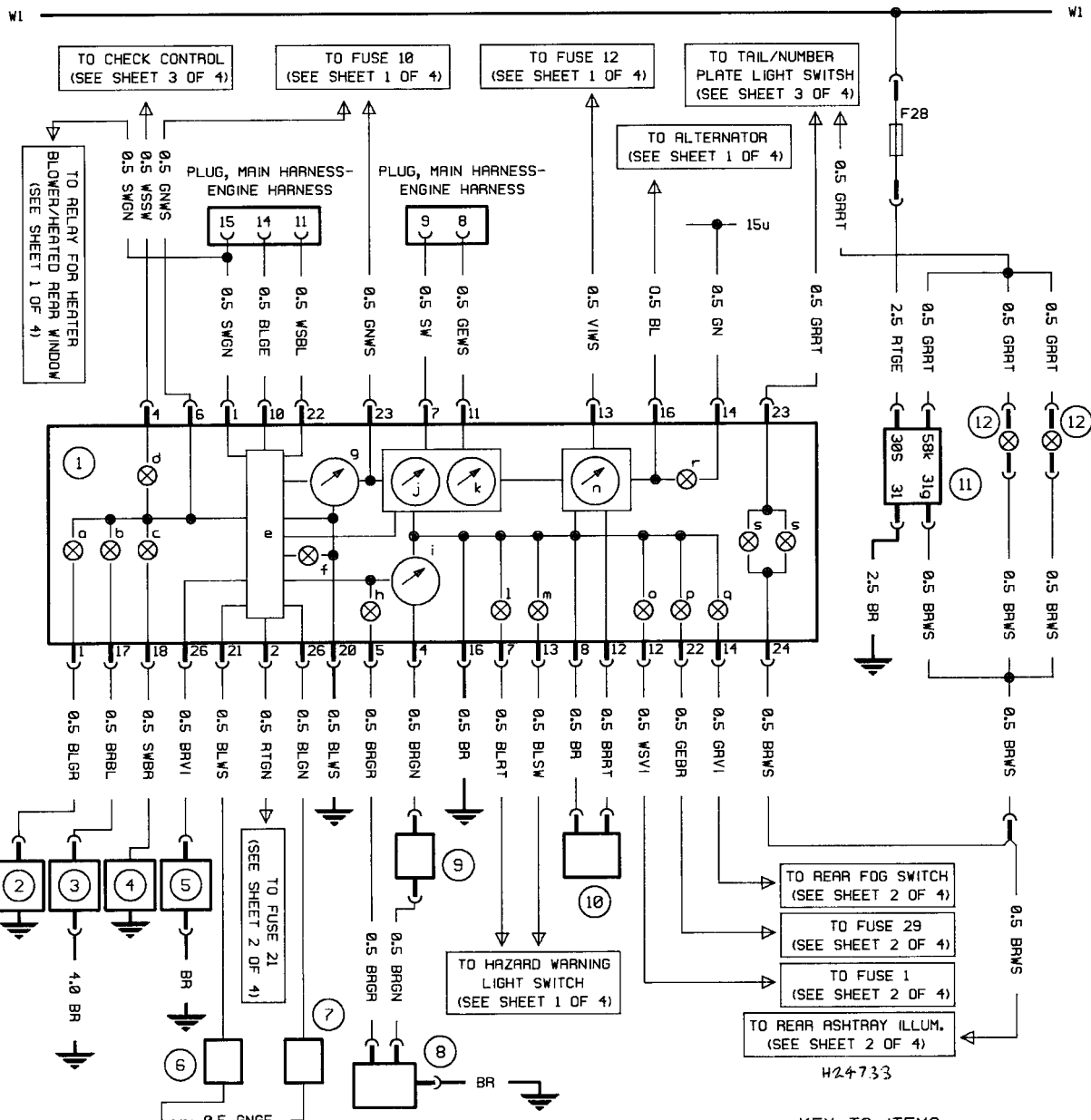
BK Black	GE Yellow	GY Grey	R Red	SW Black	VI Violet	WS White
BL Blue	GN Green	OR Orange	RS Pink	TN Tan	W White	Y Yellow
BR Brown	GR Green or Grey	PK Pink	RT Red	V Violet		



Typical headlights/foglights and interior lights (2 of 4)



Typical check control, electric mirrors, stop and parking light (3 of 4)



KEY TO INSTRUMENT CLUSTER (ITEM 1)

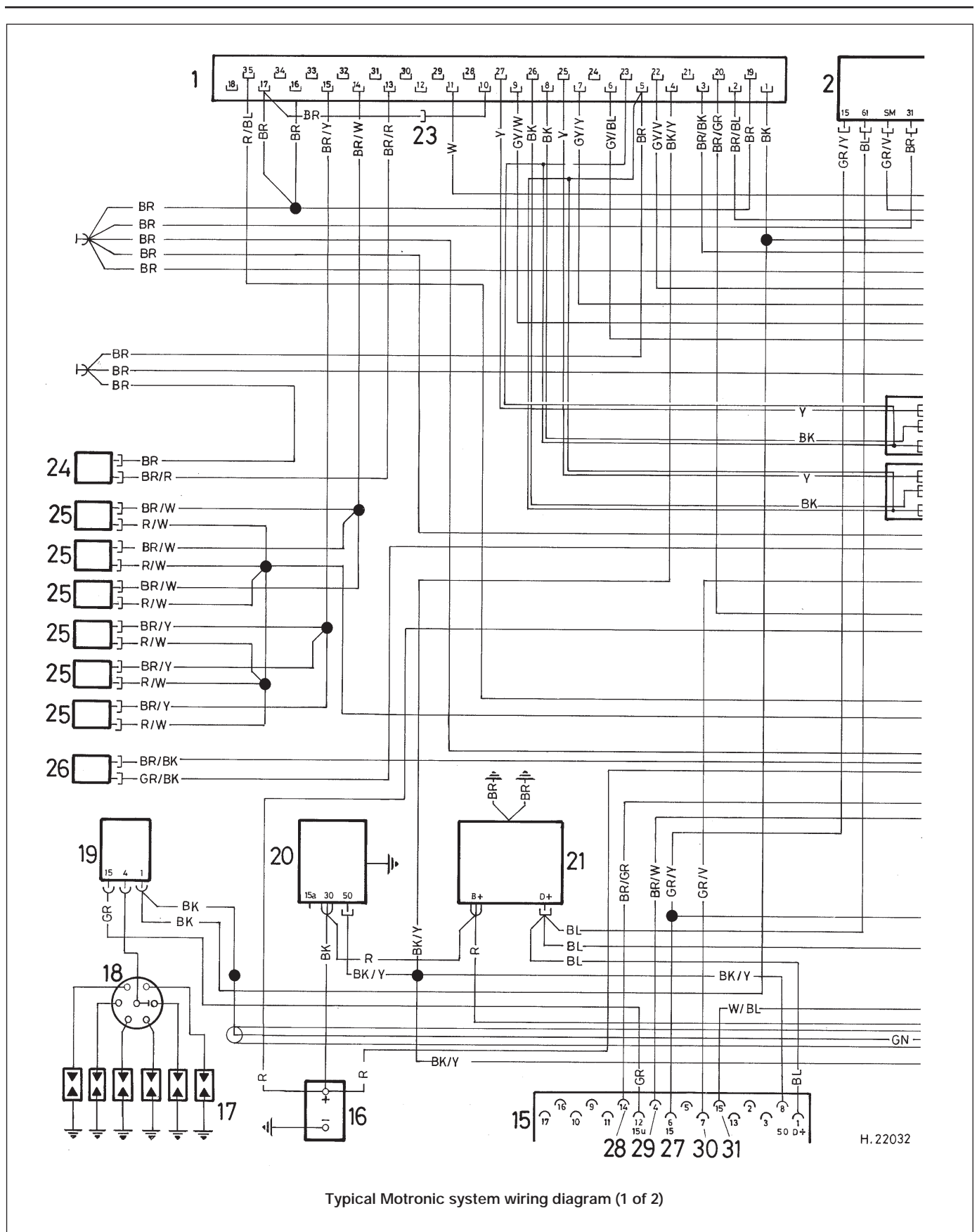
- | | | | |
|---|----------------------------|---|---------------------------|
| a | HANDBRAKE WARNING LIGHT | k | ECONOMY CONTROL |
| b | BRAKE FLUID WARNING LIGHT | l | DIRECTION INDICATOR LEFT |
| c | OIL PRESSURE WARNING LIGHT | m | DIRECTION INDICATOR RIGHT |
| d | CENTRAL WARNING LIGHT | n | SPEEDOMETER |
| e | SERVICE INDICATOR | o | HIGH BEAM WARNING LIGHT |
| f | PAD WEAR WARNING LIGHT | p | FRONT FOG WARNING LIGHT |
| g | COOLANT TEMP. GAUGE | q | REAR FOG WARNING LIGHT |
| h | LOW FUEL WARNING LIGHT | r | NO CHARGE WARNING LIGHT |
| i | FUEL GAUGE | s | INSTRUMENT ILLUMINATION |
| j | TACHOMETER | | |

