

SECTION 14**7600 Electric/Electronic system**

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ABBREVIATIONS AND GRAPHIC SYMBOLS



Indicates a general warning

A

Ampere

kW

KiloWatt

NB

Note Well

m2

Identification of an earth point

IWT

IVECO Wiring Tester

V

Volt

Ω

Ohm



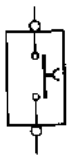
Connection to a power earth point



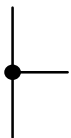
Connection to a signal earth point

72030_{3C}

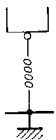
Code of connector between cables:
72030 = connector code
3C = cell identification co-ordinates



Base equipment



Base electrical connection



Connection to earth by cable

II₆

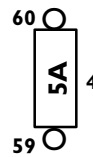
Connector between cables:
II = connector number
6 = cell number

7777

Cable colour code



Consult



Reed fuse on control box
4 = fuse number
5A = capacity
59-60 = terminal identification



Electronic component or control unit



Optional equipment



Optional electrical connection in a
base circuit chart

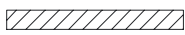


Connection to earth through metal
agglomerate

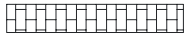
Cables symbol



No protection



Protection with continuous PVC tape



Protection with 30 mm spiral PVC tape



The symbol identifies a knot

GENERAL CONDITIONS FOR LAYING ELECTRIC CIRCUITS

- ☐ Engine off
- ☐ Ignition switch off
- ☐ Handbrake engaged
- ☐ Neutral gear
- ☐ Fluids at normal level

GENERAL WARNINGS



Do not ever disconnect the system batteries and do not open the general current switch with the i.c. engine running. Do not start the engine without first connecting the batteries in a permanent manner.

- ☐ Before doing any work on the vehicle chock the wheels appropriately.
- ☐ Do not use quick chargers to start the engine. Starting must only be carried out with separate batteries or with the special trolley.
- ☐ Make sure that the polarity on the battery terminals is correct when starting from an auxiliary trolley.
- ☐ The incorrect polarisation of the power voltage of electronic control units (for example incorrect polarisation of the batteries) may lead to their destruction.
- ☐ When needing to disconnect the battery from the system, firstly always disconnect the battery negative cable that goes to the engine from the negative terminal of the battery itself.
- ☐ Before connecting the battery to the system, make sure that it is well insulated.
- ☐ When seeking faults, insert a wander fuse between the battery negative terminal and the engine earth cable.
- ☐ Before removing any electrical and/or electronic components, disconnect the ground cable from the negative terminal of the battery.
- ☐ Disconnect the battery from the system when charging it with external equipment.
- ☐ Disconnect the external charging equipment from the mains before removing its grippers from the terminals of the battery.
- ☐ Do not insert or remove the connector of electronic control units with the power on.
- ☐ With temperatures above 80 °°C (drying ovens) remove the electronic control units
- ☐ During electric welding work disconnect the connectors of electronic control units.
- ☐ During connection, tighten the nuts of the connectors (temperature, pressure sensors, etc.) only with the specified tightening torque.



Key storing procedures are affected by electromagnetic noise (mobile phones, etc.). Therefore, during key storing:

1. Pay attention that there are no noise sources in the cab or near keys.
2. Keys not inserted in panel must be at least at 1 metre distance.



Measurements in electronic control units, plug connections and electric connections to components may be carried out only on appropriate testing lines, with special plugs and sockets. Never use improper means such as metal wires, screwdrivers, clips or the like. In addition to the danger of a short circuit, damage to the plug connectors may also result and this would subsequently cause contact problems.

TECHNICAL CODES

03000	Self-rectifying alternator with built in voltage regulator
08000	Starter motor
12006	Motor for adjustable mirrors
12010	Motor for locking right door
12011	Motor for locking left door
12012	Compressor for air conditioning system
12025	Power takeoff motor
12026	Motor, winch control
12027	Motor for opening or closing left side door lock
19005	Thermal starter
19010	Heater plug
20000	Starter battery
22001	Horn
22039	Bell for parking lights on signal
25003	Relay for switching on fog lights
25006	Brake lights relay
25014	Relay for enablement of parking lights with engine off
25023	Relay for disconnection of low beam lights with parking lights on
25104	Relay for switching off Retarder with ABS engaged
25209	Relay for switching off services during starting
25222	Relay for allowing connection of thermal starter
25223	Relay for allowing connection of thermal starter fuel tank with atmosphere
25307	Relay for controlling air conditioning compressor
25336	Relay for engine cooling electromagnetic joint
25337	Relay for disconnecting air-conditioning system compressor
25340	Relay, compressor operation, signal to EDC
25620	Relay for fuel filter clogged signal
25704	Relay for switching NC/NO signal for third steering axle
25705	Relay for enabling point switching on
25810	Relay for controlling diesel heating circuit
25811	Ignition timer relay (KSB)
25818	Relay for switching on heated windscreen
25837	Relay for connection of fuel pump
25858	Relay for EDC connection
25926	Relay for enablement of suspension lifting and stopping of suspension lowering function
25927	Relay for enablement of suspension lowering and stopping of suspension lifting function
25928	Relay, rear window heating
28002	Engine stopping electromagnet
30003	Multifunctional side headlight
30011	Fog light
32002	Front direction indicator
33001	Side direction indicator
33004	Side marker lamp
34000	Multifunctional rear light
34007	Stop light
34009	Rear fog lamp
35000	Number plate light
37001	Front dimensions light
39020	Ashtray light
39022	Courtesy light for cabin interior with adjustable spot light

39025	Lamp for lighting rear hatch
39026	Lamp for lighting side hatch
40011	Electronic tachograph
40030	Sender unit for electronic tachometer
40031	Sender unit for electronic tachograph
40046	Inductive type chassis height sensor (rear axle)
42035	Absolute pressure sensor
42102	Switch signalling handbrake applied
42350	Switch signalling body tilted
42351	Switch signalling air filter blocked
42354	Switch for air suspension system failure
42374	EDC clutch switch
42550	Switch signalling engine oil pressure
42552	Fuel filter clogged indicator switch
42608	Coolant pressure signalling 3-switch assembly
44031	Sender unit, fuel level indicator with w/lamp contact
44033	Insufficient brake fluid level gauge control
44036	Insufficient radiator coolant level gauge control
44037	Insufficient power assisted steering fluid level gauge control
44044	Engine oil low level indicator control
47034	Engine coolant temperature sensor (EGR)
47035	Engine coolant temperature sensor
47104	Switch for engaging engine cooling electromagnet coupling
47106	Switch for engaging diesel fuel heating
47109	Switch for connection of ignition timer (KSB)
47207	Switch/sender unit, engine water temperature indicator
48035	Engine rpm sensor
48042	Engine rpm sensor (on timing gear)
52005	Switch with built in w/l for heated rear view mirrors
52036	Switch with built in w/l for engaging windscreen heater
52082	Switch with built-in w/lamp, fog lights
52083	Switch with built-in w/lamp, hazard lights
52084	Switch with incorporated warning light for switching on rear differential lock
52090	Suspension levelling switch (ECAS)
52091	Switch with incorporated warning light for switching on rearscreen heating
52093	Switch for tail hatch locking safety
52310	Switch for adjustable mirrors
52312	Switch controlling headlamp alignment adjustment
52502	Ignition switch for services with starting
53004	Switch for headlamp washer
53041	Switch for checking EDC system
53051	Suspension lifting switch
53052	Suspension lowering switch
53300	Switch for driver's side electric window
53302	Switch for passenger side electric window
53501	Switch signalling vehicle stopped
53503	Switch signalling reversing lights
53505	Rear differential lock engaged indicator switch
53509	Switch for switching on interior lights
53565	Switch for signalling brake pedal fully pressed
53590	Switch for bonnet open signal

54032	8 function steering column switch unit
58700	Led, battery charging failure
58701	Led, EDC failure
58702	Led, preheating on
58703	Led, ABS failure
58709	Trailer direction indicators ON LED
58710	Water in fuel pre-filter indicator LED
58713	Led, ECAS system failure
58715	Total power take off (PTO) ON indicator LED
58717	Led, Immobilizer on
58718	Brake system failure warning led
58719	Led per segnalazione freno a mano inserito
58720	Led, radiator water level
58722	Led, engine oil pressure (low)
58725	Led, air cleaner restriction
58728	Power steering fluid level w/lamp
58730	Engine oil level w/lamp
58735	Led for indicating rear differential lock on
58918	32-optical indicator panel
61002	3 diode holder container 3A (with + common)
61101	Diesel fuel heater resistor
61102	Rheostat for antipollution device (EGR)
61103	Variable resistance for ignition timer control (KSB)
61106	Windscreen heater resistor
61124	Resistance for rearscreen heating
64000	Electric windscreen washer pump
65000	Windscreen wiper unit
66005	Headlamp washer pump
66010	Headlamp washer timer
68000	Radio equipment
68001	Speaker
72016	13-pole coupling for 12V connection to trailer
72027	38-pole coupling for connection with IVECO
78000	Solenoid valve for connection with atmosphere from fuel tank for thermal starters
78013	Pressure regulator solenoid valve
78015	Solenoid valve to cut out third pumping element
78208	Transmission total power take-off solenoid valve
78209	Solenoid valve for antipollution devices (EGR)
78233	Vehicle raising solenoid valve assembly
78247	Solenoid valve for electronic injection
78248	Solenoid valve for variable geometry turbine order
80000	Motor for right electric window
80001	Motor for left electric window
82000	Windscreen defrosting control unit
82010	Joint between cab-bonnet cable and climate control cable
84020	Outdoor temperature sensor
85000	Cigar lighter
85005	Electrically adjustable heated rear view mirror
85022	Engine cooling electromagnet coupling
85028	Locking device for rear differential
85036	Heated air-suspended seat (driver's side)
85038	Heated air-suspended seat (driver's opposite side)

85130	Immobilizer
85131	Volumetric sensor
85132	Antitheft device self-supplying syren
85150	4-channel methane control unit
85151	EDC injection pump
85152	Accelerator load sensor (EDC)
85156	Turbofan air pressure temperature sensor, (EDC)
85157	Pressure adjustment sensor
86002	Sensors for front brake shoe wear
86003	Sensors for rear brake shoe wear
86011	Electronic control unit, pre/after-heating system
86012	Electronic control unit for signalling water in fuel filter
86013	Sensor, water in fuel filter
86020	Antipollution device control unit (EGR)
86023	Vehicle raising/lowering control unit
86029	Electronic control unit for central door locking
86046	Electronic control unit for trailer lights control
86047	Electronic control unit for switching on total power takeoff
86060	Airbag control unit
86061	Air bag
86062	Pretightener
88000	ABS system electronic control unit
88001	ABS system sensor

POWER NETWORK

General



Never disconnect the battery from the system with the engine running.
When needing to disconnect the battery from the system, always firstly disconnect the earth cable on the engine from the battery negative terminal.
Before connecting the battery to the system, make sure that the system is well insulated.
Disconnect the battery from the system when charging it.

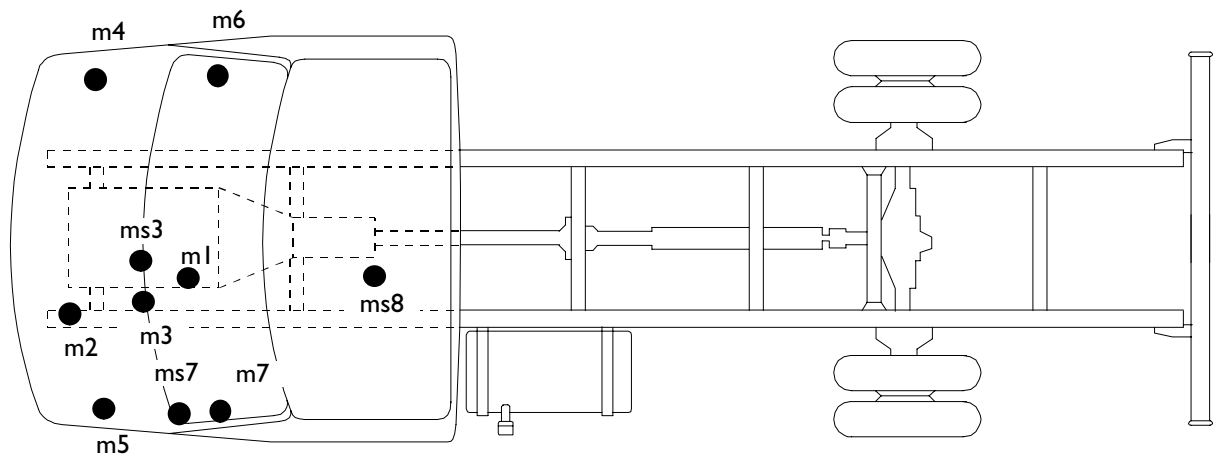
The purpose of the electric system is to generate, regulate, store and distribute the energy needed to make the vehicle components work.

For this reason the supply of the base electric system is ensured by a generator (14V, 50 – 110A alternator) and a 12 V, 110 Ah battery.

The battery is located in a special compartment on the left front side of the bonnet.

Figure 1

Earth points



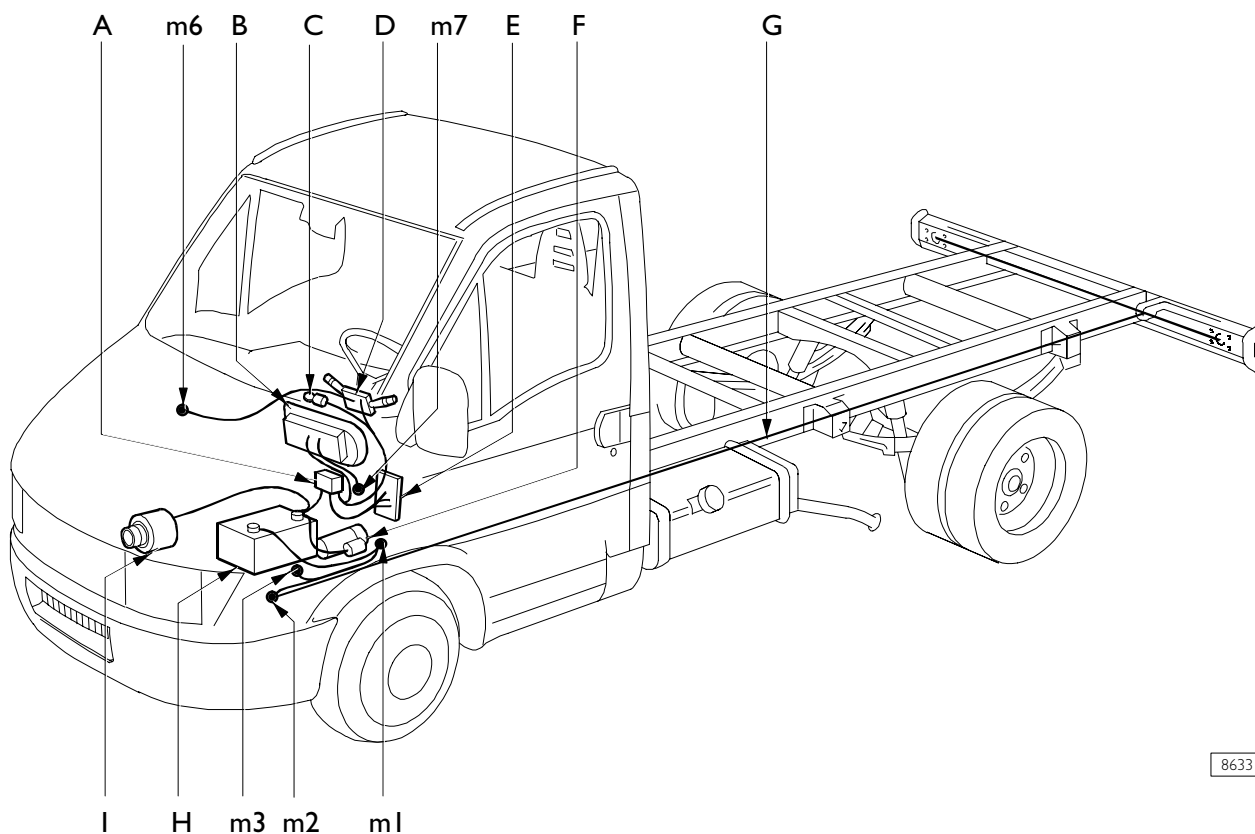
7389

EARTH POINTS

m1. Engine earth – m2. Frame earth – m3. Bonnet power earth – ms3. Bonnet signal earth – m4. Bonnet right side earth
m5. Bonnet left side earth – m6. m7. Cab inside earths – ms7. Cab inside signal earth – ms8. Air bag signal earth

Power network assembly

Figure 2

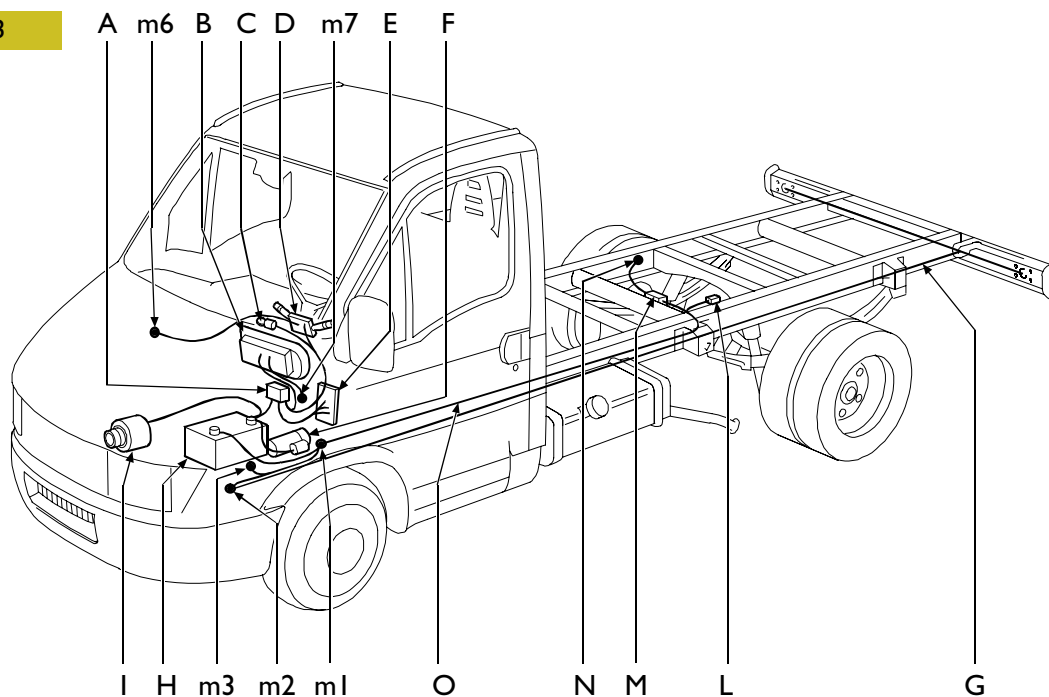


8633

POWER NETWORK ASSEMBLY

A. Control box – B. Instrument cluster with warning lights – C. Ignition switch – D. Stalk unit – E. Relay/fuse holder Support – F. Starter motor – G. Earth cables of frame and tail lighting components – H. Battery – I. Alternator

Figure 3



73720

POWER NETWORK ASSEMBLY WITH TELMA SPEED LIMITER

A. Control box – B. Instrument cluster with warning lights – C. Ignition switch – D. Stalk unit – E. Relay/fuse holder Support – F. Starter motor – G. Earth cables of frame and tail lighting components – H. Battery – I. Alternator – L. Relays – M. Electromagnets – N. Ground point – O. Ground cable for Telma speed limiter

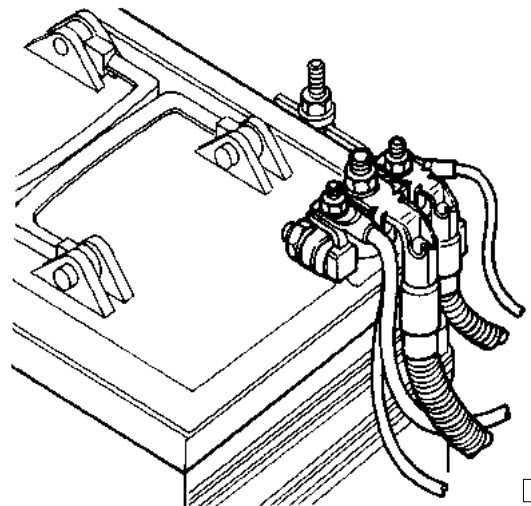
Positive network

The battery positive terminal is connected through a 50 mm² cable to terminal 30 of the starter motor. Two 16 mm² and one 6 mm² cables are also connected to the battery positive terminal cable. The first two cables are connected to alternator and interconnection central unit, while the other cable feeds 60A fuse for pre-heating glow plugs central unit.

At the terminal of the battery positive cable in vehicles with ABS a 6 mm² cable connects the 40A fuse that supplies the ABS electronic control unit.

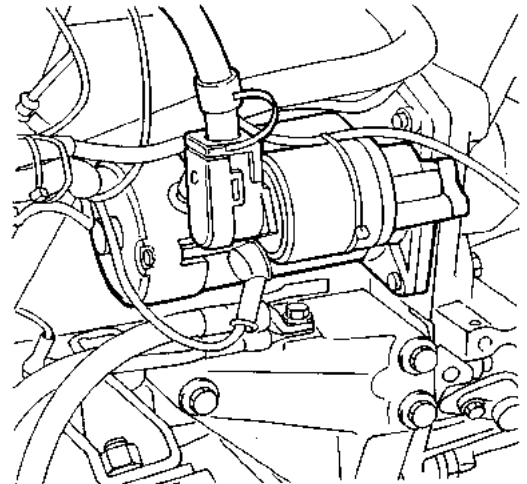
In the vehicles that are provided with a cab/bonnet cable preset for various options, a 4 mm² cable is also connected to battery positive cable pin; via ultrasound weld, it feeds key switch, 38-pole diagnosis connector and instrument panel with warning indicators.

Figure 4



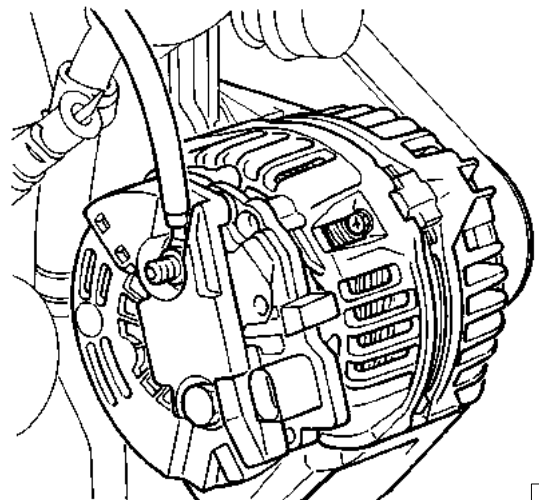
CONNECTIONS TO BATTERY POSITIVE TERMINAL

Figure 5



CONNECTION OF STARTER MOTOR TERMINAL 30 TO BATTERY POSITIVE TERMINAL

Figure 6



POSITIVE NETWORK CONECTION TO ALTERNATOR

Figure 7

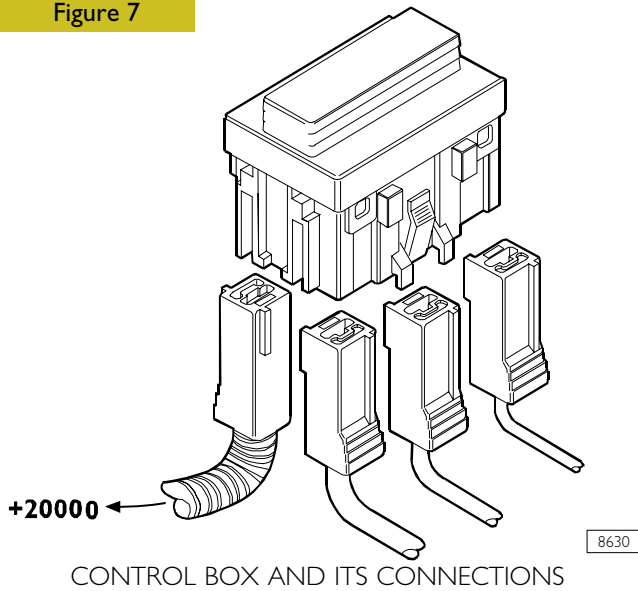


Figure 8

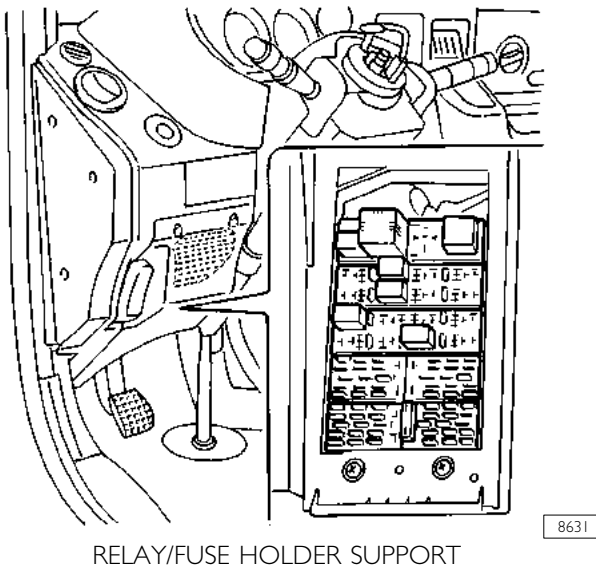
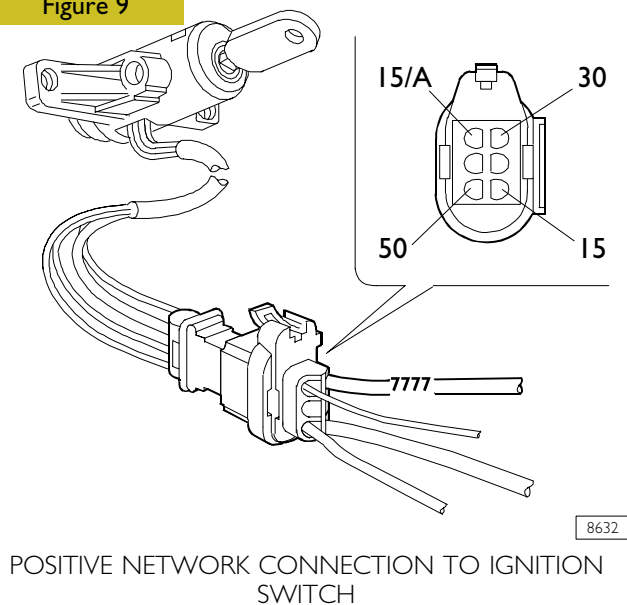


Figure 9



In the immediate vicinity of the battery, there is the control box; this has the task of providing the battery + supply, through internal bridges to the different electric functions of the vehicle.

A 6 mm² cable and a 10 mm² cable are connected to it; through ultrasonic welds they supply certain components and part of the fuses and relays located on the support on the lower left part of the dashboard.

In particular, the components and electric functions supplied by the 6 mm² cable are:

- ☐ interior lighting, radio-receiver, cigar lighter
- ☐ services cut-off relay during starting
- ☐ headlamp washer
- ☐ 13-pin current socket
- ☐ socket for converter

The 10 mm² cable supplies:

- ☐ ignition switch (base vehicle)
- ☐ stalk unit (exterior lights and hazard warning)
- ☐ stop lights
- ☐ horns
- ☐ EDC switching on relay
- ☐ instrument cluster with warning lights
- ☐ modus diagnostics enable relay
- ☐ heated fuel filter
- ☐ climate control system
- ☐ door locking

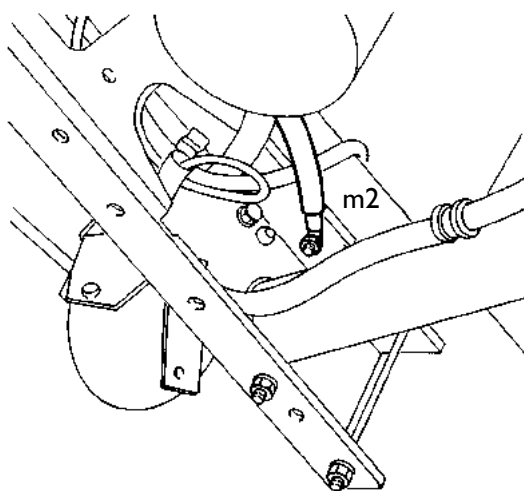
Lastly, a 2.5 mm² cable can be connected to the control box which supplies fuse 33 (20A), where applicable, of the relay/fuse holder support relating to the additional heater control unit.

Negative network

The battery negative terminal is connected to with a brown 50 mm² cable to the earth point **m1** to be found on the left-hand side of the crankcase, next to the starter motor. From this point, two copper braids are connected to earth points **m2** on the front of the left sidemember and **m3**, on the bonnet under the vacuum servobrake. At m3 the wirings concerning the frame and engine are connected. Near m3, there is another earth point, called **ms3** which, through a 2.5 mm² cable performs the signal earth function for the ABS electronic control unit.

A 6 mm² cable also connects the battery cable pin to the ultrasound weld on which the earth cables of immobilizer electronic central unit, EDC system function control switch, EDC electronic central unit and diagnosis connector converge.

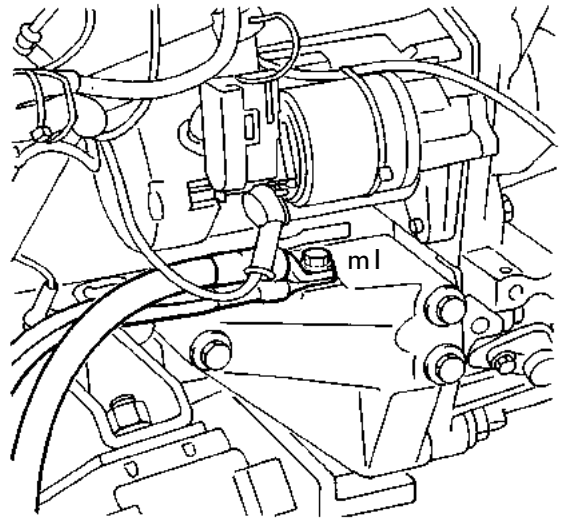
Figure 10



8623

EARTH POINT ON FRAME

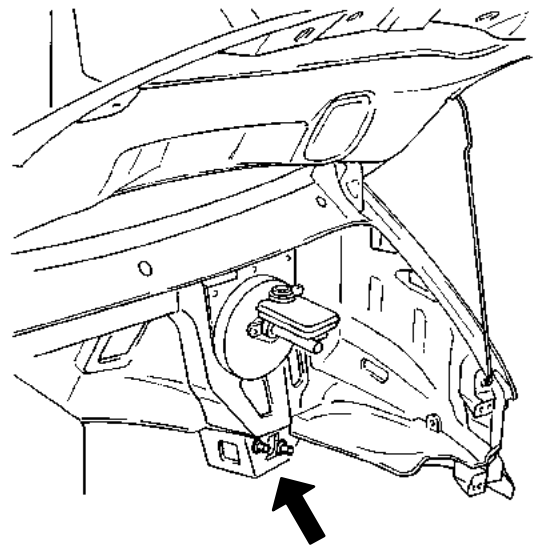
Figure 11



8622

EARTH POINT ON ENGINE

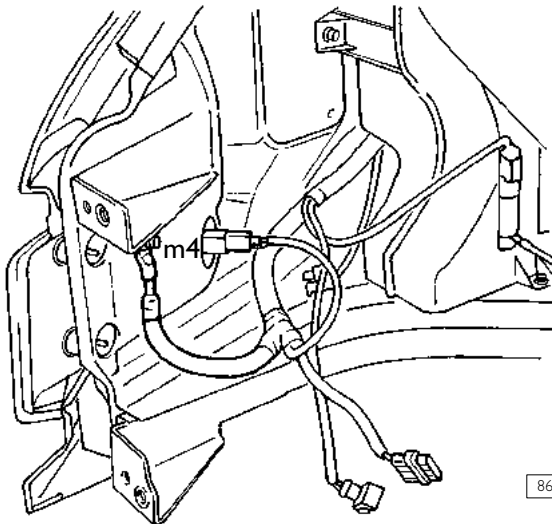
Figure 12



8624

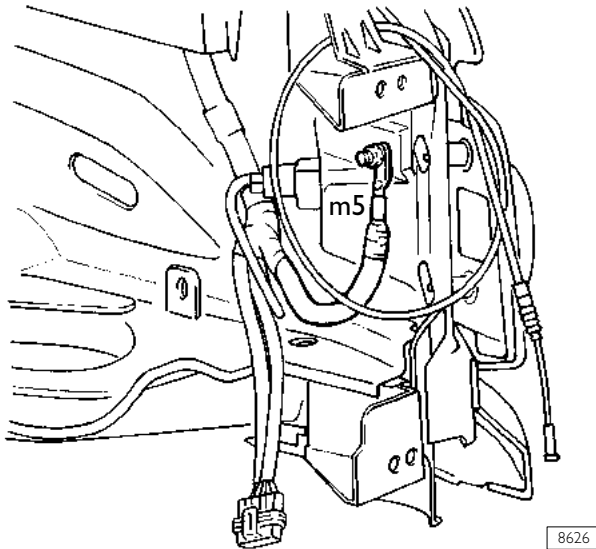
EARTH POINT ON LOWER BONNET (m3–ms3)

Figure 13



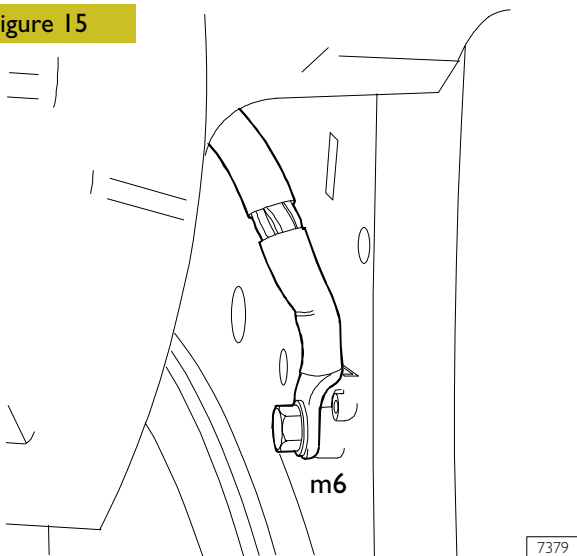
EARTH POINT ON BONNET RIGHT-HAND SIDE

Figure 14



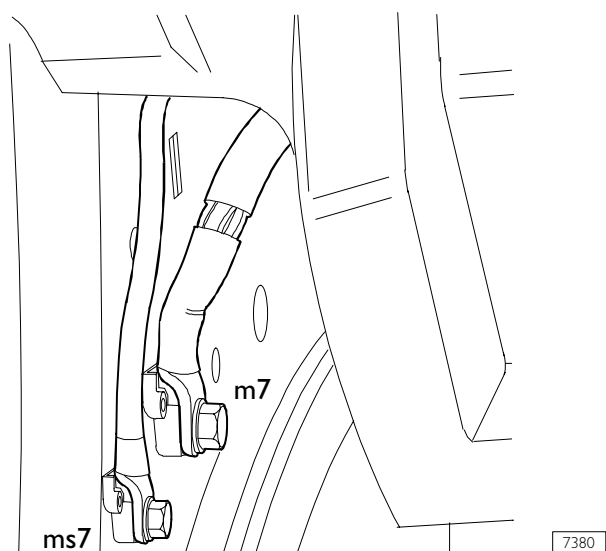
EARTH POINT ON BONNET LEFT-HAND SIDE

Figure 15



EARTH POINT ON CAB RIGHT-HAND SIDE

Figure 16



EARTH POINT ON CAB LEFT-HAND SIDE

Earth point **m4** to which the components concerning the front and right side lighting, windscreen wiper, windscreen washer, windscreen washer pump and air cleaner clogged signal switch are connected, is located in the bonnet near the right front direction indicator.

Earth point **m5** to which the components concerning the left front lighting and the fuel oil heating device are connected, is located near the left front direction indicator.

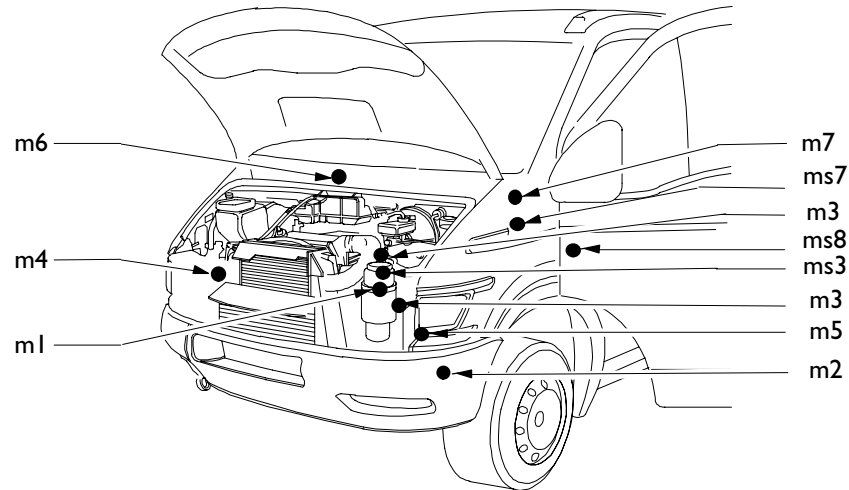
Earth points **m6** and **m7** are respectively located on the right and left of the cab, near the upper hinges of the doors. To these are connected the components in the dashboard (stalk unit, instruments, warning lights, switches), in the doors, where applicable (power window switches, motors for power window/door locking, rear-view mirror aiming) and in the upper part of the cab (roof lamp, front clearance lights).

Near **m7** earth point, there is the **ms7** signal earth; from here, a 1.5 mm² cable is connected to an ultrasound weld towards which the signal earth cables of cab/bonnet cable electronic components like steering column stalk and instrument panel with warning indicators for diagnosis converge.

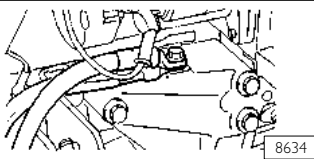
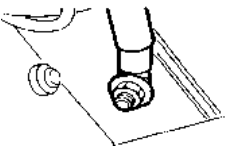
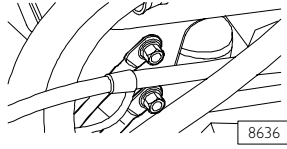
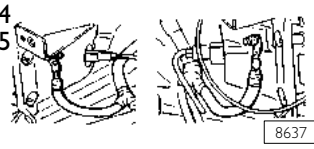
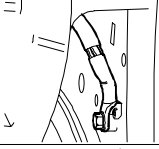
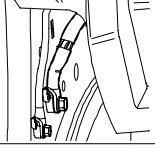
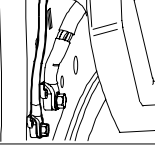
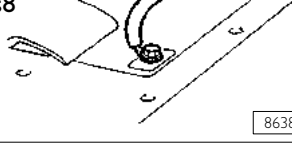
Lastly on the floor panel, next to the handbrake lever, there is an earth point (**ms8**) specific for the air bag electronic control unit.

Earth points on the vehicle

Figure 17



7390

Earth connection	Location	Components concerned
 8634	Left crankcase	Battery negative terminal—connection to earth points m2 and m3
 8635	Front part of left sidemember	Connection to earth point m1
 8636	Lower bonnet (under vacuum power steering)	Connection to earth point m1 – components on frame and engine – electronic ABS control unit
 8637	Bonnet (near right and left side direction indicator)	Fuel oil heating resistance – air cleaner clogged signal switch – front and side lights – windscreen washer pump
 7395	Cab inner right side	Stalk unit – windscreen electric demister control unit – cigar lighter– ashtray light – hazard warning light switch – radio–receiver unit
 7396	Cab inner left side	Instrument cluster with warning lights – front clearance lights – headlamp aiming control – relays on relay/fuse holder support – interior lighting
 7397	Cab inner left side	Instrument cluster with warning lights – stalk unit – low engine coolant fluid level indicator control – transmitter for electronic tachograph
 8638	Centre floor	Air bag electronic control unit

CONCEPT OF EARTH AND ELECTROMAGNETIC COMPATIBILITY

The electric system is traditionally a single-pole system. The body, the frame, the metal container of electromechanical components act as equipotential return conductor to the generator, as any point of their metal structure or any negative terminal not isolated is at the same reference potential or EARTH. This is why the earth has been chosen as reference to the whole system, conventionally giving it the value of zero.

Due to obvious reasons of construction, in the negative network of the system there are various earth points located on the vehicle in relation to the location of the components on the frame, engine and body.

On the other hand, ideally, all the equipment should be connected to **only** one earth point in order to provide them, particularly for electronic devices, a clearly defined earth reference.

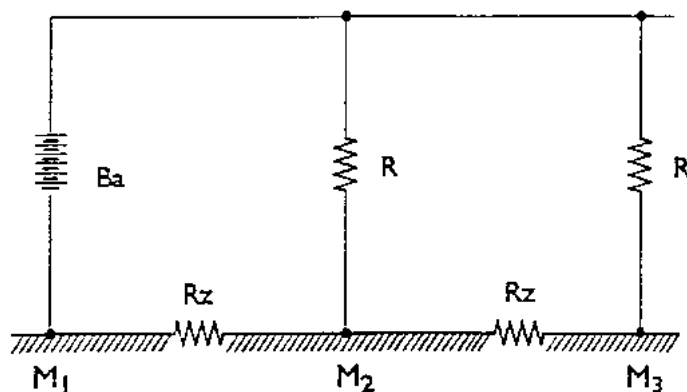
For the above-mentioned reasons it is necessary to distinguish the **supply earth** or system earth, characterised by strong direct current intensity (> 1 A for electromechanical components), from the **analogue earth**, characterised by wave shapes at determinate frequencies and very low current intensity (mA, μ A) of electronic systems.

The definition of signal earth or analogue earth depends on the sensitivity of the electronic systems to EMC (electromagnetic compatibility), as parasite signals emitted by the systems on board or outside the vehicle, induce failures and/or deterioration of the systems themselves. The best solution for a signal earth is connection with the battery negative terminal.

In order to minimise both continuous and transient disturbance or interference generated by parasite radiation, **it is of the utmost importance** to always bear in mind that the satisfactory efficiency of the reference plane or system earth depends on the excellent conductivity characteristics (contact resistance tending towards zero) in each of its connection points.

Briefly, we can say that the earth understood as equipotential electrical conductor, i.e. as potential reference for all the electric/electronic components on board, is subdivided into system earth and analogue earth.

Figure 18



6616

IDEAL EQUIPOTENTIAL EARTH NETWORK

Ba. Battery – R. Loads – Rz. Frame impedance – M₁, M₂, M₃. Earth

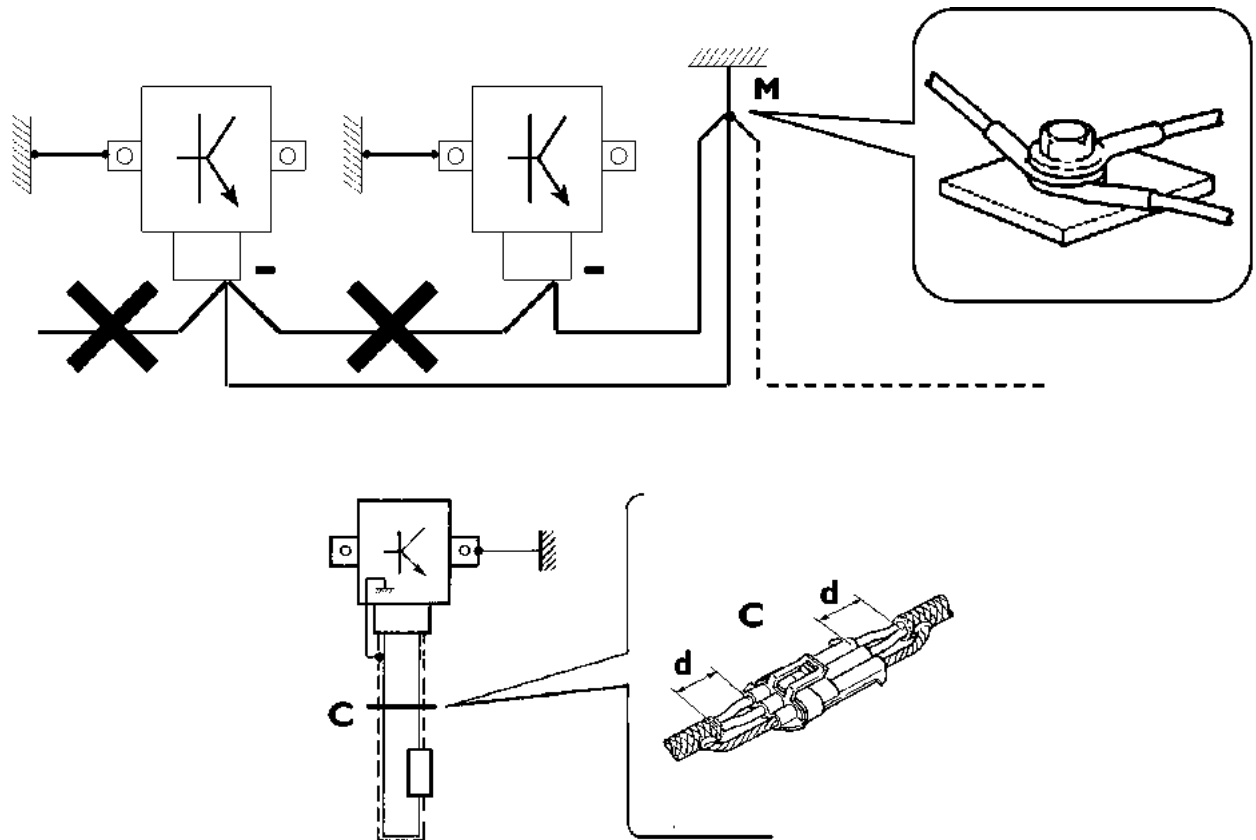
Practical advice

The negative cables connected to an earth point must be as short as possible and connected to one another in a "star" connection, trying to tighten them neatly and adequately.

Additionally, for electronic components the following instructions should absolutely be followed:

- ☐ Electronic control units must be connected to the system earth when they have a metal container.
- ☐ The negative cables of electronic control units must be connected to both a system earth point, for example the dashboard earth (avoiding "serial" or "chain" connections), and to the negative terminal of the battery/ies.
- ☐ Though they are not connected to the system earth/battery negative terminal, analogue earths (sensors) must be perfectly insulated. Therefore, particular care should be given to the parasite resistances of the terminals: oxidation, clinching defects, etc.
- ☐ In the presence of joining connectors the unscreened section **d**, near them, should be as short as possible.
- ☐ The cables should be laid on parallel with the reference plane, i.e. as near as possible to the frame/body structure.
- ☐ Additional electromechanical systems should be carefully connected to the system earth and must not be set at the side of the cables of electronic components.

Figure 19



88039

SCREENING BY METAL BRAID OF A CABLE TO AN ELECTRONIC COMPONENT
C. Connector – d. Distance → 0

Ultrasonic cable welding

In order to eliminate earth, supply, outer/inner lighting bridges between components, ultrasonic welding points have been used. These are not easily identifiable as they appear along the cables inside the corrugated tube of the various harnesses and they are isolated from the cables through heat-shrinking sheaths or insulating plastic.

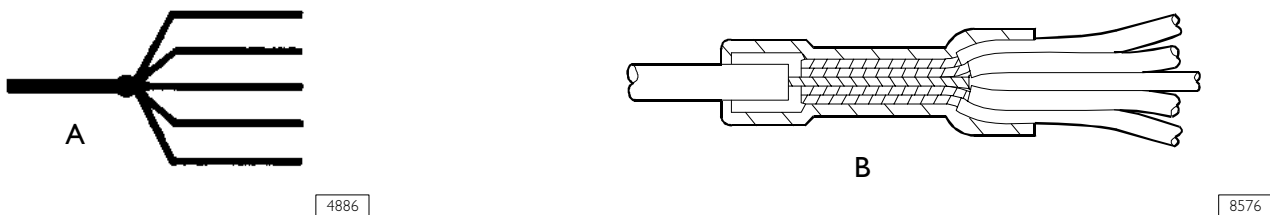
Generally, the cables of the components converge on one side in the different welding points, while on the other only one cable connects them with the earth or supply.

It is also possible to have several welding points connected to one another in which several cables converge on both sides of the welding.

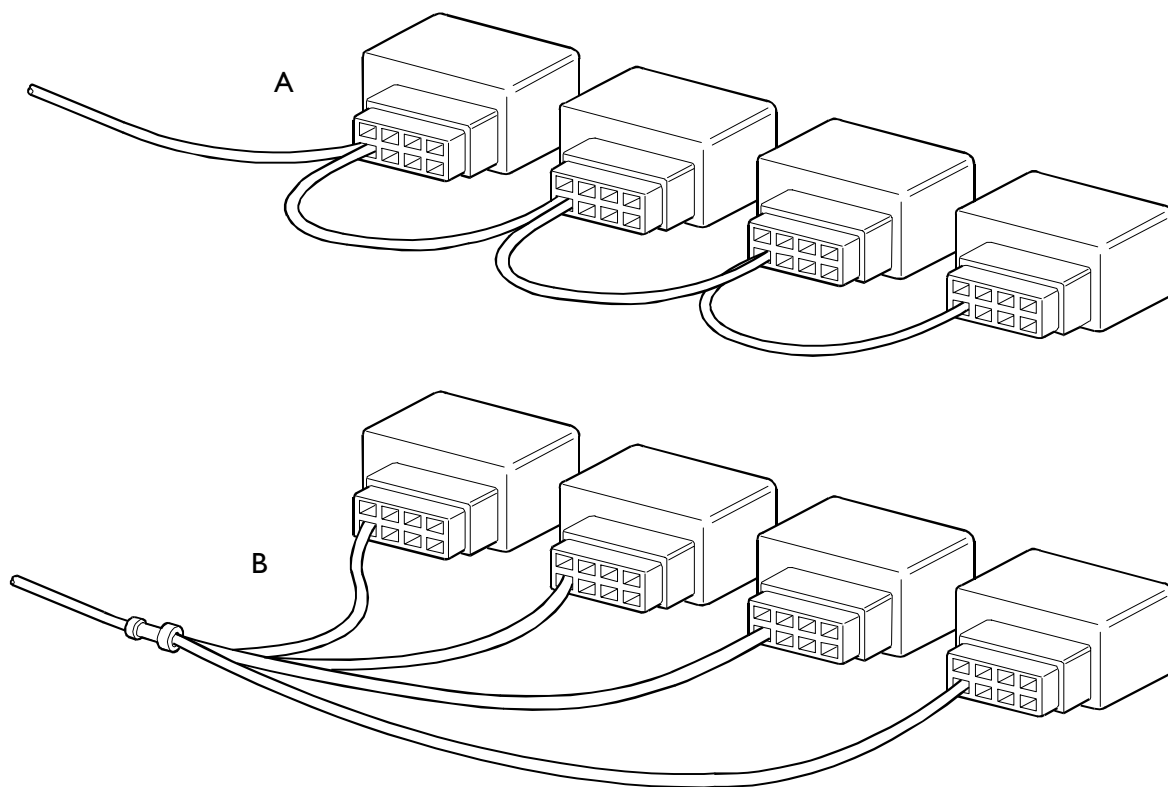
Ultrasonic welding brings considerable advantages, including:

- ☐ reduction of electromagnetic interference outside the vehicle
- ☐ the almost total reliability of the electric system, due to elimination of the bridges, with lower possibility of faults.

Figure 20



ULTRASONIC WELDING
A. Wiring diagram – B. Technical layout



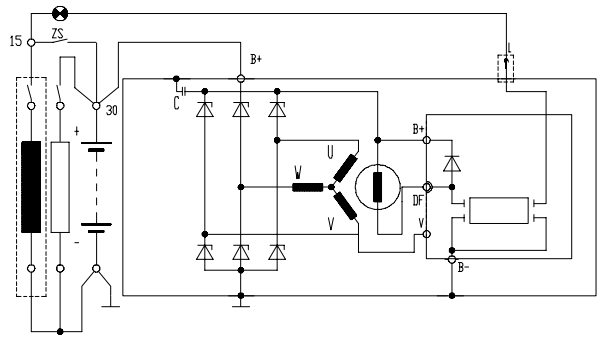
CONNECTION BETWEEN COMPONENTS
A. Connection through bridges – B. Connection through ultrasonic welding point

MAIN COMPONENTS OF POWER NETWORK

BOSCH KCBI 14V 110A Alternator

03000

Figure 21



WIRING DIAGRAM

8649

Specifications for use

Vehicle electric system rated voltage:
Suitable for coupling with battery of any capacity
It must work with the battery connected.

12 V

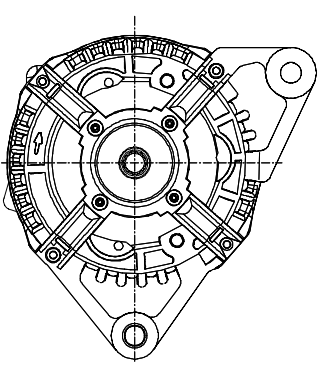
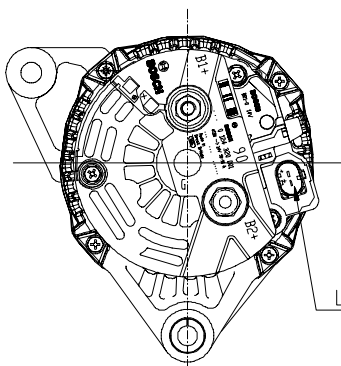
Connection with inverted polarity is not allowed.

Operating specifications

Rated voltage
Rated current delivery
Drive side direction of rotation
Maximum continuous speed
Storage temperature

14 V
110A
clockwise
 $\leq 12.000 \text{ min}^{-1}$
 $-40 \text{ }^{\circ}\text{C} / +110 \text{ }^{\circ}\text{C}$

Figure 22

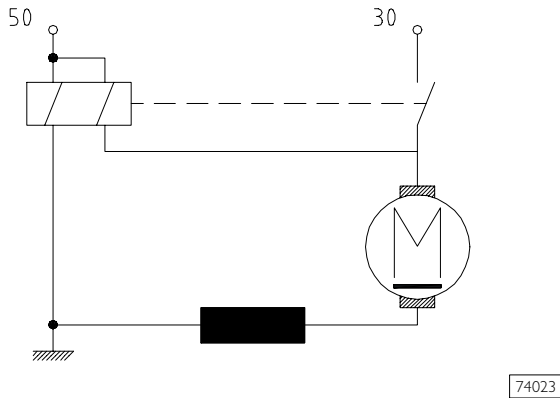


TECHNICAL VIEW

8656

EV 12V – 2.3 kW Starter motor

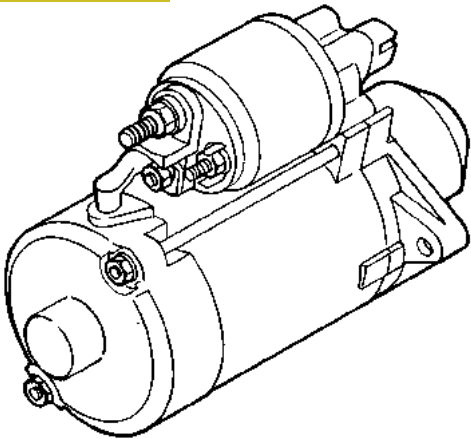
Figure 23



WIRING DIAGRAM

74023

Figure 24

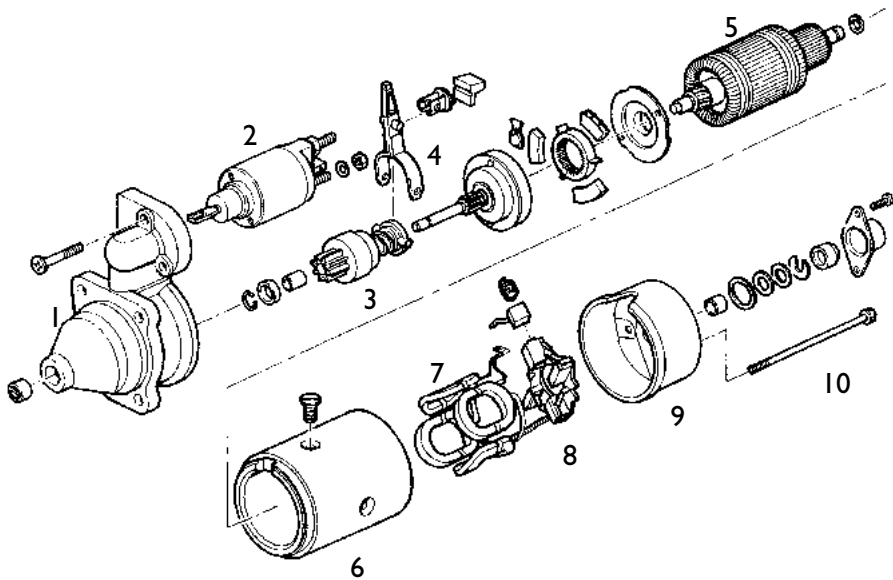


PERSPECTIVE VIEW

08000

8642

Figure 25



PERSPECTIVE BLOWN-UP VIEW

5260

1. Support – 2. Pinion engagement control electromagnet – 3. Pinion – 4. Pinion engagement fork – 5. Rotor – 6. Frame – 7. Inductors – 8. Brush holder support – 9. Cover – 10. Screw

Fast diagnosis

Defect	Possible causes	Remedy
Low drawing torque	1. Low battery	Recover
	2. Oxidized or loose circuit connections	Check starter motor and battery connections
	3. Faulty brushes	Check brush slide length and pressure
	4. Field coils short circuited	Replace coils
	5. Rotor cut out or short circuited	Replace rotor
	6. Oval collector	Grind correct or replace
Low drawing torque but engine does not start	1. Defective free wheel or electromagnet	Replace
Pinion disconnected	1. Worn toothed crown	Recover

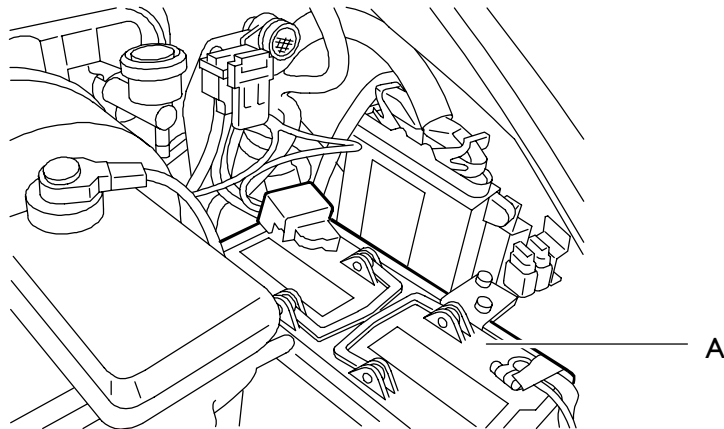
Battery

The battery shown below has a 12Vdc 110Ah 460 A power supply voltage and is installed on the left side of the engine compartment near the EDC control unit (Ref. A of figure).

Requirements

- ☐ Case and cover in polypropylene plastics PR. 50.100. Matt white case.
- ☐ C.S. plugs, black. Grids: positive and negative made of Pb Ca.
- ☐ Cover integral polypropylene
- ☐ Separator: envelope-type polyethylene
- ☐ Battery for "tropical duty" marked with red color.
- ☐ "Environmental precautions" plate according to Law no. 126 of 10/04/91 "Standards for user information".
- ☐ Adhesive label with "Selective disposal" acc. to EEC Directive no. 93/86.

Figure 26



73721

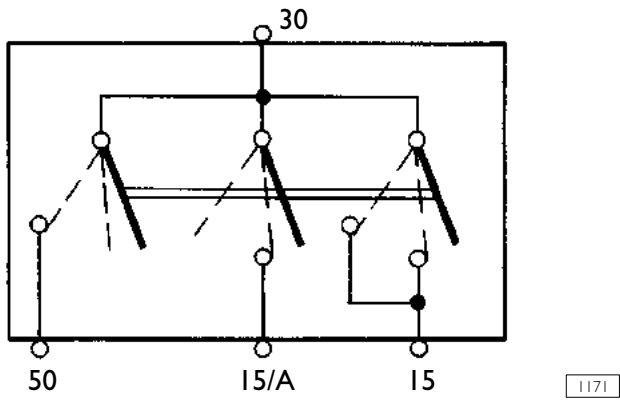
Fast diagnosis

Defect	Possible causes	Remedy
Start defect	1. Low battery	Check battery charge; if regular check recharge circuit
	2. Loose, oxidized or burnt out contacts	Recover
	3. Starter circuit defective	Cf. start section
Low voltage at component leads	1. Battery at half power	Check battery charge; if regular check recharge circuit
	2. Oxidized connections	Sand and replace
Electrolyte level often low	1. Over voltage	Check recharge circuit and/or connection tightness

Ignition switch

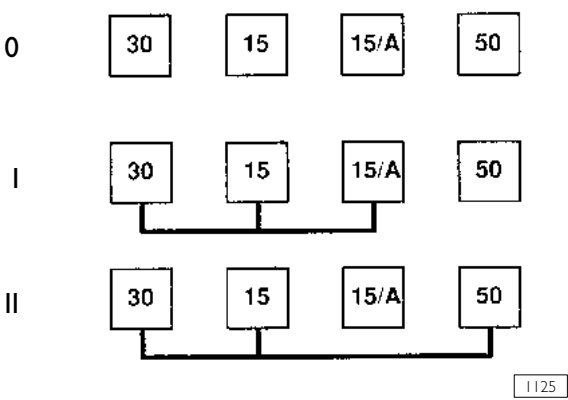
52502

Figure 27



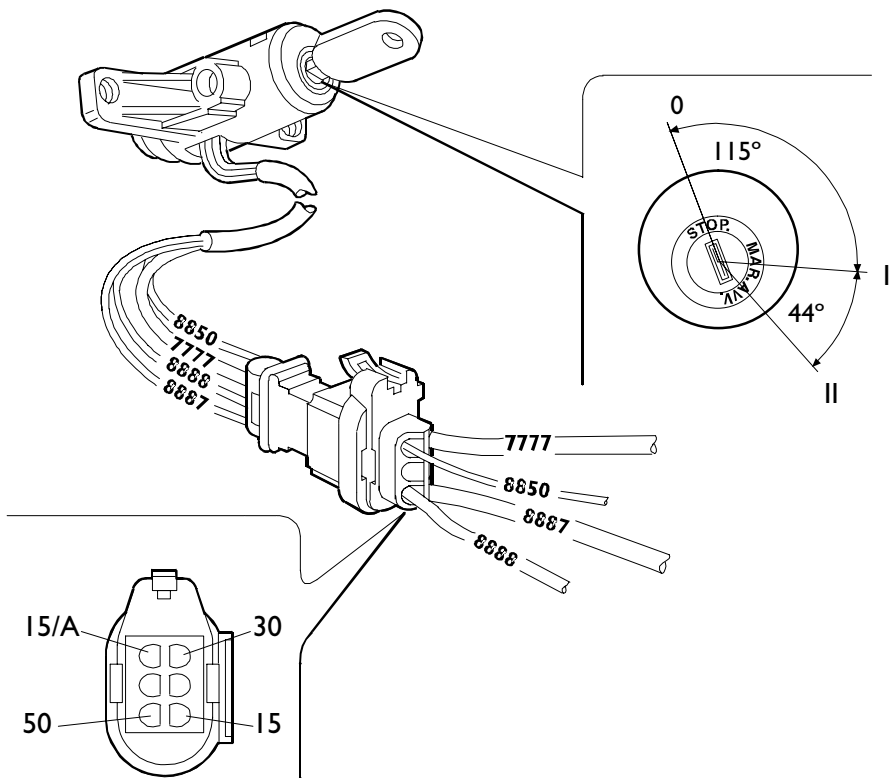
WIRING DIAGRAM

Figure 28



SWITCHING SEQUENCE
0. Stop – I. Drive – II. Starting

Figure 29

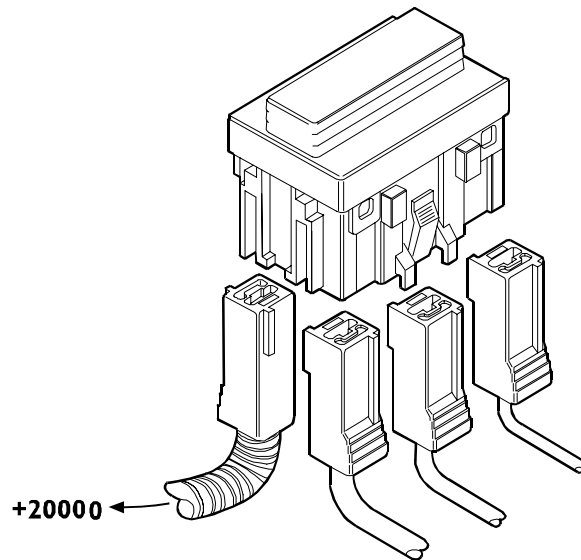


PERSPECTIVE VIEW WITH ASSOCIATED CONNECTIONS AND KEY ROTATION TECHNICAL LAYOUT

Position	Under current	Live circuit	Terminal	Function	Cable colour code
0	30	–	30	Supply	7777
I	30 – 15 30 – 15/A	Services Users	15 15/A	Services User cut-off relay during starting	8887 8850
II	30 – 15 30 – 50	Services Starting	50	Starting	8888

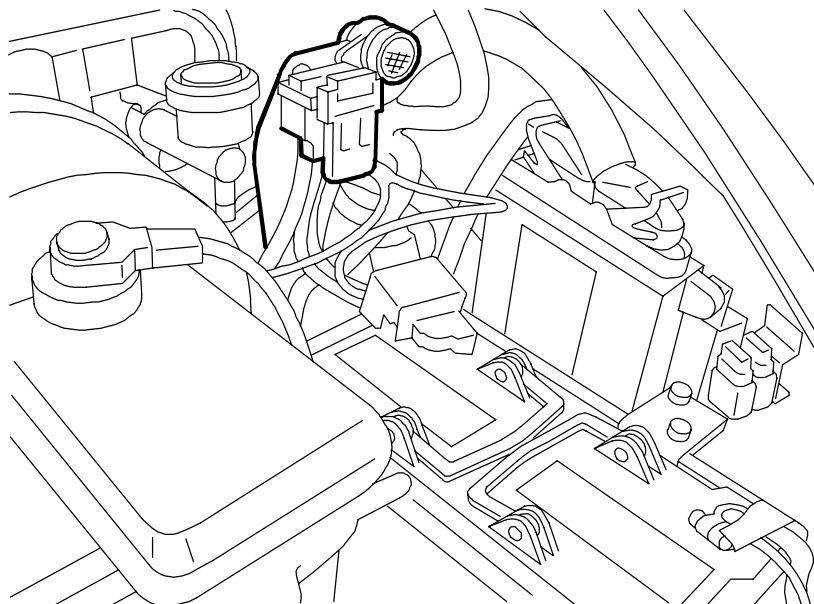
Interconnection center

This is a shunt center distributing battery positive power via internal jumpers.

Figure 30

8630

PERSPECTIVE VIEW OF THE JUNCTION BOX AND ASSOCIATED CONNECTORS AND THEIR SURFACE WITH CONTACT BLADES

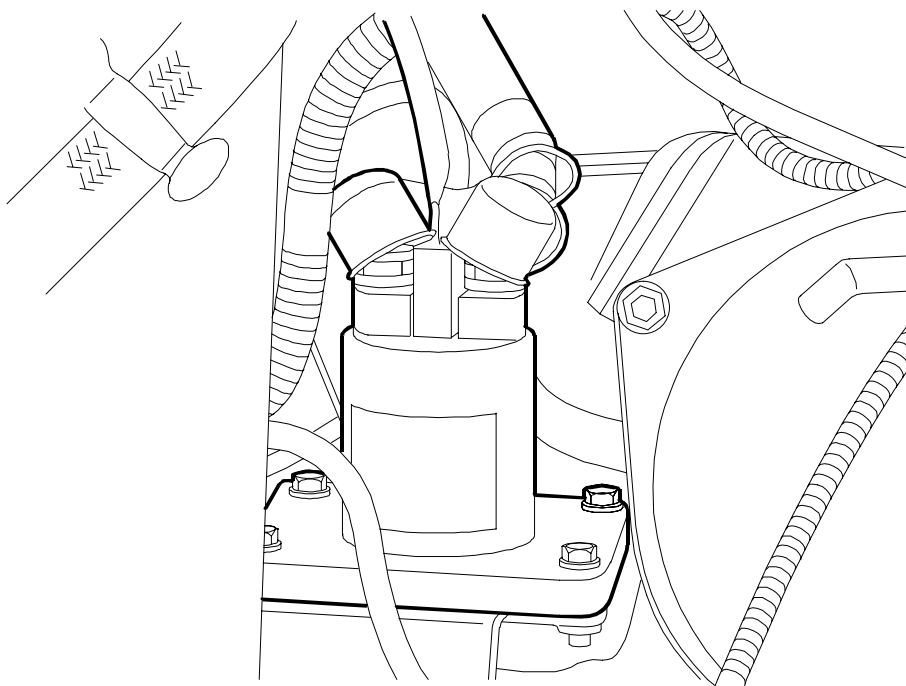
Figure 31

73722

VIEW OF THE ENGINE COMPARTMENT LOCATION

General remote control switch (T.G.C.)

The general remote control switch is installed in vertical position to the vehicle chassis near the battery using special mounting brackets. The remote control switch closing is controlled by switch 53008 and the associated relay to energize TGC from inside cab 25226.

Figure 32

73717

GENERAL REMOTE CONTROL SWITCH

ONBOARD CABLES

Components of the injection system (E. 8140)

1. Injector
2. Injector retainer screw and bracket
3. Injector retainer screw and bracket
4. Rail sound-absorbing protection (pressure accumulator)
5. High pressure pipe
6. Pump backflow pipe
7. High pressure pump
8. Thermal starter supply pipe
9. Fuel outlets unit

Components of the injection system

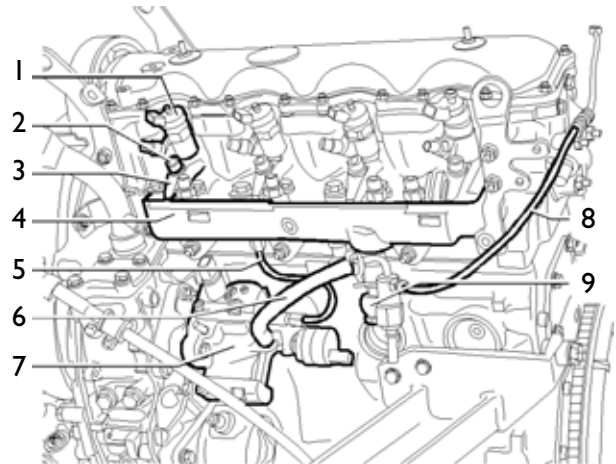
1. Thermal starter supply pipe
2. Brackets
3. Brackets
4. Connection pipe with intercooler
5. Thermal starter
6. Piping
7. After warming solenoid valve
8. Intake manifold
9. Boosting air pressure sensor

Engine cable

All engine cabling is in one bundle assembly.

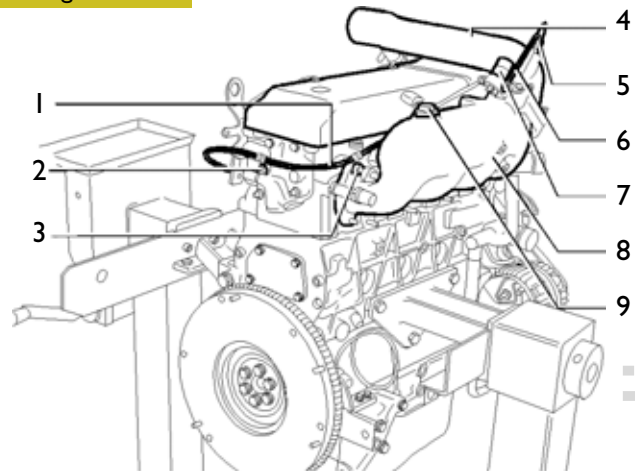
In case of need replace the entire bundle assembly and not individual cables or cable sections.

Figure 33



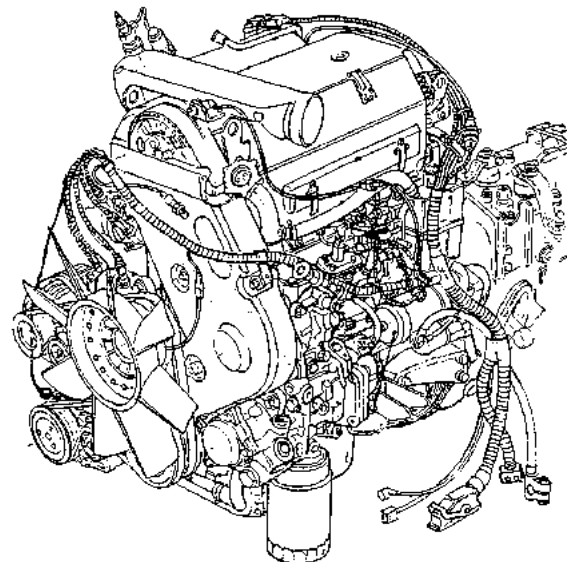
COMPONENTS OF THE INJECTION SYSTEM

Figure 34



COMPONENTS OF THE FUEL SUPPLY SYSTEM –
INJECTION

Figure 35



CABLE ON ENGINE

Figure 36

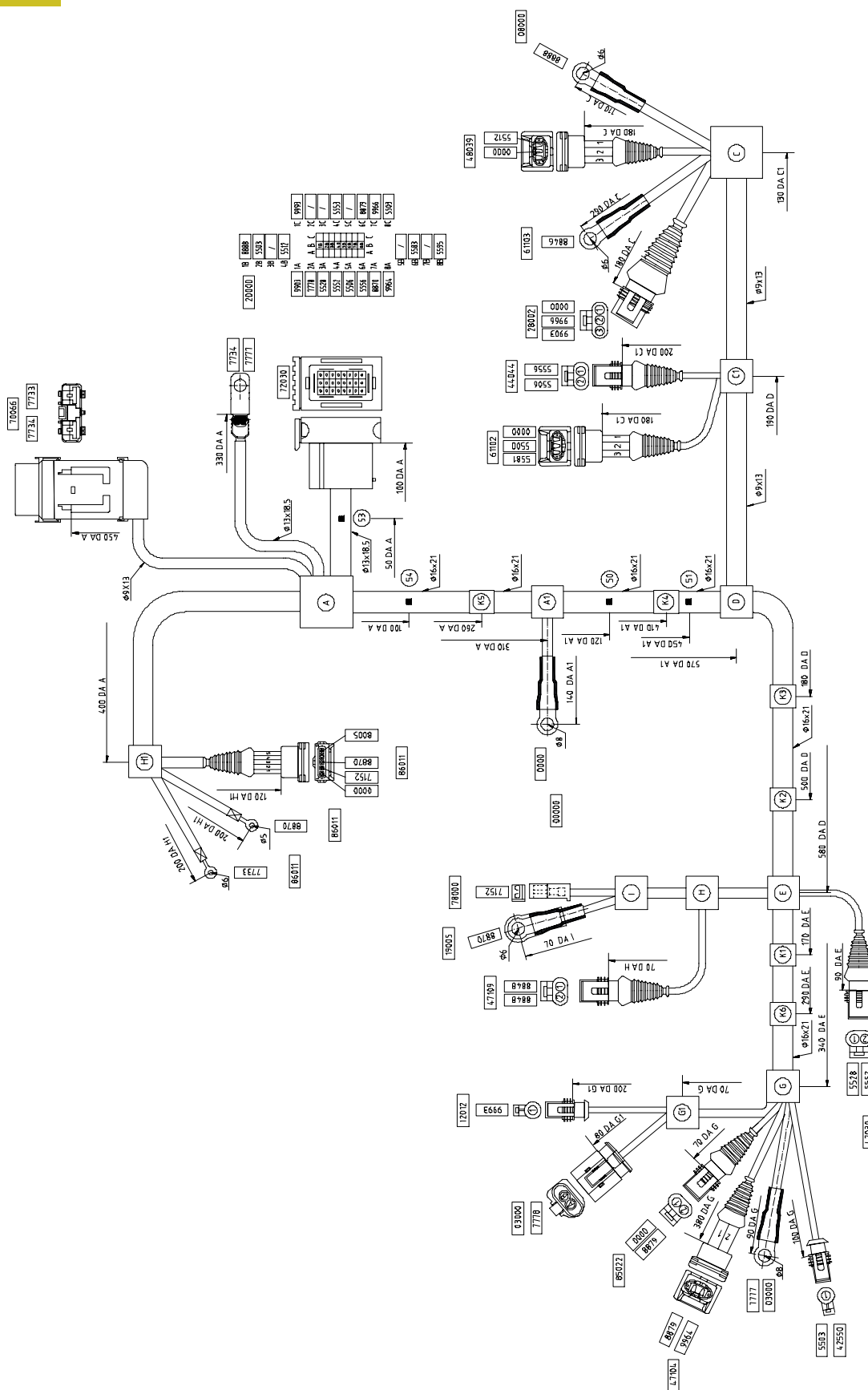
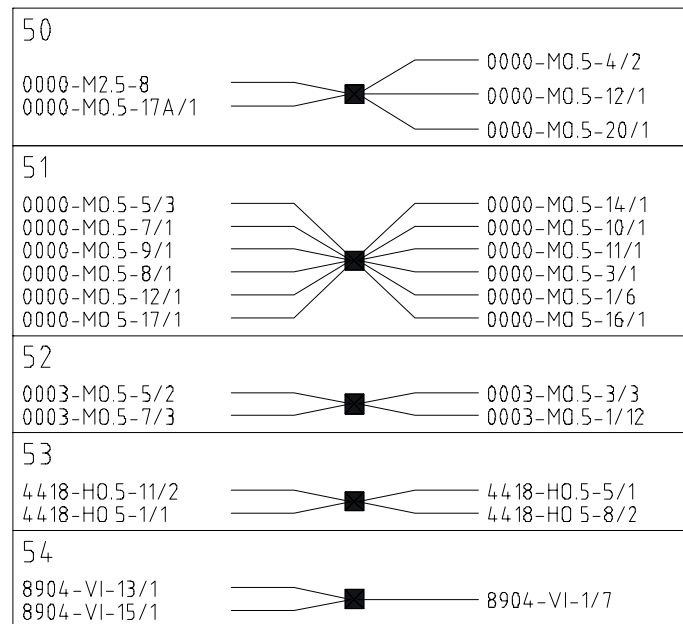


Figure 37

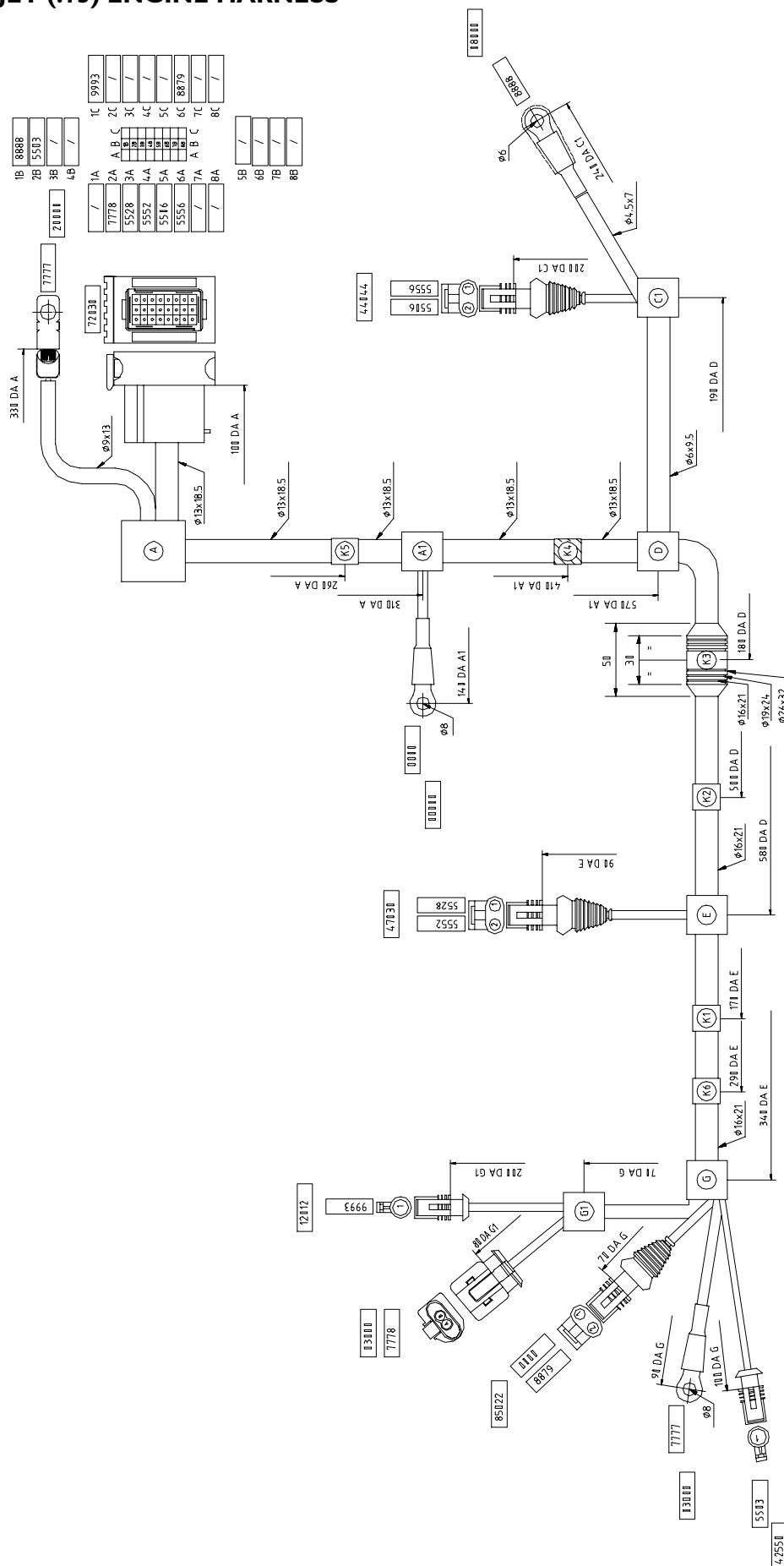
WELDING 8140.43C



74003

Component code	Description
00000	Ground
03000	Self-rectifying alternator with incorporated voltage regulator
08000	Starter motor
12012	A/C compressor
19005	Thermostarter
20000	Starter battery
28002	Engine shutdown solenoid
42550	Engine oil low pressure indicator switch
44044	Low engine oil level indicator control
47030	Transmitter for engine water temperature thermometer
47104	Engine cooling electromagnetic coupling
47105	Diesel oil heating switch
47109	Spark advance variator switch (KSB)
48035	RPM sensor
61103	Variable resistance for spark advance variator (KSB)
70066	40A one-way fuse holder
72030	Engine service harness connector to cab/hood harness
78000	Solenoid valve for fuel tank connection to atmosphere
85022	Electromagnetic coupling for engine cooling
86011	Pre-post-heating electronic control unit

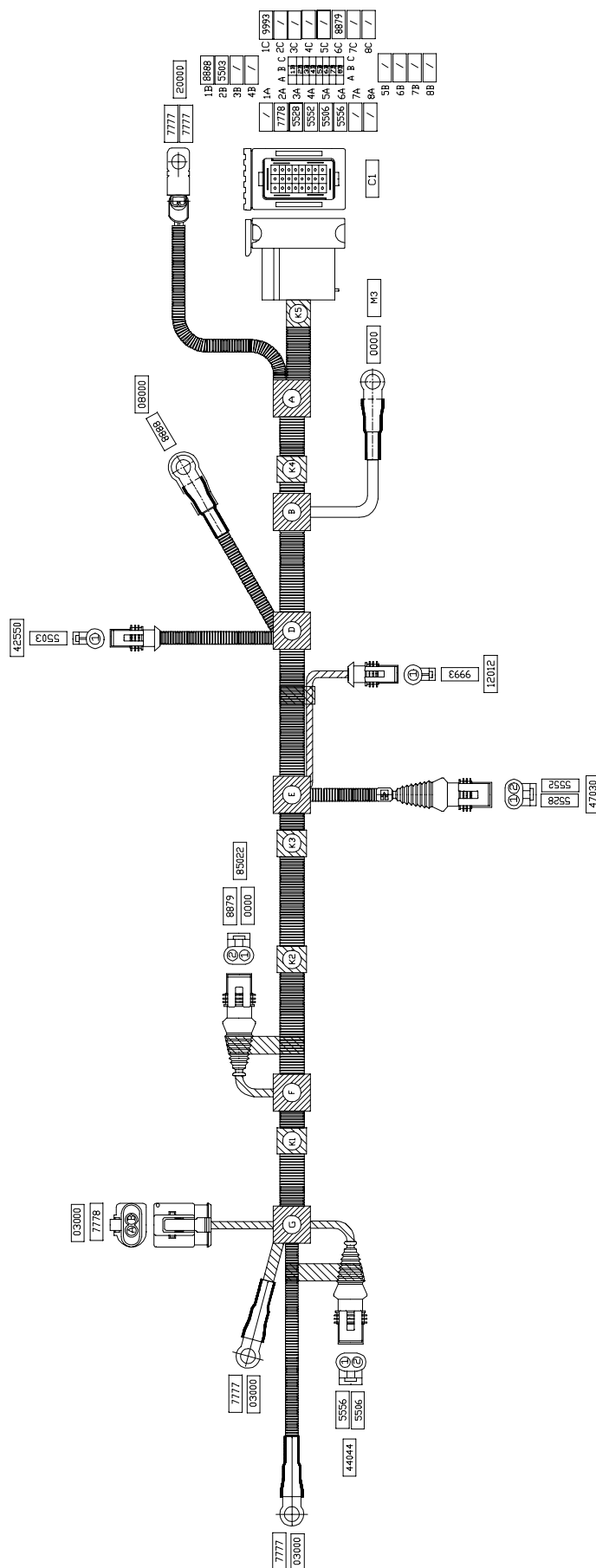
Figure 38



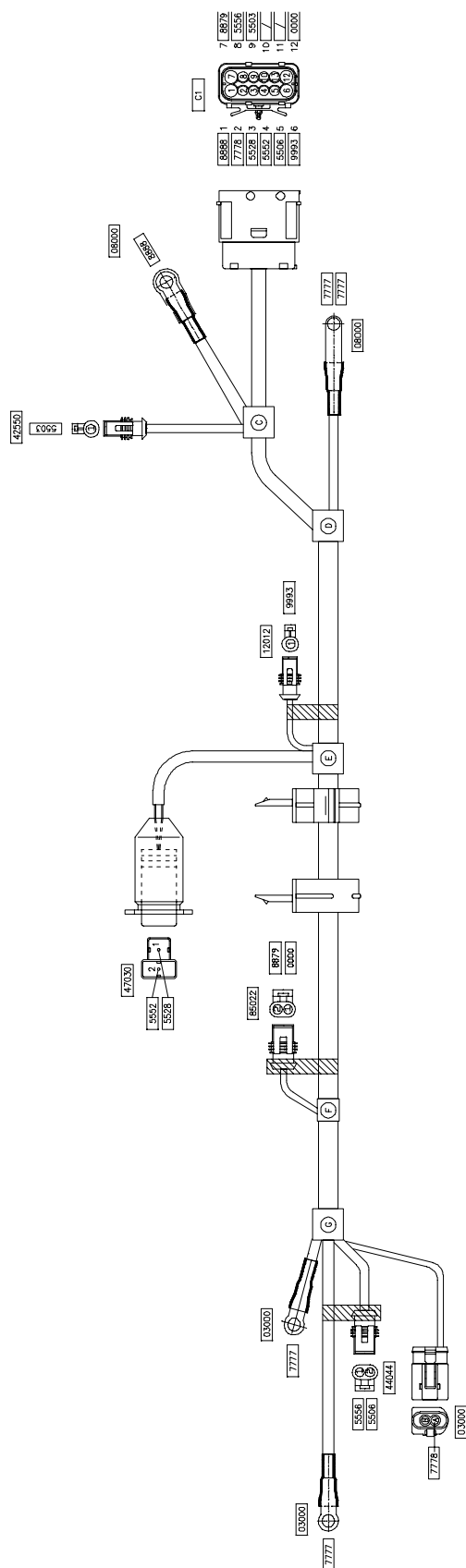
Component code	Description
00000	Ground
03000	Self-rectifying alternator with integrated voltage regulator
08000	Starter motor
12012	A/C compressor
20000	Starter battery
42550	Engine oil low pressure indicator switch
44044	Low engine oil level indicator control
47030	Transmitter for engine water temperature thermometer
72030	Engine service harness connector to cab/hood harness
78000	Solenoid valve for fuel tank connection to atmosphere
85022	Electromagnetic coupling for engine cooling

Component code	Description
85150	EDC center
I	Connection to hood cab cable
47035	Coolant temperature sensor
78015	Radialjet pump control electro valve
85157	Fuel pressure sensor
78247	Electrical injection electro valve
48042	rpm sensor on distributor
48035	Engine rpm sensor
78013	Pressure adjustment electro valve
47106	Fuel heat on switch
85156	EDC blower air pressure sensor
61101	Fuel heat resistor

Figure 40



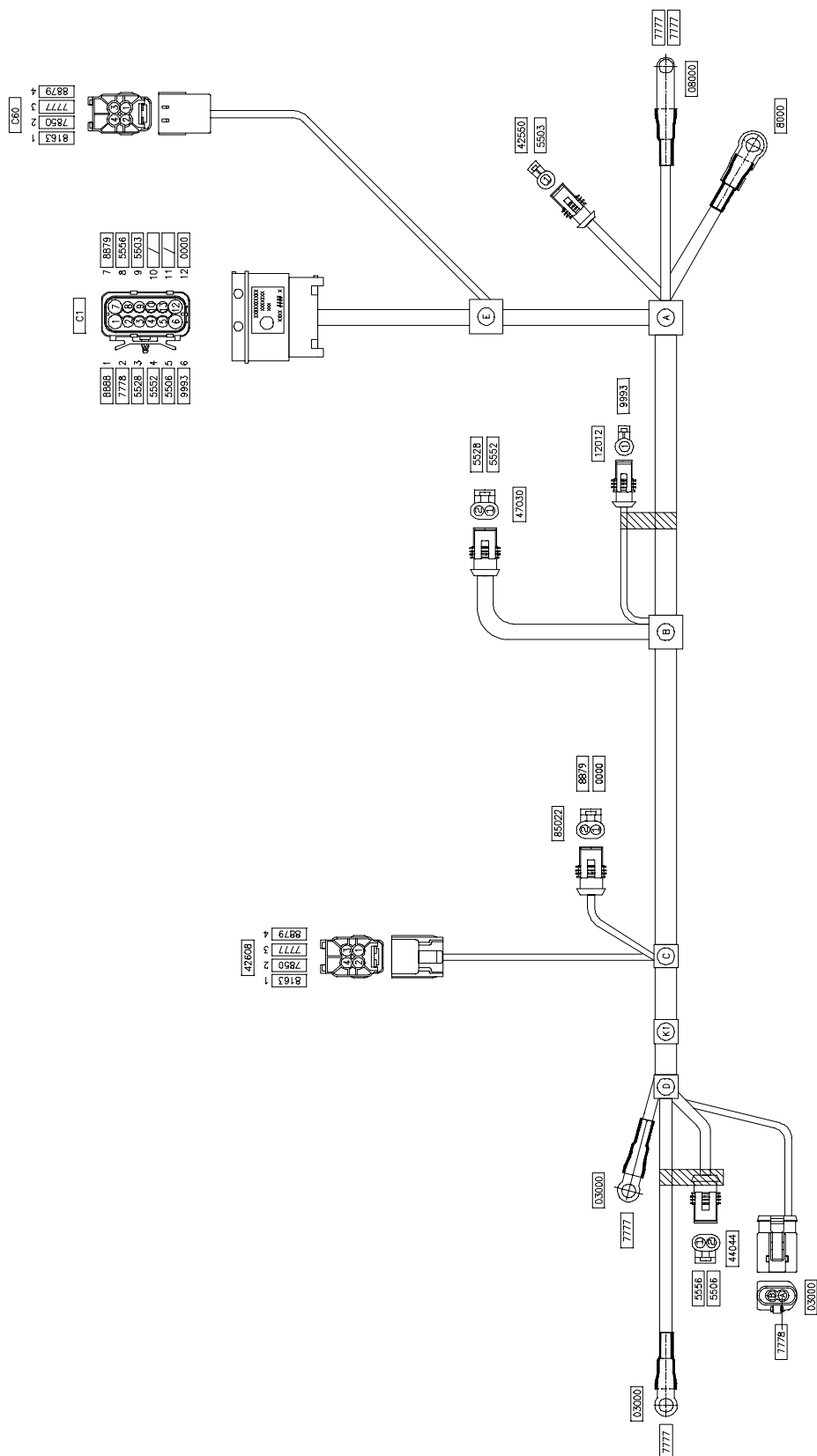
Component code	Description
00000	Ground
03000	Self-rectifying alternator with integrated voltage regulator
08000	Starter motor
12012	A/C compressor
20000	Starter battery
42550	Engine oil low pressure indicator switch
44044	Low engine oil level indicator control
47030	Transmitter for engine water temperature thermometer
85022	Electromagnetic coupling for engine cooling
CI	Engine service harness connector to cab/hood harness

FIA UNIJET WITH EDC16 (.10 - .12 - .14) ENGINE HARNESS**Figure 40/I**

101861

Component code	Description
03000	Self-rectifying alternator with integrated voltage regulator
08000	Starter motor
12012	A/C compressor
42550	Engine oil low pressure indicator switch
44044	Low engine oil level indicator control
47030	Transmitter for engine water temperature thermometer
85022	Electromagnetic coupling for engine cooling
CI	Engine service harness connector to cab/hood harness

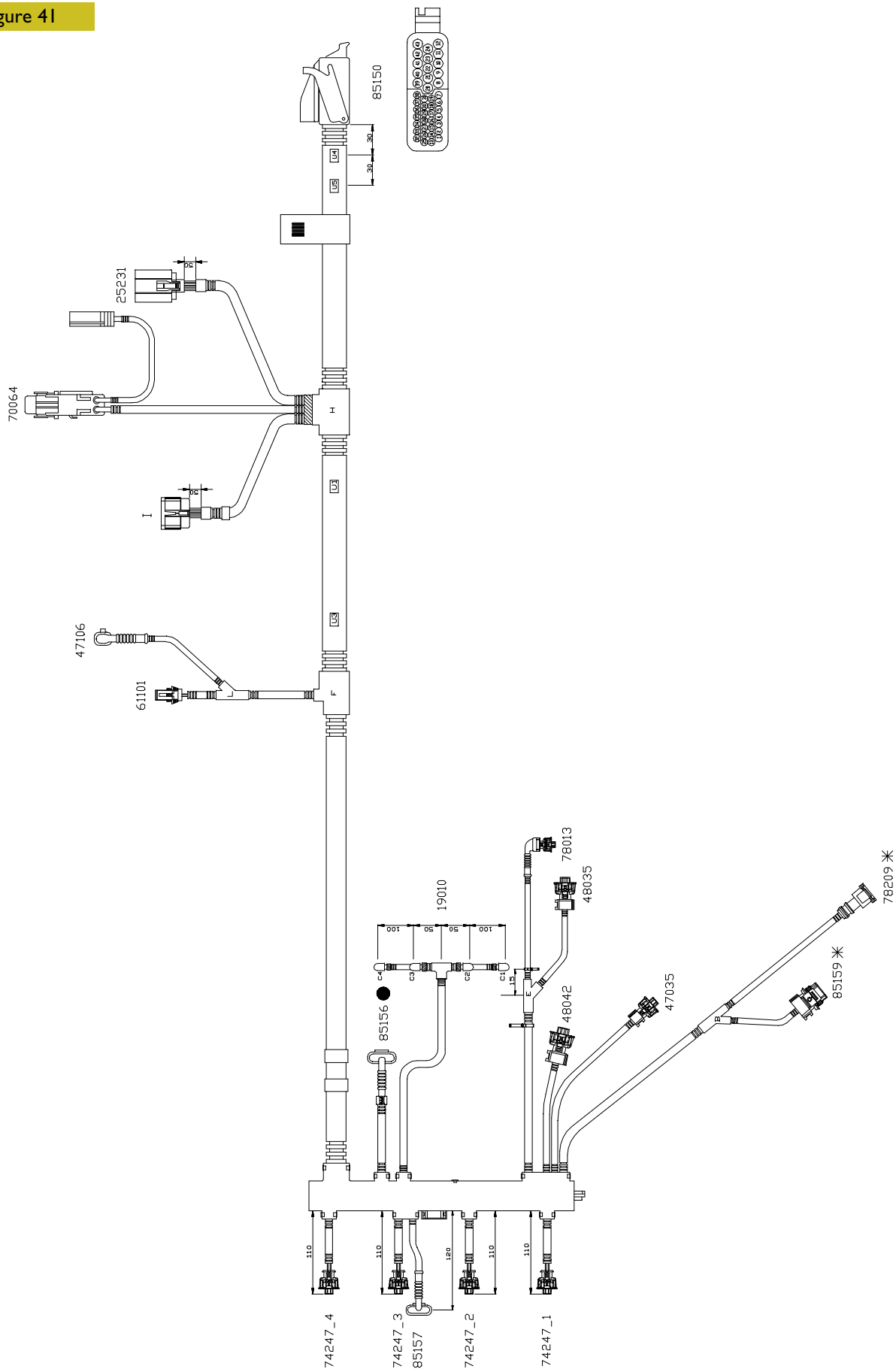
Figure 40/2



Component code	Description
03000	Self-rectifying alternator with integrated voltage regulator
08000	Starter motor
12012	A/C compressor
42550	Engine oil low pressure indicator switch
42608	Three-level pressure switches
44044	Low engine oil level indicator control
47030	Transmitter for engine water temperature thermometer
85022	Electromagnetic coupling for engine cooling
CI	Engine service harness connector to cab/hood harness
C60	Three-level pressure switch cable joint with cabin/hood cables

INJECTION CABLE - FIA (.10 - .12) WITH AND WITHOUT EGR

Figure 41



74268

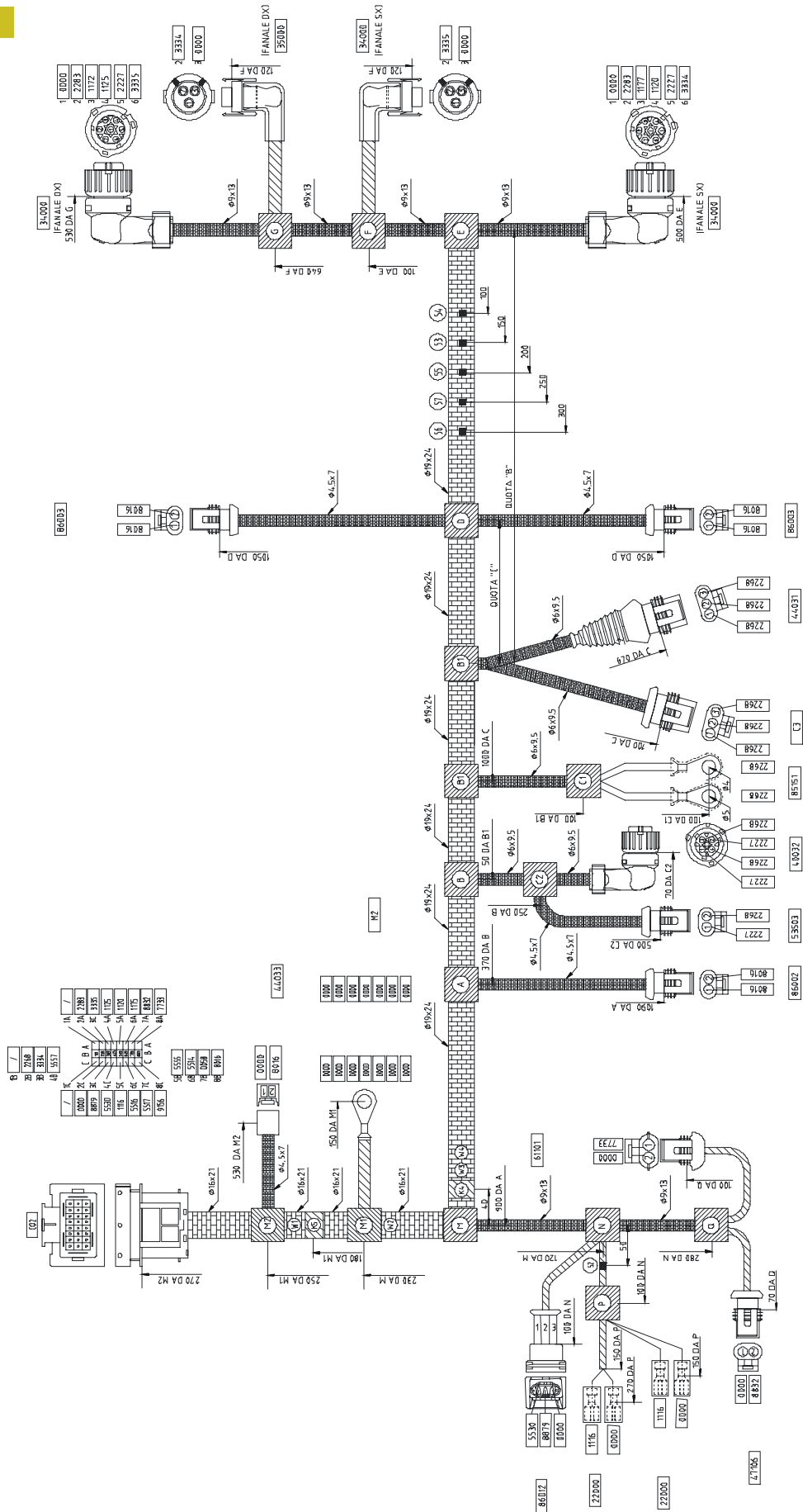
Component code	Description
85150	EDC center
I	Connection to hood cab cable
47035	Coolant temperature sensor
85157	Fuel pressure sensor
78247	Electrical injection electro valve
48042	rpm sensor on distributor
48035	Engine rpm sensor
78013	Pressure adjustment electro valve
47106	Fuel heat on switch
● 85156	EDC blower air pressure sensor
61101	Fuel heat resistor
19010	Preheat plug
25231	Plug insert centre
70064	I-way fuse holder
* 85159	Environment air temperature and pressure sensor for EDC
* 78209	EGR electro valve

● Without EGR

* With EGR

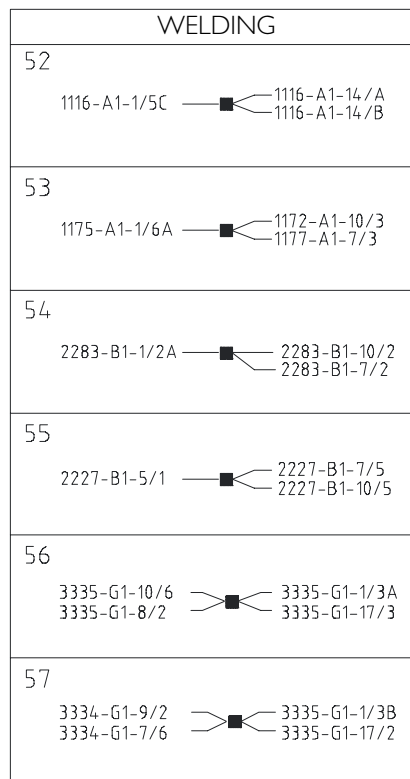
TRUCK CHASSIS CABLE

Figure 42



74017

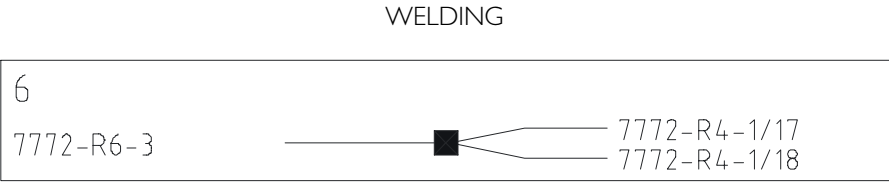
Figure 43



74018

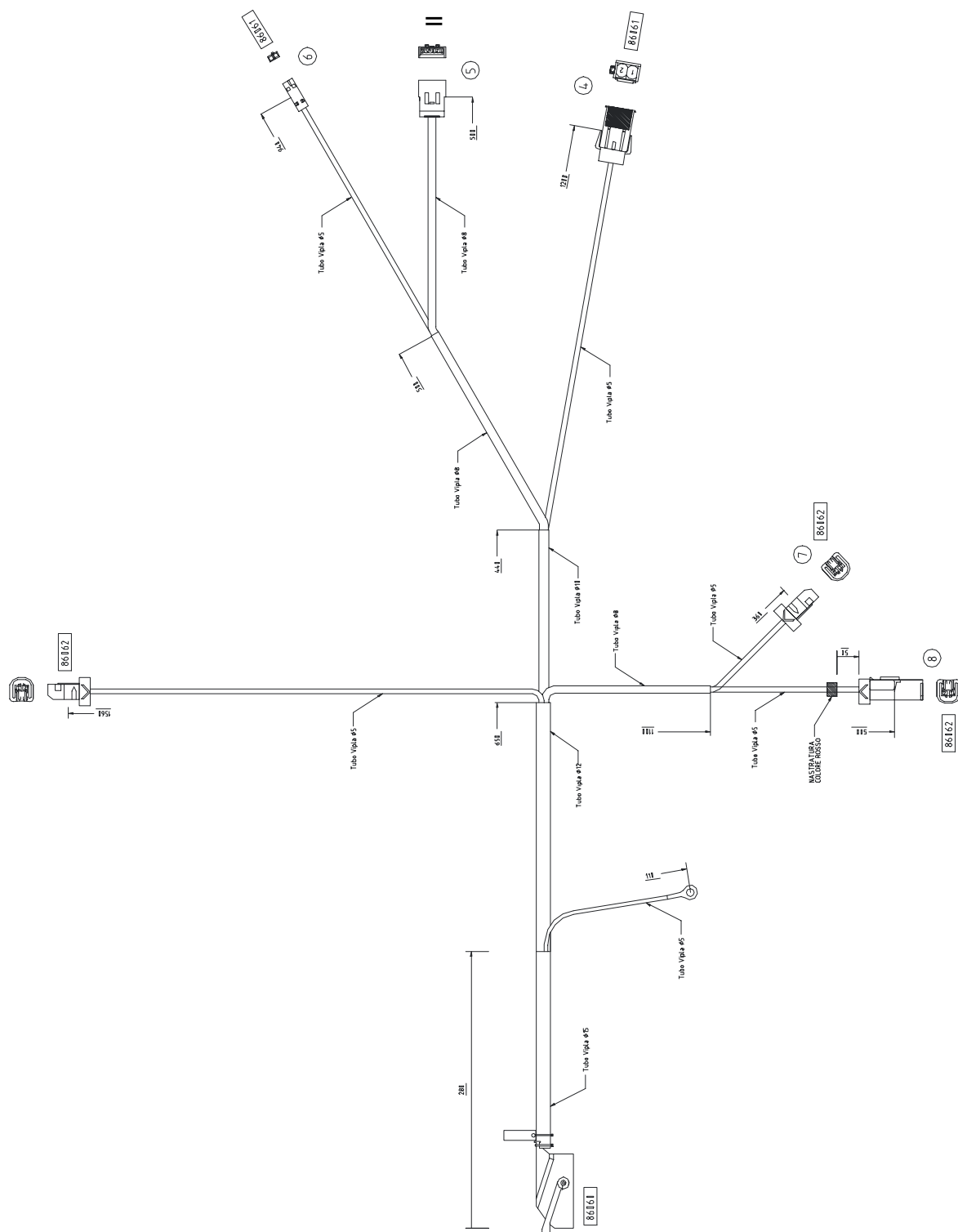
Component code	Description
22000	Horn
34000	Multifunctional rear floodlight
35000	License plate light
40032	Transmitter for tachometer and tachograph
42351	Air filter clogged sensor
44031	Fuel oil level indicator transmitter with contact for min. level indicator
44033	Brake fluid low indicator control
47106	Diesel oil heating switch
53503	Backup light switch
61101	Diesel oil preheating resistor
85151	EDC injection pump
86002	Front wheel pad wear indicator sensors
86003	Rear wheel pad wear indicator sensors
86012	Water-in-fuel-filter indicator sensor
C2-C4	Chassis harness connector to cab/hood cables
C3	Chassis harness connector to side clearance lights
M2	Ground

Figure 45



74016

Component code	Description
20000	Starter battery
70060	40A one-way fuse holder
72048	Cab-hood harness to ABS harness connector
88000	ABS electronic control unit
88001	ABS sensor

AIR-BAG CABLE WITH ONE-CONNECTOR CONTROL UNIT**Figure 46**

74021

Component code	Description
86060	AIRBAG control unit
86061	Passenger airbag – Driver airbag
86062	Passenger pretensioner – Central pretensioner – Driver pretensioner
II	Dashboard harness connector

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Component code	Description
86060	AIRBAG control unit
86061	Passenger airbag – Driver airbag
86062	Passenger pretensioner – Central pretensioner – Driver pretensioner
II	Dashboard harness connector

Figure 48

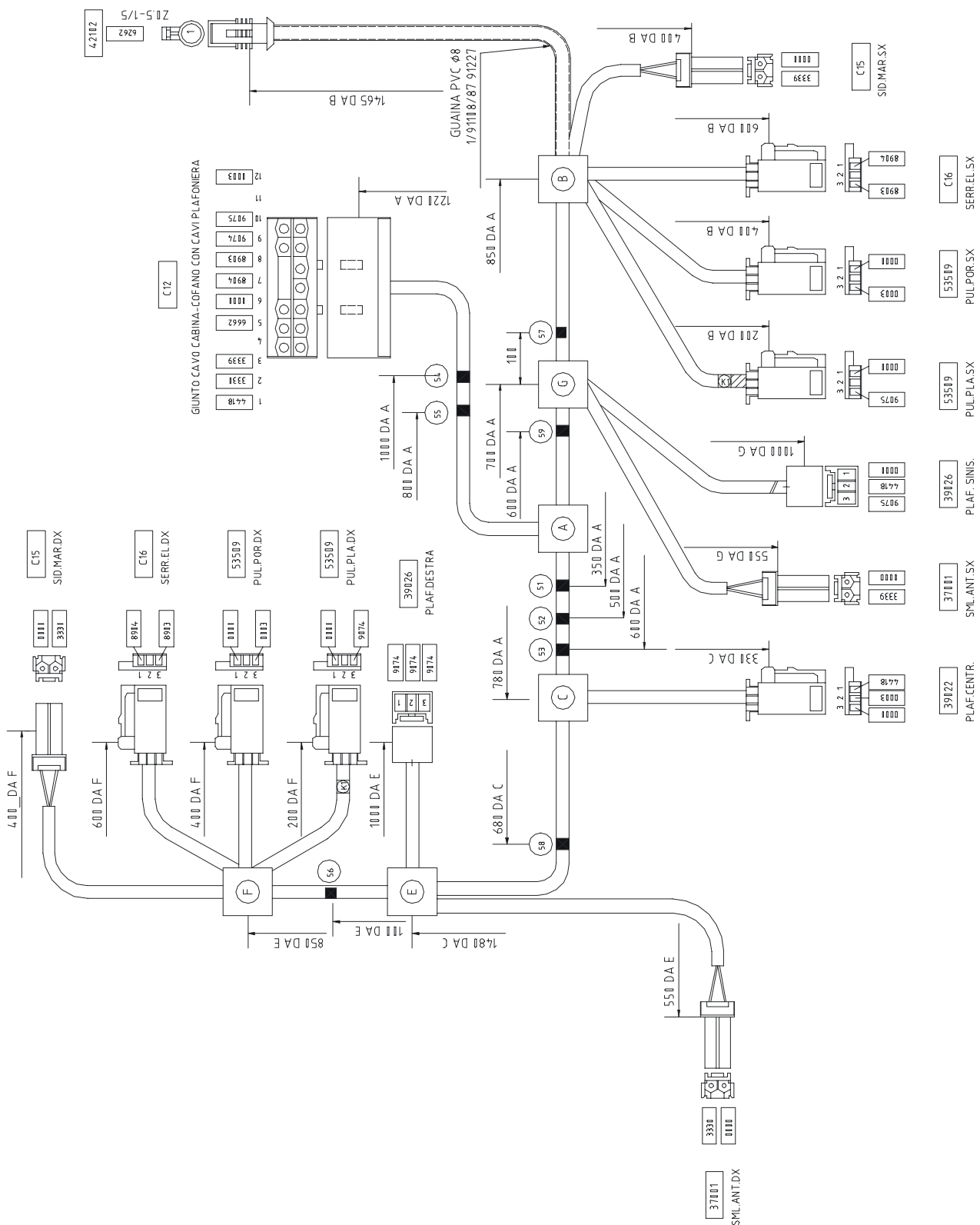
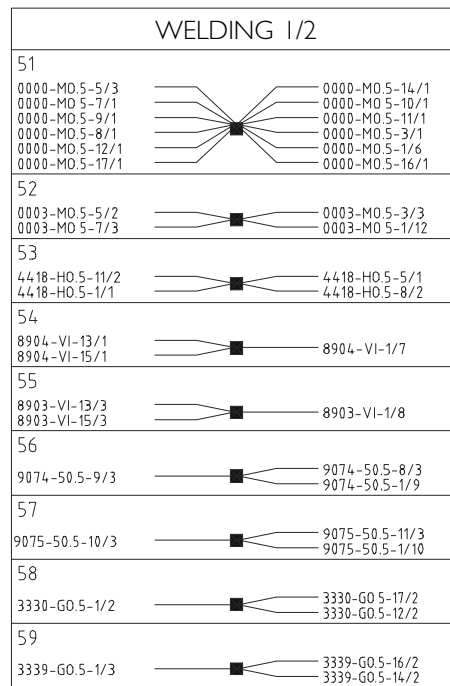


Figure 49



Component code	Description
C12	Cab-hood harness to dome lamp harness connector
C15	Dome lamp connectors to slide door bridge
C16	Dome lamp connectors to electrical lock contacts
37001	Front clearance lamp
39022	Interior door lamp with adjustable spot
39026	Side door lighting dome lamp
42102	Parking brake on indicator switch
53509	Interior lighting switch

VAN INTERIOR DOME LAMP CABLES 2/2

Figure 50

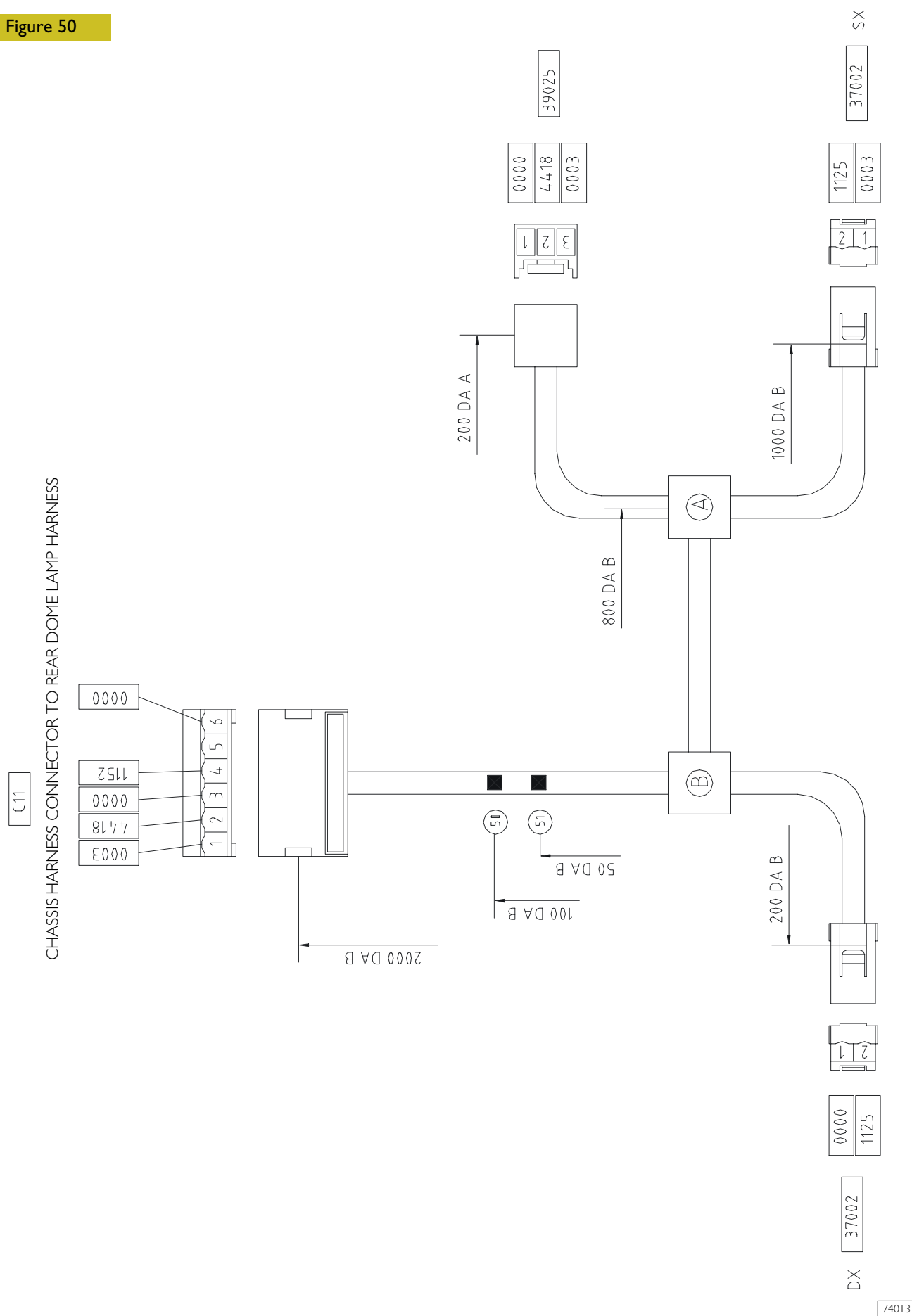
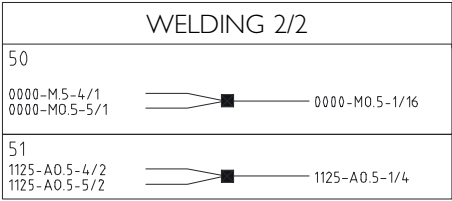


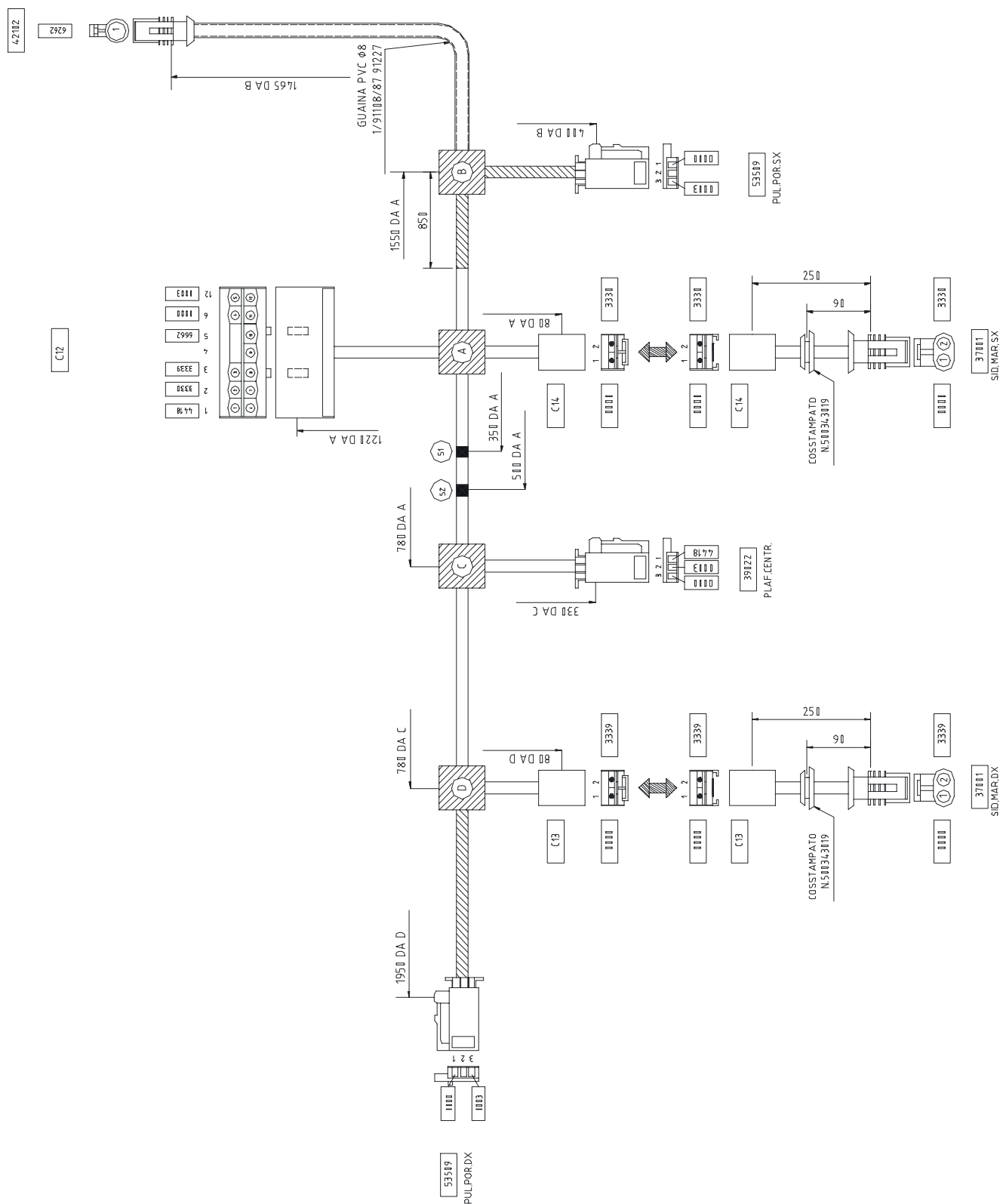
Figure 51



74014

Component code	Description
37002	Rear clearance lamp
39025	Liftgate lighting dome lamp
C I I	Chassis harness connector to rear dome lamp harness

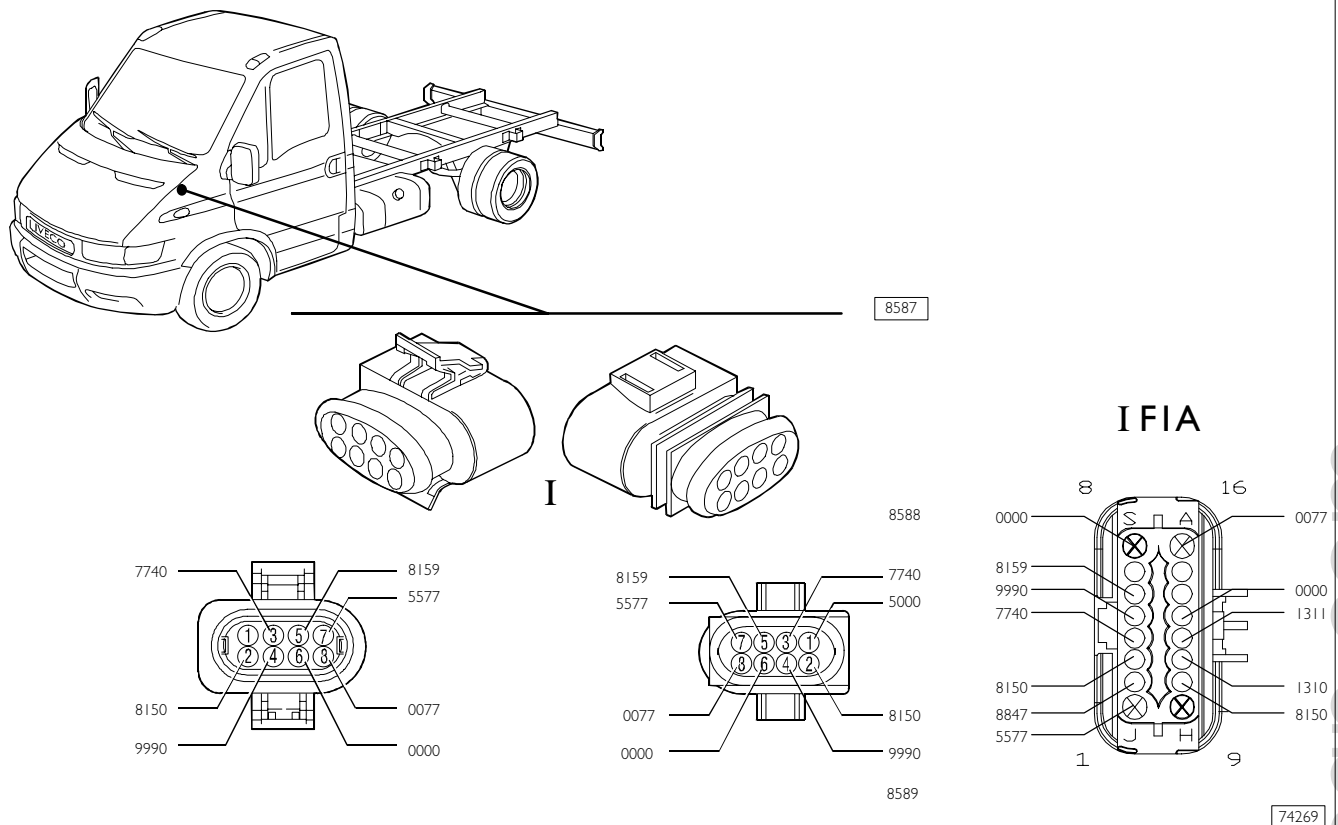
Figure 52



JUNCTION CONNECTORS

Connection between cab/bonnet cable and injection cable (Unijet)

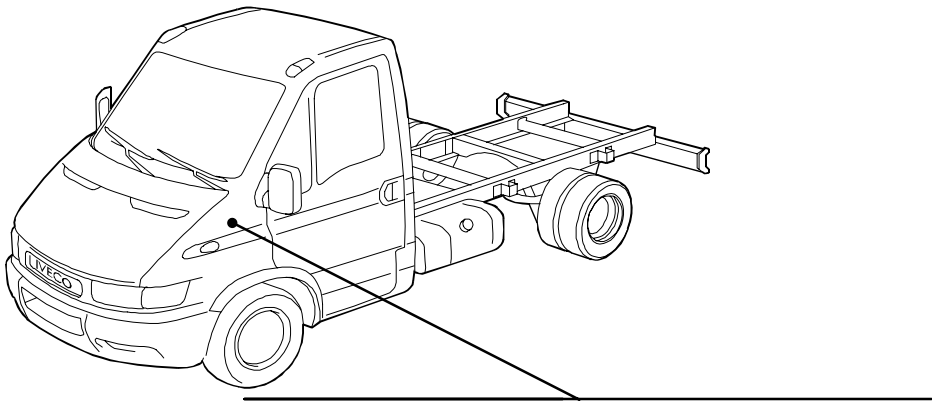
Figure 53



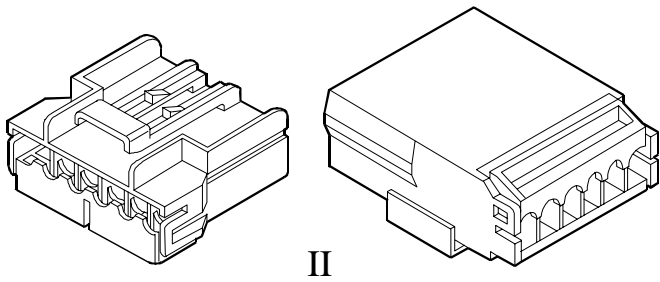
Ref.	Ref. (FIA)	Cable colour code	Function
I 1		5000	To pin 36 of EDC electronic control unit
2	3	8150	Fuel pump engagement relay
3	4	7740	Relay engagement for engine cooling electromagnetic joint control
4	5	9990	Air conditioning compressor switching off
5	6	8159	Fuel oil heating circuit switching on
6	8	0000	Earth
7	1	5577	Fuel oil heating resistance supply
8	16	0077	Fuel oil heating resistance earth
	10	8150	Preheat plug centre positive (pin-86)
	11	1310	Preheat plug centre control (pin-D1), (EDC pin-B37)
	12	1311	Preheat plug centre control (pin-ST), (EDC pin-B42)
	13	0000	Preheat plug centre mass (pin-31)
	2	8847	Speed adjustment sensor positive
	7	—	Free
	9	—	Free
	14	—	Free
	15	—	Free

Connection between cab/bonnet cable and air bag cable

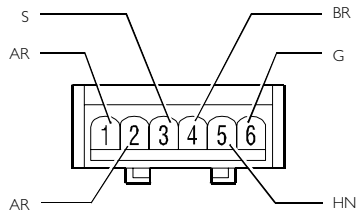
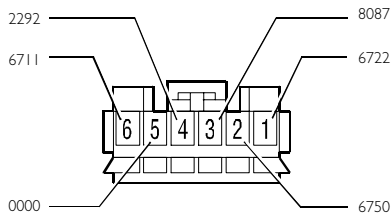
Figure 54



8587



8590

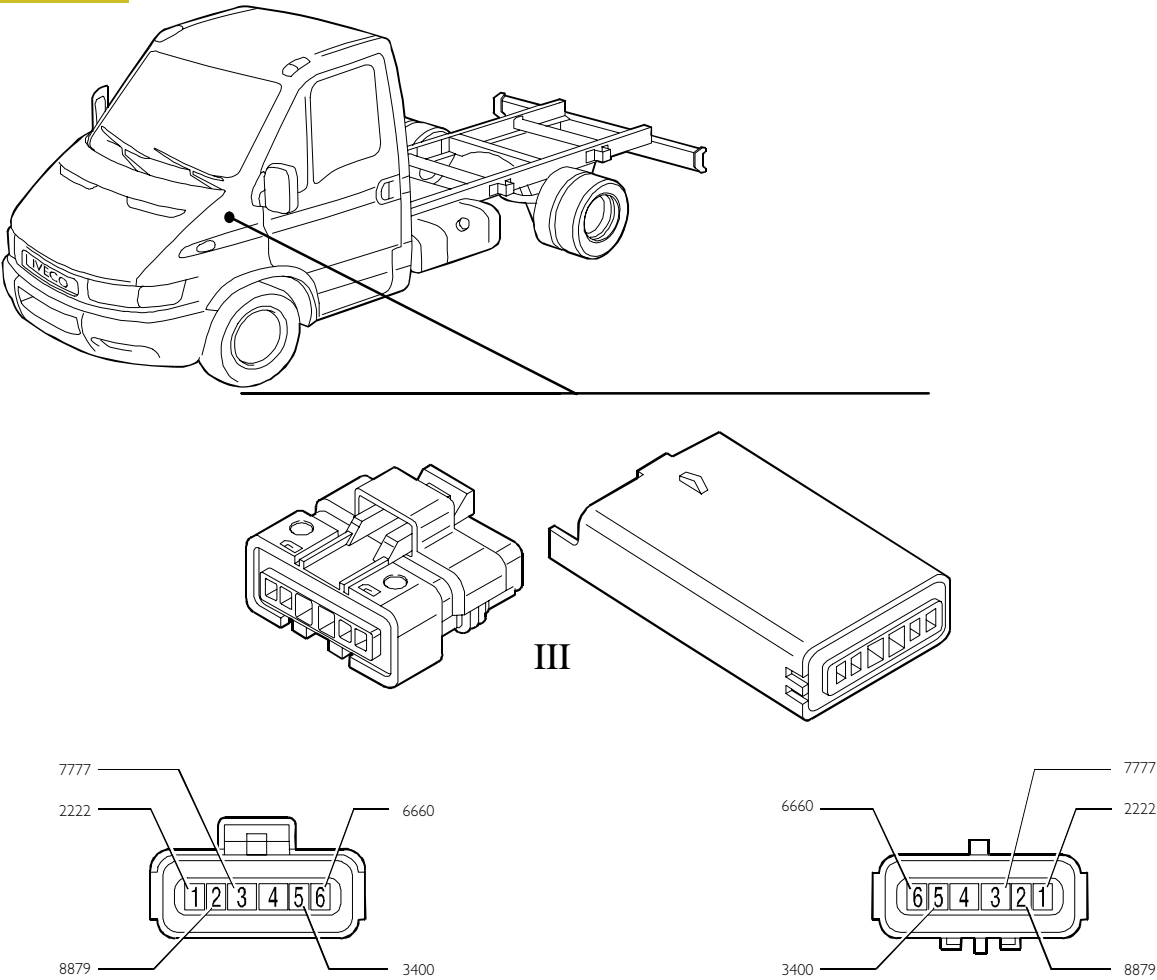


8591

Ref.	Cable colour code	Function
II	1 6722-AR	Supply (+15)
	2 6750-AR	Supply (+15)
	3 8087-S	Supply (+15) for air bag electronic control unit
	4 2292-BR	To diagnostic connector
	5 0000-HN	Earth
	6 6711-G	To air bag failure warning light

Connection between cab/bonnet cable and rear differential lock cable

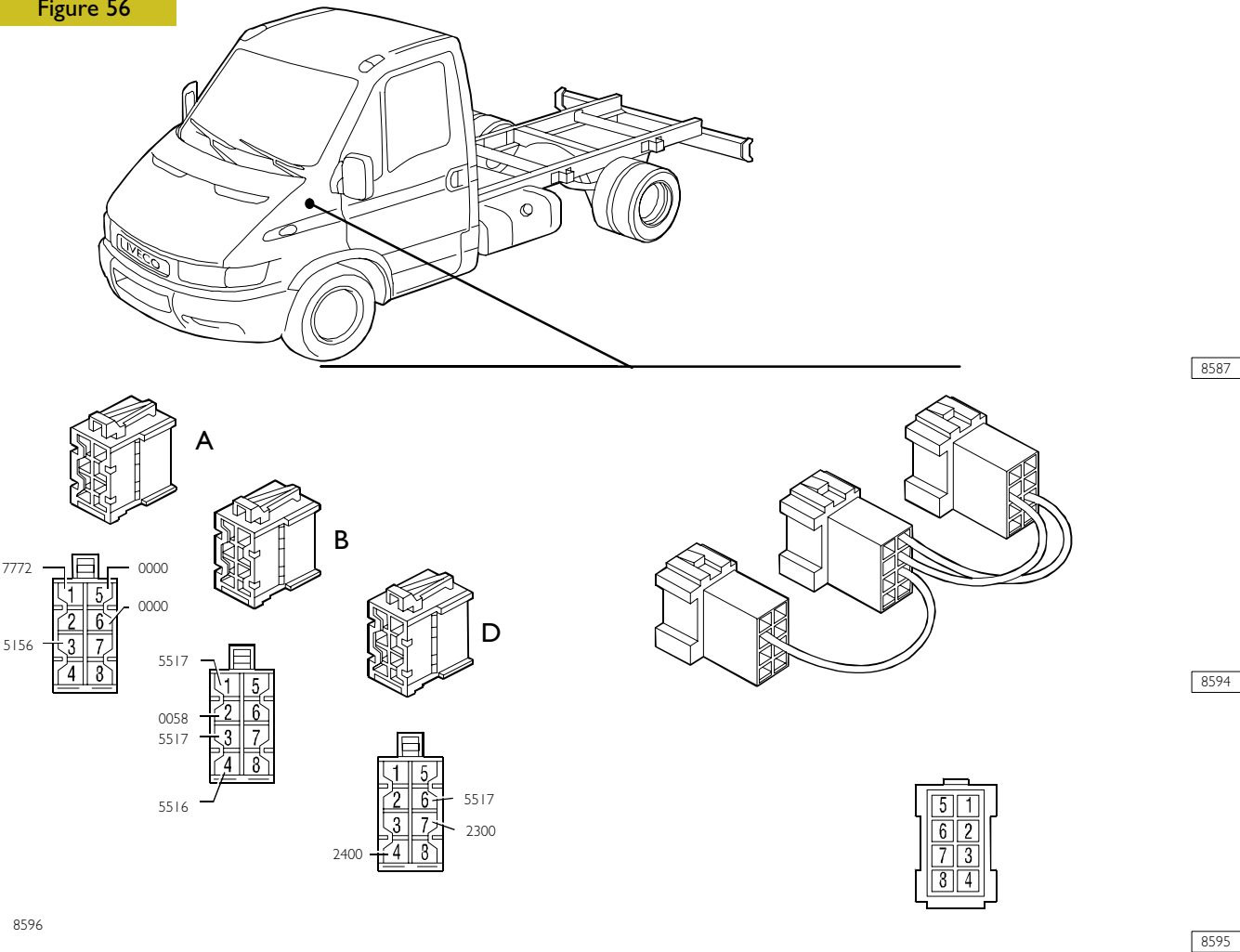
Figure 55



Ref.	Cable colour code	Function
III	1 2222	Tachometric signal
	2 8879	Supply (+15)
	3 7777	Supply (+30)
	4 –	Spare
	5 3400	Rear differential lock engagement
	6 6660	To rear differential lock on warning light

Connection between cab/bonnet cable and cable for tachometer

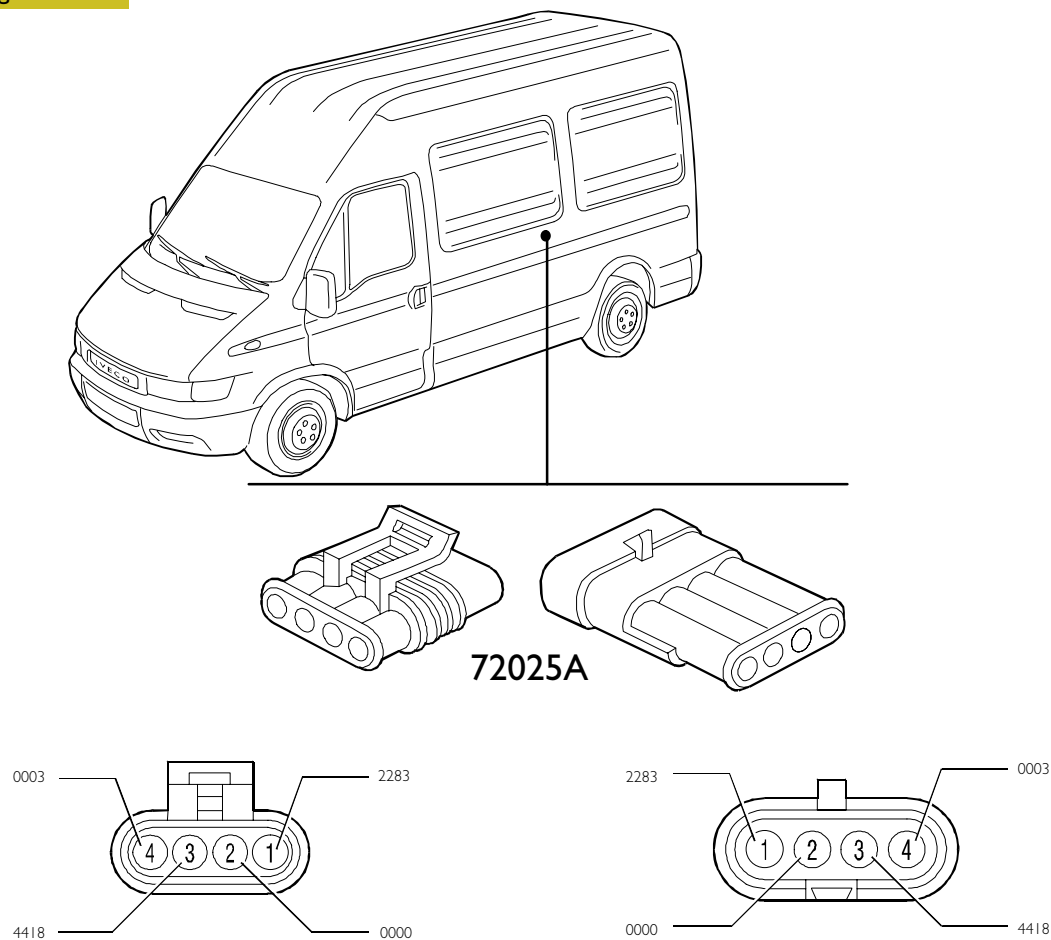
Figure 56



Ref.	Cable colour code	Function
4001IA (white)	1 7772	Supply (+30)
	2 -	Spare
	3 5156	Supply (+15)
	4 -	Spare
	5 0000	Earth
	6 0000	Earth
	7 -	Spare
	8 -	Spare
4001IB (yellow)	1 5517	Supply (+15)
	2 0058	Earth
	3 5517	Tachometric signal
	4 5516	To transmitter for tachometer
	5 -	Spare
	6 -	Spare
	7 -	Spare
	8 -	Spare
4001ID (brown)	1 -	Spare
	2 -	Spare
	3 -	Spare
	4 2400	To instrument cluster with warning lights
	5 -	Spare
	6 5517	Tachometric signal
	7 2300	To instrument cluster with warning lights
	8 -	Spare

Connection between frame cable and right tail lamp cable

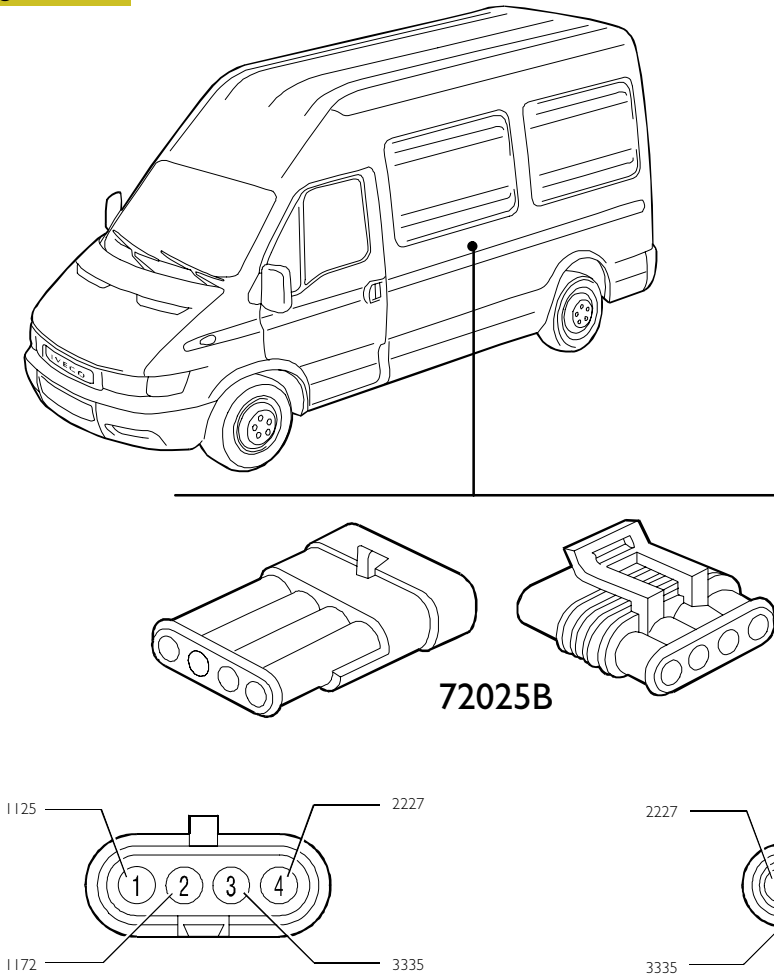
Figure 57



Ref.	Cable colour code	Function
72025A	1 2283	Rear fog guard
	2 0000	Earth
	3 4418	Rear roof lamp supply
	4 0003	Switching on interior lights

Connection between frame cable and right tail lamp cable

Figure 58



8597

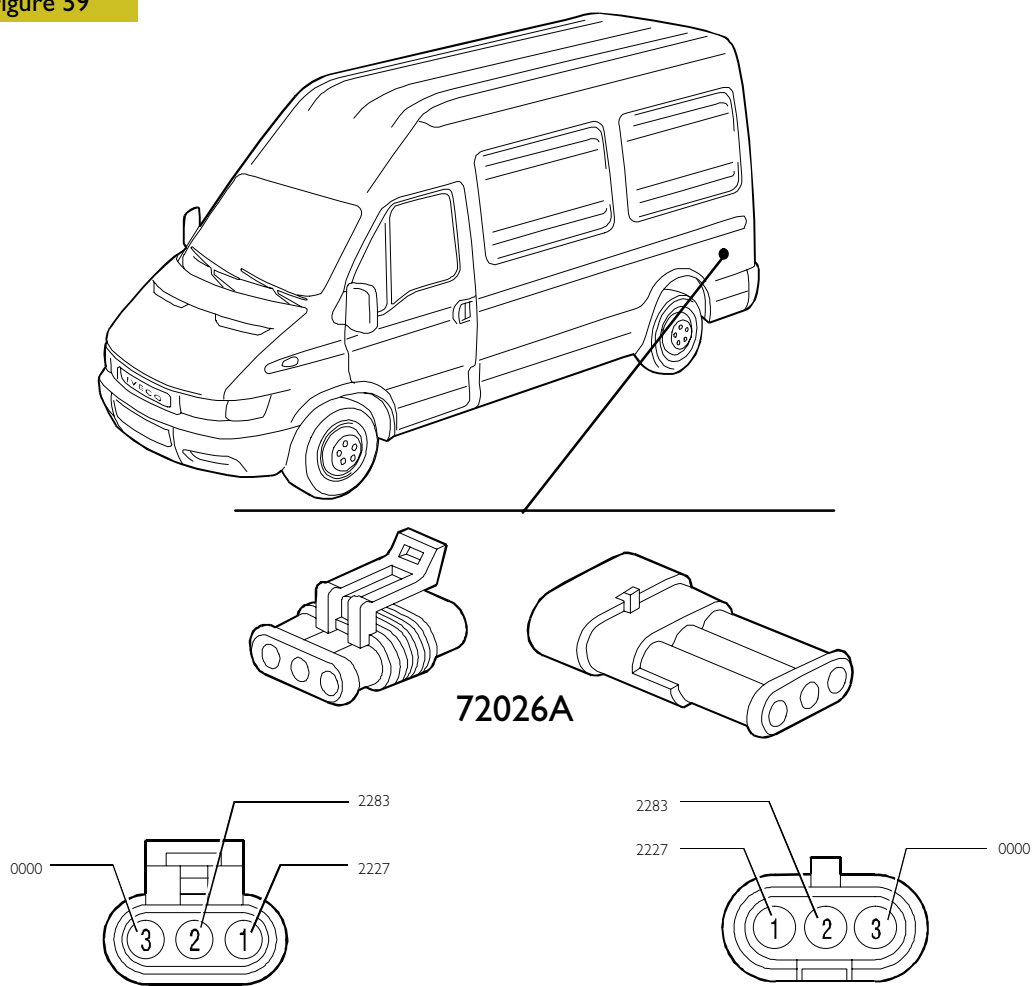
8600

8601

Ref.	Cable colour code	Function
72025B	1 1125	Direction indicator
	2 1172	Stop light
	3 3335	Side light
	4 2227	Reversing light

Connection between frame cable and left tail lamp cable

Figure 59



8597

8602

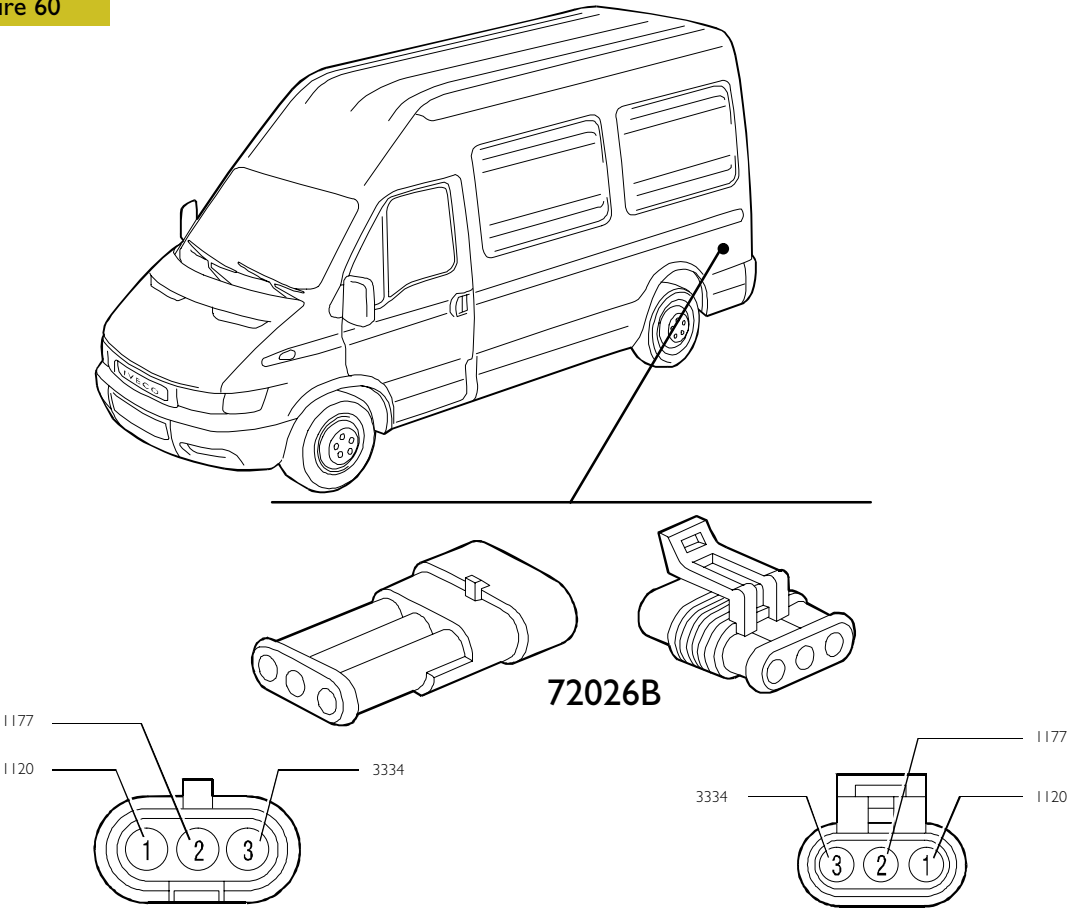
8603

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Ref.	Cable colour code	Function
72026A	1 2227	Reversing light
	2 2283	Rear fog guard
	3 0000	Earth

Connection between frame cable and left tail lamp cable

Figure 60



8597

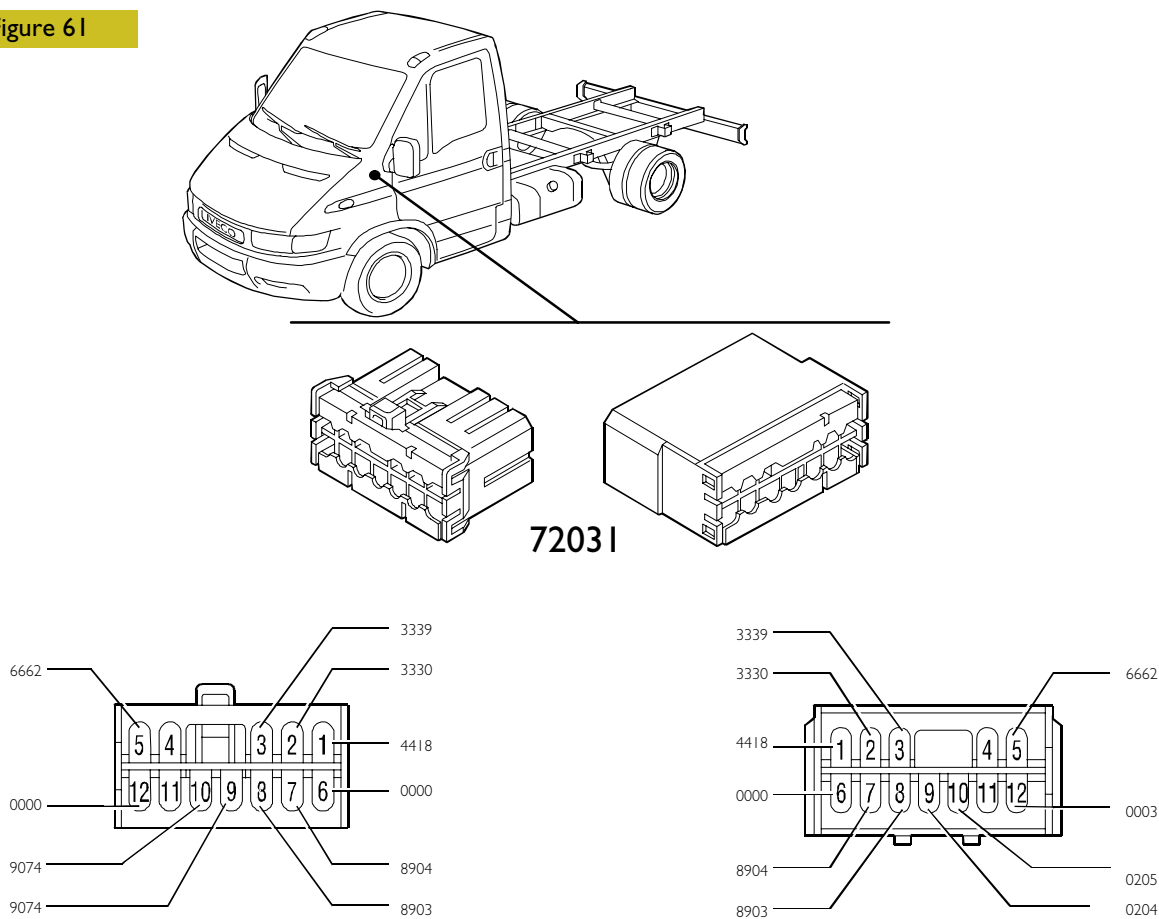
6804

8605

Ref.	Cable colour code	Function
1	1120	Direction indicator
72026B 2	1177	Stop light
3	3334	Side light

Connection between cab/bonnet cable and roof lamp cable inside cab

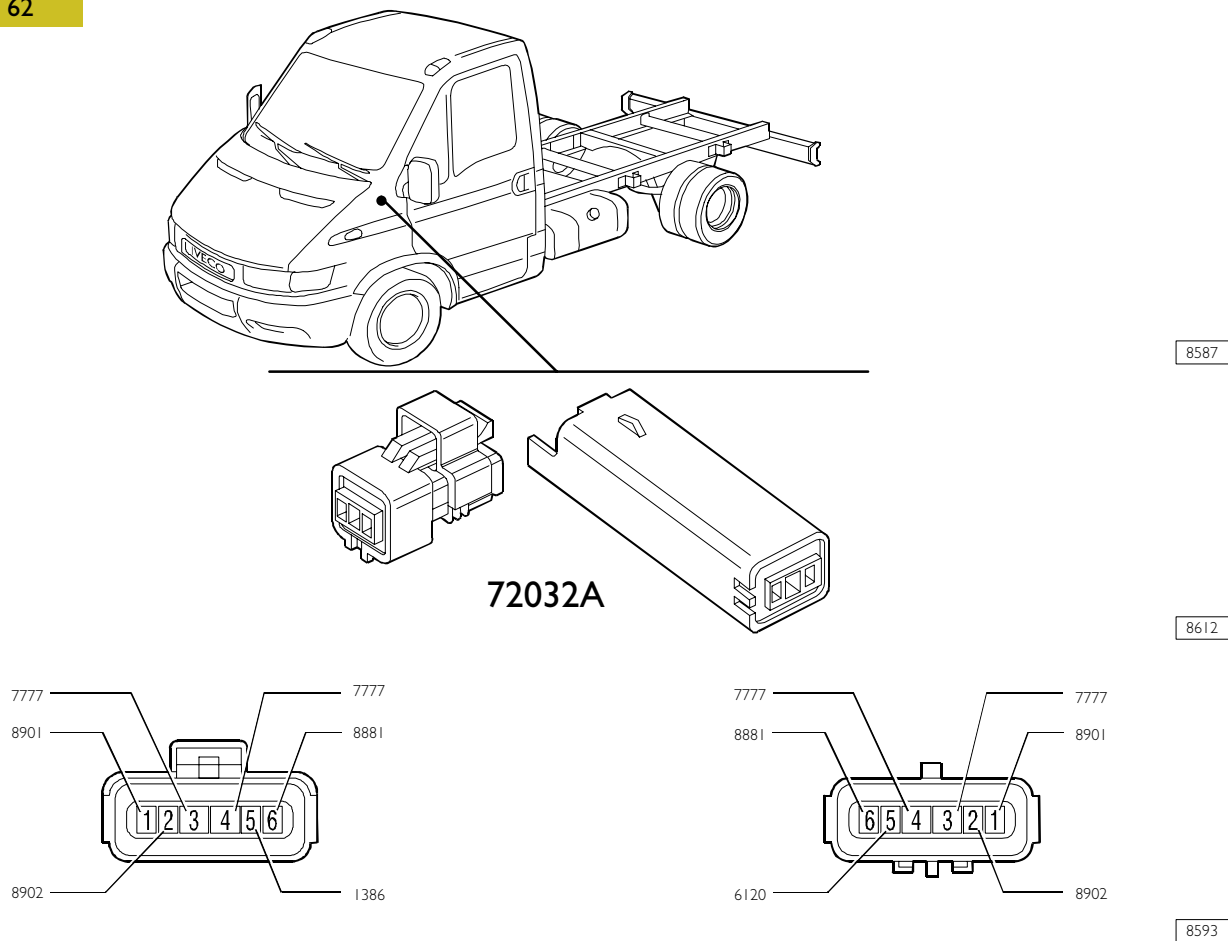
Figure 61



Ref.	Cable colour code	Function
72031	1 4418	Supply (+30)
	2 3330	Left front clearance light
	3 3339	Right front clearance light
	4 –	Spare
	5 6662	Handbrake on signal
	6 0000	Earth
	7 8904	To motor for side door closing control (van)
	8 8903	To motor for side door closing control (van)
	9 9074–0204	To switch for turning on interior lights (van)
	10 9074–0205	To switch for turning on interior lights (van)
	11 –	Spare
	12 0000–0003	Turning on roof lamp

Connection between cab/bonnet cable and 13 pin current socket cable or rear door opening/closing cable (van)

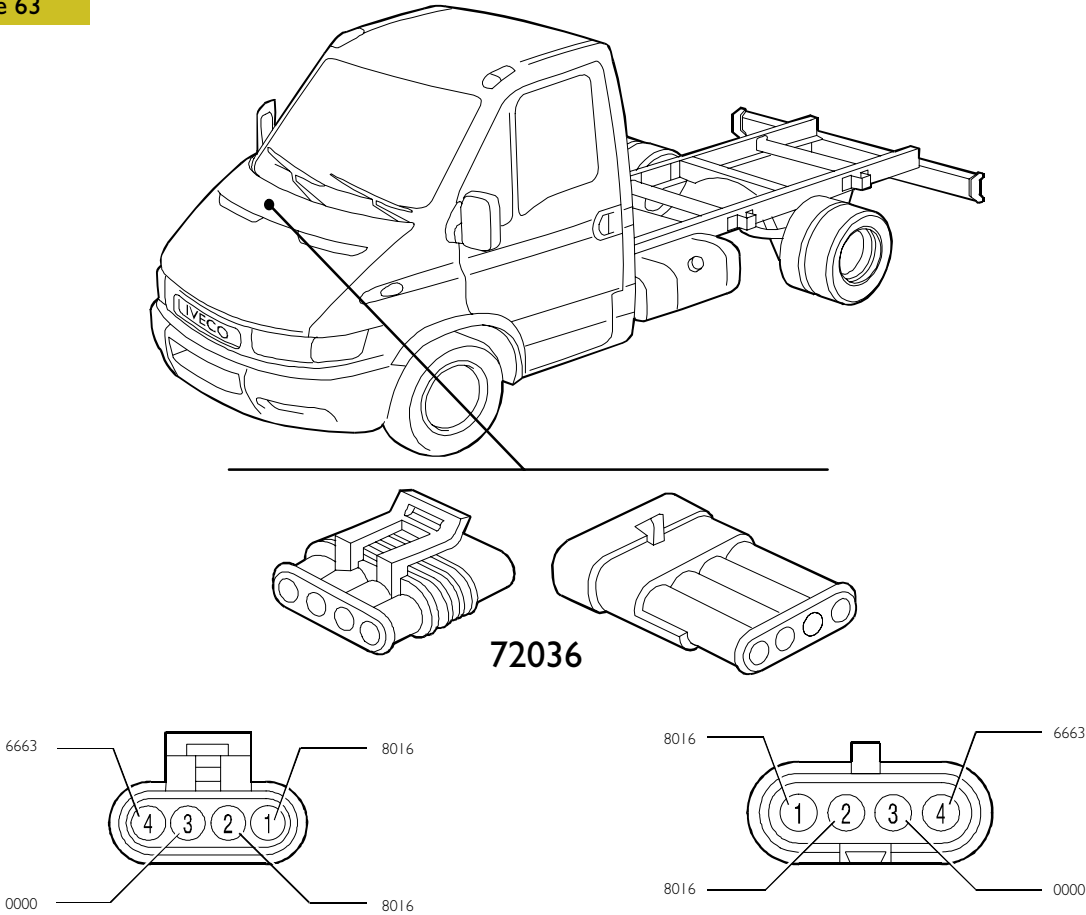
Figure 62



Ref.	Cable colour code	Function
72032A	1 8901	To pin 8 connector A of electronic control unit for central door locking
	2 8902	To pin 7 connector A of electronic control unit for central door locking
	3 7777	Supply (+30)
	4 7777	Supply (+30)
	5 1386-6120	Trailer direction indicator on signal
	6 8881	Supply (+15)

