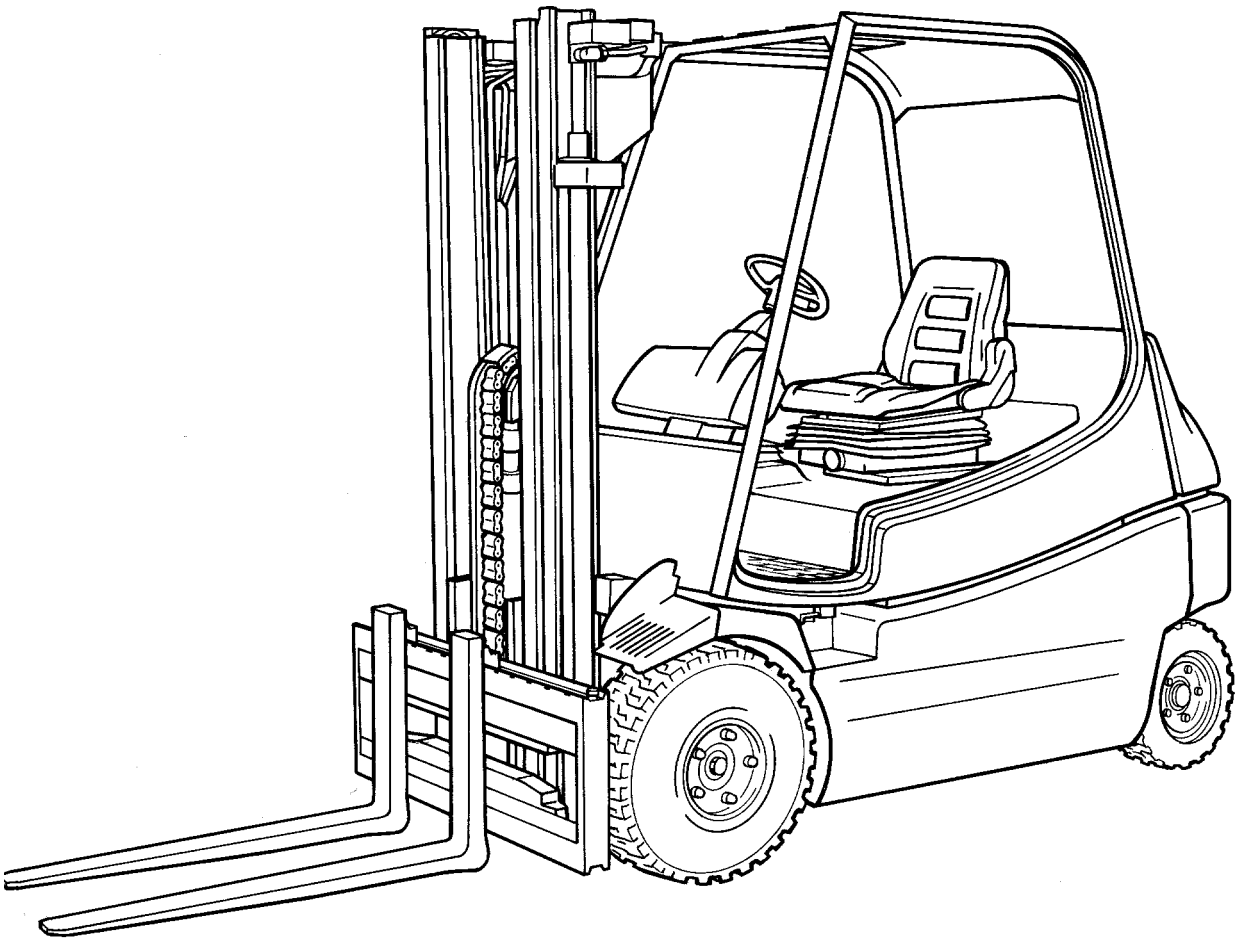
Service Training

Linde Electric Fork Truck
E 20 / 25 / 30
Series 336



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2 LINDE ELECTRIC FORK TRUCK E 20 / 25 / 30 SERIES 336

2.1 DRIVE - MOTOR

The electric fork trucks are powered by DC series-wound motors. DC series-wound motors develop the highest torque of all electric motors. In series-wound motors the field winding is connected in series to the armature.

The field windings terminals D1 and D2 and the armature winding terminals A1 and A2 are marked. They are lead out of the motor separately. The traction motor direction is reversed by reversing the armature field.

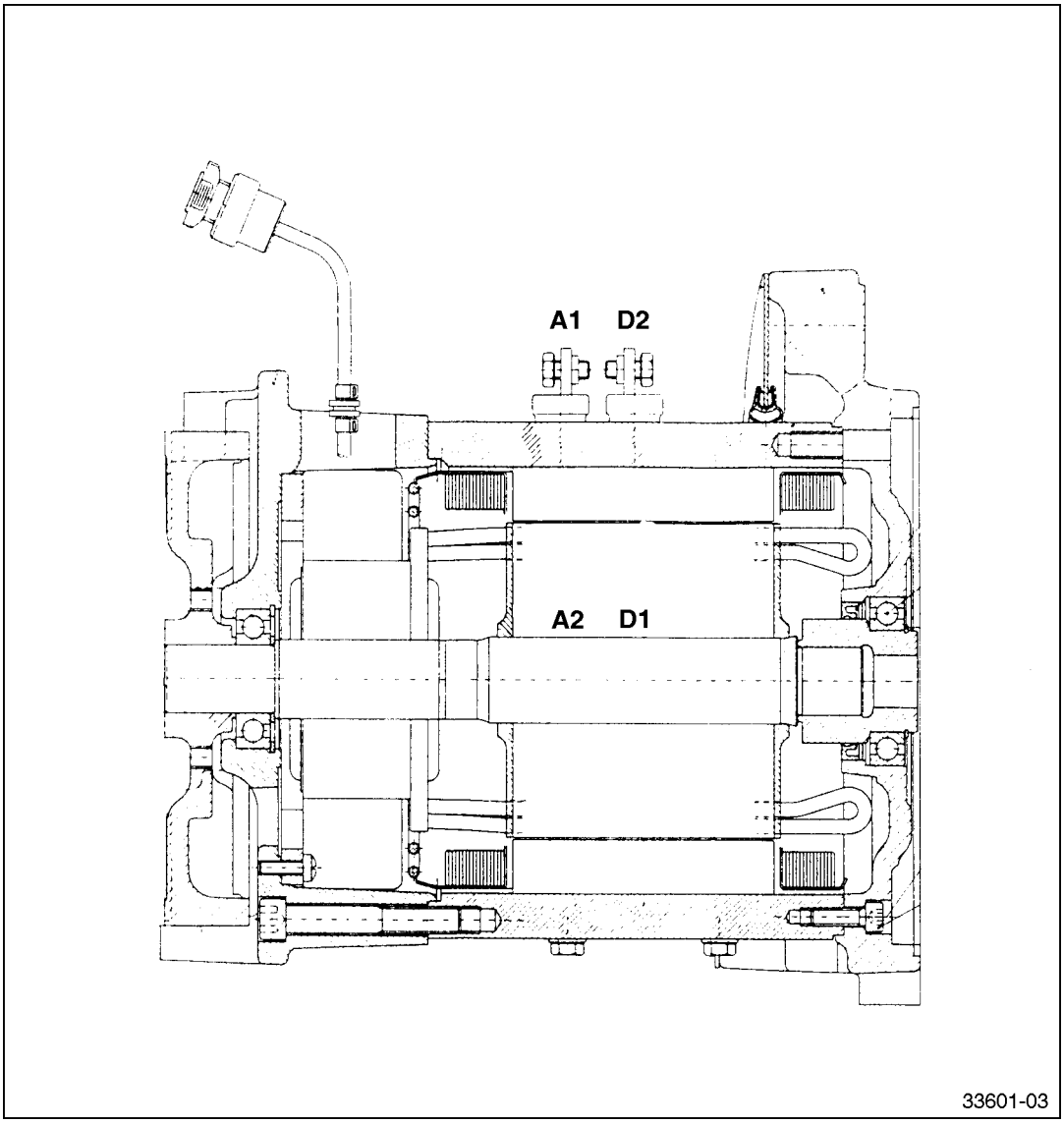
A speed sensor is installed on the left-hand traction motor for sensing the motor RPM and direction of rotation.

2.1.1 TRACTION MOTOR TO 6/95

Type:	DC series-wound motor with armature reversal	
Model:	E 20	GF 144-14/5.4
	E 25 / 30	GF 146-14/7.8
Voltage:	80 V	
Power:	E 20	5.0 kW S2 (60 min rating)
	E 25 / 30	6.4 kW S2 (60 min rating)
Type of protection:	IP00 / IP23 DIN 40 050	
Brush dimensions:	12.5x40x40 mm	
Permissible wear:	down to 16 mm	
Collector diameter:	original 104 mm	
Reworking down to:	100 mm	

Components: 2 thermal switches; 1 normally open operates at 80 °C; 1 normally closed operates at 160 °C; brush monitoring, speed sensor on left-hand motor

Right-hand traction motor 1M1



Armature terminals A1 and A2
Field terminals D1 and D2

Connector 1X7 for RH traction motor 1M1

1 Brush switch 6B1
2 Brush switch 6B2
3 Thermal switch 160 °C 1B7
4 Thermal switch 160 °C 1B7
5 Thermal switch 80 °C 1B5
6 Thermal switch 80 °C 1B5
7 Not used
8 Not used

Connector 1X8 for LH traction motor 1M2

1 Brush switch 6B3
2 Brush switch 6B4
3 Thermal switch 160 °C 1B6
4 Thermal switch 160 °C 1B6
5 Thermal switch 80 °C 1B4
6 Thermal switch 80 °C 1B4
7 Not used
8 Not used

2.1.2 TRACTION MOTOR FROM 7/95

Type:	DC series-wound motor with armature reversal	
Model:	E 20	Juli GF 144-14/5.4
	E 25 / 30	Juli GF 146-14/7.8
Voltage:	80 V	
Power:	E 20	5.0 kW S2 (60 min rating)
	E 25 / 30	6.4 kW S2 (60 min rating)
Type of protection:	IP00 / IP23 DIN 40 050	
Brush dimensions:	12.5x40x40 mm	
Permissible wear:	down to 16 mm	
Collector diameter:	original 104 mm	
Reworking down to:	100 mm	

Components: 1 thermal sensor; potential-free brush monitoring

Connector 1X7 for RH traction motor 1M1

1 Brush switch 6B4
2 Brush switch 6B4
3 Thermal sensor 6B1
4 Thermal sensor 6B1

Connector 1X8 for RH traction motor 1M2

1 Brush switch 6B5
2 Brush switch 6B5
3 Thermal sensor 6B2
4 Thermal sensor 6B2

Armature terminals A1 and A2
Field terminals D1 and D2

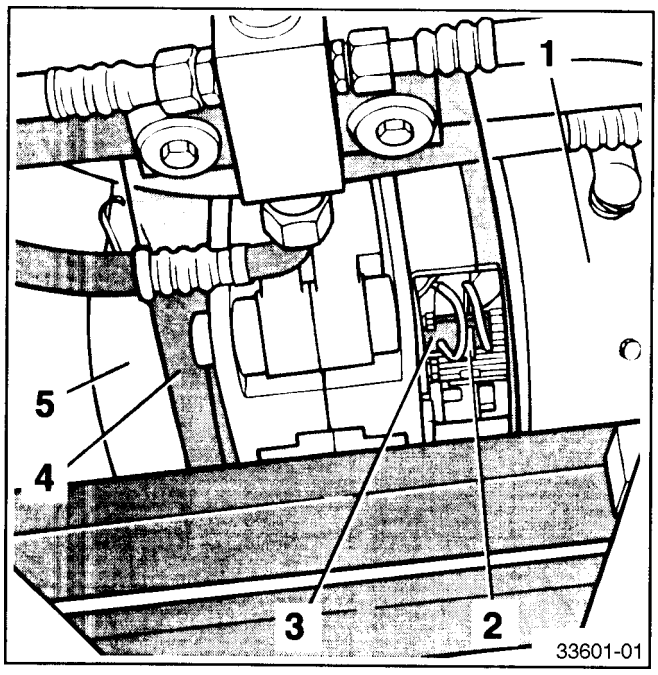
2.1.3 CHECKING AND RENEWING THE TRACTION MOTOR BRUSHES

The motor brushes can be checked for wear and free movement after opening the driver's overhead guard.

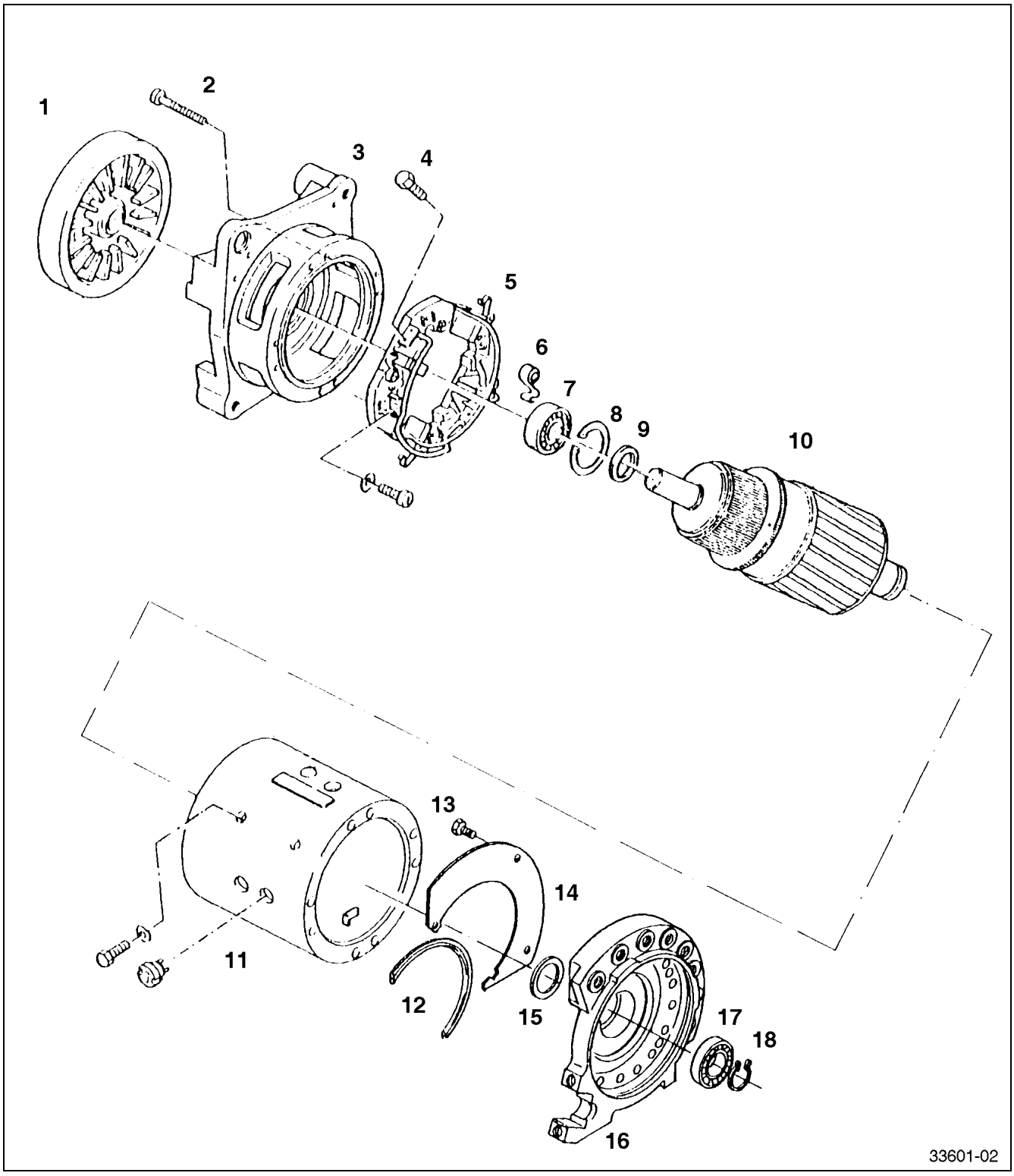
- Block up the truck at the axle.
- Raise the fork carriage and secure against inadvertent lowering.
- Chock the wheels
- Turn off the key switch.
- Disconnect the battery plug.
- Open the overhead guard as far as the second detent position.
- Lift up the rubber covers (4) over the traction motors.
- Remove the brush cover on the traction motors (1) and (5).
- Lift up the pressure springs (2).

NOTE: When lifting the springs from the motor brushes and putting them on the holder, be sure that they do not slide off and open, as compressing them when the motors are installed is extremely difficult

- Pull the motor brushes (3) out of the guide.
- Check the length of the motor brushes (minimum length 16 mm).
- Renew worn motor brushes only as a set.
- After renewing the brushes, check the brushes for free movement in the guides and the brush leads for security.



2.1.4 TRACTION MOTOR DISASSEMBLY



1 Brake disc
2 Hexagonal screw
3 Bearing plate
4 Hexagonal screw
5 Brush holder
6 Brush spring
7 Bearing
8 Retaining ring
9 Shim
10 Armature assembly
11 Housing
12 Gasket
13 Hexagonal screw
14 Cover
15 Sealing ring
16 Bearing plate
17 Grooved ball bearing
18 Retaining ring

- Remove the speed sensor when dismantling the left-hand traction motor.
- Remove the cover strap.
- Remove the four brushes.
- Screw two M10x50 press-off screws into the brake disc (1).
- Remove the brake disc with the press-off screws. Turn the screws alternately to prevent the brake disc from seizing (brake disc is pressed on with 30 kN).
- Remove the retaining ring (18).
- Mark the position of the bearing plate (16) to the motor housing (11).
- Remove the bearing plate (16).
- Press out the armature assembly (10).
- Do not lose the shim (9) and re-use it during re-assembly.
- Remove the 8 fastening screws (2) (torque 110 Nm, secured with Loctite 243).
- Mark the position of the inner bearing plate (3) to the motor housing (11).
- Disconnect the field leads at the brush holder (5).
- Remove the inner bearing plate (3).
- Remove the retaining ring (8).
- Drive out the bearing (7).

2.1.5 FAN

Fan method of operation to 6/95:

The traction motors and pump motor are forced-air ventilated by axial-flow fan 9M1. When the operating temperature of one of the three motors exceeds 80 °C, battery negative is applied to the fans via three thermal switches (1B4, 1B5 and 2B5) connected in parallel. The fans are supplied with 24 V direct current over voltage converter U1. The 80 °C thermal (make) switches are mounted on the motor brush holders.

Fan method of operation from 7/95:

In contrast to the above fan method of operation up to 6/95, thermal sensors 6B1, 6B2 and 6B3 are mounted on the brush holders of the traction motors and pump motor. When the temperature in one of the three motors exceeds 80 °C, +24 V is applied to axial-flow fan 9M1 and 9M2 via the combined instrument.

NOTE: The fan operates only when the key switch is turned on, i.e. the fan does not run when the key switch is turned off.

SPECIFICATIONS FOR FAN 9M1

Rated voltage:	24 V
Voltage range:	12 - 24 V
Power consumption:	710 mA
Power:	17 W
Temperature range:	-20 ... +72 ℃
Rated speed:	3400 rpm

2.1.6 SPEED SENSOR

A differential speed sensor (1B8) is installed on the left-hand motor. The speed sensor senses the brake disc bridges and supplies information regarding the motor speed and direction of rotation.

Adjustment:

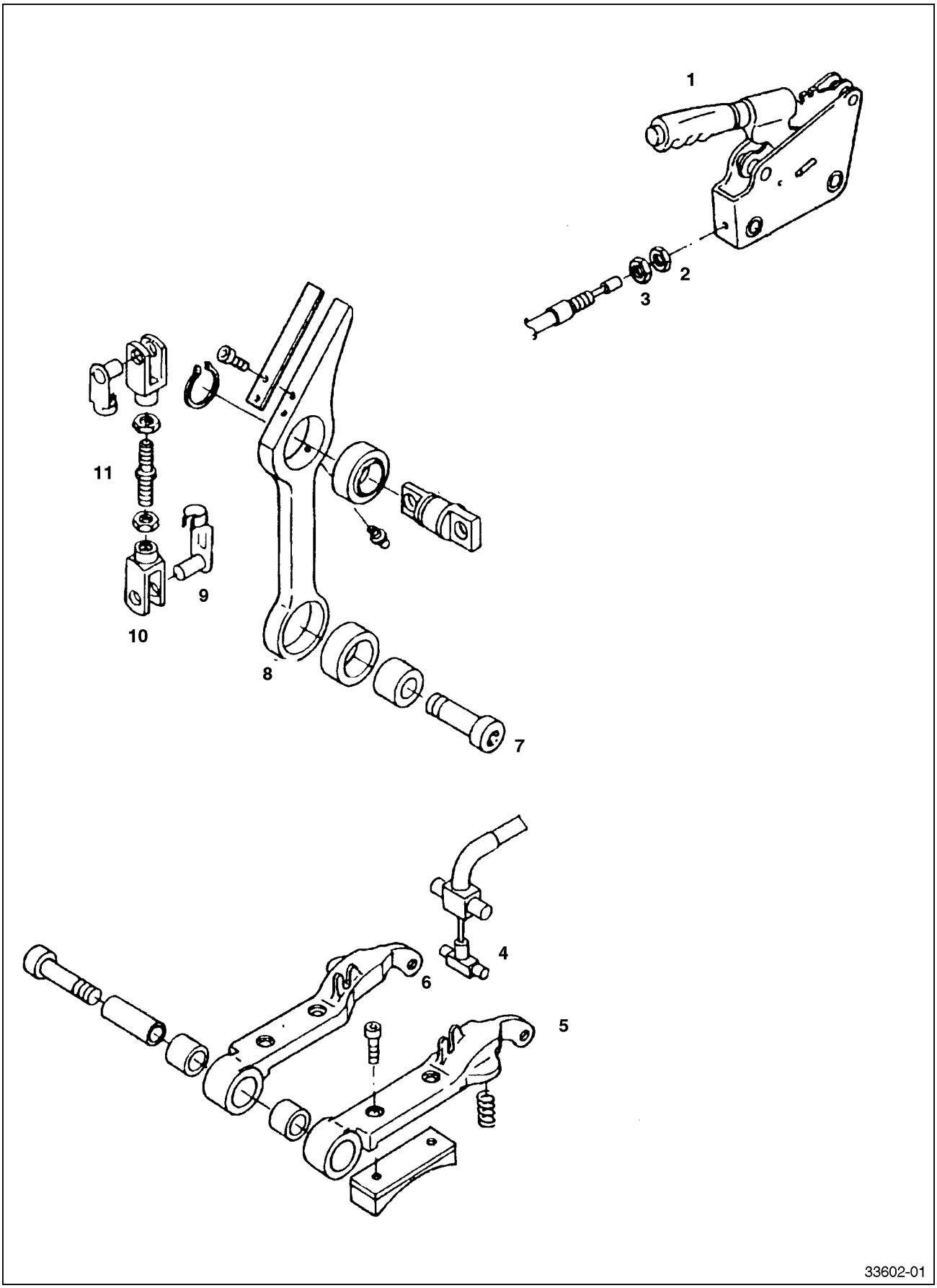
The speed sensor is mounted on an angle plate on the inside bearing plate. The air gap between the active sensor area and a web on the brake disc must be 1.0 ± 0.3 mm.

2.2 DRIVE - GEARBOX

The series 336 electric fork trucks are powered by two traction motors. The two traction wheels are driven by two planetary hub reduction gearboxes mounted on the traction motors. The motor and the reduction gearbox together form one drive unit that is bolted to the truck chassis. For repairs, the drive axle can be removed as a single unit.

2.2.1 DRIVE AXLE REMOVAL

- Remove the mast and the front wheel bolts.
- Jack up and secure the truck.
- Tilt the overhead guard back to the second detent.
- Unscrew the wheel bolts and remove the wheels.
- Loosen the locknut (3) on the parking brake lever (1) and the adjustment nut (2) on the parking brake cable (4).
- Unhook the parking brake cable (4) at the bottom of the brake shoes (5) and (6).
- Remove one pin retainer (9) on each of the two brake shoes (5) and (6).
- Unscrew the socket head screw (7) at the bearing plates and remove the lever (8) along with the connecting rod (11).
- Disconnect the cables at the traction motors.
- Disconnect cable connectors 1X7 and 1X8 at the traction motors.
- Disconnect the cable connector for the speed sensor on the left-hand traction motor.
- Disconnect the cable connector for the fan.
- Remove the air duct hose.
- Support the drive axle with a pallet truck and blocks of wood.
- Remove the eight fastening screws on each bearing plate.
- Lower the drive axle.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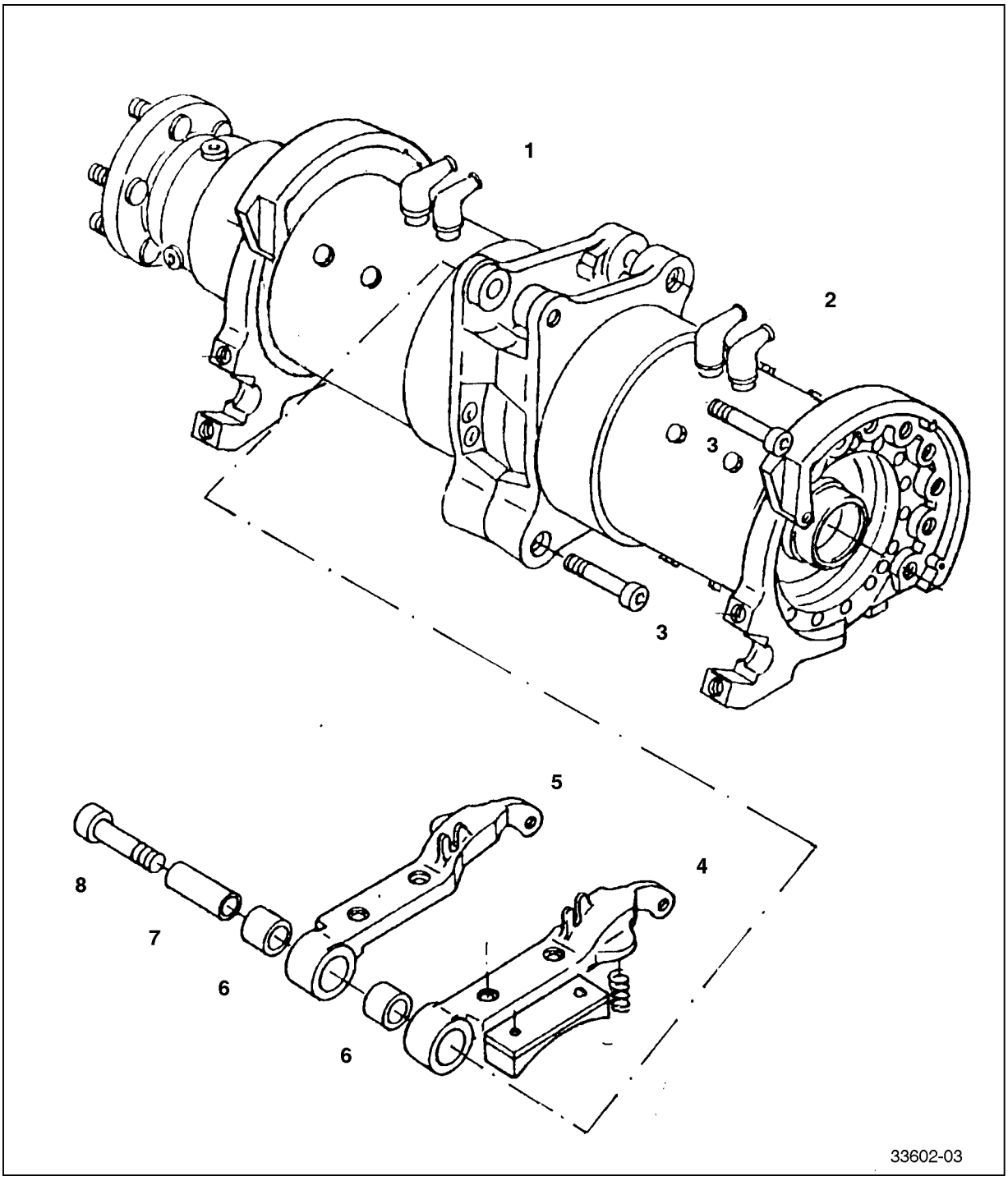
2.2.2 DRIVE AXLE DISASSEMBLY AND ASSEMBLY

Disassembly:

- Remove the motor brush cover on each traction motor.
- Remove the fan along with the air duct.
- Remove the two lower socket head screws (3).
- Remove socket head screws (8).
- Take out the brake shoes (4) and (5) with bushings (6) and (7).
- Separate the two drive halves (1) and (2).

Assembly:

- Join the two drive halves (1) and (2) and bring them into alignment.
- Insert the brake shoes (4) and (5) with bushings (6) and (7).
- Screw in socket head screws (8).
- Screw in the lower socket head screws (3).
- Torque socket head screws (3) and (8) to 540 Nm.
- Install the fan along with the air duct.
- Fasten the motor brush cover on each traction motor.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2.2.3 PLANETARY HUB REDUCTION GEARBOX (FROM 1/95 TO 5/95)

NOTE: For design reasons, the planetary hub reduction gearbox on trucks to series 12/94 can only be exchanged as an assembly.

2.2.3.1 REMOVING THE PLANETARY HUB REDUCTION GEARBOX FROM THE TRACTION MOTOR

- Jack up and secure the truck.
- Remove the wheel nuts and wheels.
- Place an oil pan underneath the gearbox.
- Remove the oil filler plug (1).
- Remove the oil drain plug (14) and copper sealing ring (15).
- Drain the transmission oil.
- Remove the 14 socket head screws (13).
- Remove the planetary hub reduction gearbox from the bearing plate, taking care not to lose the O-ring (17).
- Clean the sealing areas.

2.2.3.2 DISASSEMBLY OF THE PLANETARY HUB REDUCTION GEARBOX

- Remove the hexagonal head screw (6).

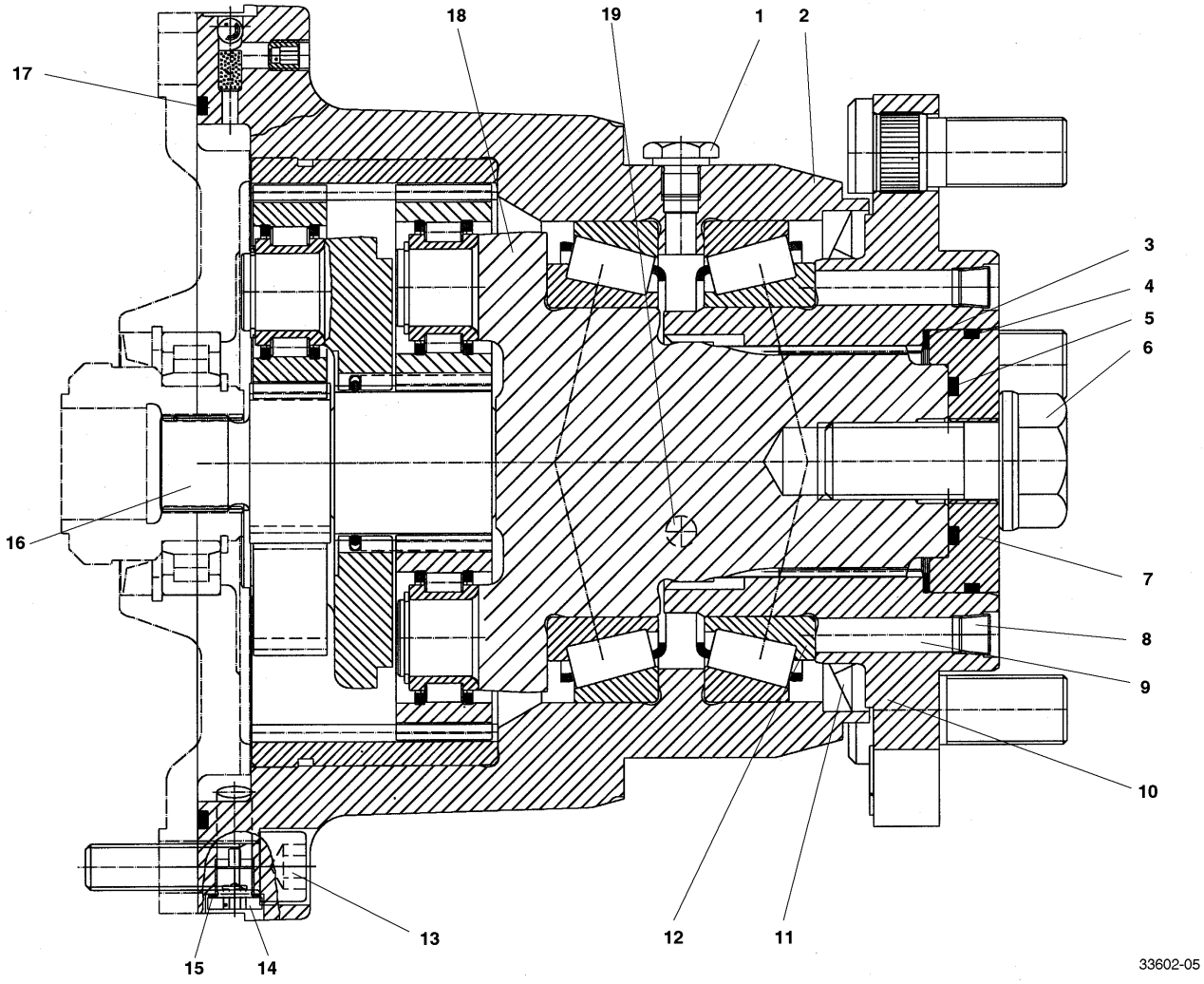
NOTE: The hexagon head screw (6) is self-locking and can therefore only be used once.

- Remove the two plugs (8).
- Use a puller to extract the flange (10).
- Put the flange (10) aside and secure it against sliding.
- Insert a drift alternately into the two access holes (9) and knock the bearing inner race (12) off the flange.
- Remove and renew the shaft sealing ring (11).
- The O-ring (4) is accessible after pressing out the washer (7) from the flange (10).
- Check and renew, if necessary, O-rings (5) and (4).

NOTE: There are shims (3) mounted between the flange (10) and washer (7). During assembly all shims must be installed again with the 0.5 mm shim on the profile side of the flange (10).

2.2.3.3 ASSEMBLY OF THE PLANETARY HUB REDUCTION GEARBOX

- Put the gearbox housing vertical and secure it against sliding.
- Install the bearing inner race (12), making sure that it is seated evenly.
- Half fill the sealing shaft ring (11) with grease and drive it into the housing (2).
- Install the shims (3) in the flange (10).
- Position the O-ring (5) on the washer (7) and secure it with grease.
- Press the washer (7) and O-ring (4) into the flange (10).
- Position the flange (10) and washer (7) on the planetary hub reduction gearbox (18), taking care not to damage the teeth.
- Install the hexagon head screw (6) through the washer (7) and carefully tighten it to seat the flange (10) and washer (7) correctly (torque to 810 Nm).
- Install the 2 plugs (8) in the flange (10) (torque to 20 Nm).



1	Plug	7	Washer	13	Socket head screw
2	Housing	8	Plug	14	Oil drain plug
3	Shim	9	Hole	15	Sealing ring
4	O-ring	10	Flange	16	Sun gear
5	O-ring	11	Shaft sealing ring	17	O-ring
6	Hexagon head screw	12	Bearing inner race	18	Planetary carrier
				19	Plug

2.2.3.4 INSTALLING THE PLANETARY HUB REDUCTION GEARBOX ON THE TRACTION MOTOR

- Install the O-ring (17) in the housing.
- Position the planetary hub reduction gearbox on the bearing plate with the plug (14) showing down, being sure that the holes are in alignment.
- When installing the gearbox, take care that the sun gear (16) meshes with the internal toothing of the motor shaft without damage.
- Install the 14 socket head screws (13) and torque them to 86 Nm.
- Install the oil drain plug (14) and copper sealing ring (15) and torque to 18 Nm.
- Fill 250 ml of gear oil SAE 85W/90 into the filler plug bore.
- Install the plug (1) and tighten to 18 Nm.

2.2.4 PLANETARY HUB REDUCTION GEARBOX (FROM SERIES 6/95)

2.2.4.1 REMOVING THE PLANETARY HUB REDUCTION GEARBOX FROM THE TRACTION MOTOR

- Jack up and secure the truck.
- Remove the wheel nuts and wheels.
- Place an oil pan underneath the gearbox.
- Remove the oil filler plug (6) and copper sealing ring (7).
- Remove the oil drain plug (15) and copper sealing ring (16).
- Drain the transmission oil.
- Remove plug (8)
- Remove the 14 socket head screws (14).
- Remove the planetary hub reduction gearbox from the bearing plate, taking care not to lose the O-ring (18).
- Clean the sealing areas.

2.2.4.2 DISASSEMBLY OF THE PLANETARY HUB REDUCTION GEARBOX

- Remove the four hexagonal head screws (4).
- Use a puller to extract the flange (1),
- Paying attention to the O-rings (3), (5) and (10).
- O-ring (2) is accessible after pressing the washer (11) out of the flange (1).
- If necessary, remove and renew the shaft sealing ring (13).

2.2.4.3 ASSEMBLY OF THE PLANETARY HUB REDUCTION GEARBOX

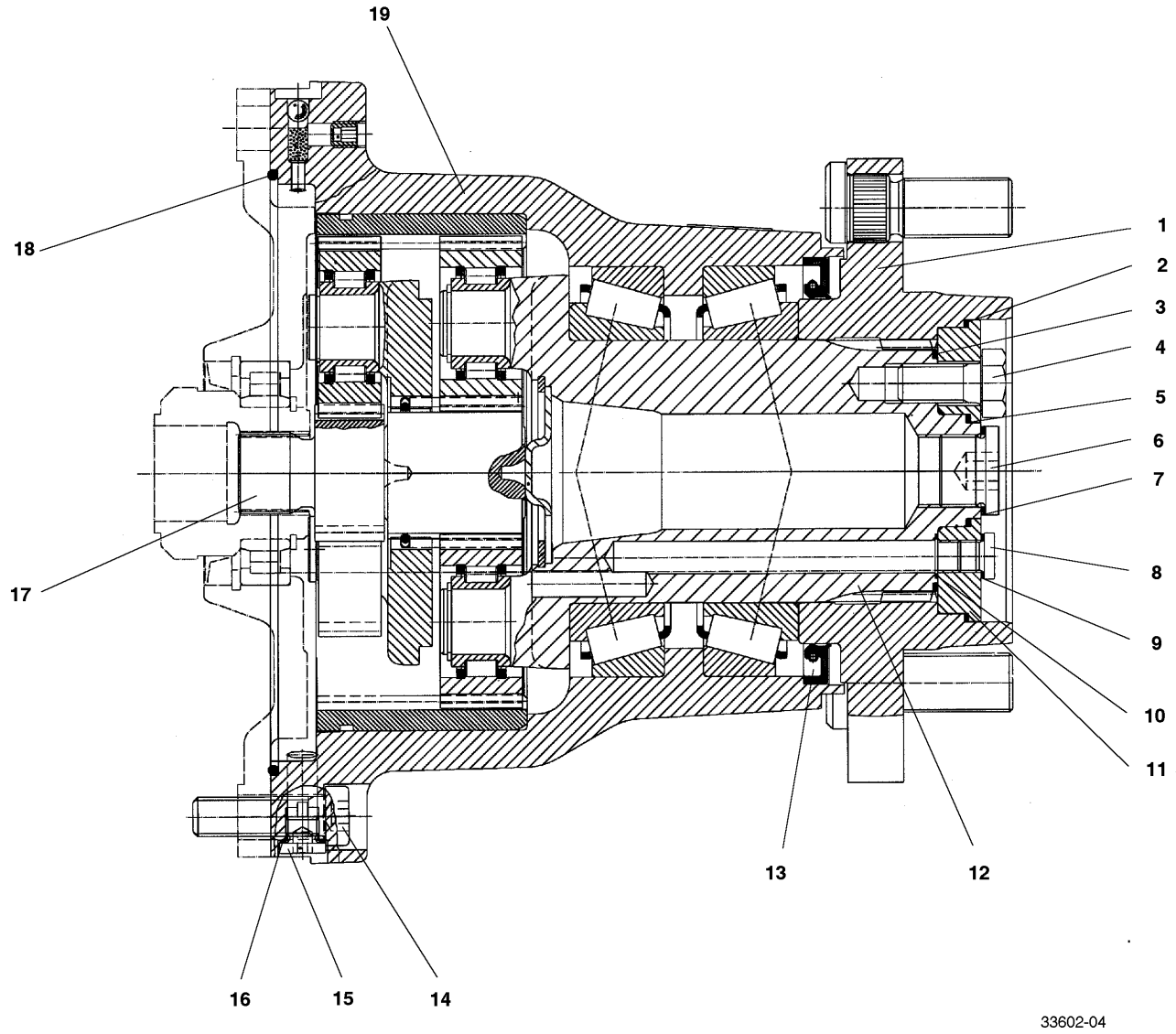
- Half fill the sealing shaft ring (13) with grease and drive it into the housing (19).
- Position the O-rings (3), (5) and (10) on the planetary carrier (12) and secure it with grease.
- Carefully slide the flange (1) onto the planetary carrier (12), taking care not to damage the toothing.
- Hit the washer (11) and O-ring (2) into the flange, making sure that the holes are in alignment.
- Install the four hexagon head screws (4) and torque to 110 Nm.

2.2.4.4 MOUNTING THE PLANETARY HUB REDUCTION GEARBOX ON THE TRACTION MOTOR

- Install the O-ring (18) into the housing.
- Position the planetary hub reduction gearbox on the bearing plate with the oil drain plug opening showing down, being sure that the holes are in alignment.
- When installing the gearbox, take care that the sun gear (17) meshes with the internal toothing of the motor shaft without damaging it.
- Install the 14 socket head screws (13) and torque to 86 Nm.
- Install the oil drain plug (15) and copper sealing ring (16) and torque to 18 Nm.
- Fill 250 ml of gear oil SAE 85W/90 into the filler plug bore.

NOTE: The oil level must reach the lower edge of the threaded bore for plug (8).

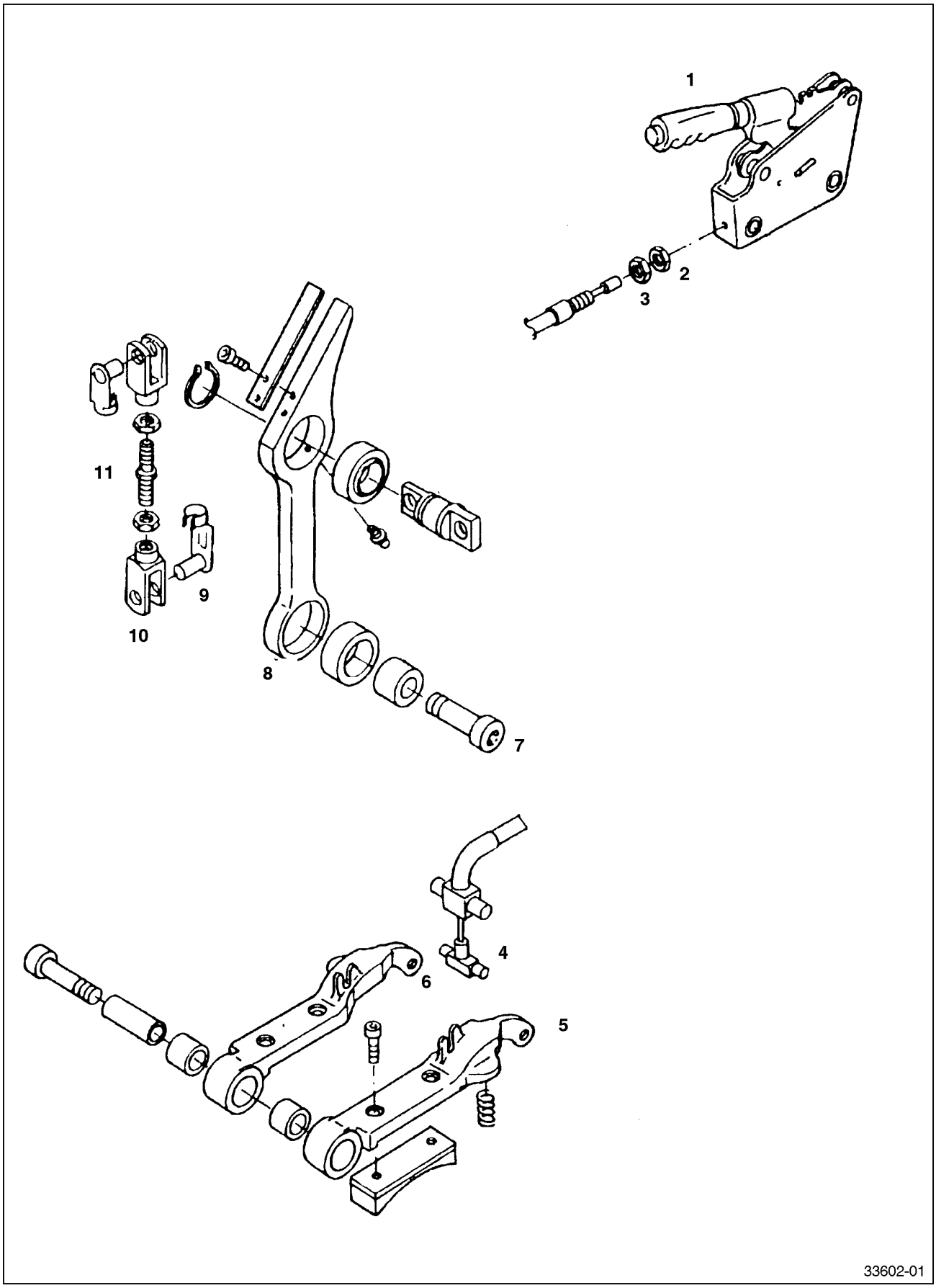
- Install the plug (8) and sealing ring (9), and torque to 18 Nm.
- Install the oil filler plug (6) and copper sealing ring (7), and torque to 102 Nm.



1	Flange	11	Washer
2	O-ring	12	Planetary carrier
3	O-ring	13	Shaft sealing ring
4	Hexagon head screw	14	Socket head screw
5	O-ring	15	Oil drain plug
6	Plug	16	Sealing ring
7	Sealing ring	17	Sun gear
8	Plug	18	O-ring
9	Sealing ring	19	Housing
10	O-ring		

2.2.5 DRIVE AXLE INSTALLATION

- Move the pre-assembled drive axle with a pallet truck into the truck.
- Raise the axle until the bearing plate socket head screws can be inserted.
- Tighten 8 socket head screws each on the bearing plates and torque them to 600 Nm.
- Mount the lever (8) and the connecting rod (11) and fasten them to the bearing plates with screw (7).
- Check the brake levers for ease of movement.
- Insert the bolt with cotter (9) on the two brake shoes (5) and (6).
- Hook the parking brake cable (4) to the brake shoes (5) and (6).
- Adjust the parking brake cable (4) with the nut (2) and tighten the locknut (3).
- Mount the hose on the air duct.
- Connect the cable connector to the fan.
- Connect the cable connector to the speed sensor at the left-hand traction motor.
- Connect the traction motor cables.
- Check the oil level in the wheel drive gearbox, adding SAE 85W / 90 transmission oil, if needed.
- Mount the wheels and torque the wheel bolts to 460 Nm.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Service Training

2.3 CHASSIS

The series 336 fork trucks are available for various load capacities.

Type	Standard Version	Higher Seat Version	Load Capacity
E 20	400 Ah	480 Ah	2.0 t
E 25	500 Ah	600 Ah	2.5 t
E 30	500 Ah	600 Ah	3.0 t

The standard versions of the trucks can be used with containers. With the option “higher driver’s seat”, batteries with a higher capacity rating can be used.

2.3.1 SEAT SWITCH

Method of operation to series 6/95:

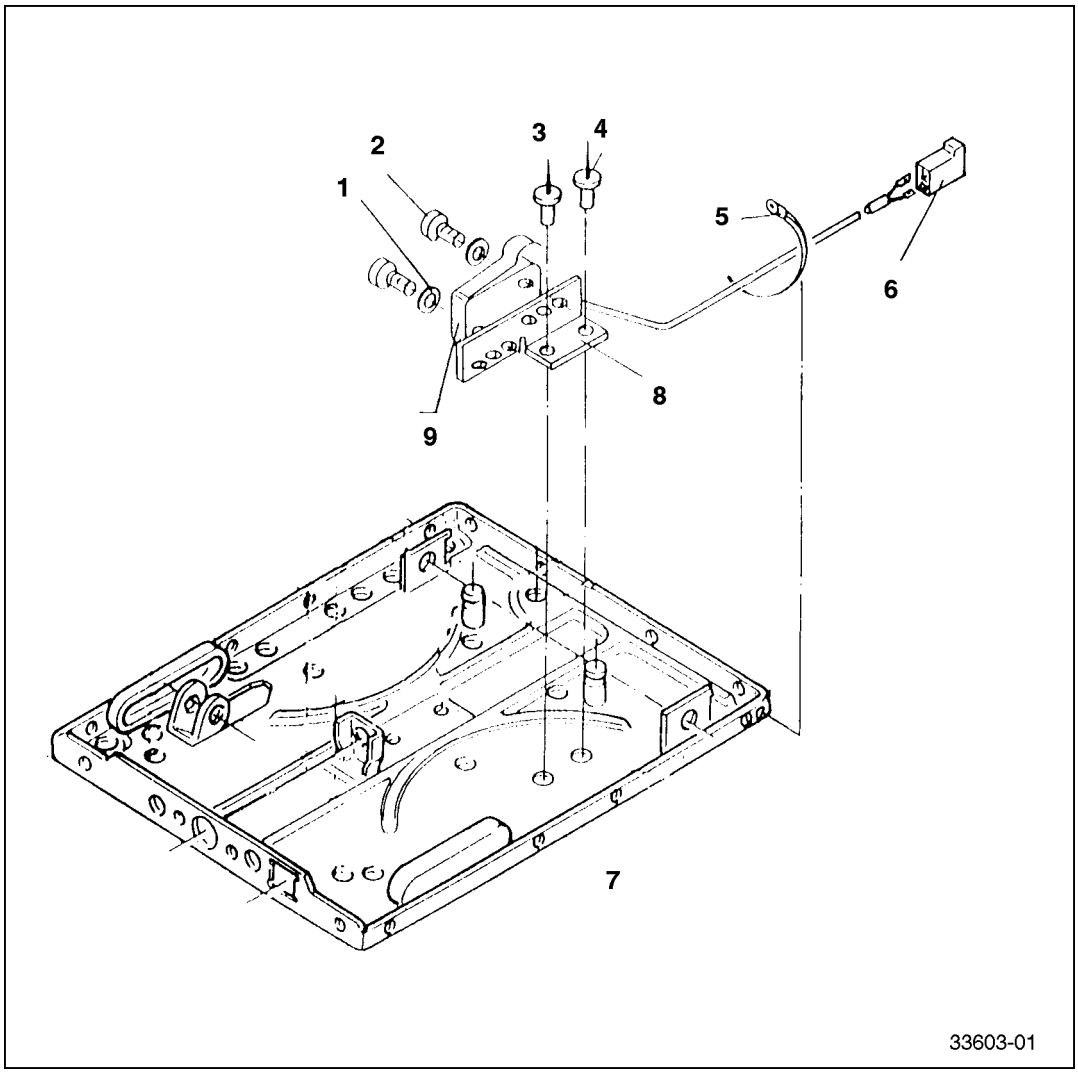
A seat switch is installed in the driver’s seat, which activates timer 1A3 when actuated. In order to prevent a faulty operation of the switch on uneven roadways, the timer cuts off the enable signal for the traction and lift control after a delay of approx. 2 seconds when the seat switch is no longer actuated.
Timer 1A3 is mounted opposite the voltage converter on the contactor board. The timer is connected to the main cable harness via a 8-pin connector.

Method of operation from series 7/95:

The timer 1A3 has been omitted on trucks built since 7/95. The travel control time delay is integrated into the electronic travel unit 1A2. Starting with this series, the working hydraulics can be operated without the seat switch having to be activated.

2.3.1.1 RENEWING THE SEAT SWITCH

- Pull out the lower fastener on the driver's seat gaiter.
- Push the gaiter up.
- Remove the socket head screw (2) and washer (1).
- Renew the microscwitch (9) after disconnecting the cable tie (5).



1 Washer
2 Socket head screw
3 Holding plug
4 Holding plug
5 Cable tie
6 Cable connector
7 Base plate
8 Bracket
9 Microswitch

2.3.2 CABIN

The cabin can be tilted back completely. The first detent position is at an opening angle of 35°. This position is used for charging the battery. For changing the battery, the cabin can be held at an opening angle of 100 degrees.

The cabin is available in various versions.

Model	Version
1	Overhead guard only
2	Overhead guard + roof pane
3	Overhead guard + roof pane + front windscreen with wiper and washer
4	Overhead guard + roof pane + front windscreen with wiper and washer + rear windscreen with wiper and washer
5	Overhead guard + roof pane + front windscreen with wiper and washer + rear windscreen with wiper and washer + doors

2.3.2.1 TORSION BAR SPRINGS

A torsion bar spring pack is located in the articulated area of the cabin. This spring pack twists when the cabin is closed. The mass energy of the cabin is thus stored in the springs, allowing easy opening of the cabin. A gas-filled shock-absorber prevents the cabin from closing too fast.

Depending on the cab version, the correct number of springs and washers and the right type of fishplates must be chosen.

The correct combination can be determined with the following table.