KEY TO ITEMS

- | | |
|----|----------------------------------|
| 1 | INSTRUMENT CLUSTER |
| 2 | HANDBRAKE WARNING SWITCH |
| 3 | BRAKE FLUID LEVEL SWITCH |
| 4 | OIL PRESSURE SWITCH |
| 5 | COOLANT TEMPERATURE SENDER |
| 6 | BRAKE PAD WEAR SENSOR REAR RIGHT |
| 7 | BRAKE PAD WEAR SENSOR FRONT LEFT |
| 8 | FUEL LEVEL SENDER I |
| 9 | FUEL LEVEL SENDER II |
| 10 | SPEEDOMETER SENDER |
| 11 | CIGAR LIGHTER |
| 12 | HEATER CONTROL LIGHT |
| W1 | POWER RAIL IN POWER DISTRIBUTOR |

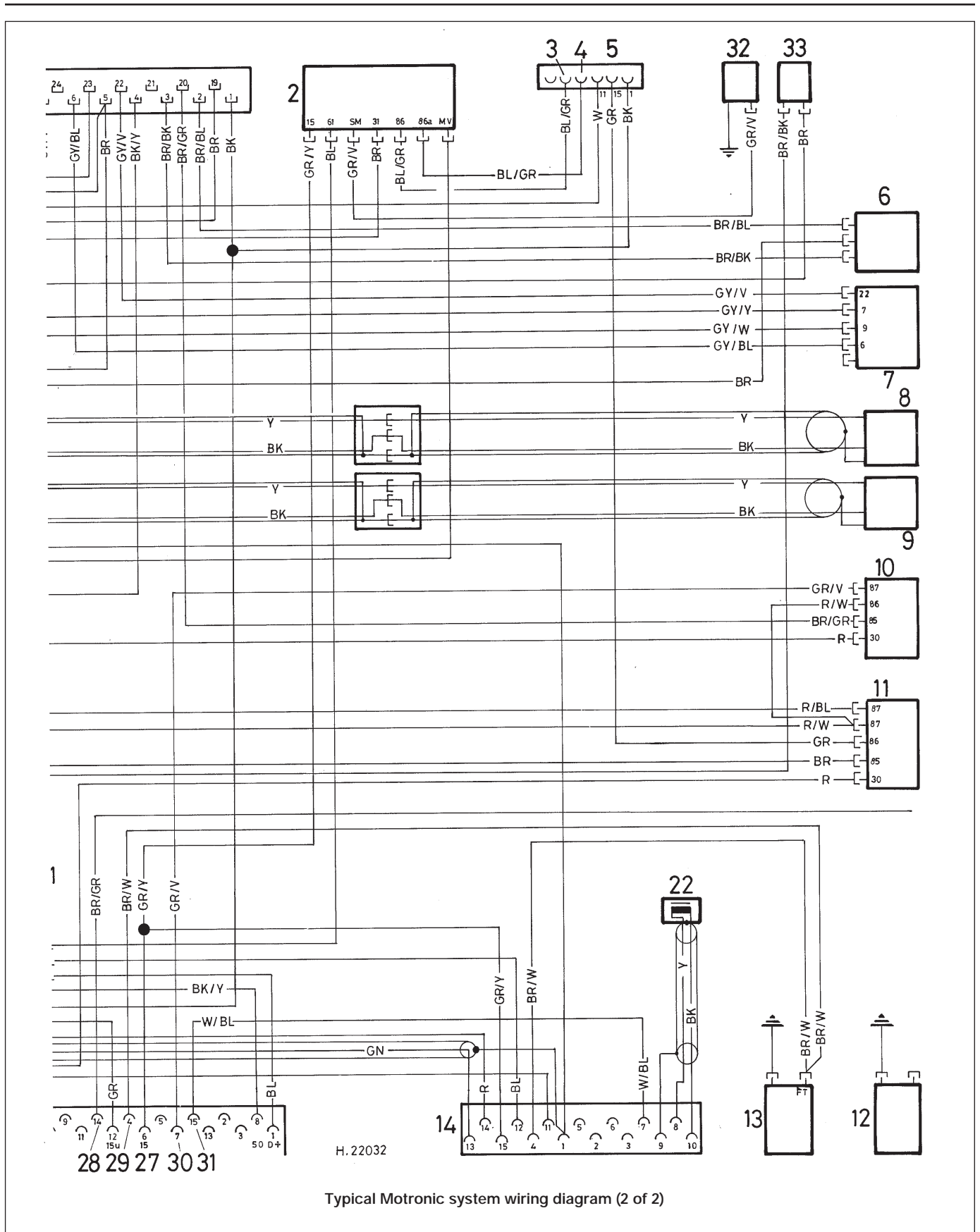
Typical instrument cluster and cigar lighter (4 of 4)

12•14 Wiring diagrams



Typical Motronic system wiring diagram (1 of 2)

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Typical Motronic system wiring diagram (2 of 2)

