Central on-board computer 2 (ZBR2) A302

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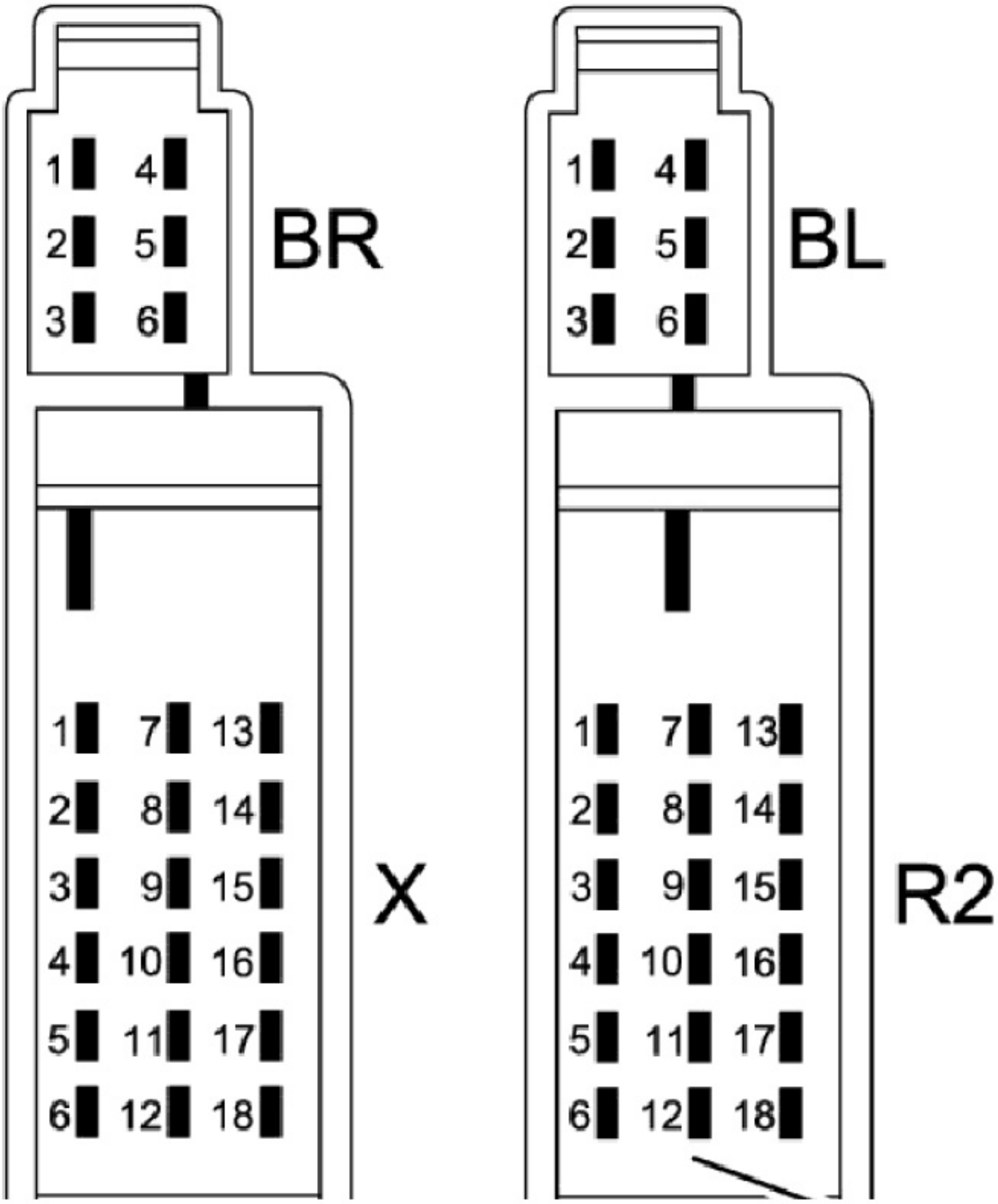
The electrical power supply comes from the central electrical system (A100).

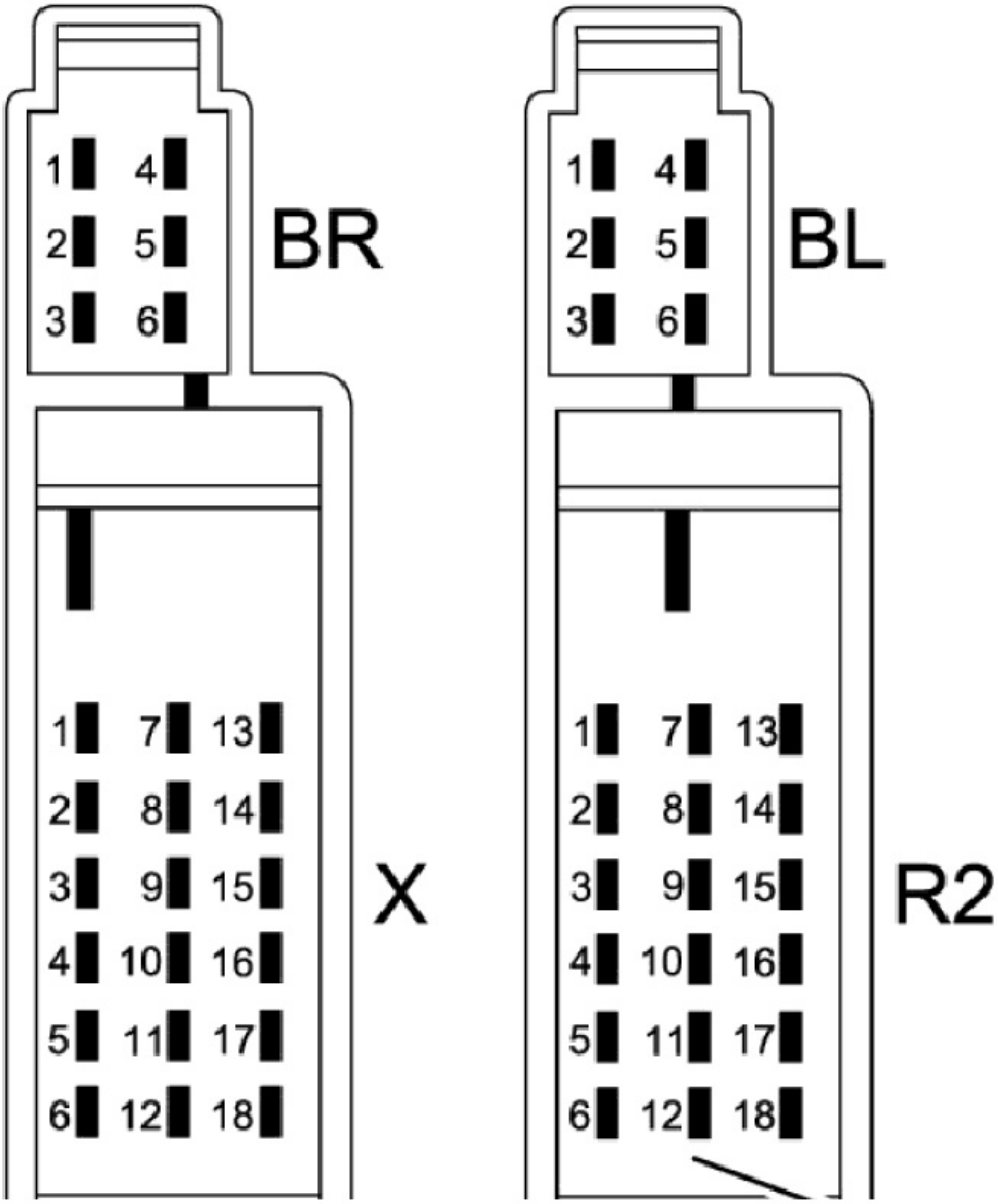
The central on-board computer has the following functions:

- Indicator functions
- Sensing functions
- Monitoring functions
- Control functions
- Diagnostic functions – Entire vehicle
  Central on-board computer (built-in device fault memory)
- Emergency functions

Connector pin assignment

The central on-board computer has 9 electrical plug connections.


1 4
2 5
3 6
BR
1 4
2 5
3 6
BL
1 7 13
2 8 14
3 9 15
4 10 16
5 11 17
6 12 18
X
1 7 13
2 8 14
3 9 15
4 10 16
5 11 17
6 12 18
R2


BR
1 4
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BL
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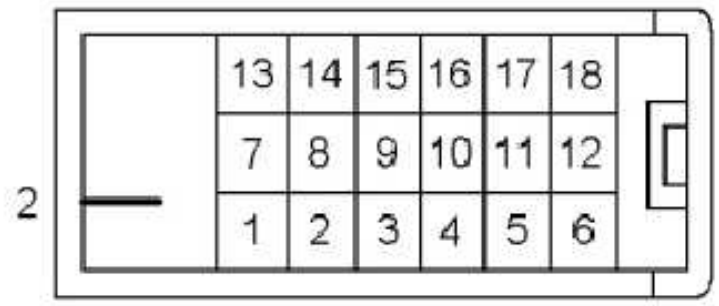
X
1 7 13
2 8 14
3 9 15
4 10 16
5 11 17
6 12 18
R2
1 7 13
2 8 14
3 9 15
4 10 16
5 11 17
6 12 18

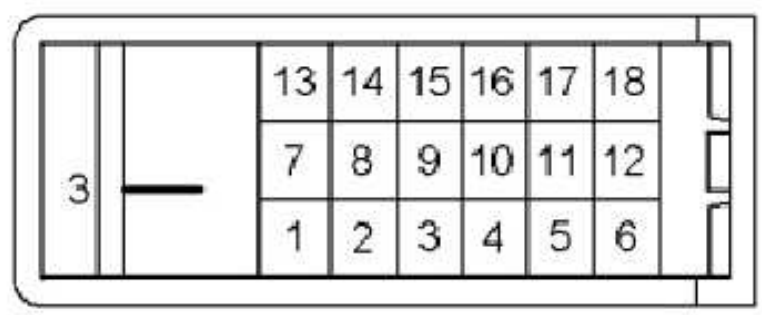
ZE	Connector, central electrical system, 12+8-pin	F2	Connector, cab, 18-pin
BR	Connector, lighting, right, 6-pin	F1	Connector, cab, 18-pin
BL	Connector, lighting, left, 6-pin	R1	Connector, frame, 18-pin
X	Connector, spare, 18-pin	M	Connector, engine, 18-pin
R2	Connector, frame, 18-pin		

Connector R1 (frame) – code: 2



Pin	Line no.	Connection	Designation
1	80101/80104	Analogue input	Cable lock switches right and left
2	92121	Analogue input	Clutch fluid level probe
3	16116	Analogue input	Cooling water level probe
4-5	-----	-----	Not used
6	92116	Analogue input	Switch, steering oil reservoir
7	-----	-----	Not used
8	16106	Analogue input	Reservoir pressure brake circuit 3
9	16102	Analogue input	Reservoir pressure brake circuit 2
10	-----	-----	Not used
11	16101	Analogue input	Reservoir pressure brake circuit 1
12	-----	-----	Not used
13	16114	Analogue input	Tank sensor
14	-----	-----	Not used
15	31002	Analogue input	Analogue ground, ZBR2
16-18	-----	-----	Not used

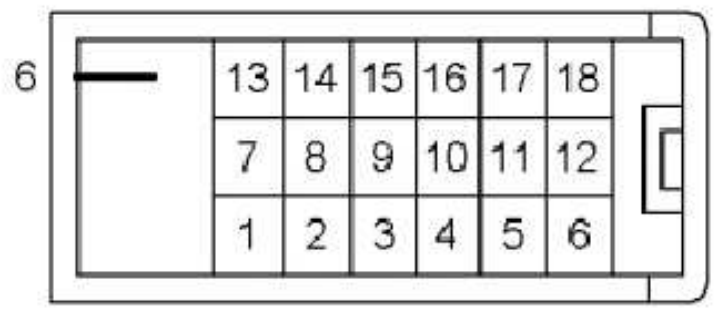
Connector R2 (frame) – code: 3



Pin	Line no.	Connection	Designation
1	49301	Digital output	Turn indicator rear left
2	49302	Digital output	Pl. con. trailer socket connection 1 (X1586)
3	49303	Digital output	Pl. con. trailer socket connection 1 (X1586)
4	43300	Digital output	Brake lamp right and left
5	43312	Digital output	Pl. con. trailer socket connection 1 (X1586)
6	58341	Digital output	Plug connection, side marker lights, left (X1170) Plug connection, body (X628)

