SECTION 14

7600 Electric/Electronic system

ABBREVIATIONS AND GRAPHIC SYMBOLS

Indicates a general warning

A — Ampere

kW — KiloWatt

NB — Note Well

m2 — Identification of an earth point

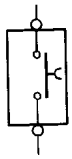
V — Volt

Ω — Ohm

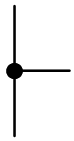
Connection to a power earth point

Connection to a signal earth point

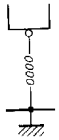
72030$_{3C}$ — Code of connector between cables:
72030 = connector code
3C = cell identification co-ordinates



Base equipment



Base electrical connection

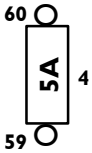


Connection to earth by cable

II$_6$ — 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

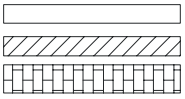
Electronic component or control unit

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 WARNINGS

General conditions for laying electric circuits

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

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 °^{0}C (drying ovens) remove the electronic control units
- ❑ During electric welding work disconnect the connectors of electronic control units.

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.

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.

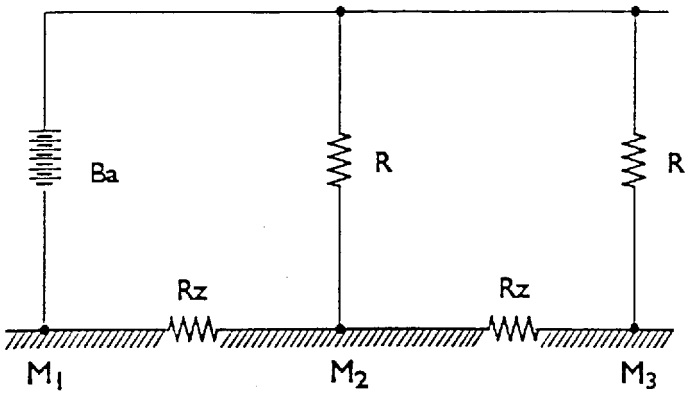
For the above-mentioned reasons it is necessary to distinguish the **supply earth** or system earth, characterised by strong direct current intensity (> 1 A for electromechanical components), from the **analogue earth**, characterised by wave shapes at determinate frequencies and very low current intensity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



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EARTH NETWORK
Ba. Battery - R. Loads - Rz. Frame impedance - M_1, M_2, M_3. Earth

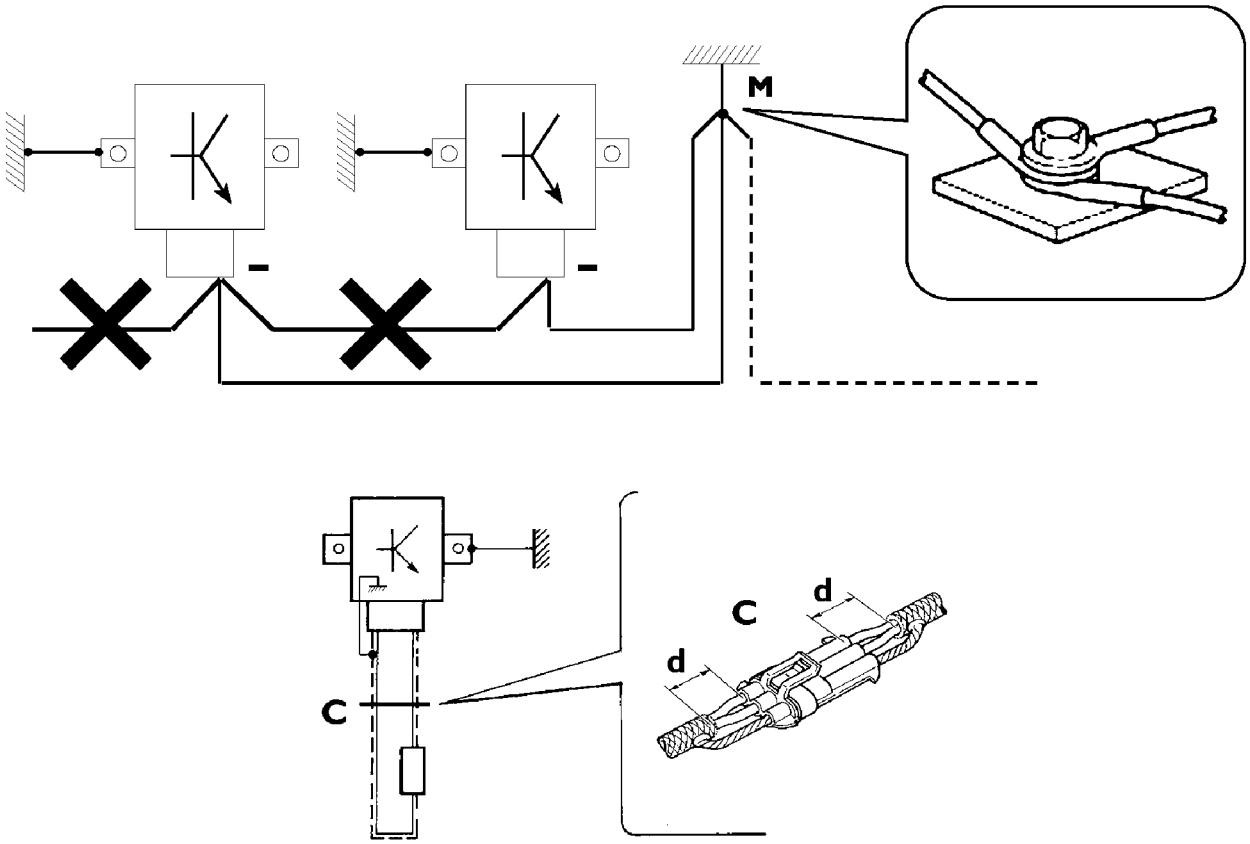
Practical advice

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 jointing 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 2



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.

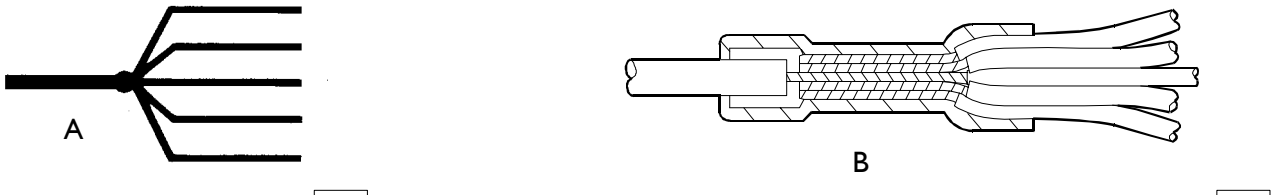
Generally, the cables of the components converge on one side in the different welding points, while on the other only one cable connects them with the earth or supply.

It is also possible to have several welding points connected to one another in which several cables converge on both sides of the welding. In this case, the earth or supply cable will be connected to the last weld of the series.

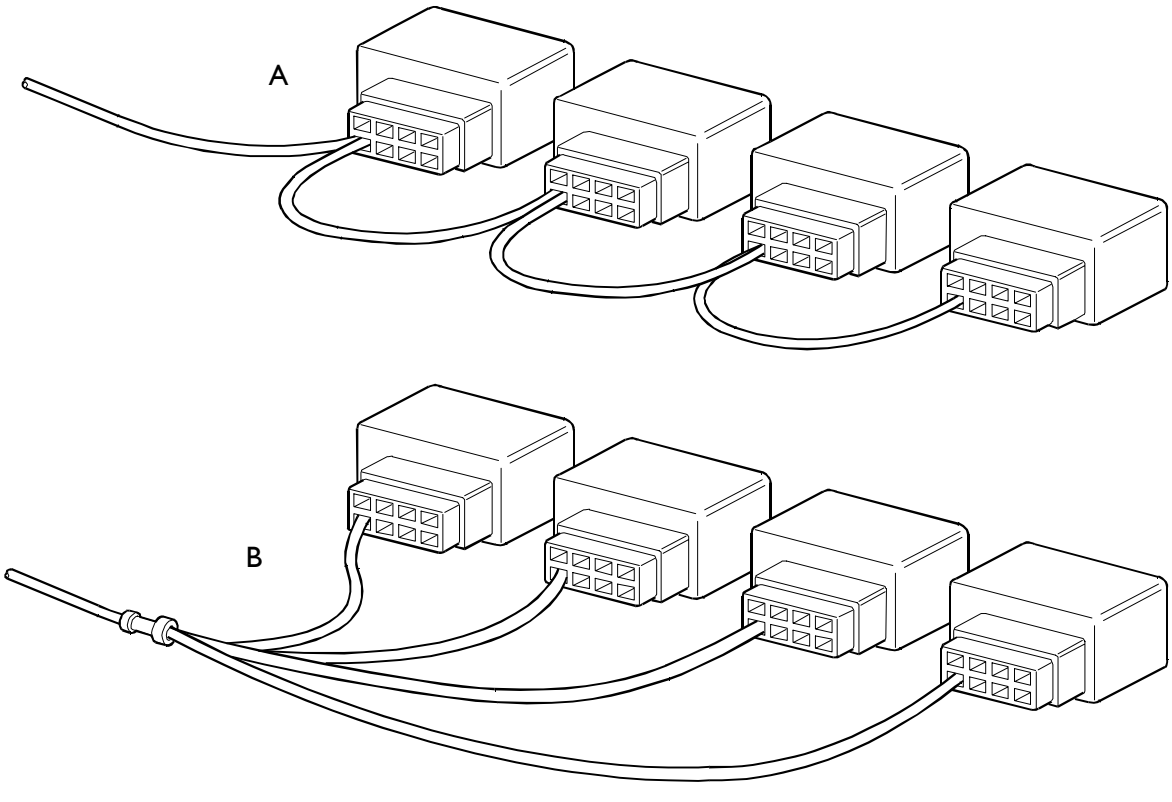
Ultrasonic welding brings considerable advantages, including:

- 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 3



ULTRASONIC WELDING
A. Wiring diagram - B. Technical layout



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

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

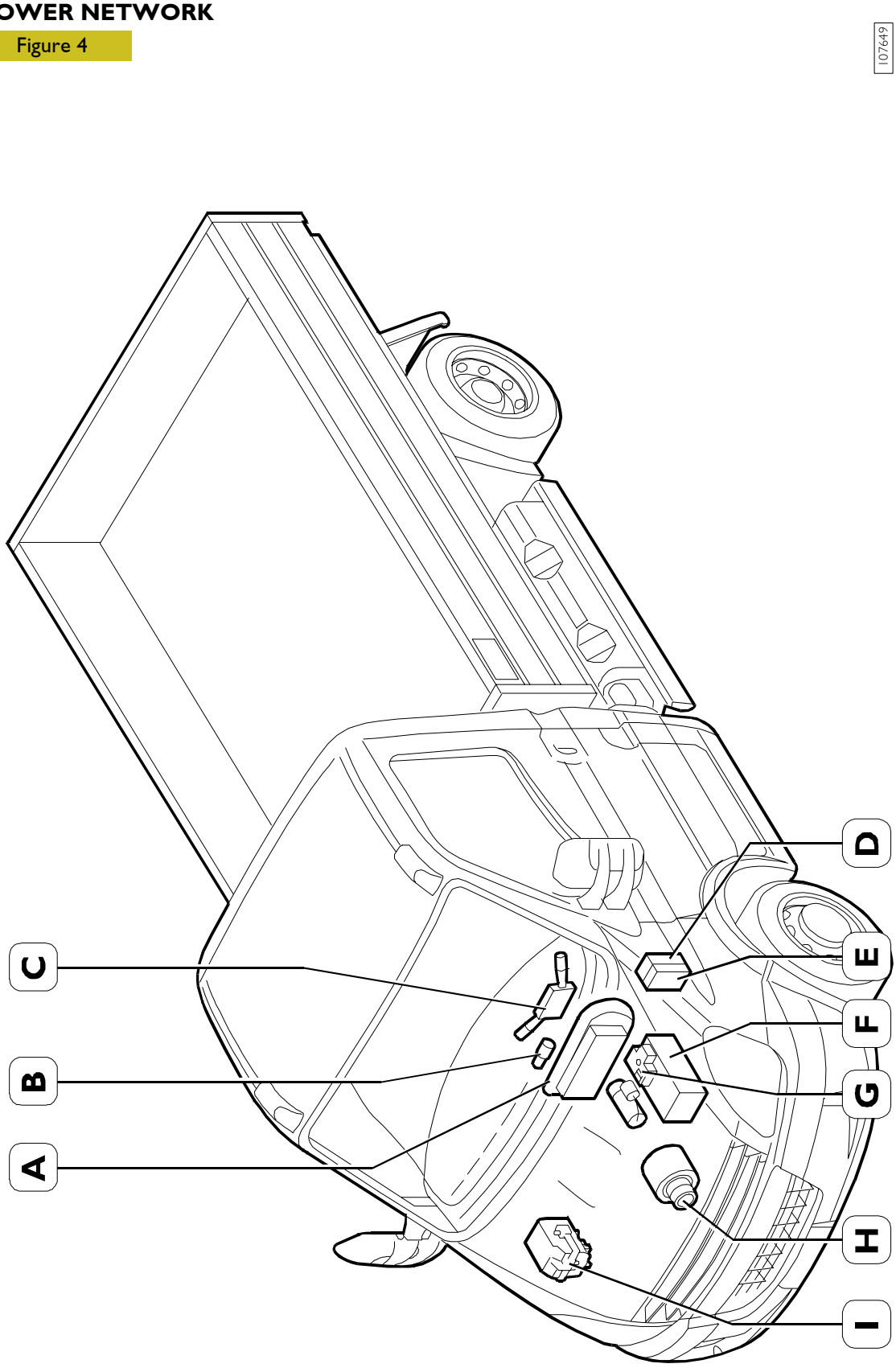
39025	Lamp for lighting rear hatch
39026	Lamp for lighting side hatch
40011	Electronic tachograph
40030	Sender unit for electronic tachometer
40031	Sender unit for electronic tachograph
40046	Inductive type chassis height sensor (rear axle)
42035	Absolute pressure sensor
42102	Switch signalling handbrake 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
68013	Monitor for controlling reverse gear
68014	Camera for controlling reverse gear
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
86***	Engine oil level control
1-2	Parking sensors (Table no. 5)
3-4	Parking sensors (Table no. 5)
*	Clutch actuator (Table no. 9A)
**	Gears engagement actuator (Table no. 9A)
**	Parking sensors central unit (Table no. 5)
***	Gearbox actuator selector (Table no. 9A)

POWER NETWORK

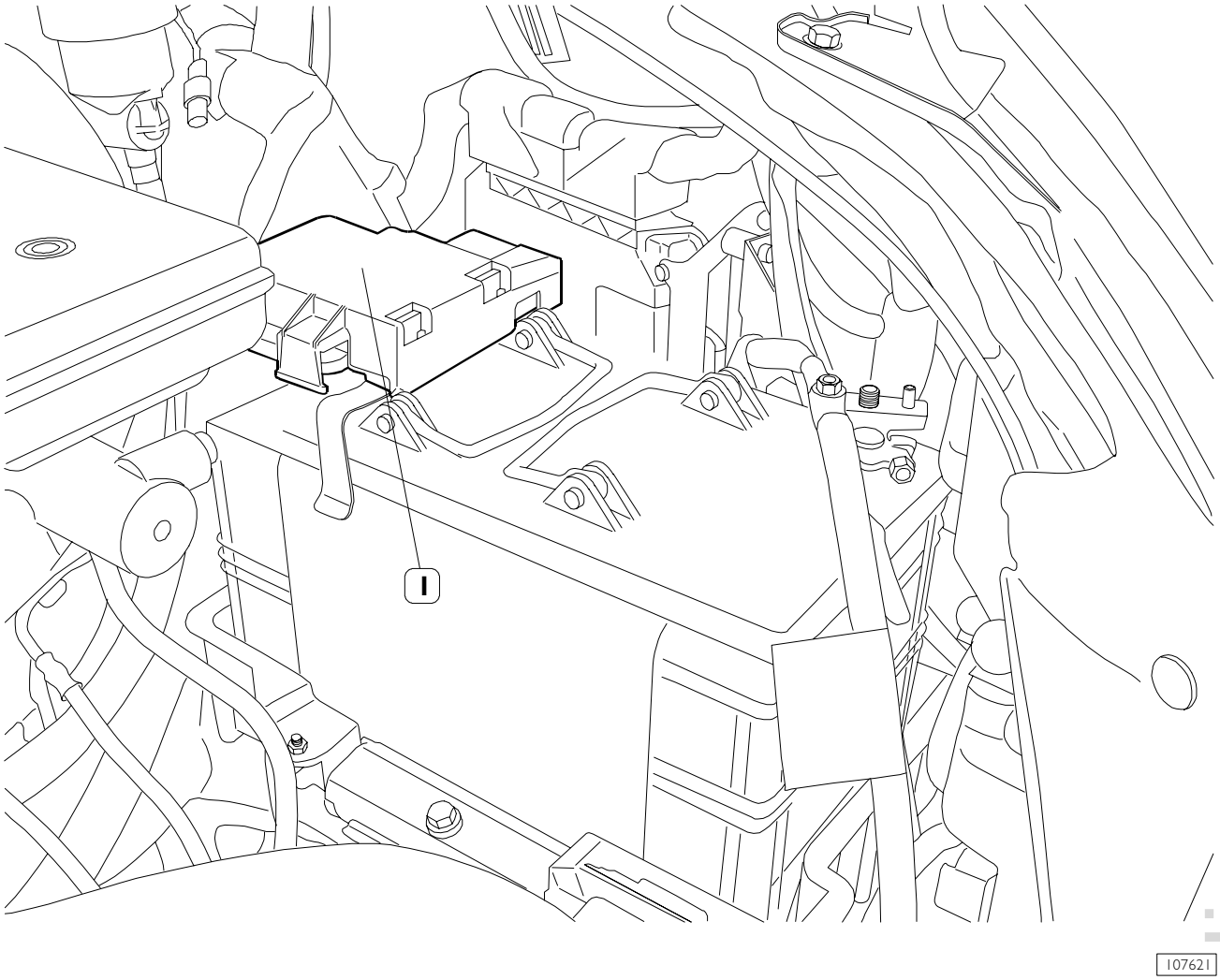
Figure 4



A. Instrument cluster - B. Key switch - C. Steering column switch unit - D. Interconnection central unit "CPL" - E. Body Computer - F. Battery - G. Positive (+30) distribution central unit "CBA" - H. Alternator - I. (Engine) interconnection central unit "CVM".

POSITIVE NETWORK (CBA)

Figure 5



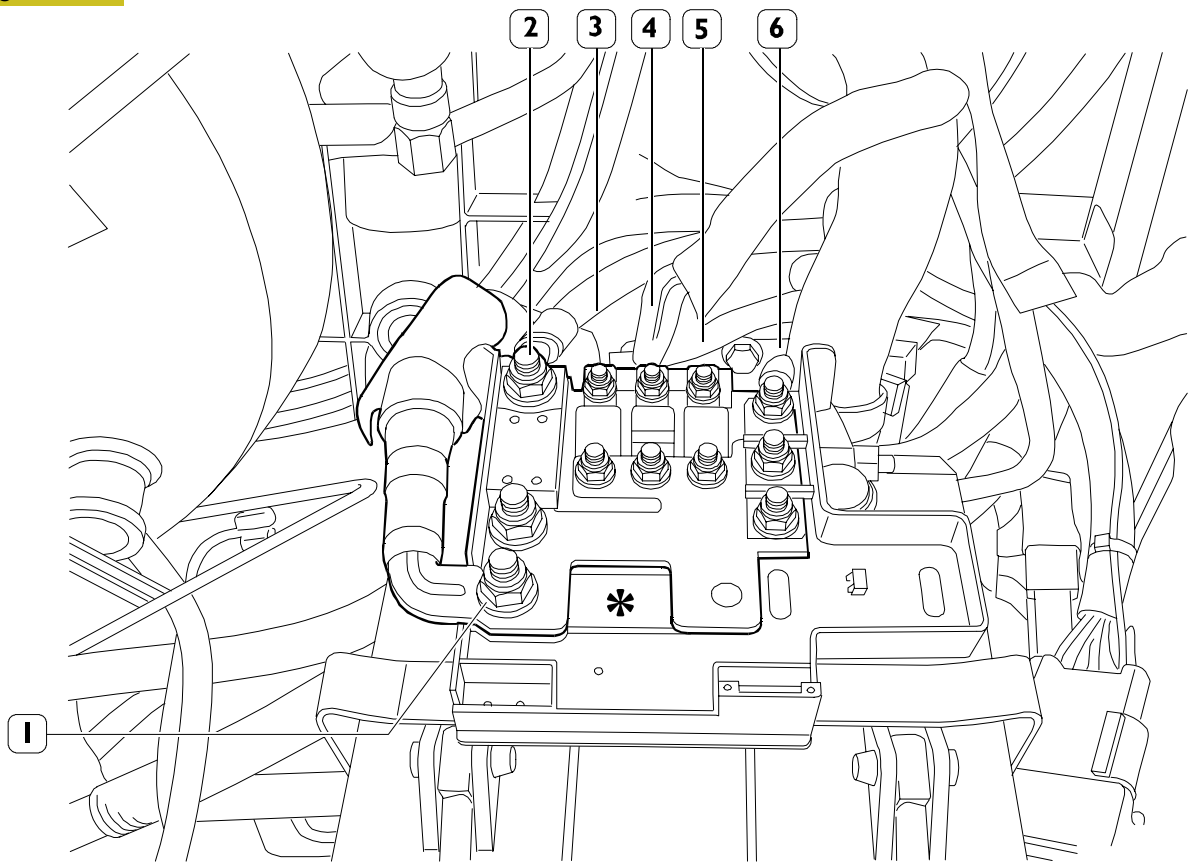
1. Positive connection central unit (CBA)

On battery terminal an interconnection central unit is positioned named "CBA". Its task is to provide + battery (+30) power supply to the different functions of the vehicle.
To this unit there are connected one 6 mm^2 cable, three 10 mm^2 cables, one 35 mm^2 cable, and one 50 mm^2 cable.

There are present five fuses by:

- ❑ 150 A
- ❑ 70 A
- ❑ 70 A
- ❑ 50 A
- ❑ 500 A

Figure 6

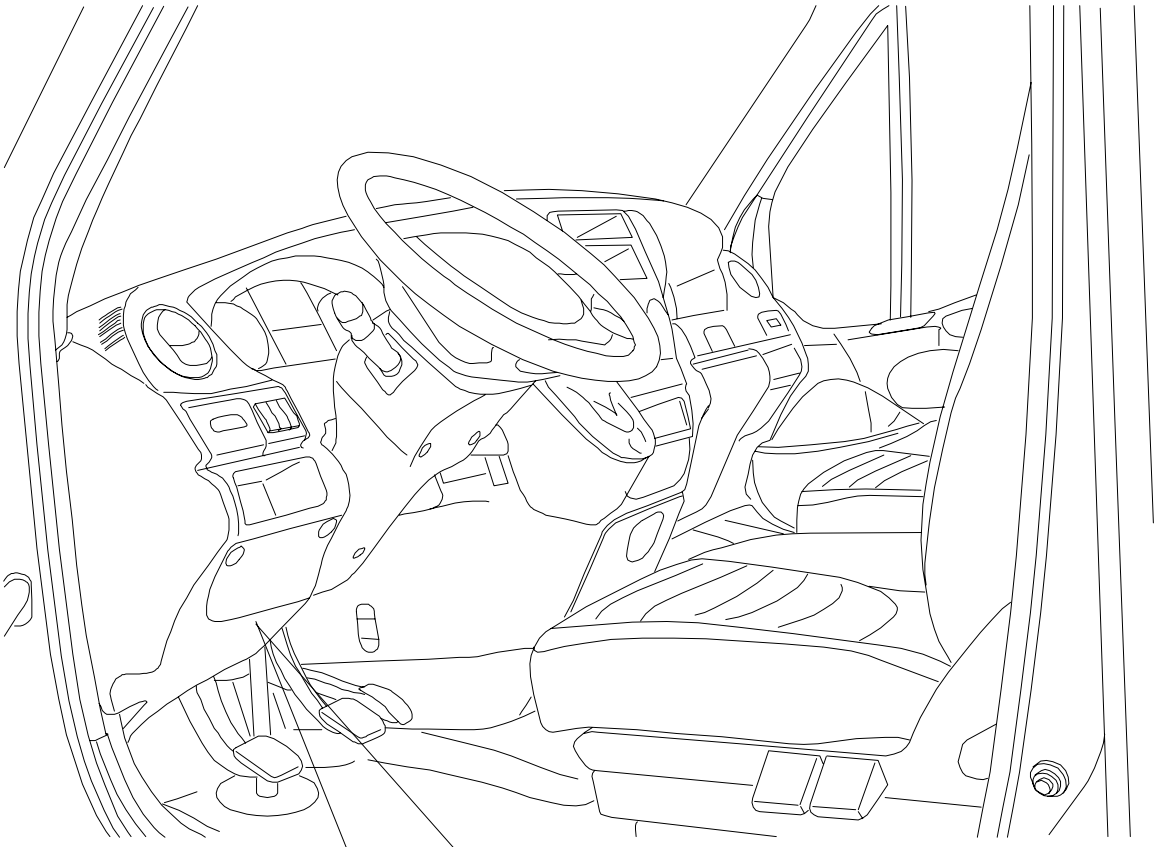


Ref.	Function	Fuse range	Sect.
1	Positive +30 for alternator starter	500	50
2	Positive for engine opening central unit "CVM"	150	35
3	Positive +30 for "CPL"	70	10
4	Positive +30 for "CPL"	70	10
5	Positive +30 for box OPT	50	6
6	Positive +30 for "CPL" - OPT prearrangement	-	10

* On cable no. 1 there is a 500 A fuse (not visible in figure).

INSTRUMENT PANEL INTERCONNECTION CENTRAL UNITS (CPL) "75002"

Figure 7



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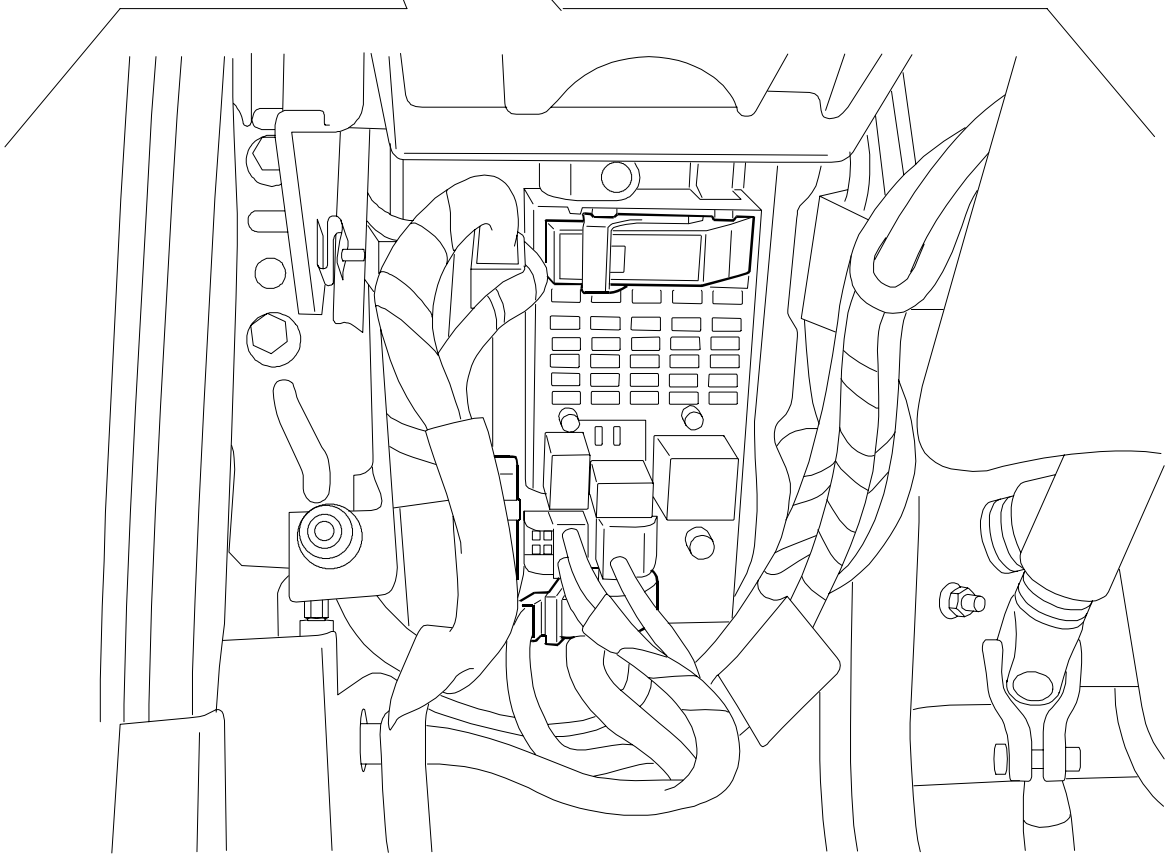

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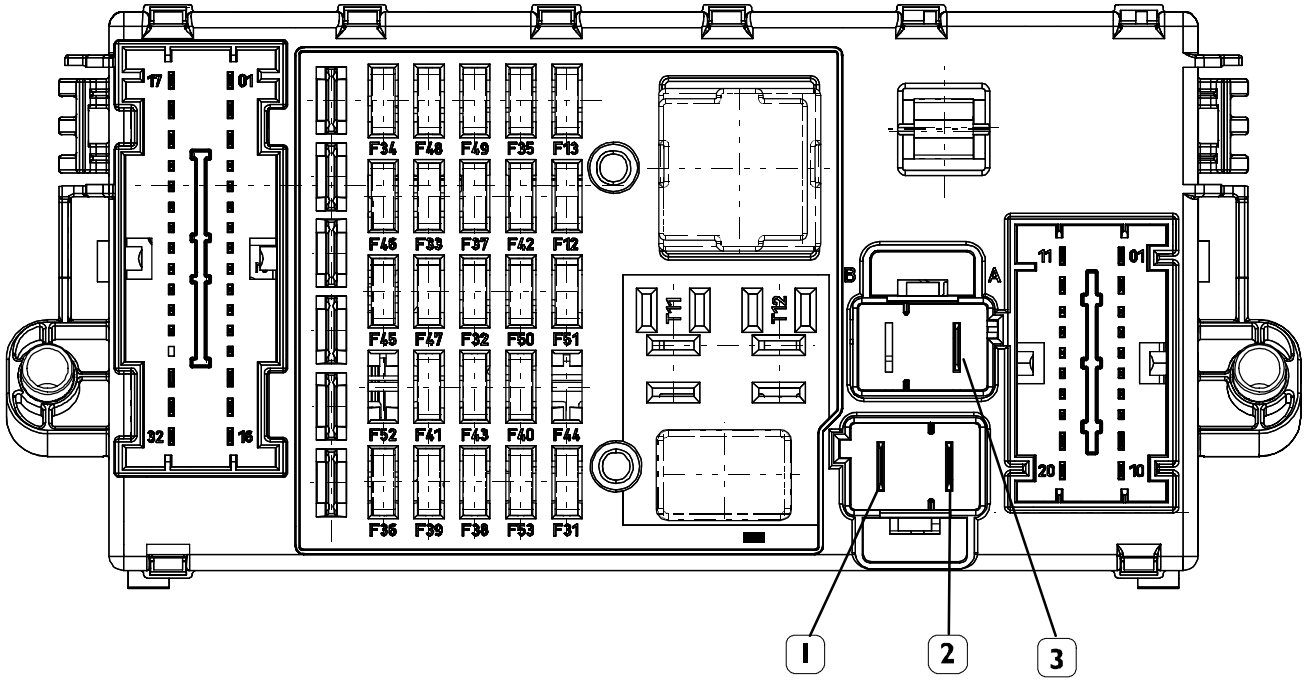
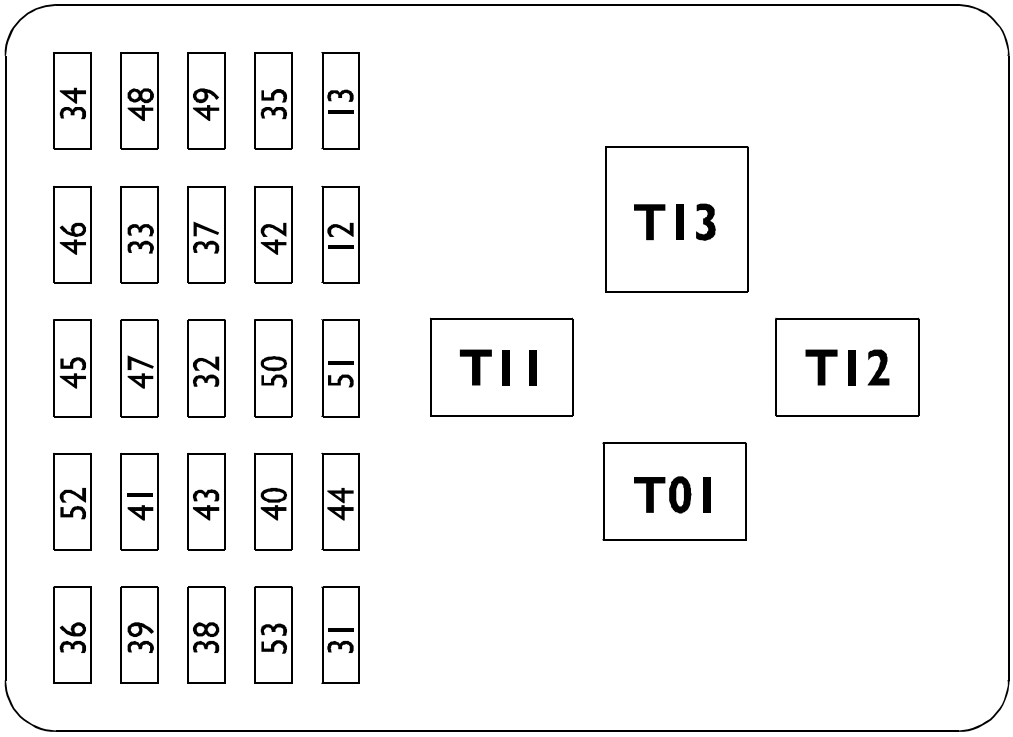
Figure 8



Ref.	Function	Sect.
1	Positive from "CBA" (fuse 70A) - connector B/A	10
2	Positive from "CBA" (fuse 70A) - connector B/B	10
3	Positive from "CBA" - OPT connector D	10

Fuses / remote control switches identification

Figure 9

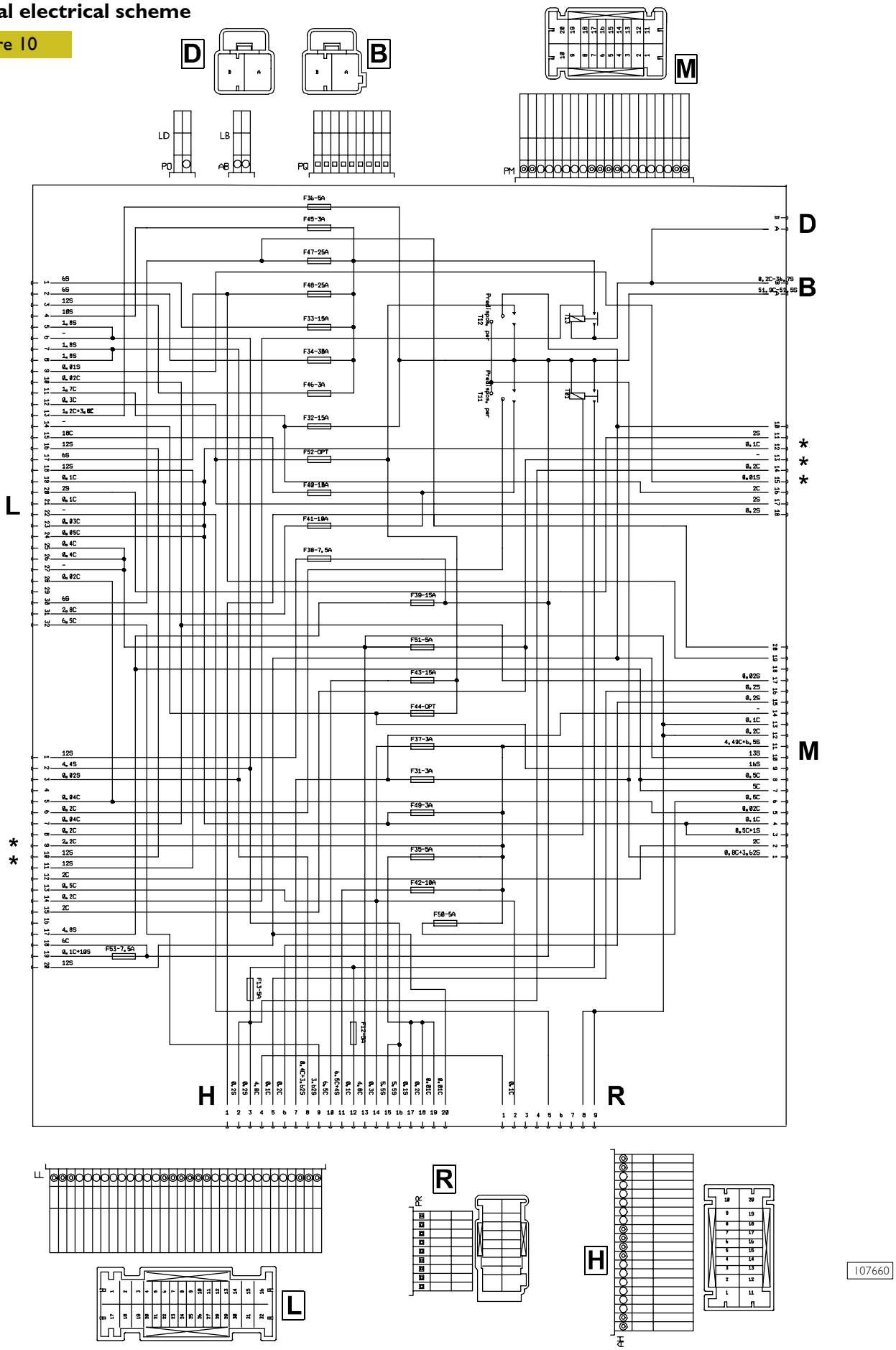


No.	Function	Maximum nominal current
F-12	Right hand dipped headlight	7,5A
F-13	Left hand dipped headlight - headlamp attitude rectifier	7,5A
F-31	Relay T08-T17 in CVM and BC	3A
F-32	Rotating-translating door	15A
F-33	Air heater / Cigarette lighter	15A
F-34	Socket	20A
F-35	ABS8 or ESP8. Telma	10A
F-36	Central locking	20A
F-37	Switches for stop lights and various loads under 15	5A
F-38	BC / Roof lamps internal relays power supply	10A
F-39	Car radio - chrono-tachograph	15A
F-40	Rh heated rear window	10A
F-41	Lh heated rear window	10A
F-42	Reverse lights switch	5A
F-43	Windscreen wiper	20A
F-44	AVAILABLE	-
F-45	AVAILABLE	-
F-46	AVAILABLE	-
F-47	Driver window winder	25A
F-48	Passenger window winder	25A
F-49	ECU for climate control system, car radio, heated seats	15A
F-50	Airbag	5A
F-51	Chrono-tachograph	5A
F-52	AVAILABLE	-
F-53	Instrument cluster, rear fog lights	7,5A

Relay	Function	Maximum nominal current
T-01	Right and left hand dipped headlights	20A
T-11	Heated rear window	20A
T-12	Cigarette lighter / socket / heater or climate control system	20A
T-13	Power release from key	50A

Internal electrical scheme

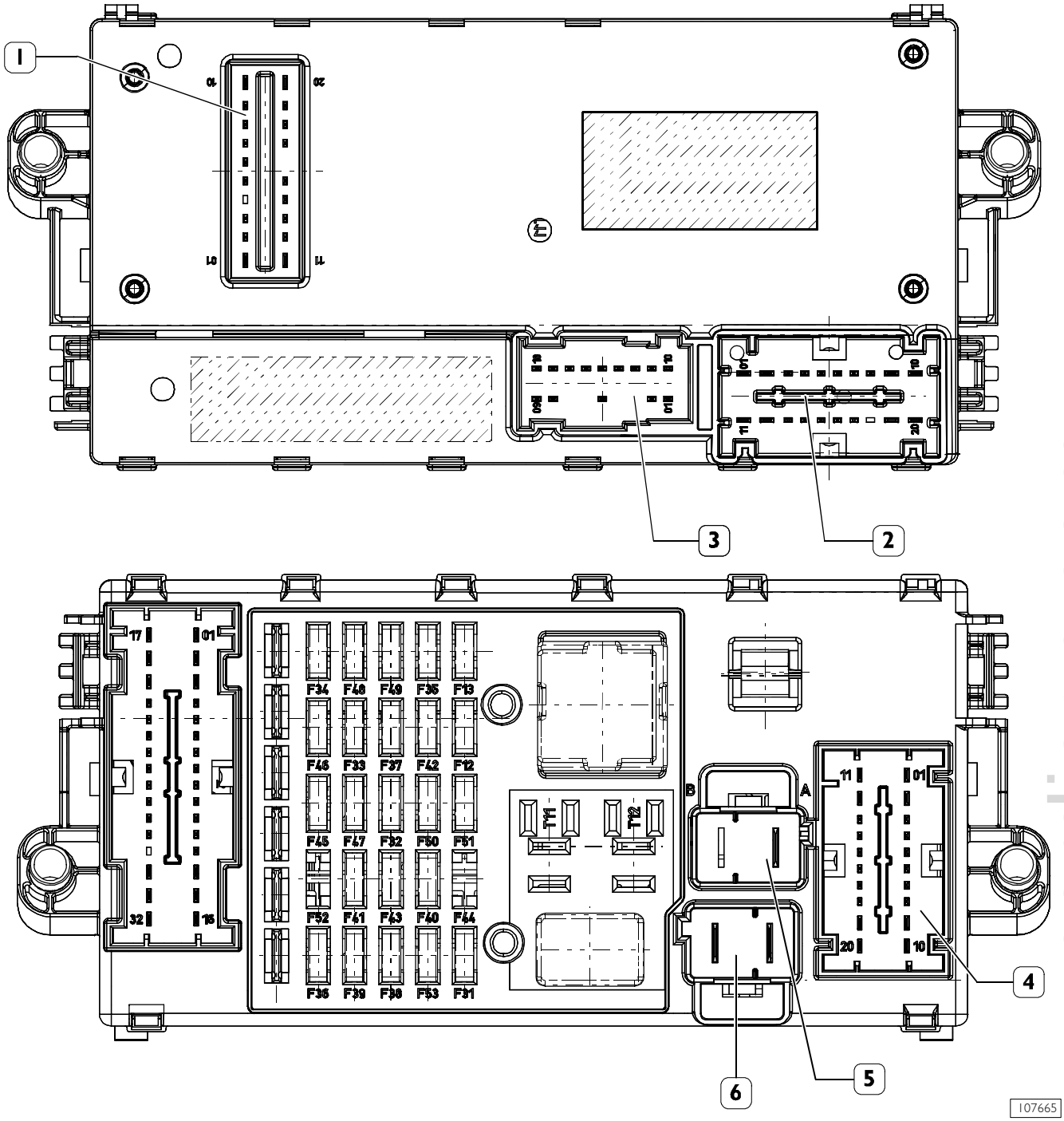
Figure 10



** Junction between central unit "CPL" and "Body Computer" (internal lamellar junction)
*** Connector "R" unused pins (18 pins)

Junction connectors

Figure 11



FRONT VIEW

Ref.	Function
1	Connector (**)
2	Connector "M"
3	Connector "R"
4	Connector "H"
5	Connector "D"
6	Connector "B"
7	Connector "L"

Junction connector "L"

Ref.	Function	Code
1	Positive for cigarette lighter	7721
2	Positive for socket	7721
3	-	-
4	Positive for (rh & lh) door control assembly	8180
5	-	-
6	-	-
7	Positive for reverse headlamp	2226
8	Positive for reverse headlamp	2226
9	-	-
10	B Can line "L" for parking sensors	6111
11	Positive +30	7772
12	-	-
13	Positive for central locking	9076
14	-	-
15	Positive for heated rear window	8021
16	-	-
17	Positive for rh lateral window winder	8863
18	Positive +30 for cab roof lamps	7772
19	Positive +15 for parking sensors	8879
20	-	-
21	-	-
22	-	-
23	-	-
24	-	-
25	-	-
26	-	-
27	-	-
28	B Can line "H" for parking sensors	6110
29	-	-
30	Positive for lh lateral window winder	8863
31	Positive for heated rear window	8021
32	-	-

Junction connector "M"

Ref.	Function	Code
1	Positive +15 with the exclusion of users during start-up step	8849
2	-	-
3	Positive +15 for air-conditioner central unit	8879
4	Positive +15 for radio	8879
5	B Can line "H" for radio	6110
6	Positive +15 for air bag	8879
7	Positive +30 for radio	7772
8	Positive for tachograph	5156
9	-	-
10	Earth	0000
11	-	8887
12	Positive for tachograph	8879
13	-	-
14	Positive +15 for rh & lh window winders	8849
15	-	-
16	-	-
17	B Can line "L" for radio	6111
18	-	-
19	-	-
20	-	-

Junction connector "R"

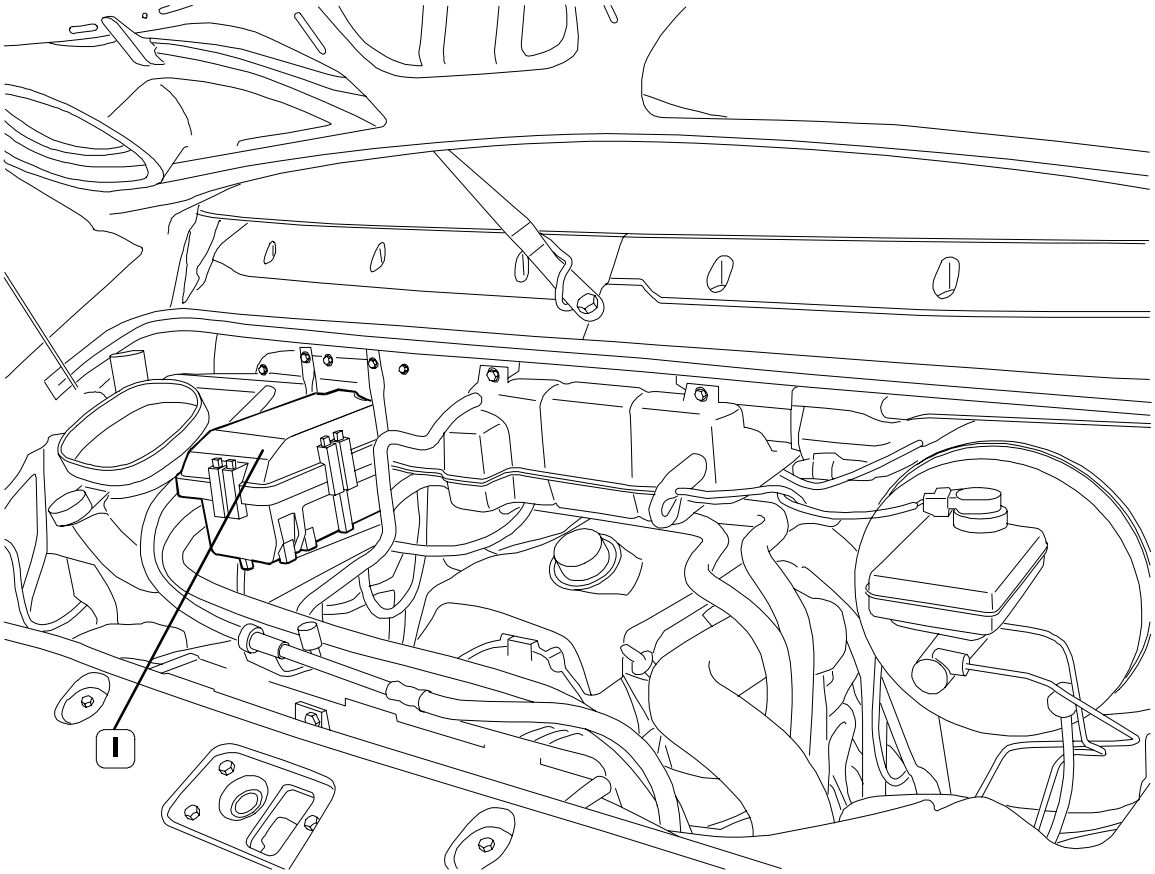
Ref.	Function	Code
1	-	-
2	Positive +15 to control the exclusion of ASR	8879
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	-	-
9	-	-
10	-	-
11	-	-
12	-	-
13	-	-
14	Headlamp attitude rectifier	9934
15	-	-
16	-	-
17	-	-
18	Headlamp attitude rectifier	9935

Junction connector "H"

Ref.	Function	Code
1	Positive for headlight attitude electric motor	9935
2	Positive for headlight attitude electric motor	9934
3	Positive for lh dipped headlight	2231
4	-	-
5	-	-
6	-	-
7	Positive +15 with the exclusion of users during start-up step	8849
8	Positive for reverse gear	2226
9	-	-
10	Positive +15 (with exclusion) for windscreen wiper remote control switches	8849
11	Positive for reverse gear on switch	2268
12	Positive for rh dipped headlight	2223
13	-	-
14	Positive +15 to stop warning switch	8879
15	Positive for stop lights control	1176
16	-	-
17	-	-
18	-	-
19	Positive +15 for central unit ESP8	8879
20	-	-

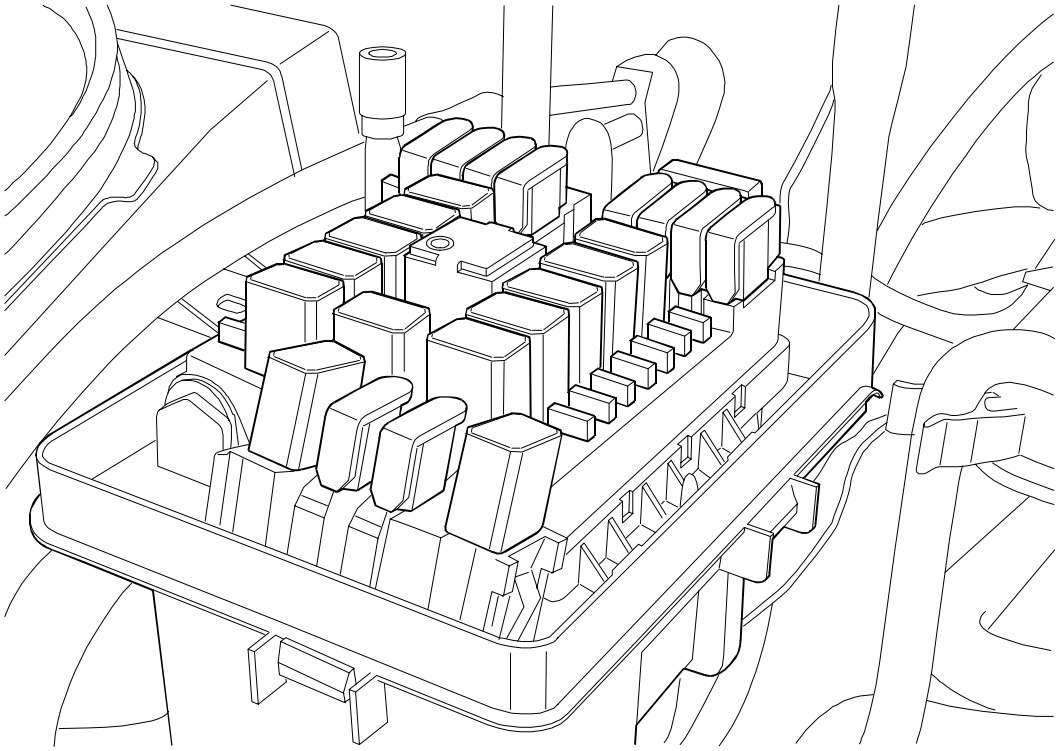
ENGINE OPENING CENTRAL UNIT (CVM) "75001"

Figure 12



1. Interconnection central unit "CVM"

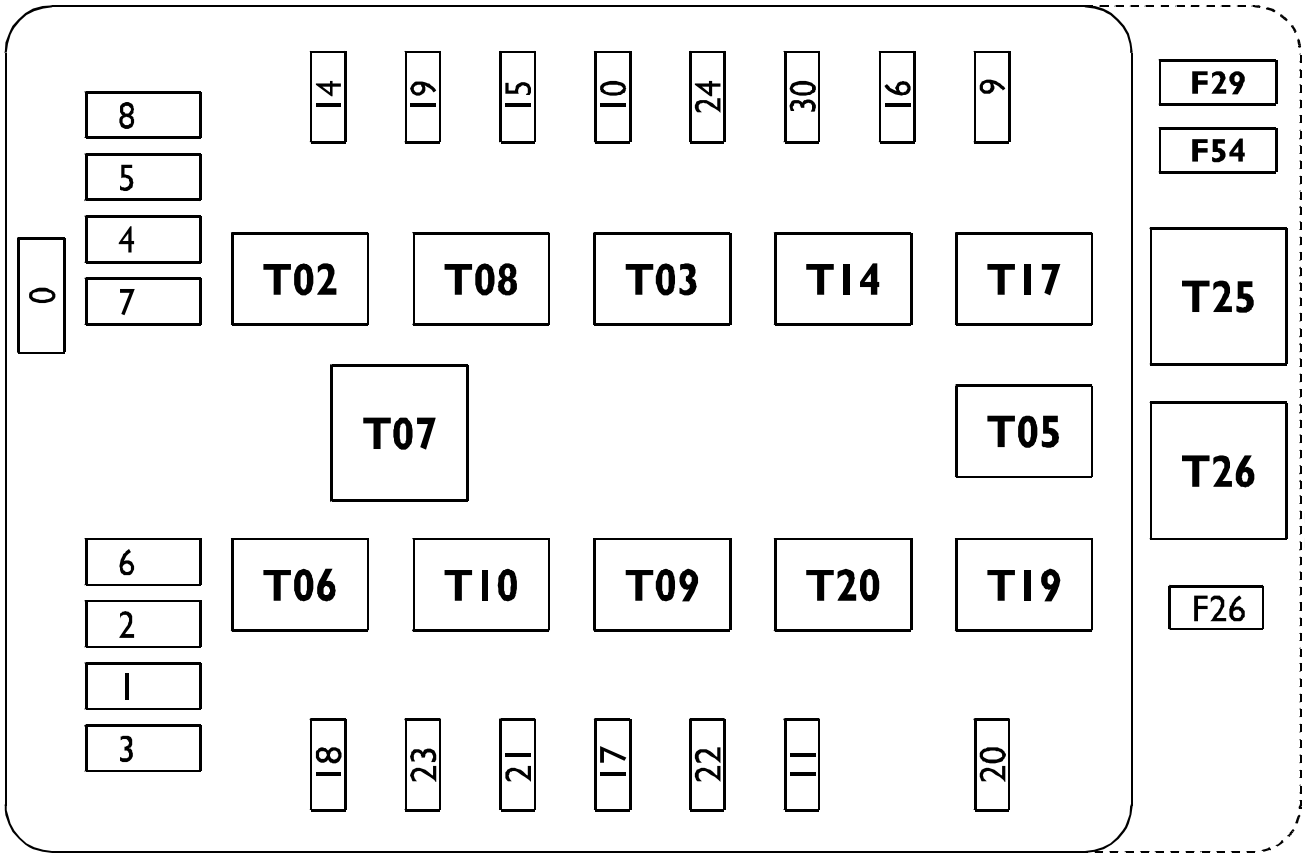
107623



107622

Fuses / remote control switches identification

Figure 13

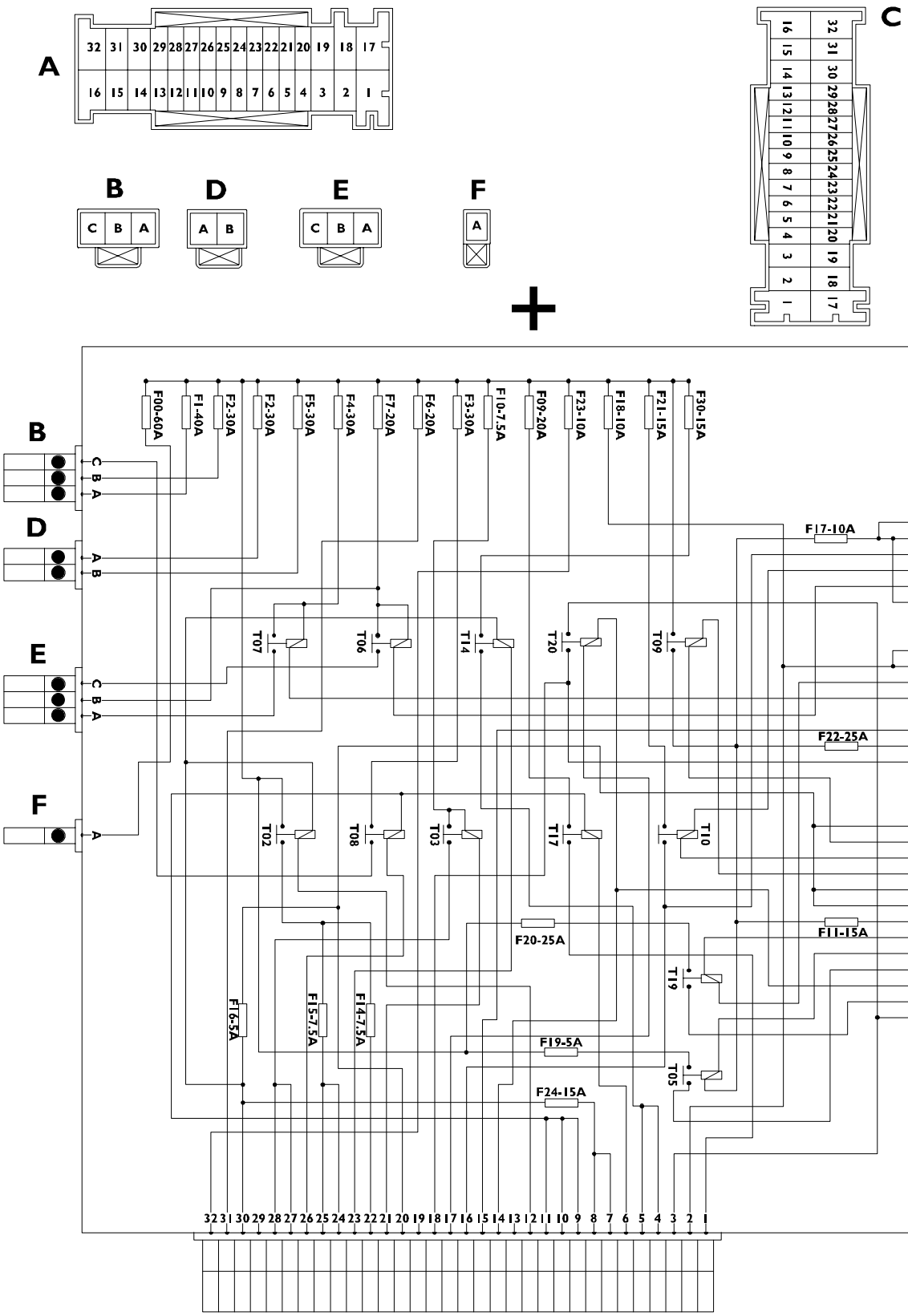


Ref.	Function	Maximum nominal current
F-0	Ignition glow plugs	60A
F-1	ABS8 or ESP8	40A
F-2	ABS8 or ESP8	30A
F-3	ECU ESV1 (automatic gearbox)	30A
F-4	ECU ESV1 (automatic gearbox)	30A
F-5	Start-up switch	30A
F-6	Heated mirrors and windscreen	20A
F-7	Side marker lamps	20A
F-8	Heater or climate control system fans	30A
F-9	Windscreen washer	20A
F-10	Horn	7,5A
F-11	EDC16 (secondary loads)	10A
F-14	Right hand full beam headlight	7,5A
F-15	Left hand full beam headlight	7,5A
F-16	EDC16, T02, T14, Additional heater	5A
F-17	EDC16 (primary loads)	15A
F-18	ECU ESV1 (automatic gearbox)	10A
F-19	Baruffaldi	5A
F-20	Fuel filter heater	25A
F-21	Fuel pump	15A
F-22	EDC16 (primary loads)	25A
F-23	Additional heater	10A
F-24	ECU ESV1 (automatic gearbox), PTO	15A
F-30	Left and right hand front fog lights	15A
IN CONTAINER, OUT OF CENTRAL UNIT		
F-26	Trailer socket	10A
F-29	Air spring suspensions	40A
F-54	Air spring suspensions	40A

Ref.	Function	Maximum nominal current
T02	Right and left hand full beam headlights	20A
T03	Horn	20A
T05	Baruffaldi power supply	20A
T06	Heater / mirrors / windscreen	20A
T07	Side marker lamps	20A
T08	Heater or climate control system fans	20A
T09	EDC16 (main relay)	20A
T10	Fuel pump	20A
T14	Left and right hand front fog lights	20A
T17	Windscreen washer	20A
T19	Fuel filter heater	20A
T20	Diagnosis MODUS	20A
IN CONTAINER, OUT OF CENTRAL UNIT		
T25	Windscreen wiper on/off	10/20A
T26	Windscreen wiper 1st / 2nd speed	10/20A

Internal electrical scheme

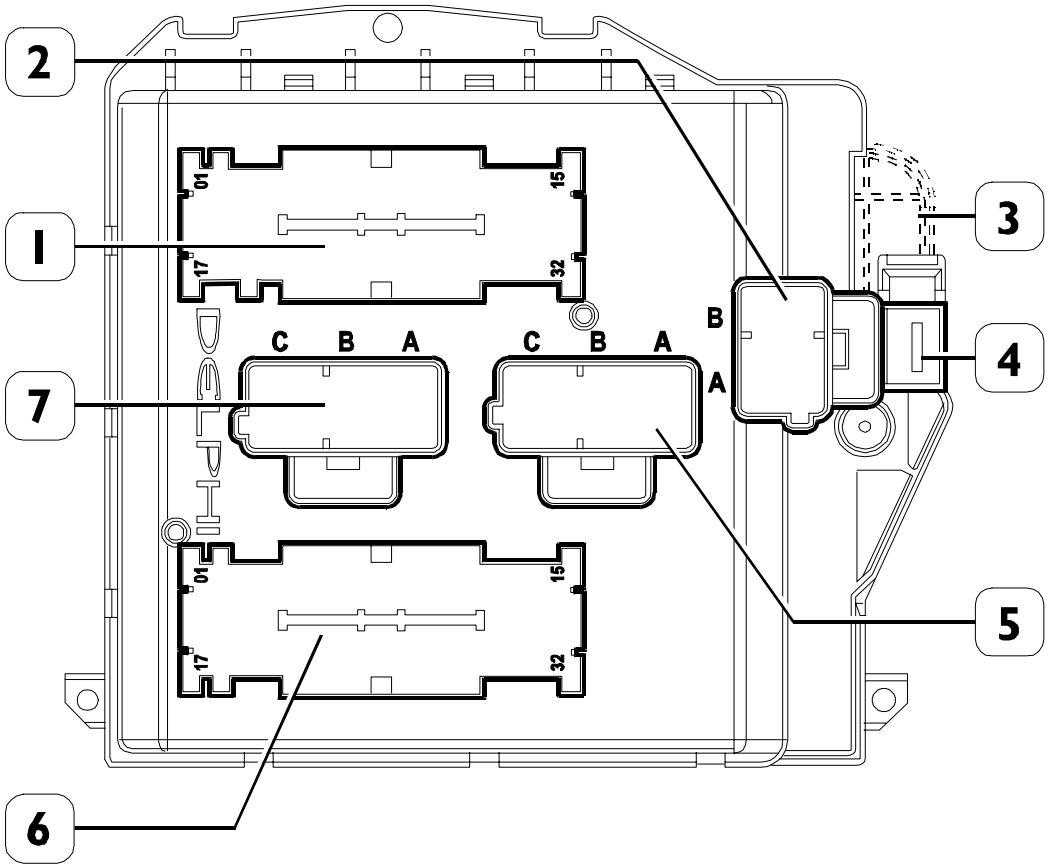
Figure 14



107645

Junction connectors

Figure 15



REAR VIEW

Ref.	Function
1	Connector "A"
2	Connector "D"
3	Positive "+30" from "CBA"
4	Connector "F"
5	Connector "B"
6	Connector "C"
7	Connector "E"

Junction connectors "A"

Ref.	Function	Code
1	Positive for windscreen washer pump	8886
2	-	-
3	-	-
4	Positive for lh front fog headlamps	2228
5	Positive for rh front fog headlamps	2228
6	Positive from Body Computer	8879
7	Positive for gear selector switch for semi-automatic gearbox	8110
8	Positive +15 for total power take-off	8879
9	-	-
10	-	-
11	Jumper with H7 of 75002	8849
12	Jumper with AV12 of Body Computer	8879
13	-	-
14	Earth	0000
15	-	-
16	-	-
17	Positive for diagnostics connection joint (+)	7797
18	-	-
19	-	-
20	Positive +15	8879
21	Positive for horns	1116
22	Positive for rh full beam headlight	2221
23	Jumper for Body Computer	8879
24	-	-
25	Positive for lh full beam headlight	2219
26	Earth	0000
27	Positive +15 for horns	1116
28	-	-
29	-	-
30	Positive +15	8887
31	Positive +30 for automatic gearbox central unit	7772
32	Positive +30	7772

Junction connectors "C"

Ref.	Function	Code
1	Positive +30 for start-up	7772
2	Positive for diesel oil heating on control	8036
3	-	-
4	Positive for electromagnetic clutch for air conditioning system	9993
5	Earth	0000
6	Positive +30	7772
7	-	-
8	-	-
9	Positive +15	8879
10	Main relay signalling cable for EDC	155
11	Earth	0000
12	(Not protected) direct positive on batteries	7777
13	-	-
14	-	-
15	-	-
16	-	-
17	Positive +15	7772
18	Positive for EDC/MS6 system from main relay	7150
19	-	-
20	-	-
21	Positive +15	8879
22	Water in pre-filter warning lamp	5530
23	Jumper between C23 and C12	7772
24	Positive +30 for automatic gearbox central unit	7772
25	-	-
26	-	-
27	-	-
28	Negative for heated rear view mirrors switch	0000
29	Positive +30	7772
30	Injection pump diesel oil flow actuator for EDC16	9156
31	Positive for EDC16	7150
32	-	-

Junction connectors "B"

Ref.	Function	Code
A	Positive +30 for ABS	7772
B	Positive +30 for ABS	7772
C	Positive +15 for air-conditioner	8849

Junction connectors "D"

Ref.	Function	Code
A	Positive +30 for key switch	7772
B	Positive +30 for automatic gearbox	7772

Junction connectors "E"

Ref.	Function	Code
A	Positive for chassis cable	3390
B		-
C	Positive +15 for heated rear view mirrors	8830

Junction connectors "F"

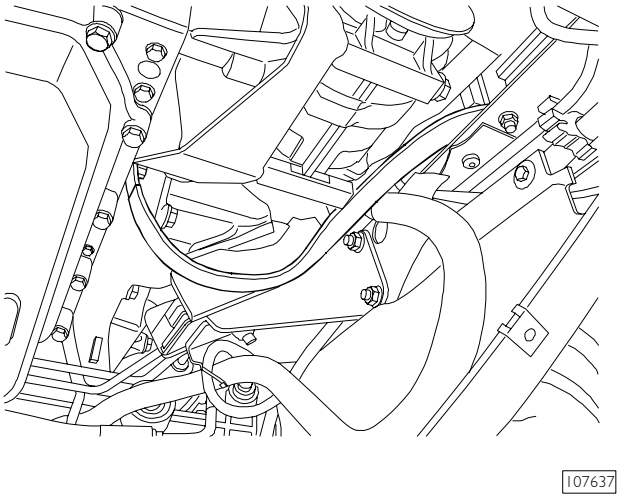
Ref.	Function	Code
A	Positive +30 for pre-heating	7772

NEGATIVE NETWORK

EARTH POINTS

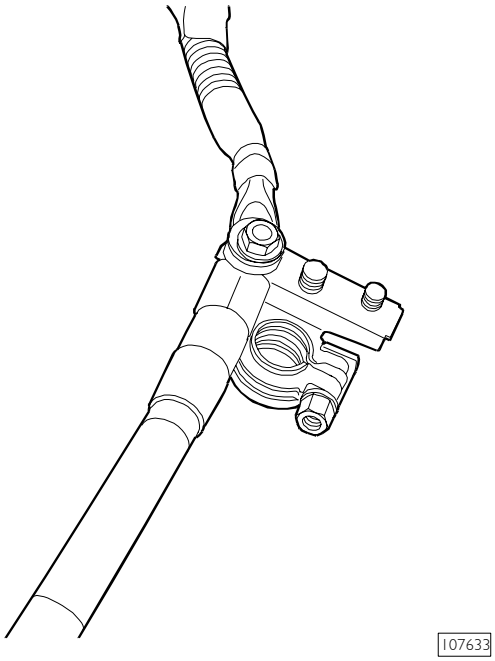
Through a brown 50 mm2 cable, battery negative terminal is connected to earth point (LM2) located at chassis left side on the side member; from this point, a copper braid is connected to engine block, near the starter (*lm1*). At point *lm2* there are connected the earth points relating to chassis cable.