Key to Motronic engine control system wiring diagram

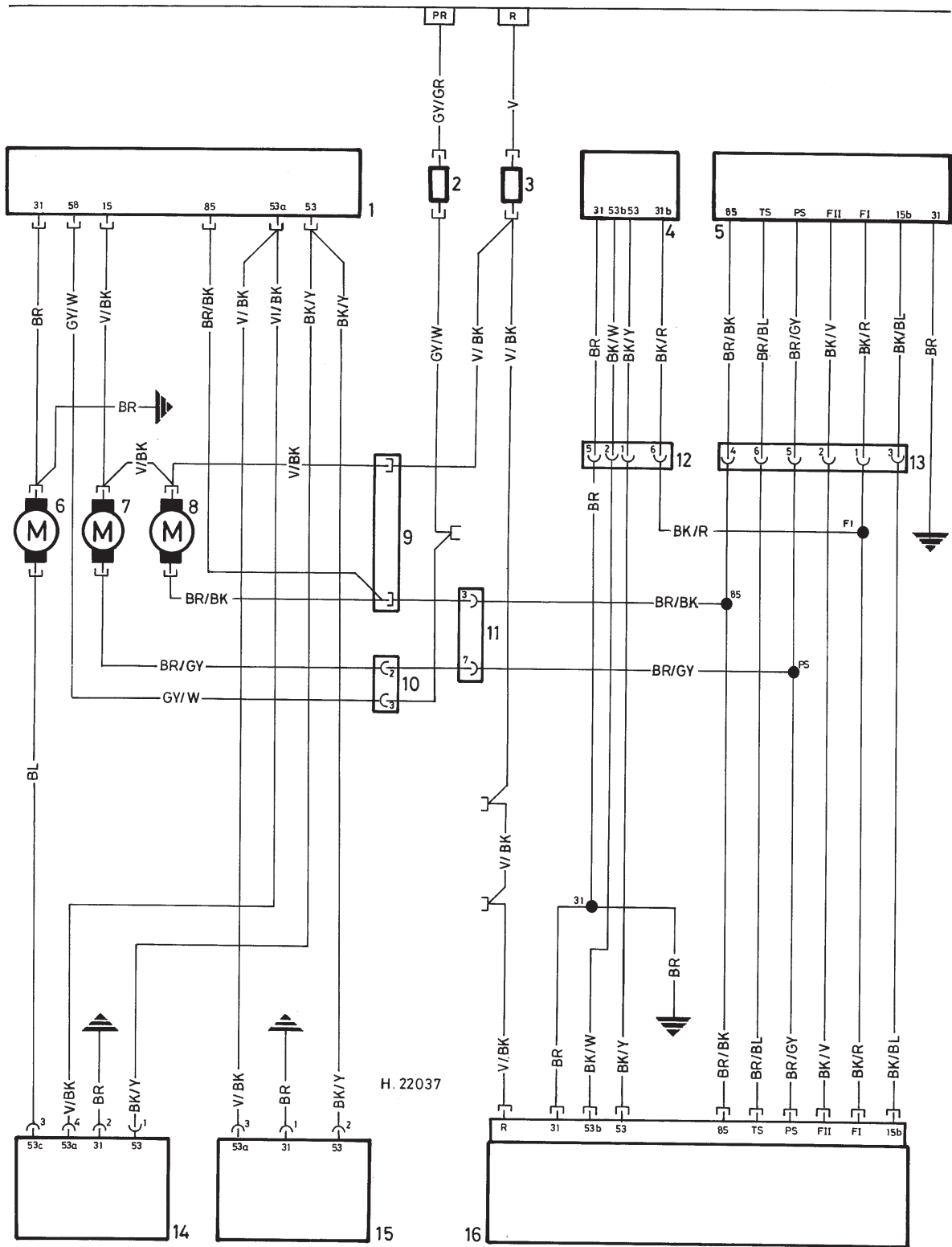
No	Description	No	Description
1	Electronic Control Unit (ECU)	18	Distributor
2	Speed control relay	19	Ignition coil
3	Temperature switch	20	Starter
4	Air conditioner	21	Alternator
5	Car wire harness connection	22	Position transmitter
6	Throttle switch	23	Plug disconnected for automatic transmission
7	Airflow sensor	24	Coolant temperature sensor
8	Speed sensor	25	Fuel injector
9	Reference mark sensor	26	Solenoid
10	Relay 1	27	Electric power distributor
11	Relay 2	28	Oil pressure
12	Oil pressure switch	29	Temperature gauge
13	Temperature transmitter	30	Electric fuel pump
14	Diagnosis connection	31	Service indicator
15	Engine plug	32	Drive motor
16	Battery	33	Temperature switch
17	Spark plugs		

Key to cruise control system wiring diagram

No	Description
1	Plug connection – centre section to instrument cluster (26-pin)
2	Steering column switch
3	Instrument cluster
4	Plug connection – range indicator
5	Range indicator D
6	Range indicator N
7	Range indicator R
8	Plug connection – speedometer outlet
9	Connection – instrument cluster (2-pin)
10	Plug connection – steering column switch
11	Plug connection – special equipment
12	Steering column switch
13	Plug connection – rear section to centre section (29-pin)
14	Stoplight switch
15	Plug connection – drive motor
16	Connection – clutch switch to bridge
17	Stoplight left
18	Stoplight right
19	Electronic control – cruise control
20	Drive motor – cruise control
21	Bridge (only for automatic transmission)
22	Clutch switch

Key to wiring diagram for the central locking, burglar alarm, on-board computer, additional heater and digital clock