Connection between cab/bonnet cable and brake wear/air cleaner clogged cable

Figure 63



8587

8598

8601

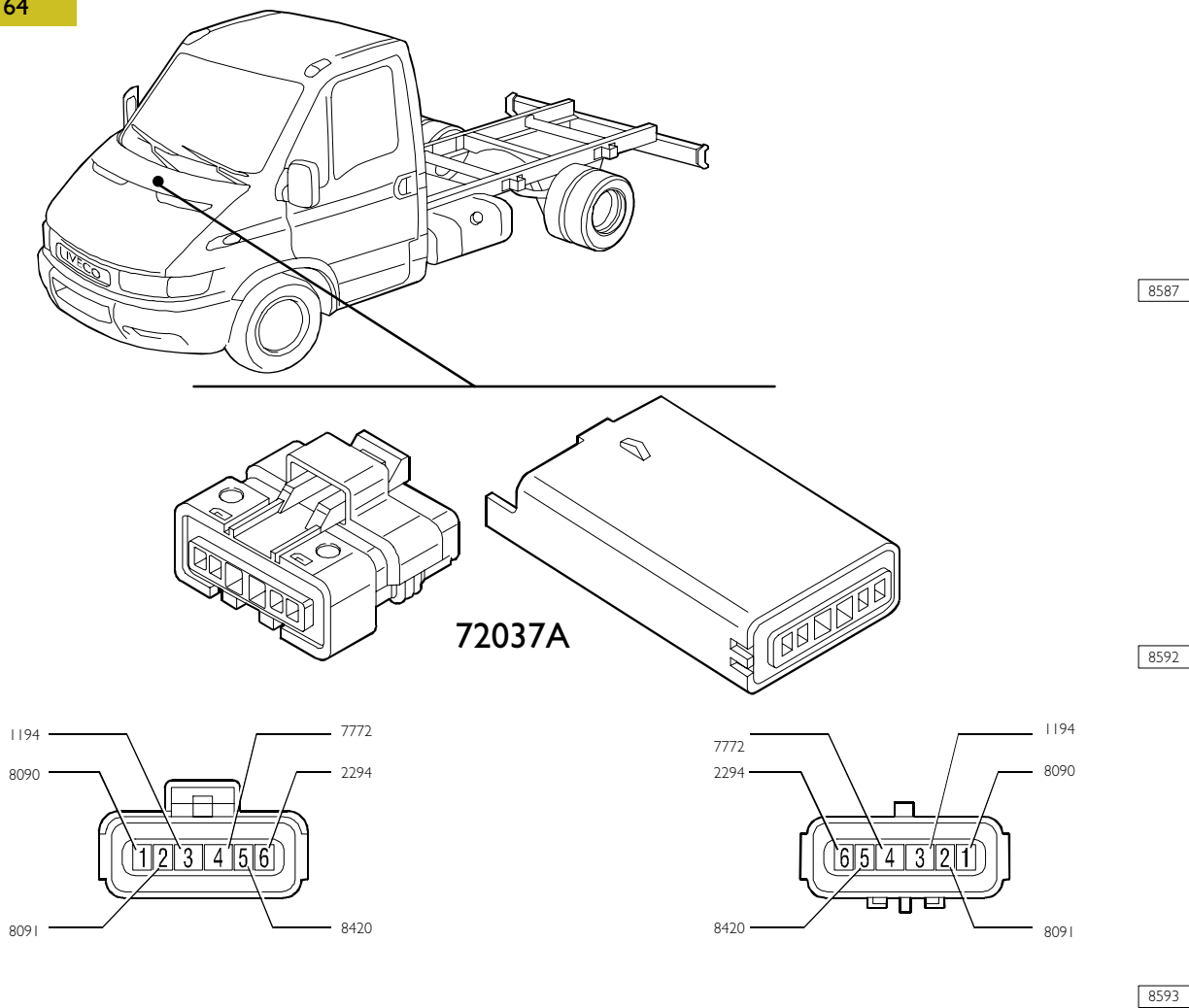
8599

cardiagn.com

Ref.	Cable colour code	Function
72036	1 8016	Brake wear signal
	2 8016	Brake wear signal
	3 0000	Earth
	4 6663	Air cleaner clogged signal

Connection between cab/bonnet cable and self-levelling suspension cable

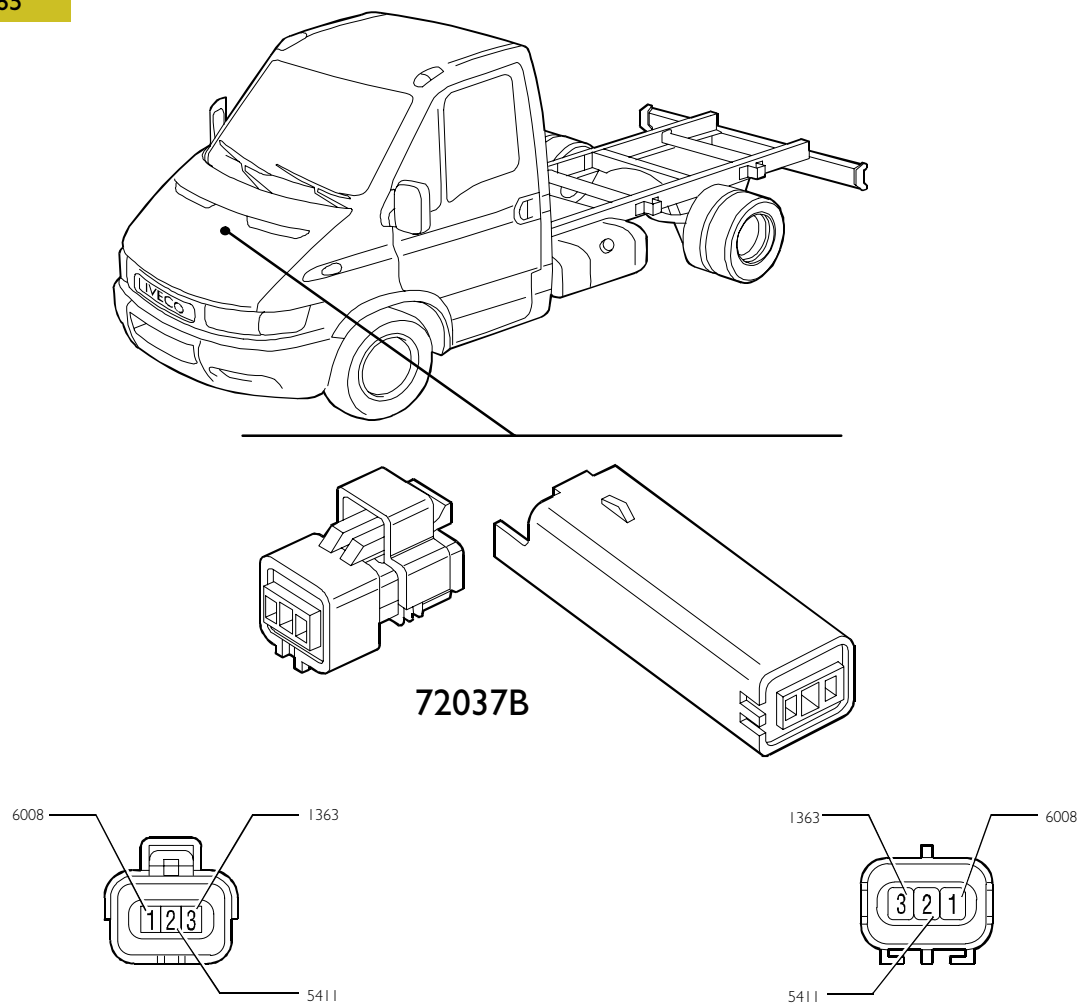
Figure 64



Ref.	Cable colour code	Function
72037A	1 8090	Supply (+15)
	2 8091	To pin 26 of electronic control unit for vehicle raising/lowering control
	3 1194	To 38-pin diagnostic connector (cell 15)
	4 7772	Supply (+30)
	5 8420	Suspension levelling control
	6 2294	To 38-pin diagnostic connector (cell 16)

Connection between cab/bonnet cable and self-levelling suspension cable

Figure 65



8587

8612

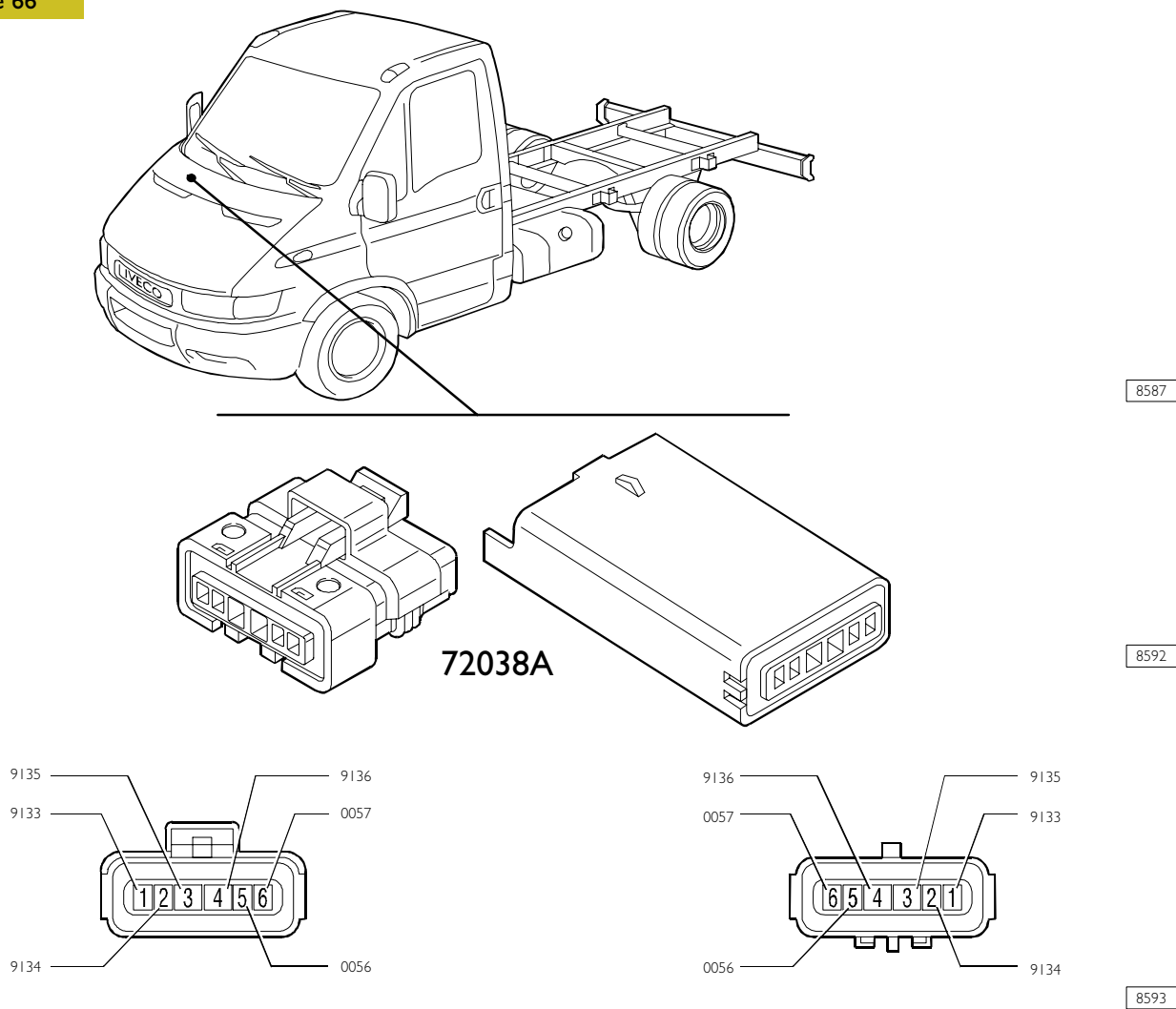
8613

cardiagn.com

Ref.	Cable colour code	Function
1	6008	Self-levelling suspension system failure signal
72037B 2	5411	Tachometric signal
3	1363	Positive with vehicle stop signal switch engaged

Connection between cab/bonnet cable and total power takeoff cable

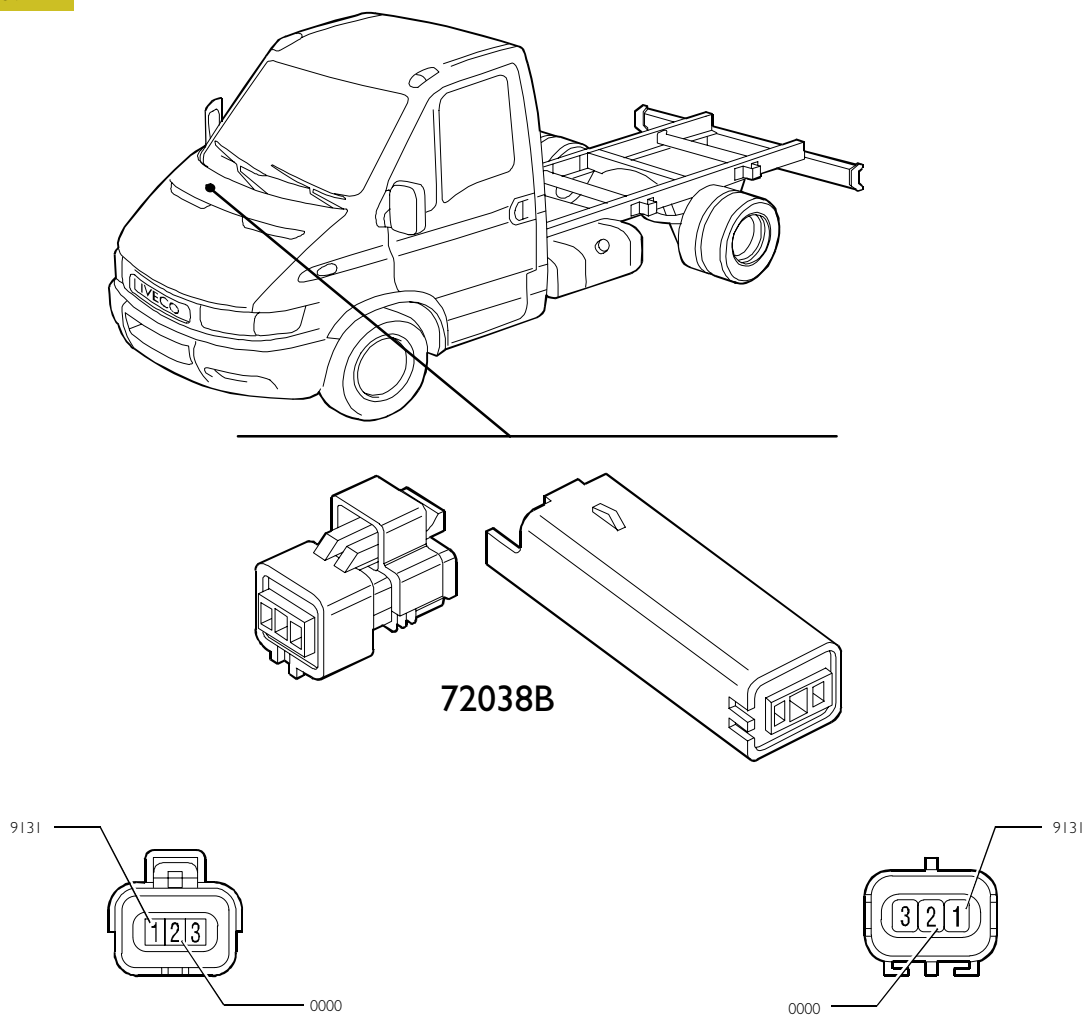
Figure 66



Ref.	Cable colour code	Function
72038A	1 9133	To electronic control unit for switching on total power takeoff (connector P2 cell 3)
	2 9134	To electronic control unit for switching on total power takeoff (connector P2 cell 4)
	3 9135	To electronic control unit for switching on total power takeoff (connector P2 cell 5)
	4 9136	To electronic control unit for switching on total power takeoff (connector P2 cell 6)
	5 0056	To electronic control unit for switching on total power takeoff (connector P2 cell 7)
	6 0057	To electronic control unit for switching on total power takeoff (connector P2 cell 8)

Connection between cab/bonnet cable and total power takeoff cable

Figure 67



8587

8612

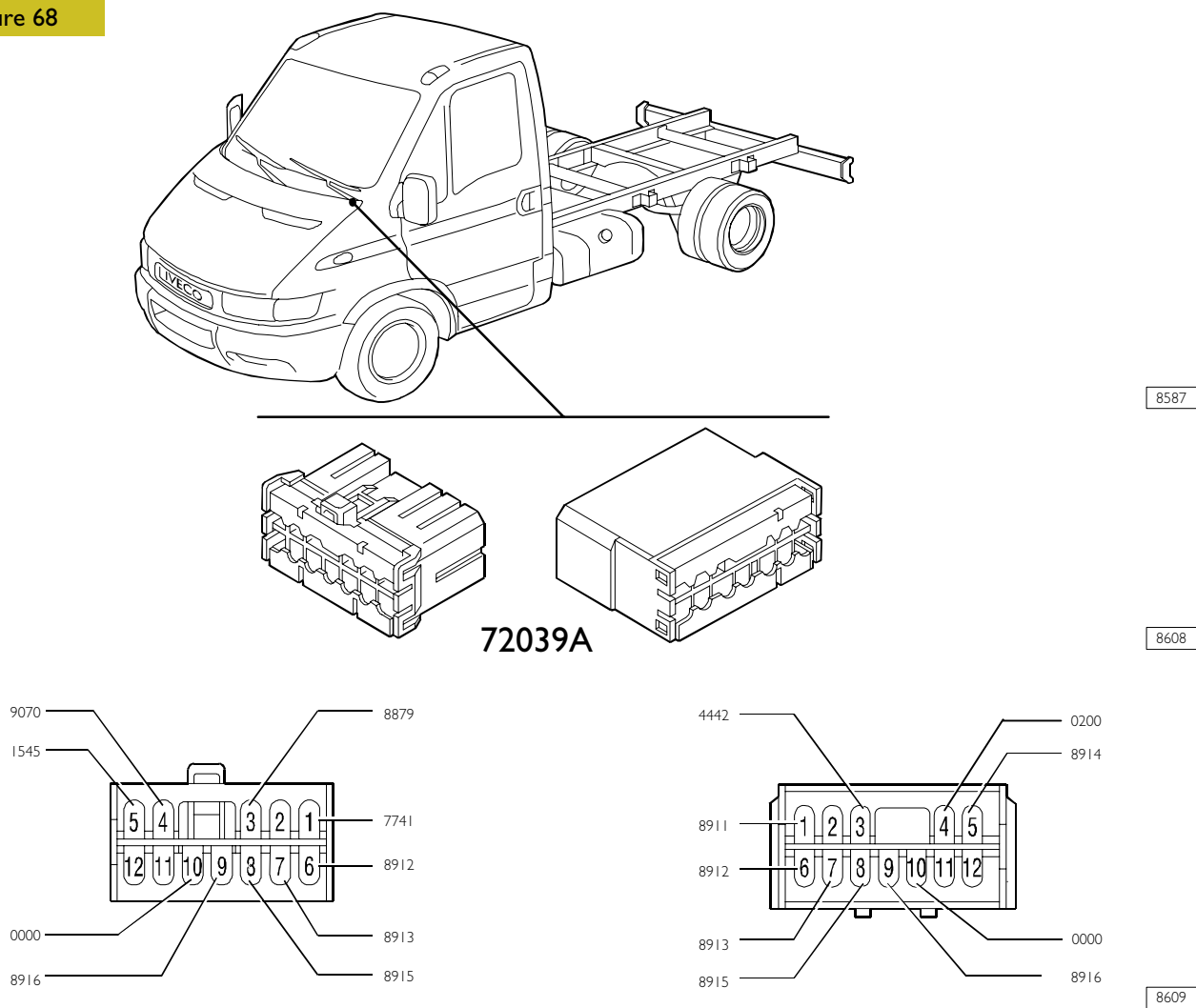
8613

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Ref.	Coble colour code	Function
1	9131	To switch for total power takeoff engaged signal
72038B 2	0000	Earth
3	—	Spare

Connection between cab/bonnet cable and antitheft cable

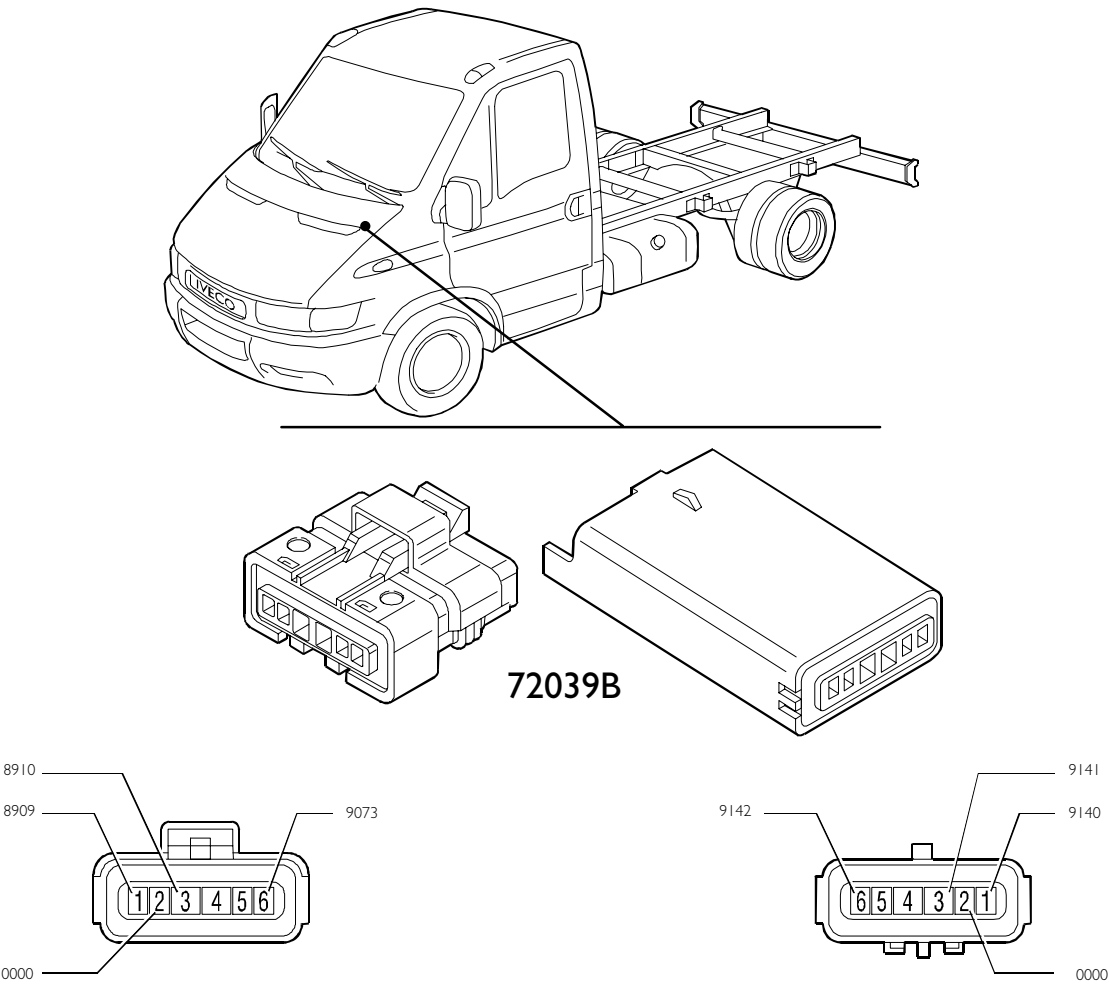
Figure 68



Ref.	Cable colour code	Function
72039A	1 7741-8911	Supply (+30)
	2 -	Spare
	3 8879-4442	Supply (+15)
	4 9070-0200	To switch for locking rear door (van)
	5 1545-8914	To volumetric sensor
	6 8912	To volumetric sensor
	7 8913	To volumetric sensor
	8 8915	To volumetric sensor
	9 8916	To volumetric sensor
	10 0000	Earth
	11 -	Spare
	12 -	Spare

Connection between cab/bonnet cable and antitheft cable with central door locking

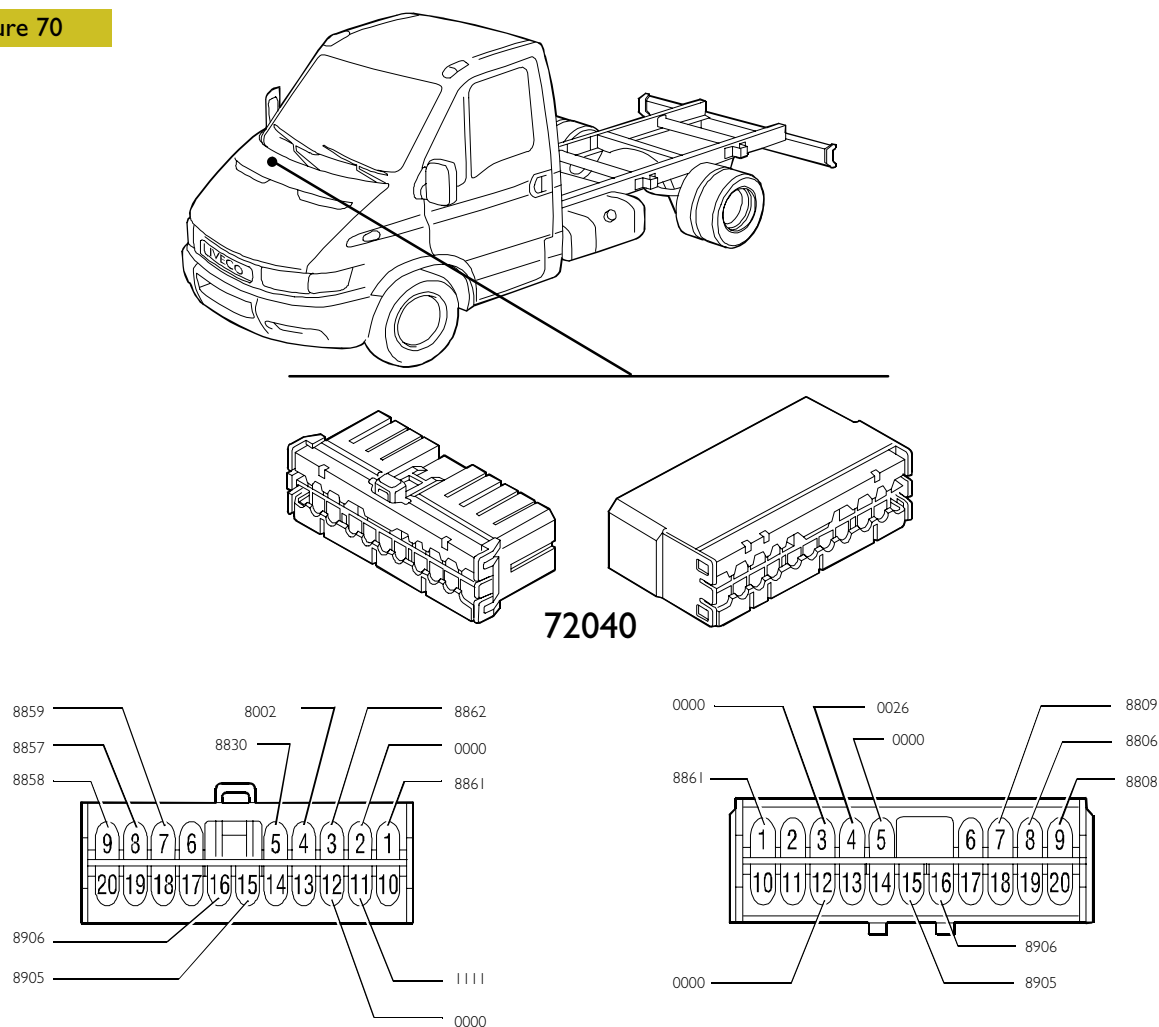
Figure 69



Ref.	Cable colour code	Function
72039B	1 8909-9140	Supply (+15)
	2 0000	Earth
	3 8910-9141	Supply (+30)
	4 -	Spare
	5 -	Spare
	6 9073-9142	To self-powered siren for alarm

Connection between cab/bonnet cable and right door cable

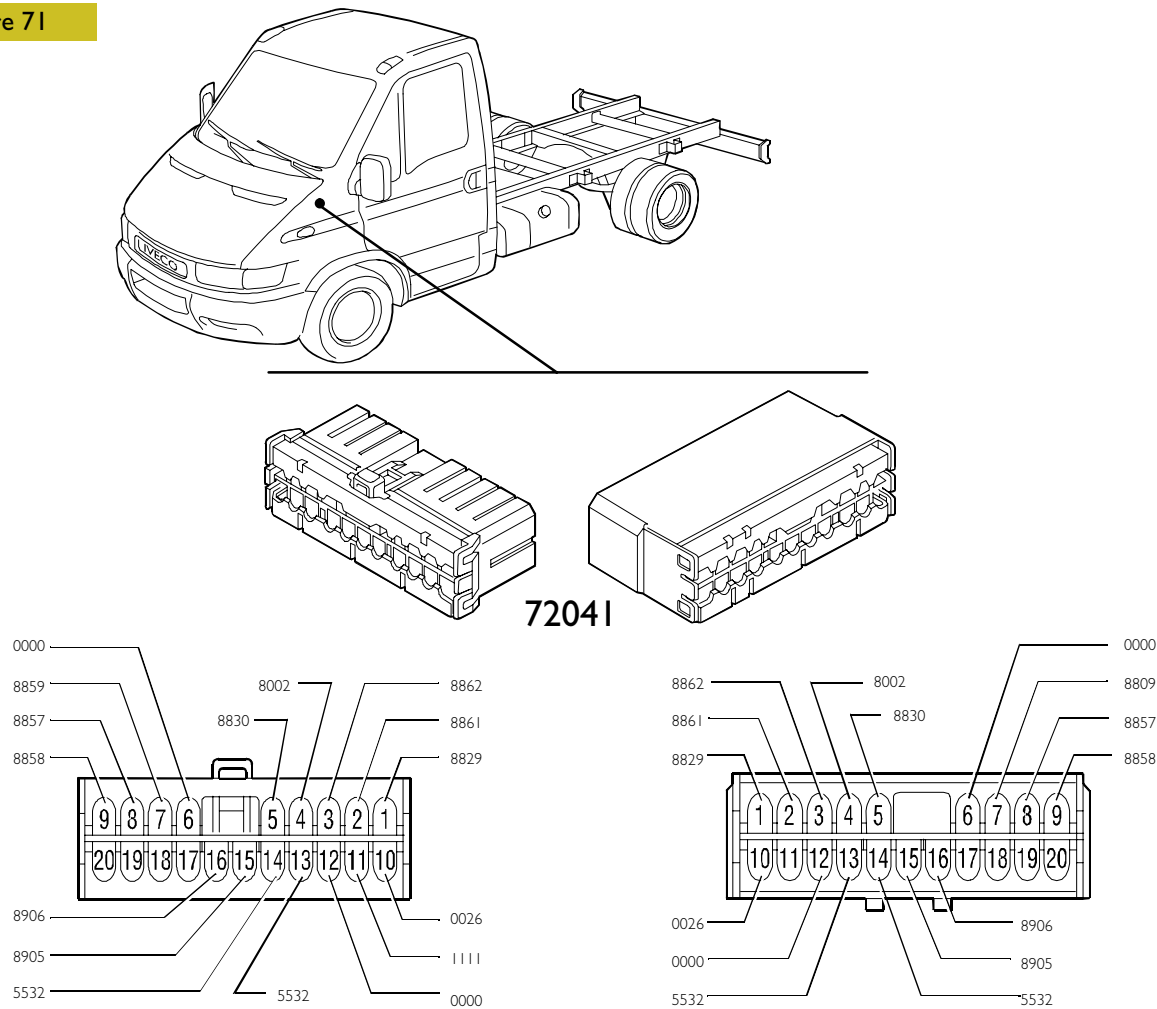
Figure 70



Ref.	Cable colour code	Function
72040	1 8861	Supply (+15/A)
	2 0000	Earth
	3 8862-0000	Connection between switches for passenger's door power window
	4 8002-0026	Connection between switches for passenger's door power window
	5 8830	Heated rear-view mirror
	6 -	Spare
	7 8859-8809	Electrically-operated aimable mirror
	8 8857-8806	Electrically-operated aimable mirror
	9 8858-8808	Electrically-operated aimable mirror
	10 -	Spare
	11 1111	To connection between cab/bonnet cable and left door cable
	12 0000	Earth
	13 -	Spare
	14 -	Spare
	15 8905	To door closing control motor
	16 8906	To door closing control motor
	17 -	Spare
	18 -	Spare
	19 -	Spare
	20 -	Spare

Connection between cab/bonnet cable and left door cable

Figure 71



8587

8614

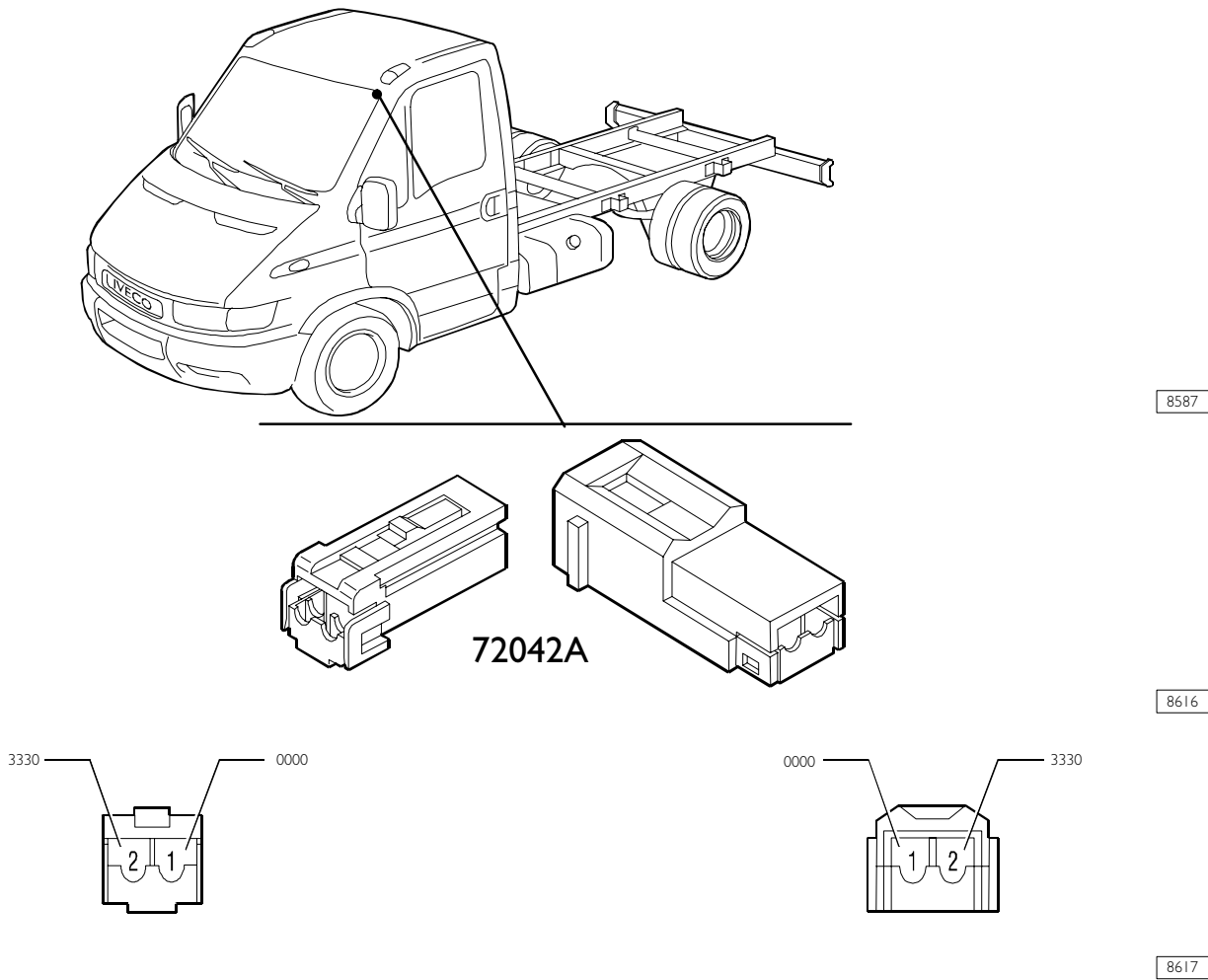
8615

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Ref.	Cable colour code	Function
72041	1 8829	Supply (+15)
	2 8861	Supply (+15/A)
	3 8862	Connection between switches for passenger's door power window
	4 8002	Connection between switches for passenger's door power window
	5 8830	Heated rear-view mirror
	6 0000	Earth
	7 8859-8809	Electrically-operated aimable mirror
	8 8857	Electrically-operated aimable mirror
	9 8858	Electrically-operated aimable mirror
	10 0026	Earth
	11 1111	To connection between cab/bonnet cable and left door cable
	12 0000	Earth
	13 5532	To outside temperature sensor
	14 5532	To outside temperature sensor
	15 8905	To door closing control motor
	16 8906	To door closing control motor
	17 -	Spare
	18 -	Spare
	19 -	Spare
	20 -	Spare

Connection between cab roof lamp and left front clearance light cable

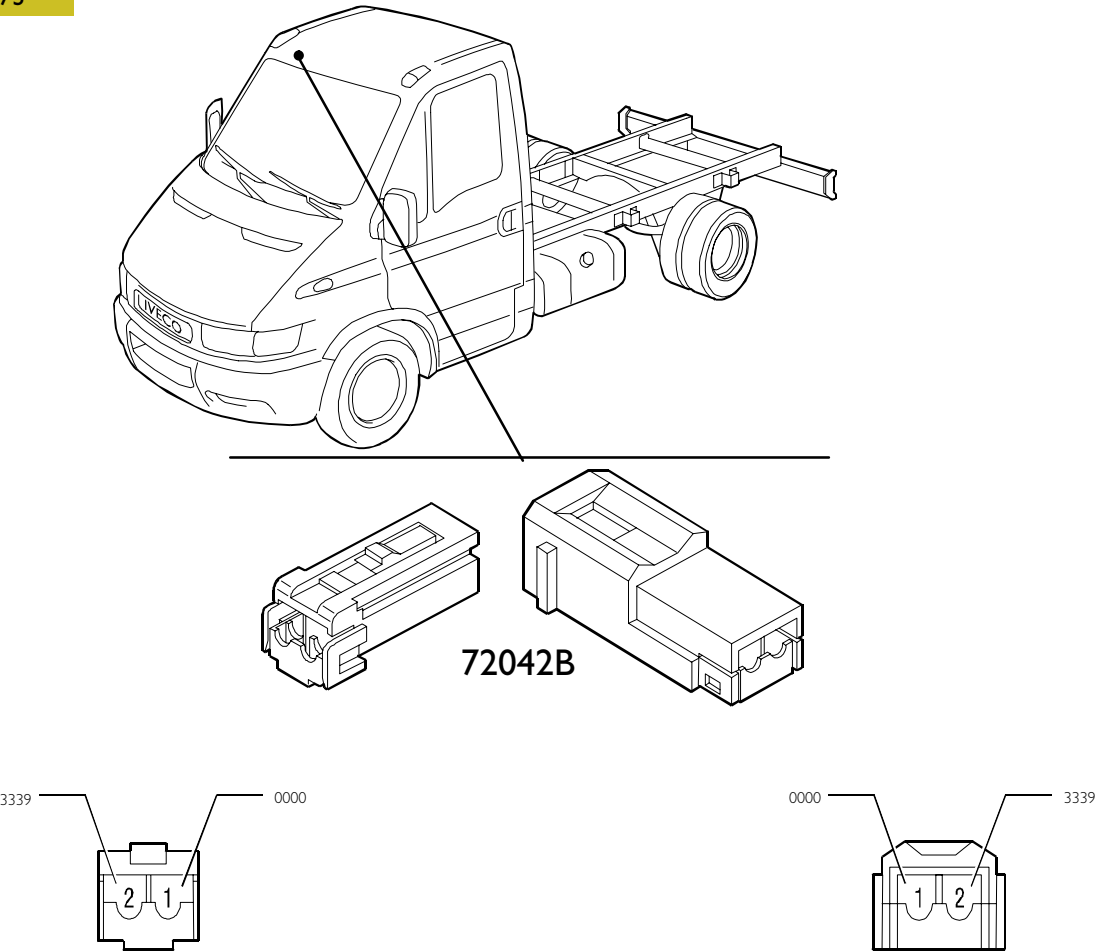
Figure 72



Ref.	Cable colour code	Function
72042A	1 0000	Earth
	2 3330	Front clearance light

Connection between cab roof lamp and right front clearance light cable

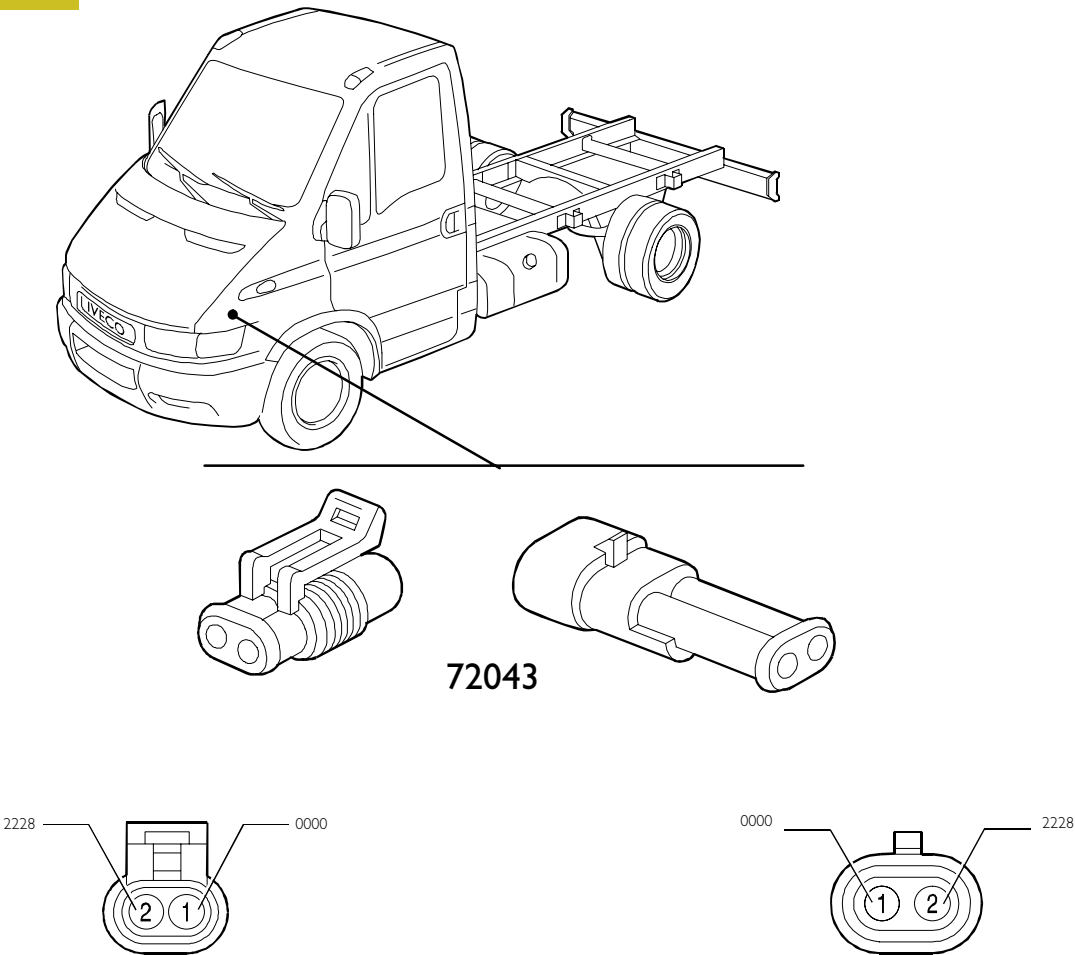
Figure 73



Ref.	Cable colour code	Function
72042B	1 0000	Earth
	2 3330	Front clearance light

Connection between cab/bonnet cable and fog lamp cable

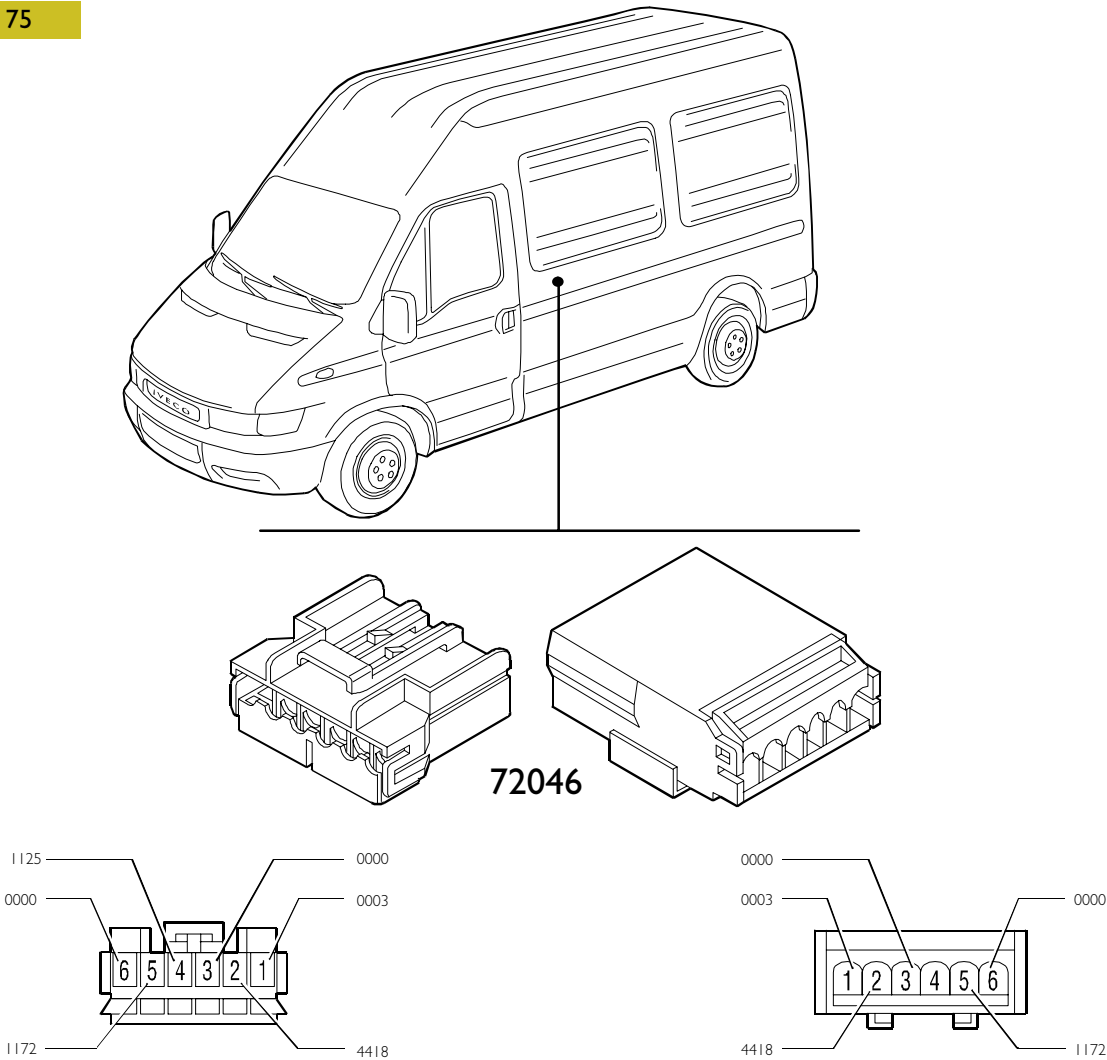
Figure 74



Ref.	Cable colour code	Function
72043	1 0000	Earth
	2 2228	Fog lamps

Connection between right tail light cable and rear roof lamp cable

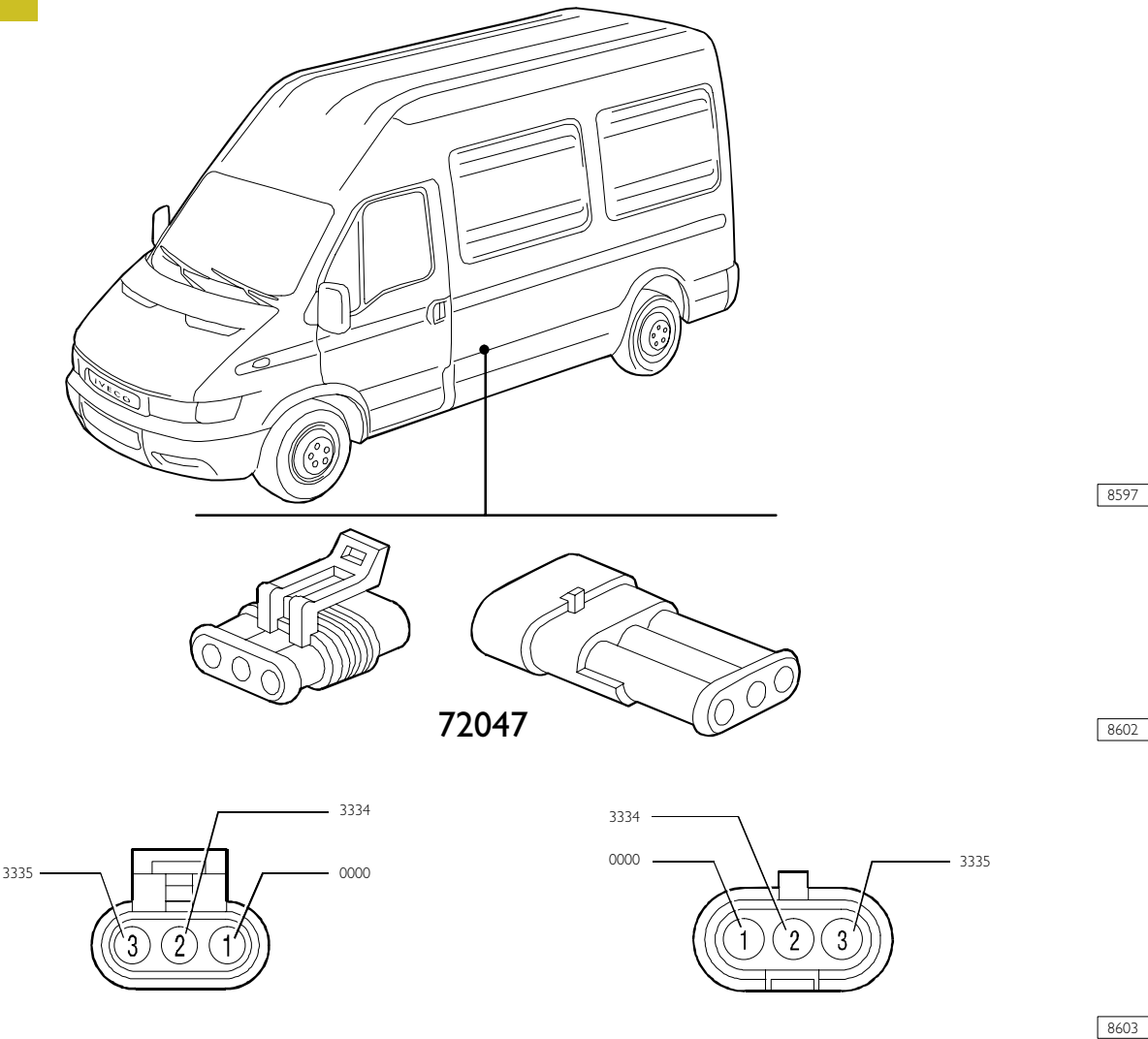
Figure 75



Ref.	Cable colour code	Function
72046	1 0003	Switching on roof lamp
	2 4418	Supply (+30)
	3 0000	Earth
	4 1125	Positive with direction indicators/hazard warning lights on
	5 1172	Additional stop light
	6 0000	Earth

Connection between frame cable and side clearance lights cable

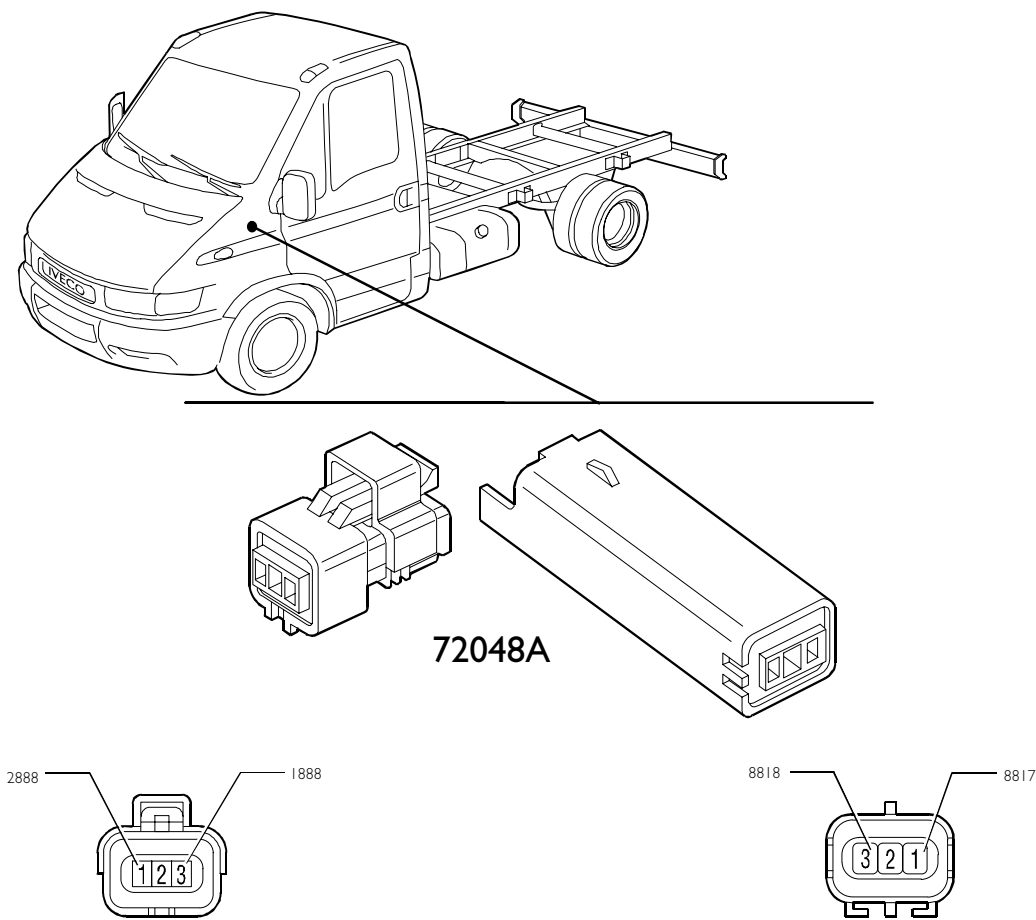
Figure 76



Ref.	Cable colour code	Function
72047	1 0000	Earth
	2 3334	Vehicle right side clearance lights
	3 3335	Vehicle left side clearance lights

Connection between cab/bonnet cable and ABS cable

Figure 77



8587

8612

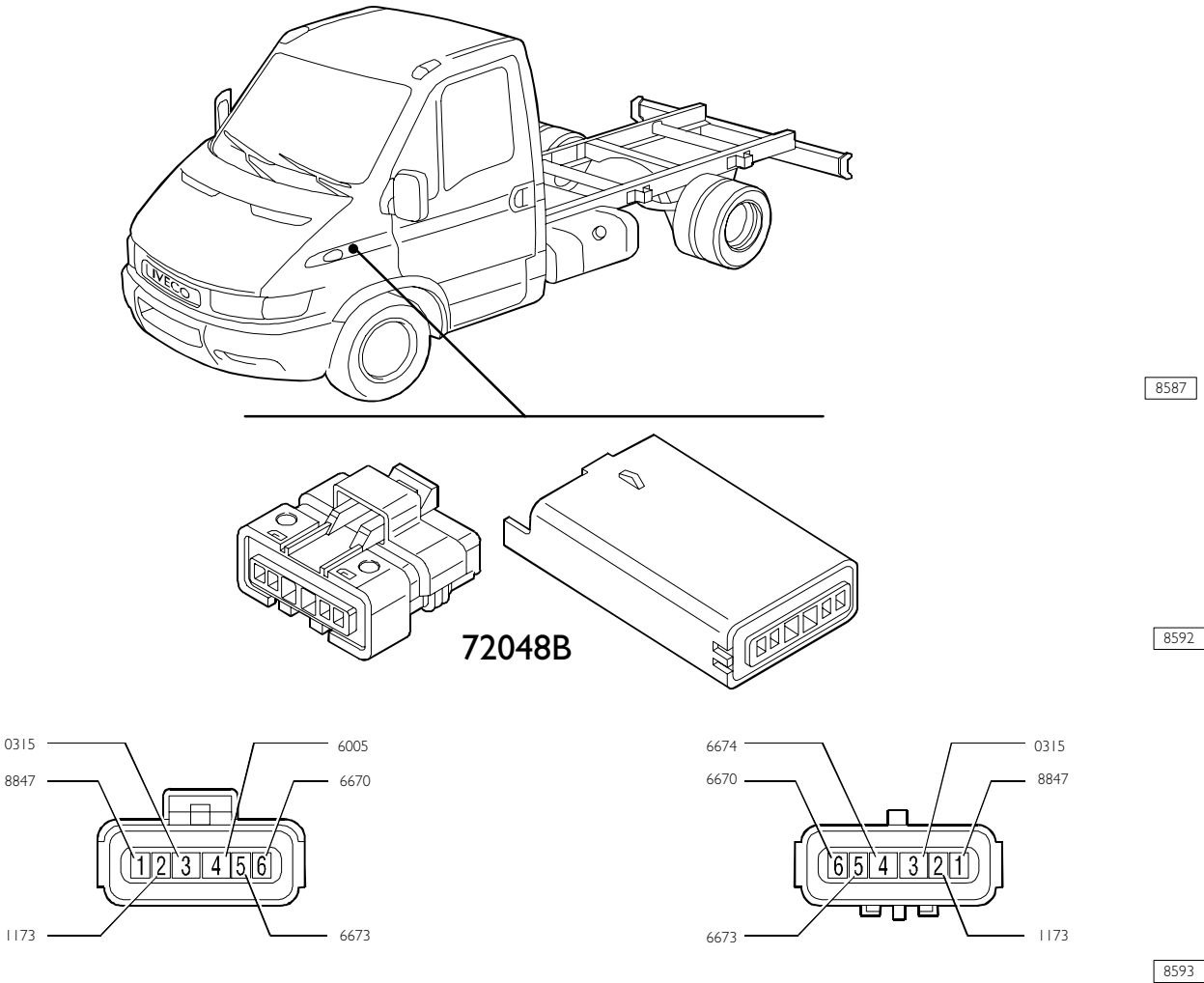
8613

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Ref.	Cable colour code	Function
72048A	1 2888-8817	To 38-pin diagnostic connector (cell 4)
	2 -	Spare
	3 1888-8818	To 38-pin diagnostic connector (cell 3)

Connection between cab/bonnet cable and ABS cable

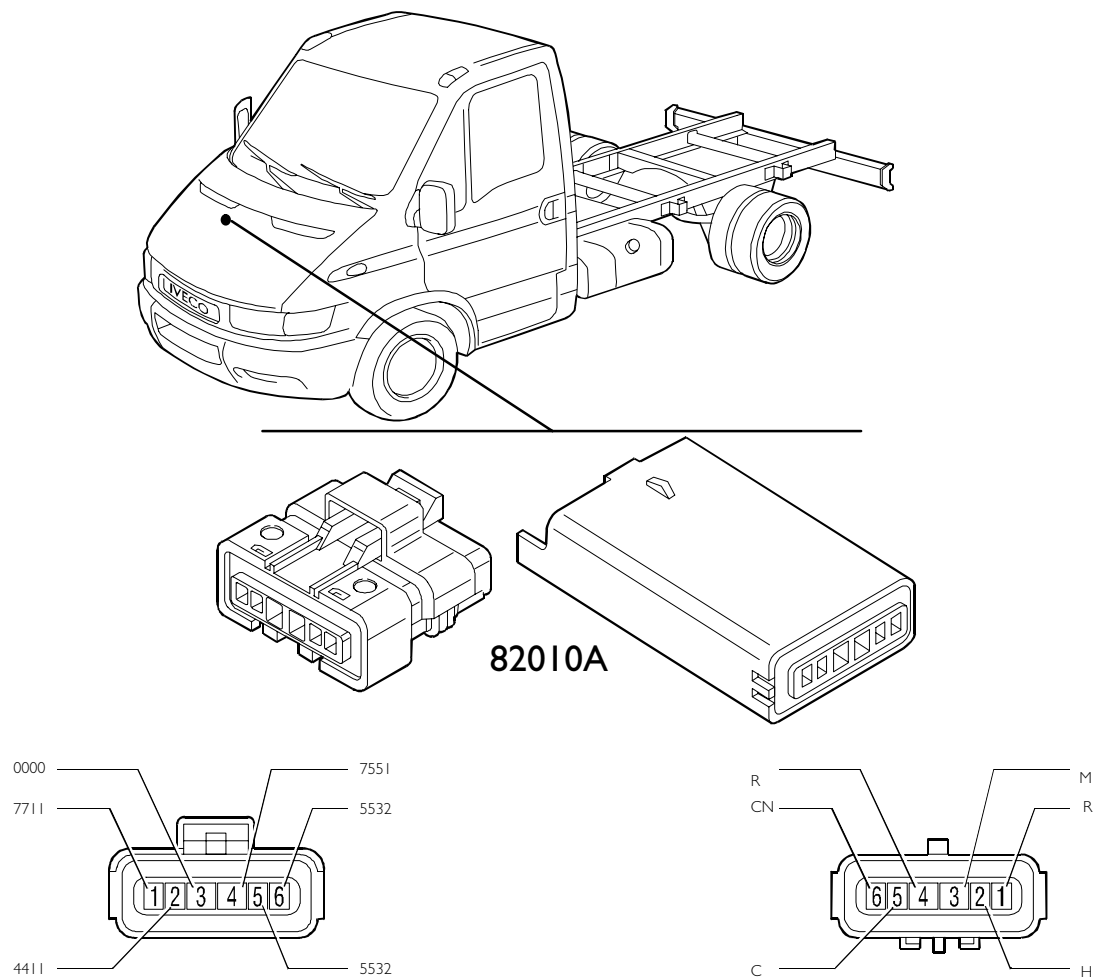
Figure 78



Ref.	Cable colour code	Function
72048B	1 8847	Supply (+15)
	2 1173	Positive with switch for vehicle stop engaged signal
	3 0315	Switching off retarder
	4 6005–6674	ABD device on signal
	5 6673	EBD device failure signal
	6 6670	ABS device failure signal

Connection between cab/bonnet cable and climate control system cable

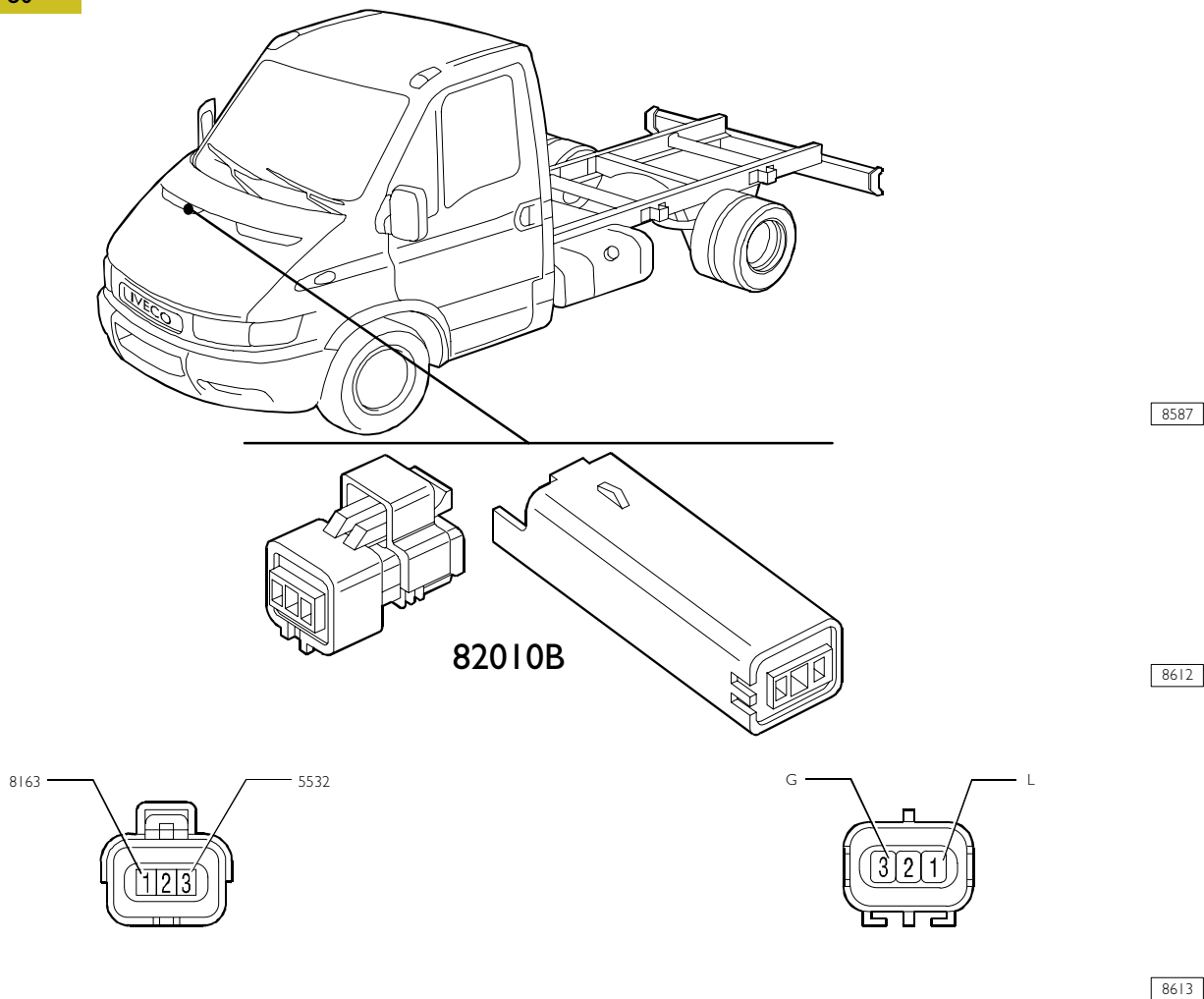
Figure 79



Ref.	Cable colour code	Function
82010A	1 7551-R	Supply (+30)
	2 4411-H	Positive with side lights on
	3 0000-M	Earth
	4 7711-R	Supply (+15/A)
	5 5532-C	Outside temperature detection
	6 5532-CN	Outside temperature detection

Connection between cab/bonnet cable and climate control system cable

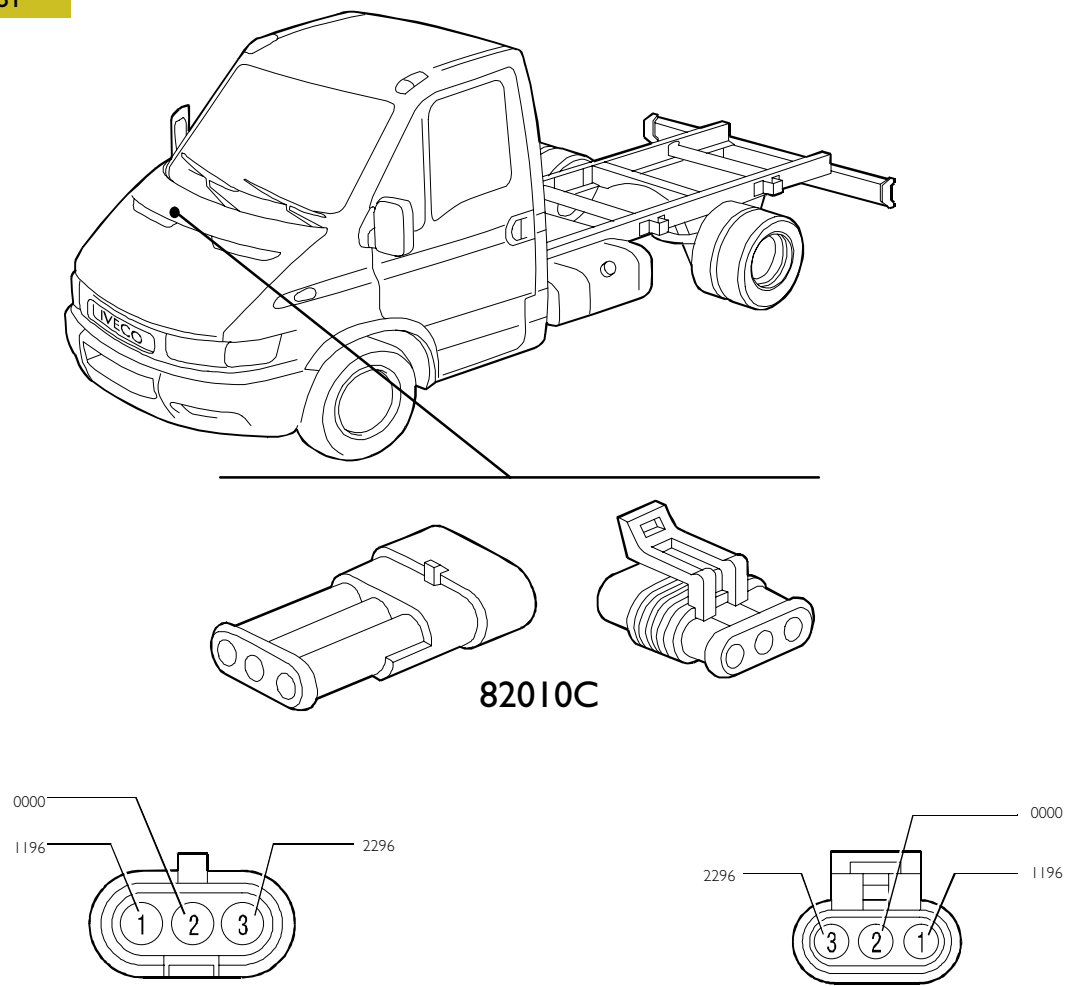
Figure 80



Ref.	Cable colour code	Function
82010B	1 8163-L	To set of 3 switches for coolant fluid pressure signal
	2 -	Spare
	3 5532-G	To instrument cluster with warning lights (connector B pin 11)

Connection between cab/bonnet cable and climate control system cable

Figure 81



8587

8604

8605

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Ref.	Cable colour code	Function
82010C	1 1196	To 38-pin diagnostic connector (cell 13)
	2 —	Spare
	3 2296	To 38-pin diagnostic connector (cell 14)

VENDOR-DERIVED BUS VERSION

General Information

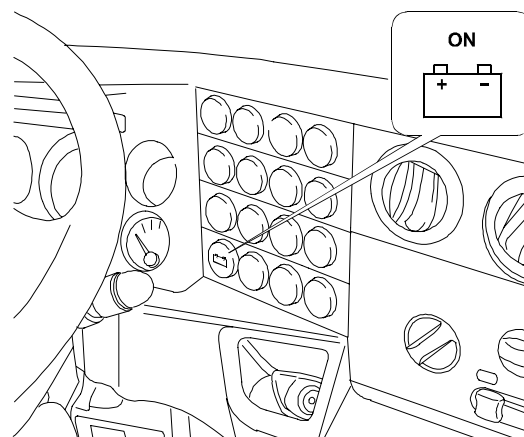
Within this handbook, school-buses are included in the Bus version. If compared to other vehicles, Buses are provided with different interior lighting harness.

The TGC switch position on dashboard panel is shown in the Push-button location Figure 82 while the main switch is located in the engine compartment near the oil filter (Figure 83). To turn the TGC off, turn the ignition key-switch to STOP and turn off the general safety switch 52029 Figure 84 ref. 1, on the left of the steering wheel.

A perspective view of the interior lighting harness is provided in Figure 85.

Figure 84 ref. 2 shows the fan control switch.

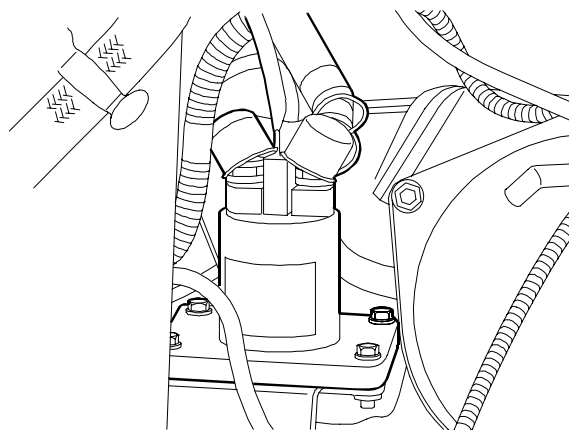
Figure 82



73728

TGC CONTROL SWITCH

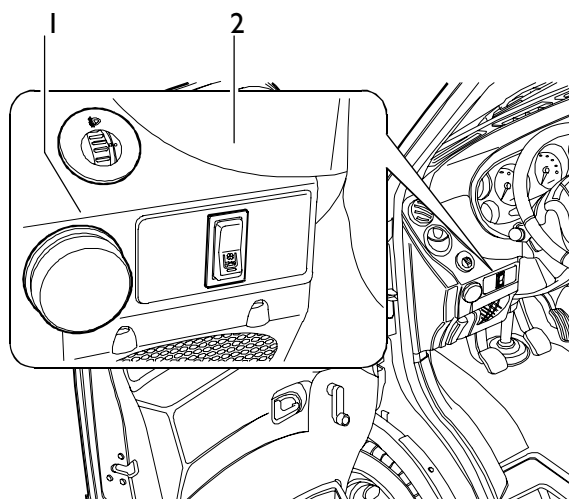
Figure 83



73717

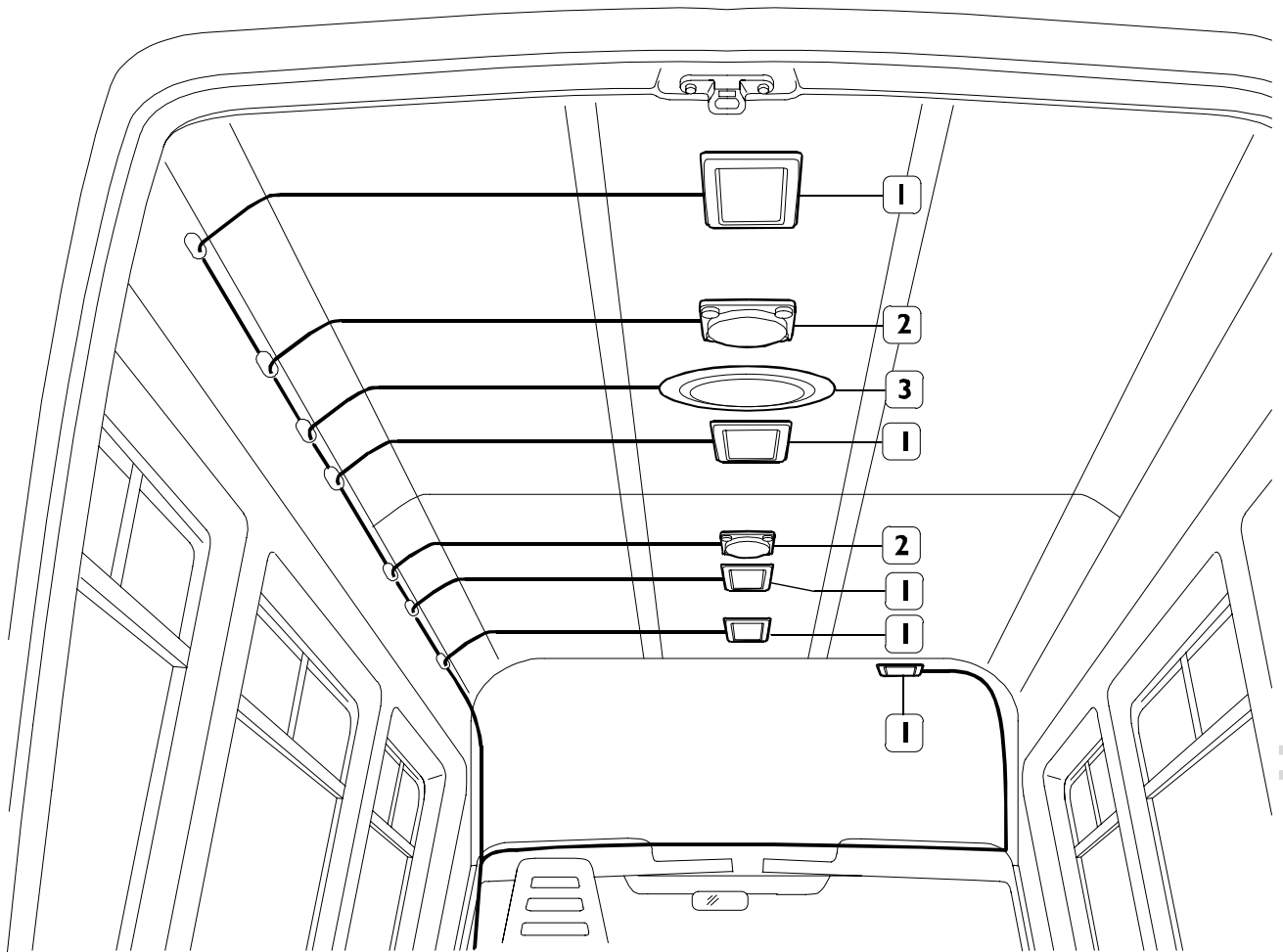
VOLTAGE MAINS REMOTE SWITCH

Figure 84



73712

1. General safety switch – 2. Fan control switch

Perspective view of Vendor-derived Bus version interior lighting harness**Figure 85**

73716

1. Interior lighting – 2. Driver loudspeaker provisions – 3. Fan

Diagnostic connector

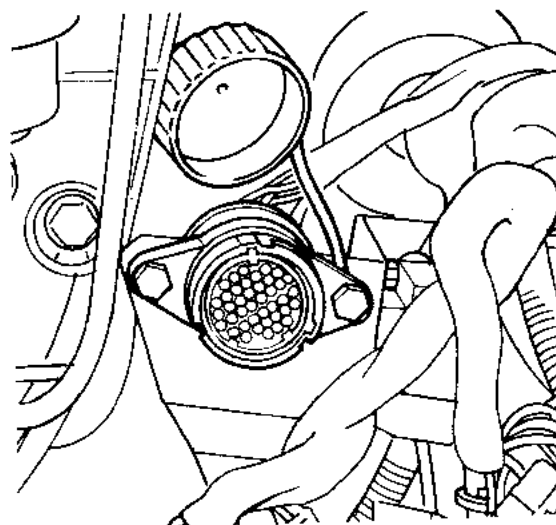
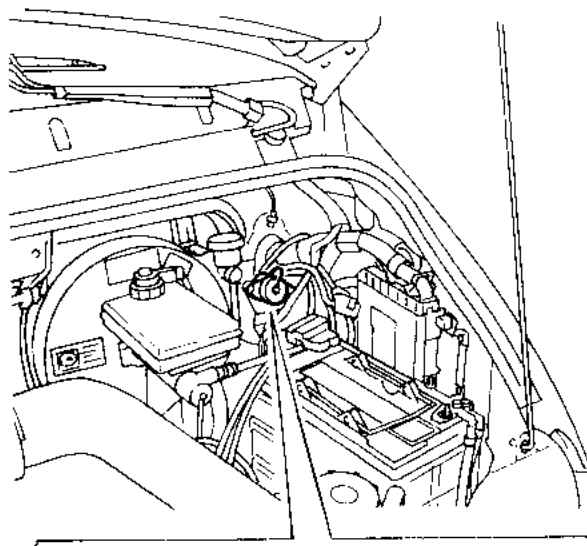
Near the positive terminal of the battery there is a diagnostic connector. It is fastened by 2 screws to a special bracket fitted on the body and access to it is gained by unscrewing the protective cap; suitably connected to the diagnostic system (IWT, MODUS), it allows quick identification of the cause of faults in the various electronic devices.

The diagnosis connector on FI engine vehicles is located on the conveyor unit lower part on the passenger side.

The table on the following page shows the correspondence between the various electronic systems and the connector pins referring to them.

NOTE The connector shown is seen from the pin side.

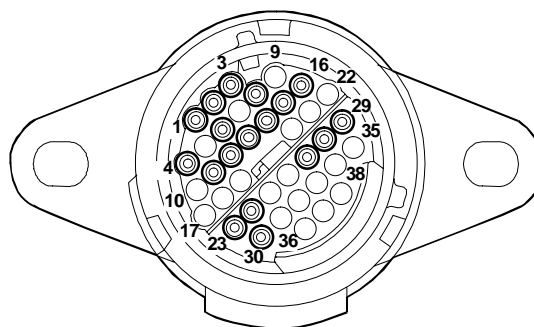
Figure 86



8620

38-PIN DIAGNOSTIC CONNECTOR

Figure 87



8621

IDENTIFICATION OF THE PINS OF THE 38-PIN DIAGNOSTIC CONNECTOR

System	Pin	Function
EDC/EGR/Methane	1	L
	2	K
ABS/EBD/ABD	3	L
	4	K
Air Bag/Retarder	6	K
Tachometer (connector A cell 2 instrument cluster)	8	K
Supply +15/A services	11	Input
Immobilizer/Central door locking/Alarm	12	K
Climate control system	13	L
	14	K
Self-levelling suspension	15	L
	16	K
Engine timing signal (connector B pin 28 EDC control unit) Engine timing earth (battery –)	23	–
	24	Screening
Supply +30	27	Battery +V
Engine rpm	28	RPM
Vehicle speed	29	–
Earth	30	–

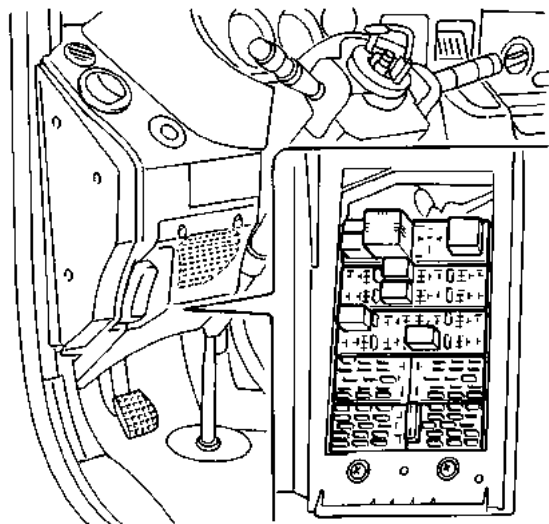
☐ With EDC16: pins 1/23 are not connected.

☐ Can Line pin 21/22.

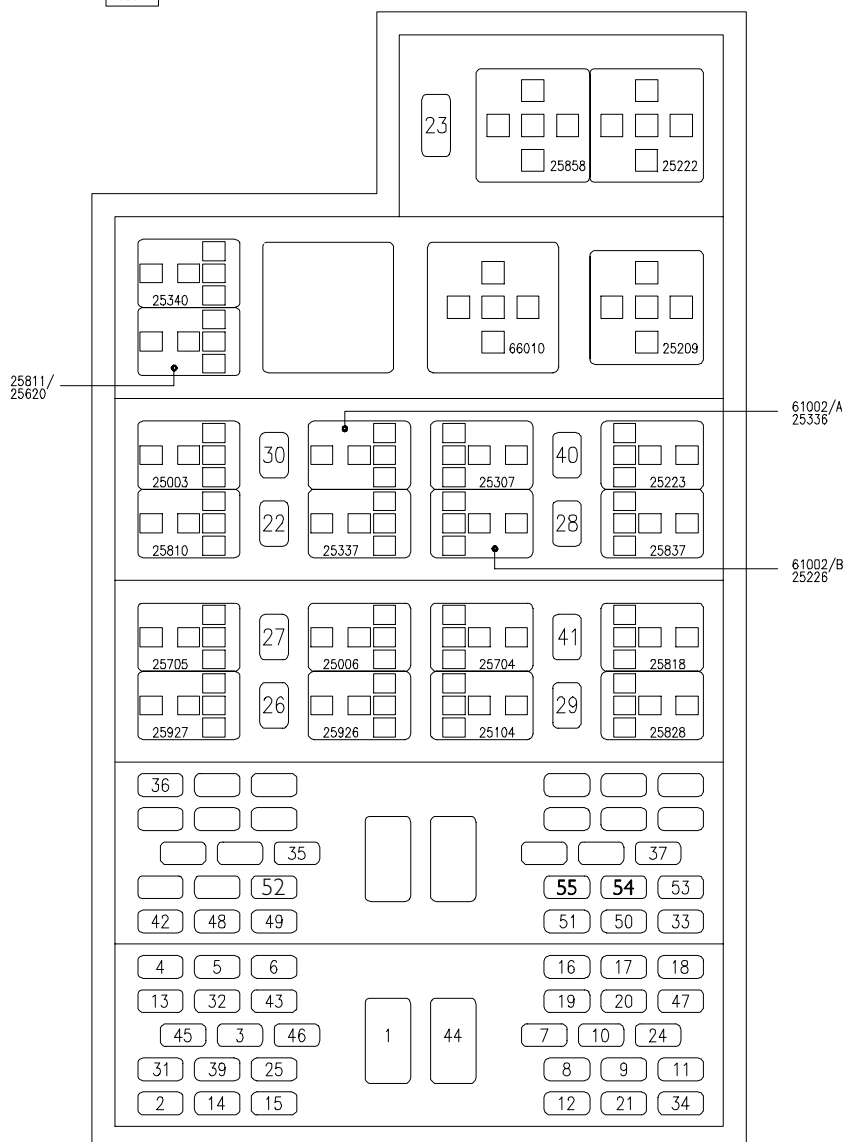
The unused pins are not indicated.

RELAY AND FUSE HOLDER SUPPORT

Figure 88



8631



Identification of fuses

N.	Functions	
1.	Additional heater	30
2.	Immobilizer/Warming/EDC	5
3.	—	—
4.	Instrument cluster (+30)	5
5.	Instrument cluster (+15)	5
6.	Stalk unit (rear fog guard, flasher)	5
7.	Stalk unit (low beams)	10
8.	Stalk unit (high beams)	15
9.	Stalk unit (side lights)	15
10.	Windscreen wiper	15
11.	Stalk unit (direction indicators/hazard warning lights)	15
12.	Stalk unit (horns)	15
13.	Reversing light	5
14.	Side light, clearance, no. plate light	5
15.	Side light cluster lighting	5
16.	Left low beam headlamp	10
17.	Right low beam headlamp	10
18.	Left high beam headlamp	10
19.	Right high beam headlamp/headlamp aming	10
20.	Interior lighting/radio/cigar lighter	10
20.	Interior lighting/radio	10
21.	Electric windscreen defrosting unit	30
21.	Cigar lighter	15
22.	Heated fuel filter	15
23.	EDC electronic control unit	25
24.	EDC	10
25.	Stop lights	5
26.	13-pin current socket	15
27.	13-pin current socket	15
28.	13-pin current socket	10
29.	38-pin diagnostic connector	5
30.	Fog lamps	10
31.	Climate control, additional heater, engine cooling	5
31.	Compressor, timer, engine fan	10
32.	Climate control	5
33.	Additional heater	20
34.	Headlamp washer	20
35.	Rear differential lock	5
36.	ABS, EBD, ABD failure warning light	5
37.	ABS	5
39.	Heated mirrors	10
39.	Heated mirrors, heated rear-screen, heated windscreen	15
40.	Power windows	30
40.	Power windows (left)	20
41.	Heated rear-screen, heated windscreen	10/ 20
42.	Self-levelling suspensions	5
43.	Air bag failure warning light	5
44.	Self-levelling suspensions (Wabco)	40
45.	Air-bag	5
46.	—	—
46.	Power windows (right)	20
47.	Electric fuel pump	10
48.	Door locking/alarm	30
49.	Door locking/alarm	5
50.	Rear differential lock	30
51.	Total power takeoff	10
52.	Front differential lock (4x4)	30
53.	Self-levelling suspensions Technik	30
54.	Electric hatch (van and 6+1)	15
55.	Rototranslating door	15

Identification of relays/diode holders

Code	Function
25035	Switching on external lights
25003	Switching on fog lamps
25006	Switching on stop lights
25704	Total power takeoff engagement control
25104	Switching off Retarder with ABS on
25209	Loads cut-off during starting
25222	Thermal starter engagement enable
25223	Thermal starter fan control
25307	Climate control compressor engagement
25336	Engine cooling
25337	Climate control compressor disengagement
25340	Compressor on signal
25620	Fuel filter clogged signal
25705	Diagnostics enable
25810	Heated fuel filter circuit control
25811	Advance variator control (KSB)
25818	Heated windscreen switching on
25837	Electric fuel pump switching on
25858	EDC switching on
25926	Suspension raising enable
25927	Suspension lowering enable
25928	Rear-screen heating switching on
61002A	Anti-return from Trinary
61002B	Anti-return from TGC (bus)
66010	Timer for headlamp washer



Fuse 39 must be replaced with a 10A fuse if the following optionals are present on the vehicle at the same time:

- ☐ heated wing mirrors with heated driver's seat;
- ☐ heated wing mirrors with heated driver's and passenger's seat;
- ☐ heated wing mirrors with electric aiming with heated driver's seat;
- ☐ heated wing mirrors with electric aiming with heated driver's and passenger's seat.

Fuse 41 (39 for FIA) must be replaced with a 15A fuse if the following optionals are present on the vehicle at the same time:

- ☐ heated windscreen with heated rear-screen.

Fuse 55 must be replaced with a 15A fuse if both the seats are heated.

Fuse 70060 (40A) relating to the ABS, device is located in the engine compartment, near the control box.

For the FIA, plug preheat centre 25231 is located on the engine compartment to the right of the EDC centre and is powered by 60A fuse 70064.

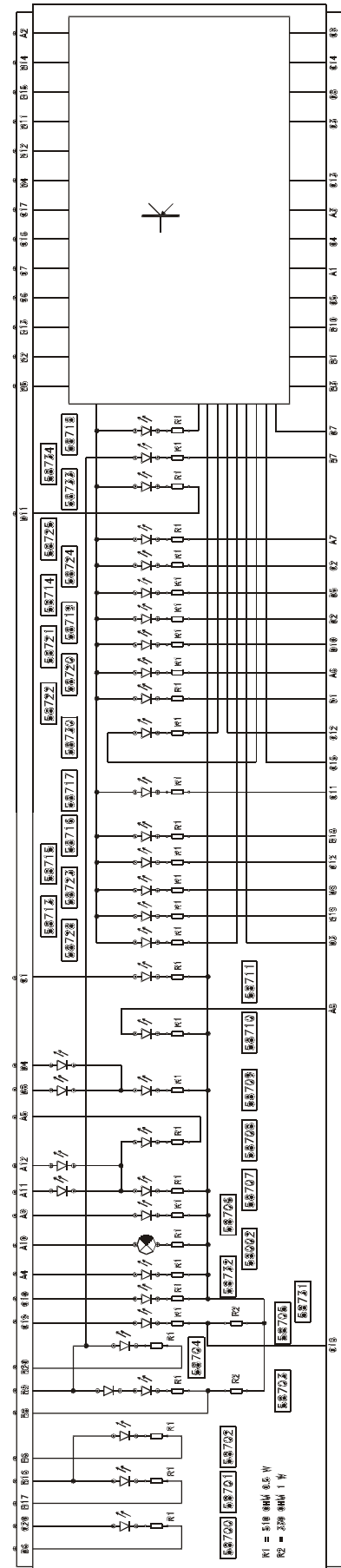
The previous indications (fuses/remote control switches) can be changed. Should it occur, make reference to the indications on the sticker label next to the fuses.

OPTICAL INDICATORS

A table is shown below with pin out 58918 in 4–connector version, as well as a 2–connector version one.

1	2	1	2	1	2
D6	B5	* B15	A2	B3	B156
C20	A5	B2	A17	B1	A22
B17	A29	B12	A18	B10	A21
B16	A14	C8	A4	C5	B26
B6	A30	* B4	A3	A1	A23
B8	A32	* B14	A19	C4	B24
B9	A16	A2	A6	A3	A7
B20	A15	C18	B14	C13	B27
C19	B13	A8	A11	C3	B25
C10	B15	D3	B29	B11	B2
A4	A8	B19	A13	C14	B1
A10	A9	D9	B30	C9	B23
A9	A10	D12	B9		
A11	A24	B18	A12		
A12	A25	C11	B11		
A5	A26	C15	B22		
D8	B3	C12	B21	1	2
D4	B4	D1	B6	* B4	A19
C1	B12	A6	A27	* B14	A2
D11	B10	D10	B8	* B15	A3
B5	A20	D2	B7	* Variant for versions .11/.13/.15.	
B13	A1	D5	B31		
C6	B18	C2	B32		
C7	B20	A7	A28		
C16	B19	B7	A31		
C17	B17	D7	B28		

Figure 89

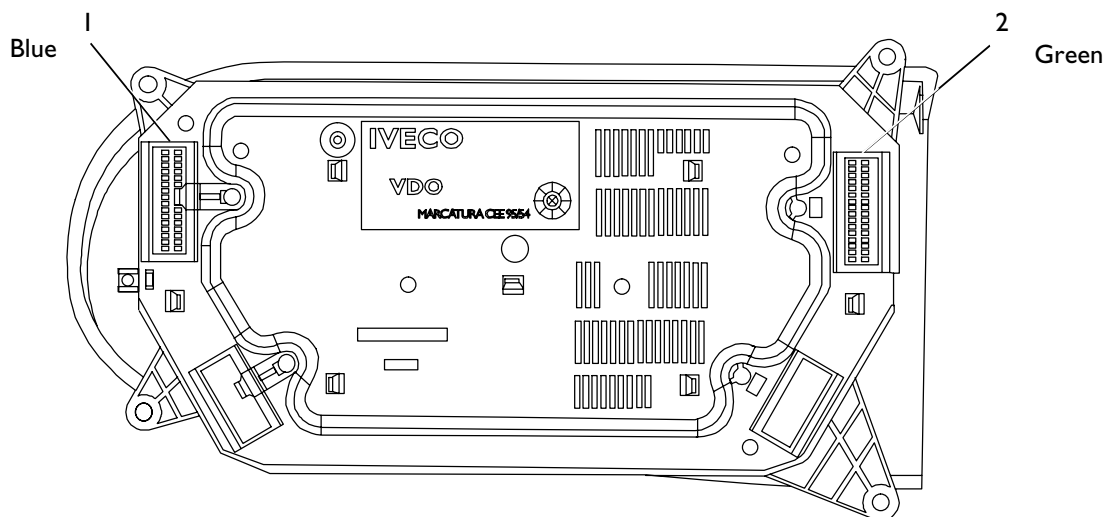
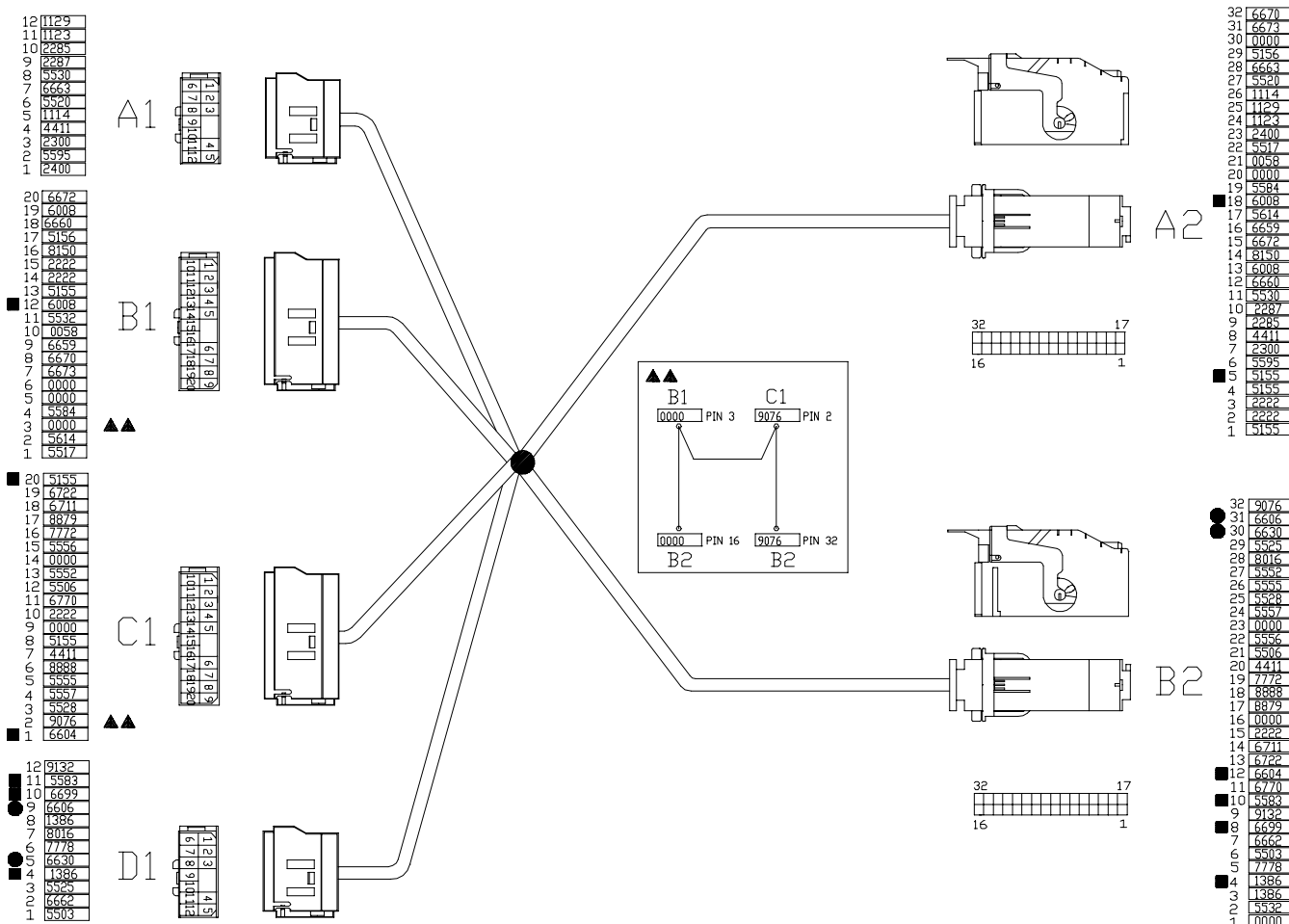


058918 PIN OUT OF THE PREVIOUS VERSION

74024

Interface bride with the new tool with 32-way connectors

Figure 90



REAR VIEW OF 32-WAY CONNECTOR UNIT

1. Blue colour seat "A" for 32-way female holder connector complete with terminals
2. Blue colour seat "B" for 32-way female holder connector complete with terminals

77025

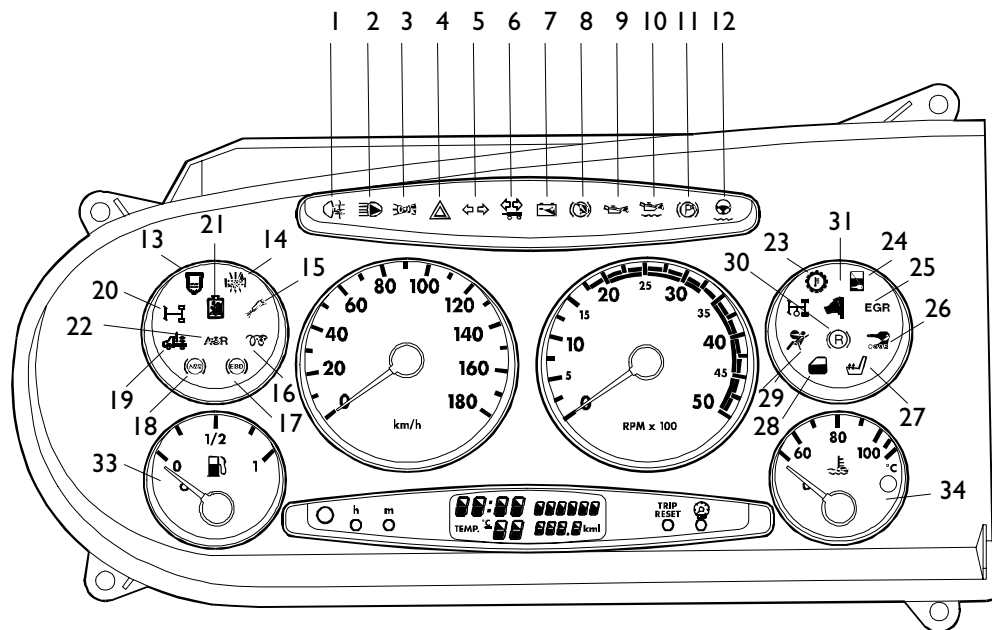
0742528t

INSTRUMENT CLUSTER

Warning lights assembly

Figure 91

58918

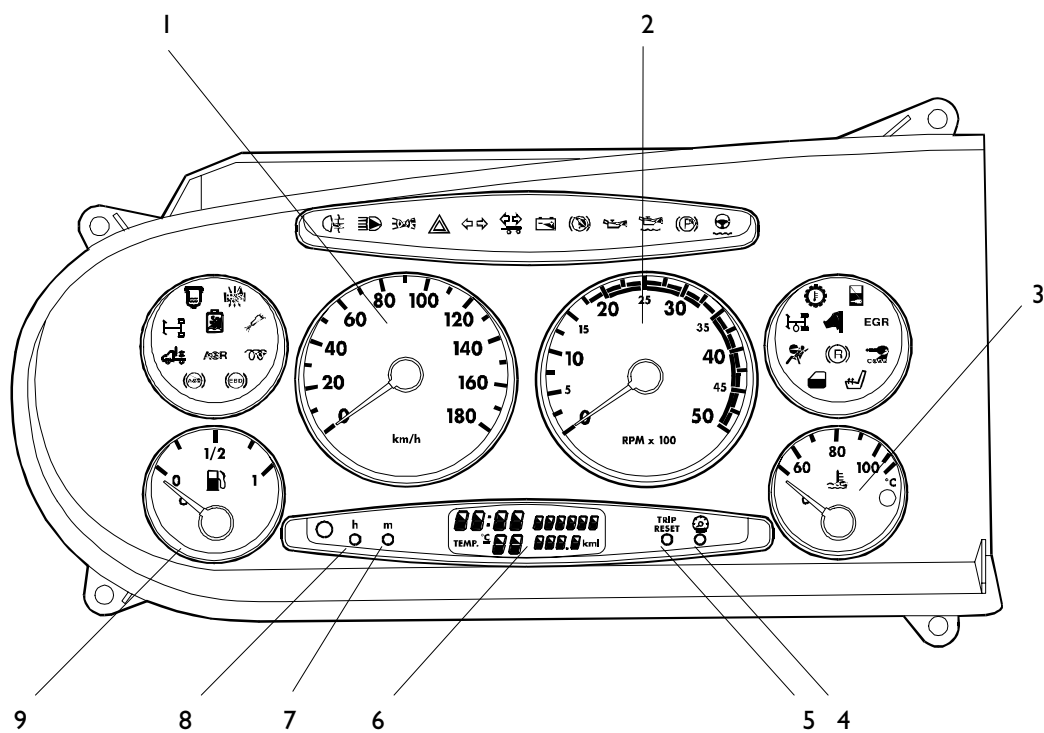


8655

Ref.	Component code	Description
1	58706	Rear fog guard
2	58002	High beam headlamps
3	58732	Side lights
4	58708	Hazard warning lights
5	58707	Tractor direction indicators
6	58709	Trailer direction indicators
7	58700	No battery charge
8	58718	Brake system failure (under TEST)
9	58722	Low engine oil pressure
10	58730	Low engine oil pressure (under TEST)
11	58719	Handbrake on (under TEST)
12	58728	Low power steering fluid level (under TEST)
13	58710	Water in fuel filter (under TEST)
14	58725	Air cleaner clogged (under TEST)
15	58701	EDC failure
16	58702	Engine warming
17	58734	EBD failure
18	58703	ABS failure
19	58713	ECAS failure
20	58735	Rear transversal differential lock
21	58720	Low engine coolant fluid level (under TEST)
22	58704	ABD on
23	58721	High gearbox oil temperature (under TEST)
24	58723	Emergency handle lock (under TEST)
25	58733	EGR failure
26	58717	Immobilizer engaged
27	58731	Seat heating
28	58724	Door open indicator
29	58705	Airbag failure
30	58715	Total power takeoff (PTO) on
31	58714	Emergency handle activated (under TEST)
32	58711	Retarder on
33	44031	Low fuel level (under TEST)
34	47207	High engine coolant fluid temperature (under TEST)

Instrument assembly

Figure 92

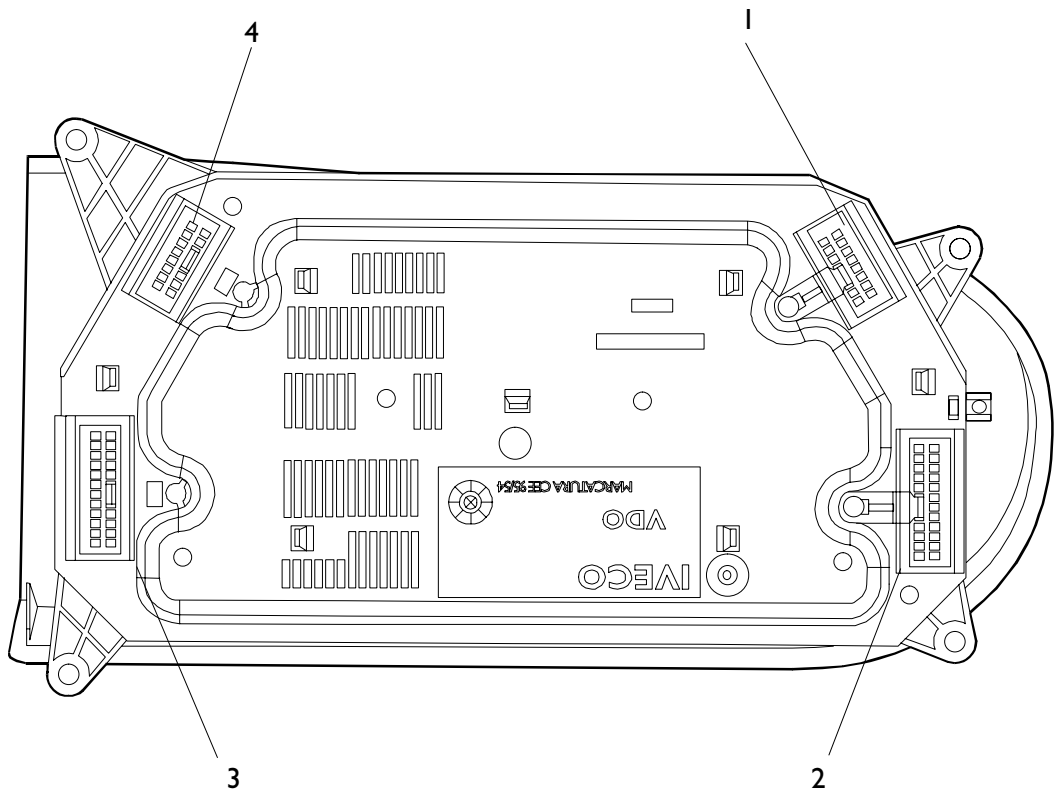


8655

Ref.	Description
1	Electronic tachometer
2	Electronic gyrometer
3	Engine coolant fluid temperature gauge with incorporated warning light
4	Instrument lighting adjustment button
5	Trip meter reset button
6	Display for: clock, outside temperature (only with climate control), total odometer (km), trip meter (km)
7	Clock adjustment button (minutes)
8	Clock adjustment button (hours)
9	Fuel level gauge with reserve warning light

Rear view

Figure 93



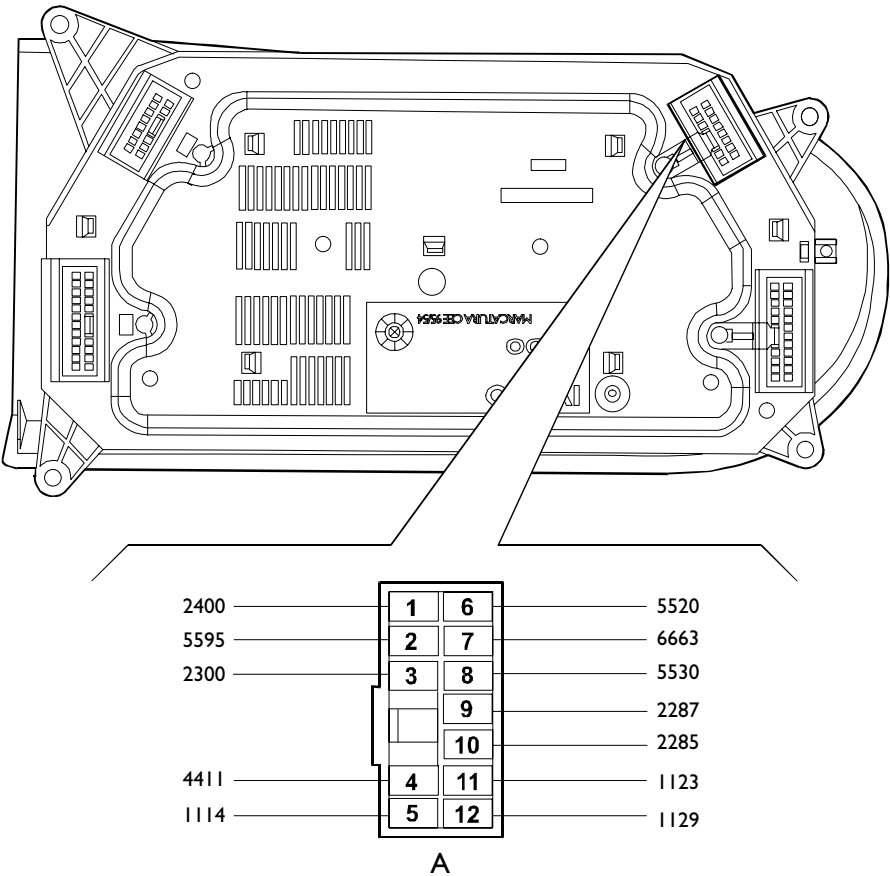
8643

Ref.	Description
1	Seat "A" for 12-way, blue, female holder connector complete with terminal
2	Seat "B" for 20-way, blue, female holder connector complete with terminal
3	Seat "C" for 20-way, black, female holder connector complete with terminal
4	Seat "D" for 12-way, black, female holder connector complete with terminal

Connector assembly (cable input side view)

Connector A

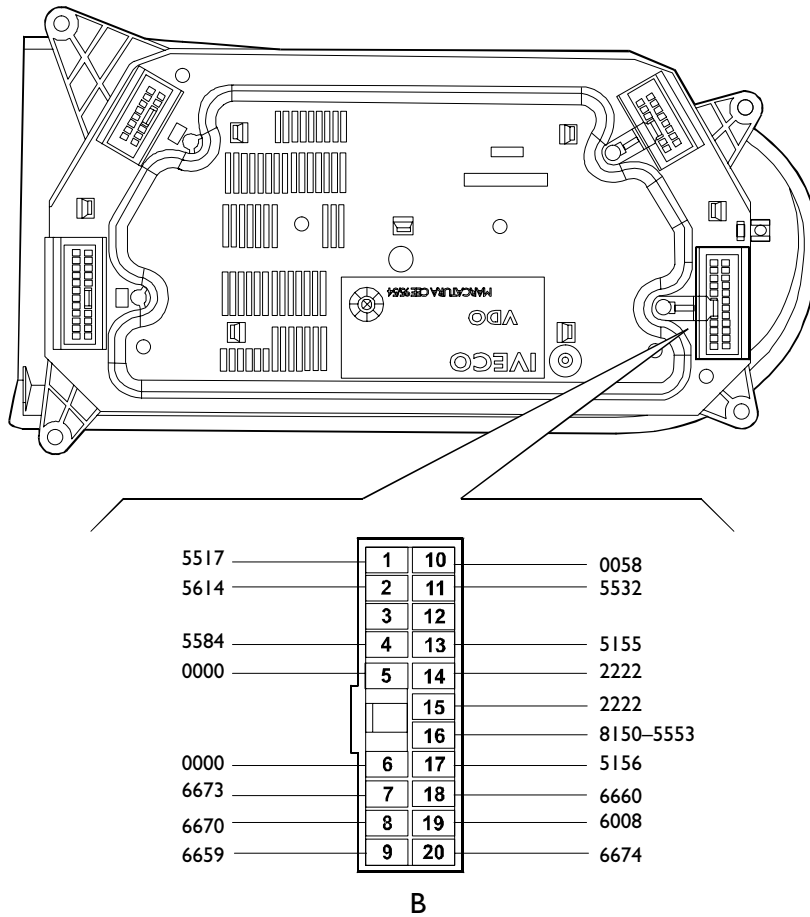
Figure 94



Ref.	Cable colour code	Function
A	1 2400	Tachograph failure warning light
	2 5595	To cell 8 of diagnostic connector (serial line K)
	3 2300	Speed indication from tachograph
	4 4411	Side lights on warning light
	5 1114	Hazard warning lights on warning light
	6 5520	Low engine coolant fluid level warning light
	7 6663	Air cleaner clogged warning light
	8 5530	Water in fuel oil filter warning light
	9 2287	Rear fog guard on warning light
	10 2285	High beam headlamps on warning light
	11 1123	Direction indicators on warning light
	12 1129	Direction indicators on warning light

Connector B

Figure 95



8643

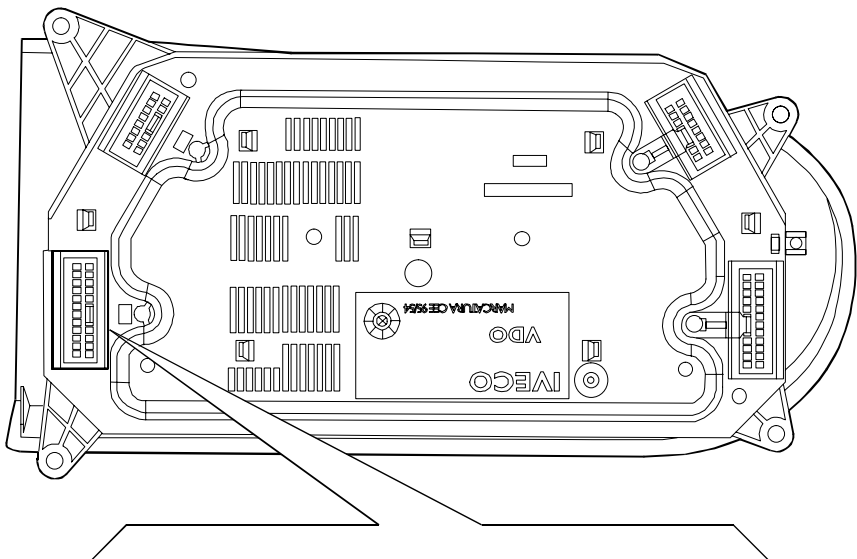
8645

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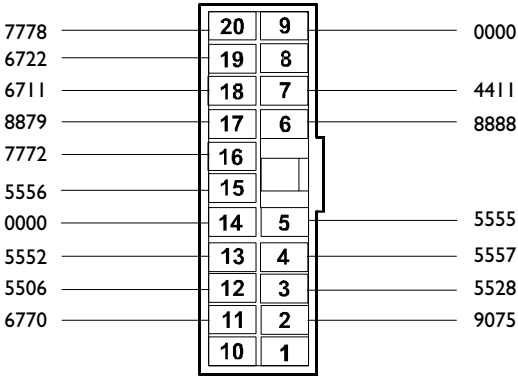
Ref.	Cable colour code	Function
B	1 5517	Tachometric signal
	2 5614	Rev counter signal
	3 -	-
	4 5584	To cell 28 of diagnostic connector (engine rpm repeater)
	5 0000	To pin 14 of connector B of electronic control unit for EDC
	6 0000	Earth for warning on warning light
	7 6673	EBD Failure warning light
	8 6670	ABS failure warning light
	9 6659	Supply (+15) for ABD, ABS and EBD failure warning lights
	10 0058	To electronic tachometer transmitter
	11 5532	To pin 2 of connector B of air conditioning system electronic control unit
	12 -	-
	13 5155	To pin 4 of connector B of EDC electronic control unit (tachometric signal repeater)
	14 2222	Tachometric signal repeater for rear differential lock
	15 2222	Tachometric signal repeater
	16 8150	Positive for EDC failure and warning on warning lights (Unijet)
	5553	Positive for warning on warning light
	17 5156	EDC failure warning light
	18 6660	Rear differential lock warning light
	19 6008	Self-levelling suspension system failure warning light
	20 6674	A.S.R. pilot lamp

Connector C

Figure 96



8643



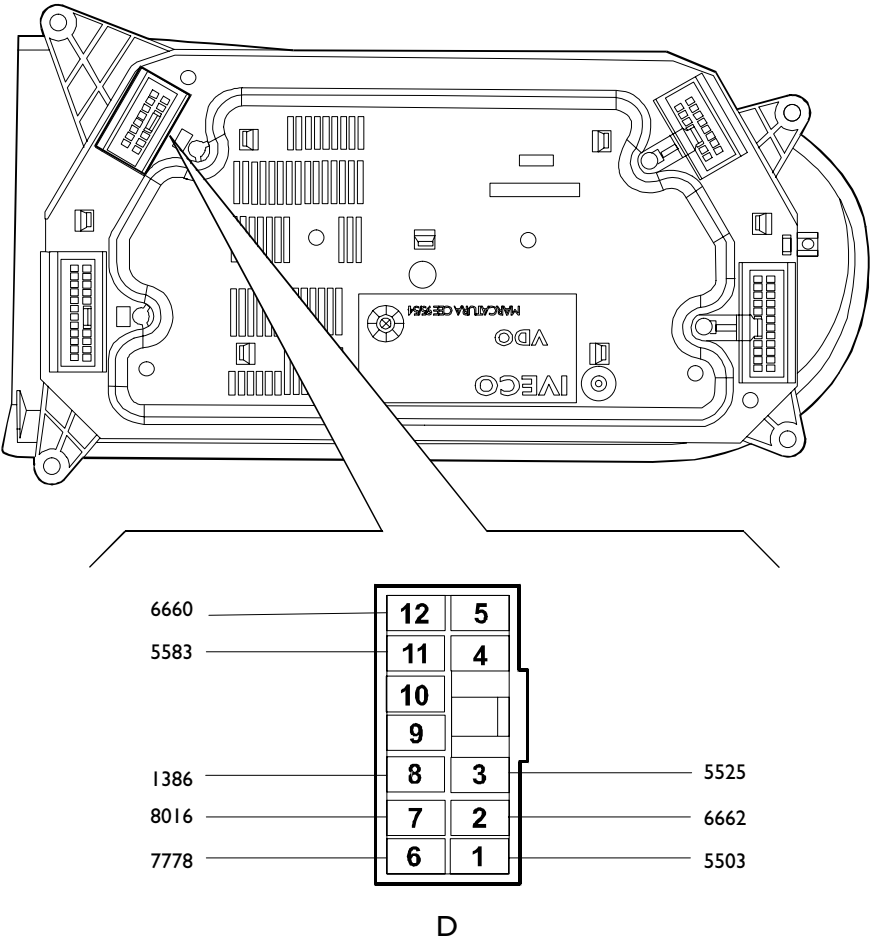
8646

C

Ref.	Cable colour code	Function	
C	1	–	Retarder on warning light (bus)
	2	9075	Door open warning light
	3	5528	Engine coolant fluid temperature gauge
	4	5557	Fuel level gauge
	5	5555	Fuel reserve warning light
	6	8888	Supply (+50)
	7	4411	Positive with exterior light switch on
	8	–	To pin A1 of radio receiver set
	9	0000	Connection to signal earth ms7
	10	–	Fog lamp pilot lamp
	11	6770	Sensor for immobilizer on signal
	12	5506	Low engine oil level sensor
	13	5552	Engine coolant fluid high temperature warning light
	14	0000	Earth
	15	5556	Low engine oil level sensor
	16	7772	Supply (+30)
	17	8879	Supply (+15)
	18	6711	Air bag failure warning light
	19	6722	Supply (+15) for air bag failure signal
	20	7778	Supply (+15) for battery charge failure warning light

Connector D

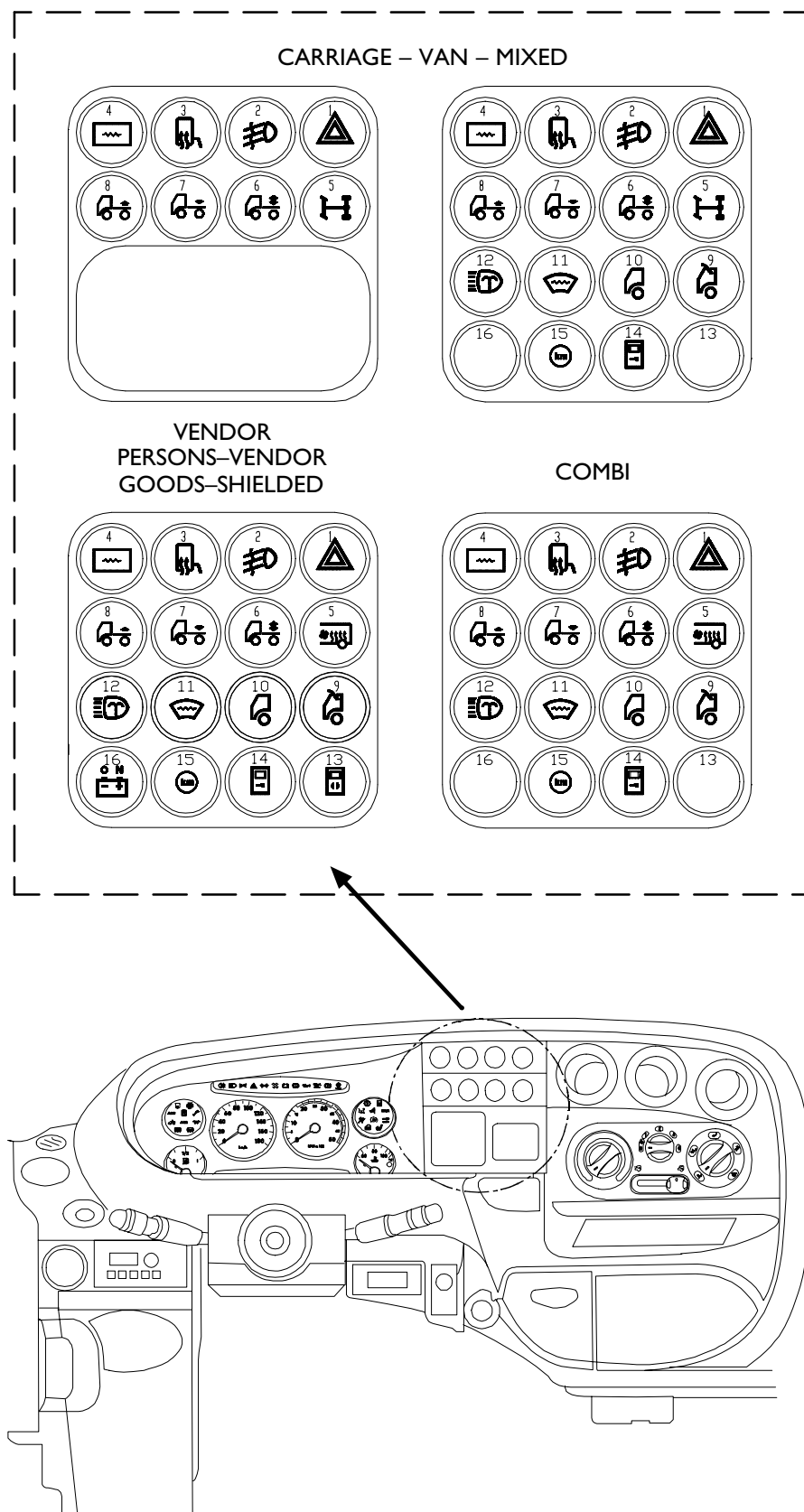
Figure 97



Ref.	Cable colour code	Function
D 1	5503	Low engine oil pressure warning light
2	6662	Handbrake engaged warning light
3	5525	Low power steering fluid level warning light
4	–	–
5	–	Rotary translating door failure warning lamp (bus)
6	7778	Battery charge failure warning light
7	8016	Brake failure warning light
8	1386	Trailer direction indicators on warning light
9	–	Handle lock pilot lamp
10	–	–
11	5583	EGR failure warning light
12	6660	Total power takeoff (PTO) on warning light

SWITCH ASSEMBLY

All the switches and push buttons of this module incorporate a warning led.

Figure 98

74271

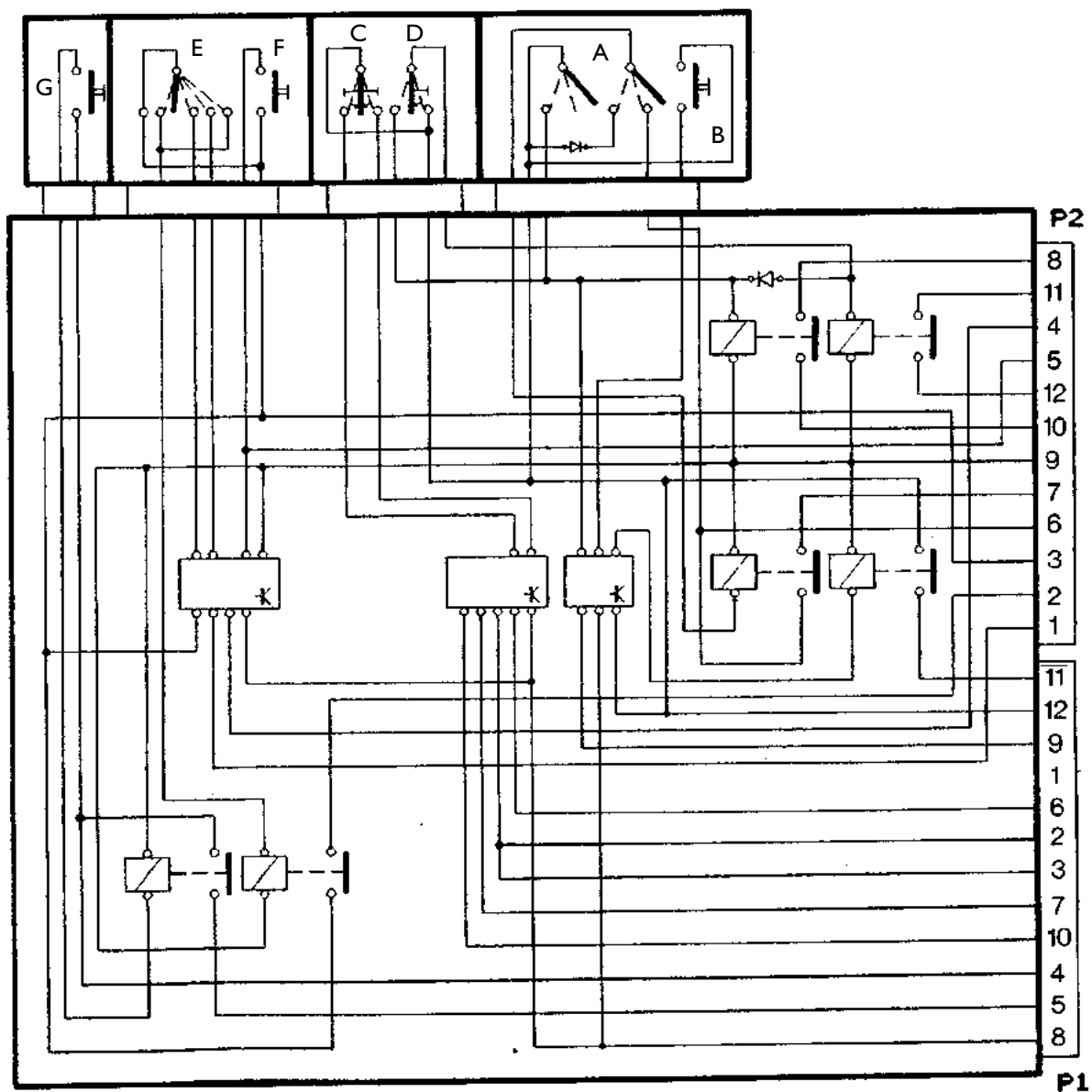
Legend

Position	Function	Vehicles	
		CARRIAGE – VAN – MIXED	
		Standard	Optional
1	Emergency lights	X	
2	Fog lights		X
3	Heated rearview mirrors		X
4	Rear glass		X
5	Rear differential lock		X
6	Level compressed air suspension		X
7	Lower compressed air suspension		X
8	Lift compressed air suspension		X
9	Electrical manhole opens		X
10	Electrical manhole closes		X
11	Heated windshield		X
12	Light washer		X
13	Cap		
14	Rear door lock		X
15	Speed limiter adjustment		X
16	Cap		
		VENDOR PERSONS–VENDOR GOODS–SHIELDED	
1	Emergency lights	X	
2	Fog lights		X
3	Heated rearview mirrors		X
4	Rear glass		X
5	Air heating		X
6	Level compressed air suspension		X
7	Lower compressed air suspension		X
8	Lift compressed air suspension		X
9	Electrical manhole opens		X
10	Electrical manhole closes		X
11	Heated windshield		X
12	Light washer		X
13	Rotary travel holder	X	
14	Rear door lock		X
15	Speed limiter adjustment		X
16	Battery sectioner reset	X	
		COMBI	
1	Emergency lights	X	
2	Fog lights		X
3	Heated rearview mirrors		X
4	Rear glass		X
5	Air heating		X
6	Level compressed air suspension		X
7	Lower compressed air suspension		X
8	Lift compressed air suspension		X
9	Electrical manhole opens		X
10	Electrical manhole closes		X
11	Heated windshield		X
12	Light washer		X
13	Cap		
14	Rear door lock		X
15	Speed limiter adjustment		X
16	Cap		

STALK UNIT

54032

Figure 99

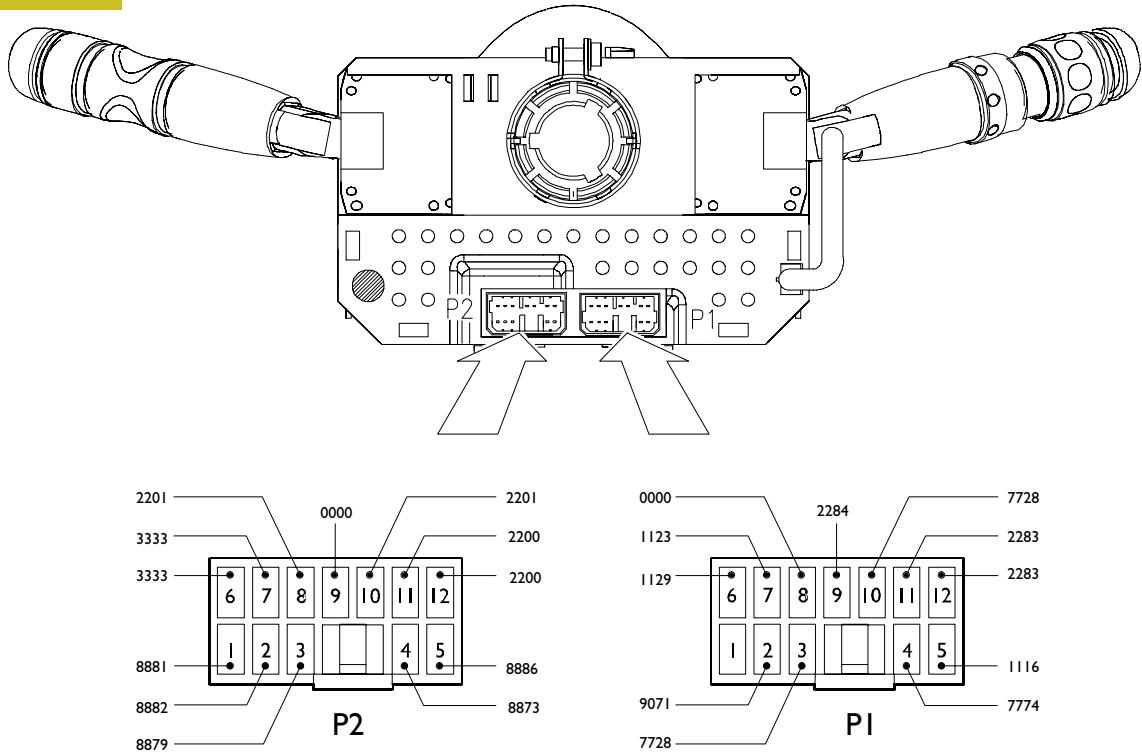


8651

WIRING DIAGRAM

A. Exterior light switch – B. Rear fog guard button – C. Direction indicator switch –
 D. High beam headlamp/flasher switch – E. Windscreen wiper switch – F. Windscreen washer pump button –
 G. Horn button

Figure 100

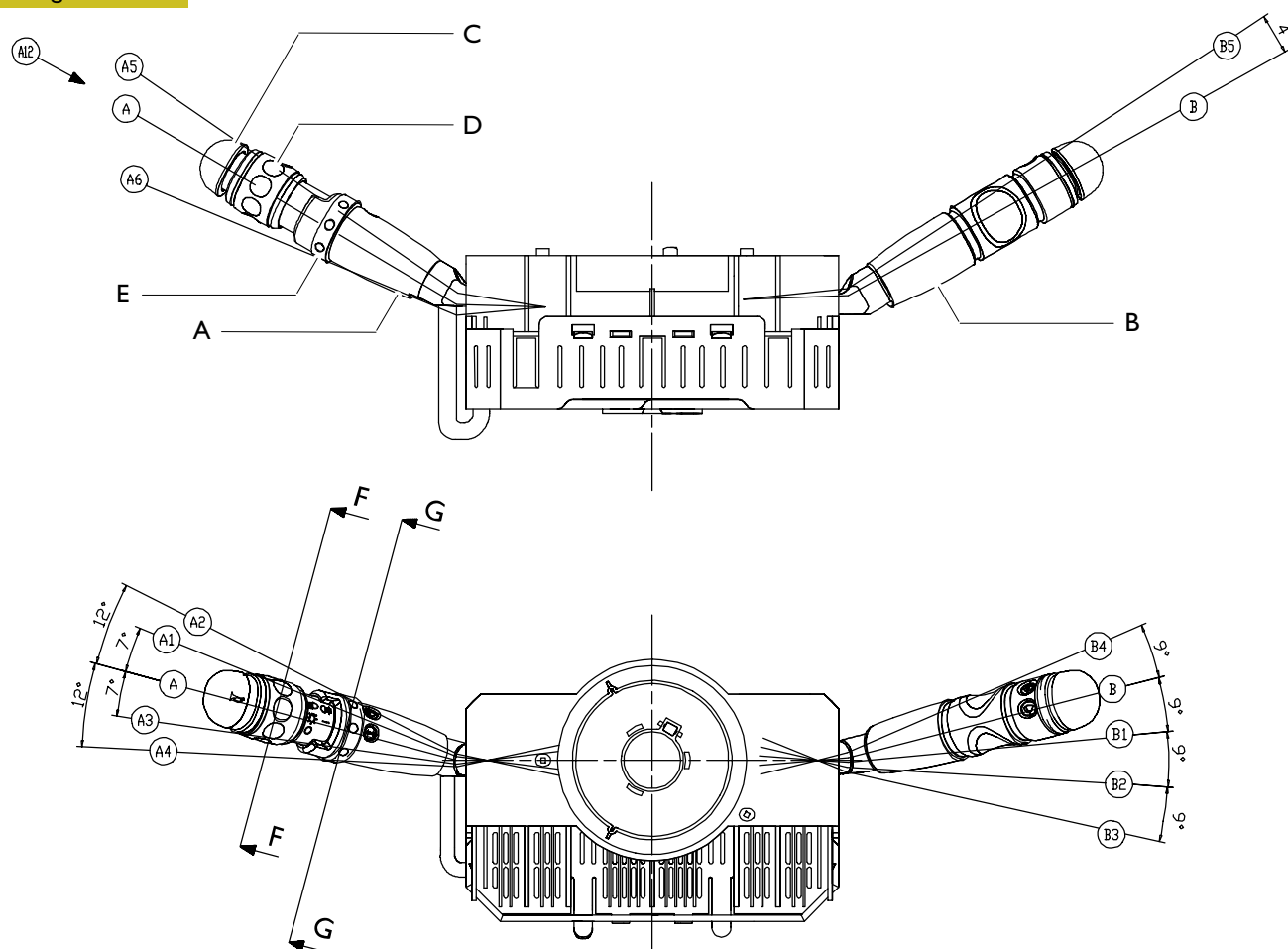


TECHNICAL VIEW OF COMPONENT AND CONNECTORS OF CAB/BONNET CABLE TO BE CONNECTED TO STALK UNIT

Ref.	Function	Cable colour code
P1 (Black)	1 –	–
	2 Input from alarm	9071
	3 Input from hazard warning lights	7728
	4 Supply (+30) for horn button	7774
	5 Horns	1116
	6 Left-hand direction indicator	1129
	7 Right-hand direction indicator	1123
	8 Signal earth	0000
	9 Positive with fog lights on	2284
	10 Supply (+30) for direction indicators and hazard warning lights	7728
	11 Rear fog guard and rear fog guard on warning	2283
	12 Supply (+15)	2283
P2 (Blue)	1 Windscreen wiper first speed	8881
	2 Windscreen wiper second speed	8882
	3 Supply (+15/A) for windscreen wiper	8879
	4 Windscreen wiper reset input	8873
	5 Electric pump for windscreen washer	8886
	6 Supply (+30) for side lights switch	3333
	7 Side lights	3333
	8 Supply (+15/A) for switching on low beam headlamps	2201
	9 Power earth	0000
	10 Low beam headlamps	2201
	11 Supply (+15/A) for switching on high beam headlamps	2200
	12 High beam headlamps	2200

Functions

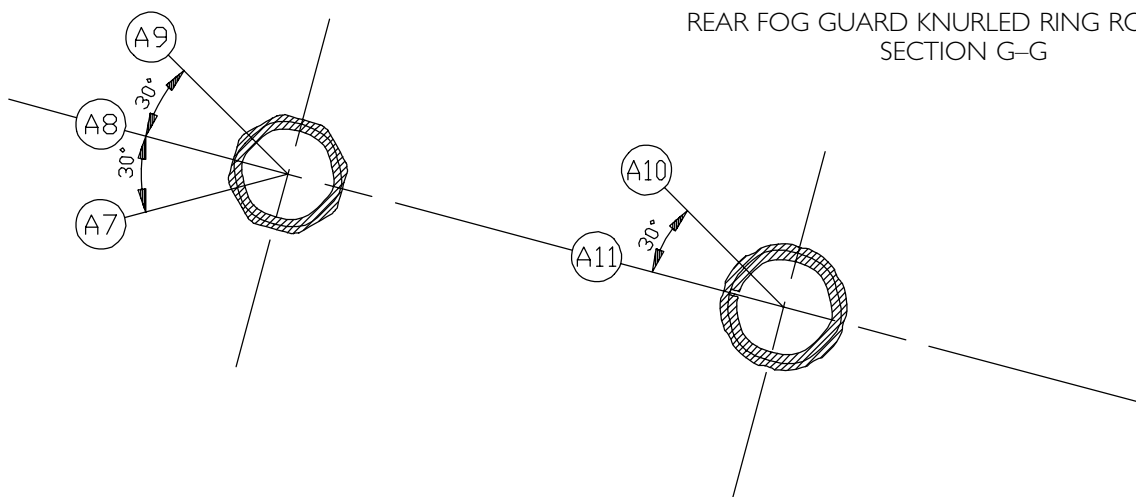
Figure 101



7409

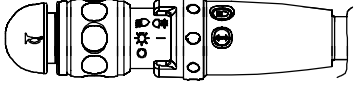
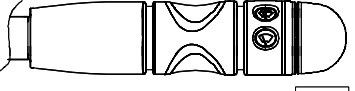
EXTERIOR LIGHTING KNURLED RING ROTATION
SECTION F-F

REAR FOG GUARD KNURLED RING ROTATION
SECTION G-G



7433

A.-B. Positions of stalks – C. Horn control – D. Exterior lights knurled ring – E. Rear fog guard knurled ring

Technical view	Position	Electrical function
 7410	A	Position "0"
	A1	Right lane change (unstable)
	A2	Right direction
	A3	Left lane change (unstable)
	A4	Left direction
	A5	Light flashing
	A6	High beam headlamps
	A7	Side light switch position "0"
	A8	Side lights
	A9	Low beam headlamps plus high beam and fog guard enable
	A10	Rear fog guard stable position (on or off)
	A11	Rear fog guard unstable position off Rear fog guard unstable position on only with light switch at position A9 of rear fog guards on
	A12	Horn
 7411	B	Windscreen wiper reset
	B1	Intermittent device
	B2	First Speed
	B3	Second speed
	B4	Second speed unstable
	B5	Windscreen washer

Cruise Control

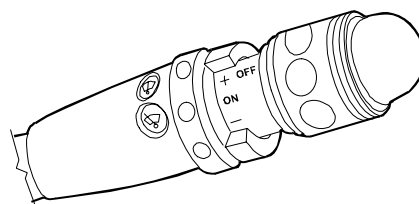
The cruise control is operated by push-buttons (Figure 102) installed on the windscreen wiper control lever with following functions:

- ☐ adjust engine idle speed;
- ☐ read and adjust drive rpm;
- ☐ set and store travel speed.

Cruise control is deactivated by pressing the clutch pedal, the brake pedal and keeping the accelerator pedal pressed for over 10 seconds or by turning the switch to "OFF".

Cf. the Use and Maintenance Handbook on board the vehicle for further information on use.

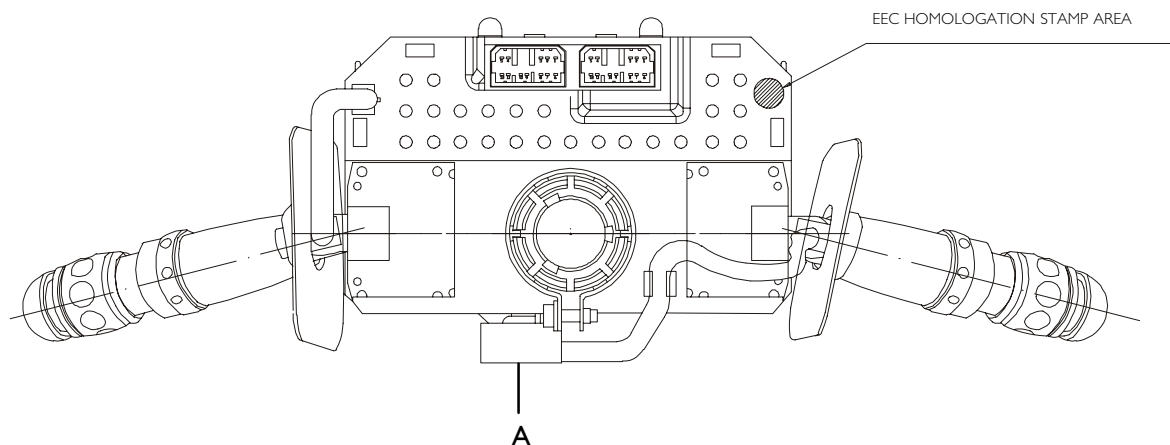
Figure 102



000245t

CRUISE CONTROL

Figure 103



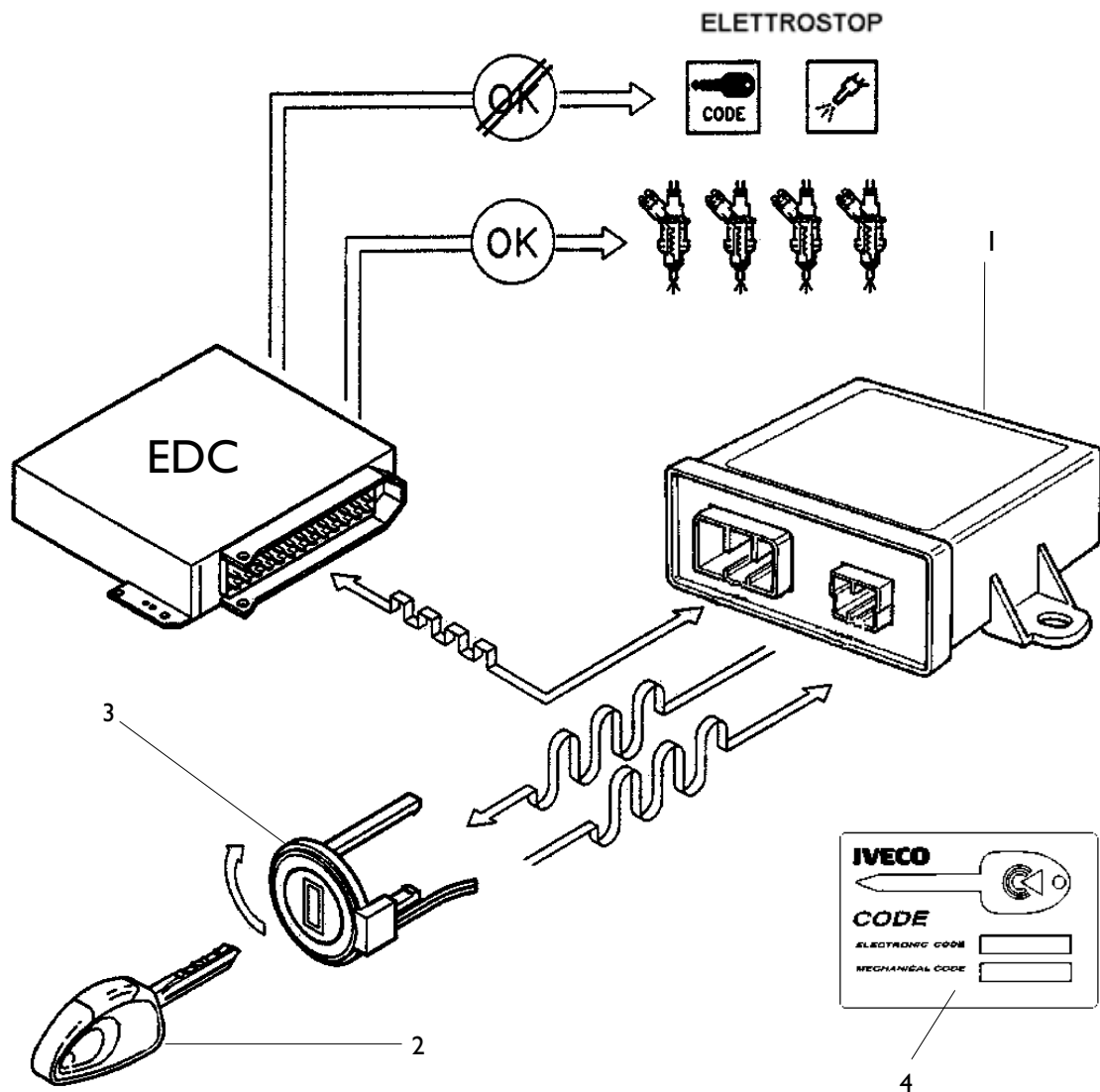
TECHNICAL VIEW OF THE COMPONENT
A. Connector (Cruise control)

ELECTRONIC SYSTEMS

Immobilizer

In order to increase protection against attempted theft, the vehicles have been fitted with an electronic engine block system called "Immobilizer" which is activated automatically removing the ignition key. In fact, the keys are fitted with an electronic "Transponder" that sends a code signal to a special electronic control unit which, only allows the engine to be started if it recognises the code sent. del motore.

Figure 104



WARNING LIGHT MAIN SYSTEM COMPONENTS

1. Immobilizer electronic control unit – 2. Electronic key containing the transponder – 3. Aerial used for sending/reading the key code – 4. Code card containing the code for emergency starting

000245t

System components

Electronic control unit

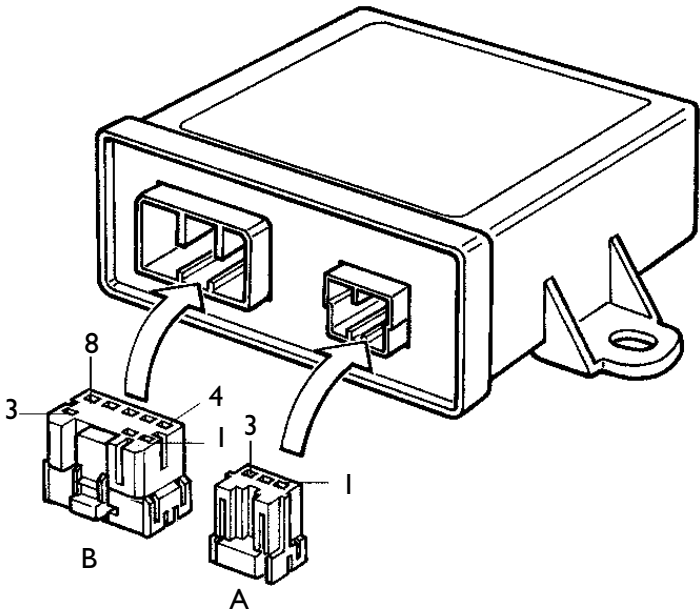
This is located behind the steering wheel column.

It is able to communicate with "EDC" central unit by a "CAN line".

The main functions of the control unit are:

- ❑ recognising insertion and rotation of the key in the ignition switch,
- ❑ activating and reading the secret code emitted by the Transponder,
- ❑ managing control and processing the codes,
- ❑ communicating with the "EDC" control unit,
- ❑ memorising any faults,
- ❑ system diagnostics.

Figure 105



00290t

Pin	Function
A1	Aerial
A2	Aerial
A3	—
B1	CAN line L for EDC control unit pin 39 (EDC I6 – pin 61)
B2	Line K for 38-pin diagnostic connector pin 12
B3	Negative for Immobilizer failure warning lamp
B4	CAN H line for EDC control unit pin 8 (EDC I6 – pin 62)
B5	—
B6	Earth
B7	Key-operated positive supply
B8	—

cardiagn.com

Electronic keys

An electronic device called "Transponder" is fitted in the key grip which is not supplied by any battery, it is not removable and contains and transmits the secret code.

Inserting the key, the "Transponder" is activated, then, when it receives the radio waves emitted by the aerial (fitted on the ignition switch block), it automatically answers transmitting the secret code.

If the two codes correspond, the control unit enables starting, otherwise it shuts off the flow of fuel thereby preventing the engine from starting.



The keys provided are two. Each key contains a "Transponder" with the corresponding secret code. It is highly to carry out the correct key teaching procedure.

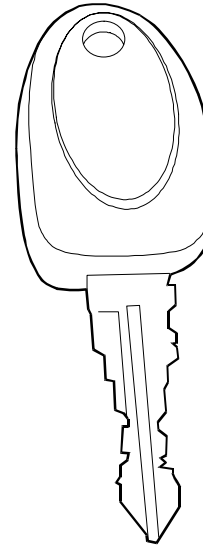
Aerial

This is fitted coaxially with the ignition switch and it has the task of:

- ☐ supplying the energy to the "Transponder" for sending the secret code
- ☐ receiving the signal from the Transponder and sending it to the control unit.

It is connected to the control unit on pins A1/A2.

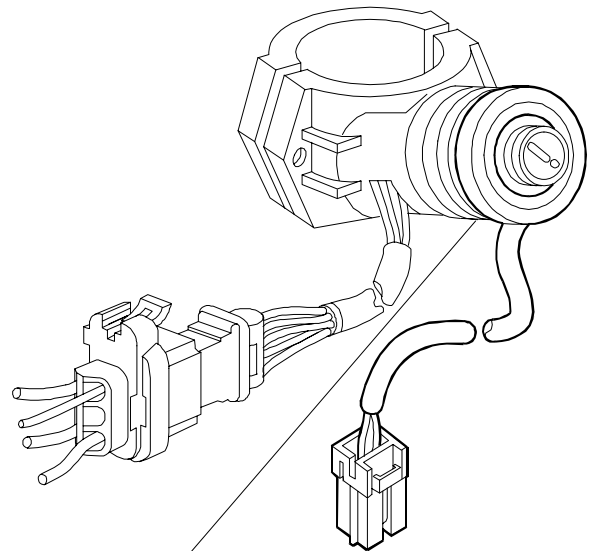
Figure 106



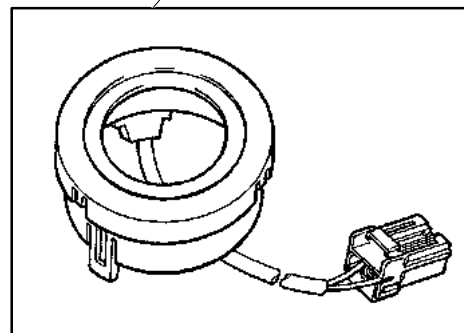
ELECTRONIC KEYS

000291t

Figure 107



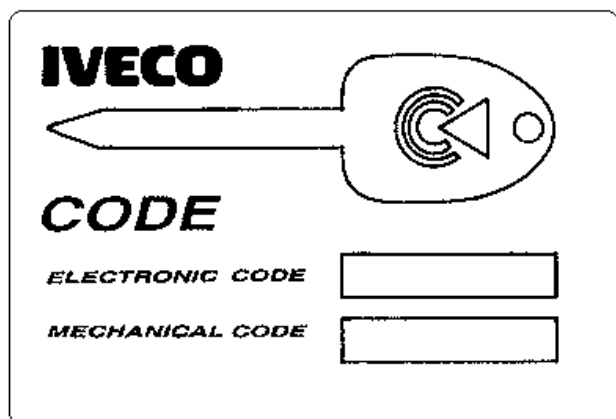
8659



000292t

AERIAL

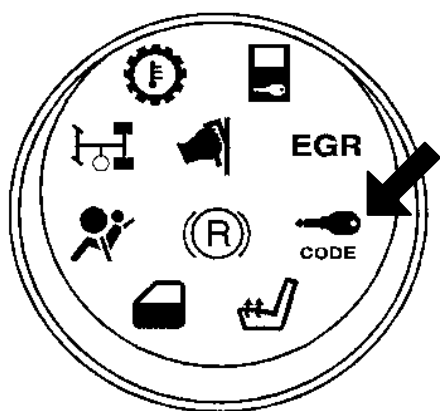
Figure 108



CODE CARD

000293t

Figure 109



000294t

WARNING LIGHT

Code card

Card containing the Electronic code and the Mechanical code.

- ☐ Electronic code or PIN code
Code absolutely necessary for the starting procedure in the event of an emergency.
- ☐ Mechanical code
Code needed for request to duplicate the mechanical part of the key.

Warning light

This is located on the instrument cluster and informs the driver whether the system is working properly or of any possible faults.

Moving the ignition key to drive the control unit tests the system turning on the warning light for about "4 seconds".

If it goes out after this time, this means that the key has been recognised and the system is working, if it does not it indicates the possible system faults.

Key teaching procedure

In the event of loss or replacement of the keys it will be absolutely necessary to follow a precise procedure solely through the diagnostic tools.

- ☐ Connect the diagnostic tool.

Key teaching

- ☐ Engage the first key and turn it to drive.
- ☐ Wait for the "code" warning light on the cluster to go out and turn the key to stop.
- ☐ Engage the new key and turn it to drive, repeat the operations described previously.

If the code warning light does not go out during the teaching procedure, this means that the operation has not been carried out correctly.

Possible causes:

- ☐ The same key has been engaged twice.
- ☐ The key has not been turned to stop in useful time.
- ☐ An attempt has been made to teach more than three keys.
- ☐ Keys already used with another control unit have been used.
- ☐ Aerial reception problems.

NOTE After following this procedure the control unit memorises the keys and will no longer make this operation possible without entering the PIN code.
The keys enabled for starting will never be more than three.
A previously memorised key but not included in the last teaching process is no longer able to start the vehicle.

Emergency procedure

It is absolutely necessary to enter the "PIN code" given on the "Code Card", only using the accelerator pedal as described below:

- ☐ Move the ignition key to Drive.
- ☐ After about ~ 2 seconds the EDC warning light starts to flash quickly
- ☐ Press the accelerator pedal and keep it pressed for about ~ 15 seconds.
- ☐ The EDC warning lamp starts flashing slowly.
- ☐ When the number of flashes corresponds to the first digit of the PIN code press the accelerator completely and then release it again. (During this press the EDC warning light stays off).
- ☐ Continue with the reading and corresponding pressing on the accelerator pedal for the remaining four numbers of the "PIN code".
- ☐ At the end of the sequence if the code entered is correct and there are no system faults, the EDC warning light stops flashing. The operation has been concluded correctly.
- ☐ Start the vehicle.



If after accurate diagnosis it is necessary to replace one or more components, proceed as described below

PART TO BE REPLACED	PARTS TO BE ORDERED	OPERATIONS AND NOTES
One or two keys (with one still available)	<ul style="list-style-type: none"> Parts Keys 	⇒ Cut the keys according to the mechanical code. ⇒ Perform "Key memorising" in Immobilizer diagnostics (*). NB. In this procedure also enter the remaining working keys otherwise they will NO LONGER be enabled for starting.
Addition of a key		
Steering lock and/or ratchets	<ul style="list-style-type: none"> KEYS KIT with: 2 cut Parts keys Steering lock + Ratchets 	⇒ Change the steering lock and ratchets. ⇒ Perform "Key memorising" in Immobilizer diagnostics (*). ⇒ State the new mechanical code on the Code Card.
ALL the keys		
Ratchets (excluding steering lock)	<ul style="list-style-type: none"> KIT with: 2 traditional keys + ratchets 	⇒ Change the ratchets. NB. Traditional keys means keys without Transponder.
Code card (due to loss)	<ul style="list-style-type: none"> Code Card 	⇒ Complete the "Code Card Duplicate Request Form" printing it from MODUS and send it as mentioned in the ORDER MANAGEMENT form of the IVECO SPARES warehouse concerned.
Aerial	<ul style="list-style-type: none"> Aerial 	⇒ Replace.
ECU Immobilizer	<ul style="list-style-type: none"> KIT ECU Including: Immobilizer ECU – 2 keys to be cut New Code Card 	⇒ Cut the keys according to the mechanical code. ⇒ Perform "Key memorising" in Immobilizer diagnostics (*). NB. At the end of this operation, check that the electronic code shown on the screen corresponds to the one printed on the Code Card, if it is different, put the one on the screen on the Code Card. ⇒ In EDC diagnostics perform "new key recognition". ⇒ Put the old mechanical code on the new Code Card. ⇒ Scrap the old keys as it will be NO LONGER possible to use them. ⇒ Complete the "New Immobilizer Installation Form" printing it from MODUS and send it as mentioned in the ORDER MANAGEMENT form of the IVECO SPARES warehouse concerned.
EDC control unit	<ul style="list-style-type: none"> EDC control unit 	⇒ The system recognises the new actuator automatically the first time the ignition key is moved to Drive. NB. To order the EDC Control Unit complete the specific form printing it from Modus and sending it to the Market Technical help Desk.



(*) With release MODUS 2.0 (Windows), 1.6C (DOS) or IWT 1.4, before "Storing new keys", it is necessary to disconnect EDC central unit. Once the operation has been completed, clear the fault memory to prevent the error from staying memorised on the actuator.

⇒ For subsequent releases keep to any new instructions given on the screen.

ABS/EBD/ABD

General

The braking of a vehicle in motion and the consequent deceleration and stopping space mainly depend on the grip between the tyre surface and the type of road surface.

With a perfectly efficient braking system, further improvement of braking can be obtained only acting on the tyre friction characteristics or on the quality of the road surface.