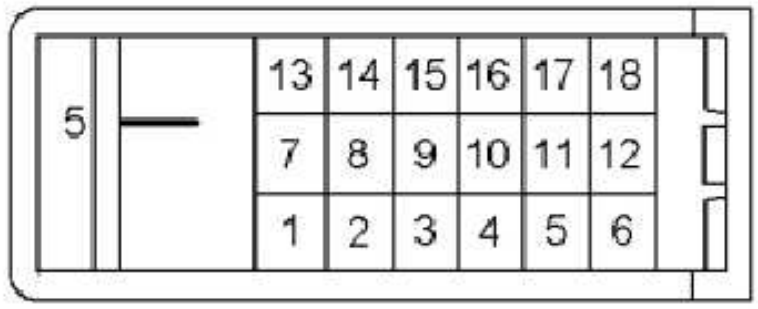
7	58342	Digital output	Plug connection, side marker lights, right (X1169) Plug connection, body (X628)
8	-----	-----	Not used
9	173 (CAN_H)	Input/output	Instrumentation CAN databus, high (I-CAN)
10	174 (CAN_L)	Input/output	Instrumentation CAN databus, low (I-CAN)
11-12	-----	-----	Not used
13	49300	Digital output	Turn indicator rear right
14	73508	Digital output	ABS trailer socket
15	56308	Digital output	Button, rear fog lamp Pl. con. trailer socket connection 2 (X1587)
16	56305	Digital output	Rear fog lamp right and left
17	-----	-----	Not used
18	14504 16012	Digital output	Diode group, 8x, battery isolator switch Pl. con. voltage supply adaptation parking brake/battery master switch (X4113) Polyswitch fuse (F782) for parking brake with electrical battery master switch

Connector F1 (cab) – code: 6



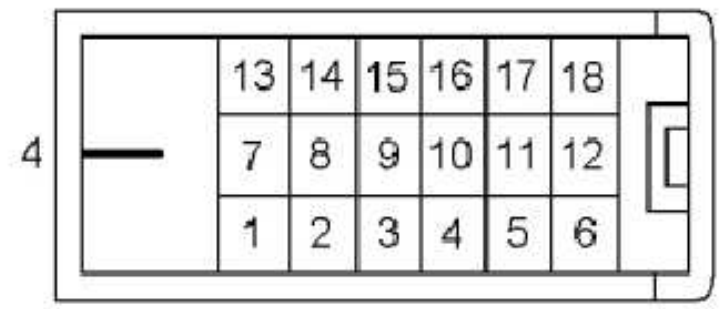
Pin	Line no.	Connection	Designation
1	49500	Digital input	Switch, hazard warning lights
2	55102	Digital input	Switch, blackout light
3	-----	-----	Not used
4	20306	Digital input	Steering column stalk
5	20500	Digital input	Steering column stalk
6	-----	-----	Not used
7	20101	Analogue input	Windscreen washer pump
8-9	-----	-----	Not used
10	20501	Digital input	Windscreen wiper motor Relay, interference suppression filter (K1285)
11	55514	Digital input	Diode group V910, V975 (V909)
12	14102	Digital input	Control unit battery isolator switch battery emergency off
13	56519	Digital input	Steering column stalk
14	58012	Digital input	Light switch / blackout light switch
15	49503	Digital input	Steering column stalk
16	49502	Digital input	Steering column stalk
17	56500	Digital input	Light switch / blackout light switch
18	-----	-----	Not used

Connector F2 (cab) – code: 5



Pin	Line no.	Connection	Designation
1	55103	Digital output	Relay sockets K198, K835 (X2381) Diode group V910, V975 (V909)
2-8	-----	-----	Not used
9	64101	Digital output	Warning buzzer (instrumentation)
10-11	-----	-----	Not used
12	15002	Digital output	Ignition "ON" / terminal 15
13	71506	Digital output	Relay, reversing light
14	-----	-----	Not used
15	20302	Digital output	Windscreen washer pump
16	49525	Digital output	Switch, hazard warning lights
17	59104	Digital output	Solder connector line 59104 (X1754), engine running signal Switch, windscreen heater Relay sockets K678, K679 (X1984)
18	-----	-----	Not used

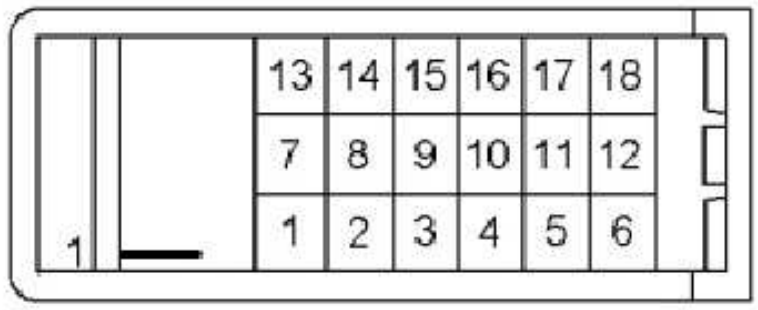
Connector M (engine) – code: 4



Pin	Line no.	Connection	Designation
1	Blue-red	Input/output	Powertrain CAN databus High (T-CAN)
2	16168	Analogue input	Pl. con. auxiliary consumer 1 (X3345)
3	-----	-----	Not used
4	59000	Digital input	Alternator terminal L
5	-----	-----	Not used
6	71300	Digital input	Reverse gear switch Pl. con. light/blackout light (X2235)
7	Blue-white	Input/output	Powertrain CAN databus Low (T-CAN)
8	59105	Input/output	Alternator terminal S
9	-----	-----	Not used
10	64201/16202	Input/output	K-line (diagnosis)
11-12	-----	-----	Not used
13	17300	Digital output	Flame starter solenoid valve

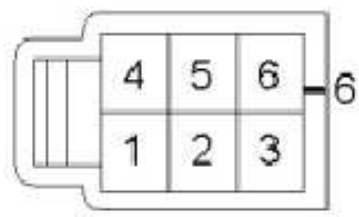
14	59101	Frequency input	Alternator terminal W Diagnosis socket, pin 1 (X200)
15	-----	-----	Not used
16	31002	Analogue input	Analogue ground, ZBR2
17	-----	-----	Not used
18	24364	Digital output	Spare for HGS heating

Connector X (spare) – code: 1



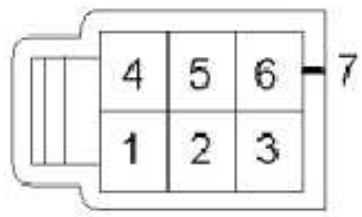
Pin	Line no.	Connection	Designation
1	-----	-----	Not used
2	73101	Digital input	Trailer socket ABS fault
3	16139	Analogue input	Pressure transmitter, air filter
4	40631	Frequency input	Diode group V782, V783
5-9	-----	-----	Not used
10	16132	Frequency input	Sensor, flow indicator (B552) Sensor, switch position indicator (B554)
11	16117	Frequency input	Sensor, flow indicator (B553)
12	56523	Digital output	Button, rear fog lamp
13	-----	-----	Not used
14	16161	Digital output	Check, failure, instrumentation (central warning light)
15-18	-----	-----	Not used

Connector BL (lighting, left) – code: 6



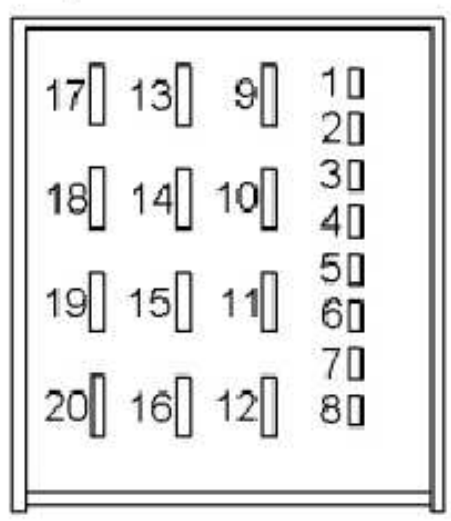
Pin	Line no.	Connection	Designation
1-3	-----	-----	Not used
4	49301	Digital output	Turn indicator front left Plug connection, cab-turn indicators, additional (X512) Plug connection, body (X628)
5	56303	Digital output	Headlight high beam, left
6	56301	Frequency output	Low beam left

Connector BR (lighting, right) – code: 7



Pin	Line no.	Connection	Designation
1	56302	Digital output	Headlight high beam, right
2	56300	Frequency output	Low beam right
3	49300	Digital output	Turn indicator front right Plug connection, cab-turn indicators, additional (X512) Plug connection, body (X628)
4-6	-----	-----	Not used

Connector CES (central electrical system)



Pin	Line no.	Line fuse	Connection	Designation
1	-----	-----	Analogue output	connected to central electrical system (A100 connection A3/4, B/7, D/4)
2	-----	-----	Analogue output	connected to central electrical system (A100 connection B/8)
3	-----	-----	Analogue output	connected to central electrical system (A100 connection B/6)
4	-----	0.2 A	Digital output	Relay, parking/tail lights
5	50300	0.2 A	Digital input	Starter terminal 50
6		0.2 A	Digital output	Relay, wiper pulse
7	-----	-----	Analogue output	connected to central electrical system (A100 connection A3/1, B/5, D/1)
8		1A	Digital output	Relay, flame start system
9	30010-1	25A	Analogue input	Terminal 30-1 via battery master switch
10		10A	Analogue input	Parking/tail lights, right
11	30010-1	10A		Connected to pin CES/12, voltage supply, vehicle management computer, terminal 30 (F371)
12	60027			Connected to pin CES/11, central electrical system (A100 connection A1/4), vehicle management computer (A403 pin X1/1)
13	30010-1	25A	Analogue input	Terminal 30-1 via battery master switch

14	58303	10A	Analogue input	Parking/tail lights, left
15	60028			Connected to pin CES/16, central electrical system (A100 connection A3/2), vehicle management computer (A403 pin X1/2)
16	15001	10A		connected to pin ZE/15, voltage supply, FFR, terminal 15 (F372)
17	15001	20A	Analogue input	Terminal 15 – ignition
18	30000	25A	Analogue input	Terminal 30, not switched
19		40A	Analogue input	connected to pin CES/20, flame glow plug input
20	17301	40A	Analogue output	connected to pin CES/19, central electrical system (A100 connection C/6), flame glow plug output

Inputs and outputs on ZBR2

All inputs and outputs on the central on-board computer are short-circuit-proof (short-circuit to ground and short-circuit to supply voltage).

The following values apply to the digital inputs and outputs:

- Low level: U_{low} = 0 – 4 V
- High level: U_{high} = 16 – 32 V

For status detection, all digital inputs must be sensed at least 3x before the status at the input is validated.

The analogue inputs are configured for a wide range of values as the protective circuits for the individual inputs have different electrical parameters.

One pull-up resistor and one pull-down resistor are provided for each spare input.

Power supply

Terminal 30 battery voltage not carried via the (mechanical/electrical) battery master switch (= not connected) is protected by a 25 A fuse on the central electrical system (A100).

Terminal 30 battery voltage carried via the (mechanical/electrical) battery master switch (= connected) is split into 2 branches in the central electrical system. Each branch is protected by a 25A fuse.

When the ignition is switched "ON", the terminal 15 consumer relay (K171) is activated and the battery voltage is applied at the terminal 15 input on the central on-board computer. The terminal 15 input is protected by a 20A fuse in the central electrical system.

The analogue ground serves as a reference for the detection performed by the analogue sensors. The ground contacts are connected to each other within the central on-board computer.

The voltage is monitored at each terminal 30.

The purpose of terminal 30 (not connected) is to pick up the battery voltage.