Model	Spring (6 mm)	Spring (4 mm)	Washers	Fishplates
1	4 items	------	4 items	30 mm
2	4 items	------	4 items	30 mm
3	5 items	------	------	30 mm
4	5 items	------	------	30 mm
5	6 items	2 items	------	20 mm

2.3.2.1.1 REMOVING AND INSTALLING THE TORSION BAR SPRINGS

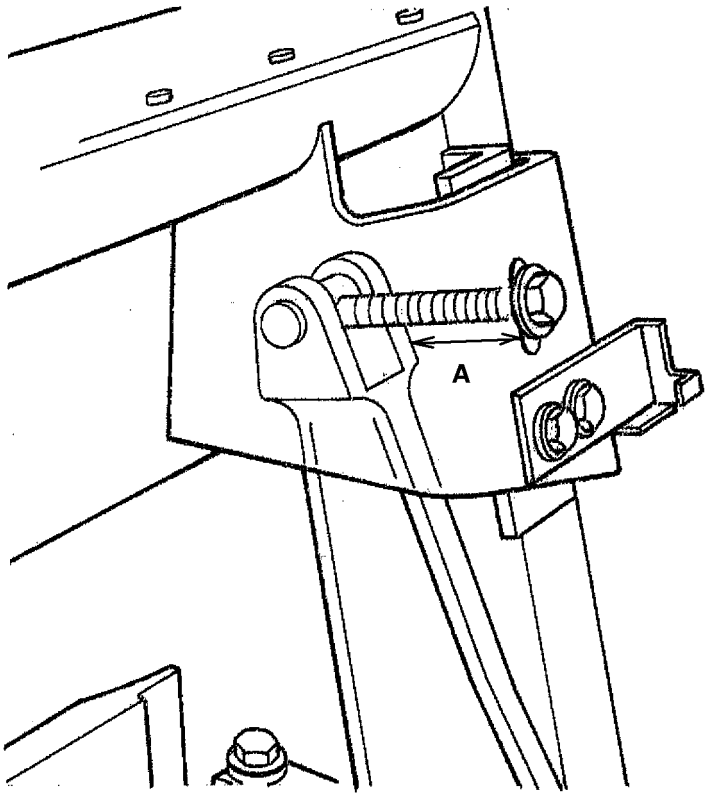
The number of torsion bar springs installed in the truck depends on the version of the cabin. When the cabin is retrofitted to a different cabin version, the number of torsion bar springs must be changed, otherwise the cabin will be too difficult to open or close too easily.

- Remove the electrical system cover.
- Dismantle the contactor support assembly and pull it aside until the spring pack is accessible.
- Open the cabin until the weight is full removed from the torsion bar springs (all springs are flat).
- Fix the overhead guard in this position with the aid of a crane and a sling.
- Remove the clamping plates on the right and left of the spring pack.
- Install the correct number of torsion bar springs.
- Install the correct fishplates and correct number of washers.
- Fasten fishplates at the left and right of the spring pack.
- Release the cabin from the crane.
- A fine adjustment of the spring pack can be done with the adjusting screw on the tensioning lever on the right-hand side of the cabin. Measure distance A for the adjustment.

NOTE: Distance A is measured vertically from the rear edge of the lever to the inner edge of the roof bracket.

Lever adjustment:

Cab Model	Distance A
1	40 mm
2	40 mm
3	35 mm
4	35 mm
5	25 mm



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NOTE: The cabin should be able to be opened and closed without too much effort.

2.4 STEERING SYSTEM

2.4.1 STEERING AXLE

The Linde combined steering axle has all the advantages of the close-coupled wheel axle and the swing axle:

- large swing for good driving comfort
- small turning radius, narrow aisle width
- good curve stability
- minimal tipping
- steering cylinder mounted in the counterweight for all-round protection.

2.4.1.1 STEERING AXLE REMOVAL

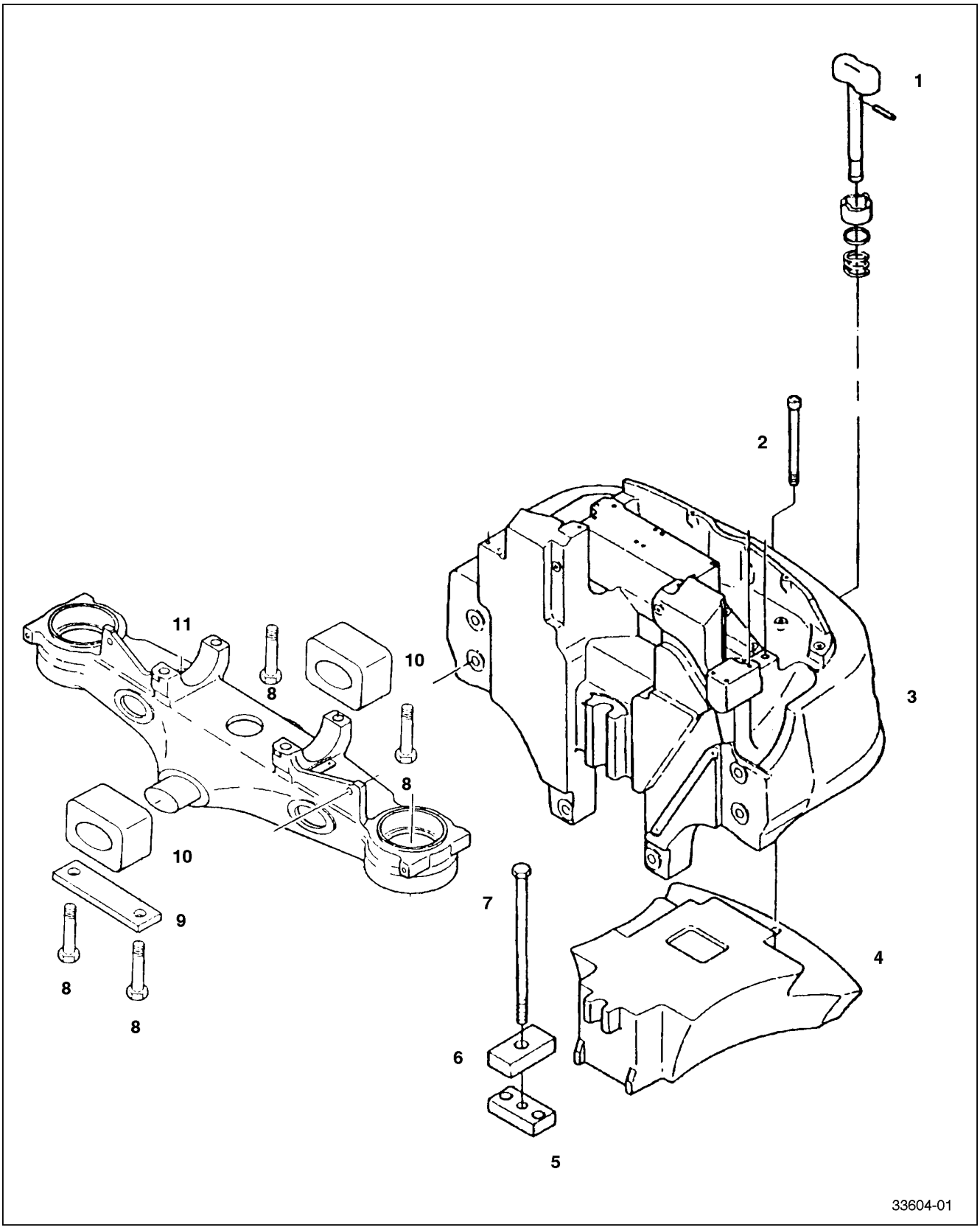
- A second person and a fork truck are required for the removal of the additional weight and the steering axle.
- Remove the battery.
- Remove the wheel bolts.
- Jack up the rear of the truck at least 350 mm.
- Secure the front wheels against rolling with chocks.
- Remove the rear wheels.
- Open the overhead guard to the second detent.
- Disconnect cable connectors X6 and X7 to the proximity switches.
- Place an oil pan underneath the truck.
- Disconnect the two hydraulic hoses to the steering cylinder at the pipes.

NOTE: Trucks without the optional “higher driver’s seat” have an additional weight on the counterweight. This weight must be removed before the removal of the steering axle, otherwise the truck must be raised too high due to the large height of the steering axle.

- Place a support under the additional weight (4).
- Loosen the fastening bolt (7) on the additional weight in the battery compartment.
- Take out the trailer coupling pin (1).
- Remove the second additional weight fastening bolt (2) from the additional weight (4) through the hole for the trailer coupling pin.

NOTE: On trucks from series 10/94, the mounting bolt (2) can be accessed from below at the ballast weight (4).

- Slowly lower the additional weight.
- Support the steering axle (11).
- Remove the steering axle fastening bolts (8).
- Remove the support piece by piece to slowly lower the steering axle.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2.4.1.2 STEERING CYLINDER AND TRACK ROD LINK

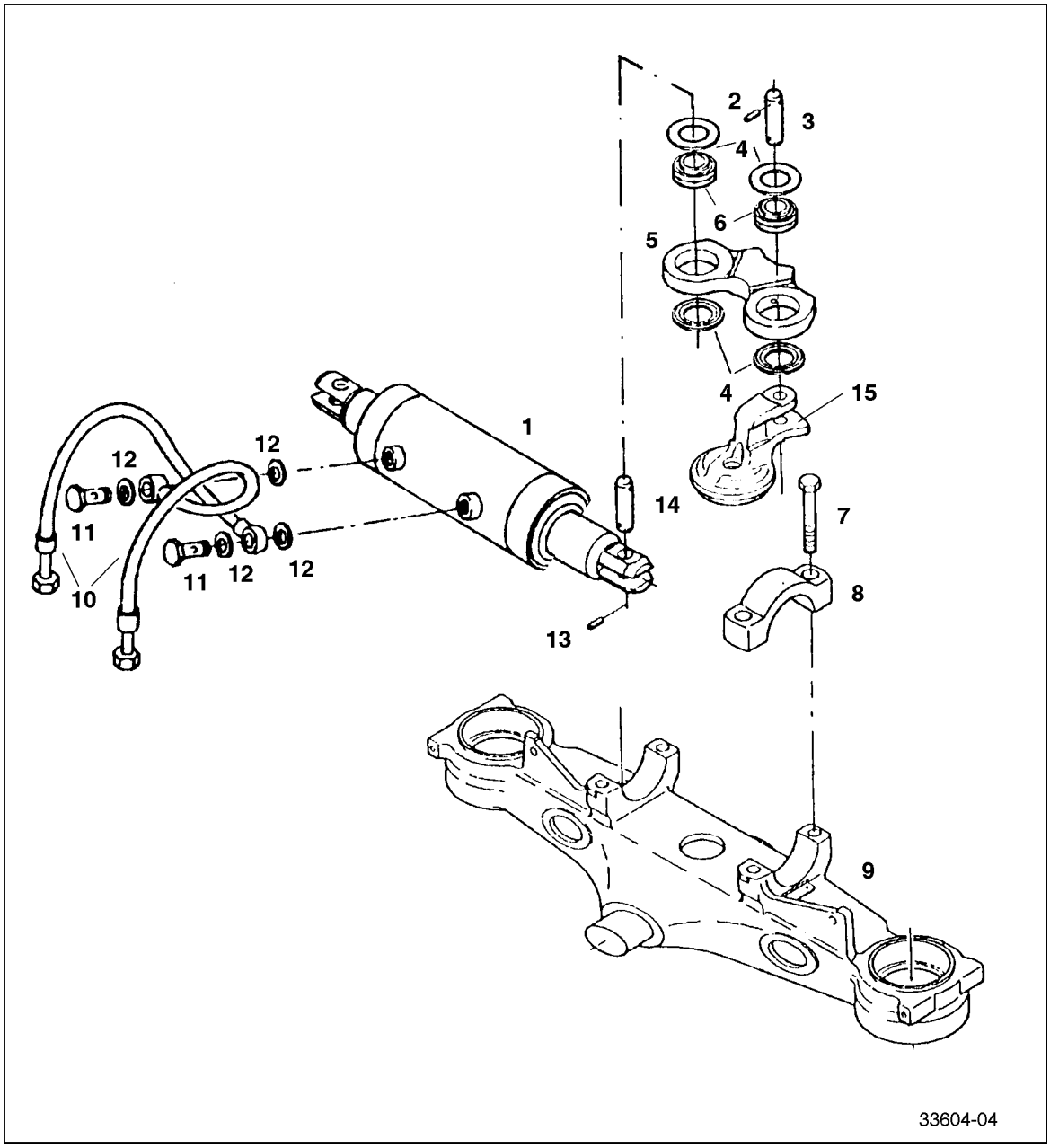
- Dismantle the steering axle.
- Remove the banjo bolts (11) along with the O-rings (12).
- Disconnect the two hydraulic hoses (10) at the steering cylinder (1).
- Drive out the roll pin (2) at the top and press the pin (3) out of the steering knuckle arm (15) to the track rod link.
- Put the steering in the straight-ahead position.

NOTE: When pressing out the pin (3), support the underside of the steering knuckle arm (15) to prevent it from being damaged.

- Remove the track rod link (5) along with the bearings (6) and sealing rings (4) from the steering knuckle arm (15).
- Unscrew the sensor nut and remove the sensor.
- Mark the position of the two bearing brackets (8) in relation to the axle body (9).

NOTE: The two bearing brackets must not be interchanged during re-assembly.

- Unscrew the fastening screws (7) for the bearing brackets (8) and remove the bearing brackets.
- Remove the steering cylinder (1) and track rod links.
- Drive the roll pin (13) out the pin (14) on the steering cylinder at the track rod end and press the pin out.
- Remove the track rod link.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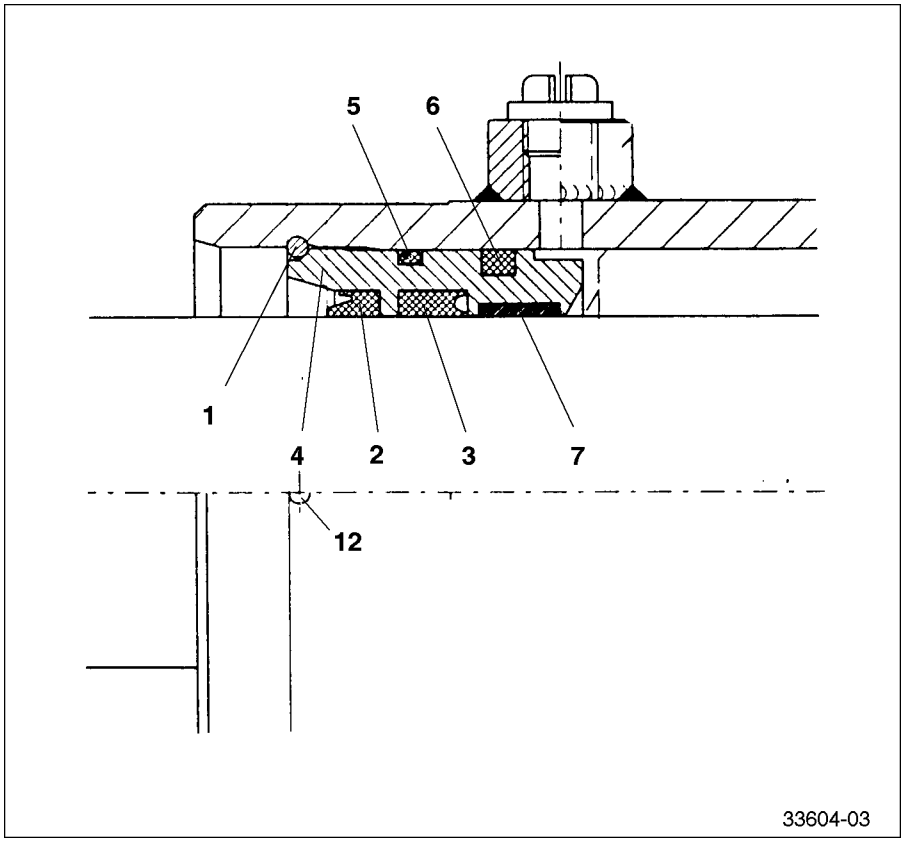
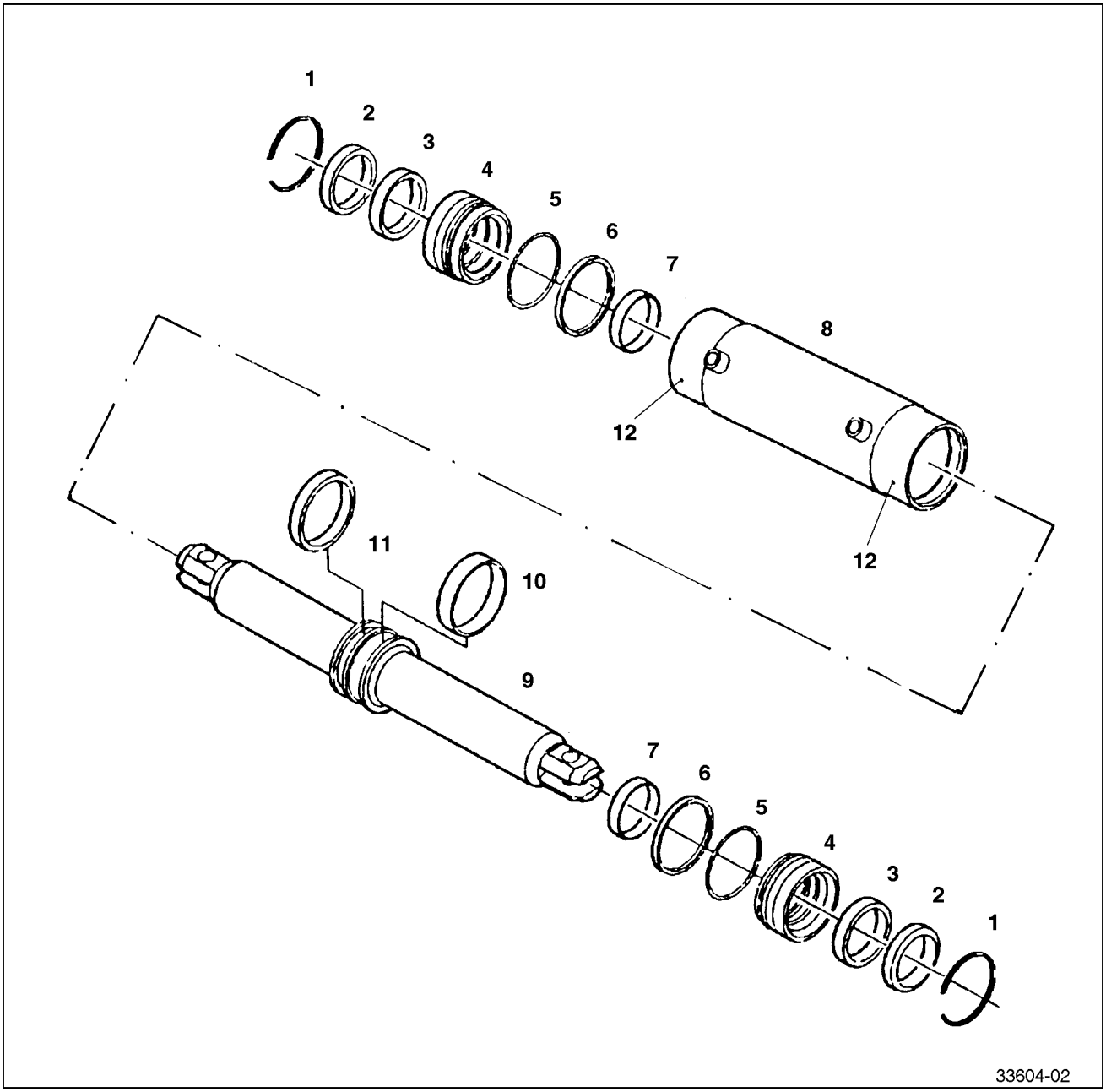
2.4.1.3 RENEWING THE STEERING CYLINDER SEALS

- Remove the steering axle and steering cylinder.
- Clamp the steering cylinder in a vice.
- Pull the piston rod out as far as possible to one side.
- Press guide bushing approx. 2 to 3 mm into the cylinder housing sung a sleeve.
- Loosen the retaining ring (1) with a drift punch through hole (12) at the cylinder barrel and remove it with a screwdriver.
- Slide the piston rod in the direction of the removed retaining ring and drive out the guide bushing (4) with light taps (soft hammer) on the end of the opposite piston rod and guide the opposite piston rod end with the hand..
- Pull the piston rod out of the cylinder and remove the guide bushing (4) from the piston rod, taking care not to damage the guide bushing.
- Remove the O-rings (5) and (6), U-cup packing (3), wiper (2) and guide band (7) from the guide bushing
- Install new O-rings, U-cup packing, wiper and guide band, taking care to position the single sealing parts correctly (see detail 33604-03).
- Remove the sealing ring (11) and guide band (10) from the piston rod and renew them.
- Remove the second retaining ring (1).
- Remove the guide bushing (4) and renew the sealing elements.
- Slightly grease the guide bushing (4) and install it in the cylinder, paying attention to its correct position (chamfer on the out, side circumference shows out).
- Install the retaining ring (1).
- Carefully insert the piston rod (9) into the cylinder from the opposite end and slide it in as far as possible through the guide bushing (4), taking care not to damage the sealing lips of the sealing elements.
- Insert the second greased guide bushing (4), slide it in as far as the stop and fasten it with the retaining ring (1).

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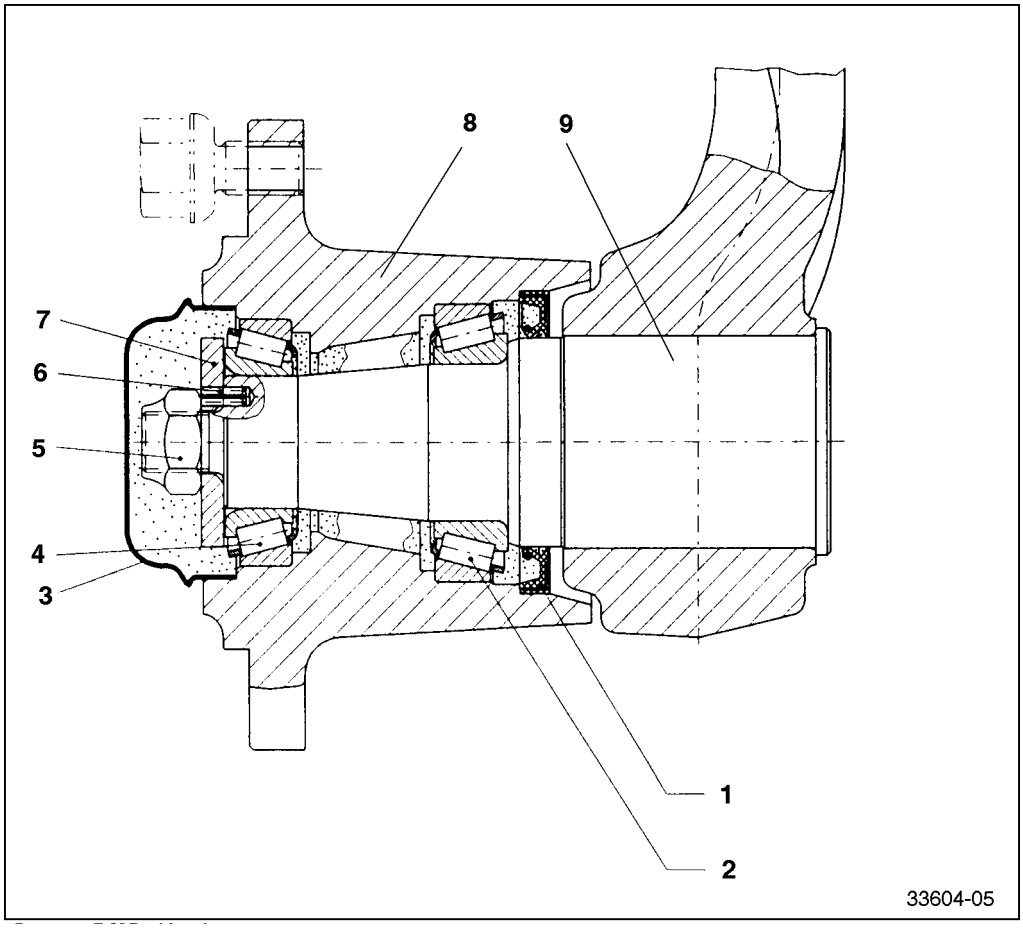
2.4.1.4 RENEWING THE WHEEL HUB TAPERED ROLLER BEARINGS AND SHAFT SEALING RING

- Jack up the truck and secure it.
- Remove the wheel.
- Remove the wheel hub (3).
- Loosen and remove the retaining nut (5).
- Remove the washer (7) and the roll pin (6).
- Drive out the wheel hub (8) from the inside out using a soft hammer. Do not let the inner race of the tapered roller bearing (4) fall out.
- Take the shaft sealing ring (1) out of the hub (8).
- Take the inner race of the tapered roller bearing (2) out of the wheel hub.
- Take the outer races of the tapered roller bearings (2) and (4) out of the wheel hub (8).
- Install the outer races of the new tapered roller bearings (2) and (4) in the wheel hub (8).

NOTE: Be sure that the bearings are properly positioned.

- Fill the space around the tapered roller bearing (2) with Linde heavy duty grease.
- Grease the inner races of the tapered roller bearing (2) well and install carefully on the outer race.
- Fill the inside of the new shaft sealing ring (1) with Linde heavy duty grease and install it in the wheel hub in the correct position (sealing lip showing inside).
- Slide the wheel hub onto the wheel shaft, taking care not to damage the shaft sealing ring (1) and that the inner race of the tapered roller bearing (2) does not stick.
- Fill the space around the tapered roller bearing (4) with Linde heavy duty grease.
- Grease the inner races of the tapered roller bearing (4) well and install carefully on the wheel shaft.
- Slide the washer (7) onto the wheel shaft and drive in the cotter pin (6).
- Install a new retaining nut (5) and tighten it with a torque of 210 Nm.
- Fill the wheel cap (3) fully with Linde heavy duty grease, position the cap and drive it in place with a soft hammer.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2.4.1.5 RENEWING THE AXLE BODY TAPERED ROLLER BEARINGS AND WIPERS

- Remove the steering axle.
- Remove the steering cylinder.
- Remove wheel hub (on E 25 / 30 only).
- Turn the steering axle so that the steering knuckles show, and secure it against turning.
- Slacken the retaining screw (7) for the steering knuckle arm (1) and unscrew it about 2 mm.
- Loosen the steering knuckle arm by tapping on the retaining screw (7).
- Unscrew the retaining screw a few millimetres several times and remove the steering knuckle arm from the axle body by tapping on the retaining screw.
- Remove the retaining screw (7) and the steering knuckle arm (1).

NOTE: The steering axle of the E 20 truck has two retaining screws for securing the steering knuckle arm. Loosen both retaining screws equally to prevent the steering knuckle arm from seizing.

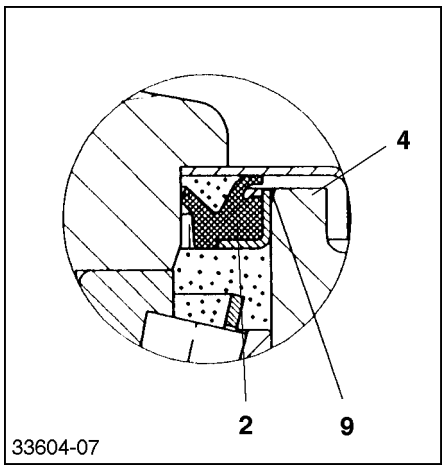
- Pull out the axle body (8) upwards.
- Remove wiper (2), taking care that the inner race of the tapered roller bearing (3) does not fall out.
- Remove wiper (6) and the inner race of the tapered roller bearing (5).
- Extract both outer races of the tapered roller bearing (3) and (5).

NOTE: When installing the tapered roller bearings, make sure that the outer and inner races of the two bearings are not interchanged.

- Drive new outer races into the axle centre.
- Fill the space around the bearing completely with lithium-based grease.
- Grease the inner race of the tapered roller bearing (5) well and install it.
- Fill wiper (6) well with grease and drive it into the centre axle body with the aid of special tool part no. 000 941 9721.
- Carefully install the axle body (8) in the centre axle body (4).
- Grease the inner race of the tapered roller bearing (3) well and install it.
- Fill wiper (2) well with grease and drive it into the centre axle body (4) with the aid of special tool part no. 000 941 9721.

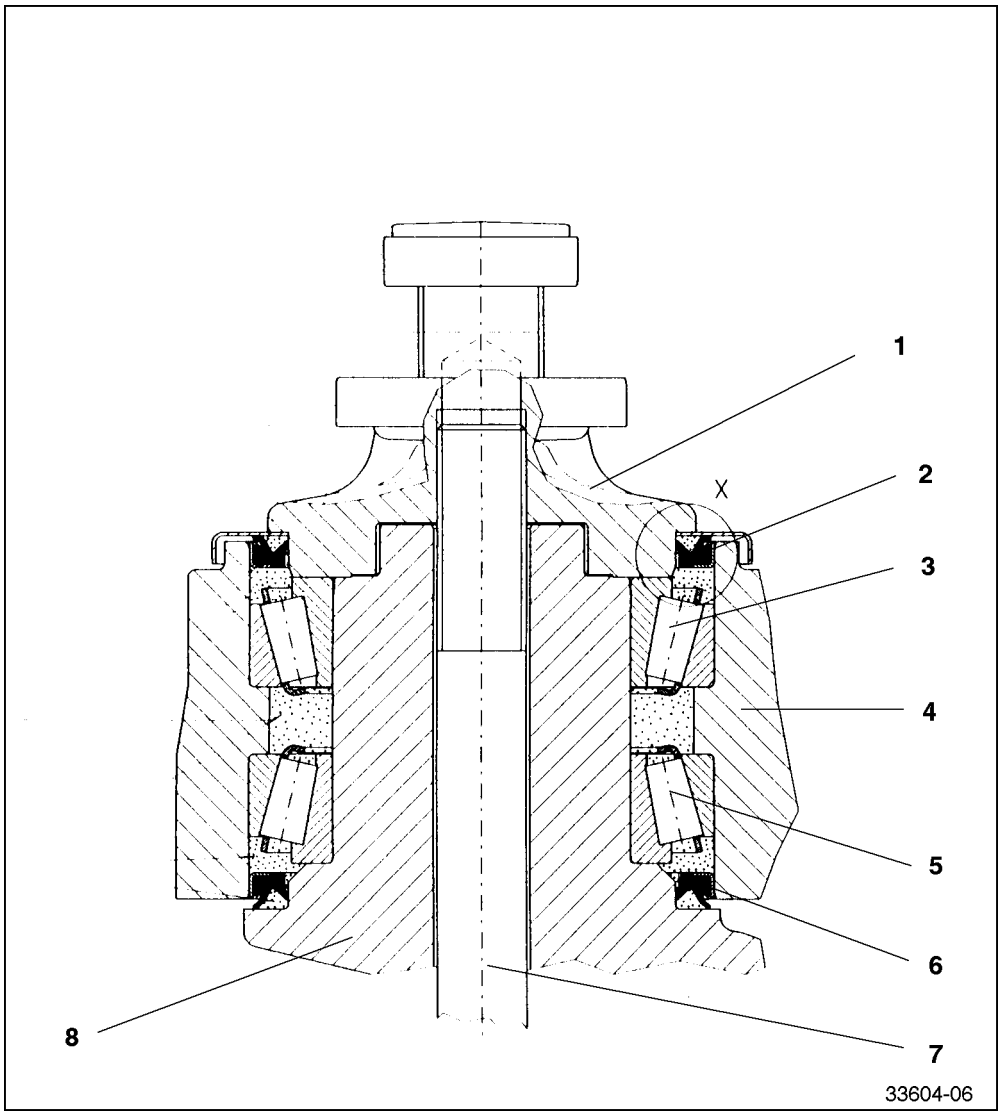
NOTE: The top edge on the steel ring of wiper (2) must be flush with the face (9) of the centre axle (4).

Detail X:



- Install the steering knuckle arm (1) and insert the retaining screw (7).
- At first torque the retaining screw (7) only to 120 - 150 Nm so that the rollers in the tapered roller bearings can come into alignment.
- Move the axle body through the full swivel range several times so that the rollers in the tapered roller bearings can become aligned.
- Tighten the retaining screw (7) to the full torque of 1100 Nm.

NOTE: The steering axle of the E 20 truck has two retaining screws, each of which must be torqued to 295 Nm.

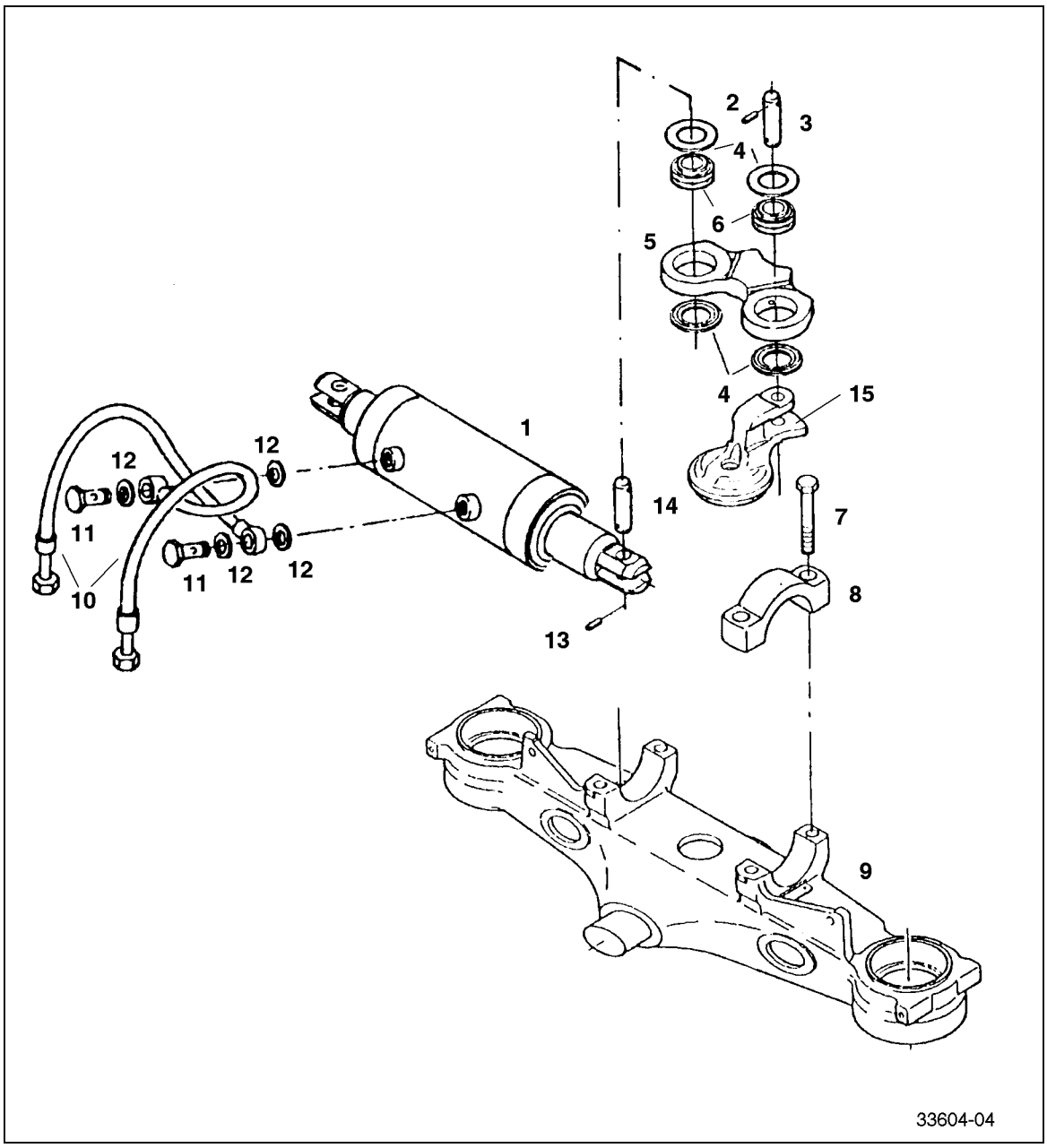


2.4.1.6 INSTALLING THE STEERING CYLINDER AND TRACK ROD LINK

- Insert the track rod links (5) into the steering cylinder (1).
- Coat the pin (14) with MoS_2 grease and press it in (pressing force 5 - 50 kN).
- Secure the pin (14) with a roll pin (13).
- Place the steering cylinder along with the track rod links on the centre axle (9).
- Install the marked bearing brackets (8) correctly and fasten them with screws (7) (torque to 425 Nm).
- Coat the pin (3) with MoS_2 grease and press it into the track rod link (5) and steering knuckle arm with the roller pin pointing up (pressing force 4 - 38 kN).

NOTE: When pressing in pin (3), support the steering knuckle arm from below to prevent any damage to it.

- Secure pin (3) with a roll pin (2).
- Install the hydraulic hoses (10) along with the banjo screws (11) and O-rings (12) on the steering cylinder (1).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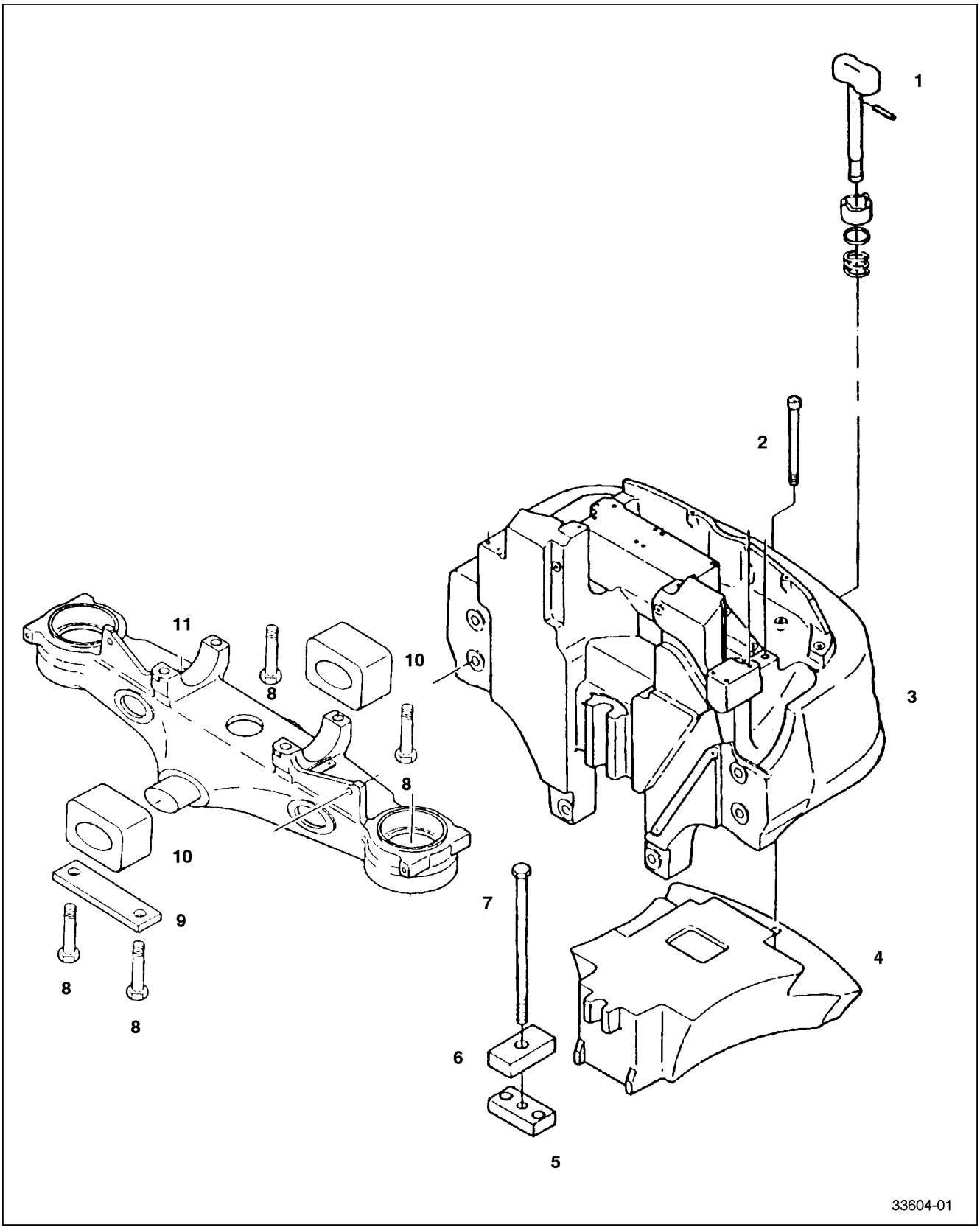
2.4.1.7 INSTALLING THE STEERING AXLE

- Put two rubber axle blocks (10) on the centre axle.
- Install the steering axle (11) with the axle blocks (10) in the counterweight (3) from below, raise it slightly until the axle blocks contact the counterweight and safely support it.
- Lead both hydraulic hoses through the counterweight into the battery compartment.
- Lead the steering sensor cables into the counterweight.
- Coat the steering fastening screws (8) with Loctite 243.
- Secure the two plates (9) and rubber axle mounts (10) with the screws (8).
- Torque the screws (8) to 195 Nm.
- On trucks without the higher driver's seat, install the additional weight (4) in the counterweight from below and safely support it.
- Install the first fastening screw (2) through the hole for the trailer coupling pin.

NOTE: On trucks from series 10/94, the mounting bolt (2) can be accessed from below at the ballast weight (4).

- Install the second fastening screw (7) along with the plate (6).
- Tighten both screws.
- Connect the two steering cylinder hose lines to the appropriate pipelines.
- Connect the proximity switch connectors X6 and X7.
- Install the battery.
- Eliminate any air in the steering by operating the steering wheel through 10 complete travel cycles.
- Check the oil level in the oil reservoir and add oil, if necessary.
- Remount the wheels.
- Lower the truck to the ground.
- Torque opposite wheel bolts to 180 Nm.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2.4.2 POWER STEERING CONTROL VALVE

The power steering control valve is mounted under the front cross member of the frame. At the end of the steering wheel shaft is a taper with a pin. When the overhead guard is lowered, the steering column is connected mechanically to the steering shaft through the internal gear coupling that engages in the taper, i.e. in the pin.

The power steering control valve itself is essentially a rotor pump and a control valve built together into one unit. The rotor pump is a gear-type pump that meters the hydraulic oil flow from the working hydraulic system in accordance with the rotation of the steering wheel.

The steering control valve consists of the steering housing with the valve bore and the spool that can be turned and moved axially in the bore. The axial movement of the spool modulates the working pressure and the reversal of the oil flow depending upon the steering wheel direction of rotation.

The spool has a groove into which a pin engages. The pin is lifted and it engages in a sleeve with an annular magnet when the steering wheel is operated and the spool is moving. This arrangement is used to control a reed switch.

The reed switch allows a signal to go to the working hydraulic system electronics, which lets the pump motor run at 600 rpm as soon as the steering wheel is operated.

2.5 CONTROLS

2.5.1 TRAVEL CONTROL

The travel control pedals are integrated in the overhead guard. Two different types of pedal group models are available:

Double-pedal model
Single-pedal model

The truck is braked either mechanically (brake pedal) or electrically (regenerative braking and plug braking).

2.5.1.1 ACCELERATOR SENSOR

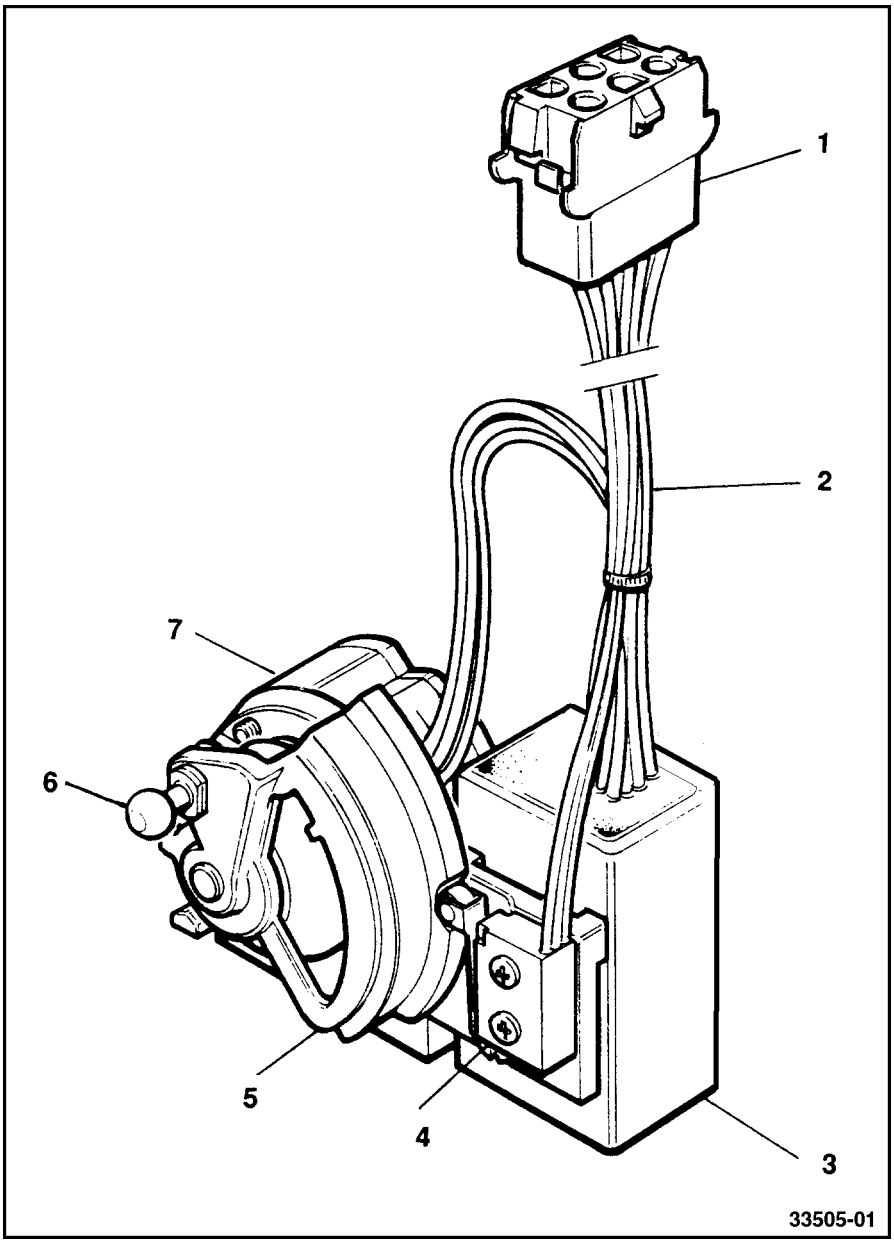
The accelerator sensor is mounted under the overhead guard and connected to the pedals by means of an adjustable linkage. The accelerator sensor microswitch is actuated by a control cam when travelling forward or reverse.

A conductive plastic potentiometer connected to the moveable control cam is fitted to the accelerator sensor. The potentiometer has a built-in return spring, which moves the potentiometer and the control cam to a safe position when the linkage rod is disconnected. In this position the microswitch turns the directional contactors off.

The change in resistance in the potentiometer is converted by the transducer, which is also mounted on the accelerator sensor, into a set-point signal directly proportional to the position of the pedal. The accelerator sensor itself can not be adjusted.

When connector 1X10 is not plugged in, the control is inoperative and the directional contactors cannot make.

Service Training

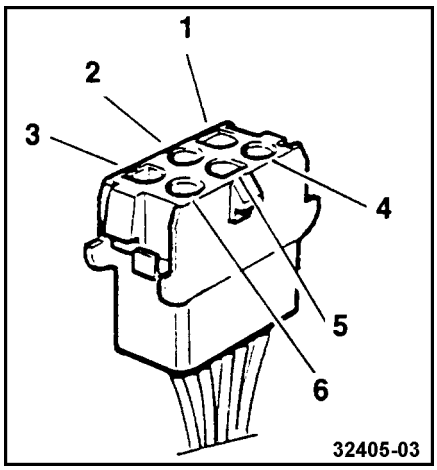


DESCRIPTION

1 Connector
2 Cable harness
3 Transducer
4 Microswitch
5 Control cam
6 Ball
7 Potentiometer

2.5.1.1.1 ACCELERATOR SENSOR OUTPUT SIGNALS

The accelerator output signal can be measured at connector 1X10.



Pin arrangement 1X10

1=(15 V)
2=(output signal)
3=(-)
4=(1S12 direction of travel)
5=(+ U_B direction of travel)
6=Enable

The output signal can vary within the following range:

	Neutral Position	Max. Reverse	Max. Forward
Output signal measured (1X10/2-3)	7.5 V	11.25±0.65 V	3.75±0.65 V

The control range for the accelerator sensor is between 7.5 V and 11.25 V for reverse travel and between 7.5 V and 3.75 V for forward travel.
The following voltages are important for the control range when checking the traction control for proper function.

	Reverse	Forward
Neutral position:	7.5 V	7.5 V
Contactor makes:	8.2 V	6.8 V
Clocking starts:	8.4 V	6.6 V
End-point signal approx.:	11.25 V	3.75 V
Contactor breaks:	8.0 V	7.0 V

2.5.1.1.2 ADJUSTMENT OF THE NEUTRAL POSITION

After loosening both locknuts, adjust the connecting rod from the pedals to the accelerator sensor so that the travel required to actuate the accelerator sensor microswitch is equal in both directions of travel.

2.5.2 BRAKING

2.5.2.1 RENEWING THE BRAKE LININGS

The brake linings must be replaced when the linings are 2 mm thick at the thinnest point.

- Open and tilt the overhead guard to the second detent.
- Loosen the locknut (3) on the handbrake lever (1) and the adjusting nut (2) on the parking brake cable (4).
- Unhook the handbrake cable (4) at the brake shoes (5) and (6).
- Remove one pin retainer (10) on each of the two brake shoes (5) and (6).
- Tilt the brake shoes up.
- Remove the fastening screws (7) for the brake shoes (8).
- Fit new brake shoes (8).
- Fit handbrake cable

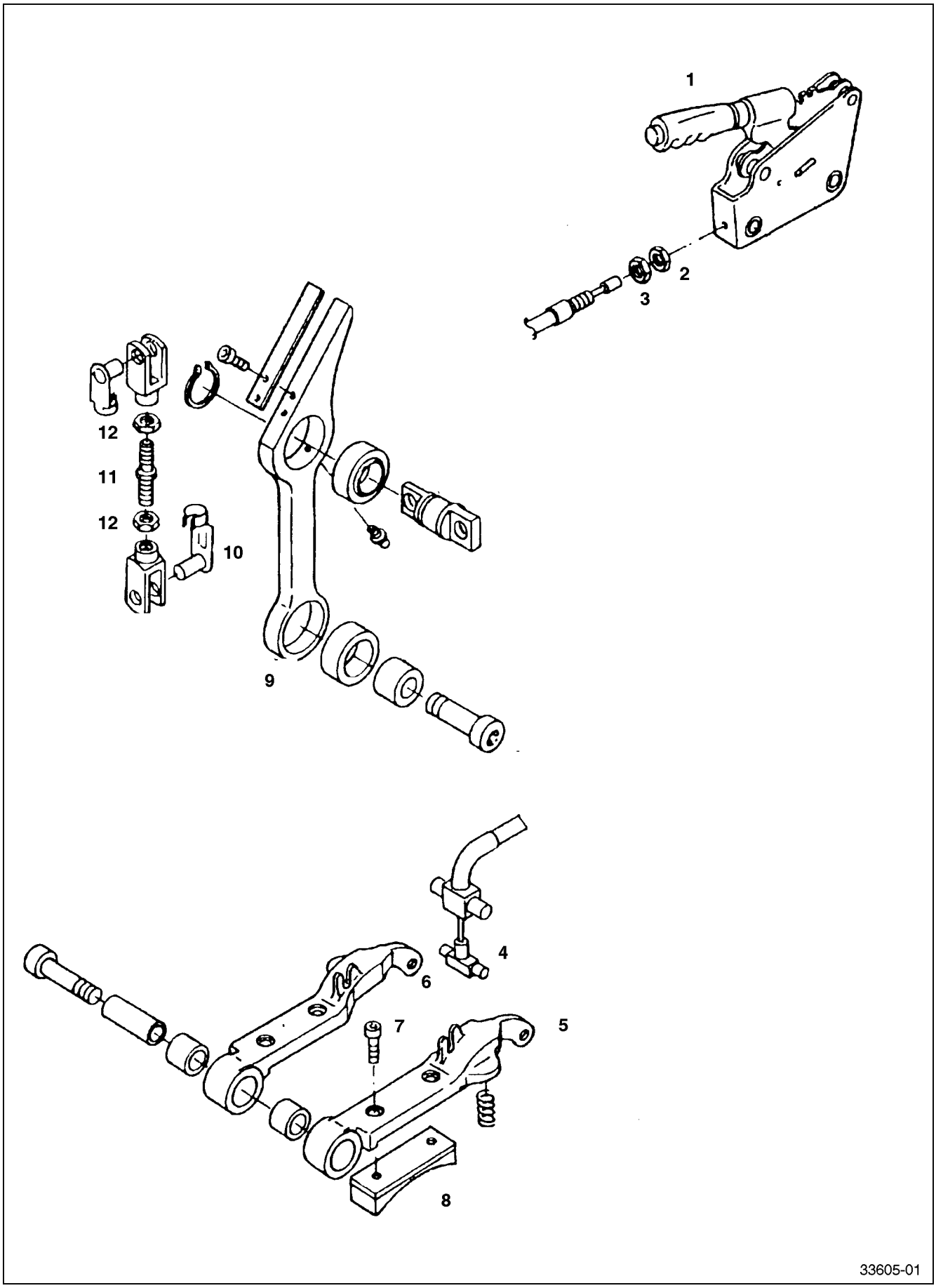
2.5.2.2 ADJUSTING THE FOOT BRAKE

The foot brake can be adjusted if the brake linings are worn.