Figure 16



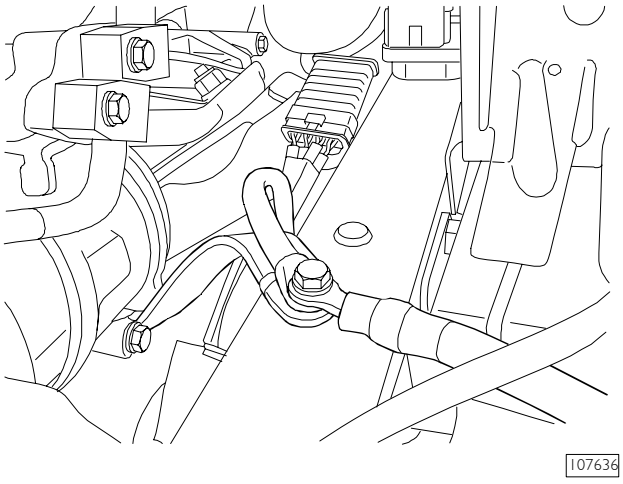
ENGINE BLOCK BRAID (LM1)

Figure 17



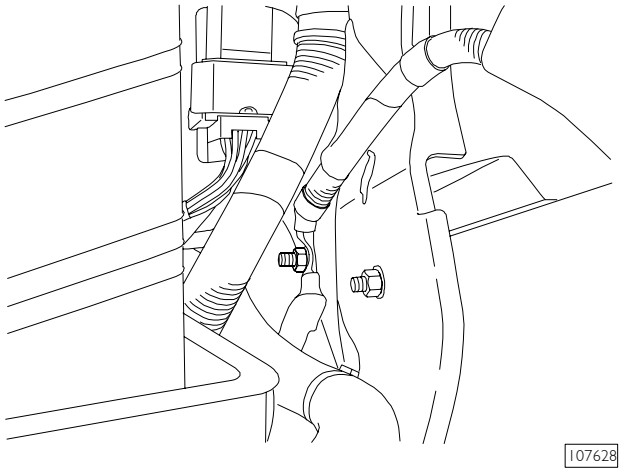
NEGATIVE PIN

Figure 18



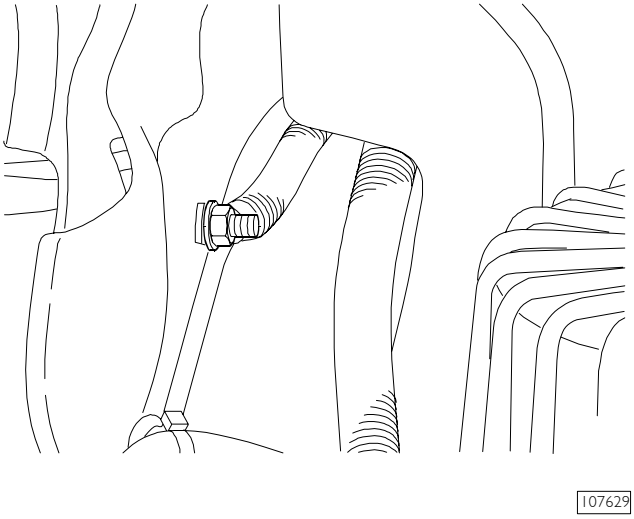
EARTH POINT ON LEFT HAND SIDE MEMBER (LM2)

Figure 19



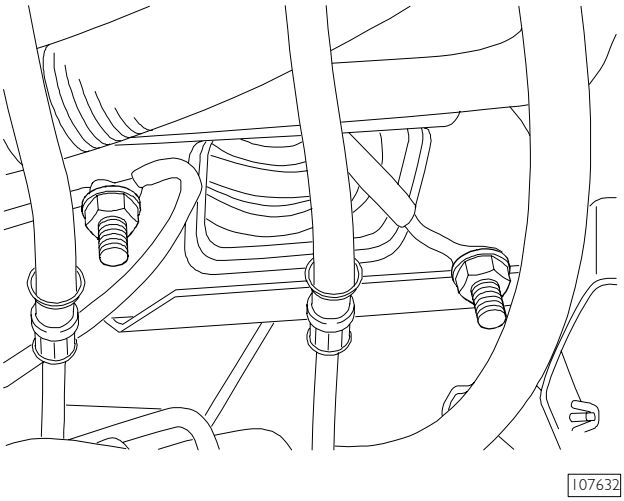
LH BONNET EARTH POINT (LM5)

Figure 20



RH BONNET EARTH POINT (LM4)

Figure 21



EARTH POINTS UNDER POWER-ASSISTED BRAKE (LM3)

In bonnet, in the vicinity of left front blinker there is located earth point ***lm5*** to which connected are:

- Central unit "CVM"
- Lh headlamp
- Pre-heating remote control switch
- EDC
- Electromagnetic joint for engine cooling
- Heated pre-filter
- Remote control switch to enable air-conditioner compressor to be put on
- Headlight washer pump
- Fuel filter clogged switch
- Switch for engine bonnet opening

In bonnet, in the vicinity of right front blinker there is located earth point *lm4* to which connected are:

- Rh headlamp
- Windscreen washer pump
- Horn
- Windscreen wiper
- Compressor connected remote control switch (for EDC)
- Air-conditioner compressor
- Heated windscreen
- Gearbox power take-off in switch
- Antitheft siren
- Air filter clogged switch

In the bonnet, under power-assisted brake there are two earth points present:

- ***lm3***: central unit ABS - heated pre-filter central unit
- ***lm3****/S*: central unit ABS

Cab interior left side

- ❑ CPL
- ❑ Body Computer
- ❑ Central locking central unit
- ❑ Switch for the exclusion of ASR (symbol)
- ❑ Power central unit
- ❑ Height sensors (ECAS)
- ❑ Steering column switch unit (***lm7/S***)
- ❑ Gear selector for automatic gearbox (***lm7/S***)

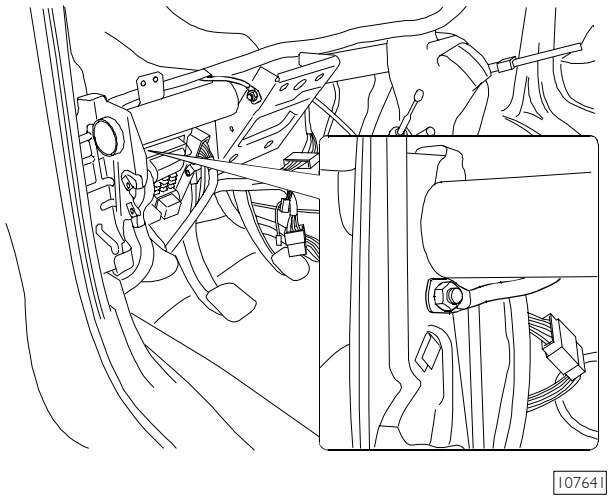
Cab interior right side

- ❑ Emergency lights pushbutton
- ❑ Front fog lights (pushbutton)
- ❑ Speed limit setting (pushbutton)
- ❑ Radio
- ❑ Windscreen electric defroster control assembly
- ❑ Air-conditioner central unit
- ❑ Pushbutton for heated rear window
- ❑ Heated mirrors switch
- ❑ Vehicle lifting/lowering pushbuttons (ECAS)
- ❑ Tachograph (***lm6/S)***

Loading platform central part ***(lm8)***

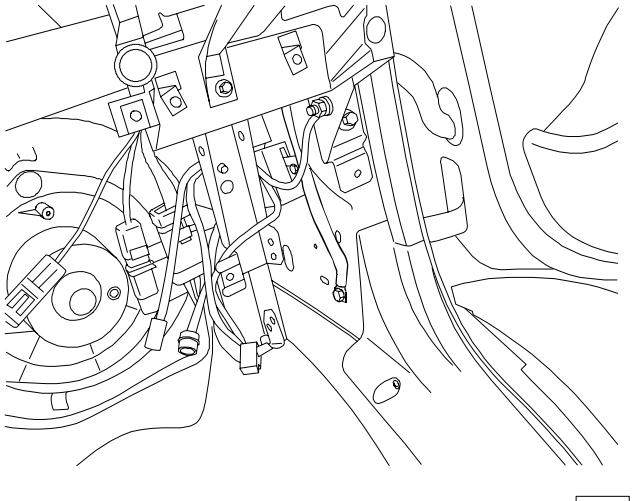
- ❑ Clearance (rh / lh) front lights
- ❑ AIR BAG (central unit) ***lm8/S***
- ❑ Switch for anti-twisting with gears engaged

Figure 22



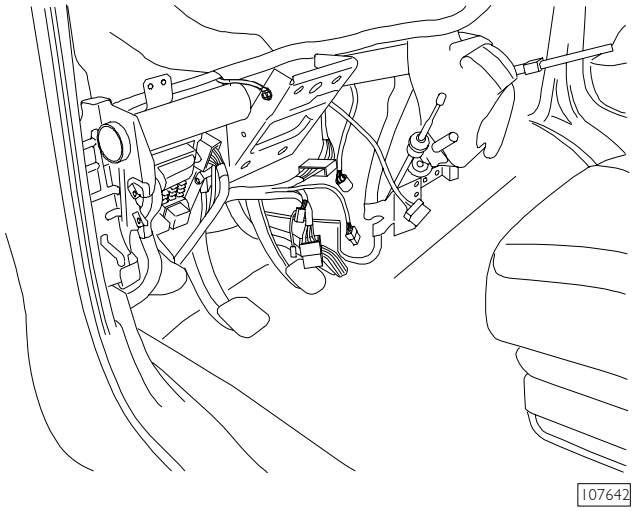
CAB INTERIOR LEFT SIDE (LM7)

Figure 23



CAB INTERIOR RIGHT SIDE (LM6)

Figure 24



CAB INTERIOR LEFT SIDE (LM7/S)

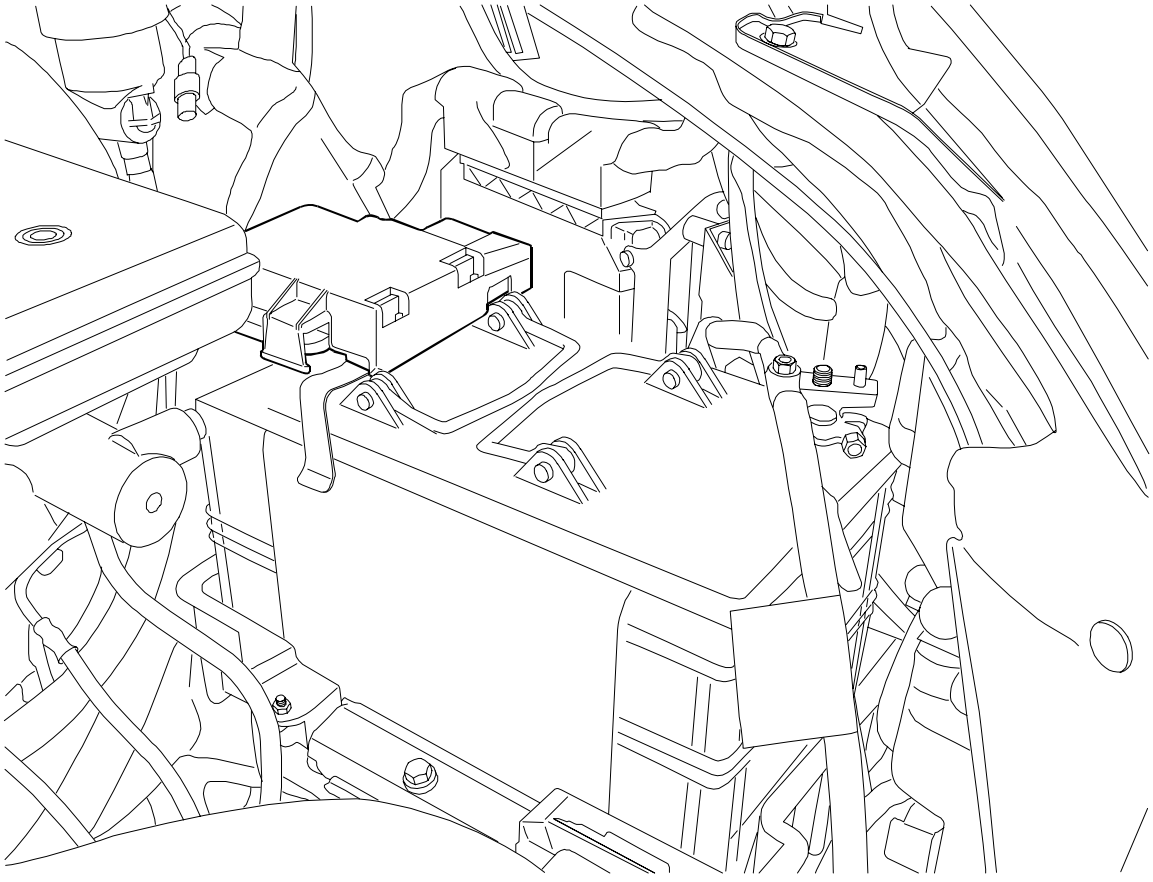
BATTERY (20000)

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.

Requirements

- ❑ Case and cover in polypropylethylene 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 25



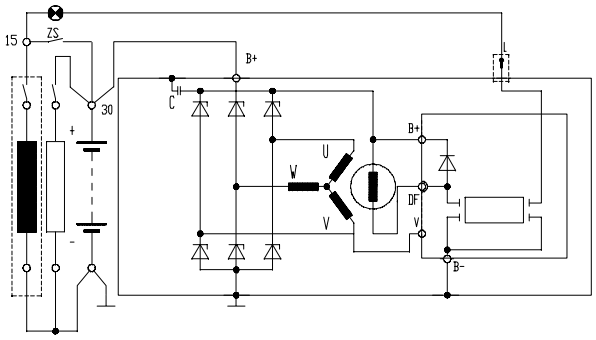
Fast diagnosis

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

BOSCH KCBI 14V 110A ALTERNATOR

03000

Figure 26



8649

WIRING DIAGRAM

Specifications for use

Vehicle electric system rated voltage:	12 V

Suitable for coupling with battery of any capacity
It must work with the battery connected.

Connection with inverted polarity is not allowed.

Operating specifications

Rated voltage	14 V
Rated current delivery	110A
Drive side direction of rotation	clockwise
Maximum continuous speed	≤ 12.000 min^{-1}
Storage temperature	-40 °C / +110 °C

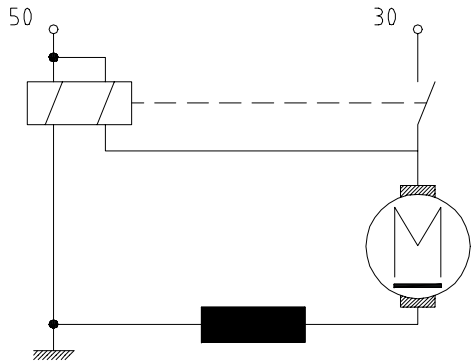
Figure 27

8656

TECHNICAL VIEW

EV 12V - 2.3 KW STARTER MOTOR

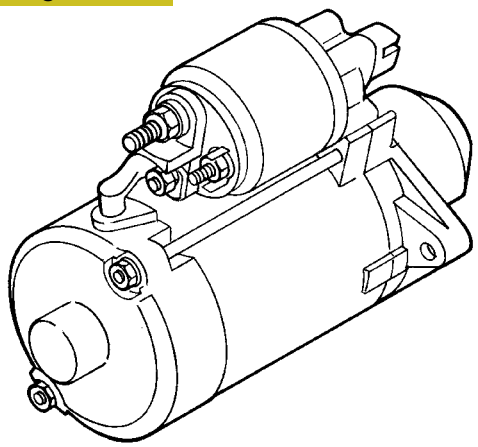
Figure 28



WIRING DIAGRAM

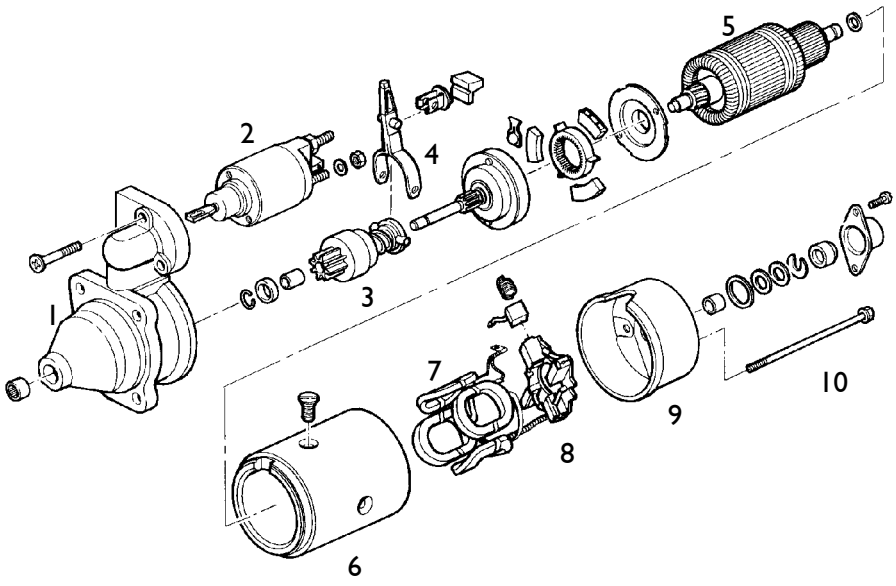
Figure 29

08000



PERSPECTIVE VIEW

Figure 30



PERSPECTIVE BLOWN-UP VIEW
1. Support - 2. Pinion engagement control electromagnet - 3. Pinion - 4. Pinion engament 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

JUNCTION WELDS

Inside each cable there are ultrasound welds (see start of manual) joining between each other those cable which have similar functions (positive, earth, various junctions, etc.).
In these pages, their location is described divided according to the cable to which the location is belonging to.
This description will be in the future integrated by the drawing of respective cable in order that their location can be identified more easily.

INSTRUMENT PANEL CABLE

Weld	A9	near central instrument panel switches shunt
Weld	A30/A65	near central instrument panel switches shunt
Weld	A43	near instrument panel cable central part
Weld	A49/50	near tachograph
Weld	A51/54	near the shunt towards CPL
Weld	A78	near the shunt for climate control system
Weld	A100	near instrument cluster shunt
Weld	A101/102	near rh speaker shunt

CAB CABLE

Weld	A15	near lh window bag shunt
Weld	A21/a601	near central roof lamp shunt
Weld	A/25	near (lh front) shunt for cable/bonnet junctions
Weld	A26/A18/A700	near lh front shunt for cable / instrument panel junction, Body Computer (LN), CPL (connector "L")
Weld	A/600	near (rh) lateral hatch roof lamp shunt
Weld	A/602	near (lh) driver roof lamp shunt
Weld	A/603	near rh window bag shunt

BONNET CABLE

Weld	A3	near CBA
Weld	A4	near brake oil level sensor cable shunt
Weld	A5/A32/A39/A53	near heated windscreen shunt
Weld	A7/A8/A31/A36/A40	near heated windscreen shunt
Weld	A13/A24/A44/A45/A22	near passage between bonnet and cab (cab side)
Weld	A14/A64	near sensor shunt on DPF
Weld	A17/A20	near passage between bonnet and cab (bonnet side)
Weld	A19	near lh headlight shunt
Weld	A33/A41	near IE cable shunt

Weld	A34/A35	near switching on switch shunt
Weld	A37/A38	near Telma (bonnet side) shunt
Weld	A66	near junction for automatic gearbox (bonnet side)
Weld	A67	near central unit CPL
Weld	A70	near central unit EDC
Weld	A77	near shunt for ECAS, lambda, additional heater (bonnet side)

TRUCK CHASSIS CABLE

Weld	A6	near rear lights shunt
Weld	A10	near fuel level transmitter shunt

VAN CHASSIS CABLE

Weld	A6/A10	near lh clearance lateral headlamp shunt

WIRING HARNESS SECTION

Description

Engine cable
(van-truck) chassis cable
ABS probes cable
cab cable
instrument panel cable
bonnet cable
AIR BAG cable
doors cable

BONNET - INSTRUMENT PANEL - CAB - CHASSIS cables interface to each other through following connectors:

BONNET - INSTRUMENT PANEL cable

Connectors 600-601H 600-601B 600-601D

BONNET - CAB cable

Connectors 600-601G 600-601A

INSTRUMENT PANEL - CAB cable

Connectors 600-601C

BONNET-CHASSIS cable

Connectors C4 C2 C70

All junction connectors are on vehicle left side at interconnection central unit CPL.

The three BONNET - CHASSIS connectors are in engine opening on vehicle left side under front headlamp.

The two AIR-BAG connectors are in cab floor central part. They can be identified by cable yellow colour.

Figure 31

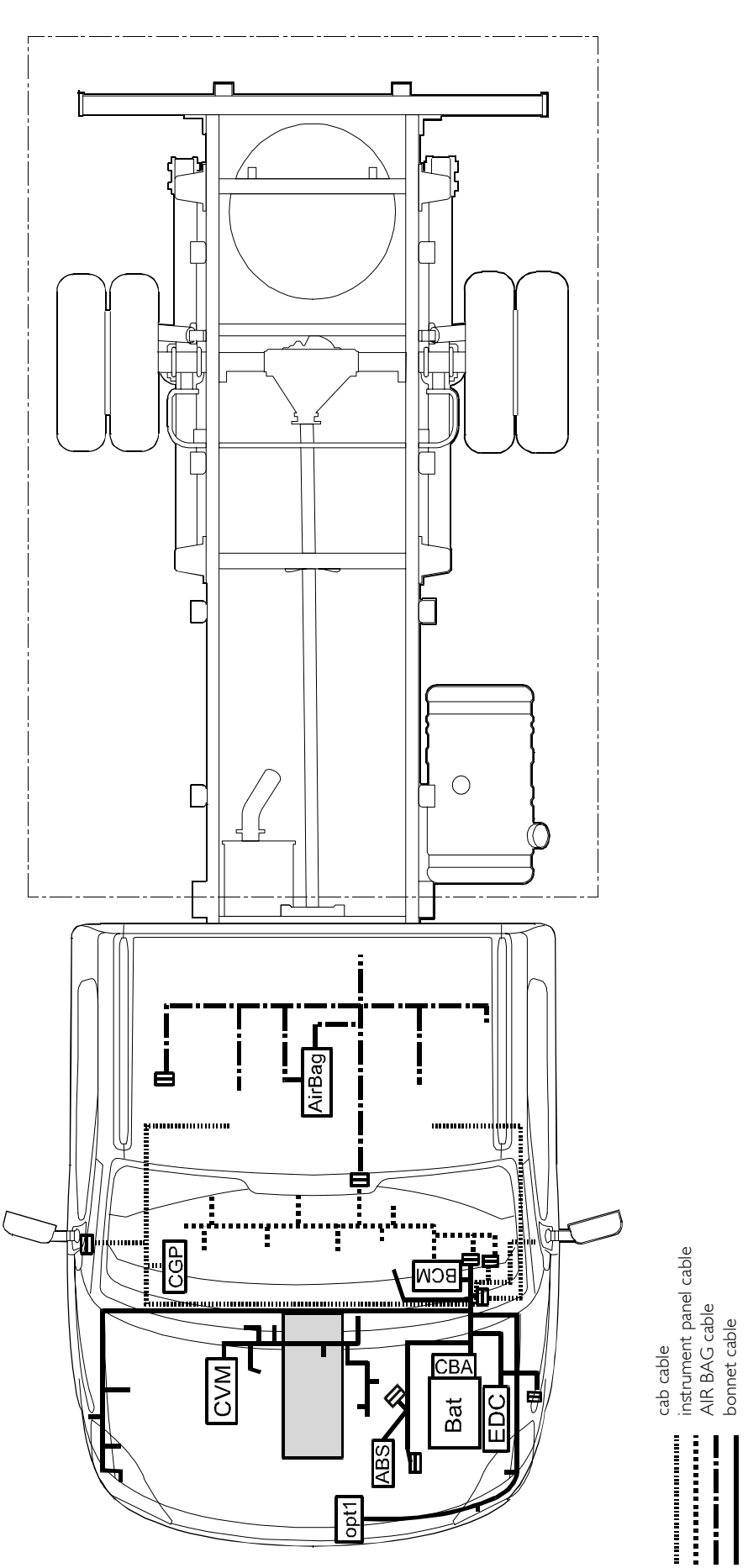
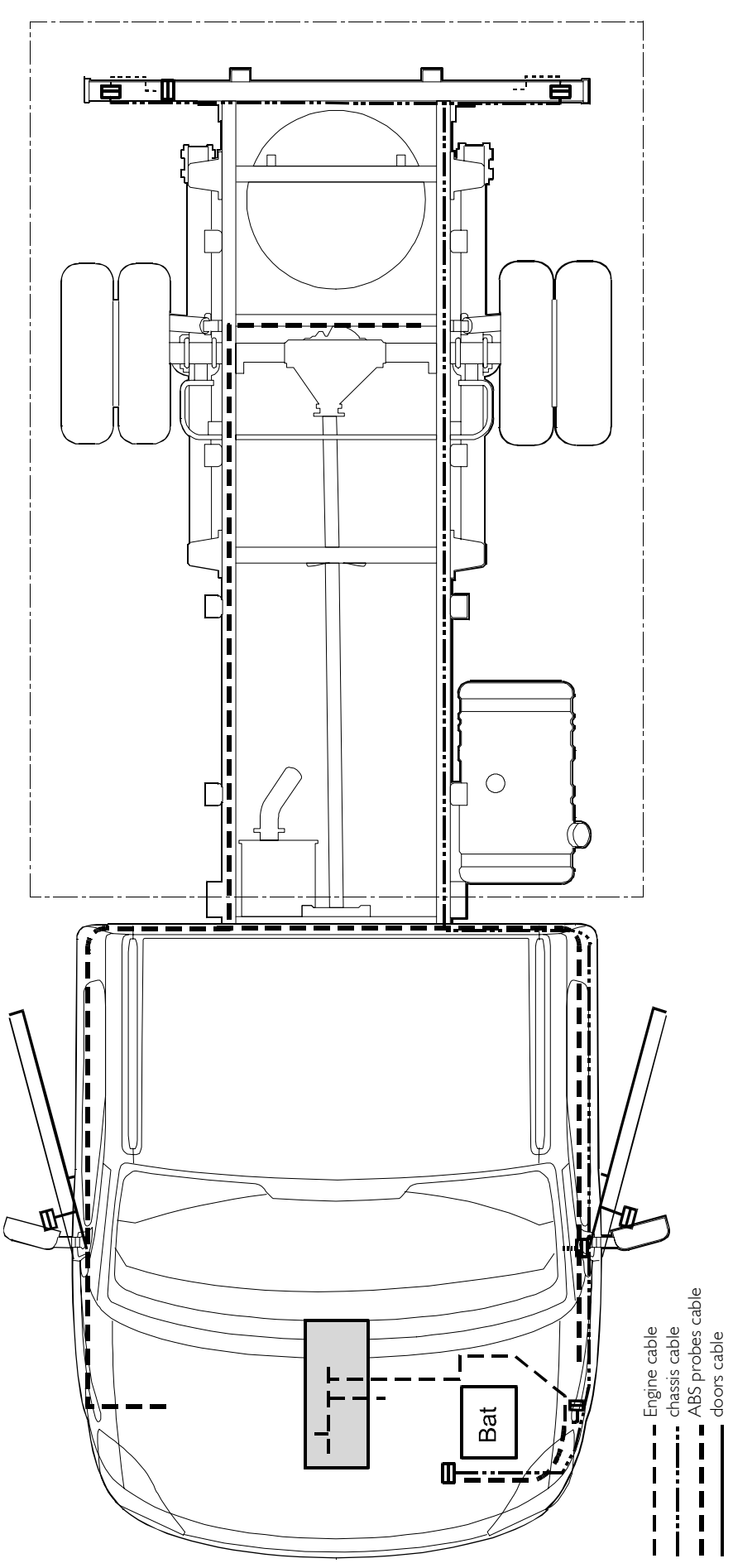


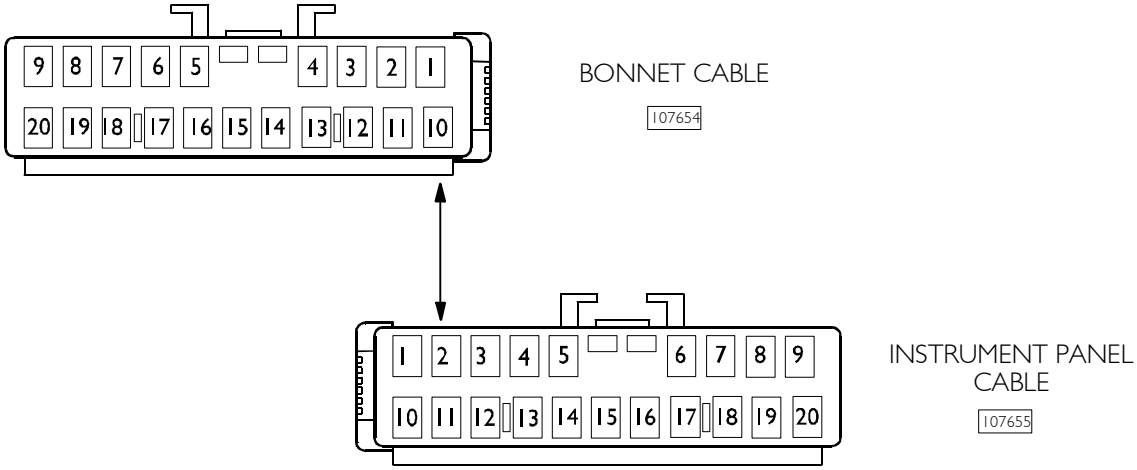
Figure 32



JUNCTION CONNECTORS

Bonnet - instrument panel junction (600/601H)

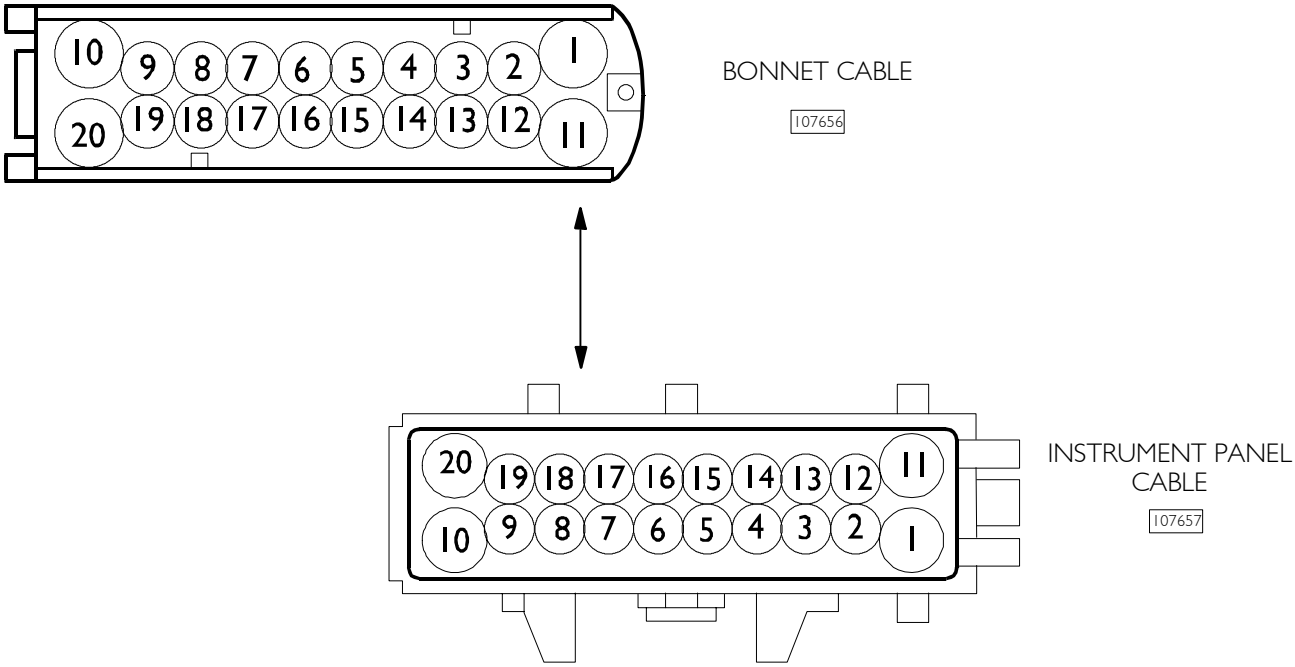
Figure 33



Ref.	Function	Code
1	Positive for power take-off solenoid valve	9131
2	Positive +15	8879
3	Optical indicator to signal that power take-off on gearbox has been connected	6601
4	Positive for "opening" solenoid valve for tilt body	9137
5	Positive for "closing" solenoid valve for tilt body	9138
6	Negative for "opening" solenoid valve for tilt body	9139
7	Positive (+15) to antitheft siren	9140
8	Signal from antitheft central unit to siren	9142
9	Negative for power take-off actuator	9136
10	Positive for power take-off actuator	9135
11	Automatic gearbox central unit pin 3	6141
12	Automatic gearbox central unit pin 5	6143
13	Positive +15	8887
14	Positive for automatic gearbox gear selector	8110
15	Automatic gearbox Gear selector pin 3	White
16	Automatic gearbox Gear selector pin 4	Green
17	Positive for optical indicator for heated rear view mirrors	6652
18	Positive +15	8051
19	Positive +15 for additional heater timer	8879
20	Positive +15 for central unit EDC pin K28	8051

Bonnet - instrument panel junction (600/601B)

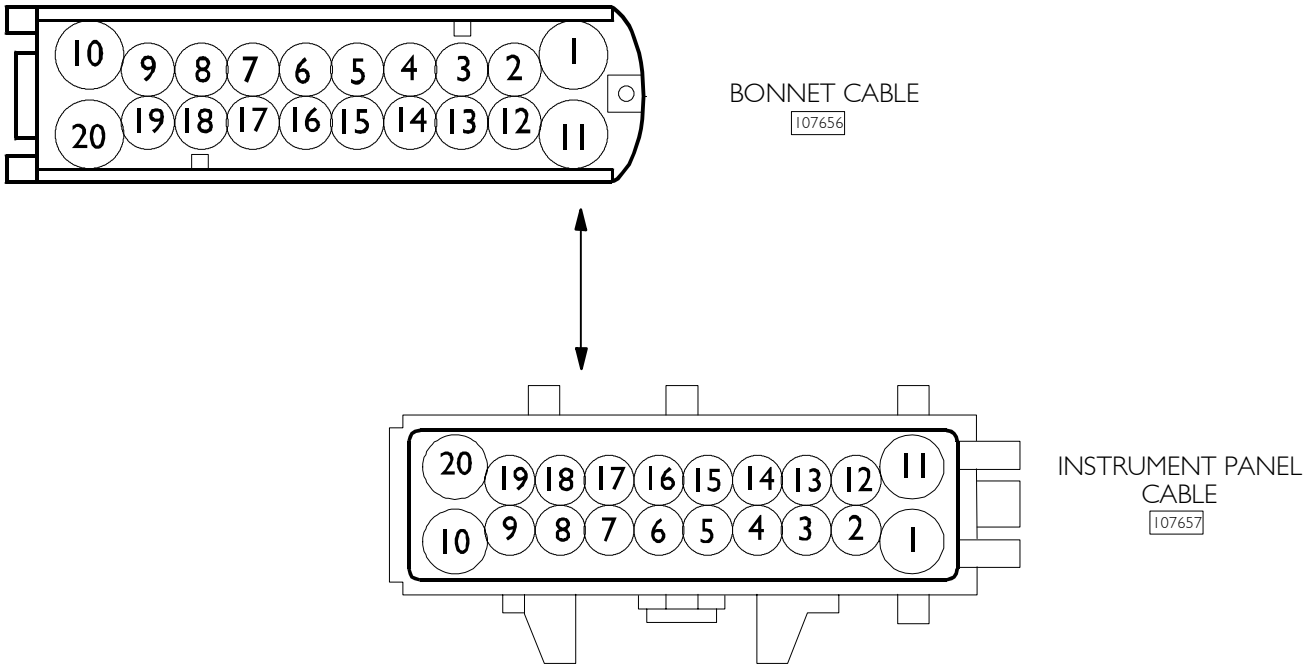
Figure 34



Ref.	Function	Code
1	Positive +15 with the exclusion of users during start-up step	8849
2	Earth	0000
3	Earth	0000
4	Control for EDC from speed limiter pushbutton	-
5	Positive for 3-level air-conditioner pressure switch and remote control switch to signal to EDC that compressor has been connected	8163
6	Signal from external temperature sensor for air-conditioner	5532
7	Acceleration sensor earth (ESP8)	0050
8	Acceleration signal (from acceleration sensor) ESP8	9090
9	Positive to acceleration sensor (ESP8)	9091
10	Positive for differential locking system	8066
11	Positive +15	8887
12	Yaw sensor reference signal (ESP8)	9094
13	Yaw sensor test signal (ESP8)	9093
14	Positive +15	8879
15	Yaw sensor signal	9095
16	Lateral acceleration signal	9092
17	Yaw sensor earth	9096
18	-	-
19	Positive for electromagnetic joint for air-conditioner	9993
20	Positive +30	7772

Bonnet - instrument panel junction (600/601D)

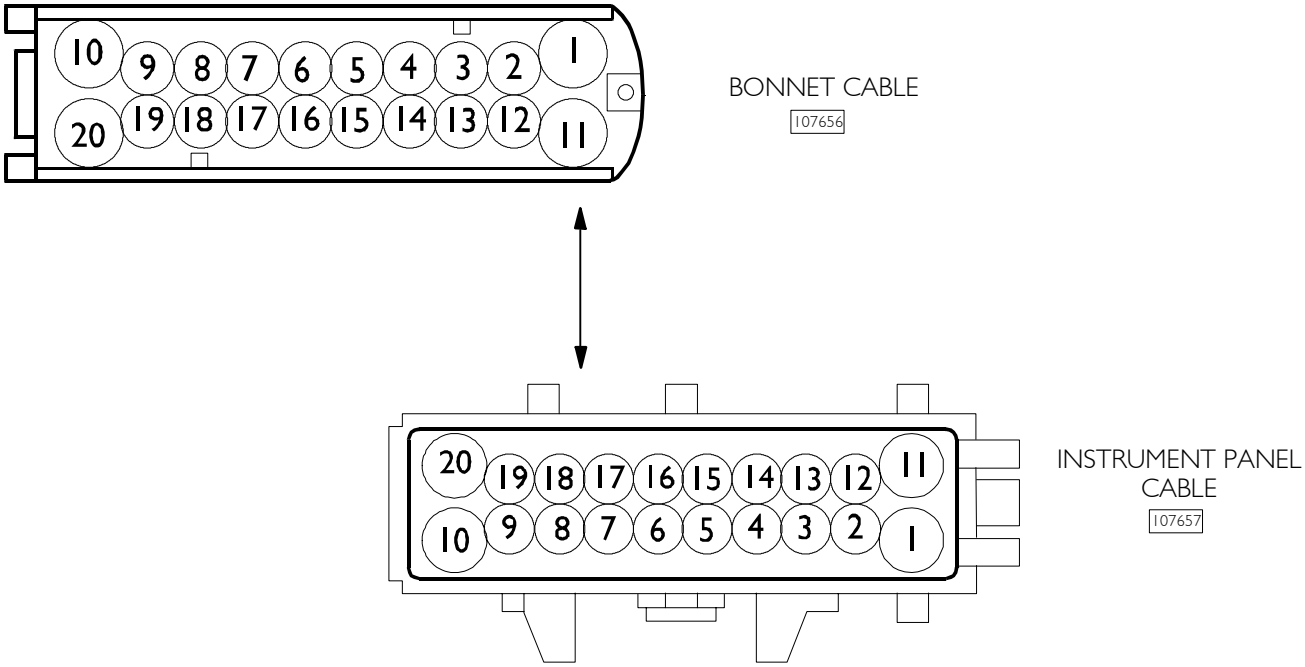
Figure 35



Ref.	Function	Code
1	Positive for diagnosis connector	7797
2	Positive for electronic tachograph transmitter	5514
3	Negative isolated from electronic tachograph transmitter	0058
4	Speed signal from electronic tachograph transmitter	5517
5	Reversed signal from electronic tachograph transmitter	5516
6	Positive for TELMA decelerator: first position	9913
7	Positive for TELMA decelerator: second position	9910
8	Positive for TELMA decelerator: third position	9916
9	Positive for TELMA decelerator: fourth position	9912
10	Positive for TELMA control switch	9911
11	Positive +15	8879
12	Positive for EDC failure warning lamp	5180
13	Negative for optical indicator for differential locking on transfer box (from signalling switch)	6603
14	Positive for horn	1116
15	Earth	0000
16	Air spring suspension control (lifting)	9981
17	Air spring suspension control (lowering)	8091
18	Earth for signal for tachometric sensor	0058
19	Signal from tachometric sensor	5517
20	Positive +30	7772

Bonnet - instrument panel junction (600/601G)

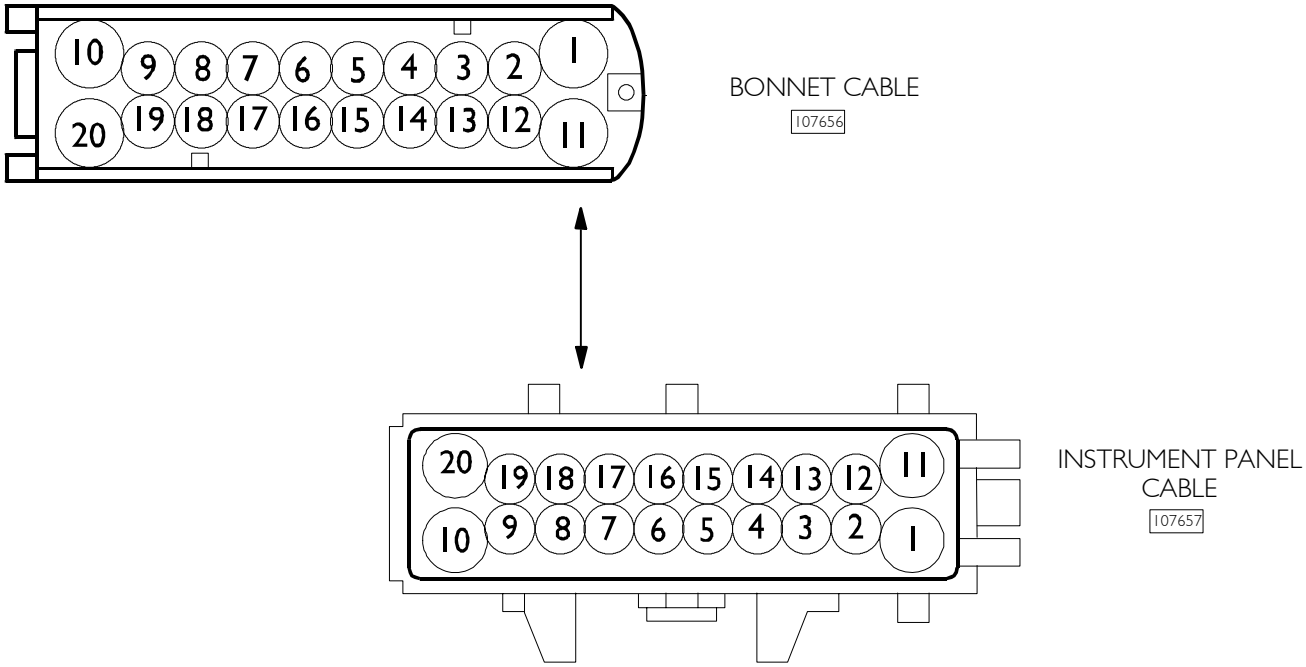
Figure 36



Ref.	Function	Code
1	Negative for rear door actuator	8902
2	Negative for optical indicator for hand brake engaged	6662
3	-	-
4	Negative for fuel level transmitter	0000
5	Signal from fuel level transmitter	5557
6	Positive +30	7772
7	-	-
8	Positive for clearance lights (van)	3325
9	Positive for clearance lights (van)	3324
10	Positive for rear door actuator	8901
11	-	-
12	-	5164
13	Positive for lh front parking light, lh front clearance	3321
14	Positive for rh front parking light, rh front clearance	3320
15	Positive +15	8879
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-

Bonnet - instrument panel junction (600/601A)

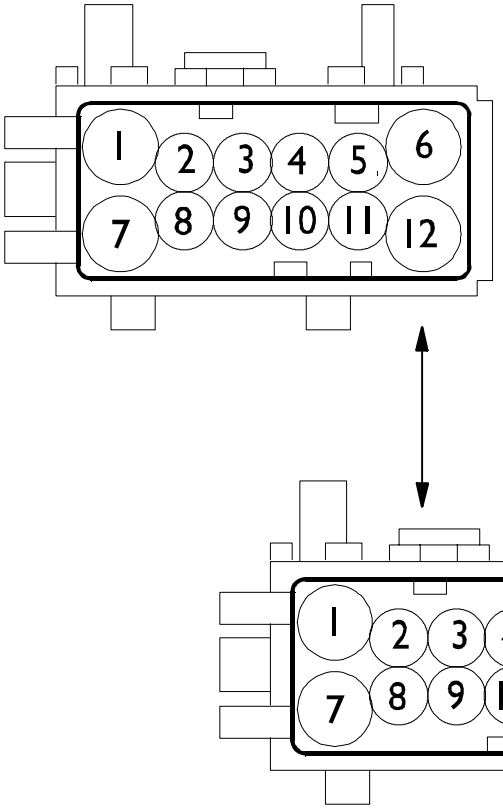
Figure 37



Ref.	Function	Code
1	-	-
2	Positive for reverse headlamp	2226
3	Positive for reverse headlamp	2283
4	Optical indicator TELMA (to Body Computer)	6604
5	Positive for rear fog headlamps	2283
6	Line "K" for air spring suspensions	2294
7	Air spring suspension failure warning lamp (to Body Computer)	6008
8	Positive for plate light	3337
9	Positive for rh blinker	1125
10	Positive for heated rear window	8021
11	Positive for heated rear window	8021
12	Positive for stop rear signalling	1177
13	Positive for heated mirrors	8830
14	Positive for heated mirrors	8830
15	Positive for reverse headlamp	2226
16	Positive for lh rear blinker	1120
17	Positive for rh rear blinker	3322
18	Positive for stop rear signalling	1172
19	Positive for lh rear parking light	3323
20	-	-

Bonnet - instrument panel junction (600/601C)

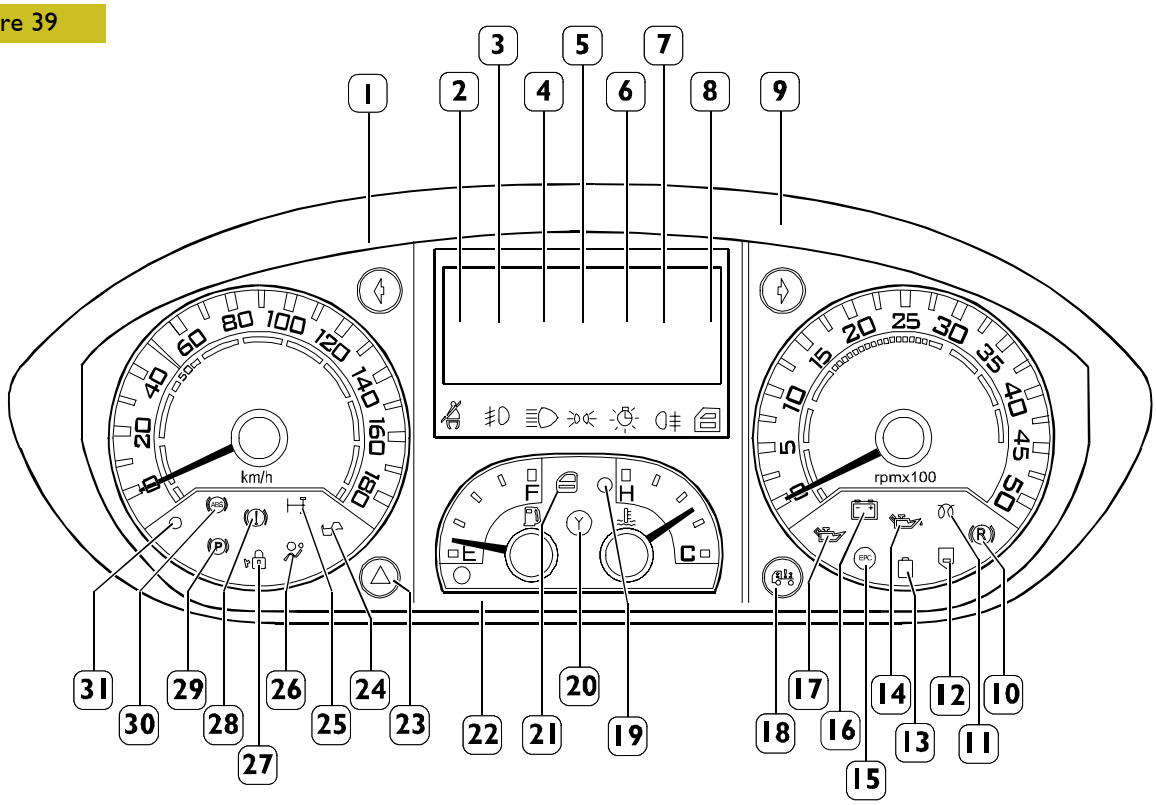
Figure 38



Ref.	Function	Code
1	Positive +15	8879
2	-	5647
3	To Body Computer (instrument panel - PF - pin 23)	5159
4	External temperature sensor for air-conditioner	5532
5	External temperature sensor for air-conditioner	5532
6	-	-
7	Positive for cigarette lighter	7721
8	Positive +15 with the exclusion of users during start-up step	8849
9	Positive +15 with the exclusion of users during start-up step	8849
10	"B" Can line H (parking sensors)	6111
11	"B" Can line L (parking sensors)	6110
12	Positive for cigarette lighter	7721

INSTRUMENT CLUSTER (58919)

Figure 39



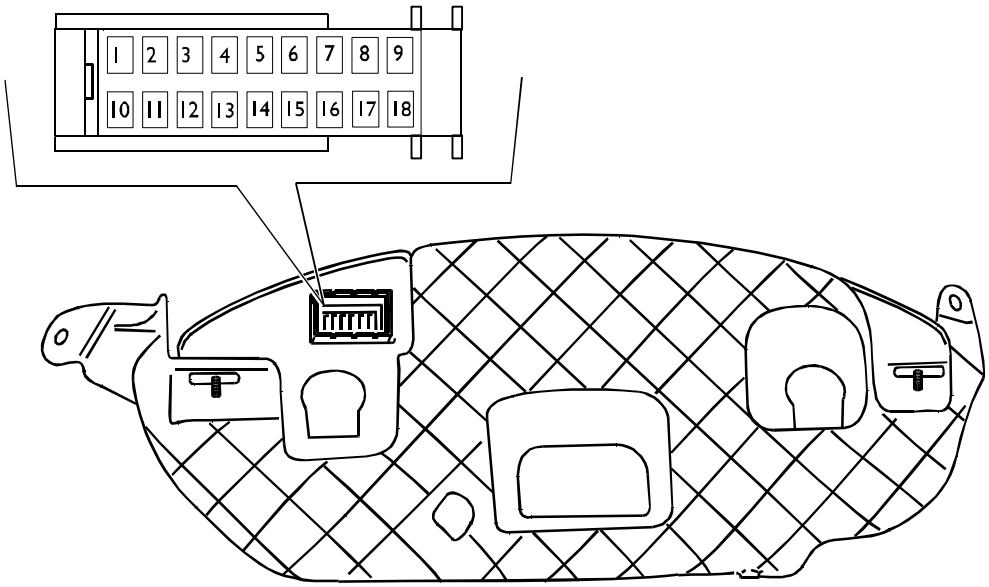
Position	Warning lamps	Colour
1	Lh blinker	green
2	Driver belt unfastened	red
3	Front fog lights	green
4	Full beam headlights	blue
5	Parking lights	green
6	Tractor external light failure	yellow
7	Rear fog lights	yellow
8	Doors open	red
9	Rh blinker	green
10	Decelerator connected	yellow
11	Glow plugs pre-heating	yellow
12	Water present in diesel oil filter	yellow
13	Engine coolant low level	red
14	Engine oil low pressure	red
15	EDC failure	red
16	Battery not being recharged	red

Position	Warning lamps	Colour
17	EOBD	yellow
18	Air spring suspension failure	red
19	Engine coolant high temperature	red
20	Tachograph failure (symbol T)	yellow
21 *	Programmed maintenance	yellow
22	Fuel reserve	yellow
23	Generic failure	yellow
24	Passenger airbag de-activated	yellow
25	Differential locking connected	yellow
26	Air bag failure	red
27	Vehicle protection system failure	yellow
28	Brake failure and EBD failure	red
29	Parking brake	red
30	Failure	yellow
31	Function ESP/ASR	yellow

* "Modal" Version - Outer emergency handle locked by key

Junction connector

Figure 40



REAR VIEW

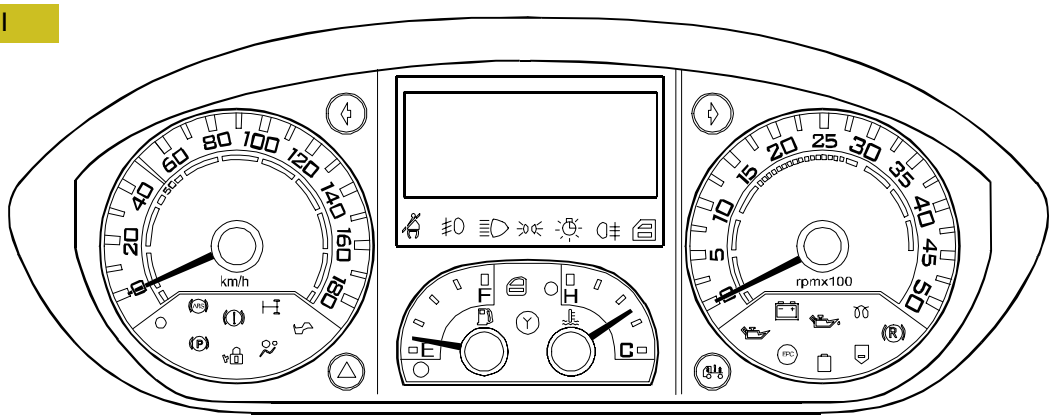
Ref.	Function	Cable Code
1	Earth	0000
2	Positive +30	7772
3	Positive +15	8879
4	-	-
5	"B" CAN Line L	6111
6	"B CAN Line" H	6110
7	Positive for headlight attitude rectifier (position C)	9935
8	Positive for headlight attitude rectifier	9934
9	Earth (to instrument panel switch assembly)	0000
10	-	-
11	-	-
12	-	-
13	To instrument panel switch assembly	9086
14	To instrument panel switch assembly	9085
15	-	-
16	To instrument panel switch assembly	9087
17	Positive for differential locking optical indicator	6603
18	Positive for EDC failure	5180

Where instrument cluster is replaced, reprogram by diagnosis tools.