Pin	Signal name	Signal from	Electrical parameter	Remarks
M/16	Analogue ground	Central earthing point, engine		Line 31002
R1/15				
CES/17	Terminal 15	Central electrical system	20A	
CES/9	Terminal 30-1	Central electrical system	25A	Via battery master switch
CES/13	Terminal 30-1	Central electrical system	25A	Via battery master switch
CES/18	Terminal 30, not switched	Central electrical system	25A	Not via battery master switch

Digital inputs

Pin	Signal name	Signal from	Electrical parameter	Remarks
F1/12	Emergency off information	Battery master switch		Systems which influence holding circuit; positive-controlled
F1/10	Limit switch, wiper motor (park position)	Wiper motor limit switch		Positive-controlled, ground in end position, U_{bat} when wipers running
M/4	Alternator terminal L (switches to ground)	Alternator/controller	I <= 20 mA	Signal, charge check lamp from multifunction controller; to ground at alternator
CES/5	Starter terminal 50	Central electrical system	0.2 A; pull-up and pull-down	Positive-controlled, can be switched over to CAN signal by means of EOL
X/2	Malfunction, trailer socket ABS	Trailer socket ABS	Pull-up in ZBR2	For trailer socket ABS without CAN capability

Analogue inputs

Pin	Signal name	Signal from	Electrical parameter	Remarks
R1/1	Cab lock	Switch, cab lock	Closed-circuit current 10 mA	Ground-controlled
R1/3	Coolant level	Coolant fill level sensor	1-stage: R_{cod} = 2.2 kΩ	Ground-controlled; Scanning frequency 1 sec
R1/2	Fill level, clutch fluid	Sensor, fill level, clutch fluid	R_{cod} = 2.2 kΩ	Ground-controlled; scanning frequency 1 sec (switch function), can be deactivated by EOL
R1/6	Oil tank switch	Oil tank fill level sensor		Ground-controlled; Scanning frequency 1 sec
F1/7	Fill level, windscreen washer pump	Cleaning water fill level sensor		Ground-controlled
R1/8	Reservoir pressure brake circuit 3	Sensor, reservoir pressure Brake circuit 3	0.5 – 4.5 V	
R1/11	Reservoir pressure brake circuit 1	Sensor, reservoir pressure Brake circuit 1	0.5 – 4.5 V	
R1/9	Reservoir pressure brake circuit 2	Sensor, reservoir pressure Brake circuit 2	0.5 – 4.5 V	
R1/13	Fuel fill level	Tank sensor	R = 10 – 72 Ω	Analogue input; tank empty: R = 72 Ω; resistance measurement, offset correction alternative: Frequency input, scanning frequency 1 sec
X/3	Low pressure in air filter		0.5 – 4.5 V	

Frequency inputs

Pin	Signal name	Signal from	Electrical parameter	Remarks
M/14	Alternator terminal W	Alternator		Speed at alternator/phase, (V-belt slip)
			See analogue	

R1/13	Fuel fill level	Tank sensor	inputs	Scanning frequency 1 sec

Control sensing

Pin	Signal name	Signal from	Electrical parameter	Remarks
F1/15	Left indicator button	Turn indicator switch, steering column stalk	R_{cod} = 1.47 kΩ	Direct control due to emergency function; ground-controlled
F1/16	Right indicator button	Turn indicator switch, steering column stalk	R_{cod} = 1.47 kΩ	Direct control due to emergency function; ground-controlled
F1/1	Hazard warning light switch	Instrumentation	R_{cod} = 1.47 kΩ	Direct activation due to emergency function; pull-up to 12 V
F1/17	Light switch, blackout light switch	Blackout light switch (lighting switch)	R_{cod} = 1.47 kΩ	Direct activation due to emergency function
F1/11	Wake-up computer	Diode, central on-board computer wake-up		
F1/14	Light switch, blackout light switch	Blackout light switch (lighting switch)	R_{cod} = 1.47 kΩ	high-active
F1/2	Switch, blackout light			
F1/4	Steering column stalk	Button, windscreen washer		U_{bat}; positive-controlled
F1/5	Steering column stalk	Wiper switch		Positive-controlled
F1/13	Steering column stalk	Headlight high beam button	R_{cod} = 1.47 kΩ or R1 = 620 Ω R2 = 1.6 kΩ	Ground-controlled with a coding resistor if headlight high beam/headlight flash switch installed; 2 coding resistors (R1, R2) if headlight high beam/headlight flash button installed

Analogue output
Load current I_{load} < = 0.5 A

Output voltage U_{out} = U_{bat} = 16 – 32 V

(the values indicated apply to output voltage U_{out} = test voltage U_{test} = 28 V.)

Pin	Signal name	Signal to	Electrical parameter	Remarks
M/8	Alternator terminal S	Alternator	U_{offset} = 2 V ±0.5 V	This value is calculated from the outside temperature, the engine temperature and the load conditions; analogue voltage value is output $U_{veh.\ system}$ – U_{offset}

Digital outputs
Load current I_{load} < = 1A (at 32 V)

Output voltage U_{out} = U_{bat} = 16 – 32 V

(The values indicated apply to output voltage U_{out} = 32 V; load (consumers) grounded)

Pin	Signal name	Signal to	Electrical parameter	Remarks
X/12	Check lamp, button, rear fog lamp	-----	I_{max} = 0.5 A high-active	Signal arrives at rear fog lamp button
M/13	Flame starter solenoid valve	Flame starter solenoid valve	I_N = 1 A; U_N = 24 V	Nominal current Rated voltage
F2/12	Ignition "ON" (terminal 15)	Terminal 15 consumer relay (central electrical system)	I_{max} = 0.5 A	Terminal 15 holding circuit for lighting learning
F2/13	Relay, reversing light	Relay, reversing light	I_{max} = 0.5 A	For automatic gearbox only (AS-Tronic)
F2/16	Check lamp, hazard warning lights	Hazard warning light switch	Rv ~ 1 kΩ in switch	Only when hazard warning lights are operating, LED built into switch
F2/9	Buzzer	Buzzer in instrumentation	I_{max} = 0.5 A high-active	Interval time and idle time can be adjusted by EOL (function-dependent); monitoring can be shut off by EOL
CES/8	Relay, flame start	Central electrical system	I_{max} = 0.5 A	Coil resistance: R_{coil} = 200 +10/-5 Ω; U_{bat} = 18 – 30 V; switched current 70 A
CES/4	Relay, parking lights	Central electrical system	I_{max} = 0.5 A	
CES/6	Wiper relay (wiper interval)	Central electrical system	I_{max} = 0.2 A	If central electrical system changed: 2nd parking light relay possible instead of wiper interval relay

1A <= load current I_{load} <= 4A

Output voltage U_{out} = U_{bat} = 16 – 32 V

(The values indicated apply to output voltage U_{out} = 32 V; load (consumers) grounded)

Pin	Signal name	Signal to	Electrical parameter	Remarks
M/18	Spare for HGS heating	HGS heating	I_N = 1 A high-active	
BL/6	Low beam left	Low beam left	I_{max} = 3.1 A	1 x 24 V/70 W
BR/2	Low beam right	Low beam right	I_{max} = 3.1 A	1 x 24 V/70 W
F2/17	Engine running (= signal D+)	ECUs without CAN	I_N = 2 A	Output short-circuit-proof; monitoring can be deactivated by EOL
BL/5	Headlight high beam, left	Headlight high beam, left	I_{max} = 3.3 A	1 x 24 V/75 W
BR/1	Headlight high beam, right	Headlight high beam, right	I_{max} = 3.3 A	1 x 24 V/75 W
X/14	Check, failure, instrumentation			Activation of a check lamp (LED)

4A <= load current I_{load} <= 7A

Output voltage U_{out} = U_{bat} = 16 – 32 V

(The values indicated apply to output voltage U_{out} = 32 V; load (consumers) grounded)

Pin	Signal name	Signal to	Electrical parameter	Remarks
F2/15	Windscreen washer pump	Windscreen washer pump	I_N = 4A	High-side, sensing for line break Short-circuit to U_{bat} Short-circuit to ground

Inputs and outputs for current sensing

Pin	Signal name	Signal from/to	Electrical parameter	Remarks
R2/3	Trailer socket 1	Turn indicator, trailer, left (output)	I_{max} = 5.7 A (at 32 V)	5 x 24 V/21 W; 4 A < I_{load} < 7 A shunt with closed-circuit current sensing for trailer detection
R2/2	Trailer socket 1	Turn indicator, trailer, right (output)	I_{max} = 5.7 A (at 32 V)	5 x 24 V/21 W; 4 A < I_{load} < 7 A shunt with closed-circuit current sensing for trailer detection
R2/1 and BL/4	Turn indicator, tractor, left	Turn indicator, tractor, left (output)	I_{max} = 5.7 A (at 32 V)	5 x 24 V/21 W or 4 x 24 V/21 W and 1 x 24 V/10 W; 4 A < I_{load} < 7 A; with current sensing via shunt
R2/13 and BR/3	Turn indicator, tractor, right	Turn indicator, tractor, right (output)	I_{max} = 5.7 A (at 32 V)	5 x 24 V/21 W or 4 x 24 V/21 W and 1 x 24 V/10 W; 4 A < I_{load} < 7 A; with current sensing via shunt
R2/16	Tractor rear fog lamp	Rear fog lamp, tractor (output)		4 x 24 V/21 W; 2-stage dimming possible by means of PWM; shut off if trailer hitched up
R2/15	Trailer rear fog lamp	Rear fog lamp, trailer (output)		4 x 24 V/21 W; 2-stage dimming possible by means of PWM
CES/20	Current, flame glow plug	Central electrical system (output)	40 A	With current sensing via shunt; I_{block} = 70A (clocked)
CES/19	Current, flame glow plug	Central electrical system (input)	40A	Shunt input
CES/14	Current, parking lights, left	Central electrical system (input)	10A	
CES/10	Current, parking lights, right	Central electrical system (input)	10A	
R2/5	Trailer socket 1	Brake lights, trailer (output)	4 A	4 x 21 W/24 V power output; current sensing
R2/4	Brake lamp, tractor	Brake lights, tractor (output)	4 A	4 x 21 W/24 V power output; current sensing
R2/14	Trailer socket ABS voltage supply	ABS voltage supply (output)	0.1 A < I_{ABS} < 7 A	Current sensing
R2/6	Side marker light, left	Side marker light, left, tractor (output)	I_{max} = 2 A I_{sens} = 20 mA	Current sensing
R2/7	Side marker light, right	Side marker light, right, tractor (output)	I_{max} = 2 A I_{sens} = 20 mA	Current sensing

Serial port

Pin	Signal name	Signal from/to	Electrical parameter	Output	Input
M/10	K-line	Diagnostic connectors		Yes	Yes

CAN interface

The central on-board computer has the following CAN interfaces:
- Interface to the “powertrain” CAN databus (T-CAN)
  The drive train stations send current data to the central on-board computer for the purpose of fault recording, evaluation and instrumentation activation.
  Failed receive or output signals are stored in the central on-board computer’s fault memory.
- Interface to the “instrumentation” CAN databus (I-CAN)
  Current operating data are cyclically sent to the instrumentation for the purpose of visualisation.
  Failed receive or output signals are stored in the central on-board computer’s fault memory.

Pin	Signal name
M/1	Powertrain CAN databus, T-CAN High
M/7	Powertrain CAN databus, T-CAN Low
R2/9	Instrumentation CAN databus, I-CAN High
R2/10	Instrumentation CAN databus, I-CAN Low

Diagnostic interface

The central on-board computer has the following diagnostic interfaces:
- Diagnosis based on KWP 2000
- Diagnosis via CAN
  The “powertrain” CAN databus (T-CAN) deals with all the diagnostic functions (on-board and off-board).

End Of Line (EOL) – programming is via the diagnostic interface.

Memory areas and memory size

The central on-board computer has the following memory areas:
- Vehicle fault memory for on-board and off-board diagnosis
- Device fault memory
- Program memory for user program (updatable)
- Program memory for loading program (non-volatile)
- Memory for EOL parameters (updatable)
- Memory

The fault memory and memory for the EOL data are configured in such a way that their entire content is not changed following loss of power. The programming times must be kept short if possible. The central on-board computer is supplied with the user program and the standard set of EOL parameters. After fitting a new central on-board computer, parameterisation by means of vehicle data file or conversion file is required without fail. Each central on-board computer is configured for a single vehicle and may not therefore be installed in a different vehicle.

All saving must be completed within 2 seconds after the ignition is switched “OFF” (“voltage terminal 15 off” signal).

Power consumption

Closed-circuit current:	<= 3 mA when ignition “OFF” (closed-circuit current must be kept as low as possible).
Overvoltage detection:	32 V (detected after a delay).

Protection

The electrical power supply comes from the central electrical system (A100).