- Open and tilt the overhead guard to the second detent.
- Slowly press the lever (9) with the hand.
- The lever must then be approx. 20 mm from the end stop of the lever.
- For the adjustment, loosen the locknut (12) at the threaded pin (11) and adjust the threaded pin.
- Tighten the locknuts (12) again.

2.5.2.3 ADJUSTING THE HANDBRAKE

Open and tilt the overhead guard to the second detent.
- Slowly engage the handbrake (1) while watching lever (9).
- The lever must move jointly with the handbrake lever until the point of higher spring pressure (brake lining contacts the brake disc) is reached.
- Release the release button.
- The brake must be applied when the handbrake has clicked five times.
- If an adjustment is necessary, loosen the locknut (3) for the handbrake cable on the handbrake lever to adjust the tension of the handbrake cable (4) with the adjusting nut (2).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2.6 ELECTRICAL SYSTEM

The series 336 trucks are equipped with a compact LTM control for the travel drive and the working hydraulic system. The steering system is controlled via the lift LTM control.
The compact LTM control has the following advantages over the previous LTM control:

- less space required
- easier installation
- available as replacement part
- integrated freewheel diode
- integrated brake diode
- integrated regenerative braking diode
- easier troubleshooting
- improved dissipation of heat

Features of the power unit:

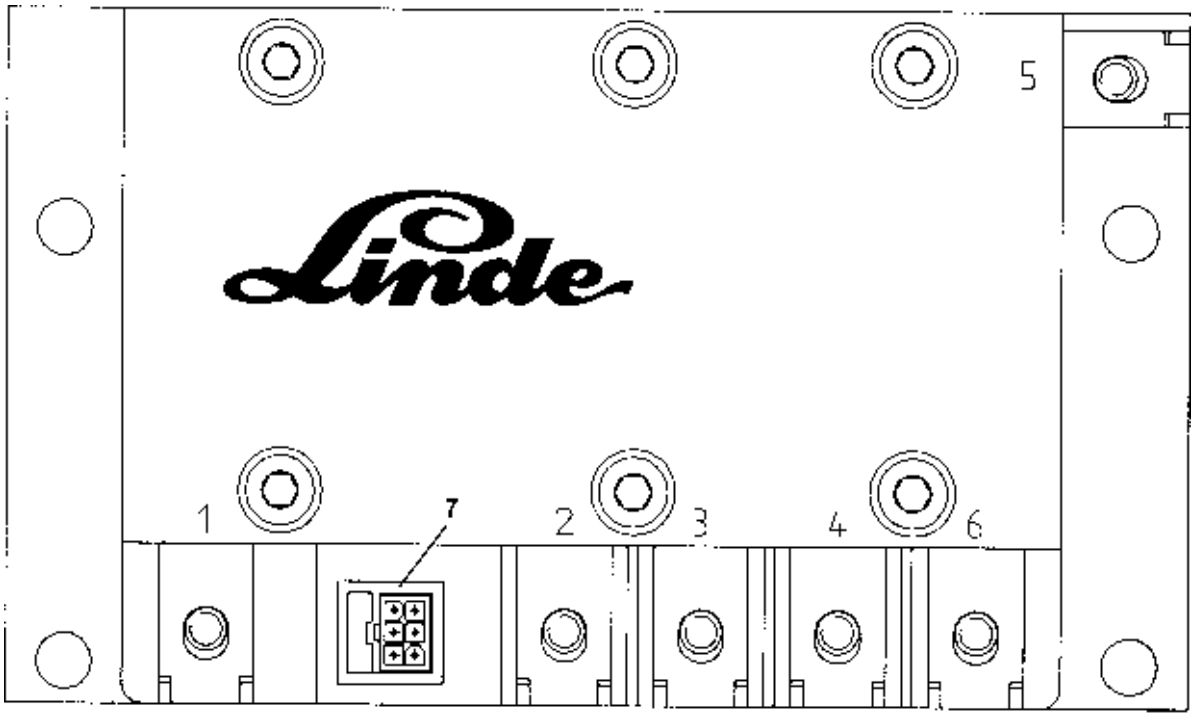
- N-type channel enhancement type MOSFET
- Zener diode for active overvoltage protection
- gate-source Zener diode and resistor against static overvoltage at the gate
- integrated gate resistors against internal oscillations
- insulated aluminium base plate
- longer air gaps

Regenerative braking is standard equipment for this series, which returns part of the energy generated during braking back to the battery. The control unit and the fan are supplied with 24 V direct current via a separate voltage converter.

Trucks equipped with optional lighting require a separate voltage converter.

2.6.1 COMPACT POWER MODULE

2.6.1.1 TRACTION POWER MODULE



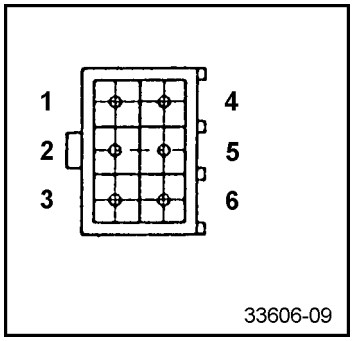
33606-11

Main terminals:

1 Source
2 Drain
3 Anode of brake diode 1V51 (for motor 1M1)
4 Anode of brake diode 1V52 (for motor 1M2)
5 Anode of regenerative current diode 1V53
6 Cathode terminals of freewheel and brake diodes

Connector (7)

1 Auxiliary source S
2 Not used
3 Gate
4 Not used
5 Not used
6 Auxiliary drain D



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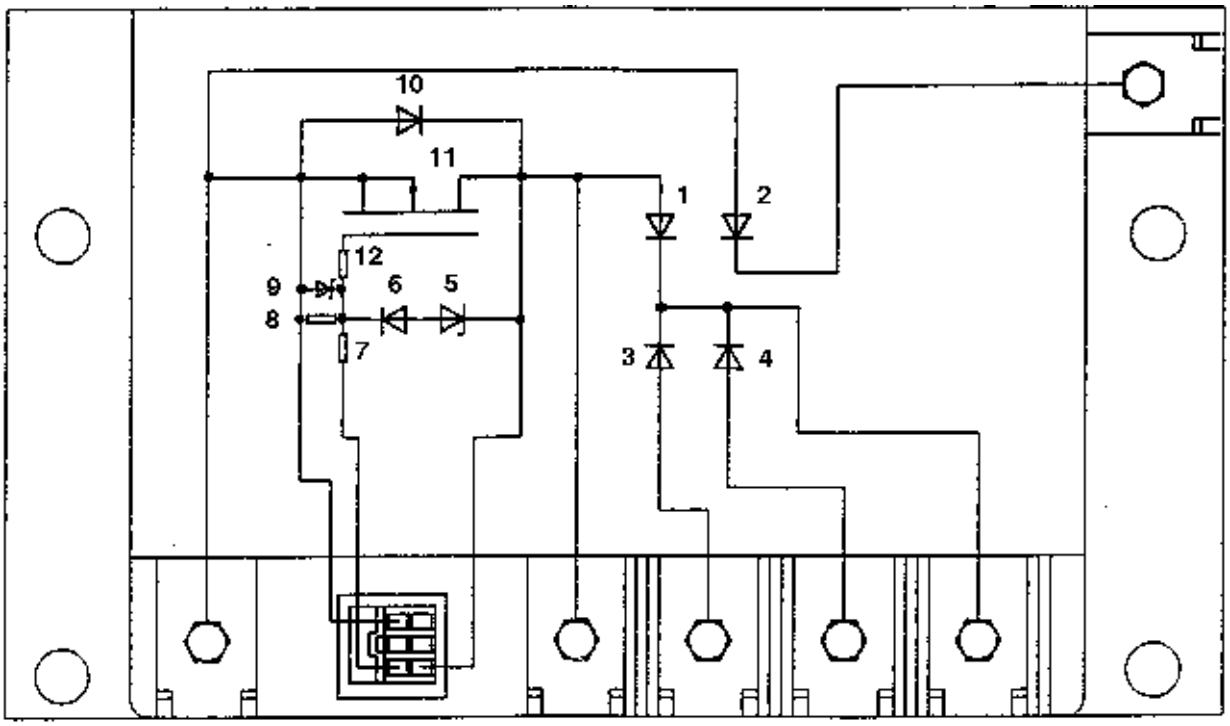


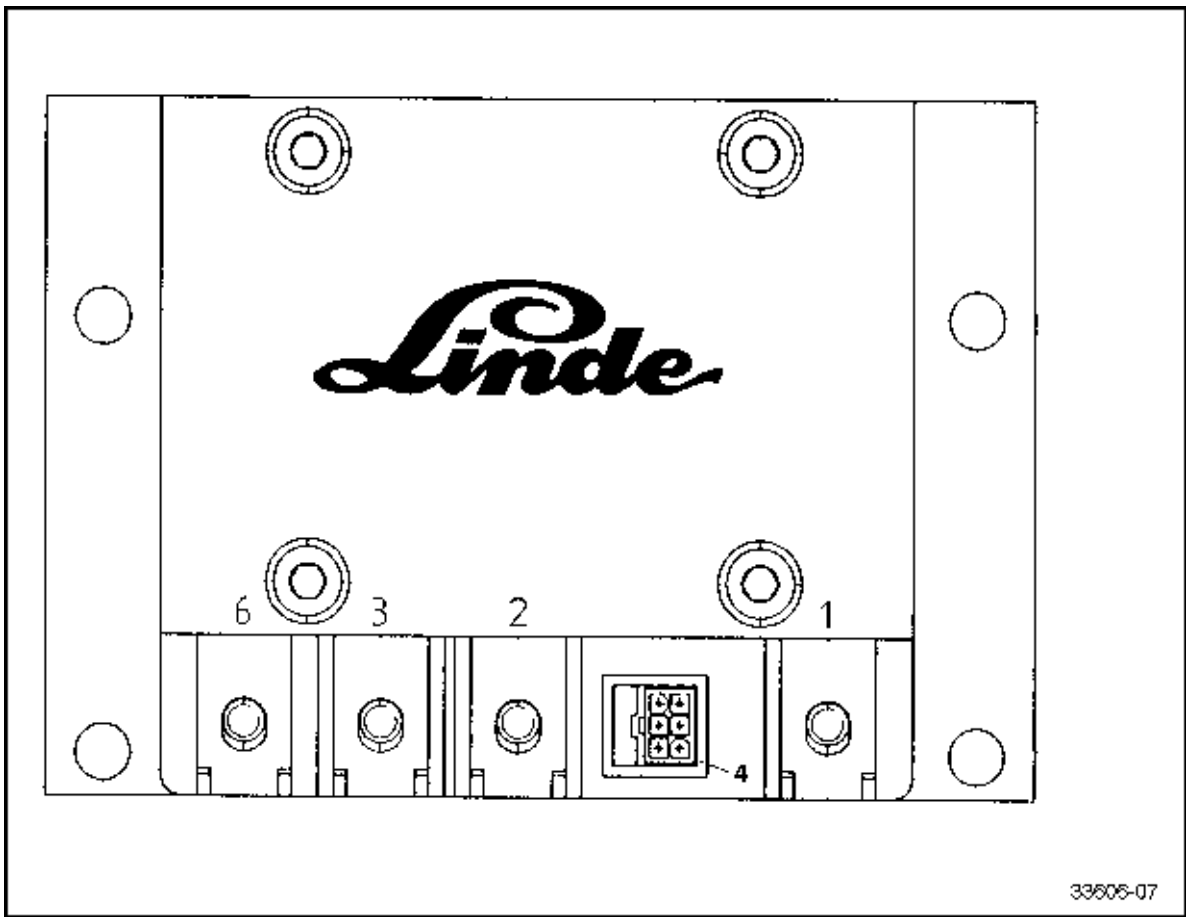
33606-76

1 Freewheel diode
2 Regenerative braking diode
3 Braking diode
4 Braking diode
5 Zener diode
6 Diode
7 Ballast Zener diode
8 Leakage resistor
9 Zener diode
10 Protective diode
11 MOSFET transistor
12 Gate ballast resistor

Specifications:

Voltage: 80 V
Max. current: 430 A at 70 ℃

2.6.1.2 POWER MODULE FOR LIFT CONTROL

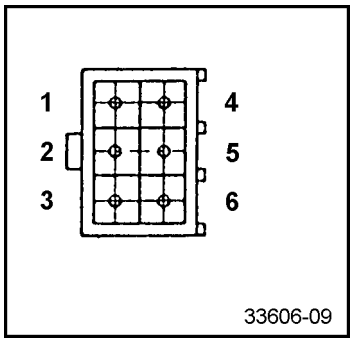


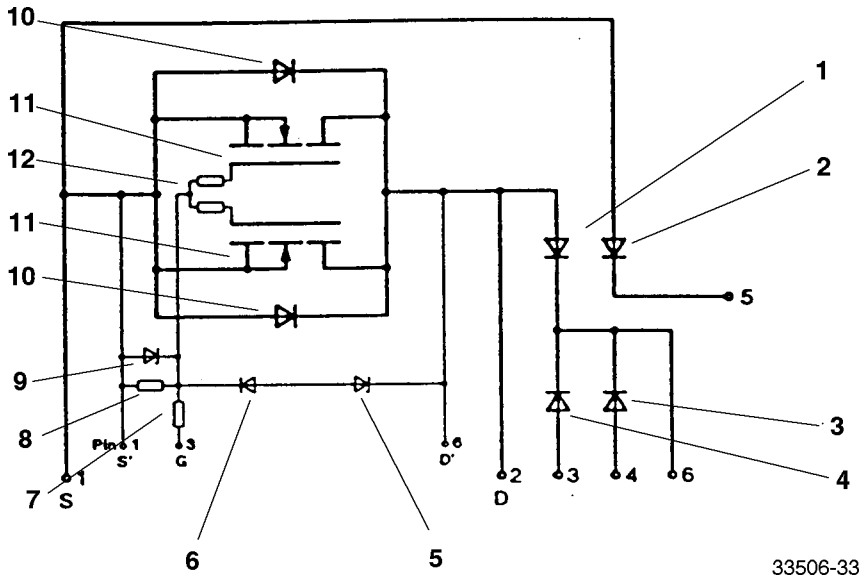
Main terminals:

1 Source
2 Drain
3 Anode terminal of freewheel diode
6 Cathode terminal of freewheel diode

Connector (4)

1 Auxiliary source S
2 Not used
3 Gate
4 Not used
5 Not used
6 Auxiliary drain D





1 Freewheel diode
2 Braking diode (not used)
3 Zener diode
4 Diode
5 Ballast Zener diode
6 Leakage resistor
7 Zener diode
8 Protective diode
9 MOSFET transistor
10 Gate ballast resistor

Specifications:

Voltage: 80 V
Max. current: 350 A at 70 ℃

2.6.1.3 POWER MODULE TESTS

The tests for the traction and lift control power module are the same.

TEST CONDITIONS:

- To test the power modules, you need a multimeter for measuring impedance and a 9 Volt block battery.
- When performing the test with the modules on the truck, disconnect the battery plug and disconnect the main circuit lines on the power module.

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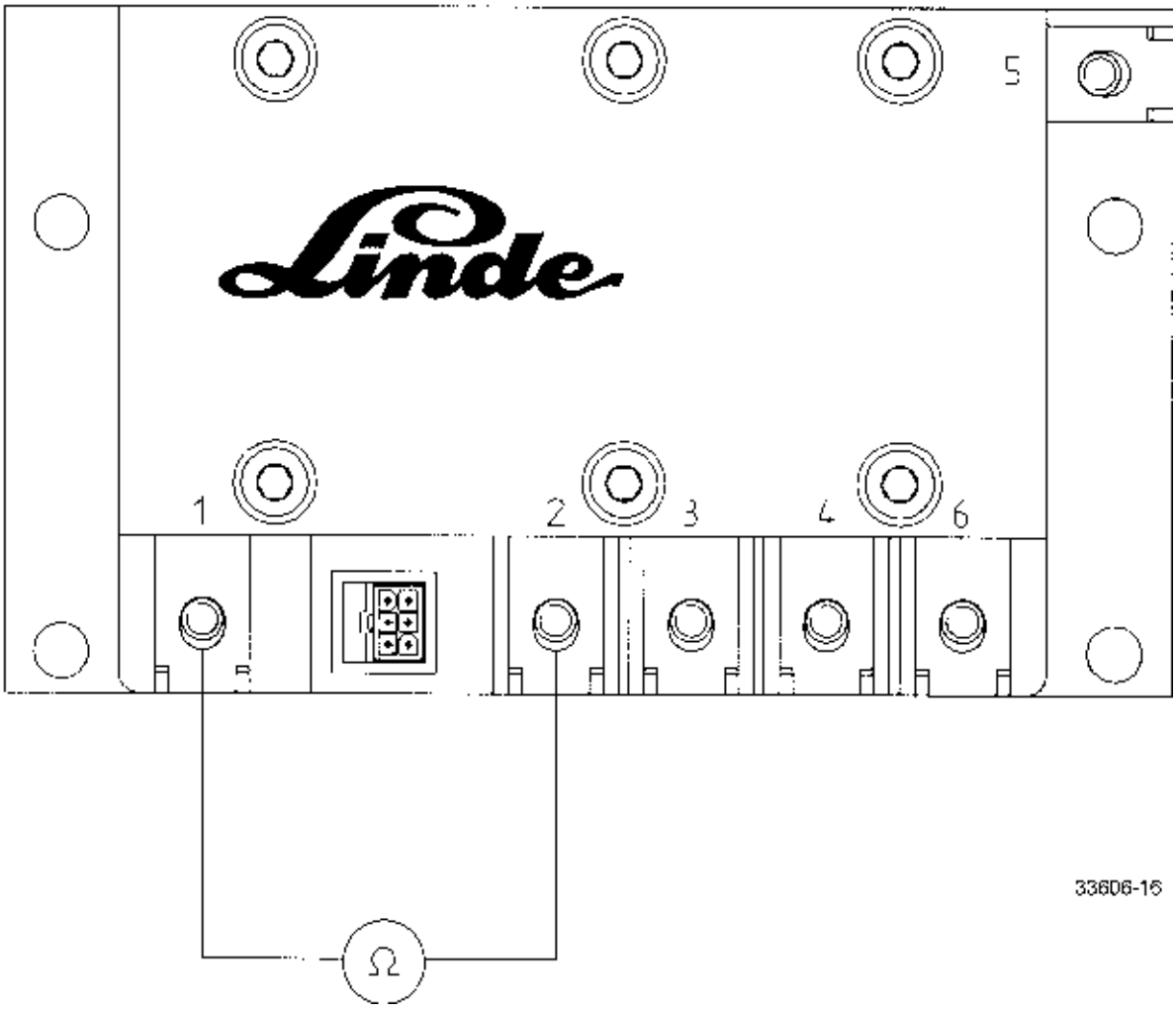
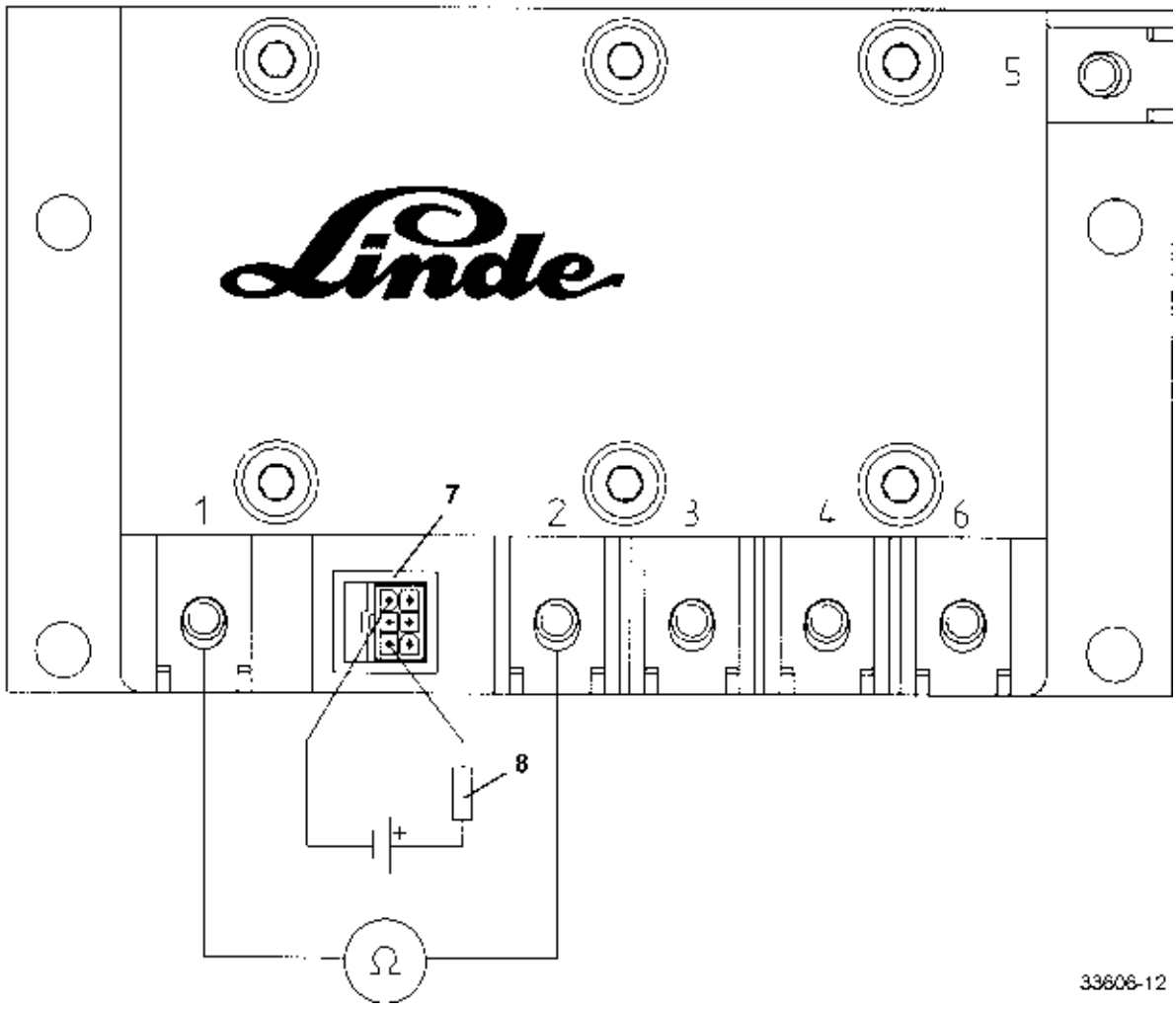


TESTING IF POWER MODULE IS OFF

- Connect the ohmmeter to source 1 and drain 2 (+ lead to the drain and - lead to the source). If there is no voltage measured at the gate, the module is off. The impedance between source and drain is highly resistive.
  If the impedance between source and drain is low, the module is not working properly.

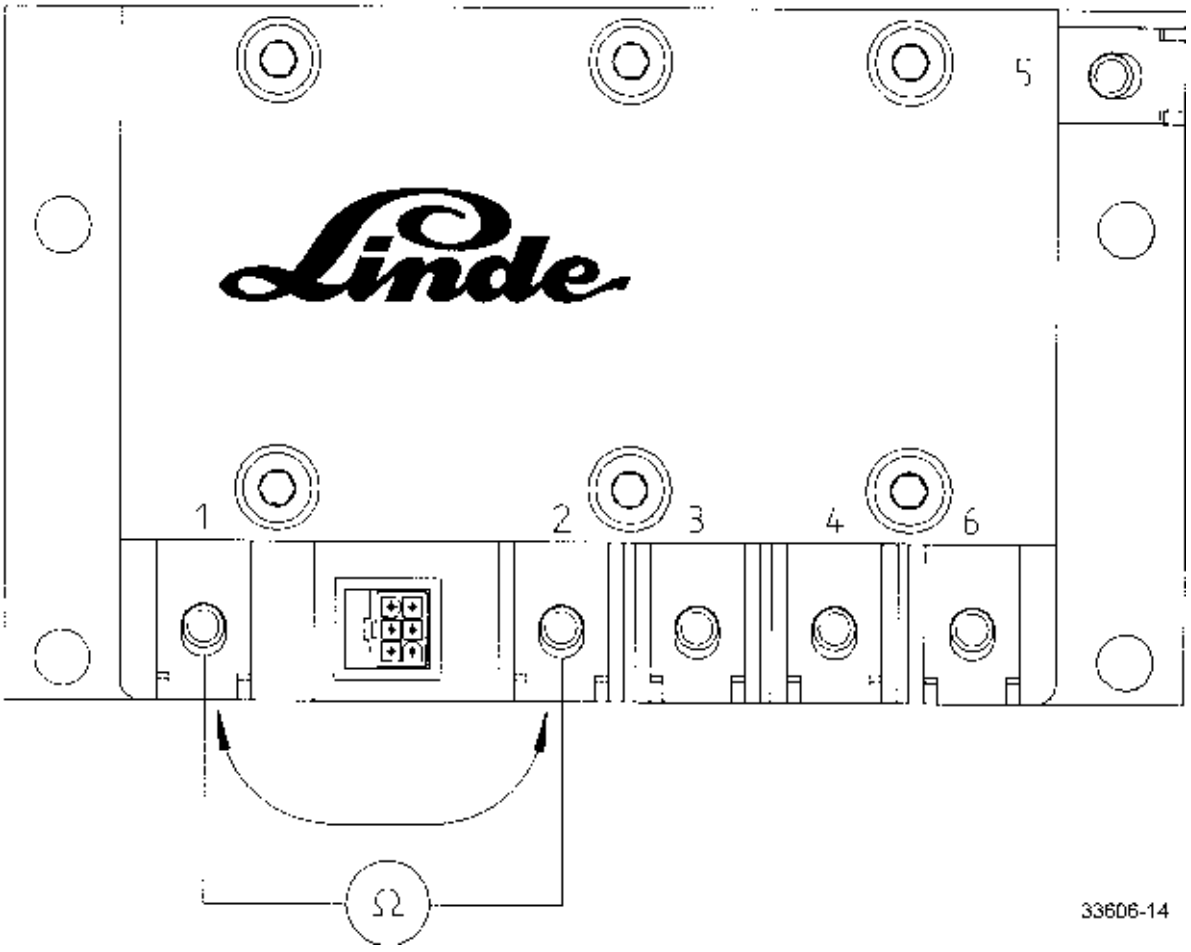
TESTING IF POWER MODULE IS ON



- Connect the ohmmeter to source 1 and drain 2 (+ lead to the drain and - lead to source)
- Connect a 9 Volt block battery with - to auxiliary source 1 of the 6-pin plug (7); control the module with the + lead to gate terminal 3 of the 6-pin plug (7).
  If there is positive voltage at the gate, the module is on and the impedance between source and drain is zero.
  If the impedance is highly resistive, the module is not working properly.

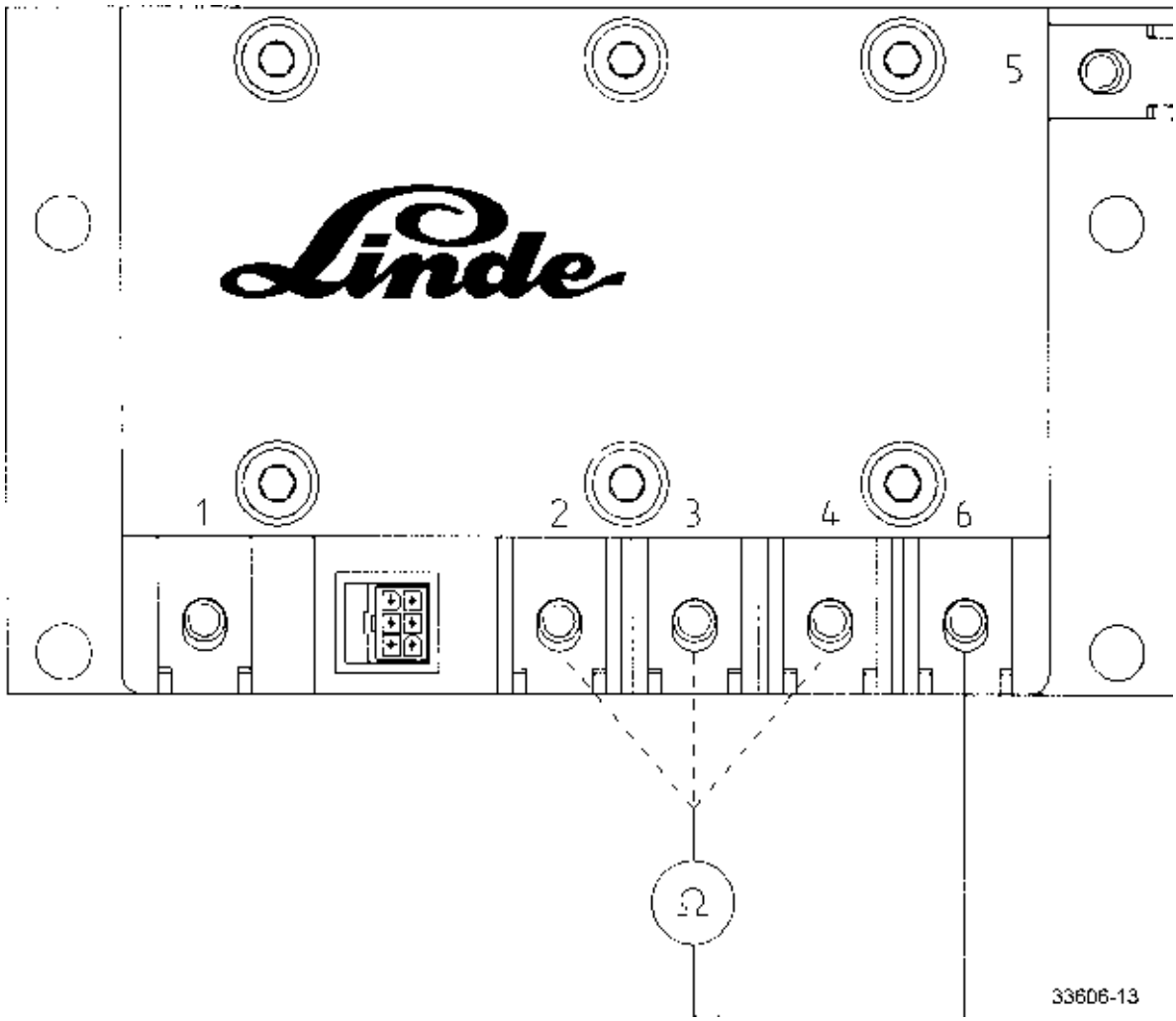
CAUTION: When connecting the 9 Volt block battery to gate terminal 3 and to auxiliary source terminal 1 of the 6-pin plug, make absolutely sure that the polarity is correct. To reduce the test current, install a 1 kOhm/0.25 W resistor (8) in the 9 Volt battery lead.

TESTING THE PROTECTIVE DIODE IN THE POWER MODULE



- Perform the test with the multimeter set to the Ohm range, + lead connected to source 1, - lead connected to drain 2.
  The protective diode does not block, low impedance indicated.
- + lead connected to drain 2, - lead connected to source 1.
  The protective diode blocks, high impedance is indicated.
- If both readings are the same, the diode is defective.

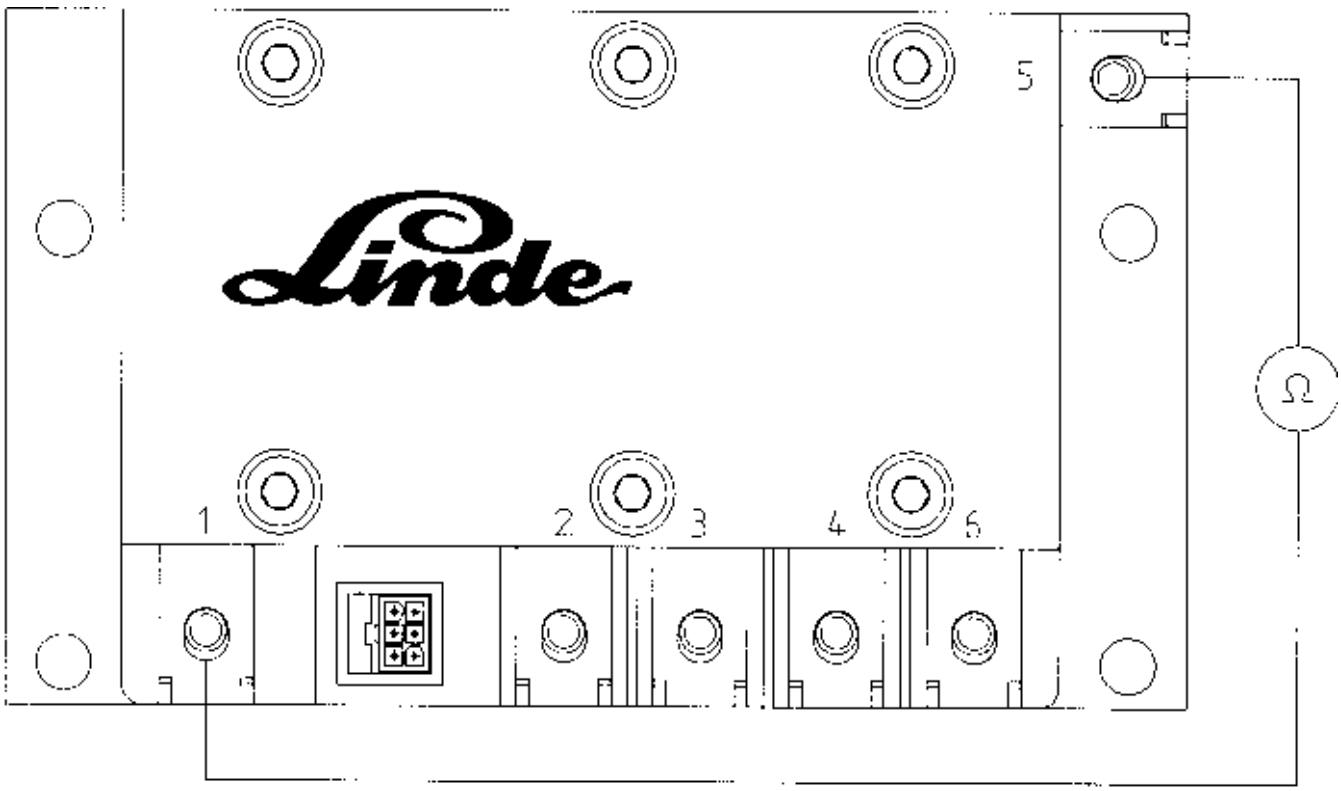
TESTING THE FREEWHEEL AND BRAKE DIODES IN THE POWER MODULE



- Perform the test with the multimeter set to the Ohm range, + lead connected to 6, - lead connected one after the other to 2, 3 and 4.
  The diodes block, high impedance is indicated.
- - lead connected to 6, + lead connected one after the other to 2, 3 and 4.
  The diodes do not block, low impedance is indicated.
- If both readings are the same, the protective diode is defective.

Service Training

TESTING THE REGENERATIVE BRAKING DIODE IN THE POWER MODULE



- Perform the test with the multimeter set to the Ohm range, + lead connected to 5, - lead connected to 1.
  The diodes block, high impedance is indicated.
- - lead connected to 5, + lead connected to 1.
  The diodes do not block, low impedance is indicated.
- If both readings are the same, the diode is defective.

2.6.1.4 INSTALLATION OF THE POWER MODULES

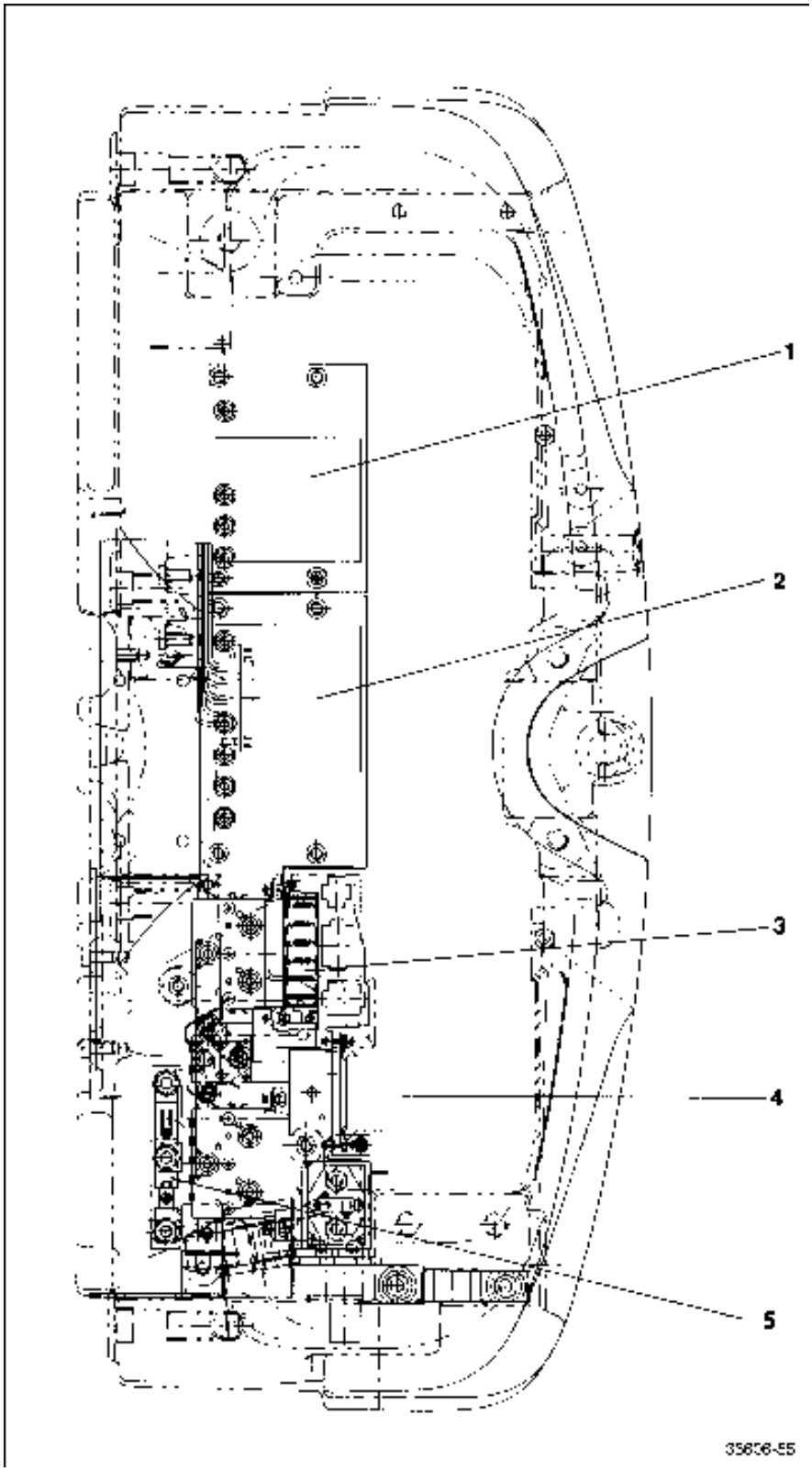
The power modules used are of the MOSFET type. MOS transistors react sensitively to static discharges. Static charges can already arise when walking over a carpet. In the worst case, the body can be charged up to 35,000 V.

CAUTION: Before working on the power modules, the human body must be discharged by touching earth (e.g. water pipe).
Handle the power modules carefully to prevent damage to the cooling area and to the connector.

- Clean the underside of the power module in the area of the heat sink of any dust and foreign objects.
- To reduce the heat transfer resistance between the power module and the counterweight,using a spatula, apply a thin coating of thermal compound WPV10 to the mounting area of the power module
- Position the power module correctly.
- Tighten the M10x35 socket head screws alternately to a torque of 49 Nm.
- Insert the plug.

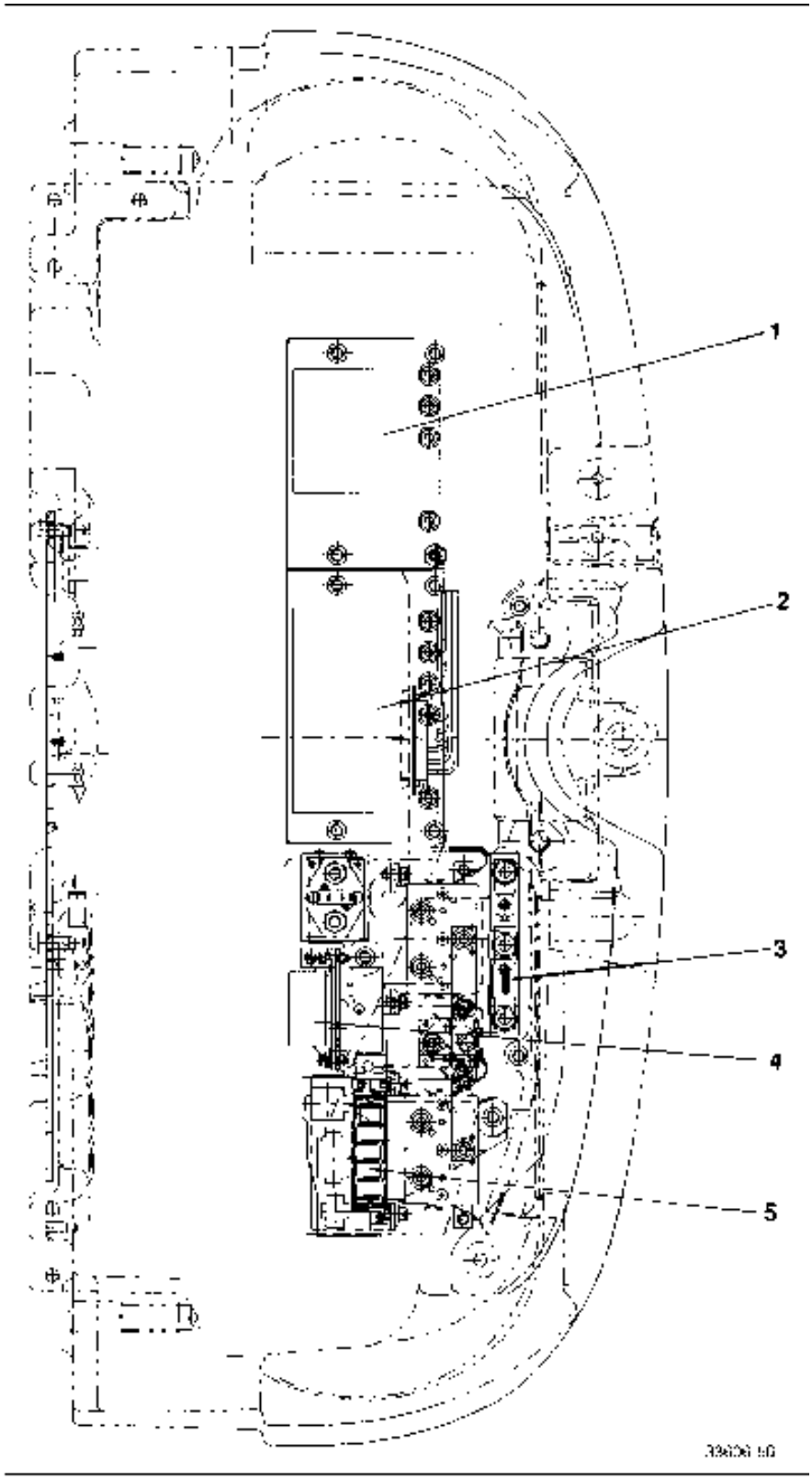
CAUTION: The M10x35 socket head screws must be tightened to the proper torque to ensure the correct contact of the power module.
After 30 minutes, tighten alternate M10x35 socket head screws again.

2.6.1.5 ARRANGEMENT OF CONTROL PANELS IN E 20 MODEL



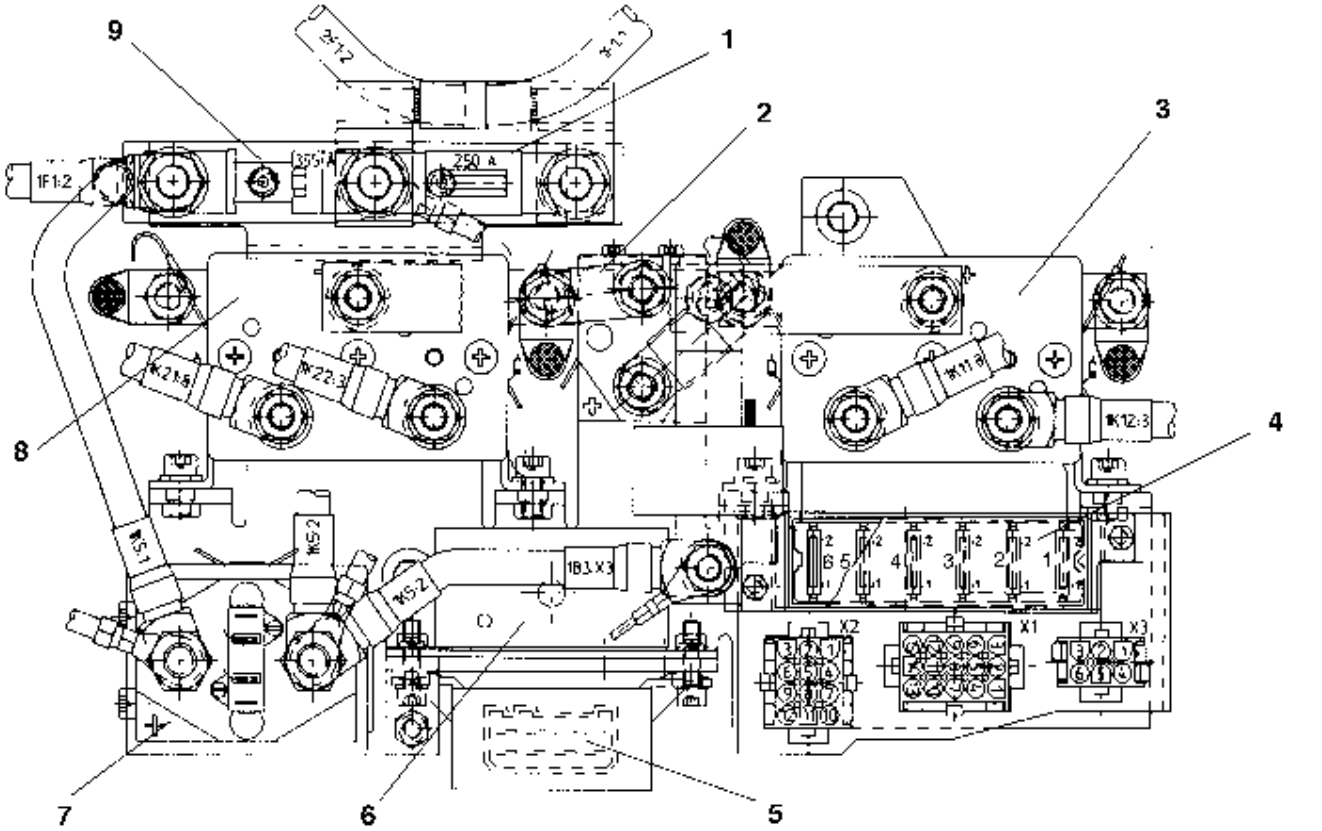
1 Lift control
2 Traction control
3 Control current fuses
4 Timer 1A3 (to series 6/95 trucks only)
5 Main circuit fuses

2.6.1.6 ARRANGEMENT OF CONTROL PANELS IN E 25 / E 30 MODEL



1 Lift control
2 Traction control
3 Main circuit fuses
4 Timer 1A3 (to series 6/95 trucks only)
5 Control current fuses

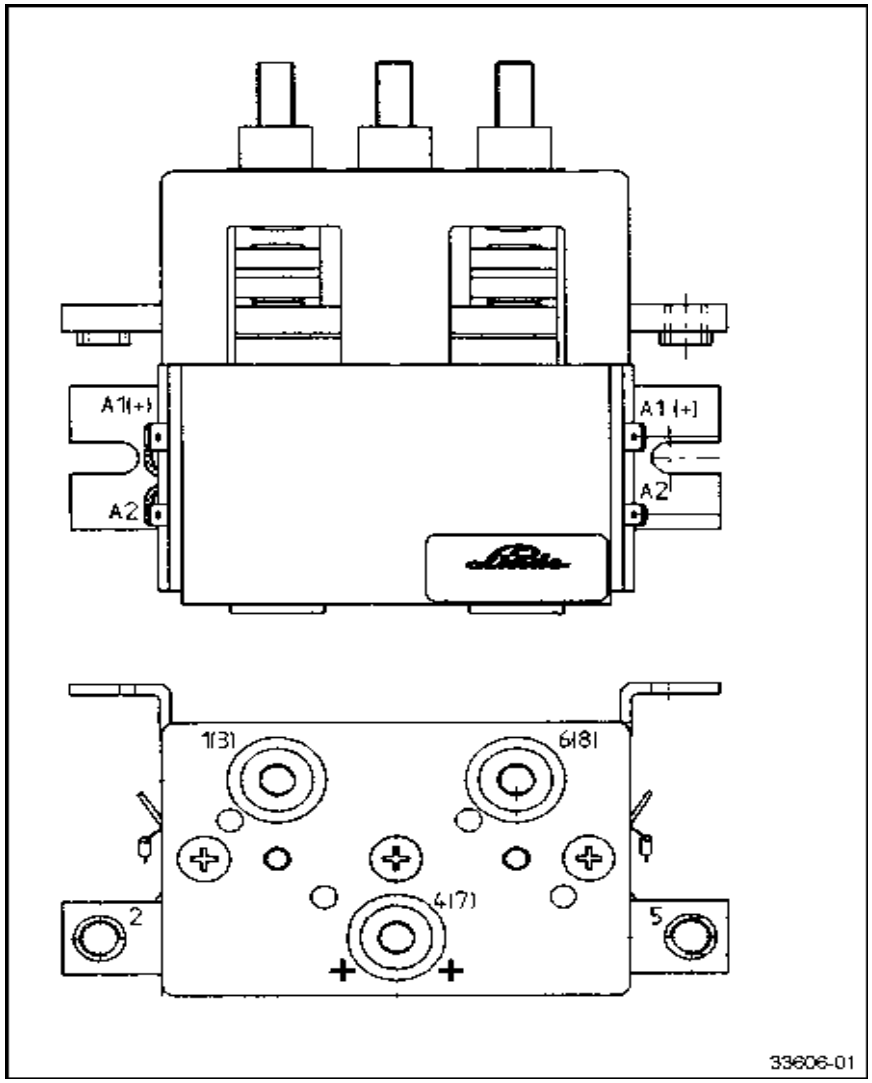
2.6.1.7 CONTACTOR PANELS



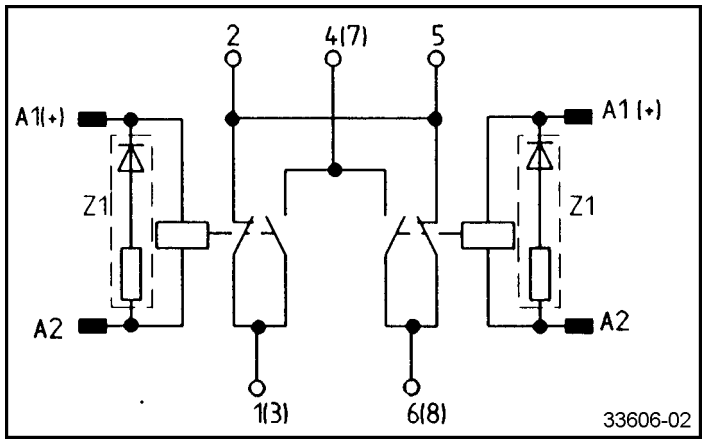
1 Main circuit fuse 2F1 for pump motor
2 Circuit breaker 1K6
3 Directional contactors 1K11, 1K12
4 Control current fuses
5 Timer 1A3 (to series 6/95 trucks only)
6 Voltage converter U1
7 Regenerative current contactor 1K5
8 Directional contactors 1K21, 1K22
9 Main circuit fuse 1F1 for traction motors

2.6.2 CONTACTORS

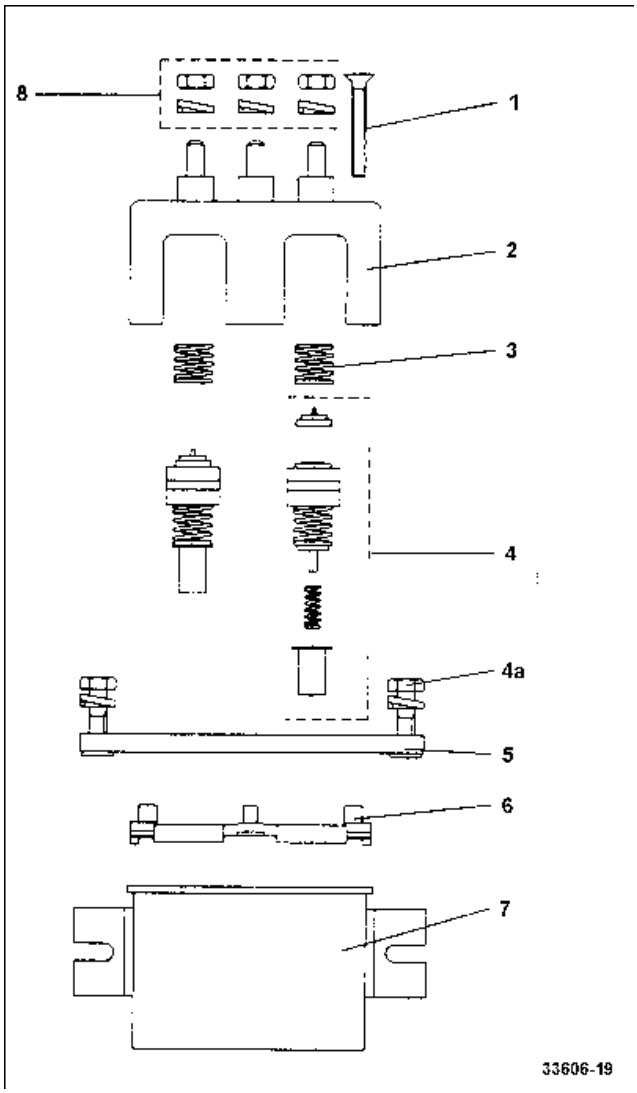
2.6.2.1 DIRECTIONAL CONTACTORS



Circuit diagram:



CONTACTOR TIP RENEWAL

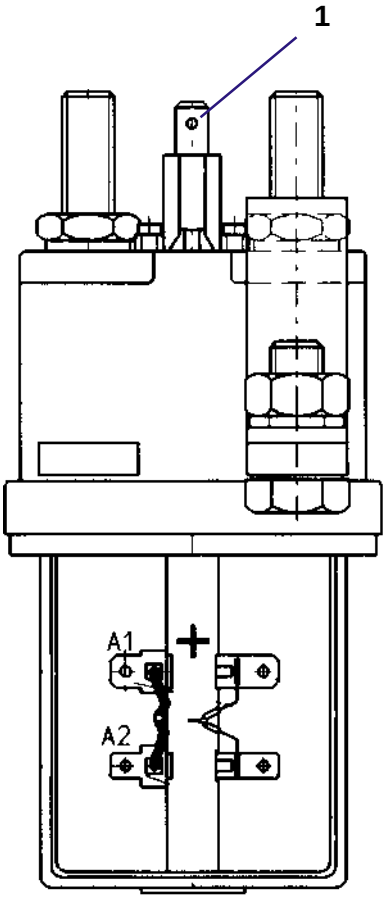


- Remove the hexagonal nuts (8), disconnect the electric cables.
- Remove the hexagonal nuts (4a) on the tip plate (5) and disconnect the electric cables.
- Remove the Phillips screws (1) and take off the cover (2). (Note the position of the + mark.)
- Remove the movable tip (4) along with the tip spring (3).
- Remove the tip plate (5).
- Renew the plastic part (6).
- Install new tip plate (5).
- Install a new tip (4) along with a new tip spring (3).
- Renew the fixed contacts on the cover (2).
- Install the cover (2), ensuring that the + mark is correctly positioned.