A = 1 ÷ 9
B = 10 ÷ 18

Display screen

Figure 41



Instrument Cluster: Magneti Marelli

Two versions are present of display screen mounted on instrument cluster:

- Modal version
- Comfort version

the two versions are different in display size and information displayed.

Modal Version:

this version has a smaller display screen and displays:

- total/partial KM
- consumption indication
- time
- headlamp attitude rectifier indication.

Comfort Version:

this version has a larger display screen with 14 characters that are used to display trip computer data, menu with relating messages for settings/adjustments, activation/service messages, failure/warning messages. The display also displays:

- automatic gearbox indication
- time
- indication of danger owing to ice
- adjustable spanner symbol for "service"
- external temperature
- headlamp attitude rectifier indication
- total/partial KM.

Displaying messages on display screen:

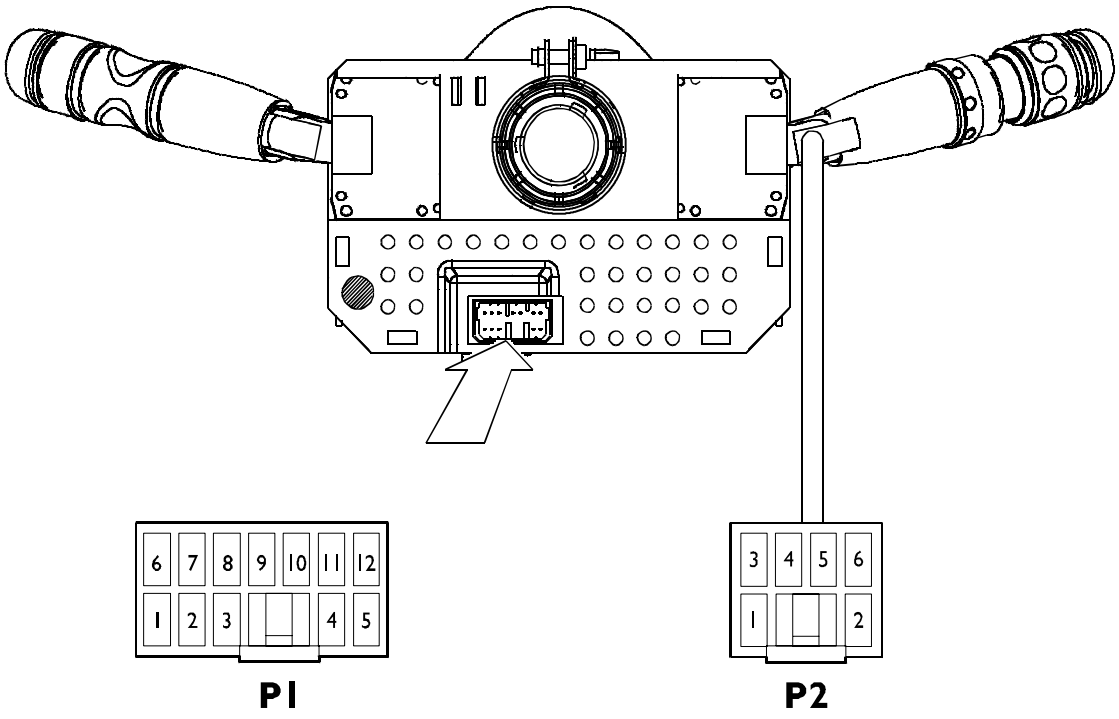
Messages on display screen are divided into four different classes:

- High priority faults (8 display cycles)
- Low priority faults (4 display cycles)
- Information messages (4 display cycles)
- Feedback messages (1 display cycle)
- Messages driven by central unit (while their cause is persisting)

Longer messages are divided into lines with 14 characters appearing on display screen in order that these messages can be displayed entirely.

STEERING COLUMN SWITCH UNIT (54030)

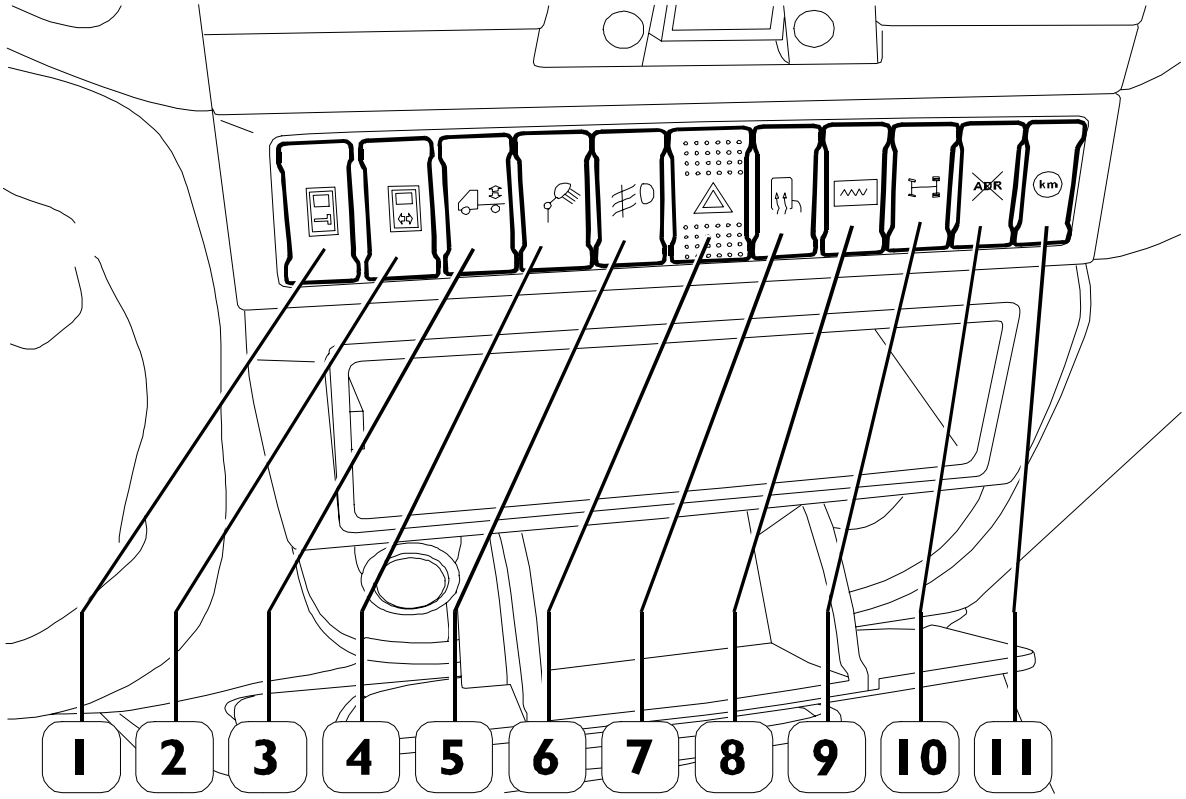
Figure 42



Ref.		Function	Cable colour code
P1 (Black)	1	Windscreen wiper motor control (to Body Computer)	8880
	2	Windscreen washer pump control (to Body Computer)	8886
	3	Earth	0000
	4	Signal earth (to Body Computer)	0050
	5	Blinker control (to Body Computer)	1111
	6	Flashing control (to Body Computer)	8024
	7	Parking lights control (to Body Computer)	3333
	8	Horns	1116
	9	Front fog lights control (to Body Computer)	2228
	10	-	-
	11	Front fog lights control (to front fog lights on pushbutton)	2228
	12	-	-
P2 (Black)	1	Positive for Cruise Control	7155
	2	Positive for Cruise Control	7155
	3	Slow down signal (SET-)	8157
	4	Windscreen wiper reset input	8154
	5	Electric pump for windscreen washer	8155
	6	Supply (+30) for side lights switch	8156

CENTRAL INSTRUMENT PANEL

Figure 43

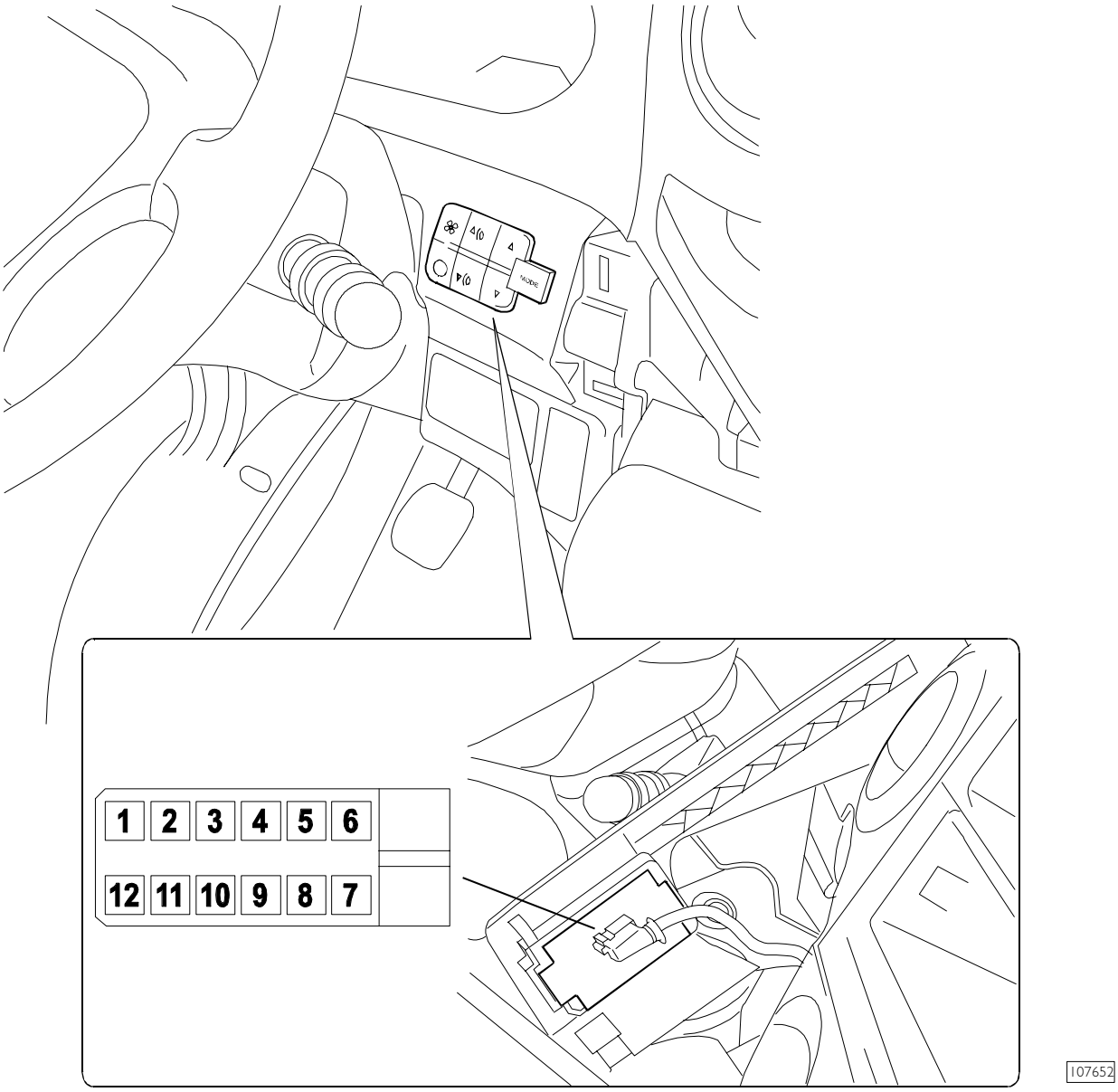


Ref.	Function
1	Hatchback locking
2	Rotating-translating door control
3	Self-levelling air spring suspensions
4	Load area illumination
5	Front fog lights
6	Emergency lights
7	Heated rear view mirrors
8	Heated rear window
9	Rear differential locking
10	Exclusion of ASR
11	Speed limiter in

Pushbutton arrangement may change depending on different preparations.

INSTRUMENT PANEL SWITCH ASSEMBLY (53807)

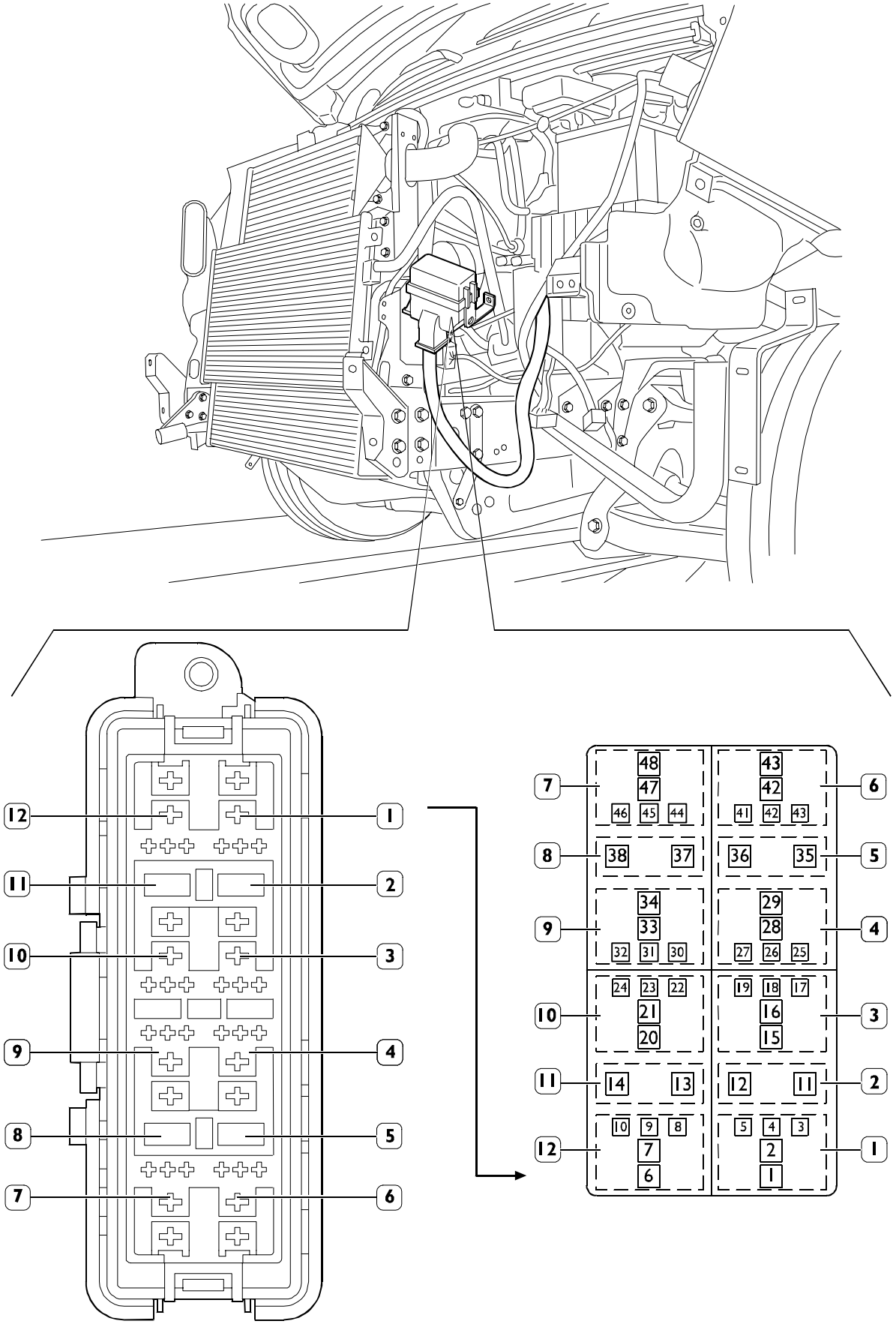
Figure 44



Ref.	Function	Cable Code
1	Positive +15	3320
2	Earth (to Body Computer)	0000
3	-	-
4	To instrument cluster (headlamp attitude)	9085
5	To instrument cluster (MODE +)	9086
6	To instrument cluster (MODE -)	9087
7	-	-
8	-	-
9	Earth (to instrument cluster (TRIP))	0000
10	Air heater	-
11	-	-
12	-	-

OPTIONAL BOX

Figure 45



CENTRAL UNIT FRONT VIEW

CENTRAL UNIT REAR VIEW

Fuses / remote control switches identification

Ref.	Component identification	Function
1	T4	Remote control switch to release retarder with ABS in
2	F55	30A fuse for additional climate control system
3	T15	Remote control switch (at disposal)
4	T22	Remote control switch to enable compressor switching on
5	F25	10A fuse
6	T18	Remote control switch to set gearbox to neutral position (automatic gearbox)
7	T24	Remote control switch to enable PTO switching on
8	F28	30A fuse for positive for rear differential locking central unit
9	T23	Remote control switch to control air-conditioner compressor
10	T21	Remote control switch to warn that compressor for EDC is on
11	F27	20A fuse for positive for headlight wiper
12	T16	Remote control switch for headlight wipers

* Front view

OPT central unit Pin-Out

Ref.	Cable Code	Function
1	9911	Positive for decelerator control switch
2	-	-
3	8879	Positive +15
4	9911	Positive for decelerator control switch
5	0000	Negative from central unit ABS
6	7772	Positive +30 for headlamp wipers from CBA
7	7777	Positive for headlamp wiper pump
8	0000	Negative from Body Computer
9	-	-
10	8849	Positive +15
11	7772	Positive +30 for additional climate control system
12	7772	Positive +30 for additional climate control system
13	7772	Positive +30 for headlight wipers
14	7772	Positive +30 for headlight wipers
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	7772	Positive +30 for remote control switch to warn that compressor is on (to EDC)
21	7772	Positive +30 for remote control switch to warn that compressor is on
22	0000	Earth for remote control switch to warn that compressor is on
23	-	-
24	8163	Connection to 3-level pressure switch for air-conditioner
25	0000	Negative from EDC for remote control switch to enable compressor to be put on
26	-	-
27	7772	Positive +30 for remote control switch to enable compressor to be put on
28	0000	Earth for remote control switch to enable compressor to be put on
29	0000	Negative from compressor control remote control switch
30	0000	Negative from remote control switch to enable compressor to be put on (30)
31	-	-
32	0000	Connection to 3-level pressure switch for air-conditioner
33	8883	Positive for air-conditioner compressor control
34	9067	Positive for air-conditioner compressor control remote control switch
35	7772	Positive +30
36	7772	Positive +30
37	8887	Positive +15 for rear differential locking central unit
38	8887	Positive +15 for rear differential locking central unit
39	7772	Positive +30 for remote control switch to put gearbox in neutral position (automatic gearbox)
40	-	-
41	0000	Negative from automatic gearbox central unit
42	8888	Connection to starter
43	8888	Connection to start-up switch
44	7155	Positive for remote control switch to enable PTO to be put on
45	9131	Connection to total power take-off switching on central unit
46	0000	Earth
47	-	-
48	0000	Earth

"CAN LINES" SYSTEM DESCRIPTION

The electrical / electronic system is characterised in the presence of two communication lines which manage vehicle electrical system, directly controlling body functions, access, visibility, board information, comfort, etc.
The structure consists of two CAN communication networks to which all electronic central units present and instrument cluster complete with display screen are connected.
A new central unit is also present: the Body Computer, which manages many functions present and communicates with both CAN lines. For diagnosis, 38-pole connector is not present any more; on the contrary, a 16 pin connector is present named EOBD.
In particular, on CAN line named **Ccan**, connected are central units relating to vehicle systems and information for driver:

- ❑ Yaw sensor present with ESP8
- ❑ ABS
- ❑ Automatic gearbox
- ❑ EDC16
- ❑ Decelerator
- ❑ Digital tachograph
- ❑ Body Computer

This communication line is characterised in high speed data transmission relevant to electronic systems connected to it. It is comparable to VDB line present on other vehicles.

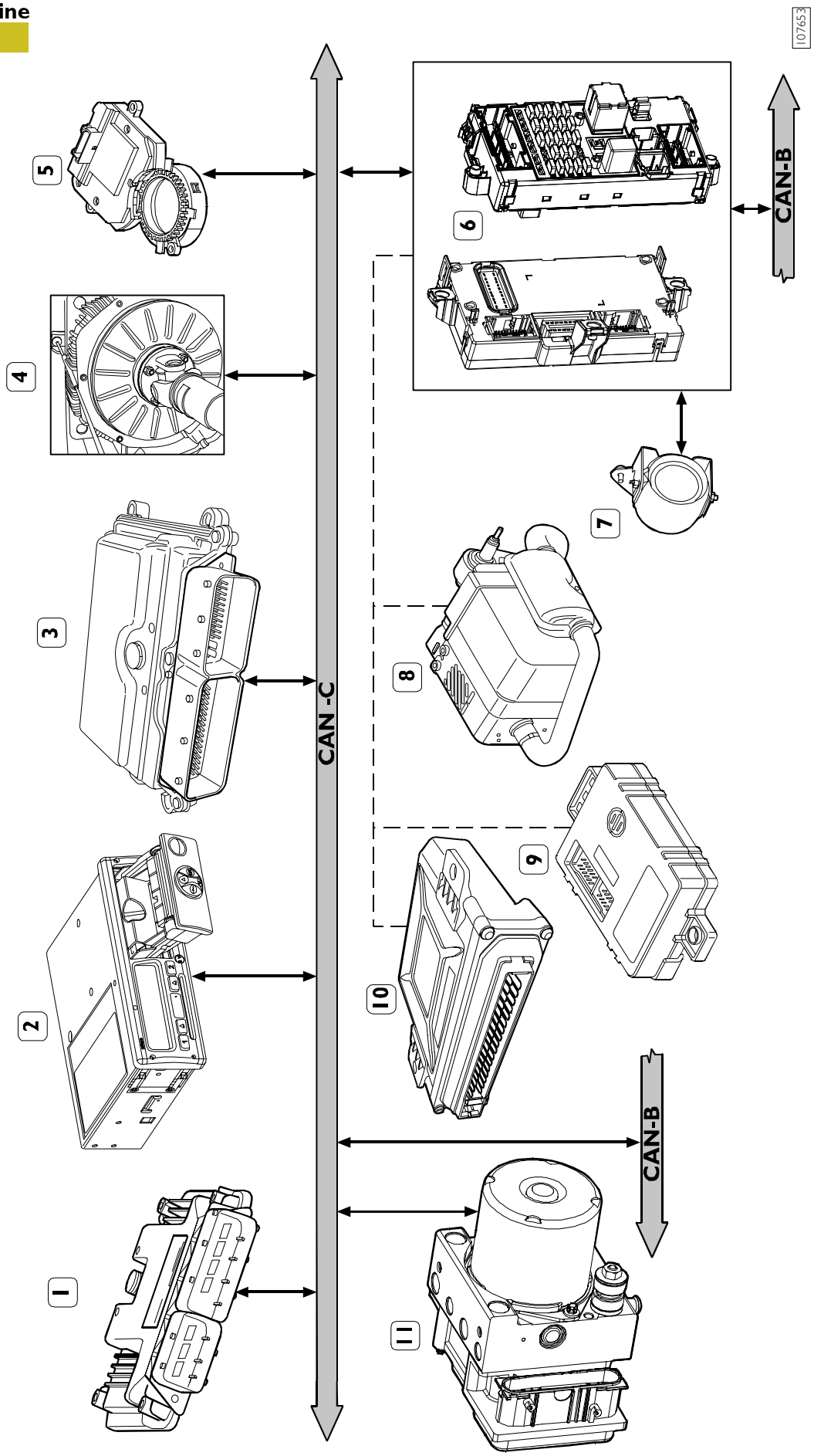
Communication line named **Bcan** enables communication between Body Computer and the various central units employed for the various board services. To this line connected is the instrument cluster, equipped with a display screen.

This communication line enables data transmission at a lower speed than above Ccan line.
Central units connected to this line:

- ❑ Body Computer
- ❑ Instrument cluster
- ❑ Radio and navigator
- ❑ Air Bag
- ❑ Rotating-translating door

"C" CAN line

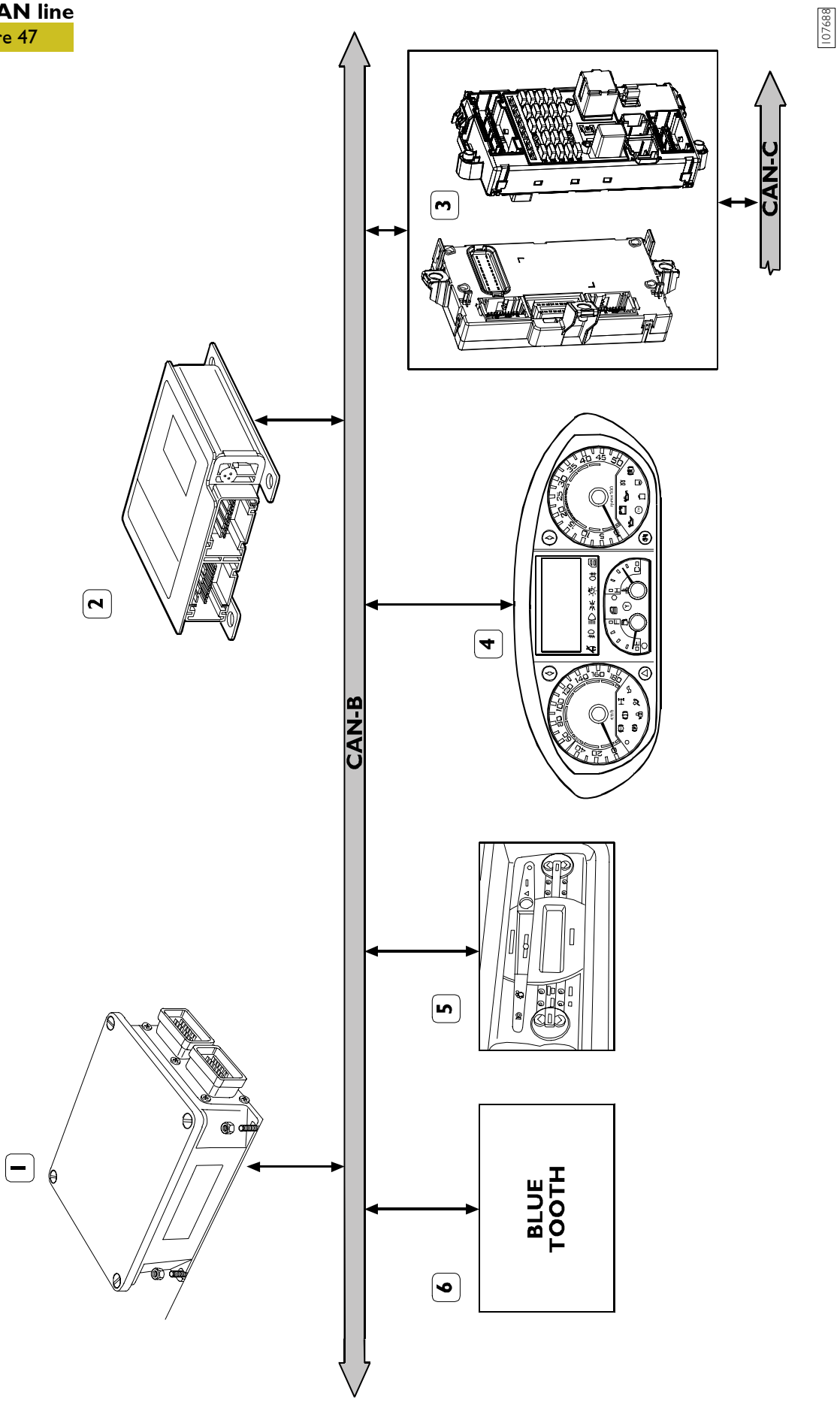
Figure 46



1. Central unit EDC16 - 2. Digital tachograph - 3. Automatic gearbox central unit - 4. Decelerator - 5. Steering angle sensor (ESP8) - 6. Body Computer - 7. Alarm siren - 8. Additional heater - 9. Climate control system central unit - 10. Central unit WABCO - 11. Central unit ABS8/ESP8

"B" CAN line

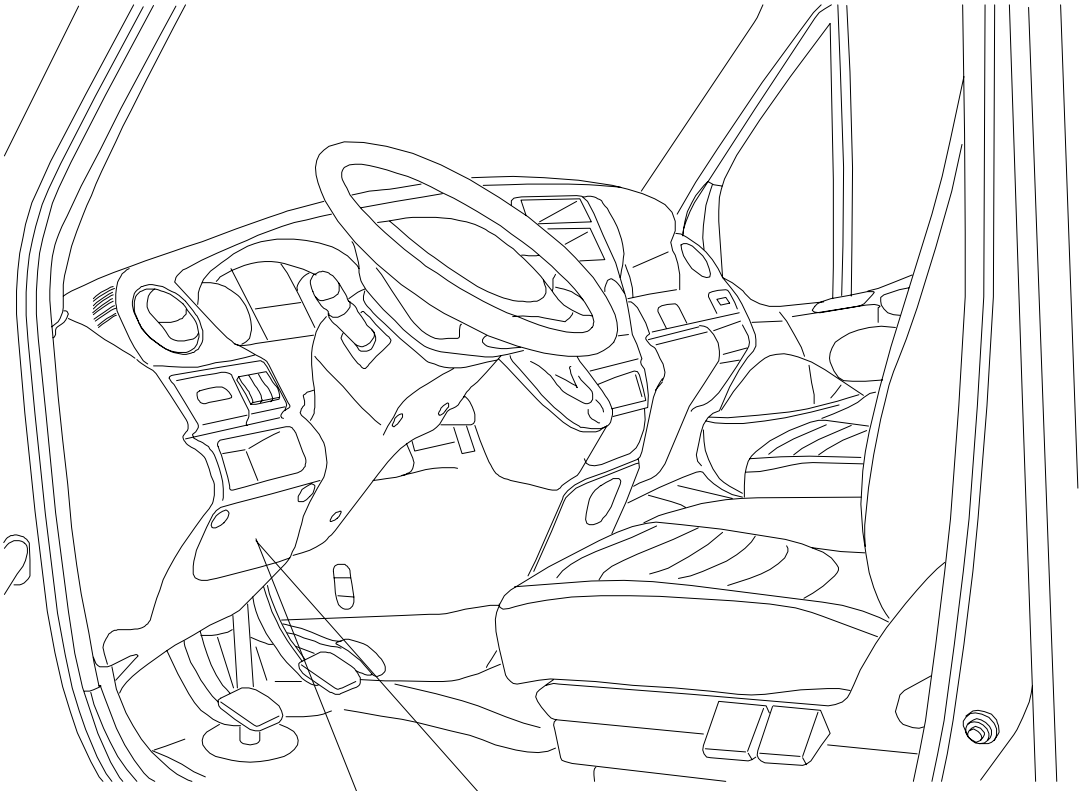
Figure 47



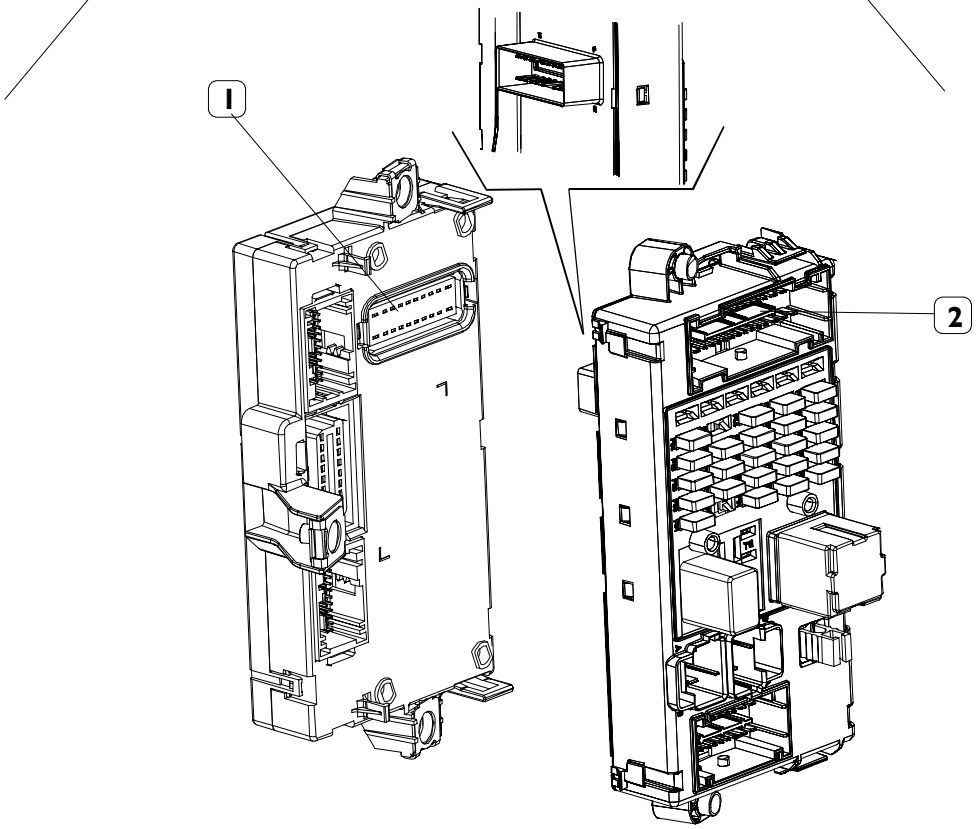
1. Rotating-translating door central unit (start of 2007) - 2. Air Bag central unit - 3. Body Computer - 4. Instrument cluster - 5. Radio / navigator - 6. Blue Tooth

BODY COMPUTER - (86116)

Figure 48



107624



107673

1. Body Computer - 2. Central unit "CPL"

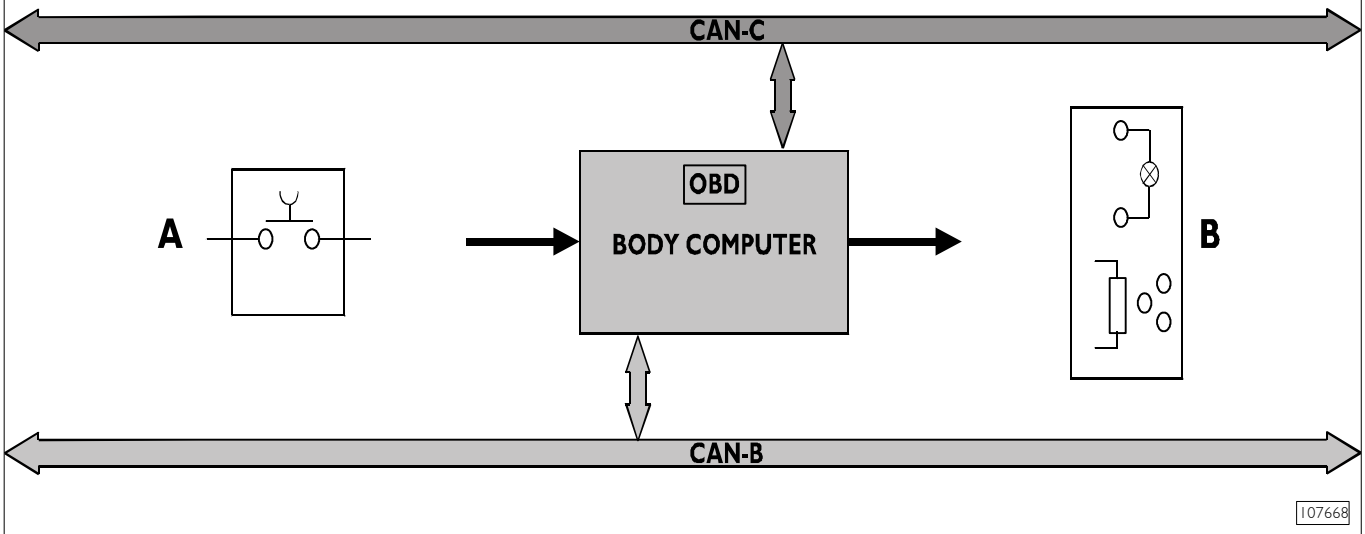
Description

The Body Computer is the central unit of the electrical system of vehicle under examination. Its task is to manage main functions present.
Inside, it integrates "immobilizer" function; therefore, an external central unit is not present any more for this function.
Further, it manages:

- External and internal illumination
- Central door locking actuator controls, windscreen washers and wipers, front electric window winders, etc.
- Acquisition of switches and controls from steering column switch unit, pushbuttons, etc.

Inside, it integrates diagnosis connector EOBD (16 pins) for board diagnostics (previous diagnosis connector is not present any more), it communicates with the two CAN lines present (Bcan, Ccan) and instrument cluster. It is mounted in the cab behind interconnection central unit "CPL" and interfaces with it through a 20 pin lamellar connector located inside the component.

Figure 49



A. Input signals - B. Output signals

It interfaces with vehicle system through three connectors: two connectors are located in front side and one connector is located in rear side accessed by tilting the whole assembly through unscrewing special securing screws.

Front connectors:

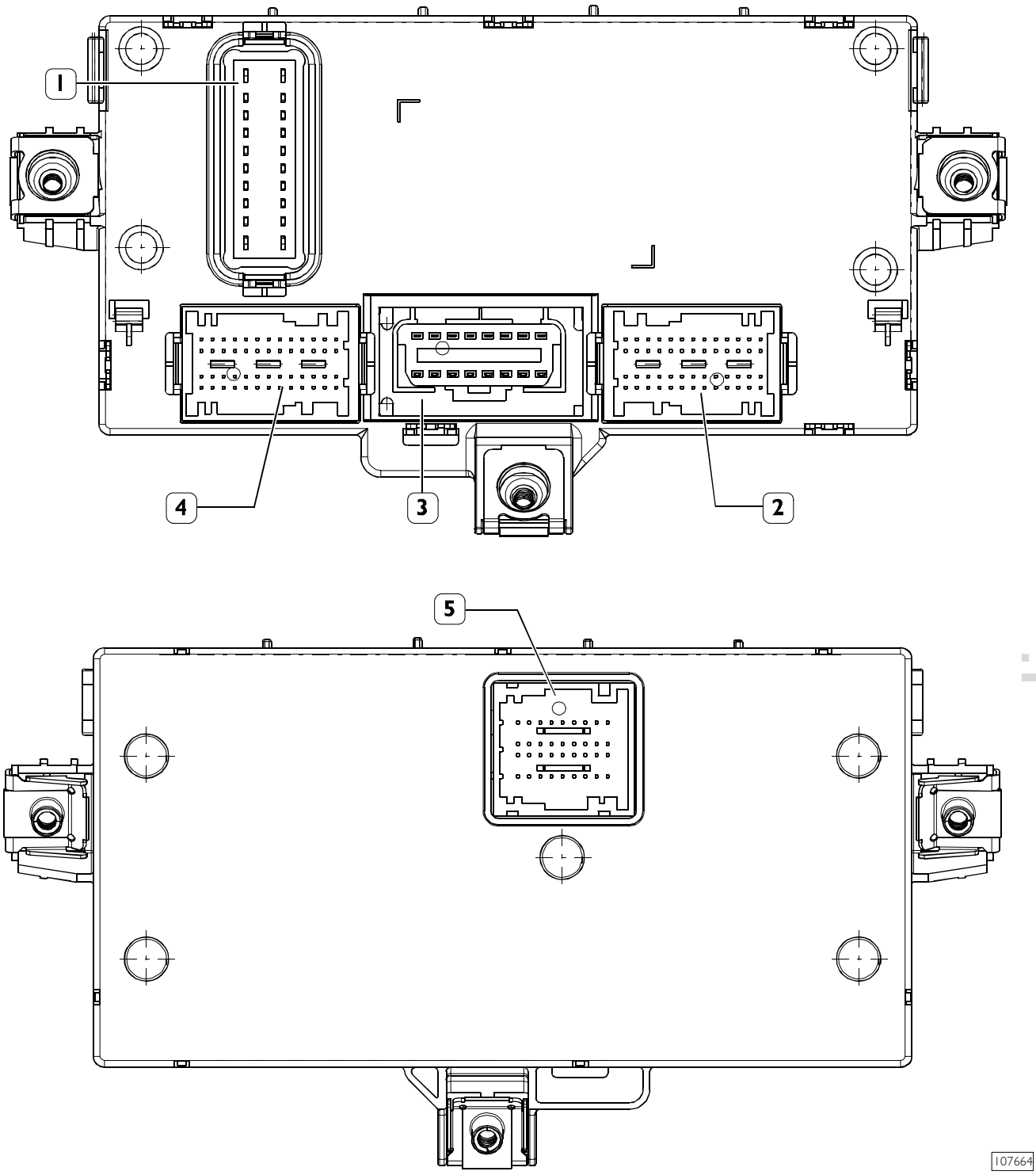
- cab wiring harness (black) connector "LN"
- bonnet wiring harness (blue) connector "AV"
- diagnosis connector EOBD

Rear connector:

- instrument panel wiring harness (blue) connector "PF"

A closing resistance is present on "C" CAN line positioned in the vicinity of steering column switch unit inside instrument panel.

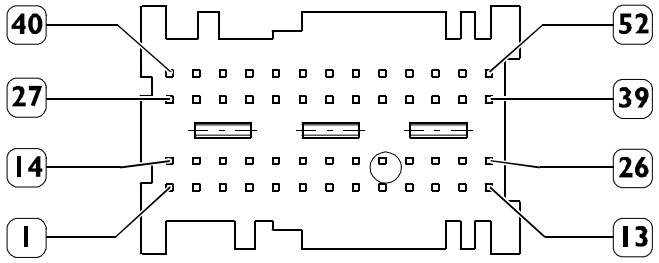
Figure 50



1. Connector "CY" for junction with "CPL" (interior) - 2. Junction connector "AV" (bonnet) - 3. Diagnosis connector "EOBD" - 4. Junction connector "LN" (cab) - 5. Junction connector "PF" (instrument panel)

Black cab junction connector "LN"

Figure 51



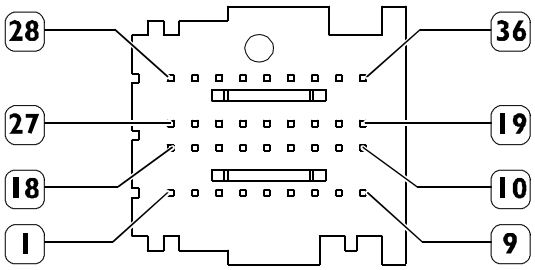
107661

Ref.	Function	Cable Code
1	-	-
2	-	-
3	-	-
4	Central locking "H6"	0000
5	Positive for lh lateral blinker	1126
6	Positive for rh rear blinker	1125
7	Fuel level gauge "PIN 4"	5557
8	Positive for lh rear parking light	3323
9	Positive for rh rear parking light	3322
10	-	-
11	Earth for roof lamp switching on	0003
12	Positive for plate light	3337
13	(Driver - passenger) central locking "PIN 1"	8180
14	-	-
15	-	-
16	-	8879
17	-	5164
18	Positive for lh rear blinker	1120
19	Positive for rh blinker	1124
20	Signal for hand brake optical indicator	6662
21	Fuel level gauge "PIN 3"	0000
22	Earth for roof lamp switching on	0003
23	-	-
24	Line "K" for air spring suspension central unit	2294
25	Air spring suspension failure warning lamp	6008
26	Positive for rh rear fog light	2283
27	13-pole socket PIN 9	6120
28	Negative for illumination pushbutton with tools	0000
29	Side hatch roof lamp	4110
30	Cab interior roof lamp	4111
31	Positive for rh stop rear light	1172
32	Positive for rear roof lamp	7772
33	Earth for roof lamp switching on	0003
34	Earth for roof lamp switching on	0003
35	Earth for roof lamp switching on	0003
36	Central locking "C7"	0000

Ref.	Function	Cable Code
37	-	-
38	-	-
39	-	4112
40	Decelerator "TELMA" optical indicator	6604
41	Central locking "C2"	0000
42	Central locking "A2"	0000
43	Positive for lh rear fog light	2283
44	Positive for lh stop rear light	1177
45	-	-
46	-	6606
47	-	-
48	_	6630
49	Roof lamp for side hatch illumination	4113
50	-	-
51	-	-
52	-	-

Blue instrument panel junction connector "PF"

Figure 52

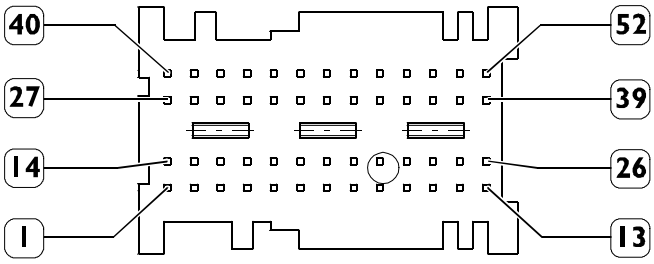


107662

Ref.	Function	Cable Code
1	-	-
2	Parking lights (from steering column switch unit)	3333
3	Positive for instrument cluster	7772
4	Flashing remote control switch control (from steering column switch unit)	8024
5	Instrument cluster "B" CAN line L	6111
6	Instrument cluster "B" CAN line H	6110
7	Positive for blinkers (from steering column switch unit)	1111
8	Earth from instrument panel switches	0000
9	Earth (from steering column switch unit)	0050
10	Earth	0000
11	Positive for diagnosis connector	7797
12	Climate control system central unit line "K"	2296
13	-	-
14	-	-
15	-	-
16	-	-
17	-	0000
18	Positive for the illumination of the symbols of switches	3320
19	Earth	0000
20	Negative for cab roof lamp switch	0000
21	Positive for the illumination of the symbol of heated rear window on	6653
22	-	5647
23	Camera PIN B-1 (visual system for reverse gear)	5+59
24	Air Bag "B" CAN line H	6110
25	Air Bag "B" CAN line L	6111
26	-	-
27	Positive (+15)	8849
28	Positive for windscreen wiper (from steering column switch unit)	8880
29	-	-
30	Positive for windscreen washer pump (from steering column switch unit)	8886
31	Positive for instrument cluster (+15)	8879
32	Negative from heated rear window switching on pushbutton	0000
33	-	-
34	Negative for emergency lights switching on (from pushbutton)	1113
35	Fog front headlamps power supply (from steering column switch unit)	2228
36	Negative for instrument cluster	0000

Blue bonnet junction connector "AV"

Figure 53



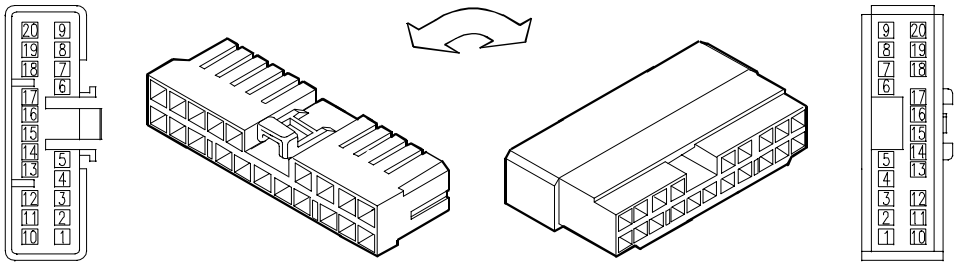
107661

Ref.	Function	Cable Code
1	Negative from fuel filter clogged sensor	5531
2	-	2663
3	Positive for general power-assisted units (+15)	8879
4	-	-
5	For rh front blinker	1129
6	-	-
7	"IMMOBILIZER" antenna PIN 2	8092
8	"IMMOBILIZER" antenna PIN 1	8092
9	Signal from sensor for engine water level gauge	5520
10	Electronic tachometer transmitter "PIN 3"	5517
11	Positive +15	8879
12	Positive +15	8879
13	-	-
14	-	-
15	-	-
16	Positive +15	8879
17	-	-
18	-	-
19	Fixed stop for windscreen wiper "PIN 2A"	8873
20	Negative for remote control switch to switch on headlight wipers	0000
21	Negative for automatic gearbox central unit "PIN 45"	0000
22	Line K for central unit ABS / ASR	2299
23	-	-
24	Negative from brake liquid level sensor	6661
25	Generator charge optical indicator	7778
26	Line "K" for central unit EDC 16	2298
27	Negative for electronic tachometer transmitter "PIN 2"	0058
28	Positive for rh front blinker	1123
29	Control for remote control switch to insert windscreen wiper 1st/2nd speed	8879
30	Central locking antenna "PIN 1"	-
31	-	-
32	Signal from (front / rear) shoes wear sensors	6004
33	Negative from engine bonnet opening switch	5621
34	Signal for antitheft system	9142
35	-	-
36	-	-

Ref.	Function	Cable Code
37	Speed signal (from tachometer) for EDC / automatic gearbox	5517
38	External temperature signal (air-conditioner)	5532
39	Positive for rh front parking light - rh front clearance light	3320
40	Control for remote control switch to switch on windscreen wiper	8879
41	-	-
42	-	-
43	Central locking antenna "PIN 2"	-
44	"C" CAN Line L – Steering angle sensor (PIN 1) - CAN line closing resistance	
45	"C" CAN Line H - Steering angle sensor (PIN 3) - CAN line closing resistance	
46	Positive for antitheft siren (+30)	
47	Line K for additional heater	
48	"C" CAN Line L - ABS / automatic gearbox / EDC16	2950
49	"C" CAN Line H - ABS / automatic gearbox / EDC16	8950
50	-	-
51	-	-
52	Positive for lh front parking light - lh front clearance light	3321

FITTER CONNECTOR (61071)

Figure 54



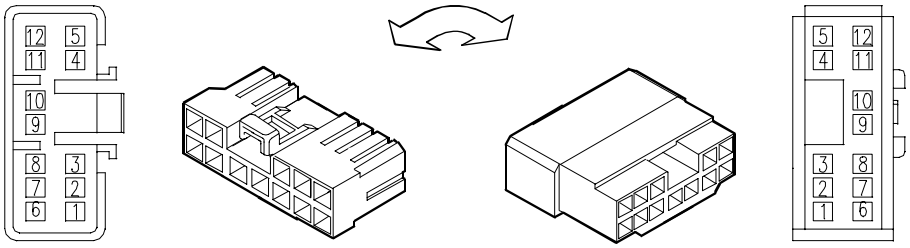
101564

Ref.	Function
1	-
2	-
4	-
5	Hand brake in
6	-
7	Positive K58 (external lights)
8	Alternator charge (alternator signal L)
9	Clutch status (activated / not activated)
10	Reverse gear engaged (positive)
11	-
12	Cruise control (set +)
13	Cruise control (set -)
14	Cruise control (reset)
15	Cruise control (on)
16	-
17	Earth
18	Power take-off 1
19	Power take-off 2
20	Power take-off 3

Positioned in the cab near junction connectors - Air-Bags (at the bottom to the right)

FITTER CONNECTOR (72068)

Figure 55



101554

Ref.	Function
1	Activating secondary speed limiter
2	Activating speed limiter
3	Selecting idling and 2 speeds
4	Vehicle speed signal
5	Positive +15 (key)
6	Power take-off activated
7	Horn activated
8	-
9	-
10	Engine rotation speed
11	-
12	-

ELECTRONIC INJECTION EDC16
Particular features of engines Euro 4

To observe emission limits Euro 4, engines E4 have following features:

- E.G.R. system present;
- D.P.F. filter (solid particulate trap with constant regeneration) present;
- new digital flow meter HFM6 (positioned after the air filter);
- air pressure sensor present (on the intake manifold after the intercooler);
- fuel electrical pump suitable to pressurise the circuit according to specifications Euro 4;
- vehicle wiring harness for central unit EDC16C39 new electrical scheme;
- throttle valve present driven by EDC central unit (positioned on the intake manifold after the intercooler).

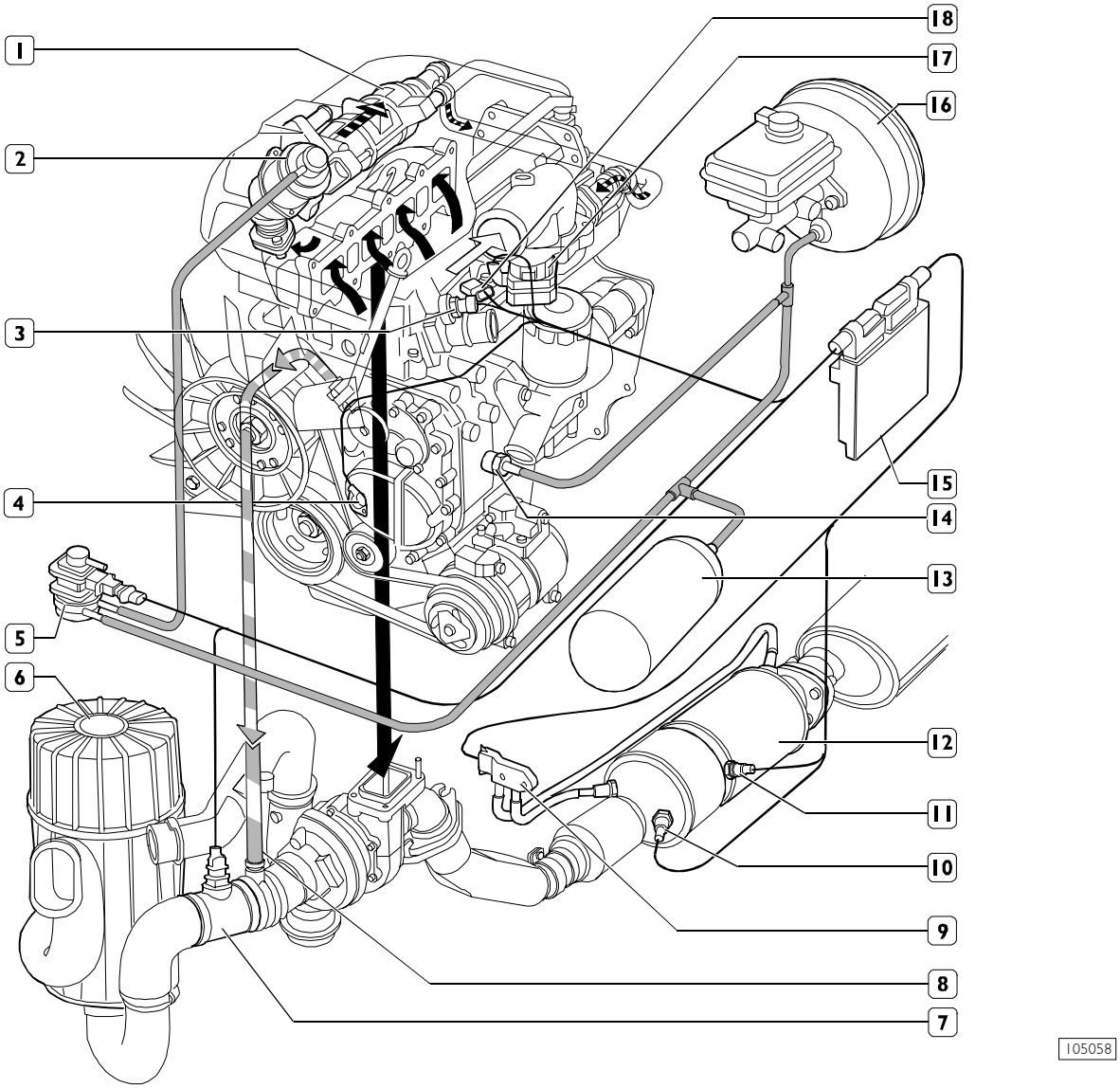
Constant regeneration particulate trap is mounted on engine exhaust. Through data processing (engine rpm's, H2O temperature, oil temperature, lambda probe signal, etc.), the central unit calculates the quantity of particulate accumulated in filter and chooses to increase exhaust gas temperature (through post-injection) in order to burn particulate accumulated inside filter.

Further, vehicles (for compliance with regulations Euro 4) differ from the ones of present production mainly in following components:

- ❑ fitting with catalytic converter DPF (Diesel Particulate Filter) provided with exhaust gas temperature sensors,
- ❑ differential pressure (Delta-p) sensor for detecting DPF catalyst particulate filter clogging,
- ❑ fuel electric pump with different characteristics for boosting fuel system pressurisation,
- ❑ electrical wiring harness.

System to reduce pollutants at exhaust

Figure 56



1. E.G.R. heat exchanger - 2. E.G.R. valve - 3. Engine coolant temperature sensor - 4. Engine rpm sensor - 5. Modulator solenoid valve - 6. Air filter - 7. Air flow rate meter (flow meter) - 8. Oil vapours recirculation tube - 9. Differential pressure (delta p) sensor - 10. Inlet exhaust gas temperature sensor - 11. Outlet exhaust gas temperature sensor - 12. DPF catalysed silencer - 13. Vacuum tank - 14. Vacuum unit fitting - 15. EDC 16 central unit - 16. Power-assisted clutch - 17. Throttle valve assembly - 18. Air pressure sensor.

General

To constrain exhaust emission values of pollutants such as nitrogen oxides (NOx), hydrocarbons (HC) and particulate (PM) within limits requested by Euro 4 regulation, the engine was equipped with an EGR system paired to DPF catalysed silencer for the post-treatment of above substances.

E.G.R. (Exhaust Gas Recirculation) SYSTEM

Operation

E.D.C. 16 electronic central unit processes information from atmospheric pressure sensor, water temperature sensor, engine rpm sensor, accelerator pedal potentiometer and drives modulator solenoid valve and throttle valve with PWM signals, according to modes properly programmed in its memory.

Modulator solenoid valve, whenever driven by E.D.C. 16 central unit, puts under-pressure power-assisted brake circuit into communication with E.G.R. circuit. In E.G.R. circuit there is set an under-pressure value depending on drive signal.
Such under-pressure acts on pneumatic valve E.G.R. membrane calling and lifting the cut-off unit, which normally shuts out exhaust gas passage towards intake.

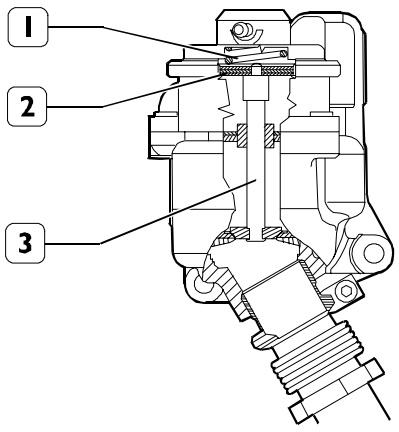
In this way, exhaust gasses, through the heat exchanger, are carried into throttle valve assembly chamber to be mixed to air from intercooler and flowed into intake manifold.

During engine operation steps not requiring gas recirculation (particulate filter regeneration, startup, cold engine, idling rotation speed, load request, high elevation), the central unit control signal to modulator solenoid valve is suppressed. The solenoid valve closes the connection between power-assisted brake under-pressure circuit and E.G.R. circuit, and simultaneously restores atmospheric pressure into E.G.R. circuit.

Main system components

E.G.R. valve

Figure 57



E.G.R. valve is mounted on heat exchanger end.
To ensure higher efficiency and longer durability to the valve, the valve is cooled by engine coolant from heat exchanger.

Recirculated gas quantity regulation is through a mushroom valve, pneumatically driven under under-pressure; the under-pressure, through calibrated section fitting, is taken from the tube connecting the vacuum unit to power-assisted brake.

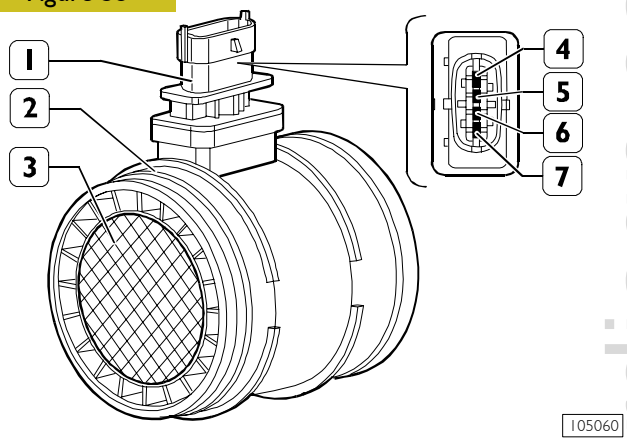
Driving under-pressure modulated by the solenoid valve and overcoming the force exerted by counteracting spring (1), will lift membrane (2), connected to cut-off unit (3), which moves upwards and enables the recirculation of burnt out gasses towards inlet manifold.