Line/connection to A100	Fuse	Remarks
Terminal 30 – battery (continuous positive)	F243 (25A)	Not via the battery master switch (not connected)
Terminal 30-1 battery	F244 (25A)	Connected (terminal 30-1)
Terminal 30-2 alternator	F245 (25A)	Connected (terminal 30-2)
Terminal 15 – starter switch (steering lock)	F246 (20A)	

Sealing class IP 30 (IEC 529)

Thermal application range: -40°C ... +65°C
Storage temperature: -40°C ... +95°C

General functions
Activating / evaluating display with keypad

Following a driver inquiry, this function is used to request data on the instrument panel display. The central on-board computer acts as a gateway and sends the desired data to the instrumentation (A407) via the "instrumentation" CAN databus (I-CAN).

Inputs

Signal	Signal presentation	Signal from	Remarks
ANF_FKT	I-CAN	Instrumentation	Request function

Outputs

Signal	Signal presentation	Signal to	Remarks
ANF_Data	I-CAN	Instrumentation	Desired data

Check lamps
The instrument panel check lamps are activated by the "instrumentation" CAN databus (I-CAN). End of line (EOL) programming is used to assign different instrumentation functions to the check lamps (position in the vehicle).

Inputs

Signal	Signal presentation	Signal from	Remarks
FKT_ANF	I-CAN	Instrumentation	-----
FKT_ANF	T-CAN	Control units	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Lamp status	I-CAN	Instrumentation	-----

Switches
The switches are activated by the instrumentation via the "instrumentation" CAN databus (I-CAN). EOL is used to assign different instrumentation functions to the switches (position in the vehicle). The switch positions are sent from the instrumentation to the central on-board computer.

Inputs

Signal	Signal presentation	Signal from	Remarks
FKT_ANF	I-CAN	Instrumentation	-----
FKT_ANF	Direct (from sensor)	Switches	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
FKT_AUSF	T-CAN	ECU/actuator	-----
FKT_AUSF	Direct (from sensor)	Actuator	-----
Lamp status	I-CAN	Instrumentation	Feedback
Lamp status_n	Direct (from sensor)	Check lamps	Checkback (hazard warning light switch)

Indicator functions

Time of arrival/remaining distance
The time of arrival is calculated based on the entered route mileage, the completed mileage and the average

vehicle speed over the last 15 minutes. The route mileage is entered using the keypad. The time of arrival and remaining mileage can be requested using the keypad.

Inputs

Signal	Signal presentation	Signal from	Remarks
Route mileage	I-CAN	Instrumentation	Input via keypad/menu
Request time of arrival	I-CAN	Instrumentation	-----
Request remaining mileage	I-CAN	Instrumentation	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Time of arrival	I-CAN	Instrumentation	-----

Outside temperature display/black ice warning
The outside temperature is sent to the instrumentation via the “instrumentation” CAN databus and is shown by a symbol and a text message on the display.

The measuring range is within -40 – +60 °C, the resolution is 0.5 °C and the maximum permitted measurement inaccuracy is ±1 °C. The displayed exterior temperature may differ from the actual temperature by several °C when the vehicle is stationary. This is due to the sensor being influenced by heat radiated from the engine.

If the outside temperature is in the warning range whilst the engine is running, the “outside temperature” warning and the current temperature appear on the instrumentation display (outside temperature gauge P113). The symbol and text message on the display are deactivated when the vehicle is at a standstill or when the outside temperature is not in the critical range.

Inputs

Signal	Signal presentation	Signal from	Remarks
Temperature, outside	T-CAN	Vehicle management computer	Cyclic on CAN

Outputs

Signal	Signal presentation	Signal to	Remarks
Temperature, outside	I-CAN	Instrumentation	-----

Operating hours/trip operating hours
The trip operating hours are the operating hours since the last reset. The saved operating hours on the counter at the time of the reset are subtracted from the total operating hours at the time of the trip operating hours request.

The vehicle operating hours are recorded in the vehicle management computer (A403). When requested via keypad, the data are sent from the vehicle management computer to the instrumentation via the central on-board computer.

If the permanent display option is selected, the instrumentation cyclically inquires about the operating hours.

The trip operating hours are calculated by the vehicle management computer. To do this, it calculates the difference between the current operating hours and the operating hours on the counter at the time of the last reset.

The maximum number of trip operating hours the computer can record is 99 h and 57 min. The displayed value remains the same if this limit is exceeded.

This function is not part of the standard specification but is available as special equipment.

Inputs

Signal	Signal presentation	Signal from	Remarks
(Total) operating hours	T-CAN	Vehicle management computer	-----
Request trip operating hours	I-CAN	Instrumentation	-----
Reset trip operating hours	I-CAN	Instrumentation	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Request operating hours	T-CAN	Vehicle management computer	-----
Day operating hours	I-CAN	Instrumentation	-----

Average speed

The average road speed is calculated by computer. The function is activated when the engine is running. The keypad can be used to reset the average road speed to zero. The calculation is based on the average road speed since the last reset. The average road speed calculation only takes into account road speeds v > 3 km/h. If the road speed v < 3 km/h, calculation of the average road speed is paused, i.e. pauses do not reduce the average road speed.

Inputs

Signal	Signal presentation	Signal from	Remarks
Engine speed	T-CAN	Electronic diesel control	A302 pin F2/17 engine running
Time	I-CAN	Tachograph	-----
Reset average road speed	I-CAN	Instrumentation	-----
Mileage	T-CAN	Vehicle management computer	-----
Request average road speed	I-CAN	Instrumentation	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Average road speed	I-CAN	Instrumentation	-----

Driving times

The driving time is the time that the vehicle has been moving at a speed v > 3 km/h since the last reset. The maximum driving time that can be recorded is 99 hours and 59 minutes. The displayed value remains the same if this maximum limit is exceeded. The driving time is reset using the keypad.

The individual time intervals in which the vehicle is travelling at a speed v > 3 km/h are recorded accurate to 1 second. However, the driving time “minutes” are incremented every 60 seconds of total driving time at a speed v > 3 km/h.

Inputs

Signal	Signal presentation	Signal from	Remarks
Reset driving time	I-CAN	Instrumentation	Does not affect tachograph
Request driving time	I-CAN	Instrumentation	-----
Time	I-CAN	Tachograph	-----
Vehicle speed	I-CAN	Tachograph	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Driving time	I-CAN	Instrumentation	-----

Stop time

The stop time is the time that has elapsed since the last reset. The stop time is reset using the keypad. The requested stop time is sent to the instrumentation via the keypad. After the central on-board computer has received the required signal, it calculates the difference between the current time and the time stored at the last reset (stop time). The maximum stop time that can be recorded is 99 hours and 59 minutes. The displayed value remains the same if this maximum limit is exceeded.

Inputs

Signal	Signal presentation	Signal from	Remarks
Reset stop time	I-CAN	Instrumentation	Does not affect tachograph
Request stop time	I-CAN	Instrumentation	-----
Time	I-CAN	Tachograph	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Stop time	I-CAN	Instrumentation	-----

Parking brake

When the parking brake is applied, this is indicated by the parking brake check lamp (H117) on the instrument panel.

Inputs

Signal	Signal presentation	Signal from	Remarks
Parking brake	T-CAN	Vehicle management computer	-----
Malfunction in brake system	T-CAN	Vehicle management computer	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Parking brake	I-CAN	Instrumentation	Parking brake check lamp (H117) or display
Brake malfunction	I-CAN	Instrumentation	Check lamp

Cab lock indicator

When the cab lock is not closed, this is indicated by the cab lock check lamp (H149) on the instrument panel.

Inputs

Signal	Signal presentation	Signal from	Remarks
Cab lock	Direct (from sensor)	Switch, cab lock	A302 pin R1/1

Outputs

Signal	Signal presentation	Signal to	Remarks
Cab lock	I-CAN	Instrumentation	Cab lock check lamp (H149)
Cab lock	T-CAN	Vehicle management computer	Due to starter interlock

Speedometer – set speed

The road speed is permanently indicated on the instrumentation (speedometer, P118). The driver may

choose to have the set speed displayed whilst driving the vehicle (cruise control, driving speed limiter (cruise control/driving speed limiter check lamp H378), “Bremsomat” braking control and adaptive cruise control).

Inputs

Signal	Signal presentation	Signal from	Remarks
Speed	I-CAN	Tachograph	-----
Set vehicle speed	T-CAN	Vehicle management computer	CC/VHS-Signal

Outputs

Signal	Signal presentation	Signal to	Remarks
Speed	I-CAN	Instrumentation	Permanently updated
Set vehicle speed	I-CAN	Instrumentation	Check lamp/display

Fuel gauges
The average consumption per 100 km since the last reset (trip consumption) is calculated based on the fuel consumption and the distance covered. The average consumption function is reset using the keypad.

The average consumption per 100 km is calculated based on the total fuel consumption since odometer reading “0” and the distance covered since.

The current fuel consumption is calculated based on the currently injected fuel quantity (CAN signal). The vehicle management computer calculates this value. The function is activated using the keypad.

The tank content is precisely sensed. The sensor input is located on the central on-board computer. This function is activated using the keypad or when the level falls below 10 % of the total fill volume.

The operating range is calculated based on the average consumption and the tank content. This function is activated via the keypad or when the operating range falls below 100 km. The total operating range (i.e. with all tanks) is displayed.

The tank quantity is the fuel fill amount. The mileage and the date are stored each time a fuel fill takes place. The last 30 fuel fills are recorded in a ring buffer store. At least 20 litres of fuel must be added to constitute a fuel fill. Fuel fills of less than 20 litres are added to the last fuel fill. The fuel quantity in the 2 tanks is detected and can only be reset using MAN-cats II. Refuels of less than 20 litres are added to the last refuel.

The fuel draw is the amount of fuel drawn from the tank. The last 30 fuel draws are recorded in a ring buffer. At least 5 litres of fuel must be drawn to constitute a fuel draw. Fuel draws of less than 5 litres are not sensed.

The data are saved when the ignition is switched OFF and when the ignition is switched ON, providing that the data save conditions are fulfilled. If the date has not changed when the ignition is switched ON, the new value is added to the value saved when the ignition was switched OFF.

The following data are saved when fuel is drawn (fuel draw at road speed v = 0):
- Mileage and date
- Time for which the power take-off and heating have been switched on whilst speed was 0
- Outside temperature or fuel temperature

The amount of fuel drawn from the tank is recorded and can only be reset using MAN-cats® II.

The amount of fuel remaining in the tank is indicated on the display in the instrument panel. This display function can be disabled by EOL programming.

The amount of fuel consumed since the last reset is shown on the instrument panel display. The value is calculated based on the EDC injection quantity. This display function can be disabled by EOL programming.

The unit of measurement used to measure fuel consumption is changed over as follows:
- When the speed $v_{changeover}$ < 3 km/h, the current fuel consumption is shown in l/h. When the speed $v_{changeover}$ > 3 km/h, the current fuel consumption is shown in l/100 km. The limit value $v_{changeover}$ can be applied using EOL. The central on-board computer changes the unit of measurement over to l/h. The unit of measurement used to measure fuel consumption is changed over automatically and cannot be selected by the driver.

Inputs

Signal	Signal presentation	Signal from	Remarks
Fuel tank fill level	Direct (from sensor)	Tank sensor	A302 pin R1/13; analogue or PWM input
Mileage	I-CAN	Tachograph	-----
Date	I-CAN	Tachograph	-----
Power take-off switched on	T-CAN	Vehicle management computer	-----
Heating on	Direct (from sensor)	Stationary heating switch	Digital input
Speed	T-CAN	Vehicle management computer	-----
Consumption	T-CAN	Vehicle management computer	-----
Reset average fuel consumption	I-CAN	Instrumentation	-----
Request average fuel consumption	I-CAN	Instrumentation	-----
Request remaining quantity	I-CAN	Instrumentation	-----
Request current fuel consumption	I-CAN	Instrumentation	-----
Request operating range	I-CAN	Instrumentation	Operating range with current tank fill level
Request fuel fill amount	I-CAN	Instrumentation	Inquiry about last 20 fuel fills
Request amount of fuel drawn	I-CAN	Instrumentation	Inquiry about last 20 fuel draws

Outputs

Signal	Signal presentation	Signal to	Remarks
Tank content	I-CAN	Instrumentation	Analogue indicator (fuel gauge P104)
Current fuel consumption	I-CAN	Instrumentation	-----
Average consumption	I-CAN	Instrumentation	-----
Operating range	I-CAN	Instrumentation	Operating range with current tank fill level
Fuel fill amount	I-CAN	Instrumentation	Output last 20 fuel fills
Amount of fuel drawn	I-CAN	Instrumentation	Output last 20 fuel draws
Amount of fuel remaining	I-CAN	Instrumentation	Display
Amount of fuel consumed	I-CAN	Instrumentation	Display

Rev counter

The engine speed is permanently indicated and monitored on the instrument panel (rev counter P101). A warning function on the instrument panel display is activated when the engine speed exceeds a defined limit value.