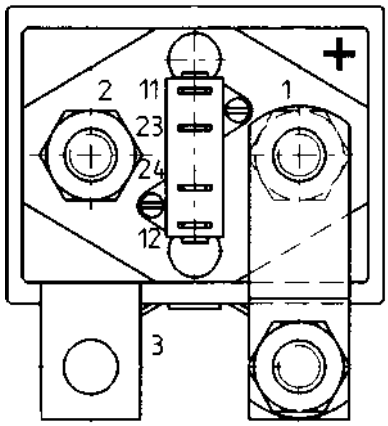
NOTE: The contactor tip kit consists of items 3, 4, 5 and 6 and the fixed tips in the cover.

2.6.2.2 REGENERATIVE BRAKING CONTACTOR 1K5

The regenerative braking contactor 1K5 has a microswitch 1S10 (1) built into the top for monitoring the correct switching operation of the contactor.

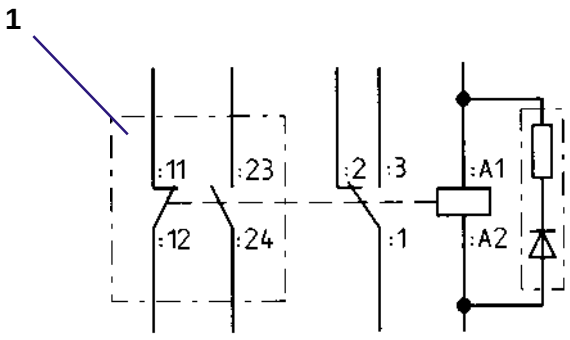


33506-35

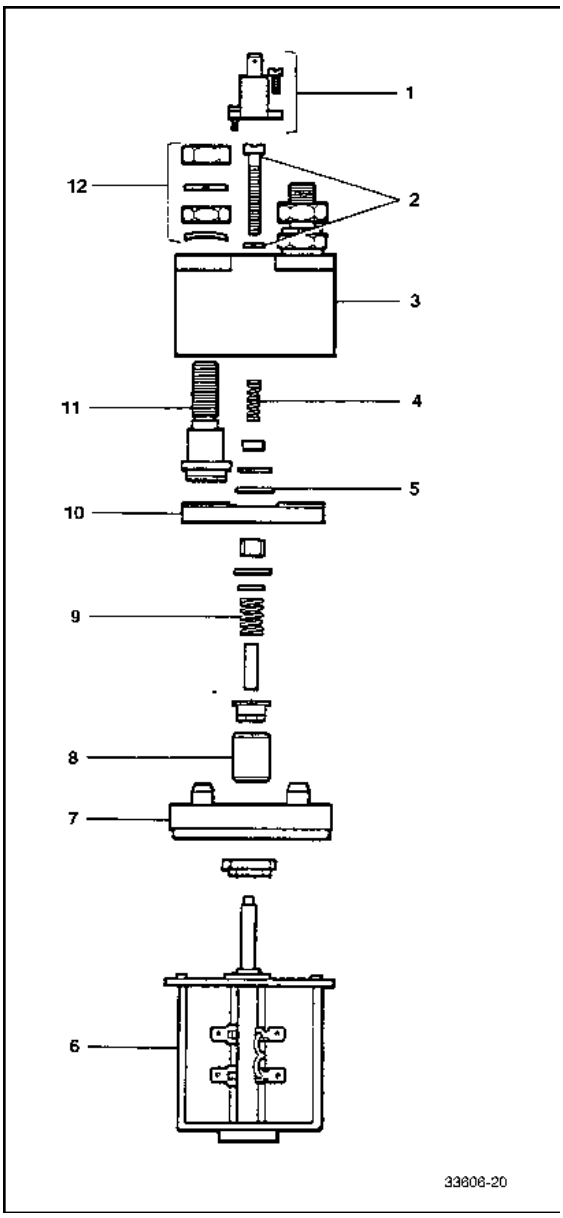


33506-34

Circuit diagram:



33506-36



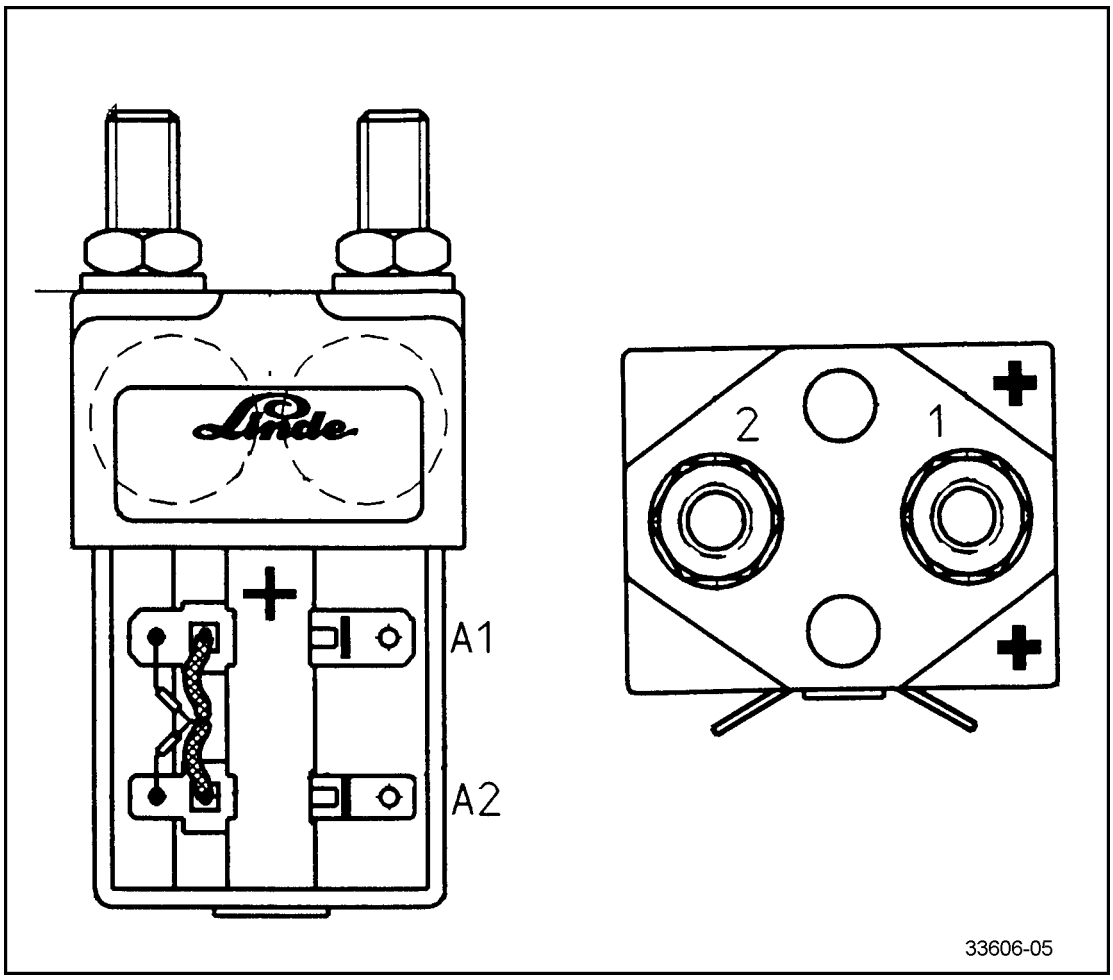
1 Microswitch
2 Screws and washers
3 Cover
4 Spring
5 Washer
6 Coil
7 Plastic part
8 Guide
9 Spring
10 Tip plate
11 Fixed tip
12 Nuts and washers

REPLACING THE CONTACTOR TIPS

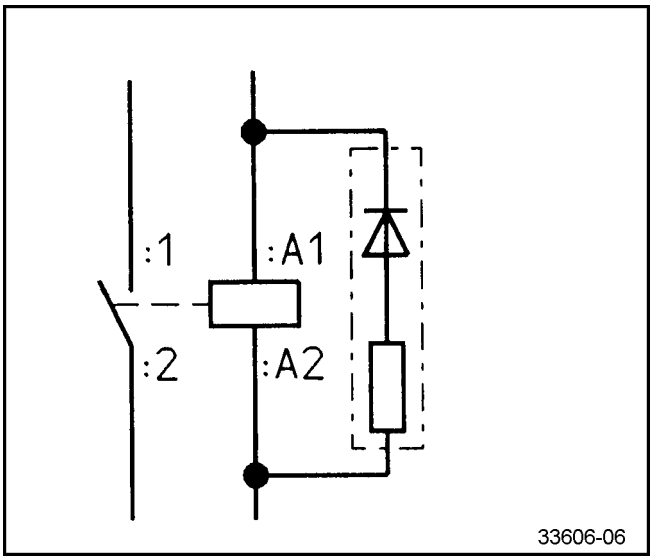
- Remove the hexagonal nuts (12) and washers, disconnect the electric cables.
- Remove the microswitch from the regenerative braking contactor.
- Remove the Phillips screws (2) and washers and take off the cover (3). (Note the position of the + mark.)
- Remove the movable tip (4, 5, 9 and 10)).
- Remove the tip plates (10).
- Renew the plastic part (7).
- Install new tip plate (10).
- Install new movable tip (4, 5, 9 and 10).
- Install the cover (3), ensuring that the + mark is correctly positioned.
- Install the electric cables.

NOTE: The contactor tip kit consists of items 4, 5, 7, 9, and 10.

2.6.2.3 CIRCUIT BREAKER CONTACTOR 1K6



Circuit diagram



2.6.2.4 TESTING THE PROTECTIVE CIRCUITRY

The contactors are provided with a protective circuitry (diode and resistor) at the coils.

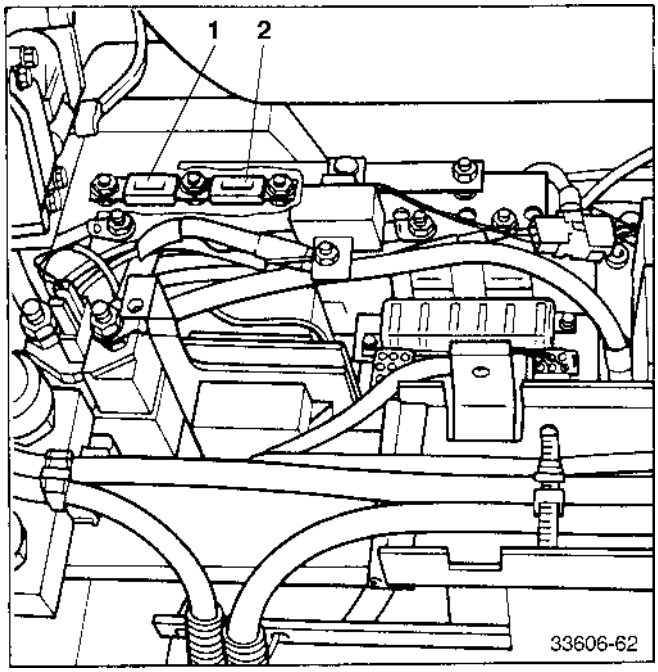
TEST PROCEDURE:

- Disconnect the battery plug.
- Disconnect the connector at the contactor coils.
- Apply a voltage of approx. 4 V to the coils (2 cells of the truck battery or a 4.5 V flat battery) and measure the current.
- Reverse the poles of the power source.
- The protective circuit is okay if the two test readings are clearly different.
- If both test readings are identical, renew the protective circuitry.

2.6.3 FUSES

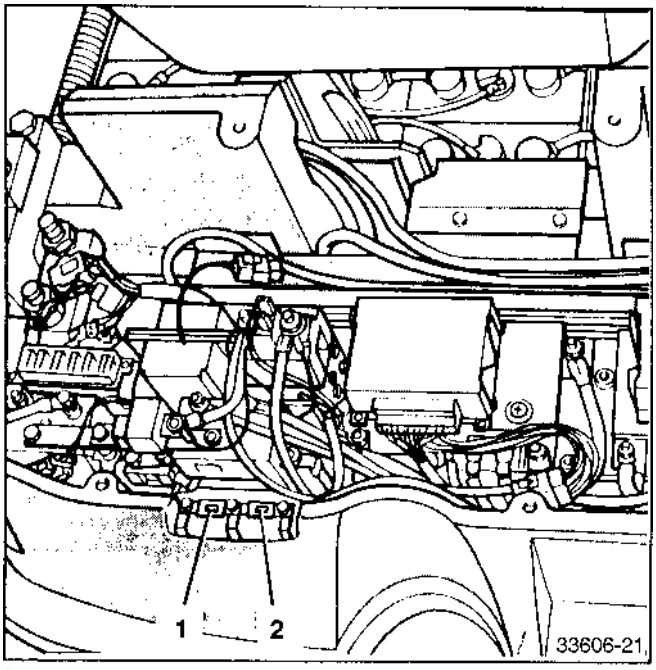
2.6.3.1 MAIN CIRCUIT FUSES IN MODEL E 20

Remove the cover to gain access to the main circuit fuses.



1 Main circuit fuse for traction motors 1F1, 355 A
2 Main circuit fuse for pump motor 2F1, 250 A
3 Main circuit fuse for regenerative braking 1F3, 100 A, located on mounting plate for RH diode 1V1

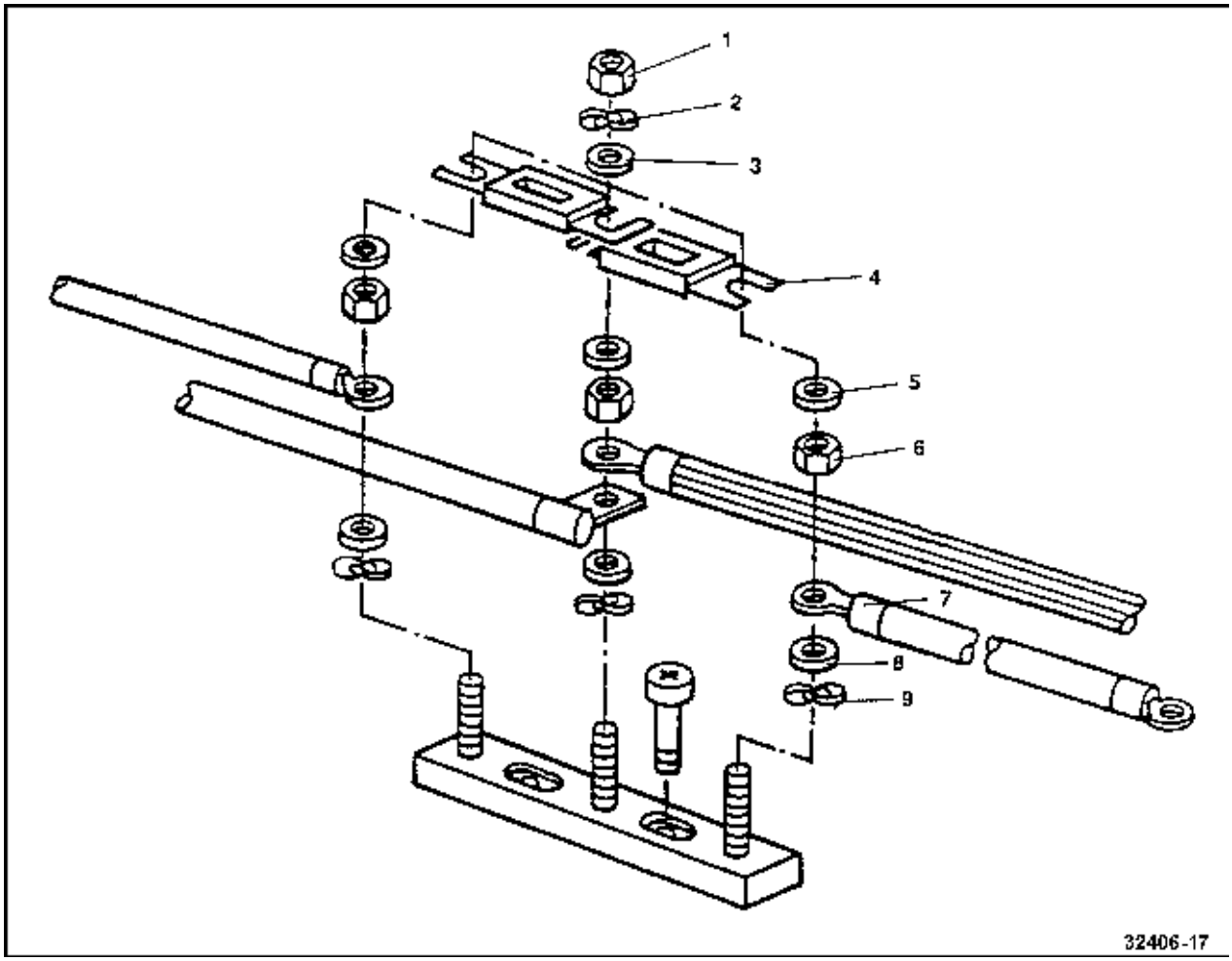
2.6.3.2 MAIN CIRCUIT FUSES IN MODEL E 25 / E 30



1 Main circuit fuse for pump motor 2F1, 250 A
2 Main circuit fuse for traction motors 1F1, 355 A
3 Main circuit fuse for regenerative braking 1F3, 100 A, located on mounting plate for RH diode 1V1

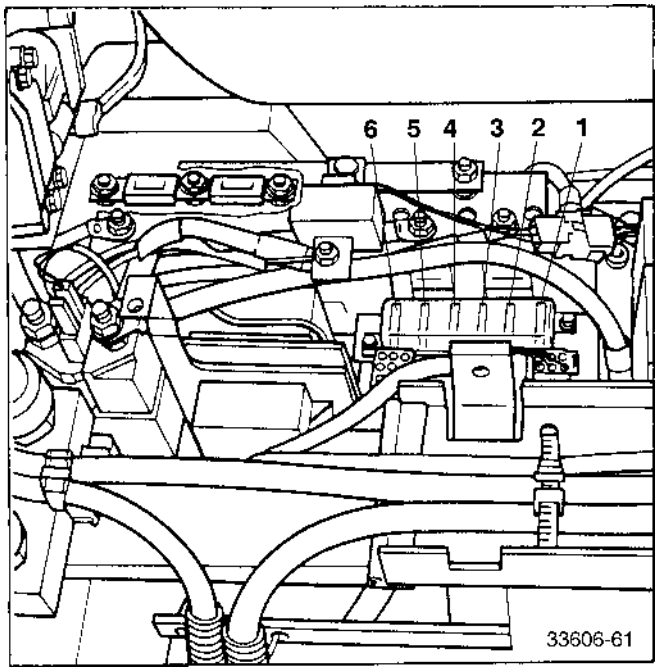
2.6.3.3 INSTALLATION OF THE MAIN CIRCUIT FUSES

Carry out the installation of the main circuit fuses (plate fuses) according to the following illustration. The two plate fuses must each be mounted with brass washers (3) on the top and bottom. Subsequently, torque the hexagonal nut (1) to 20 Nm.



1,6 Nut
2,9 Lock washer
3,5,8 Brass washer
4 Fuse
7 Cable

2.6.3.4 CONTROL CURRENT FUSES IN MODEL E 20

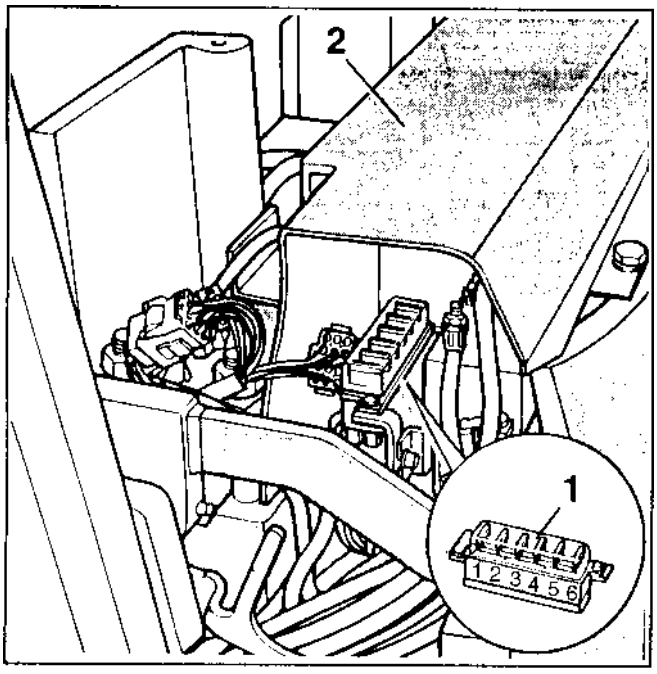


Remove the plastic cover to gain access to the control current fuses.

1	1F2	15A	Ahead of key switch
2	6F1	15A	Combined instrument
3	4F3	15A	Horn, circuit breaker and regenerative current contactor
4	1F4	5A	Traction control, curve sensors
5	2F5	5A	Control of working hydraulics, steering
6	1F6	5A	Fan motors

CAUTION: Use only genuine Linde replacement fuses (high voltage version).

2.6.3.5 CONTROL CURRENT FUSES IN MODEL E 25 / E 30



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Remove the plastic cover (2) to gain access to the control current fuses (1).

1	1F2	15A	Main control fuse
2	6F1	15A	Combined instrument
3	4F3	15A	Horn, circuit breaker and regenerative current contactor
4	1F4	5A	Traction control, curve sensors
5	2F5	5A	Control of working hydraulics, steering
6	1F6	5A	Fan motors

CAUTION: Use only genuine Linde replacement fuses (high voltage version).

2.6.4 VOLTAGE CONVERTER

The voltage converter (DC-DC converter) converts the 80 V battery voltage into a constant 24 V direct current voltage. This voltage is used to power the electronic controls, fan and steering axle proximity switches.

The output voltage of the converter is not separated galvanically from the input voltage. The maximum output current at 24 Volt is 3.3 Ampere (equals 80 Watt).
The green LED on the voltage converter is illuminated when the converter supplies the 24 V power output.
The converter is short-proof.

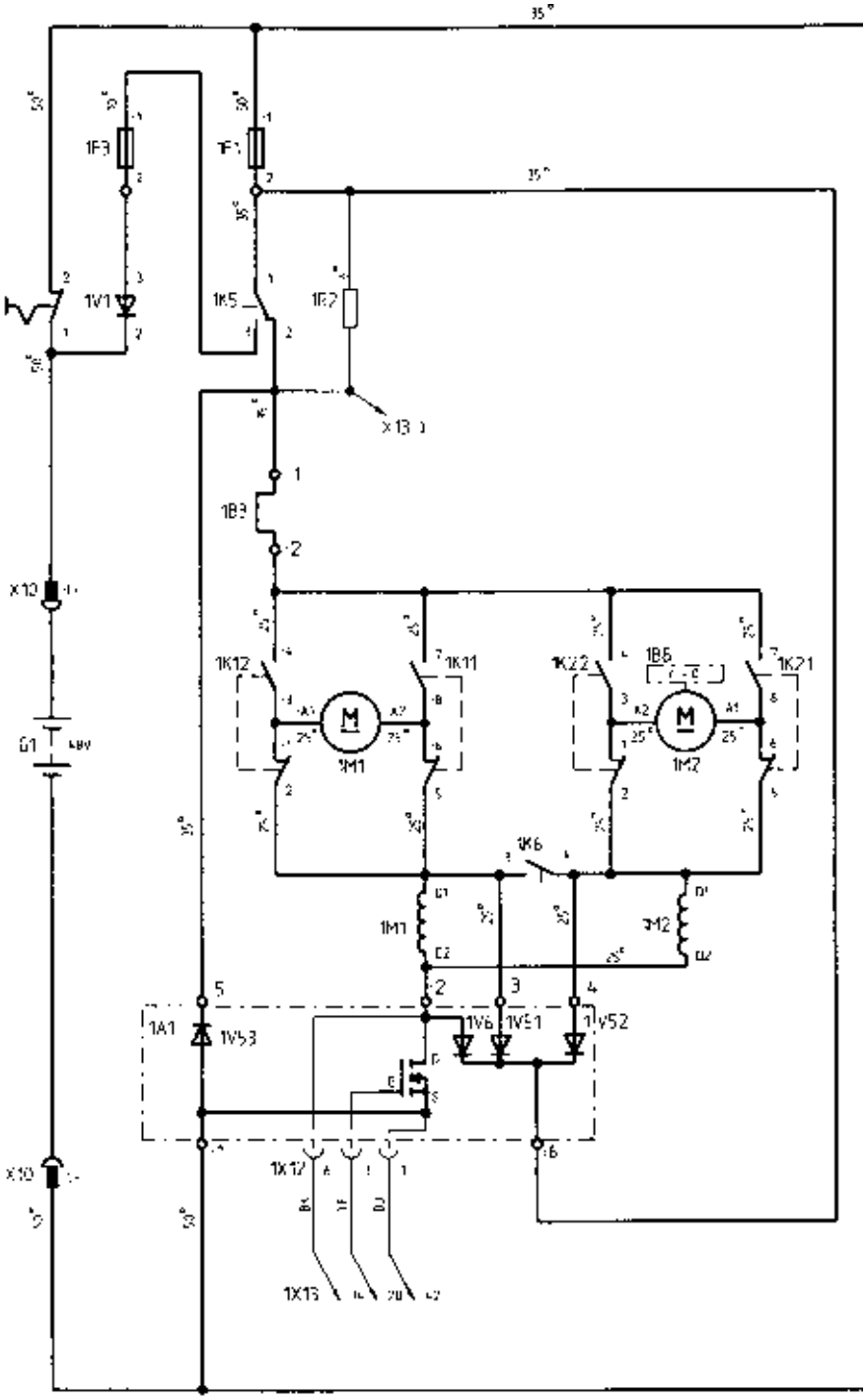
Specifications:

Input voltage:	50 - 150 Volt
Output voltage:	24 VDC
Power:	80 Watt
Intermittent rating:	100 %
Temperature range:	-35 to +70 °C
Type of protection:	IP 65 to DIN 40 050
Insulation voltage:	1500 V

Pin layout of 6-pin connector X8:

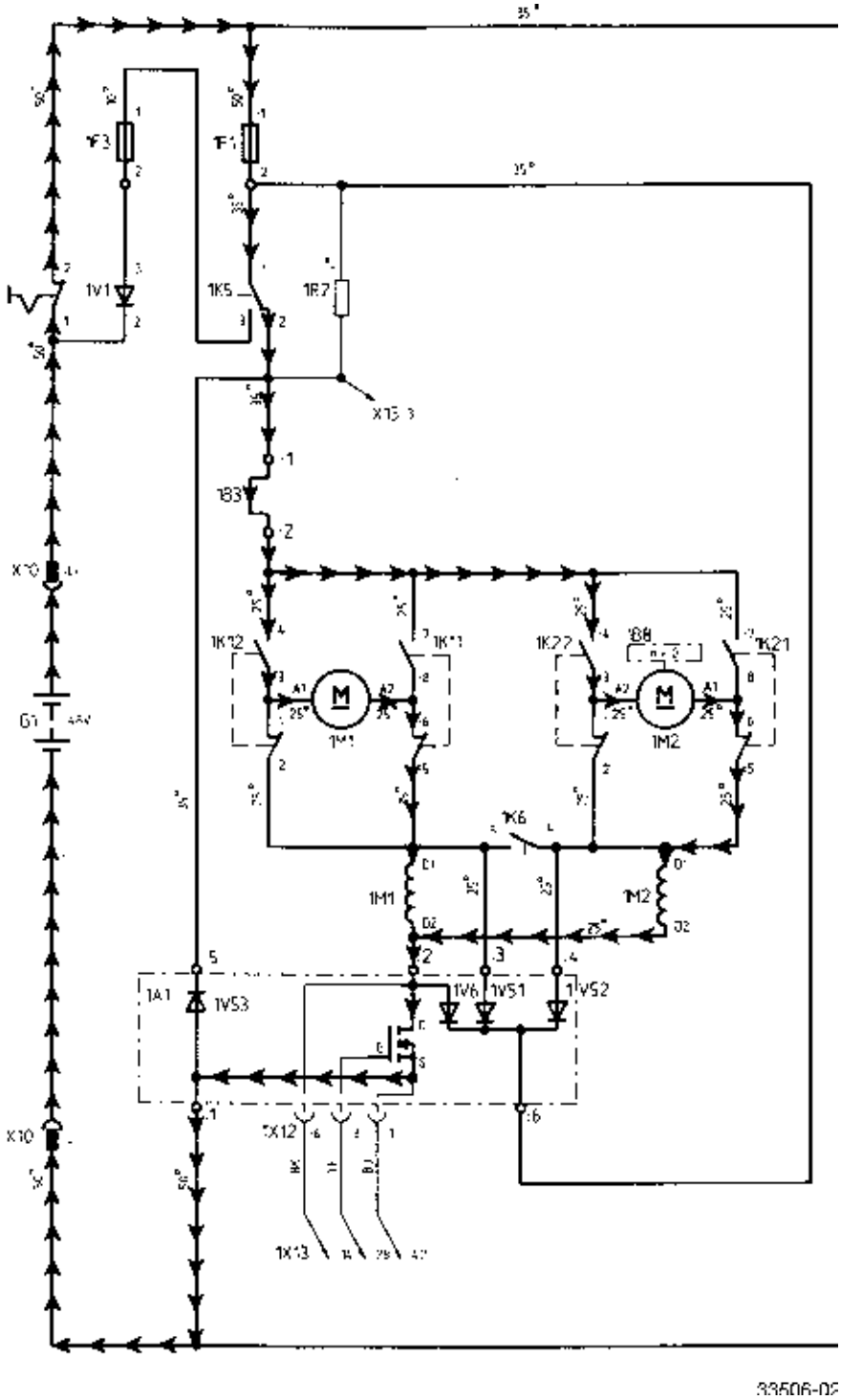
1	Input voltage +80 V
2	Input, battery negative
3	Output voltage +24 V
4	Output, battery negative
5	Not used
6	Not used

2.6.5 MAIN CIRCUIT SECTION TRACTION CONTROL



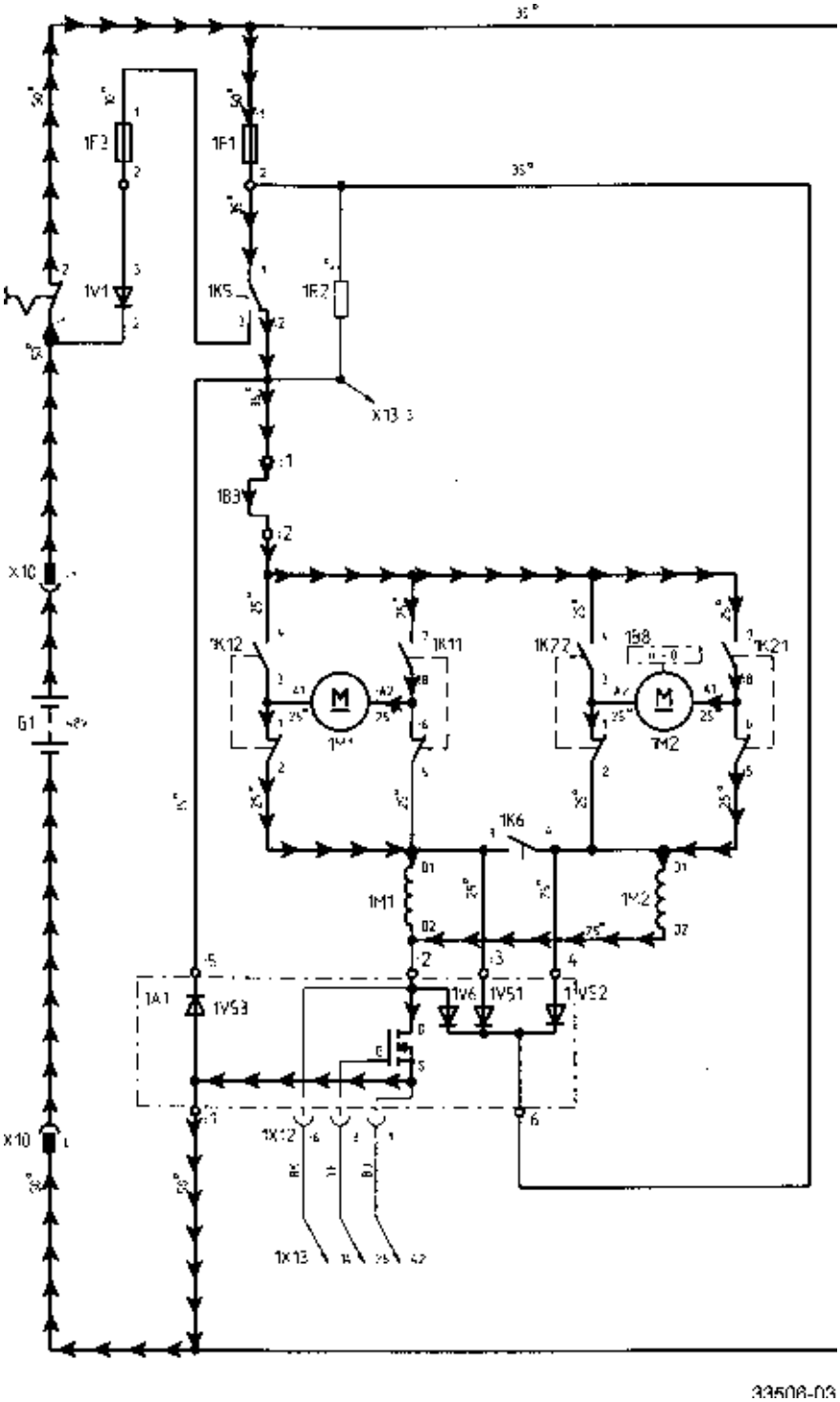
G1 Battery
S2 Emergency off switch
1A1 Power unit
1B3 Current sensor
1F1 Main circuit fuse
1F3 Fuse
1K5 Regenerative current contactor
1K11 Reverse contactor, right-hand
1K12 Forward contactor, right-hand
1K21 Reverse contactor, left-hand
1K22 Forward contactor, left-hand
1M1 Traction motor, right-hand
1M2 Traction motor, left-hand
1R2 Resistor
1V1 Diode
1V6 Freewheel diode
1V51 Brake diode
1V52 Brake diode
1V53 Regenerative current diode

2.6.5.1 CURRENT PATH FOR FORWARD TRAVEL DIRECTION



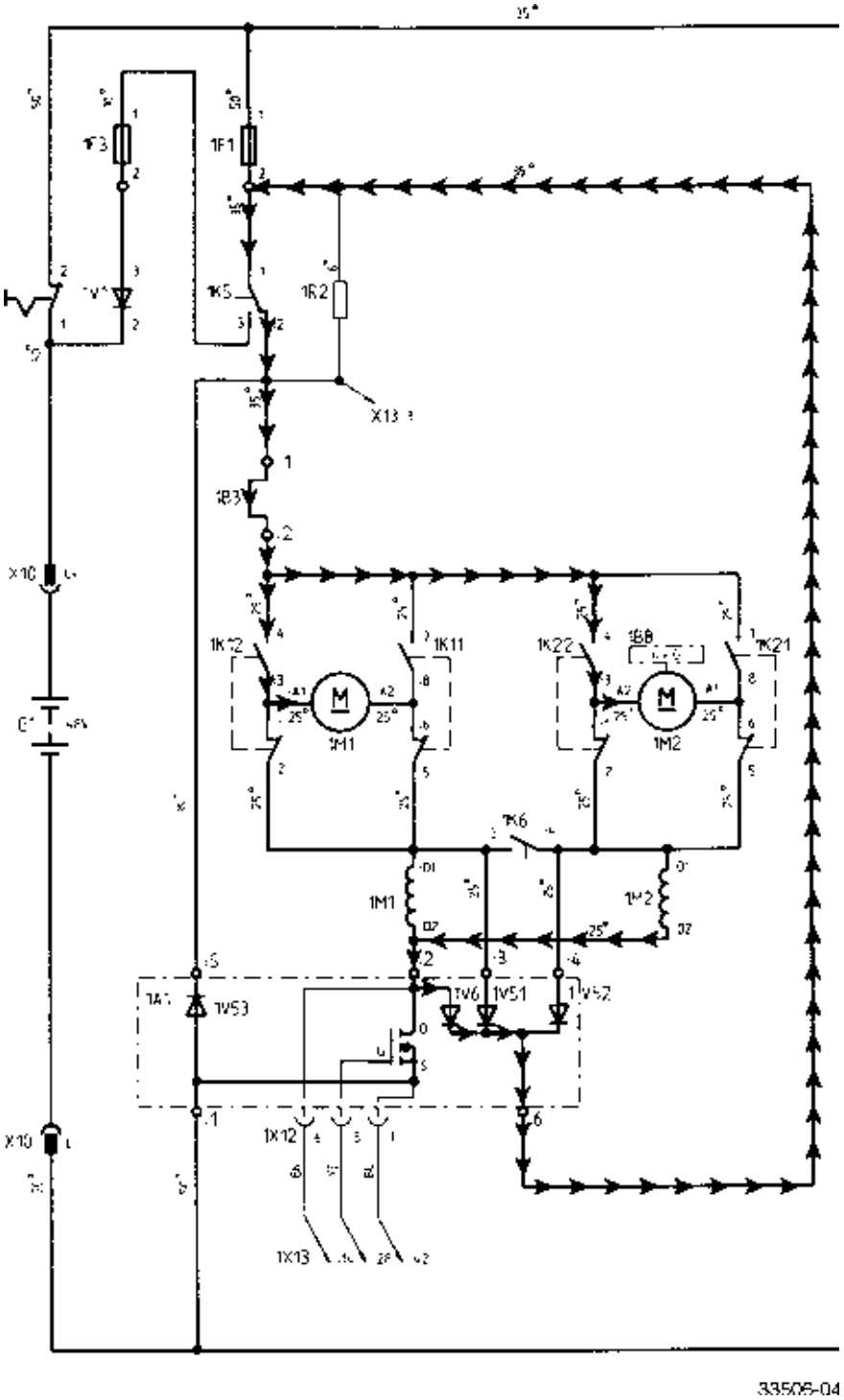
Battery G1 + -> emergency off switch S2 ->main circuit fuse 1F1 -> regenerative current contactor 1K5 (break contact) current sensor 1B3 -> contactor 1K12 (make contact) and contactor 1K22 (break contact) -> motor armature winding 1M1 (A1, A2) and motor armature winding 1M2 (A2, A1) -> contactor 1K11 (break contact) and contactor 1K21 (break contact) -> motor field winding 1M1 (D1, D2) and motor field winding 1M2 (D1, D2) ->power unit 1A1-> battery G1-

2.6.5.2 CURRENT PATH FOR REVERSE TRAVEL DIRECTION



Battery G1 + -> emergency off switch S2 ->main circuit fuse 1F1 -> regenerative current contactor 1K5 (break contact) current sensor 1B3 -> contactor 1K11 (make contact) and contactor 1K21 (make contact) -> motor armature winding 1M1 (A1, A2) and motor armature winding 1M2 (A2, A1) -> contactor 1K12 (break contact) and contactor 1K22 (break contact) -> motor field winding 1M1 (D1, D2) and motor field winding 1M2 (D1, D2) ->power unit 1A1-> battery G1-

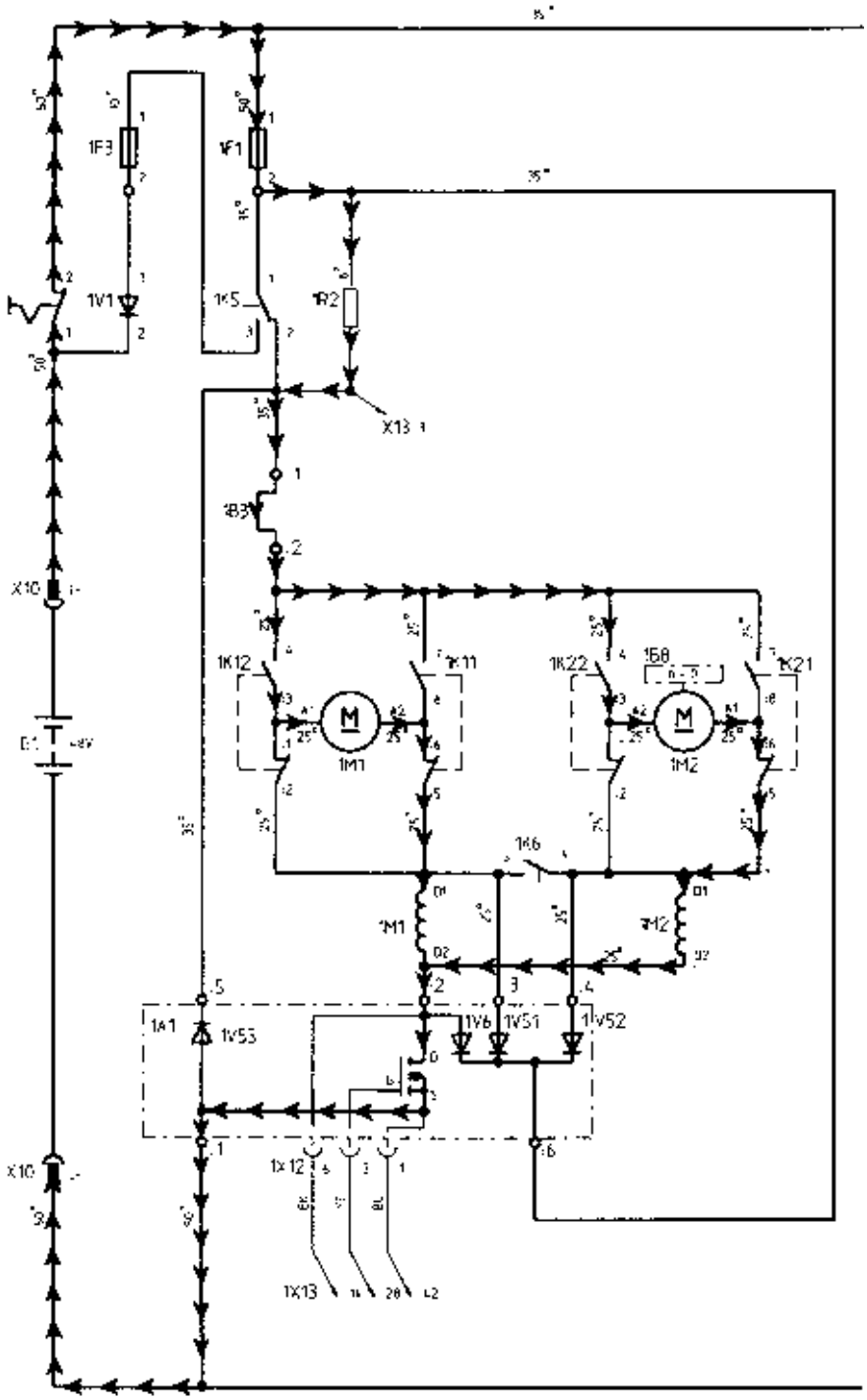
2.6.5.3 FREEWHEEL CIRCUIT



When the FETs in the power module are turned off, the traction motors induce a voltage. The induced voltage is negative at terminals A1 and A2 and positive at D2. Therefore a freewheel current can flow through freewheel diode 1V6 bypassing the motors.

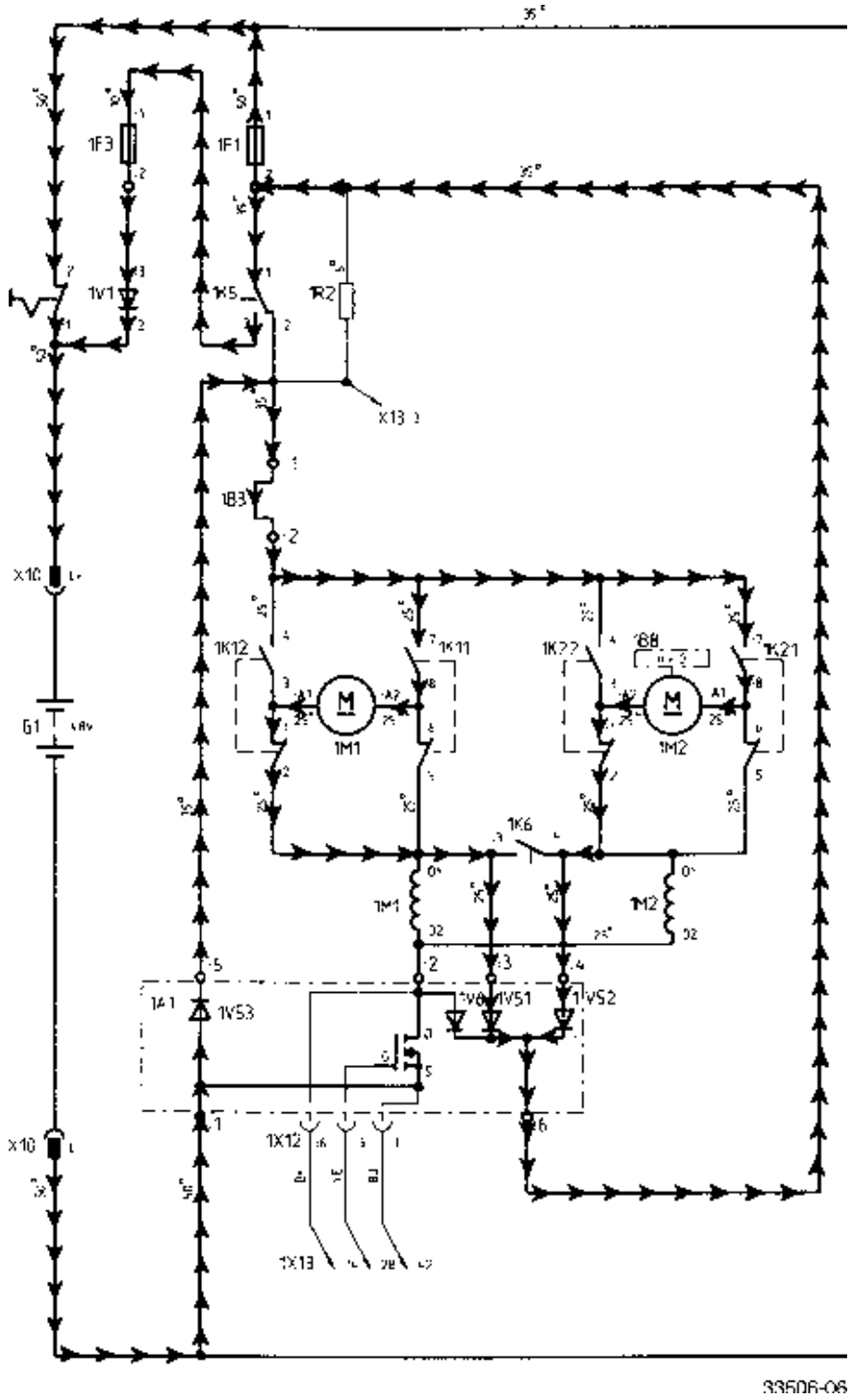
2.6.5.4 REGENERATIVE CURRENT BRAKING

2.6.5.4.1 BRAKE CIRCUIT STAGE 1



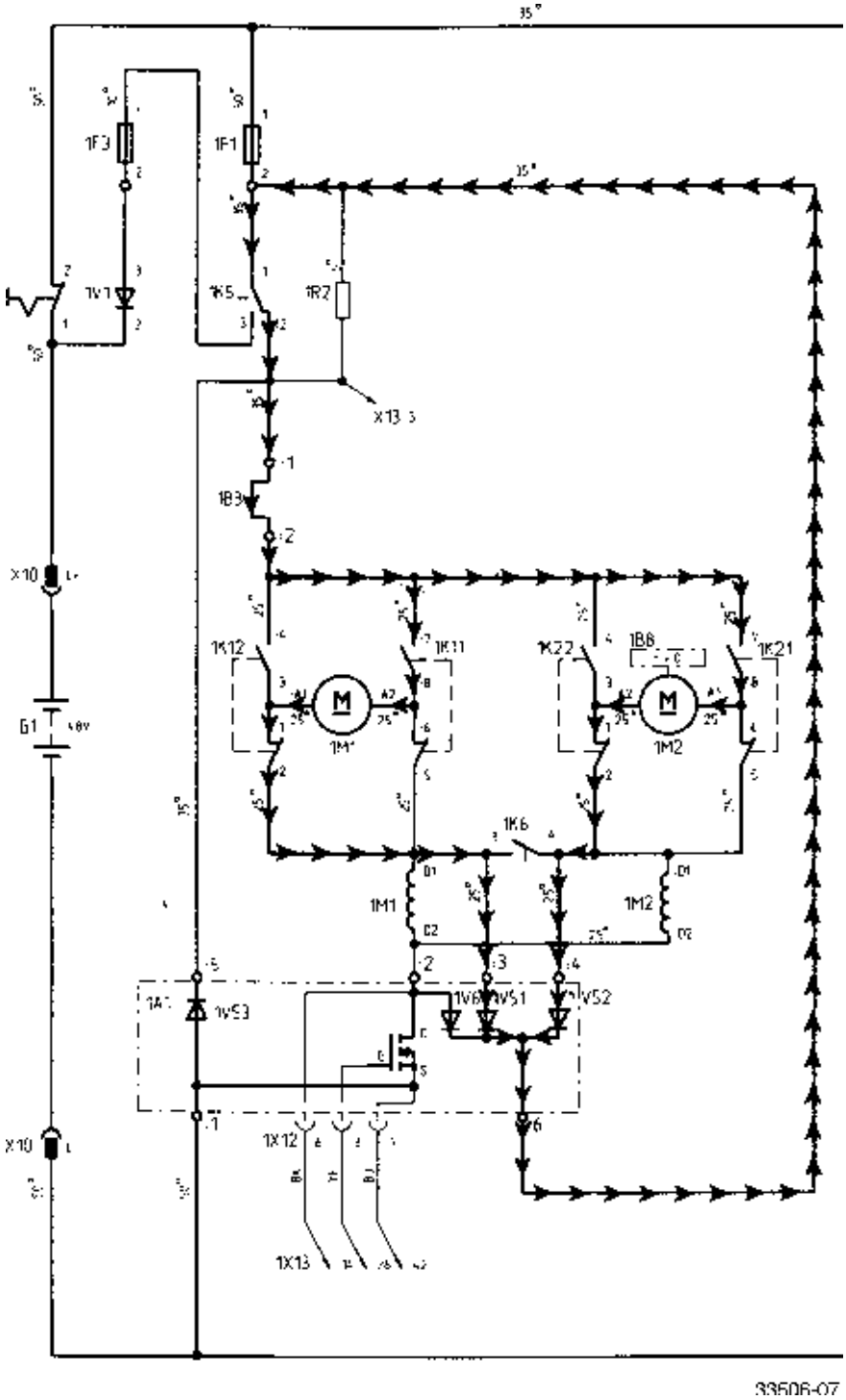
When the driver depresses the accelerator pedal for the opposite direction of travel or the brake pedal, regenerative current braking is initiated. In order to activate regenerative current braking, the speed of the truck must be at least 0.9 km/h (below this speed the truck operates with the traditional reverse current braking). The regenerative current contactor 1K5 makes and the contact of 1K5 opens. At the start of braking the power module is on, allowing a current to flow from the battery through resistor 1R2 and so exciting the field windings of the motor. After their excitation, the motors function as generators and they supply a generator voltage. Contactor 1K6 makes at the same time, which connects both field windings of the two motors in parallel to prevent transient currents from flowing between the motors that would lead to unfavourable braking characteristics.