Even in these optimum conditions, absolute braking safety is not however guaranteed when needing to cope with particular critical situations, such as low grip due to the conditions of the wet or icy road surface: this compels the driver to moderate the braking action to prevent one or more wheels from partially locking, with the possibility of dangerous skidding.

The friction between the tyre and the road surface does not correspond to the friction between rigid bodies but to the

skidding (or slipping) between the tyre and the road in the contact area.

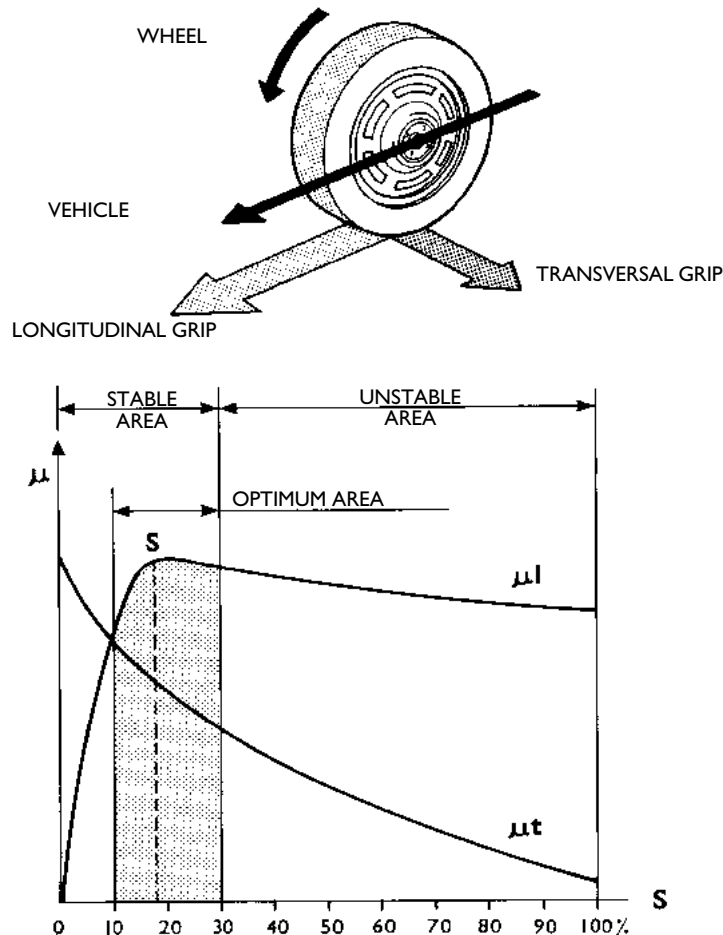
The figure shows the indicative trend of the longitudinal " μ_l " and transversal " μ_t " grip coefficients in relation to the percentage of slipping "S".

The diagram reveals that the maximum value of the longitudinal grip coefficient is not when the wheel is locked, but for a much lower slipping value.

Therefore, the road-tyre grip can be exploited to optimise longitudinal or transversal control of the vehicle. Namely, it is possible to utilise the grip trying to make the braking distance as short as possible or to ensure the best possible handling.

An excellent compromise is obtained using slip rates near the point S^* in which there is a high μ_l value which ensures optimum braking and a μ_t value that offers good lateral roadholding.

Figure 111



TREND OF WHEEL LONGITUDINAL AND TRANSVERSAL GRIP IN RELATION TO SLIPPING

In order to better understand the logic of the system and the parameters that govern it a few basic concepts should be briefly examined.

Due to the effect of the braking action the tyre, that before was rolling freely, undergoes a deformation, called "braking" deformation, in its area of contact with the road and slows down rotation reducing its peripheral speed, to a higher extent than the linear speed of the vehicle.

At the limit, with the wheels completely locked under the braking action, and thus with a wheel peripheral speed of zero, there is the maximum deviation between the wheel rotation speed and the linear speed of the vehicle.

Slipping varies its values within the limits set by the two extreme conditions in which the wheel and vehicle speed may be in.

When the wheel is free, not braked, thus turning at the same speed as the vehicle, the slipping coefficient is 0%.

When the braked wheel is completely locked and the vehicle continues moving forwards due to inertia, the skidding coefficient amounts to 100%.

Experimentation has made it possible to establish that the most effective braking condition is obtained for optimum slipping values contained between about ~ 5% and 20%.

The need to contain the slipping values within precise limits is imposed by the behaviour of the tyres under the braking action, during which the braking friction coefficient comes into play.

The higher this coefficient, the more braking is effective.

If the relation between slipping S and the friction coefficient μ , we see how there are the highest friction coefficient values for slipping values between an average of 5% and 20%.

As the friction coefficient is directly proportionate with the applicable braking force, the result is that the "ABS" device acts in such a way as to apply the maximum braking force exactly in correspondence with the best friction coefficient, and this system tends to bring any type of vehicle within this sector.

Figure 112

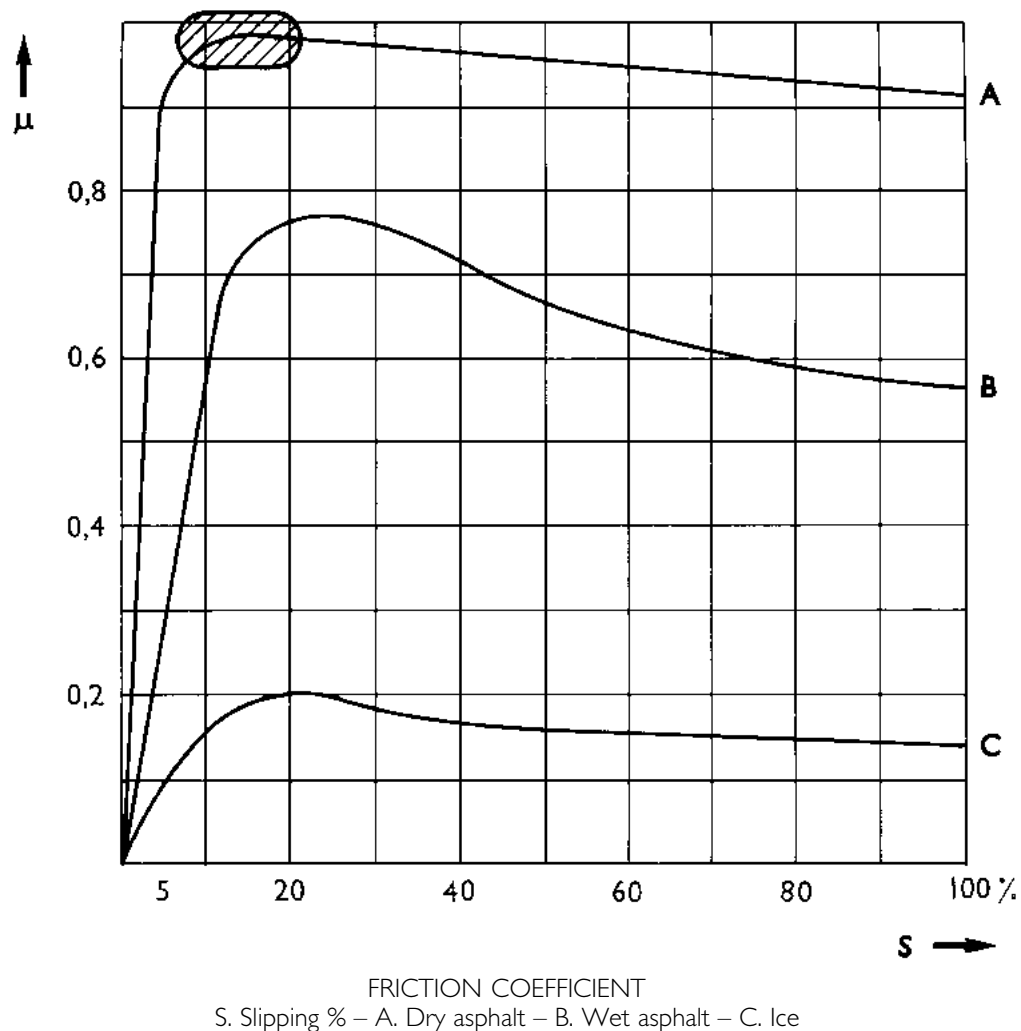
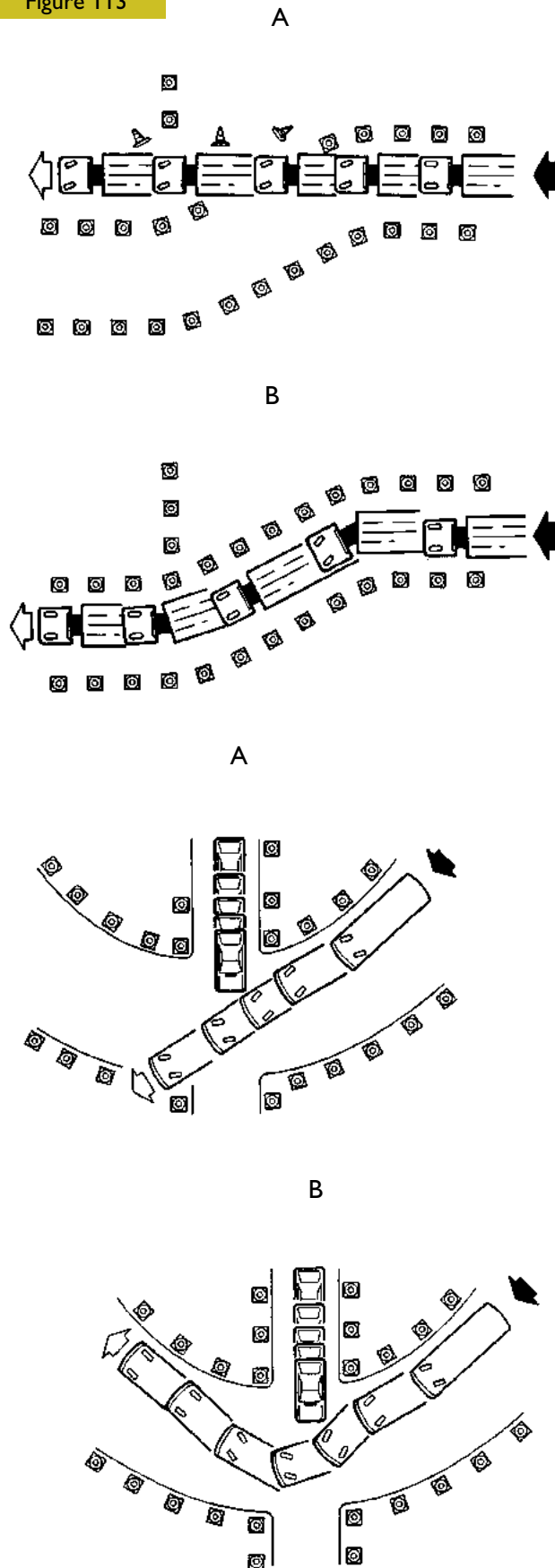


Figure 113



VEHICLE BRAKING TREND
WITHOUT AND WITH ABS

A. Vehicle without ABS – B. Vehicle with ABS

The locking of one or more wheels, due to excessive pressure on the brake pedal, (anyway higher than allowed by the grip) can cause loss of steering control of the vehicle if both front wheels lock, skidding, resulting in about-facing, if both rear wheels lock.

The need for abrupt braking on a bend, compels the driver to immediate action to avoid losing control of the vehicle, resulting in skidding.

Lastly, the so-called panic braking (caused by a sudden obstacle), compels the driver to press the brake pedal as forcibly as possible in the desperate attempt to stop in time..

So what is the solution even for the most expert drivers?

Being able to avail of a braking system capable of fully exploiting all the grip available without locking the wheels, except at a minimum pre-established speed.

The ABS Antibrake Locking System has been developed exactly to obtain this.

A device inserted in the braking system, with the task of preventing wheel locking when the brake operating pressure is too high in relation to the grip of the tyre on the ground.

Therefore, the purpose of the "ABS" device is to ensure vehicle stability (under all braking conditions) preventing locking of the wheels regardless of the conditions of the road surface, thereby ensuring total use of the grip available.

Also in the vent of emergency braking, the system makes it possible to maintain "steerability" of the vehicle, i.e. acting on the steering to avoid obstacles, without the danger of skidding.

Keeping the rotation and grip of the wheels within the optimum parameters, the system makes it possible to obtain those braking distances that only an expert driver would be able to approach; this way even the less expert driver is able to act like one of the best.

The diagram opposite shows some examples of braking without ABS and with ABS.

In order to be able to intervene effectively the system must not only be precise in response, but also very quick.

This is now possible thanks to electronic information which warrants reliability, precision and rapidity, with a minimal number of components and lower system cost.

In addition to the ABS, the system in question also incorporates the EBD and ABD functions.

EBD – Electronic Brake Force distribution

This device replaces and optimises the function of the present hydraulic braking action proportioning valve, better controlling the braking force on the rear wheels.

It is obtained by adding specific software to the ABS and it acts in a determinate interval before the cutting in of the ABS.

It ensures control on any locking of the rear wheels in relation to the front ones, optimising the braking force in the different load, driving and conditions of use of the vehicle.

ABD – Automatic Brake Differential

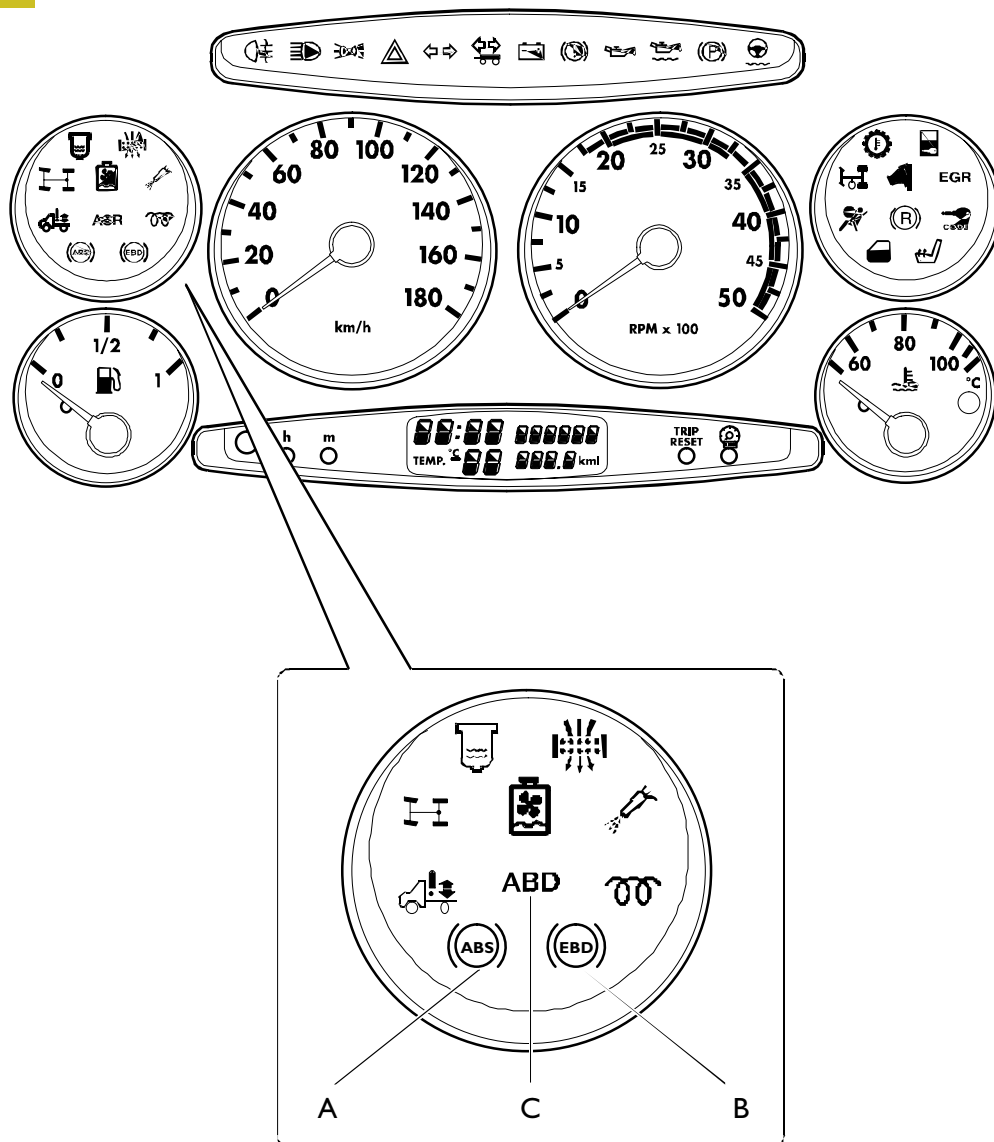
This device comes into action automatically braking the driving wheel that has less grip when moving off or travelling and tends to skid transferring the torque through the differential to the wheel with higher grip.

It cuts in up to a speed of about 40 km/h and does not interfere with the normal braking system.

It cuts in up to a speed of about 40 km/h and does not interfere with the normal braking system.

The driver is informed when this system is engaged by the flashing of the yellow warning light on the dashboard.

Figure 114



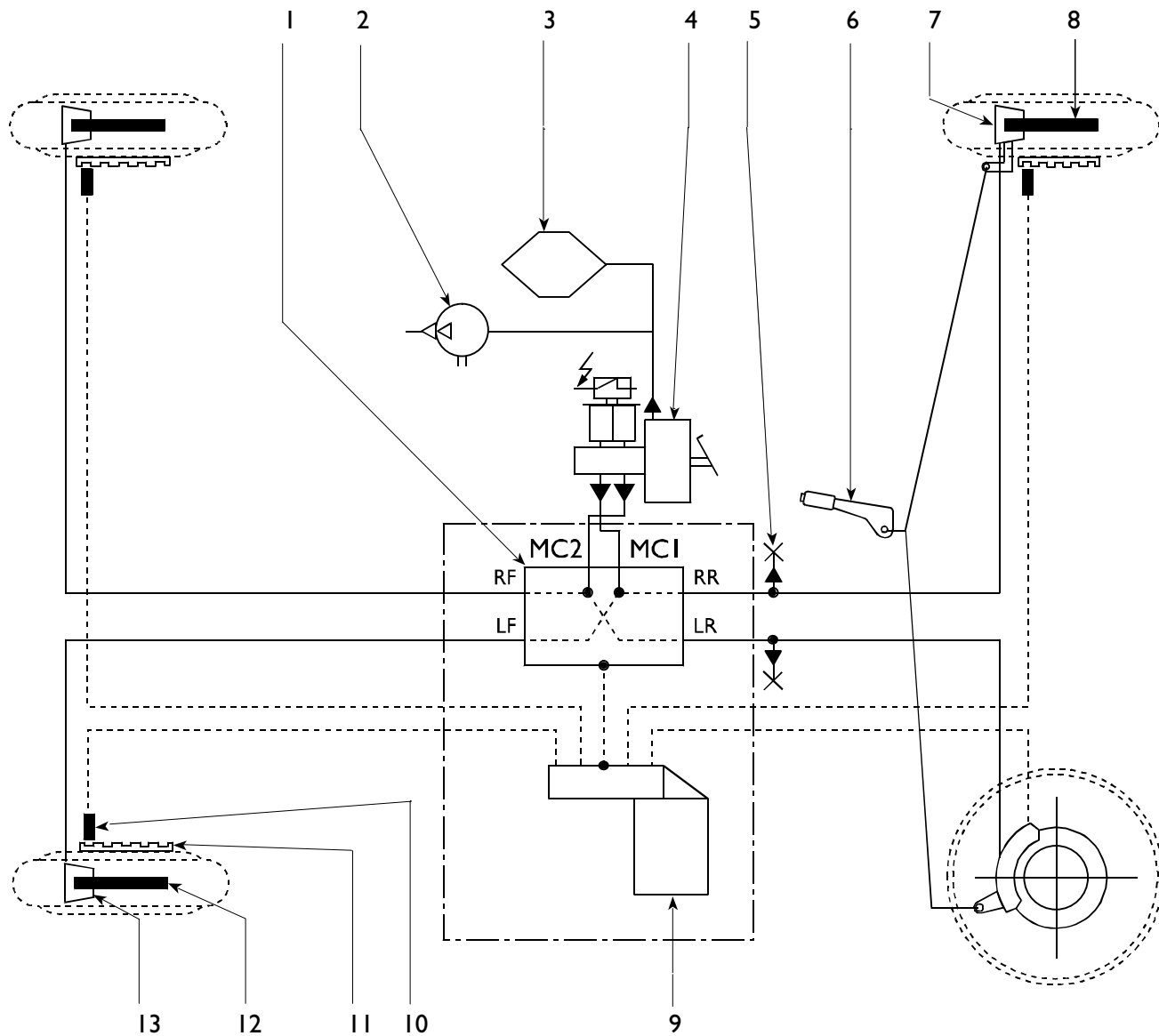
SYSTEM WARNINGS ON DASHBOARD

A. ABS failure warning light 58703 – B. EBD failure warning light 58734 – C. ABD failure warning light 58704

SYSTEM WITH 4 CROSSED CHANNELS (X)

The system shown is used on the following vehicles: 29 L – 35 S

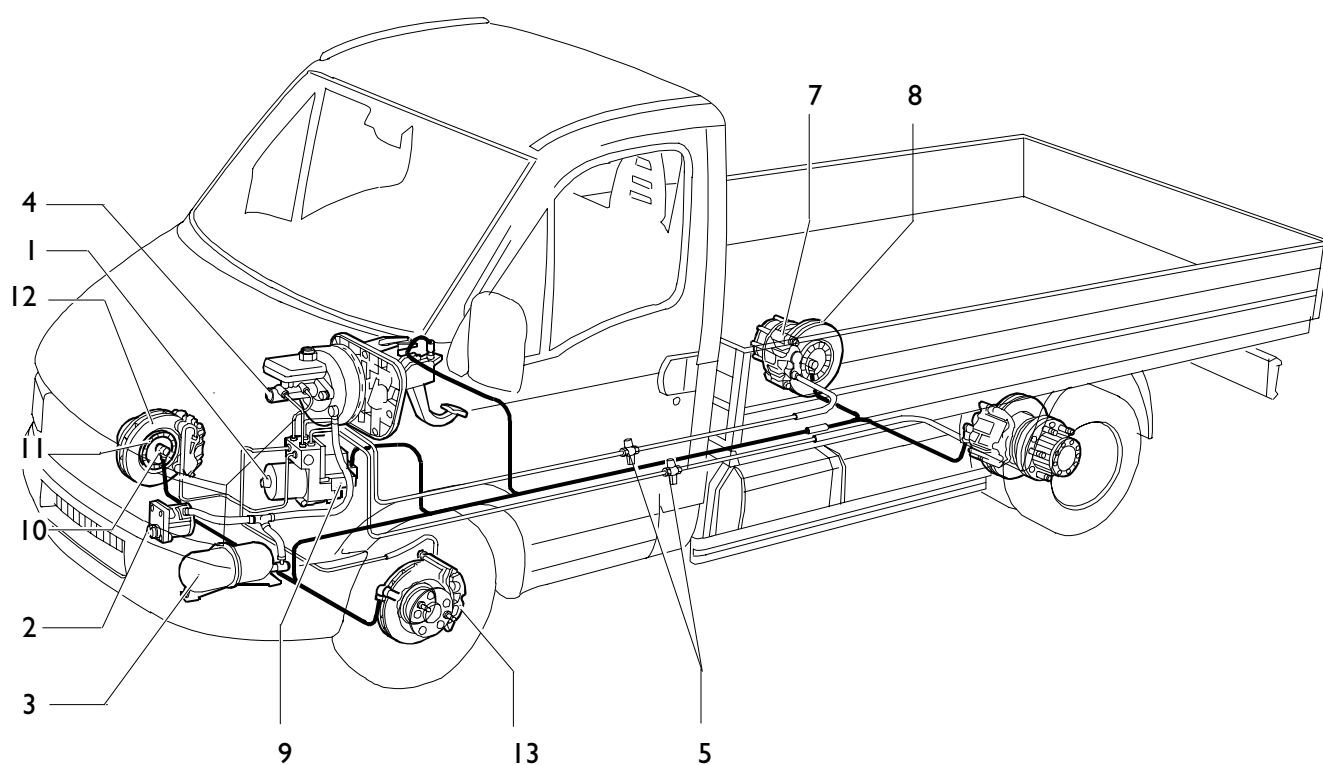
Figure 115



1. Electrohydraulic modulator – 2. Vacuum pump – 3. Vacuum tank – 4. Vacuum servobrake – 5. Hydraulic control sockets
 6. Parking brake lever – 7. Rear brake caliper – 8. Rear disk brake – 9. Electronic control unit – 10. Sensor –
 11. Phonic wheel – 12. Front brake disk – 13. Front brake caliper

Location of components

Figure 116



1. Electrohydraulic modulator – 2. Vacuum pump – 3. Vacuum tank – 4. Vacuum servobrake – 5. Hydraulic control sockets – 7. Rear brake caliper – 8. Rear disk brake – 9. Electronic control unit 88000 – 10. Sensor 88001 – 11. Phonic wheel – 12. Front brake disk – 13. Front brake caliper

Sensor on phonic wheel

The sensors supply the electronic control unit all the useful information, with the necessary continuity, for it to be able to control the solenoid valves.

The signals are obtained by magnetic flux lines which are closed through the teeth of an iron toothed wheel facing the sensor and turned with the wheel.

The passage from solid to hollow, due to the presence or absence of the tooth determines a change of the magnetic flux which is enough to create an electromotive force induced at the terminals of the sensor and thus an alternate electric signal, which is sent to the electronic control unit.

The distance between the sensor and the wheel, called gap, must clearly have a pre-established value so that correct signals are supplied ($0,8 \pm 1,6 \text{ mm}$).

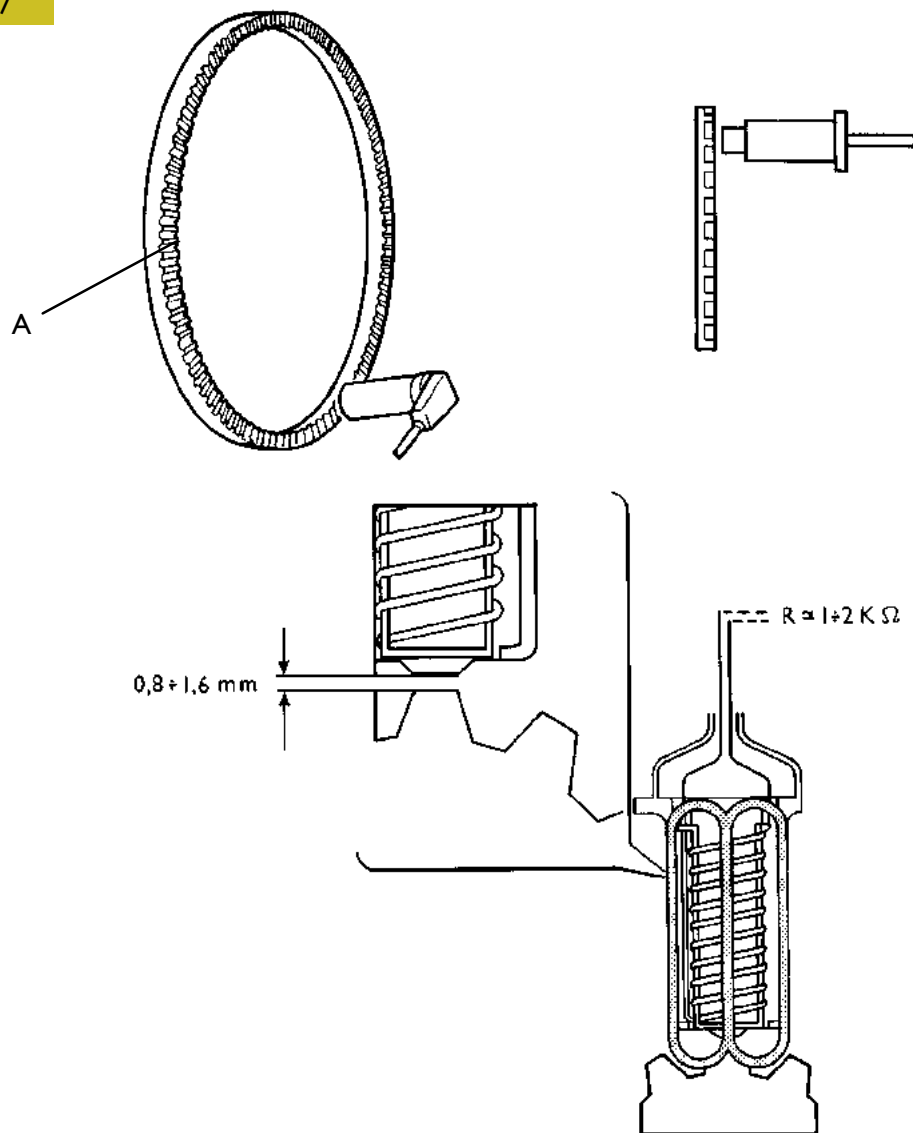
The resistance rating of each single sensor detected at the ends of the connector is between $1 \pm 2 \text{ k}\Omega$.

The toothed wheel is called phonic wheel because the signal it generates has the frequency of a sound wave.

The frequency of this signal serves to define the wheel rotation speed.

The changes of the frequency, i.e. the rapidity with which the signals follow one another serve to define the acceleration and deceleration values.

Figure 117



SENSOR ON PHONIC WHEEL

A. Phonic wheel

Electrohydraulic control unit/modulator

The component integrates both the electronic part and the hydraulic modulator for system management.

It comprises the following:

A – Electronic control unit

B – Electrohydraulic modulator

C – Accumulator

It is connected to the hydraulic system by the following connections:

MC1 – Diagonal supply LF/RR

MC2 – Diagonal supply RF/LR

LF – Left front axle output

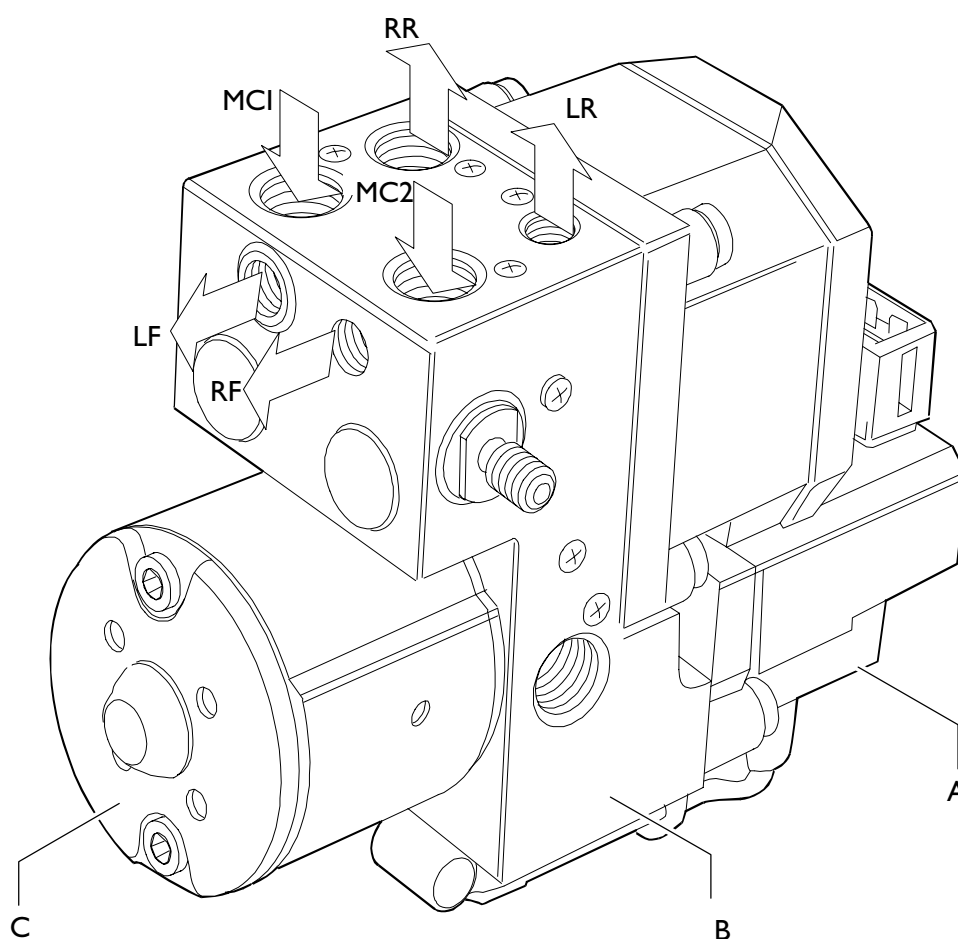
RR – Right rear axle output

RF – Right front axle output

LR – Left rear axle output

It is connected to the electric system through a 31-pin connector.

Figure 118



CONTROL UNIT/ELECTROHYDRAULIC MODULATOR

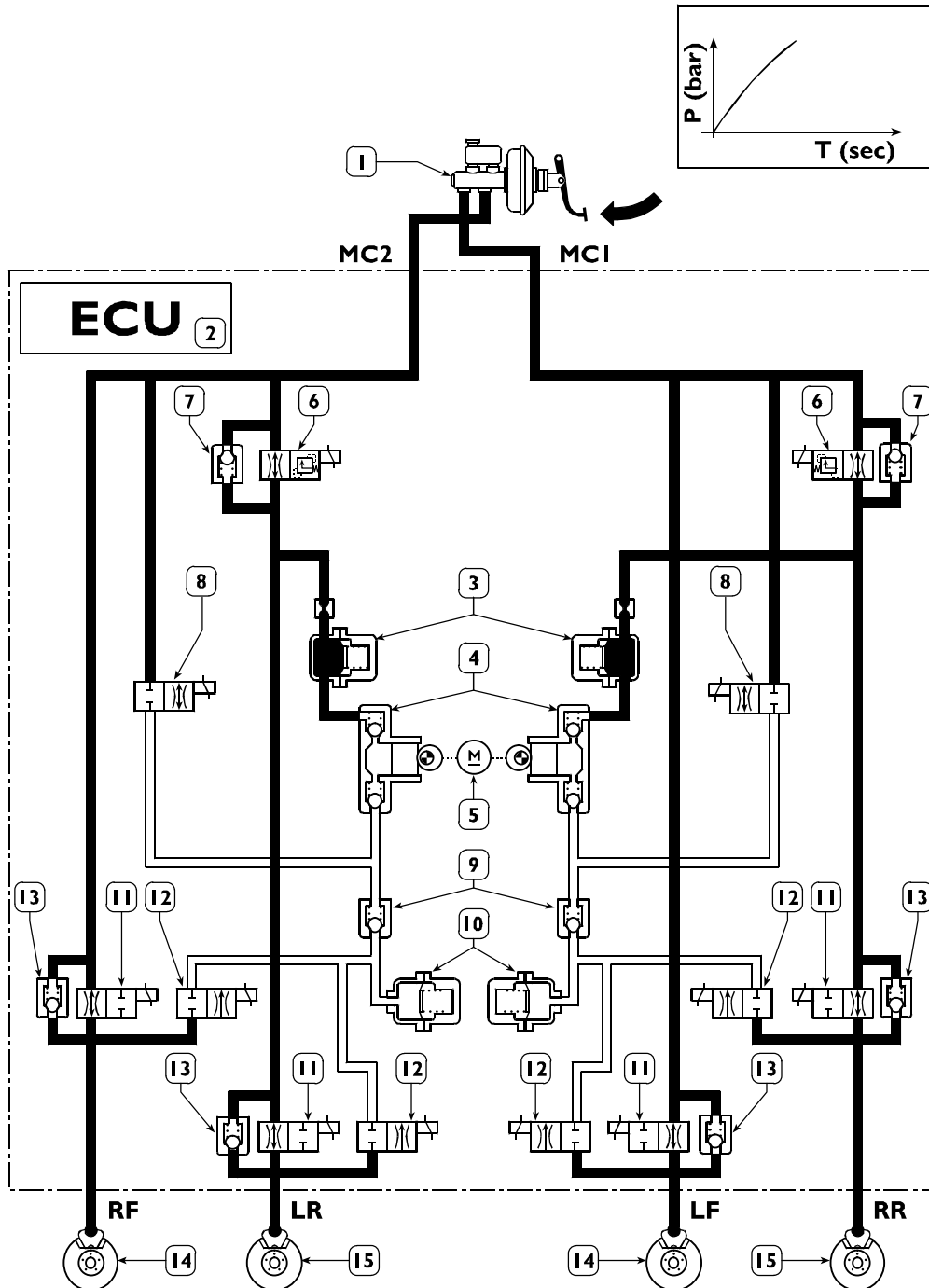
Electrohydraulic modulator

The figure schematically shows the connection of the modulator and its internal components.

Pressure increase

Operating the brake pedal, the pressurised oil can reach the brake calipers as both the drive solenoid valves "6" and the supply solenoid valve "11" are open.

Figure 119



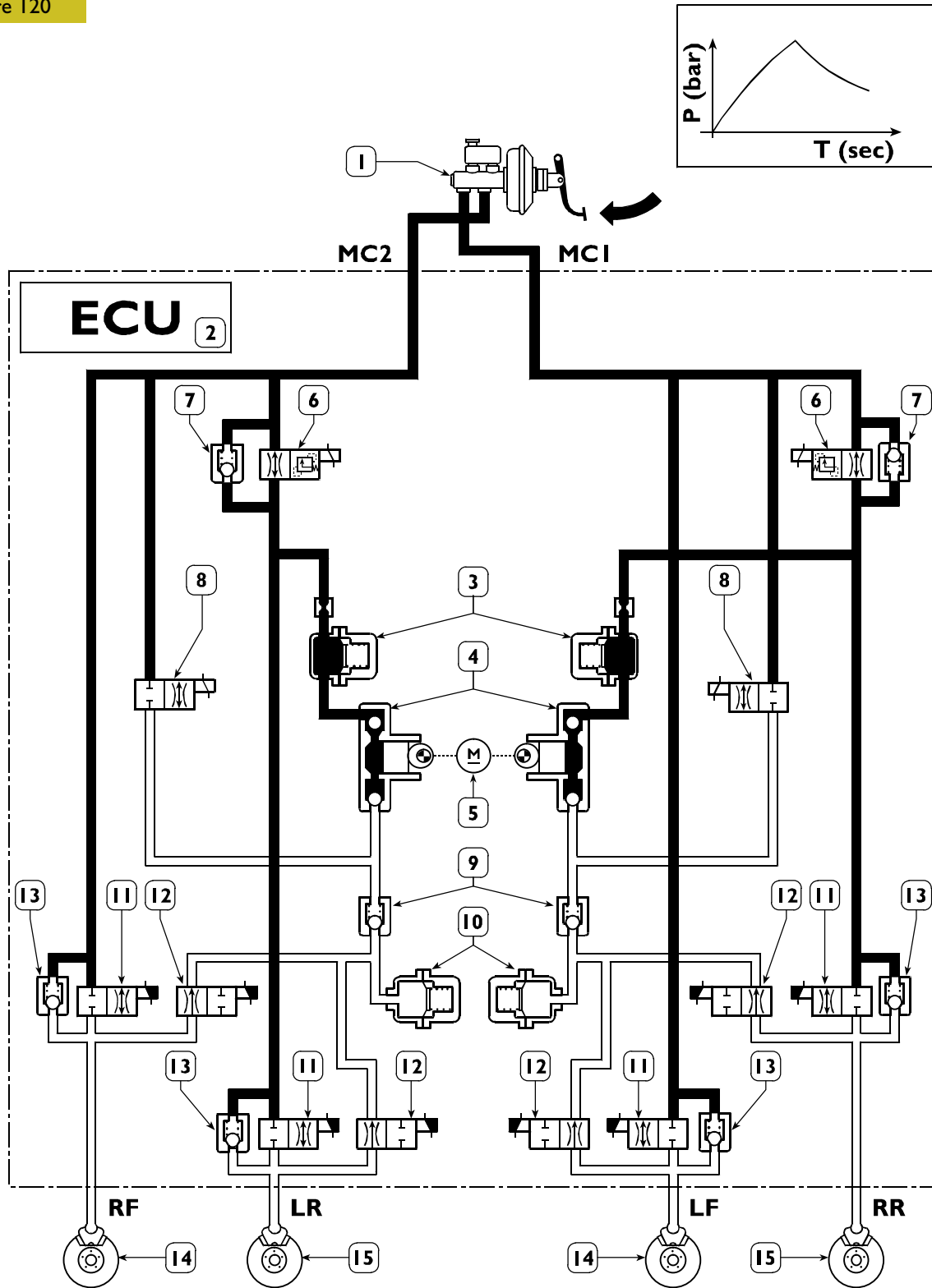
1. Vacuum servobrake – 2. Electronic control unit – 3. High pressure accumulator – 4. Recovery pumps – 5. Recovery pump drive motor – 6. ABD control solenoid valves (setting 90 bar) – 7. One-way safety valves – 8. ABD intake solenoid valves – 9. ABD one-way valves – 10. Low pressure accumulator – 11. Supply solenoid valves – 12. Discharge solenoid valves – 13. One-way quick pressure reduction valves – 14. Front axle disk brakes – 15. Rear axle disk brakes

Pressure lowering

If the sensors detect the tendency of a wheel or wheels to lock, they inform the control unit which reduces the braking force activating the supply solenoid valves "11" and the discharge solenoid valves "12".

At the same time, supplying the motor "5" that drives the pumps "4" it will be possible to recover the excess oil volume in the high pressure accumulators "3".

Figure 120

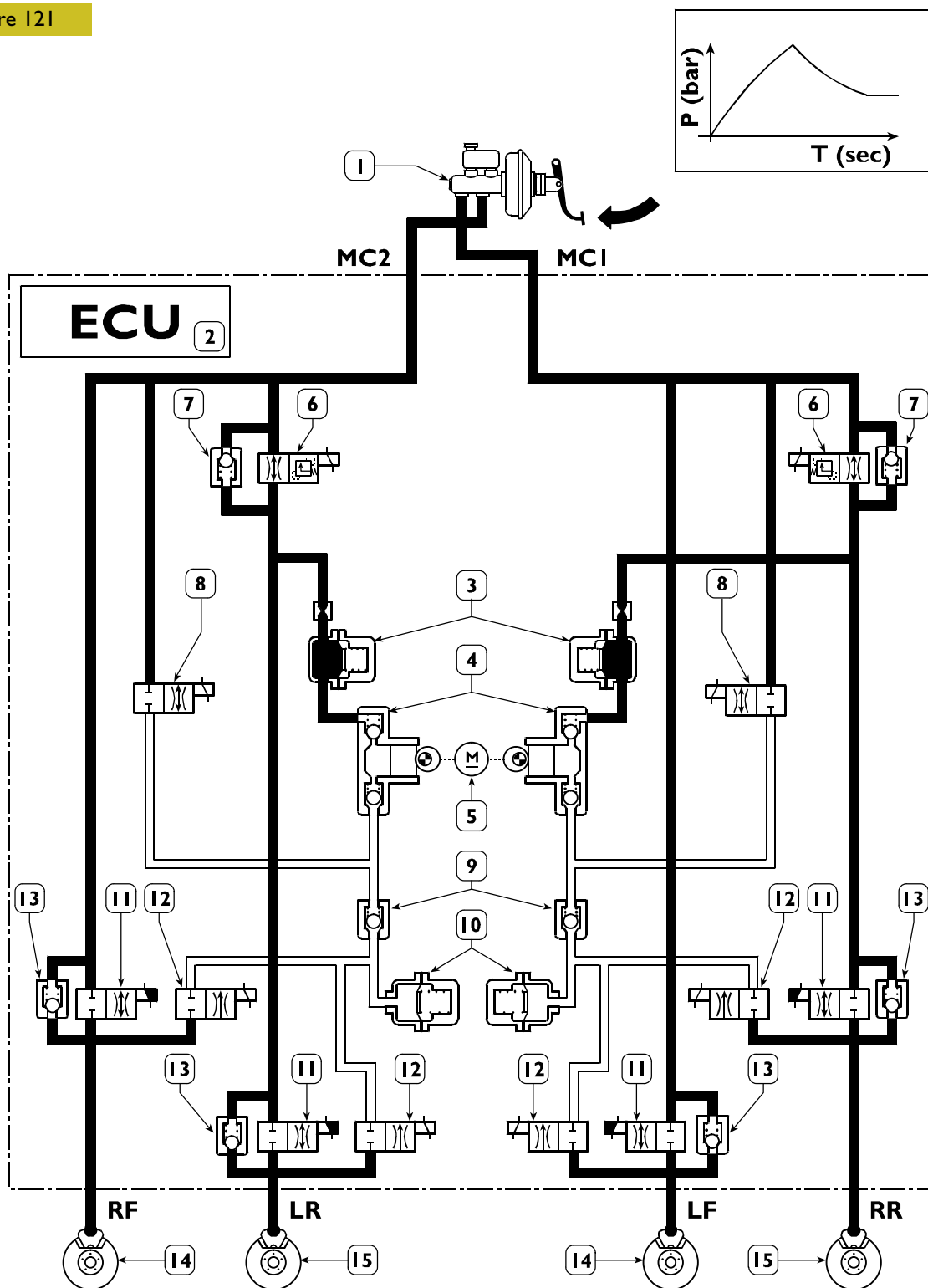


SYSTEM OPERATING LAYOUT SHOWING THE PRESSURE MAINTENANCE PHASE

Pressure maintenance

Once the optimum braking force has been reached, the control unit can keep it constant, no longer energising the discharge solenoid valves "12", the motor "5" and the associated recovery pumps "4", while the supply solenoid valves "11" continue being supplied.

Figure 121



SYSTEM OPERATING LAYOUT SHOWING THE PRESSURE MAINTENANCE PHASE

Cutting in of EBD device

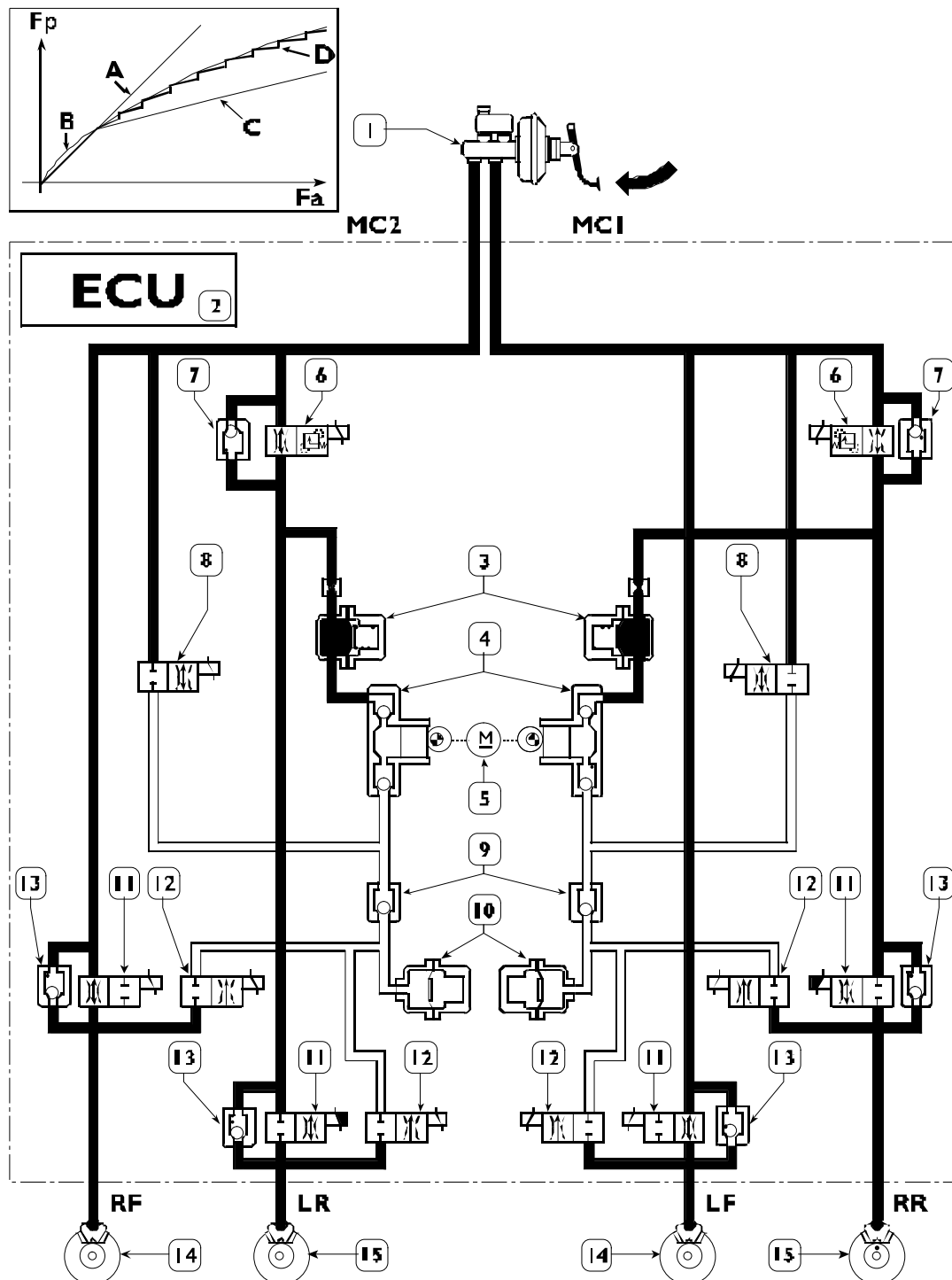
If the sensors detect that one or both wheels tend to lock in relation to the front wheels, they inform the control unit which suitably supplies the supply solenoid valves "II" of the rear axle to optimise the braking force.

A fault on certain system components causes the ABS system to be cut off (displayed by turning on the special warning light), still leaving the EBD system operational.

If both failure warning lights turn on (ABS and EBD) this means an EBD system failure.

Under these conditions the braking force will not be distributed between the axles, therefore rear wheel locking may occur with the possibility of skidding.

Figure 122



FP. Rear axle braking force – FA. Front axle braking force – A. Servobrake distribution curve – B. Ideal distribution – C. Curve – distribution curve of any porportioning valve – D. EBD system distribution curve

Cutting in of ABD device

If the sensors detect that one or both rear axle wheels tend to skid, they inform the control unit which supplies the intake solenoid valves "8" and the drive valves "6".

At the same time, supplying the motor "5" which drives the pumps "4" it will be possible to generate the pressure to be sent to the brake calipers concerned.

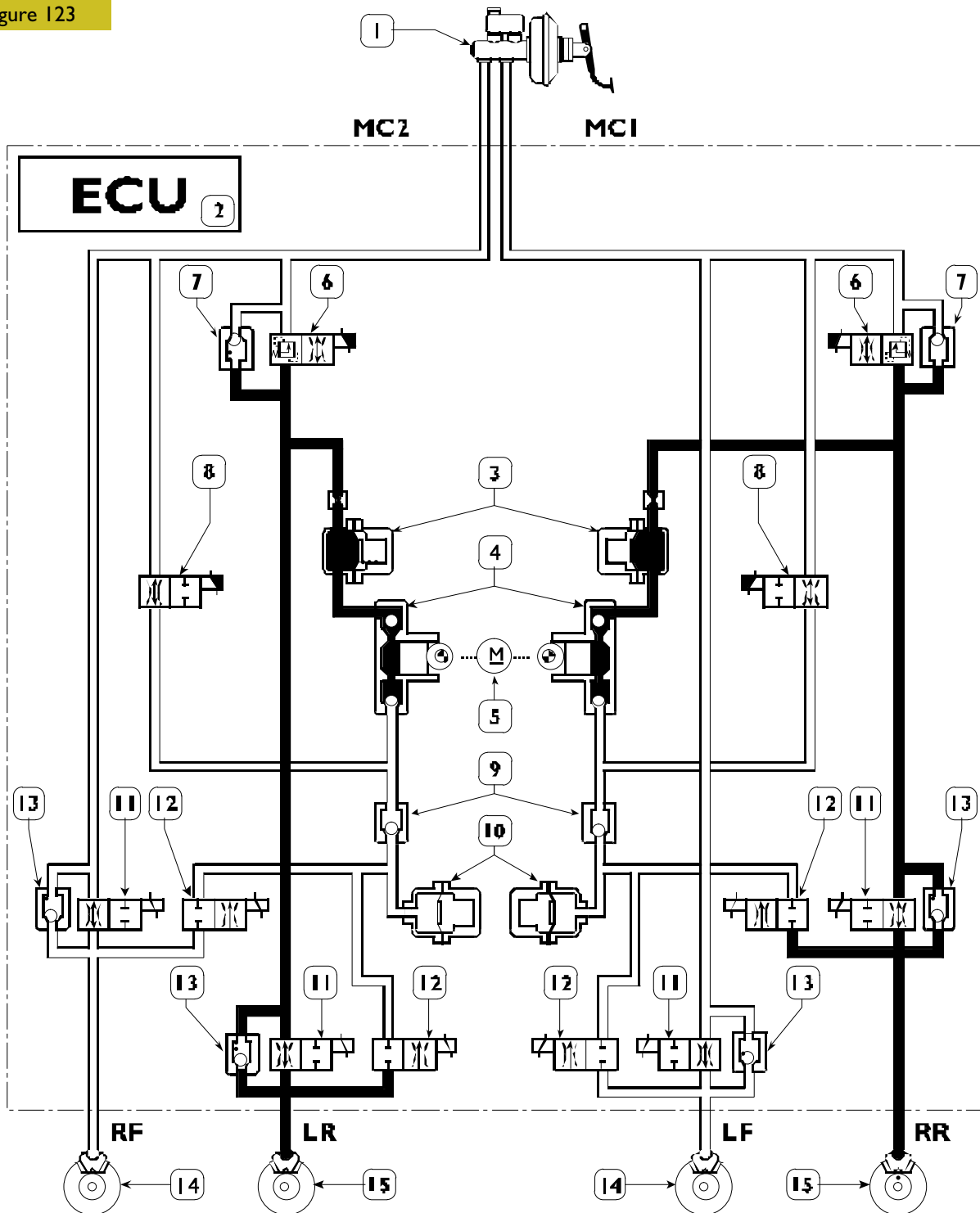
The braking force generated in this manner is modulated by solenoid valves "11" and "12".

During this phase the maximum pressure is limited by the drive solenoid valves "6" and cannot exceed 90 bar.

The driver is informed of the cutting in of this system by the flashing of the corresponding warning light on the dashboard.

If the warning light turns on and glows steadily, there is an ABD system failure.

Figure 123

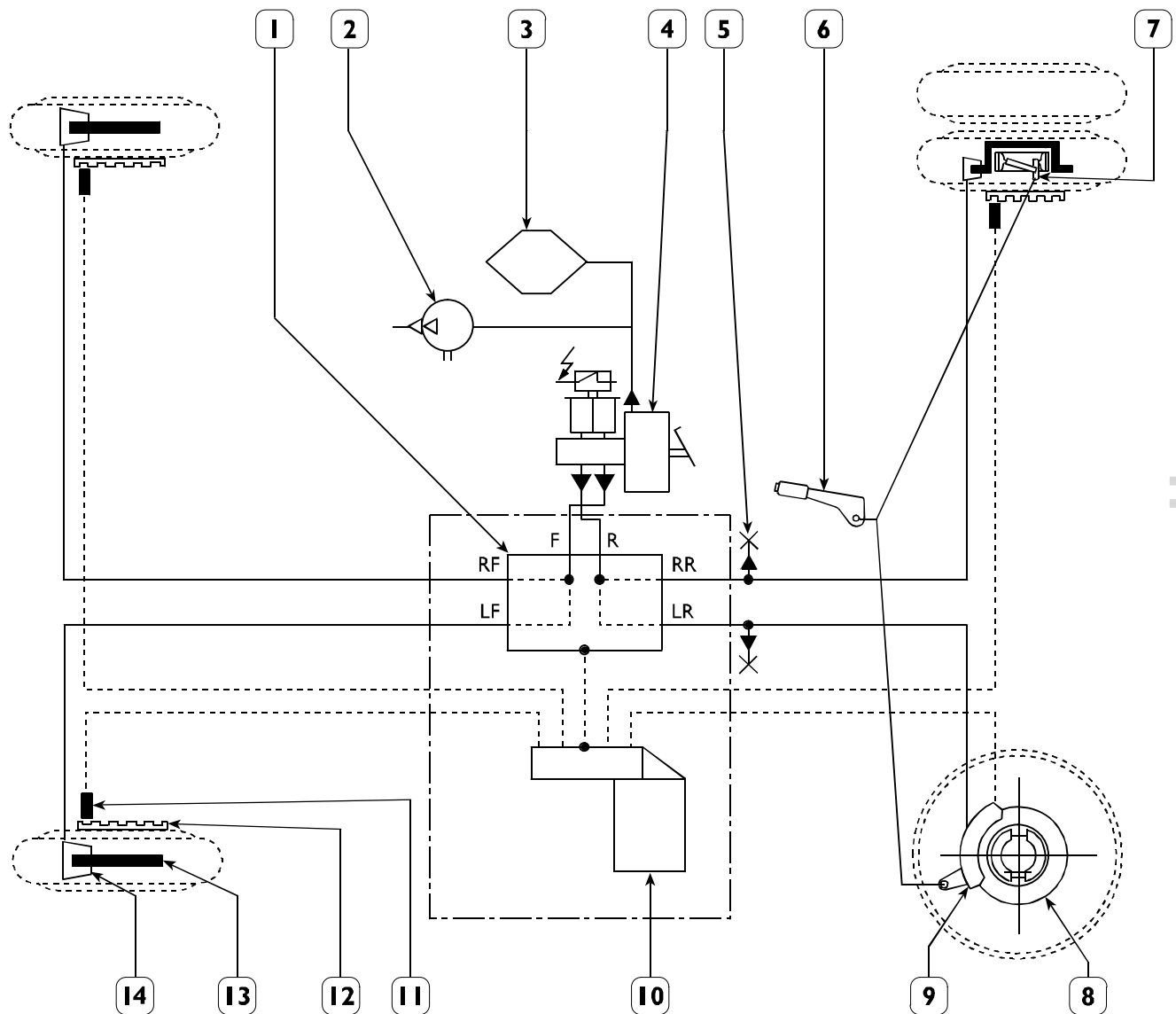


ABD DEVICE OPERATING LAYOUT

SYSTEM WITH 4 PARALLEL CHANNELS (II)

The system shown in Figure 124 is used on the following vehicles: 35 C – 40 C – 45 C – 50 C – 65C.

Figure 124



1. Electrohydraulic modulator – 2. Vacuum pump – 3. Vacuum tank – 4. Vacuum servobrake – 5. Hydraulic control sockets – 6. Parking brake lever – 7. Parking drum brake – 8. Rear brake disk – 9. Rear brake caliper – 10. Electronic control unit – 11. Sensor – 12. Phonic wheel – 13. Front brake disk – 14. Front brake caliper

Electrohydraulic control unit/modulator

This component integrates both the electronic part and the electrohydraulic system control modulator.

It comprises the following:

A – Electronic control unit

B – Electrohydraulic modulator

C – Accumulator

It is connected to the hydraulic system by the following connections:

F – Front axle supply

R – Rear axle supply

LF – Left front axle output

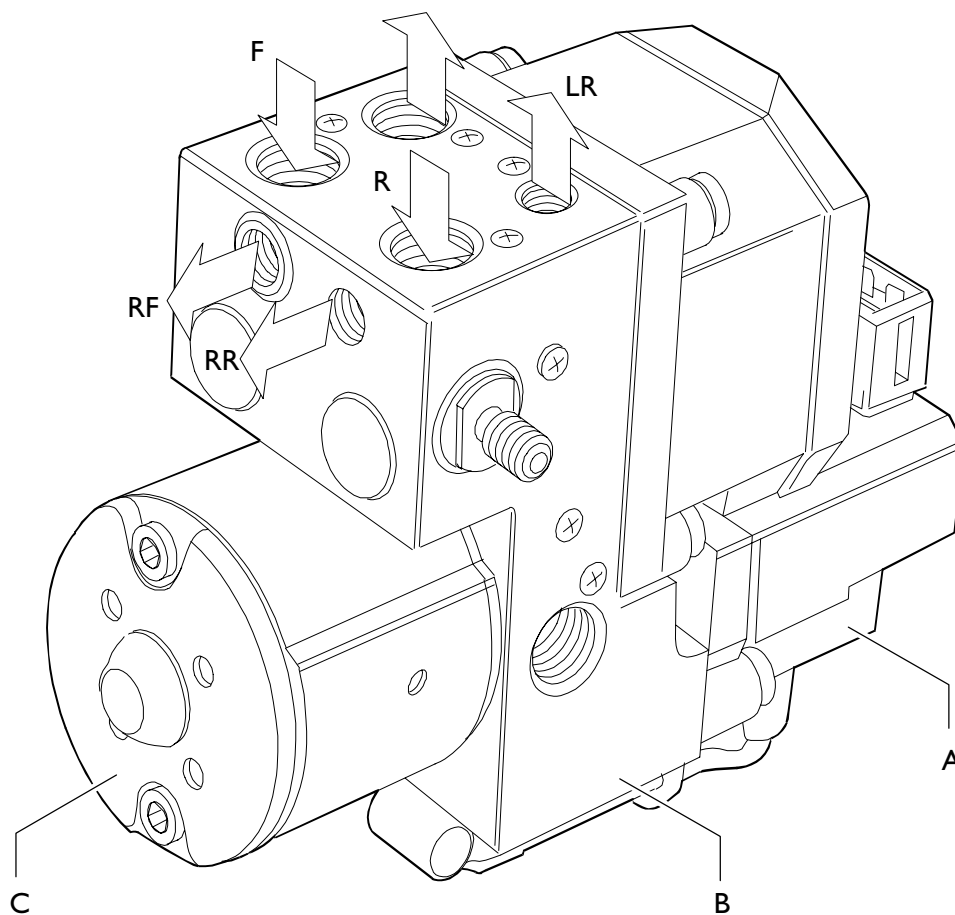
RF – Right front axle output

LR – Left rear axle output

RR – Right rear axle output

It is connected to the electric system through a 31-pin connector.

Figure 125



CONTROL UNIT/ELECTROHYDRAULIC MODULATOR

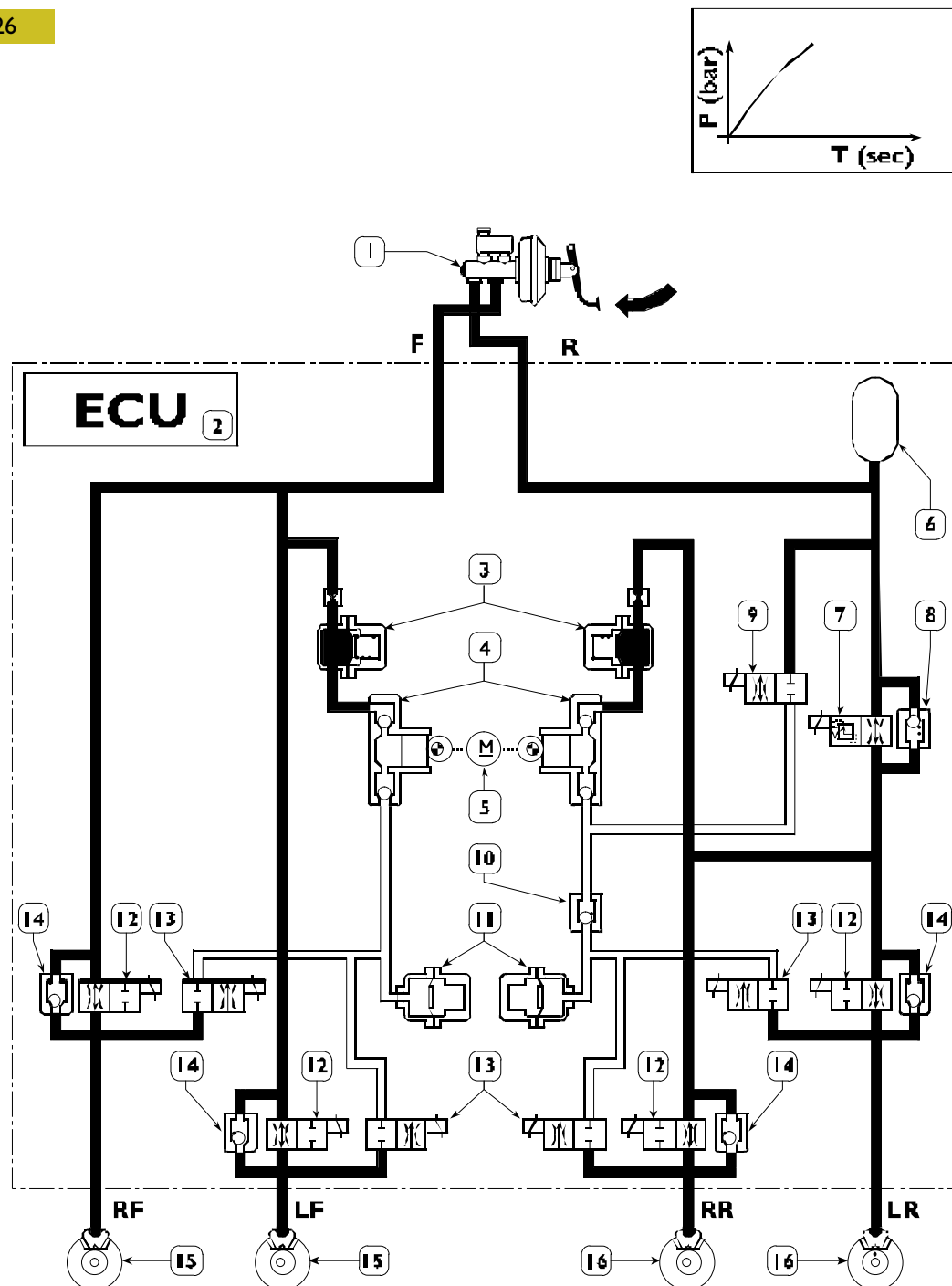
Electrohydraulic modulator

The figure shows the layout of the connection of the modulator and its internal components.

Pressure increase

Operating the brake pedal, the pressurised oil can reach the brake calipers as both the drive solenoid valve "7" and the supply solenoid valves "12" are open.

Figure 126



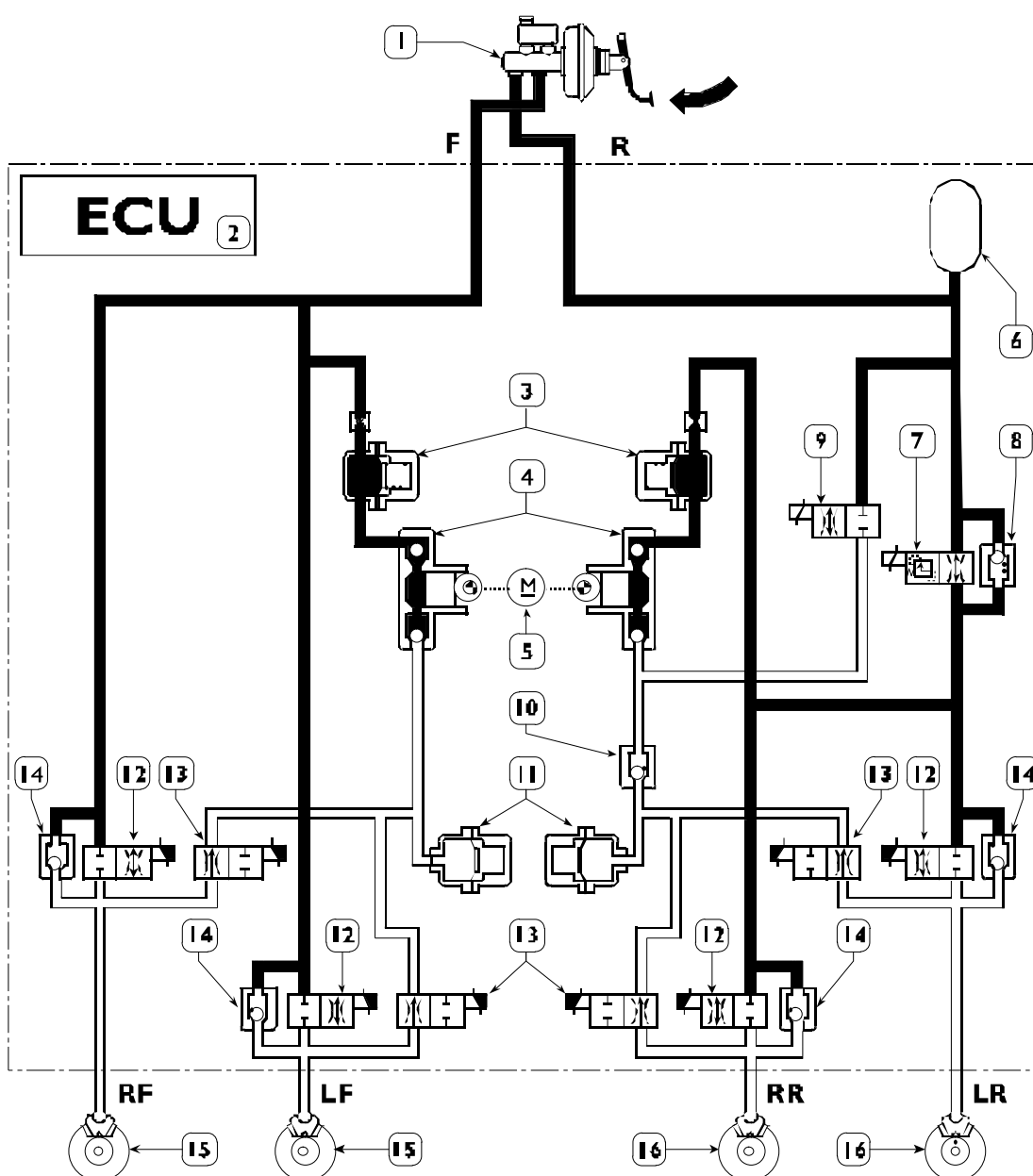
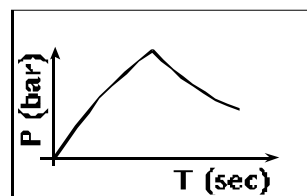
1. Vacuum servobrake – 2. Electronic control unit – 3. High pressure accumulators – 4. Recovery pumps – 5. Recover pump drive motor – 6. Accumulator for rear axle system – 7. ABD drive solenoid valve (90 bar setting) – 8. One-way abd valve – 9. Intake abd solenoid valve – 10. ABD one-way valve – 11. Low pressure accumulators – 12. Supply solenoid valves – 13. Discharge solenoid valve – 14. One-way quick pressure relief valves – 15. Front axle disk brake – 16. Rear axle disk brakes

Pressure reduction

If the sensors detect that a wheel or wheels tend to lock, they inform the control unit which reduces the braking force activating the supply solenoid valves "12" and the discharge solenoid valves "13".

At the same time, supplying the motor "5" which drives the pumps "4", it will be possible to recover the excess oil in the high pressure accumulators "3".

Figure 127



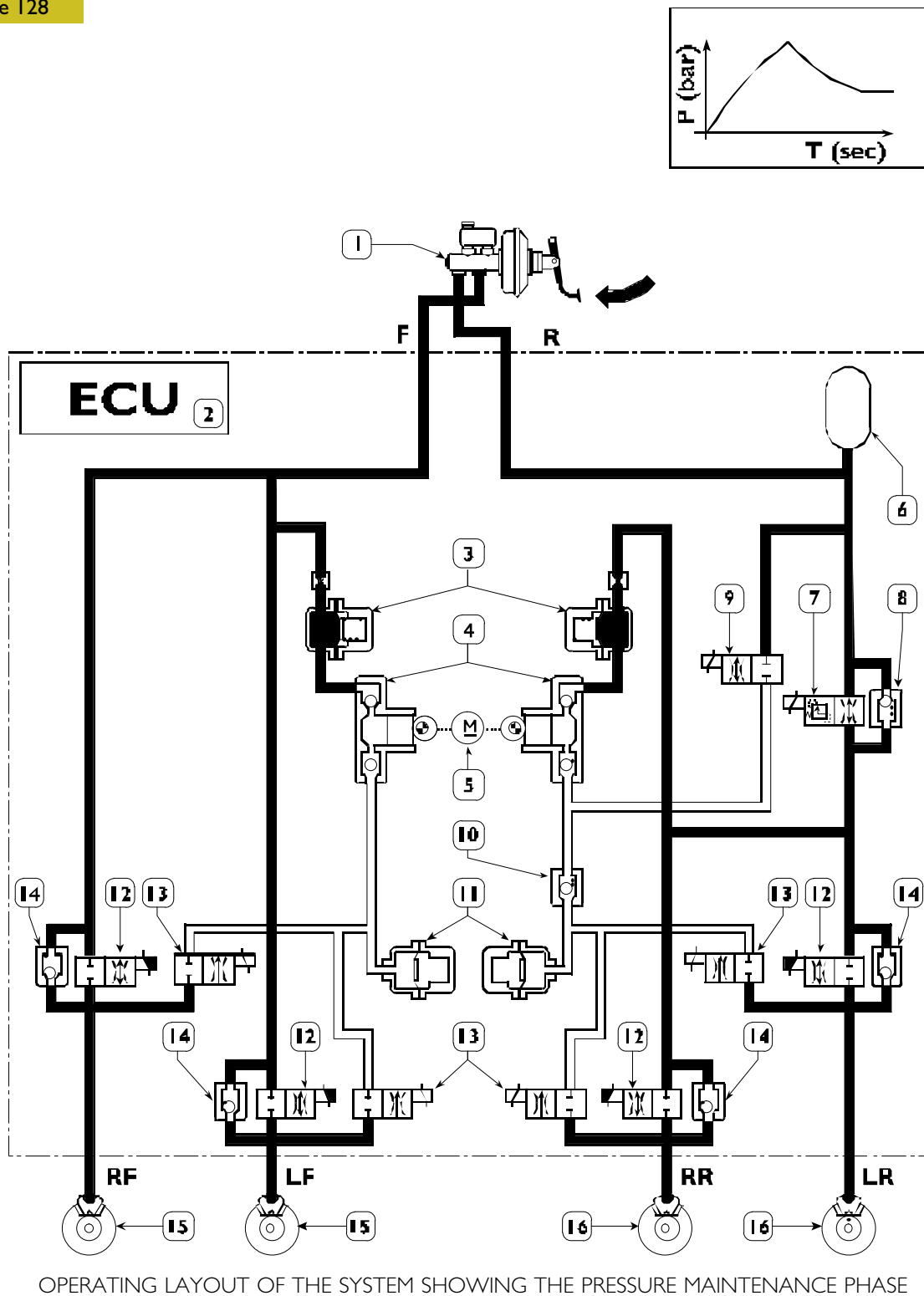
OPERATING LAYOUT OF THE SYSTEM SHOWING THE PRESSURE REDUCTION PHASE

Pressure maintenance

Once the optimum braking force has been reached, the control unit is able to keep it constant by no longer

energising the discharge solenoid valves "13", the motor "5" and the corresponding recovery pumps "4"; while the supply solenoid valves "12" continue being energised.

Figure 128



Cutting in of the EBD device

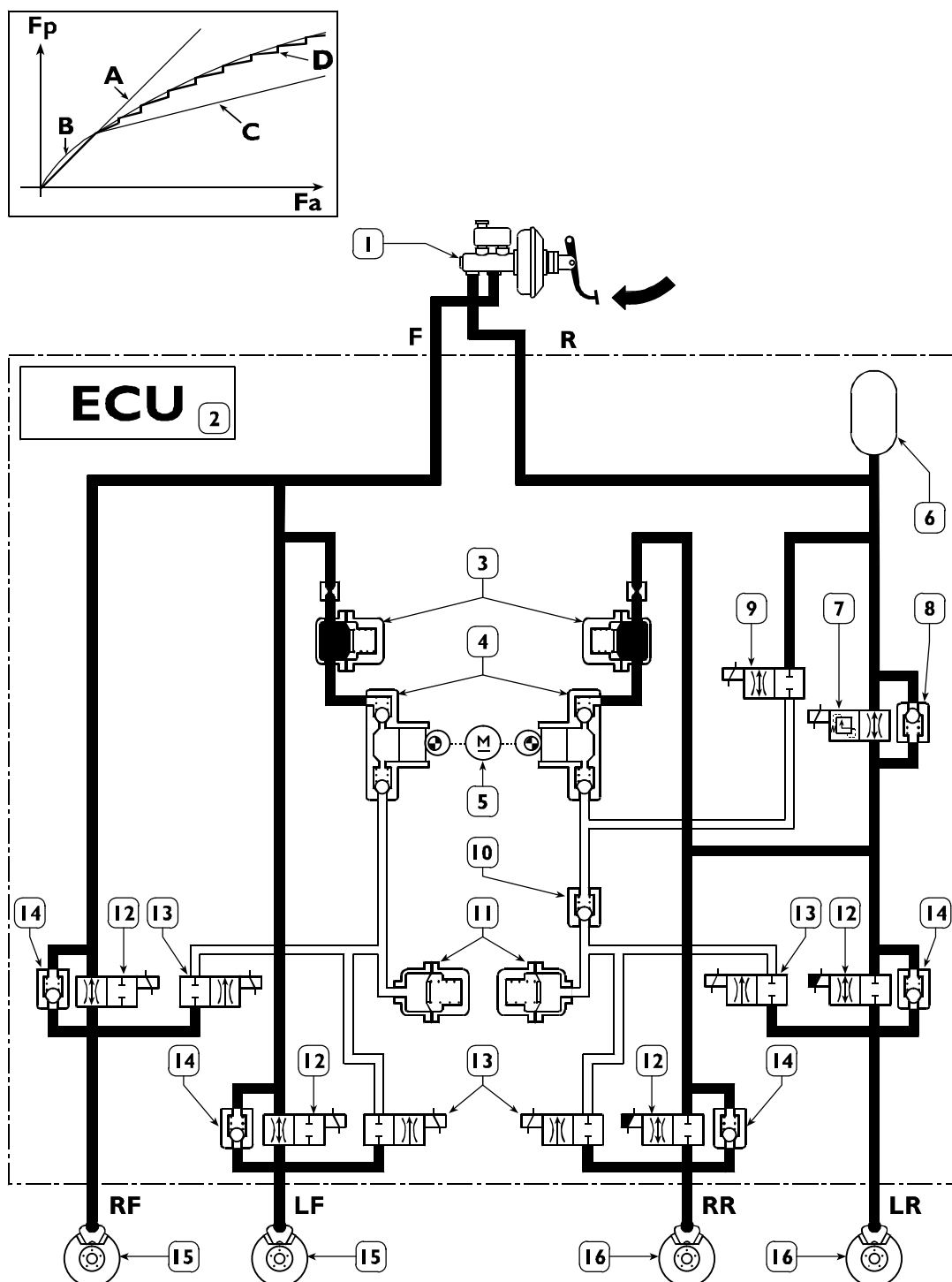
If the sensors detect that one or both rear wheels tend to lock in relation to the front wheels, they inform the control unit which appropriately supplies the supply solenoid valves "12" of the rear axle, in order to optimise the braking force.

A fault on certain system components causes the ABS system to be cut off (displayed by turning on the special warning light), still leaving the EBD system operational.

If both failure warning lights turn on (ABS and EBD) this means an EBD system failure.

Under these conditions the braking force will not be distributed between the axles, therefore rear wheel locking may occur with the possibility of skidding.

Figure 129



FP. Rear axle braking force – FA. Front axle braking force – A. Servobrake distribution curve – B. Ideal distribution curve – C. Any proportioning valve distribution curve – D. EBD system distribution curve

Cutting in of the ABD device

If the sensors detect that one or both rear axle wheels tend to skid, they inform control unit which supplies the intake solenoid valves "9" drive valves "7".

At the same time, supplying the motor "5" which drives the pumps "4" it will be possible to generate the pressure to be sent to the brake calipers concerned.

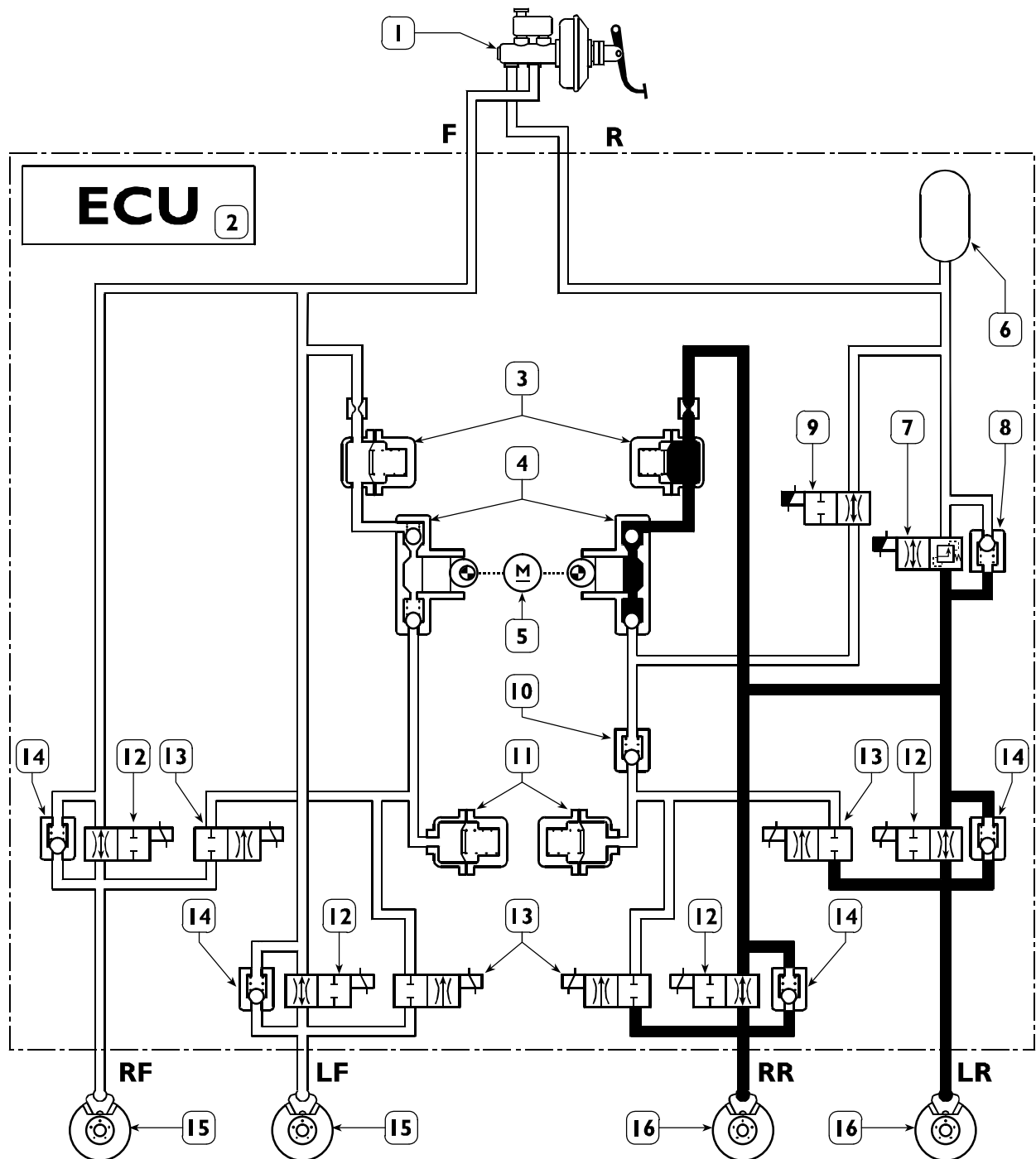
The braking force generated in this manner is modulated by solenoid valves "12" and "13".

During this phase the maximum pressure is limited by the drive solenoid valves "6" and cannot exceed 90 bar.

The driver is informed of the cutting in of this system by the flashing of the corresponding warning light on the dashboard.

If the warning light turns on and glows steadily, there is an ABD system failure.

Figure 130

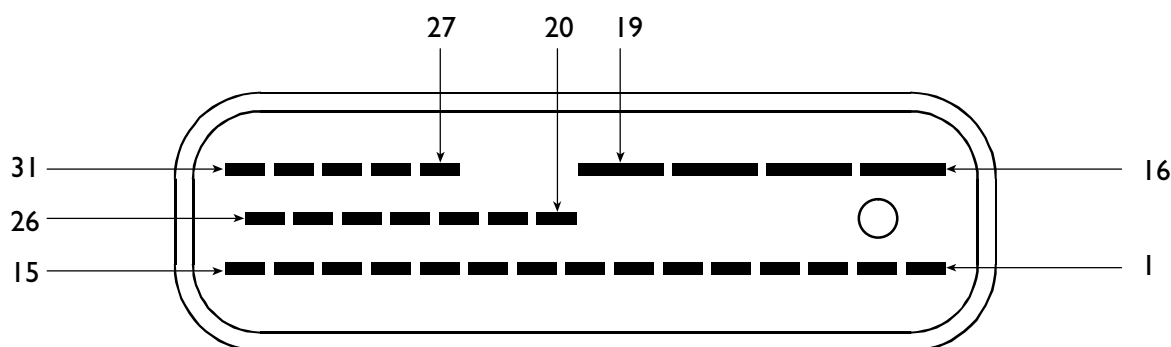


ABD DEVICE OPERATING LAYOUT

Electronic control unit

The following table shows the pin out of the control unit in question.

Figure 131



Pin	Function	Cable colour code
1	Right rear sensor	—
2	Right rear sensor	—
3	Right front sensor (only for 35 C – 40 C – 45 C – 50 C – 65 C vehicles)	—
4	Right front sensor	—
5	Right front sensor (only for 29 L – 35 S vehicles)	—
6	Left front sensor	—
7	Left front sensor	—
8	Left rear sensor	—
9	Left rear sensor	—
10	—	—
11	Line K to pin 4 38-pin connector for diagnostics	8817
12	Line L to pin 3 38-pin connector for diagnostics	8818
13	Negative for third brake relay	0315
14	Positive from stop light switch	1173
15	Key-operated positive	8847
16	Earth	0000
17	Direct positive	7772
18	Direct positive	7772
19	Earth	0000
20	Negative for ABS failure warning light	6670
21	Negative for EBD failure warning light	6673
22	—	—
23	—	—
24	Negative for ABD operating warning light	6674
25	—	—
26	—	—
27	—	—
28	—	—
29	—	—
30	—	—
31	—	—

ABS 8/ESP 8**The ABS 8 system integrates the following functions:**

- ☐ **ABS - Antilock Braking System**
It prevents wheels from being locked during braking, thus making it possible to avoid possible obstacles.
It prevents losing control of the vehicle when braking on a slippery surface (even on one side only → mu-split).
It also reduces the braking distance compared with the one with the wheels locked.
- ☐ **EBD - Electronic Brake Force distribution**
It supersedes and optimizes the function of current hydraulic brake correctors, by better controlling the braking force on rear wheels.
It is implemented by adding a special software to the ABS, and comes into action within a given time interval prior to ABS actuation.
It makes it possible to control any locking condition affecting the rear wheels compared with the front wheels, by optimizing the braking force under different load, running and vehicle utilization conditions.

NOTE The ABD (Automatic Brake Differential) function is available only in systems of the ABS 5.3 type.

The ESP 8 system, in addition to the ESP 8 system, incorporates the following functions:

- ☐ **ESP - Electronic Stability Program**
It monitors the vehicle behaviour continuously (both along straight stretches and bends, when braking or accelerating).
It also monitors the driver's actions: steering the wheel, pressing the brake pedal, accelerator position, and speed.
It is always active in the background, i.e. the ESP system compares the actual vehicle ride with the driver's desired ride 50 times a second. It recognizes dangerous situations before the driver does.
The system considers the different possibilities of coming into operation. It brakes on every single wheel separately.
It operates on the engine control system.
- ☐ **ASR – Acceleration drive control device**
This system prevents driving wheel skid through quick action on the engine and brakes. It allows the vehicle to set off safely and fast even on slippery roads or when one driving wheel is skidding. It also reduces the risk of understeering when you accelerate too much when cornering.

☐ MSR – Engine braking torque control

This system avoids driving wheel drag due to the exhaust brake. It ensures vehicle stability when releasing on slippery roads (e.g. snow, ice), and assists in keeping the path when cornering and shifting down, especially on slippery roads. It requires a slight increase of revs number, through the CAN line.

☐ HHC – Hill holder control

This function allows the vehicle to be kept automatically locked (braked) until the clutch is closed and the driver subsequently presses the accelerator pedal, thus preventing undesired vehicle motion.

The function is actuated automatically: the braking situation is detected by the sensor inside the modulator. When the brake pedal is released, the vehicle will be kept for 2.5 seconds, thus allowing the driver/system to put the gear (and the vehicle to be started). This ensures safe, easy start with any incline, regardless of the weight carried.

☐ HBA (Hydraulic Brake Assistant) – Hydraulic assistant in emergency braking

The main feature of the HBA function is to recognize an emergency braking situation followed by “automatic” increase of vehicle deceleration.

Vehicle deceleration is only restricted to actuation of ABS control, thus taking the greatest advantage of the grip between the tyre and the roadbed currently available. Therefore, ordinary drivers can now achieve braking distances which only experienced drivers could achieve in the past.

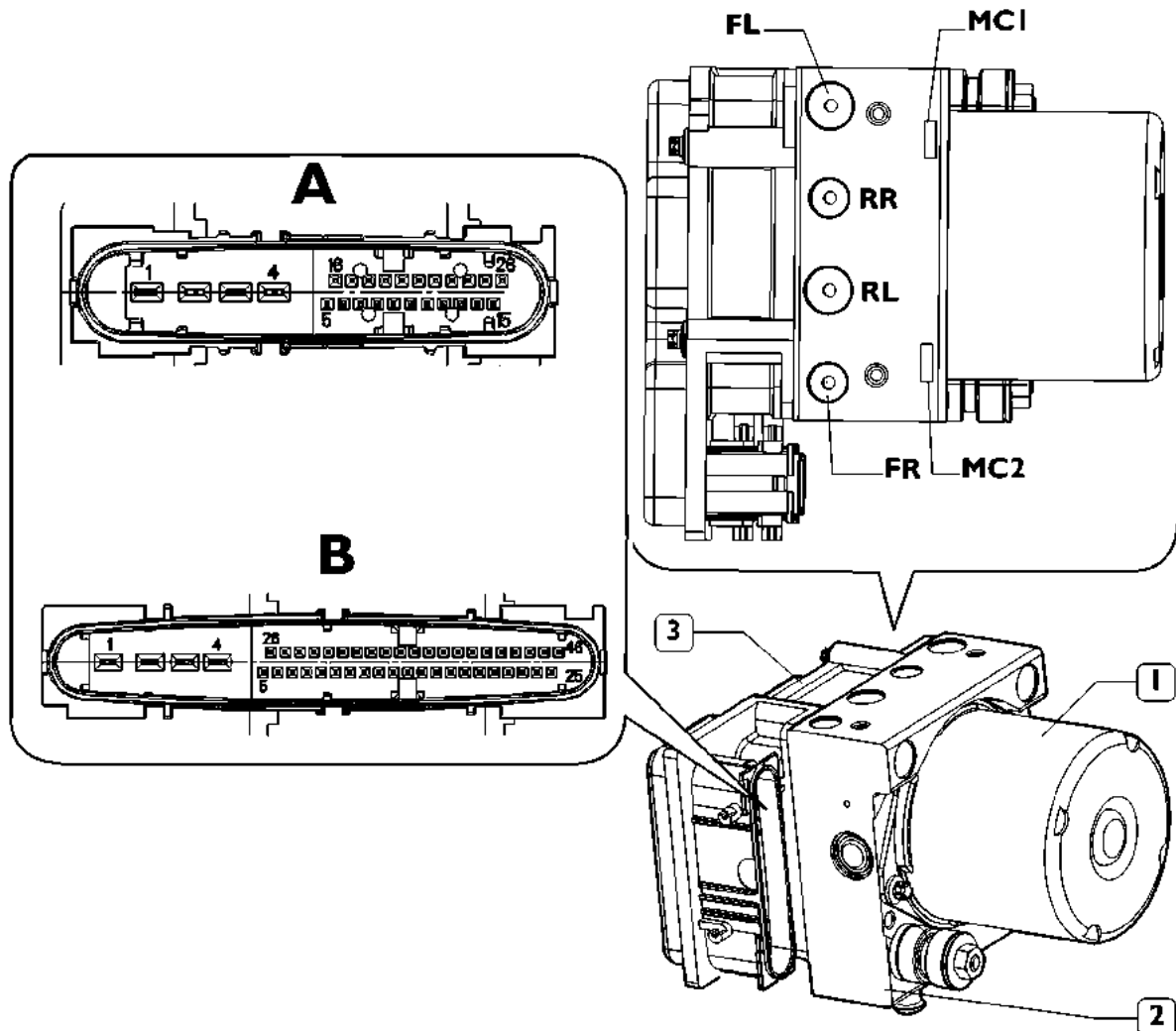
If the driver reduces the braking intensity, vehicle deceleration is reduced depending on the reduction of the force applied onto the pedal.

Therefore, the driver can control deceleration accurately after overcoming the emergency situation.

The extent of the braking request from the driver corresponds to the force applied onto the pedal. Such force is derived from measuring the pressure in the brake pump.

Application of the ABS 8/ESP8 systems

SYSTEM	ABS8		ESP8	
	X (crossed)	II (parallel)	X (crossed)	II (parallel)
VEHICLES	FIA engine with 6 AS 300 VD automatic gearbox		FIA and FIC engines	
	29L – 35S	35C – 65C	29L – 35S	35C

Four crossed channel system (x)**Electro-hydraulic modulator/control unit****Figure 131/I**

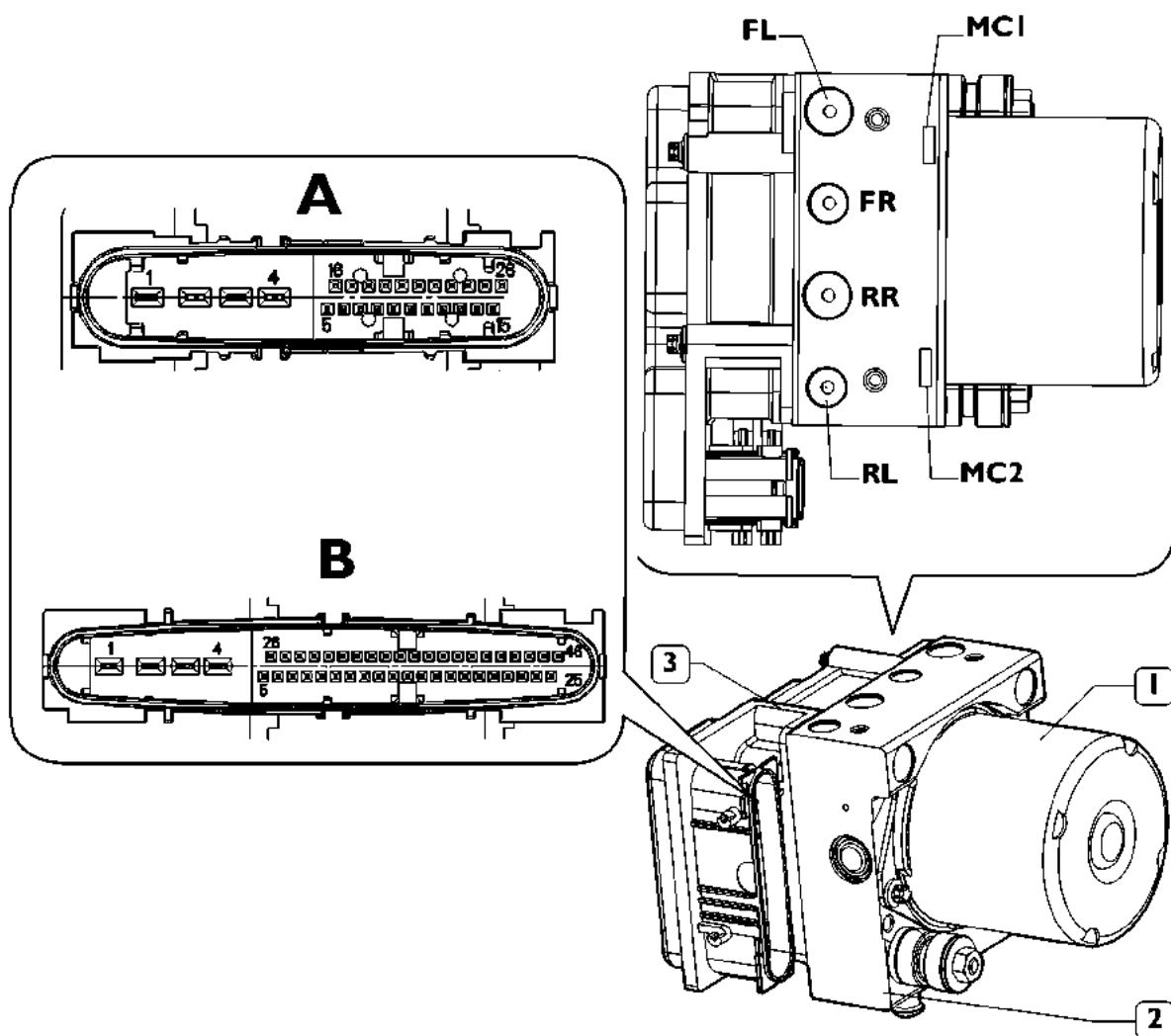
102113

1. Hydraulic accumulator - 2. Electro-hydraulic modulator - 3. Electronic control unit - A. ABS8 connector - B. ESP8 connector - MCI. LF/RR diagonal power supply (or FL/RR with ABS8/ESP8 systems) - MC2. RF/LR diagonal power supply (or FR/RL with ABS8/ESP8 systems) - LF (or FL with ABS8/ESP8 systems). Left front axle output - RR. Right rear axle output - RF (or FR with ABS8/ESP8 systems). Right front axle output - LR (or RL with ABS8/ESP8 systems). Left rear axle output

Four parallel channel system (II)

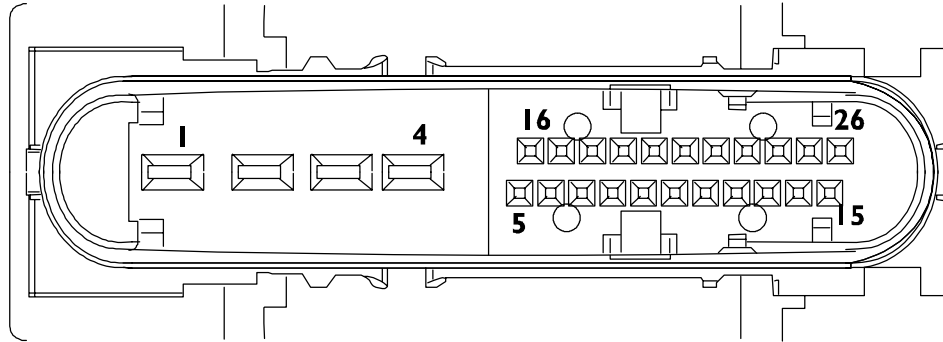
Electro-hydraulic modulator/control unit

Figure 131/2



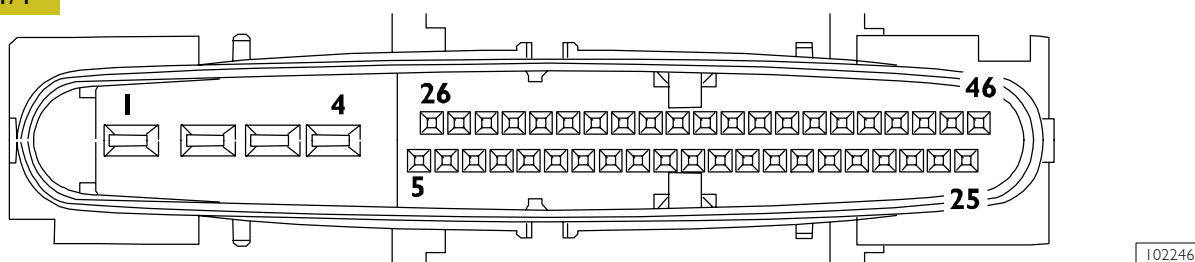
102114

1. Hydraulic accumulator - 2. Electro-hydraulic modulator - 3. Electronic control unit - A. ABS8 connector - B. ESP8 connector - MC1. Front axle power supply - MC2. Rear axle power supply - LF (or FL with ABS8/ESP8 systems). Left front axle output - RR. Right rear axle output - RF (or FR with ABS8/ESP8 systems). Right front axle output - LR (or RL with ABS8/ESP8 systems). Left rear axle output

ABS 8 control unit PIN OUT (X - crossed channels, II - parallel channels)**Figure 131/3**

102245

Pin (X)	Pin (II)	Function	Cable
1	I	Earth (pump control motor)	0000
2	2	Positive after fuse (pump control motor power supply enable relay)	7772
3	3	Positive after fuse (valve lock power supply enable relay)	7772
4	4	Signal earth	0000
5	5	Front left sensor	5570
6	16	-	-
7	7	Rear left sensor	5572
8	8	Rear right sensor earth	5573
9	9	Front right sensor earth	5571
10	10	Front right sensor	5571
11	11	Diagnosis K line	2299
12	12	EBD failure warning light	6673
13	13	Decelerator deactivation with ABS system ON	0315
14	14	-	-
15	15	CAN L line	Green
16	6	Front left sensor earth	5570
17	17	Rear left sensor earth	5572
18	18	Positive after fuse for ABS (KL 15)	8847
19	19	Rear right sensor	5573
20	20	Stop signalling switch – brake lights	1173
21	21	-	-
22	22	ABS failure warning light	6670
23	23	-	-
24	24	-	-
25	25	Diagnosis L line	1199
26	26	CAN H line	White

ESP 8 control unit PIN OUT (X - crossed channels, II - parallel channels)**Figure 131/4**

Pin (X)	Pin (II)	Function	Cable
1	1	Earth (pump control motor)	0000
2	2	Positive after fuse (pump control motor power supply enable relay)	7772
3	3	Positive after fuse (valve lock power supply enable relay)	7772
4	4	Signal earth	0000
5	5	Front left sensor	5570
6	26	-	-
7	7	Rear left sensor	5572
8	8	Rear right sensor earth	5573
9	9	Front right sensor earth	5571
10	10	Front right sensor	5571
11	11	Diagnosis K line	2299
12	12	EBD failure warning light	6673
13	13	-	-
14	14	CAN L line	Green
15	15	Yaw sensor earth	9096
16	16	Yaw sensor signal	9095
17	17	Longitudinal acceleration sensor	9099
18	18	Yaw sensor reference signal	9094
19	19	Voltage stabilization signal to the acceleration sensor	9091
20	20	Side acceleration sensor signal	9092
21	21	Side acceleration sensor signal earth	0050
22	22	Decelerator deactivation with ABS system ON	0315
23	23	-	-
24	24	Diagnosis L line	1199
25	25	-	-
26	6	Front left sensor earth	5570
27	27	Rear left sensor earth	5572
28	28	Positive after fuse for ABS (KL 15)	8847
29	29	Rear right sensor	5573
30	30	Stop signalling switch – brake lights	1173
31	31	Exhaust brake actuation enable switch (ASR/ESP passive switch)	8800
32	32	ABS failure warning light	6670
33/34	33/34	-	-
35	35	CAN H line	White
36	36	Hand brake ON signal	6662
37	37	Yaw sensor test signal	9093
38/39/40	38/39/40	-	-
41	41	Stop signalling switch	1173
42	42	-	-
43	43	Reverse gear signal	2227
44/45	44/45	-	-
46	46	Speed limiter or ASR failure warning light	6672

ESP (Electronic Stability Program) operation

The ESP function controls the vehicle's stability and side dynamics.

The main goals of this function are as follows:

- ☐ to improve stability, especially in understeering and oversteering conditions;
- ☐ to reduce the braking distance in line change conditions and on slippery roads.

The ESP function evaluates the following driver's requests:

- steering-wheel position;
- wheel revs number (speed);
- pressure on the brake pedal or accelerator position.

The ESP control unit microprocessor recognizes the specific manoeuvre and examines the vehicle's behaviour:

- degree of yaw;
- wheel revs number;
- transverse acceleration.

The microprocessor assesses the running behaviour based on the data provided, and the ESP comes into operation by acting on the brakes.

The hydraulic modulator controls brake pressure for every single wheel as quick as possible.

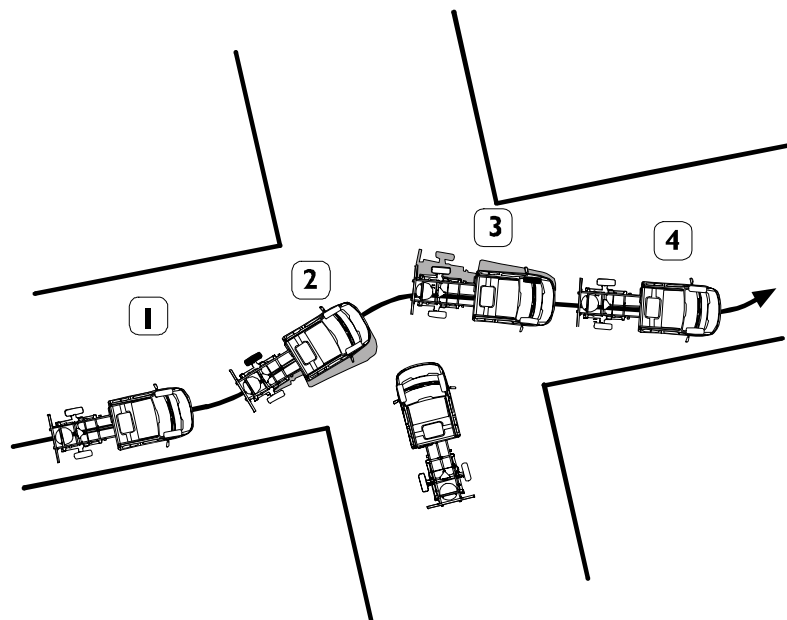
The ESP may, through engine management, reduce the number of revolutions of the engine itself, in order to withstand vehicle deceleration.

The ESP system is always active in the background, i.e. it compares the actual vehicle ride with the driver's desired ride 50 times a second.

Control strategy

Sudden obstacle

Figure 131/5

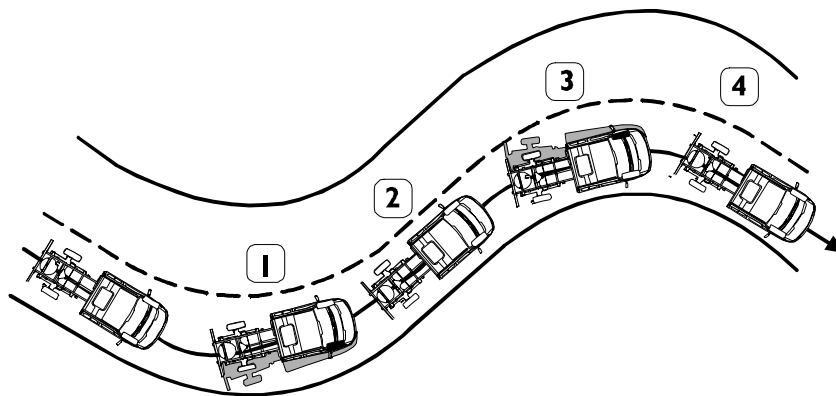


- 1) Acting on the steering-wheel suddenly: danger of understeering.
- 2) The ESP brakes the rear left wheel \Rightarrow the vehicle follows the steering command.
- 3) The driver countersteers: Danger of oversteering \Rightarrow The ESP brakes the front left wheel.
- 4) The vehicle recovers stability.

102246

Sudden steering

Figure I31/6

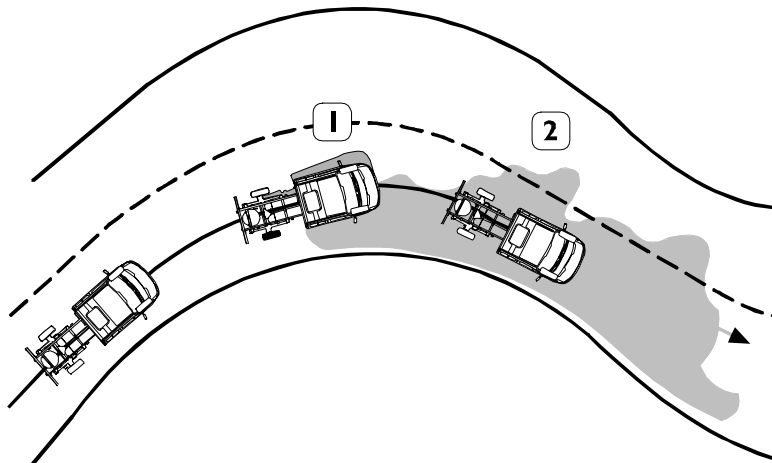


101864

- 1) The vehicle risks skidding (oversteering): the ESP brakes the front right wheel.
- 2) The vehicle recovers stability.
- 3) The vehicle risks skidding (oversteering): the ESP brakes the front left wheel.
- 4) The vehicle recovers stability.

Vehicle running on a slippery road

Figure I31/7



101865

- 1) The vehicle risks skidding (understeering): the ESP brakes the rear right wheel and reduces the engine revs number.
- 2) The vehicle recovers stability.

ASR deactivation strategies

- ☐ Disabling any engine intervention of the ESP and ASR/MSR (torque increase/decrease) over the entire speed range.
- ☐ Traction Control actuation enabled up to the speed of 60 k.p.h. (electronic locking of differential, with no reference to the dragged wheels).
- ☐ Stability intervention (ESP) enabled over the entire speed range.
- ☐ ABS enabled over the entire speed range.
- ☐ EBD enabled over the entire speed range.

NOTE ASR deactivation is recommended when driving with the snow-chains mounted, or when the wheels sink into gravel, sand, etc.

Recovery strategy in case of component failure

System failure (warning light ON)	ESP/ASR	ABS	EBD
Broken component			
Steering angle sensor	X		
Yaw sensor	X		
Brake light switch	X	X	
1 or 2 wheel revs sensors	X	X	
3 ou 4 capteurs tours roue 3 or 4 wheel revs sensors	X	X	X
Electronic control unit	X	X	X
Solenoid valve hydraulic unit	X	X	X
Pressure sensor, ABS pump motor		X	X

NOTE If the warning lights are OFF, all the systems are working.

Warning light legend

Warning light ON: ESP/ASR/MSR not working. No action taken by the ESP/ASR on the engine or the brakes.

N.B. Warning light blinking = ESP/ASR coming into operation.

ABS not working

The front axle may get locked sooner than the rear axle. EBD recovery reduces the rear axle pressure.

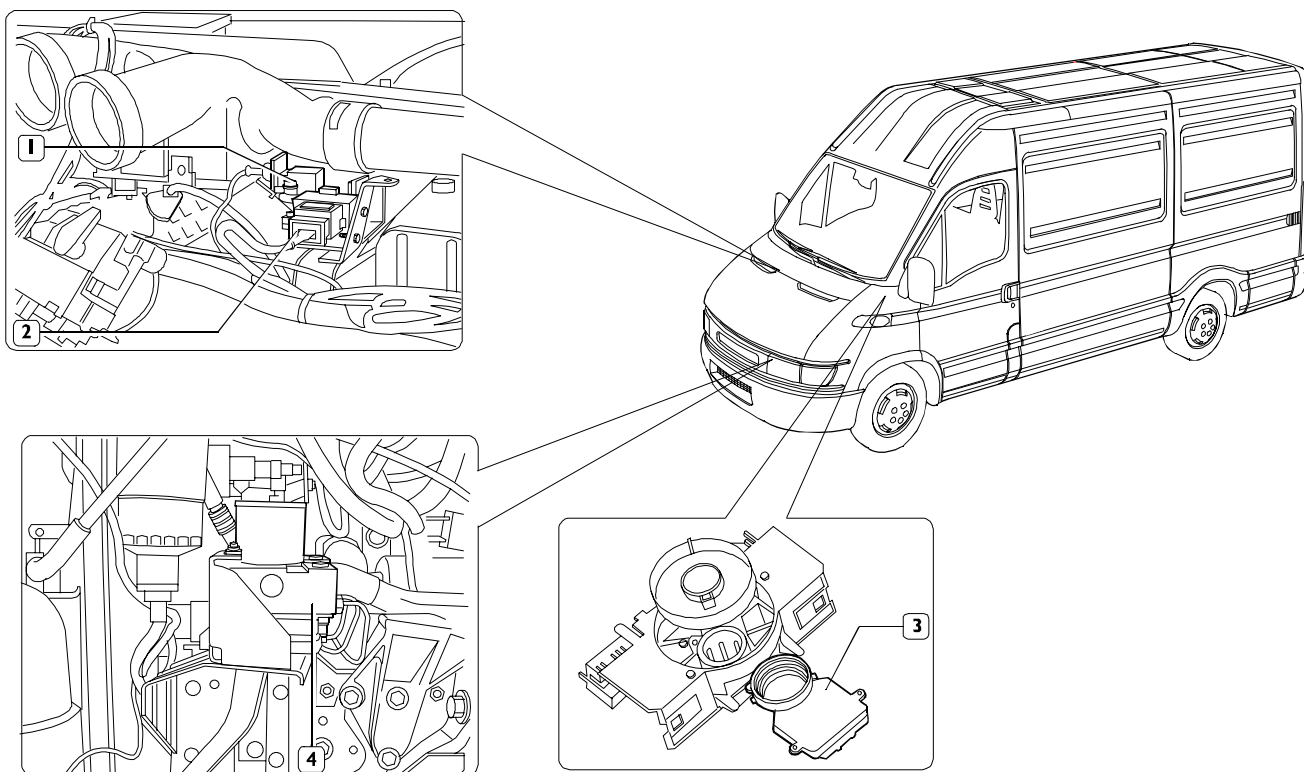
EBD not working

No correction of the rear axle braking pressure: DANGER OF SPINNING THROUGH 180 DEGREES!

The warning light also warns the driver of low brake fluid level, hand brake ON, brake pads worn.

Installing the esp components

Figure I31/8



102108

1. Acceleration sensor - 2. Yaw sensor - 3. Steering angle sensor - 4. Electro-hydraulic modulator/control unit

NOTE Installation of the electro-hydraulic modulator/control unit is similar in ASB 8 systems, too.

ESP system components and calibration

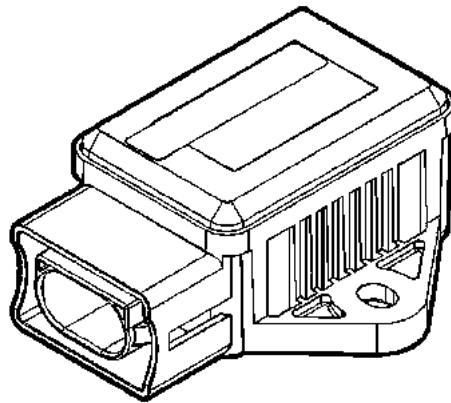
Some modifications or repairs affecting the ESP system components require a calibration procedure.

The repair operations that require the above procedure are detailed as follows:

- ☐ Replacing the system's braking apparatus electronic control unit (incorporated into the electro-hydraulic modulator).
- ☐ Replacing the steering angle sensor fitted into the steering wheel.
- ☐ Replacing the longitudinal acceleration sensor.

Yaw sensor with built-in side acceleration sensor

Figure 131/9



102115

It measures the motion of the vehicle around its own vertical axis (yaw) as well as the vehicle's side acceleration.

These signals continuously inform the control unit about the vehicle's behaviour.

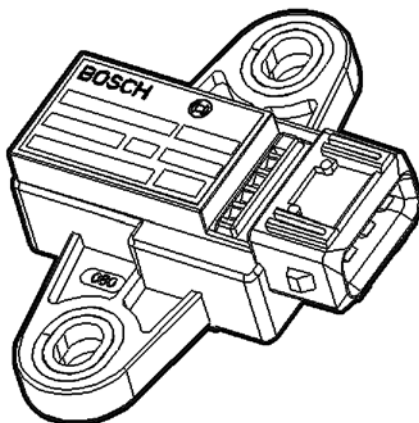
The comparison between these signals and those from the driver (steering-wheel position, wheel spin number/speed and pressure on the brake pedal/accelerator position) allows the ESP control unit to define the actions to be taken. The hydraulic unit controls brake pressure as quickly as possible, separately for every single wheel.

Moreover, the ESP system may decrease the engine revs number by means of the engine control feature.

NOTE Replacing the yaw sensor requires no calibration.

Longitudinal acceleration sensor

Figure 131/10



102116

It measures the vehicle's acceleration and deceleration changes.

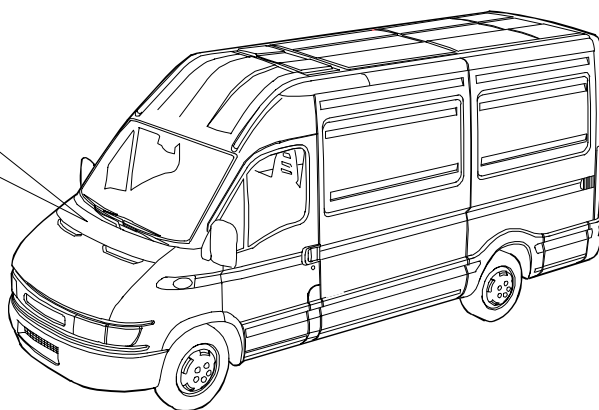
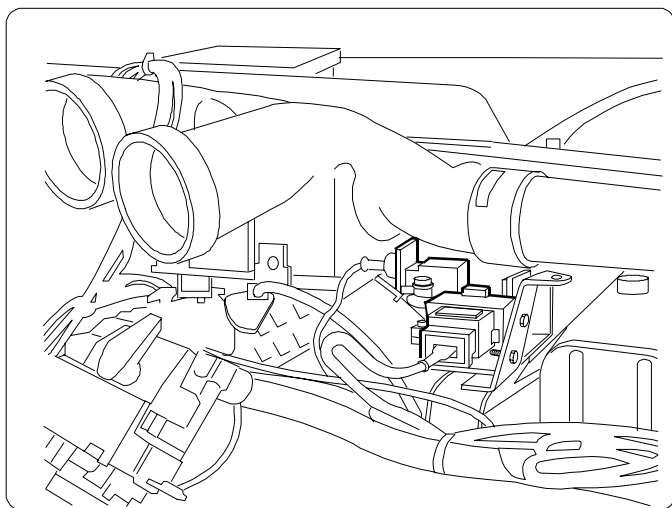
These signals continuously inform the control unit about the vehicle's behaviour.

The comparison between these signals and those from the driver (steering-wheel position, wheel spin number/speed and pressure on the brake pedal/accelerator position) allows the ESP control unit to define the actions to be taken. The hydraulic unit controls brake pressure as quickly as possible, separately for every single wheel.

Moreover, the ESP system may decrease the engine revs number by means of the engine control feature.

Longitudinal acceleration sensor calibration

Figure 131/11



102111

In a horizontal position, you will obtain the sensor "zero" condition through the diagnosis instrument, i.e. you will assign its absolute zero position.

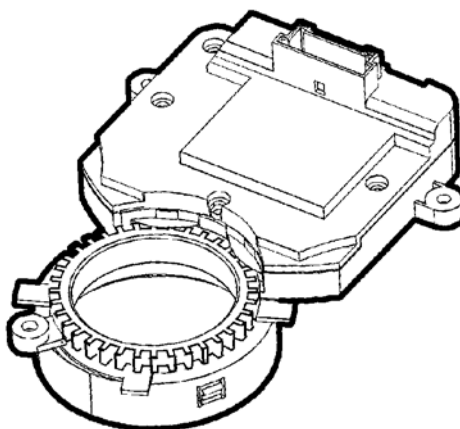
Use a diagnosis instrument to clear the errors.

Carry out a road test, to make the control unit verify whether errors are still found. The vehicle is to be taken to a slight slope and checked if it is kept braked for 2.5 seconds.

Drive back to the service centre, then use a diagnosis instrument to verify that the anomaly is no longer found.

Steering angle sensor

Figure 131/12



102116

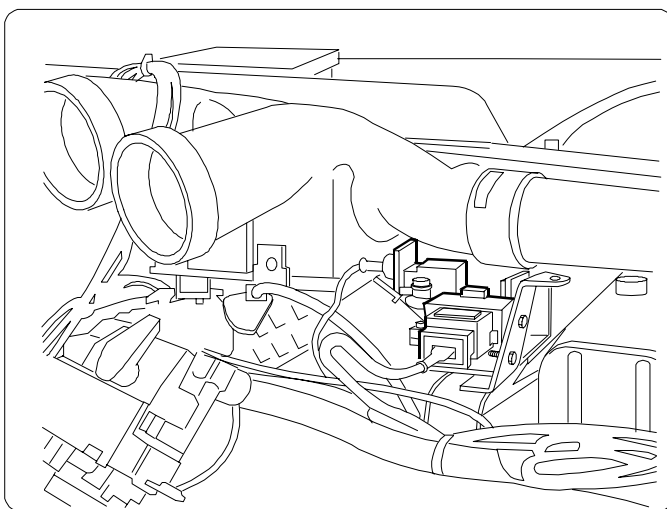
It measures the steering angle required by the driver.

The comparison between this signal and those from all the other sensors allows the ESP control unit to define the actions to be taken. The hydraulic unit controls brake pressure as quickly as possible, separately for every single wheel.

Moreover, the ESP system may decrease the engine revs number by means of the engine control feature.

Steering angle sensor calibration

Figure 131/13



102110

With both the steering-wheel and the wheels in straight position (after checking toe-in), you will obtain the sensor "zero" condition through the diagnosis instrument, i.e. you will assign its absolute zero position.

Use a diagnosis instrument to clear the errors.

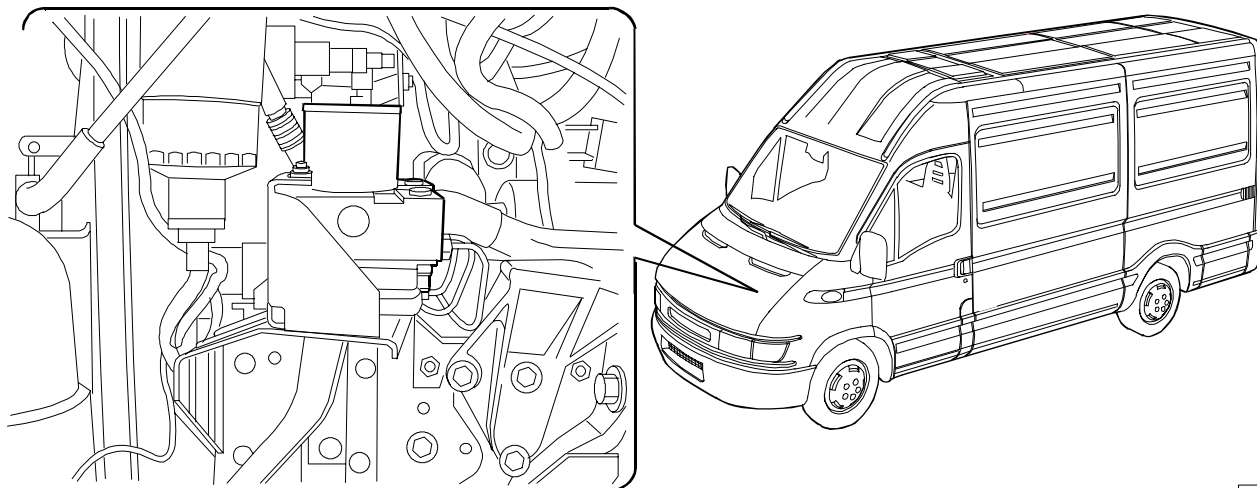
Carry out a road test, to make the control unit verify whether errors are still found. Drive along a straight road at a speed of approximately 50 k.p.h. Steer to the right and then to the left several times, after making sure you do not endanger other drivers.

NOTE You need not oversteer to cause the ESP warning light to come on.

Drive back to the service centre, then use a diagnosis instrument to verify that the anomaly is no longer found.

ESP control unit programming

Figure 131/14



102109

Entering the variant codes: type of drive, engine, MTT, wheelbase, type of front and rear suspensions, height.

Easy compares the type of vehicle (PIC reading) with the control unit code, to avoid installation errors (single wheels instead of dual), and downloads the variant codes into the control unit.

Clear the errors (if any) by means of the diagnosis instrument.

Carry out a road test. Drive along a straight road at a speed of approximately 50 k.p.h. Brake suddenly as if in an emergency, after making sure you do not endanger other drivers: you should feel the system "respond" on the brake pedal. This test makes the control unit verify whether errors are still found.

Drive back to the service centre, then use a diagnosis instrument to verify that the anomaly is no longer found.

Replacing ESP central unit needs the longitudinal acceleration sensor calibration that was already described in previous page.

The steering angle sensor, in this case, is not to be calibrated as it has its own internal memory.

6AS 300 VD AUTOMATIC TRANSMISSION

Description of operation

The gear engaging system of the 6 AS 300 VD gearbox is a combination of a traditional system of the mechanic type and an electric one.

Below are the main components of the system:

- 1) electronic control unit;
- 2) gear selecting/engaging actuator;
- 3) gear shift lever;
- 4) clutch actuator;
- 5) display/buzzer.

In the manual mode, the first gear is used to start the vehicle.

In the automatic mode, you just need to act on the selection lever (A/M): the gear is selected directly by the control unit (1a).

The electronic control unit picks up all the signals required to meet the safety conditions and the parameters programmed in the same. It also drives the electric actuating motor(s) for gear selection/engagement and clutch control.

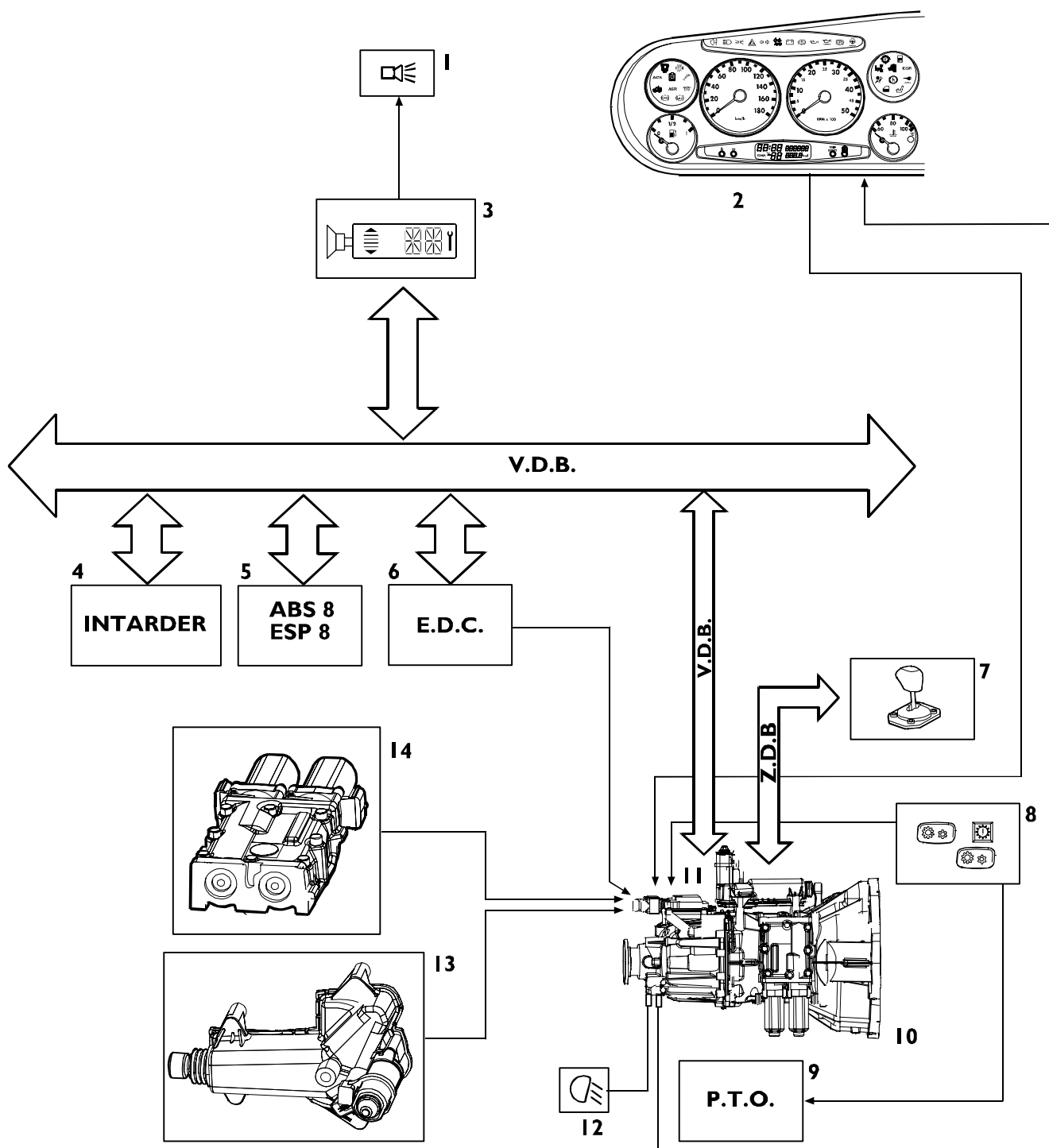
The information required for driving is in any case made available to the driver by means of the display.

NOTE To ensure correct management of the gearbox and the other auxiliary functions provided for by the system, the control unit is interfaced (CAN line) with the other electric and electronic system fitted to the vehicle, such as:

- EDC
- ABS8/ESP8
- IMMOBILIZER
- PTO (POWER TAKE-OFF, if available).

Electronic control

Figure 131/15



101868

1. Buzzer - 2. Tachograph - 3. Display - 4. IMMOBILIZER control unit - 5. ABS8/ESP8 control unit - 6. EDC control unit -
 7. Gear shift lever - 8. PTO icon - 9. PTO - 10. Gearbox - 11. Gearbox control unit - 12. Reversing light actuation -
 13. Clutch actuator - 14. Gearbox actuator.

COMPOSITION OF THE SYSTEM

System control unit

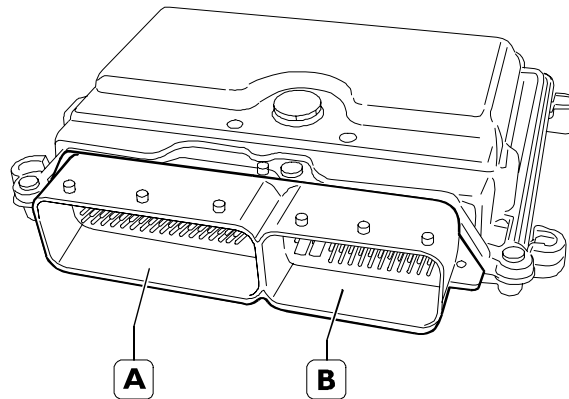
The electronic control unit receives the signals from the sensors/switches: the management and control of the system under the different operating conditions of the gearbox are based on the above signals.

It is interfaced with other electronic systems available on the vehicle, such as EDC and ABS, through CAN communication lines.

A - Connector on the gearbox side

B - Connector on the vehicle side

Figure 131/16



90135

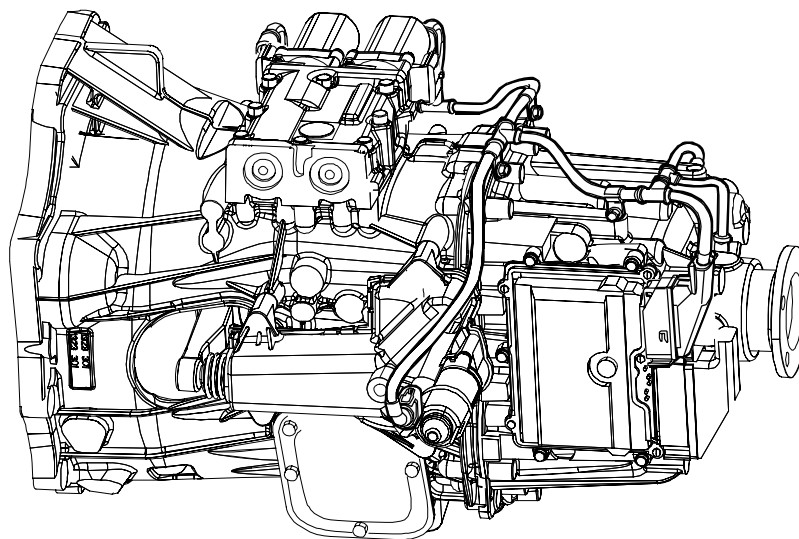
Through the connection with the EDC I6 system, the gearbox control unit is able to detect the position of the accelerator pedal and also the engine revs number.

Connection with the ABS8/ESP8 control unit is used to prevent the "UP" gear shift at bends and also control driving under poor grip conditions in case of mode "A" driving.

The new ABS system controls "smart" warning lights incorporated into the on-board panel. These warning lights come on to indicate braking system failure.

NOTE The "Brake" signal, upon start-up, comes directly from the EDC control unit. The reverse gear signal is direct.

Figure 131/17

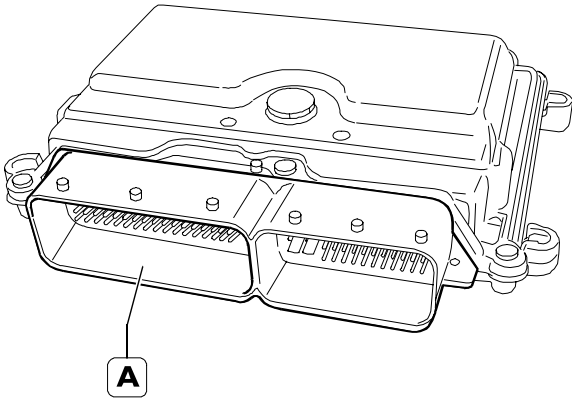


101870

Position of the electronic control unit

Connector control unit PIN-OUT – gearbox side (A)

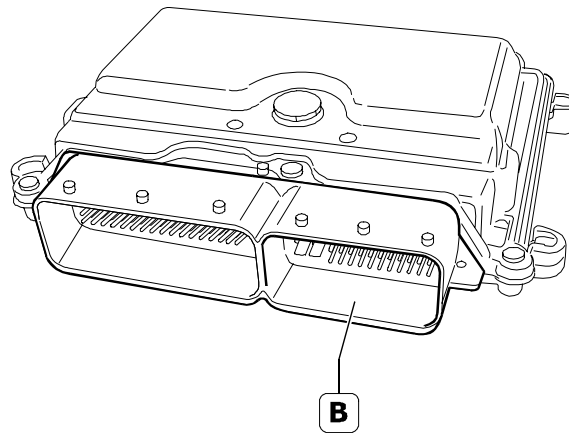
Figure 131/18



101869

Pin	Function
1	Electric motor positive (gearbox actuator selector pin 6)
2	Electric motor negative (gearbox actuator selector pin 1)
3	Electric motor positive (clutch actuator pin 3)
4	Electric motor negative (clutch actuator pin 4)
5	Electric motor positive (gear engaging gearshift actuator pin 6)
6	Electric motor negative (gear engaging gearshift actuator pin 1)
11	Sensor direction signal (clutch actuator pin 4)
12	Sensor speed signal (clutch actuator pin 2)
13	Clutch actuator pin 5 sensor voltage signal (5 V)
15	Sensor direction signal (gear engaging gearshift actuator pin 4)
16	Sensor voltage signal, 12 V (gear engaging gearshift actuator pin 3)
17	Sensor voltage signal, 12 V (gearbox actuator selector pin 3)
18	Sensor direction signal (gearbox actuator selector pin 4)
33	Earth (clutch actuator pin 1)
35	Sensor speed signal (gear engaging gearshift actuator pin 5)
36	Earth (gear engaging gearshift actuator pin 2)
37	Earth (gearbox actuator selector pin 2)
38	Sensor speed signal (gearbox actuator selector pin 5)

cardiagn.com

Connector control unit PIN-OUT – vehicle side (B)**Figure 131/19**

101871

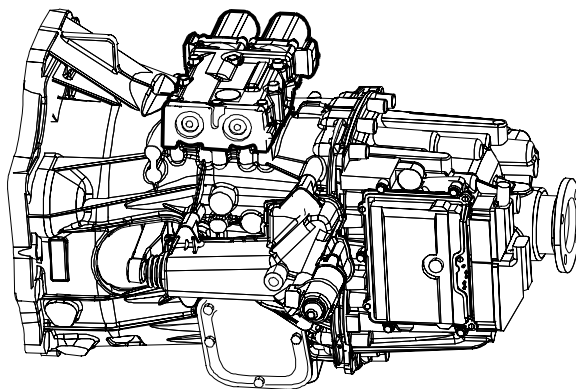
Pin	Function
1	Earth
2	Earth
3	Earth
4	Battery positive
5	Battery positive
6	Battery positive
7	Earth
8	Earth
9	KL 30
14	PTO actuation request signal (option)
17	CAN H VDB line (female junction)
18	CAN H VDB line (female junction)
28	CAN L VDB line (male junction)
29	CAN L VDB line (female junction)
33	Free
37	Free
38	Free
39	KL 30
40	CAN L --- ZF LINE
41	CAN H --- ZF LINE
43	KL 15
44	On-board panel signal (doors open)
45	On-board panel signal (emergency brake)
46	PTO state signal
47	PTO ON signal
49	Power supply from gearbox electronic control unit
51	Speed signal from on-board panel
52	Diagnosis K line

Gearbox actuator

The function of the gear actuator is to continuously exchange information with the electronic control unit for gear selection and engagement.

It is made up of two electric motors, control cylinders, and respective sensors.

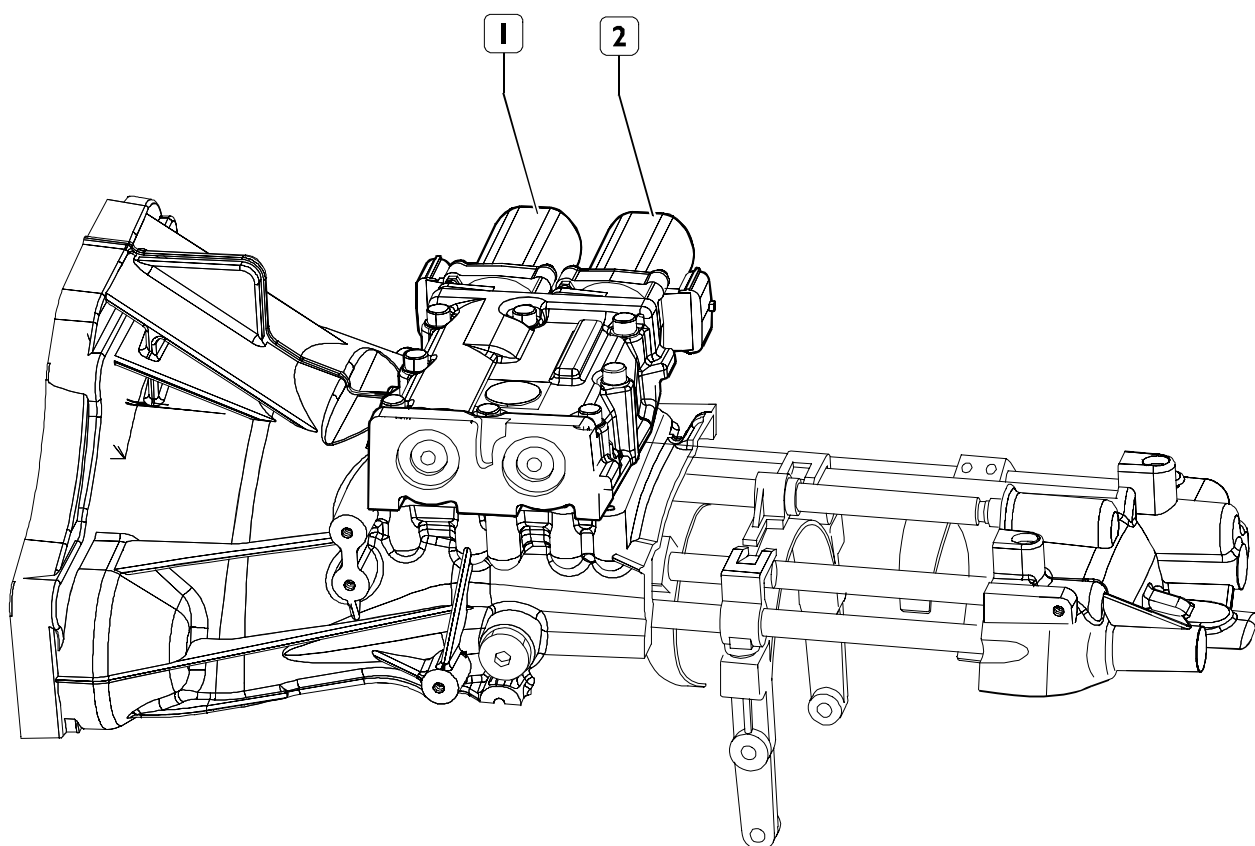
Figure 131/20



90139

Position of actuator

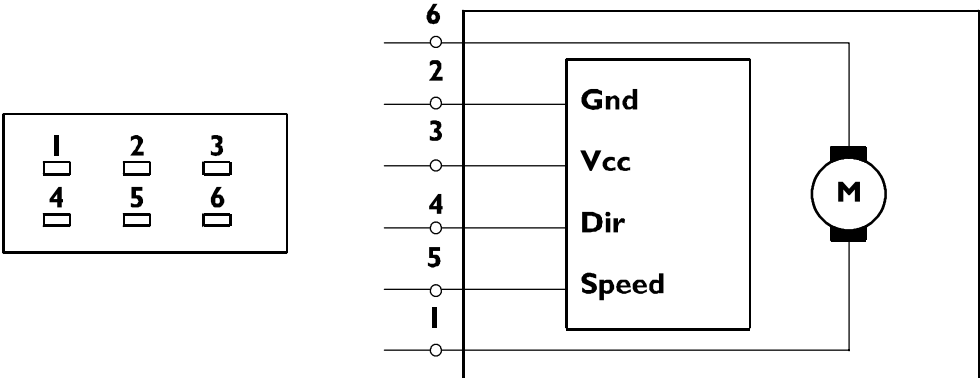
Figure 131/21



101872

1. Gear engaging electric motor - 2. Gear selection electric motor

Figure 131/22



101873

Wiring diagram

Pin	Function
1	Electric motor negative
2	Earth
3	Sensor voltage signal (5 V)
4	Sensor direction signal
5	Sensor speed signal
6	Electric motor positive

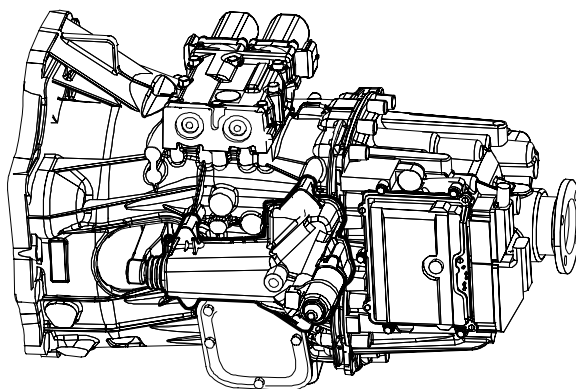
Characteristics of electric motor

Voltage	12 V
Output	95 W
Torque	0.72 Nm (at 125 °C)
n _{max}	5400 r.p.m.

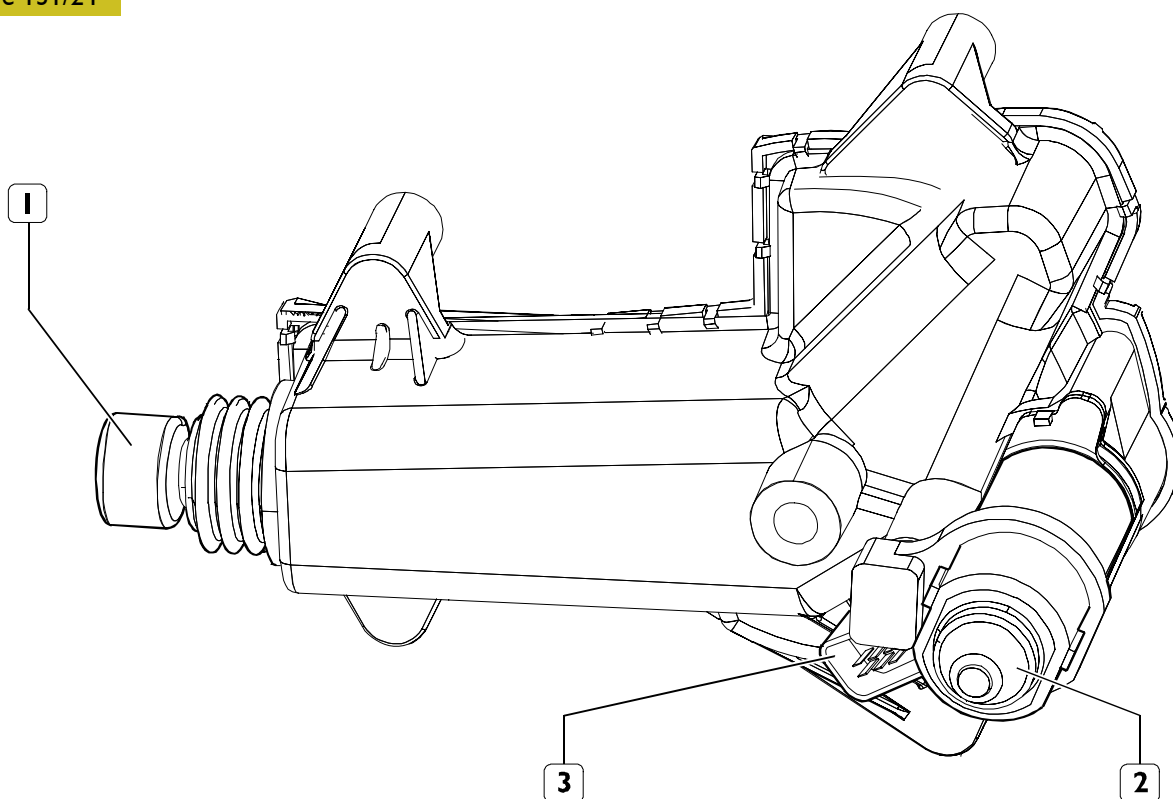
Clutch actuator

It is made up of the following:

- ☐ a cylinder acting on the clutch engaging/disengaging lever;
- ☐ a position sensor that detects the clutch lever stroke, by informing the electronic control unit of the actuating cylinder position and the clutch plate wear.

Figure 131/23

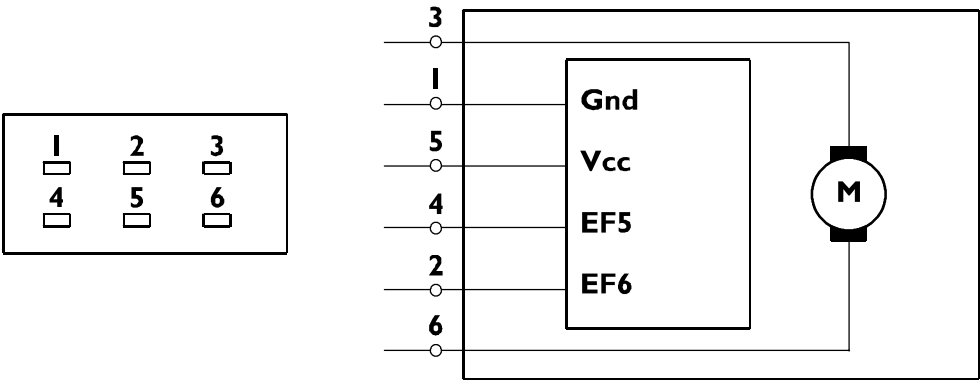
90137

Figure 131/24

90138

1. Actuating cylinder - 2. Electric motor - 3. Vehicle electric wiring junction block

Figure 131/25



101873

Wiring diagram

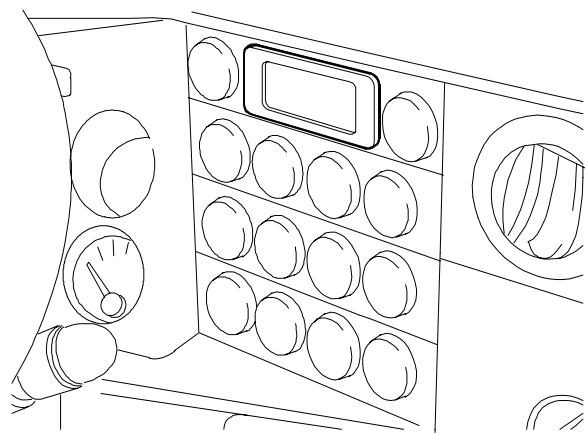
Pin	Function
1	Earth
2	Incremental sensor speed signal
3	Electric motor positive
4	Incremental sensor direction signal
5	Sensor voltage signal (5 V)
6	Electric motor negative

Characteristics of electric motor

Max. torque	0.65 Nm
No-load revs number	5800 r.p.m.
Output	80 W (0.3 Nm - 2,500 r.p.m.)

Display

Figure I31/26



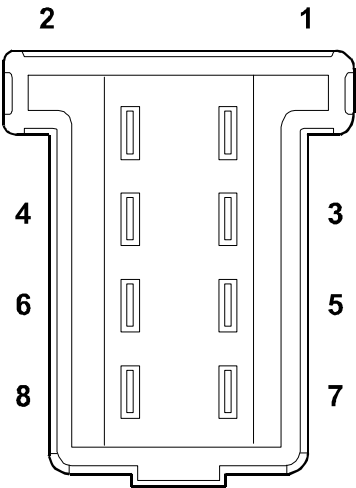
I01875

The display, located on the board, makes it possible to show all the information required for correct use of the system, such as, for instance:

- ☐ mode (manual or automatic) and, in both cases, the gear engaged;
- ☐ the reverse gear/neutral position (R/N);
- ☐ faults/misuse with acoustic signal (e.g. clutch overheating);
- ☐ the fault code (troubleshooting) shown on page 47 can be displayed only by means of the diagnosis instrument;
- ☐ vehicle state condition: gear engaged.

Pin	Function
1	Backlighting ON/OFF control
2	
3	Analog backlighting control
4	-
5	CAN H
6	Earth
7	CAN L
8	+12 V

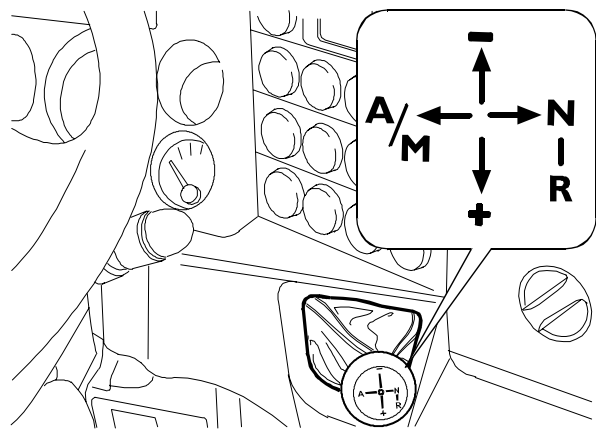
Figure I31/27



90263

Gear selector

Figure 131/28

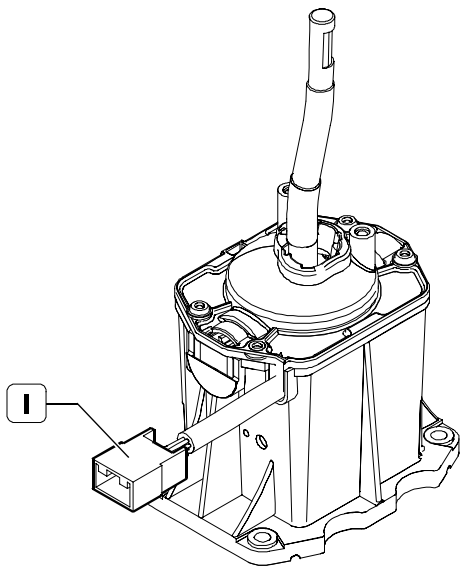


101876

The gear selector is an electronic component located in the cabin next to the driver. It is interfaced with the gearbox control unit, by means of the CAN communication line, in order to inform of the driver's intention of selecting and engaging the gears.

Pin	Function
1	KL 15
2	KL 30
3	CAN L
4	CAN H
5	-
6	-

Figure 131/29



90262

I. Gear selector connector

Accelerator pedal

To detect the engine idling position and allow the clutch to be engaged when the vehicle is about to start, the N.O. switch, incorporated into the position sensor, is used, with the pedal released.

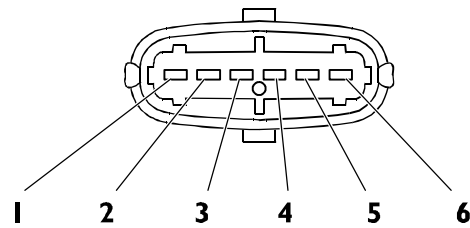
This signal reaches the EDC electronic control unit and is sent, through the CAN VDB (Vehicle Data Base) line, to the 6AS 300 VD gearbox control unit.

The "kick-down" function can be actuated during running, in the automatic mode.

When the pedal is pressed down almost fully (98%), e.g. when overtaking, the system will automatically shift down by one speed, thus making it possible to use the deflecting torque at its best.

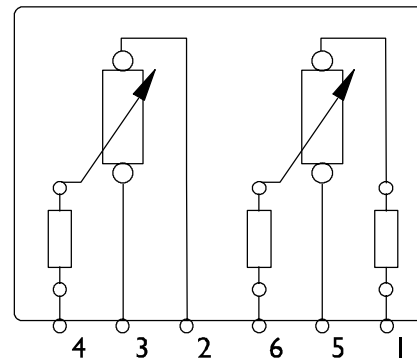
In practice, if the accelerator pedal is pressed fully down, the vehicle will ride at a running speed with a higher gear shift.

Figure I31/30



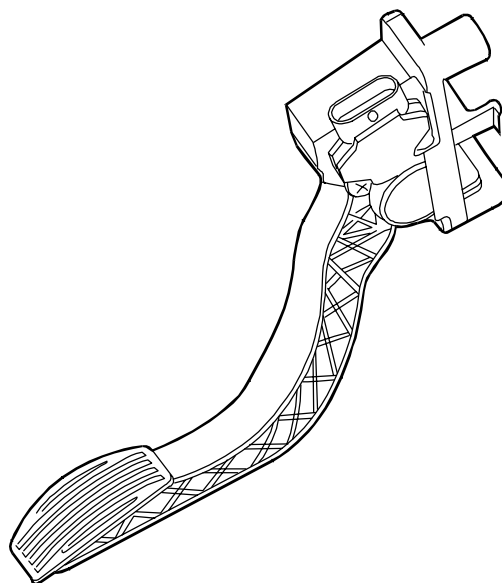
101877

Figure I31/31



101878

Figure I31/32



101879

PTO

One single button is used to actuate and deactivate the power take-off (PTO).

Operation under NON-STATIONARY conditions

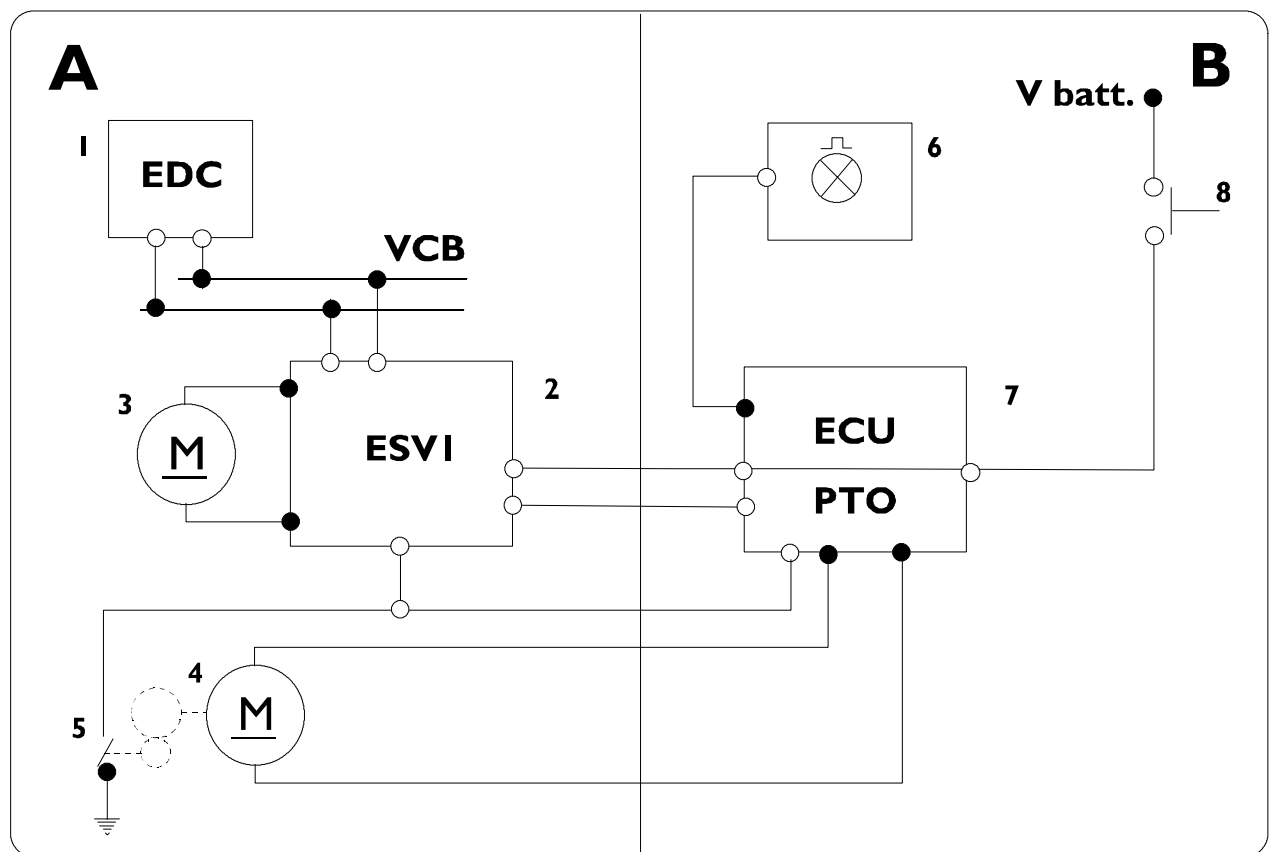
- ☐ The PTO can be engaged only when the gear shift is in neutral and the engine is ON;
- ☐ then, the first gear can be engaged, and the vehicle can be started;
- ☐ after setting off, the gear cannot be changed any more when the vehicle is running;
- ☐ the PTO can be disengaged both with the gears running and the neutral ON.

Operation under STATIONARY conditions

- ☐ The PTO can be engaged only when the gear shift is in neutral and the engine is ON.

PTO diagram

Figure 131/33



1. EDC control unit - 2. Gearbox control unit - 3. Clutch actuator electric motor - 4. PTO actuator motor - 5. PTO ON switch - 6. PTO ON warning light - 7. PTO control unit - 8. PTO actuation switch - A. Gearbox side - B. Vehicle side.

101880

PTO engaging procedure

To engage the power take-off, the following operations must be carried out:

- 1) press the PTO button;
- 2) wait at least 0.5 seconds;
- 3) release the PTO button.

NOTE

- ☐ The PTO will be actuated only if the PTO button is kept depressed for more than 0.5 seconds.
- ☐ The PTO button will be ignored until the next 5 seconds have elapsed.
- ☐ After such time, if the button is kept depressed for more than 30 seconds, a quick flash will be displayed, and PTO disengagement and lock will be commanded until the vehicle is switched on again.