540746 Modulator solenoid valve

Modulator solenoid valve is an integrating part in E.G.R. system and power-assisted brake under-pressure tubes.
It is a proportional solenoid valve modulating E.G.R. valve driving under-pressure depending on PWM signal generated by EDC 16 central unit.

85159 Air flow rate meter (flow meter)

Figure 58



1. Connector - 2. Flow meter body - 3. Recirculated oil vapours air inlet grid - 4. Power supply - 5. Earth - 6. Inlet air temperature sensor - 7. Flow rate output signal.

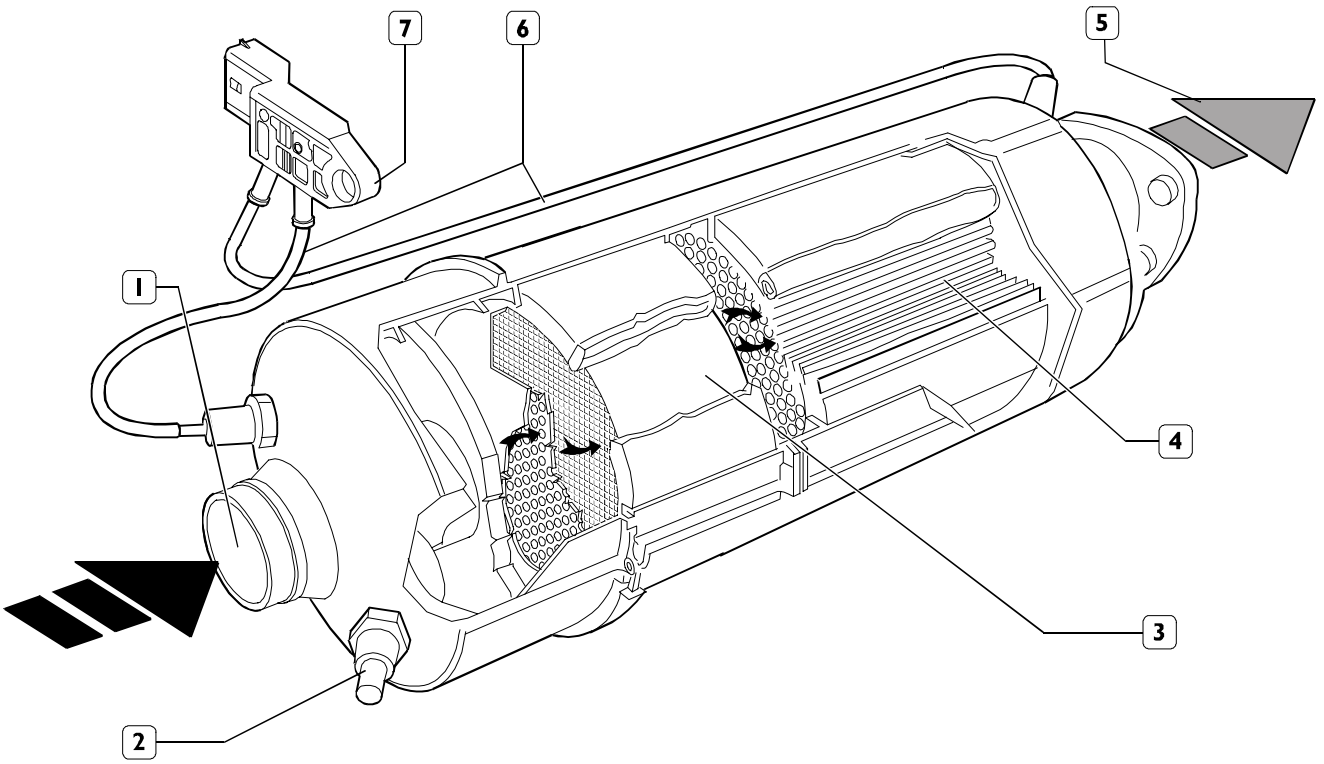
The flow meter is a heated film type flow meter and is placed between turbocharger and intercooler.
Inside the flow meter, sucked in air temperature sensor is built in.

Operation

Operation principle is based on a heated membrane put in between a measurement channel through which inlet air entering the engine is flowing.
The heated film membrane is kept at constant temperature (about 120 °C, higher than incoming air temperature) by heating resistance.
The air mass which runs through measurement channel tends to take out heat from the membrane; therefore, to keep the membrane at constant temperature, the current must run through the resistance.
Absorbed current is proportional to air mass flowing to engine; the current is measured by a Wheatstone bridge and signal obtained is sent to the electronic central unit.

507130 D.P.F. (Diesel Particulate Filter) CATALYST

Figure 59



D.P.F. CATALYST VIEW

1. Exhaust gas inlet- 2. Exhaust gas temperature sensor connection - 3. Catalyst module - 4. Particulate filter - 5. Exhaust gas outlet - 6. Pipes connecting pressure sensor to catalyst - 7. Differential pressure (Δp) sensor

Description

D.P.F. catalyst is made up of an oxidiser catalyst and a particulate filter.
Oxidiser catalyst (3) is an exhaust gas post-treatment device. Active substances, contained in the catalyst, oxidise, at 250 °C÷450 °C temperature, carbon oxide (CO) and hydrocarbons (HC), turning them into carbon dioxide (CO_2) and steam (H_2O).

Catalyst module is made up of a ceramic structure impregnated with platinum, as platinum is a catalysing substance in oxidation reactions. Exhaust gasses heat the catalyst, so triggering the conversion of pollutants into inert compounds.

Particulate filter (4), connected to the catalyst, has a double task: retaining particulate particles (PM) depositing between the pores of the ceramic structure of which the filter is made up and working as a particulate particles combustion chamber when the filter is being clogged.

If filter interior is kept at a temperature higher than 530 °C and oxygen percentage is higher than 8% (oxygen being produced by the decomposition of nitrogen oxide NO_2), then some combustion reactions, boosted by the catalyst put before the filter, burn particulate particles (regeneration), so keeping the filter clean.

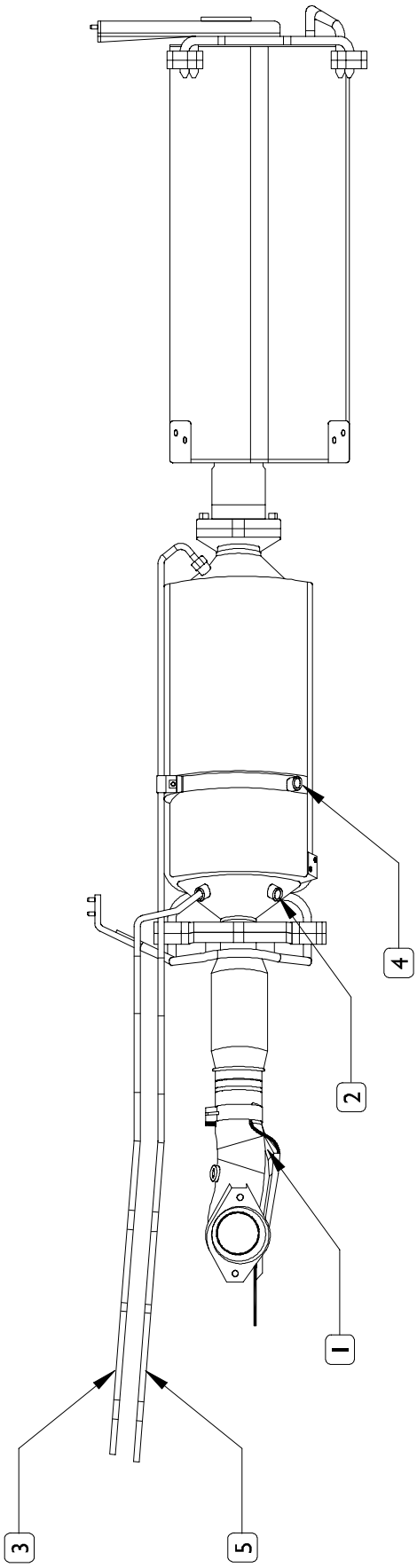
On the contrary, if its temperature is lower, the filter is clogged, with negative effects, on counterpressure, on exhaust gasses generated by the filter.

In this case, to regenerate the filter, temperature of exhaust gasses is artificially raised (up to 630 °C) by fuel post-injection.

A differential pressure sensor (7), connected to D.P.F. catalyst, as it detects a pressure difference between inlet and outlet, sends a (feed-back) signal to the central unit to warn about particulate filter possible clogging.

Particulate filter (components location)

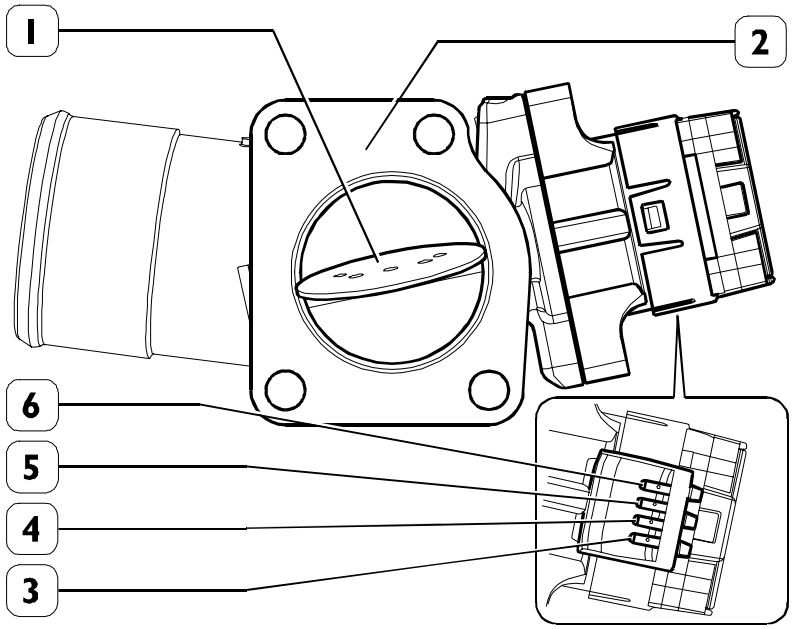
Figure 60



1. Lambda probe - 2. Exhaust gas temperature sensor - 3. TO Pressure sensor (at filter inlet) - 4. Exhaust gas temperature sensor - 5. TO Pressure sensor (at filter outlet)

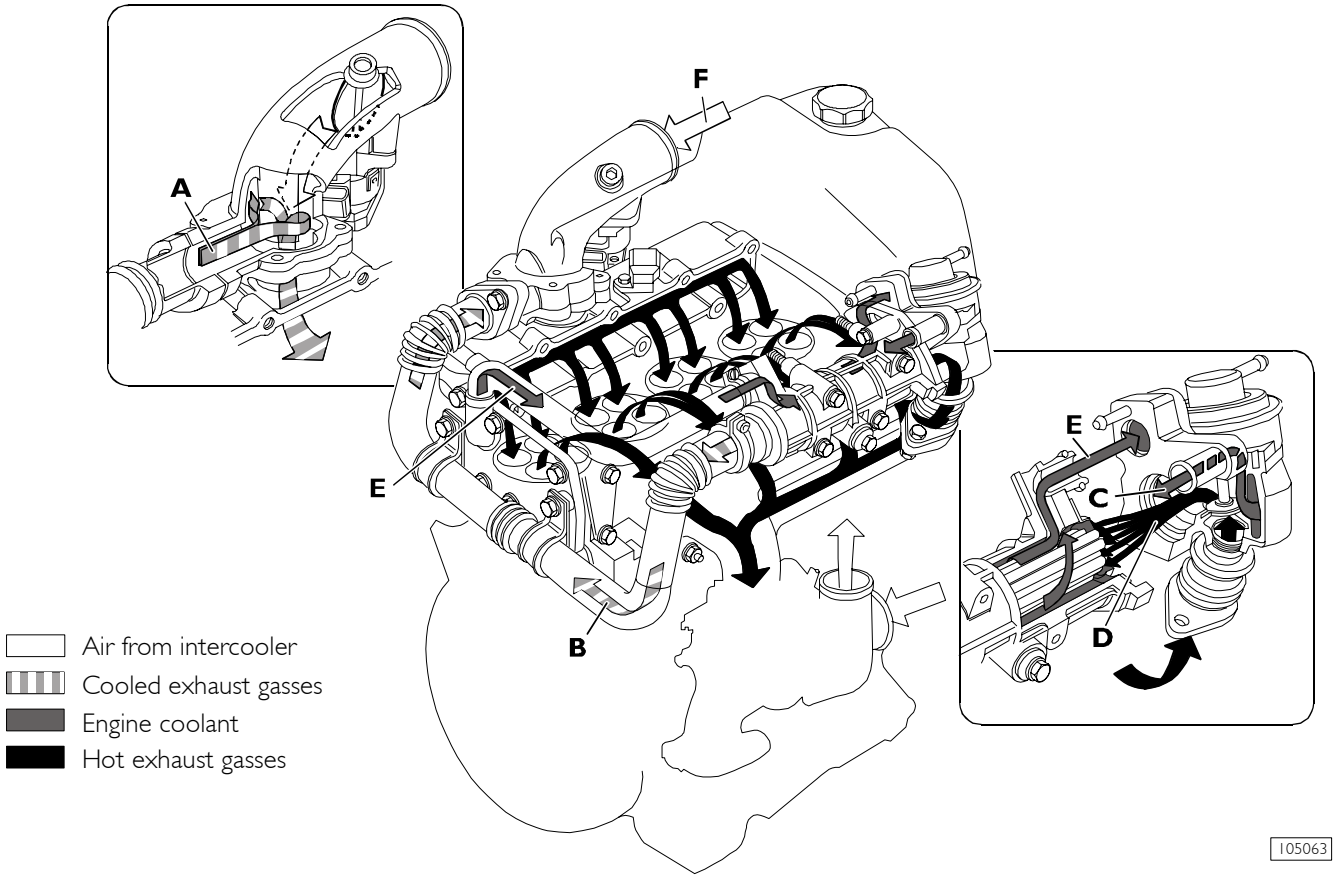
540760 Throttle valve assembly

Figure 61



1. Throttle valve - 2. Electrical actuator - 3. Throttle position signal - 4. Earth - 5. Positive - 6. PWM signal

Figure 62



A. Inlet exhaust gasses - B. Cooled exhaust gasses - C. Coolant to heater -
D. Exhaust gasses from E.G.R. valve - E. Coolant coming in from cylinder head - F. Air from intercooler

The assembly of (normally open) throttle valve is mounted on inlet manifold. Its task is to regulate the flow rate of air coming in from the intercooler that is to be mixed with exhaust gasses recirculated by E.G.R. valve according to a programmed percentage.
The throttle valve is driven by an electrical actuator controlled by a PWM signal from central unit EDC 16.

REPLACING THE COMPONENTS

Replacing particulate filter

Particulate filter, as it is suggested by its name, has the task to filter particulate particles depositing between the pores of the ceramic structure of which the filter is made up.

If the filter is maintained at a temperature over 530 °C and with adequate oxygen content, some reactions, boosted by (Oxicat) catalyst put before the filter, allow particles to burn, so keeping the filter indefinitely clean.

On the contrary, if its temperature is lower, the filter is forced to become clogged, with negative effects, on counterpressure, on exhaust gasses generated by the filter.

To allow to "clean up" the filter at proper time intervals, temperature of exhaust gasses is artificially raised (up to 630 °C) at filter inlet by an hexothermic reaction which takes place in the catalyst put before the filter on exhaust line.

With a lag, after combustion dead point, such as to ensure filter non involvement with combustion, a small fuel quantity is injected which vaporises in combustion chamber and, dragged by exhaust gas draught, is sent to the catalyst. The catalyst (made of noble metals, mainly Platinum) boosts filter combustion through the catalyst itself, easily allowing to reach 630 °C temperature. A regulator of the central unit meters both post-injection and oxygen quantity (closing throttle valve) in order to maintain regeneration optimal temperature.

The reaction can only take place if gas temperature at catalyst inlet is over 230 °C. Proper engine management maps enhance exhaust gas temperature increase when it is necessary to start up a regeneration.

E.G.R. system is of course shut out during regeneration in order to prevent post-injections vapours from being sucked into the cylinder.

During vehicle run, the central unit processes plenty of information on filter status which are relevant to have correct filter operation and reach duration targets.

In particular there are constantly counted and saved, on non volatile memory, following parameters:

- quantity of particulate accumulated in filter (regeneration is triggered if the quantity overflows preset values);
- quantity of ashes accumulated in the filter (not burning, so limiting filter accumulation capacity and consequently the regeneration frequency);
- calculated drift of Oxidant Catalyst efficiency;
- quantity of fuel post-injected to activate and maintain the regeneration, which is important for assessing the danger of presence of fuel in excess in engine oil;
- regeneration status: regeneration unnecessary, in progress, interrupted, resumed;
- miles covered and times from last complete regeneration.

Therefore, replacing particulate filter requires that all the parameter counters are reset, as:

- particulate quantity in filter is zero;
- quantity of accumulated ashes is zero;
- post-injected fuel quantity can be maintained if oil engine is not simultaneously refilled;
- all parameters about regeneration are to be reset, because there is an all new life cycle.
- if ashes counter is not reset, regeneration frequency will be greater than needed, consequently needlessly increasing fuel consumption, and particulate filter thermal fatigue; and, in extreme cases, there will be a groundless request to refill engine oil;
- if Oxicat ageing function is not reset, there is the risk of having unjustified quantities of post-injections;
- if post-injected fuel counter is not reset, there may be an early request to refill engine oil.

Replacing flow meter

In software, a function is present which is capable to rectify flow meter duration drift. In practice, while some manoeuvres (vehicle deceleration with pedal released) are executed, the central unit performs a number of checks and determines some flow meter reading rectification factors. It is a self-adapting process. Therefore, it is clear that replacing the flow meter involves resetting the self-rectifying process.

Where the central unit is replaced, on the contrary, flow meter rectification coefficients are to be copied down from old to new central units; where it is not possible, they are to be reset and self-learning process is started again.

Replacing rail pressure sensor in hydraulic accumulator

Rail pressure sensor can affect injector minimum flow rate correction accuracy, since minimum flow rate depends on both injection times and hydraulic accumulator actual pressure.

Replacing delta-p sensor

During vehicle life time, the central unit makes some checks on filter differential pressure sensor drift, e.g., with engine stopped, pressure value is the same upstream and downstream of filter.

So, some parameters are calculated and engine running values are consequently rectified.

Replacing delta-p sensor involves resetting the rectifications.

Replacing engine oil

During vehicle life time, the central unit counts up the quantity of post-injected fuel in order to activate and maintain regeneration.

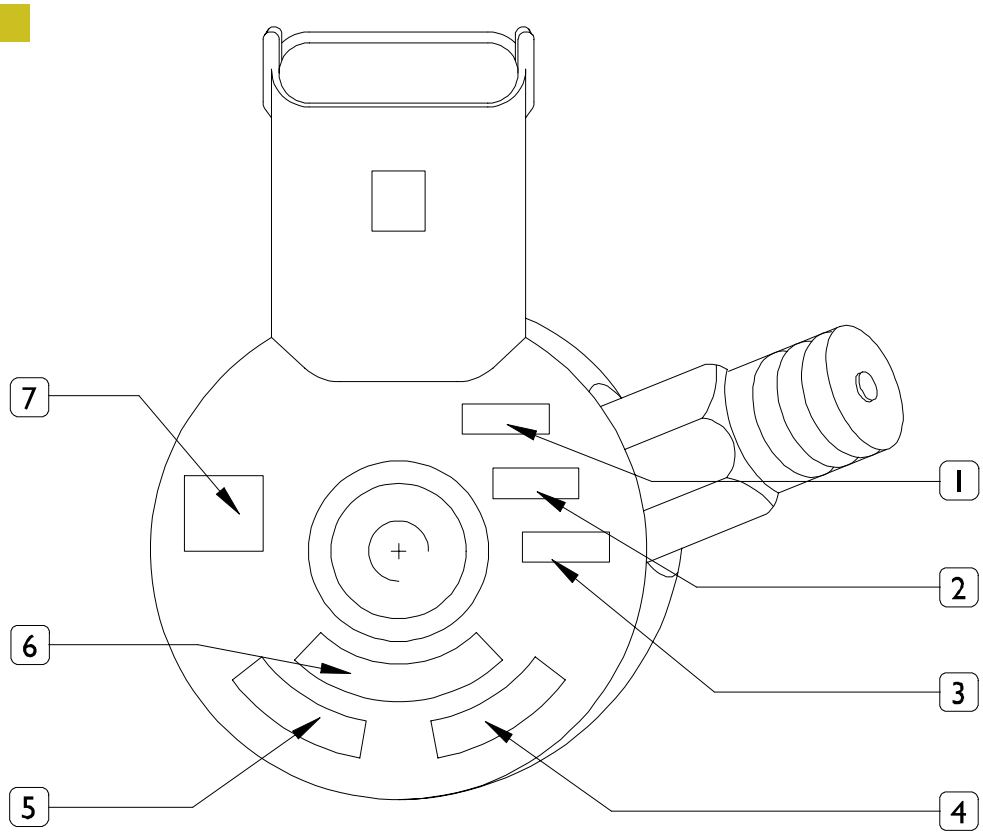
A least fraction of this fuel (which is injected at a very long time after combustion, and consequently is not burning, i.e. is not involved in combustion), through engine rings, comes into contact with lubrication oil and dissolves into it. Accumulated post-injection quantity may increase, in case of loss of efficiency in Oxicat, the emissions at low temperature and, of course, impair engine normal running.

The central unit is capable to calculate the limit quantity of fuel dissolved into oil and, consequently, to suggest oil refilling.

It is obvious that, if after engine oil refilling the function is not reset, the central unit will keep on counting the increase of oil fraction in engine oil even with new oil and, sooner or later, groundlessly request to refill engine oil.

Replacing an injector

Figure 63



1. Production date - 2. Series number - 3. Code - 4. Iveco component number - 5. IMA code - 6. Bosch code - 7. IMA code

On engines Euro 4 there is applied an injection flow rate individual rectification (I.M.A. - Injector Menge Abgleichung) [Injector Quantity Offset].

It means that injectors are not assigned any more to classes (Min – Med – Max, or 01 – 02 – 03), but unavoidable flow rate deviations from average design values are detected, during final check step on Bosch line, on each single injector and stored by printing on injector magnet.

At Sofim Plant, I.M.A. code (7) is read from an on line automatic reading station, converted into bar code and printed on engine identification label applied on the engine itself.

At Vehicle Production Plant, the central unit is programmed at the end of line automatically reading the label.

For interventions off production line (such as Service interventions) I.M.A. code (5) is used.

Therefore, it is necessary to take some precaution measures:

- injector mounting sequence is important and cannot be changed in service operations without reprogramming the central unit;
- it is not possible to replace one or more injectors without reprogramming the central unit;
- where an injector is replaced, it is suggested to note down its code "before" mounting it, since it is problematic to read its value on the vehicle.

It is obvious to conclude that, where the central unit is replaced, the central unit is to be reprogrammed with the I.M.A. codes of the injectors that are mounted on the engine.

During engine running, the central unit makes some checks on injectors minimum flow rate. Under certain specified operation conditions (deceleration with pedal released) an increasing (very small) fuel quantity starting from zero is injected and its effect on engine rotation smoothness is observed. Injection start threshold is then detected and stored into the central unit. The process is a self-learning process, and is carried out on each single cylinder.

Replacing an injector involves the need of resetting the rectification factors on cylinder considered.

Replacing all injectors extends the need of resetting to all the rectification coefficients.

Replacing the central unit requires to store the coefficients on new central unit.

EDC16

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 F1 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

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

During:

- ❑ the start step
- ❑ the after start step

the injection centre times the heater starter (or preheat plugs for the F1 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 (mm^3 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 (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 F1 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).

Cylider 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.

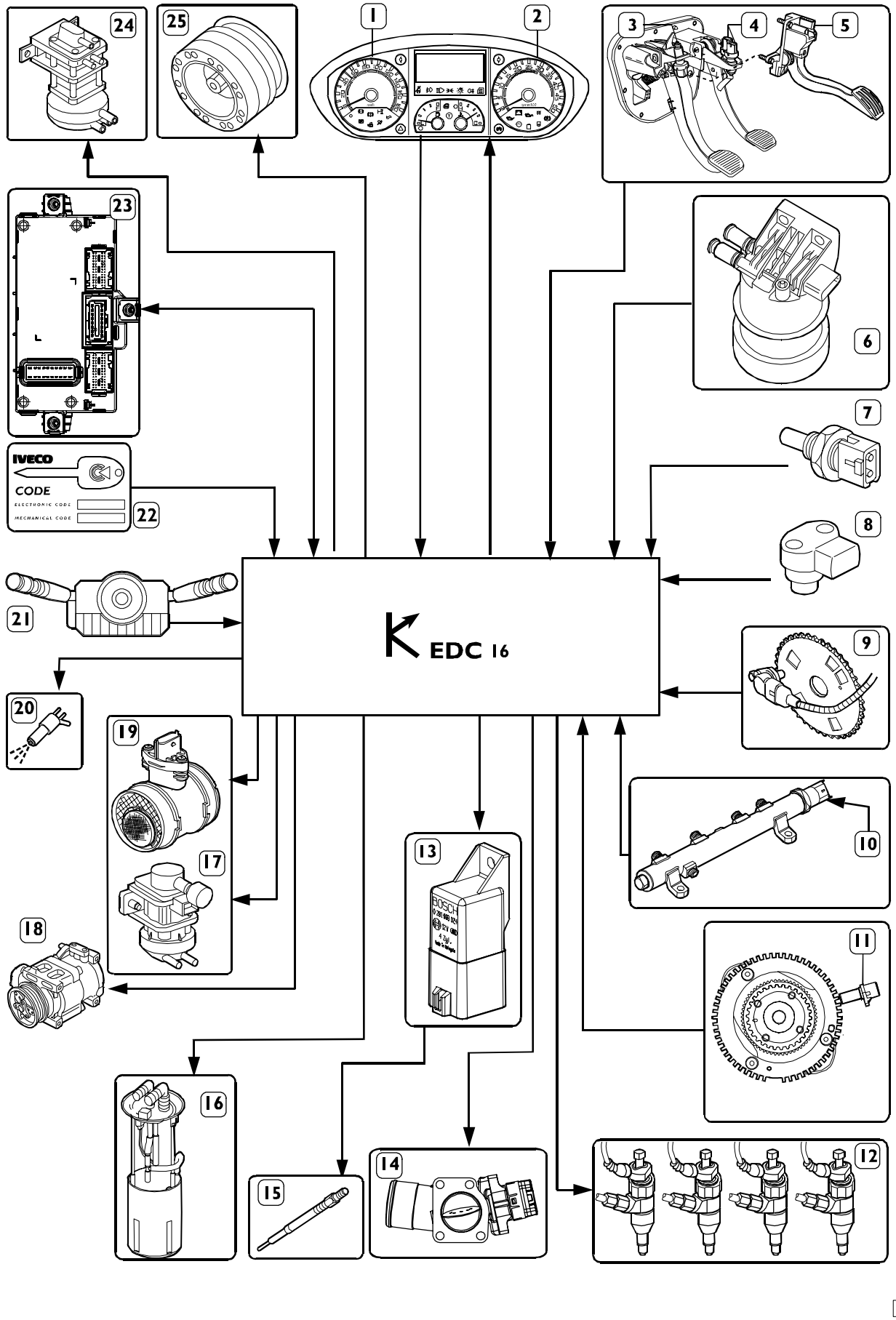
Synchronisation search

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.

EDC system components

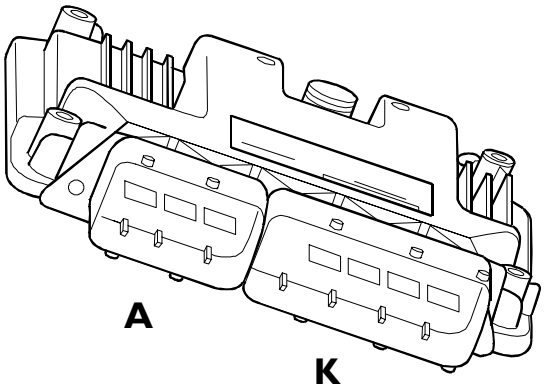
Ref.	Component code	Description
1	58918	Tachometer on instrument cluster
2	58918	Revolution counter on instrument cluster
3	42374	Clutch pedal switch
4	53565	Brake pedal switches
5	85152	Accelerator pedal position sensor
6	47106	Fuel temperature sensor (on fuel filter)
7	47035	Coolant temperature sensor
8	85156	Air pressure and temperature sensors
9	48042	Timing system shaft sensor
10	85157	Fuel pressure sensor
11	48035	Engine shaft sensor
12	78247	Electrical injectors
13	25231	Glow plugs pre-heating central unit
14	-	Throttle valve assembly
15	19010	Pre-heating glow plug
16	44030	Fuel electric pump (with level gauge)
17	78209	E.G.R. solenoid valve
18	12012	AC compressor
19	85159	Flow meter
20	58701	EDC warning lamp
21	54032	Cruise Control / PTO (optional) control
22	85130	Key for starting up with Immobilizer
23	72027	Diagnosis socket (EOBD) on Body Computer
24	78248	VGT control solenoid valve
25	85022	Fan electromagnetic joint

Figure 64



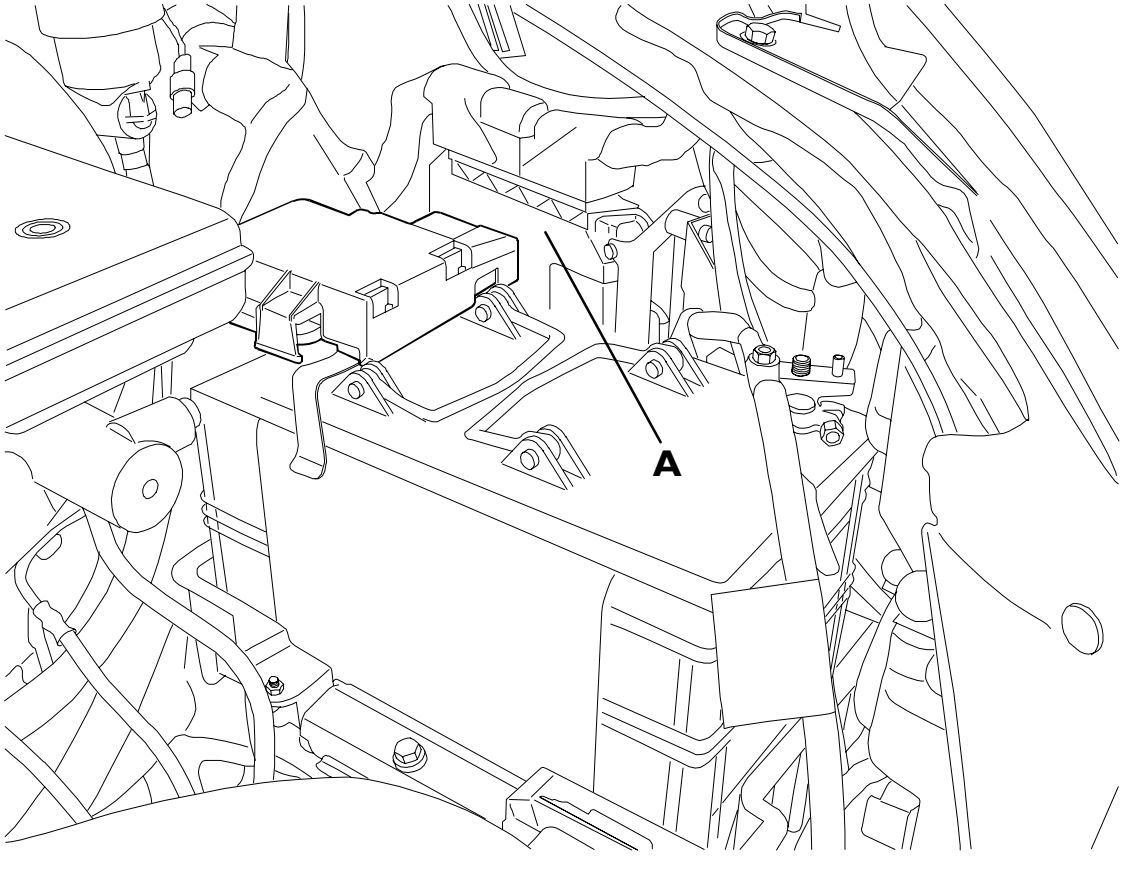
Bosch EDC16 control unit

Figure 65



PERSPECTIVE VIEW
A. Engine side injection cable connector - K. Bonnet/cab cable connector

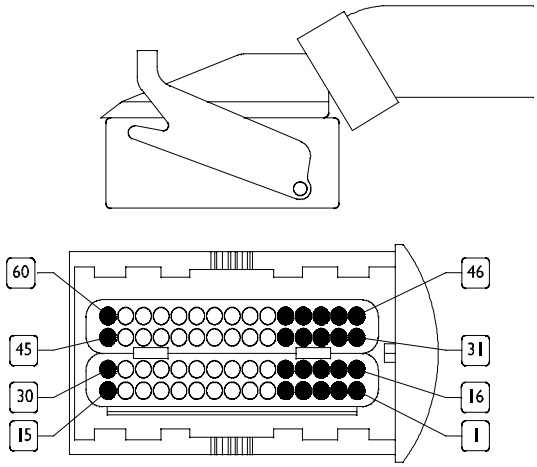
Figure 66



A. Central unit EDC

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

Figure 67



85708

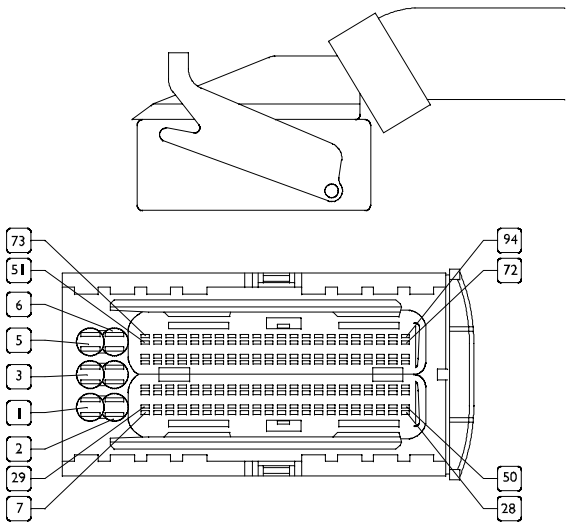
85710

Pin	Cable colour code	Function
1	0000	Cylinder injector 3
2	0000	Cylinder injector 2
6	-	Throttle valve actuator
7	-	Drive shaft sensor braided wire
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
15	-	VGT solenoid valve
16	9924	Cylinder injector 1
17	9924	Cylinder injector 4
19	0000	Pressure regulator negative
20	7158	Distributing shaft sensor positive
23	0165	Boosting air pressure and temperature sensor negative
26	-	Throttle valve actuator
27	white	Drive shaft sensor
28	5591	Rail sensor power supply
31	9924	Cylinder injector 2
33	0000	Cylinder injector 4
35	-	Engine oil level signal
37	5151	Air flow meter air temperature signal (available with EGR)
39	-	Engine oil level signal
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)
45	-	Throttle valve actuator
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
56	**-**	Throttle valve actuator
58	**5154**	Water temperature sensor signal
60	**8150**	EGR solenoid valve
●	Power seats	
○	Signal seats	
-	Pins not highlighted are not used	

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

Figure 68



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)
10	-	Δp differential sensor
11	-	Exhaust gas temperature sensor 1
12	0000	Coolant pressure switch
13	-	Signal from power takeoff (if any) state selector
15	-	Δp differential sensor
16	-	Negative from power takeoff (if any) state selector
17	-	Signal from brake pedal pressed for stop light ignition
22	-	Δp differential sensor
25	2298	K line
27	5180	Exhaust gas temperature sensor 1
28	8051	+15
30	0157	Accelerator pedal sensor negative (pin 3)
31	5157	Accelerator pedal sensor signal (pin 6)
38	8155	Cruise Control (resume)
42	-	Speed limiter button
45	5157	Accelerator pedal sensor power supply (pin 2)
46	5157	Accelerator pedal sensor power supply (pin 1)
48	5614	Engine speed sensor (revs counter)
49	0000	Exhaust gas temperature sensor 1
50	-	Exhaust gas temperature sensor 1
51	-	Lambda probe
52	1310	To preheating spark plug actuation remote-control switch pin D1

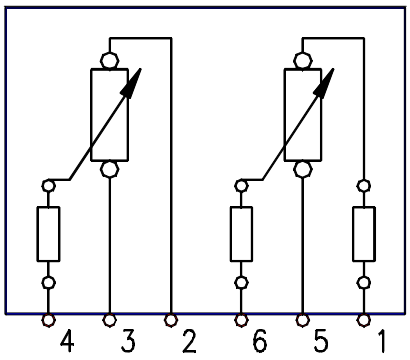
Pin	Cable colour code	Function
54	7772	Positive for air-conditioner compressor switched on
56	8157	Cruise Control (set +)
57	0000	Auxiliary speed limiter (where available)
58	8150	Signal from clutch switch
61	-	CAN L line
62	-	CAN H line
63	8293	Exhaust gas temperature sensor 2
64	8292	Lambda probe
65	8291	Lambda probe
66	8282	Exhaust gas temperature sensor 2
68	8156	Fuel filter heating remote-control switch positive
70	-	Compressor switching on
71	-	EDC warning light negative
72	0155	Main relay (negative)
75	5517	Vehicle speed signal (tachometer)
77	8154	Cruise Control (off)
78	8156	Cruise Control (set -)
79	8167	Coolant pressure switch
80	8158	Brake pedal signal
81	5530	Water in fuel filter
86	8294	Lambda probe
87	8293	Lambda probe
90	-	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.

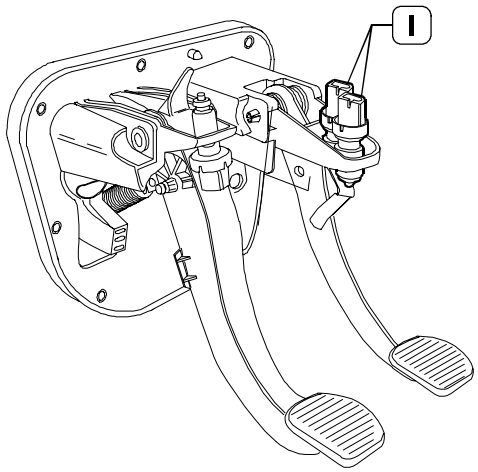
Figure 69



EDC 16

85714

Figure 70

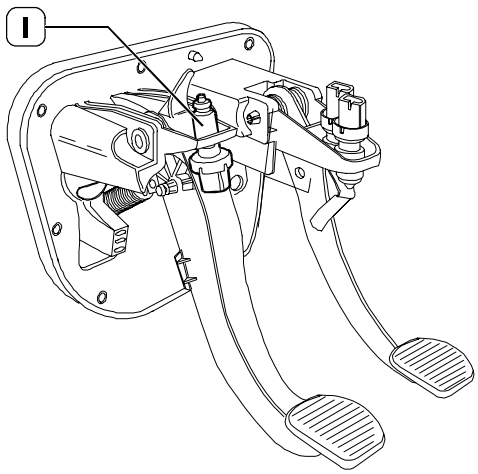


1. Brake pedal switches

Brake pedal switches (53501)

Two switches are present on brake pedal: one is directly connected to pin KB0 of central unit, the other is connected to central unit ESP8 at PIN 30.

Figure 71



1. Clutch pedal switch

Clutch pedal switch (42374)

An N.C. switch connected to electronic centre pin K58 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 disenables the Cruise Control function.

Preheat plug electronic centre (F1A/F1C 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 shirt circuit.

Preheat centre pin-out

31 - Mass

86 - Start switch (+15)

ST - EDC electronic centre (pin K93)

DI - EDC electronic centre (pin K52)

30 - Battery positive (+30)

G1 - Preheat plugs

G2 - Preheat plugs

G3 - Preheat plugs

G4 - Preheat plugs

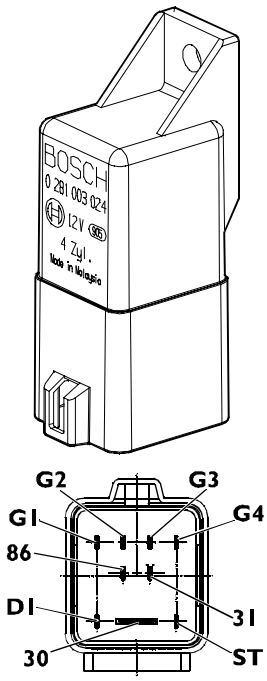
Preheat plugs

CONTROL VALUES

With constant di 11V power supply:

- ❑ maximum current absorbed 18 A
- ❑ in 5" 11 ± 1,5 A
- ❑ in 30" 6 ± 0.9 A
- ❑ temperature after 7" 850°C
- ❑ torque 8-10 Nm

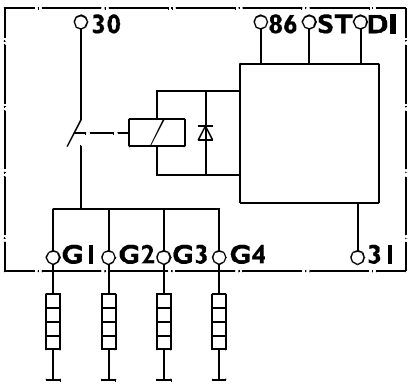
Figure 72



003332t

PREHEAT CENTRE

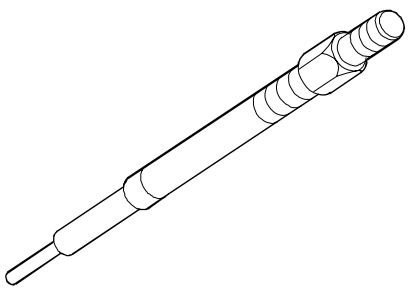
Figure 73



003331t

ELECTRICAL DIAGRM

Figure 74

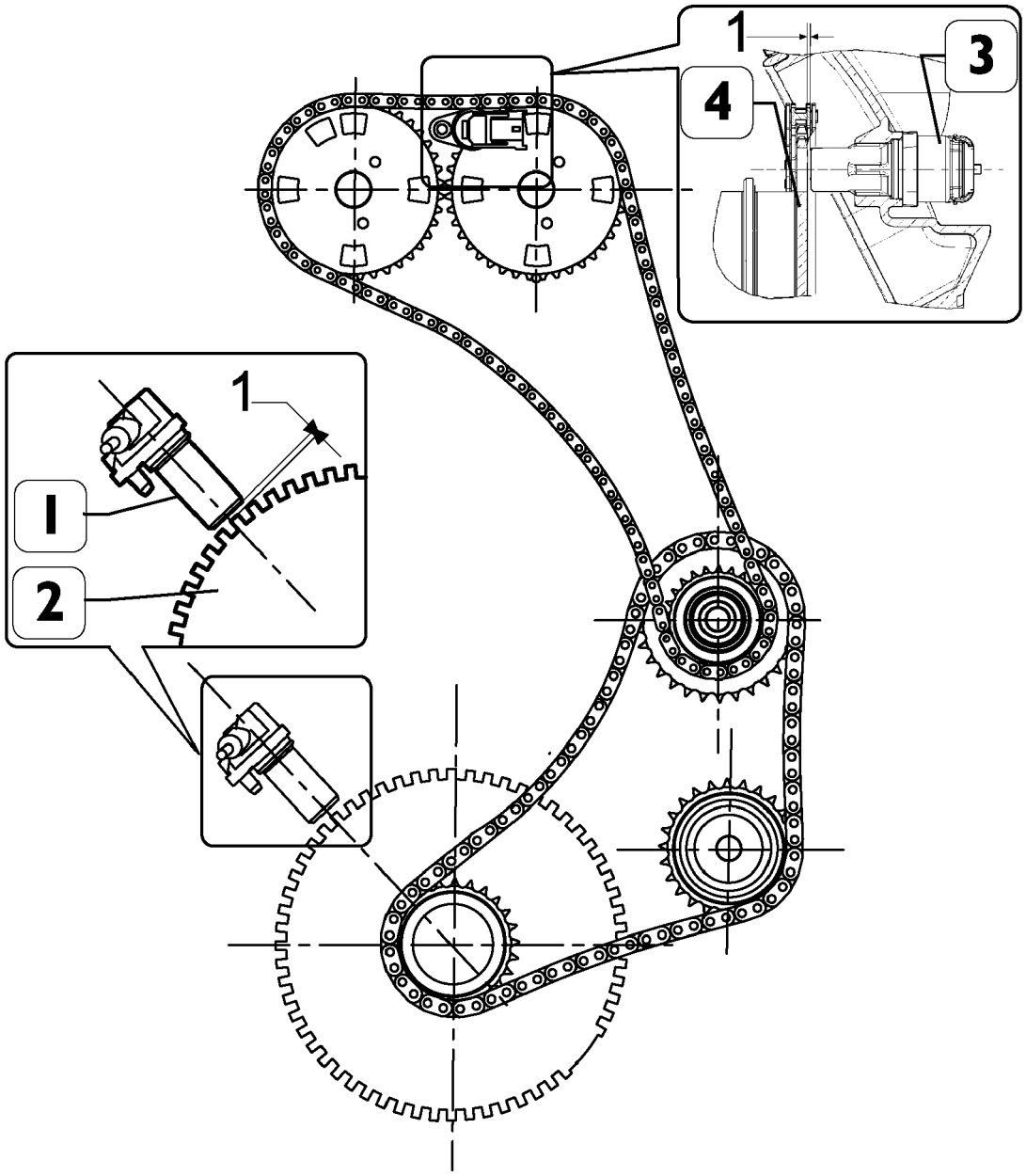


75579

PREHEAT PLUS

R.p.m. / timing sensors (F1C)

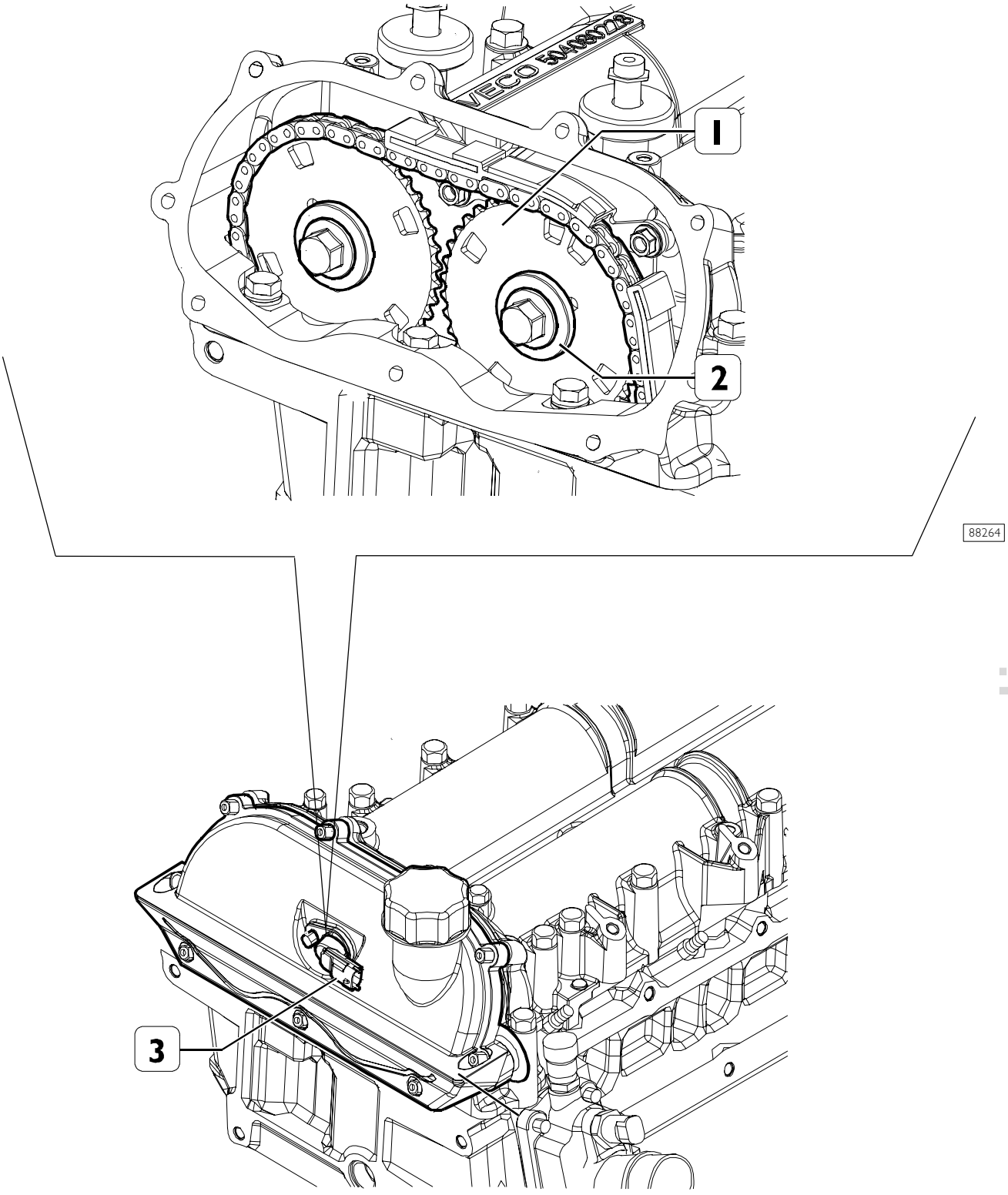
Figure 75



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

Timing sensor (stroke) (F1C)

Figure 76



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

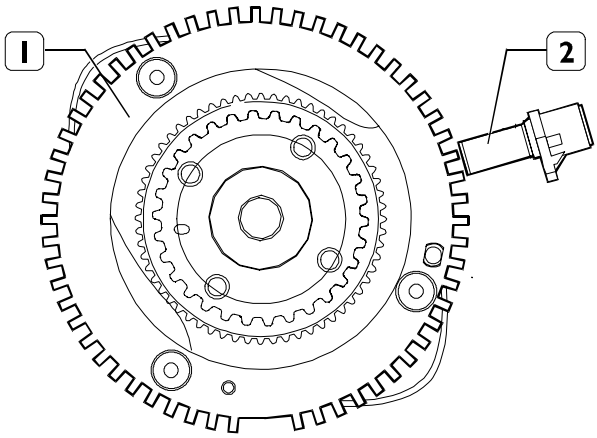
RPM sensor

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.

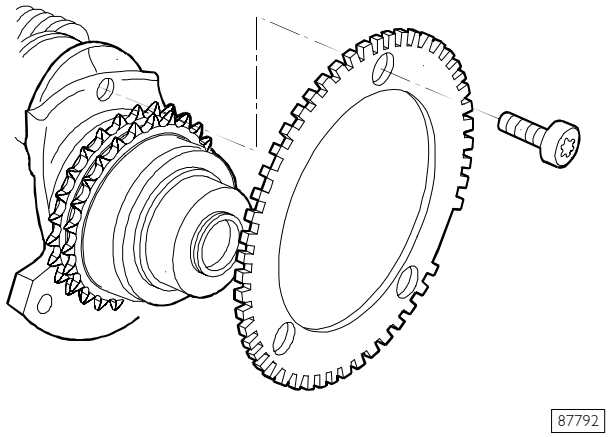
This signal is also used by the control unit to detect the engine rotation speed, the duration of injection and to control the rev counter.

Figure 77



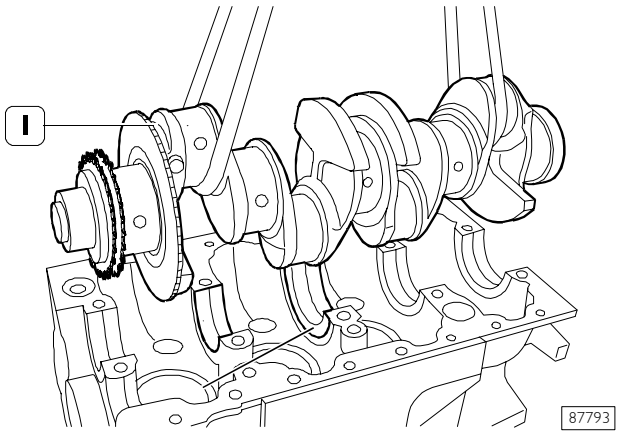
TECHNICAL VIEW OF THE SOUND WHEEL AND SENSOR
1. Sound wheel - 2. Sensor

Figure 78



PHONIC WHEEL MOUNTING

Figure 79

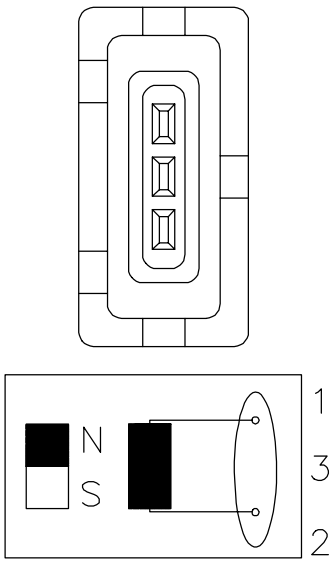


1. Phonic wheel

Figure 80

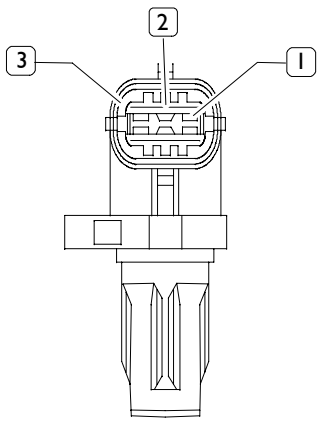
RPM SENSOR AND CONNECTION CABLE

Figure 81



SENSOR CONNECTOR AND WIRING DIRAGRAM

Figure 82



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.

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).

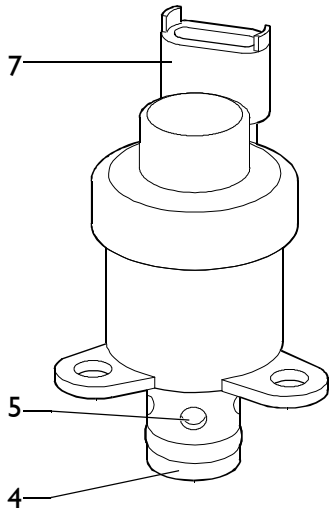
Core movement causes cylinder (3) axial displacement by fuel delivery partialization.

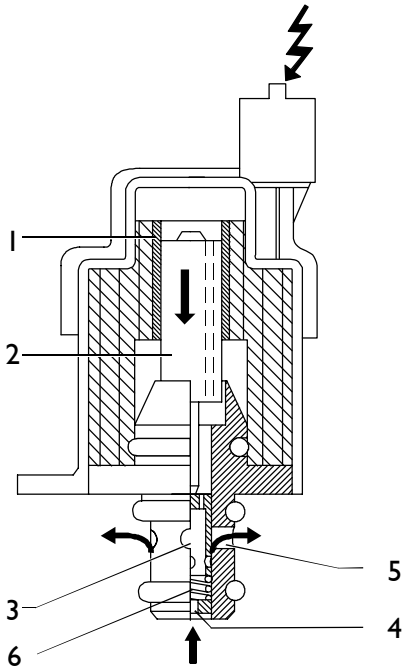
When solenoid (1) is not activated, the magnetic core is moved to its rest position by preload spring (6).

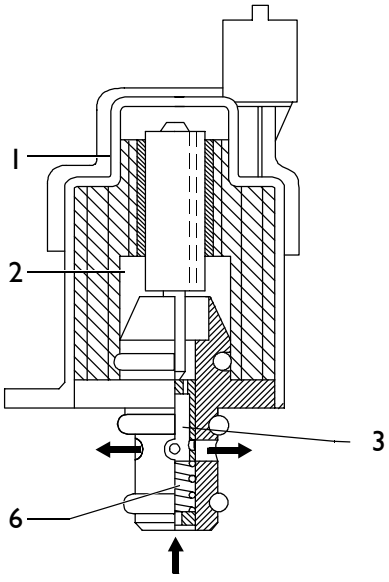
In these conditions, cylinder (3) is in a position to offer maximum fuel passage cross-section.

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

Figure 83







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

Rail (pressure accumulator) F1C

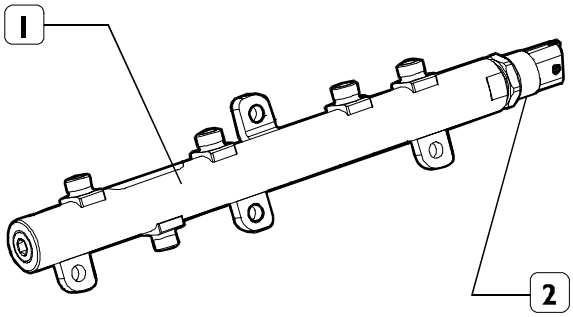
The hydraulic accumulator is mounted in the cylinder head on the side opposite aspiration.

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 84

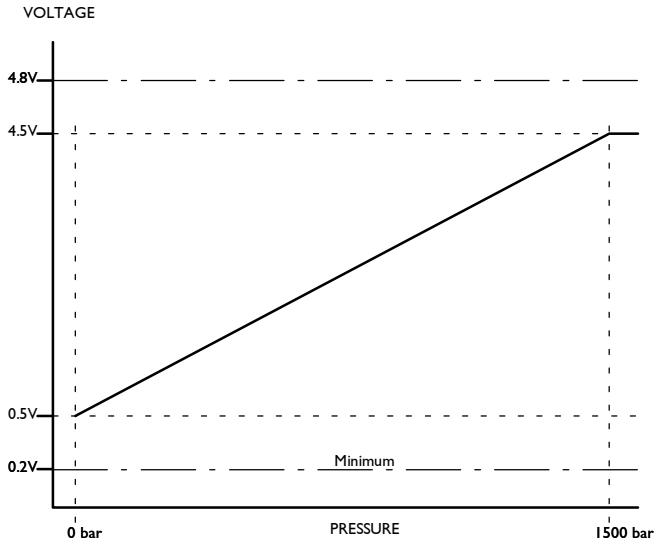


1. Rail - 2. Pressure sensor

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 85



PRESSURE LIMITER OPERATING GRAPH

Air temperature/pressure sensor

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

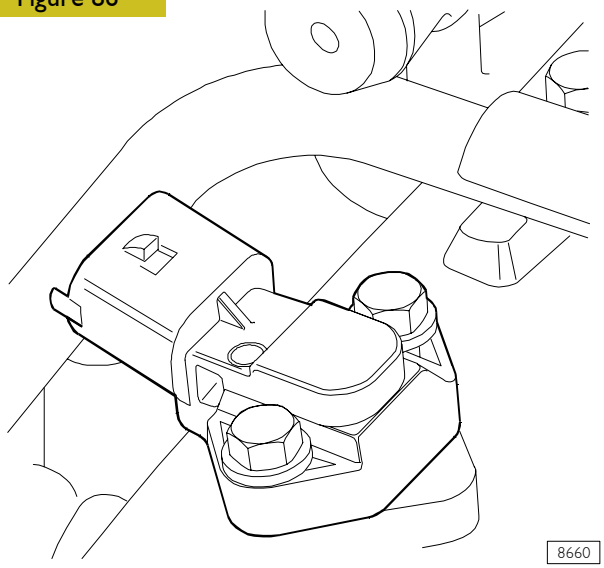
Course of sensor in relation to the temperature

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:

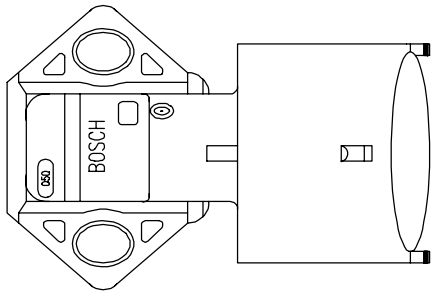
See graph opposite.

Figure 86



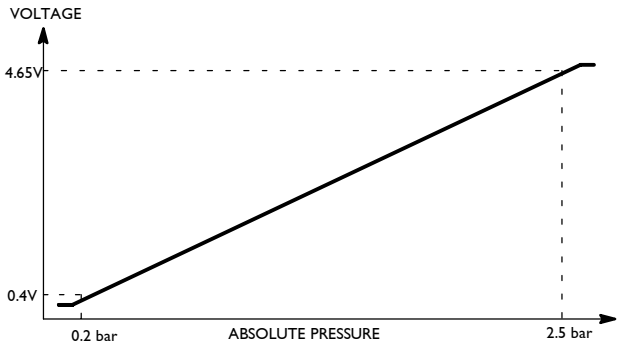
AIR FLOW METER

Figure 87



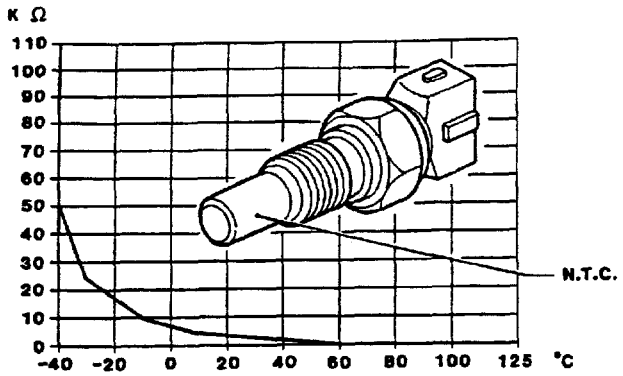
AIR FLOW METER CONNECTION

Figure 88



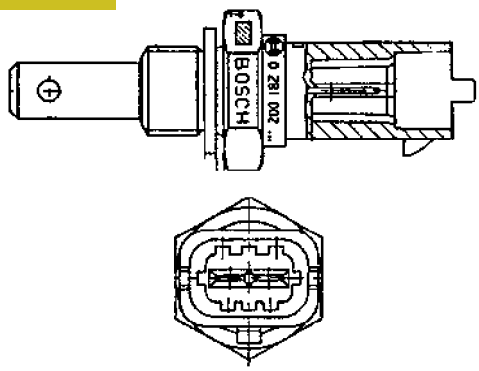
AIR FLOW METER OPERATING GRAPH

Figure 89



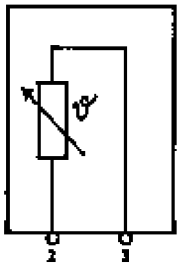
COURSE OF SENSOR RESISTANCE IN RELATION TO TEMPERATURE

Figure 90



TECHNICAL VIEW OF ENGINE COOLANT TEMPERATURE SENSOR

Figure 91



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.