No	Description	No	Description
1	Plug – rear section to centre section	45	Diode
2	Connection for special equipment plug	46	Plug – burglar alarm wire to central lock connecting wire
3	Connection for central lock control unit	47	Chime (left of steering column)
4	Central lock electronic control unit (A pillar end plate)	48	Connection for chime
5	Plug – driver's door wire to rear section	49	Plug – centre section to LE-Jetronic wire harness
6	Plug – central lock connecting wire to driver's door wire (13-pin)	50	Ignition switch
7	Plug – central lock connecting wire to passenger's door wire	51	Remote control switch for on-board computer
8	Plug – driver's door central lock wire to switch	52	Plug – on-board computer to outside temperature sensor wire
9	Central lock switch/unlocking arrest (driver's door, on lock)	53	Plug – outside temperature sensor wire to outside temperature sensor
10	Connection for central lock motor to driver's door (6-pin)	54	Outside temperature sensor (lower front panel)
11	Central lock motor – driver's door	55	Plug – extra heater wire to automatic aerial
12	Plug – passenger's door wire to microswitch	56	Parked car heating electronic control unit (on parked car heater underneath right seat)
13	Microswitch (passenger's door, on lock)	57	Connection for electronic control unit
14	Central lock motor – passenger's door	58	Relay for parked car heater (on heater)
15	Central lock motor – passenger's door	59	Plug – on-board computer wire to extra heater wire
16	Connection for central lock motor to boot lid (6-pin)	60	Plug – centre section to instrument cluster
17	Central lock motor – boot lid	61	Connection for instrument cluster
18	Connection for central lock motor to fuel filler flap (6-pin)	62	On-board computer electronic control unit (right of instrument cluster)
19	Central lock motor – fuel filler flap	63	Connection for on-board computer
20	Connection for central lock motor to left rear door (6-pin)	64	Connection for instrument cluster II
21	Central lock motor – left rear door	65	Instrument cluster
22	Connection for central lock motor to right door (6-pin)	66	Plug – rear section to instrument cluster
23	Plug – central lock connecting wire to right rear door (7-pin)	67	Plug – digital clock wire to instrument cluster
24	Plug – central lock connecting wire to left rear door (7-pin)	68	Plug – extra wire to heater wire
25	Central lock motor – right rear door	69	Plug – heater wire to fuel pump wire
26	Rear window heater switch	70	Connection for heater
27	Burglar alarm electronic control unit (left of steering column)	71	Ballast resistor in heater
28	Connection for burglar alarm electronic control unit I (26-pin)	72	Thermoswitch (parked car heater)
29	Connection for relay box (4-pin)	73	Heater motor
30	Connection for burglar alarm electronic control unit II (4-pin)	74	Overheating switch (parked car heater)
31	Plug 150 (in main wire harness)	75	Heater plug for parked car heater
32	Light diode for burglar alarm	76	Heater
33	Plug for boot light	77	Fuel pump
34	Boot light	78	Plug – on-board computer to remote control
35	Door contact switch front left	79	Plug – speed dependent loudness control
36	Door contact switch front right	80	Plug – wire for cruise control
37	Door contact switch rear left	81	Fuel level transmitter
38	Door contact switch rear right	82	Speed transmitter
39	Boot lid contact	83	Plug – digital clock wire to digital clock (4-pin)
40	Bonnet contact	84	Plug – digital clock wire to digital clock (2-pin)
41	Rear window heater	85	Digital clock
42	Plug – centre section to wire for on-board computer/burglar alarm		
43	Horn		
44	Plug for light diode		



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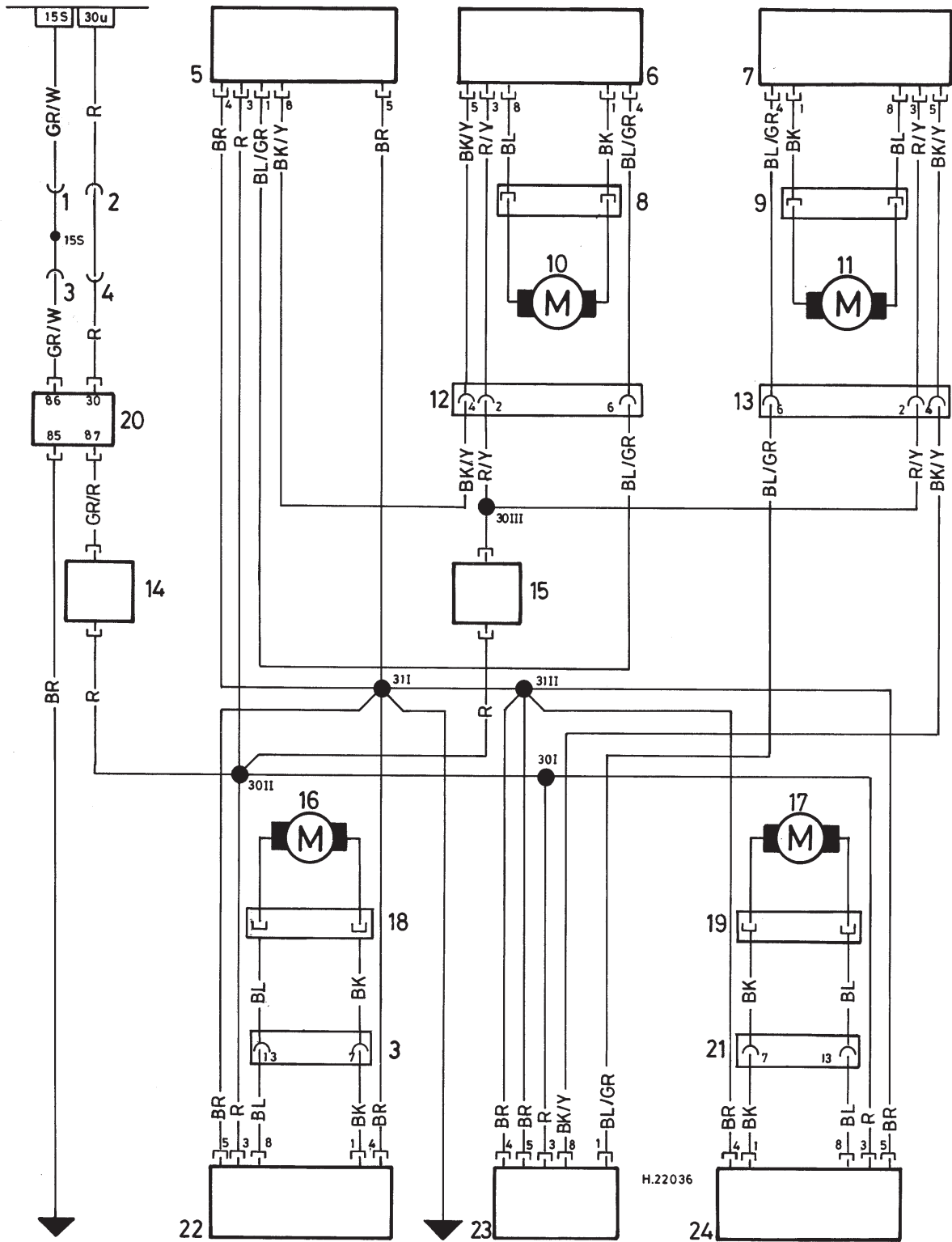
Typical headlight washer system wiring diagram

Key to headlight washer system wiring diagram

No	Description
1	Control unit for headlight cleaners (on fluid reservoir)
2	Fuse – overnight, tail and parking lights
3	Fuse – horns, wash/wipe control unit and headlight cleaners
4	Motor – windscreen wipers
5	Wiper switch
6	Pump – headlight cleaning system
7	Pump – intensive cleaning fluid
8	Pump – windscreen washing system
9	Plug – headlight cleaner wire to front section I (washer fluid pump)
10	Plug – Headlight cleaner wire to front section II (plug for headlight cleaners)
11	Plug – centre section to front section (7-pin)
12	Plug for wiper motor
13	Plug – centre section to wiper switch
14	Motor – windscreen wipers
15	Motor – left headlight wiper
16	Wash/wipe interval control unit