Inputs

Signal	Signal presentation	Signal from	Remarks
Engine speed	T-CAN	Electronic diesel control	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Engine speed	I-CAN	Instrumentation	Permanent, analogue display (rev counter P101)
Maximum engine speed exceeded	I-CAN	Instrumentation	Warning (engine brake!)

Reset trip data

The following trip data are all zeroed when the reset function is activated so as to avoid having to reset each value separately:

- Average speed
- Stop time/driving time
- Route mileage
- Average fuel consumption (current trip)
- Day operating hours

Inputs

Signal	Signal presentation	Signal from	Remarks
Request reset trip data	I-CAN	Instrumentation	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Indicator reset complete	I-CAN	Instrumentation	Central on-board computer sends confirmation to instrumentation

Time (vehicle system time)

A "Date/Time" message – repeated every second – is provided on the "instrumentation" CAN databus (I-CAN). The date and time are factory settings and are used for vehicle diagnosis.

The time can be called up on the CAN databus accurate to ±1 second. The central on-board computer provides this signal for the "powertrain" CAN databus (T-CAN).

The vehicle system time is only used internally in the vehicle for saving diagnostic data. If one of the time-generating components fails (e.g. flat battery), the central on-board computer uses the device-internal operating hours counter (redundancy).

Inputs

Signal	Signal presentation	Signal from	Remarks
Time	I-CAN	Tachograph or replacement	-----
Date	I-CAN	Tachograph or replacement	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Time	T-CAN	All control units	-----
Date	T-CAN	All control units	-----

Display in the event of instrumentation failure

If the instrumentation (A407) stops sending data to the central on-board computer, the central on-board computer transmits a remote frame and asks the instrumentation for information. If it stops detecting information, it assumes that the instrumentation has failed or is defective because the instrumentation is no longer acting as a CAN station.

The central on-board computer activates the central warning light (H111) directly if the instrumentation fails. This red light flashes at 1-Hz intervals. Activation is by means of a high level and is output at central on-board

computer pin X/14. There is no pull-up resistor at this output.

The central warning light is activated under the following conditions:

Inputs

Signal	Signal presentation	Signal from	Remarks
Instrumentation CAN message	I-CAN	Instrumentation	-----
Reservoir pressure brake circuit 1	Direct (from sensor)	Sensor	A302 pin R1/11; switching function via sensor
Reservoir pressure brake circuit 2	Direct (from sensor)	Sensor	A302 pin R1/9; switching function via sensor
Reservoir pressure brake circuit 3	Direct (from sensor)	Sensor	A302 pin R1/8; switching function via sensor

Outputs

Signal	Signal presentation	Signal to	Remarks
Central warning light	Direct (from sensor), high signal	Instrumentation	A302 pin X/14

Sensing functions

Trailer ABS detection
If a trailer is hitched up on the tractor, a current is measured in the trailer ABS circuit to determine whether the towed trailer is equipped with ABS or not.

The “ABS information” check lamp (H151) signals the following to the driver
- Trailer with ABS check lamp “OFF”
- Trailer without ABS check lamp “ON”

Alternatively, the electronic brake system EBS sends the “trailer without EBS” signal via the “powertrain” CAN databus (T-CAN) so that this signal can be displayed by the central on-board computer.

A trailer with ABS is detected when the current I_{ABS} is in the indicated nominal range. If the current is in the nominal range, the “ABS information” check lamp (H151) is deactivated. If the current is below the nominal range, the “ABS information” check lamp switches itself back on and no fault message is output.

Inputs

Signal	Signal presentation	Signal from	Remarks
Trailer without ABS (malfunction)	T-CAN	EBS	A302 pin X/2

Outputs

Signal	Signal presentation	Signal to	Remarks
Trailer ABS current	Direct (from sensor)	Trailer ABS power supply	A302 pin R2/14 Current measurement at output: 0.1 A < I_{ABS} < 2.0 A
Trailer ABS check lamp	I-CAN	Instrumentation	-----

Trailer detection

Trailers are detected via the turn indicator circuits and via the brake lamp circuit
- Left trailer turn indicator or
- right trailer turn indicator or
- trailer brake lamp or
- trailer rear fog lamp

A trailer is detected when ground signals – triggered by the installed bulb – are measured in the left/right trailer turn indicator circuit or trailer brake lamp circuit or trailer rear fog lamp circuit. There is no trailer detection in the parking light circuit.

Inputs: see Lighting control – brake lamp, brake lamp for vehicle deceleration

Outputs

Signal	Signal presentation	Signal to	Remarks
Trailer operation	T-CAN	Vehicle management computer	Signal also used for internal ZBR2 functions

Terminal sensing, terminal 15 and terminal 50
The central on-board computer has the task of measuring the voltage on terminals 15 and 50. It then sends a corresponding signal to the T-CAN databus and the I-CAN databus.

Inputs

Signal	Signal presentation	Signal from	Remarks
Terminal 15	Direct (from sensor)	Central electrical system	A302 pin CES/17
Terminal 50	Direct (from sensor)	Central electrical system	A302 pin CES/5

Outputs

Signal	Signal presentation	Signal to	Remarks
Ignition "ON"	T-CAN	All control units	-----
Ignition "ON"	I-CAN	Instrumentation	-----
Starter actuated	I-CAN	Instrumentation	-----

Engine running
When the engine or alternator is running, the "engine running" output on the central on-board computer is set to $+U_{bat}$.

If the engine and alternator are not running, the "engine running" output on the central on-board computer is reset. The output on the central on-board computer therefore has high resistance and does not switch to ground.

Activation conditions for setting the "engine running" signal to $+U_{bat}$
- Alternator speed > 600 rpm or
- engine speed > 300 rpm

Reset conditions for deactivating the "engine running" signal in status of high resistance
- Alternator speed <= 600 rpm and
- engine speed <= 250 rpm

Inputs

Signal	Signal presentation	Signal from	Remarks
Engine running	Direct (from sensor), rectangular signal	Terminal W (G102)	A302 pin M/14
Engine speed	T-CAN	Electronic diesel control	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Engine running (signal D+)	Direct (from sensor)	-----	A302 pin F2/17; I_{load} = max 2A if engine running; high resistance if engine stationary

Monitoring functions

Turn indicator learning routine
The solution described here is merely a temporary solution for a finalised light test (lighting learning routine). Only the turn indicators for the tractor and trailer are sensed in the turn indicator test.

The turn indicator learning routine enables recording of the currently connected lamp loads as reference values for lamp failure monitoring and the saving of these values in the non-volatile memory of the central on-board computer.

The following conditions must be met before a turn indicator learning routine can take place:
- Road speed <= 3 km/h
- Voltage at terminal 15 and terminal 30
- Parking brake applied
- Engine speed as required.

If the engine is started during the turn indicator learning routine, the routine must be aborted and ignition switched off.

Selecting the turn indicator learning routine type

The driver starts the tractor turn indicator learning routine manually.

The trailer turn indicator learning routine is performed automatically by the central on-board computer when the trailer is changed.

Exception in case of trailer: If the body turn indicator was changed for the trailer, the turn indicator learning routine for the trailer must be started manually.

Description of turn indicator learning routine

The turn indicator learning routine is started by pressing the lighting learning routine button (S329). This is communicated to the central on-board computer via the “instrumentation” CAN databus (I-CAN).

There are 2 defined statuses based on which the turn indicator learning routine can be started:
- If there is a voltage at terminal 15, request the turn indicator learning routine using the lighting learning routine button.
  Switch off the starter switch to start the turn indicator learning routine. Once engine speed = 0 has been detected, the terminal 15 relay is energised. However, if engine speed = 0 is not recognised within the central on-board computer delayed switch-off time, the turn indicator learning routine is aborted immediately
  Alternatively
- If there is a voltage at terminal 15, select the turn indicator learning routine from the menu using the lighting lighting learning routine button.
  To start the turn indicator learning routine, press the headlight flash switch for more than one second. The turn indicator learning routine begins one second after the pressed headlight flash switch has been detected. The central on-board computer sends a signal to the instrumentation via the instrumentation CAN databus (I-CAN).

As soon as the turn indicator learning routine has been activated, the “light test active” function is set in the central on-board computer.

The following switch and function requests are then ignored during the turn indicator learning routine:
- Left/right turn indicators
- Hazard warning lights

Tractor turn indicator learning routine

All turn indicators on the tractor are switched on and off at 1.5 second intervals for a duration of 2 minutes. The turn indicator learning routine is based on symmetrical detection of the turn indicator loads on the left and right-hand sides of the vehicle. The central on-board computer is designed for a minimum sensed load of 3 x 21 W and a maximum sensed load of 4 x 21 W on each side of the vehicle.

In the tractor turn indicator learning routine, the current is measured in the left and right turn indicator circuits. The number of detected turn indicator lamps is derived from the current values learned during the turn indicator learning routine and saved. Non-symmetrical loads are not accepted during a turn indicator learning routine.

If a defective load is sensed, this appears on the instrumentation display. If the lamp load is higher than the learned current values, the turn indicator learning routine must be repeated. As a result, the central on-board computer repeats the symmetry check and saves the number of turn indicator lights.

In order to end a turn indicator learning routine with saving of the current values, pressing of the headlight flash switch must be detected at the end of a cycle (pressing >= 100 msec). The current values are then saved in the central on-board computer.

If the headlight flash switch is not pressed within 2 minutes, the turn indicator learning routine is aborted without saving of the current values at the end of the current cycle, indicated by the sounding of a buzzer. After an unsuccessful or successful attempt to save the current values or after the turn indicator learning routine has been aborted, the terminal 15 relay is no longer energised and the blocked functions are enabled. If the turn indicator learning routine was started by pressing the headlight flash switch, the terminal 15 relay is not activated. The turn indicator learning routine is complete.

Trailer turn indicator learning routine

The central on-board detects whether the tractor is being operated with or without a trailer. As already mentioned, the central on-board computer carries out the trailer turn indicator learning routine automatically. The turn indicator learning routine is based on symmetrical detection of the turn indicator loads on the left and right-hand sides of the trailer. The central on-board computer is designed for a minimum sensed load of 1 x 21 W and a maximum sensed load of 4 x 21 W on each side of the trailer.

In the trailer turn indicator learning routine, the current is measured in the left and right turn indicator circuits. The number of detected turn indicator lamps is derived from the current values learned during the turn indicator learning routine and saved. Non-symmetrical loads are not accepted during a turn indicator learning routine.

If a defective load is sensed, this appears on the instrumentation display.

If the trailer is changed, the hazard warning lights are automatically activated once when the trailer is connected up to enable the central on-board computer to sense the lamp current. Based on this information, the central on-board computer calculates the number of lamp loads on the trailer and saves this data.

Activation is always automatic, regardless of the conditions which lead to aborting of the turn indicator learning routine.

Non-symmetrical loads on the trailer are not accepted in this case either. In this case, a fault message is set when the turn indicators are actuated, i.e. the central on-board computer sends a signal to the instrumentation via the instrumentation CAN databus (I-CAN).

During the automatic trailer turn indicator learning routine, the trailer hazard warning lights are energised until a definitive current measurement has taken place.

Inputs

Signal	Signal presentation	Signal from	Remarks
Button, lighting learning routine	I-CAN	Instrumentation	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Buzzer	I-CAN	Instrumentation	Audible signal during lighting learning sequence
Lighting learning routine check lamp (H383)	I-CAN	Instrumentation	Instrumentation without display
Display message	I-CAN	Instrumentation	Instrumentation with display

Vehicle electrical system voltage monitoring, terminal 30

The vehicle electrical system voltage is monitored at terminal 30. A fault is entered in the central on-board computer’s device fault memory if the voltage exceeds U_{Bmax} or falls below U_{Bmin}.