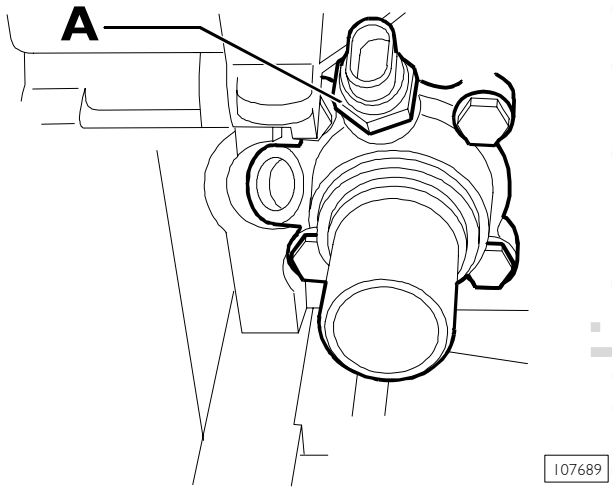
Engine coolant temperature sensor

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.

The same signal is used (via CAN lines) to control the instrument cluster where the gauge is present.

Figure 92



A. Temperature sensor

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.

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.

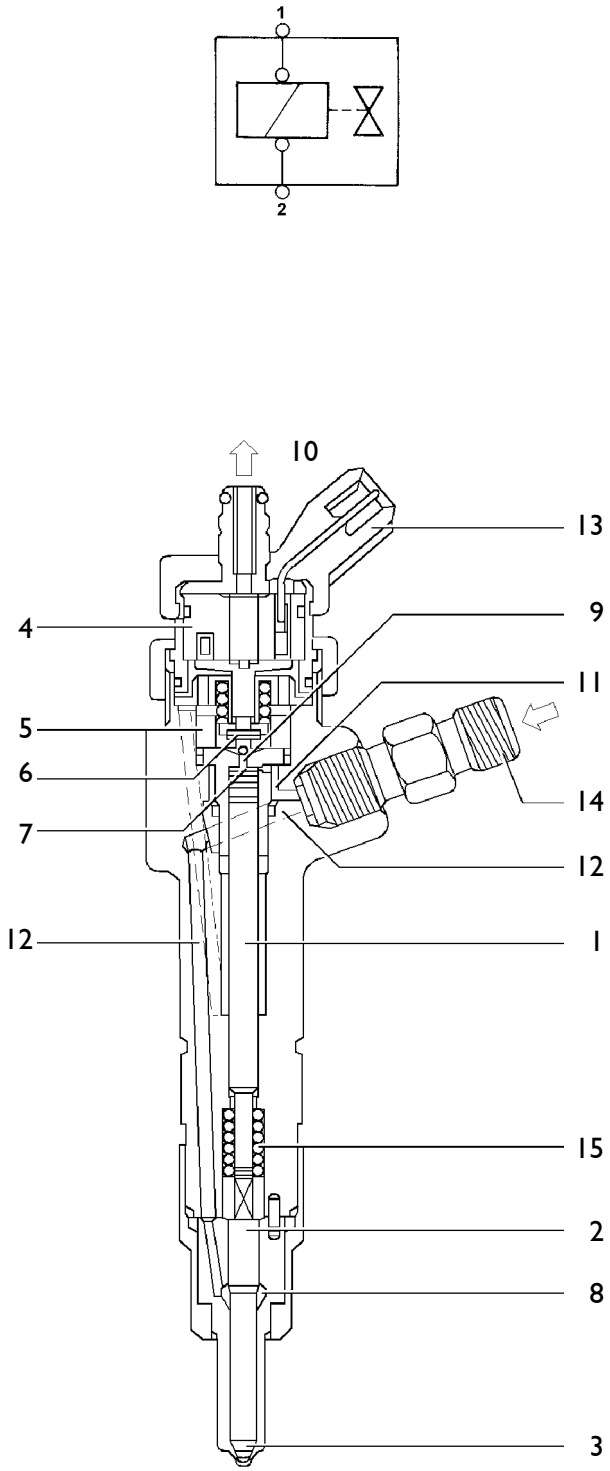
Injectors (78247)

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 93



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

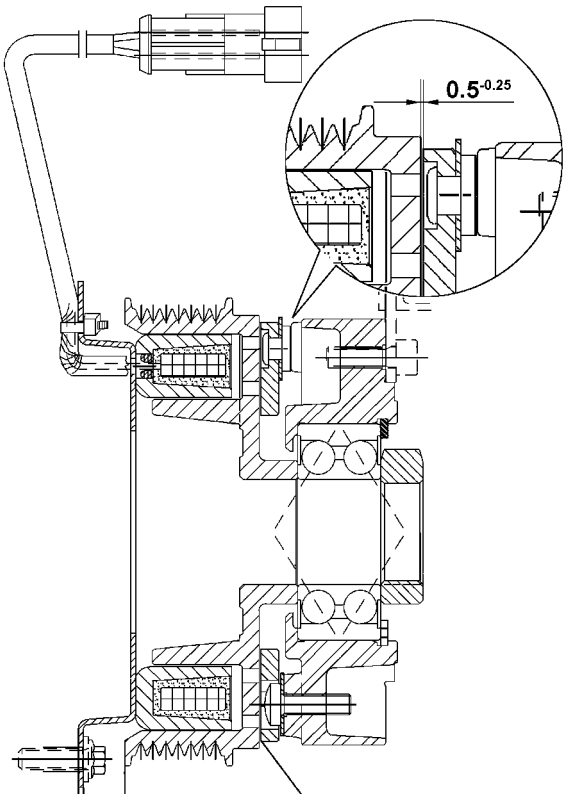
Over supply air temperature

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 94



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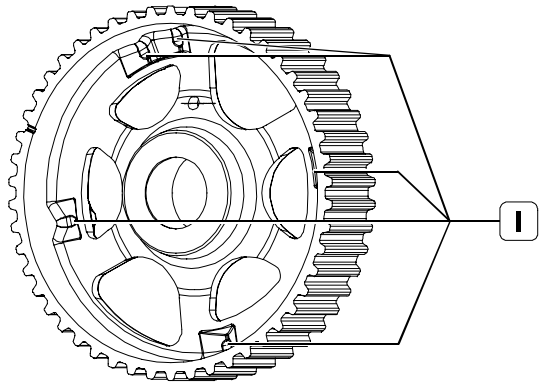
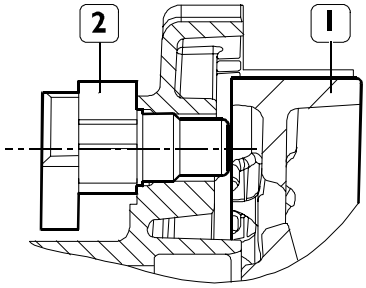
ELECTROMAGNETIC JUNCTION TECHNICAL VIEW
1. Coil - 2. Connector

Figure 95



1. Phase identification holes

Figure 96



1. Distributing shaft pulley - 2. Sensor

Camshaft sensor (F1A) 48042

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.

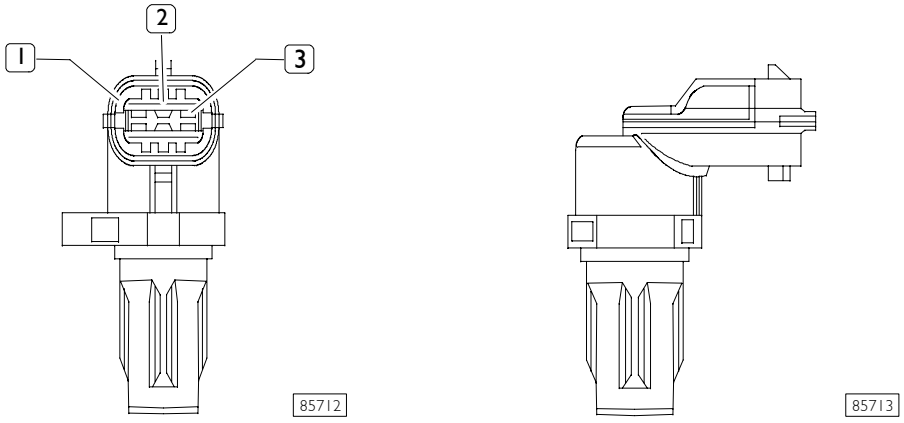
Phase sensor signals are acquired, and the engine position is recognized according to the sequence of the phonic wheel notches.

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.

It is connected to PINs A20, A50, A11 of central unit EDC16.

Figure 97



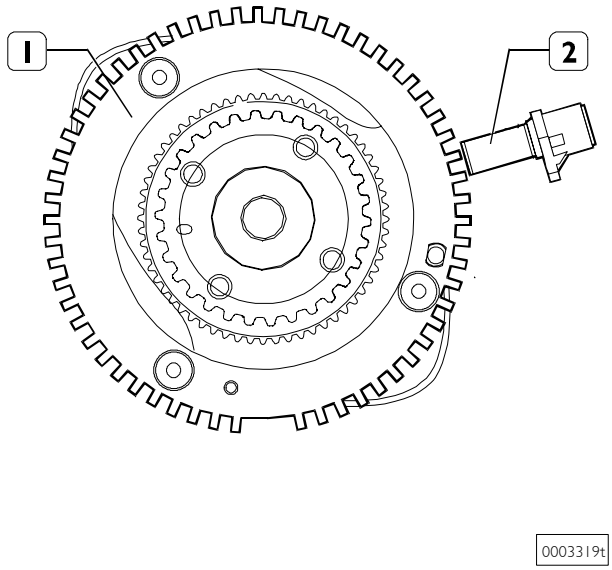
PERSPECTIVE VIEW
1. Power supply positive - 2. Signal output - 3. Earth

Flywheel and rpm sensor

The F1A 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 98



TECHNICAL VIEW OF THE SOUND WHEEL AND SENSOR
1. Sound wheel – 2. Crankshaft sensor

Characteristics of flywheel rpm and timing system sensors

These are inductive sensors.

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

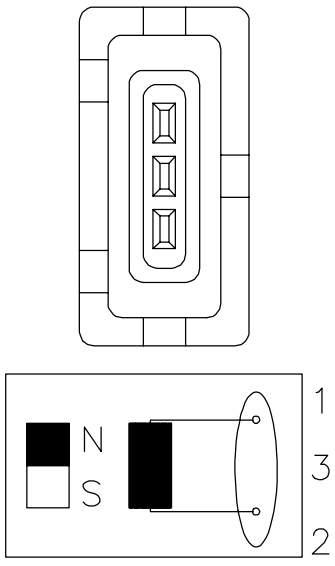
It is also used to control the electronic rev counter on the instrument cluster.

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

Figure 99

SENSOR AND CONNECTION CABLE

Figure 100



SENSOR CONNECTOR AND WIRING DIRAGRAM

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).

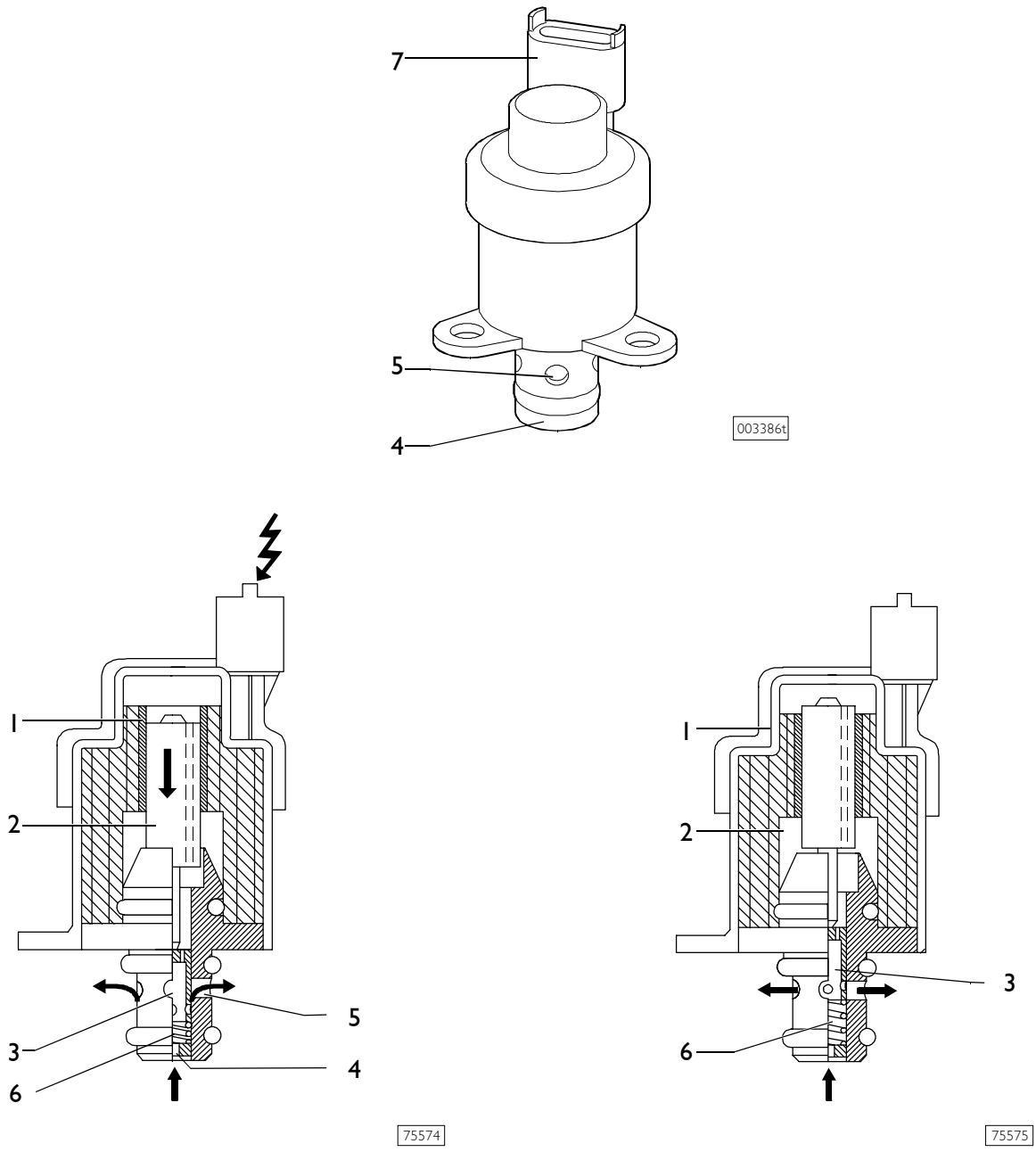
Core movement causes cylinder (3) axial displacement by fuel delivery partialization.

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 101



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

Rail (pressure accumulator) F1A

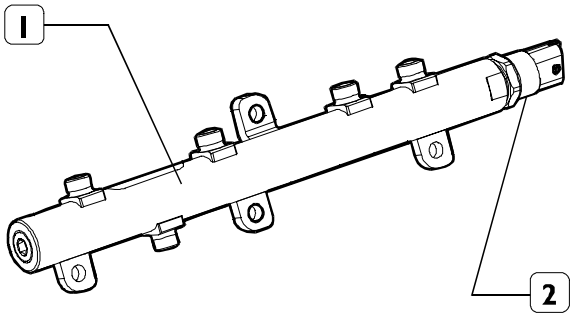
The hydraulic accumulator is mounted in the cylinder head on the side opposite aspiration.

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 102

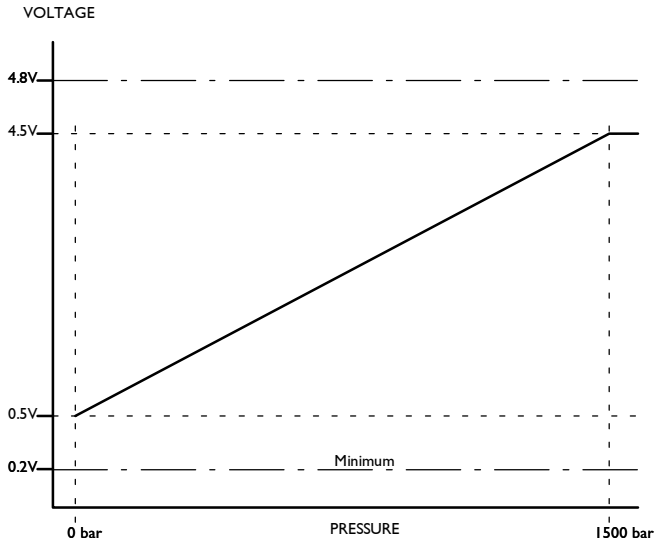


1. Rail - 2. Pressure sensor

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 103



PRESSURE LIMITER OPERATING GRAPH

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)

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

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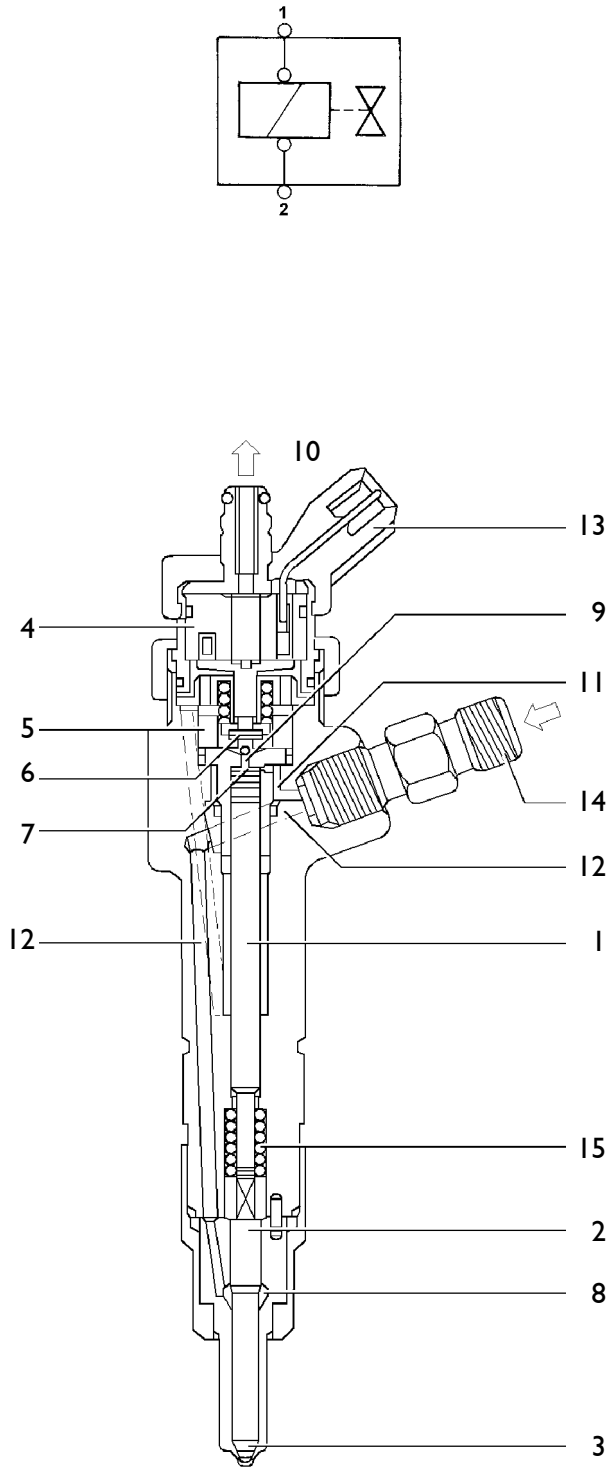
- A2 / A31 cylinder 2 injector
- A1 / A46 cylinder 3 injector
- A17 / A33 cylinder 4 injector

Figure 104



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

Air temperature / pressure meter

This component incorporates a temperature sensor and a pressure sensor.

It is fitted on the engine intake manifold (Figure 107) 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 A23 ECU - earth -

Pin 2 sensor - Pin A53 ECU - temperature signal

Pin 3 sensor - Pin A13 ECU - 5V - supply

Pin 4 sensor - Pin A40 ECU - 0 ÷ 5V pressure signal -

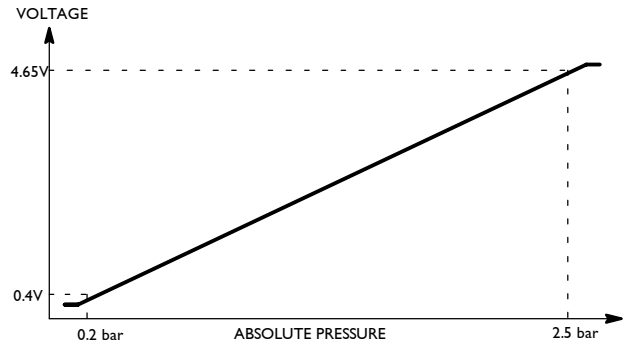
Course of sensor in relation to the temperature:

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:

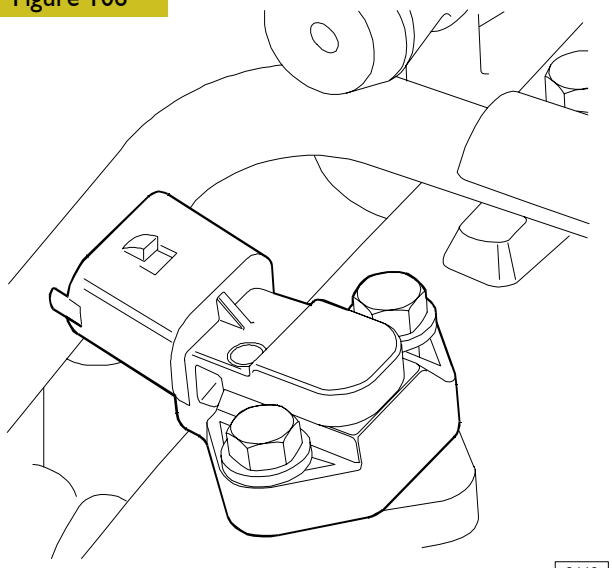
See graph opposite.

Figure 105



AIR FLOW METER OPERATING GRAPH

Figure 106



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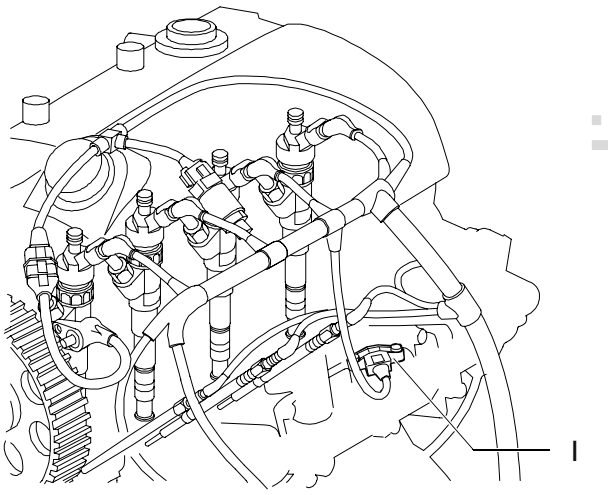
AIR FLOW METER

Figure 107



003323t

1. Air flow meter location

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

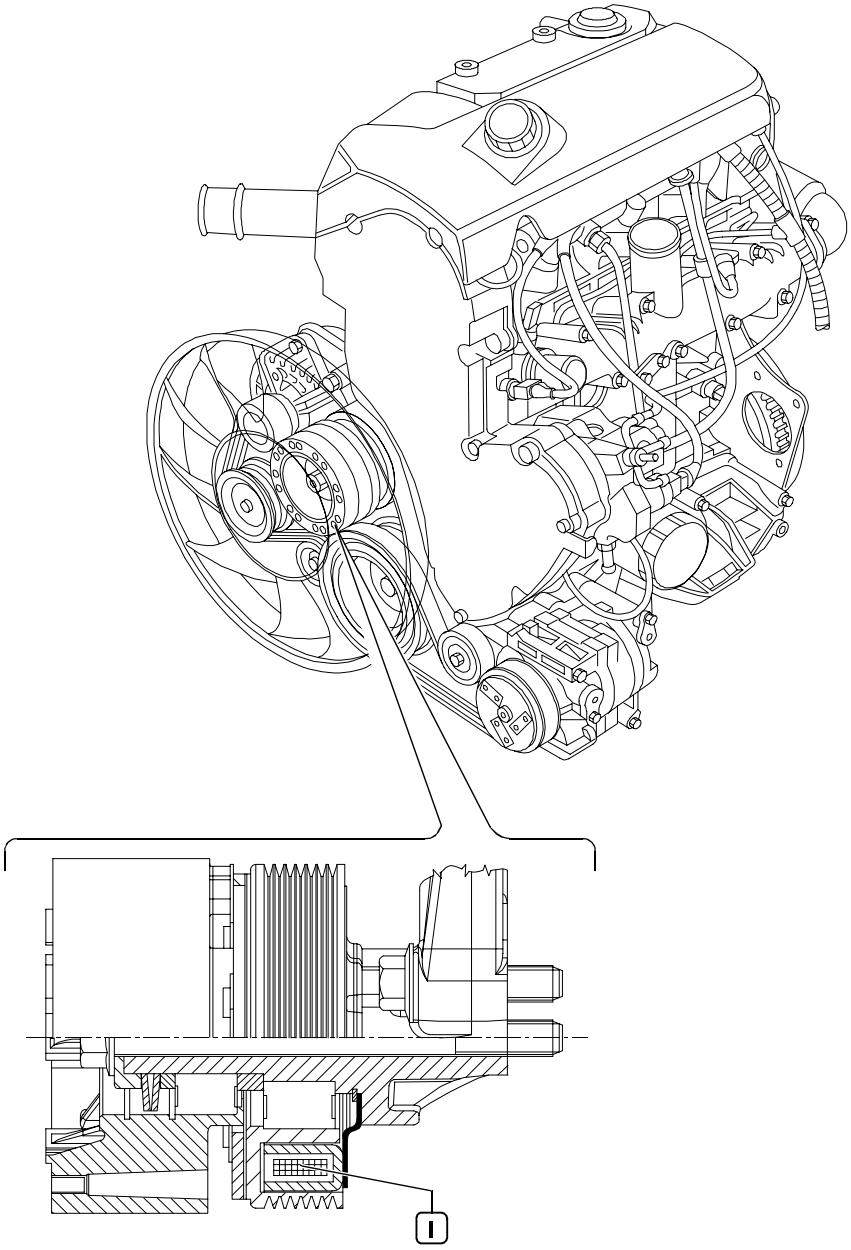
Over supply air temperature

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

Fuel temperature

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

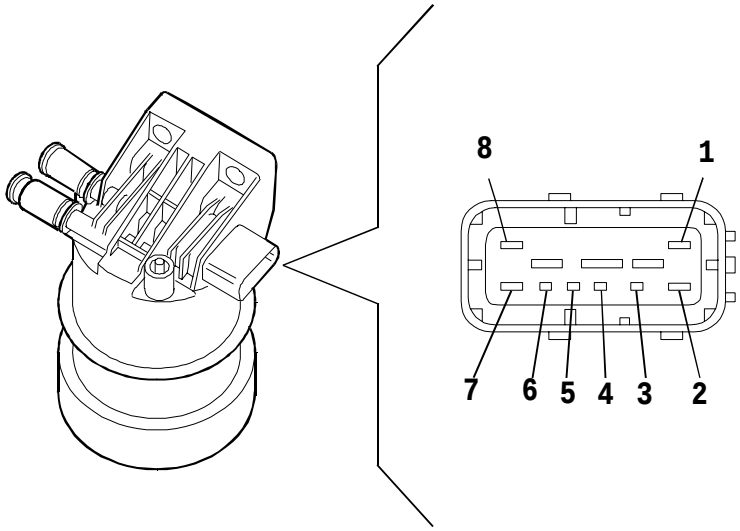
Figure 108



ELECTROMAGNETIC JUNCTION TECHNICAL VIEW0 (F1A)
1. Coil

FUEL FILTER

Figure 109



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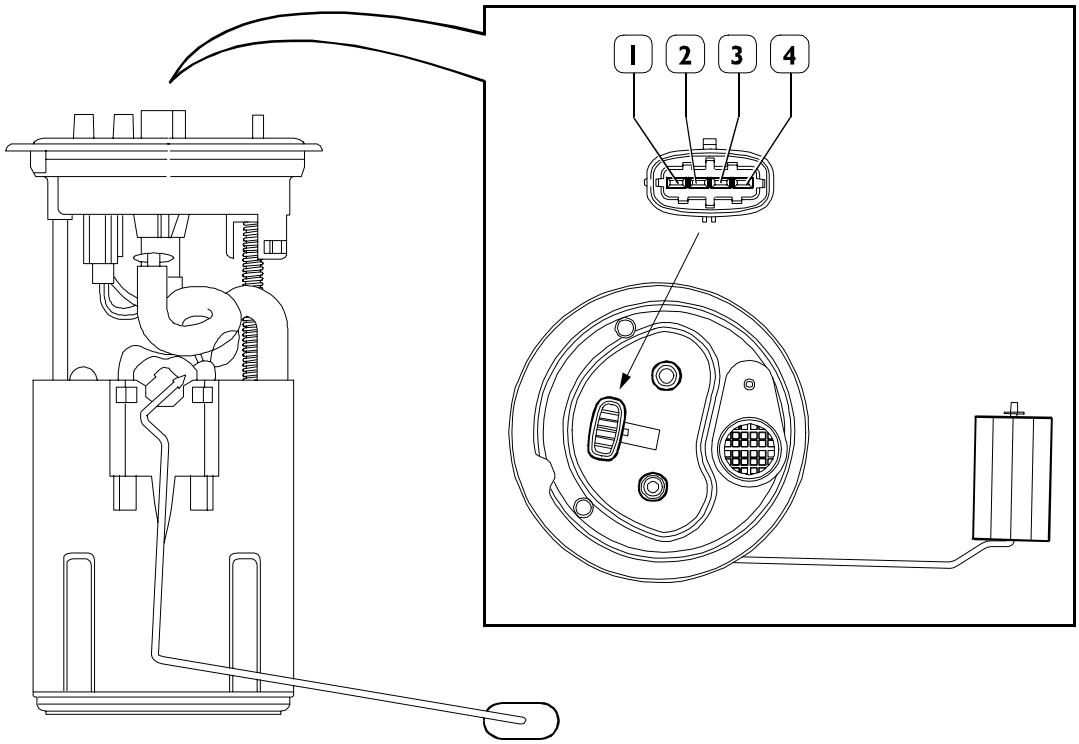
1. Positive for power supply - 2. Heater - 3. Water present sensor - 4. Filter clogged sensor - 5. Fuel temperature sensor - 6. Fuel temperature sensor - 7. Earth for heater - 8. Earth

FUEL PUMP / FUEL LEVEL

Figure 110



1. Level sensor - 2. Level sensor - 3. Negative for fuel pump - 4. Positive for fuel pump

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.

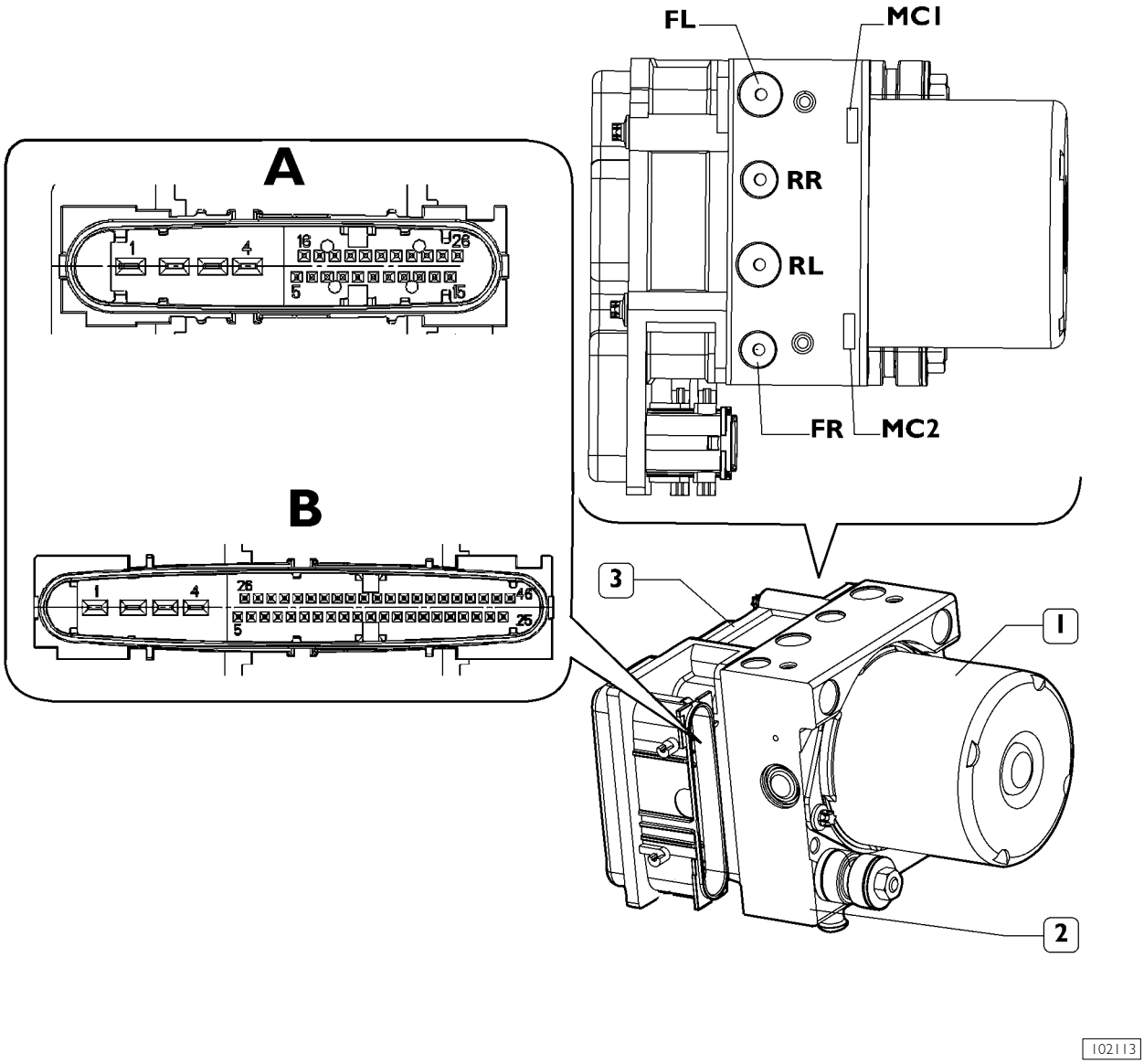
The ESP 8 system, in addition to the EBS 8 system, incorporates the following functions:

- 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.

Four crossed channel system (x)

Electro-hydraulic modulator/control unit

Figure 111

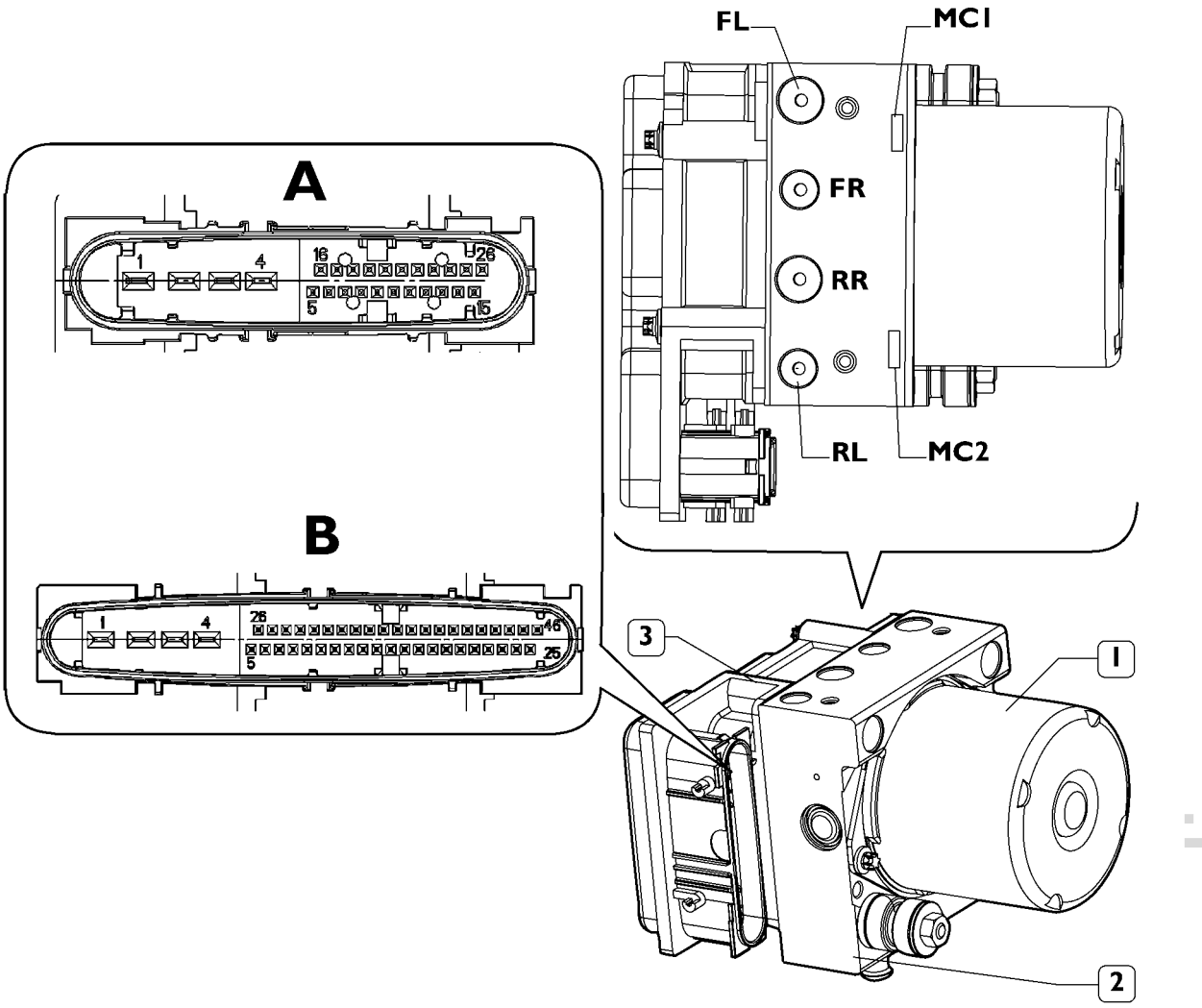


1. Hydraulic accumulator - 2. Electro-hydraulic modulator - 3. Electronic control unit - A. ABS8 connector - B. ESP8 connector - MC1. LF/RR diagonal power supply (or FL/RR with ABS8/ESP8 systems) - MC2. RF/LR diagonal power supply (or FR/RL with ABS8/ESP8 systems) - LF (or FL with ABS8/ESP8 systems). 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

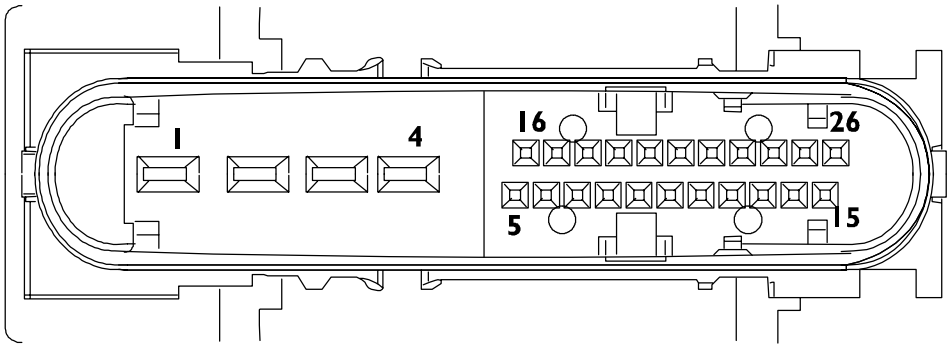
Figure 112



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 113

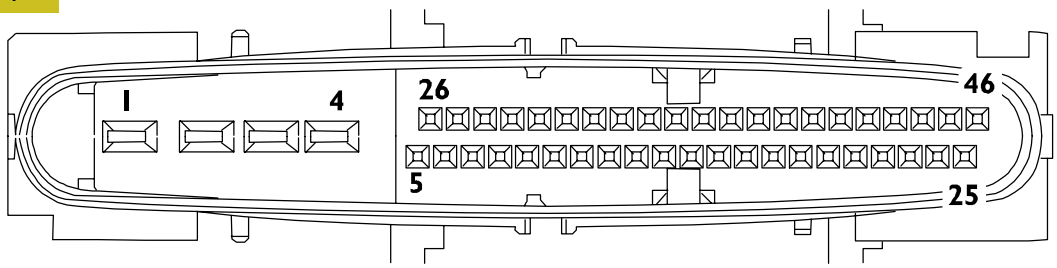


102245

Pin (X)	Pin (II)	Function	Cable
1	1	Earth	0000
2	2	Positive after fuse	7772
3	3	Positive after fuse	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	-	-
13	13	Decelerator deactivation with ABS system ON	0000
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 (KL 15)	8879
19	19	Rear right sensor	5573
20	20	Stop signalling switch – brake lights	1176
21	21	-	-
22	22	-	-
23	23	-	-
24	24	-	-
25	25	-	-
26	26	CAN H line	White

ESP 8 control unit PIN OUT (X - crossed channels, II - parallel channels)

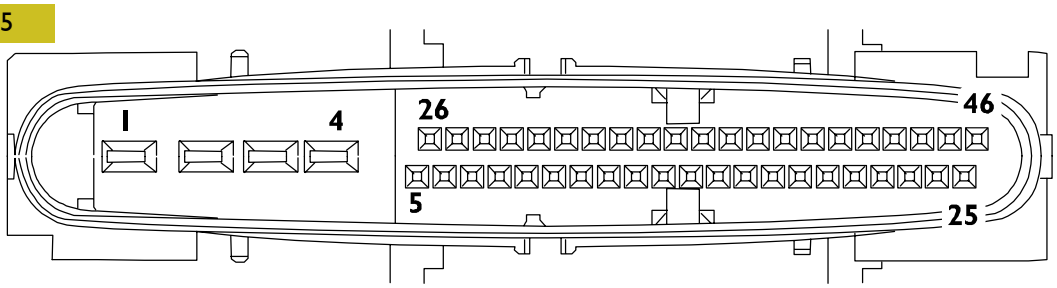
Figure 114



Pin (X)	Pin (II)	Function	Cable
1	1	Earth	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	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	-	-
13	13	-	-
14	14	CAN L line	Green
15	15	Yaw / steering angle sensor earth	9096
16	16	Yaw sensor signal	9095
17	17	Longitudinal acceleration sensor	9090
18	18	Yaw sensor reference signal	9091
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	0000
23	23	-	-
24	24	-	1199
25	25	-	-
26	6	Front left sensor earth	5570
27	27	Rear left sensor earth	5572
28	28	Positive after fuse +15	8879
29	29	Rear right sensor	5573
30	30	Stop signalling switch (PIN3)	8158
31	31	Switch for the exclusion of ASR	8921
32	32	-	-
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 (PIN1)	1176
42	42	-	-
43	43	Reverse gear signal	2226
44/45	44/45	-	-
46	46	Speed limiter or ASR failure warning light	6672

PIN OUT of central unit ASR 8 (4 channels -X)

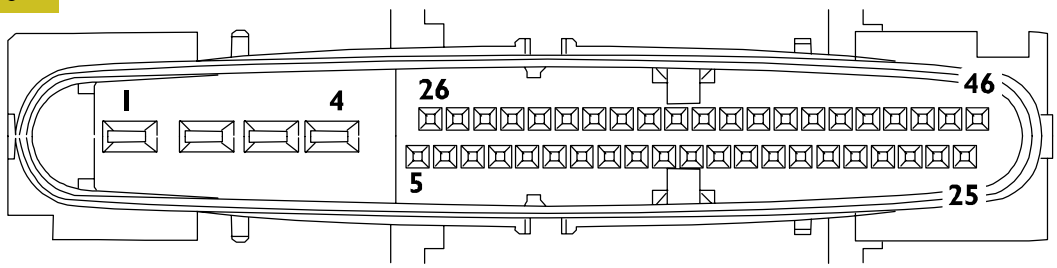
Figure 115



Pin	Function	Cable
1	Earth	0000
2	Positive after fuse	7772
3	Positive after fuse	7772
4	Signal earth	0000
5	-	-
6	Left rear sensor earth	5571
7	Right rear sensor earth	5572
8	Right rear sensor	5572
9	-	-
10	Front sensor	5570
11	Diagnosis line K	2299
12	-	-
13	De-activating the decelerator with ABS in	0000
14	CAN line L	Green
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	-	-
22	-	-
23	-	-
24	-	-
25	-	-
26	-	-
27	Left rear sensor	5571
28	Positive after fuse for ABS (KL 15)	8847
29	Front sensor earth	5570
30	Stop signalling switch - Stop lights	1173
31	Switch to enable engine brake to be put on (ASR/ESP passive switch)	8800
32/33/34	-	-
35	-	White
36	-	-
37	-	-
38/39/40	-	-
41	-	-
42	-	-
43	-	-
44/45	-	-
46	-	-

(4 channels -II)

Figure 116



Pin	Function	Cable
1	Earth	0000
2	Positive after fuse	7772
3	Positive after fuse	7772
4	Signal earth	0000
5	Left front sensor	5570
6	Left front sensor earth	5572
7	Left rear sensor	5572
8	Left rear sensor earth	5573
9	Right front sensor earth	5571
10	Right front sensor	5571
11	Diagnosis line K	2299
12	-	-
13	De-activating the decelerator with ABS in	0000
14	CAN line L	Green
15	-	-
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-
21	-	-
22	-	-
23	-	-
24	-	-
25	-	-
26	Left front sensor earth	5570
27	-	5572
28	Positive after fuse (KL 15)	8879
29	Right rear sensor	5573
30	Stop signalling switch - Stop lights	1173
31	Switch for the exclusion of ASR	8921
32/33/34	-	-
35	CAN Line H	White
36	-	-
37	-	-
38/39/40	-	-
41	-	-
42	-	-
43	-	-
44/45	-	-
46	-	-

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.

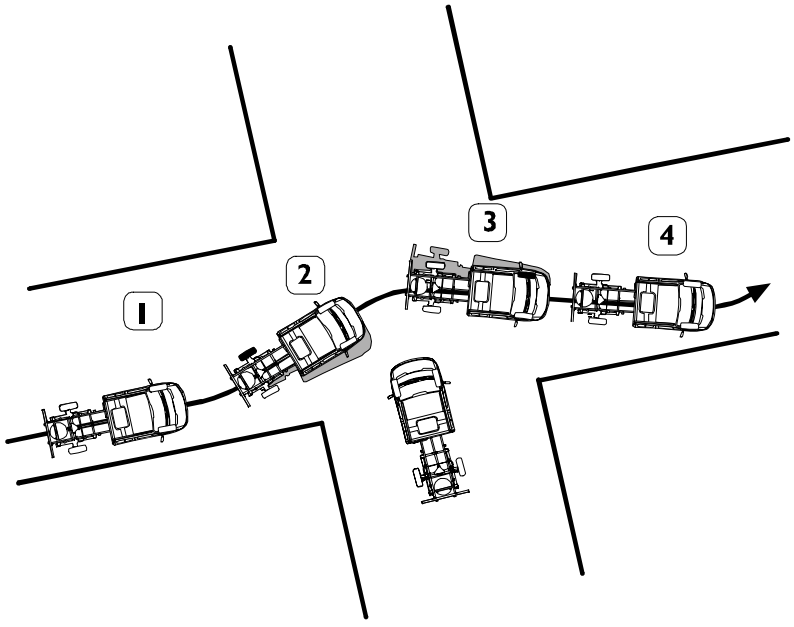
The ESP may, through engine management, reduce the number of revolutions of the engine itself, in order to withstand vehicle deceleration.

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

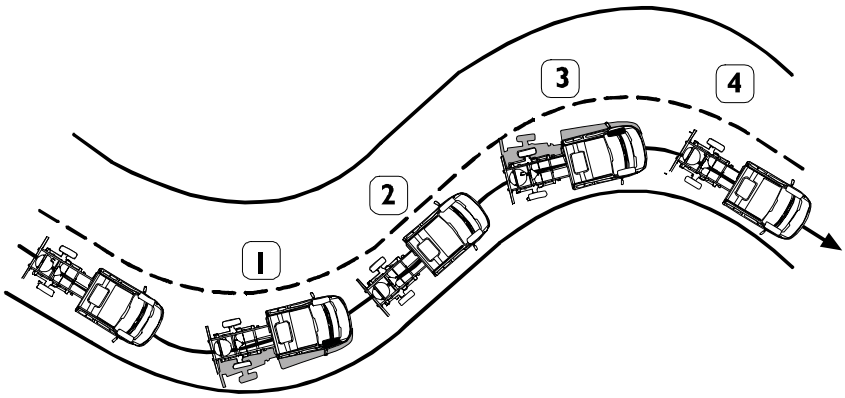
Figure 117



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

Sudden steering

Figure 118

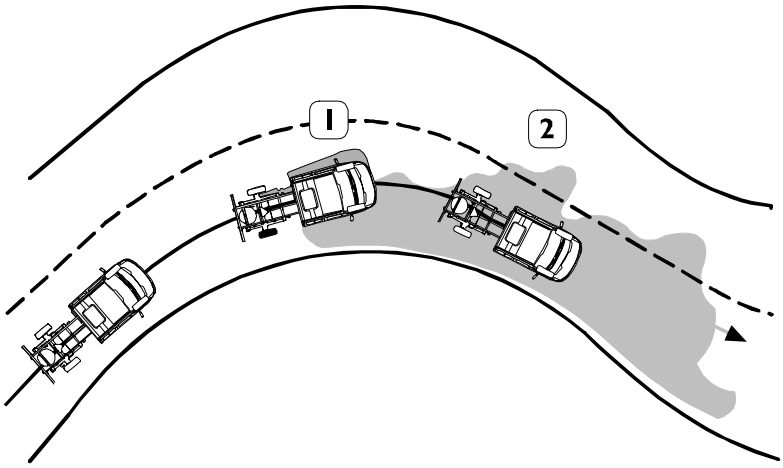


101864

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 119



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 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.

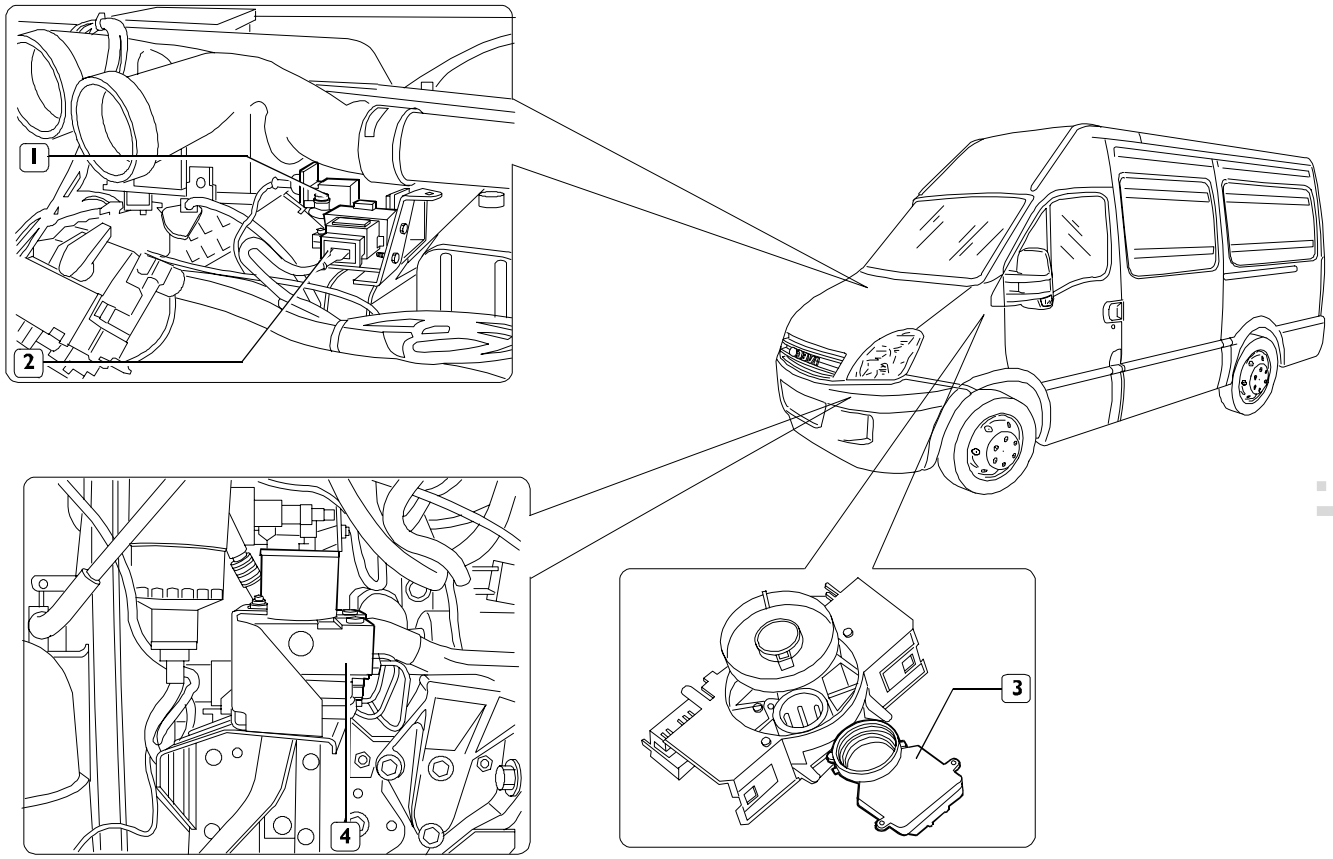
EBD not working

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 120



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

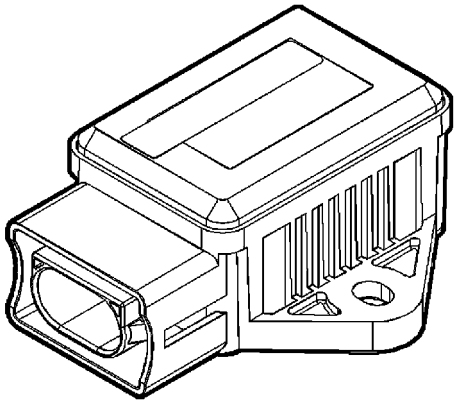
Some modifications or repairs affecting the ESP system components require a calibration procedure.

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 121



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.

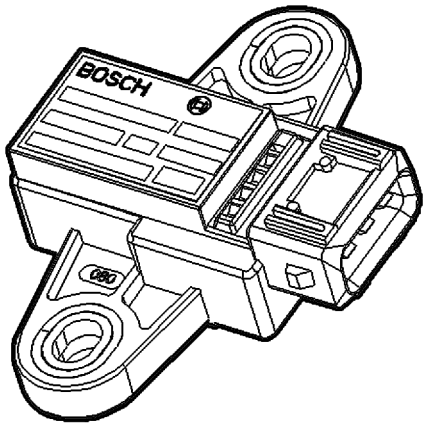
The comparison between these signals and those from the driver (steering-wheel position, wheel spin number/speed and pressure on the brake pedal/accelerator position) allows the ESP control unit to define the actions to be taken. The hydraulic unit controls brake pressure as quickly as possible, separately 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 122



102116

It measures the vehicle's acceleration and deceleration changes.

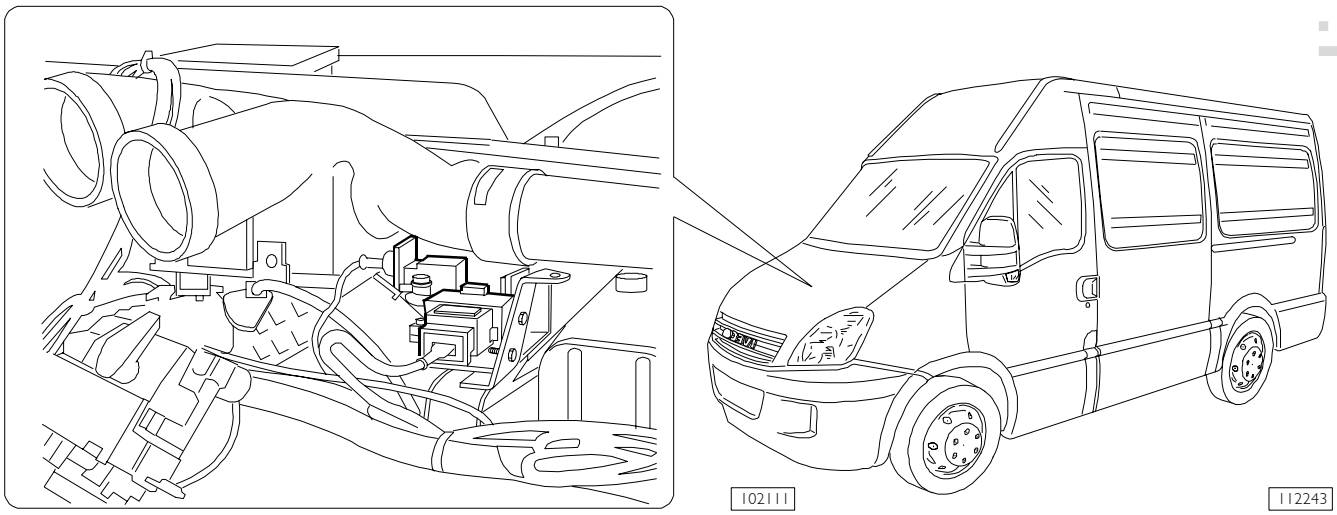
These signals continuously inform the control unit about the vehicle's behaviour.

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 123



102111 112243

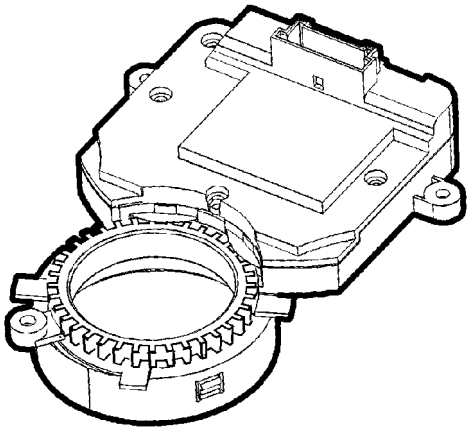
In a horizontal position, you will obtain the sensor "zero" condition through the diagnosis instrument, i.e. you will assign its absolute zero position.

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 124



102116

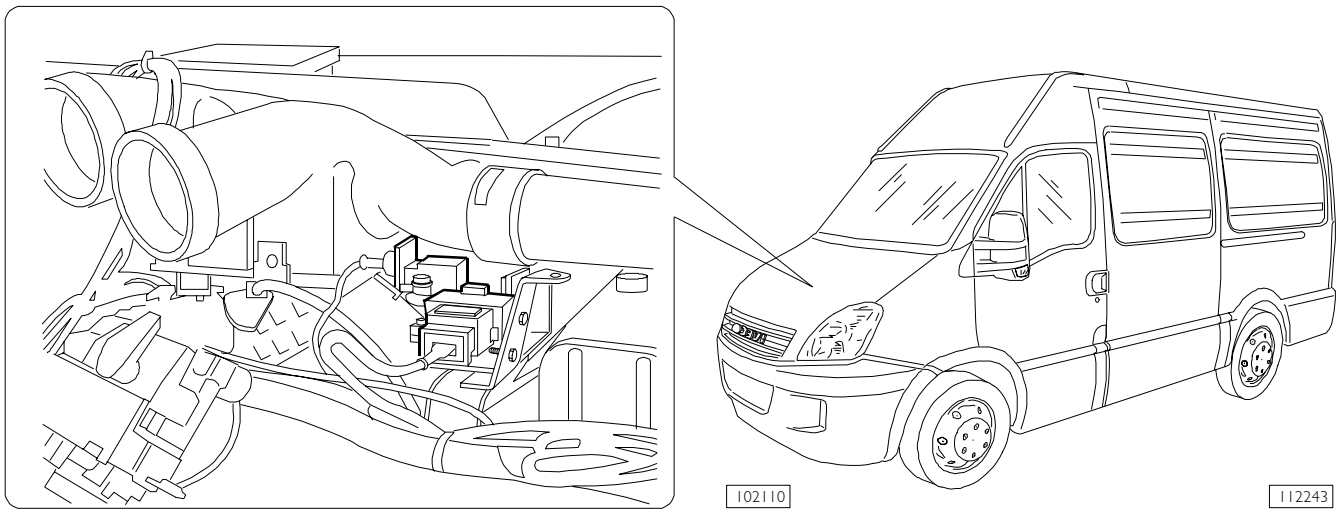
It measures the steering angle required by the driver.