Key to electric window system wiring diagram

No	Description
1	Plug for rear section to driver's door (6-pin)
2	Plug for rear section to center section (27-pin)
3	Plug for window control and central lock wire to driver's door (13-pin)
4	Plug for window control and central lock wire to special equipment plug
5	Window switch rear left
6	Window switch rear left
7	Window switch rear right
8	Plug for left rear door wire to window motor rear left
9	Plug for right door wire to window motor rear right
10	Window motor rear left
11	Window motor rear right
12	Plug for window control and central lock wire to left rear door
13	Plug for window control and central lock wire to right rear door (7-pin)
14	Power safety switch
15	Child safety switch
16	Window motor front left
17	Window motor front right
18	Plug for driver's door wire to window motor front left
19	Plug for passenger's door wire to window motor of passenger's door
20	Relay
21	Plug for window control and central lock wire to passenger's door (13-pin)
22	Window switch front left
23	Window switch rear right
24	Window switch front right



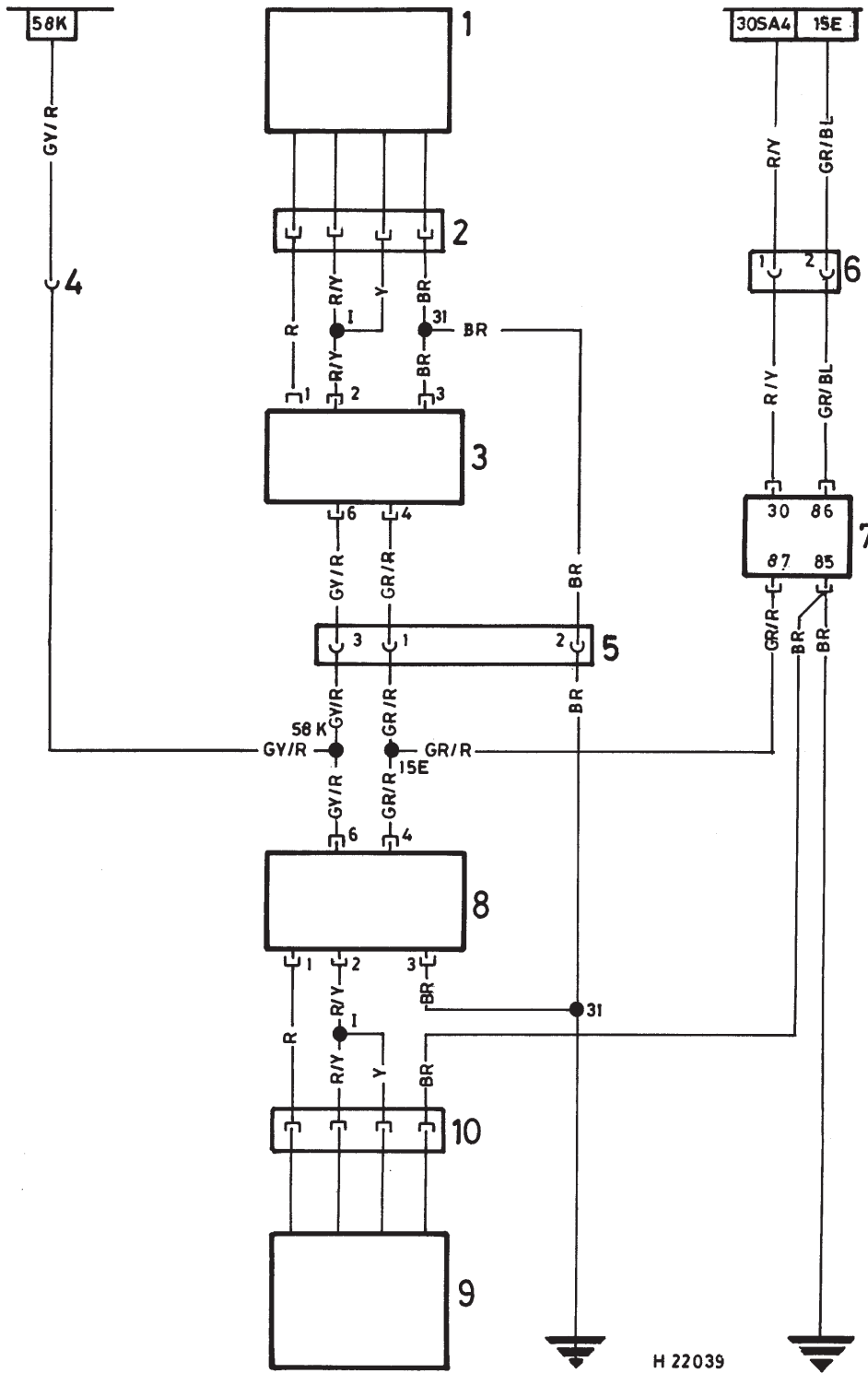
Typical electric window system wiring diagram

Key to air conditioning system wiring diagram

No	Description
1	Light for heater controls
2	Light diode III
3	Light diode II
4	Light diode I
5	Switch – heater/evaporator blower
6	Plug – heater control wire harness to centre wire harness (13-pin)
7	Plug – front wire harness section to heater controls
8	Fuse – heater blower
9	Fuse – extra fan stage II
10	Fuse – ind. lamp, reversing lights, tachometer and mirrors (power distributor)
11	Temperature switch 91°C – stage I
12	Temperature switch 99°C – stage II
13	Switch – air conditioner
14	Water valve
15	Evaporator temperature regulator
16	Air conditioner control unit (heater controls)
17	Plug – extra fan motor (on extra fan motor)
18	Relay – extra fan stage II (on power distributor)
19	Relay – extra fan stage I (on power distributor)
20	Switch – high pressure pressostat (drier)
21	Switch – temperature 110°C (only for 524 td)
22	Motor – heater blower
23	Motor – evaporator blower
24	Plug – high pressure pressostat to electromagnetic coupling
25	Evaporator temperature sensor (in evaporator)
26	Heater temperature sensor (in heater)
27	Inside temperature sensor (lower trim panel left)
28	Electromagnetic coupling for compressor
29	Motor – extra fan