2.6.5.4.2 BRAKING CIRCUIT STAGE 2



As soon as the motors act as generators, a regenerative current flows through the brake diodes 1V51 and 1V52 back to the battery. The battery negative pole is connected to the armature winding of the motors via regenerative brake diode 1V53.

2.6.5.4.3 BRAKING CIRCUIT STAGE 3

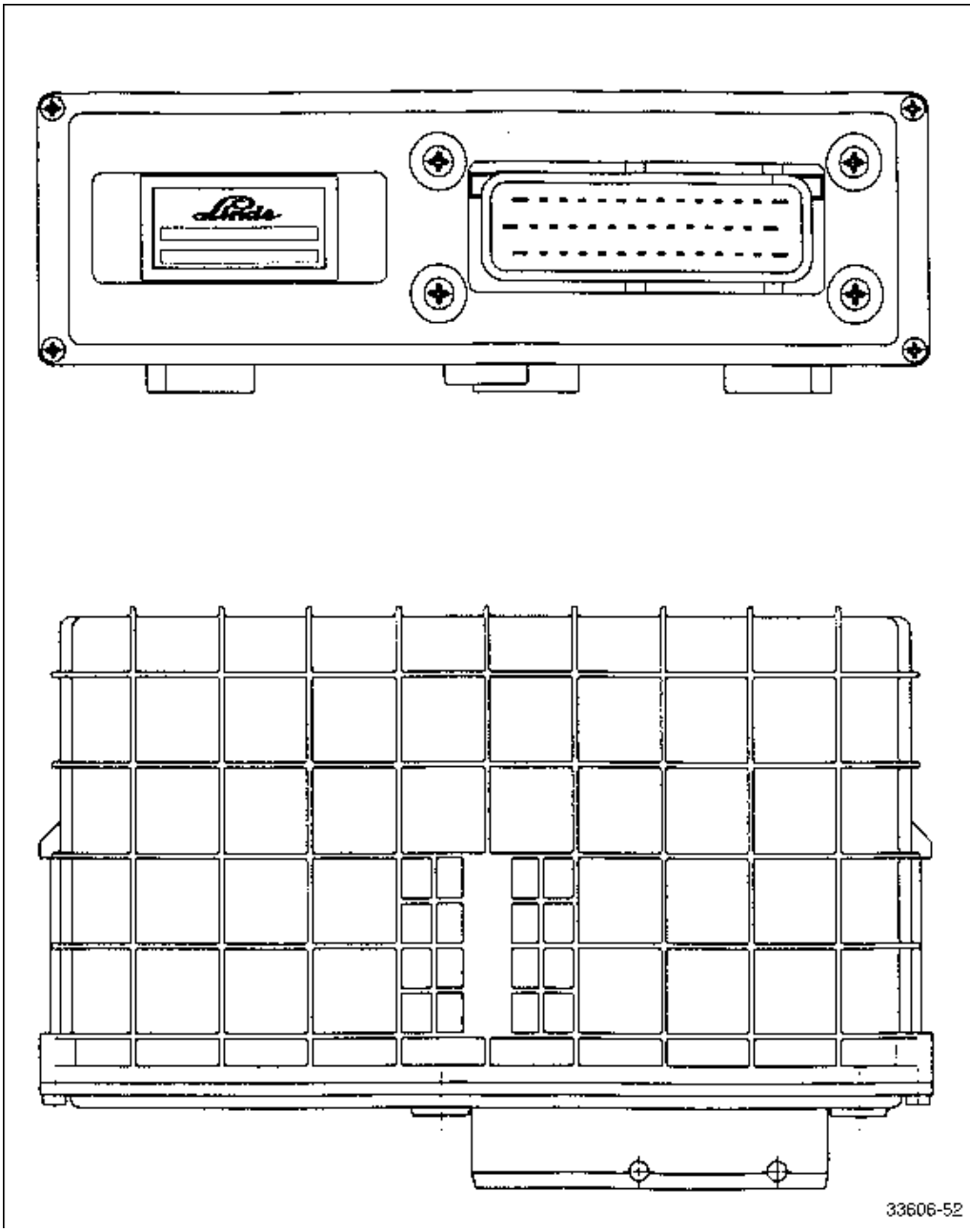


When truck speed has dropped to 0.45 km/h, the regenerative current contactor 1K5 and circuit breaking contactor 1K6 and the truck is braked to a standstill with plugging. The regenerative current flows over the two brake diodes 1V51 and 1V52 and the contact of the open regenerative current contactor 1K5.

The generator voltage is regulated in the field winding by the current flow.
If the emergency stop switch is operated during braking, the generator current returns to the battery via fuse 1F3 and diode 1V1.

2.6.6 ELECTRONIC TRACTION CONTROL UNIT

The electronic traction control unit contains the entire control logic for the evaluation of the sensor signals, the control of the power module, the directional contactors and the control of the regenerative braking. The electronic traction control unit has a 42-pin connector for monitoring and controlling all traction functions and regenerative braking.

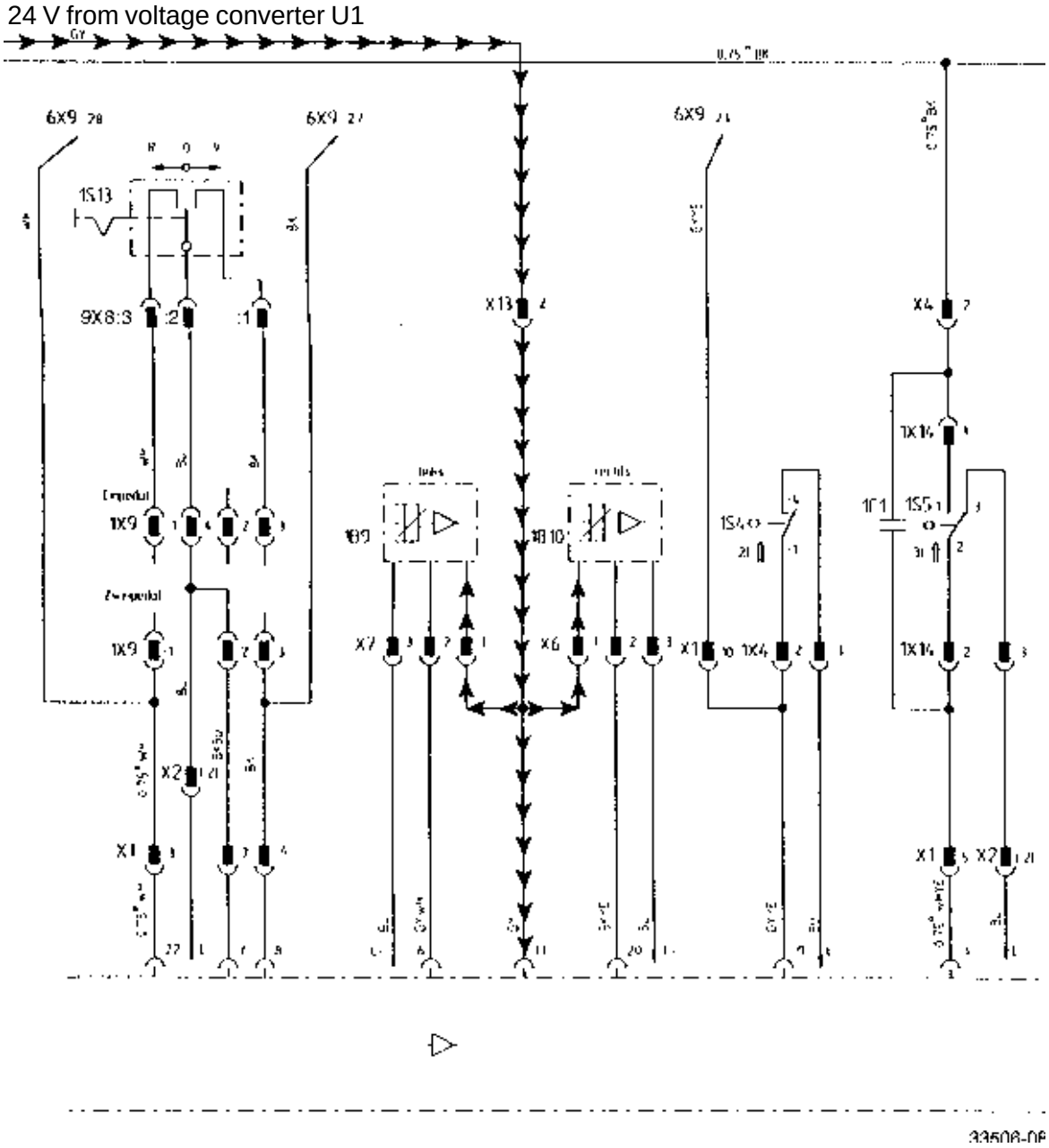


PIN LAYOUT

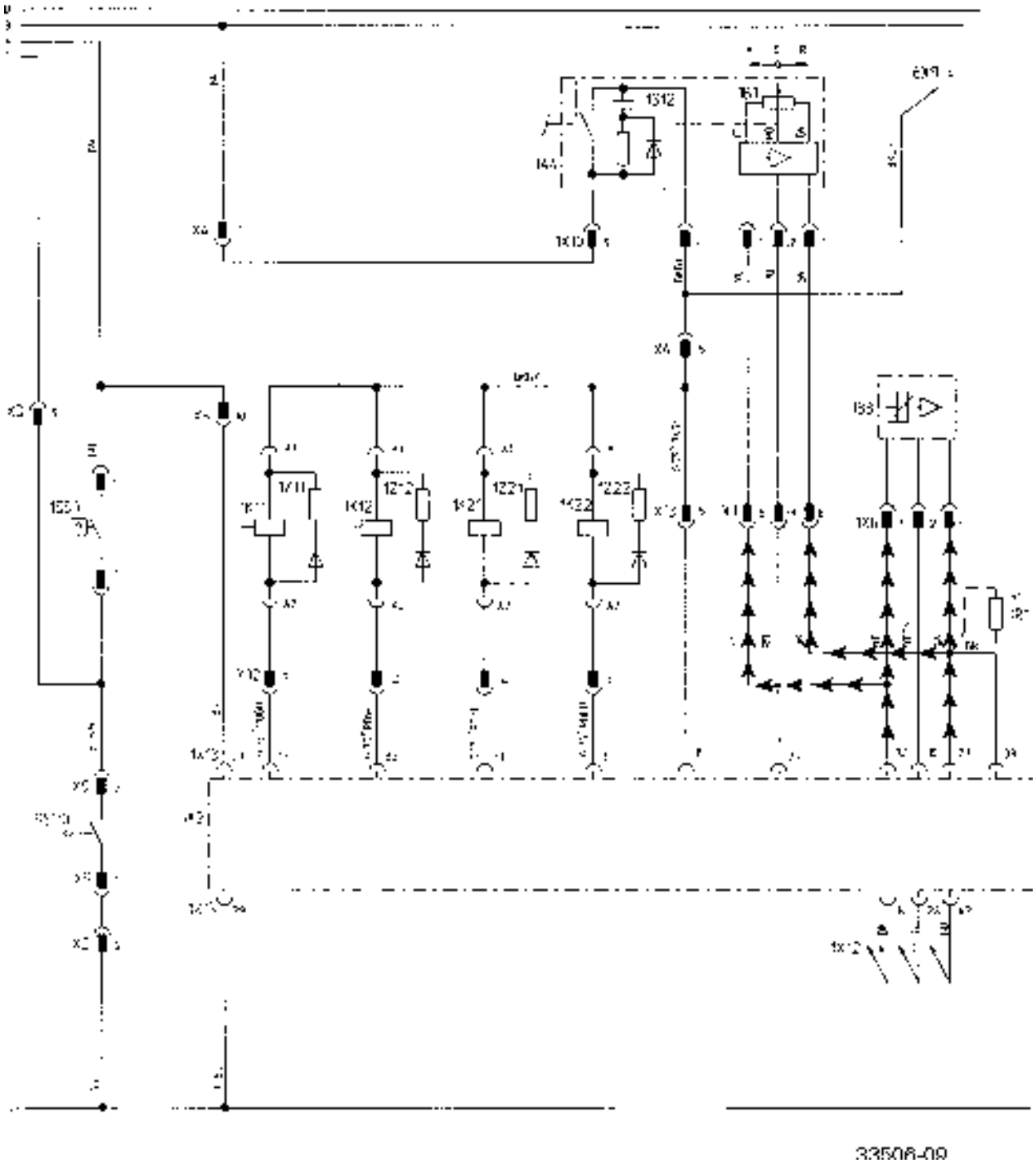
Pins for connector 1X13

Terminal	Colours	Functions
1	white/yellow	signal of brake current switch 1S5
2		not used
3	red/blue	negative directional contactor 1K22
4	black/yellow	negative circuit breaking contactor 1K6
5	white/blue	signal microswitch 1S10 (regenerative current contactor 1K5)
6	grey/white	signal of left curve sensor 1B9
7	black/blue	encoding for single-pedal models
8	black forward	direction signal, single-pedal models
9	grey/yellow	signal of handbrake switch 1S4
10	yellow/green	signal of current sensor 1B3
11	green	signal of speed sensor 1B8, channel A
12	yellow	power supply 15 V for 1A4 and 1B3
13	grey	power supply 24 V
14	black	auxiliary drain of compact module
15	black/grey	power supply for directional contactors (when braking)
16		not used
17	red/green	negative directional contactor 1K11
18	violet	negative regenerative current contactor 1K5
19		not used
20	black/yellow	signal of right curve sensor 1B10
21	brown	seat switch enable signal
22	white reverse	direction signal, single-pedal models
23	black/green	signal of temperature switch 1B6 and 1B7 (traction motors)
24	red	signal of accelerator sensor 1A4 (desired value)
25	white	signal of speed sensor 1B8, channel B
26		centre feed 7.5 V
27	green	negative voltage for 1A4 and 1B3
28	yellow	gate control in compact module
29	blue	negative voltage for directional contactor transistors
30	white/green	main circuit, regenerative current contactor 1K5
31	red/yellow	negative of directional contactor 1K21
32	red/white	negative of directional contactor 1K12
33		not used
34		not used
35		not used
36		not used
37		not used
38	green	speed reduction
39	yellow	15 V power supply for speed sensor 1B8
40		not used
41	green	negative of power supply for speed sensor 1B8
42	blue	auxiliary source in compact module

2.6.6.1 POWER SUPPLY



When key switch S1 is turned on, the voltage converter is connected to the primary side of battery positive. The electronic traction control unit is supplied with 24 Volt at 1X13:13 via connector X8:3 and fuse 1F4. Battery negative is connected to the electronic traction control unit via the auxiliary source terminal 1A1 of the compact module.



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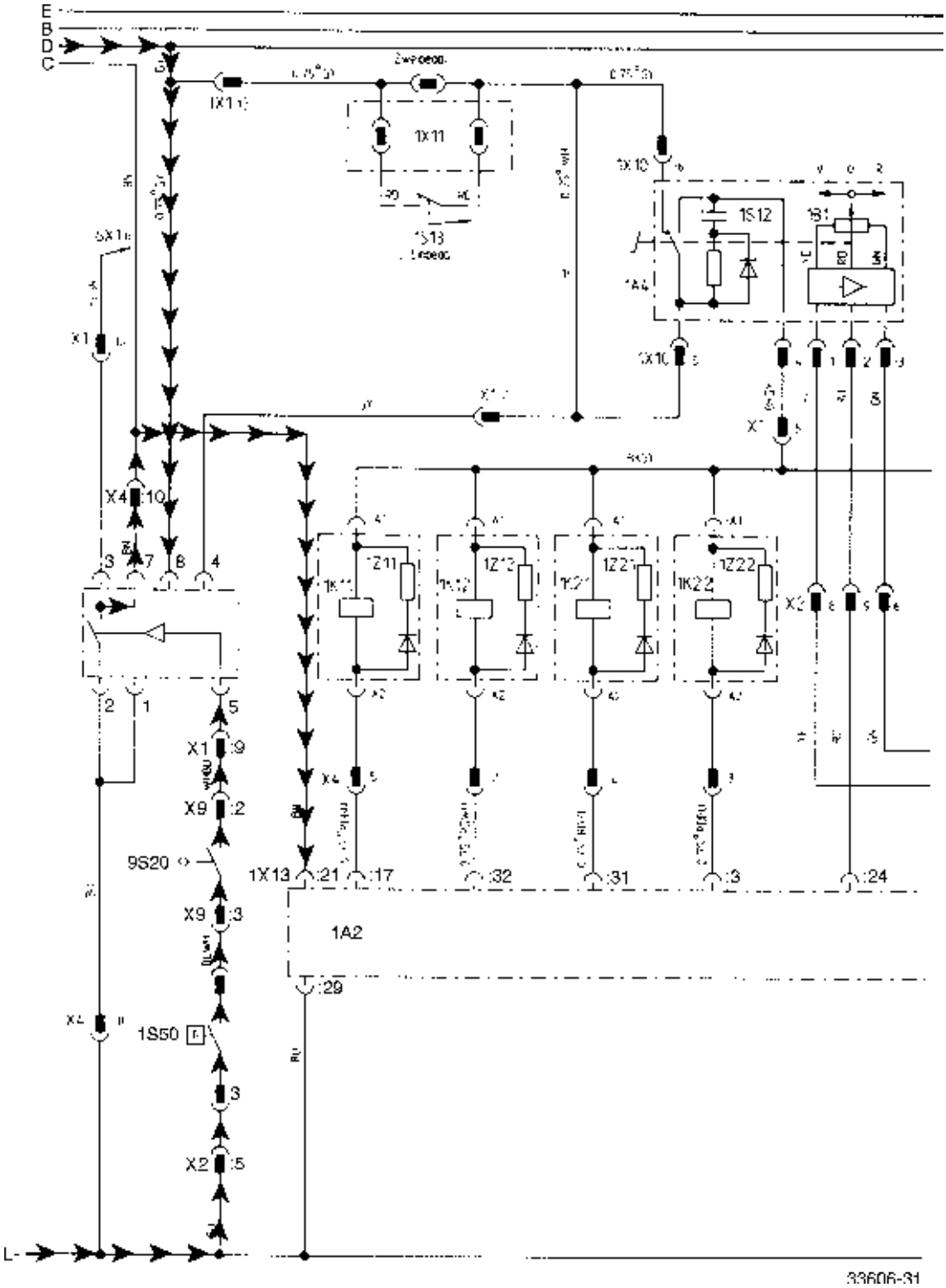
The electronic traction control unit makes a stabilized 15 V direct current supply of the 24 VDC from the voltage converter. This d.c. voltage supplies the electronic traction control unit, the integrated circuits and other electronic components. This 15 Volt power supply is also required for the accelerator sensor, the current sensor and the speed sensor.

Supply voltage for accelerator sensor and current sensor:

+15 V via 1X13:12
Negative via 1X13:27

2.6.6.2 TRACTION ENABLE

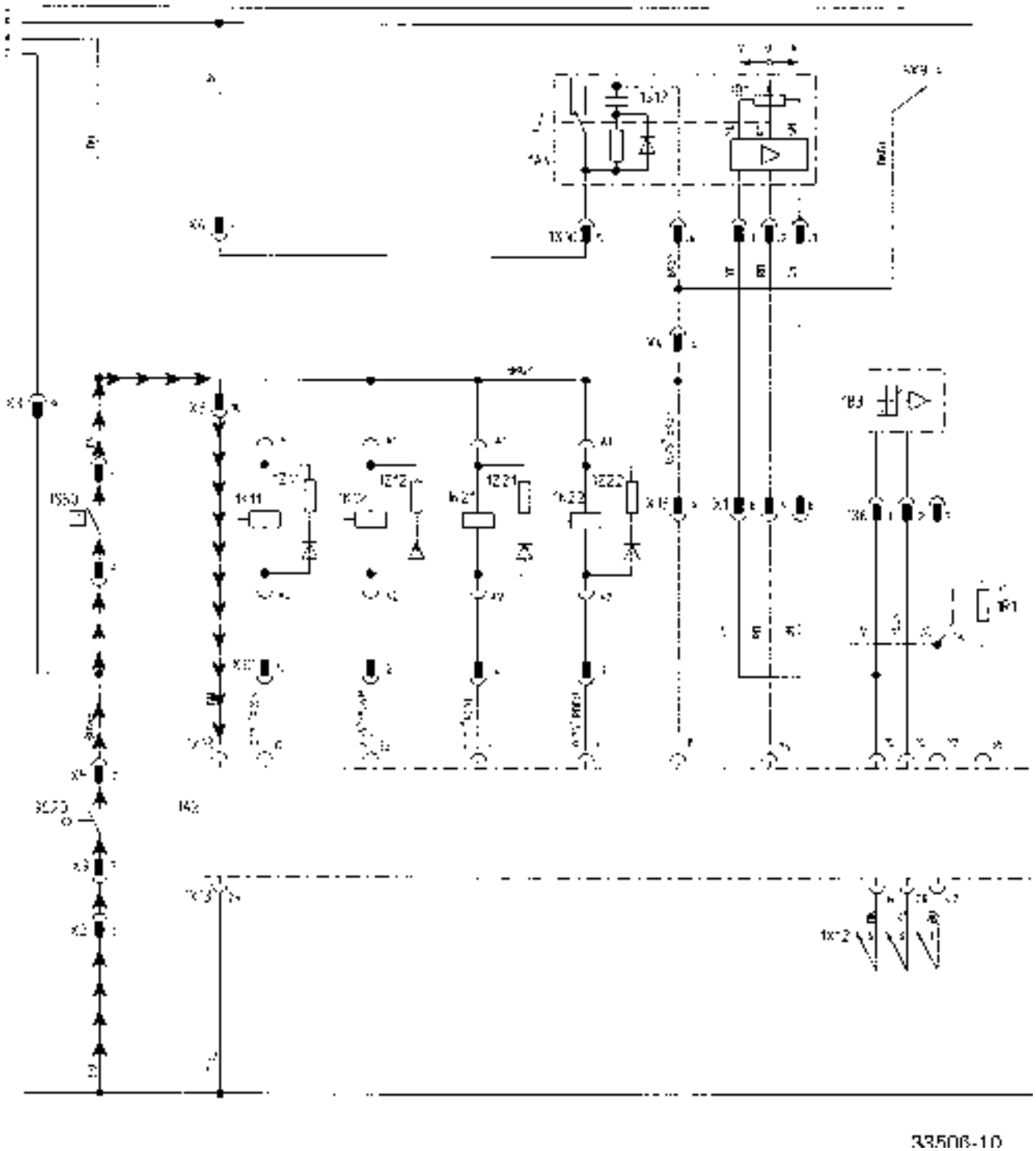
2.6.6.2.1 TRACTION ENABLE TO SERIES 6/95



.

The timer 1A3 for the seat switch controls the enable signals for the electronic traction and lift control unit. Battery negative is applied to 1A3:5 via seat switch 1S50 and overhead guard switch 9S20. When the key switch is turned on, battery positive is applied to 1A3:8 via line D. The relay in timer 1A3 makes and applies battery negative to traction control unit 1X13:21 via 1A3:7.

2.6.6.2.2 TRACTION ENABLE FROM SERIES 7/95

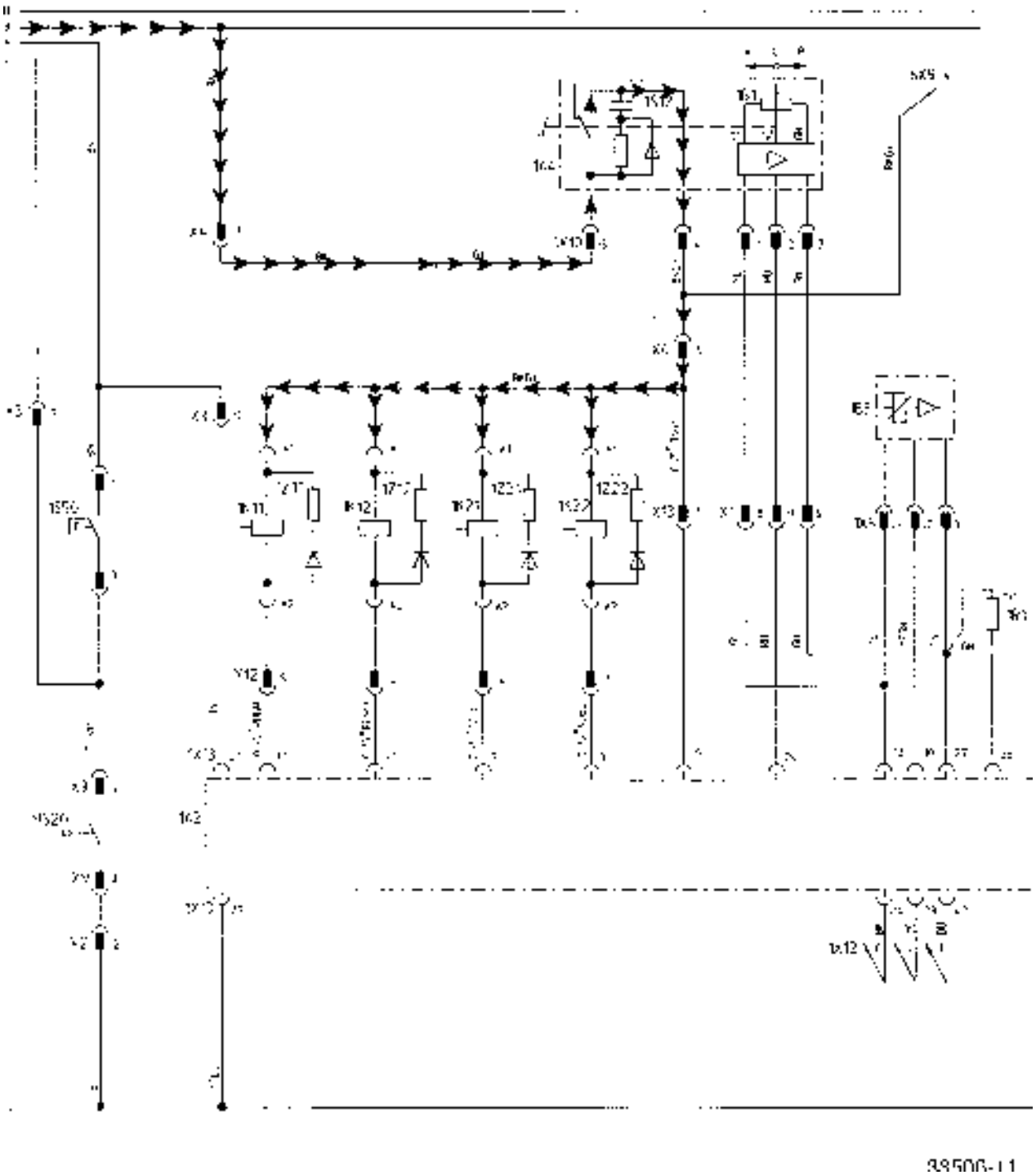


33506-10

Battery negative is applied to the traction module 1X13:21 via seat switch 1S50 and overhead guard switch 9S20.

When seat switch 1S50 or overhead guard switch 9S20 is opened, the timer relay opens after a delay of approx. 2 seconds in order to prevent inappropriate switching when travelling on an uneven roadway.

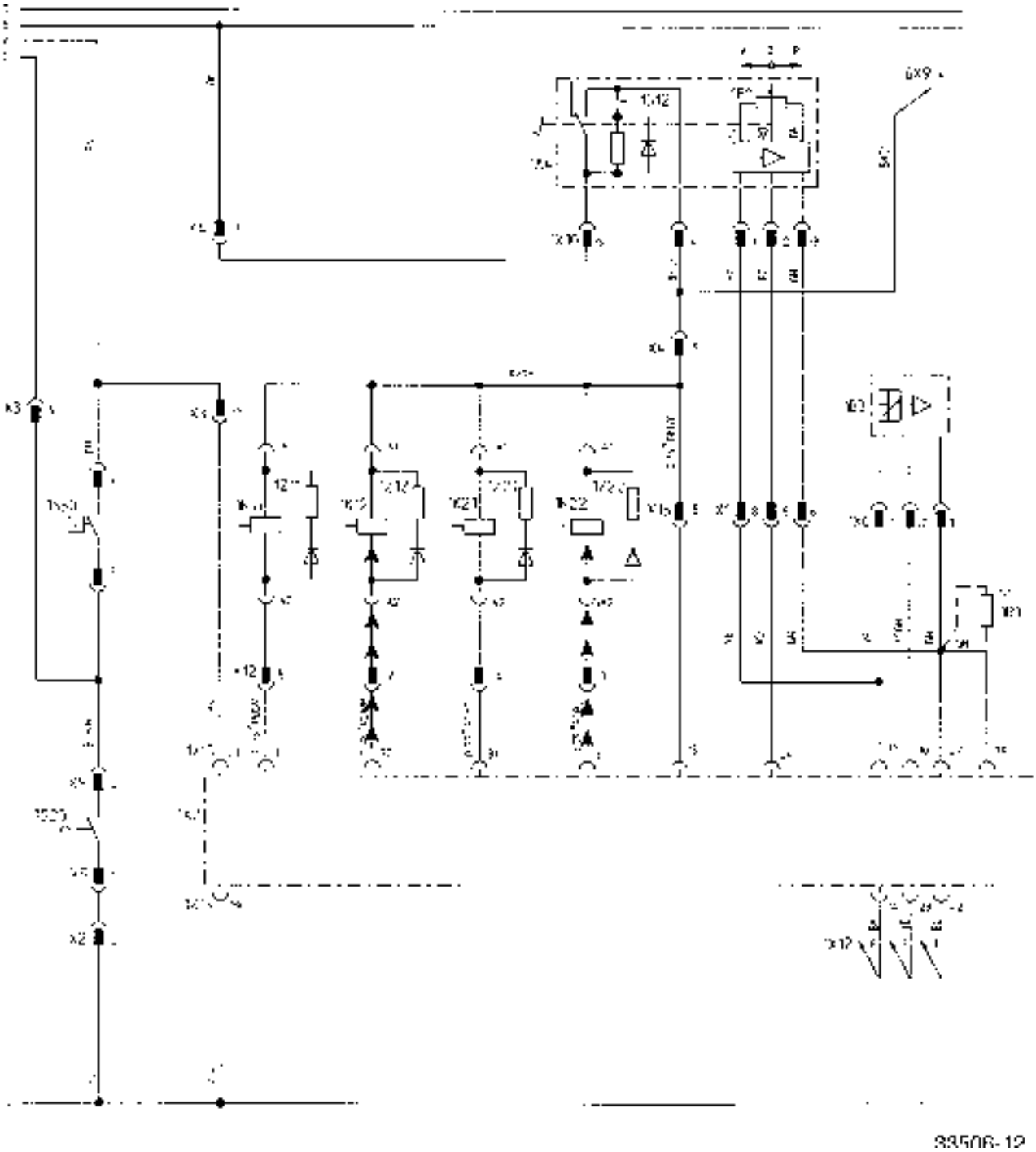
2.6.6.3 CONTROL OF DIRECTION CONTACTORS



38500-11

When key switch S1 is turned on and the seat switch is actuated, battery positive is applied to 1X10:5 of the accelerator sensor. When the accelerator pedal is depressed either for forward or reverse travel, battery positive is applied via microswitch 1S12 to the coils of the four directional contactors. The field effect transistors in the electronic traction control unit control the appropriate directional contactors, dependent upon the output voltage of the accelerator sensor.

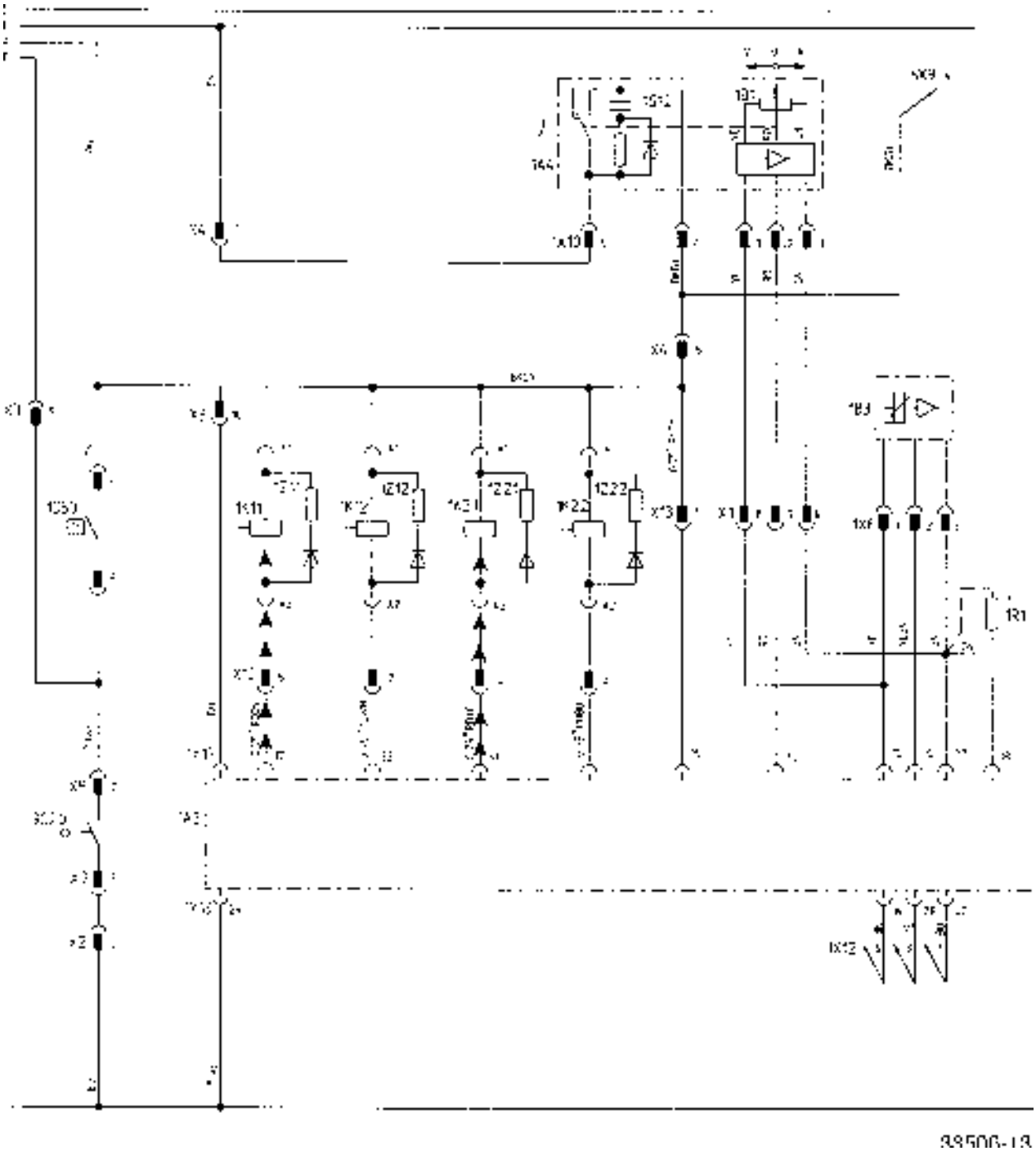
2.6.6.3.1 FORWARD DIRECTION OF TRAVEL



83506-12

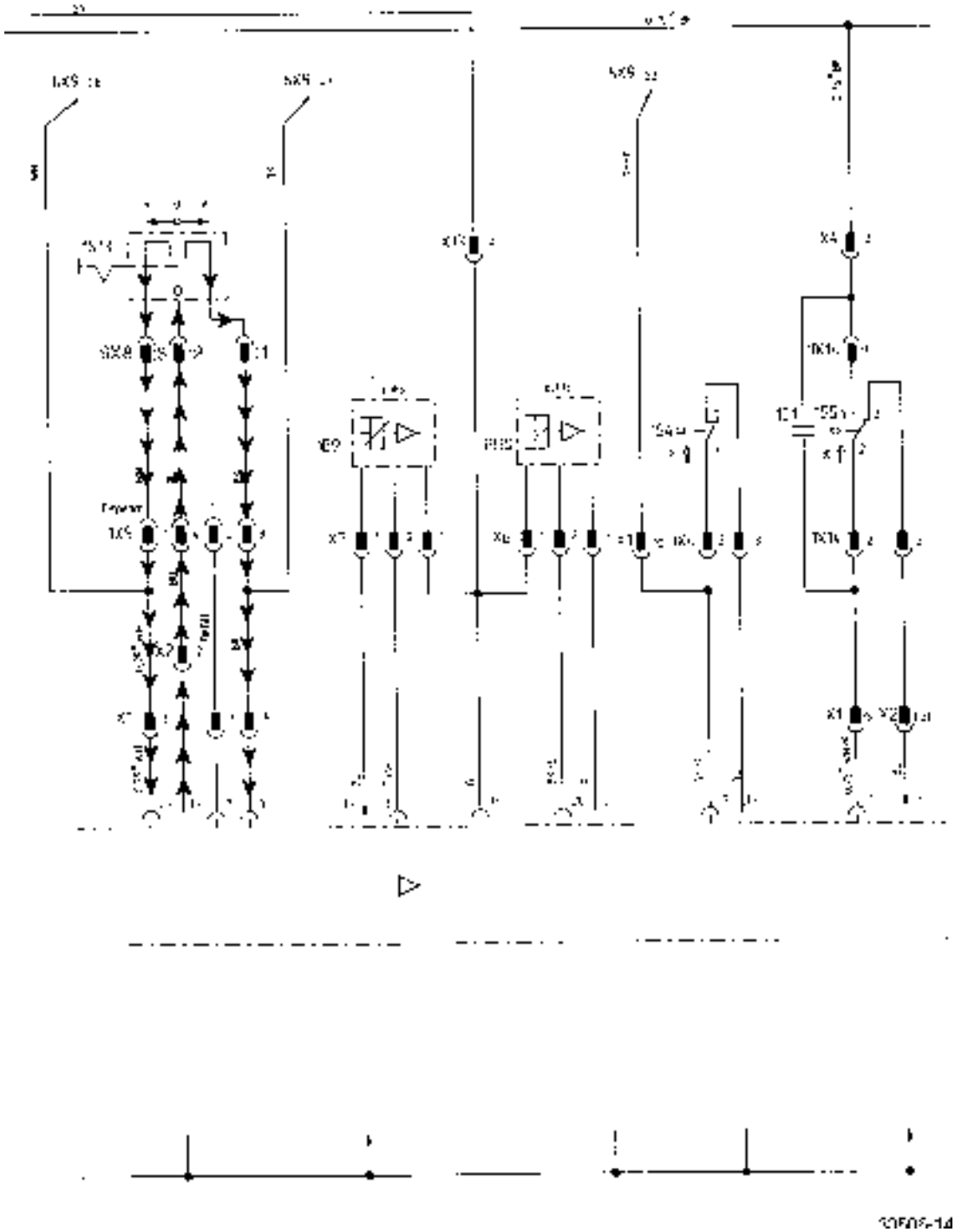
When the accelerator pedal for forward travel is depressed, the accelerator sensor output voltage at terminal 1X13:24 is less than 7.5 Volt.
When the accelerator sensor output voltage is less than 7.5 V, a logic circuit integrated in the electronic traction control applies battery negative to contactors 1K12 (right-hand motor) and 1K22 (left-hand motor) with the help of the two transistors for forward direction of travel.
In this way, switch 1S12 in the accelerator sensor does not control the directional contactors and it is therefore electrically wear-free.

2.6.6.3.2 REVERSE DIRECTION OF TRAVEL



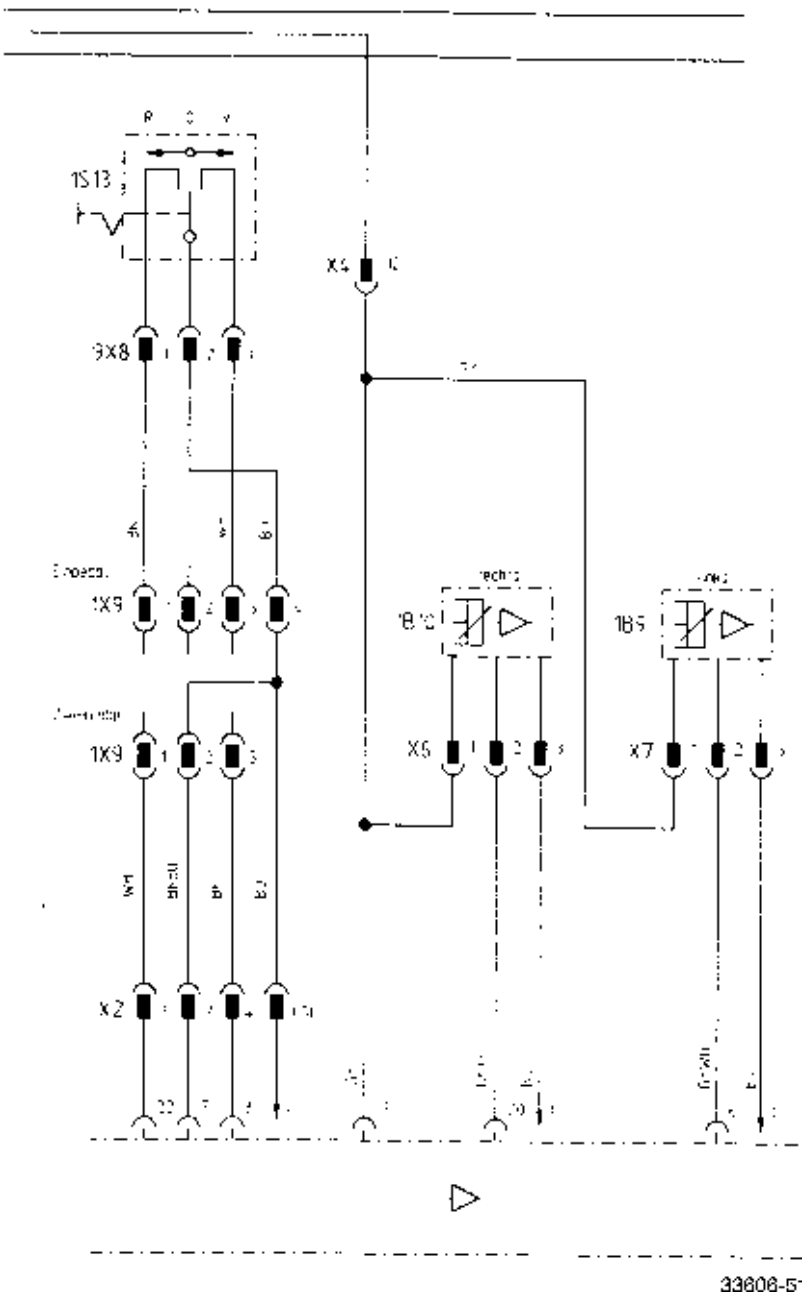
When the accelerator pedal for reverse travel is depressed, the accelerator sensor output voltage at terminal 1X13:24 is over 7.5 Volt. The two transistors for reverse travel now apply battery negative to contactors 1K11 (right-hand motor) and 1K21 (left-hand motor).

2.6.6.4 SINGLE PEDAL MODELS



On single-pedal model trucks, the directional contactors are controlled via travel direction switch 1S13, which is located on the steering column.
This travel direction switch is connected to the electronic traction control unit via 4-pin flat connector 1X9.
The black/blue cable coming from the electronic traction control unit (1X13:7) is connected to terminal 2 of 4-pin connector 1X9.
The directional switch is used to apply battery negative to 1X13:8 when driving forward or to 1X13:22 when reversing. This battery negative signal then takes over control of the directional transistors in the electronic traction control unit.

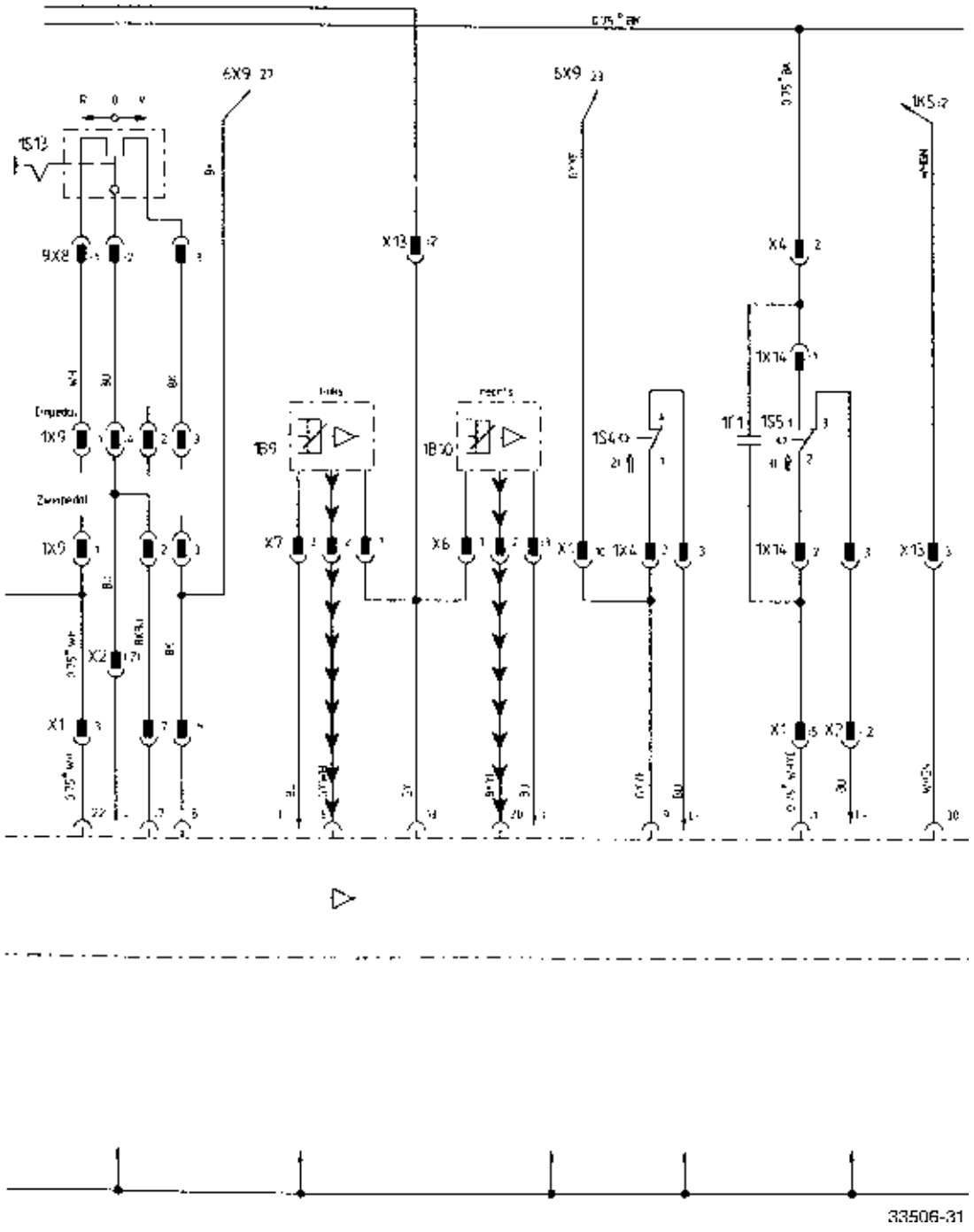
2.6.6.4.1 MODIFICATION TO SINGLE-PEDAL MODEL



- Modify the traction control to the single-pedal version.
- Remove the steering column cover.
- Disconnect the blue cable on terminal 1X9:2 and plug it on the unused terminal 1X9:4.
- Install directional switch 1S13 on the steering column.
- Connect directional switch 1S13 to flat connector 1X9 according to the wiring diagram.

NOTE: From series 7/95, two indicator lights in the instrument show the preselected direction of travel. They are controlled directly via the two terminals :1 and :3 on plug 1X9.

2.6.6.5 DRIVING AROUND CORNERS



The two proximity switches 1B9 and 1B10 are mounted on the steering axle for sensing the steering lock. They are actuated when the steering lock is accordingly.
The two proximity switches are supplied with 24 VDC from the voltage converter via X6:1 or X7:1. The sensors are connected to battery negative via terminals X6:3 or X7:3. They are activated by the steering cylinder. When travelling straight ahead, both sensors are activated and battery negative is applied to terminals :6 and :20 in connector 1X13 of the electronic traction control unit. When the steering lock is over 40°, the sensor in question (1B9 = left-hand sensor, 1B10 = right-hand sensor) is no longer actuated and the battery negative signal at 1X13:20 (left) or 1X13:6 (right) is cut off. As a result, the motor on the inside curve is turned off by means of the directional contactors.

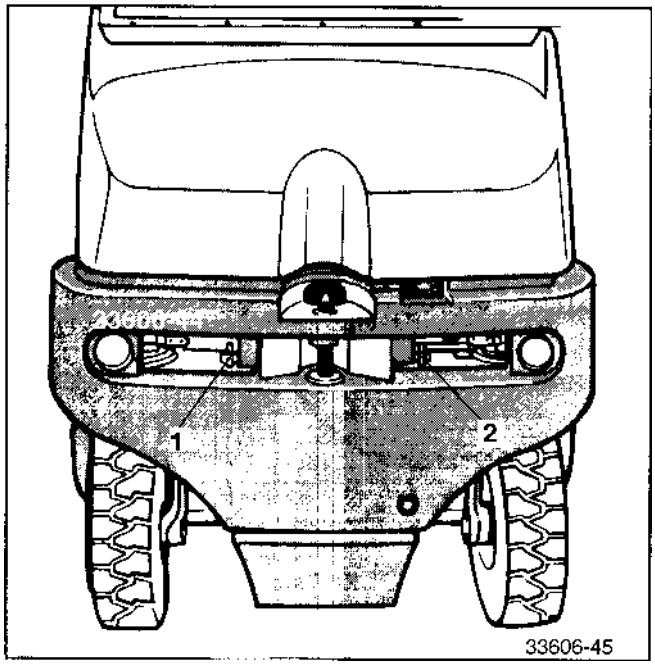
2.6.6.5.1 SENSORS FOR STEERING POSITION

Two curve sensors working on the principle of inductive proximity are used for sensing the steering lock. The two sensors sense the position of the steering cylinder directly and without contact. They are insensitive to dirt, wetness and temperature. When the steering lock is over 40°, the sensing area of the sensor is no longer influenced by the steering cylinder and the sensor output is switched off. When the steering cylinder is over the sensing area of the sensors (steering lock under 40°), the two sensors apply battery negative voltage to the electronic traction control.

Both sensors are connected to the main wiring harness via a 3-pin connector (sensor X6 with 1B9 on left-hand side, sensor X7 with 1B10 on right-hand side).

An LED is built into the sensor, which indicates the switching function of the sensor. The LED is not illuminated when the steering cylinder is no longer over the sensing area.

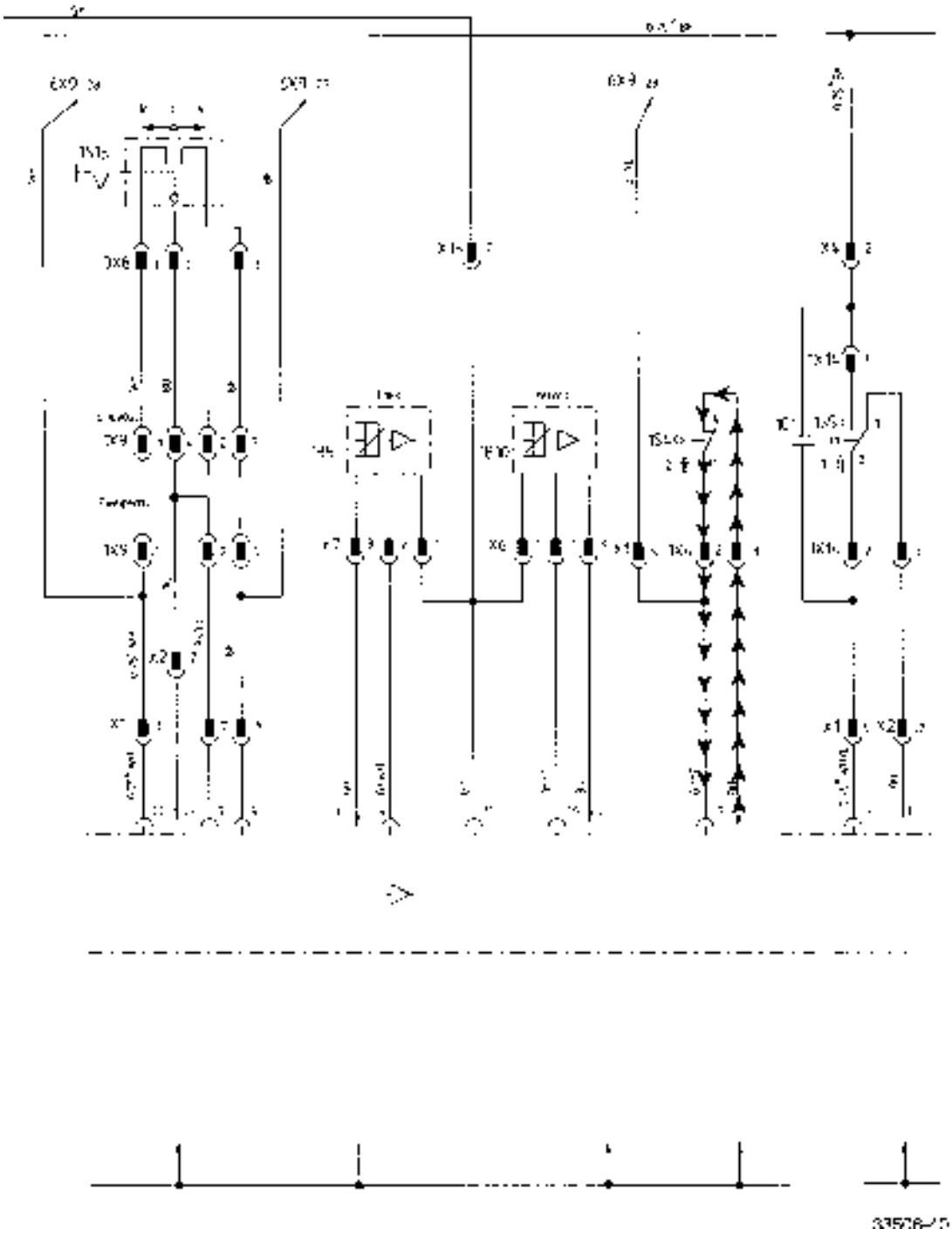
Curve sensor 1B9 (1), curve sensor 1B10 (2)



SENSOR ADJUSTMENT:

The sensors require a clearance of 1 mm between the sensing area and the steering cylinder. Both sensors can be set to the specified dimension with a feeler gauge after loosening the fastening nut.