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 125



102110 112243

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.

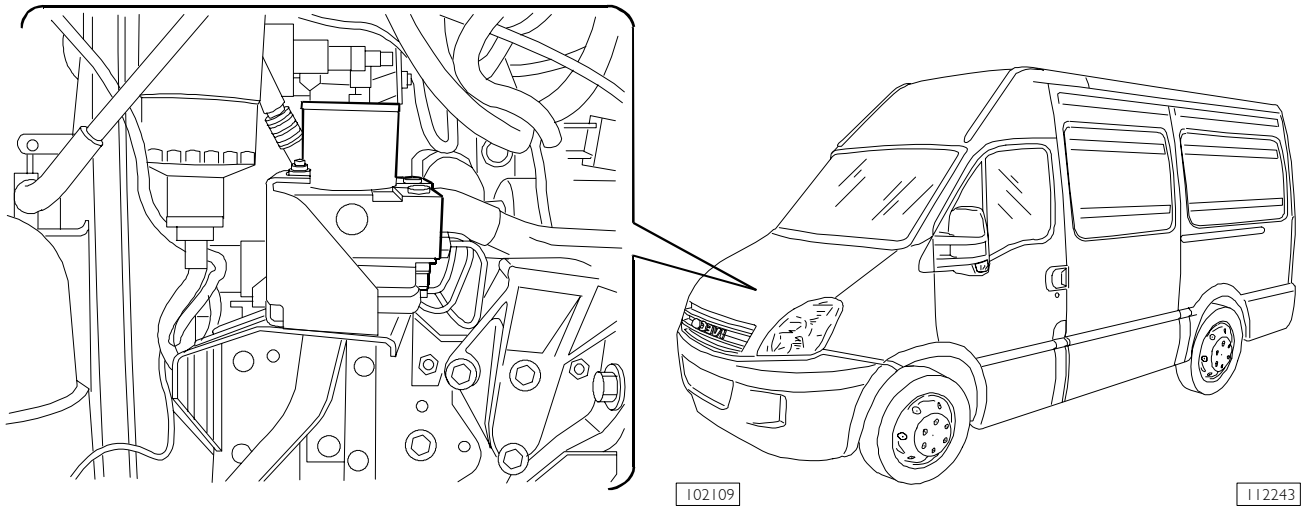
Use a diagnosis instrument to clear the errors.
Carry out a road test, to make the control unit verify whether errors are still found. Drive along a straight road at a speed of approximately 50 k.p.h. Steer to the right and then to the left several times, after making sure you do not endanger other drivers.

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 126



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.

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.

System components are connected to each other and to the rest of electrical system through a special wiring harness that can be easily identified as it is provided with a yellow sheathe.

SYSTEM OPERATION

Device intervention sequence can be INDICATIVELY REPRESENTED as illustrated in following figure.

For convenience's sake, drive side device only is shown: passenger side air bag operation is quite similar.

Represented diagrams are qualitative and are not concerning subject vehicle.

Diagram A: this diagram represents inflation pressure in cushion versus crash dynamics developing time.

Diagram B: this diagram represents body positions during a front crash with respect to steering wheel and air bag positions. Below is events time sequence from the time of electrical pulse triggering off by electronic central unit.

Time "t1"

Time when inflation system is triggered off. Thereafter, inflation pressure starts rising in the cushion, which is still enclosed inside module cover. The module is made up of a plastic layer located at steering wheel centre. Driver's body is still in almost normal position (Figure B, reference 1).

Time "t2"

Pressure inside still closed module rises until it reaches such a value that the cover is opened, cushion stuck out and inflation started.
Driver's body starts in this time period to move forwards and is placed between normal position taken during drive and the position of the collision against the cushion (Figure B, reference 2).
At the time when the cushion is released from its shell, gas pressure slows rapidly down owing to the high inertia of the cushion. At a certain time, pressure is drawn to take negative values.

Time "t3"

Cushion pressure takes back positive values because from this time the very inflation starts which will lead the cushion to maximum expansion condition.

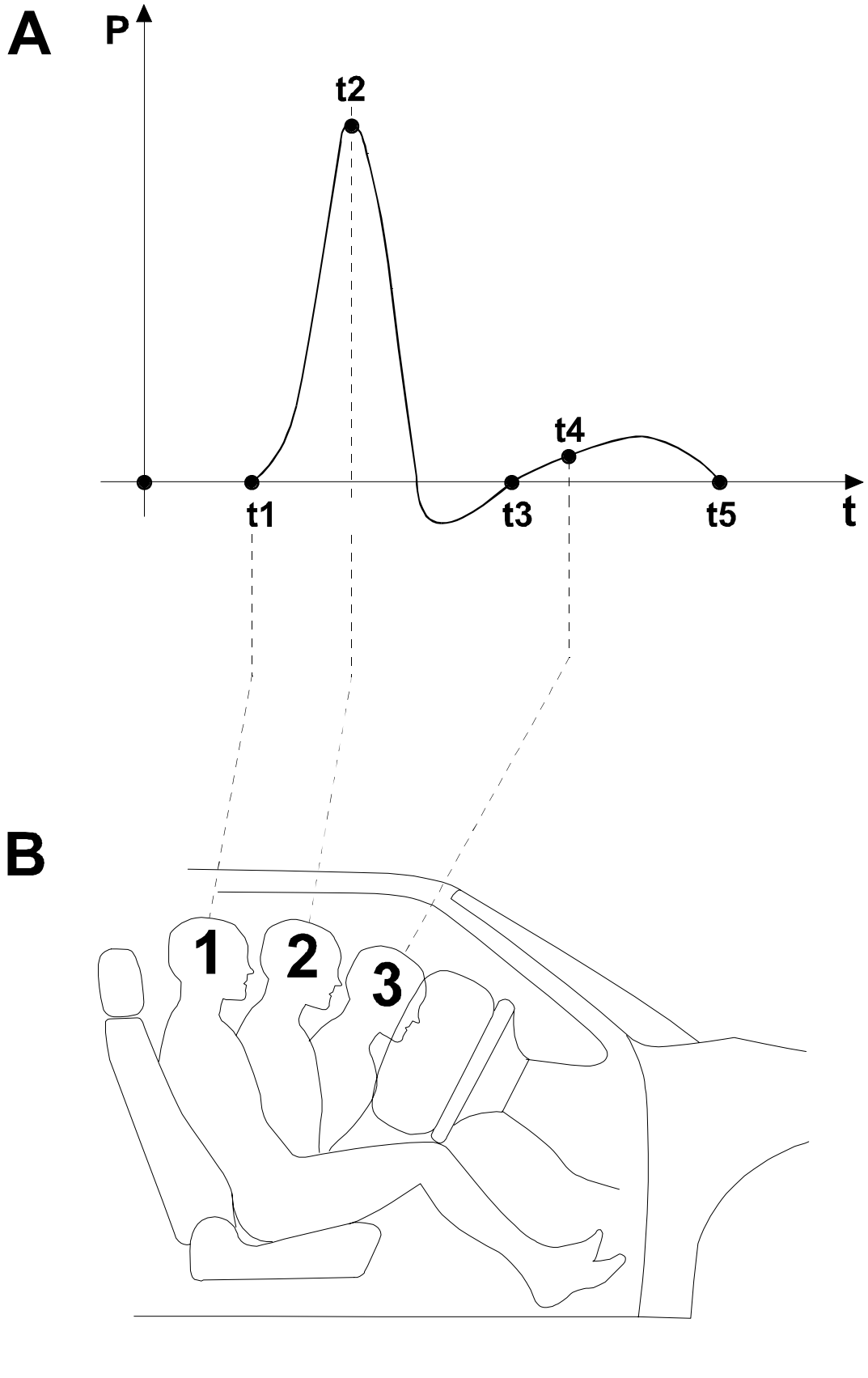
Time "t4"

Driver's body impact against the cushion takes place (Figure B, reference 3).
Pressure inside the cushion rises because of pressure exerted on it by driver.

Time "t5"

Pressure in the cushion slows rapidly down owing to the presence of an air vent hole and the cushion deflates entirely to the end of allowing driver high mobility (compatible with the rest of the vehicle).

Figure 127



INTERVENTION LOGICS

The system is capable to cover a deceleration angle, according to vehicle longitudinal axis, of ? 30 degrees and intervenes if a deceleration is reached which matches deceleration present when a front crash occurs at a speed of ~ 24 km/h against a fixed barrier.

NOTE These values are just indicative and depend on various factors, including vehicle weight, etc.

Electronic central unit, if detecting a deceleration exceeding preset calibration curve, triggers off the reaction of a chemical compound through electrical detonators.
Gas inflates the two cushions and activates the pretensioners which enable safety belts rolling up devices rewinding and locking.

Central unit is capable to detect this deceleration by two sensors, one electromechanical sensor and one electronic sensor, that are placed inside it.

The cushions, made of a synthetic fibre, are respectively housed at steering wheel centre and at an opening of the instrument panel in front of passengers.

- ❑ At each start-up operation, the central unit puts on the warning lamp and keeps it on for about 4 seconds, making a system self-diagnosis operation.
- ❑ After each system activation, the central unit keeps fault warning lamp always on, on instrument cluster and **the whole system** (central unit, belts and relating pretensioners, cushions and wiring harness) **shall necessarily be replaced**.
- ❑ The system does **NOT** need either any type of maintenance or any checks.

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 i 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.

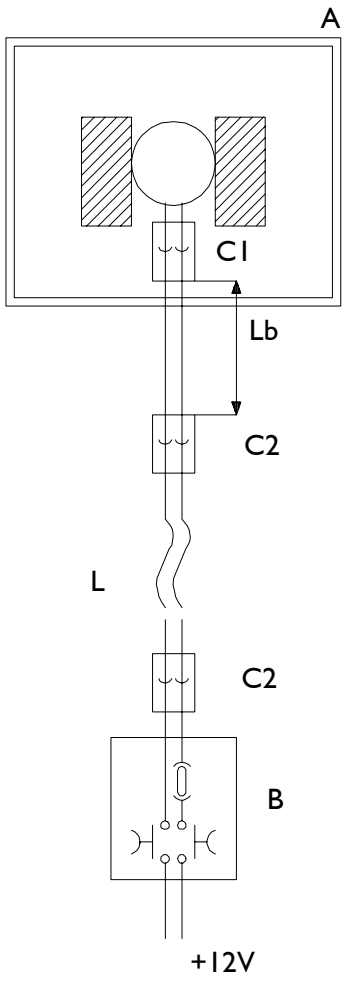
If the connector is cut or removed from the air bag unit, the safety device is disabled and this could cause unforeseen activation with serious consequences for the physical integrity of people.
Air bag systems have a reserve power unit in the control unit. This must be deactivated disconnecting the 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 decive 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 128



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

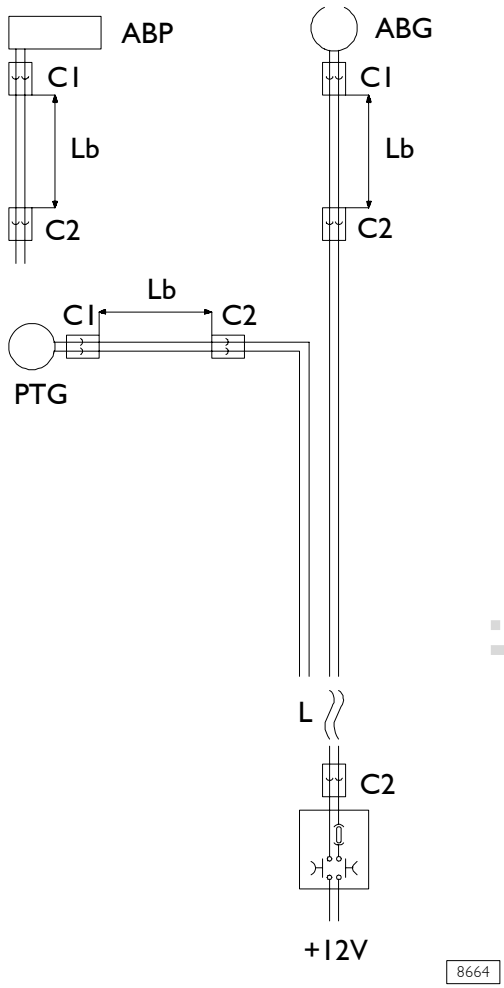
This procedure is followed when the vehicle with one or more active air bags needs to be scrapped. This procedure applies whether the air bag and/or pretensioner system is still intact or not.
It is advisable to deploy the explosive charges on the vehicle directly connecting the electric connector of 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 129

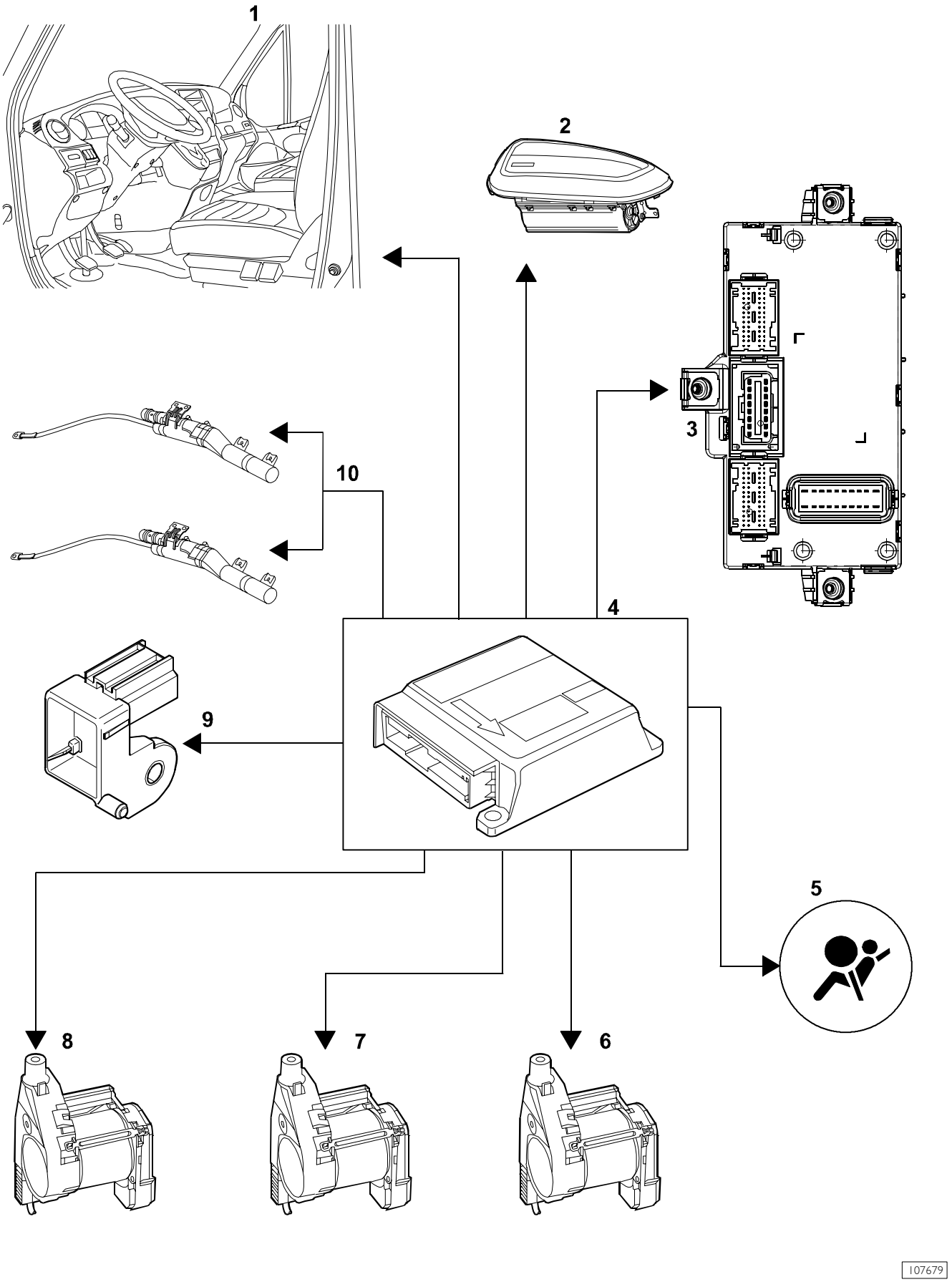


LAYOUT FOR DEPLOYING EXPLOSIVE CHARGES ON THE VEHICLE, SINGLE DEPLOYMENT

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 130



Air bag system includes following components:

1. drive side air bag module
2. passenger side air bag module
3. diagnosis connector (EOBD) on Body Computer
4. electronic central unit
5. air bag failure warning lamp on instrument cluster
6. safety belts with passenger side electronic control pretensioner
7. safety belts with drive side electronic control pretensioner
8. safety belts with central electronic control pretensioner
9. lh/rh lateral sensor
10. lh/rh curtain air-bag

DE-ACTIVATING PASSENGER AIR-BAG

Passenger air-bag can be disabled from instrument cluster menu directly by the driver.
Air-bag central unit will send a message through "B" Can line to instrument cluster which activates a yellow warning lamp and a message on display screen (comfort). If passenger air-bag is enabled, the warning lamp will flash on going on and then go off.

Electronic control unit

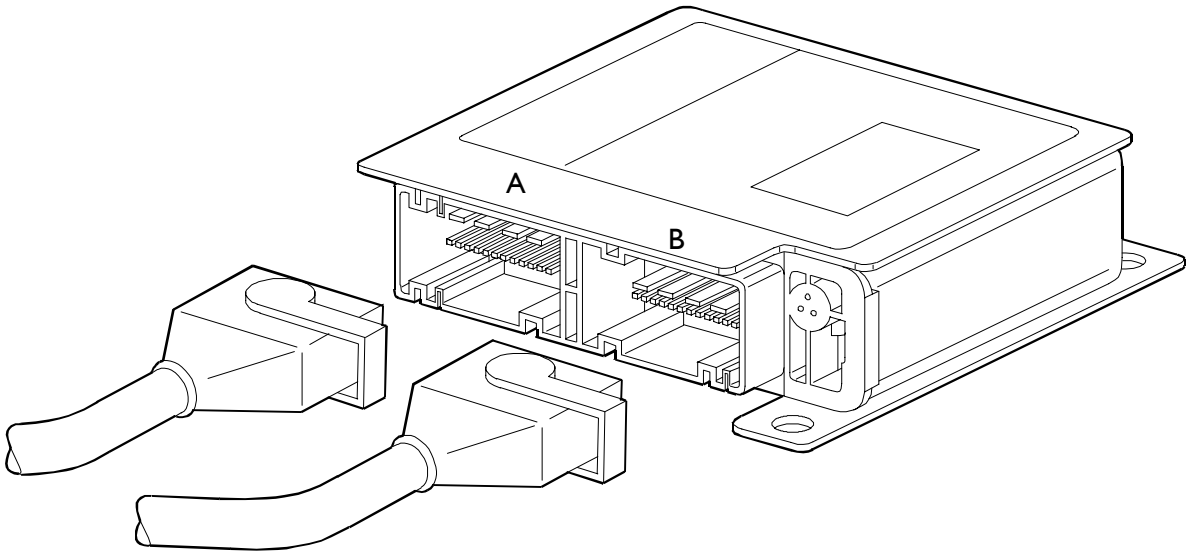
The electronic control unit is located on the floor at the side of the driver's seat between the gearshift lever and the parking brake lever; it is supplied at 12 Volt by a key-operated device, but it is still in a condition to be able to work for about 200 msec after a power cut off.

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.

Figure 131



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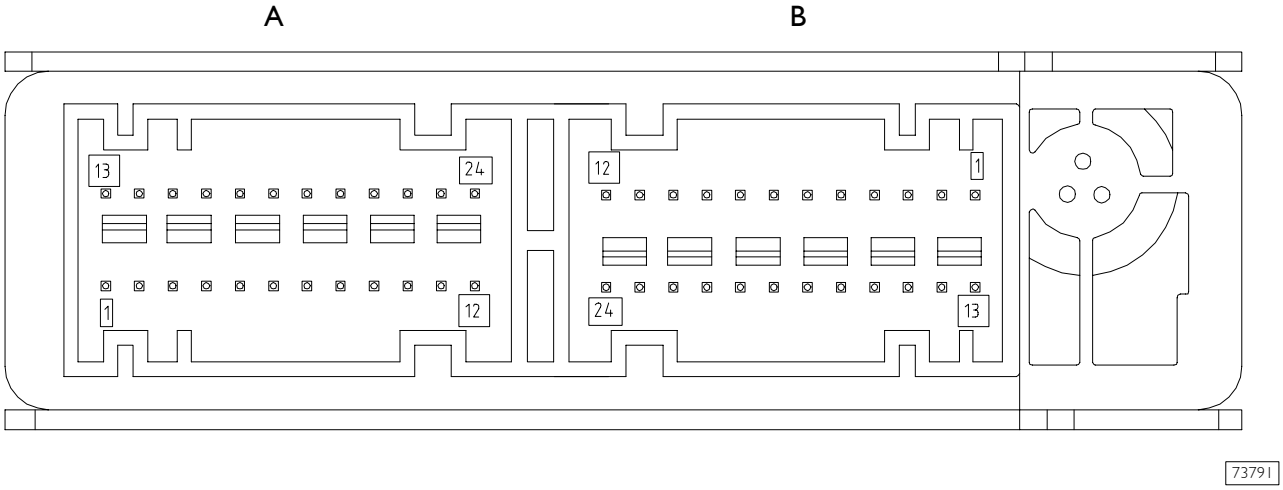
PERSPECTIVE VIEW OF THE ELECTRONIC CONTROL UNIT WITH TWO CONNECTORS
A. Black - B. Brown

Central unit Pin Out

Figure 132



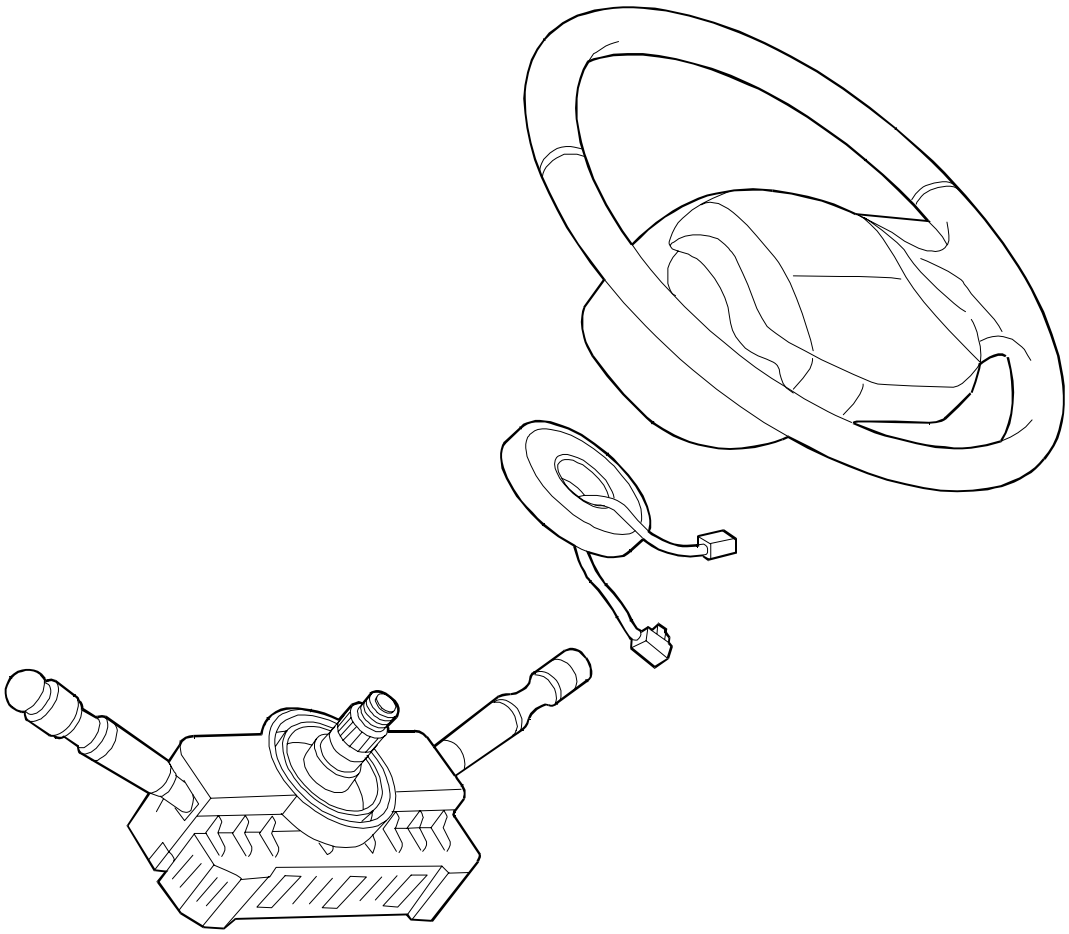
CONNECTOR B WITH BROWN COLOUR		CONNECTOR A WITH BLACK COLOUR	
Pin	Function	Pin	Function
1	"B" Can line L	1	Lh lateral sensor "-"
2	"B" Can line H	2	Lh lateral sensor "+"
3	----	3	Rh lateral sensor "-"
4	----	4	Rh lateral sensor "+"
5	----	5	----
6	----	6	----
7	----	7	----
8	----	8	----
9	----	9	Lh pretensioner "-"
10	----	10	Lh pretensioner "+"
11	----	11	Rh pretensioner "+"
12	Positive for power supply	12	Rh pretensioner "-"
13	----	13	----
14	----	14	----
15	----	15	----
16	Earth	16	----
17	Central pretensioner "+"	17	Lh curtain air-bag "+"
18	Central pretensioner "-"	18	Lh curtain air-bag "-"
19	----	19	Rh curtain air-bag "-"
20	----	20	Rh curtain air-bag "+"
21	Positive for driver air-bag "+"	21	----
22	Negative for driver air-bag "-"	22	----
23	Negative for passenger air-bag "-"	23	----
24	Positive for passenger air-bag "+"	24	----

SPIRAL CONTACT

It is a part which is installed on steering column switch unit and used to enable the connection cables of the cushion on steering wheel to follow steering wheel rotation without risks of breakage.
The device is made up of two caps: lower cap is fixed to steering column switch unit by three screws, while upper cap is made integer to steering wheel through two add-ons inserted on upper side.
Inside the two caps, connection cables are wound up in a spiral shape in order that they are enabled to follow movements.
Spiral contact is also equipped with a device which automatically locks spiral contact rotation when spiral contact is removed from steering wheel; this is done in order to prevent upper cap, that is not constrained any more, from freely rotating, so causing the cables to unexpectedly unwind or wind up and creating consequent risks of cable breakage.
On steering wheel mounting operation, the device is automatically locked.

- ❑ Where spiral contact is disconnected/reconnected, it must be made sure that it is remounted on the steering column switch unit in the same position it was removed.
- ❑ Where spiral contact is replaced, if it is provided as a spare apart from steering column switch unit, then spiral contact must be installed with wheels perfectly aligned, because this is new device corresponding position.

Figure 133



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PRETENSIONERS

Pyrotechnic device that can be electrically activated by a signal from central unit, it is an integrating part of safety belts rolling up device, so that a single component is created which is fixed to vehicle pillar.

In the case of a crash having a certain extent, it intervenes in such a way that it recovers the unavoidable stretch of the belts caused by the action exerted by body weight and it keeps the body adherent to seat back.
At the end of intervention, the belt remains locked, so highlighting that device intervention has occurred.

Operation principle

At the time when a determined deceleration of the vehicle occurs, the electronic sensor, that is placed in control central unit, sends a signal which ignites gas generator pyrotechnic charge (detonator).
Propellant combustion develops a gas the pressure of which generates a force pushing rack piston upwards.
Rack piston upward movement rotates gear wheels, which reverse tape rotation direction, so winding back the tape by a few centimetres.

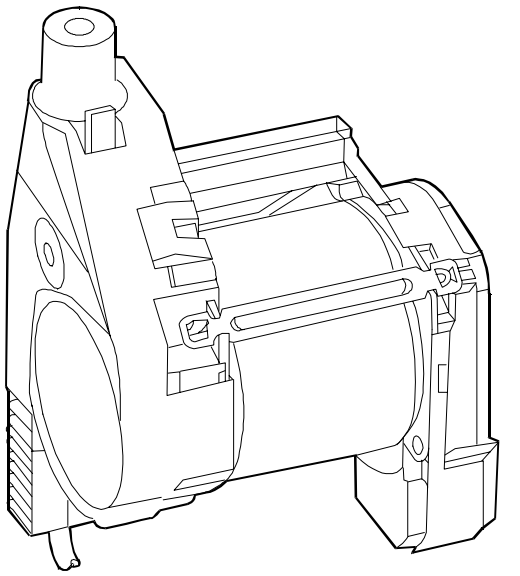
After every crash, the belt becomes unusable: therefore, it must be replaced.

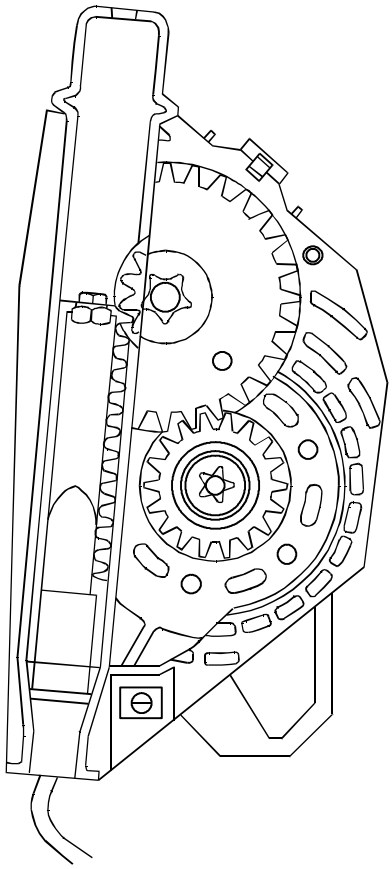
The charge for driver side pretensioner is connected to central unit on pins A9/A10.

The charge for passenger side pretensioner is connected to central unit on pins A11/A12.

The charge for central pretensioner is connected to central unit on pins B17/B18.

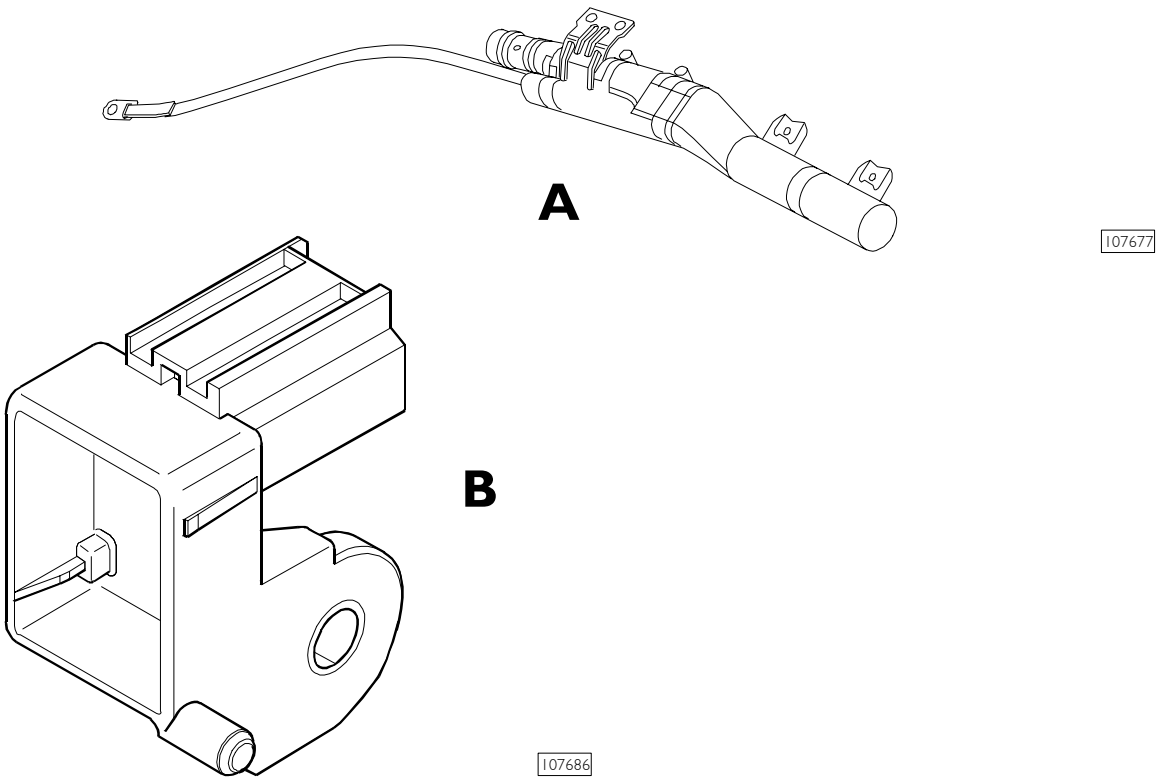
Figure 134





CURTAIN AIR BAG

Figure 135



A. "Curtain" air bag - B. Side crash sensor

On door pillars, two air bags named "curtain" air bags are provided. These devices intervene in case of a side crash. For this purpose, two (lh & rh) sensors are present which detect the occurrence of this event.
For the connections of these components, see central unit pin-out and relating electrical scheme.

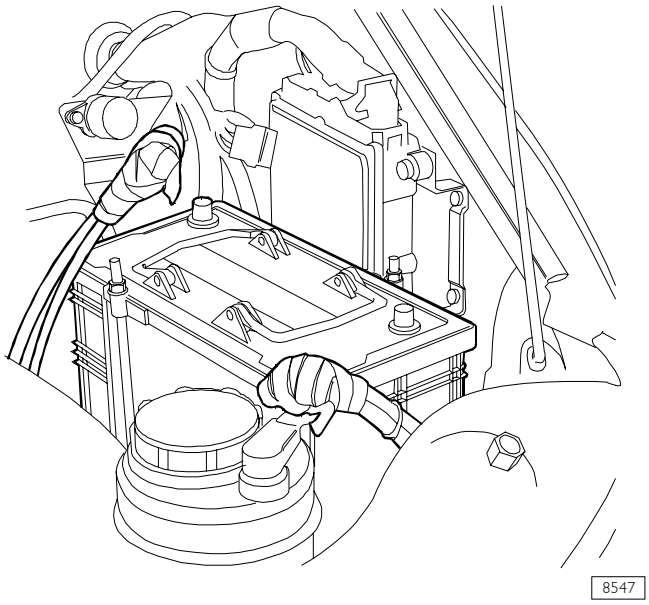
COMPONENT REPLACEMENT INTERVENTIONS

Electronic central unit

To remove the central unit, the following is needed:

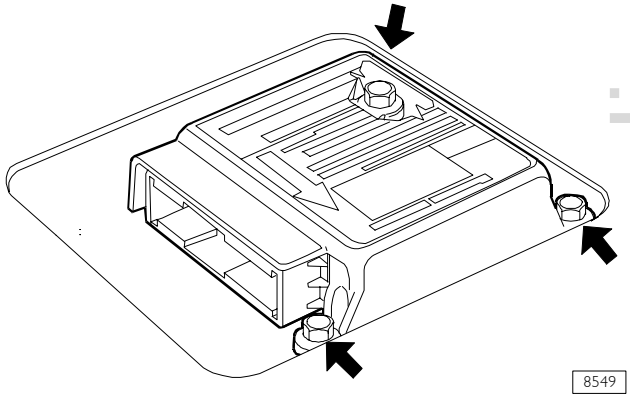
- ❑ observing safety rules;
- ❑ disconnecting battery cables (first negative cable, then positive cable) and isolating them by applying an adhesive tape on pins (Figure 136);
- ❑ waiting for at least ten minutes before resuming operations;
- ❑ removing the protection under which central unit is located;
- ❑ operating using a small screwdriver on connector stops locking connector fastening levers and rotating the levers inwards;
- ❑ disconnecting the connectors from central unit;
- ❑ unscrewing the three screws which fasten central unit to floor (Figure 137).

Figure 136



ISOLATING THE BATTERY CABLES

Figure 137



REMOVING THE CENTRAL UNIT

Drive side air bag module

For removing air bag module, the following is needed:

- ❑ observing safety rules;
- ❑ disconnecting battery cables (first negative cable, then positive cable) and isolating them by applying an adhesive tape on pins;
- ❑ waiting for at least ten minutes before resuming operations;
- ❑ unscrewing the screws located at steering wheel rear side, and, in order to be able to gain access to each screw, rotating the steering wheel in such a way that you can always operate from steering column upper half-shell side;
- ❑ lifting the module by just what needed to be able to disconnect the connector that is placed at the centre of the module;
- ❑ removing the module from steering wheel.

Not activated air bag modules, after they have been removed, must be put back into a special locked cabinet with the plate resting on the plane.

Passenger side air bag module

For removing air bag module, the following is needed:

- ❑ observing safety rules;
- ❑ disconnecting battery cables (first negative cable, then positive cable) and isolating them by applying an adhesive tape on pins;
- ❑ waiting for at least ten minutes before resuming operations;
- ❑ unscrewing the screws fastening instrument panel upper coating (including the screws that are present near central air diffusers);
- ❑ removing the coating;
- ❑ disconnecting module cable connector from air bag cable;
- ❑ unscrewing the four screws, two per side, which fasten module support bracket to body and removing the module.

NOTE Where passenger side cushion is not present as it is optional, on relating connector there is since vehicle production mounted a specific resistance for simulating the charge (R = 2.15 Ohm + 0.35).

Spiral contact

For removing the spiral contact, the following is needed:

- ❑ removing the drive side air bag module;
- ❑ aligning the wheels and keeping them in such position throughout the operation;
- ❑ unscrewing the nut which fixes the steering wheel to steering column;
- ❑ always with the vehicle having the wheels aligned, marking the position between steering wheel hub and steering column;
- ❑ taking out the steering wheel paying attention not to unthread spiral contact cable;

Make sure that steering wheel removal has caused spiral device upper cap lifting. Where upper cap rotates, it has to be locked by taking it outwards; if a click is heard, it will mean that the locking has occurred.

- ❑ removing steering column lower half-shell by unscrewing the three fastening screws;
- ❑ operating from inside, removing steering column upper half-shell by unscrewing the two fastening screws;
- ❑ cutting the clamp fixing spiral device cable to steering column and disconnect spiral device cable connector from air bag cable;
- ❑ unscrewing the three screws fastening spiral device to steering column switch unit and removing it.

Spiral device must be removed without rotating the upper cap, locking spiral device position by either a clamp or some adhesive tape.

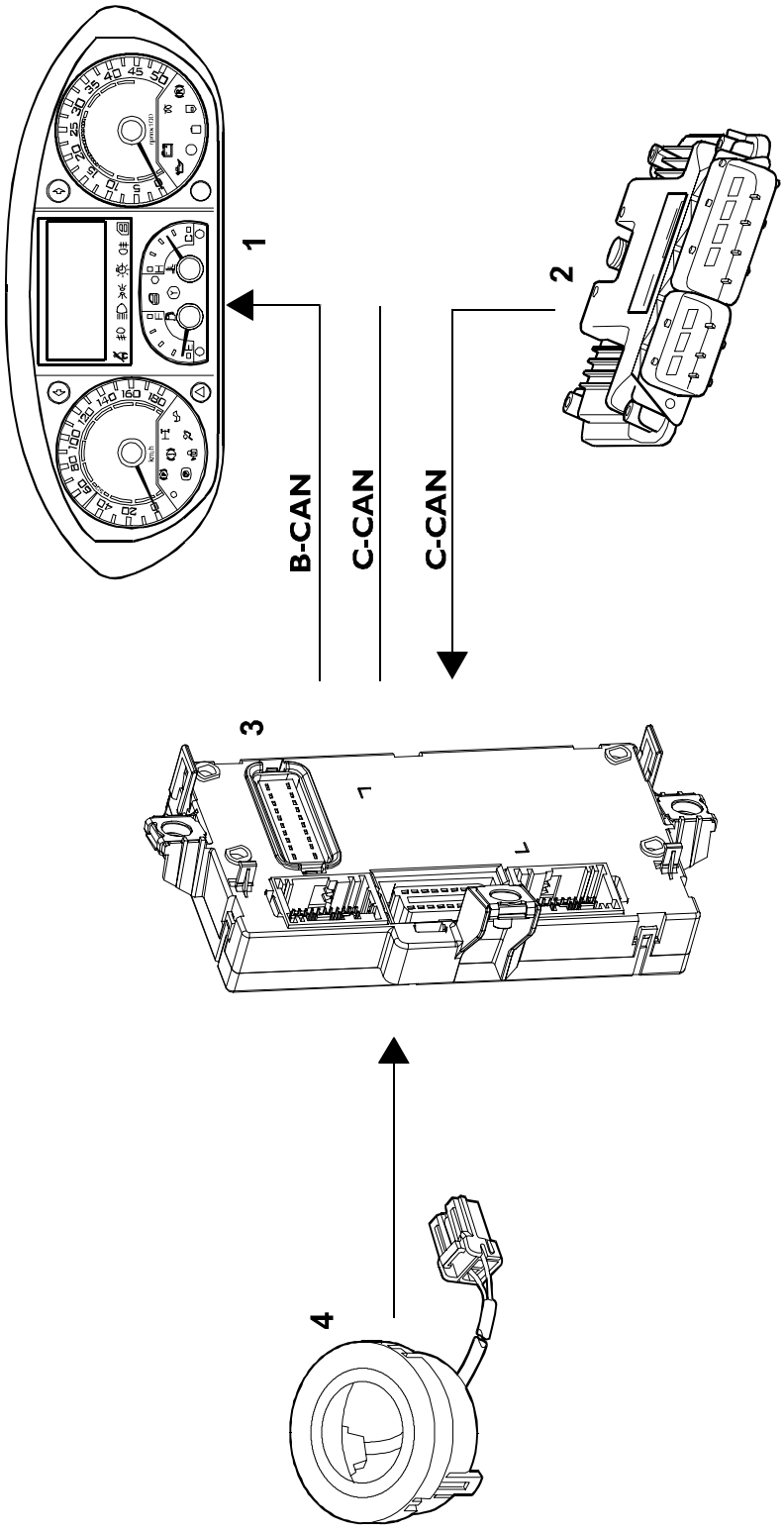
For remounting the spiral device, the following is needed:

- ❑ making sure that wheels are aligned;
- ❑ if spiral device has not to be replaced, after taking off either adhesive tape or the clamp previously mounted, remounting the spiral device without rotating the upper cap, then screwing the three fastening screws;
- ❑ where a new spiral device is mounted, after fixing it to steering column switch unit, tearing off plastic tab locking the upper cap and checking that the upper cap is not rotating;
- ❑ connecting air bag cable connector to spiral device cable and fixing spiral device cable to steering column through suitable clamp;
- ❑ mounting the two half-shells of steering column fixing them to their support plate through special screws;
- ❑ cautiously entering the cable, to be connected to drive side air bag module, into special slit on steering wheel hub;
- ❑ mounting the steering wheel making previously marked references match;
- ❑ tightening the nut, fixing the steering wheel, at prescribed torque.

NOTE Where steering column switch unit is replaced, it must be replaced by a steering column switch unit comprehensive of spiral device.

IMMOBILIZER

Figure 138



1. Instrument cluster - 2. Central unit EDC 16 - 3. Body Computer - 4. Antenna on start-up switch

Operation description

Immobilizer present on Daily E4 differs from previous one in some features:

- ❑ "Immobilizer" central unit is not present any more, but this function has been integrated inside Body Computer;
- ❑ the warning lamp has a different symbol;
- ❑ a display screen is present where messages relating to the system are displayed (COMFORT).

Signal received from the "transponder" from the key is sent to connector AV to pins 8 and 7. Body Computer communicates with central unit EDC 16 through "C" Can line and, if the signal is acknowledged, start-up enabling is sent to central unit EDC. By rotating start-up key, engine lock is only de-activated if protection system acknowledges the code that was transmitted by the key.
Body Computer through "B" second Can line communicates with instrument cluster, where Immobilizer warning lamp is present (change of symbol with respect to previous version).

- ❑ warning lamp on: key not acknowledged;
- ❑ warning lamp off: key acknowledged.

A warning lamp on after approximately two seconds from vehicle start-up not necessarily means system failure but can mean a particularly low charge status in battery.
Where such event occurs, in order to make a system test, vehicle must be stopped and engine put off. Rotate the key again: warning lamp will go on and shall go off after approximately 1 second.
Where warning lamp remains on after this test too, repeat the operation keeping engine stopped up for more than 30 seconds. if the problem persists, comply with provided prescriptions appearing on display screen (if any).

Emergency procedure

It is necessary to enter "PIN code" only operating on accelerator pedal as described below:

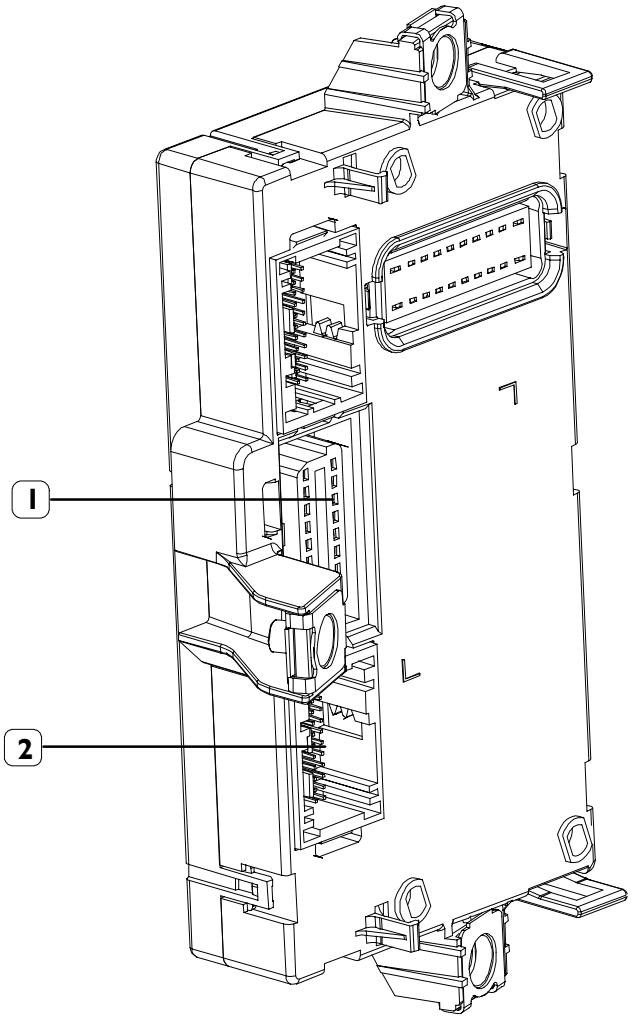
- ❑ Insert the key to ride position.
- ❑ EDC warning lamp, after ~ 2 seconds, starts flashing rapidly.
- ❑ Press accelerator pedal and keep it pressed for ~ 15 seconds.
- ❑ EDC warning lamp starts flashing slowly.
- ❑ When the number of flashings is matching "PIN code" first figure, fully press down accelerator pedal, then release it again. (While this pressing operation is performed, EDC warning lamp remains off).
- ❑ Go on with reading and performing relating pressing operation on accelerator pedal for remaining four "PIN code" figures.
- ❑ At the end of the sequence, if entered code results to be correct and no failure is present in the system, EDC warning lamp stops flashing: operation terminated correctly.
- ❑ Start up the vehicle.

Keys

- ❑ New key memorization procedure (centralized by Iveco)
- ❑ New type of key with trasponder (with or without wireless control)
- ❑ You can memorize min 1 up to max. 8 keys

Body computer

Figure 139



1. "EDBD" diagnosis connector - 2. "AV" connector

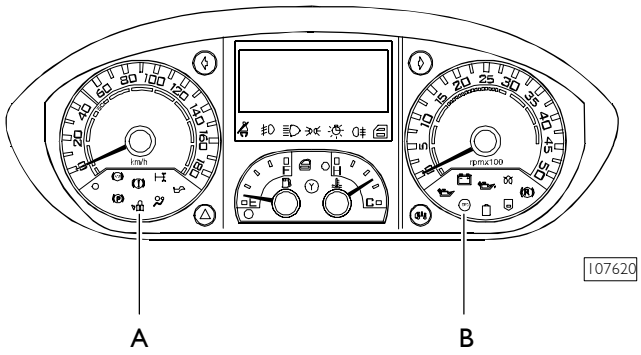
Capable to communicate with central unit "EDC" through "CAN line".

Central unit main tasks are:

- acknowledging that the key was entered into the switch and rotated,
- activating and reading the secret code issued by "Transponder",
- managing code check and processing,
- communicating with central unit "EDC",
- storing any failures,
- making system diagnosis.

AV/7 - AV/8 antenna signal input (Transponder)

Figure 140



A. Immobilizer warning lamp - B. EDC failure warning lamp

Antenna

It is mounted coaxial to key switch and has the task of:

- ❑ supplying "Transponder" for sending the secret code;
- ❑ receiving the signal from "Transponder" and sending it to central unit.

It is connected to Body Computer to connector AV/7 - AV/8.

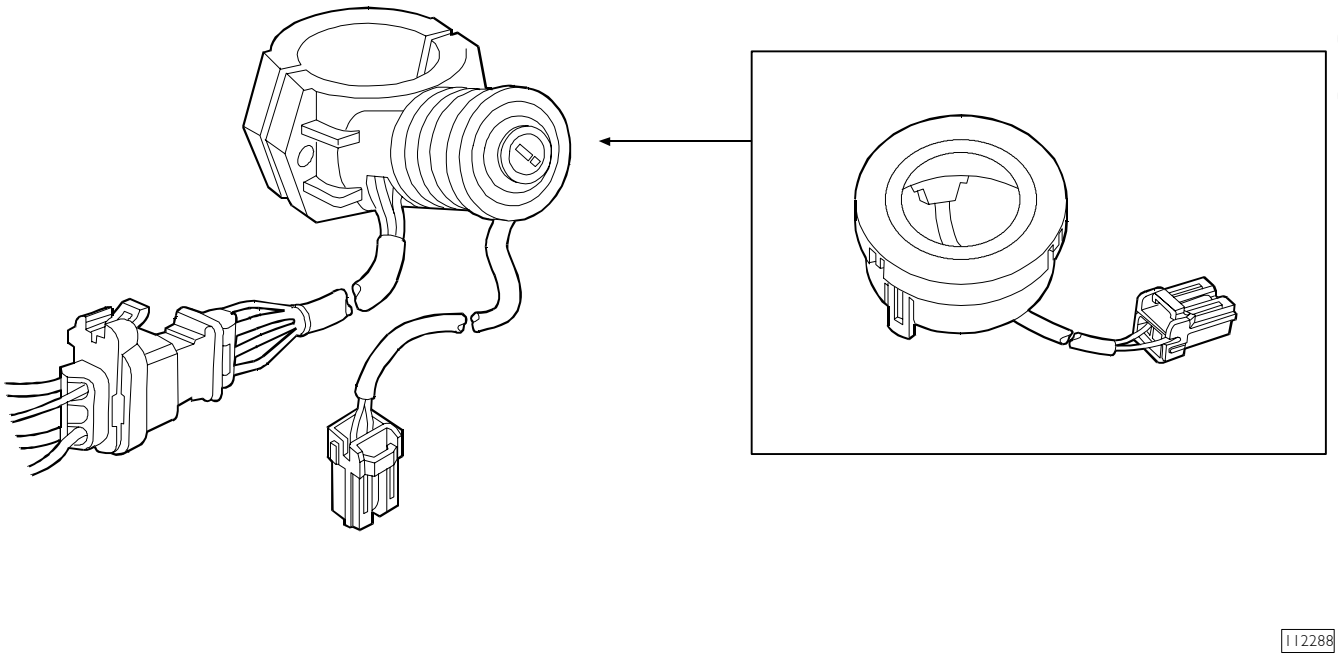
Warning lamp

Placed on instrument cluster, it acquaints the driver of system correct operation or possible failure.

Inserting the key to ride position, central unit makes a system test putting on the warning lamp and keeping it on for a time of about "1 second".

If it goes off after said time, it means that the key was acknowledged and system is working. On the contrary, if it behaves in a different way, it means that key was not acknowledged (star-up not possible).

Figure 141



IMMOBILIZER NEW PROCEDURES

Storing new keys into Body Computer	❑ Send out a fax to Iveco with key VIN and PN. ❑ Keys arrive programmed by Iveco but it is necessary to have them acknowledged through diagnosis tool. Old keys can be stored later
Storing radio commands	Through diagnosis tool
Replacing Body Computer (readable)	Through diagnosis tool: keys need not to be learnt again
Replacing Body Computer (not readable) with remote services	Through remote services: to reset the plan (instrument cluster), Programmed Maintenance keys and/or radio commands need to be learnt again
Replacing Body Computer (not readable) without remote services	❑ BC already programmed by Iveco is sent and it will be necessary to have old keys acknowledged on new Body Computer. ❑ Rewrite maintenance plan. Information stored in old B.C. are lost
Replacing EDC16	No particular procedure: as soon as new EDC is connected, it is automatically configured by Body Computer
Replacing key switch	❑ Order a kit complete with switch and two keys to be programmed at Iveco. ❑ Workshop shall just store the keys into Body Computer by Easy.

Programmed maintenance is a function of display screen in version COMFORT.

6AS 400 A O.D. 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.

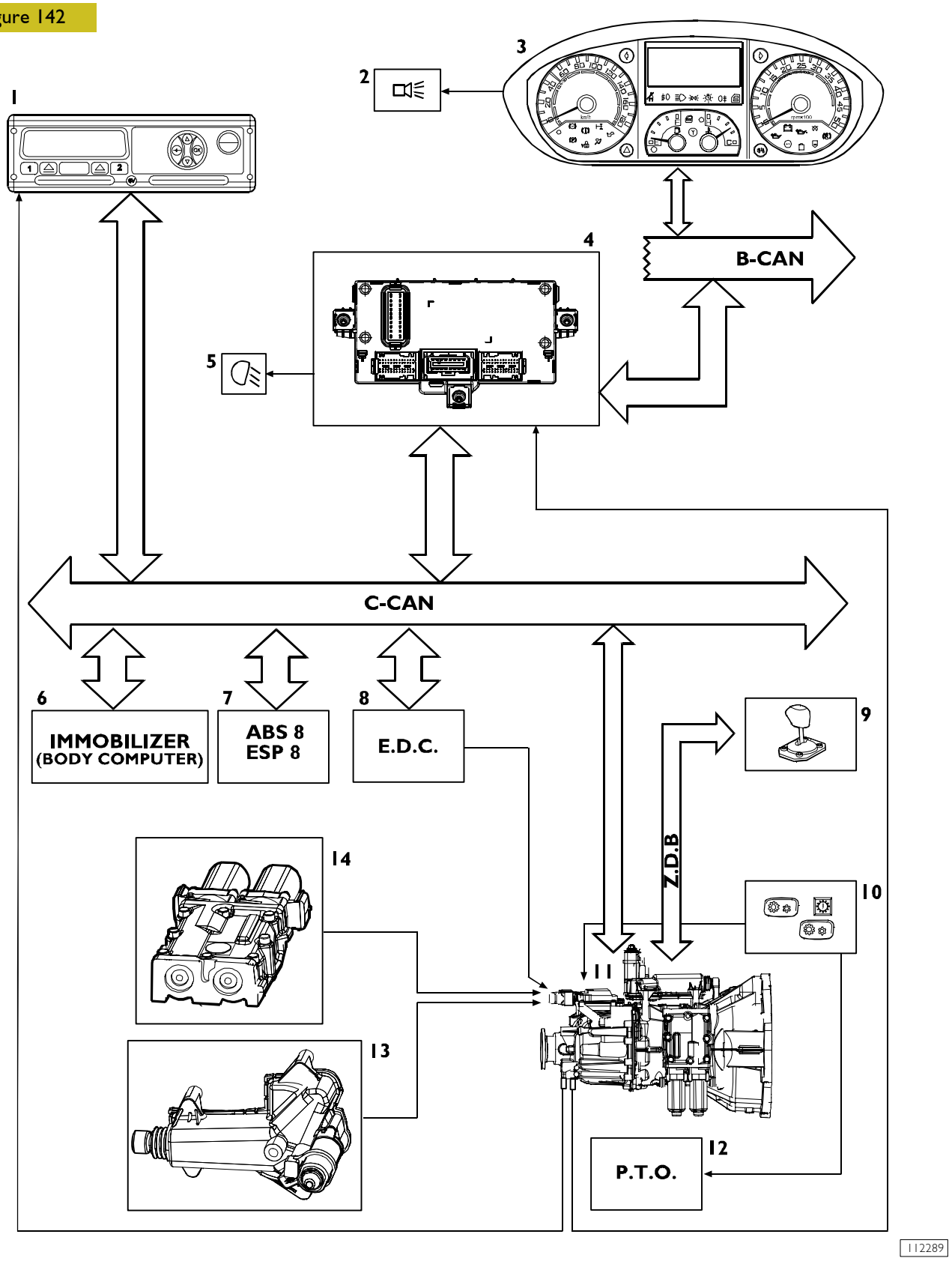
The electronic control unit picks up all the signals required to meet the safety conditions and the parameters programmed in the same. It also drives the electric actuating motor(s) for gear selection/engagement and clutch control.

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.

Electronic management

Figure 142



1. Digital tachograph - 2. Buffer (located inside Instrument Cluster - 3. Instrument Cluster - 4. Body Computer - 5. Switching on reverse lights - 6. IMMOBILIZER central unit - 7. Central unit ABS8/ASP8 - 8. Central unit EDC - 9. Gears lever - 10. Pushbutton board - 11. Central unit gearbox - 12. PTO - 13. Clutch actuator - 14. Gearbox actuator

COMPOSITION OF THE SYSTEM

System control unit

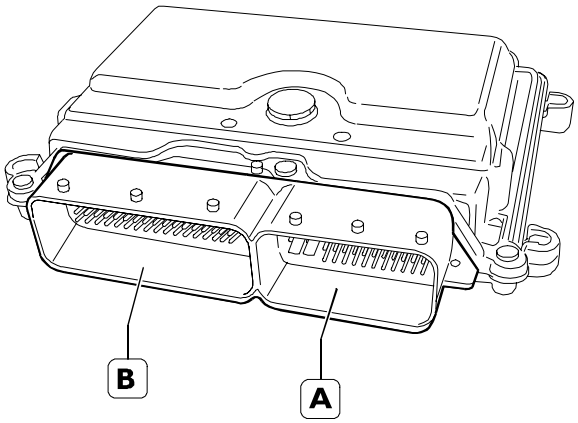
The electronic control unit receives the signals from the sensors/switches: the management and control of the system under the different operating conditions of the gearbox are based on the above signals.

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 143



90135

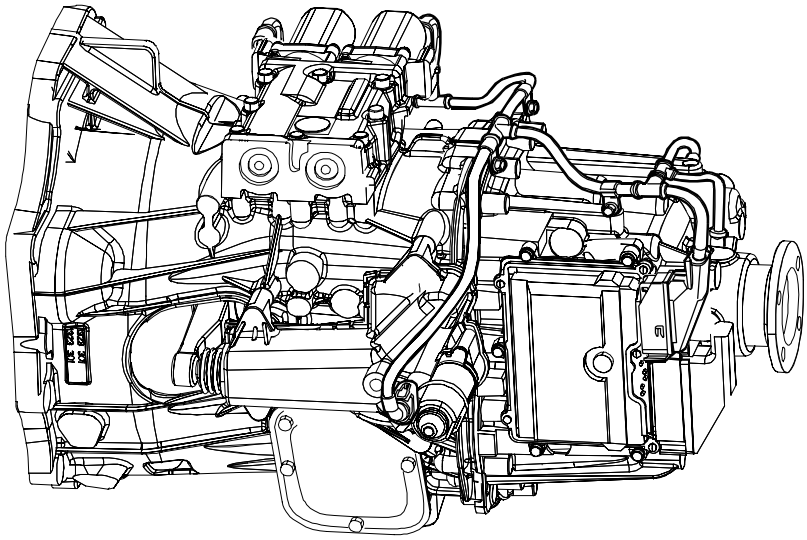
Through the connection with the EDC 16 system, the gearbox control unit is able to detect the position of the accelerator pedal and also the engine revs number.