Key to wiring diagram for heated seats

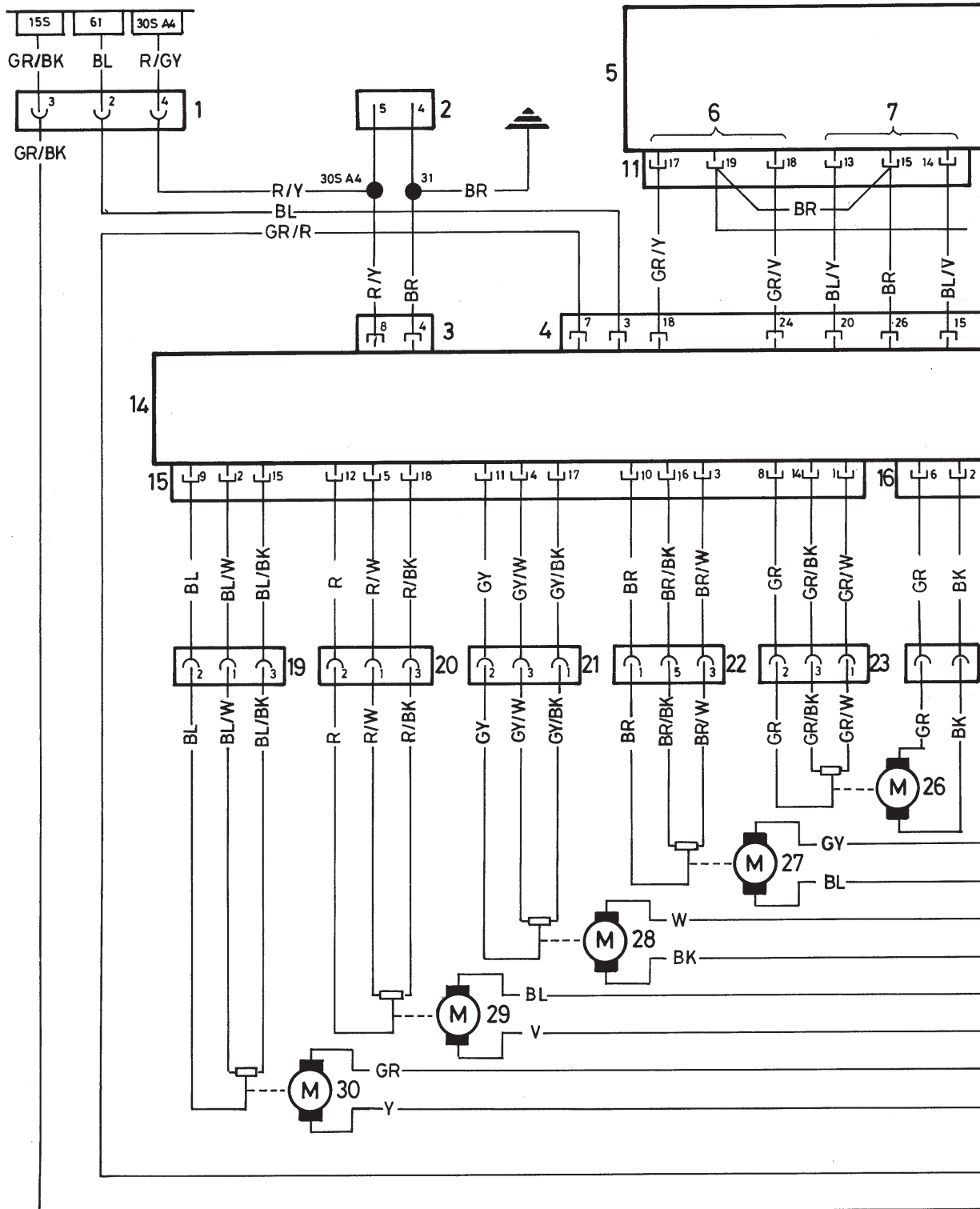
No	Description
1	Heating – passenger's seat
2	Seat heating connection – passenger's side
3	Seat heating switch – passenger's side
4	Plug for heated seat wire (driver's side) to special equipment plug (58K)
5	Plug for heated seat wire (driver's side) to passenger's side
6	Plug for heated seat wire (driver's side) to special equipment plug (15E and 30SA4)
7	Seat heating relay
8	Seat heating switch – driver's side
9	Heating – driver's seat
10	Seat heating connection – driver's side



Typical heated seats wiring diagram

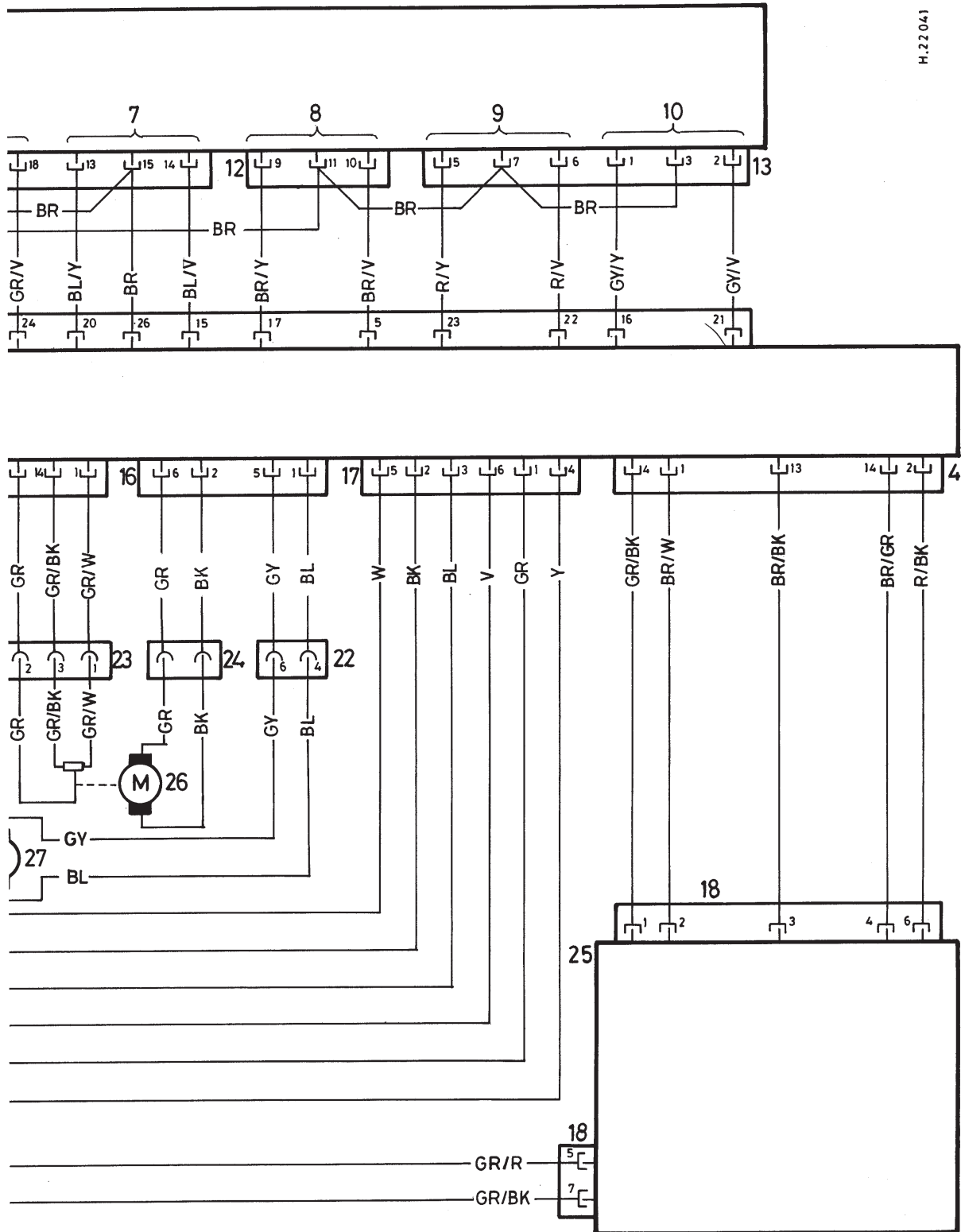
Key to wiring diagram for memory power seats