PTO disengaging procedure

To disengage the power take-off, the following operations must be carried out:

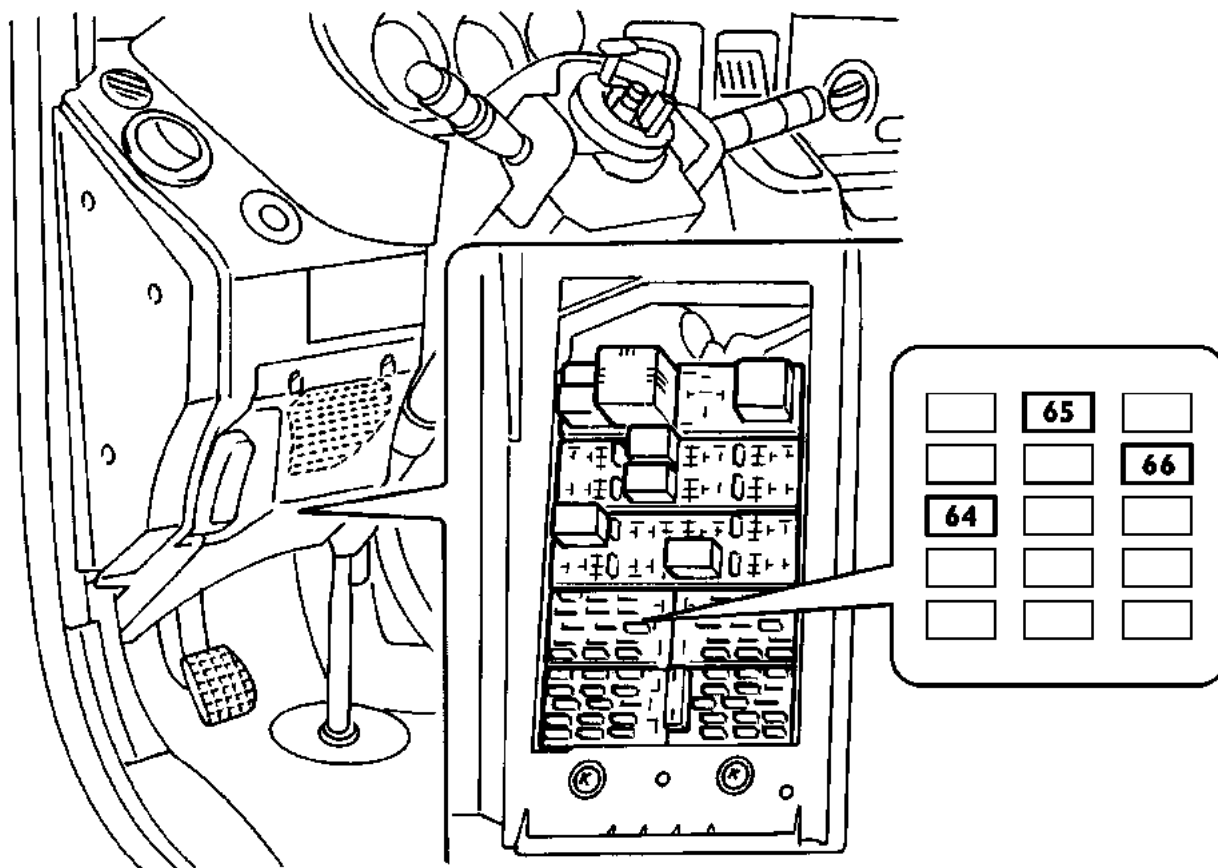
- 1) press the PTO button;
- 2) wait at least 0.5 seconds;
- 3) release the PTO button.

NOTE

- ☐ The operation will be carried out only if the PTO button is kept depressed for more than 0.5 seconds.
- ☐ The PTO button will be ignored until the next 5 seconds have elapsed. • In the event that the power take-off is not disengaged within 5 seconds, the operator may carry out the operation again, by pressing the button again.
- ☐ After such time, if the button is kept depressed for more than 30 seconds, a quick flash will be displayed, and PTO disengagement and lock will be commanded until the vehicle is switched on again.

Remote-control switch and fuse assembly

Figure 131/34



90264

The system's power supply is ensured by a set of fuses located in the cabin (see figure) in the marked positions.

64 - control unit power supply

65 - automatic transmission services

66 - start prevent

There are three more 25 A fuses (electric motor power supply) that are connected with control unit pins 4, 5, and 6. In the event that one or two of these fuses blow, the gearbox functions are not affected. If the third fuse is broken, the gearbox is not able to operate (i.e. both the clutch motion and the gear selection/engagement will be disabled).

Accelerator pedal sensor

The accelerator pedal position is provided to the gearbox control unit, through a suitable communication line, by the EDC electronic control unit which is informed about the position by the load transmitter fitted directly to the accelerator pedal.

Engine revs sensor

The sensor is mounted just next to the engine flywheel.

The engine running speed values are sent to the EDC electronic control unit which conveys them to the gearbox control unit by means of a special communication line.

Vehicle speed sensor

This sensor sends the pulses to the tachometer/electronic tachograph.

The signal is duplicated by the ABS/ESP sensors available on the wheels.

DIAGNOSIS INSTRUMENTS

DISPLAY

First-level diagnosis that provides coded displaying of the errors found in the control unit memory. The information is shown on the display only by means of diagnosis instruments.

MODUS

Computer-assisted diagnosis station used for diagnosis of braking systems, pneumatic suspensions, engines and electronically-controlled systems.

The station is equipped with auxiliary functions, such as electronic control unit programming, spare part catalogue referencing, time-charts, etc.

IT 2000

IT 2000 is a diagnosis instrument for all the Electronic Systems fitted to IVECO vehicles. It allows you to promptly operate on a vehicle by recognizing the latter by means of the chassis number.

It stores the results of the diagnostic work carried out.

It can also be used as a laptop PC and is set for remote diagnosis.

Using MODUS as a mother station allows you to update and configure IT 2000.

E.A.SY.

The E.A.SY. system allows you to easily diagnose and program the various electronic control units fitted to the vehicle. It is made up of an ECI module for communication with the electronic control units and a Panasonic PC.

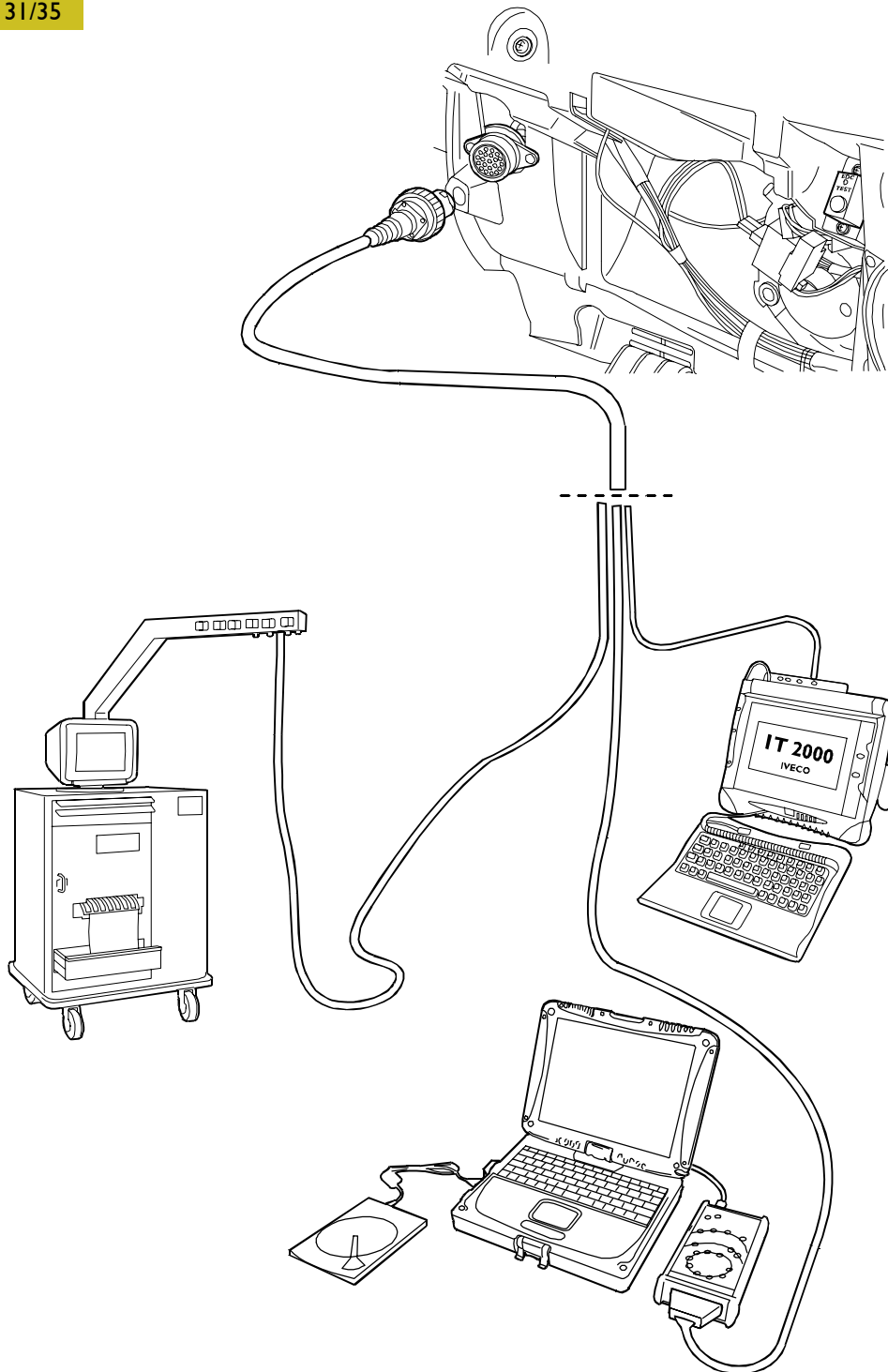
The ECI module allows you, by taking advantage of the Panasonic PC, to easily carry out work on the road; in particular, diagnostic work can be assisted by a specialized remote centre, thanks to the wireless technology incorporated into the Panasonic PC (e.g. GPRS).

MODUS - IT 2000 - E.A.SY. CONNECTION

The 38-pole connection makes it possible to perform the following operations:

- ☐ Gearbox control unit data reading
- ☐ Error (if any) detection and clearing
- ☐ Gear shift programming
- ☐ Clutch engagement/release control
- ☐ Control unit programming and configuring

Figure 131/35



A. IT 2000 - B. E.A.SY. - C. MODUS

102266

TROUBLESHOOTING

DTC DEC	DTC HEX	Description
10	A	ELECTRONIC CONTROL UNIT / TOO LOW TEMPERATURE
11	B	ELECTRONIC CONTROL UNIT / TOO HIGH TEMPERATURE
12	C	VEHICLE CAN LINE / FAULT
13	D	ZF CAN LINE / FAULT
30	1E	VEHICLE CAN LINE / DELAY IN RECEIVING THE EEC1 CAN MESSAGE
31	1F	VEHICLE CAN LINE / DELAY IN RECEIVING THE EEC2 CAN MESSAGE
32	20	VEHICLE CAN LINE / DELAY IN RECEIVING THE CCVS CAN MESSAGE
33	21	VEHICLE CAN LINE / DELAY IN RECEIVING THE EEC3 CAN MESSAGE
34	22	VEHICLE CAN LINE / DELAY IN RECEIVING THE EBC1 CAN MESSAGE
35	23	VEHICLE CAN LINE / DELAY IN RECEIVING THE ENGCONFMPM CAN MESSAGE
36	24	VEHICLE CAN LINE / DELAY IN RECEIVING THE HRW CAN MESSAGE
37	25	ZF CAN LINE / DELAY IN RECEIVING THE SL_2_TCU CAN MESSAGE
38	26	VEHICLE CAN LINE / DELAY IN RECEIVING THE VDC1 CAN MESSAGE
39	27	VEHICLE CAN LINE / DELAY IN RECEIVING THE VDC2 CAN MESSAGE
50	32	VEHICLE CAN LINE / ERROR ON ENGINE REVS SIGNAL - EEC1 CAN MESSAGE
52	34	VEHICLE CAN LINE / ERROR ON SIGNAL FOR REQUESTED ENGINE TORQUE - EEC1 CAN MESSAGE
54	36	VEHICLE CAN LINE / ERROR ON ACCELERATOR PEDAL POSITION SIGNAL - EEC2 CAN MESSAGE
56	38	VEHICLE CAN LINE / ERROR ON SIGNAL FROM BRAKE PEDAL - CCVS CAN MESSAGE
57	39	VEHICLE CAN LINE / ERROR ON ENGINE TORQUE AND BRAKING TORQUE CONFIGURATION SIGNAL - EEC1 CAN MESSAGE
58	3A	VEHICLE CAN LINE / ERROR ON ACTUAL ENGINE TORQUE SIGNAL - EEC1 CAN MESSAGE
60	3C	VEHICLE CAN LINE / ERROR ON ABSORBED ENGINE TORQUE SIGNAL - EEC2 CAN MESSAGE
62	3E	VEHICLE CAN LINE / ERROR ON REFERENCE ENGINE TORQUE SIGNAL - ENG_CONF_MPM CAN MESSAGE
66	42	VEHICLE CAN LINE / ERROR ON REAR LEFT WHEEL SPEED SIGNAL - HRW CAN MESSAGE
67	43	VEHICLE CAN LINE / ERROR ON REAR RIGHT WHEEL SPEED SIGNAL - HRW CAN MESSAGE
77	4D	VEHICLE CAN LINE / ERROR ON VEHICLE SPEED SIGNAL - CCVS CAN MESSAGE
100	64	SPEED ACTUATOR - SELECT / SHORT-CIRCUIT TO EARTH ON CONTROL MOTOR OUTPUT
101	65	SPEED ACTUATOR - SELECT / SHORT-CIRCUIT TO POSITIVE ON CONTROL MOTOR OUTPUT
102	66	SPEED ACTUATOR - SELECT / INTERRUPTION ON CONTROL MOTOR OUTPUT
103	67	SPEED ACTUATOR - SELECT / SENSOR SUPPLY VOLTAGE - TOO HIGH
104	68	SPEED ACTUATOR - SELECT / SENSOR SUPPLY VOLTAGE - TOO LOW
105	69	SPEED ACTUATOR - SELECT / SENSOR SHORT-CIRCUIT TO EARTH
106	6A	SPEED ACTUATOR - SELECT / SENSOR SHORT-CIRCUIT TO POSITIVE OR INTERRUPTION
107	6B	SPEED ACTUATOR - SELECT / NON-PLAUSIBLE MOTOR CONTROL SIGNAL
120	78	SPEED ACTUATOR - SELECT / TOO HIGH CURRENT
121	79	SPEED ACTUATOR - SELECT / TOO HIGH TEMPERATURE

DTC DEC	DTC HEX	Description
130	82	SPEED ACTUATOR - SELECT / MECHANIC FAULT
131	83	SPEED ACTUATOR - SELECT / MECHANIC FAULT
132	84	SPEED ACTUATOR - SELECT / POSITION CONTROL ERROR
180	B4	SPEED ACTUATOR - SELECT / REFERENCE EOL PARAMETER ERROR (LACKING MEASUREMENT VALUES)
181	B5	SPEED ACTUATOR - SELECT / REFERENCE EOL PARAMETER ERROR (OUT-OF-TOLERANCE MEASUREMENT VALUES)
200	C8	SPEED ACTUATOR - SHIFT / SHORT-CIRCUIT TO EARTH ON CONTROL MOTOR OUTPUT
201	C9	SPEED ACTUATOR - SHIFT / SHIFT / SHORT-CIRCUIT TO POSITIVE ON CONTROL MOTOR OUTPUT
202	CA	SPEED ACTUATOR - SHIFT / INTERRUPTION ON CONTROL MOTOR OUTPUT
205	CD	SPEED ACTUATOR - SHIFT / SENSOR SHORT-CIRCUIT TO EARTH
206	CE	SPEED ACTUATOR - SHIFT / SENSOR SHORT-CIRCUIT TO POSITIVE OR INTERRUPTION
207	CF	SPEED ACTUATOR - SHIFT / NON-PLAUSIBLE MOTOR CONTROL SIGNAL
220	DC	SPEED ACTUATOR - SHIFT / TOO HIGH CURRENT
221	DD	SPEED ACTUATOR - SHIFT / TOO HIGH TEMPERATURE
230	E6	SPEED ACTUATOR - SHIFT / MECHANIC FAULT
231	E7	SPEED ACTUATOR - SHIFT / MECHANIC FAULT
232	E8	SPEED ACTUATOR - SHIFT / POSITION CONTROL ERROR
252	FC	SPEED ACTUATOR - SHIFT / ENGAGING ERROR - 1 st SPEED
253	FD	SPEED ACTUATOR - SHIFT / ENGAGING ERROR - 2 nd SPEED
254	FE	SPEED ACTUATOR - SHIFT / ENGAGING ERROR - 3 rd SPEED
255	FF	SPEED ACTUATOR - SHIFT / ENGAGING ERROR - 4 th SPEED
256	100	SPEED ACTUATOR - SHIFT / ENGAGING ERROR - 5 th SPEED
257	101	SPEED ACTUATOR - SHIFT / ENGAGING ERROR - 6 th SPEED
258	102	SPEED ACTUATOR - SHIFT / ENGAGING ERROR - REVERSE GEAR
259	103	SPEED ACTUATOR - SHIFT / TEACHING REQUEST GEARBOX BOUNDARY OVERRIDE
260	104	SPEED ACTUATOR - SHIFT / TEACHING REQUEST GEARBOX NEUTRAL POSITION FAILURE
280	118	SPEED ACTUATOR - SHIFT / REFERENCE EOL PARAMETER ERROR (LACKING MEASUREMENT VALUES)
281	119	SPEED ACTUATOR - SHIFT / REFERENCE EOL PARAMETER ERROR (OUT-OF-TOLERANCE MEASUREMENT VALUES)
282	11A	SPEED ACTUATOR - SHIFT / SYSTEM GEOMETRY ERROR (ASYMMETRY)
283	11B	SPEED ACTUATOR - SHIFT / MECHANIC FAULT
300	12C	CLUTCH ACTUATOR / SHORT-CIRCUIT TO EARTH ON CONTROL MOTOR OUTPUT
301	12D	CLUTCH ACTUATOR / SHORT-CIRCUIT TO POSITIVE ON CONTROL MOTOR OUTPUT
302	12E	CLUTCH ACTUATOR / INTERRUPTION ON CONTROL MOTOR OUTPUT
303	12F	CLUTCH ACTUATOR / SENSOR SUPPLY VOLTAGE - TOO LOW
320	140	CLUTCH ACTUATOR / TOO HIGH CURRENT
321	141	CLUTCH ACTUATOR / TOO HIGH TEMPERATURE
330	14A	CLUTCH ACTUATOR / MECHANIC FAULT ON CONTROL MOTOR
331	14B	CLUTCH ACTUATOR / MECHANIC FAULT - LOCK AT END OF STROKE
350	15E	CLUTCH ACTUATOR / POSITION CONTROL ERROR
351	15F	CLUTCH ACTUATOR / NON-PLAUSIBLE POSITION SIGNAL AT THE END OF STROKE
352	160	CLUTCH ACTUATOR / NON-PLAUSIBLE POSITION SIGNAL
354	162	CLUTCH ACTUATOR / MULTIPLE INPUT SPEED PLAUSIBILITY ERROR
355	163	CLUTCH ACTUATOR / MULTIPLE CLUTCH TORQUE PLAUSIBILITY ERROR

DTC DEC	DTC HEX	Description
356	164	CLUTCH ACTUATOR / NO ENGINE REACTION UPON TORQUE REDUCTION REQUEST
380	17C	CLUTCH ACTUATOR / TOO SLOW OR JAMMED CLUTCH MOTION WHEN PERFORMING ACTIVE DIAGNOSIS
381	17D	CLUTCH ACTUATOR / OUT-OF-RANGE CLUTCH MOTION WHEN PERFORMING ACTIVE DIAGNOSIS
382	17E	CLUTCH ACTUATOR / CLUTCH MOTION BEYOND PERMITTED LIMITS
383	17F	ELECTRONIC CONTROL UNIT / DATA MEMORY (EEPROM) ACCESS ERROR WHEN PERFORMING ACTIVE DIAGNOSIS
384	180	CLUTCH ACTUATOR / ERROR DURING CLUTCH CLOSING
385	181	CLUTCH ACTUATOR / ERROR DURING CLUTCH OPENING
386	182	ELECTRONIC CONTROL UNIT / DATA MEMORY (EEPROM) ACCESS ERROR WHEN PERFORMING ACTIVE DIAGNOSIS (TOUCH-POINT)
400	190	DIGITAL OUTPUTS / SHORT-CIRCUIT TO POSITIVE ON ENGINE STARTING ENABLE OUTPUT
401	191	DIGITAL OUTPUTS / SHORT-CIRCUIT TO POSITIVE ON REVERSING LIGHT IGNITION OUTPUT
402	192	DIGITAL OUTPUTS / SHORT-CIRCUIT TO POSITIVE ON PTO ACTUATION ENABLE OUTPUT
403	193	SUPPLY VOLTAGE / SUPPLY VOLTAGE INSIDE THE ECU - TOO HIGH
404	194	SUPPLY VOLTAGE / SUPPLY VOLTAGE INSIDE THE ECU - TOO LOW
405	195	SUPPLY VOLTAGE / ECU SUPPLY VOLTAGE +30 HS - TOO HIGH
406	196	SUPPLY VOLTAGE / ECU SUPPLY VOLTAGE +30 HS - TOO LOW
407	197	SUPPLY VOLTAGE / KEY-CONTROLLED SUPPLY VOLTAGE +15 - TOO HIGH
408	198	SUPPLY VOLTAGE / KEY-CONTROLLED SUPPLY VOLTAGE +15 - TOO LOW
409	199	SUPPLY VOLTAGE / SUPPLY VOLTAGE INSIDE THE ECU - TOO HIGH
410	19A	SUPPLY VOLTAGE / SUPPLY VOLTAGE INSIDE THE ECU - TOO LOW
411	19B	SUPPLY VOLTAGE / ECU SUPPLY VOLTAGE +30 - TOO LOW
412	19C	SUPPLY VOLTAGE / ECU SUPPLY VOLTAGE +30 - TOO LOW
413	19D	GEARBOX OUTPUT REVS SENSOR / SHORT-CIRCUIT TO EARTH
414	19E	GEARBOX OUTPUT REVS SENSOR / NON-PLAUSIBLE SIGNAL
415	19F	GEARBOX OUTPUT REVS SENSOR / WRONG SIGNAL
434	1B2	SUPPLY VOLTAGE / ECU SUPPLY VOLTAGE (+30) DIFFERENT FROM KEY-CONTROLLED VOLTAGE (+15)
435	1B3	GEARBOX OUTPUT REVS SENSOR / NON-PLAUSIBLE SIGNAL
436	1B4	SPEED ACTUATOR - SELECT / NON-PLAUSIBLE SIGNAL FROM THE SENSOR
437	1B5	SPEED ACTUATOR - SHIFT / NON-PLAUSIBLE SIGNAL FROM THE SENSOR
438	1B6	DIGITAL OUTPUTS / SHORT-CIRCUIT TO EARTH ON ENGINE START-PREVENT SIGNAL
439	1B7	DIGITAL OUTPUTS / TOO LOW VOLTAGE ON START-PREVENT SIGNAL
440	1B8	GEAR SELECTOR LEVER / MINOR ANOMALY
441	1B9	GEAR SELECTOR LEVER / SERIOUS ANOMALY - LACKING SIGNAL
442	1BA	GEAR SELECTOR LEVER / GEARBOX LEVER POSITION NOT DEFINED
443	1BB	DIGITAL OUTPUTS / SHORT-CIRCUIT TO EARTH ON REVERSING LIGHT IGNITION SIGNAL

DTC DEC	DTC HEX	Description
444	IBC	DIGITAL OUTPUTS / SHORT-CIRCUIT TO EARTH ON PTO ACTUATION SIGNAL
450	IC2	ELECTRONIC CONTROL UNIT / GENERIC DATA MEMORY (EEPROM) ACCESS ERROR

ELECTRONIC INJECTION SYSTEM

Common rail

General

In order to reduce the emission of particulate, particularly high injection pressures are required.

The system on the new Daily makes it possible to inject the fuel at pressures reaching 1350 bar, while the pressure obtained with electronic system management optimises the work of the engine limiting emissions and consumption.

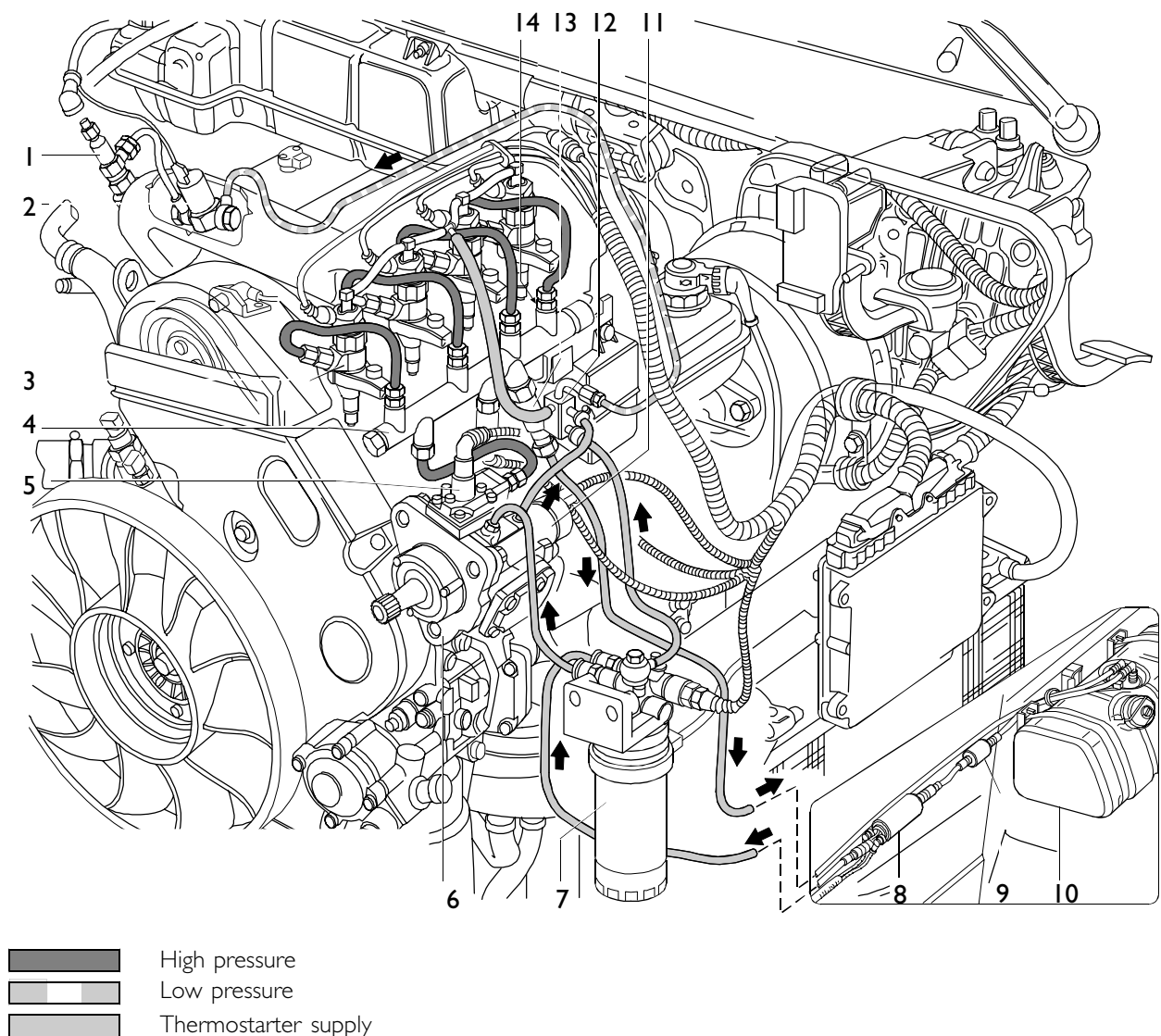
In other diesel systems the high pressure is generated only at the moment of injection for each single cylinder (injection pump or injector-pump).

In the common rail a special pump continuously keeps the fuel at high pressure, regardless of the stroke and of the cylinder that is to receive injection, and accumulates it in a common duct for all the injectors.

Therefore, fuel already at the injection pressure is always present at the inlet of the injectors.

When the solenoid valve of an injector is energised by the electronic control unit, injection takes place in the corresponding cylinder.

Figure 132



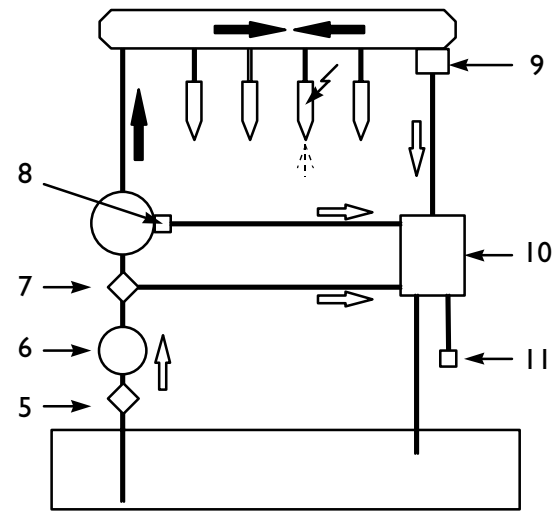
FUEL FEED AND RECIRCULATION DIAGRAM

1. Heat starter plug – 2. Heat starter electro valve – 3. Electrical injector – 4. Rail hydraulic accumulator – 5. 3rd pump cutout electro valve – 6. High-pressure pump – 7. Fuel filter – 8. Electrically driver pump – 9. Prefilter – 10. Reservoir – 11. Pressure regulator valve – 12. Connection – 13. Pressure limiter valve – 14. Flow limiter

In reality the system is much more complex, as the various control and adjustment components have to be integrated.

The MS6.3 electronic control centre monitors the entire system: it receives data from sensors and activates the actuators as required based on input signal processing.

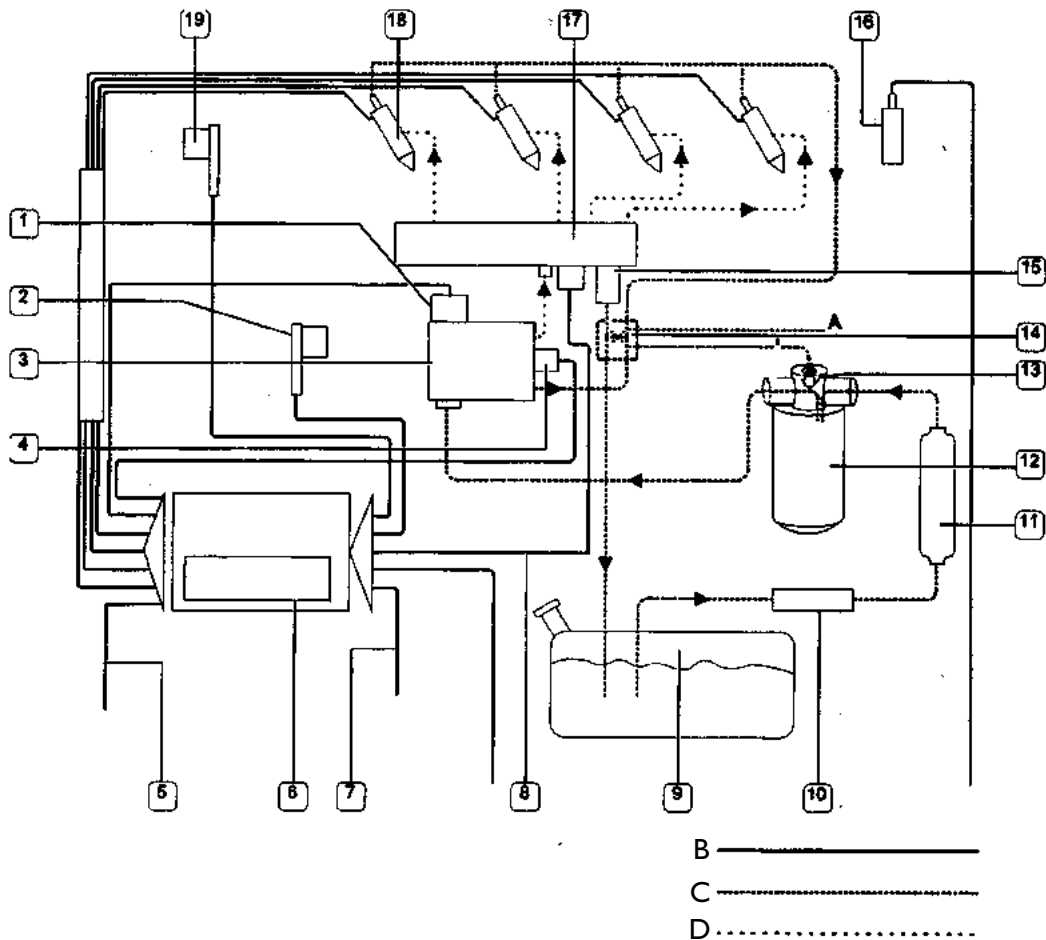
Figure 133



HYDRAULIC LAYOUT

5. Pre-filter – 6. Electric pump – 7. Filter with overpressure valve – 8. Pressure regulator – 9. Pressure limiter – 10. Fuel outlets unit – 11. Thermal starter

Figure 134



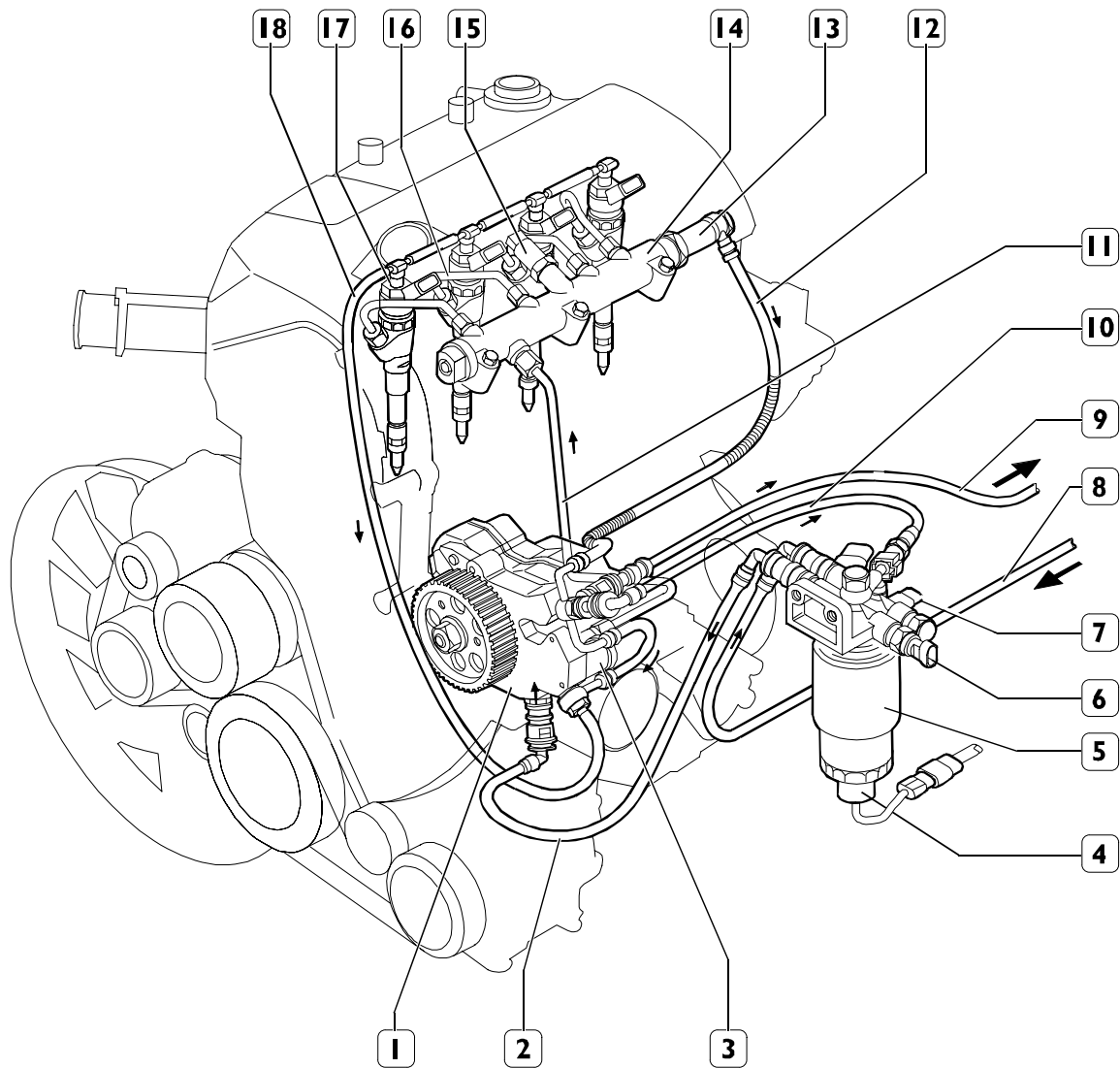
1. 3rd impeller cut-off device – 2. Flywheel rpm sensor – 3. High pressure pump – 4. Pressure regulator – 5. Other actuators (thermal starter, heated filter, fan control, ac control) – 6. Electronic control unit with built-in atmospheric pressure sensor – 7. Other sensors (accelerator, brake, clutch, vehicle speed, water temperature, air temperature) – 8. From rail pressure sensor – 9. Fuel tank – 10. Pre-filter – 11. Electric pump – 12. Fuel filter – 13. Filter overpressure valve – 14. Outlets unit with calibrated hole – 15. Rail pressure limiter – 16. Air flow meter – 17. Common rail – 18. Injectors – 19. Timing sensor on camshaft – A. To thermal starter – B. Electric circuit – C. Low pressure fuel – D. High pressure fuel

Common rail (FIA)

It differs from the Common rail system on previous engines in that injected fuel pressure is 1600 instead of 1350 bars.

Preheat plugs are provided for cold starts.

Figure 135



1. High pressure pump – 2. Piping – 3. Pressure regulator – 4. Water in filter sensor – 5. Fuel filter with water separator – 6. Fuel filter clogging sensor – 7. Fuel temperature sensor – 8. Fuel pressure line to filter – 9. Fuel return line to tank – 10. Fuel return line to filter – 11. High pressure piping to common rail – 12. Low pressure return line from rail – 13. Over pressure valve – 14. Common rail – 15. Fuel pressure sensor – 16. High pressure line between rail and electro injectors – 17. Electro injectors – 18. Return line from electro injectors

0003343t

Hydraulic system (Common Rail – FIA)

The hydraulic system consists of a low and high-pressure circuit, the former consisting of the following piping:

- ☐ connecting high-pressure output to the Rail;
- ☐ Common Rail;
- ☐ connecting the Rail and supplying electro injectors.

The low-pressure circuit consists of the following piping:

- ☐ fuel aspiration from tank to prefilter;
- ☐ supplying the pump and prefilter;
- ☐ supplying the high-pressure pump via the fuel filter.

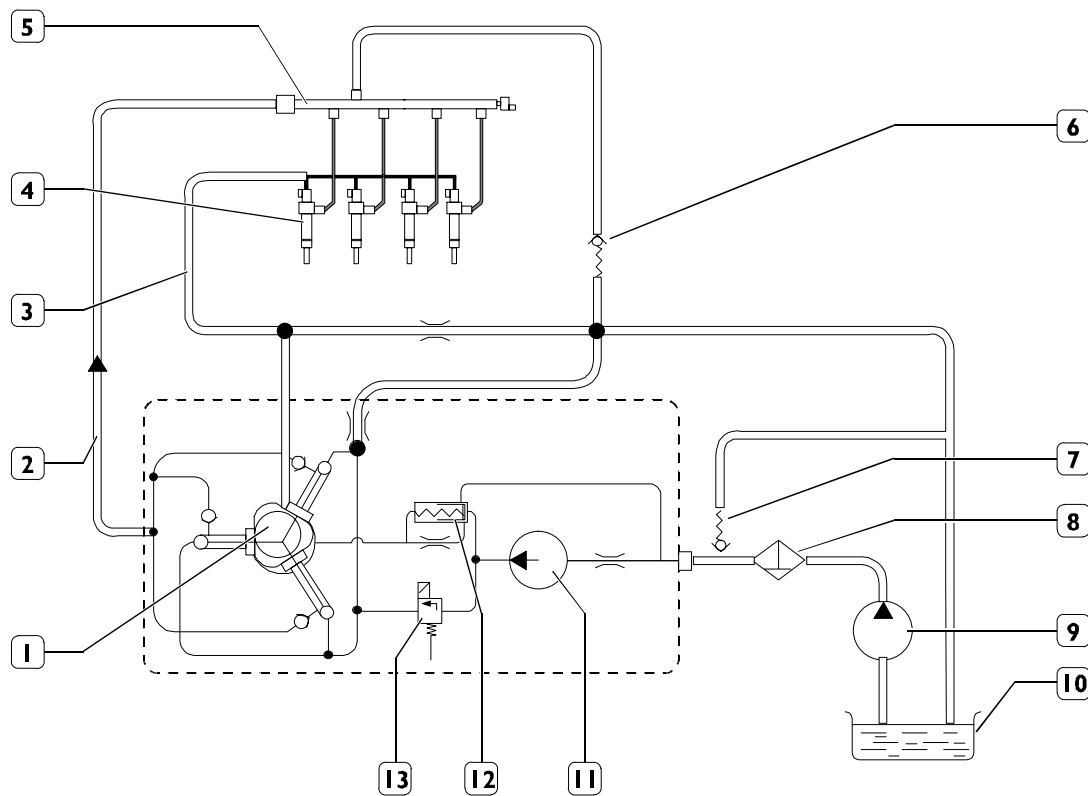
The Rail exhaust circuit and the electro injectors complete the supply circuit.

The following are mandatory for safety reasons because of high-pressure levels inside this hydraulic system:

- ☐ avoid improper connection of high pressure piping junctions;
- ☐ avoid connecting high pressure piping with the engine running (useless and hazardous attempts at purging must be avoided!)

Low-pressure circuit integrity is essential to proper system operation, so mishandling and modifications must be avoided, with immediate action required in case of leaks.

Figure 136

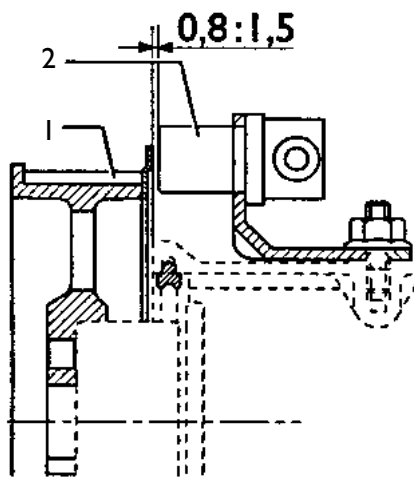
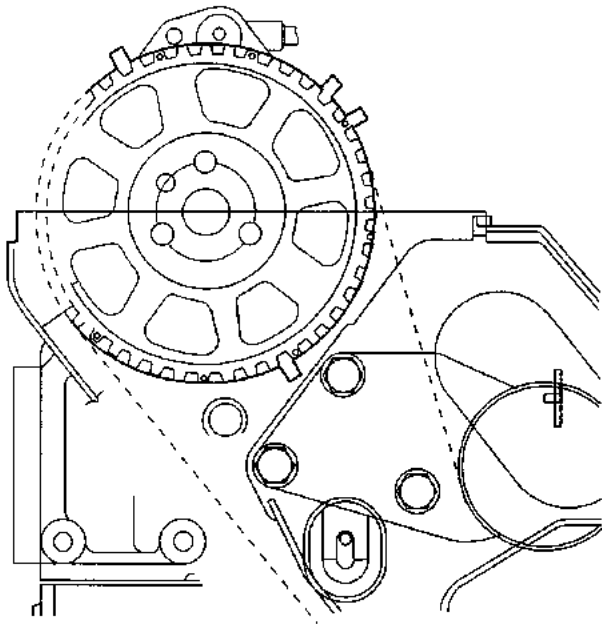


1. High pressure pump – 2. High pressure line – 3. Electro injector recirculation line – 4. Electro injectors – 5. Common rail – 6. Over pressure valve – 7. Bypass valve – 8. Filter – 9. Priming pump – 10. Tank – 11. Mechanical supply pump – 12. High pressure pump limiter valve – 13. Pressure regulator

0003340t

Figure I37

Motor 8040



TECHNICAL VIEWS OF PULLEY AND SENSOR
1. Camshaft pulley – 2. Sensor

SYSTEM COMPONENTS

Camshaft pulley and timing sensor

5 teeth (4 + 1 for timing detection) are machined on the pulley opposite an inductive sensor equal to the one on the flywheel.

5 holes (4 + 1 timing recognition hole) are provided on the FIA engine pulley.

The sensor is of the inductive type and is used by the electronic control unit to detect the engine stroke during synchronisation (when starting).

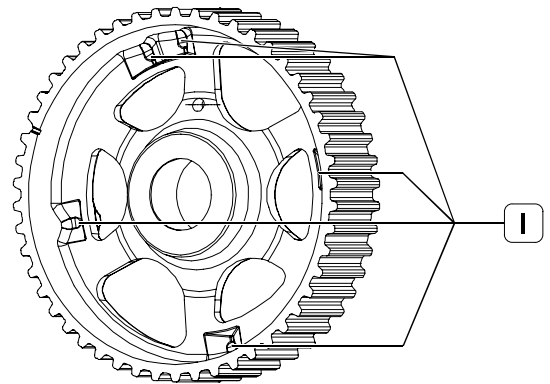
When assembling the sensor:

ensure the dimension illustrated working on the slots of the bracket and measuring with a thickness gauge

- ☐ make sure that the sensor is perpendicular in relation to the wheel tightening the nuts.

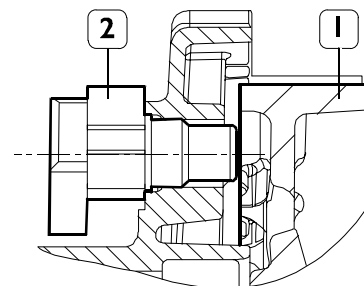
Figure I38

Motor FIA



0003320t

TIMING RECOGNITION HOLES



0003321t

1. Camshaft pulley – 2. Sensor

Flywheel and rpm sensor

The flywheel has a set of 58 holes (60 – 2), as illustrated, for generating the signal for the inductive sensor.

It is the same as the one on the camshaft and is positioned on the crankcase and detects the passage of the 58 holes on the flywheel.

The change in the signal caused by the lack of 2 holes (synchronism gap) which takes place at each rotation of the crankshaft is the reference signal that allows the control unit to recognise the advance in relation to the TDC of piston pair 1–4.

This signal is also used by the control unit to detect the engine rotation speed, the duration of injection and to control the rev counter.

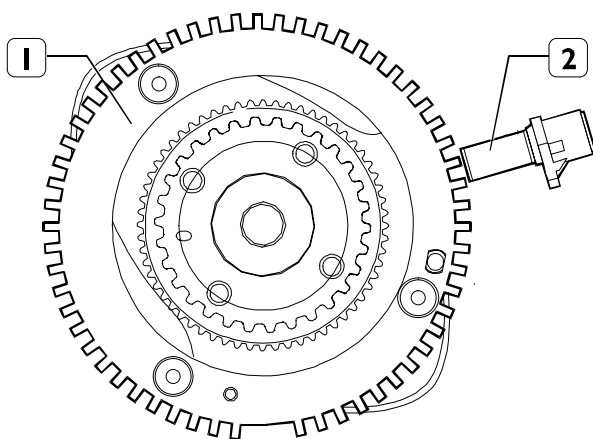
When assembling the sensor:

- ☐ ensure the dimension illustrated working on the slots of the bracket and measuring with a thickness gauge.
- ☐ make sure that the sensor is perpendicular in relation to the wheel tightening the nuts.

The FIA engine crankshaft sensor features a slatted sound wheel on the crankshaft front.

This features 58 (60–2) teeth and the sensor detects their passage.

Figure 139

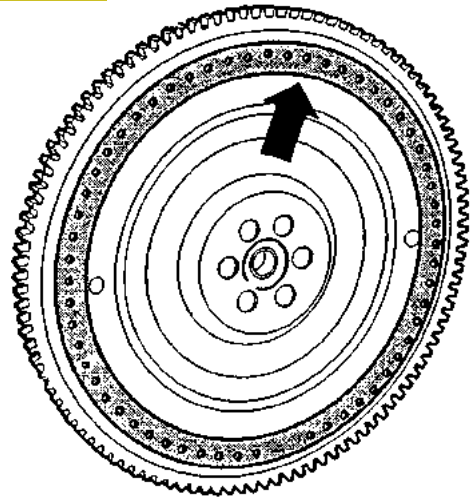


0003319t

TECHNICAL VIEW OF THE SOUND WHEEL AND SENSOR

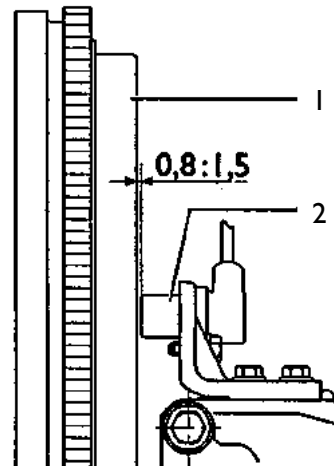
1. Sound wheel – 2. Crankshaft sensor

Figure 140



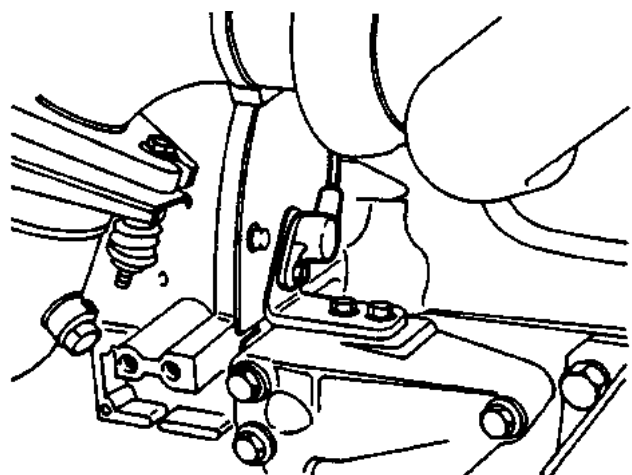
HOLES FOR GENERATING SIGNALS ON THE FLYWHEEL

Figure 141



TECHNICAL VIEW OF FLYWHEEL AND SENSOR
1. Flywheel – 2. Sensor

Figure 142



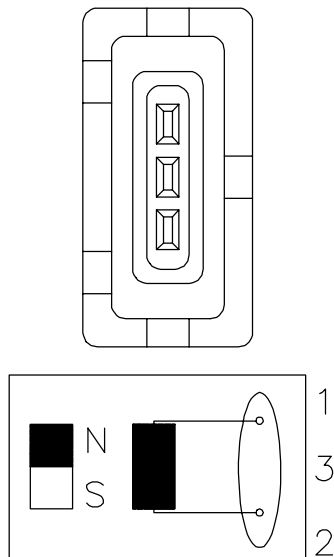
RPM SENSOR ON CRANKCASE

Figure 143



SENSOR AND CONNECTION CABLE

Figure 144



SENSOR CONNECTOR AND WIRING DIRAGRAM

Flywheel and camshaft sensor specifications

These are inductive sensors.

The flywheel sensor (48035) is connected at pins 29 and 37 of connector A of the control unit.

It is also used to control the electronic rev counter on the instrument cluster.

The timing sensor (48042) is connected at pins 4 and 31 of connector A of the control unit.

The resistance at 20 °C is approx. ~ 860 Ohm.

Pre-filter

This is a simple transparent filter like the one in petrol supply systems.

Replace it only when a sight check reveals traces of impurity.

Electric pump

Rotary volumetric pump with integrated by pass (Figure 145) located outside the fuel tank.

It is on the left-hand side of the frame in an accessible area.

There is no need to bleed the fuel supply system.

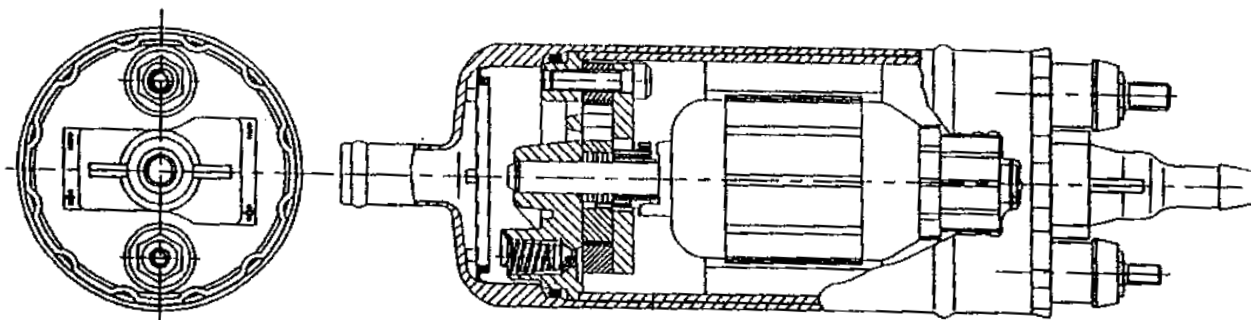
The pipes are fitted with quick couplings.

It is connected to pins 7 and 8 of connector A of the control unit.

Specifications

Delivery pressure:	2,5 bar
Flow rate:	> 155 litres/h
Supply:	13,5 V – < 5 A
Coil resistance at 20 °C:	28,5 Ohm

Figure 145



TECHNICAL VIEW AND CROSS SECTION OF ELECTRIC FUEL PUMP

Fuel filter

Cartridge degree of filtering: 5 micron

Differential operating pressure (obstruction indicator): 0.6 bar

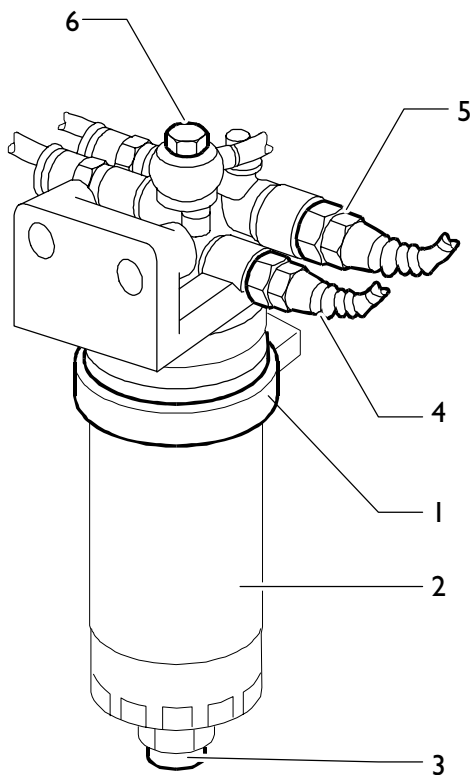
The fuel temperature sent by the sensor to the electronic injection control unit allows very accurate calculation of the flow rate of the fuel to be injected in the cylinders.

It is located in a fairly accessible position in the left front part of the engine compartment.

1. Actuated by ECU via relay with fuel temperature below 3°C.
2. Filtering element
3. Shows presence of water through a warning lamp on instrument panel.
4. Differential pressure sensor calibrated at 0,6 bar : any clogging is shown by warning lamp
5. It is a NTC sensor connected to EDC for fuel temperature reading enabling electronic control to calculate the amount of diesel oil to be injected into the cylinders.
6. Installed on filter support for excess fuel return to tank.

Figure 146

Engine 8040



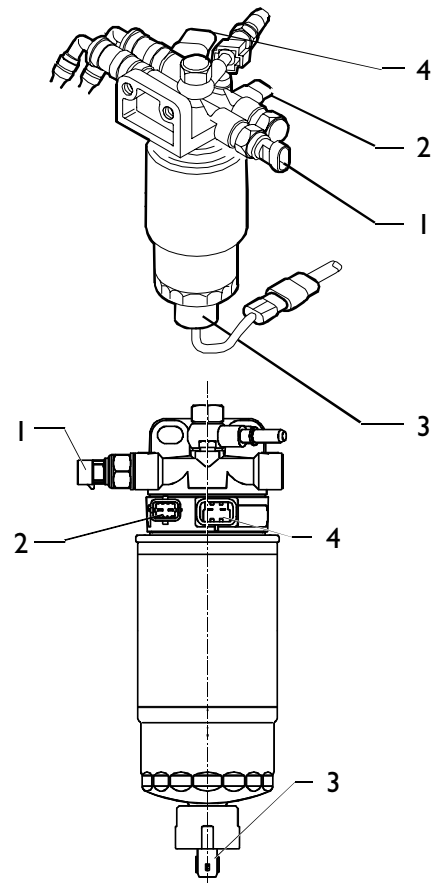
73731

FUEL FILTER

1. Heater – 2. Filtering element – 3. Condensation indicator – 4. Obstruction indicator – 5. Fuel temperature sensor – 6. Discharge

Figure 147

Engine F1A



003312t

1. Clogged filter sensor – 2. Fuel temperature sensor – 3. Water sensor – 4. Heater

High pressure pump

This pump has three radial pistons (total displacement 0,7 cc) controlled by the timing gear belt, with no need for calibration.

Each impeller unit comprises:

- ☐ a piston (5) operated by a cam (2) integral with the pump shaft (6)
- ☐ a plate inlet valve (3)
- ☐ a ball delivery valve (4)

The delivery pressure to the rail is modulated between 250 and 1350 bar by the electronic control unit, acting on the pressure regulator solenoid valve.

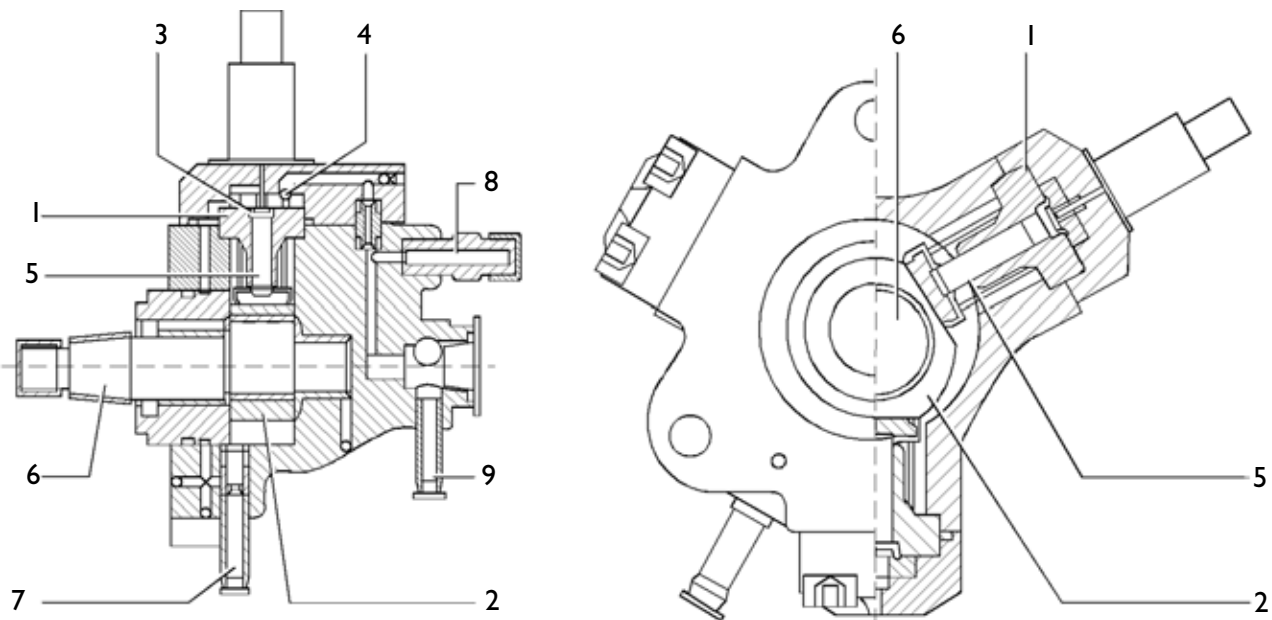
The pump is lubricated and cooled by the fuel itself.

The 3rd impeller cut-off solenoid valve (78015) serves to increase the part of fuel oil that lubricates the radialjet pump, it is used above 4200 rpm (when power is no longer needed) and keeps the intake valve open also when the cylinder is compressing. It sends one third of the capacity of the high pressure pump back to low pressure.

The on-off time is considerably lower than conventional injection pumps.

The control solenoid valve is connected to pins 20 and 21 of connector A of the control unit.

Figure I48



TECHNICAL VIEW AND CROSS SECTION OF HIGH PRESSURE PUMP

1. Cylinder – 2. Cam – 3. Plate inlet valve – 4. Ball delivery valve – 5. Piston – 6. Pump shaft – 7. Low pressure fuel inlet – 8. High pressure fuel delivery – 9. Fuel backflow

High-pressure pump (FIA engine)

This pump is similar to the 8140 engine one.

It differs in Rail line pressure, modulated at between 250 and 1600 bars by the electronic centre by acting on the pressure regulator electro valve and is not provided with a 3rd pump cutout electro valve (78015).

Pump (3) is oriented on the pump shaft cam.

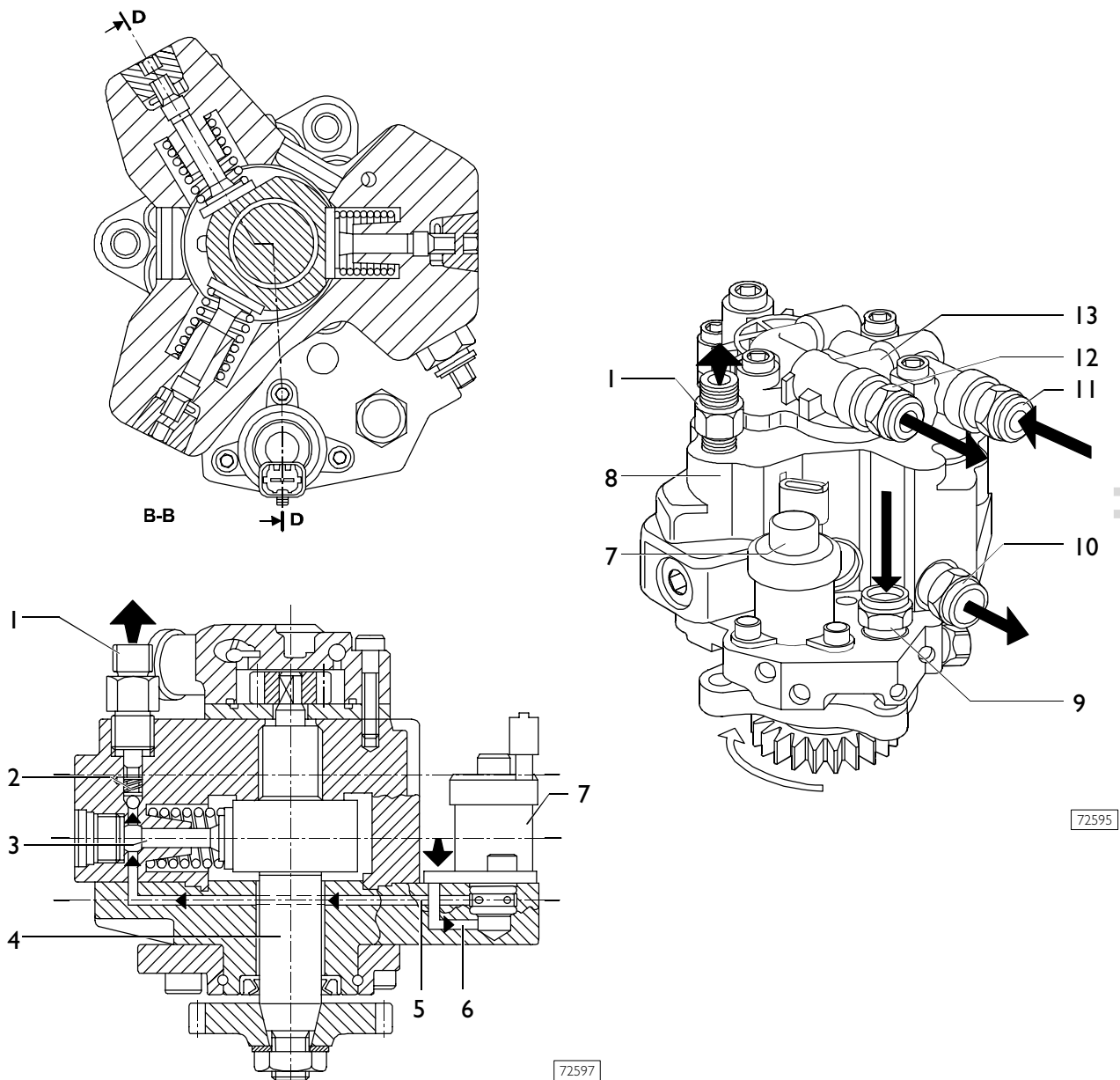
During aspiration the pump is powered via supply conduit (5).

The amount of fuel to be sent to the pump is set by pressure regulator (7).

The pressure regulator stops fuel inflow to the pump based on PWM input from the centre.

During pump compression, fuel reaches a pressure level sufficient to open the pressure valve to common rail (2), and supplies it via output (1).

Figure 149



1. Output for rail pressure - 2. Rail pressure valve - 3. Pump - 4. Pump shaft - 5. Pump supply conduit - 6. Pressure regulator supply conduit - 7. Pressure regulator - 8. High pressure pump - 9. Fuel input connection from filter - 10. Fuel output connection to filter support - 11. Fuel input connection from centre heat exchanger - 12. Fuel output connection from mechanical pump to filter - 13. Supply mechanical pump

72595

72597

Pressure regulator

This is located on the high pressure pump and modulates the fuel pressure to the rail (and thus to the injectors) on the basis of the commands received from the electronic control unit.

It mainly comprises:

- ☐ a ball shutter (1)
- ☐ a valve (3) control pin (2)
- ☐ a preloading spring (4)
- ☐ a coil (5)

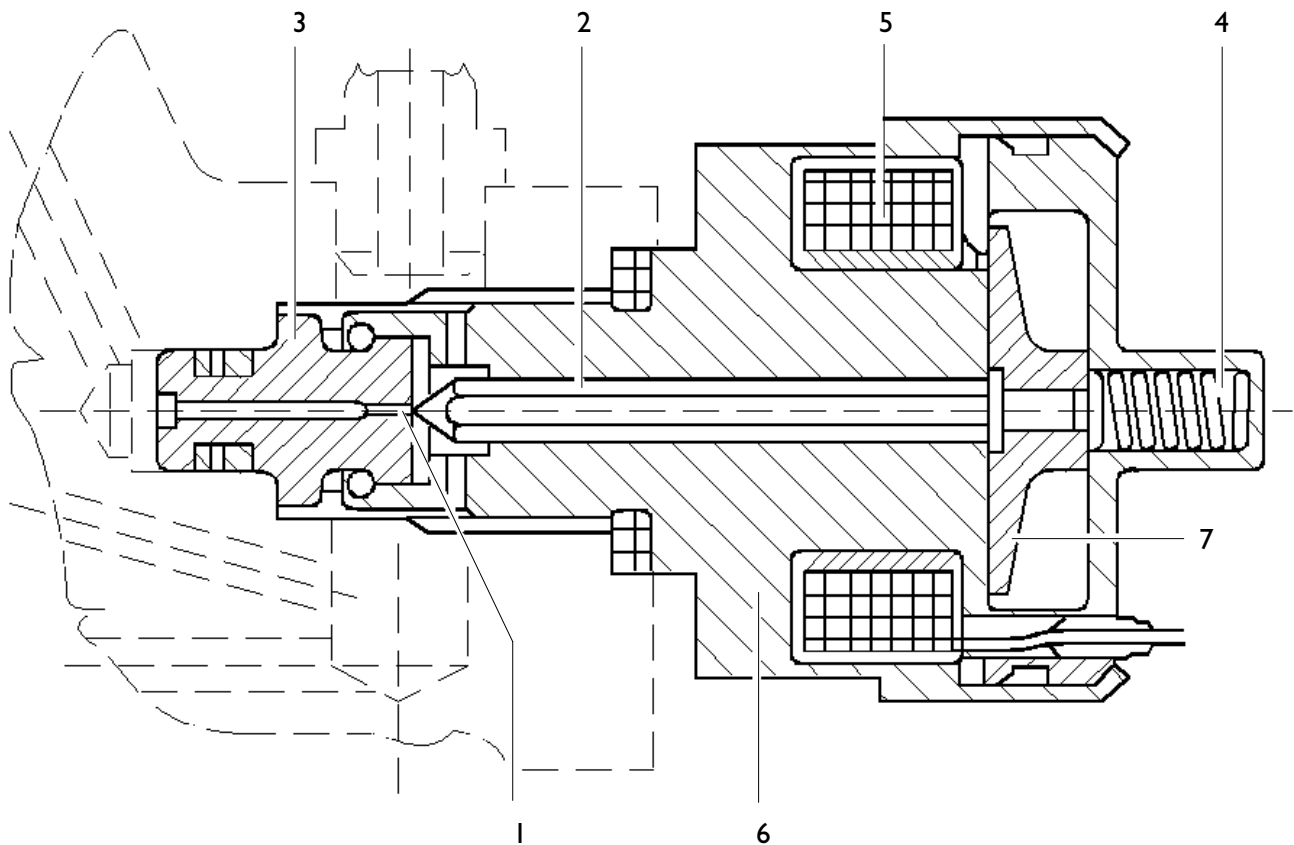
When the solenoid is not energised, the delivery pressure depends only on the spring preload.

When, after processing the various engine operating parameters, the electronic control unit determines the need for a different injection pressure, it modulates a command signal in PWM to the regulator solenoid valve which discharges the excess pressure in the pump backflow duct.

The modulated pressure is checked through the pressure sensor on the rail by the control unit, which, if necessary, suitably modifies the intensity of the command signal to reach the required result.

The control solenoid valve (78013) is connected to pins 9 and 20 of connector A of the control unit.

Figure 150



PRESSURE REGULATOR CROSS SECTION

1. Ball shutter – 2. Ppin – 3. Valve – 4. Preloading spring – 5. Coil – 6. Body – 7. Anchor

Pressure regulator (FIA)

Similar to the one installed on the 8140 engine and mounted on the CP3 pump low-pressure circuit.

When the engine control centre pilots the pressure regulator via the PWM signal, solenoid (1) is activated, which in its turn generates movement of magnetic core (2).

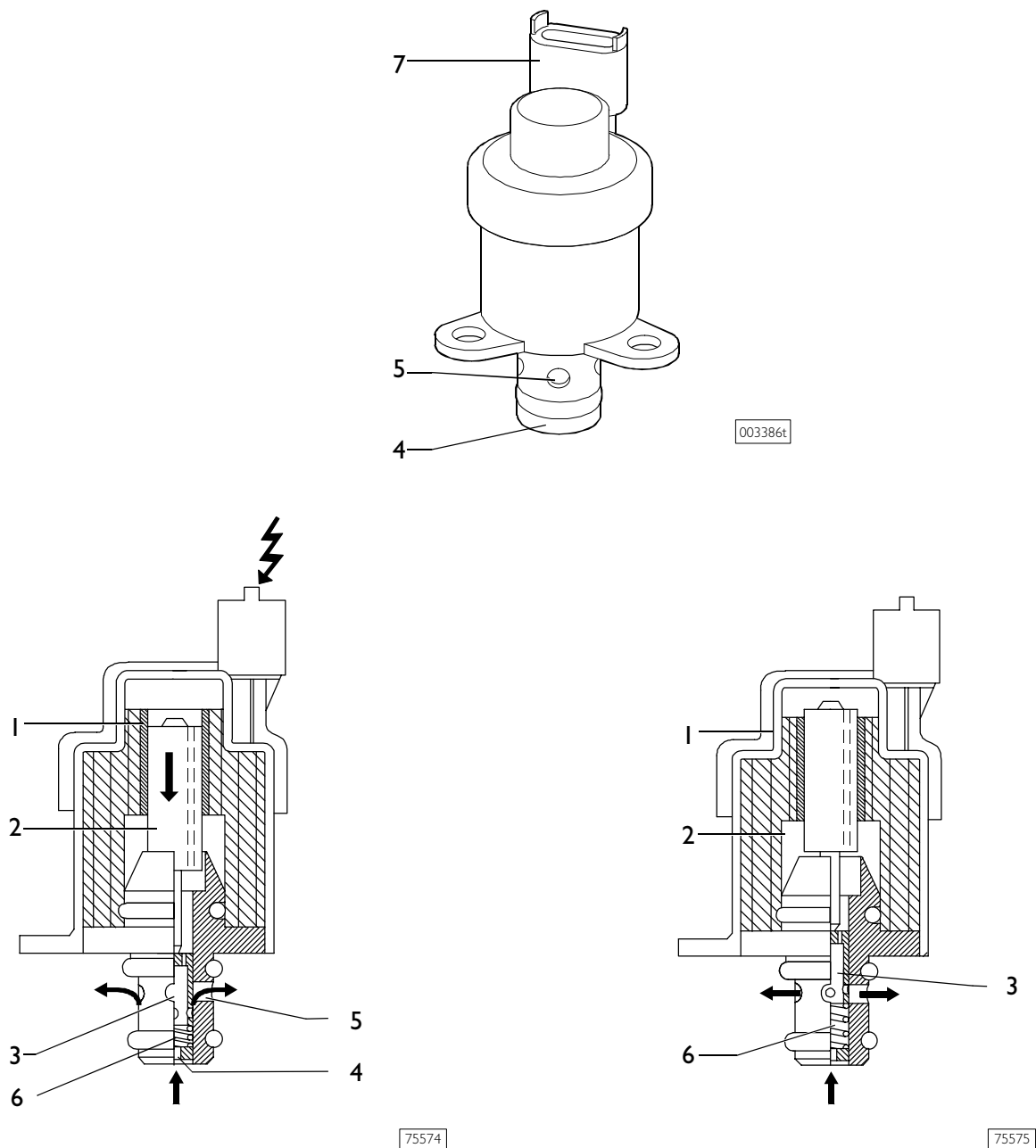
Core movement causes cylinder (3) axial displacement by fuel delivery partialization.

When solenoid (1) is not activated, the magnetic core is moved to its rest position by preload spring (6).

In these conditions, cylinder (3) is in a position to offer maximum fuel passage cross-section.

Control electro valve 78013 is connected to centre connector A pins 9 and 20.

Figure 151



1. Solenoid - 2. Magnetic core - 3. Cylinder - 4. Fuel input - 5. Fuel output - 6. Preload spring - 7. Connector

Rail (pressure accumulator)

The volume of the rail is small in size (29 cc) to allow quick pressurising when starting, at idle speed and in the event of high loads.

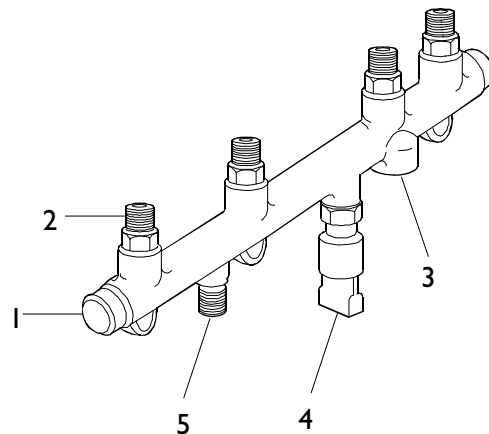
It has however sufficient volume to minimise the plenum effect caused by opening and closing of the injectors and operation of the high pressure pump.

Screwed onto the rail there is a fuel pressure sensor. The signal sent by this sensor to the electronic control unit is feedback information on the basis of which correct actuation of the rail pressure is checked.

Common Rail for engines with serial numbers over 3089322

Temporary solution with simulated flow limiters and over pressure valve connected to the fuel discharge unit.

Figure I52

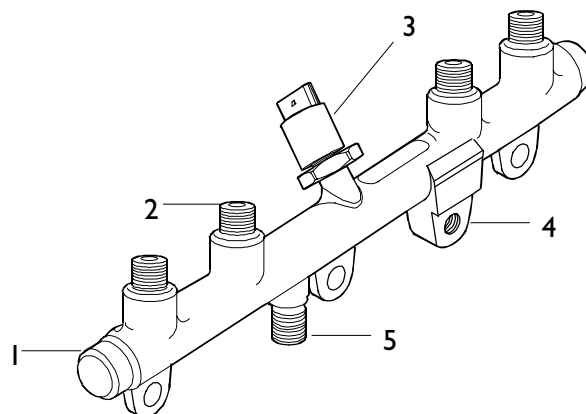


1. Common Rail – 2. Simulated flow limiter – 3. Simulated over pressure valve seat – 4. Pressure sensor – 5. Fuel input from high-pressure pump

Common Rail for engines produced since end-October 2000

Final Common Rail solution without flow limiters and over pressure valve. The new Common Rail features different pressure sensor layout and discharge unit connection predisposition.

Figure I53



1. Common Rail – 2. To electrical injectors – 3. Pressure sensor – 4. Fuel discharge unit attachment – 5. Fuel input from high-pressure pump

Rail (pressure accumulator – FIA)

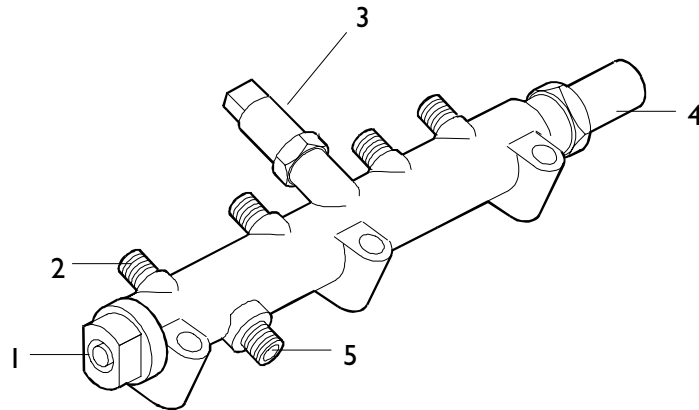
The hydraulic accumulator is mounted in the cylinder head on the side opposite aspiration.

Its some 22-cm³ volume dampens fuel pressure oscillations due to:

- ☐ high-pressure pump operation
- ☐ electro injector opening.

The fuel sensor and overpressure valve are positioned on the hydraulic accumulator.

Figure 154



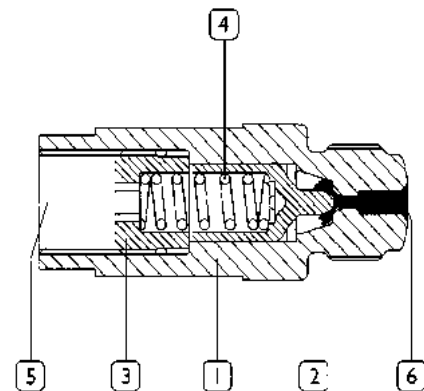
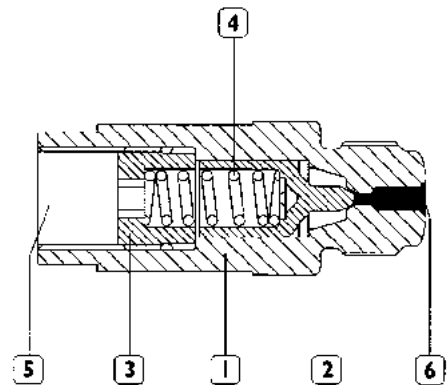
1. Common rail – 2. To electro injectors – 3. Fuel pressure sensor – 4. Overpressure valve – 5. Fuel input from high pressure pump

Over pressure valve

The over pressure valve protects system components in the event that fuel pressure exceeds rated 1750 bars.

- A The piston's conical end normally keeps discharge to tank open.
- B In the event of fuel pressure being over 1750 bars in the rail, the piston is relocated and excess pressure is discharged into the tank.

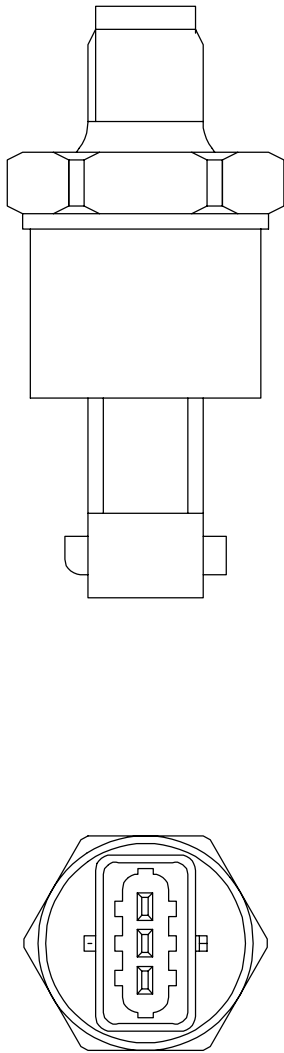
Figure 155



OVER PRESSURE VALVE

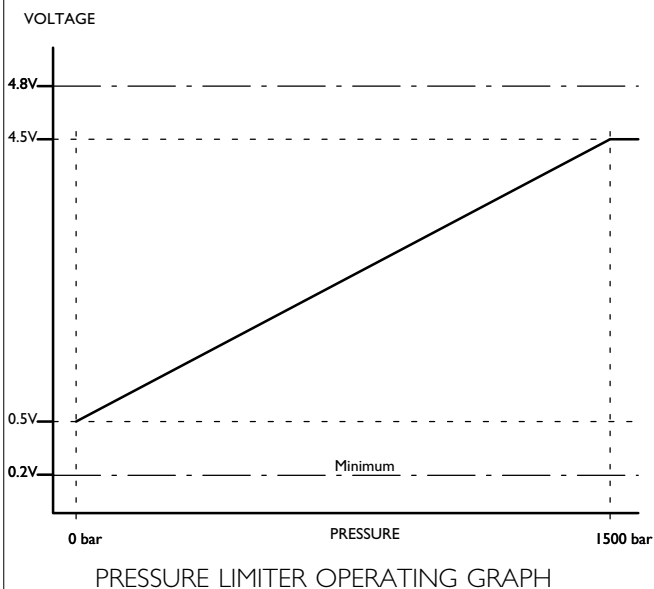
1. Body – 2. Piston – 3. Stop – 4. Spring – 5. Direct discharge to tank – 6. Seat on the rail

Figure 156



TECHNICAL VIEW OF COMPONENT AND LIMITER CONNECTOR

Figure 157



Flow limiters

These are located on the rail fuel outlet and their function is to protect the engine or vehicle in the event of internal leaks (for example, atomiser blocked open) and external leaks (example: high pressure pipe damaged).

Under these circumstances they also allow, within certain limits, the system to work through the components that are still intact.

The passage of fuel from the rail to the injectors takes place through the holes machined on the small diameter of the piston.

Under normal conditions, the fuel pressure is exerted on both sides of the piston, held in the open position by the spring.

In the event of a heavy loss of pressure downstream of the limiter, the inlet pressure becomes preponderant and moves the piston from the opposite side, obstructing the fuel outlet.

Pressure limiter

The pressure limiter (1500 bar) screwed in the rail, serves to protect the system components in the event of a failure to the pressure regulator on the pump.

If the pressure of the fuel in the rail exceeds 1500 bar the piston is raised and the excess pressure is eliminated.

Fuel pressure sensor

This is fitted at the centre of the rail and measures the existing fuel pressure in order to determine the injection pressure.

The injection pressure value is used as feedback for closed loop pressure control and to determine the duration of the electric command for injection.

It is connected to pins 6, 13 and 33 of connector A of the control unit.

It is supplied at 5 Volt.

Injectors

The solenoid valve controls the lift of the atomiser needle.

On the fuel inlet union a filter protects the injector for impurities. The injector is constructively the same as conventional ones, except that there is no needle return spring.

Access to the injectors is gained by releasing the side soundproof cover from the cylinder head. The fuel recovery pipe has a quick coupling.

The injector comprises two parts:

- ☐ actuator – atomiser composed of pressure rod (1), pin (2) and nozzle (3)
- ☐ control solenoid valve comprising a coil (4) and drive valve (5).

1st phase: rest position

The coil (4) is not activated and the shutter (6) is in the closed position.

The same fuel pressure acts in both the control area (7) and in the pressure chamber (8), but as the shutter (6) is closed, the needle (2) cannot be raised.

2nd phase: start of injection

The coil (4) is energised and causes the shutter (6) to move upwards.

The fuel of the control volume (9) flows towards the backflow duct (10) causing a drop in the pressure in the control area (7).

At the same time, the pressure of the fuel in the pressure chamber (8) causes the needle (2) to rise, resulting in fuel injection to the cylinder.

3rd phase: end of injection

The coil (4) is not activated and makes the shutter (6) return to the closed position, which re-creates a balance of forces that makes the needle (2) return to the closed position and consequently end injection.

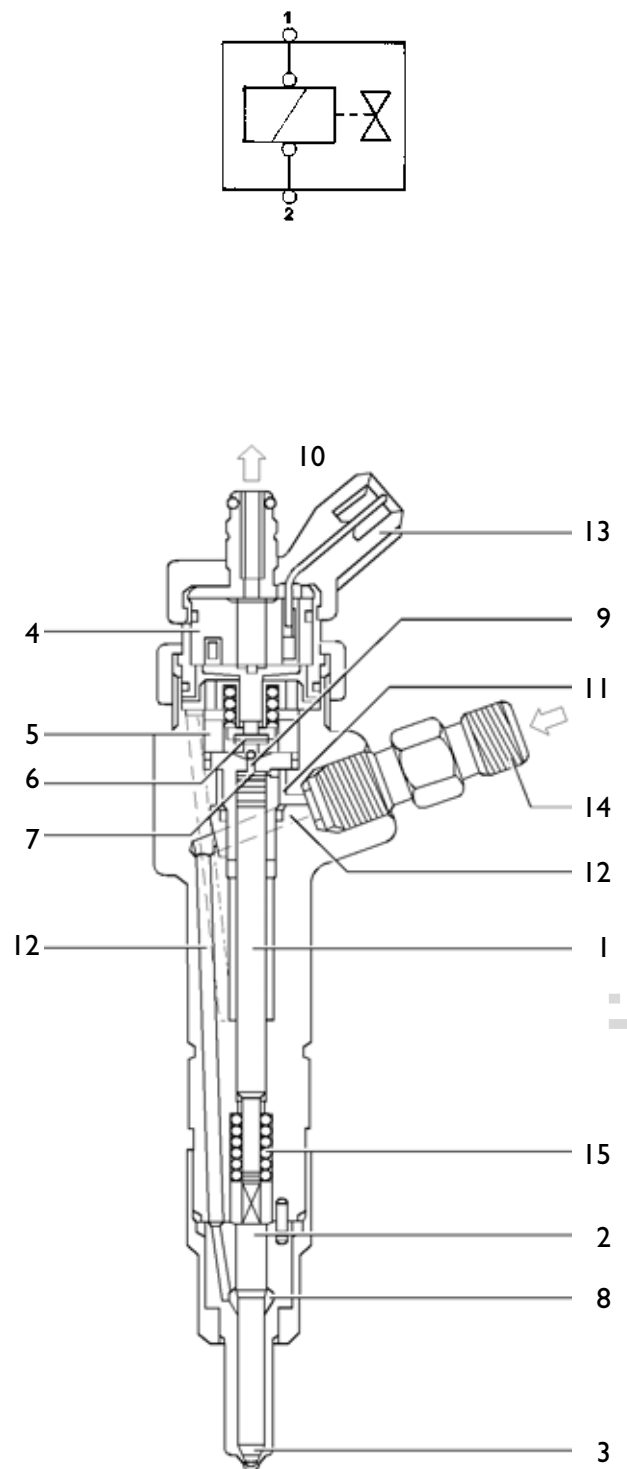
Injectors (78247)

The solenoid valve is of the N.C. type.

The injectors are connected individually to the control unit at the following pins:

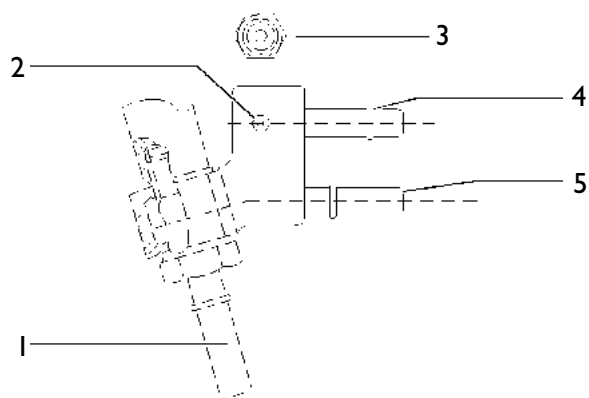
- ☐ A12 / A40 cylinder 1 injector
- ☐ A10 / A43 cylinder 2 injector
- ☐ A23 / A42 cylinder 3 injector
- ☐ A24 / A41 cylinder 4 injector

Figure 158



INJECTOR WIRING DIAGRAM AND CROSS SECTION
 1. Pressure rod – 2. Needle – 3. Nozzle – 4. Coil – 5. Pilot valve – 6. Ball shutter – 7. Control area – 8. Pressure chamber – 9. Control volume – 10. Backflow duct – 11. Control duct – 12. Supply duct – 13. Electrical connection – 14. High pressure fuel inlet – 15. Spring

Figure 159



FUEL OUTLET UNIT

1. Fuel outlet to tank – 2. Return from injectors –
3. Delivery to thermal starter – 4. Leading from high
pressure pump – 5. Arrival from filter

Fuel outlets unit

All the outlets, overpressure and backflows of the various hydraulic components converge in this unit.

Part of them is made available to the thermal starter, while the rest returns to the fuel tank.

In the unit there is a 2,3 mm diameter drain hole.

This hole regulates the whole outlet system to maintain a constant counter pressure of 0,5 bar, which is indispensable for correctly supplying the thermal starter and it ensures flow rates which prevent overheating of the fuel.



The calibrated hole is made in a union similar to the other unions. In the event of work on the system, take care not to fit another different union in its place as this would cause serious operating failures.

Air flow meter

This component incorporates a temperature sensor and a pressure sensor.

It is fitted on the engine intake manifold (Figure 162) and measures the maximum flow rate of the intake air which is used to accurately calculate the amount of fuel to be injected at each cycle.

It is connected to the control unit on pins A2 / A3 / A19 / A34.

Pin 1 sensor – Pin A19 ECU	–	earth –
Pin 2 sensor – Pin A2 ECU	–	temperature signal
Pin 3 sensor – Pin A3 ECU	–	5V – supply
Pin 4 sensor – Pin A34 ECU	–	0 ÷ 5V pressure signal –

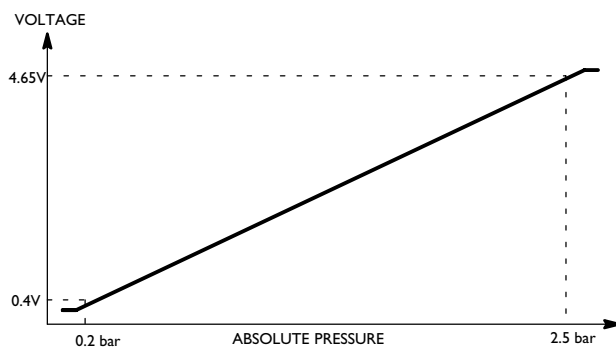
Course of sensor in relation to the temperature:

Temperature	Resistance
– 40 °C	48.50 kOhm
– 20 °C	15.67 kOhm
0 °C	5.86 kOhm
20 °C	2.50 kOhm
40 °C	1.17 kOhm
60 °C	0.59 kOhm
80 °C	0.32 kOhm
100 °C	0.18 kOhm
120 °C	0.11 kOhm

Course of sensor in relation to the pressure:

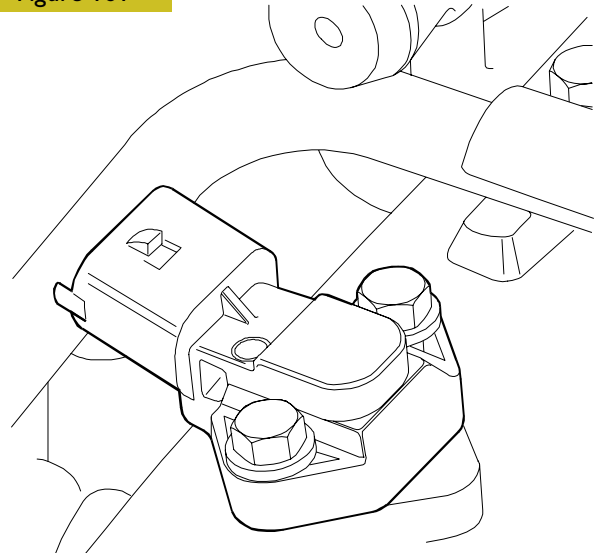
See graph opposite.

Figure 160



AIR FLOW METER OPERATING GRAPH

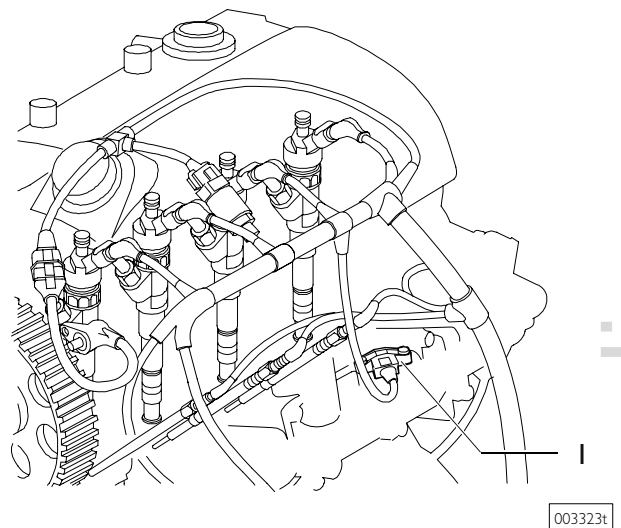
Figure 161



AIR FLOW METER

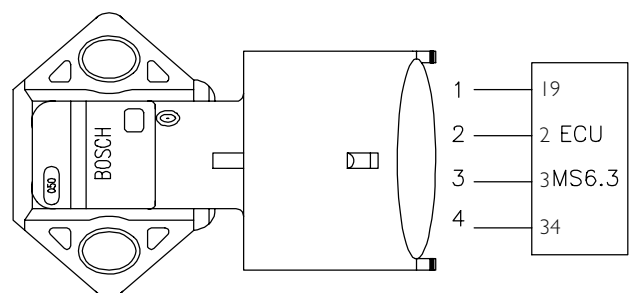
8660

Figure 162



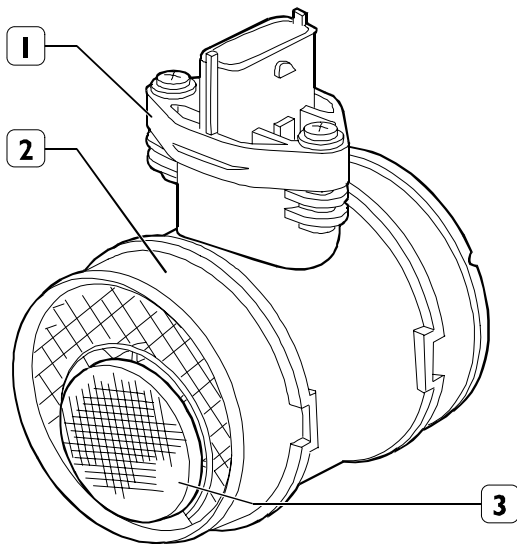
I. Air flow meter location

Figure 163



AIR FLOW METER CONNECTION

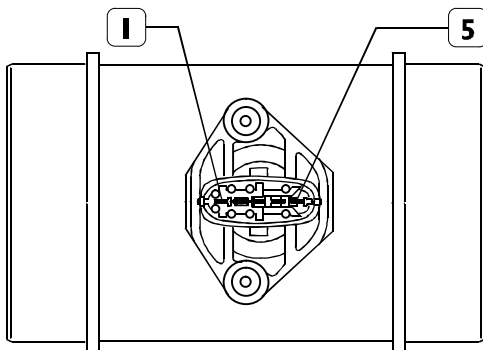
Figure 164



003333t

1. Connector – 2. Gauge body – 3. Air input grid

Figure 165



003334t

TECHNICAL VIEW OF GAUGE CONNECTOR

Air delivery gauge

Used in the EGR version to replace the one mounted on the engine aspiration manifold.

The gauge is of the heated film type and is located on their aspiration conduit between the turbine and the air filter.

The gauge contains the aspired air temperature sensor.

It is connected to the centre on pins **A5 / A17 / A18 / A26 / A28**.

- Pin 1 sensor – Pin A5 ECU – temperature signal
- Pin 2 sensor – Pin A17 ECU – 5V power supply
- Pin 3 sensor – Pin A18 ECU – mass
- Pin 4 sensor – Pin A26 ECU – reference voltage
- Pin 5 sensor – Pin A28 ECU – pressure signal

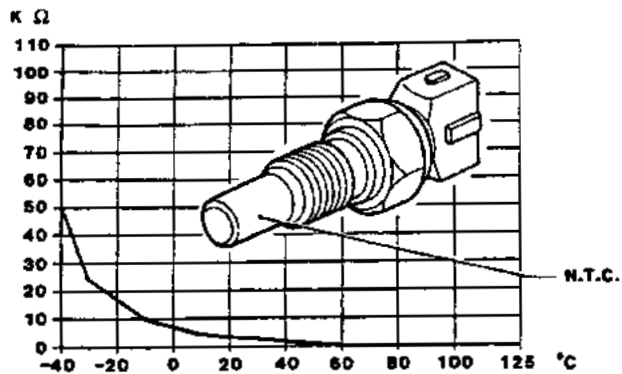
The operating principle is based on a heated membrane inserted in a measurement canal through which air to the engine flows.

The hot film membrane is kept at a constant temperature some 120 °C above incoming air level by the heating resistor.

The air mass traversing the measurement canal tends to subtract heat from the membrane so current must cross the resistor to maintain constant film temperature.

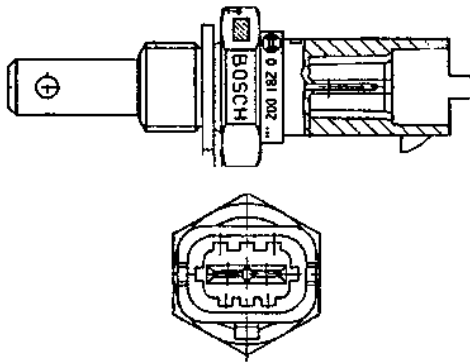
Current absorbed is proportional to the air mass flowing to the engine and is measured with a Wheatstone bridge and the signal is forwarded to the electronic centre.

Figure 166



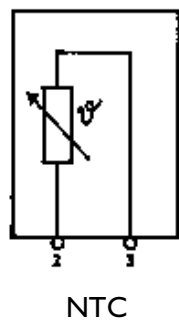
COURSE OF SENSOR RESISTANCE IN RELATION TO TEMPERATURE

Figure 167



TECHNICAL VIEW OF ENGINE COOLANT TEMPERATURE SENSOR

Figure 168



WIRING DIAGRAM

Atmospheric pressure sensor

This is integrated inside the control unit.

It measures the atmospheric pressure to correct the flow rate in relation to the altitude.

Engine coolant temperature sensor

This is an NTC sensor located on the thermostat box.

It detects the temperature of the coolant fluid to give the control unit information about the engine temperature conditions.

It is connected to pins 1 and 30 of connector A of the control unit.

Course of the sensor in relation to the temperature:

Temperature	Resistance
- 40°C	48.30 kOhm
- 20°C	15.46 kOhm
0°C	5.89 kOhm
20°C	2.50 kOhm
40°C	1.17 kOhm
60°C	0.59 kOhm
80°C	0.32 kOhm
100°C	0.19 kOhm
120°C	0.11 kOhm

Fuel temperature sensor

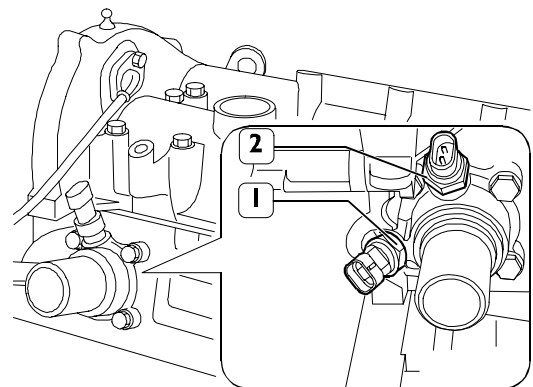
This is an NTC sensor located on the fuel filter.

It detects the temperature of the fuel to give the control unit information about the fuel oil temperature conditions.

It is connected to pins 15 and 30 of connector A of the control unit.

It is exactly the same as the engine coolant temperature sensor.

Figure 169



003324t

LOCATION OF FIA ENGINE COOLANT TEMPERATURE SENSOR

1. EDC – 2. Signal instrument panel signal

The accelerator pedal position sensor is of the potentiometric type with incorporated N.O. minimum switch.

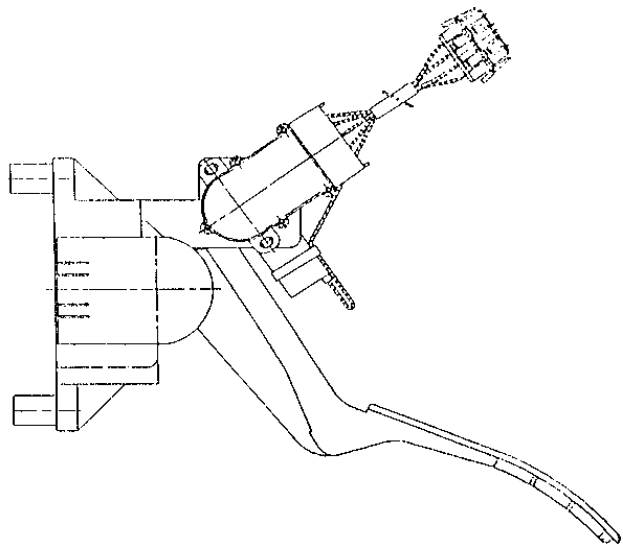
It gives the electronic control unit a value proportionate with the operating angle of the pedal itself determining fuel delivery.

It is supplied at 5 Volt.

The potentiometer resistance is approx. $\sim 1 \text{ k}\Omega$.

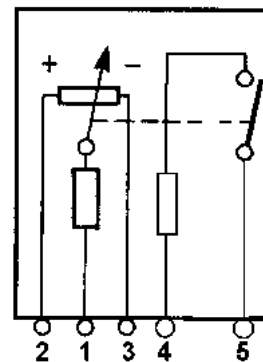
It is connected at pins 2, 13, 27, 29 and 35 of connector B of the control unit.

Figure 170



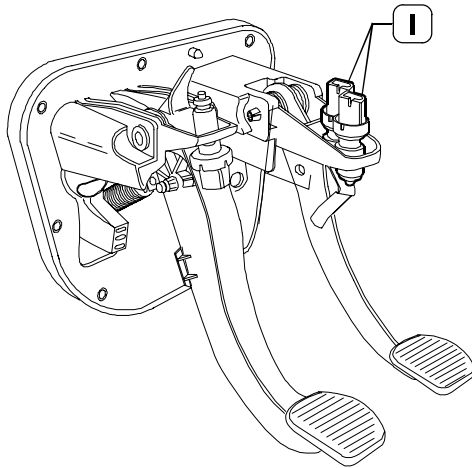
LOCATION OF SENSOR ON ACCELERATOR PEDAL

Figure 171



SENSOR WIRING DIAGRAM

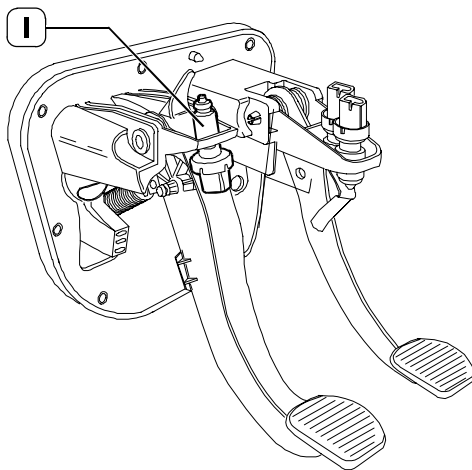
Figure 172



003326t

I. Brake pedal switches

Figure 173



003327t

I. Clutch pedal switch

Brake pedal switches

Two switches are located on the brake pedal; N.C. 53565 is connected directly to electronic centre pin B31 and 53501 is connected to the centre via remote switch 25006 for stop light actuation and to generate a redundant signal on the centre increasing system reliability degree.

Clutch pedal switch

An N.C. switch connected to electronic centre pin B38 is mounted on the clutch pedal.

The "clutch pedal actuated signal" is used by the centre to identify gear condition selected and gear shifts.

In absence of the pedal pressed switch signal, the centre disengages the Cruise Control function.

Electromagnetic junction fan

The fan is provided with an electromagnetic junction monitored by the electronic centre pin A39 that activated the junction remote control switch, to optimise water cooling.

The electrical fan remote control switch is activated or deactivated by the centre according to the temperature of:

- ☐ the coolant
- ☐ over supply air
- ☐ the fuel

Engine coolant temperature

Activated at over 96 °C and deactivated at under 84 °C

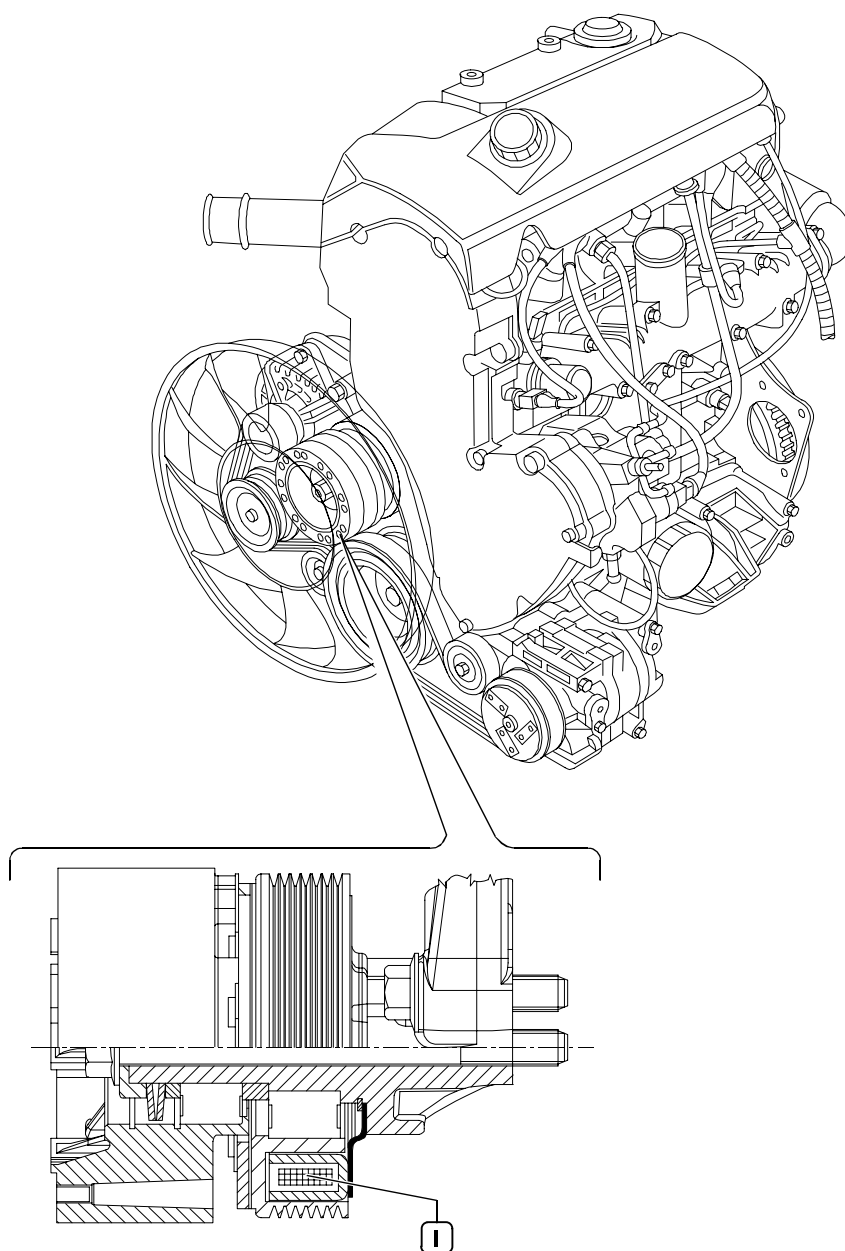
Over supply air temperature

Activated at over 75 °C and deactivated at under 65 °C

Fuel temperature

Activated at over 20 °C and deactivated at under 10 °C

Figure 174



ELECTROMAGNETIC JUNCTION TECHNICAL VIEW0 (FIA)

I. Coil

003328t

Preheat plug electronic centre (FIA/FIC engine)

EDC central unit effects the timing of the functioning of glow plugs pre-heating central unit depending on engine temperature, which, in turn, activates the glow plugs.

The preheat centre contains an "intelligent" remote control switch that sends a feed-back to the control centre for information on any preheat centre defect or plug earth short circuit.

Preheat centre pin-out

- 31 – Mass
- 86 – Start switch (+15)
- ST – EDC electronic centre (pin B42)
- DI – EDC electronic centre (pin B37)
- 30 – Battery positive (+30)
- G1 – Preheat plugs
- G2 – Preheat plugs
- G3 – Preheat plugs
- G4 – Preheat plugs

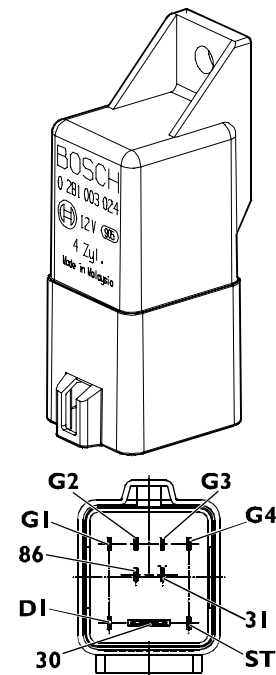
Preheat plugs

CONTROL VALUES

With constant di 11 V power supply:

- | | |
|---|----------------|
| <input type="checkbox"/> maximum current absorbed | 18 A |
| <input type="checkbox"/> in 5" | $11 \pm 1,5$ A |
| <input type="checkbox"/> in 30" | $6 \pm 0,9$ A |
| <input type="checkbox"/> temperature after 7" | 850°C |
| <input type="checkbox"/> torque | 8–10 Nm |

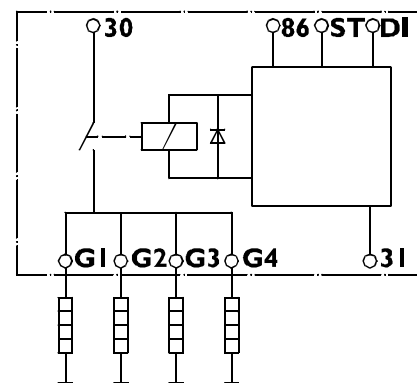
Figure 175



PREHEAT CENTRE

003332t

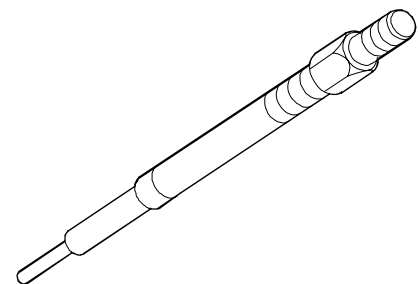
Figure 176



ELECTRICAL DIAGRAM

003331t

Figure 177



PREHEAT PLUS

75579

EDC MS6.3 / EDC I6

Electronic injection control

The system calculates injection on the basis of the processing of the following parameters:

- ☐ Engine rpm
- ☐ Engine coolant fluid temperature
- ☐ Intake air capacity
- ☐ Battery voltage
- ☐ Fuel pressure
- ☐ Accelerator pedal position

Fuel pressure ranges from 400 to 1350 bars (1600 for FI engines), according to engine rpm and load operating conditions.

The lower pressure is compensated by longer injection times and vice versa, always taking account of the loads required.

Up to 2800 rpm pre-injection is also carried out in order to reduce the typical noise of direct injection.

Pre-injection advance angles, the distance between pre-injection and main injection and advance angles of main injection vary according to the instantaneous engine operating conditions.

System diagnosis is performed by means of diagnostic instruments (no Blink Code is used).

Immobilizer recognition

When the control unit receives the signal of the key on "MAR" it communicates with the immobilizer control unit to enable starting.

Checking fuel temperature

With the fuel temperature greater than 75°C, detected by the sensor on the fuel filter, the control unit operates the pressure regulator to decrease the line pressure (injection times are not changed). If the temperature exceeds 90°C, the power is reduced to 60%.

Checking engine coolant temperature

The control unit, depending on the temperature:

- ☐ of the engine coolant, turbocharging air and fuel, operates the electromagnetic fan (Baruffaldi) and switches on the coolant temperature warning light.

Checking quantity of fuel injected

According to the signals from the sensors and the mapped values, the control unit:

- ☐ operates the pressure regulator;
- ☐ varies the "pilot" injection time to 2200 rpm;
- ☐ varies the "main" injection time.
- ☐ Checking idling adjustment

The control unit processes the signals from the various sensors and regulates the amount of fuel injected:

- ☐ it operates the pressure regulator;
- ☐ it varies the injection times of the electro-injectors.

Within certain thresholds the speed takes account of the battery voltage.

Fuel cut-off in release phase

In the phase of releasing the throttle pedal the control unit actuates the following logic elements:

- ☐ it cuts off supply to the electro-injectors;
- ☐ it partially reactivates supply to the electro-injectors before reaching idling speed;
- ☐ it operates the fuel pressure regulator.

Checking cylinder balancing on idling

According to the signals received from the sensors, the control unit controls the regularity of the torque at idling speed:

- ☐ it varies the amount of fuel injected into the single electro-injectors (injection time).

Checking regular engine rotation (anti-sawing)

It ensures regular engine rotation at a constant rate while increasing revs.

The control unit processes the signals received from the sensors and determines the amount of fuel to be injected via:

- ☐ the pressure regulator;
- ☐ the electro-injector opening time.

Checking smokiness at exhaust on acceleration

With heavy acceleration, on the basis of the signals received from the air introduction meter and engine speed sensor, the control unit determines the optimum amount of fuel to inject:

- ☐ it operates the pressure regulator;
- ☐ it varies the electro-injector injection time.

Checking exhaust gas recirculation (E.G.R. if present)

Depending on the engine load and the signal from the accelerator pedal sensor, the control unit limits the amount of air taken in, actuating partial suction of the exhaust gases.

Checking top speed limit

Depending on the number of revs, the control unit actuates two action strategies:

- ☐ at 4250 rpm it cuts off the fuel, decreasing the electro-injector opening time. Over 5000 rpm it deactivates the electro-injectors.

Checking regular rotation on acceleration

Regular progression is assured in all conditions by the control of the pressure regulator and the electro-injector opening time.

Preheat plug centre control (FI Engine)

During:

- ☐ the start step
- ☐ the after start step

the injection centre times the heater starter (or preheat plugs for the FI Engine) according to engine temperature.

Checking activation of air-conditioning system

The control unit operates the air-conditioning compressor:

- ☐ switching it on/off when the relative switch is pressed;
- ☐ momentarily turning it off (approximately 6 sec.) if the engine coolant reaches the set temperature.

Checking fuel pump

Irrespective of the speed, the control unit:

- ☐ supplies the auxiliary fuel pump with the key on MAR;
- ☐ cuts off auxiliary pump supply if the engine is not started up within a few seconds.

Checking diesel warming

It times operation of diesel warming in relation to ambient temperature.

Checking cylinder position

During each turn of the engine, the control unit recognizes which cylinder is in the power stroke and operates the injection sequence for the appropriate cylinder.

Checking pilot and main injection timing

According to the signals from the various sensors, including the absolute pressure sensor built into the control unit, the control unit determines the optimum point of injection according to internal mapping.

Checking injection pressure closed cycle

Depending on the engine load, determined by processing the signals from the various sensors, the control unit operates the regulator to obtain optimum line pressure.

Fuel supply

The fuel supply is calculated in relation to:

- ☐ accelerator pedal position
- ☐ engine speed
- ☐ quantity of air introduced.

The outcome may be corrected in relation to:

- ☐ the water temperature.

Or to avoid:

- ☐ noise
- ☐ smoke
- ☐ overloading
- ☐ overheating
- ☐ turbine over-revving.

The delivery can be modified in the case of:

- ☐ action of external devices (ABS), ABD, EDB
- ☐ serious trouble decreasing the load or stopping the engine.

After determining the mass of air introduced by measuring its volume and temperature, the control unit calculates the corresponding mass of fuel to inject into the relevant cylinder (mg per delivery) also taking into account the temperature of the diesel.

The mass of fuel calculated in this way is first converted into volume (mm³ per delivery) and then into degrees of throw, or duration of injection.

Correcting flow rate according to water temperature

A cold engine meets with greater resistance during operation: friction is high, the oil is still very viscous, and the various clearances are not yet optimized.

In addition, the injected fuel tends to condense on the metal surfaces that are still cold.

The fuel supply for a cold engine is therefore greater than for a warm one.

Correcting flow rate to avoid noise, smoke or overloading

The behaviour that could lead to this kind of trouble is well known.

The designer has therefore included special instructions in the control unit to avoid it.

De-rating

In the event of the engine overheating, injection is modified, decreasing the delivery to a varying degree, in proportion to the temperature reached by the coolant.

Turbine rpm setting (.15 – .17) (for the variable geometry turbo-compressor)

By changing its geometry, adjusted turbine speed is monitored by the electronic centre via an electrical signal feeding the compressed air actuator electro valve. Based on signals from the accelerator pedal position and suction manifold air temperature/pressure engine rpm sensors, the electronic centre processes the field-back signal to properly modulate turbine actuator pilot electro valve opening.

Injection timing electronic test

The advance (start of delivery, expressed in degrees) may be different from one injection to the next, also differentiated from one cylinder to another. It is calculated, similarly to the delivery, in relation to the engine load (accelerator position, engine speed and air introduced).

The advance is appropriately corrected:

- ☐ in phases of acceleration;
- ☐ according to the water temperature.

And also to obtain:

- ☐ lower emissions, noise and overloading;
- ☐ better vehicle acceleration.

An extremely high advance is set on starting, depending on the water temperature.

Feedback from the start of delivery is supplied by the change in impedance of the injector solenoid valve.

Speed governor

The electronic speed governor has both features of governors:

- ☐ idling and top speed
- ☐ all speeds

It is stable in ranges where conventional, mechanical governors are imprecise.

Engine starting

During the first few turns of the engine, the timing and cylinder no. 1 recognition signals (flywheel sensor and camshaft sensor) are synchronized.

The accelerator pedal signal is ignored on starting. Starting delivery is set only according to water temperature, by a special map.

When the control unit detects such speed and acceleration of the flywheel as to be able to consider the engine started up and no longer driven by the starter motor, it re-enables the accelerator pedal.

Cold starting

If even just one of the three temperature sensors (water, air or diesel) records a temperature lower than 10°C, pre-post heating is activated.

On inserting the key contact, the pre-heating indicator goes on and remains on for a period varying depending on temperature (air is heated by the pre-heating glow plugs that are located on cylinder head for FI engines), then it blinks. Thereafter, the engine can be started up.

When the motor is running this indicator light goes out, while the glow plugs continue to be powered for a certain length of time (variable) for post-heating.

If, with the indicator light flashing, the engine is not started up within 20–25 seconds (inattention time), the operation is cancelled so as not to run down the batteries pointlessly. The pre-heating curve is also variable in relation to the battery voltage.

Warm starting

If the reference temperatures all exceed 10°C, when the key makes contact the indicator light comes on for approximately 2 sec., for a short test, and then goes out. It is now possible to start up the engine.

Run up

When the key makes contact, the control unit transfers the information stored in memory when the engine was last stopped into the main memory (see After Run) and makes a diagnosis of the system.

After run

Whenever the engine is switched off with the key, the control unit stays powered for a few seconds by the main relay.

This makes it possible for the microprocessor to transfer some data from the main memory (volatile) to a non-volatile memory, which can be erased and written over (EEPROM), so as to make it available at the next start up (see Run Up).

These data basically consist of:

- ☐ various settings (engine idling adjustment, etc.);
- ☐ settings of some components;
- ☐ fault memory.

The process lasts a few seconds, typically from 2 to 7 (depending on the amount of data to save), after which the ECU sends a command to the main relay and makes it disconnect from the battery.



It is extremely important for this procedure not to be broken off, for example by switching off the engine with the battery cut-out, or by disconnecting the battery cut-out before 10 seconds have passed since switching off the engine.

If this happens, the functioning of the system is ensured, but repeated interruptions may damage the control unit.

Cut – off

This function cuts off fuel delivery when the vehicle is decelerating (accelerator pedal released).

Cylinder balancing

Individual cylinder balancing contributes to increasing comfort and handling.

This function permits individual, customized control over the delivery of fuel and the start of delivery for each cylinder, even differently from one cylinder to another, to compensate for the hydraulic tolerances of the injector.

The differences in flow (delivery specifications) between the various injectors cannot be evaluated directly by the control unit. This information is supplied by Modus reading the bar code of each injector at the time of assembly.

Synchronisation search

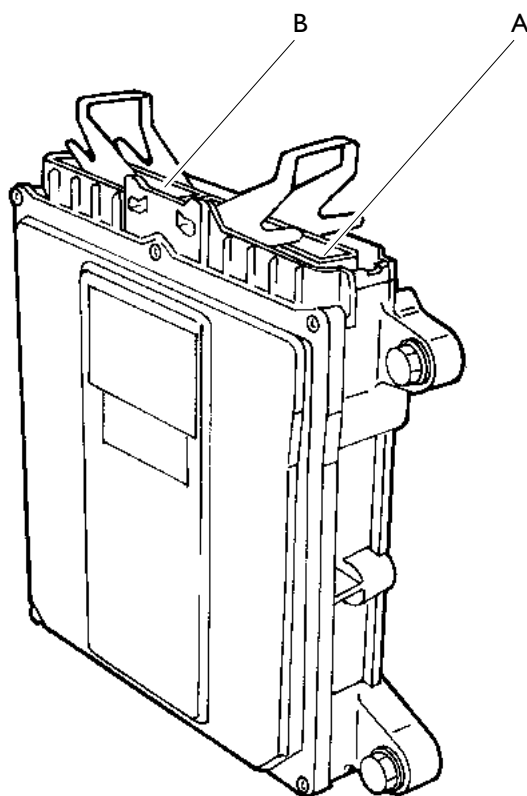
If there is no signal from the camshaft sensor, the control unit is anyhow able to recognize the cylinders into which the fuel is to be injected.

If this occurs when the engine is already running, the combustion sequence has already been acquired, so the control unit continues with the sequence on which it has already been synchronized.

If this occurs when the machine is at a standstill, the control unit energizes a single solenoid valve. Within at most 2 turns of the crankshaft, injection will take place in that cylinder, so the control unit just needs to get synchronized on the firing sequence and to start up the engine.

Bosch MS6.3 control unit**Figure 178**

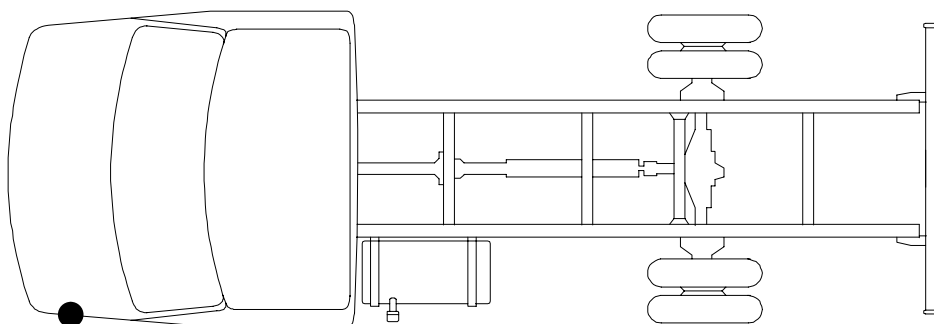
85150



7420

PERSPECTIVE VIEW

A. Housing for injection cable connector – B. Seat for cabin-bonnet cable (UNIJET motor drive)

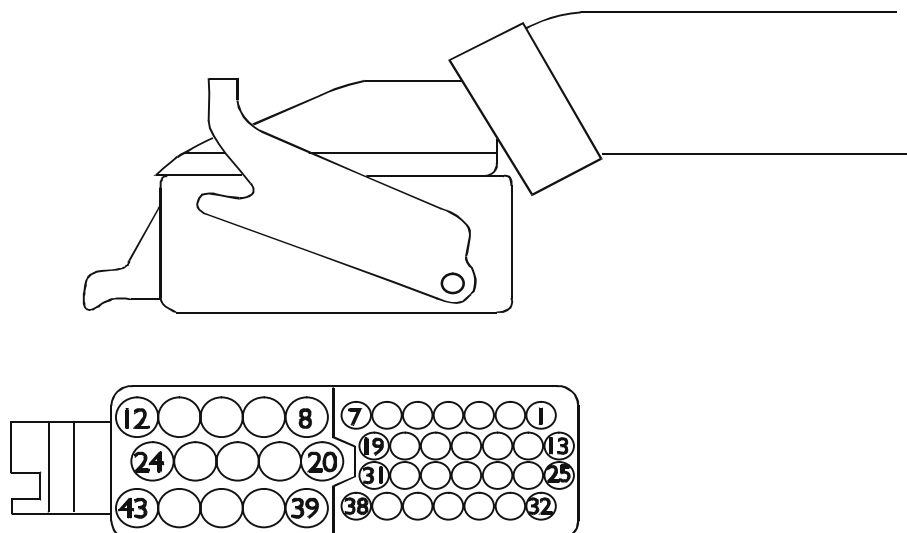
Figure 179

7406

LOCATION ON THE VEHICLE

Control unit connection to the injection cable on engine side (housing A)

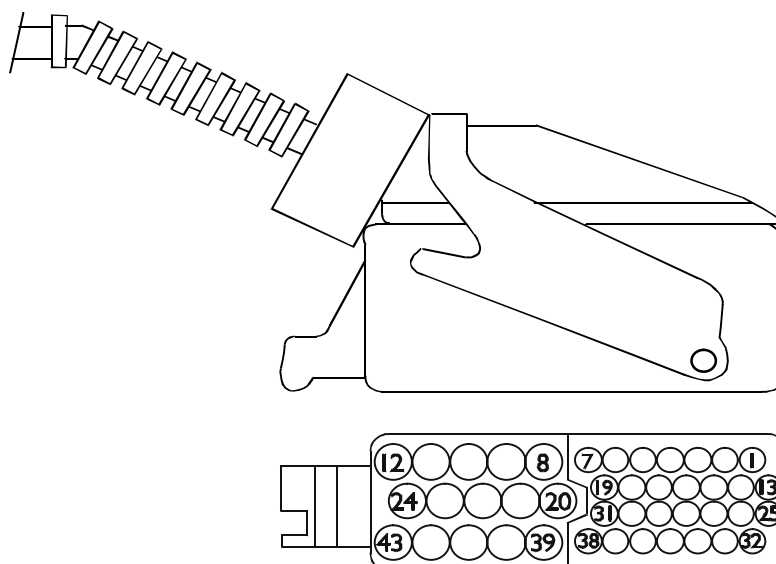
Figure 180



VIEW OF BOSCH 43-WAY CONNECTOR FROM CABLE INPUT SIDE

7421

Pin	Function	Cable colour code
1	To engine coolant temperature sensor	5154
2	To turbo-blower air pressure and temperature sensor for EDC (without EGR)	5151
3	To turbo-blower air pressure and temperature sensor for EDC (without EGR)	5153
4	To engine rpm sensor on camshaft (cams)	White
5	To temperature sensor and ambient air pressure for EDC (with EGR)	5151
6	Fuel pressure adjustment sensor earth	0000
7	Control to relay for switching on fuel pump	8150
8	Common EDC centre mass – Centre monitored remote control switches – EGR electro valve	0000
9	To solenoid valve for pressure adjustment	9925
10	To solenoid valve for electronic injection (injector 2 – cylinder 3)	—
11	Spare	—
12	To solenoid valve for electronic injection (injector 1 – cylinder 1)	—
13	To solenoid valve for pressure adjustment	5590
14	Spare	—
15	Sensor (fuel temperature) for switching on fuel warming	5592
16	Spare	—
17	To ambient air temperature and pressure sensor for EDC (with EGR)	8150
18	To ambient air temperature and pressure sensor for EDC (with EGR)	8151
19	Air temperature and pressure sensor earth (without EGR)	0165
20	Earth shared by control unit and radialjet and pressure solenoid valves (no radialjet for FIA)	0000
21	To solenoid valve for radialjet pump control (not for FIA)	9917
22	Spare	—
23	To solenoid valve for electronic injection (injector 3 – cylinder 4)	—
24	To solenoid valve for electronic injection (injector 4 – cylinder 2)	—
25	To solenoid valve controlling anti-pollution system (EGR) (.13 – FIA)	5577
26	To ambient air temperature and pressure sensor for EDC (with EGR)	8152
27	To speed limiter adjustment sensor	8847
28	To ambient air temperature and pressure sensor for EDC (with EGR)	8153
29	To sensor for engine rpm	White
30	Earth shared by control unit and temperature sensors	0150
31	To engine rpm sensor on camshaft (cams)	Black
32	Control to relay for heated fuel oil filter	8159
33	To sensor for fuel pressure adjustment	5591
34	To turbo-blower air pressure and temperature sensor for EDC (without EGR)	5152
35	Control to relay for engaging conditioner compressor	9990
36	To solenoid valve actuator for VGT (.15) or to WASTE GATE solenoid valve (.13)	5000
37	To engine rpm sensor (.13 – .15 – FIA)	Black
38	Spare	—
39	Control to relay for engine cooling joint	7740
40	To solenoid valve for electronic injection (injector 1 – cylinder 1)	—
41	To solenoid valve for electronic injection (injector 4 – cylinder 2)	—
42	To solenoid valve for electronic injection (injector 3 – cylinder 4)	—
43	To solenoid valve for electronic injection (injector 2 – cylinder 3)	—

Control unit connection to cab-bonnet cable (housing B)**Figure 181**

VIEW OF BOSCH 43-WAY CONNECTOR FROM CABLE INPUT SIDE

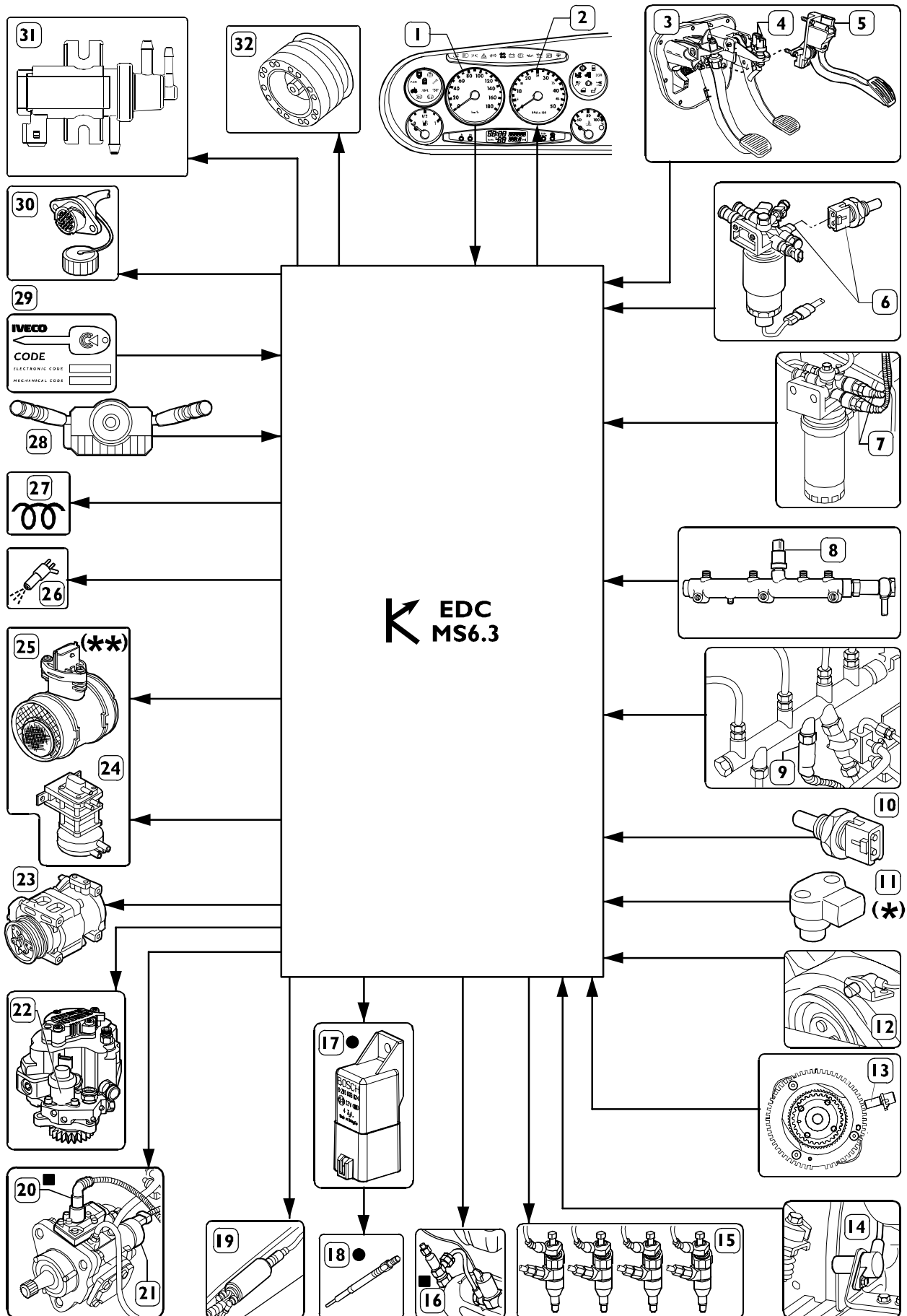
7422

Pin	Function	Cable colour code
1	To cruise Control	8156
2	To load sensor on accelerator for EDC	5157
3	Spare	—
4	To instrument panel module A1 rpm indicator repeater	5155
5	Spare	—
6	Compressor engaged signal to EDC	8162
7	To diagnostic socket	2299
8	To alarm control unit	Green
9	EDC control unit supply	8150
10	EDC control unit supply	8150
11	Control to relay for connection with fuel tank for thermal starter (not for FIA)	0000
12	To earth signal (battery negative)	0000
13	To load sensor on accelerator for EDC	5156
14	Instrument panel module A20 rpm indicator repeater mass	0000
15	Spare	—
16	To instrument panel module A17 rpm signal	5614
17	Spare	—
18	Spare	—
19	To diagnostic socket	1199
20	To key-operated fuse 2	8051
21	To instrument panel module A1 A30 engine preheat warning leds	0000
22	EDC control unit supply	8150
23	To instrument panel module A1 EDC A29 defect warning leds	5156
24	To earth signal (battery negative)	0000
25	To Cruise Control	8155
26	Supply with stop lights on	8153
27	To load sensor on accelerator for EDC	0150
28	To diagnostic socket	9932
29	To load sensor on accelerator for EDC	0159
30	Spare	—
31	Supply when brake pedal is pressed	8158
32	To cruise Control	8154
33	To cruise Control	8157
34	Spare	—
35	To load sensor on accelerator for EDC	5158
36	Spare	—
37	FIA preheat centre control	1310
38	To clutch pressed signal relay for EDC	0160
39	To alarm control unit	White
40	Control to relay for EDC engagement	8150
41	EDC control unit supply	8150
42	Heater starter insertion remote control switch control/FIA preheat centre control	0000 / 1311
43	To earth signal (battery negative)	0000

EDC system components

Ref.	Component code	Description
1	58918	Instrument panel tachometer
2	58918	Instrument panel rev counter
3	42374	Clutch pedal switch
4	53565	Brake pedal switch
5	85152	Idling switch and accelerator pedal position sensor
6	47106	Fuel temperature sensor (FIA engine)
7	47106	Fuel temperature sensor Fuel filter clogging sensor (8140 engine)
8	85157	Fuel pressure sensor (FIA engine)
9	85157	Fuel pressure sensor (8140 engine)
10	47035	Coolant temperature sensor
11	85156	Air delivery sensor
12	48042	Distribution sensor
13	48035	Crankshaft sensor (FIA engine)
14	48035	Flywheel sensor (8140 engine)
15	78247	Electro injectors
16	19005	Hot starter
	78000	Hot starter electro valve (8140 engine)
17	25231	Plug preheat centre (FIA engine)
18	19010	Preheat plug (FIA engine)
19	85151	Fuel electro pump
20	78015	3rd pump cutout electro valve (8140 engine)
21	78013	Pressure regulator (8140 engine)
22	78013	Pressure regulator (8140 engine)
23	12012	AC compressor
24	78209	EGR modulating electro valve
25	85159	Air delivery sensor
26	58701	EDC warning light
27	58702	Preheat warning light
28	54032	Cruise Control/PTO controls
29	85130	Start key with Immobilizer
30	72027	Diagnosis connection
31	78248	VGT control electro valve (for 8140.43N engine)
32	85022	Fan electromagnetic connection
(*)	On version without EGR	
(**)	On version with EGR	
■	Only on 8140 engines	
●	Only on FIA engines	

Figure 182



77024

Blink Code (up to chassis no. 5383302/ DI87233)

With the ignition switch off, press the diagnostic button.

Two series of blinks of the EDC warning light, at intervals with a brief pause, will indicate the code of the first error memorised.

Press the button again to move to the next error.

Each time the last error is reached, the first one will be repeated.

The list of the errors contains all the errors memorised and not only the active ones.

The order in which the errors are shown is the one in which they occurred.

To remove the error list from the memory, proceed as follows:

- ☐ With the ignition key off, press the diagnostic button
- ☐ keeping the button pressed, switch the ignition on
- ☐ keep the button pressed for 5 seconds
- ☐ release the button
- ☐ Switch the ignition off.

The error codes are given in the following table.

Common Rail 8140.43B – 8140.43S – 8140.43N – EDC MS6.3

(Software version 5.5)

Blink-Code	Warning light EDC	Warning light	Reduction level (*)
VEHICLE			
1.1	on	Vehicle speed	
1.3	off	Cruise Control	
1.4	flashing	Accelerator pedal	X
1.5	off	Clutch switch	
1.6	on	Brake switch	
1.7	off	Brake/accelerator plausibility	Idling setting
1.8	off	Diagnostic warning light / Main EDC warning	
1.9	off	Conditioner control relay	
ENGINE 1			
2.1	flashing	H ₂ O temperature sensor	X
2.2	off	Air temperature sensor	
2.3	on	Fuel oil temperature sensor	
2.4	flashing	Boosting pressure sensor	X
2.5	off	Atmospheric pressure sensor	
2.7	flashing	Fuel pump	
2.8	off	Fuel filter heater control relay	
2.9	on	Fan control relay	
ENGINE 2			
3.1	flashing	Cylinder 1 balancing	
3.2	flashing	Cylinder 2 balancing	
3.3	flashing	Cylinder 3 balancing	
3.4	flashing	Cylinder 4 balancing	
3.5	off	Battery voltage	
3.6	off	Thermal starter warning light	
3.7	off	Thermal starter	
3.8	off	Thermal starter solenod valve	
3.9	off	Preheat monitoring	
TURBINE			
4.4	flashing	VGT monitoring	
4.5	on	VGT electro valve	

Blink-Code	Warning light EDC	Warning light	Reduction level (*)
INJECTORS			
5.1	flashing	Cylinder injector 1	
5.2	flashing	Cylinder injector 2	
5.3	flashing	Cylinder injector 3	
5.4	flashing	Cylinder injector 4	
5.7	on	Bearing 1 (cylinders 1-4)	
5.8	on	Bearing 2 (cylinders 2-3)	
ENGINE RPM			
6.1	flashing	Engine rpm sensor	X
6.2	flashing	Camshaft revolution sensor	X
6.4	flashing	Over-revving	
INTERFACE			
7.1	off	PWM signal	
7.2	off	CAN bus inactive	
7.3	off	CAN bus control	
7.4	off	CAN message control	
FUEL PRESSURE/EGR			
8.1	flashing	Fuel pressure control	X or Engine cutout
8.2	flashing	Fuel pressure sensor	X
8.3	flashing	Pressure regulator	
8.4	off	3 rd impeller cut-off solenoid valve	
8.5	on	EGR control	
8.6	on	EGR valve	
8.7	on	Debit meter	X
8.8	off	EGR atmospheric pressure sensor	
CENTER			
9.1	flashing	Control unit error	X or Engine cutout
9.2	on	Control unit EEPROM fault	
9.3	flashing	Immobiliser – EDC communication	
9.4	on	Main relay	
9.5	off	After run Test	
9.6	flashing	Engine stop test (ECU) Engine stop test (ECU)	
9.7	flashing	Sensor supply	X or Engine cutout
9.8	flashing	Control unit error	Start impossible
9.9	flashing	ECU operating system	Engine cutout

FIA Common Rail

Differs for the following codes:

3.6	off	Preheat warning light	
3.7	off	Preheat plug centre	
3.8	off	Preheat plug centre	
3.9	off	Preheat monitoring	
8.4	off	(Not used)	

EDC16

The EDC16 control unit offers a few innovations compared to the control unit used with system EDC MS6.3.

- ☐ latest-generation hardware and software;
- ☐ possibility of processing a greater number of signals (both input and output);
- ☐ preset for the control of new additional functions and devices, which will be adopted later for technological improvement of the product range or compliance with forthcoming anti-pollution rules.

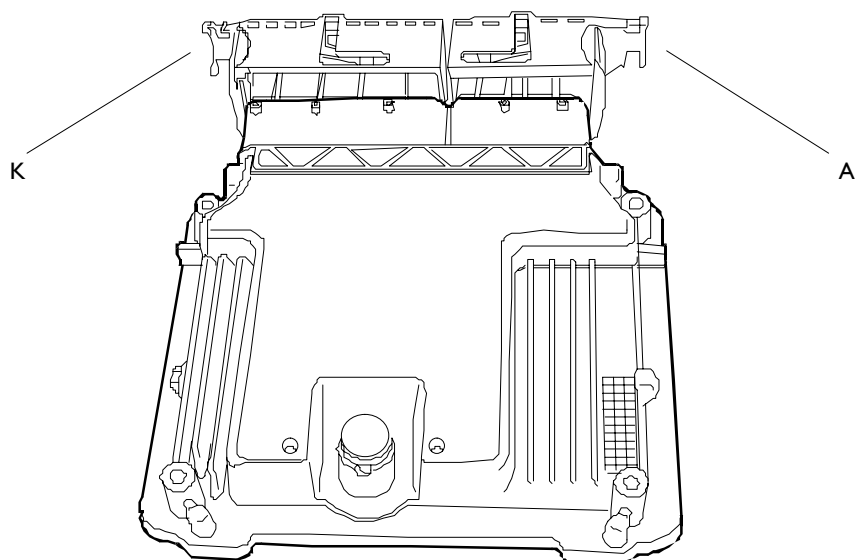
The variants compared with the MS6.3 system are as follows:

- ☐ new sensor on the accelerator pedal;
- ☐ new sensor on the distributing shaft (phase);
- ☐ engine cable;
- ☐ bonnet/cab cable;
- ☐ new connectors for control unit connection.

The EDC16 system replaces the MS6.3 system on engines F1A (.10 – .12). It is present on F1C engines.

Diagnosis is only performed by using the diagnostic instruments available. No Blink Code is provided.

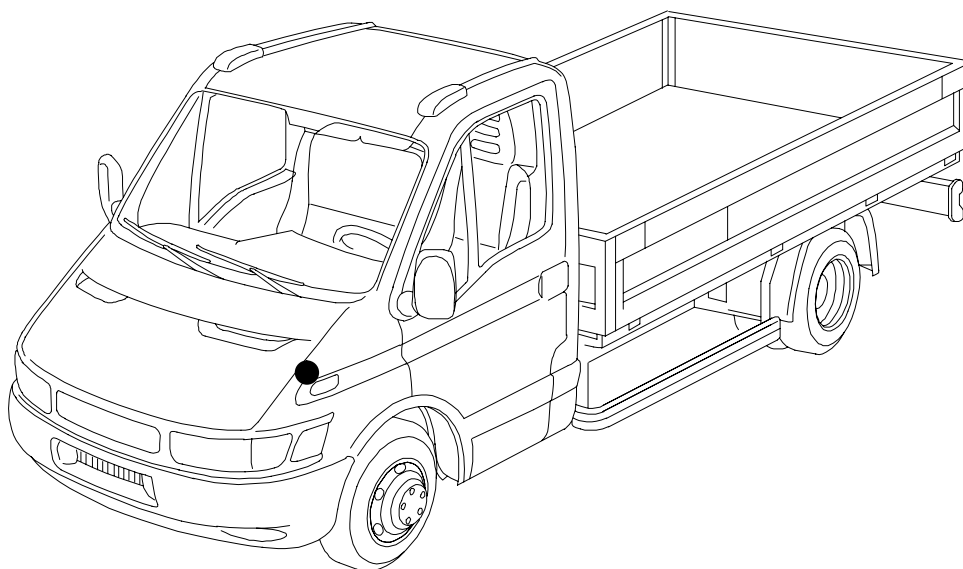
The other features are the same as the 6.3 system.

Bosch EDC16 control unit**Figure 183**

85711

PERSPECTIVE VIEW

A. Engine side injection cable connector – K. Bonnet/cab cable connector

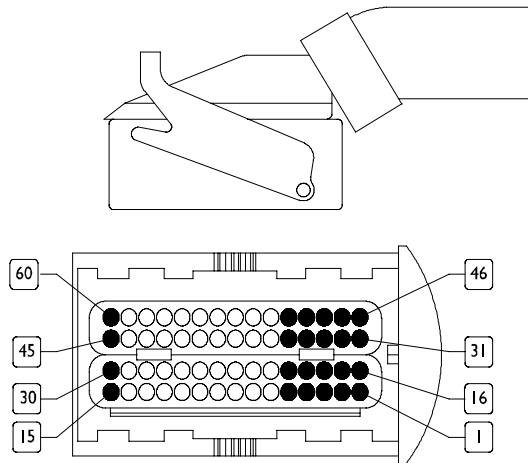
Figure 184

7373

LOCATION ON THE VEHICLE

Control unit connection to the injection cable on engine side (housing A)

Figure 185



85708

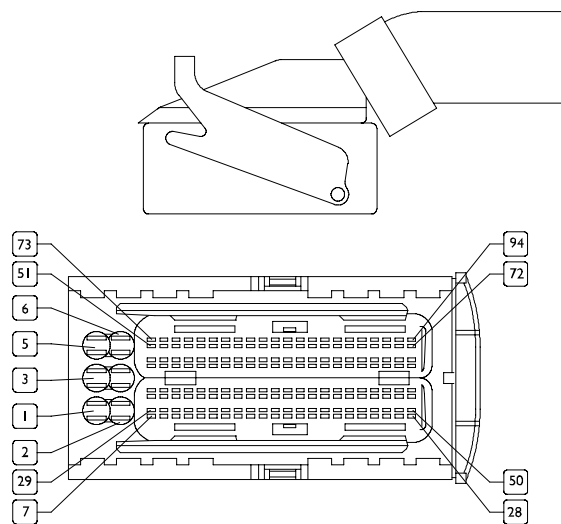
85710

Pin	Cable colour code	Function
1	0000	Cylinder injector 3
2	0000	Cylinder injector 2
8	0000	Rail pressure sensor negative
11	0174	Distributing shaft sensor negative (phase)
12	red	Drive shaft sensor
13	5153*	Boosting air pressure and temperature sensor power supply
16	9924	Cylinder injector 1
17	9924	Cylinder injector 4
19	0000	Pressure regulator negative
20	7158	Distributing shaft sensor positive
21	—	Drive shaft sensor braided wire
23	0165*	Boosting air pressure and temperature sensor negative
27	white	Drive shaft sensor
28	5591	Rail sensor power supply
29	8152	Air flow meter power supply (available with EGR)
31	9924	Cylinder injector 2
33	0000	Cylinder injector 4
37	5151	Air flow meter air temperature signal (available with EGR)
40	5152*	Boosting air pressure sensor signal
41	0150	Water temperature sensor negative
42	8153	Air flow meter signal
43	5591	Rail pressure signal
44	8151	Air flow meter negative (available with EGR)
46	9924	Cylinder injector 3
47	0000	Cylinder injector 1
49	9925	Pressure regulator
50	9160	Distributing shaft sensor signal (phase)
51	0150	Fuel temperature sensor negative

Pin	Cable colour code	Function
52	5592	Fuel temperature sensor signal
53	5151*	Boosting air temperature sensor signal
58	5154	Water temperature sensor signal
60	8150	EGR solenoid valve
●	Power seats	
○	Signal seats	
(*)	Available when the EGR is not provided	
–	Pins not highlighted are not used	

Control unit connection to cab–bonnet cable (housing K)

Figure 186



85708

85709

Pin	Cable colour code	Function
1	–	+30 (main relay)
2	0000	Earth
4	0000	Earth
5	8150	+30 (main relay)
6	0000	Earth
8	0150	Accelerator pedal sensor negative (pin 5)
9	5157	Accelerator pedal sensor signal (pin 4)
13	–	Signal from power takeoff (if any) state selector
16	–	Negative from power takeoff (if any) state selector
17	–	Signal from brake pedal pressed for stop light ignition
25	2299	K line
28	8051	+15
30	0159	Accelerator pedal sensor negative (pin 3)
31	5157	Accelerator pedal sensor signal (pin 6)
38	8155	Cruise Control (resume)
42	–	Speed limiter button
45	5158	Accelerator pedal sensor power supply (pin 2)
46	5158	Accelerator pedal sensor power supply (pin 1)
48	5614	Engine speed sensor (revs counter)
52	1310	To preheating spark plug actuation remote–control switch pin D1
54	8162	Signal from air–conditioning ON compressor remote–control switch
56	8157	Cruise Control (set +)
57	–	Auxiliary speed limiter (where available)
58	–	Signal from clutch switch
61	–	CAN L line
62	–	CAN H line
68	8150	Fuel filter heating remote–control switch positive

Pin	Cable colour code	Function
70	9990	Positive to the remote-control switch for engine water recirculation shut-off solenoid valve control with auxiliary heater ON
71	5156	EDC warning light negative
72	8150	Main relay (negative)
75	5155	Vehicle speed signal (tachometer)
77	8154	Cruise Control (off)
78	8156	Cruise Control (set -)
80	8158	Brake pedal signal
90	7740	Positive for engine cooling electromagnetic joint control
91	-	Fuel electric pump remote-control switch negative
92	0000	Pre-heating warning light negative
93	1311	To pre-heating spark plug actuation remote-control switch pin ST
-	Pins not highlighted are not used	

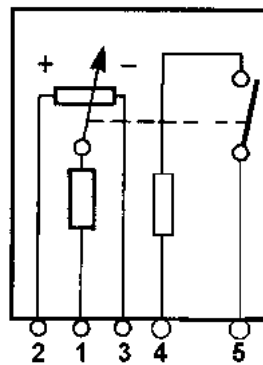
Accelerator pedal sensor

A new sensor which incorporates two potentiometers (no idling switch is provided) is available on the accelerator pedal. The ratio between the signals from the two potentiometers is 2:1 (one potentiometer exhibits a twofold resistance value compared with the other). Both of these signals (V) are detected by the control unit that processes them according to stored threshold values and manages the

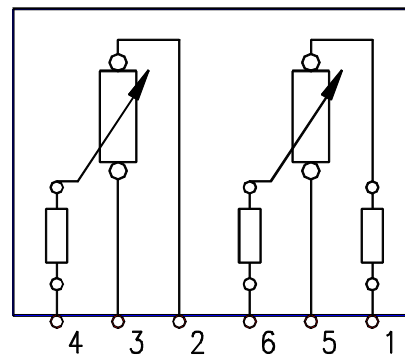
injection system as an accelerator pedal position set by the driver. (At the output of these potentiometers, a variable voltage is available which corresponds to the potentiometer resistance value.)

It is connected to the EDC control unit connector K pins 9–30–45–31–8–46. The potentiometers are powered with 5 V voltage supplied by the control unit itself.

Figure 187

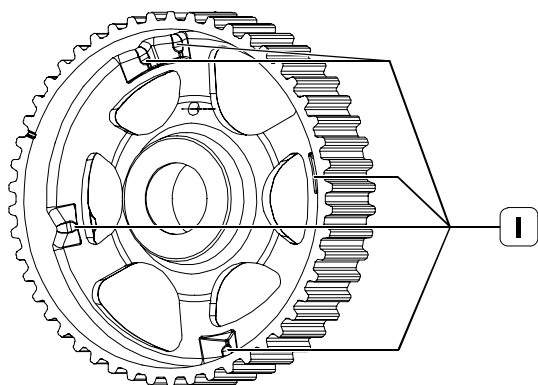


EDC MS6.3



EDC 16

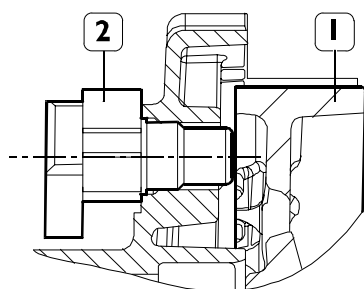
Figure 188



I. Phase identification holes

0003320t

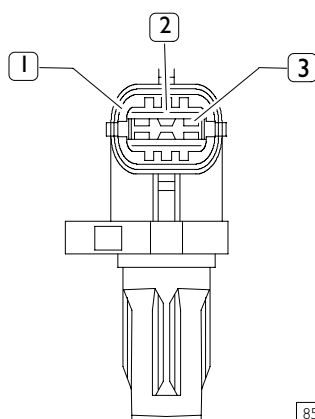
Figure 189



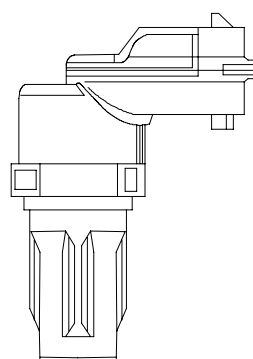
I. Distributing shaft pulley – 2. Sensor

0003321t

Figure 190



85712



85713

PERSPECTIVE VIEW

I. Power supply positive – 2. Signal output – 3. Earth

Camshaft sensor (FIA)

A semiconductor layer, immersed in a magnetic field and through which current flows, generates a potential difference (called Hall voltage) at its ends.

If current intensity remains constant, the generated voltage depends only on the magnetic field strength: periodical variation of field strength is enough to obtain a modulated electric signal.

The smooth portion of the phonic wheel (distributing shaft pulley) covers, while moving, the sensor, thus blocking the magnetic field with resulting low output signal.

On the contrary, the sensor generates a high signal next to the openings and when a magnetic field is available.

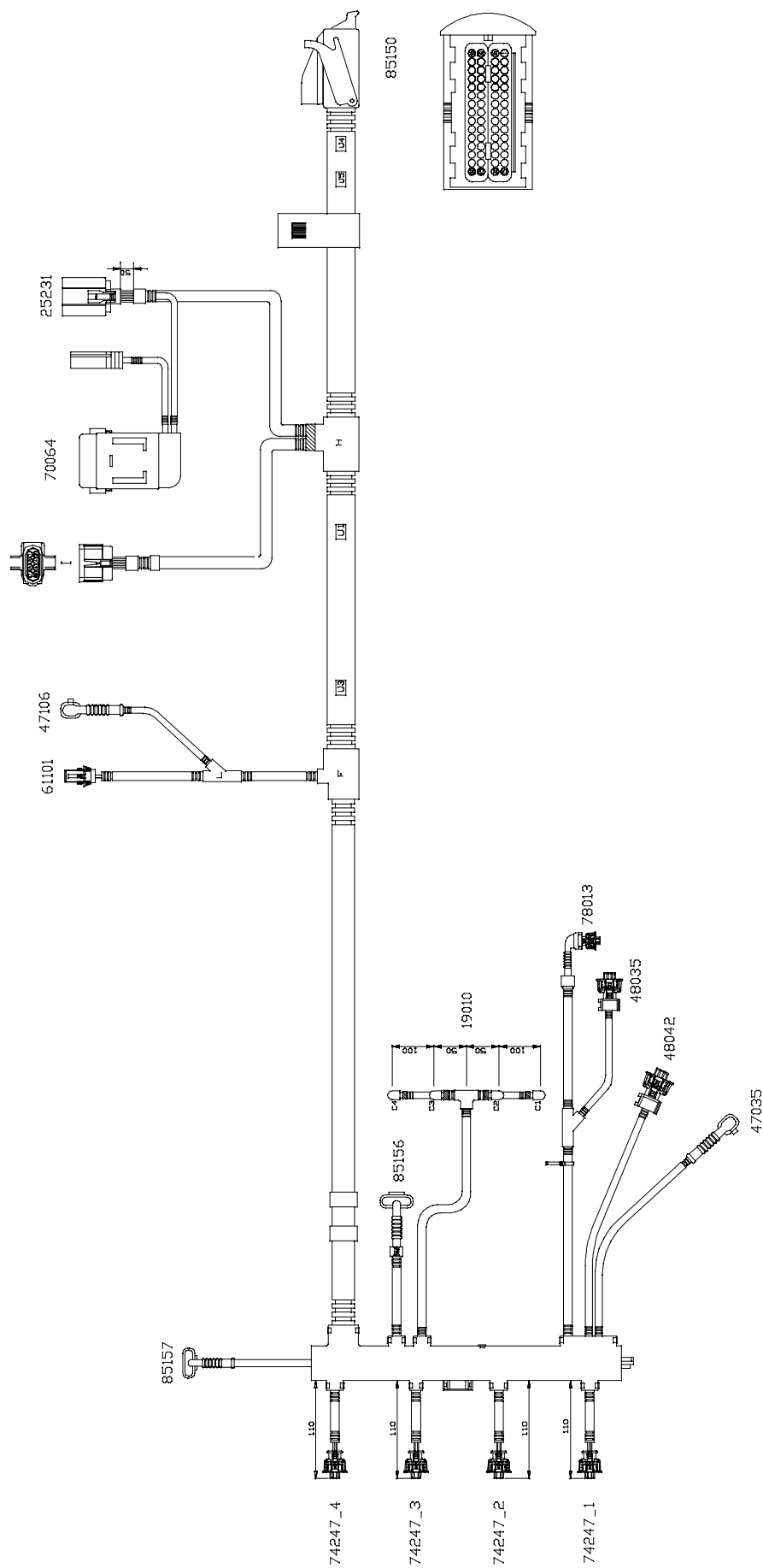
Phase sensor signals are acquired, and the engine position is recognized according to the sequence of the phonic wheel notches.

The mounting function makes it possible to identify signal errors and interferences (if any).

The resulting signal is supplied to the processor that controls the injection system.

Injection cable FIA (.14)

Figure 191/I

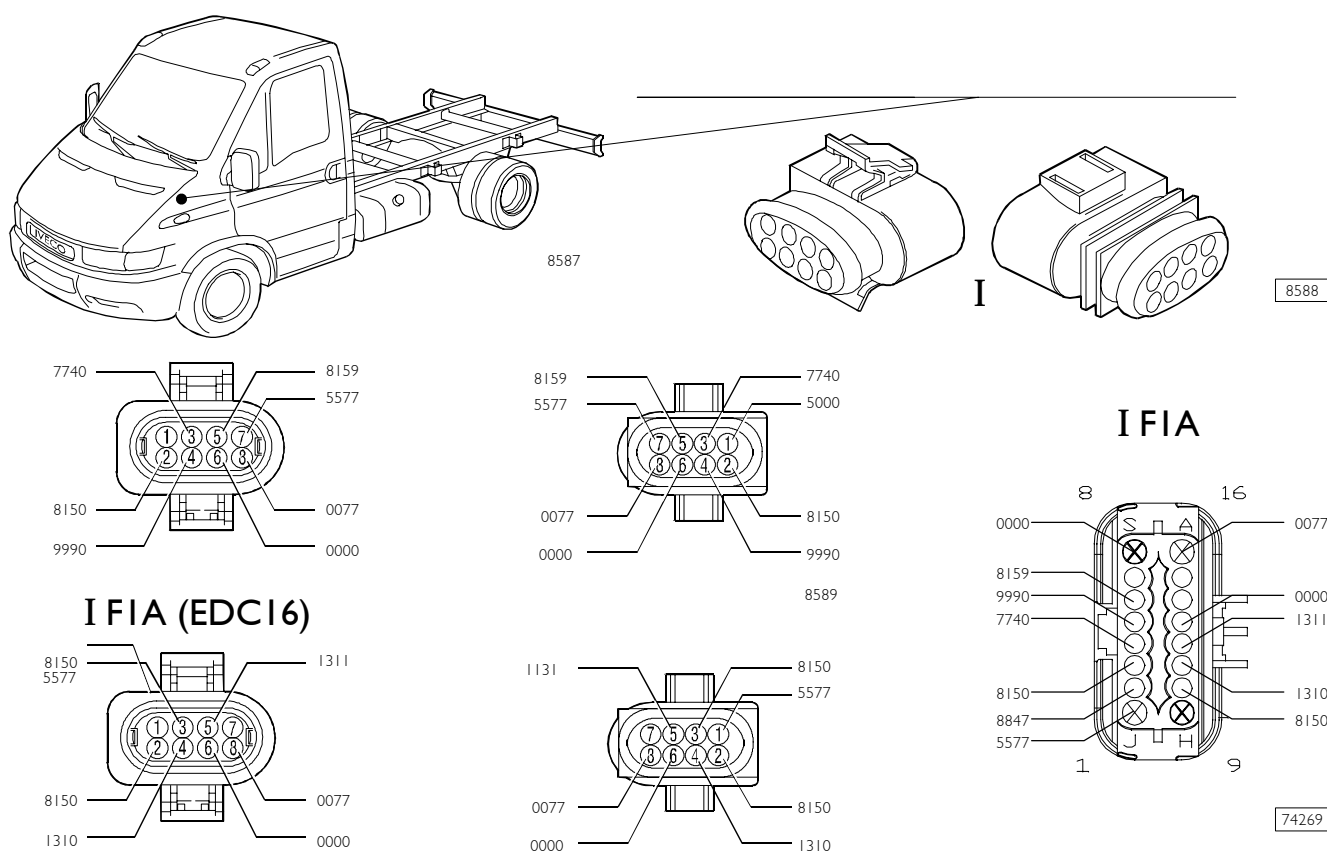


101882

Component code	Description
I	Connection to hood cab cable
19010	Preheat plug
25231	Plug insert centre
47035	Coolant temperature sensor
47106	Fuel heat on switch
48035	Engine rpm sensor
48042	rpm sensor on distributor
61101	Fuel heat resistor
70064	I-way fuse holder
78013	Pressure adjustment electro valve
78247	Electrical injection electro valve
85150	EDC center
85157	Fuel pressure sensor
85156	EDC blower air pressure sensor

Joint connector

Connection between cab/bonnet cable and injection cable (Unijet)

Figure 192

Ref.	Ref. (FIA)	Ref. (FIA EDCI6)	Cable colour code	Function
I	1		5000	To pin 36 of EDC electronic control unit
	2	3	8150	Fuel pump engagement relay
	3	4	7740	Relay engagement for engine cooling electromagnetic joint control
	4	5	9990	Air conditioning compressor switching off
	5	6	8159	Fuel oil heating circuit switching on
	6	8	0000	Earth
	7	1	5577	Fuel oil heating resistance supply
	8	16	0077	Fuel oil heating resistance earth
		10	8150	Preheat plug centre positive (pin-86)
		11	1310	Preheat plug centre control (pin-D1), (EDC pin-B37)
		12	1311	Preheat plug centre control (pin-ST), (EDC pin-B42)
		13	0000	Preheat plug centre mass (pin-31)
	2		8847	Speed adjustment sensor positive
	7		-	Free
	9		-	Free
	14		-	Free
	15		-	Free
		3	8150	Positive after key for air flow meter

Diagnostic connector

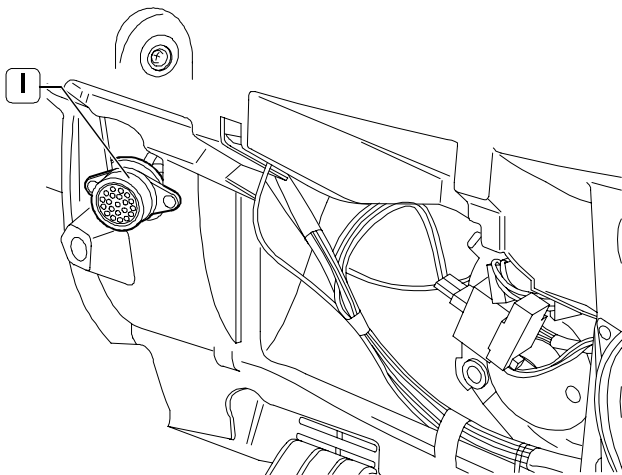
Near the positive terminal of the battery there is a diagnostic connector. It is fastened by 2 screws to a special bracket fitted on the body and access to it is gained by unscrewing the protective cap; suitably connected to the diagnostic system (IWT, MODUS), it allows quick identification of the cause of faults in the various electronic devices.