When the engine is not running (engine speed = 0):
- U_{Bmax} >= 32 V ±0.2 V
- U_{Bmin} <= 18 V ±0.2 V

When the engine is running (idle and under load):
- U_{Bmax} >= 36 V ±0.2 V
- U_{Bmin} <= 22 V ±0.2 V

During the starting procedure (starter actuated):
- U_{Bmax} >= 36 V ±0.2 V
- U_{Bmin} <= 6 V ±0.2 V

Inputs

Signal	Signal presentation	Signal from	Remarks
Terminal 30	Direct (from sensor)	Alternator	A302 pin CES/9 (connected)
Terminal 30	Direct (from sensor)	Alternator	A302 pin CES/13 (connected)
Terminal 30	Direct (from sensor)	Alternator	A302 pin CES/18 (not connected)

Outputs

Signal	Signal presentation	Signal to	Remarks
Display message	I-CAN	Instrumentation	Warning to the instrumentation

Monitoring, CAN
The central on-board computer monitors the CAN interfaces.

Inputs

Signal	Signal presentation	Signal from	Remarks
WATCH_T-CAN	T-CAN	Internal	Powertrain CAN monitoring
WATCH_I-CAN	I-CAN	Internal	Instrumentation CAN monitoring

Outputs

Signal	Signal presentation	Signal to	Remarks
ERR_MLDG (ERR_MSG)	I-CAN	Instrumentation	CAN monitoring

Monitoring power steering fill level
The central on-board computer monitors the power steering oil level. A warning appears on the instrumentation display (hydraulic oil level check lamp H158) if the oil level falls below a certain limit value.

Inputs

Signal	Signal presentation	Signal from	Remarks
Power steering oil level	Direct (from sensor)	Steering oil tank switch (B371)	A302 pin R1/6

Outputs

Signal	Signal presentation	Signal to	Remarks
Steering oil below min. level	I-CAN	Instrumentation (display)	Warning

Monitoring clutch fluid fill level
The central on-board computer monitors the fill level in the clutch fluid reservoir. A warning appears on the instrumentation display if the fill level falls below a certain limit value for more than 30 seconds.

Inputs

Signal	Signal presentation	Signal from	Remarks
Fill level, clutch fluid	Direct (from sensor)	Probe for clutch fluid (B434)	A302 pin R1/2

Outputs

Signal	Signal presentation	Signal to	Remarks
Clutch fluid below min. level	I-CAN	Instrumentation (check lamp / display)	Warning

Monitoring windscreen wiper/washer water fill level

The central on-board computer monitors the fill level in the windscreen wiper/washer water reservoir, which is connected to a grounded switch. The switch is closed and the check lamp for the windscreen wiper/washer water level (H382) comes on if the level falls below the specified fill level. The check lamp in question goes out again as soon as the input changes the potential (switch is opened).

Inputs

Signal	Signal presentation	Signal from	Remarks
Fill level, windscreen wiper/washer water	Direct (from sensor)	Sensor, windscreen wiper/washer reservoir fill level	A302 pin F1/7 (analogue input)

Outputs

Signal	Signal presentation	Signal to	Remarks
Windscreen washer/wiper water level too low	I-CAN	Instrumentation	Check lamp, windscreen wiper/washer water level (H382)

Monitoring V-belt slip

The V-belt slip is calculated based on the difference between the alternator speed and the engine speed. A warning appears on the instrumentation display as soon as the V-belt slip exceeds a certain value.

Inputs

Signal	Signal presentation	Signal from	Remarks
Alternator terminal W	Direct (from sensor)	Alternator (G102)	A302 pin M/14 (frequency input)
Engine speed	T-CAN	Electronic diesel control	-----
Coolant temperature	T-CAN	Electronic diesel control	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
V-belt slip	I-CAN	Instrumentation	Warning on display

Monitoring cooling water level

A switch (Reed contact) is used to monitor the coolant level. The coding resistors on the switch (R_{cod} = 2.2 kΩ) detect any line interrupts that occur. A warning appears on the instrument panel display if the coolant level falls below a certain minimum level. A fault is indicated on the display if insufficient coolant is detected for longer than 3 seconds.

Inputs

Signal	Signal presentation	Signal from	Remarks
Coolant level	Direct (from sensor)	Coolant fill level sensor	A302 pin R1/3 (analogue input)

Outputs

Signal	Signal presentation	Signal to	Remarks
Coolant below min. level	I-CAN	Instrumentation	Warning on display

Monitoring coolant temperature

The current coolant temperature value is continuously sent to the instrument panel (coolant temperature gauge P106). The coolant temperature check lamp (H110) on the instrument panel switches itself on as soon as a certain limit value is exceeded.

Inputs

Signal	Signal presentation	Signal from	Remarks
Coolant temperature	T-CAN	Electronic diesel control	Continuously updated (value in °C)

Outputs

Signal	Signal presentation	Signal to	Remarks
Coolant temperature	I-CAN	Instrumentation	Continuously updated (analogue display)
Coolant temperature exceeds max. level	I-CAN	Instrumentation	Check lamp, cooling water temperature

Charge pressure, indication and monitoring

The central on-board computer monitors the engine charge pressure. The charge pressure is indicated by the charge pressure gauge (P116) on the instrument panel. A warning message appears on the instrument panel display as soon as the charge pressure exceeds a certain limit value. A compensation curve (characteristic) is required for calculating a standardised charge pressure signal in the EDC.

Inputs

Signal	Signal presentation	Signal from	Remarks
Accelerator pedal setting	T-CAN	Vehicle management computer	-----
Engine speed	T-CAN	Electronic diesel control	-----
Boost pressure	T-CAN	Electronic diesel control	(Compensation curve)

Outputs

Signal	Signal presentation	Signal to	Remarks
Max. charge pressure exceeded	I-CAN	Instrumentation	Warning on display
Boost pressure	I-CAN	Instrumentation	Bar-type display

Monitoring air filter dirt build-up

The central on-board computer monitors the level of dirt build-up in the air filter (dirty filter check lamp H374). This process involves the measuring of the air filter vacuum. A warning message is output on the instrumentation display when a defined limit value is exceeded. When the ignition is switched ON ("terminal 15 voltage on" signal) and the engine is running, the air filter vacuum is measured and compared with a reference value saved in the EEPROM. This value is overwritten each time the ignition is switched OFF ("terminal 15 voltage off" signal) and replaced by the newly calculated reference value. The new reference value is stored in the diagnosis memory together with the current mileage and date. It can be read out using MAN-cats® II. However, it must be noted that the vacuum reference value in the diagnostic memory is not overwritten if the engine run time is less than 10 seconds and if, whilst the engine is running, all measured vacuum values exceed the stored reference value in less than 5 time intervals of 2 seconds each. In total, 5 time intervals of 2 seconds each are taken into account in order to calculate the vacuum reference value when the ignition is switched ON ("terminal 15 voltage on" signal) and the engine is running.

Inputs

Signal	Signal presentation	Signal from	Remarks
Low pressure in air filter	Direct (from sensor)	Pressure transmitter, air filter	A302 pin X/3

Outputs

Signal	Signal presentation	Signal to	Remarks
Air filters dirty	I-CAN	Instrumentation	Warning on display; dirty air filter check lamp
Air filters dirty	T-CAN	Vehicle management computer	For trend data recording

Monitoring engine oil temperature

There is not always a linear correlation between the engine oil temperature and the coolant temperature (e.g. during long periods of retarder operation, when high engine power is required for long periods). A warning message is output on the instrument panel display when a defined limit value is exceeded. The engine oil temperature is used as a default if the coolant temperature sensor fails.

Inputs

Signal	Signal presentation	Signal from	Remarks
Engine oil temperature	T-CAN	Electronic diesel control	(Sensing on EDC)

Outputs

Signal	Signal presentation	Signal to	Remarks
Max. engine oil temperature exceeded	I-CAN	Instrumentation	Warning on display

Monitoring engine oil pressure

The engine oil pressure is monitored as a function of the engine speed (oil pressure check lamp H109). A warning message appears on the instrumentation display when a specified limit value is exceeded or not reached.

Inputs

Signal	Signal presentation	Signal from	Remarks
Engine oil pressure	T-CAN	Electronic diesel control	(Sensing on EDC)
Engine speed	T-CAN	Electronic diesel control	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Max. engine oil pressure exceeded	I-CAN	Instrumentation (display)	Warning on display
Engine oil pressure below min. level	I-CAN	Instrumentation (display)	Warning on display
Engine oil pressure	I-CAN	Instrumentation	Actual value shown on display (standardised, engine speed)

Monitoring tank transmitter

The connected tank sensors are monitored by means of a plausibility check. The average fuel consumption and the mileage covered are determined over a period of 3 operating hours. These 3 operating hours constitute the evaluation period. 2 values – the tank content before the evaluation period and the tank content after the evaluation period – are compared. The difference between these two values is then calculated. If the consumed quantity of fuel differs from this calculated difference by at least 10 % of the total content of the evaluated tank, the tank sensor for this tank is defective.

The tank sensor detects increases in the fuel quantity. The monitoring must be reset and restarted. A tank sensor fault which is already known can only be reset using MAN-cats II®.

Inputs

Signal	Signal presentation	Signal from	Remarks
Tank sensor	Direct (from sensor)	Tank	Analogue or PWM
Operating hours	T-CAN	FFR	-----
Consumption	T-CAN	FFR	-----
Mileage	I-CAN	Tachograph	-----
Speed	I-CAN	Tachograph	-----
Tank (reserve)	I-CAN	Instrumentation	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Tank transmitter defective	I-CAN	Instrumentation	Warning

Warning " gearbox not in neutral"
If the ignition is ON or the engine is running, the buzzer (H162) sounds to warn the driver if an attempt is made to leave the vehicle (door contact switch) when the TIP-Matic (AS-Tronic) automated manual gearbox is not in neutral and the parking brake is not applied. The buzzer is located on the instrument panel and is activated as follows: The pulses and pauses each last 200 msec and there is no time limit. A text message is output on the instrument panel display at the same time.

The warning is output in the following instances:
- Parking brake not applied
- Gearbox not in neutral
- "Terminal 15 voltage on" signal
- Engine running

Inputs

Signal	Signal presentation	Signal from	Remarks
Terminal 15 on	Direct (from sensor)	Starter switch (Q101)	A302 pin F2/12
Engaged gear	T-CAN	Gearbox	-----
Engine running	Direct (from sensor)	Terminal W (G102)	A302 pin F2/17

Outputs

Signal	Signal presentation	Signal to	Remarks
Warning, gearbox not in neutral	I-CAN	Instrumentation	Audible buzzer warning
Buzzer	Direct (from sensor)	Instrumentation	A302 pin F2/9

Warning, " reverse gear engaged"
In vehicles with an AS-Tronic gearbox, the buzzer is automatically activated by the instrumentation (A407) as soon as the driver engages reverse gear.

Inputs

Signal	Signal presentation	Signal from	Remarks
Terminal 15 on	Direct (from sensor)	Starter switch (Q101)	A302 pin F2/12
Reversing light on	Direct (from sensor)	Switch, reversing light	A302 pin M/6

Outputs

Signal	Signal presentation	Signal to	Remarks

Buzzer	Direct (from sensor)	Instrumentation	A302 pin F2/9

Control functions

Lighting control – parking lights
When the parking light switch (light switch S111) is switched on, the central on-board computer activates the parking light relay (K116). The parking light switch has the task of "waking up" the central on-board computer when the "terminal 15 voltage off" signal is present at the switch-on point.

The current in the tractor parking light circuits is measured in switched-on status for the purpose of lamp monitoring:
- Tractor parking light, left (E109) and
- tractor parking light, right (E108)
  and, in the case of trailer operation:
- Trailer parking light, left and
- parking light, trailer, right

Inputs

Signal	Signal presentation	Signal from	Remarks
Switch, parking lights	Direct (from sensor)	Light switch (S111)	A302 pin F1/14 (low-active)
Wake-up computer	Direct (from sensor)	Light switch (S111)	A302 pin F1/14 (low-active)
Current, parking lights, left	Direct (from sensor)	Central electrical system	A302 pin CES/14
Current, parking lights, right	Direct (from sensor)	Central electrical system	A302 pin CES/10

Outputs

Signal	Signal presentation	Signal to	Remarks
Relay, parking lights	Direct (from sensor)	Central electrical system	Load disconnecting relay, parking lights, on central electrical system pin CES/4
Current, parking lights, tractor, left	Direct (from sensor)	Central electrical system	A302 pin CES/7
Current, parking lights, tractor, right	Direct (from sensor)	Central electrical system	A302 pin CES/1
Current, parking lights, trailer, left	Direct (from sensor)	Central electrical system	A302 pin CES/2
Current, parking lights, trailer, right	Direct (from sensor)	Central electrical system	A302 pin CES/3

Lighting control – tractor side marker light
Activating the parking light switch (light switch S111) also switches on the side marker lights on the left (E211, E213, E215,...) and on the right (E210, E212, E214,...).