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 144

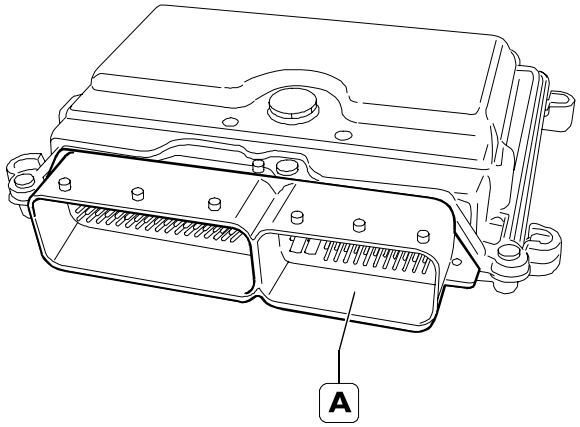


101870

Position of the electronic control unit

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

Figure 145

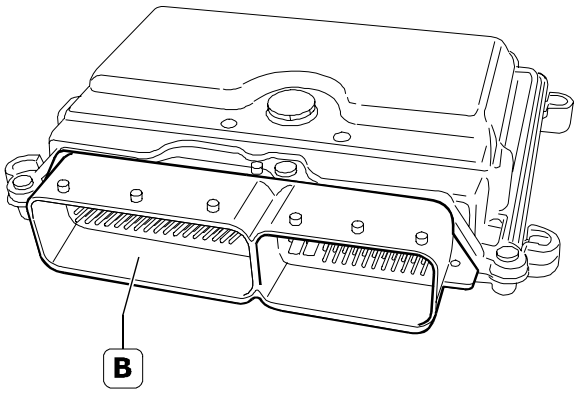


101869

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 6)
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)

Connector control unit PIN-OUT – vehicle side (B)

Figure 146



101871

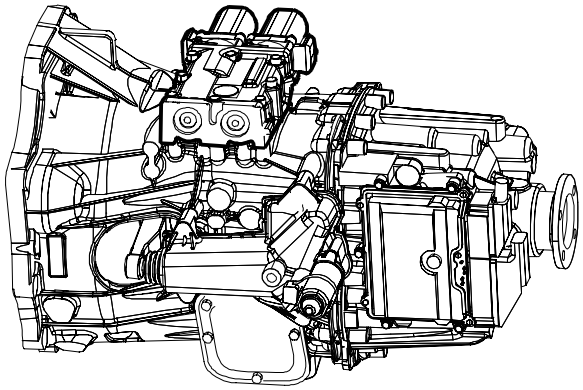
Pin	Function
1	Earth
2	Earth
3	Earth
4	Battery positive
5	Battery positive
6	Battery positive
7	Earth
8	Earth
9	KL 30
14	PTO actuation request signal (option)
17	CAN C "H" line
18	CAN C "EDC" line
28	CAN C "EDC" line
29	CAN "L" line
33	Free
37	Free
38	Free
39	KL 30
40	CAN L --- ZF LINE
41	CAN H --- ZF LINE
43	KL 15
44	Hand brake in signal
45	Signal to Body Computer
46	PTO status signal
47	PTO in signal
49	"Gearbox in neutral position" remote control switch control
51	Speed signal
52	Diagnosis line K (heater, Body Computer)

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 147



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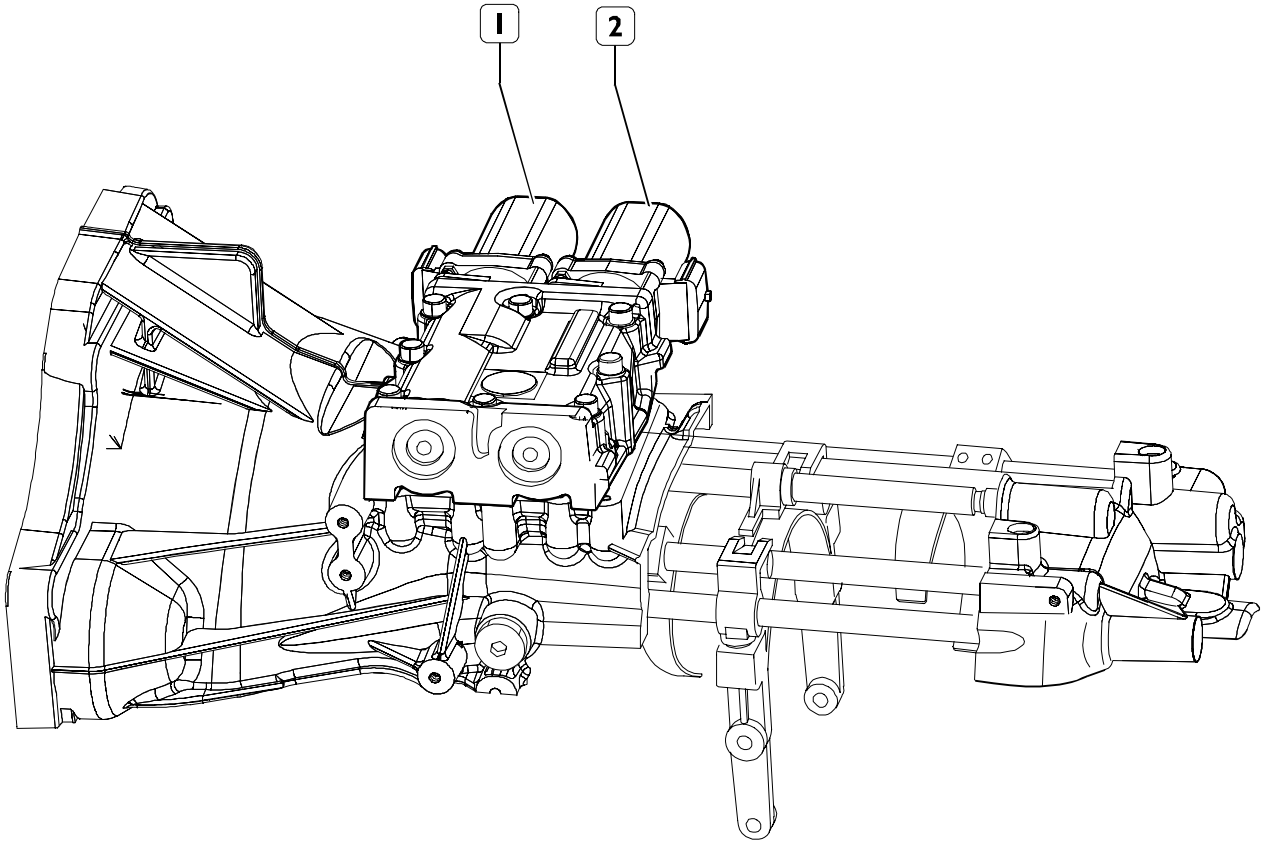
Position of actuator

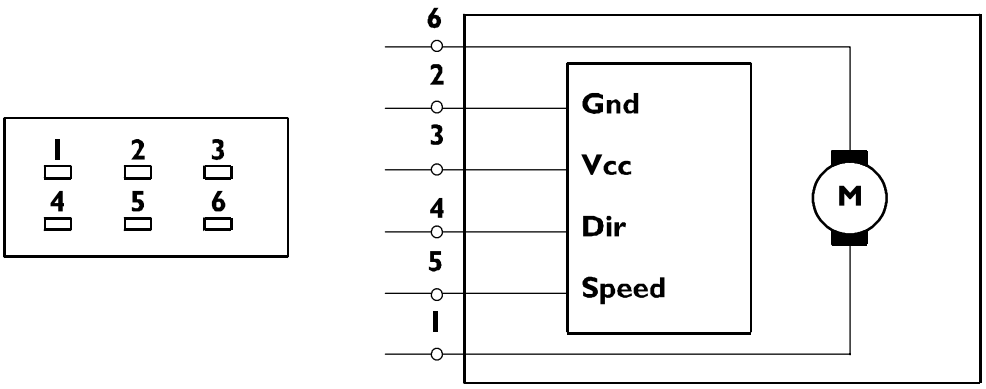
Figure 148



101872

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

Figure 149



Wiring diagram

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

Characteristics of electric motor

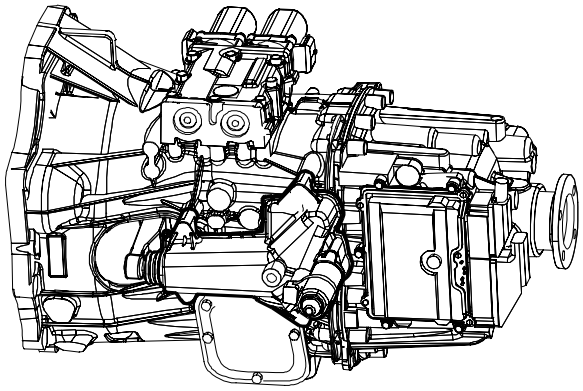
Voltage	12 V
Output	95 W
Torque	0.72 Nm (at 125 °C)
n_{max}	5400 r.p.m.

Clutch actuator

It is made up of the following:

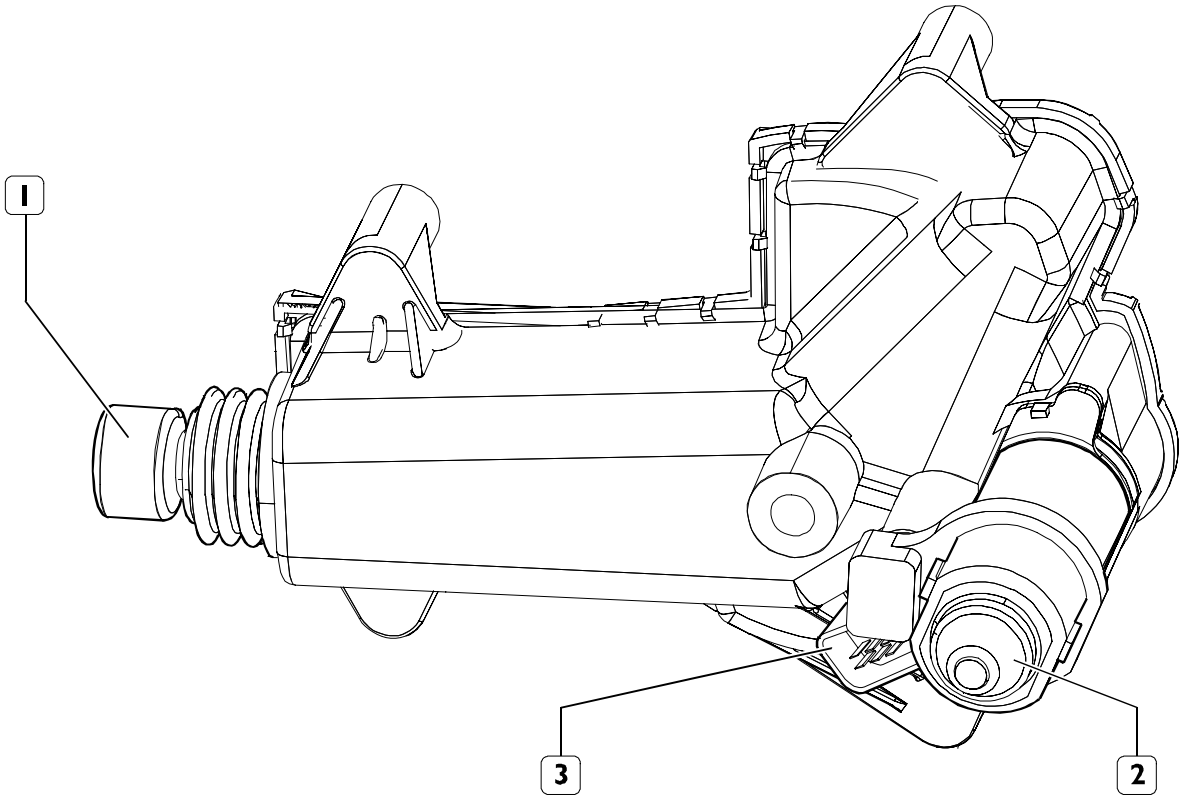
- a cylinder acting on the clutch engaging/disengaging lever;
- a position sensor that detects the clutch lever stroke, by informing the electronic control unit of the actuating cylinder position and the clutch plate wear.

Figure 150



90137

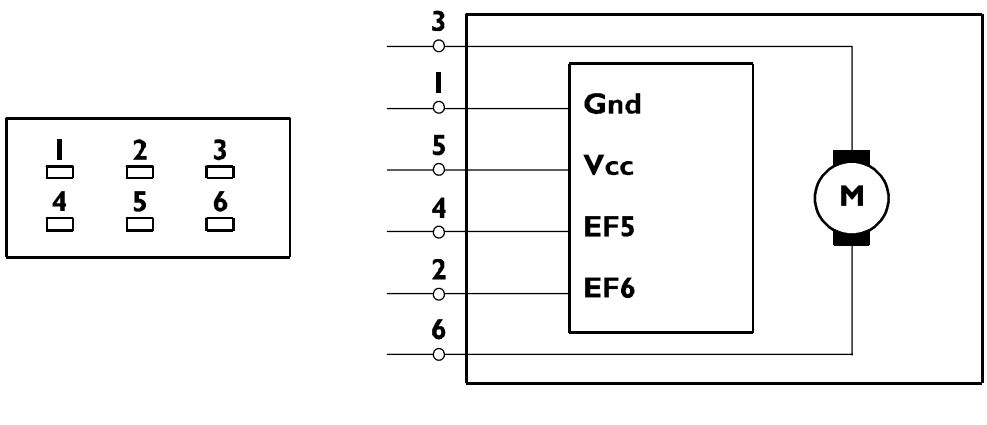
Figure 151



90138

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

Figure 152



Wiring diagram

Pin	Function
1	Earth
2	Incremental sensor speed signal
3	Electric motor positive
4	Incremental sensor direction signal
5	Sensor voltage signal
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.)

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.

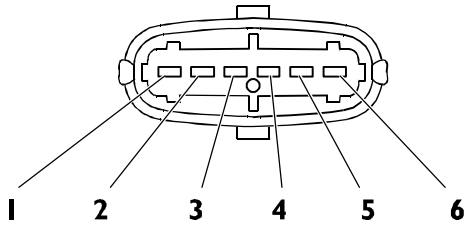
This signal reaches the EDC electronic control unit and is sent, through the CAN VDB (Vehicle Data Base) line, to the gearbox control unit.

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.

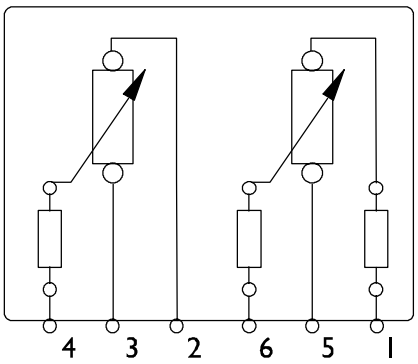
In practice, if the accelerator pedal is pressed fully down, the vehicle will ride at a running speed with a higher gear shift.

Figure 153



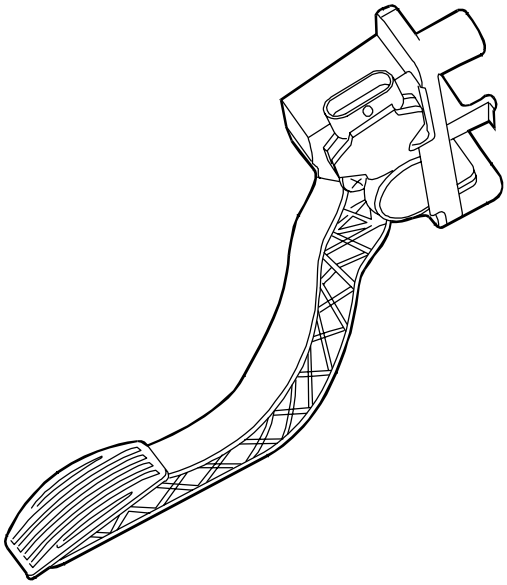
101877

Figure 154



101878

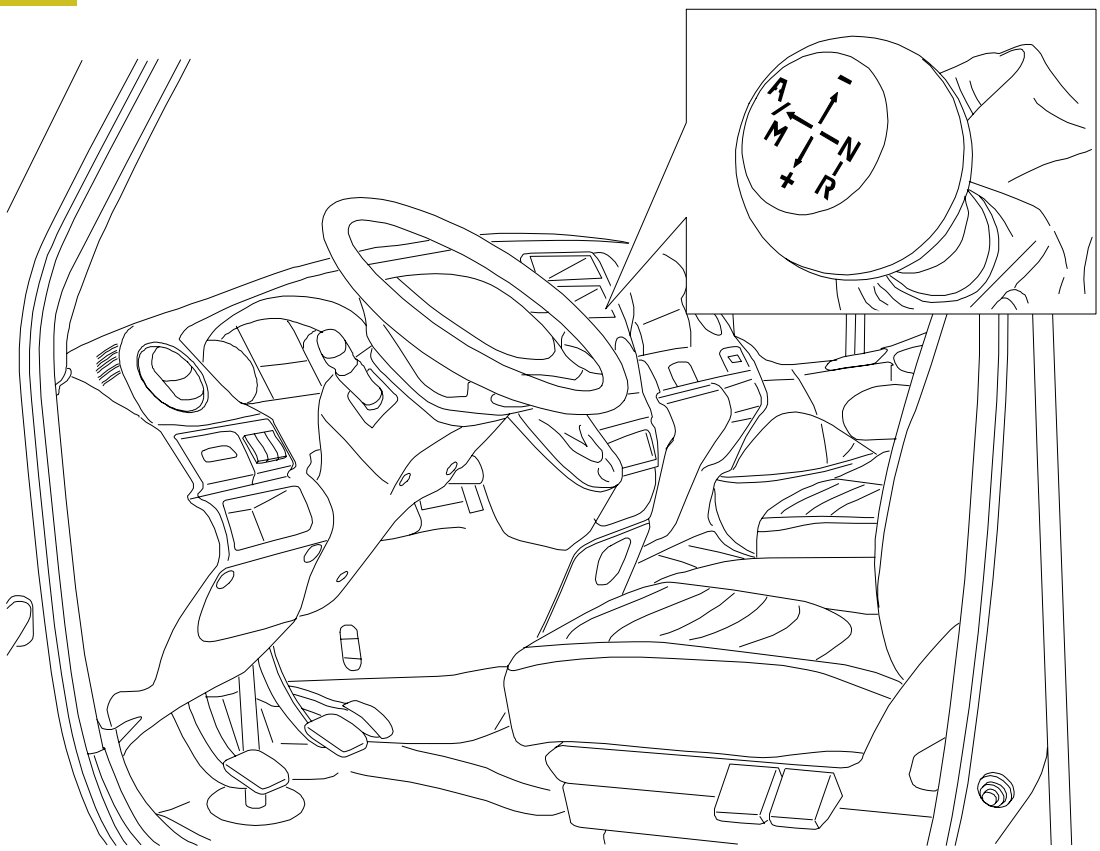
Figure 155



101879

Gear selector

Figure 156



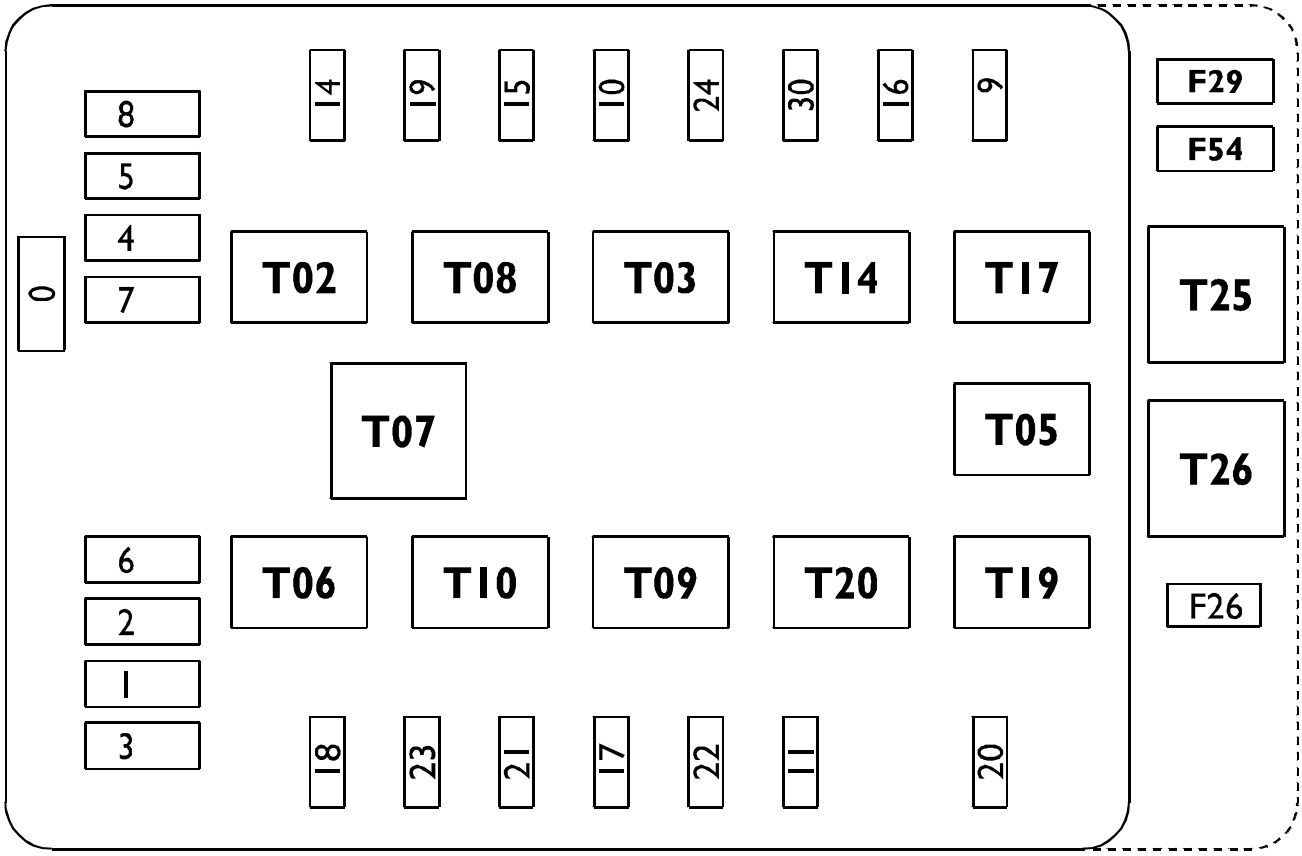
Gear selector is an electronic component placed in the cab at driver side.

It is interfaced with gearbox central unit through CAN communication line in order to signal that the driver is going to select and engage a gear.

PIN	FUNCTION
1	KL 15
2	GROUND
3	CAN L
4	CAN L
5	-
6	-

REMOTE CONTROL SWITCHES / FUSES ASSEMBLY

Figure 157



System power supply is ensured by an assembly of fuses located in engine opening in interconnection central unit at highlighted positions.

F3 – is connected to central unit pin B4

F4 - is connected to central unit pins B5 and B6

F18 - Central unit power supply

F24 – Automated gearbox services

Where one or two of these fuses is burnt, gearbox functionality is not impaired. Failure of fuse F24 only prevents gearbox from operating (clutch movement, gear selection and engagement are inhibited).

Accelerator pedal sensor

Accelerator pedal position is provided to gearbox central unit through proper communication line by electronic central unit EDC, which learns the position thanks to load transmitter directly mounted on accelerator pedal.

Engine rpm sensor

The sensor is mounted at engine flywheel.

Engine rotation speed values are transmitted to electronic central unit EDC, which through proper communication line transfers them to gearbox central unit.

Vehicle speed sensor

The sensor transmits pulses to electronic tachograph / tachometer.

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

PTO

There is one pushbutton only, which is used for inserting and disconnecting PTO.

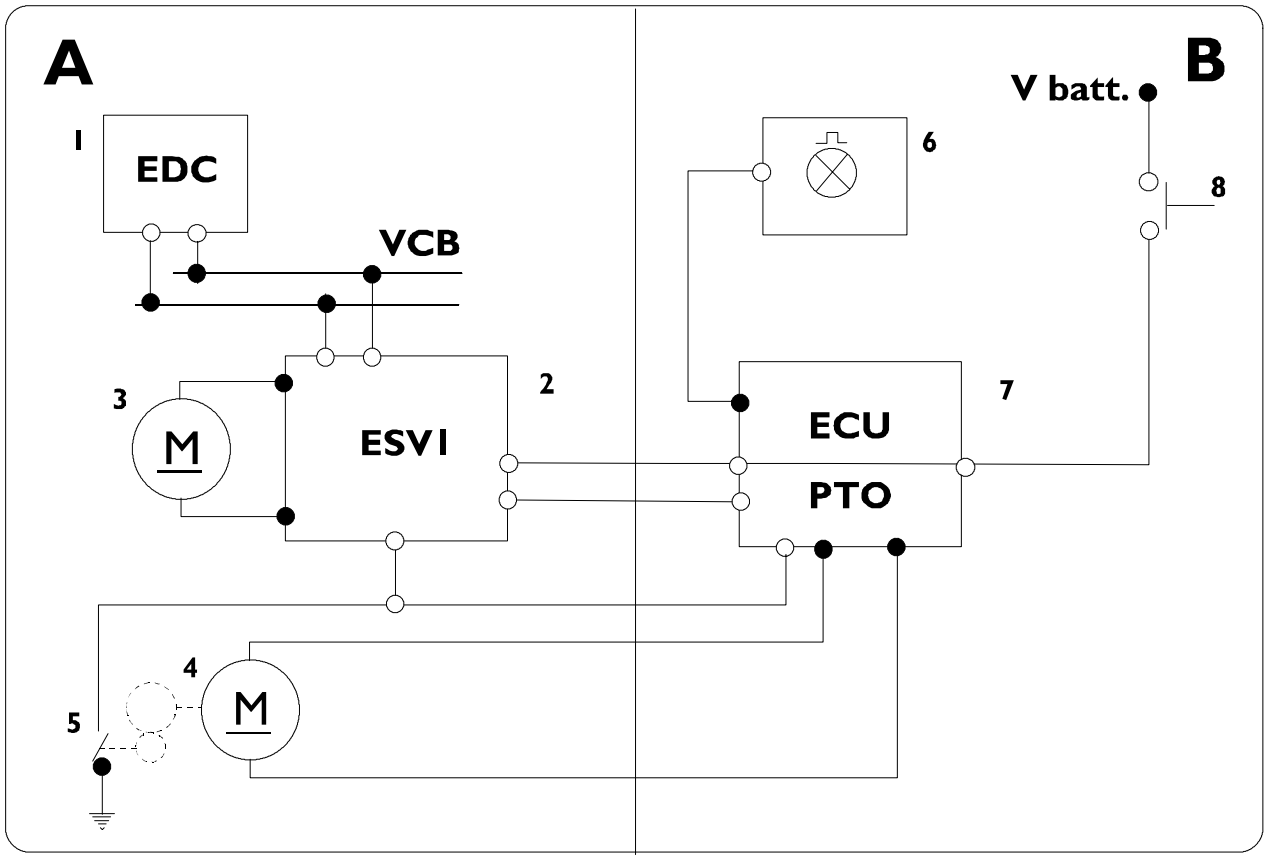
PTO can only be engaged with gearbox in neutral position and engine on.

PTO can be used both in STATIONARY and NON STATIONARY conditions.

In NON STATIONARY conditions valid are following conditions:

- First gear can be put in and vehicle moved.
- Once started, with vehicle moving, gear cannot be shifted any more;
- PTO can be disengaged with gearbox in both gear and neutral position.
- Depending on signal coming in to Pins, self-implementing device acknowledges if it is working with either a mechanical or automated gearbox. If it is working with a mechanical gearbox, signal comes in from clutch pedal.

Figure 158



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.

PTO engaging procedure

To engage power take-off, following operations must be preformed: Put on engine with gearbox in neutral position.

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.

PTO disengaging procedure

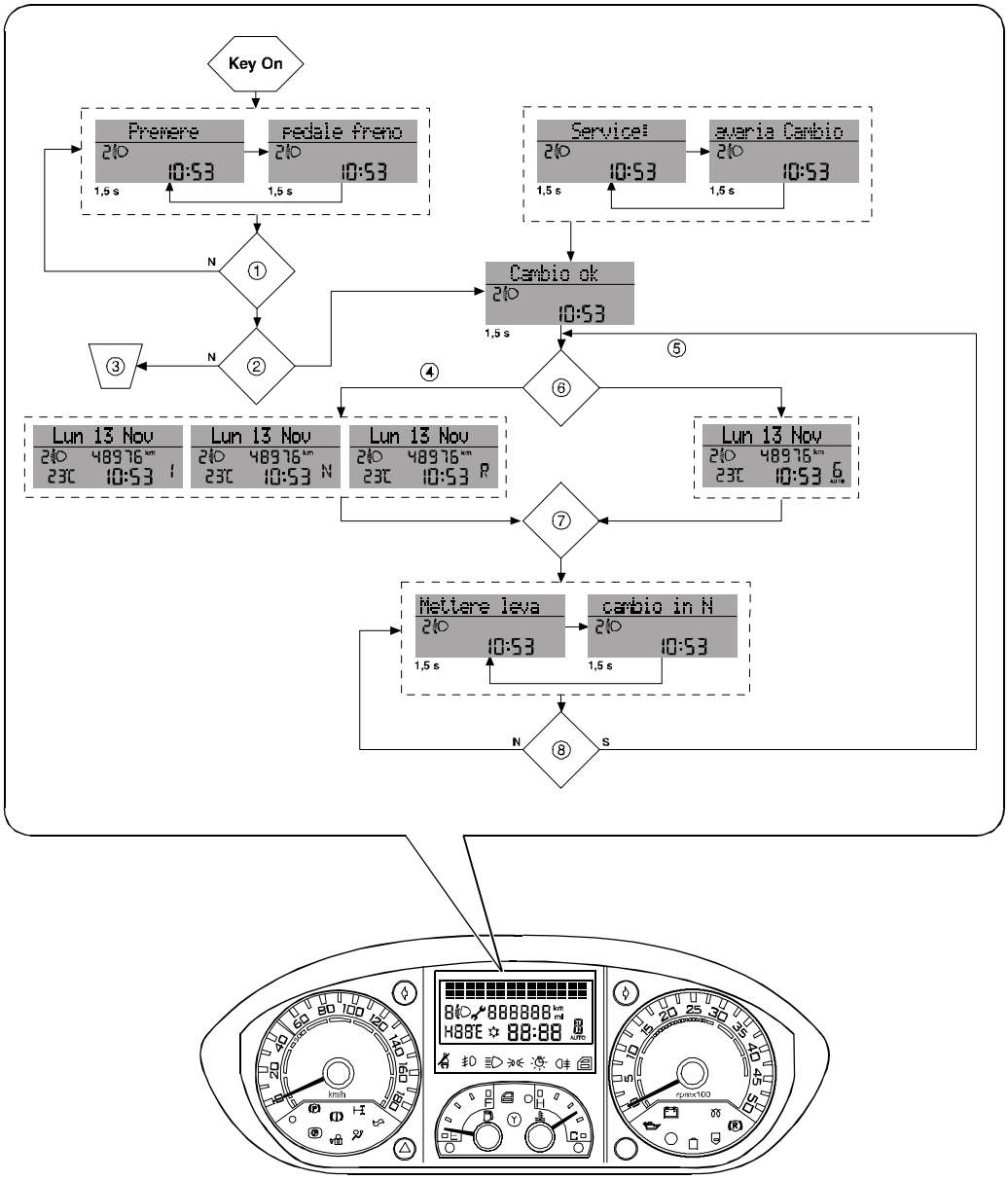
To disengage the power take-off, the following operations must be carried out:

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.

Display screen

Figure 159



Display screen, positioned on instrument panel, allows to display all information necessary for system correct use, as, for example:

Mode: manual or automated, and, in both cases, gear ratio entered;

Reverse gear / neutral (R/N) position;

Signalling faults:

- ❑ "SERVICE: gearbox failure"
- ❑ "SERVICE: serious gearbox failure" (associated to sound warning)
- ❑ "SERVICE: clutch excessive temperature" (associated to sound warning)
- ❑ "Gearbox failure in SERVICE mode" (message that can only be displayed at Assistance Network)

Alarm is integrated in Body Computer central unit; it is optional.

Where alarm is to be mounted at Assistance, the following is needed:

1. PROGRAMMING THE BODY COMPUTER
2. INSTALLING THE SIREN
3. INSTALLING ENGINE BONNET SWITCH
4. Storing radio commands into Body Computer central unit

Body Computer manages alarm.

Alarm controls vehicle perimetral portion (doors and bonnet switches), and also any battery and siren disconnections. BC directly controls external siren. It also activates inserted alarm LEDs, activates blinkers and transmits all information to Instrument Cluster via B-CAN for managing VPS (Vehicle Protection System) warning lamp on the dashboard.

Body Computer controls and diagnoses alarm siren, receives input from vehicle alarm system and also provides siren condition.

DIAGNOSIS (CONNECTOR EOBD)

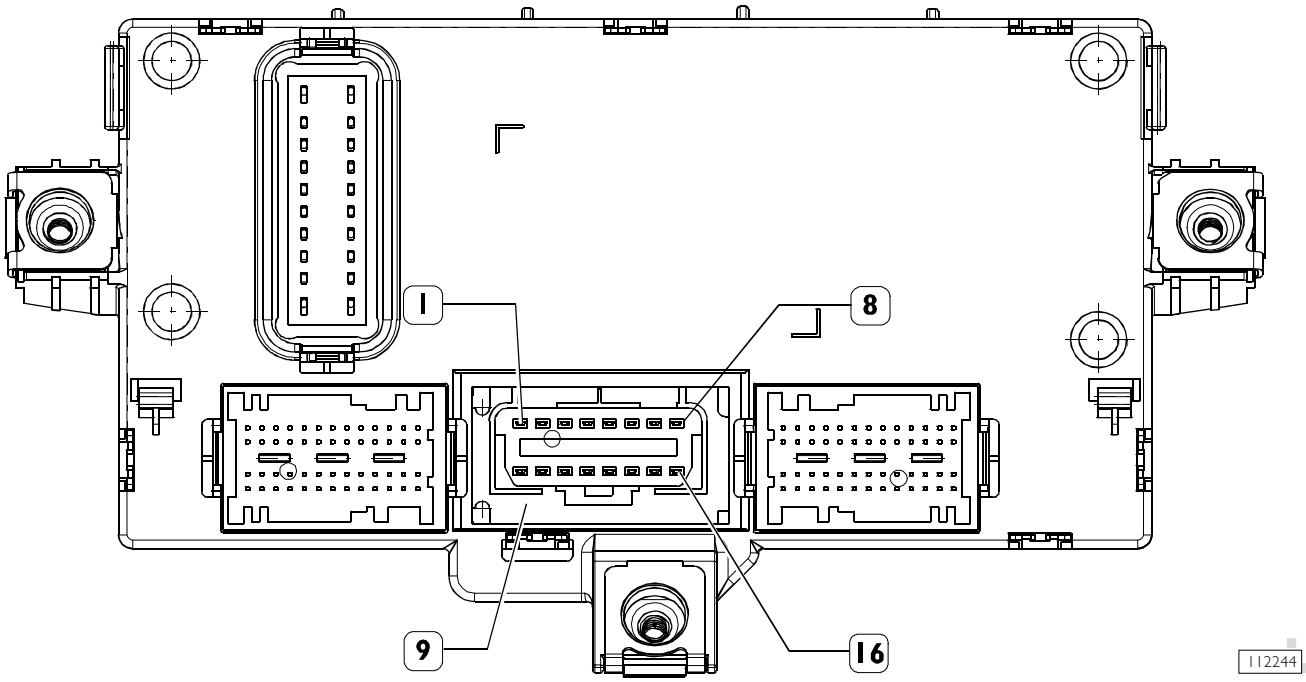
The vehicle that is described in this section has a number of differences with respect to previous version. 30-pole diagnosis connector located on vehicle right side in front of passenger was replaced by a 16-pin connector.

It is placed on vehicle left side near interconnection central unit CPL.

This connector is placed on Body Computer (it is a part of the component). Therefore, connection cables are not present as necessary connections are directly implemented on Body Computer printed circuit.

To be connected to it will be available diagnosis tools.

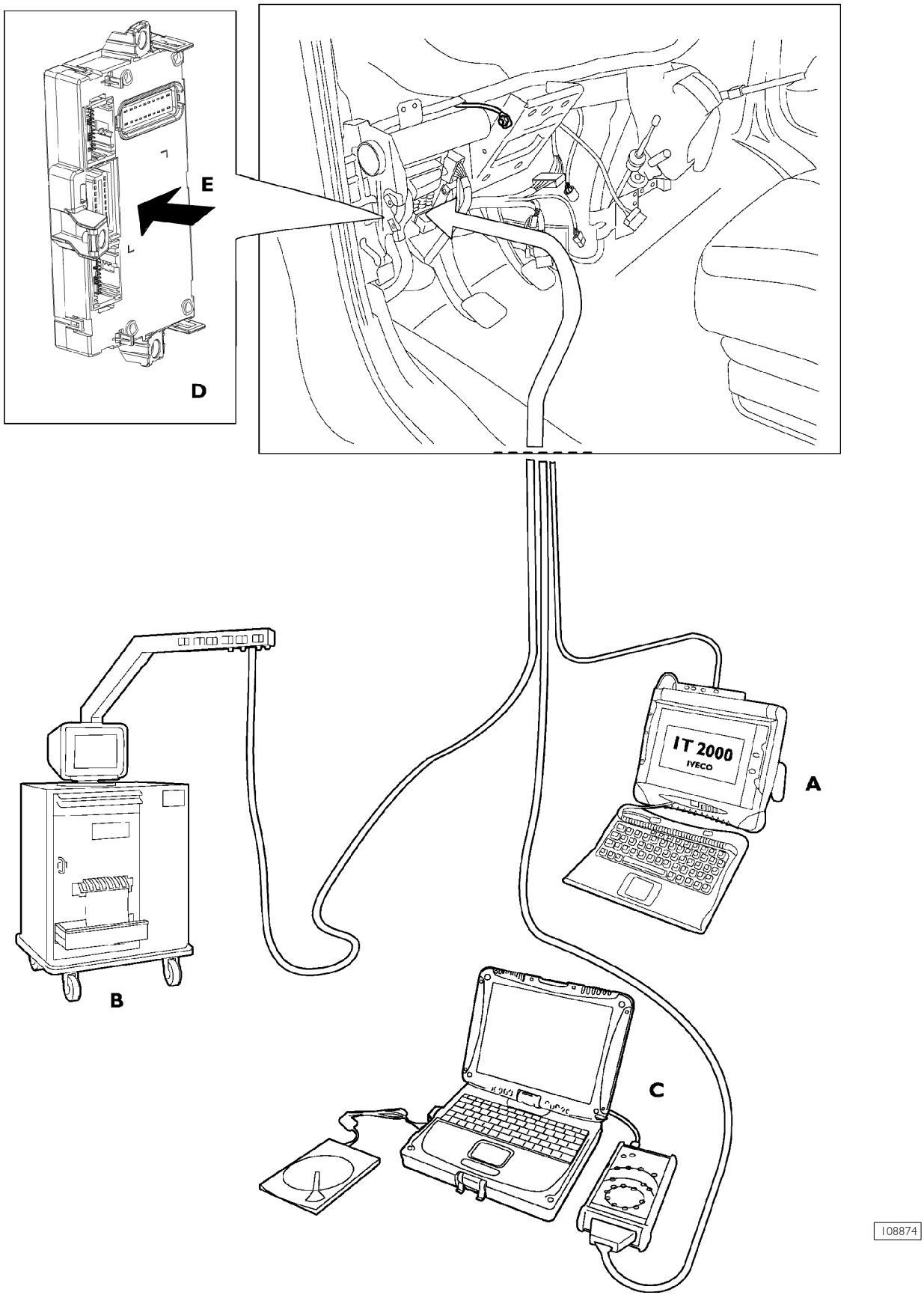
Figure 160



Diagnosis connector "EOBD"

PIN	FUNCTION
1	free
2	free
3	positive +15
4	earth
5	signal earth
6	B Can line "H"
7	line "K" EDC
8	line "K" ABS/ESP, Tachometer
9	free
10	free
11	line "K" for climate control system
12	free
13	line "K" for suspensions, retarder
14	B Can line "L"
15	free
16	positive +30

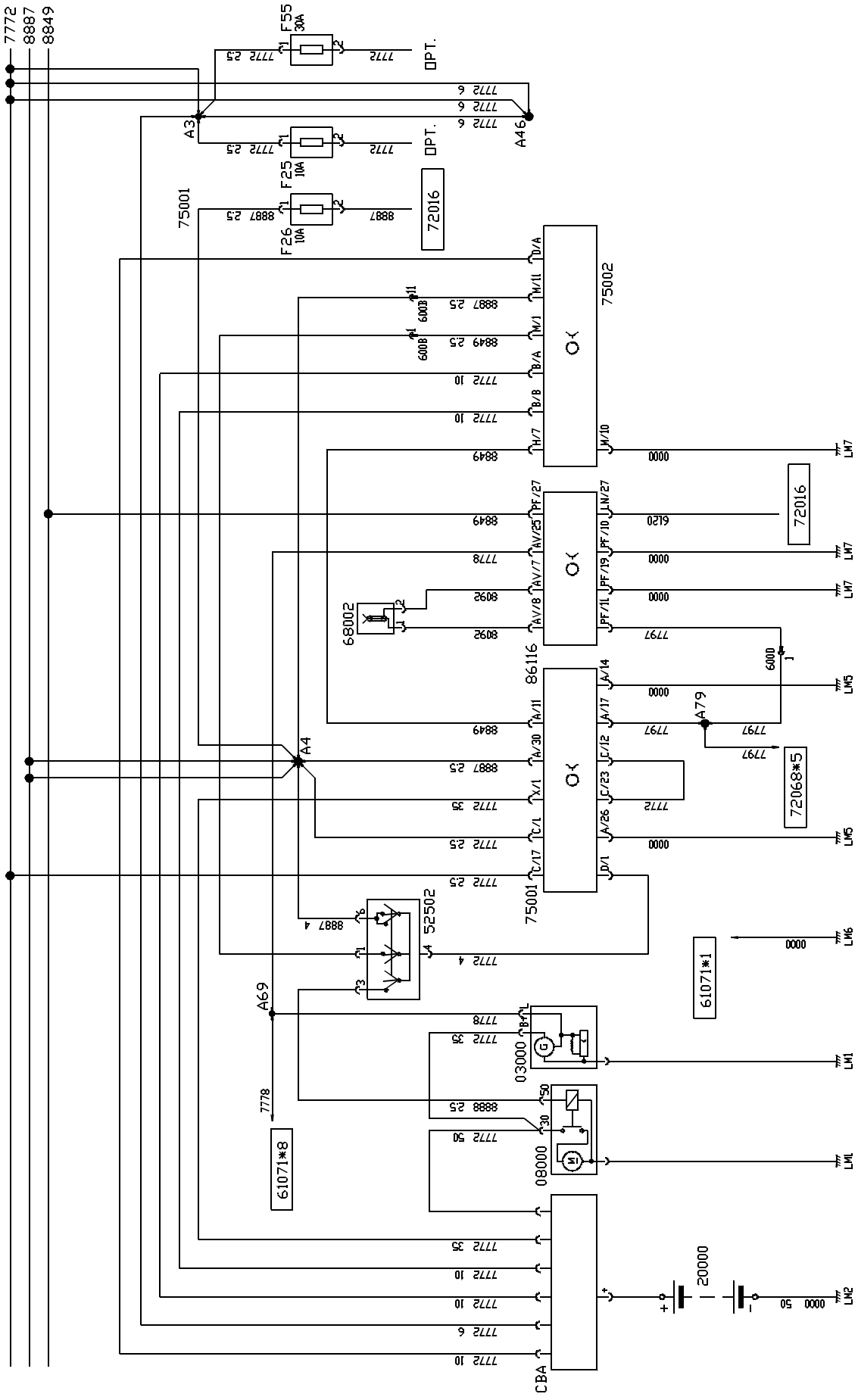
Figure 161



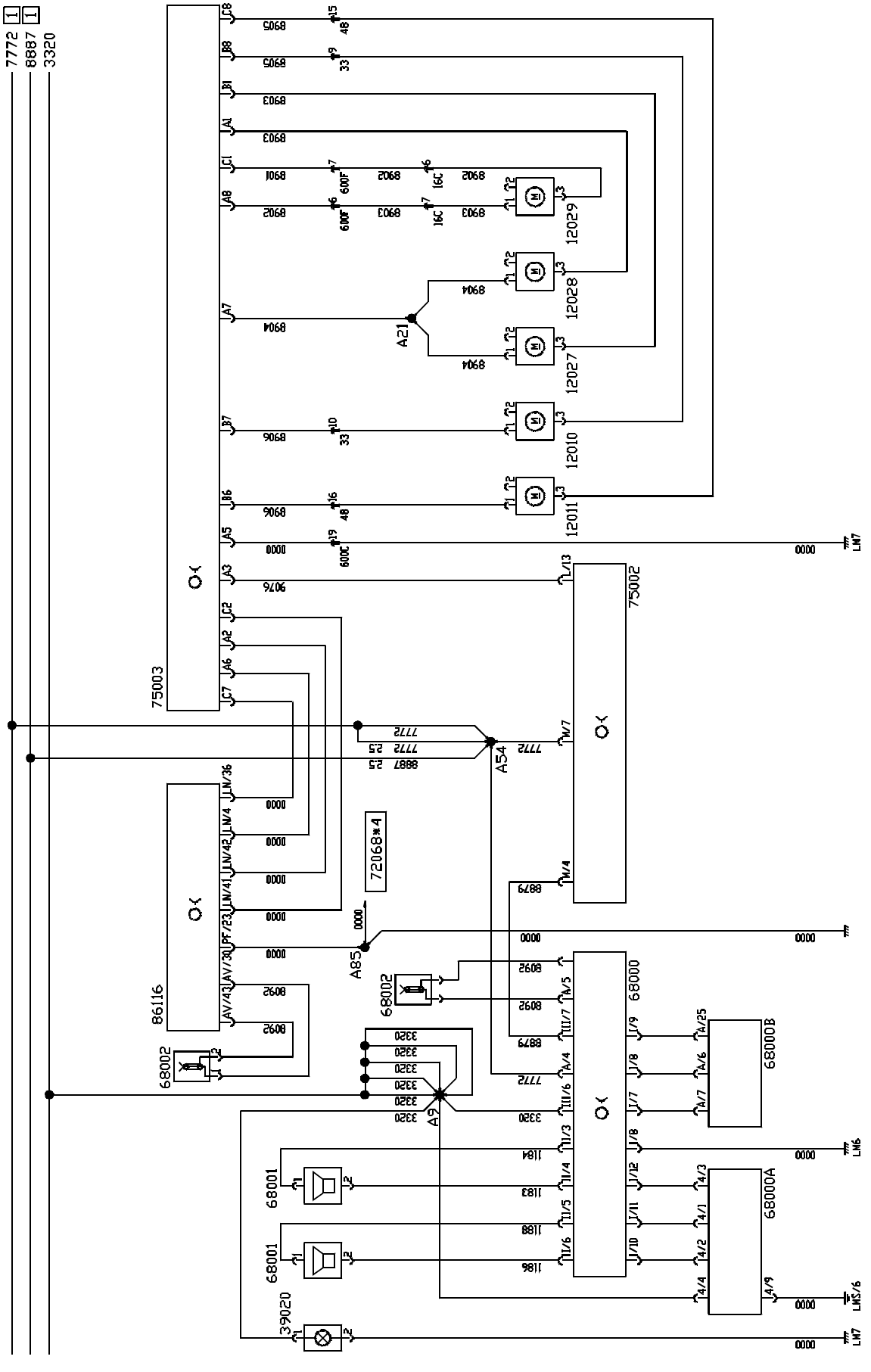
A. IT 2000 - B. Modus - C. EASY - D. Body Computer - E. Diagnosis connector EOBD

Circuit cards

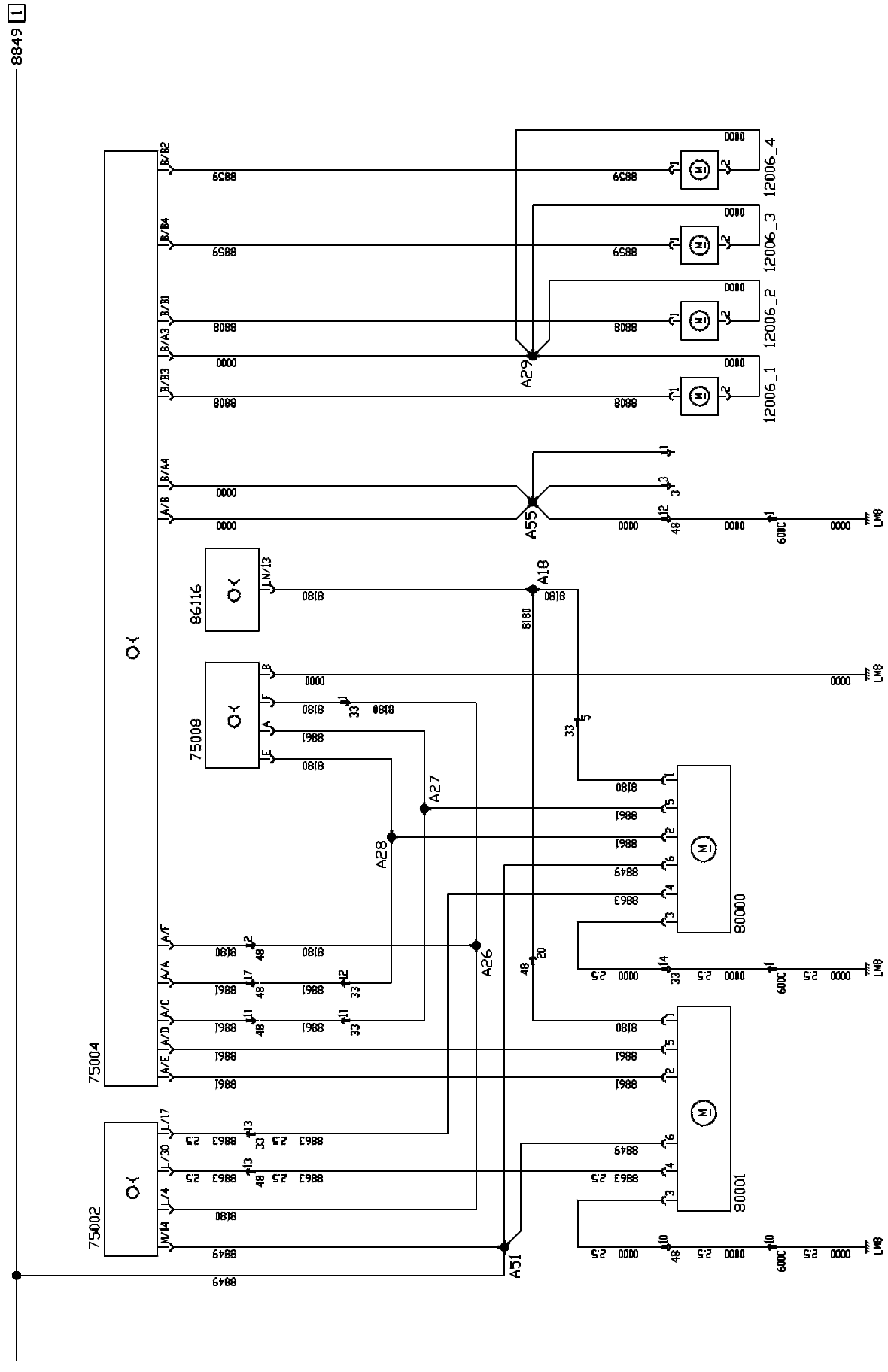
Card 1: Power network



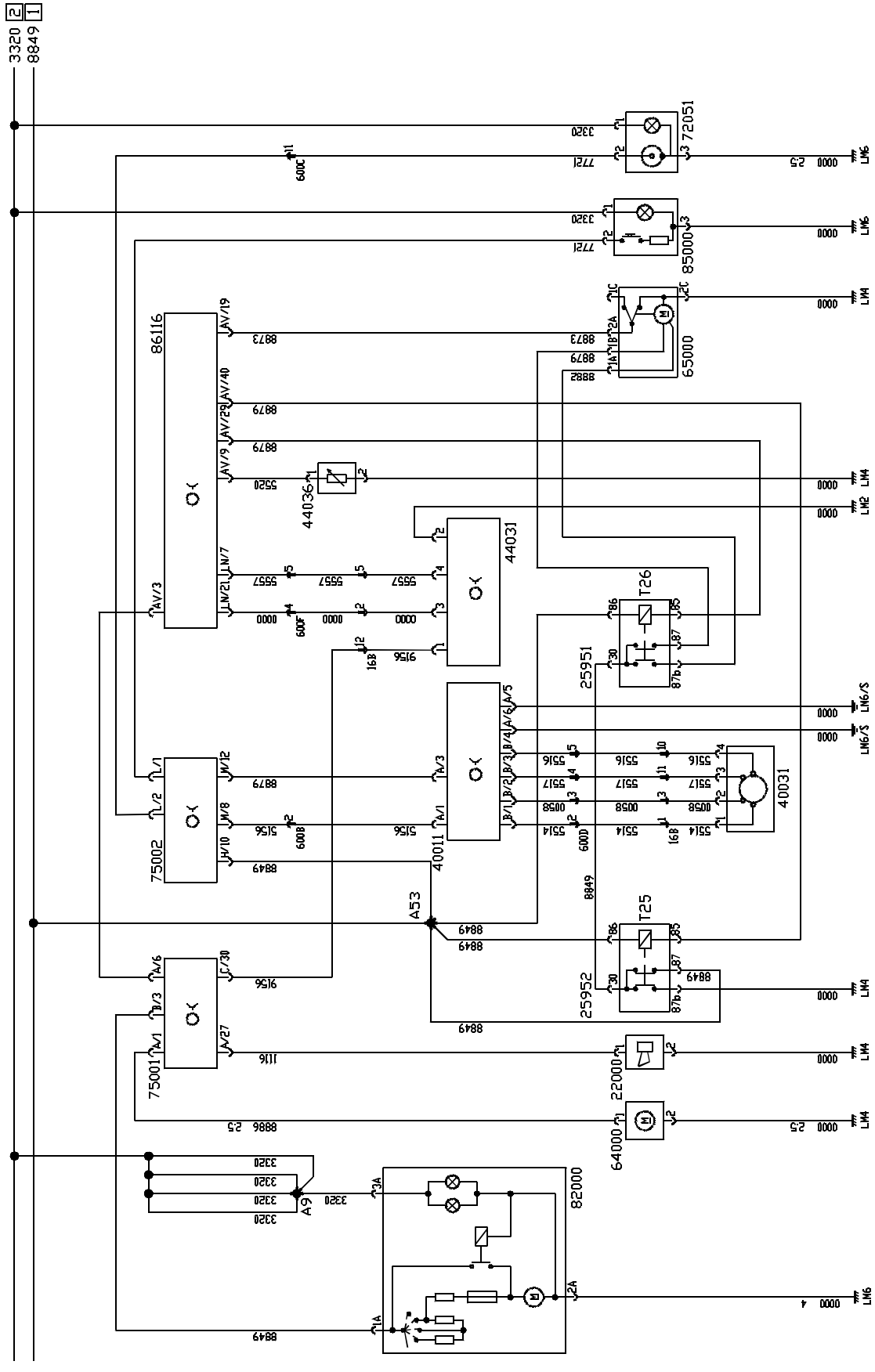
Card 2: Cab interior components



Card 3: Window winders – Electric mirrors



Card 4: Cab interior components



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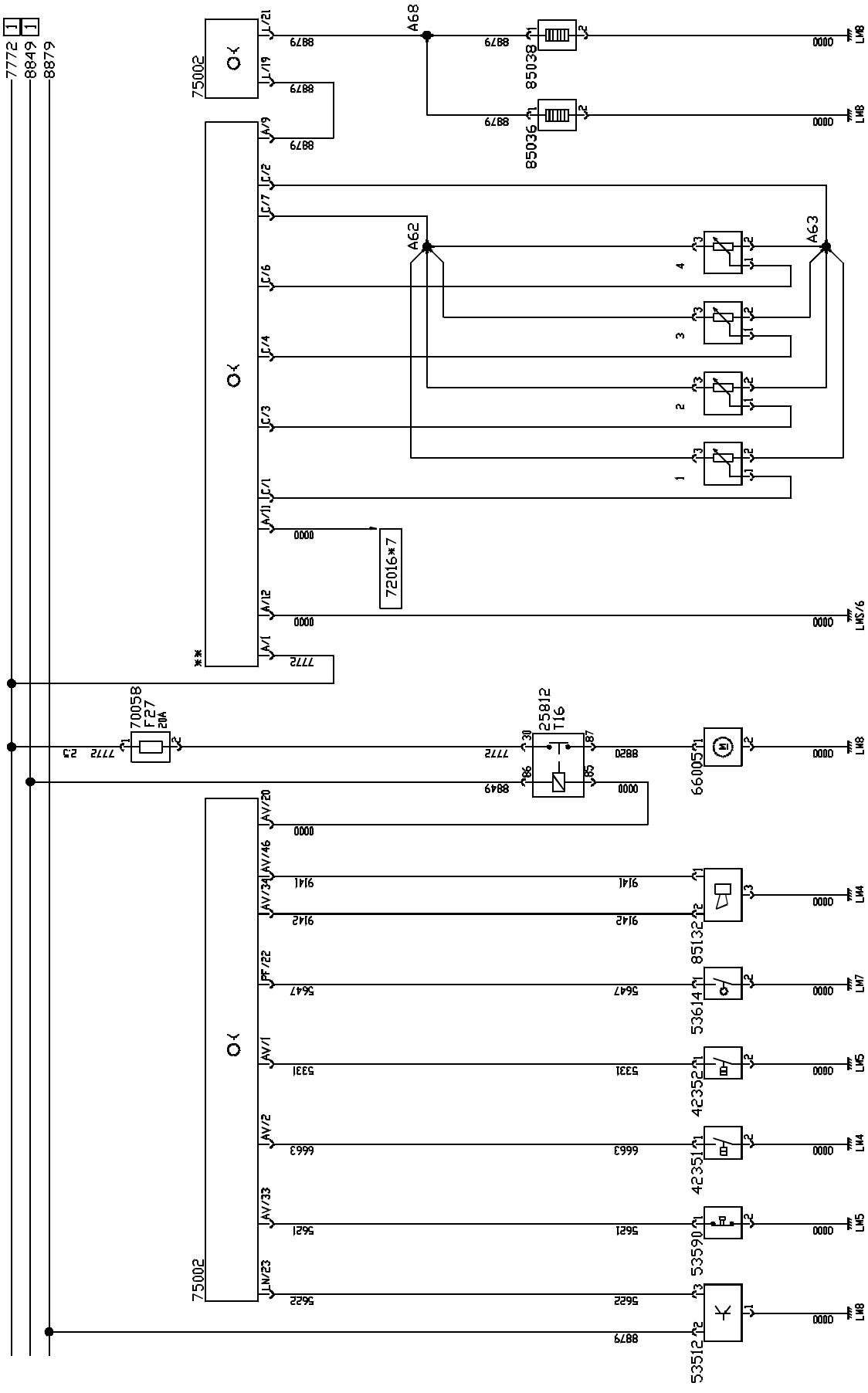
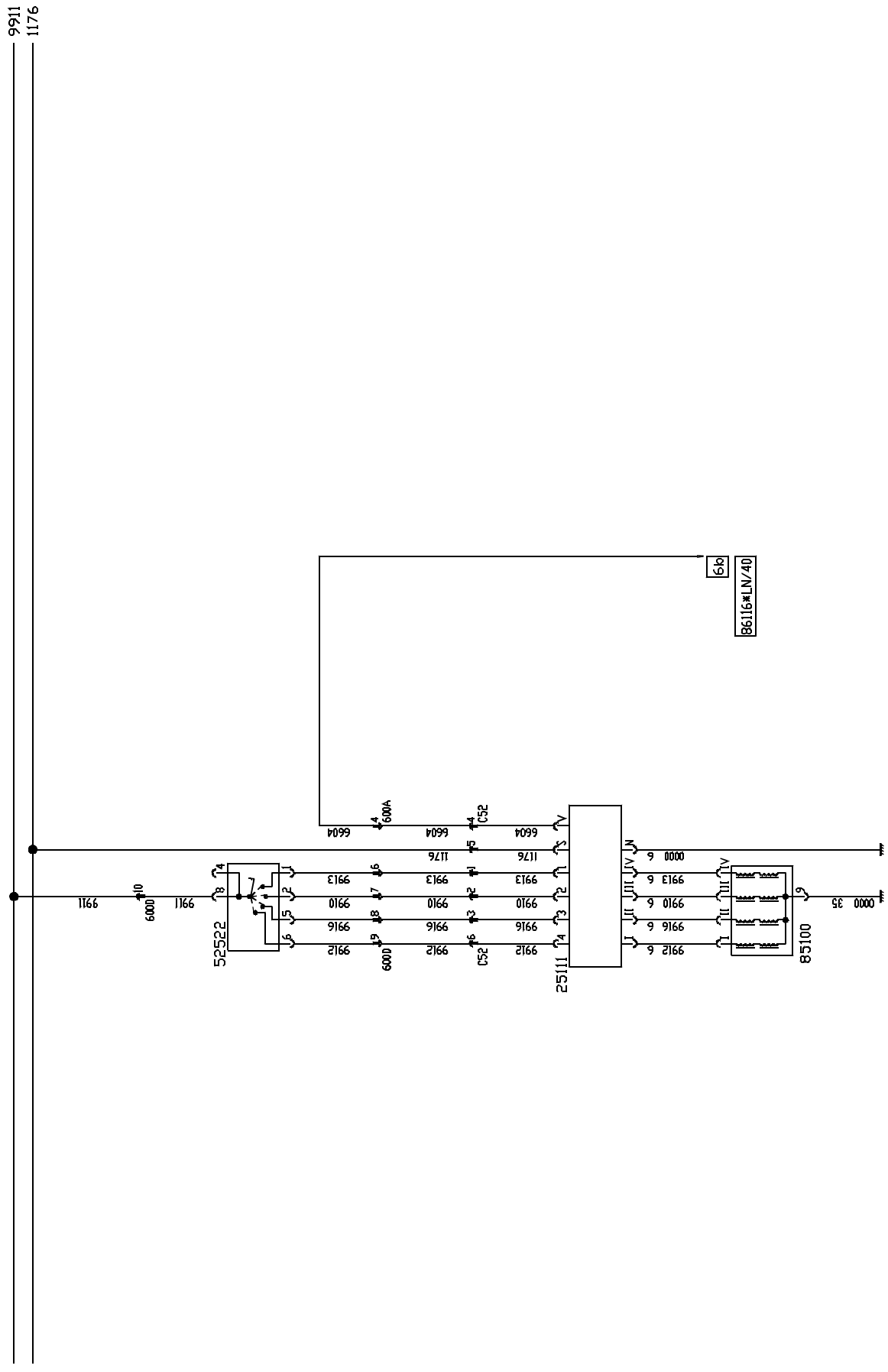
Card 5: Various loads