The table on the following page shows the correspondence between the various electronic systems and the connector pins referring to them.

NOTE The connector shown is seen from the pin side.

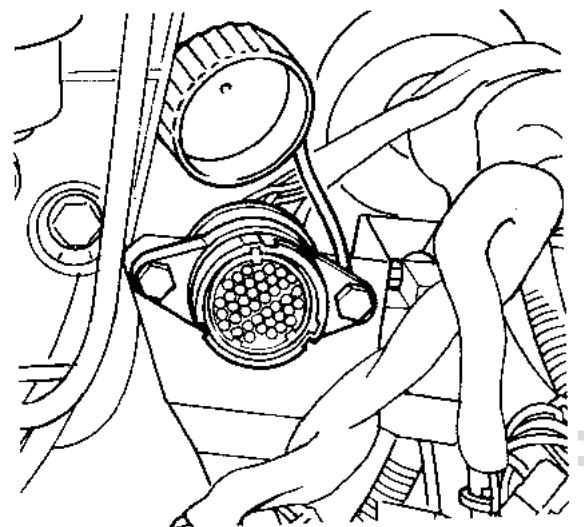
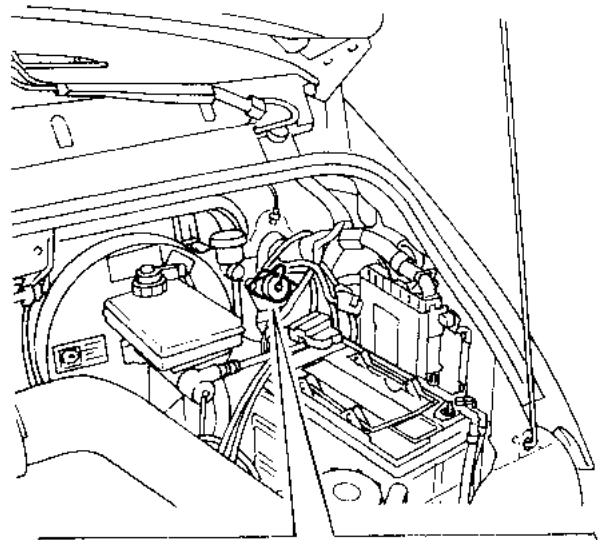
The diagnosis connector on FIA engine vehicles is located on the conveyor unit lower part on the passenger side.

Figure 193



38-POLE DIAGNOSIS TAKEOFF

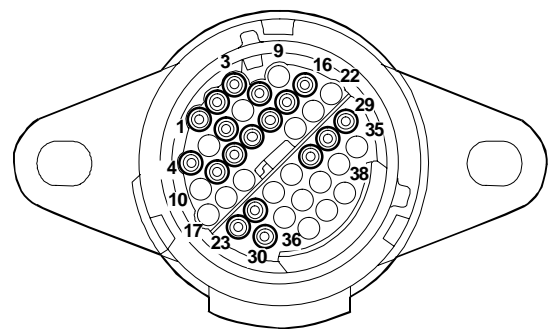
Figure 194



85620

38-PIN DIAGNOSTIC CONNECTOR

Figure 195



8621

IDENTIFICATION OF THE PINS OF THE 38-PIN DIAGNOSTIC CONNECTOR

Diagnostic connector pin description table

System	Pin	Function
EDC/EGR/Methane	1* 2	L K
ABS/EBD/ABD	3 4	L K
Air Bag/Retarder	6	K
Tachometer (connector A cell 2 instrument cluster)	8	K
Supply +15/A services	11	Input
Immobilizer/Central door locking/Alarm	12	K
Climate control system	13 14	L K
Self-levelling suspension	15 16	L K
Engine timing signal (connector B pin 28 EDC control unit) Engine timing earth (battery -)	23* 24	— Screening
Supply +30	27	Battery +V
Engine rpm	28	RPM
Vehicle speed	29	—
Earth	30	—

(*) In vehicles equipped with FI engine and EDC 16 electronic control unit, diagnosis connector pins 1 and 23 are free.
Pin 21/22 CAN line

High-pressure pump (FIA engine)

This pump is similar to the 8140 engine one.

It differs in Rail line pressure, modulated at between 250 and 1600 bars by the electronic centre by acting on the pressure regulator electro valve and is not provided with a 3rd pump cutout electro valve (78015).

Pump (3) is oriented on the pump shaft cam.

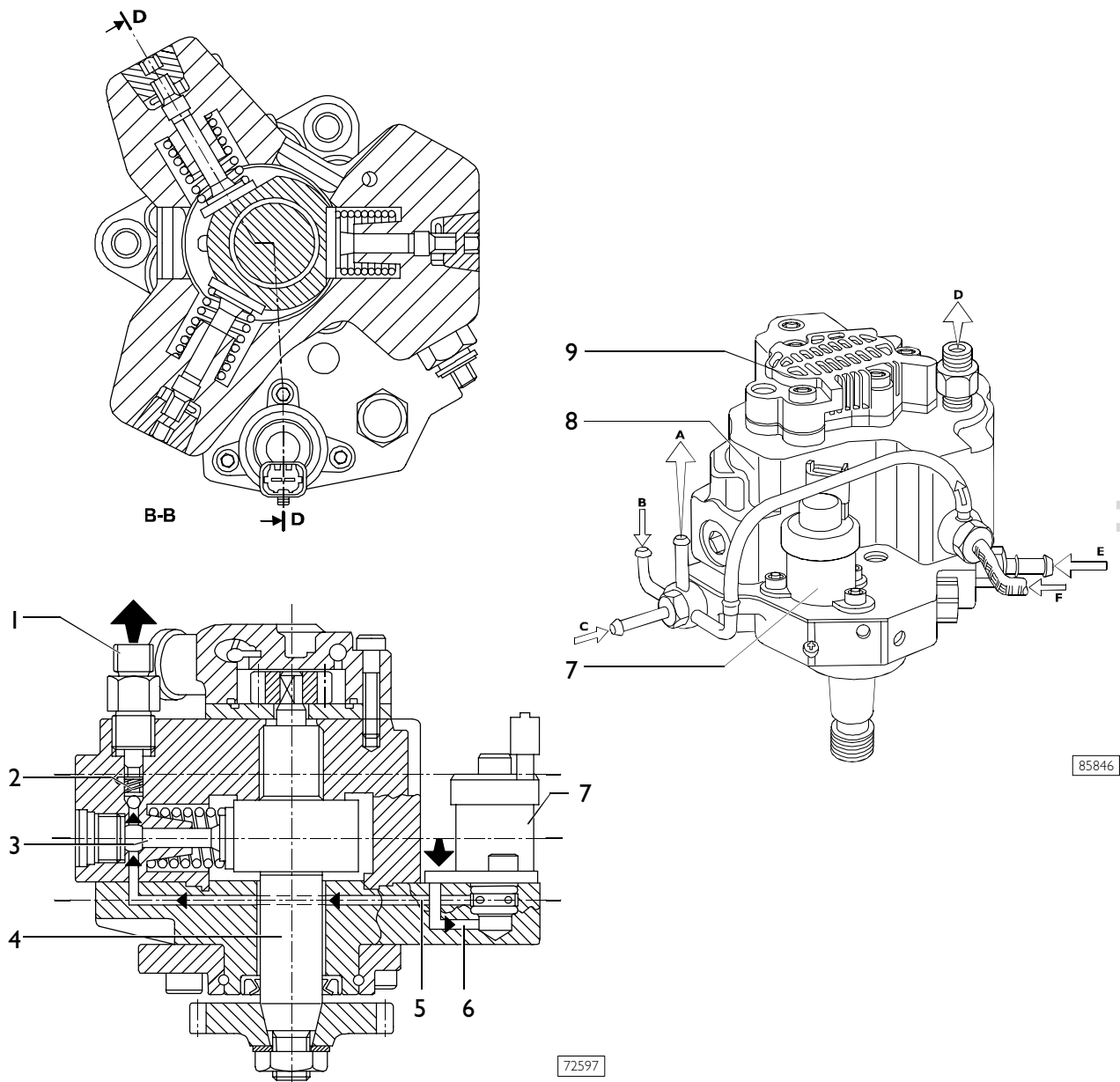
During aspiration the pump is powered via supply conduit (5).

The amount of fuel to be sent to the pump is set by pressure regulator (7).

The pressure regulator stops fuel inflow to the pump based on PWM input from the centre.

During pump compression, fuel reaches a pressure level sufficient to open the pressure valve to common rail (2), and supplies it via output (1).

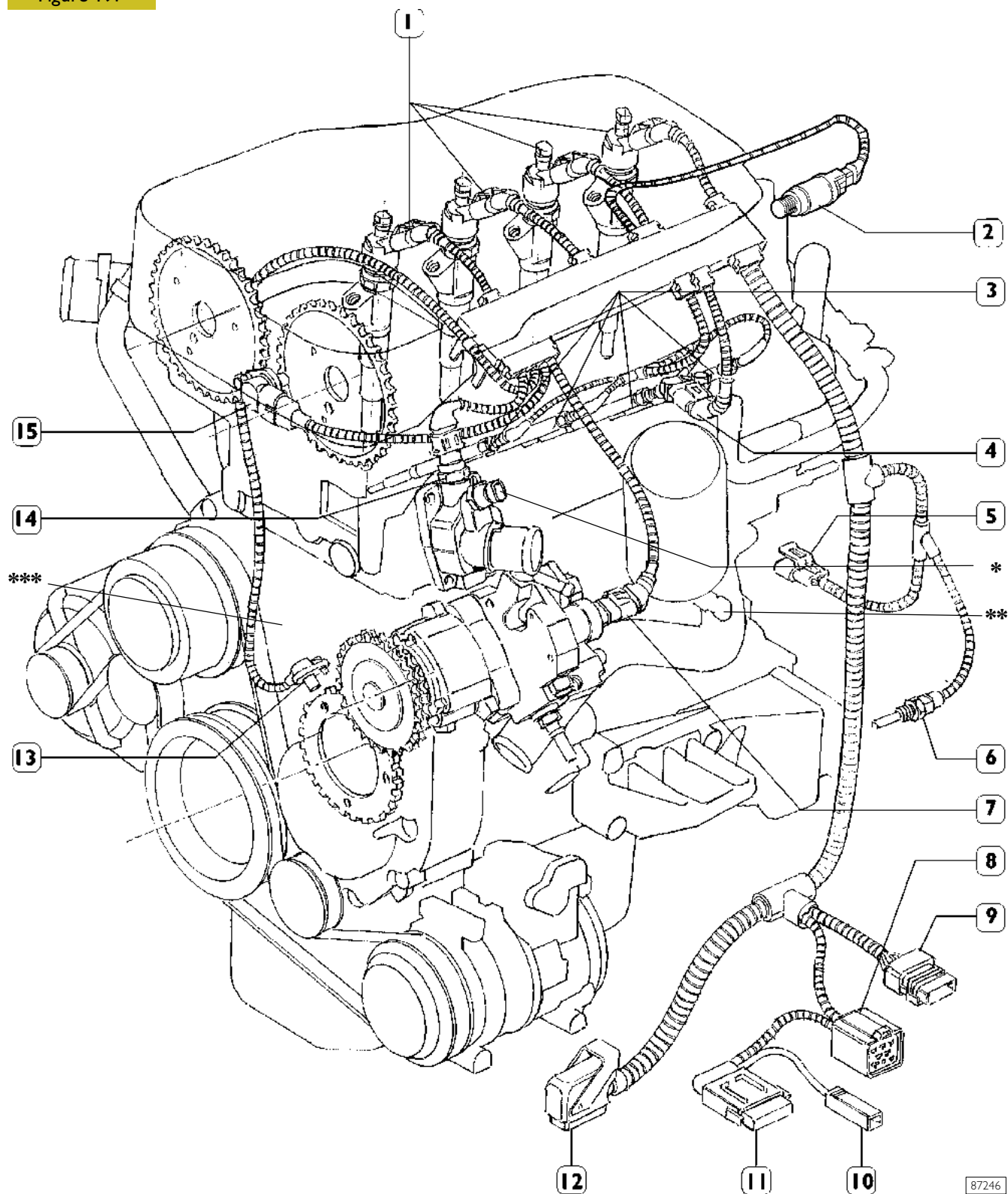
Figure 196



1. Rail delivery output – 2. Rail delivery valve – 3. Plunger – 4. Pump shaft – 5. Plunger supply duct – 6. Pressure regulator supply duct – 7. Pressure regulator – 8. High-pressure pump – 9. Mechanic feed pump – A. To the tank – B. Return from hydraulic accumulator (rail) – C. Fuel filter return – D. Delivery to hydraulic accumulator (rail) – E. From the tank – F. Return from injectors.

FIC ENGINE

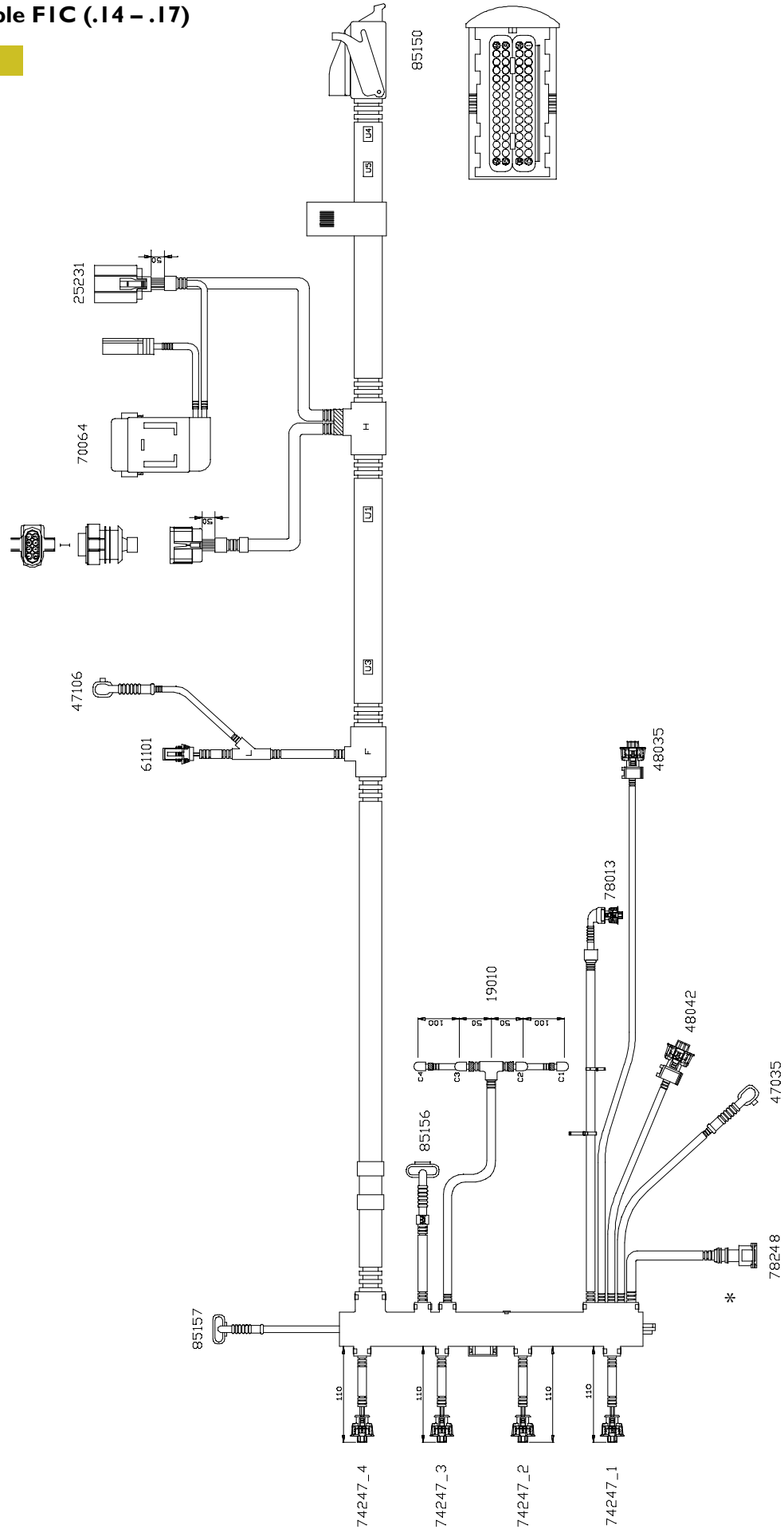
Figure 197



1. Injectors – 2. Common-Rail pressure sensor – 3. Pre-heating glow plugs – 4. Air temperature sensor – 5. Pre-heated diesel oil filter – 6. Diesel oil temperature sensor – 7. High pressure sensor – 8. Pre-heating glow plugs central unit – 9. Sectioning by cab cable – 10. Pre-heating central unit positive – 11. Fuse – 12. Central unit – 13. Engine r.p.m. sensor – 14. Water temperature sensor for EDC – 15. Camshaft r.p.m. sensor – *, Water temperature transmitter for thermometer – **, Oil filter clogged sensor – ***, Engine oil level sensor

Injection cable FIC (.14 – .17)

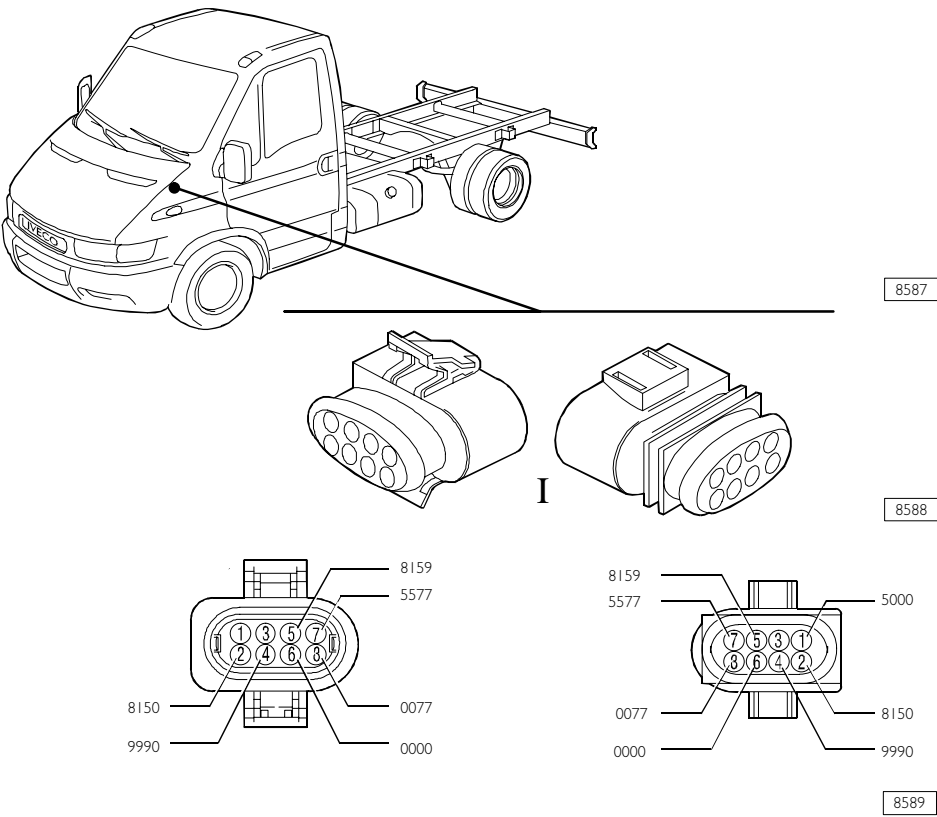
Figure 198



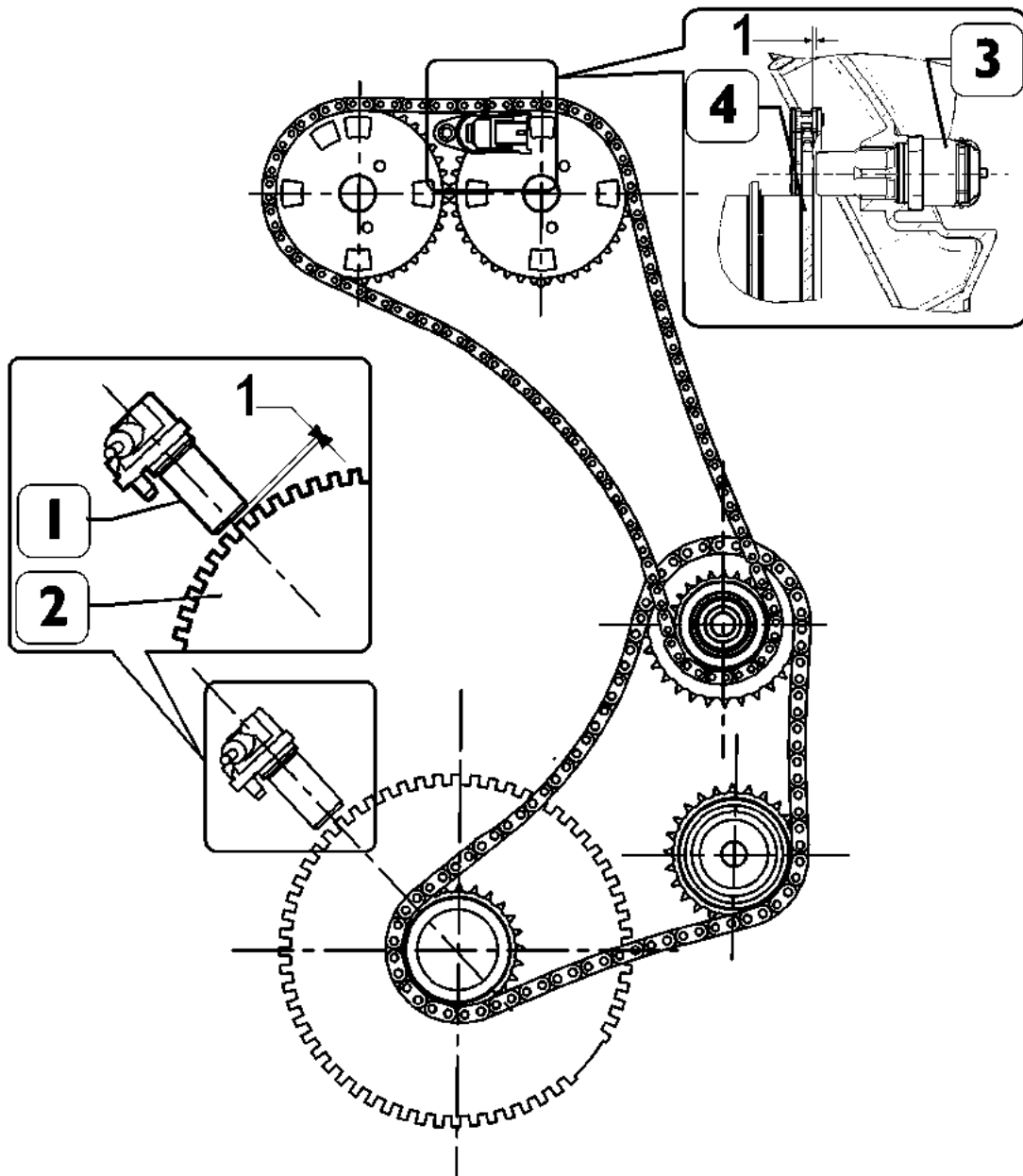
* with .17 (VGT)

Connection between cab/bonnet cable and injection cable

Figure 199



Ref.	Cable colour code	Function
I	1 5577	Heated diesel oil filter positive
	2 8150	Pre-heating central unit (pin 86)
	3 -	-
	4 1310	Pre-heating central unit (pin-DI)
	5 1311	Pre-heating central unit (pin-ST)
	6 0000	Pre-heating central unit earth (pin-31)
	7 -	-
	8 0077	Heated diesel oil filter earth

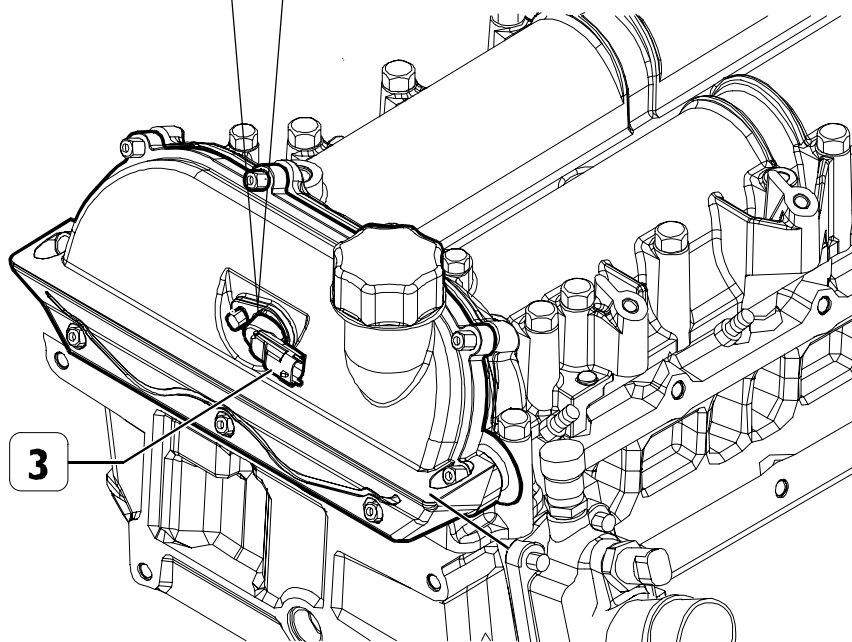
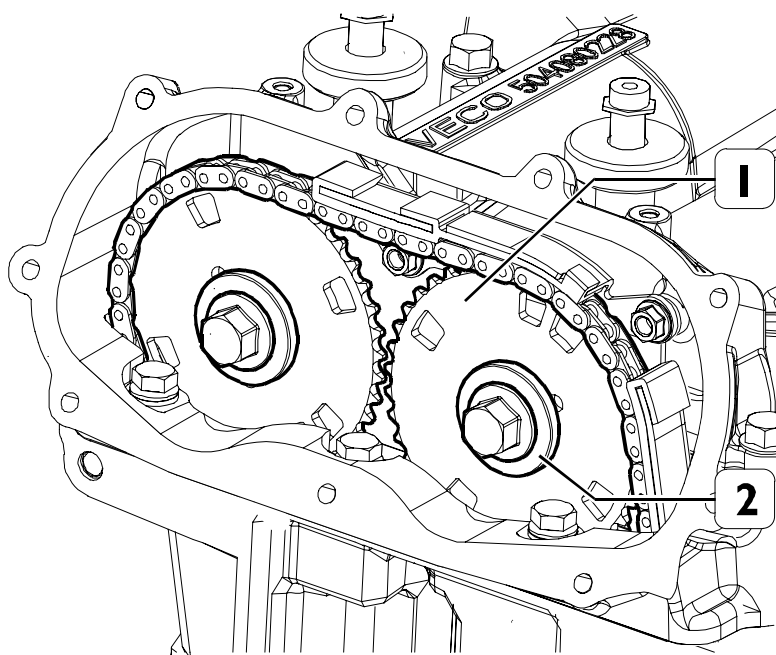
R.p.m. / timing sensors**Figure 200**

1. R.p.m. sensor – 2. Phonic wheel on drive shaft – 3. Timing sensor – 4. Phonic wheel on camshaft

88056

Timing sensor (stroke)

Figure 201



1. Phonic wheel on camshaft – 2. Identification slots – 3. Sensor

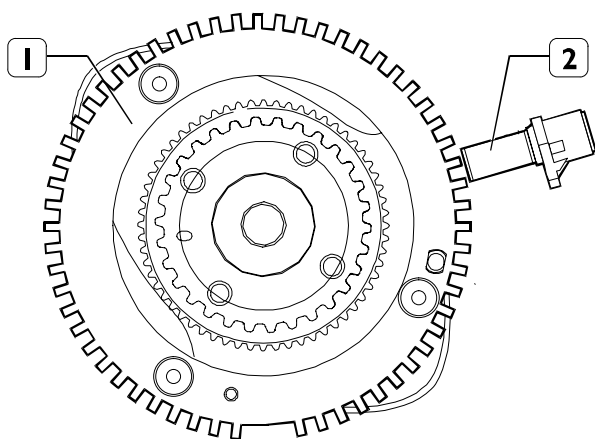
RPM sensor

A phonic wheel is fitted on the drive shaft. As the sensor detects existing teeth passing, it provides the central unit with the signal that is necessary to determine engine r.p.m.'s.

The variation of the signal generated by the lack of some teeth (synchronisation gap) occurring at each drive shaft turn is the reference signal which enables the central unit to detect the lead of the pair of pistons 1–4 with respect to PMS.

This signal is also used by the control unit to detect the engine rotation speed, the duration of injection and to control the rev counter.

Figure 202

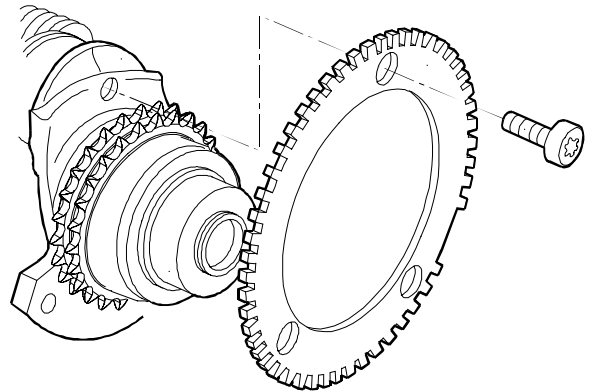


0003319t

TECHNICAL VIEW OF THE SOUND WHEEL AND
SENSOR

1. Sound wheel – 2. Sensor

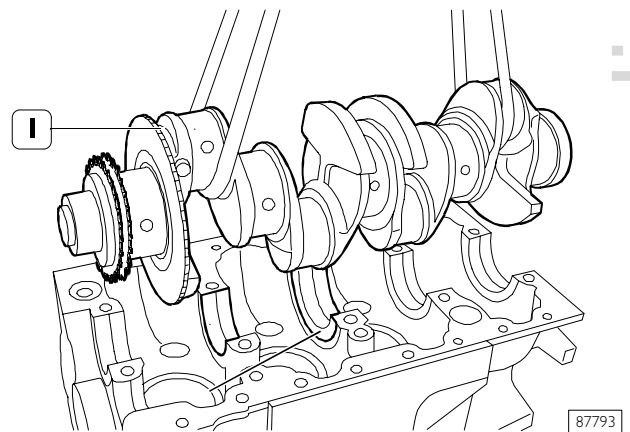
Figure 203



87792

Phonic wheel mounting

Figure 204



87793

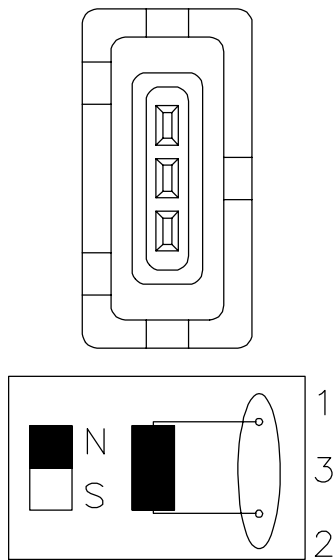
1. Phonic wheel

Figure 205



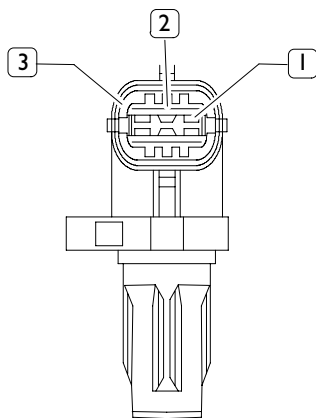
RPM SENSOR AND CONNECTION CABLE

Figure 206



SENSOR CONNECTOR AND WIRING DIAGRAM

Figure 207



85712

TIMING SENSOR

1. Earth – 2. Signal output – 3. Power supply positive

RPM sensor

These are inductive sensors.

The flywheel sensor (48035) is connected at pins 27 and 12 of connector A of the control unit.

Timing sensor

A semiconductor layer, immersed in a magnetic field and through which current flows, generates a potential difference (called Hall voltage) at its ends.

If current intensity remains constant, the generated voltage depends only on the magnetic field strength: periodical variation of field strength is enough to obtain a modulated electric signal.

The smooth portion of the phonic wheel (distributing shaft pulley) covers, while moving, the sensor, thus blocking the magnetic field with resulting low output signal.

On the contrary, the sensor generates a high signal next to the openings and when a magnetic field is available.

Phase sensor signals are acquired, and the engine position is recognized according to the sequence of the phonic wheel notches.

The mounting function makes it possible to identify signal errors and interferences (if any).

The resulting signal is supplied to the processor that controls the injection system.

The sensor (48042) is connected to the central unit at pins A20/50/11.

High-pressure pump

Pressure delivered to the rail is modulated between 250 and 1600 bars by the electronic central unit by operating on the solenoid valve of pressure regulator.

Pump (3) is oriented on the pump shaft cam.

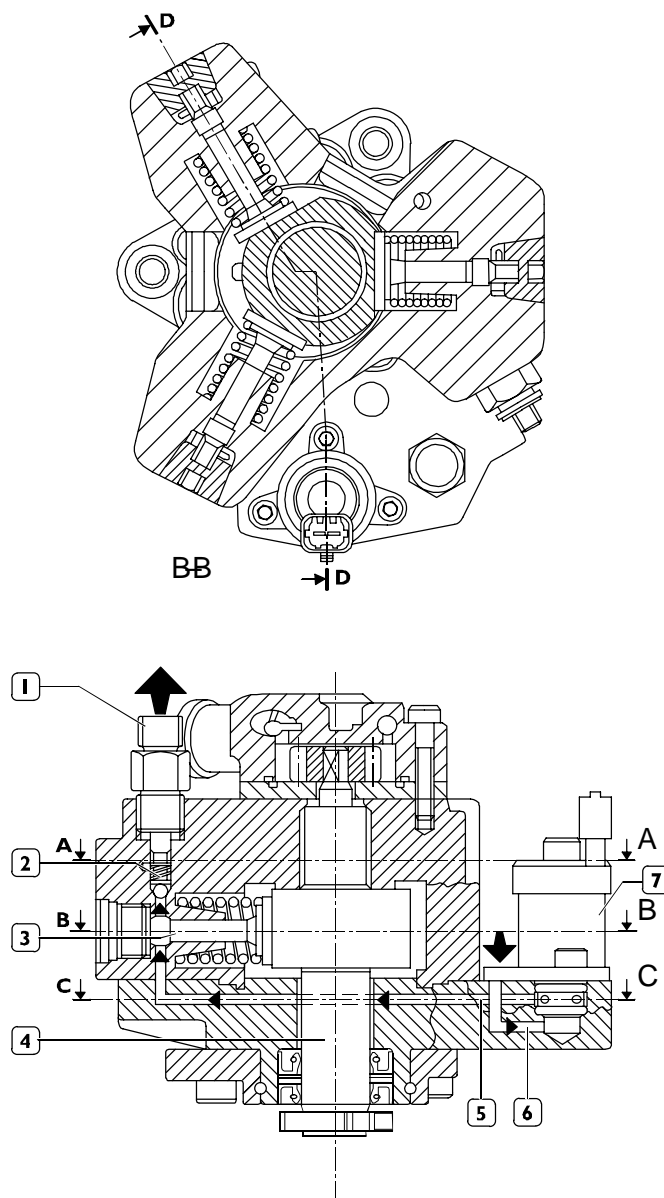
During aspiration the pump is powered via supply conduit (5).

The amount of fuel to be sent to the pump is set by pressure regulator (7).

The pressure regulator stops fuel inflow to the pump based on PWM input from the centre.

During pump compression, fuel reaches a pressure level sufficient to open the pressure valve to common rail (2), and supplies it via output (1).

Figure 208



1. Output for rail pressure – 2. Rail pressure valve – 3. Pump – 4. Pump shaft – 5. Pump supply conduit – 6. Pressure regulator supply conduit – 7. Pressure regulator – 8. High pressure pump – 9. Fuel input connection from filter – 10. Fuel output connection to filter support – 11. Fuel input connection from centre heat exchanger – 12. Fuel output connection from mechanical pump to filter – 13. Supply mechanical pump

88072

Pressure regulator

When the engine control centre pilots the pressure regulator via the PWM signal, solenoid (1) is activated, which in its turn generates movement of magnetic core (2).

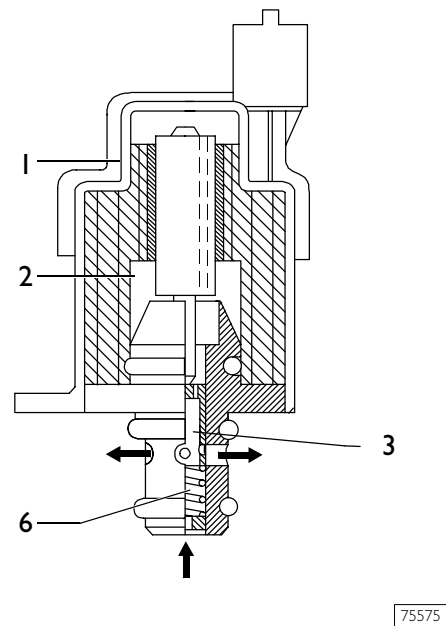
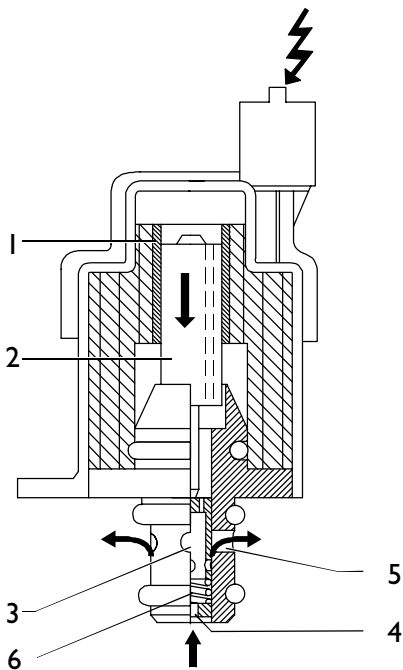
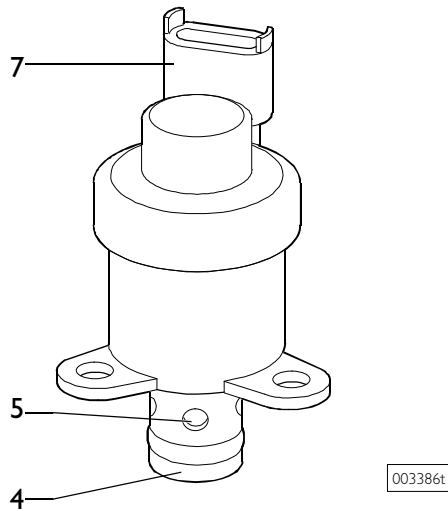
Core movement causes cylinder (3) axial displacement by fuel delivery partialization.

When solenoid (1) is not activated, the magnetic core is moved to its rest position by preload spring (6).

In these conditions, cylinder (3) is in a position to offer maximum fuel passage cross-section.

Control electro valve 78013 is connected to centre connector A pins 19 and 49.

Figure 209



1. Solenoid – 2. Magnetic core – 3. Cylinder – 4. Fuel input – 5. Fuel output – 6. Preload spring – 7. Connector

Rail (pressure accumulator) FIC

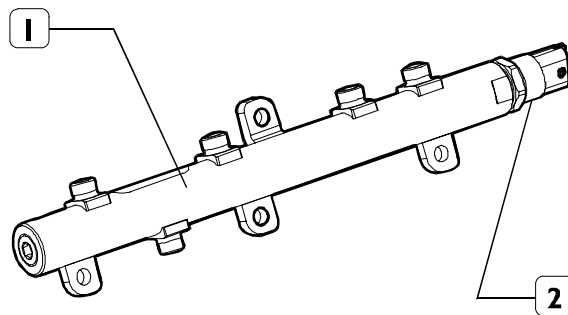
The hydraulic accumulator is mounted in the cylinder head on the side opposite aspiration.

By its volume, it damps fuel pressure oscillations owing to:

- ☐ high-pressure pump operation
- ☐ electro injector opening.

On hydraulic accumulator there is located the fuel pressure sensor.

Figure 210



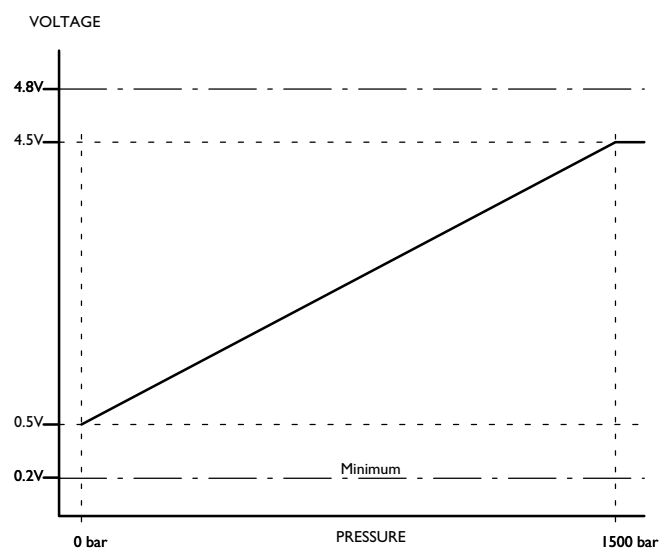
88418

1. Rail – 2. Pressure sensor

Pressure sensor

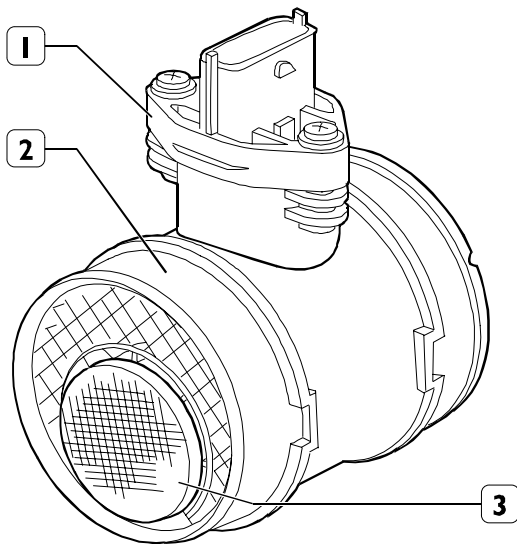
Fitted to a rail end, it measures fuel pressure present to the purpose of determining existing fuel pressure. Pressure value is used to control pressure and determine injection electric control duration (85157). It is connected to the central unit at pins A 8/43/28. It is fed at 5 V.

Figure 211



PRESSURE LIMITER OPERATING GRAPH

Figure 212

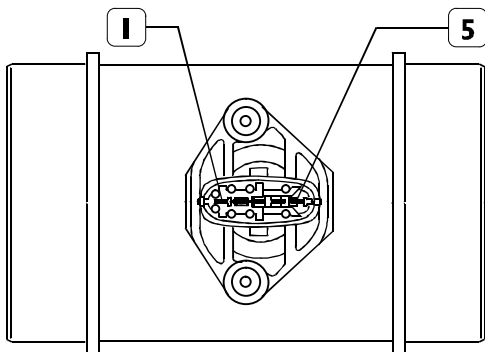


003333t

GAUGE

1. Connector – 2. Gauge body – 3. Air input grid

Figure 213



003334t

TECHNICAL VIEW OF GAUGE CONNECTOR

Air delivery gauge with EGR

Used in the EGR version to replace the one mounted on the engine aspiration manifold.

The gauge is of the heated film type and is located on their aspiration conduit between the turbine and the air filter.

The gauge contains the aspired air temperature sensor.

It is connected to the central unit on connector "A".

Pin 1 sensor – Pin A37 – temperature signal

Pin 2 sensor – Power supply (+15)

Pin 3 sensor – Pin A44 – mass

Pin 4 sensor – Pin A29 – reference voltage

Pin 5 sensor – Pin A42 – pressure signal

* **If present**

The operating principle is based on a heated membrane inserted in a measurement canal through which air to the engine flows.

The hot film membrane is kept at a constant temperature some 120 °C above incoming air level by the heating resistor.

The air mass traversing the measurement canal tends to subtract heat from the membrane so current must cross the resistor to maintain constant film temperature.

Current absorbed is proportional to the air mass flowing to the engine and is measured with a Wheatstone bridge and the signal is forwarded to the electronic centre.

Air temperature/pressure sensor (without EGR)

This component incorporates a temperature sensor and a pressure sensor (85156).

It is fitted on the engine intake manifold and measures the maximum flow rate of the intake air which is used to accurately calculate the amount of fuel to be injected at each cycle.

It is connected to the central unit on connector "A".

Pin 1 sensor – Pin A23 – earth –

Pin 2 sensor – Pin A53 – temperature signal

Pin 3 sensor – Pin A13 – 5V – supply –

Pin 4 sensor – Pin A40 – 0 ÷ 5V
pressure signal

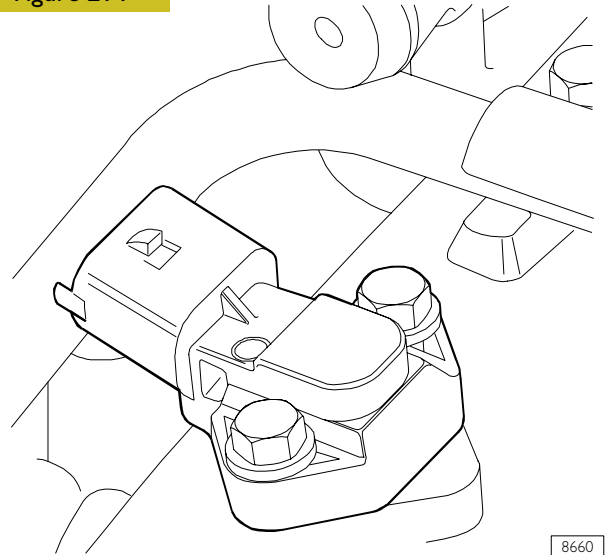
Course of sensor in relation to the temperature

Temperature	Resistance
– 40 °C	48.50 kOhm
– 20 °C	15.67 kOhm
0 °C	5.86 kOhm
20 °C	2.50 kOhm
40 °C	1.17 kOhm
60 °C	0.59 kOhm
80 °C	0.32 kOhm
100 °C	0.18 kOhm
120 °C	0.11 kOhm

Course of sensor in relation to the pressure:

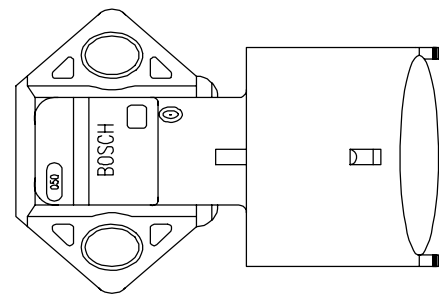
See graph opposite.

Figure 214



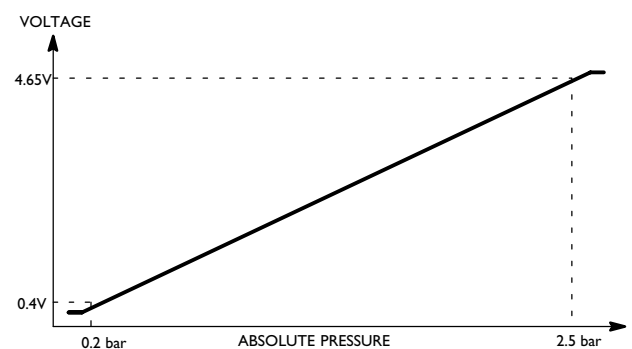
AIR FLOW METER

Figure 215



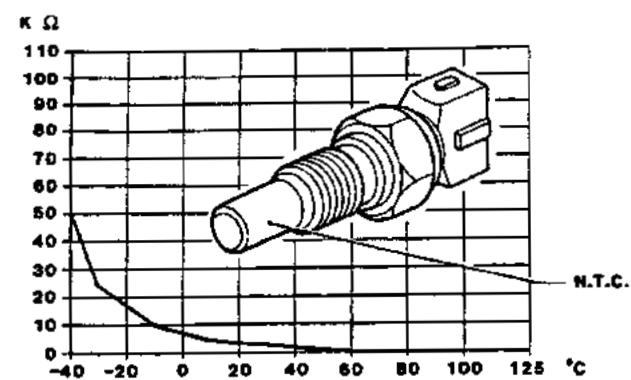
AIR FLOW METER CONNECTION

Figure 216



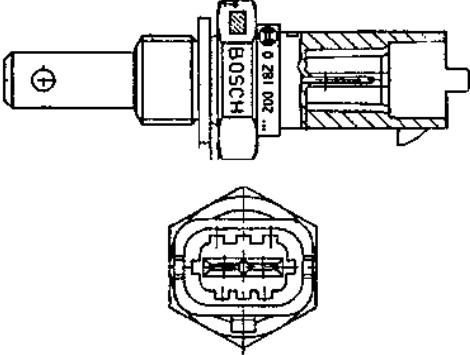
AIR FLOW METER OPERATING GRAPH

Figure 217



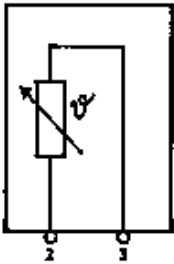
COURSE OF SENSOR RESISTANCE IN RELATION TO TEMPERATURE

Figure 218



TECHNICAL VIEW OF ENGINE COOLANT TEMPERATURE SENSOR

Figure 219



NTC
WIRING DIAGRAM

Atmospheric pressure sensor

This is integrated inside the control unit.
It measures the atmospheric pressure to correct the flow rate in relation to the altitude.

Engine coolant temperature sensor

This is an NTC sensor located on the thermostat box.
It detects the temperature of the coolant fluid to give the control unit information about the engine temperature conditions.
It is connected to pins 58 and 41 of connector A of the control unit.

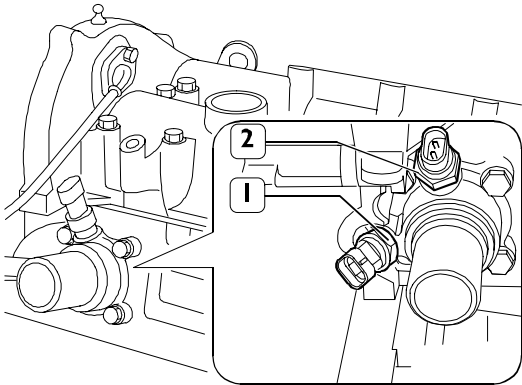
Course of the sensor in relation to the temperature:

Temperature	Resistance
- 40°C	48.30 kOhm
- 20°C	15.46 kOhm
0°C	5.89 kOhm
20°C	2.50 kOhm
40°C	1.17 kOhm
60°C	0.59 kOhm
80°C	0.32 kOhm
100°C	0.19 kOhm
120°C	0.11 kOhm

Fuel temperature sensor

This is an NTC sensor located on the fuel filter.
It detects the temperature of the fuel to give the control unit information about the fuel oil temperature conditions.
It is connected to pins 52 and 51 of connector A of the control unit.
It is exactly the same as the engine coolant temperature sensor.

Figure 220



LOCATION OF ENGINE COOLANT TEMPERATURE SENSOR
1. EDC signal – 2. Signal instrument panel

Fuel filter

Cartridge degree of filtering: 5 micron

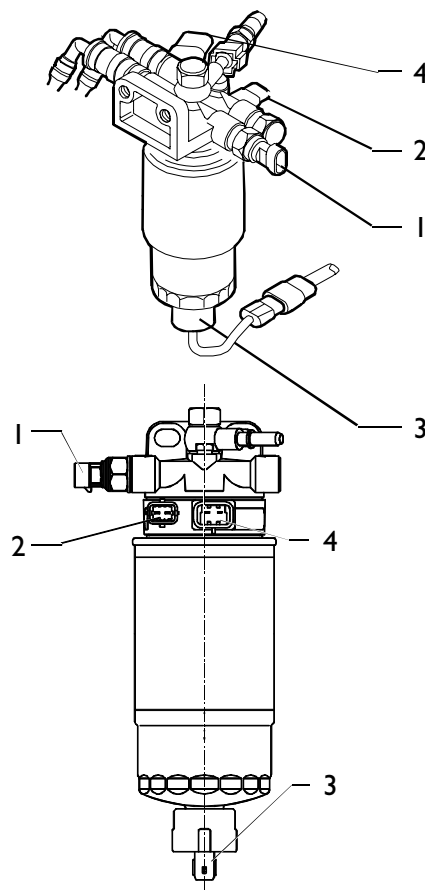
Differential operating pressure (obstruction indicator): 0.6 bar

The fuel temperature sent by the sensor to the electronic injection control unit allows very accurate calculation of the flow rate of the fuel to be injected in the cylinders.

It is located in a fairly accessible position in the left front part of the engine compartment.

1. Actuated by ECU via relay with fuel temperature below 3°C.
2. Filtering element
3. Shows presence of water through a warning lamp on instrument panel.
4. Differential pressure sensor calibrated at 0,6 bar : any clogging is shown by warning lamp
5. It is a NTC sensor connected to EDC for fuel temperature reading enabling electronic control to calculate the amount of diesel oil to be injected into the cylinders.
6. Installed on filter support for excess fuel return to tank.

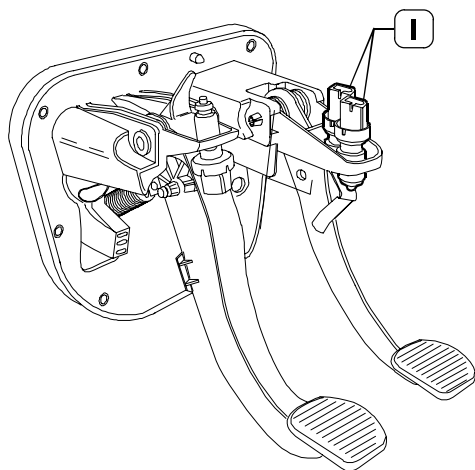
Figure 221



1. Clogged filter sensor - 2. Fuel temperature sensor - 3. Water sensor - 4. Heater

003312t

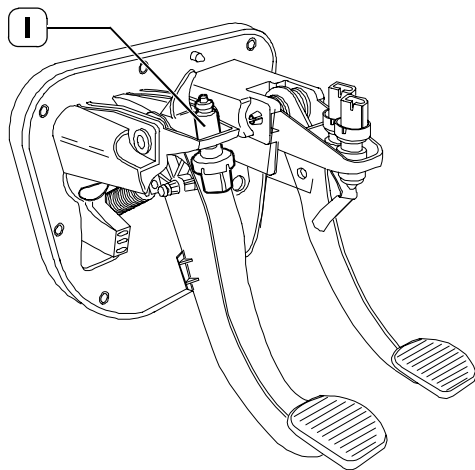
Figure 222



003326t

I. Brake pedal switches

Figure 223



003327t

I. Clutch pedal switch

Brake pedal switches

On brake pedal there are two switches; an N.C. (53565) is directly connected to the central unit at pins K17–K80. It provides signals (voltages) in order to warn the central unit about occurred braking.

Second switch 53501 N.A. provides a voltage for turning on stop lights.

Clutch pedal switch

An N.C. switch connected to electronic centre pin K58 is mounted on the clutch pedal (42374).

The “clutch pedal actuated signal” is used by the centre to identify gear condition selected and gear shifts.

In absence of the pedal pressed switch signal, the centre disengages the Cruise Control function.

Injectors

The solenoid valve controls the lift of the atomiser needle.

On the fuel inlet union a filter protects the injector for impurities. The injector is constructively the same as conventional ones, except that there is no needle return spring.

Access to the injectors is gained by releasing the side soundproof cover from the cylinder head. The fuel recovery pipe has a quick coupling.

The injector comprises two parts:

- ☐ actuator – atomiser composed of pressure rod (1), pin (2) and nozzle (3)
- ☐ control solenoid valve comprising a coil (4) and drive valve (5).

1st phase: rest position

The coil (4) is not activated and the shutter (6) is in the closed position.

The same fuel pressure acts in both the control area (7) and in the pressure chamber (8), but as the shutter (6) is closed, the needle (2) cannot be raised.

2nd phase: start of injection

The coil (4) is energised and causes the shutter (6) to move upwards.

The fuel of the control volume (9) flows towards the backflow duct (10) causing a drop in the pressure in the control area (7).

At the same time, the pressure of the fuel in the pressure chamber (8) causes the needle (2) to rise, resulting in fuel injection to the cylinder.

3rd phase: end of injection

The coil (4) is not activated and makes the shutter (6) return to the closed position, which re-creates a balance of forces that makes the needle (2) return to the closed position and consequently end injection.

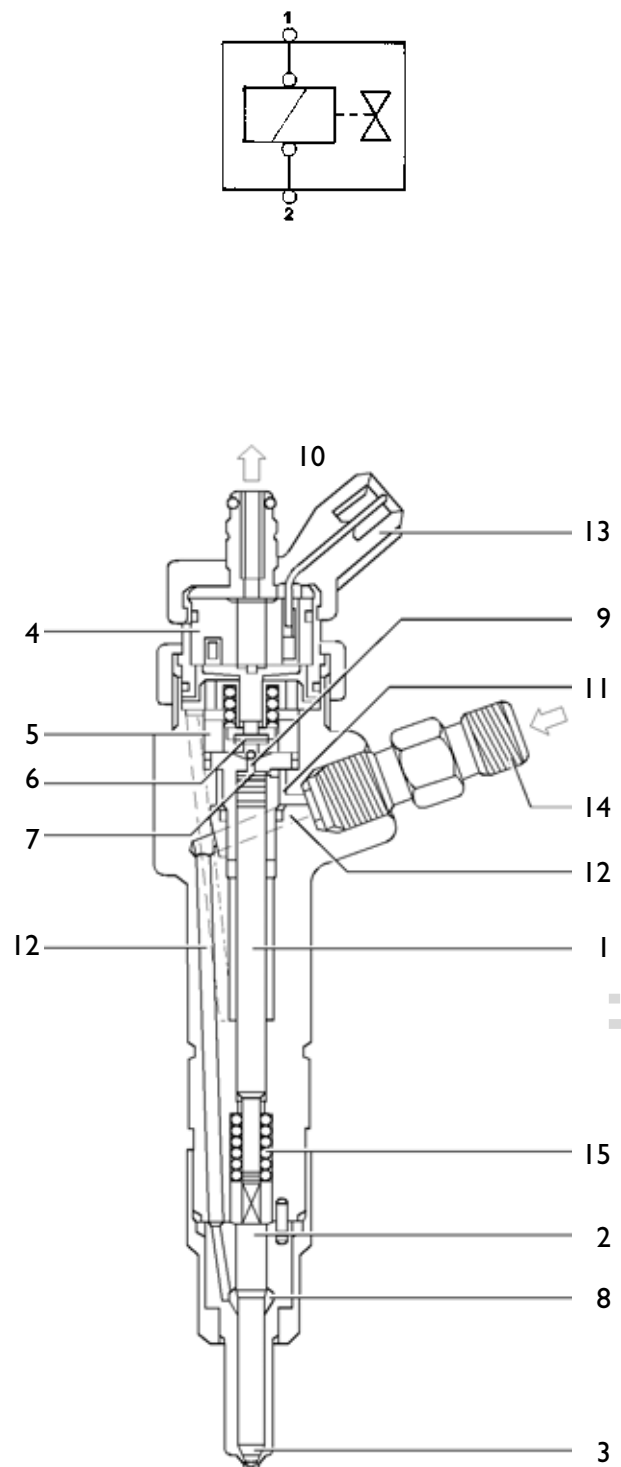
Injectors (78247)

The solenoid valve is of the N.C. type.

The injectors are connected individually to the control unit at the following pins:

- ☐ A16 / A47 cylinder 1 injector
- ☐ A2 / A31 cylinder 2 injector
- ☐ A1 / A46 cylinder 3 injector
- ☐ A17 / A33 cylinder 4 injector

Figure 224



INJECTOR WIRING DIAGRAM AND CROSS SECTION
 1. Pressure rod – 2. Needle – 3. Nozzle – 4. Coil – 5. Pilot valve – 6. ball shutter – 7. control area – 8. pressure chamber – 9. Control volume – 10. Backflow duct – 11. Control duct – 12. Supply duct – 13. Electrical connection – 14. High pressure fuel inlet – 15. Spring

Electromagnetic junction fan

The fan is provided with an electromagnetic junction monitored by the electronic centre pin A39 that activated the junction remote control switch, to optimise water cooling.

The electrical fan remote control switch is activated or deactivated by the centre according to the temperature of:

- ☐ the coolant
- ☐ over supply air
- ☐ the fuel

Engine coolant temperature

Activated at over 96 °C and deactivated at under 84 °C

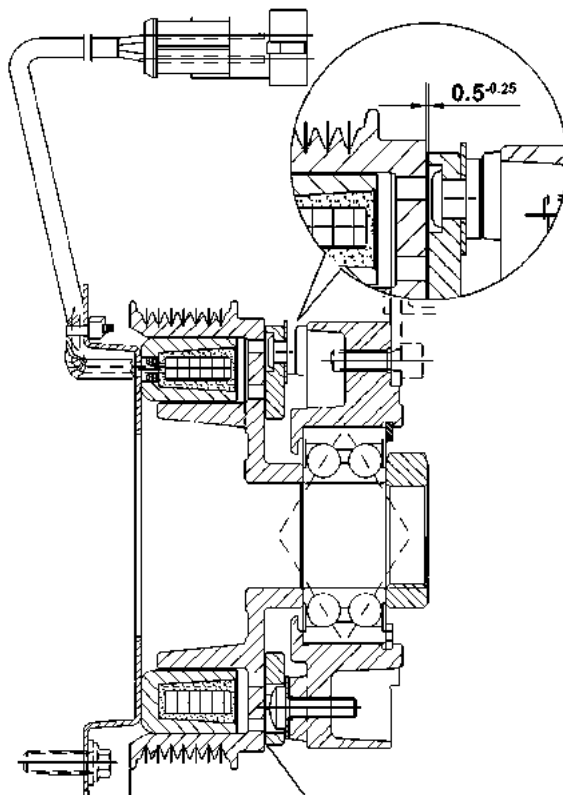
Over supply air temperature

Activated at over 75 °C and deactivated at under 65 °C

Fuel temperature

Activated at over 20 °C and deactivated at under 10 °C

Figure 225



ELECTROMAGNETIC JUNCTION TECHNICAL VIEW
1. Coil – 2. Connector

88064

CLIMATE CONTROL

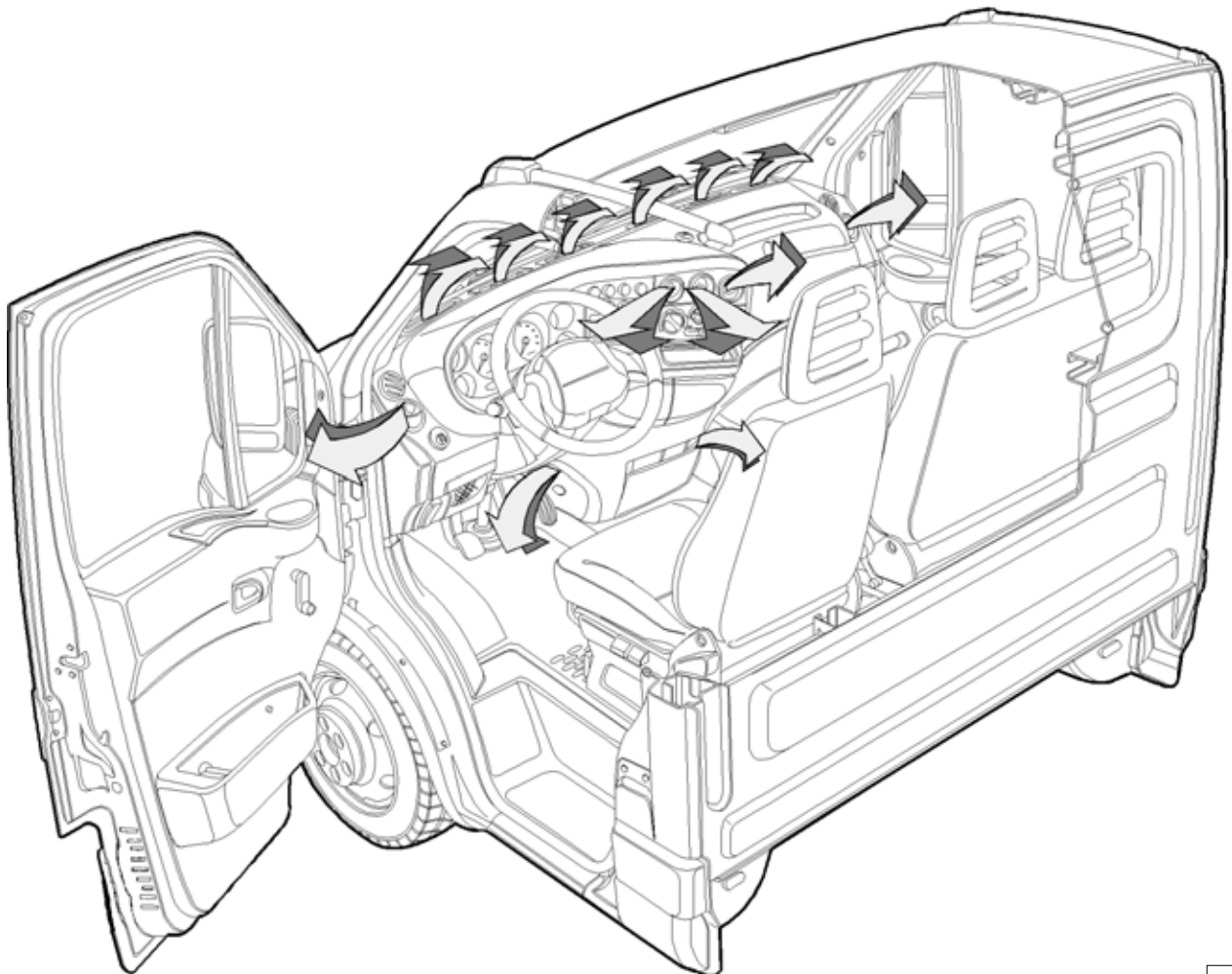
General

The function of the system is to automatically or manually control the temperature required in the cab.

According to the set required temperature the system controls:

- ☐ automatically:
 - air vent temperature
 - fan speed (continuous changing)
- ☐ manually:
 - fan speed
 - compressor on/off
 - outside air inlet/re-circulation
 - MAX DEF function (defrosting);
- ☐ totally manually (through bowden cables):
 - distribution of air flows to the air vents.

Figure 226



000250t

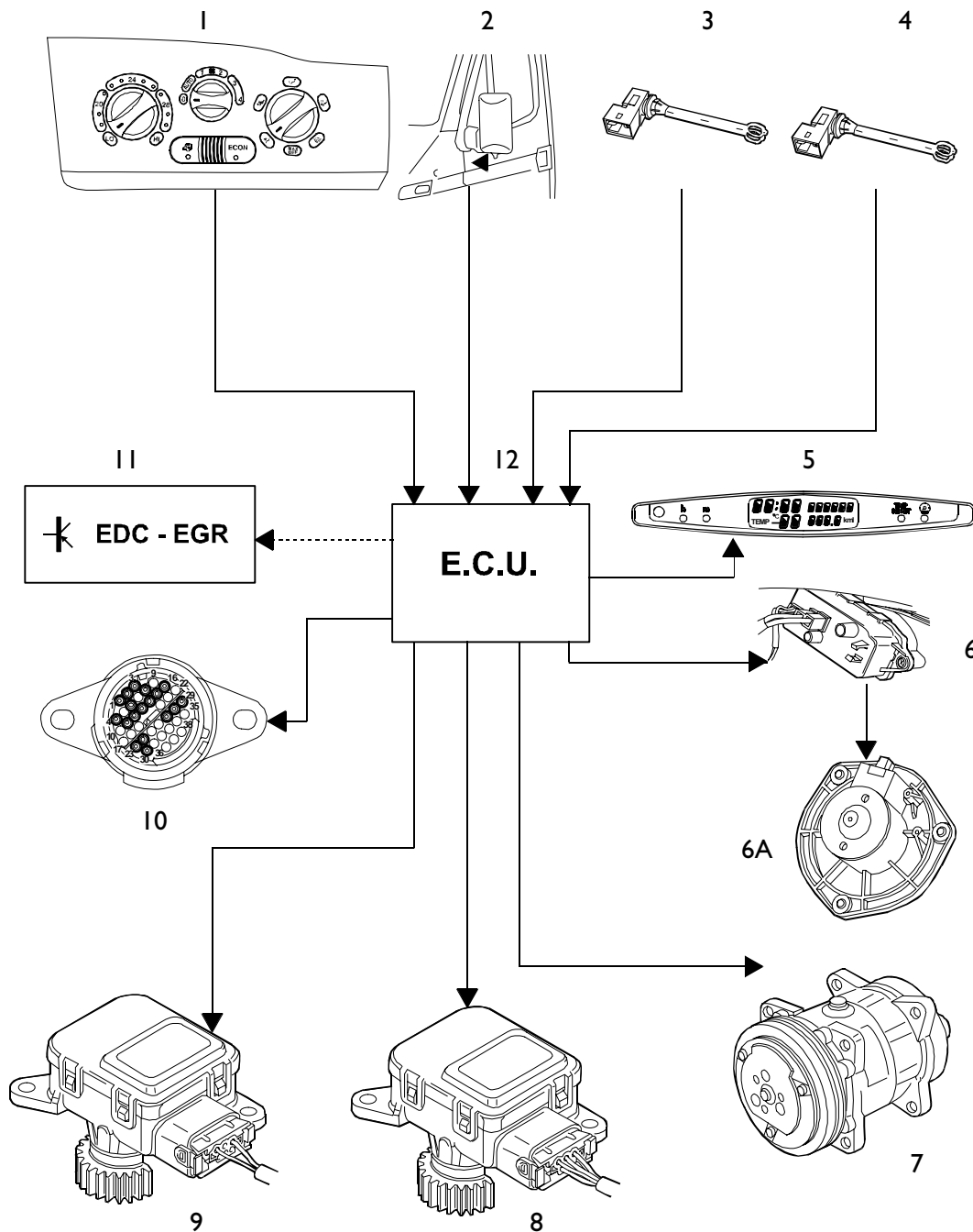
AIR FLOW DISTRIBUTION INSIDE THE CAB

Operating logic

A special electronic control unit controls automatic system operation checking the various parameters in order to provide the comfort required in the cab.

The control unit carries out and sets certain functions to obtain adaptation of the temperature of the cab to the one required depending on the requests received and the temperature conditions detected.

Figure 227



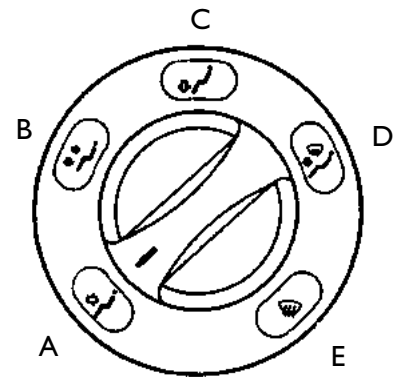
CLIMATE CONTROL ELECTRONIC CONTROL UNIT CONNECTIONS

1. Controls on dashboard: inside temperature sensor, re-circulation switch, "eco" switch, fan control potentiometer –
2. Outside temperature sensor – 3. Evaporator sensor – 4. Blown air sensor – 5. Digital display – 6. Fan electronic control module – 6A. Fan – 7. Compressor – 8. Gear motor for re-circulation function – 9. Air mixing gear motor –
10. Diagnostic connector – 11. EDC-EGR control unit – 12. Climate control electronic control unit

000251t

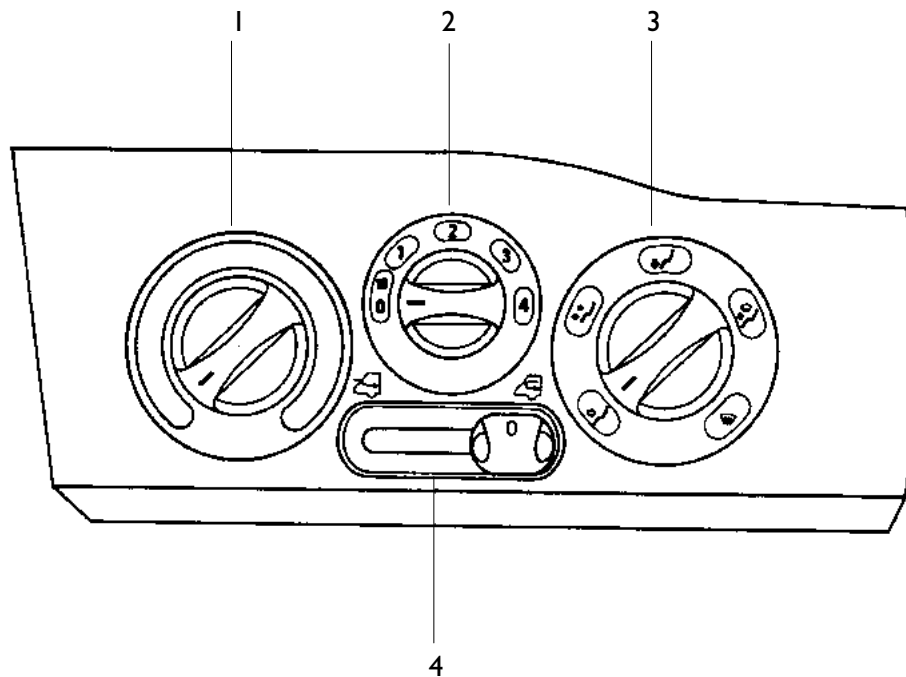
Air distribution knob

- A. Face area vents
- B. Face and floor area vents
- C. Floor area vents
- D. Floor and windscreen area vents
- E. Windscreen area vents

Figure 228

000252t

DETAIL OF AIR DISTRIBUTION KNOB

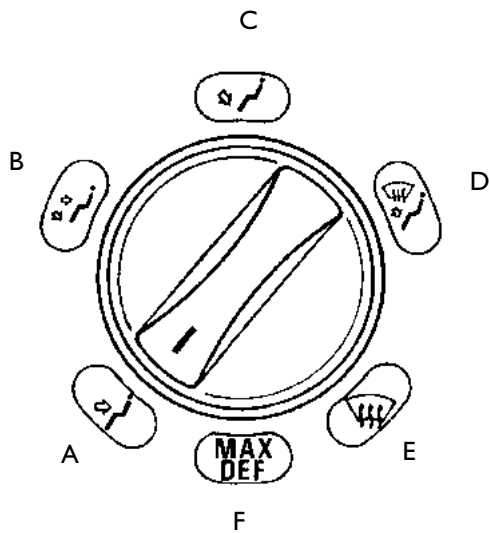
Figure 229

000241t

VENTILATION AND HEATING CONTROLS ASSEMBLY

1. Temperature adjustment knob – 2. Fan speed control knob – 3. Air distribution knob – 4. Outside air inlet or re-circulation

Figure 230



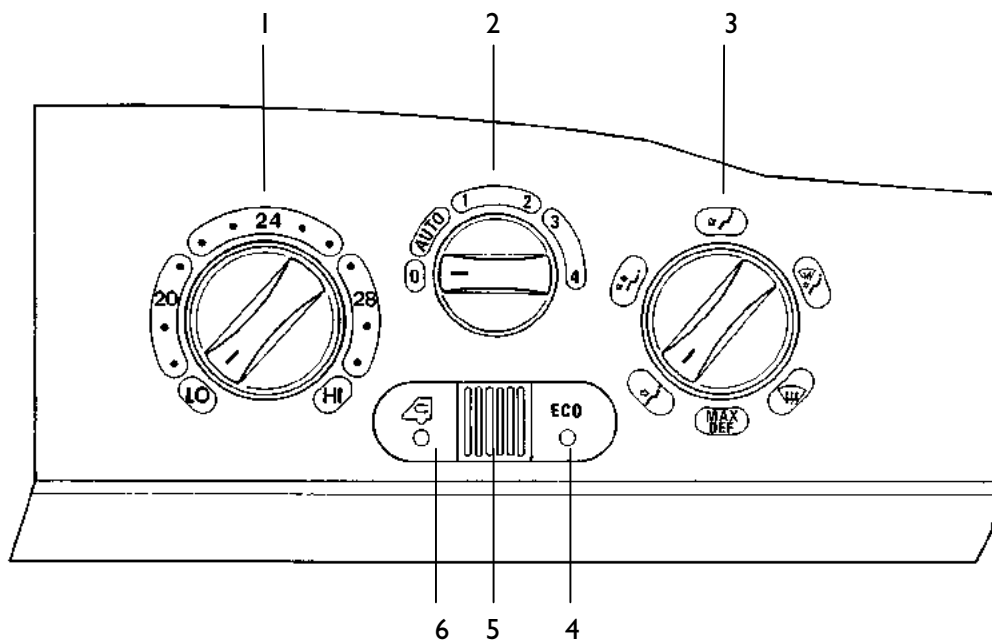
000254t

DETAIL OF AIR DISTRIBUTION KNOB

Air distribution knob with climate control system

- A. Face area vents
- B. Face and floor area vents
- C. Floor area vents
- D. Floor and windscreen area vents
- E. Windscreen area vents
- F. "Max def" function

Figure 231



00025et

CLIMATE CONTROL SYSTEM CONTROLS ASSEMBLY

1. Knob for setting required temperature – 2. Fan speed control knob – 3. Air distribution knob – 4. "Eco" function switch – 5. inside temperature sensor – 6. Re-circulation knob

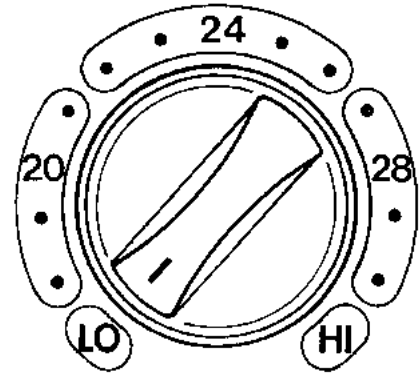
Setting the required temperature

To set the required temperature, turn the corresponding knob (Figure 232) to the 18 °C – 30 °C range.

This knob is connected to a potentiometer which detects the different angular positions and transmits a signal to the electronic control unit.

There are fifteen different positions (one per degree centigrade) with two extremes "LO" and "HI" which correspond respectively to the coldest and warmest positions.

Figure 232



000255t

KNOB FOR SETTING REQUIRED TEMPERATURE

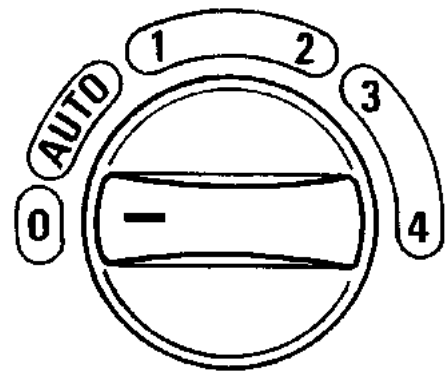
Setting the fan speed

To set the required fan speed, turn the corresponding knob (Figure 233) to the 0 to 4 range.

This knob is connected to a potentiometer which detects the different angular positions and transmits a signal to the electronic control unit.

There are six different positions, four of which are set manually (1, 2, 3, and 4), one for no air flow (0) and an automatic one controlled by the electronic control unit where the system itself selects the most suitable air flow to reach and/or maintain the required temperature (AUTO).

Figure 233



000256t

KNOB FOR SETTING FAN SPEED

“Auto” function

With the ventilation control knob in the “AUTO” position, the control unit will be able to control:

- ☐ The air temperature at the vents.
- ☐ Fan speed.

Function “0” (OFF)

With the ventilation control knob in the “0” position, the control unit acts as follows:

- ☐ No air flow (fan off).
- ☐ Mixing stopped in the previous position.
- ☐ Re-circulation on.
- ☐ Compressor off.
- ☐ “MAX DEF” function cut off if in progress.

“ECO” function

The engagement of this function is completely manual and is obtained through the special switch which makes it possible to disengage the compressor electromagnetic clutch.

Compressor control is however linked to other parameters, namely:

- ☐ Outside temperature (> 5 °C “ON”)
- ☐ Evaporator temperature (> 4 °C “ON”, < 3.5 °C “OFF”)
- ☐ Coolant fluid system pressure (min. 3.5 bar, max. 28 bar)
- ☐ EDC or EGR control unit (in versions where applicable).

“Re-circulation” function

The engagement of this function is completely manual and is obtained through the special switch which makes it possible to shut off the outside air inlet.

In the “MAX DEF” mode this function is cut off regardless of the position of the switch.

“MAX DEF” function

The engagement of this function is completely manual and is obtained turning the air distribution clockwise as far as the “MAX DEF” position.

The control unit will be informed of this request by the closing of a special N.O. microswitch in the rear part of the knob.

The engagement of this function involves:

- ☐ Maximum air flow, regardless of the position of the knob.
- ☐ Air distribution towards the windscreen through bowden cables.
- ☐ Mixing with the highest heat available (memorising the last position of the motor before leaving the adjustment state).
- ☐ Outside air inlet, regardless of the position of the re-circulation button.
- ☐ Compressor on, regardless of the position of the ECO button.

Switching this function off the gear motor moves back to the position memorised previously if the temperature adjustment knob is not at “LO” or “HI”.

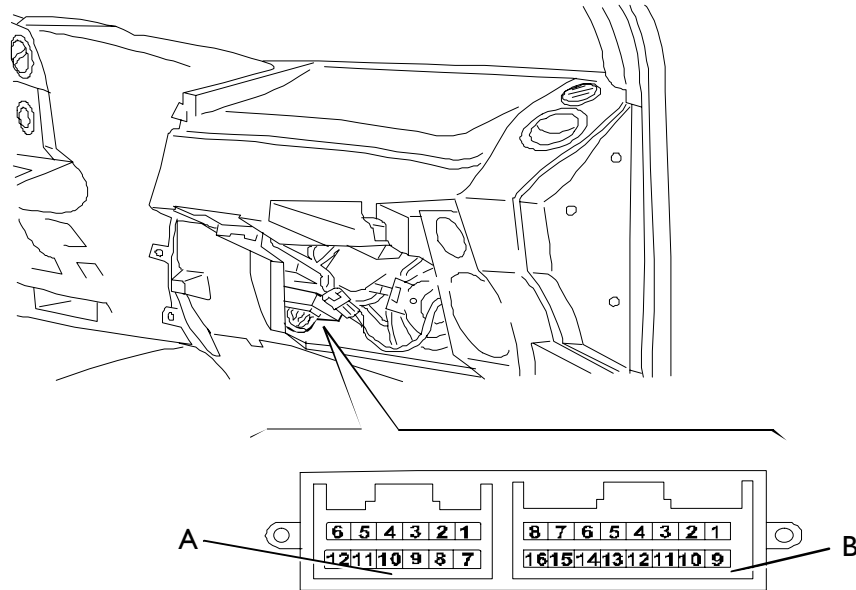
If this function is already selected when the ignition key is turned on, no position will be memorised, and switching it off, the adjustment procedure will be started with the mixing gear motor in the “HI” condition.

Electronic control unit

This automatically controls the system monitoring the thermodynamic parameters in order to provide the suitable climate (temperature and humidity) required by the driver.

It is located on the lower part of the passenger's side duct unit.

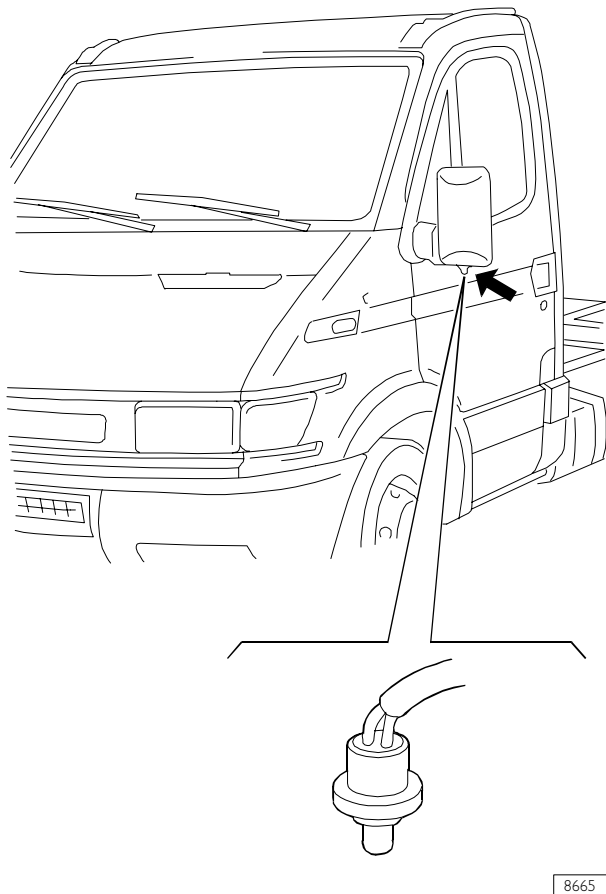
Figure 234



000257t

Connector	Pin	Function
A	1	Signal from treated air temperature sensor
	2	Signal from required temperature potentiometer
	3	Signal from ventilation control potentiometer
	4	Earth
	5	Positive from "ECO" switch
	6	Positive from microswitch for "MAX DEF" function
	7	Signal earth
	8	Supply (+15/A)
	9	5 V supply for ventilation, temperature and air mixing potentiometers
	10	Line L for 38-pin diagnostic connector pin 13
	11	Line K for 38-pin diagnostic connector pin 14
	12	Positive from switch for re-circulation
B	1	Positive (0 to 8 V) for fan electronic control module (0 to 6 V)
	2	Serial line for digital display (instrument cluster pin "B 11")
	3	Signal from evaporator temperature sensor
	4	Reference voltage from air mixing motor (0 to 5 V)
	6	Signal from outside temperature sensor
	7	Signal from inside temperature sensor
	8	Negative for fan electronic control module
	10	Supply (0 to 12 V) for re-circulation gear motor (+12 V for switching on re-circulation)
	11	Supply (0 to 12 V) for re-circulation gear motor (+12 V for switching on re-circulation)
	12	Key-operated positive supply
	13	Positive for compressor control relay
	14	Supply (0 to 12V) for air mixing gear motor (+12V with "HI" function)
	15	Supply (0 to 12V) for air mixing gear motor (+12V with "LO" function)
	16	Reference voltage from electronic fan control module (0 to 12 V)

Figure 235



OUTSIDE TEMPERATURE SENSOR

Outside air temperature sensor

This is an NTC sensor on the left wing mirror (Figure 235) for both types of drive.

The resistance at 25 °C is 10 kOhm.

Operating range between – 30 °C and + 50 °C.

It is connected to pin 6 connector B of the control unit.

Inside temperature sensor

This is an NTC sensor located on the climate control module (Figure 237) between the two “Re-circulation” and “ECO” switches.

It is ventilated and contains a motor/fan so that the temperature reading is not affected by stagnating air inside the dashboard which is not realistic.

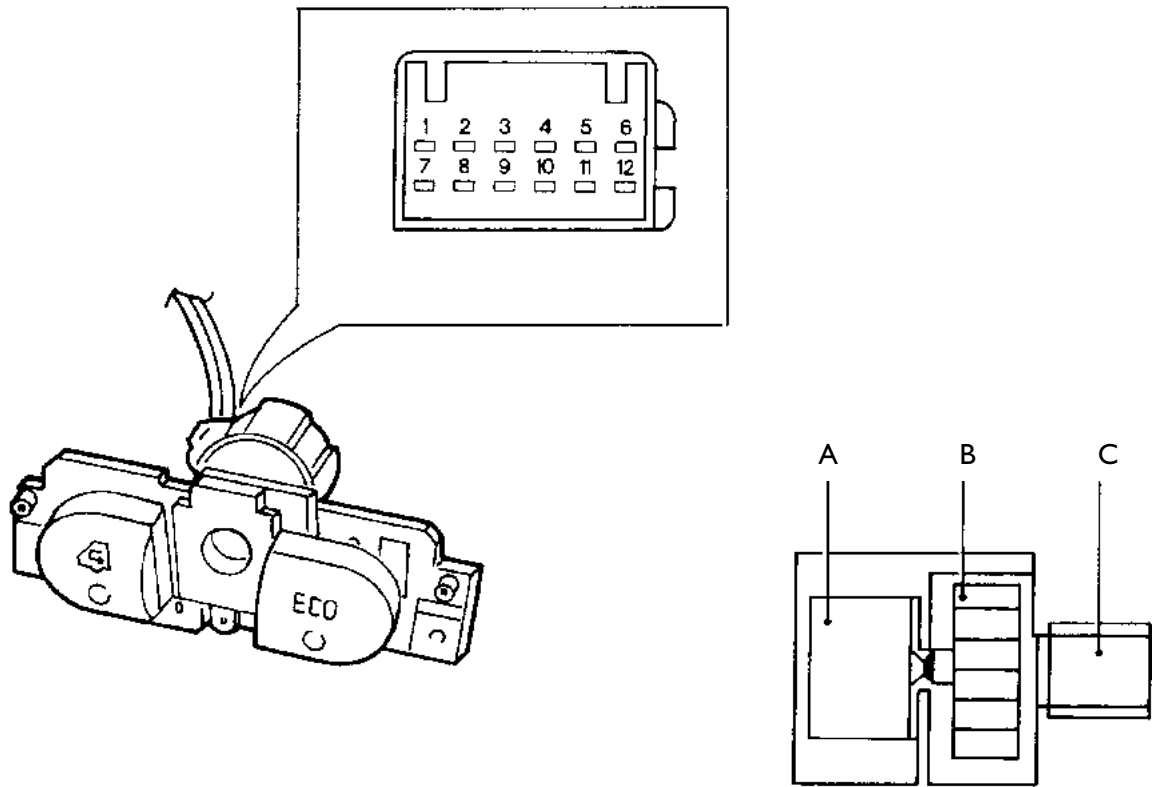
The resistance is 2.2 kOhm at 25 °C

Operating range between + 5 °C and + 45 °C

It is connected to pin 7 connector B of the control unit.

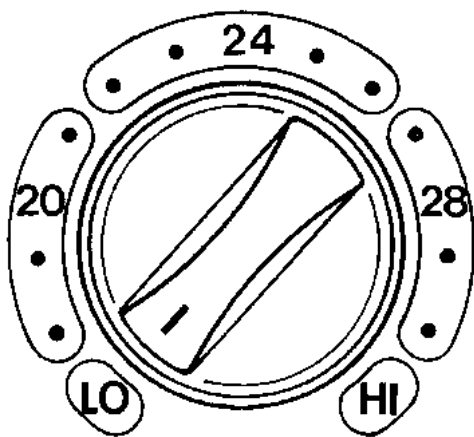
The motor **A**, fan **B** and sensor **C** are a single part and are connected to the wiring by a single connector at pin 12.

Figure 236



Pin	Function
1	Positive for motor
2	Negative for motor
3	Signal earth
4	Sensor signal for control unit (pin 7 connector B)
5	Positive from microswitch for “MAX DEF” function to control unit (pin 6 connector A)
6	—
7	Positive from “ECO” switch to control unit (pin 5 connector A)
8	Earth
9	+15/A supply
10	+15/A supply
11	Negative for lighting pictograms
12	Positive from re-circulation switch to control unit (pin 12 connector A)

Figure 237



000255t

REQUIRED TEMPERATURE SETTING KNOB

Blown air temperature sensor

This is an NTC sensor positioned inside the distributor unit upstream of the air distribution ports to the various vents.

The resistance at 25 °C is 10 kOhm.

Operating range between 0 °C and – 80 °C

It is connected to pin 1 connector A of the control unit.

Evaporator temperature sensor

This is an NTC sensor positioned inside the distributor unit and it is fitted directly on the evaporator. It causes switching on (>4 °C) and switching off (>3.5 °C) of the compressor electromagnetic clutch. The resistance at 25 °C is 10 kOhm.

Operating range between 0 °C and +25 °C.

It is connected to pin 3 connector B of the control unit.

Required temperature potentiometer

This is a potentiometer connected to the required temperature setting knob on the climate control panel.

It detects the various angular positions (Figure 238) and transmits a signal to the electronic control unit for a total of fifteen different positions (one per degree centigrade) two of which are the extremes "HI" and "LO" which correspond respectively to a request for the coldest and warmest positions.

It is supplied by the control unit at 5V.

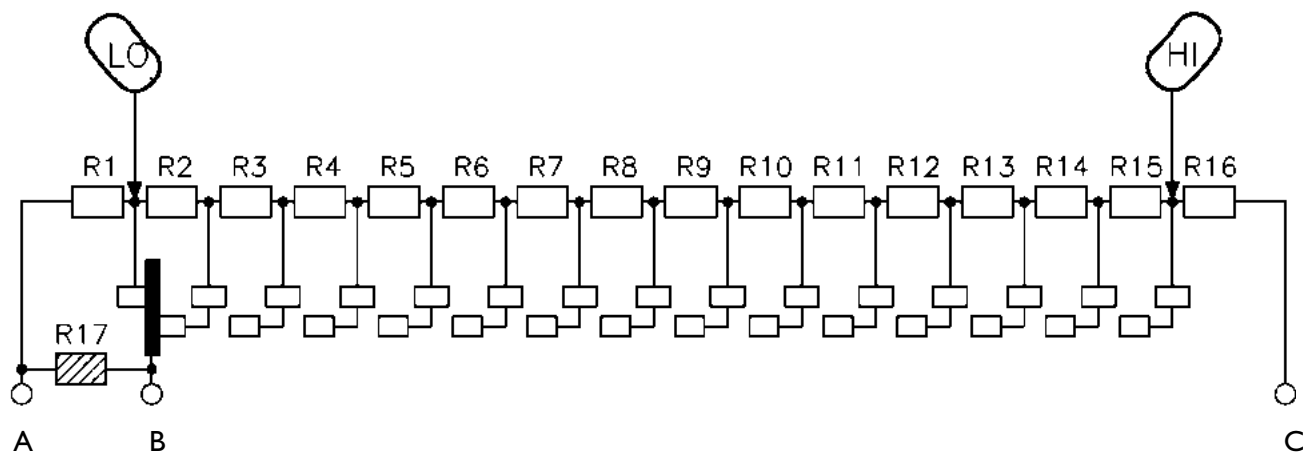
Resistances R1 to R16 are approx. 700 Ohm.

Resistance R17 is approx. 1.1 Mohm

The total resistance R is approx. 11 kOhm.

It is connected to pin 2 and 9 connector A of the control unit.

Figure 238



000265t

POTENTIOMETER POSITION DETECTION LAYOUT

A. Signal earth (ms7) – B. Signal to control unit pin 2 connector A – C. positive from control unit pin 9 connector A

Ventilation control potentiometer

This is a potentiometer connected to the ventilation control knob positioned on the climate control panel.

It detects the various angular positions (Figure 240) and transmits a signal to the electronic control unit for a total of six different positions, four of which are manual flows (1, 2, 3, and 4), one no air flow (0) and one automatic (AUTO).

It is supplied by the control unit at 5 V.

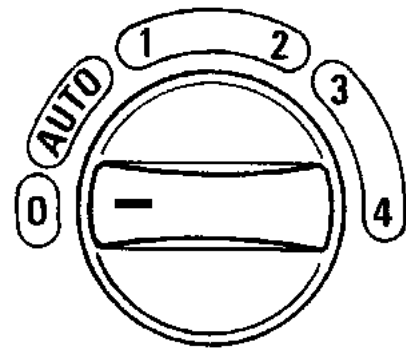
The resistance R1 to R7 are approx. 1.5 kOhm.

Resistance R8 is approx. 1.1 Mohm.

The total resistance R is approx. 10.5 kOhm.

It is connected to pins 3 and 9 connector A of the control unit.

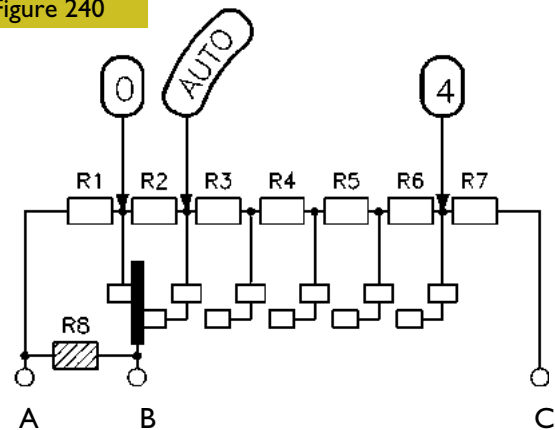
Figure 239



000256t

VENTILATION CONTROL KNOB

Figure 240

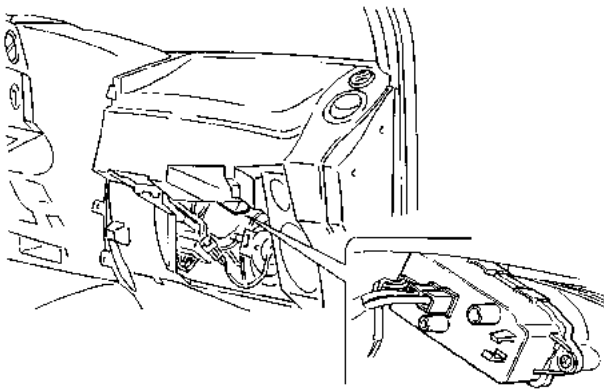


000266t

POTENTIOMETER POSITION DETECTION LAYOUT

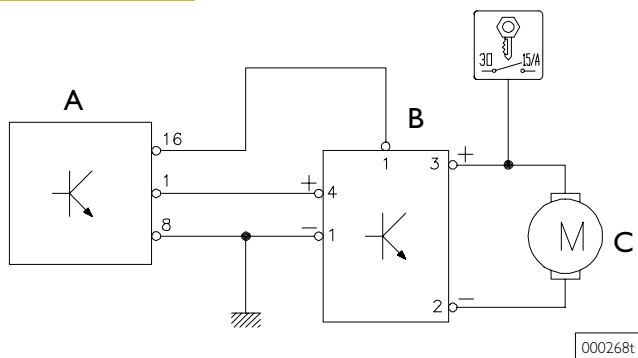
A. Signal earth (ms7) – B. signal to control unit pin 3 connector A – C. Positive from control unit pin 9 connector A

Figure 241



LOCATION OF FAN ELECTRONIC CONTROL MODULE

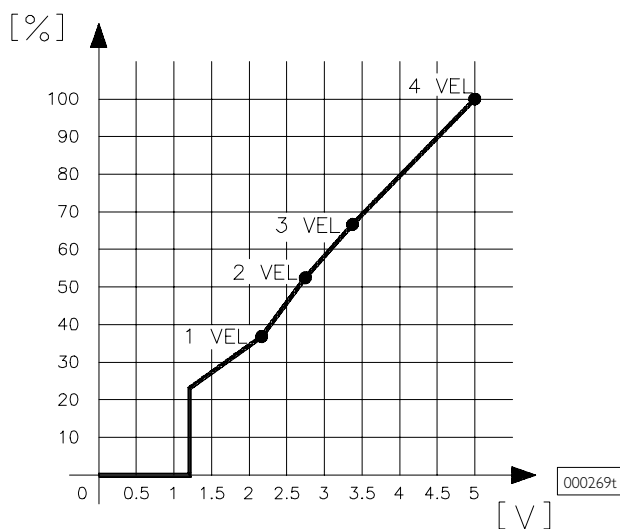
Figure 242



ELECTRONIC FAN CONTROL MODULE CONNECTIONS

A. Electronic fan control module – B. Electronic climate control unit – C. Fan motor

Figure 243



GRAPH OF AIR FLOW RATE IN RELATION TO VOLTAGE

Electronic fan control module

This is an electronic circuit inside the distributor unit near the fan (Figure 241) and it adjusts the fan speed.

It is driven by the control unit with a voltage of between 0 and 5 Volt.

It drives the fans with a voltage of 0 to 12 Volt.

It is connected to pins 1 and 16 connector B of the control unit.

The graph (Figure 243) represents the air flow rate in relation to the control voltage from the control unit.

Air mixing gear motor

The gear motor formed of a motor and potentiometer is positioned inside the distributor unit and acts on the port that sends or does not send the flow of incoming air onto the heater radiator to be able to adjust the required temperature.

The potentiometer detects the actual position of the mixing port and informs the control unit of its position. The control unit reaches the two extreme positions, which correspond to the request for the coldest position “LO” and the warmest position “HI” inverting the polarity on pins 14 and 15 of connector B of the control unit.

- + 15 / – 14 for “LO” function
- 15 / + 14 for “HI” function.

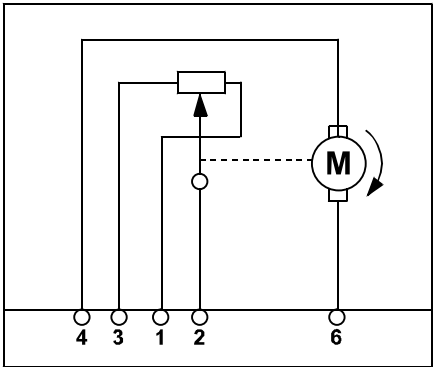
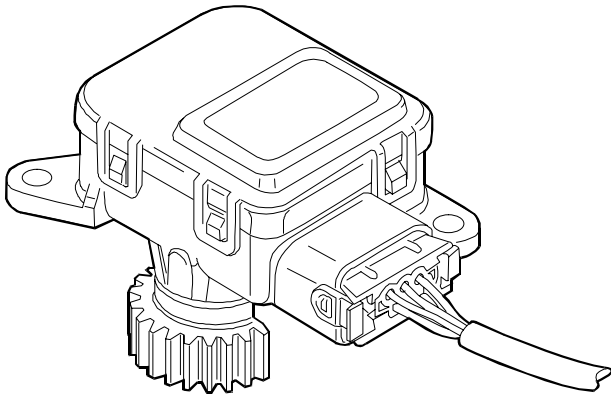
Motor

This is supplied by the control unit at 12 V. It is connected to the control unit on pins 14 and 15 of connector B of the control unit. Loadless absorption is ≤ 60 mA, in D.C. it is ≤ 380 mA.

Potentiometer

It is supplied by the control unit at 5 V. The resistance is 4.7 kOhm. It is connected to the control unit on pins 7 and 9 connector A and on pin 4 connector B of the control unit.

Figure 244



8669

Pin	Cable colour	Function
1	White–Blue	Positive (5 V) for potentiometer from pin 9 connector A of the control unit
2	Grey–Black	Reference voltage (0 to 5 V) from pin 4 connector B of the control unit
3	Black	Signal earth
4	Yellow–Green	Supply (0 to 12 V) for motor from pin 15 connector B of the control unit
5	–	–
6	Blue–Red	Supply (0 to 12 V) for motor from pin 14 connector B of the control unit

Re-circulation gear motor

The gear motor is located on the front part of the distributor unit and acts on the air inlet port.

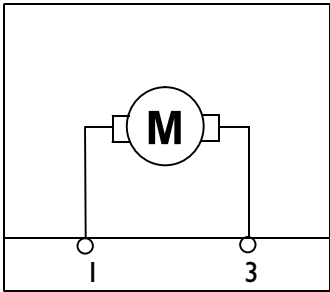
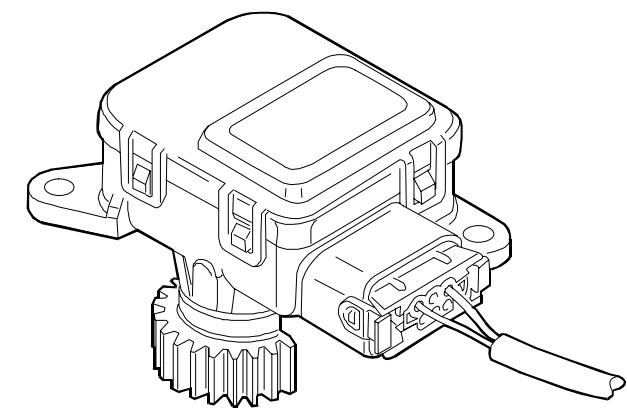
The control unit opens or closes this port to control air inlet from outside or re-circulation inverting the polarity on pins 10 and 11 of connector B of the control unit.

+ 11 / - 10 to switch on re-circulation

- 10 / + 11 for outside air inlet.

There are no intermediate positions. It is supplied by the control unit at 12 V. It is connected to the control unit on pins 10 and 11 connector B of the control unit. Loadless absorption is ≤ 60 mA, in D.C. it is ≤ 380 mA.

Figure 245



8668

Pin	Cable colour	Function
1	Blue-Red	Supply (0/12 V) from pin 11 connector B of the control unit
3	Brown	Supply (0/12 V) from pin 10 connector B of the control unit

Compressor

This is fitted on the left-hand side of the engine and it is a NIPPONDENSO SCROLL 08.

The fluid used is "Freon R 134A".

The quantity of fluid is 720 grams.

The type of oil used is solely ND Oil 08.

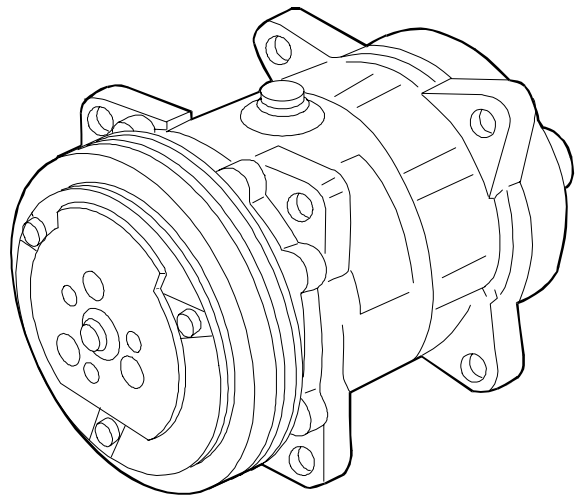
The quantity of oil is 80 grams.

Safety pressure switches

These are fitted directly on the dryer filter (Figure 248).

The minimum "A" and maximum "B" pressure switches make it possible to keep the pressure constant in the system between a minimum of 2 bar and a maximum of 27 bar, while the average set at 19 bar is used to switch on the condenser fan.

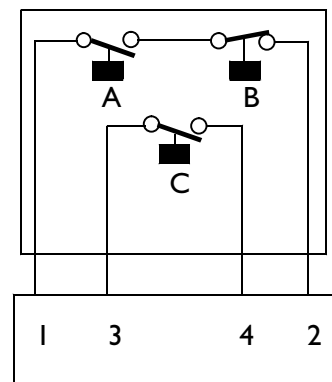
Figure 246



COMPRESSOR

000274t

Figure 247



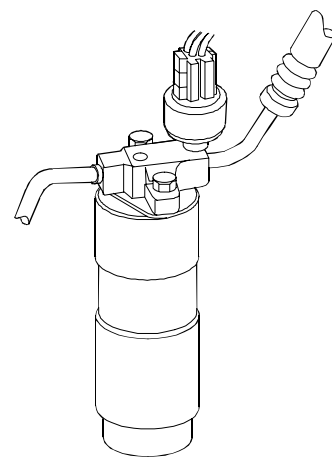
PRESSURE SWITCH UNIT WIRING DIAGRAM

A. Minimum = 2 bar – B. Maximum = 27 bar –

C. Average = 19 bar

8666

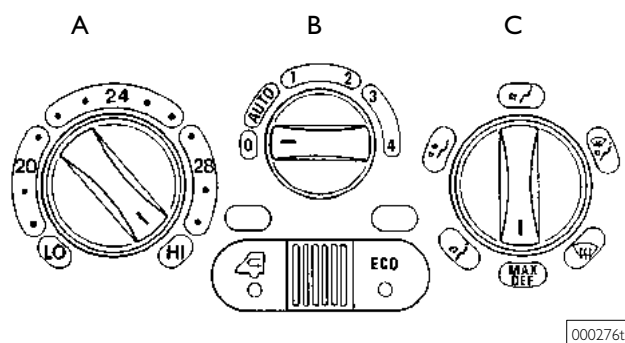
Figure 248



PRESSURE SWITCH UNIT ON DRYER FILTER

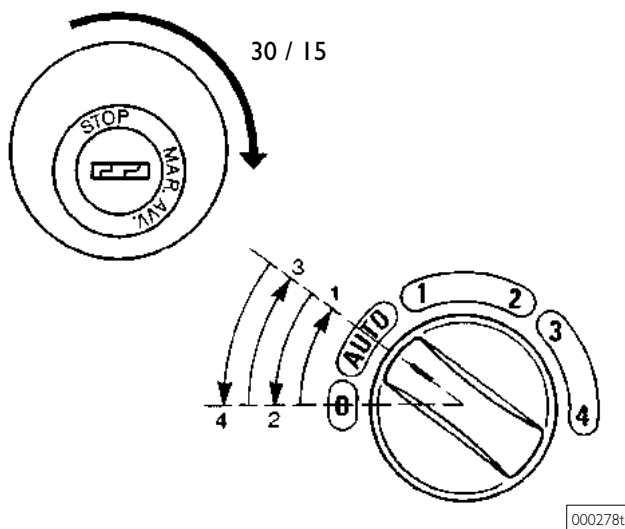
8666a

Figure 249



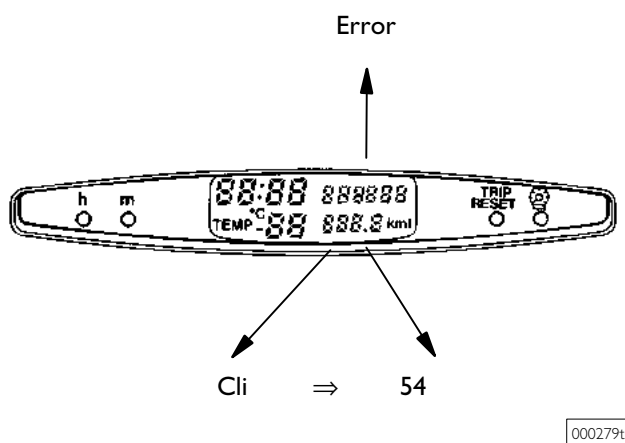
CLIMATE CONTROLS ASSEMBLY
A. Required temperature setting knob
B. Speed control knob
C. Air distribution knob

Figure 250



IGNITION SWITCH AND FAN SPEED CONTROL
KNOB SETTING

Figure 251



DISPLAY ON INSTRUMENT CLUSTER

SYSTEM SELF-DIAGNOSTICS

Through suitable control logic the control unit is able to memorise and display a series of faults (present and/or intermittent) that may occur to the system.

In the event of these faults the control unit still continues controlling the system replacing the abnormal values detected with suitable "recovery" values which ensure minimal operation of the system.

As a fault arises, the control unit shows the wording "Error Cli" on the display on the instrument cluster.

- ☐ For preliminary information it is possible to show any faults on the display on the instrument cluster following a precise procedure.
- ☐ For complete more thorough diagnostics it is however necessary to use the diagnostic tools available to the service network such as MODUS.

Diagnostics through blink code

To find out which is the component concerned, proceed as follows:

Move the temperature setting knob to the "HI" position (Ref. A Figure 249).

Move the fan control knob to the "0" position (Ref. B Figure 249).

Move the air distribution knob to the "MAX DEF" position (Ref. C Figure 249)

Engage the ignition switch (Figure 250) at the services position (+15).

Within 10 seconds, operate the fan control knob (Figure 250) with the following sequence:

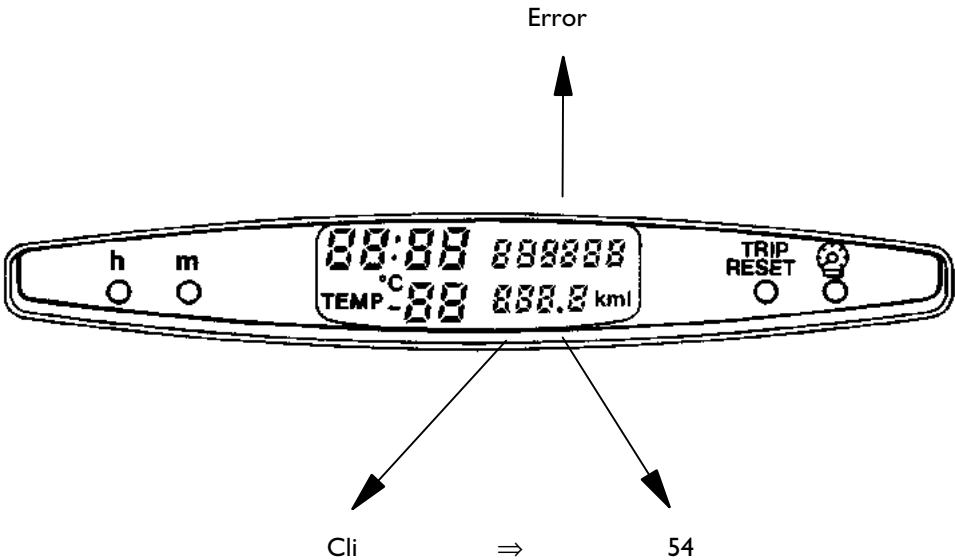
"0" ⇒ "AUTO" ⇒ "0" ⇒ "AUTO" ⇒ "0".

At this point the display on the instrument cluster (Figure 251) displays the error code. If more than one error is present, they are displayed every 3 seconds.

Blink codes

The table below shows the different error codes that may appear on the display on the instrument cluster instead of “CLI” during diagnostics.

Figure 252



000279t

Codice	Description
I4	Short circuit or open circuit of blown air temperature sensor
32	Short circuit towards earth of outside temperature sensor
34	Short circuit or open circuit of outside air temperature sensor
42	Short circuit towards earth of inside temperature sensor
44	Short circuit or open circuit of inside air temperature sensor
52	Short circuit towards earth of evaporator temperature sensor
54	Short circuit or open circuit of evaporator temperature sensor
65	Air mixing gear motor failure
82	Short circuit towards earth of required temperature potentiometer
84	Short circuit or open circuit of required temperature potentiometer
92	Short circuit towards earth of ventilation control potentiometer
94	Short circuit or open circuit of ventilation control potentiometer
B2	Short circuit towards earth of air mixing potentiometer signal
B4	Short circuit or open circuit of air mixing potentiometer signal
D5	Fan electronic control module failure
E2	Short circuit towards earth of pin 9 of connector A of control unit for supplying potentiometers
E3	Short circuit towards positive of pin 9 of connector A of control unit for supplying potentiometers
F6	Supply voltage over maximum limit
F7	Supply voltage below minimum limit

AIR BAG

General

The air bag is a passive safety device comprising one or two cushions which, in the event of a head-on crash, inflate automatically setting themselves between the body of the occupants and the front structures of the cab.

The system is always integrated by seat belts with pretensioner, which are controlled by the air bag control unit, in the event of head-on crashes.

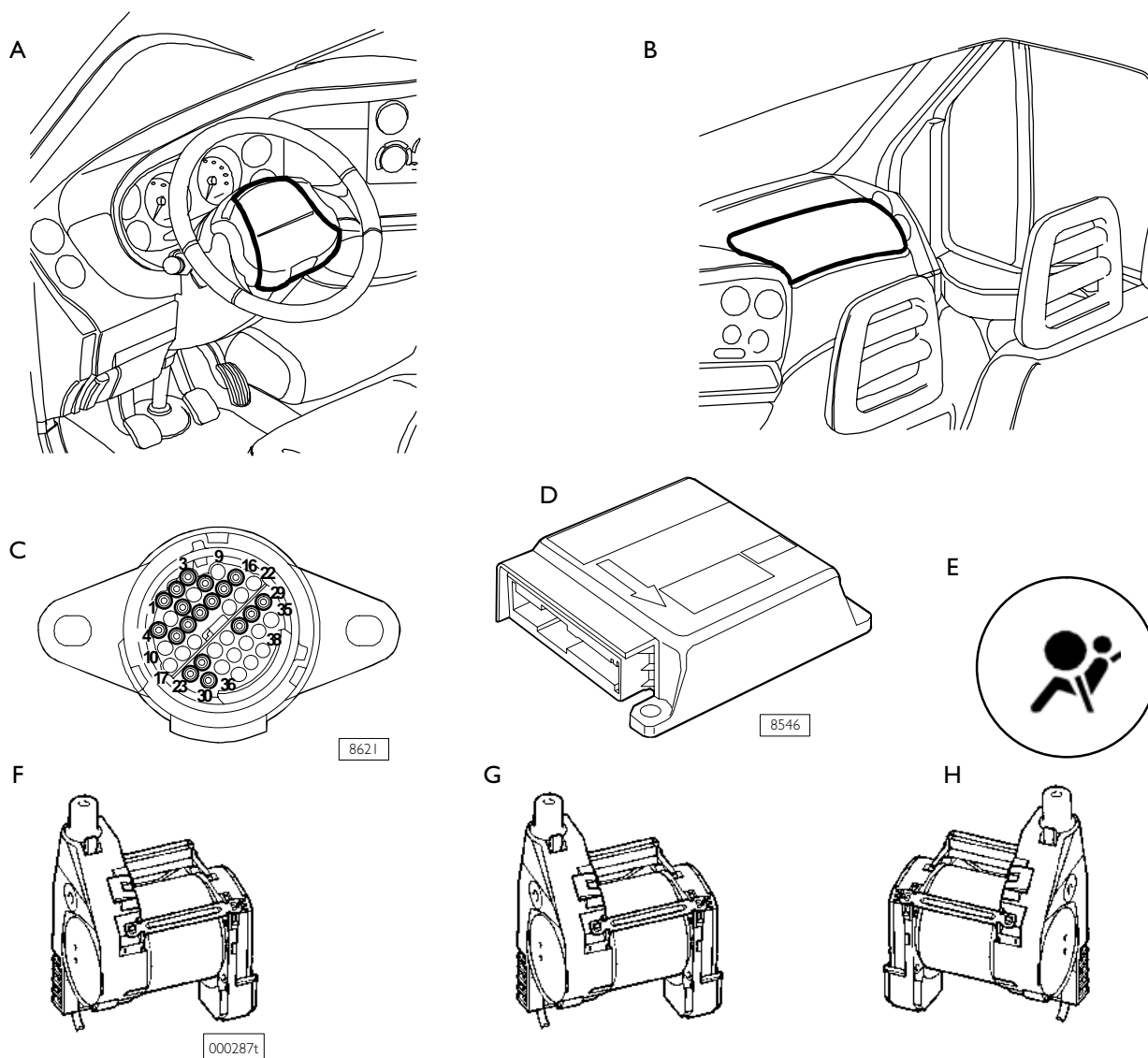
The system does not cut in for front crashes at low speed, side crash, overturning or crashes from behind.

NOTE The air bag is complementary to the use of the seat belts and not in replacement of them.

Inflation of the bags without the restraint of the belts compromises the safety of the driver and passengers.

The system components are connected to one another and with the rest of the electric system through a special harness, that can be easily recognised as it has a yellow sheath which is connected to the cab/bonnet cable by a 6-cell connector.

Figure 253



AIR BAG SYSTEM COMPONENTS

A. Driver's air bag module – B. Passenger's air bag module – C. 38-pin diagnostic connector – D. Electronic control unit – E. Air bag failure warning light on instrument cluster – F. Driver's reel with pretensioner – G. Centre reel with pretensioner – H. Passenger's side reel with pretensioner.

Operation

The air bag system consists of a cushion which inflates instantly contained in a special recess in the centre of the steering wheel for the driver and in the dashboard for the two passengers.

In the event of a head-on crash a deceleration sensor inside the air bag control unit activates the pretensioners and the instantaneous inflating device of the cushion or cushions which act as protective barrier between the body of the occupants and the vehicle structure. Immediately afterwards the driver's air bag and, if requested, the passenger's air bag deflate.

Deployment of the air bag system produces heat and a small amount of powder. This powder is not harmful and does not cause fire. In addition the surface of the

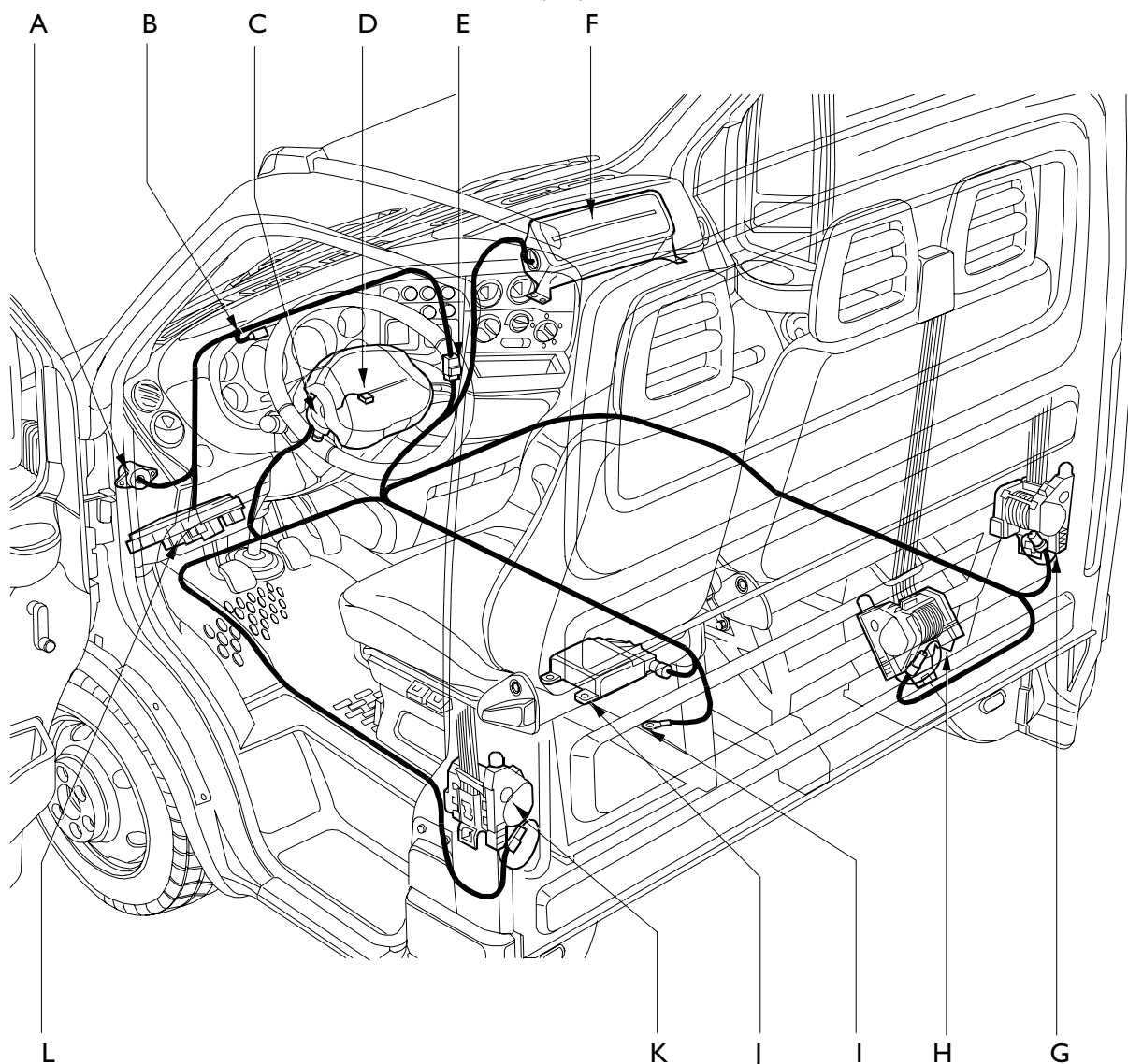
deployed bags and the inside of the vehicle may be covered with dust: this may irritate the skin and eyes. In the case of exposure, wash with neutral soap and water.

NOTE Turning the ignition switch to MAR, the air bag failure warning light turns on for four seconds as system self-diagnostics takes place.

Each time the system is activated, the control unit keeps the failure warning light on the instrument cluster on and it will be necessary to change the whole system (control unit, belts and pretensioners, bags and harness).

The system does not require any maintenance or checks.

Figure 254



LOCATION OF AIR BAG SYSTEM COMPONENTS AND CABLE

A. 38-pin connector for diagnostics – B. Air bag failure warning light – C. Cock spring – D. Driver's air bag module – E. Connection between cab/bonnet cable and air bag cable – F. Passenger's air bag module – G. Passenger's reel with pretensioner – H. Centre reel with pretensioner – I. Air bag earth – J. electronic control unit – K. driver's reel with pretensioner – L. relay/fuse holder support

8556

Rules of safety to be followed for operations on vehicles fitted with the air bag system supplied to us by the supplier.



The following rules must absolutely be followed when doing any work concerning vehicles fitted with safety system with air bag.

Preliminary rules



Remember that air bag modules are devices to be handled with care. Their use, transport and storage are ruled by the following procedures.

Before starting any body repair work, welding, work requiring the removal of air bags or of the control unit, it is necessary to:

- ☐ move the ignition key to "STOP" and remove it
- ☐ always disconnect the battery, i.e.: disconnect the two terminals from their post and isolate them taping appropriately
- ☐ wait for at least 10 minutes before proceeding
- ☐ disconnect the control unit connector.

Store the modules with the cover upwards in a key-lockable metal cabinet. The cabinet, to be used for this purpose only, must not be used for storing other types of material, especially if inflammable.

All the connectors used and wired on air bag modules contain a short circuit clip. Up to the moment in which the air bag modules are connected to an appropriate source of energy, there is no possibility of undue activation of the units.

A system component not activated during an accident is to be considered still "active".

Therefore, undeployed components to be removed from vehicles (due to faults, guarantee expiry or other causes) must be returned to the special centre through the procedure described below.

NOTE The assembly or disassembly of components may ONLY be carried out by competent and authorised personnel.

The failure to follow the instructions given below may involve unwanted activation of the system, personal injury or unnecessary system repair. IT IS STRICTLY PROHIBITED TO DISASSEMBLE AIR BAG MODULES STRIPPING THEIR COMPONENTS.

All the system components have been specifically designed to work on vehicles of a specific brand and type. Therefore, air bags cannot be adapted, re-used or installed on other vehicles than the one for which they have been designed and manufactured.

NOTE Any attempt to re-use, adapt or install them on a different type of vehicle may cause serious or lethal harm to the occupants of the vehicle in the event of a crash.

Operations after an accident

NOTE If any component of the safety system is damaged following an accident, it should be replaced.
Do not attempt to repair the control unit, clock spring or air bag modules.

Accidents with or without deployment of the air bag device

Some system components should be inspected whether the system has been activated or not. These components are:

- ☐ steering column;
- ☐ steering column support;
- ☐ electronic control unit and modules retaining area;
- ☐ clock spring;
- ☐ dashboard (in the passenger's air bag area).

The component must be replaced in the presence of distortion, breakage and flexure.

Accidents with the deployment of the air bag device

If the vehicle has undergone a head-on crash involving the total deployment of the system, the following components must be replaced:

- ☐ air bag modules;
- ☐ pretensioners;
- ☐ electronic control unit;
- ☐ clock spring.

The harness and connectors should be inspected for signs of burns, melting of the outer insulation or damage due to excessive heat.

Any signs of damage on the clock spring in the control unit retaining area and on the air bag modules call for the replacement of the damaged components.

Painting work

No particular rules of safety are to be followed for painting work followed by oven drying, as the modules and pretensioners have been designed in such a way that they will not be damaged heating the outer surfaces of the vehicle with normal paint drying systems.

It is prohibited to use naked flames near the modules.

All electronic control units (including the air bag system) should always be removed if their temperature in certain environments may reach or exceed 85 °C.

Health hazards

The precautions to be taken when handling deployed air bags are the following:

- ☐ use protective polyethylene gloves and safety goggles;
- ☐ after touching triggered air bags, wash your hands and the parts of the body exposed with soap and water.

Effects of over-exposure

There is no potential hazard of exposure to the propellants as the system is completely sealed.

The propellant mixture is in the solid state, therefore inhalation is impossible even in the event of breakage of the gas generator cartridge.

Should any gas come out there is not health hazard.

Avoid any contact with the skin and do not swallow the propellant.

In the event of:

- ☐ contact with the skin wash immediately with soap and water;
- ☐ contact with the eyes: wash immediately with running water for at least 15 minutes;
- ☐ inhalation: take the person outdoors immediately;
- ☐ swallowing: induce vomit if the person is conscious.



Always call a doctor for all the above conditions.

Rules of safety in handling air bag modules

Under normal conditions the driver's and passenger's air bag are activated by the electronic triggering device during the crash. The gas developed (mainly nitrogen) under these conditions is not harmful.

Personnel carrying out operations on the device fitted on vehicles must absolutely adhere to the rules of safety given below.

Personnel operating on these devices must be suitably trained and follow the precautions given below:

- ☐ In open (exploded) air bag removal and replacement operations handle only one air bag at a time and for removal use polyethylene gloves and protective goggles.
- ☐ Always rest the air bag module with the opening lid and pre-split groove facing upwards. Do not put anything on top of this lid.
- ☐ Afterwards wash your hands carefully with neutral soap and in the event of contact with the eyes of residual powder, rinse immediately with running water.
- ☐ Before starting work on the system, disconnect the two battery cables (firstly the negative one) isolate the terminals with insulating tape and wait at least 10 minutes before proceeding.
- ☐ The metal components of an air bag that has just been deployed are very hot. Avoid touching these components for 20 minutes from the time of air bag deployment.
- ☐ Do not carry out repairs on air bag modules. Send all faulty modules to the supplier. Do not heat the air bag module for example by welding, hammering, drilling, mechanical machining etc.
- ☐ Never install on the vehicle air bags that have been dropped or show signs of any type of damage.
- ☐ It is prohibited to keep air bags together with inflammable material or fuel.
- ☐ The gas generators must not come into contact with acids, greases and heavy metals. Contact with these substances may cause the formation of poisonous, harmful gas or explosive compounds.
- ☐ Never use naked flames near air bag devices and system components.

Any spare parts should be stored in their original packing and temporary storage should follow the same procedure as for an undeployed air bag removed from the vehicle, i.e. a key-lockable metal cabinet must be used, especially for this purpose (metal, shock resistant cabinet with grilles to allow natural ventilation inside). The cabinet must have special warning notices (DANGER EXPLOSIVES – NO NAKED FLAMES – NOT TO BE OPENED BY UNAUTHORISED PERSONS).

Air bag module scrapping

The air bag modules fitted on the vehicle must not be scrapped with the vehicle itself, but removed beforehand and then deployed as described in the following pages.

Air bag units must not be scrapped without firstly deploying them.

If the air bag module has not been activated during a crash, the device is to be considered as still charged.

All unexploded material **MUST NOT BE ACTIVATED** and should be sent to a specialised centre with the following wording on the delivery note:

- ☐ AIR BAG DEVICE CONTAINING EXPLOSIVE CHARGE TO BE DEACTIVATED

The devices must absolutely be shipped in the same package in which the spares are received and if this is not available it is possible to ask the SPARES division for the package only.

Clearly in the case of replacing air bag devices the original packing should be kept intact for sending the undeployed device.

For FOREIGN MARKETS follow local regulations.



The failure to follow the procedures listed here may cause undue activation of the air bag units and personal injury. Undeployed air bag units must NOT be disposed of through the usual refuse disposal channels. Undeployed air bag units contain harmful substances for the health and may cause personal injury if the sealed container which contains them is damaged during disposal.

Rules of safety in handling pretensioners

In the event of a head-on crash, the driver's and passenger's pretensioners are activated an instant before the air bag modules.

The personnel that intervenes on the devices must be suitably trained and observe the following precautions:

- ☐ When handling activated pretensioners, i.e. when the propellant has already been triggered, use protective gloves and goggles.
- ☐ At the end of operations wash your hands carefully with neutral soap and in the event of contact of residual powder with the eyes, rinse immediately with running water.
- ☐ Disconnect the two battery cables (firstly the negative one) isolate the terminals with insulating tape and wait at least 10 minutes before proceeding.
- ☐ During activation the pretensioner develops heat; it is therefore necessary to wait at least 10 minutes after deployment, before touching them.
- ☐ During transport or handling, pretensioners should be protected from shocks or falling; pretensioners that have been knocked or dropped must not be used and must be returned to the supplier stating the reason.
- ☐ Pretensioners should not be carried by the belt.
- ☐ Pretensioners must be protected from sparks and naked flames; they should not contact surfaces for over 6 hours with temperatures above 100 °C.
- ☐ The gas generator propellant that is not burnt is inflammable, therefore, the parts of the generator should never be taken to pieces, damaged or tampered with.
- ☐ It is prohibited to store pretensioners with inflammable materials or fuel.
- ☐ The gas generators must not come into contact with acids, greases and heavy metals. Contact with these substances may cause the formation of poisonous, harmful gas or explosive compounds.
- ☐ Belts with pretensioners may only be stored in key-lockable places or cabinets, ventilated and away from naked flames and sources of heat.



After every crash in which the pretensioner has been activated, the belt is unserviceable and must be replaced.

Scrapping pretensioners

Undeployed pretensioners (not fitted on the vehicle) to be scrapped must firstly be deployed; those not activated but fitted on the vehicle must be removed and not scrapped with the vehicle.

If the pretensioner was not activated during a crash, the device is to be considered as still active; proceed as described in this manual.

Operations on system components

At the end of every operation on the system, it must be checked using Modus, I.W.T. or other diagnostic tools.

During assembly, the air bag components are labelled with a sticker with a removable part stating the date of installation of the system and components. The removable part is detached and the information on it is filed together with the system check report supplied by Modus, by the workshop that installed the components.

After 10 years from installation, unless the components are replaced before that time, a new air bag system (cable and components) should be installed. As mentioned previously, the data concerning the components and the date of system installation are to be filed.

Removing and scrapping an activated air bag module and pretensioner from a vehicle

Always wear gloves and safety goggles for handling an activated air bag or pretensioner. Wash the hands and exposed skin immediately with neutral soap and water after handling the components of an air bag module or pretensioner. In the case of exposure to secondary products, immediately rinse the eyes with running water. The failure to comply with these instructions may result in injury.

To remove and scrap an already activated air bag module and pretensioner:

1. Follow the instructions given in this manual for removing activated air bag module and pretensioners.
2. Disconnect the air bag module and pretensioner mechanical fastenings.
3. Disconnect the component connector from the air bag harness.
4. Place the air bag module and pretensioner in a special sealed polythene bag.
5. Send to the authorised collection/disposal centre.
6. Dispose of, recycle or scrap deployed air bag modules and pretensioners in the appropriate manner.

The residues left by combustion of the propellant require some consideration. They are mostly concentrated in the generator body or in small quantities in the bag. These residues may contain copper or chloride (e.g. potassium chloride). If the propellant is based on sodium azide or potassium nitrate, the combustion residues are highly alkaline and corrosive. **Always wear appropriate protection for the eyes and skin.** Deployed air bags should always be stored in dry, suitably ventilated places.

Removing or scrapping an air bag module that has not been deployed from a reparable vehicle



Do not cut cables or tamper with the connector between the vehicle harness and the air bag module. The connector contains a safety circuit.

If the connector is cut or removed from the air bag unit, the safety device is disabled and this could cause unforeseen activation with serious consequences for the physical integrity of people.

Air bag systems have a reserve power unit in the control unit. This must be deactivated disconnecting the two battery terminals and waiting for at least 10 minutes before doing any work on any components of the air bag.

When handling an air bag module, always keep the bag and outer cover away from the body. When positioning an active air bag on a bench or other surface, always place the bag and its cover upwards, not on the resting surface and away from people. Never put any object near an active air bag as it would become a bullet in the event of deployment.

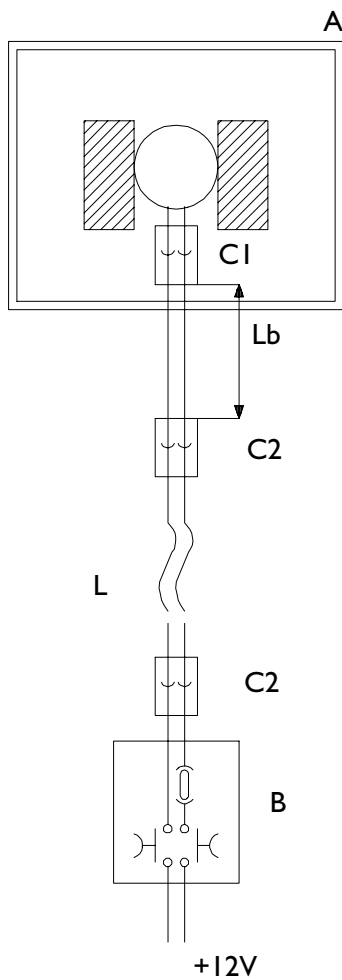


Always keep active, undamaged, air bag modules and pretensioners in a cool, dry, locked and safe place. Do not expose to naked flames or temperatures above 150 °C. Do not cut, drill, braze weld an air bag module or its components with electric current. Never expose an air bag module or pretensioner to electric currents. The failure to comply with these instructions may damage the unit, cause fire, cause unforeseen deployment and serious harm to persons.

Active, damaged air bag modules and pretensioners (e.g. breakage of the electrical connection) must be kept away from corrosive or oxidising substances. The failure to comply with these instructions may cause fire, and/or serious harm to persons.

NOTE The air bag modules and pretensioners have an energy reserve. This device gives the electric pulse needed to deploy the bag if the battery or cables are damaged during the crash before the sensor activates the gas generator.

Figure 255



8663

REMOTE DEPLOYMENT OF AIR BAG MODULES

C1 = air bag module connector

C2 = Connector to remote deployment device (connector for air bag with circuit clip; counterparts with male pins on air bag side)

Lb = bridle length – approx. 1 m

L = general cable, safety distance 10 m

A. Enclosed area

B. Remote deployment device

Deployment of an air bag

Remote activation

General instructions

1. The deployment procedure can be carried out in a suitably identified and enclosed open area away from potentially inflammable materials, fluids or other substances and from persons. Place the air bag module on a firm surface and clamp it closely.
2. Clean the area on which the module is placed from materials and bits (glass, instruments, pieces, etc.) which could be thrown out during deployment.
3. Make sure that connector C2 is disconnected from the remote deployment device (10 m).
4. Connect the electrical connector C1 specified by the vehicle manufacturer to the air bag module
5. Connect connector C2 to the remote deployment device.
6. Connect the remote deployment device to a 12 V circuit or equivalent device.
7. Make sure all persons are under shelter.
8. Wear accident prevention goggles and protective clothing.
9. Press the double deployment button
10. After deploying an air bag module, let it cool before touching it (about 20 min.).
11. Dispose of, recycle or scrap activated air bag modules according to the cases, as described in the corresponding chapters.

Deployment of air bag modules and electronic pretensioners still on board of irreparable vehicles

This procedure is followed when the vehicle with one or more active air bags needs to be scrapped. This procedure applies whether the air bag and/or pretensioner system is still intact or not.

It is advisable to deploy the explosive charges on the vehicle directly connecting the electric connector of the single module to the remote deployment system.



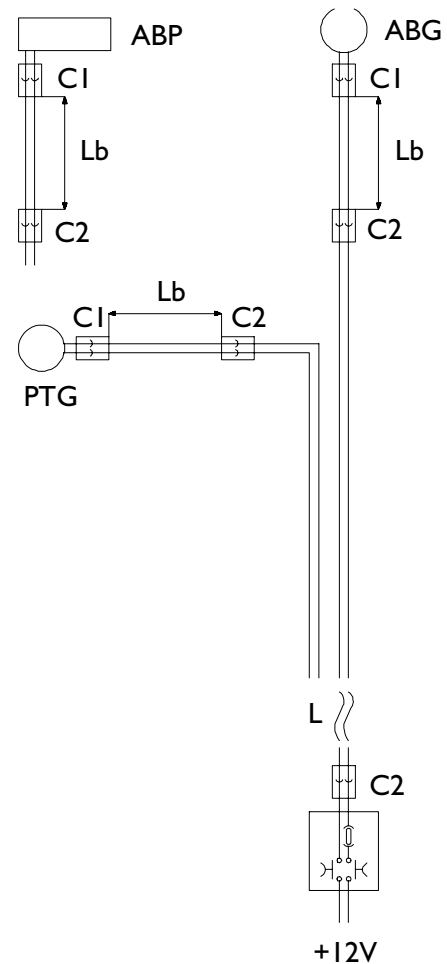
The deployment procedure must be carried out away from other persons in a suitably identified area. Check that no type of object has been left near the modules and pretensioners and make sure that there are no inflammable liquids in the vicinity. No-one should remain on board during deployment and remember to close the vehicle doors. Personnel should stay under shelter (e.g. behind a wall, vehicle, etc.) to protect themselves from any objects that may be thrown. Leave the generators and modules to cool after deployment (wait at least 20 min.). The failure to follow these instructions may result in serious physical harm.

General instructions

1. Follow all the WARNINGS, PRECAUTIONS and safety instructions given in this manual.
2. Take the vehicle to the area foreseen.
3. Remove all materials and bits (glass, instruments, pieces, etc.) around the air bag cover and check that there are no inflammable fluids in the immediate vicinity.
4. Disconnect the two battery cables (firstly the negative one) and wait at least 10 minutes before proceeding.
5. Use a connection bridle (L = approx. 1 m) with specific terminal connector for electrical connection with the module to be deployed.
6. Reach the electrical connection of the module in question (air bag or pretensioner) following the instructions given in this manual.
7. Disconnect connector C1 of the air bag module or pretensioner.
8. Check that connector C2 is disconnected from the remote deployment device.
9. Connect electric connector C1 of the air bag module or pretensioner to the connection bridle of the remote deployment device.
10. Connect connector C2 to the remote deployment device.
11. Make people go to a safe place.
12. Connect the remote deployment device to a 12 V circuit or equivalent device.

13. Press the double activation button to deploy all the air bag modules and pretensioners at the same time.
14. After deploying the air bag modules and pretensioners always let them cool before touching them (about 20 min.).
15. Once the modules and pretensioners have been deployed the vehicle can be scrapped – by squashing or crushing – and/or recycled depending on the cases.

Figure 256

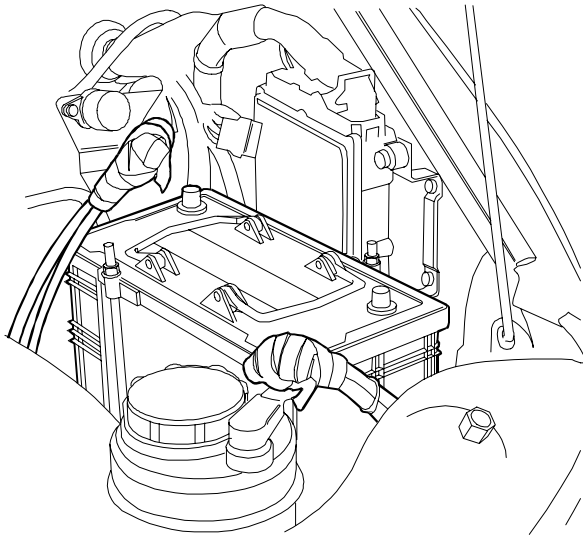


LAYOUT FOR DEPLOYING EXPLOSIVE CHARGES ON THE VEHICLE, SINGLE DEPLOYMENT

- ABG = driver's air bag
 ABP = passenger's air bag
 C2 = connector to remote deployment device
 C1 = specific connector to explosive charge
 L = general cable, safety distance 10 m
 Lb = bridle length
 PTG = driver's pretensioner

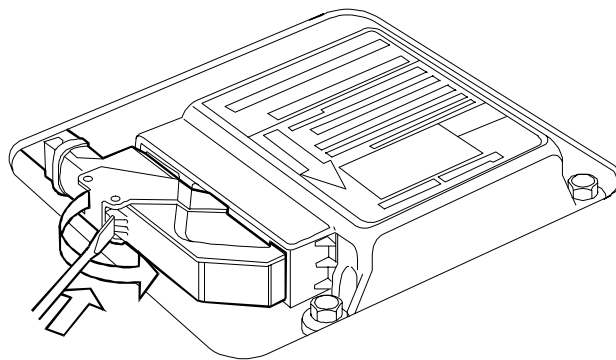
A. Remote deployment device

Figure 257



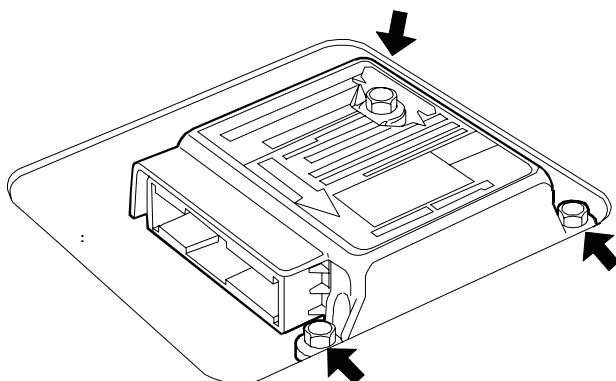
BATTERY CABLE INSULATION

Figure 258



REMOVING THE CONNECTOR FROM THE CONTROL UNIT

Figure 259



REMOVING THE CONTROL UNIT

Electronic control unit

The electronic control unit is located on the floor at the side of the driver's seat between the gearshift lever and the parking brake lever; it is supplied at 12 Volt by a key-operated device, but it is still in a condition to be able to work for about 200 msec after a power cut off.

This is possible due to the presence of a buffer condenser inside which accumulates electric energy for normal operation of the control unit and generate the signal for triggering the explosive capsule.

This way system operation is guaranteed if the crash causes a power system failure (for example damage or breakage of the battery, power cable cut-off etc.).



The control unit must be directed with the arrow printed on the sticker facing the vehicle direction of travel. This is absolutely necessary as it determines the direction in which the deceleration sensor reads the values for defining the crash condition and thus triggering the air bag.

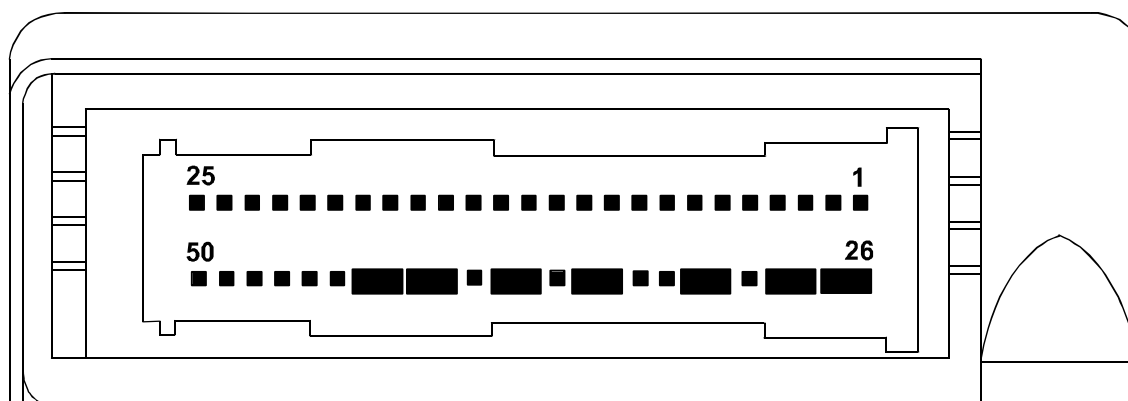
The electronic control unit should always be replaced after a crash that causes deployment of the complete system (air bag and pretensioners).

To remove the control unit:

- ☐ follow the rules of safety
- ☐ disconnect the battery cables (firstly the negative one then the positive) and isolate them taping the terminals
- ☐ wait at least ten minutes before proceeding
- ☐ remove the cover under which the control unit is to be found
- ☐ using a small screwdriver on the catch of the connector that locks the connector fastening lever, turn the latter outwards
- ☐ disconnect the connector from the control unit
- ☐ slacken the three screws fastening the control unit to the floor.

One-connector electronic control unit pin-out

Figure 260

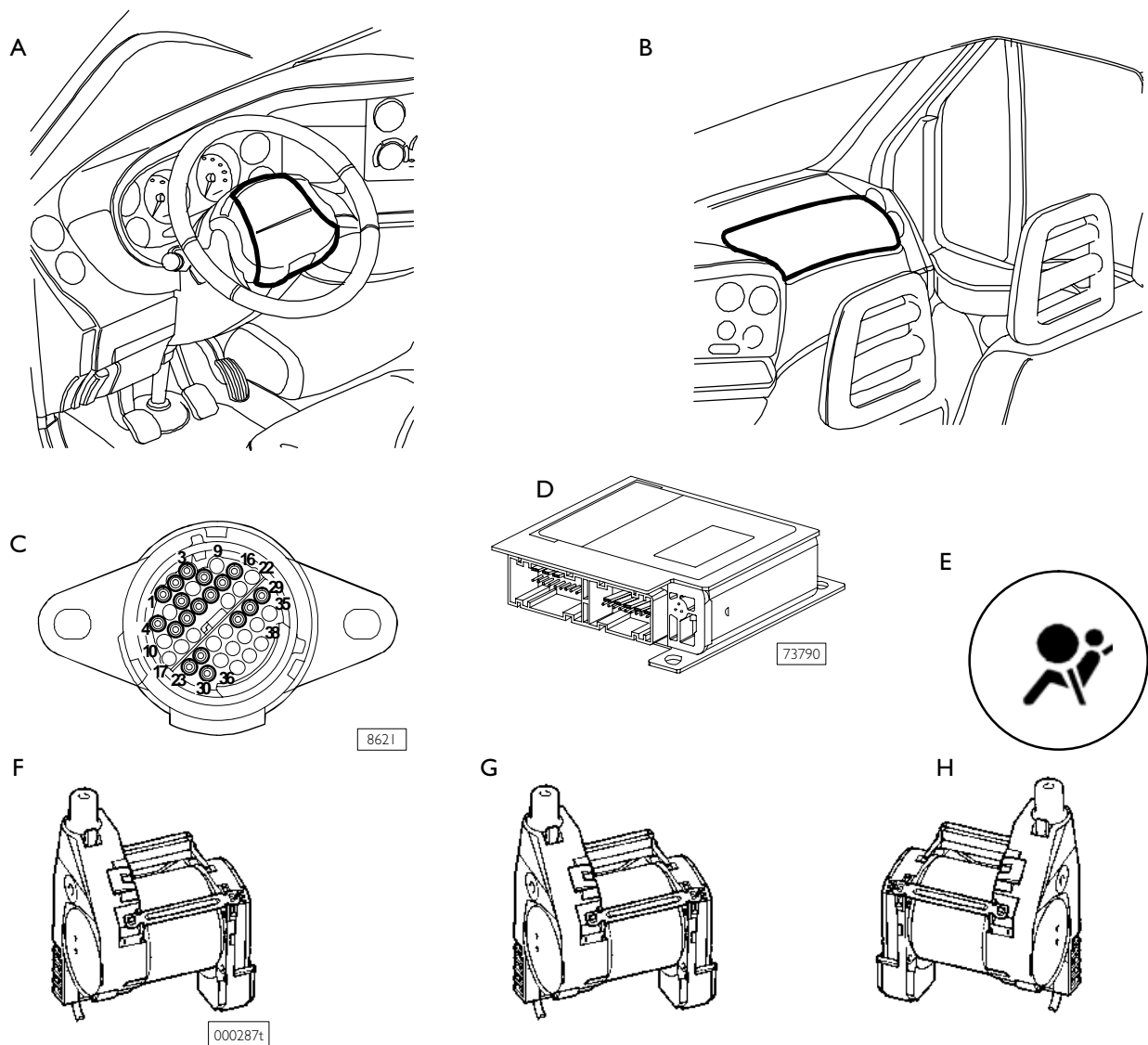


000283t

Pin	Function	Pin	Function
1	Positive for driver's pretensioner	26	Driver's pretensioner short circuit
2	Negative for driver's pretensioner	27	Driver's pretensioner short circuit
3	Positive for passenger's pretensioner	28	Passenger's pretensioner short circuit
4	Negative for passenger's pretensioner	29	Passenger's pretensioner short circuit
5	Key-operated positive supply	30	—
6	Earth	31	Earth short circuit
7	—	32	Short circuit
8	—	33	—
9	Line k for diagnostics	34	—
10	Positive for driver's bag	35	Driver's bag short circuit
11	Negative for driver's bag	36	Driver's bag short circuit
12	—	37	—
13	Positive for passenger's bag	38	Passenger's bag short circuit
14	Negative for passenger's bag	39	Passenger's bag short circuit
15	—	40	Failure warning light
16	Positive for centre pretensioner	41	Centre pretensioner short circuit
17	Negative for centre pretensioner	42	Centre pretensioner short circuit
18	—	43	—
19	—	44	—
20	—	45	—
21	—	46	—
22	—	47	—
23	—	48	—
24	Earth for diagnostics	49	—
25	—	50	—

The figure shows the components of the AIRBAG system with two–connector control unit. This type of control unit shall be fitted on the vehicles in the future to replace the one–connector control unit.

Figure 261

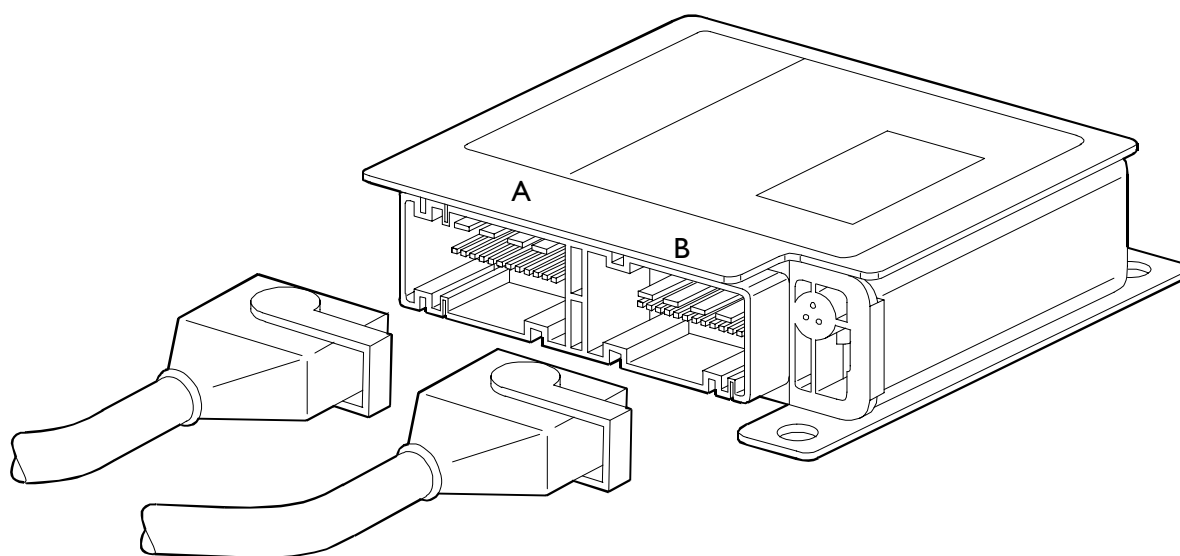


AIR BAG SYSTEM COMPONENTS

A. Driver's air bag module – B. Passenger's air bag module – C. 38–pin diagnostic connector – D. Electronic control unit – E. Air bag failure warning light on instrument cluster – F. Driver's reel with pretensioner – G. Centre reel with pretensioner – H. Passenger's side reel with pretensioner

The two-connector control unit operates within a temperature range of -40 a $+85^{\circ}\text{C}$ with a maximum inclination angle tolerance at installation of $\pm 4^{\circ}$. The control unit weight is 200g max and features software version 4.4 and hardware version 1.1.0. The following figure represents a perspective view of the electronic control unit with two connectors (A and B).