The current in the respective tractor light circuits is measured in switched-on status for the purpose of lamp monitoring:
- Tractor side marker light, left and
- tractor side marker light, right

The current is measured at a resolution of 20 mA in order to ensure that each individual light emitting diode is localised in the event of lamp failure (3-4 light emitting diodes in one side marker light). The central on-board computer has a 2 A output for the left side marker lights and a 2 A output for the right side marker lights.

Inputs

Signal	Signal presentation	Signal from	Remarks
Switch, parking lights	Direct (from sensor)	Light switch (S111)	A302 pin F1/14 (low-active)
Wake-up computer	Direct (from sensor)	Light switch (S111)	A302 pin F1/14 (low-active)

Current, parking lights, left	Direct (from sensor)	Central electrical system	A302 pin CES/14
Current, parking lights, right	Direct (from sensor)	Central electrical system	A302 pin CES/10

Outputs

Signal	Signal presentation	Signal to	Remarks
Side marker lights, left	Direct (from sensor)	Side marker lights, left	A302 pin R2/6; current sensing, load, left
Side marker lights, right	Direct (from sensor)	Side marker lights, right	A302 pin R2/7; current sensing, load, right

Lighting control – low beam/high beam/headlight flash

When the driving light switch (light switch S111) is activated, the power outputs for left low beam (E111) and right low beam (E110) are also activated.

Only low beam may be activated when:

- The driving lights are switched on or
- "Terminal 15 voltage on" signal is present (ignition ON) whilst the driving lights are switched on

The headlight flash button/switch (S108) is used to switch between low beam and high beam:

- Headlight flash function: Move the headlight flash button/switch to the detent position.
- Headlight high beam function: Move the headlight flash button/switch past the detent position; to change from headlight high beam to headlight low beam, push the headlight flash button/switch back past the detent position.

Inputs

Signal	Signal presentation	Signal from	Remarks
Button, headlight flash	Direct (from sensor)	Button, headlight flash Steering column stalk	A302 pin F1/2; direct activation due to reaction speed
Low beam switch	Direct (from sensor)	Light switch (S111)	A302 pin F1/17; direct activation due to emergency function

Outputs

Signal	Signal presentation	Signal to	Remarks
Low beam left	Direct (from sensor)	Headlight low beam, left (E111)	A302 pin BL/6; power output
Low beam right	Direct (from sensor)	Headlight low beam, right (E110)	A302 pin BR/2; power output
Check lamp, headlight high beam (H129)	I-CAN	Instrumentation	-----
Headlight high beam, left	Direct (from sensor)	Headlight high beam, left (E113)	A302 pin BL/5; power output
Headlight high beam, right	Direct (from sensor)	Headlight high beam, right (E112)	A302 pin BR/1; power output

Lighting control – turn indicators/hazard warning lights

Actuating the left/right turn indicator switch (S108) activates the left/right turn indicator power outputs for tractor and trailer with a frequency of 1.5 Hz. All the turn indicators for the direction concerned (left or right) are activated at the same time.

Activating the hazard warning light switch (S109) activates the left/right turn indicator power outputs for tractor and trailer with a frequency of 1.5 Hz.

The turn indicator switch has one momentary contact position (position I) and one contact position (position II) for right and the same for left:
- Position I: Actuate right/left turn indicator switch – flashes during actuation
- Position II: Actuate right/left turn indicator switch – flashes continuously

If the turn indicator switch is released from position I, it returns to the centre position. The turn indicator switch is held in place by a latch mechanism when it is in position II.

The turn indicator switch can be moved from position II to the centre position:
- Either manually
- or by means of latch mechanism release (the switch has a built-in electromagnet).

The current in the tractor turn indicator circuits is measured in switched-on status for the purpose of lamp monitoring:
- Indicator light in tractor vehicle front left (H121), rear left (H123) and
- indicator light in tractor vehicle front right (H120), rear right (H122)
  and, in the case of trailer operation:
- Trailer turn indicator, left and
- trailer turn indicator, right

If the central on-board computer detects a turn indicator failure, the corresponding check lamp is deactivated. The indicator outputs continue flashing at a frequency of 1.5 Hz. The hazard warning light check lamp is not sensed.

The left/right turn indicator switch (position I) must not be switched on using the emergency functions (e.g. when the ignition is OFF).

Inputs

Signal	Signal presentation	Signal from	Remarks
Turn indicator button, left (position I)	Direct (from sensor)	Steering column stalk (S108)	A302 pin F1/15; direct activation due to emergency function
Turn indicator button, right (position I)	Direct (from sensor)	Steering column stalk (S108)	A302 pin F1/16; direct activation due to emergency function
Turn indicator button, left (position II)	Direct (from sensor)	Steering column stalk (S108)	A302 pin F1/15; direct activation due to emergency function
Turn indicator button, right (position II)	Direct (from sensor)	Steering column stalk (S108)	A302 pin F1/16; direct activation due to emergency function
Hazard warning light switch	Direct (from sensor)	Instrumentation	A302 pin F1/1; direct activation due to emergency function

Outputs

Signal	Signal presentation	Signal to	Remarks
Tractor turn indicator, left	Direct (from sensor)	Tractor turn indicator, left	A302 pin R2/1, BL/4; power output with current sensing
Tractor turn indicator, right	Direct (from sensor)	Tractor turn indicator, right	A302 pin R2/13, BR/3; power output with current sensing
Trailer turn indicator, left	Direct (from sensor)	Trailer turn indicator, left	A302 pin R2/3; power output with current sensing
Trailer turn indicator, right	Direct (from sensor)	Trailer turn indicator, right	A302 pin R2/2; power output with current sensing
Hazard warning lights	Direct (from sensor)	Turn indicators, left and right	Left turn indicator output, right turn indicator output
Tractor turn indicator	I-CAN	Instrumentation	(Check lamp, turn indicator,

check lamp, left			tractor, left H381)
Check lamp, turn indicator, tractor, right	I-CAN	Instrumentation	(Check lamp, turn indicator, tractor, right H380)
Check lamp, turn indicators in trailer	I-CAN	Instrumentation	(Check lamp, turn indicators, trailer H119)
Hazard warning light check lamp (H371)	Direct (from sensor)	Hazard warning light switch (S109)	A302 pin F2/16; during hazard warning light operation only
Buzzer	I-CAN	Instrumentation	Audible signals during indication; activation 60 msec

Lighting control – automatic indicator cancelling

2 Hall sensors are used for turn indicator reset. The purpose of the Hall sensors, which are positioned on the steering ring, is to sense the steering wheel direction of rotation. When the driver activates the right turn indicator, the steering wheel is turned to the right (from the sensor standpoint). The Hall element for "right turn indicator reset" is the first to be energised when the steering wheel is turned to the right.

The Hall element for "left turn indicator reset" is energised late (lagging) when the steering wheel is turned to the right. If the driver then turns the steering wheel in the opposite direction, i.e. to the left, the turn indicator is reset after one complete turn of the wheel.

The driver can also manually reset the turn indicator by moving the turn indicator switch in the opposite direction to the current direction for less than 600 msec. Actuating the switch for longer than 600 msec in the opposite direction changes the direction indicated by the turn indicators.

If the turn indicator switch is held firm in position (left or right), the automatic reset is overridden until the switch is released. Automatic reset is also overridden when the hazard warning lights are active.

Inputs

Signal	Signal presentation	Signal from	Remarks
Turn indicator button, left (position I)	Direct (from sensor)	Steering column stalk (S108)	A302 pin F1/15; direct activation due to emergency function
Turn indicator button, right (position I)	Direct (from sensor)	Steering column stalk (S108)	A302 pin F1/16; direct activation due to emergency function
Turn indicator button, left (position II)	Direct (from sensor)	Steering column stalk (S108)	A302 pin F1/15; direct activation due to emergency function
Turn indicator button, right (position II)	Direct (from sensor)	Steering column stalk (S108)	A302 pin F1/16; direct activation due to emergency function
Hazard warning light switch	Direct (from sensor)	Instrumentation	A302 pin F1/1; direct activation due to emergency function

Outputs

Signal	Signal presentation	Signal to	Remarks
Tractor turn indicator, left	Direct (from sensor)	Tractor turn indicator, left	A302 pin R2/1, BL/4; power output with current sensing
Tractor turn indicator, right	Direct (from sensor)	Tractor turn indicator, right	A302 pin R2/13, BR/3; power output with current sensing
Trailer turn indicator, left	Direct (from sensor)	Trailer turn indicator, left	A302 pin R2/3; power output with current sensing

Trailer turn indicator, right	Direct (from sensor)	Trailer turn indicator, right	A302 pin R2/2; power output with current sensing
Tractor turn indicator check lamp, left	I-CAN	Instrumentation	(Check lamp, turn indicator, tractor, left H381)
Check lamp, turn indicator, tractor, right	I-CAN	Instrumentation	(Check lamp, turn indicator, tractor, right H380)
Check lamp, turn indicators in trailer	I-CAN	Instrumentation	(Check lamp, turn indicators, trailer H119)
Hazard warning light check lamp (H371)	Direct (from sensor)	Hazard warning light switch (S109)	A302 pin F2/16; during hazard warning light operation only
Buzzer	I-CAN	Instrumentation	Audible signals during indication; activation 60 msec

Lighting control – brake lamp, brake lamp for vehicle deceleration
Brake lamp during vehicle deceleration is a standard feature with the automatic gearbox.

Brake lamp monitoring

When the brake pedal is depressed (“ERC1 evaluation”) or vehicle deceleration is calculated, the vehicle management computer records the brake signal and converts it into a databus format. From here, the brake signal is sent to the central on-board computer via the “powertrain” CAN databus (T-CAN). The vehicle management computer calculates the vehicle deceleration. The central on-board computer activates the brake lamps via the power output. If current is measured whilst the brake pedal is depressed, this indicates a lamp failure in the brake lamp circuit.

In the light test (lighting learning), the lamp load in the brake lamp circuit is determined and then stored as a setpoint in the non-volatile memory.

If the parking lights and rear fog lamp fail, the brake lamp output is activated in dimmed mode by means of pulse width modulation. The dimmed brake lamps must be as bright as the parking lights. The driver then depresses the brake pedal, thus activating the brake lamps in non-dimmed mode. The default function for the brake lamps is only activated if no faults are detected during sensing of the brake lamp current.

The brake lamps on the left of the tractor (H113), right of the tractor (H112) and trailer are always activated at the same time. If the vehicle is operated without a trailer, the “trailer brake lamp” fault message is suppressed.

Default function for the brake lamp:

If the brake status is invalid or if the connection between the CAN databus (T-CAN) and vehicle management computer fails, the central on-board computer activates the brake lamp as a function of the vehicle deceleration. If this is the case, the vehicle deceleration is not calculated by the vehicle management computer but, instead, by the central on-board computer based on the tachograph speed. This process involves the weighted evaluation of the last 6 CAN messages by the central on-board computer.

Inputs

Signal	Signal presentation	Signal from	Remarks
Brake signal	T-CAN	Vehicle management computer	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Brake lamp, trailer	Direct (from sensor)	Trailer brake lamps	A302 pin R2/5; power output with current sensing
Brake lamp, tractor	Direct (from sensor)	Tractor brake lamps	A302 pin R2/4; power output with current sensing

Lighting control – rear fog lamp

The rear fog lamp check lamp (located in the switch) is activated when:
- Ignition “ON” (“terminal 15 voltage on” signal) is activated and
- the driving light switch is switched on and
- the rear fog lamp button (S502) is switched on or
- ignition “ON” (“terminal 15 voltage on” signal) is activated and
- the parking light switch is switched on and
- the rear fog lamp button is activated.

If the vehicle is operated with a trailer, the trailer rear fog lamp output is activated. If the vehicle is operated without a trailer, the tractor rear fog lamp output is activated. The rear fog lamp outputs are cyclically switched on to limit the making current.

The tractor rear fog lamp output or trailer rear fog lamp output and the rear fog lamp check lamp are not operational when:
- Ignition “OFF” (“terminal 15 voltage off” signal) is activated or
- the rear fog lamp button is pressed again or
- the driving light switch is deactivated.