No	Description
1	Plug connection for special equipment plug
2	Plug connection of wire for passenger's seat
3	Plug connection of wire for seat control with memory
4	Connection of wire for seat control with memory
5	Seat control switch
6	Backrest
7	Slide
8	Headrest
9	Height front
10	Height rear
11	Plug connection for seat backrest/slide control
12	Plug connection for seat headrest control
13	Plug connection for seat height control
14	Electronic control unit (underneath seat)
15	Plug connection of wire for seat control with memory
16	Plug connection of wire for seat with memory
17	Plug connection for seat control drive
18	Plug connection for memory switch
19	Plug connection for slide potentiometer
20	Plug connection for front height potentiometer
21	Plug connection for rear height potentiometer
22	Plug connection for headrest motor
23	Plug connection for backrest potentiometer
24	Plug connection for backrest motor
25	Memory switch
26	Motor – seat backrest control
27	Motor – headrest control
28	Motor – height control rear
29	Motor – height control front
30	Motor – slide

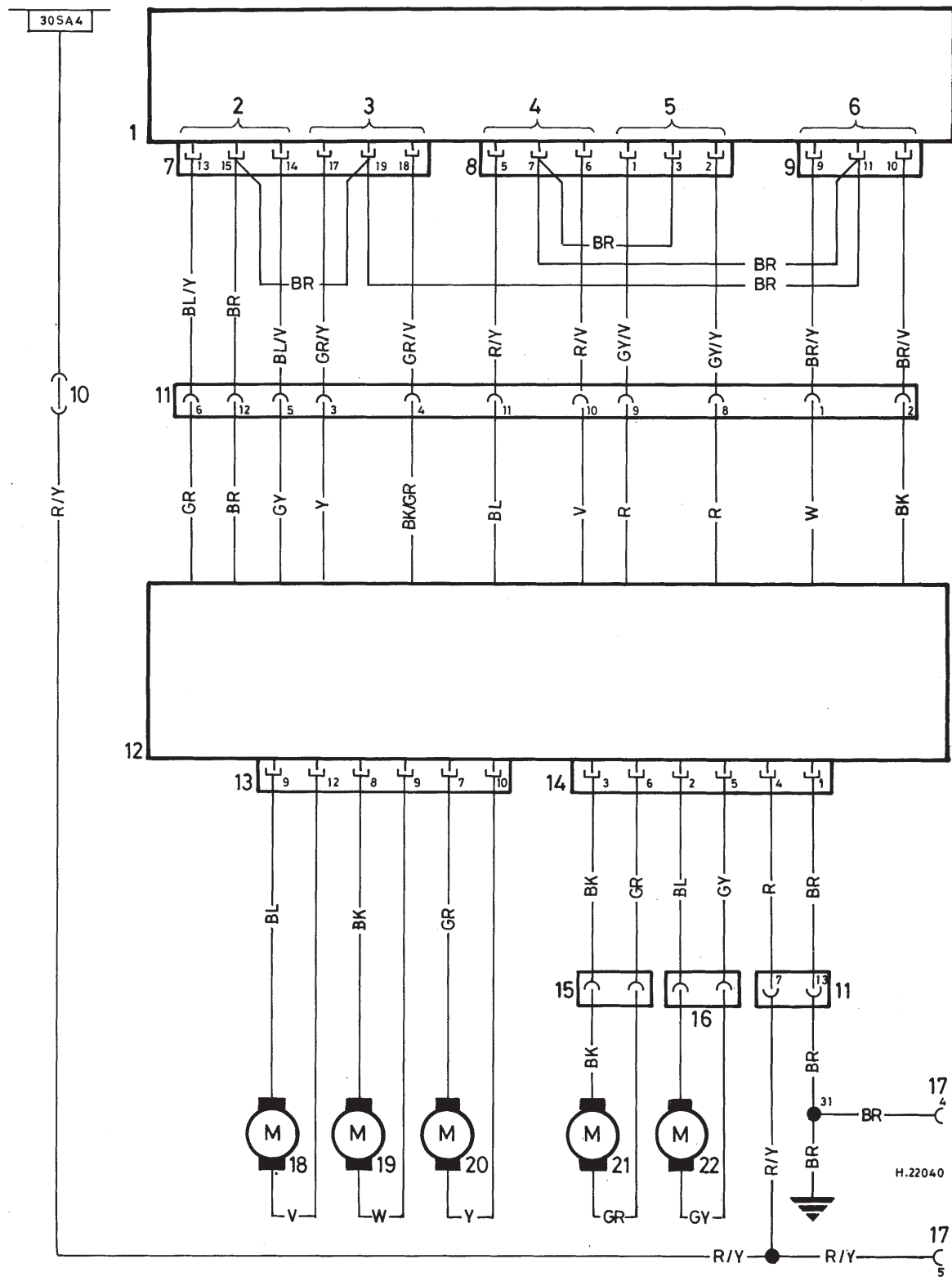


Typical wiring diagram for power seats with memory (1 of 2)

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Typical wiring diagram for power seats with memory (2 of 2)



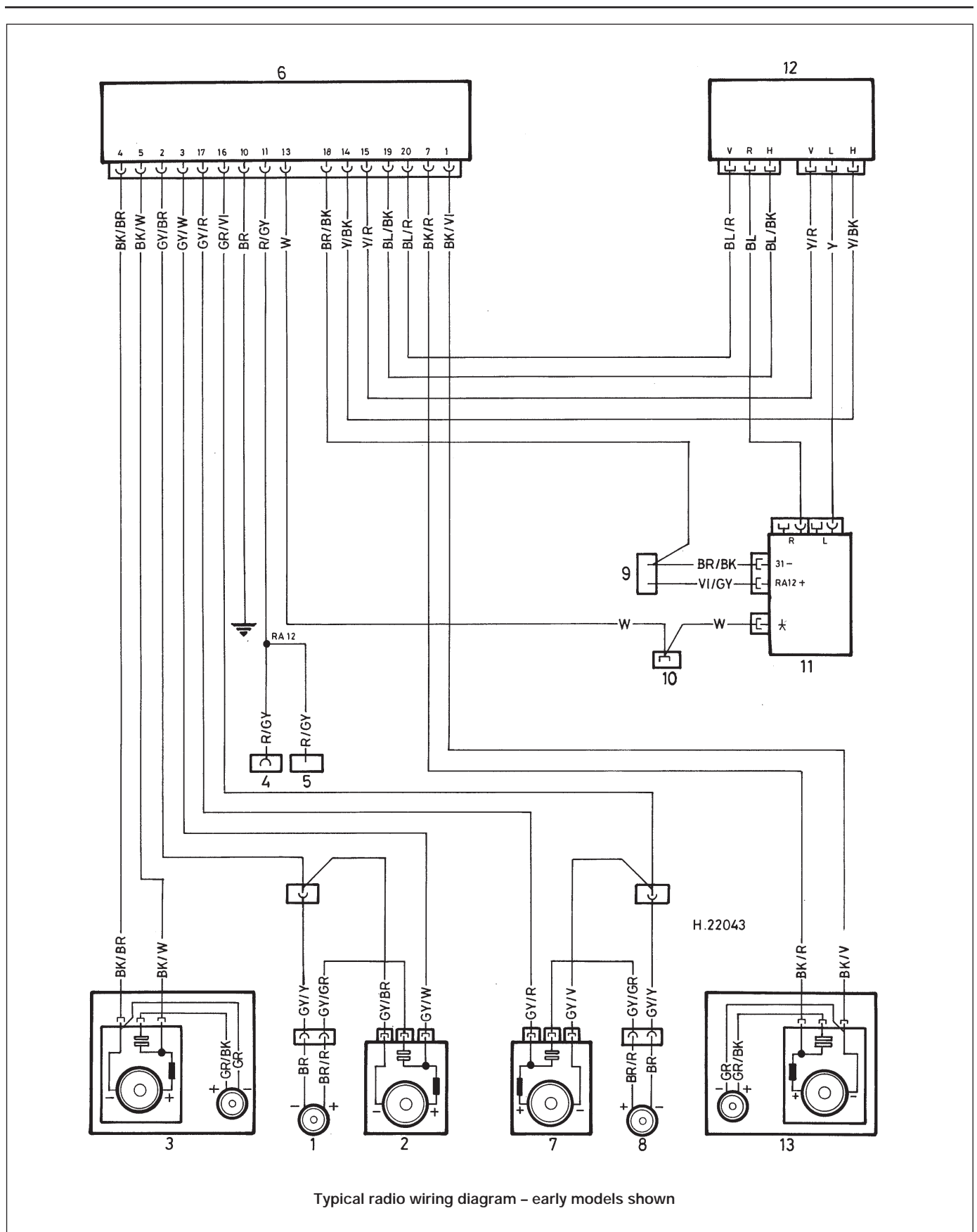
Typical wiring diagram for power seats without memory