Figure 262

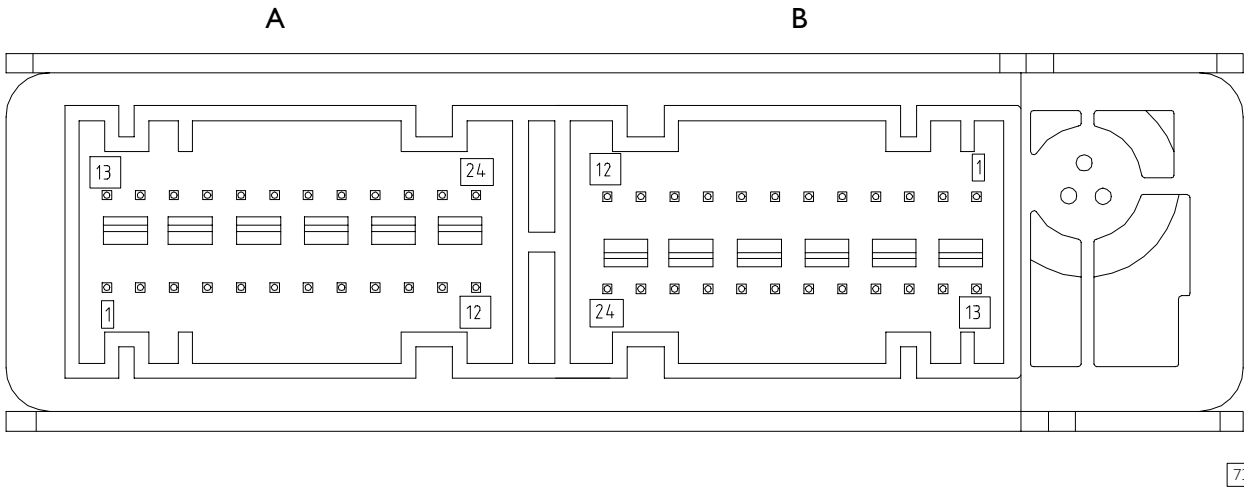


73792

PERSPECTIVE VIEW OF THE ELECTRONIC CONTROL UNIT WITH TWO CONNECTORS
A. Black – B. Grey

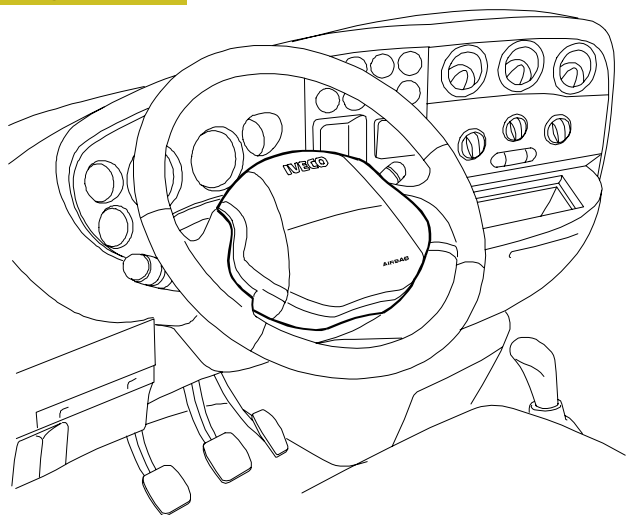
ECU pin-out to the two connectors

Figure 263



GREY CONNECTOR (A)		BLACK CONNECTOR (B)	
Pin	Function	Pin	Function
1	Ground	1	—
2	+15 power supply	2	—
3	K-line for diagnosis	3	—
4	—	4	—
5	—	5	—
6	—	6	—
7	—	7	—
8	—	8	—
9	—	9	—
10	Warning lamp	10	—
11	—	11	—
12	—	12	—
13	—	13	Driver side pre-tensioner positive
14	—	14	Driver side pre-tensioner negative
15	—	15	Front passenger seat pre-tensioner negative
16	—	16	Front passenger seat pre-tensioner positive
17	—	17	—
18	—	18	—
19	—	19	—
20	—	20	—
21	Driver front AIR-BAG positive	21	Front center pre-tensioner positive
22	Driver front AIR-BAG negative	22	Front center pre-tensioner negative
23	Passenger front AIR-BAG negative	23	—
24	Passenger front AIR-BAG positive	24	—

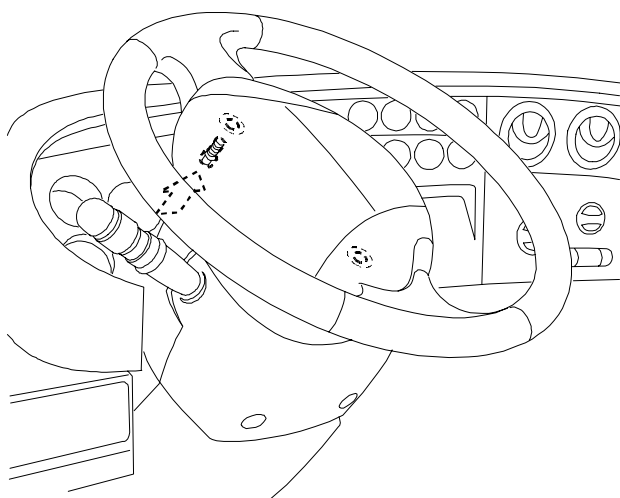
Figure 264



AIR BAG MODULE

8557

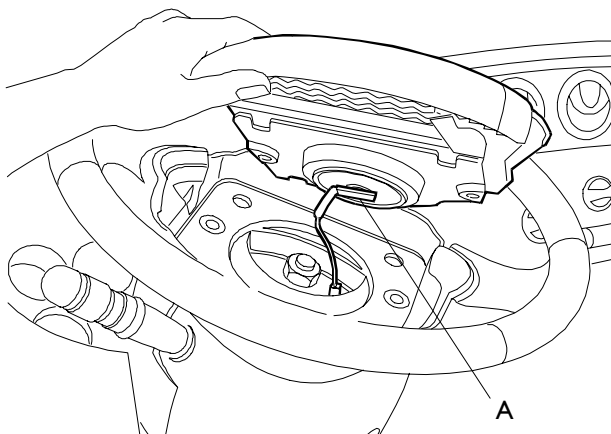
Figure 265



AIR BAG MODULE FASTENING SCREWS

8558

Figure 266

AIR BAG MODULE REMOVAL
A. Connector

8559

Drivers air bag module

The module is at the centre of the steering wheel.

It mainly comprises the following:

- ☐ a bag inflation device, containing the triggering device and the explosive charge
- ☐ a synthetic fibre bag, folded in a special wrapping
- ☐ a plastic cover which at the centre and sides has pre-established splitting lines which allow the bag out.
- ☐ A plate that fastens the module to the steering wheel with two screws

Inflation of the bag takes place through the pre-established controlled expansion of the volume of inert harmless gas (ARGON), contained in a special module, after the heating caused by a charge of solid propellant.

The rear part of the bag has suitably-sized holes which deflate the bag immediately after inflation.

To remove the air bag module, proceed as follows:

- ☐ follow the rules of safety
- ☐ disconnect the battery cables (firstly the negative one then the positive) and isolate them taping the terminals;
- ☐ wait at least ten minutes before proceeding;
- ☐ slacken the two screws in the rear part of the steering wheel; to gain access to each screw, turn the steering wheel to be able to always work from the part of the upper steering column cover;
- ☐ lift the module enough to disconnect the connector in its centre;
- ☐ remove the module from the steering wheel.



After removal undeployed air bags must be stored in a special, key-lockable cabinet with the plate rested on the shelf.

Clock spring

The clock spring is a device fitted on the stalk unit ensuring electrical continuity between the driver's module and the air bag cable; it is formed of a container from which two cables lead. One is connected to the air bag cable and one to the driver's module. The container is composed of two overlaid plates; the lower one is fastened to the stalk unit by three screws and the upper one is made integral with the steering wheel through two appendixes on its upper section.

Inside the two plates, the connection cables are wound in a coil to be able to allow the cables to follow the movements of the steering wheel. The clock spring also has a mechanism that automatically prevents it from turning when it is removed from the steering wheel; this consists in preventing the upper plate, no longer restrained, from turning freely causing unwinding or winding of the cables, with the possibility of breakage.

When the steering wheel is assembled the device locks automatically.

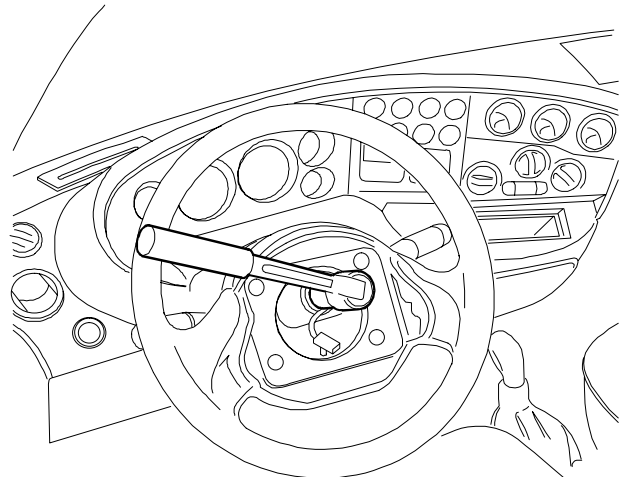
To remove the clock spring, proceed as follows:

- ☐ remove the driver's air bag module as described on the previous page
- ☐ align the wheels and keep them in this position throughout the whole operation
- ☐ slacken the nut fastening the steering wheel to the steering column
- ☐ still with the wheels aligned, mark the position between the steering wheel hub and the steering column
- ☐ remove the steering wheel taking care not to withdraw the clock spring cable



Make sure that removing the steering wheel cause the upper plate of the clock spring to raise. If the upper plate turns, it must be locked taking it outwards; a click will be heard during locking.

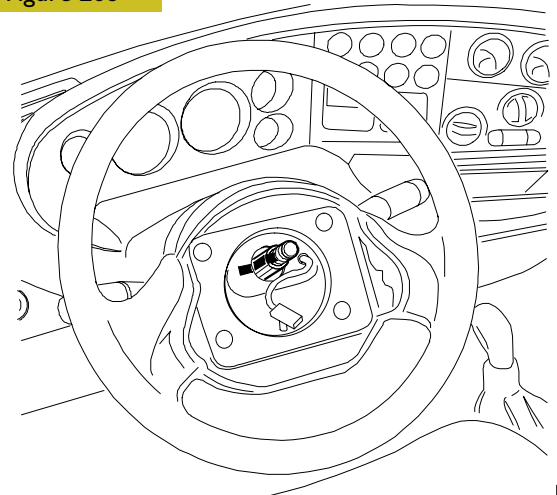
Figure 267



8560

REMOVING THE STEERING WHEEL FASTENING NUTS

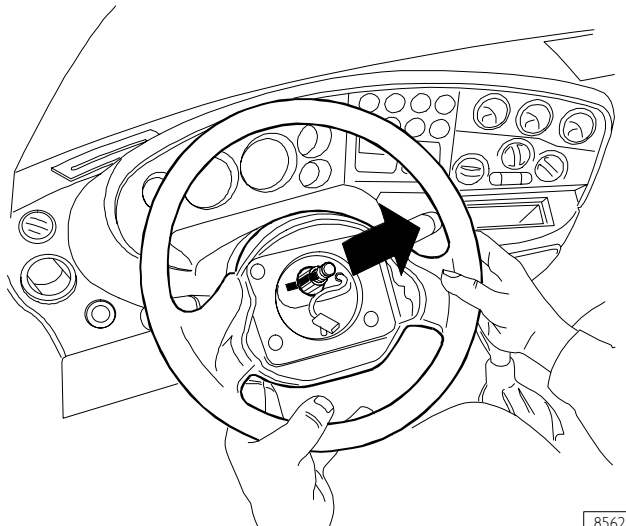
Figure 268



8561

REFERENCE BETWEEN STEERING WHEEL HUB AND STEERING COLUMN

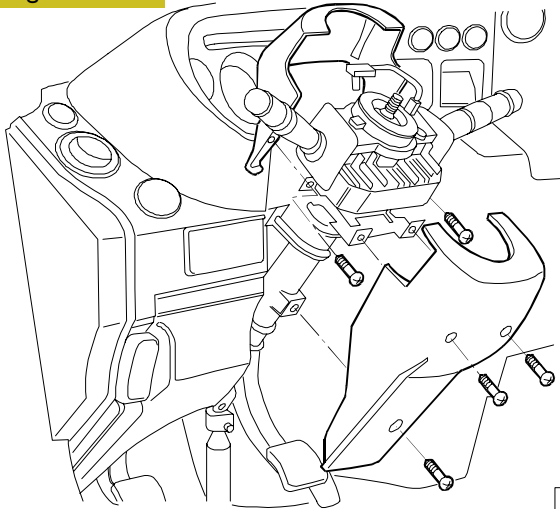
Figure 269



8562

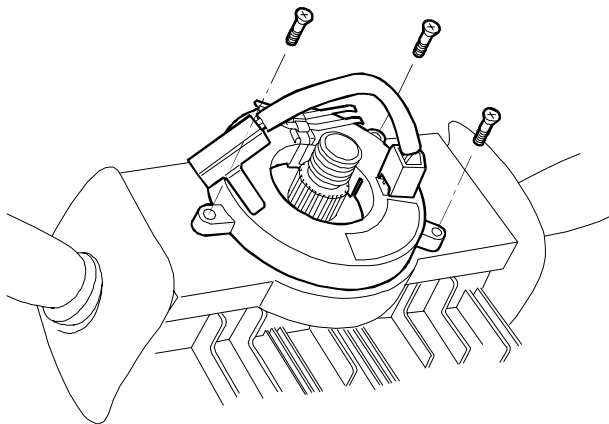
REMOVING THE STEERING WHEEL

Figure 270



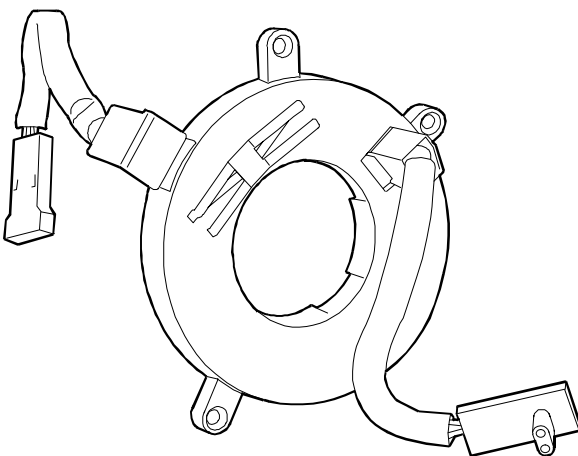
REMOVING THE STEERING COLUMN COVER HALVES

Figure 271



REMOVING THE CLOCK SPRING

Figure 272



CLOCK SPRING

- ☐ remove the steering column lower half cover slackening the three fastening screws (Figure 270)
- ☐ working from inside, remove the upper steering column half cover slackening the two fastening screws
- ☐ cut the strap that fastens the clock spring cable to the steering column and disconnect the connector of this cable from the air bag cable
- ☐ slacken the three screws fastening the clock spring to the stalk unit and remove it.



It is necessary to remove the clock spring without making it turn, holding the upper plate in place with a strap or adhesive tape.

To refit the clock spring, proceed as follows:

- ☐ make sure the wheels are aligned
- ☐ if replacement of the clock spring is not necessary, refit it, after removing the adhesive tape or strap put on previously, without making the upper plate turn, then tighten the three fastening screws
- ☐ in the case of fitting a new clock device, after fastening it to the stalk unit, tear the plastic tab to lock the upper plate and check that it does not turn
- ☐ connect the air bag cable connector to the clock spring cable and fasten the latter to the steering column using a suitable clamp
- ☐ assemble the two steering column halves fastening them on the support plate with their screws
- ☐ carefully insert the cable to be connected to the driver's air bag module through the slot provided on the steering wheel hub
- ☐ assemble the steering wheel making the reference marks made previously coincide.
- ☐ Tighten the steering wheel fastening nut to the specified torque.



Do not re-use the steering wheel fastening nut removed previously, replace it with a new one and caulk it.

NOTE If the stalk unit is changed it must be replaced by one inclusive of the clock spring.

Passenger's air bag module

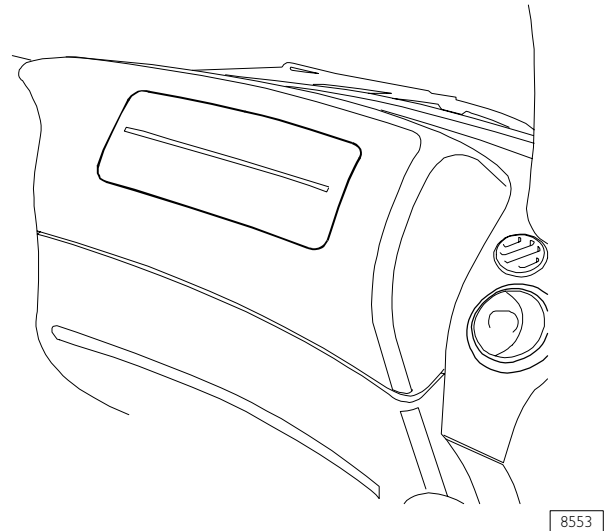
This module is fitted on the dashboard and it is fastened on the body by a special bracket; the operating principle is the same as for the driver's module, only the size of the bag differs, as it has to protect two people.

To remove the air bag module, proceed as follows:

- ☐ follow the rules of safety
- ☐ disconnect the battery cables (firstly the negative one then the positive) and isolate them taping the terminals
- ☐ wait at least ten minutes before proceeding
- ☐ slacken the two screws fastening the dashboard cover
- ☐ remove the dashboard cover in such a way as to overcome the resistance of the snap button in the lower part of the cover
- ☐ disconnect the module cable connector from the air bag cable
- ☐ slacken the four screws two on either side, that fasten the module support bracket to the body and remove it.

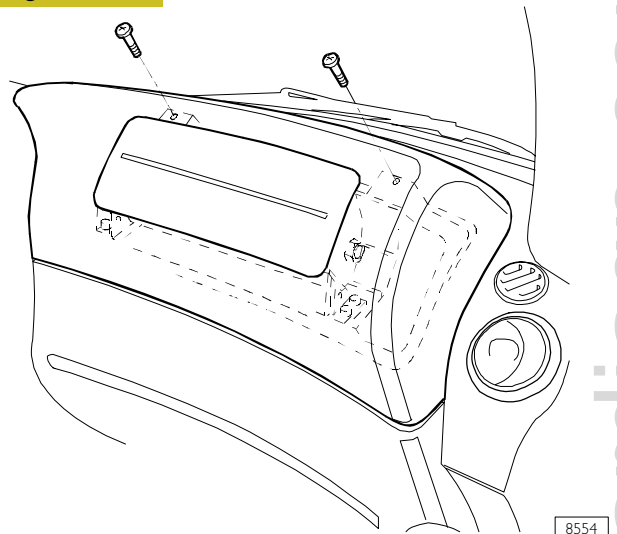
NOTE If the passenger's air bag is not fitted as it is optional, a specific resistance is fitted on the connector during production to simulate the charge ($R = 2.15 \text{ Ohm} \pm 0.35$)

Figure 273



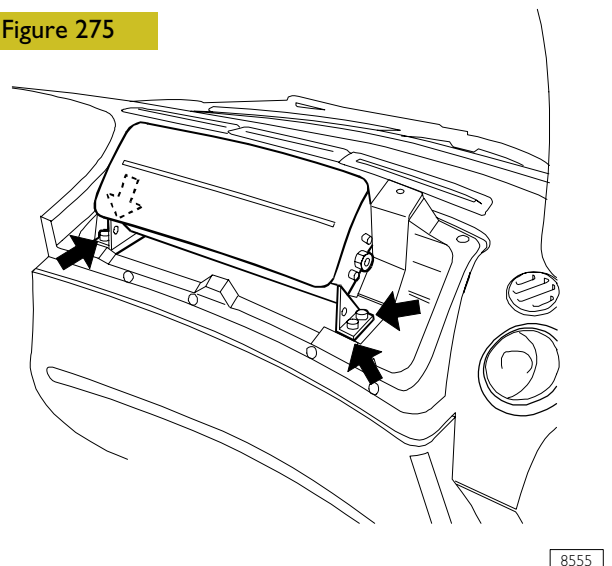
PASSENGER'S AIR BAG MODULE

Figure 274



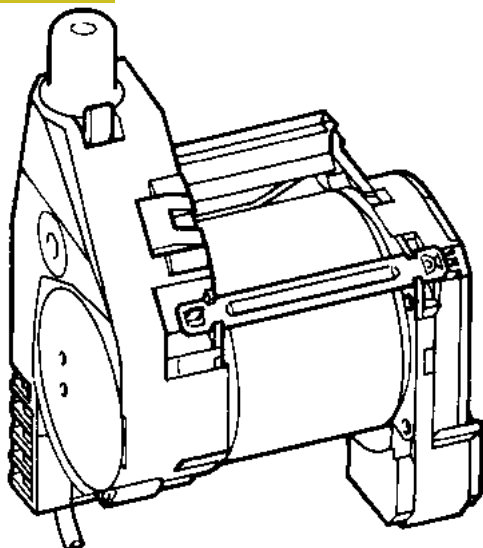
REMOVING THE DASHBOARD COVER

Figure 275



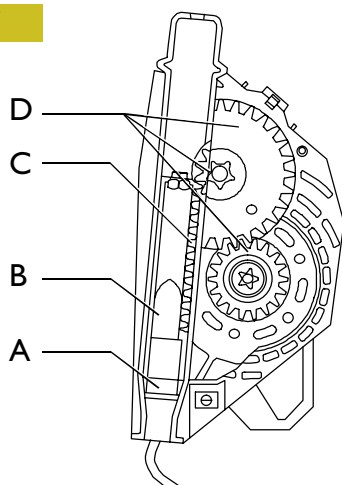
REMOVING THE AIR BAG MODULE

Figure 276



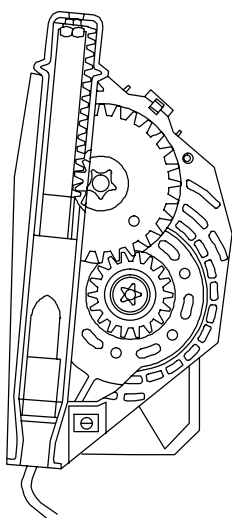
REEL WITH PRETENSIONER

Figure 277

TECHNICAL VIEW OF REEL WITH PRETENSIONER
BEFORE DEPLOYMENT

A. Explosive charge – B. Propellant – C. Rack and pinion piston – D. Gears

Figure 278

TECHNICAL VIEW OF REEL WITH PRETENSIONER
AFTER DEPLOYMENT

Pretensioners

The pretensioner is an explosive device activated electrically with a signal leading from the electronic control unit; it is an integral part of the seat belt reel and forms a single component with it which is fastened to the vehicle pillar. It comes into action in the event of a crash of a certain entity, in order to take up the unavoidable slack in the seat belts due to the action of the weight of the body, keeping the body close to the seat back.

After cutting in the belt remains locked meaning that the device has been triggered.

Operating principle

The moment in which a determinate deceleration of the vehicle takes place, the electronic sensor in the control unit sends a signal which ignites the explosive charge (ref. A) of the gas generator (detonator).

The combustion of the propellant (ref. B) develops a gas, the pressure of which generates a force that pushes the rack and pinion piston (ref. C) upwards.

The upward movement of the piston makes the gears turn (ref. D) which reverse the direction of rotation of the belt rewinding it a few centimetres.

NOTE The belt is unserviceable after every crash and needs to be changed.

- ☐ The charge for the driver's pretensioner is connected to the control unit on pins 1/2.
- ☐ The charge for the passenger's pretensioner is connected to the control unit on pins 3/4.
- ☐ The charge for the centre pretensioner is connected to the control unit on pins 16/17.

Driver's/passenger's pretensioner

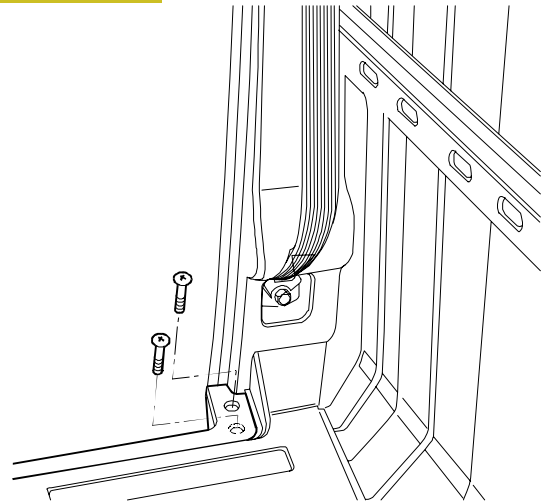


Do not use percussion screwing machines for the following operations on active pretensioners.

To remove the driver's or passenger's reel with pretensioner, proceed as follows:

- ☐ follow the rules of safety
- ☐ disconnect the battery cables (firstly the negative one then the positive) and isolate them taping the terminals
- ☐ wait at least ten minutes before proceeding
- ☐ slacken the screw fastening the tool kit under the seat
- ☐ slacken the seat fastening screw and remove it
- ☐ slacken the two screws fastening the step to the door pillar base
- ☐ partially remove the door weatherstrip
- ☐ slacken the screw fastening the seat belt
- ☐ remove the lower pillar trim overcoming the resistance of the two snap buttons in the upper part of the trim
- ☐ disconnect the pretensioner connector from the air bag cable (ref. A)
- ☐ connect the specific resistance on the air bag cable to simulate the presence of the pretensioner; this is to prevent the control unit from signalling a failure on the system that does not exist if the ignition switch is inadvertently turned to AVV or MAR.
- ☐ slacken the reel fastening screw (ref. B) and remove the reel.

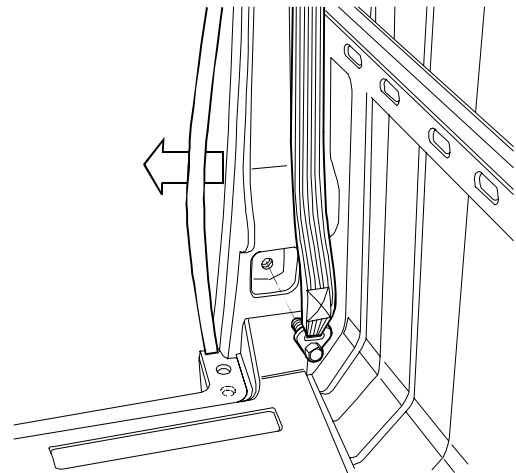
Figure 279



STEP FASTENING SCREW

8550

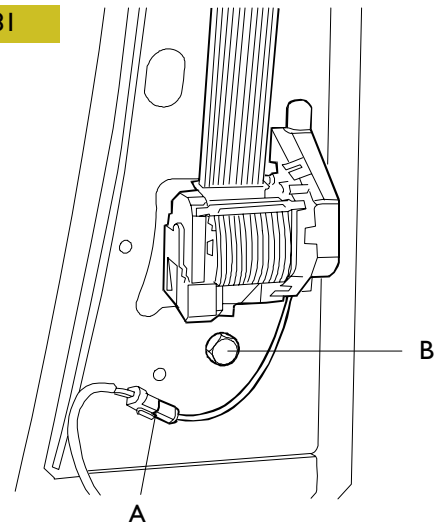
Figure 280



REMOVING THE WEATHERSTRIP AND BELT FROM THE PILLAR

8551

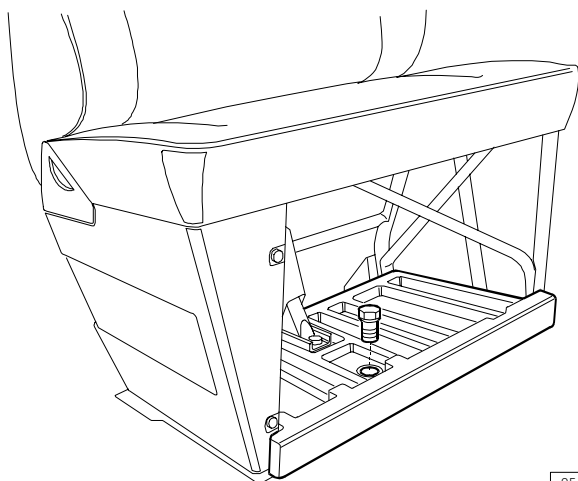
Figure 281



REMOVING THE REEL WITH PRETENSIONER
A. Connector – B. Fastening screw

8552

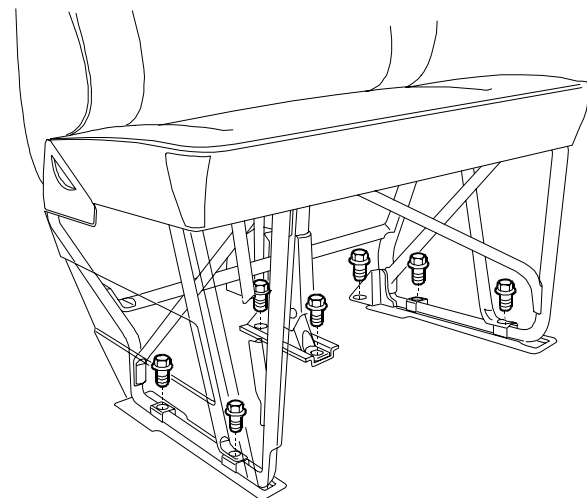
Figure 282



8566

REMOVING THE TOOL KIT

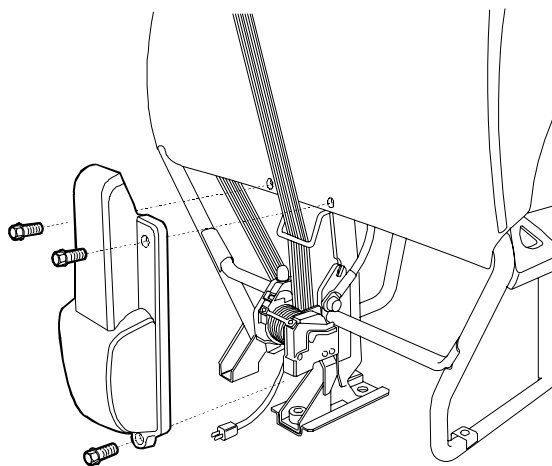
Figure 283



8567

REMOVING THE SEAT

Figure 284



8568

REMOVING THE GUARD

Centre passenger's pretensioner

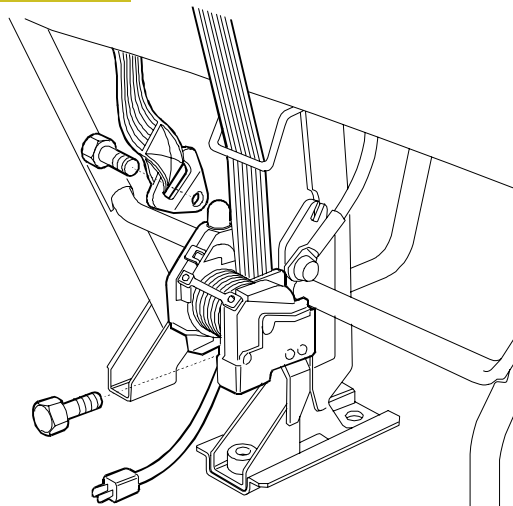


Do not use percussion screwing machines for the following operations on active pretensioners.

The centre passenger's reel with pretensioner has the same operating principle as the other two reels. To remove it proceed as follows:

- ☐ follow the rules of safety
- ☐ disconnect the battery cables (firstly the negative one then the positive) and isolate them taping the terminals
- ☐ wait at least ten minutes before proceeding
- ☐ slacken the screw fastening the tool kit under the seat
- ☐ slacken the seven screws fastening the seat
- ☐ disconnect the pretensioner connector from the air bag cable
- ☐ remove the seat
- ☐ connect the specific resistance on the air bag cable to simulate the presence of the pretensioner; this is to prevent the control unit from signalling a failure on the system that does not exist if the ignition switch is inadvertently turned to AVV or MAR.
- ☐ slacken the three screws fastening the guard on the rear part of the seat
- ☐ remove the guard
- ☐ slacken the reel and belt fastening screw, then remove the reel with pretensioner

Figure 285



8569

REMOVING THE REEL WITH PRETENSIONER

DOOR-BLOCKER WITH ANTI-THEFT PROTECTION

General information

The anti-theft protection is supplied with the door-blocker and consists of the following:

- ☐ a warning siren
- ☐ an (ultrasonic) electronic module for volumetric detection, including a LED for signalling that the anti-theft protection is ON
- ☐ an electronic central control unit (ECU) for the anti-theft/door-blocker, 433.92 MHz for the European market
- ☐ two remote-control keys.

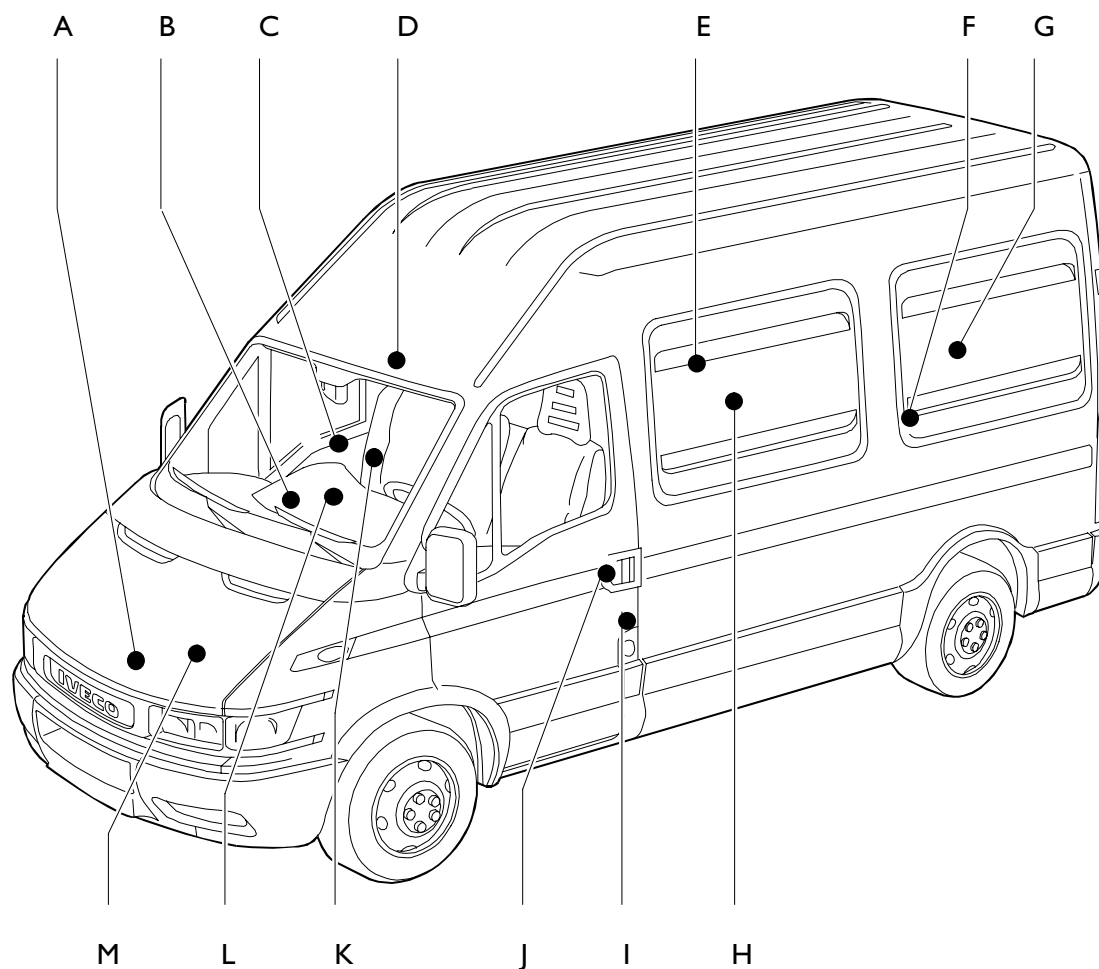
When the anti-theft protection is activated/de-activated by means of the remote-control key, the doors (driver's and passenger's doors and, for the van version, the side and rear doors) of the vehicle close/open simultaneously.

To complete the system, in addition to the components already mentioned above there are the following:

- ☐ switches and motors for closing/opening the doors.
- ☐ switch for signalling that the bonnet is being opened.
- ☐ switch on a switchboard for locking the rear door.

In addition, the electronic central control unit is connected to the immobiliser control unit, to the direction indicator switch (indicator flashing lights) and to the 38-pin diagnostics connector (cell 12).

Figure 286



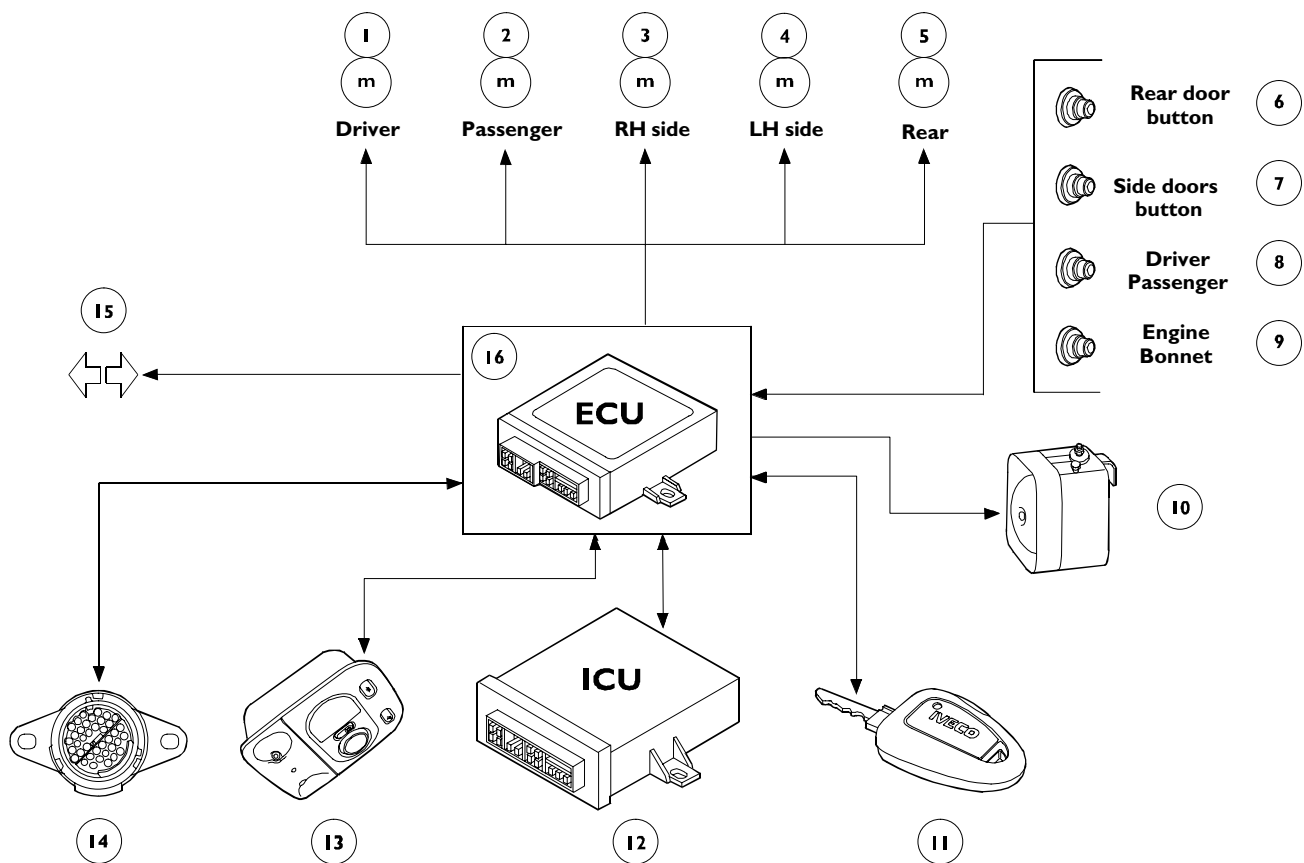
LOCATION OF COMPONENTS

- A. Switch for signalling opening of the bonnet – B. Electronic central control unit (ecu) – C. Motor for closing/opening the lock on the passenger-side door – D. Electronic module for volumetric detection and led for signalling that the anti-theft protection is on – E. Motor for closing/opening lock on right-hand side door – F. Switch for signalling opening of rear door – G. Motor for closing/opening lock on rear door – H. Switch for signalling opening of right-hand side door – I. Switch for signalling opening of door on driver's side – J. Motor for closing/opening lock of door on driver's side – K. Switch for signalling opening of door on passenger's side – L. Switch for blocking rear door – M. Self-powered siren

8572

System components

Figure 287



50288

Ref.	Function
1	Driver door lock/release motor
2	Passenger lock/release motor
3	RH door lock/release motor
4	LH door lock/release motor
5	Rear door lock/release motor
6	Rear door button
7	Side doors button
8	Driver/passenger doors button
9	Engine bonnet button
10	Siren
11	Remote control key
12	Injection system control unit
13	Volumetric detector electronic module
14	Tester connector
15	Direction indicator telltale
16	Electronic control unit

Operation

When the push-button on the remote-control key is activated, this is signalled by the LED on the key itself, and a radio-frequency (RF) signal is sent to the ECU. This signal controls closing of the doors by means of the motors, activates the volumetric sensor installed in the ceiling-lamp inside the cab and signals that the anti-theft protection has been activated by causing the indicator flashing lights to flash twice and the "anti-theft activated" LED to flash once. About ten seconds pass between the time when the signal is sent to the ECU and when the system is actually active. During this period of time, the ECU checks that all the necessary conditions (state of the doors, inside of the cab) for activating the anti-theft protection are met. Once the 10 seconds have elapsed the system is active and is constantly checked by the ECU.

If the ECU does not find all the conditions required for correct activation of the system while it carries out the anti-theft activation procedure (for example, if one of the doors is not closed), the state of the door will not be checked during the system monitoring that the ECU carries out upon completion of the activation procedure. Once the door has been closed, this too will be checked by the ECU, starting ten seconds from the time when it was closed.

The conditions in which the anti-theft protection switches on are the following:

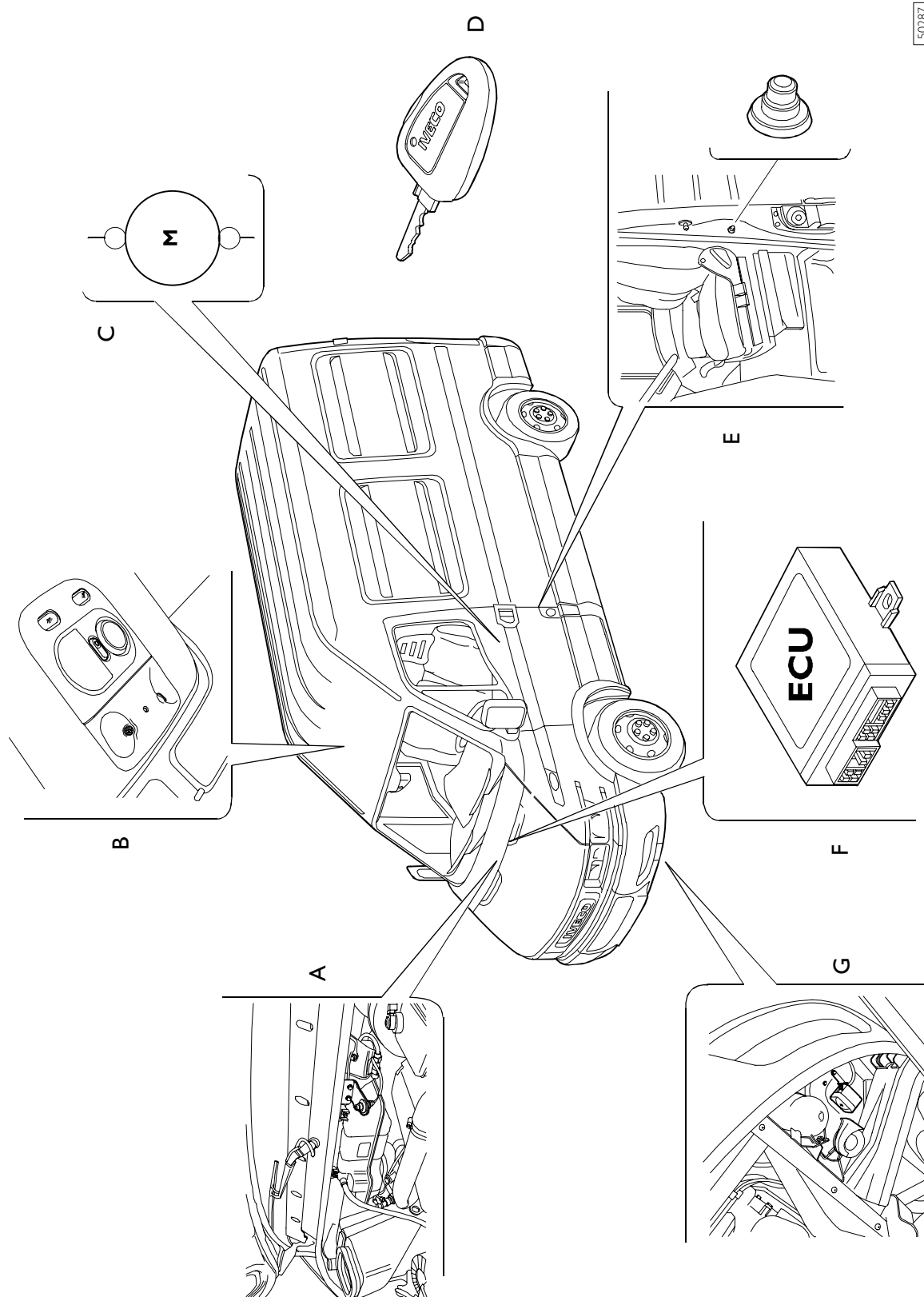
- ☐ if the driver's/passenger's doors are opened
- ☐ if the rear door is opened
- ☐ if the bonnet is opened
- ☐ if the side door(s) is(are) opened
- ☐ if the engine is switched on
- ☐ if the volumetric detection module is activated.

If any of the above conditions occur, the sound of the self-powered siren and the flashing of the indicator flashing lights for five minutes will signal that the system has switched on.

In order to be able to open the doors and de-activate/switch off the anti-theft protection, it is necessary to press the push button on the remote-control key again. The ECU will de-activate the anti-theft protection. The indicator flashing lights will flash once and the signalling LED of the anti-theft protection will go off to confirm that it has been de-activated.

Arrangement of components

Figure 288



A. Engine bonnet switch – B. Volumetric detector electronic module – C. Door lock motor – D. Remote control key – E. Door switch – F. Electronic control unit
– G. Siren

MAIN COMPONENTS OF THE SYSTEM

Remote-control key

The electronic device controlling the anti-theft protection with the door-blocker can be mounted in the grip of the key or in any suitable place for the remote-control function.

Features:

- ☐ transmission frequency 433.92 MHz
- ☐ transmission of combined code (fixed and variable)
- ☐ red LED for signalling transmission of the code
- ☐ 3V CR 2032 battery
- ☐ operation from $-30\text{ }^{\circ}\text{C}$ to $+60\text{ }^{\circ}\text{C}$
- ☐ retention of the "rolling-code" data (variable part of the combined code) in the memory of the microprocessor in the key during replacement of the battery
- ☐ maximum power transmitted: 10 mW.

On pressing the push button in the key, all the doors will be opened or closed and the anti-theft protection will be activated or de-activated. The red LED on the key will flash to signal transmission of the radio-frequency code to the ECU. If the pushbutton is activated for a time exceeding 20 minutes, transmission of the code to the ECU will be broken off, in order to prevent the battery of the remote-control key from going dead due to accidental activation of the push button.

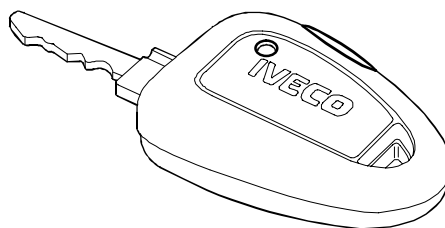
As already stated, the remote-control key transmits a combined code (fixed and variable). The fixed code that is transmitted is always the same for each individual key, while the second part changes each time the pushbutton is pressed.

The keys supplied are two. It is important that they should both follow the correct key-learning procedure by means of the IVECO diagnostic tools with the +15 power supply on. The indicator flashing lights will flash once to signal that the code has been received by the ECU.

If the remote-control key gets partly or totally damaged, with the +15 power supply on, the immobiliser will send a signal to the ECU to de-activate it.

If the exchange of data between the transponder and the engine management is successfully completed, the immobiliser will send a $500\text{ msec} \pm 10\%$ message to the ECU. This signal will occur after $500\text{ msec} \pm 10\%$ from when the +15 power supply is switched on. If it is not, that is to say if the immobiliser signal does not fall within the range of values indicated above, the ECU will switch on the anti-theft protection. The impulses generated by the immobiliser after repeated switching on of the +15 power supply will be ignored.

Figure 289



50268

Remote control key battery

The key supplied as standard contains a 3 volt type CR2032 lithium battery. Battery life is about one year, since Bosch guarantees it for 50,000 working cycles at a temperature of between -30°C to $+60^{\circ}\text{C}$.

Batteries from competing brands can be easily found on the market, but the Bosch warranty is not valid unless only PANASONIC batteries are used.

Replacing the battery

Battery replacement should not take longer than 3 minutes. When fitting the new battery pay attention to battery polarity.

If you fail to comply with the foregoing instructions the **ROLLING CODE** necessary to transmit the signal from the key to the control unit will be deleted.

The ROLLING CODE can be reset by following the **key synchronisation** procedure.

Key synchronisation procedure

- ☐ introduce the key into the switch
- ☐ turn it to start
- ☐ press the remote control button

This procedure makes it possible to reset the ROLLING CODE

Electronic central control unit (ECU)

The central control unit is located underneath the central dashboard. It controls both centralised closing/opening of the doors and activation/de-activation of the anti-theft protection by means of the signal supplied to it by the remote-control key, with the consequent switching on of the remote-control switches located inside the actual control unit.

If one of the remote-control switches should be blocked (working contact blocked) during operation, causing continuous activation of the door-locking motor(s), the control unit will switch on remote-control switches that create bridges on the remote-control switch in question, in order to avoid serious damage to the motor(s) concerned. Once normal operation of the faulty remote-control switch is reinstated, then these remote-control switches will switch off.

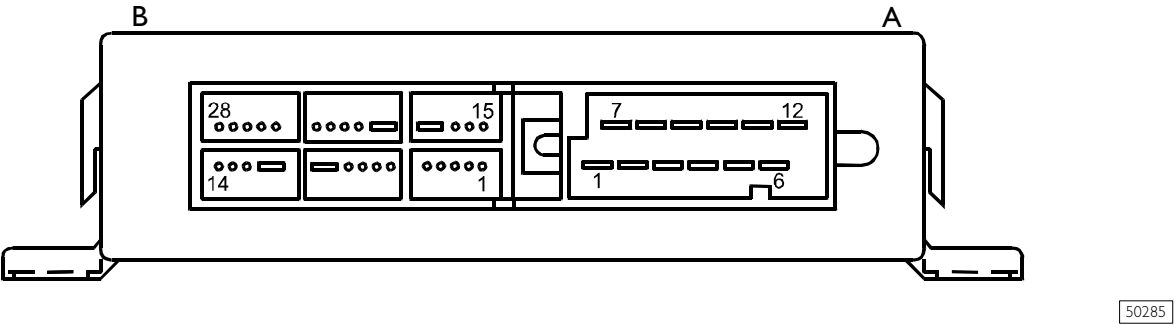
The central unit is connected to the cable in the cab/bonnet by means of one 12-pin connector and one 28-pin connector. Each central unit has a pin code, which is programmed at the end of the line test. This pin code will consist of 5 digits, each of which will be a binary-coded decimal number from 0 to 9.

In addition, the ECU detects faults in the system, signalling the by causing the anti-theft signalling LED at the centre of the ceiling light to flash. It is possible to identify two types of failure: minor and major. In the first case, with the +15 power supply on, the LED will remain on without flashing, while in the second case, again with the +15 power supply on, the LED will flash. Major failures are those concerning the ECU, and are caused by:

- ☐ an error in the ROM/RAM check sum
- ☐ an error in the EEPROM check sum
- ☐ remote-control switch with working contact blocked.

Technical view of the ECU

Figure 290

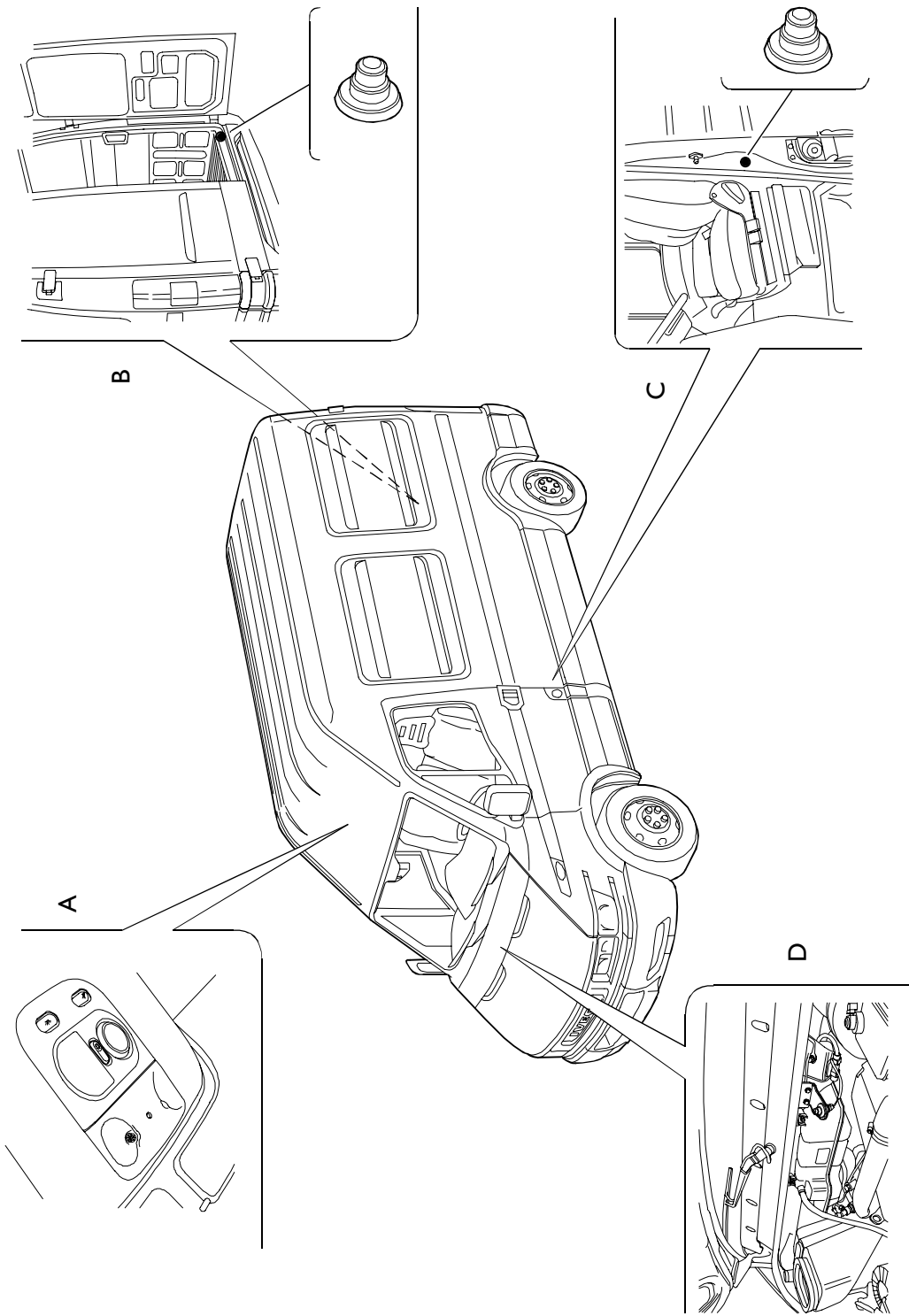


Pin out ECU

Connector	Pin	Function
A	1	Door-blocker on driver's and passenger's side
	2	—
	3	+15 power supply
	4	—
	5	Rear door-blocker from switch on dashboard
	6	—
	7	Side and rear door-blocker
	8	Door-unblocker
	9	+30 power supply
	10	—
	11	Earth
	12	—
B	1 ÷ 4	—
	5	Siren
	6	Power supply to led for signalling activation of the anti-theft protection
	7	Earth
	8 ÷ 11	—
	12	Immobiliser disabling
	13	—
	14	Switching on of LED signalling activation of the anti-theft protection
	15	To switches for switching on the inside lights on driver's and passenger's side doors
	16	To the switches for switching on the inside lights on the right-hand side doors
	17	To the switches for switching on the inside lights on the rear door
	18–19	—
	20	To the switch signalling opening of the bonnet
	21	To the 38-pin diagnostics connector (cell 12)
	22	To the switch for switching on the inside lights on the left-hand side door
	23	Signal from electronic volumetric detection module
	24	Switching on of indicator flashing lights
	25 ÷ 28	—

Arrangement of the switches

Figure 29I



50284

A. Volumetric detector electronic module – B. Rear door button – C. Buttons on front doors – D. Engine bonnet button

cardiagn.com

Switches for signalling opening of doors and bonnet

These switches are the same, excluding the one for the bonnet, that controls switching on of the ceiling lights inside the cab and, for the van version, the loading platform. They send the signal indicating the status of the doors and of the bonnet to the ECU.

Door-blocker/unblocker motors

Each door has its own motor for closing/opening the lock on the door.

Operation of the motor is enabled by switching the remote-control switches on the circuit card of the ECU on/off for a pre-established period of time, programmable in the EEPROM of the ECU.

These motors can be activated in two different ways:

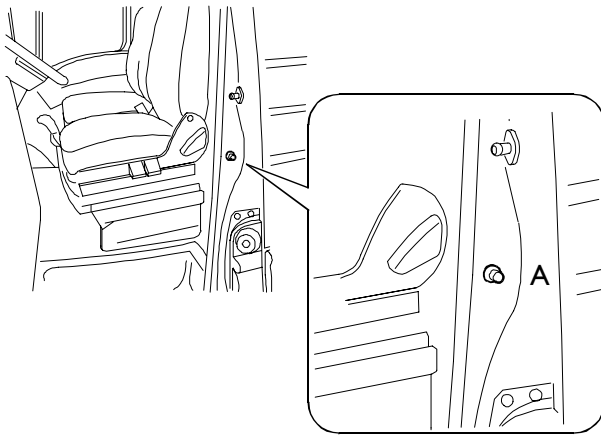
- ☐ by means of the pushbutton on the remote-control key (blocking/unblocking of all the doors)
- ☐ – by means of the switch on the switch panel (blocking/unblocking of the rear door only, in the van version).

With the +15 power supply on, operation of the motors by pressing the pushbutton on the remote-control key is not possible. Activation of the motor of the rear door by means of the switch on the switch panel is possible, on the other hand, regardless of the presence or otherwise of the +15 power supply.

Pinout of a door blocker/unblocker motor

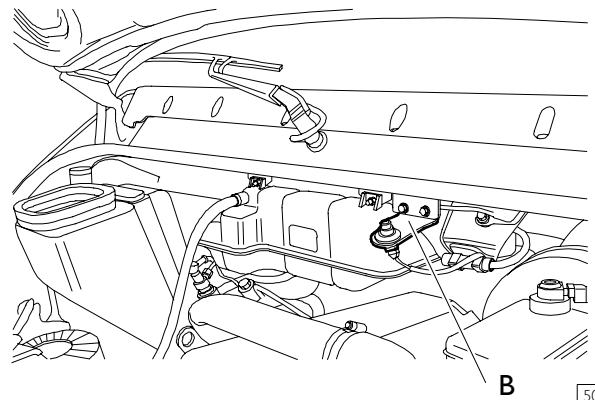
Pin	Function	V	Time required
1	Blocking	+12V	~ 750 sec.
	Unblocking	0V	~ 750 sec.
2	Blocking	0V	~ 750 sec.
	Unblocking	+12V	~ 750 sec.

Figure 292



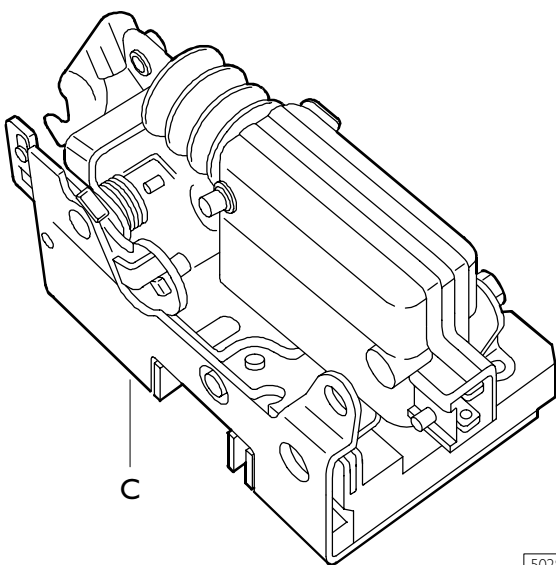
50283

A. Door opening button



50282

B. Engine bonnet switch



50281

C. Door lock/release button

Electronic volumetric–detection module

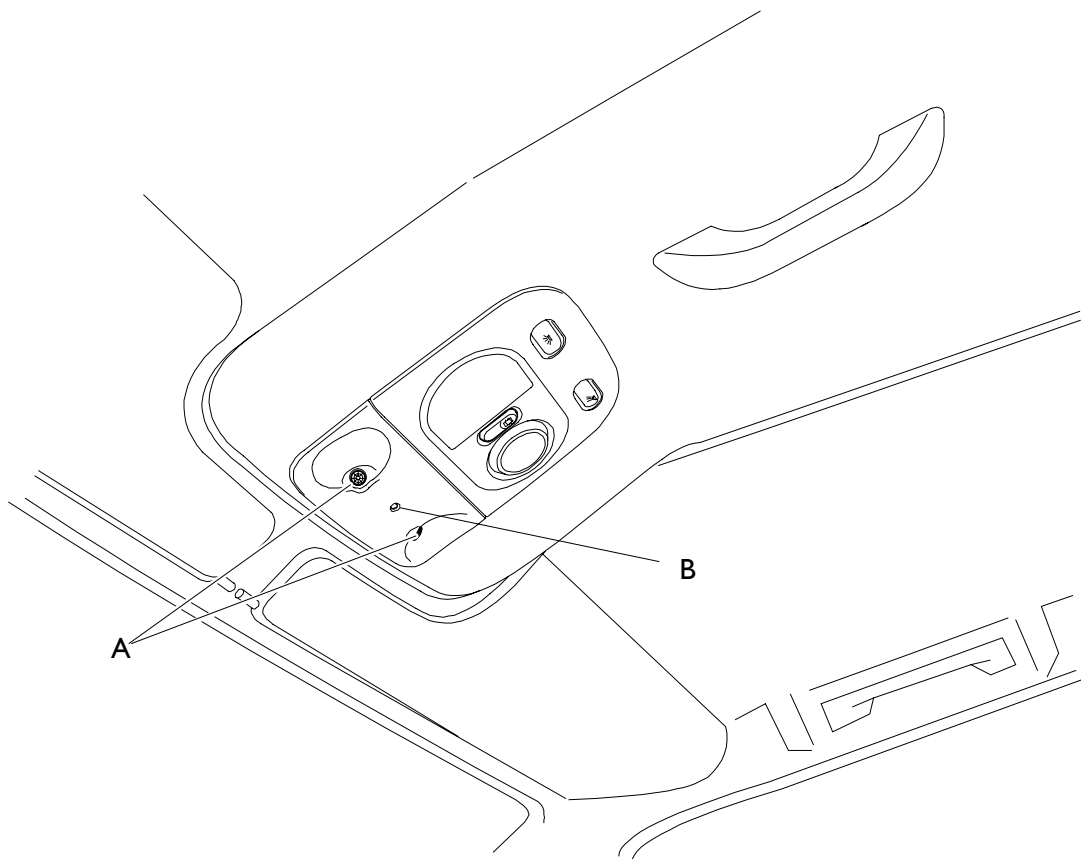
This module carries out volumetric detection inside the cab, by means of the two sensors located on the sides of the ceiling–light (A) inside the cab, starting from when the anti–theft protection is activated. It sends the data to the ECU. Any changes in the state inside the cab due, for example, to the windows being smashed or an object being accidentally moved, will be transmitted to the ECU, which will command the anti–theft protection to switch on.

The module includes a LED for signalling that the anti–theft protection has been switched on. This is also mounted in the ceiling–light inside the cab (B), and in addition to the state of the anti–theft protection (active, inactive), it also signals that key learning has been accomplished and any failures in the system.

Pin out

Pin	Function
1	Power supply from ECU (connector B pin 6)
2	+30 power supply
3	Earth
4	Receiving and transmitting of serial data
5	Signal to ECU (connector B pin 23)
6	LED driver

Figure 293



50280

Siren

The siren is located inside the engine compartment. It is self-powered by an internal battery that enables it to sound when it is disconnected from the vehicle, and it must comply with specific requisites, such as supplying a value greater than or equal to 100 dB at a distance of 1 metre from the siren after 5 minutes of operation.

The batteries of the siren are recharged in the following ways:

- ☐ trickle-charging
- ☐ rapid charging
- ☐ charging after disconnecting the siren from the vehicle

Trickle-charging is always activated in order to compensate for the normally occurring loss of charge of the batteries. The batteries will be charged by supplying a 12 mA current for one minute at intervals of one hour.

Rapid charging takes place for a duration of 14 hours with a current of 12 mA. This method is used when the siren is connected for the first time, or when it is reconnected to the system following maintenance operations on the vehicle that require the battery to be disconnected. Once the required time has elapsed, charging stops. This type of charging does not require the +15 power supply to be on.

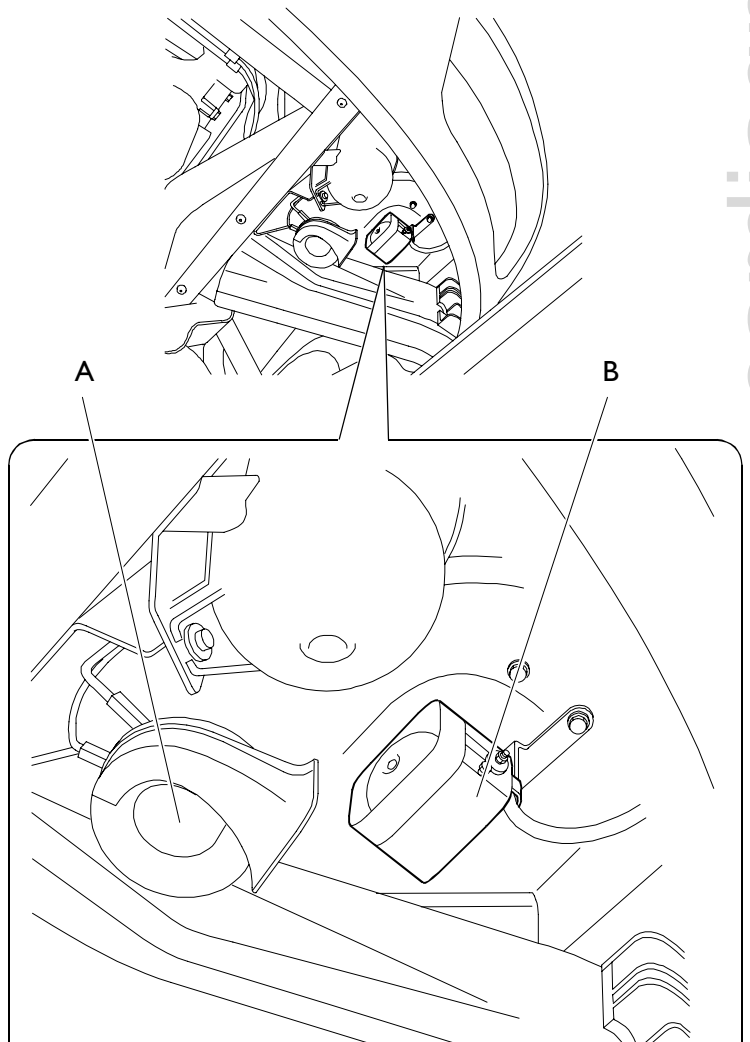
With the third type of charging, if the siren of the vehicle is disconnected while it is not sounding, the whole time for which it remains disconnected will be the same required to recharge the batteries when it is connected to the system again. If, on the other hand, the siren is disconnected after it has been triggered, when it has to be reconnected to the system the batteries will be charged for 45 seconds for each second that the siren remained disconnected. This recharging process is only carried out with the +15 power supply off. If the batteries are below the minimum charging level, they will be recharged, with the +15 power supply on, for 14 hours at 12 mA.

Figure 294

Siren pin-out

Pin	Function
1	+15 power supply
2	+30 power supply
3	Serial input/output signal
4	Earth

A. Horn
B. Siren



50279

Siren modes and states

Delivery mode/state

This mode indicates the state of the siren when it is delivered to IVECO. An acoustic signal emitted by the siren will signal its activation when it is connected to the system.

Idle mode/state

This state indicates when the siren has been disconnected and its operating state has been blocked, implementing the siren service mode described below. The siren is blocked in order to retain the charge of the batteries and its microprocessor is de-activated. An acoustic signal produced by the siren will signal its activation when it is reconnected to the system.

Siren disabled state

The siren always goes into an idle state when it is connected to the vehicle on the IVECO production line. In addition, the siren also goes into this state when the anti-theft protection is de-activated by the remote-control key.

Enabled state 1

This is the normal state of the siren, and it indicates that the anti-theft protection has not been activated and that the +15 power supply is off. In this state, the siren can still trigger off an alarm if it is disconnected from the vehicle.

Enabled state 2

In this state, the anti-theft protection is activated. The siren has already received a serial activation command from the ECU. In this state, if the siren is disconnected or the ECU detects a signal able to switch on the siren, this will be activated.

Alarm state 1

In this state the siren is on, however the ECU is not activated. The siren was activated because it was disconnected.

Alarm state 2

In this state the siren is on. The ECU is activated. The siren may have been caused to switch on by a signal from the ECU triggering anti-theft protection or because it was disconnected from the battery of the vehicle.

ERROR CODES

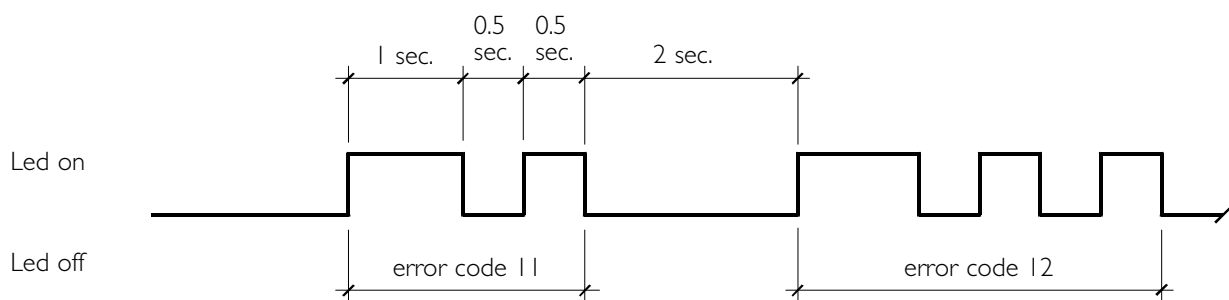
Any faults and their causes are detected by the ECU and stored in it. There is a diagnostics system that enables them to be identified, with the +15 power supply on, by detecting the number of times that the anti-theft signalling LED flashes. Correct interpretation of the flashing will lead to identification of the number of the error code. In order to do this, it is necessary to know that:

- ☐ the LED on for 1 second is equivalent to ten
- ☐ the LED on for 0.5 seconds is equivalent to one unit.

The time that passes between each time that the LED goes on and the next is 0.5 seconds. If two or more error codes should be detected, the time for which the LED remains off would be 2 seconds.

The error codes are signalled, if the corresponding fault is present, once only and in ascending order. Then, once all the active faults have been signalled, the LED will extinguish.

Figure 295



ERROR CODE SEQUENCE

8597

Error code table

Error code	Type of improper functioning	Fault detection	Condition for detecting fault
11	EEPROM of the ECU	Checksum error in the remote-control key code in the EEPROM of the ECU	Once for each time the +15 power supply is turned on.
12	ECU	RAM/ROM checksum error. Remote-control switch with working contact blocked	Checksum error on activation of the ECU. Each time the motor is operated the working contact blocks
13	No key programmed	No remote-control key programmed in the ECU	Once every second
14	No PIN code programmed	No EEPROM PIN code programmed	Once every second
15	Door-closing output signal shorted to earth or battery+	Incorrect door-closing output signal	With remote-control switch on. Once every second
16	Output signal inside cab shorted to earth or battery +	Low output with remote-control switch on. High output with remote-control switch off	With remote-control switch on. Once every second
17	Rear door output signal shorted to earth or battery+.	Low output with remote-control switch on. High output with remote-control switch off	With remote-control switch on. Once every second
18	Left direction indicator output signal to earth	Low output with remote-control switch on	With remote-control switch on
19	Right direction indicator output signal to earth	Low output with remote-control switch on	With remote-control switch on
20	Led output signal shorted to earth or battery+	Incorrect Led output signal	Once every second. For the 10 seconds required to activate the ECU
21	No response from ultrasonic module	No signal from ultrasonic module	For the 10 seconds required for activation
22	No response from siren	No signal from siren in response to ECU	For the 10 seconds required for activation
23	Siren batteries dead	Serial message from siren	For the 10 seconds required for activation
24	Siren self-test wrong	Serial message from siren	For the 10 seconds required for activation
25	Rolling code of remote-control key out of range	Rolling code transmitted in RF from the remote-control key not recognised by the EEPROM	On receiving the RF message

AIR SUSPENSIONS ECAS

High-flexibility air suspension system with highly efficient vibration damping effect provided with self-adjusting feature that keeps constant chassis-to-road height, regardless of the load carried by the vehicle. A special push-button allows to change chassis-to-road surface distance, that is the height of the vehicle cargo compartment floor.

Besides the traditional advantages of any air suspension system, the ECAS system also allows:

- ☐ air consumption reduction
- ☐ prompt response to adjustment
- ☐ simple systems
- ☐ high safety
- ☐ complete system diagnosis.

The **ECAS (Electronically Controlled Air Suspension)** system automatically controls the vehicle air suspension system nominal level.

The features described above are bound to special operating and safety conditions of the associated systems.

The ECAS electronic control unit automatically checks chassis level (height from road surface) by reading the real values supplied by the sensors and comparing them to the rated values stored in the memory.

With any change of the vehicle trimming, the electronic control unit controls the electropneumatic units to bring the actual level to the level set or previously memorized by the driver.

MODEL	MOTOR	ECAS	VTB
29L	.10 .11 .12 .14	X	
35S	.10 .11 .12 .13 .14 .17	X	
35C	.10 .11 .12 .13 .14 .17		X
40C	.10 .11 .12 .13		X
45C	.11 .13		X
50C	.11 .13 .14 .17		X
60C	.15		X
65C	.15 .17		X

The system in figure is installed in the following vehicles:
29L – 35S.

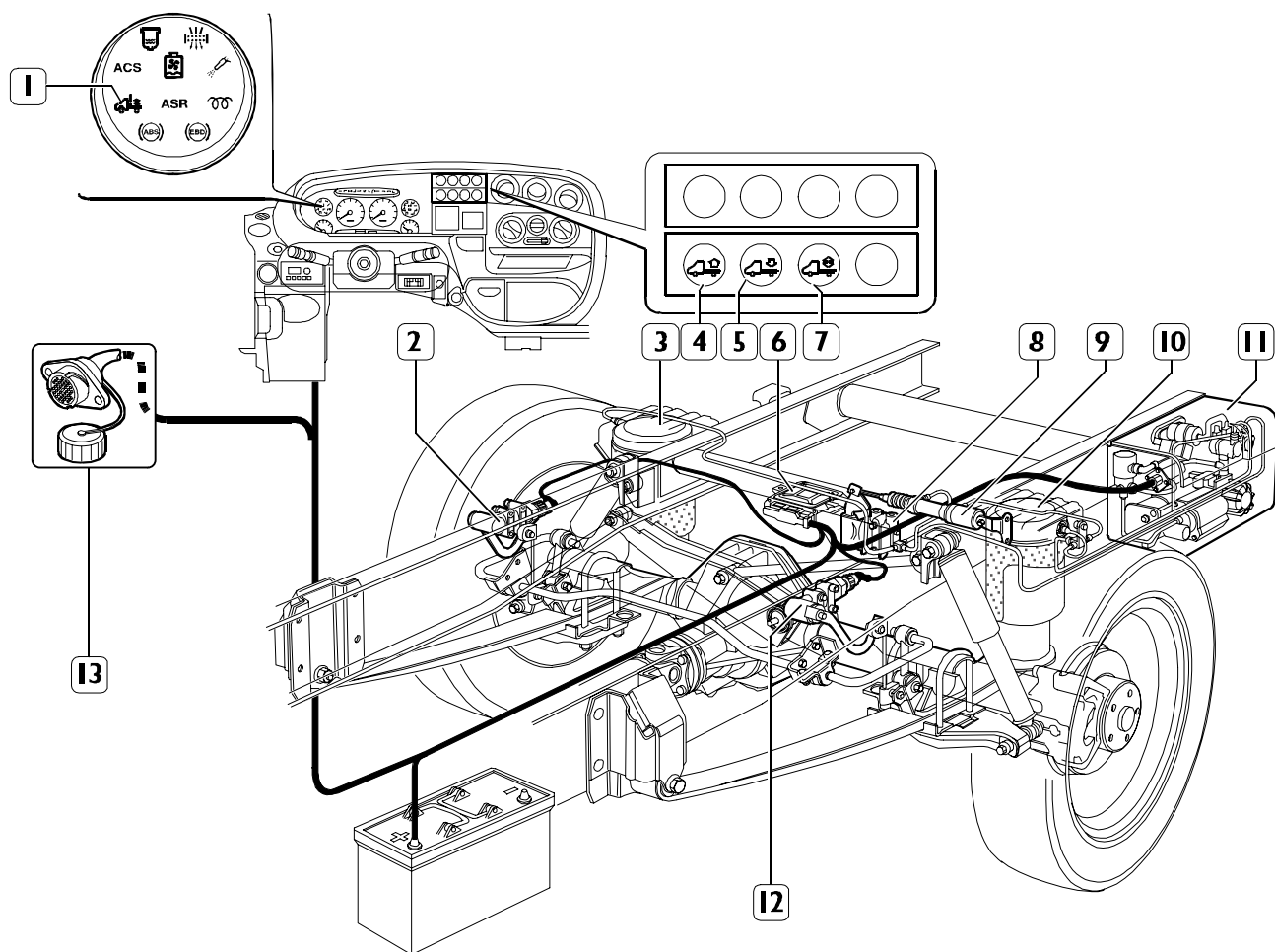
Base – May 2004

Print 603.93.281

Pin	Description	Component code
1	ECAS electronic control unit	86023
2	Chassis manual leveling control push-button	52090
3	Chassis lifting control push-button	53051
4	Chassis lowering control push-button	53052
5	ECAS pilot lamp	58713
6	Stop light switch	53501
7	Tachometer – tachograph	40001 – 40011
8	RH air spring	–
9	RH level sensor	40046
10	Hydraulic brake action compensator	–
11	Brake action compensator actuator air cylinder	–
12	LH level sensor	40046
13	LH air spring	–
14	Electrocompressor unit	78233
15	RH chassis actuator solenoid valve	–
16	LH chassis actuator solenoid valve	–
17	Throttle valve	–
18	Dryer filter	–
19	Air spring relief solenoid valve	–
20	One-way valve	–
21	Compressor	–
22	One-way valve	–
23	Intake filter	–
24	Compressor motor	–
25	Motor relay	–
26	Diagnostic socket	72008

Vehicles with braking system without ABS

Figure 297

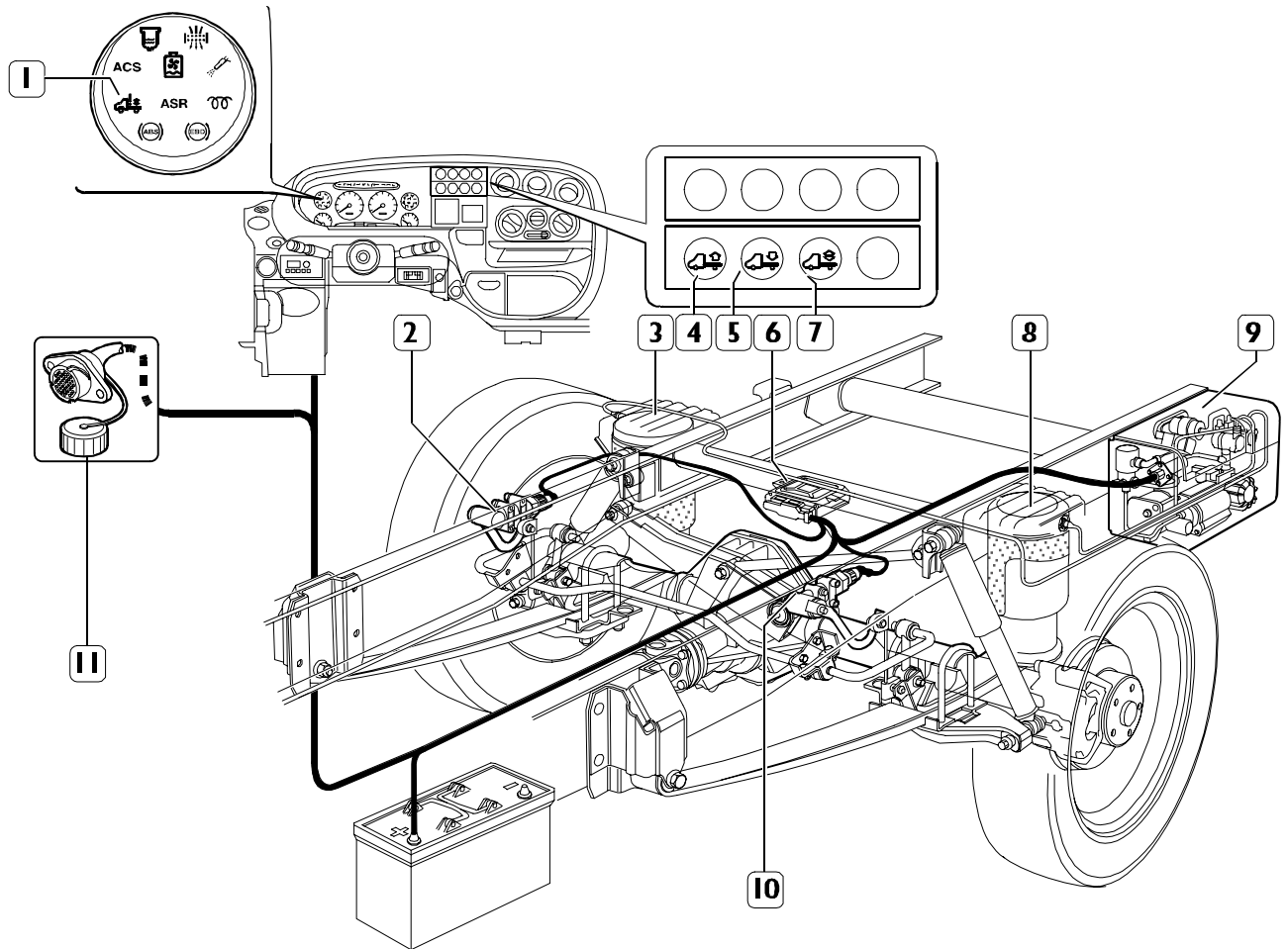


000217t

1. ECAS warning lamp – 2. RH level sensor – 3. RH air spring – 4. Chassis lifting control push-button – 5. Chassis lowering control push-button – 6. ECAS ECU – 7. Chassis leveling control push-button – 8. Hydraulic brake action compensator – 9. Brake action compensator air cylinder – 10. LH air spring – 11. Air supply unit – 12. LH level sensor – 13. Centralized diagnostic socket

Vehicles with ABS system

Figure 298



000217t

1. ECAS warning lamp – 2. RH level sensor – 3. RH air spring – 4. Chassis lifting control push-button – 5. Chassis lowering control push-button – 6. ECAS ECU – 7. Manual chassis leveling control push-button – 8. LH air spring – 9. Air supply unit – 10. LH level sensor – 11. Centralized diagnostic socket.

Electronic Control Unit

The electronic control unit controls different chassis positions in accordance with the requests from the driver.

As the ignition key switch is turned to ON position, the electronic central unit runs a system check while the red warning lamp on the dashboard panel comes on for about 2 seconds.

If any failure is detected, this warning lamp can stay on fixed for serious system failure or flashing for compressor failure due to overtemperature.

The electronic control unit checks the level sensor at regular intervals in order to keep chassis level constant as required by the driver, and operates the necessary compensation when a deviation of more than 3 counts is detected.

The compensation shall be operated with the following delay:

~ 1 sec. with vehicle still

~ 30 sec. with vehicle moving

If the level is not restored within a maximum time of 30 seconds from the beginning of the compensation, the control unit memorizes a plausibility error and the warning lamp comes on fixed.

During braking, the electronic control unit detects the signal from the stop light switch and stops any chassis level automatic adjustment.

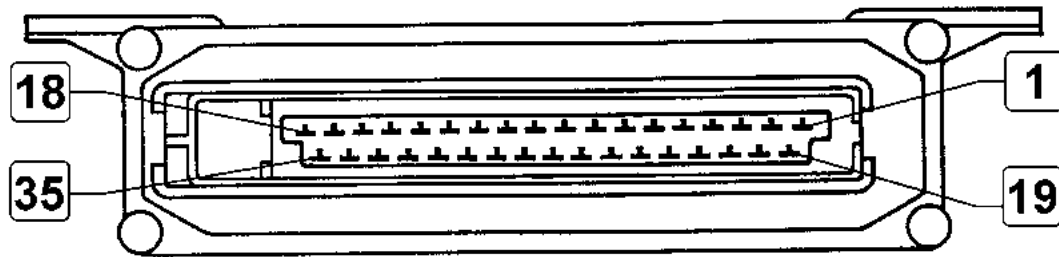
If a difference of more than 4 counts is detected between RH and LH sensors with vehicle still, after a delay of about 8 seconds, the control unit recognizes a "step" condition and stores the data in memory, keeping the chassis level as it is.

Besides a "blink code" option through the red warning lamp for preliminary diagnosis, the electronic control unit is provided with an advanced self-diagnosis system capable to detect and memorize any failures, depending on the concurrent conditions, including intermittent errors occurred in the system during operation and ensure a more appropriate and reliable servicing.

All interventions concerning diagnosis, programming, failures memory deletion, etc. can be performed by using available diagnosis instrument.

Electronic control unit pin out

Figure 299



000095t

Pin	Function	Cable colour code
1	Battery positive supply	7772
2	"L" line to pin 15 of the 38-pole diagnostic connector	1194
3	—	—
4	"K" line to pin 16 of the 38-pole diagnostic connector	2294
5	—	—
6	—	—
7	—	—
8	RH level sensor positive	5421
9	Ignition switch positive supply	8090
10	—	—
11	(Positive to air reservoir solenoid valve supply)	9445
12	—	—
13	Positive to LH chassis control solenoid valve	9425
14	—	—
15	Positive to electric compressor control relay	9444
16	Positive from stop light switch	1363
17	—	—
18	—	—
19	Negative from chassis level push-button	8420
20	—	—
21	—	—
22	Vehicle speed signal	5411
23	—	—
24	—	—
25	LH level sensor positive	5422
26	Chassis lift/lower push-button communication line	8091
27	Negative	0000
28	—	—
29	Positive to relief solenoid valve	9423
30	—	—
31	Positive to RH chassis control solenoid valve	9424
32	—	—
33	Negative for failure warning lamp	6008
34	—	—
35	—	—

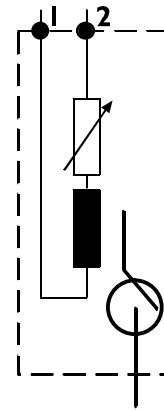
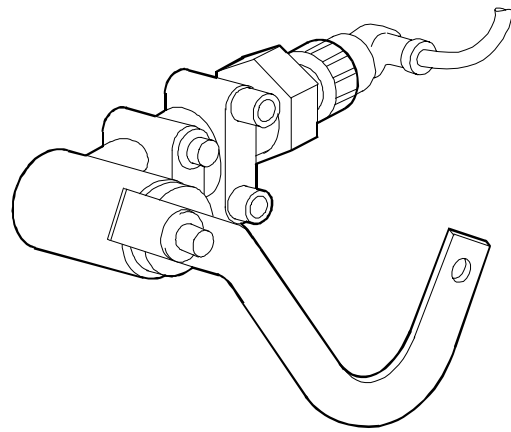
Level sensor

The level sensor consists of a coil fastened to the chassis and a piston (Figure 300).

The piston is moved inside the coil by the action of a cam and a lever connected to the axle, this way varying the coil inductance.

These variations shall be used by the electronic control unit at the different stages of system operation.

Figure 300

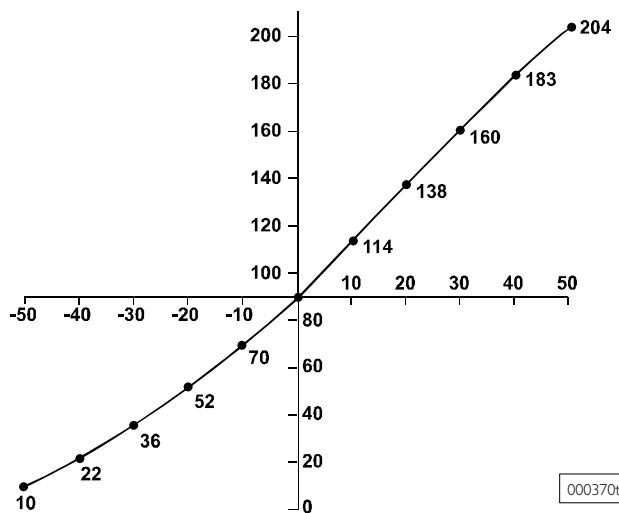


000369t

LEVEL SENSOR

Figure 301

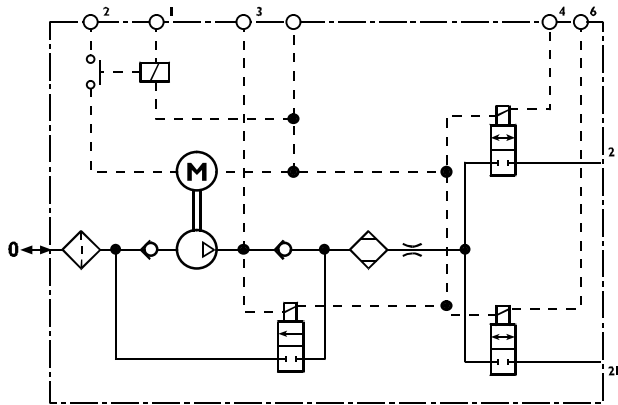
Here is shown the nominal characteristic curve of the sensor as a function of the angle displacement of the lever.



000370t

OPERATING DIAGRAM

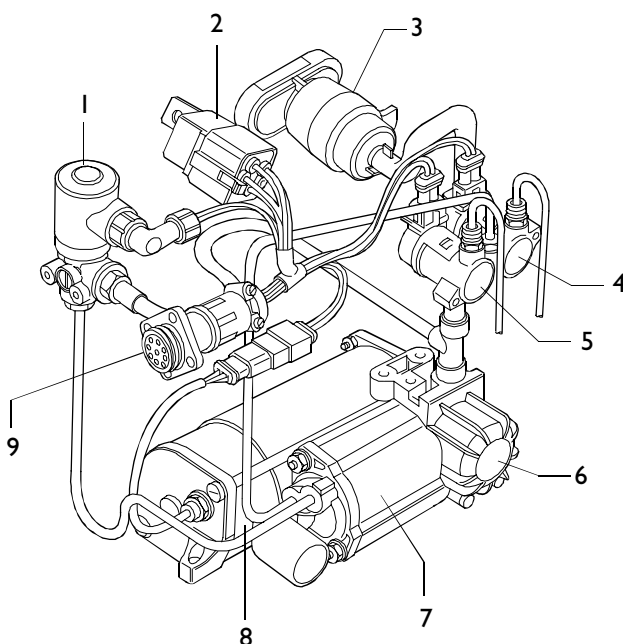
Figure 302



000222t

INTERNAL COMPRESSED AIR DIAGRAM

Figure 303



000222t

SUPPLY UNIT

Pneumatic supply unit

This component produces, dries, supplies or discharges suspension spring air.

Components of the air supply unit

1. Relief solenoid valve
2. Electrical motor control relay
3. Intake filter
4. RH chassis control solenoid valve
5. LH chassis control solenoid valve
6. Compressor
7. Drier filter
8. Compressor electrical motor
9. Electrical connector

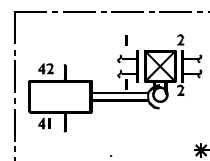
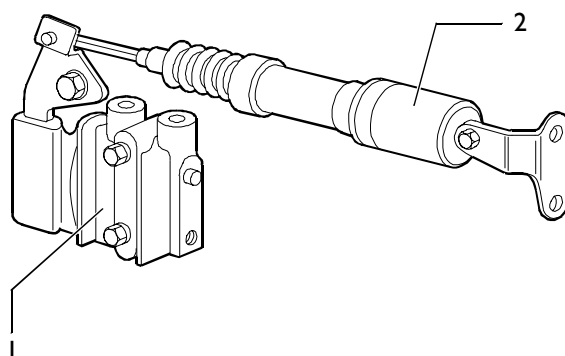
Brake action compensator

The vehicles not equipped with ABS / EBS / ABD system need a system providing a better control of the braking action on the rear wheels. This system includes an dual brake action compensator and a brake action compensator pneumatic actuator.

Depending on the load applied on the rear axle, as detected by the pneumatic actuator, the brake action compensator automatically adjust the braking torque applied to the axle by the brakes.

The diagram shows the compensation ratio corresponding to 0.15 as a function air spring variations.

Figure 304

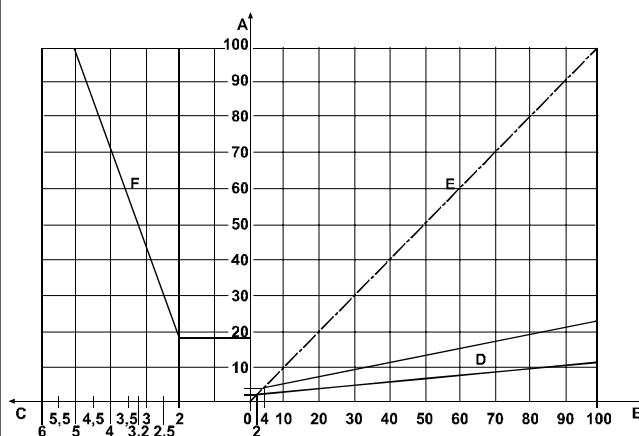


000372t

BRAKE ACTION COMPENSATOR UNIT

- 1. Dual brake action compensator
- 2. Pneumatic actuator for brake action compensator

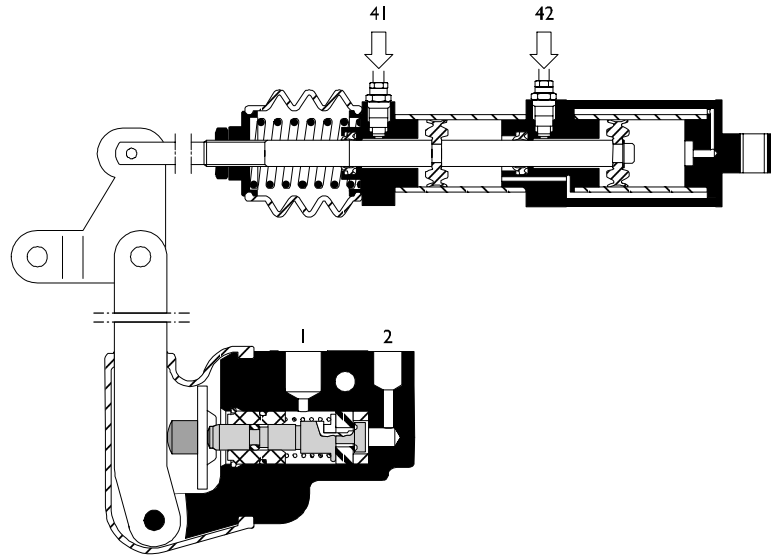
Figure 305



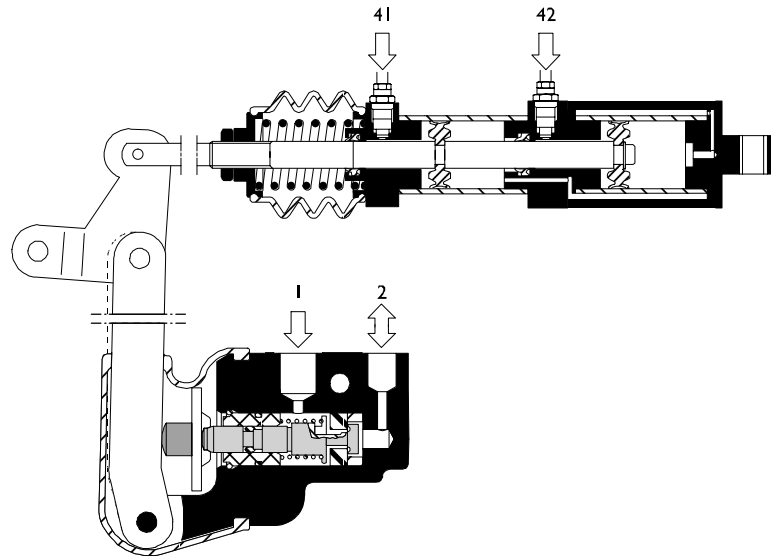
000371t

OPERATION DIAGRAM

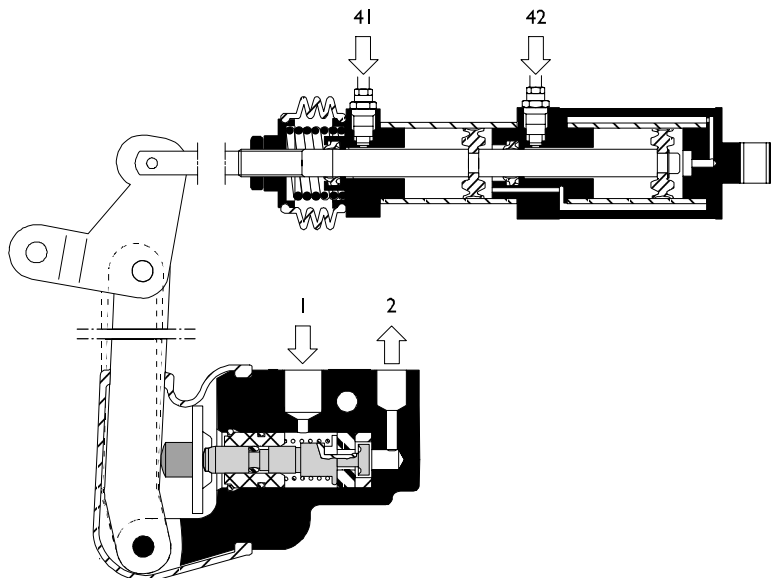
- A. Hydraulic output pressure (bars) – B. Hydraulic control pressure (bars) – C. Pneumatic control pressure (bars) –
- D. Characteristic curve with 0.15 ratio (empty) –
- E. 1:1 ratio (loaded) – F. Characteristic curve of pneumatic pressure/load

“A” Braking action**Figure 306**

000219t

“B” Braking action with empty vehicle**Figure 307**

000220t

“C” Braking action with laden vehicle**Figure 308**

000221t

Chassis lifting

This operation is allowed at a speed below 15 Km/h; as soon as this speed is exceeded, automatic chassis leveling is actuated.

Proceed as follow to lift the chassis:

- ☐ Press chassis lifting push-button and keep it pressed to enable the relay to close the switch and receive a 5A supply. Now, the control unit commands the relay to start the compressor (6) electrical motor (2). Air is then aspirated through the filter (3), compressed and delivered into the system via the one-way valve and the drying filter (7). Simultaneously, the control unit starts solenoid valves "4" and "5" so that the compressed air is supplied to the suspension air springs to lift the chassis.

During the entire operation, the red warning lamp on the dashboard panel shall flash to inform the driver that the chassis is off trim.

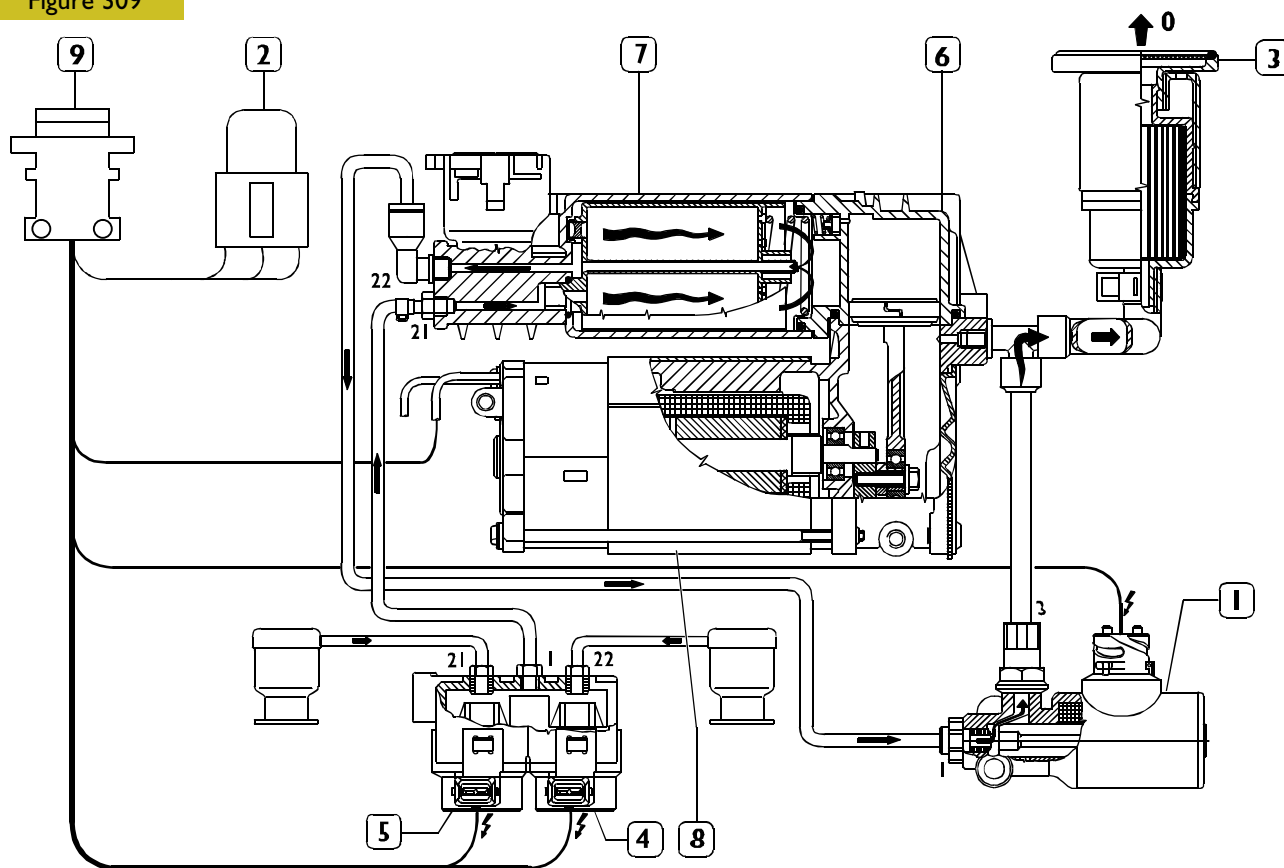
The warning lamp shall keep flashing until the chassis is off normal trim.

Chassis lowering is stopped as the push-button is released while the chassis level reached is maintained.

The maximum height is set by level sensors according to the calibration data memorized in the electronic control unit.

Maximum lifting actuation time is 2 minutes to prevent preheats that could damage the electro compressor.

Figure 309



000224t

SYSTEM OPERATION DIAGRAM

- 1. Exhaust solenoid valve – 2. Electrical motor control relay – 3. Intake filter – 4. RH chassis control solenoid valve –
- 5. LH chassis control solenoid valve – 6. Compressor – 7. Dryer filter – 8. Compressor control electrical motor –
- 9. Electrical connector

Chassis lowering

This operation is allowed at a speed below 15 Km/h; as soon as this speed is exceeded, automatic chassis leveling is actuated.

Proceed as follow to lower the chassis:

- ☐ Press the lowering push-button and keep it pressed to enable the relay to send a signal to the control unit to energize solenoid valves (4) and (5) and the exhaust valve (1).

The compressed air contained in the suspension air springs can flow back through the dryer filter "7" for cleaning and, as imposed by the closed one-way valve, flow to the relief solenoid valve to be released in the atmosphere through the intake filter.

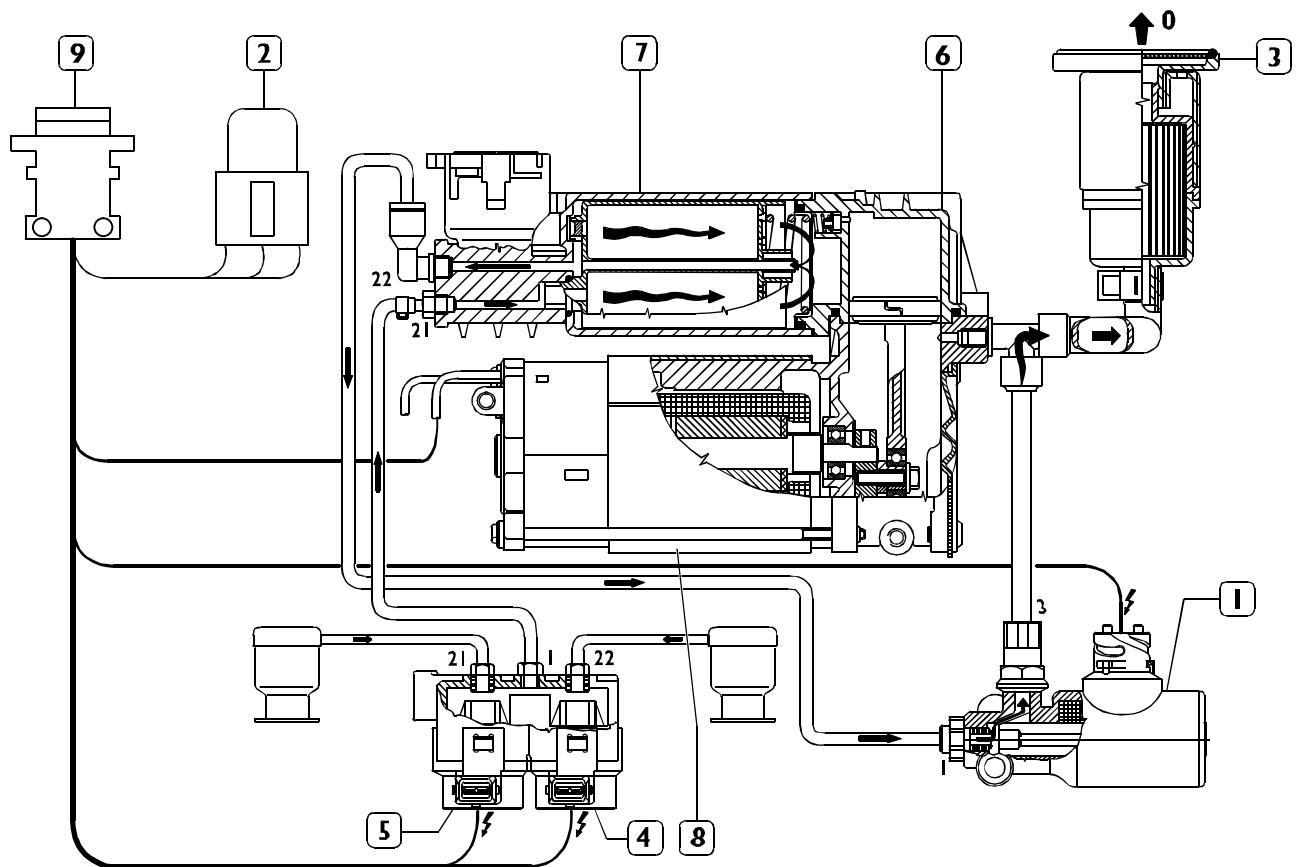
During the entire operation, the red warning lamp on the dashboard panel shall flash to inform the driver that the chassis is off trim.

The warning lamp shall keep flashing until the chassis is off normal trim.

Chassis lowering is stopped as the push-button is released while the chassis level reached is maintained.

The maximum height is set by level sensors according to the calibration data memorized in the electronic control unit.

Figure 310



SYSTEM OPERATION DIAGRAM

1. Exhaust solenoid valve – 2. Electrical motor control relay – 3. Intake filter – 4. RH chassis control solenoid valve –
5. LH chassis control solenoid valve – 6. Compressor – 7. Dryer filter – 8. Compressor control electrical motor –
9. Electrical connector

000223t

Chassis leveling

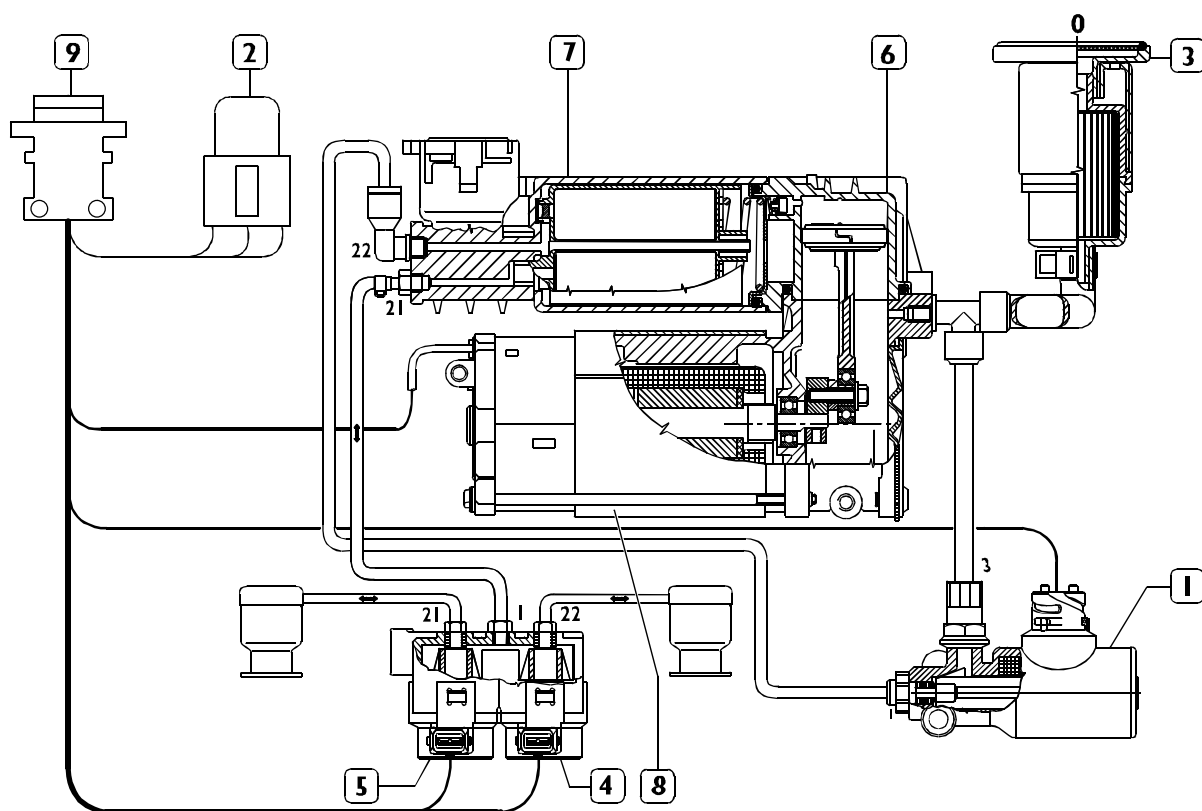
Chassis leveling can be achieved with vehicle moving at a speed below 15 Km/h by pressing the leveling push-button.

This way, the control unit shall start the lifting or lowering action until the normal height is reached and maintained in accordance with the signals received from the level sensors and the calibration data stored in the control unit memory.

On achievement of the normal trim, the warning lamp on the dashboard panel shall stop flashing.

The same leveling shall be obtained automatically as the vehicle exceed the speed of 15 Km/h.

Figure 311



SYSTEM OPERATION DIAGRAM

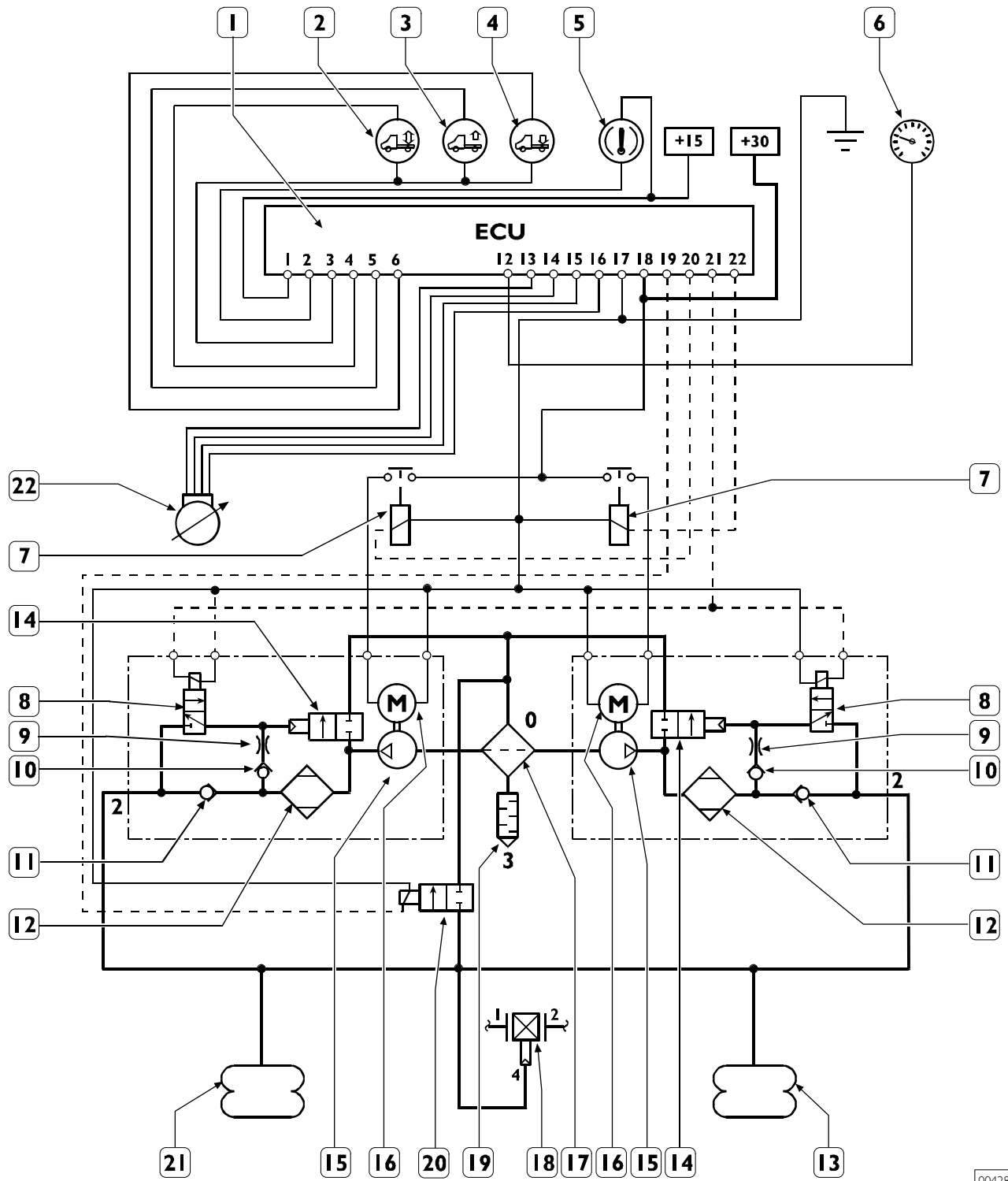
1. Exhaust solenoid valve – 2. Electrical motor control relay – 3. Intake filter – 4. RH chassis control solenoid valve – 5. LH chassis control solenoid valve – 6. Compressor – 7. Dryer filter – 8. Compressor control electrical motor – 9. Electrical connector

000363t

VB TECHNIK PNEUMATIC SUSPENSIONS

The system illustrated is used in the following vehicles:
65C – 60C – 50C

Figure 312



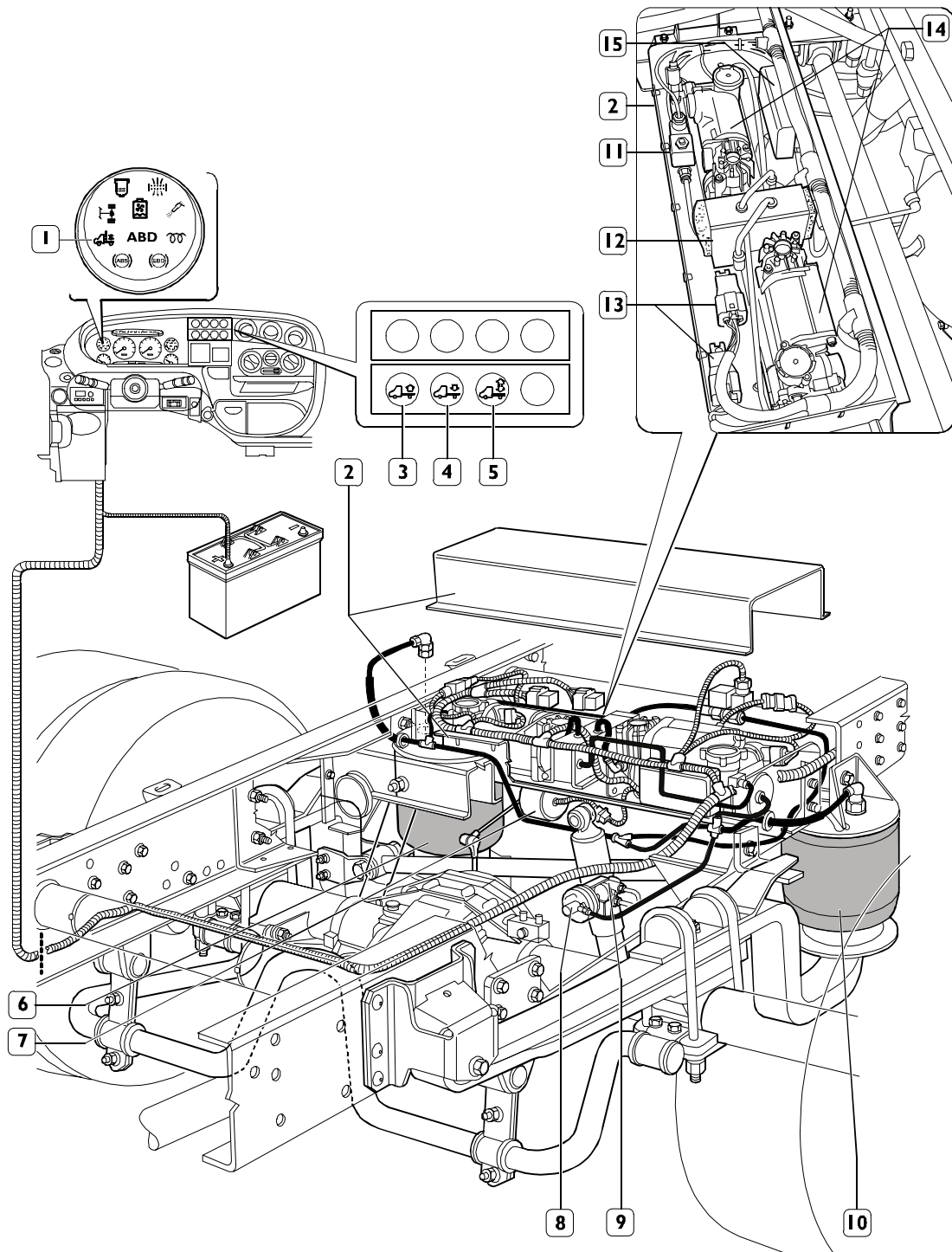
OPERATION DIAGRAMS

004282t

Pin	Description
1	Electronic control unit
2	Manual mode actuation button
3	Lowering button
4	Lifting button
5	VBt signalling warning light
6	Tachograph
7	Electric motor control relays
8	Discharge solenoid valve (for washing)
9	Choking valve
10	Unidirectional discharge valve
11	Unidirection feed valve
12	Drier filter
13	Right-hand air spring
14	Pneumatic discharge valve
15	Compressor
16	Compressor actuation electric motor
17	Filter
18	Braking connector
19	Exhaust silencer
20	Exhaust solenoid valve
21	Left-hand air spring
22	Level sensor

Vehicles with braking system without ABS

Figure 313

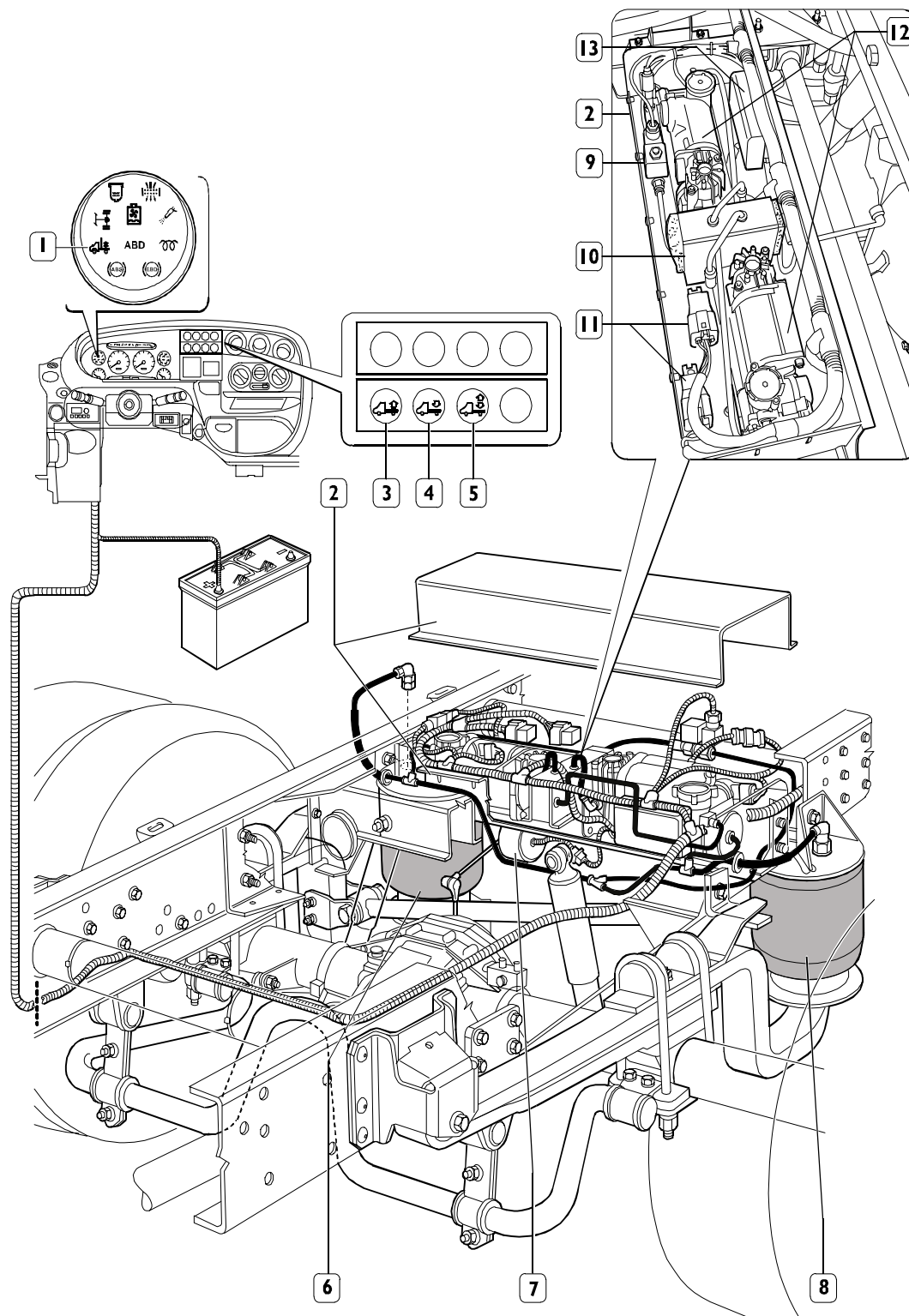


1. VBT warning lamp – 2. Suspension control unit (ECU, pneumatic supply unit) – 3. Chassis lifting switch – 4. Chassis lowering push-button – 5. Manual control button – 6. RH air spring – 7. Level sensor – 8. Pneumatic brake action compensator – 9. Brake action compensator – 10. LH air spring

85725

Vehicles with ABS system

Figure 314



85724

1. VBT warning lamp – 2. Suspension control unit (ECU, pneumatic supply unit) – 3. Chassis lifting switch – 4. Chassis lowering push-button – 5. Manual control button – 6. RH air spring – 7. Level sensor – 8. LH air spring

SYSTEM COMPONENTS

Electronic Control Unit (35C – 40C – 45C)

The electronic control unit controls different chassis positions in accordance with the driver's requests.

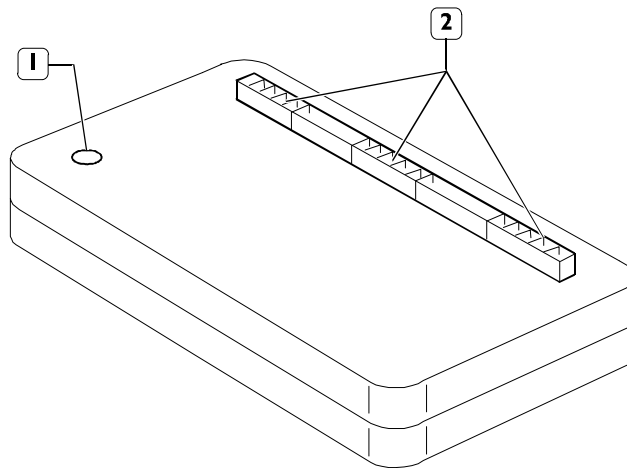
As the ignition key switch is turned to ON position, the electronic central unit runs a system check while the red warning lamp on the dashboard panel comes on for about 5 seconds.

If no failures are detected, this warning lamp shall turn off, otherwise an automatic blink code shall be started with the following meaning:

Slow blinking	–	Electric compressor overload due to prolonged manual actuation.
Fast blinking	–	Electric compressor overload
Fixed on	–	Level sensor cable
Off	–	Supply failure
Dimmed light	–	Wrong button operation (simultaneous action) or button connecting cabling failure.

The control unit is fitted with a warning led "1" connected to the warning lamp on the dashboard panel, and a set of five connectors "2" of which only 1, 3 and 5 are used.

Figure 315

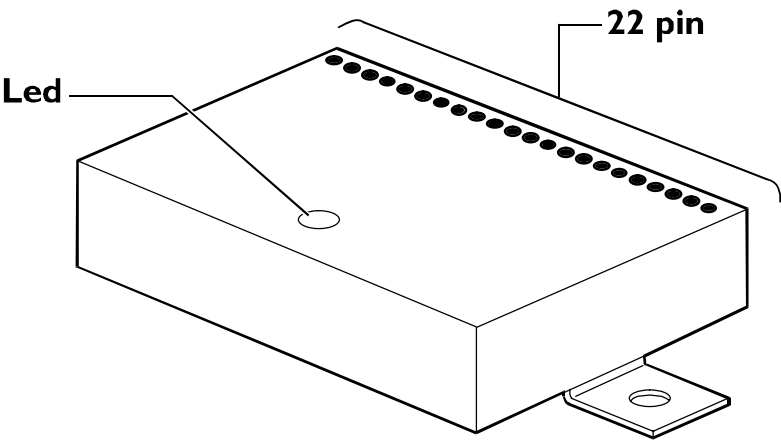


000373t

Connector	Pin	Function	Cable colour
1	1	Signal from level sensor	White
	2	Signal from level sensor	Brown
	3	Positive from level sensor	Yellow
	4	Negative from level sensor	Green
	5	–	–
	6	–	–
3	1	Signal from lifting switch	Grey
	2	Negative for trim variators	Green
	3	Signal from lowering switch	Brown
	4	Negative for failure warning light	Yellow
	5	Key-controlled positive	Pink
	6	Signal from handbrake switch	White
5	1	Electric compressor control remote-control switch positive	White
	2	Discharge solenoid valve control positive	Yellow
	3	Positive from battery	Red
	4	Negative from battery	Black
	5	–	–
	6	–	–

Electronic control unit (60C – 65C – 50C)

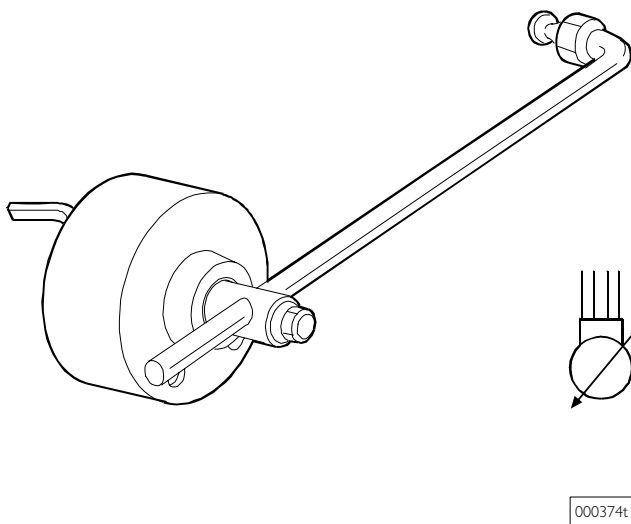
Figure 316



004283t

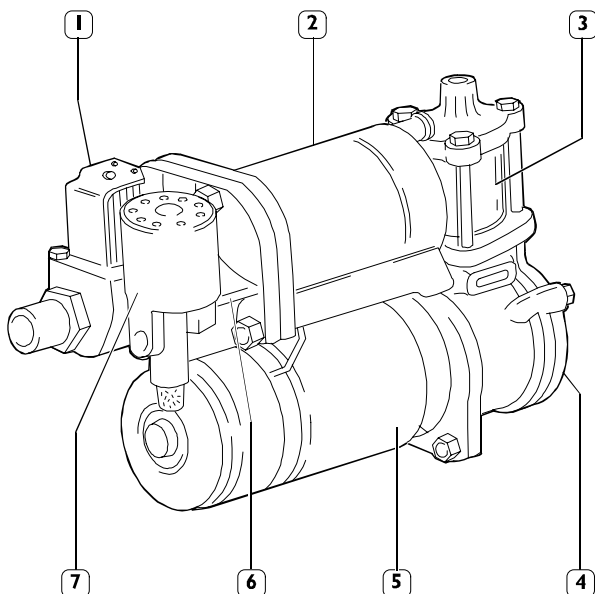
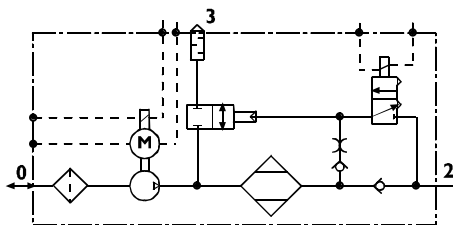
Pin	Cable colour	Function
1	Pink	+15
2	Yellow	Warning light bulb
3	Green	Button negative
4	White	Signal from handbrake
5	Brown	Lowering button
6	Grey	Lifting button
7	–	Free
8	–	Free
9	–	Free
10	–	Free
11	–	Free
12	Black	Tachograph
13	White	Signal from level sensor for lifting
14	Brown	Signal from level sensor for lowering
15	Yellow	Positive for level sensor
16	Green	Negative for level sensor
17	Green	Earth
18	Pink	+30
19	Brown	Discharge solenoid valve control
20	Grey	Compressor relay 2 control
21	Yellow	Discharge solenoid valve control
22	White	Compressor relay 2 control

Figure 317



LEVEL SENSOR

Figure 318



PNEUMATIC SUPPLY UNIT

Level sensor

In accordance to the chassis height from floor, the level sensor shown sends the signals to start chassis leveling to the ECU.

It is connected to the control unit by means of four cables:

- White: Lifting signal
- Brown: Lowering signal
- Yellow: Positive
- Green: Negative

Pneumatic supply unit

The function of this component is that of distributing or discharging suspension spring air.

Shows the connection of its internal components of the supply unit..

Components of the pneumatic supply unit

- 1 – Air spring relief solenoid valve
- 2 – Dryer filter
- 3 – Compressor
- 4 – Supply filter
- 5 – Electrical motor
- 6 – Relief pneumatic valve
- 7 – Muffer

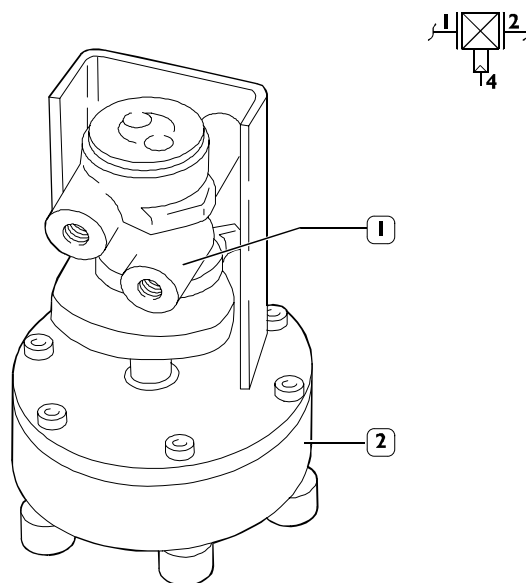
Brake action compensator

Those vehicles not equipped with ABS / EBS / ABD require the installation of a system providing better braking action on the rear wheels. This system includes an dual brake action compensator and a brake action compensator pneumatic actuator.

Depending on the load applied on the rear axle, as detected by the pneumatic actuator, the brake action compensator automatically adjust the braking torque applied to the axle by the brakes.

The correction ratio is calibrated at 0.25.

Figure 319



000376t

BRAKE ACTION COMPENSATION UNIT

1. Brake action compensator – 2. Pneumatic actuator for brake action compensator

ROTATING SLIDING DOOR

Description

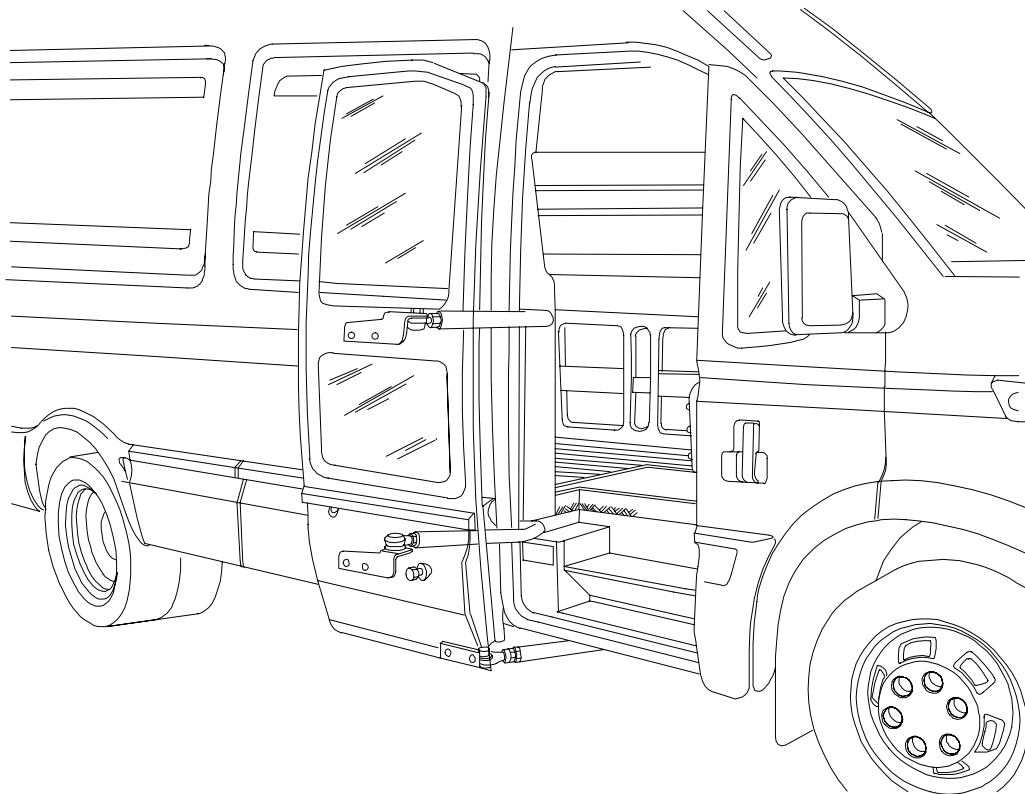
The rotating sliding door consists of:

- ☐ Complete panel and door compartment frame

This aluminum extruded profile guarantees a rigid bearing structure to support all system components such as:

- ☐ access step;
- ☐ moving hinge;
- ☐ seals;
- ☐ two locks;
- ☐ the electronic center;
- ☐ door panel front lock pins;
- ☐ extension arm;
- ☐ compressed air sensitive edge (bus version only);
- ☐ motor unit.

Figure 320



73726

ROTATING SLIDING DOOR

SYSTEM COMPONENTS

Electronic center

The electronic center is located under the access step.

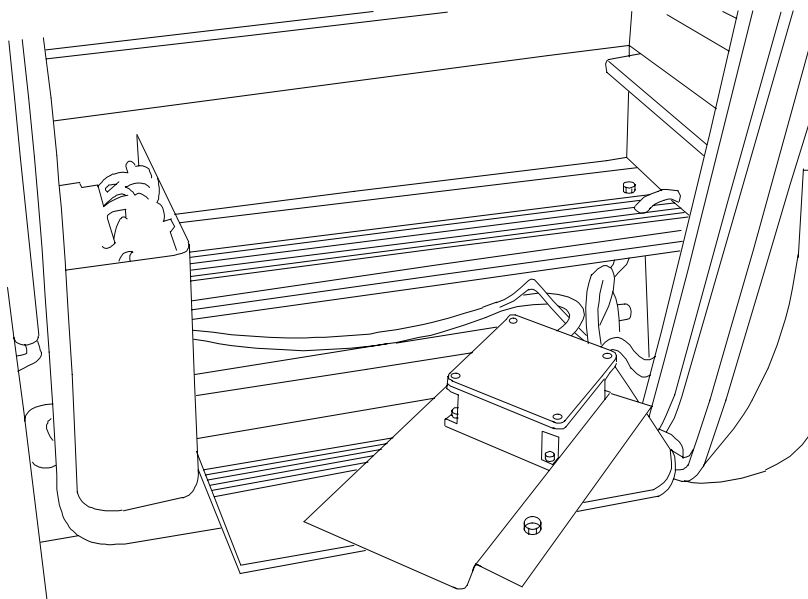
In addition to the motor reduction gear control, it also features a series of vehicle and door system communication inputs and outputs. A tachometer signal reading system for the following purposes is provided to prevent the door from being opened with the vehicle moving:

- ☐ to prevent the door from opening when the vehicle travels at over 5 Km/h;
- ☐ to generate a buzzer when the vehicle is moving and the door is open;
- ☐ for the absence of a tachometer signal involving the possibility of the door opening (after push button actuation) with the vehicle moving.

Electrical features

Power	12V dc
Stand-by absorption	20 ÷ 30 mA
Operating absorption	3.5 ÷ 5 mA
Operating temperature	-30°C ÷ +60°C

Figure 321

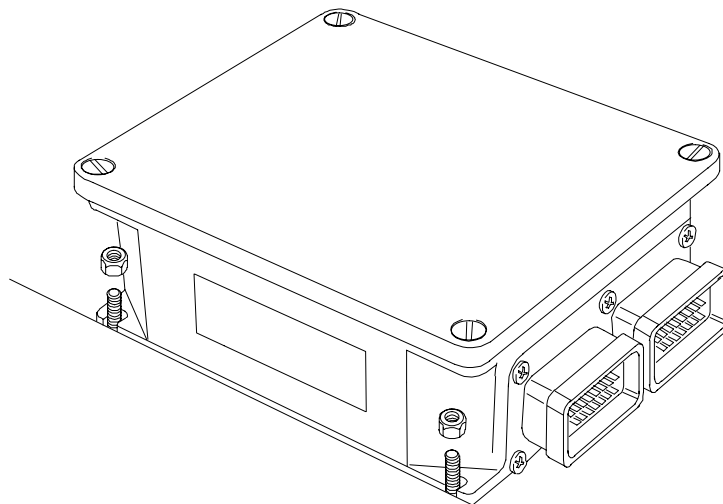


73741

ECU LOCATION

Electronic center pin-out

Pin	Description
1A	Free
2A	Free
3A	Tachometer signal
4A	Open open/close push button
5A	Centralized opening remote control input
6A	Centralized opening remote control input
7A	Free
8A	Positive from battery
1B	Free
2B	Free
3B	Positive input from key switch
4B	Door open warning output
5B	External emergency lock closed warning output
6B	Door defect warning output
7B	Free
8B	Negative from battery
1C	Free
2C	Free
3C	Free
4C	Free
5C	Free
6C	Free
7C	Ceiling light control output
8C	Free

Figure 322

73740

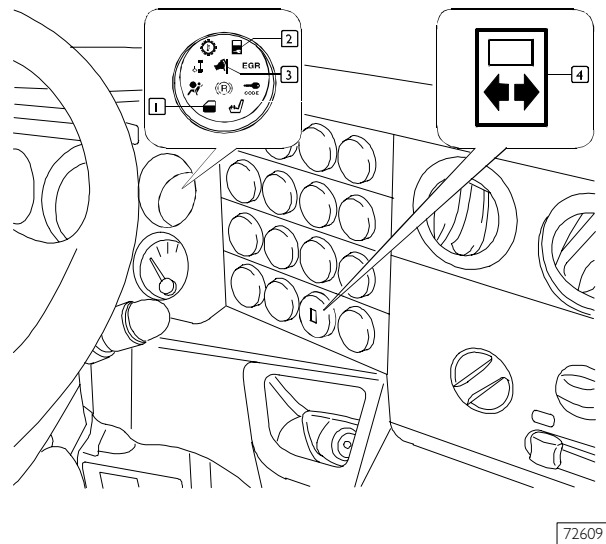
ECU LOCATION

Optical and sound warnings

Component location on instrument panel:

1. Door open warning light.
2. Emergency handle lock (yellow warning light).
3. Emergency handle lock activated (bus yellow warning light).
4. Door open/close control push button.

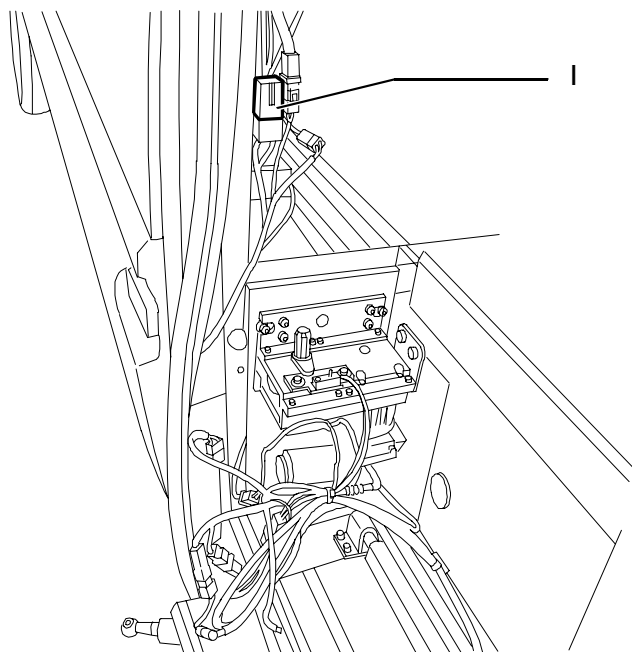
Figure 323



72609

COMPONENT LOCATION ON INSTRUMENT PANEL

Figure 324



73739

BUZZER

Sound device

This electronic center piloted device warns users of special operating conditions, such as the vehicle moving with the door open, for instance.

Description and operation

The open/close control is only activated with the vehicle moving, via the instrument panel push button.

If the vehicle is provided with a centralized closing system, door opening can be activated even with the vehicle stationary. In this case, opening and closing must be limited to prevent discharging the vehicle battery.

Opening with the instrument panel push button

The operator controls automatic door opening by actuating the instrument panel push button.

Pressing the push button sends an electrical impulse required for mechanical electro magnetic induced lock release.

At release end, the lock on travel end warning loses the signal and starts the motor reduction gear that makes the door panel rotate open and given visual warning of door open, with a warning light on the instrument panel.

Opening end is with the Complete Opening micro switch.

During door opening, a cam located on the lower part of the hinge and solidal with motor reduction gear rotation lowers the access step to its use position.

Closing with the instrument panel push button

The operator controls automatic door closing by actuating the instrument panel push button.

Pressing the push button sends an electrical impulse to the motor reduction gear that completes its closing travel.

During closing a double obstacle detection system operating on motor ammeter measurement and adjustable via a timer on the center is activated, another one is located on the compressed air sensitive edge of the two door compartment uprights.

Near door close a position reading sent to the tachometer on the door control motor disengages the ammeter controlled sensitive edge to enable otherwise impossible door closing.

The compressed air sensitive edge is activated until receipt of door closed micro switch signal, which activates a signal switching all center functions off.

When closing, the door enables rotation of the mobile step to its rest position with a return spring.

If the vehicle moves with the door open, its closing can be controlled with the push button even at speeds over 5 Km/h, in which case the buzzer remains active (inclusive of the door open warning light) until complete door closing.

Opening/closing with the remote control

The open/close control extends to all vehicle doors including the rotating sliding one.

Movement inversion

After door open/close push button actuation, in whatever position it may be, actuating the push button generates its controlled movement inversion.

Obstacle detection system

The system features motor ammeter control capable of detecting peaks of voltage and of the compressed air sensitive edge located on the front and back of the door compartment, for obstacle detection.

If an obstacle counters door panel movement during closing, over 150N force of compressed air transducer activation opens it.

If an obstacle counters door panel movement during opening, over 150N force of compressed air transducer activation closes it.

Since the door is equipped with the anti-squash function, reading the nearly closed door status signal generated by the motor encoder automatically cuts out this function to enable complete door closing.

Emergency operation

The door can be opened in case of system failure or power down by using the emergency lever from the inside of the lock close to the door panel from the outside.

In case of emergency operation, automatic door opening or closing is disabled until the system is restarted manually.

The outside emergency lock is provided with a key that can be used to secure the vehicle (Figure 325).

An internal buzzer is actuated if the starter switch is actuated in the service position with external opening emergency locked with the key.

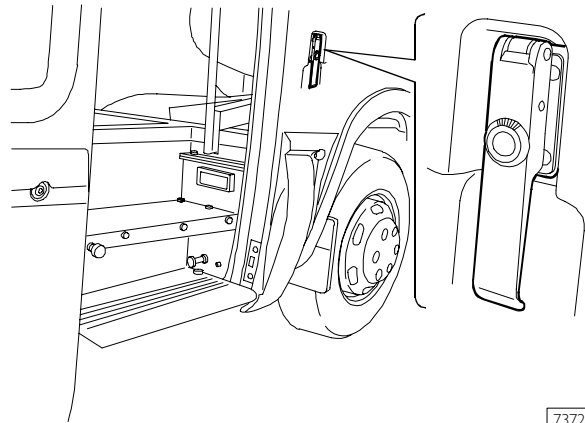
Diagnosis

The system reports a failure when the failure warning light goes on.

This failure can be due to the following causes:

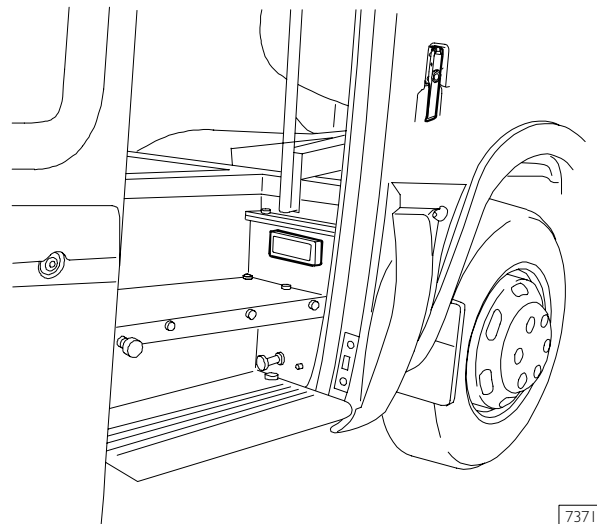
- ☐ Closing does not occur a maximum of ~20 sec after actuation
 - Possible causes:
 - Door open micro switch warning failed.
 - Electrical cabling cut.
- ☐ Over voltage when opening or closing
 - Possible causes:
 - Motor short circuit
- ☐ Door opening/closing travel abnormal.
 - Possible causes:
 - Motor encoder signals not recognized.
- ☐ Door does not open.
 - Possible causes:
 - Tachometer signal detective or down.

Figure 325



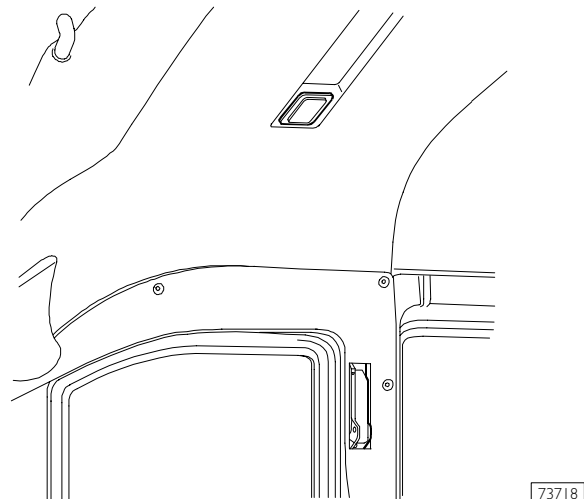
EXTERNAL EMERGENCY OPENING

Figure 326

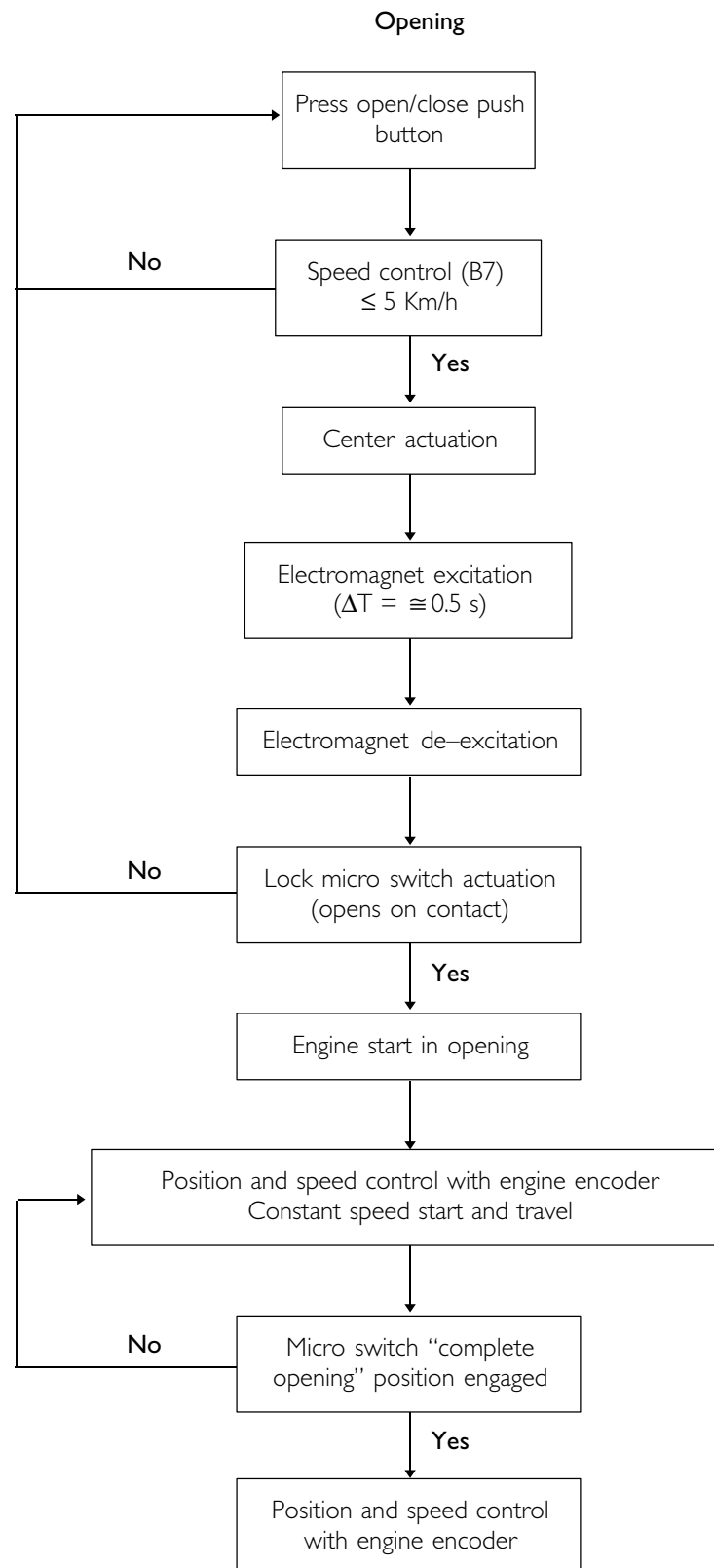


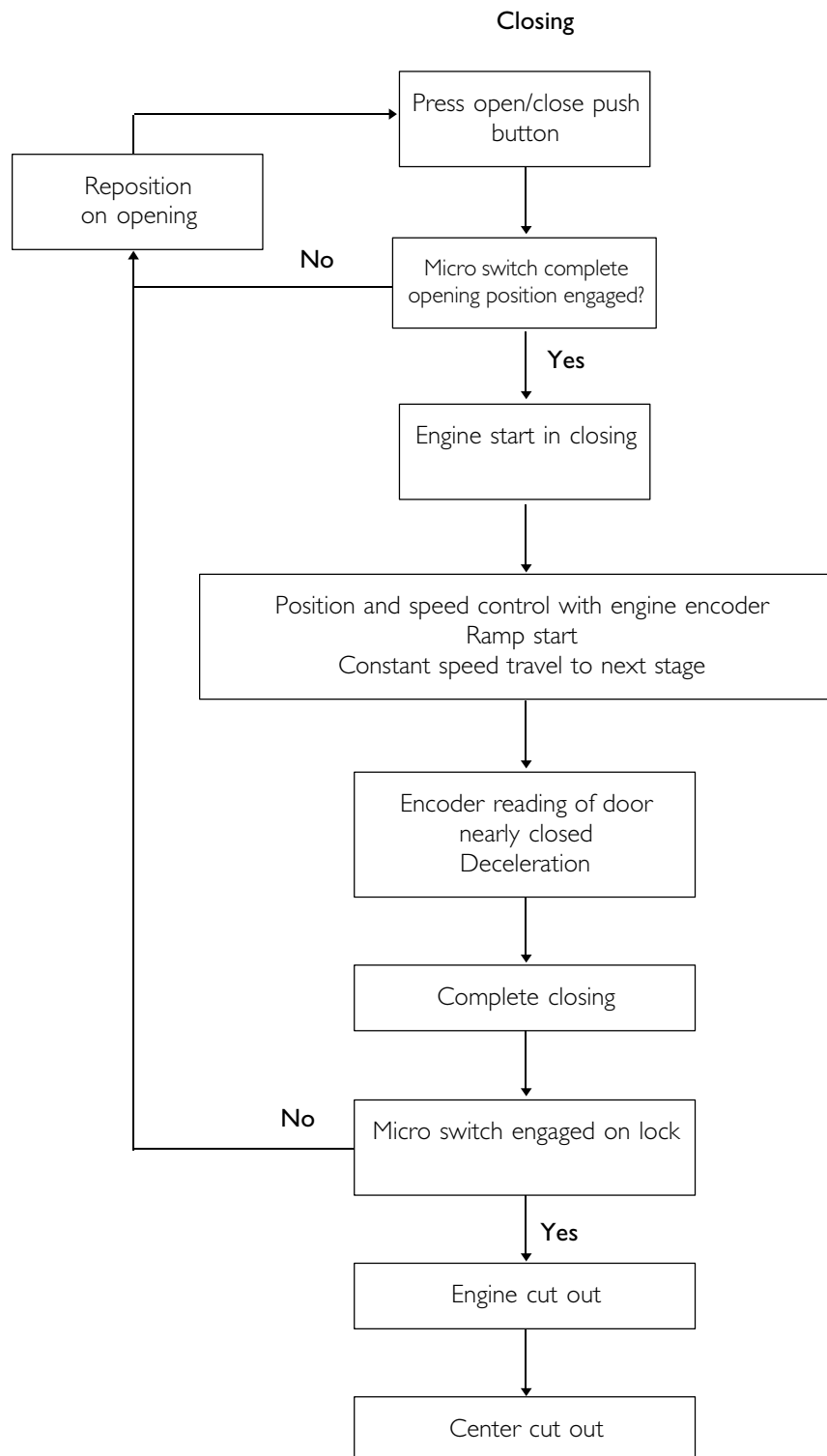
STEP LIGHT

Figure 327

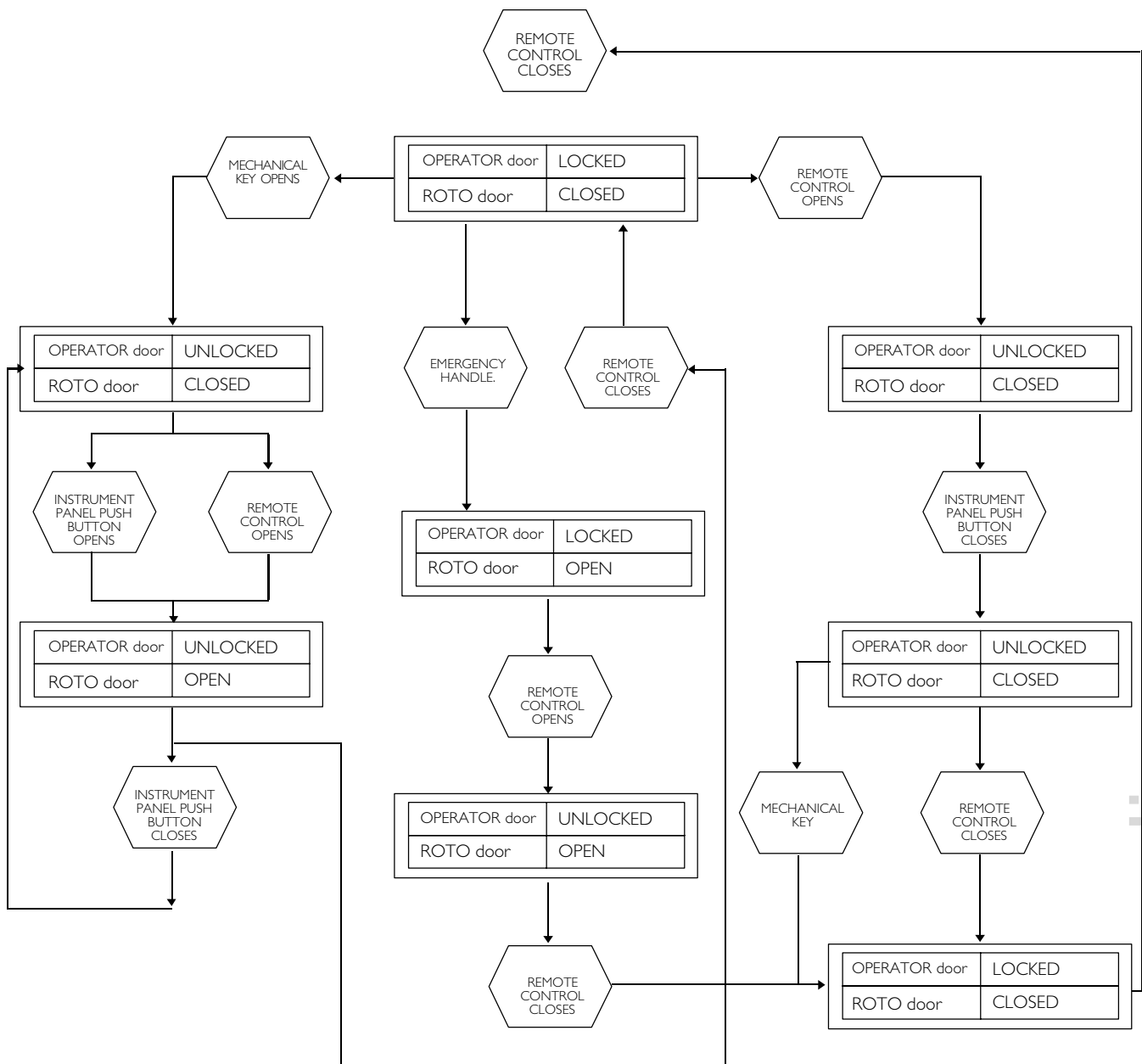


1. Light – 2. Emergency openings

Description of opening

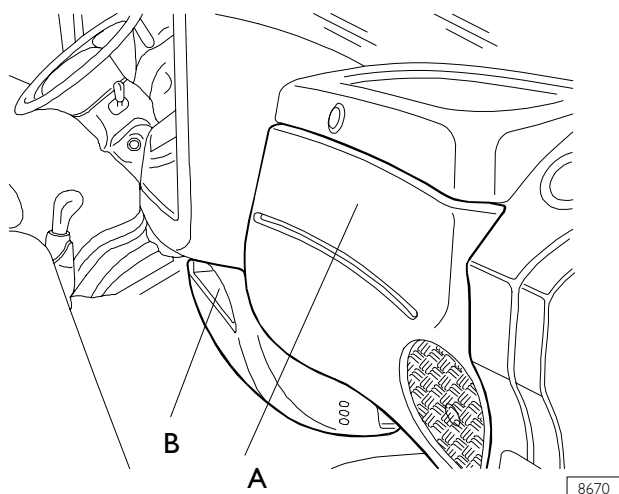
Description of closing cycle

Operating diagram



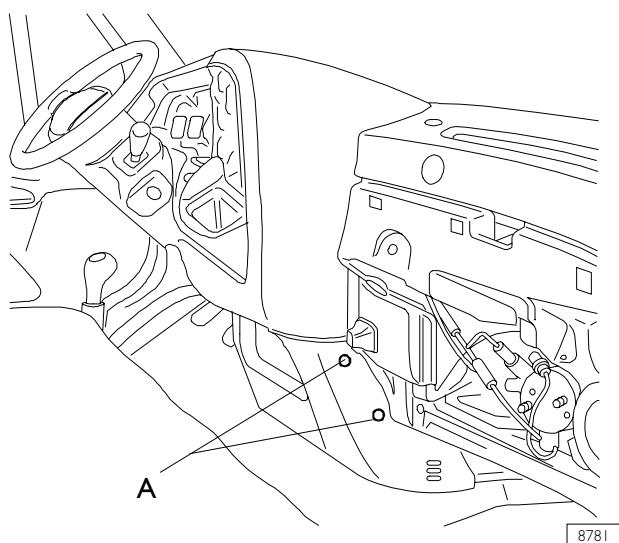
N.B.: As a consequence of use by IVECO of passive type door locks, disconnected operation may occur between operator and rotating sliding door opening and closing.