If current is measured in the tractor rear fog lamp circuit or trailer rear fog lamp circuit, this indicates a rear fog lamp failure.

The following functions are configured via the rear fog lamp:

Default function for the parking lights

The rear fog lamp is automatically activated in dimmed mode by means of pulse width modulation when a current measurement indicates a fault in the parking light circuit. The dimmed rear fog lamp is as bright as the parking lights.

Default function for the brake lamp

If current measurement in the tractor brake lamp circuit indicates failure of all lamps, the tractor rear fog lamps on the left (E125) and right (E124) are activated in dimmed mode when the brakes are applied, regardless of whether a trailer is hitched up or not. If current measurement indicates failure of all lamps in the trailer circuit when the vehicle is towing a trailer, the trailer rear fog lamp is also activated in dimmed mode.

When the brakes are applied, the activated rear fog lamp is switched off and on in undimmed mode at 1 Hz intervals. If the brakes are not applied, the rear fog lamp is permanently activated in undimmed mode. The dimmed rear fog lamp is as bright as the brake lamp.

The default functions for the parking lights/brake lamp are only activated when no faults are detected in the tractor rear fog lamp or trailer rear fog lamp circuits.

Inputs

Signal	Signal presentation	Signal from	Remarks
Terminal 15	Direct (from sensor)	Central electrical system	A302 pin CES/17
Switch, parking lights	Direct (from sensor)	Light switch (S111)	A302 pin F1/14
Current, parking lights, left	Direct (from sensor)	Central electrical system	A302 pin CES/14
Current, parking lights, right	Direct (from sensor)	Central electrical system	A302 pin CES/10
High beam switch	Direct (from sensor)	Light switch (S111)	A302 pin F1/17
Button, rear fog lamp	I-CAN	Instrumentation	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Relay, parking lights	Direct (from sensor)	Central electrical system	Parking light load disconnecting relay on central electrical system

Low beam left	Direct (from sensor)	Headlight low beam, left (E111)	A302 pin BL/6; power output
Low beam right	Direct (from sensor)	Headlight low beam, right (E110)	A302 pin BR/2; power output
Headlight high beam, left	Direct (from sensor)	Headlight high beam, left (E113)	A302 pin BL/5; power output
Headlight high beam, right	Direct (from sensor)	Headlight high beam, right (E112)	A302 pin BR/1; power output
Tractor parking light current, left	Direct (from sensor)	Central electrical system	A302 pin CES/7; current sensing
Tractor parking light current, right	Direct (from sensor)	Central electrical system	A302 pin CES/1; current sensing
Current, parking lights, trailer, left	Direct (from sensor)	Central electrical system	A302 pin CES/2; current sensing
Current, parking lights, trailer, right	Direct (from sensor)	Central electrical system	A302 pin CES/3; current sensing
Check lamp, rear fog lamp	I-CAN	Instrumentation	-----
Tractor rear fog lamp	Direct (from sensor)	Tractor rear fog lamp, left (E125) and right (E124)	A302 pin R2/16; power output, deactivated if trailer is hitched up
Trailer rear fog lamp	Direct (from sensor)	Trailer rear fog lamp	A302 pin R2/15; power output

Lighting control – DIM/DIP

Vehicles for the UK are equipped with a special DIM/DIP function. The DIM/DIP control is only activated when the driving light switch (light switch S111) is switched off and the parking light switch (light switch S111) is switched on. The function is also not available if the parking light switch is defective or if there is a short-circuit to U_{bat}or ground on the line and the driving light switch is not actuated.

Headlight low beam is switched on in dimmed mode when the engine is running. The operating voltage of the dimmed lamps is regulated to a parameterisable value of 20 V regardless of the vehicle electrical circuit voltage. Pulse width modulation allows dimming in a frequency range of 150 – 250 Hz.

If the driver activates the driving lights, the DIM/DIP control is deactivated and headlight low beam is switched off.

The parking lights and side marker lights must remain activated when the headlight flash function is activated in DIM/DIP mode.

Headlight high beam is switched on when the headlight flash is activated.

If the driver activates the headlight flash when low beam is on in dimmed mode, low beam remains activated in dimmed mode.

Inputs

Signal	Signal presentation	Signal from	Remarks
Engine running (D+)	Direct (from sensor)		A302 pin F2/17
Switch, parking lights	Direct (from sensor)	Light switch (S111)	A302 pin F1/14
High beam switch	Direct (from sensor)	Light switch (S111)	A302 pin F1/17
Switch, rear fog lamp	I-CAN	Instrumentation	A302 pin X/12
Button, headlight flash	Direct (from sensor)	Button, headlight flash (combination switch)	A302 pin F1/2

Outputs

Signal	Signal presentation	Signal to	Remarks
Low beam left	Direct (from sensor)	Headlight low beam, left (E111)	A302 pin BL/6; power output
Low beam right	Direct (from sensor)	Headlight low beam, right (E110)	A302 pin BR/2; power output

Lighting control – reversing light
As soon as the driver has engaged reverse gear, the central on-board computer activates the reversing light relay (K250). The input signals are sent via the “powertrain” CAN databus (T-CAN) in the case of TIP-Matic (AS-Tronic) automatic gearboxes.

Inputs

Signal	Signal presentation	Signal from	Remarks
Reverse gear engaged	T-CAN	Gearbox control unit	“Engaged gear” message

Outputs

Signal	Signal presentation	Signal to	Remarks
Relay, reversing light	Direct (from sensor)	Reversing light relay (K250)	A302 pin F2/13; digital switching output (500 mA); for TIP-Matic gearbox (AS-Tronic)

Electrical battery isolator switch

This circuit is used to ensure that the electrical battery isolator switch (Q105) cannot be switched off when the following input signals are activated:
- Ignition “ON” (“terminal 15 voltage on” signal)
- Parking lights activated (“terminal 58 voltage on” signal)
- Hazard warning light switch actuated
- Vehicle management computer delayed switch-off (T-CAN message)

A separate electronic control unit, which the central on-board computer energises via the battery master switch holding circuit output, is used to switch on the electrical battery master switch.

When the central on-board computer detects that the following signals are not available
- Ignition “ON” (“terminal 15 voltage on” signal)
- Parking lights activated (“terminal 58 voltage on” signal)
- Hazard warning light switch actuated
- Vehicle management computer delayed switch-off (T-CAN message)
  a delayed switch-off time of 60 seconds ensues before the electrical battery isolator switch’s power supply is deactivated.

If one of the directly interfaced input signals is activated (when the ignition is switched OFF, “terminal 15 voltage off” signal and released battery master switch), the battery master switch is supplied with power and the corresponding vehicle function is executed.

If the central on-board computer detects a high level at the “emergency off information” input, it immediately sends a top priority signal to the “powertrain” CAN databus (T-CAN) and “instrumentation” CAN databus (I-CAN). The central on-board computer then performs an emergency shut-off within 1.9 seconds. Only the most important current data are stored in the non-volatile memory during the emergency shut-off phase. These data are designed to ensure that the central on-board computer is capable of continued operation with the correct and current data when power is restored.

Inputs

Signal	Signal presentation	Signal from	Remarks
Terminal 15	Direct (from sensor)	Central electrical system	A302 pin CES/17
Terminal 15 on	T-CAN	Vehicle management computer	-----
		Vehicle management	

Engine speed	T-CAN	computer	-----
Parking light on	Direct (from sensor)	Instrumentation	A302 pin F1/14; switch, lighting
Hazard warning light switch	Direct (from sensor)	Instrumentation	A302 pin F1/1
Emergency off information	Direct (from sensor)	Battery isolator switch	A302 pin F1/12

Outputs

Signal	Signal presentation	Signal to	Remarks
Emergency off	I-CAN	All control units	High to top priority
Emergency off	T-CAN	All control units	High to top priority
Electrical battery master switch holding circuit	Direct (from sensor)	Battery master switch	A302 pin R2/18; continuous signal

Charge voltage control

Controlled alternators automatically balance out differences of 2 V ±0.5 V between the voltage on the battery and the voltage on the controller. The central on-board computer intervenes in the battery voltage checkback signal sent from the battery to the controller in order to increase or reduce the charge voltage.

Charge voltage control depends on:

- Outside temperature
- Coolant temperature/engine oil temperature
- Voltage on the battery
- Driving time(s)

The central on-board computer intervenes in the charge current circuit by

- Measuring the voltage from the battery to unconnected terminal 30 line (input) and
- forwarding the control voltage (vehicle electrical system voltage ±1 V) to alternator terminal S (output).

In the event of central on-board computer failure or if the central on-board computer has been reset, the voltage remains uninfluenced by the central on-board computer as far as is possible (voltage deviation between unconnected terminal 30 input and alternator terminal S output <= 0.1 V).

Inputs

Signal	Signal presentation	Signal from	Remarks
Terminal 30, not switched	Direct (from sensor)	Central electrical system	A302 pin CES/18; not connected: direct from the battery
Alternator terminal L	Direct (from sensor)	Alternator (G102)	A302 pin M/4
Alternator terminal W	Direct (from sensor)	Alternator (G102)	A302 pin M/14
Engine oil temperature	T-CAN	Electronic diesel control	-----
Engine oil temperature	T-CAN	Electronic diesel control	Coolant temperature
Temperature, outside	T-CAN	Vehicle management computer	-----

Outputs

Signal	Signal presentation	Signal to	Remarks
Charge check lamp (H100)	I-CAN	Instrumentation	Warning on display also
Charge control fault	I-CAN	Instrumentation	-----
Alternator terminal S	Direct (from sensor)	Alternator (G102)	A302 pin M/8; value calculated based on outside temperature and engine

Wiper control/variable wiper interval control/washer control
The wiper switch (S108) directly activates the wiper motor in levels I and II. If there is a low level at the “wiper motor limit switch” input and a high level at the “interval switch” input, the “wiper relay” output is supplied with voltage until there is also a high level at the “wiper motor limit switch” input. The windscreen wiper then executes a wipe movement. This process is repeated after a pause. If the driver switches on intermittent operation, a pre-programmed interval time of 7 seconds is activated.

If the driver then switches the combination switch (S108) from interval mode to “off” position or “level I, II” and then back to interval mode within a certain time, a new interval time equal to this certain time is set.

The road speed-dependent interval time overrides the wipe interval time. The current road speed is recorded and stored whilst the new interval time is being set.

If the vehicle speed changes in relation to the stored vehicle speed, the interval time is adjusted:
- The interval time lengthens as the driver decelerates.
- The interval time shortens as the driver accelerates.

The maximum interval time that can be achieved is 60 seconds. If the maximum interval time is exceeded, i.e. interval mode remains non-operational for longer than 60 seconds, or if the ignition is switched OFF (“terminal 15 voltage off” signal), the interval time is reset to 7 seconds when the ignition is switched back on.

Important: The “wiper electronics” output must not be activated if there is a high level at the “wiper motor limit switch” input.

Windscreen washers

If there is a low level at the “wiper motor limit switch” input and a high level at the “windscreen washer button” input, the “wiper relay” output is supplied with voltage until there is also a high level at the “wiper motor limit switch” input.

If a high level is detected when the windscreen washer button (S108) is actuated, the “wiper relay” output is not energised because the windscreen wipers are already operational.

One-sweep mode: If the windscreen washer button is pressed for <= 600 msec, only 1 wipe cycle is executed after the button is released.

Washer mode: If the windscreen washer button is pressed > 600 msec, wash mode is activated after a time of 600 msec, measured from the point which the button was pressed.

In both one-sweep mode and wash mode, the “washer pump” output remains energised for as long as the windscreen washer button is depressed. If the driver then releases the windscreen washer button (low level at “windscreen washer” input), the windscreen wipers continue wiping for 3 full wash cycles.

Inputs

Signal	Signal presentation	Signal from	Remarks
Interval switch	Direct (from sensor)	Wiper switch (S108)	A302 pin F1/5
Wiper motor limit switch	Direct (from sensor)	Limit switch, wiper motor (M102)	A302 pin F1/10
Button, windscreen washer	Direct (from sensor)	Button, windscreen washer (S108)	A302 pin F1/4
Revolutions, wiper motor	Direct (from sensor)	Wiper motor	-----
Speed	I-CAN	Tachograph	Speed-sensitive wiper interval control

Outputs

Signal	Signal presentation	Signal to	Remarks
			A302 pin CES/6; wiper