2.6.6.6 HANDBRAKE CURRENT



Applying the handbrake actuates microswitch 1S4 and cuts off the battery negative signal at 1X13:9. When the handbrake is applied and the accelerator pedal is fully depressed, a limited current of 250 A flows through the traction motors. This allows starting uphill because the truck does not roll back when the brake is released.

2.6.6.6.1 CHECKING THE MAXIMUM CURRENT AND HANDBRAKE CURRENT

Maximum current

- Jack up the truck and block it up safely.
- Connect current measuring pliers WM 120 to the cable from current sensor 1B3 to the directional contactors.
- Fully depress the brake pedal and accelerator pedal.

NOTE: The wheels must not turn.

- Read the current.
- The maximum current must be approx. 430 Ampere.

CAUTION: Perform the measurement quickly in order to prevent damage to the traction motors. The maximum measuring time should not exceed 30 seconds.

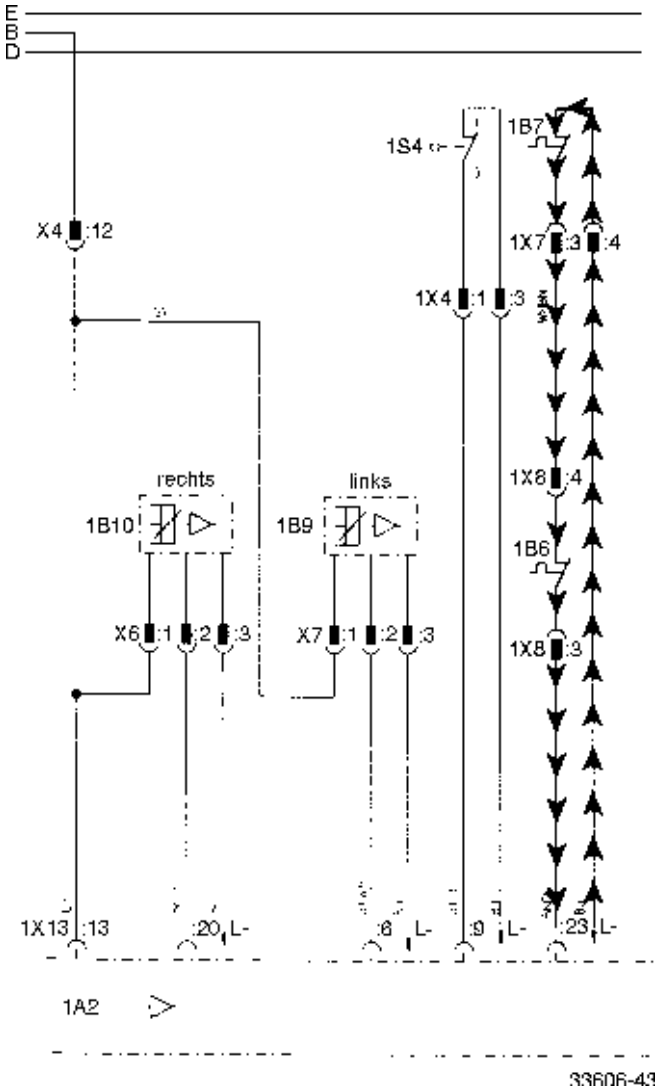
Handbrake current

- Install the current measuring pliers as described above.
- Engage the handbrake and fully depress the accelerator pedal.
- Read the current.
- The handbrake current must be approx. 150 Ampere.

NOTE: If the two current readings are not correct, the electronic traction control unit or the current sensor must be replaced.

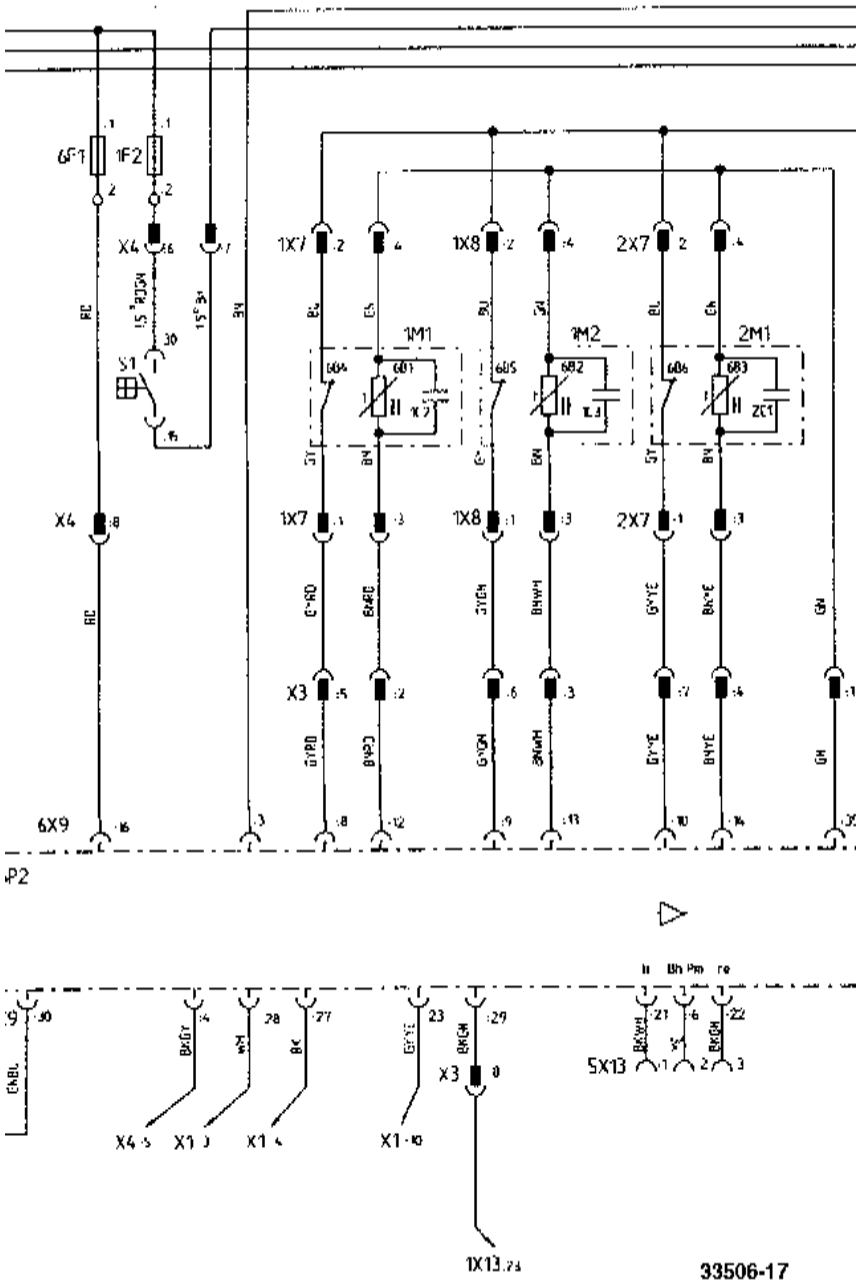
2.6.6.7 TEMPERATURE MONITORING TRACTION MOTORS

2.6.6.7.1 TEMPERATURE MONITORING WITH THERMAL SWITCHES TO SERIES 6/95



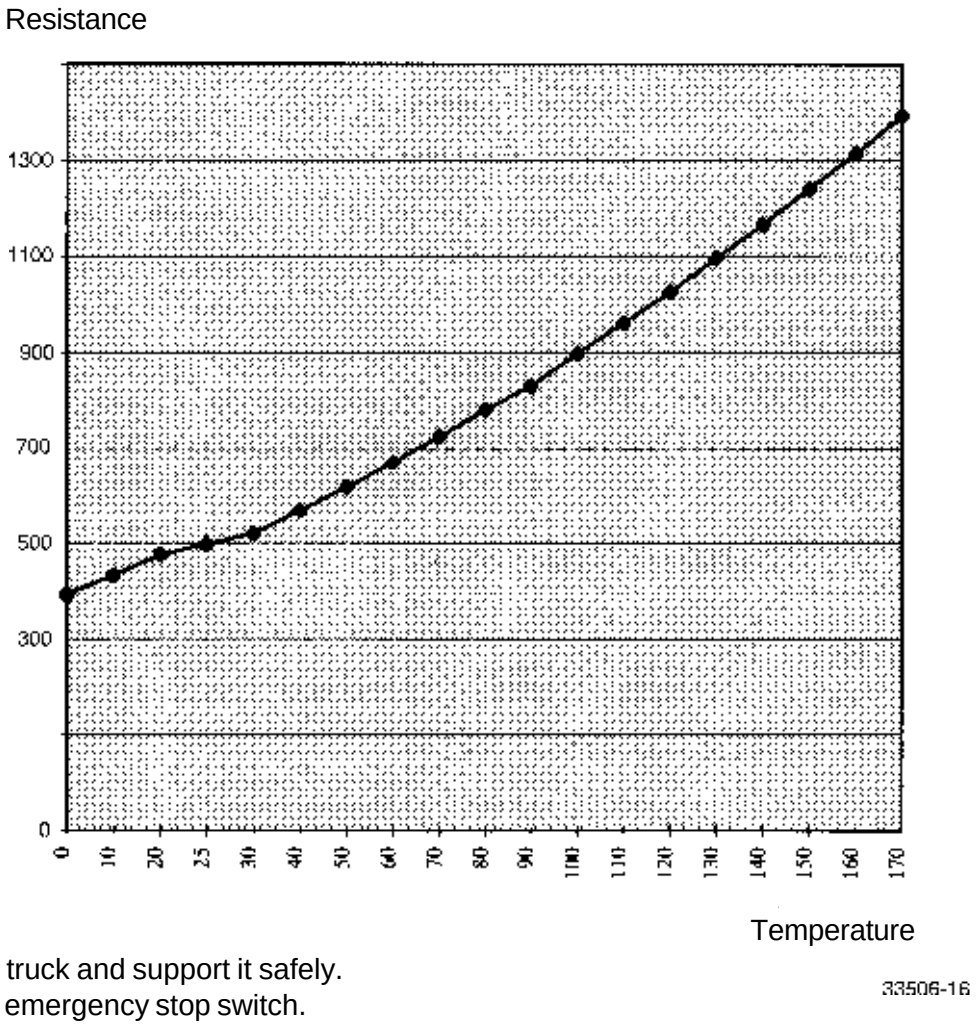
A thermal switch 1B6 or 1B7 is mounted to each or the traction motor brush holders. When the temperature of a traction motor reaches 160 °C, the battery negative signal normally applied to connector 1X13:23 is cut off. The maximum current or motor voltage is reduced to prevent damage to the traction motors. However, it is possible to drive the truck at reduced speed.

2.6.6.7.2 TEMPERATURE MONITORING WITH THERMAL SENSORS FROM SERIES 7/95



One thermal sensor 6B1 or 6B2 is mounted to each of the traction motor brush holders. The temperature sensor consists of a cold conductor (PTC-resistor). Cold conductors conduct electric current in the warm state less effectively than in the cold state. The thermal resistance of the thermal sensor increases rapidly with rising temperature. The resistance of the thermal sensor is evaluated by the combined instrument. The two thermal sensors are connected to the combined instrument via terminals 6X9:12 and :13. When the temperature is 160 °C, the battery negative signal at 6X29:29 (electronic traction unit 1X13:23) is cut out by the combined instrument. This reduces the maximum truck speed by 50 percent.

The thermal sensors are mounted on the motor brush holders and connected to the main wire harness with connectors 1X7, 1X8 and 2X7. Depending on the temperature, the resistance of the thermal sensors changes according to the following characteristic line:



Test:

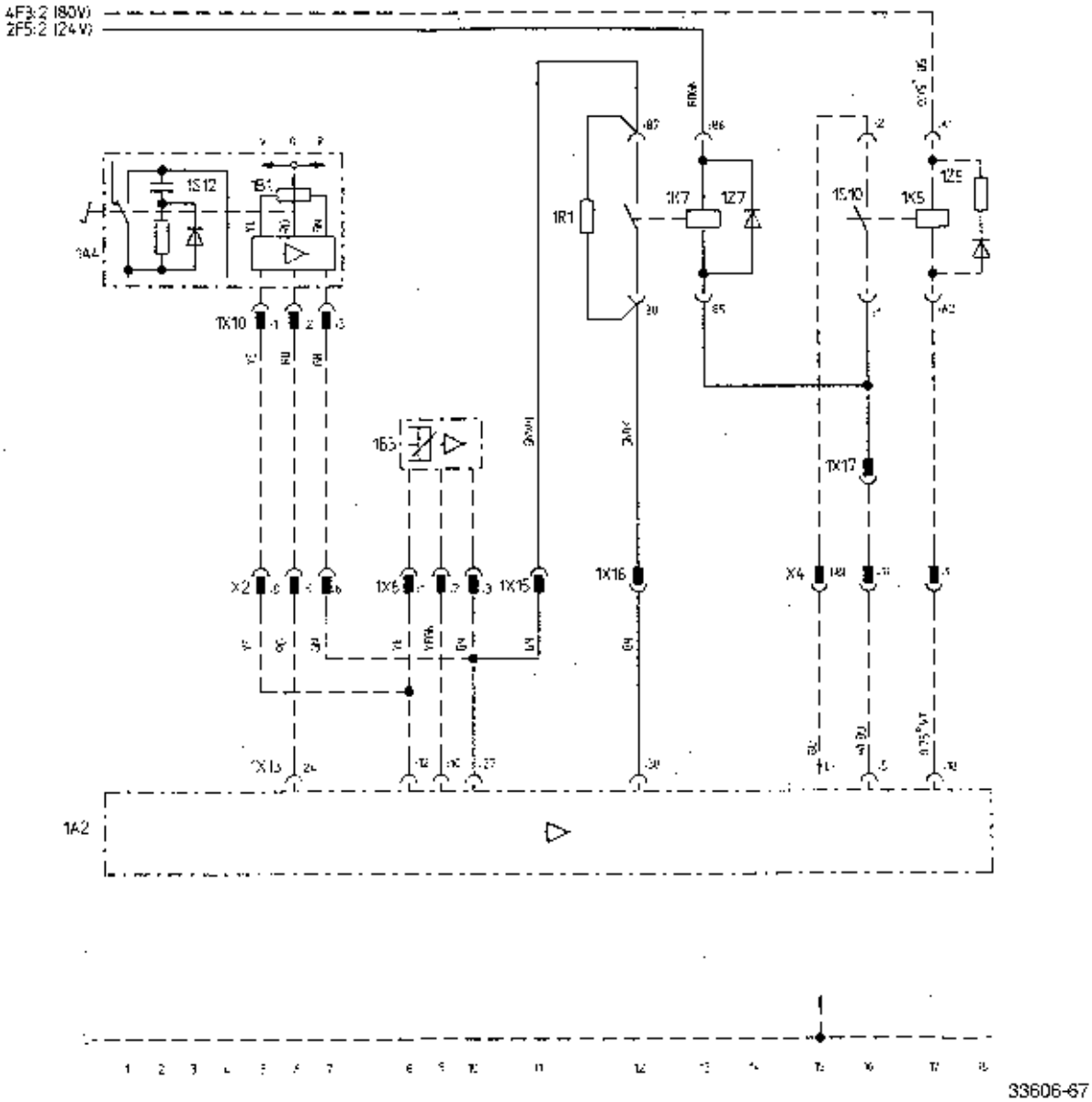
- Jack up the truck and support it safely.
- Actuate the emergency stop switch.
- Disconnect the connector to the motor in question.
- Measure the resistance between connector 1X7 or 1X8 at terminals :3 and :4. When the motor is cold (25 °C), the resistance should be approx. 500 Ohm.
- Drive the truck until the motor reaches operating temperature.
- Measure the resistance again. When the motor is warm (80 °C), the resistance should be approx. 800 Ohm.

2.6.6.8 SPEED REDUCTION

To limit the speed of the electric fork trucks it is necessary to separate the bridge between 1X13:27 and 1X13:38 and to solder fixed resistor 1R1. This fixed resistor is switched via an auxiliary 24 V relay 1K7. As soon as regenerative braking is activated, the speed reduction is cut out by the regenerative current contactor with microswitch 1S10.

NOTE: Only the travel speed of the truck will be reduced. The maximum climbing ability of the truck does not change. The resistance of 1R1 can be determined according to the following table. Replacement parts for the speed reduction are available as custom equipment (UPA).

Speed	Resistance
6 km/h	26,1 kΩ
7 km/h	24,9 kΩ
8 km/h	24,3 kΩ
9 km/h	23,7 kΩ
10 km/h	23,2 kΩ
11 km/h	22,1 kΩ
12 km/h	21,5 kΩ
13 km/h	21,0 kΩ
14 km/h	20,0 kΩ
15 km/h	18,2 kΩ



1R1 Resistor
1K7 Relay 24 V

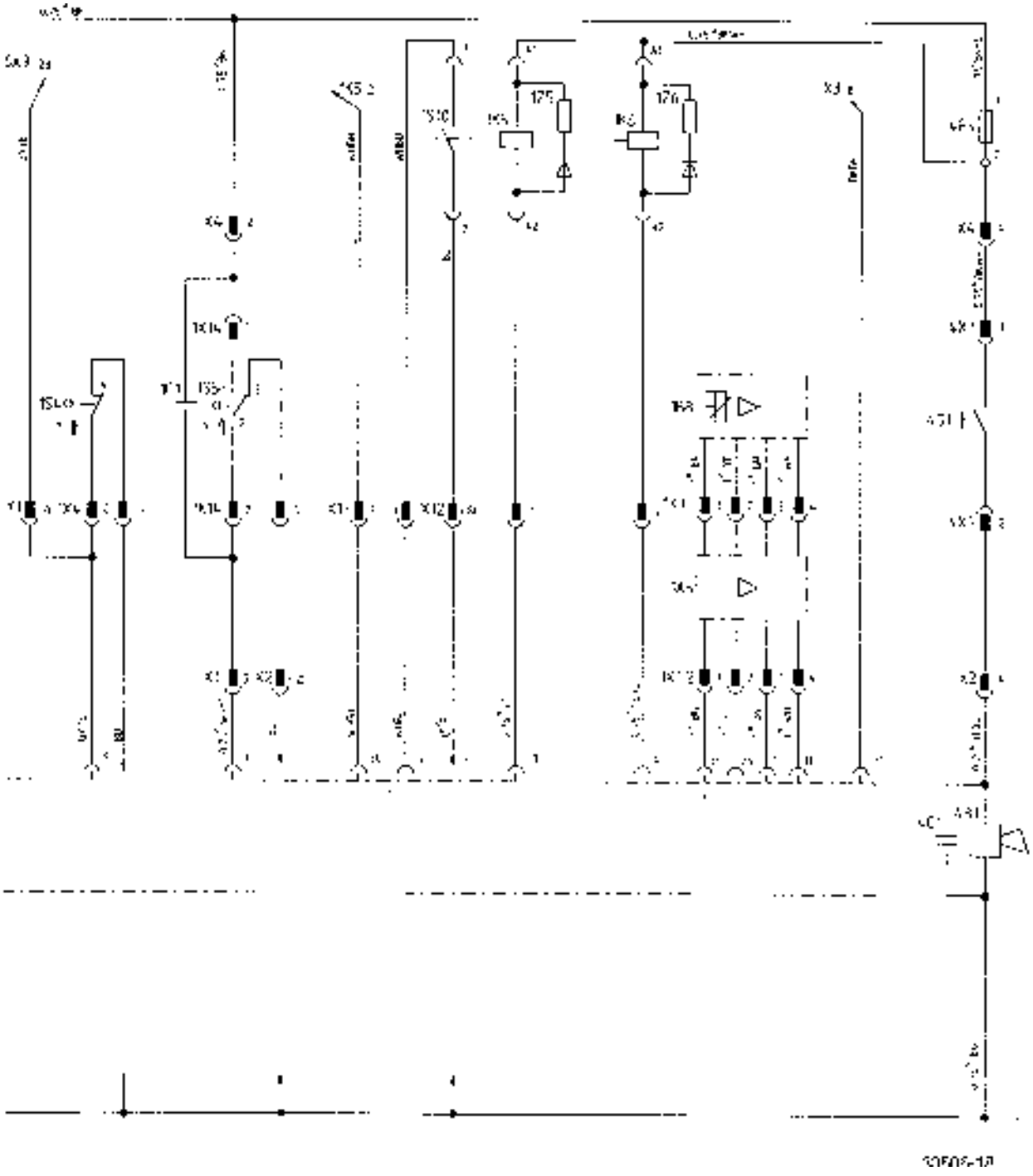
NOTE: The components marked with a broken line are already installed in the truck.

2.6.6.9 REGENERATIVE BRAKING

As described in the main circuit section, regenerative braking can be initiated in one of two ways.

1. By selecting the opposite direction with the accelerator pedal or the directional switch.

When the truck reverses, the accelerator sensor signal at 1X13:24 changes to the opposite direction, causing regenerative braking to be initiated. On trucks with a directional switch, regenerative braking is controlled via the terminals 1X13:22 and 1X13:18.



2. By depressing the brake pedal.

Depressing the brake pedal applies the battery positive signal from the key switch via braking current switch 1S5 to 1X13:1 at the electronic traction control unit. The battery positive signal flows on via 1X13:15 to the positive directional contactor terminals.

When regenerative braking is activated, the battery negative signal is applied via 1X13:18 to regenerative braking contactor 1K5 and via 1X13:4 to circuit breaking contactor 1K6. Both contactors remain activated until the truck speed has reduced to approx. 0.45 km/h.

Truck speed and the direction of travel are sensed by a speed and direction of rotation sensor mounted on the left-hand traction motor 1M2.

NOTE: Regenerative braking can only be started when truck speed is over 0.9 km/h.

2.6.6.9.1 SPEED SENSOR IN THE TRACTION MOTOR

The speed sensor is powered with a d.c. voltage of 5 Volt via an amplifier circuit. The sensor supplies two output signals, which have a different frequency or phase relationship, depending upon the motor speed and direction of rotation.

FUNCTIONAL CHECK:

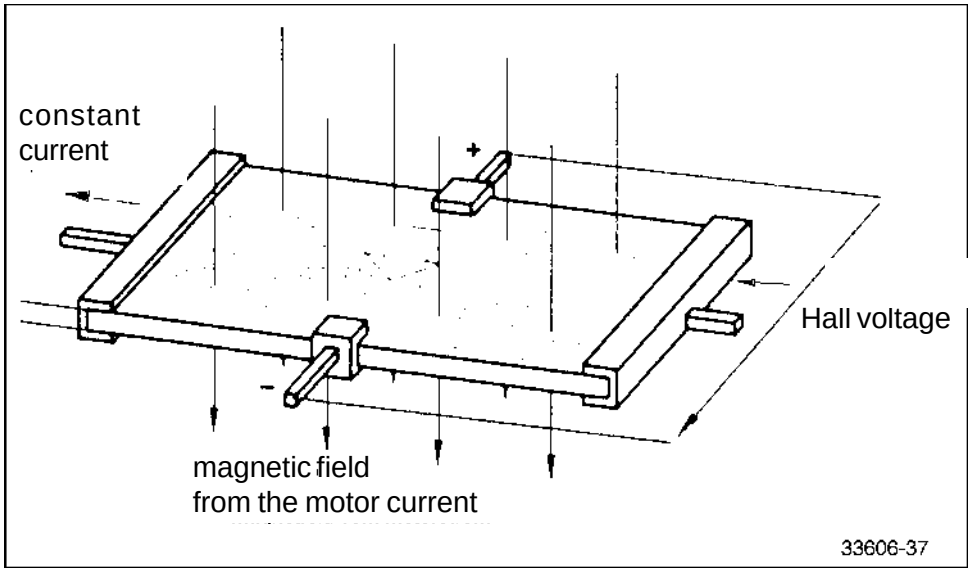
Power supply:

- Jack up the truck and support it safely.
- Check the power supply for amplifier 1A5.
- Connect a voltmeter to 1X1.2:1 and 1X1.2:3.
  The supply voltage must be 15 Volt.
- Check the power supply for the speed sensor.
- Connect a voltmeter to 1X1.1:1 and 1X1.1:3.
  The supply voltage must be 5 Volt.

Output signal:

- Check the speed sensor output signal.
- Connect a voltmeter to 1X1.2:2 and 1X1.2:3.
- Let the traction motors run.
  The output voltage must be approx. 7.5 Volt.
- Connect a voltmeter to 1X1.2:4 and 1X1.2:3.
- Let the traction motors run.
  The output voltage must be approx. 7.5 Volt.

2.6.6.10 CURRENT SENSOR



The current sensor senses the armature current of both traction motors and sends a signal to the electronic traction control unit. The current sensor contains a Hall generator and an adaptive circuitry. Hall generators consist of very thin semiconductor plates to which a constant control voltage is applied on the ends. This control voltage causes a constant current to flow.

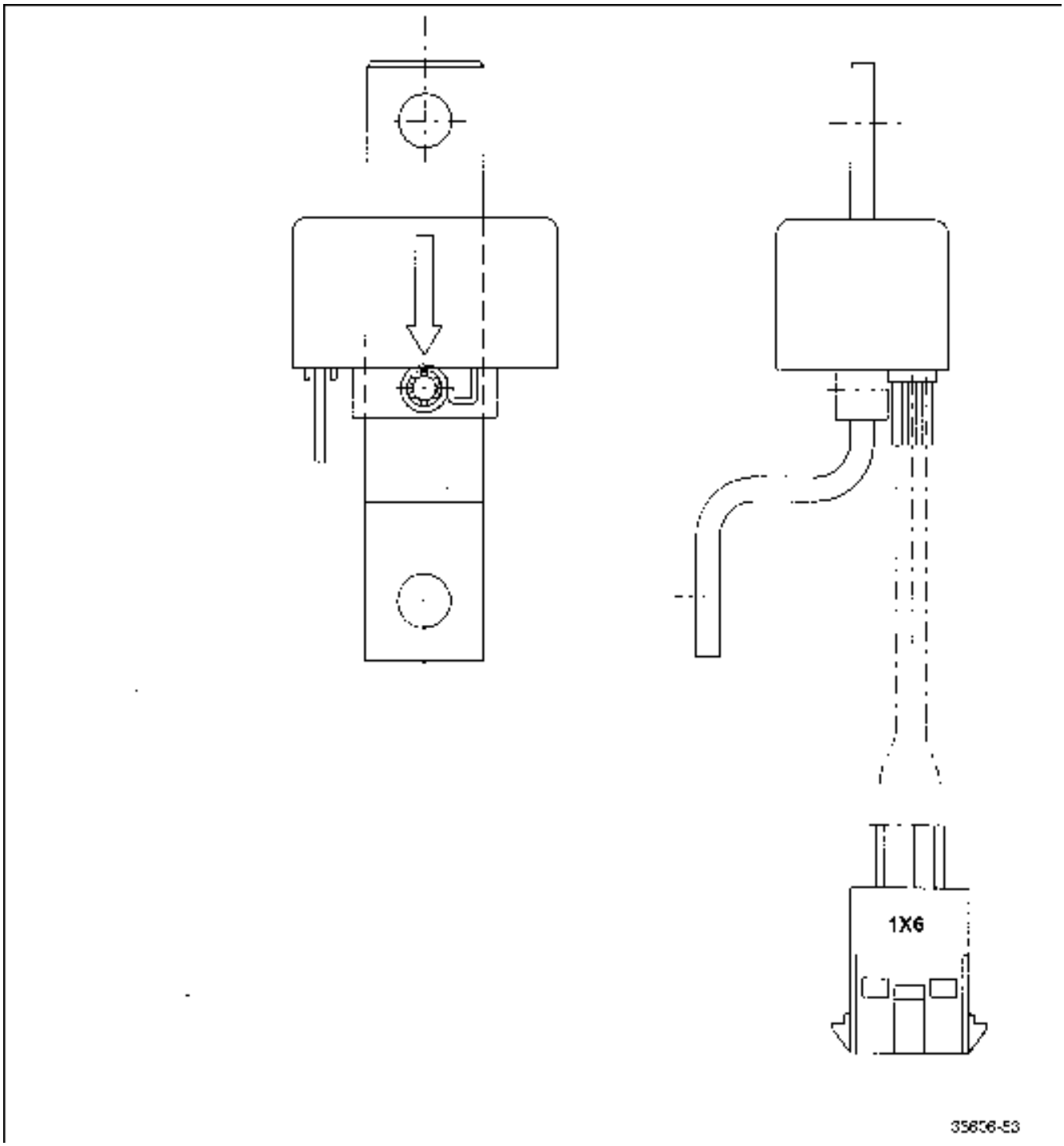
When a magnetic field caused by the flux of the motor current penetrates the semiconductor area, a voltage (Hall voltage) can be measured at the side of the semiconductor plate. This Hall voltage increases with the force of the magnetic field or of the motor current.

As the Hall voltage ranges only within a range of a few 100 mV, it is amplified by the integrated adaptive circuit and fed back to the electronic traction control unit.

The adaptive circuit is integrated in the current sensor and it supplies the following output voltages (output signal measured at connector 1X6 between terminals 2 and 3):

Motor Current	Output Signal
0 A	7.5 V
100 A	8.0 V
200 A	8.5 V
300 A	9.0 V
400 A	9.5 V
430 A	9.65 V

This means that for each 100 A increase in current, the output voltage changes by 0.5 V.



Connector 1X6
1 +15 V
2 Output signal
3 -

2.6.7 LTM CONTROL FOR WORKING HYDRAULIC SYSTEM AND STEERING

Electric fork trucks need hydraulic pumps driven by electric motors for the operation of hydraulic cylinders for lifting, tilting, auxiliary hydraulics and steering. On series 336 trucks only one hydraulic pump is used for the operation of the working hydraulic system and the power steering. The power requirement of the various hydraulic cylinders and the attachments differs greatly. For example, a larger volume of oil is required for the lifting than for tilting or operating the sideshift. If the working hydraulics pump is used for steering purposes, only a low pump motor speed is needed. The speed control for steering is regulated by means of a reed contact on the steering control valve and a speed sensor mounted on the left motor.

WHY AN LTM CONTROL IS USED FOR THE WORKING HYDRAULICS

To achieve a high degree of effectiveness of the hydraulic system, the pump should only deliver the amount of oil that is actually needed for the work cycle in question. This requirement can be fulfilled by controlling the speed of the pump motor with an LTM control as required by the hydraulic load.

The installation of an LTM control for the lift hydraulics brings measurable energy savings and, as a result, a longer service life of the battery.

The amount of energy saved by the LTM control is essentially determined by the service conditions and by the attachments fitted.

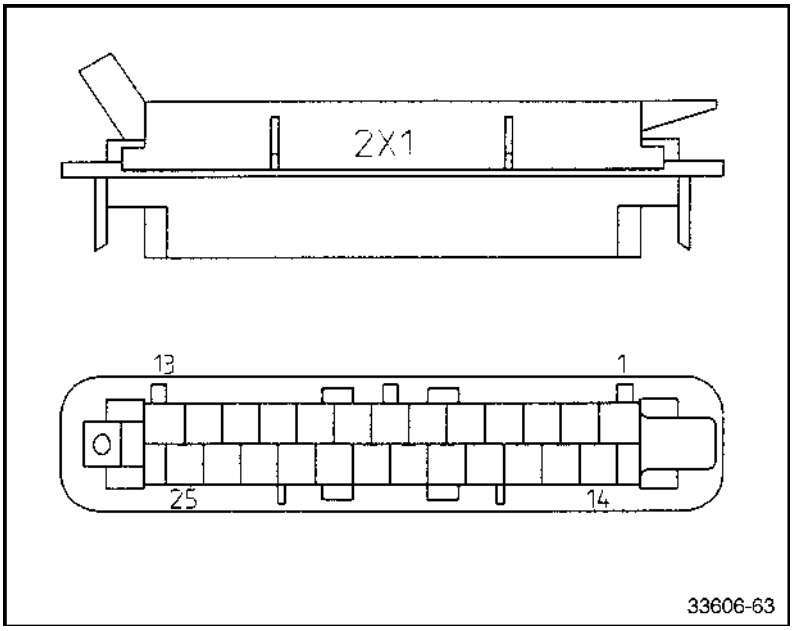
The largest energy saving is achieved with many work movements needing fine control over short driving distances.

The LINDE LTM control has the following benefits for the user:

- reduction of noise level
- longer motor service life
- longer lasting battery charge
- longer battery service life
- increased working safety
- less motor brush wear
- constant steering support
- wear-free motor control

The electronic control unit has three separate inputs over which the motor speed can be controlled independent of each other.

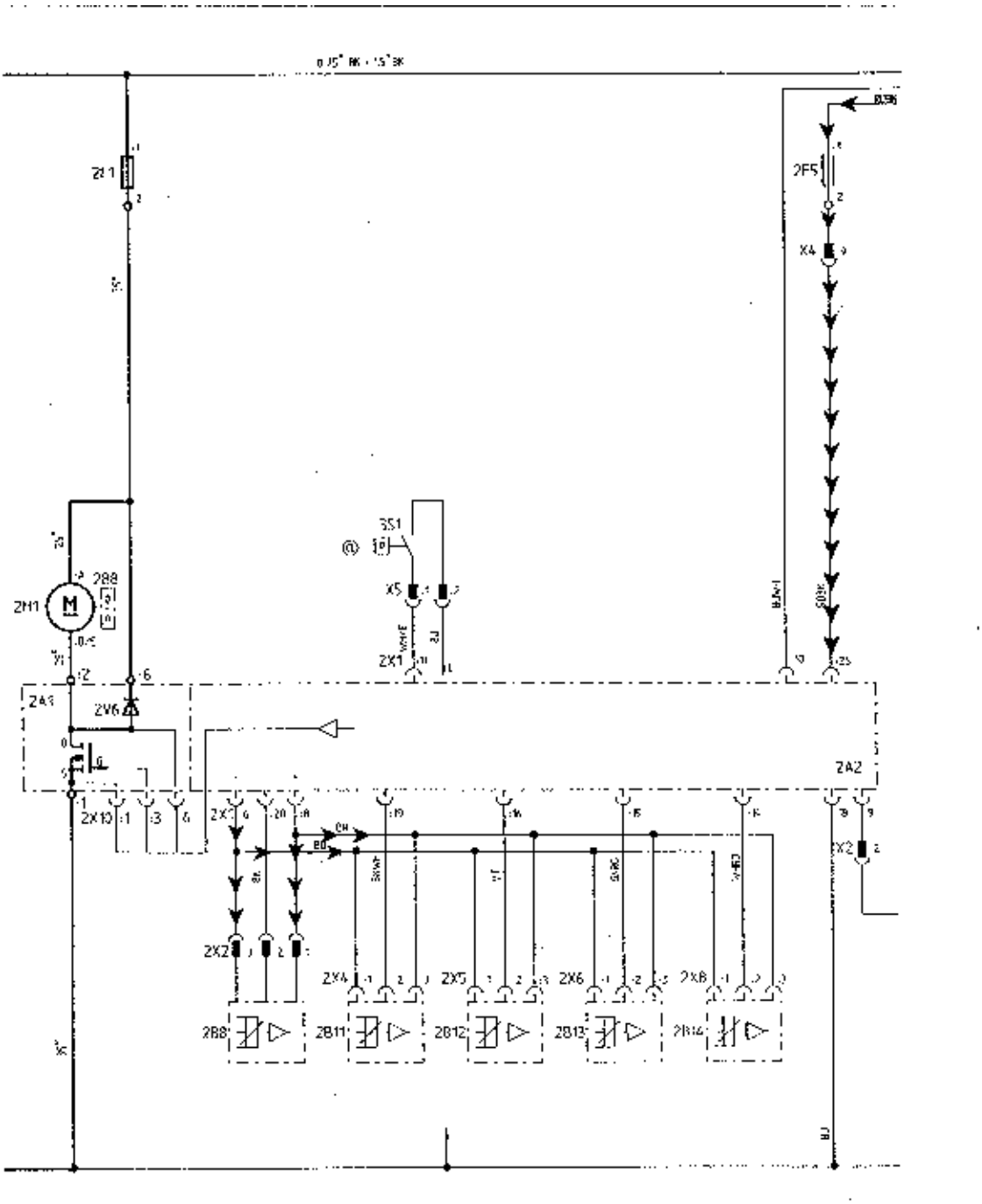
2.6.7.1 ELECTRONIC LIFT CONTROL



Pinout for connector 2X1

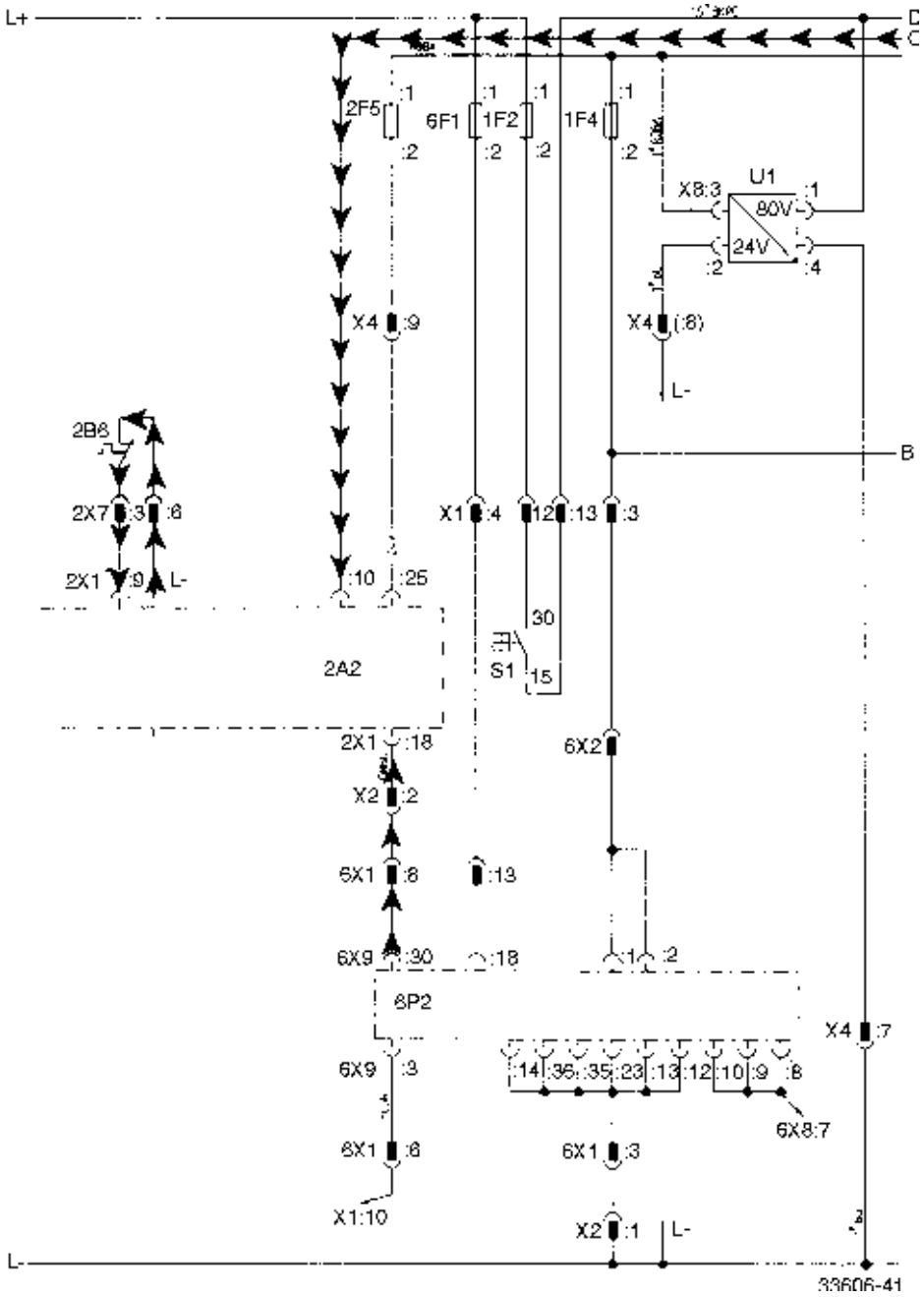
Terminal	Colours	Functions
1		not used
2		not used
3		not used
4		not used
5		not used
6	green/black	power supply for sensors
7		not used
8	yellow/black	+15 V power supply for sensors
9	blue/white	thermal switch 2B6 for pump motor
10	brown	enable signal from seat switch timer
11	white/yellow	reed switch 3S1 signal steering control valve
12		not used
13		not used
14	white/red	sensor 2B14 signal, auxiliary hydraulics 2
15	green/red	sensor 2B13 signal, auxiliary hydraulics 1
16	violet	sensor 2B12 signal, tilting
17		not used
18	green/blue	discharge indicator cut-off contact
19	black/white	sensor 2B11 signal, lifting
20	blue/red	speed sensor 2B8 signal
21		not used
22		not used
23		not used
24		not used
25	red/black	24 V power supply

2.6.7.1.1 POWER SUPPLY



The power supply for the electronic control is via voltage converter U1. When the key switch S1 is turned on, the 24 VDC from the voltage converter are applied via fuse 2F2 to 2X1:25. The control is supplied with battery negative via the source terminal of the power unit. Sensors on the control valve sense the movement of the hydraulic control levers. Furthermore, a speed sensor is mounted in hydraulic motor 2M1 to control the motor speed during steering. These sensors are supplied with a d.c. voltage as soon as the supply voltage is applied to the control unit. The sensors are provided with +15 V via terminal 2X1:8. The negative voltage for the sensors is via terminal 2X1:6.

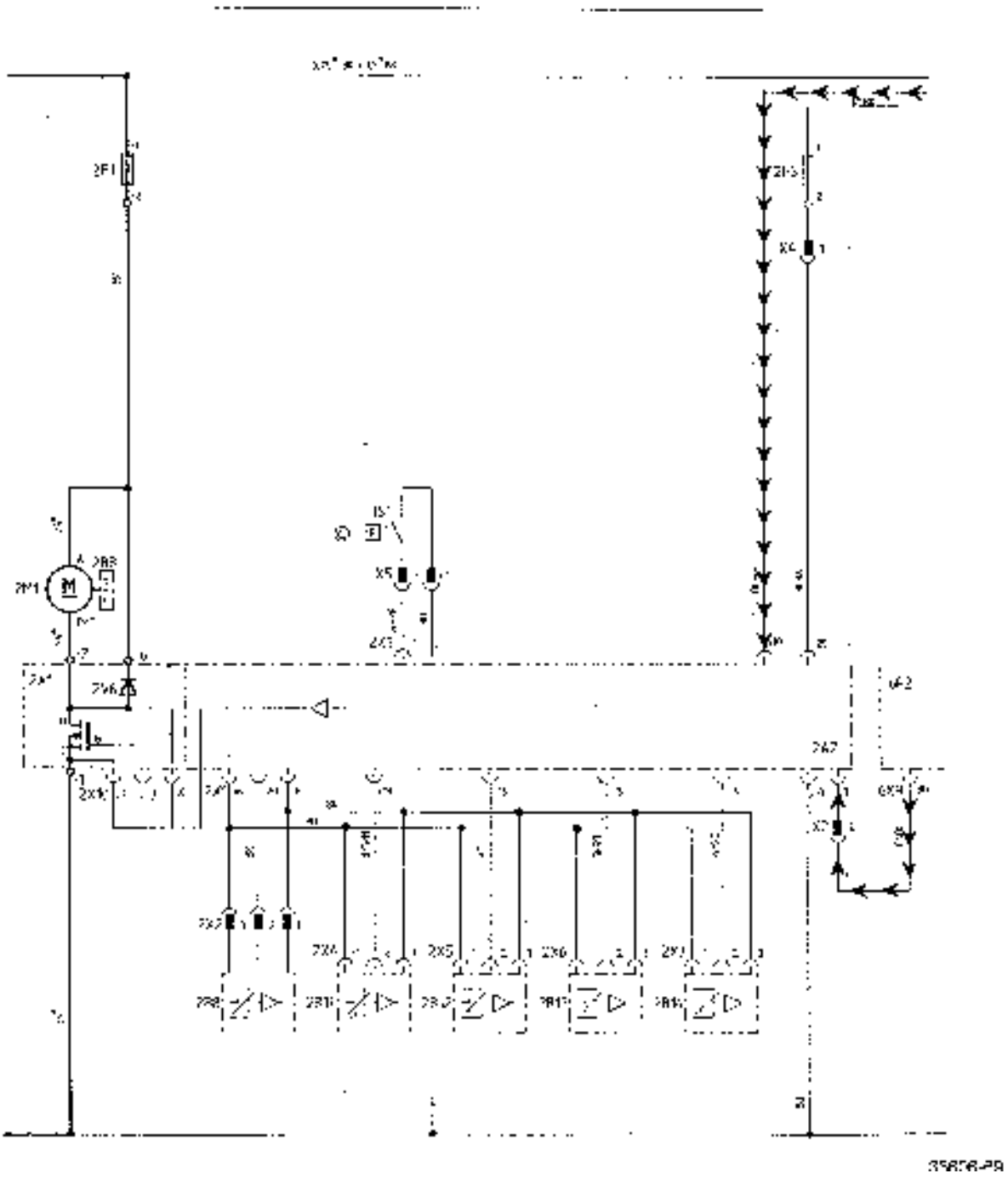
2.6.7.1.2 ENABLE SIGNAL, THERMAL SWITCH AND CUT-OFF WHEN THE BATTERY IS DISCHARGED (TO SERIES 6/95)



The enable signal provided by the timer of seat switch 1A3 is applied to connector 2X1:10. This signal is also applied to terminal 2X1:18 via the cut-off contact for the combined instrument 6P2. When the battery charge indicator (with battery discharged 80%) is cut off and the speed (motor rpm) for all work movements is reduced. It is possible to continue work at reduced working speed.

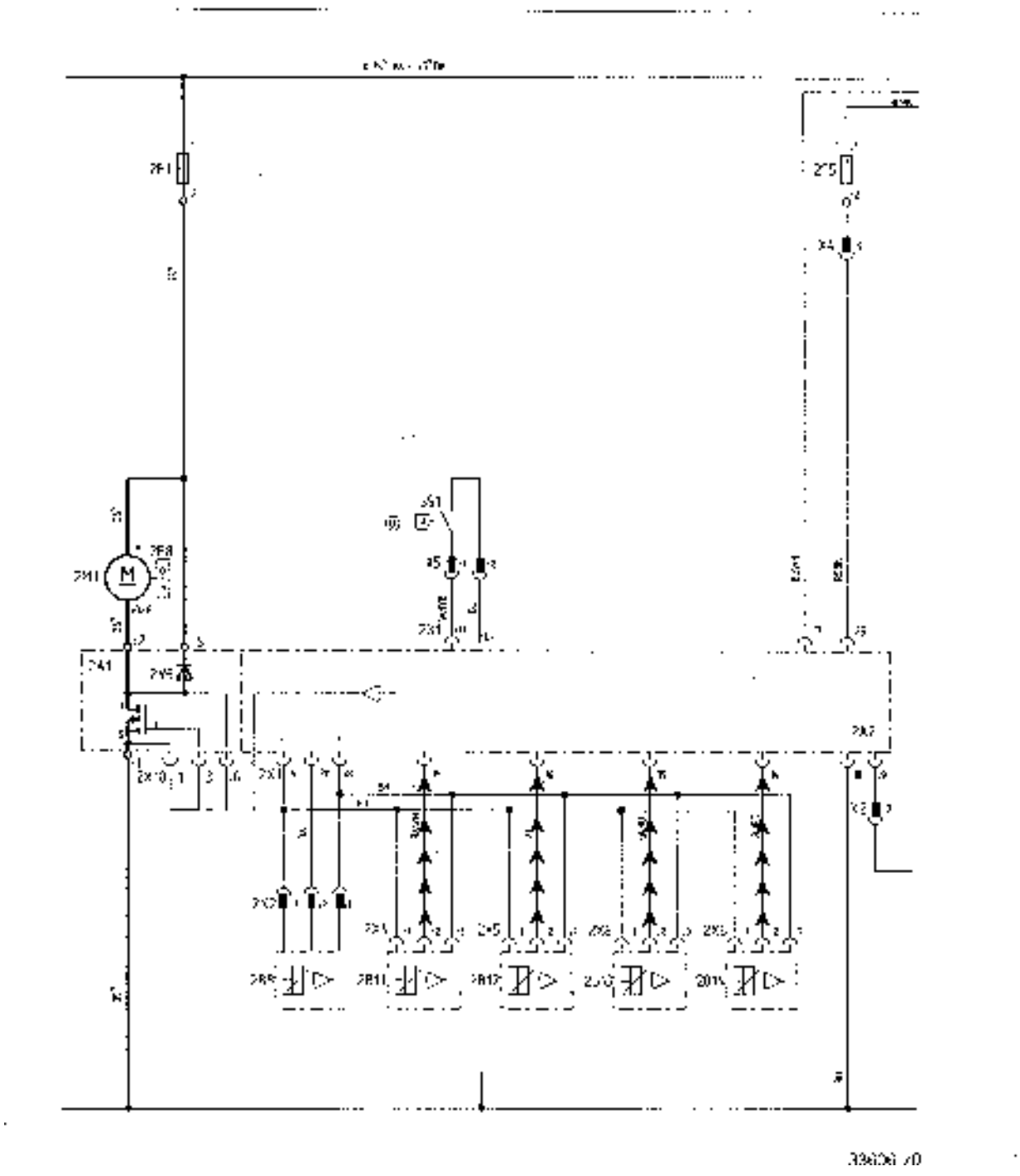
The speed of the working hydraulics is also reduced to 50 % when thermal switch 2B6 opens (breaker at 160 °C).

2.6.7.1.3 ENABLE SIGNAL, THERMAL SENSOR AND CUT-OUT WITH DISCHARGED BATTERY (FROM SERIES 7/95)



The working hydraulics are enabled as soon as switch 9S20 on the overhead guard is operated. On trucks from series 7/95 it is no longer necessary to actuate the seat switch to be able to work with the working hydraulics. As soon as the battery is discharged over 80 % or the temperature in the pump motor exceeds 160 °C, the speed of the working hydraulics is cut in half with a cut-out contact in the combined instrument. In these cases the battery negative signal applied to 2X1:9 is disconnected by combined instrument 6P2.

2.6.7.1.4 CONTROL OF THE VARIOUS WORK FUNCTIONS



All speeds of the working hydraulics can be regulated with infinitely-variable control. A distance sensor in each valve block of the control valve block senses how far the control lever in question has been moved and then sets the motor speed via the electronic control accordingly.
The motor speed is sensed with the speed sensor in the pump motor and adjusted as required. The output signal of the distance sensors 2B11, 2B12, 2B13 and 2B14 ranges from 3.75 V to 11.25 V.

2.6.7.1.5 SENSORS IN THE CONTROL VALVE BLOCK

The sensors in the various valve sections work with plunger-type coils. Each sensor contains two identical cylindrical coils. At the lower part of the control spool is a ferromagnetic anchor which moves in the cylindrical coils when the control spool is moved. Both cylindric coils are connected in series and they are operated with alternate current. The alternate current voltage is created by an internal circuit in the control valve block. The sensors are supplied with 15 Volt at 2X1:8 by the electronic lift control unit. Battery negative is provided for the sensors via terminal 2X1:6.

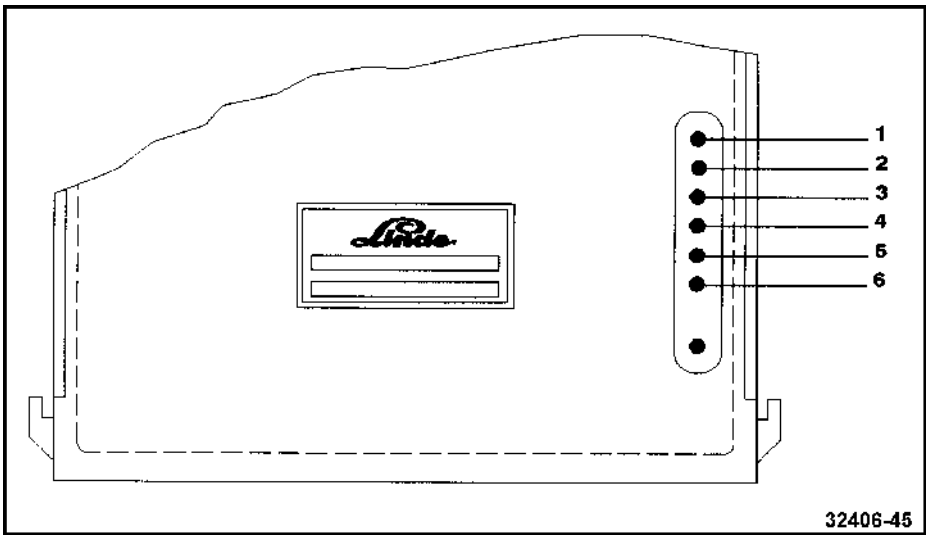
Output signals:

Neutral position of control spool	7.5 V
Extended control spool	max. 3.75 V
Retracted control spool	max. 11.25 V

Sensor 2B11, lifting	output signal at 2X1:19 and 2X1:6
Sensor 2B12, tilting	output signal at 2X1:16 and 2X1:6
Sensor 2B13, auxiliary hydraulics 1	output signal at 2X1:15 and 2X1:6
Sensor 2B14, auxiliary hydraulics 2	output signal at 2X1:14 and 2X1:6

These sensors work practically without any friction, and are contained in a tight casing, therefore preventing dust and other foreign matter from entering. Meaning that these sensors have a long service life.