Figure 328



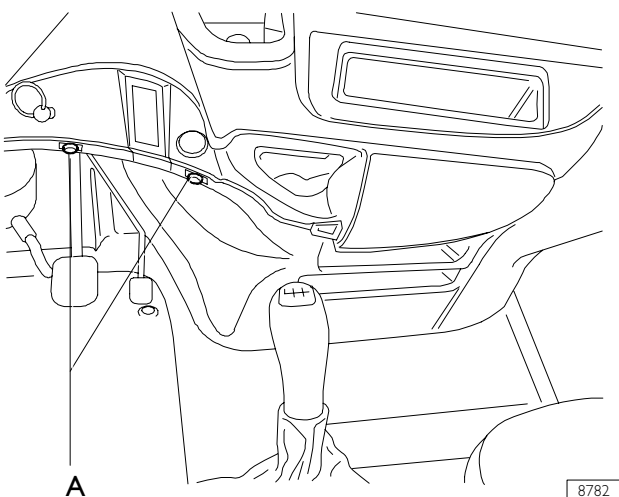
LOWER DASHBOARD SNAP-FITTED PANEL

Figure 329



LOWER PANEL FASTENING SCREWS

Figure 330



LOWER PANEL FASTENING SCREWS

ELECTRONIC TACHOGRAPH

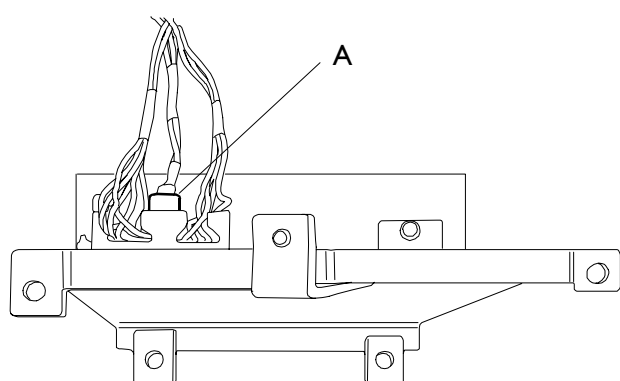
Removing the lower dashboard cover

- ☐ Remove the snap-fitted panel (Ref. A) to gain access to the panel fastening screws (Ref. B).
- ☐ Slacken the 4 fastening screws, two on either side, of the lower panel (Ref. A).

Electronic tachograph control unit housing assembly

Fasten the control unit to the support, insert the 3 connectors, eliminating the bridges between the connectors (white, yellow and brown) and apply the seals (ref. A).

Figure 331



CONNECTIONS AND TACHOGRAPH CONTROL UNIT SUPPORT

Assembling the tachograph control unit support on the dashboard

Use the six screws to fasten the tachograph control unit support to the dashboard.

Figure 333

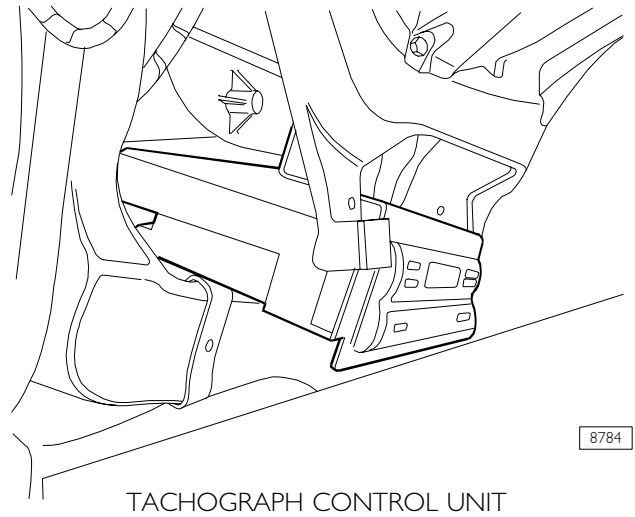


Figure 334

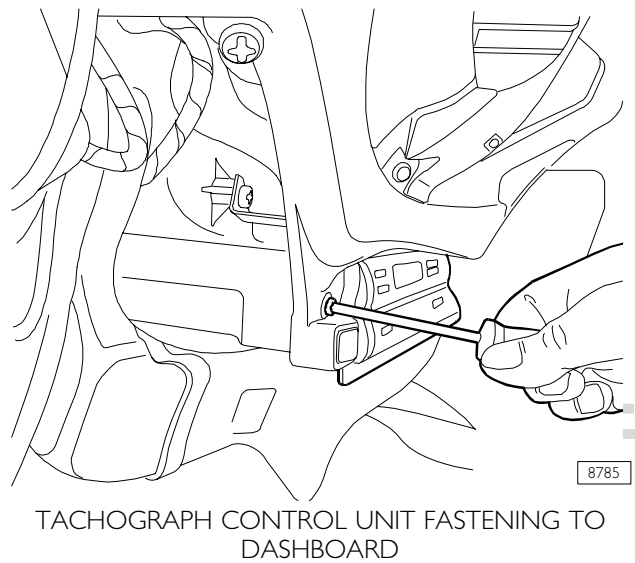


Figure 332

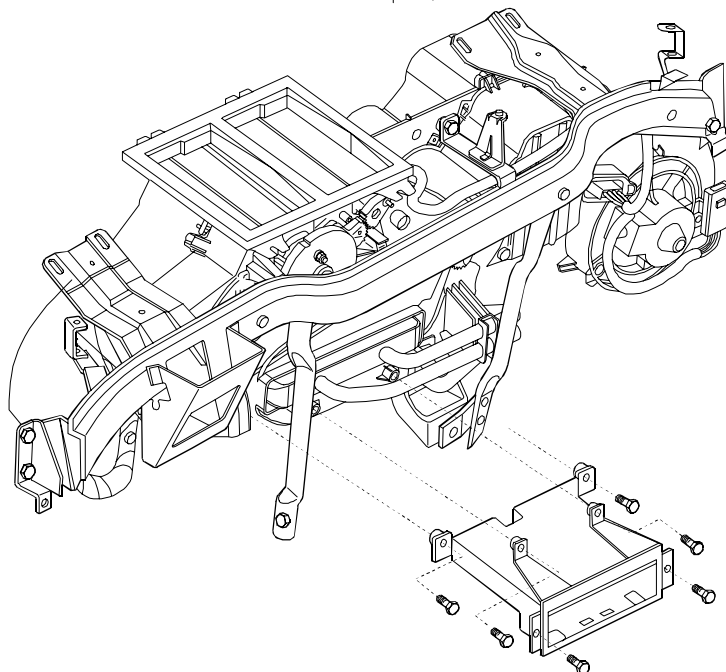
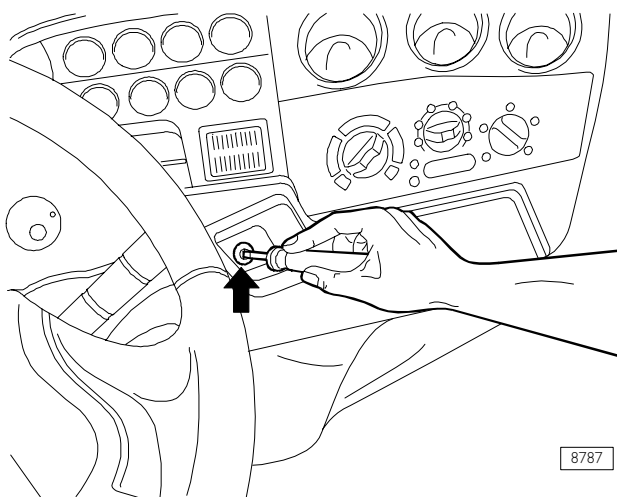


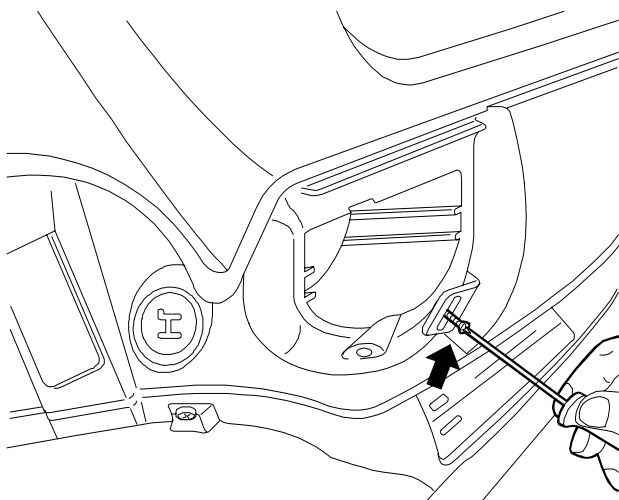
Figure 335



8787

UPPER TRIM FASTENING SCREW

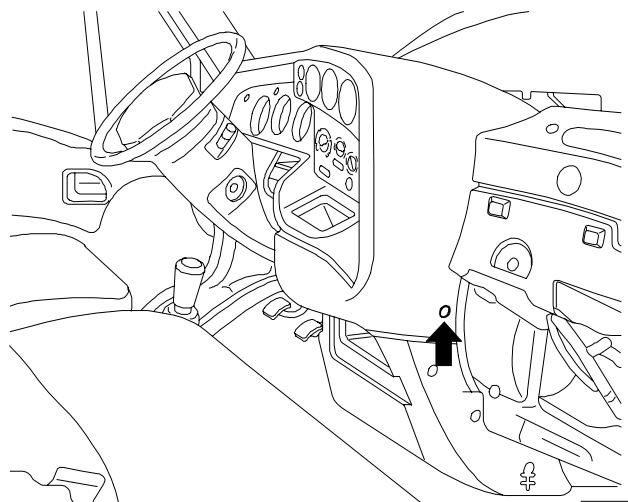
Figure 336



8788

UPPER TRIM FASTENING SCREW

Figure 337



8789

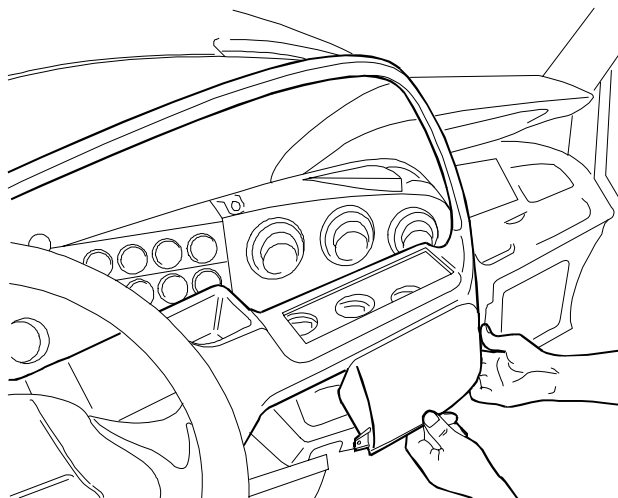
UPPER TRIM FASTENING SCREW

Removing the instrument cluster module

To replace the module, proceed as follows:

1. Remove the upper trim working on the three screws shown by the arrows.
2. Lift and remove the trim taking care not to damage the velcro stoppers.

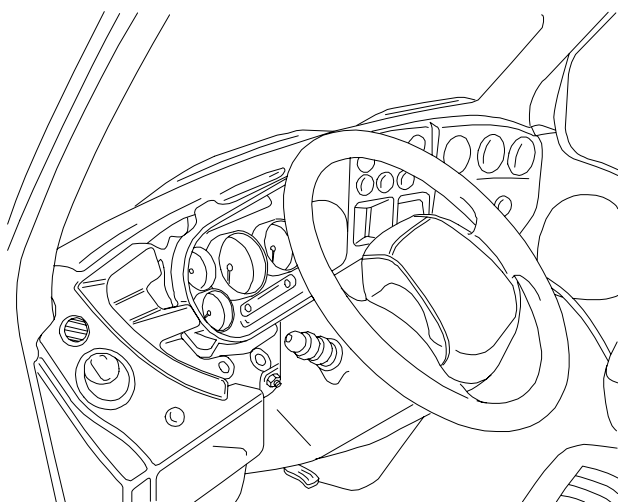
Figure 338



8790

TRIM REMOVAL

Figure 339



8791

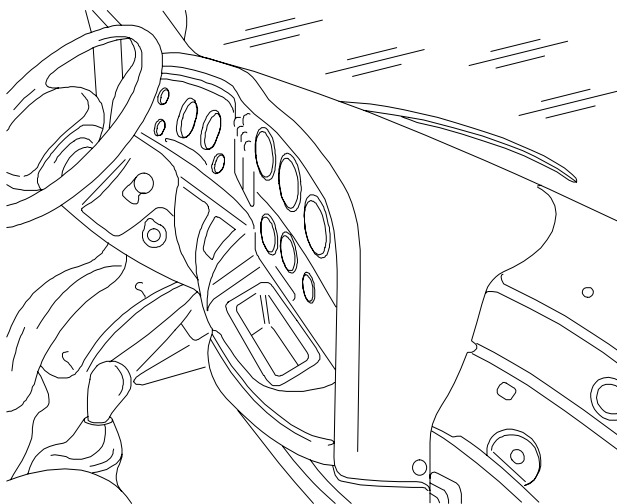
INSTRUMENT CLUSTER

Work on the 4 screws, 2 on either side, to remove the cluster module with tachometer.

Disconnect the electrical connections and replace with the module for tachograph sealing the electrical connections concerning the wiring for tachograph.

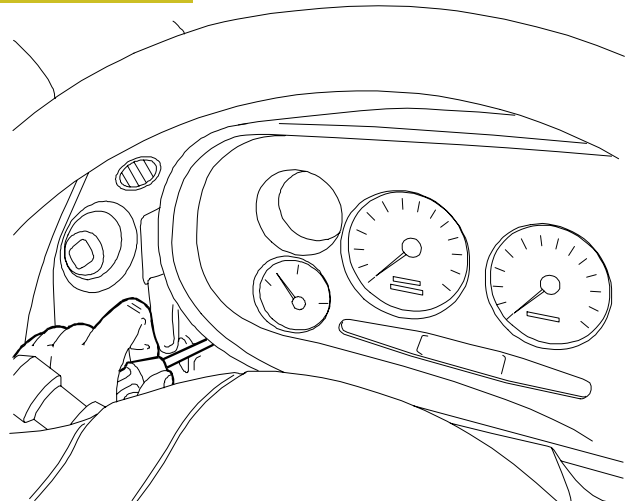
Fasten the instrument cluster to the dashboard and refit the upper and lower trim.

Figure 340



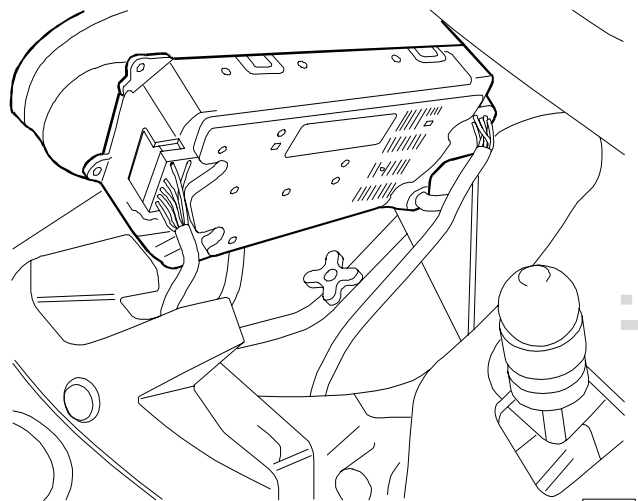
COMPLETE INSTRUMENT CLUSTER

Figure 341



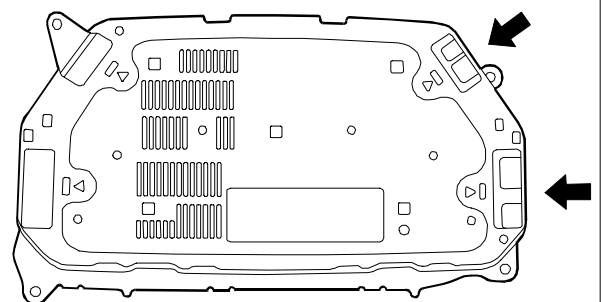
INSTRUMENT CLUSTER FASTENING

Figure 342



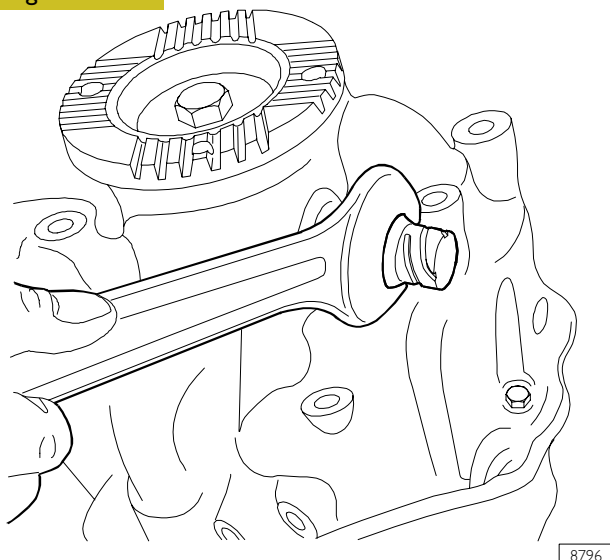
REMOVING THE INSTRUMENT CLUSTER

Figure 343



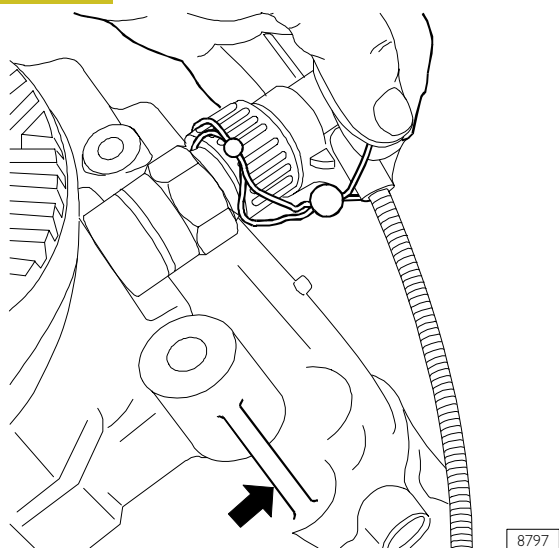
CONNECTIONS CONCERNING WIRING FOR TACHOGRAPH

Figure 344



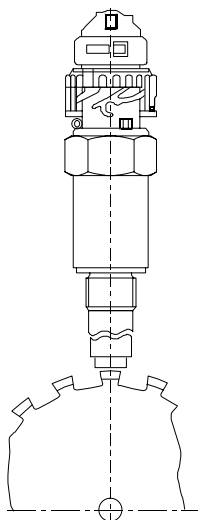
SENSOR REPLACEMENT ON GEARBOX

Figure 345



CONNECTION OF SENSOR TO WIRING

Figure 346



SENSOR TECHNICAL VIEW

Operations on gearbox

1. Replace the sensor on the gearbox with a suitable one for tachograph.
2. Seal with lead the electrical connection to the sensor and to the gearbox body.

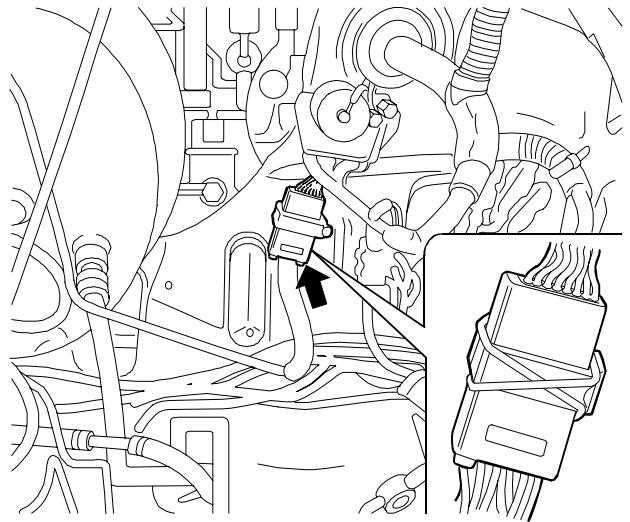
If necessary, drill (4 mm) the ribbing on the gearbox (see arrow) for passing the wire.

Operation in bonnet

1. Disconnect the terminals of the power cables from the battery terminals.
2. Remove the battery from the engine compartment, after removing the fastening bracket.
3. Seal the connector between the frame and cab/bonnet cables with sealing wire.

4. Refit the battery, re-connect the terminals to the battery terminals, ensuring correct polarity and calibrate the tachograph using the special VDO tool.
5. In the front part, seal the tachograph control unit with the special red plug as shown.
6. Apply the labels; on the driver's door and on the tilting plate of the tachograph control unit.

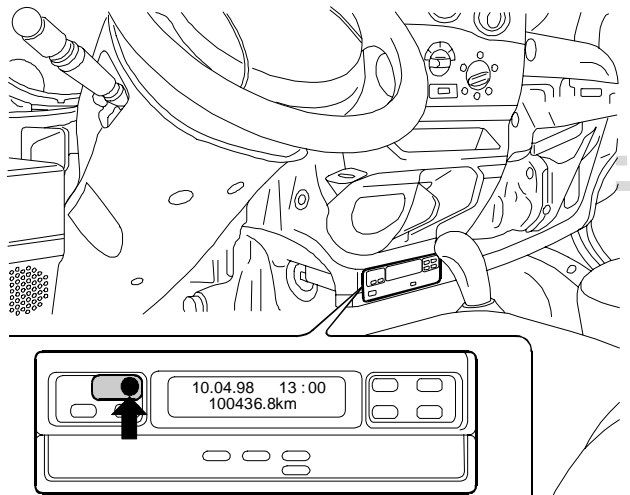
Figure 347



8799

CONNECTOR BETWEEN CAB/BONNET AND FRAME CABLES

Figure 348



8800

FRONT VIEW OF TACHOGRAPH CONTROL UNIT

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CIRCUIT CHARTS

Notes and specifications

Unless otherwise specified the charts are to be considered valid for all engines and for all truck and van versions.

The vehicle conditions considered for laying wiring circuitries are:

- ☐ engine off
- ☐ ignition key off
- ☐ handbrake on
- ☐ gearbox in neutral
- ☐ fluids at normal level
- ☐ doors closed

The relays used have an internal resistance (in parallel with the coil) of 680 Ω to reduce over-voltage on the system due to switching of the switches.

In charts 22 A–B the component distinguished by the symbol Σ is the socket for the converter.

In chart 33 the connection distinguished by the symbol \blacktriangle is valid only for vehicles with "parallel" braking system.

In chart 34B the component distinguished by the symbol Δ is present only on vehicles with reserve air tank.

Chart 38 shows a van with sliding side doors.

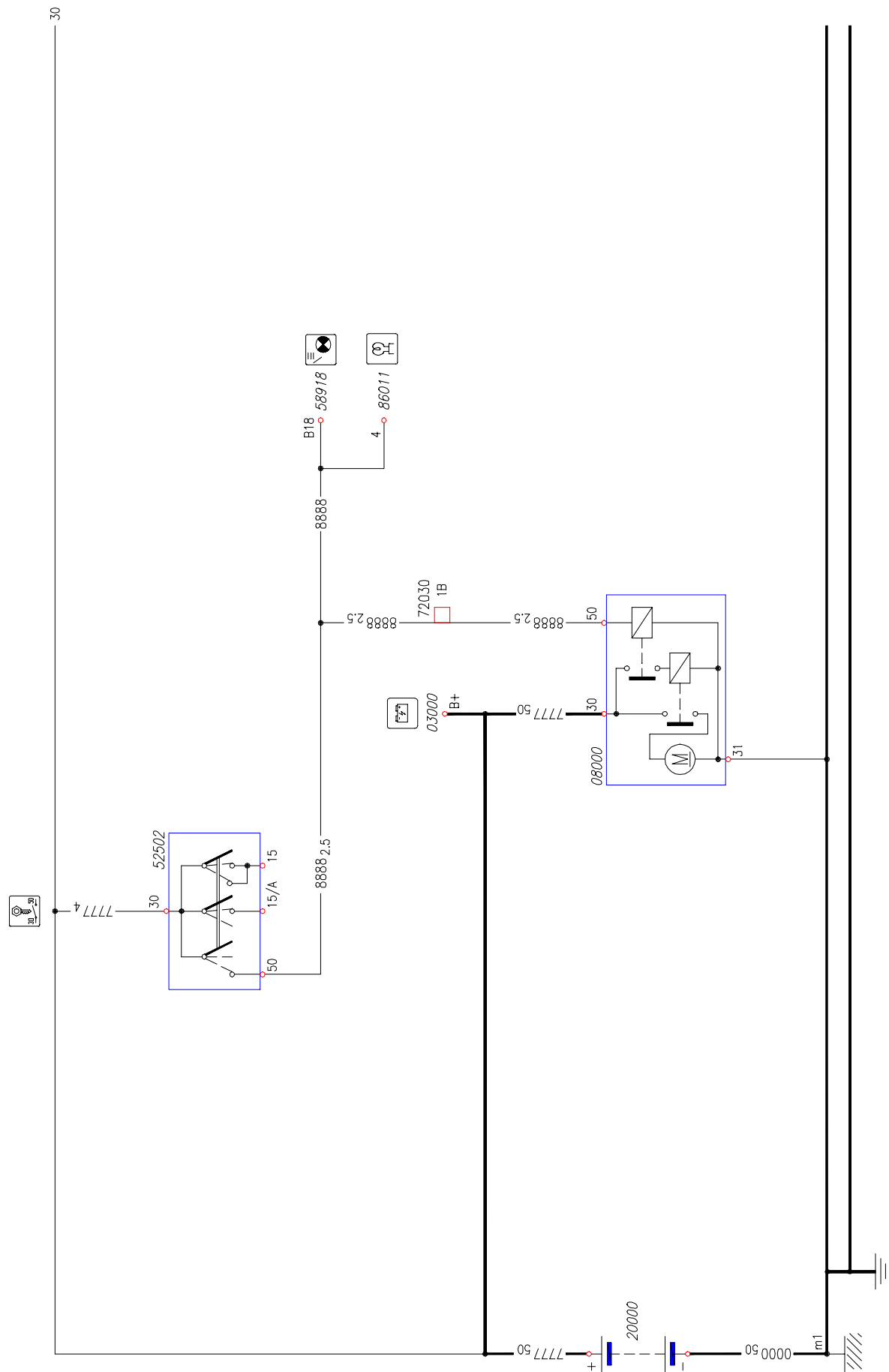
Component codes concerning chart 35D (82010A/B/C connectors – for all tables)

- 1 Sensor on evaporator
- 2 Fan motor
- 3 Fan electronic control module
- 4 Air mixing gear motor
- 5 Re-circulation gear motor
- 6 Electronic climate control unit (82010)
- 7 Treated air sensor
- 8 Fan control potentiometer
- 9 Required temperature potentiometer
- 10 Climate control module
- 11 Microswitch for MAX DEF function
- 12 Control panel lighting

Colour codes for cabling not supplied by IVECO

Code	Colour	Code	Colour
A	Light Blue	M	Brown
B	White	N	Black
C	Orange	R	Red
G	Yellow	S	Rose
H	Grey	V	Green
L	Blue	Z	Purple

Chart 1B: Start (.10 – .12)

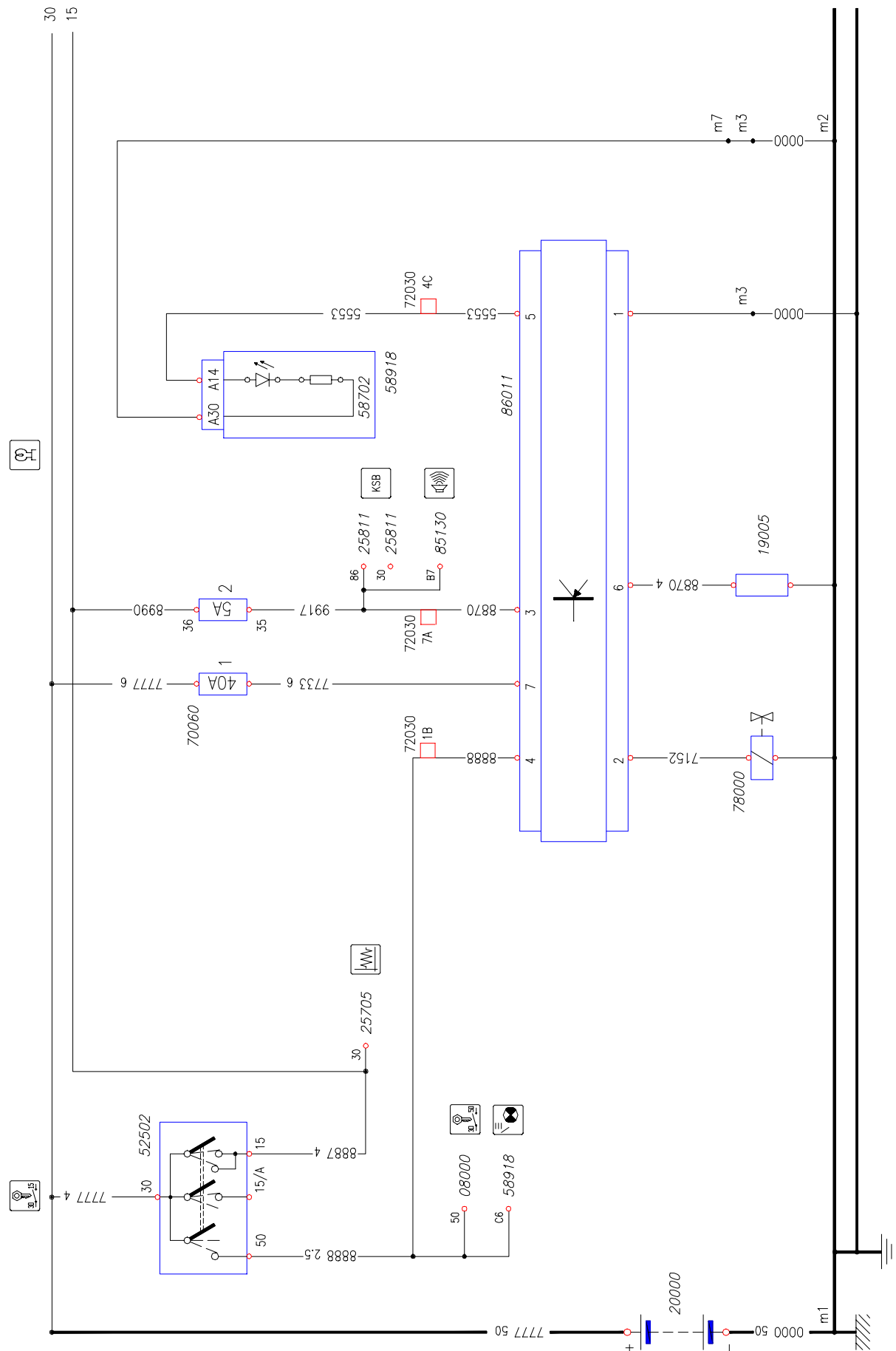


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Chart 2B: Preheating (.11)



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Chart 3: Recharge

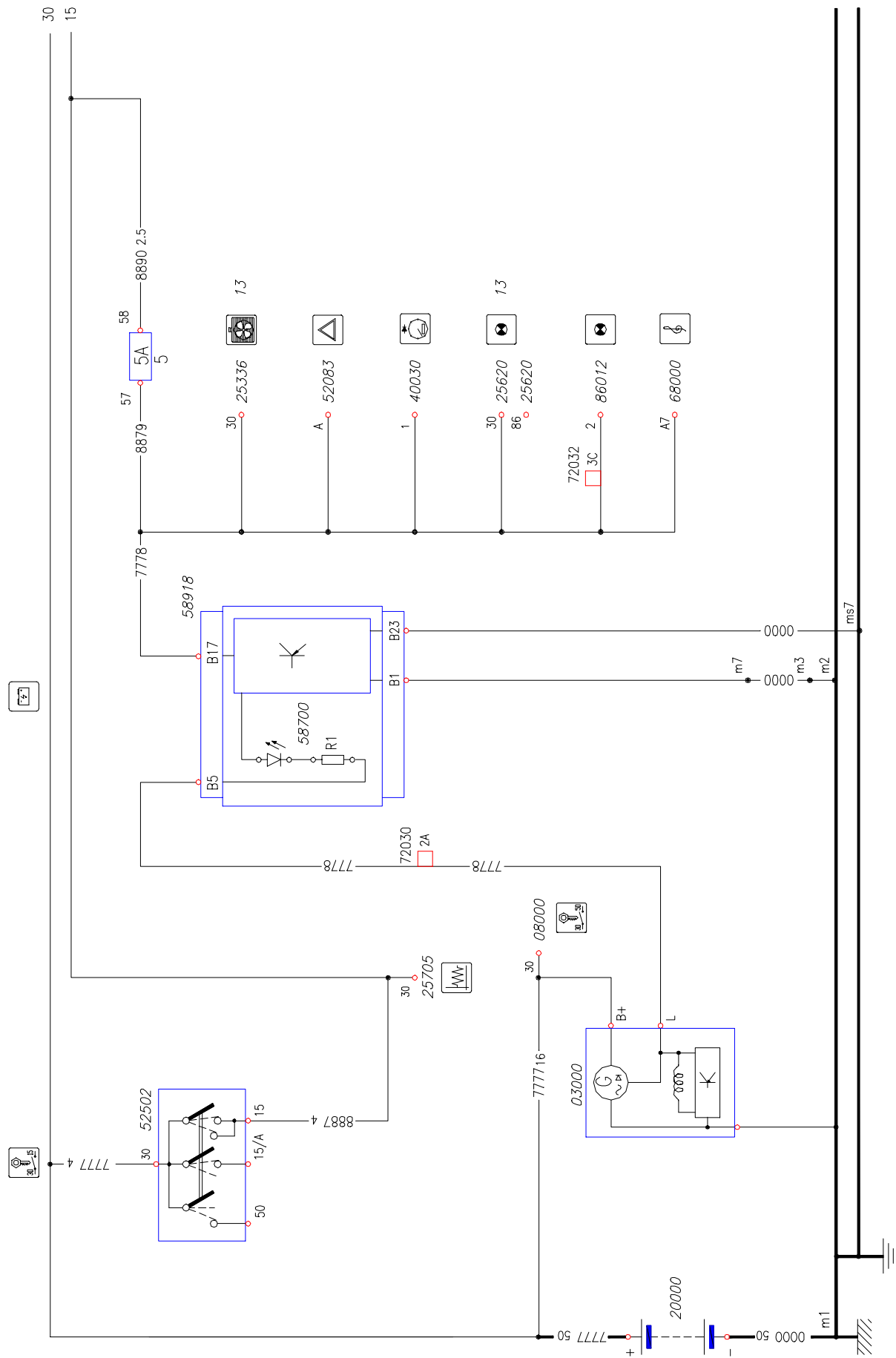


Chart 4: Instruments

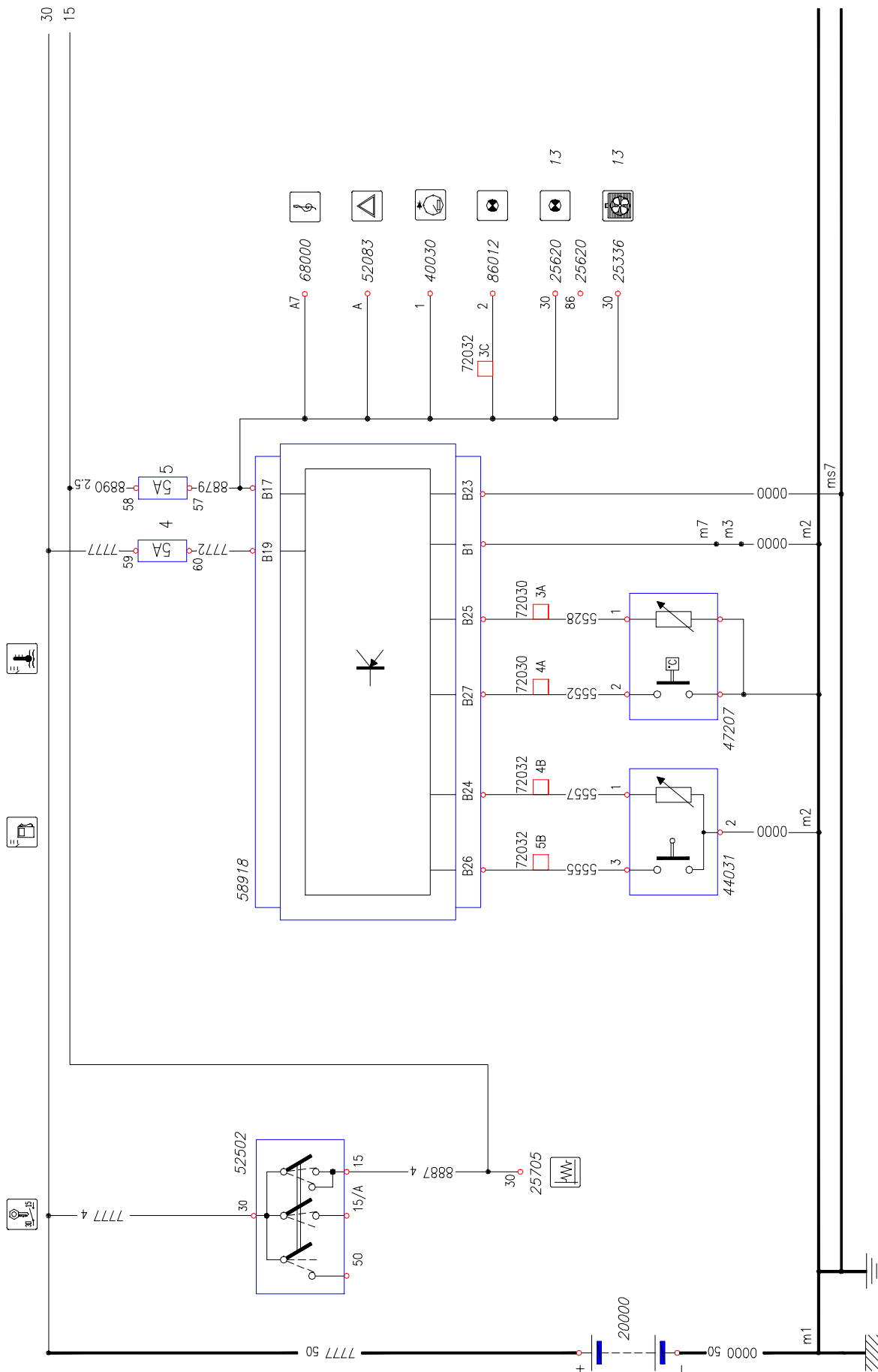
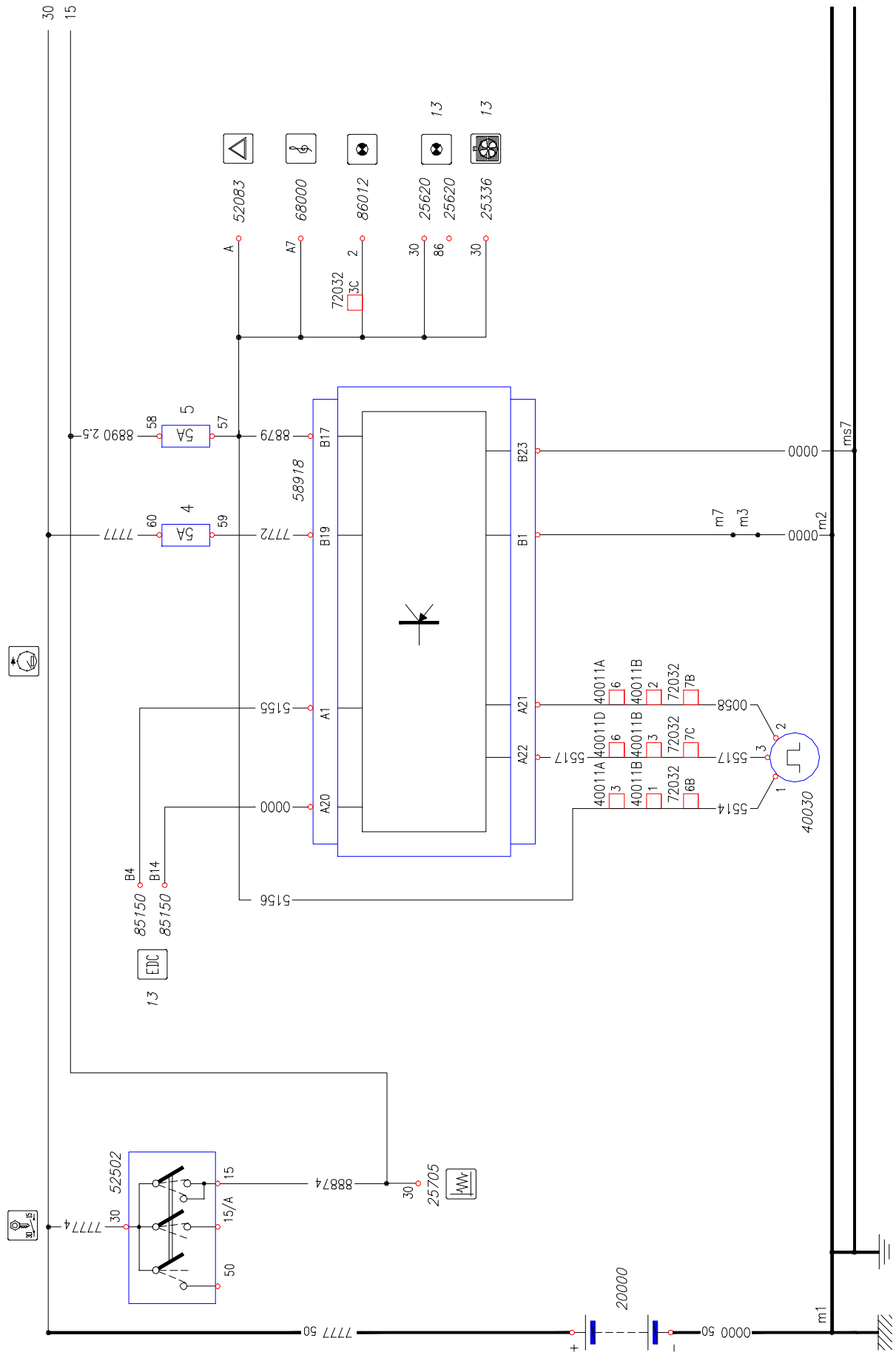


Chart 5: Tachometer

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The diagram illustrates a lighting control system with the following components and connections:

- Power Supply:** A transformer (52502) with a 30V primary and 15V/50V secondary. A 5A fuse (5A) is connected to the 15V line.
- Control Section:** A switch (5A) and a dimmer (5A) are connected to the 15V line. The dimmer is connected to a 5A fuse (5A) and a 5A fuse (5A).
- Lighting Section:**
 - Two dimmable lights (86020) are connected to the 15V line. One light is connected to a 5A fuse (5A) and a 5A fuse (5A).
 - A non-dimmable light (86012) is connected to the 15V line.
- Wiring and Connections:** The diagram shows various wiring connections between components, including a 30V line, a 15V line, and a 5A line. It also shows a 5A fuse (5A) and a 5A fuse (5A).

Chart 6B: Rpm counter (.ll)

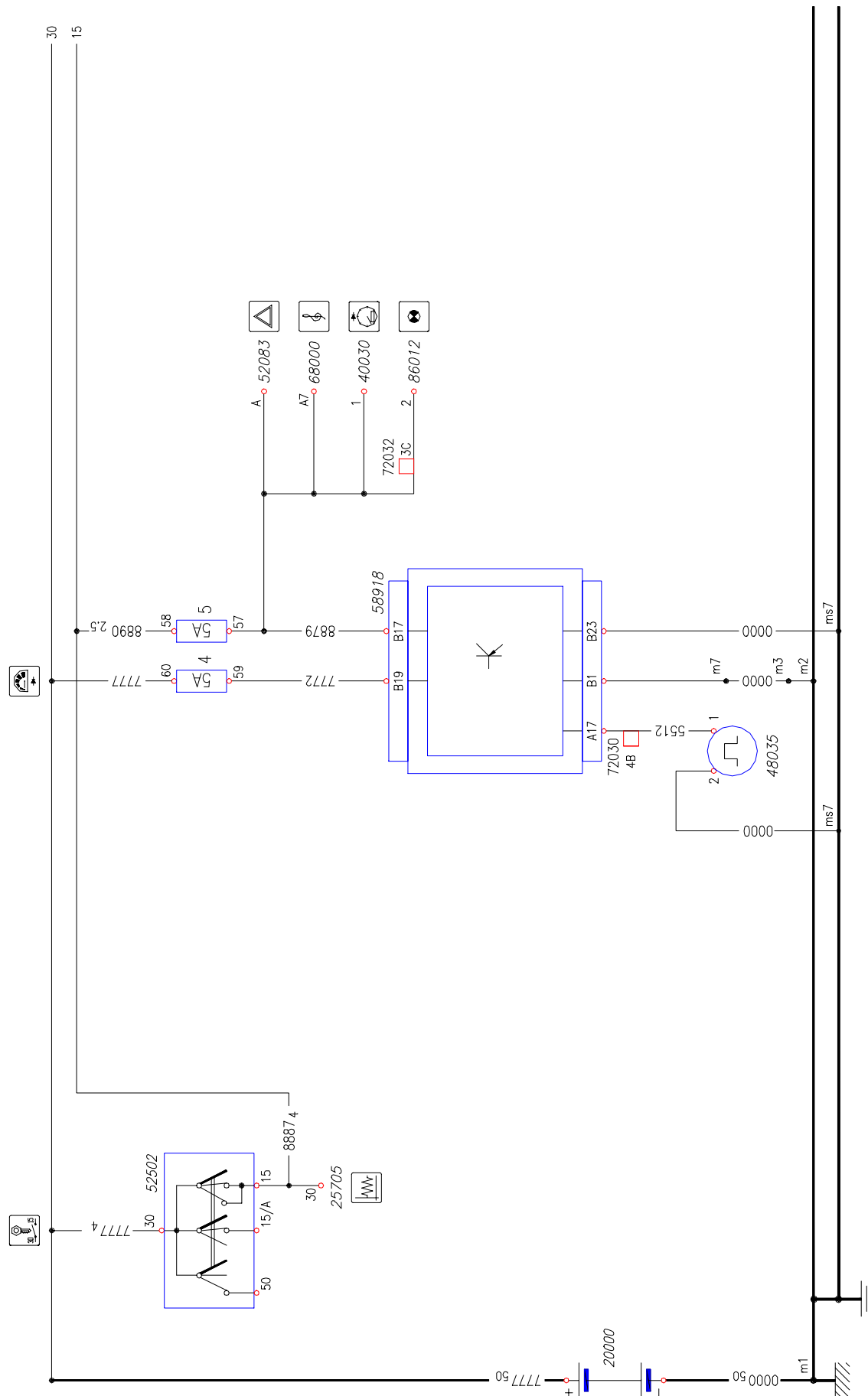
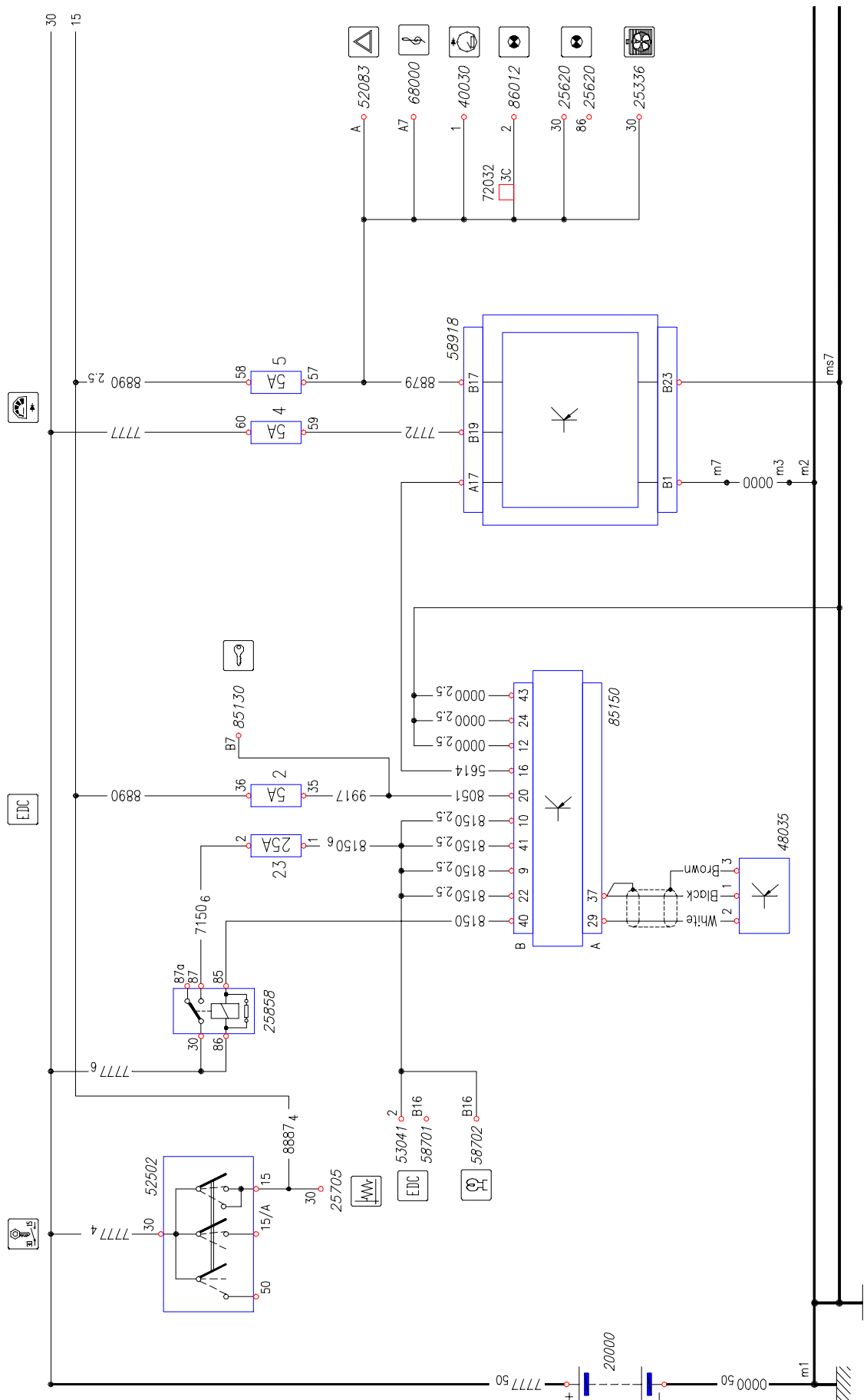
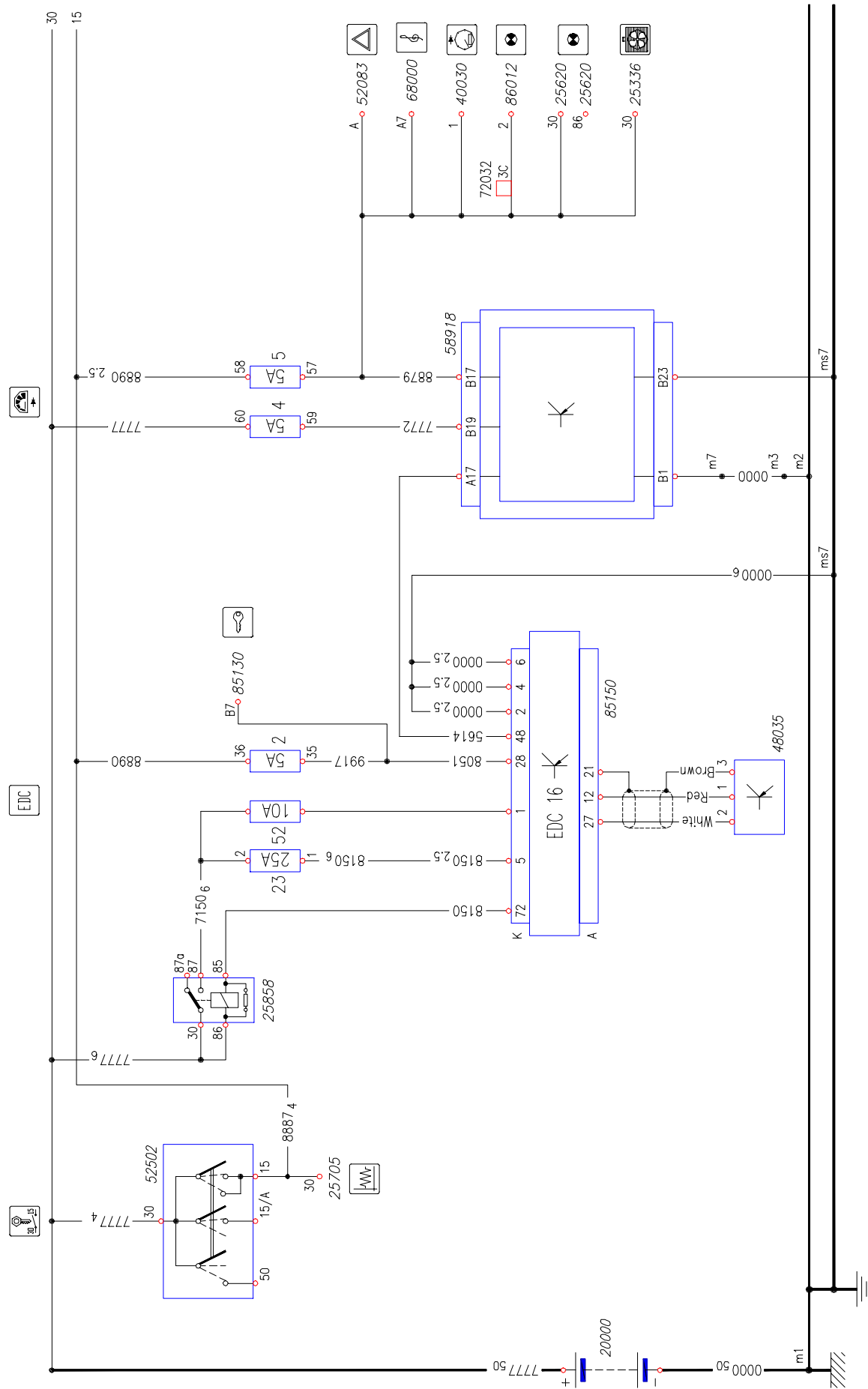


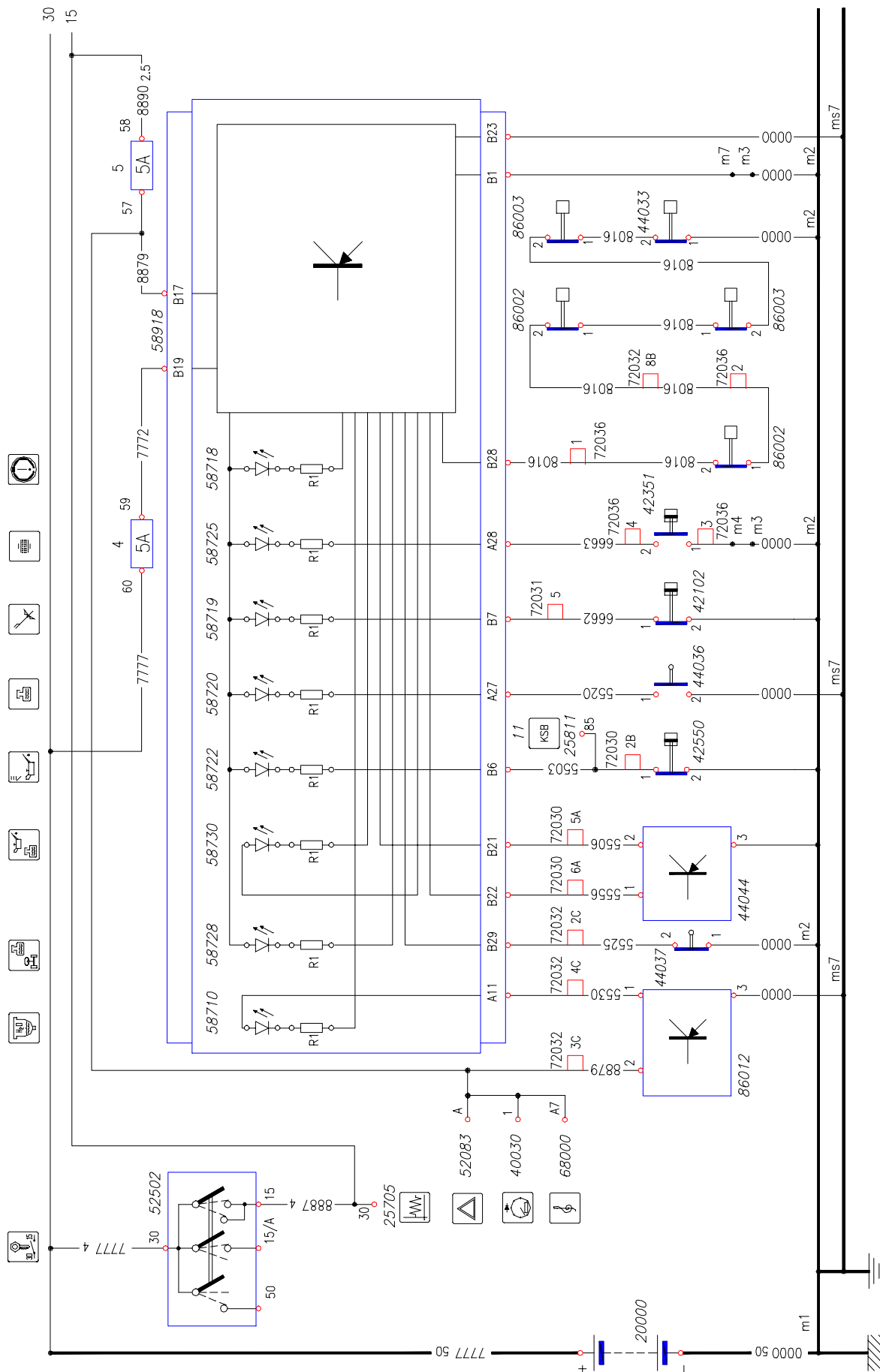
Chart 6C: Rpm counter (.10 – .12 – .13 – .15)



49940

Chart 6D: Rpm counter (.10 – .12 – .14 – .17 – EDC16)

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Chart 7A: Optical indicators (.9 – .11)

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Chart 8: Outside lighting (cab instruments)

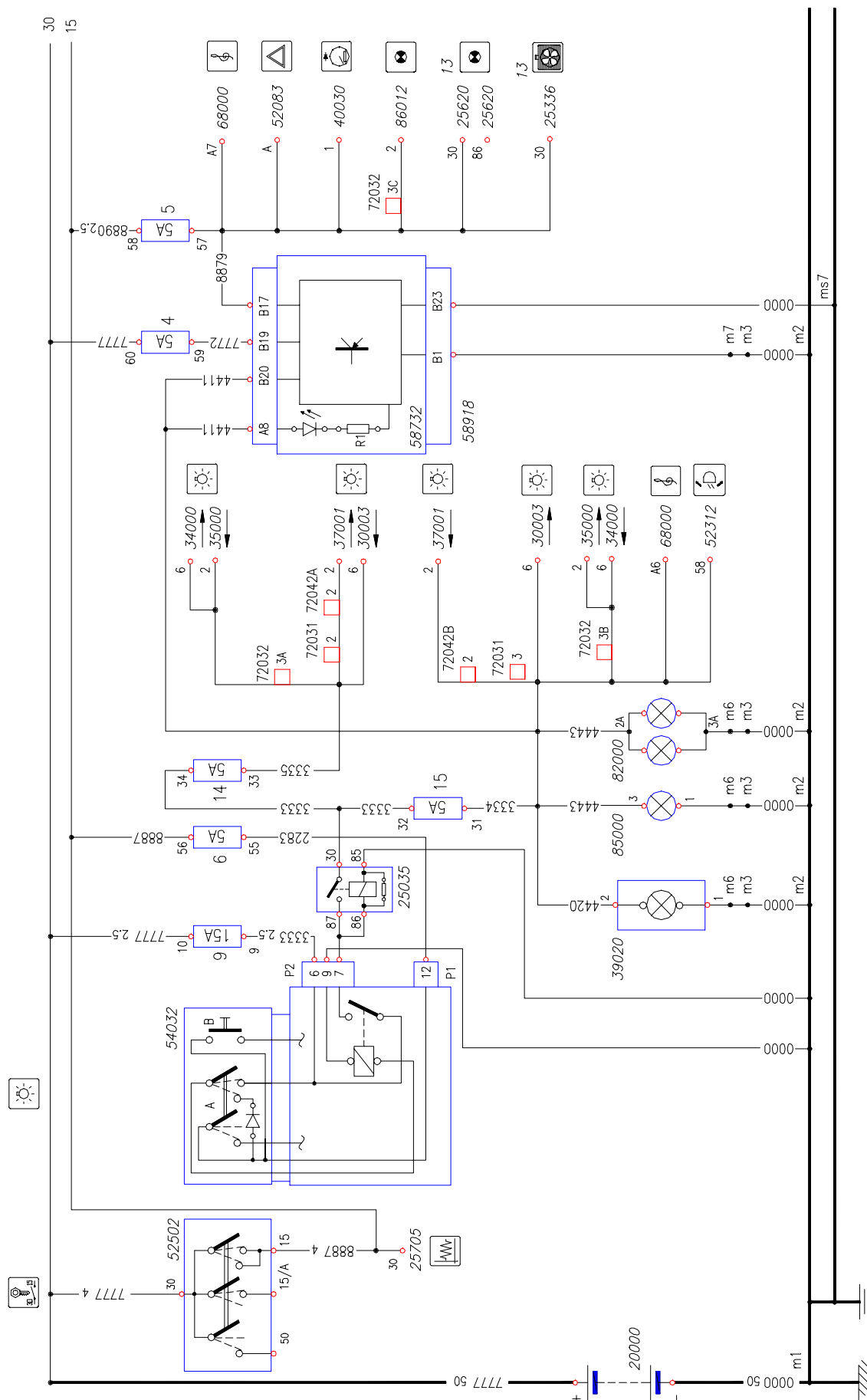
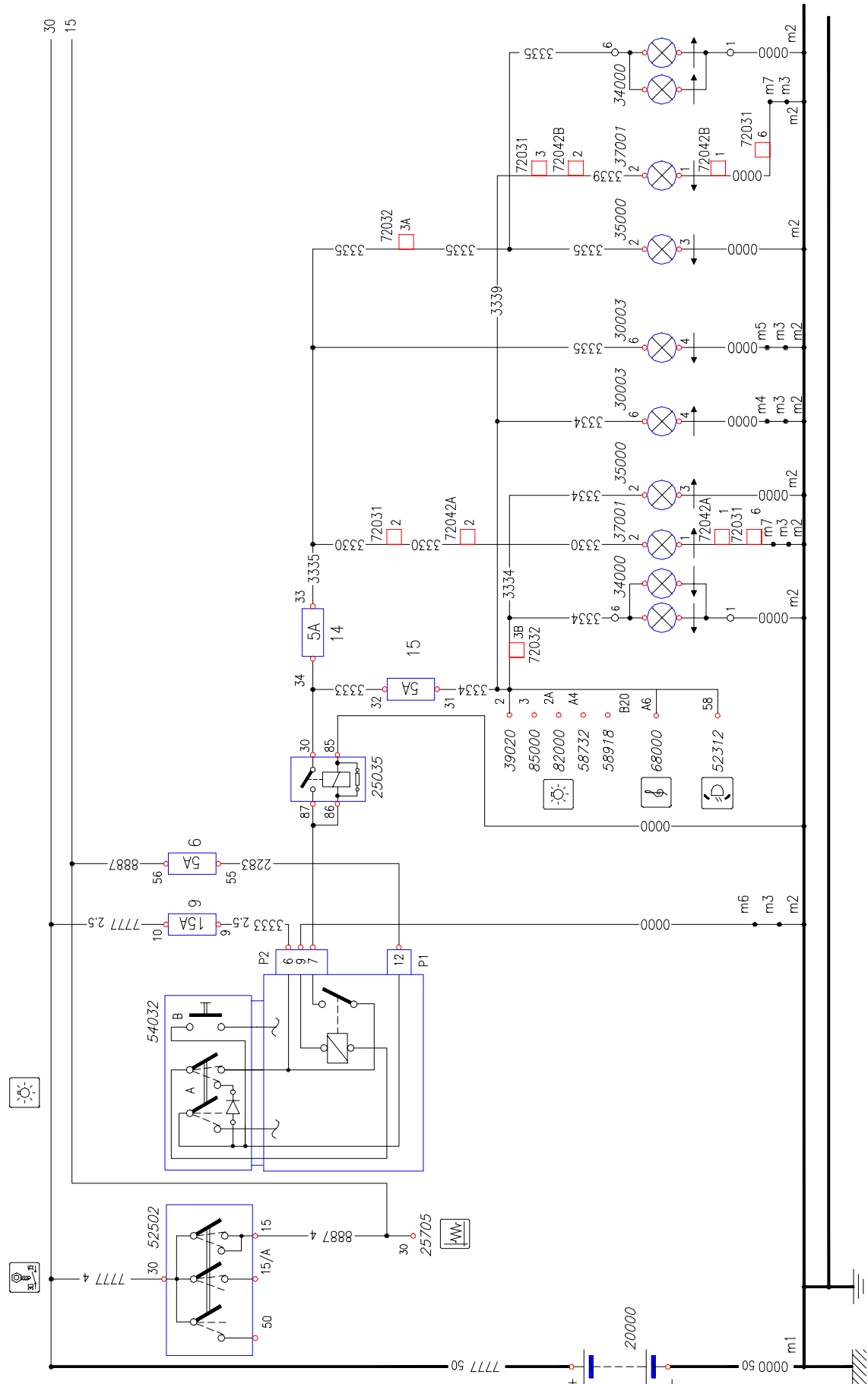
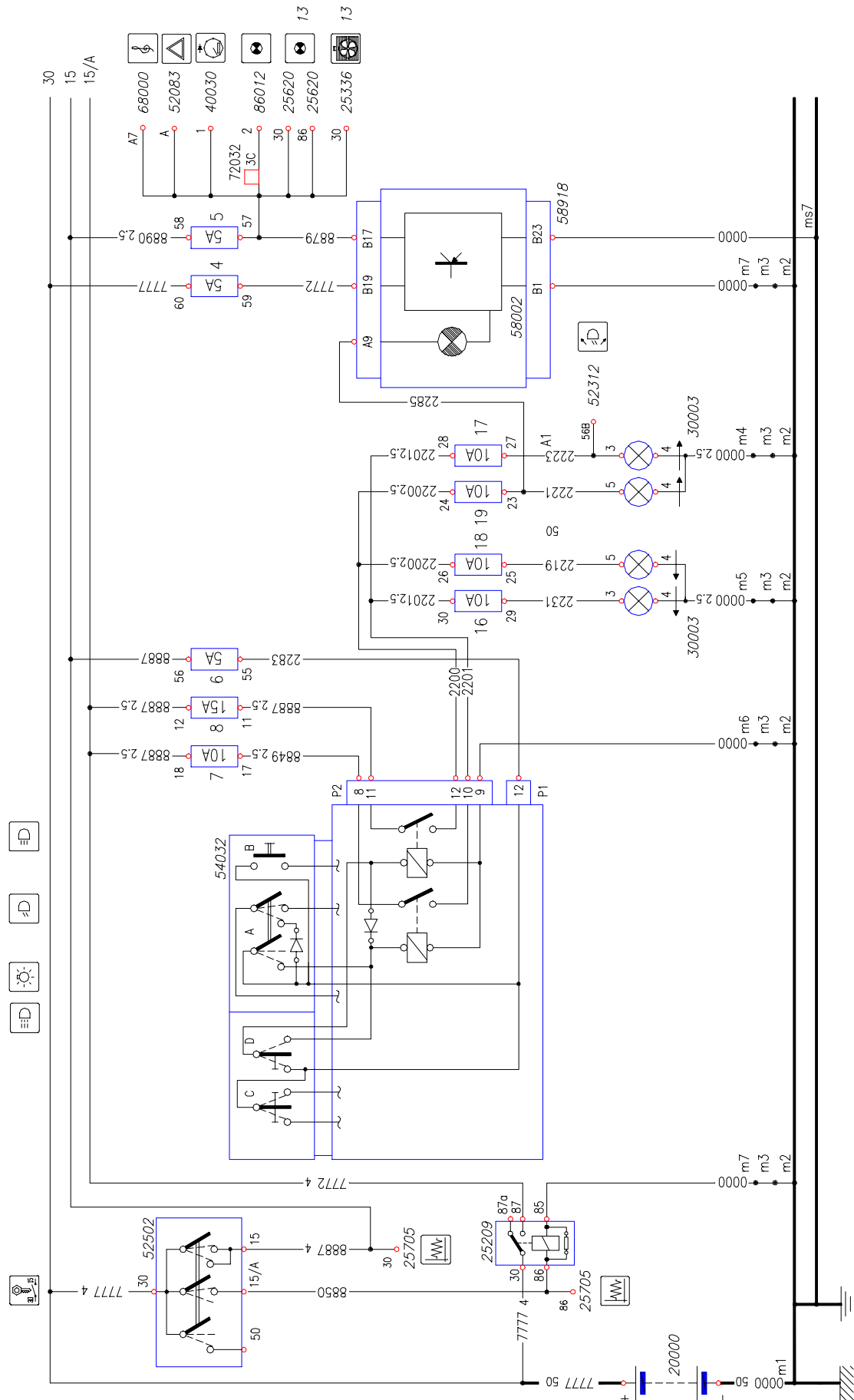
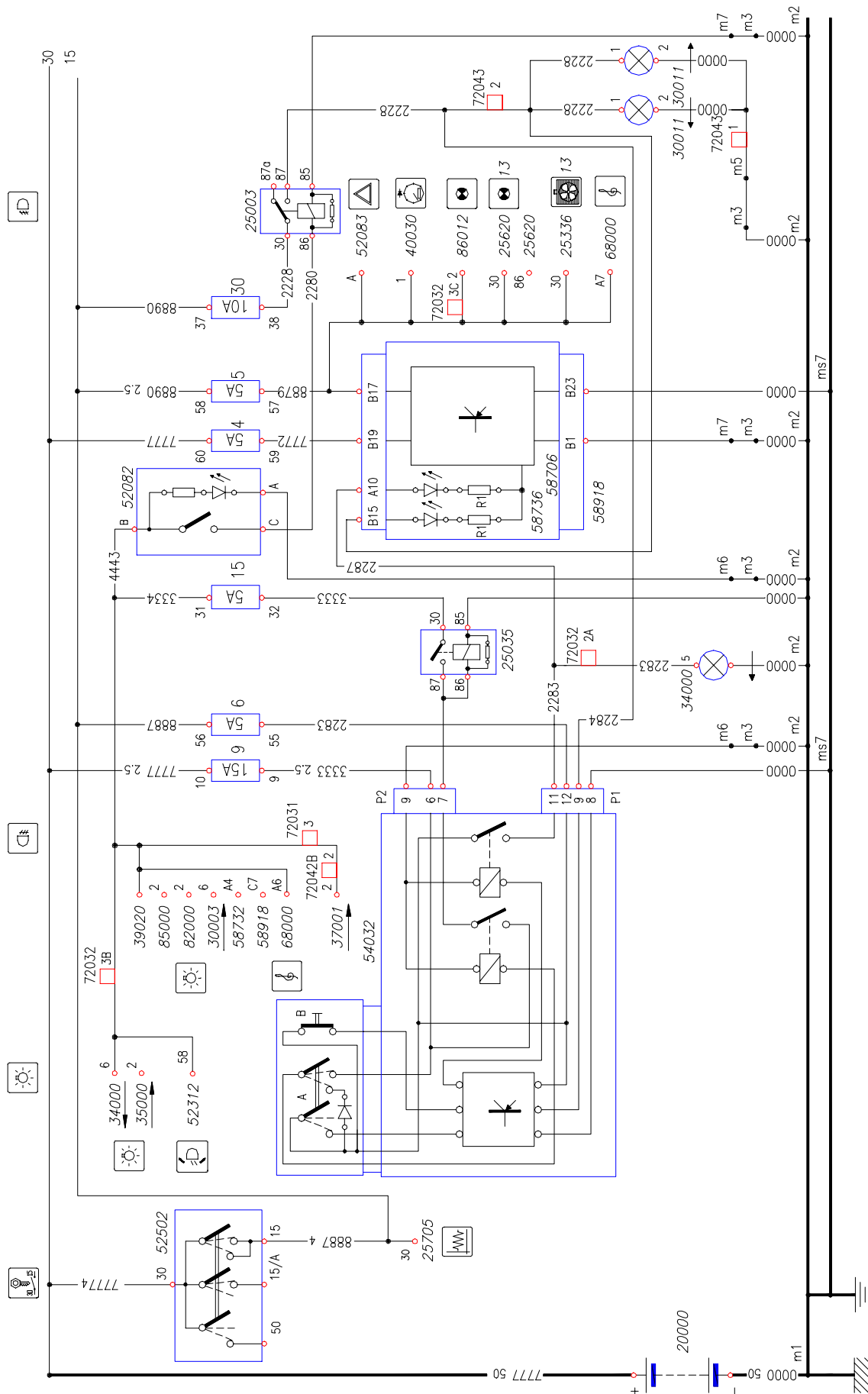


Chart 9A: Outside lighting (position lights)

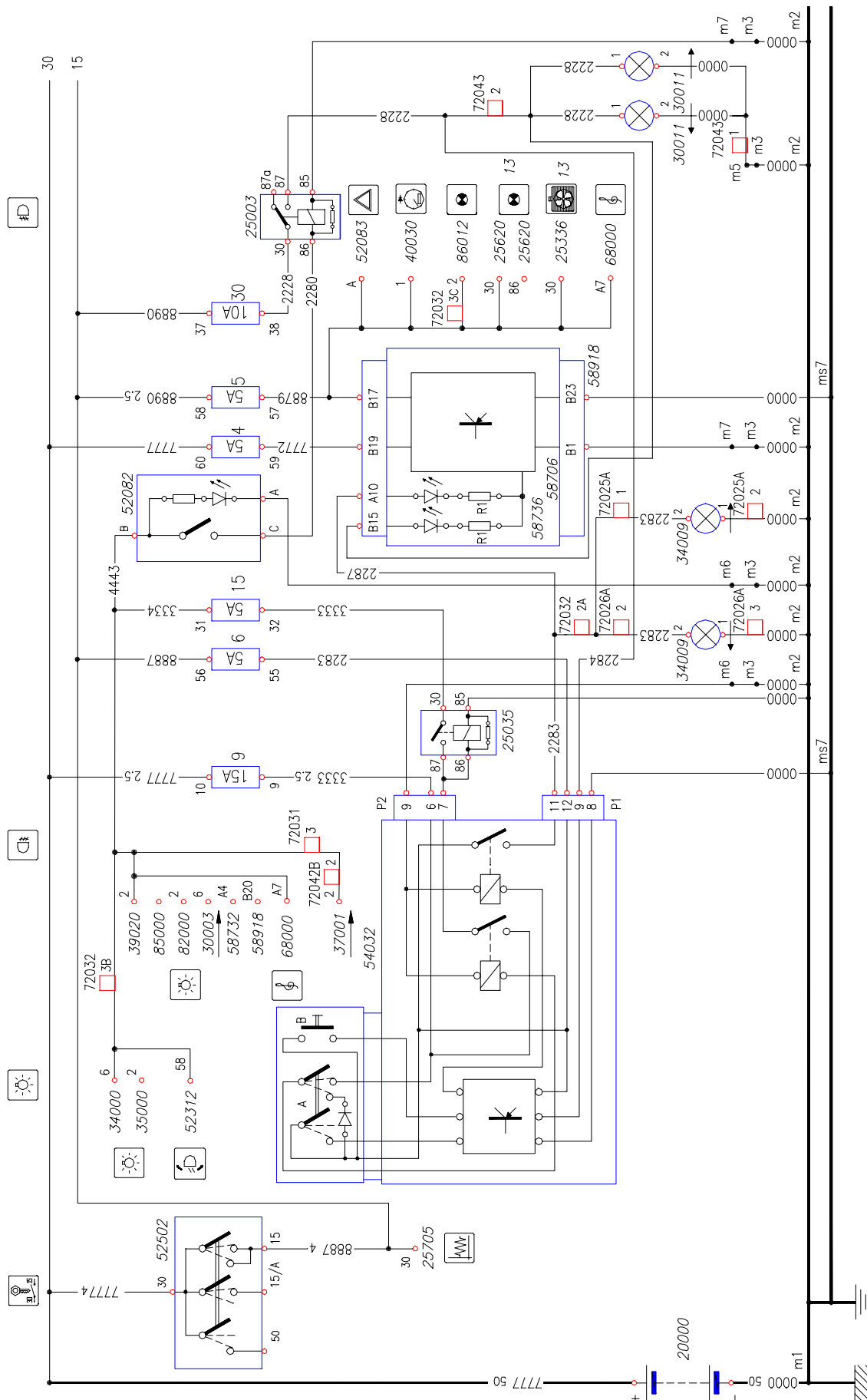
49936

Chart 10: Flood and dipped lights

49934

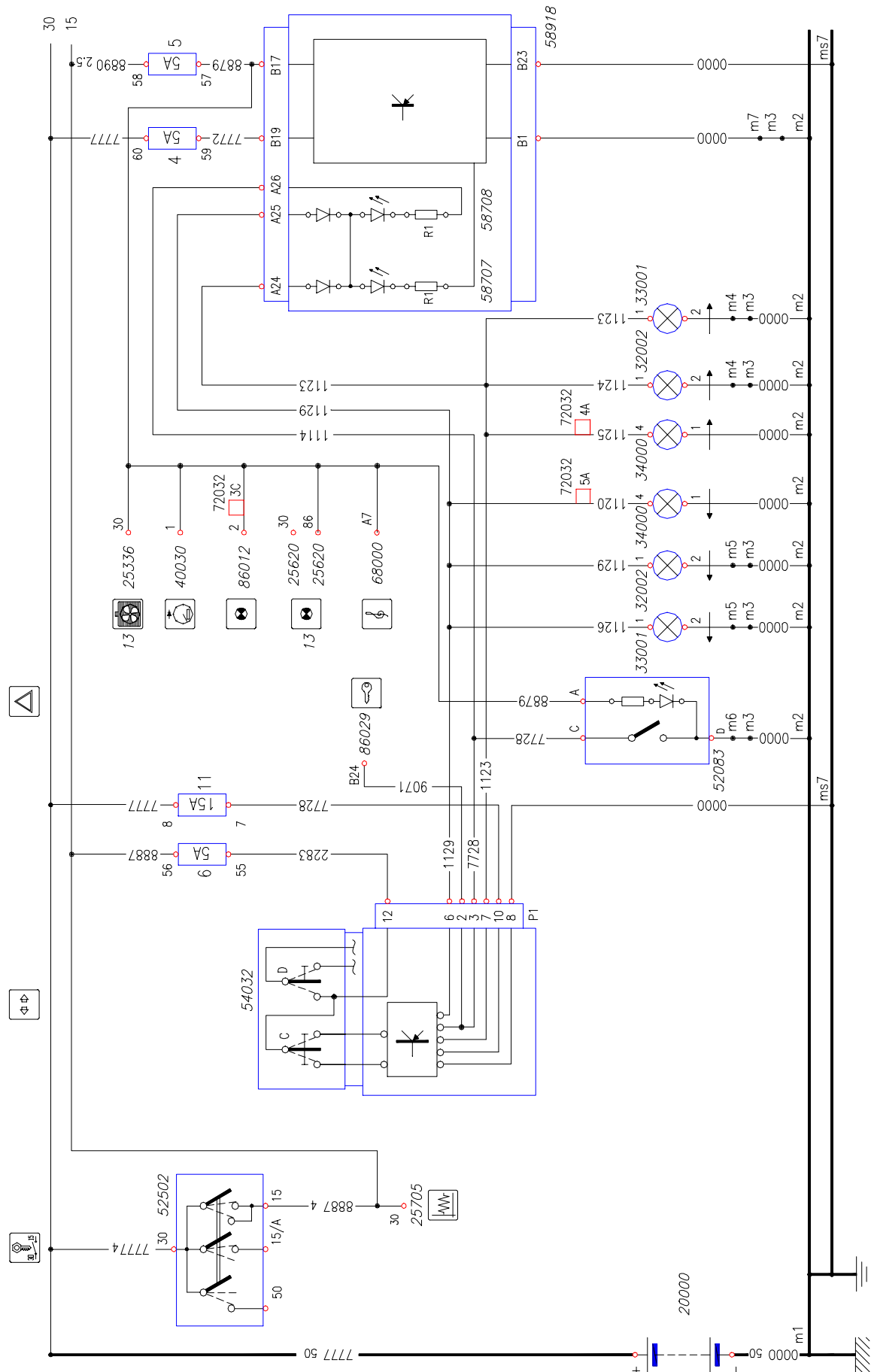
Chart 11A: Back and front fog lights

49933

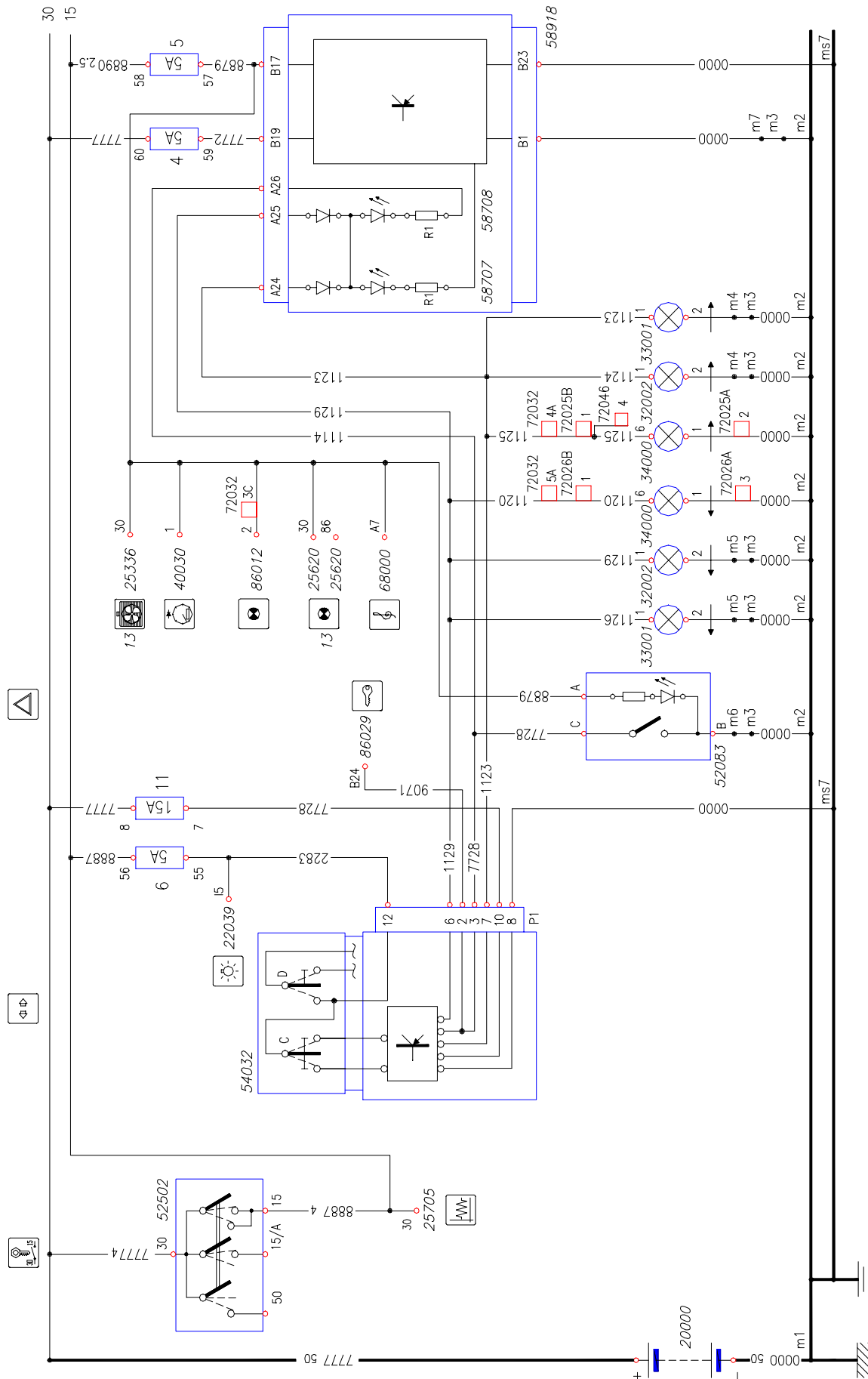
Chart I I B: Back and front fog lights(van)

49932



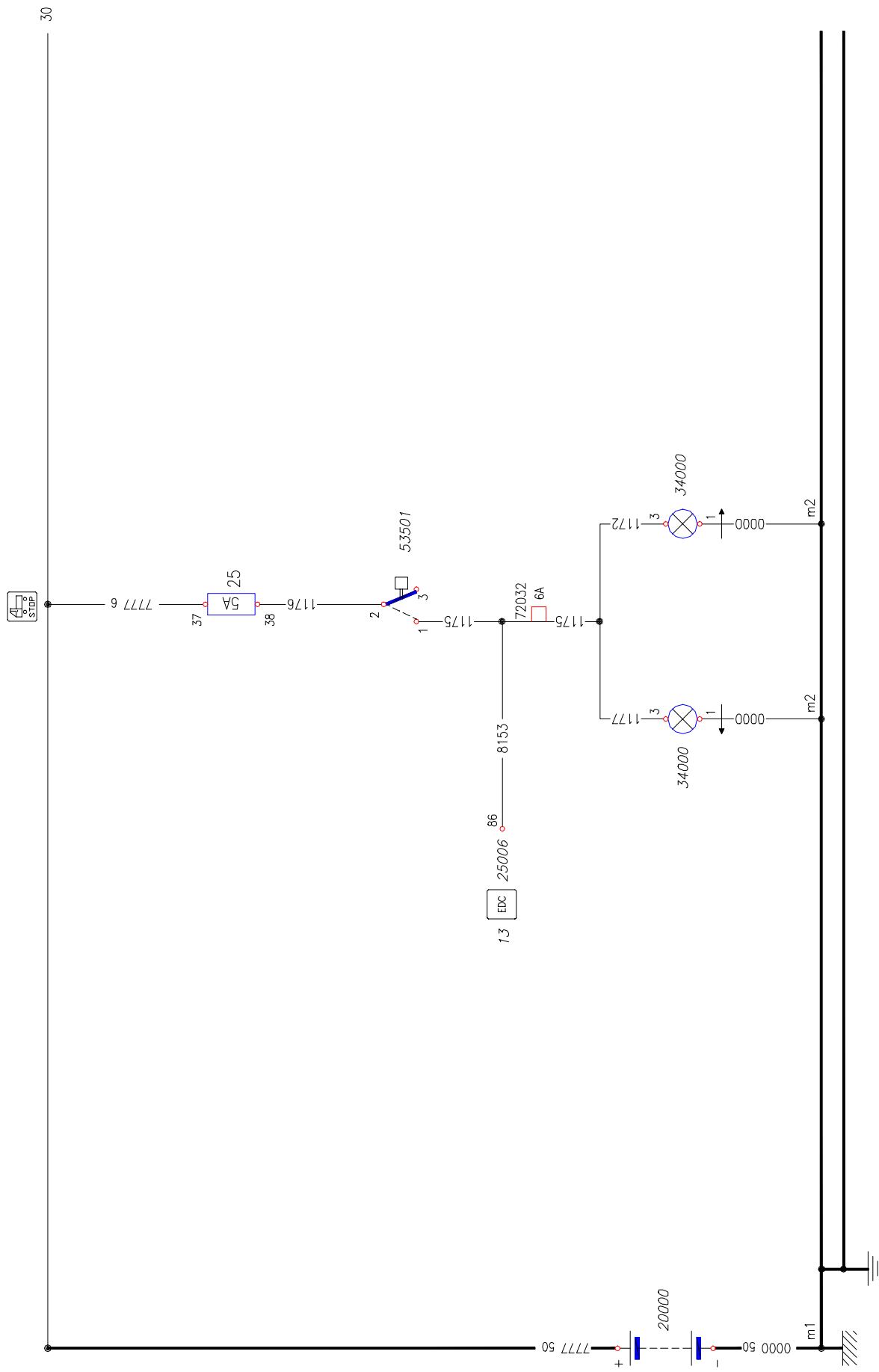
Chart 13A: Direction and emergency lights

49930

Chart 13B: Direction and emergency lights (van)

49929

Chart I4A: Stop lights



49928

Chart I4B: Stop lights (van)

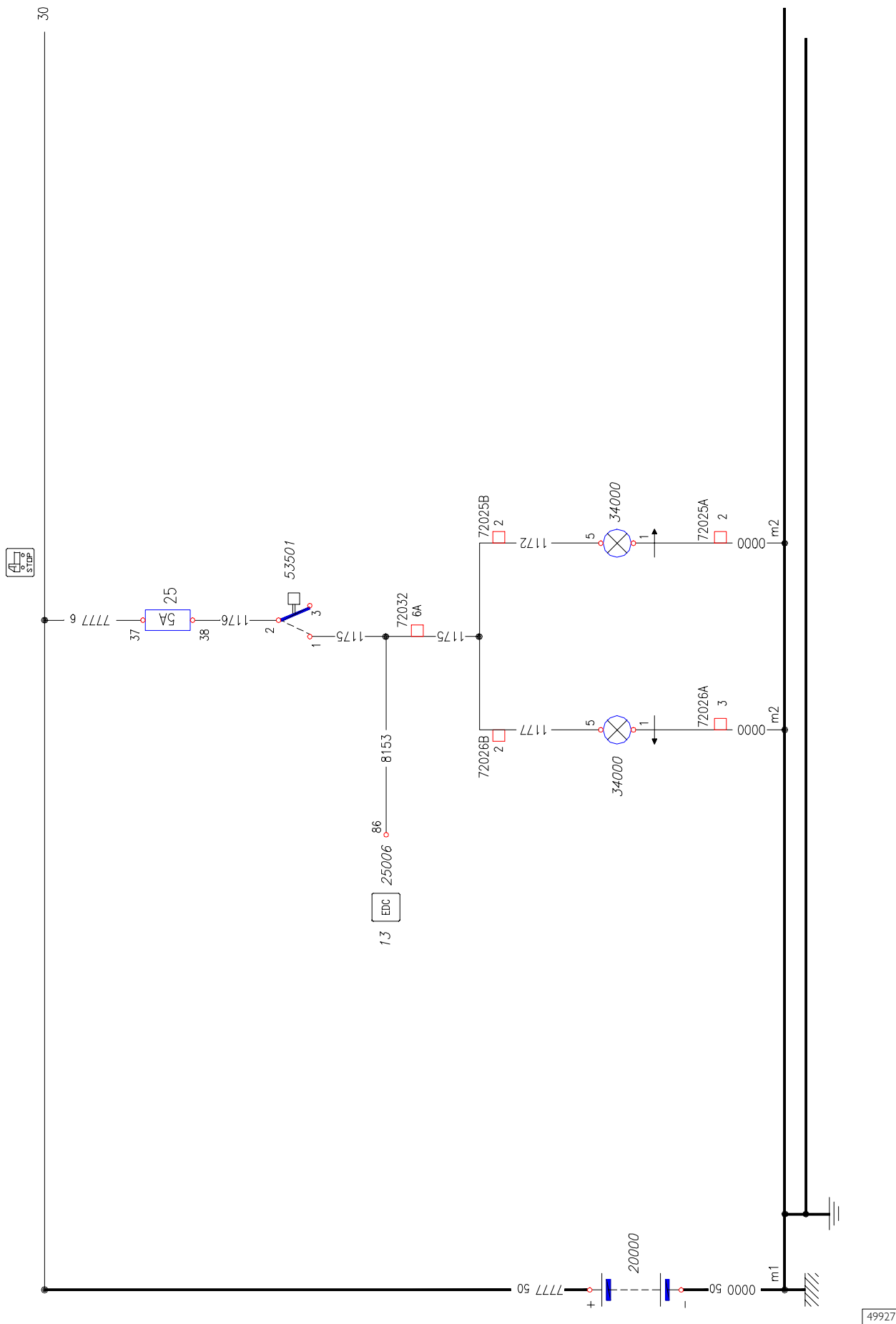
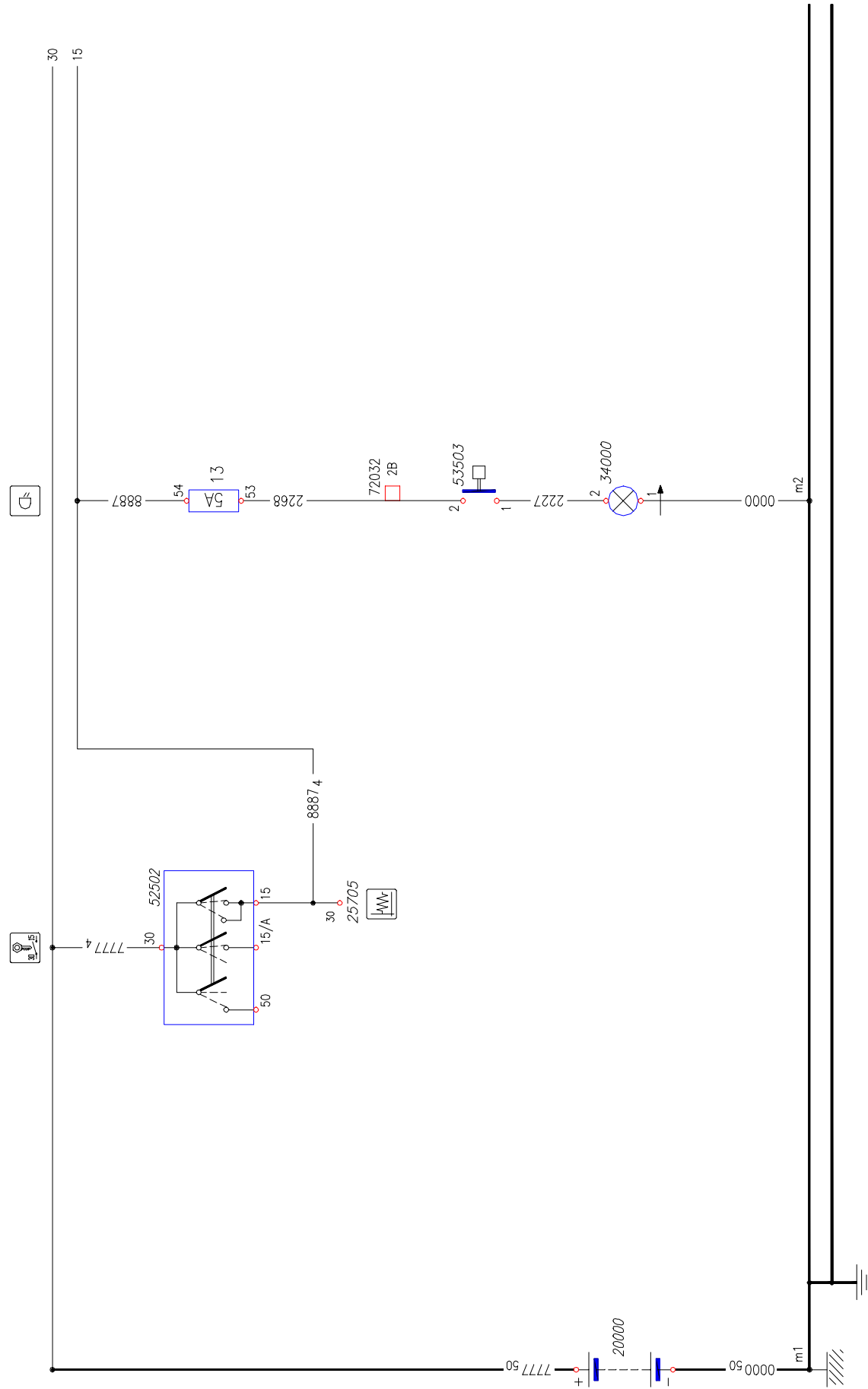
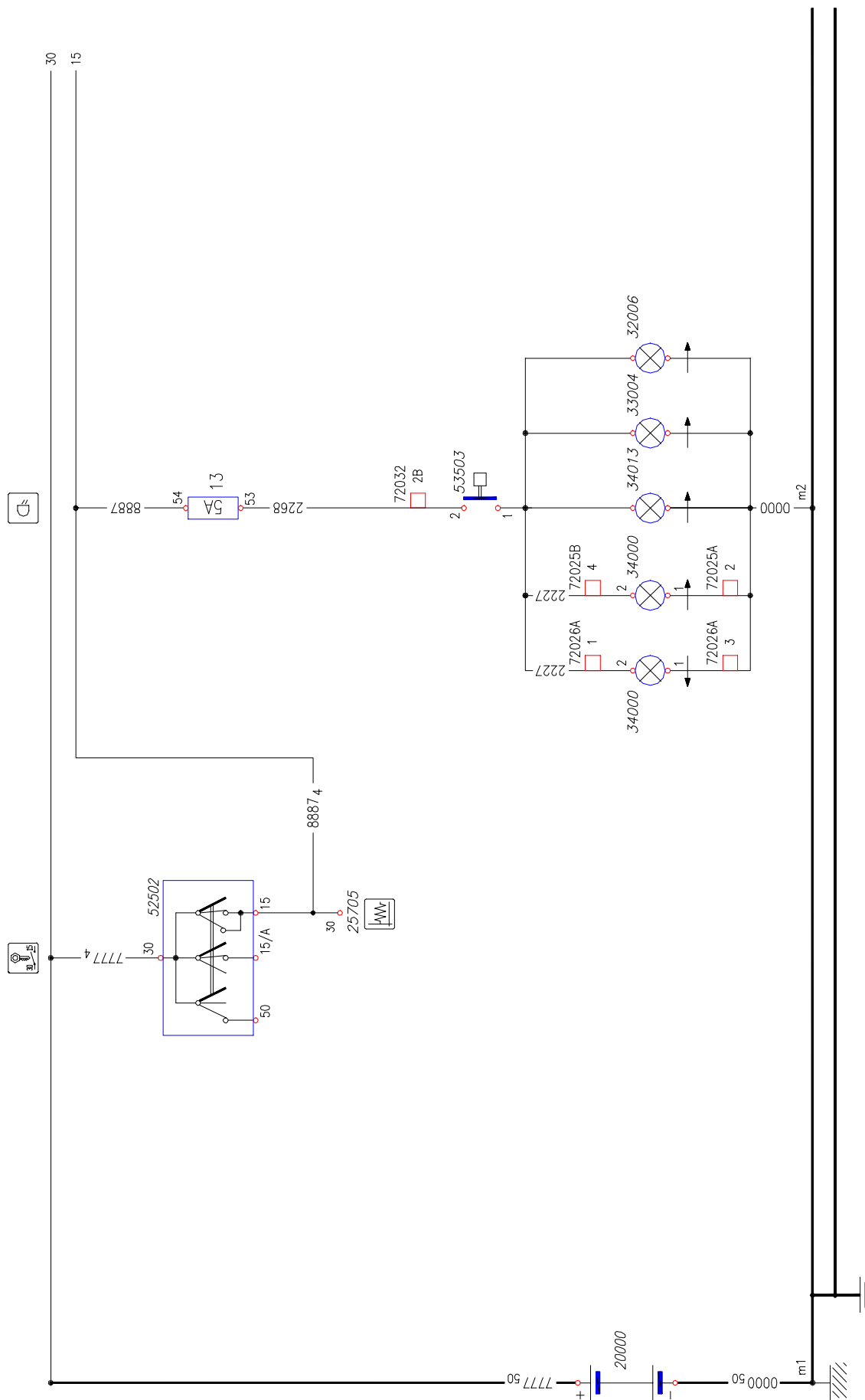


Chart 15A: Backup lights



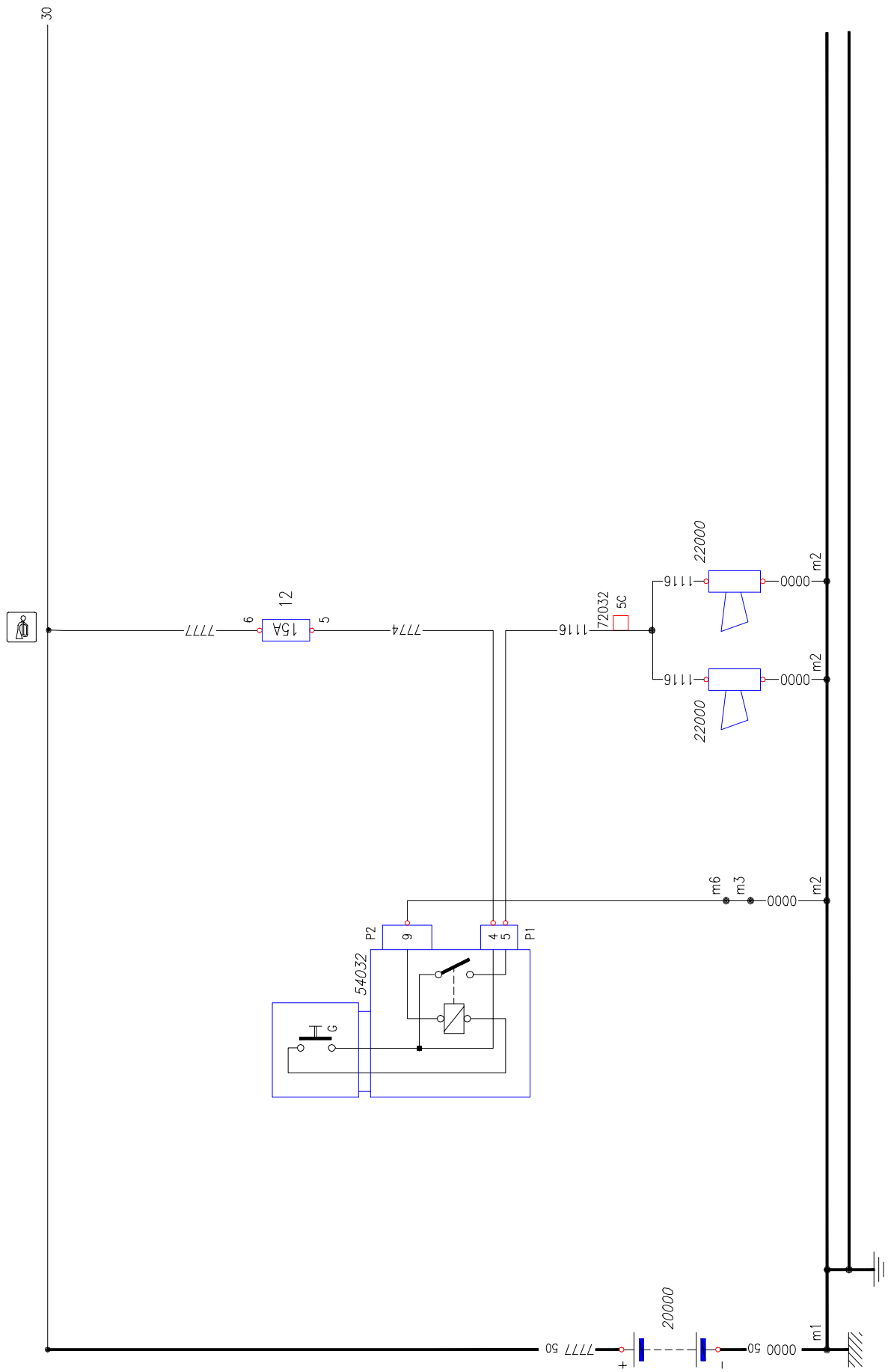
49926

Chart I5B: Backup lights (van)

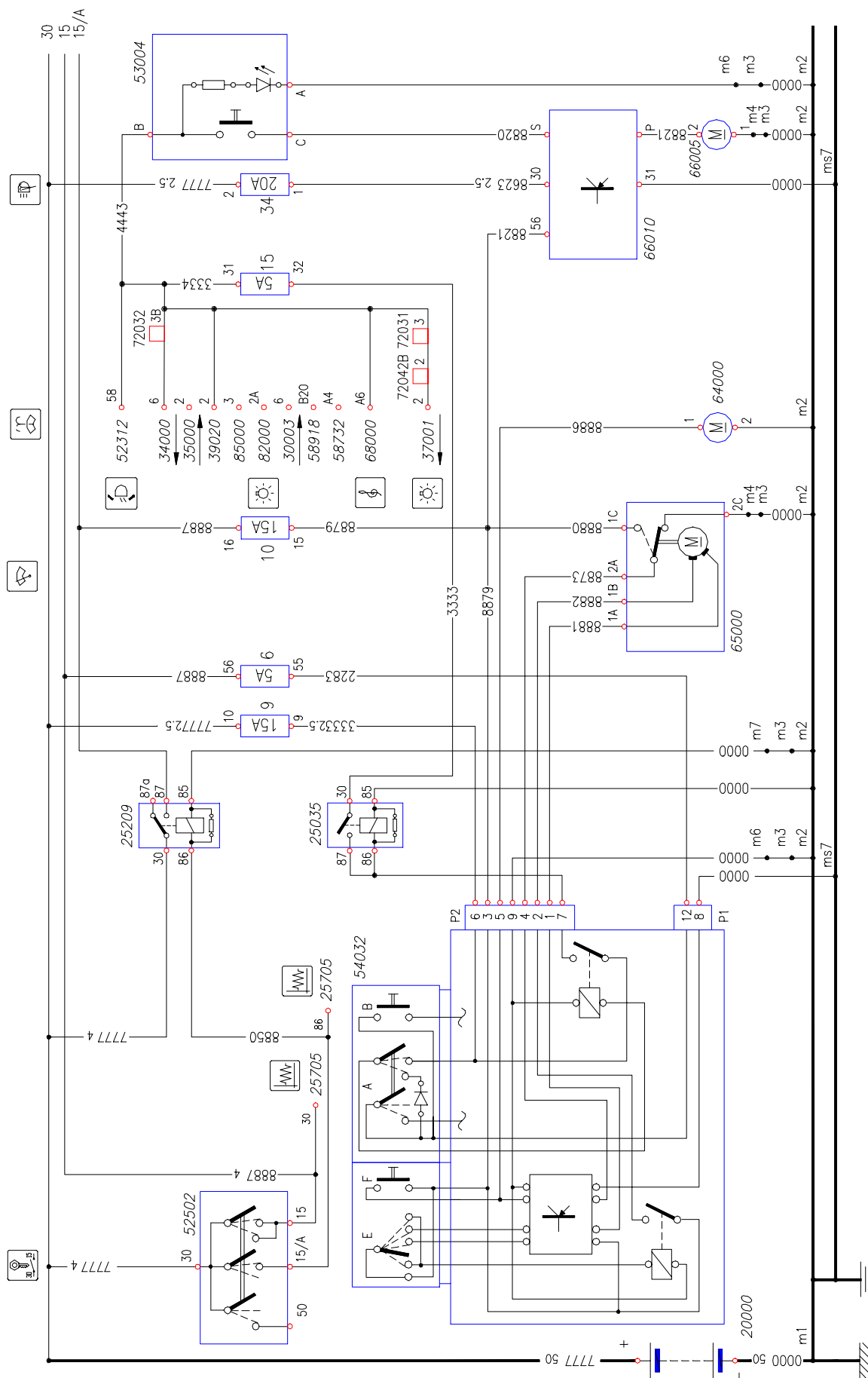


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Chart 16: Horn



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Chart 17: Windscreen and front light washer

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Chart 19: Radio set

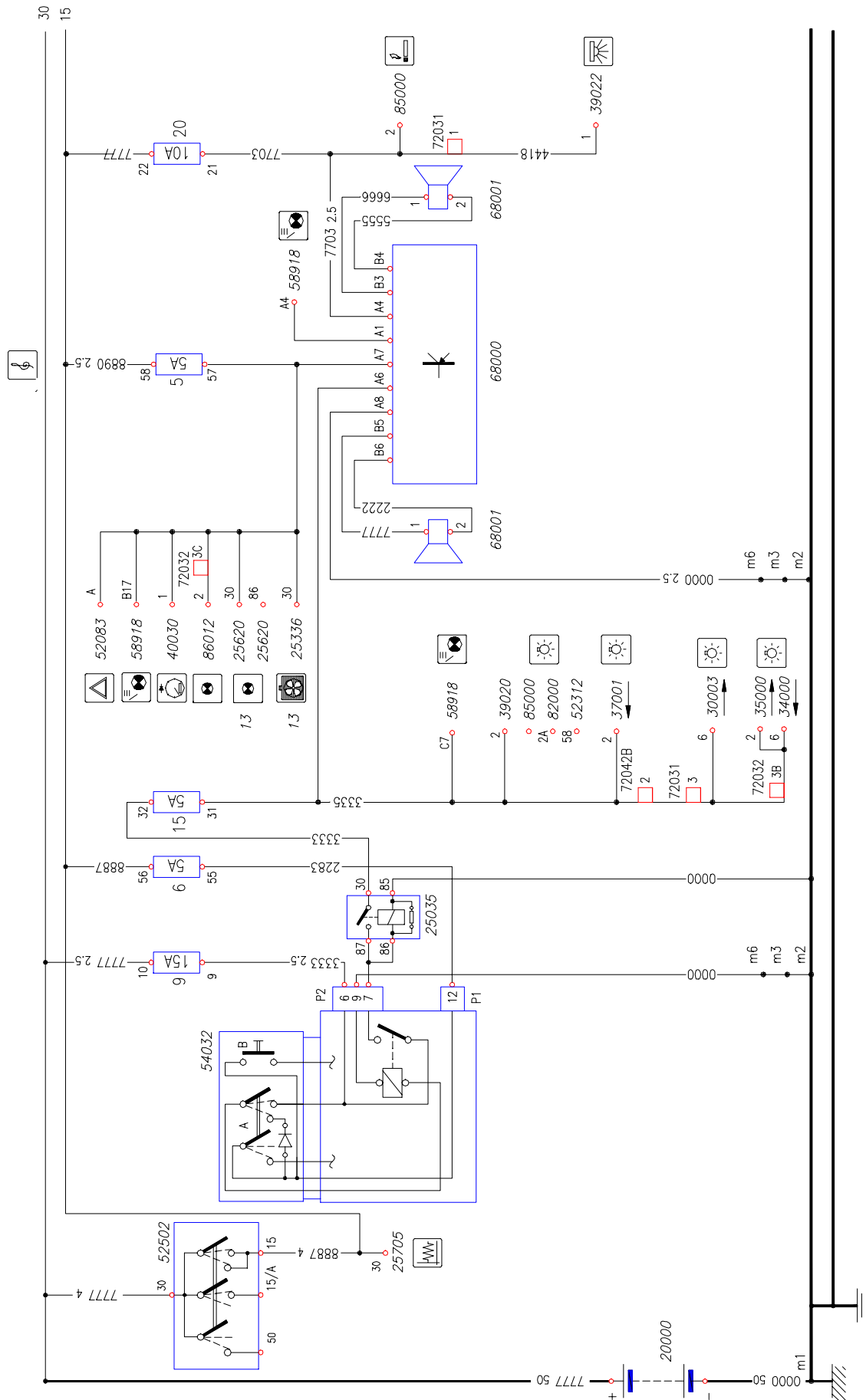
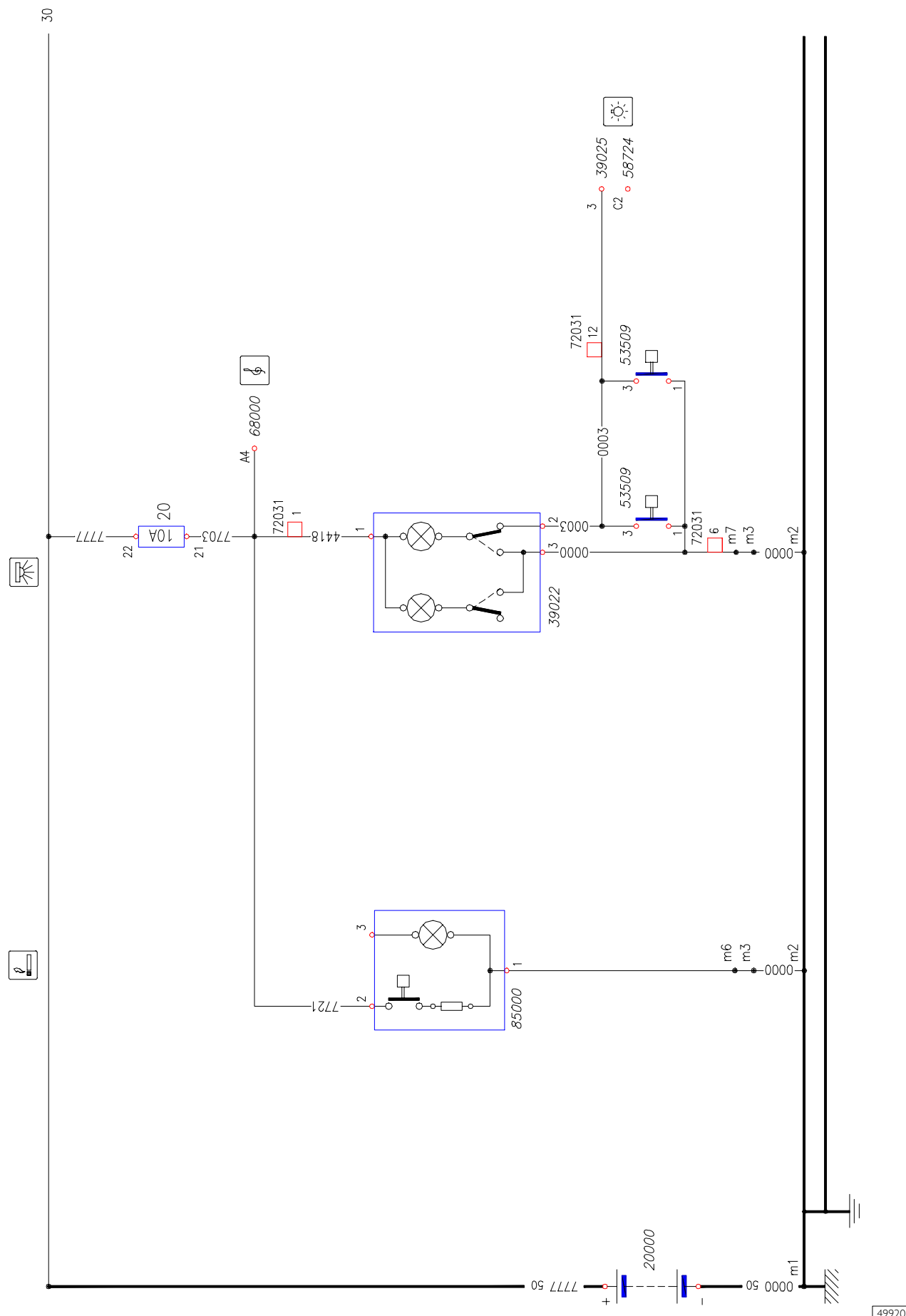
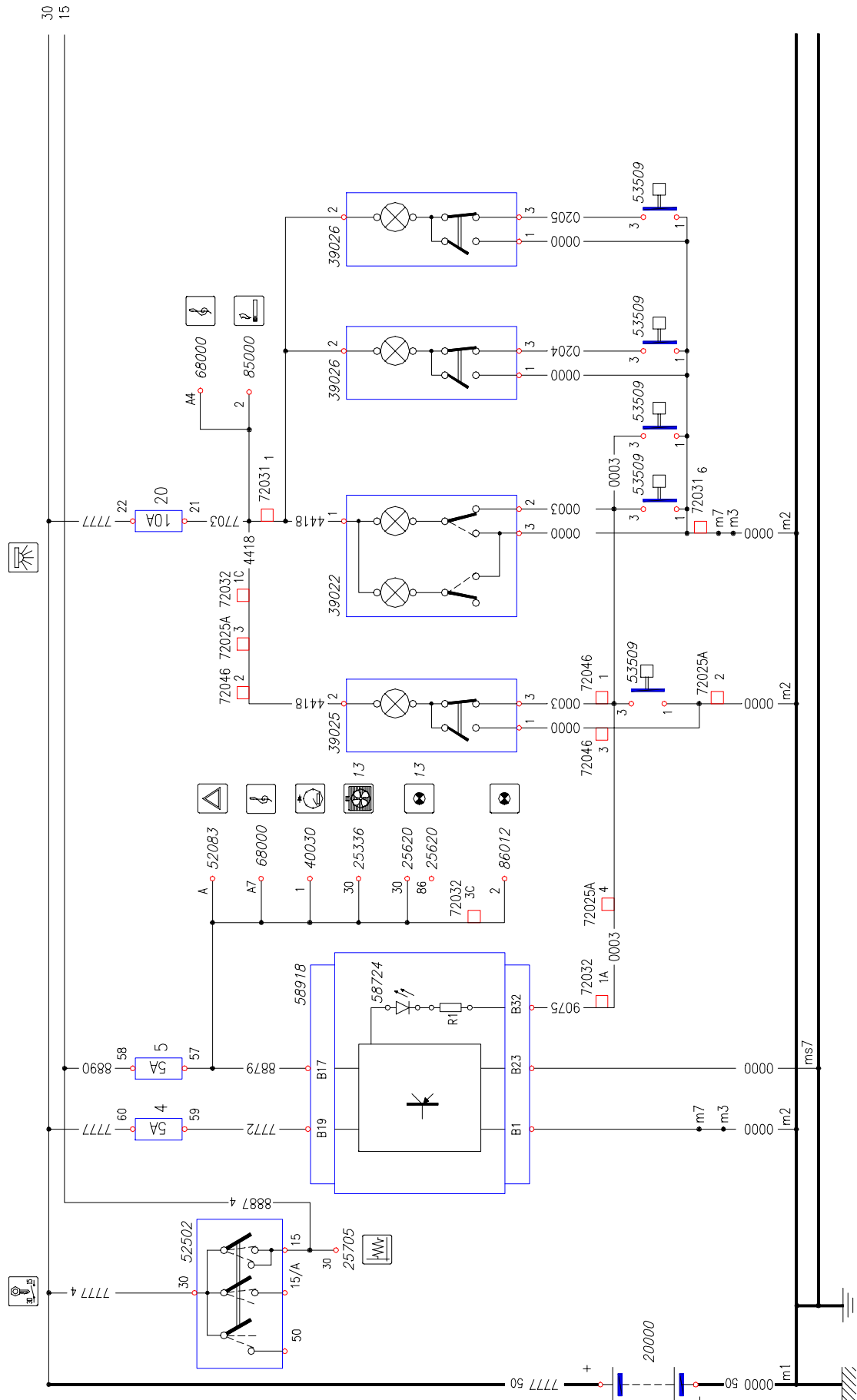


Chart 20A: Internal lighting and cigarette lighter



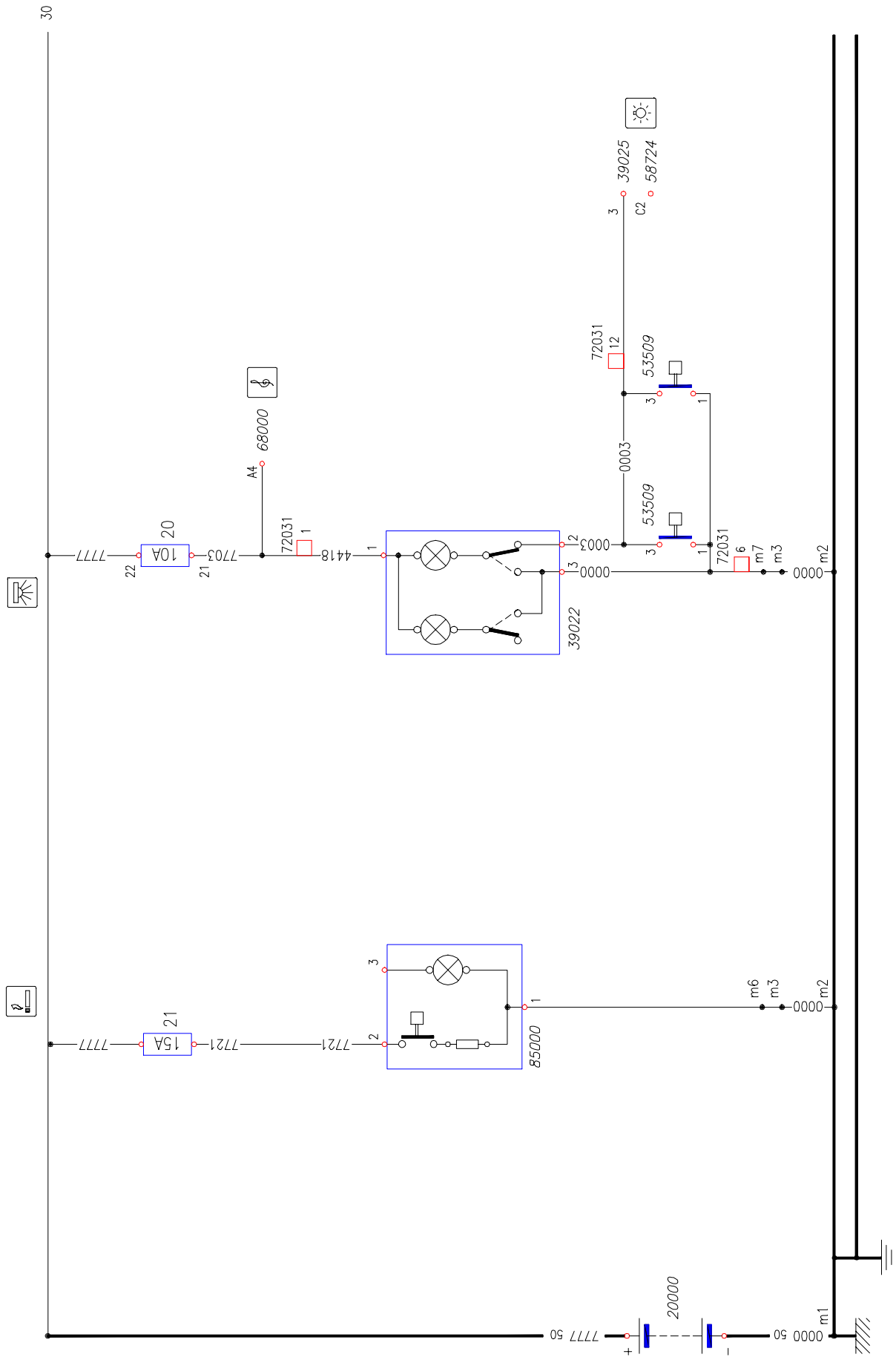
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Chart 20B: Internal lighting (van)

49919

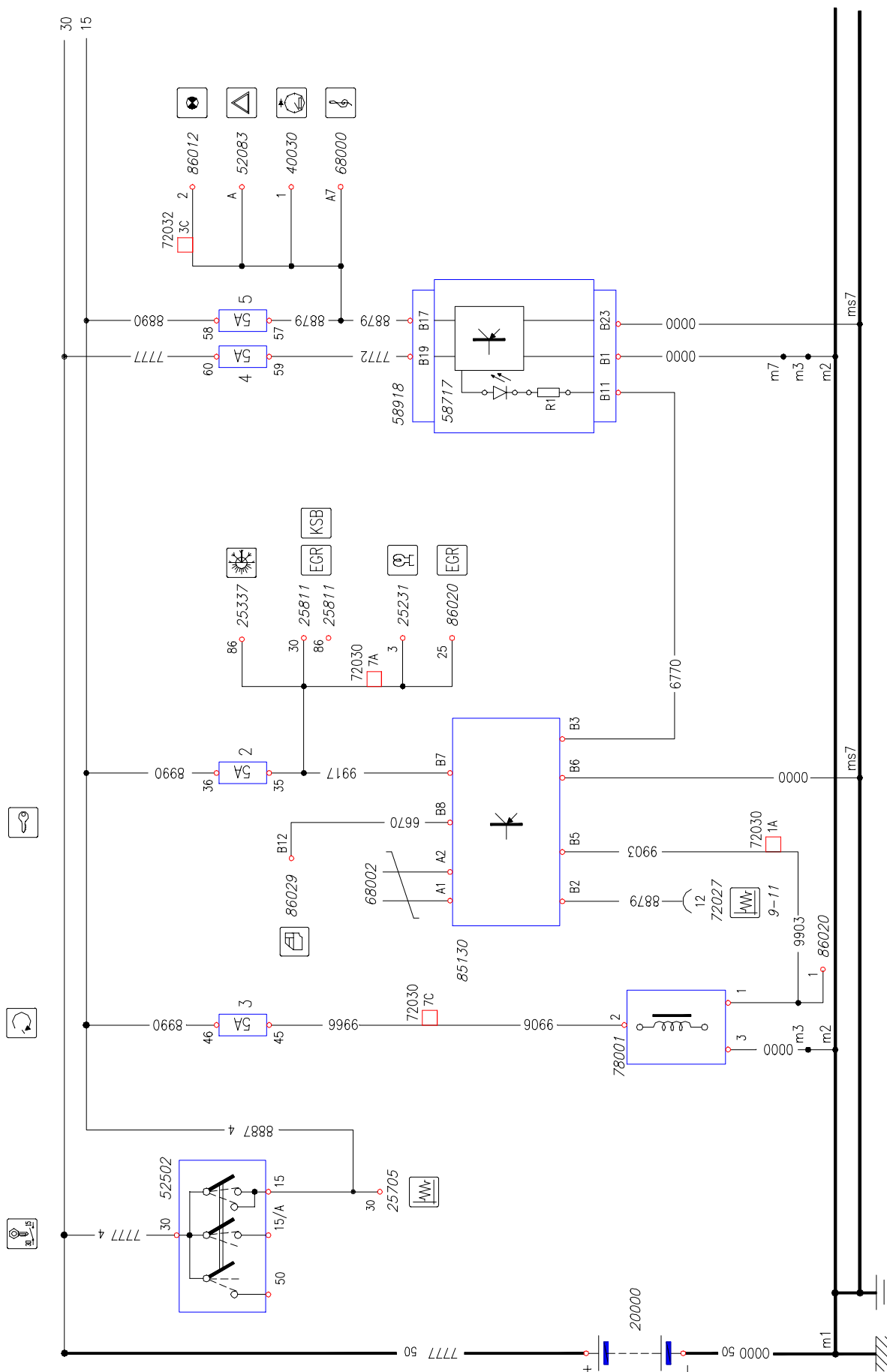
Base – May 2004



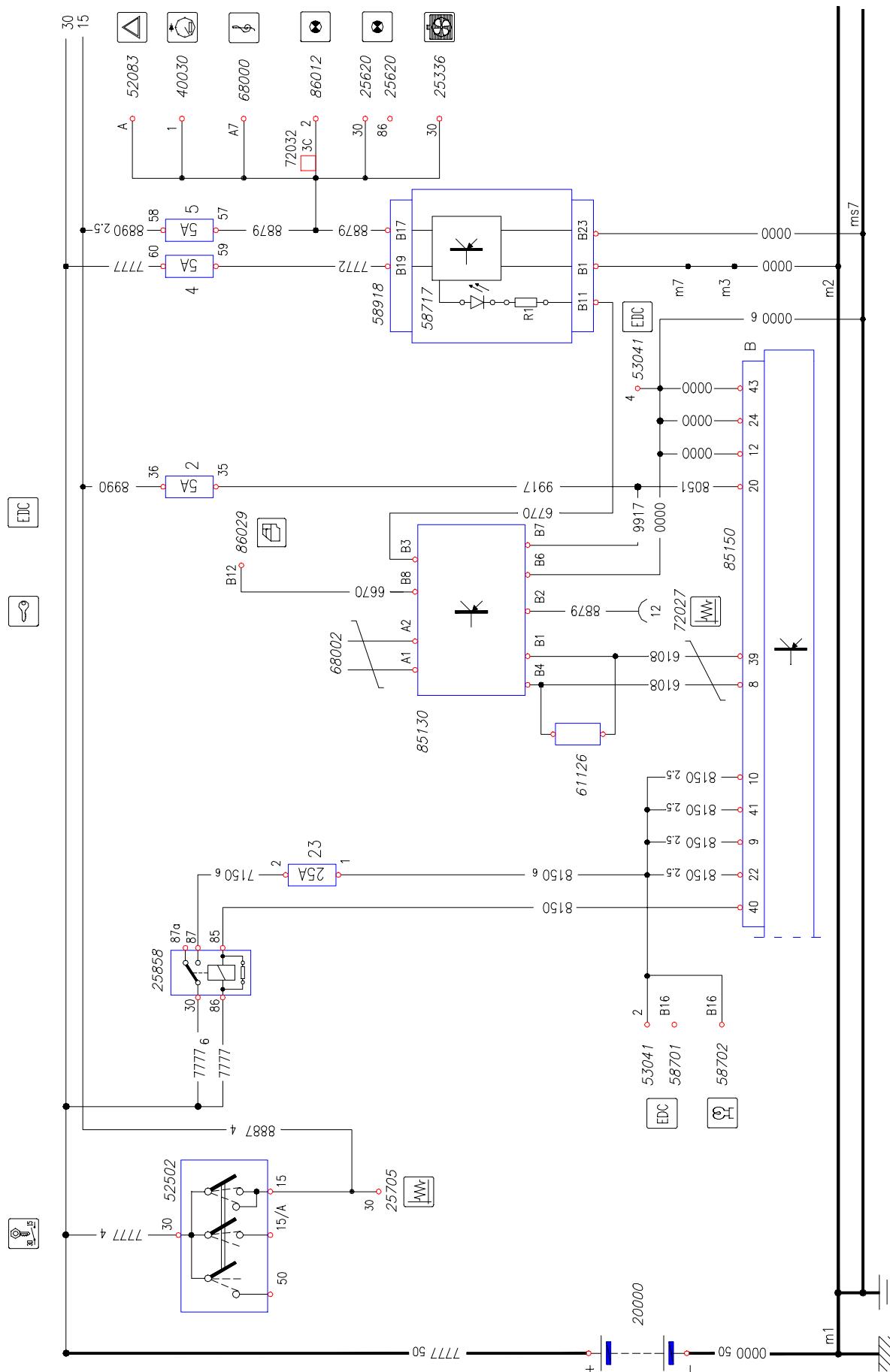
Chart 20D: Internal lighting and cigarette lighter (FIA)

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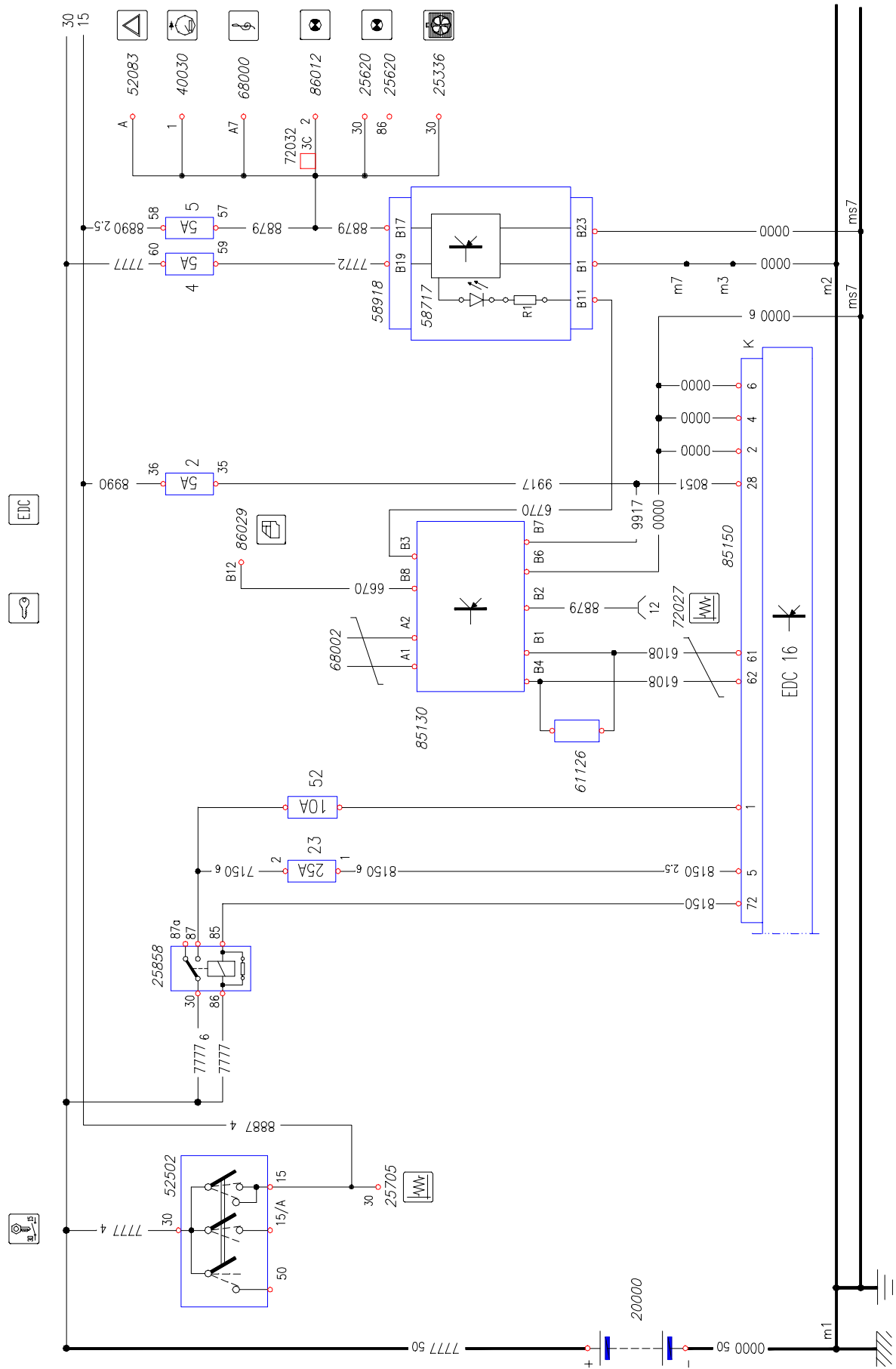
Chart 21A: Immobilizer (.9)



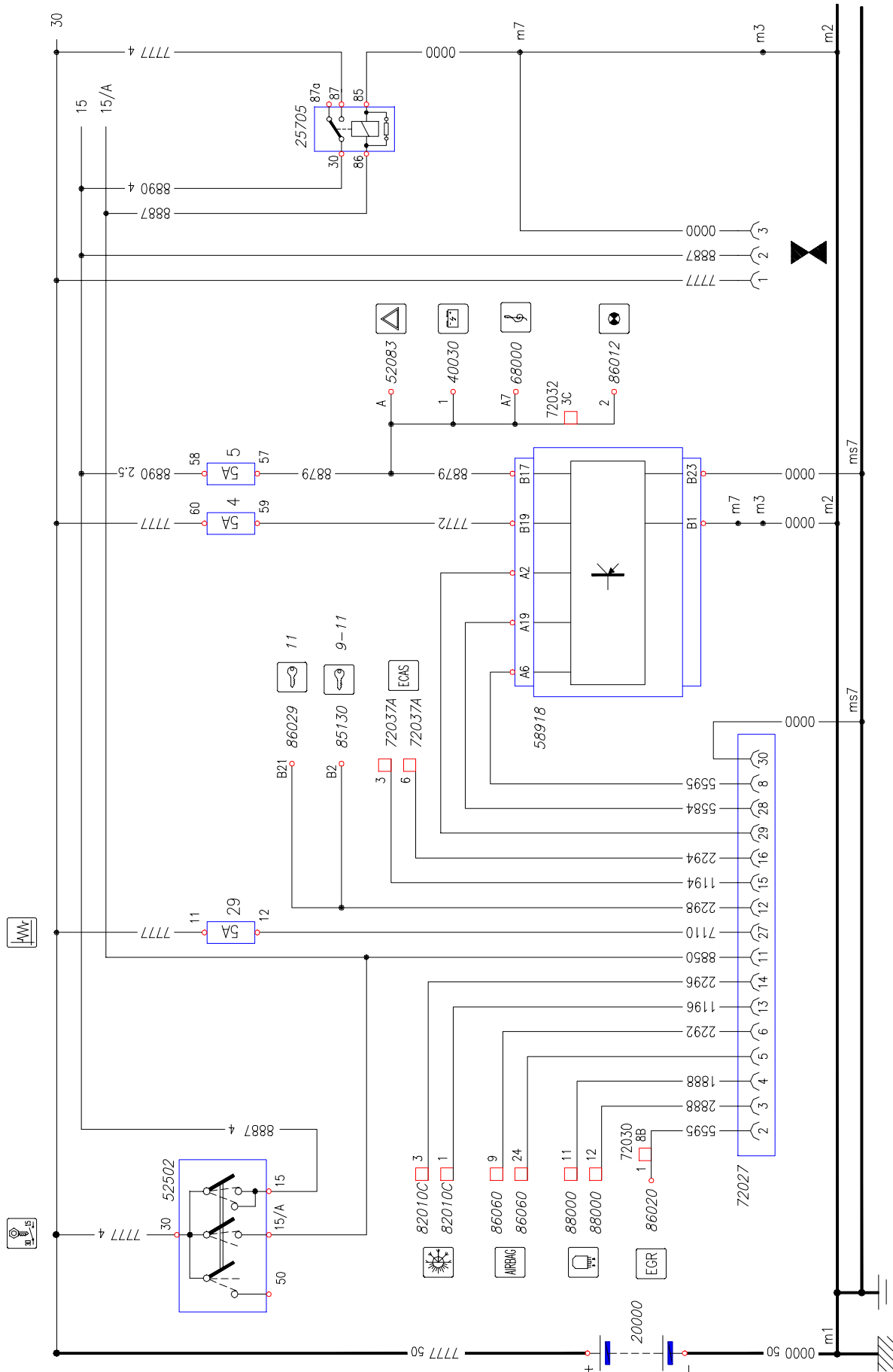
49917

Chart 21C: Immobilizer (.10 – .12 – .13 – .15)

49915

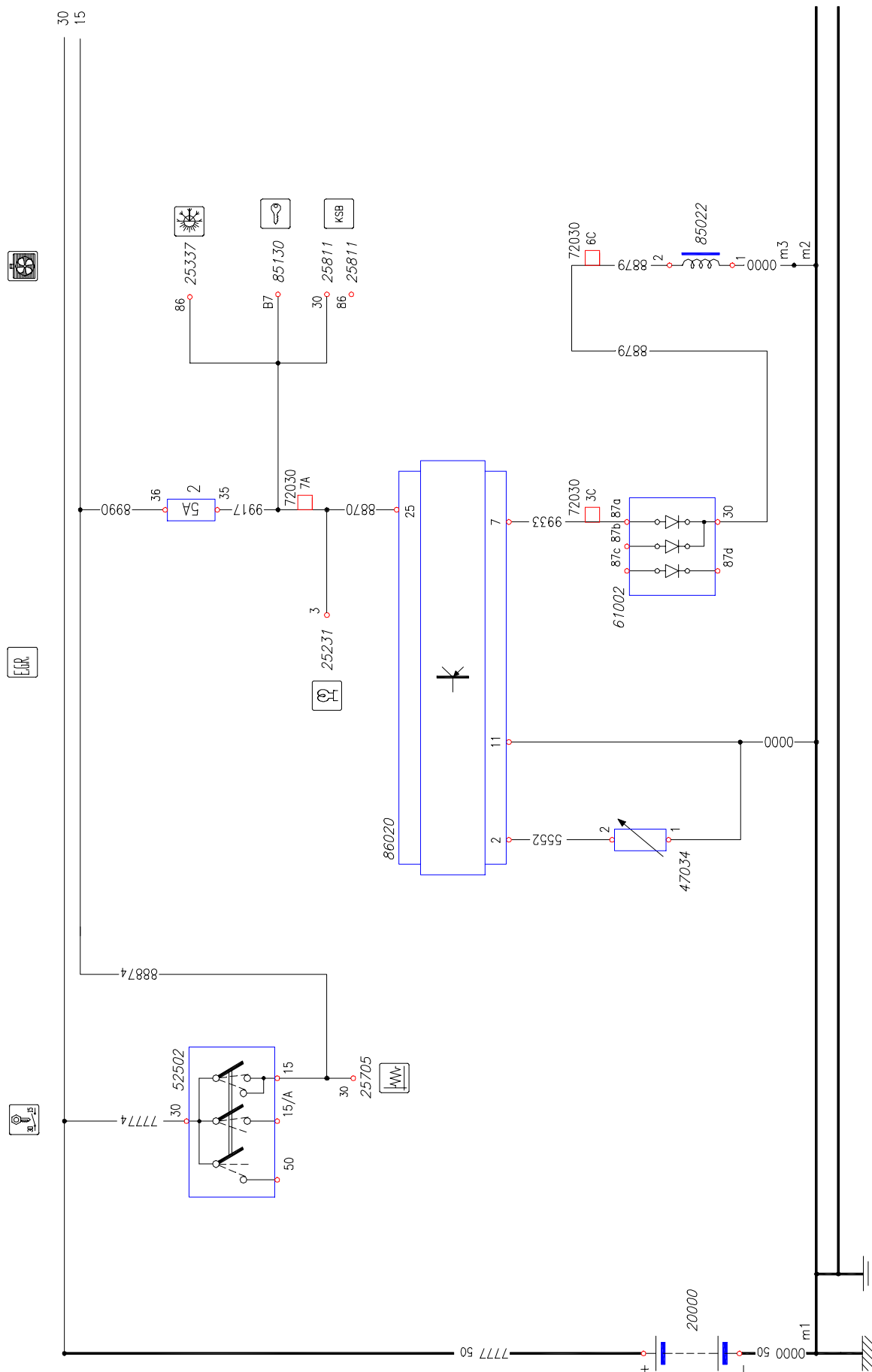
Chart 21D: Immobilizer (.10-.12-.14 - .17 EDC16)

90159

Chart 22A: Diagnosis connection (.9 – .11)

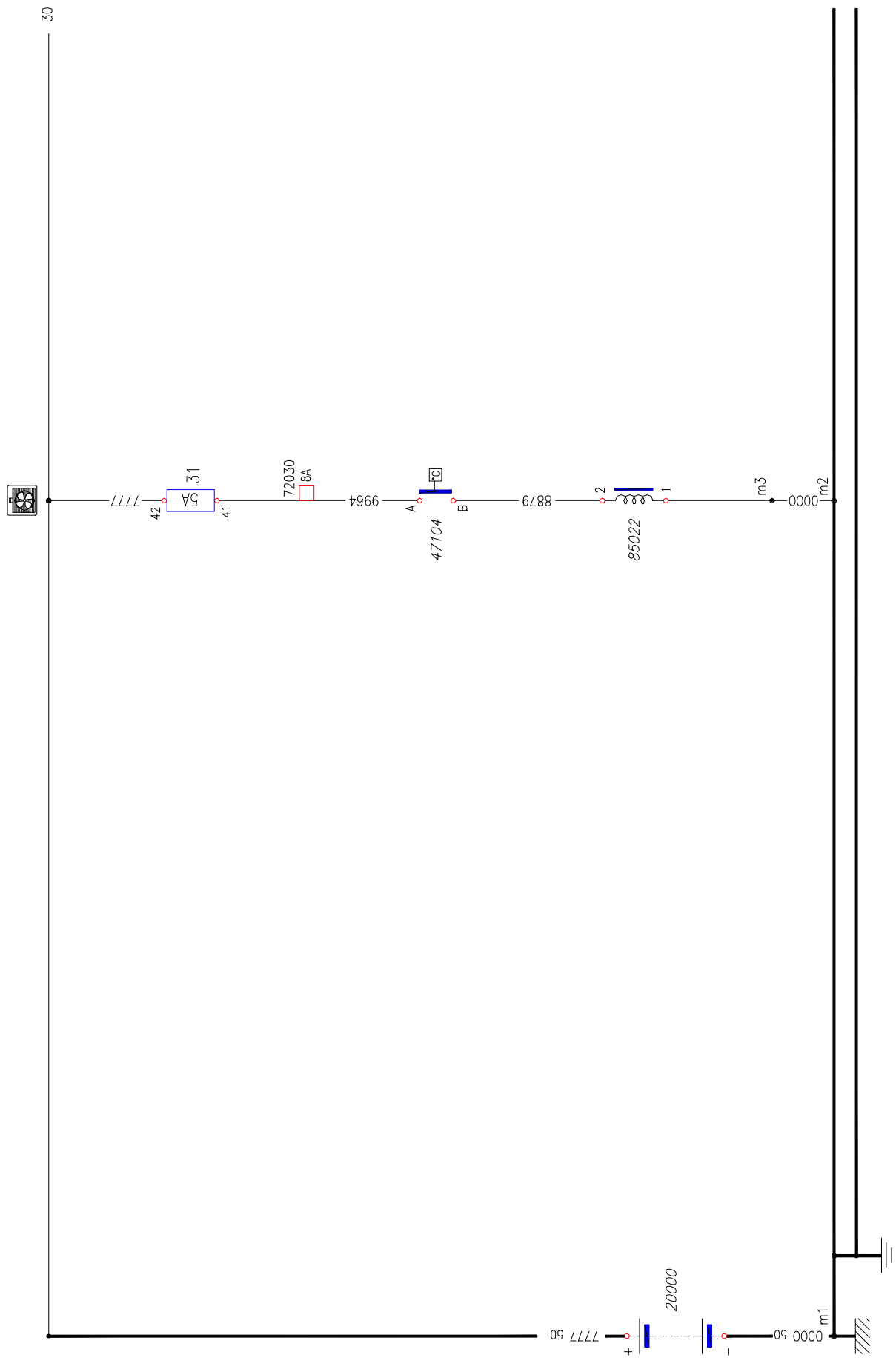
49914

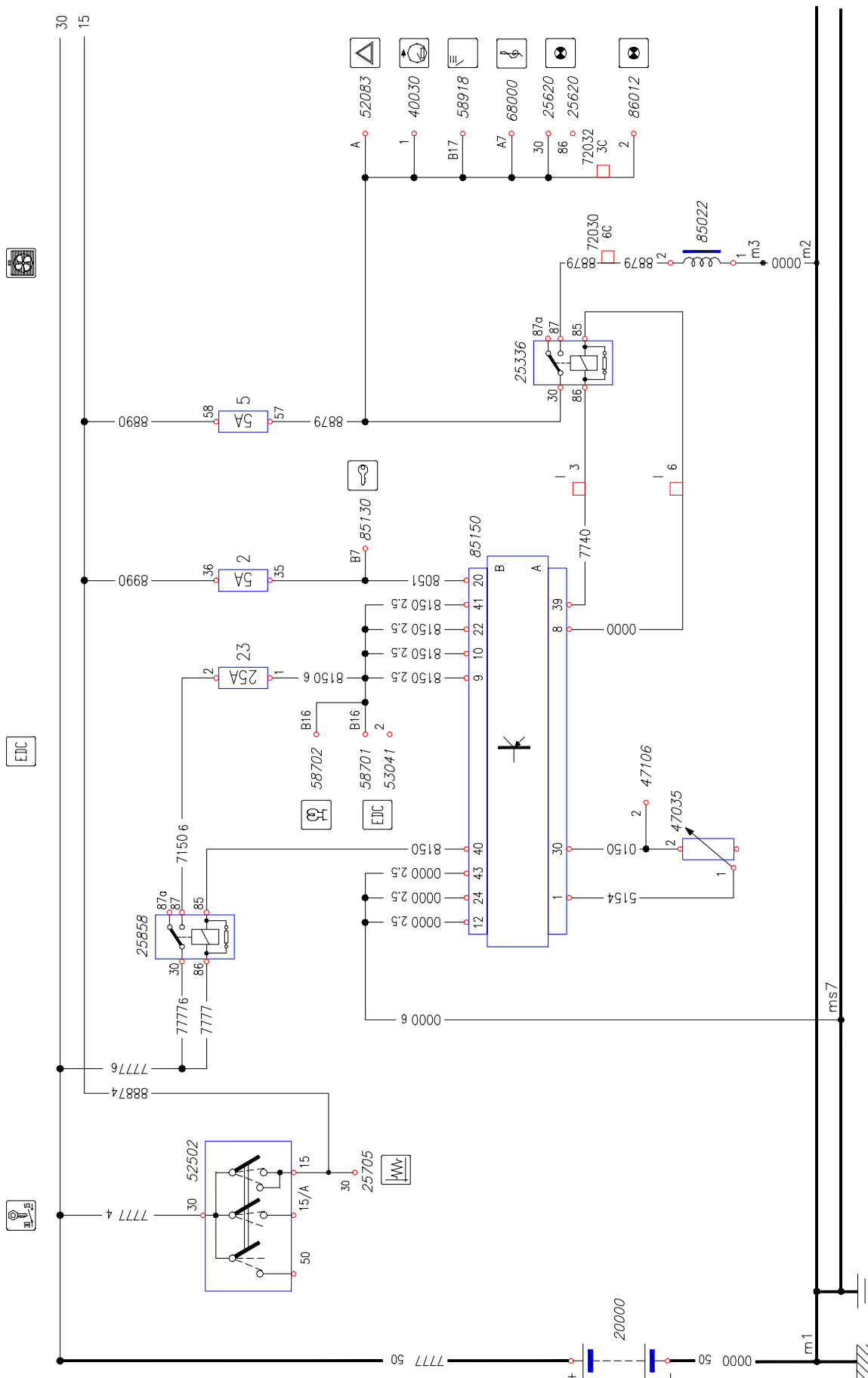
Chart 23A: Engine cooling (.9)



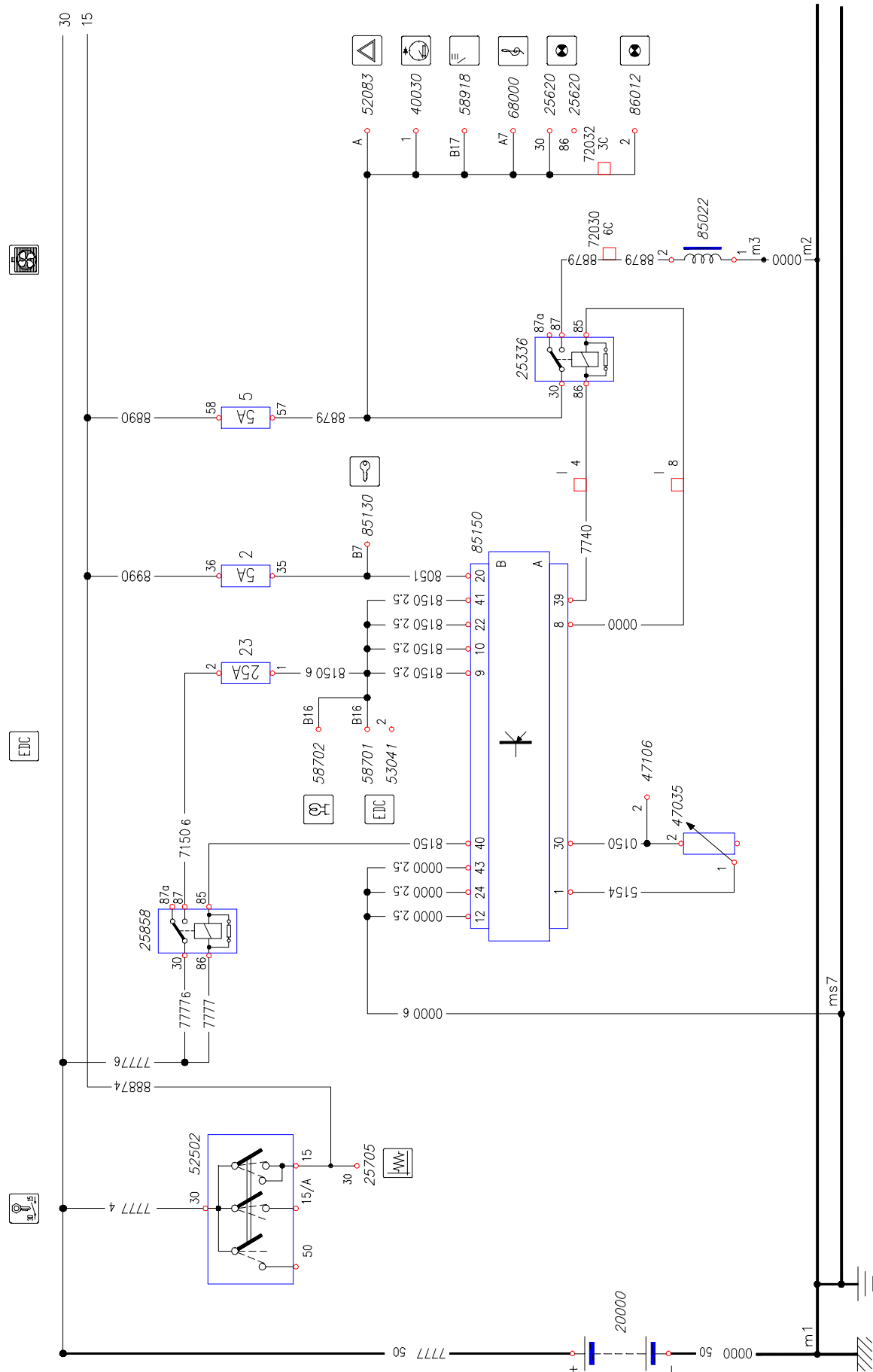
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Chart 23B: Engine cooling (.11)



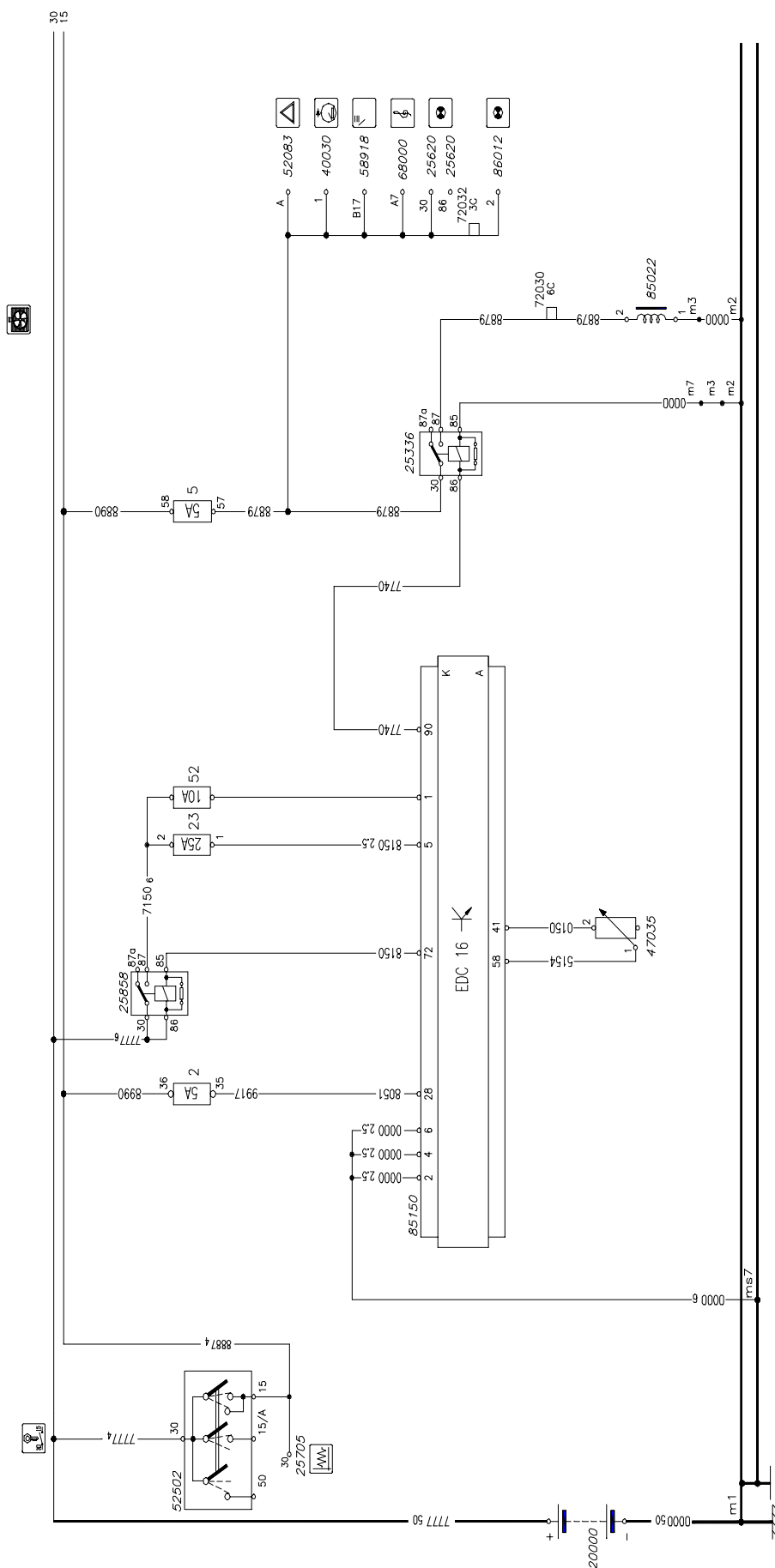


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Chart 23D: Engine cooling (.10 – .12)

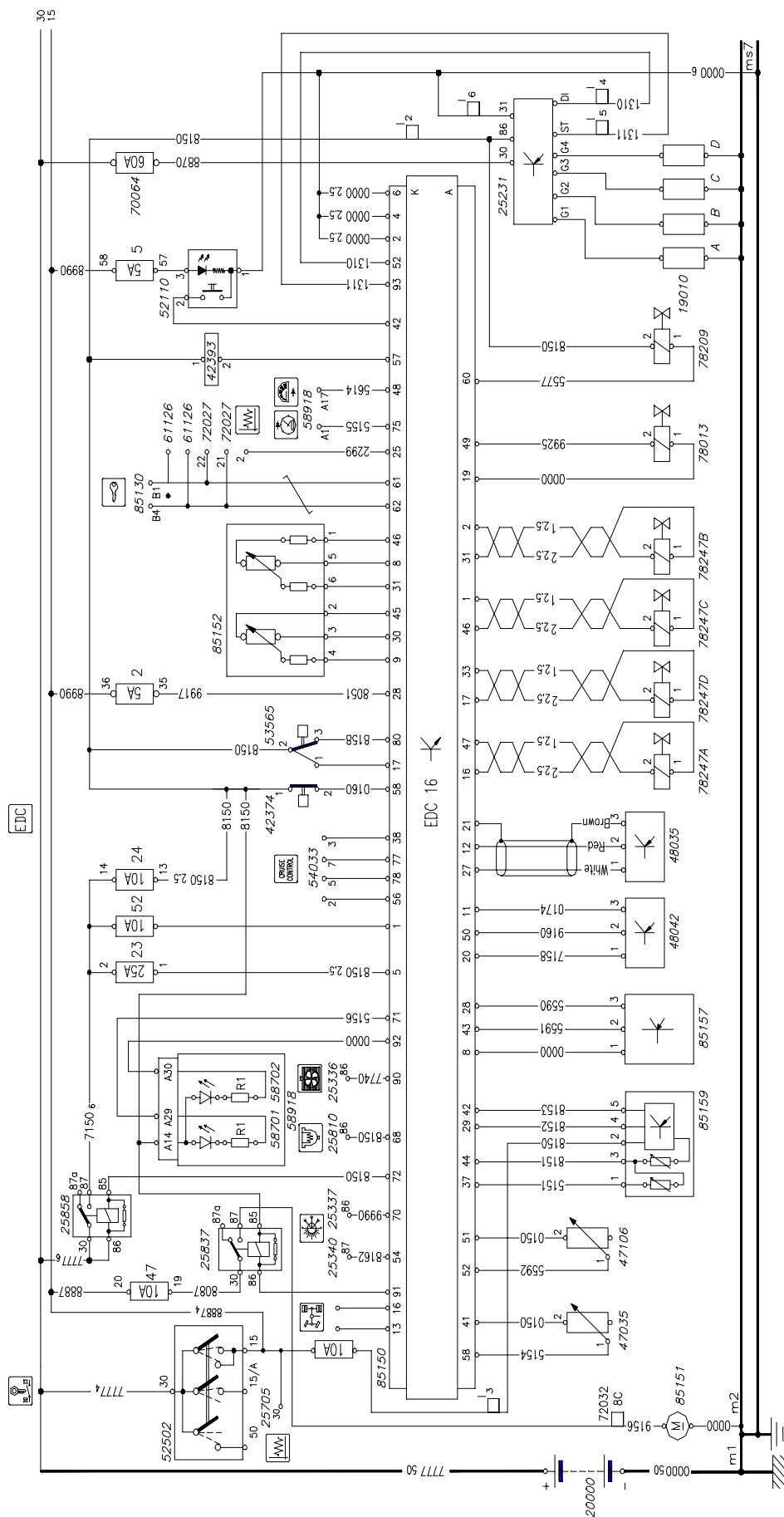
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Chart 23E: Engine cooling (.10 – .12 – .14 – .17 – EDC16)