Key to wiring diagram for power seats without memory

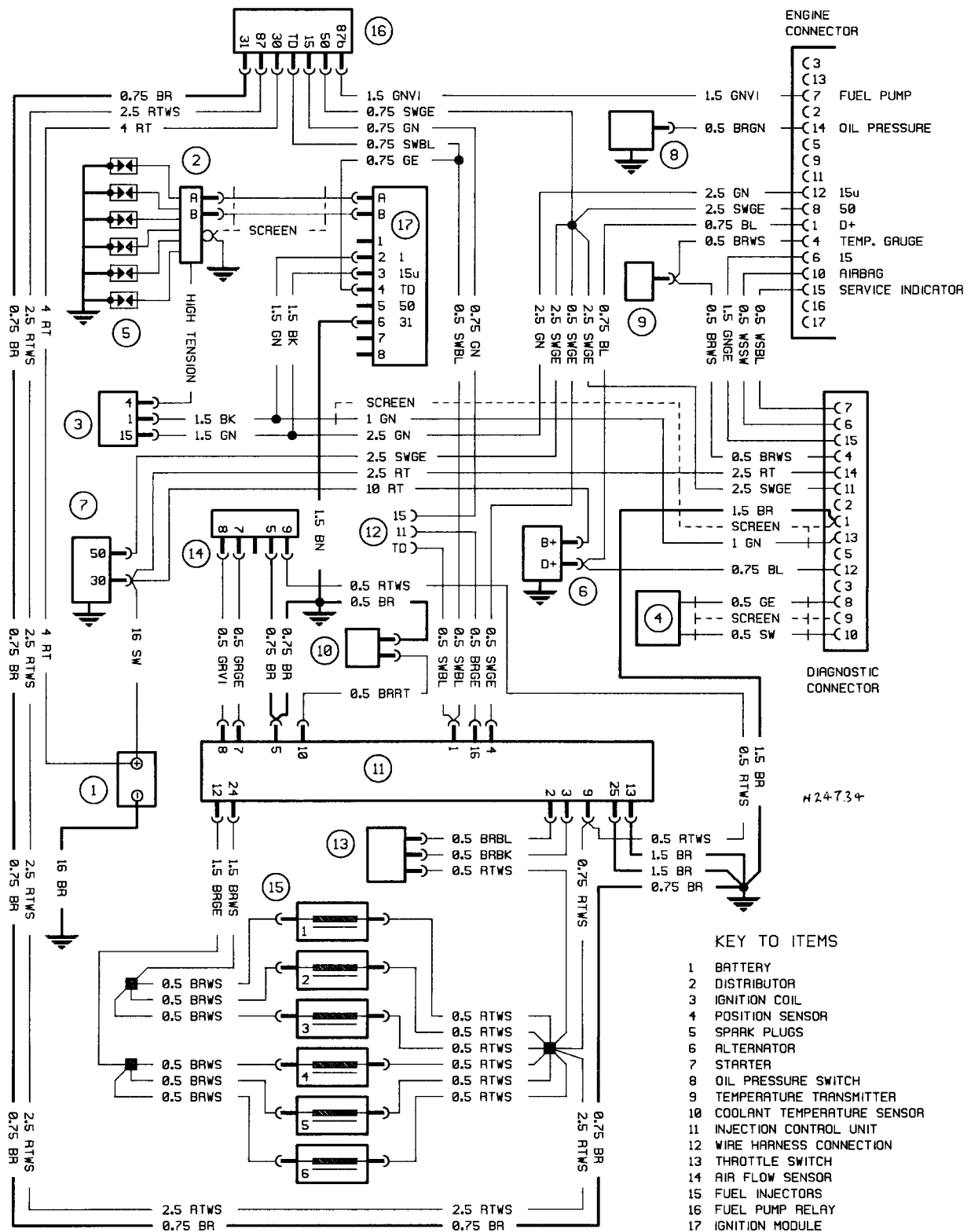
No	Description
1	Plug connection with special equipment plug
2	Backrest
3	Seat forward/backward
4	Headrest
5	Seat up/down front
6	Seat up/down rear
7	Plug – switch for backrest/seat control
8	Plug – switch for headrest control
9	Plug – switch for front/rear seat up/down control
10	Switch for power seats
11	Plug – power seat wire to power seat electronic control unit
12	Electronic control unit for power seats (below seats)
13	Plug – power seat drive to power seat electronic control unit
14	Plug – power backrest and headrest wire to power seat electronic control unit
15	Plug – power backrest and headrest wire to backrest motor
16	Plug – power backrest and headrest wire to the headrest motor
17	Plug – power seat wire on driver's side to wire on passenger's side
18	Motor – seat up/down front
19	Motor – seat up/down rear
20	Motor – seat forward/backward
21	Motor – backrest
22	Motor – headrest

Key to radio wiring diagram

No	Description
1	Speaker door right
2	Speaker front right
3	Speaker rear right
4	Special equipment plug RA12
5	Connection for power windows
6	Amplifier
7	Speaker front left
8	Speaker door left
9	Connection for power supply lead
10	Connection for power aerial
11	Radio
12	Speaker balance control
13	Speaker rear left



Typical radio wiring diagram - early models shown



Typical L-Jetronic system wiring diagram