2.6.7.1.5 ADJUSTMENTS



1 Not used
2 Not used
3 Auxiliary hydraulics 1, function 1
4 Auxiliary hydraulics 2, function 2
5 Auxiliary hydraulics 2
6 Not used

LIFTING

The lifting cycle is enabled by distance sensor 2B11. The motor speed is controlled with distance sensor 2B11 on the control valve proportionally to the movement of the spool. The lifting cycle does not need to be adjusted.

TILTING

The tilting cycle is enabled with distance sensor 2B12. The tilting cycle does not need to be adjusted.

AUXILIARY HYDRAULICS 1

The work cycle is enabled with sensor 2B13. The motor speed is set with potentiometers (3) and (4). With potentiometer (3) it is possible to adjust the motor speed for function 1 (rotate clockwise, shift to the right, etc.). With potentiometer (4) it is possible to adjust function 2 (rotate anti-clockwise, shifting to the left). The setting of the motor speed depends on the type of attachment and it should be taken from the specifications of the manufacturer of the attachment.

AUXILIARY HYDRAULICS 2

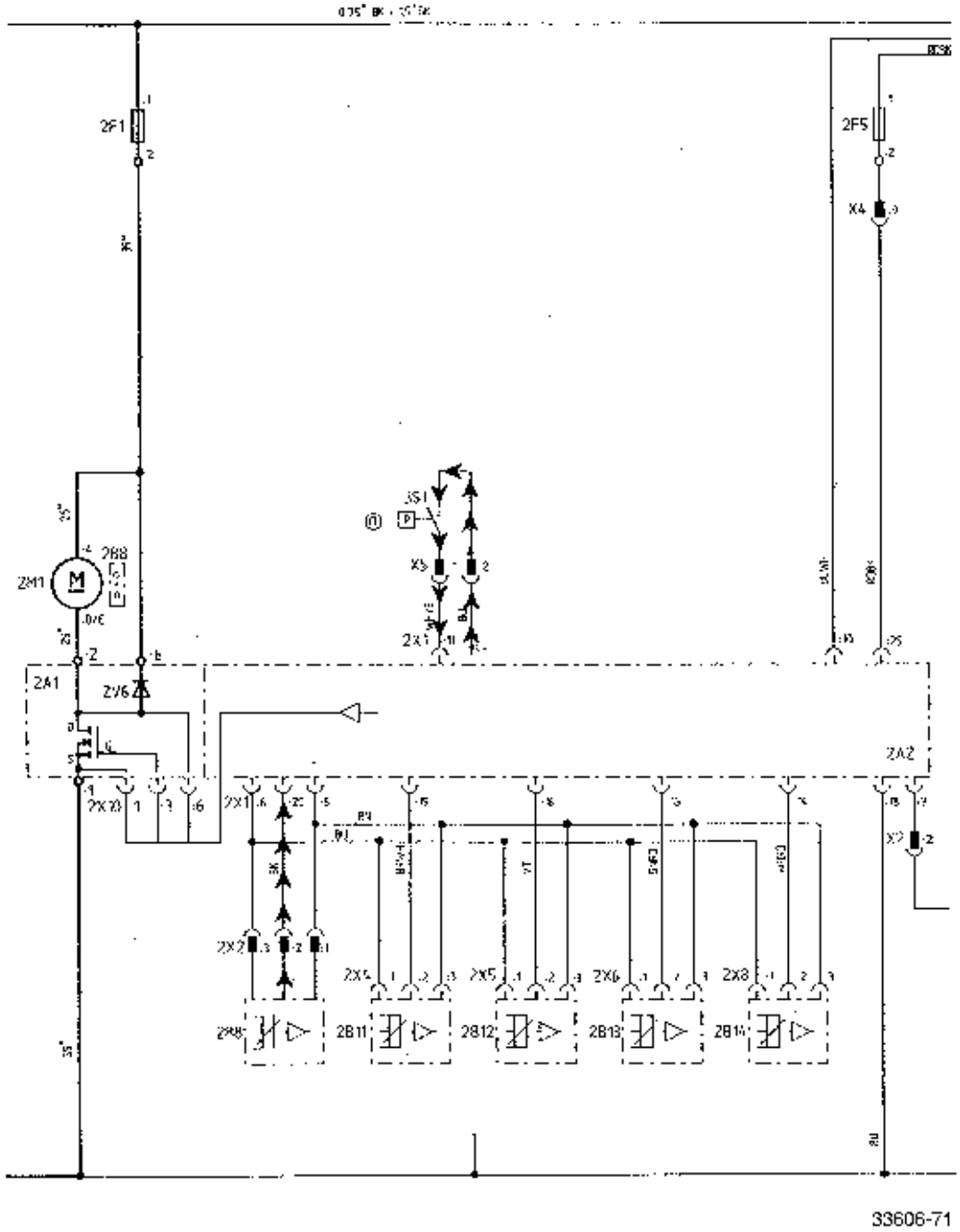
The work cycle is enabled with sensor 2B14. The motor speed is set with potentiometer (5). The setting of the motor speed depends on the type of attachment and it should be taken from the specifications of the manufacturer of the attachment.

NOTE: Use a suitable screwdriver for the adjustment. All adjustments must be performed from outside through the holes indicated by the illustration. Carry out the adjustment of the motor speed with the right amount of force. Refit the sealing cap after completion of the adjustment.

2.6.7.2 CONTROL OF THE STEERING FUNCTION

The series 336 vehicles do not have a separate steering pump motor. The required quantity of hydraulic oil for the cylinder is taken directly from the working hydraulics pump. In order to ensure that the correct quantity of oil goes to the steering cylinder even when the working hydraulics are being operated, a priority valve for the steering system is installed in the steering control valve.

As soon as the steering is operated, reed switch 3S1 in the steering control valve is actuated. This switch is connected to the working hydraulics electronics and it lets the pump motor run at 600 rpm. If the working hydraulics are not in operation, the pump motor speed is controlled with sensor 2B8.



33606-71

When the steering is operated, the reed contact in the steering control valve connects battery negative to 2X1:11.

2.6.7.2.1 OPERATION OF SPEED SENSOR 2B8

Speed sensor 2B8 is supplied with a d.c. voltage of 15 V by the electronics. When the motor rotates, a diaphragm moves in front of the sensor. The sensor output signal alternates constantly from 0 V to 15 V as soon as a segment of the diaphragm is in front of the sensing area of the sensor. In this way the frequency of the output signal changes with the speed of the motor.

FUNCTIONAL CHECK

Power supply:

- Connect a voltmeter to 2X1:6 and 2X1:8. The supply voltage must be 15 Volt.

Output signal:

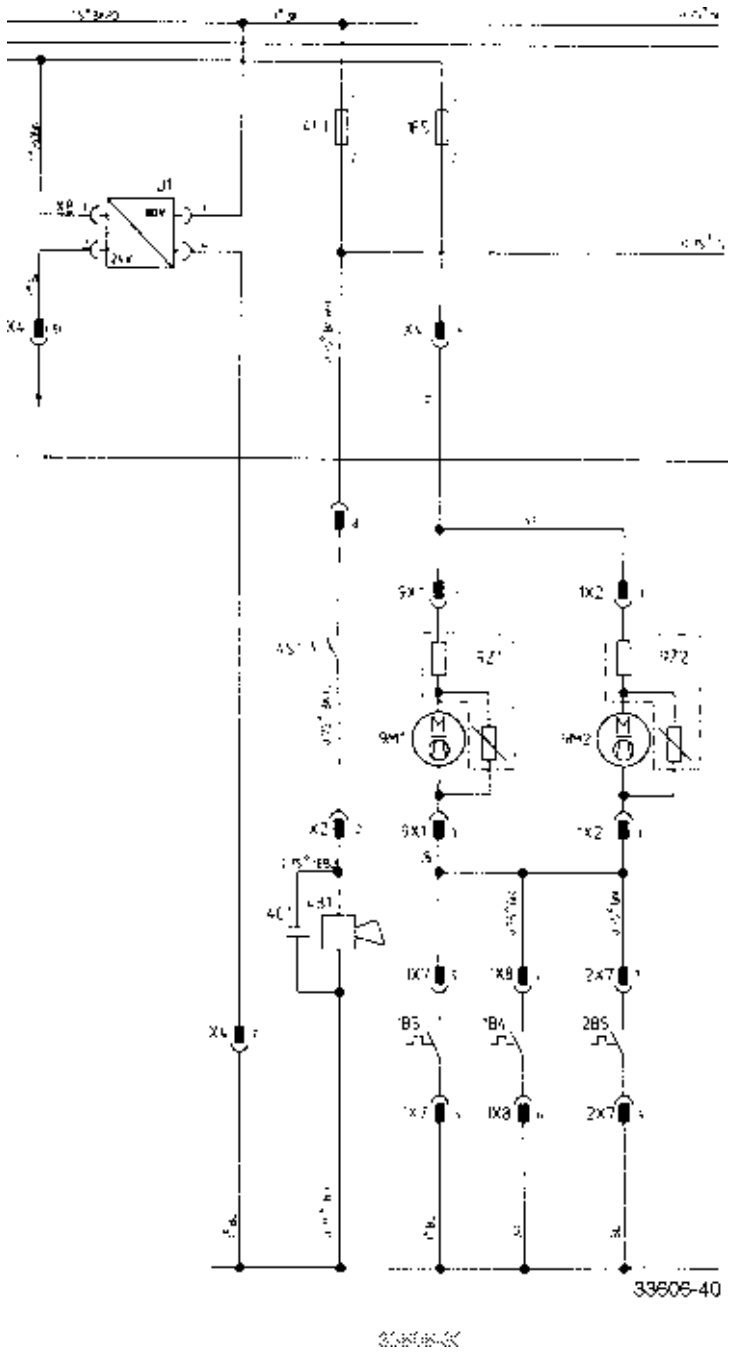
- Connect a voltmeter to 2X1:20 and 2X1:6.
- Turn on the key switch.
- Operate the steering. When the pump motor is running, the output signal must be approx. 5 to 7 Volt.

Adjustment:

The speed sensor 2B8 should be mounted 2 mm from the diaphragm.

2.6.8 FANS

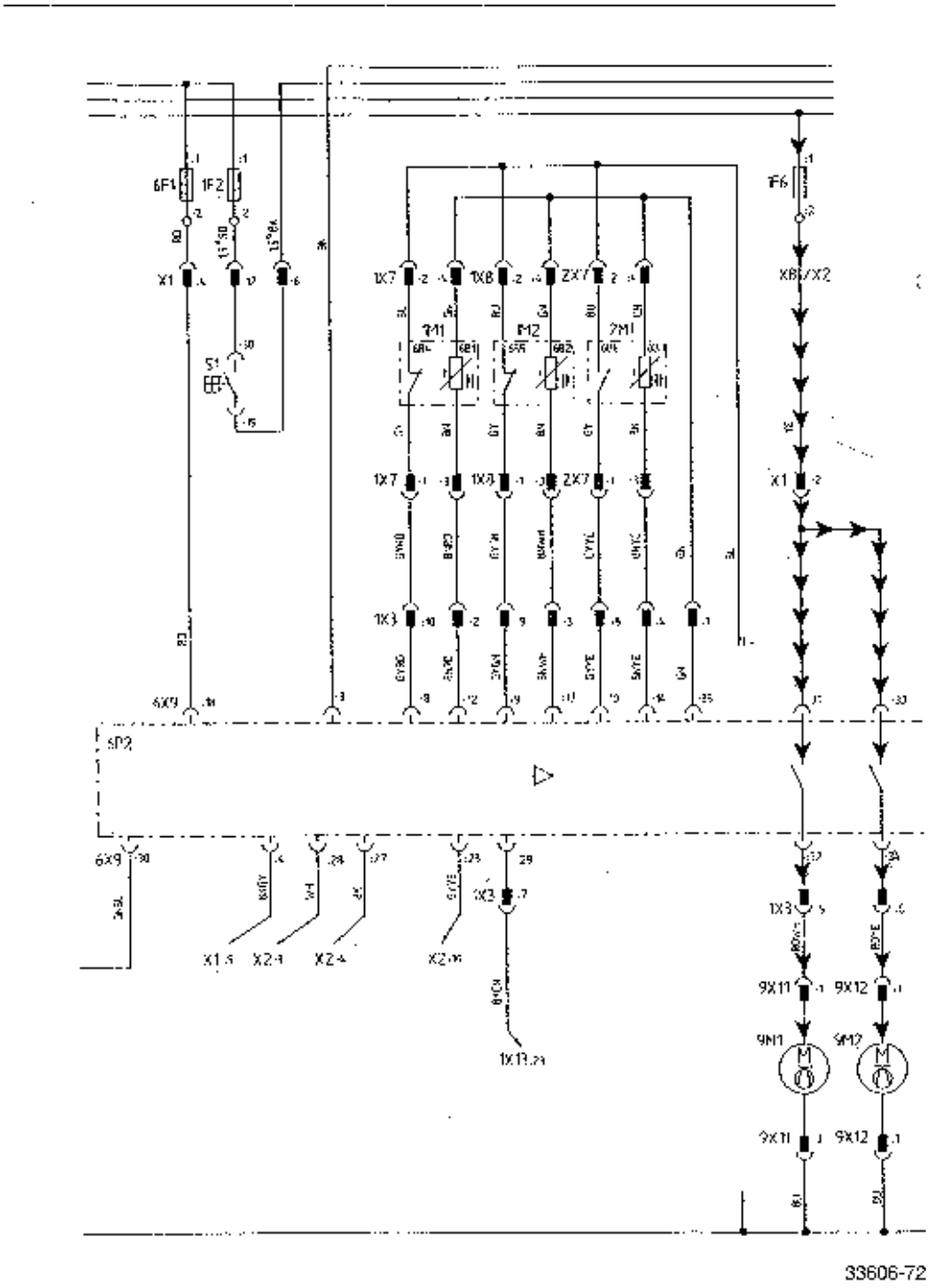
2.6.8.1 FAN METHOD OF OPERATION UNTIL SERIES 6/95



The fans 9M1 and 9M2 are supplied with 24 V on the positive side by voltage converter U1 via fuse 1F5.

When the temperature of the traction motors or pump motors rises to over 80 °C, temperature switches 1B4, 1B5 and 2B5 make, connecting battery negative to the fans.

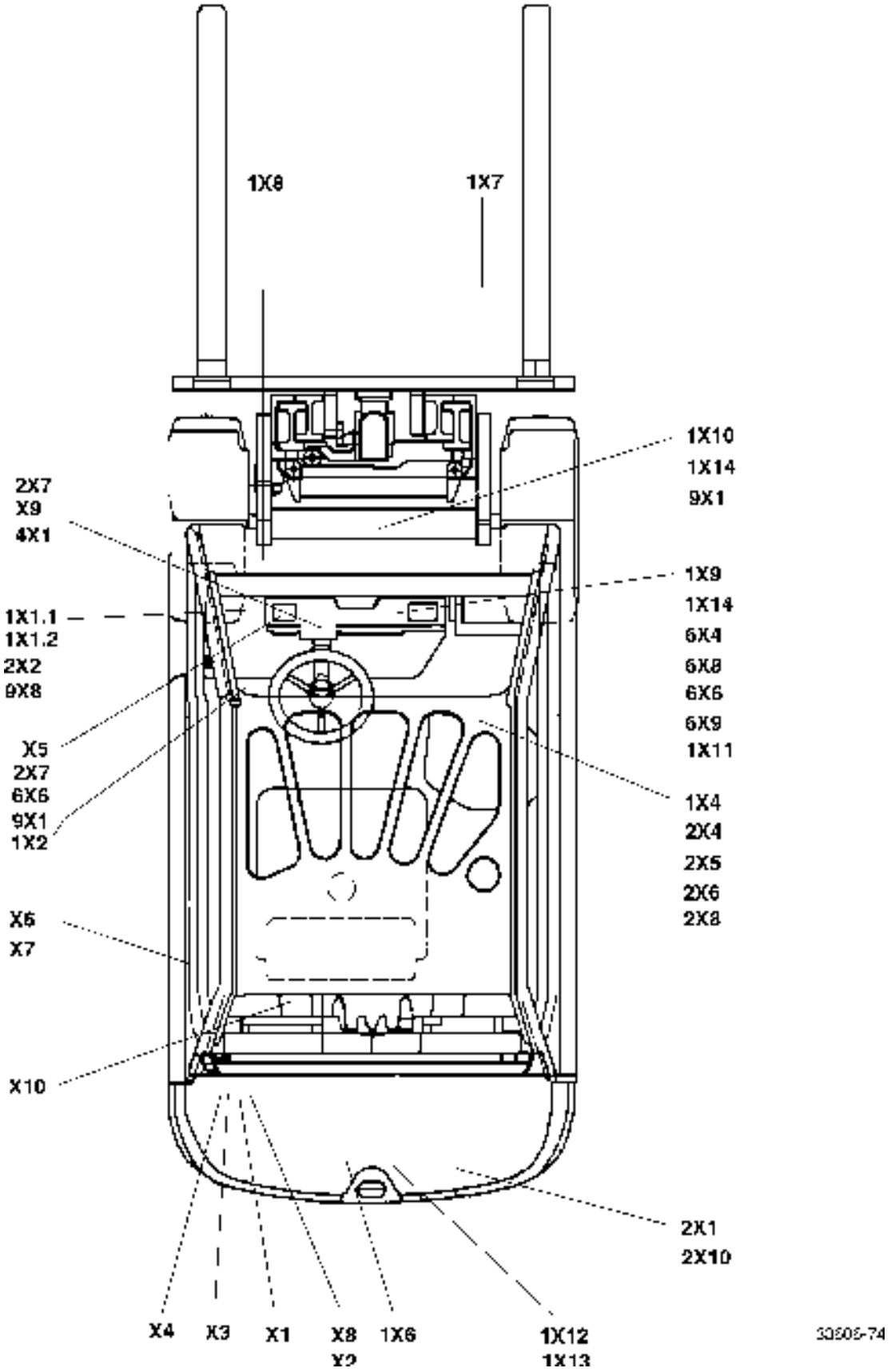
2.6.8.2 FAN METHOD OF OPERATION FROM SERIES 7/95



The fans 9M1 and 9M2 used for cooling the traction and pump motors are supplied with power on the positive side with 24 V by voltage converter U1 via fuse 1F6. When the temperature of the traction motors or pump motors exceeds 80 °C, the combined instrument 6P2 applies +24 Volt to the two fans 9M1 and 9M2.

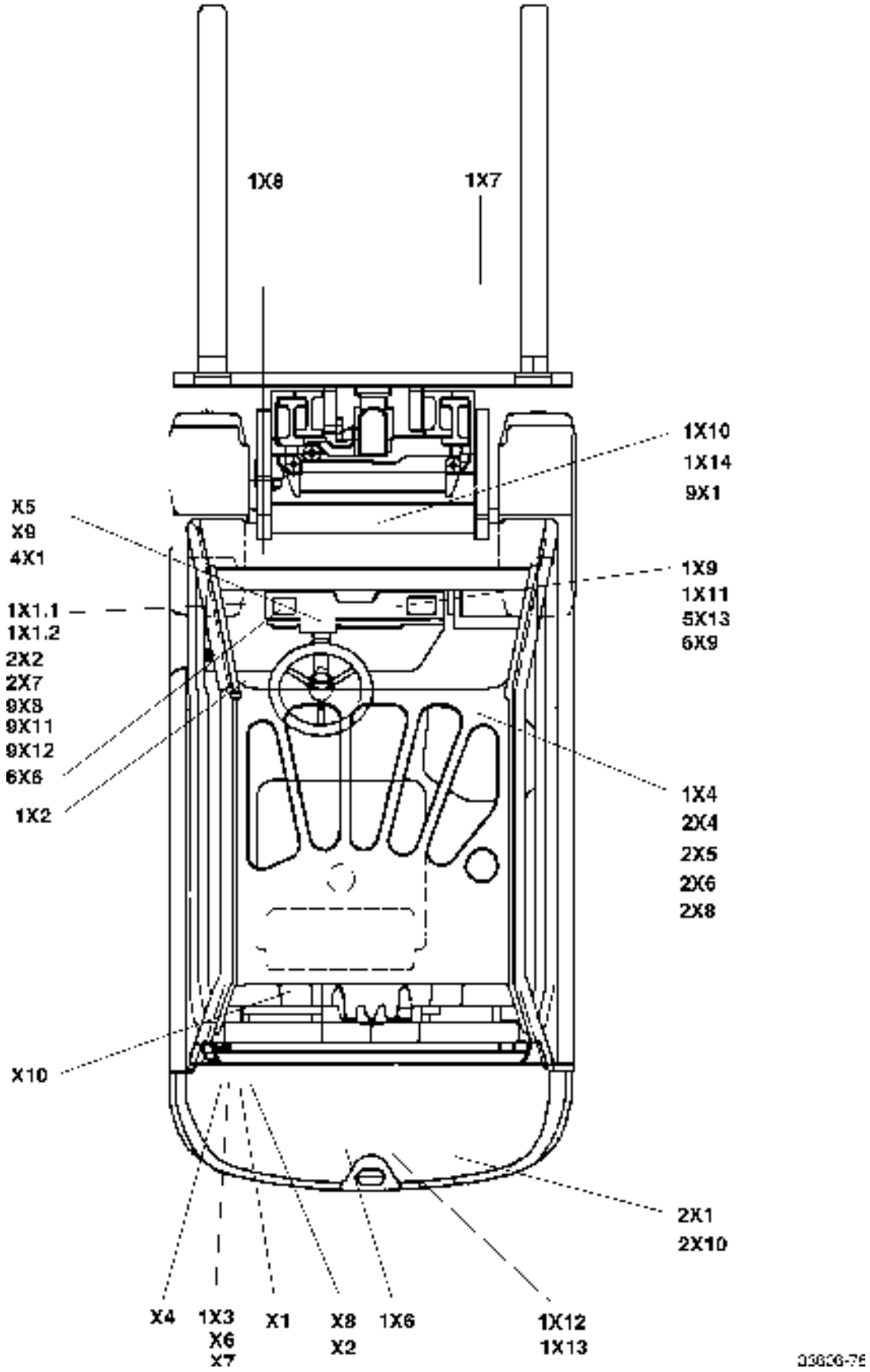
2.6.9 LOCATION OF CONNECTORS

2.6.9.1 LOCATION OF CONNECTORS TO SERIES 6/95



Connector		Location	Function
X1	15-pin	Electrical system, left side	Connector to main wire harness
X2	6-pin	Electrical system, left side	Connector to main wire harness
X3	12-pin	Electrical system, left side	Connector to main wire harness
X4	15-pin	Electrical system, left side	Connector to main wire harness
X5	2-pin	On steering control valve	Terminal on steering reed contact
X6	4-pin	In rear chassis, left side	Curve sensor
X7	4-pin	In rear chassis, left side	Curve sensor
X8	6-pin	Electrical system, left side	Voltage converter
X9	3-pin	Under steering column cover	Overhead guard switch
X10		On rear battery compartment	Battery plug
1X1.14-pin		In motor compartment, left side	Amplifier for speed sensor
1X1.24-pin		In motor compartment, left side	Amplifier for speed sensor
1X2	3-pin	In motor compartment, left side	Fan 9M2
1X4	3-pin	On hydraulic control valve	Parking brake switch
1X6	3-pin	Electrical system, left side	Current actual value sender
1X7	8-pin	On RH traction motor	Thermal switch, brush switch
1X8	8-pin	On LH traction motor	Thermal switch, brush switch
1X9	4-pin	Under RH switch cover at console	Single-pedal directional switch
1X10	6-pin	Under floor group	Accelerator sensor
1X11	2-pin	Under RH switch cover at console	Single-pedal directional switch, Baker
1X12	6-pin	Electrical system, centre	Connector for traction power unit
1X13	42-pin	Electrical system, centre	Connector for traction control unit
1X14	3-pin	Under floor group	Brake pedal switch
2X1	25-pin	Electrical system, right side	Connector for lift power unit
2X2	3-pin	On pump motor	Pump motor speed sensor
2X4	3-pin	On hydraulic control valve	Lift sensor
2X5	3-pin	On hydraulic control valve	Tilt sensor
2X6	3-pin	On hydraulic control valve	Auxiliary hydraulics sensor 1
2X7	3-pin	On pump motor	Thermal switch, brush wear
2X8	3-pin	On hydraulic control valve	Auxiliary hydraulics sensor 2
2X10	6-pin	Electrical system, right side	Connector for lift power unit
4X1	2-pin	Under steering column cover	Horn switch
6X4	12-pin	under RH switch cover at console	Brush monitor
6X6	4-pin	under LH switch cover at console	Diagnostic connector
6X8	12-pin	under RH switch cover at console	Brush monitor
6X9	36-pin	under RH switch cover at console	Combined instrument
9X1	3-pin	Motor compartment, centre	Fan 9M1
9X8	3-pin	Motor compartment, left side	Fan 9M2

2.6.9.2 LOCATION OF CONNECTORS FROM SERIES 7/95

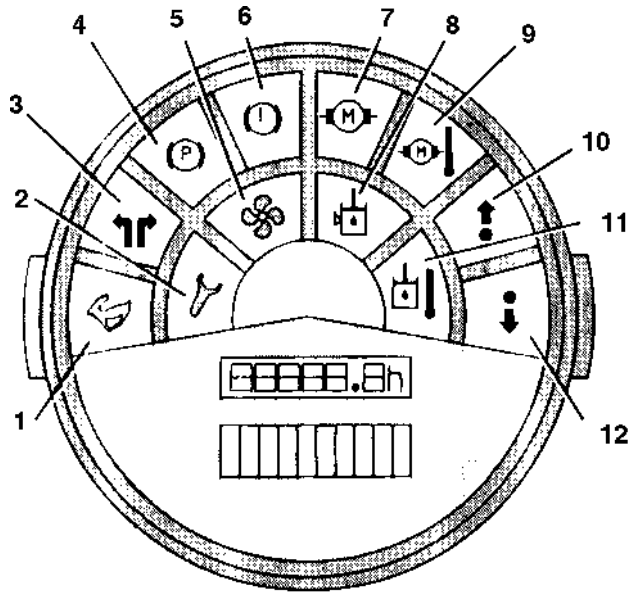


Connector		Location	Function
X1	15-pin	Electrical system, left side	Connector to main wire harness
X2	12-pin	Electrical system, left side	Connector to main wire harness
X4	15-pin	Electrical system, left side	Connector to main wire harness
X5	2-pin	In motor compartment	Terminal on reed switch, steering
X6	4-pin	Electrical system, left side	Curve sensor
X7	4-pin	Electrical system, left side	Curve sensor
X8	6-pin	Electrical system, left side	Voltage converter
X9	3-pin	Under steering column cover	Overhead guard switch
X10		On rear battery compartment	Battery plug
1X1.14-pin		In motor compartment, left side	Amplifier for speed sensor
1X1.24-pin		In motor compartment, left side	Amplifier for speed sensor
1X3	10-pin	In motor compartment, left side	Brush monitor, thermal sensor
1X4	3-pin	On hydraulic control valve	Parking brake switch
1X6	3-pin	Electrical system, left side	Current actual value sender
1X7	4-pin	On RH traction motor	Thermal switch, brush switch
1X8	4-pin	On LH traction motor	Thermal switch, brush switch
1X9	4-pin	Under RH switch cover at console	Single-pedal directional switch
1X10	6-pin	Under floor group	Accelerator sensor
1X11	2-pin	Under RH switch cover at console	Single-pedal directional switch, Baker
1X12	6-pin	Electrical system, centre	Connector for traction power unit
1X13	42-pin	Electrical system, centre	Connector for traction control unit
1X14	3-pin	Under floor group	Brake pedal switch
2X1	25-pin	Electrical system, right side	Connector for lift power unit
2X2	4-pin	On pump motor	Pump motor speed sensor
2X4	3-pin	On hydraulic control valve	Lift sensor
2X5	3-pin	On hydraulic control valve	Tilt sensor
2X6	3-pin	On hydraulic control valve	Auxiliary hydraulics sensor 1
2X7	4-pin	On pump motor	Thermal switch, brush wear
2X8	3-pin	On hydraulic control valve	Auxiliary hydraulics sensor 2
2X10	6-pin	Electrical system, right side	Connector for lift power unit
4X1	2-pin	Under steering column cover	Horn switch
5X13	3-pin	under RH switch cover at console	Directional indicator repeater light
6X6	4-pin	under LH switch cover at console	Diagnostic connector
6X9	36-pin	under RH switch cover at console	Combined instrument
9X8	3-pin	Under steering column cover	Single-pedal directional switch
9X1	3-pin	Motor compartment, centre	Fan 9M1
9X8	3-pin	Motor compartment, left side	Fan 9M2

2.6.10 COMBINED INSTRUMENT

The combined instrument consists of the battery discharge indicator, the hour meter and a number of indicator lights. All functions in the combined instrument are controlled by a 4-bit microcontroller. The microcontroller has an internal ROM (read-only memory) containing the operating software. The software version is indicated on a label on the side of the combined instrument. From software version 3.0, the software version is displayed in the display after the self-test is completed upon turning the key switch.
The microcontroller is also provided with RAM (working storage) and an EEPROM containing truck-specific data (battery characteristics, elapsed service hours and other data). With the aid of the diagnostic unit it is possible to communicate with the combined instrument via interface connector 6X6. Two relays are also installed which control the two fans (from series 7/95). The signals from the thermal sensors and brush wear switches are evaluated over various analogue and switching inputs.

2.6.10.1 INDICATOR LIGHTS



33506-19

1 Field weakening active indicator light*
2 Service interval indicator light
3 Turn signal indicator light*
4 Parking brake warning light (from series 12/94)
5 Fan warning light (from series 7/95)
6 Brake shoe warning light*
7 Motor brush warning light
8 Hydraulic oil level warning light*
9 Engine temperature warning light (from series 7/95)
10 Forward travel switch indicator light (single-pedal model)*
11 Hydraulic oil temperature warning light*
12 Reverse travel switch indicator light (single-pedal model)*

* Optional equipment

2.6.10.1.1 FIELD WEAKENING ACTIVE INDICATOR LIGHT (OPTION)

With this option this lamp signals that the field weakening function is activated. The field weakening effect is produced by connecting resistors in parallel to the field winding of the traction motors. This reduces the magnetic flux in the field winding, while simultaneously increasing the speed of the motors. The field weakening must be turned on and off depending on the load on the motors as the torque of the motors is reduced with the increase in speed.

2.6.10.1.2 TURN SIGNAL INDICATOR LIGHT (FROM SERIES 7/95)

With the lighting option this lamp indicates that the turn signals are switched on. It is controlled directly over the two 12 Volt terminals on the turn signal lights. A bidirectional optocoupler in the combined instrument decouples the two signals from the turn signals lights. The connection is made with plug 5X13 under the LH switch cover.

2.6.10.1.3 PARKING BRAKE WARNING LIGHT (FROM SERIES 12/94)

When the parking brake is applied, the parking brake switch 1S4 is opened. This cuts off the battery negative signal applied to 6X9:23 and the lamp is illuminated.

2.6.10.1.4 BRAKE SHOE WARNING LIGHT (OPTION)

2.6.10.1.5 MOTOR BRUSH WARNING LIGHT

A brush wear switch is installed on each motor brush. When a brush is worn down to 60 % of its original length, the respective brush switch is activated. The brush wear is signalled by the illumination of the lamp. Information regarding which motor is affected is also shown on the LCD display (from series 7/95).

1 = RH traction motor
2 = LH traction motor
3 = Pump motor

The display of the motor number alternates every 5 seconds with the display of the elapsed service hours. The fact that the brush wear limit of a motor has been reached is stored in the combined instrument with the number of the motor in question and the elapsed service hours. This information can be read, if necessary, with the diagnostic unit.

2.6.10.1.6 ENGINE TEMPERATURE WARNING LIGHT (FROM SERIES 7/95)

If the temperature of one of the three motors exceeds 140 °C, the lamp is illuminated to indicate overheating of the motor in question. As in the case of the indication of the brush wear limit, the motor number is shown in the LCD display and it is stored in the combined instrument together with the elapsed service hours.

2.6.10.1.7 TRAVEL DIRECTION INDICATOR (OPTION)

With the single-pedal option the chosen direction of travel is signalled by the two indicator lights. With this function the battery negative signal from the travel direction switch to the electronic traction unit is evaluated by the combined instrument.

2.6.10.1.8 HYDRAULIC OIL TEMPERATURE WARNING LIGHT (OPTION)

With this option, a thermal switch located in the hydraulic oil reservoir is activated when the oil temperature is too high. A battery negative signal is applied to terminal 6X9:25, which illuminates the light.

2.6.10.1.9 HYDRAULIC OIL LEVEL WARNING LIGHT (OPTION)

When the hydraulic oil level is too low, a battery negative signal is applied to terminal 6X9:24 of the combined instrument by a float switch.

2.6.10.1.10 FAN WARNING LIGHT (FROM SERIES 7/95)

When the temperature in a motor exceeds 140 °C, this light is illuminated in addition to the motor temperature warning light to signal that the operation of the respective fan should be checked.

2.6.10.1.11 SERVICE INTERVAL INDICATOR LIGHT

The illumination of the service interval indicator light signals to the operator that an inspection or lubrication service is due. The interval can be modified in certain areas. The modification and the reset is done with the diagnostic unit.

2.6.10.2 BATTERY DISCHARGE INDICATOR

The battery discharge indicator consists of 10 LEDs (7 green, 1 orange and 2 red). Depending on the battery state of charge, the row of illuminated LEDs goes off from battery fully charged (right green LED) to battery discharged (both red LEDs flashing). When the two red LEDs flash, the speed of the working hydraulics is reduced by 50 %.

The condition of a battery is always reflected in its discharge voltage gradient. In the case of the Linde discharge indicator, the battery voltage is measured and from this value the voltage of the cells is deduced. The cell voltage drops as the battery discharges. The cell voltage is also influenced by the momentary current consumption. The surge in cell voltage with a load is lower with a charged battery than with a discharged one. The registration of battery discharge is based on the voltage surges measured over a period of time.

The discharge voltage gradient varies with the type, age and discharge period of the battery. Various discharge characteristic curves are stored in the operating software of the combined instrument for various types of batteries. The correct curve must be chosen for the battery installed. The battery type can be modified with menu item 21.

1 Standard wet cell Varta (factory setting)
2 Standard wet cell Deta
3 Performance enhanced battery
4 Gel battery

The discharge period and the age of the battery also affect the discharge characteristic. The programmed discharge characteristic can be shifted in certain ranges in order to show the correct discharge information on the display.

When the battery discharge reaches 80 percent, the speed of the working hydraulics is reduced to warn the operator that the battery must be charged. This value can be increased to a residual capacity of 40 percent.

Depending on the type of application and battery, the discharge indicator must be optimised. An optimisation is done with the diagnostic unit using the following menu items:

21 Battery type
22 Upper discharge characteristic
23 Cut-out point

The changes should be done in the smallest possible steps. The installed battery type should be programmed first. Then a fine adjustment can be performed with menu item 22 (upper discharge characteristic), which corresponds to the adjusting potentiometer (range A to E) on the Curtis discharge indicator, and with menu item 23 (cut-out point).

The table below serves as a programming aid for the various types of batteries and applications. Depending on the application and type of battery, menu numbers 22 and 23 can be altered according to the following table. A detailed description regarding the application of the diagnostic unit in connection with the combined instrument is given in section 2.6.11.

Type of Application and Battery	Time for Reduction	Change in Menu No. 22.	Change in Menu No. 23
Particularly heavy duty Battery charging under 4 hrs required	Too early	Reduce	Increase
Particularly light duty Battery charging once a week	Too late	Increase	Increase
Trucks with many options (basic loads e.g. heater, etc.)	Too late	Increase	Increase
Performance enhanced PzS battery	Too late	Increase by 0.03 V	Increase
PzV battery	Too late	Increase by 0.06 V	Increase
CSM battery	Too late	Increase by 0.09 V	Increase

The battery discharge indicator is reset to "battery fully charged" by the increase in cell voltage after charging of the battery. This cell voltage is programmed to be 2.09 V per cell as standard value. This value can be modified with menu item 22. The cell voltage value must be applied for a certain period of time after turning on the key switch before the discharge indicator is reset. When the truck is delivered, this value is set to 0.1 min. This time can be changed with menu item 24.

2.6.11 LINDE DIAGNOSTIC UNIT

In future Linde will use more microprocessor-based controls. For this reason Linde has developed the diagnostic unit P/N 390 360 5405. This special tool and measuring unit (WM 136) can now be ordered from parts Service.

The Linde diagnostic unit is used for communication (programming, initiaiization and queries) with the microprocessor-based controls of Linde components provided with an ISO Interface (DIN/ISO 9141). The diagnostic unit contains terminal software which allows communication with the unit in question through the ISO interface.

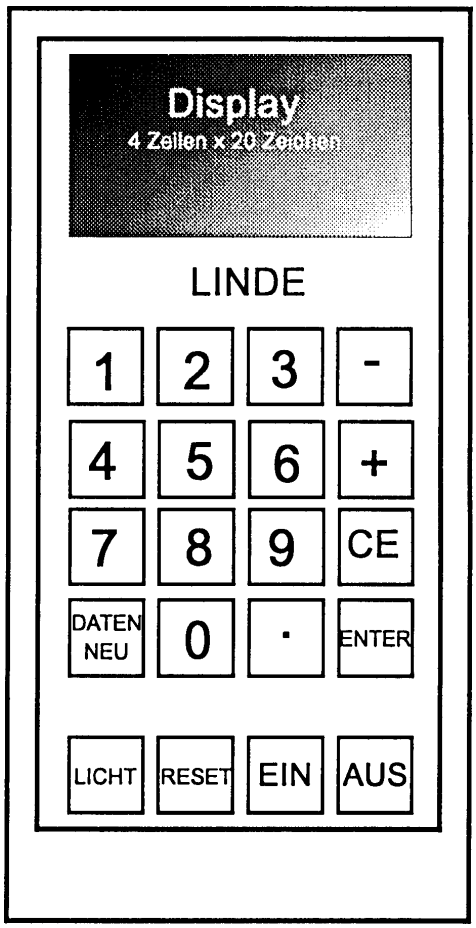
The internal operating software is integrated in an EPROM and it controls the input, output and display. No adaption of the operating software to newly developed or modified components is required.

The diagnostic unit is equipped with an LCD (liquid crystal display) with 4 lines, each consisting of 20 digits, and a foil keyboard with 20 keys. A cable supplied with the diagnostic unit is used to connect the unit to the Linde component in question.

Power is supplied by four 1.5 V round cells R6 or by electrical system of the Linde truck. The installed round cells are tested each times the diagnostic unit is switched on.

If no key is touched, the diagnostic unit is automatically switched off after 80 sec. to spare the round cells. If visibility is pour, the display can be illuminated pressing the appropriate key.

The contrast of the LCD display can be set with a potentiometer in the diagnostic unit.



EIN	Switching on the diagnostic unit
AUS	Switching off the diagnostic unit
RESET	Resetting diagnostic unit
LICHT	Display lighting
DATEN NEU	Start a new input
ENTER	Data transmission
CE	No function
0 - 9 + -	Input keys

2.6.11.1 OPERATION OF THE DIAGNOSTIC UNIT IN CONNECTION WITH THE COMBINED INSTRUMENT

With the aid of the diagnostic unit, various functions can be programmed with the combined instrument and data can also be read out of the memory of the combined instrument. All functions can be accessed with the menu numbers. It is possible to differentiate between

Programmable functions	Menu No. 11 to 24
Reset of service interval display	Menu No. 31
Programmable hours	Menu No. 32 to 35
Read-out function	Menu No. 41 to 43

The functions of the separate menu items are described in the following table.

Menu No.	Function	Factory setting	Possible settings	Explanation of funktion
11	Fan version	1	1	Both fans are turned on when temperature at one motor reaches 80 ℃
			2	Fan of motor in question is turned on when temperature at one motor reaches 80 ℃
12	Servive hour variant	1	1	Hour meter runs when activated by key switch and seat switch
			2	Hour meter runs when accelerator pedal and working hydraulics are operated
13	Service interval period	250 h	-----, 250, 500 750, 1000 h	Service hours at which service interval indicator light is illuminated (deactivated with ----)
14	Number of motors	2	2	Two traction motors installed in truck
			1	1) One traction motor installed in truck
15	Thermal sensors	1	1	Thermal sensor installed in motor
			0	2) No thermal sensor installed in motor
21	Type of battery	1	1	Battery characteristic for standard PsZ cell Varta
			2	Battery characteristic for standard PsZ cell Deta
			3	Battery characteristic for enhanced PsZ cell
			4	Battery characteristic for gel battery
22	Upper discharge characteristic	2,09 V	2,00, 2,03 2,06, 2,09 2,12, 2,15 2,18 V	Battery cell voltage value interpreted by discharge indicator as fully charged battery
23	Cut-out point for discharge indicator	20%	20, 25, 30 35, 40 %	Residual battery capacity at which power reduction of working hydraulics set in
24	Discharge indicator disable time	0,1min	0,1, 1,1, 2,1 3,1, 4,1, 5,1 6,1, 7,1, 8,1	Time after which discharge indicator jumps to full charge when cell voltage set in menu item 22 is reached
31	Reset Service Lamp			
32,33	Service hours with accelerator depressed			3) Freely programmable if total service hrs <00000.0
				3) Freely programmable if total service hrs <00000.0
34	Service hours 2M1			3) Freely programmable if total service hrs <00000.0
35	Totoal Service hours			3) Freely programmable if total service hrs <00000.0
41	Motor overheating			Display of last three motor overheatings (over 160 °C) with motor number and service hours
42	Brush wear			Display of last three brush wear signals with motor number and service hours
43	Discharge limit			Display of last five service hour values at which the battery was discharged up to the cut-out point of discharge indicator

1) Not on series 336 trucks
2) On trucks to series 6/95
3) Only possible once with a new combined instrument. Input is with numeric key pad (6 digits) and it must be concluded by pressing ENTER.

The programming possibilities of the diagnostic unit in conjunction with the combined instrument depend on the software version of the combined instrument. The software version is given on a label affixed to the side of the instrument.

For example: SW Vers.2.1 means Software Version 2.1

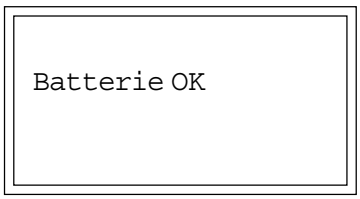
From software version 3.0 on, the software version appears in the display after the self-test when the key switch is turned on.

Since the development of the combined instrument, three software versions have been created. The following table shows which function is implemented with each software version. Only the combined instrument with the latest software version is available as replacement part.

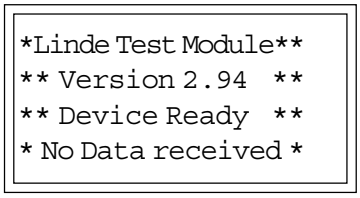
Menu No.	Function	Active from Software Version	Implemented in truck since
11	Fan version	3.1	7/95
12	Hour meter Variant	3.1	7/95
13	Service interval	2.1	4/94
14	Number of motors	3.1	--------
15	Thermal sensor	3.1	7/95
21	Battery type	3.1	4/94
22	Upper end of characteristic	2.1	4/94
23	Discharge indicator cut-out point	3.1	4/94
24	Discharge indicator disable time	2.1	4/94
31	Reset service lamp	2.0	9/94
32	Service hours (accelerator depr.)	3.1	7/95
33	Service hours (accelerator depr.)	3.1	7/95
34	Service hours of 2M1	3.1	7/95
35	Total service hours	3.1	4/94
41	Motor overheating	3.1	7/95
42	Brush wear	3.1	7/95
43	Discharge limit	3.1	4/94

2.6.11.1.1 PROGRAMMING OF MENU FUNCTIONS 11 TO 24

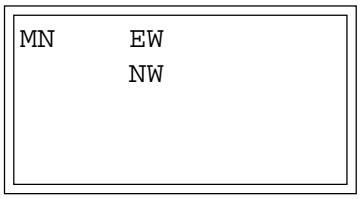
- Connect the diagnostic unit to the truck data connector. The data connector is located behind the left switch cover at the instrument panel.
- Turn on the key switch.
- Depress the **EIN** (on) button. If the internal batteries are OK, the following message will appear on the display



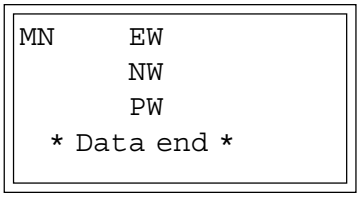
- After the battery test there will appear



- Depress the **DATEN NEU** (new data) button.
- Enter the menu number.
- The selected menu number (MN) will appear and the current value (EW).
- The programmed value can be modified with the **+** and **-** buttons. The new value (NW) will appear in the second line of the display.

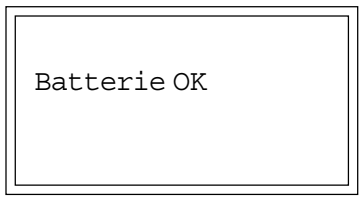


- Depress the **ENTER** button to store the new value (NW).
- The newly programmed value (PW) appears in the third line of the display.

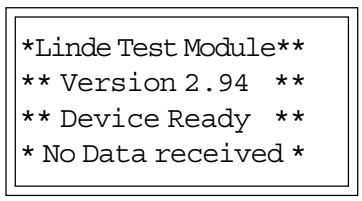


2.6.11.1.2 RESETTING THE SERVICE INTERVAL INDICATOR WITH MENU FUNCTION 31

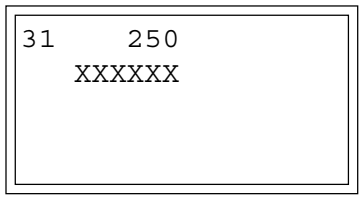
- Connect the diagnostic unit to the truck data connector. The data connector is located behind the left switch cover at the instrument panel.
- Turn on the key switch.
- Depress the **EIN** (on) button. If the internal batteries are OK, the following message will appear on the display



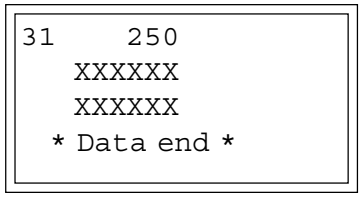
- After the battery test there will appear



- Depress the **DATEN NEU** (new data) button.
- Enter menu number **31**.
- The selected menu number will appear and also the current service interval setting (factory setting is 250 hrs).
- The service hours at which the service interval indicator was last reset are shown in the second line of the display.



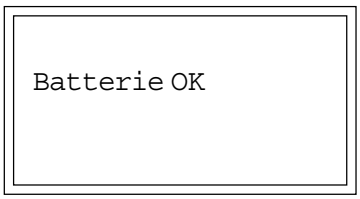
- Depress the **ENTER** button.
- The service interval indicator is reset and in the third line of the display there appears the operating hours at which the service interval indicator will next be illuminated.



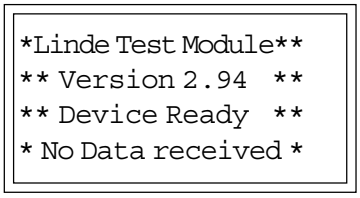
2.6.11.1.3 PROGRAMMING AND READING THE SERVICE HOUR MENU FUNCTIONS 32 TO 35

When a combined instrument is replaced in the course of a repair, it may be necessary to store the service hours of the former combined instrument in the new combined instrument. This is only possible once with a new combined instrument whose total service hour count is between 9999.7 and 00000.0 hours.

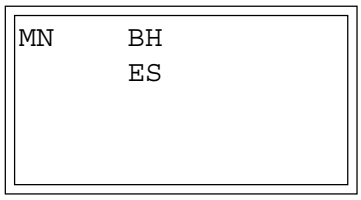
- Connect the diagnostic unit to the truck data connector. The data connector is located behind the left switch cover at the instrument panel.
- Turn on the key switch.
- Depress the **EIN** (on) button. If the internal batteries are OK, the following message will appear on the display



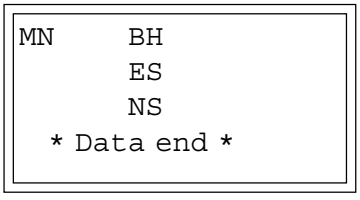
- After the battery test there will appear



- Depress the **DATEN NEU** (new data) button.
- Enter the menu number.
- The selected menu number (MN) will appear and the current number of service hours (BH).
- The desired number of service hours can be entered with the numeric buttons. The input must have 6 digits (use leading zeros and after the decimal point).
- The programmed service hours (ES) will appear in the second line of the display.
- If an error occurs during the input, the procedure can be quit with any button.



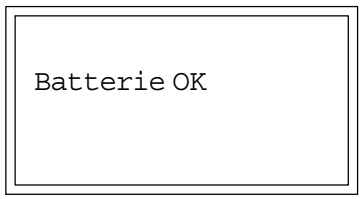
- Depress the **ENTER** button to store the new service hours (ES).
- The newly programmed service hours (NS) will appear in the third line of the display.



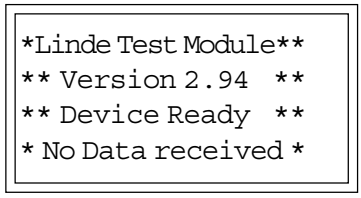
2.6.11.1.4 READ-OUT FUNCTIONS WITH MENU FUNCTIONS 41 TO 43

The data for motor overheating, brush wear and discharge limits can be read out of the memory of the combined instrument. The respective motor number and the service hours are displayed.

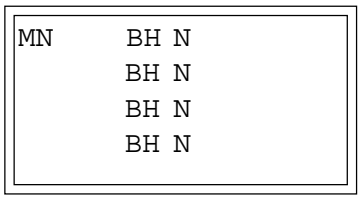
- Connect the diagnostic unit to the truck data connector. The data connector is located behind the left switch cover at the instrument panel.
- Turn on the key switch.
- Depress the **EIN** (on) button. If the internal batteries are OK, the following message will appear on the display



- After the battery test there will appear



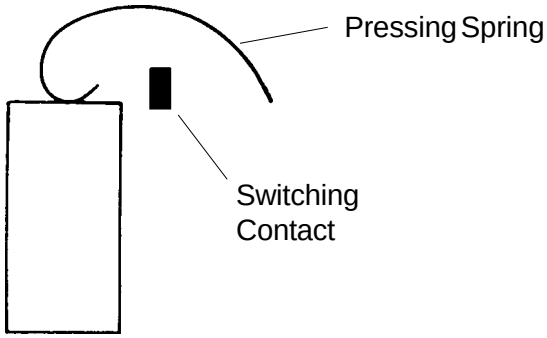
- Depress the **DATEN NEU** (new data) button.
- Enter the menu number.
- The selected menu number (MN) will appear and the current number of service hours (BH) and, if necessary, the motor number (N).



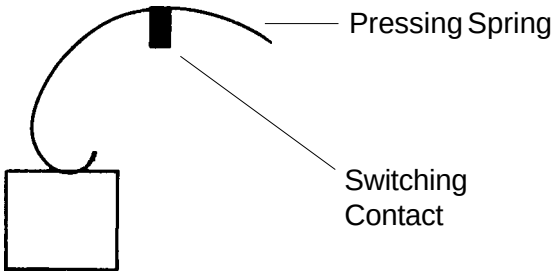
2.6.12 BRUSH MONITORING

In trucks up to series 6/95 a brush monitoring system was used in which the brush wear switch (maker) was connected to a brush monitor which, in turn, was connected to the combined instrument.
Brush monitoring from series 7/95

A switching contact is installed on each of the positive and negative brushes in the motor (traction and pump motors).



All four switching contacts are connected in series and to battery negative on one side. When one brush is worn down to 60 % of its original length, the pressure spring touches the switching contact, thus cutting off the battery negative signal at the combined instrument.



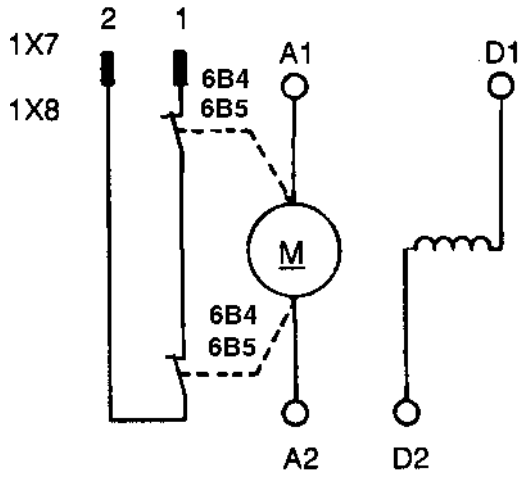
The lamp in the combined instrument is illuminated and signals the wear of a motor brush. Even if only a brief triggering of the switching contact at a motor brush occurred, this information will remain stored until the key switch is turned off. To identify the motor with the brush wear, the motor number is shown in the LCD display.

1 RH traction motor 1M1
2 LH traction motor 1M2
3 Pump motor 2M1

The motor number and the elapsed service hours are displayed alternately.