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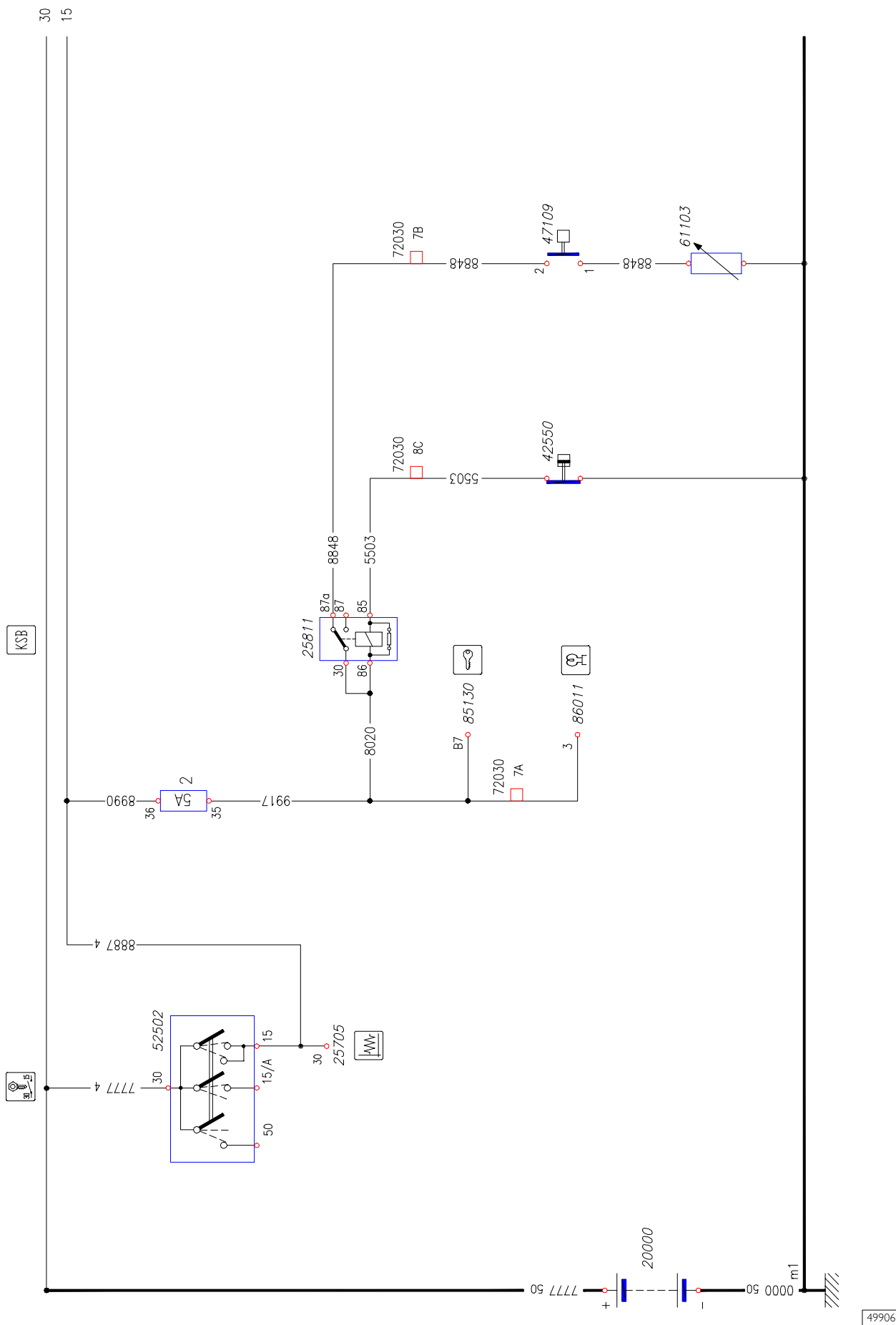


Chart 24D: EGR Exhaust gas electronic control system for EDC (.10 – .12 – .14 – .17 – EDC16)

85718

Chart 25A: Spark lead variator (.9)

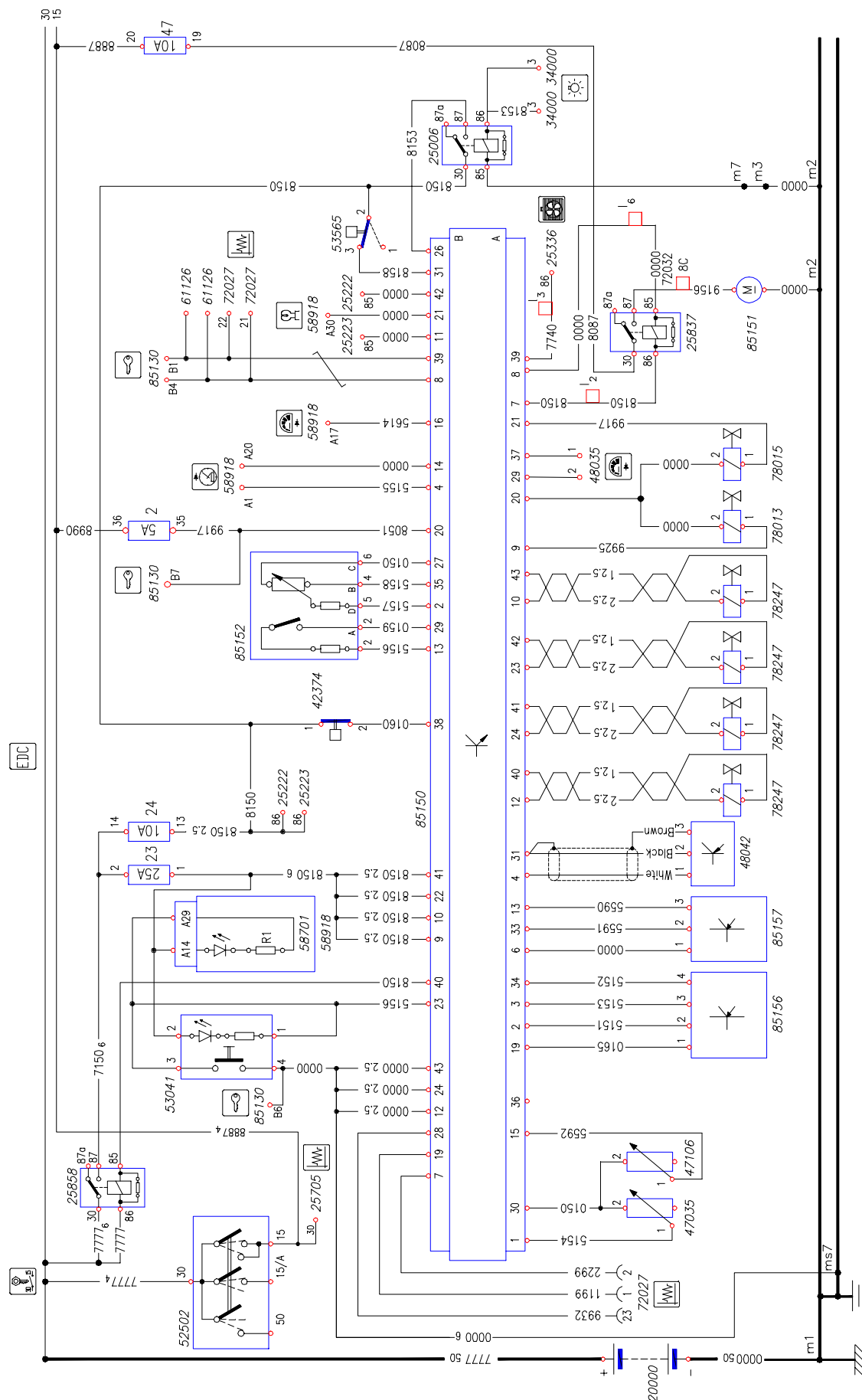
Chart 25B: Spark lead variator (.11)



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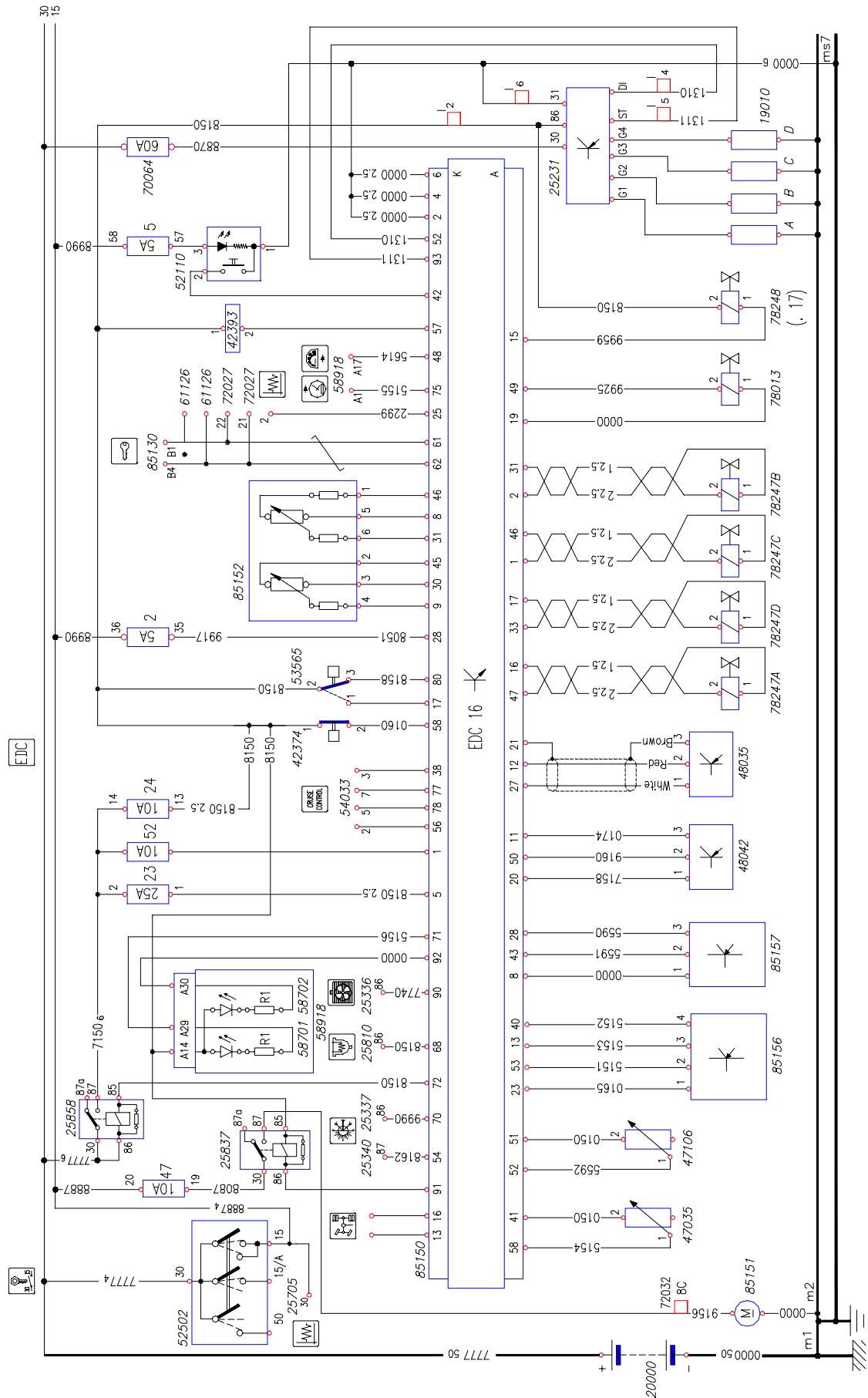


Chart 26C: E.D.C. with WASTE GATE (.13)



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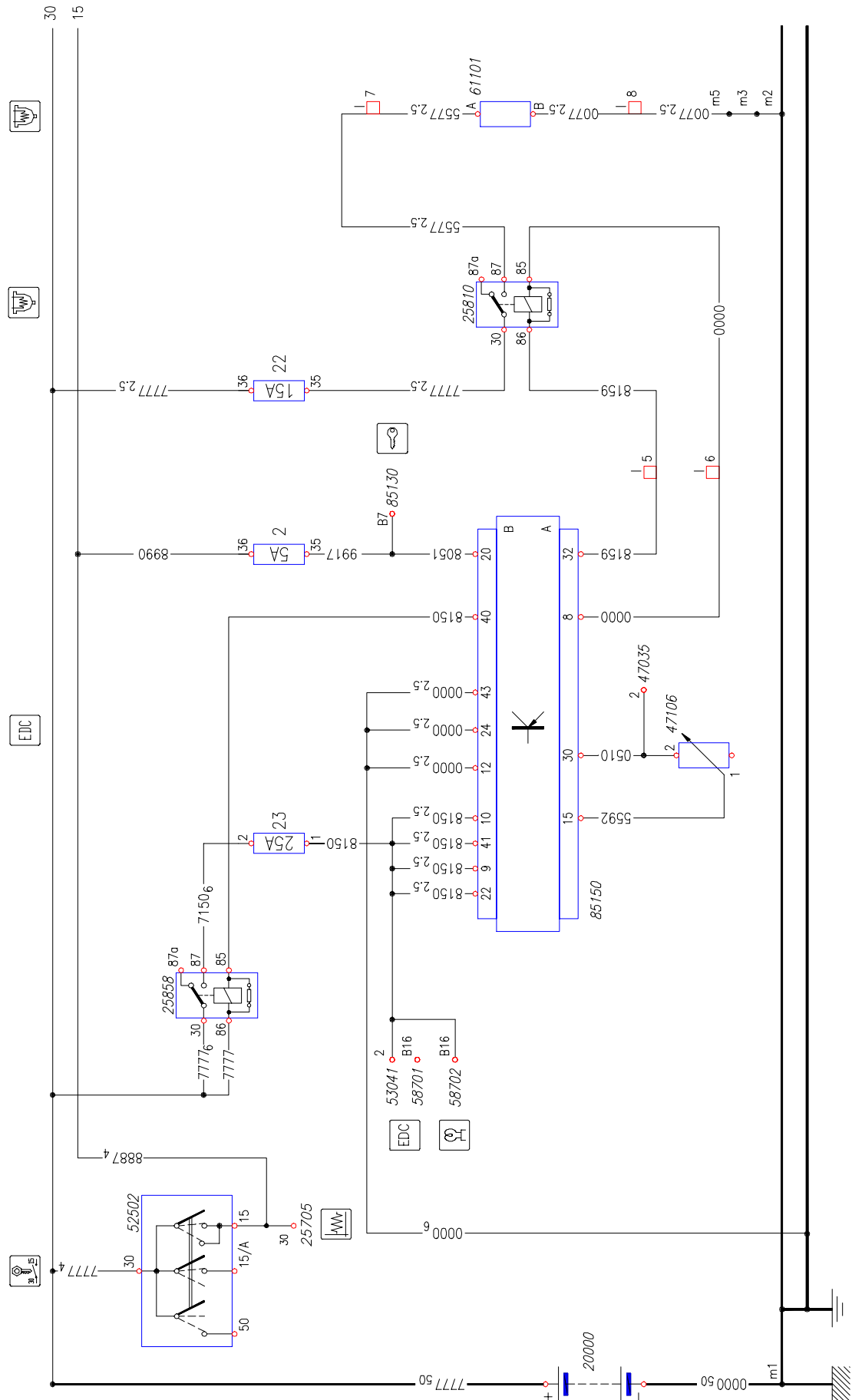


Chart 26E: E.D.C WITHOUT EGR (.10 – .12 – .14 – .17 – EDC16)

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Chart 27B: Heated fuel filter (.13 – .15)

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Chart 27D: Heated fuel filter (.10 – .12 – .14 – .17 – EDC16)

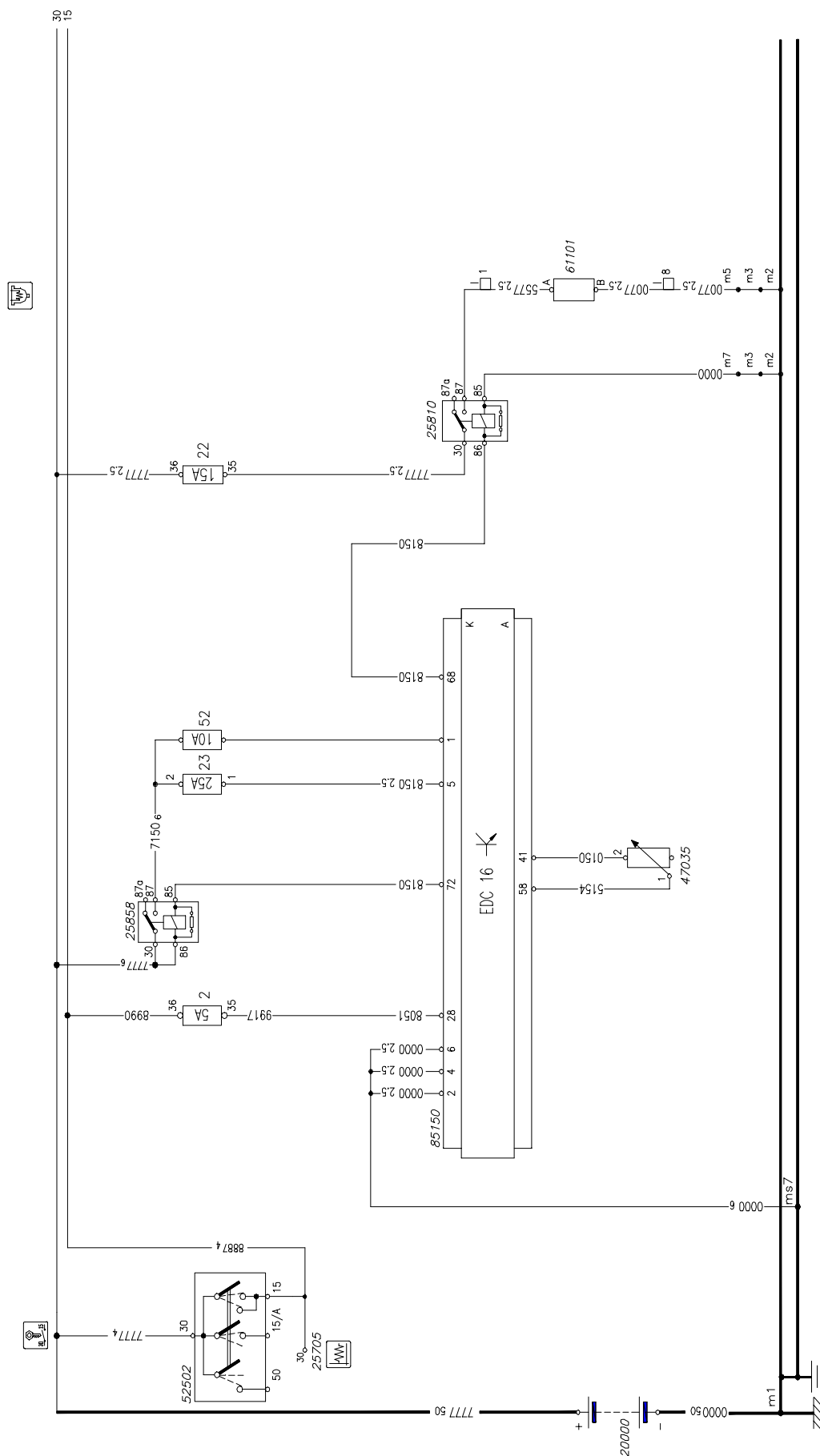
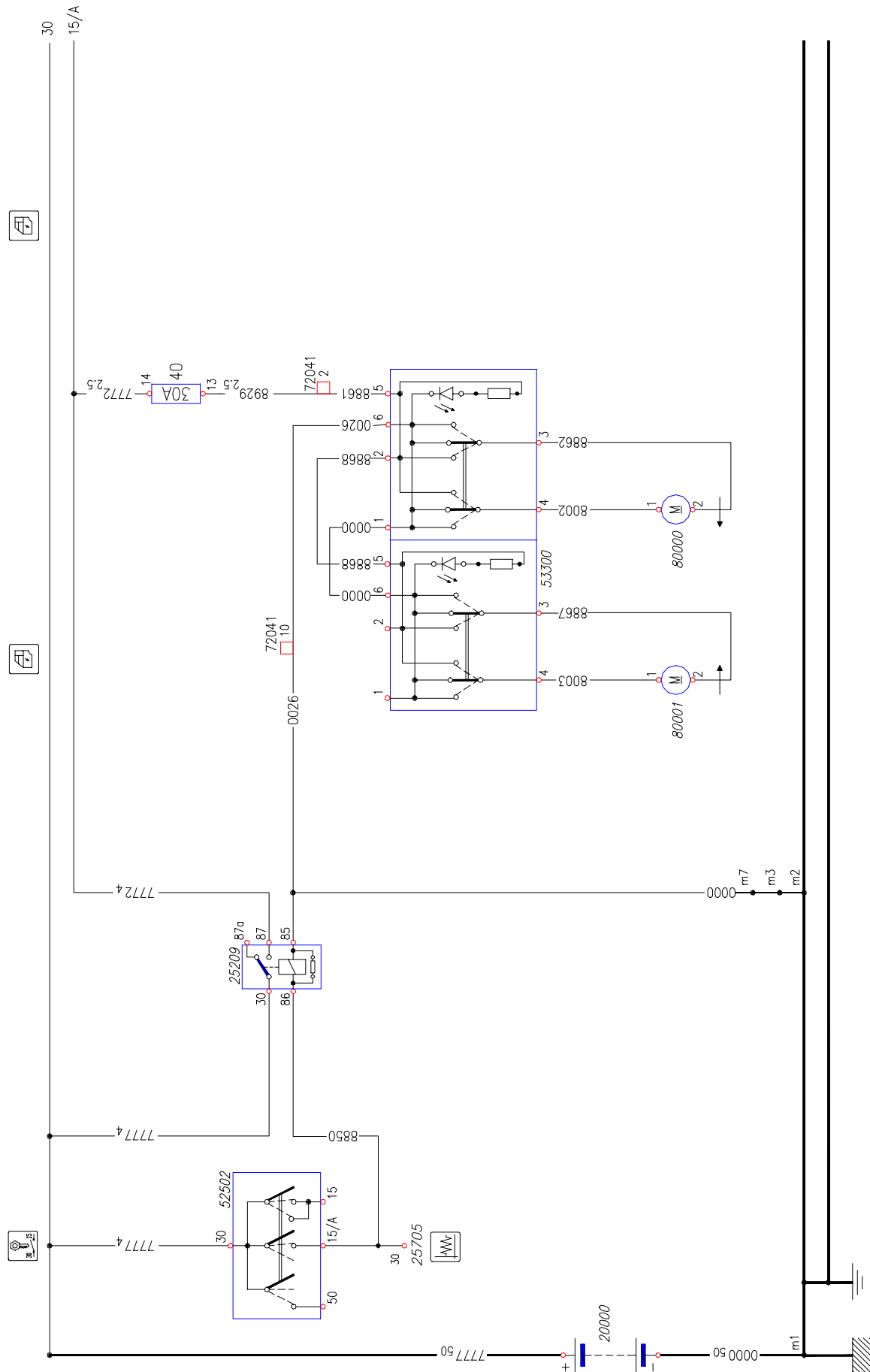
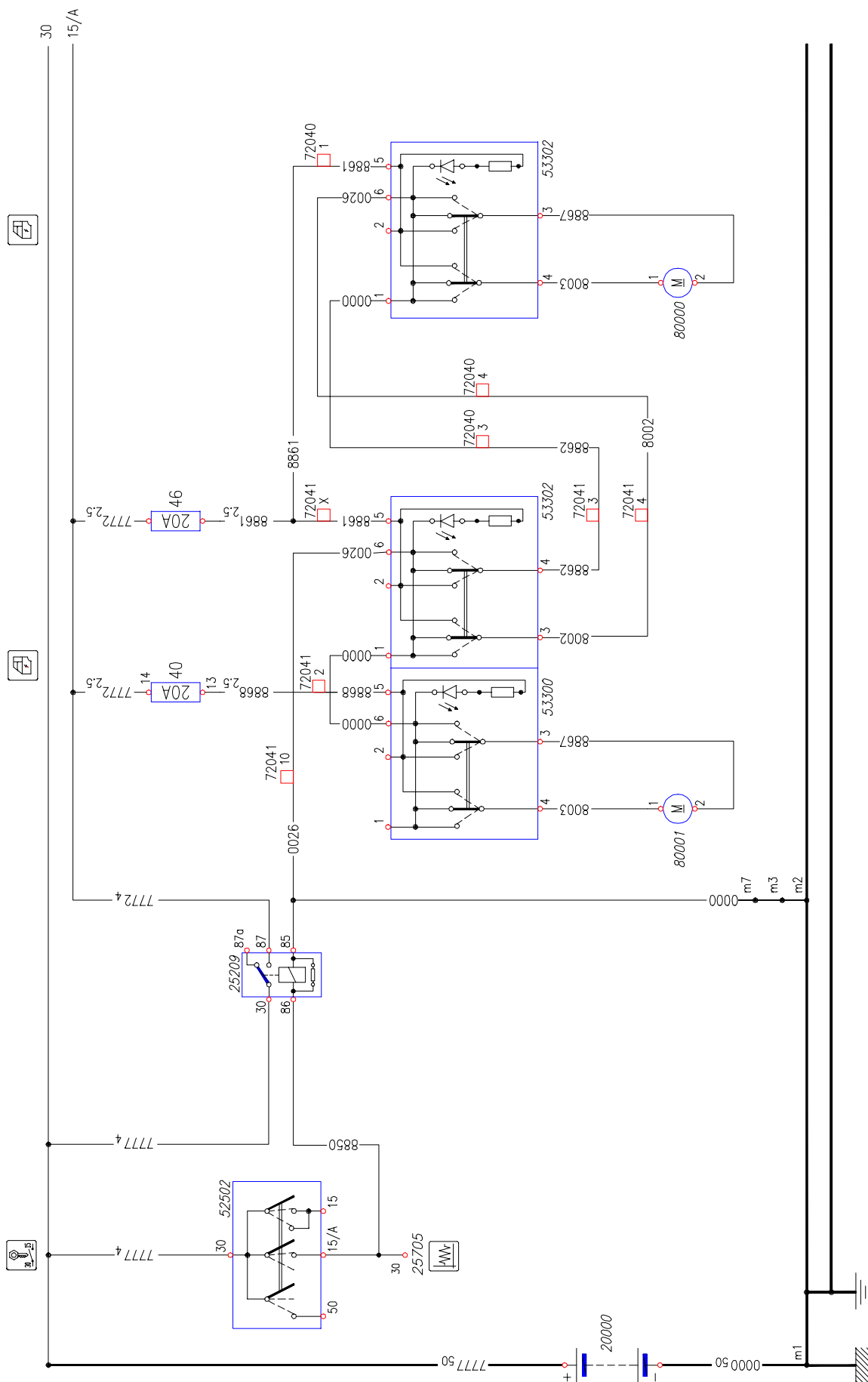


Chart 28B: Power window operator side / OPT 4028

49899

Chart 28C: Power window operator and passenger side (.10 – .12)

74264

Chart 29: Heated rearview mirrors / OPT 697

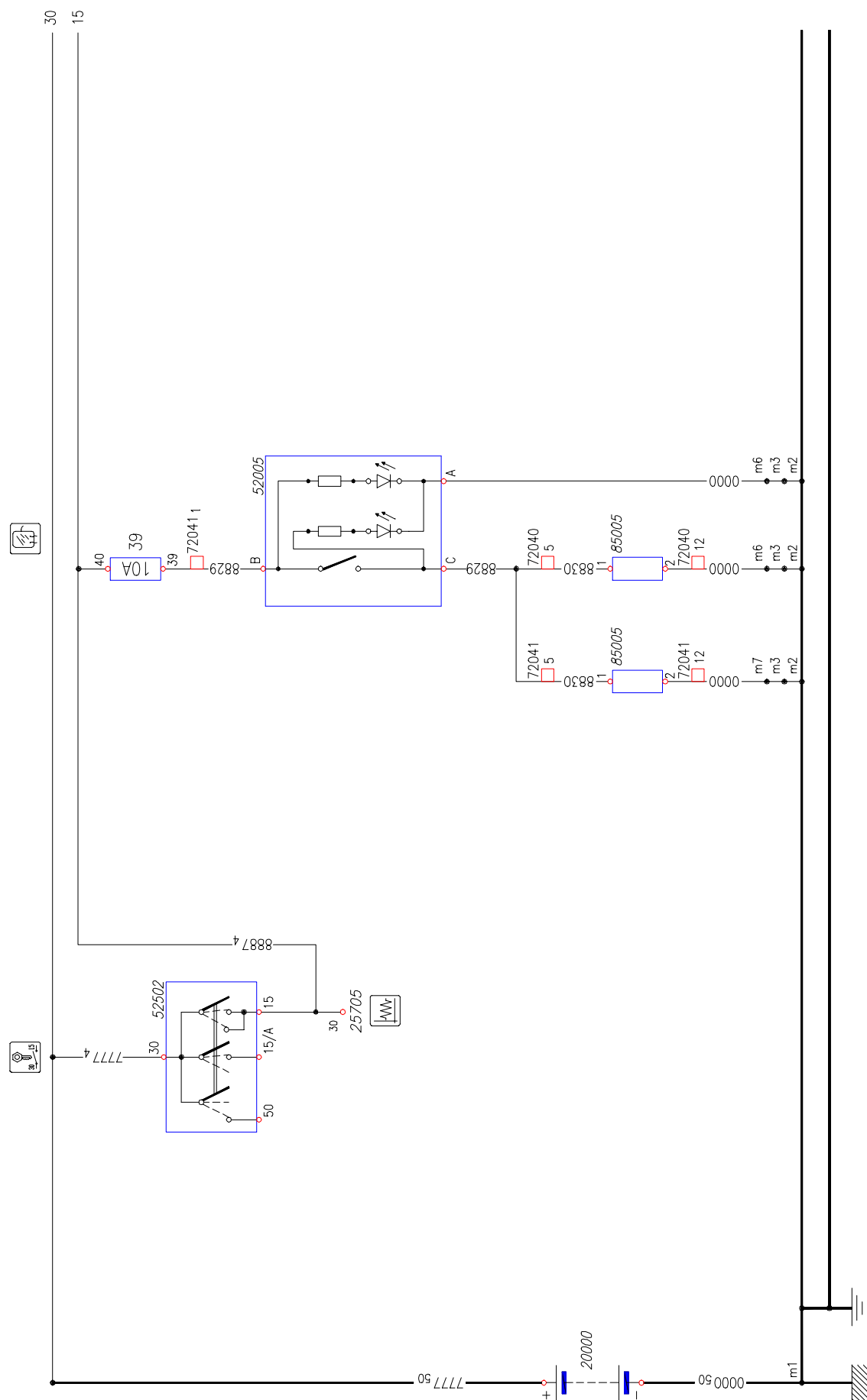
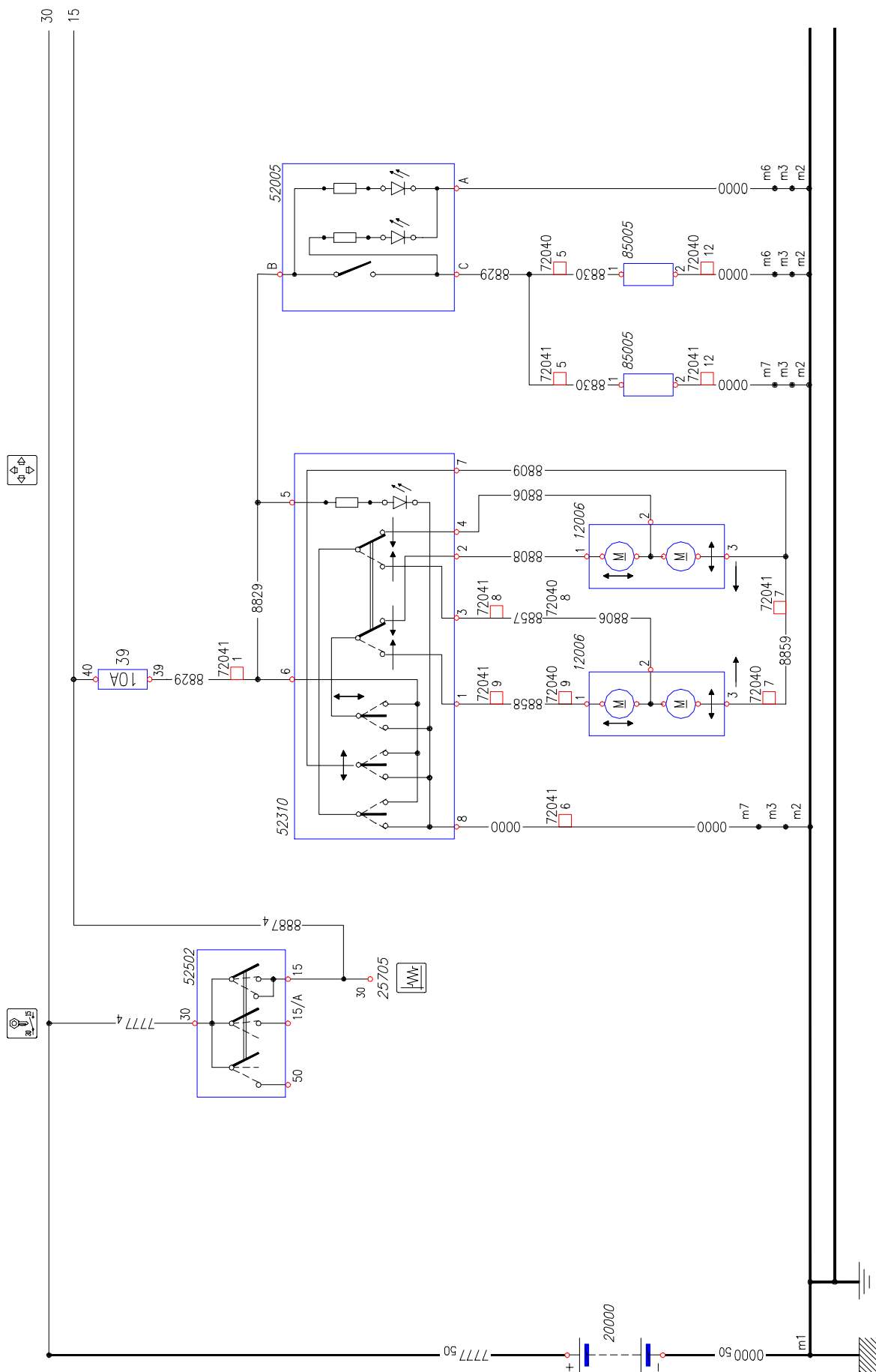
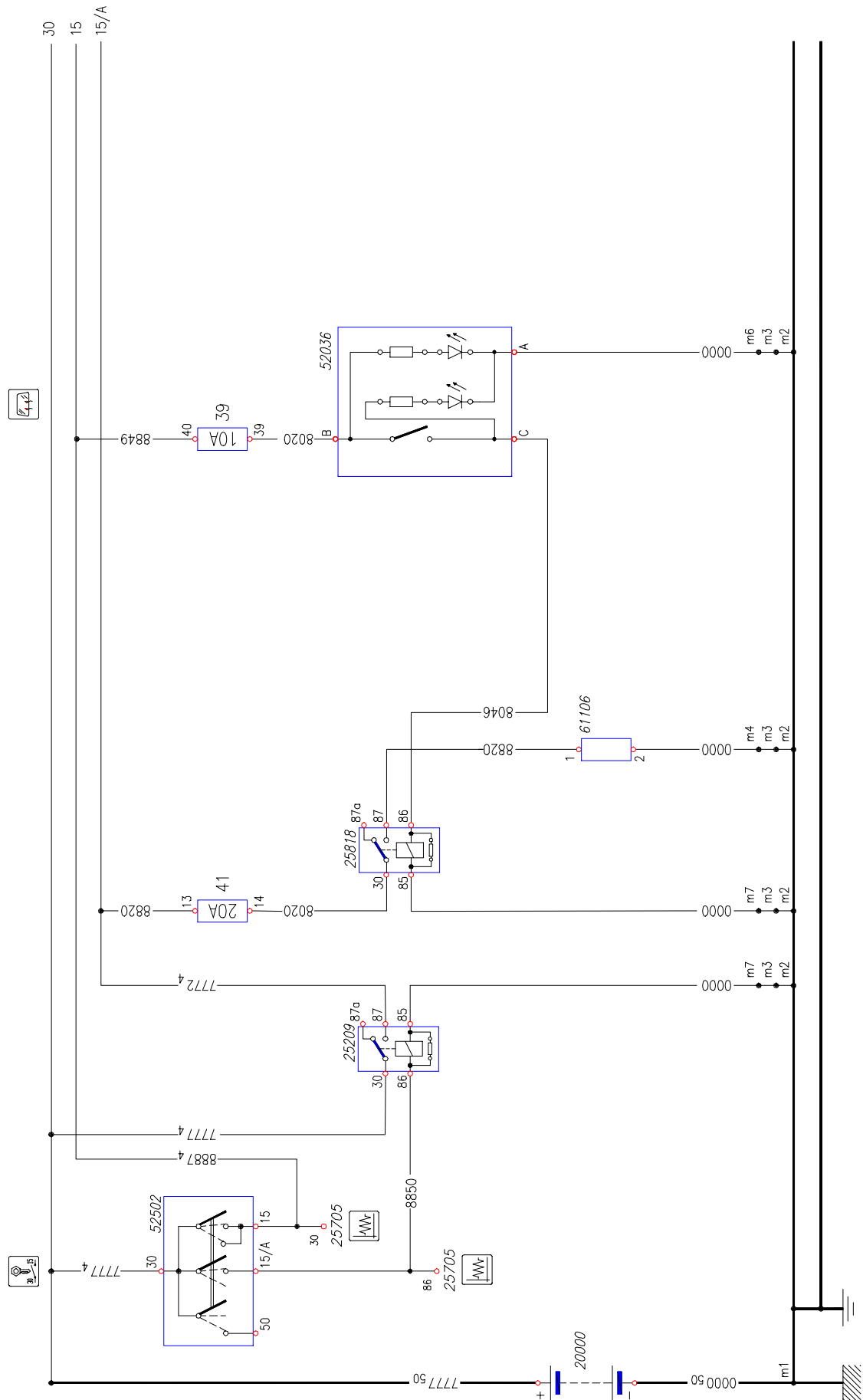


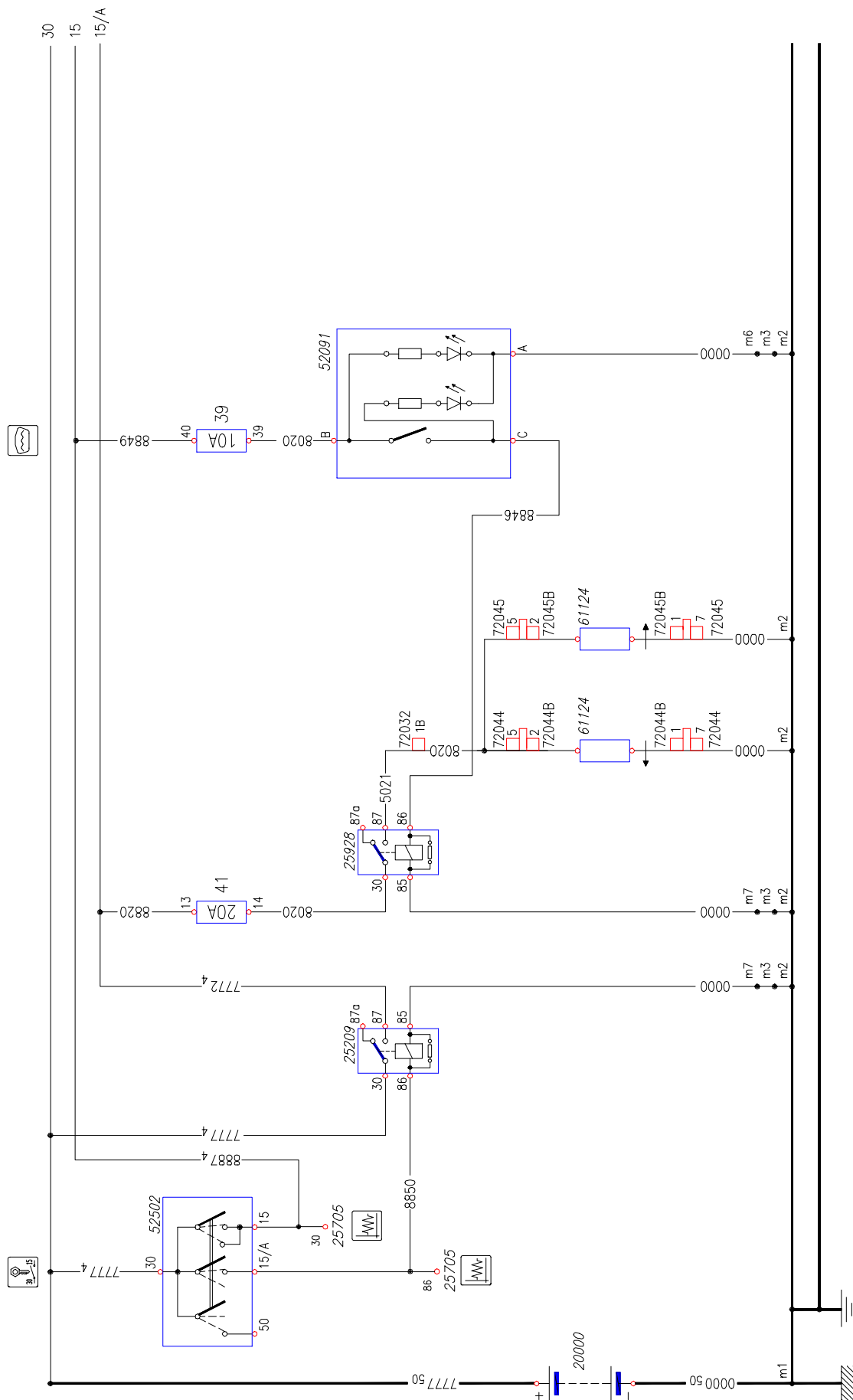
Chart 30: Rearview mirror adjustment / OPT 2714



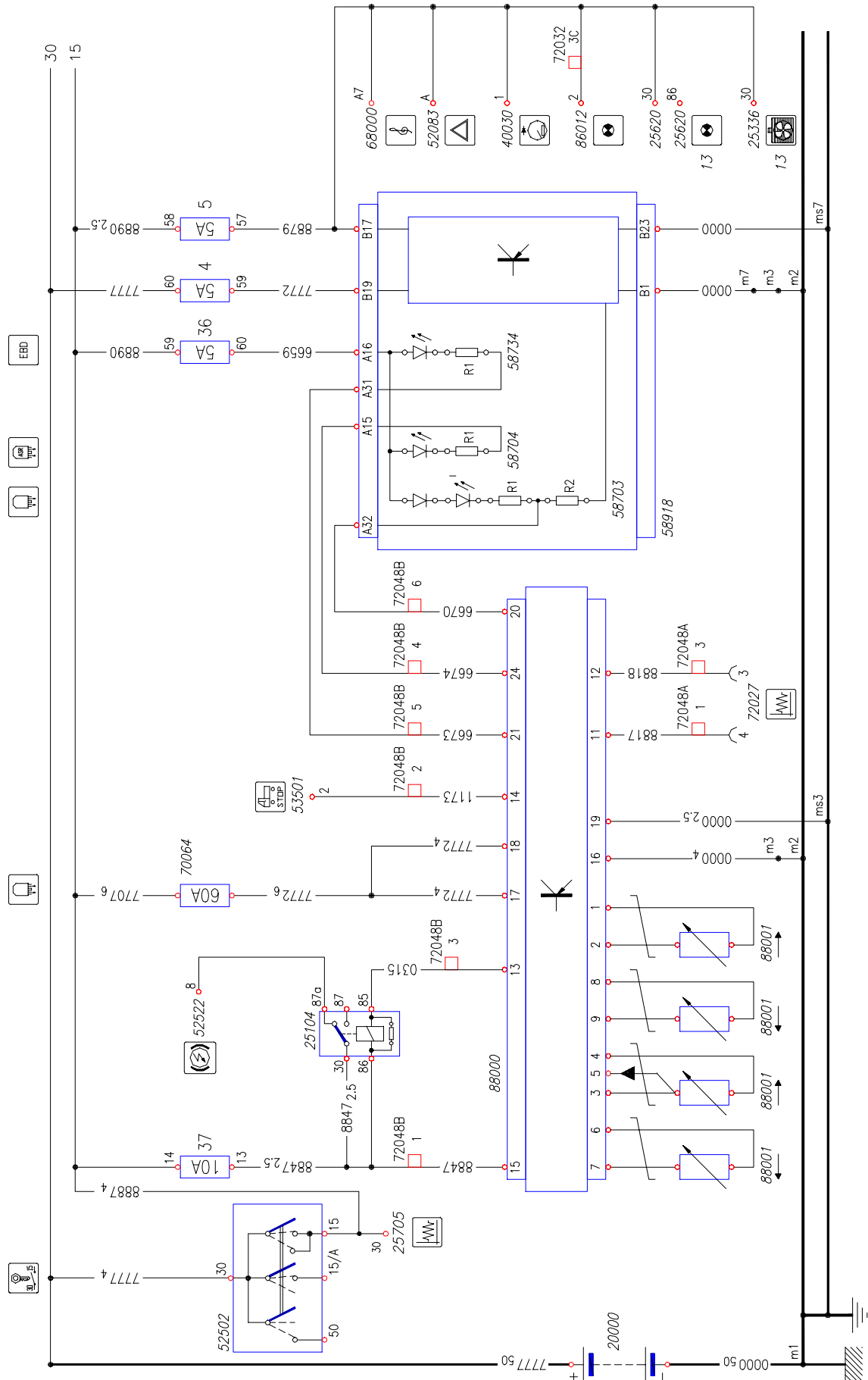
49897

Chart 31: Heated windscreen / OPT 685

49896

Chart 32: Heated rear window / OPT 6815

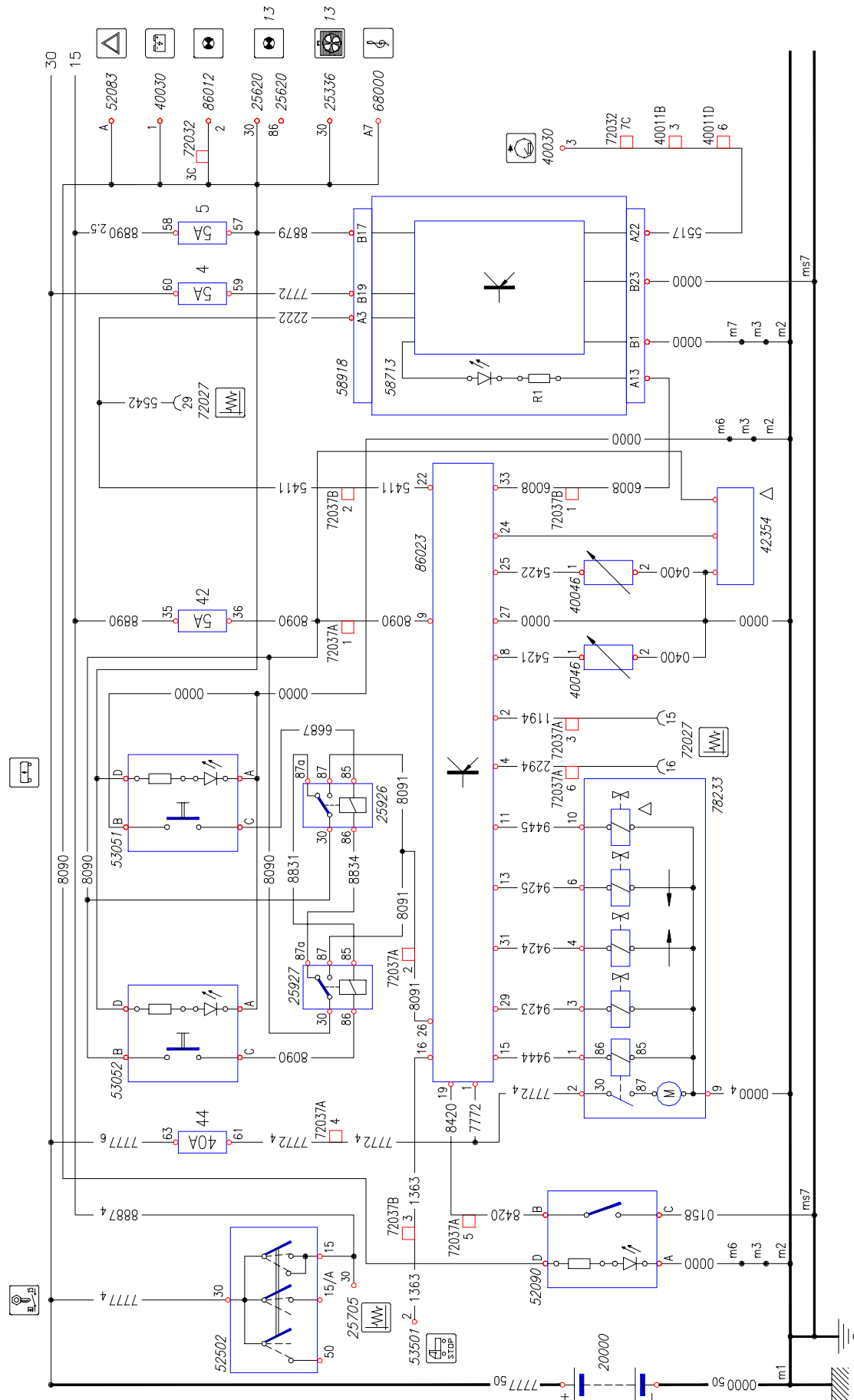
49895

Chart 33: ABS/EBD/ABD / OPT 209I

49894

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Chart 34B: E.C.A.S. with reserve air reservoir (.9-.10-.11-.12-.13-.14-.17)

49892

Chart 34C: Vb Techniek (35C – 40C – 45C)

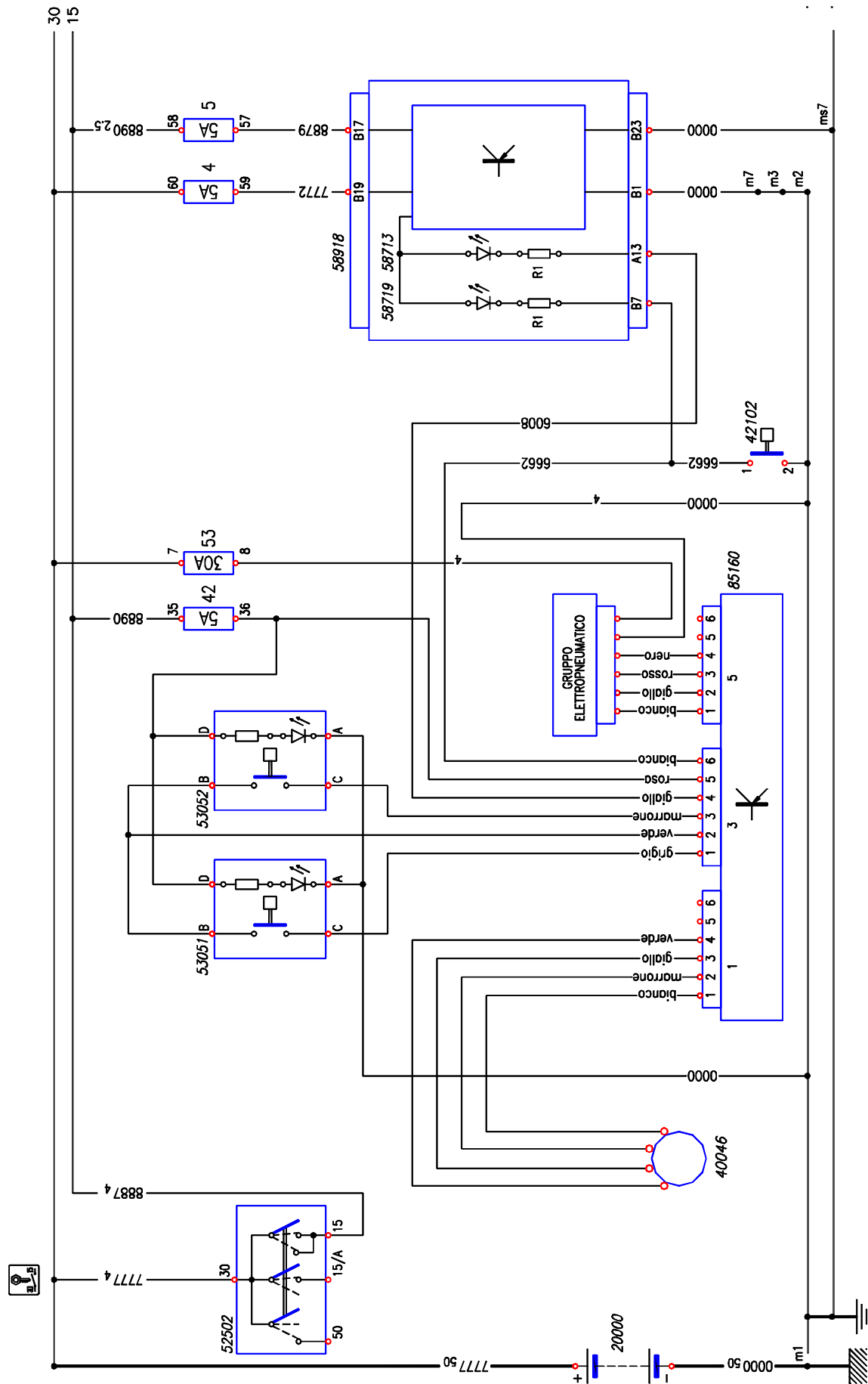
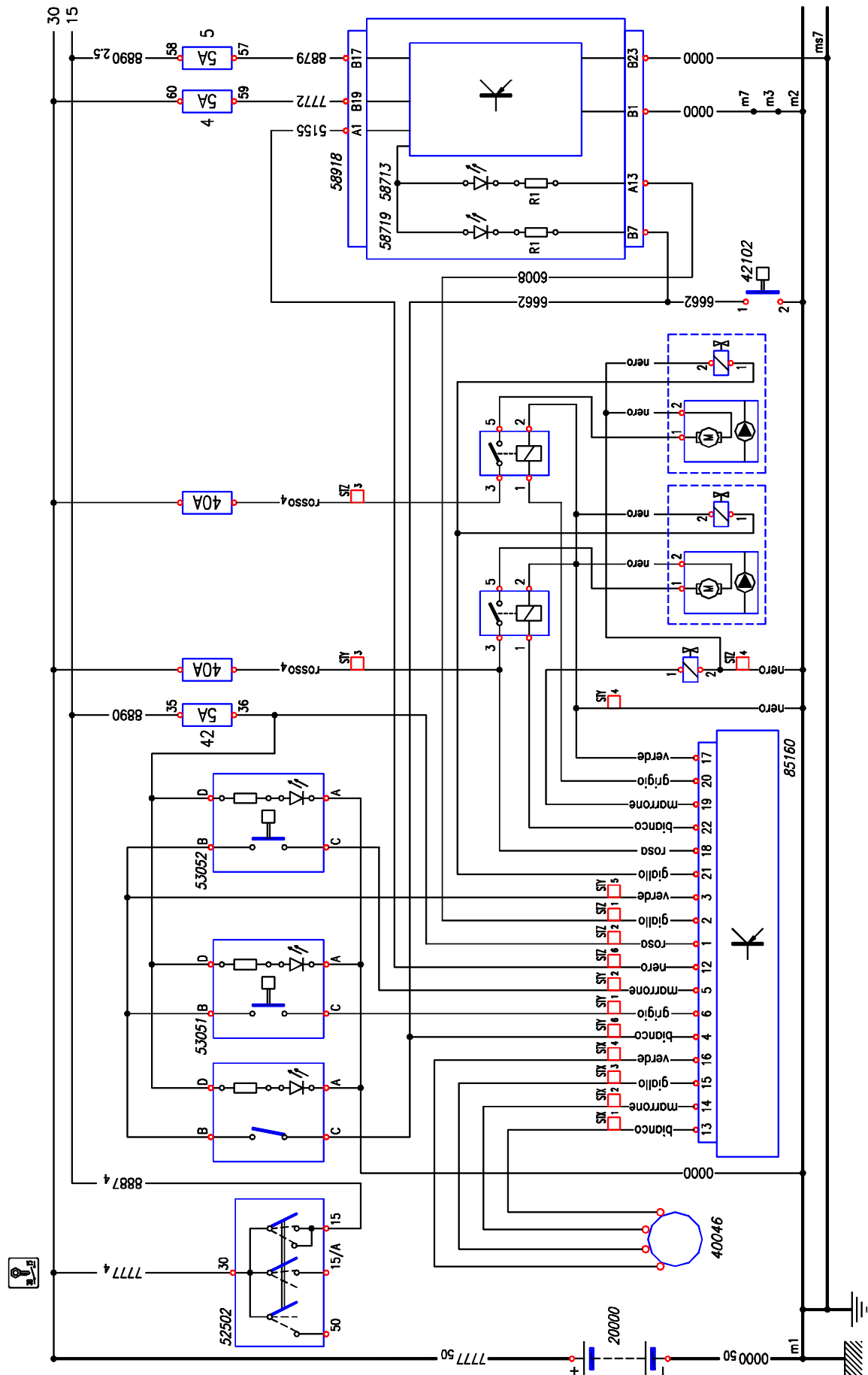
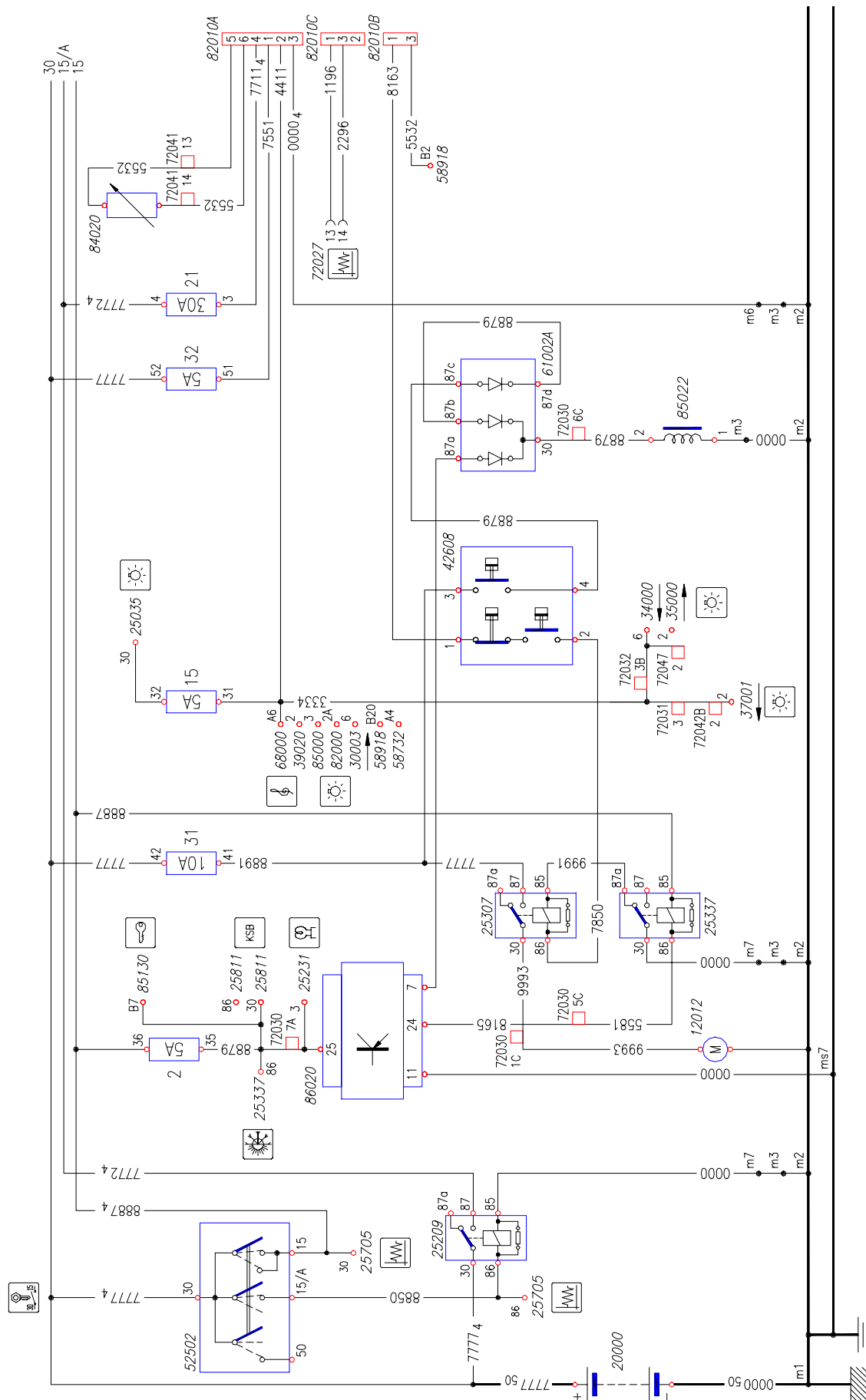


Chart 34D: Vb Techniek (60C – 65C – 50C)

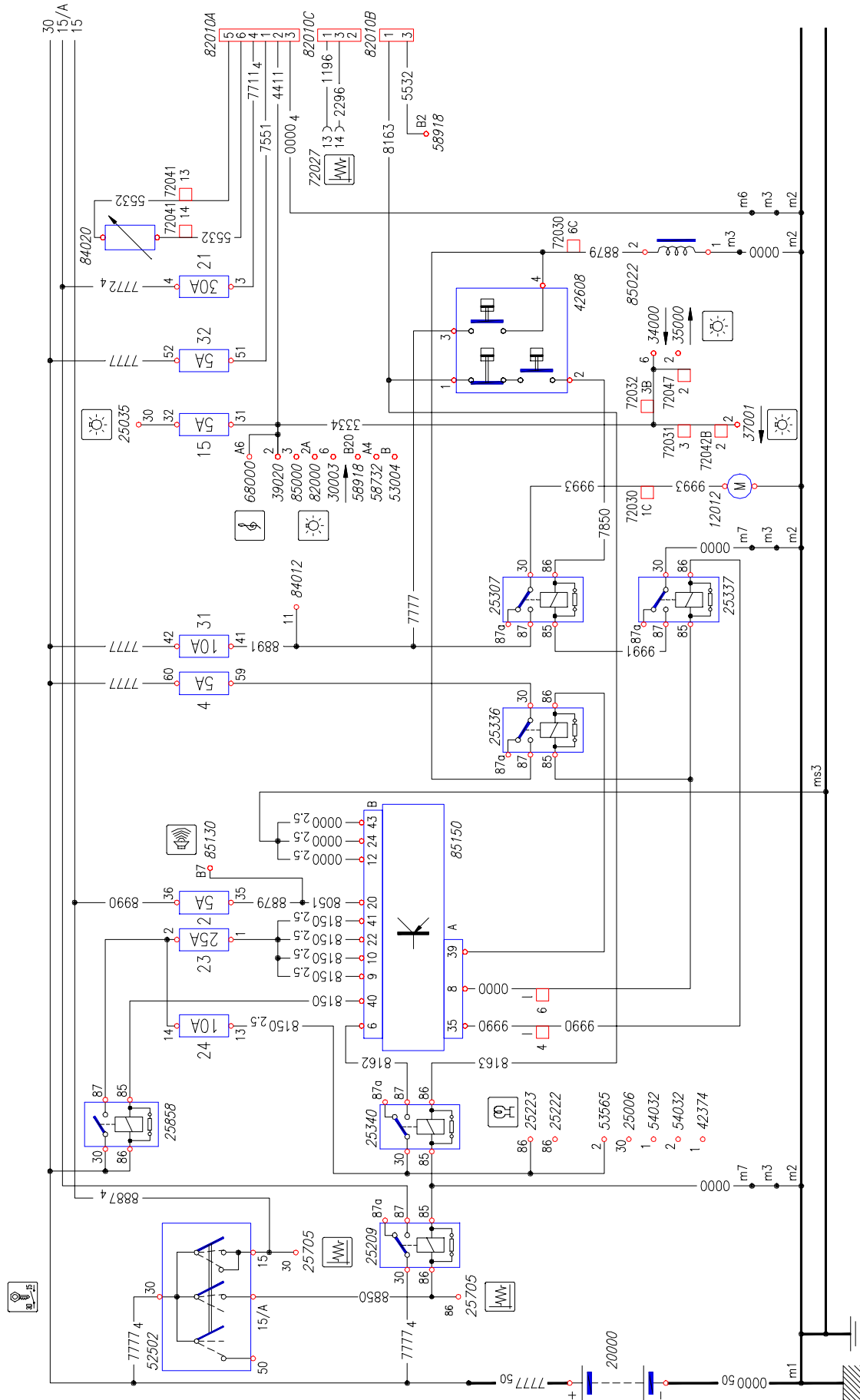


86166

Chart 35A: Automatic conditioner (.9) / OPT 6650

49890

Chart 35C: Automatic conditioner (.13-.15) / OPT 6650



49888

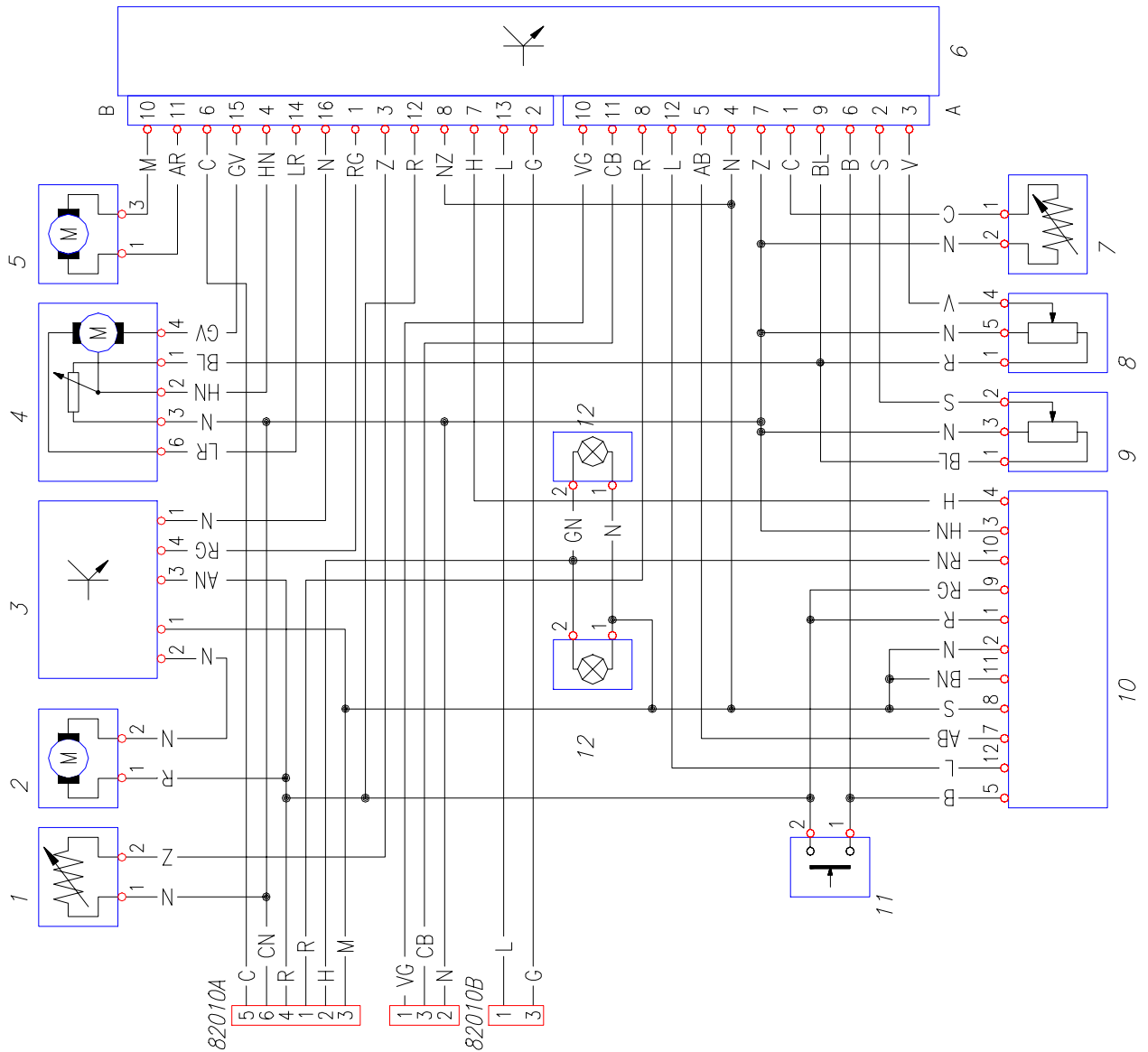
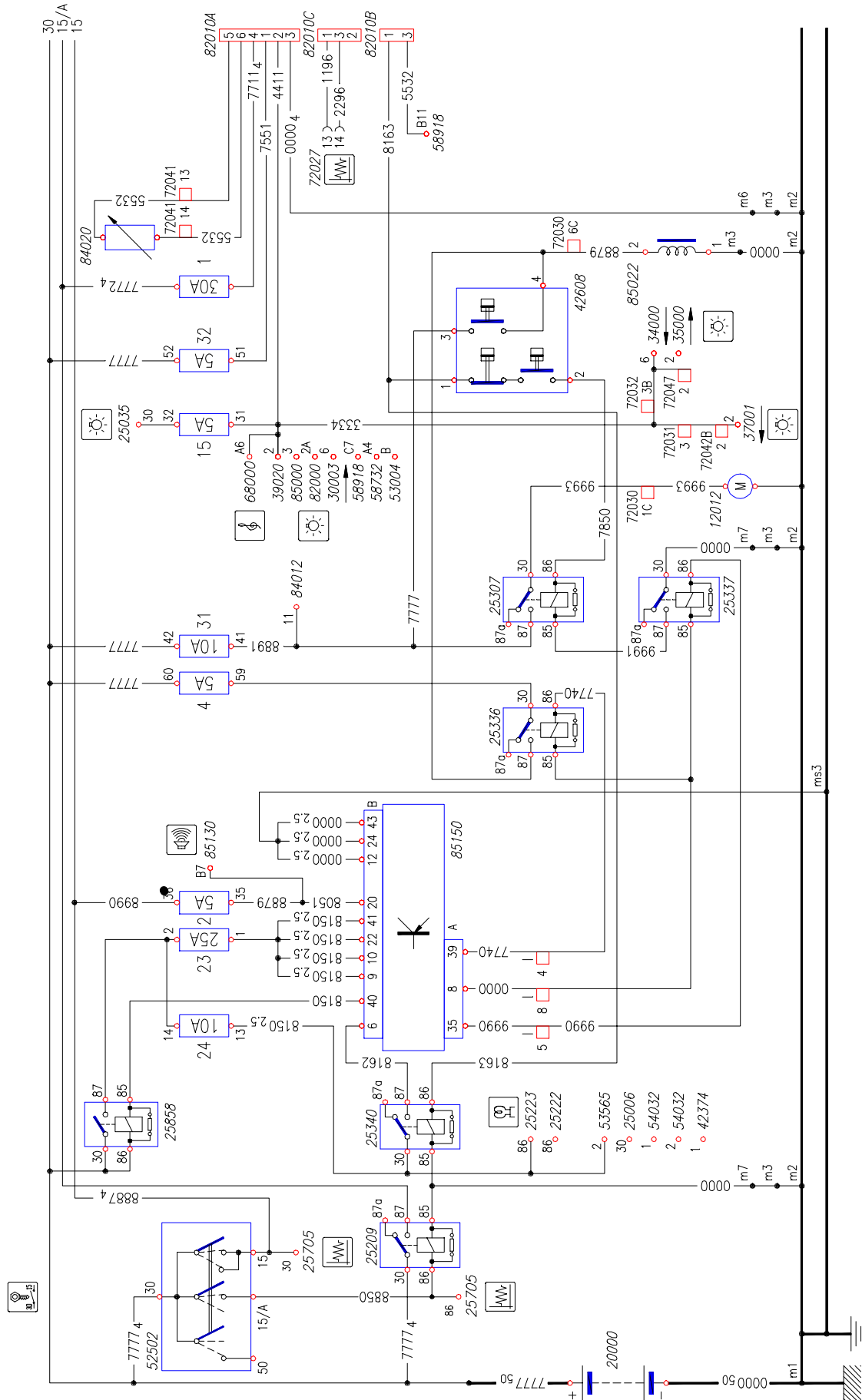
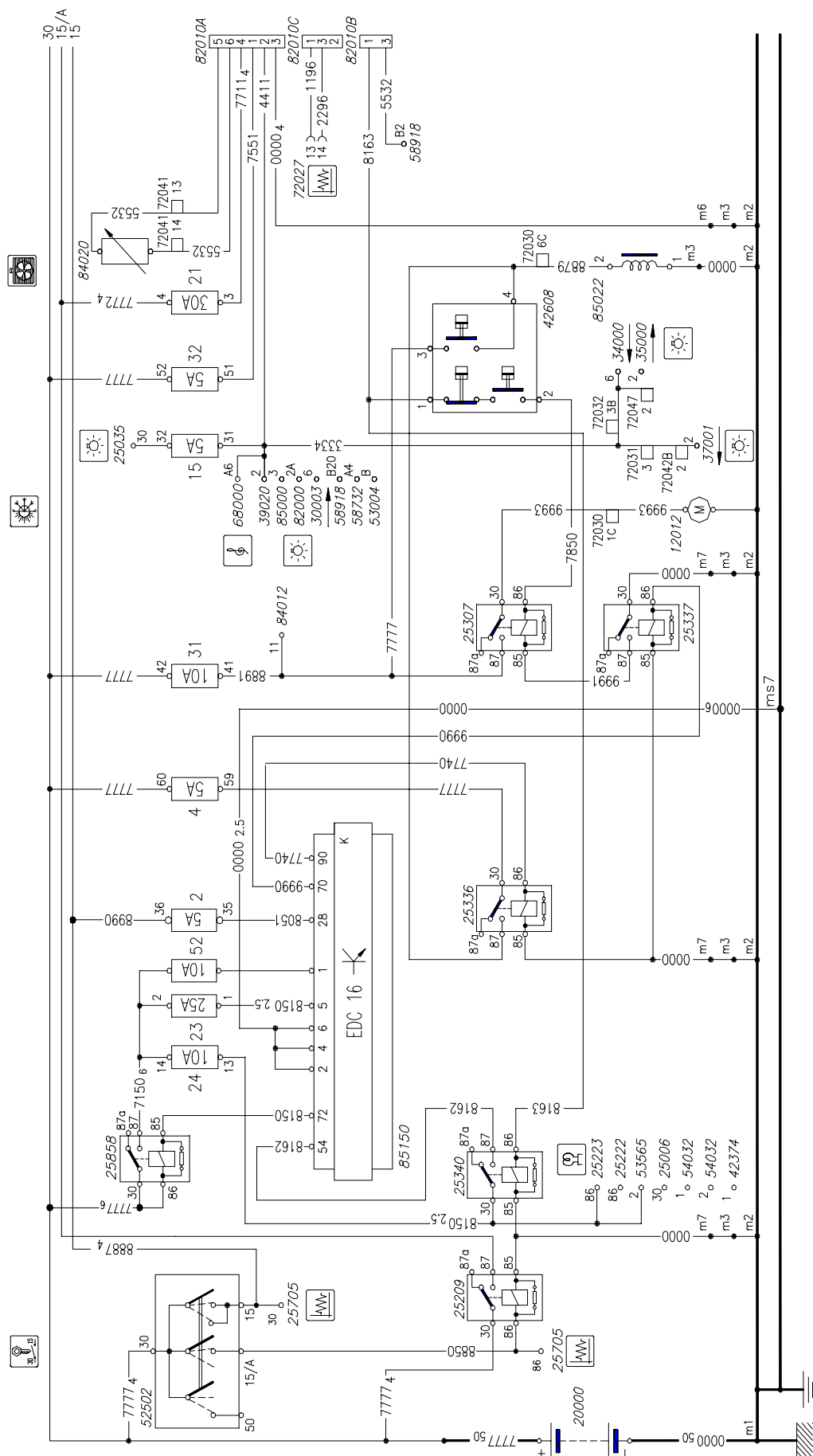
Chart 35D: Automatic conditioner (.9 – .10 – .11 – .12 – .13 – .14 – .15 – .17) / OPT 6650

Chart 35E: Automatic conditioner (.10 – .12) / OPT 6650



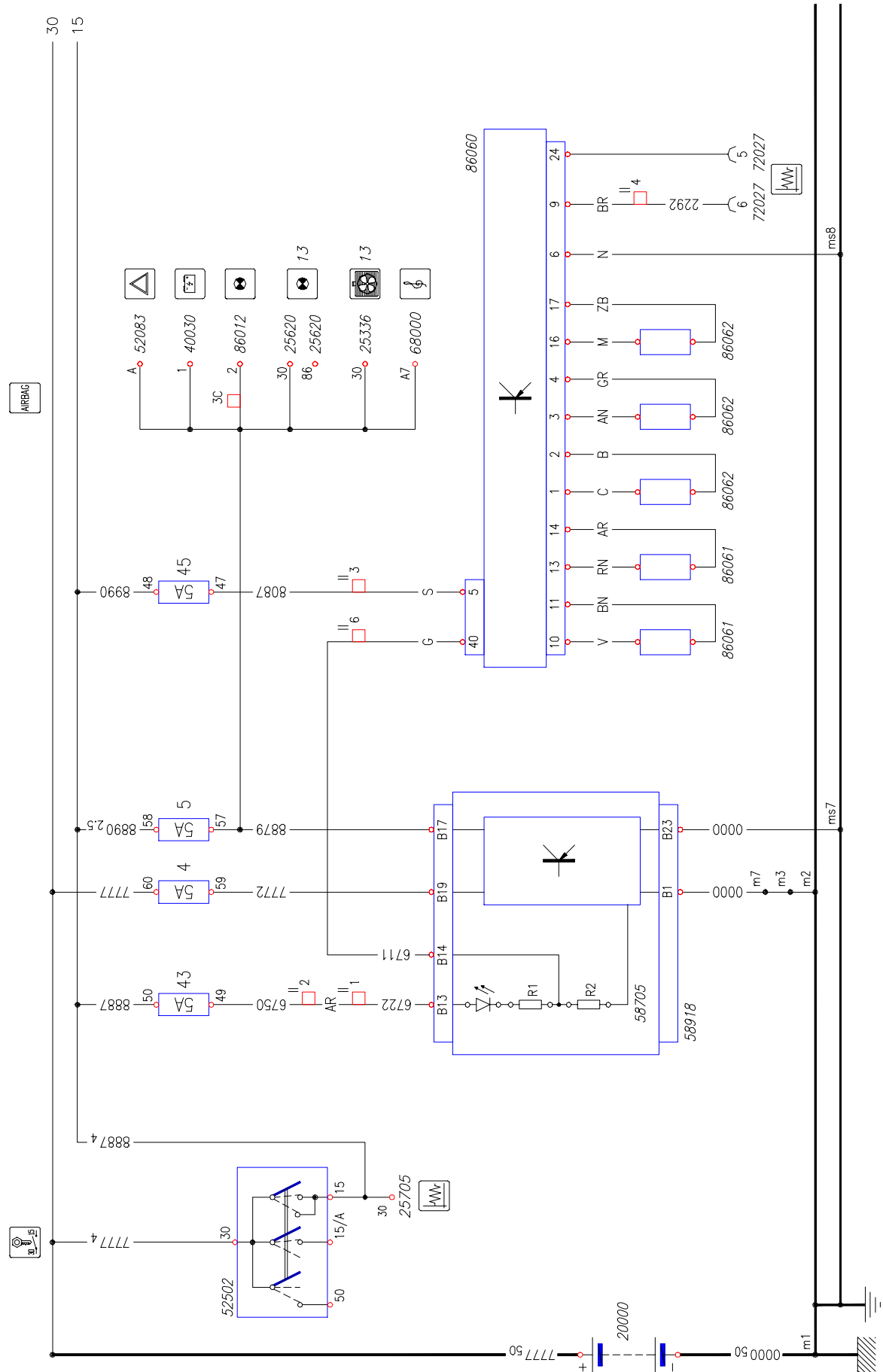
74265

Chart 35F: Automatic air conditioning (.10 – .12 – .14 – .17 – EDC16)



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Chart 37A: Air bag and pre-tensioners / OPT 4495 – 4496

49885

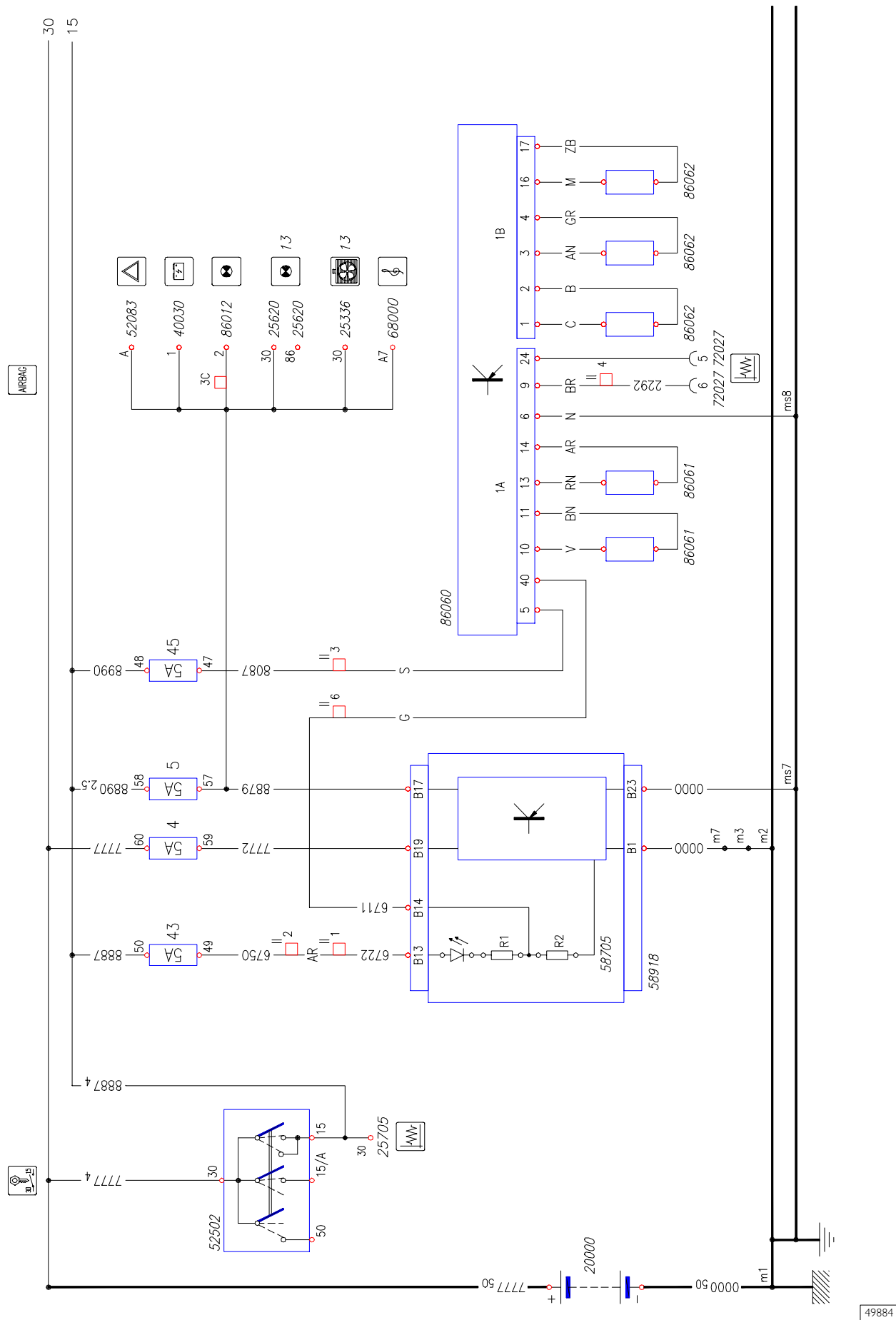
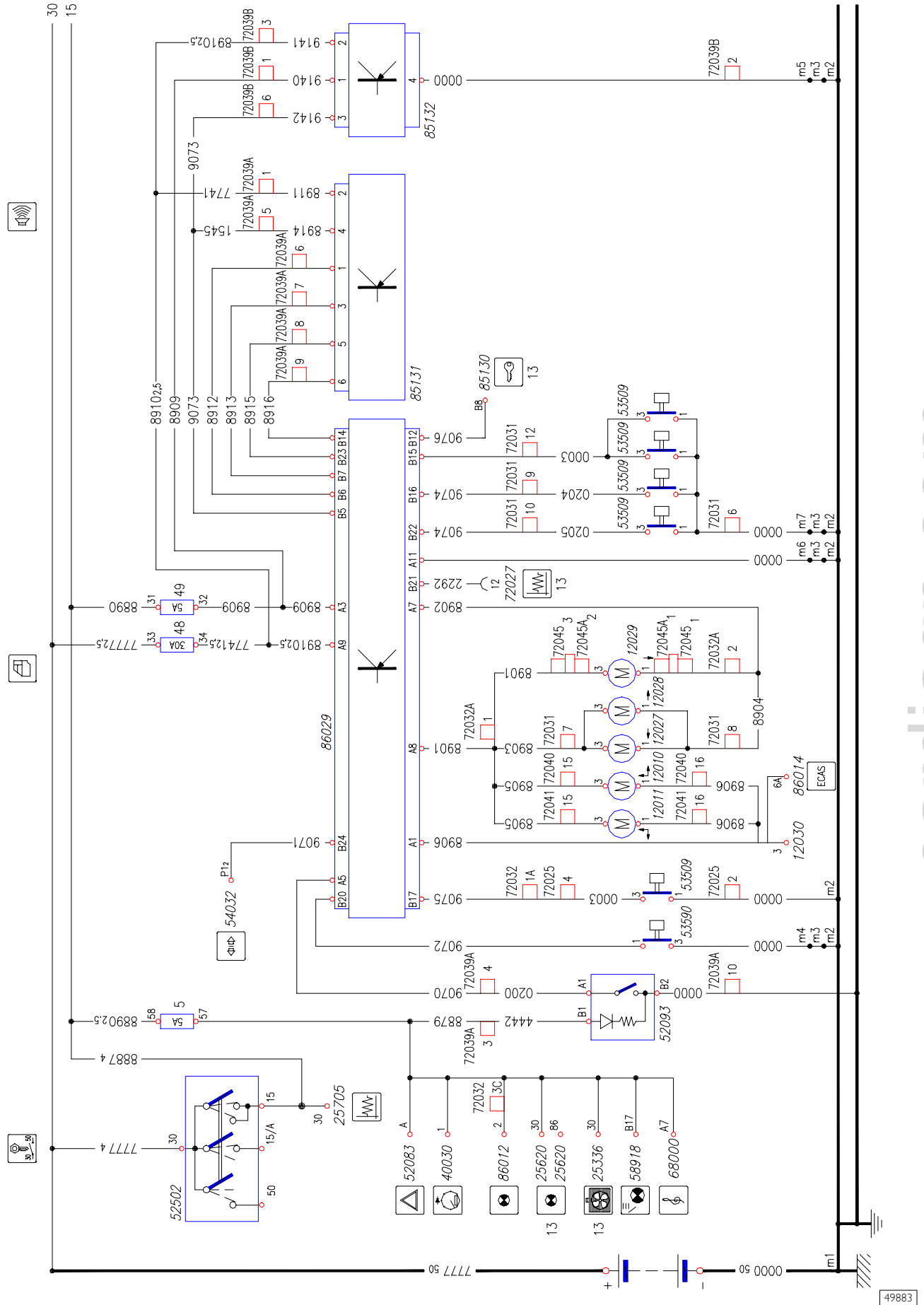
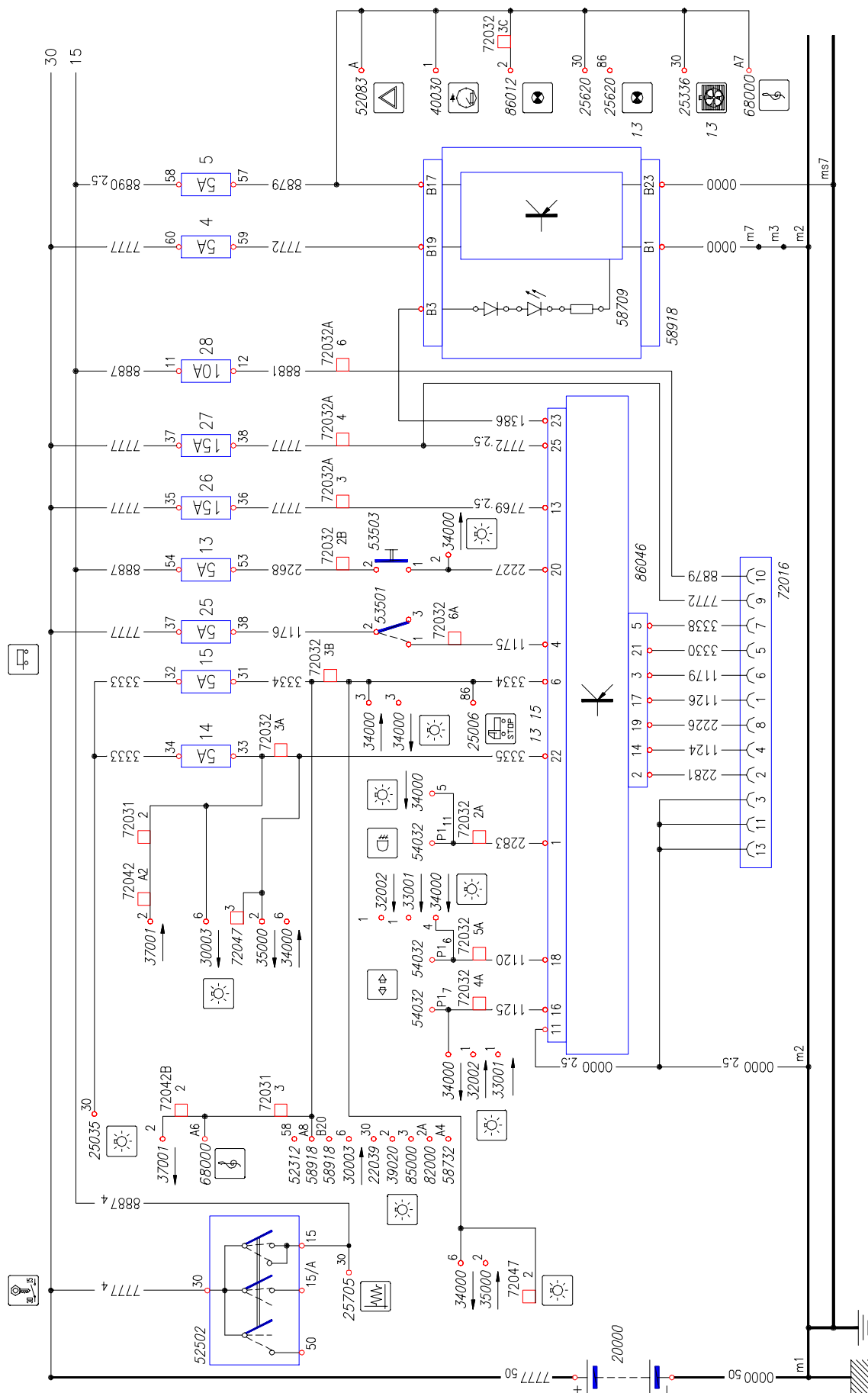
Chart 37B: Air bag and pretensioners

Chart 38: Door lock with anti-theft / OPT 6890

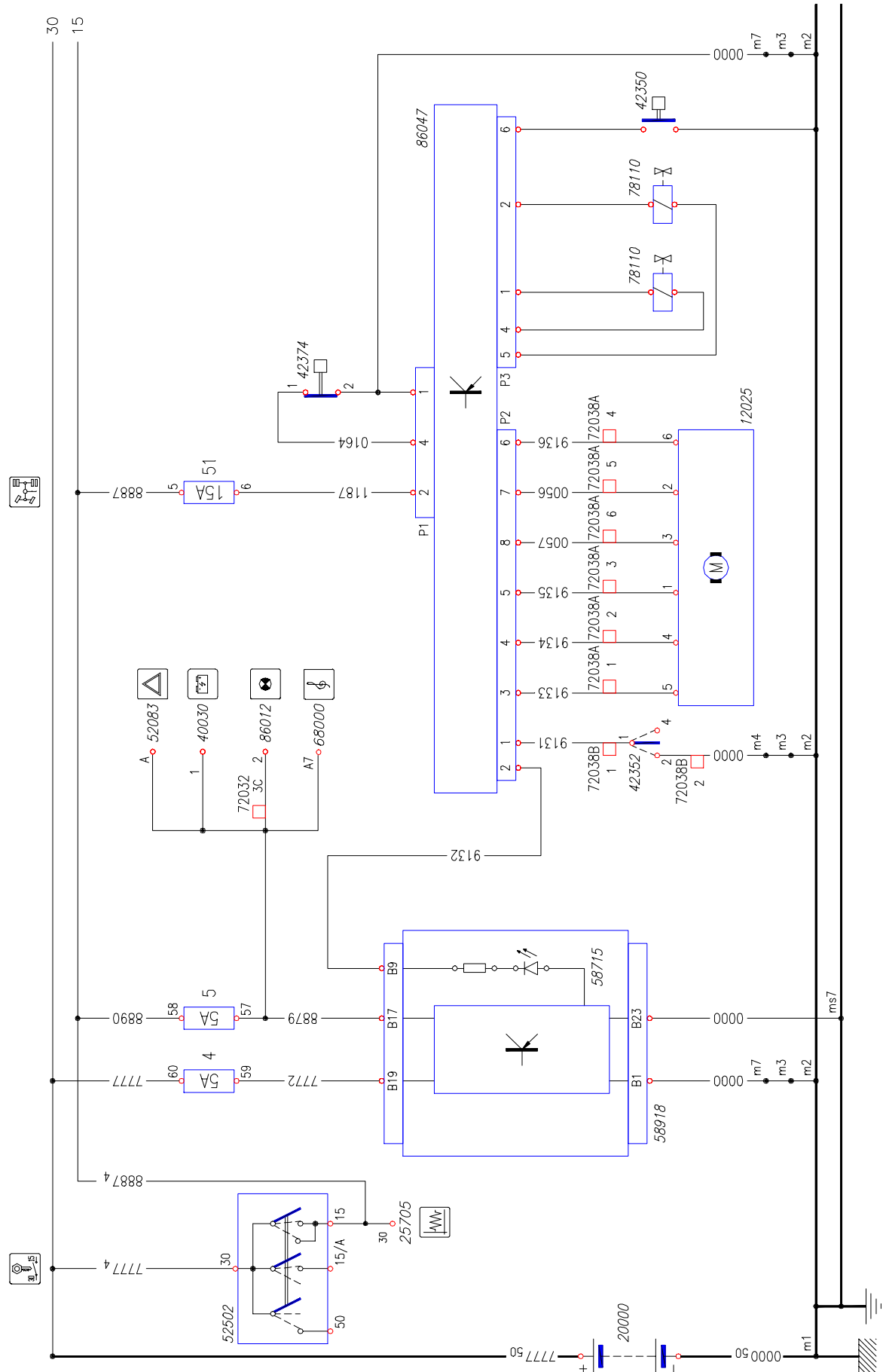
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Chart 40: 13-pole power connection / OPT 6520

49880

Chart 41A: Total PTO (.9 - .11)



49879

Chart 41C: Total PTO (EDC 16)

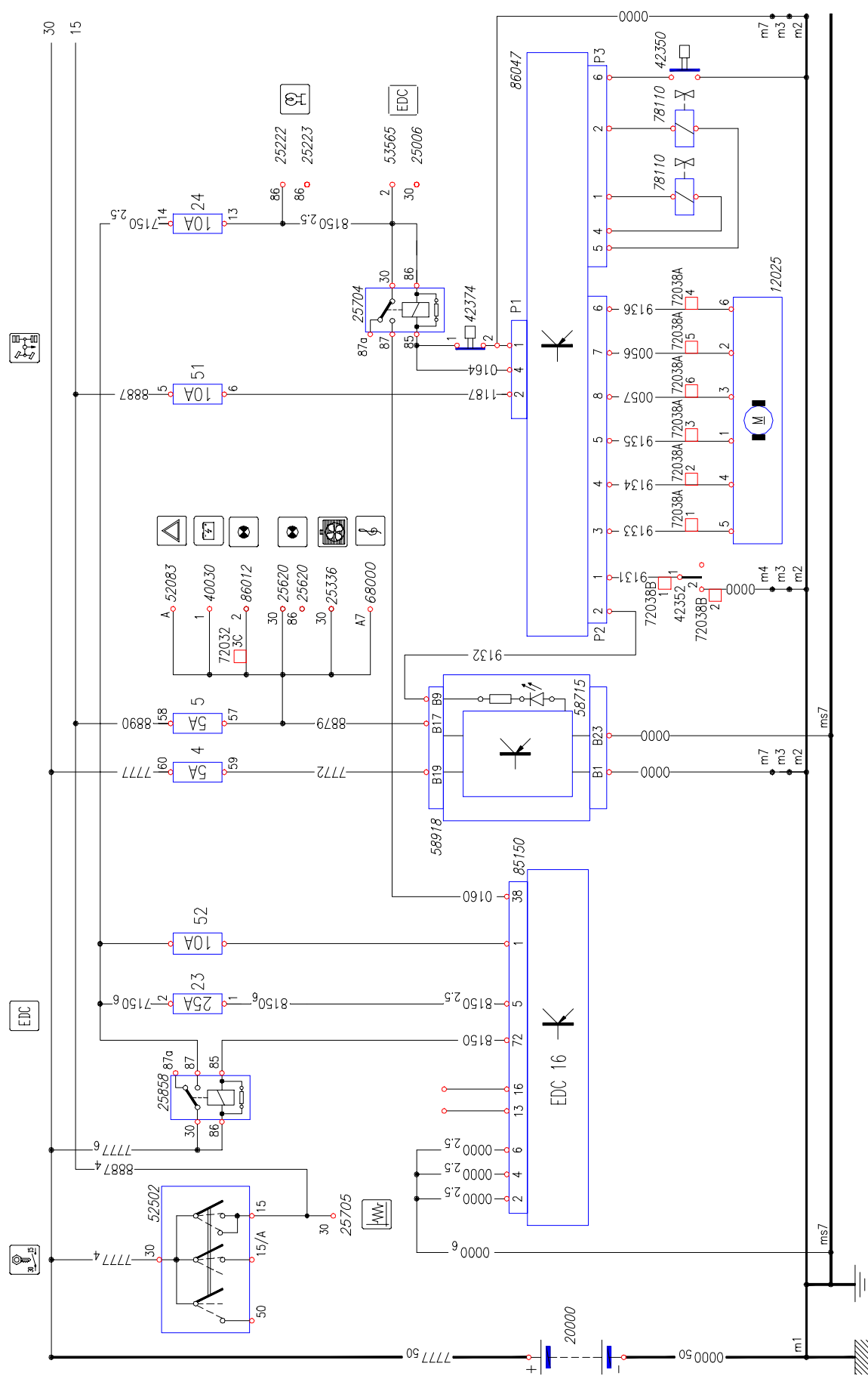
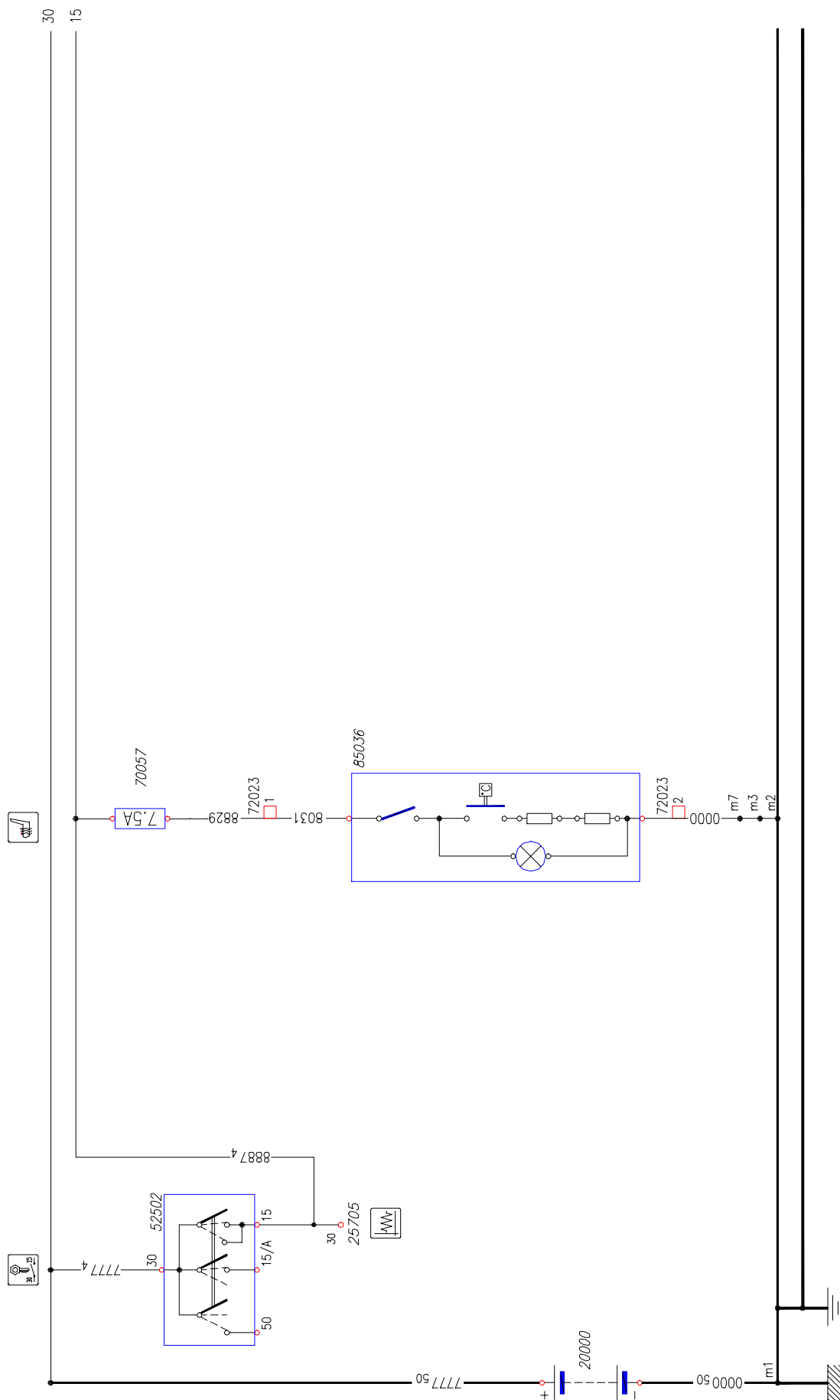
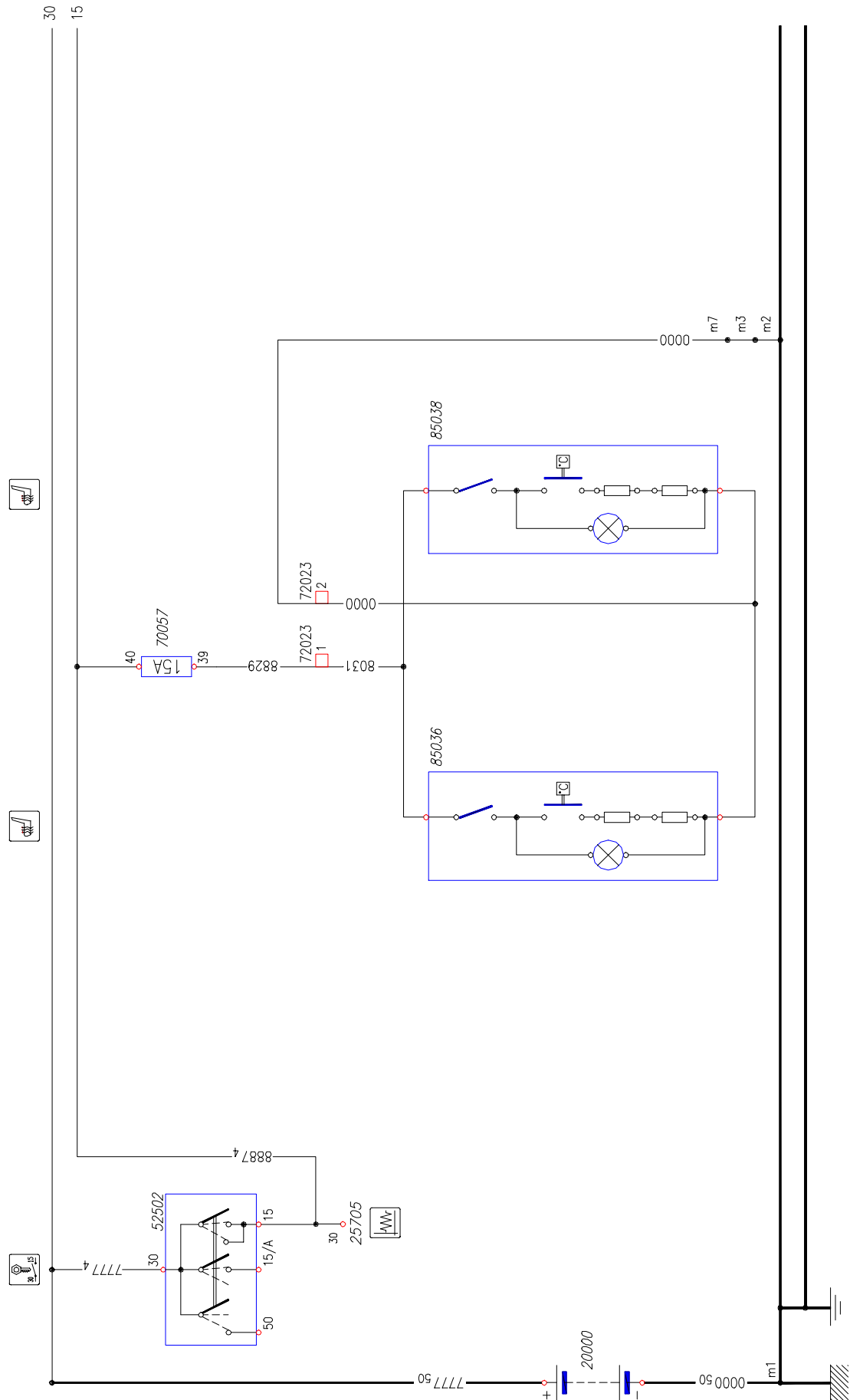


Chart 42A: Heated operator seat bus version / OPT 6628

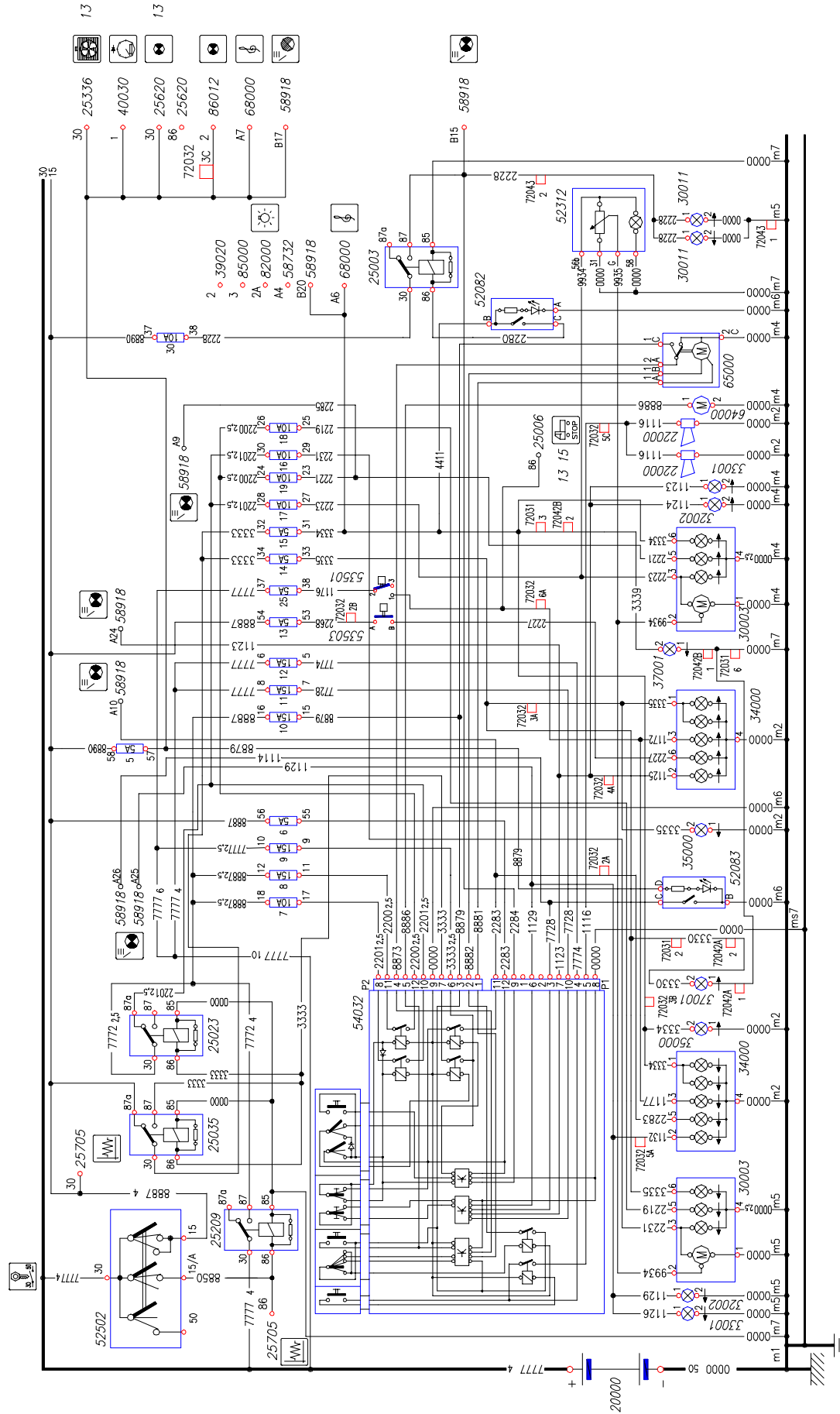


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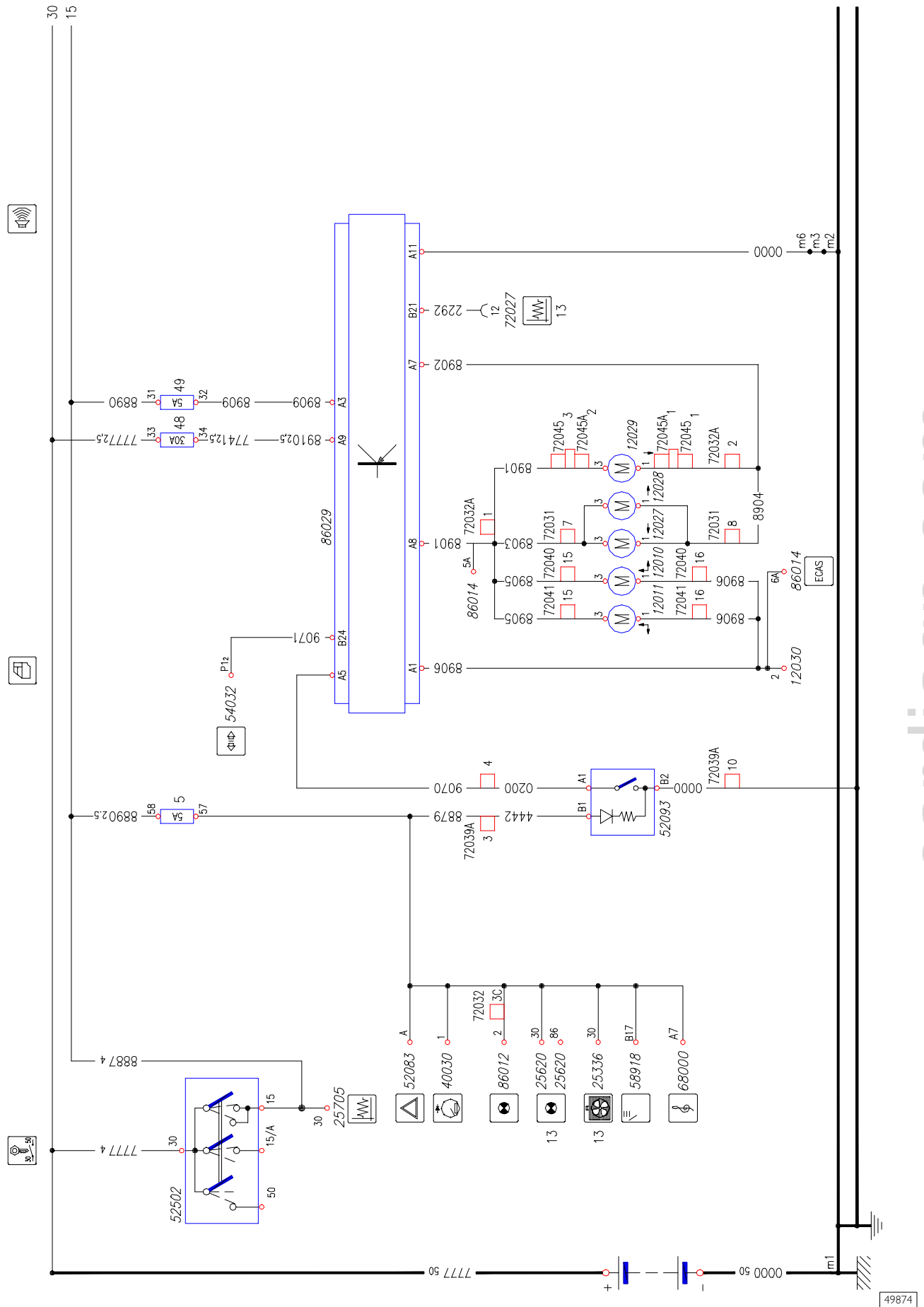
Chart 42B: Heated seats / OPT 6644

49876

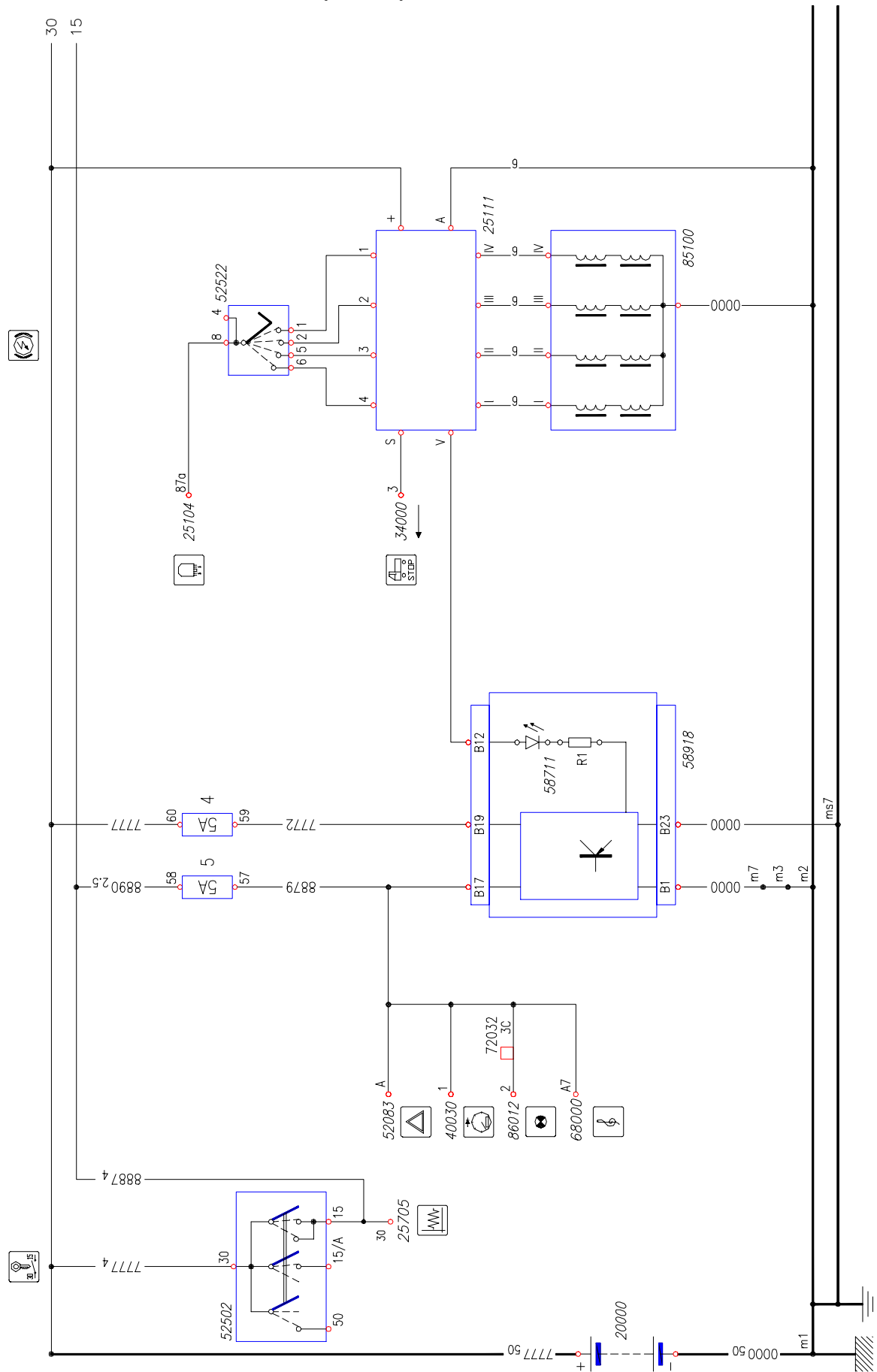
Chart 43: Day lights for Northern Europe vehicles / OPT 2536



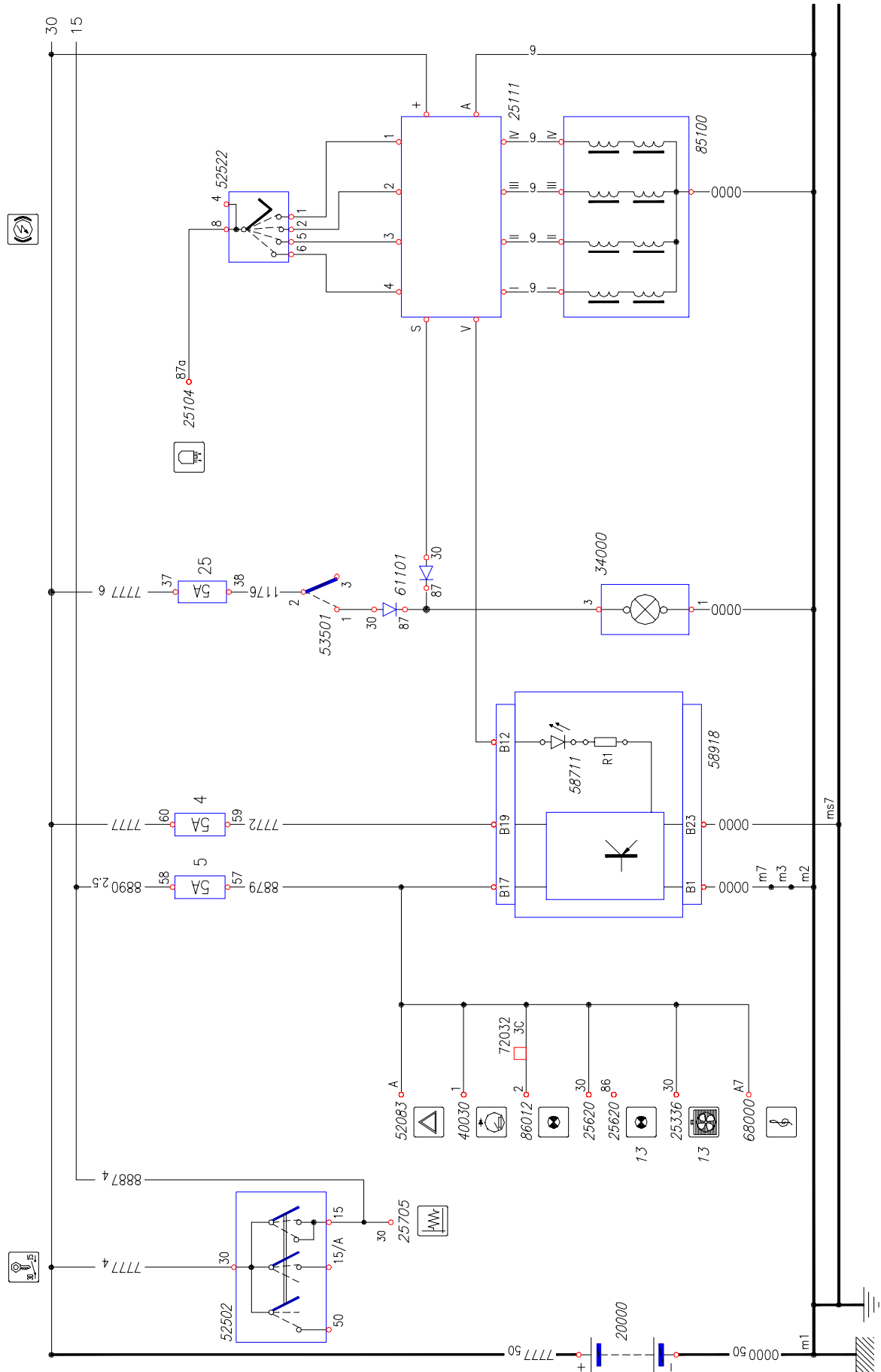
49875

Chart 44: Door lock / OPT 6536

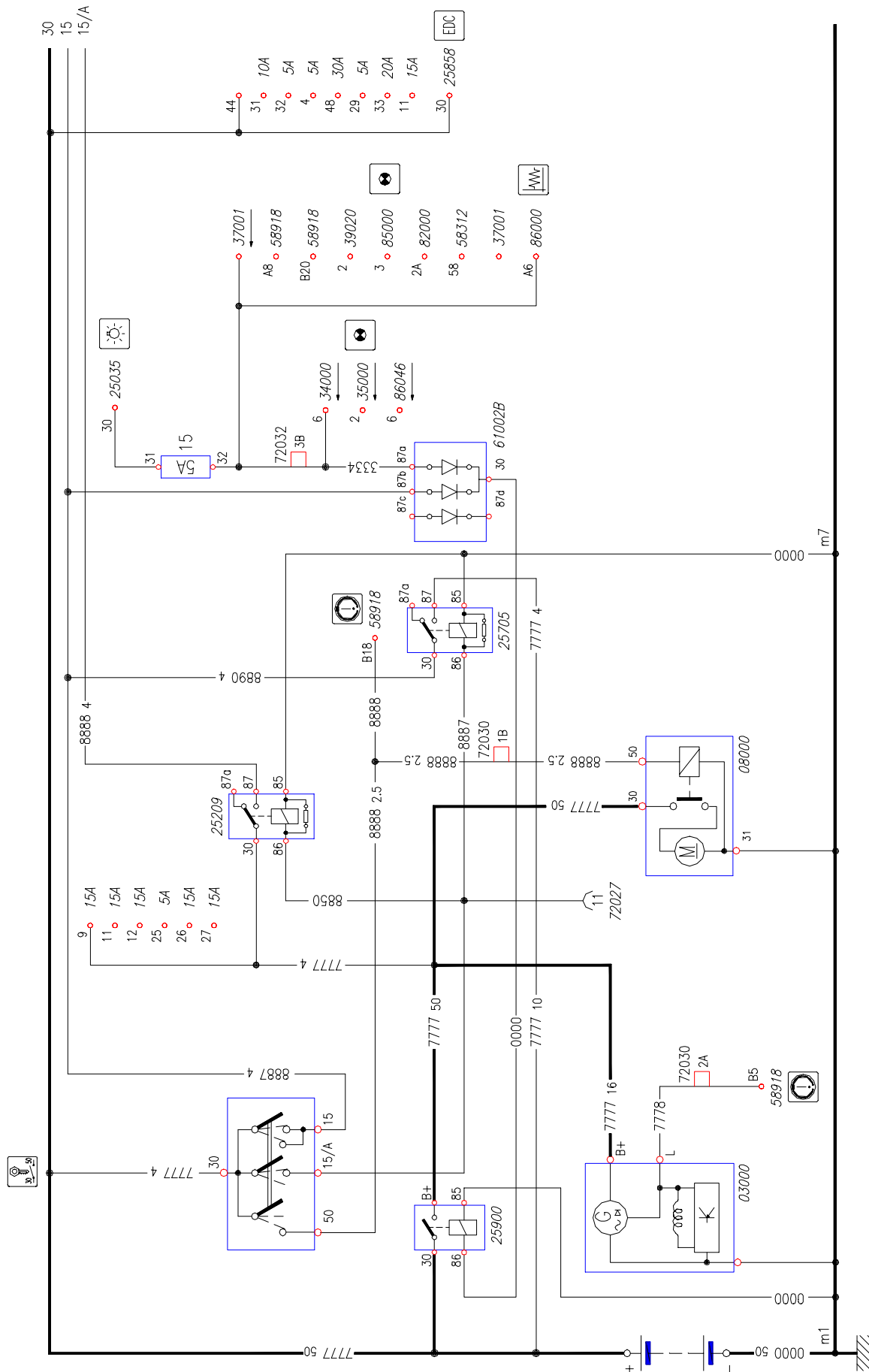
49874

Chart 45A: Telma Scudati retarder (.9 – .11) / OPT 235

49873

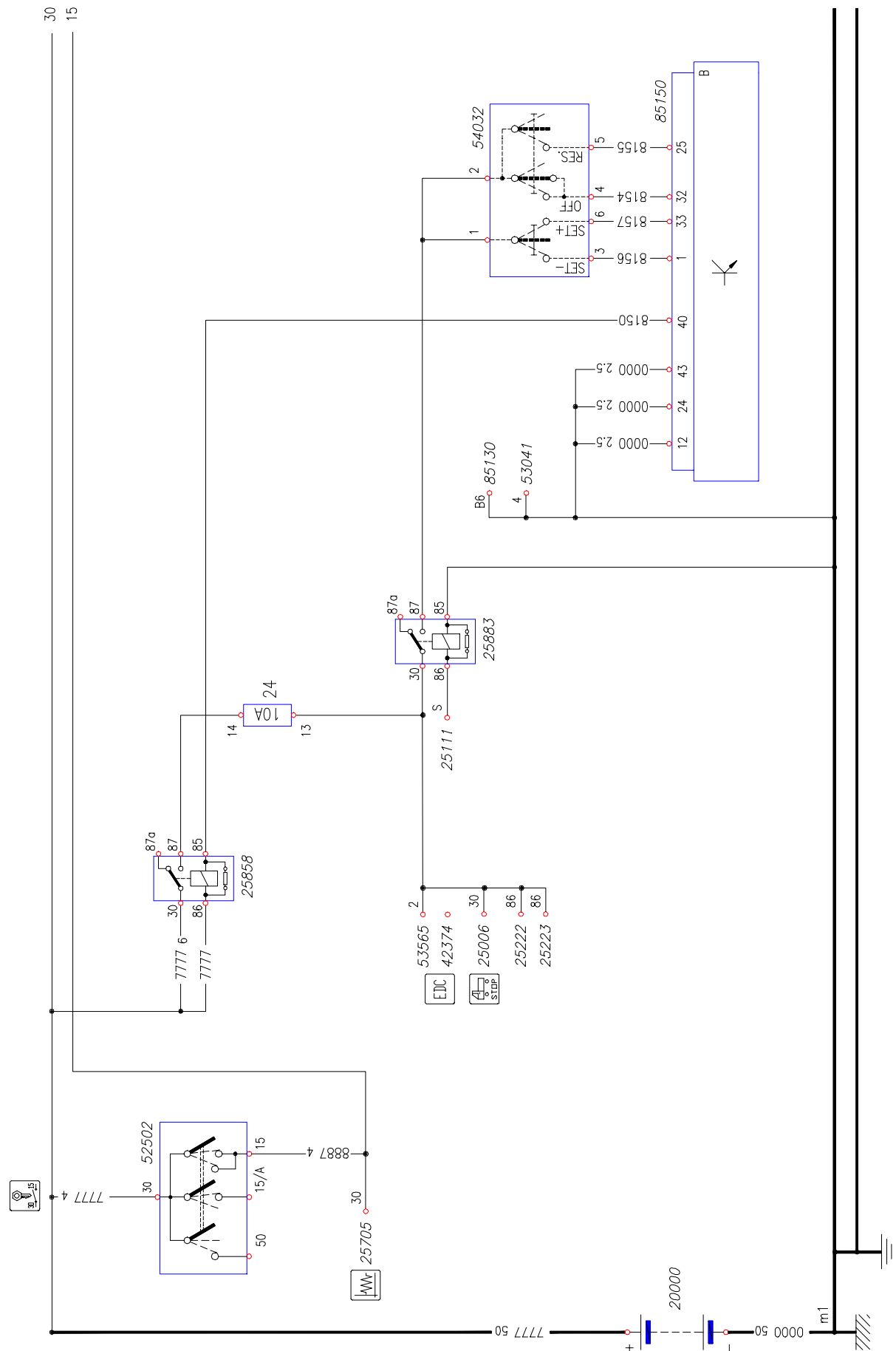
Chart 45B: Telma retarder (.10 – .12 – .13 – .15) / OPT 235

49872

Chart 46: Electrical battery sectioner / OPT 2532

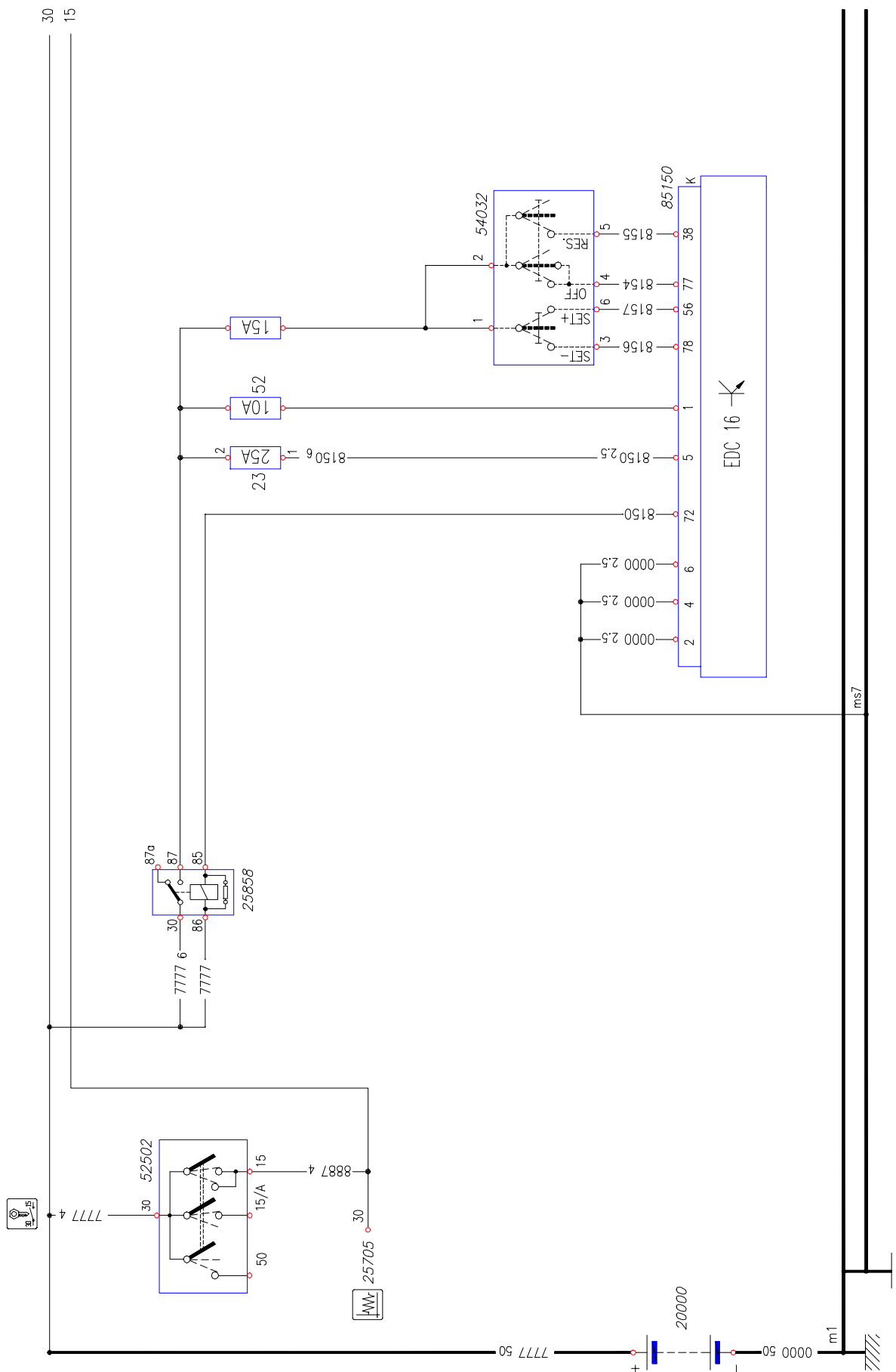
49871

Chart 47A: Cruise Control



49870

Chart 47B: Cruise Control (EDC 16)



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Chart 49: Electrical control sliding side door

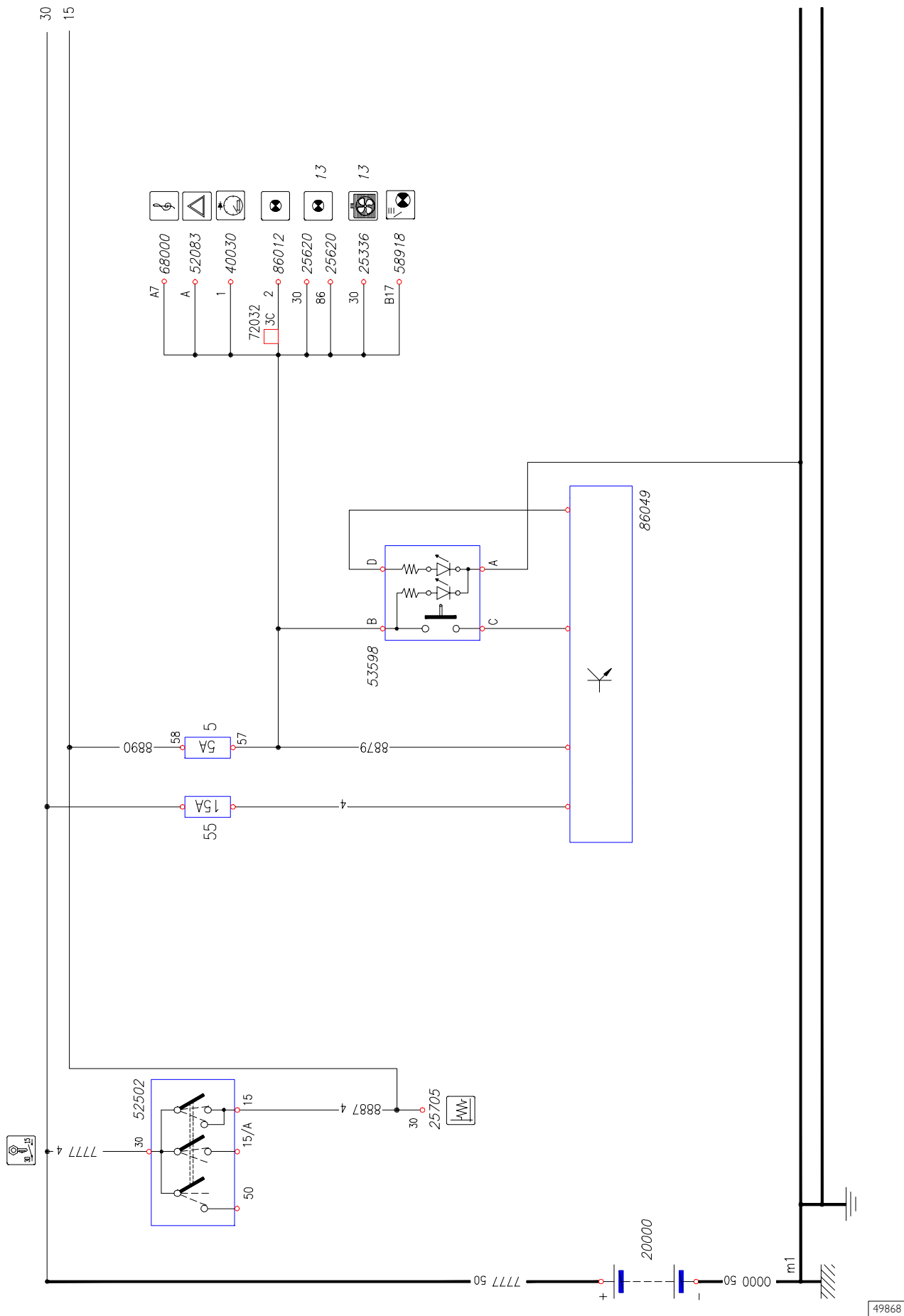
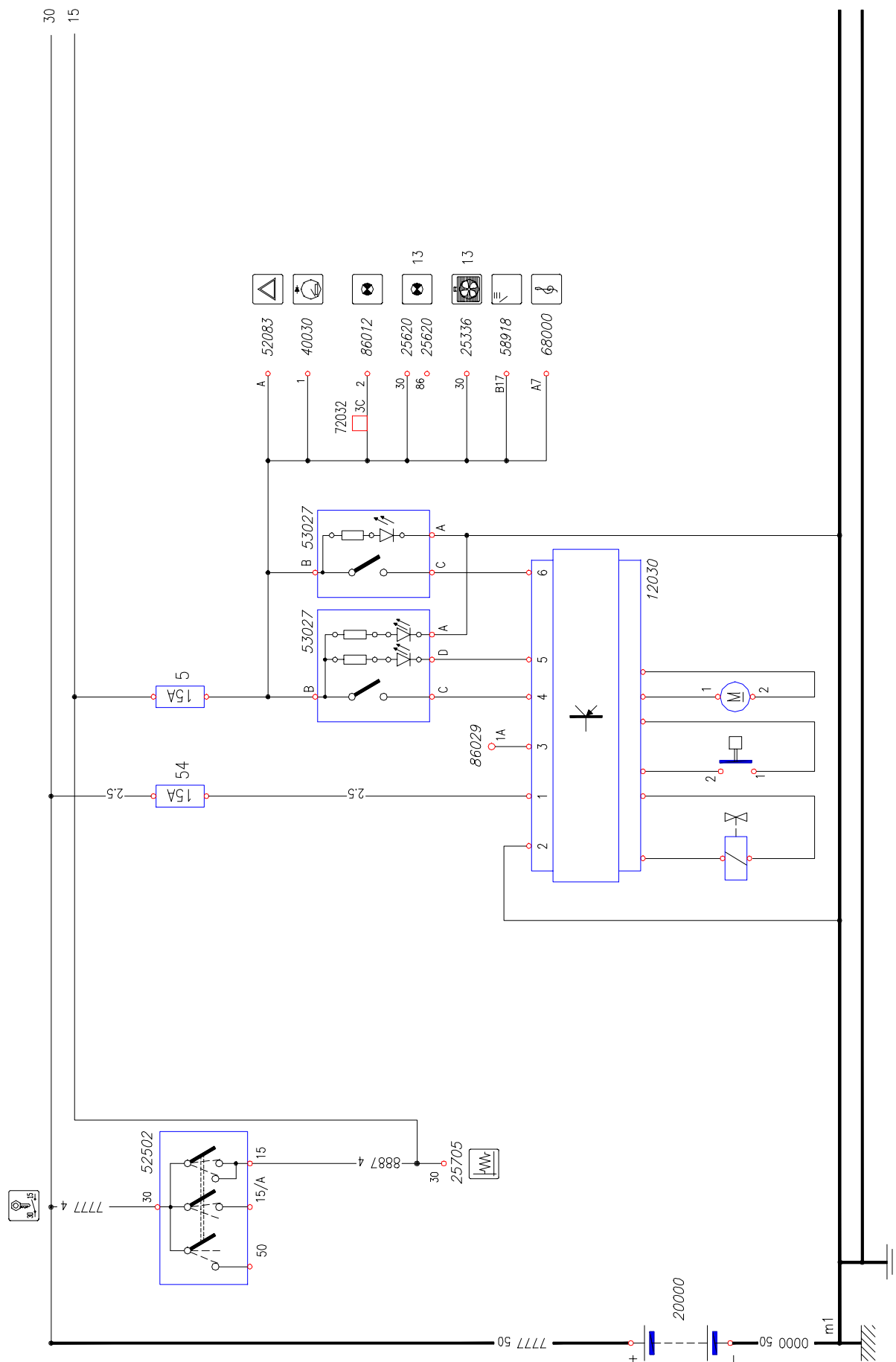
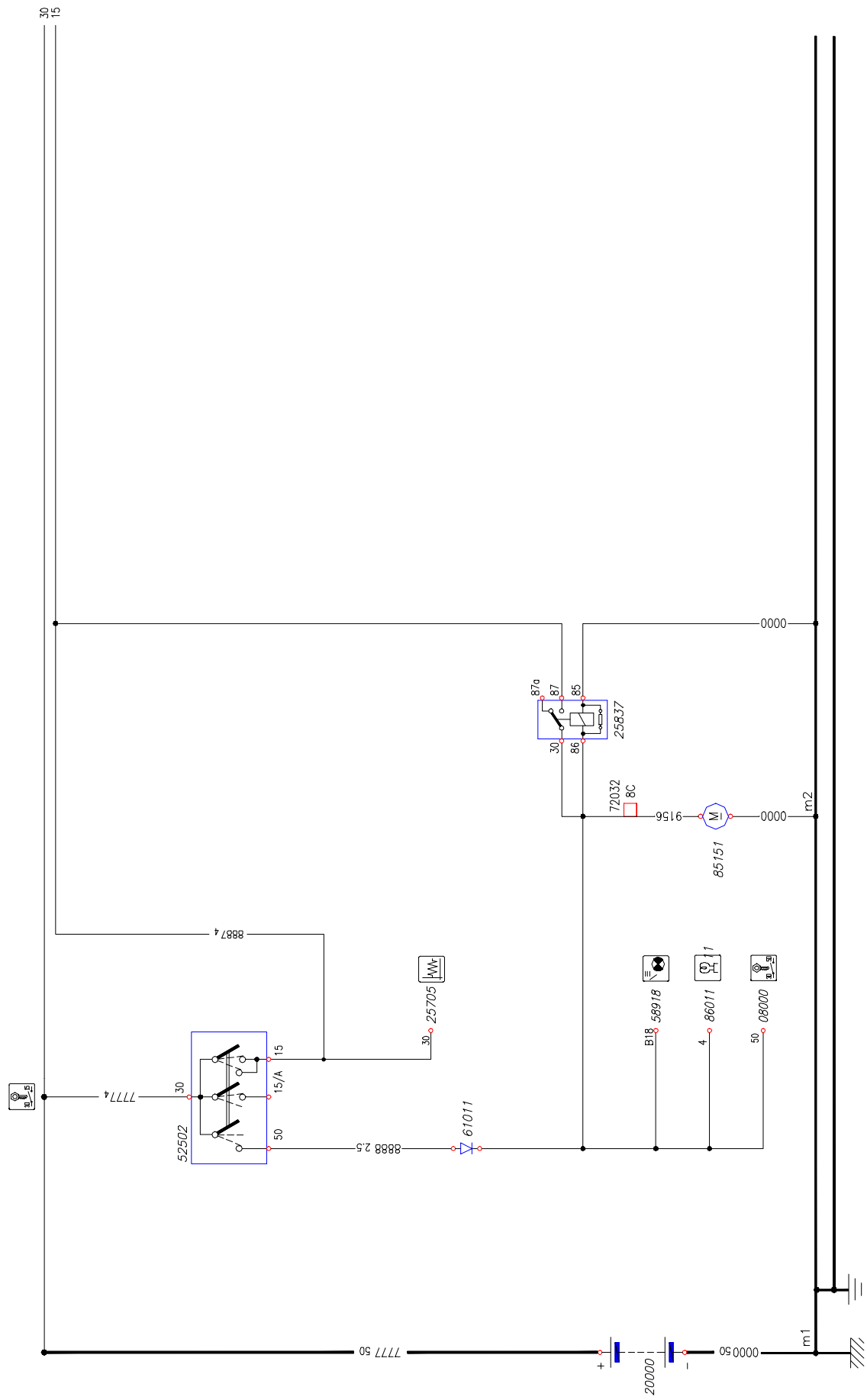


Chart 51: Electrical pit on pavilion / OPT 640



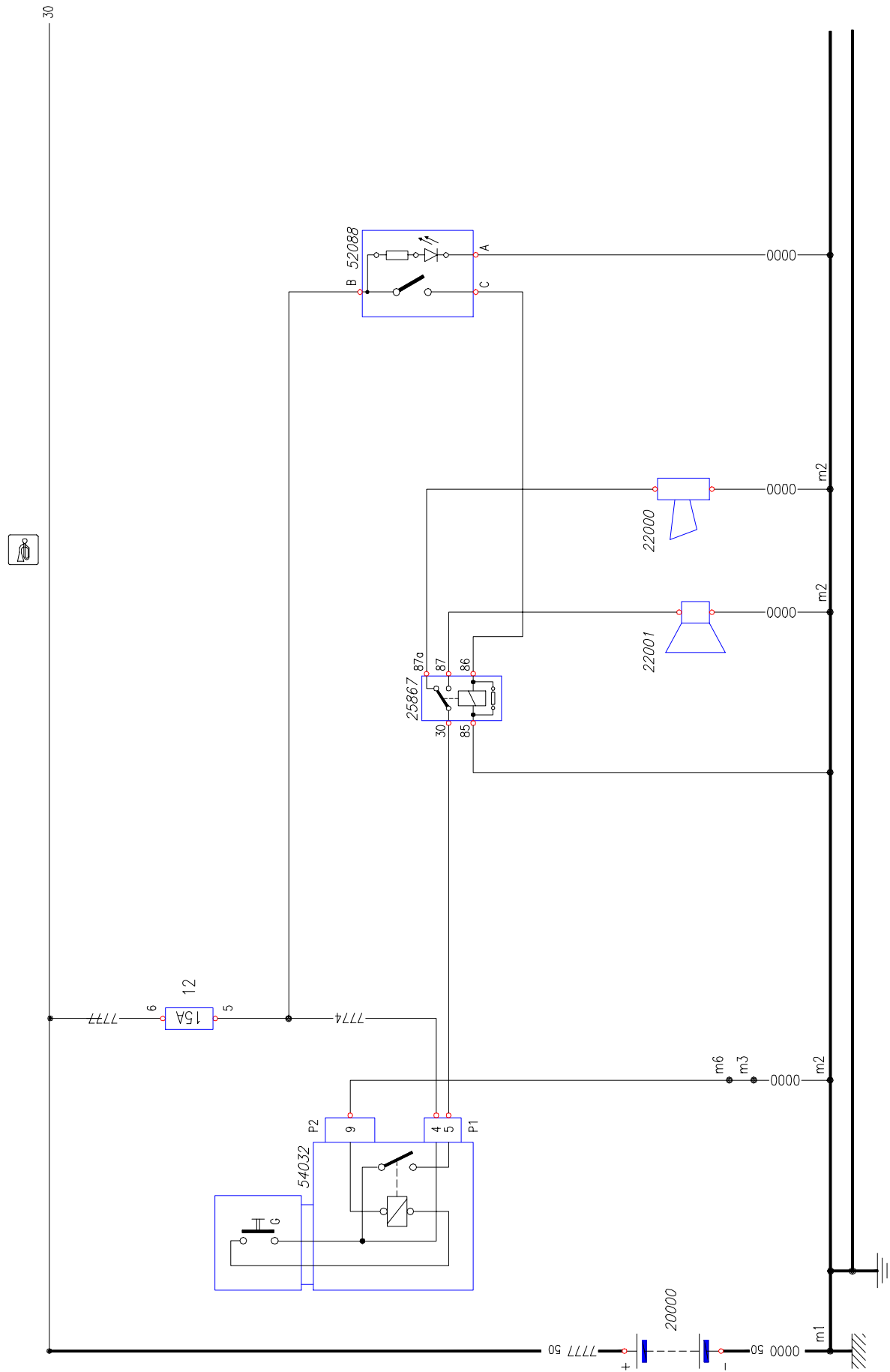
49866

Chart 53: System for North Africa vehicles



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Chart 54: System for bus vehicles with 2-tone horn

49863

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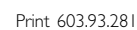


Chart 56: ABS 8

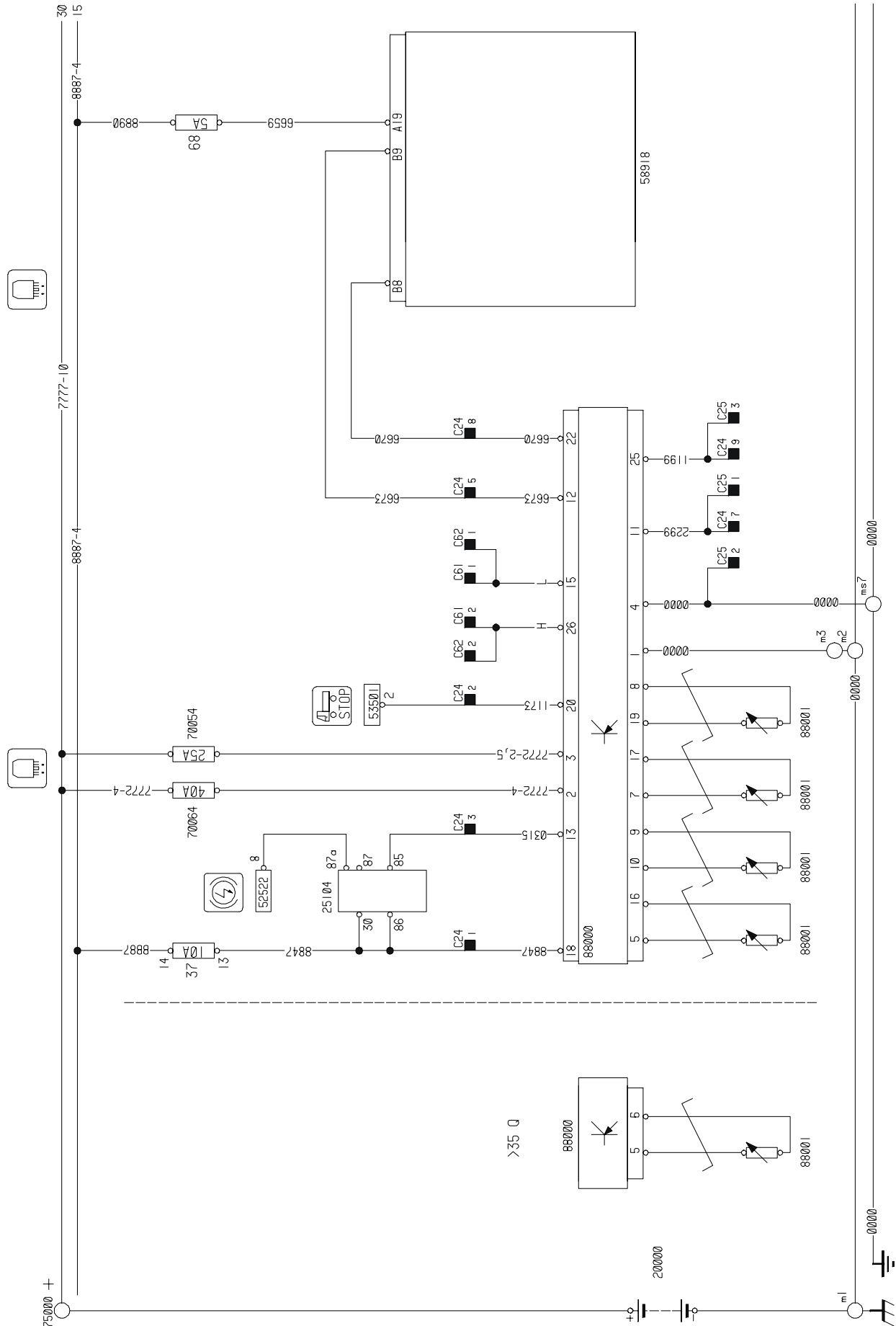
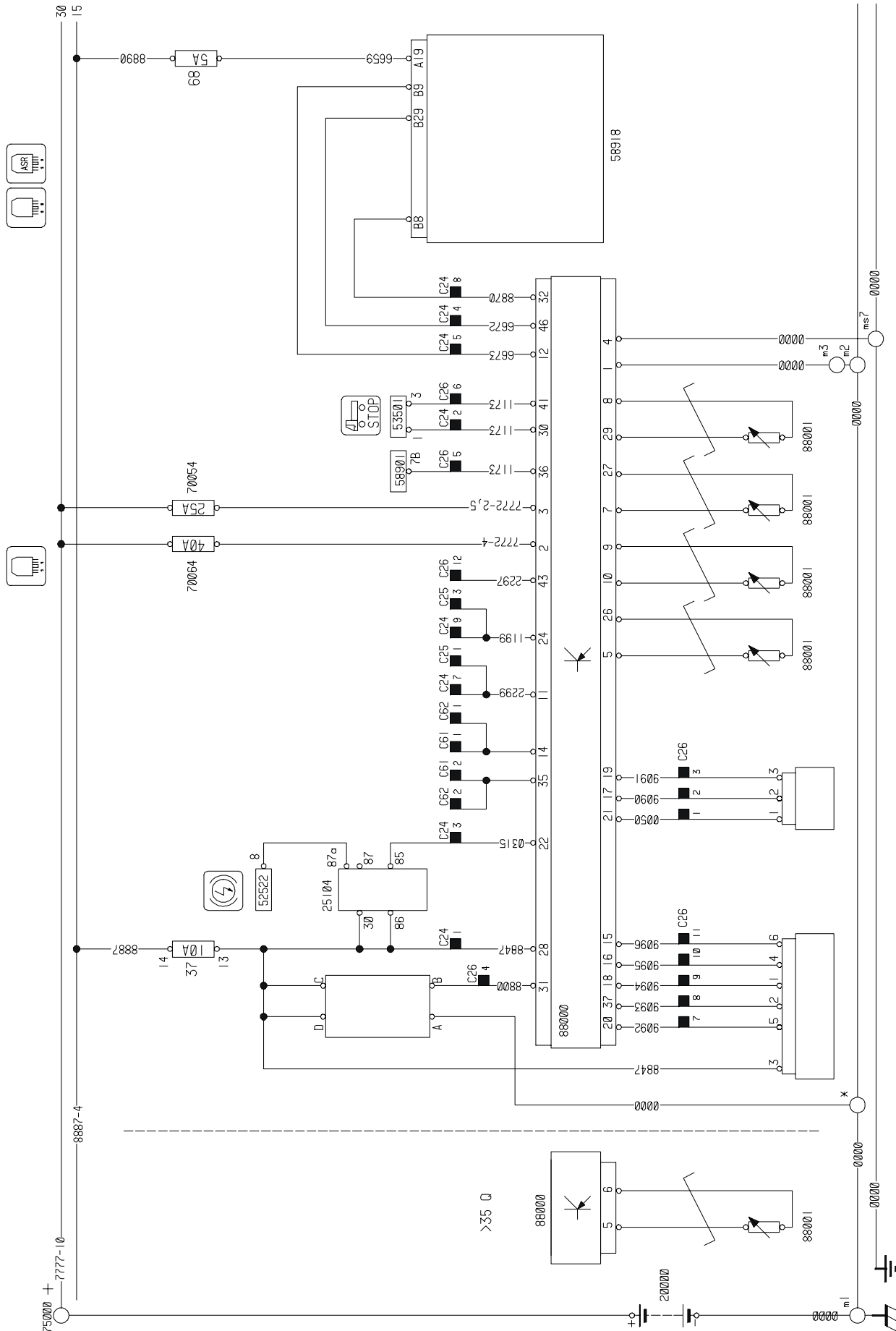
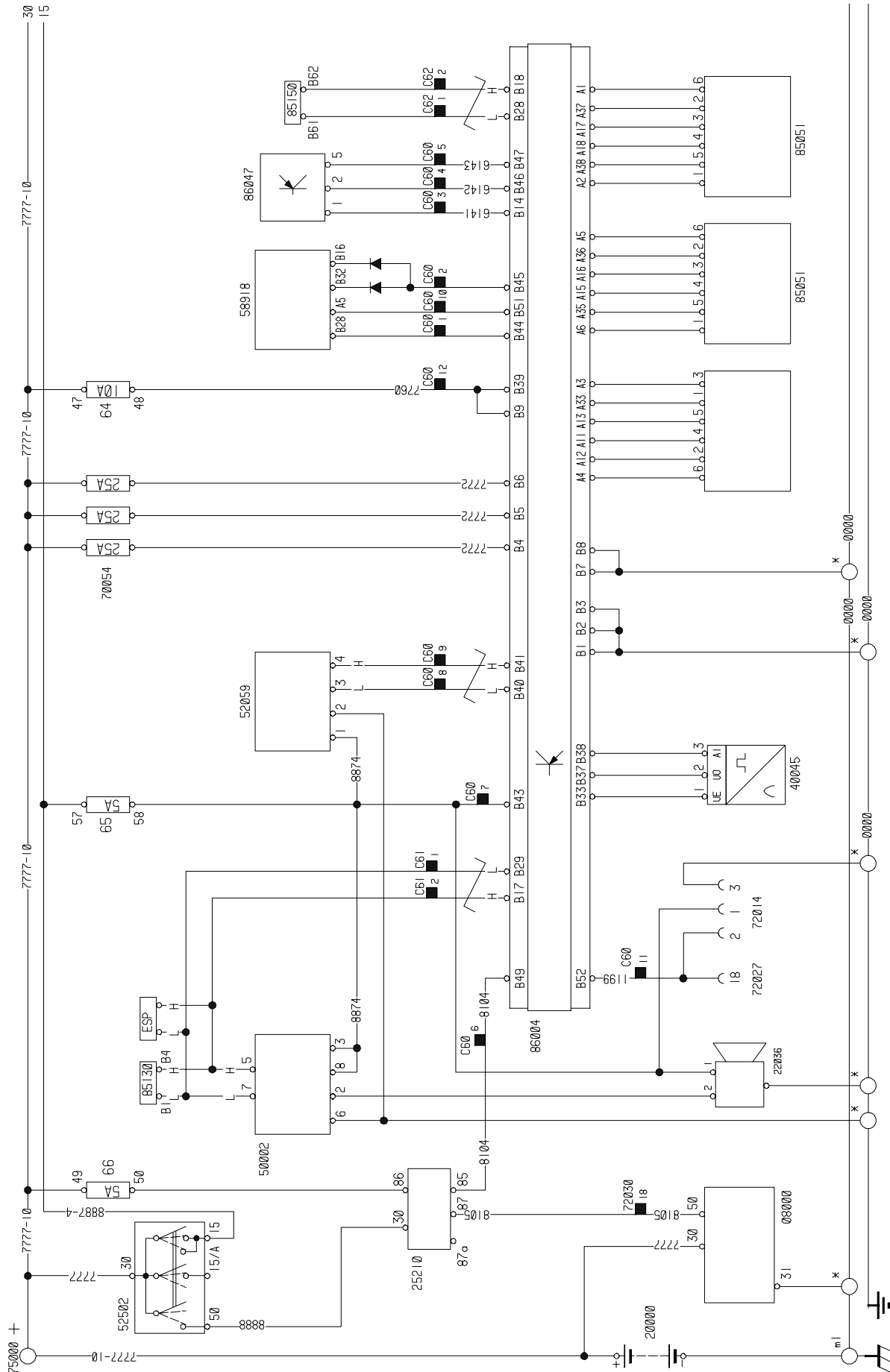


Chart 57: ESP8



101884

Card 58: 6 AS 300 VD automatic gearbox

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