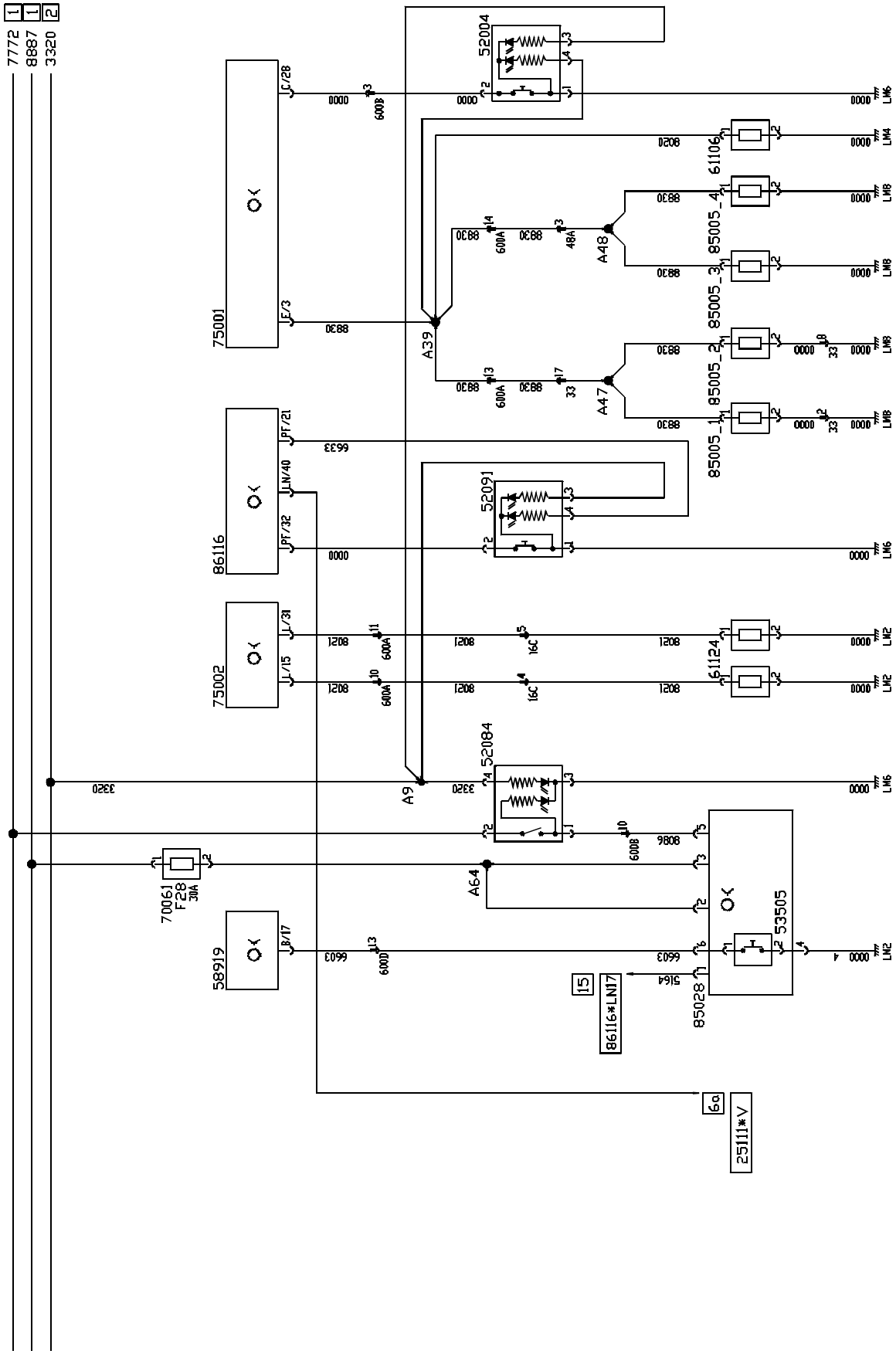


Card 6A: Telma decelerator

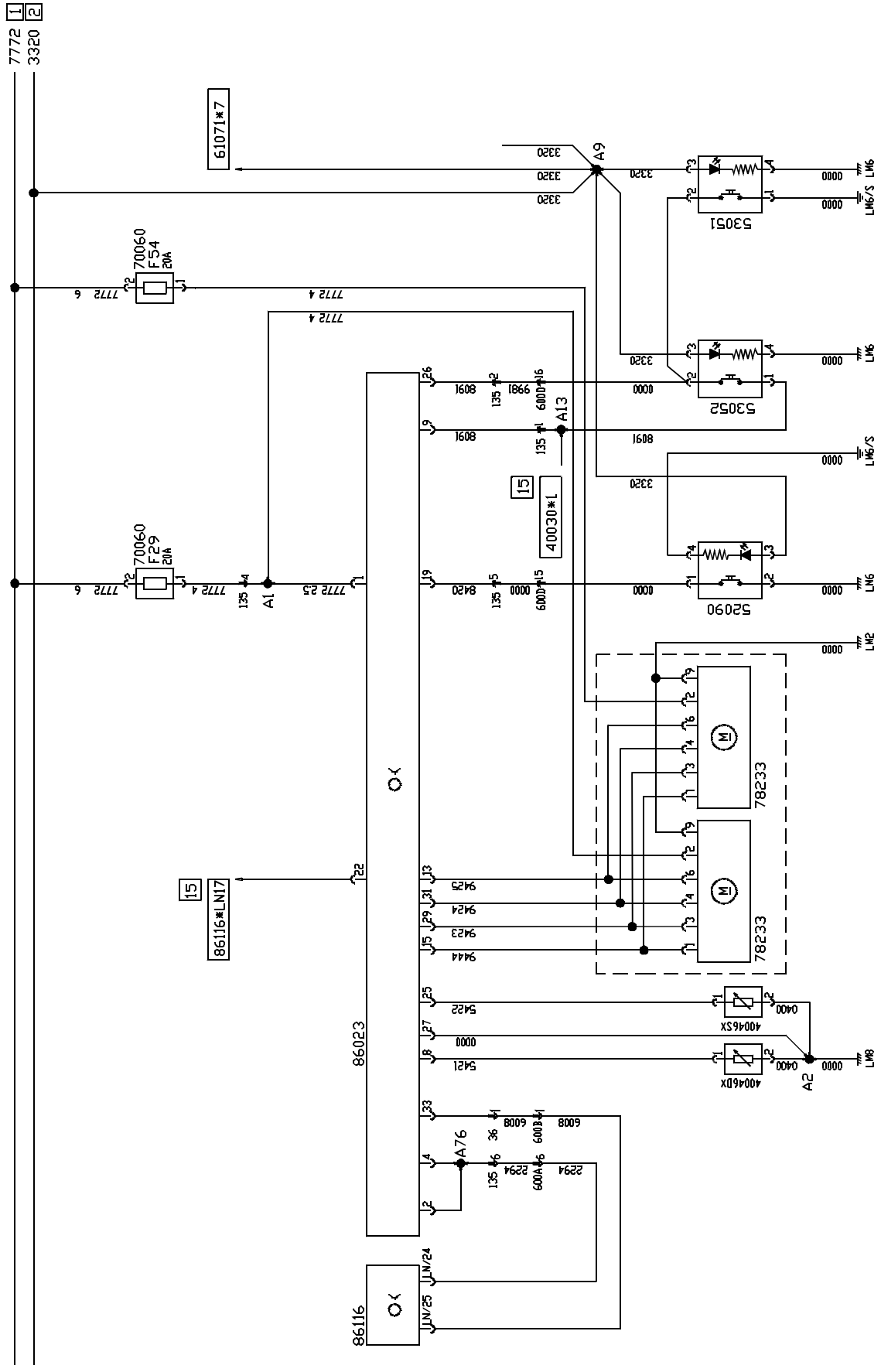


107699

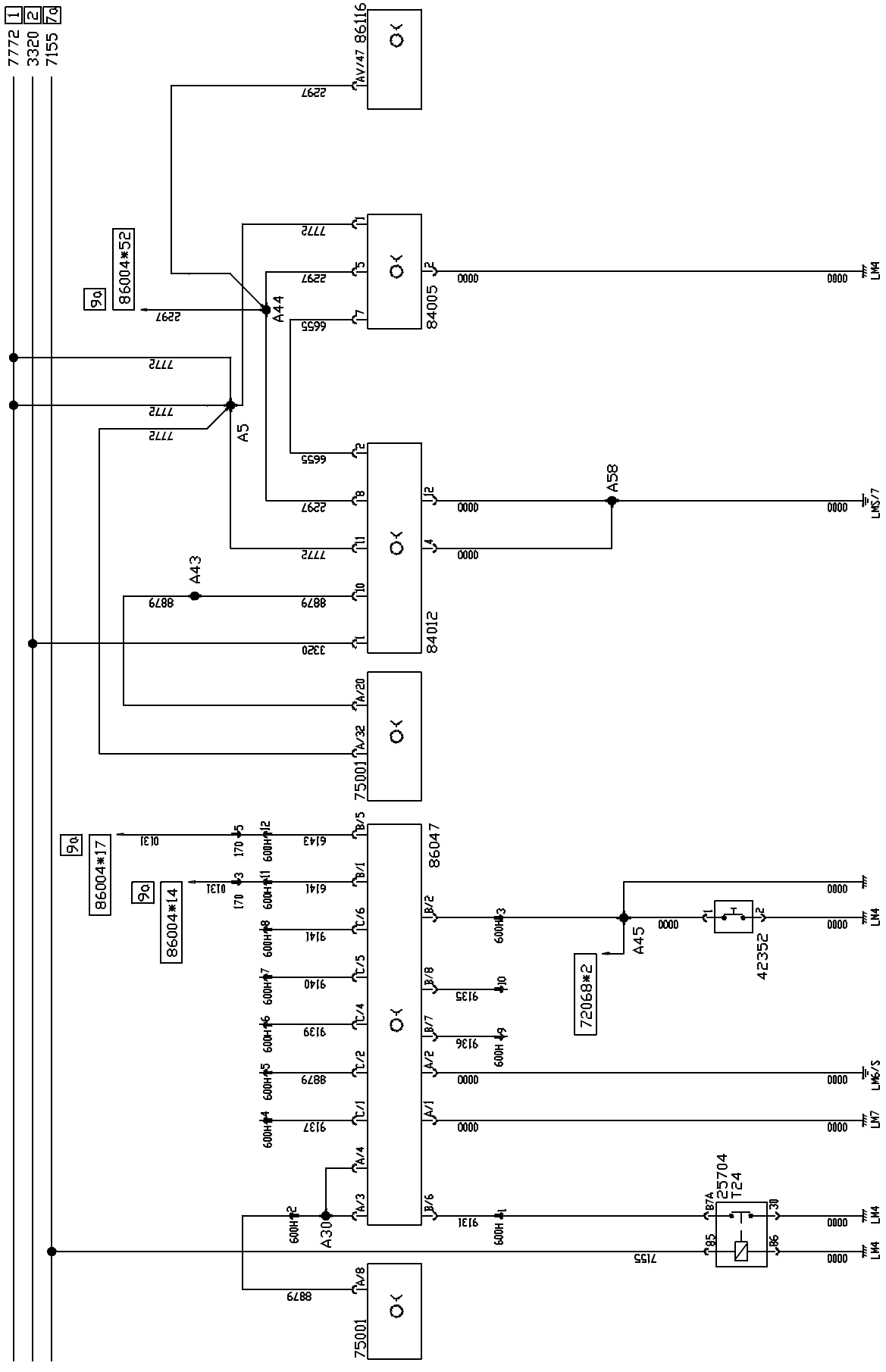
Card 6B: Differential locking - Heated rear window and windscreen



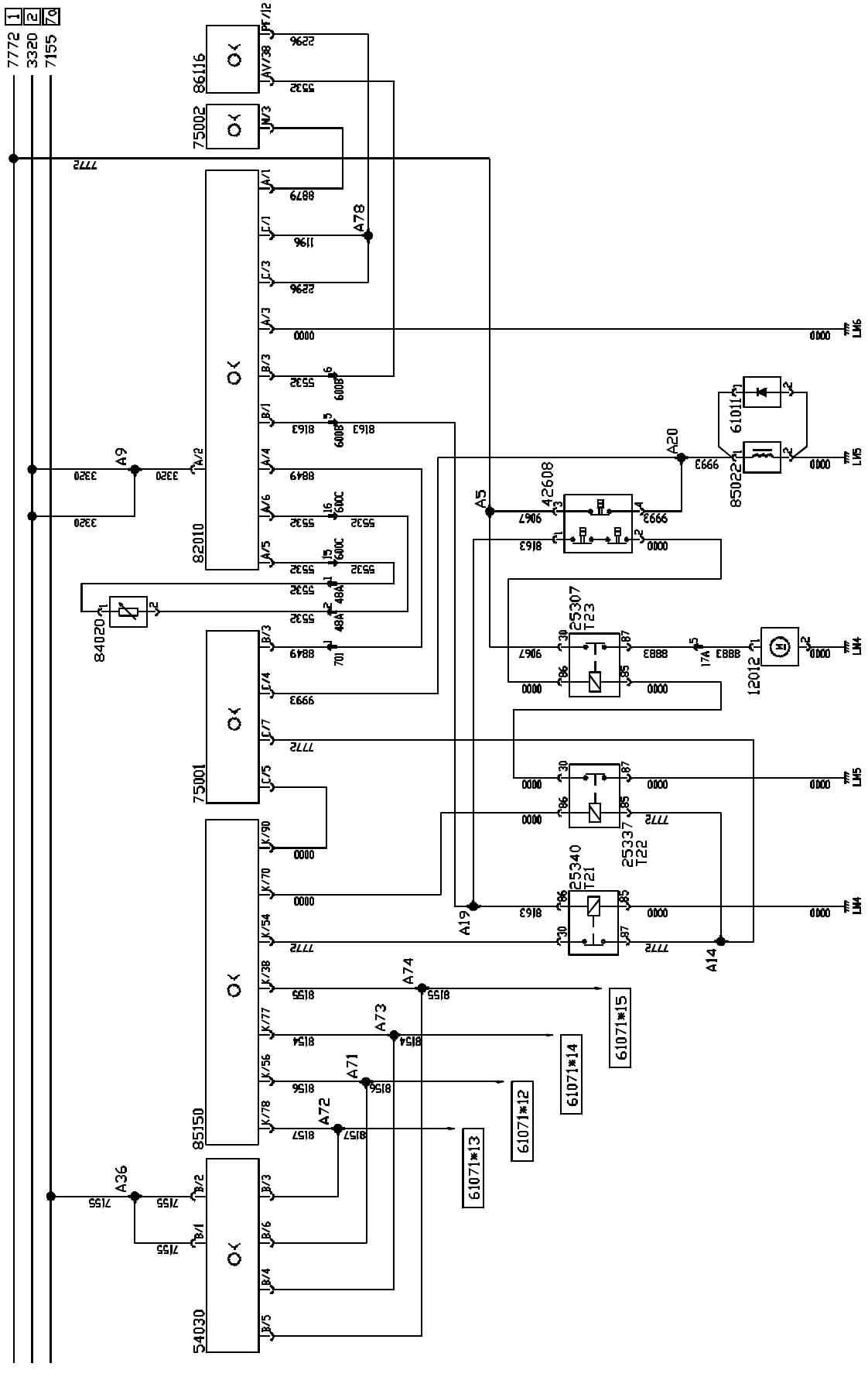
Card 7A: Air spring suspension



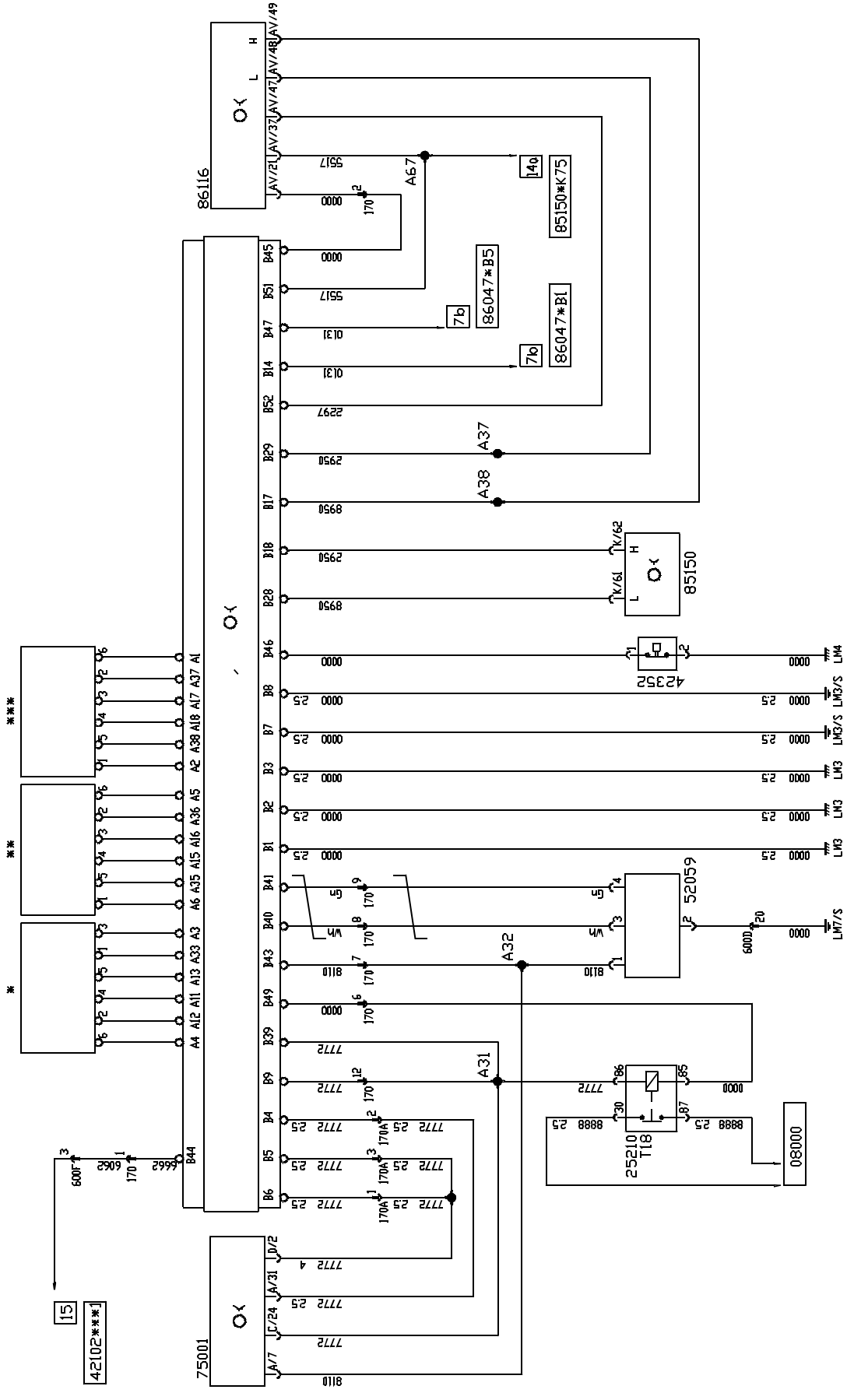
Card 7B: Additional heater - Power take-off



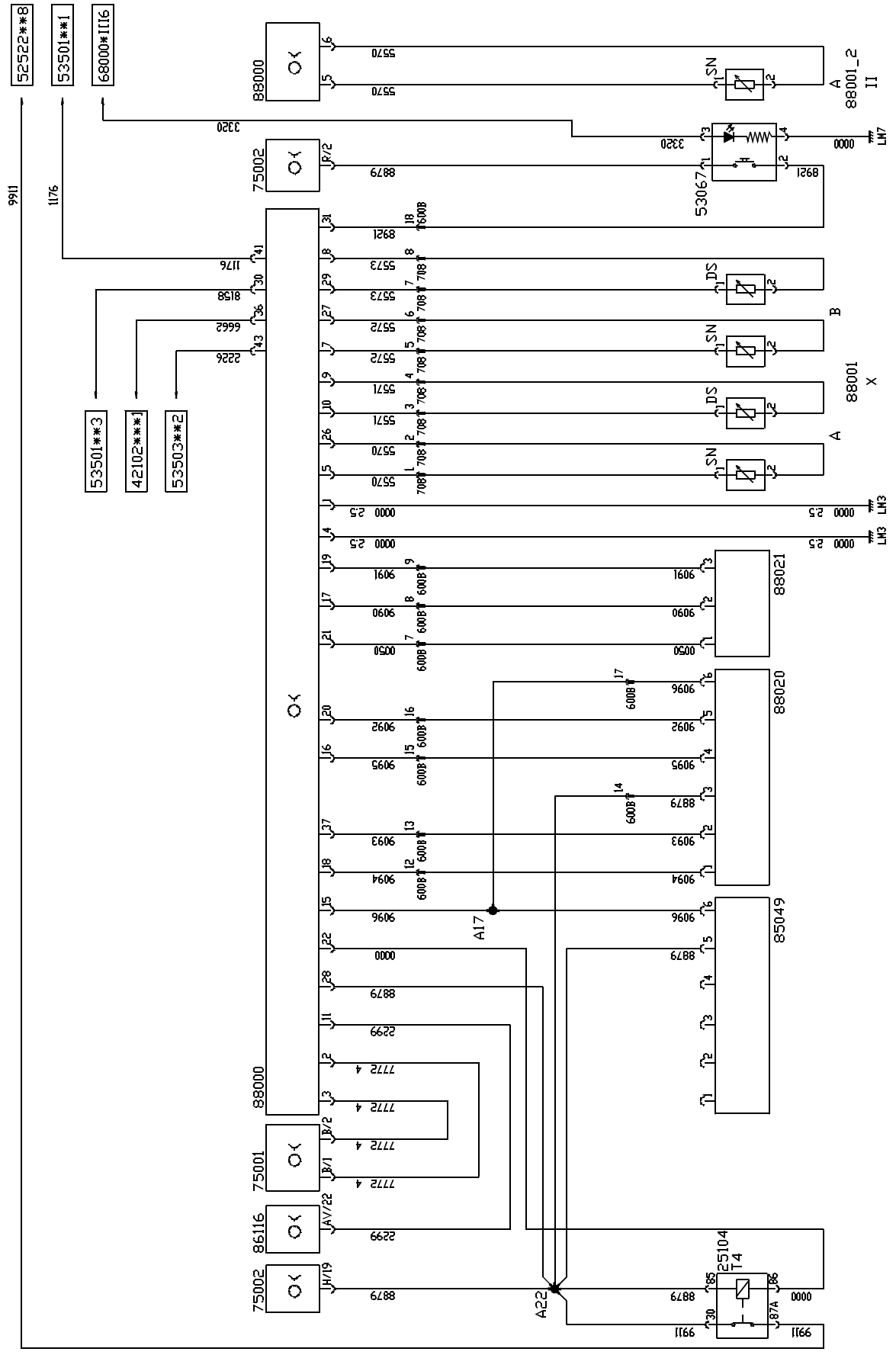
Card 8: Cruise control - Climate control system



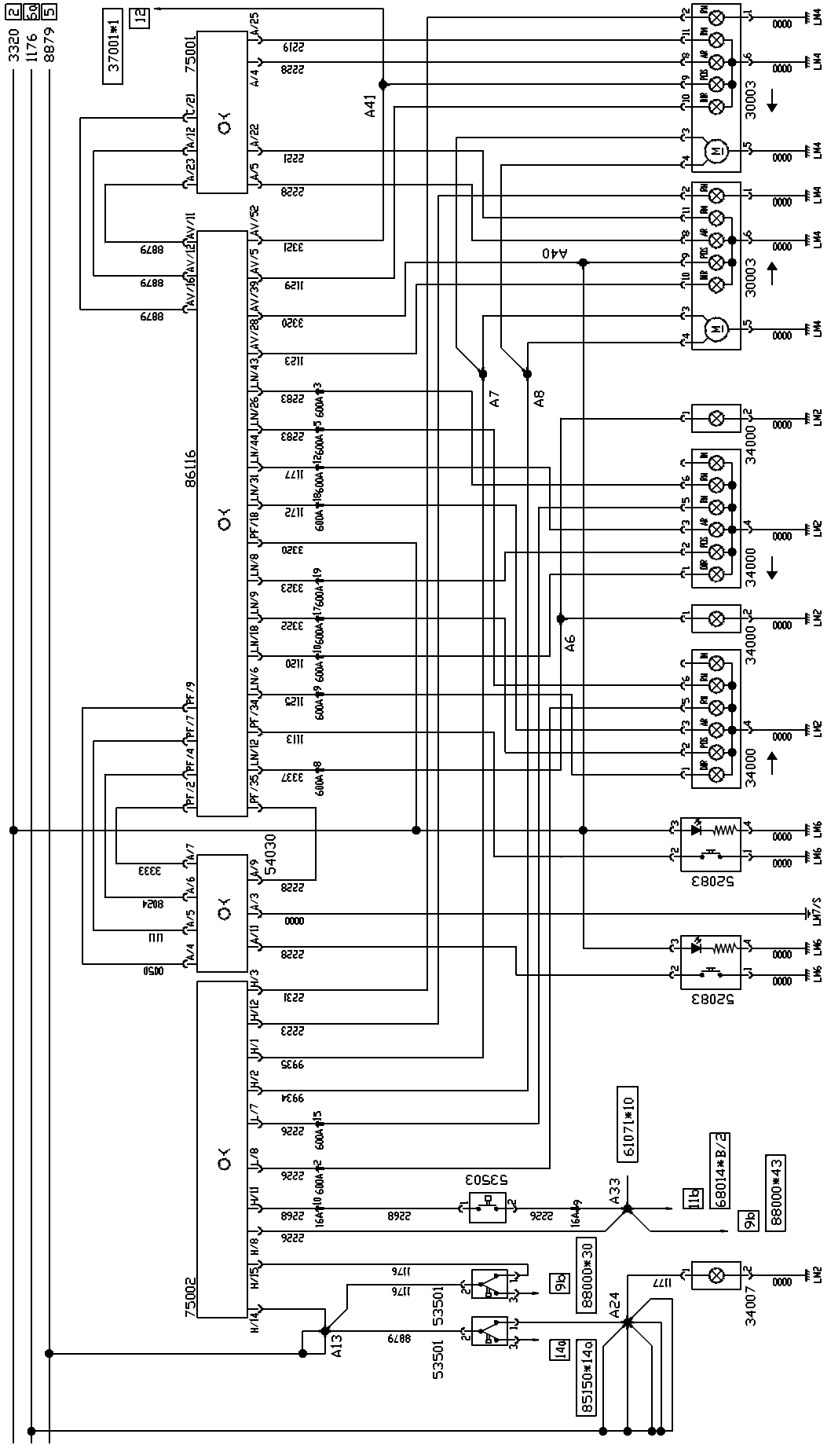
Card 9A: Automatic gearbox



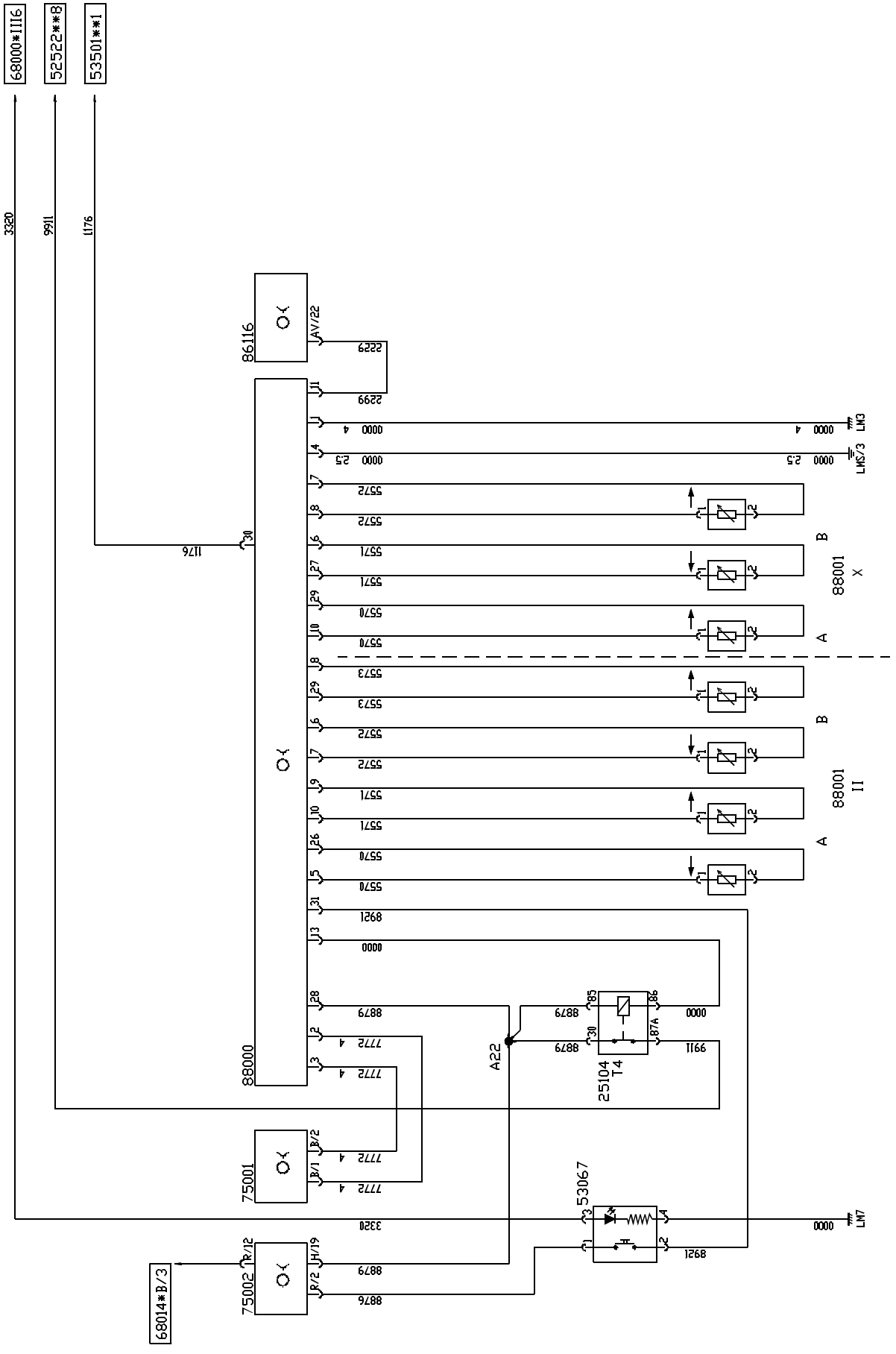
Card 9B: ESP 8



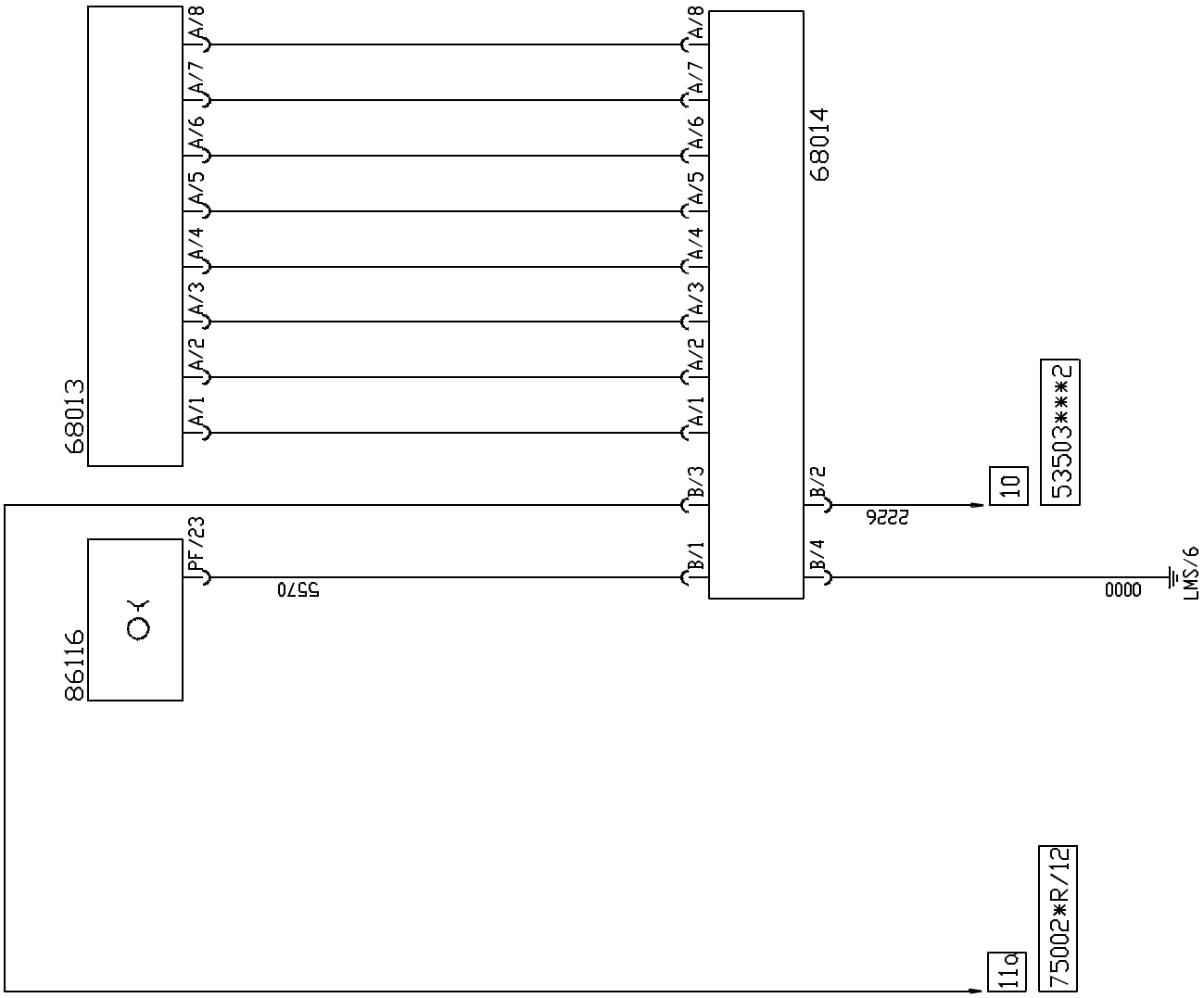
Card 10: External illumination



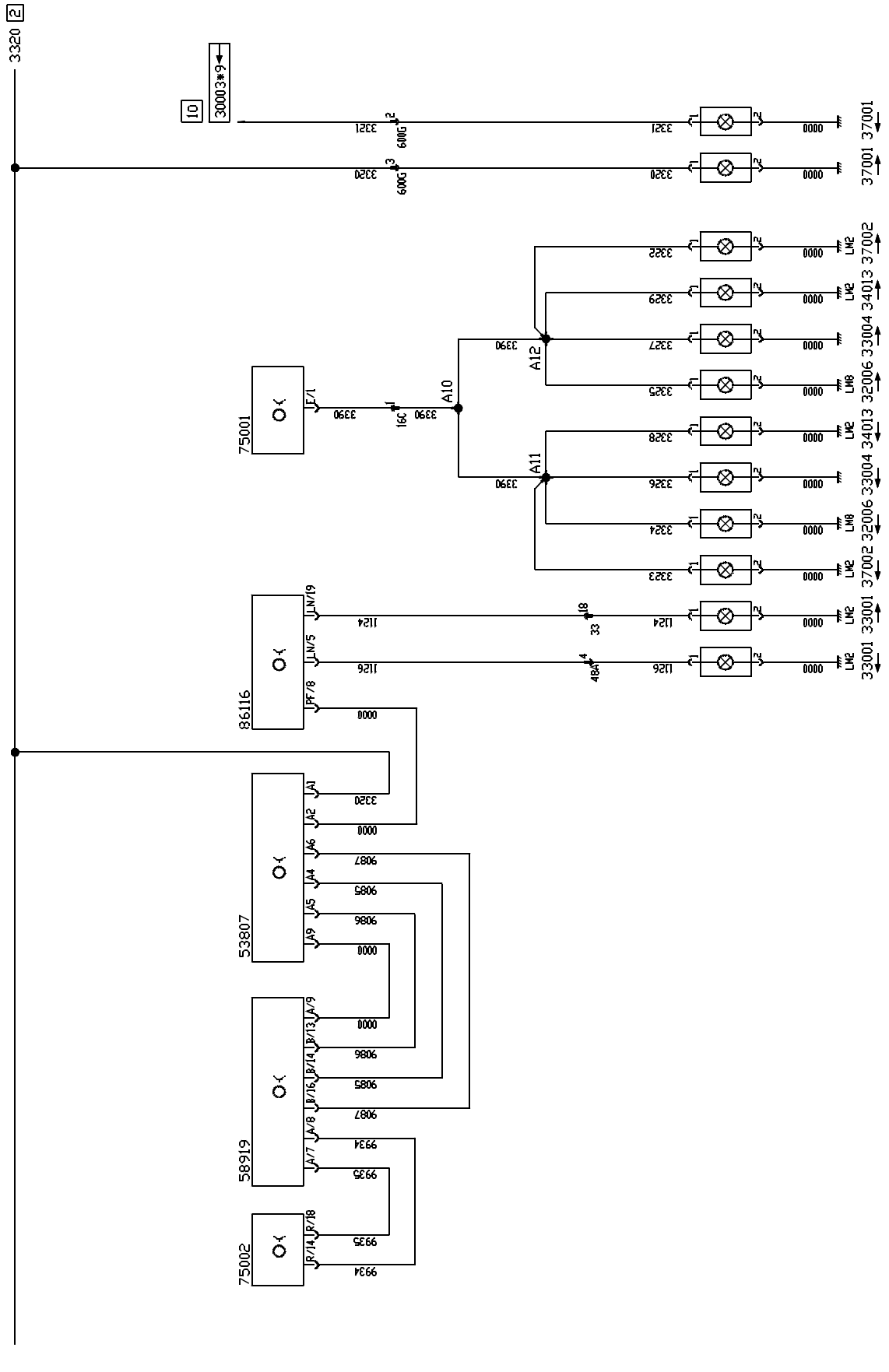
Card 11A: ASR



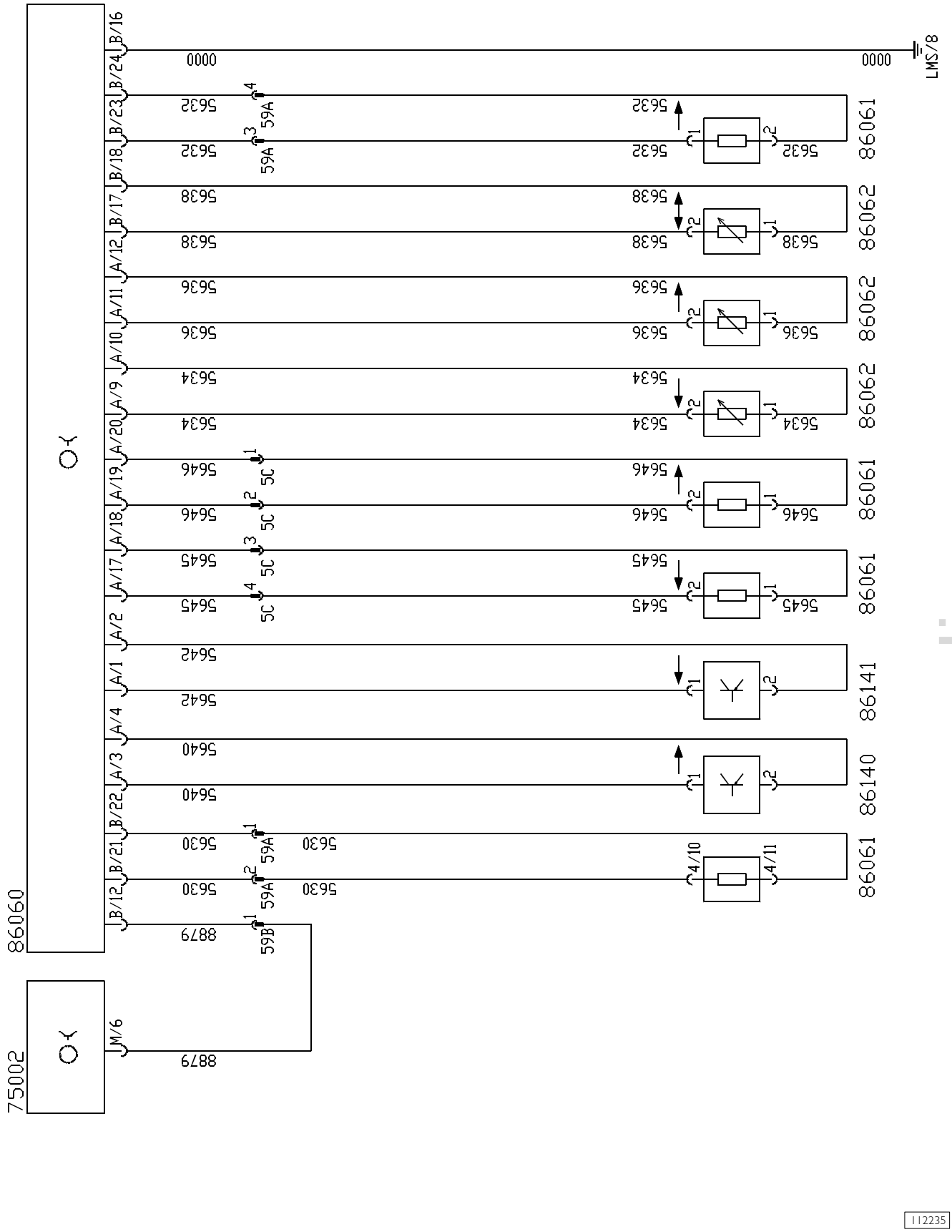
Card 11B: Camera



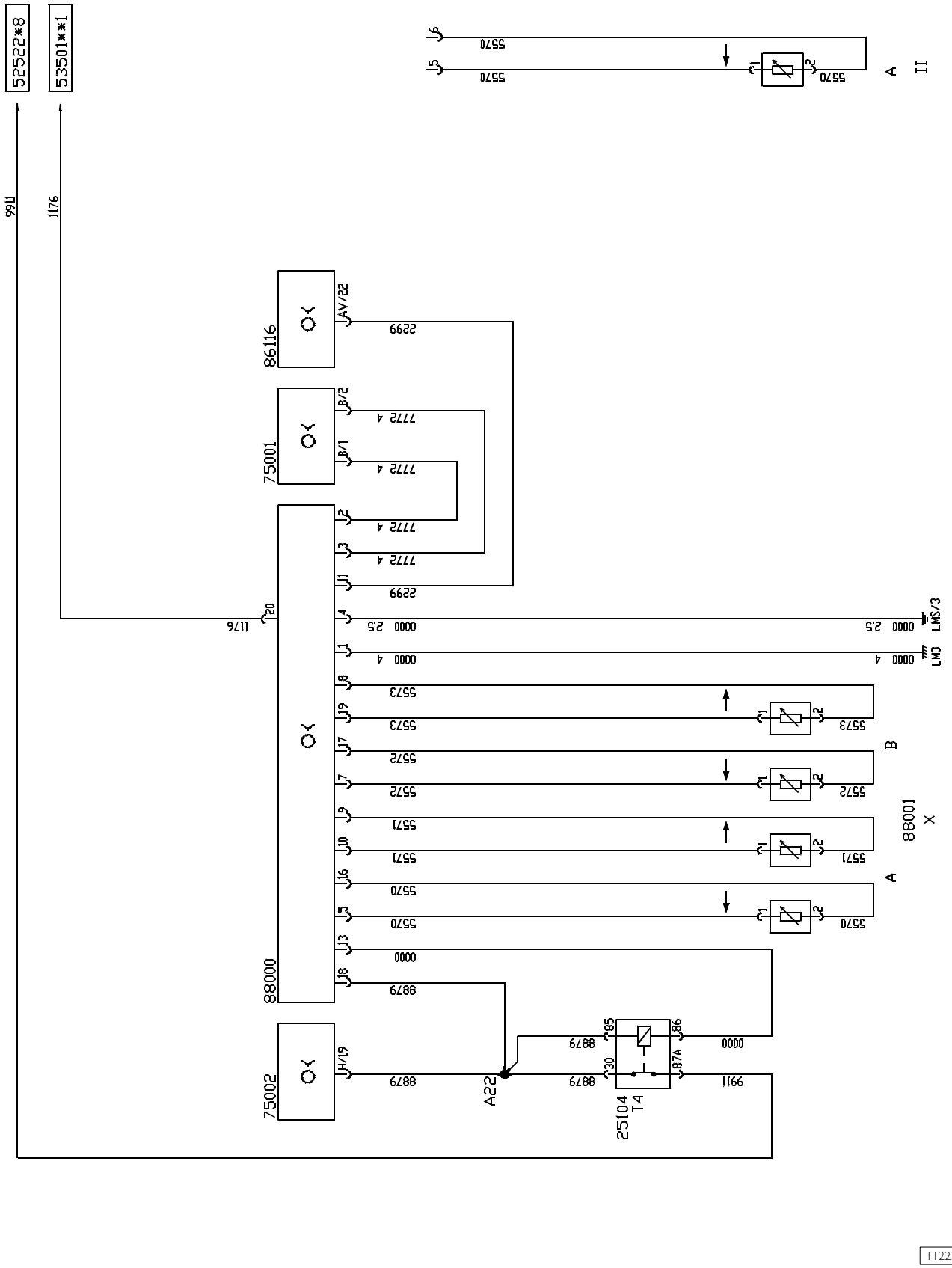
Card 12: External illumination



Card 13A: AIR BAG



Card 13B: ABS8



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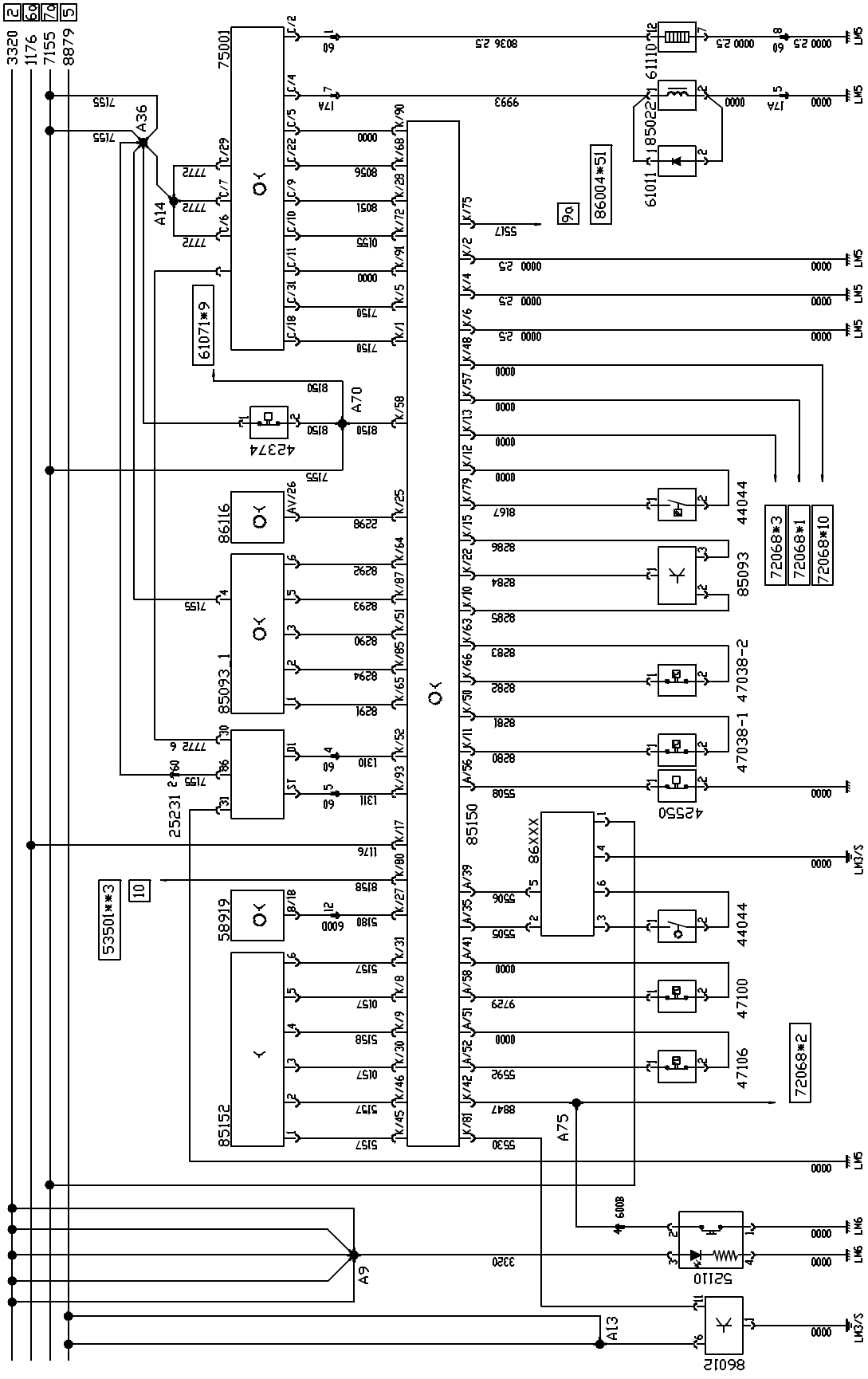
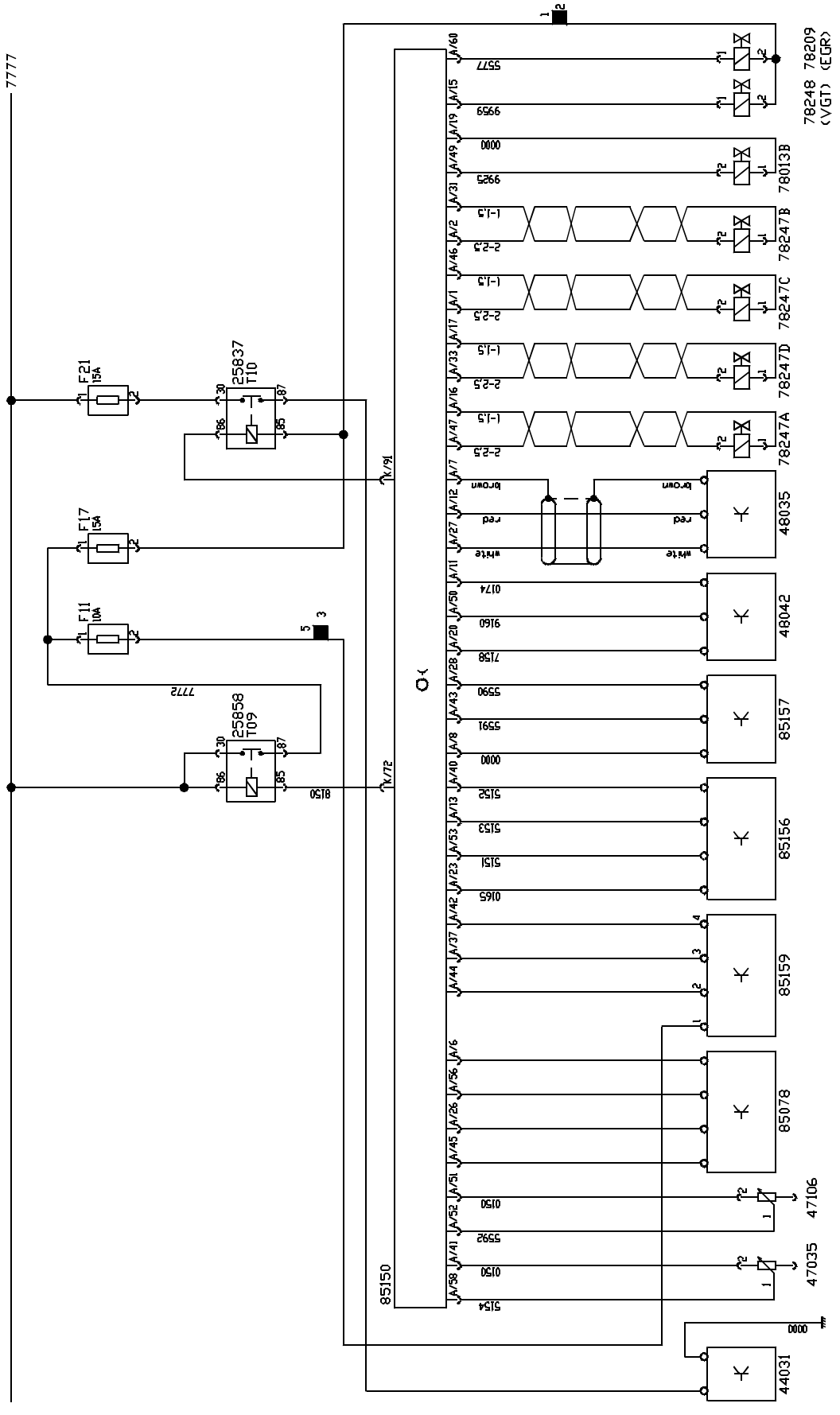
Card 14A: EDC 16

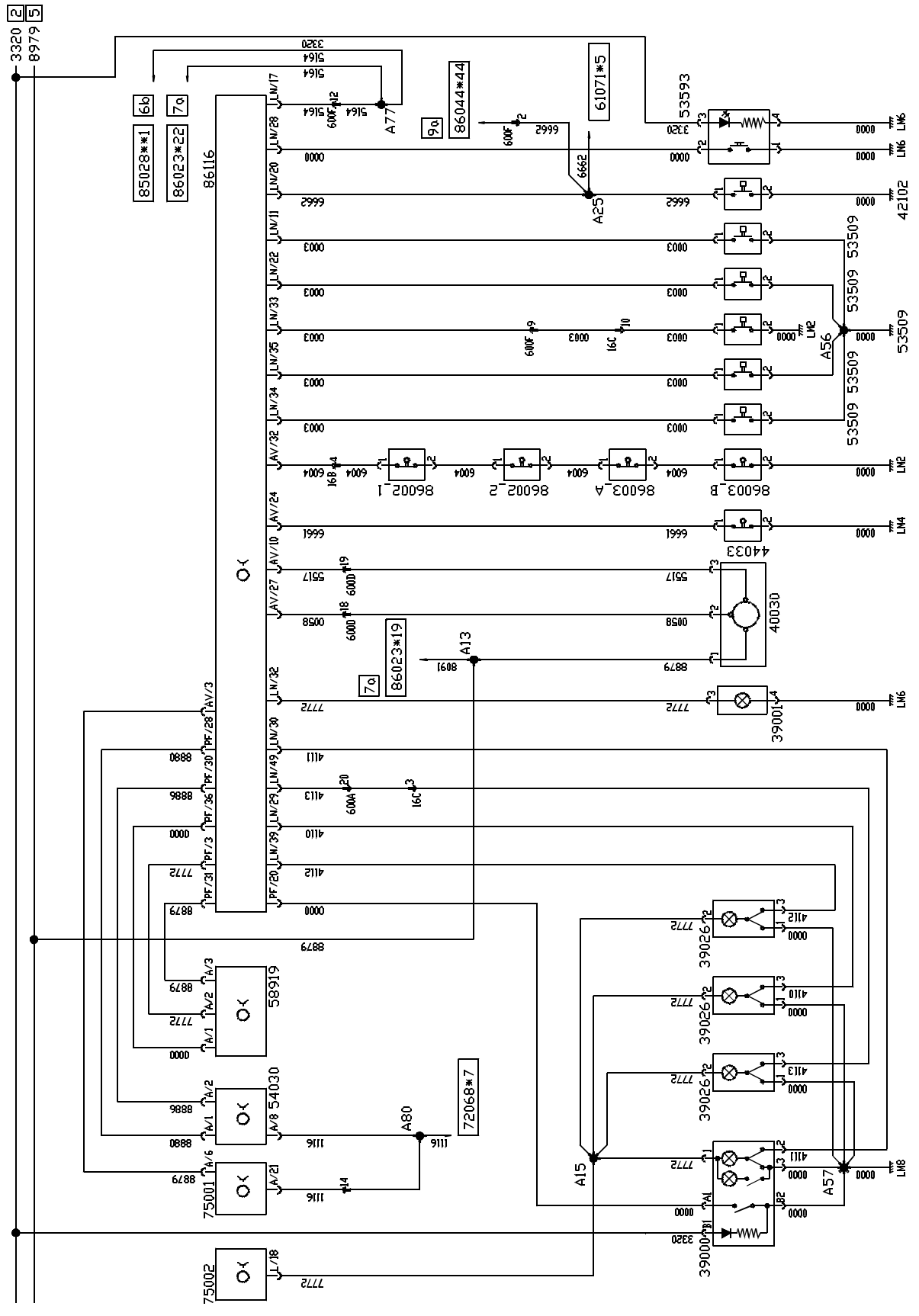


Card 14B: EDC 16

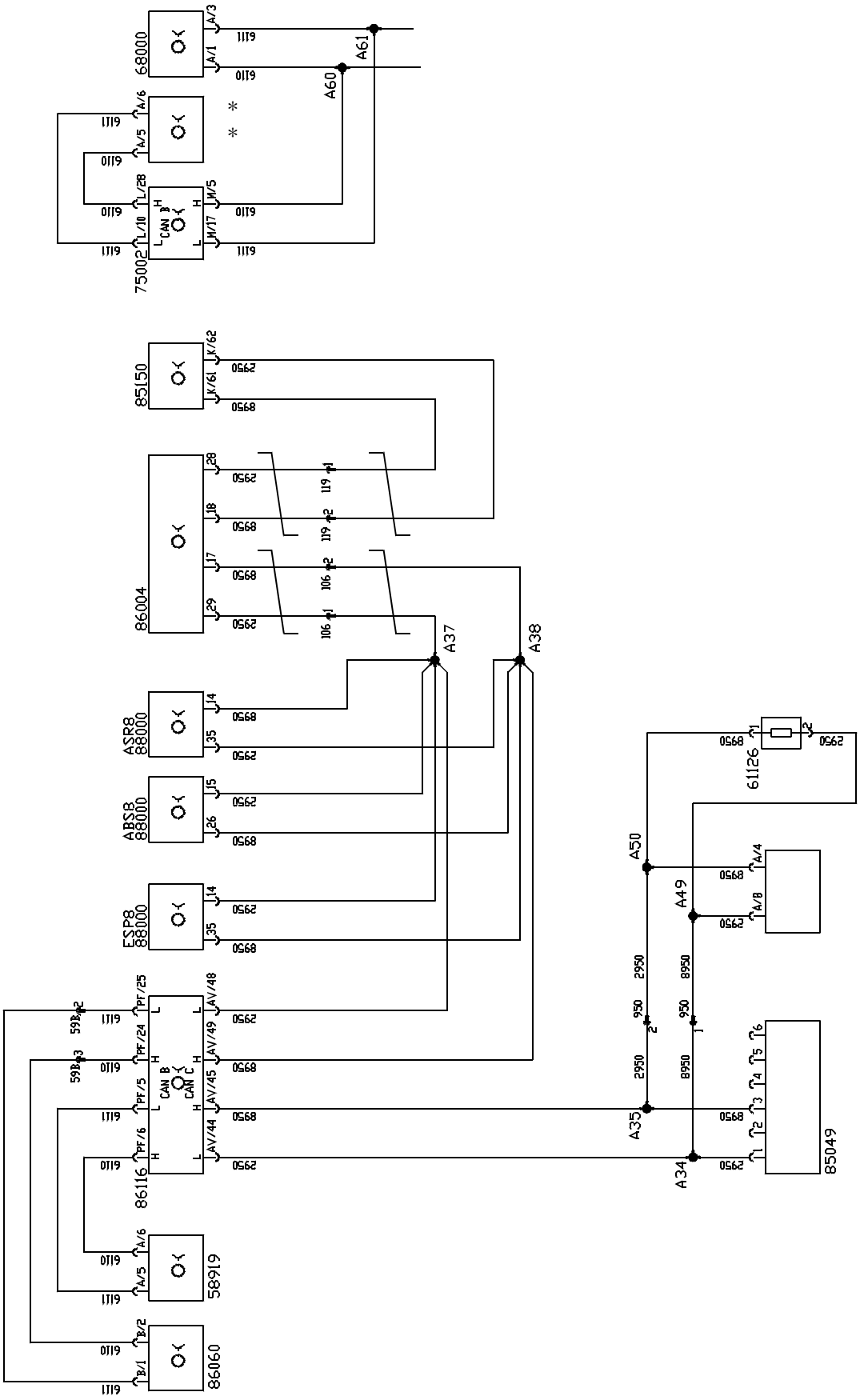


112238

Card 15B: Cab interior components



Card 16: "CAN" lines



* Tachograph / ** Parking sensors

112240