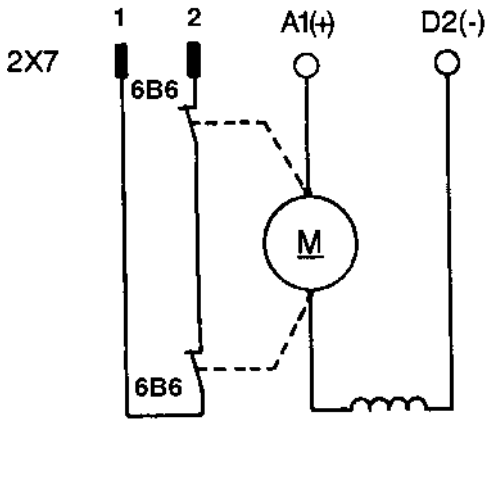
2.6.12.1 TRACTION MOTOR SWITCHING CONTACTS

Connector 1X7 RH traction motor
Connector 1X8 LH traction motor



The two switching contacts 6B4 and 6B5 in the two traction motors cut off the appropriate battery negative signal at the combined instrument when the brushes are worn.

2.6.12.2 WORKING HYDRAULICS PUMP MOTOR SWITCHING CONTACTS



On the working hydraulics pump motor the brush wear switch 6B6 cut off the battery negative signal to the combined instrument.

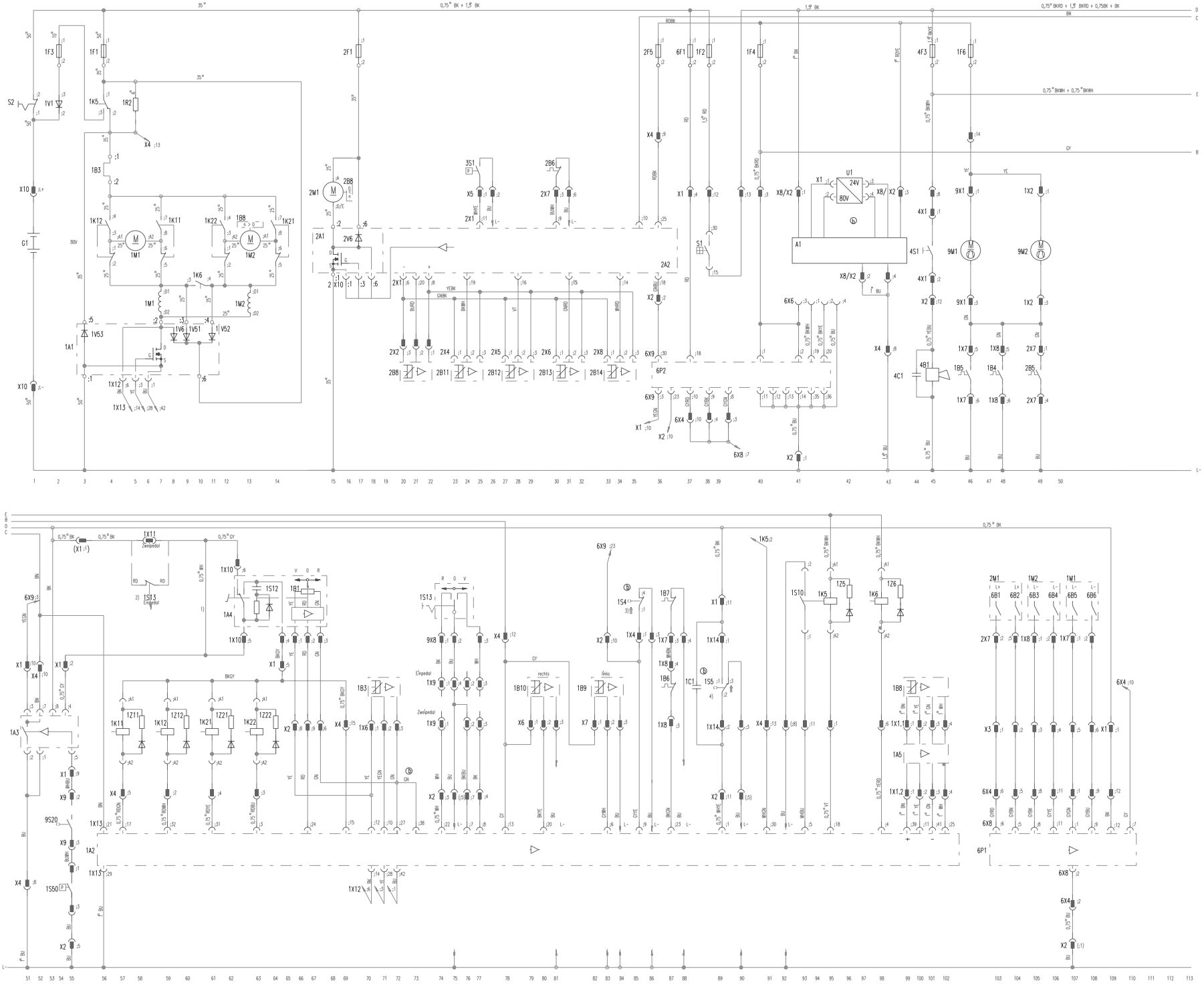
2.6.13 WIRING DIAGRAM

2.6.13.1 WIRING DIAGRAM TO SERIES 6/95

A1	Converter protective circuit	41-43
1A1	Traction control power module	3-11
1A2	Traction control	56-102
1A3	Time relay	51-55
1A4	Accelerator sensor	62-68
1A5	Amplifier for speed sensor	99-102
2A1	Lift control power module	15-20
2A2	Lift control	20-37
(1B1)	(Accelerator sensor potentiometer)	66-68
1B3	Current sensor	4, 70-72
1B4	Temperature switch 80 ℃ maker (in 1M1)	47
1B5	Temperature switch 80 ℃ maker (in 1M2)	46
1B6	Temperature switch 160 °C, breaker (in 1M2)	87
1B7	Temperature switch 160 °C, breaker (in 1M1)	87
1B8	Speed sensor1M2	13,99-102
1B9	Curve sensor, left	82-84
1B10	Curve sensor, right	79-81
2B5	Temperature switch 80 ℃ maker (in 2M1)	49
2B6	Temperature switch 160 ℃ breaker (in 2M1)	30
2B8	Speed sensor 2M1	16 20-22
2B11	Lift sensor	23-25
2B12	Tilt sensor	27-29
2B13	Aux. hydraulics sensor 1	30-32
2B14	Aux. hydraulics sensor 2	33-35
4B1	Horn	45
6B1, 6B2	Brush wear switch, pump motor	103, 104
6B3, 6B4	Brush wear switch, LH traction motor	105, 106
6B5, 6B6	Brush wear switch, RH traction motor	107, 108
1C1	Suppressor capacitor, brake switch	88
4C1	Suppressor capacitor	44
1F1	Traction fuse 355 A	4
1F2	Control fuse 15 A	38
1F3	Fuse 100 A	2
1F4	Traction control fuse 5 A	40
1F6	Fan fuse 5 A	46
2F1	Lifting fuse 250 A	15
2F5	Lifting fuse 5 A	36
4F3	Horn fuse 5 A	45
6F1	Fuse 15 A discharge indicator	37
G1	Battery	1
1K5	Regenerative current contactor	4, 95
1K6	Circuit breaker contactor	10, 98
1K11	Reverse directional contactor, right	7,57
1K12	Forward directional contactor, right	4,59
1K21	Reverse directional contactor, left	14,61
1K22	Forward directional contactor, left	12,63
1M1	RH traction motor	4-7,107,108
1M2	LH traction motor	13,105,106
2M1	Pump motor	15,103,104
9M1	Fan motor (traction and pump motor)	46
9M2	Fan motor (motor compartment)	49
6P1	Motor brush monitor	103-110
6P2	Combined instrument	36-42
1R1	Resistor for speed reduction	73
1R2	Resistor for field excitation	5
S1	Key switch	39
S2	Emergency stop switch	1
1S4	Parking brake switch	85
1S5	Brake pedal switch	89
1S10	Regenerative current switch	93
1S12	Accelerator sensor switch	63
1S13	Directional switch	58,59
	single-pedal model	74-77
1S50	Seat switch	55
3S1	Steering switch	25
4S1	Horn button	45
9S20	Overhead guard switch	55
U1	Voltage converter	42
1V1	Diode	2
1V6	Traction freewheel diode	8
1V51	Armature diode (1M1)	9
1V52	Armature diode (1M2)	11
1V53	Regenerative current diode	3
2V6	Pump motor freewheel diode	17
X1	15-pin connector	
X1	Voltage converter connector	42
X2	12-pin connector	
X3	6-pin connector	103-108
X4	15-pin connector	
X5	Reed contact 3S1 terminal	25, 26
X6	Left curve sensor, 4-pin connector.	79-81
X7	Right curve sensor, 4-pin connector	82-84
X8/X2	Voltage converter, 6-pin connector	41-43
X9	Overhead guard, 3-pin connector	55
X10	Battery plug	1
1X1 1.2	4-pin connector	99-102
1X2	3-pin connector	49
1X4	3-pin connector	85, 86
1X6	3-pin connector	70-72
1X7	8-pin connector	46,87,88 107,108
1X8	8-pin connector	48,87 105,106
1X9	4-pin connector	74-77
1X10	6-pin connector	62-68
1X11	2-pin connector	58-59
1X12	Connection, power module - traction control unit	3-6
1X13	42-pin connector	56-102
1X14	3-pin connector	89-90
2X1	25-pin connector	20-37
2X2	3-pin connector	20-22
2X4	3-pin lift signal connector	23-25
2X5	3-pin tilt connector	27-29
2X6	3-pin aux. hydraulics 1 connector	30-32
2X7	6-pin 2M1 connector.	30-31, 49 103, 104
2X8	3-pin aux. hydraulics 2 connector	33-35
2X10	Connection, power module - lift control unit	16-18
4X1	2-pin connector	45
6X4	15-pin connector	103-112
6X6	Diagnostic connector 4-pin	41-42
6X8	12-pin connector	103-110
6X9	36-pin connector	36-42
9X1	3-pin connector	46
9X8	3-pin connector	74-76
1Z5	Quench circuit	98
1Z6	Quench circuit	101
1Z11	Quench circuit	58
1Z12	Quench circuit	60
1Z21	Quench circuit	62
1Z22	Quench circuit	64

Colour code:

BK	black	GN	green
WH	white	VT	violet
BU	blue	RD	red
OG	orange	YE	yellow
BN	brown	GY	grey



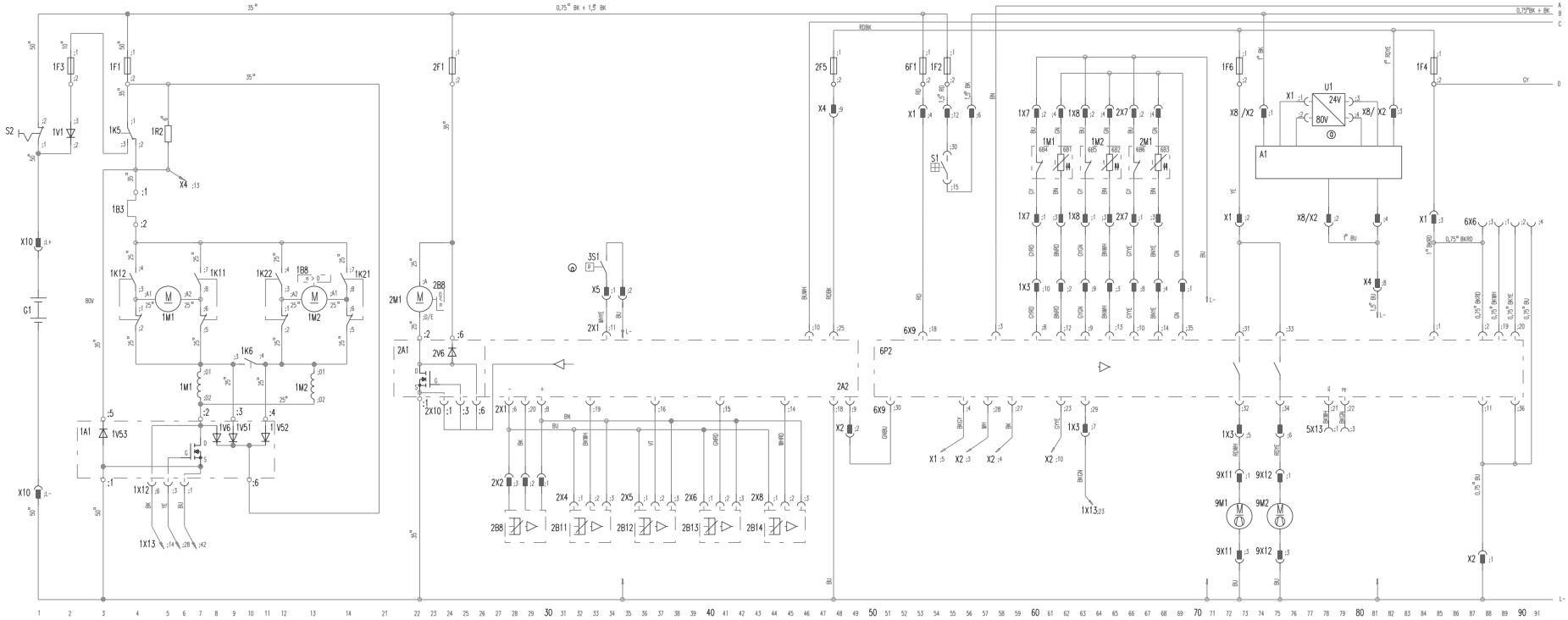
2.6.13.2 WIRING DIAGRAM FROM SERIES 7/95

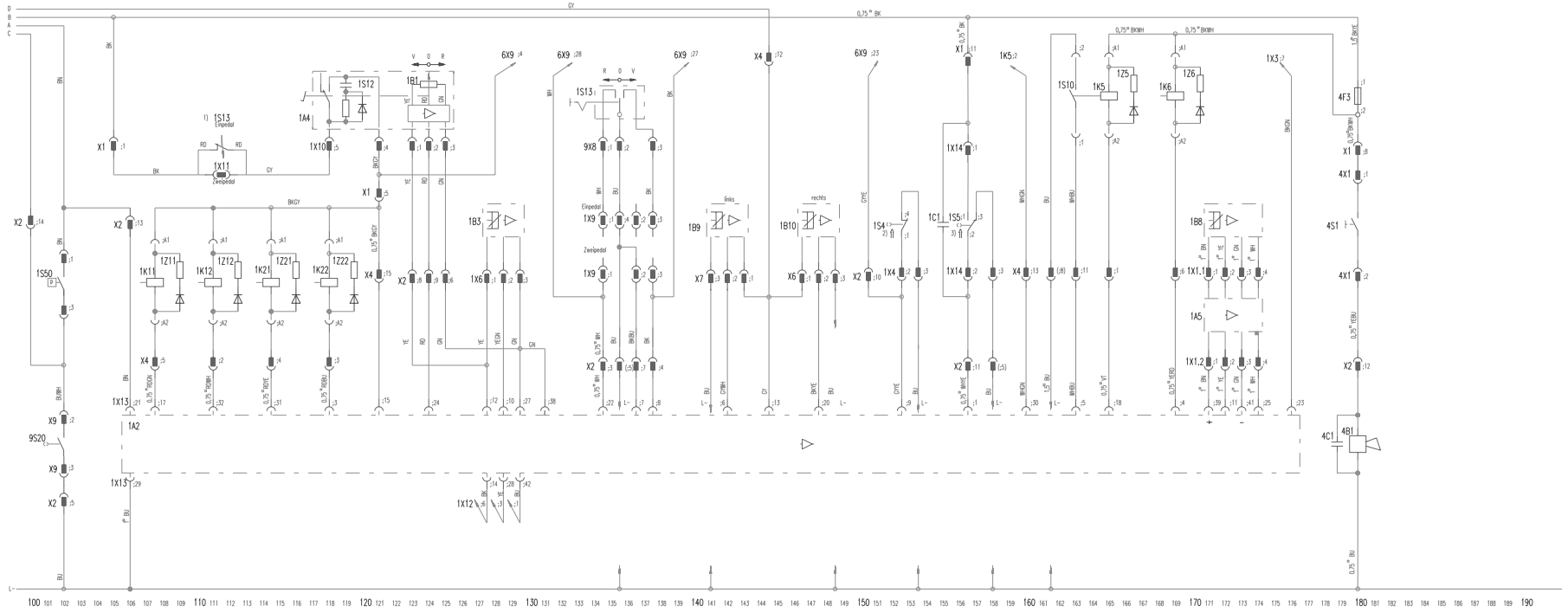
1A1	Traction control power module	3-11
1A2	Traction control	106-176
1A4	Accelerator sensor	118-124
1A5	Amplifier for speed sensor	171-174
2A1	Lift control power module	22-26
2A2	Lift control	27-49
(1B1)	(Accelerator sensor potentiometer)	123-126
1B3	Current sensor	14,127-130
1B8	Speed sensor 1M2	13,171-174
1B9	Curve sensor, left	141-143
1B10	Curve sensor, right	146-148
2B8	Speed sensor 2M1	22,28-30
2B11	Lift sensor	32-34
2B12	Lift tilt	36-38
2B13	Aux. hydraulics sensor 1	40-42
2B14	Aux. hydraulics sensor 1	44-46
4B1	Horn	180
6B1	Thermal sensor in 1M1	62
6B2	Thermal sensorr in 1M2	65
6B3	Thermal sensorr in 2M1	68
6B4	Brush wear switch,1M1	60
6B5	Brush wear switch, 1M2	63
6B6	Brush wear switch, 2M1	66
1C1	Suppressor capacitor, brake switch	255
4C1	Suppressor capacitor	179
1F1	Traction fuse 355 A	4
1F2	Control fuse 15 A	55
1F3	Fuse 100 A	2
1F4	Traction control fuse 5 A	85
1F6	Fan fuse 5 A	73
2F1	Lifting fuse 250 A	24
2F5	Lifting fuse 5 A	48
4F3	Horn fuse 5 A	280
6F1	Fuse 15 A discharge indicator	53
G1	Battery	1
1K5	Regenerative current contactor	4, 164
1K6	Circuit breaker contactor	10, 169
1K11	Reverse directional contactor, right	7,107
1K12	Forward directional contactor, right	4, 111
1K21	Reverse directional contactor, left	14, 115
1K22	Forward directional contactor, left	12, 118
1M1	RH traction motor	5, 6
1M2	LH traction motor	13
2M1	Pump motor	22
9M1	Fan motor (traction and pump motor)	73
9M2	Fan motor (motor compartment)	75
6P2	Combined instrument	50-90
1R1	Resistor for speed reduction	131
1R2	Resistor for field excitation	5
S1	Key switch	54
S2	Emergency stop switch	1
1S4	Parking brake switch	153
1S5	Brake pedal switch	156
1S10	Regenerative current switch	163
1S12	Accelerator sensor switch	118
1S13	Directional switch single-pedal model	110-113, 134-137
1S50	Seat switch	102
3S1	Steering switch	34
4S1	Horn button	180
9S20	Overhead guard switch	102
U1	Voltage converter	77-79
1V6	Traction freewheel diode	8
1V51	Armature diode (1M1)	9
1V52	Armature diode (1M2)	11
1V53	Regenerative current diode	3
2V6	Pump motor freewheel diode	25

X1	15-pin connector	
X2	12-pin connector	
X4	15-pin connector	
X5	Reed contact 3S1 terminal	34, 35
X6	Left curve sensor, 4-pin connector	147-149
X7	Right curve sensor, 4-pin connector	141-143
X8	Voltage converter connector	74, 82
X9	Overhead guard, 3-pin connector	102
X10	Battery plug	1
1X1 1.2	4-pin connector	171-174
1X3	10-pin connector	60-69
1X4	3-pin connector	152-154
1X6	3-pin connector	127-129
1X7	4-pin connector	60-62
1X8	4-pin connector	63-65
1X9	4-pin connector	134-138
1X10	6-pin connector	118-125
1X11	2-pin connector	112, 113
1X12	Connection, power module - traction control unit	4-6
1X13	42-pin connector	106-176
1X14	3-pin connector	156, 157
2X1	25-pin connector	28-48
2X2	4-pin connector	28-30
2X4	3-pin lift signal connector	23-25
2X5	3-pin tilt connector	27-29
2X6	3-pin aux. hydraulics 1 connector	30-32
2X7	4-pin 2M1 connector.	66-68
2X8	3-pin aux. hydraulics 2 connector	33-35
2X10	Connection, power module - lift control unit	23-25
4X1	2-pin connector	180
5X13	3-pin connector turn signal indicator	78, 79
6X6	Diagnostic connector 4-pin	87-90
6X9	36-pin connector	51-90
9X8	3-pin connector	134-138
9X11	2-pin connector	71
9X12	2-pin connector	75
1Z5	Quench circuit	167
1Z6	Quench circuit	171
1Z11	Quench circuit	109
1Z12	Quench circuit	112
1Z21	Quench circuit	116
1Z22	Quench circuit	120

Colour code:

BK	black	GN	green
WH	white	VT	violet
BU	blue	RD	red
OG	orange	YE	yellow
BN	brown	GY	grey





2.7 HYDRAULIC SYSTEM

2.7.1 HYDRAULIC PUMP MOTOR

Type:	DC compound-wound motor
Model:	GF 144-14/4.3
Voltage:	80 V, 200 A, 2550 rpm
Power:	13.5 kW S3 15%
Type of protection:	IP00/23
Insulation class:	F
Carbon brushes:	12.5x40x40 mm with dust groove
Admissible wear:	down to 16 mm
Equipment:	Motor brush monitor - thermal switch to series 6/95; thermal sensor from series 7/95, speed sensor

2.7.2 RENEWING THE HYDRAULIC PUMP MOTOR BRUSHES

- Tilt the overhead guard to the 2nd detent.
- Remove the hydraulic pump motor brushes.
- Lift up the brush springs.
- Pull the brushes out of their guides.
- Renew the brushes.

2.7.3 REMOVING THE HYDRAULIC PUMP UNIT

- Tilt the overhead guard to the 2nd detent.
- Loosen the hose clamp on the hydraulic reservoir and disconnect the suction line.
- Screw off the hydraulic pump supply line P at the steering control valve.
- Remove the air duct.
- Disconnect the connector 2X7 from the pump motor to the main cable harness.
- Disconnect the speed sensor connector 2X2.
- Remove the cover on top of the sensor transmitter.
- Screw an eyebolt into the motor shaft.
- Lift the hydraulic pump unit out of the vehicle with suitable lifting equipment.

2.7.4 CONTROL VALVE

2.7.4.1 REMOVING THE CONTROL VALVE

- Lower the fork carriage and tilt the mast forward.
- Release the pressure in the hydraulic system.
- Tilt the overhead guard to the 2nd detent.
- Disconnect the hydraulic lines to the control valve.
- Remove connectors 2X4, 2X5, 2X6 and 2X8 at the bottom of the control valve.
- Loosen the grub screw on the linkage rods from the control levers to the control valve and remove the rods.
- Unscrew the three hexagonal screws on the back of the control valve and remove the control valve.

2.7.4.2 ADJUSTING THE PRESSURE-RELIEF VALVE

The pressure-relief valve is installed in the control valve block end plate.

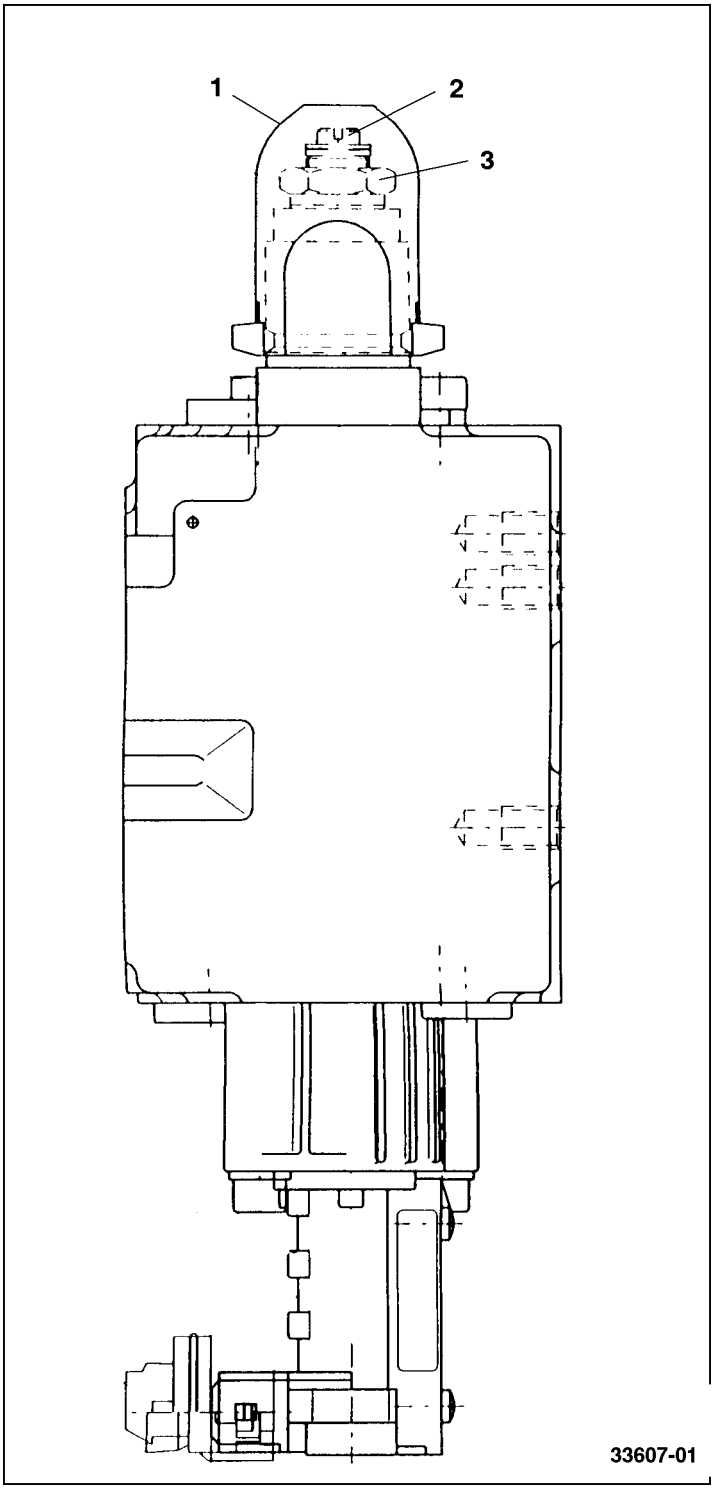
- Install a pressure gauge on the working hydraulics (if equipped with auxiliary hydraulics, preferably at the quick-disconnect coupling)
- Remove the cap (1) on the adjusting screw (2).
- Loosen the locknut (3) on the adjusting screw (2).
- Operate the control lever for the working hydraulics.
- Set the pressure at the adjusting screw (2) according to the table.

Pressure settings:

		E20/25	E30
Standart	mast type 163*	170 +5 bar	190 + 5 bar
Duplex	mast type 164	170 +5 bar	195 + 5 bar
Triplex	mast type 165	180 +5 bar	205 + 5 bar

* not for E 20

		E20	E25
Standard	mast type 183	190 +5 bar	165 +5 bar
Duplex	mast type 183	205 +5 bar	165 +5 bar
Triplex	mast type 183	215 +5 bar	----------

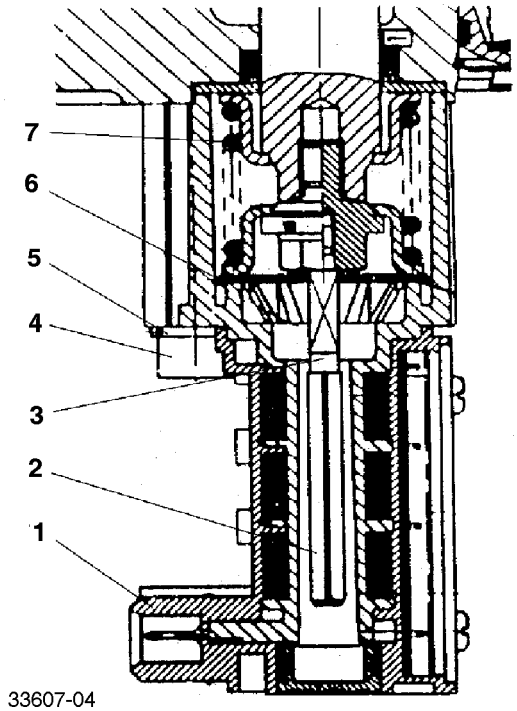

1
2
3
33607-01

2.7.4.3 Distance sensor

A replaceable distance sensor is installed on each hydraulic segment of the control valve.
Distance sensor removal

- Jack up and secure the truck.
- Tilt the cabin back to the 2nd detent.
- Disconnect the battery plug.
- Pull the control valve assembly approx. 5 - 6 cm out of the mounting with a pry bar and support the valve.
- Disconnect the connector on the distance sensor (1).
- Remove the two socket head screws (4) and lock washer (5).
- Carefully pull the distance sensor down and out of the sleeve retainer (3), taking care not to lose any shims (6).

NOTE: The shims are necessary for the mechanical adjustment of the distance sensor. Depending on the version of the control valve, one or more shims may be installed. These shims must be re-installed during the installation of the distance sensor.



1 Distance sensor
2 Sleeve
3 Sleeve retainer
4 Socket head screw
5 Lock washer
6 Shims
7 Spring

Installation:

- Carefully position the distance sensor (1) on the sleeve retainer (3) or spring (7), being sure that the number and location of the shims is correct. Retain the original connector position.
- Screw in and hand tighten the two socket head screws (4) and lock washers (5).
- Install the plug on the distance sensor.
- Remove the support at the control valve and lower the control valve.

The control of the distance sensor output signal is described in the section 2.6 on the electrical system.

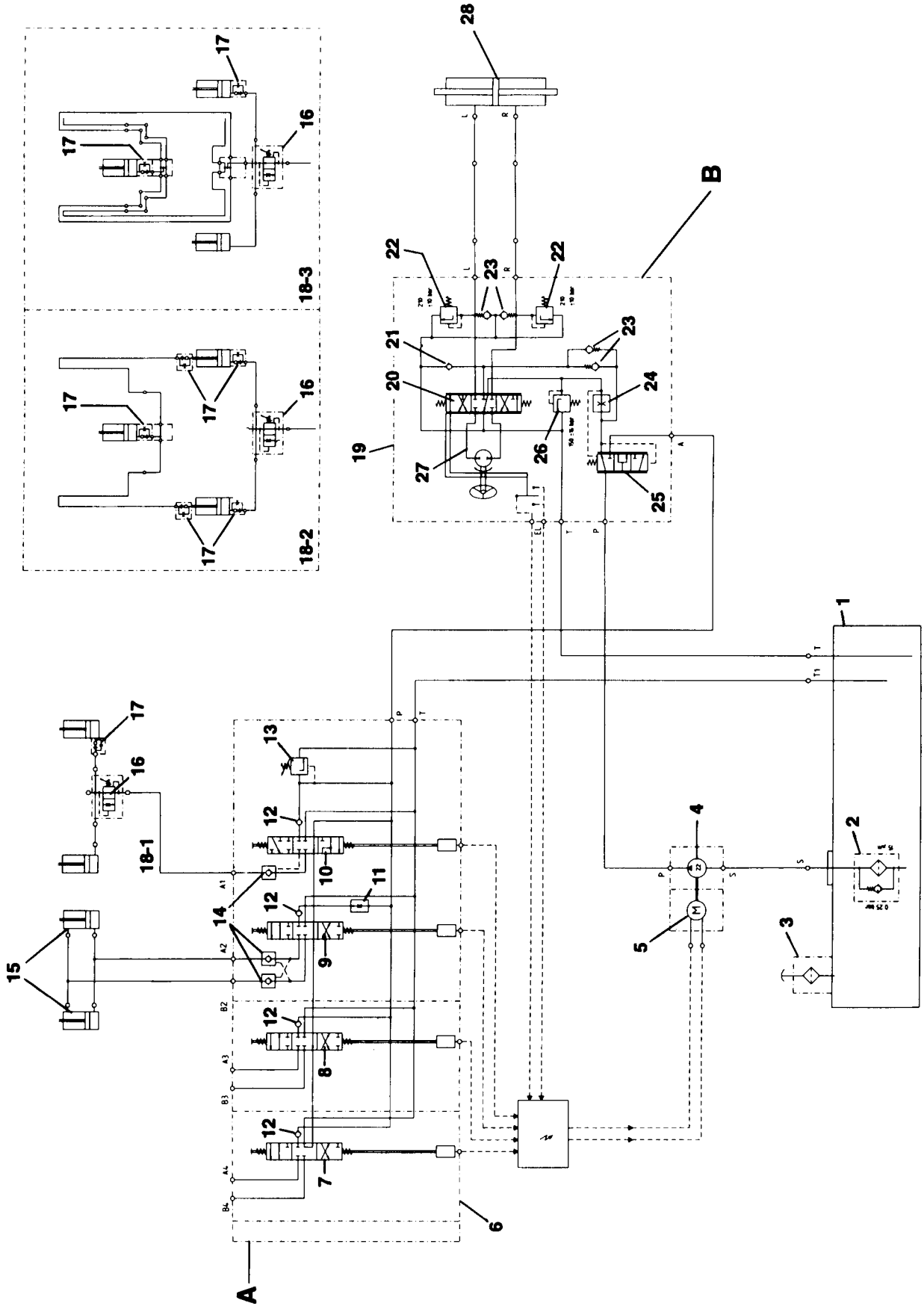
2.7.5 WORKING AND STEERING HYDRAULICS CIRCUIT DIAGRAM

A WORKING HYDRAULICS

1 Hydraulic oil reservoir.
2 Suction filter (15 µm) 0.25 bar
3 Breather filter
4 Hydraulic pump 22 cu cm/rev
5 Electric motor
6 Control valve
7 5/3 way valve for double auxiliary hydraulics
8 6/3 way valve for single auxiliary hydraulics
9 6/3 way valve for tilting
10 6/3 way valve for lifting
11 Restrictor
12 Make-up valve
13 Maximum pressure valve
14 Pressure holding valve
15 Tilt jack
16 Brake lower valve
17 Pipe safety valve
18-1 Lift jack, standard mast
18-2 Lift jack, duplex mast
18-3 Lift jack, triplex mast

B Steering hydraulics

19 Steering control valve
20 7/3 way valve
21 Non-return valve
22 Shock valve
23 Make-up valve
24 Restrictor
25 3/3 way valve
26 Maximum pressure valve
27 Power steering control
28 Steering jack


28
17
16
17
18-3
17
16
17
17
18-2
17
B
22
23
22
21
23
20
24
19
27
26
25
1
17
16
18-1
13
12
10
11
12
14
9
15
12
8
12
7
6
A
4
2
5
3

2.9 OPTIONS

2.9.1 LIGHTING, WIPERS AND HEATER

2.9.1.1 VOLTAGE CONVERTER

The options such as heater, lighting or wipers operate with a power supply of 12 V. The battery voltage of 80 V is reduced to this value by the voltage converter.

The voltage converter functions according to the chopper principle. This means that the battery voltage is converted into a 20 kHz rectangular voltage. This rectangular voltage is reduced by a transformer and subsequently rectified.

The input side is galvanically separated from the output side and is not connected to ground. The output is not regulated, i.e. the output voltage varies with input voltage and load. The output voltage is indicated by a light emitting diode. The output fuse makes the converter short-proof. There is a false pole protection at the input side of the converter.

CAUTION: The maximum power of the voltage converter is 200 W. If the required power is higher, a second voltage converter must be installed. This voltage converter must not be connected in parallel to the existing one. The two voltage converters must be separated on the secondary side at the fuse socket.

Maximum load for a voltage converter (200 Watt) corresponds to

- 3 working lights with 55 W each

or

- 2 working lights with 55 W each and front and rear windscreen wipers

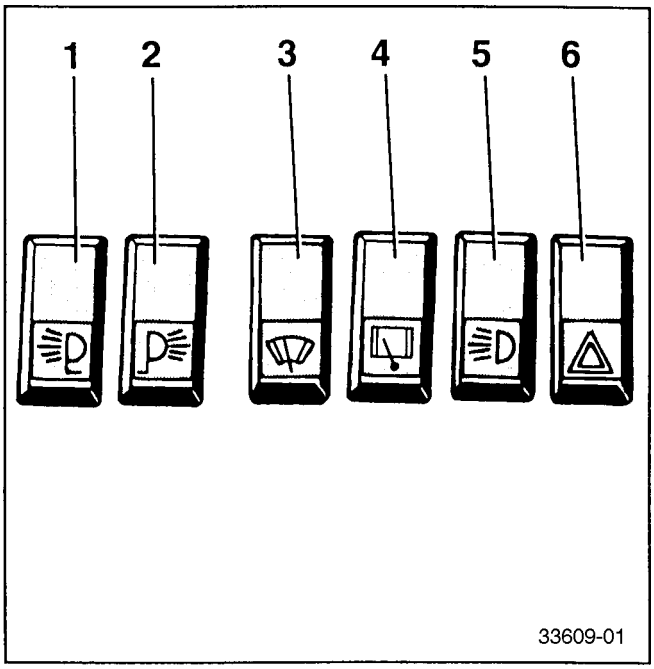
or

- truck lighting and traffic options

Specifications:

Type:	G80G12/16WDC0,2
Input voltage:	80 V ± 10%
Output voltage:	12 V
Power:	200 Watt
Output fuse:	15 Ampere slow-blowing
Input fuse:	4 Ampere slow-blowing
Ambient temperature:	-10 °C to +55 ℃
Efficiency:	80% to 85%
Max. housing temperature:	45 °C with max. load

2.9.1.2 SWITCHES



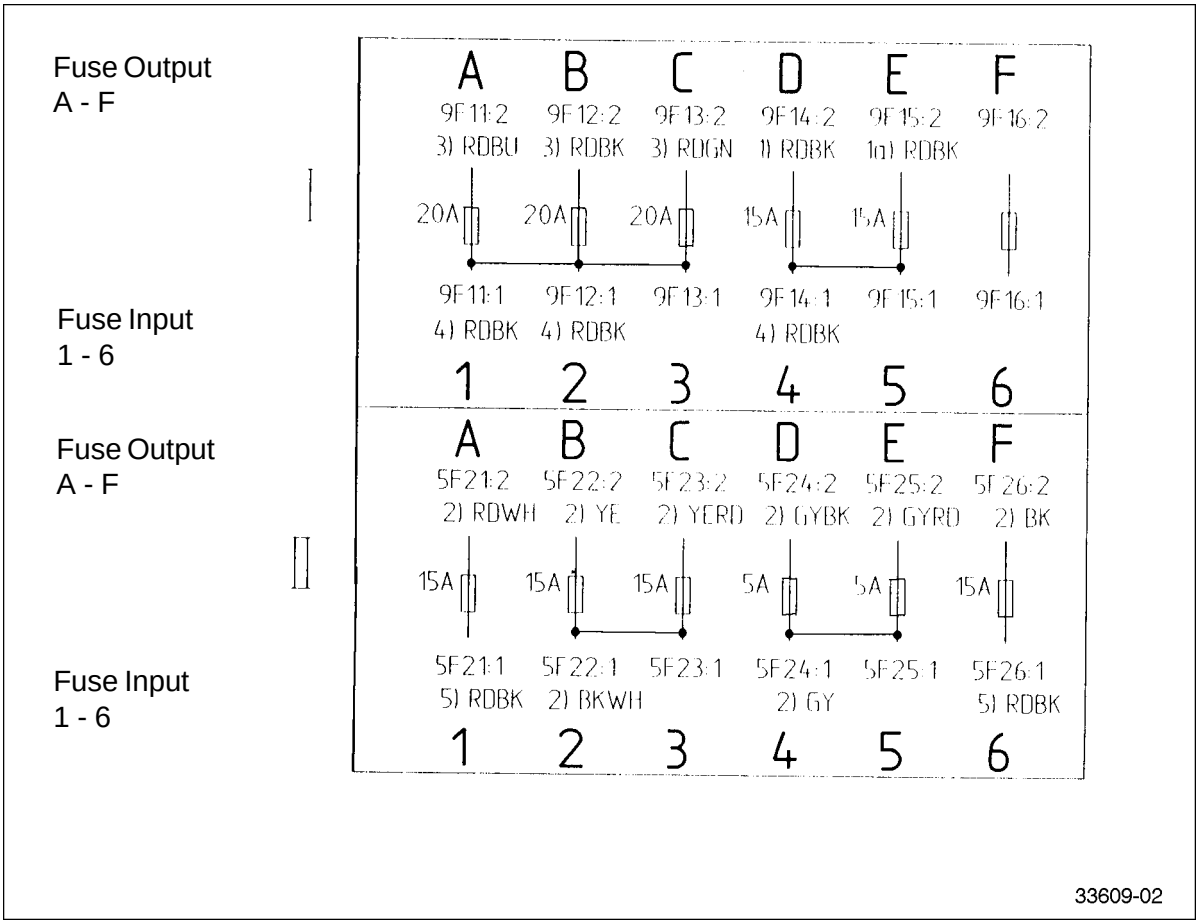
Description:

1 Working light switch 9S1
Switch lighting
2 Working light switch 9S2
Switch lighting
3 Front wiper switch 9S3
Switch lighting
4 Rear wiper switch 9S3
Switch lighting
5 Light switch 5S11
Switch lighting
6 Hazard warning flasher switch 5H19
Switch lighting

NOTE: The switches can be arranged in different sequences, depending on the version.

2.9.1.3 FUSE BOXES

Top view of fuse boxes I and II



Wire harnesses:

1 Front wiper
1a Rear wiper
2 Lighting
3 Working lights
4 Voltage converter
5 Voltage converter

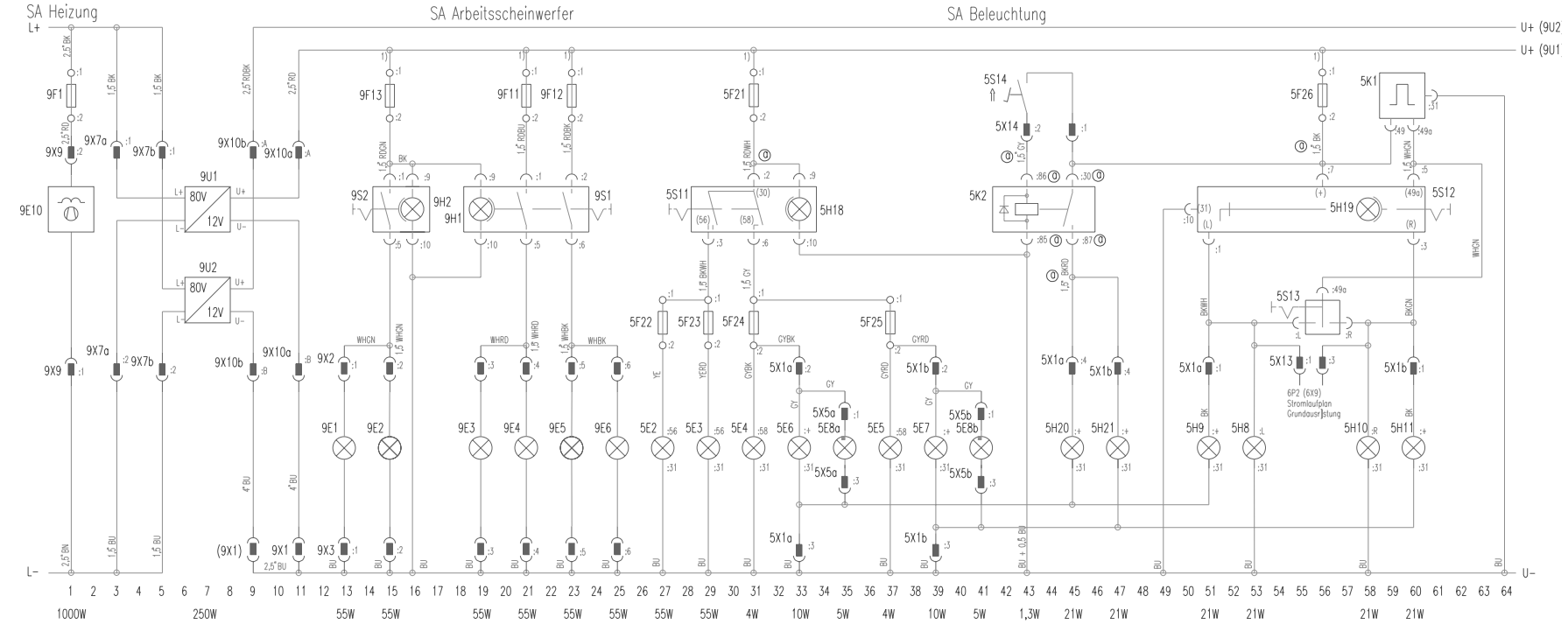
2.9.1.4 WIRING DIAGRAM

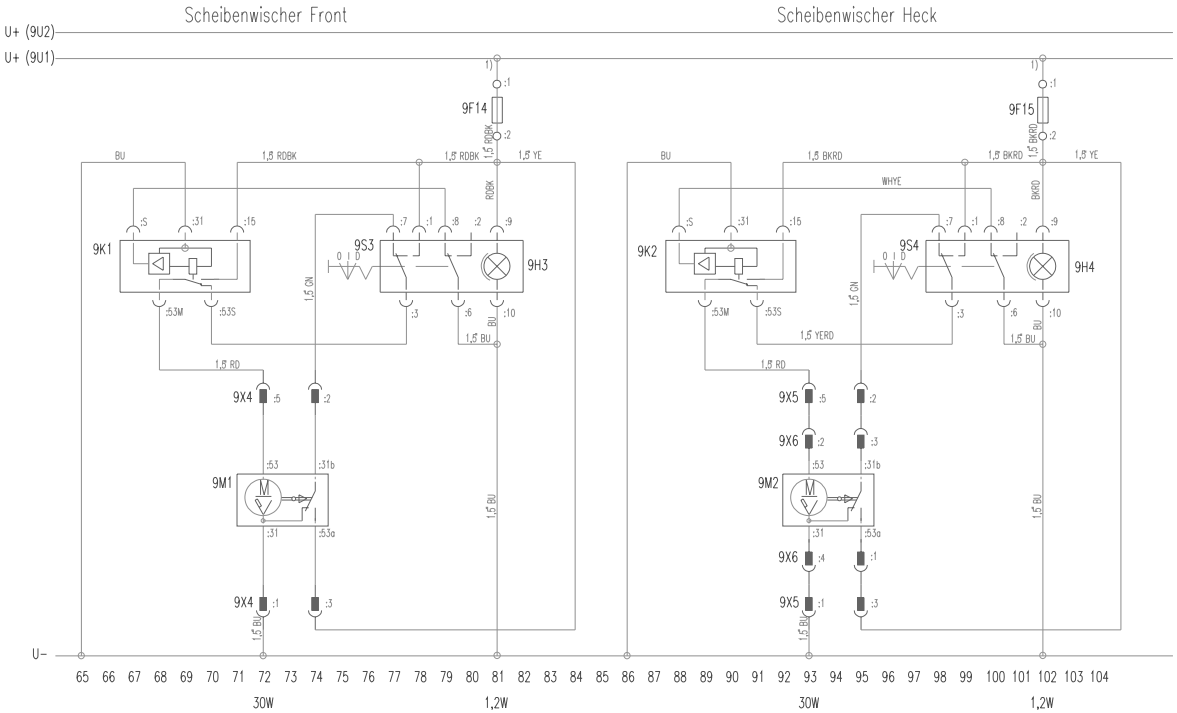
5E2	Dip beam, left		19
5E3	Dip beam, right		20
5E4	Parking light, left		21
5E5	Parking light, right		24
5E6	Side marker light, rear left		22
5E7	Side marker light, rear right		25
5E8a	License plate light, left		23
5E8b	License plate light, right		26
9E1-9E6	Working lights	12-18	
9E10	Heater		1
5F21	Fuse, light switch 15 A		21
5F22	Fuse, left dip beam 15 A		19
5F23	Fuse, right dip beam 15 A		20
5F24	Fuse, left side marker light 15 A		21
5F25	Fuse, right side marker light 15 A		24
5F26	Fuse, flasher system 15 A		31
9F1	Fuse, heater 20 A		1
9F11	Fuse, working light 20 A		16
9F12	Fuse, working light 20 A		17
9F13	Fuse, working light 20 A		13
9F14	Fuse, front wiper 15 A		53
9F15	Fuse, rear wiper 15 A	67	
5H8	Turn signal light, front left		31
5H9	Turn signal light, rear left		30
5H10	Turn signal light, front right		33
5H11	Turn signal light, rear right		34
5H12	Turn signal indicator light		32
5H18,5H19	Switch lighting	22,23	
5H20	Stop light, left		27
5H21	Stop light, right		28
9H1-4	Switch lighting	14,15,53,67	
9H5	Switch lighting	39	
5K1	Flasher		33,34
9K1	Front wiper intermittent relay	41-45	
9K2	Rear wiper intermittent relay		55-59
9M1	Front wiper motor		45-47
9M2	Rear wiper motor		59-61
5S11	Light switch		20-22
5S12	Hazard warning switch		30-34
5S13	Turn signal switch		31,32
5S14	Stop light switch		28
9S1,2	Working light switch		13-18
9S3	Front wiper switch		49-53
9S4	Rear wiper switch		63-67
9U1,9U2	Voltage converter		7-9
5X1	Connector, 6-pin		22-34
5X5a	Connector, 3-pin		23
5X5b	Connector, 3-pin		26
5X14	Connector, 6-pin		28
9X1	Connecting strip		10,11
9X2	Connector, 6-pin		12-18
9X3	Connector, 6-pin		12-18
9X4	Connector, 6-pin		46,47
9X5	Connector, 6-pin		60,61
9X6	Connector, 4-pin		60,61
9X7a	Connector, 3-pin		4
9X7b	Connector, 3-pin		6
9X9	Connector, 2-pin		1
9X10a	Connector, 2-pin		11
9X10b	Connector, 2-pin		10

NOTE:

All loads are marked on voltage converter U1. Depending on the equipment, connect the other loads to a second converter.
Colour code:

BK	black
WH	white
BU	blue
OG	orange
BN	brown
GN	green
VT	violet
RD	red
YE	yellow
GY	grey


SA Heizung
SA Arbeitsscheinwerfer
SA Beleuchtung
L+
L-
U+ (9U2)
U+ (9U1)
U-
9F1
9F13
9F11
9F12
5F21
5S14
5K2
5F26
5K1
5S11
5H18
5H19
5S12
5S13
9U1
9U2
80V
12V
9E10
9X9
9X7a
9X7b
9X10b
9X10a
9S2
9H2
9H1
9S1
9X2
9X3
9X1
(9X1)
9E1
9E2
9E3
9E4
9E5
9E6
5F22
5F23
5F24
5F25
5X1a
5X1b
5X5a
5X5b
5E2
5E3
5E4
5E5
5E6
5E7
5E8a
5E8b
5H20
5H21
5H9
5H8
5H10
5H11
6P2 (6X9)
Stromlaufplan
Grundausrüstung
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64
1000W
250W
55W
55W
55W
55W
55W
55W
55W
4W
10W
5W
4W
10W
5W
1,3W
21W
21W
21W
21W
21W
21W


Scheibenwischer Front
Scheibenwischer Heck
U+ (9U2)
U+ (9U1)
U-
9F14
9F15
9K1
9K2
9S3
9S4
9H3
9H4
9M1
9M2
9X4
9X5
9X6
65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104
30W
1,2W
30W
1,2W

2.10 SPECIALS

2.10.1 PIN CONNECTORS

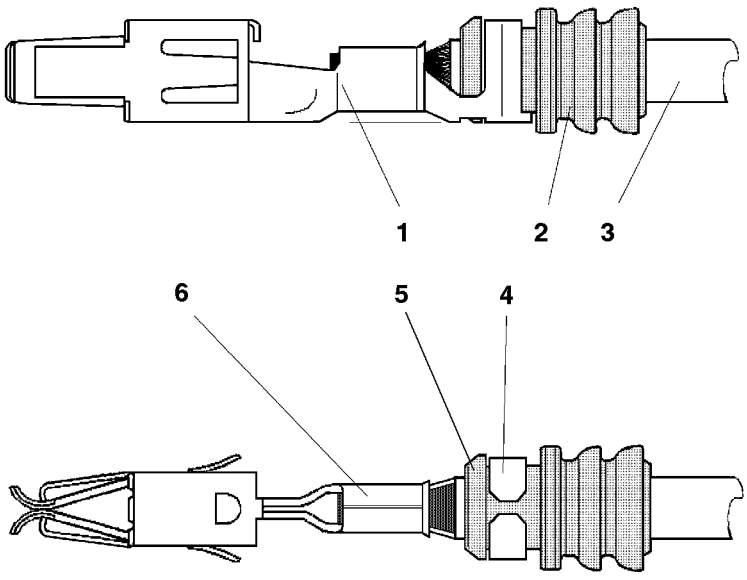
2.10.1.1 AMP-SAAB PIN CONNECTORS

The majority of the pin connectors fitted on trucks of the type 336 will be of the type AMP SAAB in the future. These pin connectors are watertight, each pin having it`s own seal with the connections locking together mechanically.

The following description will help to explain how to crimp the pins.

- Push the single seal (2) into the correct position over the insulated wire (Ensure that the shrouded end (5) is in the correct position on the insulated wire)
- With the aid of a pair wire strippers remove 5 mm the insulation, taking care not to demage the inner wire.
- The insulation of the wire must protude 1 mm from the seal (2).
- Place the wire (3) with the seal (2) into the connector pin (1) as illustrated below.
- With the crimping pliers WM 145 first crimp the connector pin onto the seal (2) in the area marked (4)
- Secondly the contactor pin should be crimped in the area marked (6)
- Press fully the contactor pin with attached wire into the plug housing.

NOTE: To remove the contactor pin there is a special extraction tool WM 143 available. For the smaller contactor pins on the 42pin connector there is also a extraction tool WM 141available.



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